CONTENTS

SECTION 7 ELECTRICAL SYSTEM

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 amide 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
   - Section number (3. Power train system)
   - Consecutive page number for each section.
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 ┐ Added pages
   10 - 4 - 2 ┘
   10 - 5

Revised edition mark (①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

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

Example

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

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
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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 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

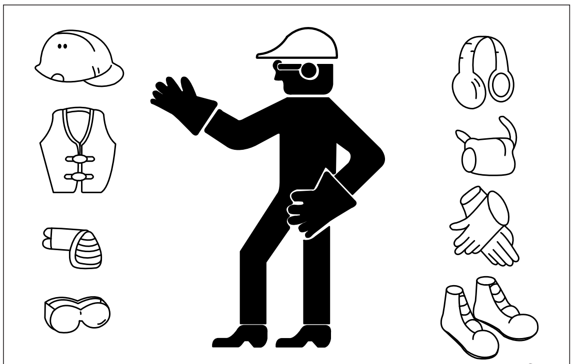
GROUP 1 SAFETY HINTS

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

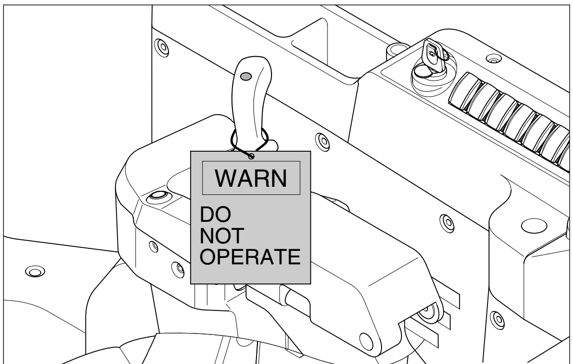
Wear close fitting clothing and safety equipment appropriate to the job.



73031GE01

WARN OTHERS OF SERVICE WORK

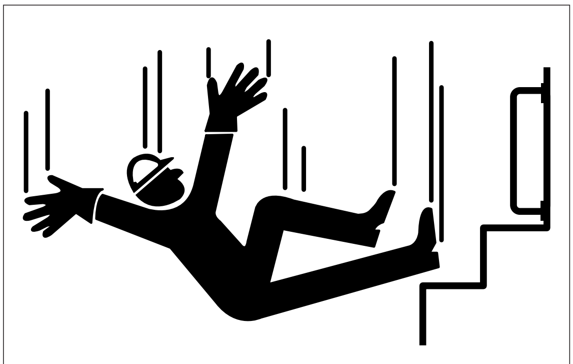
Unexpected machine movement can cause serious injury.
Before performing any work on the wheel loader, attach a 「**Do Not Operate**」 tag on the right side controller lever.



740F1GE01

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.



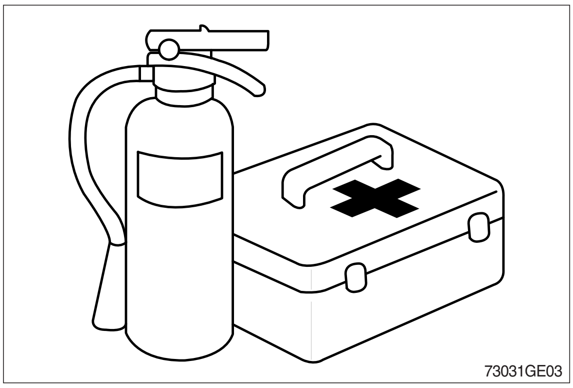
73032E01

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

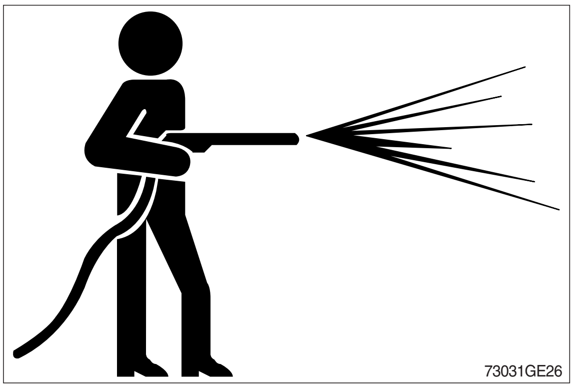
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



WORK IN CLEAN AREA

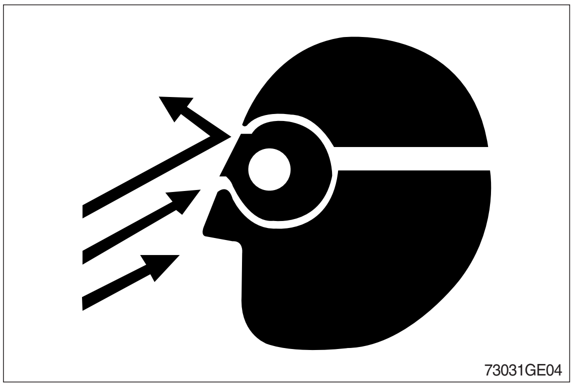
Before starting a job :

· 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

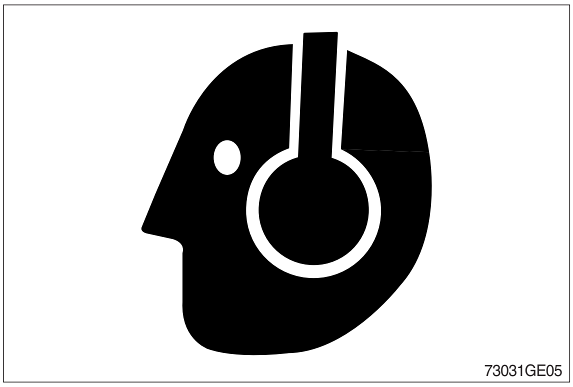
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

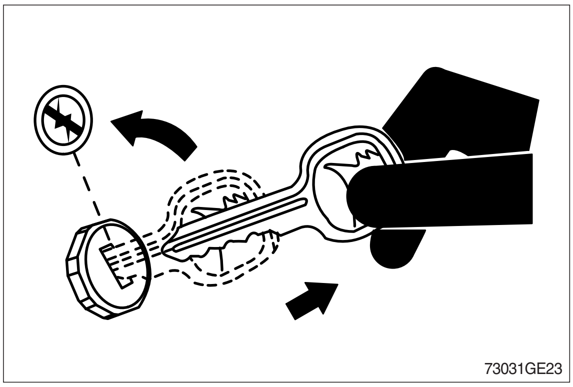
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



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 cut off switch to locked position.
- Allow engine to cool.

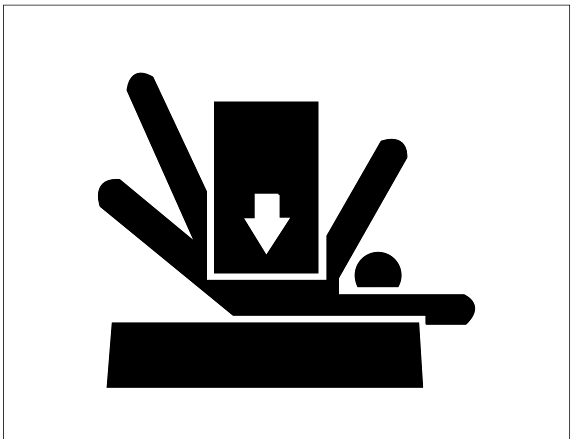


73031GE23

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.

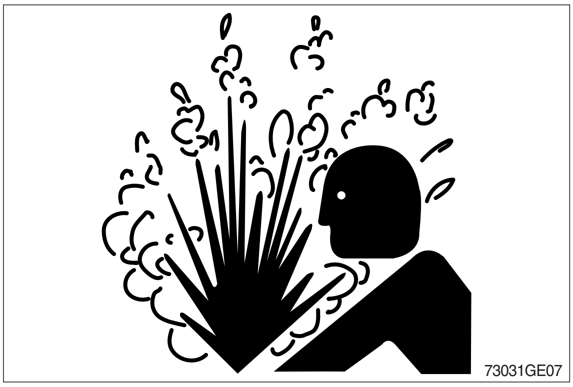


73031GE06

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.



73031GE07

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.

73031GE08

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.

73031GE09

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

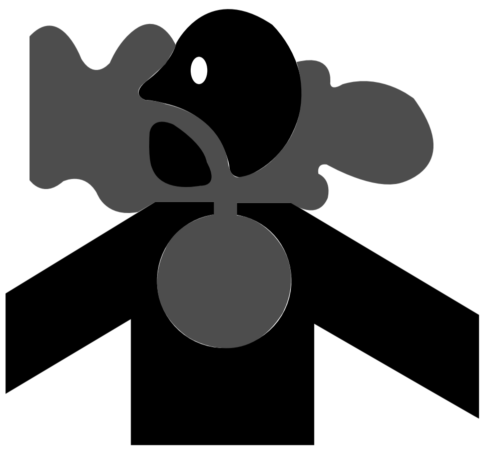
Avoid potentially toxic fumes and dust.

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:

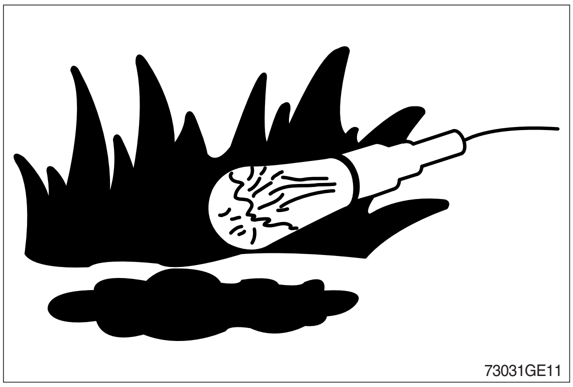
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes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



73031GE10

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.

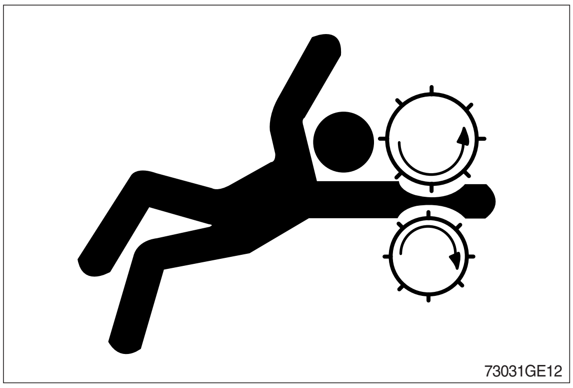


73031GE11

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.

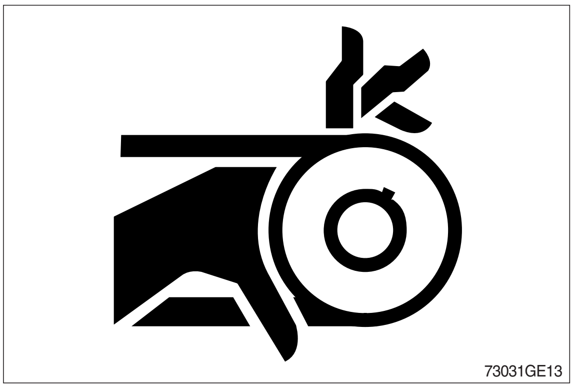


73031GE12

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



73031GE13

AVOID HIGH PRESSURE FLUIDS

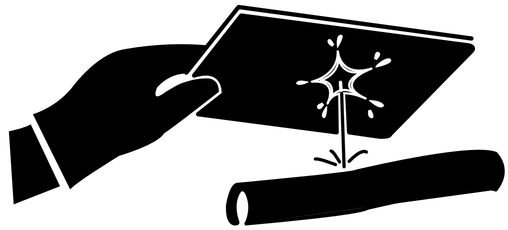
Escaping fluid under pressure can penetrate the skin causing serious injury.

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.


73031GE14


73031GE15

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.


73031GE16

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).


73031GE17

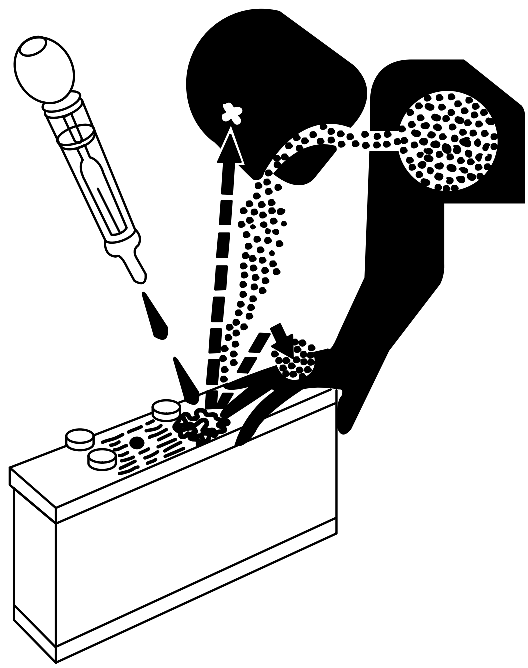
PREVENT ACID BURNS

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.

1. Avoid the hazard by:
2. Filling batteries in a well-ventilated area.
3. Wearing eye protection and rubber gloves.
   Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of 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.



73031GE18

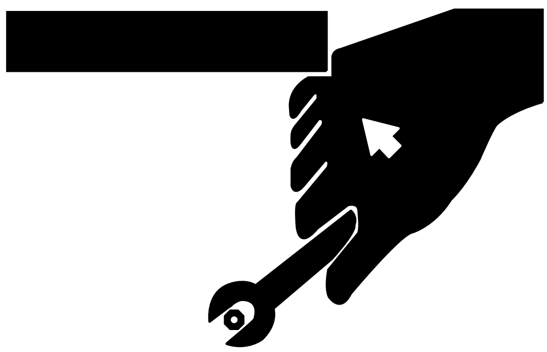
USE TOOLS PROPERLY

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.)



73031GE19

SERVICE TIRES SAFELY

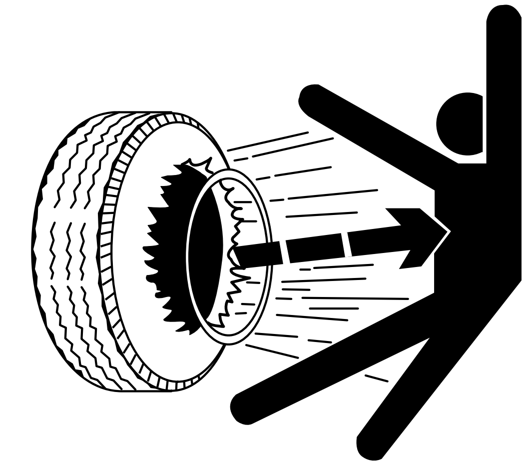
Explosive separation of a tire and rim parts can cause serious injury or death.

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.

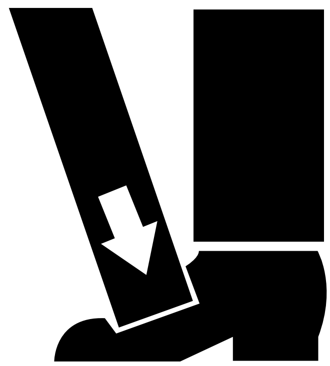


73031GE24

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.



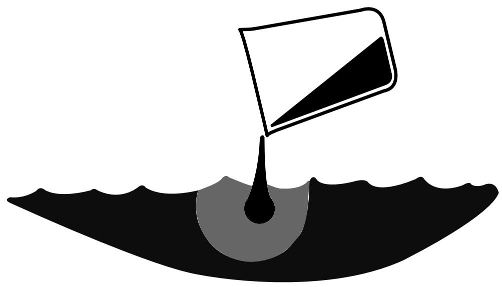
73031GE25

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.

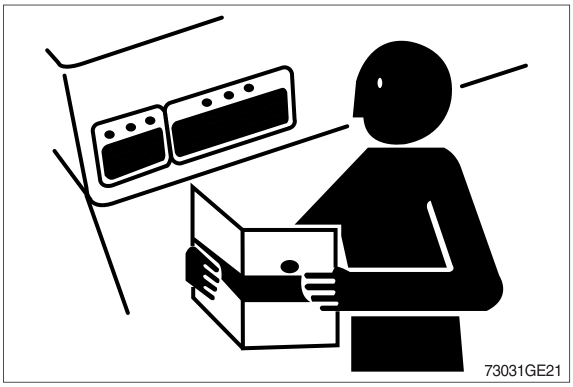
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



73031GE20

REPLACE SAFETY SIGNS

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



73031GE21

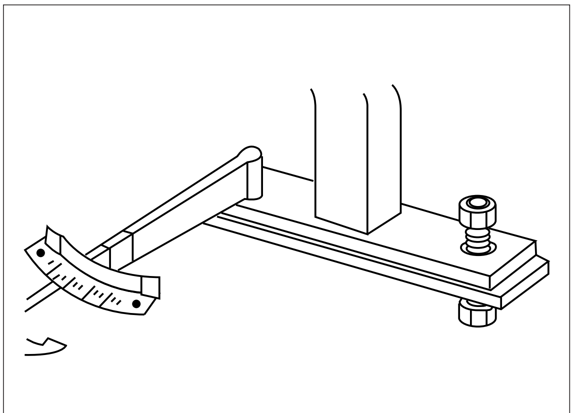
LIVE WITH SAFETY

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.

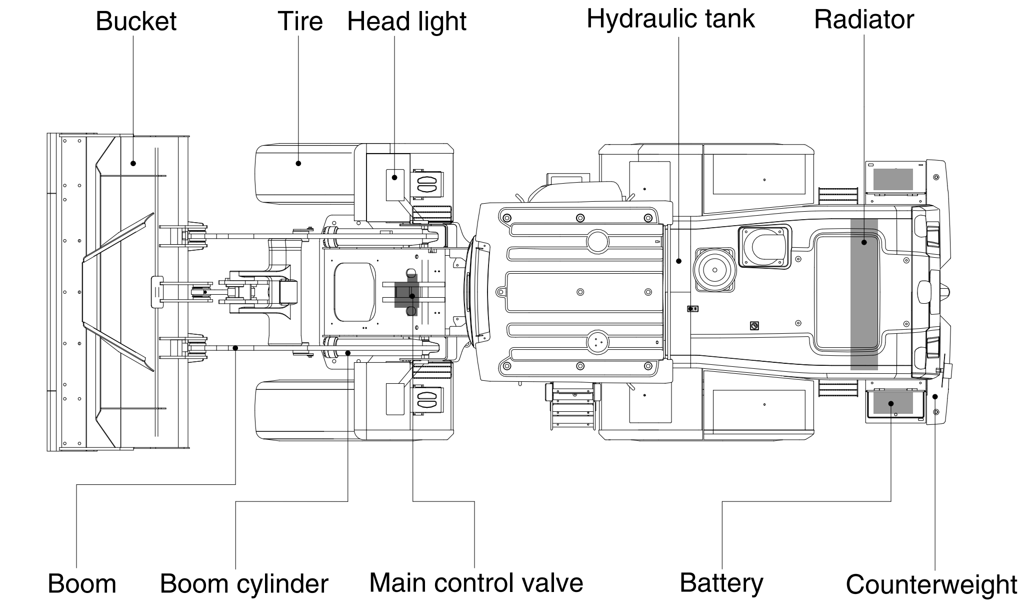
The protection offered by ROPS will be impaired if ROPS is subjected to structural damage, is involved in an overturn incident, or is in any way altered by welding, bending, drilling, or cutting. A damaged ROPS should be replaced, not reused.

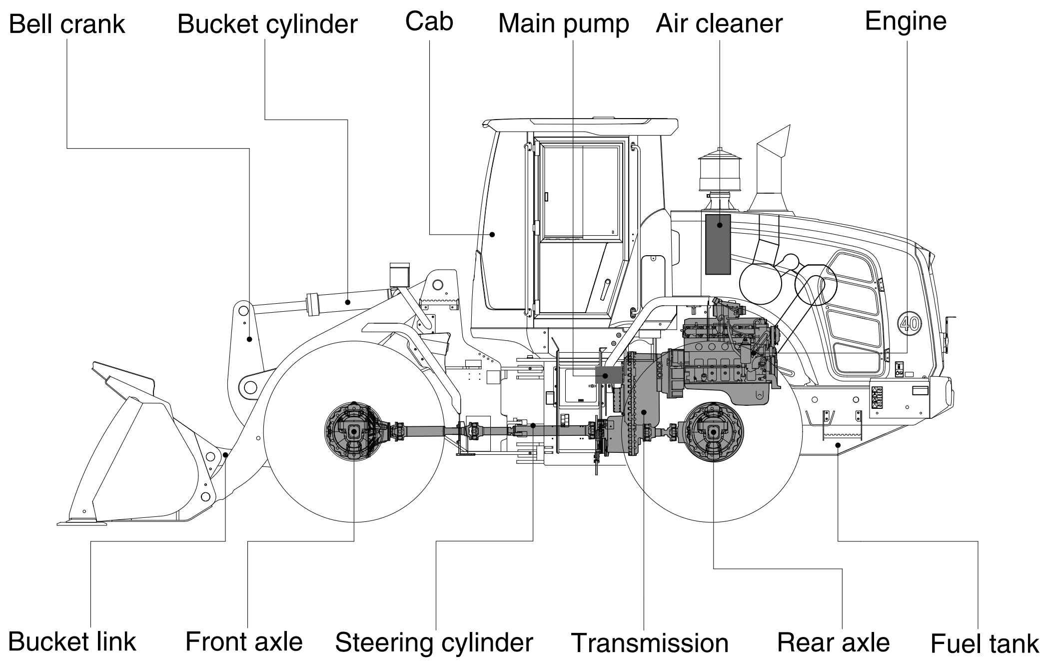


73031GE22

GROUP 2 SPECIFICATION

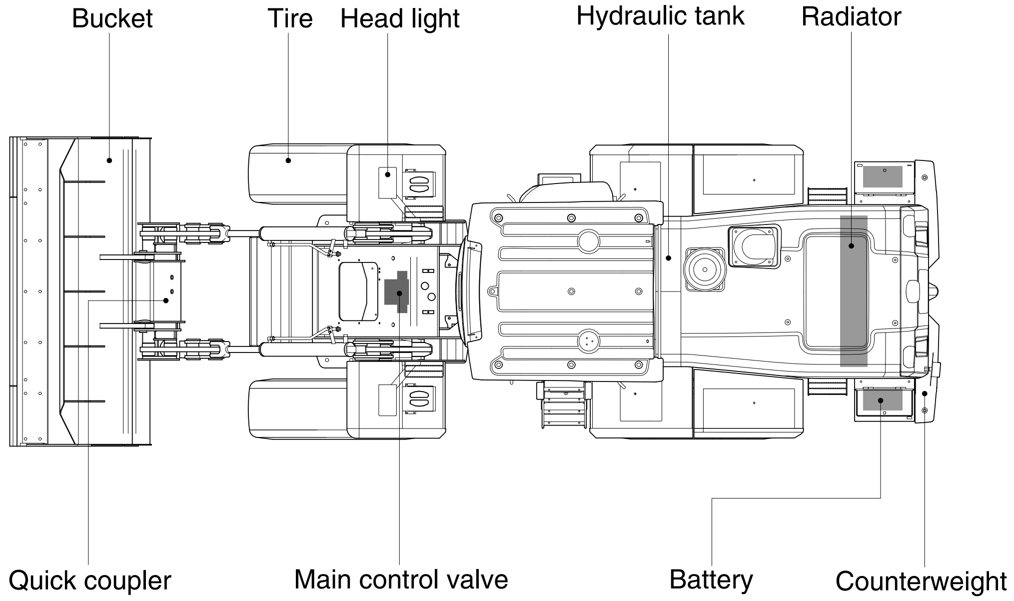
1. MAJOR COMPONENT (HL940, HL940XT)

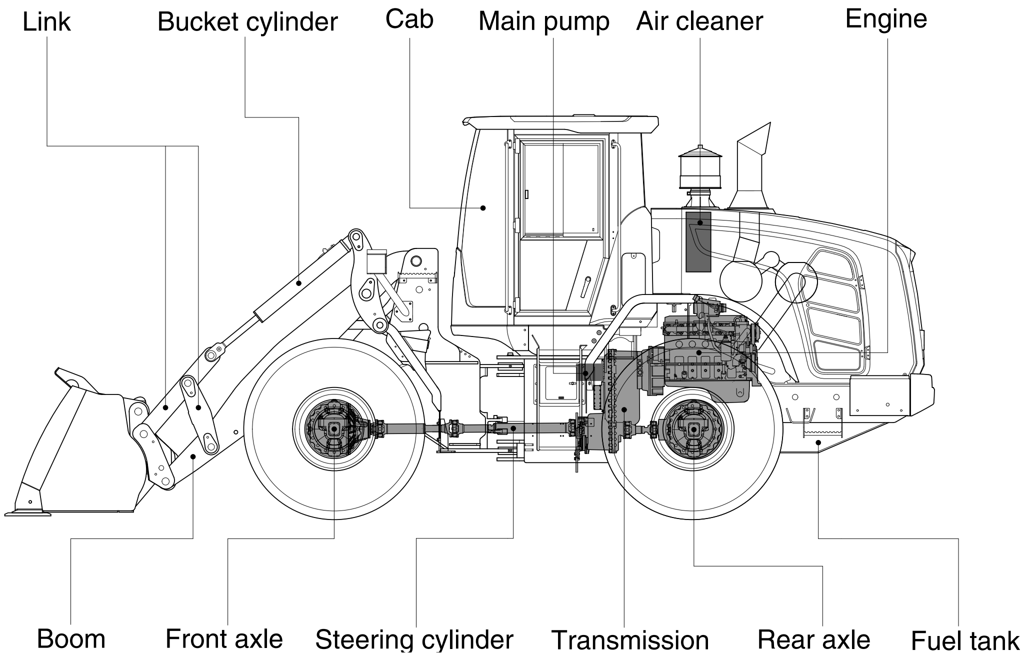




740F2SE01

MAJOR COMPONENT (HL940TM)

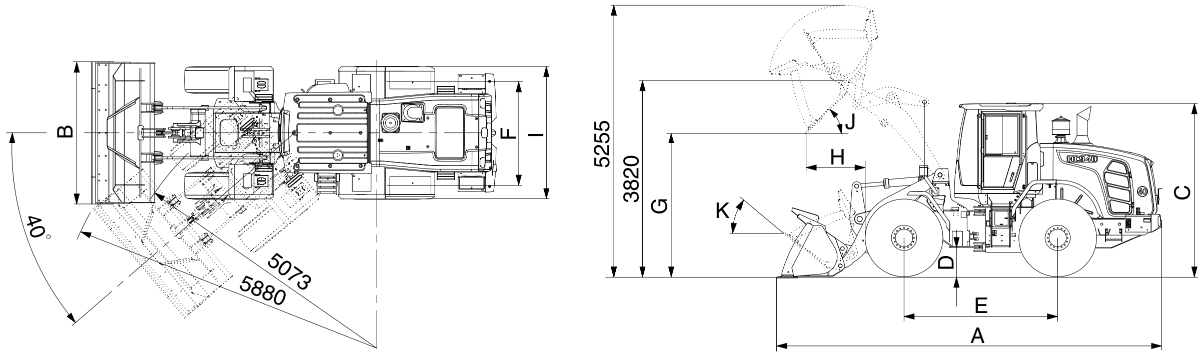




940TM2SE01

2. SPECIFICATIONS

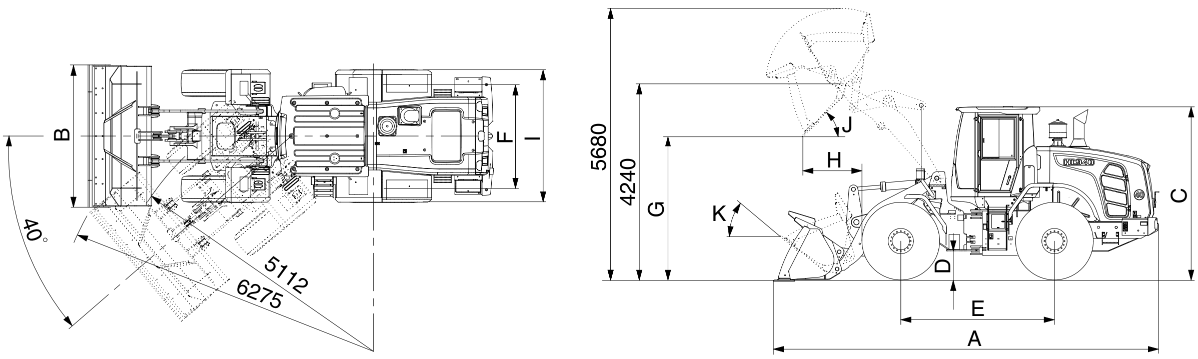
1) WITH BOLT-ON CUTTING EDGE TYPE BUCKET (HL940)



740F2SE03

Description			Unit	Specification
Operating weight			kg (lb)	13100 (28880)
Bucket capacity		Struck	m^3 (yd^3)	2.0 (2.6)
		Heaped		2.3 (3.0)
Overall length		A	mm (ft-in)	7430 (24' 5")
Overall width		B		2600 (8' 6")
Overall height		C		3300 (10' 10")
Ground clearance		D		417 (1' 4")
Wheelbase		E		2950 (9' 8")
Tread		F		1900 (6' 3")
Dump clearance at 45˚		G		2785 (9' 2")
Dump reach (full lift)		H		1025 (3' 4")
Width over tires		I		2430 (8' 0")
Dump angle		J	degree (˚)	48
Roll back angle (carry position)		K		47
Cycle time		Lift (with load)	sec	5.5
		Dump (with load)		1.1
		Lower (empty)		3.0
Maximum travel speed			km/hr (mph)	40 (24.9)
Braking distance			m (ft-in)	13.3 (43' 8")
Minimum turning radius (center of outside tire)				5.07 (16' 8")
Gradeability			degree (˚)	30
Breakout force			kg (lb)	11250 (24800)
Travel speed	Forward	First gear	km/hr (mph)	6.9 (4.3)
		Second gear		12.7 (7.9)
		Third gear		24.9 (15.5)
		Fourth gear		40 (24.9)
	Reverse	First gear		7.3 (4.5)
		Second gear		13.4 (8.3)
		Third gear		26.1 (16.2)

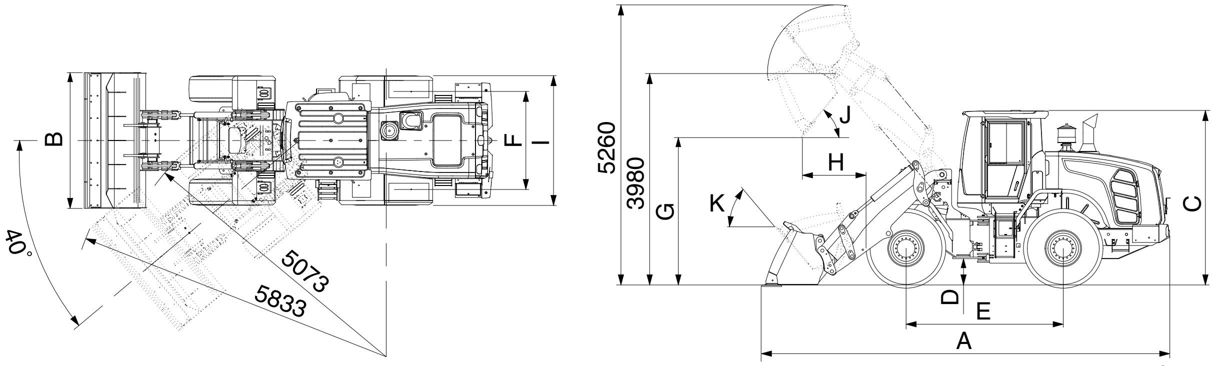
WITH BOLT-ON CUTTING EDGE TYPE BUCKET (HL940 XT)



740F2SE03-1

Description			Unit	Specification
Operating weight			kg (lb)	13400 (29540)
Bucket capacity		Struck	m^3 (yd^3)	2.0 (2.6)
		Heaped		2.3 (3.0)
Overall length		A	mm (ft-in)	7895 (25' 11")
Overall width		B		2600 (8' 6")
Overall height		C		3300 (10' 10")
Ground clearance		D		417 (1' 4")
Wheelbase		E		2950 (9' 8")
Tread		F		1900 (6' 3")
Dump clearance at 45˚		G		3210 (10' 6")
Dump reach (full lift)		H		1020 (3' 4")
Width over tires		I		2430 (8' 0")
Dump angle		J	degree (˚)	47(-#0486) / 45(#0487-)
Roll back angle (carry position)		K		49
Cycle time		Lift (with load)	sec	5.5
		Dump (with load)		1.1
		Lower (empty)		3.0
Maximum travel speed			km/hr (mph)	40 (24.9)
Braking distance			m (ft-in)	13.3 (43' 8")
Minimum turning radius (center of outside tire)				5.11 (16' 9")
Gradeability			degree (˚)	30
Breakout force			kg (lb)	11100 (24470)
Travel speed	Forward	First gear	km/hr (mph)	6.9 (4.3)
		Second gear		12.7 (7.9)
		Third gear		24.9 (15.5)
		Fourth gear		40 (24.9)
	Reverse	First gear		7.3 (4.5)
		Second gear		13.4 (8.3)
		Third gear		26.1 (16.2)

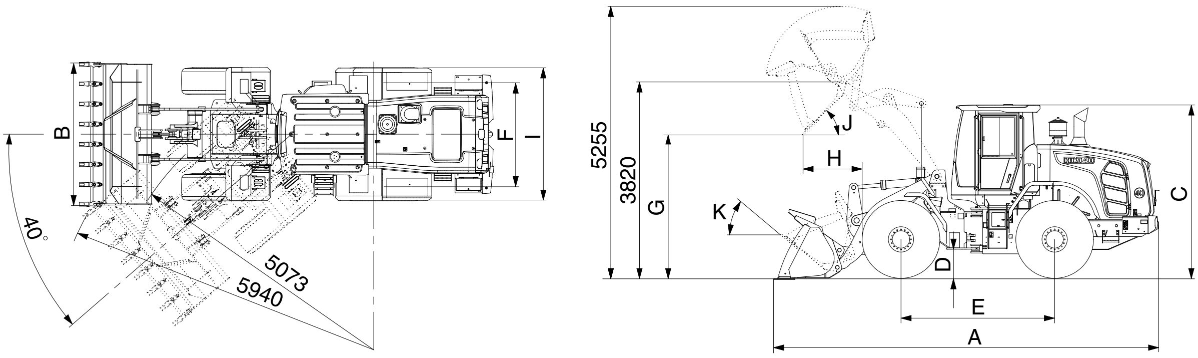
WITH BOLT-ON CUTTING EDGE TYPE BUCKET (HL940TM)



940TM2SP01

Description			Unit	Specification
Operating weight			kg (lb)	13600 (29980)
Bucket capacity		Struck	m^3 (yd^3)	2.0 (2.6)
		Heaped		2.3 (3.0)
Overall length		A	mm (ft-in)	7715 (25' 3")
Overall width		B		2550 (8' 4")
Overall height		C		3300 (10' 9")
Ground clearance		D		417 (1' 4")
Wheelbase		E		2950 (9' 8")
Tread		F		1900 (6' 3")
Dump clearance at 45˚		G		2840 (9' 3")
Dump reach (full lift)		H		1330 (4' 4")
Width over tires		I		2430 (8' 0")
Dump angle		J	degree (˚)	50
Roll back angle (carry position)		K		54
Cycle time		Lift (with load)	sec	5.5
		Dump (with load)		1.6
		Lower (empty)		3.0
Maximum travel speed			km/hr (mph)	40.0 (24.9)
Braking distance			m (ft-in)	12 (39' 4")
Minimum turning radius (center of outside tire)				5.07 (16' 8")
Gradeability			degree (˚)	30
Brakeout force			kg (lb)	10830 (23880)
Travel speed	Forward	First gear	km/hr (mph)	6.9 (4.3)
		Second gear		12.7 (7.9)
		Third gear		24.9 (15.5)
		Fourth gear		40.0 (24.9)
	Reverse	First gear		7.3 (4.5)
		Second gear		13.4 (8.3)
		Third gear		26.1 (16.2)
Tipping load		Straight	kg (lb)	8600 (18960)
		Full-turn		7400 (16310)

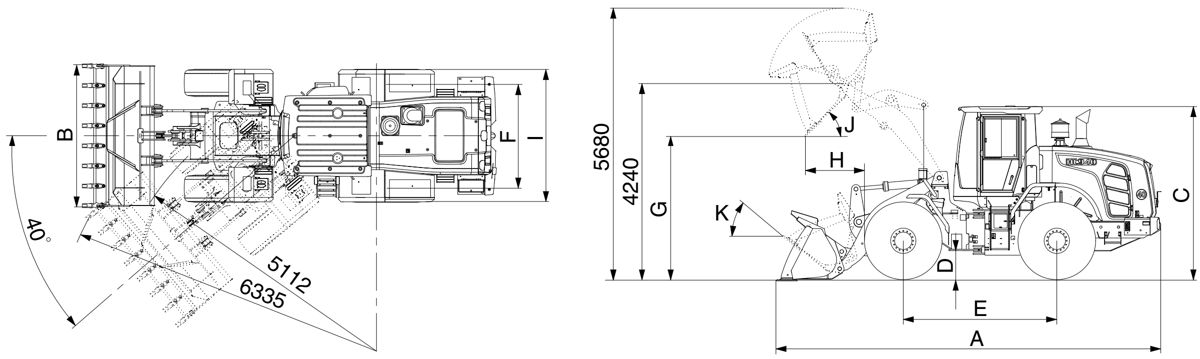
2) WITH TOOTH TYPE BUCKET (HL940)



740F2SE02

Description			Unit	Specification
Operating weight			kg (lb)	13030 (28725)
Bucket capacity		Struck	m^3 (yd^3)	1.9 (2.5)
		Heaped		2.2 (2.9)
Overall length		A	mm (ft-in)	7530 (24' 8")
Overall width		B		2650 (8' 8")
Overall height		C		3300 (10' 10")
Ground clearance		D		417 (1' 4")
Wheelbase		E		2950 (9' 8")
Tread		F		1900 (6' 3")
Dump clearance at 45˚		G		2695 (8' 10")
Dump reach (full lift)		H		1115 (3' 8")
Width over tires		I		2430 (8' 0")
Dump angle		J	degree (˚)	48
Roll back angle (carry position)		K		47
Cycle time		Lift (with load)	sec	5.5
		Dump (with load)		1.1
		Lower (empty)		3.0
Maximum travel speed			km/hr (mph)	40 (24.9)
Braking distance			m (ft-in)	13.3 (43' 8")
Minimum turning radius (center of outside tire)				5.07 (16' 8")
Gradeability			degree (˚)	30
Breakout force			kg (lb)	12070 (26610)
Travel speed	Forward	First gear	km/hr (mph)	6.9 (4.3)
		Second gear		12.7 (7.9)
		Third gear		24.9 (15.5)
		Fourth gear		40 (24.9)
	Reverse	First gear		7.3 (4.5)
		Second gear		13.4 (8.3)
		Third gear		26.1 (16.2)

WITH TOOTH TYPE BUCKET (HL940 XT)



740F2SE02-1

Description			Unit	Specification
Operating weight			kg (lb)	13330 (29390)
Bucket capacity		Struck	m^3 (yd^3)	1.9 (2.5)
		Heaped		2.2 (2.9)
Overall length		A	mm (ft-in)	8200 (26' 11")
Overall width		B		2650 (8' 8")
Overall height		C		3300 (10' 10")
Ground clearance		D		417 (1' 4")
Wheelbase		E		2950 (9' 8")
Tread		F		1900 (6' 3")
Dump clearance at 45˚		G		3120 (10' 3")
Dump reach (full lift)		H		1080 (3' 7")
Width over tires		I		2430 (8' 0")
Dump angle		J	degree (˚)	47(-#0486) / 45(#0487-)
Roll back angle (carry position)		K		49
Cycle time		Lift (with load)	sec	5.5
		Dump (with load)		1.1
		Lower (empty)		3.0
Maximum travel speed			km/hr (mph)	40 (24.9)
Braking distance			m (ft-in)	13.3 (43' 8")
Minimum turning radius (center of outside tire)				5.11 (16' 9")
Gradeability			degree (˚)	30
Breakout force			kg (lb)	11915 (26270)
Travel speed	Forward	First gear	km/hr (mph)	6.9 (4.3)
		Second gear		12.7 (7.9)
		Third gear		24.9 (15.5)
		Fourth gear		40 (24.9)
	Reverse	First gear		7.3 (4.5)
		Second gear		13.4 (8.3)
		Third gear		26.1 (16.2)

3. WEIGHT (HL940, HL940XT)

Item		kg	lb
Front frame assembly		946	2090
Rear frame assembly		1267	2790
Front fender (LH & RH)		32	71
Counterweight	HL940 (LH/RH)	150/150	331/331
	HL940XT (LH/RH)	250/250	551/551
Cab assembly		980	2160
Engine assembly		520	1150
Transmission assembly		430	948
Drive shaft (front)		15	33
Drive shaft (center)		22	49
Drive shaft (rear)		13	29
Front axle (include differential)		750	1650
Rear axle (include differential)		760	1680
Tire (20.5 R25, ★L3)		238	525
Hydraulic tank assembly		138	304
Fuel tank assembly		291	642
Main pump assembly		28	62
Fan & brake pump assembly		12	26
Main control valve (2/3 spool)		34/41	75/90
Boom assembly	HL940	713	1570
	HL940XT	813	1790
Bell crank assembly		224	495
Quick coupler assembly		400	882
Bucket link		36	79
2.3 m^3 bucket, with bolt on cutting edge		1108	2440
Boom cylinder assembly		106	234
Bucket cylinder assembly		111	245
Steering cylinder assembly		16	35
Seat		60	132
Battery		30	66

WEIGHT (HL940TM)

Item	kg	lb
Front frame assembly	1010	2230
Rear frame assembly	1259	2780
Front fender (LH & RH)	45	99
Counterweight (LH / RH)	250/250	551/551
Cab assembly	980	2160
Engine assembly	520	1150
Transmission assembly	430	948
Drive shaft (front)	15	33
Drive shaft (center)	22	49
Drive shaft (rear)	13	29
Drive shaft (upper)	7	15
Front axle (include differential)	750	1650
Rear axle (include differential)	760	1680
Tire (20.5 R25, ⋆L3)	238	525
Hydraulic tank assembly	138	304
Fuel tank assembly	291	642
Main pump assembly	35	77
Fan & brake pump assembly	12	26
Main control valve (3 spool)	41	90
Boom assembly	680	1500
Quick coupler assembly	215	474
Bucket link	300	660
2.3 m^3 bucket, with bolt on cutting edge	1020	2250
Boom cylinder assembly	106	235
Bucket cylinder assembly	54	120
Steering cylinder assembly	16	35
Seat	60	132
Battery	30	66

4. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins QSB6.7
Type	4-cycle turbocharged and charge air-cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	107×124 mm (4.2"×4.9")
Piston displacement	6700 cc (408 cu in)
Compression ratio	17.3 : 1
Rated horse power (Gross)	158 hp at 2100 rpm
Maximum torque at 1400 rpm	86 kgf · m (594 lbf · ft)
Engine oil quantity	18 ℓ (4.8 U.S. gal)
Wet weight	580 kg (1279 lb)
High idling speed	2230 ± 50 rpm
Low idling speed	800± 25 rpm
Rated fuel consumption	224 g/kW · hr
Starting motor	Nippondenso PA90L (24V-7.8kW)
Alternator	Delco Remy 24SI (24V-95Amp)
Battery	2×12V×120Ah

2) MAIN PUMP

Item	Specification
Type	Variable piston pump
Capacity	74 cc/rev
Maximum operating pressure	280 kgf/cm^2 (3980 psi)
Maximum operating speed	2230 rpm
Rated output flow	149 ℓ/min

3) FAN AND BRAKE PUMP

Item	Specification	
	Fan	Brake
Type	Variable piston pump	
Capacity	28 cc/rev	
Maximum operating pressure	250 bar	150 bar
Maximum operating speed	2230 rpm	
Rated output flow	56 l/min (14.8 U.S.gpm)	

4) MAIN CONTROL VALVE

Item	Specification
Type	2 spool (mono block)
Operating method	Hydraulic pilot assist
Main relief valve set pressure	280 kgf/cm² (3980 psi)
Overload relief valve set pressure	340 kgf/cm² (4840 psi)
Overload relief valve set pressure (bucket dump)	★1 300 kgf/cm² (4270 psi) / ★2 150 kgf/cm² (2130 psi)

★1 HL940, HL940XT ★2 HL940TM

5) REMOTE CONTROL VALVE

Item		Specification
Type		Joystick (or with aux lever)
Control pressure	Minimum	3.7 kgf/cm² (52.6 psi)
	Maximum	30 kgf/cm² (427 psi)

6) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 110 × ø 65 × 738 mm
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 125 × ø 70 × 505 mm (HL940, HL940XT)
	Bore dia × Rod dia × Stroke	ø 95 × ø 50 × 745 mm (HL940TM)
Steering cylinder	Bore dia × Rod dia × Stroke	ø 65 × ø 40 × 429 mm

7) DYNAMIC POWER TRANSMISSION DEVICES

Item		Specification
Torque converter	Model	ZF 4WG160
	Type	Single-stage, single-phase
	Ratio	2.30 : 1
Transmission	Type	Full-automatic power shift
	Gear shift	Forward fourth gear, reverse third gear
	Control	Electrical single lever type, kick-down system
	Pump rated flow	85 ℓ/min (22.5 U.S.gpm) at 2000 rpm
Axle	Drive devices	4-wheel drive
	Front	Front fixed location
	Rear	Oscillation ±12˚ of center pin-loaded
Wheels	Tires	20.5-25, 16PR (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

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	10.7 ± 1.6	77.4 ± 11.6
3		Engine mounting bolt (T/C plate-adapter, 4EA)	M10×1.5	4.5 ± 0.6	32.5 ± 4.3
4		Engine mounting stud bolt,nut (flywheel, 10EA)	M10×1.5	4.5 ± 0.6	32.5 ± 4.3
5		Engine mounting stud bolt (flywheel, 2EA)	M10×1.5	4.6 ± 0.9	33.3 ± 6.5
6		Fan motor mounting bolt	M12×1.75	12.8 ± 3.0	92.6 ± 21.7
7		Radiator mounting bolt	M16×2.0	29.7 ± 5.9	215 ± 42.7
8		Fuel tank mounting bolt	M16×2.0	29.7 ± 4.5	215 ± 32.5
9		Fuel tank mounting bolt (2EA)	M24×3.0	100 ± 15	723 ± 108
10	Hydraulic system	Main pump housing mounting bolt	M16×2.0	29.7 ± 4.5	215 ± 32.5
11		Fan & brake pump housing mounting bolt	M10×1.5	6.9 ± 1.4	50 ± 10.1
13		Main control valve mounting bolt	M10×1.5	6.9 ± 1.4	50 ± 10.1
14		Steering unit mounting bolt	M10×1.5	6.9 ± 1.4	50 ± 10.1
15		Brake valve mounting bolt	M8×1.25	2.5 ± 0.5	18.1 ± 3.6
16		Cut-off valve mounting bolt	M8×1.25	2.5 ± 0.5	18.1 ± 3.6
17		Remote control lever mounting bolt	M6×1.0	1.1 ± 0.2	8.0 ± 1.4
18		Safety valve	M10×1.5	6.9 ± 1.4	50 ± 10.1
19		Hydraulic oil tank mounting bolt	M16×2.0	29.7 ± 4.5	215 ± 32.5
20	Power train system	Transmission mounting bolt, nut (rubber, 2EA)	M24×3.0	100 ± 15	723 ± 108
21		Transmission mounting bolt (bracket, 6EA)	M20×2.5	46.3 ± 7.0	335 ± 50.6
22		Front axle mounting bolt, nut	M27×2.0	135 ± 20.2	976 ± 146
23		Rear axle support mounting bolt, nut	M27×2.0	135 ± 20.2	976 ± 146
24		Tire mounting nut	M22×1.5	79 ± 11.9	571 ± 86.1
25		Drive shaft joint mounting bolt	3/8-24UNF	6.0 ± 0.8	43.4 ± 5.8
26	Others	Counterweight mounting bolt (4EA)	M30×3.5	199 ± 30	1439 ± 216
27		Operator's seat mounting bolt	M8×1.25	3.4 ± 0.8	24.6 ± 5.0
29		ROPS Cab mounting bolt (4EA)	M20×2.5	58 ± 8.7	419 ± 63
		ROPS Cab mounting nut (4EA)	M16×2.0	20.5 ± 4.7	148 ± 34

6. TORQUE CHART

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

7. RECOMMENDED LUBRICANTS

Use only oils listed below or equivalent.

Do not mix different brand oil.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C (°F) -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	18 (4.8)	★2 SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
DEF/ AdBlue® tank	Mixture of urea and deionized water	18 (4.7)	ISO 22241, High-purity urea + deionized water (32.5 : 67.5)
Transmission	Engine oil	25 (6.6)	SAE 10W-30 SAE 15W-40
Axle	UTTO	Front : 24 (6.3) Rear : 24 (6.3)	★Refer to below list
Hydraulic tank	Hydraulic oil	Tank: 90 (23.7) System: 130 (34.3)	★2 ISO VG 15 ISO VG 46, HBHO VG 46★4 ISO VG 68
Fuel tank	Diesel fuel★1	220 (58.1)	★2 ASTM D975 NO.1 ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★2 NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★3	34 (9.0)	Ethylene glycol base permanent type (50 : 50) ★2 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
DEF : Diesel Exhaust Fluid
DEF compatible with AdBlue®

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

★ : 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

★2 : Cold region
Russia, CIS, Mongolia

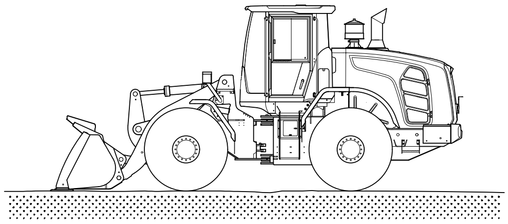
★3 : Soft water
City water or distilled water

★4 : Hyundai Bio Hydraulic Oil
- For more information, contact HYUNDAI dealers.

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.



740F1GE02

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	☐	☐	____________
· Park brake transmission lockout check	☐	☐	____________
· Service brake pump flow check	☐	☐	____________
· Service brake capacity check	☐	☐	____________
· Brake accumulator precharge check	☐	☐	____________
· Brake system leakage check	☐	☐	____________
· Service brake pedal check	☐	☐	____________
· Service and park brake system drag check	☐	☐	____________
· Clutch cut off check	☐	☐	____________

5. Driving checks

· Transmission oil warm up procedure	☐	☐	____________
· Transmission noise check	☐	☐	____________
· Speedometer check	☐	☐	____________
· Transmission kick down system check	☐	☐	____________
· 1st, 2nd, 3rd and 4th speed clutch pack drag check	☐	☐	____________
· Transmission pressure, pump flow and leakage check	☐	☐	____________
· Transmission shift modulation check	☐	☐	____________
· Torque converter check	☐	☐	____________
· Engine power check	☐	☐	____________

6. Hydraulic system checks

· Hydraulic system warm up procedure	☐	☐	____________
· Hydraulic pump performance check	☐	☐	____________
· Pilot control valve boom float check	☐	☐	____________
· Boom down solenoid valve check	☐	☐	____________
· Control valve lift check	☐	☐	____________
· Bucket rollback circuit relief valve check	☐	☐	____________
· Bucket dump circuit relief			
Low pressure check	☐	☐	____________
High pressure check	☐	☐	____________
· Boom and bucket cylinder drift check	☐	☐	____________
· Boom down solenoid valve leakage check	☐	☐	____________
· Pilot controller check	☐	☐	____________
· Return to dig check	☐	☐	____________
· Boom height kickout check-if equipped	☐	☐	____________

7. Steering system checks

- Steering unit check ☐ ☐ ________
- Steering system leakage check ☐ ☐ ________
- Steering valve (EHPS)
  Low check pressure ☐ ☐ ________
  High check pressure ☐ ☐ ________

8. Accessory checks

- Operating lights check ☐ ☐ ________
- Work light check ☐ ☐ ________
- Brake light check ☐ ☐ ________
- Cab light check ☐ ☐ ________
- Horn circuit check ☐ ☐ ________
- Windshield washer and wiper check ☐ ☐ ________
- Defroster blower check ☐ ☐ ________
- Heater/Air conditioner blower check ☐ ☐ ________
- Heater functional check ☐ ☐ ________
- Air conditioner functional check ☐ ☐ ________
- Start aid system check ☐ ☐ ________

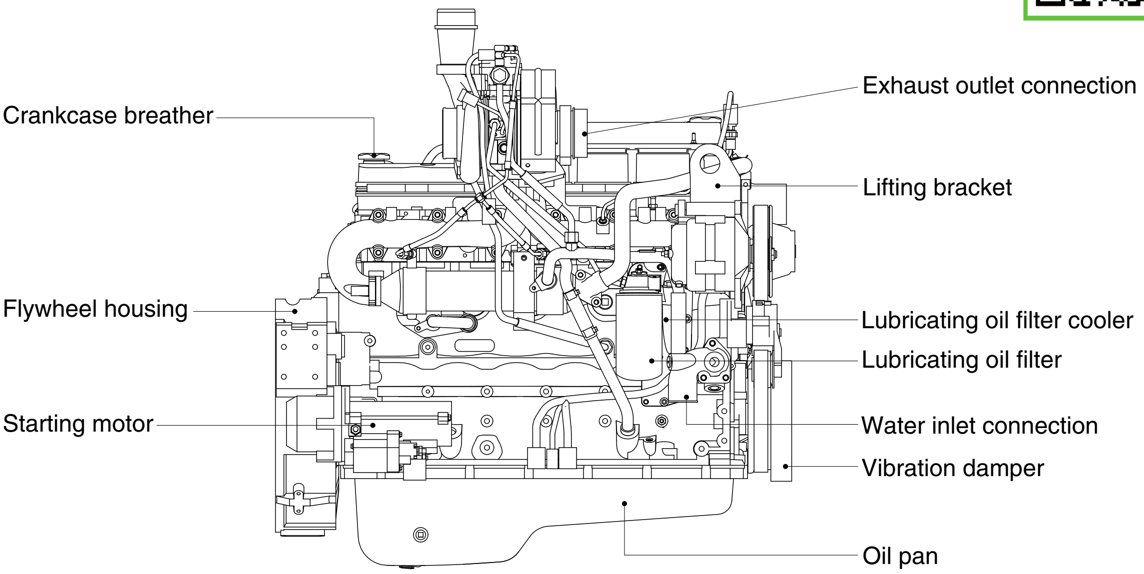
9. Cab components and vandal protection checks

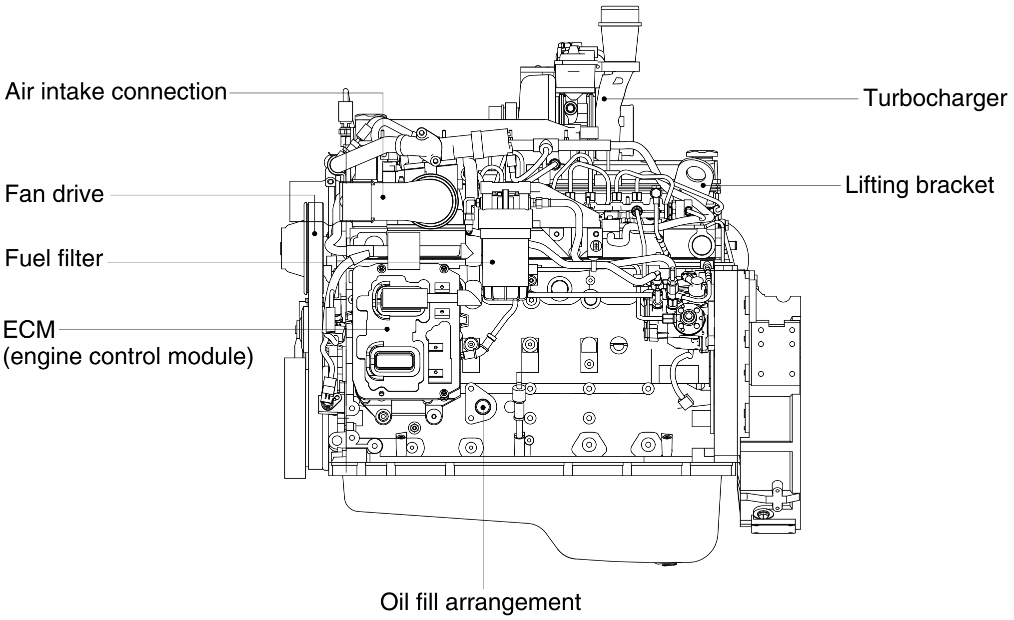
- Cab door latch check ☐ ☐ ________
- Cab door hold open latch check ☐ ☐ ________
- Cab door release button check ☐ ☐ ________
- Cab door lock check ☐ ☐ ________
- Cab door window check ☐ ☐ ________
- Cab window latch check ☐ ☐ ________
- Steering column adjustment check ☐ ☐ ________
- Seat and seat belt check ☐ ☐ ________
- Air intake filter door check ☐ ☐ ________
- Engine side panels check ☐ ☐ ________
- Radiator cap access door check ☐ ☐ ________
- Frame locking bar check ☐ ☐ ________
- Boom lock check ☐ ☐ ________
- Service decal check ☐ ☐ ________

SECTION 2 ENGINE

GROUP 1 STRUCTURE AND FUNCTION

1. STRUCTURE





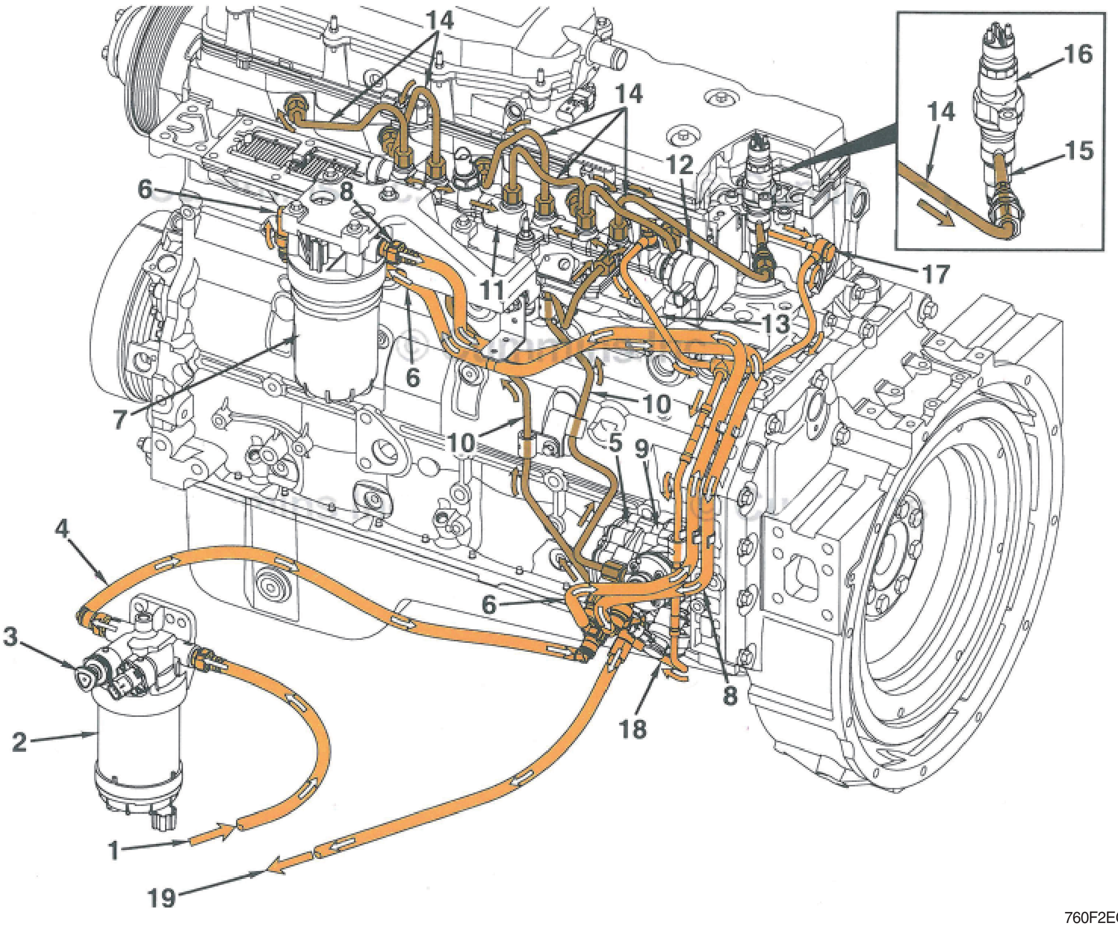
760F2EG05

· Direct 4-stroke, 6-cylinders, water-cooling and charge air cooled diesel engine in installed, cylinder block and cylinder head are made of case iron and turbocharger is attached.

2. SYSTEM DIAGRAMS

The following drawings show the flow through the engine systems.

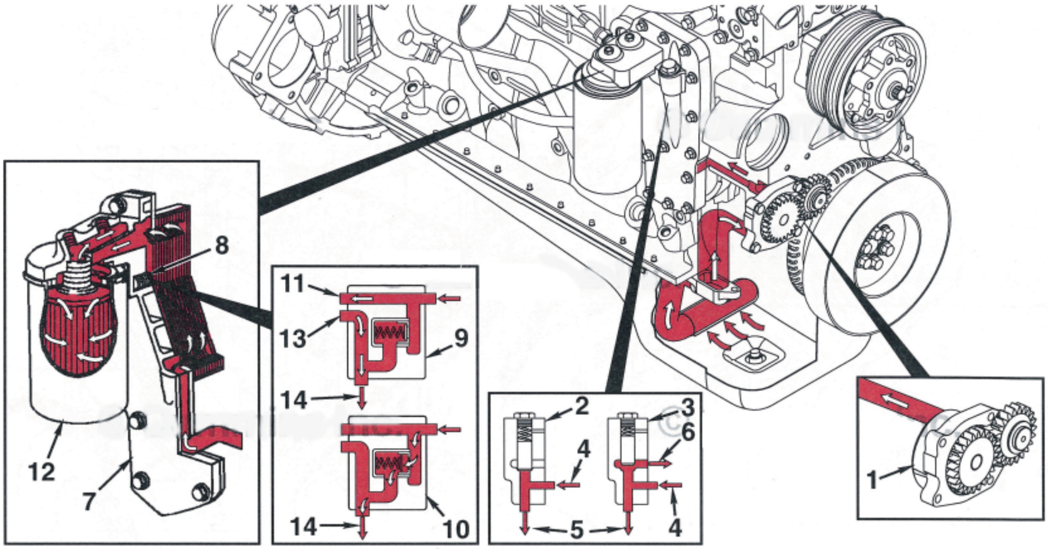
1) FUEL SYSTEM



760F2EG10

1	Fuel from supply tank	11	Fuel rail
2	Water/fuel separator filter	12	Fuel rail pressure relief valve
3	Priming pump	13	Common rail fuel return
4	Fuel supply to fuel gear pump	14	High-pressure fuel line to injector
5	Fuel gear pump	15	High-pressure connector
6	To pressure side fuel filter	16	Injector
7	Pressure side fuel filter	17	Fuel return from injectors
8	To high-pressure fuel pump	18	Combined fuel return
9	High-pressure fuel pump	19	Fuel return to fuel supply tank
10	To fuel rail		

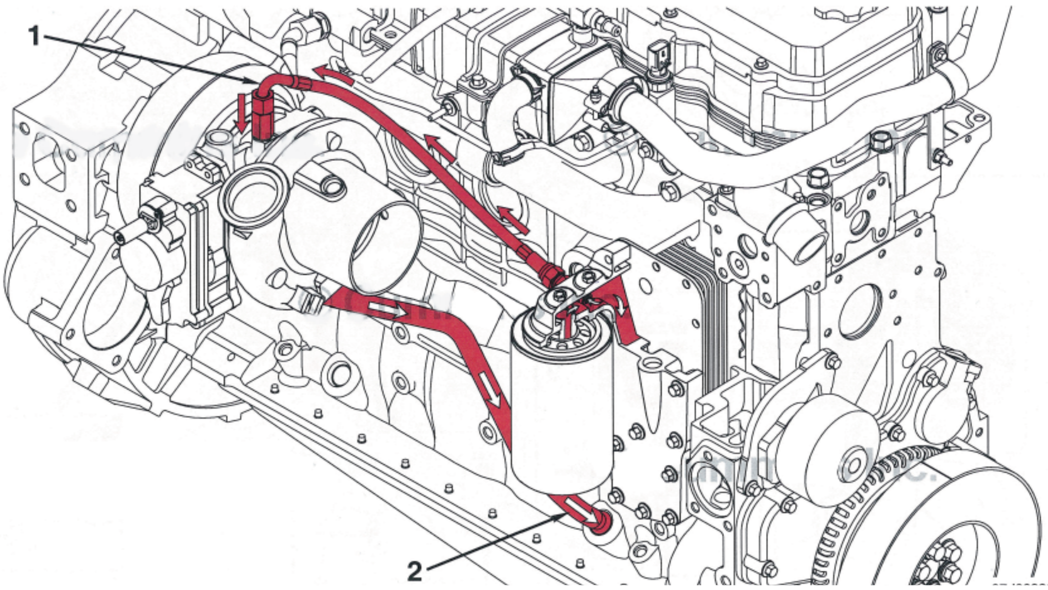
2) LUBRICATING OIL SYSTEM



7609A2EG11

1	Lubricating oil pump	8	Filter bypass valve
2	Pressure regulating valve closed	9	Filter bypass valve closed
3	Pressure regulating valve open	10	Filter bypass valve open
4	From lubricating oil pump	11	To lubricating oil filter
5	To lubricating oil cooler	12	Full-flow lubricating oil filter
6	To lubricating oil pan	13	From lubricating oil filter
7	Lubricating oil cooler	14	To main lubricating oil rifle(s)

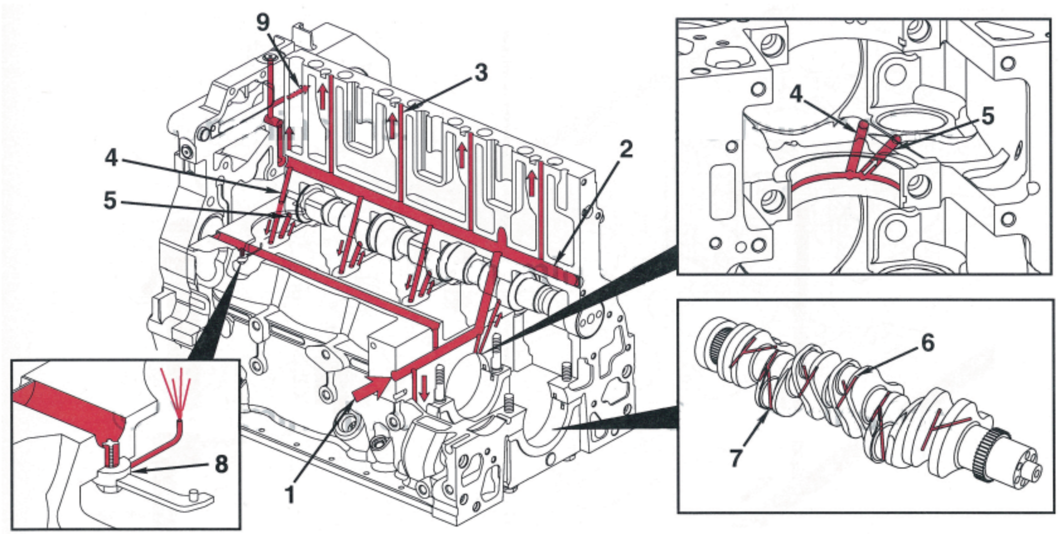
(1) Lubrication for the turbocharger



7609A2EG12

1	Turbocharger lubricating oil supply	2	Turbocharger lubricating oil drain

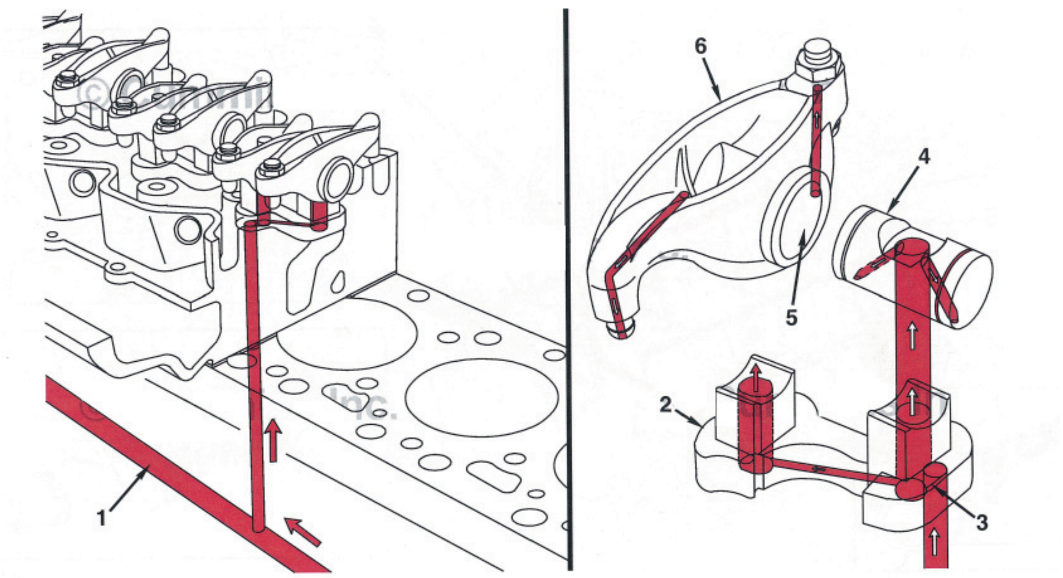
(2) Lubrication for the power components



7609A2EG13

1	From lubricating oil cooler	6	Oil supply to rod bearings
2	Main lubricating oil rifle	7	Crankshaft cross drilling from the main bearing journal
3	To overhead components	8	J-jet piston-cooling nozzle
4	To upper main bearing	9	To accessory drive oil feed
5	To camshaft journal		

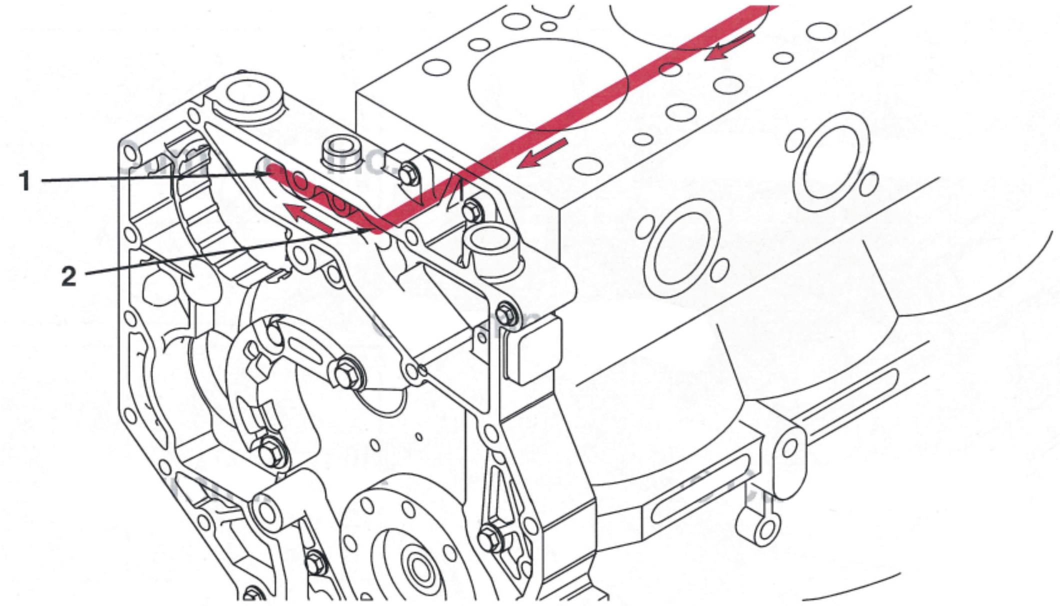
(3) Lubrication for the overhead components



7609A2EG14

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

(4) Lubrication for the accessory drive



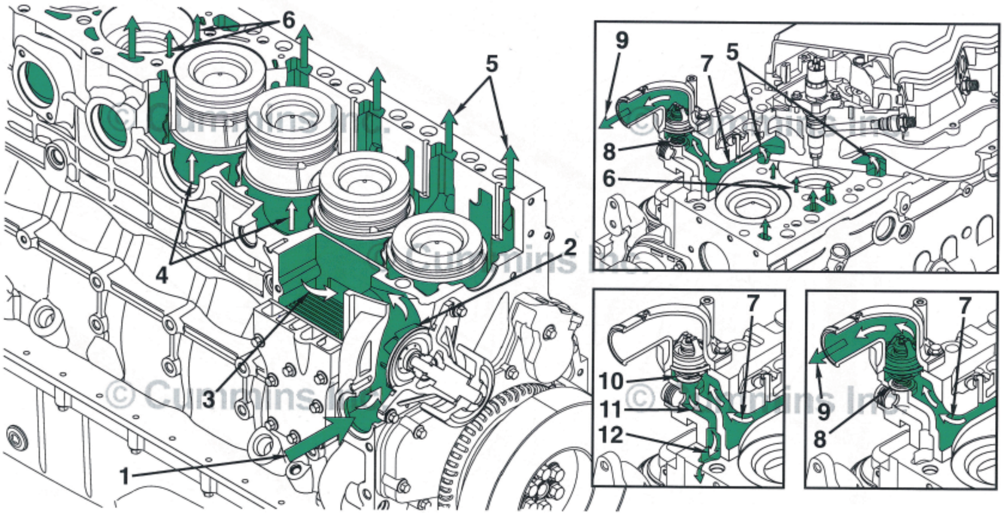
7609A2EG15

1 Oil supply to accessory drive

2 Oil feed from block

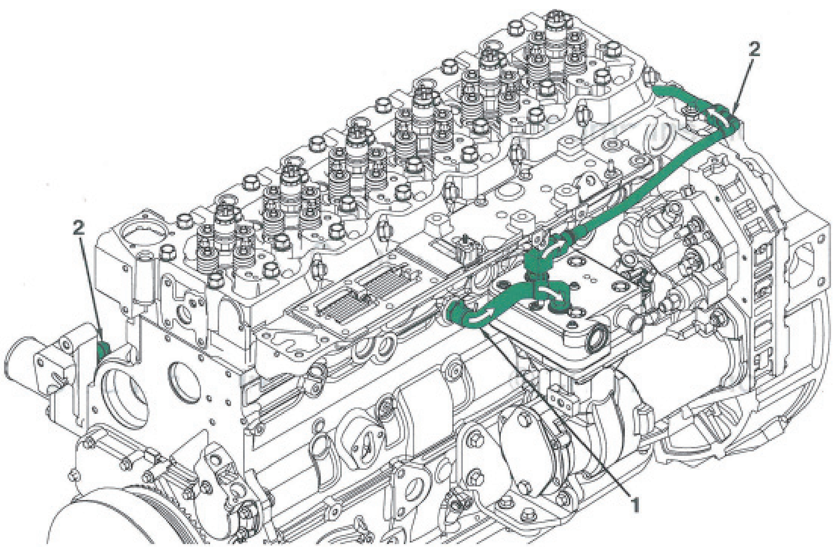
※ Oil returns to pan through the gear housing.

3) COOLING SYSTEM



7609A2EG16

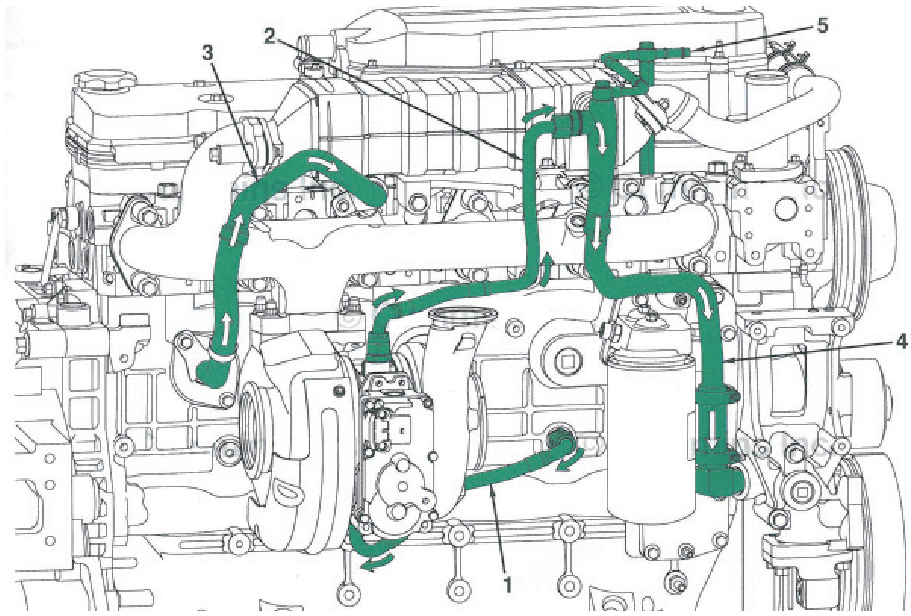
1 Coolant inlet from radiator and aftertreatment diesel exhaust fluid (DEF) dosing valve and DEF tank
2 Water pump Impeller
3 Coolant flow past lubricating oil cooler
4 Coolant flow past cylinders
5 Coolant flow from cylinder block to cylinder head
6 Coolant flow between cylinders
7 Coolant flow to thermostat housing
8 Thermostat open - bypass passage closed
9 Coolant flow back to radiator
10 Thermostat closed - bypass passage open
11 Coolant bypass passage in cylinder head
12 Coolant flow to water pump inlet



760F2EG17

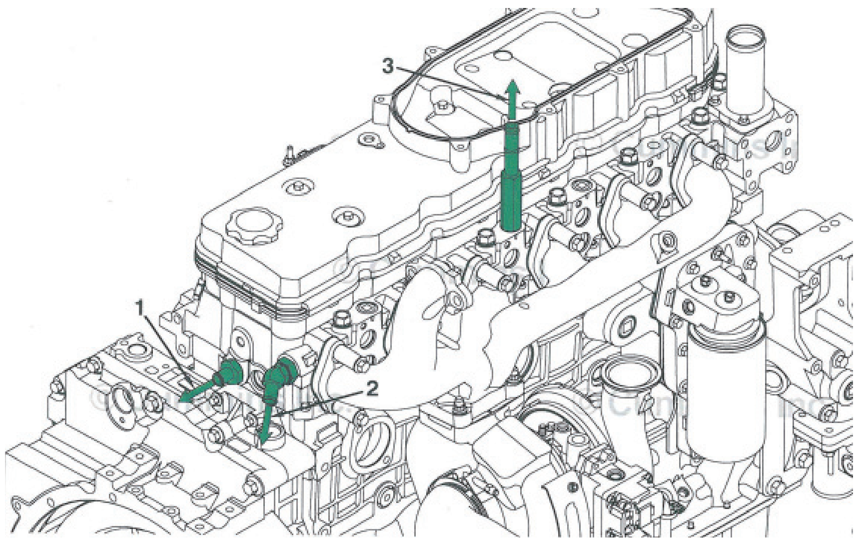
1 Air compressor coolant supply line
2 Air compressor coolant return to coolant inlet connection

COOLING SYSTEM



760F2EG18

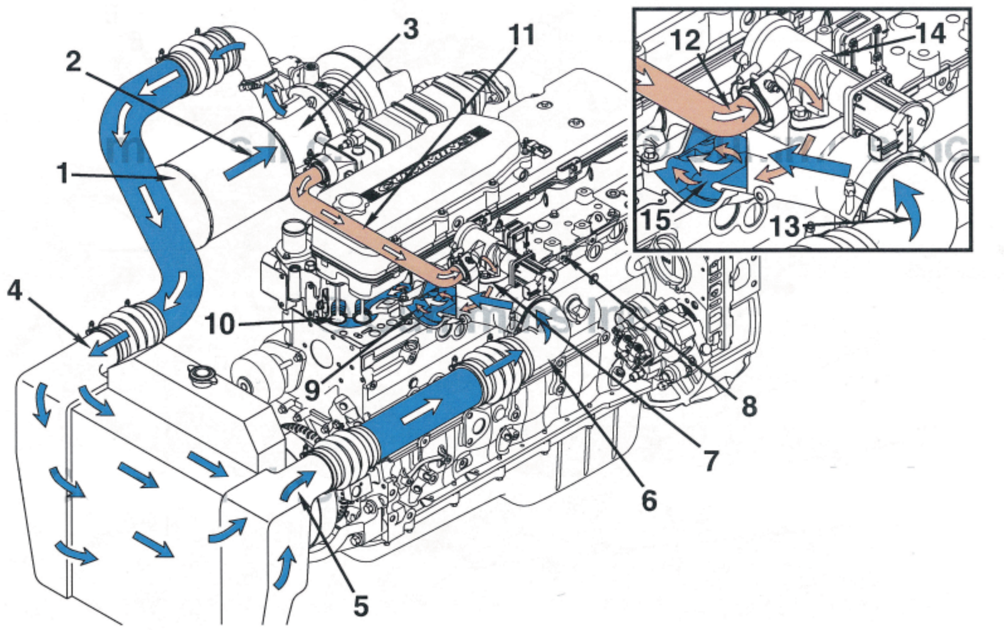
1 Coolant supply to variable geometry turbocharger from the cylinder block
2 Variable geometry turbocharger coolant return to the EGR cooler outlet tube
3 Coolant supply to the EGR cooler from the rear of the cylinder block
4 EGR cooler coolant return to the coolant inlet connection
5 De-aeration port (to coolant top tank)



760F2EG19

1 Coolant supply to aftertreatment DEF dosing valve and DEF tank
2 Coolant supply to cab heater
3 De-aeration port (to coolant top tank)

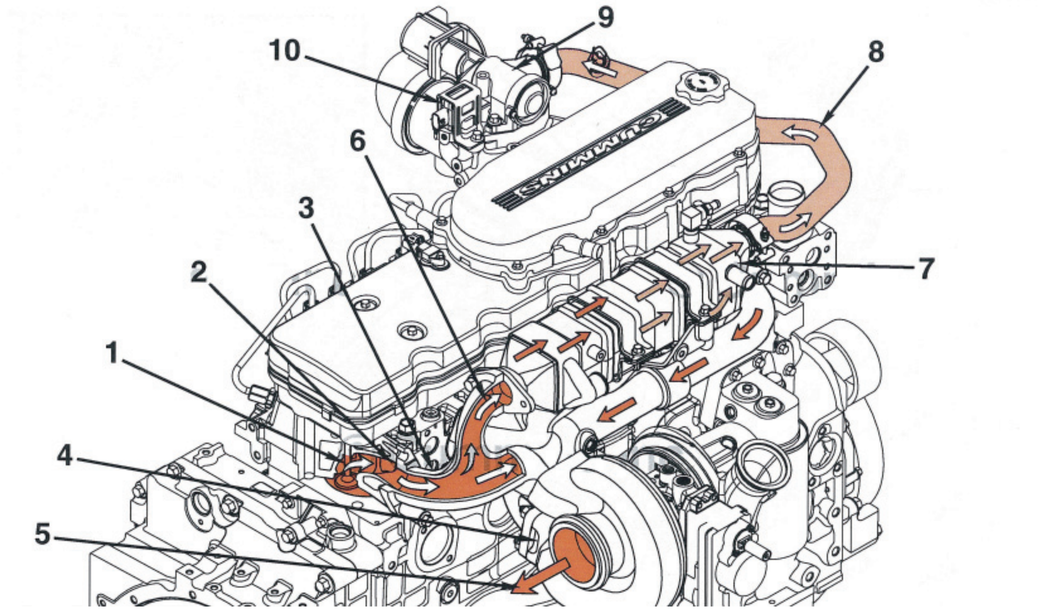
4) AIR INTAKE SYSTEM



7609A2EG20

1 Air cleaner
2 Turbocharger compressor inlet
3 Turbocharger compressor outlet
4 Charge air cooler inlet
5 Charge air cooler outlet
6 Air intake connection adapter
7 Air intake connection
8 Intake manifold
9 Intake port
10 Intake valves
11 EGR connection tube
12 EGR cooled exhaust gases
13 Charge air cooled intake air
14 EGR valve
15 Air mixture to combustion cylinder

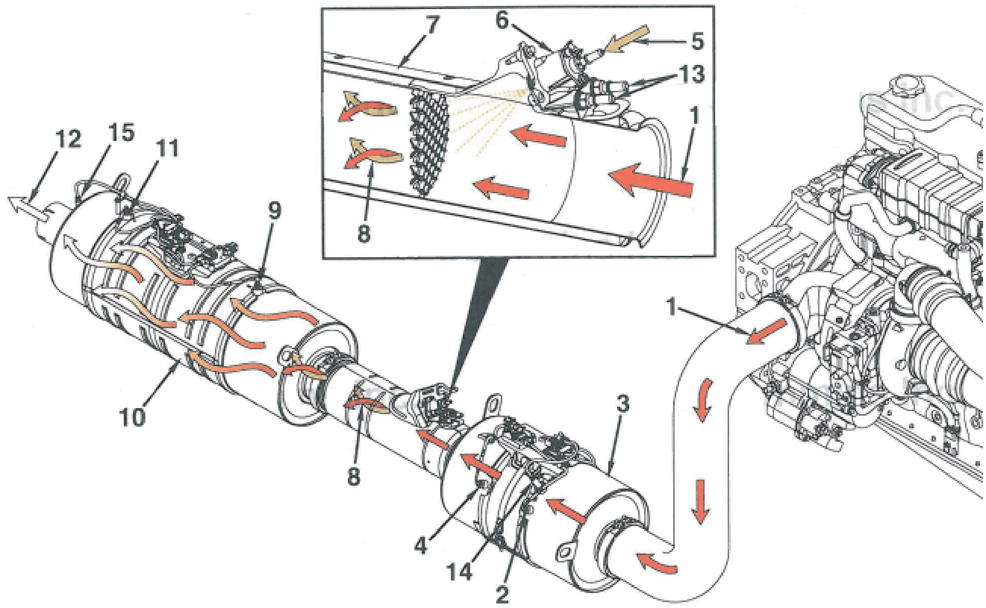
5) EXHAUST SYSTEM



7609A2EG21

1	Exhaust valves	6	Exhaust inlet to EGR cooler
2	Exhaust port	7	EGR cooler
3	Exhaust manifold	8	Cooled exhaust outlet to EGR valve
4	Turbocharger	9	EGR valve
5	Turbocharger exhaust outlet	10	EGR valve differential pressure sensor

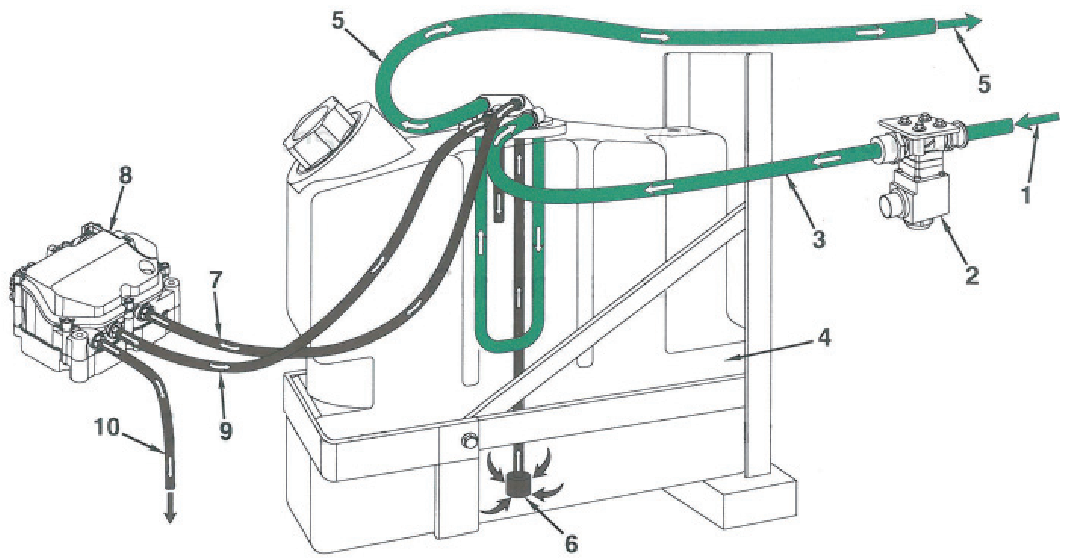
EXHAUST SYSTEM



760F2EG30

1 Exhaust from turbocharger
2 Aftertreatment diesel oxidation catalyst (DOC) intake temperature sensor probe
3 Aftertreatment DOC
4 Aftertreatment DOC outlet temperature sensor probe
5 Diesel exhaust fluid (DEF) supply to aftertreatment DEF dosing valve
6 Aftertreatment DEF dosing valve
7 Decomposion reactor
8 Exhaust DEF mixture
9 Aftertreatment selective catalyst reduction (SCR) intake temperature sensor probe
10 Aftertreatment SCR catalyst
11 Aftertreatment SCR outlet temperature sensor probe
12 Exhaust flow exiting aftertreatment system
13 Aftertreatment DEF dosing valve coolant fittings
14 Aftertreatment inlet mono-nitrogen oxides (NO_x) sensor probe
15 Aftertreatment outlet NO_x sensor probe

EXHAUST SYSTEM



760F2EG31

1 Coolant flow from engine to aftertreatment DEF
2 Aftertreatment DEF tank coolant valve
3 Coolant flow to aftertreatment DEF tank
(only when aftertreatment DEF tank coolant valve is open)
4 Aftertreatment DEF tank
5 Coolant return to engine
6 Aftertreatment DEF supply from aftertreatment DEF tank
7 Aftertreatment DEF flow to aftertreatment DEF dosing unit
8 Aftertreatment DEF dosing unit
9 Aftertreatment DEF return to aftertreatment DEF tank
10 Aftertreatment DEF flow to aftertreatment DEF dosing valve

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 6-60.

2. SPECIFICATION

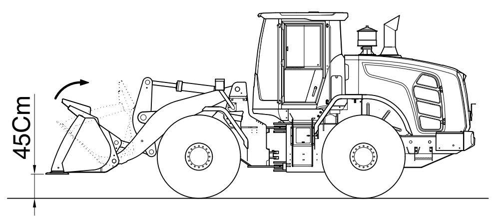
Engine speed, rpm (P mode)					Fan motor	Remark
Low idle	High idle	Pump stall	Converter stall	Full stall		
800±25	2230±50	2220±70	1910±70	1880±100	950±50	

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 6-60.

1) Pump stall rpm

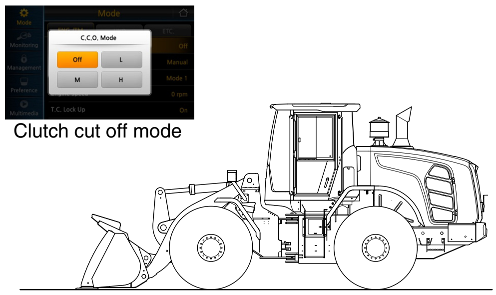
- Start the engine and raise the bucket approx 45 cm (1.5 ft) as the figure.
- Press the accelerator pedal fully and operate the bucket control lever to the retract position fully.
- Check the engine rpm at the above condition.



740F2EG01

2) Convertor stall rpm

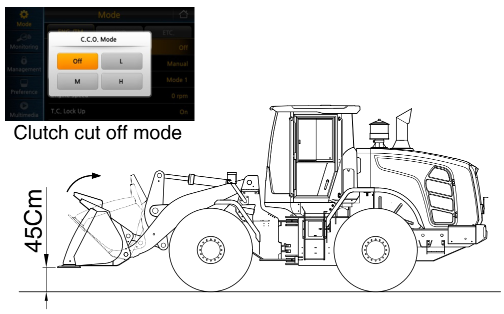
- Start the engine and lower the bucket on the ground as the figure.
- Set the clutch cut off mode at the OFF position.
- Press the brake pedal and accelerator pedal fully.
- Shift the transmission lever to the 4th forward position.
- Check the engine rpm at the above condition.



740F2EG02

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.

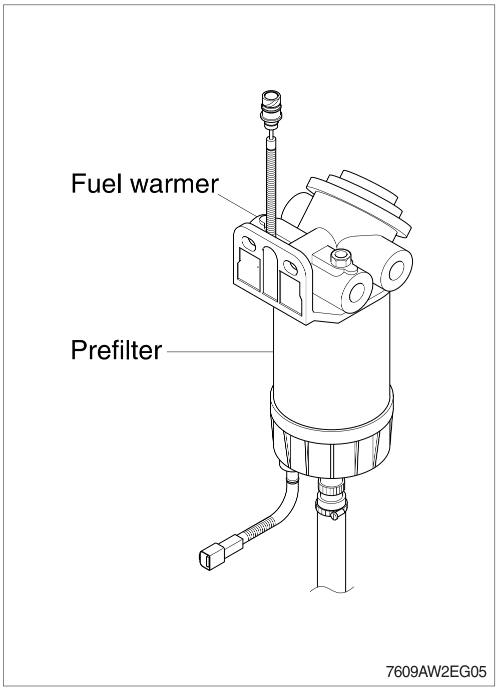


740F2EG03

GROUP 3 FUEL WARMER SYSTEM

1. SPECIFICATION

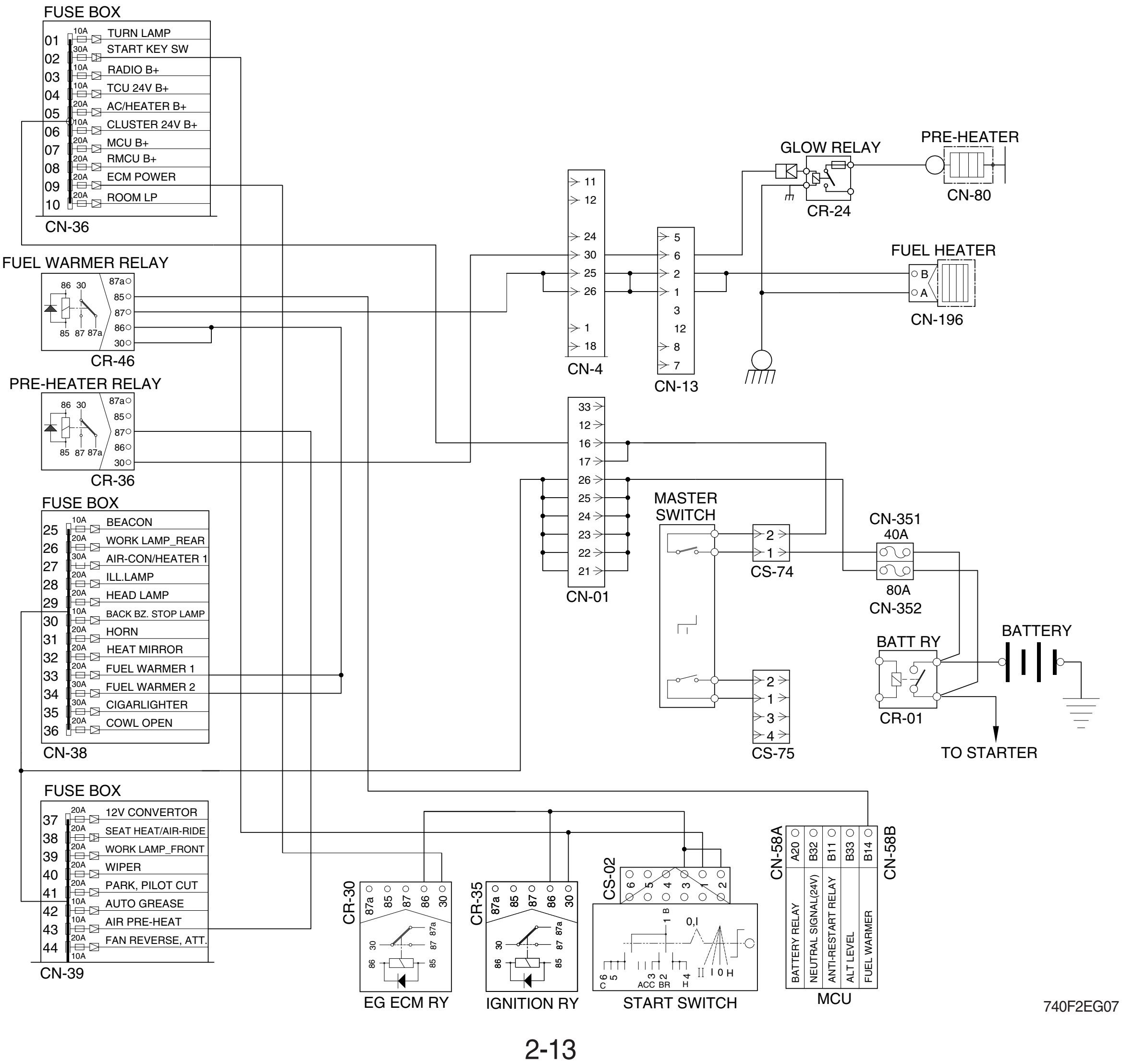
1) Operating voltage : 24±4V
2) Power : 350±50W
3) Current : 15A



2. OPERATION

1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
2) At the first state, the 15A current flows to the fuel warmer and engine may be started in 1~2 minutes.
3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5A.
   So, fuel is protected from overheating by this mechanism.

3. ELECTRIC CIRCUIT

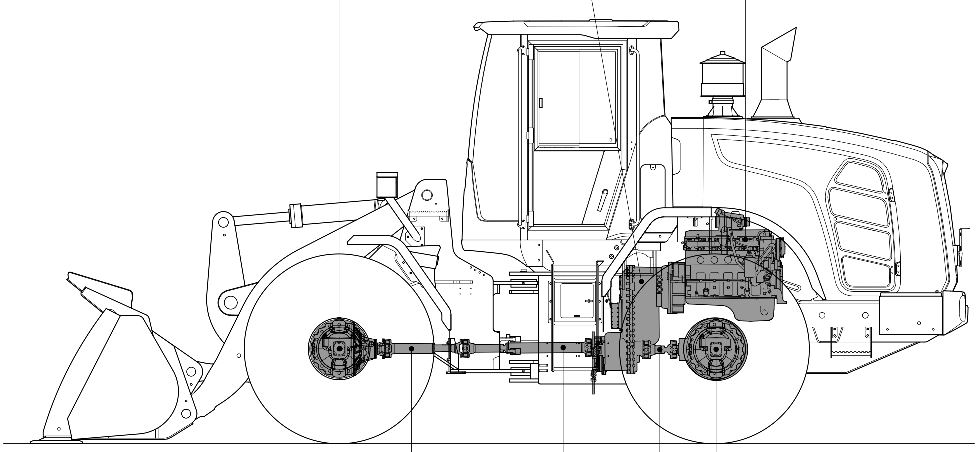


SECTION 3 POWER TRAIN SYSTEM

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. POWER TRAIN COMPONENT OVERVIEW



740F3PT01

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.

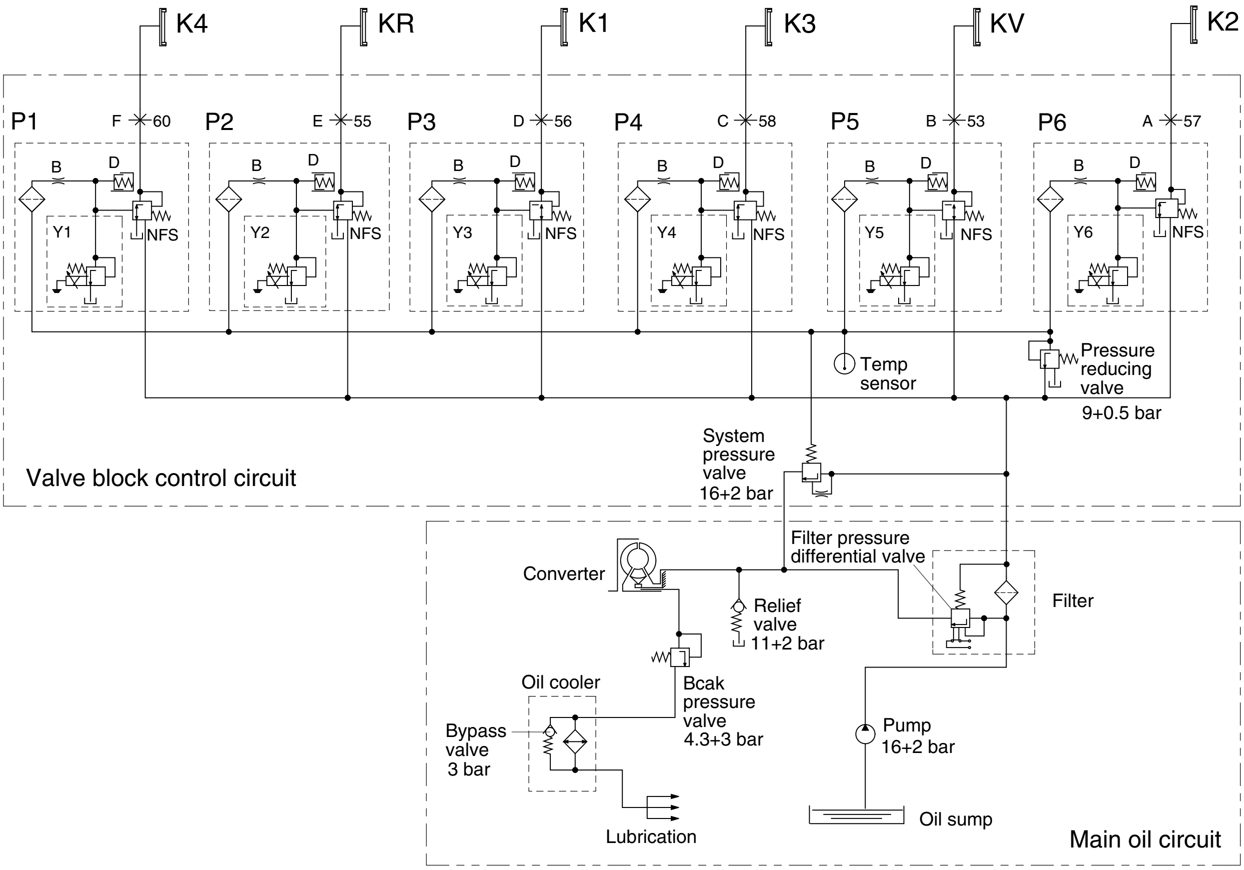
The transmission is a hydraulically engaged four speed forward, three speed reverse countershaft type power shift transmission. A calliper-disc type parking brake is located on the transmission.

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

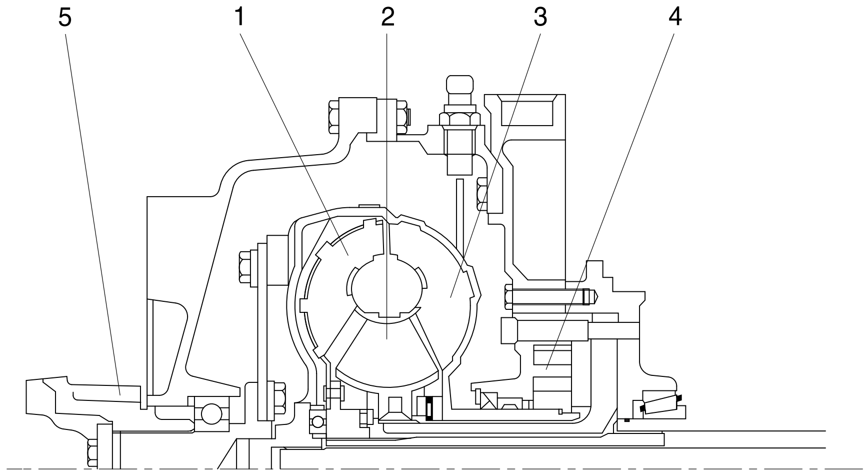
NFS	Follow-on slide
D	Vibration damper
B	Orifice
P1	Proportional valve clutch K4
P2	Proportional valve clutch KR
P3	Proportional valve clutch K1
P4	Proportional valve clutch K3
P5	Proportional valve clutch KV
P6	Proportional valve clutch K2
Y1~Y6	Pressure regulator

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.

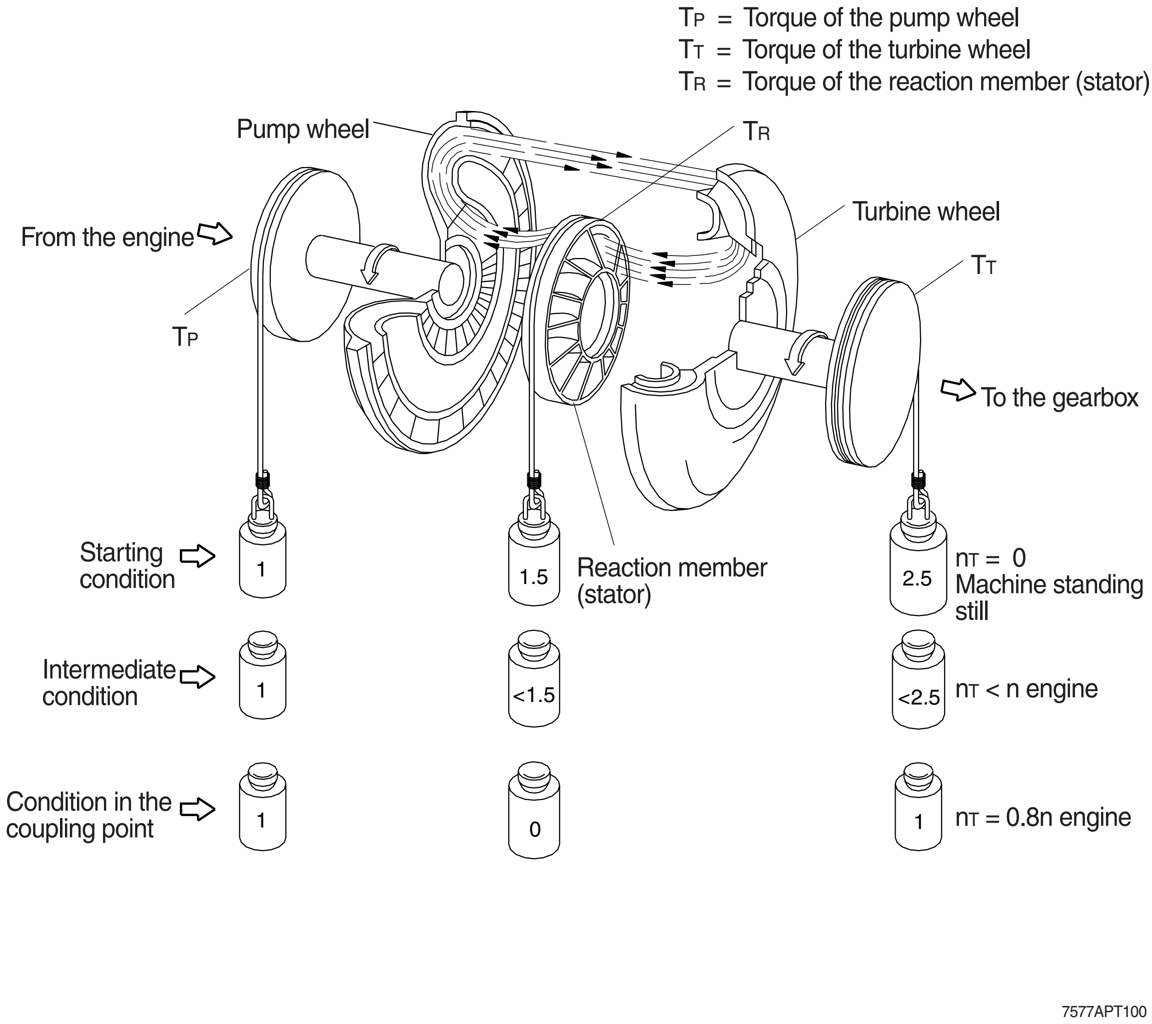
According to the rate of reversion, the turbine wheel and with it also the output shaft is receiving a more or less high reaction torque. The stator (reaction member), following the turbine, has the task to reverse the oil streaming out of the turbine once more and to deliver it under the suitable discharge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

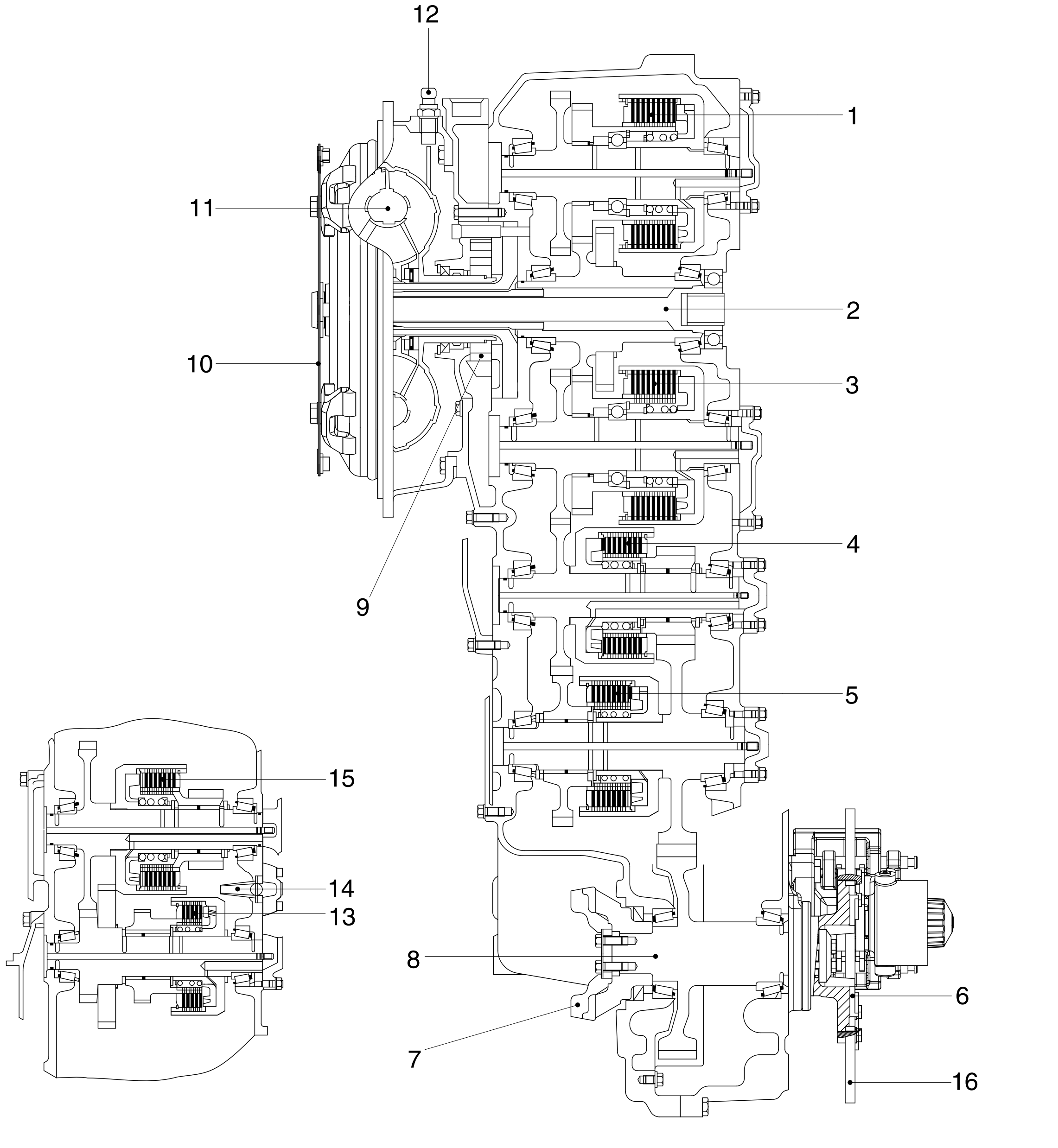
A stator freewheel serves to improve the efficiency in the upper driving range, in the torque multiplication range it is backing-up the torque upon the housing, and is released in the clutch range.
In this way, the stator can rotate freely.

Function of a hydrodynamic torque converter (schematic view)



3. TRANSMISSION

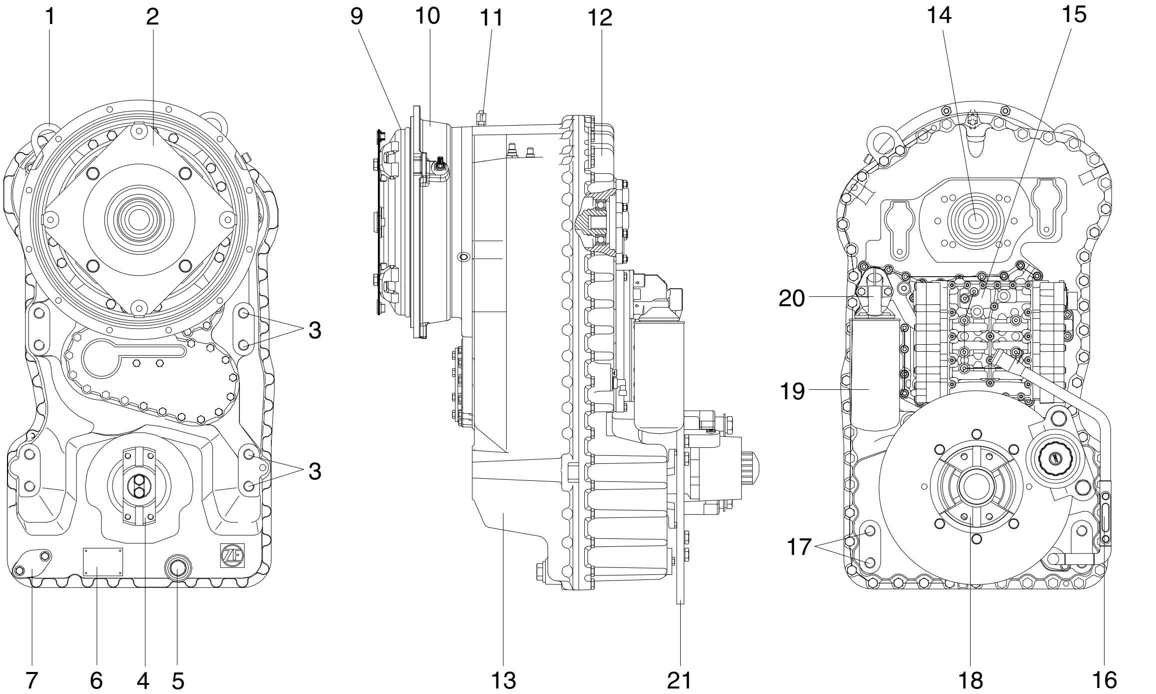
1) LAYOUT



7577APT03

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

2) INSTALLATION VIEW



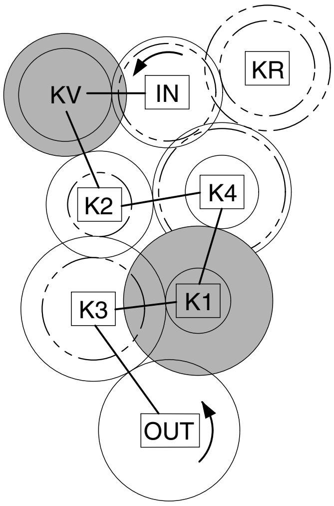
1	Lifting lugs	13	Transmission case
2	Connection to engine	14	Power take-off; Coaxial; Engine-dependent
3	Transmission suspension threads M20	15	Electro-hydraulic control
4	Output flange-converter side	16	Oil level tube with oil dipstick
5	Oil drain plug with magnetic insert M38 $\times$ 1.5	17	Transmission suspension threads M20
6	Model identification plate	18	Output flange-rear
7	Attachment possibility for oil level tube with oil dipstick (converter side)	19	Exchange filter (fine filter)
9	Cover	20	Filter head with connection for filter restriction switch
10	Converter bell housing	21	Parking brake
11	Breather		
12	Transmission case cover		

3) OPERATION OF TRANSMISSION (4 speed transmission)

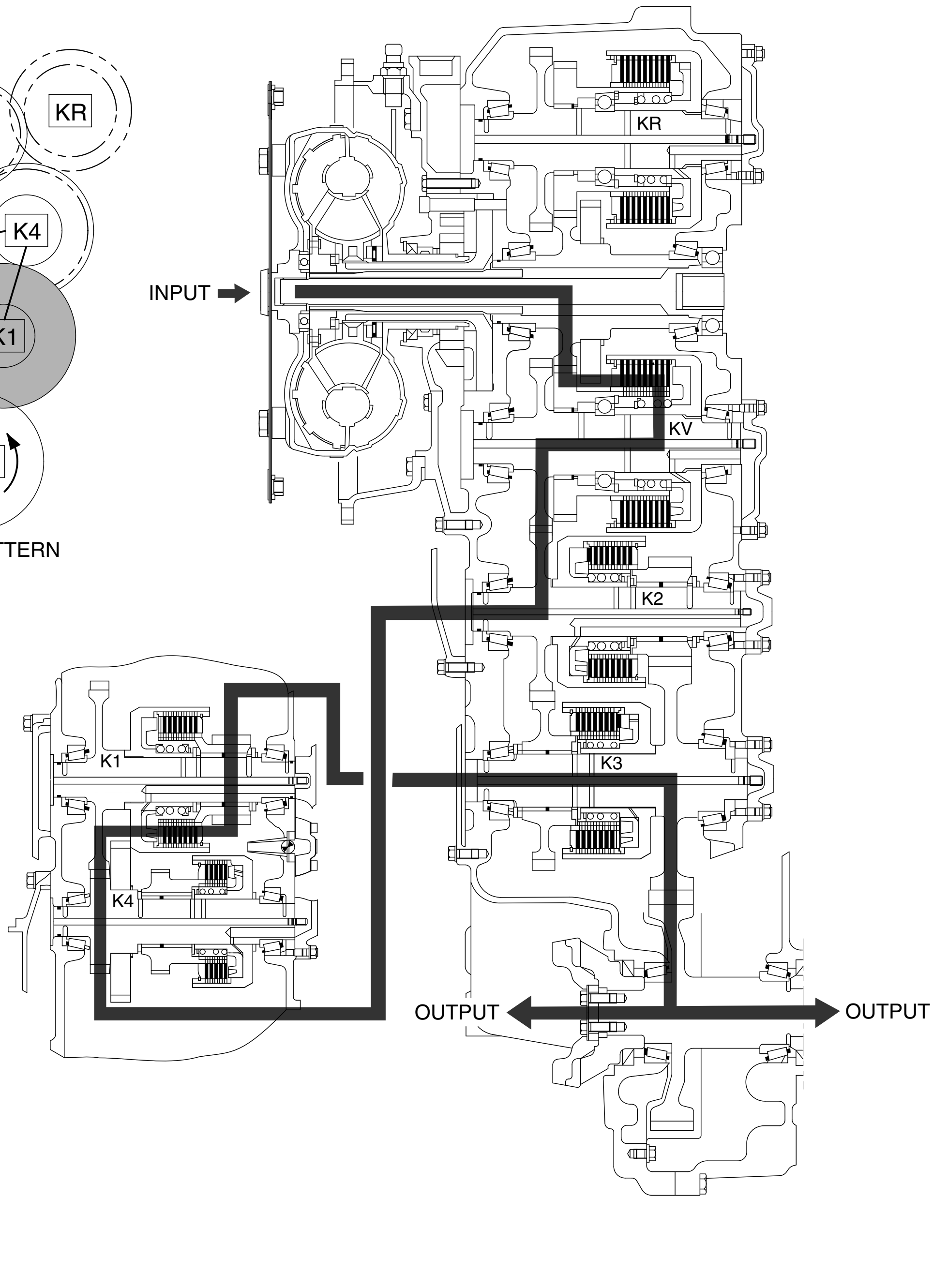
(1) Forward

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.



GEAR PATTERN

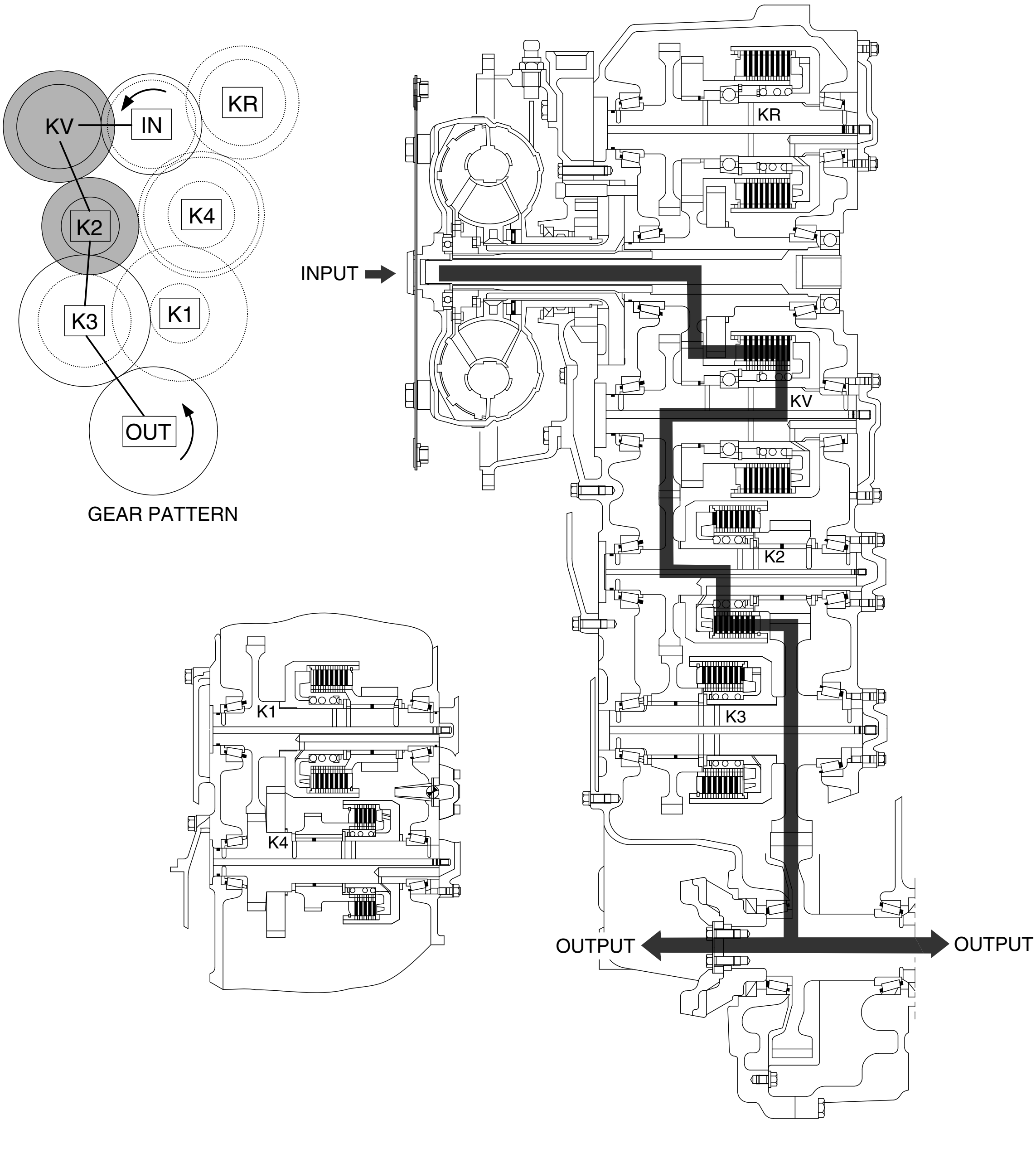


7577APT04 F1

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.

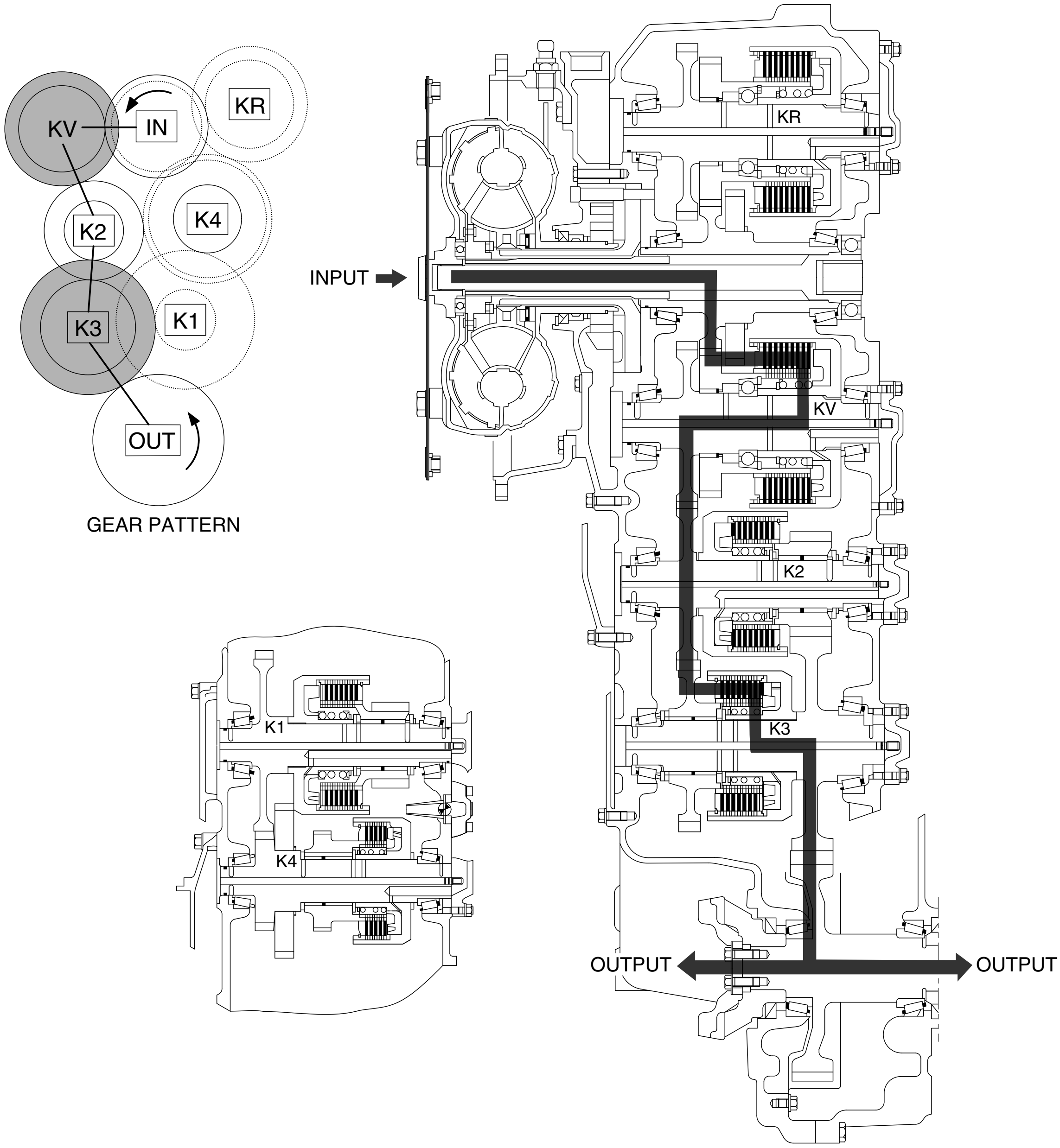


7577APT05 F2

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.

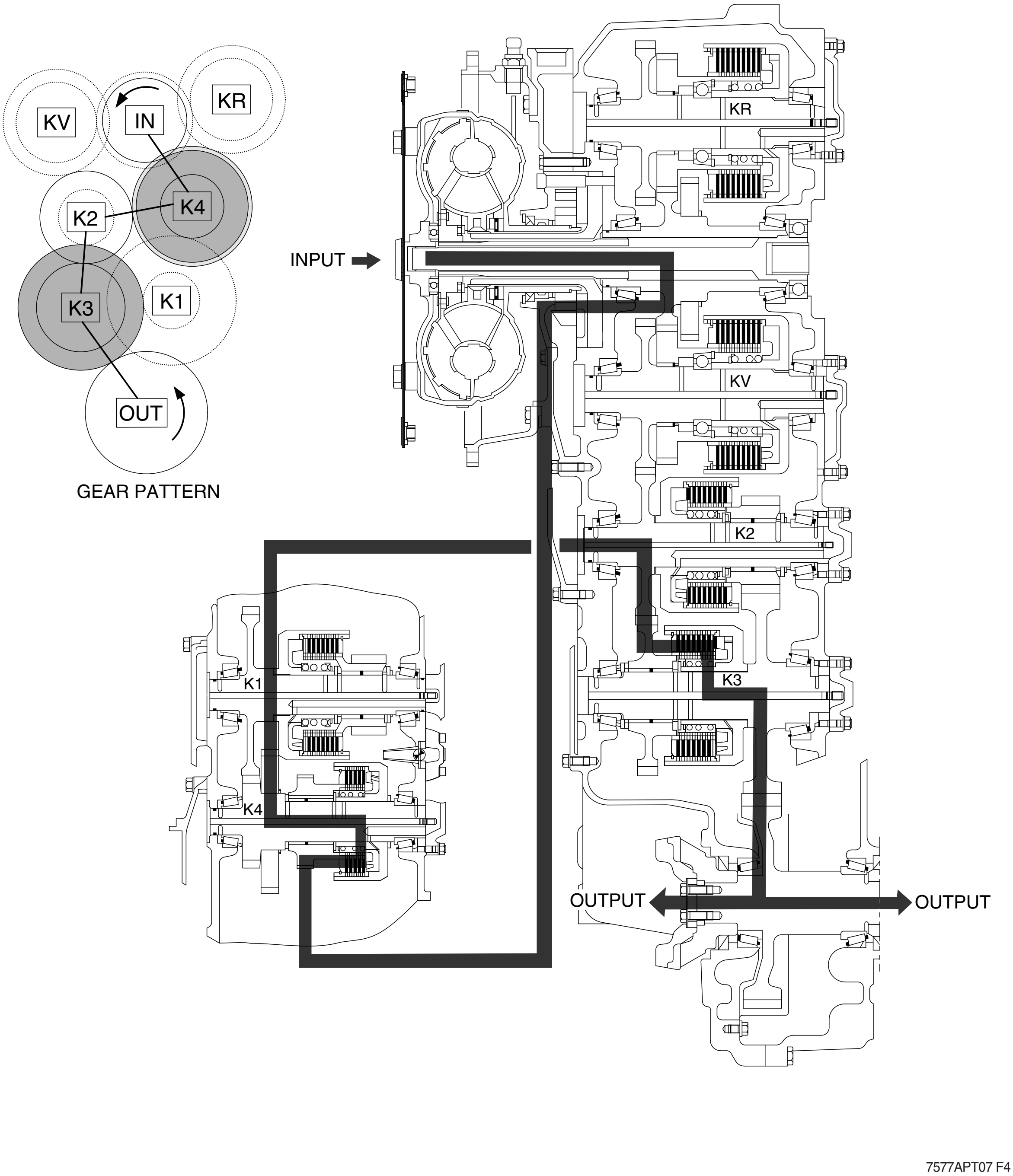


7577APT06 F3

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.

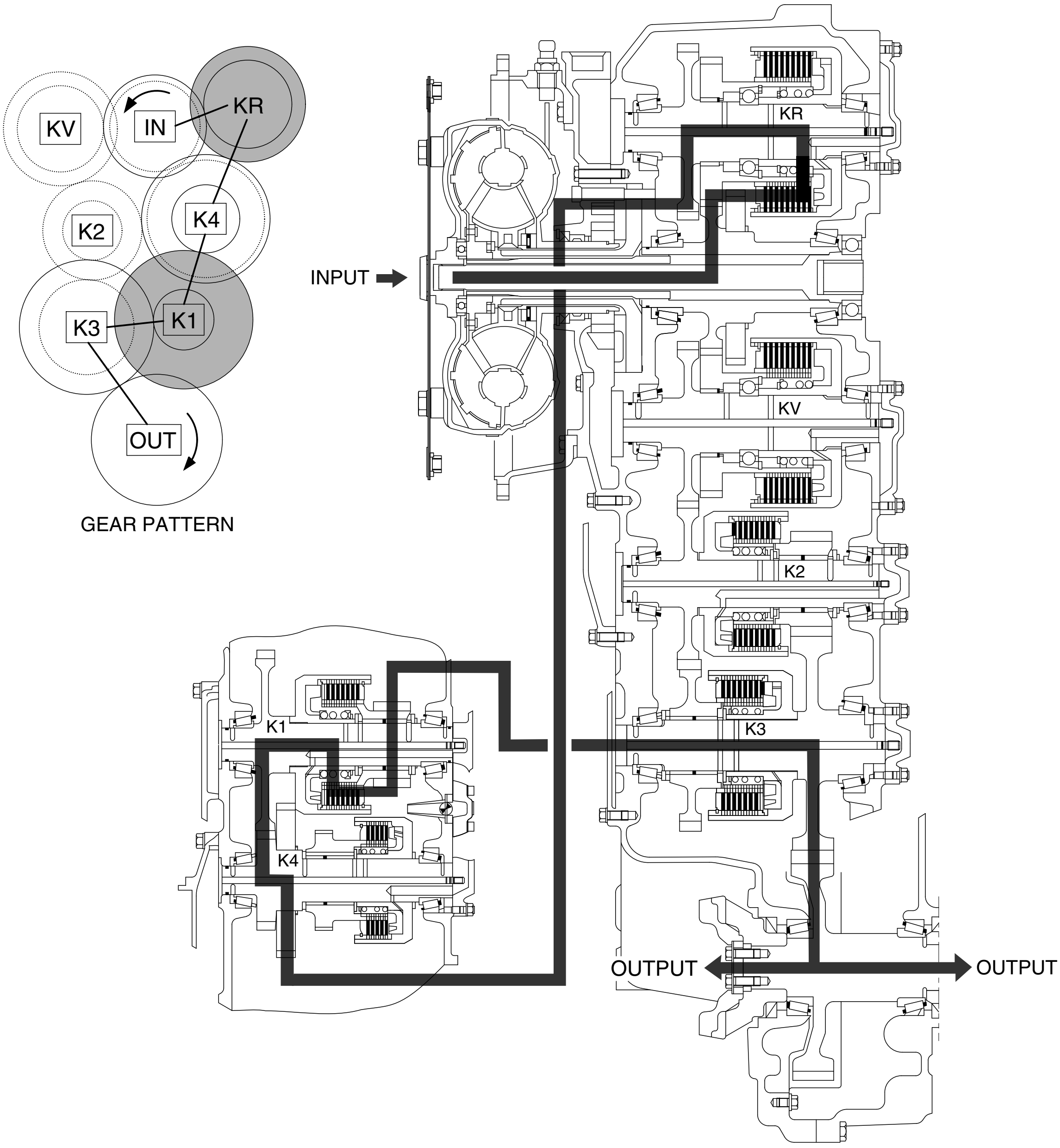


(2) Reverse

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.

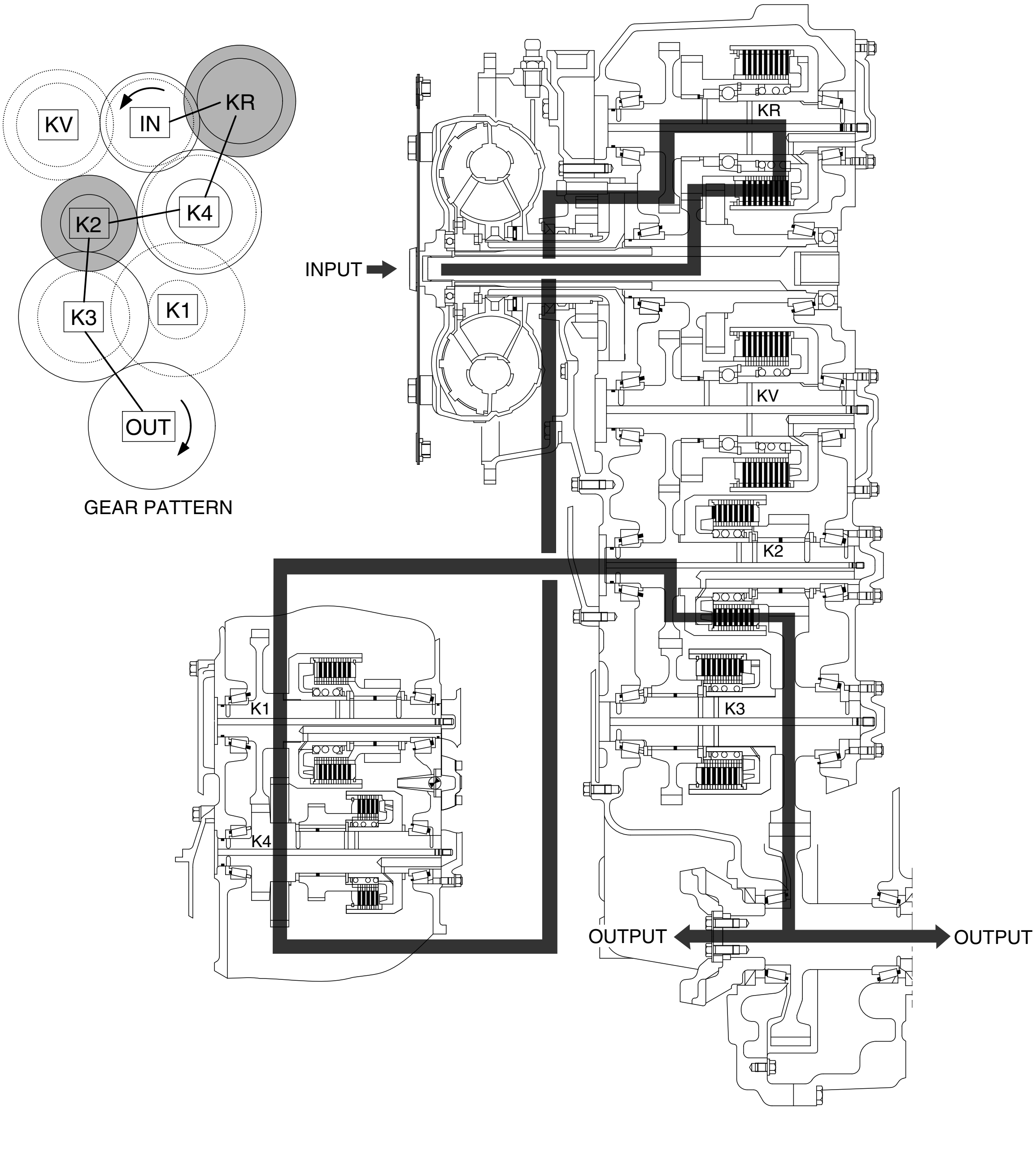


7577APT08 R1

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.

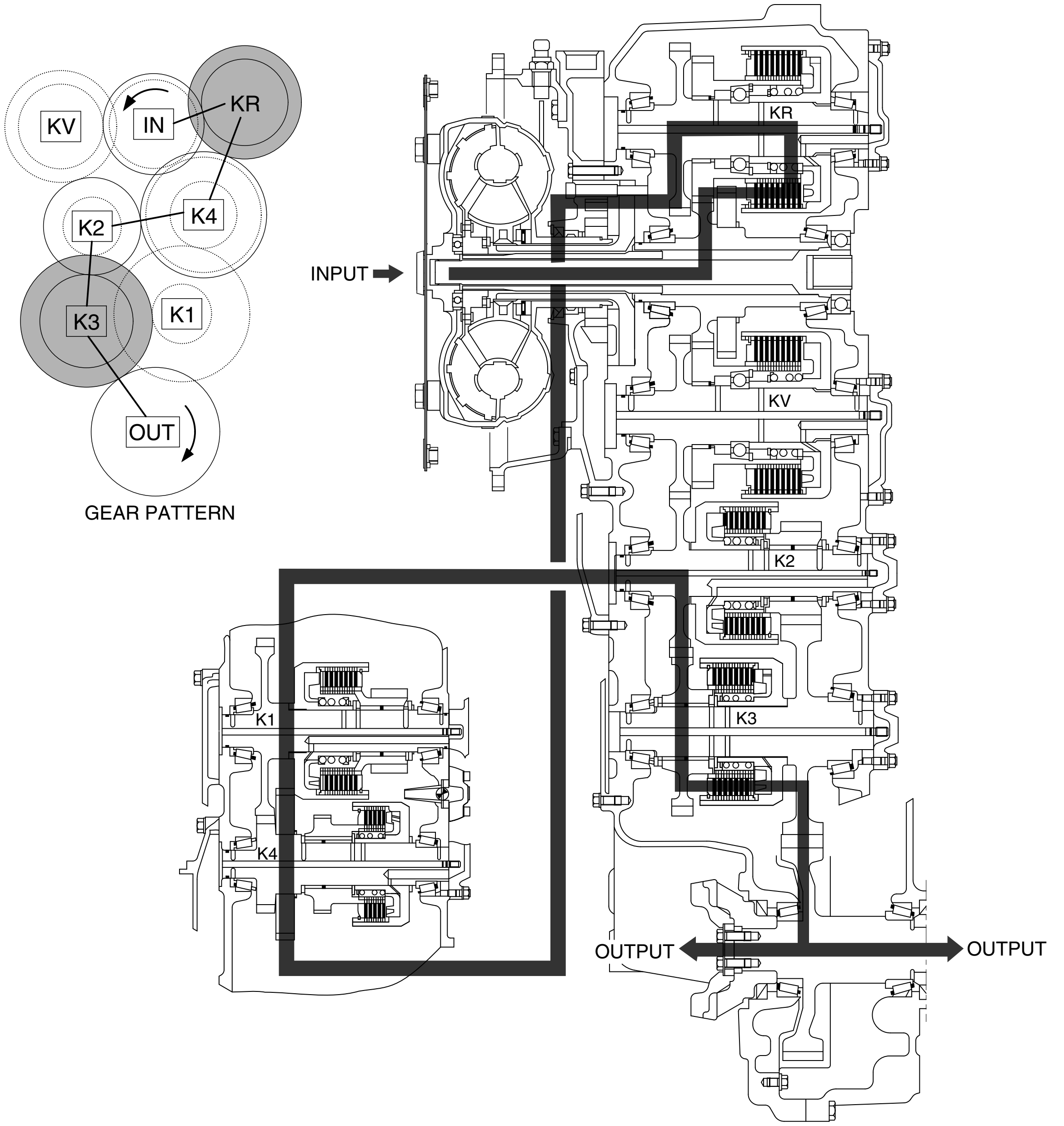


7577APT09 R2

③ Reverse 3rd

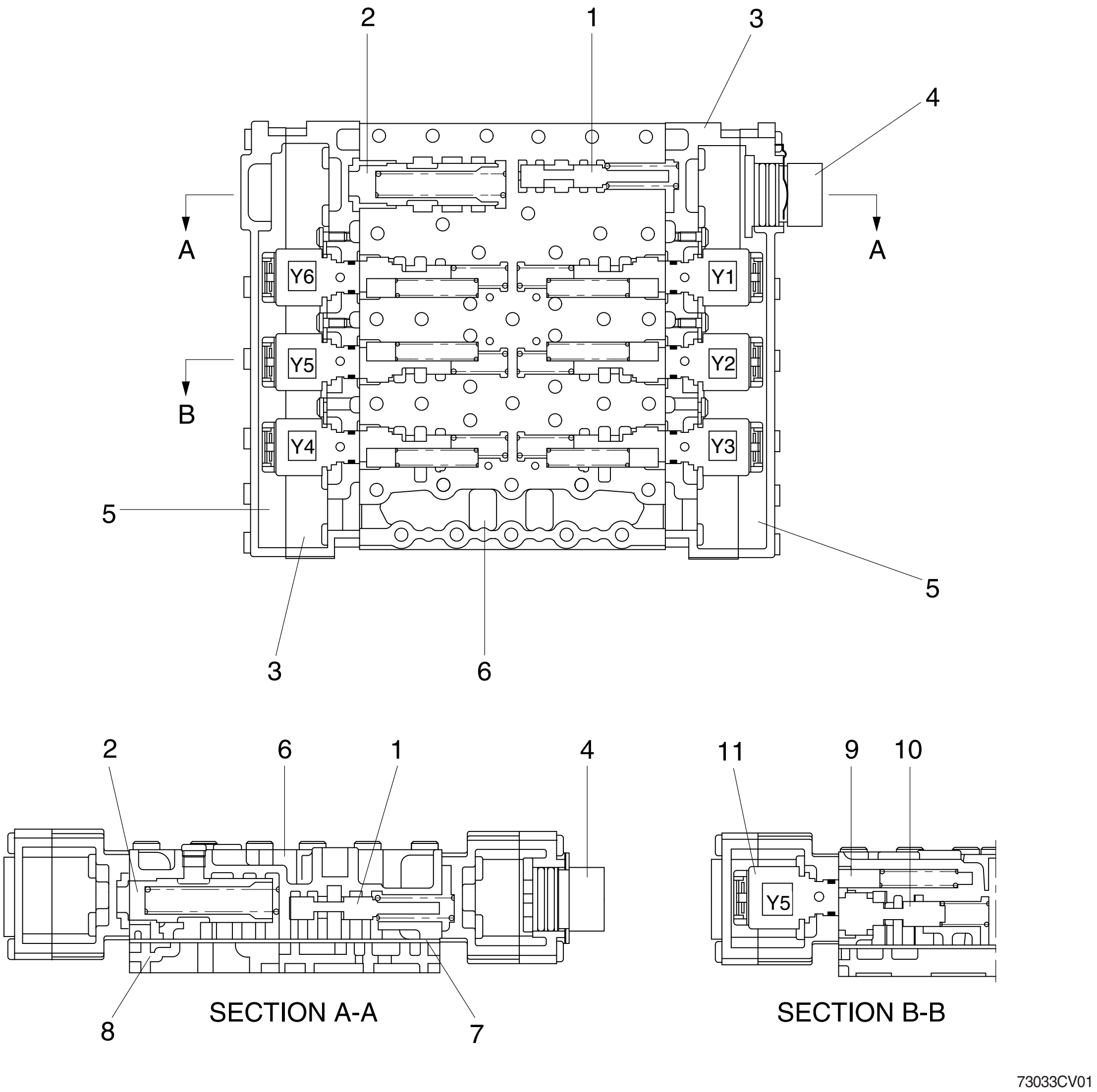
In 3rd reverse, reverse clutch (KR) and 3rd clutch (K3) are engaged.

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



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

Transmission control, see schedule of hydraulic circuit, electro-hydraulic control unit and measuring points at page 3-2, 3-14 and 3-86.

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+2bar) is directed via the follow-on slide to the respective clutch.

Due to the direct proportional selection with separated pressure modulation for each clutch, the 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+2bar).
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.

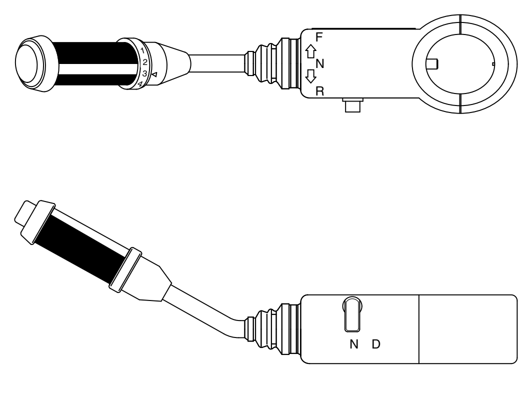
The oil is directed from the oil cooler to the transmission and from there to the lubricating oil circuit, so that all lubricating points are supplied with cooled oil.

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.

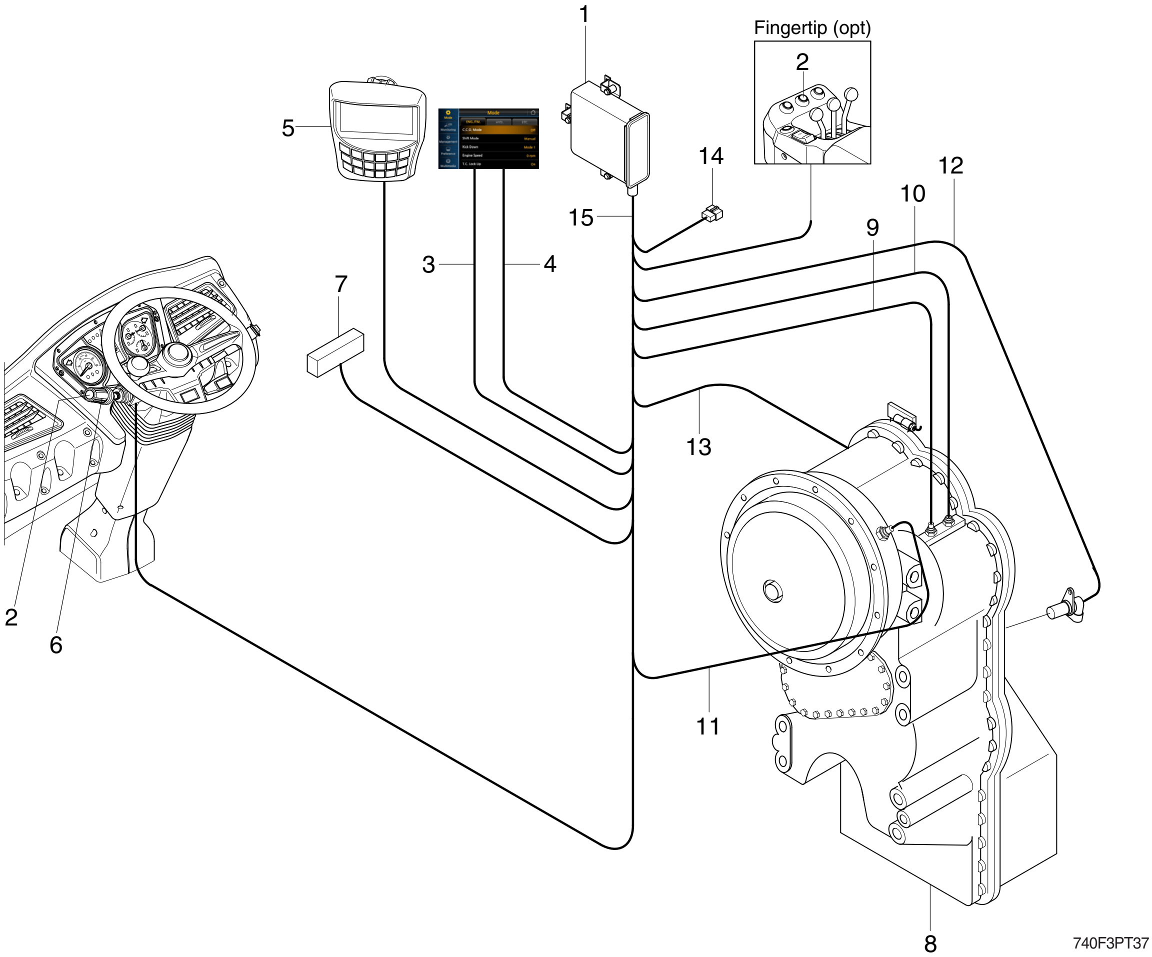
For the protection from unintended start off, a neutral interlock is installed.
Position N - Gear selector lever blocked in this position.
Position D - Driving.



73033TM17

6) ELECTRIC CONTROL UNIT

(1) Complete system



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

(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) 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

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>S</th></tr>
<tr><td rowspan="3">205</td><td>0</td><td>10 seconds continuous,
Boom cylinder 'rod' pressure Measurement Voltage > 5.3V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous,
Boom cylinder 'rod' pressure Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="3">301</td><td>3</td><td>10 seconds continuous, Fuel level Measurement Voltage > 3.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Fuel level Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="2">318</td><td>8</td><td>(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)</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="3">339</td><td>3</td><td>10 seconds continuous,
Accel pedal position 1 voltage Measurement Voltage > 5.0 V</td><td></td><td></td><td>●</td></tr>
<tr><td>4</td><td>10 seconds continuous,
Accel pedal position 1 voltage Measurement Voltage < 0.2 V</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(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</td></tr>
</table>

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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				

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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				

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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				

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1-1) AAVM FAULT CODE

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

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 **not** 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 recircuilation 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.

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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.

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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 not 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.

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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.

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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.

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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.

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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 posistion 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, entermittent or encorrect. 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 ㎞ [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 exhasut 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 exhasut 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 teh 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 aftreatment 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	· Check the cables from TCU to shift lever 3 · Check signal combinations of shift lever positions F-N-R · If shift lever is a CAN shift lever check CAN cable/shifter/device ※ 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	· Check the cables from TCU to shift lever · Check signal combinations of shift lever positions for gear range ※ 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	· Check the cables from TCU to shift lever · Check signal combinations of shift lever positions F-N-R ※ 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	· Check engine derating device ※ 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 elector active	· Check the cables from TCU to shift lever 2 · Check signal combinations of shift lever positions F-N-R ※ 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	· Check the cable from TCU to customer specific function No. 1 device · Check the connectors from customer specific function No. 1 to TCU · Check the resistance of customer specific function No. 1 device

※ 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 · Cable is defective and is contacted to battery voltage · Customer specific function No. 1 device has an internal defect · Connector pin is contacted to battery voltage	Customer specific	· Check the cable from TCU to customer specific function No. 1 device · Check the connectors from customer specific function No. 1 to TCU · Check the resistance of customer specific function No. 1 device
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 · Cable is defective and has no connection to TCU · Customer specific function No. 1 device has an internal defect · Connector has no connection to TCU	Customer specific	· Check the cable from TCU to customer specific function No. 1 device · Check the connectors from customer specific function No. 1 device to TCU · Check the resistance of customer specific function No. 1 device
21	S.C. to battery voltage at clutch cut off input The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Clutch cut off sensor has an internal defect · Connector pin is contacted to battery voltage	Clutch cut off function is disabled OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the clutch cut off sensor
22	S.C. to ground or O.C. at clutch cut off input The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Cable has no connection to TCU · Clutch cut off sensor has an internal defect · Connector pin is contacted to vehicle ground or is broken	Clutch cut off function is disabled OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the clutch cut off sensor
25	S.C. to battery voltage or O.C. at transmission sump 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 use default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature 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
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 3-71
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 3-71
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 3-71
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 3-71
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 3-71

※ 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 3-71
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 3-71
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 3-71
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 3-71
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 3-71
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 3-71

※ 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 3-71
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 3-71
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 3-71
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 3-71
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 3-71
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 3-71

※ 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 3-71
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 3-71
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 3-71
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 3-71
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 3-71
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 3-71

※ 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 3-71
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 3-71
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 3-71
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 3-71
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 3-71

※ 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 3-71
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 3-71
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 3-71
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 3-71
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 3-71

※ 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 3-71
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 3-71
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 3-71
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 · Low pressure at clutch K3 · 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 K3 · 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
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 · Low pressure at clutch K4 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine 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 K4 Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor 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 · Low pressure at clutch KV · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine 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 KV · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor · 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 · Low pressure at clutch KR · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine 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 KR Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor · Replace clutch
B7	Overtemp sump TCU measured a temperature in the oil sump that is over the allowed threshold.	No reaction OP mode : Normal	· Cool down machine · Check oil level · Check temperature sensor
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 · Oil filter is polluted · Cable/connector is broken or cable/connector is contacted to battery voltage or vehicle ground · Differential pressure switch is defective	No reaction OP mode : Normal	· Check oil filter · Check wiring from TCU to differential pressure switch · Check differential pressure switch(Measure resistance)

※ 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 · Low pressure at converter lockup clutch · Low main pressure · Wrong signal at engine speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	No reaction OP mode : Normal	· Check pressure at converter lockup clutch · Check main pressure in the system · Check sensor gap at engine speed sensor · Check sensor gap at turbine speed sensor · Check signal at engine speed sensor · Check signal at turbine speed sensor · Replace clutch
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	· Cool down machine · Check oil level · Check temperature sensor
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 · Cable is defective and is contacted to vehicle ground · Joystick status indicator has an internal defect · Connector pin is contacted to vehicle ground	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 3-71
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 · Cable is defective and is contacted to battery voltage · Joystick status indicator has an internal defect · Connector pin is contacted to battery voltage	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 3-71

※ 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 3-71
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

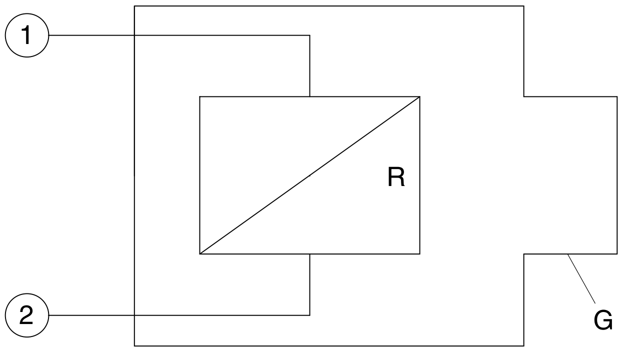
※ Some fault codes are not applied to this machine.

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

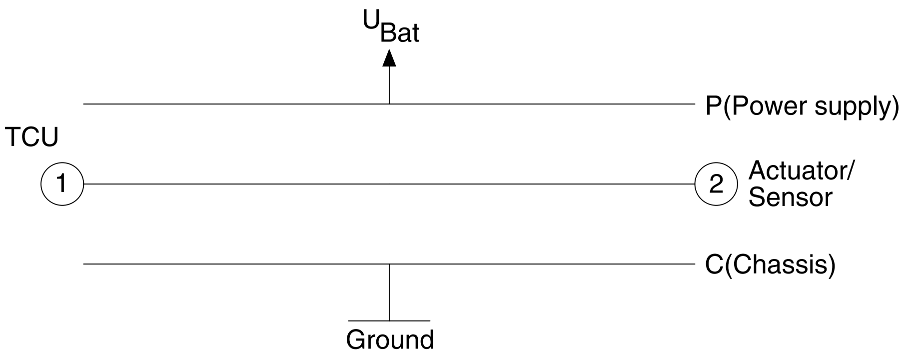
Open circuit	$R_{12} = R_{1G} = R_{2G} = \infty$
Short cut to ground	$R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$

(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

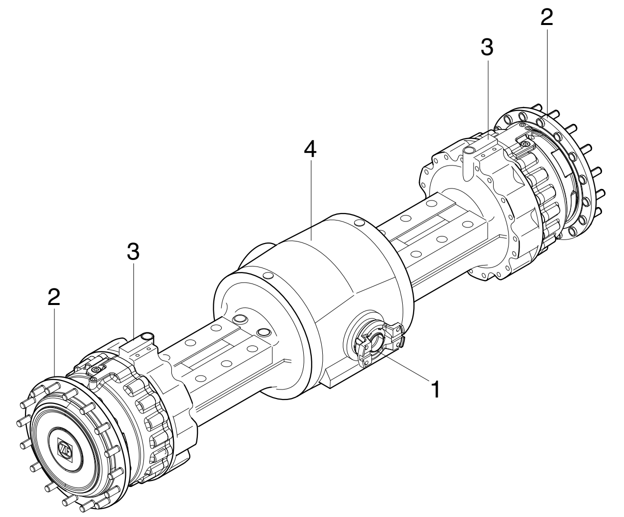
Open circuit	$R_{12} = R_{1P} = R_{1C} = R_{2P} = R_{2C} = \infty$
Short cut to ground	$R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = \infty$
Short cut to battery	$R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = 0$

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.

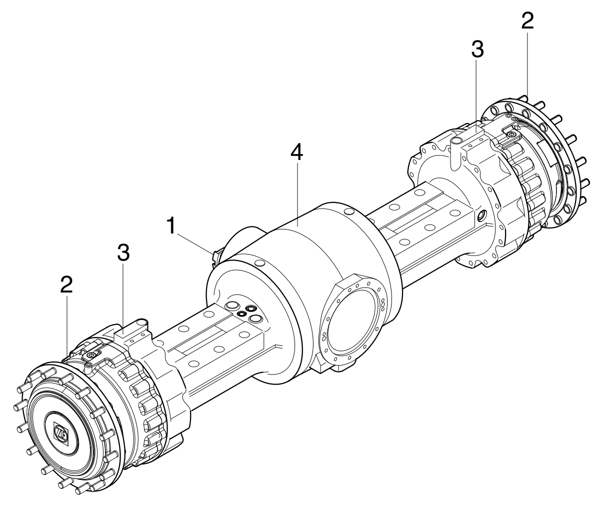
(1) Front axle



7609A3PT15

1	Input	2	Output	3	Brake
4	Axle housing				

(2) Rear axle



7609A3PT16

1	Input	2	Output	3	Brake
4	Axle housing				

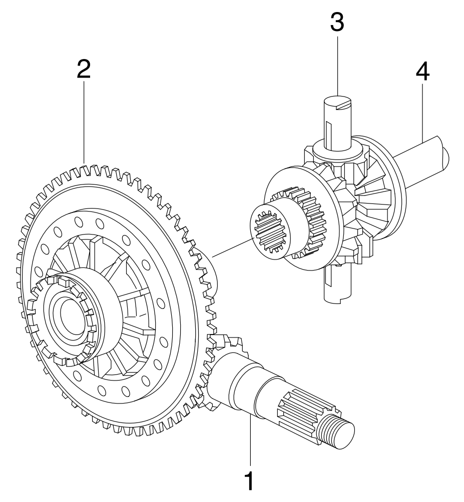
2) DIFFERENTIAL

(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 a 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.

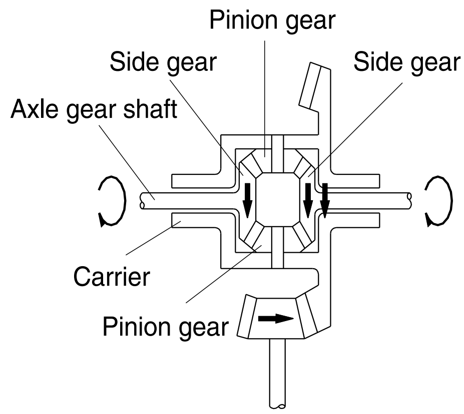
It then transmits the motive force through the differential (3) to the axle gear shaft (4).



770-3 [3-26(1)]

(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 send through the pinion gear and the side gear, therefore the power is equally transmitted to the left and right axle gear shaft.

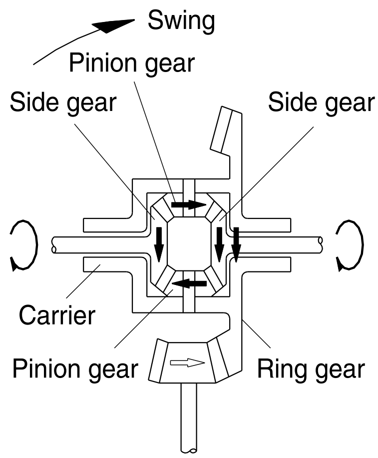


770-3 [3-26(2)]

(3) When turning

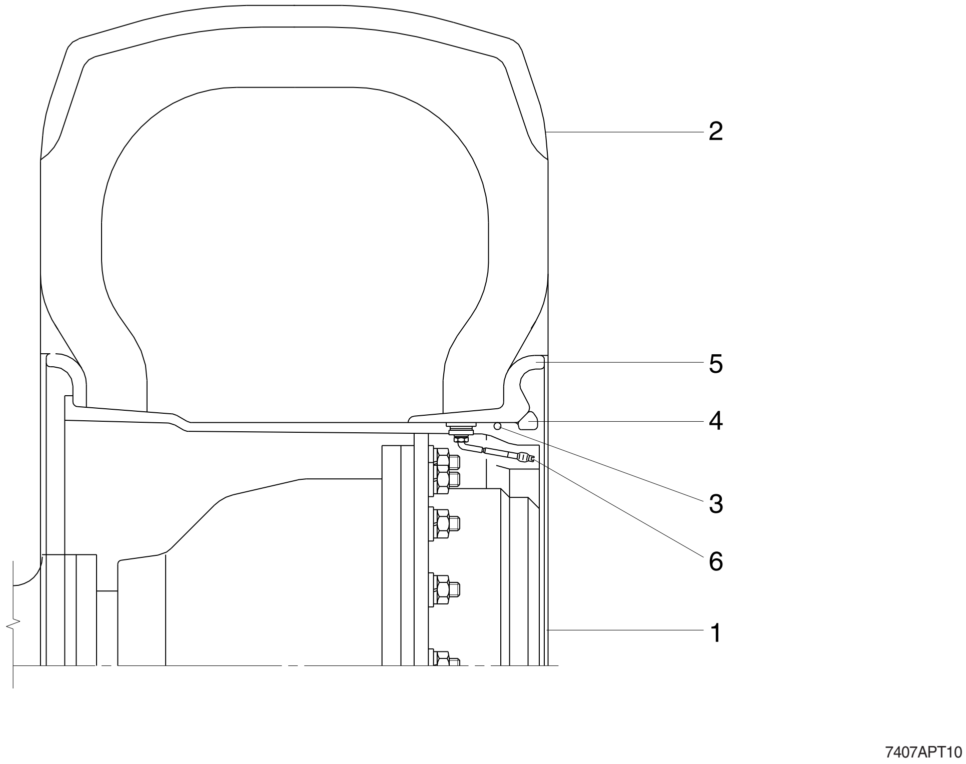
When turning, the rotating speed of the left and right wheels is different, so the pinion gear and side gear inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels.

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



770-3 [3-26(3)]

6. TIRE AND WHEEL



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.

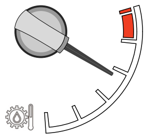
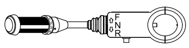
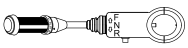
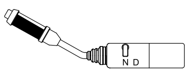
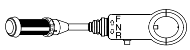
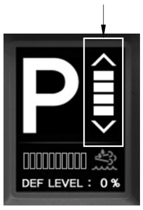
The engine and all other major components must be at operating temperature for some checks.

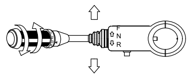
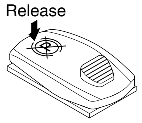
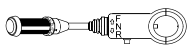
Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

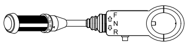
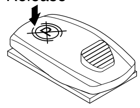
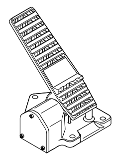
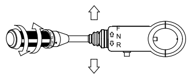
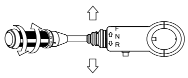
At the end of each check, if no problem is found(OK), that check is complete or an additional check is needed. If problem is indicated(NOT OK), you will be given repair required and group location.
If verification is needed, you will be given next best source of information :

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	 MANUAL mode   Start engine. Apply service brakes and release parking brake. Select T/M shift mode to MANUAL mode. Move gear selector lever to 3rd speed. Move gear selector lever to forward "F" position. Increase engine speed to high idle for 30 seconds. Move gear selector lever to neutral "N" position and run for 15 seconds. Repeat procedure until transmission temperature gauge arrow points to bar above dial.	OK Check completed.
Gear selector lever and neutral lock latch checks Engine OFF.	  Move gear selector lever to each position. NOTE : Gear selector lever position changes slightly as steering column is tilted. FEEL : Lever must move freely through all positions. Engage neutral lock. Apply slight effort to move lever into forward (F) and reverse (R). LOOK : Neutral lock must stay engaged.	OK Check completed. NOT OK Repair lock or replace switch.
Automatic shifting check	 AL mode  Automatic mode  Start engine. Move gear selector lever to 4th speed. Select T/M shift mode to AL (auto light) mode. LOOK : Automatic sign on cluster. Move gear selector lever to forward or reverse position. Increase engine rpm. LOOK : Speed on cluster must vary with machine speed.	OK Check completed. NOT OK Go to transmission fault code group at page 3-54~3-70. Repair or replace the monitor or harness.

Item	Description	Service action
Transmission noise check Engine running.	 Run engine at approximately 1600 rpm. Drive unit with transmission in each forward and reverse speed. LISTEN : Transmission must not make excessive noise in any range. Engine rpm must not "lug down" as unit is shifted between gears.	**OK** Check completed. **NOT OK** Go to transmission makes excessive noise, chapter 2 in this group.
Transmission "quick shift" check Engine running.	Release  Release parking brake and select T/M shift mode to MANUAL mode. Shift to 2nd forward. MANUAL mode  Drive machine at approximately 5km/h and press gear selector lever kick down switch or RCV levers switch once. LOOK/FEEL : Transmission must shift to and remain in 1st gear. Press gear selector lever kick down switch once.  LOOK/FEEL : Transmission must shift back to 2nd gear. Shift to (3rd or 4th) gear and press gear selector lever kick down switch once. LOOK/FEEL : Transmission must not shift down. AL mode  Select T/M shift mode to AL (auto light) mode. Drive machine at approximately 90% speed of max speed in each gear (2nd or 3rd or 4th). 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. LOOK/FEEL : 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) 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)	**OK** Check completed. **NOT OK** Check connector at base of control valve. **IF OK** Go to transmission controller circuit in group 1.

Item	Description	Service action
Forward, reverse and 4th speed clutch pack drag check ※ Transmission must be warmed up for this check. Engine running.	   Park unit on level surface. Apply service brakes. Move gear selector lever to neutral. Move gear selector lever to 1st. Release parking brake and service brakes. Run engine at low idle. LOOK : Unit must not move in either direction. NOTE : If unit moves forward, either the forward pack or the 4th speed pack is dragging.	OK Check completed. NOT OK If unit moves, repair transmission.
Transmission shift modulation check Engine running.	 Run engine at approximately 1300 rpm. Put transmission in 1st forward, shift several times from forward to reverse and reverse to forward. Repeat check in 2nd gear. LOOK : Unit must slow down and change direction smoothly.	OK Check completed. NOT OK Go to unit shifts too fast, chapter 2 in this group.
Torque converter check	 Start engine. Apply service brakes and release parking brake. Move gear selector lever to 3rd speed. Move gear selector control lever to forward "F" position. Increase engine speed to high idle. LOOK : Torque converter stall rpm must be within the following range. Stall rpm : 1910±70 rpm Move gear selector control lever to neutral "N" position and run for 15 seconds.	OK Check completed. NOT OK If stall rpm are too low or too high, problem may be engine power or torque converter. IF OK Replace transmission torque converter.

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 3-54~3-70.

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

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

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

Problem	Cause	Remedy
Torque converter stall RPM too low	Low engine power.	Do engine power test.
	Mechanical malfunction.	Remove and inspect torque converter.
Transmission pressure light comes ON when shifting from forward to reverse (all other gears OK)	Low oil level.	Add oil.
	Cold oil.	Warm oil to specification.
	Leak in reverse pack.	Do transmission pressure, pump flow, and leakage check.
Transmission pressure light comes ON for each shift	Cold oil.	Warm oil to specification.
	No time delay in monitor.	Do monitor check.
	Restriction in modulation orifice.	Remove orifice and inspect for restriction and/or plugging.
	Stuck PPC valve.	Remove and inspect.
	Low transmission pressure circuit.	Do transmission system pressure test.
	Leak in transmission pressure circuit.	Do converter out pressure test.
	Failed transmission pump.	Do transmission pump flow test.
	Clogged filter.	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.
	Mechanical failure in axle planetary.	Remove differential. Inspect, repair.
Oil seeping from outer axle seal	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.
	Overfilled differential.	Check differential oil return system for excessive internal restriction.
Axle overheats	Low differential oil.	Add oil.
	Overfilled differential.	See differential overfills with oil in this group.
	Brake drag.	See brakes drag in this group.

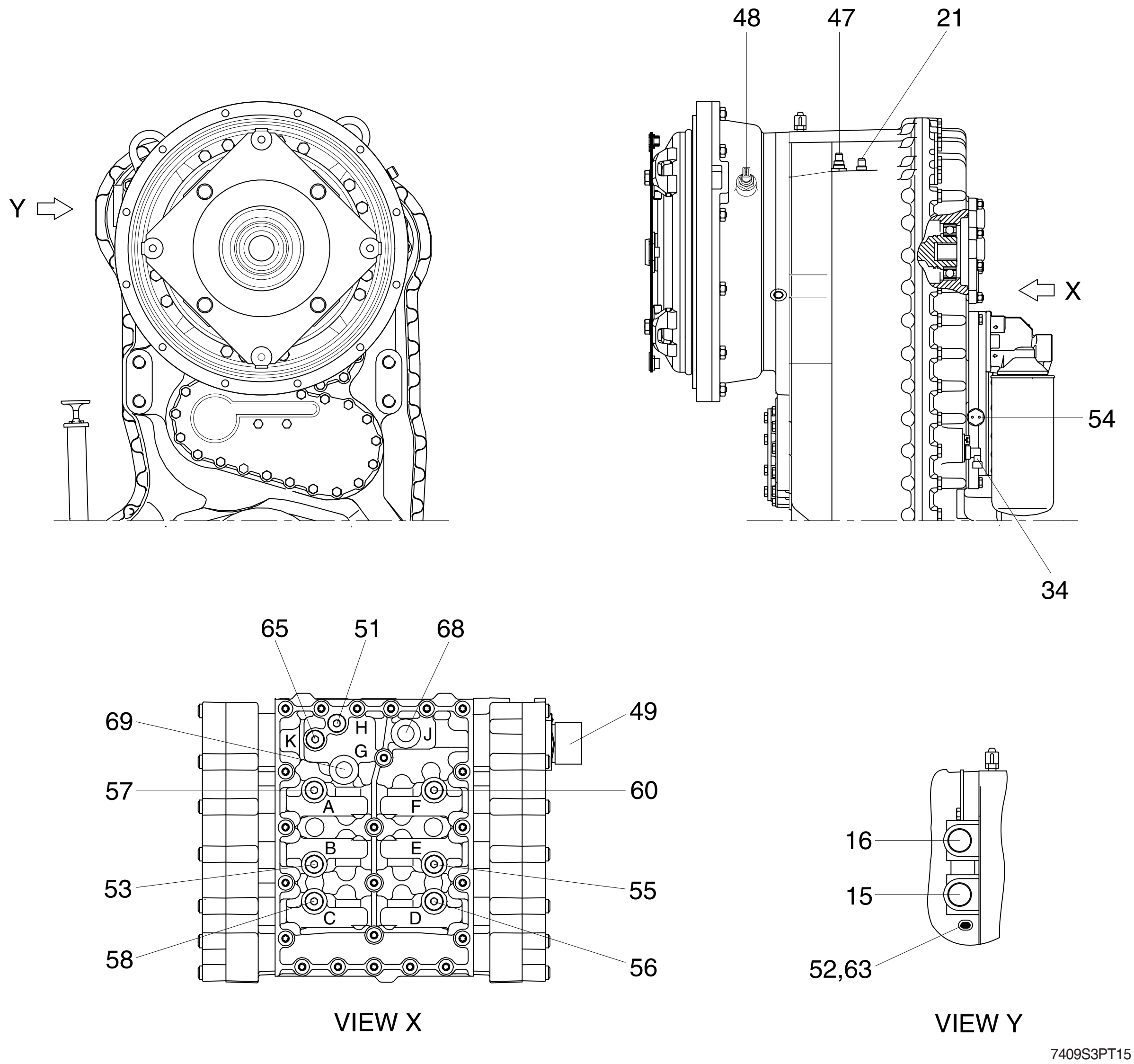
3) DRIVE LINE

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).



1) OIL PRESSURE AND TEMPERATURE

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

2) DELIVERY RATES

Port	Description	Size
15	Connection to the oil cooler	1 5/16″ -12UNF-2B
16	Connection from the oil cooler	1 5/16″ -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
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
(replaceable filter)

※ Attach transmission to assembly truck.

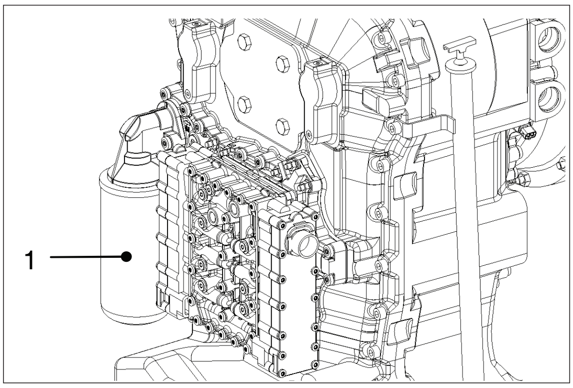
Assembly truck	5870 350 000
Holding fixtures	5870 350 063
Clamping angles	5870 350 090

※ 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

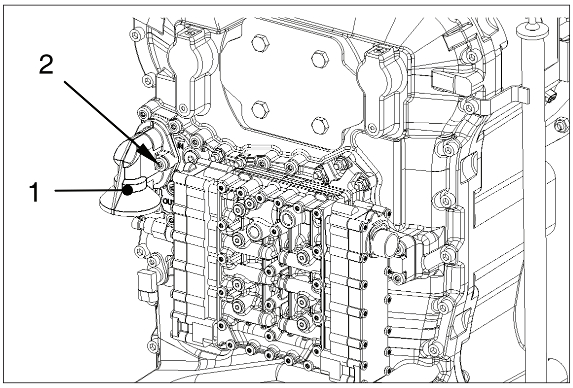


HL940TM001

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

※ Remove O-rings.

Socket wrench TX 40 5873 042 004



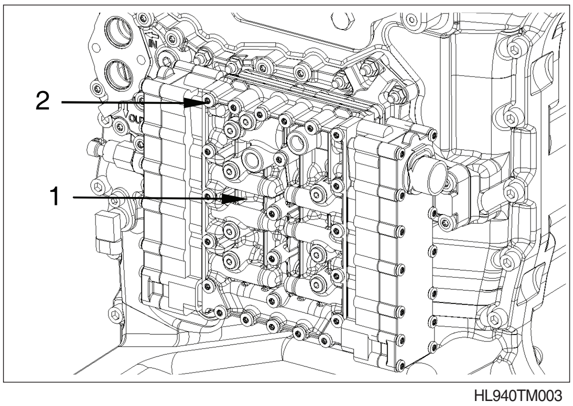
HL940TM002

(2) Removal of electric gear-shift control

① Remove gear-shift control (1).

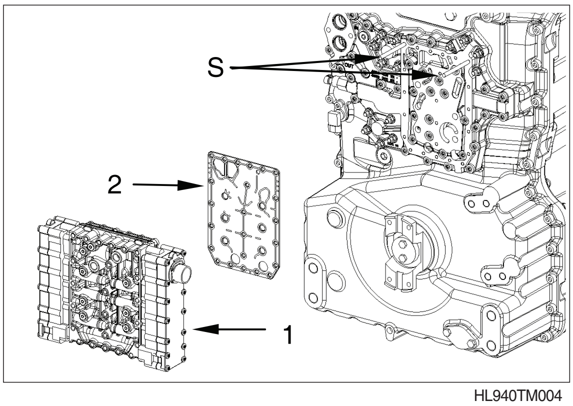
Loosen Torx screws (2) and separate gear-shift control housing from intermediate plate.

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



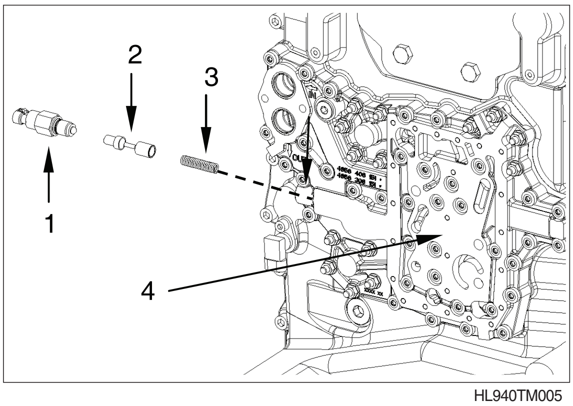
② Remove gear-shift control assy (1) and sealing plate (2).

Adjusting screws M6	5870 204 063

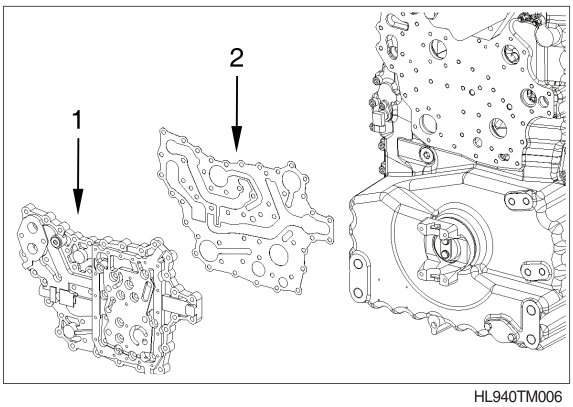


③ Remove differential pressure switch for fine filter from duct plate (4) .

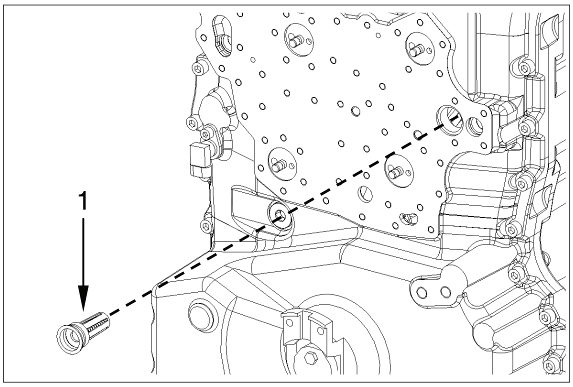
1 Switch with O-ring
2 Piston
3 Compression spring



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

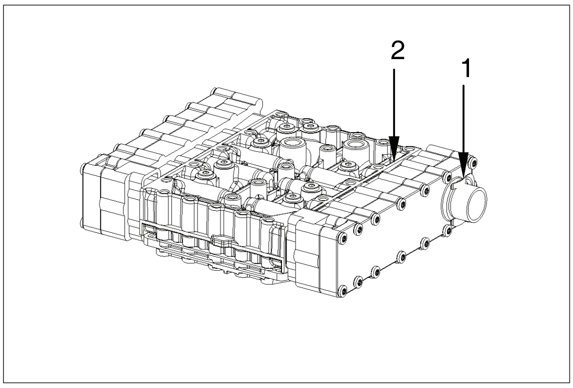


⑤ Pull converter safety valve (1) out of housing hole.



HL940TM007

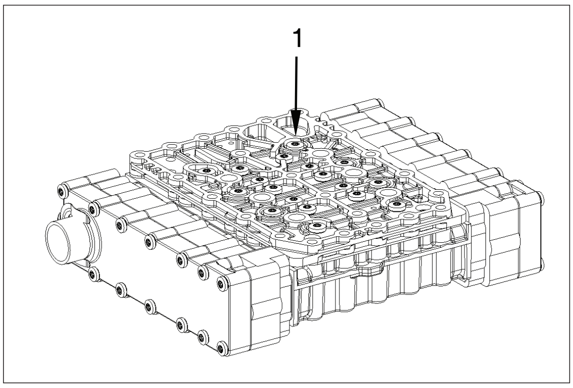
⑥ Mark installation position of wiring harness (1) towards valve block (2).



HL940TM008

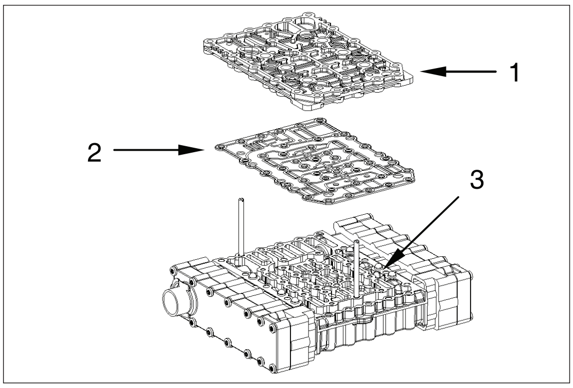
⑦ Loosen Torx screws (1).

Socket wrench TX-27 5873 042 002



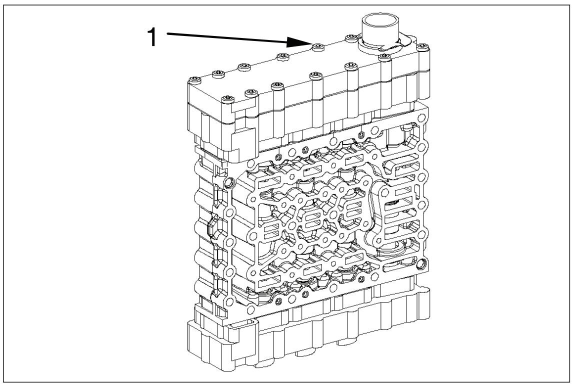
HL940TM009

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



HL940TM010

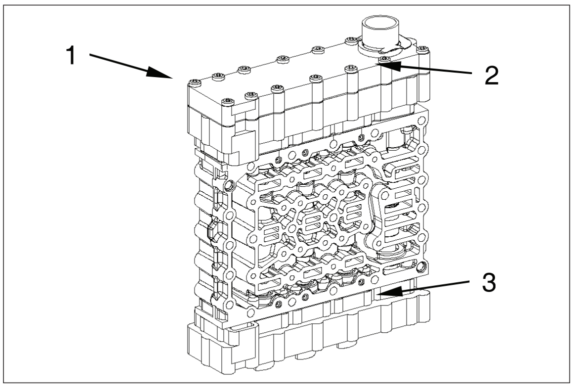
⑨ Remove retaining clamp (1).



HL940TM011

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

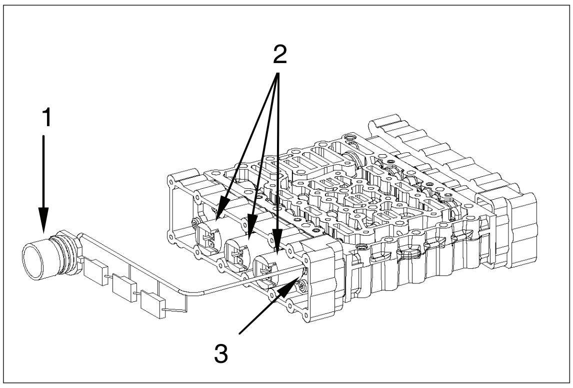
Socket wrenchTX-27 5873 042 002



HL940TM012

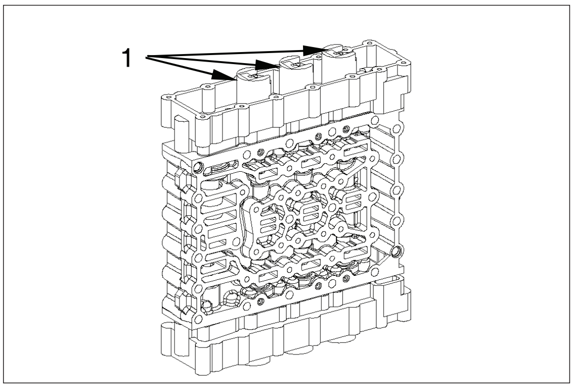
⑪ Remove wiring harness (1).

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



HL940TM013

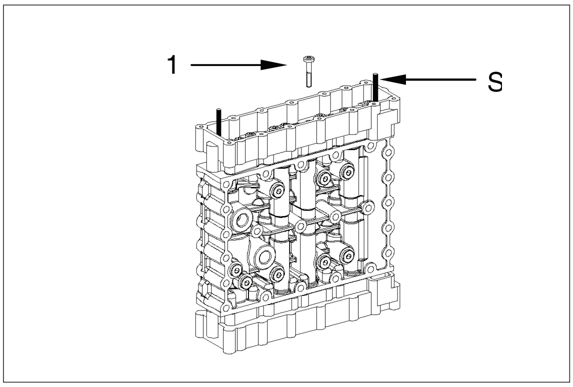
⑫ Loosen cylindrical screws, remove fixing plates and remove pressure controllers (1) on opposite side.



HL940TM014

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

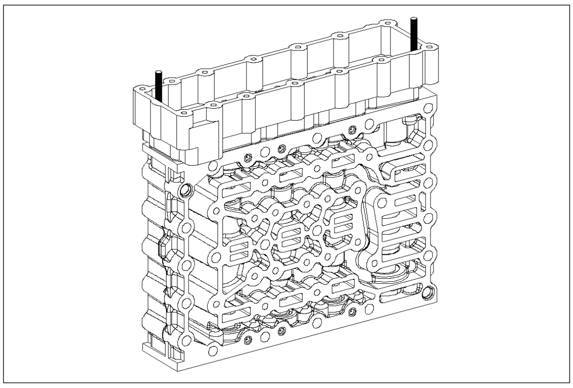
Adjusting screws 5870 204 036



HL940TM015

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

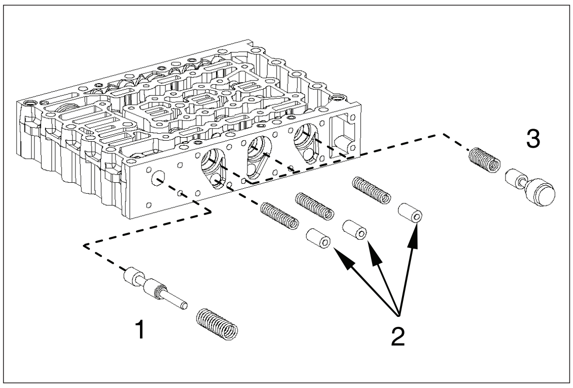
Adjusting screws 5870 204 036



HL940TM016

⑮ Remove individual parts :

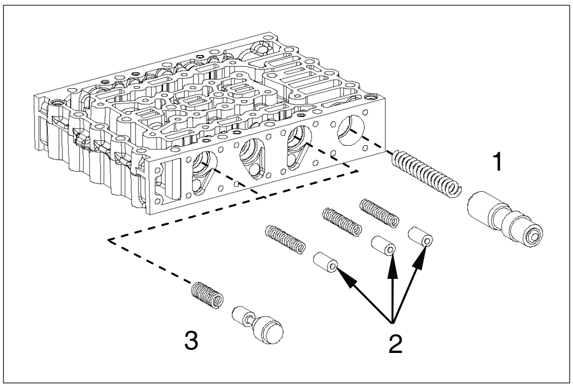
1 Pressure reducing valve
2 Vibration dampers
3 Follow-on slide



HL940TM017

⑯ Remove individual parts of opposite side analogously :

1 Main pressure valve
2 Vibration dampers
3 Follow-on slide



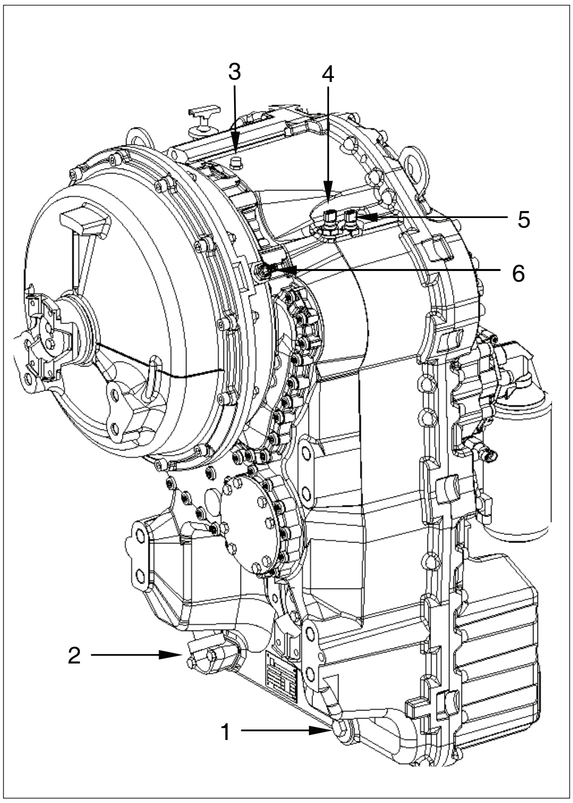
HL940TM018

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



HL940TM019

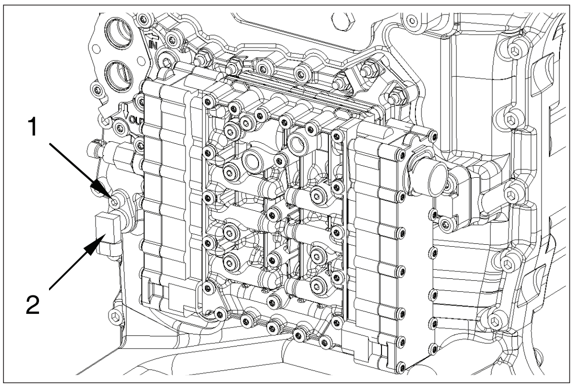
(2) Remove positioned parts.

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

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

※ Remove O-ring.

2 Speed sensor - n output



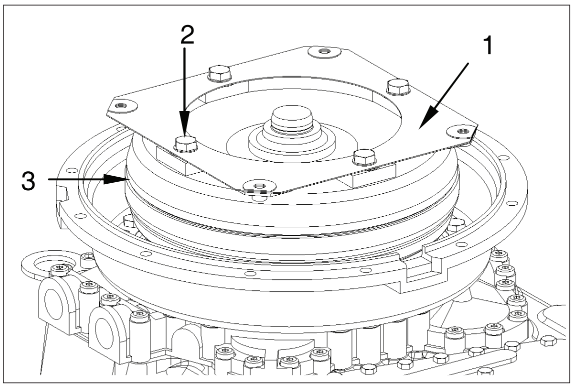
HL940TM020

3) DISASSEMBLY

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

(1) Engine connection (direct mount)

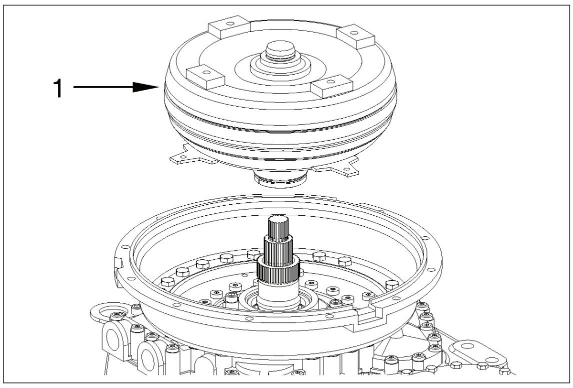
① Loosen hexagon screw (2) and separate flexplate (1) from converter (3).



HL940TM021

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

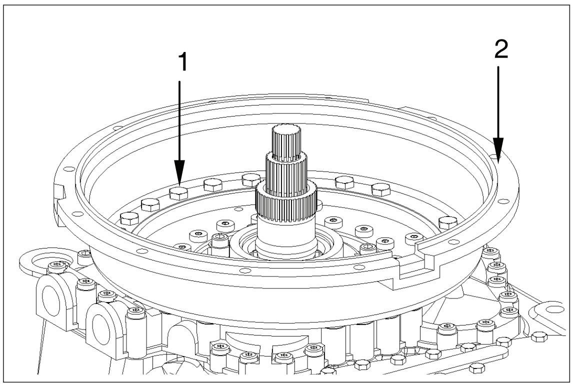
Eye bolts assortment 5870 204 002



HL940TM022

(2) Oil pressure pump

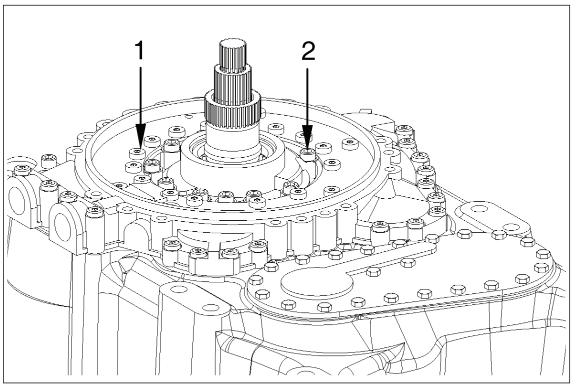
① Loosen bolted connection (1) converter bellhousing/oil feed housing and remove converter bellhousing (2).



HL940TM030

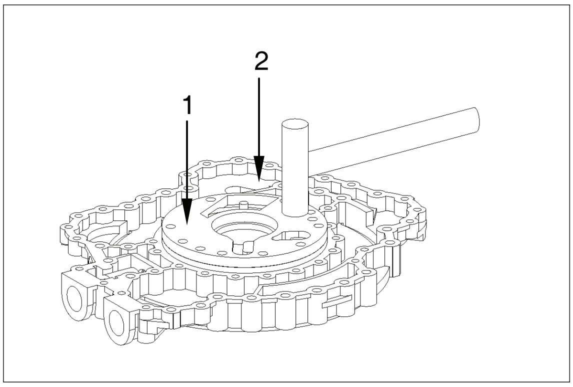
② Loosen bolted connection (1) oil feed housing/transmission housing front part with Torx screws and bolted connection (2) oil pressure pump/transmission housing front part with cylindrical screws.

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



HL940TM031

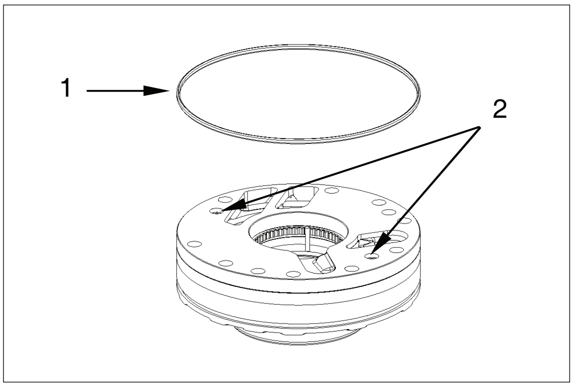
③ Separate oil pressure pump (1) from oil feed housing (2).



HL940TM032

④ Remove O-ring (1).

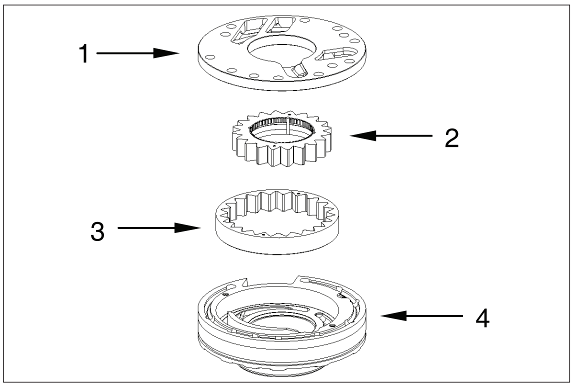
※ Loosen cylindrical screws (2).



HL940TM033

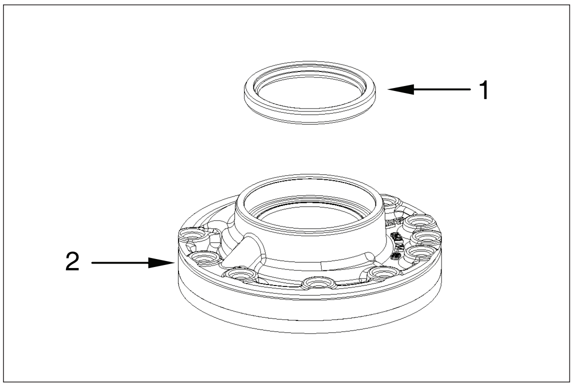
⑤ Check oil gear pump :
In case of wear marks in the pump housing, cover or on the inner and outer rotor, the complete oil pressure pump is to be replaced.

1 Cover
2 Inner rotor
3 Outer rotor
4 Pump housing



HL940TM034

⑥ Remove shaft seal (1) from the pump housing (2).

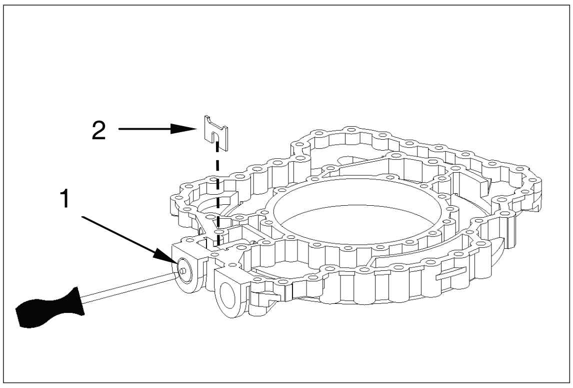


HL940TM035

(3) Converter back-pressure valve

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

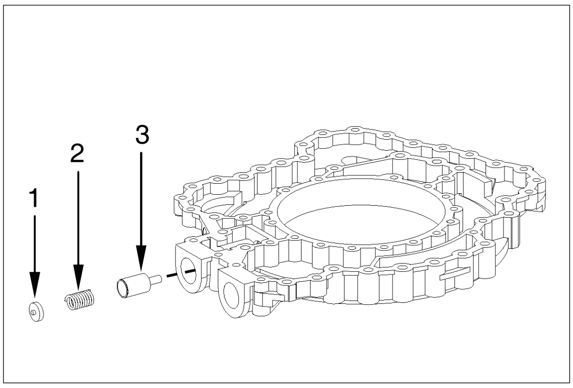
Assembly aid 5870 345 107



HL940TM036

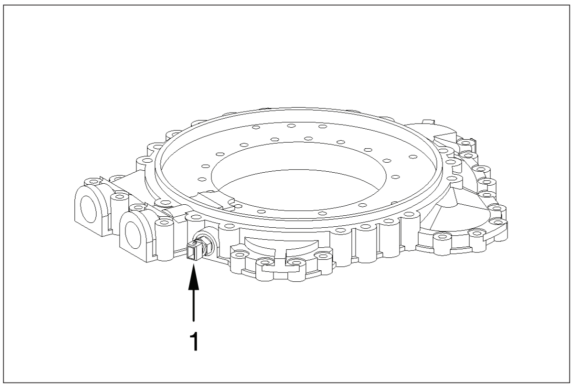
② Remove individual parts of converter safety valve which are getting released.

1 Pressure plate
2 Compression spring
3 Piston



HL940TM037

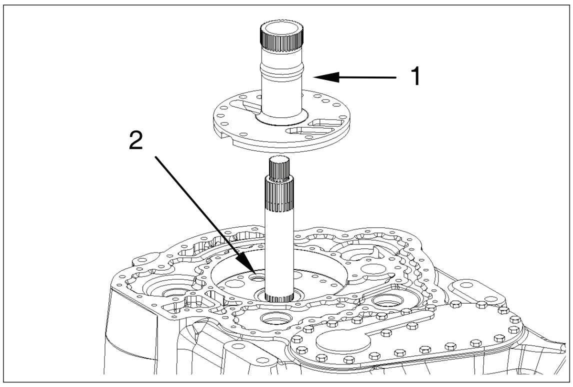
③ Remove temperature sensor (1).



HL940TM038

④ Remove stator shaft (1).
Pull pressure relief valve (2) out of the housing hole.

※ The pressure relief valve is not mounted on all versions.

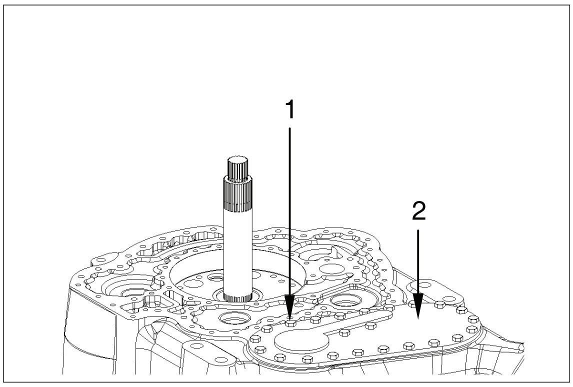


HL940TM039

4) DISASSEMBLY-EMERGENCY STEERING PUMP

(1) Version without emergency steering pump

① Loosen bolted connection (1) cover/ housing front part and remove cover (2) and seal.

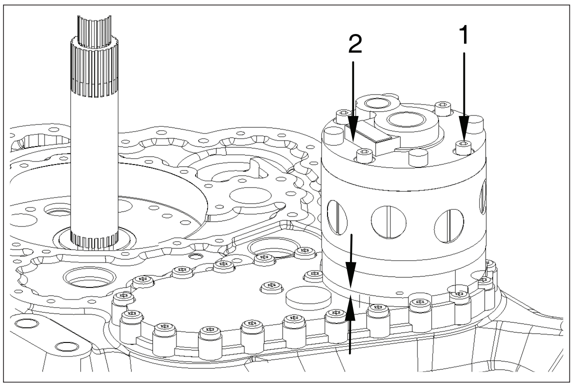


HL940TM040

(2) Version with emergency steering pump

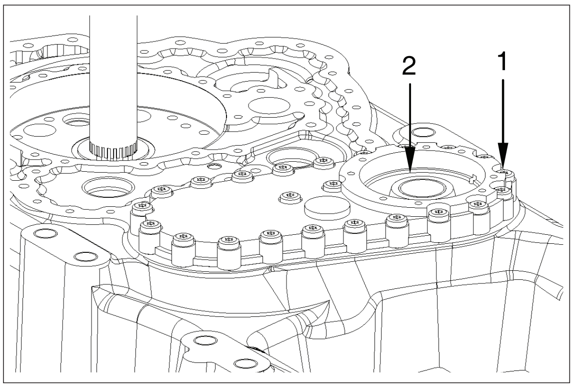
① Loosen cylindrical screws (1) and separate emergency steering pump (2) from cover.

※ Mark radial installation position (see arrows).



HL940TM041

② Loosen bolted connection (1) cover/ housing front part and remove cover (2) and seal.

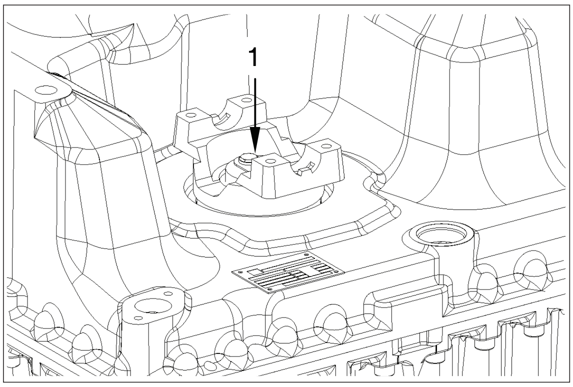


HL940TM042

5) DISASSEMBLY – OUTPUTS AND CLOSURE PARTS PUMP SHAFT (PTO-SHAFT)

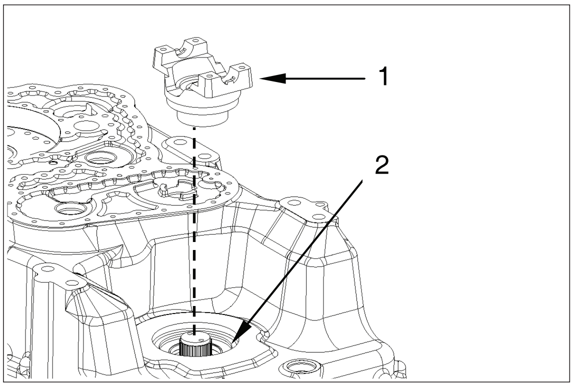
(1) Output flange on converter side

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



HL940TM043

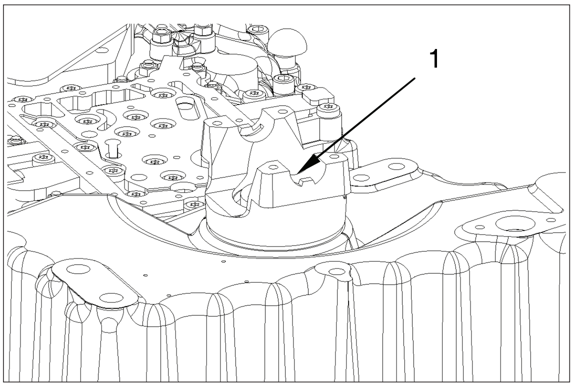
② Pull off output flange (1) and remove shaft seal (2).



HL940TM044

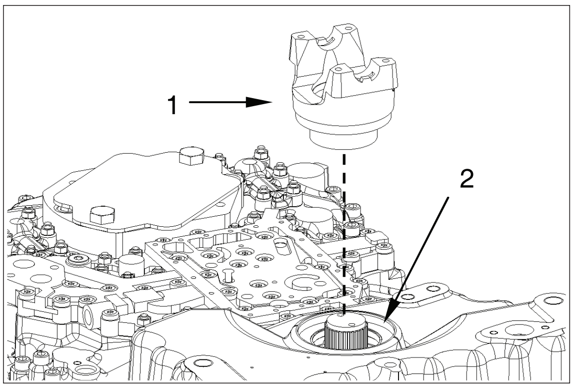
(2) Output flange on output side without parking brake

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



HL940TM045

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

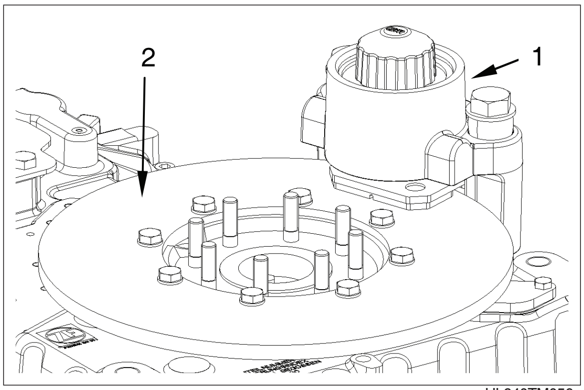


HL940TM046

(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.

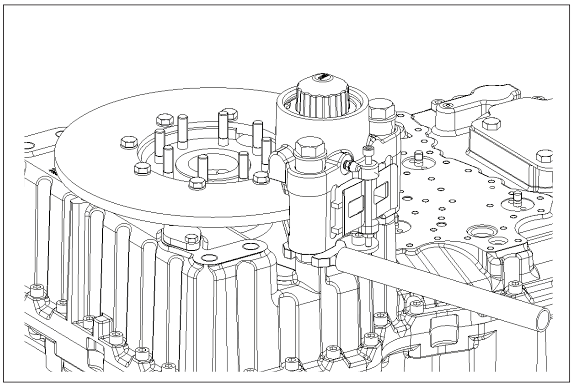
HP hand-operated pump 5870 287 007
MINIMESS coupling (M12×1.5) 5870 950 101



HL940TM056

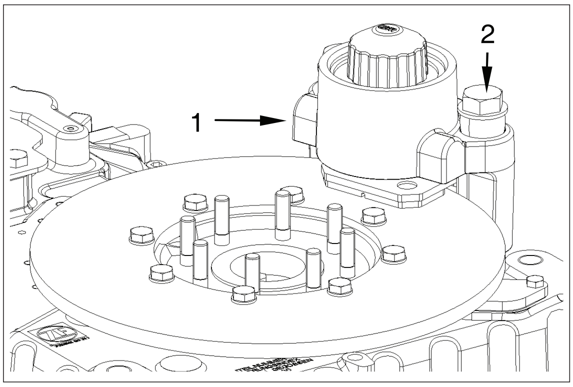
② Loosen hexagon nut with open end wrench insert.

Open end wrench insert AA00 244 432



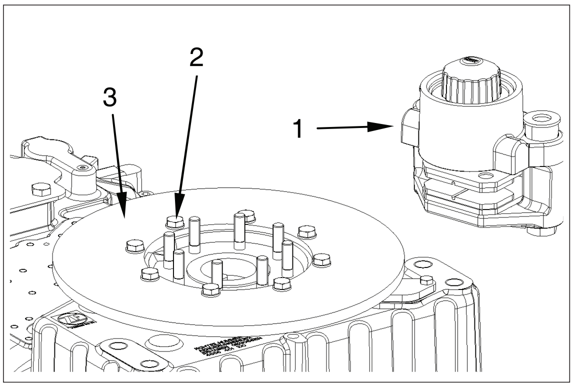
HL940TM057

③ Loosen hexagon screws (2) and remove parking brake (1) (see TM058).



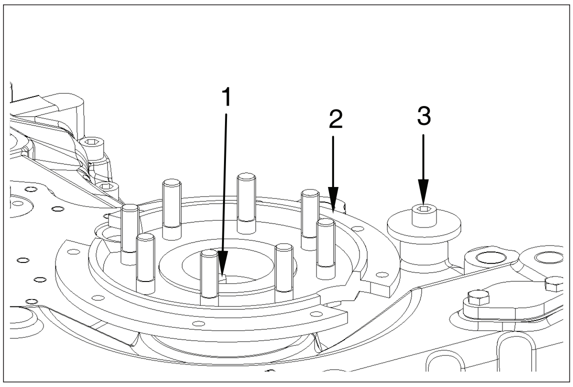
HL940TM058

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



HL940TM059

⑤ Loosen hexagon screws (1), remove washer and O ring.
Pull-off output flange (2) and remove shaft seal.
Remove cylinder screw with washer (3).

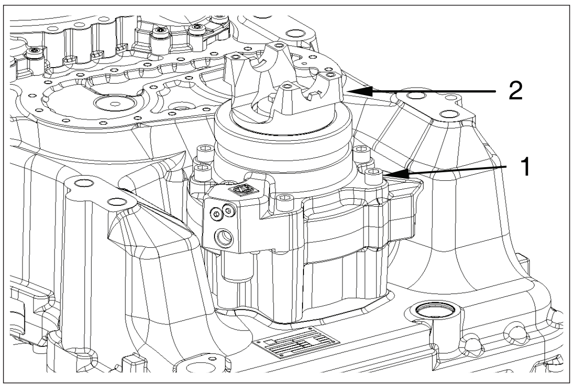


HL940TM060

(4) Output flange on converter side (with axle disconnection)

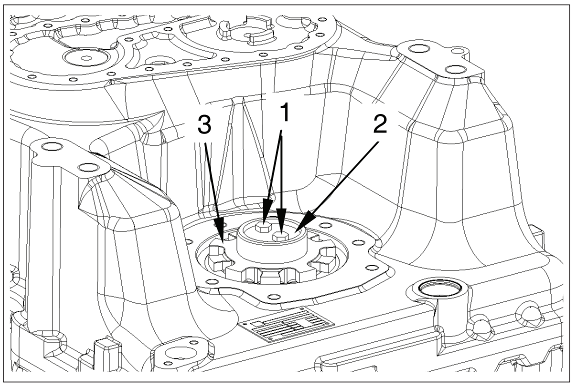
① Loosen cylinder screws (1) and separate axle disconnection (2) with two assembly levers from housing.

Assembly lever 5870 345 036



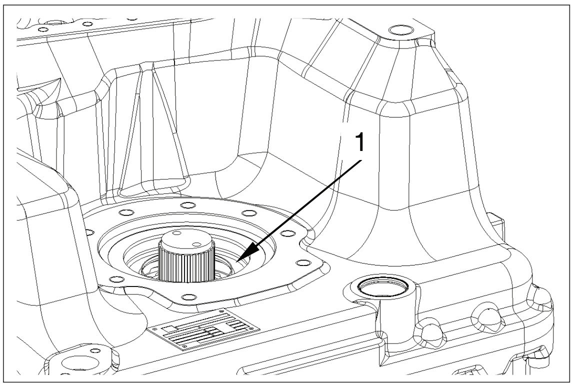
HL940TM061

② Loosen hexagon screws (1) and remove disk (2) and flange (3).



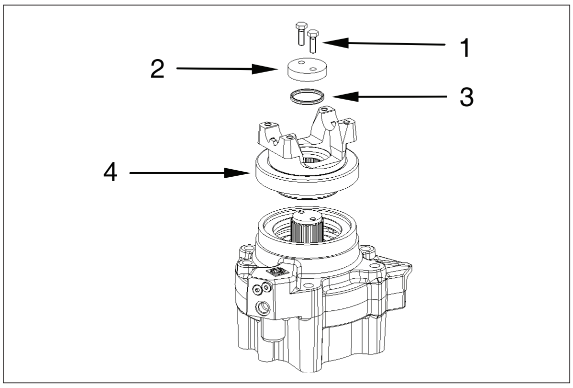
HL940TM062

③ Remove screen (1).



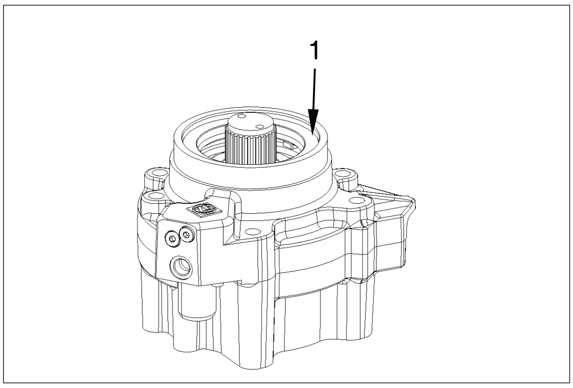
HL940TM063

④ Loosen hexagon screws (1) and remove disk (2), O-ring (3) and output flange (4).



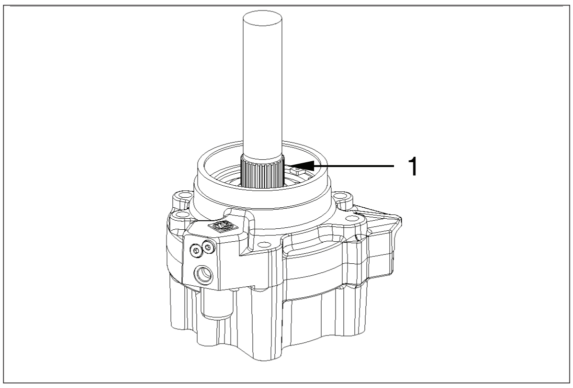
HL940TM064

⑤ Remove shaft seal (1).



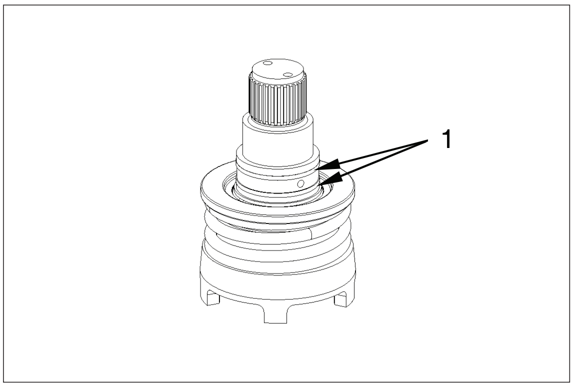
HL940TM065

⑥ Push output shaft (1) out of ball bearing.



HL940TM066

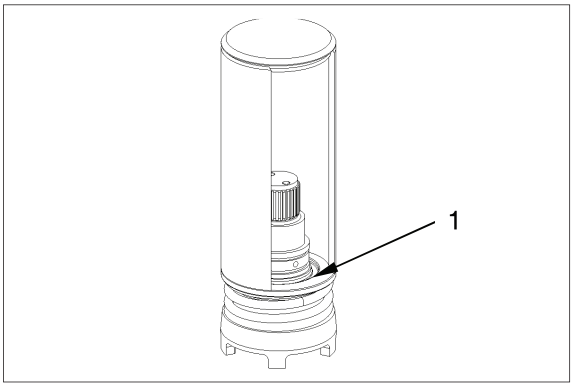
⑦ Remove both rectangular rings (1).



HL940TM067

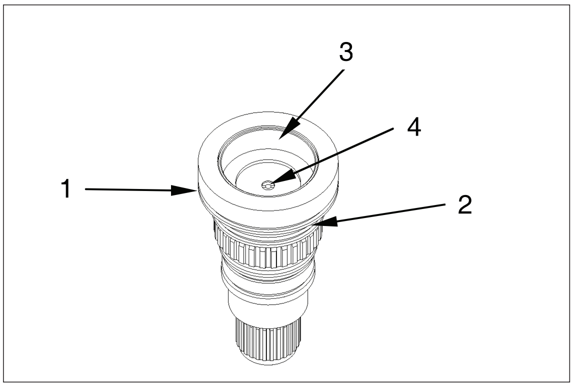
⑧ Preload compression spring and disengage snap ring (1).
Remove releasing single parts.

Press bush 5870 506 166



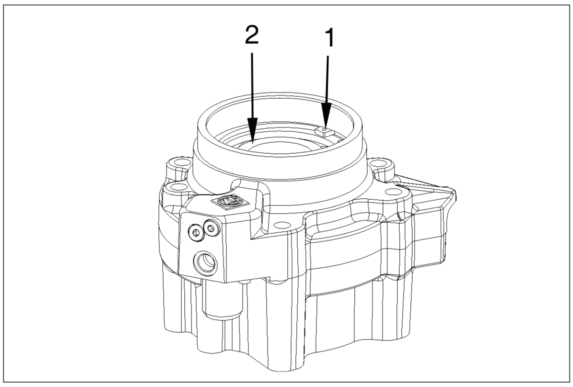
HL940TM068

⑨ Remove both O-rings (1 and 2).
If necessary, remove bearing bush (3) and orifice (4).



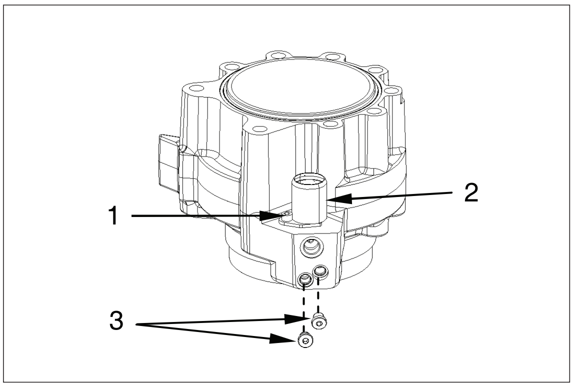
HL940TM069

⑩ Unsnap retaining ring (1) and push ball bearing (2) out of the bearing hole.



HL940TM070

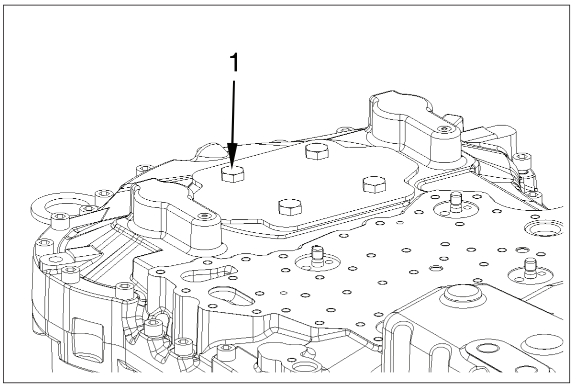
⑪ Loosen cylinder screw (1) and remove holder.
Remove solenoid valve (2) from housing.
Remove both screw plugs (3).



HL940TM071

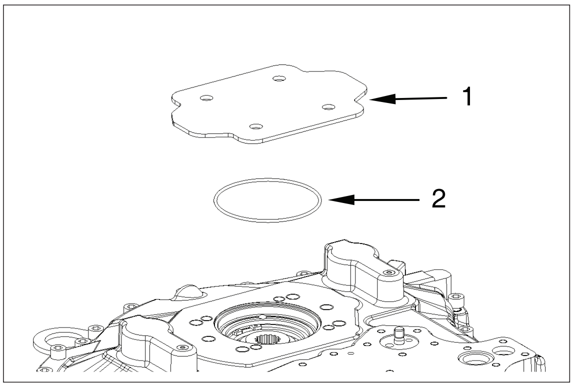
(5) Closure parts pump shaft (PTO-shaft)

① Loosen hexagon screws (1).



HL940TM072

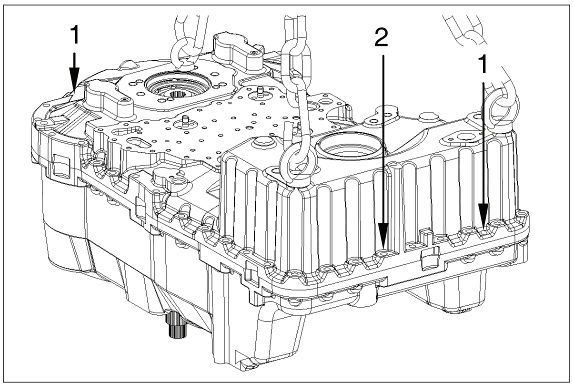
② Remove cover (1) and O-ring (2).



HL940TM073

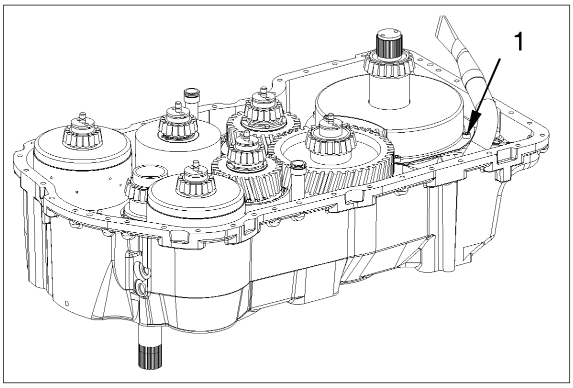
6) REMOVAL OF INPUT SHAFT, OUTPUT SHAFT, PUMP SHAFT (PTO-SHAFT) AND CLUTCHES

(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.



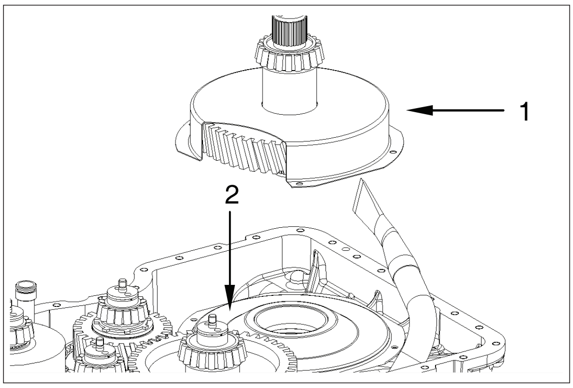
HL940TM074

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



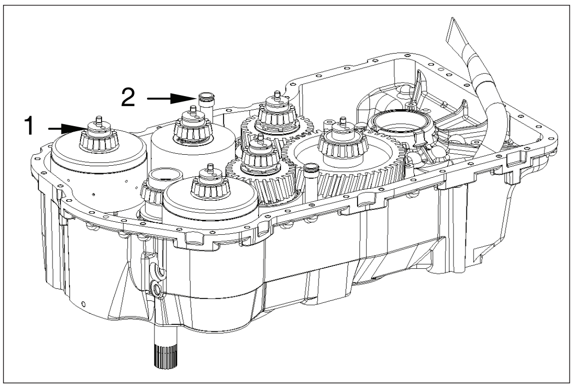
HL940TM075

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



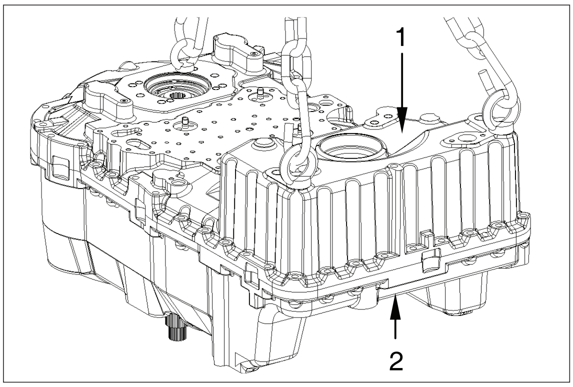
HL940TM076

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



HL940TM077

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



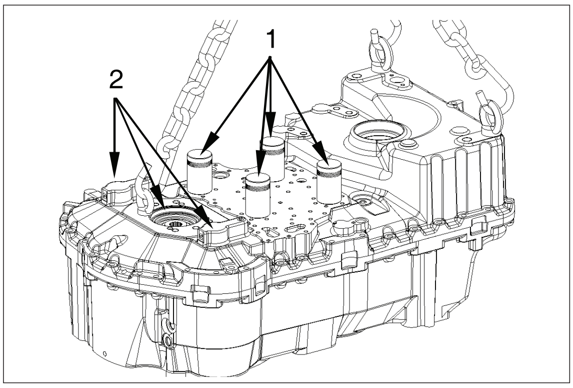
HL940TM078

※ 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.

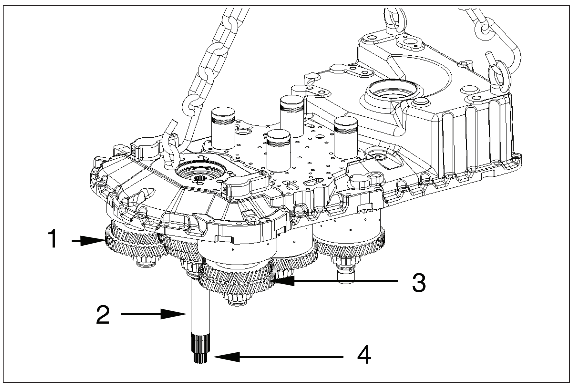


HL940TM079

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

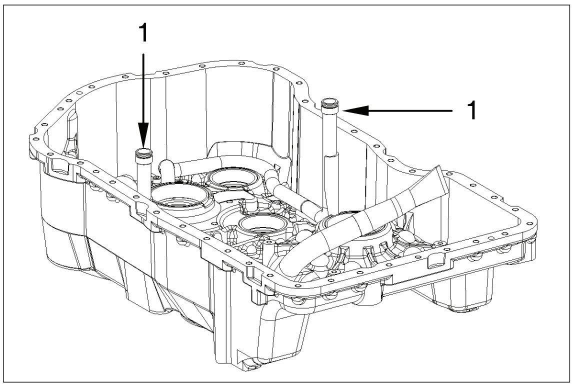
1 Clutch KV
2 Input shaft
3 Clutch KR
4 Pump shaft

※ 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.



HL940TM080

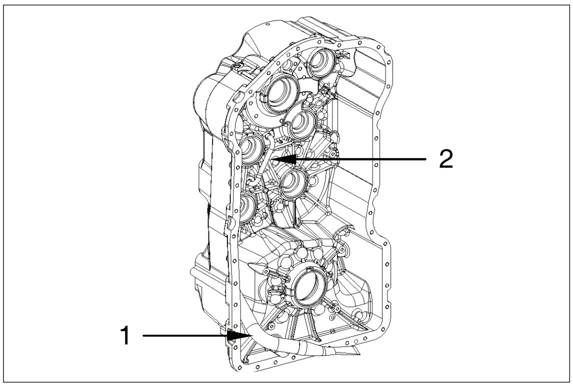
※ Loosen cylindrical screws of oil tubes (1) in the housing front part and remove them.



HL940TM081

※ 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 ZF special tool is imperative for fitting or replacing these components.

Rolling tool 5870 600 003

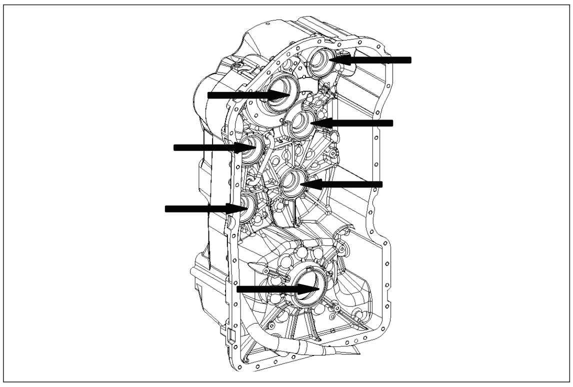


HL940TM082

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

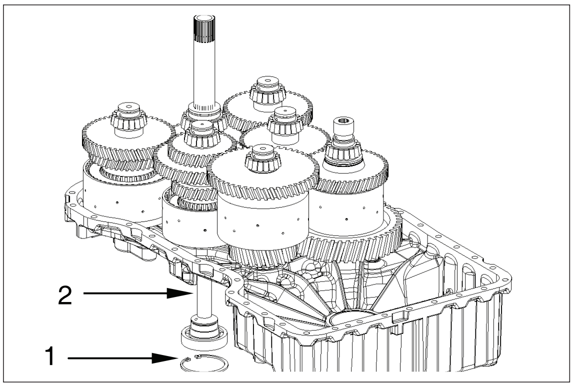
※ If the tapered roller bearings of clutches, input and output are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/ bearing inner ring).

※ Bearing outer ring and bearing inner ring must be marked.



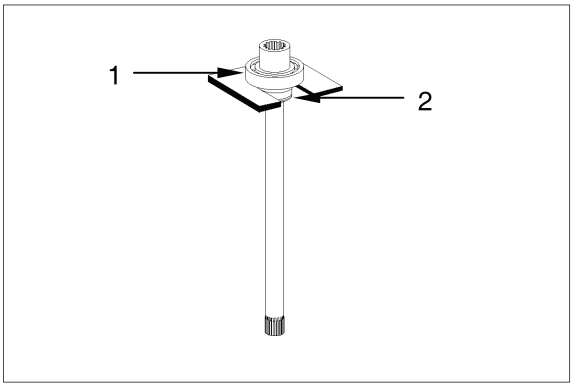
HL940TM083

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



HL940TM084

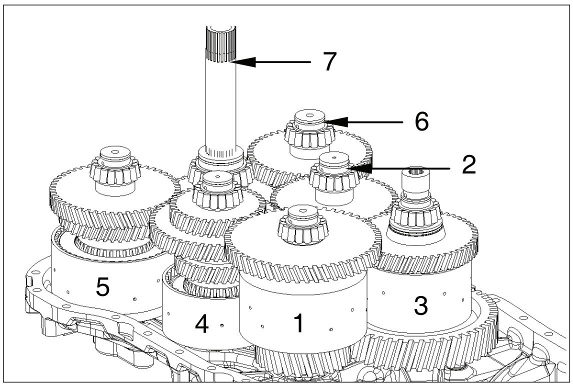
(10) Press ball bearing (1) off the pump shaft.
Snap out rectangular ring (2).



HL940TM085

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

1 K1 clutch
2 K2 clutch
3 K3 clutch (Version with Emergency steering pump)
4 K4 clutch
5 KR clutch
6 KV clutch
7 input shaft

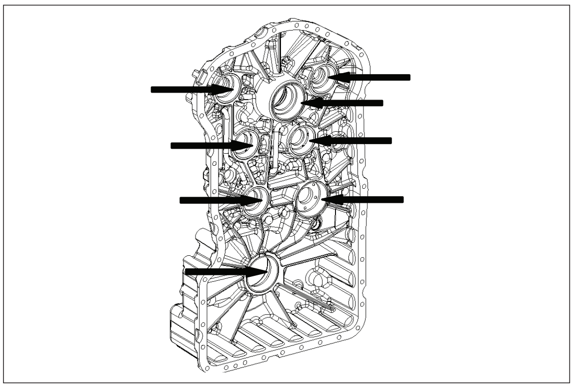


HL940TM086

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

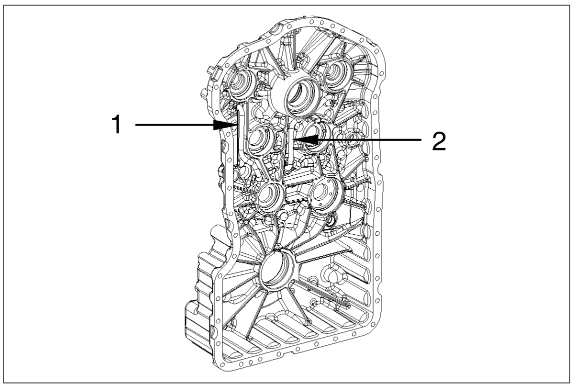
If the tapered roller bearings of clutches, input and output are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/ bearing inner ring).

Bearing outer ring and bearing inner ring must be marked.



HL940TM087

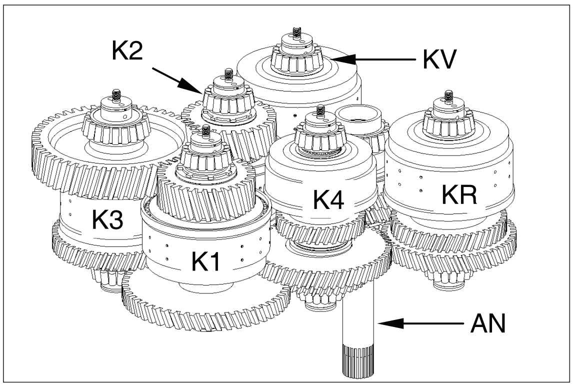
(13) The lubrication lines are rolled in (1 and 2) and are highly difficult to remove.
In case of damage, use of the appropriate special tool is imperative for fitting or replacing these components.



HL940TM088

7) DISASSEMBLY :
CLUTCHES KV / KR / K1 / K2 /K3 / K4
INPUT AND OUTPUT SHAFT

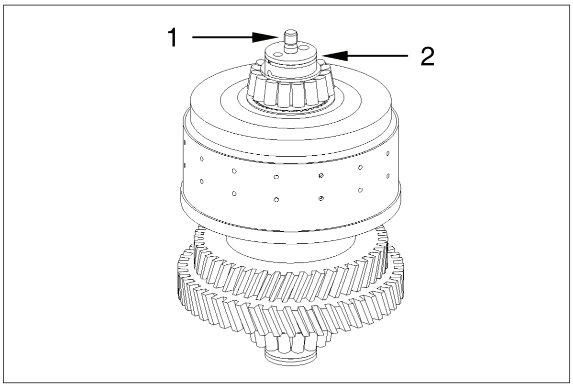
K1 Clutch
K2 Clutch
K3 Clutch
K4 Clutch
KR Clutch
KV Clutch
AN Input shaft



HL940TM089

(1) KV CLUTCH

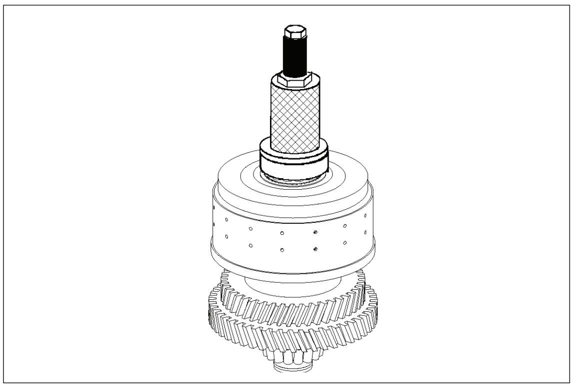
① Remove stud bolt (1) and snap out piston ring (2).



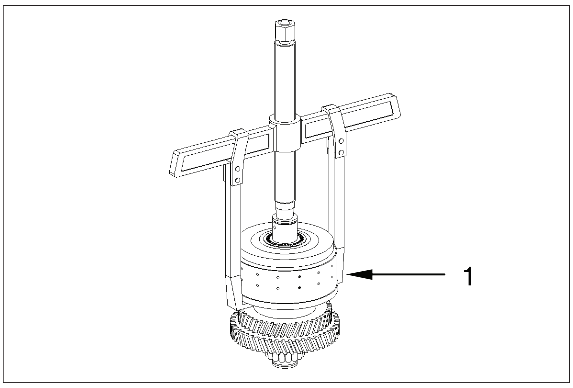
HL940TM090

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

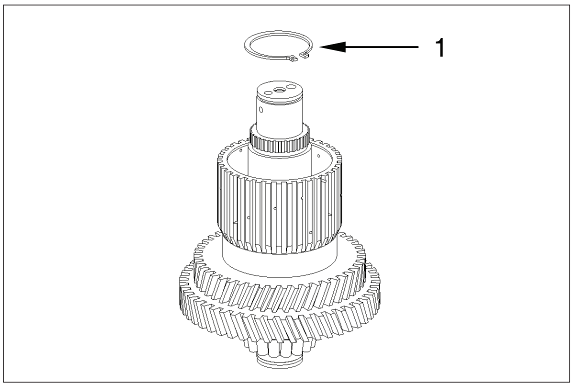

HL940TM091

③ Pull clutch (1) off the shaft.



HL940TM092

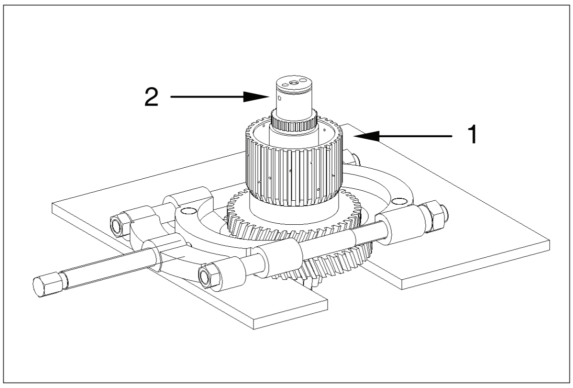
④ Snap out retaining ring (1) .



HL940TM093

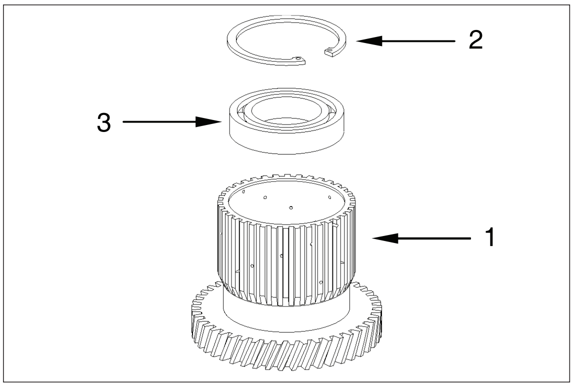
⑤ Fix idler gear (1) by means of cut-off device and press it off the clutch shaft (2).

Cut-off device 5870 300 028



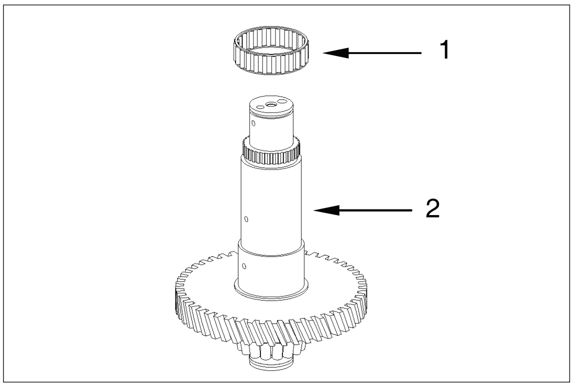
HL940TM094

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



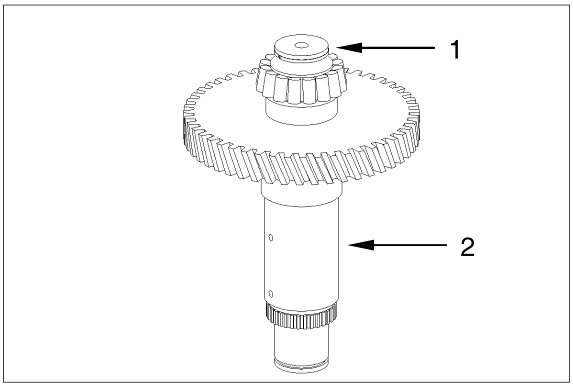
HL940TM095

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



HL940TM096

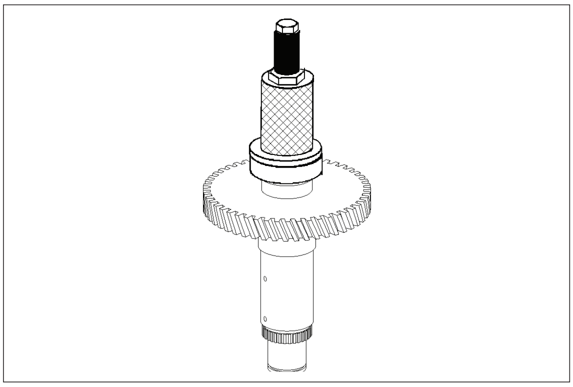
⑧ Turn shaft (2) by 180˚ and snap out piston ring (1).



HL940TM097

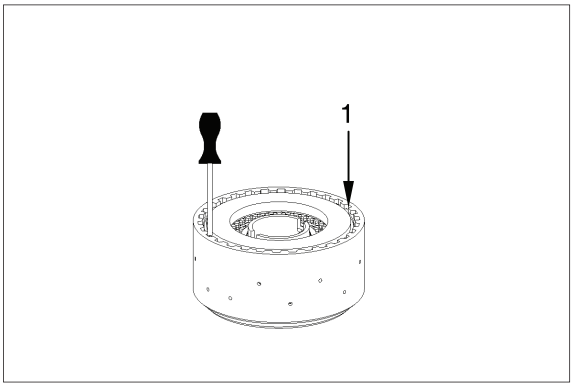
⑨ Pull tapered roller bearing (inner ring) off the shaft.

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



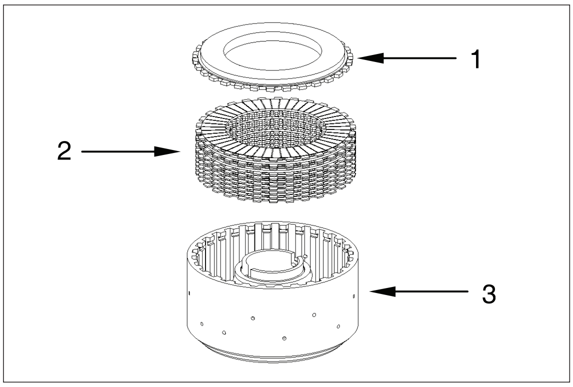
HL940TM098

⑩ Unsnap snap ring (1).



HL940TM099

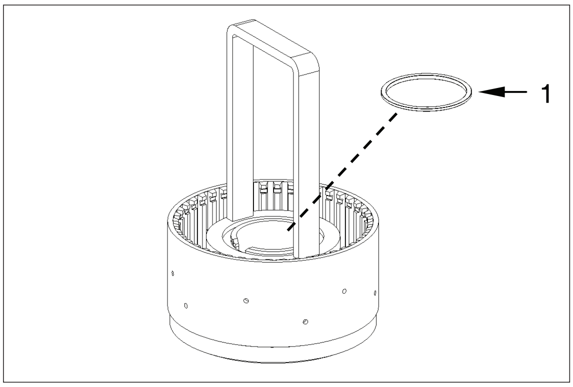
⑪ Remove end shim (1) and disc set (2) out the disc carrier (3).



HL940TM100

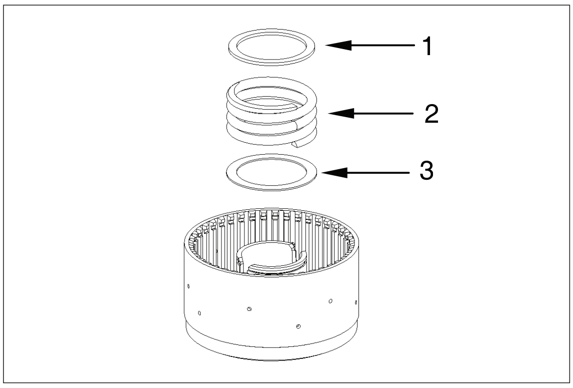
⑫ Preload compression spring (1) unsnap L-Ring.

Assembly aid 5870 345 088



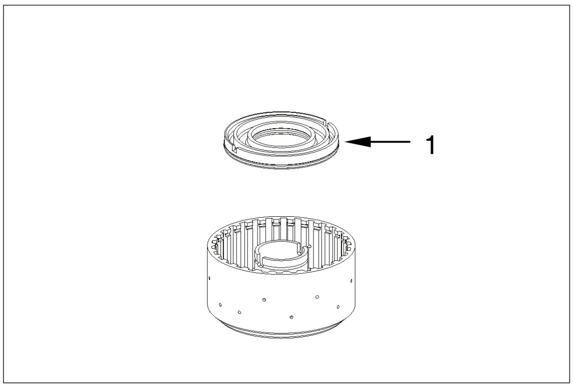
HL940TM101

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



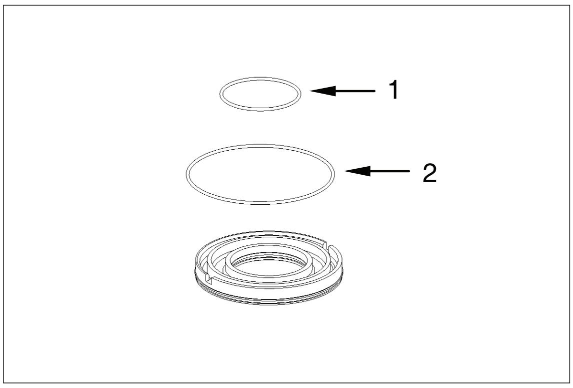
HL940TM102

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



HL940TM103

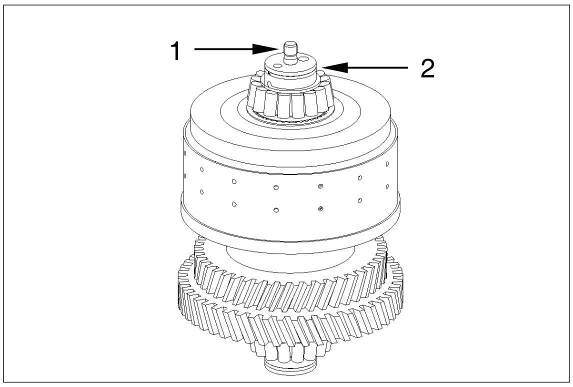
⑮ Remove both O-rings (1 and 2).



HL940TM104

(2) KR clutch

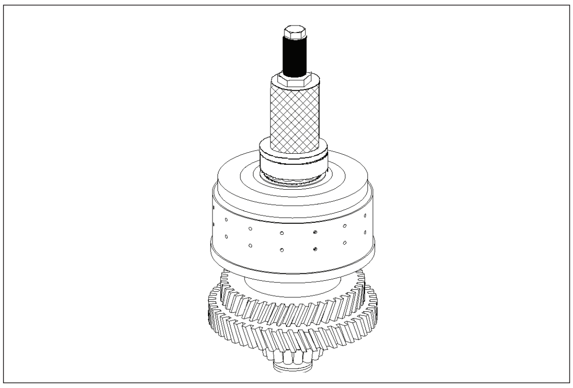
① Remove stud bolt (1) and snap out piston ring (2).



HL940TM105

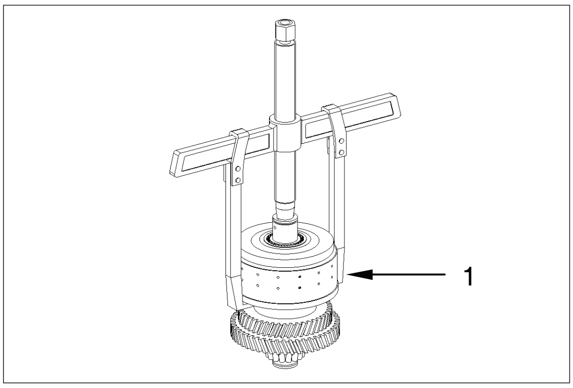
② Pull tapered roller bearing (inner ring) off the shaft.

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



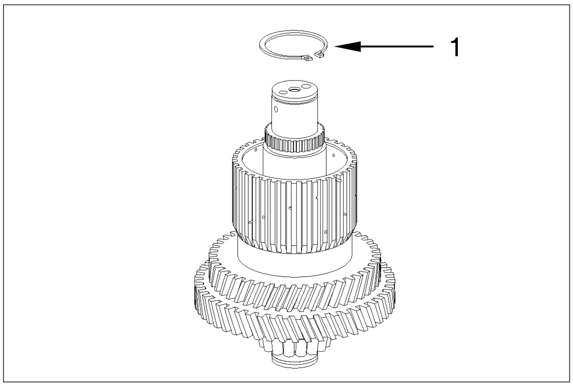
HL940TM106

③ Pull clutch (1) off the shaft.



HL940TM107

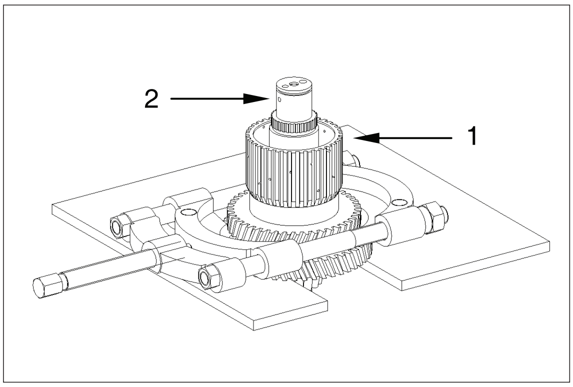
④ Snap out retaining ring (1).



HL940TM108

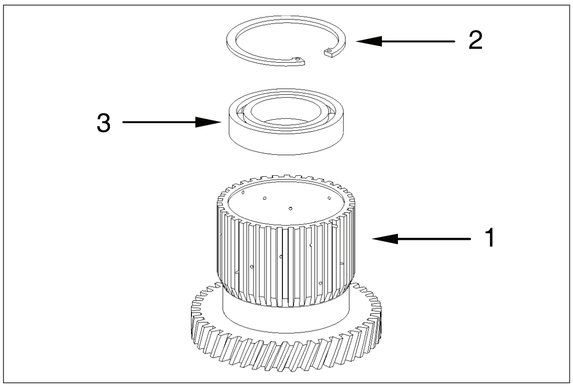
⑤ Fix idler gear (1) by means of cut-off device and press it off the clutch shaft (2).

Cut-off device 5870 300 028



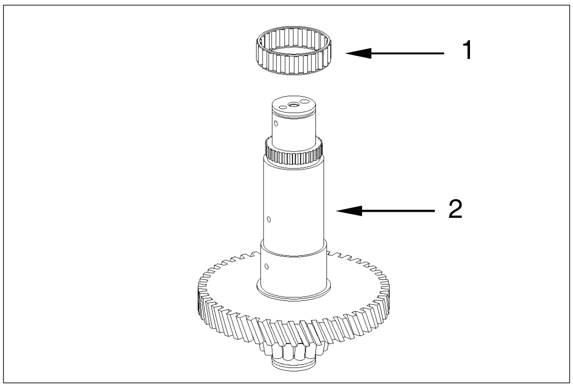
HL940TM109

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



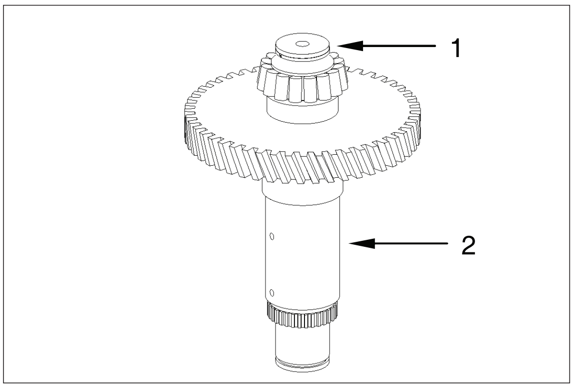
HL940TM110

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



HL940TM111

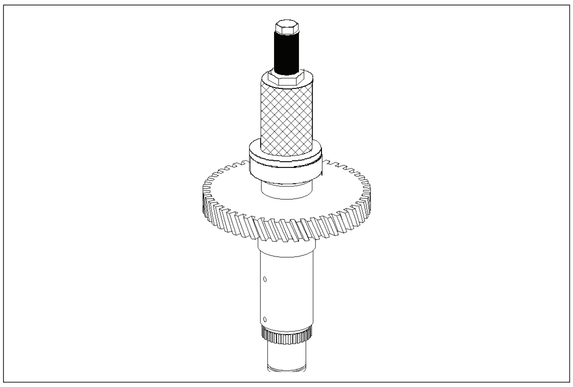
⑧ Turn shaft (2) by 180˚ and snap out piston ring (1).



HL940TM112

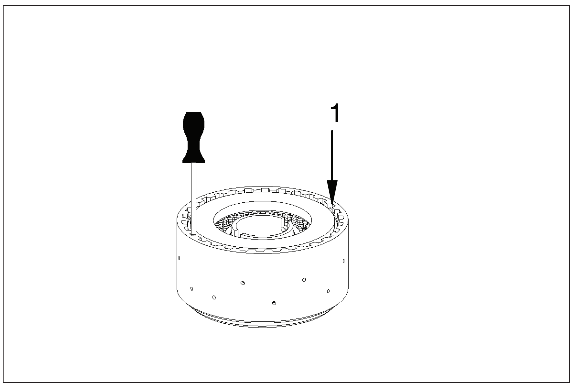
⑨ Pull tapered roller bearing (inner ring) off the shaft.

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



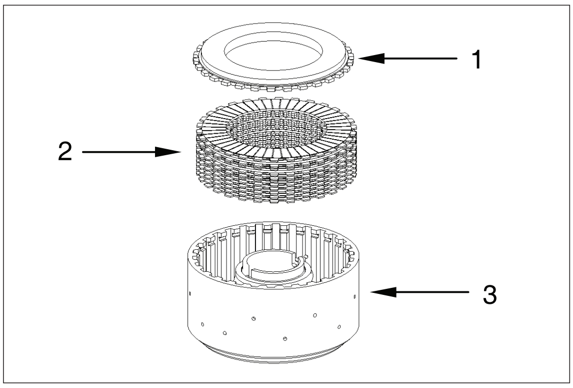
HL940TM113

⑩ Unsnap snap ring (1).



HL940TM114

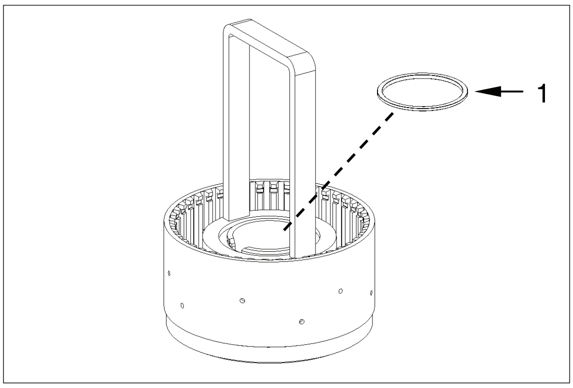
⑪ Remove end shim (1) and disc set (2) out the disc carrier (3).



HL940TM115

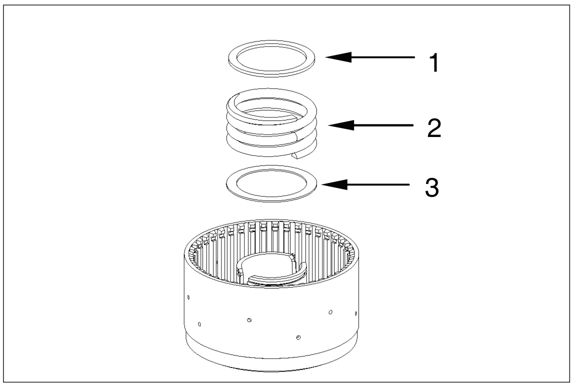
⑫ Preload compression spring (1) unsnap L-Ring.

Assembly aid	5870 345 088



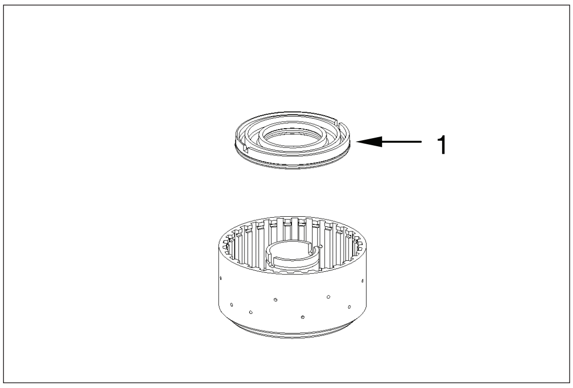
HL940TM116

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



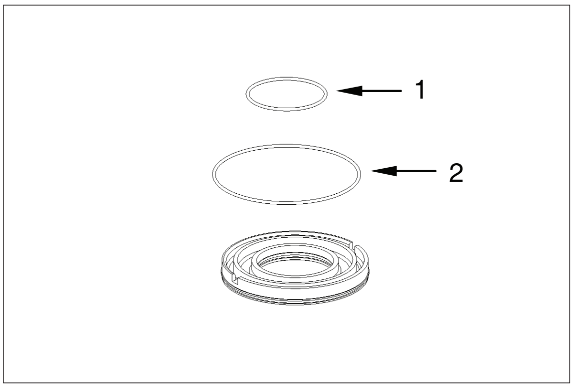
HL940TM117

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



HL940TM118

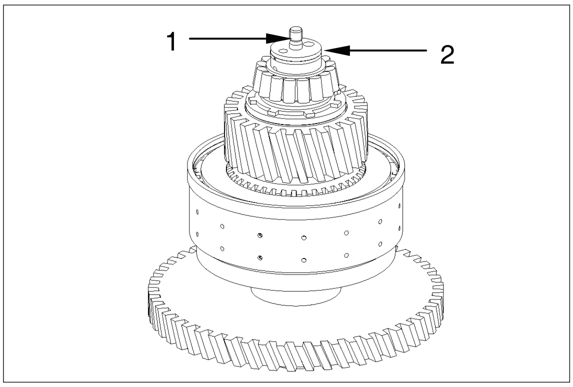
⑮ Remove both O-rings (1 and 2).



HL940TM119

(3) K1 clutch

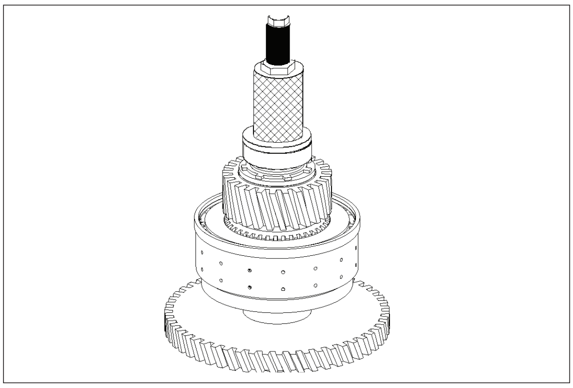
① Remove stud bolt (1) and snap out piston ring (2).



HL940TM120

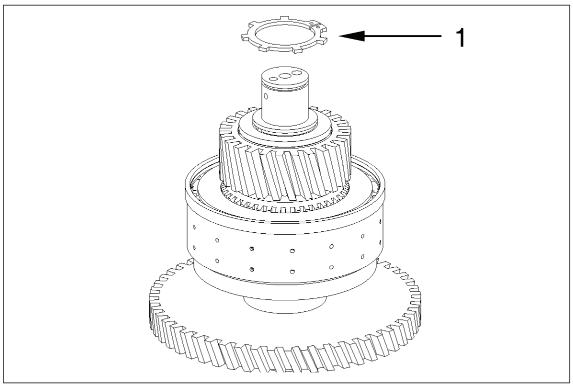
② Pull tapered roller bearing (inner ring) off the shaft.

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



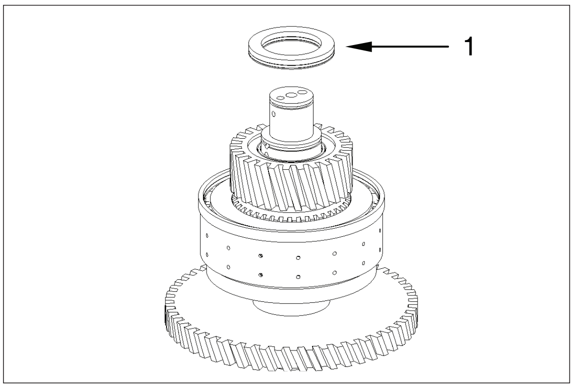
HL940TM121

③ Snap out retaining ring (1).



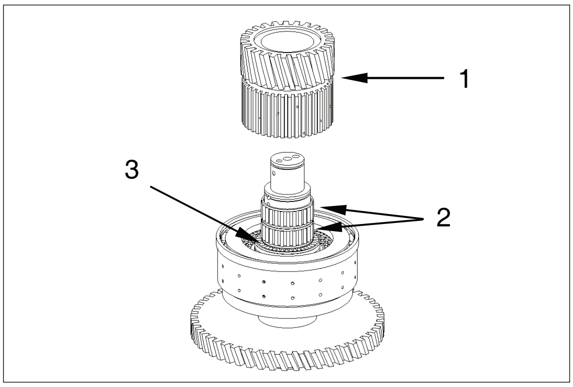
HL940TM122

④ Remove axial bearing assy (1).



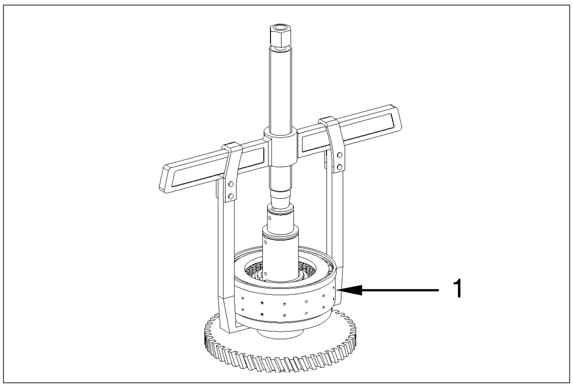
HL940TM123

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



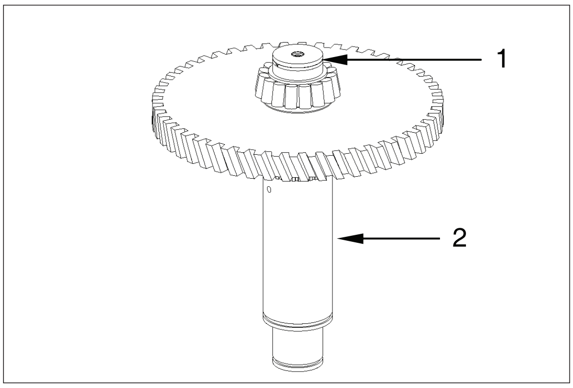
HL940TM124

⑥ Pull clutch (1) off the shaft.



HL940TM125

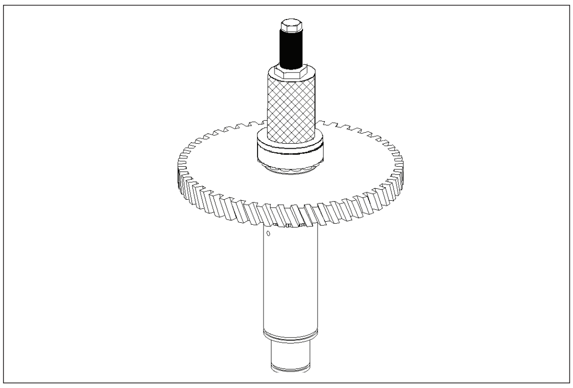
⑦ Turn shaft (2) by 180° and snap out piston ring (1).



HL940TM126

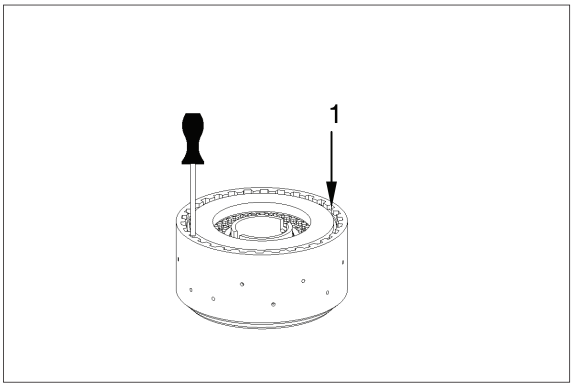
⑧ Pull tapered roller bearing (inner ring) off the shaft.

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



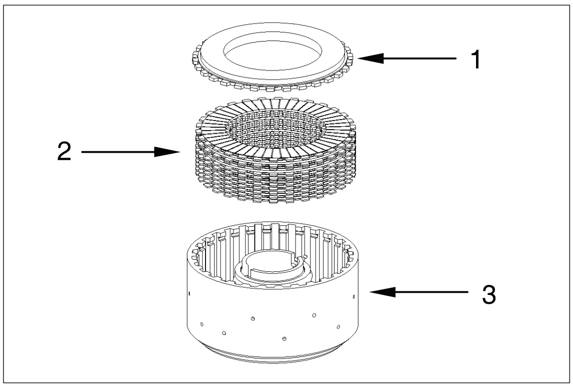
HL940TM127

⑨ Unsnap snap ring (1).



HL940TM128

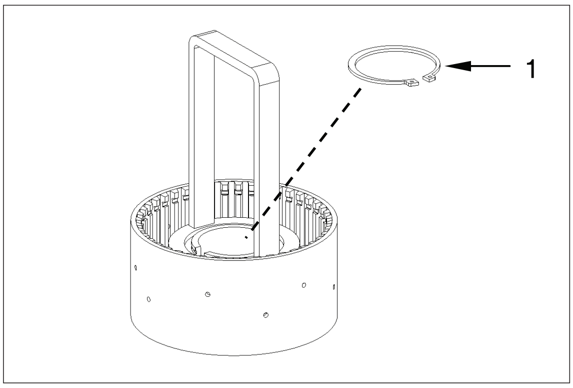
⑩ Remove end shim (1) and disc set (2) out the disc carrier (3).



HL940TM129

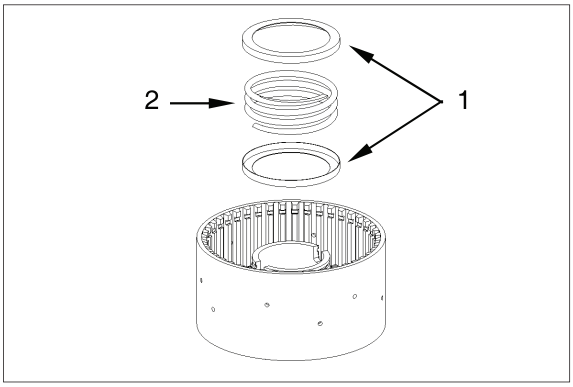
⑪ Preload compression spring unsnap retaining ring (1).

Assembly aid 5870 345 088



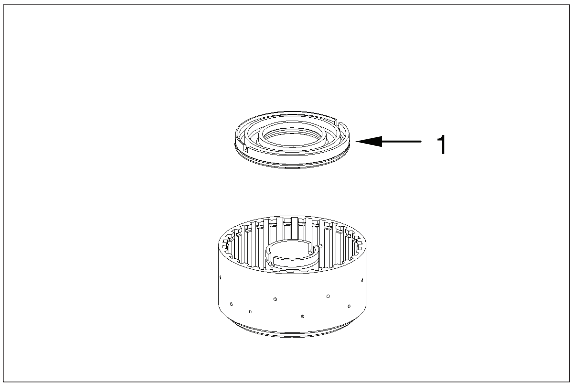
HL940TM130

⑫ Remove guide rings (1) and compression spring (2).



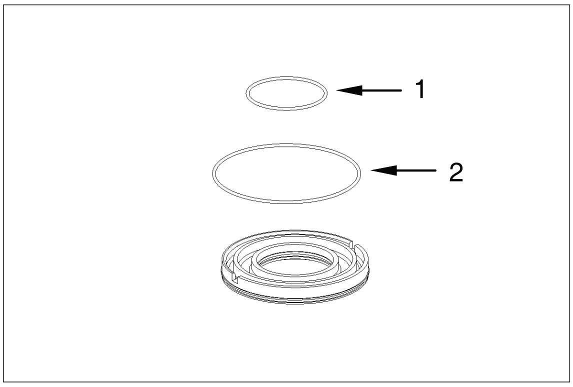
HL940TM131

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



HL940TM132

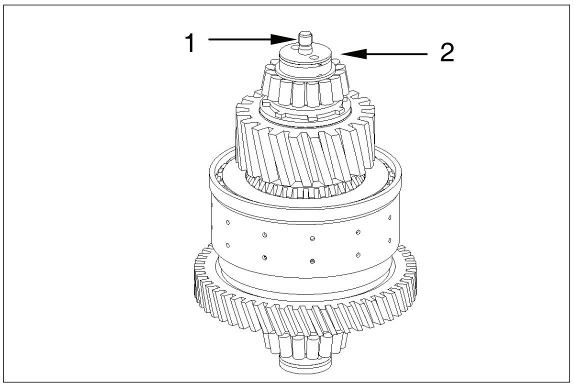
⑭ Remove both O-rings (1 and 2).



HL940TM133

(4) K2 clutch

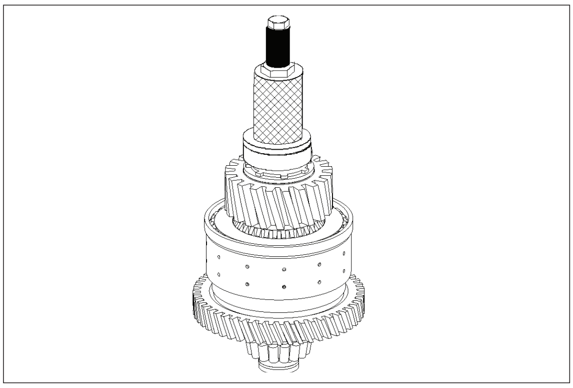
① Remove stud bolt (1) and snap out piston ring (2).



HL940TM134

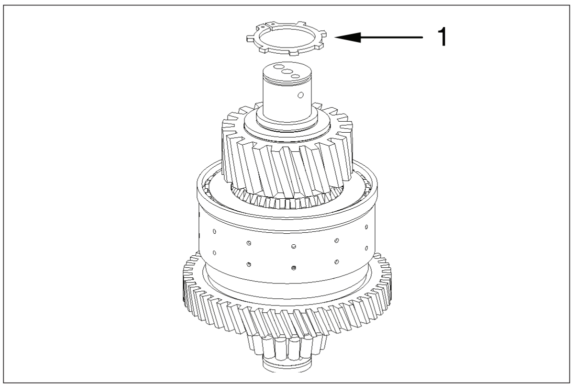
② Pull tapered roller bearing (inner ring) off the shaft.

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



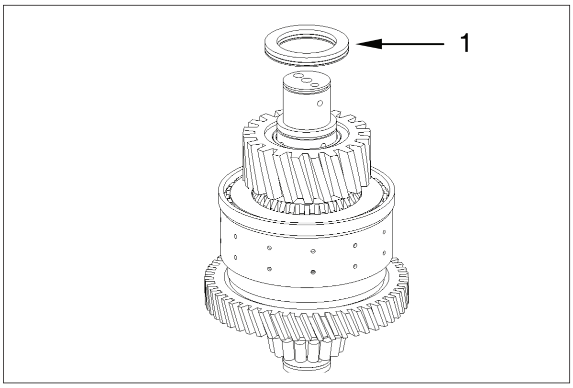
HL940TM135

③ Snap out retaining ring (1).



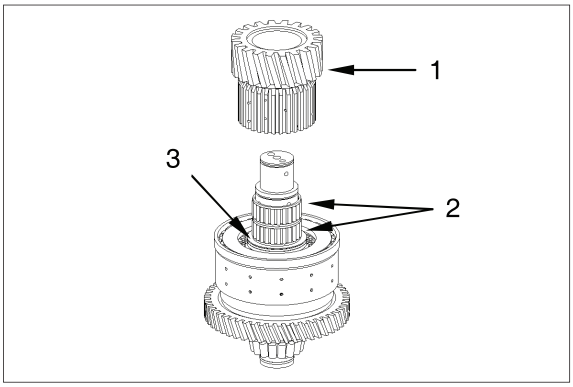
HL940TM136

④ Remove axial bearing assy (1).



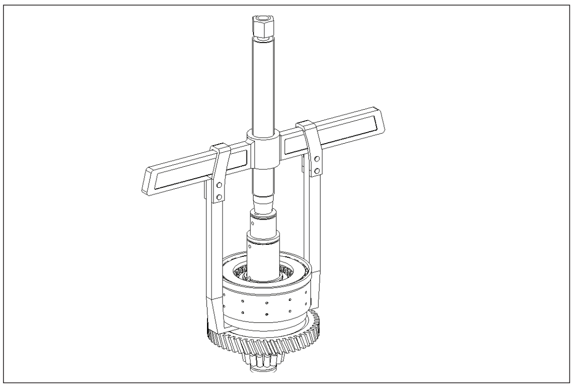
HL940TM137

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



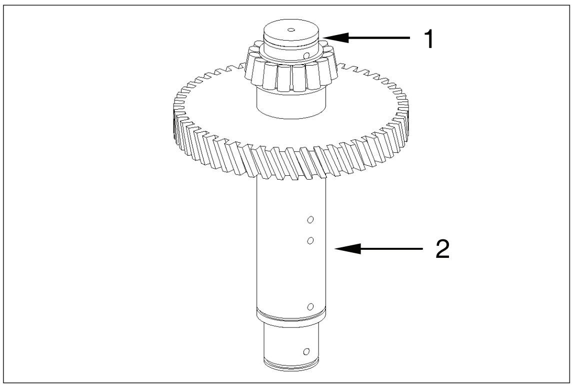
HL940TM138

⑥ Pull clutch (1) off the shaft.



HL940TM139

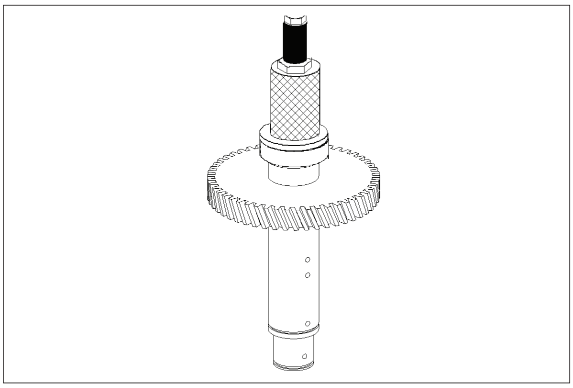
⑦ Turn shaft (2) by 180° and snap out piston ring (1).



HL940TM140

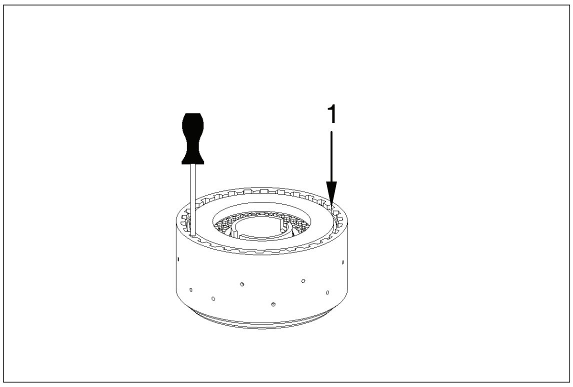
⑧ Pull tapered roller bearing (inner ring) off the shaft.

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



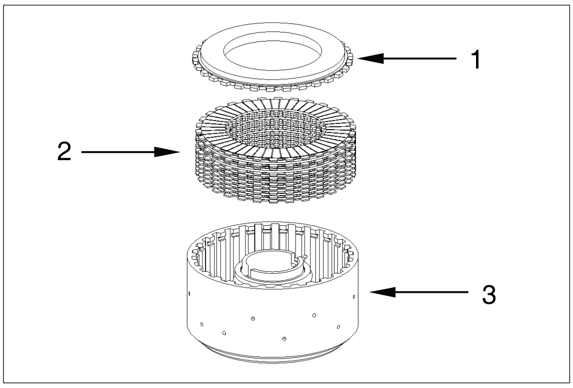
HL940TM141

⑨ Unsnap snap ring (1).



HL940TM142

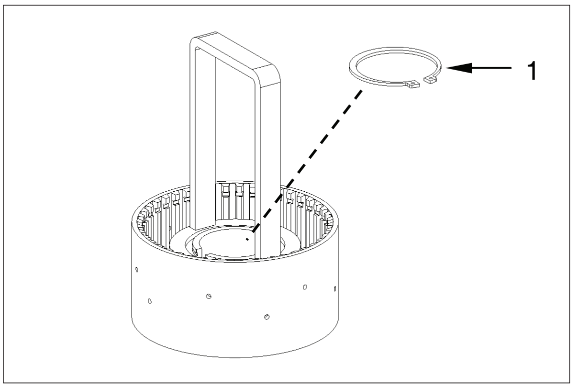
⑩ Remove end shim (1) and disc set (2) out the disc carrier (3).



HL940TM143

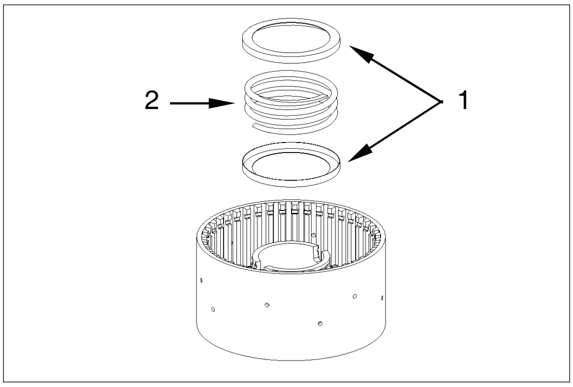
⑪ Preload compression spring unsnap retaining ring (1).

Assembly aid 5870 345 088



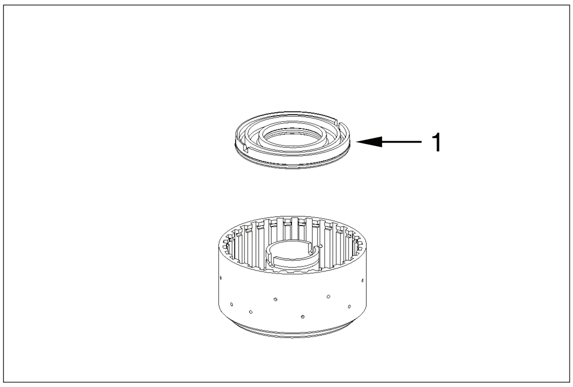
HL940TM144

⑫ Remove guide rings (1) and compression spring (2).



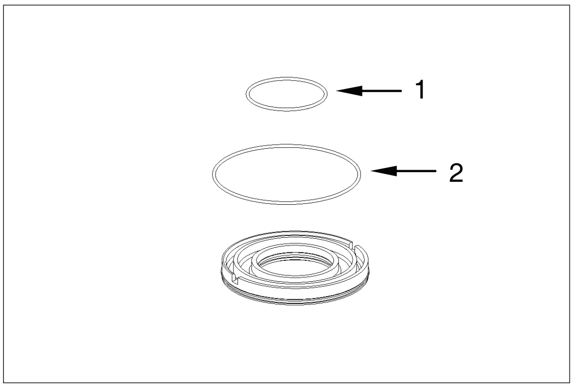
HL940TM145

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



HL940TM146

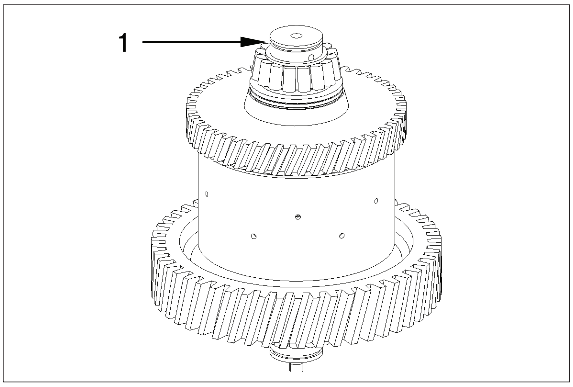
⑭ Remove both O-rings (1 and 2).



HL940TM147

(5) K3 clutch

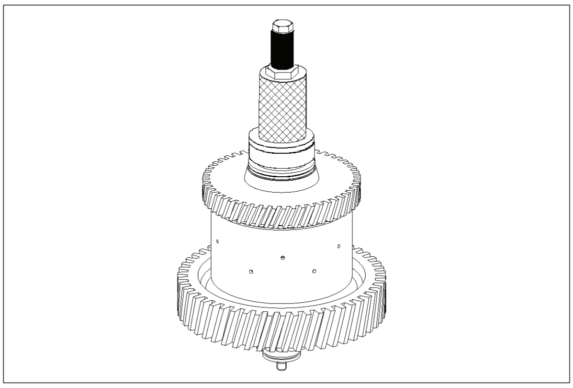
① Snap out piston ring (1).



HL940TM148

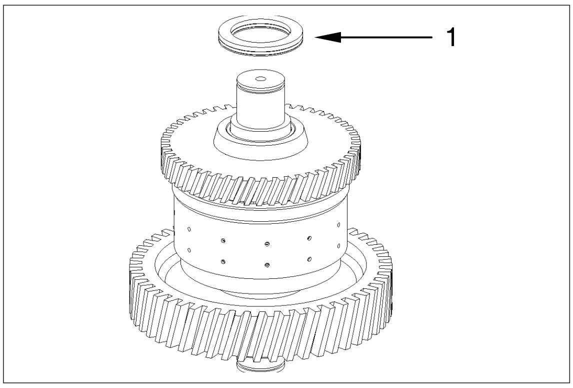
② Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 058
or	
Rapid grip	5873 011 011



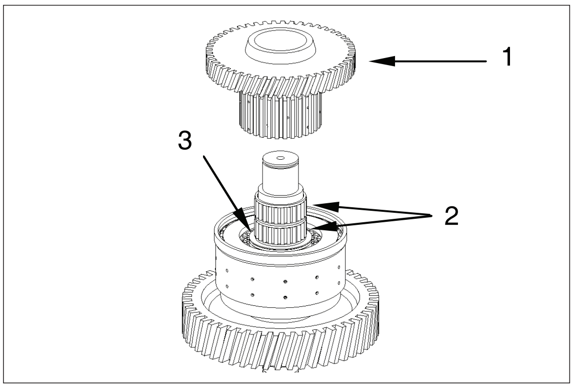
HL940TM149

③ Remove axial bearing assy (1).



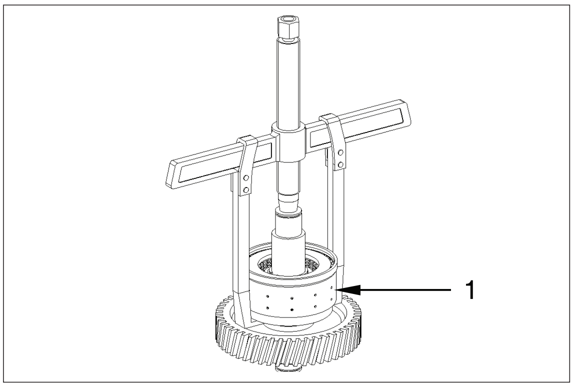
HL940TM150

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



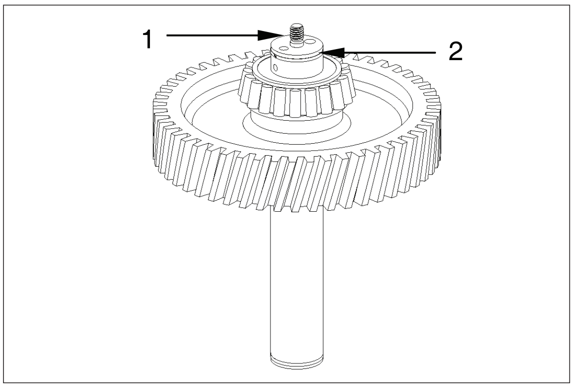
HL940TM151

⑤ Pull clutch (1) off the shaft.



HL940TM152

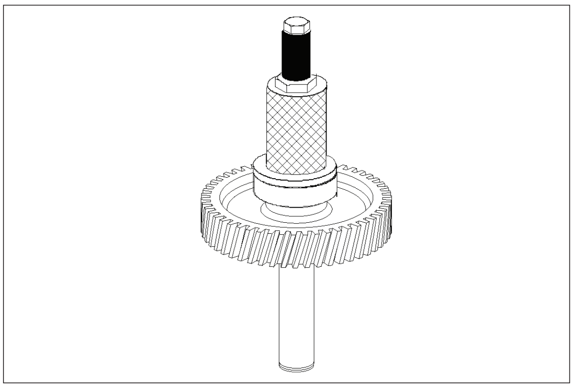
⑥ Remove stud bolt (1) and snap out piston ring (2).



HL940TM153

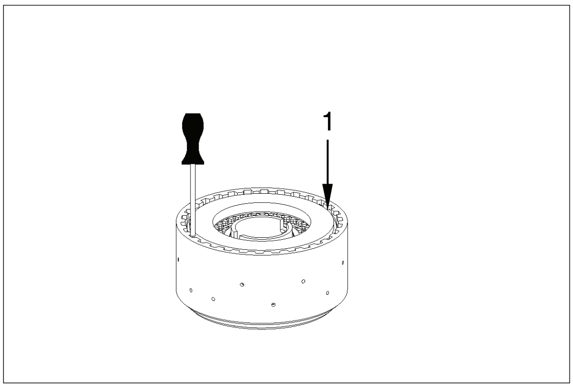
⑦ Pull tapered roller bearing (inner ring) off the shaft.

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



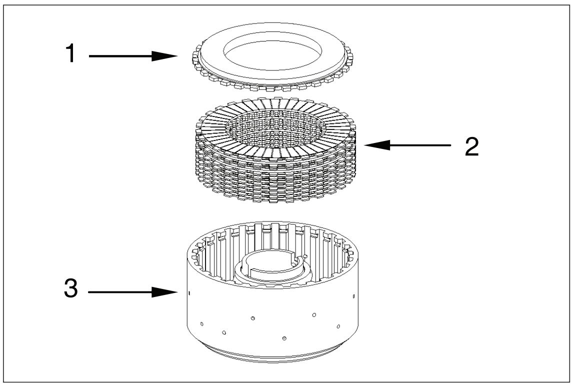
HL940TM154

⑧ Unsnap snap ring (1).



HL940TM155

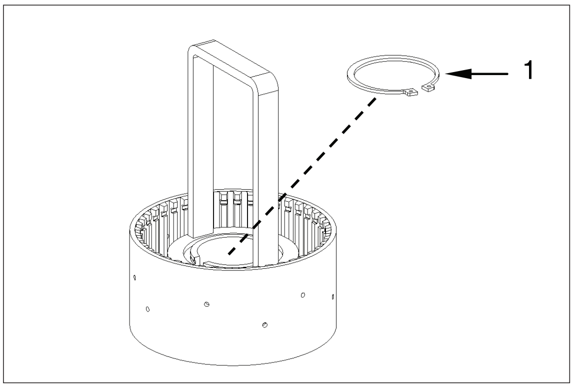
⑨ Remove end shim (1) and disc set (2) out the disc carrier (3).



HL940TM156

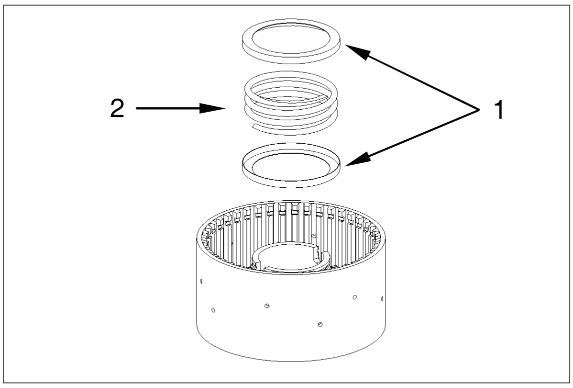
⑩ Preload compression spring (1) unsnap snap ring.

Assembly aid 5870 345 088



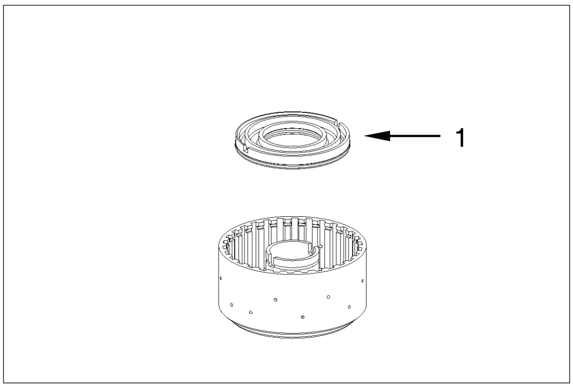
HL940TM157

⑪ Remove guide rings (1) and compression spring (2).



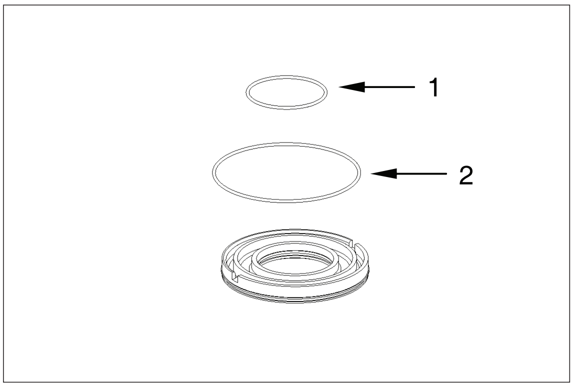
HL940TM158

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



HL940TM159

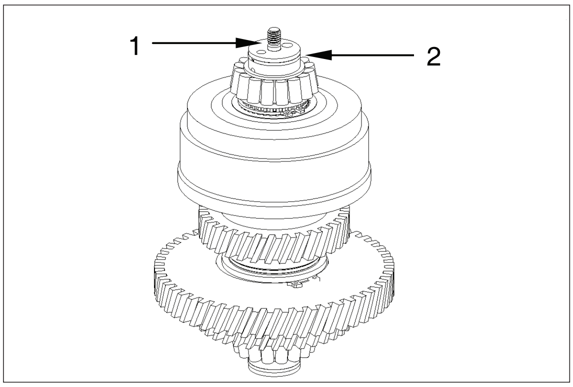
⑬ Remove both O-rings (1 and 2).



HL940TM160

(6) K4 clutch

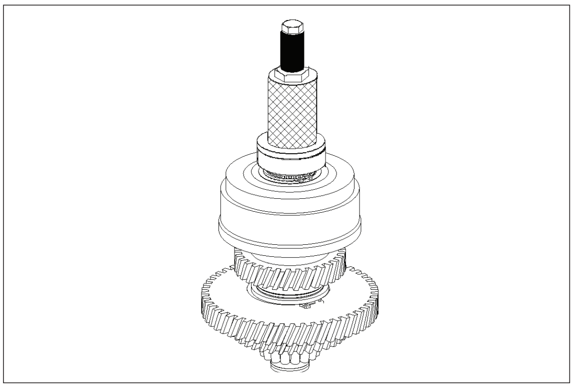
① Remove stud bolt (1) and snap out piston ring (2).



HL940TM161

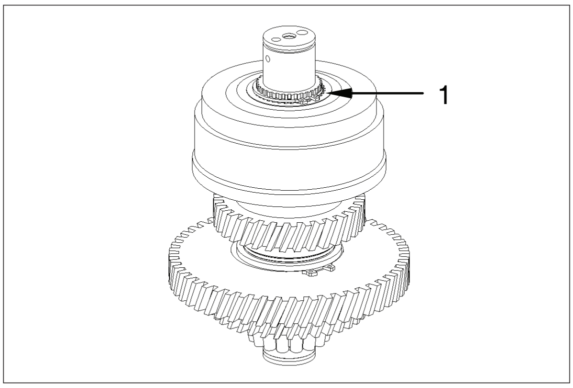
② Pull tapered roller bearing (inner ring) off the shaft.

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



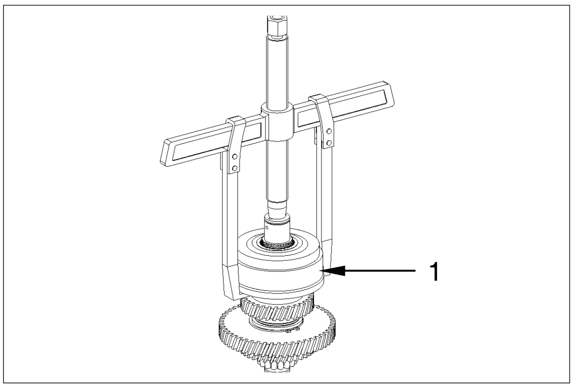
HL940TM162

③ Snap out retaining ring.



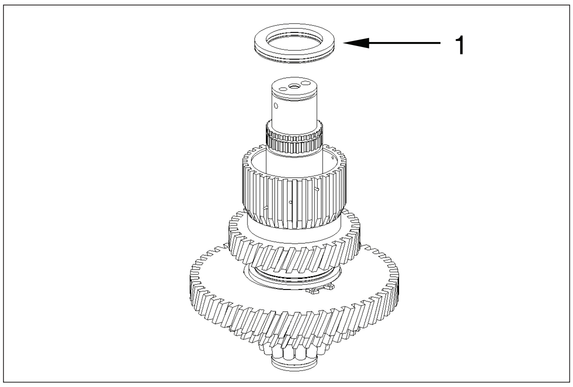
HL940TM163

④ Pull clutch (1) off the shaft.



HL940TM164

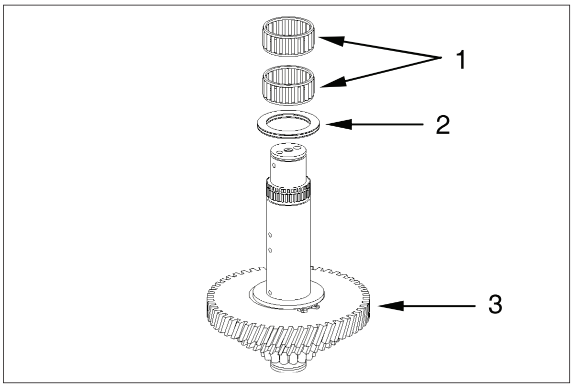
⑤ Remove axial bearing assy (1) and idler gear (2).



HL940TM165

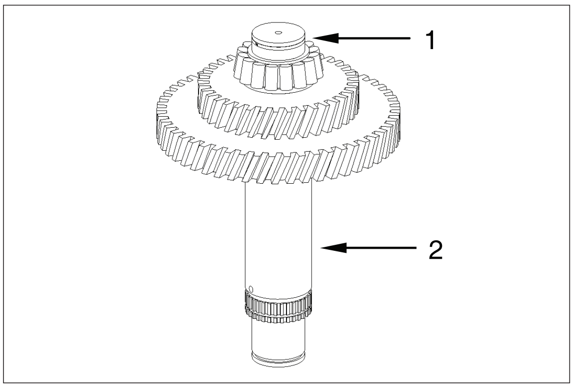
⑥ Remove needle cage (1) and axial bearing assy (2).

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



HL940TM166

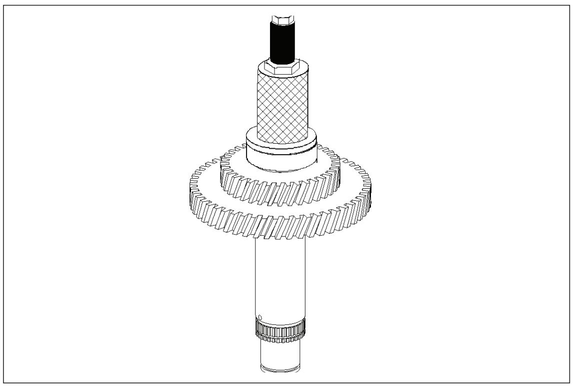
⑦ Turn shaft (2) by 180° and snap out piston ring (1).



HL940TM167

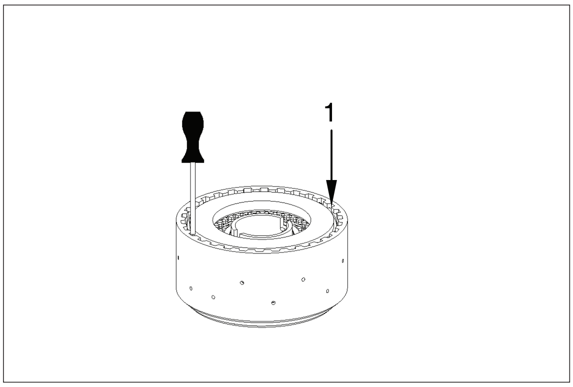
⑧ Pull tapered roller bearing (inner ring) off the shaft.

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



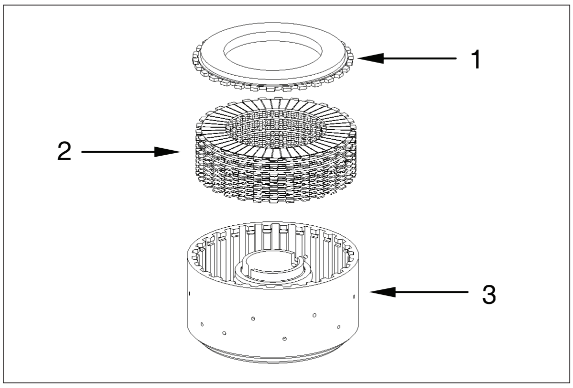
HL940TM168

⑨ Unsnap snap ring (1).



HL940TM169

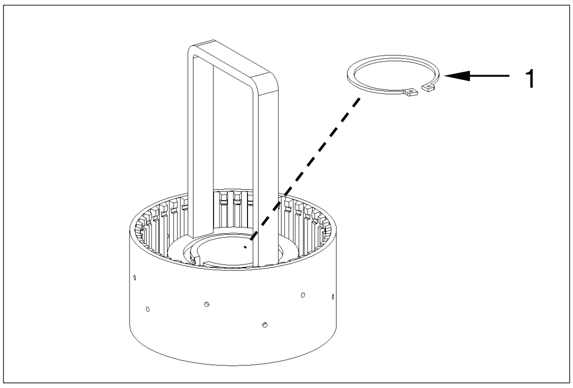
⑩ Remove end shim (1) and disc set (2) out the disc carrier (3).



HL940TM170

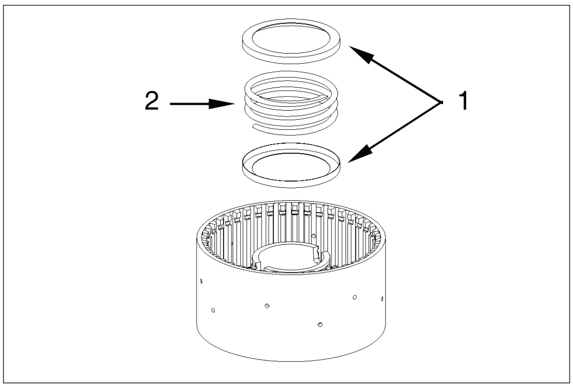
⑪ Preload compression spring (1) unsnap snap ring.

Assembly aid 5870 345 088



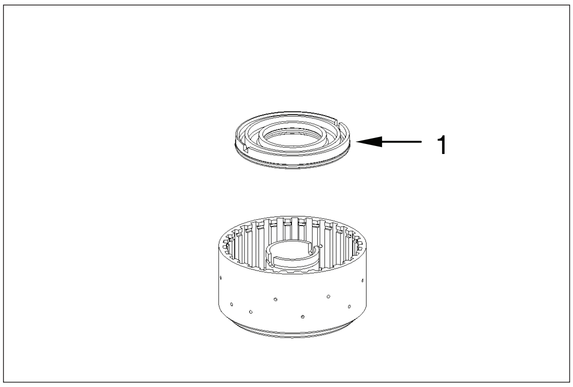
HL940TM171

⑫ Remove guide rings (1) and compression spring (2).



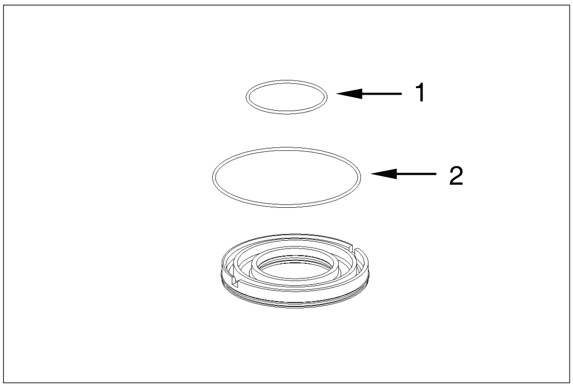
HL940TM172

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



HL940TM173

⑭ Remove both O-rings (1 and 2).

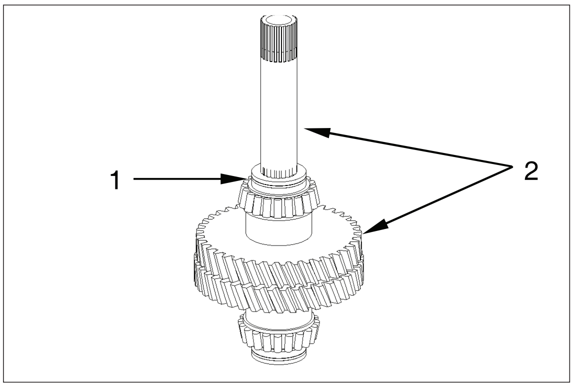


HL940TM174

(7) Input shaft

① Snap out piston ring (1).
Turbine wheel shaft and drive gear (2) are fixed by a snap ring.

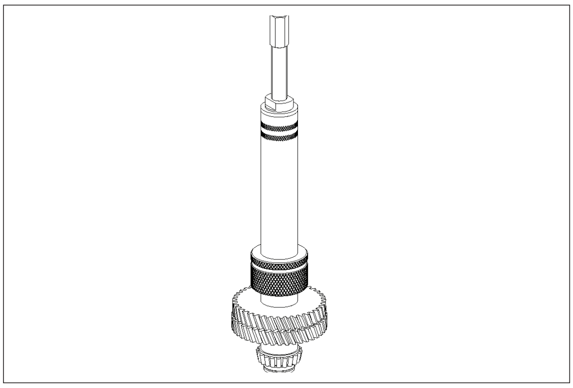
※ When separated, the components will be destroyed.



HL940TM175

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

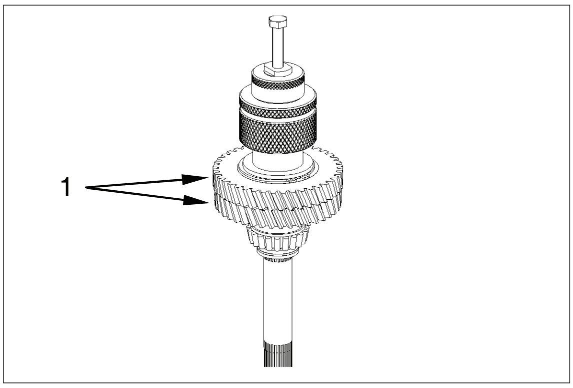


HL940TM176

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.

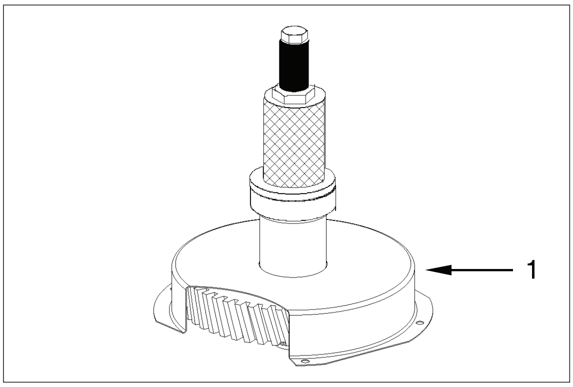


HL940TM177

(8) Output shaft

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

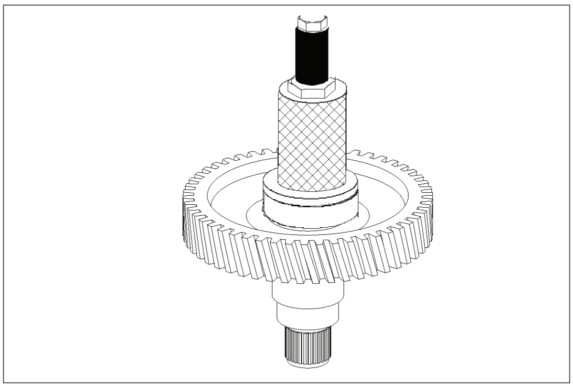
Basic tool	5873 001 000
Grab sleeve	5873 001 058
or	
Rapid grip	5873 011 014



HL940TM178

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

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



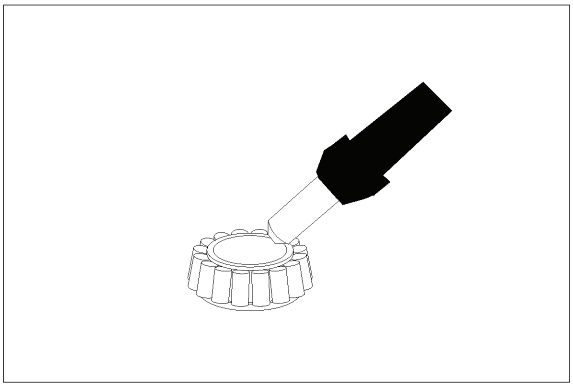
HL940TM179

8) REASSEMBLY

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

(1) KV clutch

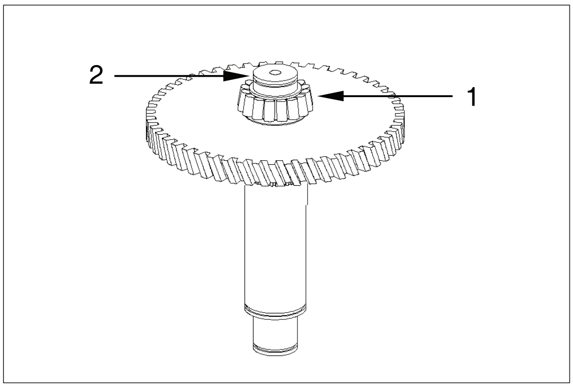
① Heat up bearing inner ring (approx. 120˚C).



HL940TM180

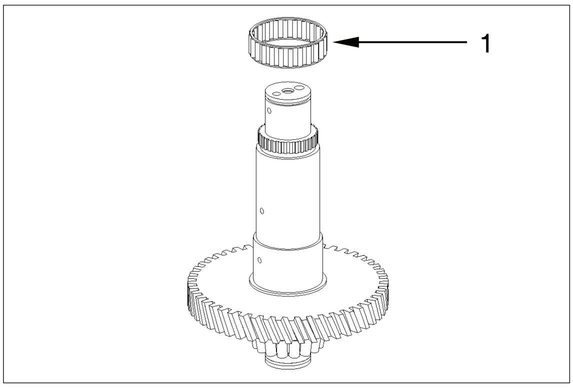
② Mount bearing inner ring (1) until contact is obtained.
Fit rectangular ring 40×2.5 (2).

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



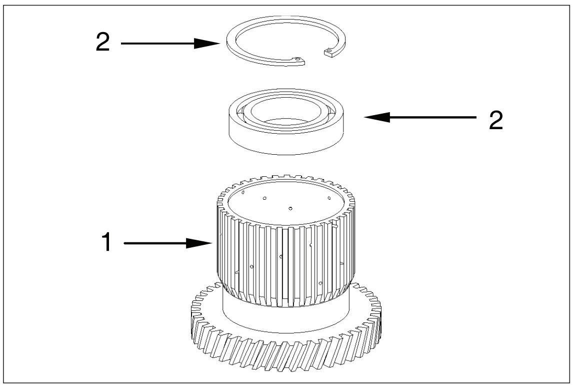
HL940TM181

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



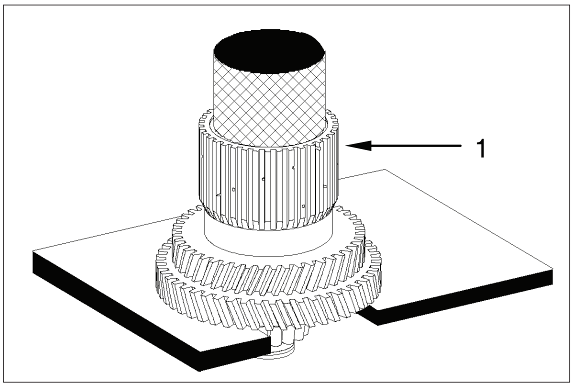
HL940TM182

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



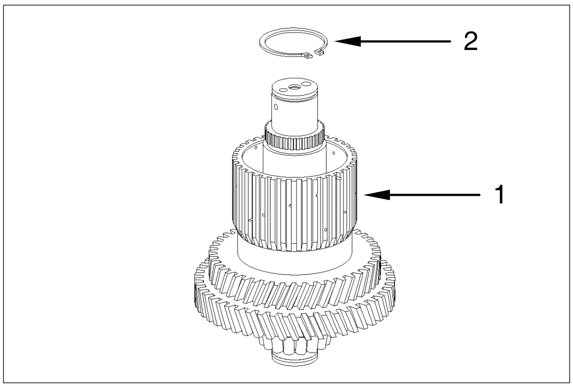
HL940TM183

⑤ Press in preassembled idler gear (1) until contact is obtained.



HL940TM184

⑥ Fix idler gear (1) by means of retaining ring 55×2 (2).

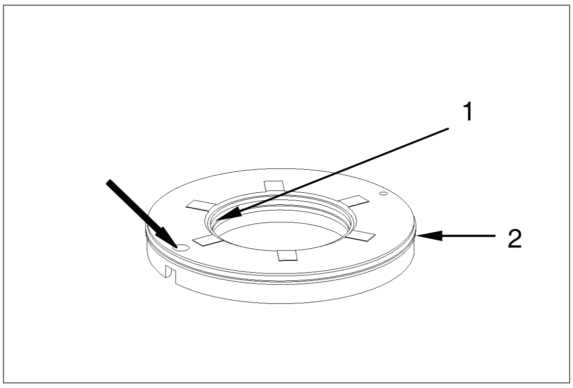


HL940TM185

⑦ Place both O-rings (1 and 2) into the piston grooves and oil them.

1 = 75×3
2 = 142×3

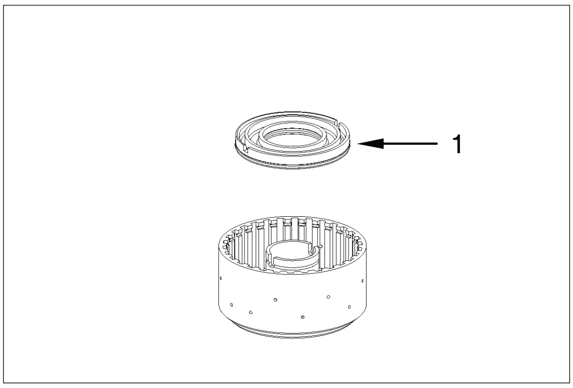
※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



HL940TM186

⑧ Place piston (1) into the disk carrier.

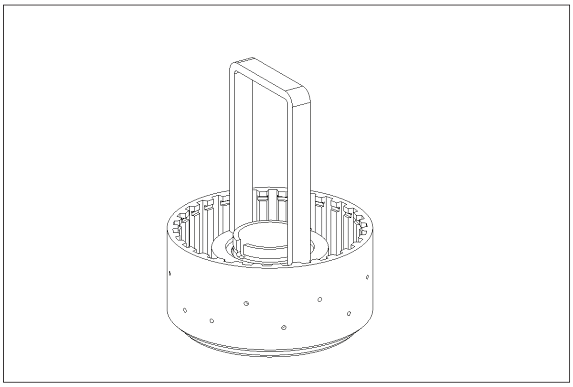
※ Observe installation position, see figure.



HL940TM187

⑨ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid 5870 345 088

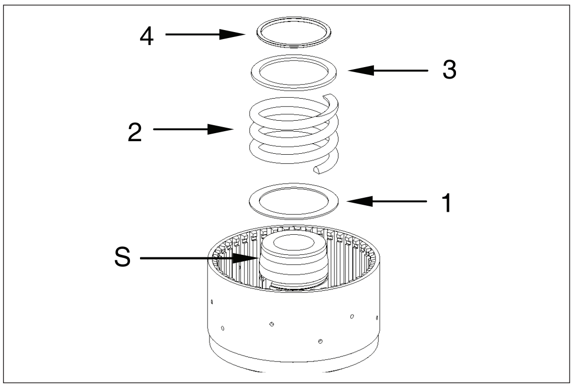


HL940TM188

⑩ Mount inner installer (S) onto the disk carrier.
Install disk (1), compression spring (2), support shim (3) and Lring (4).

※ Installation position support shim and L-ring see TM191.

Inner installer →see TM190.

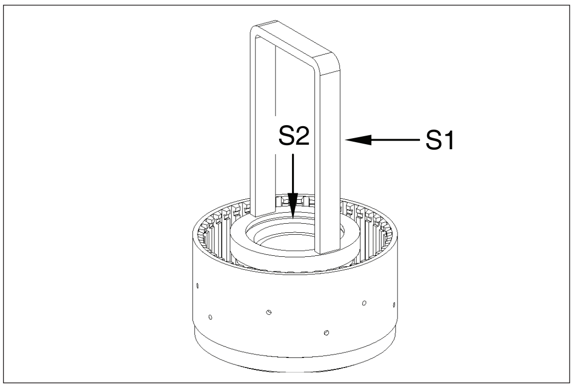


HL940TM189

⑪ Preload compression spring by means of assembly aid (S1) and pressure piece (S2), until L-Ring has engaged into the annular groove.

Assembly aid 5870 345 088
Assembly fixture 5870 345 124
(Inner installer and pressure piece)

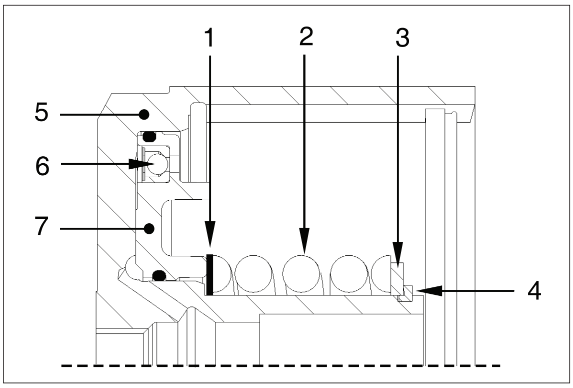
※ It is always necessary to mount a new L-ring.



HL940TM190

⑫ 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



HL940TM191

※ Different clutches (disc arrangements with relevant disc clearance) can be installed, depending on the parts list version.

※ The actually installed clutch and disc arrangement must be taken from the corresponding spare parts list.

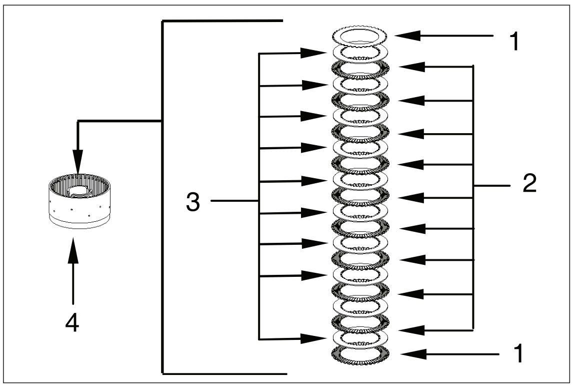
※ Figure no.: TM192 and TM193 illustrates the different disc arrangements.

※ The spare parts list shall be binding.

⑬ Install outer and inner disks alternately into the disk carrier (4) as personated in TM192.

1 Friction disk -coated on one side- (2 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 or end plate.
Number of friction surfaces: 20.

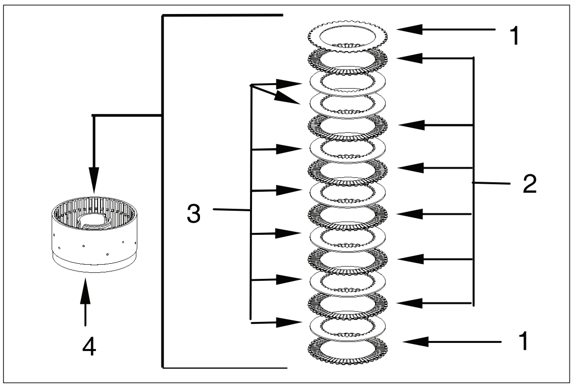


HL940TM192

⑭ Install outer and inner disks alternately into the disk carrier (4) as personated in TM193.

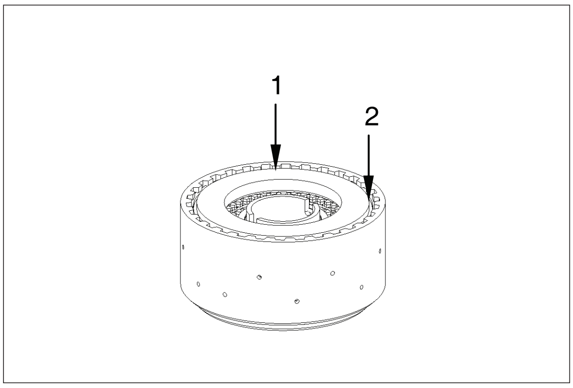
1 Friction disk -coated on one side- (2 pcs)
2 Outer disks (6 pcs)
3 Inner disks (7 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plat.
Number of friction surfaces: 12.



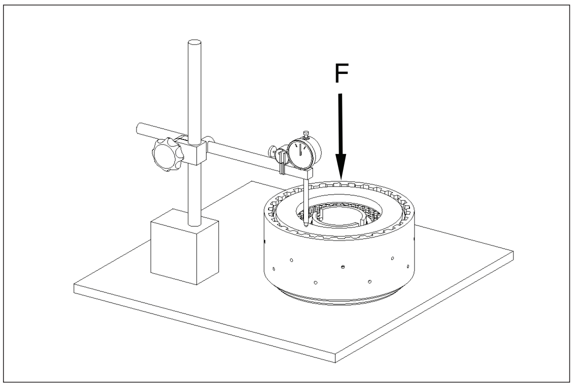
HL940TM193

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



HL940TM194

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



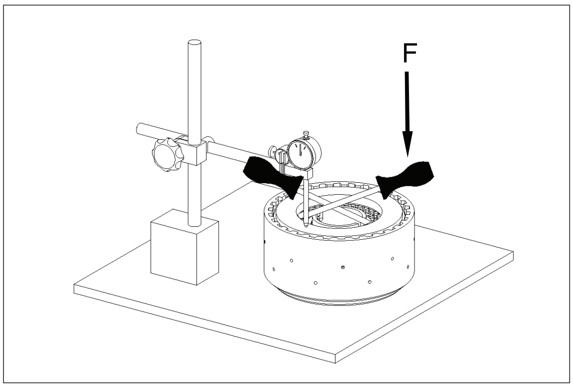
HL940TM195

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

※ Disk clearance : 2.45 to 2.75 mm (see TM192)

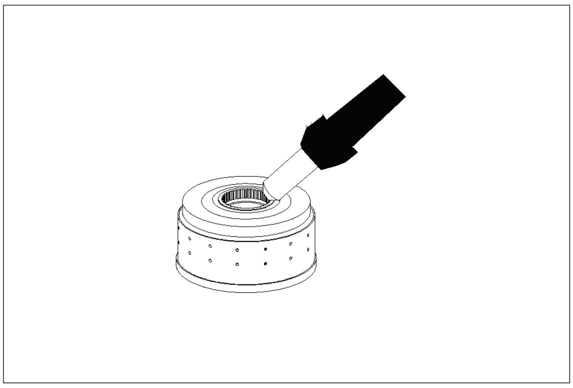
※ Disk clearance : 1.70 to 2.00 mm (see TM193)

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



HL940TM196

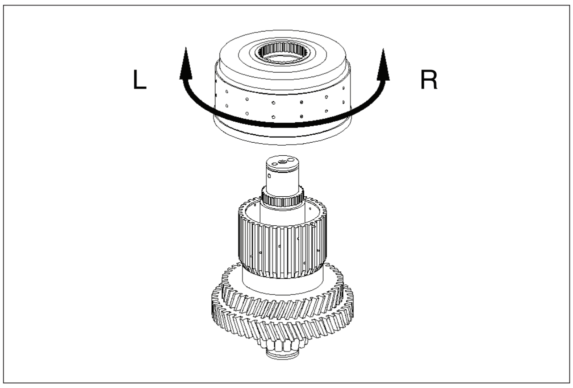
⑱ Heat up clutch inner diameter (approx. 120˚C).



HL940TM197

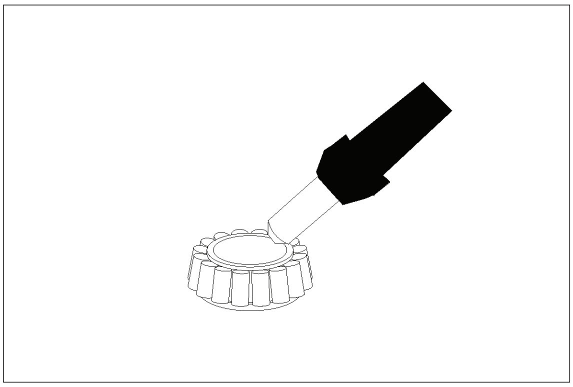
⑲ Install clutch until contact is obtained. Mount inner disks onto the inner disk carrier by means of short left/right rotations.

※ Wear protective gloves.



HL940TM198

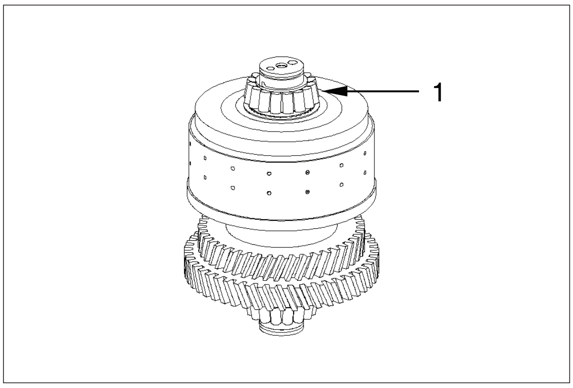
⑳ Heat up bearing inner ring (approx. 120˚ C)



HL940TM199

㉑ Mount bearing inner ring (1) until contact is obtained.

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

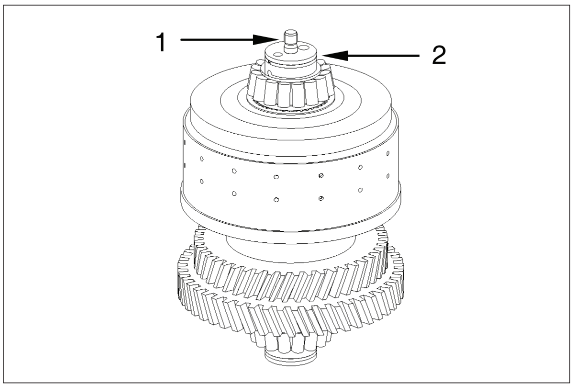


HL940TM200

㉒ Mount stud bolt (1).

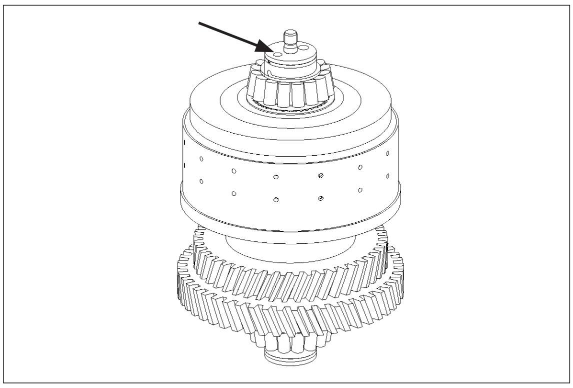
· Tightening torque (M10 /8.8×16) :
1.73 kgf · m (12.6 lbf · ft)

Fit rectangular ring 40×2.5 (2).



HL940TM201

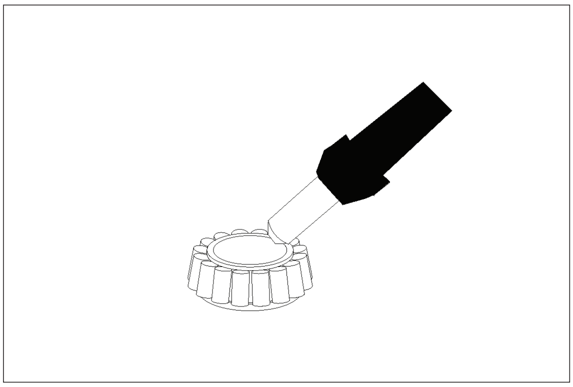
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.



HL940TM202

(2) KR clutch

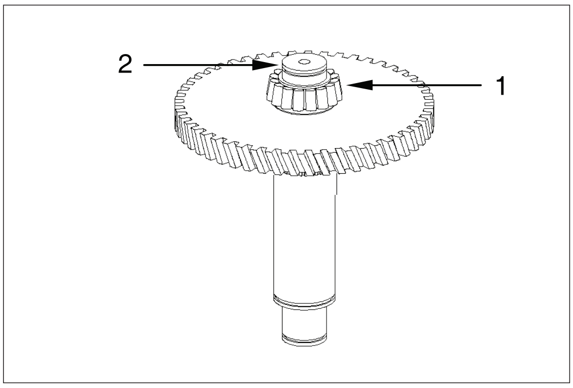
① Heat up bearing inner ring (approx. 120˚C).



HL940TM203

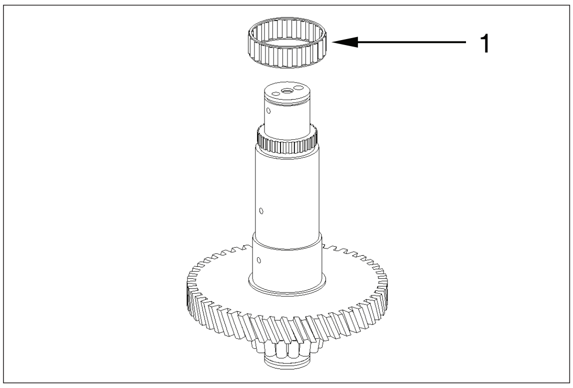
② Mount bearing inner ring (1) until contact is obtained.
Fit rectangular ring 40×2.5 (2).

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



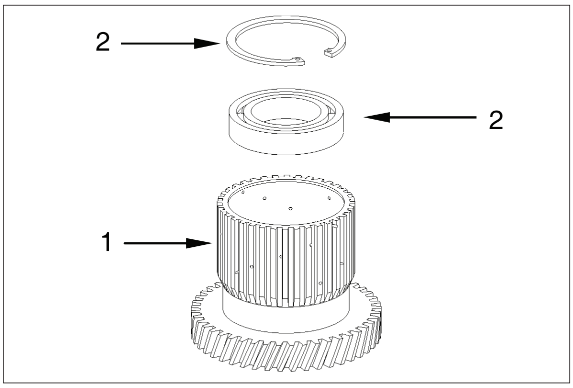
HL940TM204

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



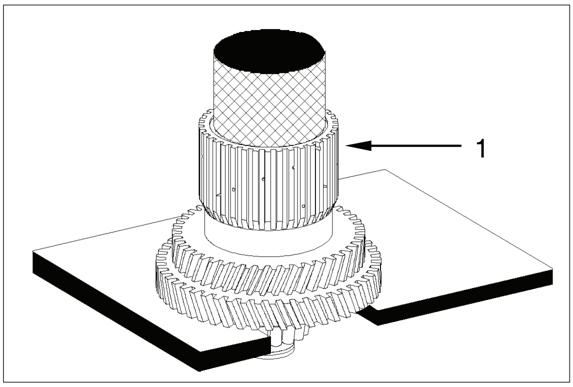
HL940TM205

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



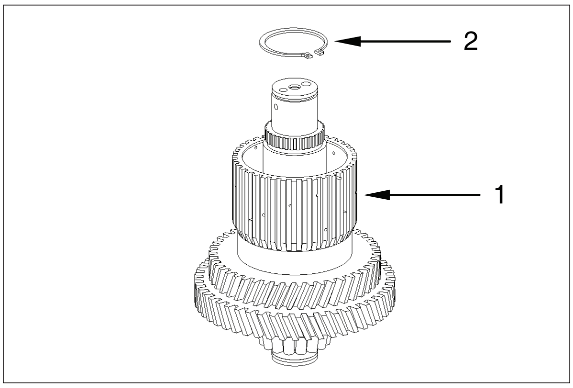
HL940TM206

⑤ Press in preassembled idler gear (1) until contact is obtained.



HL940TM207

⑥ Fix idler gear (1) by means of retaining ring 55×2 (2).

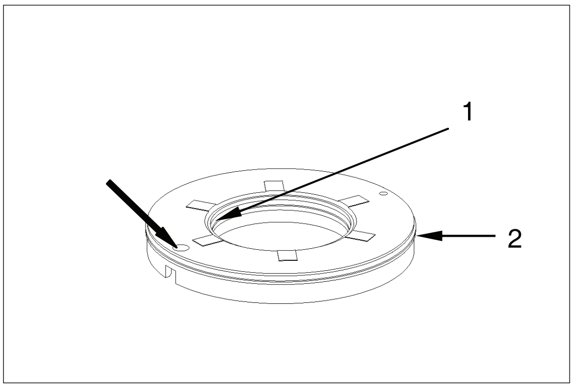


HL940TM208

⑦ Place both O rings (1 and 2) into the piston grooves and oil them.

1 = 75×3
2 = 142×3

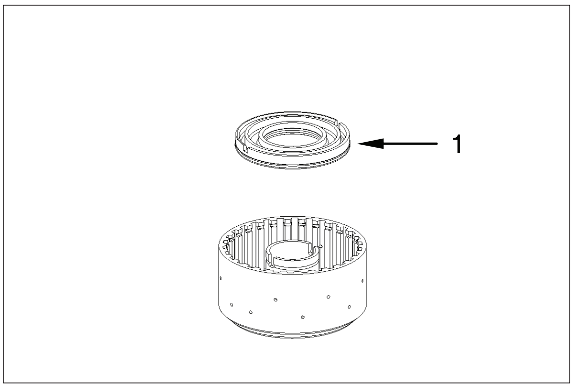
※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



HL940TM209

⑧ Place piston (1) into the disk carrier.

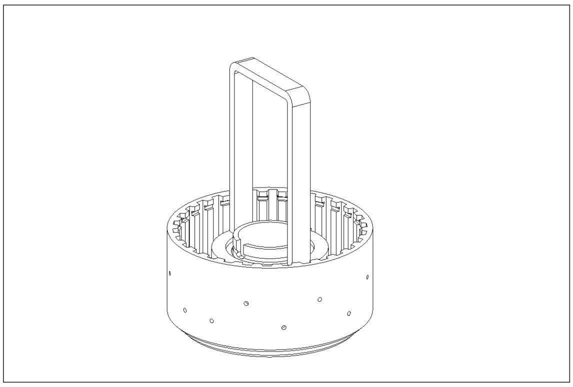
※ Observe installation position, see figure.



HL940TM210

⑨ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid 5870 345 088

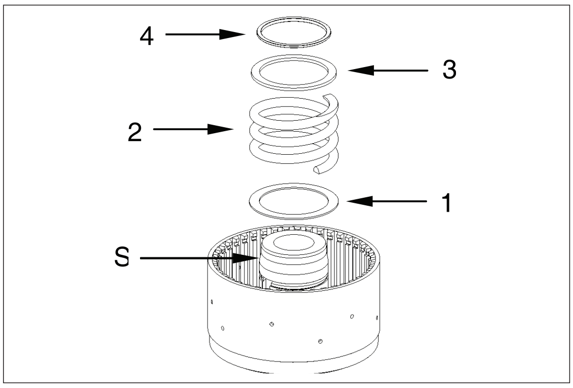


HL940TM211

⑩ Mount inner installer (S) onto the disk carrier.
Install disk (1), compression spring (2), support shim (3) and Lring (4).

※ Installation position support shim and L-ring see TM214.

Inner installer →see TM213.

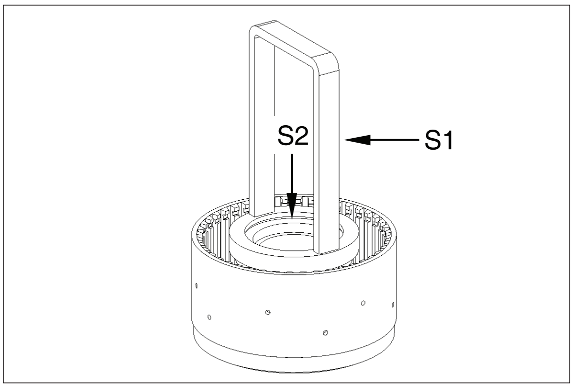


HL940TM212

⑪ Preload compression spring by means of assembly aid (S1) and pressure piece (S2), until L-Ring has engaged into the annular groove.

Assembly aid 5870 345 088
Assembly fixture 5870 345 124
(Inner installer and pressure piece)

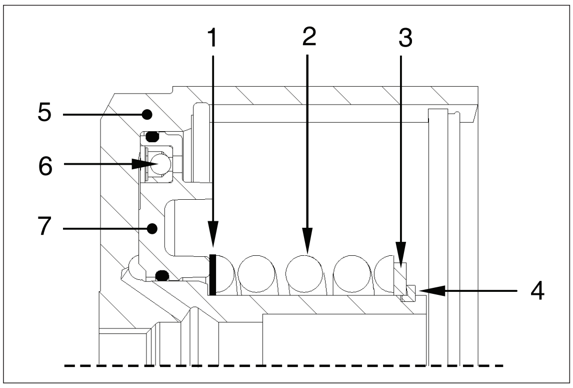
※ It is always necessary to mount a new L-ring.



HL940TM213

⑫ 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



HL940TM214

※ Different clutches (disc arrangements with relevant disc clearance) can be installed, depending on the parts list version.

※ The actually installed clutch and disc arrangement must be taken from the corresponding spare parts list.

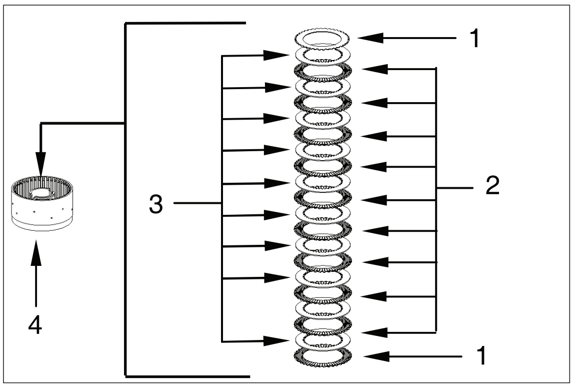
※ Figure no.: TM215 and TM216 illustrates the different disc arrangements.

※ The spare parts list shall be binding.

⑬ Install outer and inner disks alternately into the disk carrier (4) as personated in TM215.

1 Friction disk -coated on one side- (2 pcs)
2 Outer disks (9 pcs)
3 Inner disks (10 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plate.
Number of friction surfaces : 20

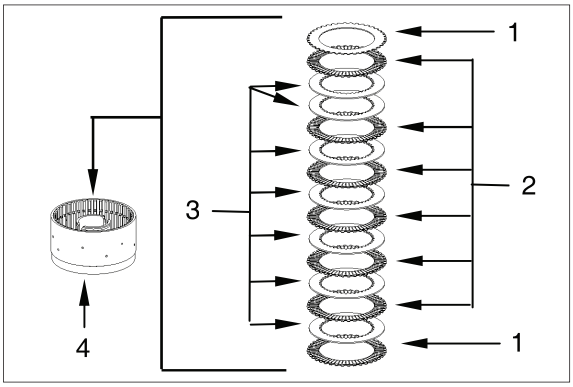


HL940TM215

⑭ Install outer and inner disks alternately into the disk carrier (4) as personated in TM216.

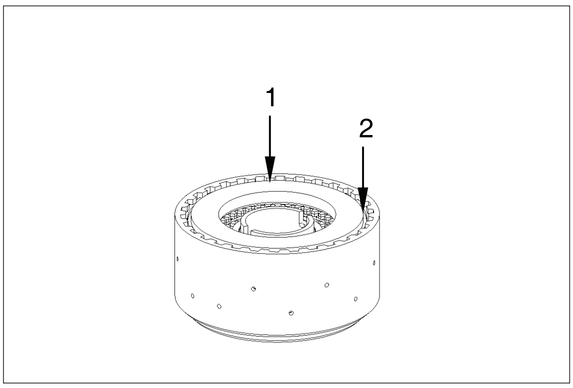
1 Friction disk -coated on one side- (2 pcs)
2 Outer disks (6 pcs)
3 Inner disks (7 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plate.
Number of friction surfaces : 12



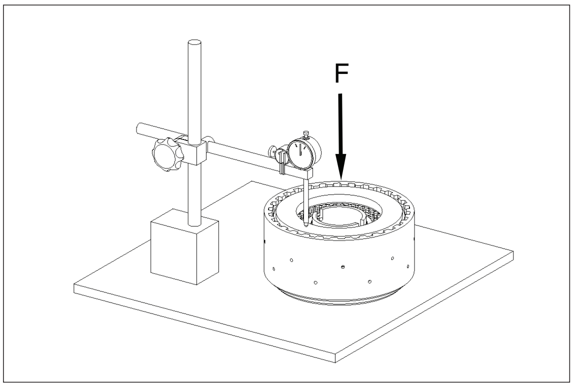
HL940TM216

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



HL940TM217

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



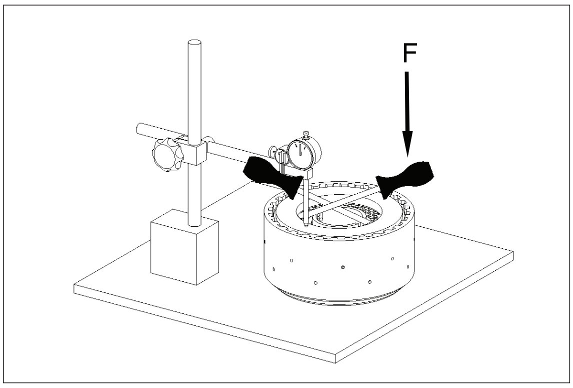
HL940TM218

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

※ Disk clearance : 2.45 to 2.75 mm (see TM215)

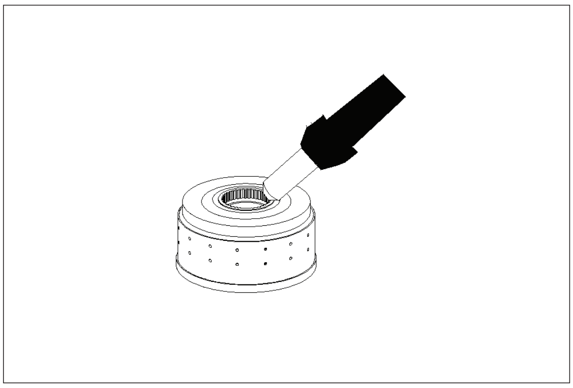
※ Disk clearance : 1.70 to 2.00 mm (see TM216)

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



HL940TM219

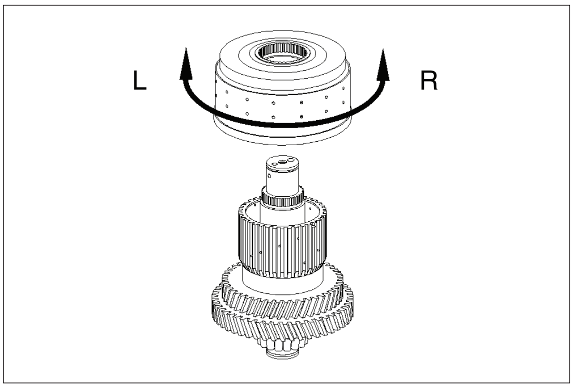
⑱ Heat up clutch inner diameter (approx. 120˚C).



HL940TM220

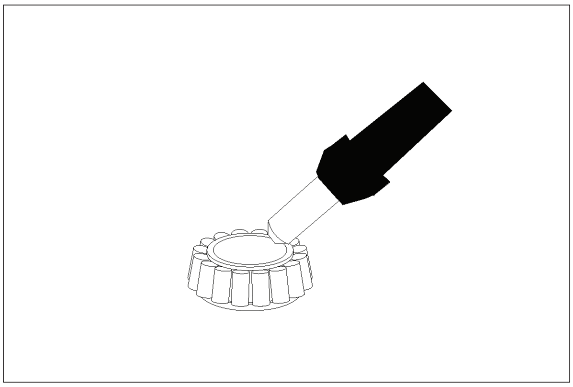
⑲ Install clutch until contact is obtained. Mount inner disks onto the inner disk carrier by means of short left/right rotations.

※ Wear protective gloves.



HL940TM221

⑳ Heat up bearing inner ring (approx. 120˚ C)

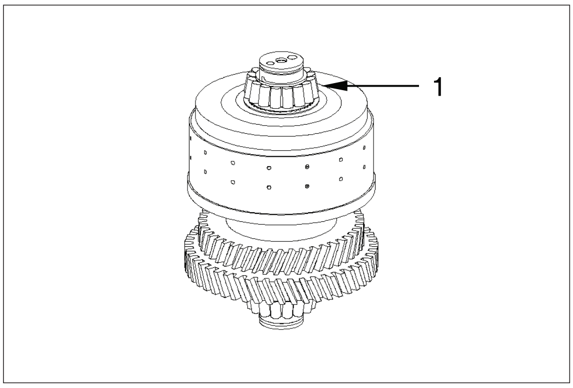


HL940TM222

㉑ Mount bearing inner ring (1) until contact is obtained.

※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

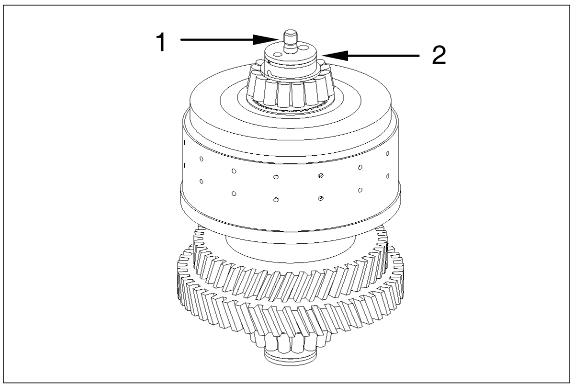


HL940TM223

㉒ Mount stud bolt (1).

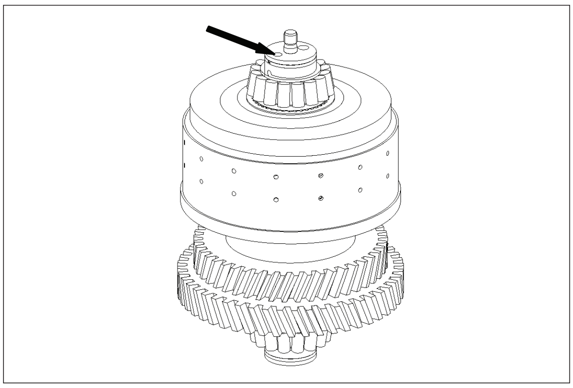
· Tightening torque (M10 /8.8×16) : 1.73 kgf · m (12.6 lbf · ft)

Fit rectangular ring 40×2.5 (2).



HL940TM224

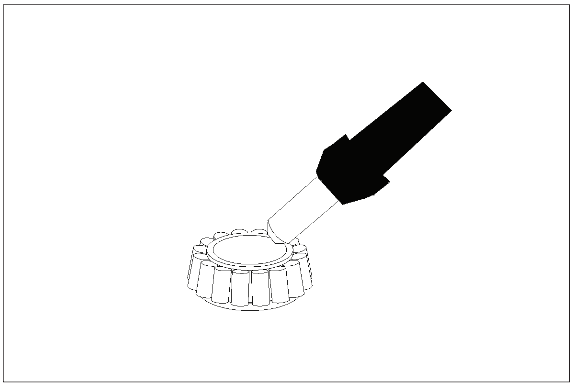
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.



HL940TM225

(3) Clutch K1

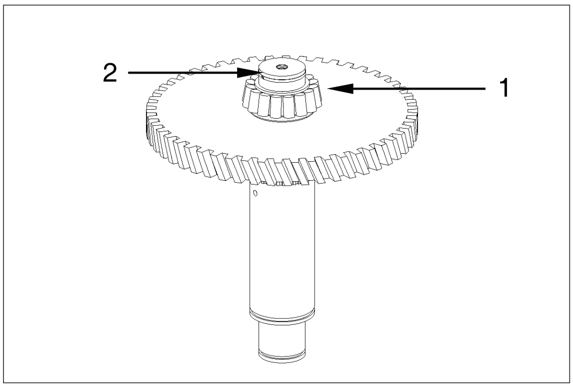
① Heat up bearing inner ring (approx. 120˚C).



HL940TM226

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.

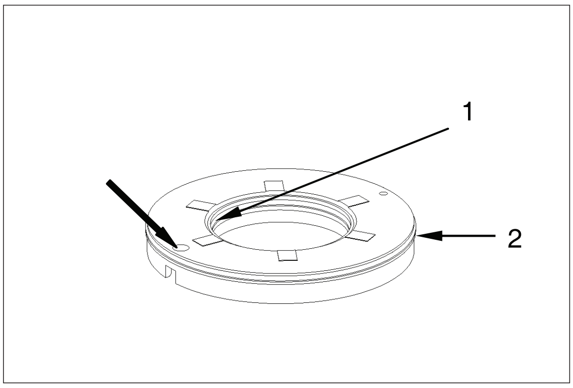


HL940TM227

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

1 = 75×3
2 = 142×3

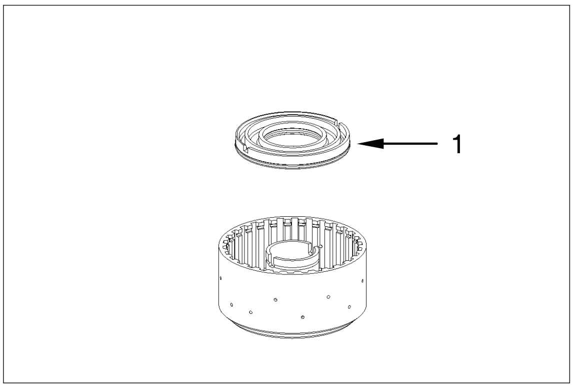
Check function of the drain



HL940TM228

④ Place piston (1) into the disk carrier.

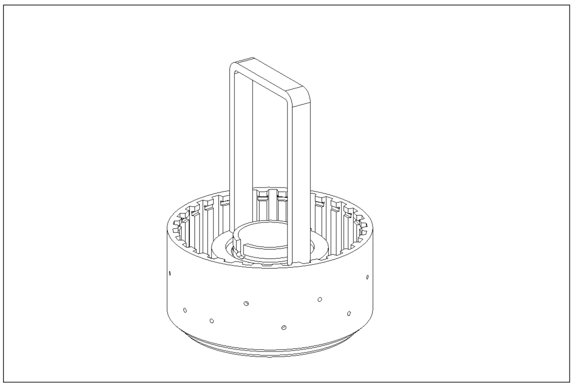
※ Observe installation position, see figure.



HL940TM229

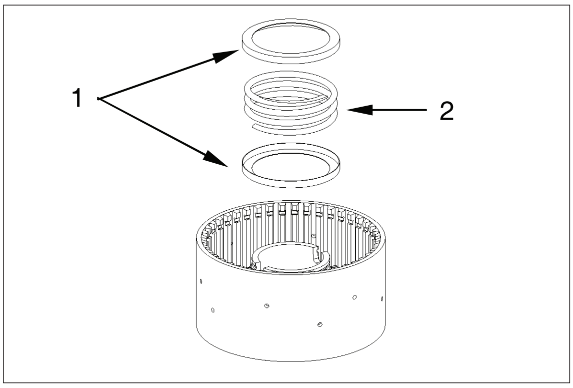
⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid 5870 345 088



HL940TM230

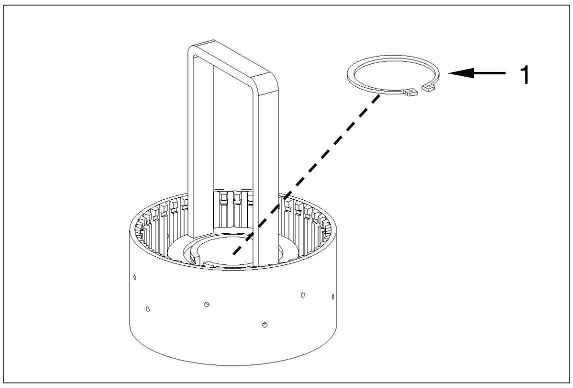
⑥ Mount guide rings (1) and compression spring (2).



HL940TM231

⑦ Preload pressure spring by means of assembly aid and fix with retaining ring 70×2.5 (1).

※ Assembly aid 5870 345 088



HL940TM232

※ Different clutches (disc arrangements with relevant disc clearance) can be installed, depending on the parts list version.

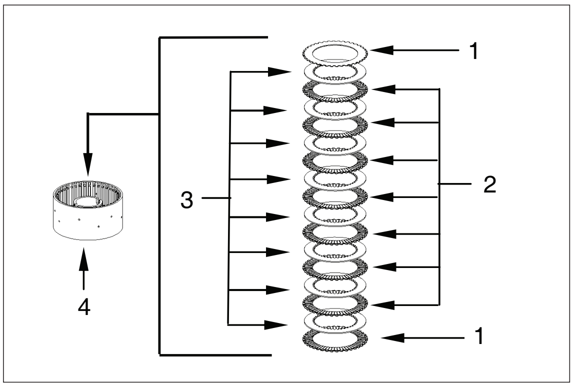
※ The actually installed clutch and disc arrangement must be taken from the corresponding spare parts list.

※ Figure no.: TM233 and TM234 illustrates the different disc arrangements.

⑧ Install outer and inner disks alternately into the disk carrier (4) as personated in TM233.

1 Friction disk -coated on one side- (2 pcs)
2 Outer disks (7 pcs)
3 Inner disks (8 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plate.
Number of friction surfaces : 16

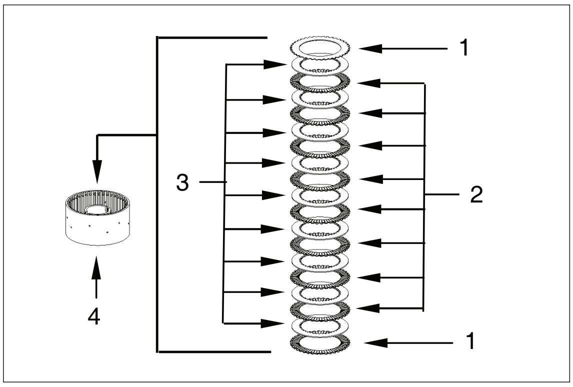


HL940TM233

⑨ Install outer and inner disks alternately into the disk carrier (4) as personated in TM234.

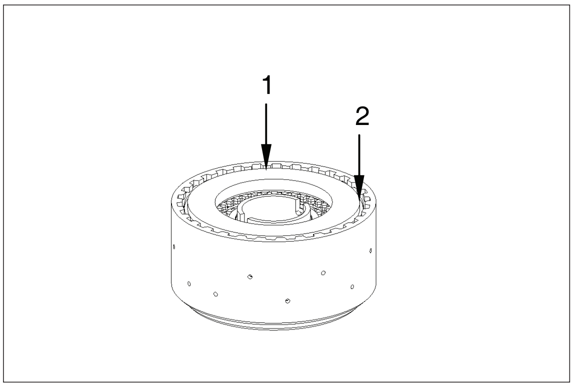
1 Friction disk -coated on one side- (2 pcs)
2 Outer disks (8 pcs)
3 Inner disks (9 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plate.
Number of friction surfaces : 18



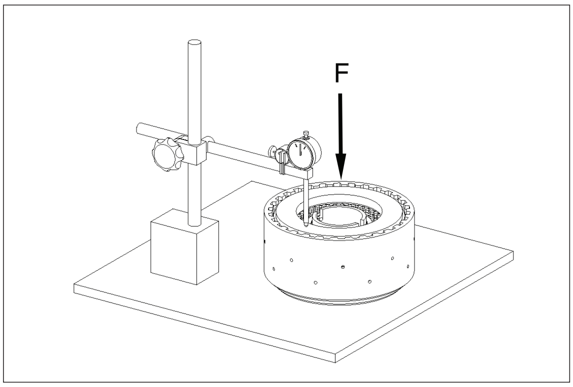
HL940TM234

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



HL940TM235

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



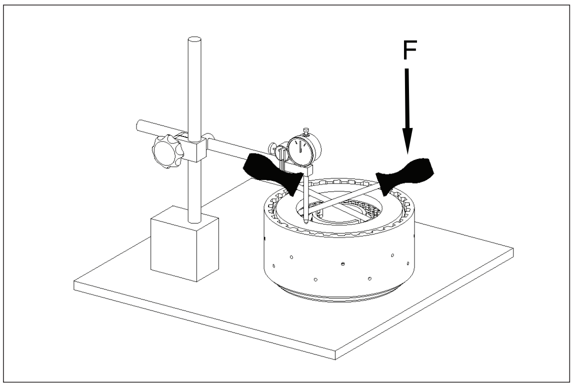
HL940TM236

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

※ Disk clearance : 2.00 to 2.30 mm
(see TM233)

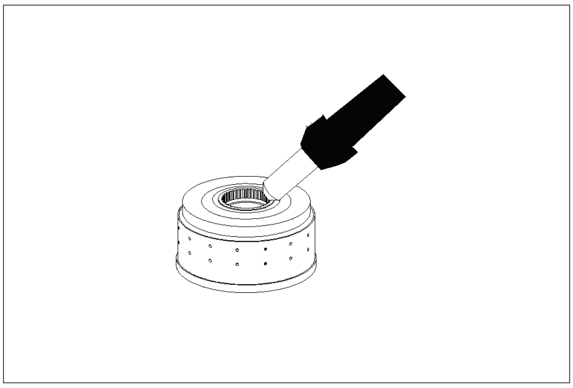
※ Disk clearance : 2.50 to 2.80 mm
(see TM234)

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



HL940TM237

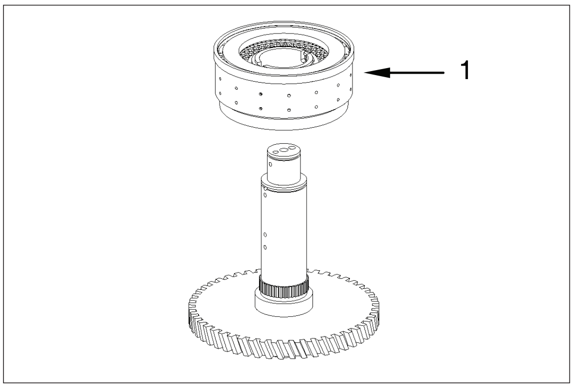
⑬ Heat up clutch inner diameter (approx. 120˚C).



HL940TM238

⑭ Mount clutch (1) until contact is obtained.

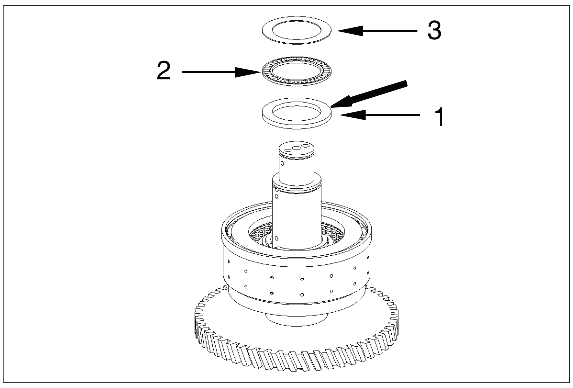
※ Wear protective gloves.



HL940TM239

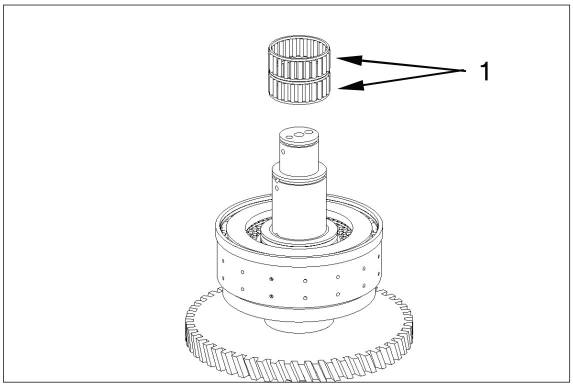
⑮ Mount running disk 55×78×5 (1), axial cage 55×78×3 (2) and axial washer 55×78×1 (3) and oil it.

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



HL940TM240

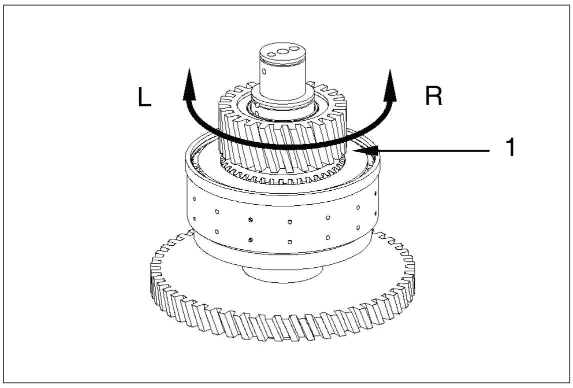
⑯ Mount needle cage 55×63×50 (1) and oil it.



HL940TM241

⑰ Install (1) idler

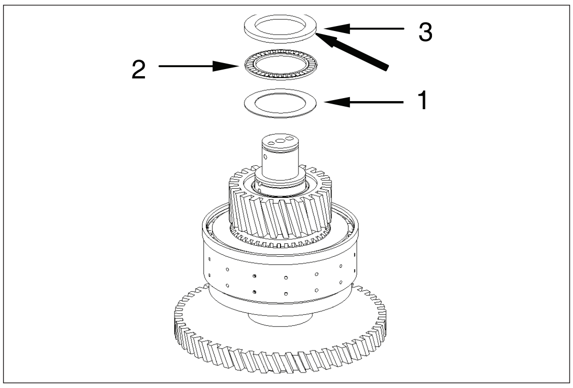
Mount inner disks onto the inner disk carrier (idler) by means of short left/right rotations.



HL940TM242

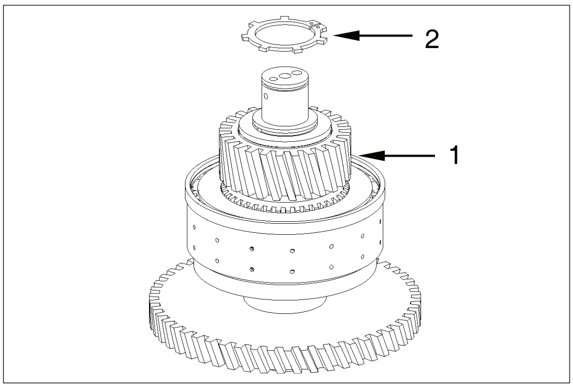
⑱ Mount axial washer 55×78×1 (1), axial cage 55×78×3 (2) and running disk 55×78×5 (3) and oil it.

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



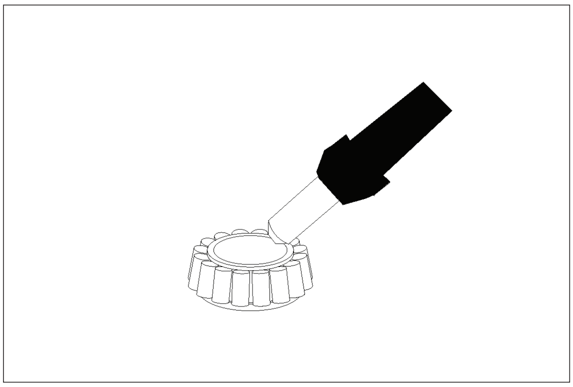
HL940TM243

⑲ Fix idler gear (1) and single parts by means of retaining ring (2).



HL940TM244

⑳ Heat up bearing inner ring (approx. 120˚C)

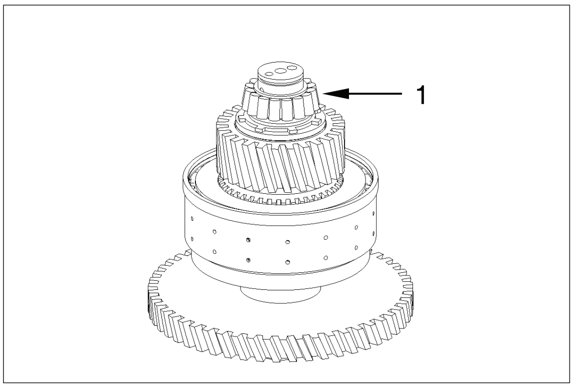


HL940TM245

㉑ Mount bearing inner ring (1) until contact is obtained.

※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

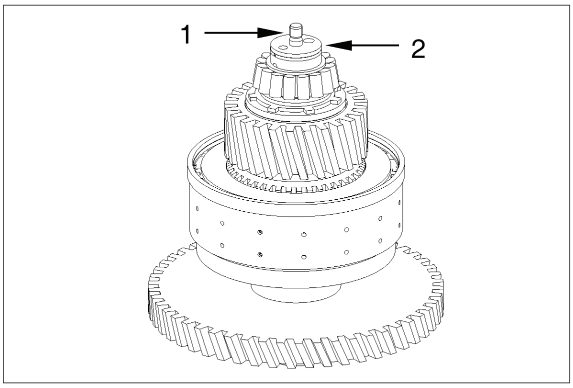


HL940TM246

㉒ Mount stud bolt (1).

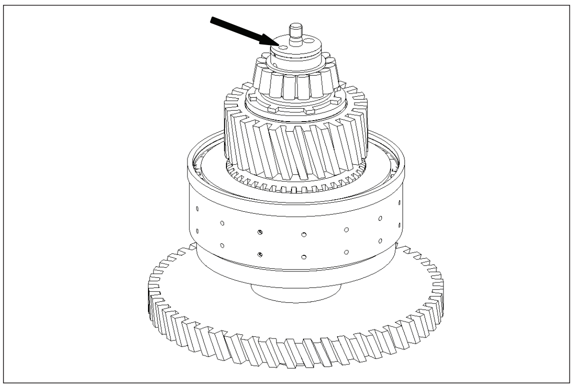
· Tightening torque (M10 /8.8×16) :
1.73 kgf · m (12.6 lbf · ft)

Fit rectangular ring 40×2.5 (2).



HL940TM247

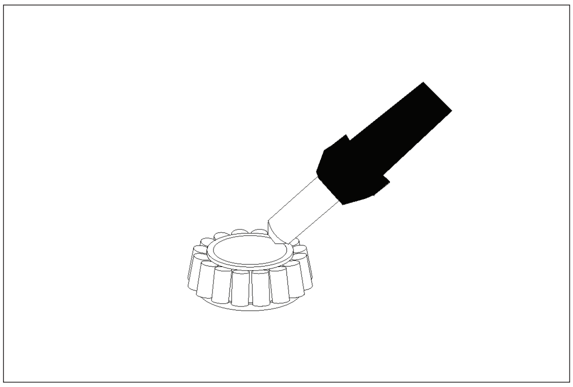
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.



HL940TM248

(4) K2 clutch

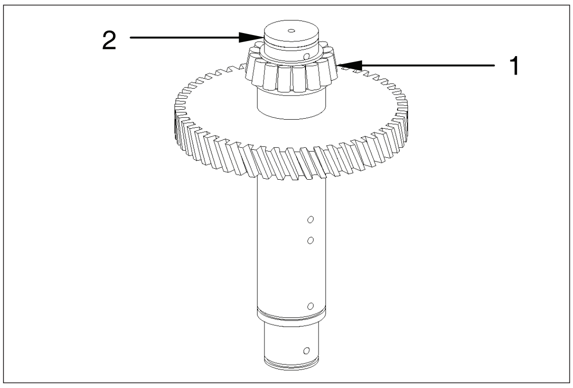
① Heat up bearing inner ring (approx. 120˚C).



HL940TM249

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.

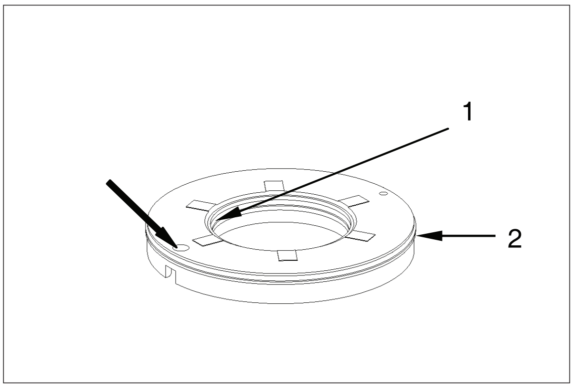


HL940TM250

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

1 = 64×3
2 = 120×3

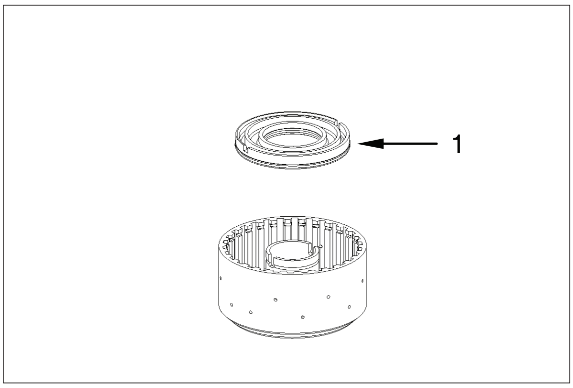
※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



HL940TM251

④ Place piston (1) into the disk carrier.

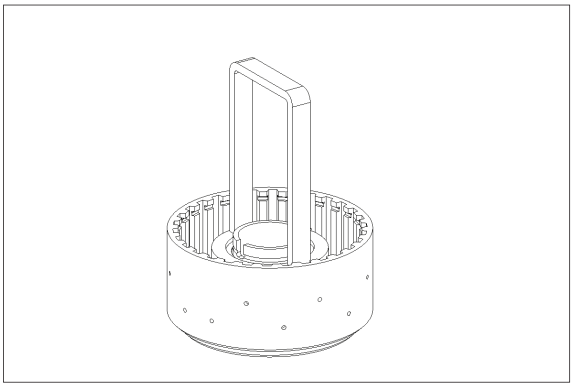
※ Observe installation position, see figure.



HL940TM252

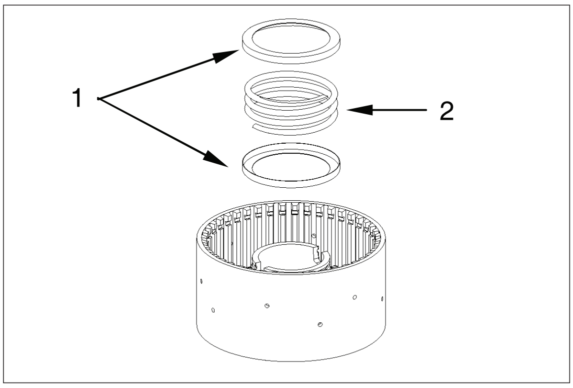
⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid 5870 345 088



HL940TM253

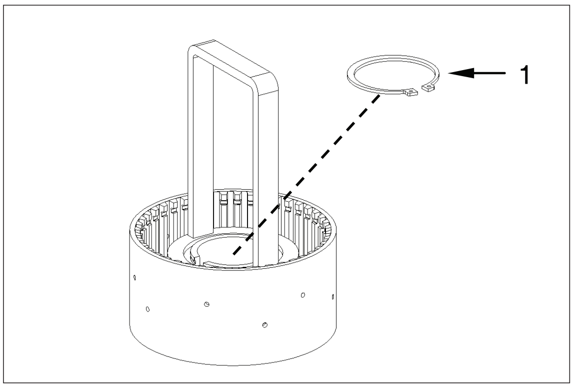
⑥ Mount guide rings (1) and compression spring (2).



HL940TM254

⑦ Preload pressure spring by means of assembly aid and fix with retaining ring 58×2 (1).

※ Assembly aid 5870 345 088

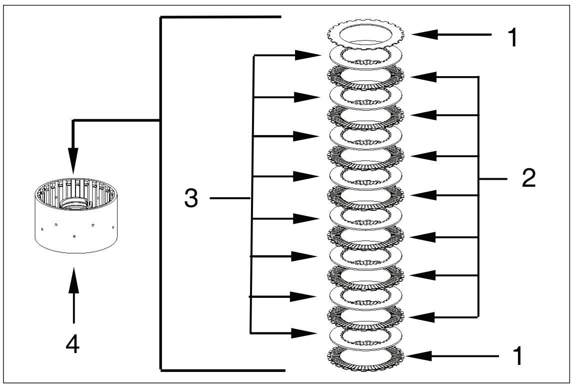


HL940TM255

⑧ Install outer and inner disks alternately into the disk carrier (4) as personated in TM256.

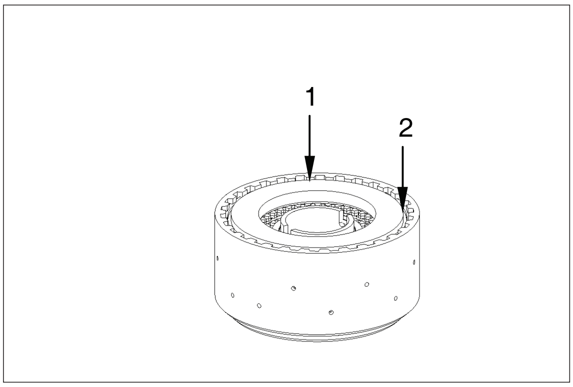
1 Friction disk -coated on one side- (2 pcs)
2 Outer disks (7 pcs)
3 Inner disks (8 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plate.
Number of friction surfaces : 16



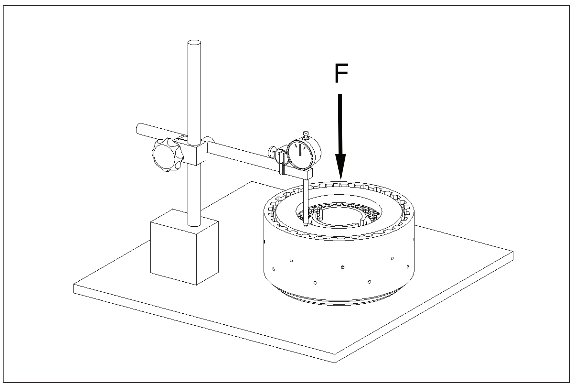
HL940TM256

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



HL940TM257

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

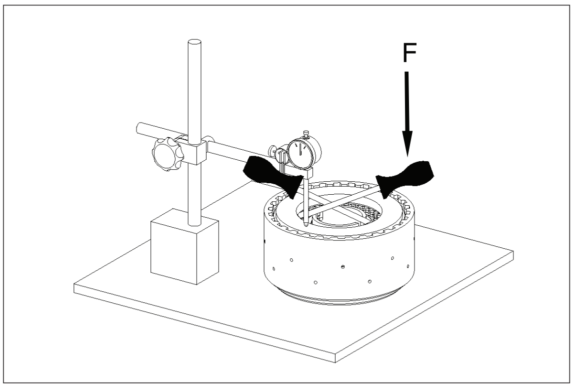


HL940TM258

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

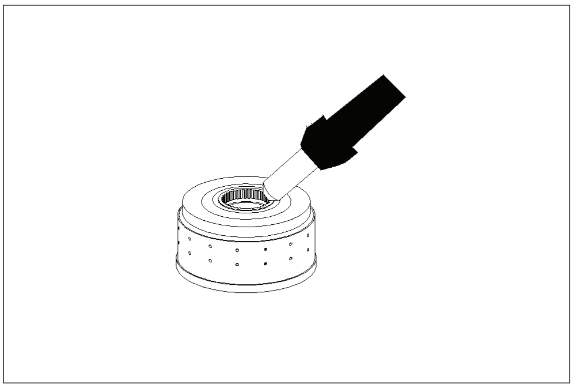
※ Disk clearance : 2.00 to 2.30 mm

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



HL940TM259

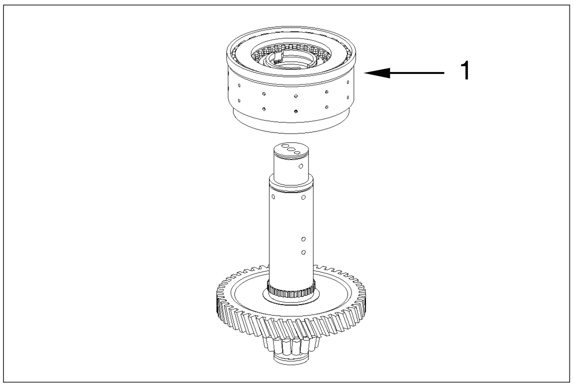
⑫ Heat up clutch inner diameter (approx. 120˚C).



HL940TM260

⑬ Mount clutch (1) until contact is obtained.

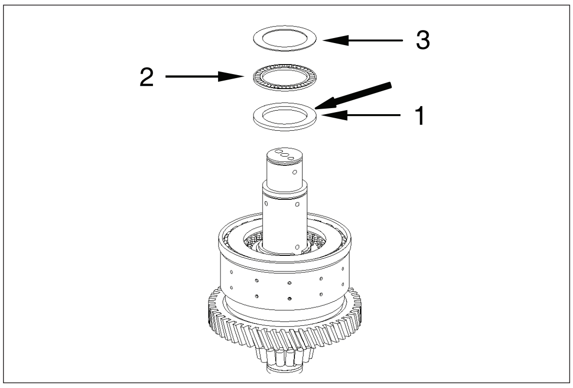
※ Wear protective gloves.



HL940TM261

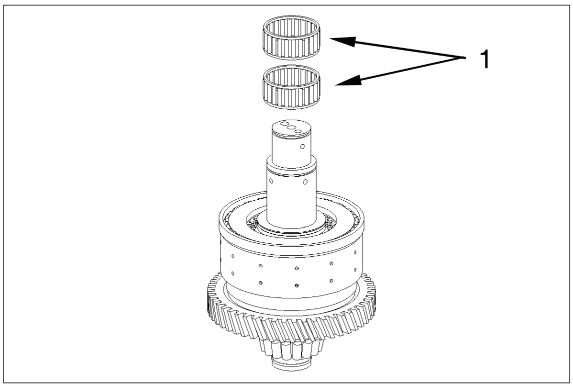
⑭ Mount running disk 50×70×4 (1), axial cage 50×70×3 (2) and axial washer 50×70×1 (3) and oil it.

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



HL940TM262

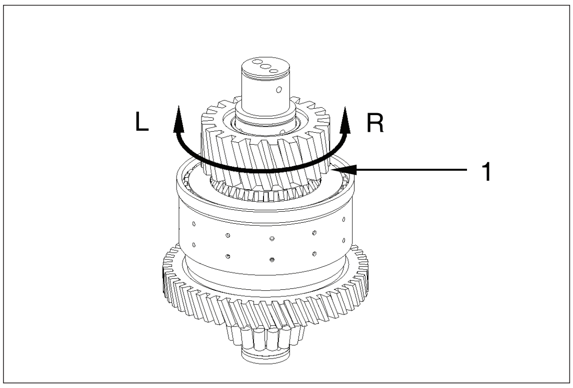
⑮ Mount needle cage 50×58×50 (1) and oil it.



HL940TM263

⑯ Install (1) idler

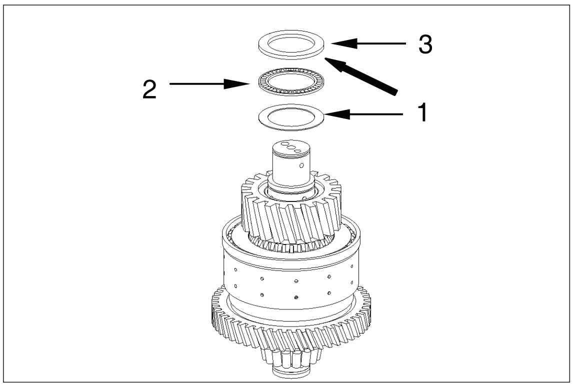
Mount inner disks onto the inner disk carrier (idler) by means of short left/right rotations.



HL940TM264

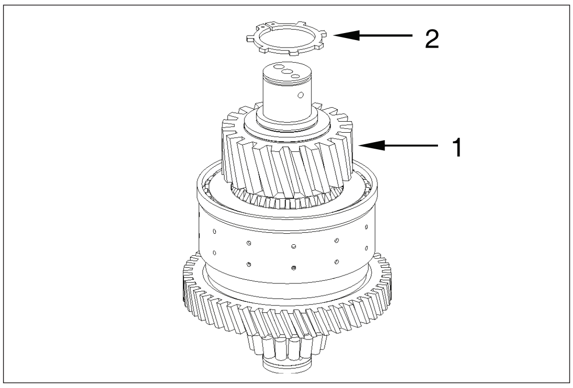
⑰ Mount axial washer 50×70×1 (1), axial cage 50×70×3 (2) and running disk 50×70×4 (3) and oil it.

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



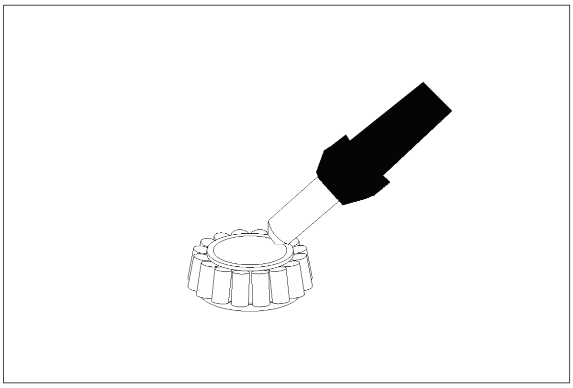
HL940TM265

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



HL940TM266

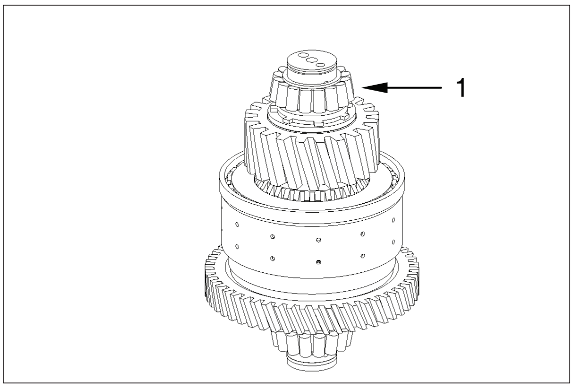
⑲ Heat up bearing inner ring (approx. 120˚C)



HL940TM267

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

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

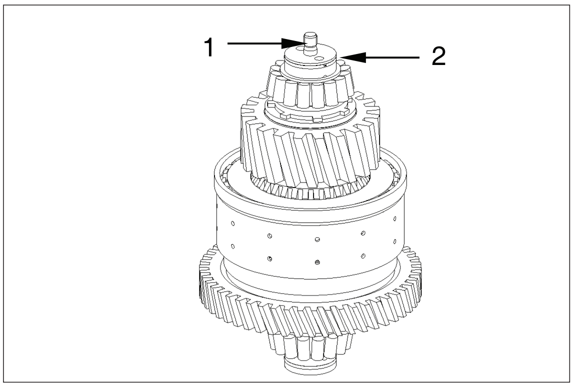


HL940TM268

㉑ Mount stud bolt (1).

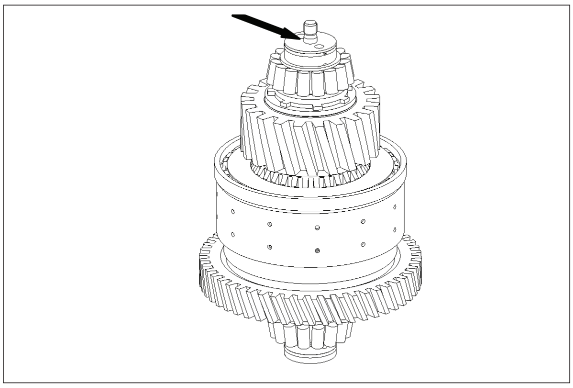
· Tightening torque (M10 /8.8×16) :
1.73 kgf · m (12.6 lbf · ft)

Fit rectangular ring 40×2.5 (2).



HL940TM269

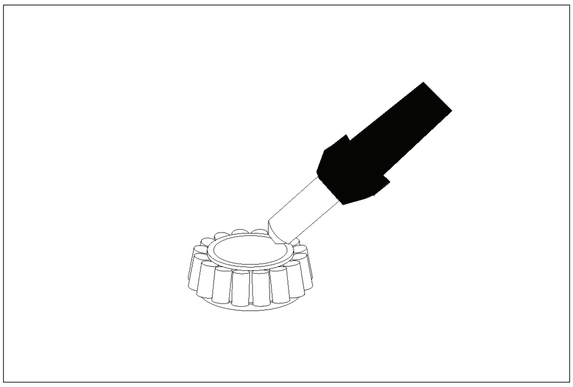
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.



HL940TM270

(5) K3 clutch

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

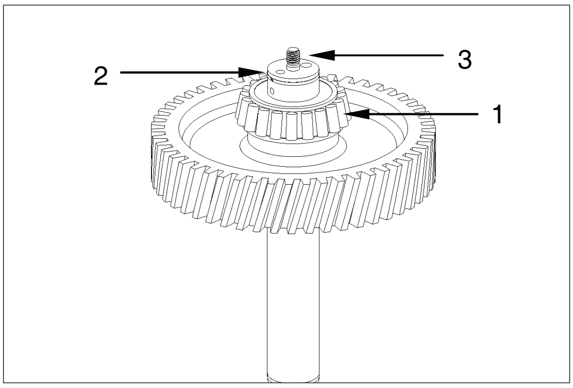


HL940TM271

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 (12.6 lbf · ft)

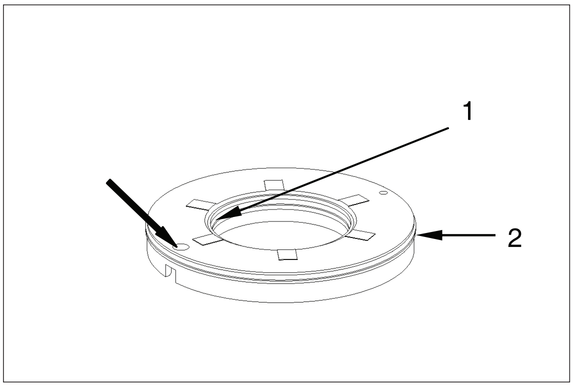


HL940TM272

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

1 = 64×3
2 = 120×3

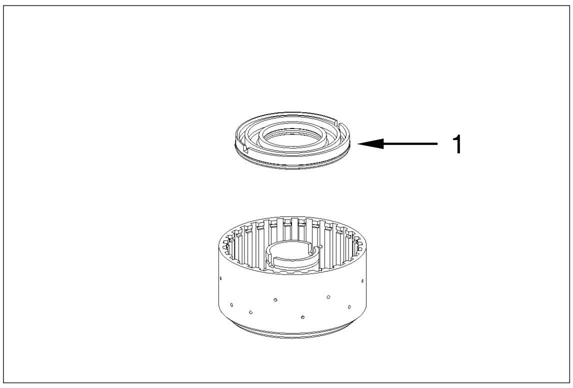
※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



HL940TM273

④ Place piston (1) into the disk carrier.

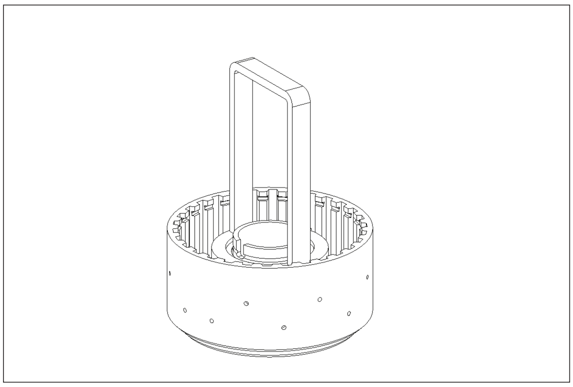
※ Observe installation position, see figure.



HL940TM274

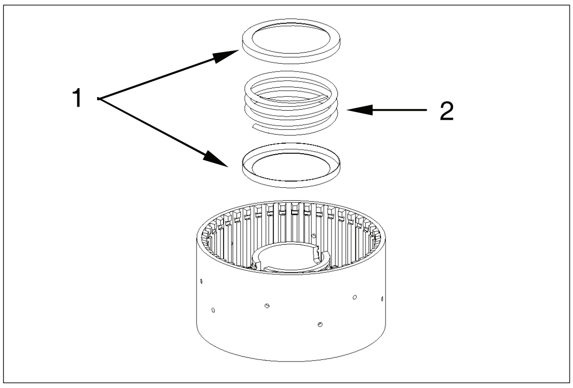
⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid 5870 345 088



HL940TM275

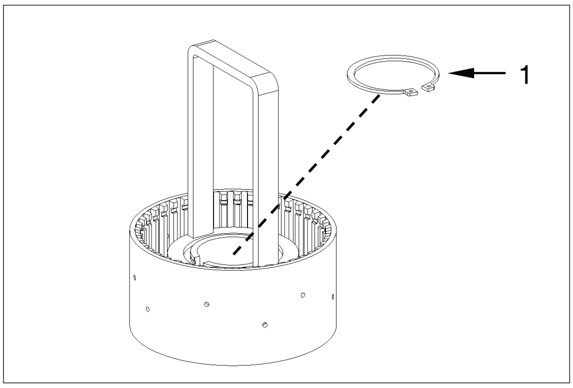
⑥ Mount guide rings (1) and compression spring (2).



HL940TM276

⑦ Preload pressure spring by means of assembly aid and fix with retaining ring 58×2 (1).

※ Assembly aid 5870 345 088

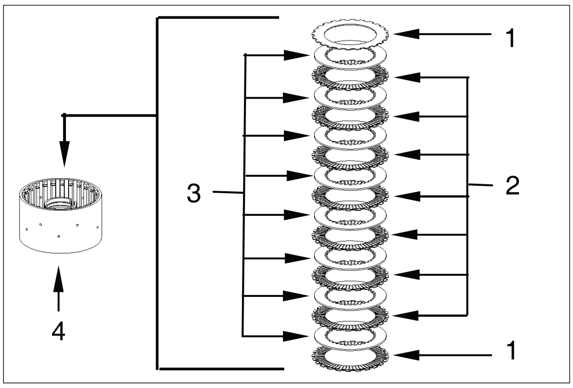


HL940TM277

⑧ Install outer and inner disks alternately into the disk carrier (4) as personated in TM278.

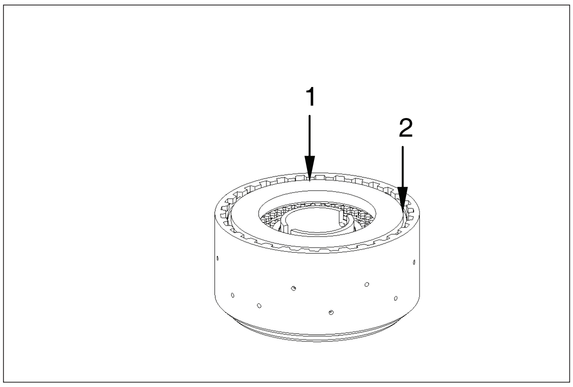
1 Friction disk -coated on one side- (2 pcs)
2 Outer disks (7 pcs)
3 Inner disks (8 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plate.
Number of friction surfaces : 16



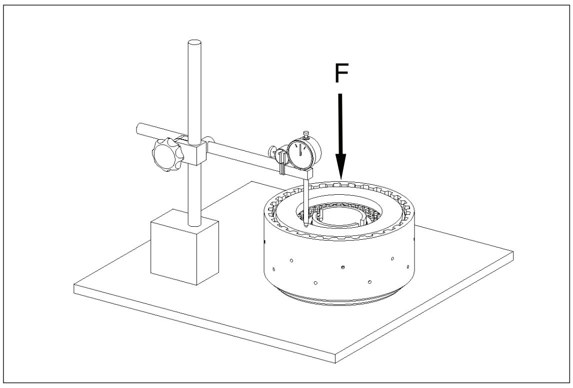
HL940TM278

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



HL940TM279

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

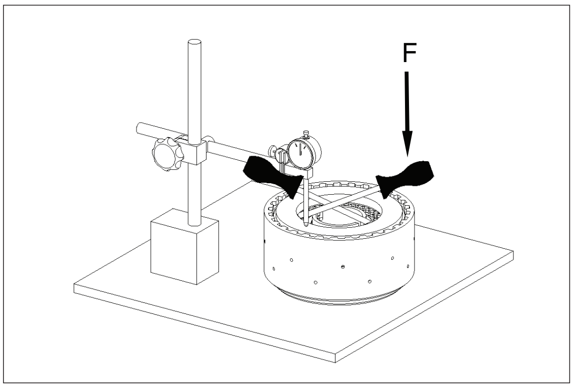


HL940TM280

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

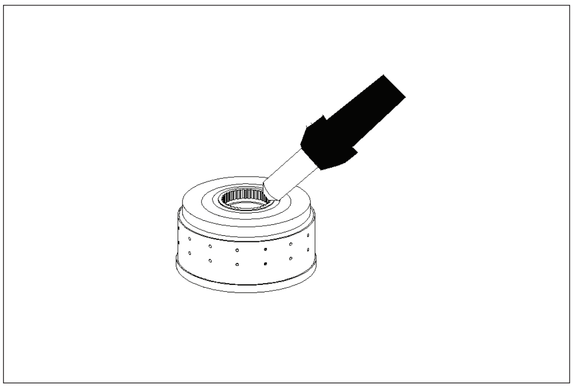
※ Disk clearance : 2.00 to 2.30 mm

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



HL940TM281

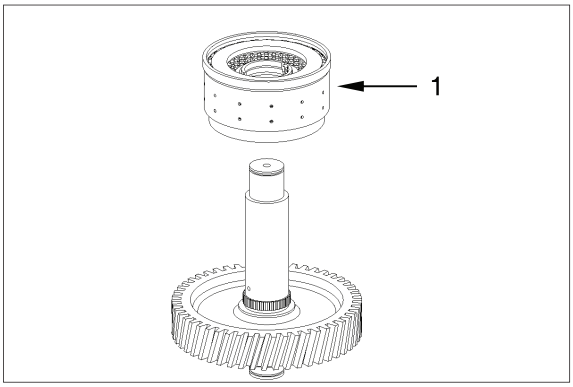
⑫ Heat up clutch inner diameter (approx. 120˚C).



HL940TM282

⑬ Mount clutch (1) until contact is obtained.

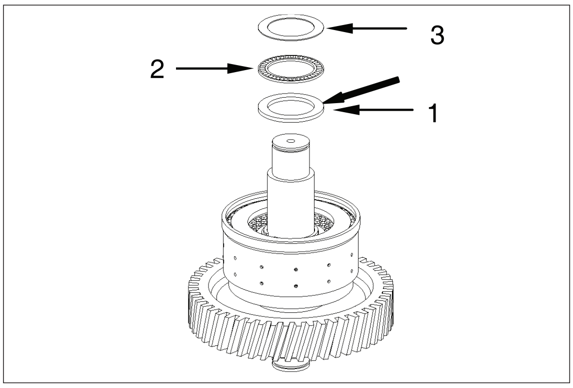
※ Wear protective gloves.



HL940TM283

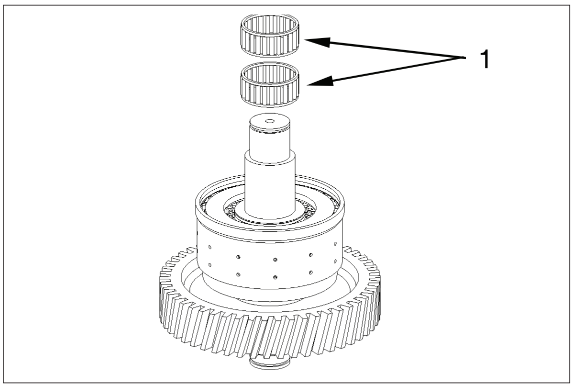
⑭ Mount running disk 50×70×4 (1), axial cage 50×70×3 (2) and axial washer 50×70×1 (3) and oil it.

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



HL940TM284

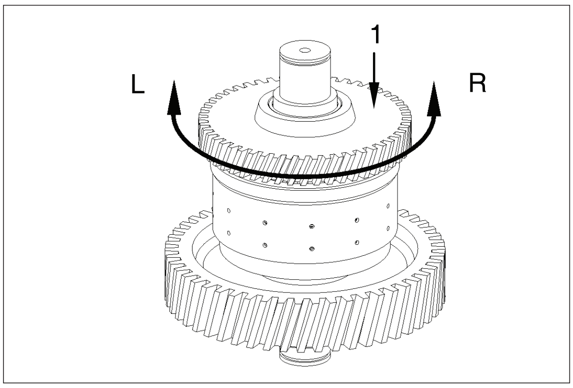
⑮ Mount needle cage 50×58×50 (1) and oil it.



HL940TM285

⑯ Install (1) idler

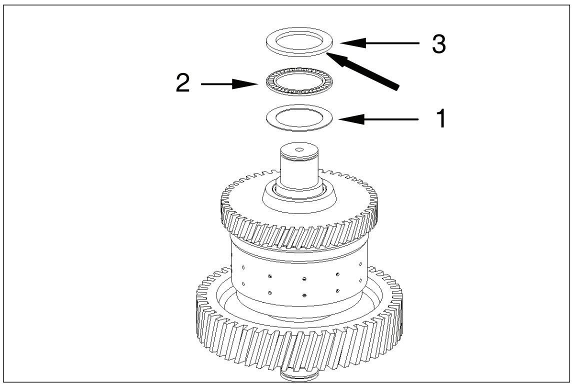
Mount inner disks onto the inner disk carrier (idler) by means of short left/right rotations.



HL940TM286

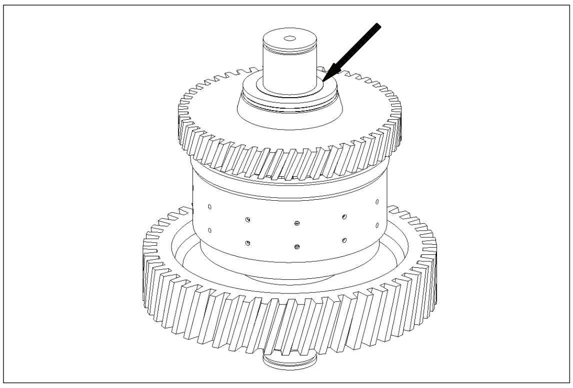
⑰ Mount axial washer 50×70×1 (1), axial cage 50×70×3 (2) and running disk 50×70×4 (3) and oil it.

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



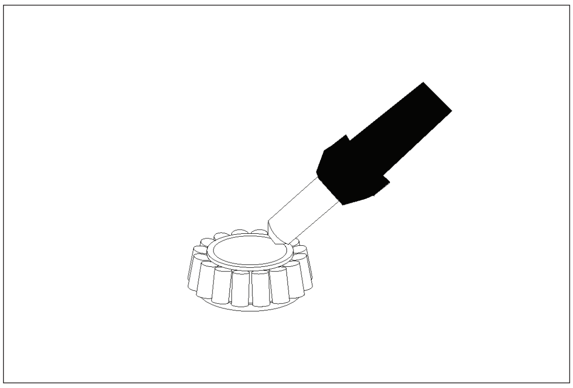
HL940TM287

※ 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.



HL940TM288

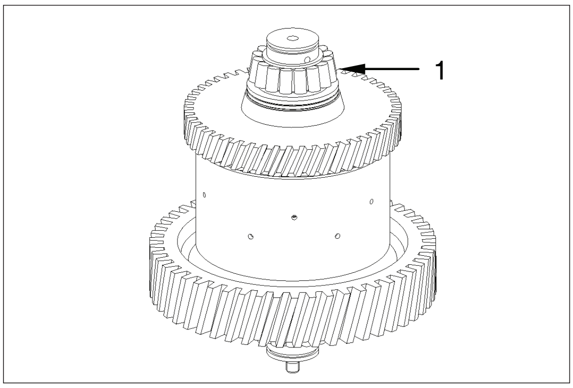
⑱ Heat up bearing inner ring (approx. 120˚C)



HL940TM289

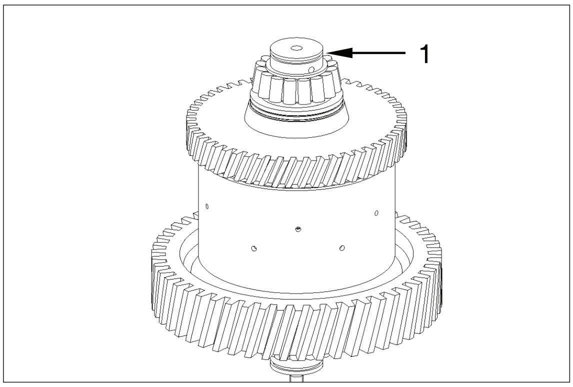
⑲ Mount bearing inner ring (1) until contact is obtained.

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



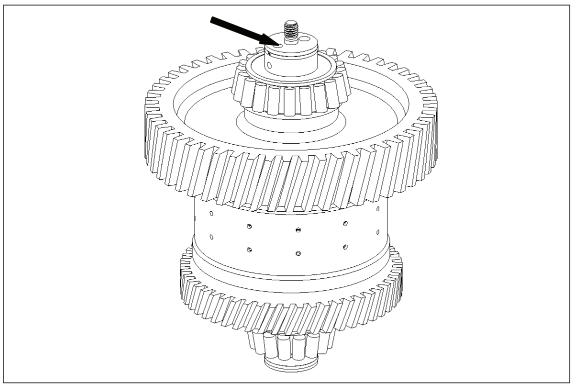
HL940TM290

⑳ Fit rectangular ring 40×2.5 (1).



HL940TM291

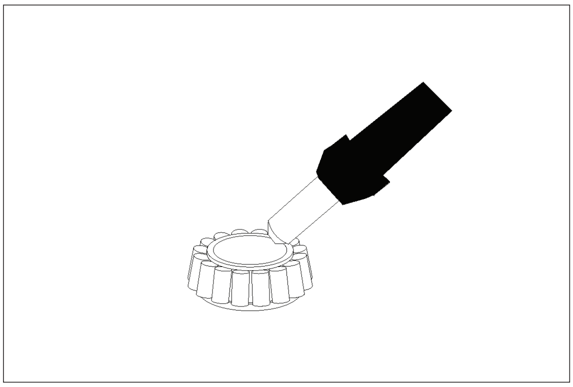
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.



HL940TM292

(6) K4 clutch

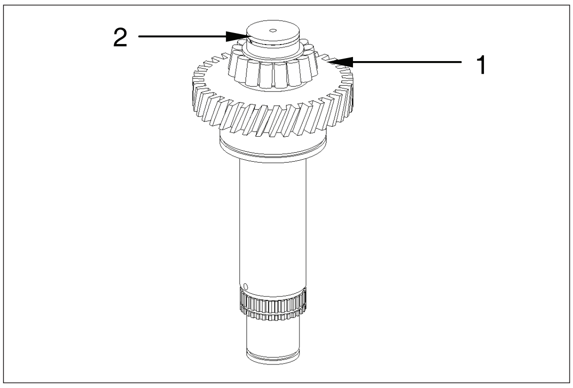
① Heat up bearing inner ring (approx. 120˚C).



HL940TM293

② Mount bearing inner ring (1) until contact is obtained.
Fit rectangular ring 40×2.5 (2).

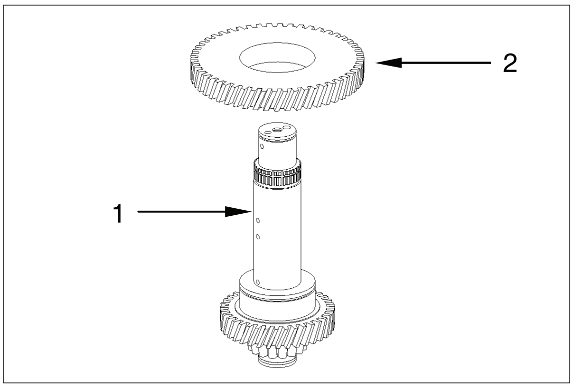
※ Wear protective gloves.
※ Adjust bearing inner ring after cooling-down.



HL940TM294

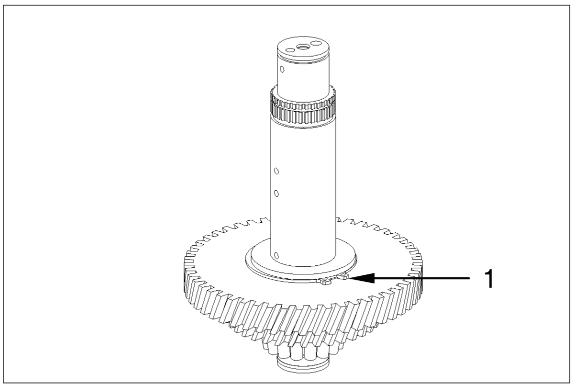
③ Undercool shaft (1) (approx. -80˚C), heat up gear (2) (approx. +120˚C) and mount until contact is obtained.

※ Wear protective gloves.



HL940TM295

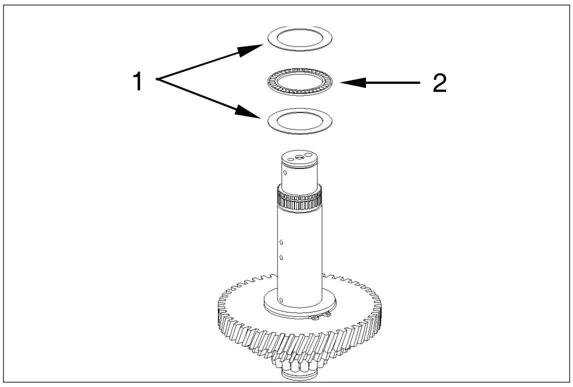
④ Secure gear by means of retaining ring 80×2.5 - (1).



HL940TM296

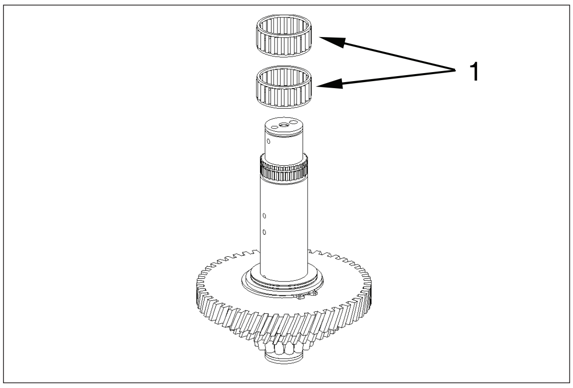
⑤ Mount lower axial washer 50×70×1 (1), axial needle cage 50×70×3 (2) and upper axial washer 50×70×1 (1) and oil it.

※ Upper and lower axial washer are identical.



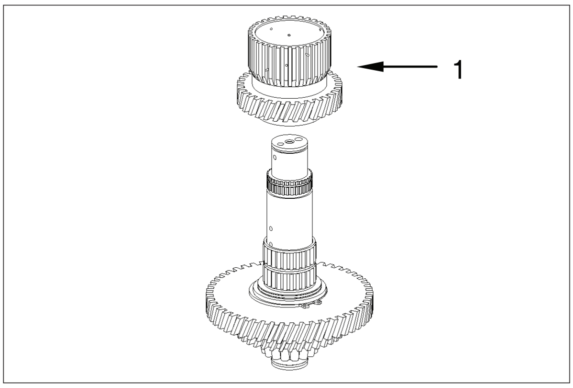
HL940TM297

⑥ Mount needle cage 50×58×50 (1) and oil it..



HL940TM298

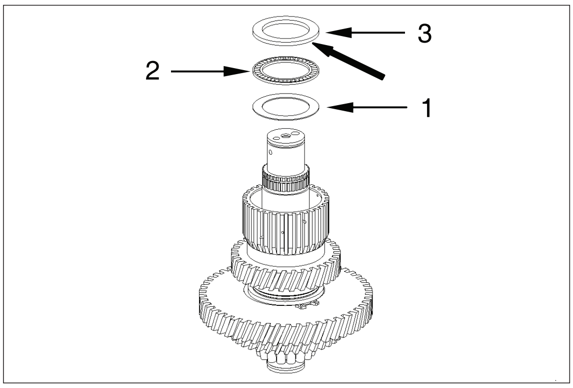
⑦ Mount idler gear (1).



HL940TM299

⑧ Mount axial washer 50×70×1 (1), axial needle 50×70×3 cage (2) and running disk 50×70×4(3) and oil it.

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

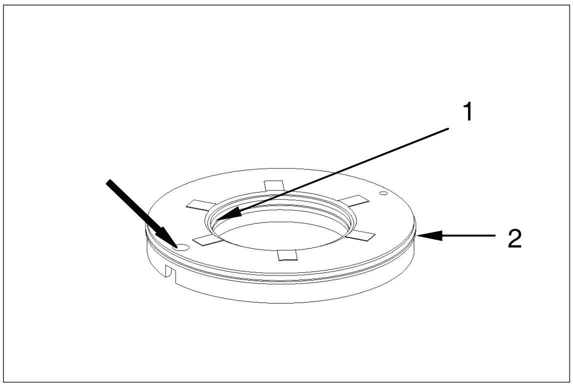


HL940TM300

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

1 = 64×3
2 = 120×3

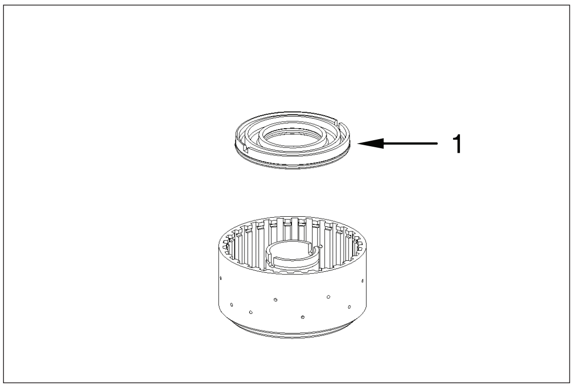
※ Check function of the drain valve (see arrow) - There must
be no jamming of the ball.



HL940TM301

⑩ Place piston (1) into the disk carrier.

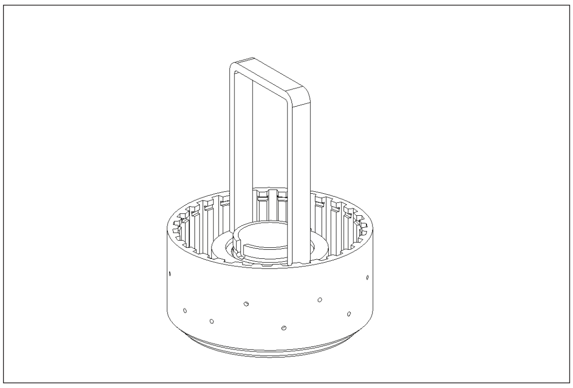
※ Observe installation position, see figure.



HL940TM302

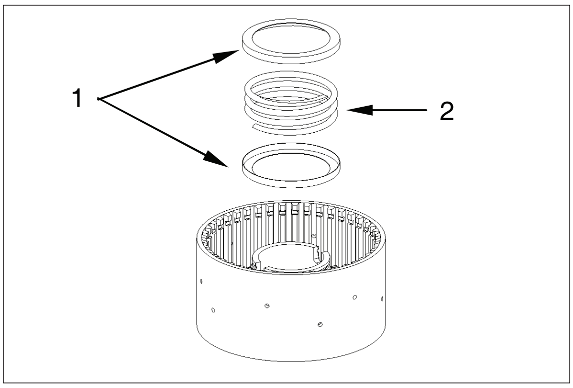
⑪ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid 5870 345 088



HL940TM303

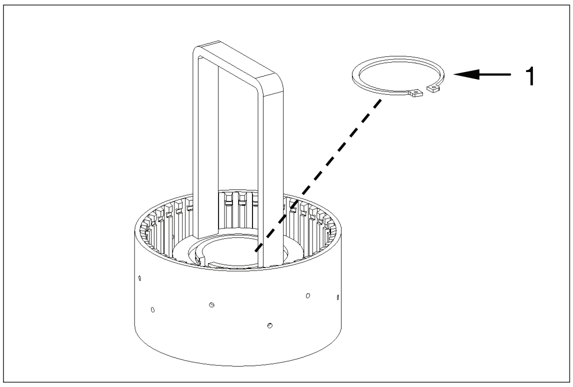
⑫ Mount guide rings (1) and compression spring (2).



HL940TM304

⑬ Preload pressure spring by means of assembly aid and fix with retaining ring 58×2 (1).

Assembly aid 5870 345 088



HL940TM305

※ Different clutches (disc arrangements with relevant disc clearance) can be installed, depending on the parts list version.

※ The actually installed clutch and disc arrangement must be taken from the corresponding spare parts list.

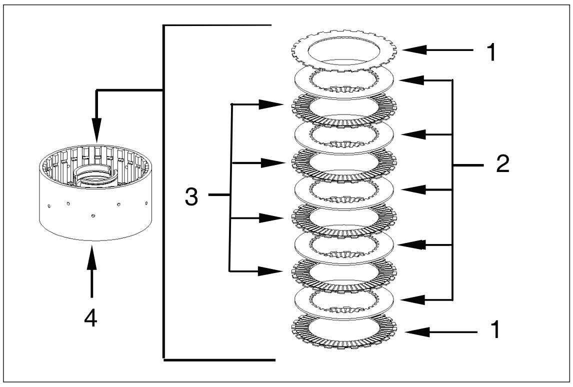
※ Figure no.: TM306 and TM307 illustrates the different disc arrangements.

※ The spare parts list shall be binding.

⑭ Install outer and inner disks alternately into the disk carrier (4) as personated in TM306.

1 Friction disk -coated on one side- (2 pcs)
2 Inner disks (5 pcs)
3 Outer disks (4 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plate.
Number of friction surfaces : 10

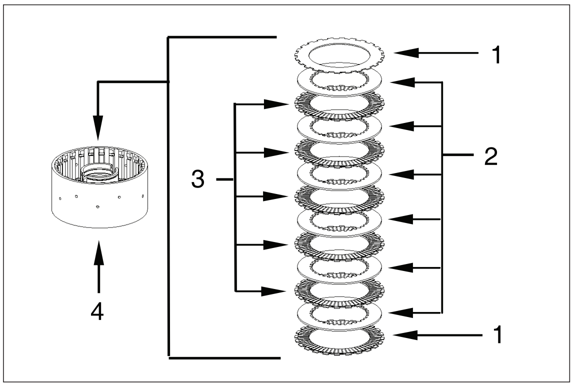


HL940TM306

⑮ Install outer and inner disks alternately into the disk carrier (4) as personated in TM307.

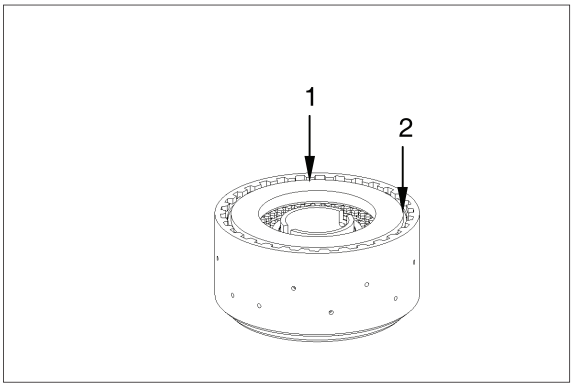
1 Friction disk -coated on one side- (2 pcs)
2 Inner disks (6 pcs)
3 Outer disks (7 pcs)

※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston or end plate.
Number of friction surfaces : 12



HL940TM307

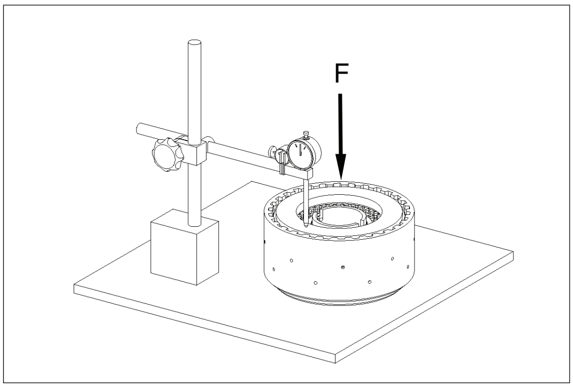
⑯ Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



HL940TM308

⑰ 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



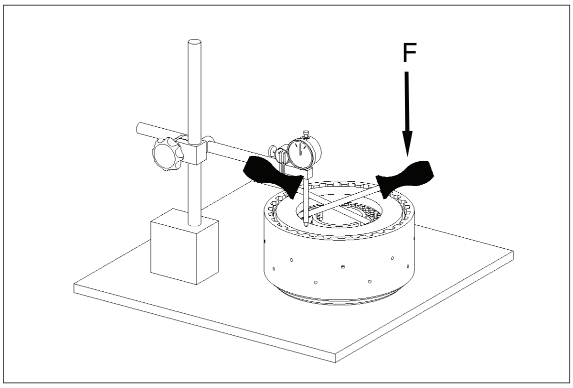
HL940TM309

⑱ Then press end plate against the snap ring (upwards) and read disk clearance.

※ Disk clearance : 1.15 to 1.45 mm
(see TM306)

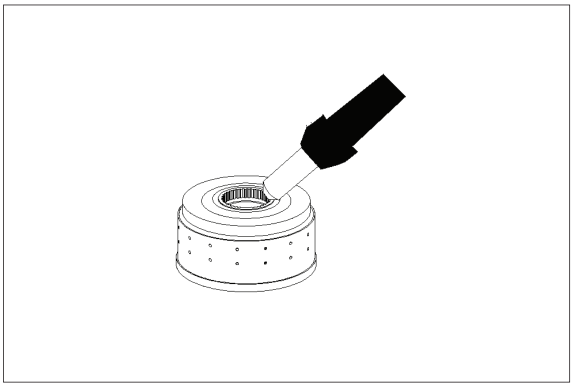
※ Disk clearance : 1.35 to 1.65 mm
(see TM307)

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



HL940TM310

⑲ Heat up clutch inner diameter (approx. 120˚C).

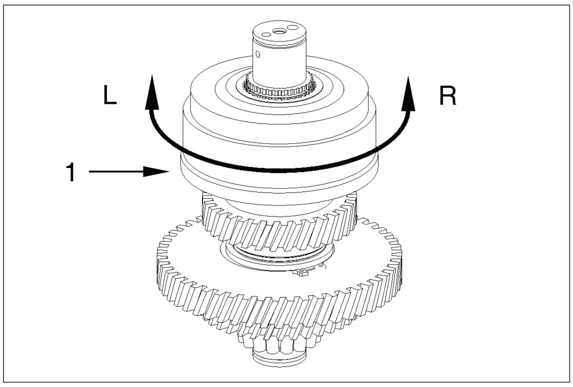


HL940TM311

⑳ Mount clutch (1) until contact is obtained .

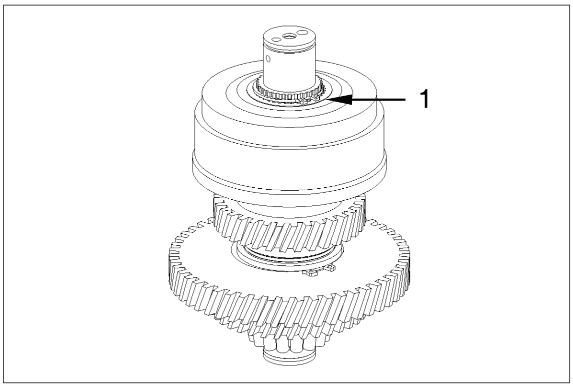
Mount inner disks onto the inner disk carrier by means of short left/right rotations.

※ Wear protective gloves.



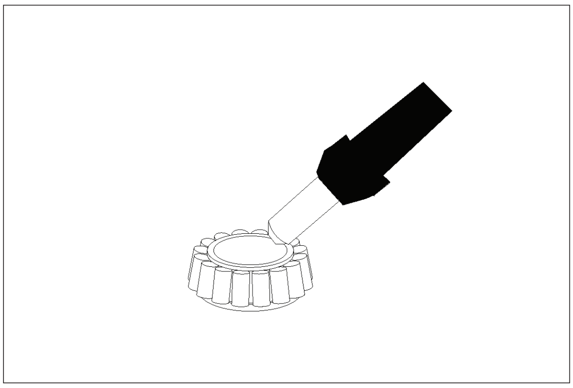
HL940TM312

㉑ Secure clutch by means of retaining ring 50×2 (1).



HL940TM313

㉒ Heat up bearing inner ring (approx. 120˚C)



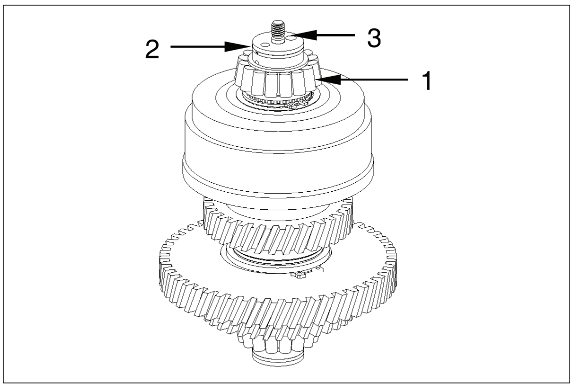
HL940TM314

㉓ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 40×2.5 (2).

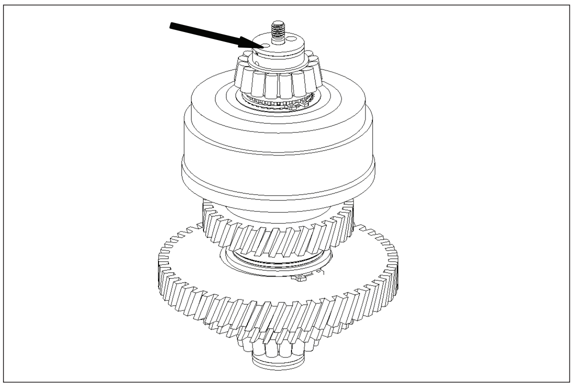
Wear protective gloves.
Adjust bearing inner ring after cooling-down.

Mount stud bolt (3).
· Tightening torque (M10 /8.8×16) :
1.73 kgf·m (12.6 lbf·ft)



HL940TM315

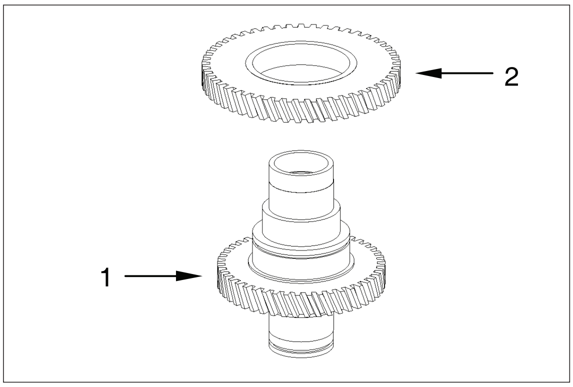
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.


HL940TM316

(7) Input shaft

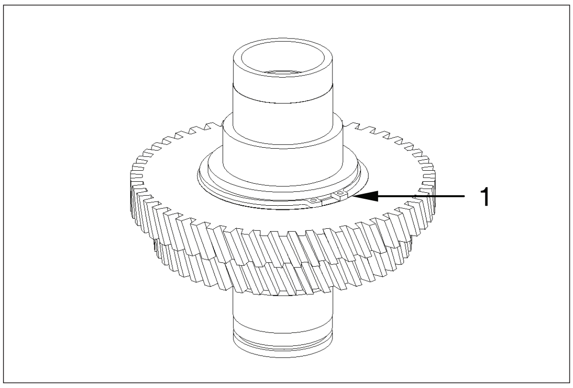
① Undercool input shaft (1) (approx. -80˚C), heat up drive gear (2) (approx. +120˚C) and mount until contact is obtained.

※ Wear protective gloves.



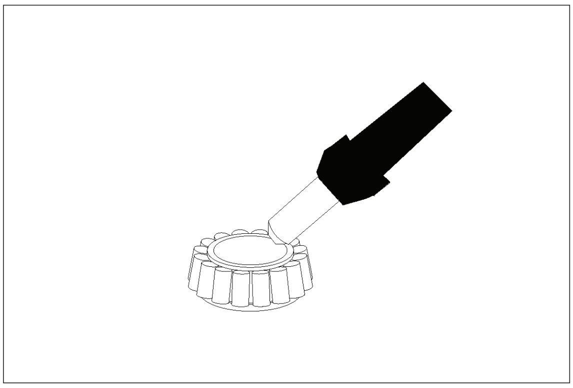
HL940TM317

② Secure drive gear by means of retaining ring 90×3 (1).



HL940TM318

③ Heat up bearing inner ring (approx. 120˚C)

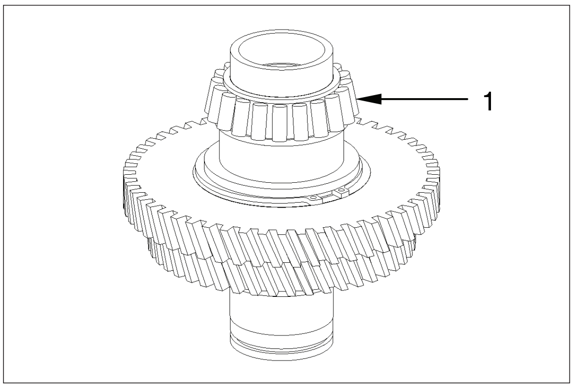


HL940TM319

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

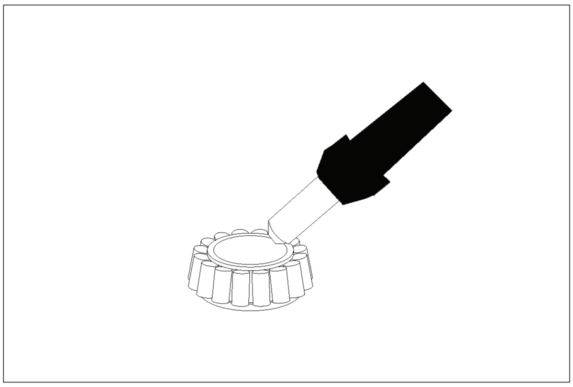
※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



HL940TM320

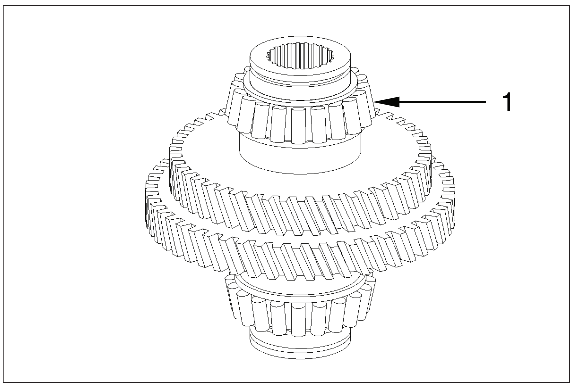
⑤ Heat up bearing inner ring (approx. 120˚C)



HL940TM321

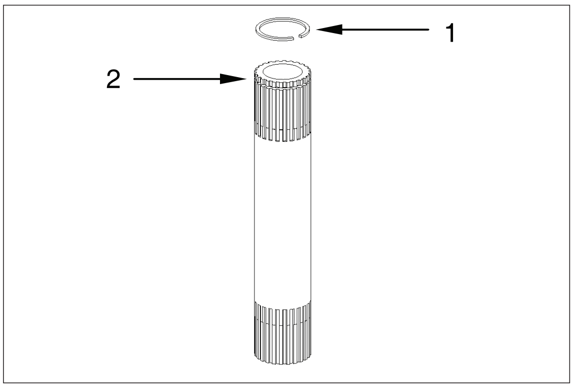
⑥ Mount bearing inner ring (1) until contact is obtained.

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



HL940TM322

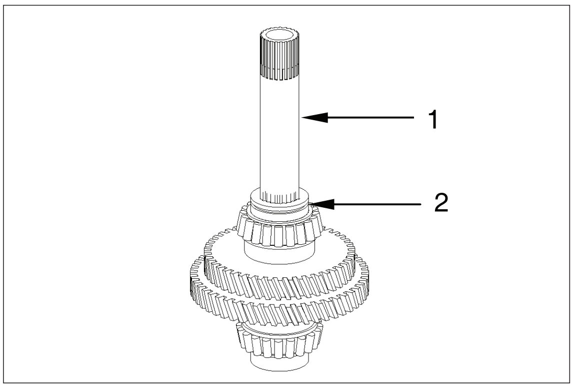
⑦ Install snap ring (1) into the annular groove (2) of the turbine shaft.



HL940TM323

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

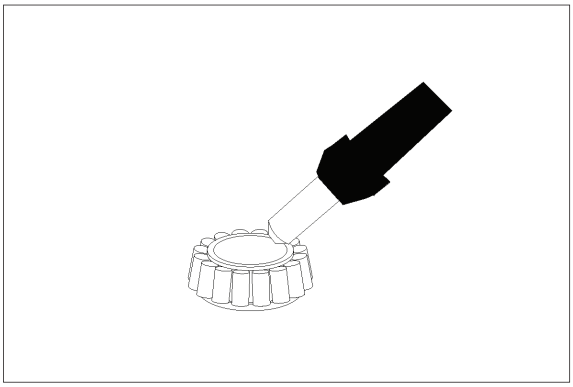
※ Turbine shaft is axially fixed.
※ Snap in and interlock rectangular ring 60×3 (2).



HL940TM324

(8) Output shaft

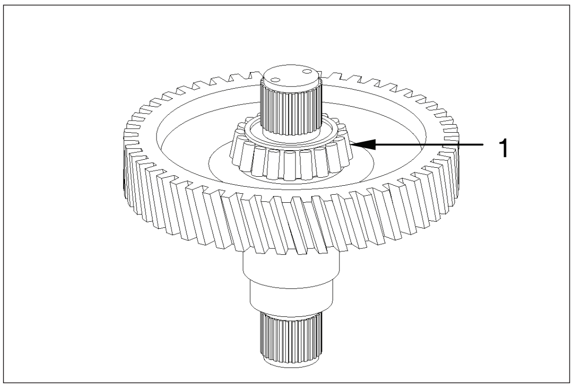
① Heat up bearing inner ring (approx. 120˚C).



HL940TM325

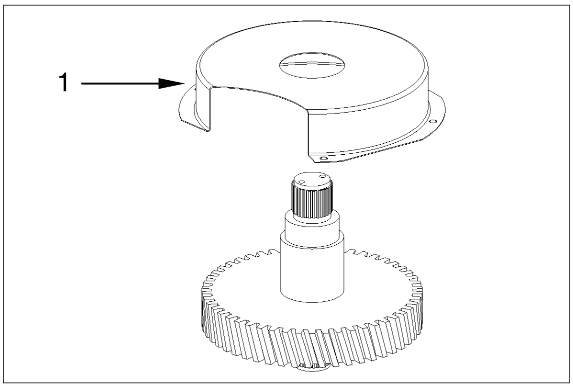
② Mount bearing inner ring (1) until contact is obtained.

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



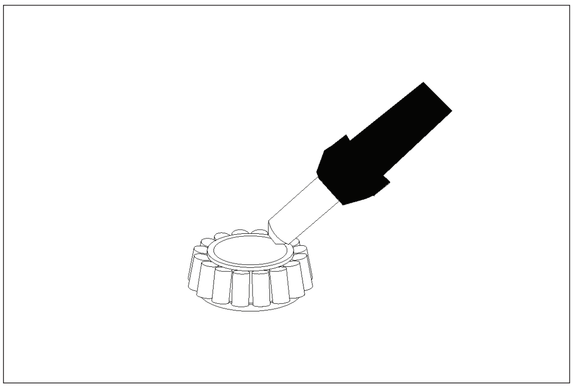
HL940TM326

③ Mount screen sheet (1).



HL940TM327

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

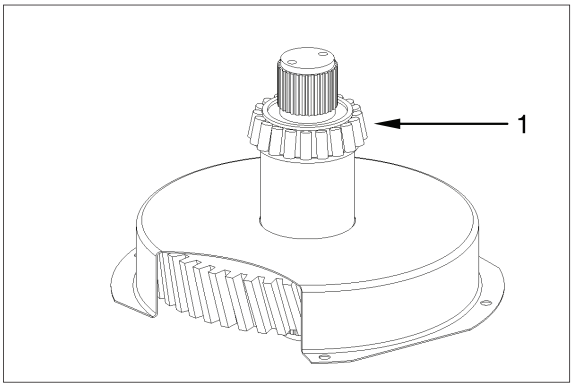


HL940TM328

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

※ Wear protective gloves.

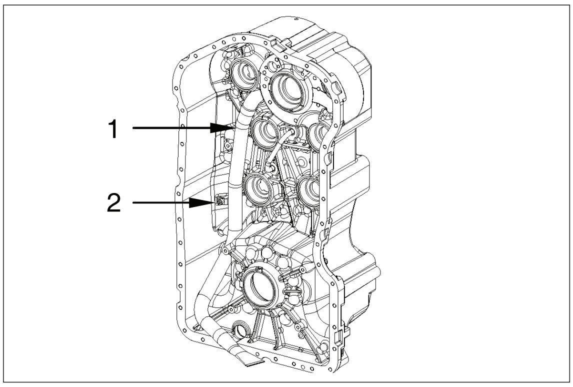
※ Adjust bearing inner ring after cooling-down.



HL940TM329

9) INSTALLATION OF INPUT SHAFT, OUTPUT SHAFT, PUMP SHAFT (POWER-TAKEOFF 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).



HL940TM330

※ It is always necessary to use new cylindrical screws.

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

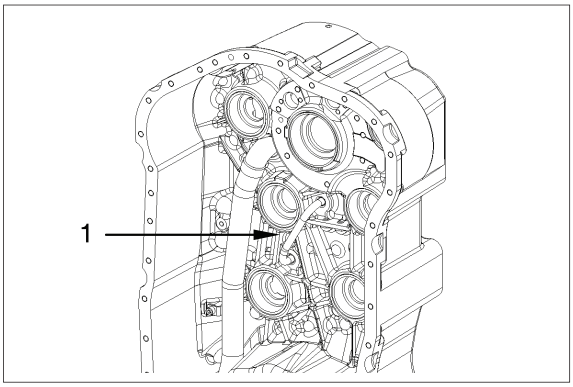
Rolling tool	5870 600 003
Lubricant	5870 451 006

※ 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

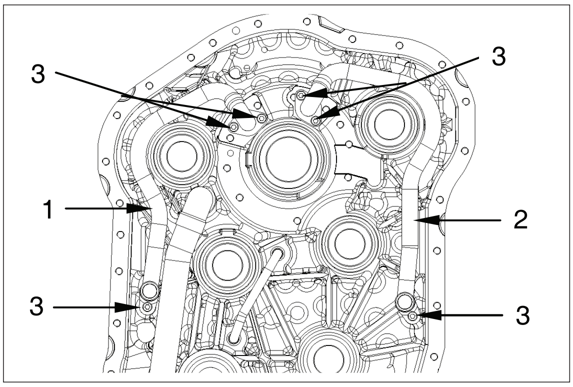


HL940TM331

(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 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)



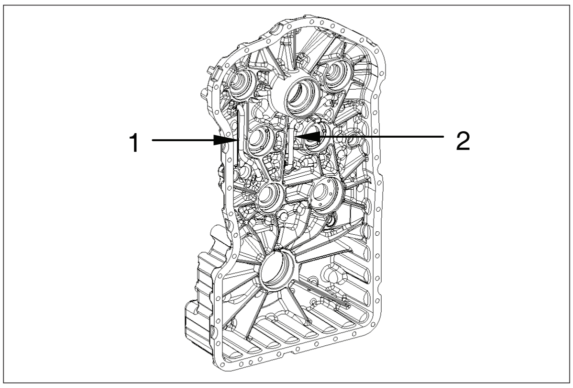
HL940TM332

※ 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

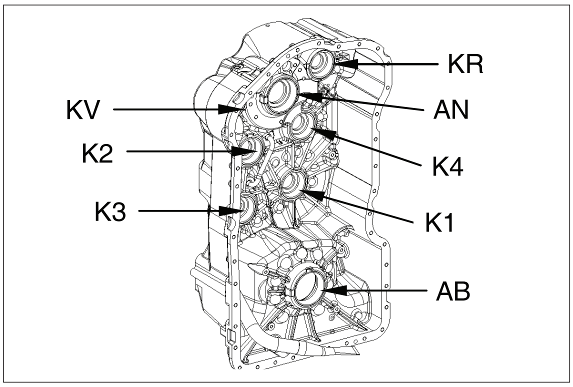


HL940TM333

(2) 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

※ Installation position see TM334 and TM335.

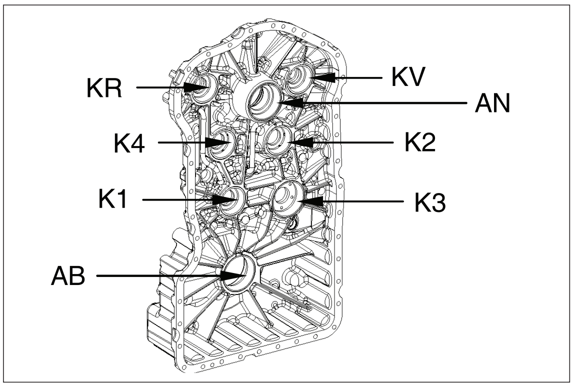


HL940TM334

(3) Housing rear part

See TM333.

※ Place bearing outer rings into the bearing holes using assembly grease.
※ If 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).



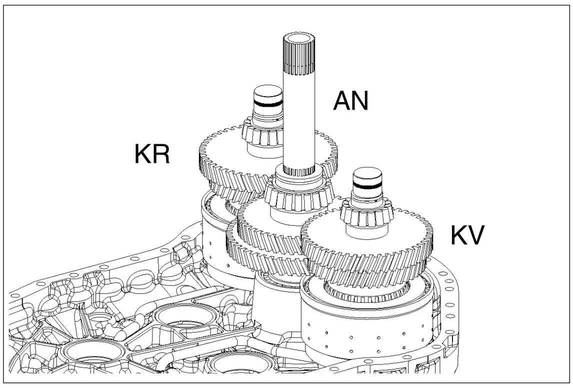
HL940TM335

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

Install clutches by means of housing rear part (TM343 to TM342).

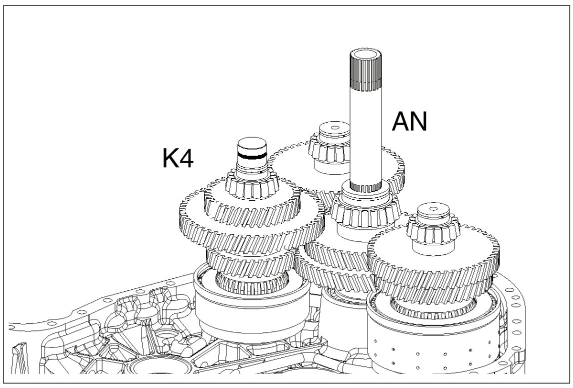
※ Housing rear part will be removed again later.

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



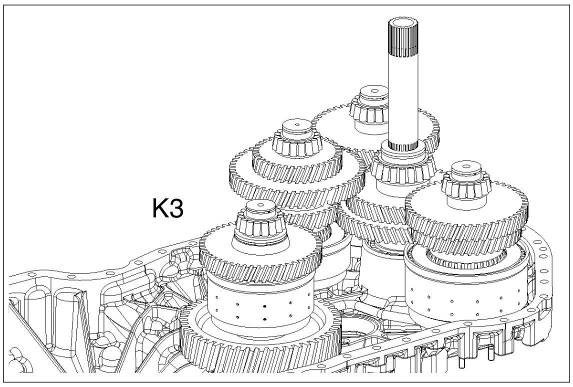
HL940TM336

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



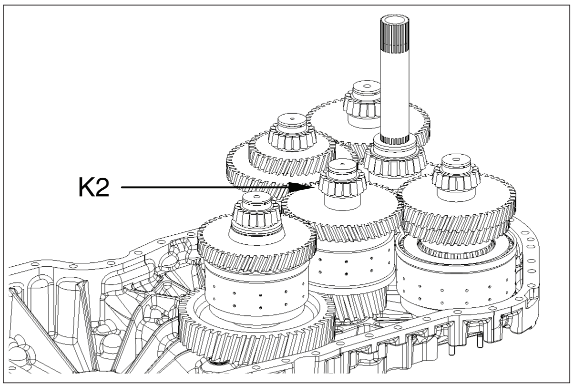
HL940TM337

(5) Mount K3 clutch.



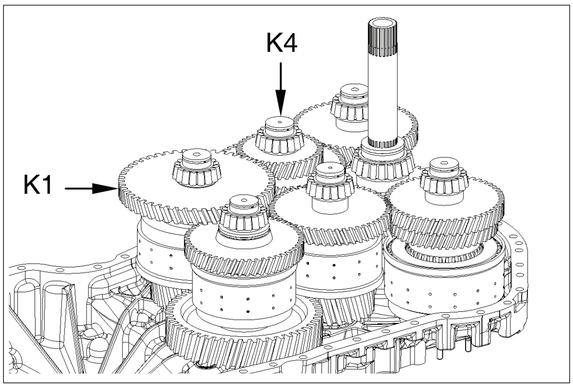
HL940TM338

(6) Position K2 clutch.



HL940TM339

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

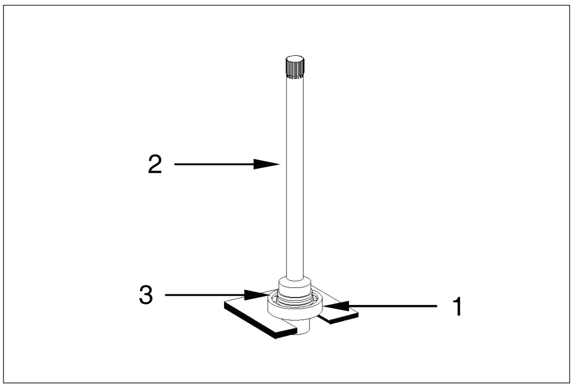


HL940TM340

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

Mount rectangular ring 50×2.5 (3).

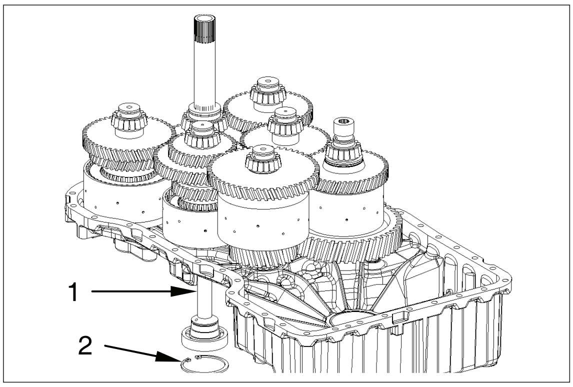
Grease and centrically align rectangular ring.



HL940TM341

(9) Mount pump shaft (2) until contact is obtained.

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



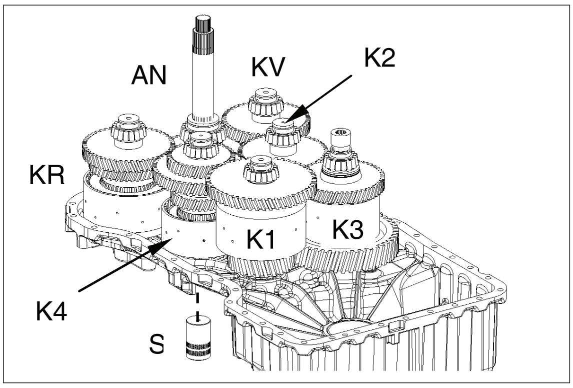
HL940TM342

(10) The figure right shows the installation position of the individual clutches in the housing rear part one more time.
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 centrically.

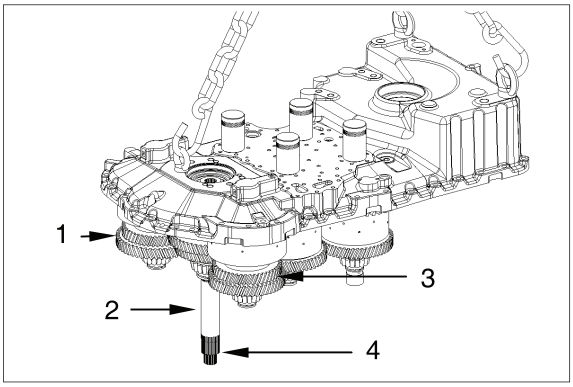


HL940TM343

(11) Pivot housing rear part 180˚ by using a lifting device.

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

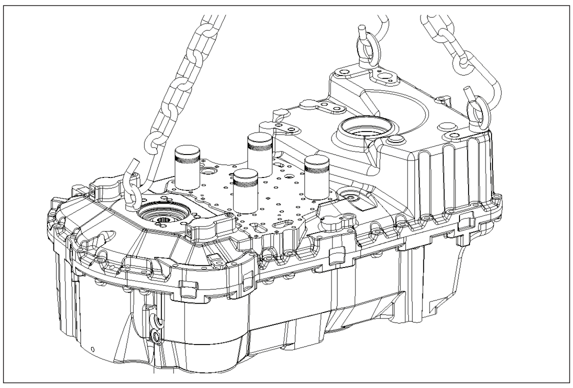
※ Clutch KV, KR and input shaft are only fixed by the gear chain.
※ Attention must be paid that the non-fixed components of the gear chain do not get loose.



HL940TM344

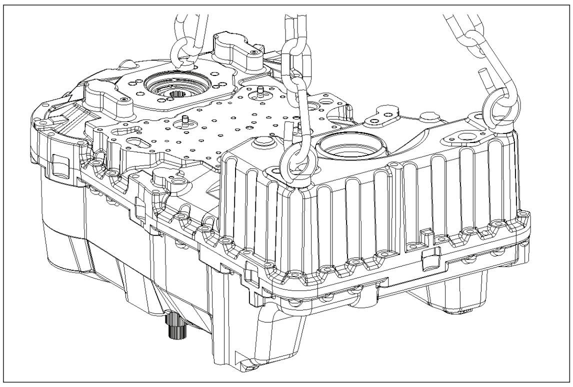
(12) Use the lifting device to bring the housing rear part into contact position with the housing front part, by cautiously assembling the clutches.

Then remove handles.



HL940TM345

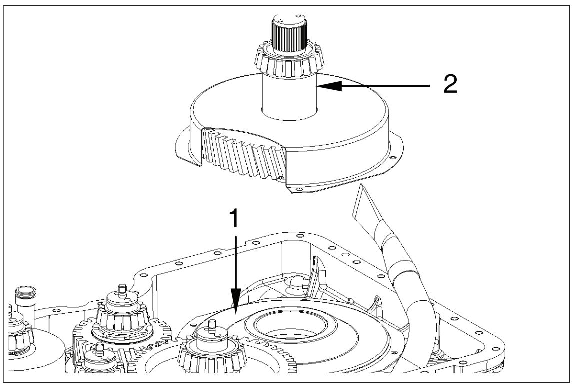
(13) Remove housing rear part again.



HL940TM346

(14) Put on screen sheet (1).

Install preassembled output shaft (2).



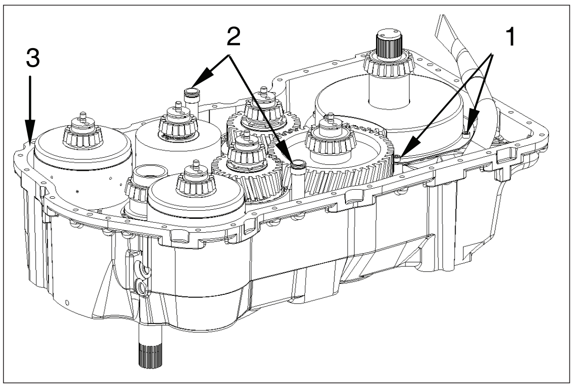
HL940TM347

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

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

※ It is always necessary to use new cylindrical screws.

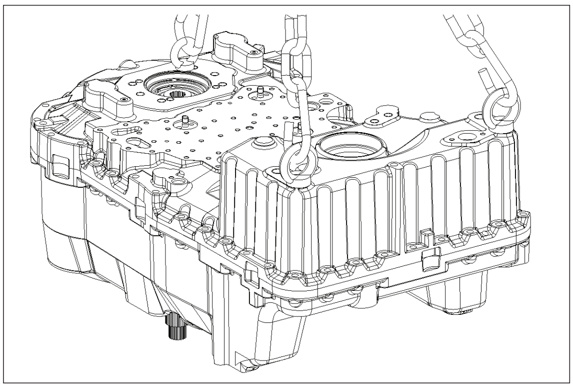
Mount O-rings 22×3 (2) into the annular groove of the oil tubes and oil them.
Mount all rectangular rings, grease and align them centrally.
Wet mounting face (3) with sealing agent loctite (type No. 574).



HL940TM348

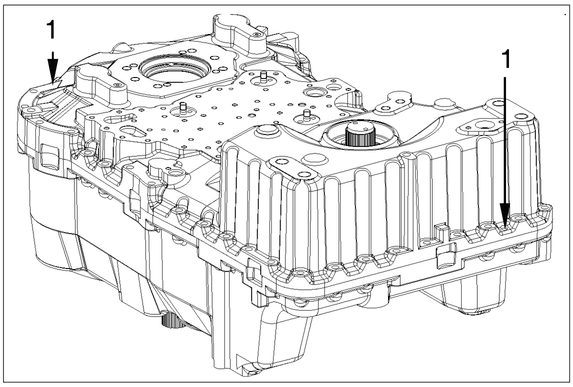
(16) Carefully bring the housing front part into contact position with the housing rear part by using the lifting device.

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



HL940TM349

(17) Fit both cylindrical pins 10×24 (1) centrically to the mounting face.



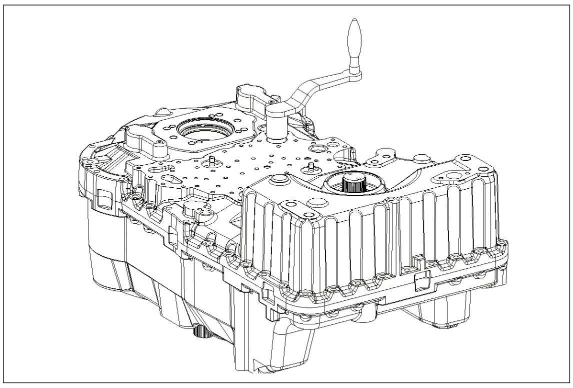
HL940TM350

(18) Checking of clearance of the gear drive train

Position driving element (S) 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



HL940TM351

(19) Fix housing front and rear part by means of cylindrical screws (1 and 2).

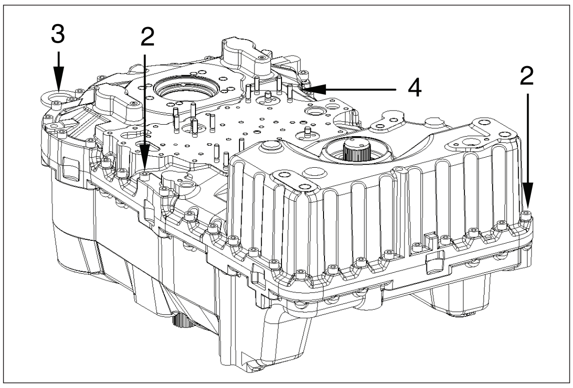
· Tightening torque (M10/8.8×60) :
4.69 kgf · m (34.0 lbf · ft)

· Tightening torque (M10/8.8×40) :
4.69 kgf · m (34.0 lbf · ft)

Mount fixing plate (3)
Mount stud bolts (4).

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

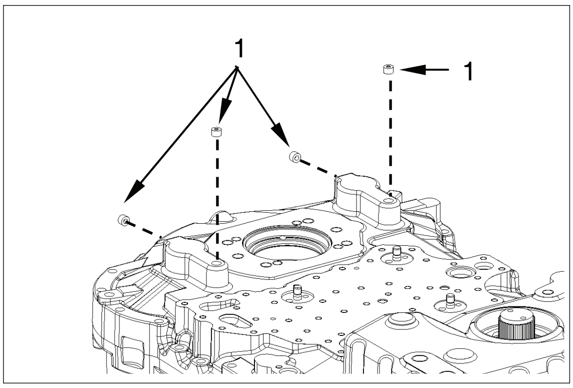
· Tightening torque (M8/10.9×25) :
1.53 kgf · m (11.1 lbf · ft)



HL940TM352

(20) 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.

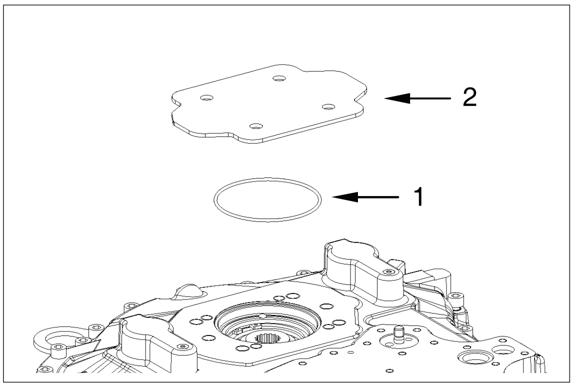


HL940TM353

10) ASSEMBLY – OUTPUTS AND CLOSURE PARTS PUMP SHAFT (PTO-SHAFT)

(1) Closure parts pump shaft (PTO-shaft)

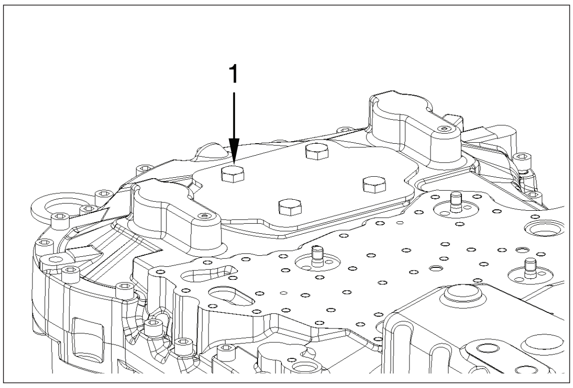
① Insert O-ring 130×3 (1) into the hole of the transmission housing and grease it. Bring cover plate (2) into contact position.



HL940TM354

② Fix cover plate with cylindrical screws (1).

· Tightening torque (M16/8.8×20) :
4.69 kgf · m (34.0 lbf · ft)



HL940TM355

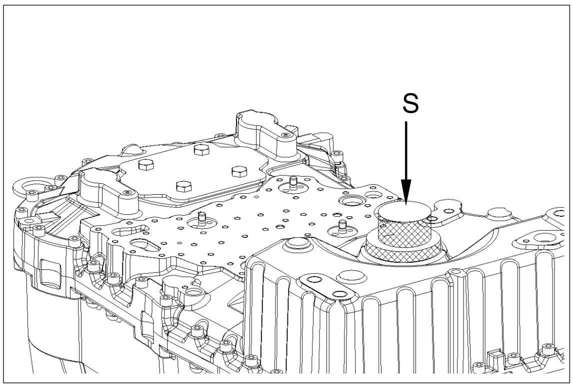
(2) Output flange on output side without parking brake

① Use driver (S) to mount shaft seal 70×100×10, with the sealing lip showing to the oil sump.

Driver 5870 048 057

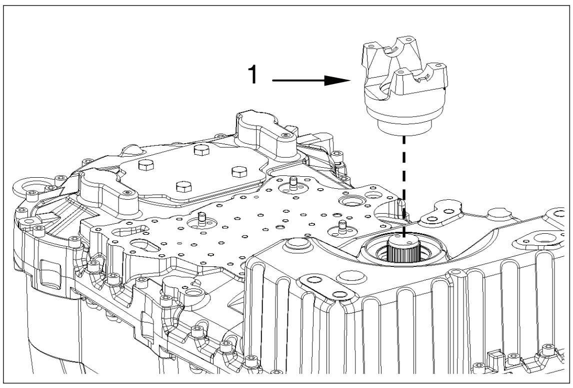
※ Use of the specified driver (S) ensures the exact installation position.

※ Fill space between sealing lip and dust lip with grease.
Wet outer diameter (rubber-coated) with spirit.



HL940TM356

② Mount output flange (1) until contact is obtained.

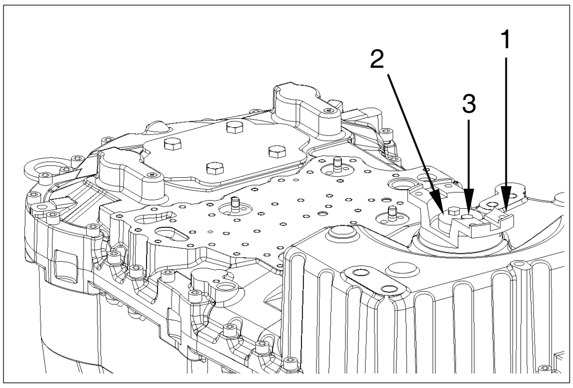


HL940TM357

③ Insert O-ring 38×4 into the space between output flange and shaft.
Fix output flange (2) by means of washer (1) and hexagon screws (3).
Oil hexagon screws before the assembly.

· Tightening torque (M8/10.9×25) :
3.47 kgf · m (25.1 lbf · ft)

※ It is always necessary to use new hexagon screws.



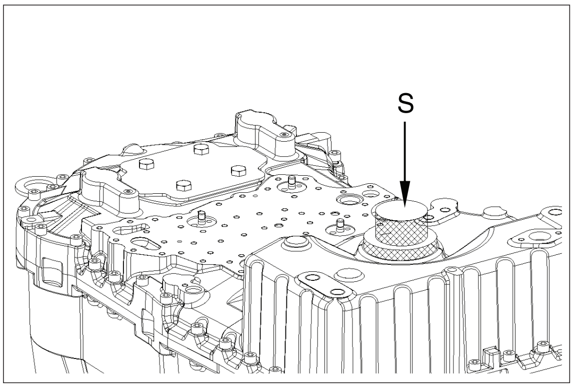
HL940TM358

(3) Output flange output side with brake

① Use driver (S) to mount shaft seal 70×100×10, with the sealing lip showing to the oil sump.

Driver 5870 048 057

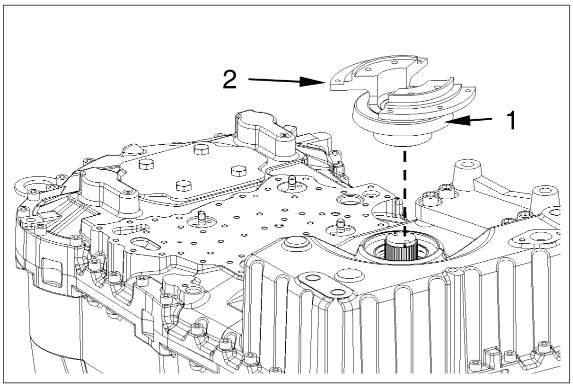
※ Use of the specified driver (S) ensures the exact installation position.
※ Fill space between sealing lip and dust lip with grease.



HL940TM372

※ Wet outer diameter (rubber-coated) with spirit.

② Press screen sheet (1) onto the input flange (2).
Mount output flange (2) until contact is obtained.



HL940TM373

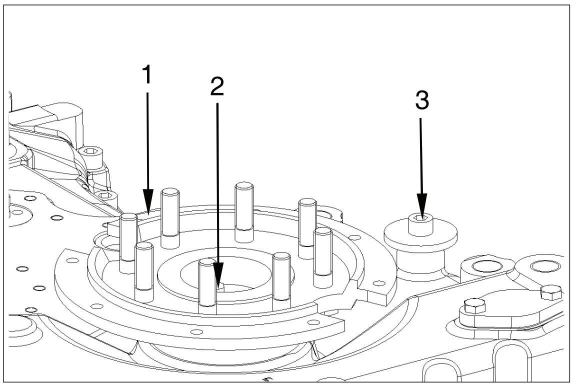
③ Insert O-ring 48×4 into the space between output flange and shaft.
Fix output flange (1) by means of washer (2) and hexagon screws.
Oil hexagon screws before the assembly.

· Tightening torque (M10/8.8×30) :
4.69 kgf · m (34.0 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) :
4.90 kgf · m (35.5 lbf · ft)



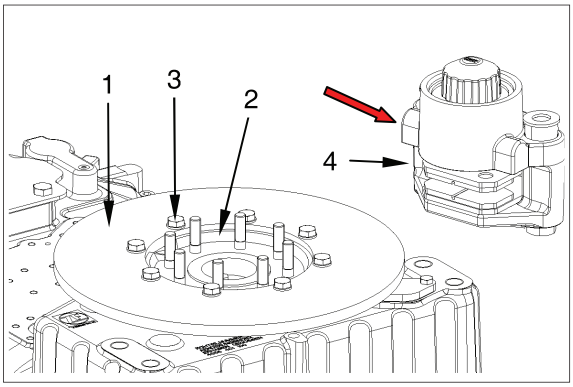
HL940TM374

④ Fix brake disk (1) at output flange (2) by means of hexagon screws (3) and washers.

· Tightening torque (M10/10.9×25) :
6.94 kgf · m (50.3 lbf · ft)

Connect HP pump on port (see arrow) and apply app. 80 bar pressure to parking brake (4) and bring it in contact position.

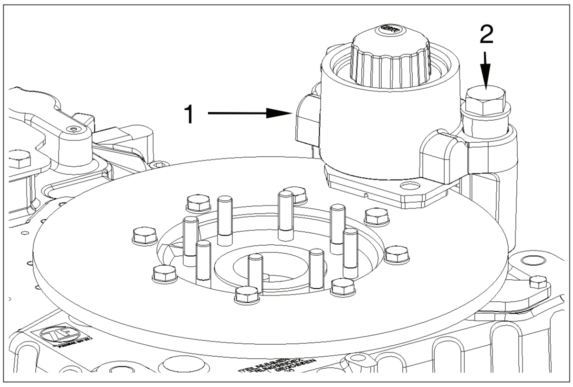
HP hand-operated pump 5870 287 007
MINIMESS coupling 5870 950 101



HL940TM375

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

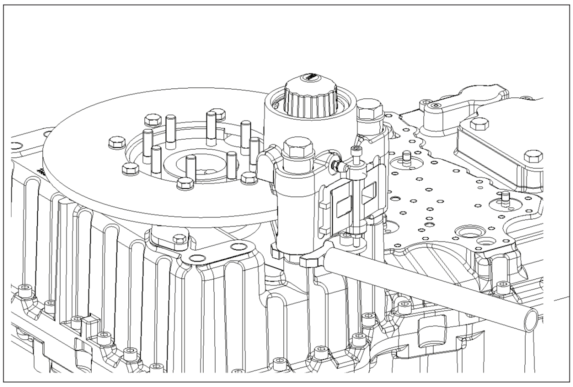
· Tightening torque (M20×1.5) :
6.12 kgf · m (44.4 lbf · ft)



HL940TM376

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

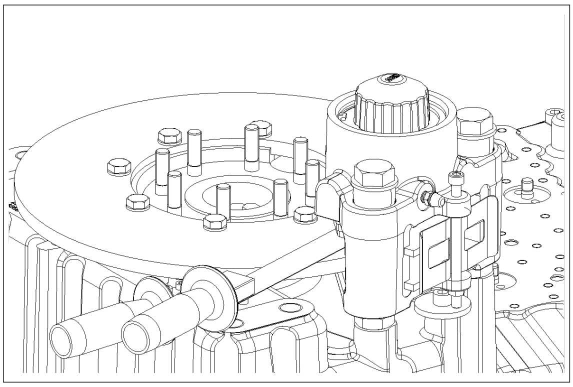
· Tightening torque (M20×1.5) :
19.9 kgf · m (143.8 lbf · ft)



HL940TM377

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

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



HL940TM378

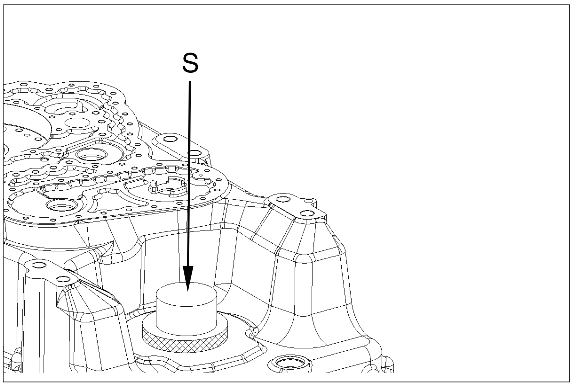
(4) Output flange on converter side

① Use driver (S) to mount shaft seal, with the sealing lip showing to the oil sump.

Driver 5870 048 057

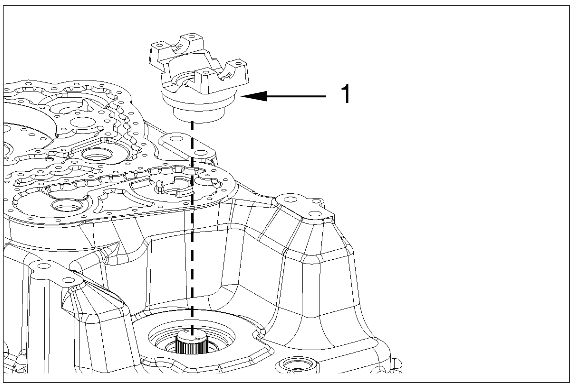
※ Use of the specified driver (S) ensures the exact installation position.

※ Fill space between sealing lip and dust lip with grease.
Wet outer diameter (rubber-coated) with spirit.



HL940TM379

② Mount output flange (1) until contact is obtained.

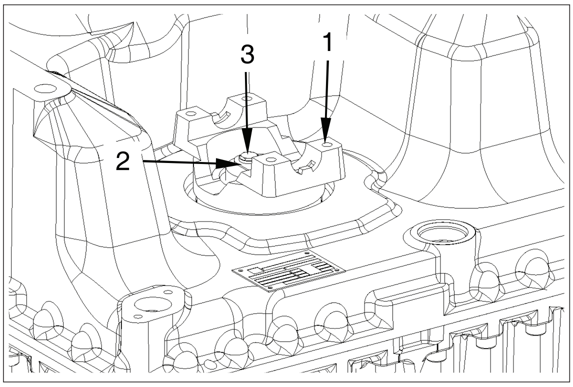


HL940TM380

③ Insert O-ring 38×4 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 (M8/10.9×25) :
3.47 kgf · m (25.1 lbf · ft)

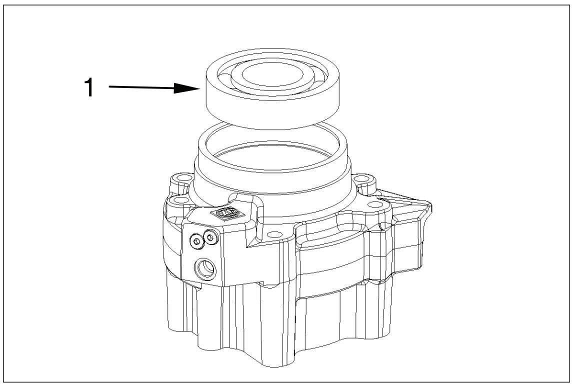
※ It is always necessary to use new hexagon screws.



HL940TM381

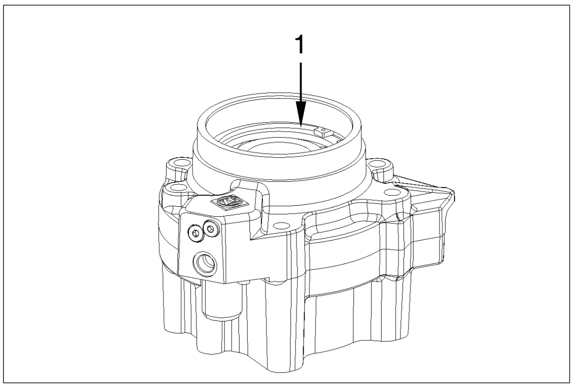
(5) **Output flange on converter side** (with axle disconnection)

① Press ball bearing 55×120×29 (1) to contact position into the housing hole.



HL940TM382

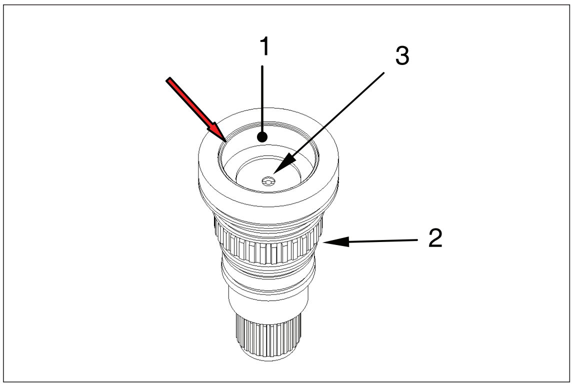
② Fix ball bearing by means of retaining ring 120×4 (1).



HL940TM383

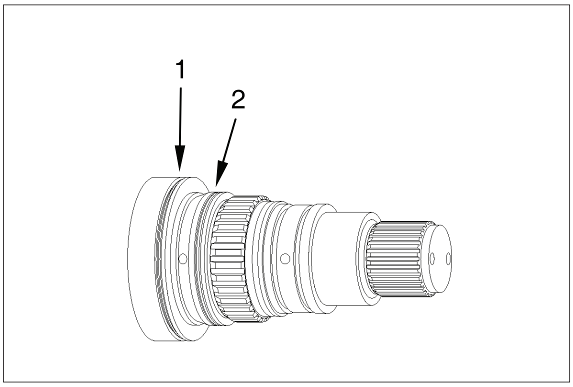
③ Flush-mount bearing bush (1) in the hole of the output shaft (2) - see arrow-.
Install orifice (3).

· Tightening torque : 1.53 kgf · m (11.1 lbf · ft)



HL940TM384

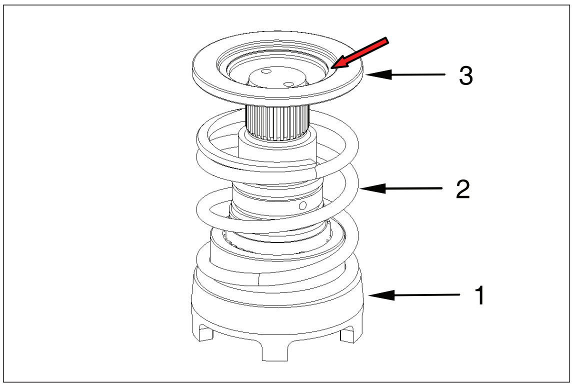
④ Insert both O-rings 90×3 (1) and O-rings 72×3 (2) free of twists into annular grooves of the output shaft.
Then apply oil onto O-rings.



HL940TM385

⑤ Mount sliding sleeve (1) until contact is obtained, and position compression spring (2) and end plate (3).

※ Pay attention to installation position of end plate, see arrow.

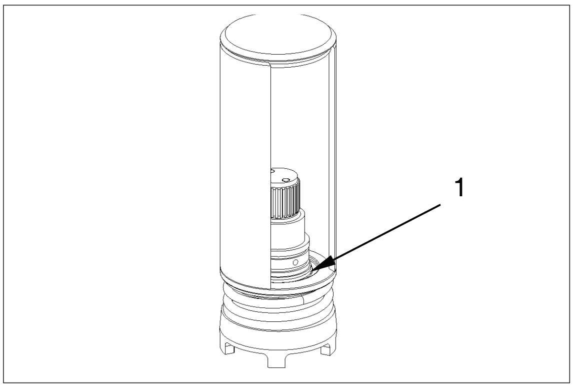


HL940TM386

⑥ Carefully preload compression spring and fix single parts by snap ring (1).

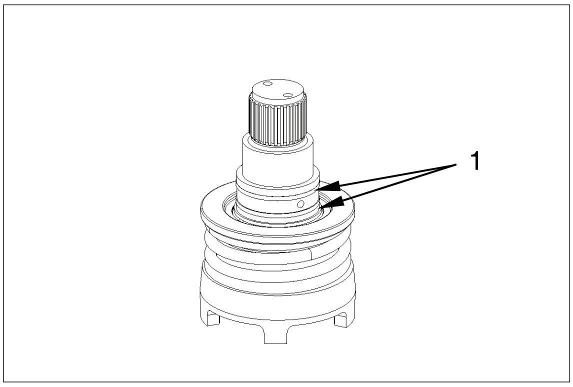
※ Pay attention to an exact contact of the snap ring in the groove.

Press bush 5870 506 166



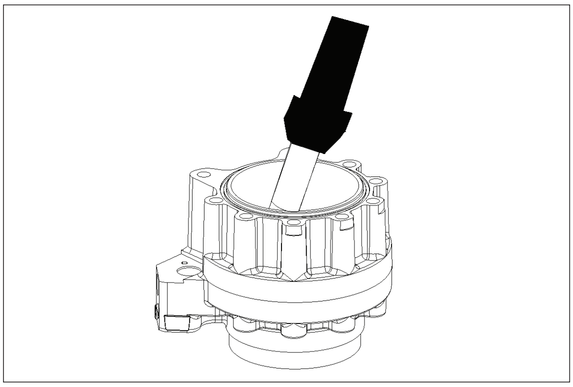
HL940TM387

⑦ Snap in and interlock both rectangular rings 65×60.7×3.5 (1).
Then apply grease on rectangular rings and align centrically.



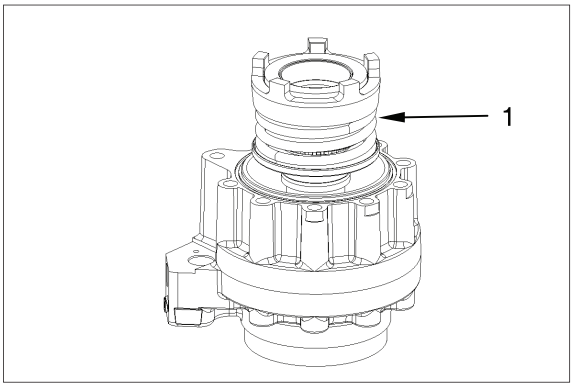
HL940TM388

※ Heat up ball bearing (approx. 120˚C).



HL940TM389

⑧ Mount the preassembled output shaft (1) until contact is obtained.



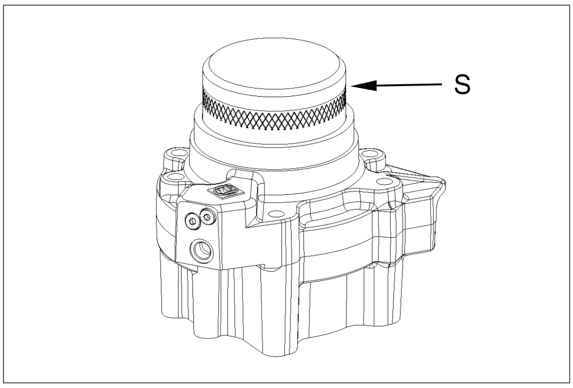
HL940TM390

⑨ Fit shaft seal 90×120×13, with the sealing lip showing towards the oil sump.

※ Use the specified driver tool (S), to obtain the exact installation position. Installation position shaft seal see TM392.

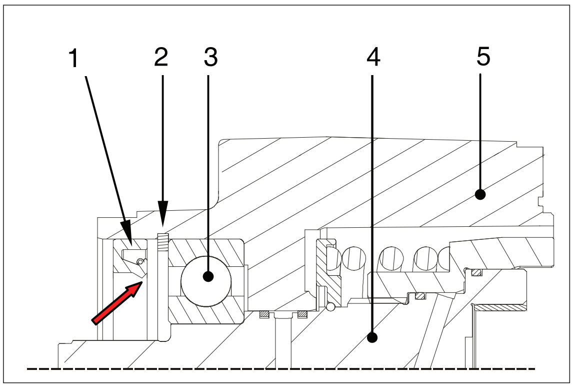
Wet outer diameter with Loctite sealing agent (product no. : 574).

Driver tool 5870 048 067



HL940TM391

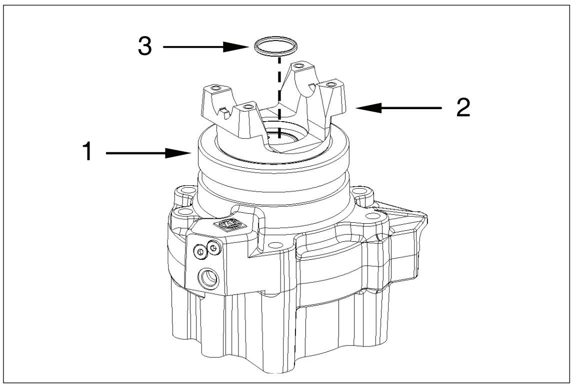
1	Shaft seal	90×120×13
2	Retaining ring	120×4
3	Ball bearing	55×120×29
4	Output shaft cpl.	
5	Housing	



HL940TM392

⑩ Press screen sheet (1) onto output flange (2) in a flush position.
Mount output flange (2) and insert O-ring 38x4 (3) into the space of output flange and output shaft.

※ Assembly is facilitated by heating the output flange to approx. 80˚C.
Wear protective gloves.

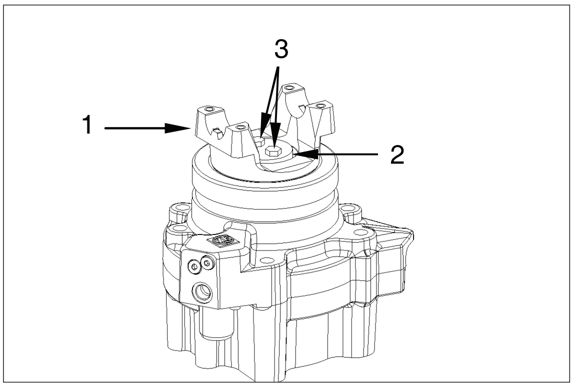


HL940TM393

⑪ Fix output flange (1) by means of washer (2) and hexagon screws M8×25 (3). Oil hexagon screws before the assembly.

· Tightening torque (M8/10.9×25) :
3.47 kgf · m (25.1 lbf · ft)

※ It is always necessary to use new hexagon screws.

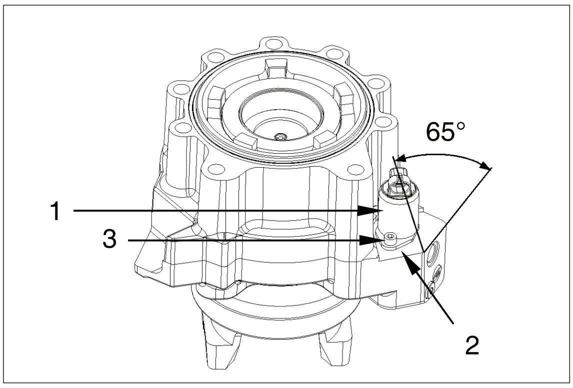


HL940TM394

⑫ Apply oil onto O-rings. Install solenoid valve (1) and fix it by holder (2) and cylinder screw M6x12 (3).

· Tightening torque (M6/8.8×12) :
0.97 kgf · m (7.03 lbf · ft)

※ Pay attention to solenoid valve installation position, see figure.

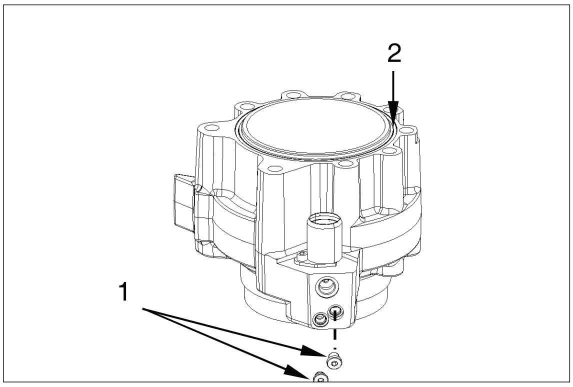


HL940TM395

⑬ Provide both screw plugs M10×1 with O-rings 8×1.5 (1) and install them.

· Tightening torque :
0.61 kgf · m (4.44 lbf · ft)

Insert round sealing ring 146×2.65 (2) into annular groove with assembly grease.



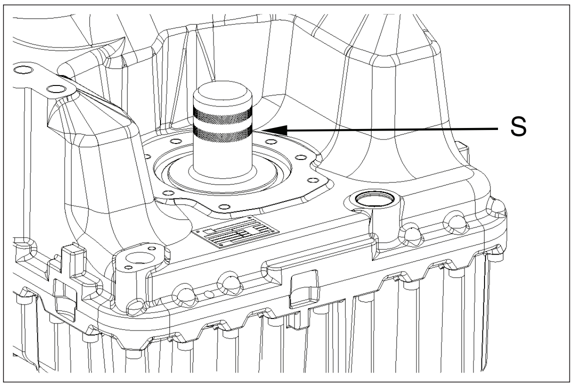
HL940TM396

⑭ Fit screen.

※ Use the specified driver tool (S), to obtain the exact installation position.

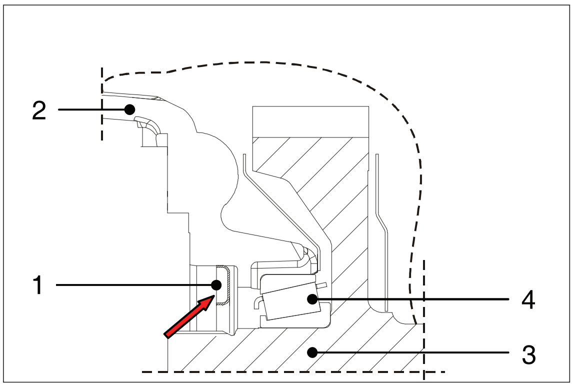
※ Installation position screen see TM398.

Driver tool AA00 238 994



HL940TM397

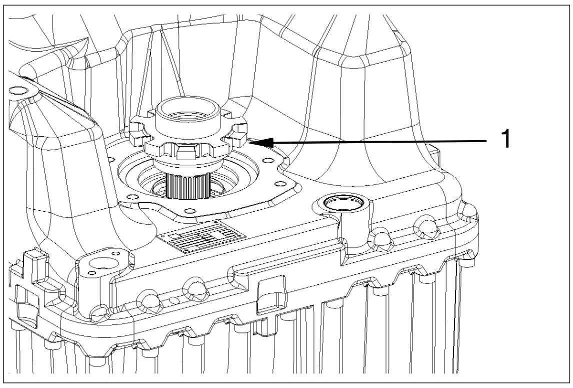
1 Screen
2 Gearbox housing
3 Output shaft
4 Roller bearing



HL940TM398

⑮ Heat flange (1) (approx. 80˚C) and mount until contact is obtained.

※ Wear protective gloves.

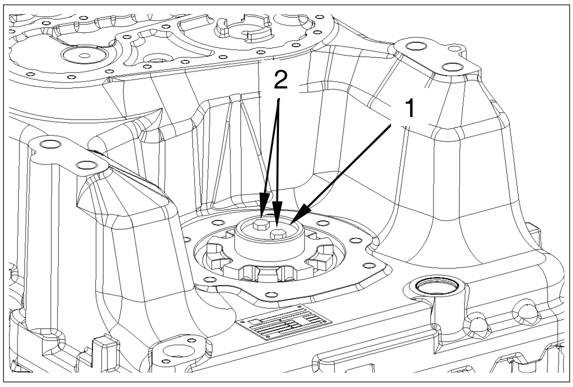


HL940TM399

⑯ Fix flange by means of the washer (1) provided and hexagon screws M8×25 (2).
Oil hexagon screws before the assembly.

· Tightening torque (M8/10.9×25) :
3.47 kgf · m (25.1 lbf · ft)

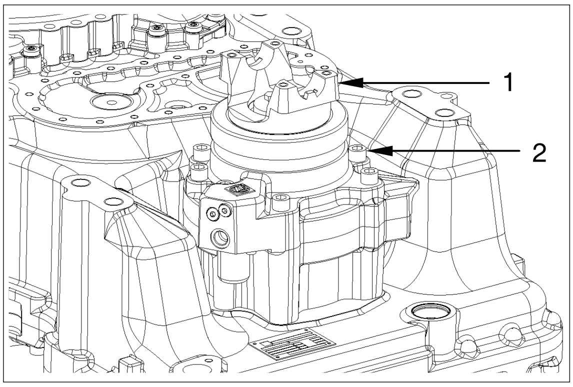
※ It is always necessary to use new hexagon screws.



HL940TM400

⑰ Insert preassembled axle disconnection (1) and fix by means of cylinder screws M12×140 (2).

· Tightening torque (M12/8.8×140) :
8.06 kgf · m (58.5 lbf · ft)



HL940TM401

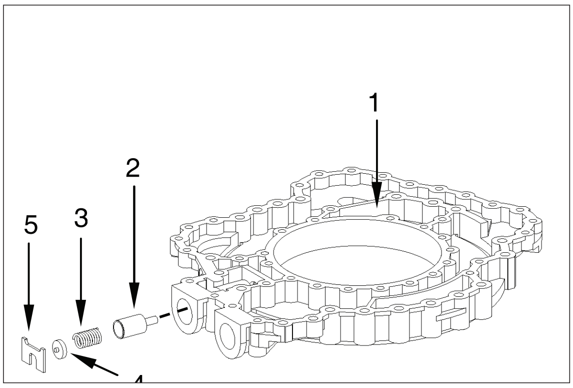
11) REASSEMBLY:

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

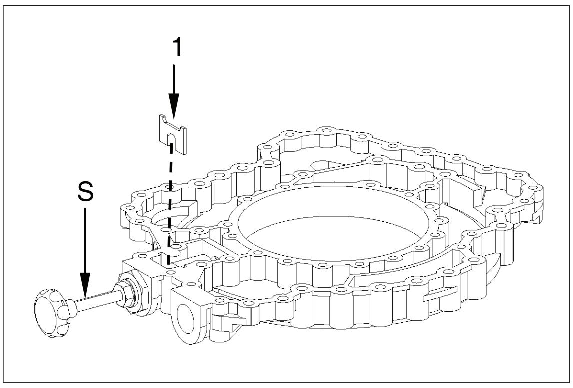


HL940TM402

※ Install pressure plate (4), with the pin (ø 6 ㎜) 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



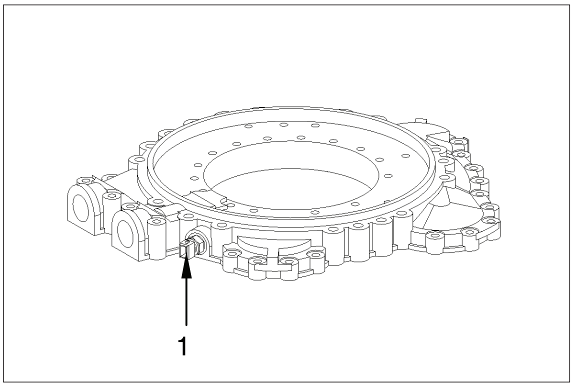
HL940TM403

③ Mount temperature sensor (1) with new O-ring 11×2.

· Tightening torque : 2.55 kgf · m (18.5 lbf · ft)

※ Version without temperature sensor: Fit a screw plug (1) with new O-ring 11×2.

· Tightening torque (M14×1.5) :
2.55 kgf · m (18.5 lbf · ft)



HL940TM404

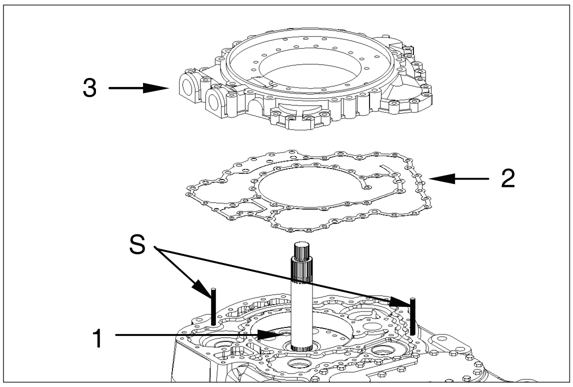
(2) Oil pressure pump

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

※ The pressure relief valve is not mounted on all versions.

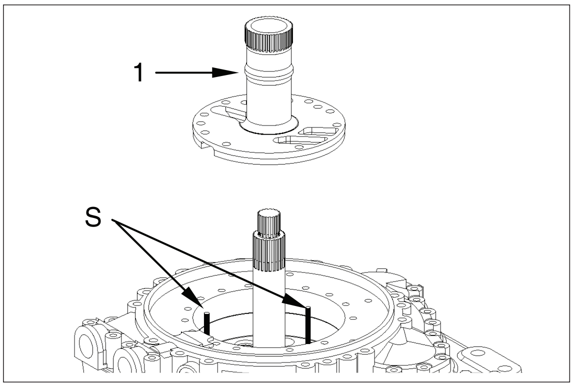


HL940TM405

② Install two adjusting screws (S) and mount stator shaft (1).

※ Pay attention to radial installation position.

Adjusting screws (M10)   5870 204 007

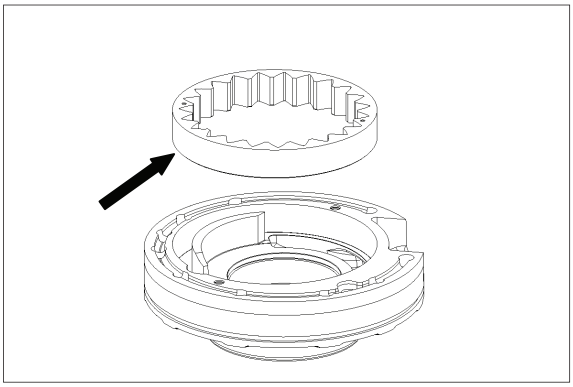


HL940TM406

※ In case of wear marks in the pump housing or on the control disk, the pump assy. must be replaced.

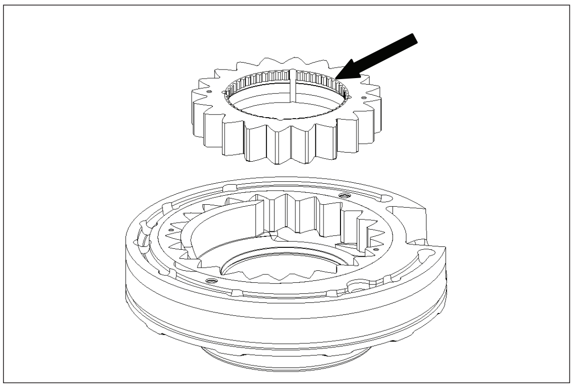
③ Install outer rotor.

※ Chamfer (see arrow) to show downwards.


HL940TM407

④ Install inner rotor.

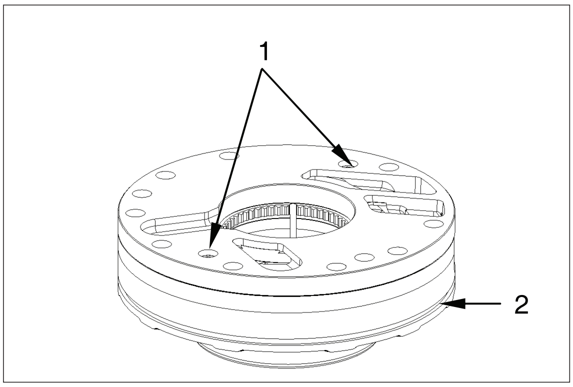
※ Teeth (see arrow) to show upwards.


HL940TM408

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. ½ 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.

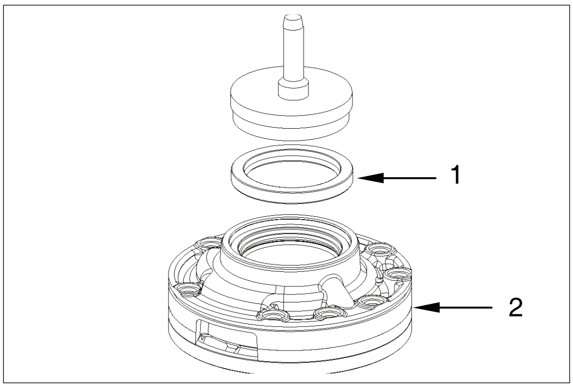


HL940TM409

⑥ With the sealing lip showing downwards, carefully insert the shaft seal (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



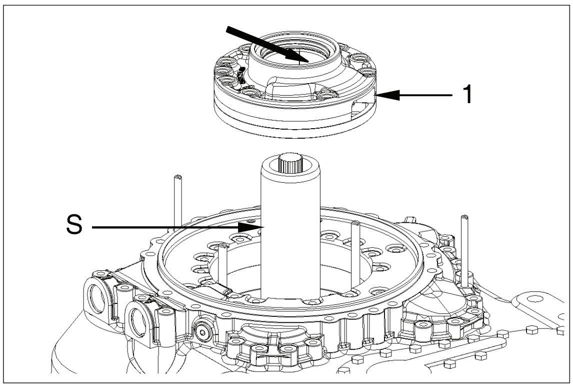
HL940TM410

※ 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.

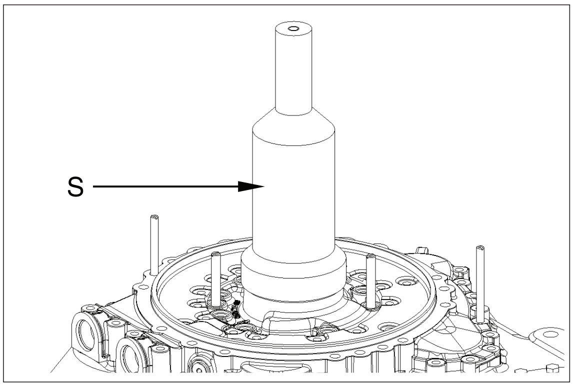
Inner installer → see TM412.



HL940TM411

⑧ Mount preassembled pump with driver (S) until contact is obtained.

Assembly fixture	5870 345 126
(Inner installer and driver)	



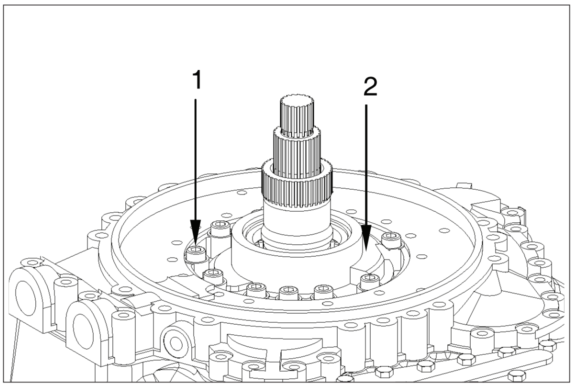
HL940TM412

⑨ Fit O-rings 9.5×1.6 to the cylindrical screws 10×75.

※ Grease O-rings.

Fix transmission pump (2) by means of cylindrical screws (1).

· Tightening torque (10/8.8×75) :
4.67 kgf · m (34.0 lbf · ft)



HL940TM413

⑩ Fix oil feed housing (1) equally by means of Torx screws (2).

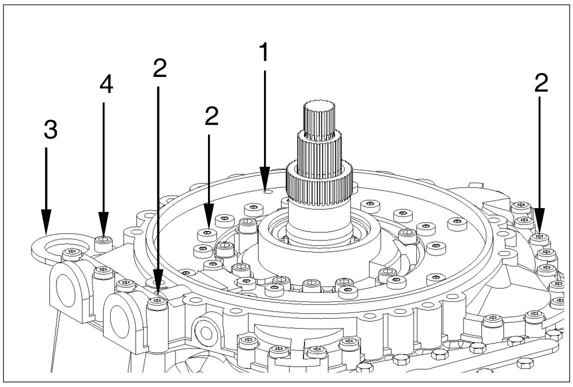
· Tightening torque (M8/10.9×30) :
2.34 kgf · m (17.0 lbf · ft)

· Tightening torque (M8/10.9×45) :
2.34 kgf · m (17.0 lbf · ft)

· Tightening torque (M8/10.9×60) :
2.34 kgf · m (17.0 lbf · ft)

Fasten fixing plate (3) by means of cylindrical screws (4).

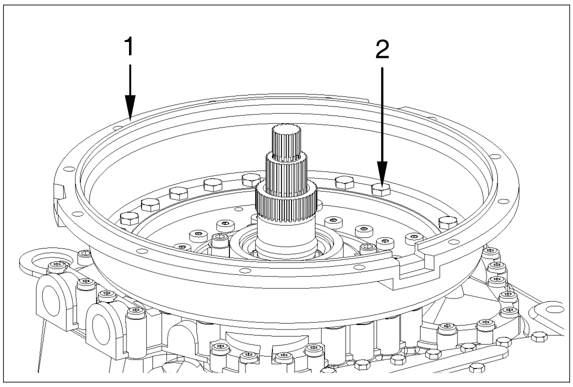
· Tightening torque (M8/8.8×40) :
3.47 kgf · m (25.1 lbf · ft)



HL940TM414

⑪ Fix converter bell housing (1) by means of hexagon screws (2).

· Tightening torque (M10/10.9×65) :
6.63 kgf · m (48.1 lbf · ft)

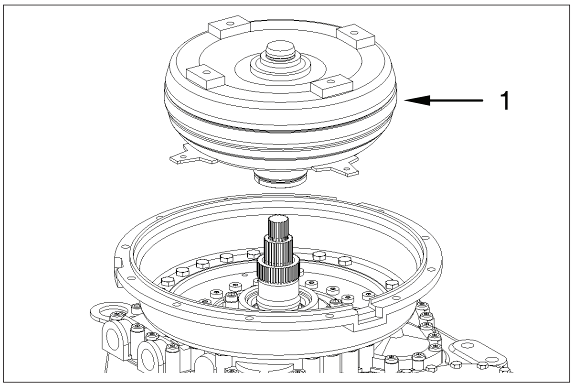


HL940TM415

(3) **Engine connection** (direct mount)

① Position converter (1) by means of lifting device until contact is obtained.

Eye bolts assortment 5870 204 002



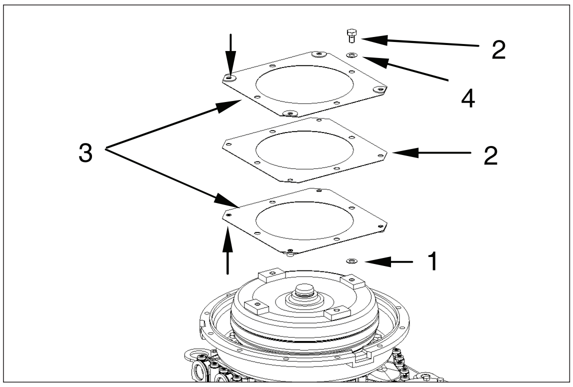
HL940TM416

② Position 1 washer/each / thickness = 1.0 mm (4EA) (1) onto the flex plate mounting webs (4EA).
Place flex plates (2 and 3).

※ Ay attention to the installation position. Spot-welded reinforcing disks of the flex plate (3) to be arranged towards the outside - see arrows.

Mount washer (4) onto the hexagon screw M10x16 (5) and fix flex plate.

※ Wet threads of hexagon screws with loctite (Type No. 262).

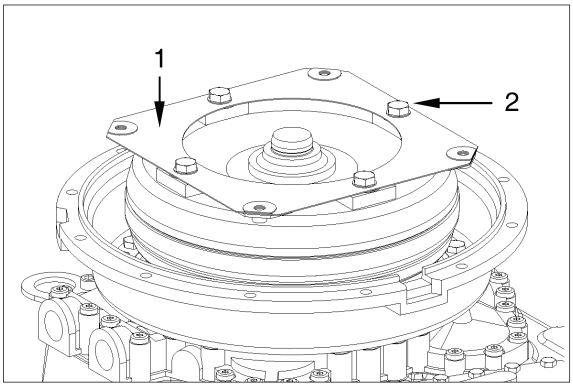


HL940TM417

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 (85.1 lbf · ft)

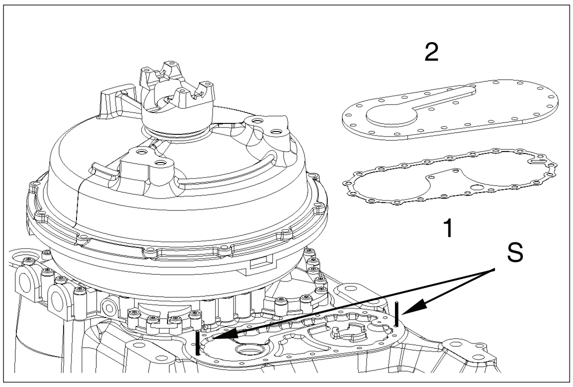


HL940TM418

12) REASSEMBLY - EMERGENCY STEERING PUMP

(1) Version without emergency steering pump

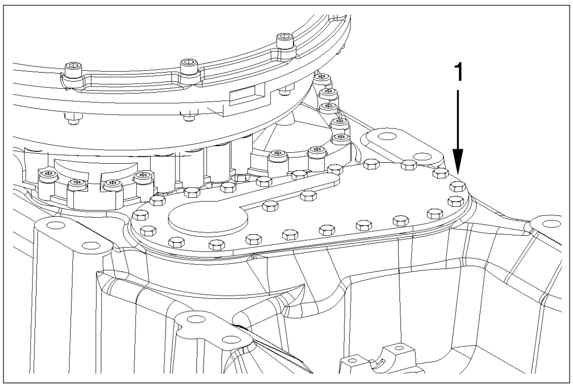
① Fit adjusting screws (S) and assemble seal (1) and cover (2).



HL940TM429

② Fix cover by means of hexagon screws (1).

· Tightening torque (M8/8.8×18) :
2.34 kgf · m (17.0 lbf · ft)

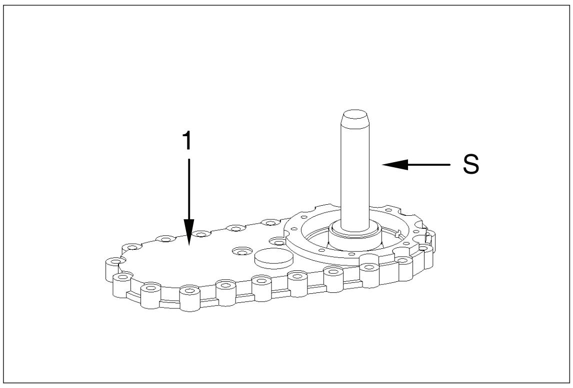


HL940TM430

(2) Version with emergency steering pump

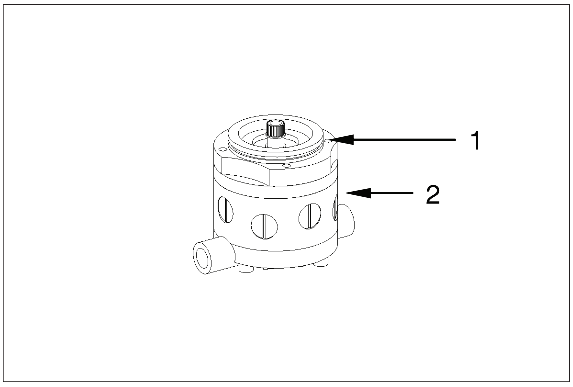
① Press sliding bearing into the cover (1) in alignment with the plane face.

Driver 5870 048 080



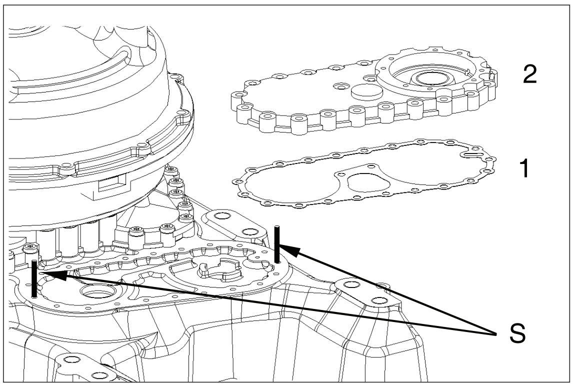
HL940TM431

② Place O-ring 100×3 (1) into the annular groove of the piston pump (2) and grease it.



HL940TM432

③ Fit adjusting screws (S) and assemble seal (1) and cover (2).



HL940TM433

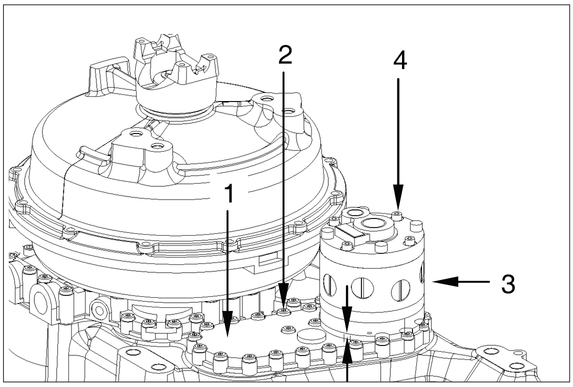
④ Fix cover (1) by means of Torx screws (2).

· Tightening torque (M8/10.9×30) :
2.35 kgf · m (17 lbf · ft)

Mount emergency steering pump (3) and fix it by means of cylindrical screws (4).

· Tightening torque (M8/8×135) :
2.34 kgf · m (17.0 lbf · ft)

※ Pay attention to radial installation position, see markings done during disassembly (arrows).



HL940TM434

13) REASSEMBLY:

(1) Inductive sensor, Hall sensor, breather, oil filler and oil drain plug

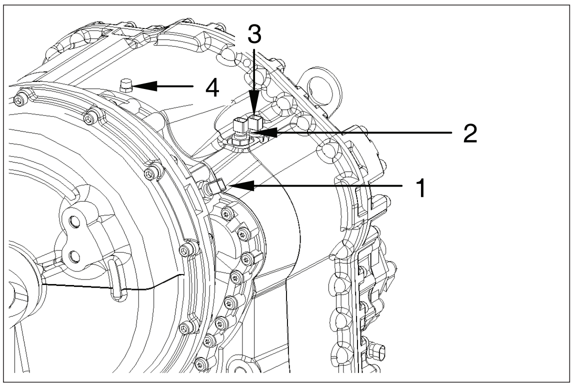
① Mount inductive sensors (1, 2 and 3) with new O-rings 15×2.

1 Inductive sensor - engine speed
2 Inductive sensor - speed/central gear chain
3 Inductive sensor - turbine speed

· Tightening torque :
3.06 kgf · m (22.2 lbf · ft)

Mount breather (4).

· Tightening torque (3) :
1.22 kgf · m (8.88 lbf · ft)



HL940TM435

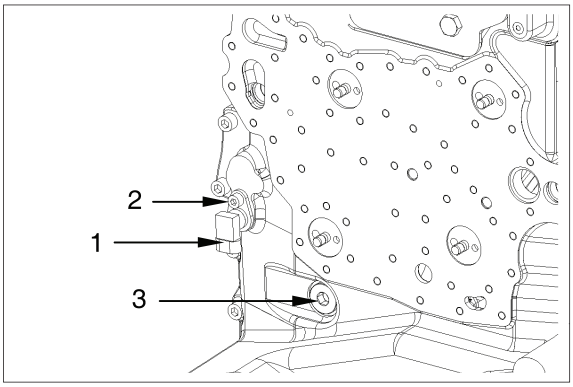
② Mount speed sensor (1) with O-ring 15.54×2.62 and fix it by means of cylindrical screw (2).

1 = speed sensor (Hall sensor) - output speed

· Tightening torque (M8/8.8×16) :
2.35 kgf · m (17 lbf · ft)

Mount screw plug M26×1.5 with O-ring 23×2

· Tightening torque :
8.16 kgf · m (59.2 lbf · ft)



HL940TM436

③ Mount oil drain plug with O-ring 35×2 (1).

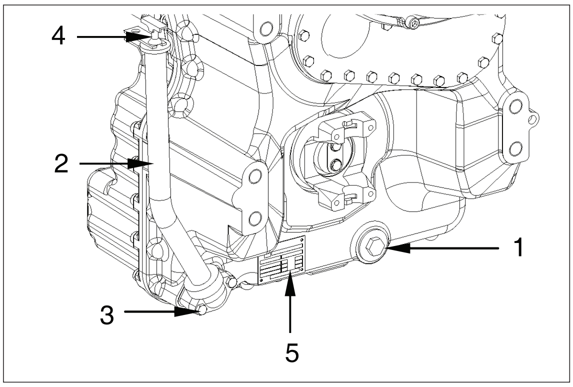
· Tightening torque (M38×1.5) :
8.16 kgf · m (59.2 lbf · ft)

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.

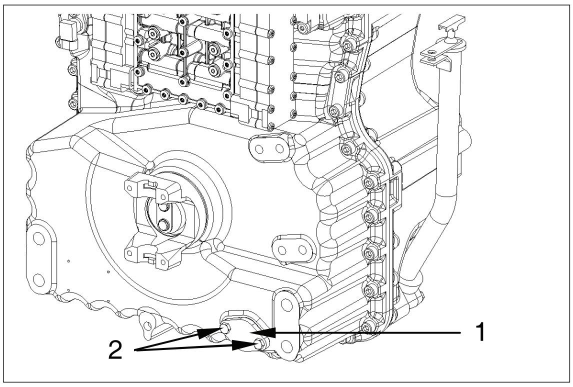
※ Use loctite (type No. MS 9360).



HL940TM437

④ Bring cover (1) with seal into contact position with the housing front part and fix it by means of hexagon screws (2).

· Tightening torque (M8/8.8×18) :
2.34 kgf · m (17.0 lbf · ft)

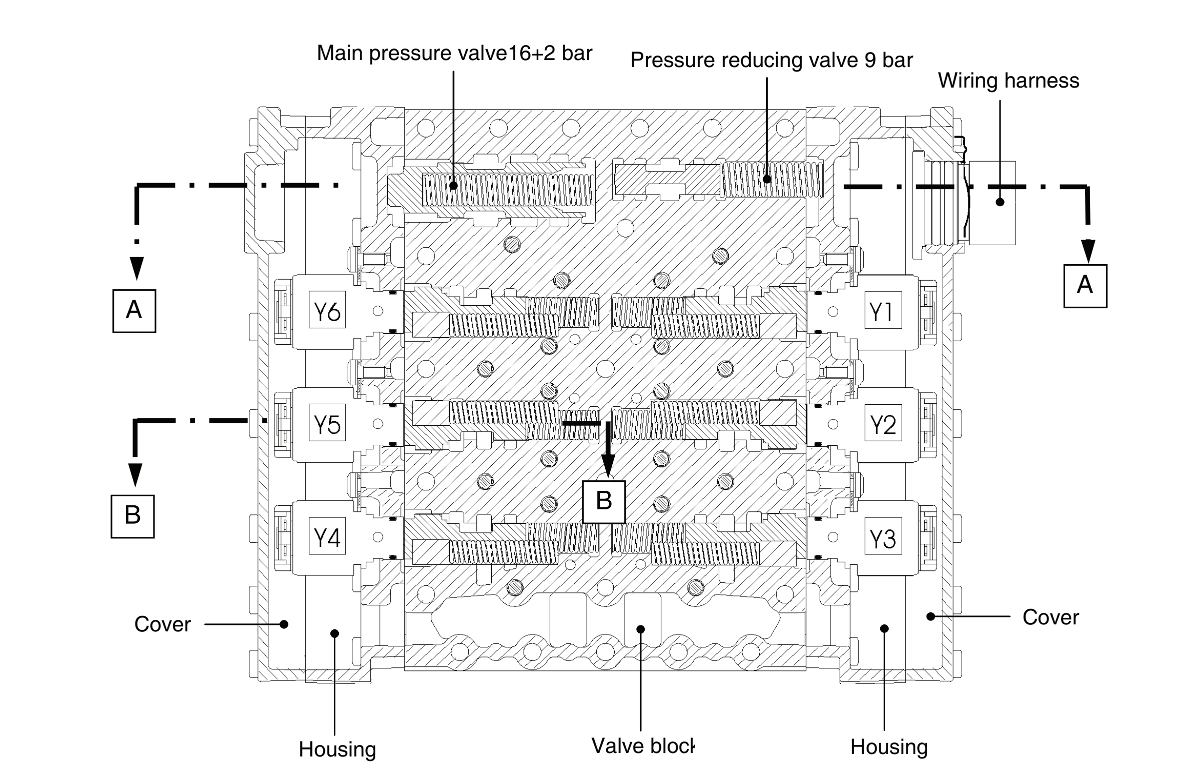


HL940TM438

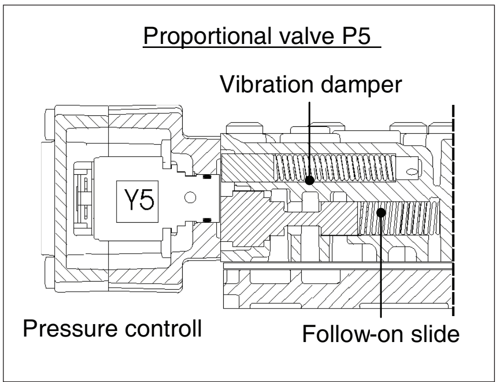
14) REASSEMBLY

Electro-hydraulic control with proportional valves:

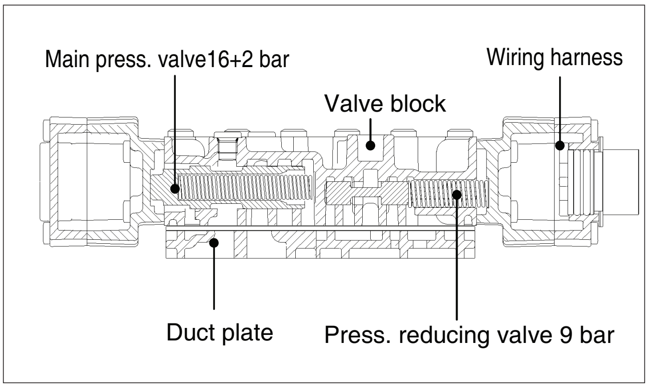
※ The following sketches show the sectional views of the electro-hydraulic control.



HL940TM439



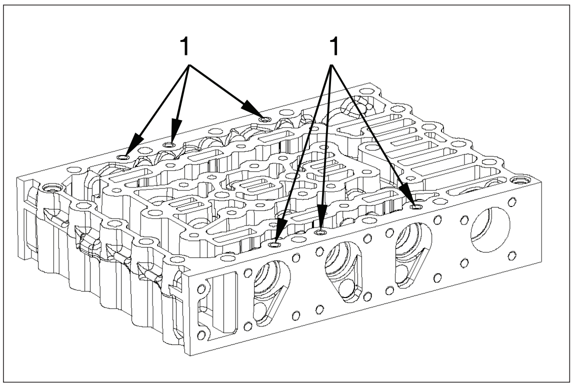
HL940TM440



HL940TM441

(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.



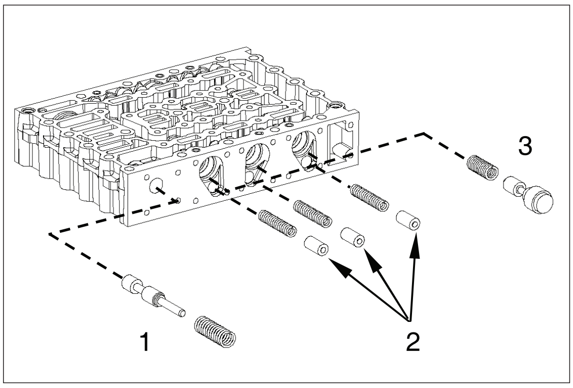
HL940TM442

① With the concave side showing upwards, insert orifice (1) until contact is obtained.

※ See arrows for installation position.

② The opposite figure shows the following single parts :

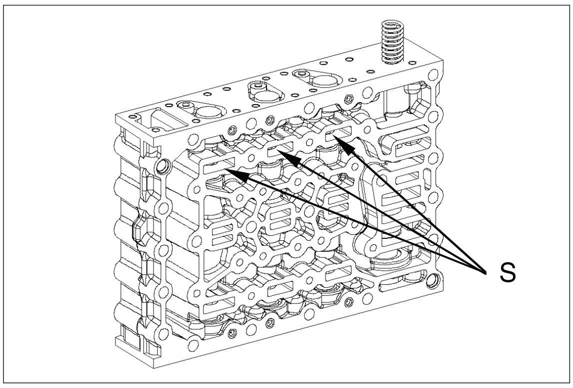
1 Pressure reducing valve
(1EA, piston and compr. spring)
2 Vibration damper
(3EA, piston and compr. spring
3 Follow-on slide
(3EA, piston and compr. spring)



HL940TM443

③ Install the single parts acc. to TM443.

※ Preload compression springs of the follow-on slides and preliminarily fix pistons by means of cylindrical pins Ø5.0 mm (assembly aid), see arrows (S).

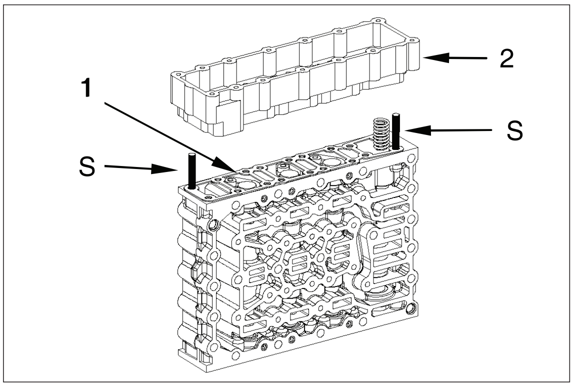


HL940TM444

④ Fit two adjusting screws.

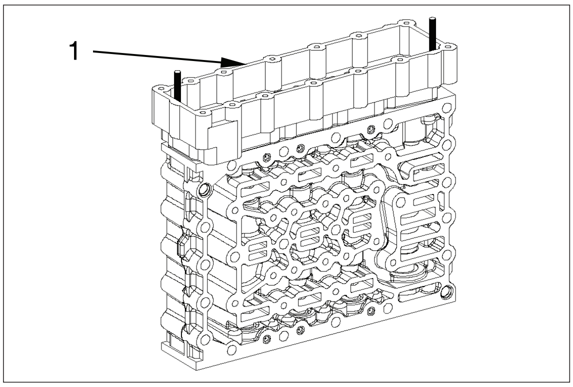
Mount seal (1) and housing (2).
Then position housing equally by means of adjusting screws until contact is obtained.

Adjusting screws 5870 204 036



HL940TM445

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).

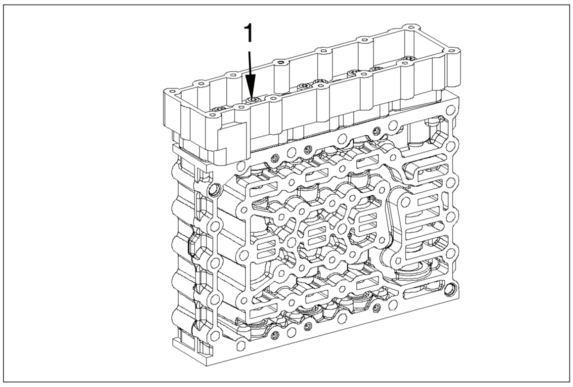


HL940TM446

⑥ Fix housing by means of Torx screws (1).

· Tightening torque (M5/10.9×30) :
0.56 kgf · m (4.07 lbf · ft)

Reducing adapter	5870 656 056
Socket wrench TX-27	5873 042 002



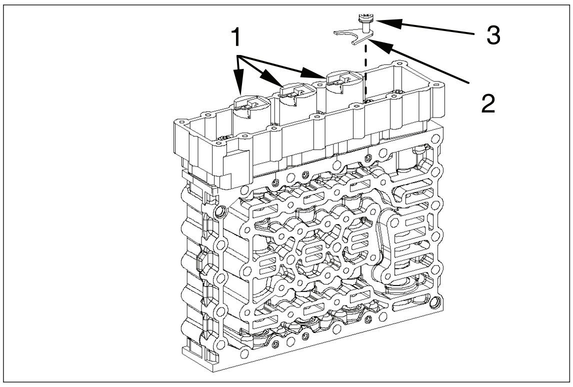
HL940TM447

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 (4.07 lbf · ft)

Reducing adapter	5870 656 056
Socket wrench TX-27	5873 042 002

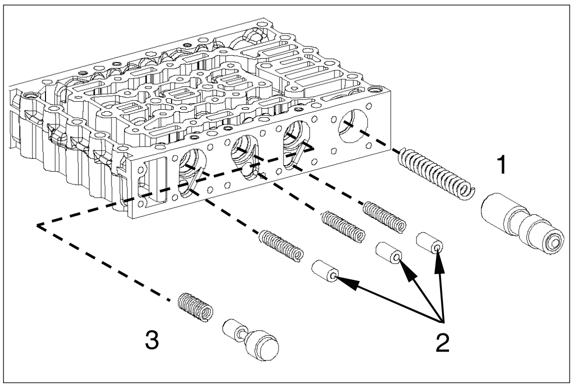


HL940TM448

Preassemble the opposite side

⑧ The figure on the left 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)



HL940TM449

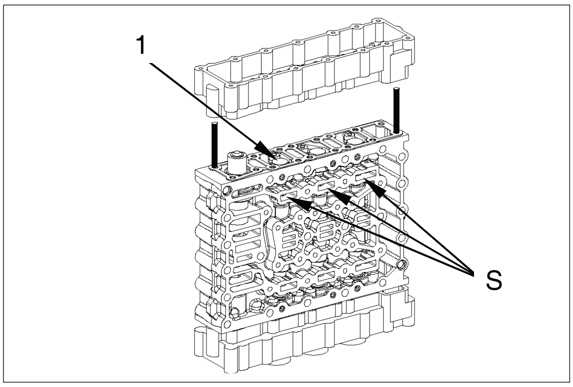
⑨ Install the single parts acc. to TM449.

※ Preload the compression springs of the follow-on slides and fasten the pistons preliminarily by means of cylindrical pins (S) Ø5.0 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.



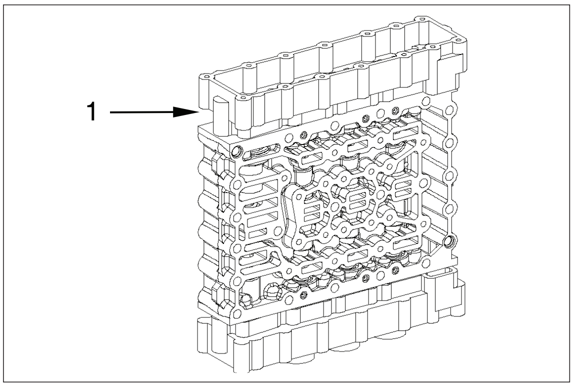
HL940TM450

⑩ Preload the pistons with Torx screws and remove the cylinderical pins (assembly aid) again.

Then fasten the housing cover by means of Torx screws (1).

· Tightening torque (M5/10.9×30) :
0.56 kgf · m (4.07 lbf · ft)

Adjusting screws	5870 204 036
Reducer	5870 656 056
Socket spanner TX-27	5873 042 002

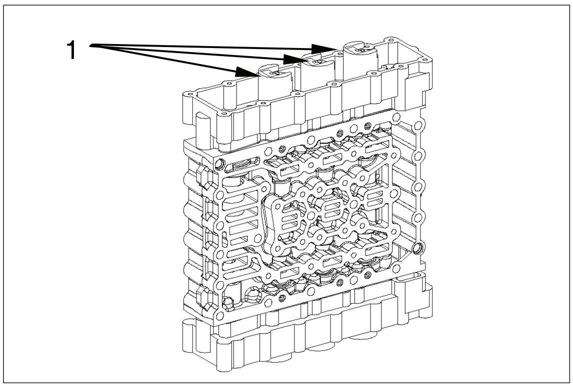


HL940TM451

⑪ Mount the pressure regulators with O-ring 13.5×2 (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 (M5/8.8×12) :
0.56 kgf · m (4.07 lbf · ft)

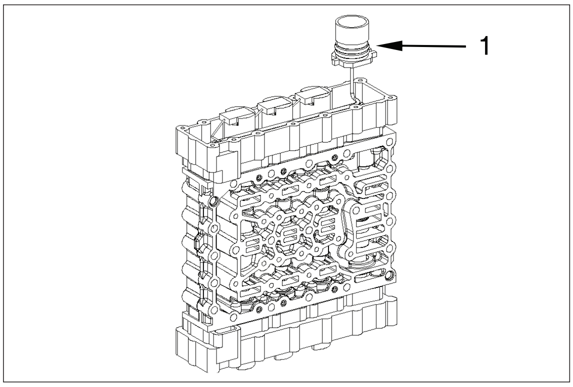


HL940TM452

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

※ See TM439 for installation position of pressure regulators.

※ Pay attention to the installation position of the wiring harness.



HL940TM453

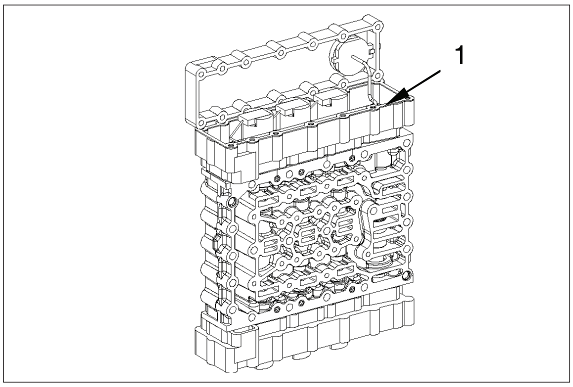
⑬ Put on the flat gasket (1).

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 (4.07 lbf · ft)

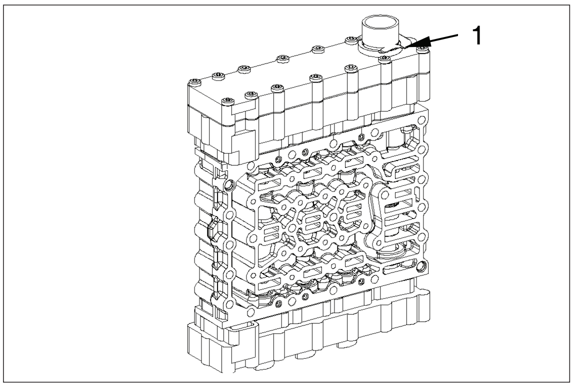
Reducer	5870 656 056
Socket spanner TX-27	5873 042 002



HL940TM454

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

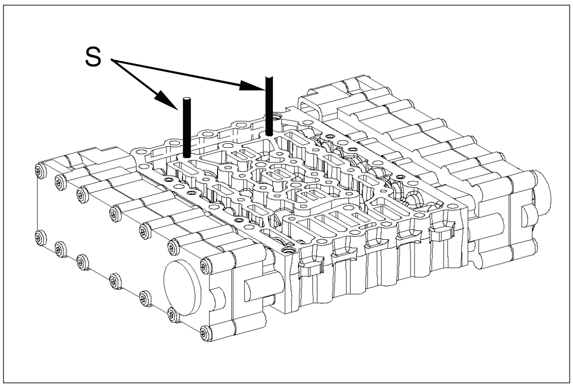
※ Install the opposite cover.



HL940TM455

⑮ Install two adjusting screws.

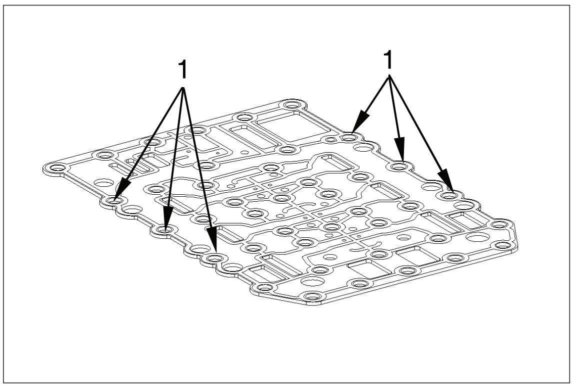
Adjusting screws	5870 204 063



HL940TM456

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).

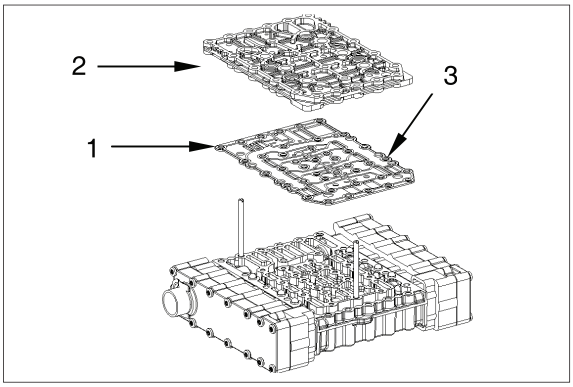


HL940TM457

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.

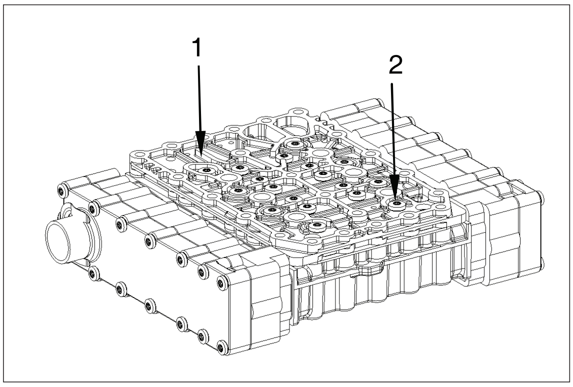


HL940TM458

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 (7.77 lbf · ft)

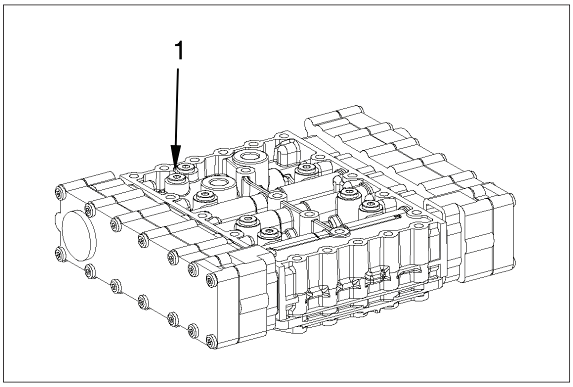
Socket wrench TX-27 5873 042 002



HL940TM459

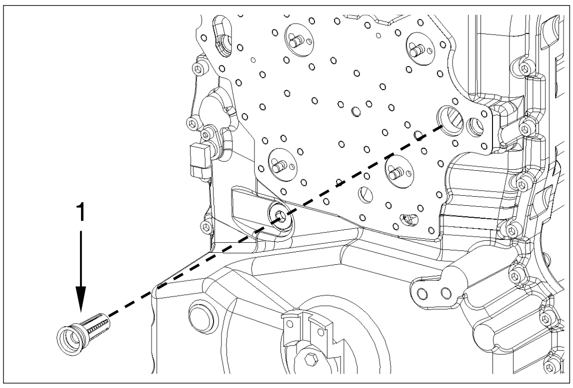
⑲ Provide the screw plugs M10×1 with O-rings 8×1.5 (1) and install them.

· Tightening torque :
0.61 kgf · m (4.44 lbf · ft)



HL940TM460

⑳ Insert converter safety valve (1) into the housing hole until contact is obtained.



HL940TM461

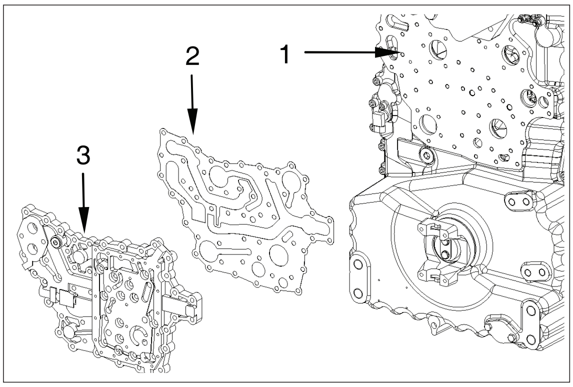
㉑ Mount stud bolts (1).

※ 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.



HL940TM462

㉒ Fix duct plate (1) by means of Torx screws (2) and hexagon nuts (3).

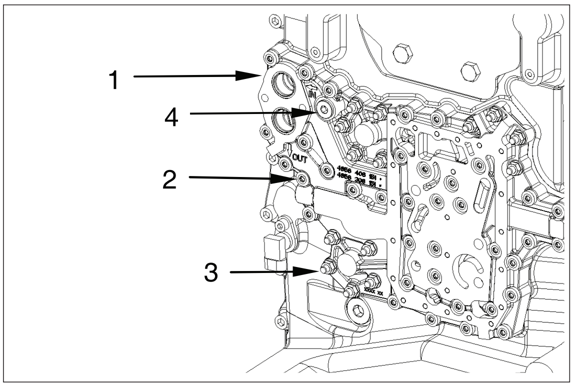
· Tightening torque (M8/10.9×30) : 2.34 kgf · m (17.0 lbf · ft)

· Tightening torque (M8) : 2.34 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 (22.2 lbf · ft)

Socket wrench TX-40 5873 042 004

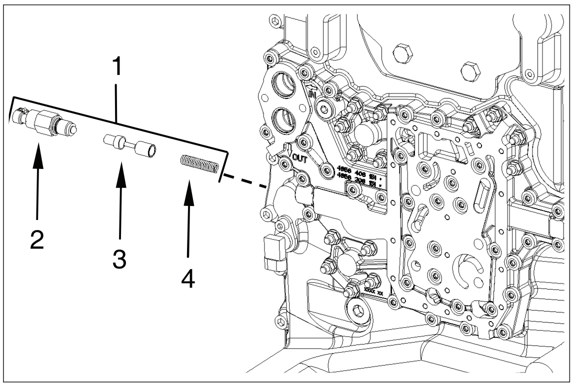


HL940TM463

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 (22.2 lbf · ft)



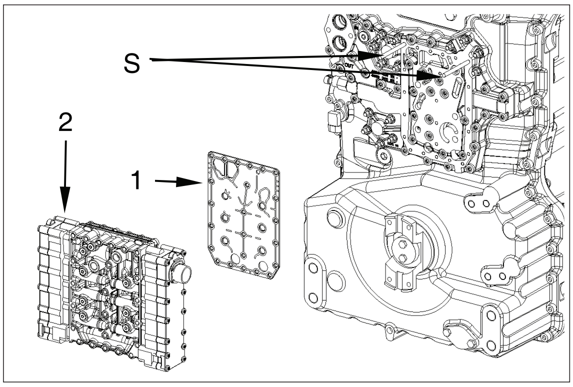
HL940TM464

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.

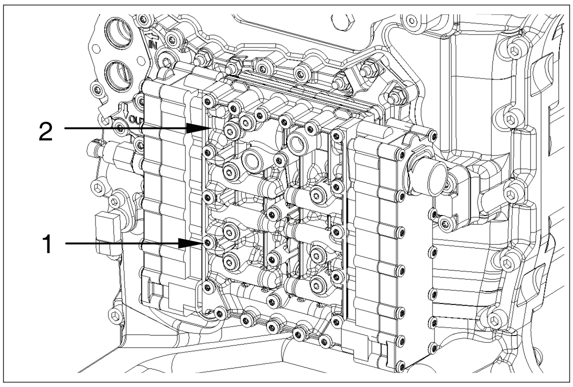


HL940TM465

㉕ Fix electro-hydraulic control unit (1) equally by means of Torx screws (2).

· Tightening torque (M6/10.9×76) : 0.97 kgf · m (7.03 lbf · ft)

Socket wrench TX-27 5873 042 002
Reducing adapter 5870 656 056



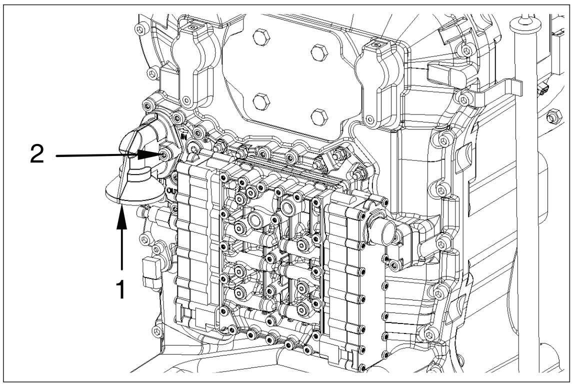
HL940TM466

(2) Fitting of fine filter (pressure filter)

① Fix filter head (1) with new O-rings 34.2×3 to the housing rear part by means of Torx screws (2).

· Tightening torque (M8/10.9×60) : 3.47 kgf · m (25.2 lbf · ft)

Socket wrench TX-40 5870 042 004

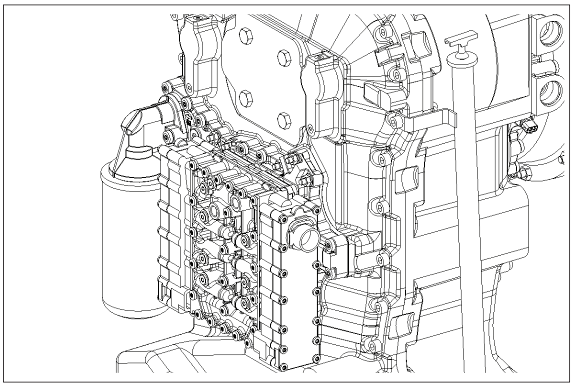


HL940TM467

※ The filter is to be installed as follows :

- 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.

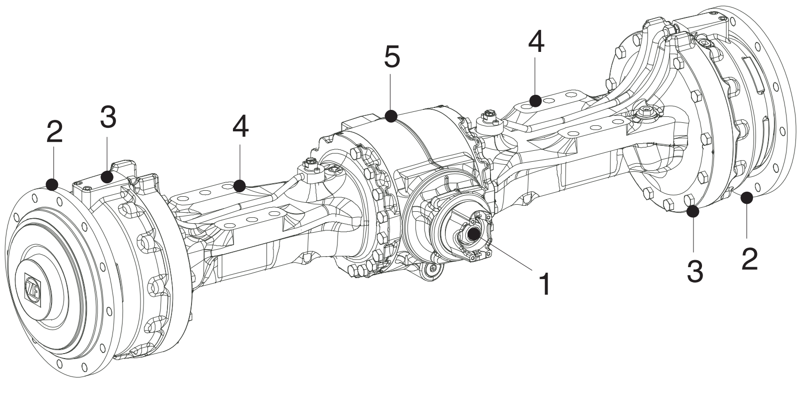
※ Before putting the transmission into operation, fill it with oil according to operation manual.


HL940TM468

3. AXLE

1) DISASSEMBLY

(1) Output and brake disassembly

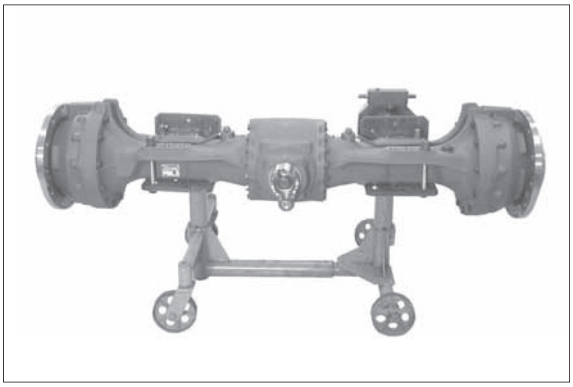


7409AAX001

1	Input	3	Brake	5	Axle drive housing
2	Output	4	Axle housing		

① Mount axle on assembly truck.

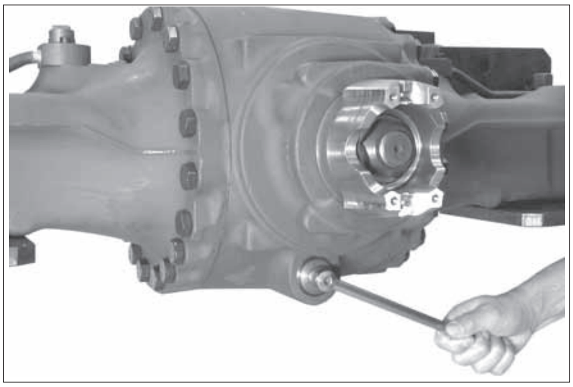
Assembly truck	5870 350 000
Supporting bracket (2EA)	5870 350 106



7409AAX002

② Drain oil from axle.

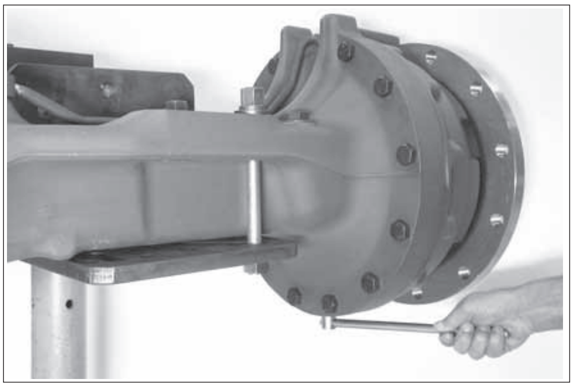
※ Use suitable reservoir-environmental protection.



7409AAX003

③ Drain oil from both outputs.

※ Use suitable reservoir-environmental protection.



7409AAX004

Disassembly output assy /brake

For any replacement of components you can remove the output assy (with brake) as one unit.
In this context refer to work steps on figure AX007~AX009 and assembly steps page 3-249~254.

※ Please consider, however, that multi discs of the brake must be replaced on both outputs each.

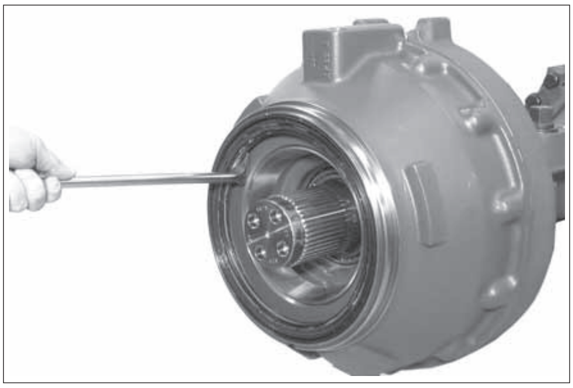
7409AAX005

Replacement combi seal ring (output)

※ The combi seal ring (output) can also be replaced on the installed axle for this purpose remove output shaft.

For the installation of the combi seal ring, refer to work steps page 3-242~243 (AX303 ~AX305).

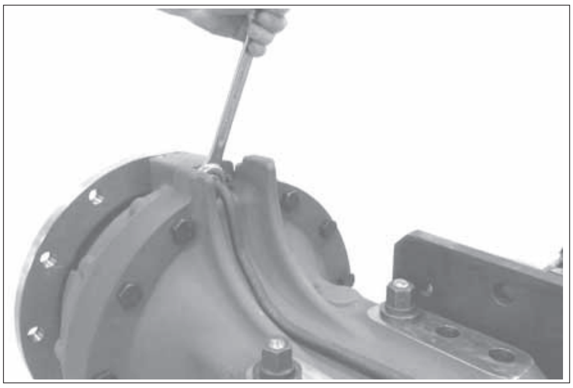
Pry bar 5870 345 071



7409AAX006

Output /brake

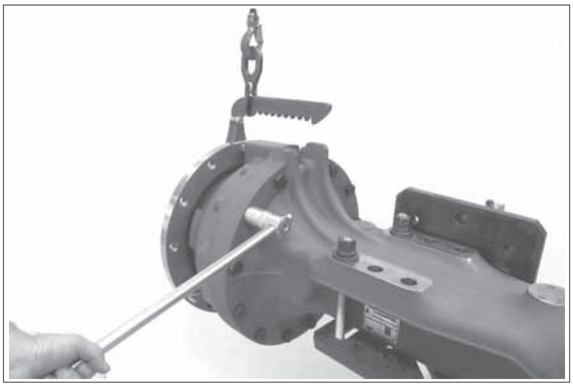
① Disassemble brake tube.



7409AAX007

② Take up output by means of a lifting bracket.
Loosen bolted connection (output /axle housing) and separate output from axle housing.
Pay attention to releasing end plate and multi discs.

Lifting bracket	5870 281 043

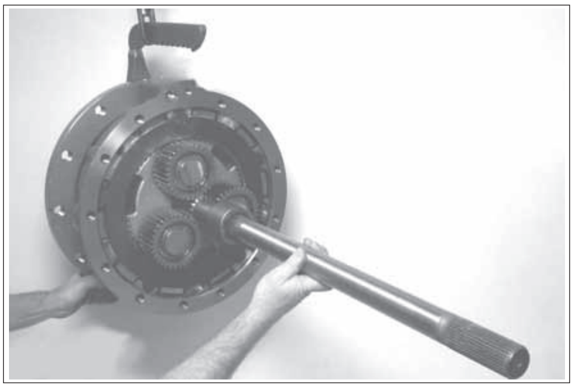


7409AAX008

③ Remove stub shaft and sun gear shaft.

※ Pay attention to shim (placed in sun gear shaft) and mark allocation of shim to sun gear shaft and output side assembly aid.

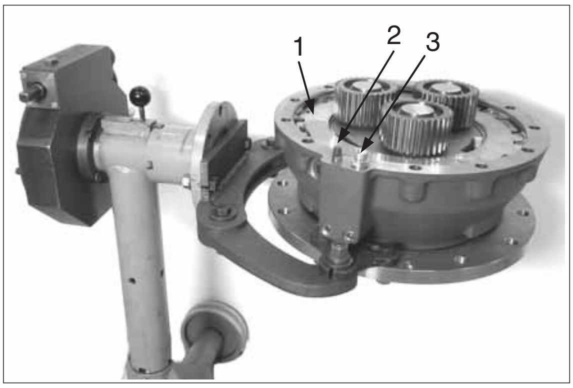
In certain cases the stub shaft /sun gear shaft could get stuck in the axle housing (gearing of axle bevel gear /differential).



7409AAX009

④ Mount output assy on assembly truck.
Remove end plate (1), brake breather valve (2) and screw neck (3).

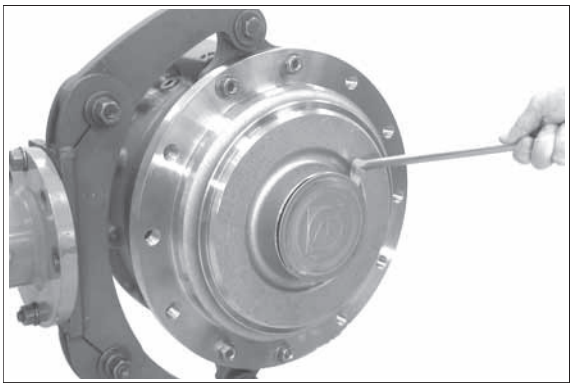
Assembly truck	5870 350 000
Fixture	5870 350 112



7409AAX010

⑤ Remove lid (with O-ring).

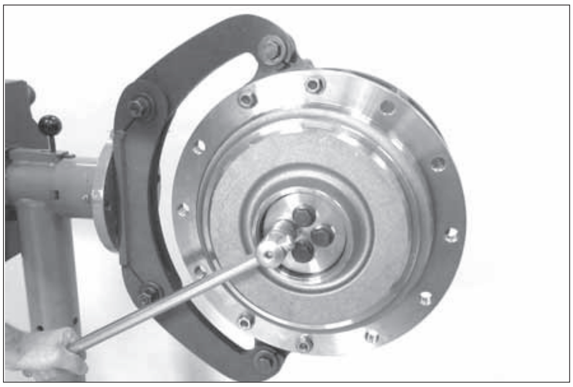
Pry bar	5870 345 071



7409AAX011

⑥ Loosen locking screws and remove lid.

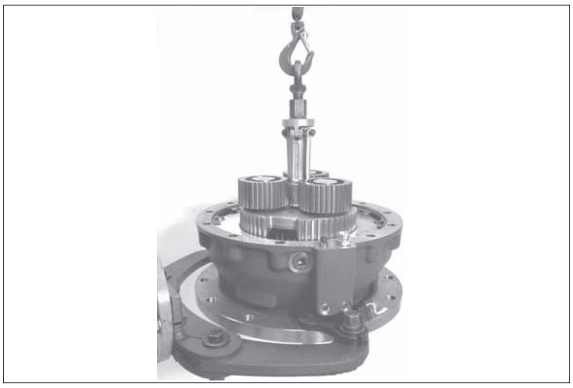
※ Pay attention to releasing planetary carrier, risk of accident.



7409AAX012

⑦ Lift compl. planetary carrier out of brake housing.

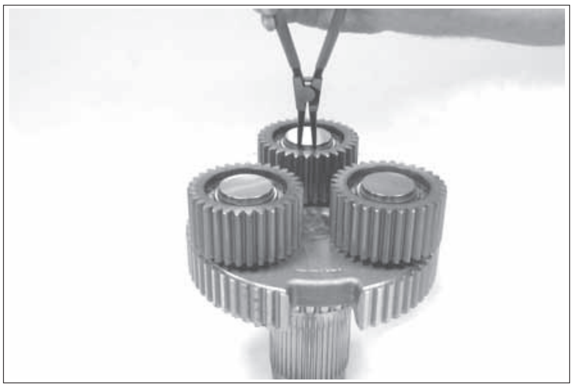
Inner extractor	5870 300 019
Eye nut	5870 204 073



7409AAX013

⑧ Snap out retaining ring.

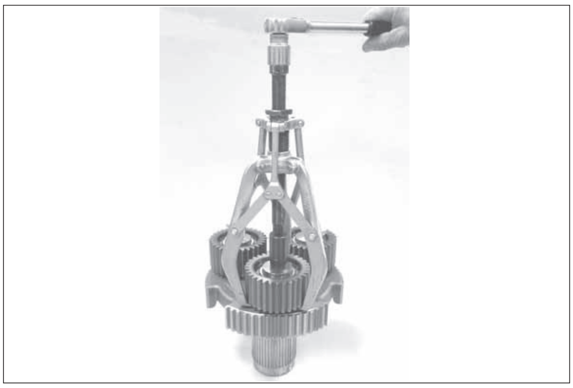
Set of external pliers	5870 900 015



7409AAX014

⑨ Pull off planetary gear.
Disassemble the remaining planetary gears in the same way.

Three armed puller	5870 971 002



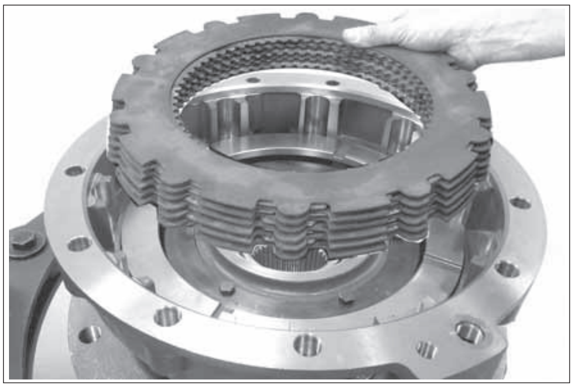
7409AAX015

⑩ Pull bearing inner ring off the planetary carrier.

Grab sleeve	5873 003 033
Basic tool	5873 003 001

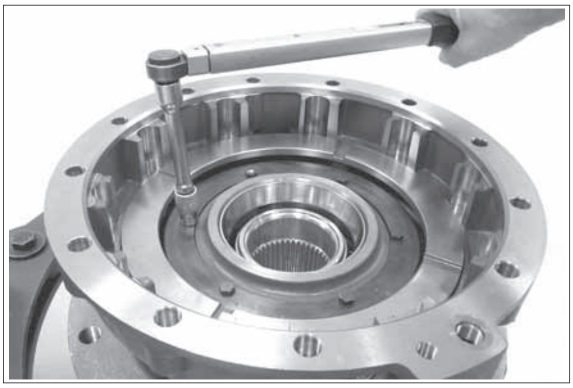
7409AAX016

⑪ Take disc package out of brake housing.



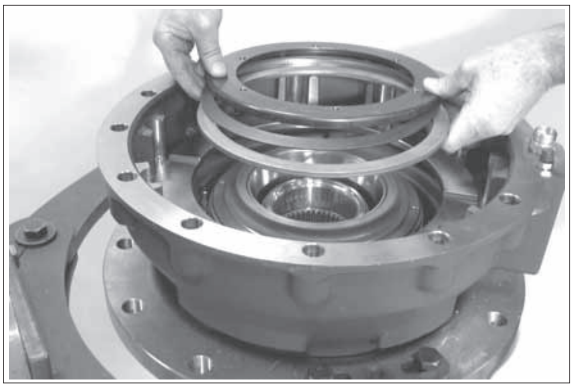
7409AAX017

⑫ Loosen threaded joint.



7409AAX018

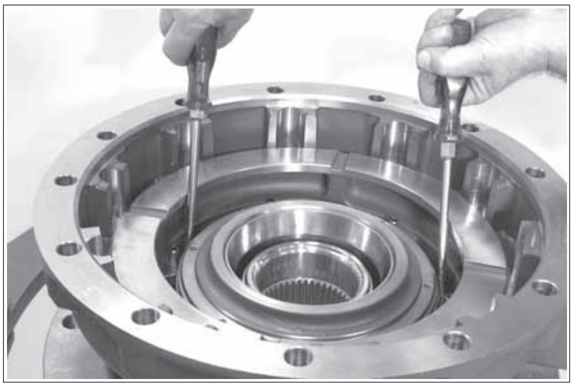
⑬ Remove lid, cup spring and disk.



7409AAX019

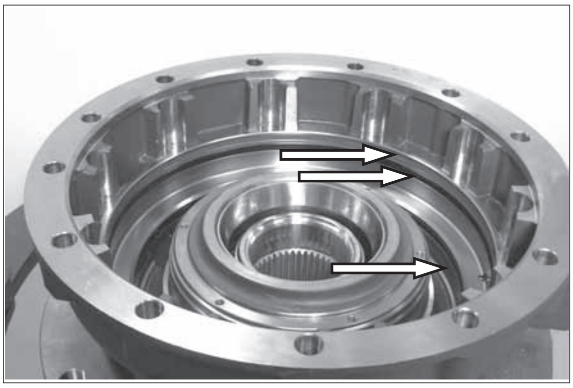
⑭ Lift piston off with lever.

Adjusting device	5870 400 001



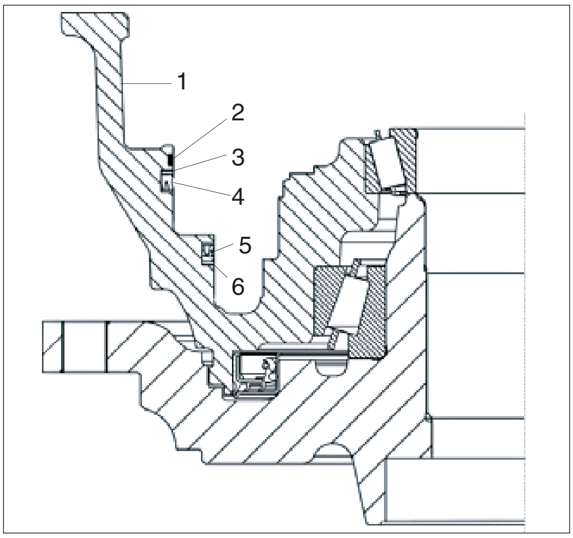
7409AAX020

⑮ Remove sealing elements (arrows also refer to AX022) from annular grooves of brake housing.



7409AAX021

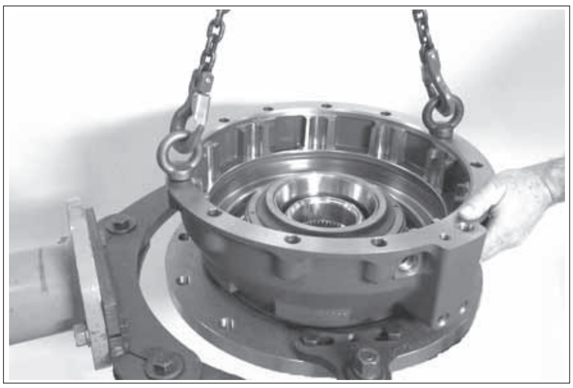
1 Brake housing
2 Guide ring
3 Support ring
4 Grooved ring
5 Grooved ring
6 Support ring



7409AAX022

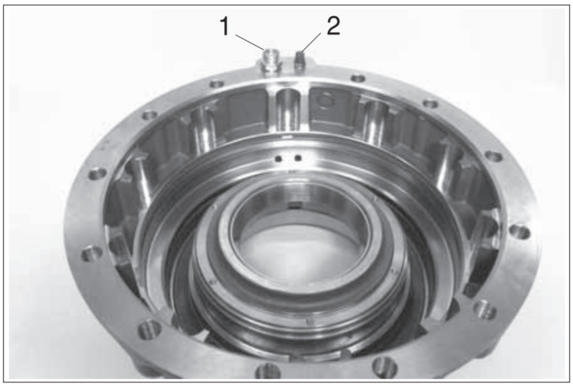
⑯ Lift brake housing off the output shaft by means of lifting device.

Lifting chain	5870 281 047
Eyebolts	5870 204 071



7409AAX023

⑰ Remove screw neck (1) and breather valve (2).



7409AAX024

⑱ Lift off shaft seal by lever and remove both bearing outer rings from brake housing, if required.

Pry bar	5870 345 071

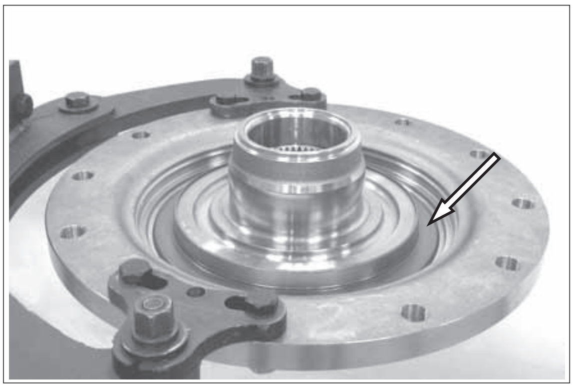
7409AAX025

⑲ Pull bearing inner ring from output shaft.

Rapid grip	5873 014 016
Basic tool	5873 004 001

7409AAX026

⑳ If required, disassemble wear sleeve (arrow) of combi seal ring.



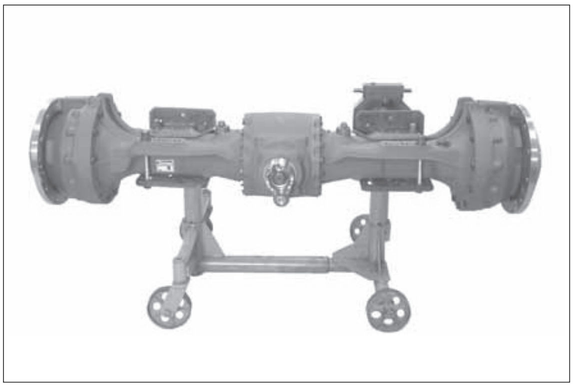
7409AAX027

(2) Differential and input disassembly

■ Differential

① Mount axle on assembly truck.

Assembly truck	5870 350 000
Supporting bracket (2EA)	5870 350 106



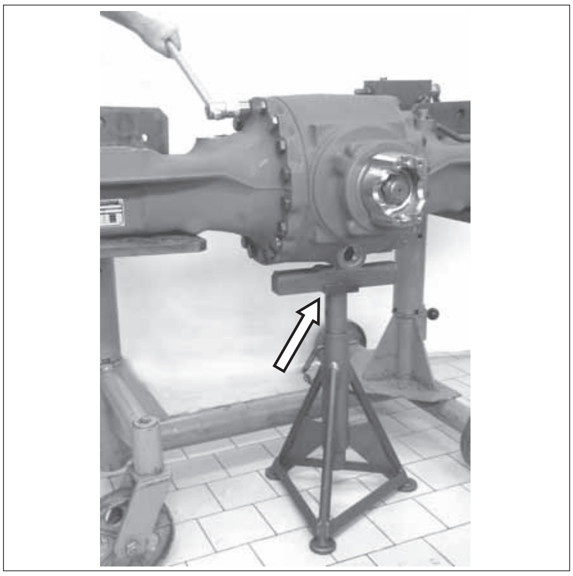
7409AAX101

※ The following illustration shows the removal of the differential in the course of a complete disassembly of the axle.
To remove the differential, however, it is possible to separate the axle half assy (axle housing with output) from the axle drive housing.

※ Secure axle by means of a support (arrow), risk of accident.

② Take up axle housing half on crown wheel side with lifting chain (see AX103) and loosen bolted connection (axle housing /axle drive housing).

Lifting chain	5870 281 047
Eyebolts	5870 204 071

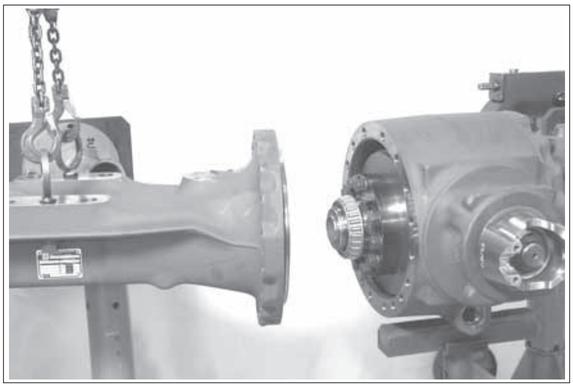


7409AAX102

③ Separate axle housing from axle drive housing.

※ Pay attention to releasing axial roller ring and differential.

※ Pay attention to releasing stub shaft and sun gear shaft with inserted shim (sun gear shaft clearance).
Mark allocation of shim versus sun gear shaft /stub shaft and output side, assembly aid.



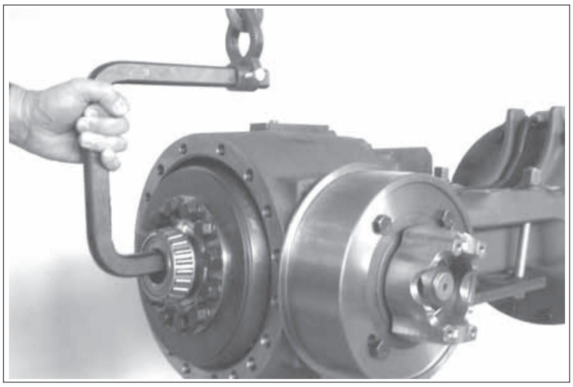
7409AAX103

Conventional differential (STD)

※ Description of disassembly and reassembly of the limited slip differential from page 3-218.

① Lift differential assy out of axle drive housing.

Lifting bracket	5870 281 033



7409AAX104

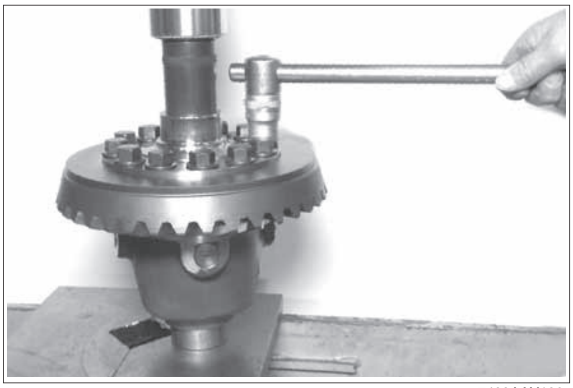
② Pull both taper roller bearings off the differential carrier.

Grab sleeve	5873 002 035
Basic tool	5873 002 001
Pressure piece	5873 100 047

7409AAX105

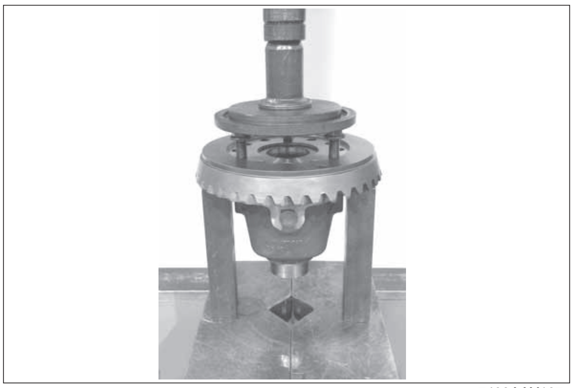
③ Hold differential by means of a press. Loosen locking screws and remove lid.

※ Locking screws permitted for one time use only.



7409AAX106

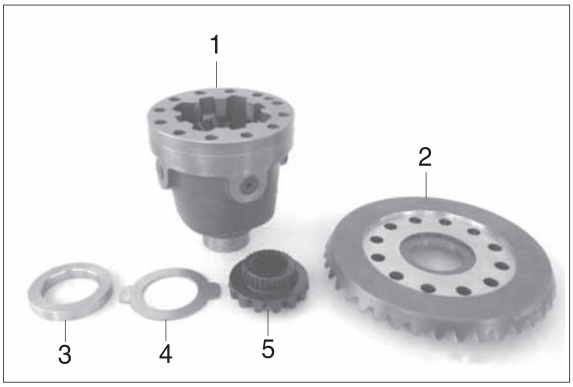
④ Insert some locking screws, position pressure plate and press differential carrier off the crown wheel.



7409AAX107

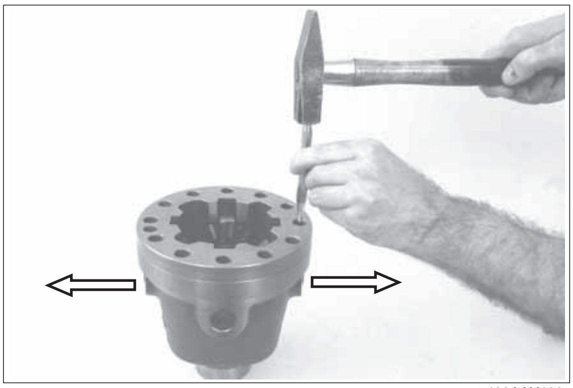
⑤ Remove axle bevel gear, thrust washer and constant spacer.

1 Differential carrier
2 Crown wheel
3 Constant spacer
4 Thrust washer
5 Axle bevel gear

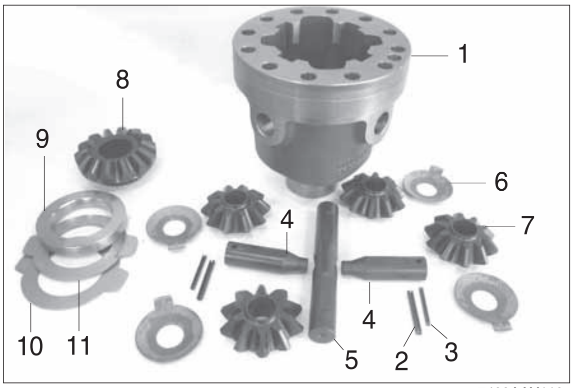


7409AAX108

⑥ Force slotted pin (fixing) out of both spider shaft halves (split version), then remove both spider shaft halves in arrow direction and take components (see AX110) out of differential carrier.


7409AAX109

1 Differential carrier
2 Slotted pin (2EA)
3 Slotted pin (2EA)
4 Spider shaft (split version)
5 Spider shaft (one piece)
6 Spider gear (4EA)
7 Thrust washer (4EA)
8 Axle bevel gear
9 Constant spacer
10 Outer disc
11 Thrust washer

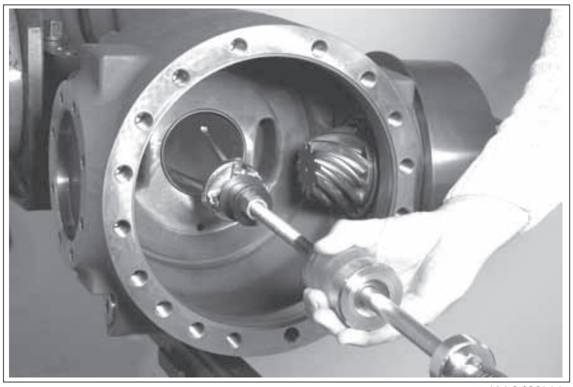


7409AAX110

⑦ Pull bearing outer ring out of hole by means of the striker and remove shim behind (backlash).

※ Mark shim (position /bearing allocation) assembly aid.

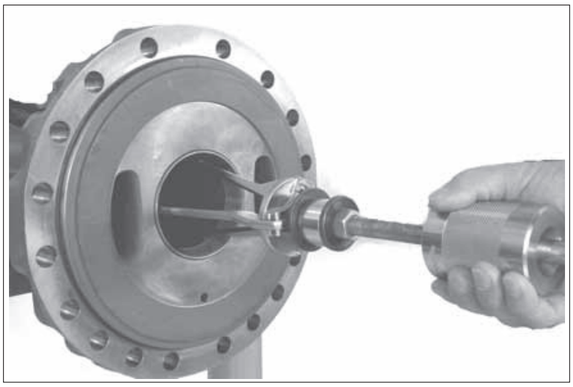
Striker 5870 650 004


7409AAX111

⑧ Remove O-ring (arrow).
Remove bearing outer ring and shim behind (rolling torque differential bearing) from axle housing.

※ Mark shim (position/bearing allocation), assembly aid.

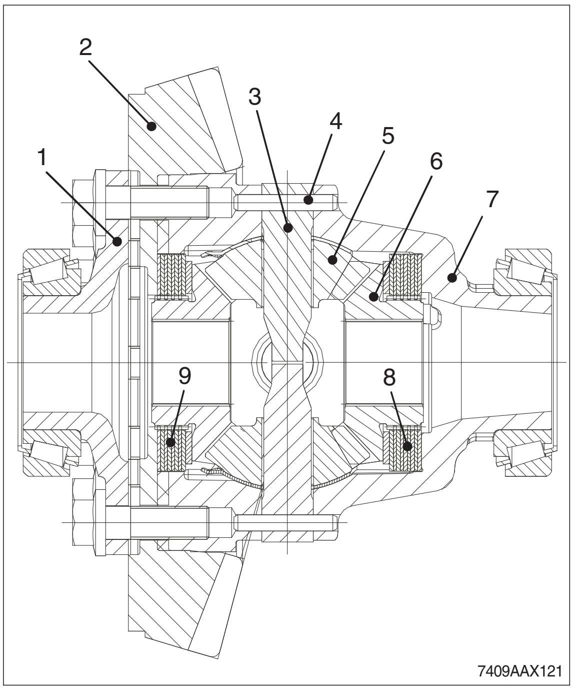
Striker 5870 650 004



7409AAX112

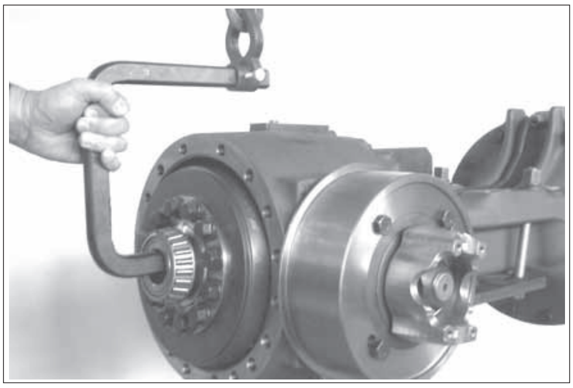
Limited slip differential (option)

1 Housing cover
2 Crown wheel
3 Spider shaft (split version) (2EA)
4 Double slotted pins
(5 × 50 and 8 × 50 mm)
5 Spider gear
6 Axle bevel gear
7 Differential carrier
8 Disk package "A"
9 Disk package "B"



7409AAX121

① Use the lifting device to lift the differential out of the axle drive housing.



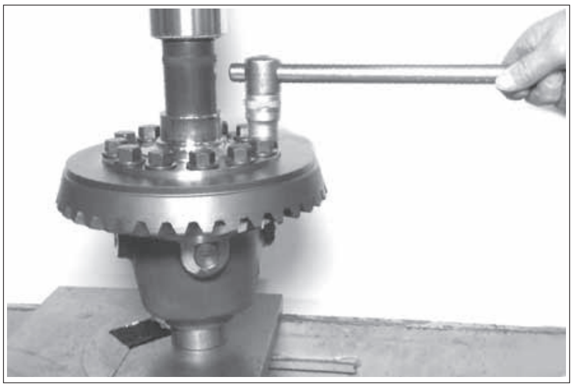
7409AAX122

② Pull the tapered roller bearing from the housing cover /differential carrier.

Grab sleeve	5873 002 035
Basic tool	5873 002 001
Pressure piece	5873 100 047

7409AAX123

③ Use the press to fix the differential ; loosen the locking screws and remove the cover.

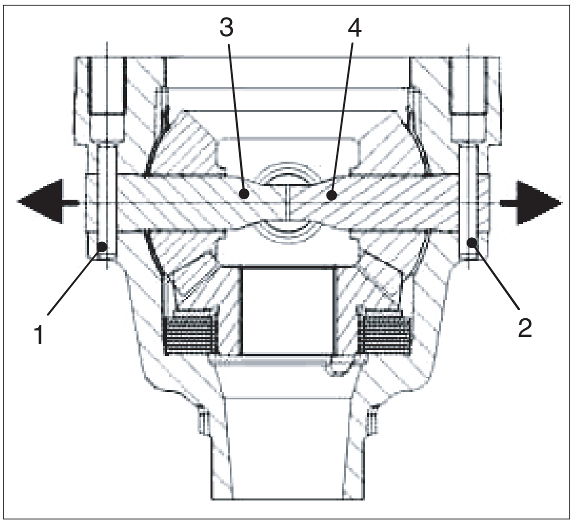


7409AAX124

④ Mount some locking screws, position the pressure plate and press the differential carrier from the crown wheel.
Remove the releasing disk package, thrust washer and axle bevel gear.

7409AAX125

⑤ Force the double slotted pins out (position 1 and 2) and pull the spider shafts (position 3 and 4) in direction of arrow out of the holes. Then remove the remaining single parts.

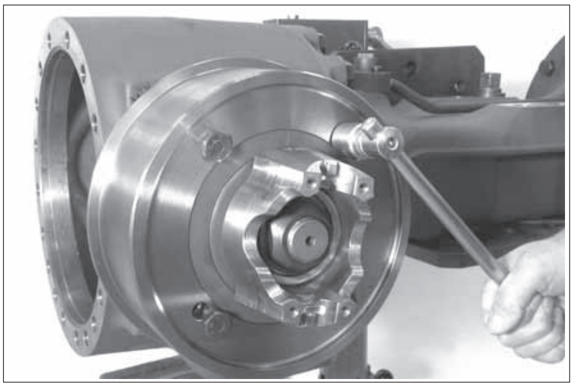


7409AAX126

■ Input

For axle version with pivot bearing only (see AX128)

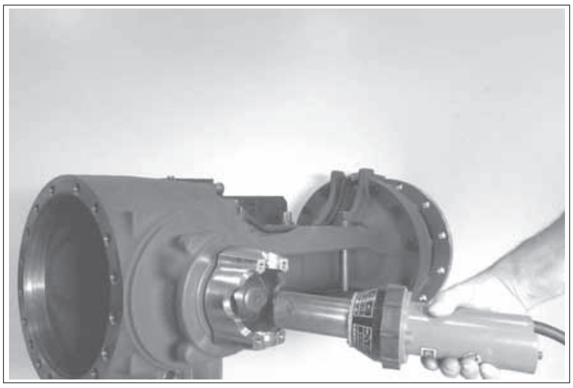
① Loosen bolted connection and pull off bearing flange.



7409AAX128

② Heat up hex nut (loctite locking compound) by means of hot air blower disassembly aid.

Hot air blower 230 V	5870 221500
Hot air blower 115 V	5870 221501

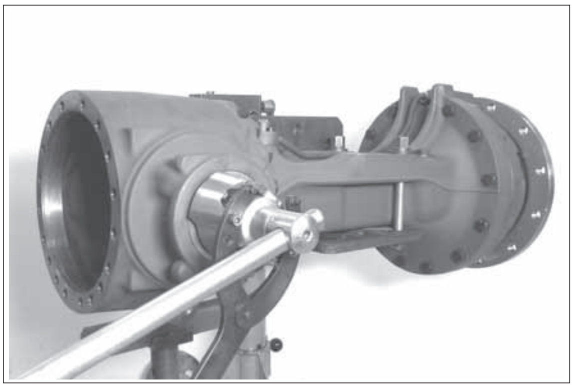


7409AAX129

③ Fix input flange by means of a clamping fork, loosen hex nut.

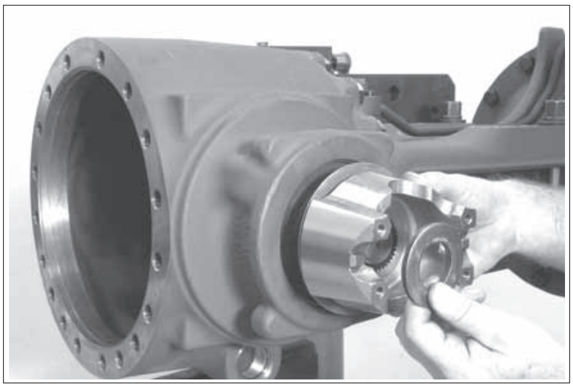
⚠ **Secure axle by means of a support, risk of accident.**

Clamping fork	5870 240 025



7409AAX130

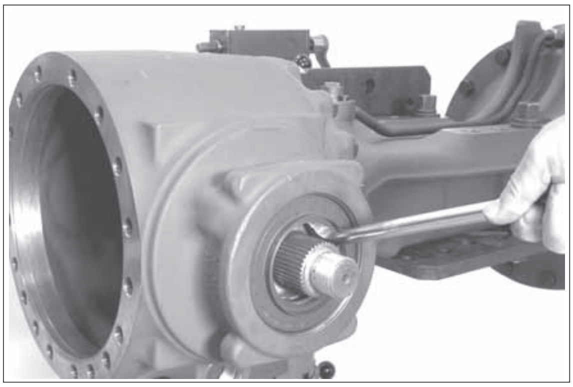
④ Remove disc and pull off flange.
Remove screen sheet from output flange, if required.



7409AAX131

⑤ Lift shaft seal off.

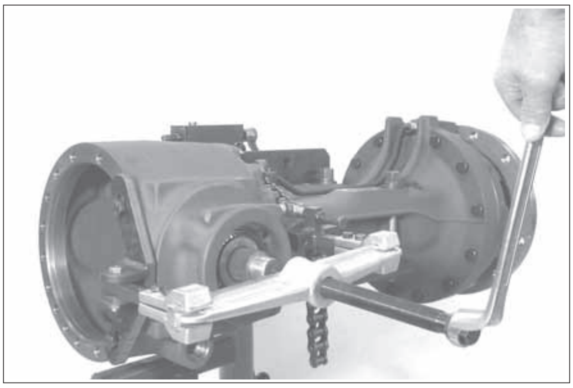
Pry bar	5870 345 071



7409AAX132

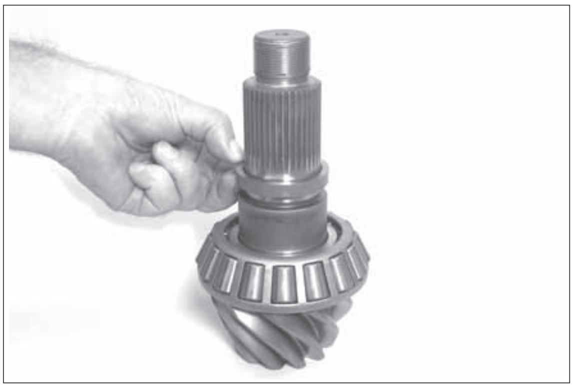
⑥ Press input pinion out by means of press off tool and remove releasing bearing inner ring.

Press-off tool	5870 280 044



7409AAX133

⑦ Remove spacer ring from pinion.



7409AAX134

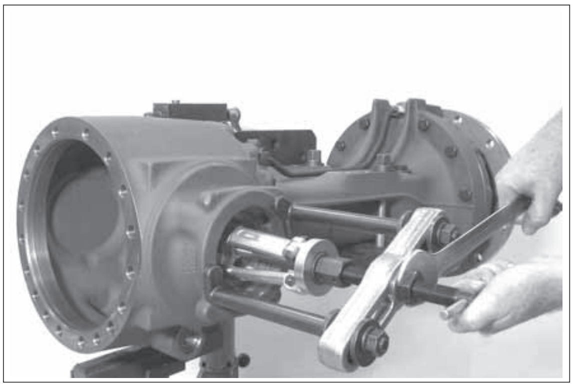
⑧ Pull bearing inner ring off the pinion.

Grab sleeve	5873 012 013
Basic tool	5873 002 001

7409AAX135

⑨ Pull-off outside bearing outer ring.

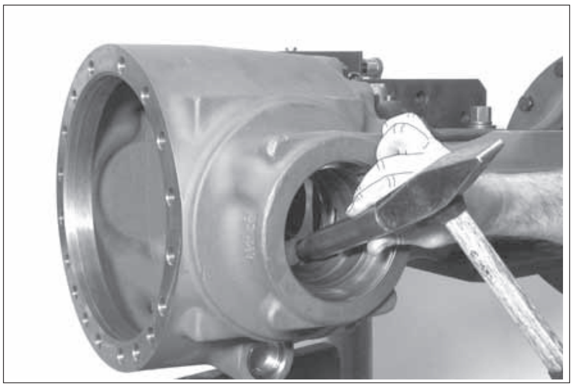
Internal extractor	5870 300 019
Counter support	5870 300 020



7409AAX136

⑩ Force bearing outer ring out of inner bearing hole, pay attention to shim behind (contact pattern/bevel gear set).

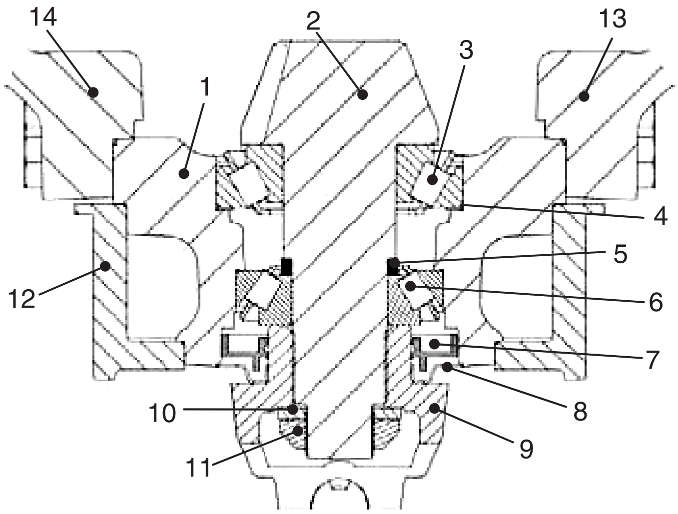
※ Mark shim (thickness/position and bearing allocation), assembly aid.



7409AAX137

2) ASSEMBLY

(1) Input assembly



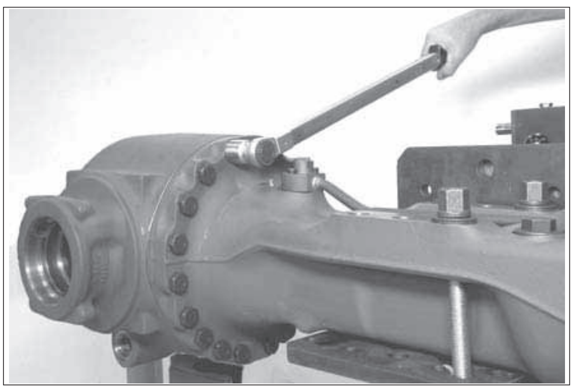
7409AA201

1	Axle drive housing	8	Protection plate
2	Input pinion	9	Input flange
3	Tapered roller bearing	10	Disc
4	Shim for contact pattern (bevel gear set)	11	Hexagon nut
5	Spacer ring (bearing roller torque/ pinion bearing)	12	Bearing flange (only for axle version with pivot bearing)
6	Tapered roller bearing	13	Axle housing/ part I
7	Shaft seal	14	Axle housing/ part II (crown-wheel side)

※ Depending on the version, crown wheel and bevel pinion may be mounted as a bevel gear set (for production reasons, crown wheel and pinion are paired and show an identical pairing number see AX204) or as single parts, the respective version has to be taken from the specification of the corresponding spare parts list.
If a bevel gear set is specified, the crown wheel must only be replaced together with the pinion.

Only for assembly of new parts or if disassembled :
Mount O-ring on axle housing /part I and install axle drive housing, pay attention to radial installation position.

· Tightening torque (M18×1.5/10.9) :
39.8 kgf · m (288 lbf · ft)



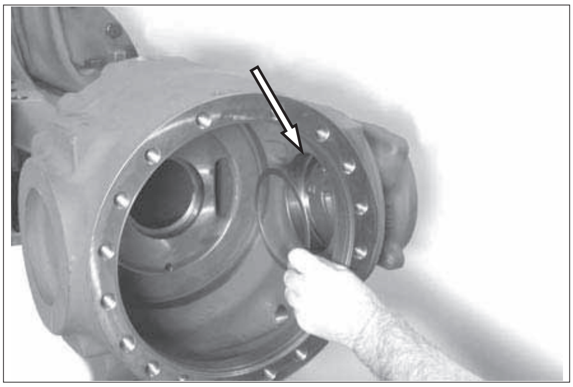
7409AAX202

Determine shim for pinion position required to obtain an optimum contact pattern on the bevel gear set (crown wheel /pinion):

※ We recommend to reinstall the shim found during disassembly (e.g. "S" = 1.20 mm, see disassembly instructions, page 3-222, AX137) into the inner bearing hole /pinion bearing.

※ The contact pattern required on the bevel gear set, however, is decisive. If this is not achieved, see contact pattern check on page 3-234, AX237, correct the pinion position with a corresponding shim.

※ As an alternative, a basic setting of the required pinion position can be made, e.g. when assembling a new part, as shown below (see AX204~AX206).

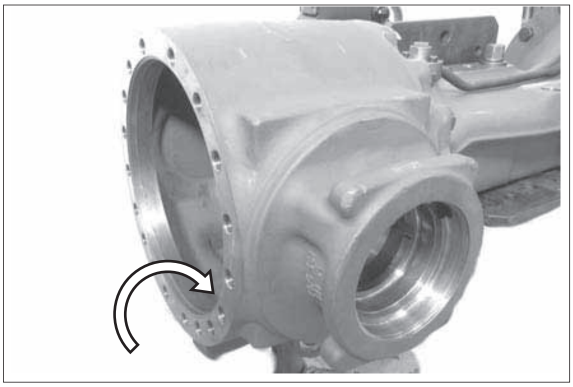


7409AAX203

Basic setting of pinion position :

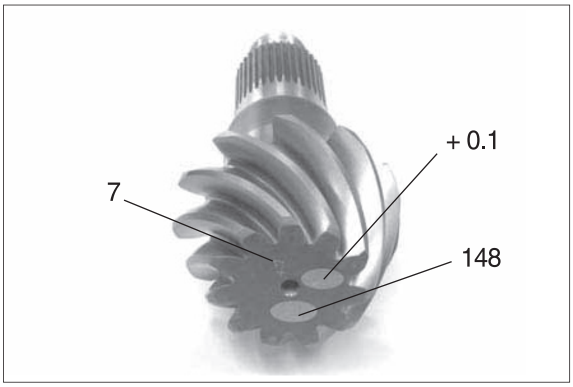
① Read dimension "I" = production dimension /axle drive housing (from axle center to bearing contact /inner bearing hole) from the axle drive housing (position, see arrow).

Dimension I e.g. .... 182.81 mm



7409AAX204

② Read pinion dimension "X" (pinion basic dimension e.g. = 148) from pinion, or determine it in case of a + or - deviation from pinion dimension due to production (value concerned is marked by hand on the pinion, e.g.+ 0.1).



7409AAX205

Pinion dimension "X" (without + or - deviation value) = 148.0 mm
Pinion dimension "X" with indication of + 0.1 deviation = 148.1 mm
Pinion dimension "X" with indication of - 0.1 deviation = 147.9 mm

Dimension II (pinion dimension X)
e.g. .... 148.00 mm

※ Pairing number e.g. 7 - only for version with bevel gear set, see note AX201.

③ Determine dimension "III" bearing width, ensure here that the rollers are located without any play (rotate bearing inner ring in both directions several times, roller setting).
Since the installed roller bearing is subject to a pre-load in installation position, deduct an experience value of -0.05 mm.


7409AAX205

Dimension III = e.g. ....
33.67 mm - 0.05 mm → 33.62 mm

CALCULATION EXAMPLE :

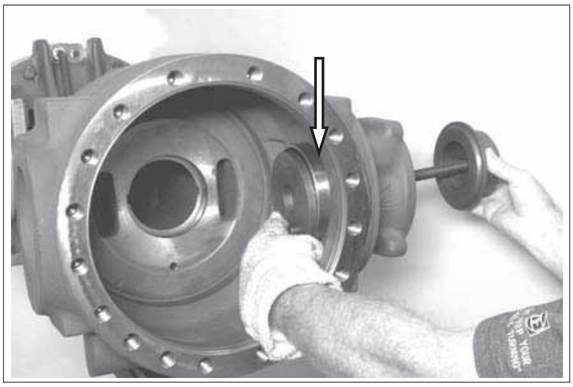
Dimension I	182.81 mm
Dimension II + III (148.00 + 33.62)	-181.62 mm
Result	= 1.19 mm
Required shim "S"	→ 1.20 mm

Insert determined shim into the hole of the axle drive housing, see AX203.

Digital depth gauge	5870 200 072
Gauge blocks	5870 200 066

④ Undercool bearing outer ring (see arrow) and bring it into contact position in the inner bearing hole /pinion bearing by means of the fixture.

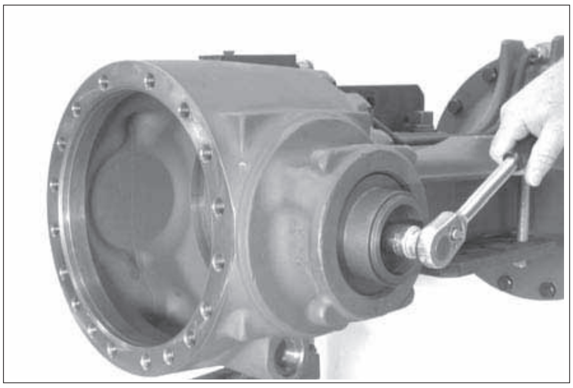
Assembly fixture 5870 345 049



7409AAX207

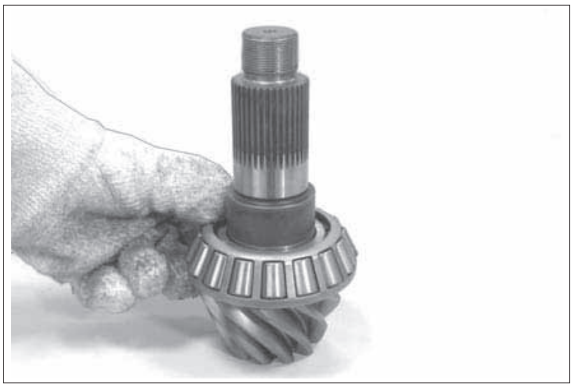
⑤ Install outside bearing outer ring /pinion bearing.

Assembly fixture 5870 345 049



7409AAX208

⑥ Mount heated bearing inner ring until contact position and adjust after cooling down.



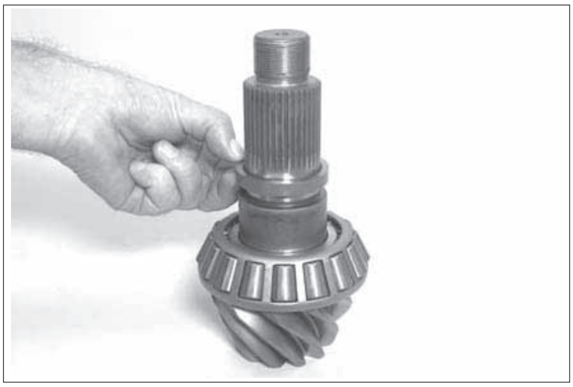
7409AAX209

Set rolling torque of input pinion bearing 0.11~0.23 kgf · m (0.81~1.70 lbf · ft) (without shaft seal) :

⑦ Mount spacer ring (s = optional).

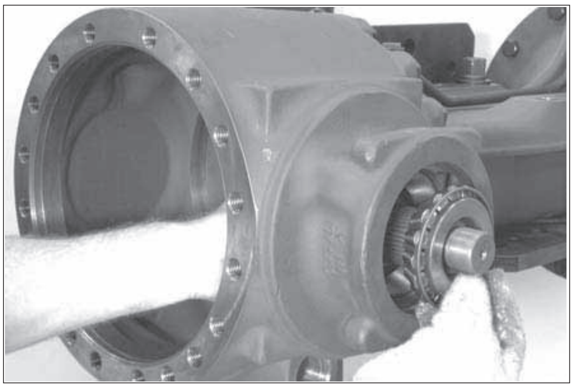
※ We recommend to reinstall the spacer ring found during disassembly (e.g. s = 8.7 mm).
If the originally installed shim was replaced (contact pattern /bevel gear set), see page 3-213, AX203, also install a spacer ring adjusted by the same correction value.

※ The required bearing rolling torque of 0.11~0.23 kgf · m (0.81~1.70 lbf · ft) (without shaft seal), however, is decisive, in case it is not achieved, see bearing rolling torque check (see AX213), correct the bearing rolling torque with a corresponding shim.



7409AAX210

⑧ Insert preassembled input pinion, mount heated bearing inner ring until contact is obtained.



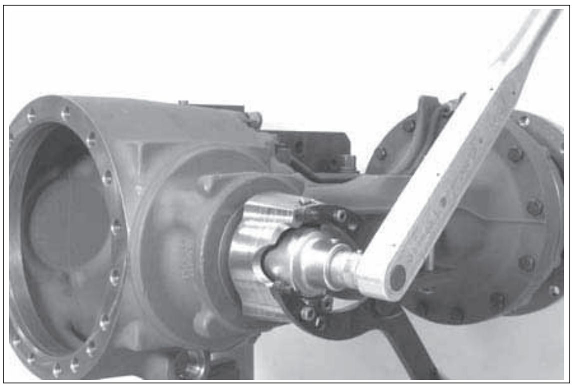
7409AAX211

⑨ Mount flange, fix with disc and hex. nut.

※ While tightening, rotate pinion in both directions several times (roller setting).

· Tightening torque (M36 × 1.5) :
71.4 kgf · m (516 lbf · ft)

Clamping fork 5870 240 025



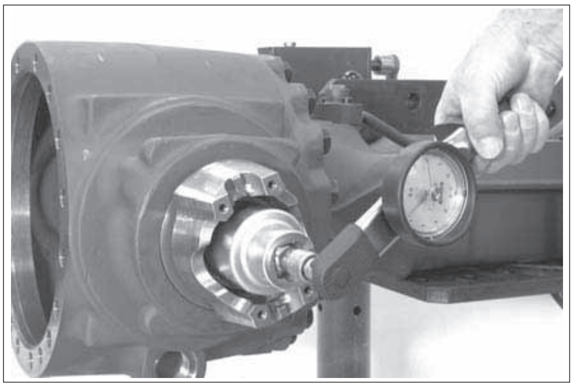
7409AAX212

⑩ Check rolling torque of the pinion bearing.
Bearing rolling torque (without shaft seal) : 0.11~0.23 kgf · m (0.81~1.70 lbf · ft).
Try to achieve upper value.

※ In case of a deviation from the required rolling torque correct it with a corresponding spacer ring (see AX210, page 3-227).

Torque wrench 5870 203 031
Reducing adapter ¼" to ½" 5870 656 056
Reducing adapter ½" to ¾" 5870 656 057

For assembly of shaft seal stick to description in page 3-184 (after completed differential assembly and positive contact pattern check).

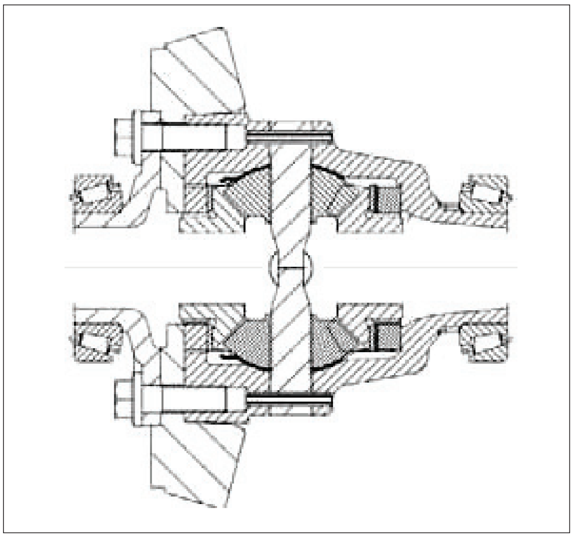

7409AAX213

(2) Differential assembly

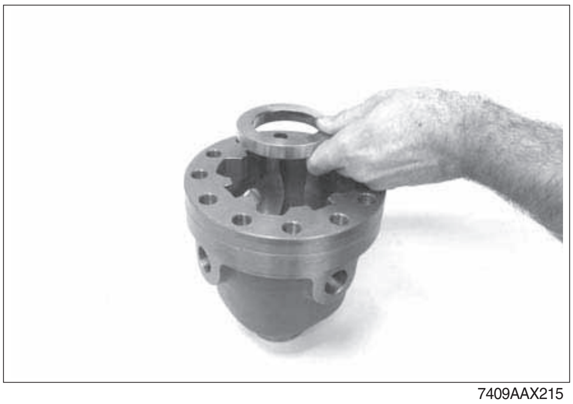
Conventinaol differential (STD)

① Illustration in figure AX214 shows conventional differential.

※ Description of the reassembly of the limited slip differential from page 3-181.

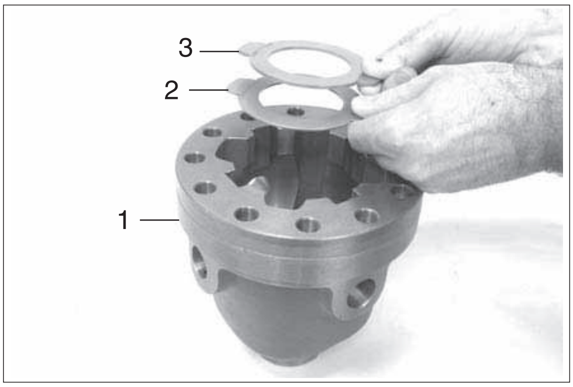

7409AAX214

② Insert constant spacer into differential carrier.


7409AAX215

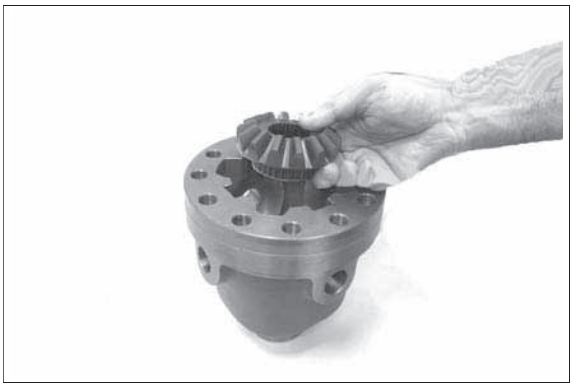
③ Insert steel outer disc (2) and thrust washer (3) into the differential carrier (1)

※ Pay attention to installation position of outer disc and thrust washer see position/figure.



7409AAX216

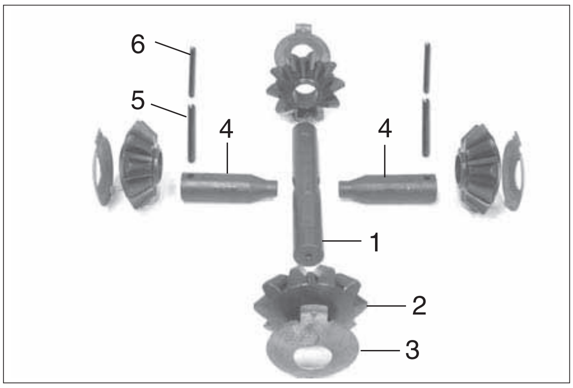
④ Insert axle bevel gear.



7409AAX217

⑤ Differential spider single parts :

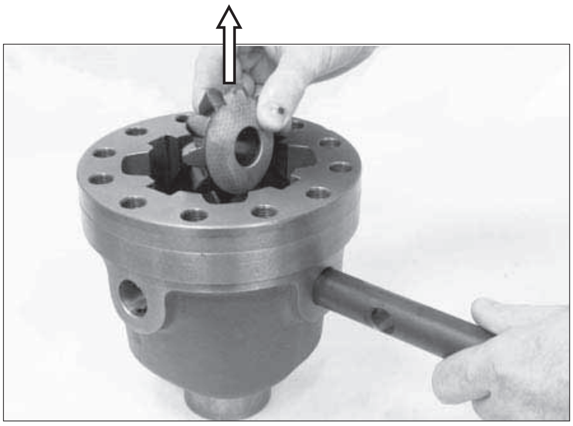
1 Spider shaft (one part)
2 Spider gear (4EA)
3 Thrust washer (4EA)
4 Spider shaft (split version)
5 Slotted pin (2EA)
6 Slotted pin (2EA)



7409AAX218

⑥ Insert one part spider shaft (1) into hole / differential (without slotted pin location hole) thereby mounting two spider gears (2) with thrust washers (3).

※ Insert thrust washers with tabs showing upwards (see arrow) and being located in recess.

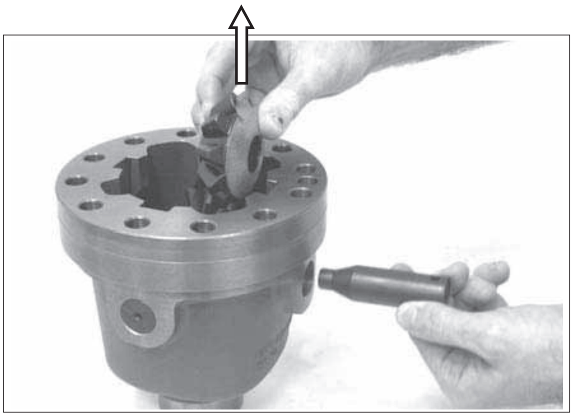


7409AAX219

⑦ Install split spider shaft (4) with spider gears (2) and thrust washers (3).

※ Insert thrust washers with tabs showing upwards (see arrow) and being located in recess.

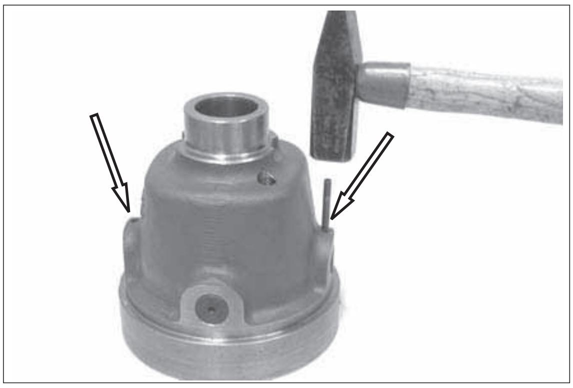
※ Pay attention to installation position of spider shaft/ halves-slotted pin/location holes of spider shaft towards differential carrier.



7409AAX220

⑧ Fix spider shaft half (arrows) with double slotted pins.

※ Install double slotted pins, always with slots in a 180° offset position to each other.



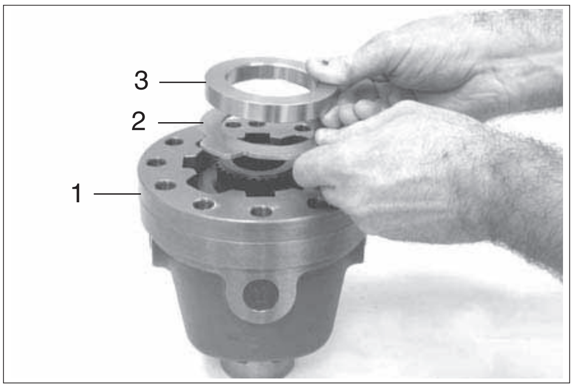
7409AAX221

⑨ Insert second axle bevel gear into differential carrier.

7409AAX222

⑩ Insert thrust washer (2) and constant spacer (3) into differential carrier (1).

※ Pay attention to installation position of thrust washer and constant spacer, see position /figure.

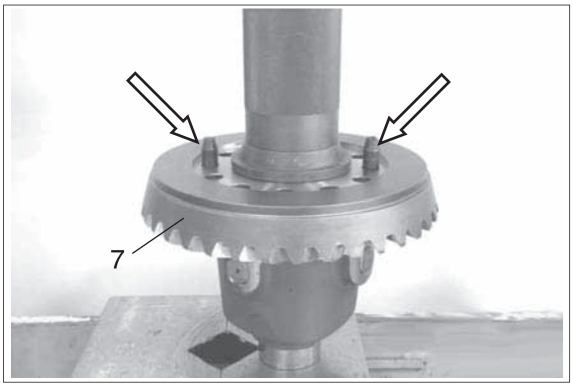


7409AAX223

⑪ Install two adjusting screws (M16) (see arrows) and press crown wheel to contact position.

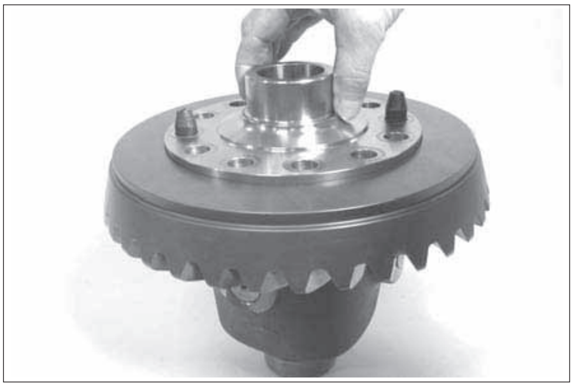
For input version with bevel gear set only, see specification in the corresponding spare parts list :
If a bevel gear set is specified, the pairing number/crown wheel (e.g. "7") must be identical with pairing number/ input pinion (also refer to note on page 3-225, AX205).

Adjusting screws (M16 × 1.5)
5870 204 040



7409AAX224

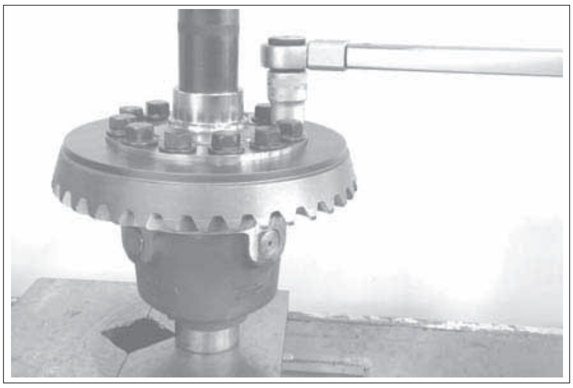
⑫ Mount housing lid.


7409AAX225

⑬ Fix differential by means of a press and fix lid with new locking screws.

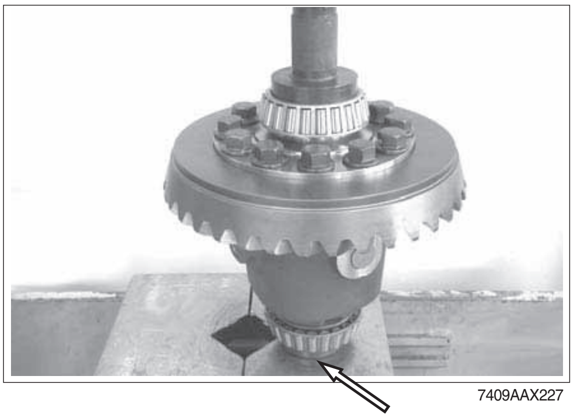
※ Locking screws permitted for one time use only.

· Tightening torque (M16 × 1.5/12.9) :
42.8 kgf · m (302 lbf · ft)


7409AAX226

⑭ Press both bearing inner rings to contact position.

※ Use suitable support (arrow) for provisionally mounted bearing ring, roller bearing cage, risk of damage.

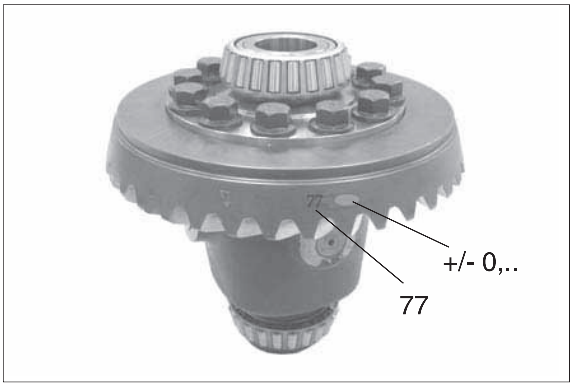

7409AAX227

Determine shims for bearing rolling torque /differential bearing and backlash /bevel gear set

⑮ Read crown wheel labeling (test dimension) from crown wheel rear side.

Determine required shims by means of the read value (crown wheel) and the relating specifications of the following table :

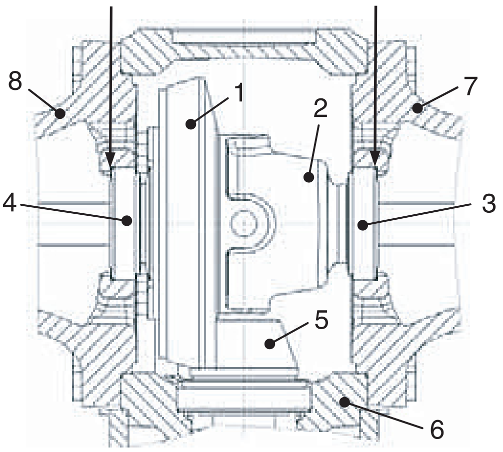
Test dimension, e.g. "77" mm is stamped on the crownwheel rear side, without + or - deviation, which corresponds to the real value/test dimension "77" in the following table. The required shims according to this real value /test dimension are allocated in the following table.



7409AAX228

⑯ Any + or - deviation from the test dimension due to production is manually applied on the crown wheel rear side (e.g. - 20 or - 10 or 10).
The required shims according to this real value /test dimension are allocated in the following table.

1 Crown wheel
2 Differential carrier
3 Tapered roller bearing (crown wheel side)
4 Tapered roller bearing (differential carrier side)
5 Input pinion
6 Axle drive housing
7 Axle housing
8 Axle housing



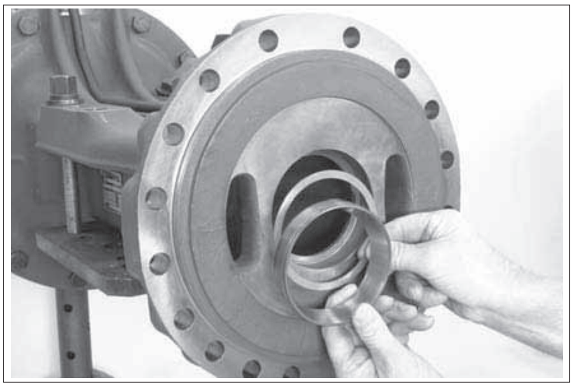
7409AAX229

Shims for differential				
Crown wheel marking	- 20	- 10	-	10
Deviation	- 0.2	- 0.1	0	0.1
Shim / Differential cage side Shim thickness	**0.8**	**0.9**	**1.0**	**1.1**
Shim	ZGAQ-02566	ZGAQ-02567	ZGAQ-02568	ZGAQ-02569
Shim / Crown wheel side Shim thickness	**1.2**	**1.1**	**1.0**	**0.9**
Shim Conventional, Limited slip	ZGAQ-02570	ZGAQ-02569	ZGAQ-02568	ZGAQ-02567

⑰ Insert determined shim (e.g. s = 1.00 mm) and bearing outer ring into hole of axle housing on crown wheel side.

※ Observe allocation of shim regarding installation position.

Driver tool	5870 058 021
Handle	5870 260 002

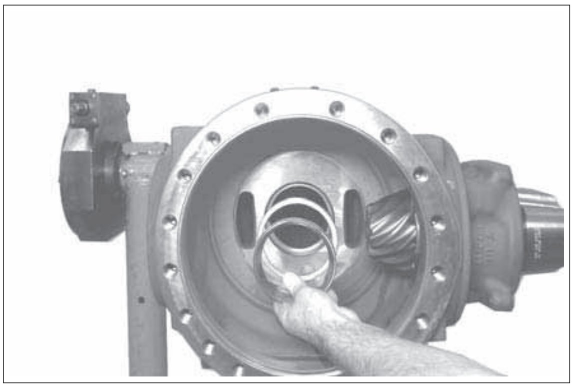


7409AAX230

⑱ Insert determined shim (e.g. s = 1.00 mm) and bearing outer ring into hole of axle housing on differential carrier side.

※ Observe allocation of shim regarding installation position.

Driver tool	5870 058 021
Handle	5870 260 002



7409AAX231

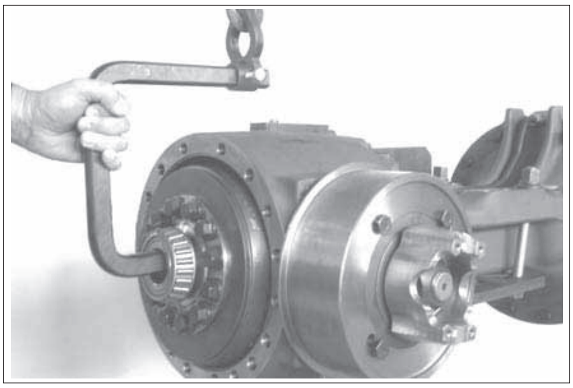
Contact pattern check of bevel gear set :

⑲ Cover some tooth flanks of crown wheel with marking ink (contact pattern check).

7409AAX232

⑳ Insert preassembled differential.

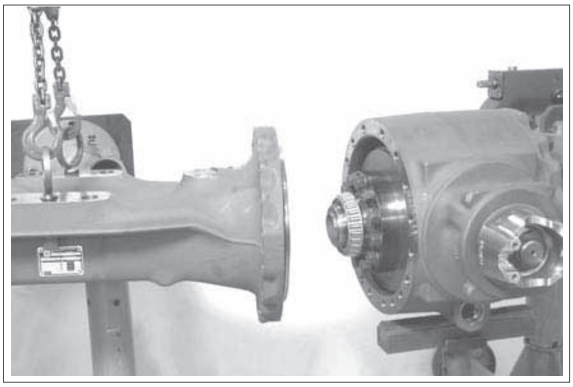
Lifting bracket	5870 281 033



7409AAX233

㉑ Position axle housing of crown wheel side (without O-ring) on axle drive housing, pay attention to radial installation position.

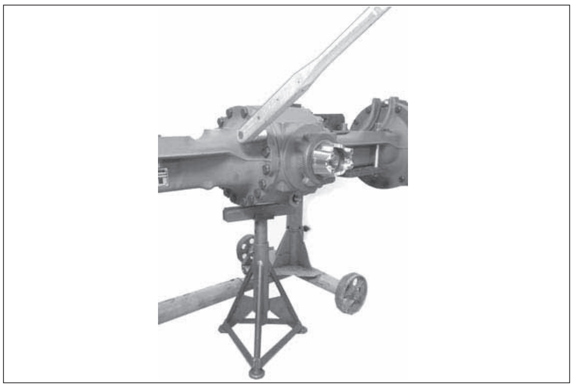
Lifting chain	5870 281 047
Eyebolts	5870 204 071



7409AAX234

㉒ Bring axle housing to contact position with hexagon screw and fix temporarily. Rotate differential several times in both directions, roller setting (also see AX236).

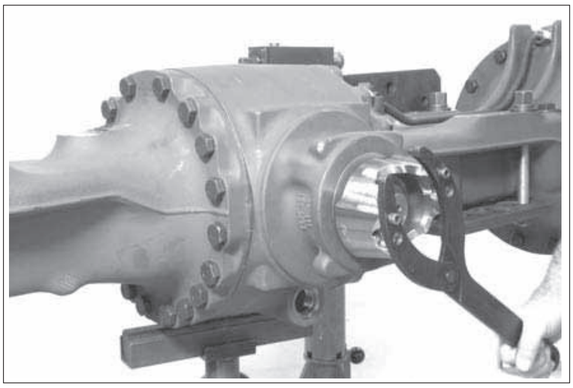
· Tightening torque (M18/10.9) :
39.8 kgf · m (288 lbf · ft)



7409AAX235

㉓ Roll input pinion over crown wheel in both directions (coast-drive flank meshing-contact pattern).

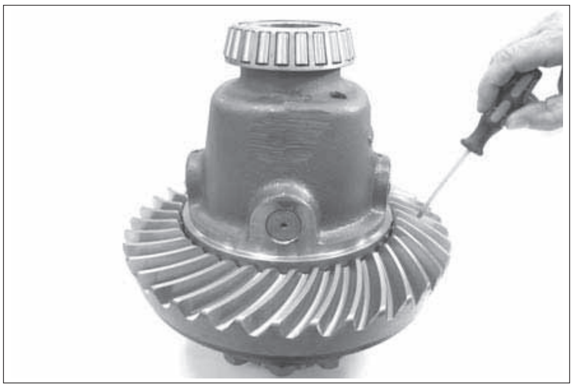
Clamping fork	5870 240 025



7409AAX236

㉔ Disassemble differential.
Compare contact pattern.

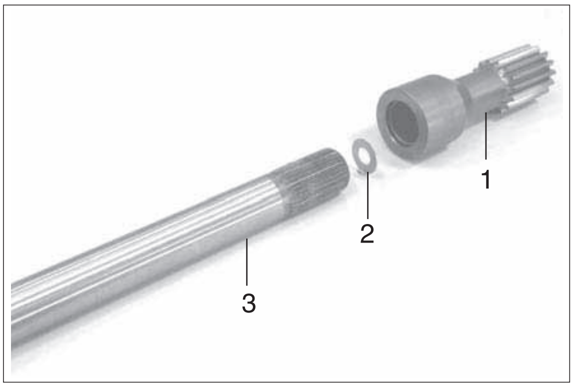
※ If contact pattern differs considerably, use a suitable shim for correction (see AX203, page 3-224).



7409AAX237

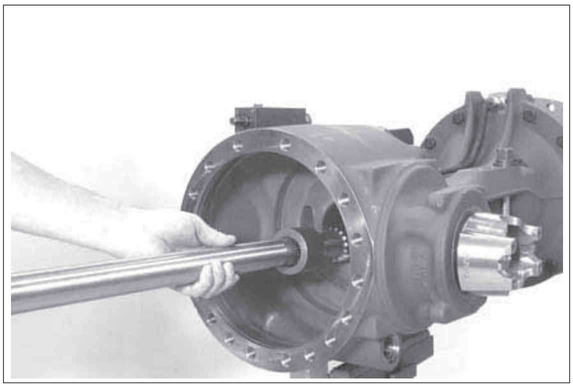
㉕ If disassembled :
Insert shim(s) (2) into sun gear shaft (1) and mount stub shaft (3).

※ If position was not allocated, as specified in disassembly instructions on AX103, sun gear shaft clearance (see AX330~AX334) must be set on both output sides.



7409AAX238

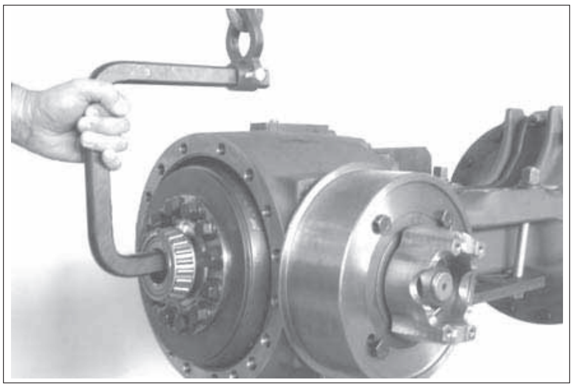
㉖ Insert preassembled stub shafts into both outputs (considering allocation to the correct output side).



7409AAX239

㉗ Remount differential by mounting stub shaft into gearing of axle bevel gear (differential).

Lifting bracket	5870 281 033

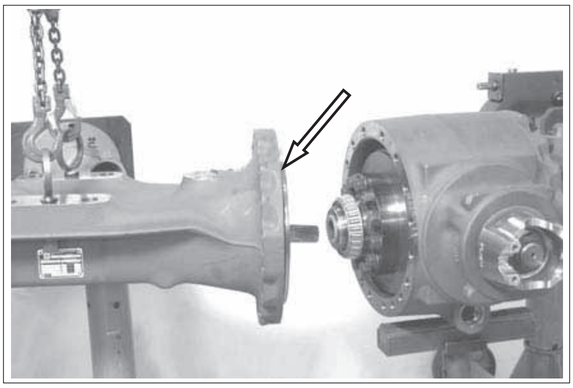


7409AAX240

㉘ Oil O-ring (arrow) and mount it.
Position complete axle half on the axle drive housing by mounting the stub shaft into the gearing of the axle bevel gear (differential).

※ Pay attention to radial installation position of output towards axle drive housing.

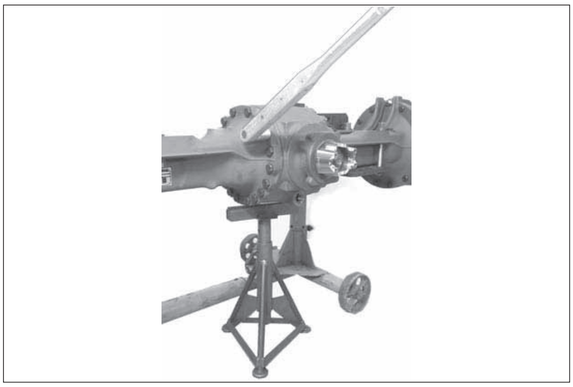
Lifting chain	5870 281 047
Eyebolts	5870 204 071



7409AAX241

㉙ Fix axle housing finally by means of hexagon screws.
Rotate differential several times in both directions roller setting.

· Tightening torque (M18/10.9) :
39.8 kgf · m (288 lbf · ft)

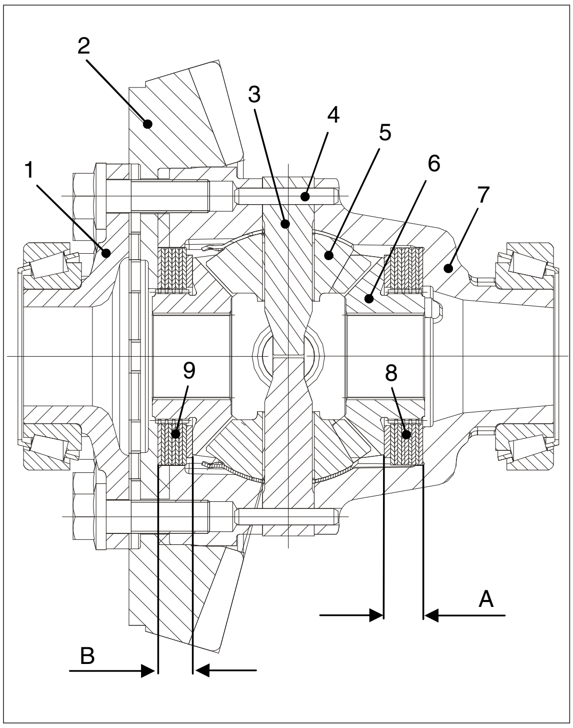


7409AAX242

(3) Limited slip differential (OPT) assembly

1 Housing cover
2 Crown wheel
3 Spider shaft (split version) (2EA)
4 Double slotted pins
(5 × 50 and 8 × 50 mm)
5 Spider gear
6 Axle bevel gear
7 Differential carrier
8 Disk package "A"
9 Disk package "B"

A Installation dimension = 18.6 - 0.2 mm
B Installation dimension = 16.7 - 0.2mm

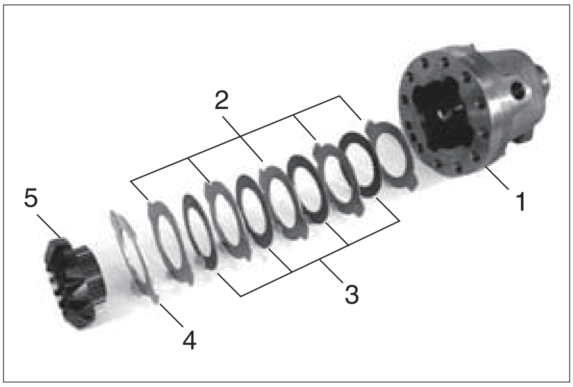


7409AAX247

① Mount the single parts as indicated on the figure right.

1 Differential carrier
2 5 outer disks (optional)
3 4 inner disks
4 Thrust washer (brass)
5 Axle bevel gear

※ Determine the installation dimension "A"= 18.6 - 0.2mm with the different outer disks (s =1.8~2.0 mm), see also AX247. Pay attention to the disk arrangement, AX248.
Oil the single parts.

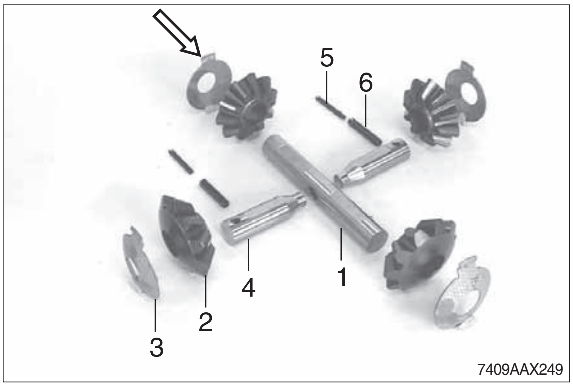


7409AAX248

② Mount the single parts, see AX249 and AX250.

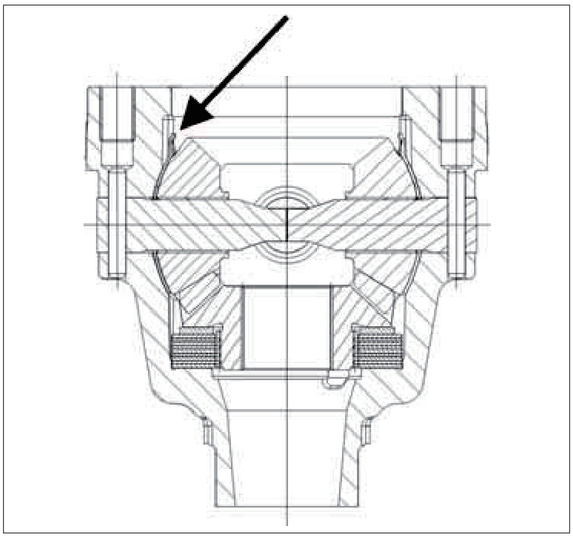
Single parts differential spider :

1 Spider shaft (one piece)
2 Spider gear (4EA)
3 Thrust washer (4EA)
4 Spider shaft (two pieces)
5 Slotted pins (2 pieces, 5 × 50 mm)
6 Slotted pins (2 pieces, 8 × 50 mm)



7409AAX249

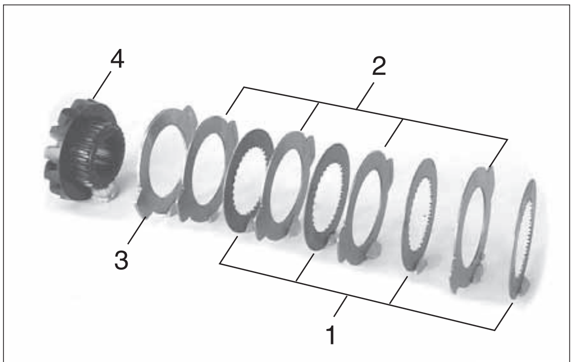
③ Pay attention to the radial installation position of the thrust washers (3). The torsional stop must show upwards, see arrow /AX250.
The two spider shafts (4) are fixed by means of double slotted pins (5 and 6). Thereby mount the slots of the slotted pins 180° offset to each other.


7409AAX250

④ Mount the single parts as indicated on the figure right.

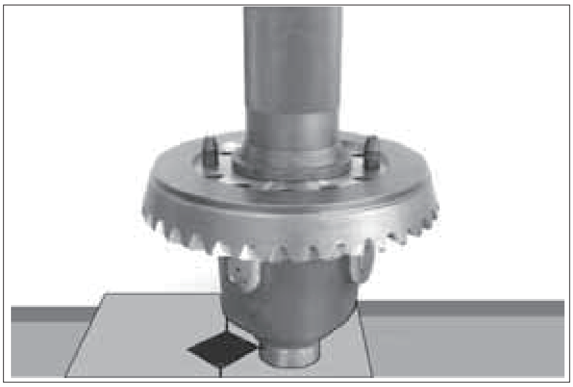
1 4 inner disks
2 4 outer disks (optional)
3 Thrust washer (brass)
4 Axle bevel gear

※ Determine the installation dimension ("B" = 16.7 - 0.2 mm) with the different outer disks =1.8~2.0 mm), see also AX247.
Pay attention to the disk arrangement, see AX251.
Oil the single parts.



7409AAX251

⑤ Mount two adjusting screws and press the crown wheel until contact is obtained.



7409AAX252

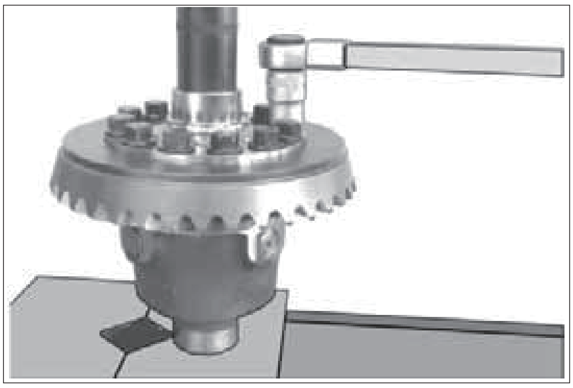
⑥ Mount the housing cover.

7409AAX253

⑦ Bolt housing cover, crown wheel and differential housing.

· Tightening torque (M16 × 1.5/12.9) : 42.8 kgf · m (302 lbf · ft)

※ It is only permitted to use new locking screws.

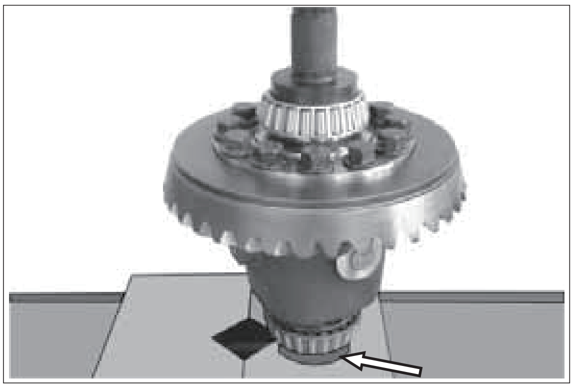


7409AAX254

⑧ Press both bearing inner rings until contact position is obtained.

※ Support the lower tapered roller bearing appropriately (arrow), pay attention that the roller cage is not damaged.

※ Description of differential reassembly from page 3-232.

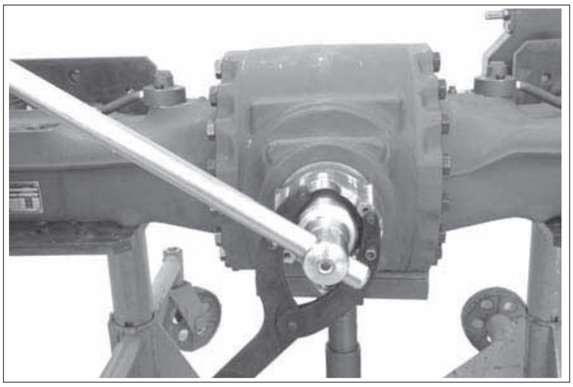


7409AAX255

(4) Shaft seal /input flange assembly

① Remove flange.

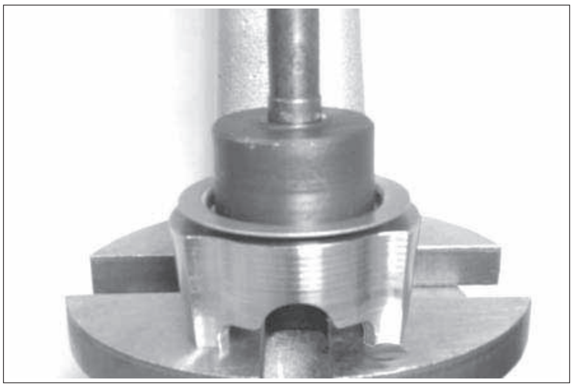
Clamping fork 5870 240 025



7409AAX289

② For new parts assembly only :
Mount protection plate on screen sheet on input flange and bring to contact position.

※ Pay attention to installation position of screen sheet also see AX292.

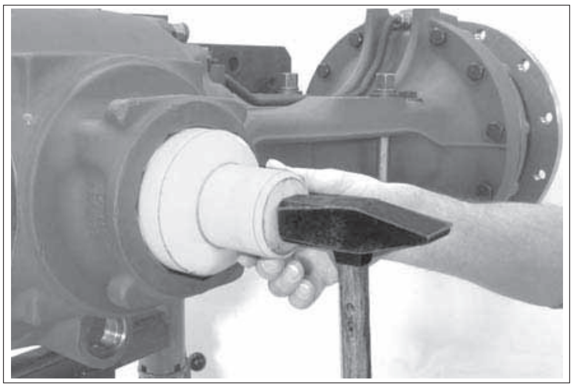


7409AAX290

③ Insert shaft seal (1), considering the required installation position (dimension "X") see detailed AX292.
Contact face (outer diameter) of shaft seal :
- if rubber - coated :
  wet with spirit (assembly aid)
- if made of metal :
  apply sealing agent (loctite no. 574)
Grease the shaft seal around the sealing and dust lip.

※ Ensure plane installation position of shaft seal use the specified driver tool to obtain an exact installation position of the shaft seal.

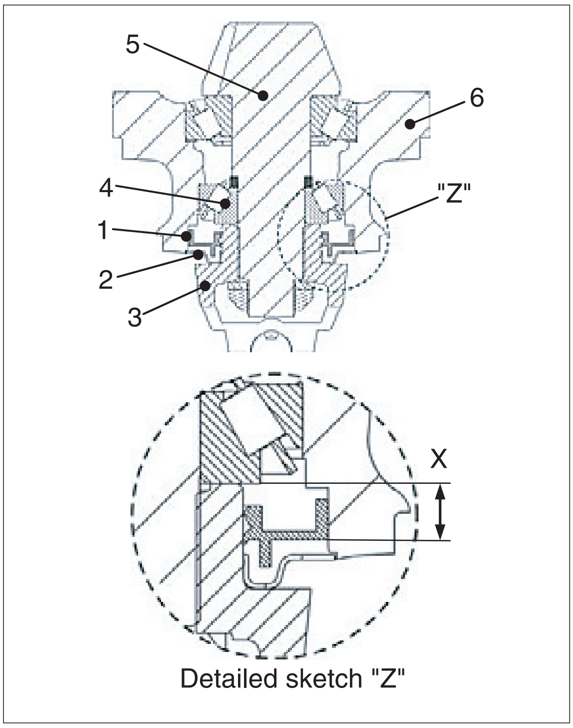
Driver tool 5870 048 225



7409AAX291

1 Shaft seal
2 Protection plate
3 Input flange
4 Tapered roller bearing
5 Input pinion
6 Axle drive housing

X = Install. dimension 16.6 ± 0.2 mm



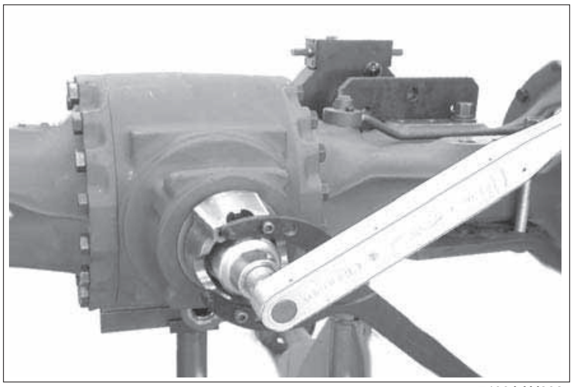
7409AAX292

④ Mount flange, fix with washer and hexagon nut.
During tightening, rotate pinion several times in both directions (roller setting).

※ Install hexagon nut with locking compound (loctite #262).

· Tightening torque (M36×1.5) :
71.4 kgf · m (516 lbf · ft)

Clamping fork 5870 240 025

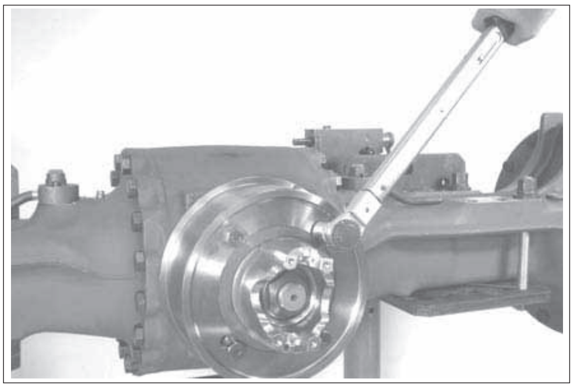


7409AAX293

(5) Pivot bearing assembly

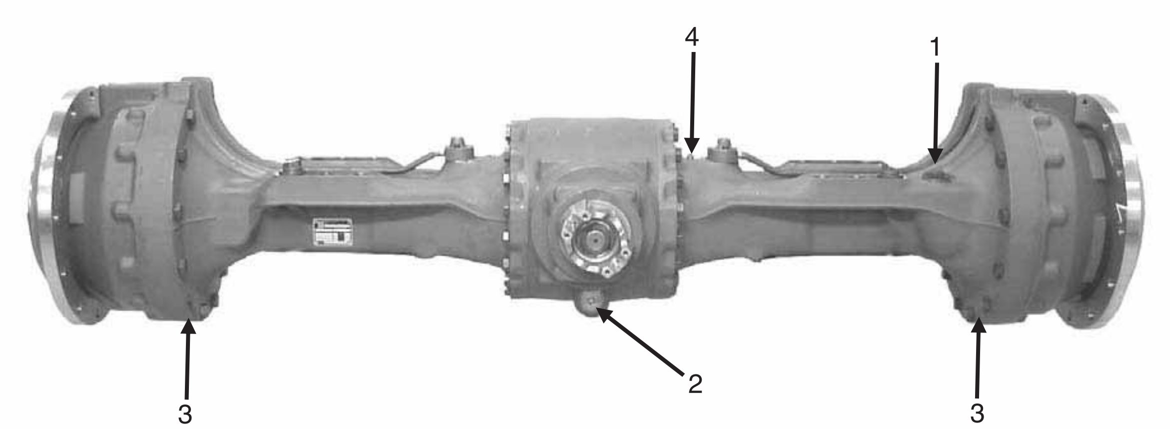
For version with pivot bearing only (AX294) :
Mount bearing flange and fix with hexagon screws.

· Tightening torque (M14/10.9) :
18.7 kgf · m (136 lbf · ft)



7409AAX294

(6) Oil dipstick, drain plugs and breather valve assembly



7409AAX295

1 Oil dipstick
2 Drain plug /axle drive housing
(Axle version with pivot bearing is fitted with another drain plug)
3 Drain plug/output
4 Depending on version
Breather valve or screw plug

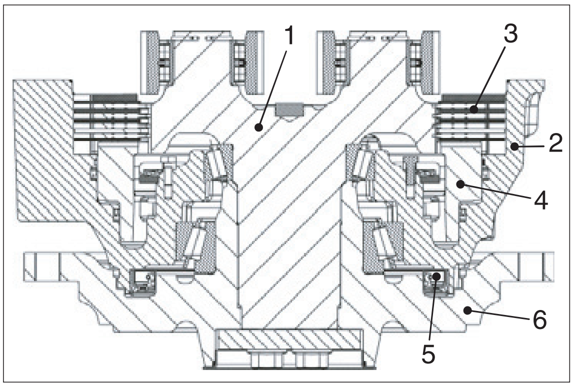
Provide oil dipstick and drain plugs with new O-ring and install them.
Mount breather valve or screw plug, depending on version.

· Tightening torque
Oil dipstick (M36 × 1.5) : 5.1 kgf · m (36.9 lbf · ft)
Drain plug (M36 × 1.5) : 5.1 kgf · m (36.9 lbf · ft)
Drain plug (M24 × 1.5) : 5.1 kgf · m (36.9 lbf · ft)
Breather valve /screw plug (M10 × 1) : 0.6 kgf · m (4.4 lbf · ft)

(7) Output and brake assembly

1 Planetary carrier
2 Brake housing
3 Disc package
4 Piston
5 Combi seal ring
6 Output shaft

Assembly truck	5870 350 000
Fixture	5870 350 112



7409AAX301

Close apertures of oil supply holes with plugs.

Hand tool	5870 320 014
Ratchet wrench	5870 320 018

7409AAX302

Installation combi seal ring

① Mount shaft seal (part I /combi seal ring) considering installation dimension "X", see detailed sketch AX304.

※ Wet contact faces of shaft seal /brake housing with spirit right before assembly, assembly aid.

※ Grease shaft seal around the dust and sealing lips.

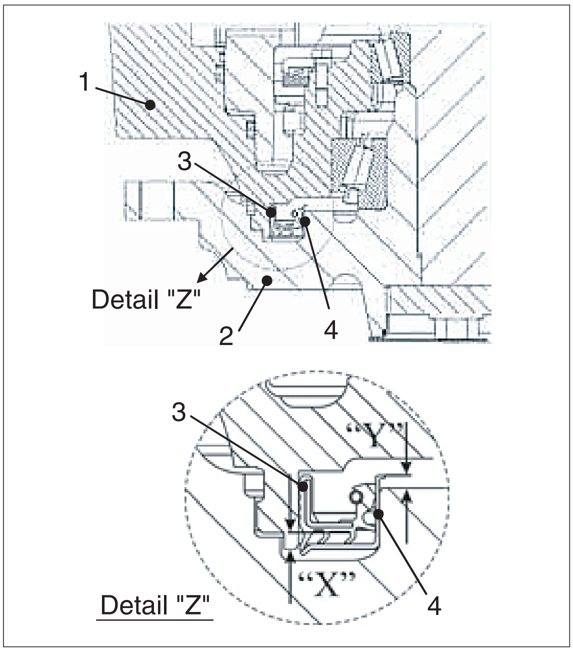
※ Observe plane installation position of shaft seal, use the specified driver to ensure an exact shaft seal installation position.

Driver tool	5870 051 065

7409AAX303

1 Brake housing
2 Output shaft
3 Shaft seal (part I) ⎤ combi
4 Wear sleeve (part II) ⎦ seal ring

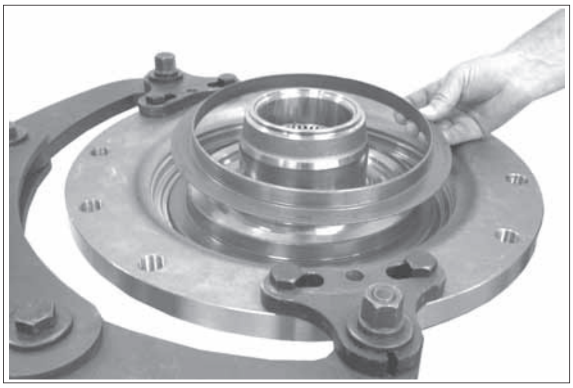
"X" = installation dimension /shaft seal
$4.1^{+0.2}$ mm
"Y" = installation dimension /wear sleeve
$2.6^{+0.2}$ mm



7409AAX304

② Apply sealing agent (loctite #574) on contact faces of wear sleeve /output shaft and mount wear sleeve (part I / combi seal ring) considering installation dimension "Y" see detailed AX304.

Pressing device 5870 506 172

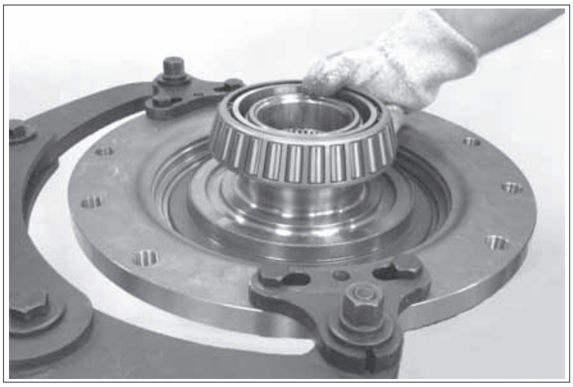


7409AAX305

Output shaft /brake housing

① Mount heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooling down.



7409AAX306

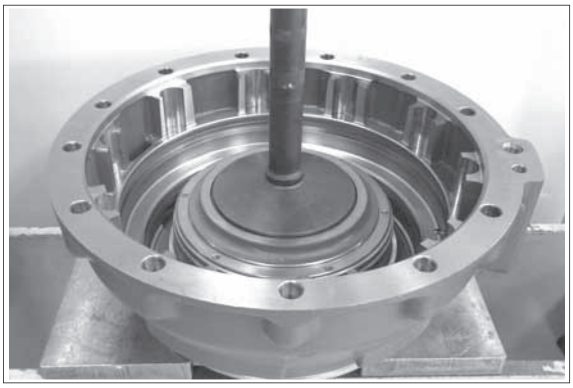
② Press outside bearing outer ring into brake housing until contact.

Driver tool	5870 050 010

7409AAX307

③ Press inside bearing outer ring into brake housing until contact.

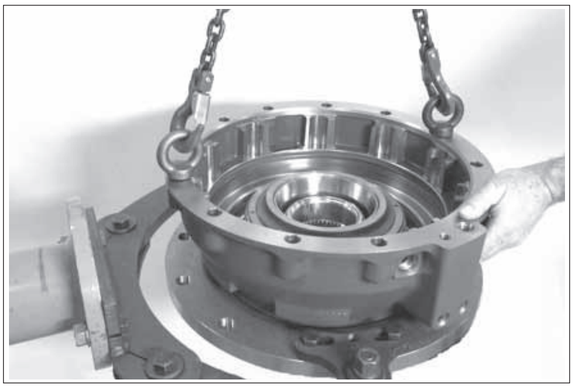
Driver tool	5870 050 003



7409AAX308

④ Position preassembled brake housing on the output shaft.

Lifting chain	5870 281 047
Eyebolts	5870 204 071

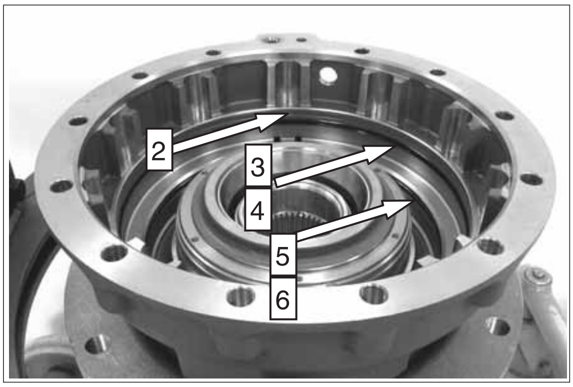


7409AAX309

⑤ Insert sealing elements (arrows) into annular grooves of brake housing paying attention to installation position and arrangement, in this context refer to AX311.

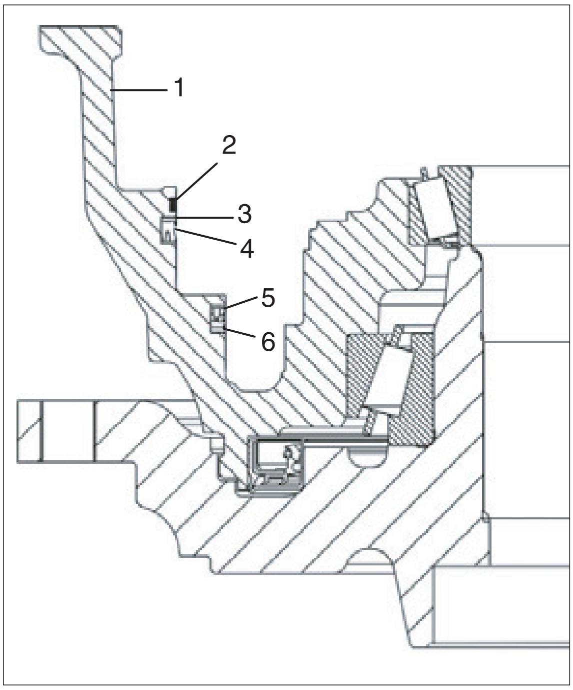
※ Guide ring installation :
Clean annular groove of brake housing with spirit. Then insert guide ring into annular groove - Ensure an exact contact position of the whole guide ring circumference - afterwards stick guide ring with glue (loctite #415) on its endpoints.

※ Ensure a correct installation position of the guide ring - Endpoints of guide ring to be in 12 o'clock position in the axle installed in the vehicle (radial position in brake housing - area of brake oil supply and vent hole).



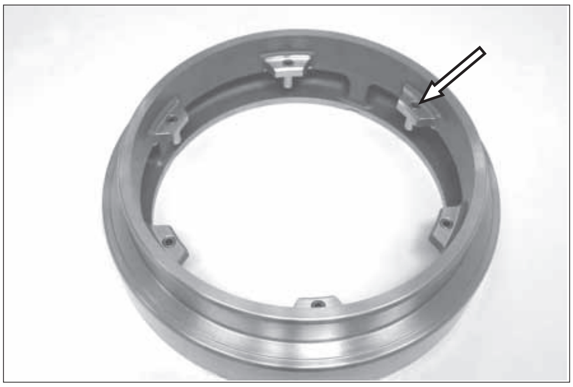
7409AAX310

1 Brake housing
2 Guide ring
3 Support ring
4 Grooved ring
5 Grooved ring
6 Support ring



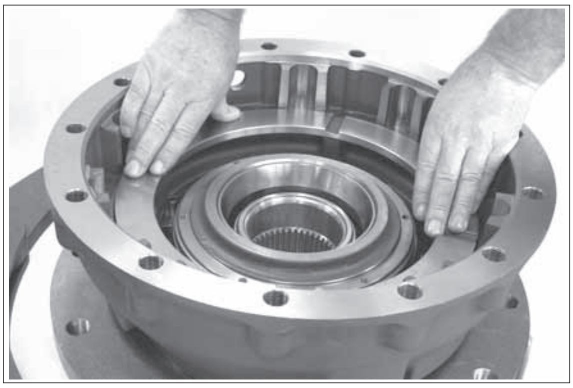
7409AAX311

⑥ Flush-mount slotted pins (for installation position refer to arrow) into the piston, if not disassembled, adjust adequately (flushfitting).



7409AAX312

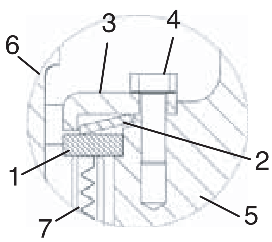
⑦ Oil sealing/sliding surface of piston and sealing elements.
Carefully bring piston in contact position.

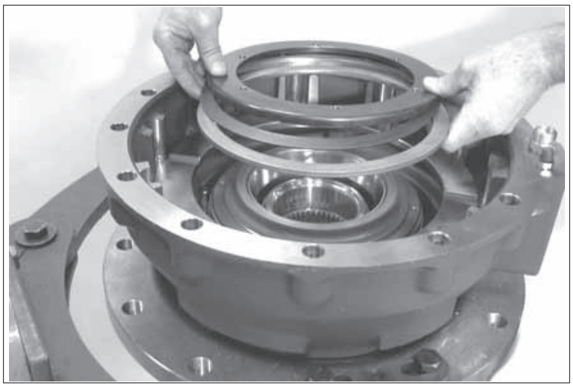


7409AAX313

⑧ Insert disc, cup spring and lid considering the installation position, see detail sketch.

1 Disc
2 Cup spring
3 Lid
4 Hexagon screw
5 Brake housing
6 Piston
7 Slotted pin

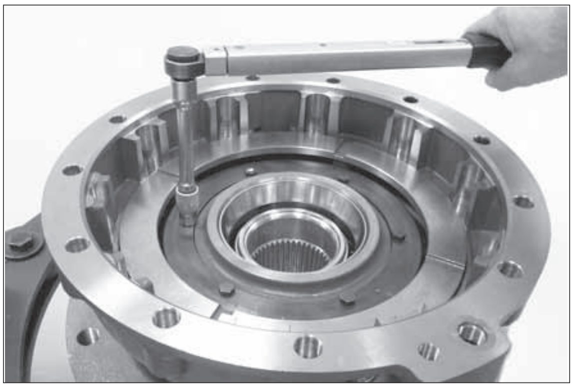




7409AAX314

⑨ Fix lid with hexagon screws evenly until contact is obtained (cup spring pre load).
Finally tighten hexagon screws.

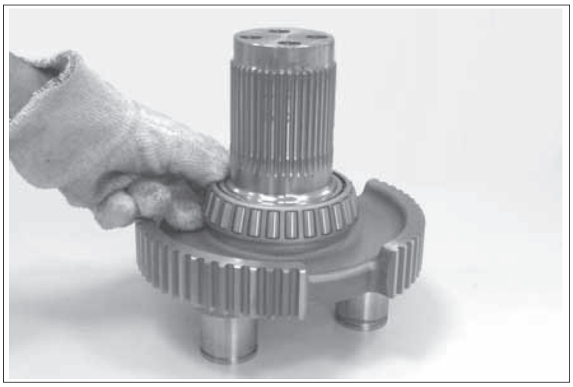
· Tightening torque (M8/10.9) :
3.47 kgf · m (25 lbf · ft)



7409AAX315

⑩ Mount heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooling down.

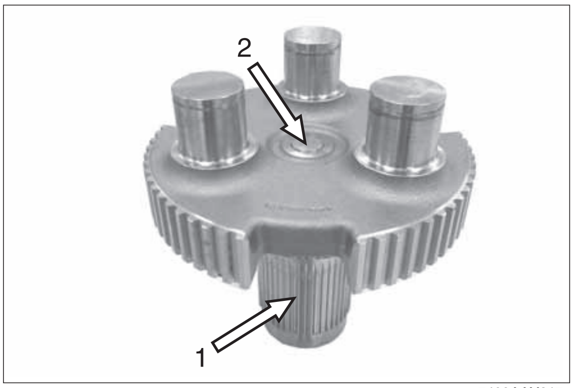


7409AAX316

⑪ Apply anti-corrosive agent on spline (arrow 1).

Only for assembly of a new planetary carrier or if disassembled :

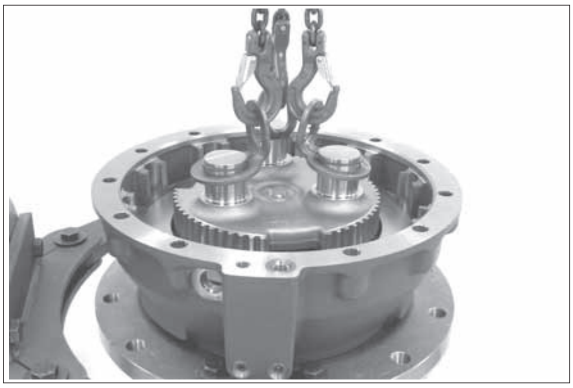
Insert shim (arrow 2) into planetary carrier until contact.



7409AAX317

⑫ Insert pre assembled planetary carrier.

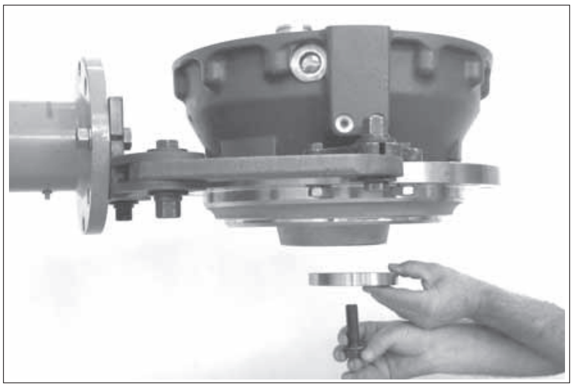
Lifting chain	5870 281 047
Lifting device	5870 281 082



7409AAX318

⑬ Fix planetary carrier with disc and new locking screws.

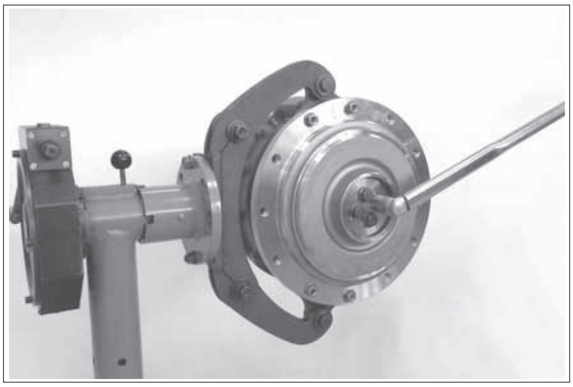
※ Do not reuse locking screws, just one time installation is permitted.



7409AAX319

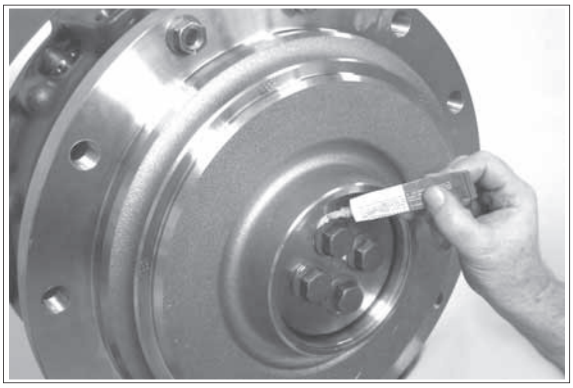
⑭ Evenly tighten locking screws crosswise while rotating the brake housing in both directions several times (roller setting).

· Tightening torque (M8/12.9) :
51.0 kgf · m (369 lbf · ft)



7409AAX320

⑮ Apply a screw safety marking paint on correctly installed locking screws.



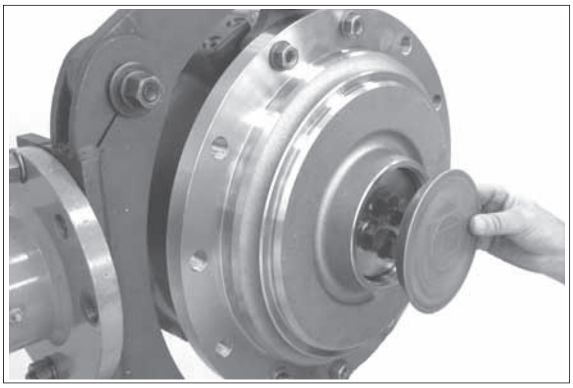
7409AAX321

⑯ Mount O-ring (arrow) on lid.

7409AAX322

⑰ Insert pre-assembled lid into output shaft.

Plastic hammer 5870 280 004

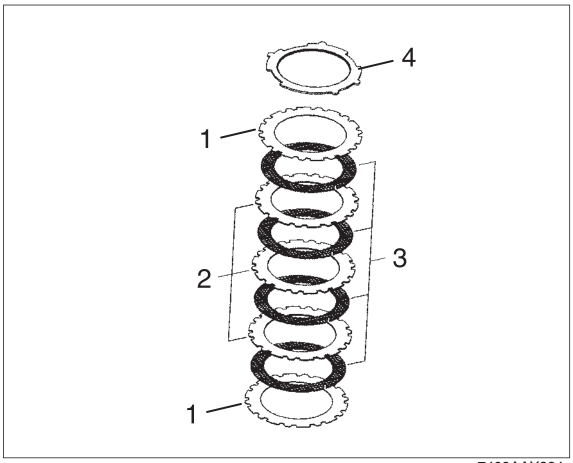


7409AAX323

Brake

※ Possible other versions could have a deviating equipment (number and arrangement of single discs), the illustration in the relating spare parts list forms the basis for the required equipment.

1 Outer disc s = 2.0 mm
2 Outer disc s = 4.0 mm
3 Inner disc (lined disc)
4 End plate



7409AAX324

① Insert disc package, considering disc arrangement and installation position of outer discs, see AX324.

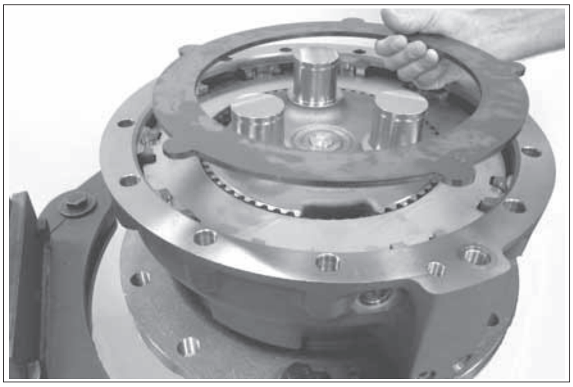

7409AAX325

② Insert end plate (item 4, see AX324) fix by means of grease assembly aid.

※ Ensure radial installation position driving tabs of end plate must be positioned in recessed grooves of the brake housing.

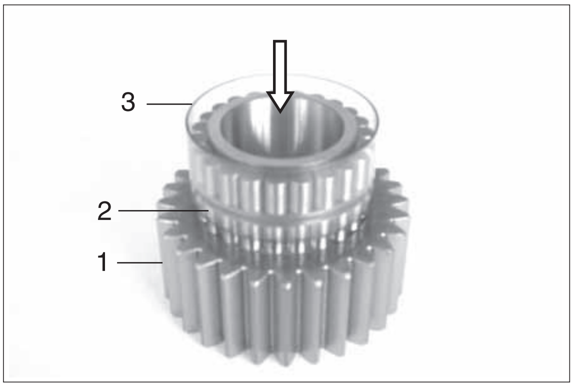
Locating screw 5870 204 078

※ Make leakage test on brake hydraulics see page 3-243.


7409AAX326

③ Only for assembly of new parts :
Install cylindrical roller bearing into planetary gear by pressing roller bearing into planetary gear by means of assembly sleeve (arrow) until snap ring engages into annular groove of planetary gear.

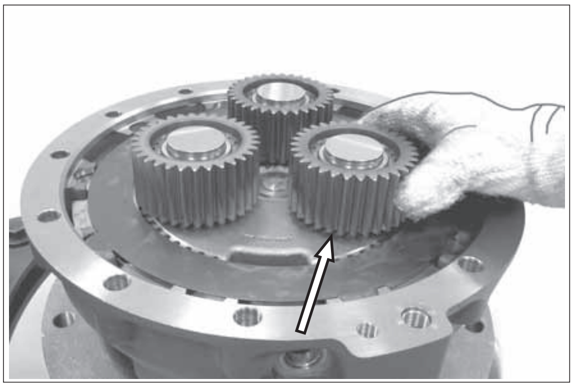
1 Planetary gear
2 Roller bearing
(with bearing inner ring /cylindical rollers /axial discs and snap ring)
3 Assembly sleeve



7409AAX327

④ Heat up planetary gears and mount to the pin of the planetary carrier until contact is obtained, with the large radius /bearing inner ring showing downwards (arrow).

※ Adjust bearing after cooling down.

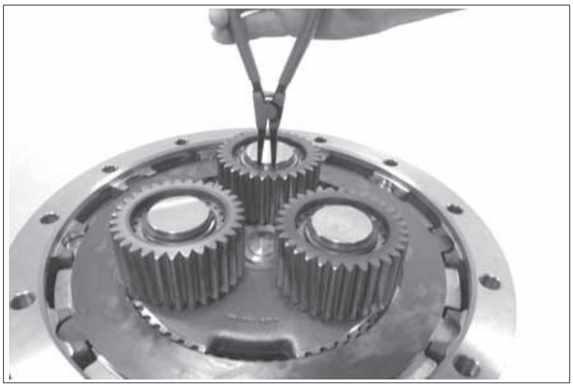


7409AAX328

⑤ Fix planetary gears with retaining ring.

※ Check contact position of retaining ring on groove base and readjust, if required.

Set of external pliers 5870 900 015

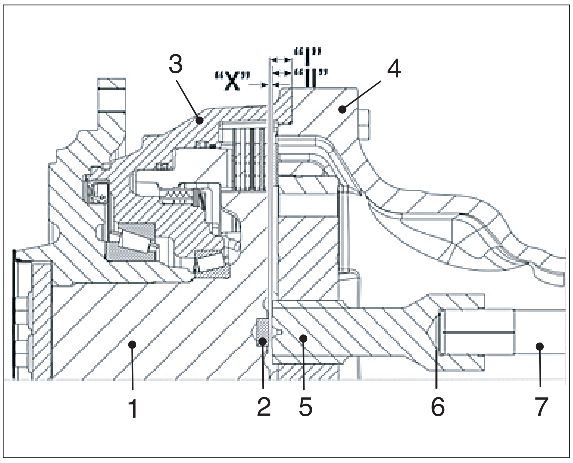


7409AAX329

Axial play setting of sun gear shaft :

1 Planetary carrier
2 Stop pin
3 Brake housing
4 Axle housing
5 Sun gear shaft
6 Shim (s = optional)
7 Stub shaft

"X" = axial play - sun gear shaft 0.5~2.0 mm

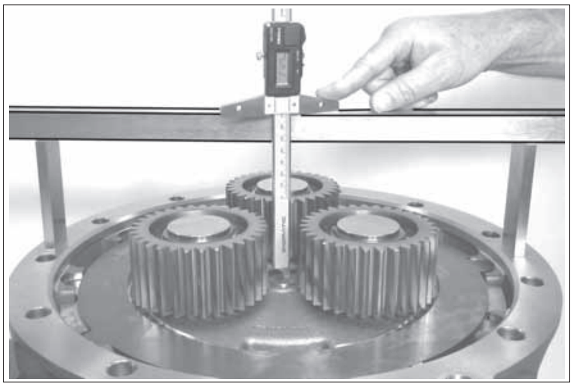


7409AAX330

① Determine dimension "I" from mounting face (brake housing/axle housing) to stop pin.

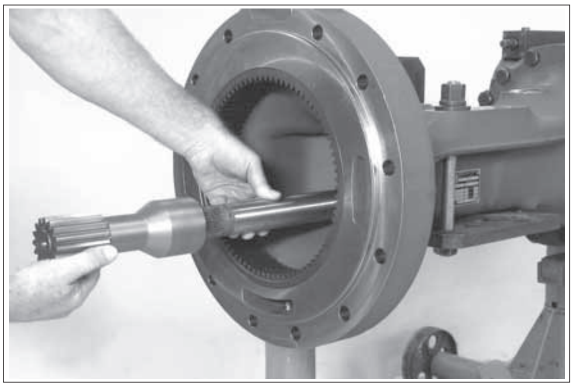
Dimension I e. g. .... 21.25 mm

Digital-depth gauge	5870 200 072
Gauge blocks	5870 200 066
Straightedge	5870 200 022



7409AAX331

② Mount stub shaft with fitted sun gear shaft (without shim) into differential /axle bevel gear until contact.



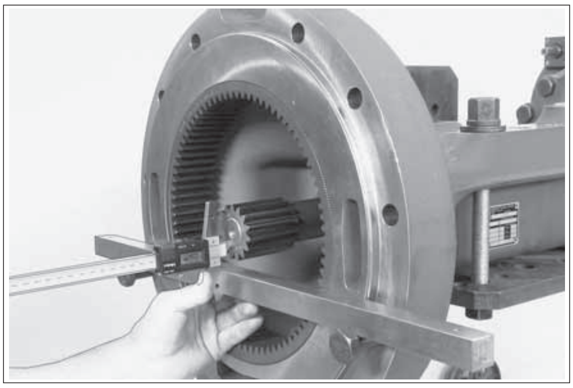
7409AAX332

③ Determine dimension "II" from mounting face (brake housing /axle housing) to front face /sun gear shaft.

Dimension II e. g. .... 19.00 mm

CALCULATION EXAMPLE:

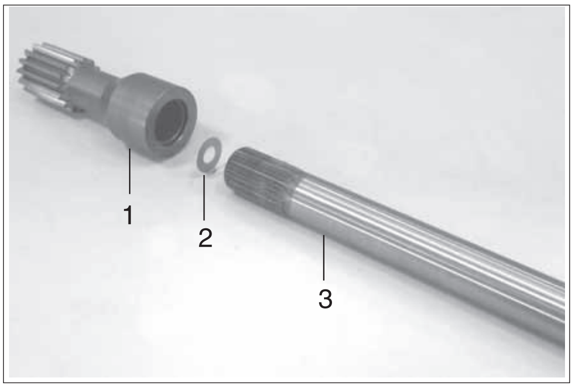
Dimension I	21.25 mm
Dimension II	- 19.00 mm
Difference	2.25 mm
Required axial play e.g. (average)	
	- 1.25 mm
Result = shim required e.g.	s = 1.00 mm



7409AAX333

④ Pull stub shaft with sun gear shaft out of axle housing.

Insert determined shim(s) (2) into sun gear shaft (1) and mount stub shaft (3).

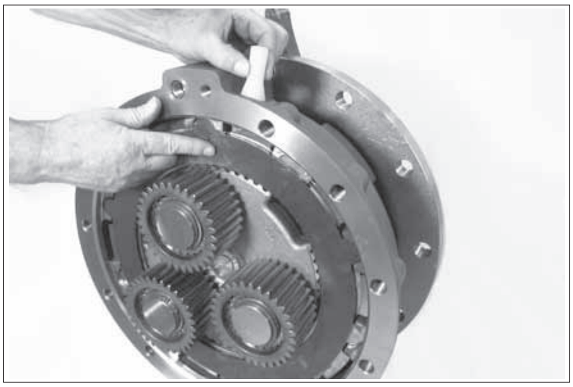


7409AAX334

Assemble output assy

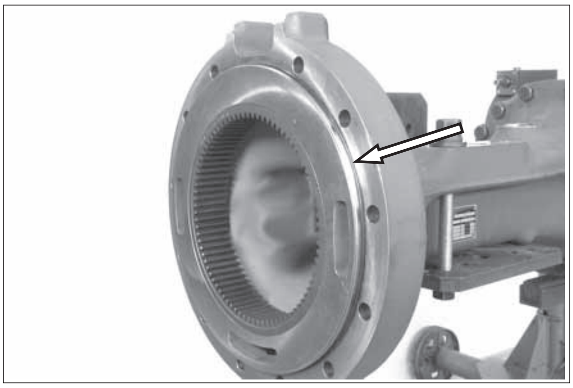
① Fix disc package by means of locating screw, assembly aid.

Locating screw 5870 204 078



7409AAX335

② Oil O-ring and mount on collar of axle housing.

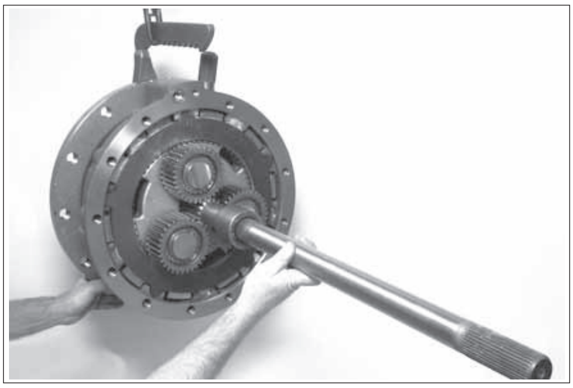


7409AAX336

③ Take up output by means of lifting bracket.

Mount pre-assembled sun gear /stub shaft into teeth of planetary gears.

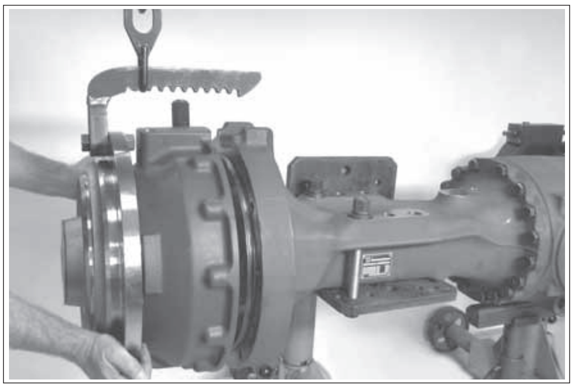
Lifting bracket 5870 281 043



7409AAX337

④ Bring output assy into contact position with axle housing by mounting the stub shaft into the gearing of the axle bevel gear /differential.

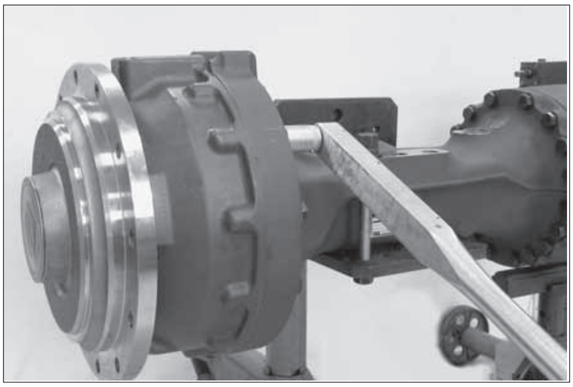
※ Pay attention to end plate see AX326, page 3-249.



7409AAX338

⑤ Connect output with axle housing evenly by means of hex. screws.

· Tightening torque (M18 × 1.5/10.9) : 39.8 kgf · m (288 lbf · ft)



7409AAX339

⑥ Install screw plug (1) with new O-ring.

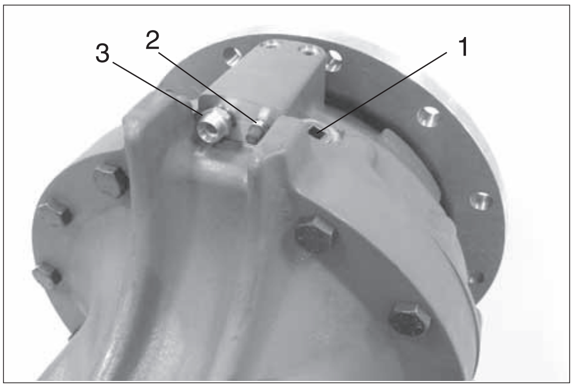
· Tightening torque (M24 × 1.5) : 5.1 kgf · m (36.9 lbf · ft)

Mount breather valve (2).

· Tightening torque : 0.6 kgf · m (4.4 lbf · ft)

Install screw neck (3) with new O-ring.

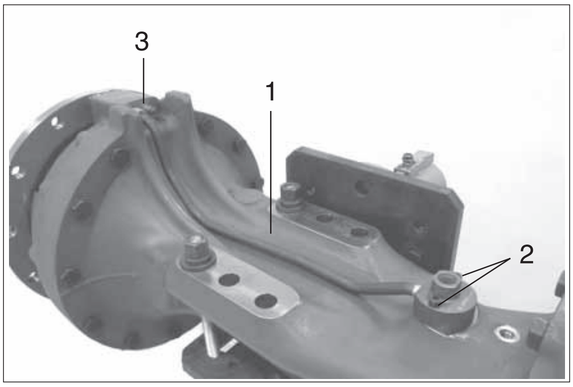
· Tightening torque : 3.7 kgf · m (26.6 lbf · ft)



7409AAX340

⑦ Install brake tube (1).

· Tightening torque:
Screw nut (2)
10.2 kgf · m (73.8 lbf · ft)
Cylindrical screw (3) (M8 /8.8)
2.35 kgf · m (17.0 lbf · ft)



7409AAX341

Make leakage test on brake hydraulics

※ Prior to starting the test, completely breathe brake hydraulics.

High pressure test :

Build up testing pressure p = 100 - 10 bar maximum and close connection to HP pump by means of a shutoff valve A pressure drop by maximum 3% (3 bar) is permissible during a 5 minute test duration.

Low pressure test :

Reduce testing pressure to p = 5 bar and close shut off valve again.

No pressure drop is permitted during a 5-minute test duration.

Test medium : SAE 15W-40

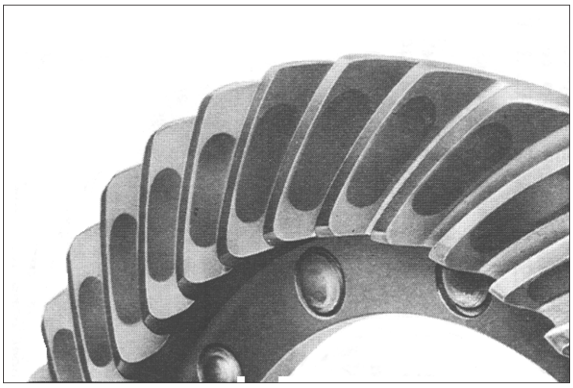
HP-pump	5870 287 007
Straight screw-in connection	0637 842 518
Measuring fitting (M18 × 1.5)	5870 950 139
Oil collector bottle	5870 286 072

7409AAX342

※ BACKLASH CHECK

- Applied the paint (or red lead) on the surface of several bevel gear teeth.
- Turn the pinioin gear and check the contact pattern.

Correct pattern



WTHAX16

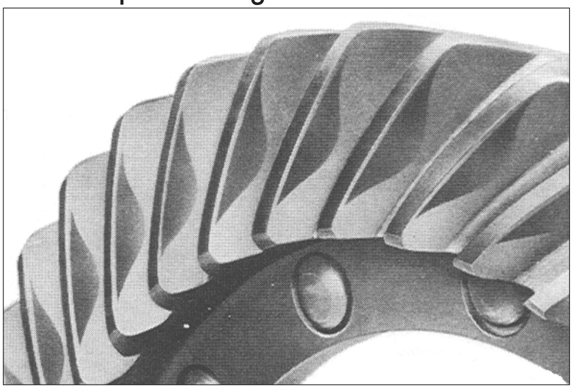
Concave side

WTHAX17

Convex side

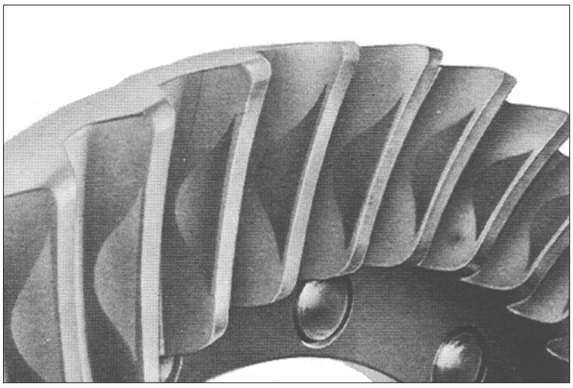
※ ADJUSTMENT

Incorrect pattern : high contact



WTHAX18

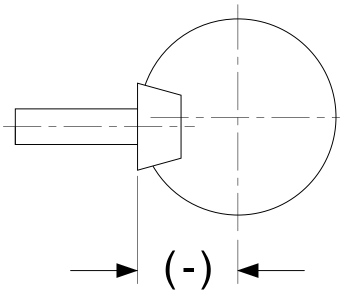
Concave side



WTHAX19

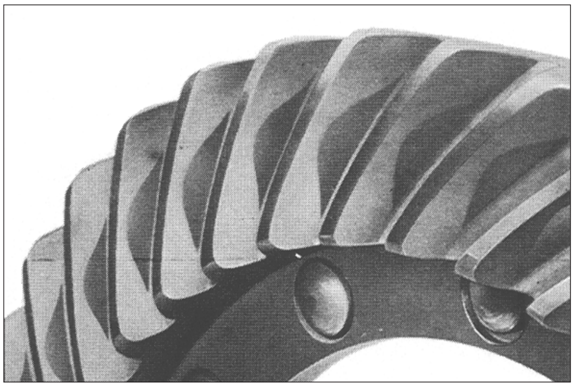
Convex side

- Reduce the distance (-)



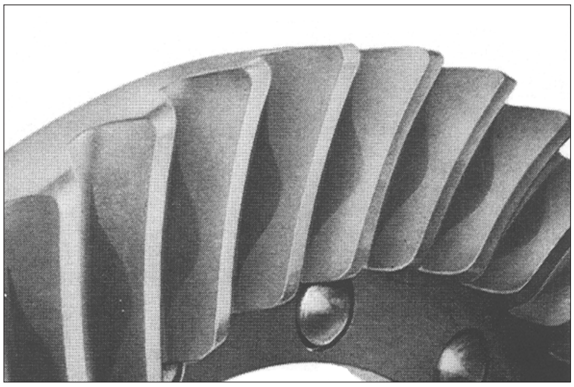
WTHAX20

Incorrect pattern, low contact



WTHAX21

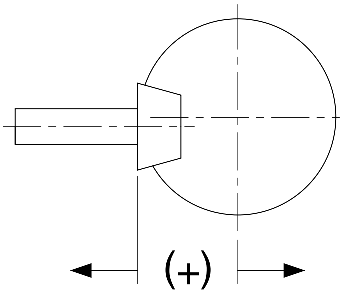
Concave side



WTHAX22

Convex side

- Add the distance (+)



WTHAX23

SECTION 4 BRAKE AND FAN SYSTEM

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.

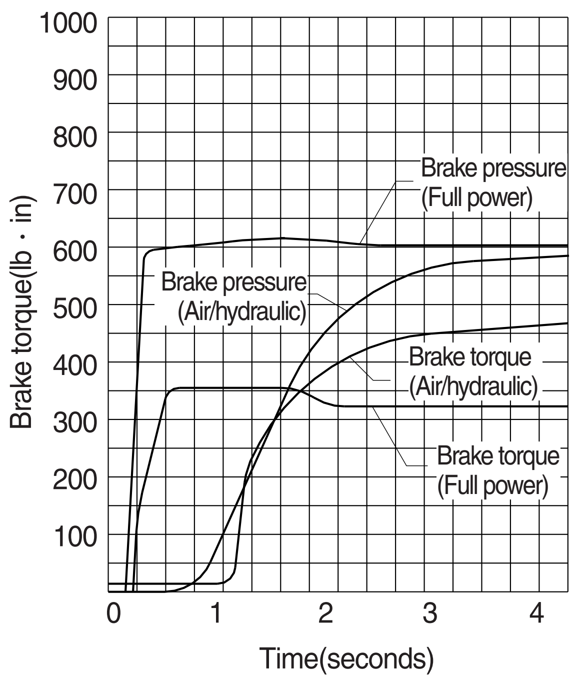
Full power systems can supply significantly higher brake pressures with relatively low reactive pedal forces. The reactive pedal force felt by the operator will be proportional to the brake line pressure being generated. This is referred to as brake pressure modulation.

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.

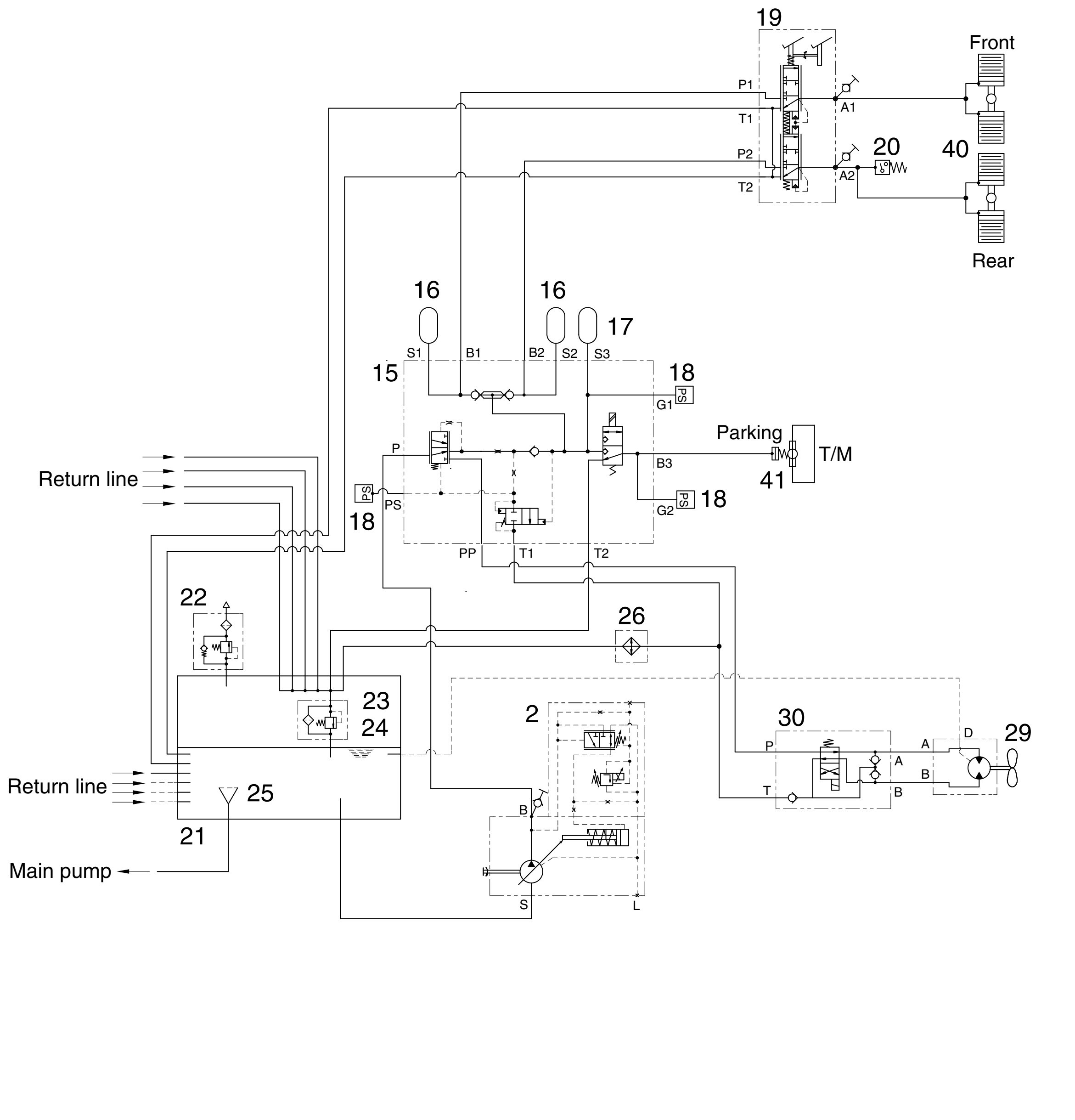
Because these systems are closed center, by using a properly sized accumulator, emergency power-off braking that is identical to power-on braking can be achieved. These systems can be either dedicated, where the brake system pump supplies only the demands of the brake system or non-dedicated, where the 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

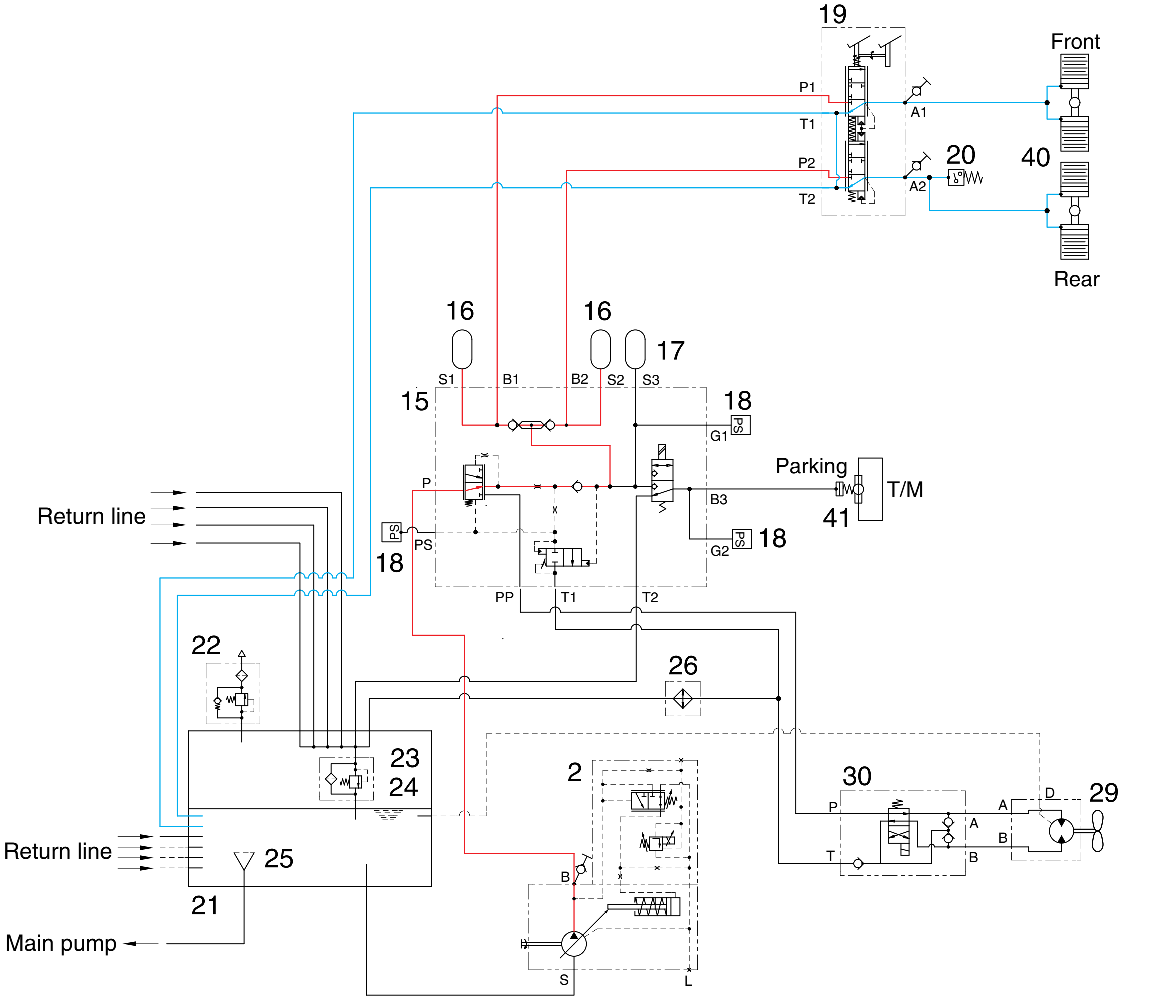


2. HYDRAULIC CIRCUIT



2	Fan & brake pump	20	Pressure switch	26	Oil cooler
15	Cut-off valve	21	Hydraulic tank	29	Fan motor
16	Accumulator	22	Air breather	30	Directional valve
17	Accumulator	23	Return filter	40	Axle
18	Pressure sensor	24	Bypass valve	41	Parking brake at T/M
19	Brake valve	25	Strainer		

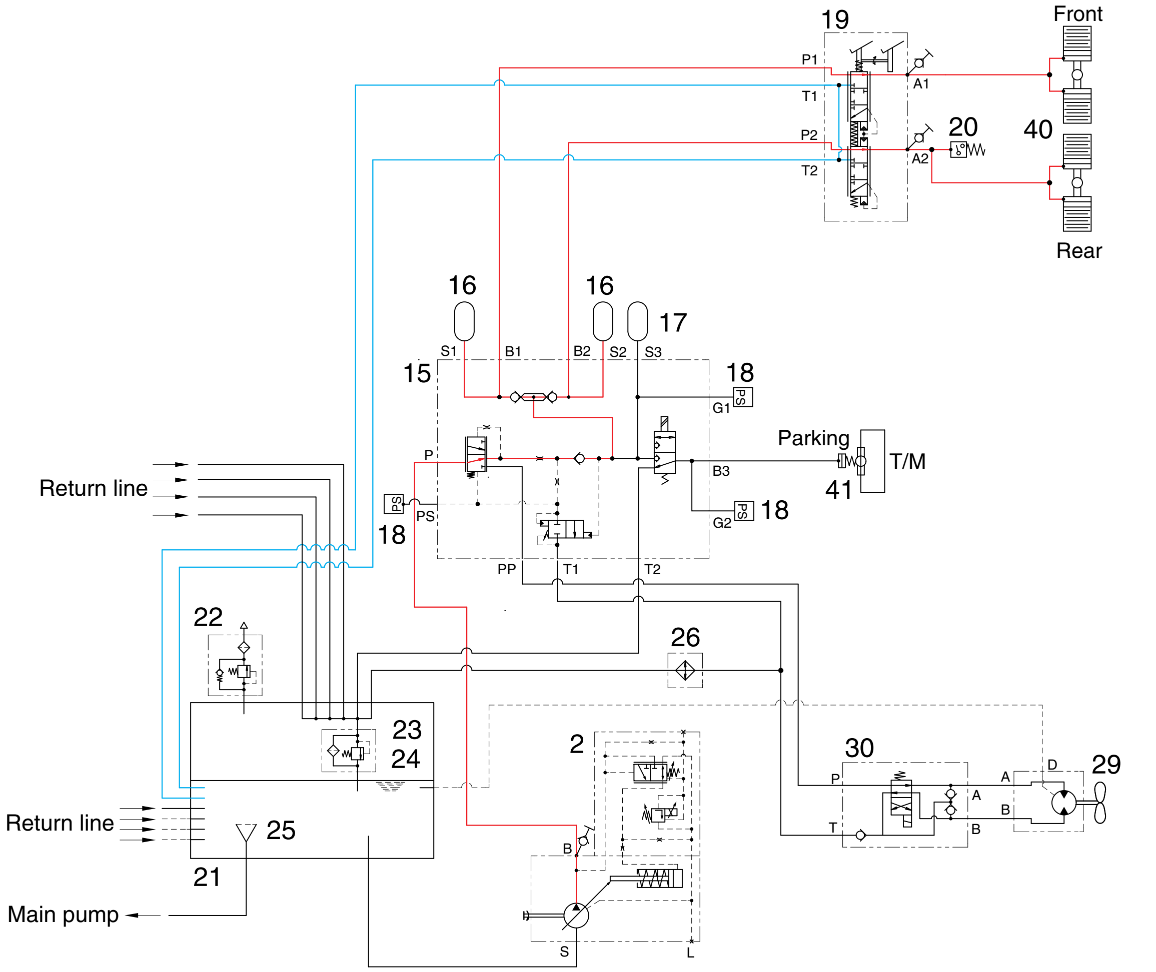
1) SERVICE BRAKE RELEASED



740F4BS02

When the pedal of brake valve (19) 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 (21).
Therefore, the service brake is kept released.

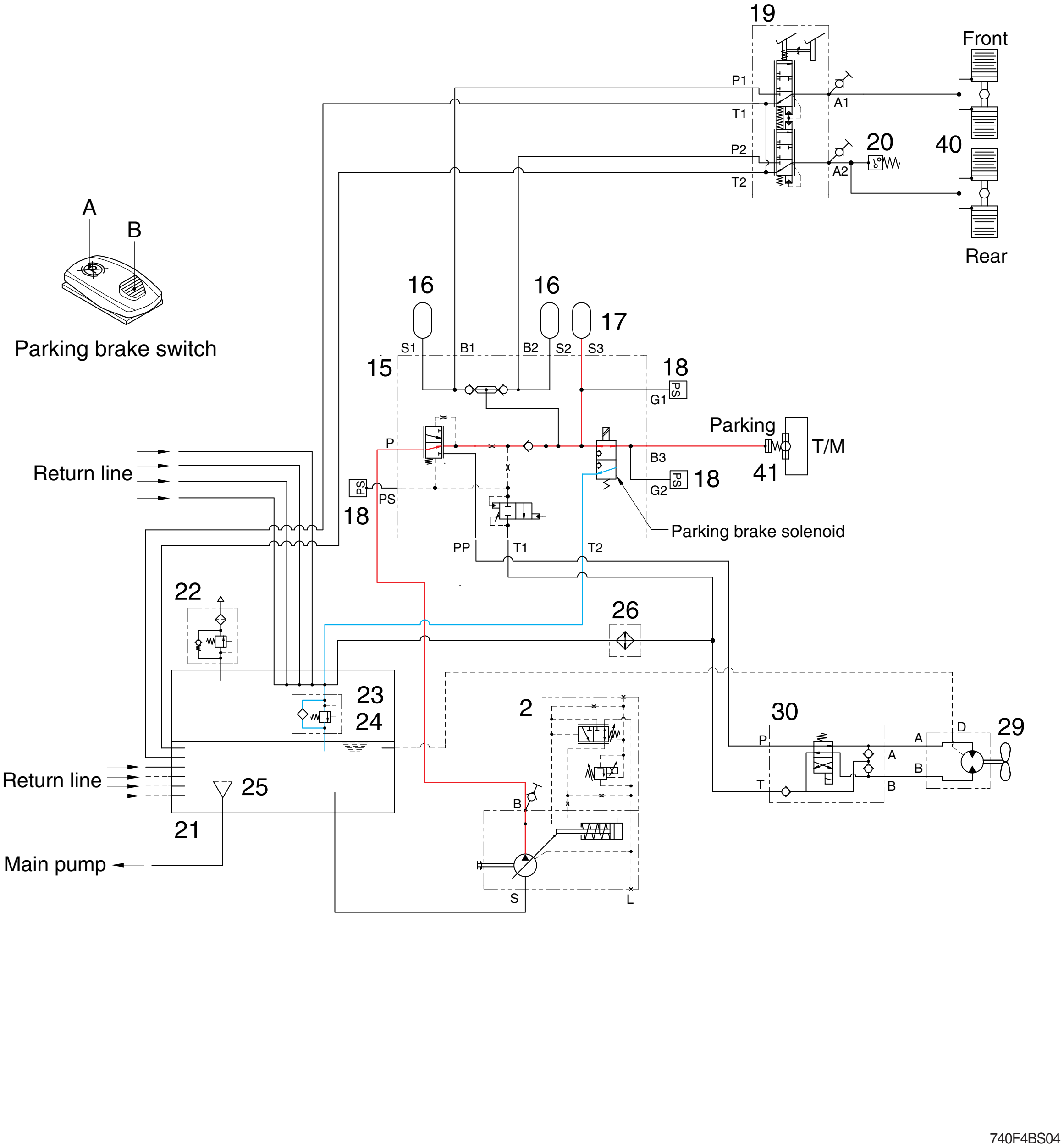
2) SERVICE BRAKE OPERATED



740F4BS03

When the pedal of brake valve (19) 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 (15) enters the piston in the front and rear axles. Therefore, the service brake is applied.

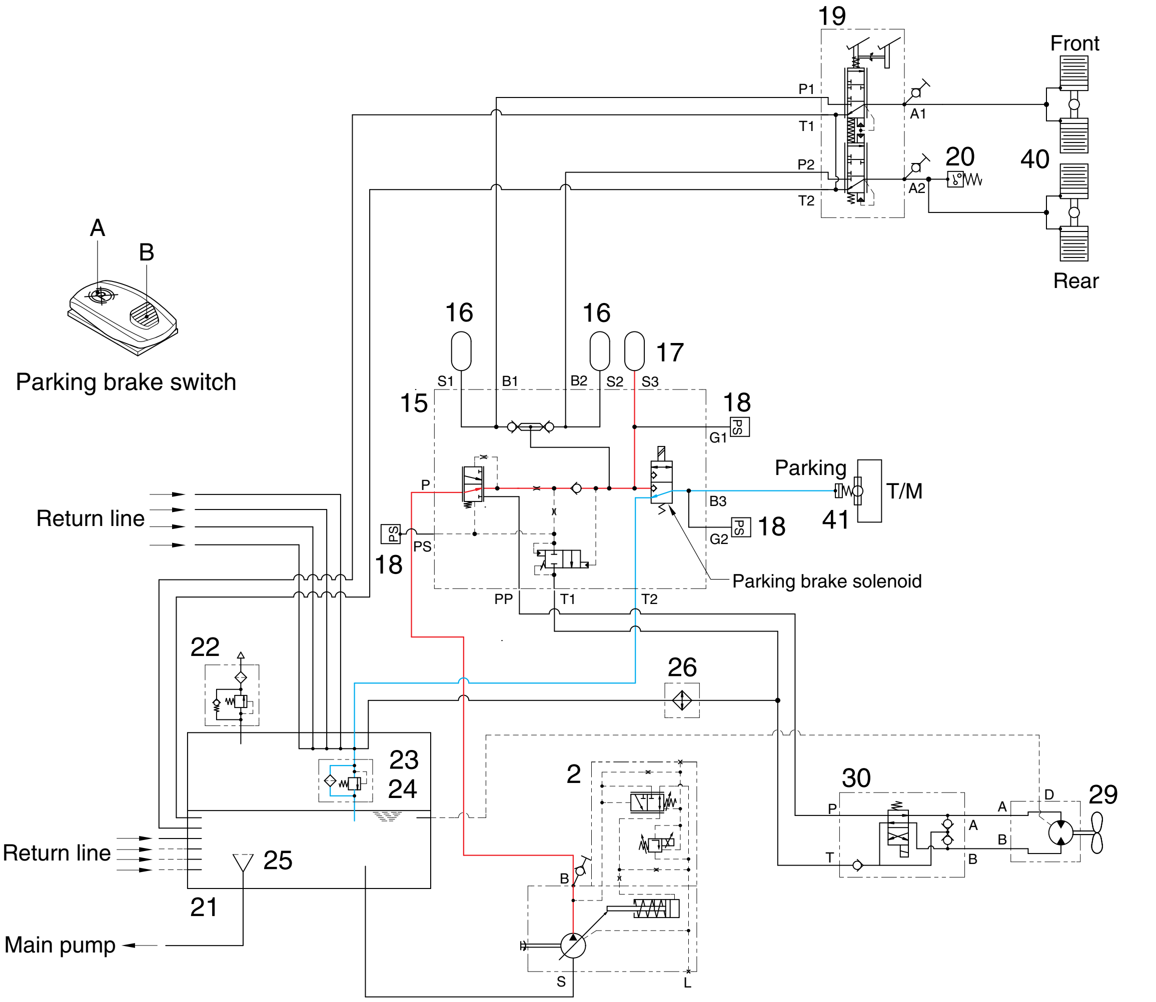
3) PARKING BRAKE RELEASED



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.

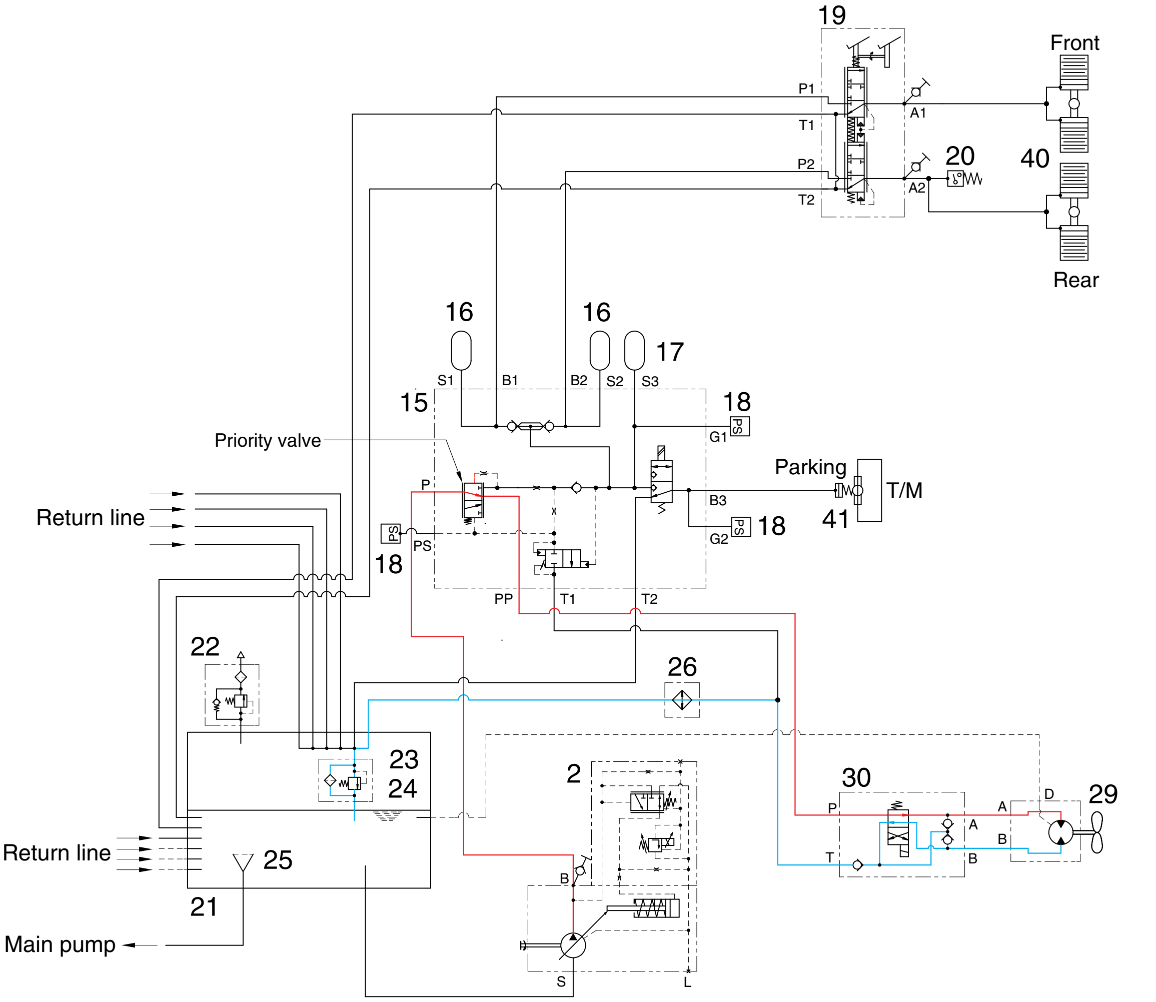
4) PARKING BRAKE OPERATED



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.

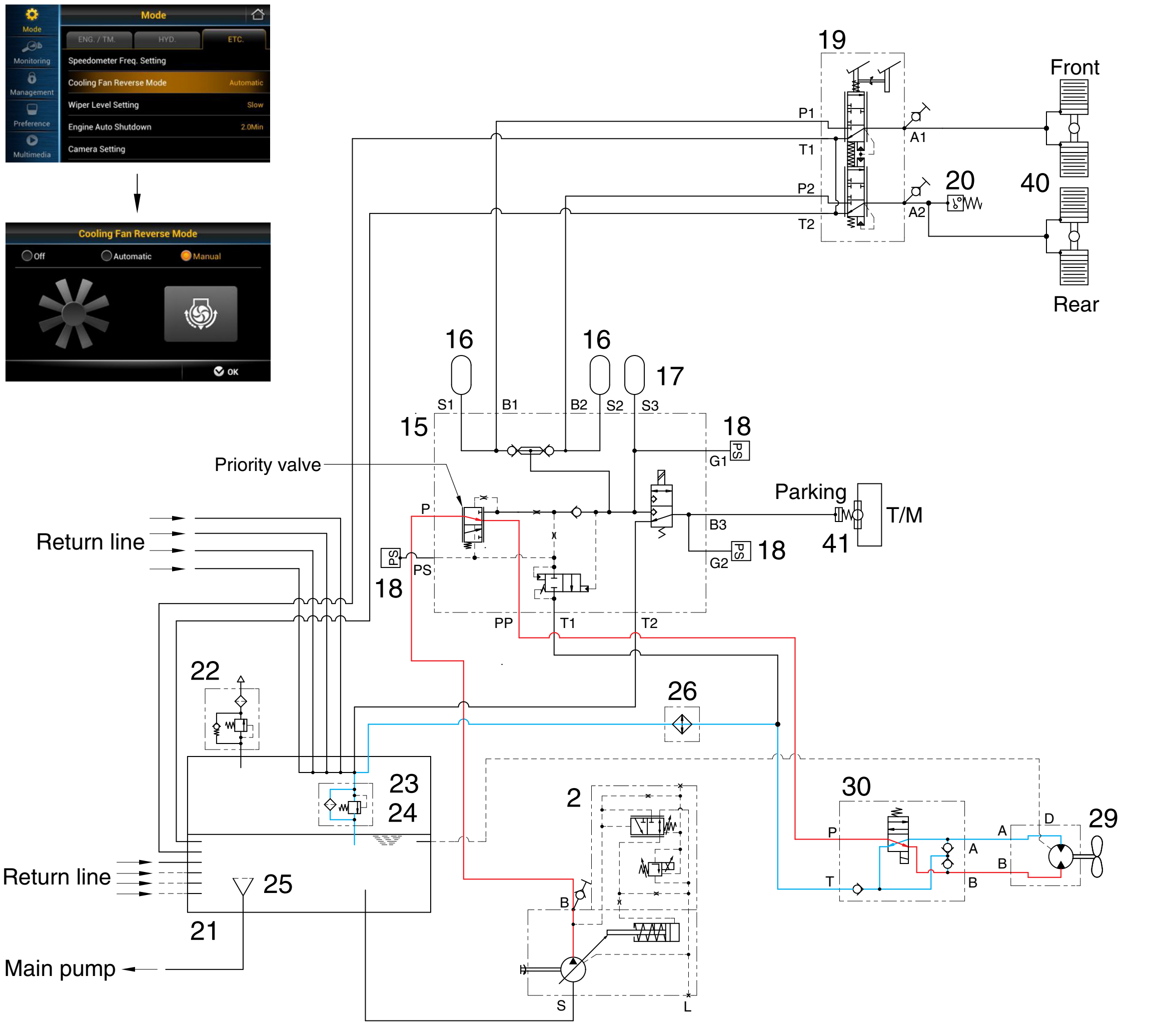
5) FAN MOTOR OPERATED



740F4BS06

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

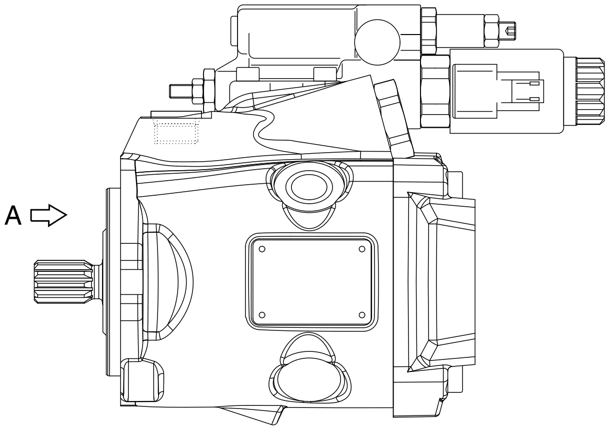


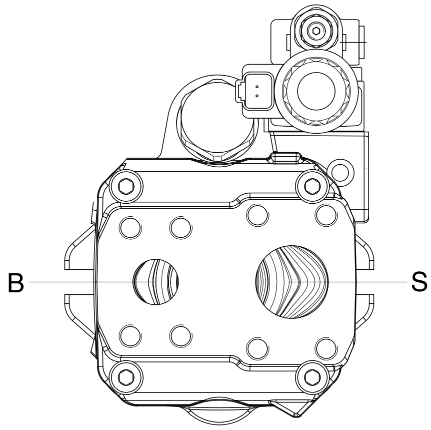
740F4BS07

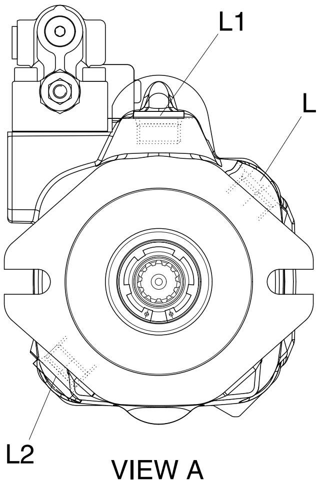
When the fan control switch is pressed A or M position, the solenoid valve in the directional valve (30) is energized and the flow of the oil is changed. The rotation of the fan is reversed to clear the radiators.

3. FAN AND BRAKE PUMP

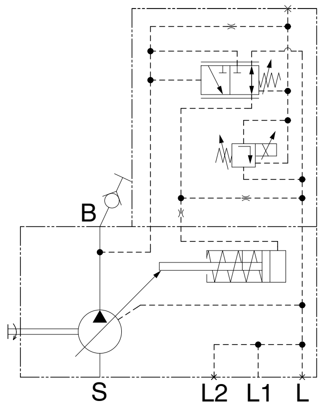
1) STRUCTURE







VIEW A

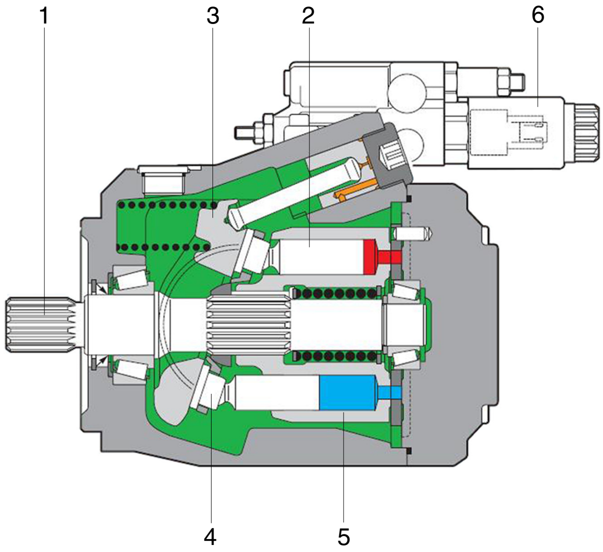


Hydraulic circuit

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



The pump is a variable displacement piston pump. This pump has a maximum delivery pressure of 250 kgf/cm². 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.

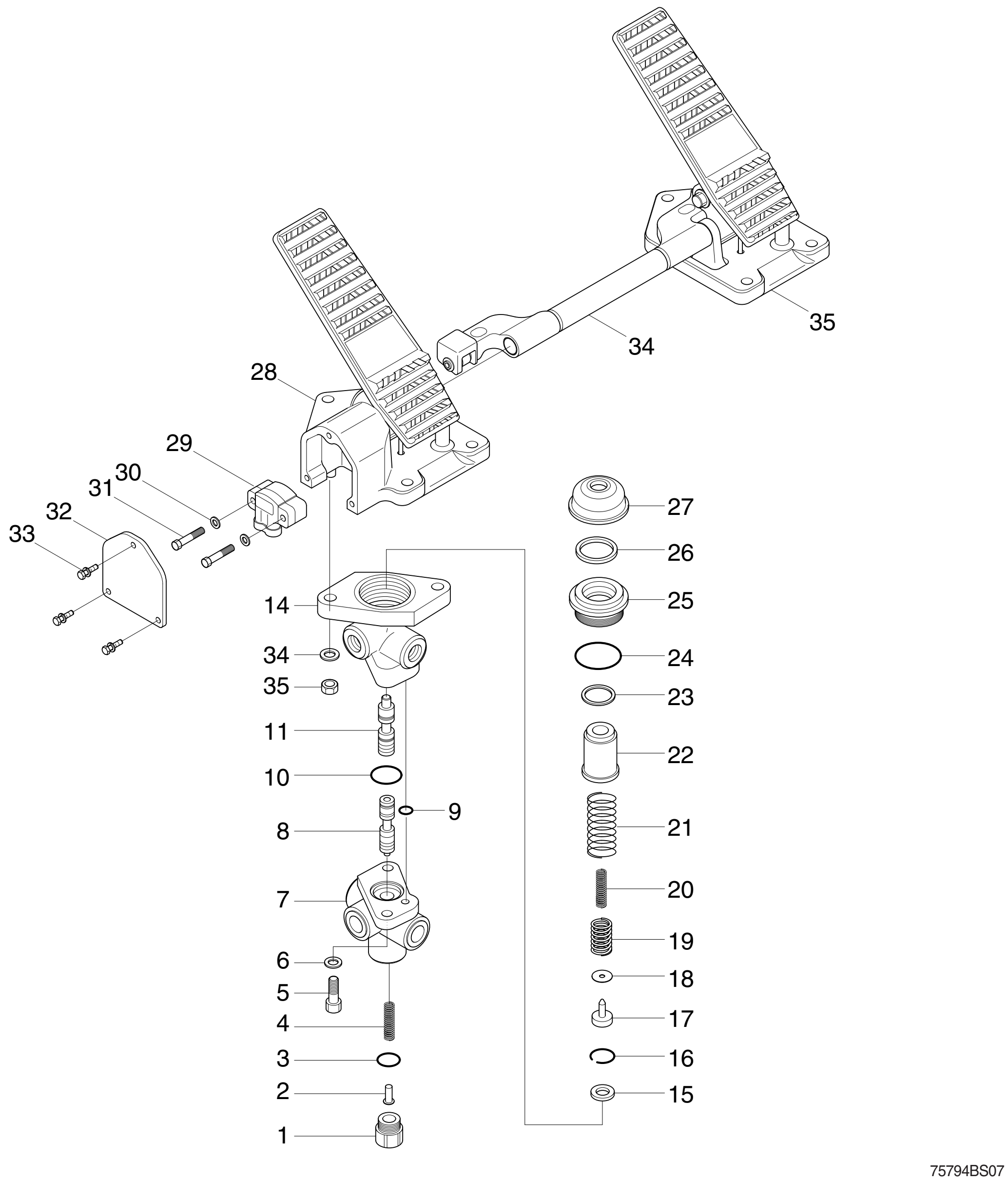
※ FAN SYSTEM OPERATION

When the brake system pressure is below minimum pressure (125±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.

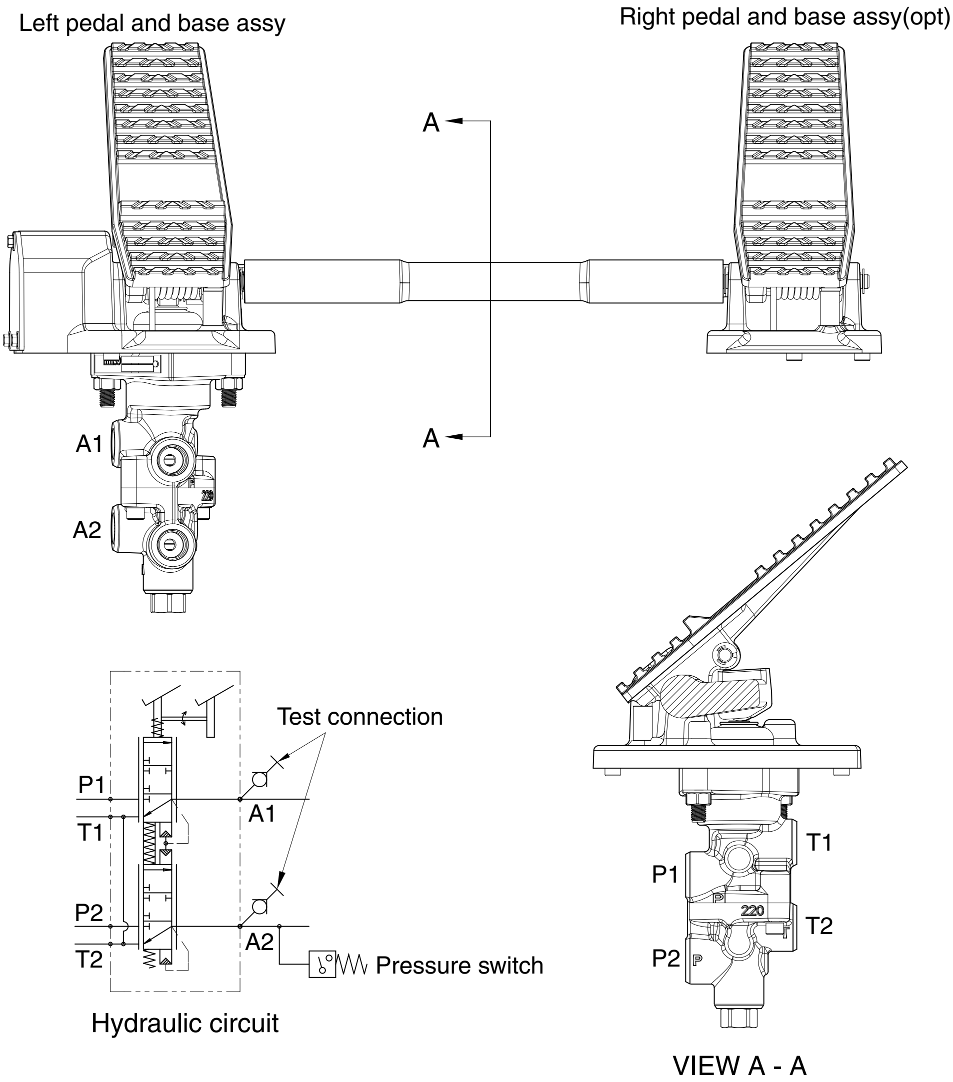
4. BRAKE VALVE

1) STRUCTURE



1	Plug	15	Spacer	27	Boot
2	Retainer	16	Retaining ring	28	Left pedal and base assy
3	O-ring	17	Retainer	29	Sensor
4	Spring	18	Shim	30	Washer
5	Cap screw	19	Spring	31	Cap screw
6	Washer	20	Spring	32	Cover
7	Housing	21	Spring	33	Screw
8	Lower spool	22	Piston	34	Lever assy (option)
9	O-ring	23	Quad ring	35	Right pedal and base assy (option)
10	O-ring	24	O-ring		
11	Upper spool	25	Retainer		
14	Housing	26	Cup		

2) OPERATION



Port	Port name	Port size
P1, P2	Pressure port	3/4-16UNF
T1, T2	Return port	3/4-16UNF
A1, A2	Brake cylinder port	3/4-16UNF

75794BS08

· Brake pressure specification : 55±5 bar (800±70 psi)

(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 (A1, A2) and ports (T1, T2) so that the wheel brakes ports (A1, A2) 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 (21) beneath base (28) 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 (21), and the lower spool is actuated hydraulically by spool. As spools (11, 8) move downward, they will first close returns (T1, T2) via the control edges, thus establishing a connection between accumulator ports (P1, P2) and ports (A1, A2) for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spools(11, 8) 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 (11, 8) are in a partial braking position, causing ports (P1, P2) and ports (T1, T2) to close and holding the pressure in ports (A1, A2).

(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 (A1, A2). Returns (T1, T2) are closed at this point.

When the braking process is ended, a connection is once again established between brake cylinder ports (A1, A2) 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 (21) will mechanically actuate spool. In the event of the upper circuit failing, the lower circuit will remain operational since the lower spool (8) is mechanically actuated by spring assembly (21) and spool (11).

(6) Installation requirements

Return lines (T1, T2) must be connected directly to the tank.

The connecting lines must be installed is 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.

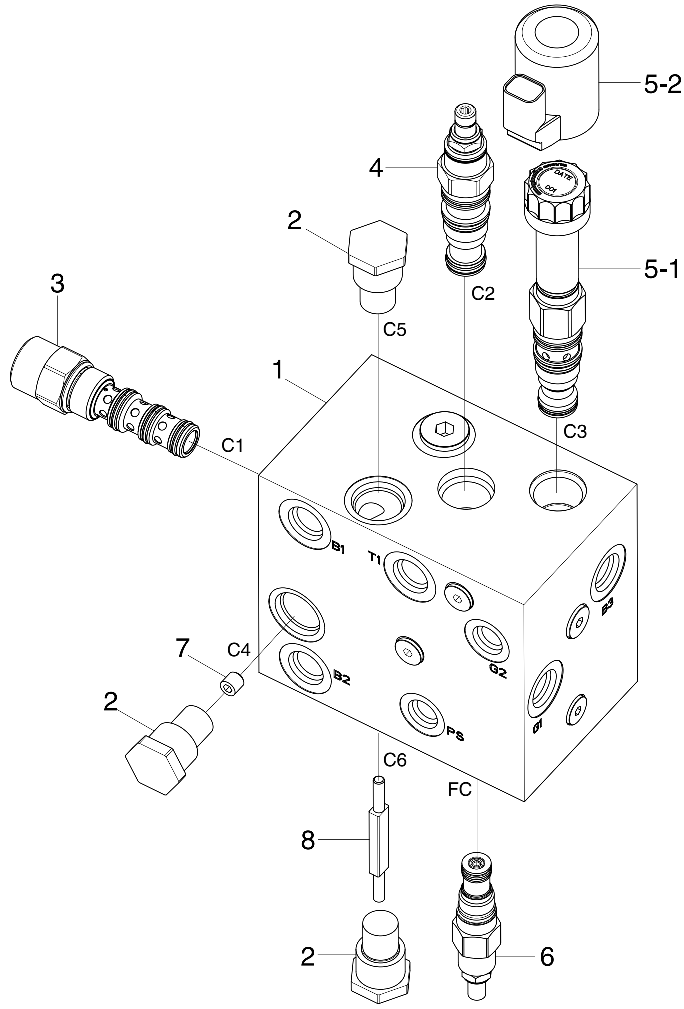
※ When doing repair work, make sure your environment is very clean.
Immediately close all open ports on the components and on pipes using plugs.

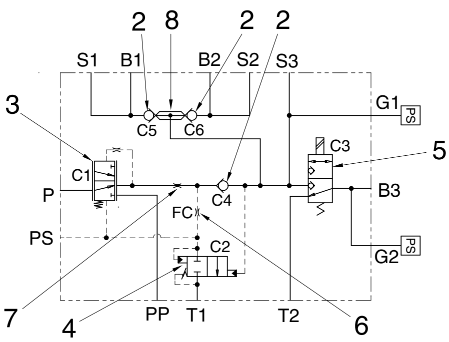
(9) Replacing the complete actuating mechanism

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 (21) does not fall out. When installing the new actuating mechanism, make sure that spring assembly (21) is fitted in the right order. Tighten the three bolts (5).

5. CUT-OFF VALVE

1) STRUCTURE





Hydraulic circuit

7609A4BS32

Part name	Port size
P, PP	SAE 3/4"
T2	PF 1/2
T1, S1, S2, S3, B1, B2, B3, G1	PF 3/8
PS, G2	PF 1/4

1	Block	4	Unload valve	6	Fixed orifice with compensated
2	Check valve	5-1	Solenoid valve	7	Orifice
3	Priority valve	5-2	Coil	8	Bar

2) OPERATION

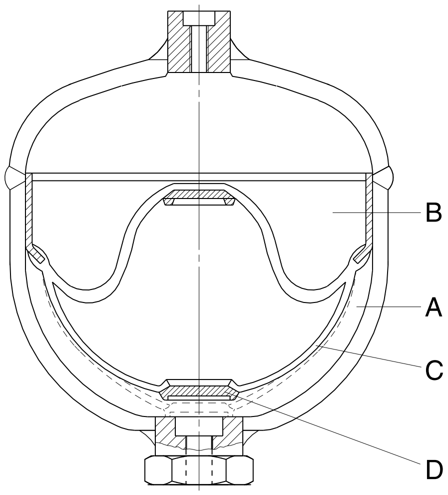
The unloading valve (4) controls the minimum and maximum pressure of the braking system. When the service brake pressure is below the maximum pressure (125±5 bar), the unloading valve (4) is blocked and PS pilot pressure (brake priority pressure) increases.

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 (7), check valve (2), shuttle valve (8).
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 bar±5 bar), unloading valve (4) opens, pilot pressure (brake priority pressure) of priority valve is low by draining the spring side of priority valve (3) to hydraulic tank through unloading valve (4).

6. BRAKE ACCUMULATOR

1) STRUCTURE



75794BS09

Item	31LL-40020 (item17)	81L1-0003 (item16)
Diameter	167 mm	138 mm
Mounting height	219 mm	187 mm
Norminal volume	2.0 ℓ	1.0 ℓ
Priming pressure	50 kgf/cm^2	50 kgf/cm^2
Operating medium	Oil	Oil
Operating pressure	Max 210 kgf/cm^2	Max 200 kgf/cm^2
Thread	M22 × 1.5	M22 × 1.5
Priming gas	Nitrogen	Nitrogen

A Fluid portion
B Gas portion
C Diaphragm
D Valve disk

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

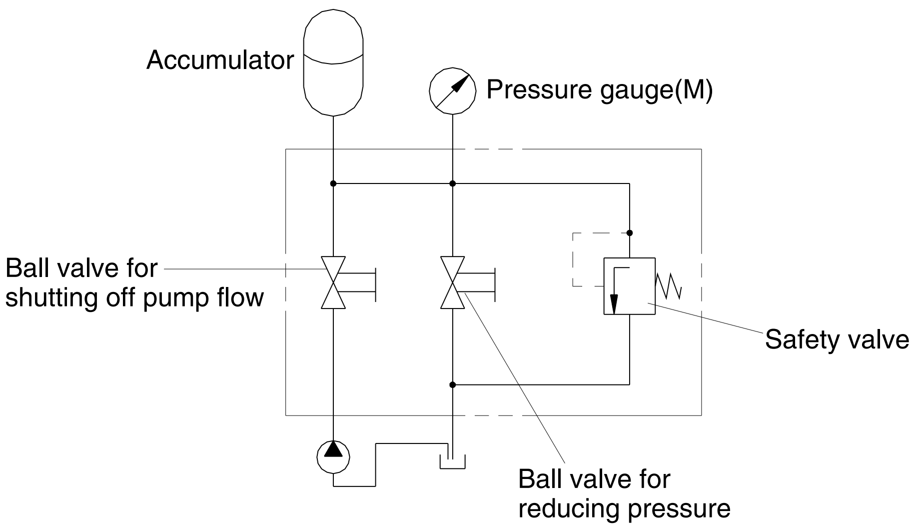
Before the accumulator is scrapped, its gas filling pressure must be reduced. For this purpose, drill a hole through gas chamber (B) using a drill approx. 3mm in diameter. The gas chamber is located on the side opposite the threaded port above the welding seam around the center of the accumulator.

※ 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 in switched off there will be some residual pressure in the system.

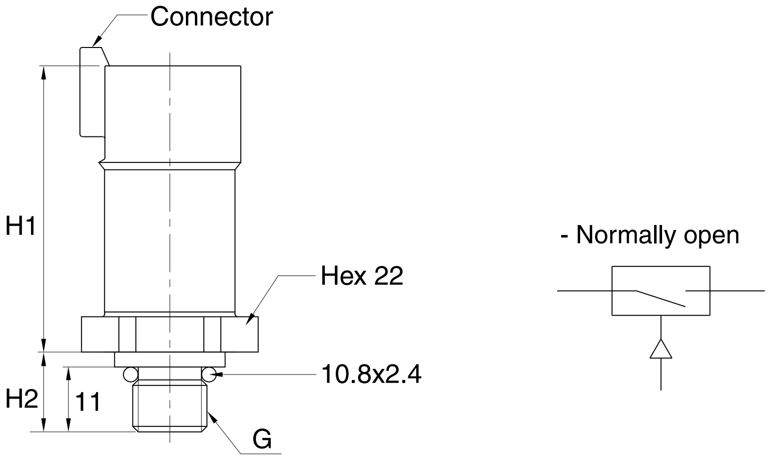
※ When doing repair work, make sure your environment is very clean.

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/cm²	Actuating pressure kgf/cm²	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	0 ~ 100	5 ± 1	Max 30

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.

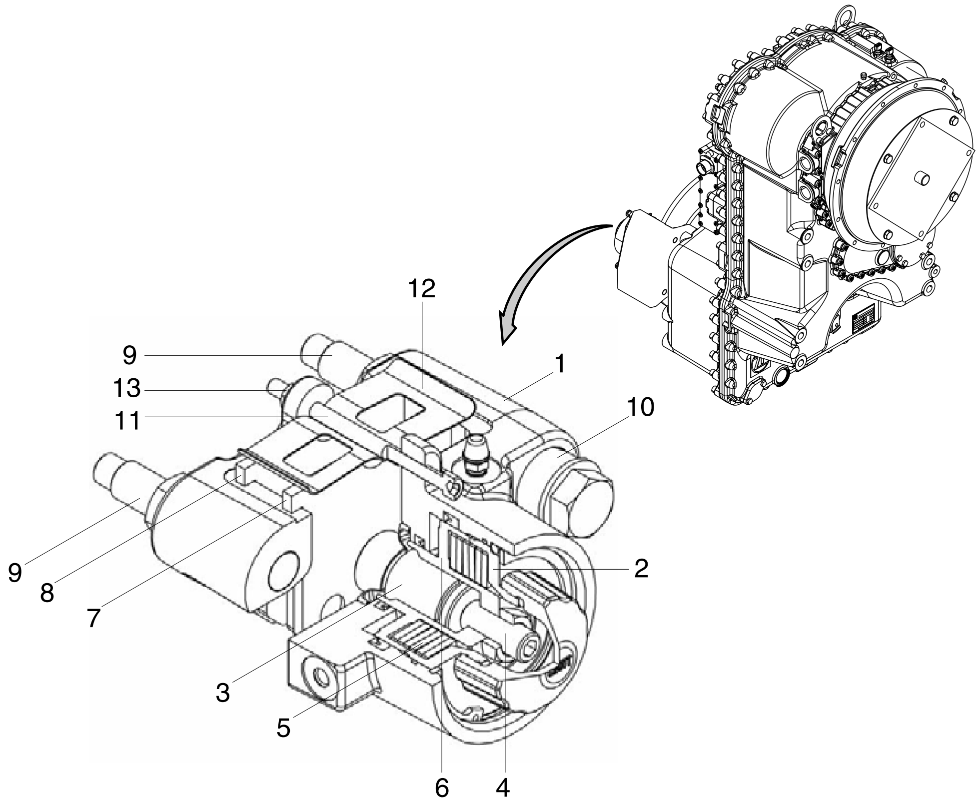
(4) Installation requirements
No special measures need to be taken.

(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.

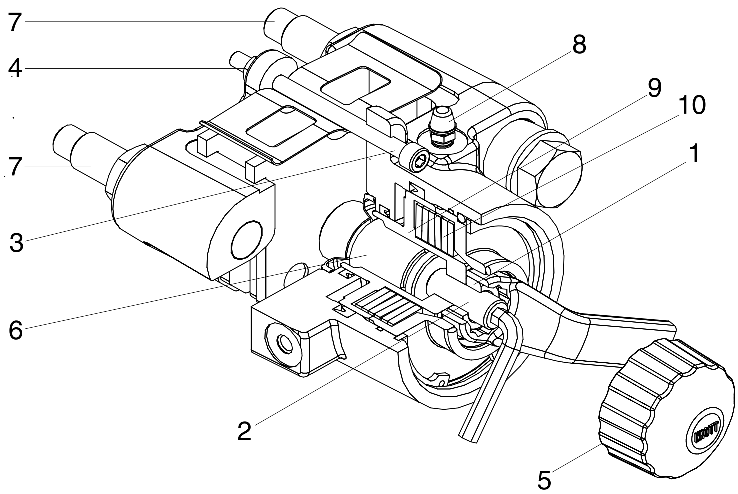
The braking effect (braking torque) is dependent upon the frictional values of the brake linings.

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



7609A4BS22

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.

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.

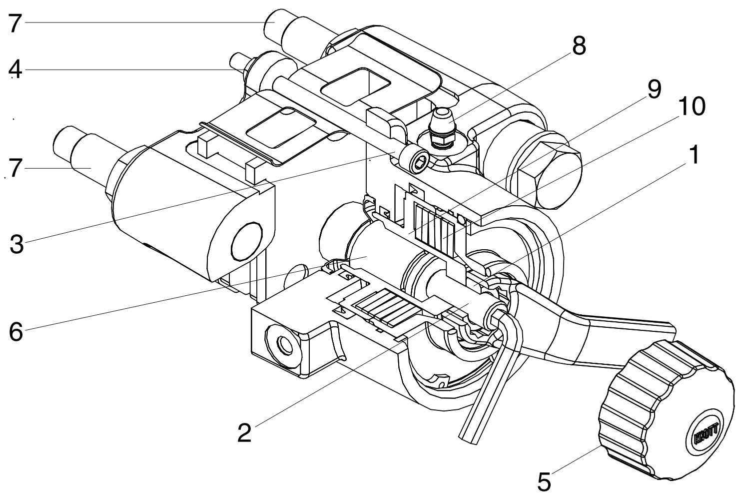
⑤ Hold the setting screw (3) in position and lock using the counter nut (4).

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.**



7609A4BS22

(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.

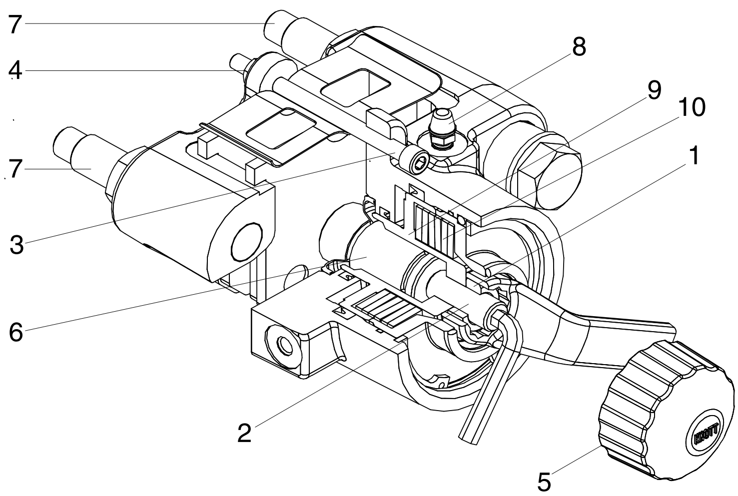
⑨ Hold the adjusting screw (3) in position and lock using the counter nut (4).

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.

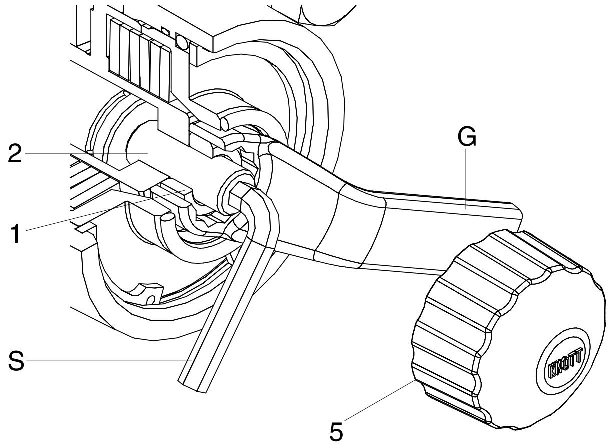
※ Actuate the brake valve several times and check the holding effect of the parking brake on a suitable incline or a suitable gradient.



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	S	Peg spanner
2	Setting screw	G	Ring spanner
5	Screw cap		

(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)

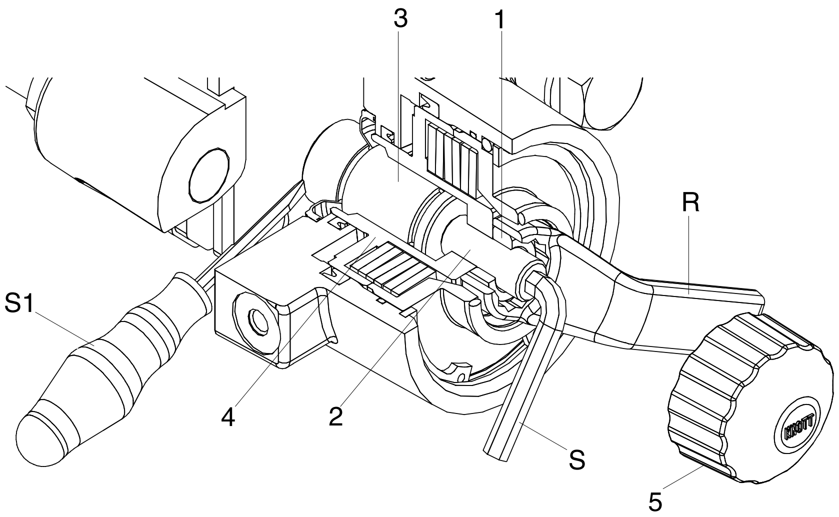
※ **In this condition the machine has no parking brake facility and thus must be protected from rolling away by different means. The brake must be adjusted before recommissioning.**

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.

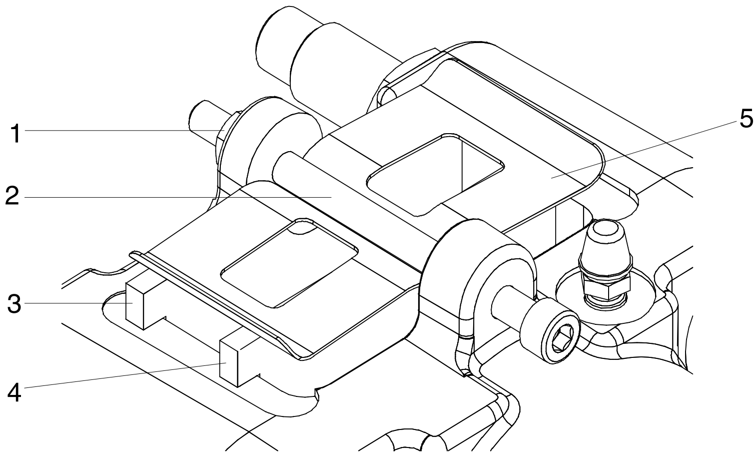
② Release the parking brake by application of the required release pressure (min. 130 bar).

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).



1 Counter nut
2 Adjusting screw
3 Lining pad
4 Lining pad
5 Lining spring

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.**

※ **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.

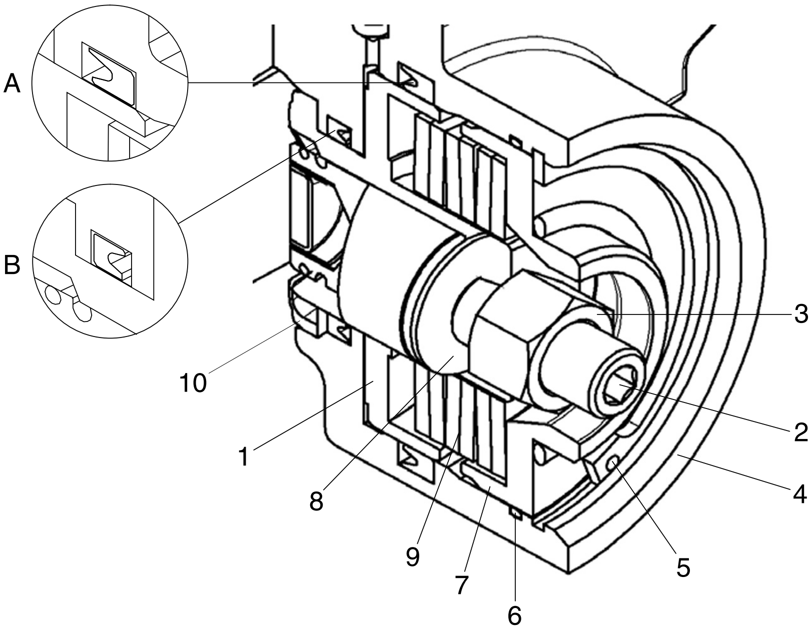
⑩ Replace the lining pads (3, 4).

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.**

※ **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



7609A4BS26

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 sealring
4	Housing	8	Pressure bolt	B	Detail sealring

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).

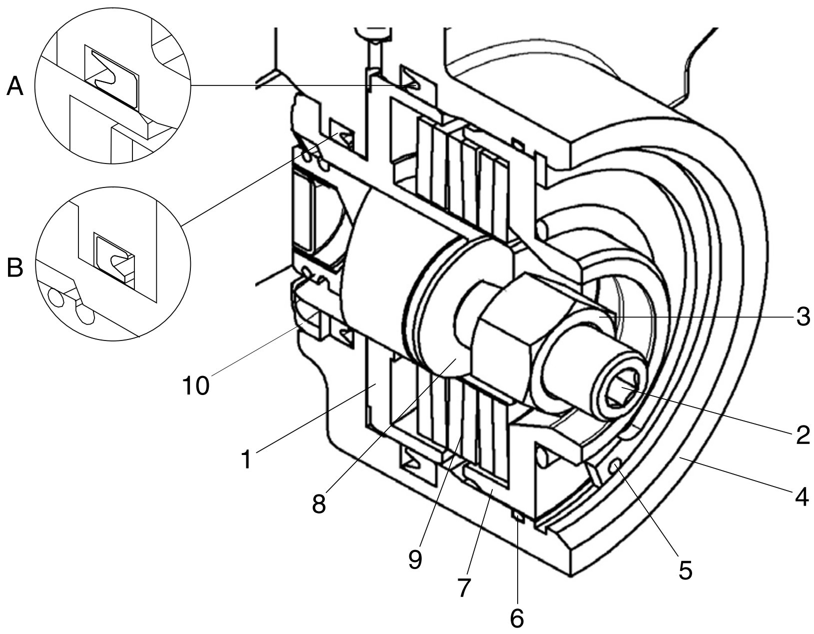
※ The dust protection cap (10) has a vulcanised-in steel ring which is used to press it into the opening in the brake housing (4).

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.

(3) General instructions

Any faults or damage detected on parts not listed here must, of course, be rectified or replaced by genuine parts.



7609A4BS26

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.

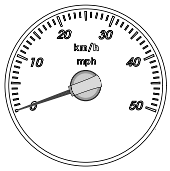
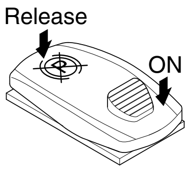
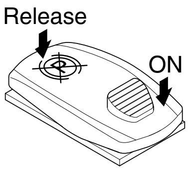
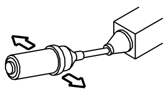
The engine and all other major components must be at operating temperature for some checks.

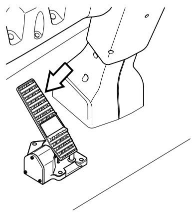
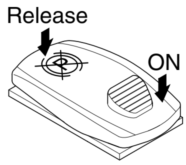
Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

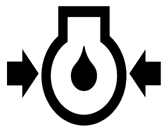
At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be given repair required and group location.
If verification is needed, you will be given next best source of information:

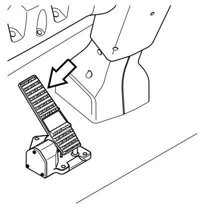
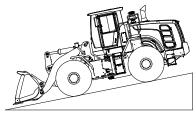
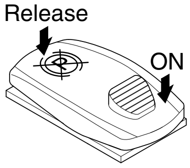
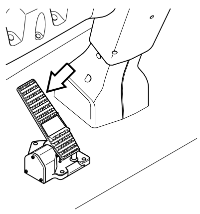
Chapter 2 : Troubleshooting
Group 3 : Tests and adjustments

※Hydraulic oil must be at operating temperature for these checks (refer to page 6-58).

Item	Description	Service action
Parking brake capacity check 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. **LOOK/FEEL** : 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.	**OK** Check completed. **NOT OK** Inspect parking brake. Go to group 3.
Parking brake transmission lockout check Engine running.	  Turn parking brake to ON. Place transmission in 1st forward. Slowly increase engine speed to high idle. **LOOK** : Machine must not move.	**OK** Check completed. **NOT OK** Go to transmission control circuit in section 3.

Item	Description		Service action
Service brake pump flow check ※ Hydraulic oil must be at operating temperature for the check. Engine OFF.	 	Stop engine. Operate brake pedal approximately 20 times. Start engine and run at low idle. Record number of seconds required for low brake pressure indicator lamp to go out. **LOOK** : Indicator lamp must go out in less than 10seconds from time engine starts. **NOTE** : Indicator will not come on approximately 1 second after starting engine.	**OK** Check completed. **NOT OK** Check for brake circuit leakage. Go to next page. **IF OK** Install a cap on line connected to inlet of brake valve and repeat pump flow check. If time does not decrease, check for worn brake pump.
Service brake capacity check Engine running.	 	Select clutch cut-off mode to OFF. Apply service brakes, release park brake and put transmission in 2nd forward. Increase engine speed to high idle. **LOOK** : Machine may not move or move at a very slow speed. Repeat check three times to ensure accurate results.	**OK** Check completed. **NOT OK** Check brake pressure. **IF OK** Inspect brake disk.

Item	Description	Service action
Brake accumulator precharge check ※ The axles and hydraulic oil must be at operating temperature for this check.	 Start and run engine for 30 seconds. Stop engine and turn start switch to ON and wait 5 seconds. **NOTE** : Engine oil pressure lamp will be on due to no engine oil pressure.  Count the number of times the brake pedal can be fully depressed before the low brake pressure warning lamp comes ON. **LOOK** : Warning lamp should not come ON in 1~5 applications. Start engine and operate at low idle. Observe cluster while applying brake pedal with maximum force. **LOOK/LISTEN** : Brake pressure indicator must not come ON.	**OK** Check completed. **NOT OK** Make sure brake pedal is not binding and keeping brakes partially engaged. Bleed brakes in group 3. Check brake system pressure. **NOT OK** If light comes ON with engine running, accumulator has lost it's charge. Inspect and recharge accumulator.
Brake system leakage check	 Start engine and wait 30 seconds. Stop engine. Wait 2 minutes. Turn start switch to ON and wait 5 seconds. **LOOK** : Brake oil pressure warning lamp must not come ON within 2 minutes after stopping engine.	**OK** Check completed. **NOT OK** 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. Check individual component leakage.

Item	Description	Service action
Service brake pedal check	 Slowly depress brake pedal. Listen for a hissing noise that indicates oil is flowing to brake pistons. LISTEN/FEEL : A hissing noise must be heard when pedal is depressed.	OK Check completed. NOT OK Inspect for debris under brake pedal.
Service and parking brake system drag checks Engine running	  Position machine on gradual slope. Lower bucket approximately 50 mm (2 in) from ground. Release parking and service brakes. LOOK : Machine must move or coast. NOTE : If machine does not move, check brake pedals to be sure they fully release when feet are removed from pedals. Drive machine at high speed for about 5 minutes. Brake drag is indicated if brake areas in differential case are hot. NOTE : Observe parking brake. If disk is hot, parking brake drag is indicated.	OK Check completed. NOT OK Adjust park brake. NOT OK Check floor mat interference to pedal or debris build-up. IF OK Check for brake pressure when brake is released. Go to brake pressure test.
Clutch cut-off check	  Select clutch cut-off mode to L mode. Release parking brake. Run engine at half speed in 1st forward. Firmly depress brake pedal. FEEL : Transmission must disengage when brake pedal is depressed at 30% of pedal stroke. NOTE : Clutch cut-off mode can be selected to operator preference to match your loading needs.	OK Check completed. NOT OK Adjust clutch cut-off mode.

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
Poor or no brakes	Brake accumulator charge low.	Do brake accumulator check.
	Brake pump standby pressure low.	Do brake pump standby pressure test.
	Brake pressure low.	Do brake valve pressure test.
	Air in system.	Bleed brakes.
	Worn brake surface material.	Inspect brake surface material.
	Leakage in brake valve.	Do brake valve leakage test.
	Leakage in brake piston seal.	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.
Aggressive brakes	Internal restriction in circuit.	Remove lines and components.
	Brake valve malfunction.	Disassemble and inspect.
	Low oil level.	Check oil level.
Brakes drag	Brake pedal not returning properly.	Inspect floor mat and pedal.
	Debris holding valve partially open in brake valve.	Do brake valve pressure test.
	Warped brake disk.	Inspect brake disk.
	Stuck brake piston.	Repair.
Brakes lock up	Brake valve malfunction.	Clean or replace brake valve.

Problem	Cause	Remedy
Brakes chatter	Air in brake system.	Do brake bleed procedure.
	Worn brake surface material.	Inspect brake surface material.
	Wrong oil in differential.	Drain.Refill.
Hissing noise when brake pedal is held with engine stopped	Leakage in brake valve, or brake piston.	Do brake system leakage test.
Brake pressure warning light will not go out or stays on excessively long after start-up	Malfunction in brake low pressure warning switch.	Replace switch.
	Brake accumulator pressure too low.	Recharge accumulator.
	Low brake pump standby pressure setting.	Do brake pump standby pressure test.
	Leakage in pressure reducing manifold block.	Do pressure reducing valve manifold leakage test.
	Leakage in brake system.	Do brake system components leakage tests.
	Worn brake pump.	Do brake pump flow test.
	Leakage in parking brake solenoid.	Do parking brake pressure test.

2) PARKING BRAKE MALFUNCTIONS

Problem	Cause	Remedy
Brake will not hold	Pads not adjusted correctly.	Adjust parking brake.
	Malfunctioning parking brake solenoid.	Inspect and replace.
	Worn brake disk and / or brake pads.	Disassemble, inspect, repair.
	Brake piston hangs up in bore.	Remove and inspect. Repair.
Brake disk overheats	Pads out of adjustment.	Adjust parking brake.
	Brake not released.	Release parking brake. Disassemble, inspect brake. Repair if necessary. Inspect for loosen or broken lines between brake pressure switch and indicator on dash.
Parking brake indicator in monitor does not come on when brake applied	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.
Brake will not apply	Pads out of adjustment.	Adjust parking brake.
	Malfunctioning wiring, switch, or solenoid.	Check electric circuit.
	Restriction between brake valve and brake.	Remove hose and inspect. Replace.

GROUP 3 TESTS AND ADJUSTMENTS

1. PARKING BRAKE PERFORMANCE

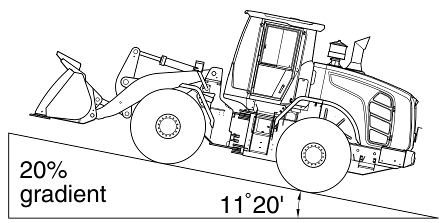
1) MEASUREMENT CONDITION

(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 valve
Parking brake performance	Keep machine on 20% (11˚20') gradient



740F4BS17

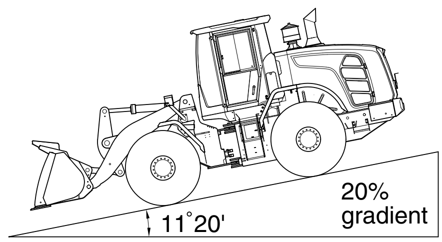
2) MEASURING PROCEDURE

(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.

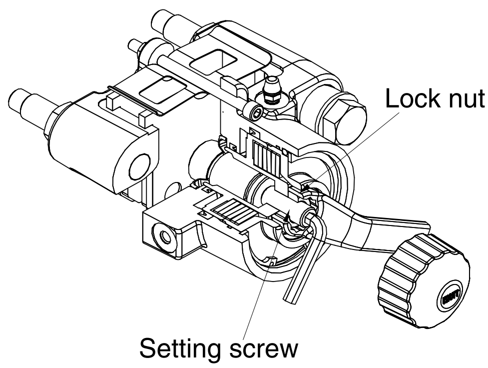


740F4BS18

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 4-22.



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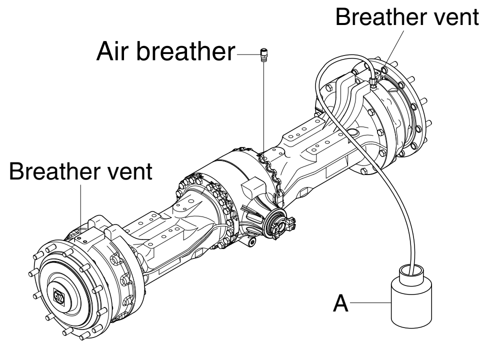
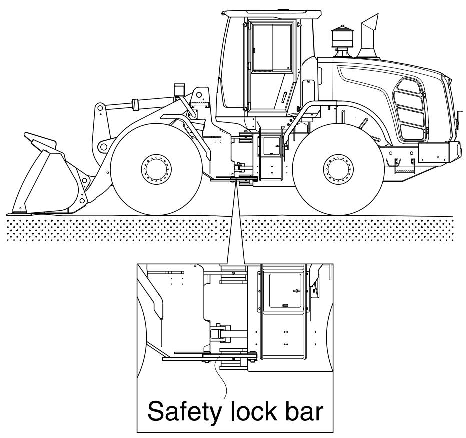
3. HYDRAULIC BRAKE BLEEDING PROCEDURE

▲ 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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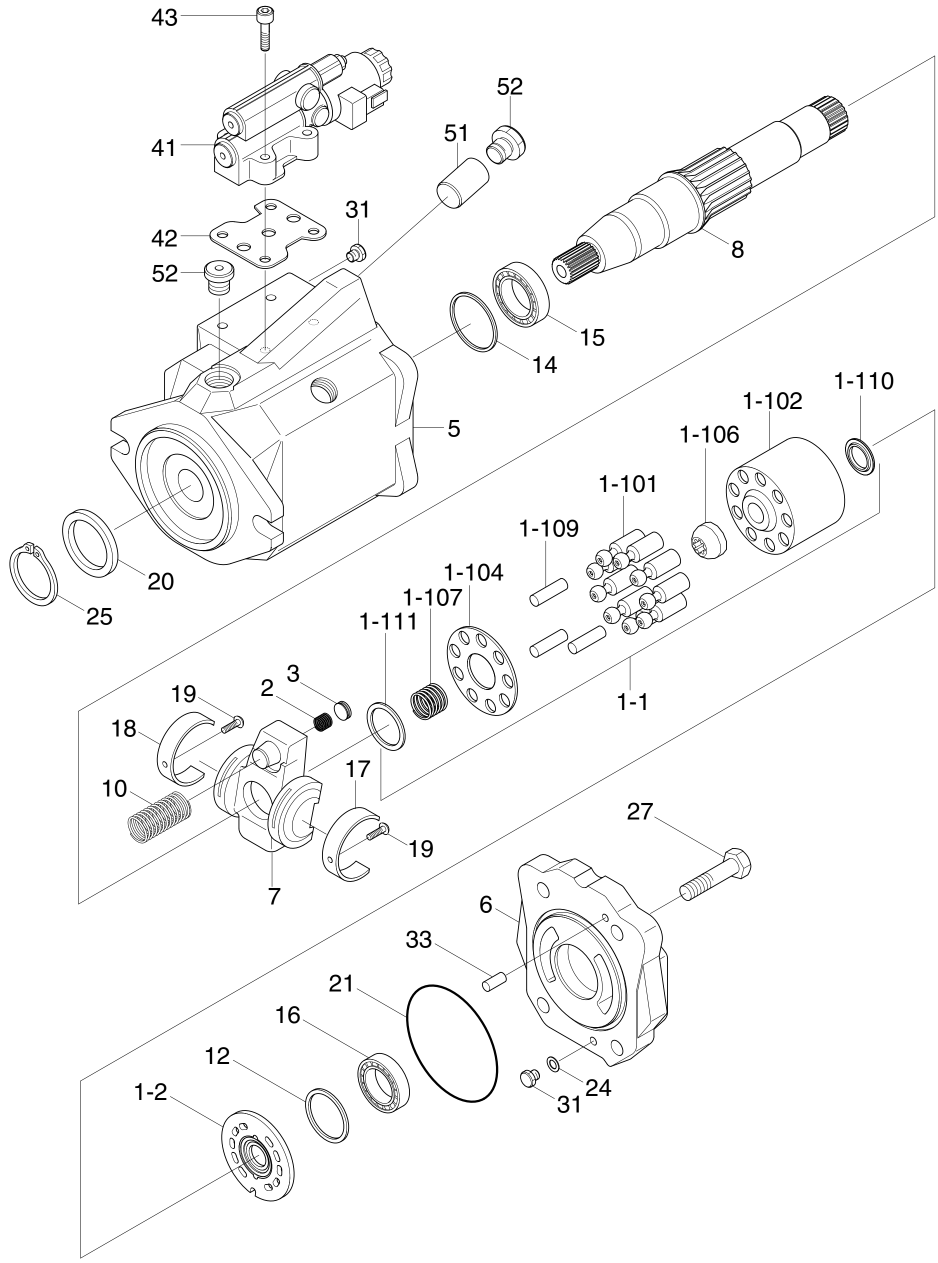
GROUP 4 DISASSEMBLY AND ASSEMBLY

1. FAN AND BRAKE PUMP

1) STRUCTURE



7609A4BS11

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.

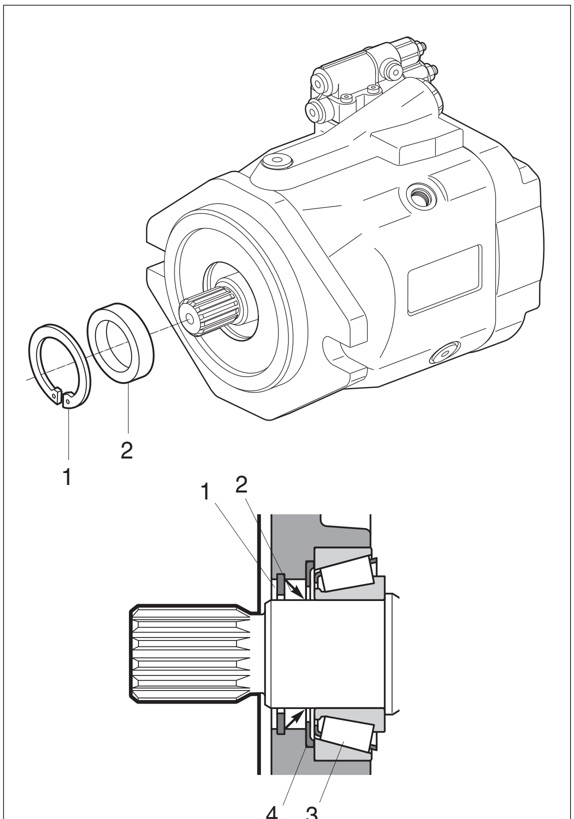
(3) Check all sealing and sliding surfaces for wear.

※ 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.

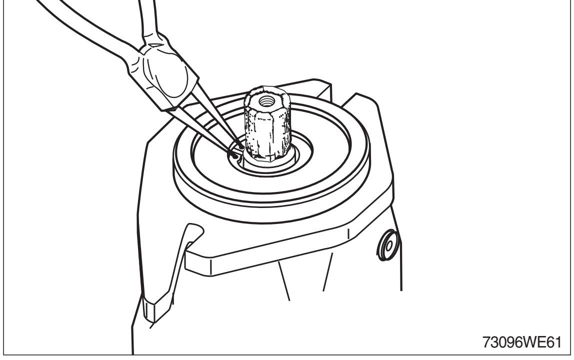
3) SEALING THE DRIVE SHAFT

1	Retaining ring	2	Shaft seal
3	Bearing	4	Stop ring

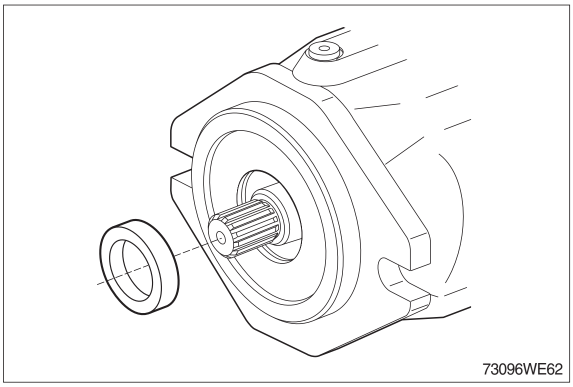


73096WE59/60

(1) Protect the drive shaft.
Wrap the drive shaft with tape.
Remove the retaining ring.
Remove shaft seal to front.

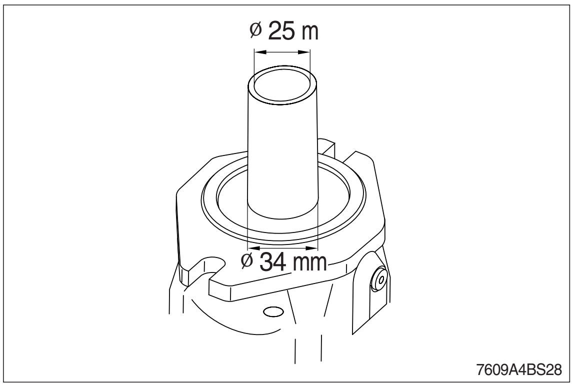

73096WE61

※ Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.
Visual check shaft seal and housing.



73096WE62

(2) Assembling of the sealing ring carefully down to the stop ring.



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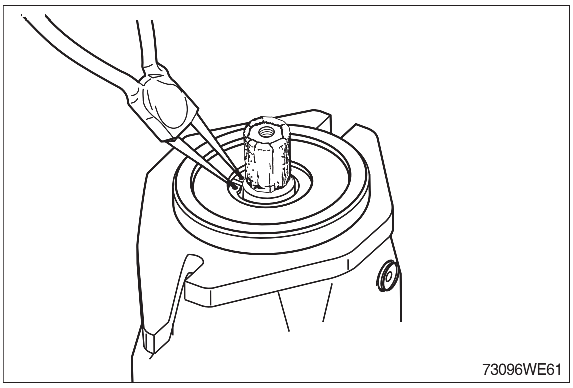
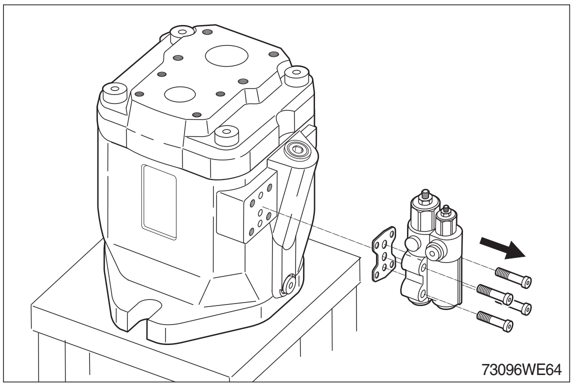
(3) Assemble the retaining ring (circlip).
※ Visual check to ensure that the circlip is correctly located in the groove.



73096WE61

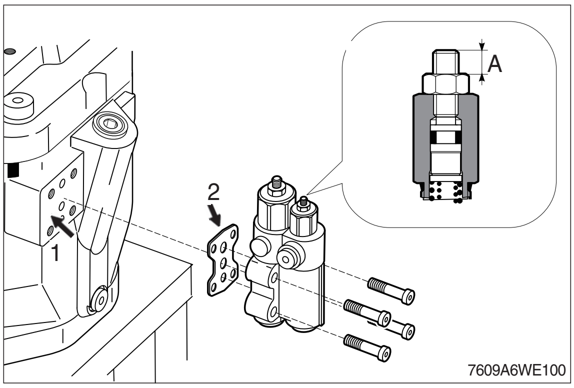
4) SEALING THE CONTROL VALVE

(1) Remove the control valve.



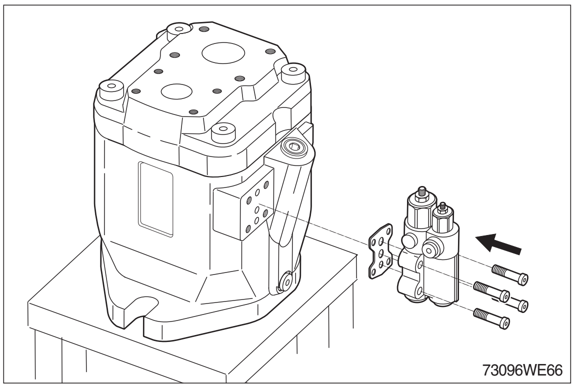
73096WE64

(2) Measure dimension A and note down.
Check sealing surface (1).
Replace gasket (2).



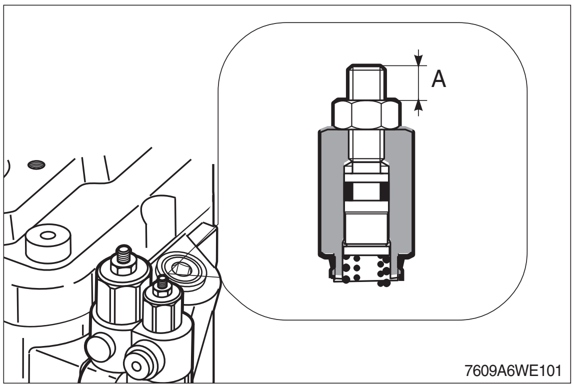
7609A6WE100

(3) Assemble control valve.
Tighten the bolts.
· Tightening torque : 1.58 kgf · m (11.4 lbf · ft)



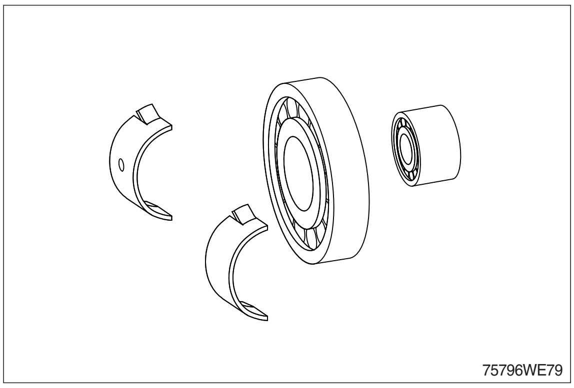
73096WE66

(4) Check dimension A.



7609A6WE101

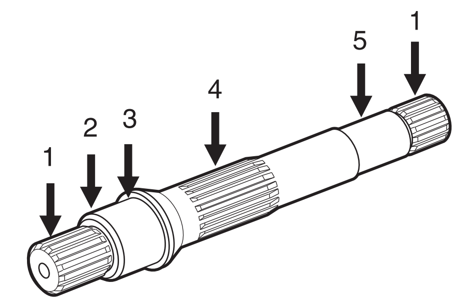
5) INSPECT HINTS
(1) Renew all bearings.



75796WE79

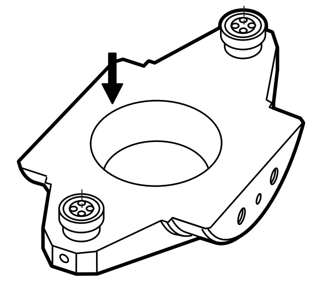
(2) Check :

1 Wear on splines, rust
2 Drive shaft seal wear grooves
3 Bearing seat
4 Splines for cylinder drive
5 Bearing seat

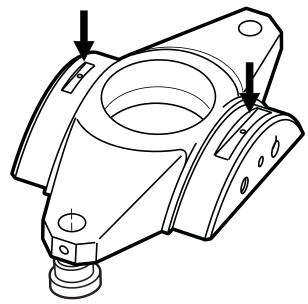


75796WE80

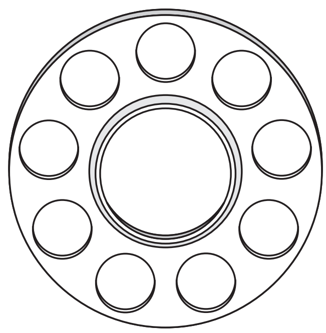
(3) Check :
Sliding surface free of grooves.


75796WE81

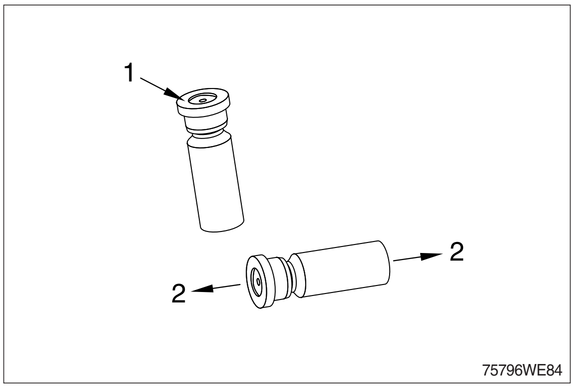
(4) Check :
Bearing surfaces.


75796WE82

(5) Check :
That the retaining plate is free of grooves and that there is no wear in the slipper pad area.

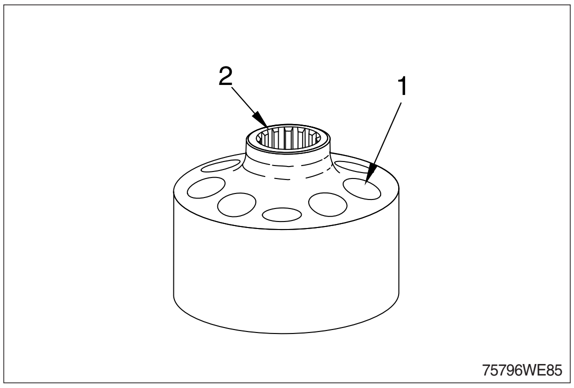

75796WE83

(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).

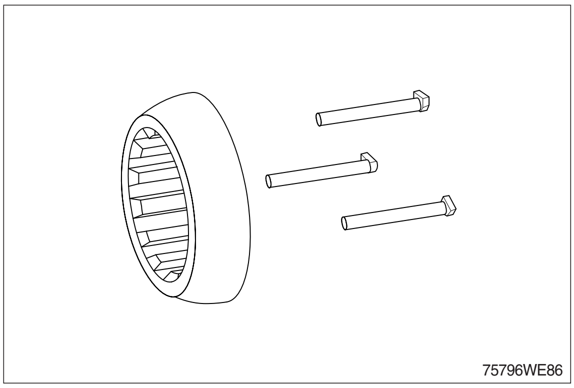


(7) Check :

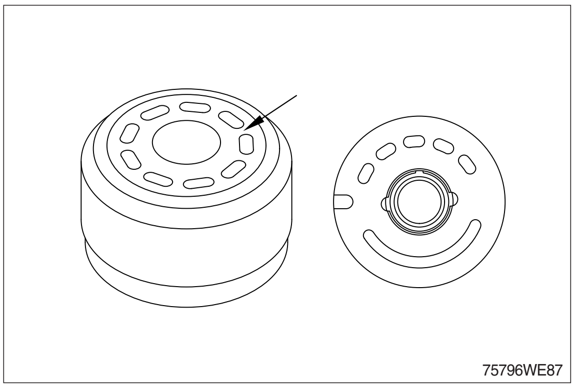
1 Cylinder bores
2 Splines



(8) Free of grooves, no signs of wear.

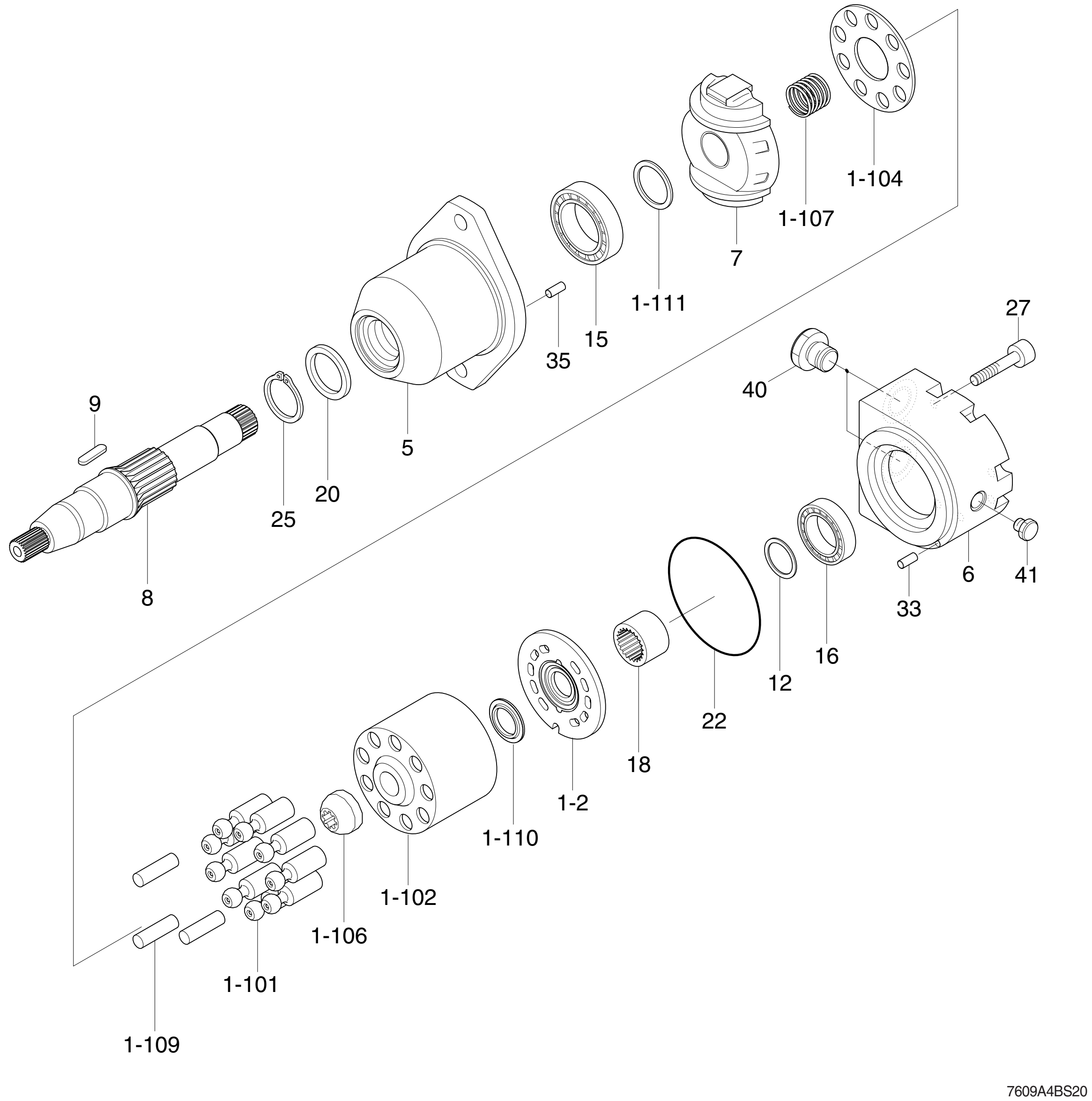


(9) Check :
Cylinder sliding surface free of grooves, no wear, no embedded foreign particles. That there are no scratches on the control plate. (Only replace them as a set).



2. FAN MOTOR

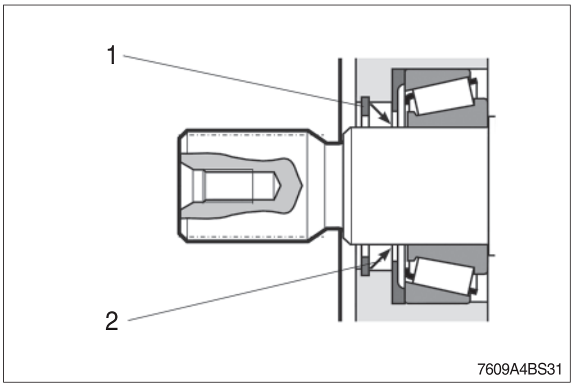
1) STRUCTURE



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

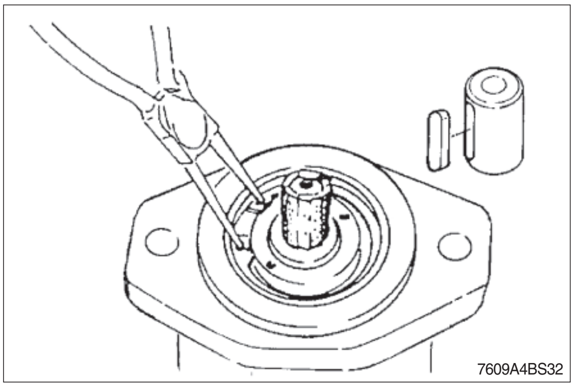
2) SEALING THE DRIVE SHAFT

(1) 1 Circlip
  2 Shaft seal



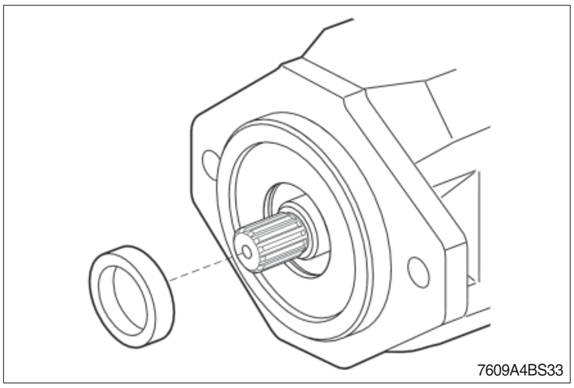
7609A4BS31

(2) Remove key.
 Protect the drive shaft.
 Remove the circlip.



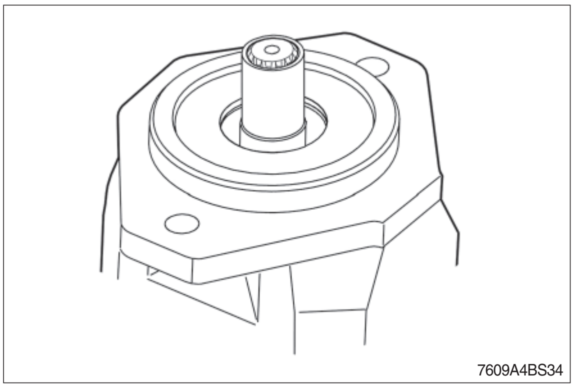
7609A4BS32

(3) Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.



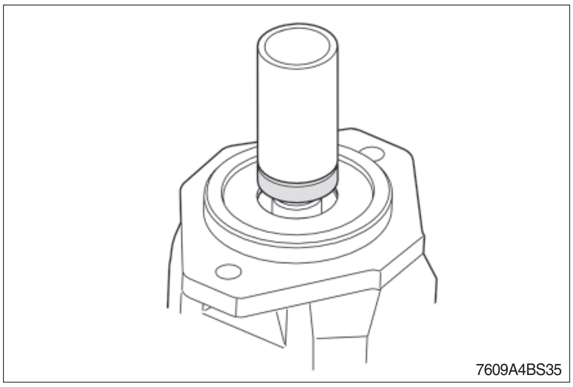
7609A4BS33

(4) Use installation tool or plastic strip for assembling seal.



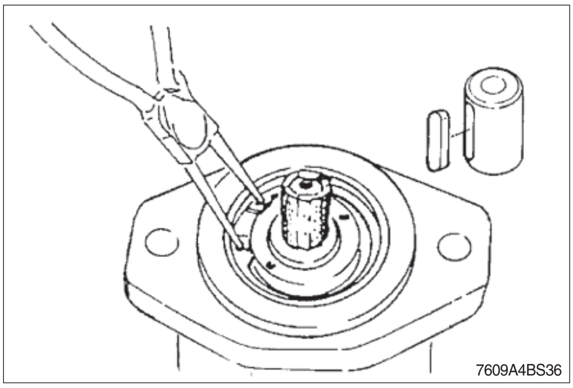
7609A4BS34

(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.



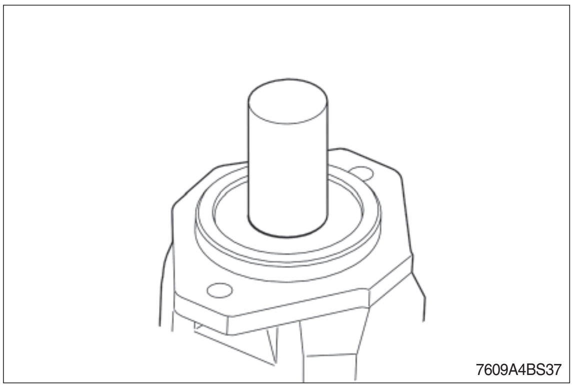
7609A4BS35

(6) Assemble the circlip.



7609A4BS36

(7) Assemble the circlip in the correct position.

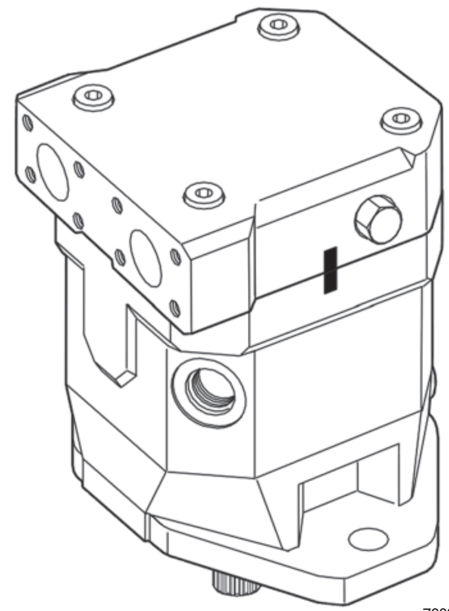


7609A4BS37

※ This discription showes 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.

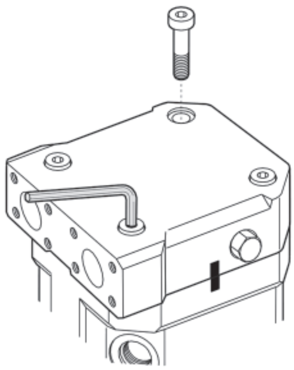
3) DISASSEMBLE THE MOTOR

(1) Disassembly position.
Mark the location of the port plate on the housing.



7609A4BS38

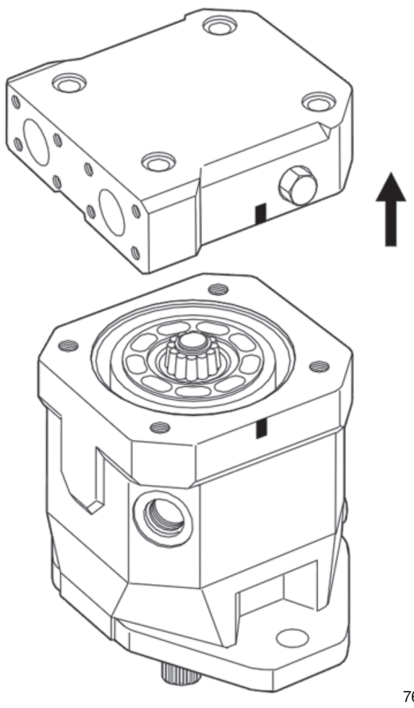
(2) Remove the port plate fixing bolts crosswise.



7609A4BS39

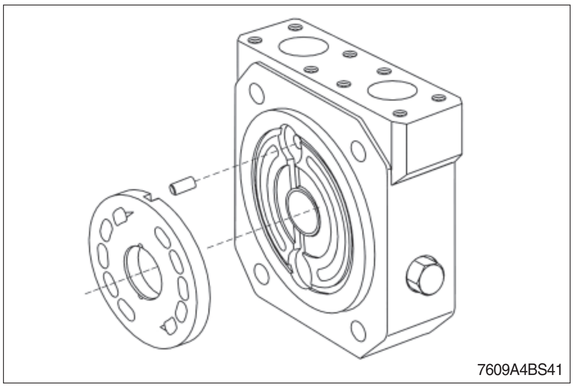
(3) Remove the port plate.

※ Control plate can drop down-hold tight.



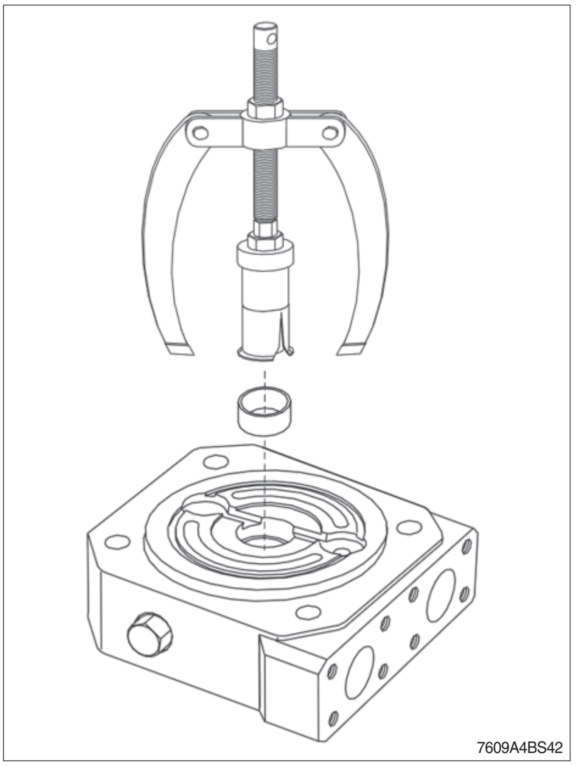
7609A4BS40

(4) Remove control plate.



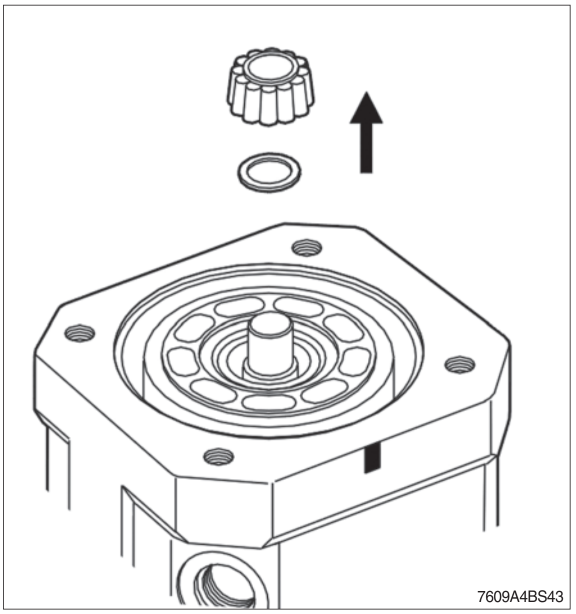
7609A4BS41

(5) Remove bearing outer ring with withdrawal tool.
Do not damage the sealing surface.



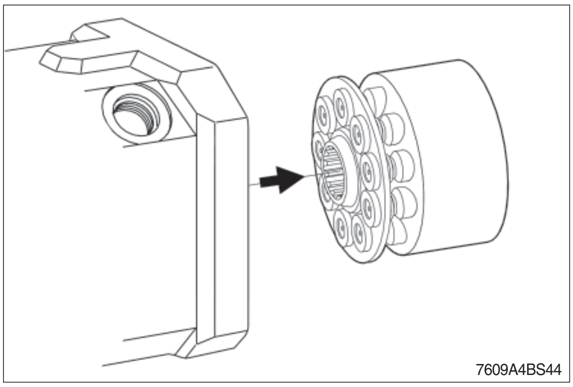
7609A4BS42

(6) Disassemble the taper roller bearing (near by port plate).
Remove the adjustment shim.

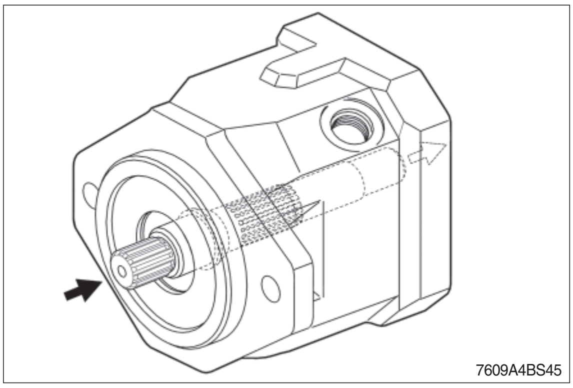


7609A4BS43

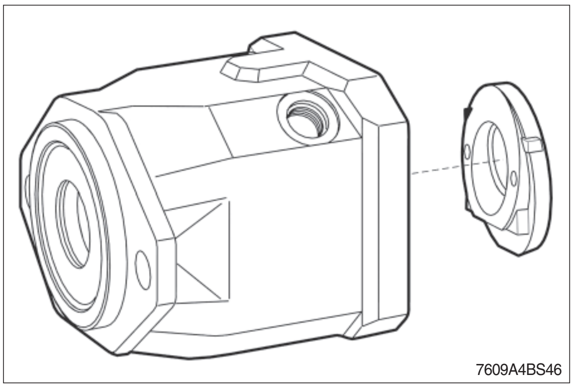
(7) Remove the rotary group in a horizontal position.



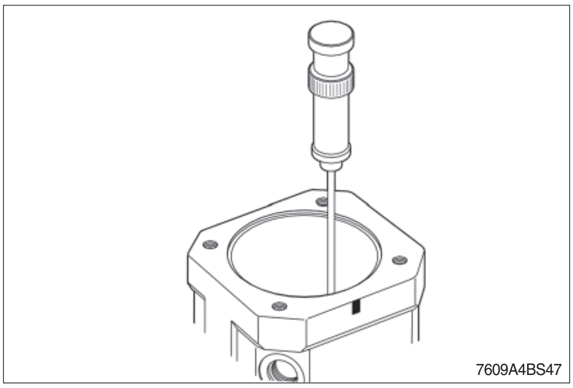
(8) Remove the drive shaft to rear side.



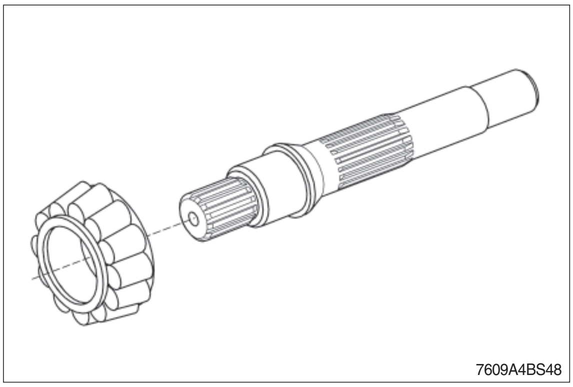
(9) Remove swash plate with special tool (see the next figure).



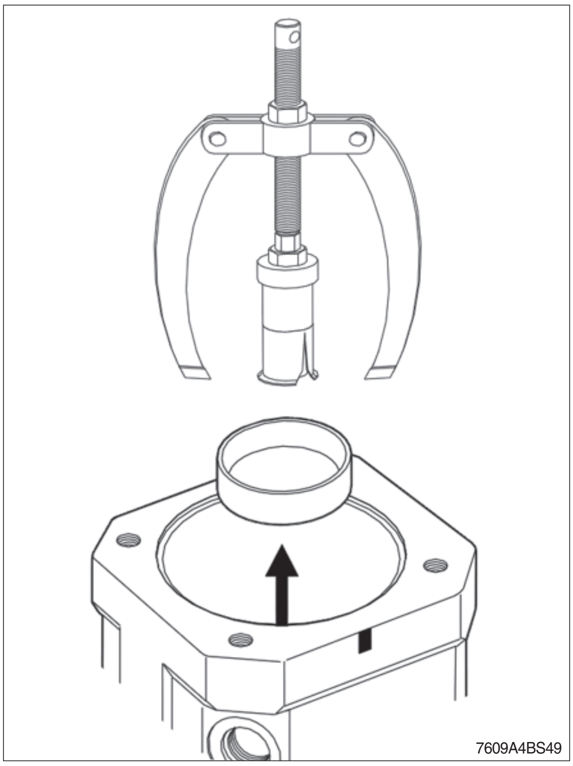
(10) Loosen the swash plate with a slide hammer (a small hook - diameter 6 mm - catches the end of the swash plate at the bottom).



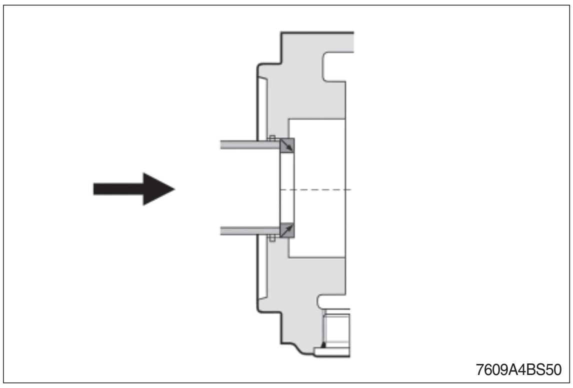
(11) Press down bearing.



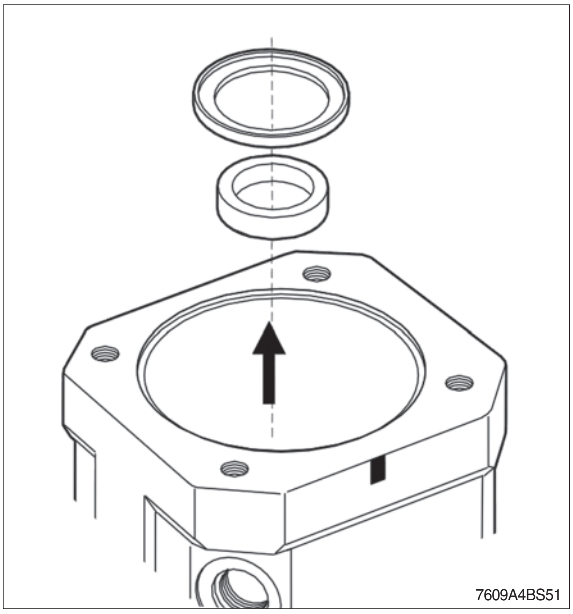
(12) The external front bearing ring is pulled out of the pump housing.



(13) Disassemble circlip and shaft seal.

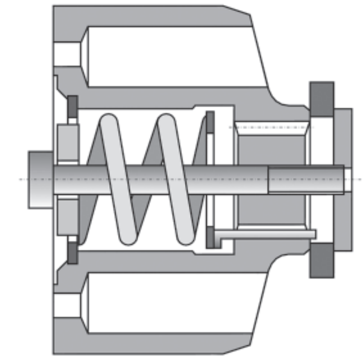


(14) Remove shaft seal and shim.



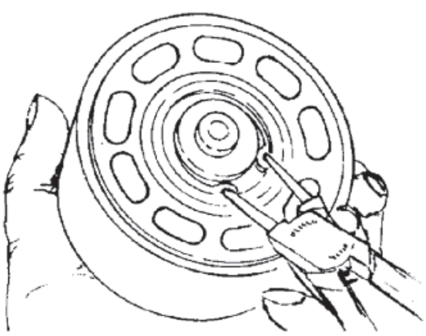
7609A4BS51

(15) Pre-tension the spring using a suitable device.



7609A4BS52

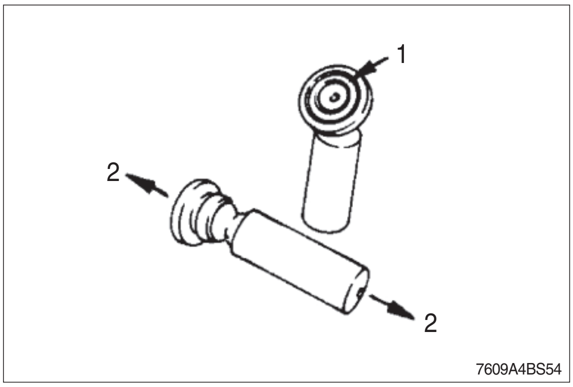
(16) Remove circlip.
Remove spring and pressure pins.



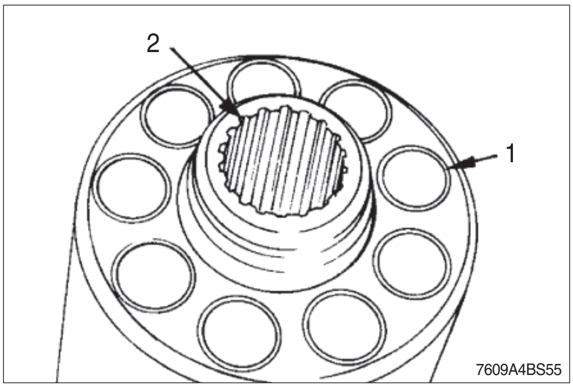
7609A4BS53

4) INSPECTION HINTS

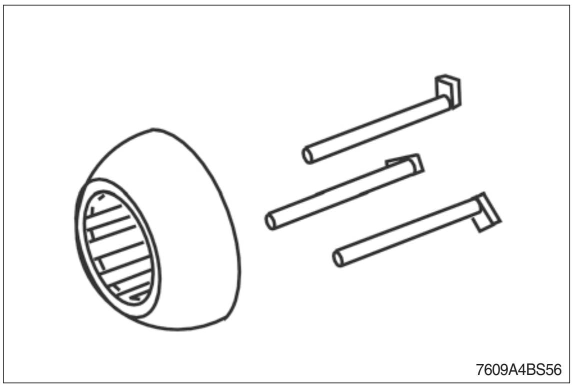
(1) Check to see that there are no scratches or metal deposits on the sliding surface (1), and that there is no axial play (2), (pistons must only be replaced as a set).



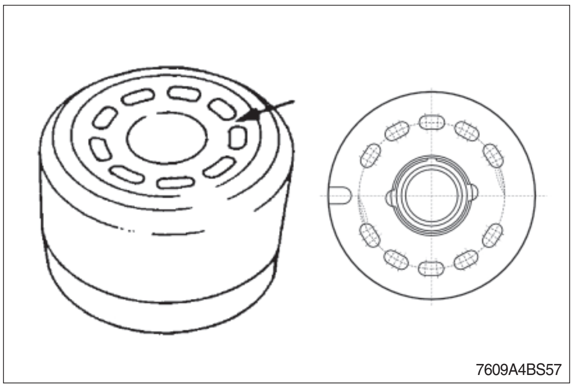
(2) Check cylinder bores (1) and splines (2).



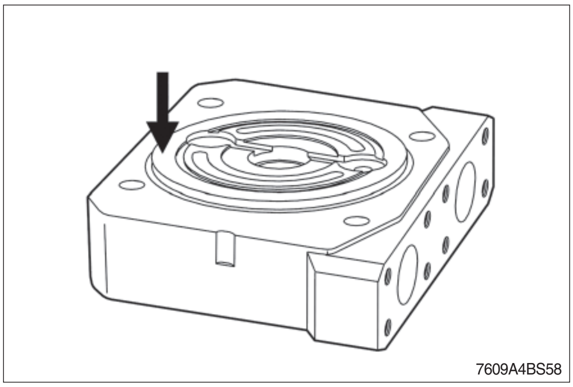
(3) Free of grooves, no signs of wear.



(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).



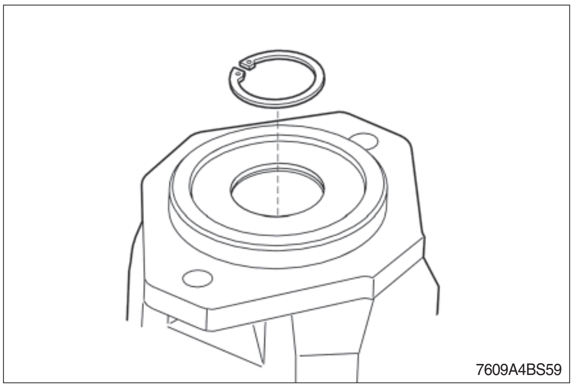
(5) Mounting surface - control plate undamaged.



7609A4BS58

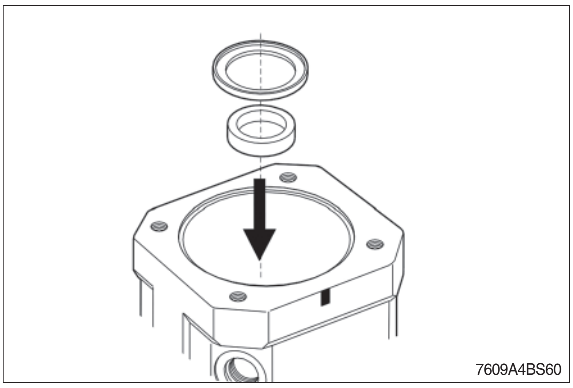
5) MOTOR ASSEMBLY

(1) Fit the circlip into the housing.



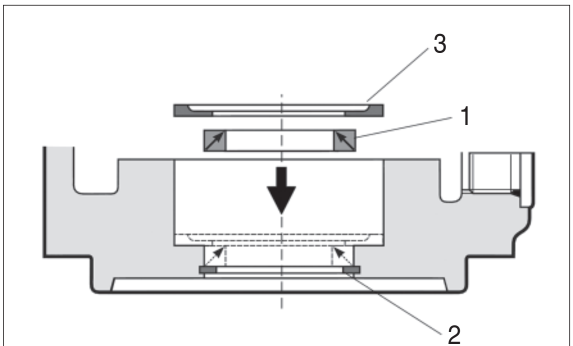
7609A4BS59

(2) Assemble shaft seal and shim against circlip.



7609A4BS60

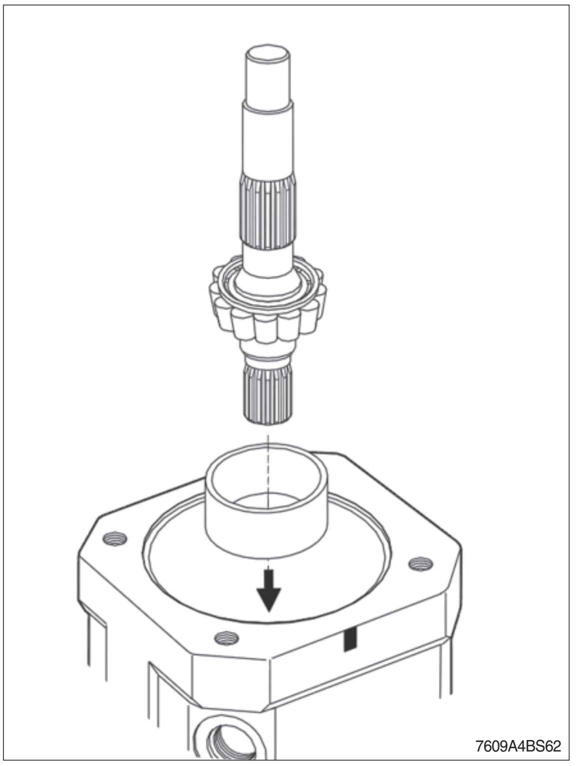
(3) Assembly of the shaft seal (1) against the safety ring (2) back up the shim (3) down to the seal ring.



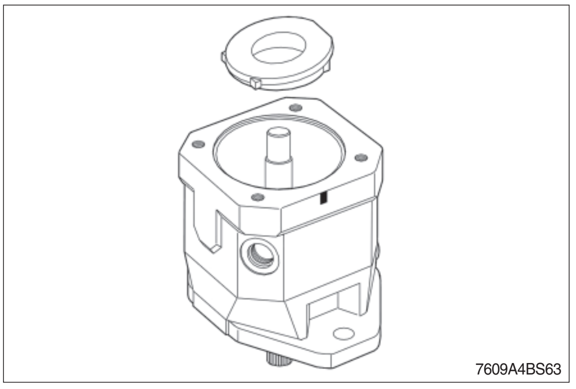
7609A4BS61

(4) Press outer bearing ring into housing. Shaft seal with pre-assembled bearing into housing.

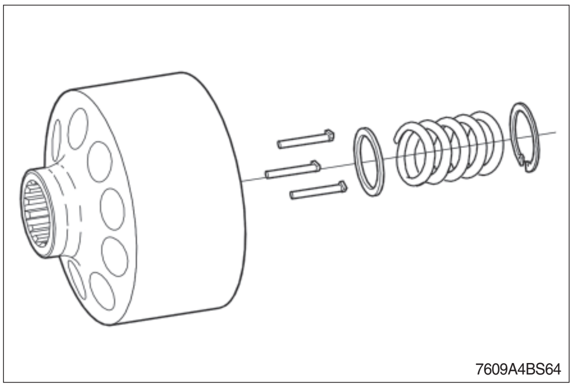
※ Protect splines of the shaft with plastic strip against damage of the seal lip.



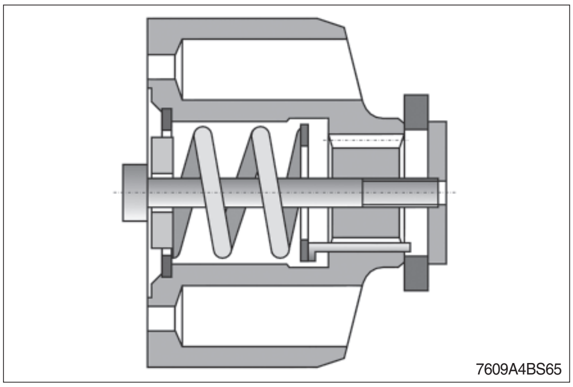
(5) Assemble swash plate.



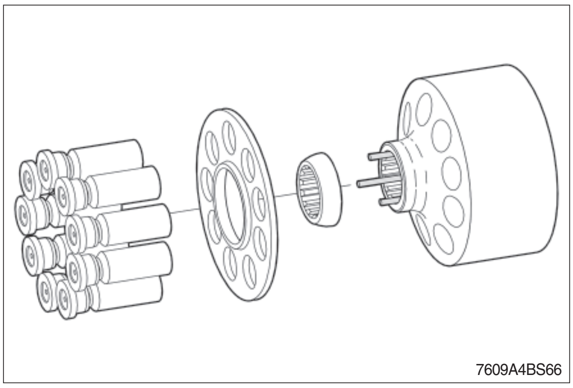
(6) Fit pressure pins using an assembly aid.



(7) Pre-tension the spring using a suitable device.



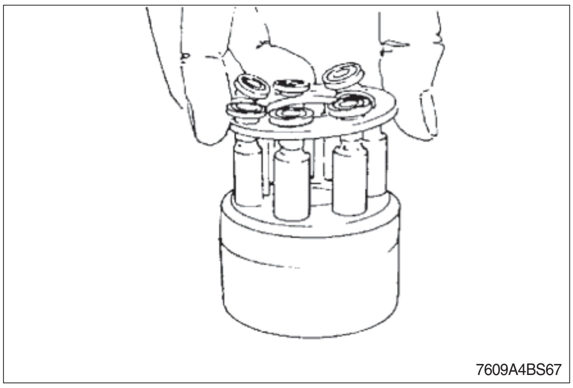
7609A4BS65



7609A4BS66

(8) Assemble piston with retaining plate.

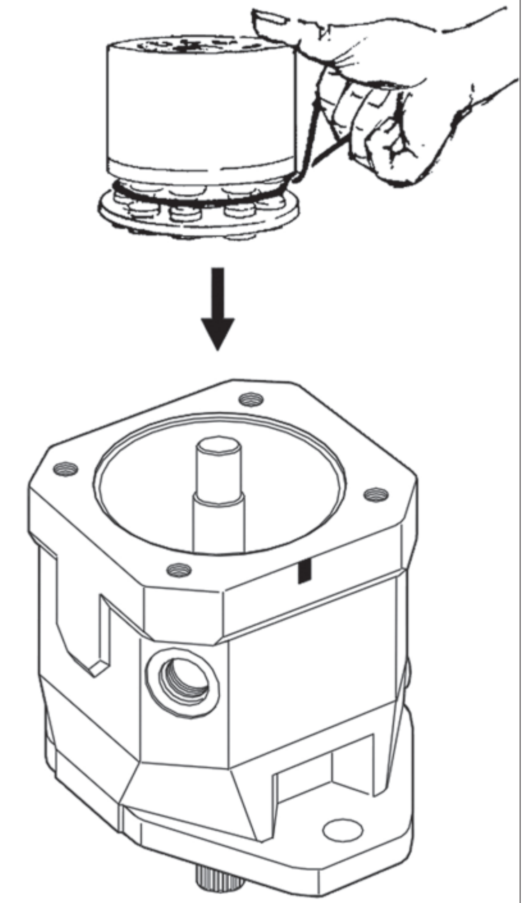
※ Oil piston and slipper pad.



7609A4BS67

(9) Fit rotary group.

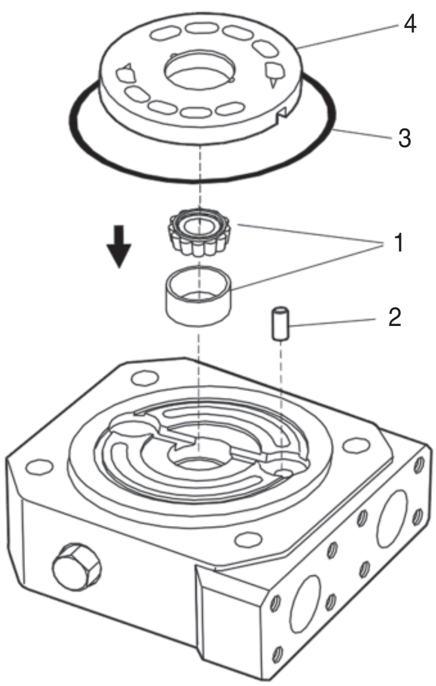
※ Assembly aid :
Hold the pistons by using an O-ring.



7609A4BS68

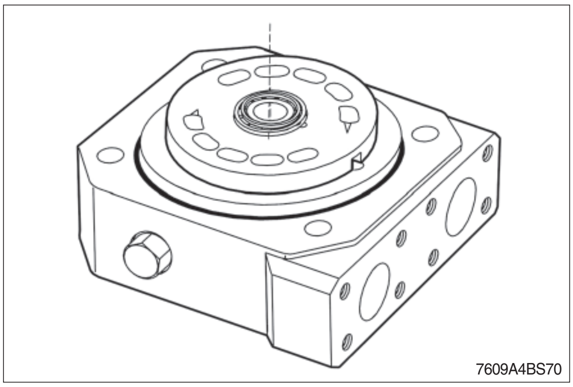
(10) Fit bearing (1) in port plate.
Fit cyilindrical pin (2).
Fit O-ring (3).
Fit control plate (4).

※ Assembly :
Hold the components in place with grease.

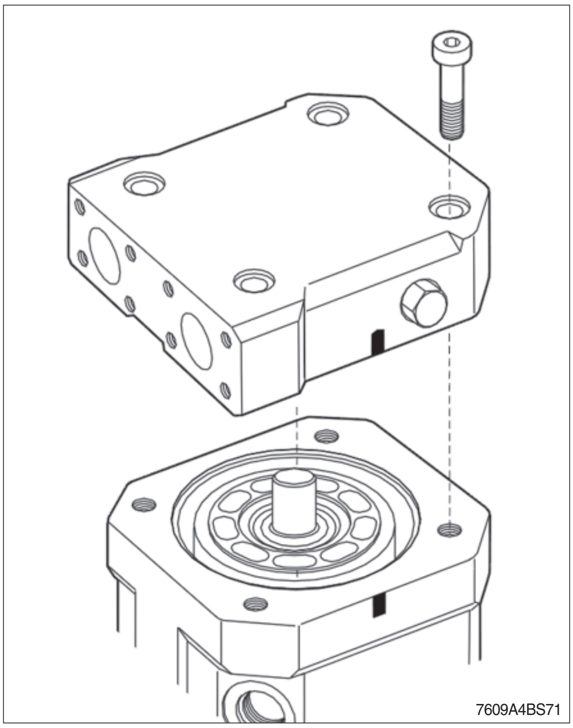


7609A4BS69

(11) Fit control plate.
Assembly aid : Grease



(12) Fit the port plate and fix it with the bolts crosswise.



SECTION 5 STEERING SYSTEM

SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

The steering system of this machine consists of a variable piston pump supplying a load sensing steering system and an closed center loader system.

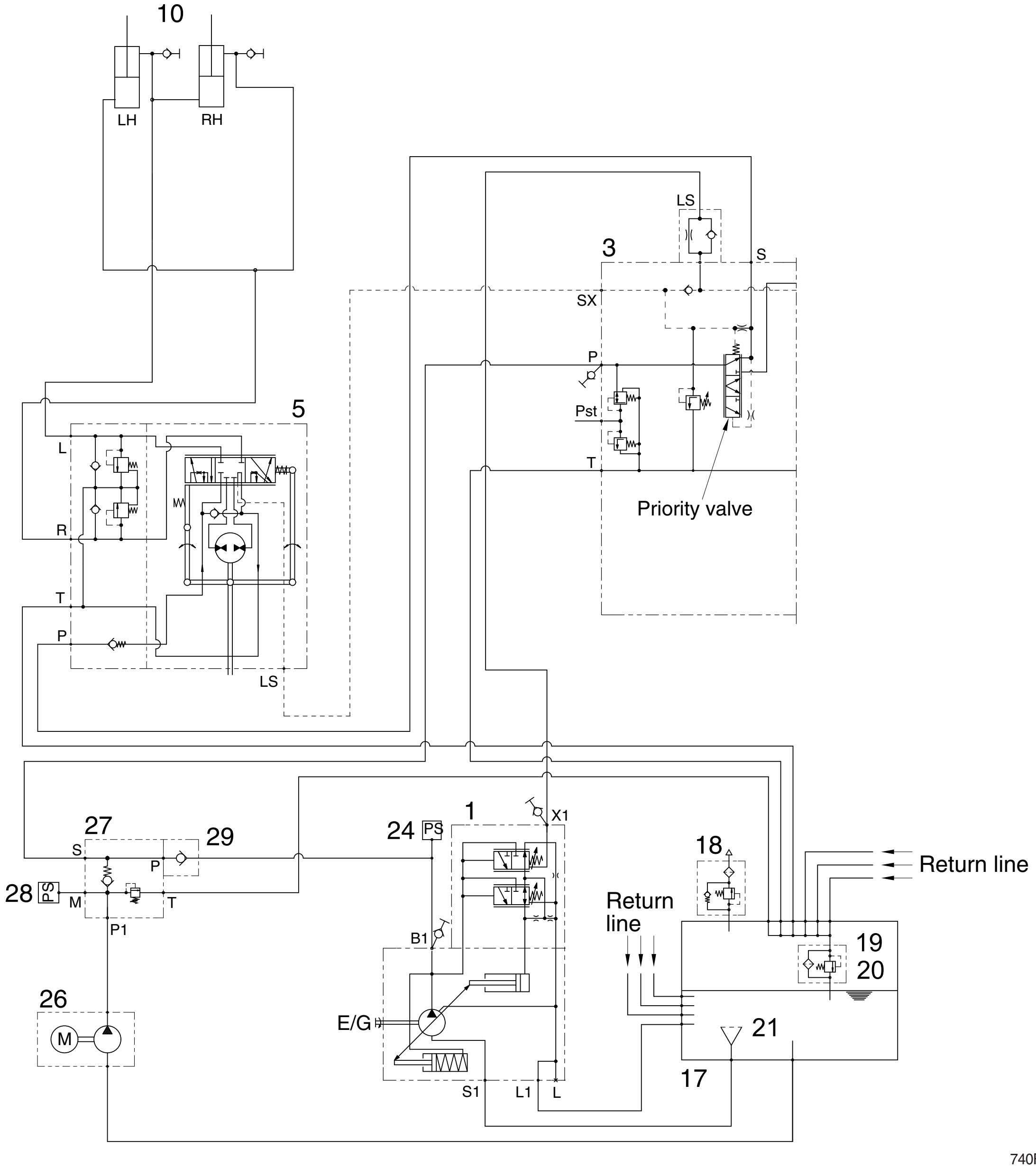
The components of the steering system are :
· Main pump
· Steering unit
· Steering cylinders

The main pump draws hydraulic oil from the hydraulic tank.
Outlet flow from the pump flows to the priority valve in main control valve. The priority valve in main control 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 pump enters into the main control valve for the operation of the attachment.

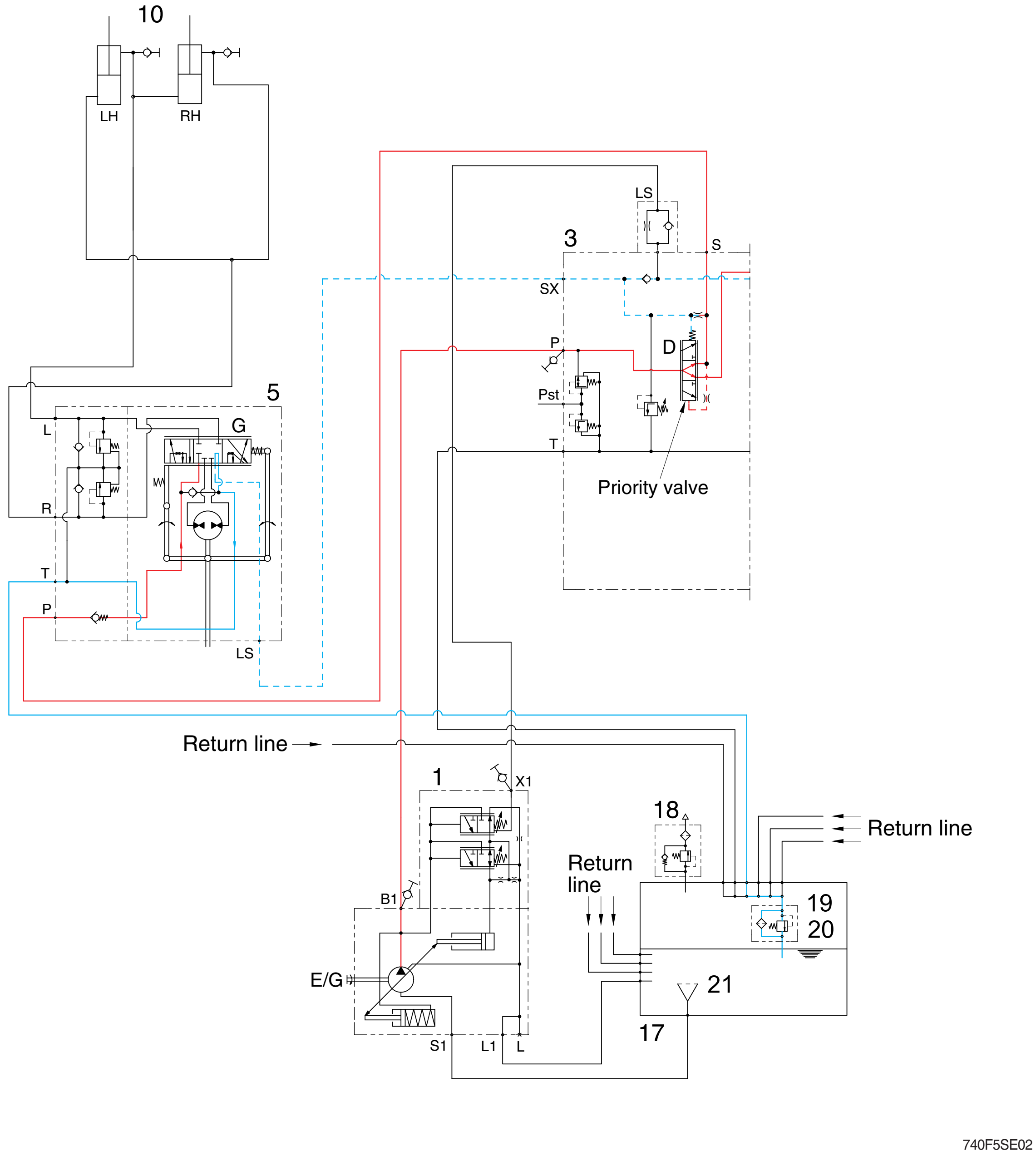
2. HYDRAULIC CIRCUIT



740F5SE01

1	Main pump	18	Air breather	26	Motor pump (option)
3	Main control vavle	19	Return filter	27	Check block (option)
5	Steering unit	20	Bypass valve	28	Pressure sensor (option)
10	Steering cylinder	21	Strainer	29	Check valve (option)
17	Hydraulic tank	24	Pressure sensor		

1) NEUTRAL

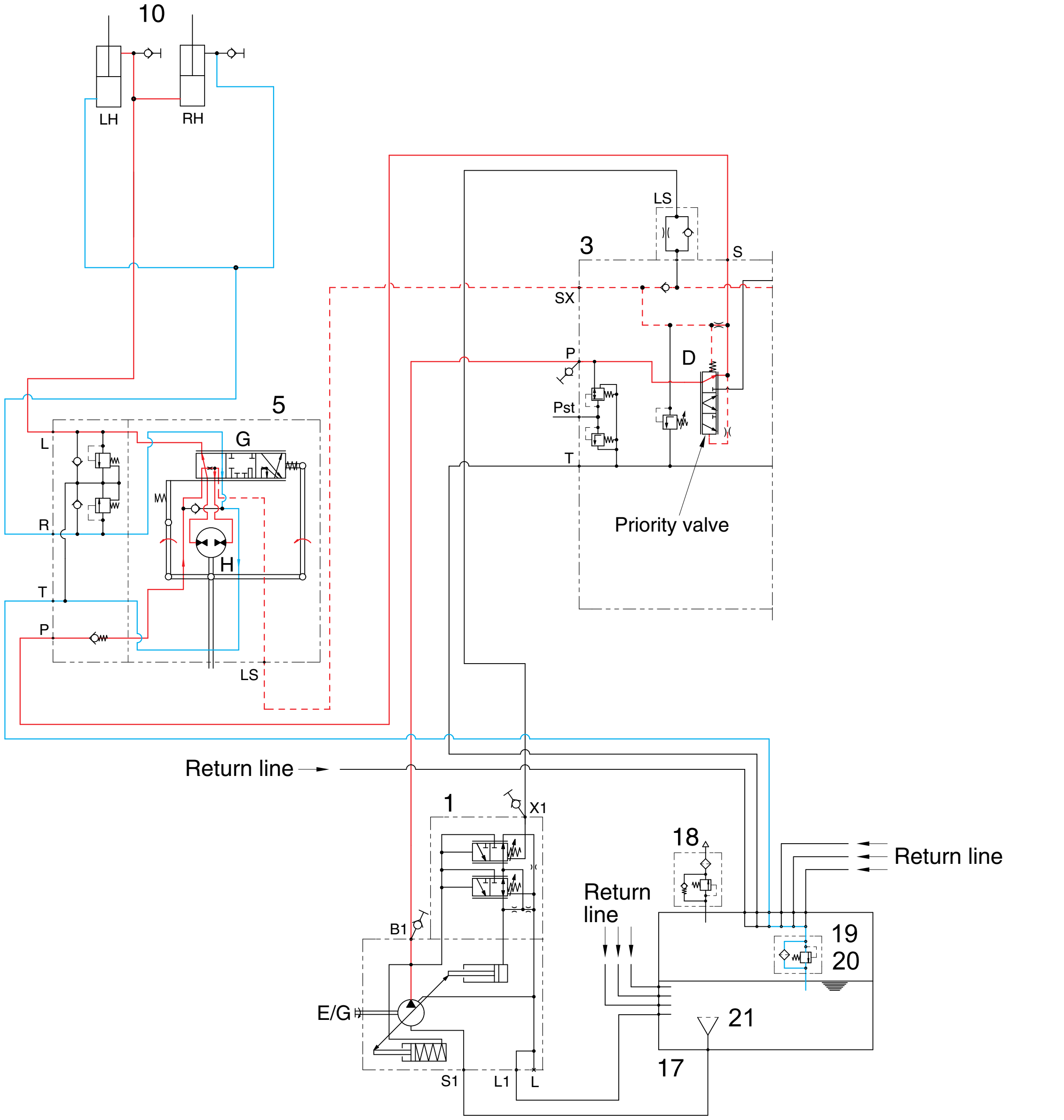


The steering wheel is not being operated so control spool (G) does not move.

The oil from the pump enters port P of the priority valve in main control valve and the inlet pressure oil moves the spool (D).

Almost all of pump flow goes to the loader system and partly flows into the hydraulic tank (17) through the spool (G).

2) LEFT TURN



740F5SE03

When the steering wheel is turned to the left, the spool (G) within the steering unit (5) connected with steering column turns in left hand direction.

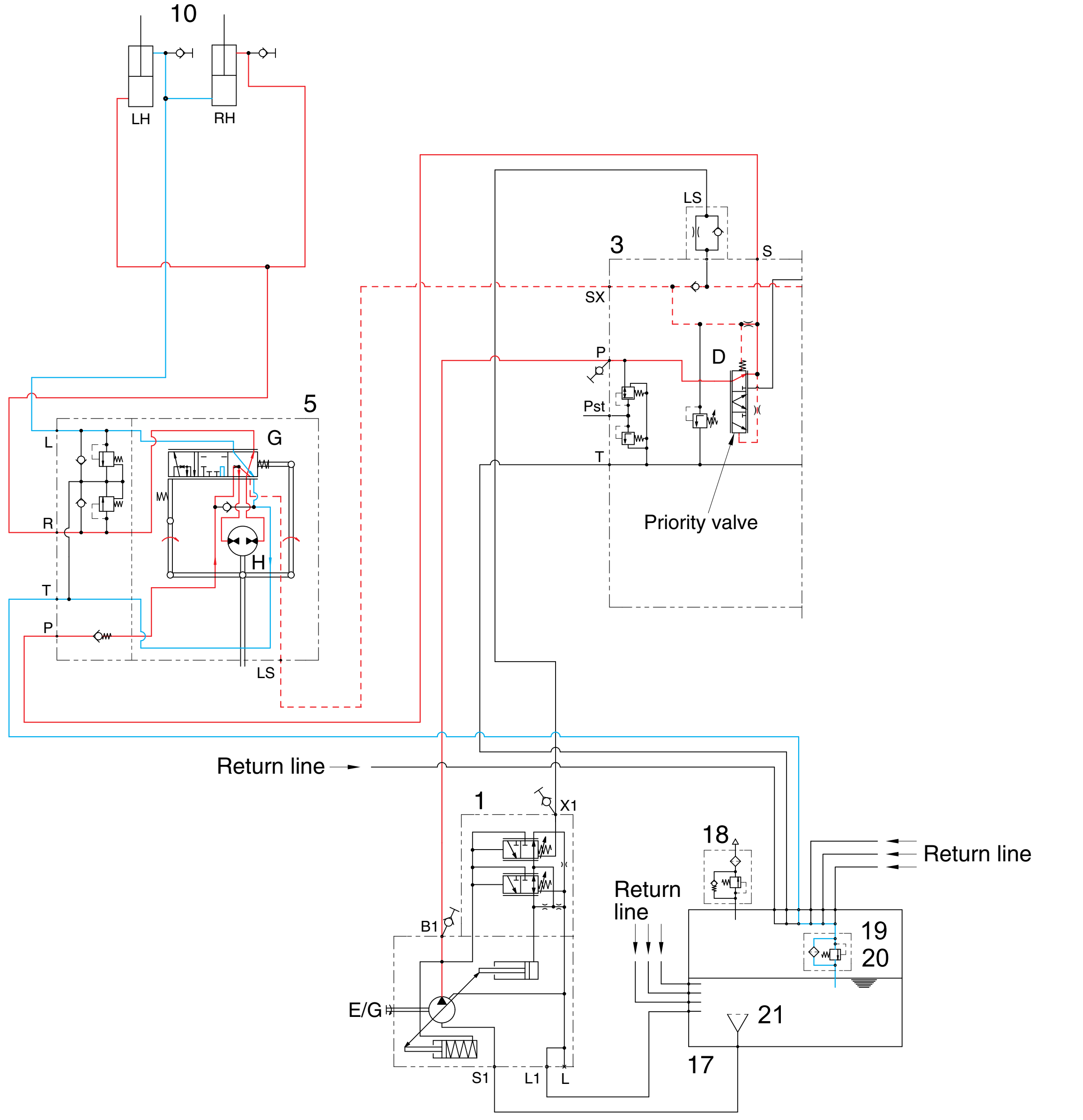
At this time, the oil discharged from the pump flows into the spool (G) of the steering unit (5) through the spool (D) of priority valve in main control valve and flows into the gerotor (H).

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 (10).

Oil returned from left and right cylinder returns to hydraulic tank through the spool (G) of the steering unit.

When the above operation is completed, the machine turns to the left.

3) RIGHT TURN



740F5SE04

When the steering wheel is turned to the right, the spool (G) within the steering unit (5) connected with steering column turns in right hand direction.

At this time, the oil discharged from the pump flows into the spool (G) of the steering unit (5) through the spool (D) of priority valve in main control valve and flows into the gerotor (H).

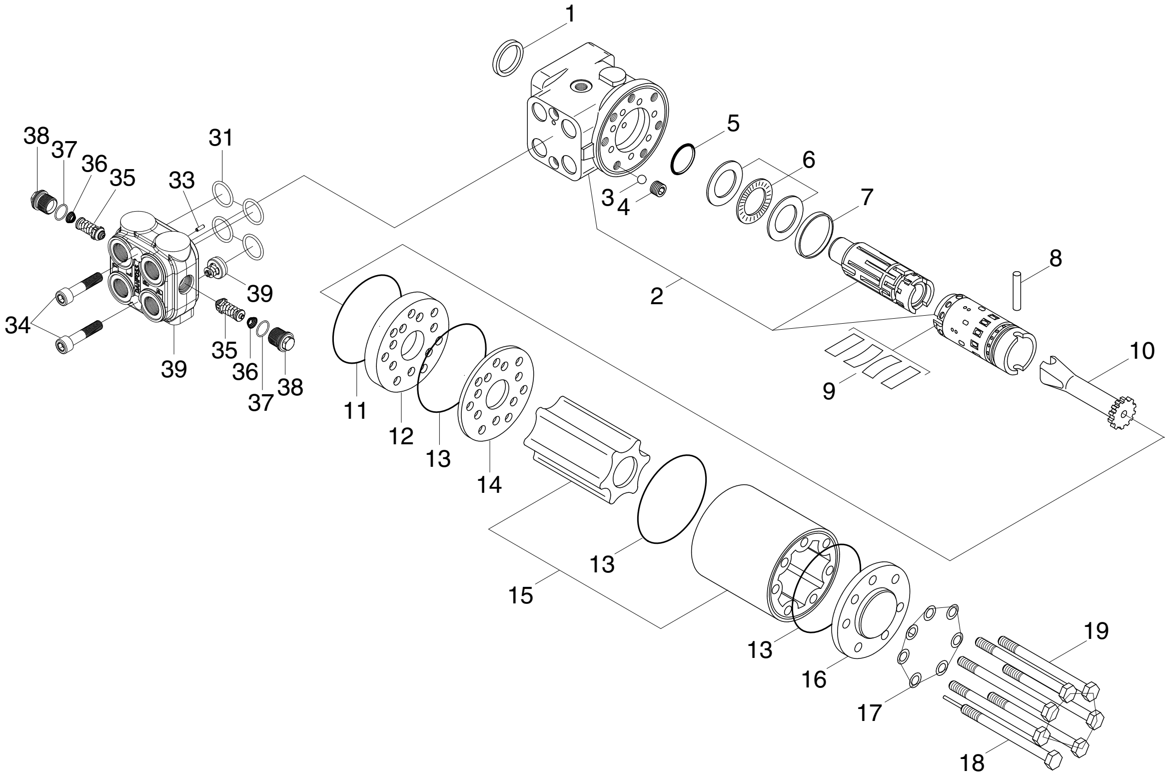
Oil flow from the gerotor flows back into the spool (G) where it is directed out the right workport to the respective chamber of the steering cylinders (10).

Oil returned from left and right cylinder returns to hydraulic tank through the spool (G) of the steering unit.

When the above operation is completed, the machine turns to the right.

3. STEERING UNIT

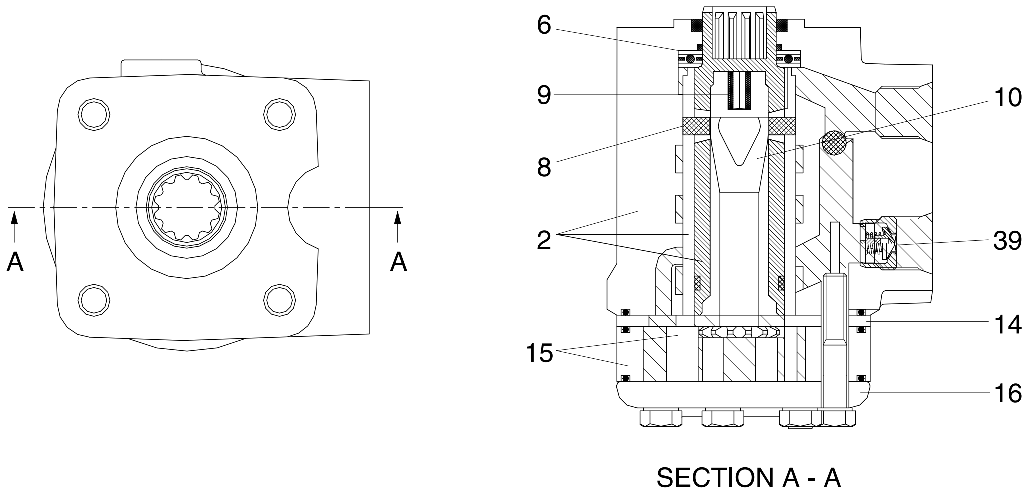
1) STRUCTURE



74095SE05

1	Dust seal ring	10	Cardan shaft	19	Screw
2	Housing, spool, sleeve	11	O-ring	31	Set of O-rings
3	Ball	12	Intermediate plate	33	Rolled pin
4	Thread bushing	13	O-ring	34	Screw
5	Roto glyd ring	14	Distributor plate	35	Shock valve
6	Bearing assembly	15	Gearwheel set	36	Spring
7	Ring	16	End cover	37	O-ring
8	Cross pin	17	Washer	38	Plug
9	Set of spring	18	Screw with pin	39	Housing, check valve

2) OPERATION



7407SE06

The steering unit consists of a rotary valve and a rotary meter.

Via a steering column the steering unit is connected to the steering wheel of the machine.

When the steering wheel is turned, oil is directed from the steering system pump via the rotary valve (spool and sleeve) and rotary meter (gear wheel set) to the cylinder ports L or R, depending on the direction of turn. The rotary meter meters the oil flow to the steering cylinder in proportion to the angular rotation of the steering wheel.

Spool is connected directly to the drive shaft (10) of steering wheel. It is connected to sleeve by cross pin (8) (not in contact with the spool when the steering wheel is at neutral) and neutral position spring (9).

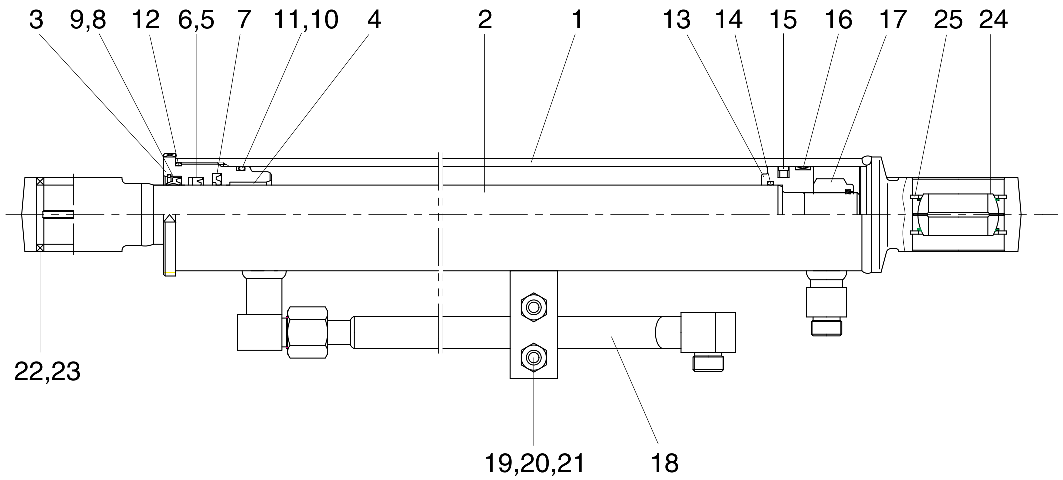
Cardan shaft (10) is meshed at the top with cross pin (8) and forms one unit with sleeve.

At the same time, it is meshed with gear rim of the gerotor set by spline.

There are four ports in valve body. They are connected to the pump circuit, tank circuit, and the head, and left and right steering cylinder. In addition, the pump port and tank port are connected inside the body by the check valve. Therefore, if there is any failure in the pump of engine, oil can be sucked in directly from the tank through the check valve.

4. STEERING CYLINDER

1) STRUCTURE



7407SE07

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

2) OPERATION

This machine use to cross connected cylinder for steering operation.
The steering cylinder use a gland (3) to remove piston and sealed seals. Dust wiper (8) located on the in side of the gland protects cylinder inner parts from dust. The piston (13) is fastened to the rod (2) by a nut (17).

The piston uses a single wear ring (16) with a piston seal (15) 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 (5).

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

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, prefer 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.

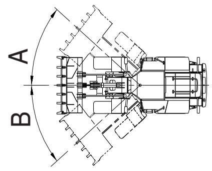
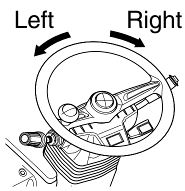
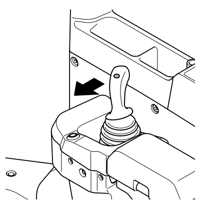
Locate system check in the left column and read completely, following this sequence from left to right.
Read each check completely before performing.

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 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 6-58).

Item	Description	Service action
Steering unit check	 Run engine at low idle. Turn steering wheel until frames are at maximum right (A) and then left (B) positions. **LOOK** : Frames must move smoothly in both directions. When steering wheel is stopped, frames must stop. **FEEL** : Excessive effort must not be required to turn steering wheel. **NOTE** : It is normal for steering to drift from stops when steering wheel is released.	**OK** Check completed. **NOT OK** Go to next check.
Steering system leakage check Heat hydraulic oil to operating temperature. Run engine at high idle.	 Turn steering wheel rapidly until frames are against stops. Hold approximately 2 kgf on steering wheel. Count steering wheel revolutions for 1 minute. Repeat test in opposite direction. **LOOK** : Steering wheel should rotate less than 5 rpm. **NOTE** : Use good judgment; Excessive steering wheel rpm does not mean steering will be affected.	**OK** Check completed. **NOT OK** Do steering system leakage test in group 3 to isolate the leakage.
Priority valve low pressure check	Park machine on a hard surface. Hold brake pedal down. Run engine at high idle. Steer machine to the right and left as far as possible. **LOOK** : Machine must turn at least half way to the right and left stops.	**OK** Check completed. **NOT OK** Do priority valve in main control valve pressure test.
Priority valve high pressure check Run engine at high idle.	 Steer to steering stop and release steering wheel. Roll bucket back and hold over relief and observe engine rpm. Turn steering wheel to steering stop and hold, observe engine rpm. **LOOK** : Steering stall engine rpm must be higher than hydraulic stall rpm.	**OK** Check completed. **NOT OK** Priority pressure is set too high. Do priority valve in main control valve pressure test.

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
No steering	Low oil level.	Add recommended oil.
	Restricted suction line.	Check.
	Failed hydraulic pump.	Remove and inspect return filter for metal pump particles.
	Failed main hydraulic pump drive.	Do main pump flow test.
	Stuck priority valve spool in MCV.	Remove and inspect priority valve spool in MCV.
	Broken priority valve spring in MCV.	Remove and inspect spring.
	Relief valve in MCV stuck open.	Do relief cartridge leakage test in group 3.
	Failed hydraulic lines.	Check.
Slow or hard steering	Too much friction in the mechanical parts of the machine.	Lubricate bearings and joints of frame or cylinders or repair if necessary. Check steering column installation.
	Cold oil.	Warm the hydraulic oil.
	Low priority valve pressure setting.	Do priority valve pressure test.
	Worn hydraulic pump.	Do hydraulic pump performance check.
	Sticking priority valve spool in MCV.	Remove and inspect.
	Broken priority valve spring in MCV.	Remove and inspect.
	Pinched or restricted LS line.	Inspect line. Do SX port of MCV flow test.
	Low system relief valve setting.	Test and adjust if necessary.
	Low overload relief valves setting.	Test and adjust if necessary.

Problem	Cause	Remedy
Constant steering to maintain straight travel	Air in system. Leakage in steering system. Worn steering unit. Leaf spring without spring force or broken. Spring in overload relief valve broken. Gear wheel set worn. Cylinder seized or piston seals worn.	Check for foamy oil. Do steering system leakage check. Do steering unit neutral leakage test in group 3. Replace leaf springs. Replace overload relief valve. Replace gear wheel set. Replace defects parts.
Slow steering wheel movement will not cause any frame movement	Leakage in steering system. Worn steering unit gerotor.	Do steering system leakage check. Do steering unit leakage check.
Steering wheel can be turned with frames against steering stop	Leakage in steering system.	Do steering system leakage check.
Steering wheel turns with no resistance and causes no frame movement	Broken steering column or splined of steering unit. 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.
Erratic steering	Air in oil. Low oil level. Sticking priority valve spool in MCV. 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.
Spongy or soft steering	Air in oil. Low oil level.	Check for foamy oil. Add recommended oil.
Free play at steering wheel	Loose steering wheel nut. Worn or damaged splines on steering column or valve.	Tighten. Inspect.
Steering unit binding or steering wheel does not immediately return to neutral when released	Binding in steering column or misalignment of column. High return pressure. 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.

Problem	Cause	Remedy
Steering unit locks up	Large particles of contamination in steering unit.	Inspect hydraulic filter for contamination. Repair cause of contamination. Flush hydraulic system.
	★ Thermal shock	Do of MCV SX port flow test. This oil flow provides a warm-up flow to steering unit when not using the steering.
	Worn or damaged steering unit.	Repair or replace steering unit.
Abrupt steering wheel oscillation	Improperly timed gerotor gear in steering unit.	Time gerotor gear.
Steering wheel turns by itself	Lines connected to wrong port.	Reconnect lines.
	Worn or damaged steering unit.	Repair or replace steering unit.
Vibration in steering system or hoses jump	High priority valve setting.	Do priority valve pressure test.
Neutral position of steering wheel cannot be obtained, i.e. there is a tendency towards "motoring"	Steering column and steering unit out of line.	Align the steering column with steering unit.
	Too little or no play between steering column and steering unit input shaft.	Adjust the play and, if necessary, shorten the splines journal.
	Pinching between inner and outer spools.	Contact the nearest service shop.
"Motoring" effect. The steering wheel can turn on its own	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.
Backlash	Cardan shaft fork worn or broken.	Replace cardan shaft.
	Leaf springs without spring force or broken.	Replace leaf springs.
	Worn splines on the steering column.	Replace steering column.
Jerky steering	Priority spool orifice in MCV missing.	Inspect orifice.
	Sticking spool in cushion valve.	Inspect cushion valve. Flush the spool in cushion valve.

★ Thermal shock is caused by a large temperature differential (approx 30˚C, 50˚F) between the steering unit and hydraulic oil. If the steering is not operated for a long period of time and the orifice in the bottom of the priority spool is plugged, the steering unit may bind up when the steering is operated if the hydraulic oil is hot enough.

Problem	Cause	Remedy
"Shimmy" effect The steered wheels vibrate (Rough tread on tires gives vibrations.)	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.
Steering wheel can be turned the whole time without the steered wheels moving	Oil is needed in the tank. Steering cylinder worn. Gear wheel set worn. Spacer across cardan shaft forgotten.	Fill with clean oil and bleed the system. Replace or repair cylinder. Replace gear wheel set. Install spacer.
Steering wheel can be turned slowly in one or both directions without the steered wheels turning	One or both anticavitation valves are leaky or are missing in overload relief valves. One or both overload relief valves are leaky.	Clean or replace defect or missing valves. Clean or replace.
Steering is too slow and heavy when trying to turn quickly	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.
"Kick back" in steering wheel from system Kicks from wheels	Fault in the system.	Contact authorized man or shop.
Heavy kick-back in steering wheel in both directions	Wrong setting of cardan shaft and gear-wheel set.	Correct setting as shown in group 4.
Turning the steering wheel activates the steered wheels opposite	Hydraulic hoses for the steering cylinders have been switched around.	Connect lines to correct ports.
Hard point when starting to turn the steering wheel	Spring force in priority valve too weak. Air in LS line. Clogged orifices in priority valve. Oil is too thick (cold).	Replace spring by a stronger. Bleed LS line. Clean orifices in spool and in connecting plugs for LS. Let machine run until oil is warm.
Too little steering force	Pump pressure too low.	Correct pump pressure.

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 × 1" 100R1 Hoses
·Quick disconnect fittings
·Discharge wand
·Connectors

※ Steering system use oil from hydraulic oil tank. Flush all lines in the steering system. Disassemble and clean major compon-ents 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 dis-assemble steering cylinders to clean debris from cylinders.

2) Install a new return filter element. Inspect filter 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 tank capacity : 130 l (34.3 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 through 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.

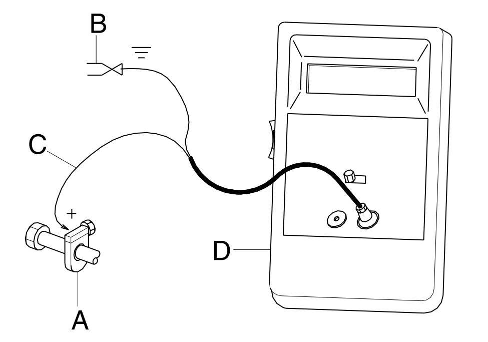
9) Install a new return filter element.

10) Check oil level in hydraulic oil tank ; Add oil if necessary.

2. TEST TOOLS

1) CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

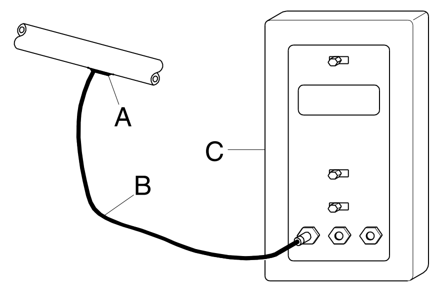
- Service equipment and tools
  Tachometer
  A : Clamp on tachometer.
  Remove paint using emery cloth and connect to a straight section of injection line within 100 mm (4in) of pump. Finger tighten only-do not over tighten.
  B : Black clip (-). Connect to main frame.
  C : Red clip (+). Connect to transducer.
  D : Tachometer readout. Install cable.



75795SE32

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.



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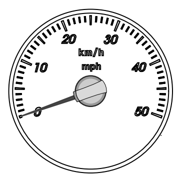
3) DISPLAY MONITOR TACHOMETER

The display monitor tachometer is accurate enough for test work.



7609A5SE35

3. STEERING SYSTEM RESTRICTION TEST

· **SPECIFICATION**

Oil temperature	45±5˚C (113±9˚F)
Engine speed	High idle
Maximum pressure at steering unit	35 bar (510 psi)

· **GAUGE AND TOOL**

Gauge 0~7 MPa (0~70 bar, 0~1000 psi) 2EA

· 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).

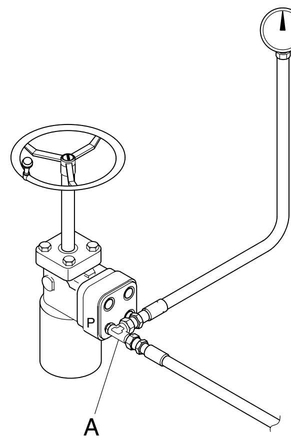
2) Heat hydraulic oil to specifications.
(see hydraulic oil warm up procedure at page 6-58).

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 spool in MCV for a stuck spool. Make sure orifice plugs are installed in ends of priority spool.
Check for plugged orifice in priority spool SX port of MCV.



4. STEERING UNIT LEAKAGE TEST

· SPECIFICATION

Oil temperature 45±5˚C (113±9˚F)
Engine speed High idle
Maximum leakage 10 ℓ/min

· GAUGE AND TOOL

Temperature reader
Measuring container (approx 20 ℓ)
Stop watch

1) Install frame locking bar to prevent machine from turning.

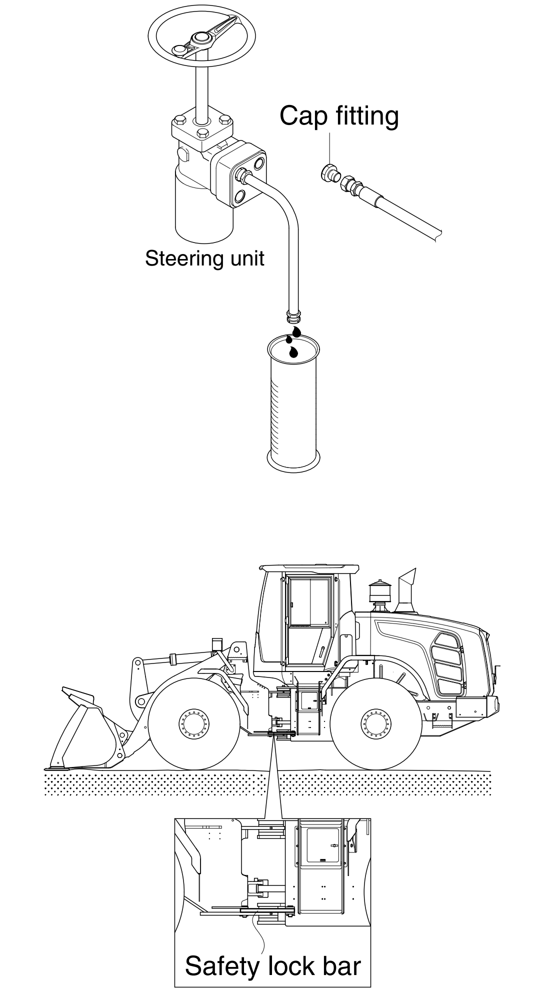
2) Install temperature reader.
(see temperature reader installation procedure in this group).

3) Heat hydraulic oil to specifications.
(see hydraulic oil warm up procedure at page 6-58).

4) Disconnect return hose from fitting.
Install cap fitting.

5) Run engine at specifications.
Rotate steering wheel against locking bar using approximately 1.2 kgf · m of force.
Measure oil flow from return hose for 1 minute.

6) Leakage is greater than specifications, repair or replace steering unit.



740F5SE09

5. STEERING UNIT PRESSURE TEST

· SPECIFICATION

Oil temperature	45±5˚C (113±9˚F)
Engine speed	High idle
Oil pressure	20.5~21.5 MPa (205~215 bar, 3200±3300 psi)

· GAUGE AND TOOL

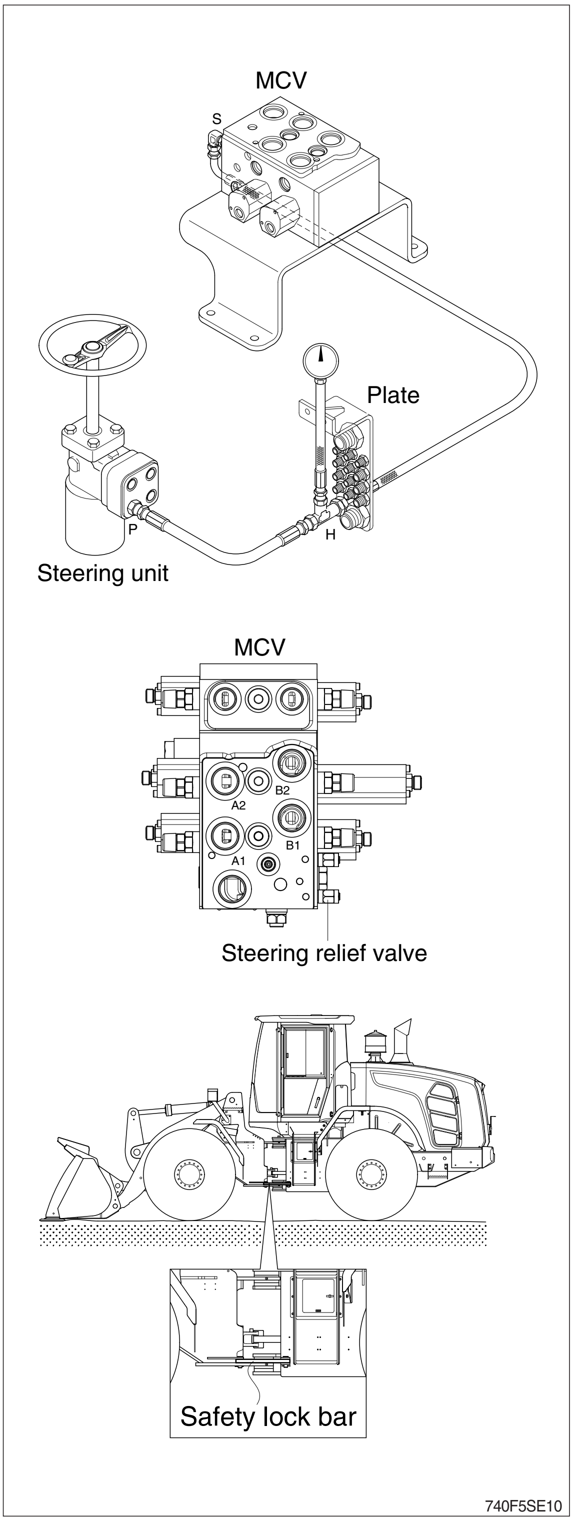
Gauge 0~35 MPa (0~350 bar, 0~5000 psi)
Temperature reader

1) Connect gauge to test port.
2) Install temperature reader (see installation procedure in this group).
3) Install frame locking bar.
4) Heat hydraulic oil to specifications (see hydraulic oil warm up procedure at page 6-58).
5) Run engine at specifications and turn steering wheel rapidly hold approximately 22N (5 lb force) pressure on wheel with frames locked.

※ If steering wheel is turned slowly, it will continue to with the frames locked.
This will give an incorrect pressure reading.
If steering wheel continues to turn rapidly with the frames locked, steering system leakage is indicated.

6) Read pressure gauge. This is the steering valve relief pressure.
7) If pressure is not to specification, loosen lock nut (17 mm) on steering relief valve and turn adjusting screw (5 mm) to adjust pressure.

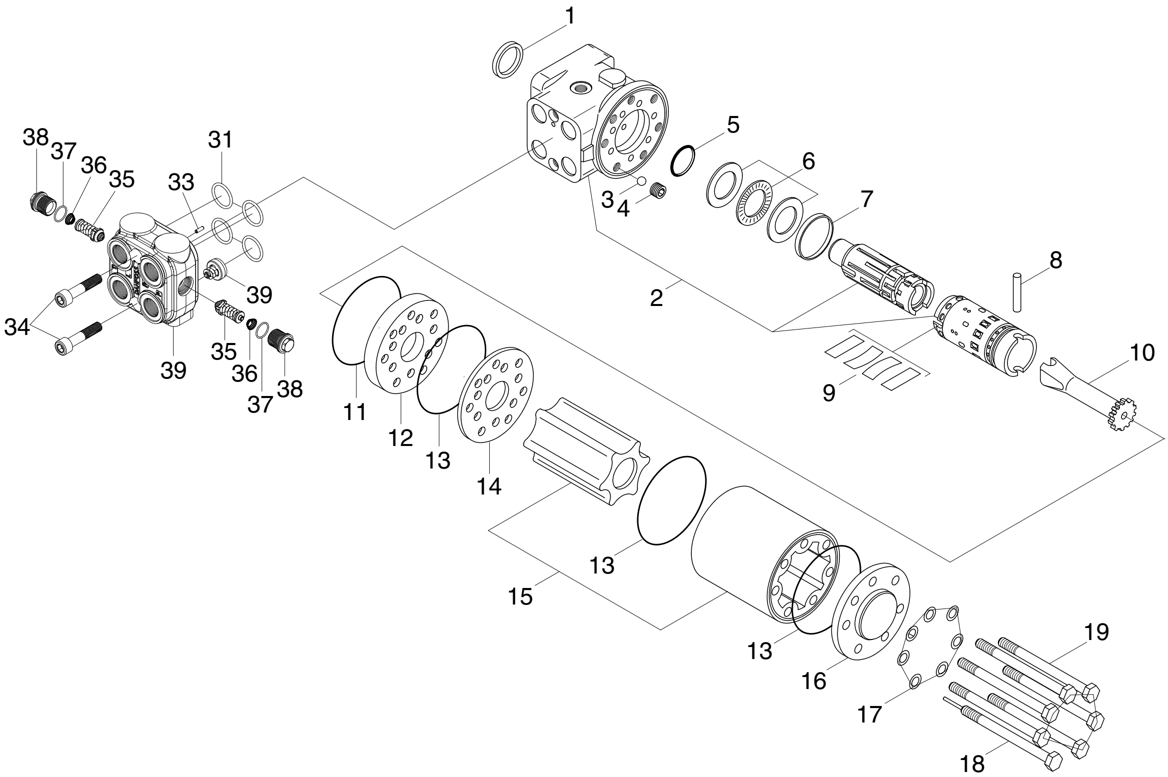
If pressure cannot be adjusted to specification, disassemble and inspect steering unit.



GROUP 4 DISASSEMBLY AND ASSEMBLY

1. STEERING UNIT

1) STRUCTURE

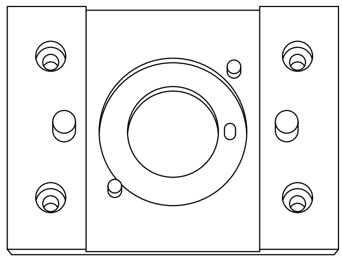


74095SE05

1	Dust seal ring	10	Cardan shaft	19	Screw
2	Housing, spool, sleeve	11	O-ring	31	Set of O-rings
3	Ball	12	Intermediate plate	33	Rolled pin
4	Thread bushing	13	O-ring	34	Screw
5	Roto glyd ring	14	Distributor plate	35	Shock valve
6	Bearing assembly	15	Gearwheel set	36	Spring
7	Ring	16	End cover	37	O-ring
8	Cross pin	17	Washer	38	Plug
9	Set of spring	18	Screw with pin	39	Housing, check valve

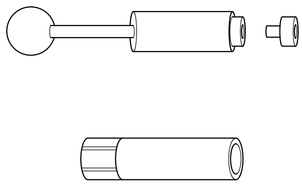
2) TOOLS

(1) Holding tool.



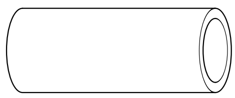
7405S STVLV38(1)

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



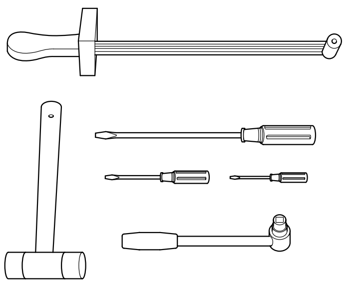
7405S STVLV38(2)

(3) Assembly tool for dust seal.



7405S STVLV38(3)

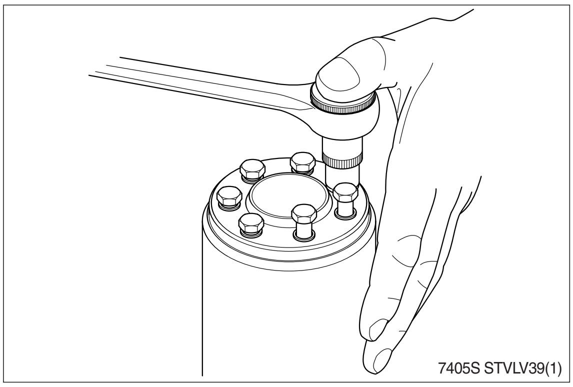
(4) Torque wrench 0-7.1 kgf · m (0-51.6 lb · ft).
13 mm socket spanner
12 mm screwdriver
6 mm screwdriver
2 mm screwdriver
Plastic hammer
Ratchet spanner



7405S STVLV38(4)

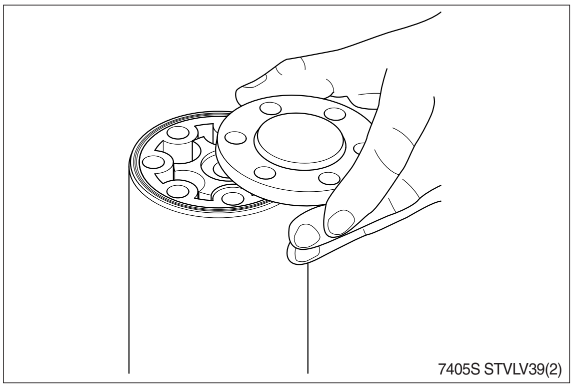
3) DISASSEMBLY

(1) Disassemble steering column from steering unit and place the steering unit in the holding tool. Screw out the screws in the end cover (7-off-one rolled pin).



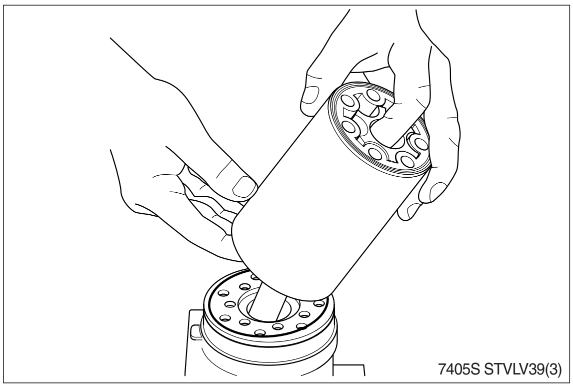
7405S STVLV39(1)

(2) Remove the end cover, sideways.



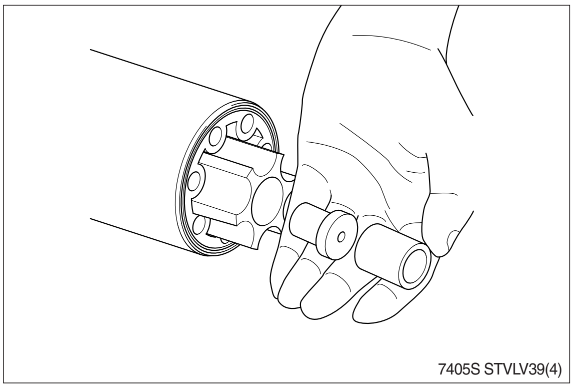
7405S STVLV39(2)

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



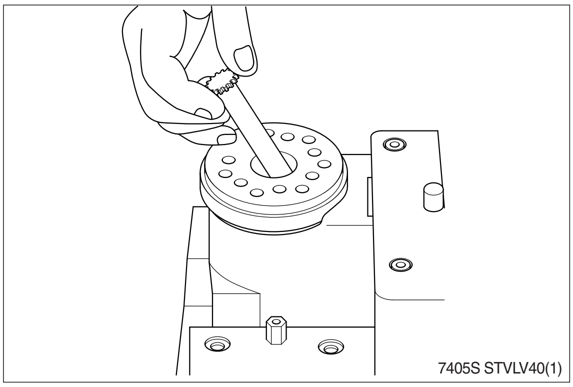
7405S STVLV39(3)

(4) Remove spacer bushing and spacer(if fitted) from the gearwheel.



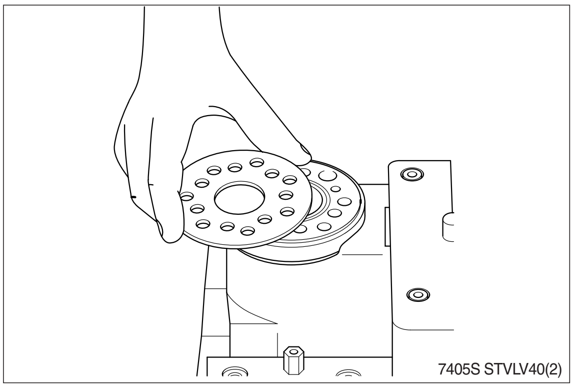
7405S STVLV39(4)

(5) Remove cardan shaft.



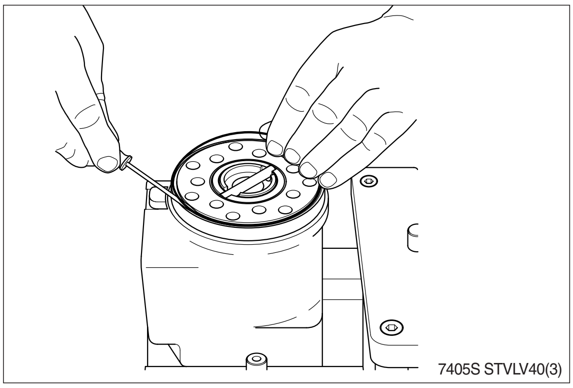
7405S STVLV40(1)

(6) Remove distributor plate.



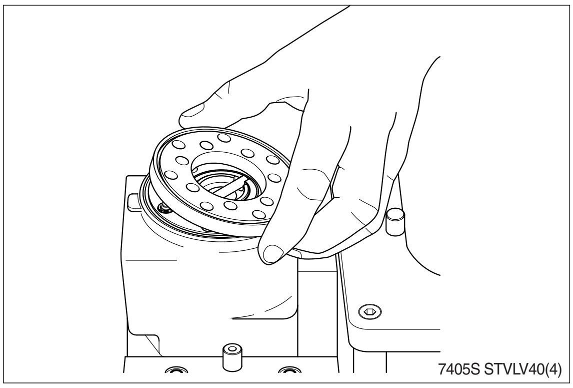
7405S STVLV40(2)

(7) Remove O-ring.



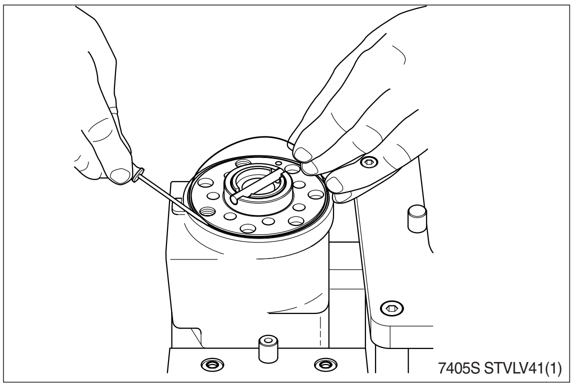
7405S STVLV40(3)

(8) Lift off intermediate plate.



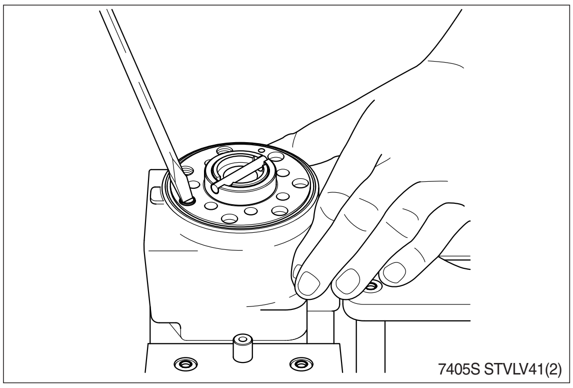
7405S STVLV40(4)

(9) Remove O-ring.



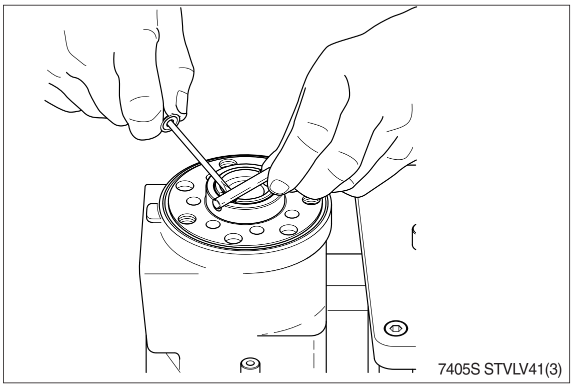
7405S STVLV41(1)

(10) Screw out the threaded bushing.



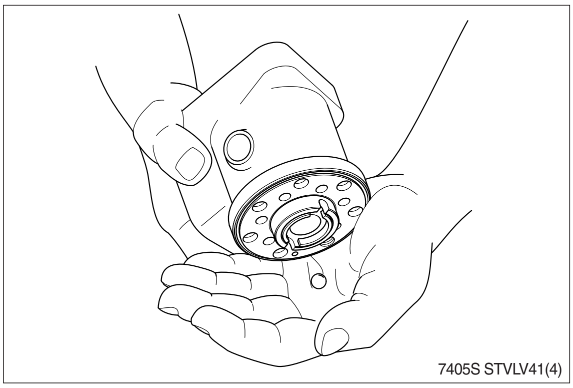
7405S STVLV41(2)

(11) Remove cross pin.



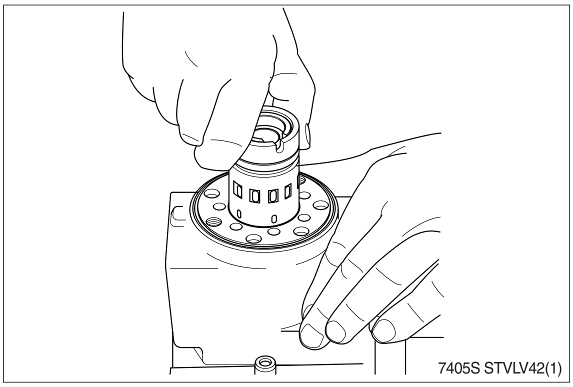
7405S STVLV41(3)

(12) Shake out the ball (ø 8.5 mm).



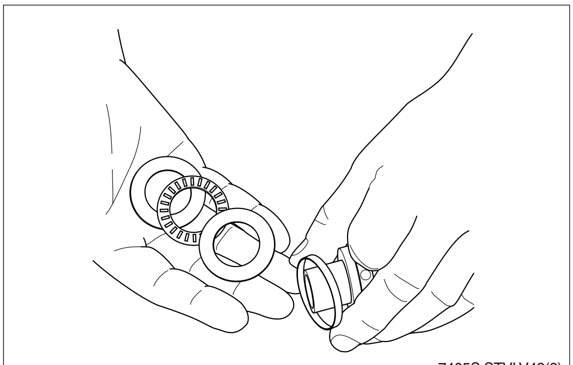
7405S STVLV41(4)

(13) Pull sleeve and spool out of the housing.



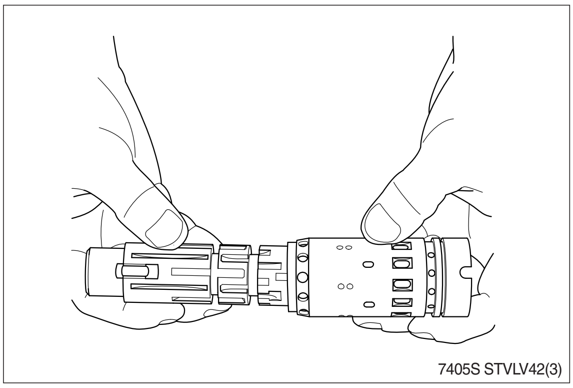
7405S STVLV42(1)

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



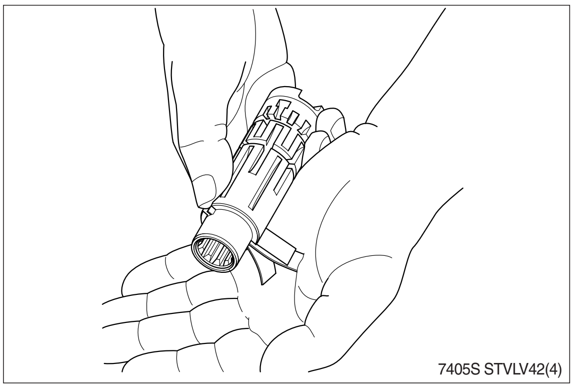
7405S STVLV42(2)

(15) Carefully pull the spool out of the sleeve.



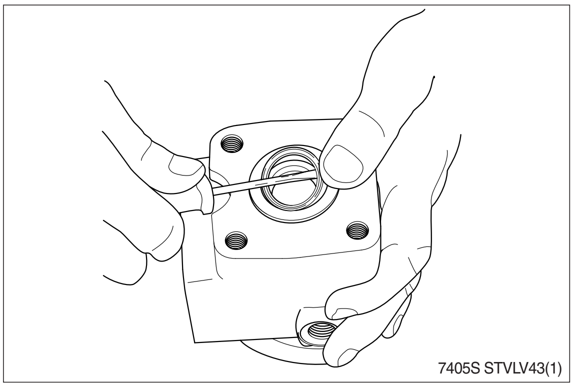
7405S STVLV42(3)

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



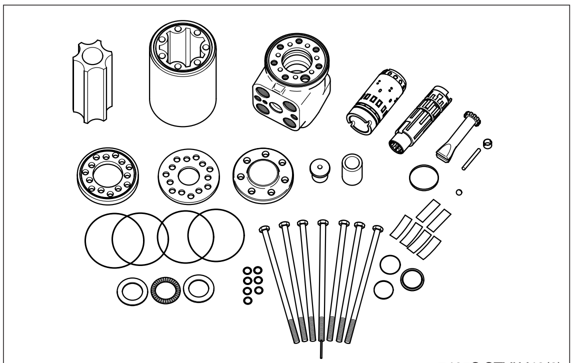
7405S STVLV42(4)

(17) Remove dust seal and O-ring.



7405S STVLV43(1)

(18) The steering unit is now completely disassembled.



7405S STVLV43(2)

Cleaning

Clamp all parts carefully in Shellsol K or the like.

Inspection an replacement

Replace all seals and washer. Check all parts carefully and make any replacements necessary.

Lubrication

Before assembly, lubricate all parts with hydraulic oil.

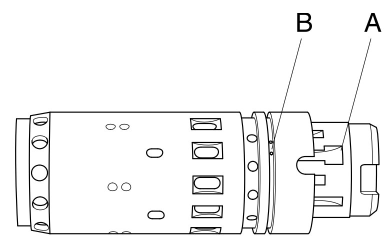
4) ASSEMBLY

(1) Assemble spool and sleeve.

※ The sleeve and spool are correctly assembled when

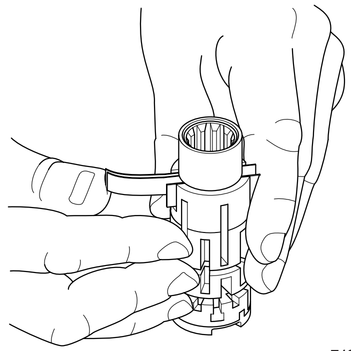
① The slots-in sleeve and spool-for the neutral position springs are opposite each other and

② One of the 3 T-shaped grooves (A) in the spool is opposite one of the sets (B) of small holes in the sleeve.



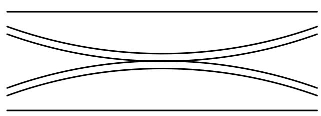
7405S STVLV44(1)

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



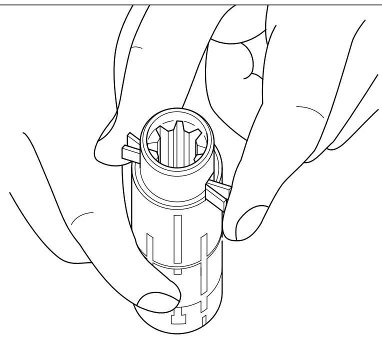
7405S STVLV44(2)

(3) Place the curved springs between the flat ones and press them into place.



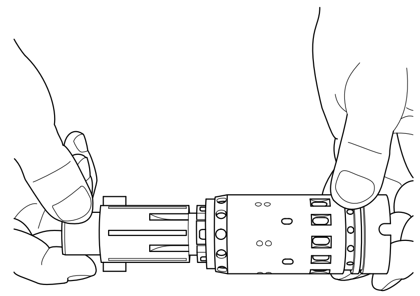
7405S STVLV44(3)

(4) Line up the spring set.



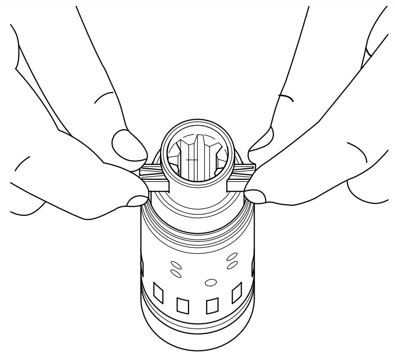
7405S STVLV44(4)

(5) Guide the spool into the sleeve.



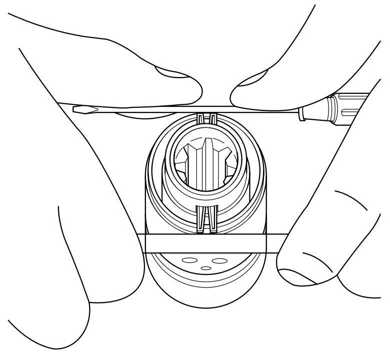
7405S STVLV45(1)

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



7405S STVLV45(2)

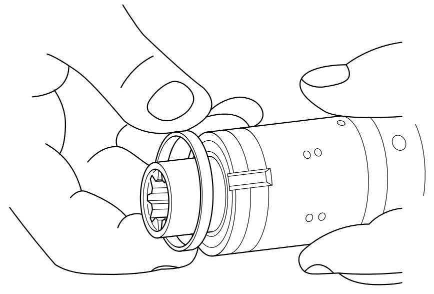
(7) Line up the springs and center them.



7405S STVLV45(3)

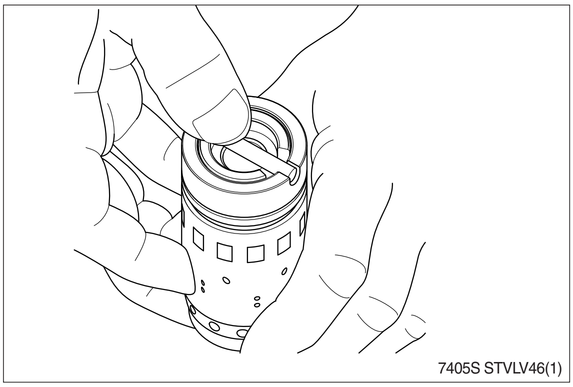
(8) Guide the ring down over the sleeve.

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



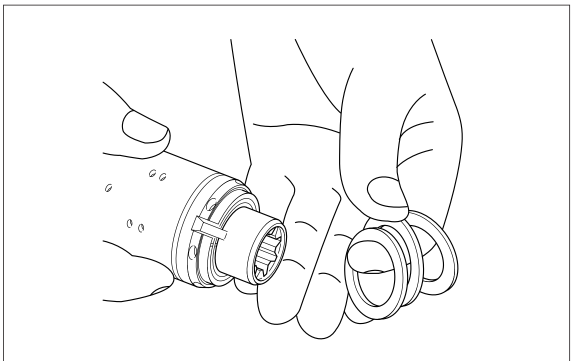
7405S STVLV45(4)

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



7405S STVLV46(1)

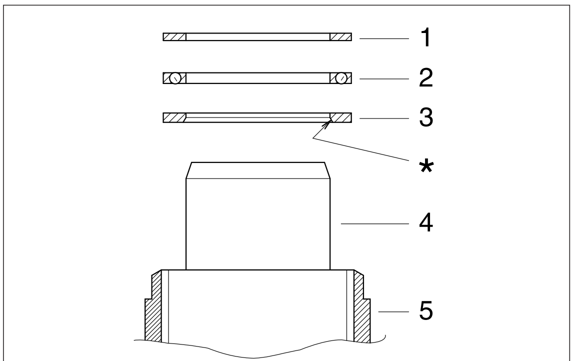
(10) Fit bearing races and needle bearing as shown on below drawing.



7405S STVLV46(2)

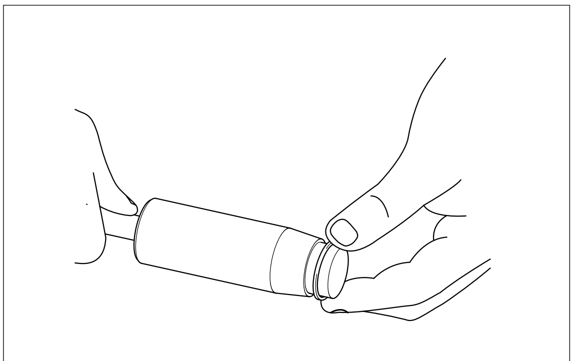
1 Outer bearing race
2 Needle bearing
3 Inner bearing race
4 Spool
5 Sleeve

* Inside chamfer on inner bearing race must face inner spool.

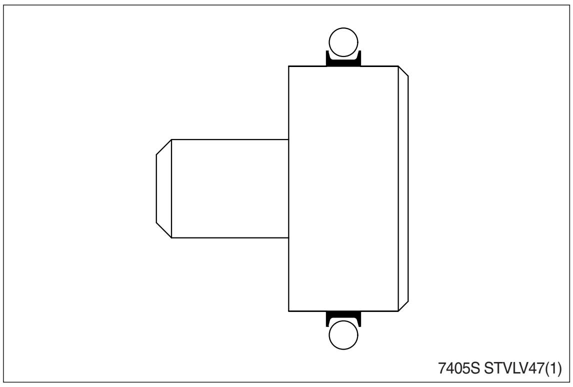


7405S STVLV46(3)

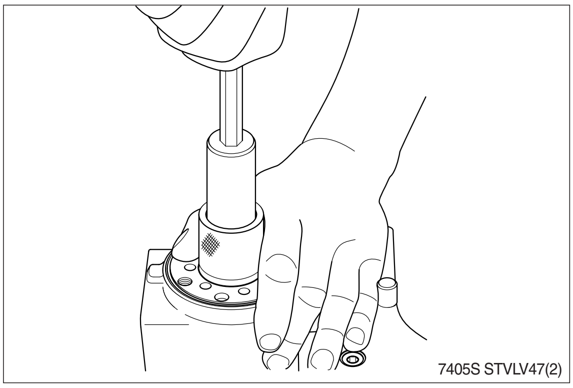
(11) Grease O-ring and kin-ring with hydraulic oil and place them on the tool. See next page.



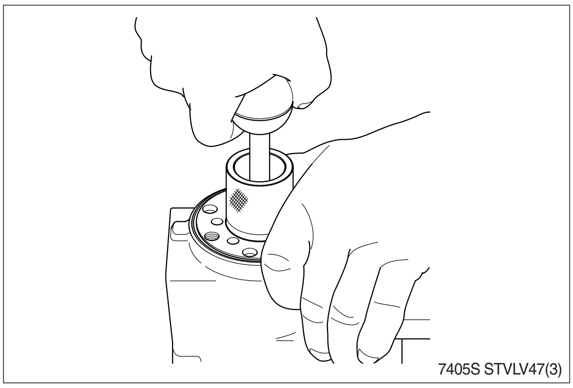
7405S STVLV46(4)


7405S STVLV47(1)

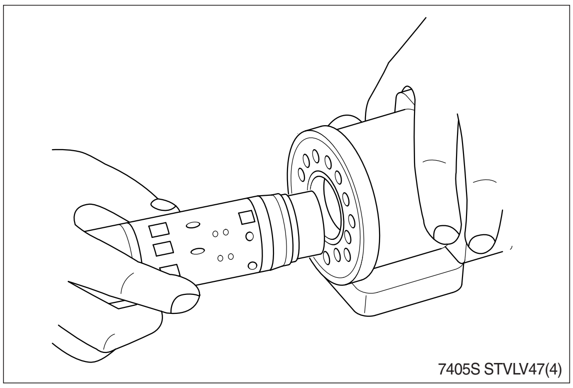
(12) Put the steering unit in the holding tool keeping the bore vertical. Guide the outer part of the assembly tool into the bore. Guide the inner part of the tool right to the bottom.


7405S STVLV47(2)

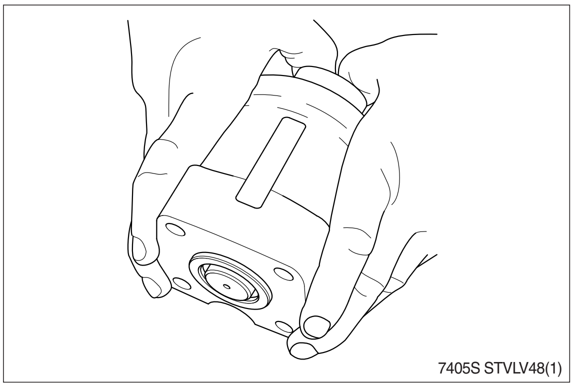
(13) Press and turn the O-ring into position in the housing. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide in the bore.


7405S STVLV47(3)

(14) Take the steering unit out of the holding tool and place it horizontally. With a light turning movement, guide the spool and sleeve into the bore.

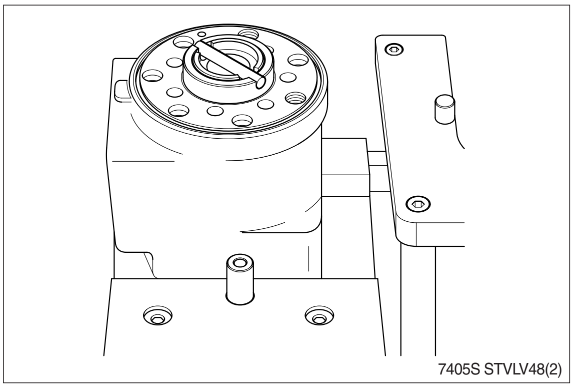

7405S STVLV47(4)

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



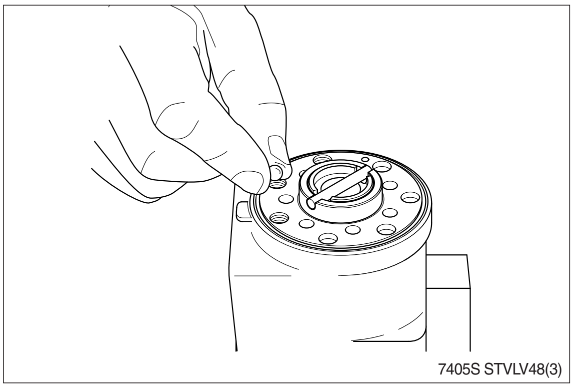
7405S STVLV48(1)

(16) Put the steering unit back into the holding tool keeping the bore vertical. Place the cross pin in the spool/sleeve so that it is parallel to the port flange.



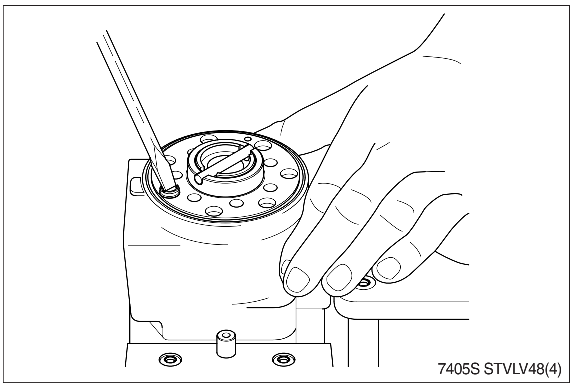
7405S STVLV48(2)

(17) Put the ball into the hole indicated by the arrow.



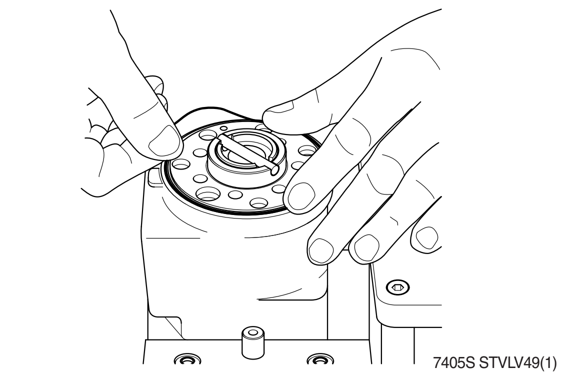
7405S STVLV48(3)

(18) Screw the threaded bushing lightly into the bore. The top of the bushing must lie just below the surface of the housing.



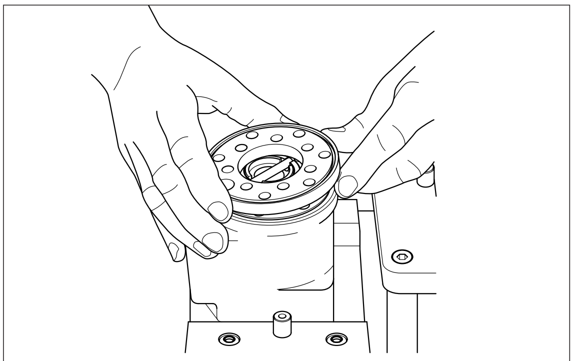
7405S STVLV48(4)

(19) Grease the O-ring with mineral oil approximate viscosity 500 cSt at 20˚C and place it in the groove.



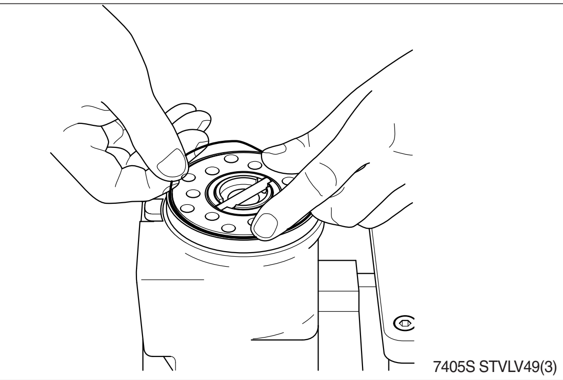
7405S STVLV49(1)

(20) Place the intermediate plate so that the channel holes match the holes in the housing.



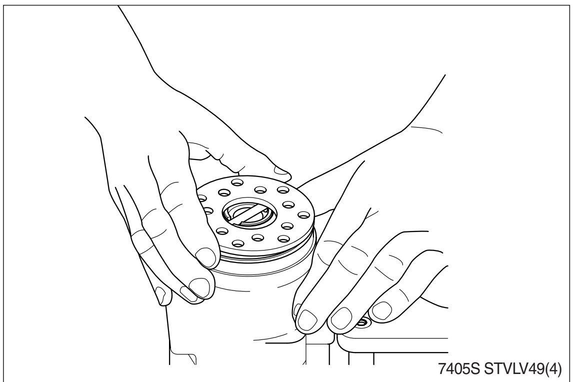
7405S STVLV49(2)

(21) Grease the O-ring with mineral oil approximate viscosity 500 cSt at 20˚C and place it in the groove.



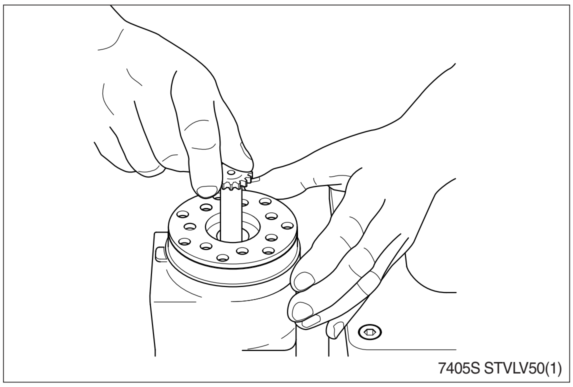
7405S STVLV49(3)

(22) Place the distributor plate so that the channel holes match the holes in the intermediate plate and the housing.



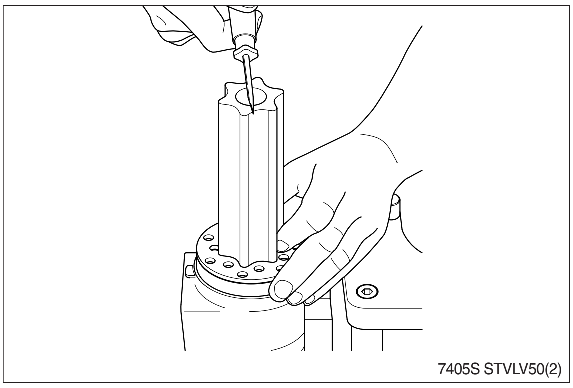
7405S STVLV49(4)

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



7405S STVLV50(1)

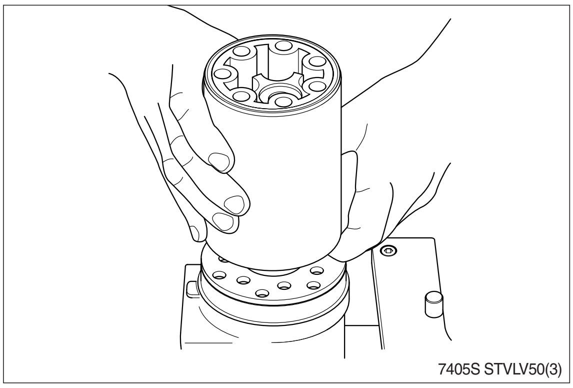
(24) Place the gear wheel (rotor) so that the cross pin from item 33 is positioned in relation to two tooth bases - as the screw driver indicates.



7405S STVLV50(2)

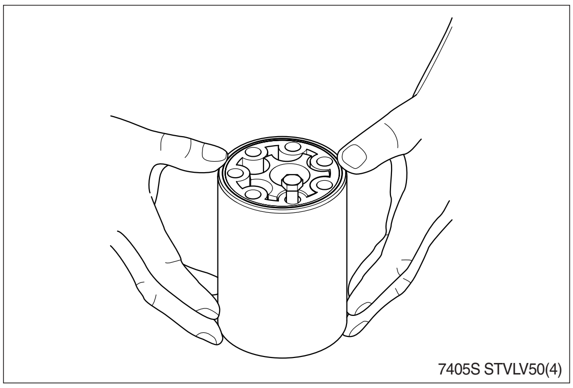
(25) Grease the two O-rings with mineral oil approximate viscosity 500 cSt at 20˚C and place them in the two grooves in the gear rim. Fit the gear rim so that the seven through holes match the holes in the distributor plate.

※ Turn the gear rim so that the smaller diameter of the holes face the distributor plate.



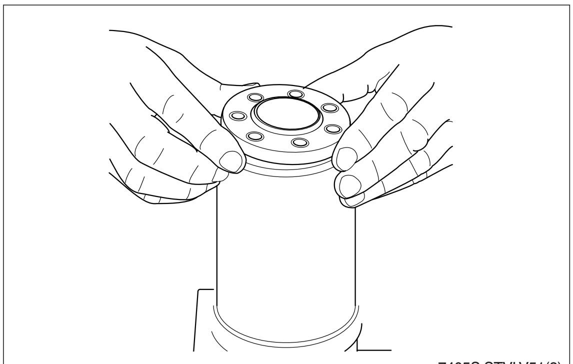
7405S STVLV50(3)

(26) Orientate the holes with a single screw.

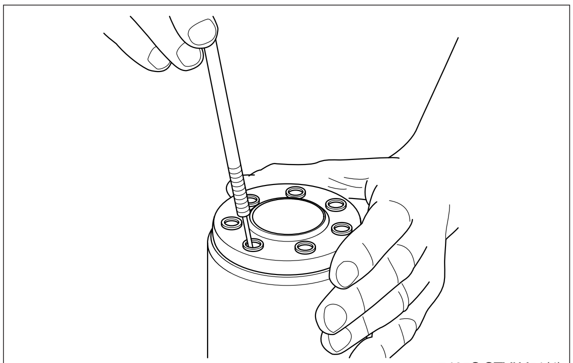


7405S STVLV50(4)

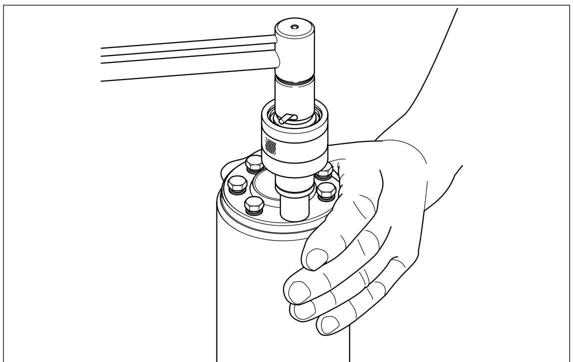
(27) Place the end cover in position.


7405S STVLV51(3)

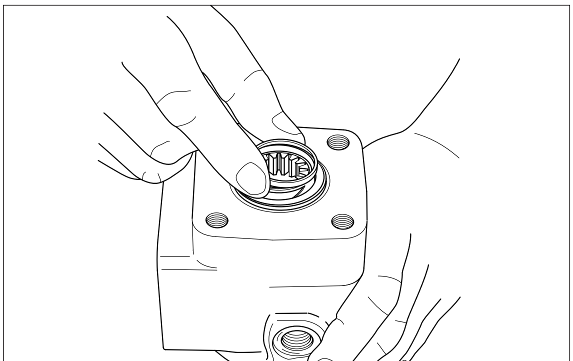
(28) Place the washers over the holes and the rolled pin in the hole shown.


7405S STVLV51(4)

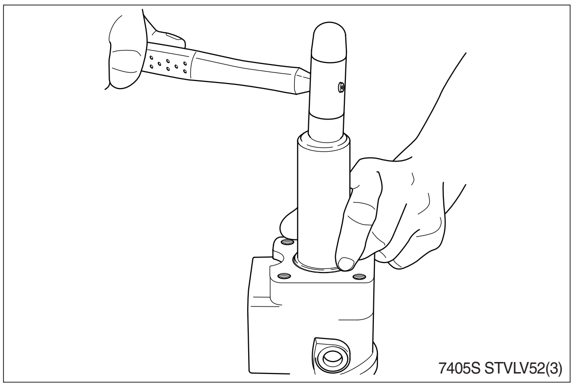
(29) Fit the other six screws. Cross - tighten all the screws and the rolled pin with a torque of $3^{\pm 0.6}$ kgf · m($22^{\pm 4.4}$ lb · ft). Steering unit can now be function tested.


7405S STVLV52(1)

(30) Turn the steering unit 180˚ and place the dust seal ring in the housing.

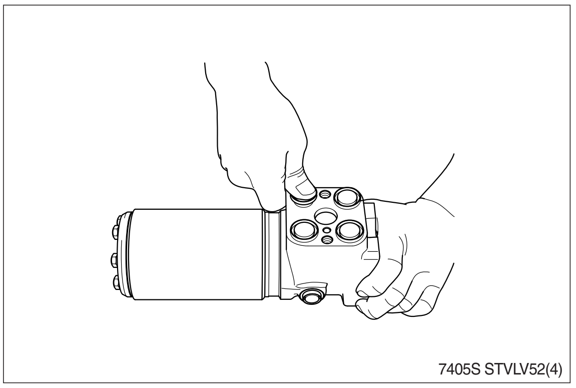

7405S STVLV52(2)

(31) Fit the dust seal ring in the housing using special tool and a plastic hammer.



7405S STVLV52(3)

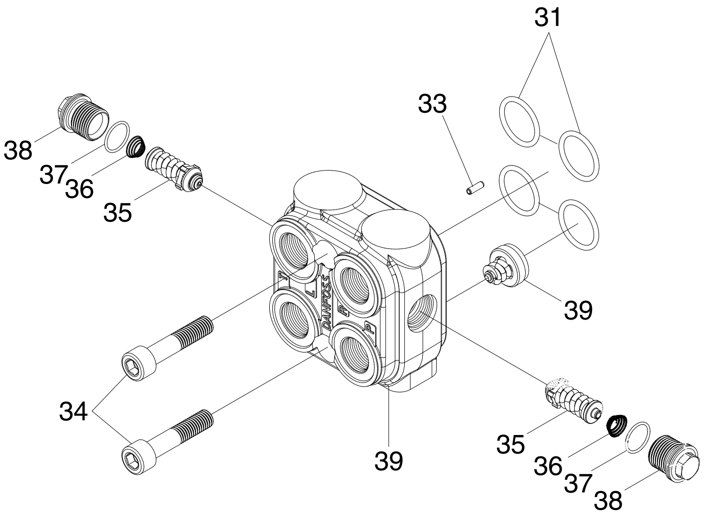
(32) Press the plastic plugs into the connection ports. Do not use a hammer.



7405S STVLV52(4)

2. VALVE BLOCK

1) STRUCTURE



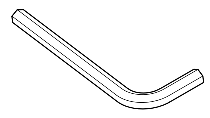
P,T,L,R port	PF 1/2
Shock valves	270-290 bar

7407SE12

31	Set of springs	36	Spring
33	Rolled pin	37	O-ring
34	Screw	38	Plug
35	Shock valve	39	Housing and check valve

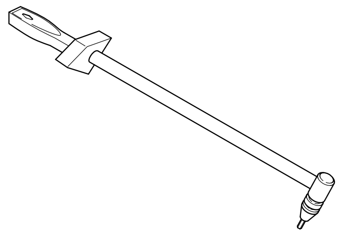
2) TOOLS

(1) Hexagon socket spanner, 8 mm.



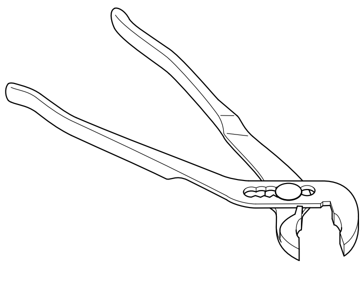
7405S OVLOAD63(1)

(2) Torque wrench, 0~7.1 kgf · m (0~51 lb · ft) with 8 mm hexagon socket spanner.



7405S OVLOAD63(2)

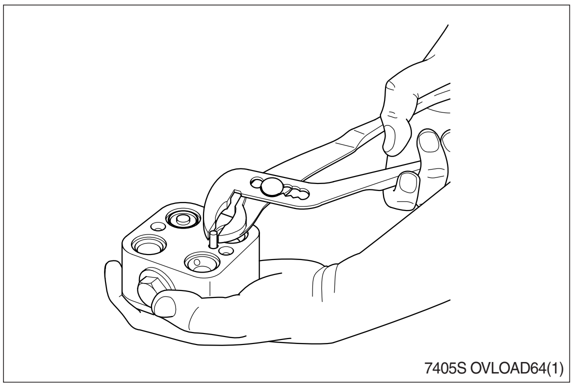
(3) Adjustable wrench.



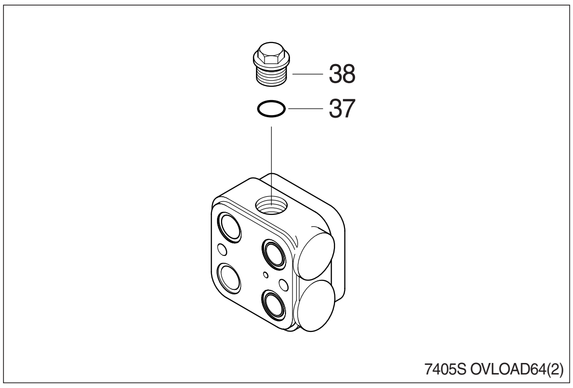
7405S OVLOAD63(3)

3) DISASSEMBLY

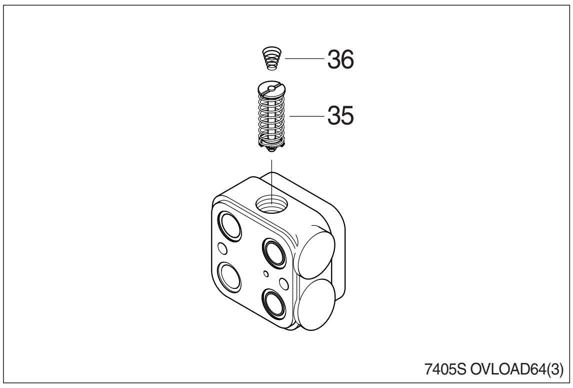
(1) Remove the rolled pin.



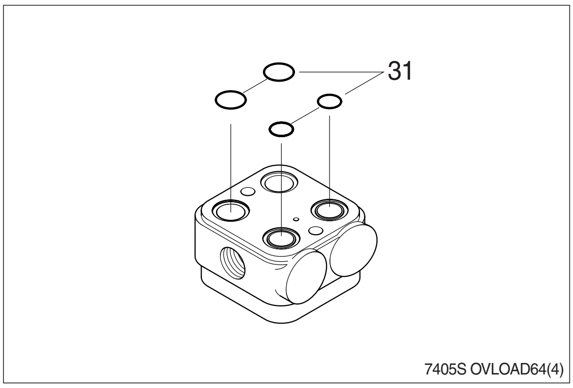
(2) Remove the plug (38) and O-ring (37).



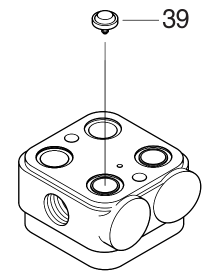
(3) Remove the spring (36) and shock valve (35).



(4) Remove the O-ring set (31).

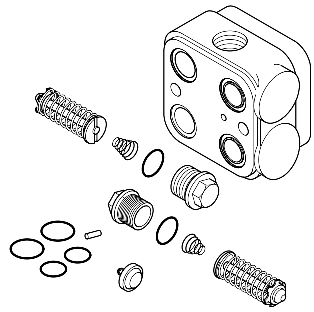


(5) Remove the check valve (39).



7405S OVLOAD65(1)

(6) The overload valve is now disassembled.



7405S OVLOAD65(2)

4) ASSEMBLY

Cleaning

Clean all parts carefully in Shellsol K or the like.

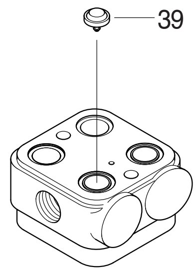
Inspection an replacement

Replace all seals and washers. Check all parts carefully and make any replacements necessary.

Lubrication

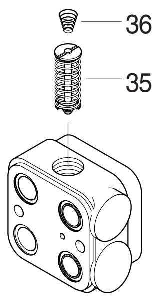
Before assembly, lubricate all parts with hydraulic oil.

(1) Fit check valve (39).



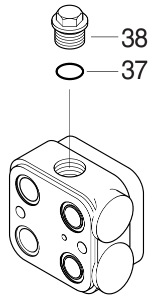
7405S OVLOAD66(1)

(2) Fit the shock valve (35) and spring (36).



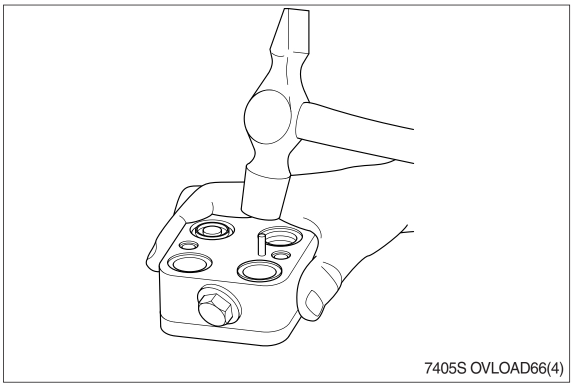
7405S OVLOAD66(2)

(3) Fit the O-ring (37) and screw the plug (38).



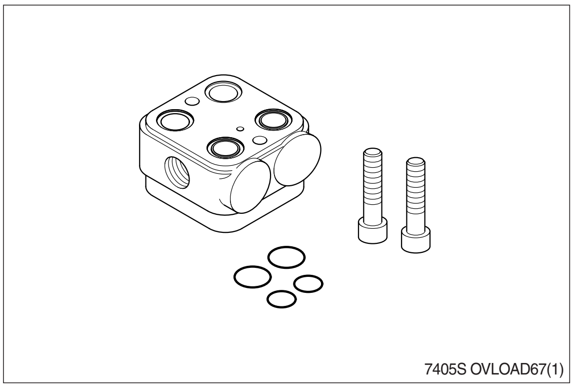
7405S OVLOAD66(3)

(4) Fit the rolled pin.



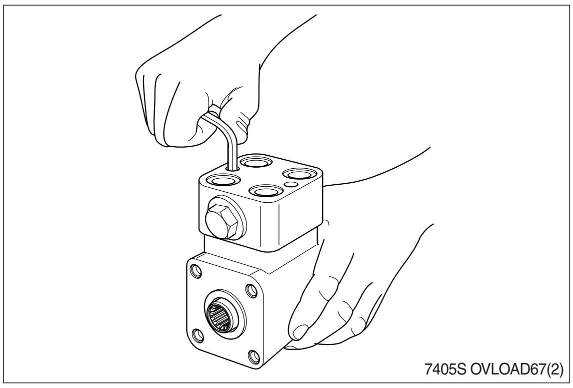
7405S OVLOAD66(4)

(5) The overload valve is now assembled. It can be checked for leakage separately or when mounted on a steering unit.



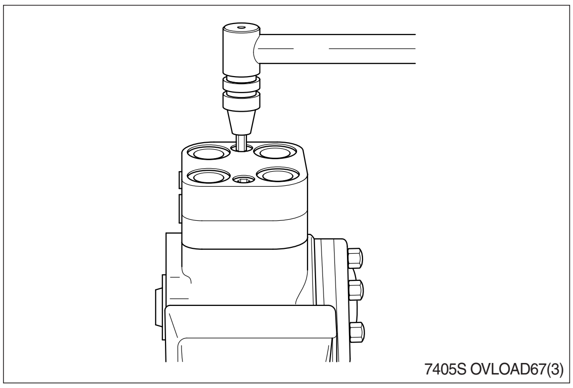
7405S OVLOAD67(1)

(6) Locate the four O-rings between overload valve and steering unit and fit these components together.



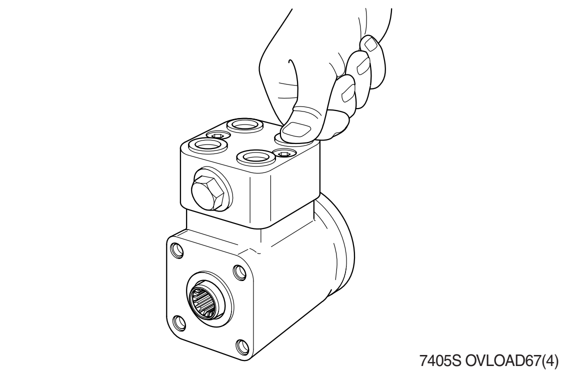
7405S OVLOAD67(2)

(7) Tighten the hexagon socket screws with a torque of $6.6^{+0.5}_{0}$ kgf · m($47.7^{+3.6}_{0}$ lb · ft).



7405S OVLOAD67(3)

(8) Press the plastic plugs into the connection ports. The overload valve is now assembled.



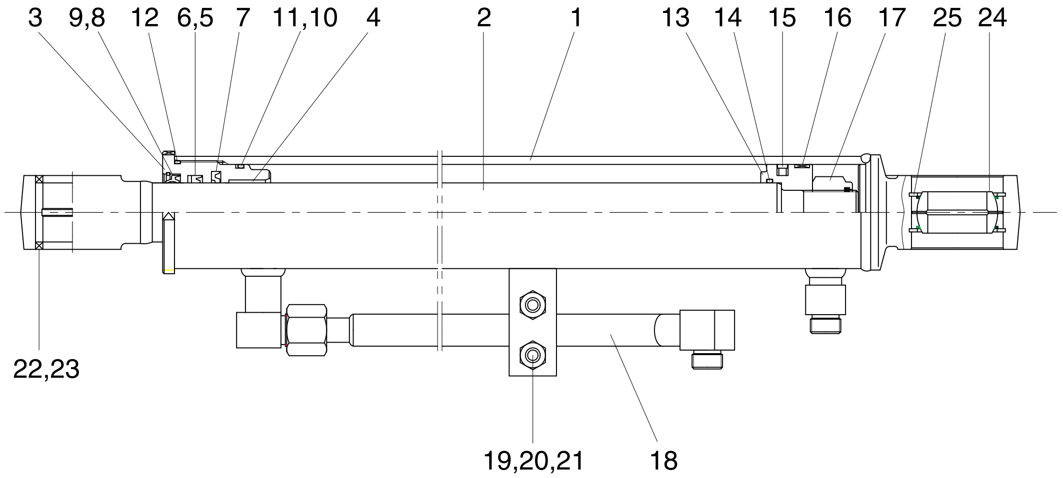
7405S OVLOAD67(4)

5) TROUBLESHOOTING

Problem	Cause	Remedy
Steering wheel is heavy	1. Over tighten mounting torque.	Retighten as specified torque.
	2. Over load valve seat side is clogged with dirt.	Disassembly, clean, reassembly.
Steering cylinder reaction is bad	1. Overload valve seat side is clogged with dirt.	Disassembly, clean, reassembly.
	2. Anti cavitation check valve seat is clogged with dirt.	Disassembly, clean, reassembly.
	3. Damage of O-ring for adjusting.	Replace.
Abnormal noise	1. Overload valve seat side clogged with dirt.	Disassembly, clean, reassembly.
Leakage	1. Loosen 2 mounting bolt.	Retighten as specified torque.
	2. Damage of O-ring.	Replace.
	3. Leakage through plug.	Apply seal tape to thread and retighten as specified torque.

3. STEERING CYLINDER

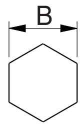
1) STRUCTURE



1	Tube assy	10	O-ring	18	Pipe assy
2	Rod assy	11	Back up ring	19	U-bolt
3	Gland	12	O-ring	20	Hexagon nut
4	Du bushing	13	Piston	21	Washer spring
5	Rod seal	14	O-ring	22	Bushing
6	Back up ring	15	Piston seal	23	Dust seal
7	Buffer ring	16	Wear ring	24	Spherical bearing
8	Dust wiper	17	Nylon nut	25	Retaining ring
9	Snap ring				

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Spanner	17	
	32	
	41	
Steel bar	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	M70 × 2.0	70 ± 7	506 ± 51
Piston	13	M27 × 2.0	75 ± 8	542 ± 58
Nut(Pipe assy)	18	M22 × 1.5	30 ± 3	217 ±21.7
Nut	20	M10 × 1.5	3.2 ± 0.3	23.1± 2.2

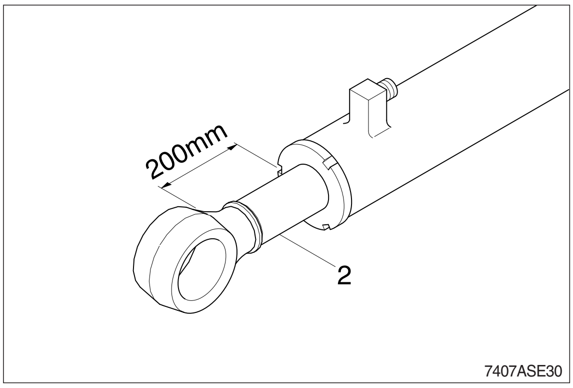
3) DISASSEMBLY

(1) Remove cylinder head and piston rod

① Hold the clevis section of the tube in a vise.

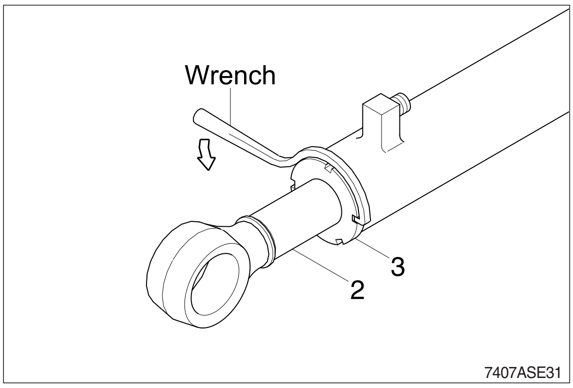
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out piston rod (2) about 200 mm (7.1 in). Because the piston rod is rather heavy, finish extending it with air pressure after the oil draining operation.



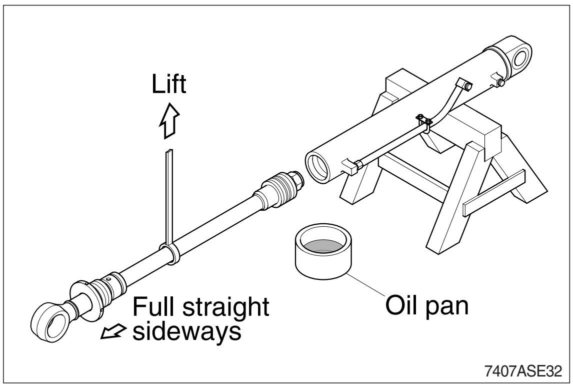
③ Loosen and remove the gland (3).

※ 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).

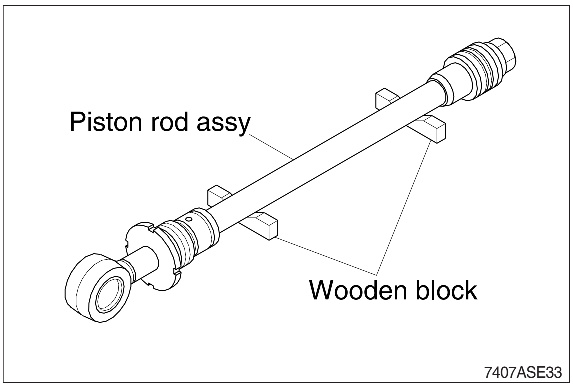
※ Since the piston rod assembly is heavy in this case, lift the tip of the piston rod (2) with a crane or some means and draw it out. However, when piston rod (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



※ 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.

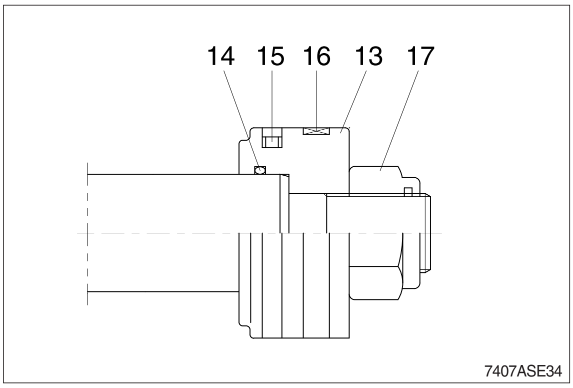
※ Cover a V-block with soft rag.



(2) Remove piston and gland assembly

① Remove the nylon nut (17).

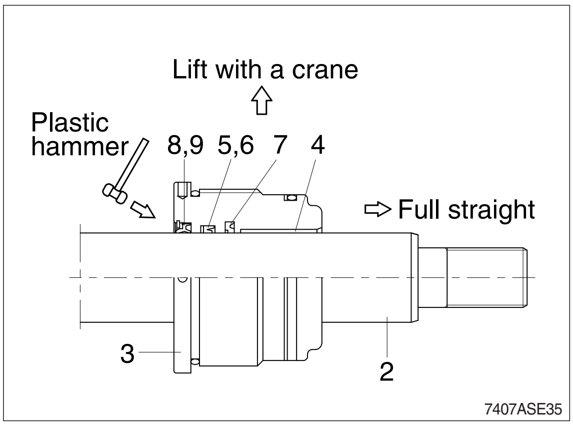
② Remove piston assembly (13), and O-ring (14).



④ 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.

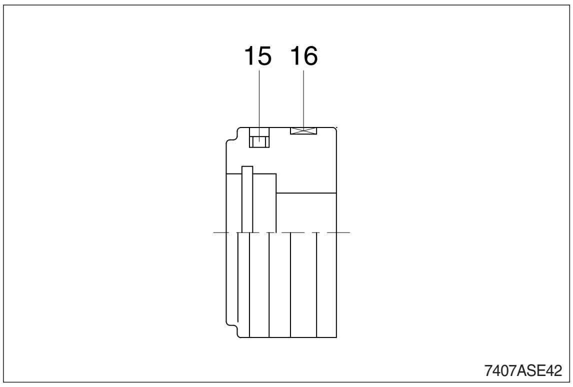
※ Pull it straight with cylinder head assembly lifted with a crane. Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9) by the threads of piston rod (2).



(3) Disassemble the piston assembly

① Remove wear ring (16) and piston seal (15).

※ 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).

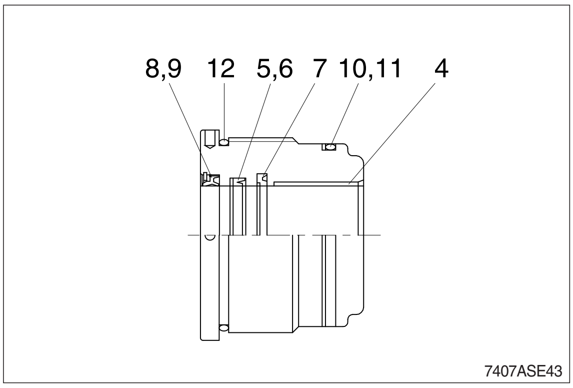
③ Remove snap ring (9) and dust wiper (8).

④ Remove back up ring (6), rod seal (5).

⑤ Remove buffer ring (7).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

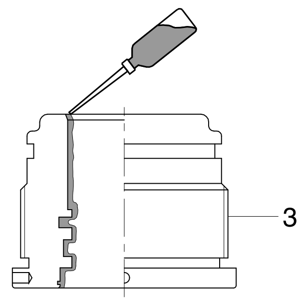


4) ASSEMBLY

(1) Assemble gland assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

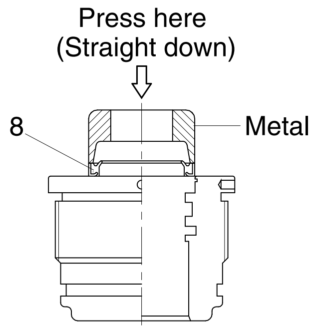
① Coat the inner face of gland (3) with hydraulic oil.



7407ASE44

② Coat dust wiper (8) with grease and fit dust wiper (8) 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 (9) to the stop face.



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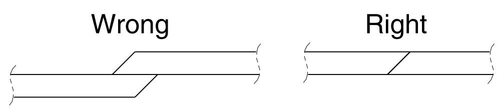
④ Fit back up ring (6) and rod seal (5) to corresponding grooves, in that order.

⑤ Fit buffer ring (7).

※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until onside of it is inserted into groove.



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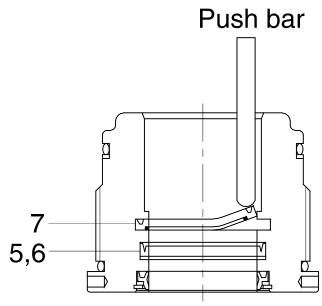
※ Rod seal (5) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (5) and buffer ring (7) up side down may damage its lip. Therefore check the correct direction that is shown in fig.



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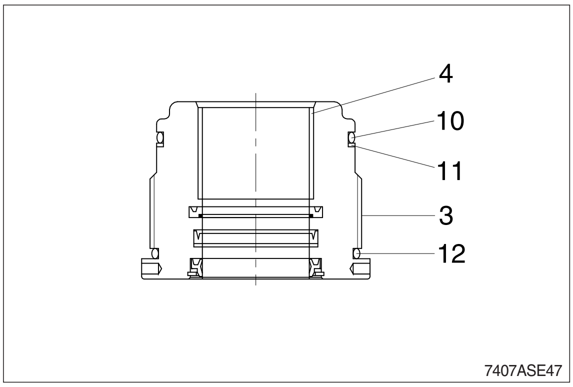
⑥ Fit back up ring (11) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

⑦ Fit O-ring (10) to gland (3).

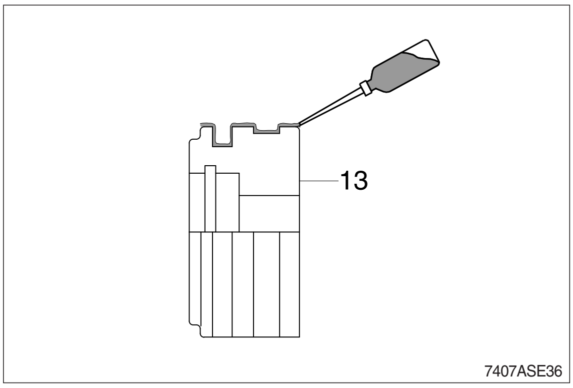
⑧ Fit bushing (4) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

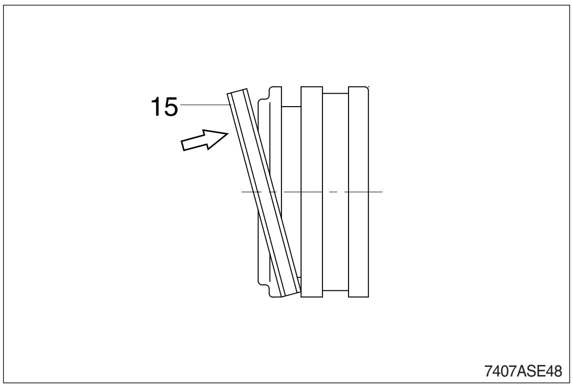
① Coat the outer face of piston (13) with hydraulic oil.



② Fit piston seal (15) to piston

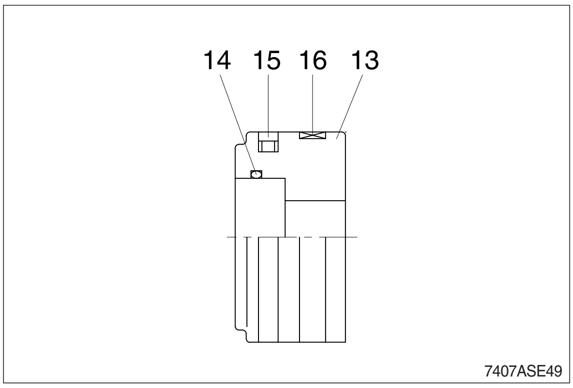
※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



③ Fit wear ring (16) to piston (13).

④ Fit O-ring (14) to piston (13).



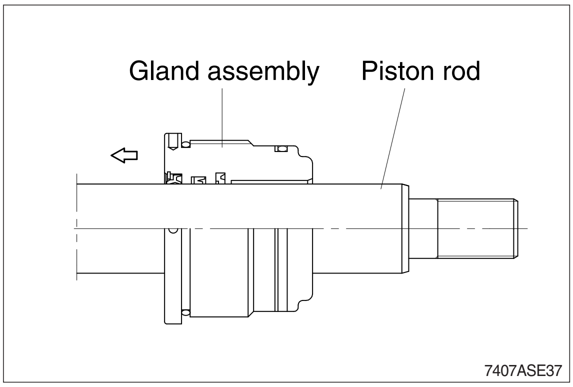
(3) Install piston and gland assembly

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.

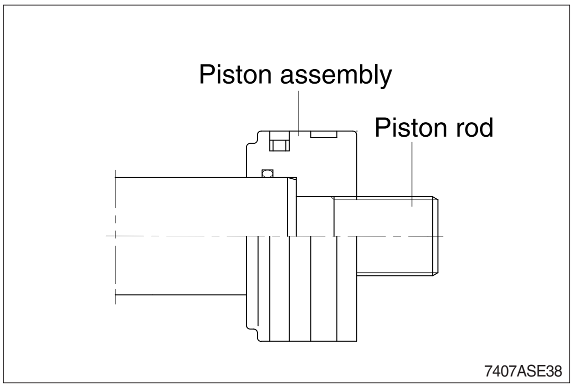
③ Insert gland assembly to piston rod (2).

- Tightening torque : 70 ± 7kgf · m (506 ± 51lbf · ft)

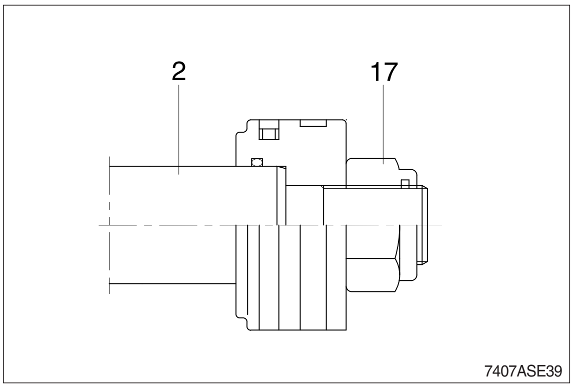


④ Fit piston assembly to piston rod.

- Tightening torque : 75 ± 8kgf · m (542 ± 58lbf · ft)



⑤ Tighten nylon nut(17) to piston rod(2).



(4) Overall assemble

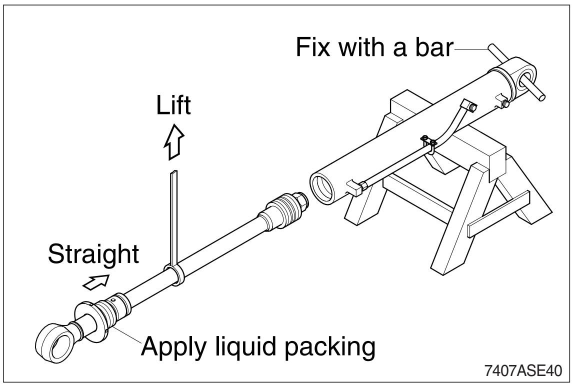
① Place a V-block on a rigid work bench. Mount the cylinder tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

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 Match the bolts holes in the cylinder head flange to the tapped holes in the cylinder tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.



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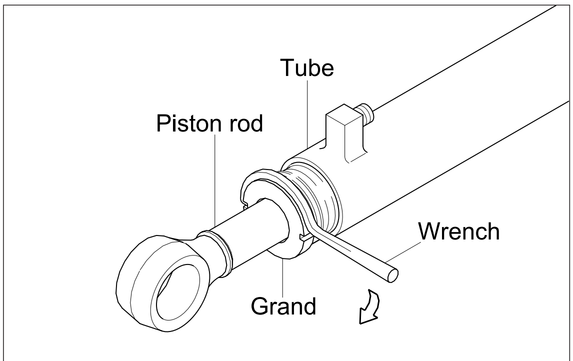

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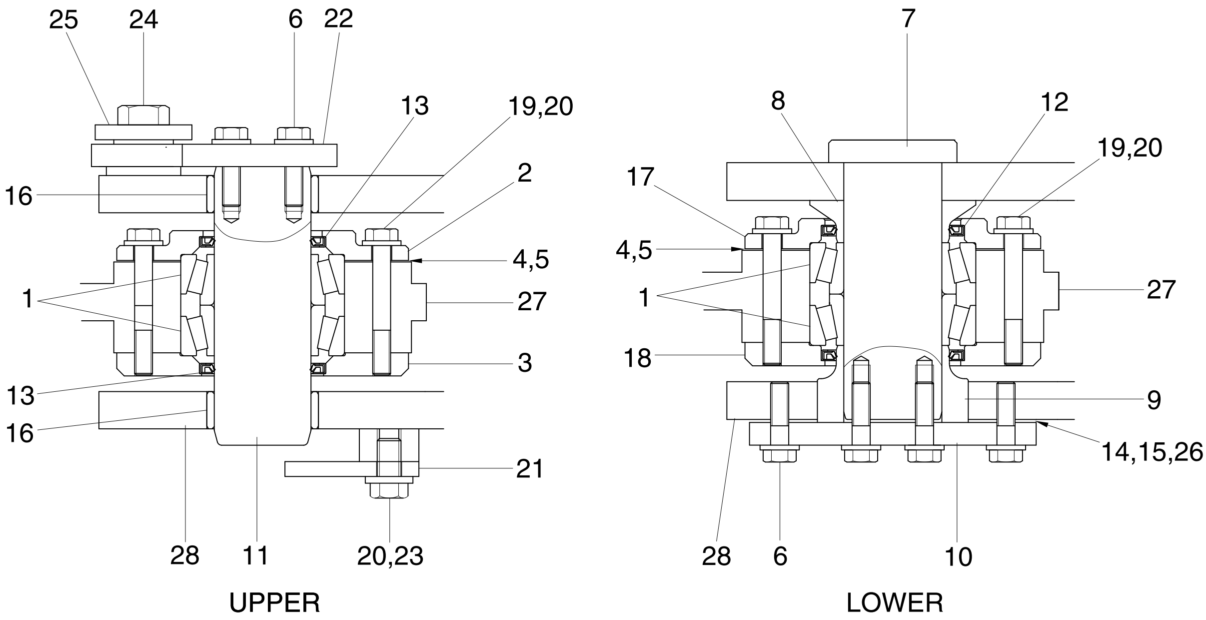
4. CENTER PIVOT PIN

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.



74095SE13

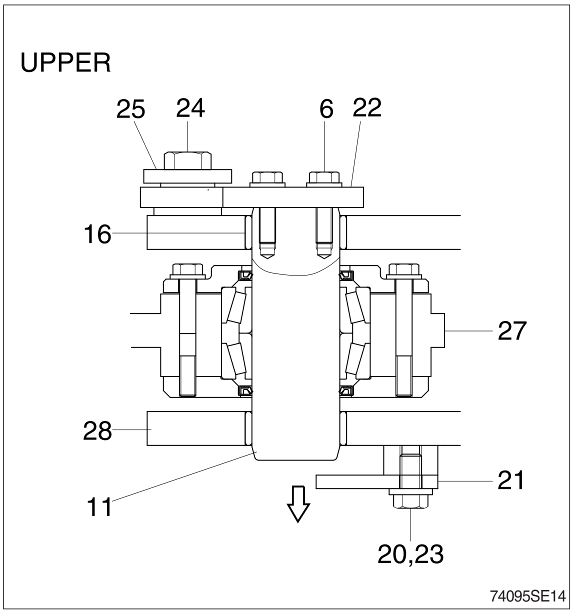
1	Bearing	11	Pin	21	Plate
2	Cover	12	Dust seal	22	Plate
3	Cover	13	Dust seal	23	Hexagon bolt
4	Shim (0.1 t)	14	Shim (0.1 t)	24	Hexagon bolt
5	Shim (0.5 t)	15	Shim (0.5 t)	25	Hardened washer
6	Bolt-w/washer	16	Bushing	26	Shim (2.0 t)
7	Pin	17	Cover	27	Front frame
8	Collar	18	Cover	28	Rear frame
9	Collar	19	Hexagon bolt		
10	Plate	20	Hardened washer		

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 (27) and rear frame (28), and then remove hexagon bolt (6, 23, 24), washer (20, 25) and plate (21, 22).

(2) Take out upper pin (11) to the downside using a metal punch.



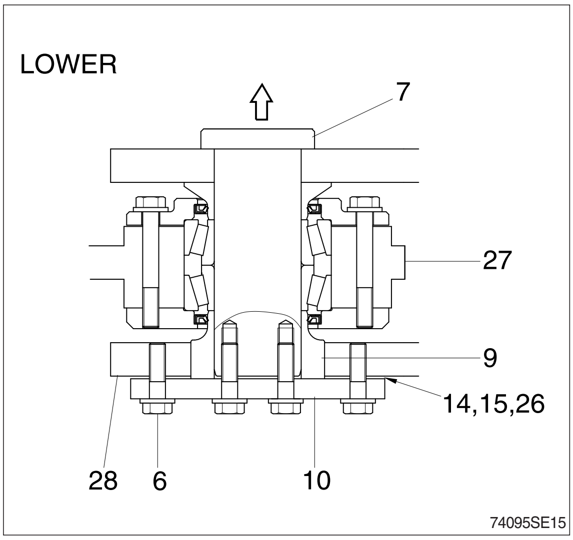
(3) Maintain the front frame horizontal level, remove hexagon bolts (6) and then remove the plate (10) and shims (14, 15, 26).

(4) Take out lower pin (7) to the upside using a metal punch carefully.

(5) Jack up or lifting the front frame (27) 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.

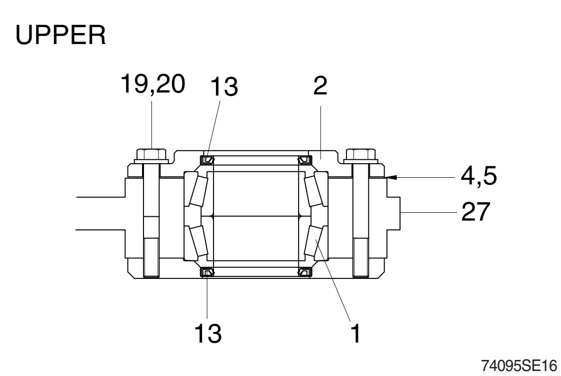
(7) Support the front frame safely.



(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).

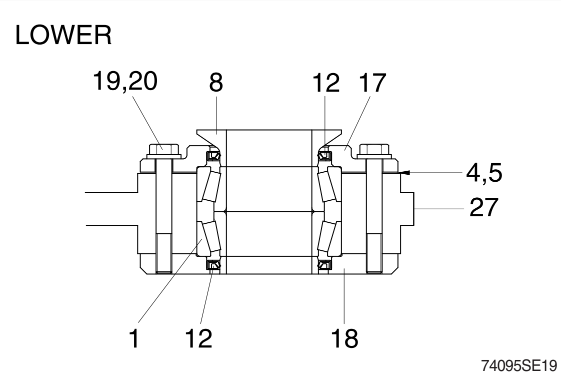
(10) Remove the bearing (1), and dust seal (13).



(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.

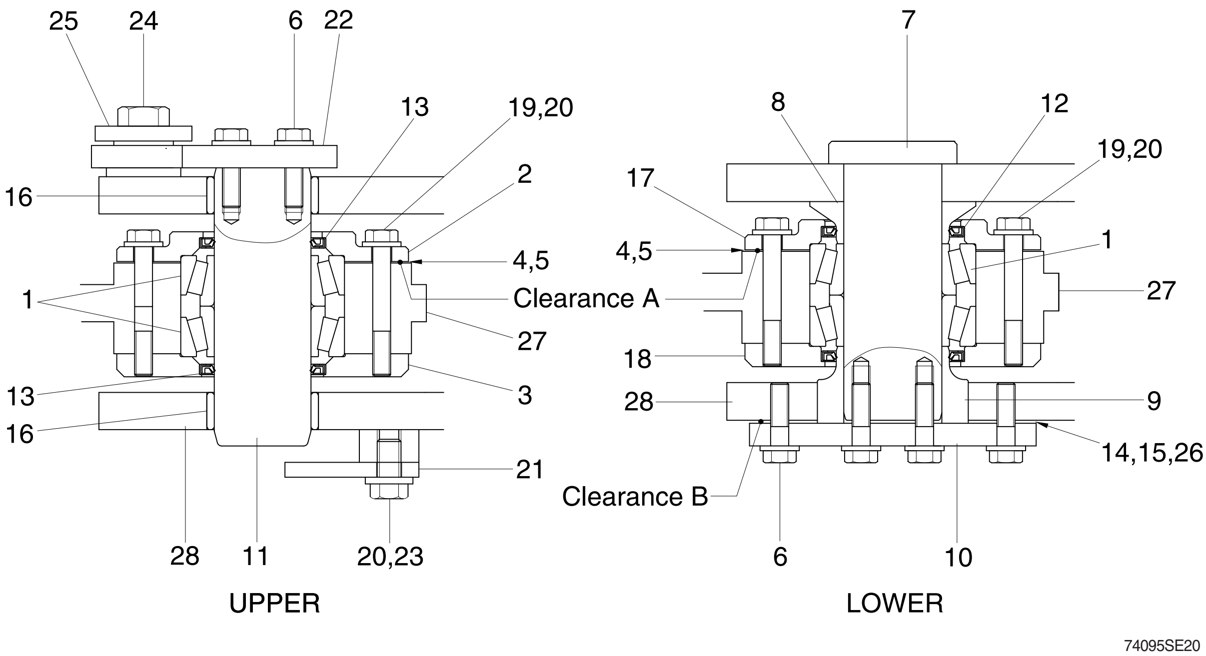
(4) Check inside cover (2, 3, 17, 18) and collar (8, 9) for dents or scratches; if any damage is found, correct with a grinder or replace.

(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	65	64.5		0.8	Replace
1	Tapered roller bearing			65.5		
8, 9	Collar			65.5		
12, 13	Dust seal	When removed				Replace

4) ASSEMBLY



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±5˚C (-103±9˚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 : 0.8~1.0 kgf · m (5.8~7.2 lbf · 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

(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. (bearing preload : 0.6 ~ 0.9 kgf · m)
; 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 (16) 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 (28).

(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 (28).
· **Adjustment method of clearance B**
① Install pin (7) and plate (21) without shim (14,15, 26).
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

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 (Pilot control valve)
- · Safety valve

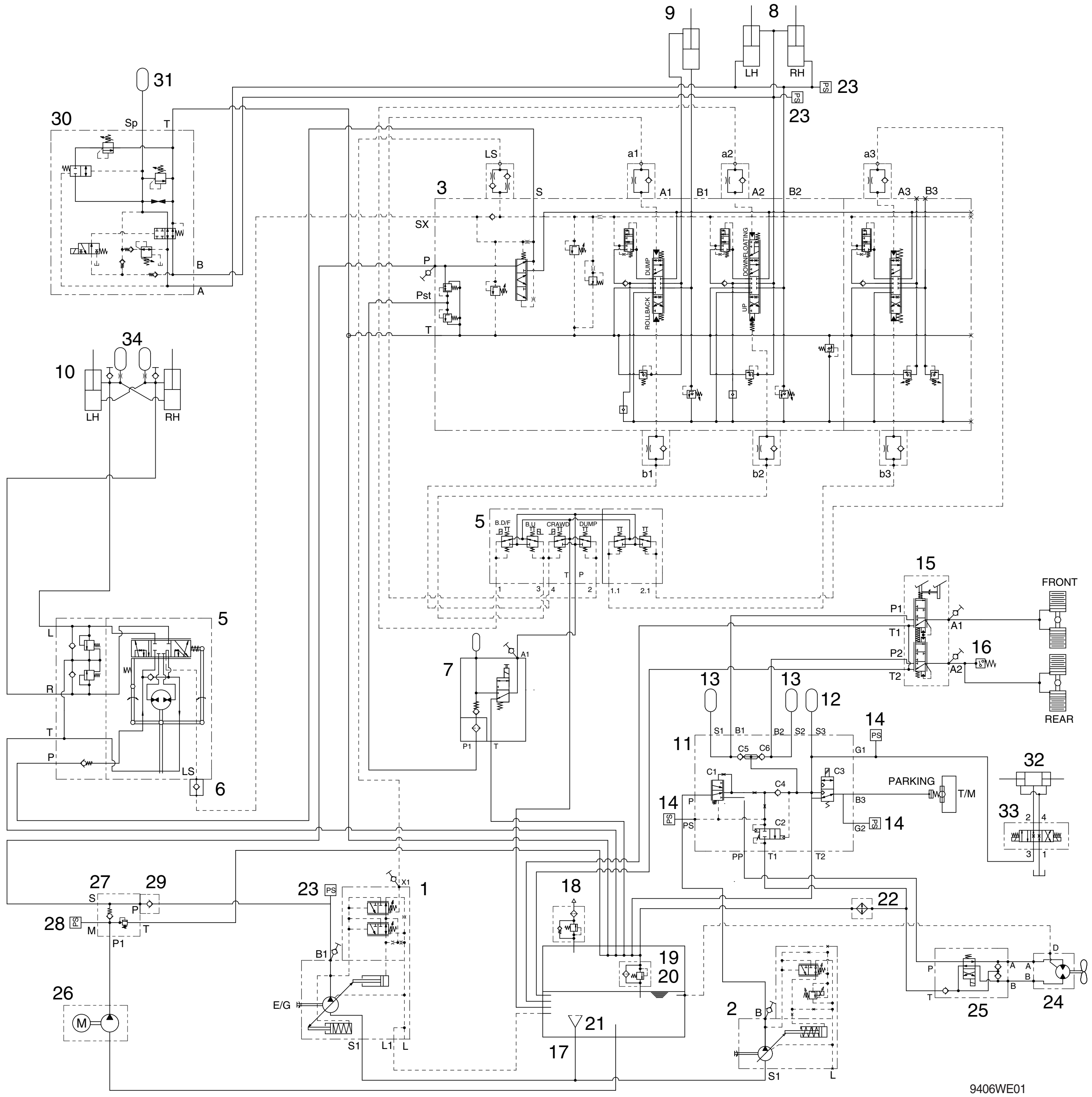
The main control valve is load pressure independent flow distribution system which routes flow to the boom, bucket or auxiliary cylinders (not shown) when the respective spools are shifted.

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.

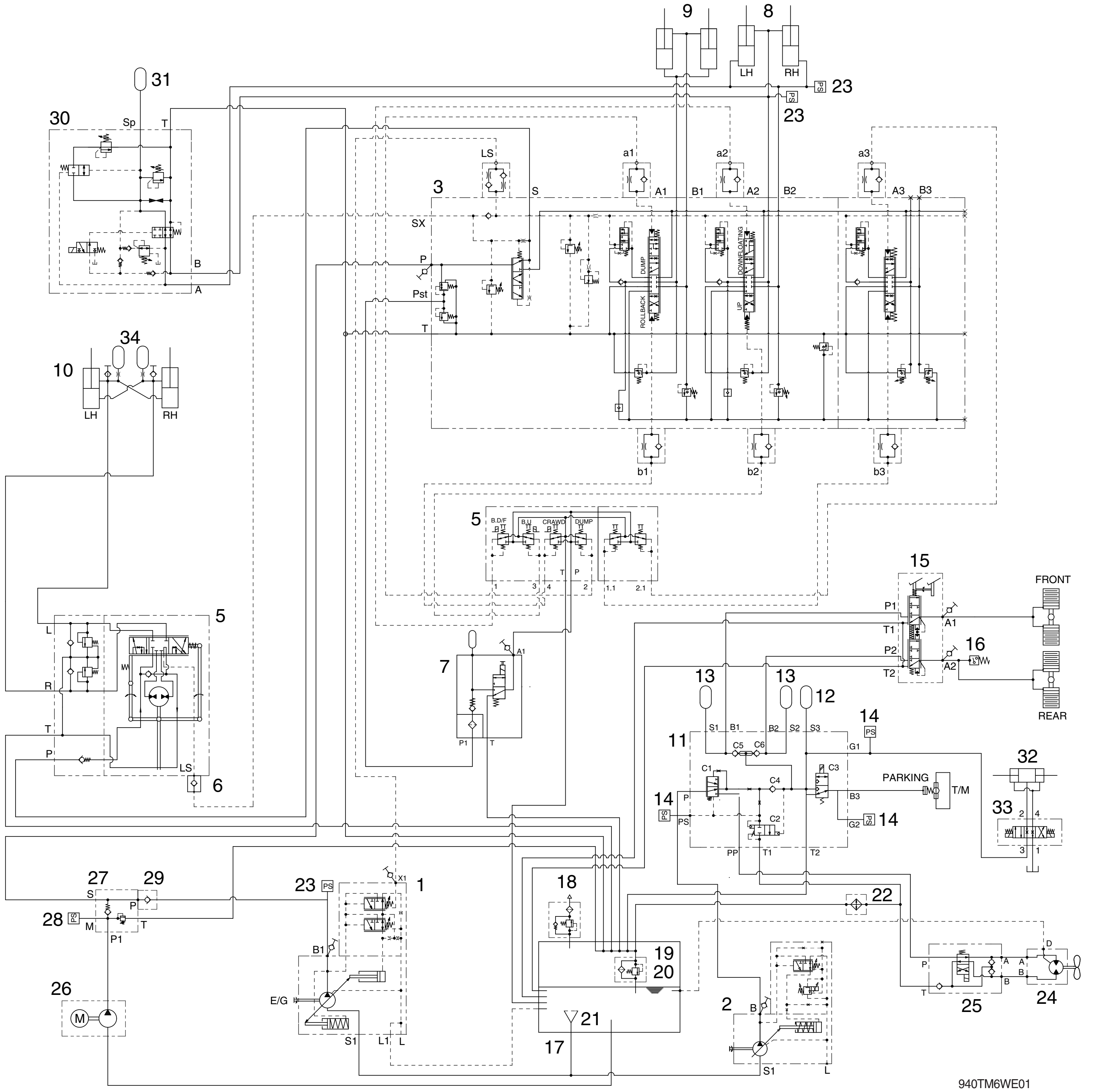
The return circuit for the main hydraulic system have return filter inside the hydraulic tank. The return filter uses a filter element and a bypass valve. The bypass valve is located in the upside of filter.

2. HYDRAULIC CIRCUIT (HL940, HL940XT)



1	Main pump	13	Accumulator	24	Fan motor
2	Fan & brake pump	14	Pressure sensor	25	Directional valve
3	Main control valve	15	Brake valve	26	Pump motor (opt)
4	Remote control valve	16	Pressure switch	27	Check block (opt)
5	Steering unit	17	Hydraulic tank	28	Pressure sensor (opt)
6	Check valve	18	Air breather	29	Check valve (opt)
7	Safety valve	19	Return filter	30	Ride control valve (opt)
8	Boom cylinder	20	By pass valve	31	Accumulator (opt)
9	Bucket cylinder	21	Strainer	32	Quick coupler cylinder (opt)
10	Steering cylinder	22	Oil cooler	33	Solenoid valve (opt)
11	Cut-off valve	23	Pressure sensor	34	Accumulator
12	Accumulator				

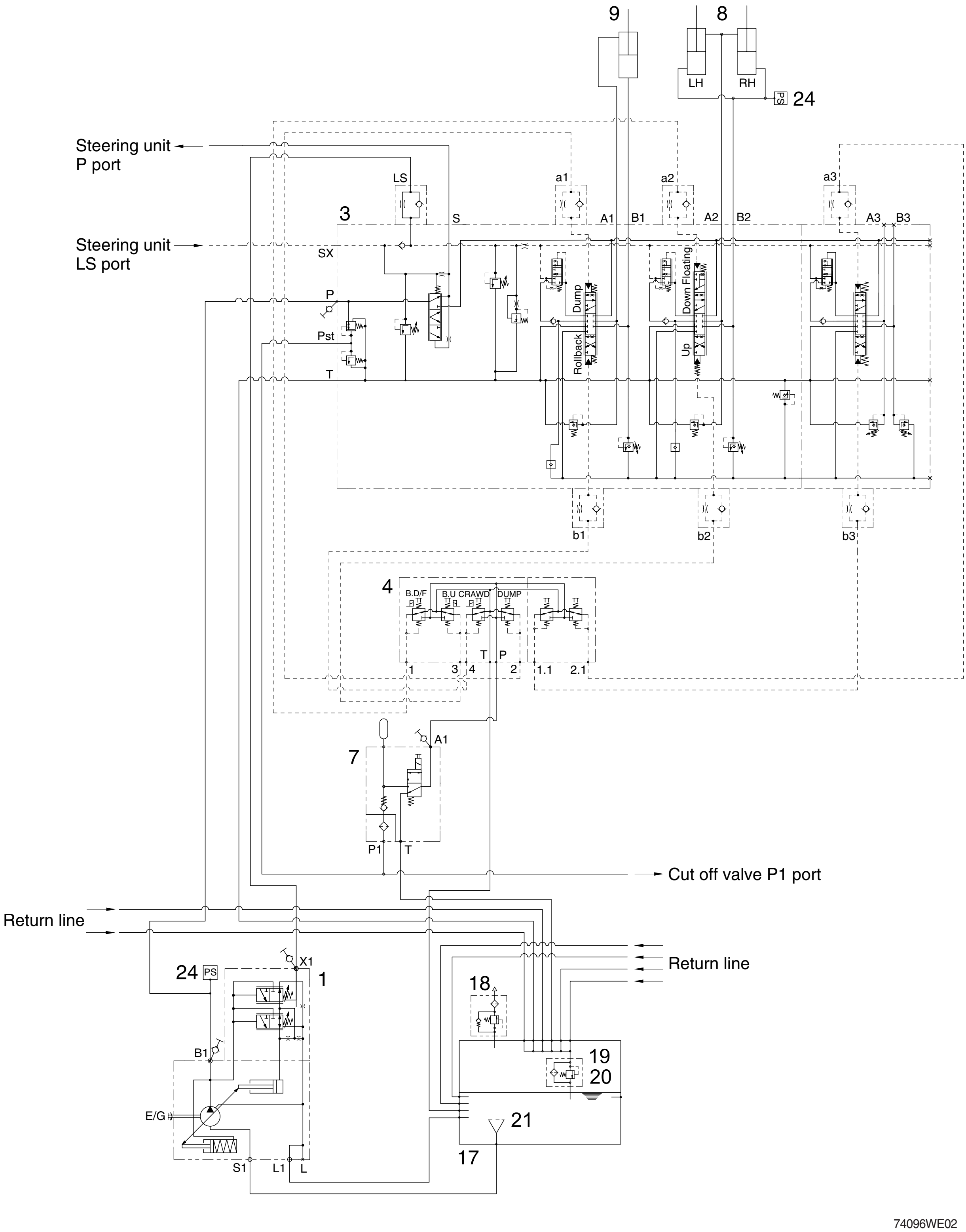
HYDRAULIC CIRCUIT (HL940TM)



940TM6WE01

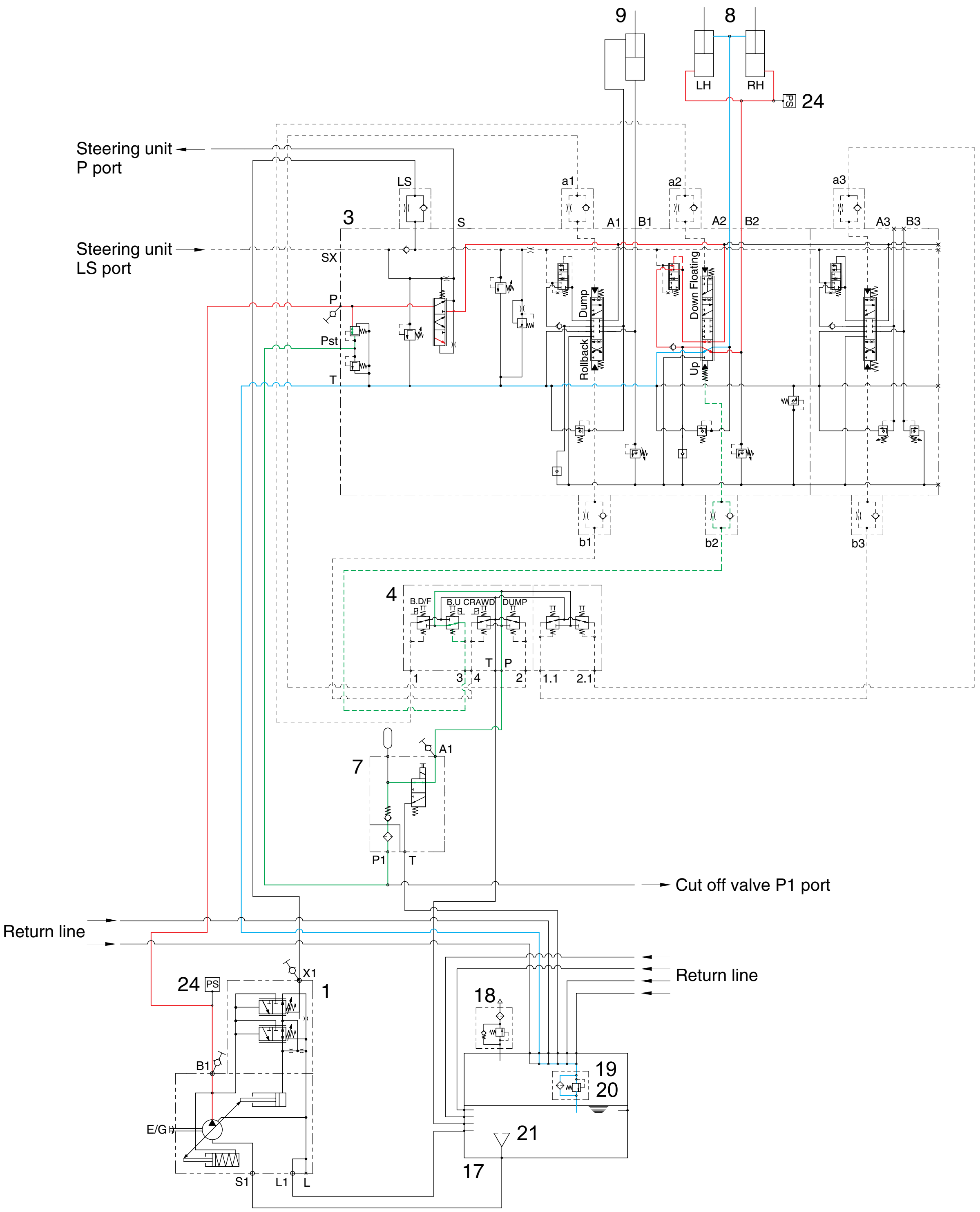
1. Main pump
2. Fan & brake pump
3. Main control valve
4. Remote control valve
5. Steering unit
6. Check valve
7. Safety valve
8. Boom cylinder
9. Bucket cylinder
10. Steering cylinder
11. Cut-off valve
12. Accumulator
13. Accumulator
14. Pressure sensor
15. Brake valve
16. Pressure switch
17. Hydraulic tank
18. Air breather
19. Return filter
20. By pass valve
21. Strainer
22. Oil cooler
23. Pressure sensor
24. Fan motor
25. Directional valve
26. Pump motor (opt)
27. Check block (opt)
28. Pressure sensor (opt)
29. Check valve (opt)
30. Ride control valve (opt)
31. Accumulator (opt)
32. Quick coupler cylinder (opt)
33. Solenoid valve (opt)
34. Accumulator

3. WORK EQUIPMENT HYDRAULIC CIRCUIT



1	Main pump	8	Boom cylinder	19	Return filter
3	Main control valve	9	Bucket cylinder	20	Bypass valve
4	Remote control valve	17	Hydraulic tank	21	Strainer
7	Safety valve	18	Air breather	24	Pressure sensor

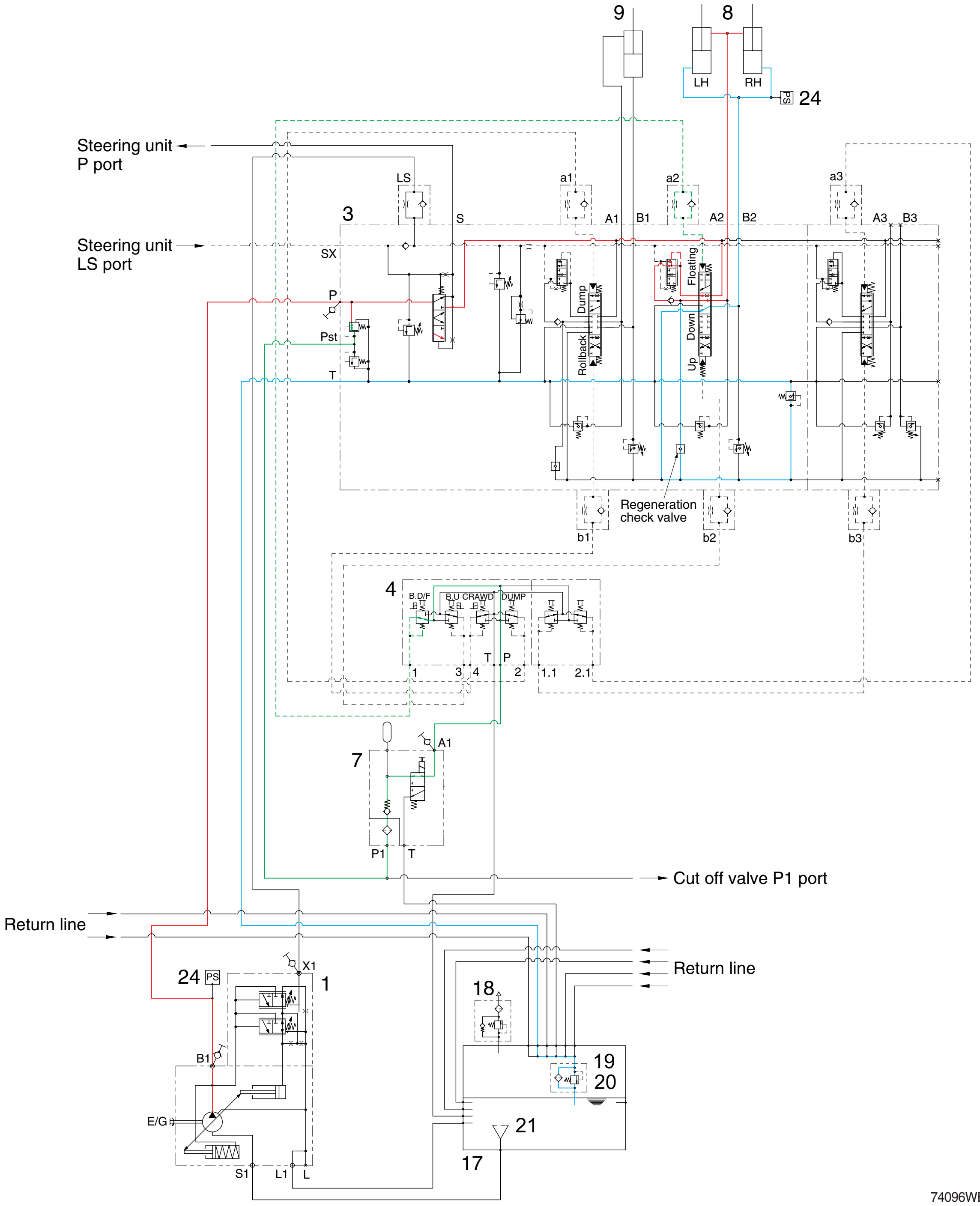
1) WHEN THE RCV LEVER IS IN THE RAISE POSITION



74096WE03

- When the RCV lever (4) is pulled back, the boom spool is moved to raise position by pilot oil pressure from port 3 of RCV.
- The oil from main pump (1) flows into main control valve (3) and then goes to the large chamber of boom cylinder (8) by pushing the load check valve of the boom spool.
- The oil from the small chamber of boom cylinder (8) returns to hydraulic oil tank (17) through the boom spool at the same time.
- When this happens, the boom goes up.

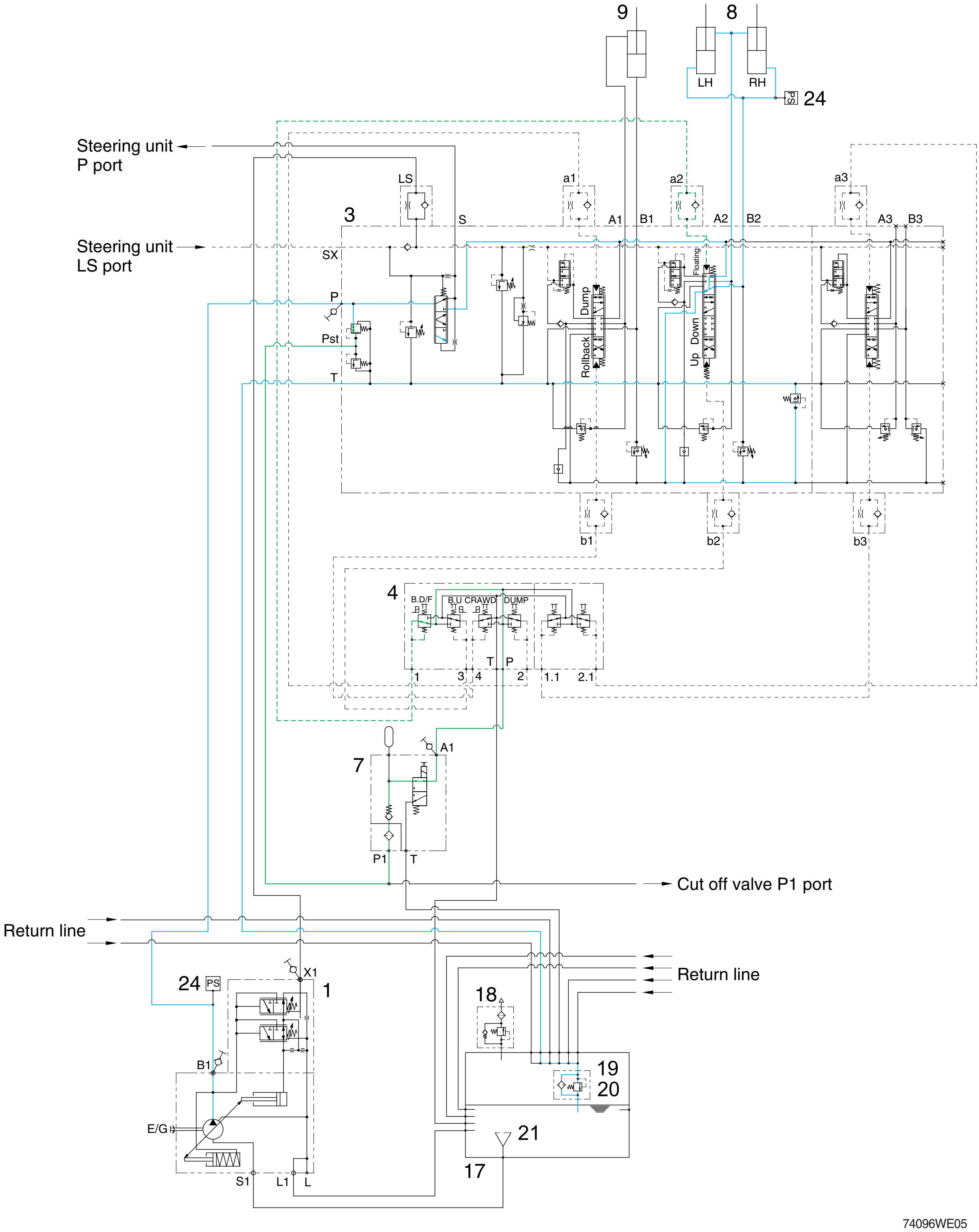
2) WHEN THE RCV LEVER IS IN THE LOWER POSITION



74096WE04

· When the RCV lever (4) is pushed forward, the boom spool is moved to lower position by pilot pressure.
· The oil from main pump (1) flows into main control valve (3) and then goes to small chamber of boom cylinder (8) by pushing the load check valve of the boom spool.
· The oil returned from large chamber of boom cylinder (8) returns to hydraulic tank (17) 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 FLOAT POSITION

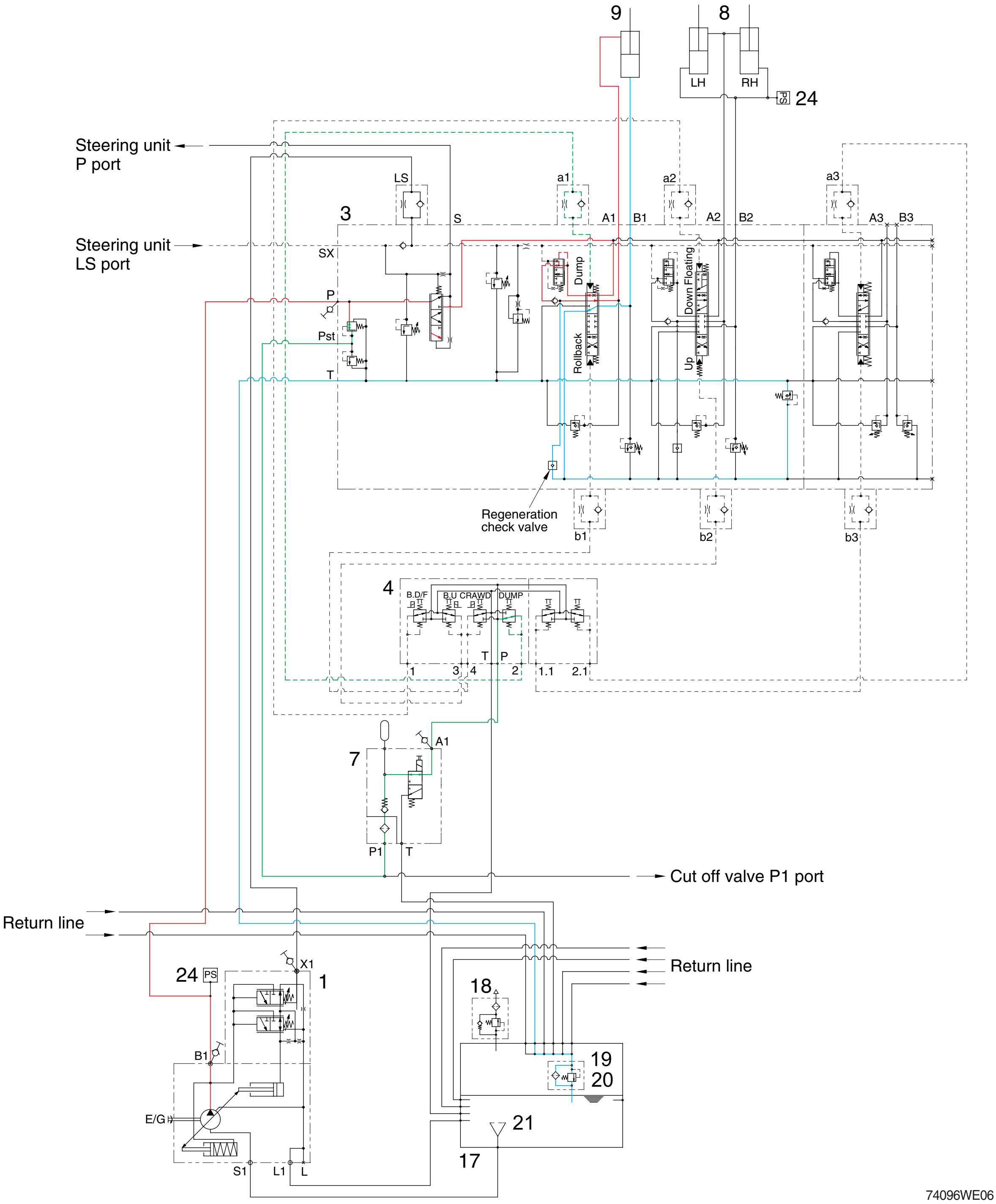


· When the RCV lever (4) is pushed further forward from the lower position, the pilot pressure reaches to 30bar, then the boom spool is moved to floating position.

· The work ports (A2), (B2) 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.

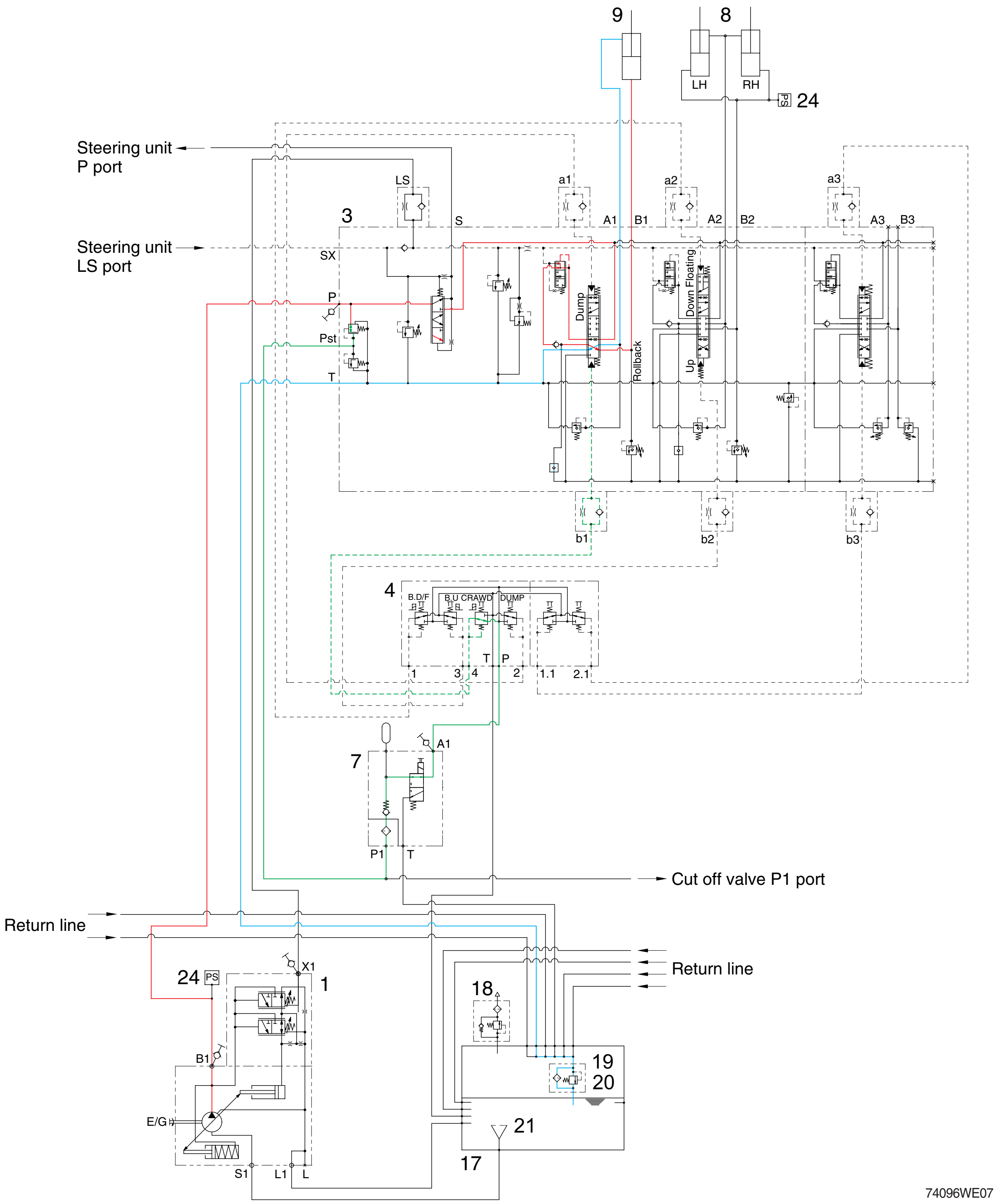
· In this condition, when the bucket is in contact with the ground, it can be move up and down in accordance with the shape of the ground.

4) WHEN THE RCV LEVER IS IN THE DUMP POSITION



- If the RCV lever (4) is pushed right, the bucket spool is moved to dump position by pilot oil pressure from port 2 of RCV.
- The oil from main pump (1) flows into main control valve (3) and then goes to the small chamber of bucket cylinder (9) by pushing the load check valve of the bucket spool.
- The oil at the large chamber of bucket cylinder (9) returns to hydraulic tank (17).
- 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.

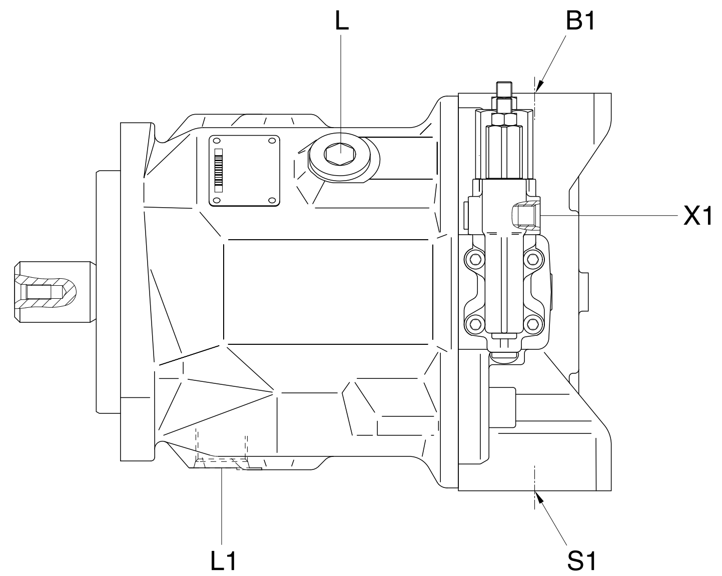
5) WHEN THE RCV LEVER IS IN THE ROLL BACK (retract) POSITION

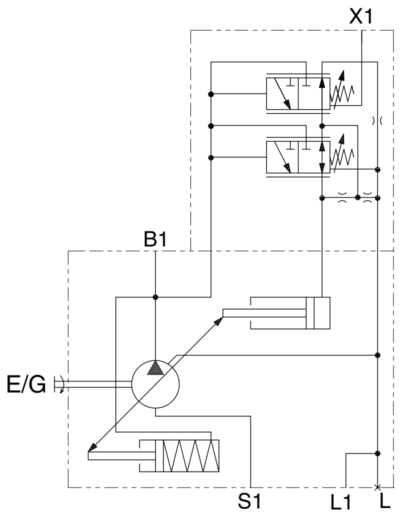


- If the RCV lever (4) is pulled left, the bucket spool is moved to roll back position by pilot oil pressure from port 4 of RCV.
- The oil from main pump (1) flows into main control valve (3) and then goes to the large chamber of bucket cylinder by pushing the load check valve of the bucket spool.
- The oil at the chamber of bucket cylinder (9) returns to hydraulic tank (17).
- When this happens, the bucket roll back.
- When the rolling speed of bucket is faster, the return oil from the small chamber of bucket cylinder combines with the oil from the pump, and flows into the large chamber of the cylinder.
  This prevents cylinder cavitation by the negative pressure when the pump flow cannot match the bucket rolling speed.

4. MAIN PUMP

1) STRUCTURE (1/2)

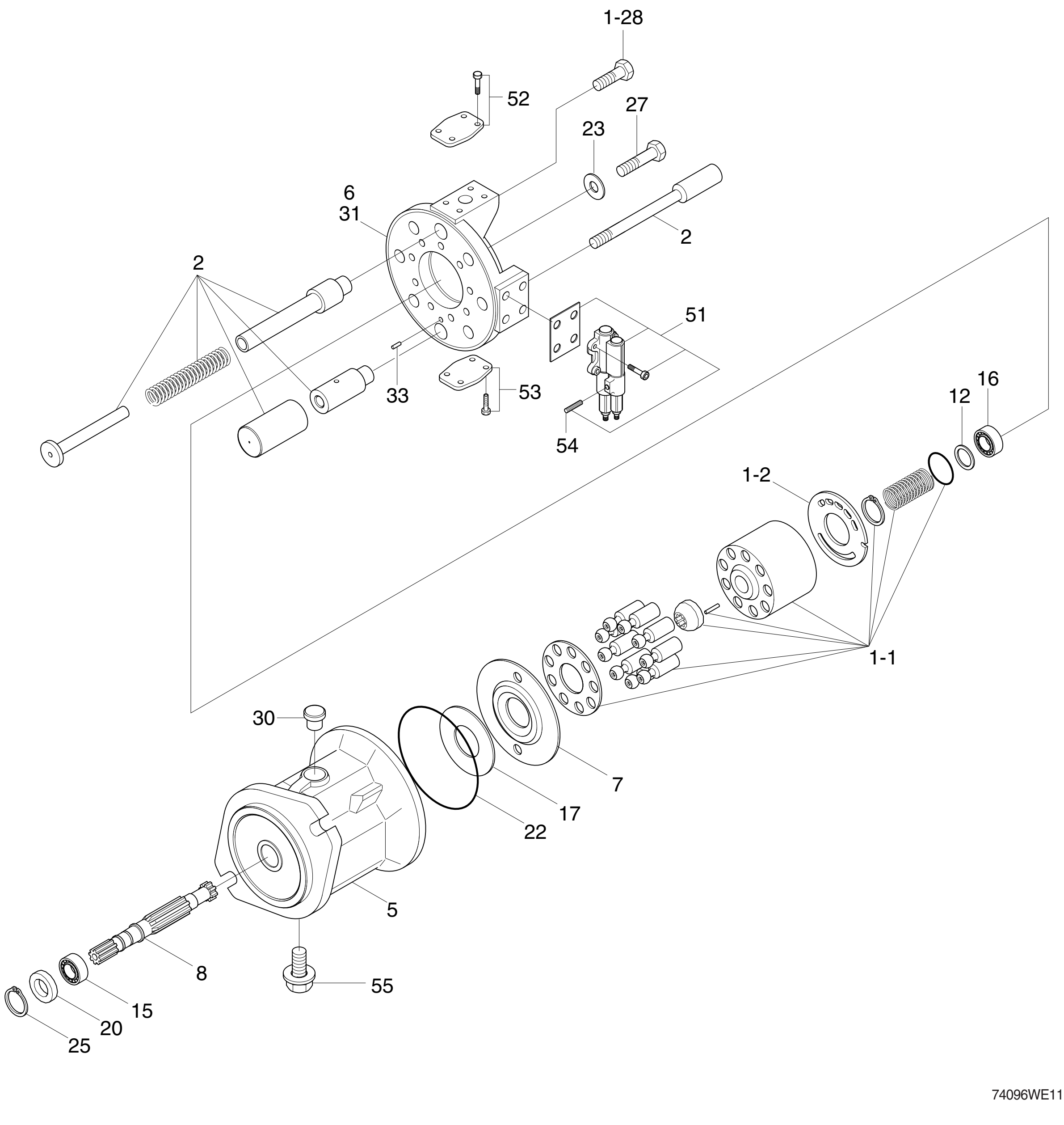




74096WE12

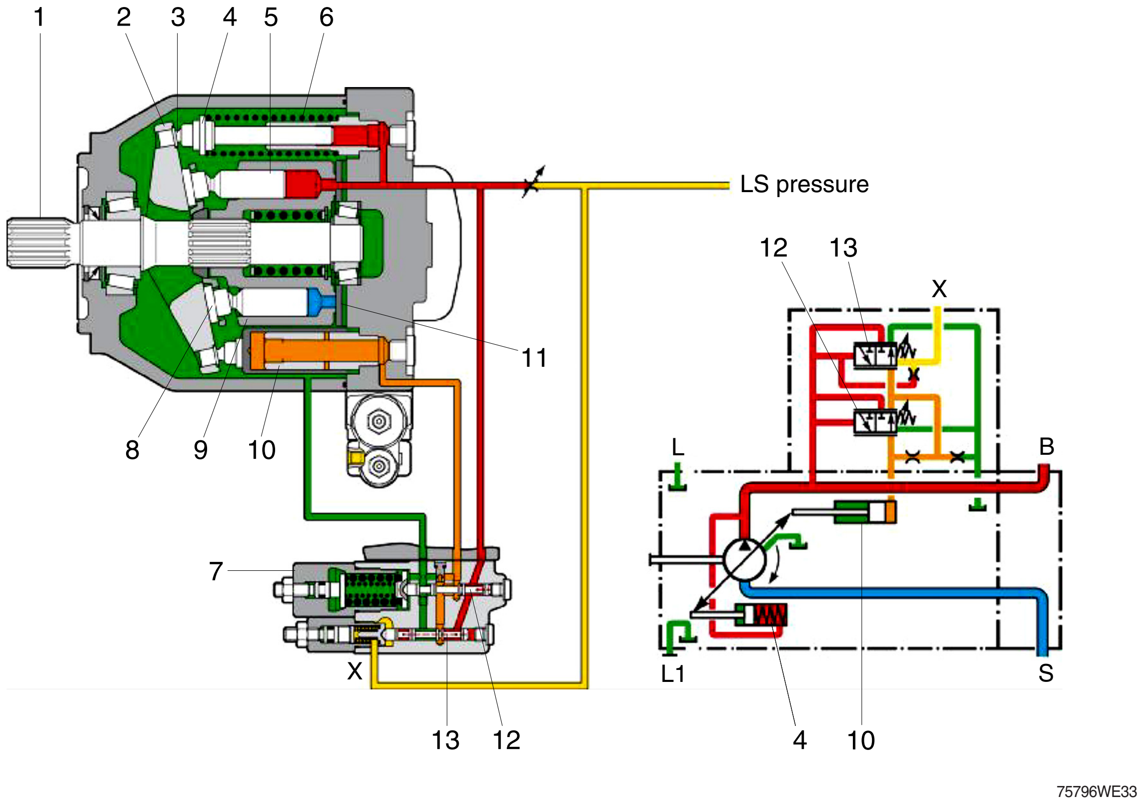
Port	Port name	Port size
B1	Pressure port	SAE 1"
S1	Suction port	SAE 2"
L, L1	Case drain port	1 1/16-12UN
X1	Pilot pressure port	7/16-20UNF

STRUCTURE (2/2)



1	Rotary group	15	Taper roller bearing	30	Locking screw
1-1	High speed rotary group	16	Taper roller bearing	31	Double break-off pin
1-2	Control plate	17	Bearing liner	33	Cylinder pin
2	Adjusting piece	20	Shaft seal ring	51	Control valve
5	Pump housing	22	O-ring	52	Flange cover
6	Port plate	23	O-ring	53	Flange cover
7	Swash plate	25	Retaining ring	54	Seal screw
8	Drive shaft	27	Socket screw	55	Seal screw
12	Adjustment shim	28	Locking screw		

2) FUNCTION



1	Drive shaft	6	Counter spring	11	Control plate
2	Swash plate	7	Pressure & flow compensator valve	12	Pressure compensator spool
3	Shoe plate	8	Piston shoe	13	Flow compensator spool
4	Counter piston	9	Cylinder		
5	Piston	10	Control piston		

The steering pump and loader pump are variable displacement piston pump. The steering pump and loader pump are flow controlled by LS signal. When the steering and loader are not being used, the pumps are at low pressure standby.

The load sensing pressure that is sensed from steering and loader hydraulic systems flows to flow compensator spool (13). This spool keeps the pump output at a level that is necessary to fulfill the requirements for the system flow and for the pressure.

The pressure compensator spool (12) also limits maximum system pressure. The pressure compensator spool (12) prevents damage to the steering and loader hydraulic components from excessive pressure.

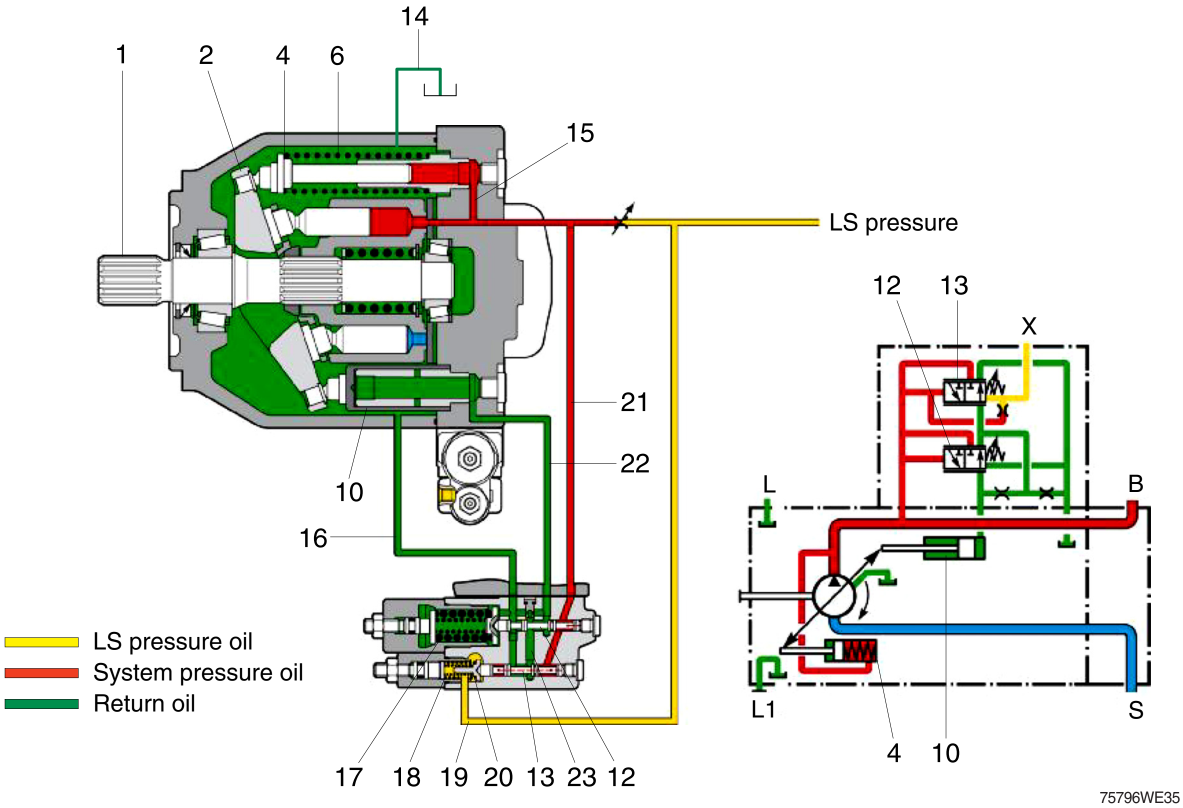
The swivel angle of the pumps is controlled by counter piston (4) and control piston (10). Counter spring (6) cause swash plate (2) to move at maximum displacement or causes swash plate (2) to upstroke.

Control piston (10) has a larger area (diameter) than counter piston (4). Control piston (10) causes swash plate (2) to destroke the pump.
Flow compensator spool (13) and/or pressure compensator spool (12) changes pump output by regulating the pump discharge pressure that is acting on control piston (10).

Control piston (10) diameter is larger than counter piston (4) diameter, the oil pressure that is acting against control piston (10) overcomes the force of counter spring (6). The oil pressure than causes the pump to destoke.

Pressure and flow compensator valve (7) also controls the maximum output of pump pressure. When steering and loader pressure rises above pressure compensator setting, pressure compensator spool (12) overrides flow compensator spool (13). This causes the pump to destroke.

(1) Upstroking



1	Drive shaft	13	Flow compensator spool	19	LS line from the metering pump
2	Swash plate	14	Case drain	20	Cavity
4	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

Upstroking of the pump occurs as flow demand from loader and steering system.
The increased flow demand causes a LS pressure in LS line (19). The LS pressure in LS line (19) combines with the force of spring (18) in cavity (20).
The force of spring (18) causes pump pressure to be higher than the LS pressure (19).
If the combination of LS pressure and of spring force is greater than the pump discharge pressure, this difference pressure causes spool (13) to move right. As spool (13) moves right, the spool (13) blocks the flow of supply oil to control piston (10). Pump swash plate (2) is controlled by pressure and flow as much as hydraulic system requests.

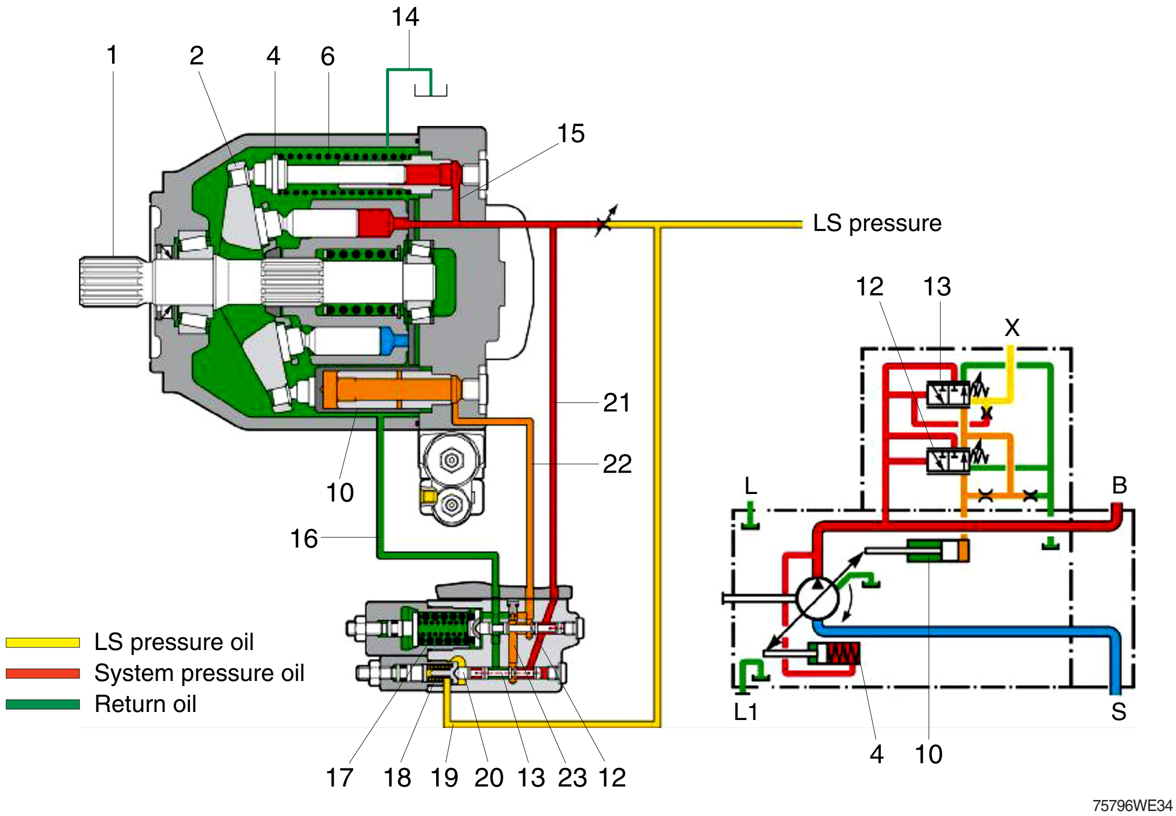
When the oil flow to control piston (10) is blocked, the pilot oil in passage (22) drains to passage (23). The oil then flows past pressure compensator spool (12) and through passage (16) into the housing and via the drain line (14) to tank.

Supply oil flows through passage (15) to counter piston (4). The oil acts against counter piston (4). The oil combines with the force of counter spring (6). This causes swash plate (2) to upstroke.

This also causes the pump flow to increase. As flow requirements are satisfied, the pump output pressure increase. The pressure increases until the pressure in passage (15) moves flow compensator spool (13) up to be satisfied with system requirement for pressure and flow.

· Pump discharge pressure = force of spring (18) + LS pressure (19)

(2) Destroking



1	Drive shaft	13	Flow compensator spool	19	LS line from the metering pump
2	Swash plate	14	Case drain	20	Cavity
4	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

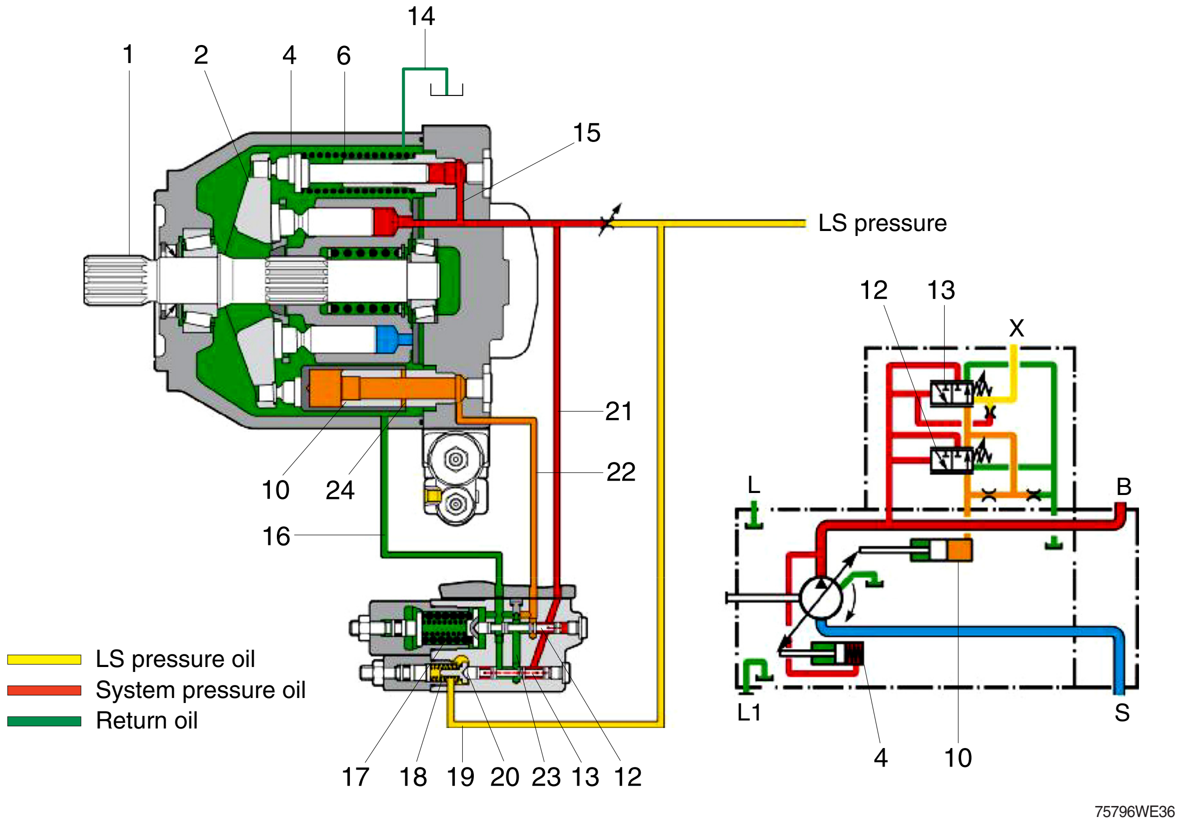
The decreased flow demand causes a LS pressure in line (19). The LS pressure in line (19) combines with the force of spring (18) in cavity (20).
This combination of LS pressure and of spring force is less than the pump pressure in passage (21). This causes flow compensator spool (13) to move left.
Pump oil now flows through passage (15). The oil then flows past flow compensator spool (13), through passage (22), and then to control piston (10).

The pump pressure behind control piston (10) is now greater than the combined force of counter piston(4) and of counter spring (6). The angle of swash plate (2) decreases.
This decreases the pump output and the system pressure.

When the lower flow requirements are met, flow compensator spool (13) moves right up to the balanced position. Swash plate (2) maintains an angle that is sufficient to provide the lower required pressure. If the operator does not turn the steering wheel and does not move RCV, then the pump will return to low pressure standby.

※ Control piston → Changes pump displacement ; influenced by controller.
Counter piston → Helps to change pump displacement but no possible to control this piston.

(3) Low pressure standby



1	Drive shaft	13	Flow compensator spool	19	LS line from the metering pump
2	Swash plate	14	Case drain	20	Cavity
4	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring	24	Cross-drilled hole

Low pressure standby constitutes the following condition: a running engine and inactive steering and loader. There are no flow demands on the pump or pressure demands on the pump. Therefore, there is no LS pressure in line (19).
Before you start the engine, counter spring (6) holds swash plate (2) at the maximum angle. As the pump begins to turn, oil begins to flow and pressure increases in the system.
Because of close centered steering control valve and close centered loader hydraulic system.

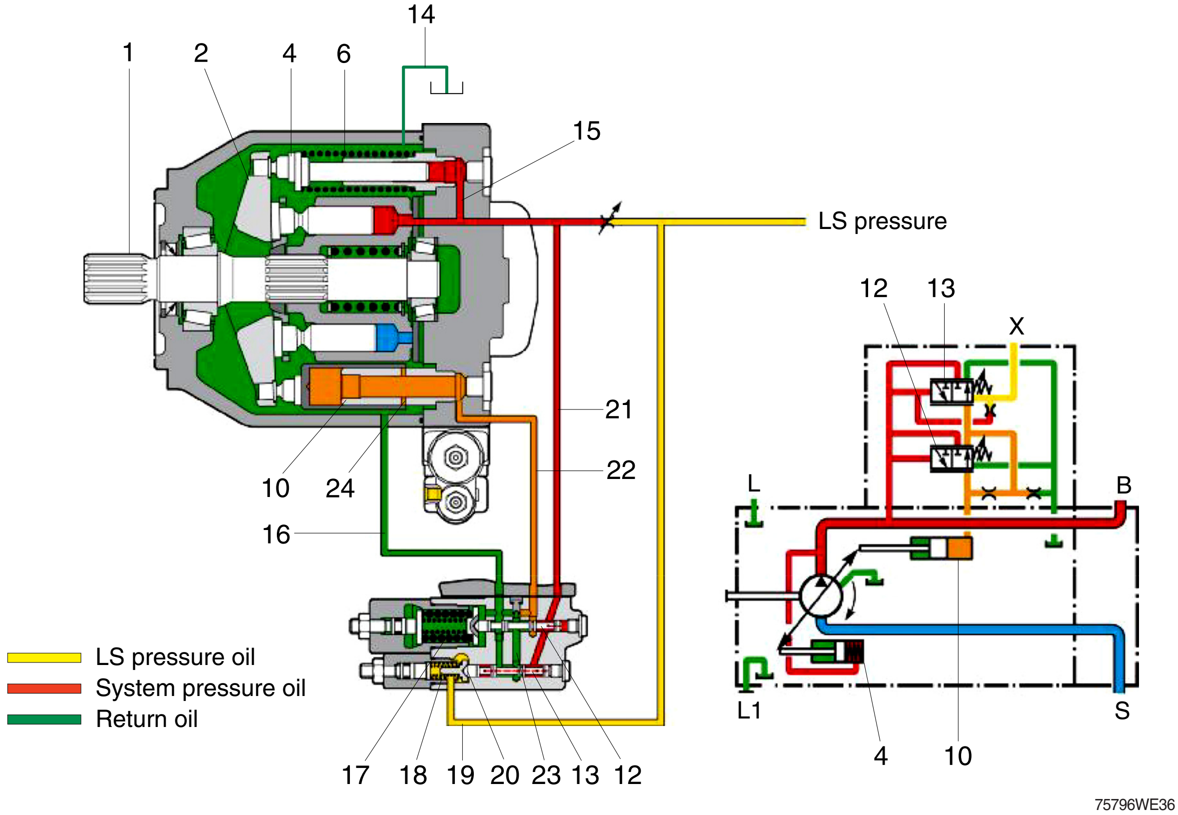
As this pressure increase, the pressure pushes flow compensator spool (13) against spring (18). This causes flow compensator spool (13) to move left. This opens passage (23) in order to allow pressure oil to flow to control piston (10).

The oil acts against control piston (10) in order to overcome the force of counter spring (6). The oil causes control piston (10) to move to the left.
When control piston (10) moves to the left, the piston moves swash plate (2) toward the minimum angle. Control piston (10) continues to move to the left until cross-drilled hole (24) allows the oil to drain to the case.

Cross-drilled hole (24) limits the maximum travel of control piston (10) to the left. The pump supplies a sufficient amount of flow that compensates for system leakage. The pump also supplies a sufficient of flow that compensates for leakage to the pump case. The leakage to the pump case is a result of the cross-drilled hole. The pump maintains low pressure standby. Low pressure standby pressure should not exceed 40 bar (580 psi).

※ Low pressure standby will vary in the same pump as the system leakage or the pump leakage increases. The pump will upstroke slightly in order to compensate for the increasing leakage. Control piston (10) will cover more of the cross-drilled hole.

(4) High pressure stall



1	Drive shaft	13	Flow compensator spool	19	LS line from the metering pump
2	Swash plate	14	Case drain	20	Cavity
4	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

When the hydraulic system stalls under load or when the cylinders reach the end of the stroke, the main system pressure increases. But LS pressure (19) is regulated by LS relief valve on steering system and loader system. The pressure difference between discharged pump and LS pressure equal to spring (18). It means no flow is necessary. Therefore, discharged pressure push flow compensator spool (13) left . Supply oil now flows past flow compensator spool (13) and through passage (23). The oil flows past flow compensator spool (13) and into passage (22). The oil then flows to control piston (10).

Pump swash plate (2) will be minimum displacement if the operator does not turn the steering wheel and RCV, then the pump will return to low pressure standby.

(5) Adjustment of flow control

Flow compensator setting must be carried out following procedures and conditions.

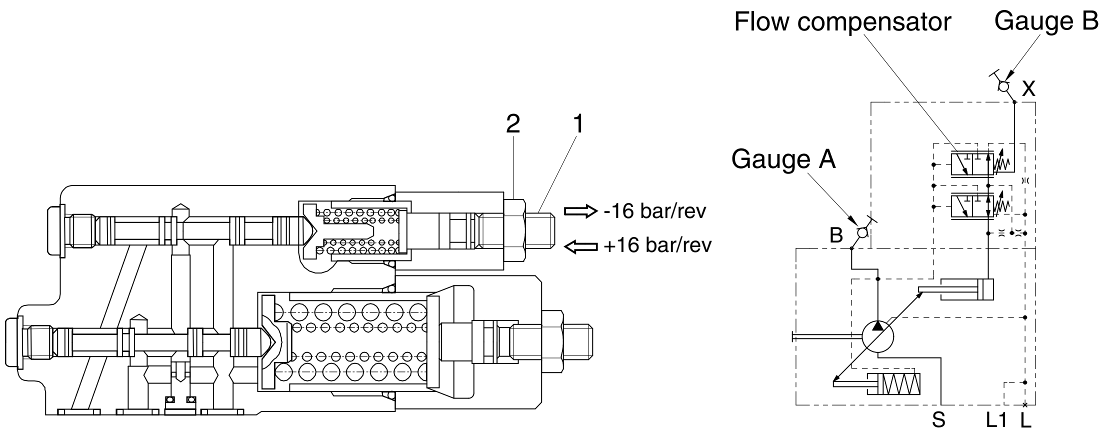
① Conditions

- 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 loosing the screw (1).
  - · Flow setting : ΔP = Gauge A - Gauge B
  - · Specification : 30 bar



75796WE37

(6) Adjustment of pressure control

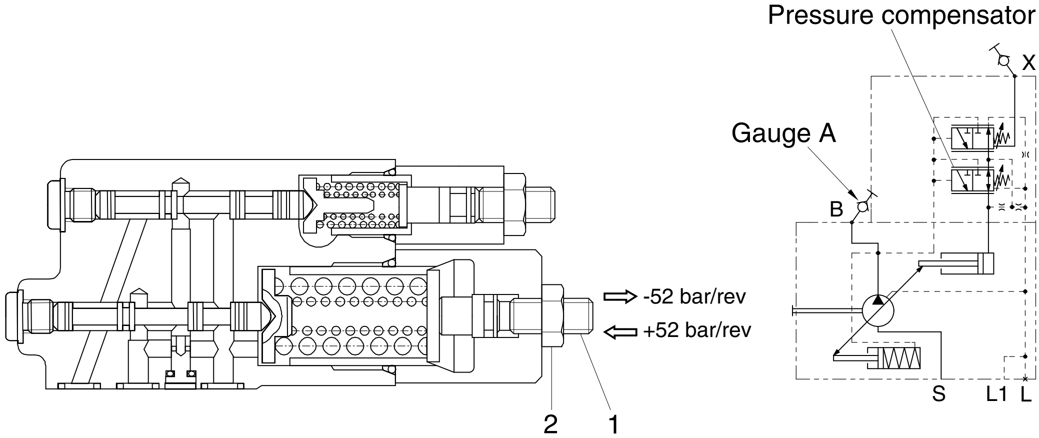
Pressure compensator setting must be carried out following procedures and conditions.

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 loosing the screw (1).
  - · Maximum pressure setting = Gauge A
  - · Specification : 300 bar



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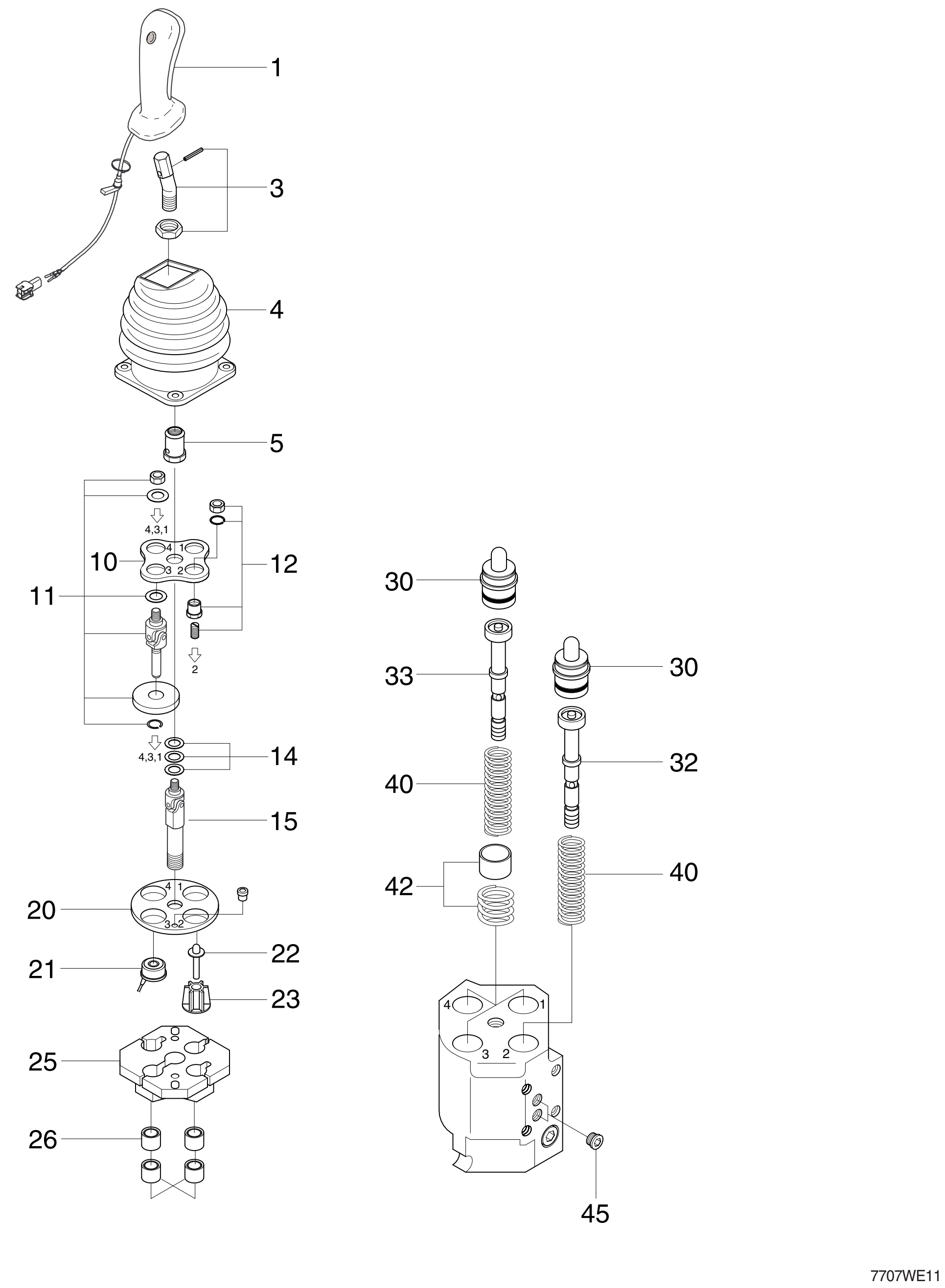
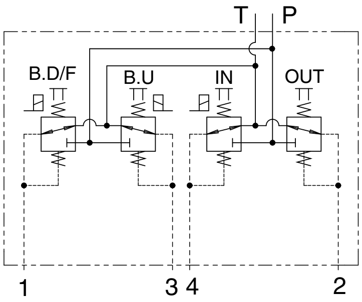
5. REMOTE CONTROL VALVE

1) STRUCTURE

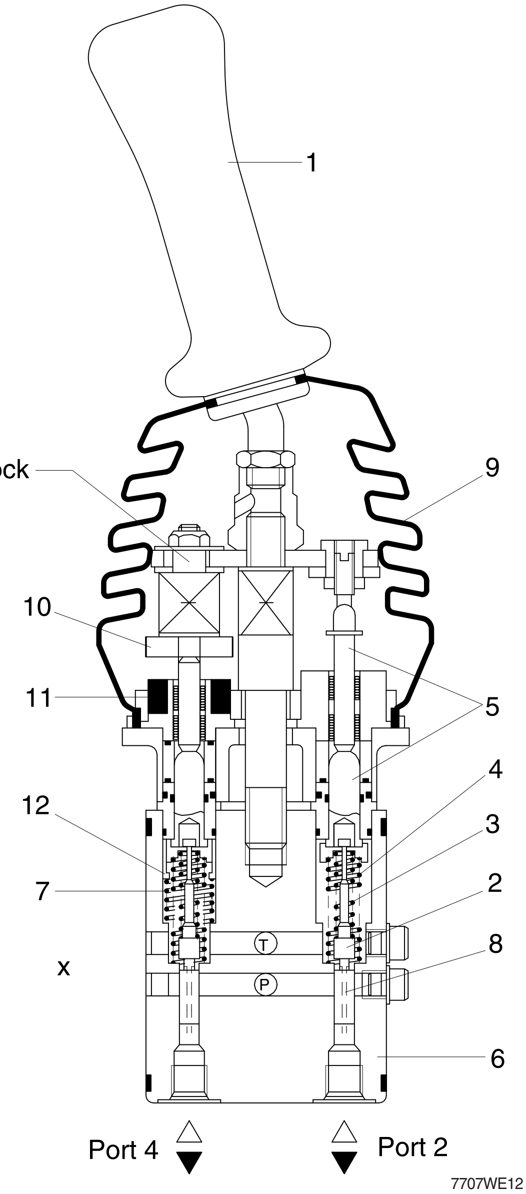


1	Handle	14	Shim set	26	Bushing kit
3	Lever kit	15	Joint	30	Plunger kit
4	Bellows	20	Flange	32	Regulating unit
5	Nut	21	Solenoid complete	33	Regulating unit
10	Bracket	22	Plunger kit	40	Spring set
11	Detent kit	23	Plunger guide	42	Prefeel point kit
12	Plunger kit	25	Electric bracket	45	Plug set

2) OPERATION



HYDRAULIC CIRCUIT
(3 Electromagnetic locks)



(1) Hydraulic functional principle

Pilot devices with end position locks operate as direct operated pressure reducing valves.

They basically comprise of control lever (1), four pressure reducing valves, housing (6) and locks.

Each pressure reducing valve comprises of a control spool (2), a control spring (3), a return spring (4) a plunger (5).

At rest, control lever (1) is held in its neutral position by return springs (4). Ports (1, 2, 3, 4) are connected to tank port T via drilling (8).

When control lever (1) is deflected, plunger (5) is pressed against return spring (4) and control spring (3).

Control spring (3) initially moves control spool (2) downwards and closes the connection between the relevant port and tank port T. At the same time the relevant port is connected to port P via drilling (8). The control phase starts as soon as control spool (2) finds its balance between the force from control spring (3) and the force, which results from the hydraulic pressure in the relevant port (ports 1, 2, 3 or 4).

Due to the interaction between control spool (2) and control spring (3) the pressure in the relevant port is proportional to the stroke of plunger (5) and hence to the position of control lever (1).

This pressure control which is dependent on the position of the control lever and the characteristics of the control spring permits the proportional hydraulic control of the main directional valves and high response valves for hydraulic pumps.

A rubber bellows (9) protects the mechanical components in the housing from contamination.

(2) End position lock

Only those control ports, for which it is necessary to hold the control lever in a deflected position are equipped with end position locks.

Electromagnetic lock

An additional spring (7), which is fitted below an additional plate (12) warns, by means of an increased force, which is required for compressing this spring, that the plunger (5) and the control lever (1) have almost reached their end position.

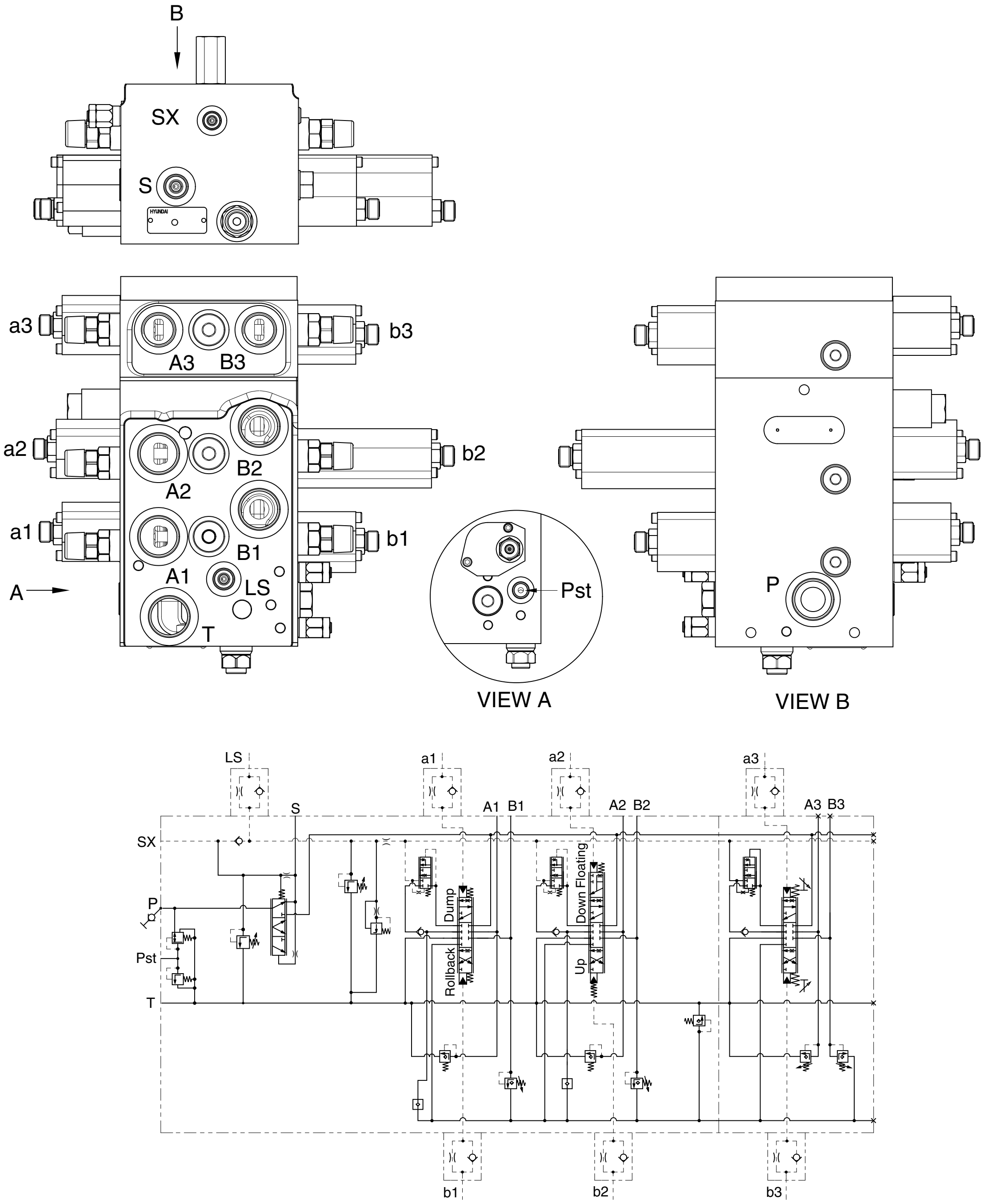
When this threshold is overcome, a ring (10) contacts the solenoid armature (11) ; if the solenoid is energized, then control lever (1) is held in its end position by magnetic force.

This lock is released automatically when the solenoid is deenergized.

6. MAIN CONTROL VALVE

1) STRUCTURE (1/3)

· Type : Closed center, Load pressure - Independent - Flow - Distribution

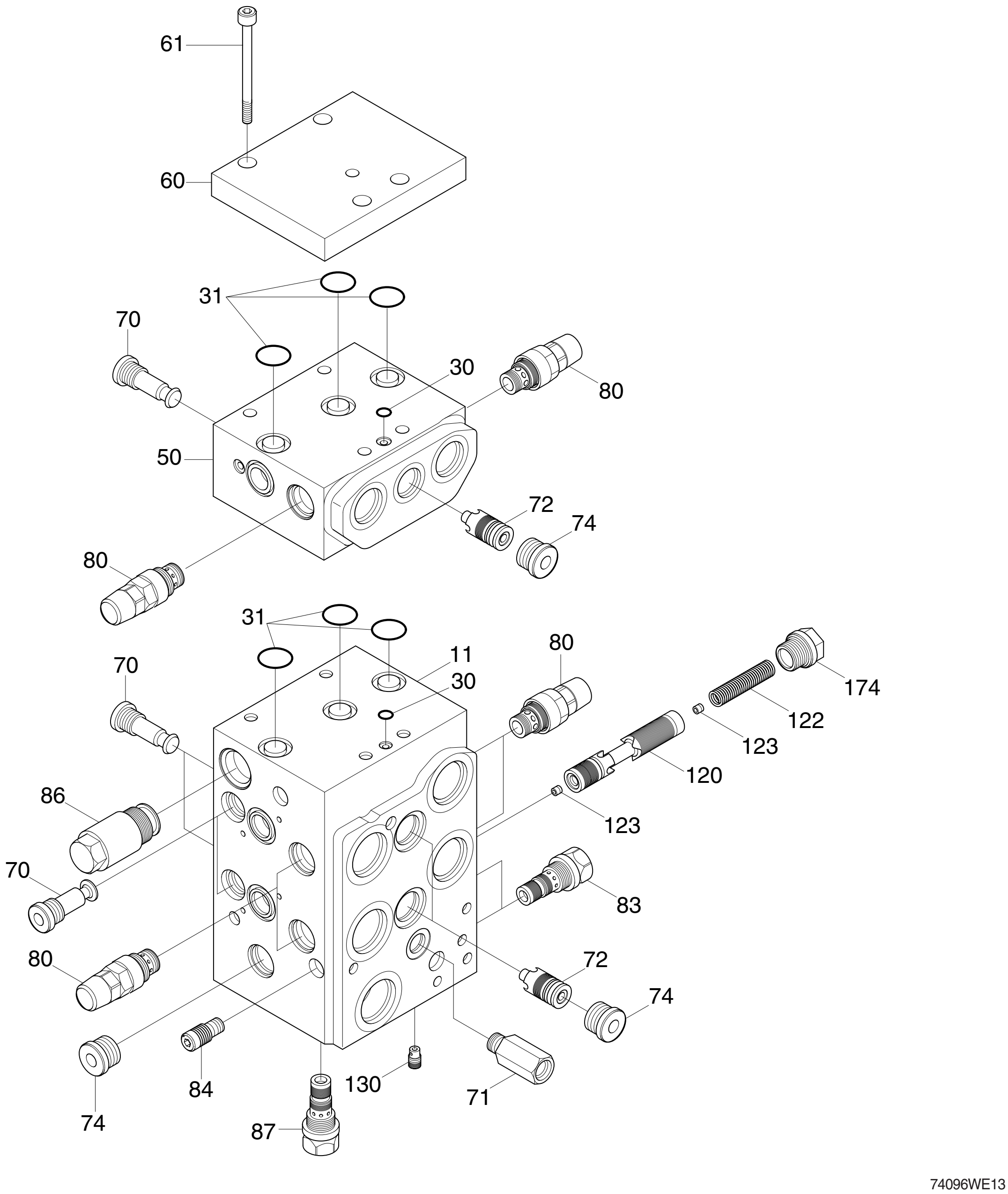


Hydraulic circuit

74096WE10

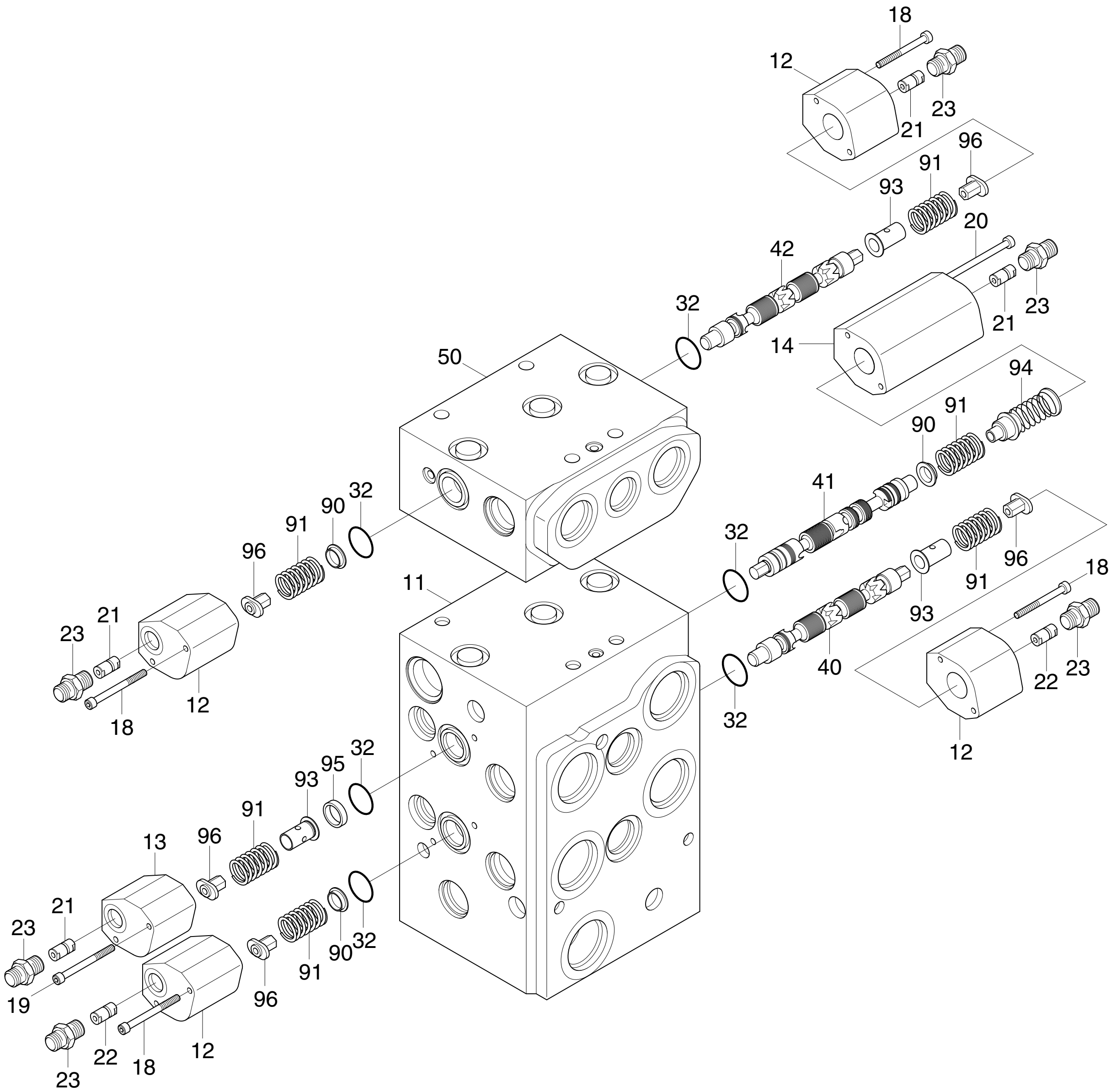
Port	Port name	Port size	Port	Port name	Port size
P	From main pump	1 5/16-12UN	a3, b3	Auxiliary pilot port	11/16-16UN
T	To hydraulic tank	1 5/16-12UN	LS	Load sensing port	9/16-18UNF
A1, B1	To bucket cylinder port	1 5/16-12UN	Pst	To RCV P port	9/16-18UNF
A2, B2	To boom cylinder port	1 5/16-12UN	SX	To steering unit LS port	9/16-18UNF
a1, b1	Bucket pilot port	11/16-16UN	S	To steering unit P port	7/8-14UNF
a2, b2	Boom pilot port	11/16-16UN	-	-	-

STRUCTURE (2/3)



11	Housing	71	Shuttle valve	87	Pressure reducing valve
30	O-ring	72	Spool	120	Spool
31	O-ring	74	Locking screw	122	Pressure spring
50	Housing	80	Pressure relief valve	123	Orifice
60	Plate	83	Pressure relief valve	130	Check valve
61	Cylinder screw	84	Flow control valve	174	Locking screw
70	Check valve	86	Counter balance valve		

STRUCTURE (3/3)



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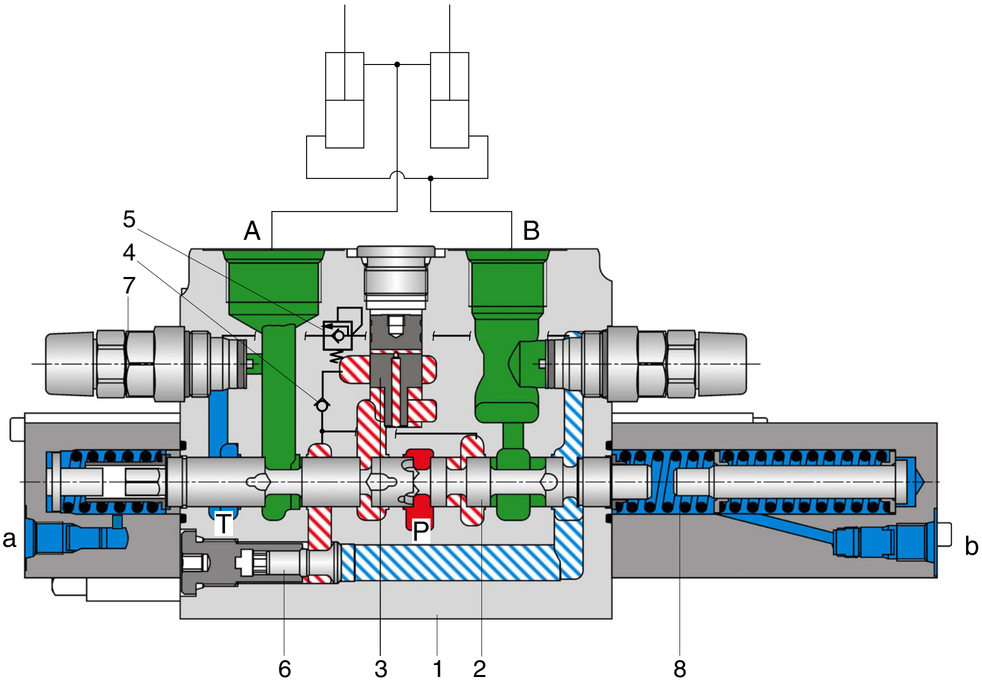
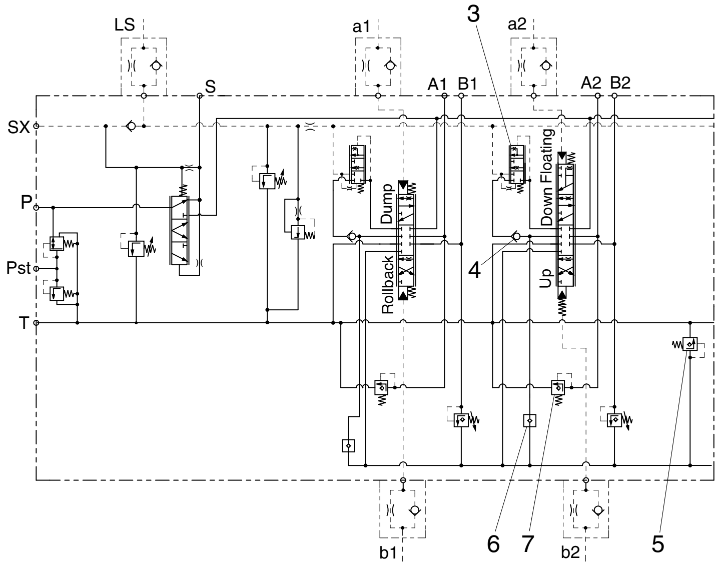
12	Cover	22	Throttle check valve	91	Compression spring
13	Cover	23	Threaded steel pipe fitting	93	Spring retainer
14	Cover	30	O-ring	94	Spring
18	Cylinder screw	40	Spool	95	Ring
19	Cylinder screw	41	Spool	96	Spring retainer
20	Cylinder screw	42	Spool		
21	Throttle check valve	90	Spring retainer		

2) FUNCTION





Hydraulic circuit

74096WE15

1 Housing
2 Spool
3 Pressure compensator
4 Loader holding valve
5 Counter balance valve
6 Regeneration check valve
7 Port relief valve
8 Spring chamber

(1) Control block
Proportional direction valve to the LUDV principle (Load pressure - Independent - Flow - Distribution)

(2) Actuator control
At the spool (2) the direction and volume of flow is determined that flows to the actuator connections (A or B).
The spring chambers (8) are supplied with pilot pressure either via the pilot connections a and b hydraulic control.
The value of the pilot pressure within the spring chamber (8) determines the stroke of the spool (2).

The pressure compensator (3) controls the pressure differential at the spool (2) and therefore, the flow to the actuators (A, B).

(3) Loader pressure compensation (LUDV)
The control block works to the LUDV principle. In this load - sensing version the pressure compensators (3) are located between the spool (2) and the actuator connections (A, B).

The highest load pressure of all of the actuators involved is applied to all of the pressure compensators. In parallel it is also applied to the pump.

If the pump flow is insufficient for all of the functions, then all work movements are reduced in speed by the same ratio.

(4) Loading holding
Within each function axis a load holding valve (4) is fitted between the pressure compensator (3) and the actuator connections.

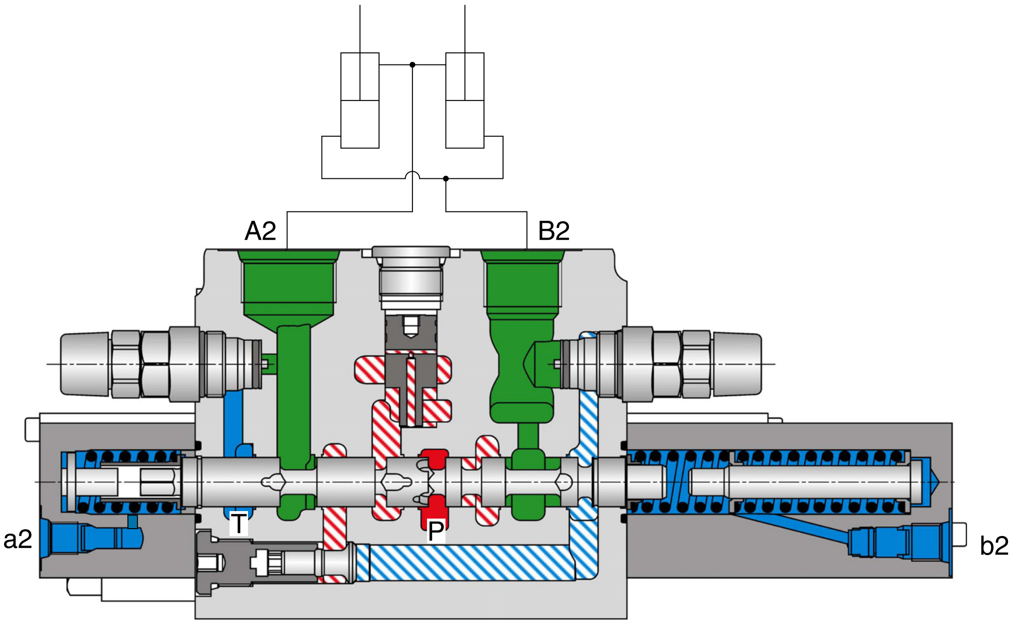
(5) Pressure safety, actuator connections
Large nominal size port relief valve (7) with combined anti-cavitation functions protect the actuators from overloads and cavitation.

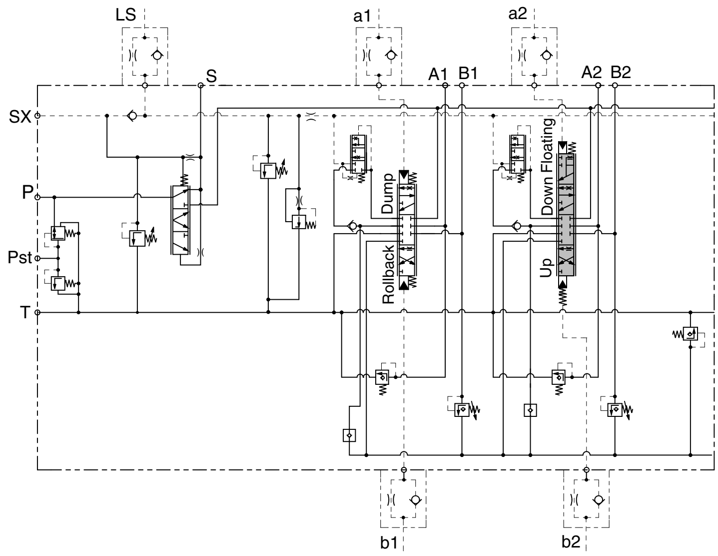
(6) Float position
The float position is obtained by means of a 4-position spool.

(7) Regeneration
To prevent cavitation, with negative loads (e. g. dump or lowering), the tank port is pre-loaded via counter balance valve (5) and is fed with oil via the regeneration check valve (6) downstream of the pressure compensator.

3) BOOM SECTION OPERATION

(1) Spool in neutral





Hydraulic circuit

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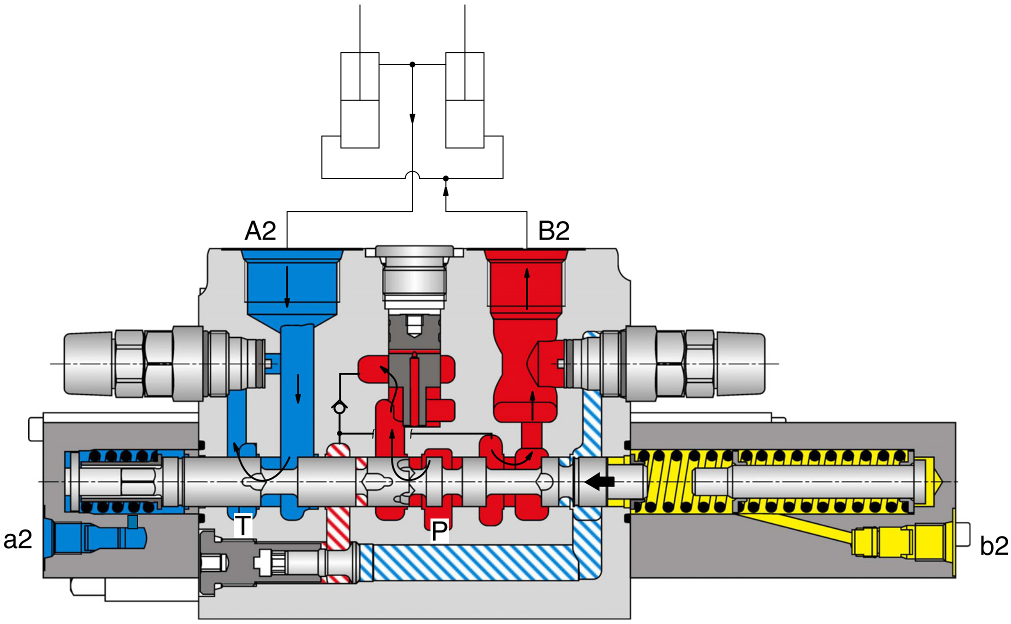
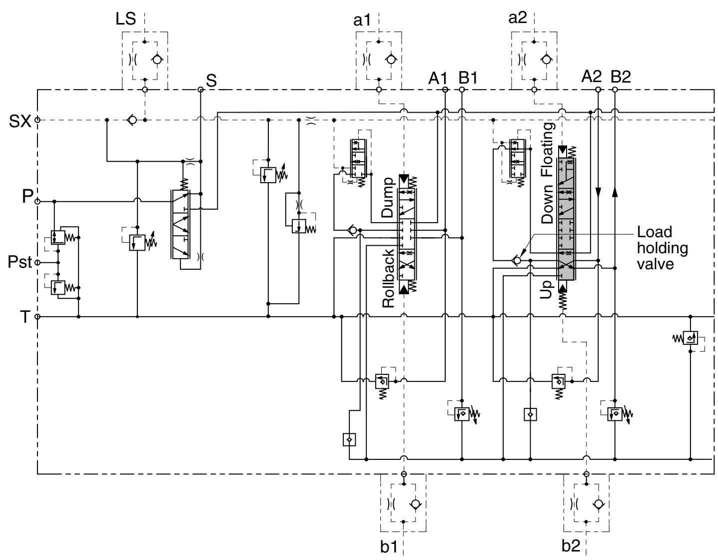
When the boom spool is in neutral position, oil from the pump will be blocked.
Then, the pumps are at low pressure stand by.

(2) Boom raise position





Hydraulic circuit

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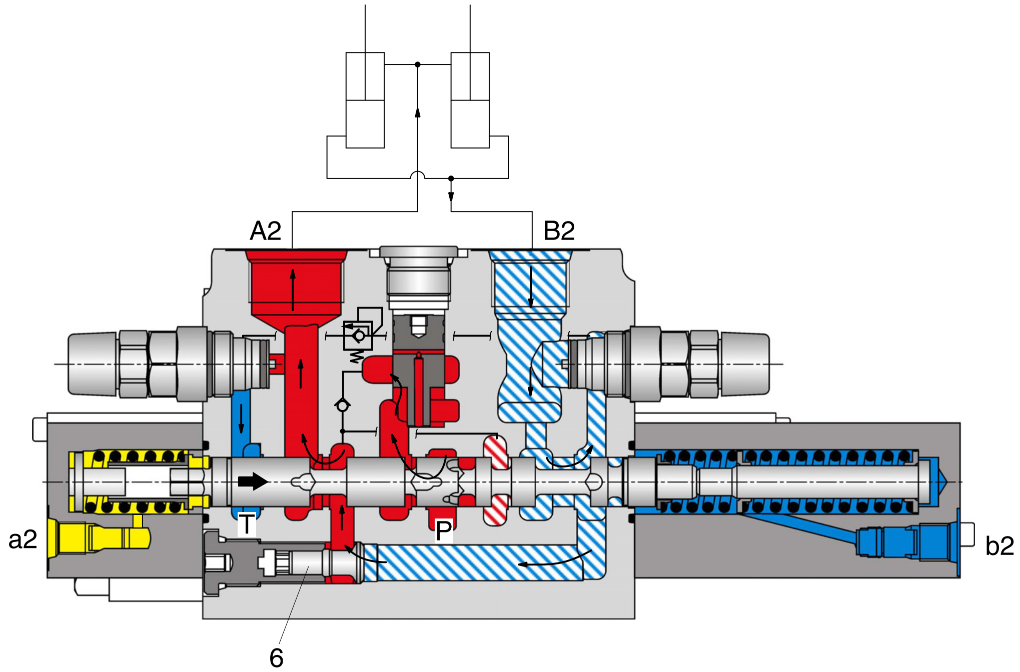
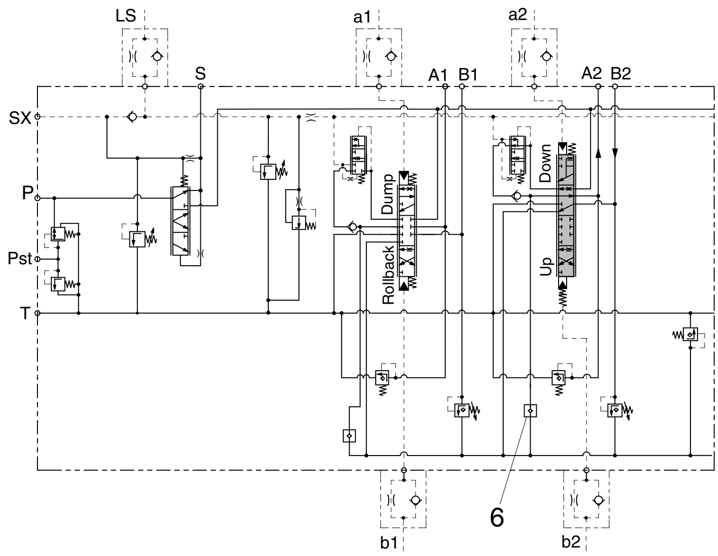
When the pilot pressure is led to the port b2, the boom spool moved to raise position.
Oil from the pump flows to the cylinder port B2 through the load holding valve and oil from the cylinder flows into the tank passage through the cylinder port A2.

※ Load holding valve
When the load pressure is higher than the pump pressure, the load holding valve shuts off the passage between the high pressure feed passage and the center bypass passage and prevents the reverse flow from the cylinder.

(3) Boom lower position



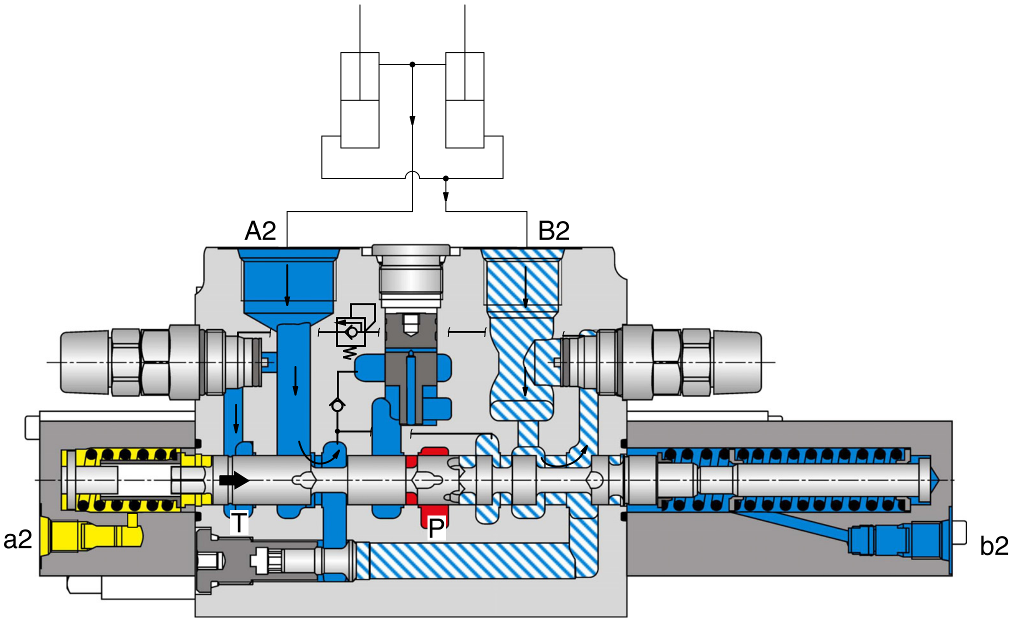


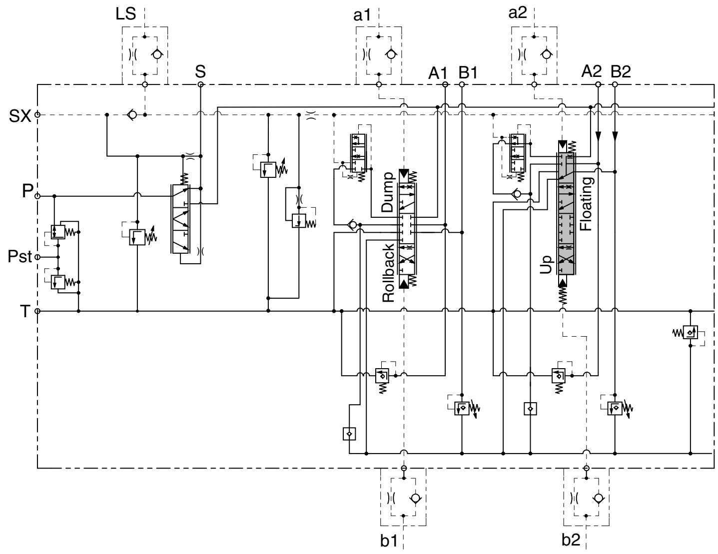
Hydraulic circuit

74096WE53

When the pilot pressure is led to the port a2, the boom spool moved to lower position.
Oil from the pump flows to the cylinder port A2, through the load holding valve and oil from the cylinder flows into the tank passage through the cylinder port B2.
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 regeneration check valve (6), 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.

(4) Boom float position





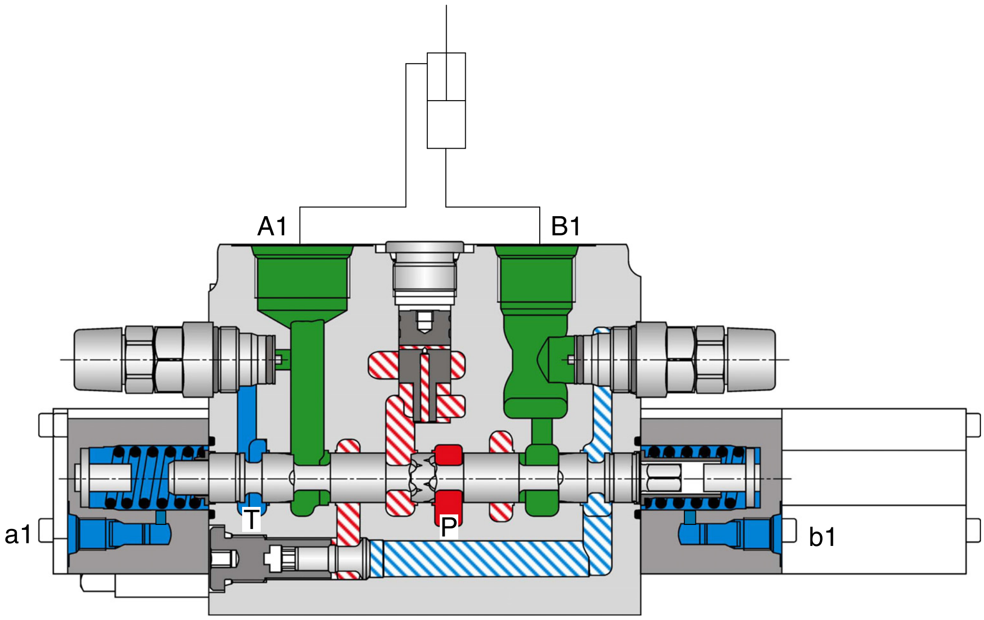
Hydraulic circuit

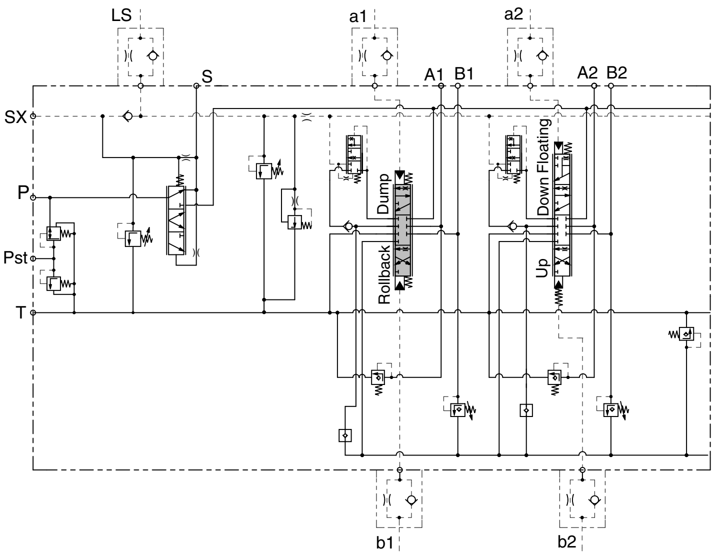
74096WE54

When the boom spool is located in float position, the oil from the pump will be blocked.
The cylinder ports (A2, B2) are connected to the tank passage, so the boom will be lowered due to it's own weight.

4) BUCKET SECTION OPERATION

(1) Spool in neutral



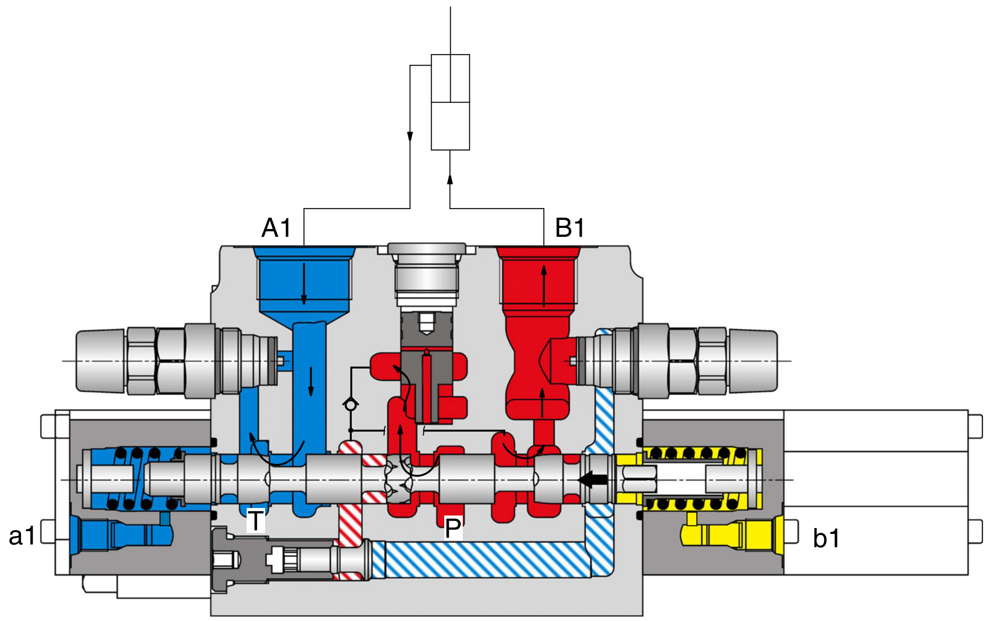


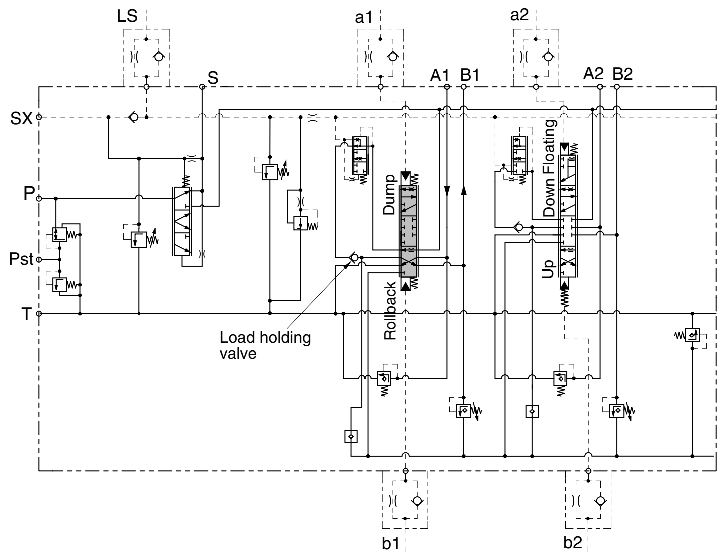
Hydraulic circuit

74096WE55

When the bucket spool is in neutral position, oil from the pump will be blocked. Then, the pumps are at low pressure standby.

(2) Bucket rollback position





Hydraulic circuit

74096WE56

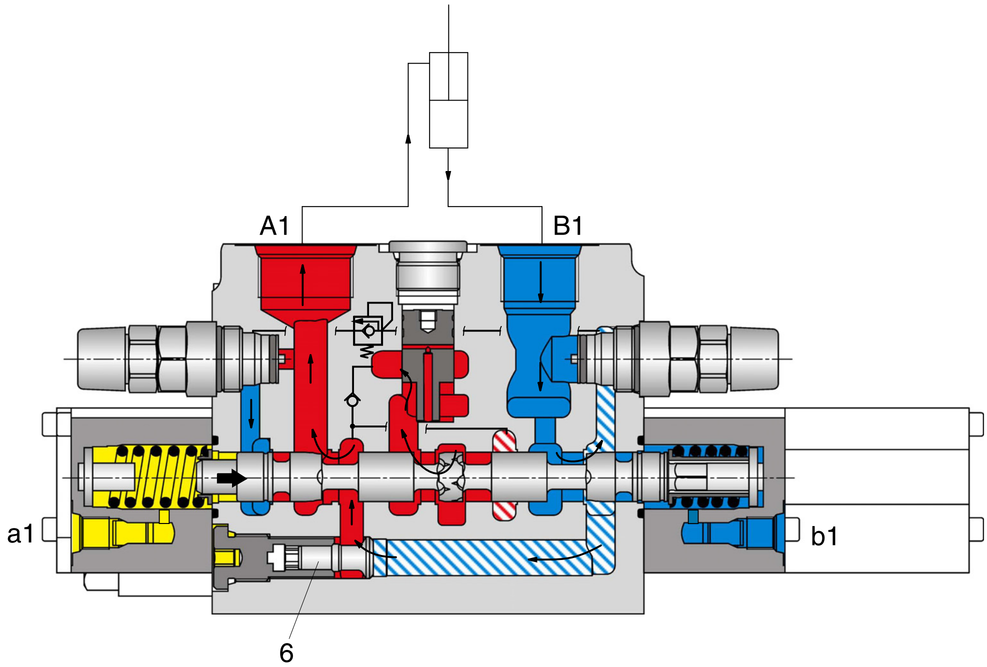
When the pilot pressure is led to the port b1, the bucket spool moved to rollback position.

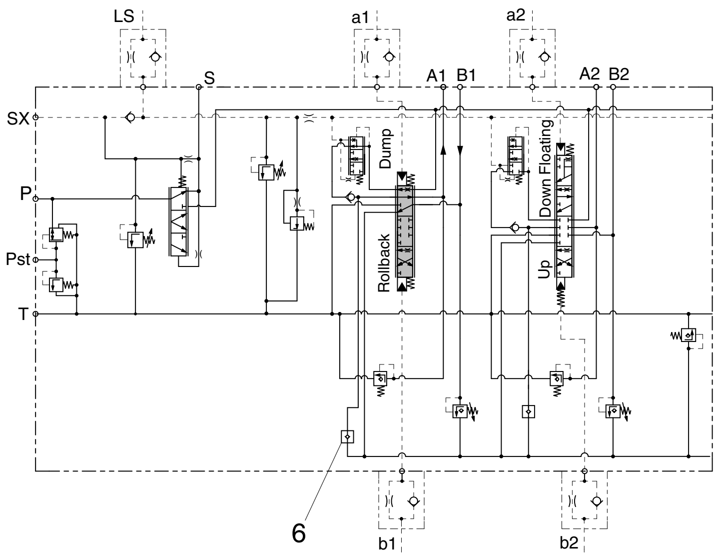
Oil from the pump flows to the cylinder port B1 through the load holding valve and oil from the cylinder flows into the tank passage through the cylinder port A1.

※ Load holding valve

When the load pressure is higher than the pump pressure, the load holding valve shuts off the passage between the high pressure feed passage and the center bypass passage and prevents the reverse flow from the cylinder.

(3) Bucket dump





Hydraulic circuit

74096WE57

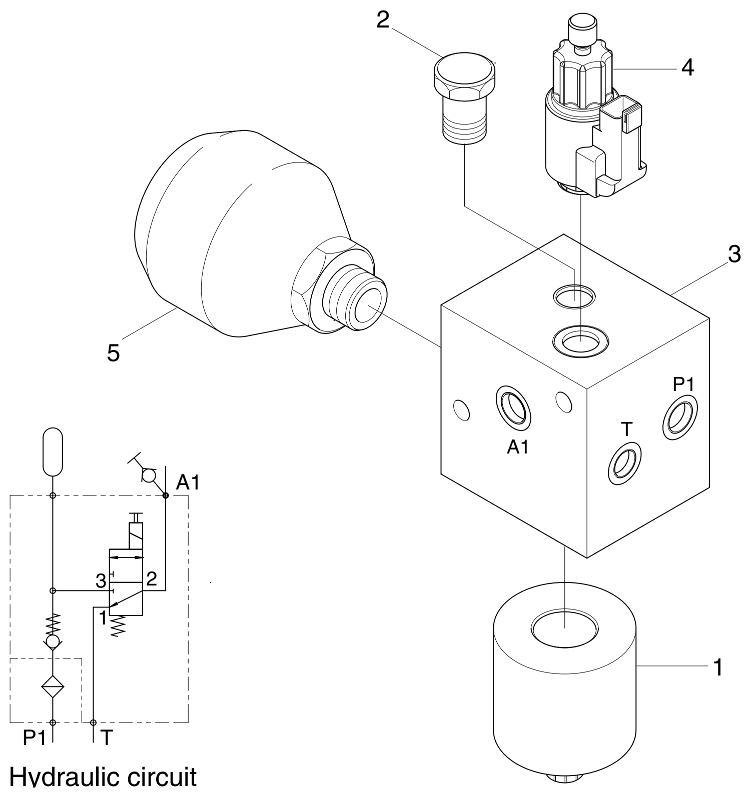
When the pilot pressure is led to the port a1, the bucket spool moved to dump position.

Oil from the pump flows to the cylinder port A1, through the load holding valve and oil from the cylinder flows into the tank passage through the cylinder port B1.

When the dumping speed of bucket is faster, the return oil from the large chamber of bucket cylinder combines with the oil from the pump through regeneration check valve (6), 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.

7. 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.

8. BOOM AND BUCKET CYLINDER

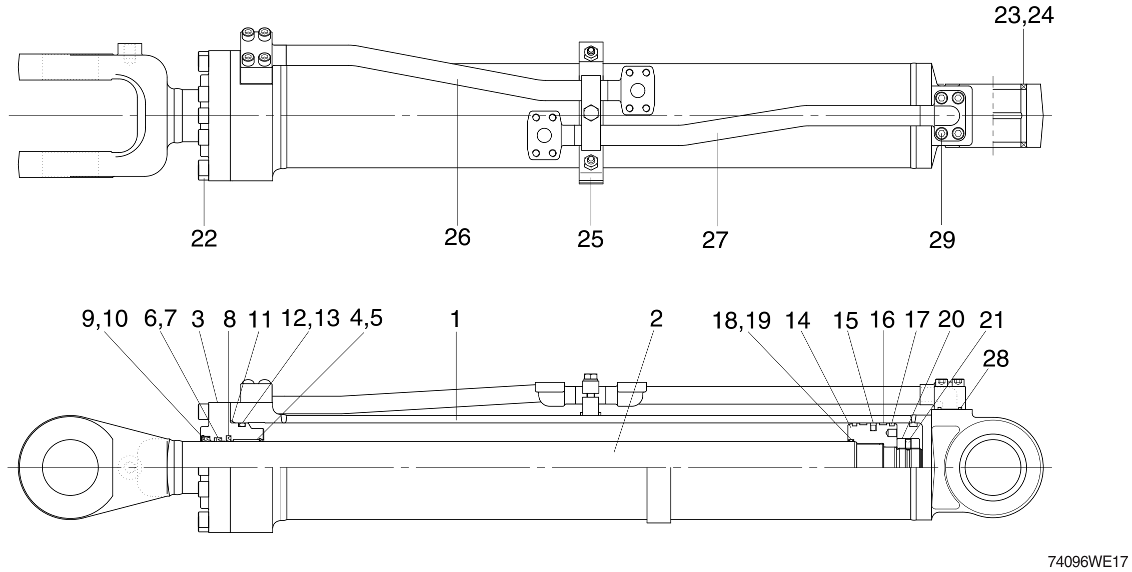
The boom cylinders are two unit and the bucket cylinder is one unit. They use a bolt on rod guide.

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.

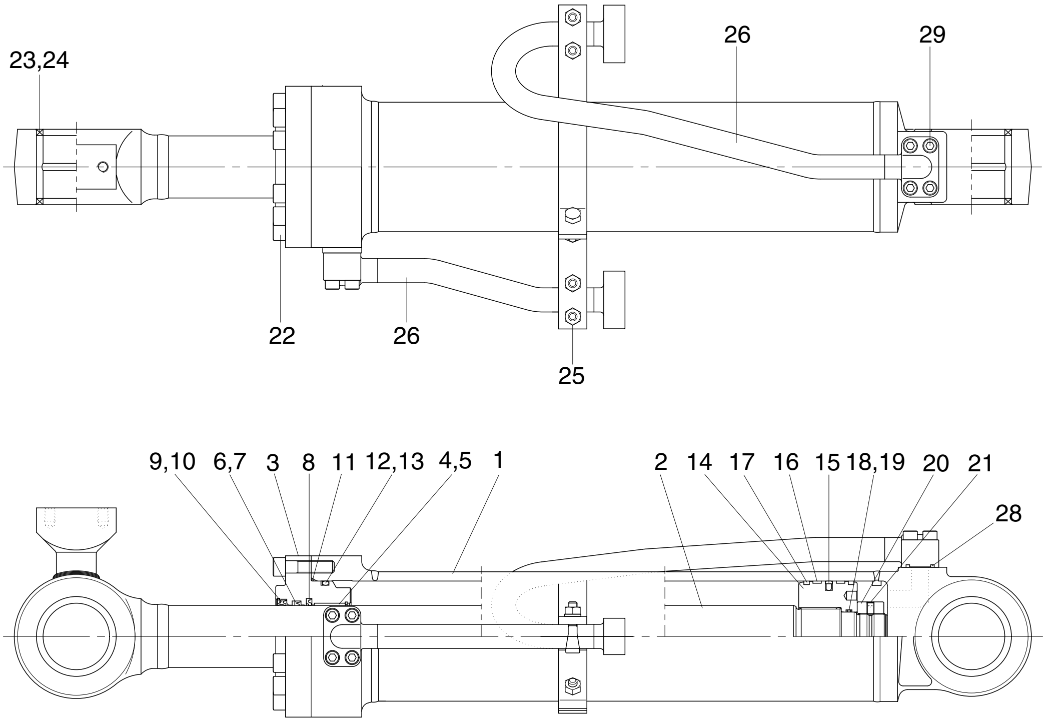
The gland (3, the rod guide) seals against the tube with an O-ring (12). The cylinder thread seals against the rod with a lip type buffer ring (8) and a rod seal (5). A dust wiper (9) cleans the rod when it is retracted.

1) BOOM CYLINDER



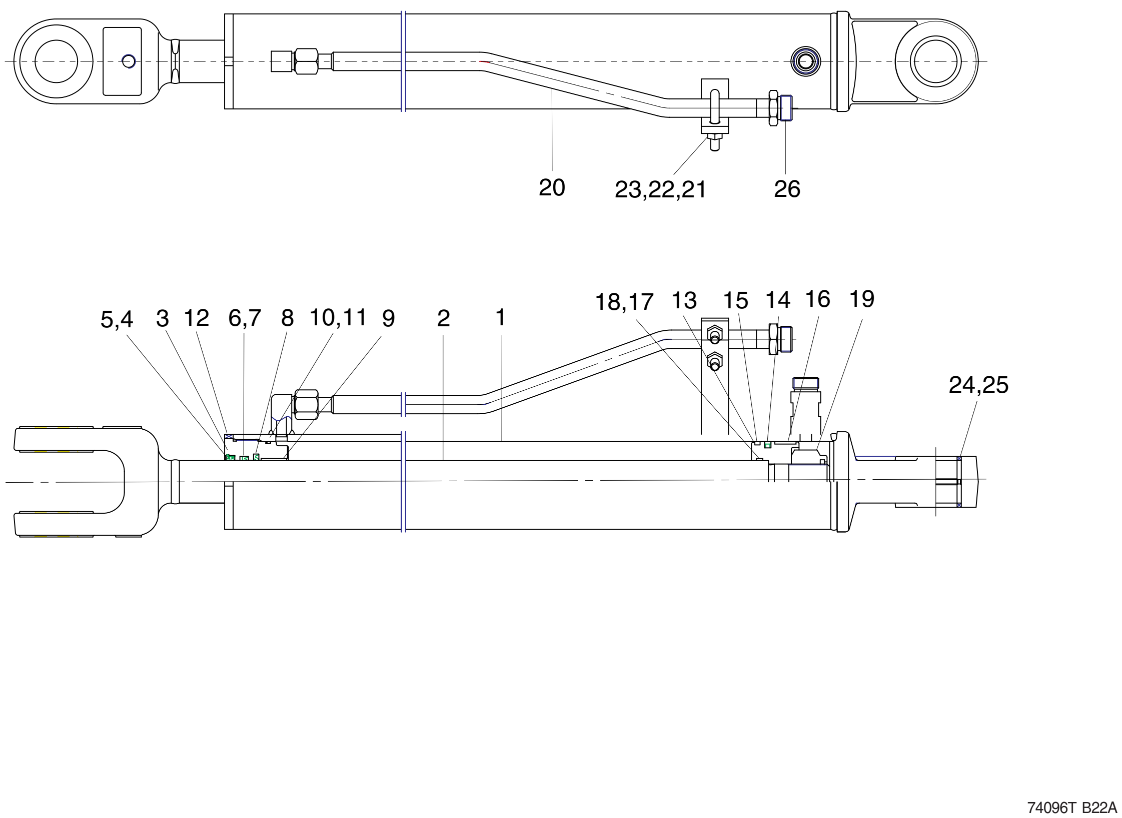
1	Tube assembly	11	O-ring	21	Set screw
2	Rod assembly	12	O-ring	22	Bolt
3	Gland	13	Back up ring	23	Bushing
4	Bushing	14	Piston	24	Dust seal
5	Snap ring	15	Piston seal	25	Band assembly
6	Rod seal	16	Wear ring	26	Pipe assembly
7	Back up ring	17	Dust ring	27	Pipe assembly
8	Buffer ring	18	O-ring	28	O-ring
9	Dust wiper	19	Back up ring	29	Bolt
10	Snap ring	20	Lock nut		

2) BUCKET CYLINDER (HL940)



1	Tube assembly	11	O-ring	21	Set screw
2	Rod assembly	12	O-ring	22	Bolt
3	Gland	13	Back up ring	23	Bushing
4	Bushing	14	Piston	24	Dust seal
5	Snap ring	15	Piston seal	25	Band assembly
6	Rod seal	16	Wear ring	26	Pipe assembly
7	Back up ring	17	Dust ring	27	Pipe assembly
8	Buffer ring	18	O-ring	28	O-ring
9	Dust wiper	19	Back up ring	29	Bolt
10	Snap ring	20	Lock nut		

3) **BUCKET CYLINDER** (HL940TM)

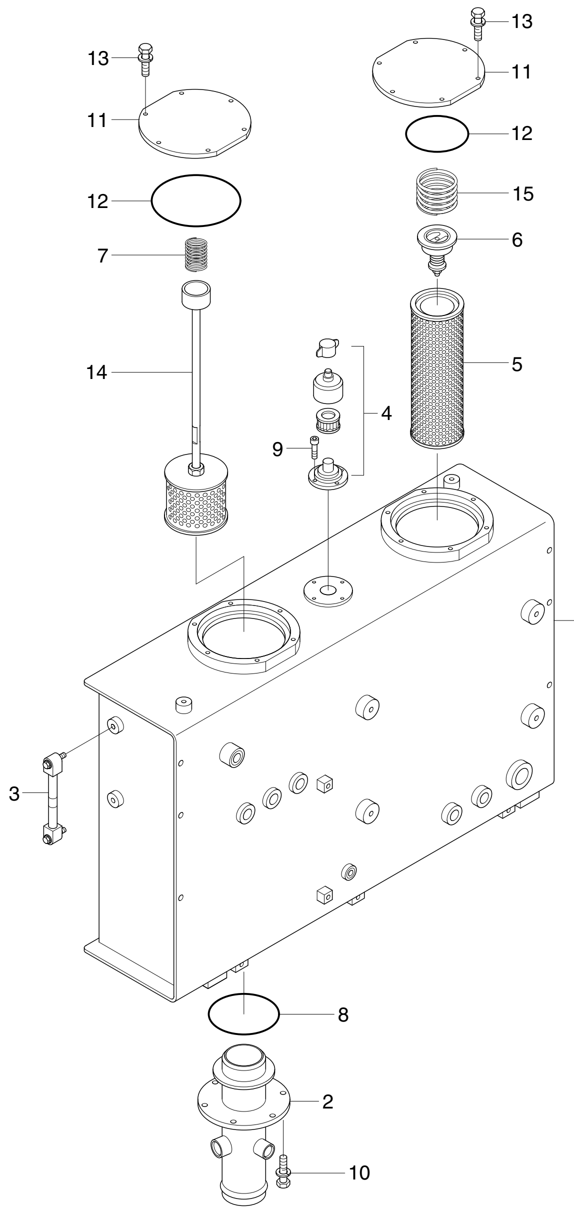


1	Tube assembly	11	Back up ring	21	U-bolt
2	Rod assembly	12	O-ring	22	Nut
3	Gland	13	Piston	23	Spring washer
4	Dust wiper	14	Piston seal	24	Pin bush
5	Retain ring	15	Dust ring	25	Dust seal
6	Rod seal	16	Wear ring	26	O-ring
7	Back up ring	17	O-ring		
8	Buffer ring	18	Back up ring		
9	Dry bearing	19	Nylon nut		
10	O-ring	20	Pipe assembly		

9. 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.



740F6WE23

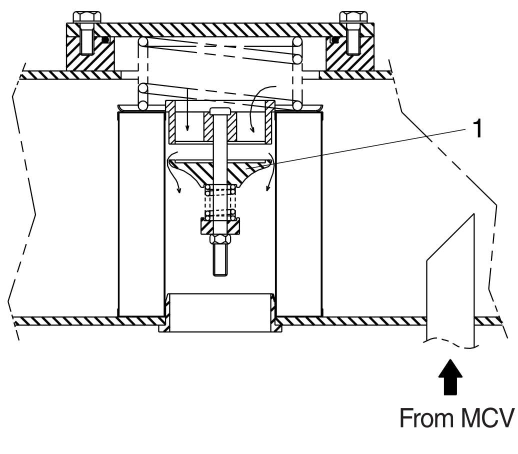
1	Hydraulic tank wa	6	Bypass valve	11	Cover
2	Pipe wa	7	Spring	12	O-ring
3	Sight gauge	8	O-ring	13	Bolt
4	Air breather	9	Socket bolt	14	Strainer
5	Element assembly	10	Bolt	15	Spring

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^2 (19.3 psi)



770-3ATM (6-33)

3) AIR BREATHER

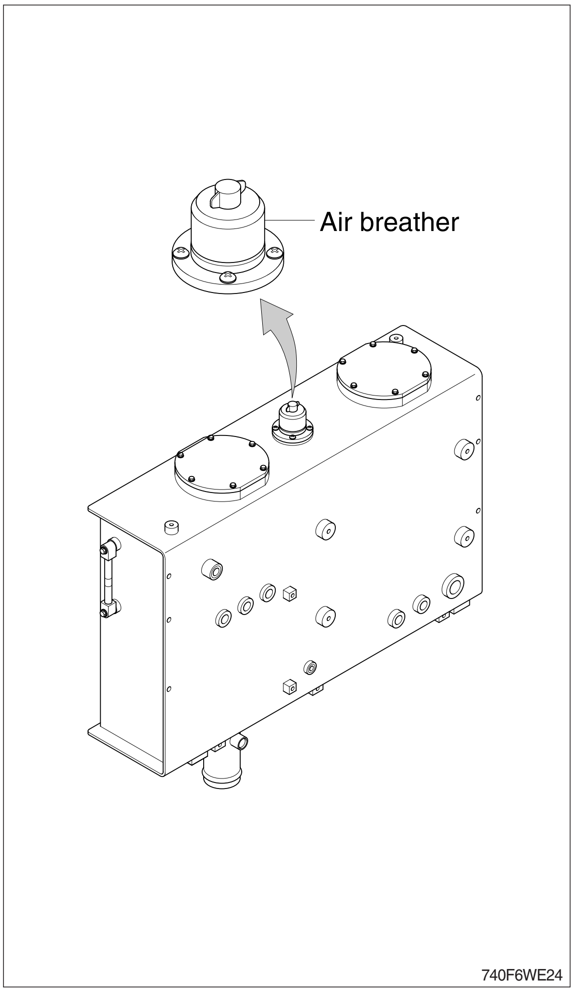
The air breather is equipped with the capacity to perform three functions simultaneously-as an air filter, breathing valve, and as a lubrication opening.

(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

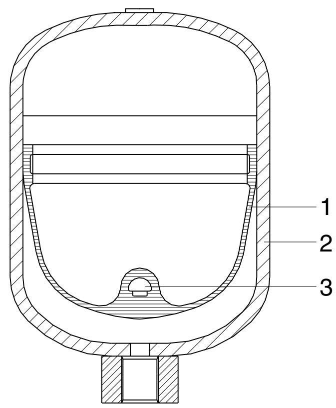
When the hydraulic cylinder is being used, the oil level in the hydraulic system increases and as temperature rises. If the hydraulic pressure rises above the set pressure, breather is actuated to release the hydraulic pressure inside the tank.



10. 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_2)
Volume of gas	0.75 l (0.2 U.S.gal)
Charging pressure of gas	16 kg/cm^2 (228 psi)
Max actuating pressure	128 kg/m^2 (1820 psi)



1 Diaphragm
2 Steel pressure vessel
3 Closure button

7803AWE56

11. 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.)

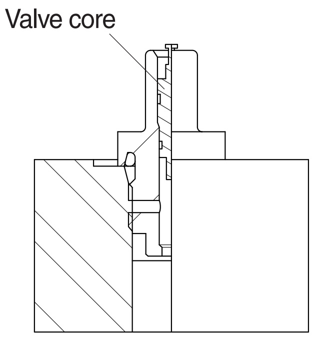
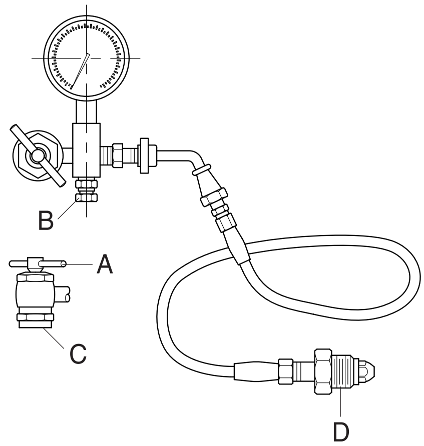


Figure 1

WLACC01



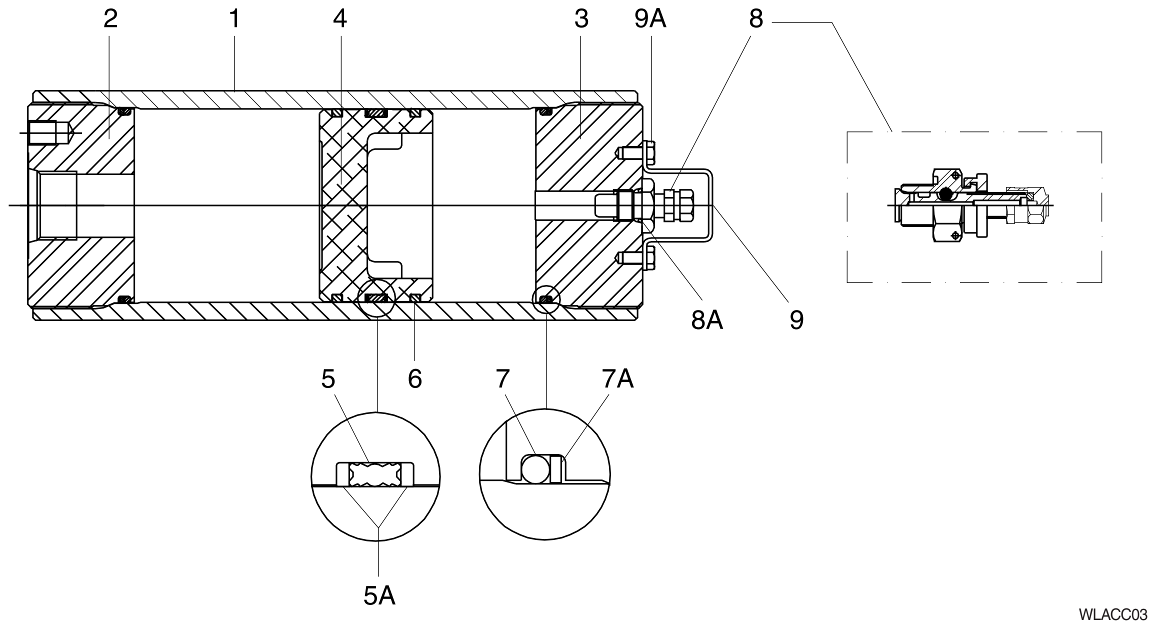
Charging and gauging kit (31LM-90100)

WLACC02

(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



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		

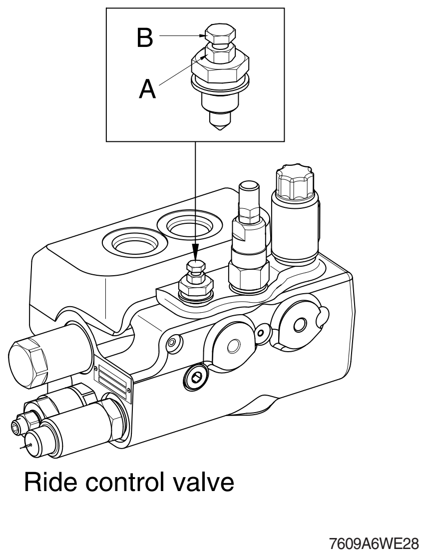
2) REMOVE FROM HYDRAULIC SYSTEM

⚠ Attention

1) Before carrying out any maintenance work the accumulators must be unloaded (zero pressure).
2) For this, loosen the nut (4) and bolt (B) counterclockwise with 10 mm spanner.

※ The accumulator will be unloaded (zero pressure) in less than a minute.

3) The lifting system must firstly be secured against lowering.
4) After carrying out maintenance work, screw the bolt (B) and nut (A).
   · Tightening torque
     A : 2.04 kgf · m (14.8 lbf · ft)



Ride control valve

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.

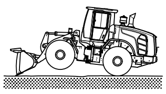
The engine and all other major components must be at operating temperature for some checks.

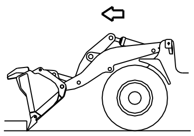
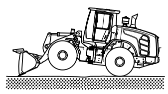
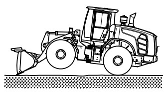
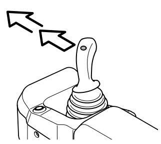
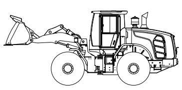
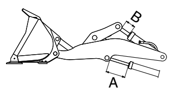
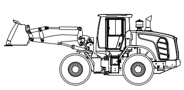
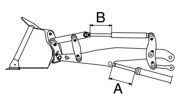
Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

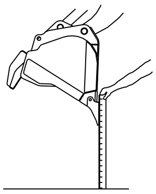
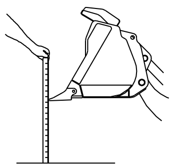
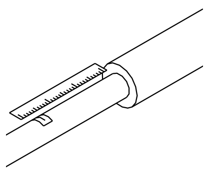
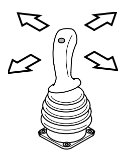
At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be given repair required and group location.
If verification is needed, you will be given next best source of information:

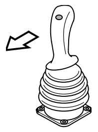
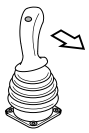
- Chapter 2 : Troubleshooting
- Group 3 : Tests and adjustments

※ Hydraulic oil must be at operating temperature for these checks (refer to page 6-58).

Item		Description	Service action
Hydraulic system warm-up procedure Run engine at high idle. Refer to page 6-58.		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. **FEEL** : Hydraulic reservoir must be uncomfortable to hold your hand against. (approximately 40 ~50˚C)	**OK** Check completed.
Hydraulic pump performance check 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. **LOOK** : Boom must raise to full height in less than 7 seconds.	**OK** Check completed. **NOT OK** Go to priority valve (in main control valve) high pressure check at page 5-21. **IF OK** Do steering system leakage check at page 5-19. **IF OK** Do main hydraulic pump flow test at page 6-59.
Control valve lift check 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. **LOOK** : Boom must not raise before moving down. Bucket must not rollback before dumping.	**OK** Check complete. **NOT OK** Repair lift checks in loader control valve.

Item	Description	Service action
Bucket rollback circuit relief valve check	 Position bucket at a 45˚ angle against an immovable object. Engage transmission in 3rd speed forward. **LOOK** : Bucket angle must not change.	**OK** Check complete. **NOT OK** Replace boom lower check valve.
Bucket dump circuit relief valve low pressure check	 Raise front of machine which bucket at 45˚ angle. Backdrag with bucket while observing bucket angle. **LOOK** : Bucket must not rollback	**OK** Go to next check. **NOT OK** Do loader system and circuit relief valve test at page 6-60.
Pilot control valve float check Run engine at low idle.	  With the bucket partially dumped, lower boom to raise front of machine. Push control lever to the float detent position and release lever. **LOOK** : Front of machine lower to the ground and valve must remain in float position when lever is released.	**OK** Check complete. **NOT OK** Do pilot control valve pressure test in group 3.
Boom cylinder and bucket cylinder drift check Heat hydraulic oil to operating temperature.	    Set the boom and bucket horizontal, then stop the engine. Stop the engine, wait for 5 minutes, then start measuring. Measure the amount the lift and dump cylinder rods retract during 5 minutes. (unloaded bucket) A : Retraction of boom cylinder rod B : Retraction of bucket cylinder rod Boom cylinder must drift less than 8 mm Bucket cylinder must drift less than 13mm (★15mm)	**OK** Check complete. **NOT OK** Go to next check. ★HL940TM

Item	Description	Service action
Boom cylinder leakage check Heat hydraulic oil to operating temperature.	 Dump bucket until teeth or cutting edge is perpendicular to the ground. Raise boom until cutting edge is about 1 m (3 ft) above ground. Stop engine. Measure drift from tooth or cutting edge to ground for 1 minute. Wait 10 minutes. Measure drift from tooth or cutting edge to ground for 1 minute. **LOOK** : Compare the drift rate between the first measurement and the second measurement.	**OK** Drift is approximately the same between first and second measurement. Repair loader control valve or circuit relief valve. **NOT OK** If drift is considerably less on second measurement, repair cylinder.
Bucket cylinder leakage check Heat hydraulic oil to operating temperature.	 Raise bucket about 1 m (3 ft) off ground with bucket level. Stop engine. Place a support under boom. Measure drift from tooth or cutting edge to ground for 1 minute. Wait 10 minutes. Measure drift from tooth or cutting edge to ground for 1 minute. **LOOK** : Compare the drift rates between the first measurement and the second measurement.	**OK** Drift is approximately the same between first and second measurement. Repair loader control valve or circuit relief valve at page 6-60. **NOT OK** Drift is considerably less on second measurement. Repair cylinder.
Check valve of safety valve leakage check Heat hydraulic oil to operating temperature.	 Put bucket level and position about 1.2 m (4 ft) above ground. Place a piece of tape on cylinder rod at least 51 mm (2 in) from rod guide. Run engine at low idle in safety-release position. **LOOK** : Bucket must not drift up.	**OK** Check complete. **NOT OK** Check or replace safety valve.
Pilot control valve (RCV lever) check	 Stop engine. Turn key switch to OFF position. Move control lever to all positions and then release. **LOOK** : Lever must return to neutral when released from all positions.	**OK** Check completed. **NOT OK** Repair pilot control valve.

Item	Description		Service action
Bucket leveler (positioner) check Run engine at low idle.		Position bucket fully dumped just above ground level. Move control lever to bucket leveler detent position and release. **LOOK** : 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.	**OK** Check complete. **NOT OK** Do bucket leveler checks.
Boom height kickout check Run engine at low idle.		Position bucket flat on ground. Move control lever to boom raise detent position and release. **LOOK** : Boom must raise to the set height and stop. Control lever must return to neutral.	**OK** Check complete. **NOT OK** Do boom height kickout check.
Cycle time check Heat hydraulic oil to operating temperature. Run engine at high idle.	Function	Operating condition.	Maximum cycle time
	Boom raise	Bucket flat on ground to full height.	5.5 sec
	Boom lower	Full height to level ground.	3.0 sec
	Bucket dump	Boom at full height.	1.1 sec (★1.6sec)
	Bucket rollback	Boom at full height.	1.8 sec (★2.3sec)
	Steering [No. of turns]	Frame stop to frame stop.	3.9 turns ★ : HL940TM **OK** Check complete. **NOT OK** 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

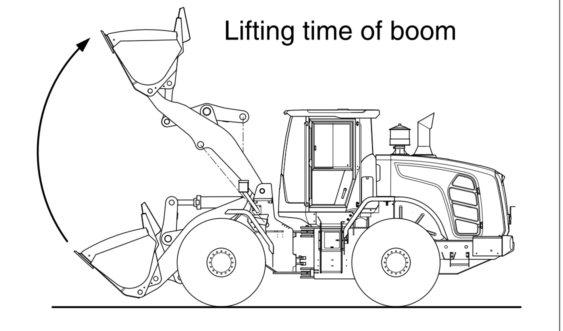
2) MEASURING TOOL

· 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.



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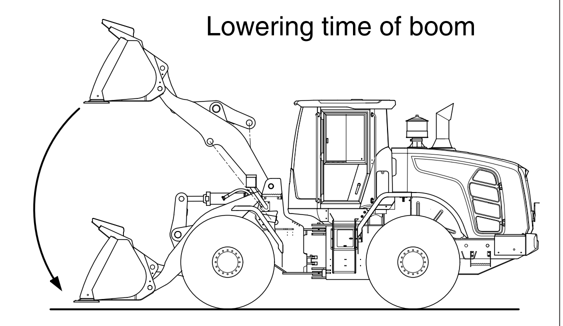
(2) LOWERING TIME OF BOOM

Set the bucket horizontal with the boom at the maximum height, lower the bucket and measure the taken for the bucket to reach the lowest position on the ground.



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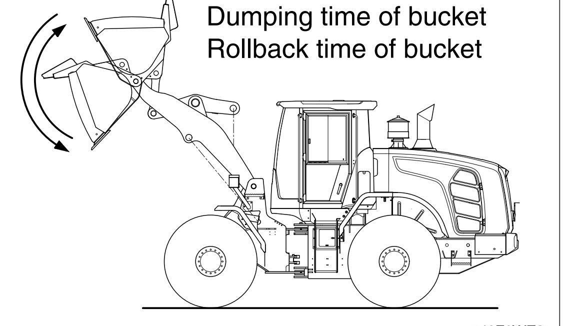
(3) DUMPING TIME OF BUCKET

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.



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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
Noisy hydraulic pump	Low oil supply or wrong viscosity.	Fill reservoir with recommended oil.
	Plugged or pinched suction line.	Clean or replace line.
	Air in oil.	Check for foamy oil. Tighten connections. Replace O-rings and or lines.
	Plugged suction strainer.	Inspect and clean strainer in reservoir.
	Loose or missing hydraulic line clamps.	Tighten or replace clamps.
	Hydraulic lines in contract with frame.	Inspect and repair.
	Worn or damaged pump.	Do hydraulic pump performance check in group 2. Do hydraulic pump flow test in group 3.
No or Slow hydraulic functions	Failed or worn hydrualic pump.	Do performance check.
	Cold oil.	Warm oil up.
	Slow engine speed.	Adjust engine speed. Check high idle speed.
	Suction line air leak.	Check for foamy oil.
	Low oil supply.	Add recommended oil.
	Wrong oil viscosity.	Use recommended oil.
	Oil leaking past cylinders or control valve.	Check cylinder drift in group 2.
	Blocked or damaged line.	Inspect lines.
	Faulty pilot control valve (RCV).	Do pilot control valve (RCV) pressure test in group 3.
	Binding loader control valve (MCV) spool.	Inspect valve.
	Faulty steering unit.	Check steering unit specification.

Problem	Cause	Remedy
No steering or hydraulic function	Low oil level.	Add recommended oil.
	Failed hydraulic pump.	Remove and inspect return filter for metal pump particles.
No hydraulic functions steering normal	Failed hydraulic pump.	Remove and inspect return filter for metal pump particles, or replace the pump.
	Failed line filter.	Remove and inspect line filter for RCV.
	Faulty safety valve.	Safety valve leakage test or ON, OFF function test.
	Stuck open port relief valve.	Replace relief valve.
Boom float function does not work	Low pilot control pressure.	Do pressure reducing valve pressure test in group 3.
	Faulty pilot control valve (RCV).	Replace relief valve.
	Loader control valve (MCV) spool binding in bore.	Do pressure reducing valve pressure test in group 3.
One hydraulic function does not work.	Faulty pilot control valve (RCV).	Do pilot control valve pressure test. Inspect and repair valve.
	Stuck open port relief valve.	Replace relief valve.
	Oil leaking past cylinder packings.	Do boom and bucket cylinder leakage test in group 3.
	Blockage in oil lines or valve.	Inspect lines for damage. Disconnect and inspect lines for internal blockage.
	Loader control valve (MCV) spool stuck in bore.	Inspect and repair valve.
Low hydraulic power	Leakage within work circuit.	Do cylinder drift check in group 2.
	Low system relief valve (main relief valve) setting.	Do loader system and port relief valve pressure test in group 3.
	Low port relief valve setting.	Do loader system and port relief valve pressure test in group 3.
	Leaking system relief valve.	Remove and inspect valve.
	Worn hydraulic pump.	Do hydraulic pump performance check in group 2.
	Faulty pilot control valve (RCV).	Do pilot control valve pressure test in group 3.

Problem	Cause	Remedy
Function drifts down	Leaking cylinders.	Do cylinder leakage checks in group 3.
	Leaking seals in circuit relief valve (port relief valve) or valve stuck open.	Inspect seals. Replace relief valve.
	Leaking loader control valve (MCV).	Repair or replace valve section.
Boom drifts up	Leakage in boom down spool.	Remove and inspect boom down spool.
Boom down does not work (engine off)	Safety valve not operated.	Operate valve.
	Stuck pilot control valve.	Inspect.
	Faulty line filter.	Remove and inspect filter.
	Accumulation not operated.	Inspect.
	MCV spool stuck.	Inspect and repair valve.
Oil overheats	Low oil viscosity in hot weather.	Use recommended oil.
	Excessive load.	Reduce load.
	Holding hydraulic system over relief.	Reduce load.
	Leakage in work circuit.	Do boom and bucket cylinder leakage test in group 3.
	Plugged fins in oil cooler.	Inspect and clean oil cooler.
	Internally plugged oil cooler.	Do hydraulic oil cooler restriction test.
	Incorrect system or circuit relief valve setting.	Do loader system and circuit relief valve pressure test in group 3.
	Restriction in oil lines or loader control valve (MCV).	Inspect for dented or kinked lines.
	Malfunctioning steering valve.	Do hydraulic system restriction test in group 3.
	Leaking system main relief valve.	Do hydraulic system restriction test in group 3. Remove and inspect valve and seals.
	Worn hydraulic pump (internal leakage).	Do hydraulic pump performance check in group 2.
Function drops before raising when valve is activated	Stuck open lift check valve.	Do control valve lift check in group 2.
Hydraulic oil foams	Low oil level.	Add recommended oil.
	Wrong oil.	Change to recommended oil.
	Water in oil.	Change oil.
	Loose or faulty suction lines (air leak in system).	Tighten or install new lines.
Remote control valve (RCV) leaking	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 1-25, **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 : 130 *l* (34.3 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 through 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

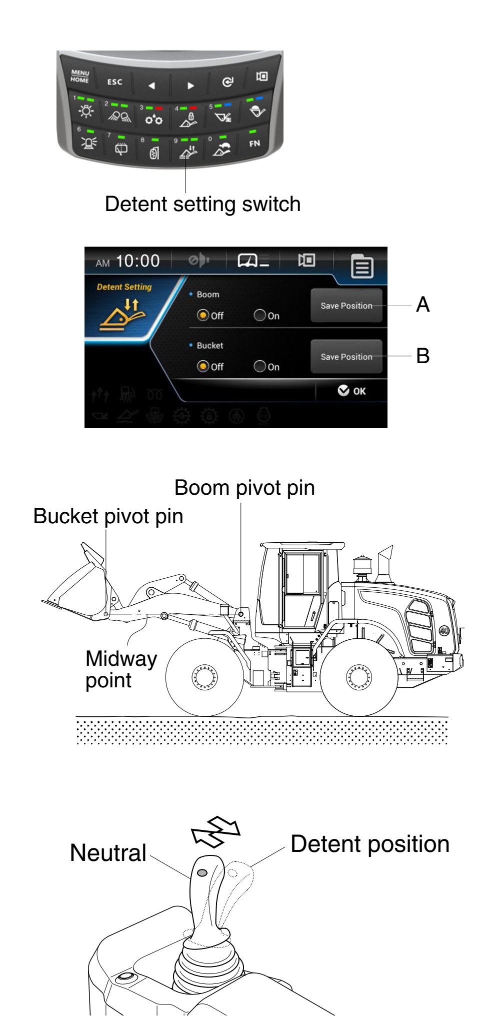
To set the lift kickout, raise the bucket to the desired position above the midway point. Then push icon (, A) for 2~3 seconds. The boom will return to the programmed position when the raise detent is activated and the boom is below the kickout position.

(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.



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3. TEST TOOLS

1) CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

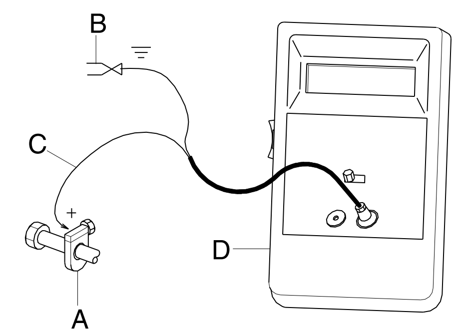
· Service equipment and tools
 Tachometer

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.



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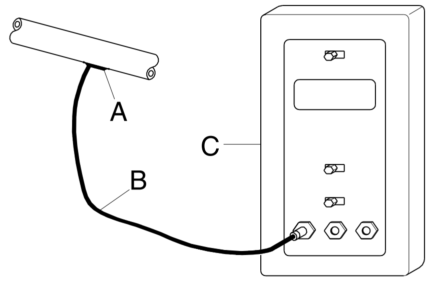
2) DIGITAL THERMOMETER INSTALLATION

· 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.



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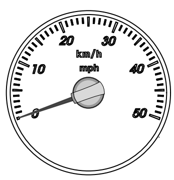
3) DISPLAY MONITOR TACHOMETER

The display monitor tachometer is accurate enough for test work.



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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

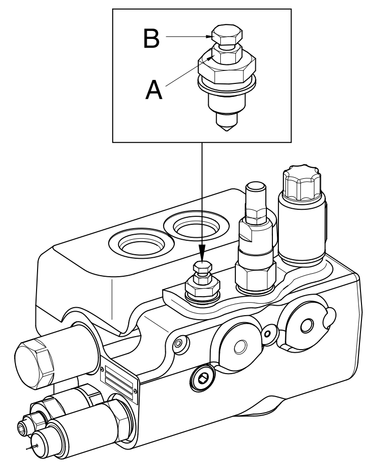
1) Before carrying out any maintenance work the accumulators must be unloaded (zero pressure).

2) For this, loosen the nut (A) and bolt (B) counterclockwise with 10 mm spanner.

※ The accumulator will be unloaded (zero pressure) in less than a minute.

3) The lifting system must firstly be secured against lowering.

4) After carrying out maintenance work, screw the bolt (B) and nut (A).
   · Tightening torque
     A : 2.04 kgf · m (14.8 lbf · ft)



Ride control valve

5. MAIN HYDRAULIC PUMP FLOW TEST

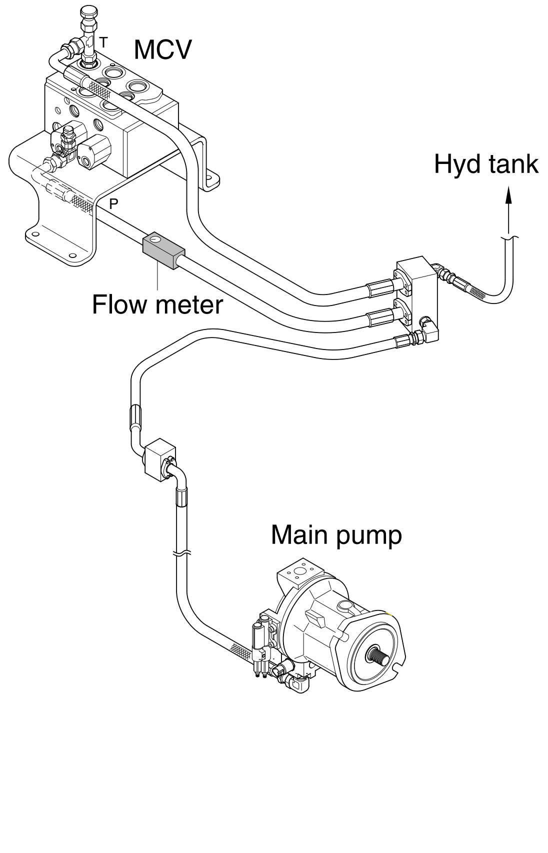
· SPECIFICATION

Oil temperature	45±5˚C (113±9˚F)
Engine speed	2230 rpm
Test pressure	280±5 bar (3980 psi)
Maximum pump flow	149 l/min (39.4 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.



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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/cm² (3980±70 psi)
Boom raise (U) Boom down (W) Bucket rollback (R)	Low	340±10 kg/cm² (4840±140 psi)
Bucket dump (D)	Low	HL940, HL940XT 300±10 kg/cm² (4270±140 psi) HL940TM 150±10 kg/cm² (2130±140 psi)

· Gauge and tool

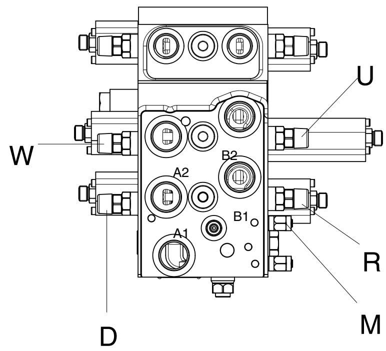
Gauge 0~35 MPa (0~350 bar, 0~5000 psi)

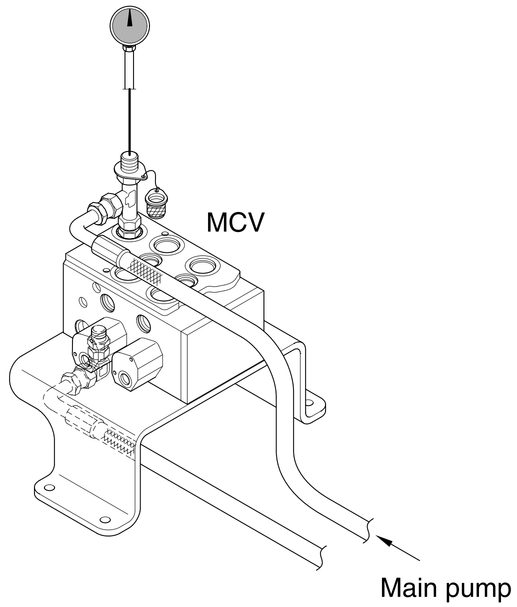
M : System (main) relief valve

R : Bucket rollback relief

D : Bucket dump relief

U/W : Boom raise/down relief





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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/cm² (3980 psi). Damage to the pump will result from excessive pressure settings.

7. HYDRAULIC SYSTEM RESTRICTION TEST

· SPECIFICATION

Oil temperature 45±5˚C(113±9˚F)

Engine speed High idle

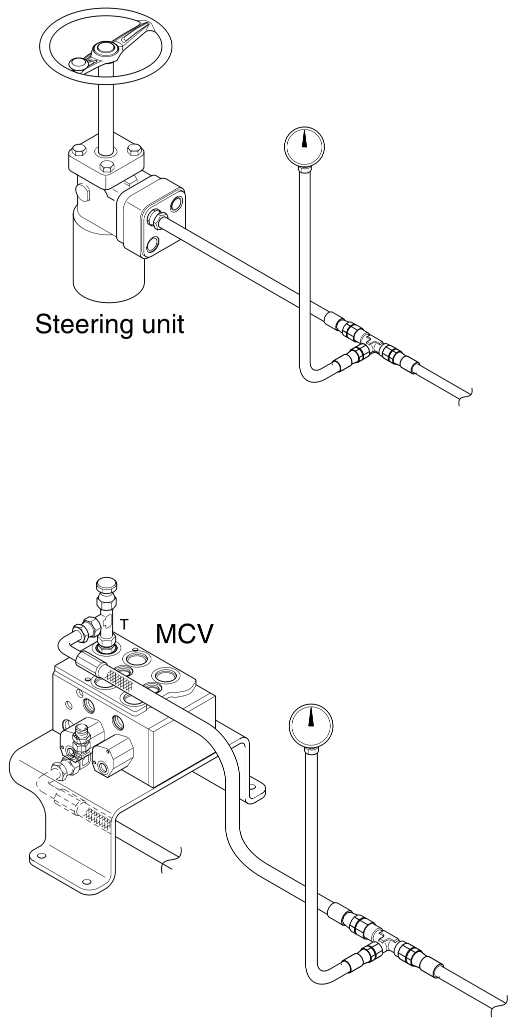
Maximum pressure 1 MPa (10 bar, 145 psi) at steering unit.

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 funct-ions 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 for a stuck spool. Make sure orifice plugs are installed in ends of priority spool in MCV.

Check for plugged orifice in priority valve and dynamic signal orifice on steering valve body.

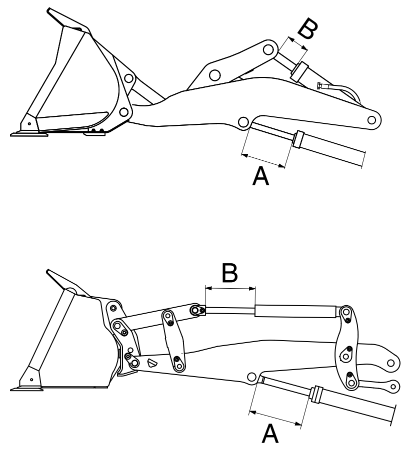
8. LOADER CYLINDER DRIFT TEST

· SPECIFICATION

Oil temperature 45±5˚C(113±9˚F)
Boom horizontal
Bucket horizontal
Bucket unloaded

Item	Standard value
Retraction of boom cylinder rod	8 mm
Retraction of bucket cylinder rod	13 mm *15mm

*HL940TM



A : Retraction of boom cylinder rod
B : Retraction of bucket cylinder rod

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· GAUGE AND TOOL

Stop watch
Temperature reader

⚠ Put the safety lock lever in the lock 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 5 minutes.

9. BOOM AND BUCKET CYLINDER LEAKAGE TEST

· SPECIFICATION

Oil temperature	45±5˚C(113±9˚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.**

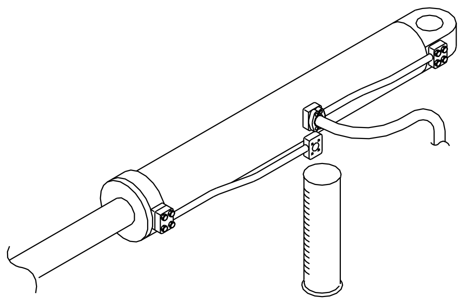
3) Full extend the cylinder to be tested. If testing the boom cylinders, restrain boom in the fully raised position using a hoist or a stand.

※ 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.



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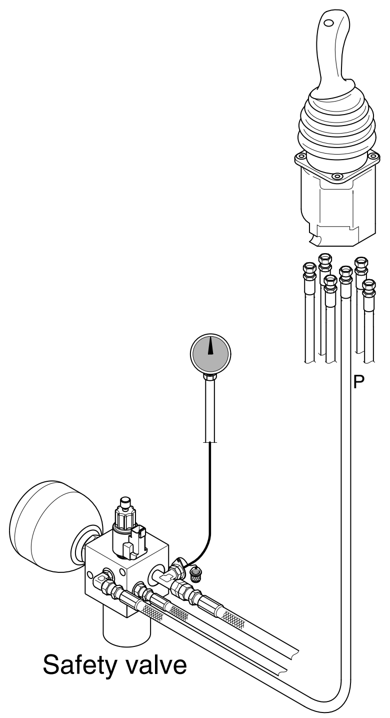
10. PILOT CONTROL VALVE PRESSURE TEST

· SPECIFICATION

Oil temperature　$45\pm5^\circ C(113\pm9^\circ F)$
Engine speed　Low idle
Begin metering　1/4" of lever travel
Pressure in detent :
Boom float detent　2.5 MPa (25 bar)
Pressure at feel position :
Boom power down　22~25bar
Boom raise　22~25bar
Bucket rollback　22~25bar
Bucket dump　22~25bar

· GAUGE AND TOOL

Gauge 0~7 MPa (0~70 bar, 0~1000 psi)



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As the control lever is moved from neutral, the pilot pressure will suddenly jump up to approximately 6.5bar at 1/4in. travel. The pressure should then increase smoothly to the specification at the FEEL position (or 3/4 lever travel), and then jump up about 510psi as the lever is moved into detent.

This test will determine if adequate pilot pressure is available to move the loader control valve spools.

※ The FEEL position is when lever is moved to feel the ramp of the detent before lever passes into detent position.

1) Lower boom to ground.
2) Connect gauge to the pilot pressure port of function to be checked.
3) Install temperature reader (see temperature reader installation procedure in this group).
4) Heat hydraulic oil to specification (see hydraulic oil warm up procedure in this group).
5) Run engine at specification. Activate function to be checked and record pressure reading.

※ If boom raise or bucket rollback FEEL positions are not operation due to boom or bucket position, plug boom float detent wires into bucket leveler solenoid or boom height kickout solenoid. This will provide a feel position on the control lever.

11. CYCLE TIME TEST

· **SPECIFICATION**

Oil temperature —— 45±5˚C (113±9˚F)

Engine speed —— High idle

Function	Operating conditions	Maximum cycle time (seconds)	
		HL940 / HL940XT	HL940TM
Boom raise	Bucket flat on ground to full height	5.5	
Boom lower (float)	Full height to ground level	3.0	
Bucket dump	Boom at full height	1.1	1.6
Bucket rollback	Boom at full height	1.8	2.3
Steering (number of turns)	Frame stop to stop	3.9 turns	

Hydraulic pump performance cycle time.

Function	Operating conditions	Maximum cycle time (seconds)
Boom raise	Bucket flat on ground to full height while holding steering over relief	10.0

12. 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 indicated cylinder packing or other packing failure.

※ The hydraulic oil filter in the filter case of the hydraulic oil tank should be replaced every 250 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.

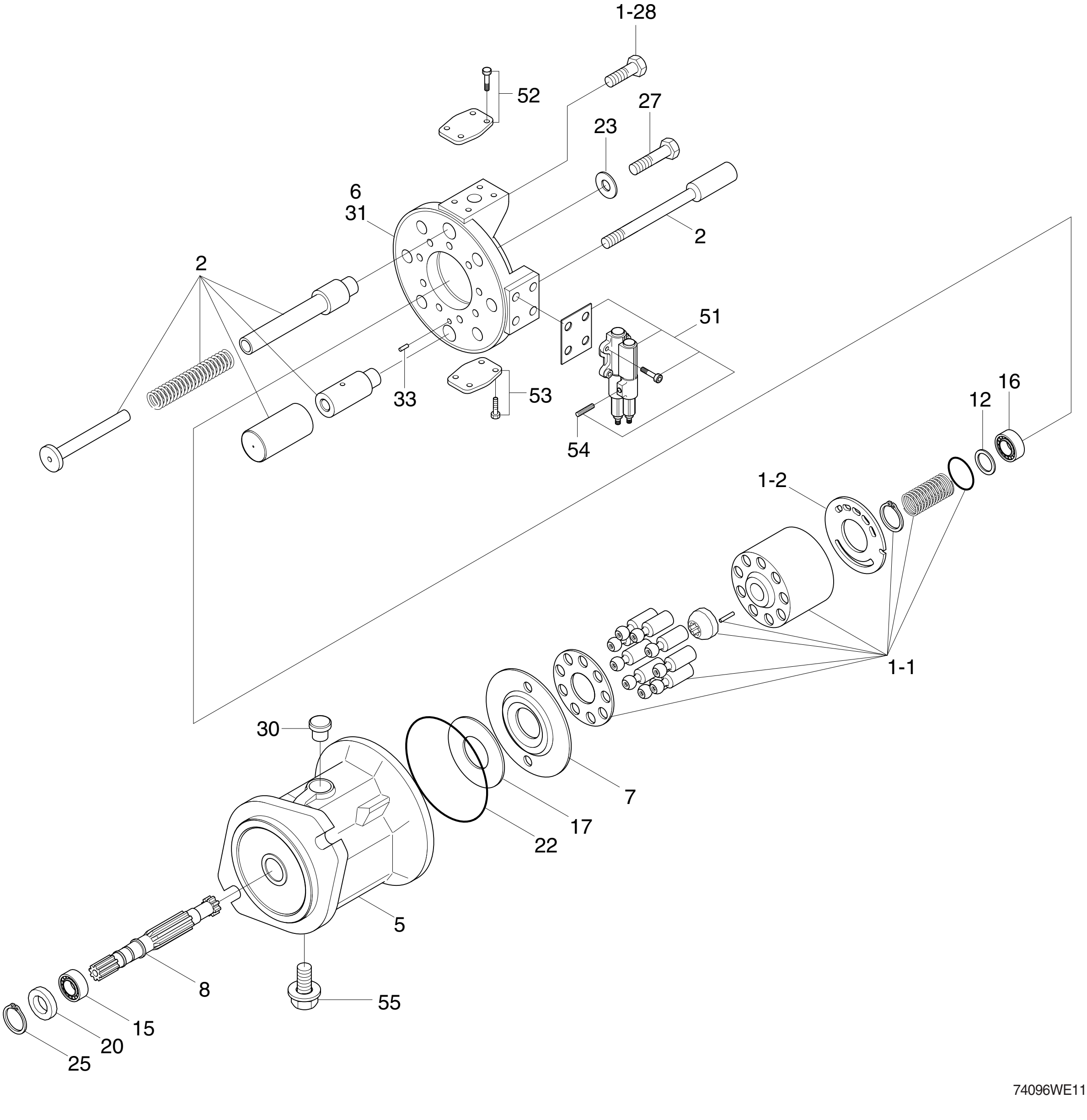
(3) Install the bypass valve and spring. Make sure the element stand upright, and check for complete contact of the element bottom with the filter case bottom.

(4) Install the O-ring and filter case covers. Tighten them with bolt. Replace the O-ring with new one if damaged.sa

GROUP 4 DISASSEMBLY AND ASSEMBLY

1. MAIN PUMP

1) STRUCTURE (1/2)



1	Rotary group	15	Taper roller bearing	30	Locking screw
1-1	High speed rotary group	16	Taper roller bearing	31	Double break-off pin
1-2	Control plate	17	Bearing liner	33	Cylinder pin
2	Adjusting piece	20	Shaft seal ring	51	Control valve
5	Pump housing	22	O-ring	52	Flange cover
6	Port plate	23	O-ring	53	Flange cover
7	Swash plate	25	Retaining ring	54	Seal screw
8	Drive shaft	27	Socket screw	55	Seal screw
12	Adjustment shim	28	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.

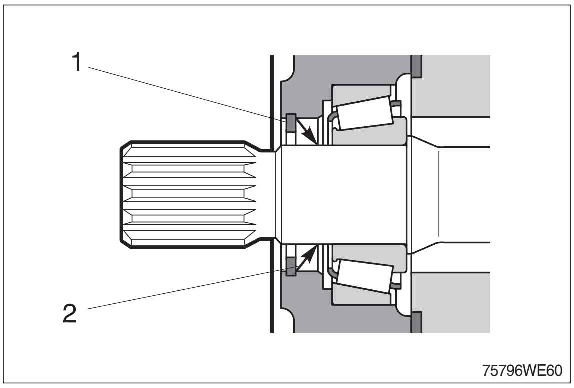
※ Re-work of the sliding surfaces by using, for example abrasive paper, can damage the surface.

(4) Fill the hydraulic pump with hydraulic oil before commissioning.

3) SEALING THE DRIVE SHAFT

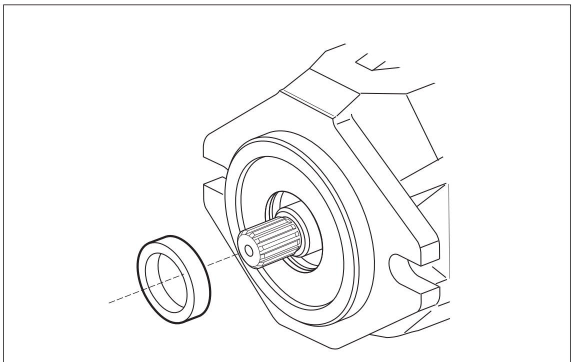
(1) Protect the drive shaft.
Remove the circlip.
Remove the shaft seal.

1 Circlip 2 Shaft seal

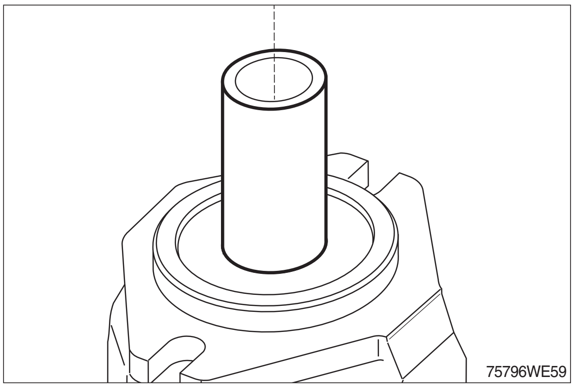


75796WE60

(2) Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.


75796WE58

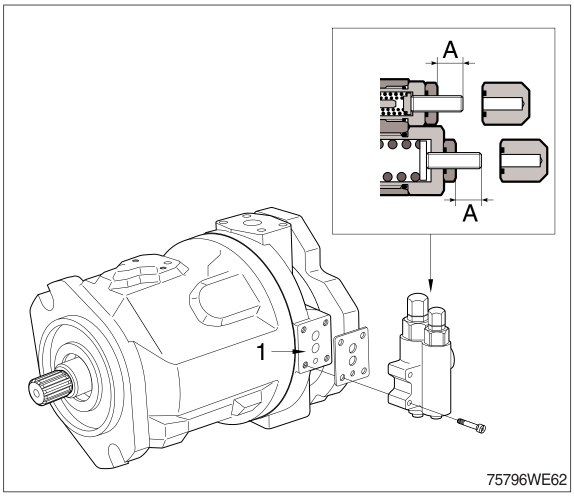
(3) Assemble the sealing ring, fitting tool holds the correct position of the sealing ring in the pump housing.
Assemble the circlip in the correct position.


75796WE59

4) SEALING / CLEANING THE CONTROL VALVE

(1) Disassemble the control valve.

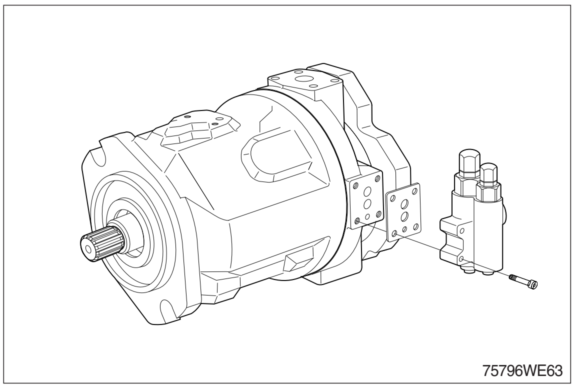
※ Measure dimension A and note down.
Check sealing surface (1).



75796WE62

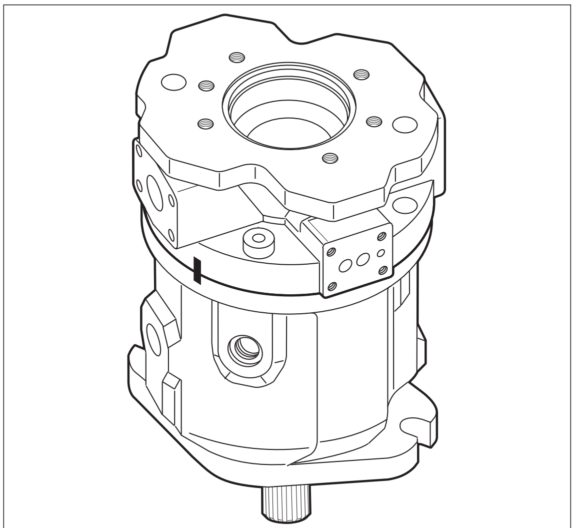
5) DISASSEMBLE THE PUMP

(1) Remove the control valve.



75796WE63

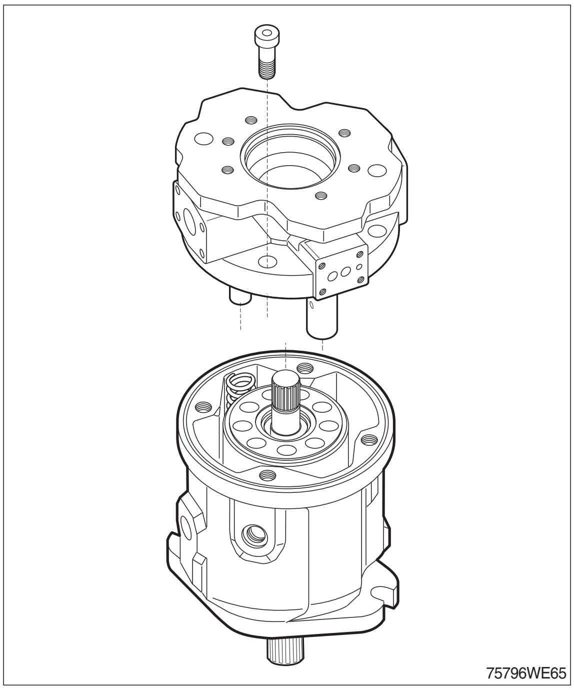
(2) Mark the location of the connection plate on the housing.



75796WE64

(3) Remove the connection plate fixing bolts and the connection plate.

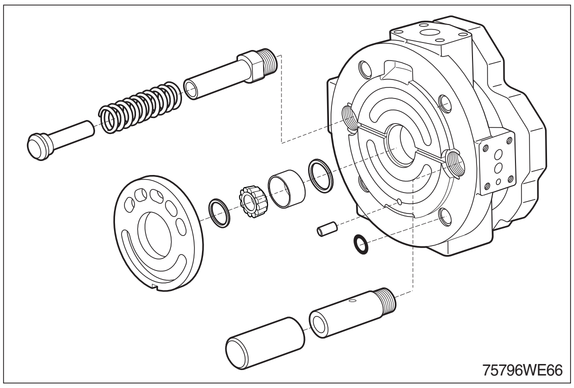
※ Distributor plate and adjustment piston can drop down.



75796WE65

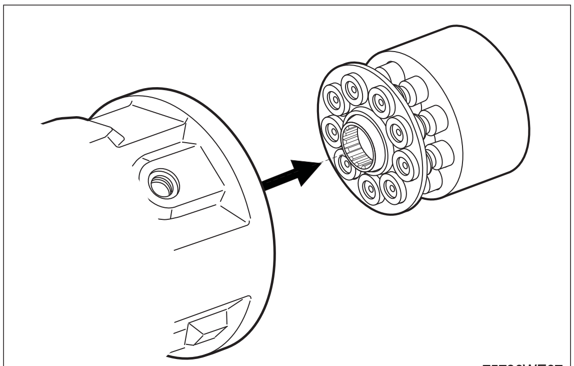
(4) Remove distributor plate.
Take note of the orientation.

※ Remove bearing with withdrawal tool.
Do not damage the sealing surface.



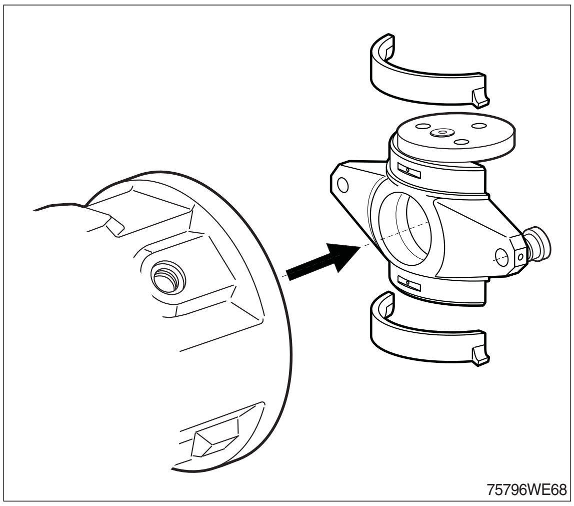
75796WE66

(5) Remove the rotary group in a horizontal position.

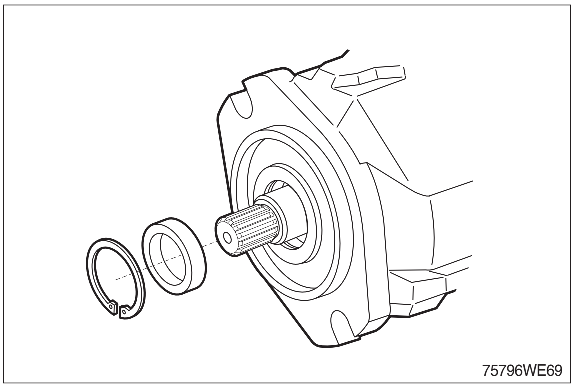


75796WE67

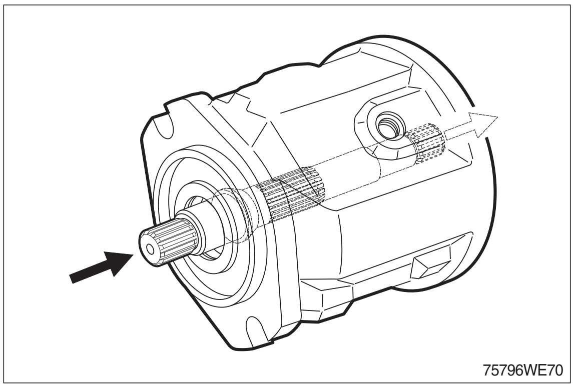
(6) Remove swash plate and bearing shells.



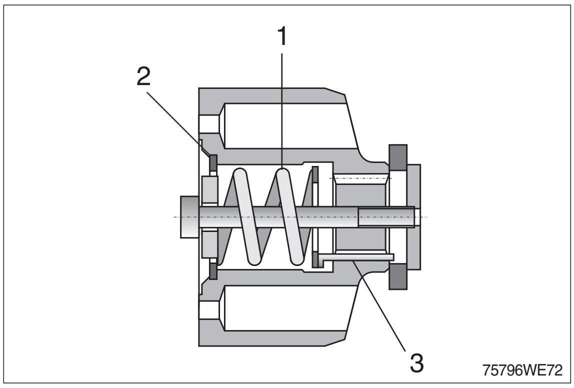
(7) Remove the circlip and the shaft seal.



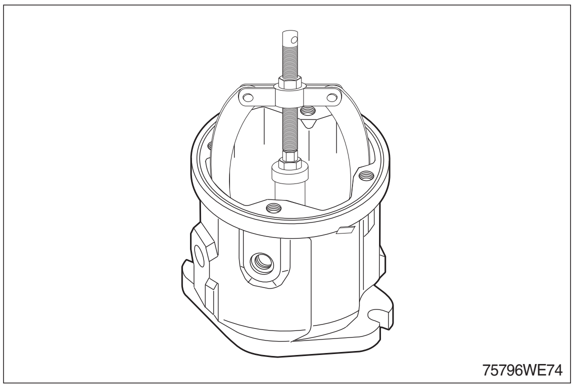
(8) Remove the drive shaft through rear side.



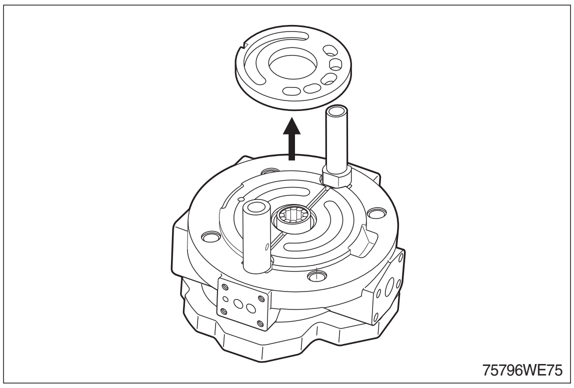
(9) Pre-tension the spring (1) using a suitable device.
Remove circlip (2).
Remove spring (1) and pressure pins (3).



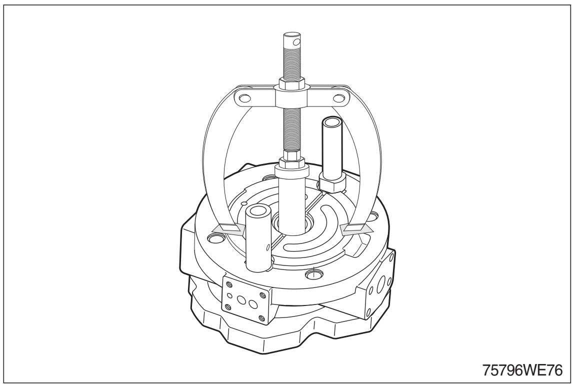
(10) Use bearing puller to remove outer bearing race of front bearing out of housing press seat.



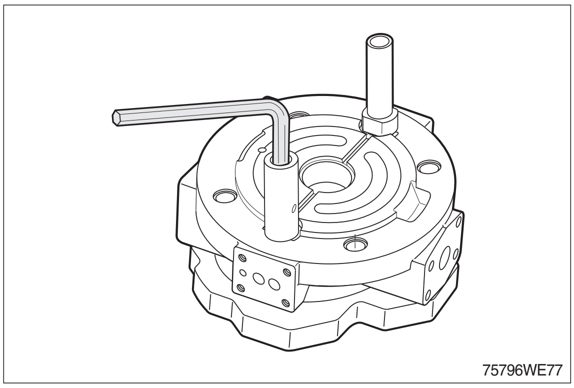
(11) Remove the control plate.



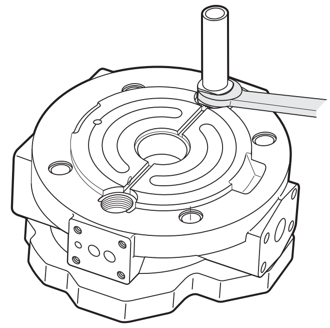
(12) Use bearing puller to remove outer bearing race of rear bearing - press seat.



(13) Disassemble the guide of control piston (Mounting position: pilot valve side).



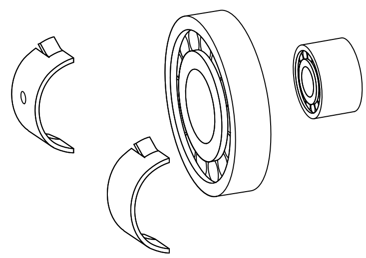
(14) Disassemble the guide of the opposite piston.



75796WE78

6) INSPECT HINTS

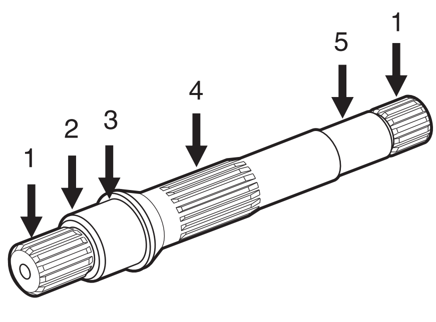
(1) Renew all bearings.



75796WE79

(2) Check :

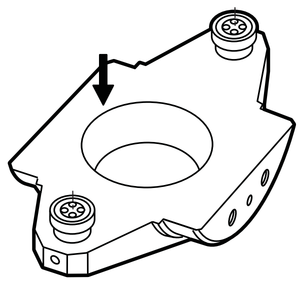
1 Wear on splines, rust
2 Drive shaft seal wear grooves
3 Bearing seat
4 Splines for cylinder drive
5 Bearing seat



75796WE80

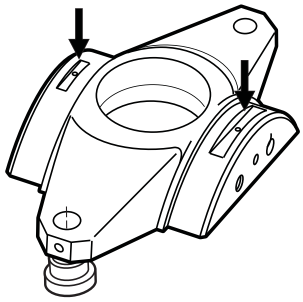
(3) Check :

Sliding surface free of grooves.



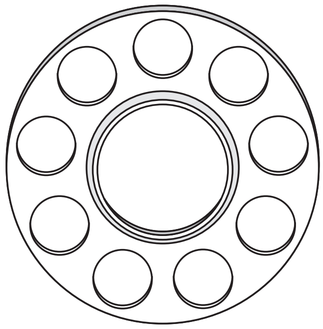
75796WE81

(4) Check :
Bearing surfaces.



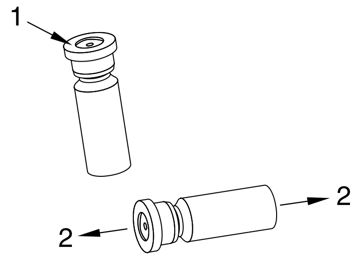
75796WE82

(5) Check :
That the retaining plate is free of grooves and that there is no wear in the slipper pad area.



75796WE83

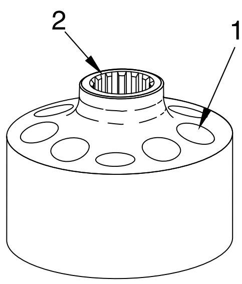
(6) Check :
Check to see that there are no scratches or metal deposits on the sliding surface (1) and that there is no axial play (2) (Pistons must only be replaced as a set).



75796WE84

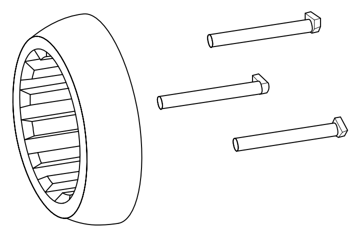
(7) Check :

1 Cylinder bores
2 Splines



75796WE85

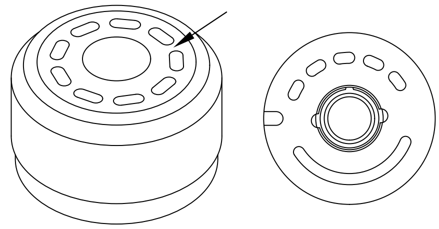
(8) Free of grooves, no signs of wear.



75796WE86

(9) Check :

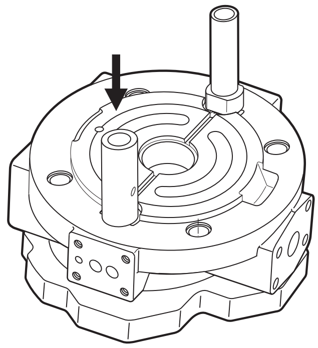
Cylinder sliding surface free of grooves, no wear, no embedded foreign particles. That there are no scratches on the control plate. (Only replace them as a set).



75796WE87

(10) Check :

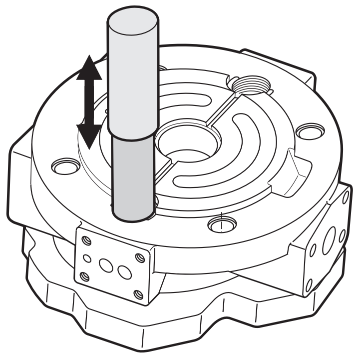
Mounting surface - control plate undamaged.



75796WE120

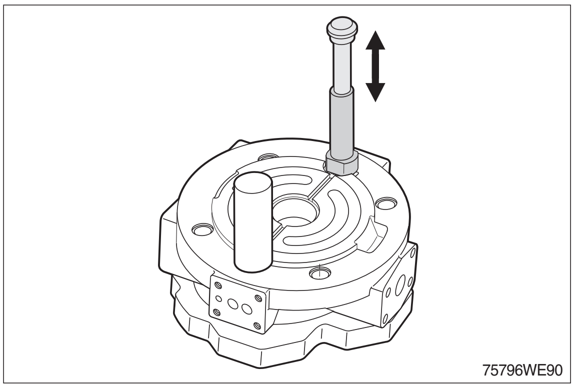
(11) Check :

Check running conditions of the control piston.



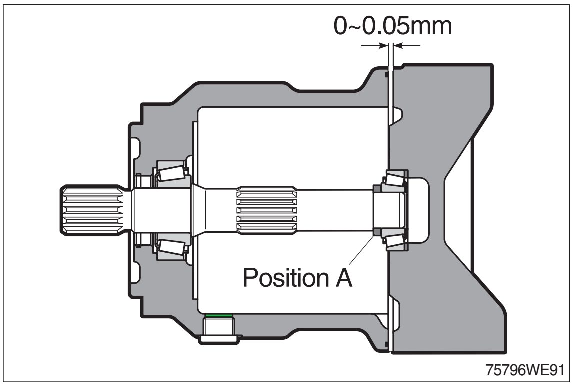
75796WE89

(12) Check :
Check running conditions of the opposite piston.


75796WE90

7) ADJUSTMENT OF TAPER ROLLER BEARING SET

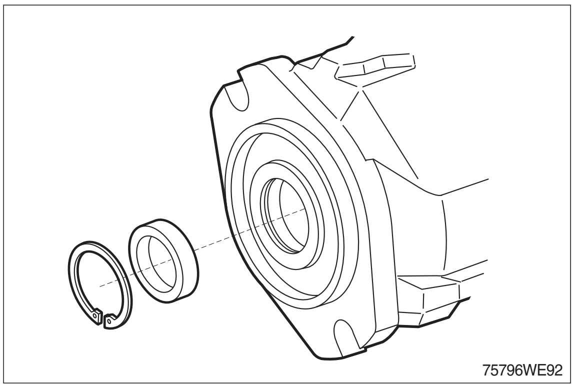
(1) Cast iron housing must have initial tension of the bearings: 0~0,05 mm, grind position A if necessary.



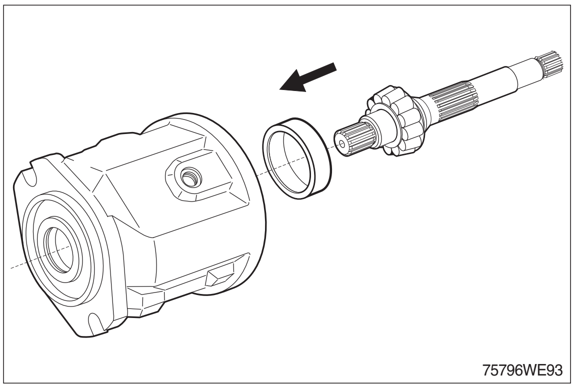
75796WE91

8) PUMP ASSEMBLY

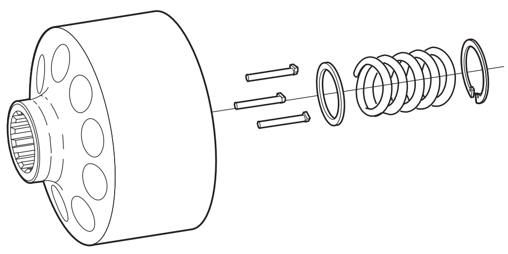
(1) Fit the seal into the housing.
Fit the circlip.


75796WE92

(2) Fit the drive with bearing from rear end.
※ Do not touch seal lip with edge of keyway or spline.

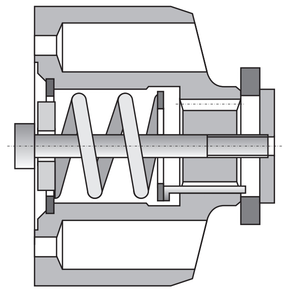

75796WE93

(3) Fit pressure pins using an assembly aid.



75796WE94

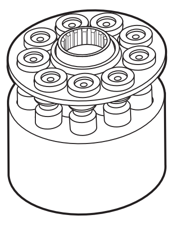
(4) Pre-tension the spring using a suitable device.



75796WE95

(5) Assemble piston with retaining plate.

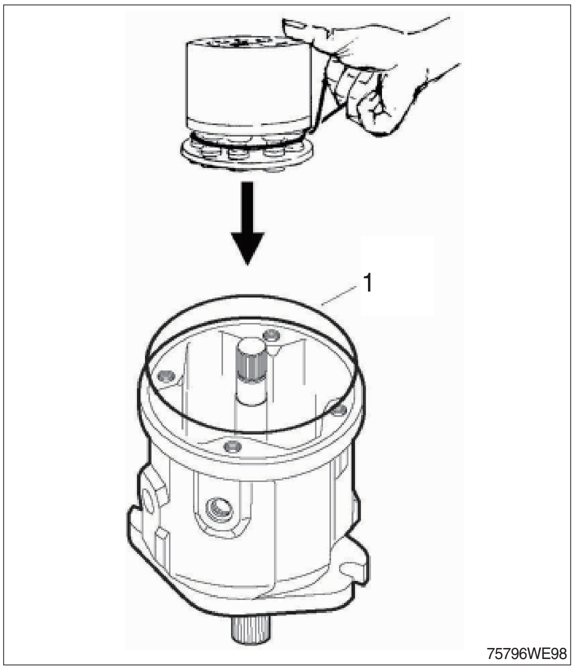
※ Oil piston and slipper pad.



75796WE97

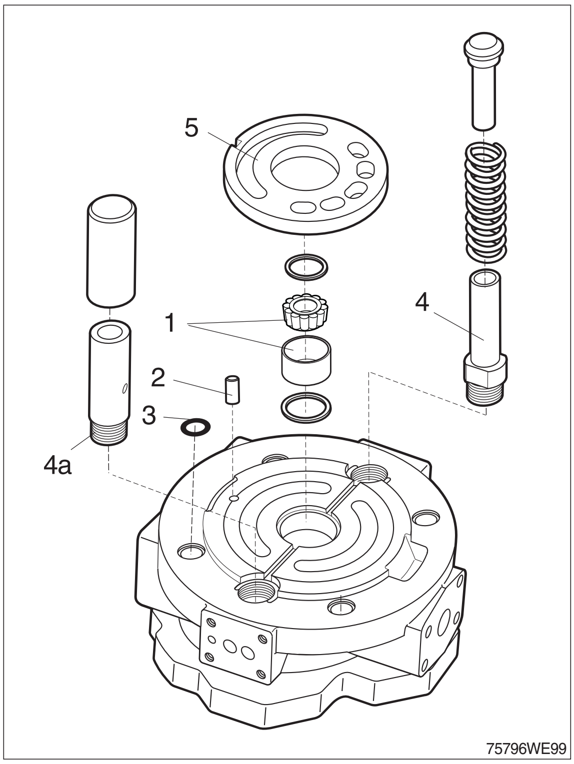
(6) Fit rotary group.

※ Hold the piston by using an O-ring.
Fit O-ring (1).



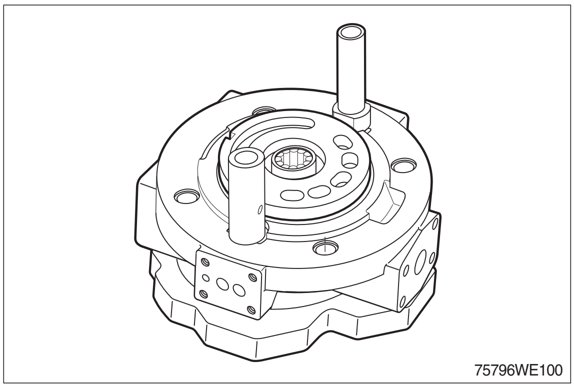
(7) Fit bearing (1) in connection plate.
Fit cyilindrical pin (2).
Fit O-rings (3) 4 pieces.
Fit adjustment spool (4) and guide piston (4a).
Fit distributor plate (5) (direction of rotation dependent)

※ Assembly.
Hold the components in place with grease.



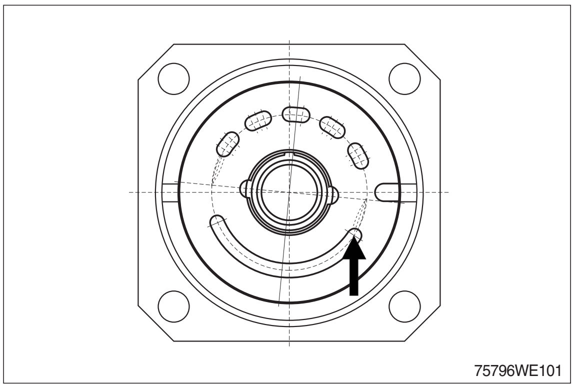
(8) Fit distributor plate.

※ Assembly aid : Grease



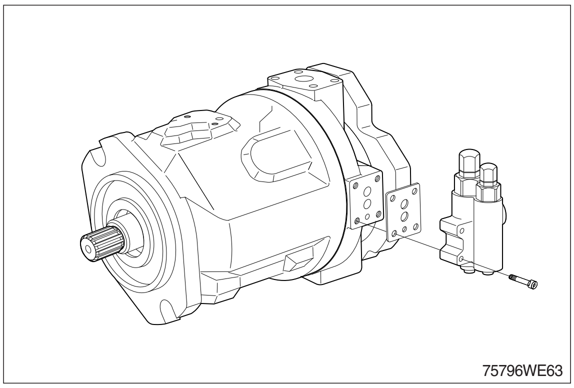
75796WE100

(9) For clockwise rotation pumps the distributor plate is off-set by 4˚ to the right from the centre position.
(Clockwise and anti-clockwise rotation distributor plates are not identical).



75796WE101

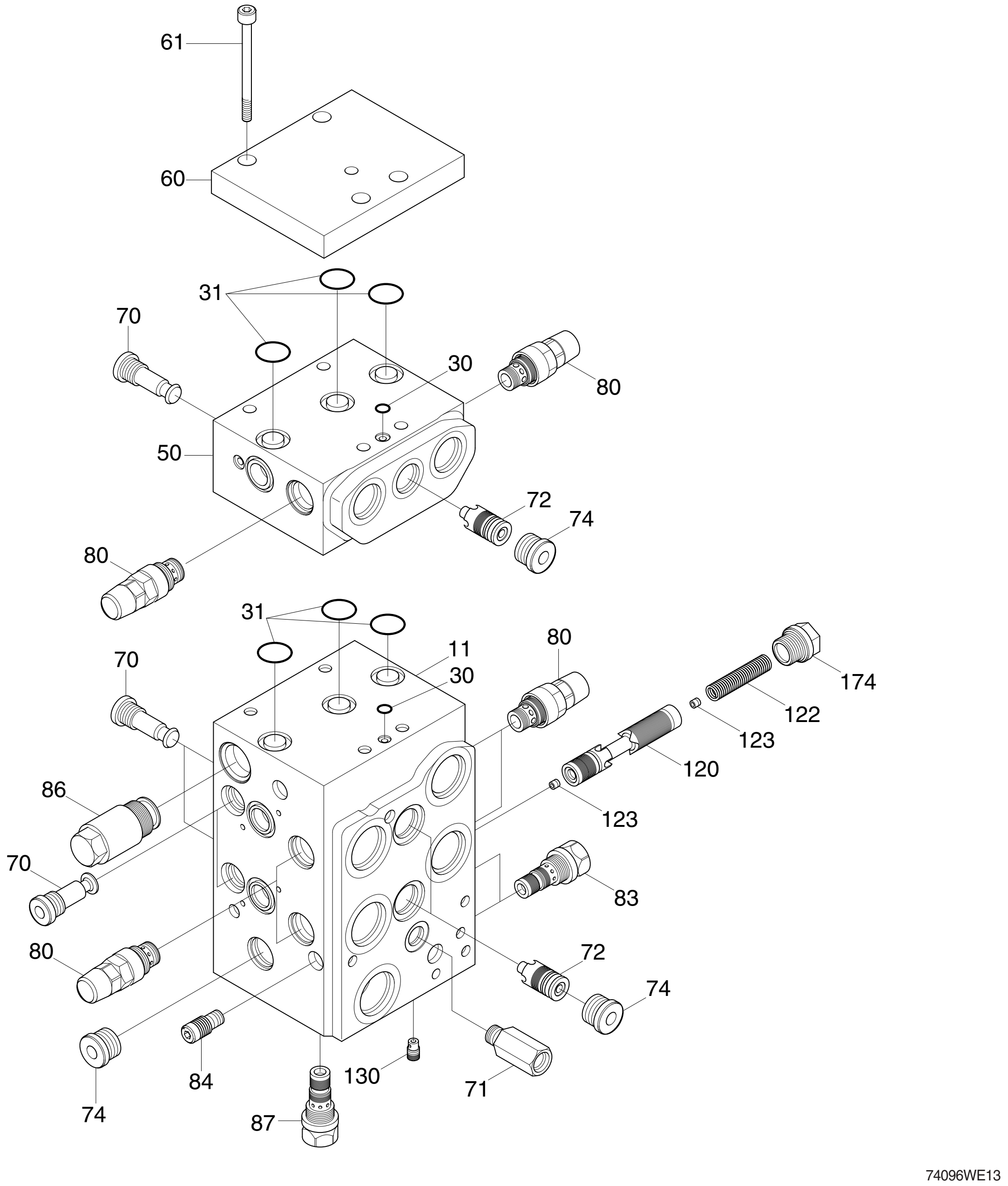
(10) Fit connection plate and control valve.



75796WE63

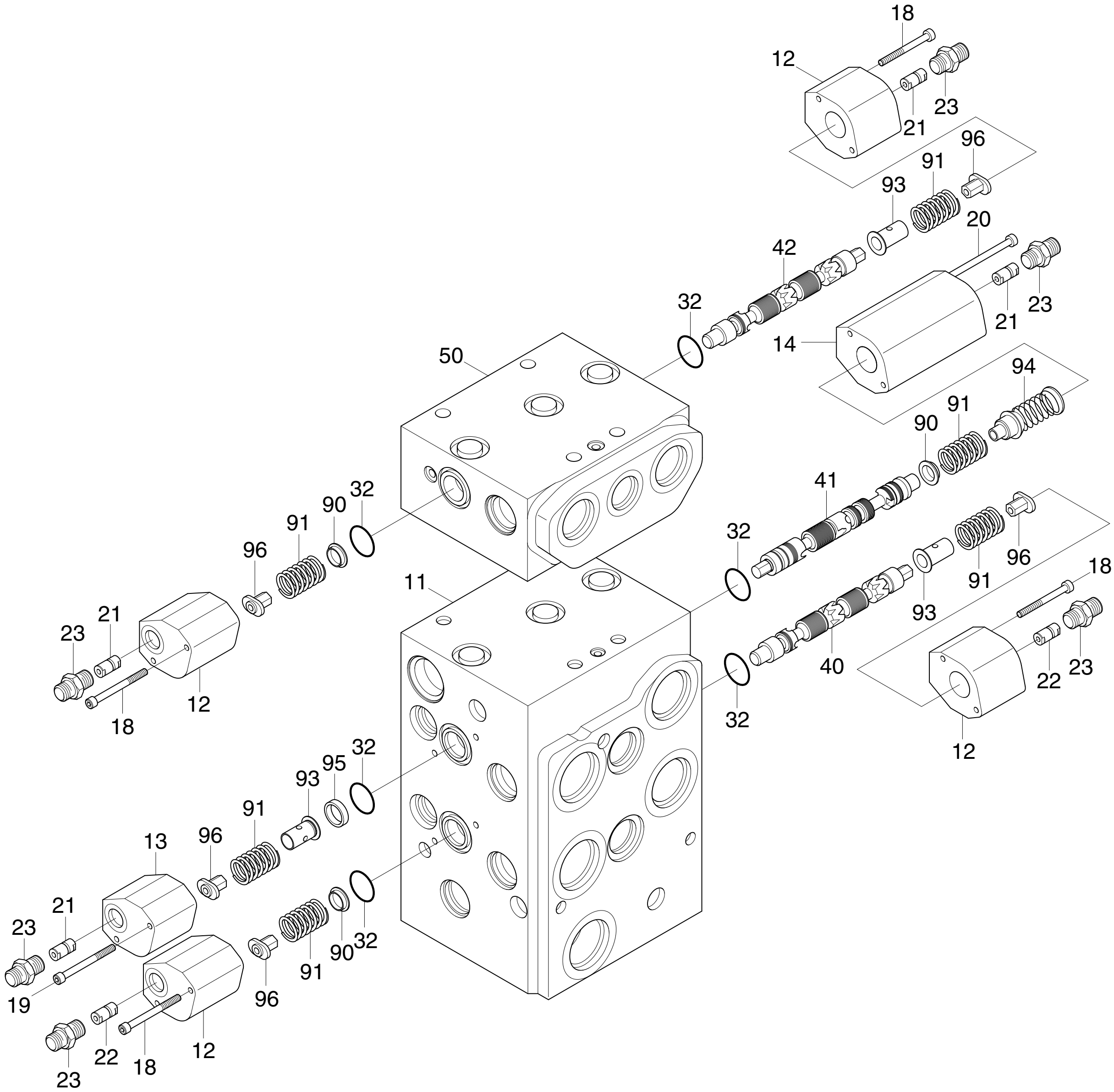
2. MAIN CONTROL VALVE

1) STRUCTURE (1/2)



11	Housing	71	Shuttle valve	87	Pressure reducing valve
30	O-ring	72	Spool	120	Spool
31	O-ring	74	Locking screw	122	Pressure spring
50	Housing	80	Pressure relief valve	123	Orifice
60	Plate	83	Pressure relief valve	130	Check valve
61	Cylinder screw	84	Flow control valve	174	Locking screw
70	Check valve	86	Counter balance valve		

STRUCTURE (2/2)



75796WE14

11	Housing	21	Throttle check valve	50	Housing
12	Cover	22	Throttle check valve	90	Spring retainer
13	Cover	23	Threaded steel pipe fitting	91	Compression spring
14	Cover	32	O-ring	93	Spring retainer
18	Cylinder screw	40	Spool	94	Spring
19	Cylinder screw	41	Spool	95	Ring
20	Cylinder screw	42	Spool	96	Spring retainer

2) GENERAL PRECAUTIONS

(1) Clean room with no dust is recommended for maintenance. Because hydraulic components are precision, and have minute clearance. Tool and wash-oil must be clean, too. Handle them carefully.
(2) At removing control valve from the machine, wash around the piping port, and neither dust nor water should go into inside with plugging. It is same at attaching the machine.
(3) Prepare the required parts by checking structure figure before assembly. There are parts which are supplied with only sub-assembly part, so check the parts list before assembly.

3) PRECAUTIONS FOR DISASSEMBLY

(1) Handle the components carefully not to drop them or bump them with each other as they are made with precision.
(2) Do not force the work by hitting or twisting as burred or damaged component may not be assembled or result in oil leakage or low performance.
(3) When disassembled, tag the components for identification so that they can be reassembled correctly.
(4) Once disassembled, O-ring and back-up rings are usually not to be used again.(Remove them using a wire with its end made like a shoe-horn. Be careful not to damage the slot)
(5) If the components are left disassembled or half-disassembled, they may get rust from moisture or dust. If the work has to be interrupted, take care to prevent rust and dust.

4) PRECAUTIONS FOR REASSEMBLY

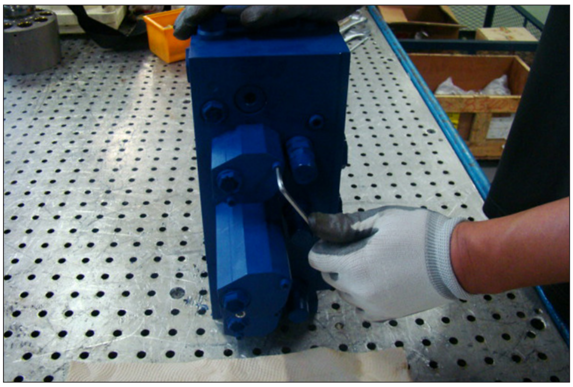
(1) Take the same precautions as for disassembly.
(2) When assembling the components, remove any metal chips or foreign objects and check them for any burrs or dents. Remove burrs and dents with oil-stone, if any.
(3) O-rings and back-up rings are to be replaced with new ones, as a rule.
(4) When installing O-rings and back-up rings, be careful not to damage them. (Apply a little amount of grease for smoothness)
(5) Tighten the bolts and caps with specified torque.

5) DISASSEMBLY AND ASSEMBLY

(1) Spool

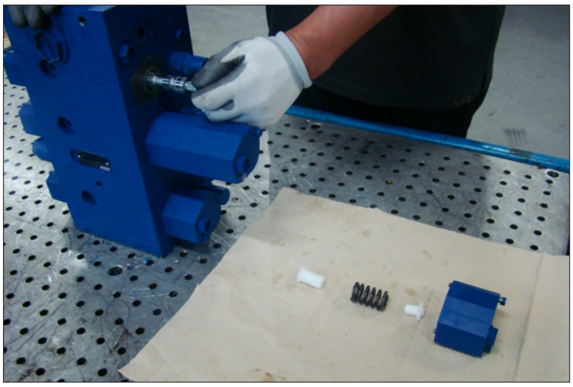
① Loosen the bolt (2EA).

- Tool : Wrench 4 mm
- Tightening torque : 0.85 kgf · m (61 lbf · ft)



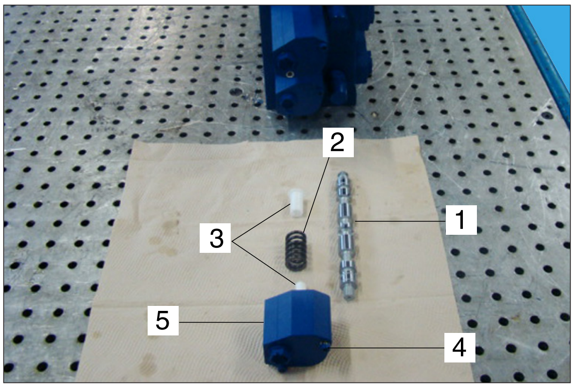
75796WE41

② Remove the cover, spring retainer, spring and spool.



75796WE42

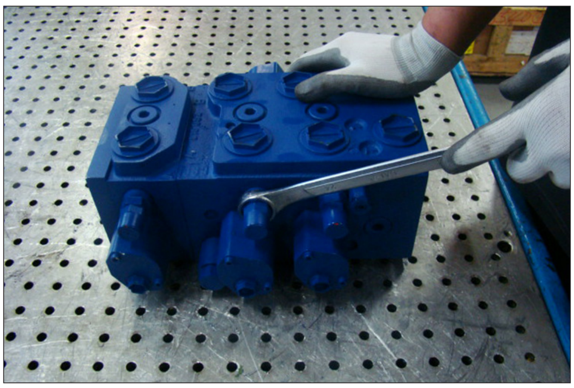
1 Spool
2 Spring
2 Spring ratainer
4 Bolt
5 Cover



75796WE43

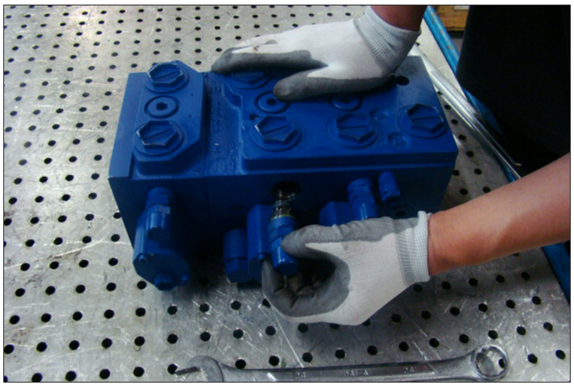
(2) Port relief valve

- Tool : Spanner 24 mm



75796WE44

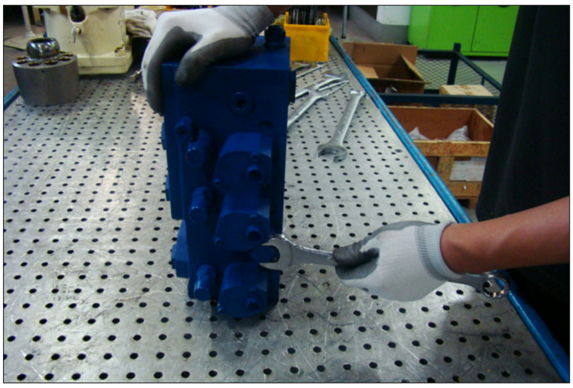
· Tightening torque : 10.2 kgf · m
(73.8 lbf · ft)



75796WE45

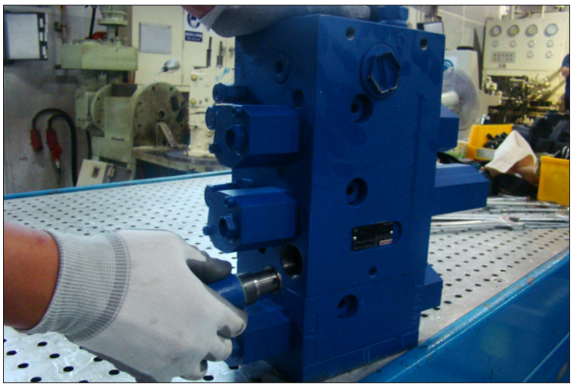
(3) Precharge valve

· Tool : Spanner 24 mm



75796WE46

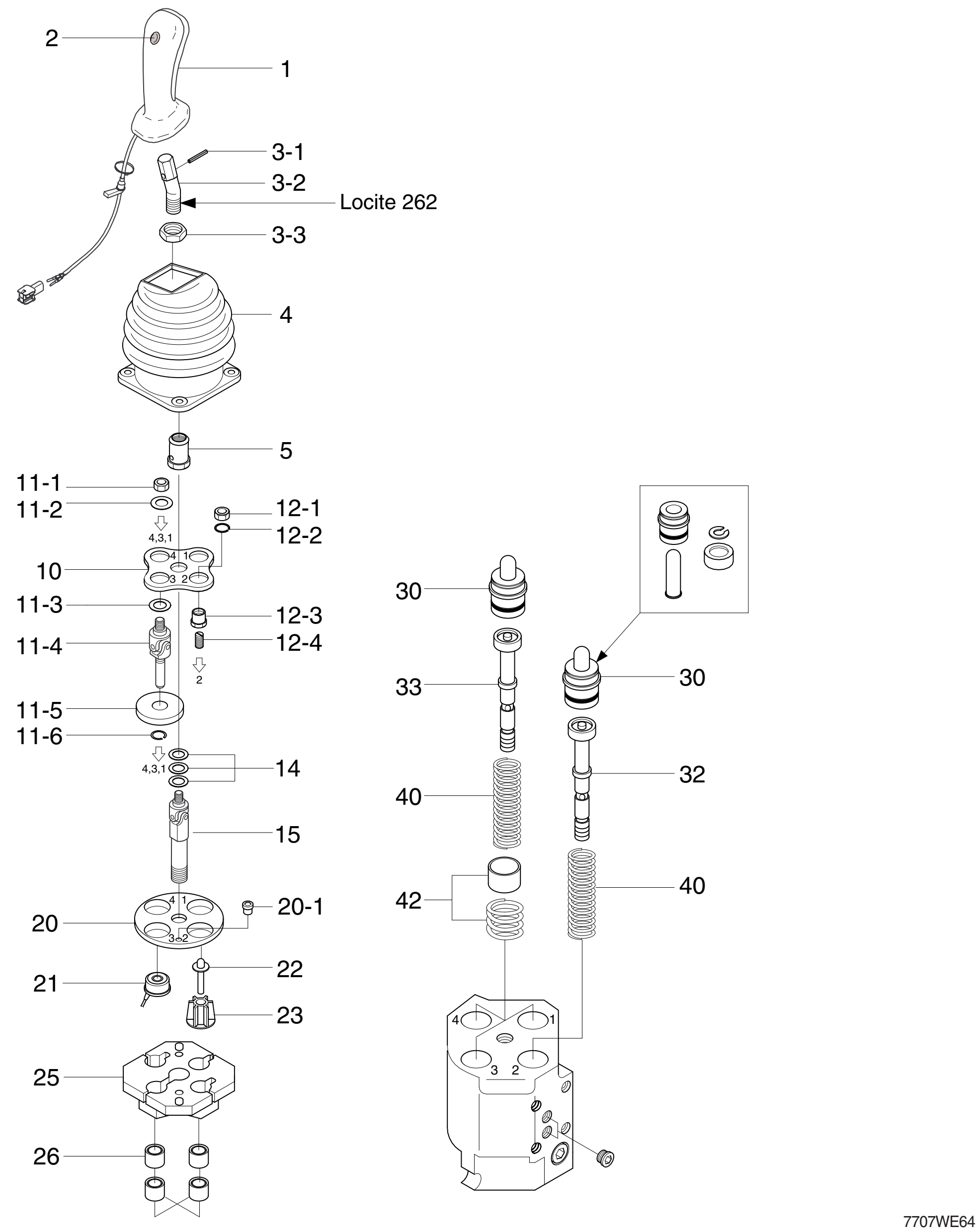
· Tightening torque : 6.1 kgf · m
(44.3 lbf · ft)



75796WE47

3. REMOTE CONTROL VALVE

1) STRUCTURE



1	Handle	11-4	Cardan	22	Intermediary plunger kit
2	Push button	11-5	Armature	23	Intermediary plunger guide
3-1	Locking pin	11-6	Spring ring	25	Electric bracket
3-2	Bent lever	12-1	Counter nut	26	Bushing
3-3	Nut	12-2	Spring ring	30	Plunger kit
4	Rubber boot	12-3	Switch plate screw	32	Regulation unit
5	Locking nut	12-4	Press screw	33	Regulation unit
10	Cardan bracket	14	Shims (0.1, 0.2, 0.5 ㎜)	40	Return spring
11-1	Self-locking nut	15	Cardan	42	Prefeeling point kit
11-2	Washer	20	Flange		
11-3	Washer	21	Solenoid		

2) DISASSEMBLY AND ASSEMBLY

(1) PUSH BUTTON

※ The remote control valve does not need to be removed from the machine to perform this operation.
Remove worn pushbutton using a small screwdriver.
The installation of new elements is performed without any special tools; the parts are simply pressed into place.

(2) RUBBER BOOT

① Remove the remote control valve from the machine or free the valve by unscrewing the 4 screws fixing the plate in order to release the electrical cable.
· Assembly
Torque : 1.02 kgf · m (7.4 lbf · ft)
Hold the remote control valve using a vice or a vice-grip wrench (clamp onto the body).

※ The pilot unit does not need to be removed from the machine to release the cable. However, it is recommended to lift the control unit by undoing the 4 fixing screws on the arm rest.
※ It is unnecessary to remove the units with no electrical functions.

② Lift and turn the boot inside out.
③ Remove the grommet (7) from its emplacement to free the cable.
④ Loosen the handle mounting nut (3-3) using a 19 mm open-end wrench.
· Assembly : torque 4.08 kgf · m (29.5 lbf · ft)
⑤ Unscrew and remove the handle (1).
· Assembly
- Add loctite 262 onto the lever thread
- Torque : 4.08 kgf · m (29.5 lbf · ft)
⑥ Replace the faulty rubber boot (4) with a new one.
⑦ Replace the handle (1) following the disassembly instructions in reverse order.

(3) HANDLE

① Clamp the threaded section of the lever (3-2) in a vice fitted with V-shaped vice clamp.
② Remove the pin (3-1) using a 5mm pin driver.
③ Replace the lever (3-2) onto the new handle (1) and secure it with the pin (3-1) using a 5mm pin driver.

※ Respect the position of the curved lever to ensure that the handle is correctly oriented as indicated by the machine's technical specifications.

④ Replace the nut (3-3) on the threaded section and replace the boot (4).

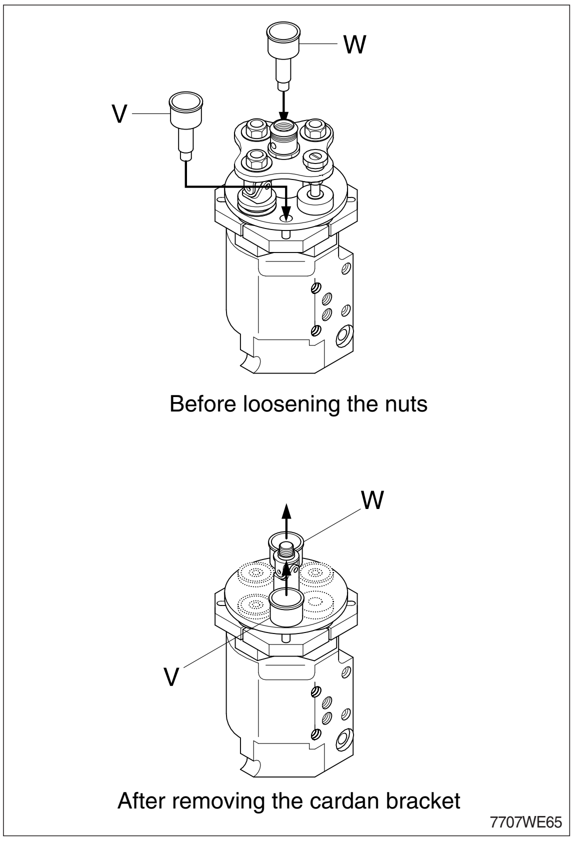
(4) DETENT CARDAN BRACKET KIT

※ Remove the 2 grommets (20-1) from the flange (20).

※ Place centering sleeves V & W to avoid damaging the cardan knuckles while loosening the nuts.

※ Unscrew the locking nut (5) using a 23mm open-end wrench.

· Assembly : Torque 4.08±0.4 kgf · m (29.5±2.9 lbf·ft)



Before loosening the nuts

After removing the cardan bracket

① Unscrew the self-locking nut (11-1) using a 13mm open-end wrench.

· Assembly

- Torque 1.02 kgf · m (7.4 lbf · ft)
- Place centering sleeves (V-W) to avoid damaging the cardan knuckles while screwing the nuts.

② Remove : - Friction washer (11-2)

- Friction washer (11-3)
- Cardan/armature assembly (11-4 ~ 11-6)

(5) NON-DETENT PLUNGER KIT

① Unscrew the self-locking nut (12-1) using a 13 mm open-end wrench.

· Reassembly : - Torque 1.02 kgf · m (7.4 lbf · ft)

- Place centering sleeves (V-W) to avoid damaging the cardan knuckles while screwing the nuts.

② Undo the snap ring (12-2) using a flat-end screwdriver.

③ Remove the screw assembly (12-3, 12-4)

(6) CARDAN

① Remove the centering sleeves V & W.

② Remove the cardan bracket (10) and the shims (14).

③ Unscrew the cardan (15) using a 17 mm open-end wrench.

· Reassembly : - Ungrease the cardan threads

- Add loctite 262 onto the cardan threads (both end)
- Torque 4.08 kgf · m (29.5lbf · ft)

(7) SOLENOID AND CONNECTOR

※ It is advised to mount the connector onto the solenoid cable once the remote control valve is assembled.

① Remove the flange (20) and the electrical bracket (25),

② Remove the protecting bushes (26) from the electrical bracket (25).

③ Undo the solenoid (21) from the electric bracket (25).

④ Replace the solenoid.

※ Clean the polar face using a piece of cloth and pay attention not to hit them.

⑤ Assembly : Place the solenoid cable in its emplacement on the electric bracket before fitting the protection bushes.

(8) INTERMEDIARY PLUNGER KIT

① Undo the intermediary plunger guide (23).
② Remove and replace the intermediary plunger kit assembly (22).

(9) GUIDE / PLUNGER AND REGULATION UNIT

※ Beware of the plungers that might jump out due to the spring return.

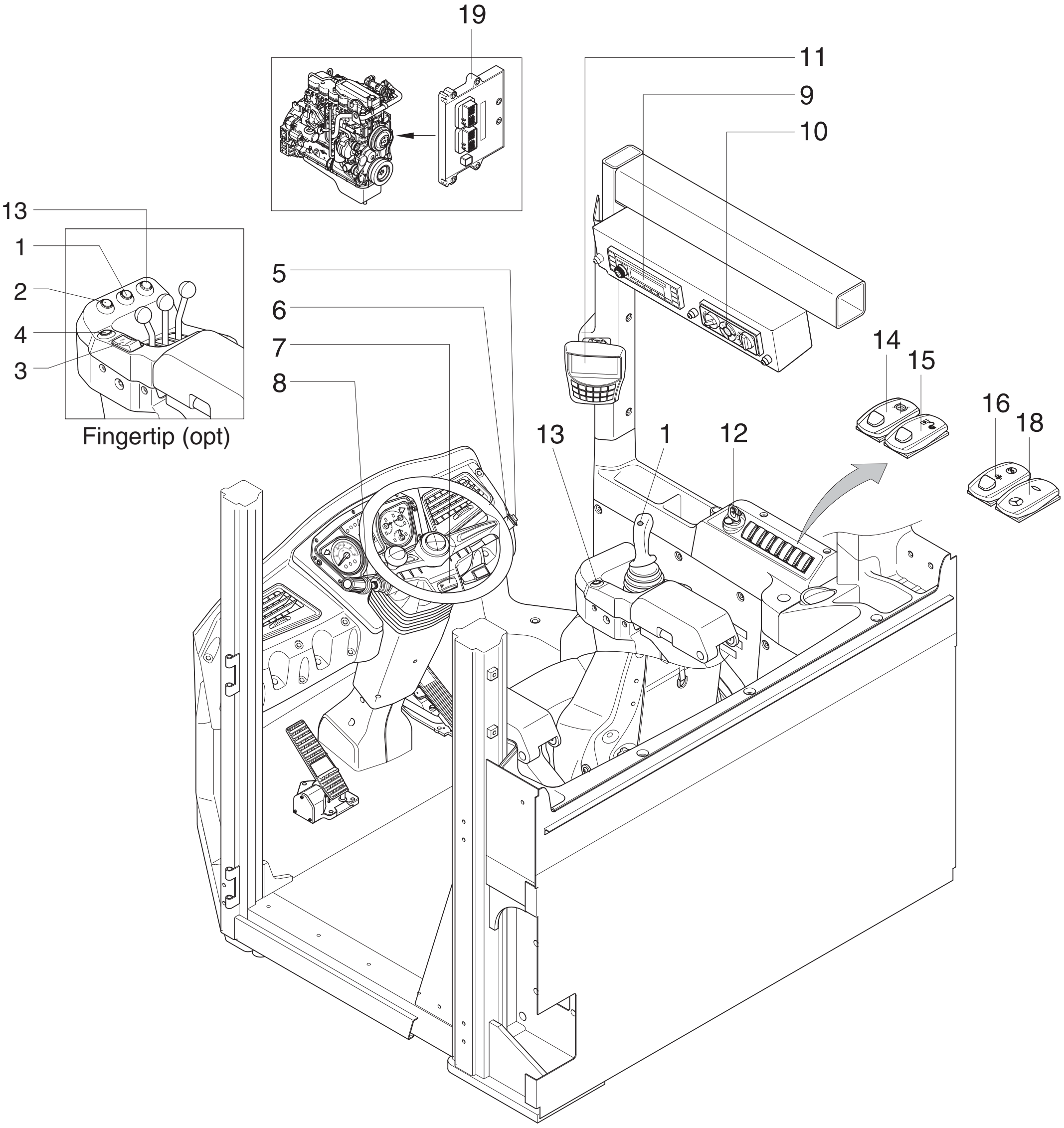
① Remove : - Guide/plunger assembly (30).
- Regulation unit (32/33).
- Return spring (40).
- Pre-feeling point kit (42).

② The remote control valve is now totally disassembled.
Assemble in reverse order following the torque specification.

SECTION 7 ELECTRICAL SYSTEM

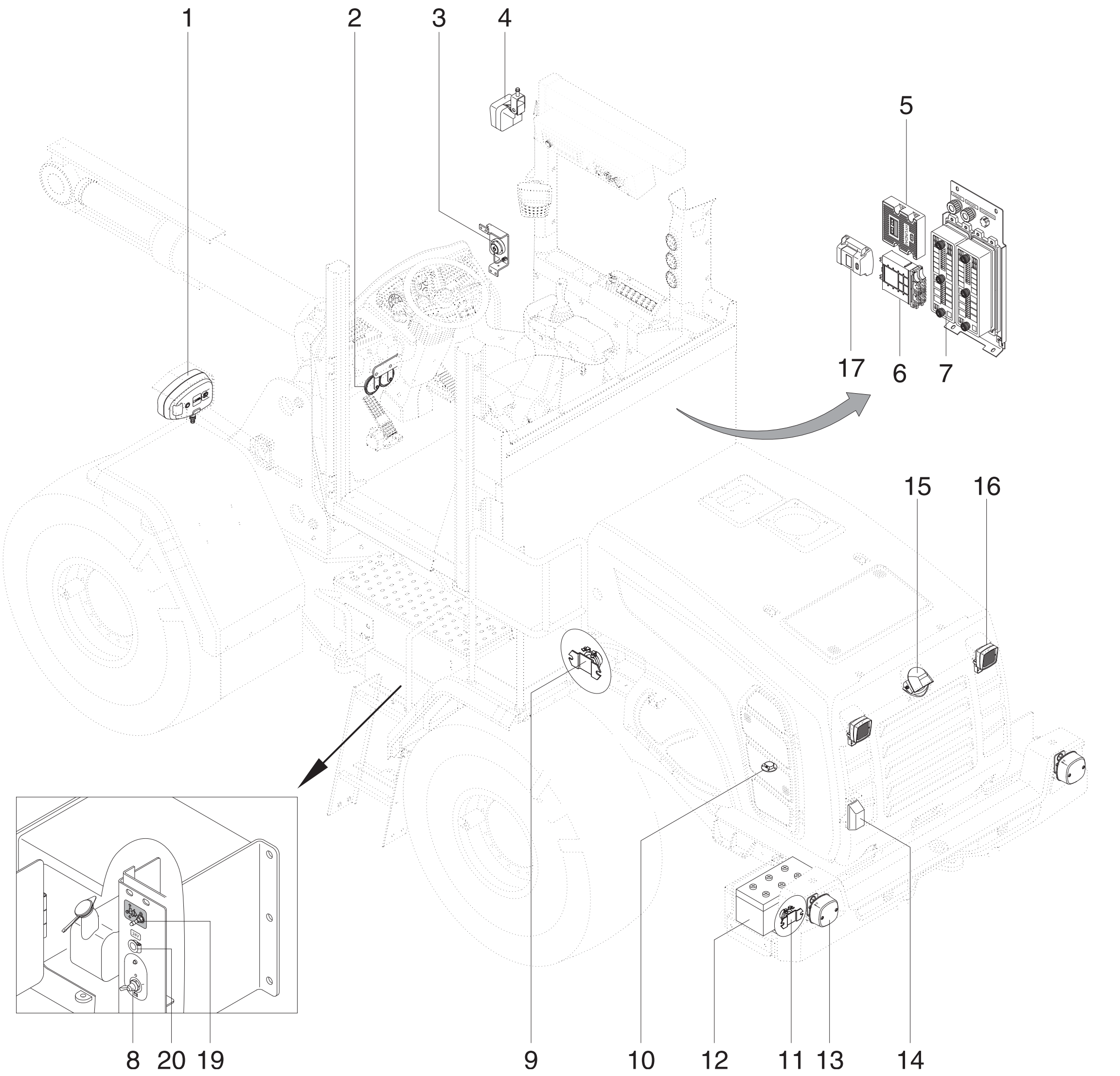
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



1	Kick down button	8	Gear select lever	14	Parking brake switch
2	Horn button	9	Radio & USB player	15	Pilot cut off switch
3	FNR switch	10	Aircon & heater switch	16	SCR switch
4	FNR select button	11	Monitor	18	Emergency test switch
5	Hone button	12	Starting switch Starting button (opt)	19	Engine control unit (ECU)
6	Multi function switch	13	Work load button		
7	Hazard switch				

2. LOCATION 2



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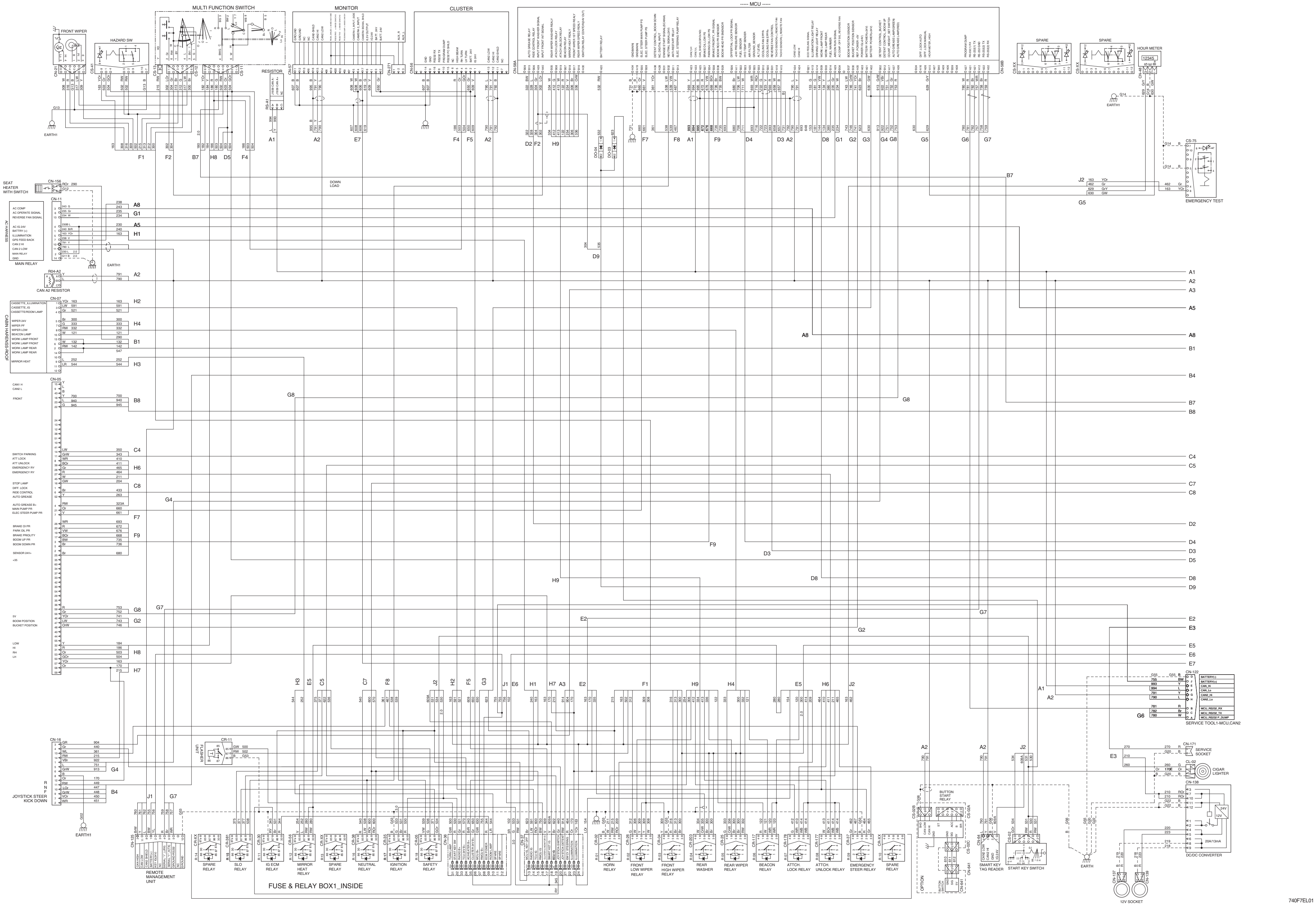
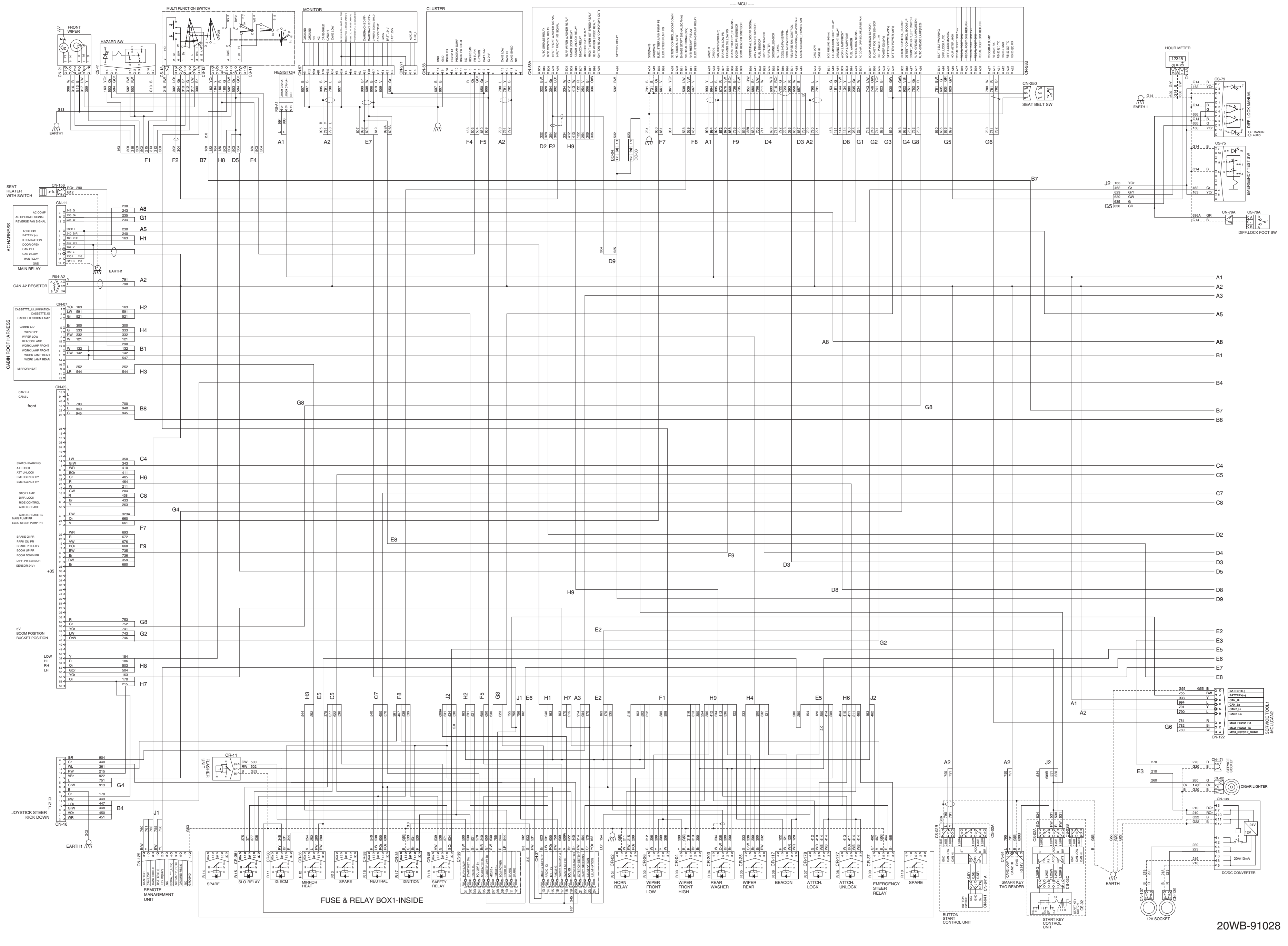
1	Head lamp	8	Master switch	15	Camera (opt)
2	Horn	9	Start relay	16	Work lamp
3	Angle sensor	10	Fuel sender	17	Control unit (RMCU)
4	Work lamp	11	Battery relay	19	Engine hood open switch
5	Machine control unit (MCU)	12	Battery	20	24V socket
6	Transmission control unit (TCU)	13	Rear combi lamp		
7	Fuse and relay box	14	Number plate lamp		

· ELECTRICAL CIRCUIT (1/3, machine serial number : ~#0492)



· ELECTRICAL CIRCUIT (1/3, machine serial number : #0493~)



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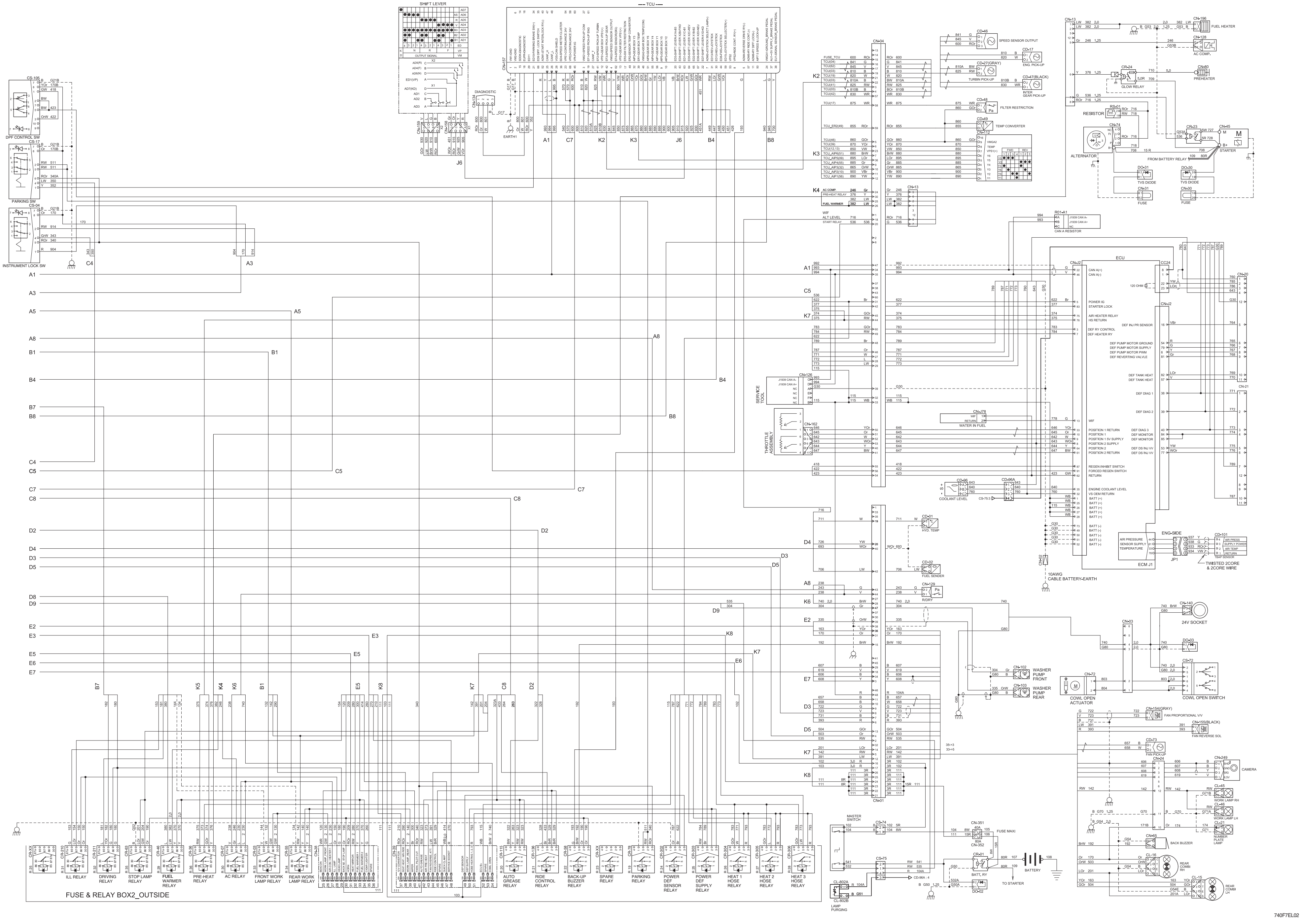
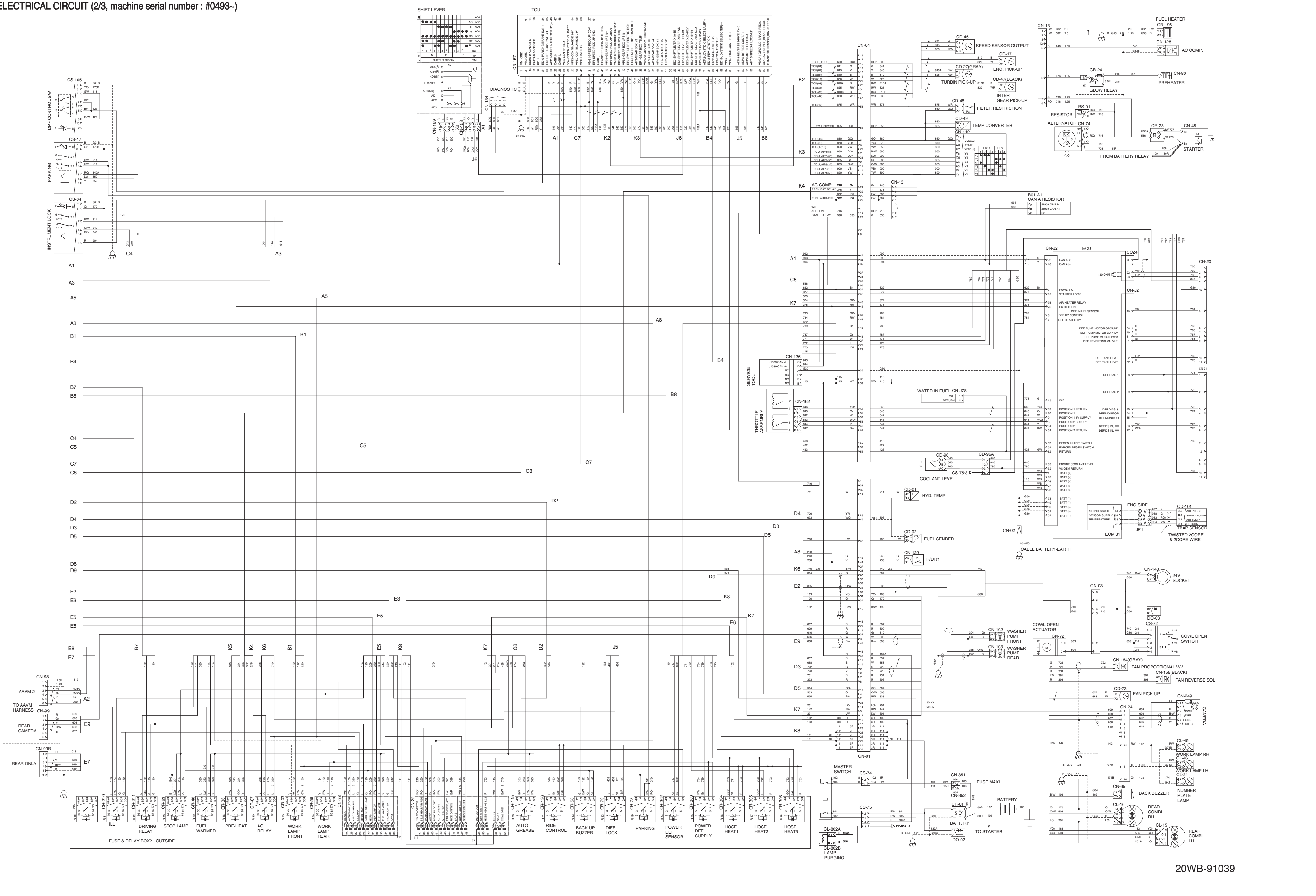
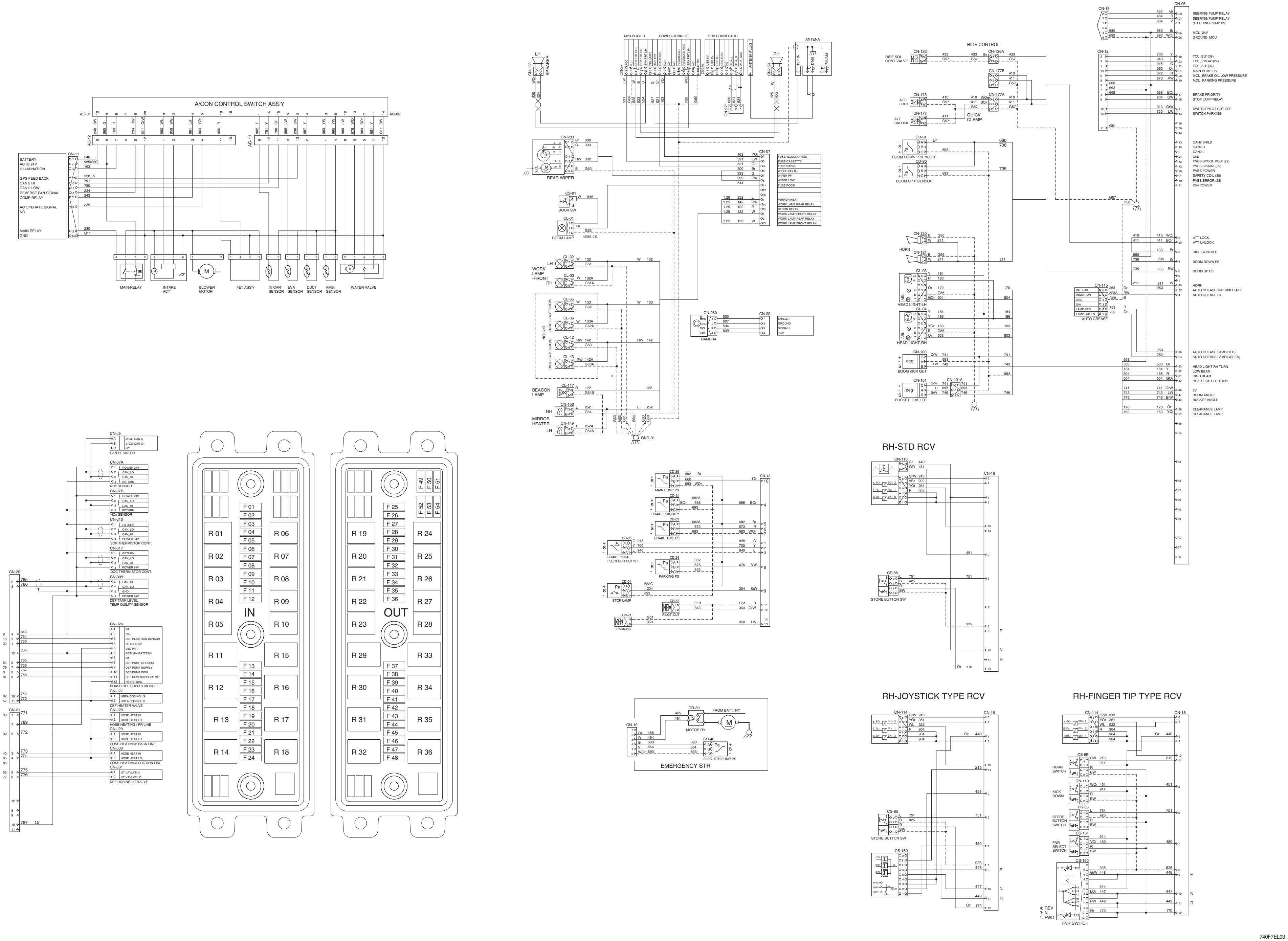
· ELECTRICAL CIRCUIT (2/3, machine serial number : ~#0492)



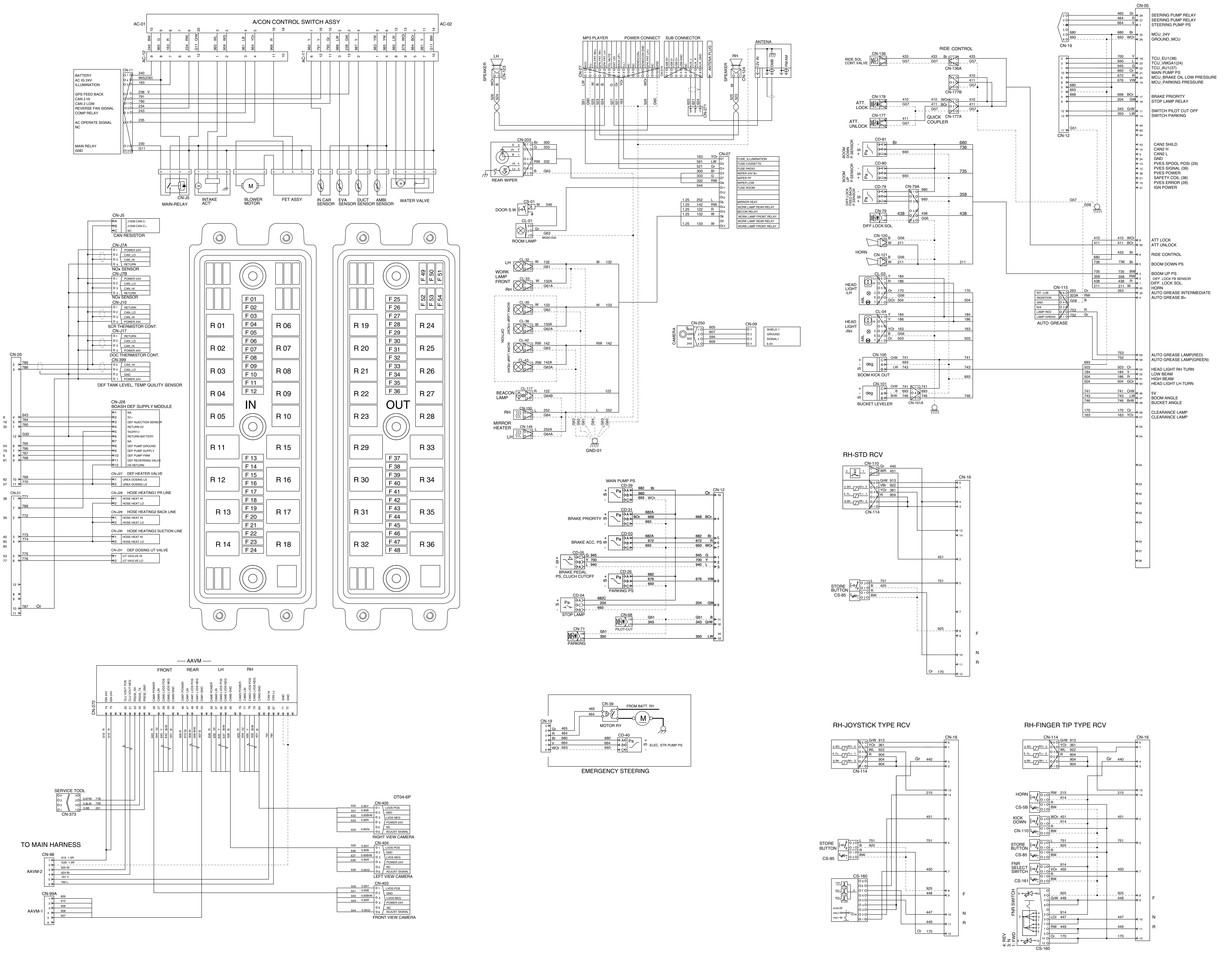
· ELECTRICAL CIRCUIT (2/3, machine serial number : #0493~)



· ELECTRICAL CIRCUIT (3/3, machine serial number : ~#0492)



· ELECTRICAL CIRCUIT (3/3, machine serial number : #0493~)



20WB-91016

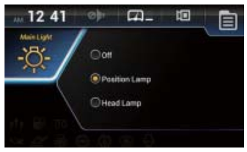
MEMORANDUM

1. ILLUMINATION CIRCUIT

1) OPERATING FLOW

Main light switch on monitor → Switch ON, Select position lamp → MCU [CN-58A (A13)]

→ Illumination relay [CR-210 (87)]



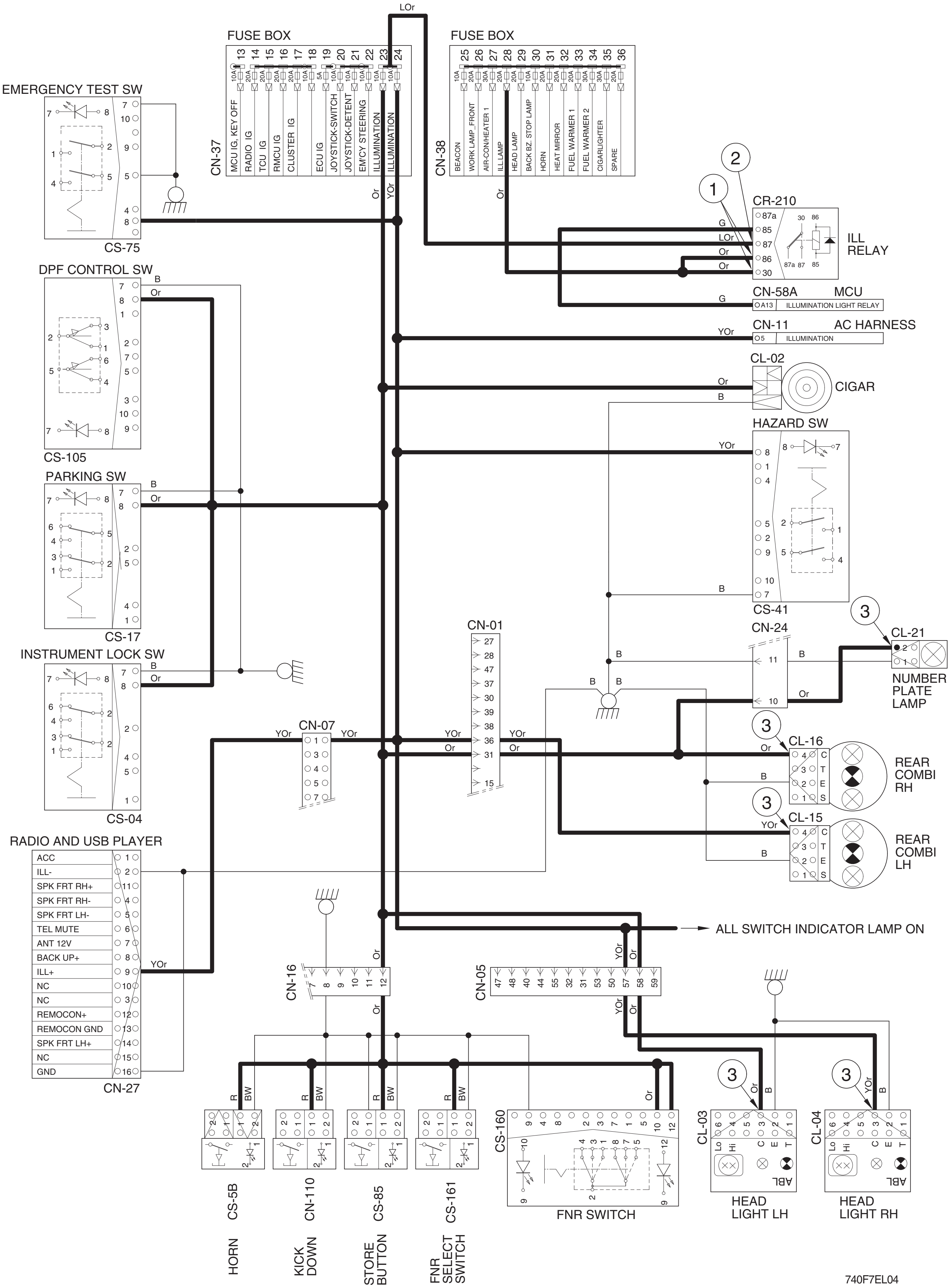
- → Fuse box [CN-37 (23)]
  - → Switch and button indicator lamp
  - → Cigar lighter lamp [CL-02]
  - → I/conn [CN-01 (31)]
    - → I/conn [CN-24 (10)]
      - → Number plate lamp [CL-21 (2)]
    - → RH Combi clearance lamp ON [CL-16 (4)]
  - → I/conn [CN-05 (58)] → LH Head lamp ON [CL-03 (3)]
- → Fuse box [CN-37 (24)]
  - → Switch indicator lamp
  - → Radio & USB player [CL-27 (9)]
  - → I/conn [CN-01 (36)] → LH Combi clearance lamp ON [CL-15 (4)]
  - → I/conn [CN-05 (57)] → RH Head lamp ON [CN-04 (3)]

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

ILLUMINATION CIRCUIT



2. HEAD LIGHT CIRCUIT

1) OPERATING FLOW

Main light switch on monitor → Switch ON, Select head lamp → MCU [CN-58A (A14)]

→ Driving relay [CR-211 (87)] → Multi function switch [CS-11(8)]

→ Multi function switch MIDDLE [CS-11(7)] → I/conn [CN-05 (32)]

→ LH Head light low beam ON [CL-03 (6)]

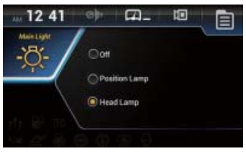
→ RH Head light low beam ON [CL-04 (6)]

→ Multi function switch DOWN [CS-11(6)] → I/conn [CN-05 (31)]

→ LH Head light high beam ON [CL-03 (4)]

→ RH Head light high beam ON [CL-04 (4)]

→ Cluster high beam pilot lamp ON [CN-56 (5)]

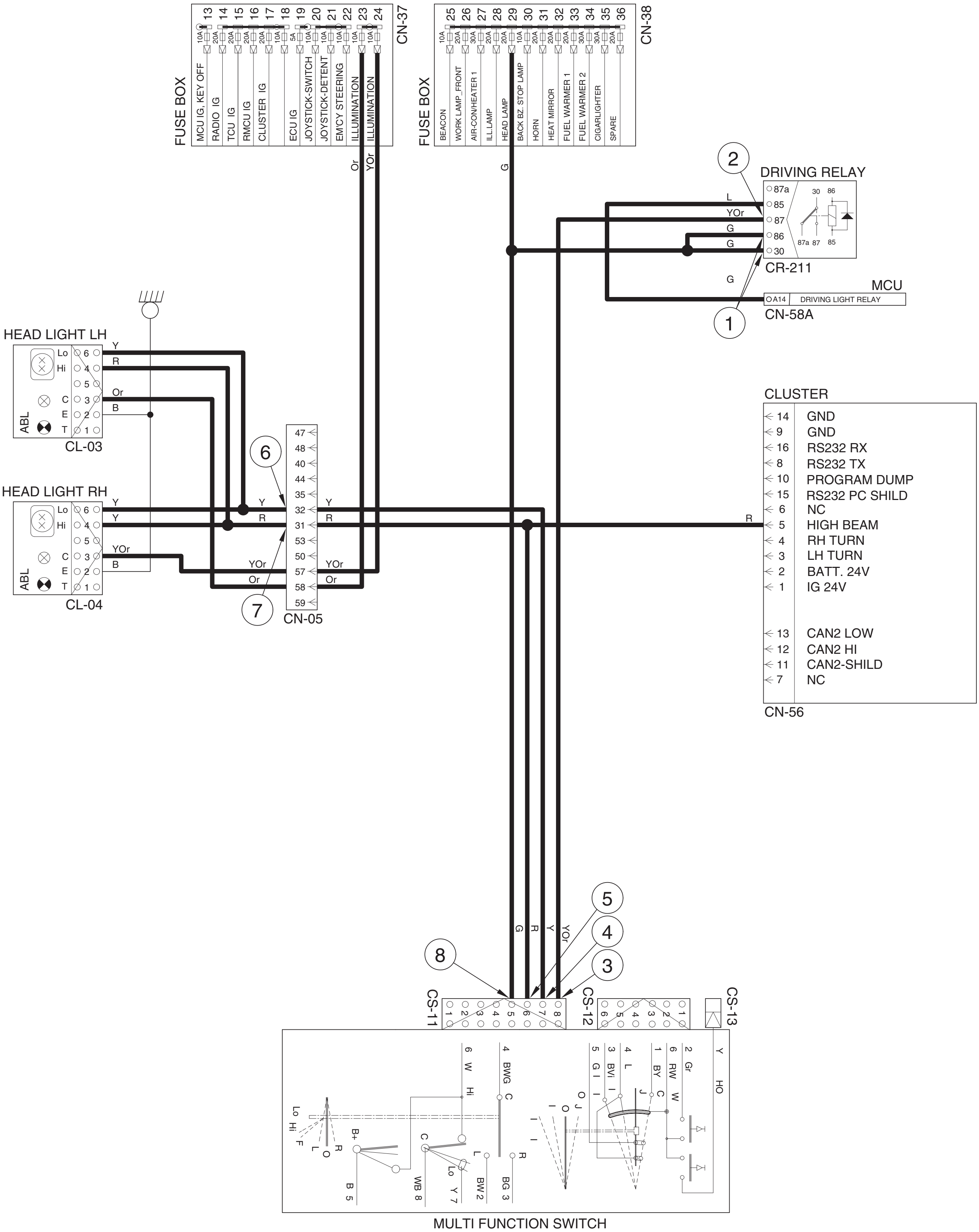


2) CHECK POINT

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^+)	20~25V

※ GND : Ground

HEAD LIGHT CIRCUIT



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3. WORK LIGHT SWITCH

1) OPERATING FLOW

※ Main light switch on monitor : Select position lamp.

(1) Work lamp switch (select Front)

MCU [CN-58B (B09)] → 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-58B (B03)] → Rear work lamp relay [CR-55 (87)] → I/conn [CN-01 (33)]

→ I/conn [CN-24 (12)] → LH Rear work lamp ON [CL-46 (1)]

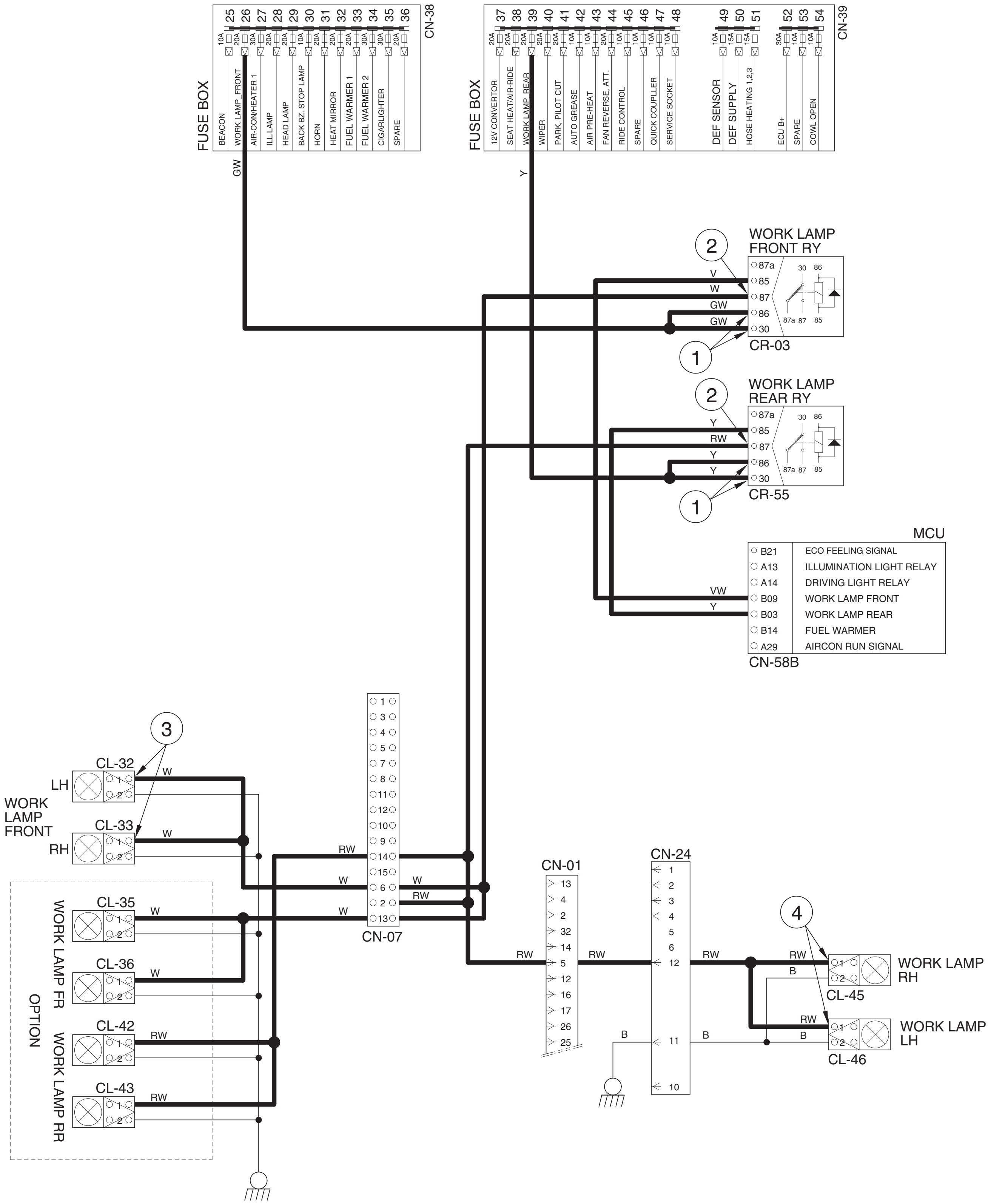
→ RH Rear work lamp ON [CL-45 (1)]

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

WORK LIGHT SWITCH



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4. STARTING CIRCUIT

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 lever is neutral position. It is necessary condition before the starting.
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.

(1) When start key switch is in ON position

Start switch ON [CS-02 (2, 3)]
- → I/conn [CN-01(2)] → Master switch [CS-75 (1) → (2)]
  → Battery relay [CR-01]
  → Battery relay operating (All power is supplied with the electric component)
- → ECM power relay [CR-30 (30) → (87)] → Fuse box [CN-37 (19)]
  → I/conn [CN-04 (31)] → ECM [CN-J2 (5)]
- → Fuse box [CN-37 (13)] → MCU [CN-58A (A03)]
- → Power relay [CR-35 (30) → (87)] → Fuse box [CN-37 (15)]
  → TCU [CN-157 (45)]

(2) When start key switch is in START position

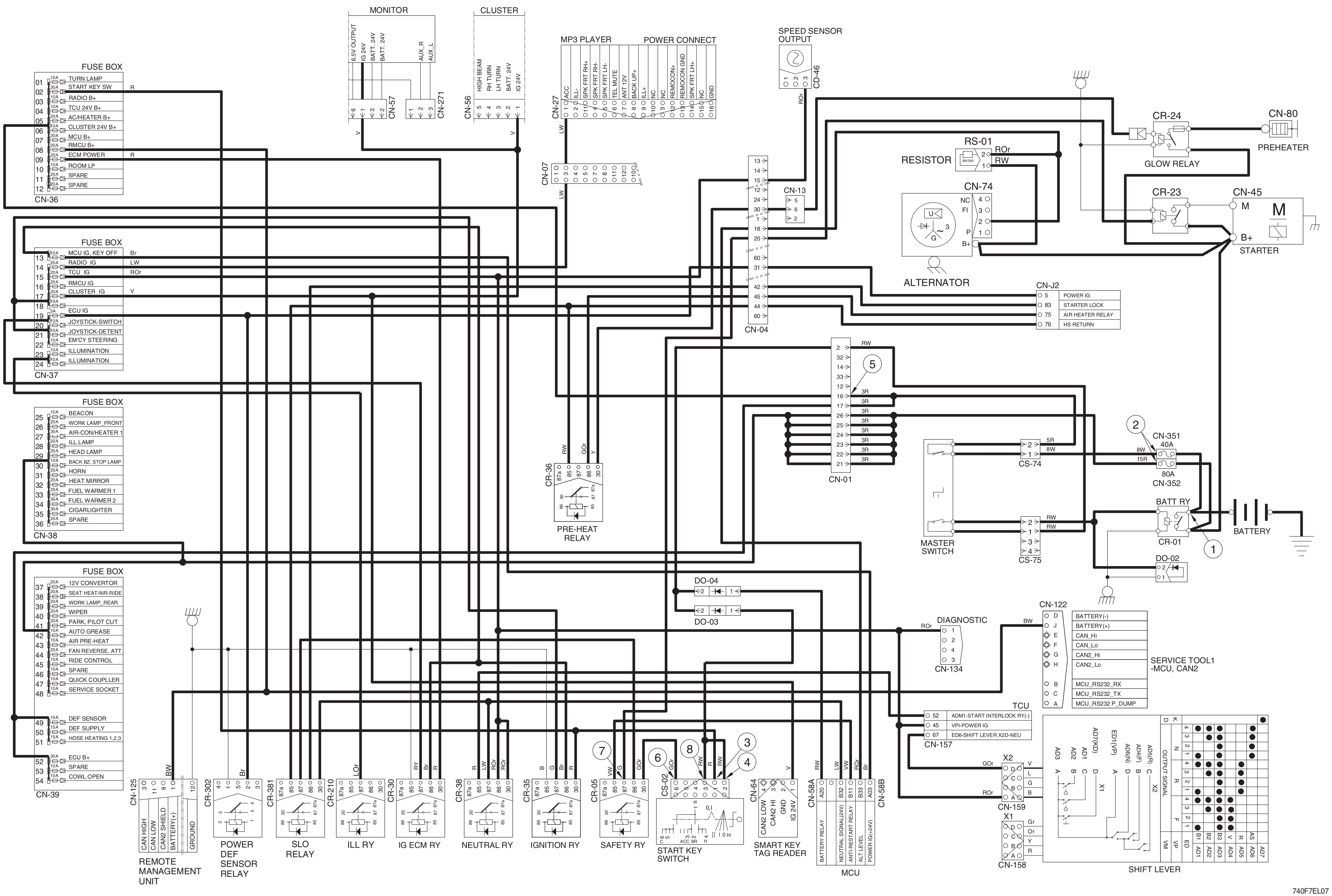
Start switch START [CS-2 (6)] → Start safety relay [CR-05 (30) → (87)] → I/conn [CN-04 (20)] → Start relay [CR-23] → Starter (terminal B^+ and M connector of start motor)

2) CHECK POINT

Engine	Key switch	Check point	Voltage
Running	ON	① - GND (battery B^+) 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

※ GND : Ground
※ ECM : Electronic control module
※ MCU : Machine control unit
※ TCU : Transmission control unit

STARTING CIRCUIT



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

Altermator [CN-74 (2)] → I/conn [CN-04 (18)] → MCU [CN-58B (B33)]
→ Cluster charge warning lamp ON

(2) Charging flow

Alternator → Starter [CN-45 (B+)] → 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]

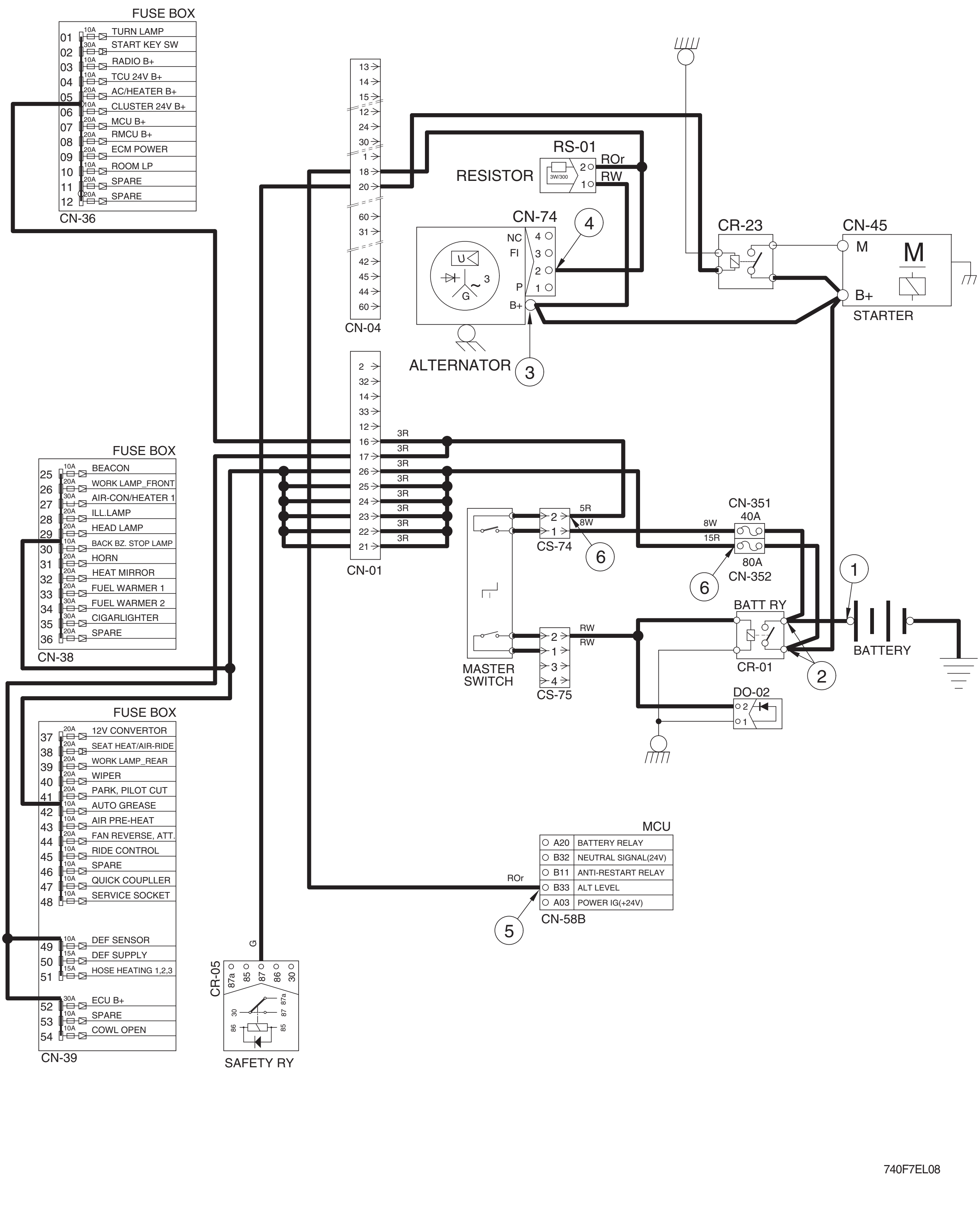
2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	ON	① - GND (battery) ② - GND (battery relay) ③ - GND (alternator B+) ④ - GND (alternator 2) ⑤ - GND (MCU) ⑥ - GND (fuse box)	20~28V

※ GND : Ground

※ MCU : Machine control unit

CHARGING CIRCUIT

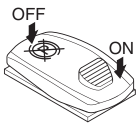


6. ELECTRIC PARKING, PILOT CUT OFF CIRCUIT

1) OPERATING FLOW

(1) Parking OFF

Fuse box [CN-39 (41)] → Parking switch OFF → [CS-17 (5)→(4)] → I/conn [CN-05 (14)]
→ I/conn [CN-12 (13)]
→ Parking solenoid ON (activated)
→ Parking brake released (by hydraulic pressure)
→ [CS-17 (2)→(1)] → T/M control unit [CN-157 (21)]



(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

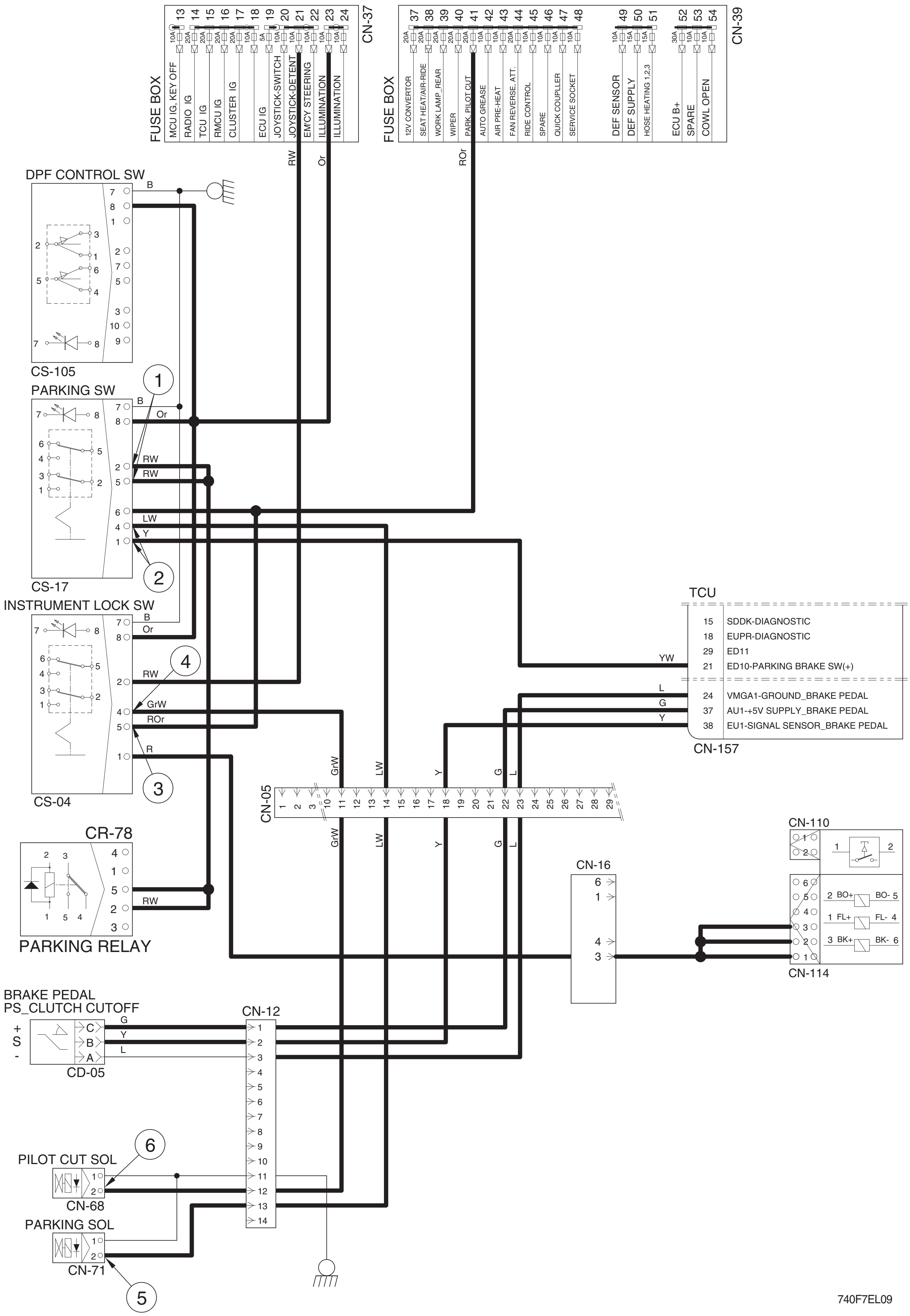
Fuse box [CN-39 (41)] → Pilot cut off switch OFF → Pilot cut off solenoid [CN-68] OFF
→ Pilot cut off applied

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

ELECTRIC PARKING, PILOT CUT OFF CIRCUIT



7. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

Fuse box [CN-39 (40)]
- → Wiper relay Hi [CR-4 (3)→(4)]
  - → Front wiper motor [CN-21 (1)]
  - → Wiper relay Lo [CR-26 (5), (2)]
- → Multi function switch [CS-12 (6)]
- → Rear washer relay [CR-203 (2, 3)]
- → Rear wiper relay [CR-25 (2, 5)]
- → I/conn [CN-07 (5)] → Rear wiper motor [CN-203 (1)]

(1) Front washer switch ON

① Washer switch ON [CS-12(6)→(2)]
- → Front washer [CN-102 (1)] → Washer operating
- → MCU [CN-58A (A39)→(B17)] → Front wiper relay Lo [CR-26 (5)→(3)] → Front wiper motor [CN-21 (5)] → Wiper motor operating (low)

(2) Front wiper switch ON

① INT position

Wiper switch ON [CS-12 (6)→(1)] → MCU [CN-58A (A40)→(B17)] → Wiper relay Lo [CR-26 (5)→(3)] → Front wiper motor [CN-21(5)] → Front wiper motor intermittently operating

② Lo position

Wiper switch ON [CS-12 (6)→(4)] → Wiper relay Lo [CR-26 (4)→(3)] → Front wiper motor [CN-21 (5)] → Front wiper motor operating (low)

③ Hi position

Wiper switch ON [CS-12 (6)→(3)] → Wiper relay Hi [CR-4(3)→(5)] → Front wiper motor [CN-21(4)] → Front wiper motor operating (high)

(3) Auto-parking (when switch OFF)

Switch OFF → Fuse box [CN-39 (40)] → Wiper relay Hi [CR-4 (3)→(4)] → Front wiper motor [CN-21 (1)→(2)] → Multi function switch [CS-12 (5)→(4)] → Wiper relay Lo [CR-26 (4)→(3)] → Front wiper motor [CN-21 (5)] → Wiper motor stop

(4) Rear wiper and washer switch

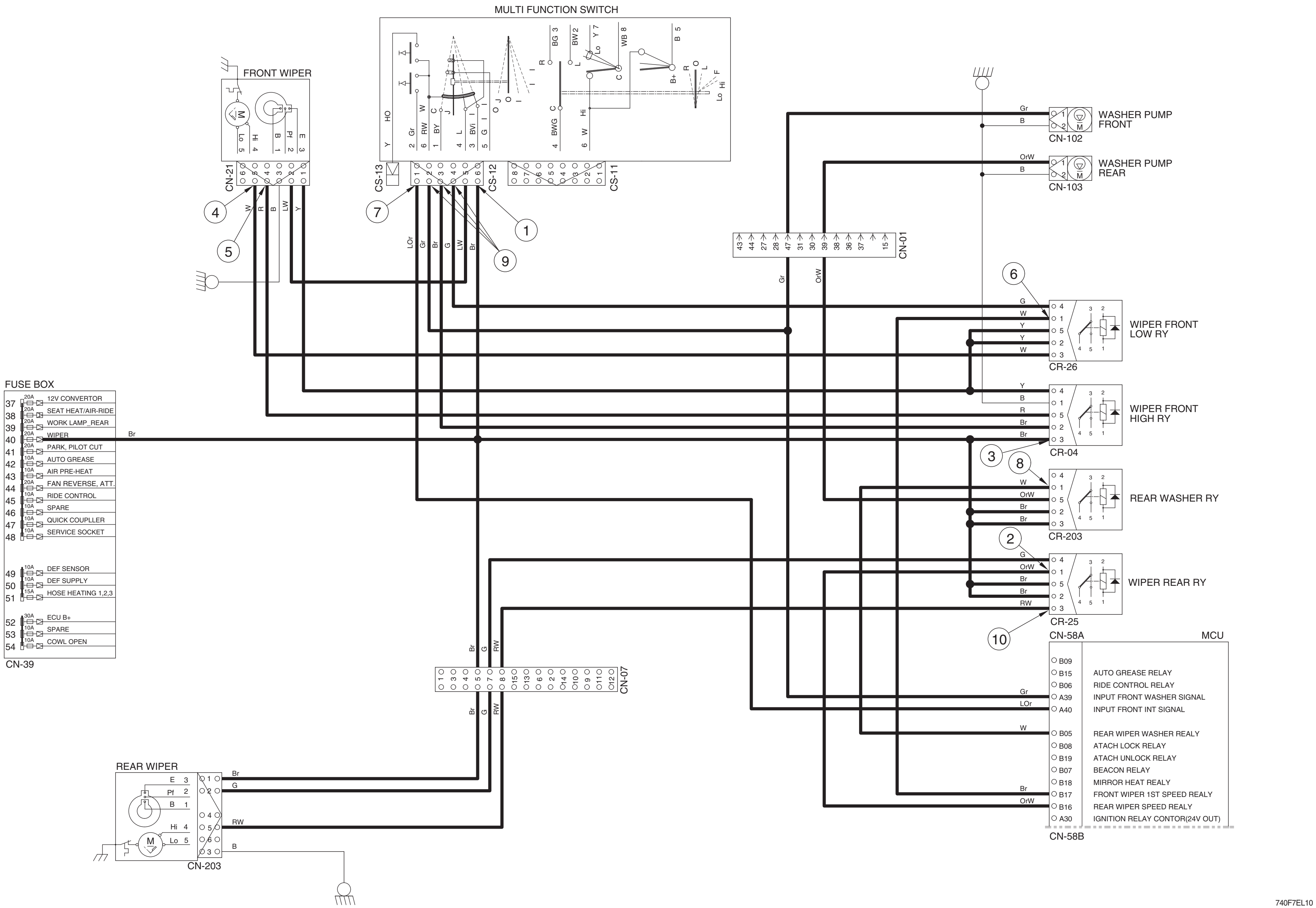
Rear wiper switch on monitor
- → MCU [CN-58B (B16)] → Rear wiper relay [CR-25 (5)→(3)] → I/conn [CN-07 (8)] → Rear wiper motor [CN-203 (5)] → Rear wiper motor operating
- → MCU [CN-58B (B05)] → Rear washer relay [CR-203 (3)→(5)] → I/conn [CN-01 (39)] → Rear washer pump [CN-103 (1)] → Washer operating

2) CHECK POINT

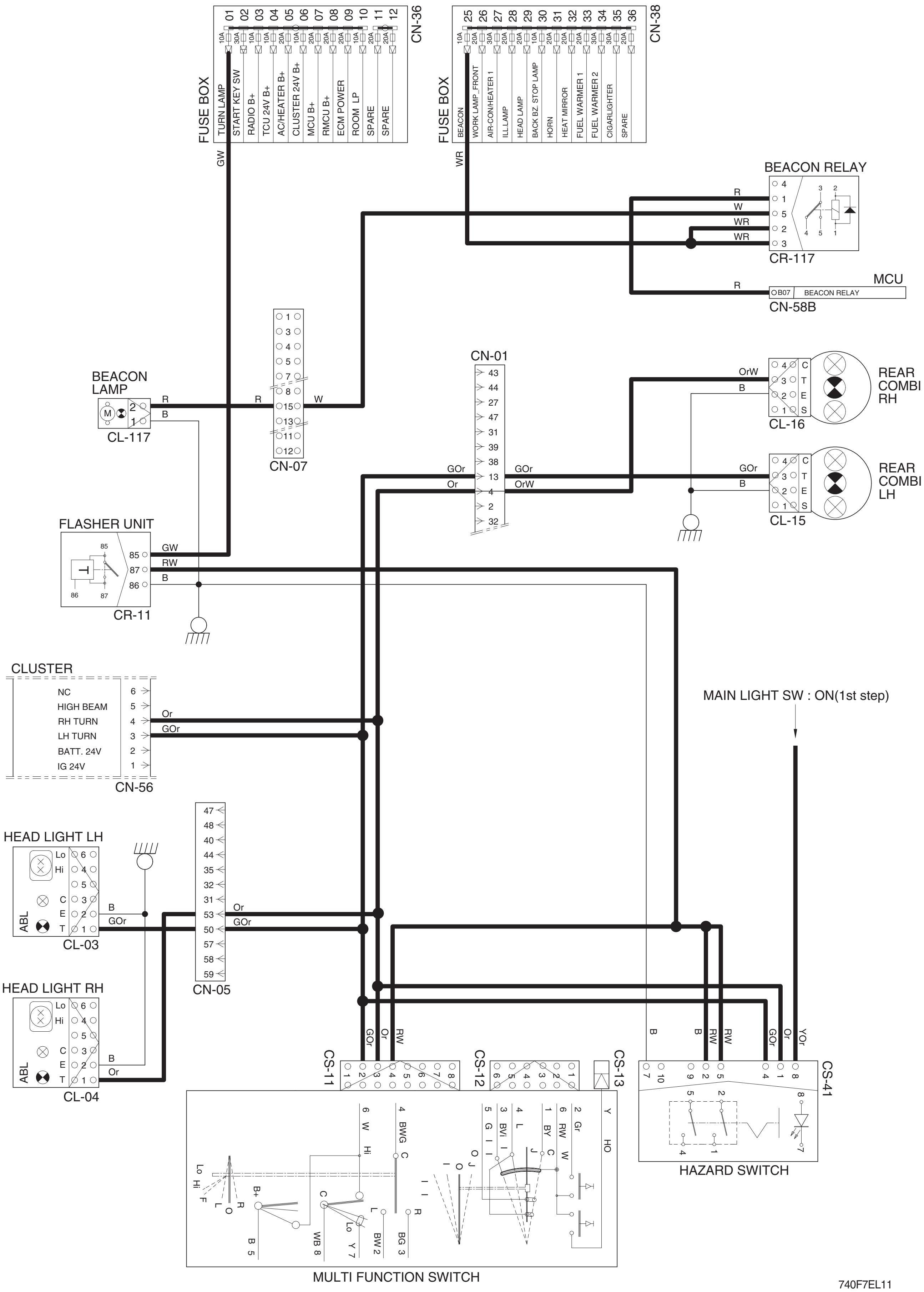
Condition	Check point	
Engine : Stop Key switch : ON Voltage : 20~25V	① - GND (front wiper switch power input)	⑥ - GND (wiper relay power input)
	② - GND (rear wiper relay power input)	⑦ - GND (front washer power output)
	③ - GND (wiper relay power input)	⑧ - GND (rear washer power output)
	④ - GND (front 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

WIPER AND WASHER CIRCUIT



HAZARD, TURN AND ROTARY CIRCUIT



GROUP 3 MONITORING SYSTEM

1. CLUSTER

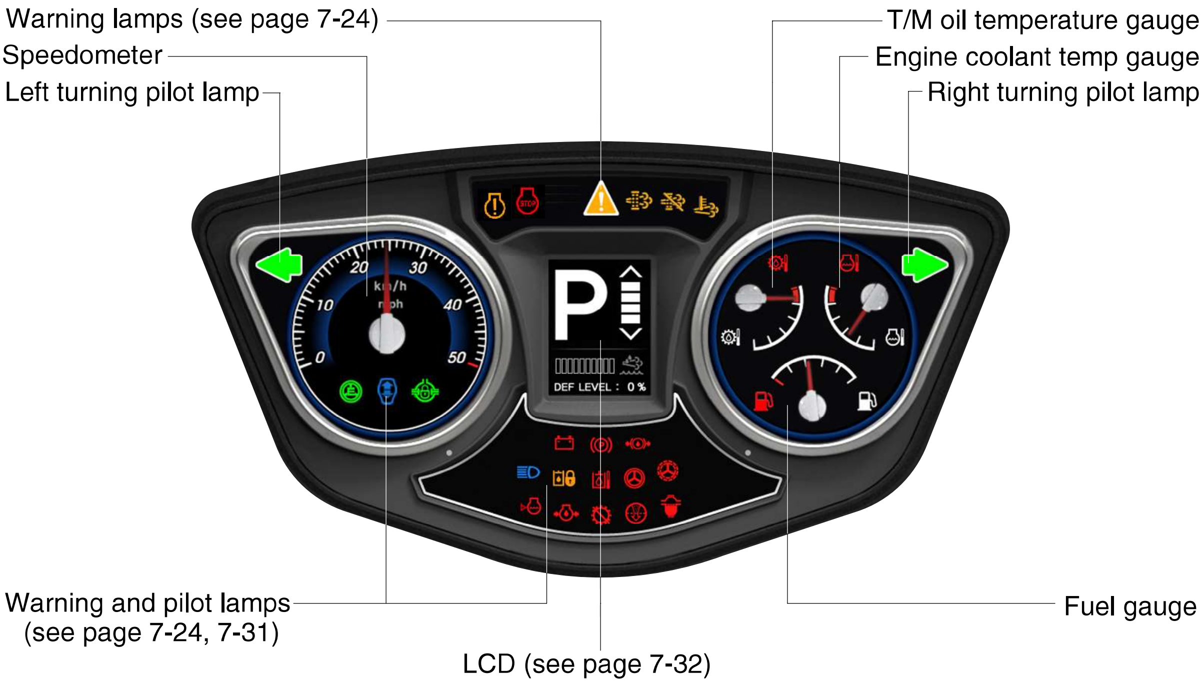
1) STRUCTURE

The cluster consists of gauges, lamps and LCD as shown below, to warn the operator in case of abnormal machine operation or conditions for the appropriate operation and inspection.

- Gauges : Indicate operating status of the machine.
- Warning lamps : Indicate abnormality of the machine.
- Pilot lamps : Indicate operating status of the machine.
- LCD : Indicates selected the driving speed and direction.

※ **The cluster installed on this machine does not entirely guarantee the condition of the machine. Daily inspection should be performed according to chapter 6, MAINTENANCE.**

※ **When the cluster provides a warning immediately check the problem, and perform the required action.**



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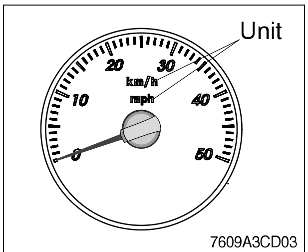
2) GAUGE

(1) Speedometer



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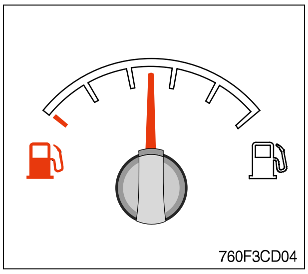
① The speedometer displays the speed of machine in mph and km/h.

※ **The unit (km/h or mph) can be set by the display set up menu of the monitor and selected unit is displayed.**
Refer to page 7-54.

(2) Fuel gauge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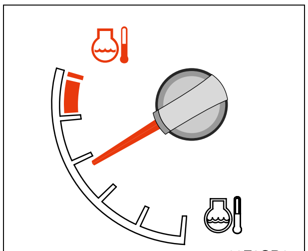
① This gauge indicates the amount of fuel in the fuel tank.

② Fill the fuel when the indicator moves red range or lamp blinks in red, refuel as soon as possible to avoid running out of fuel.

※ **If the gauge indicates red range even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

(3) Engine coolant temperature gauge

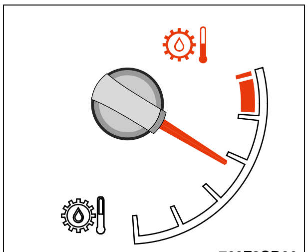

760F3CD05

① This gauge indicates the temperature of coolant.
- White range : 40~105˚C (104~221˚F)
- Red range : Above 105˚C (221˚F)

② If the indicator is in the red range or lamp blinks in red, turn OFF the engine and check the radiator and engine.

※ **If the gauge indicates red range even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

(4) Transmission oil temperature gauge

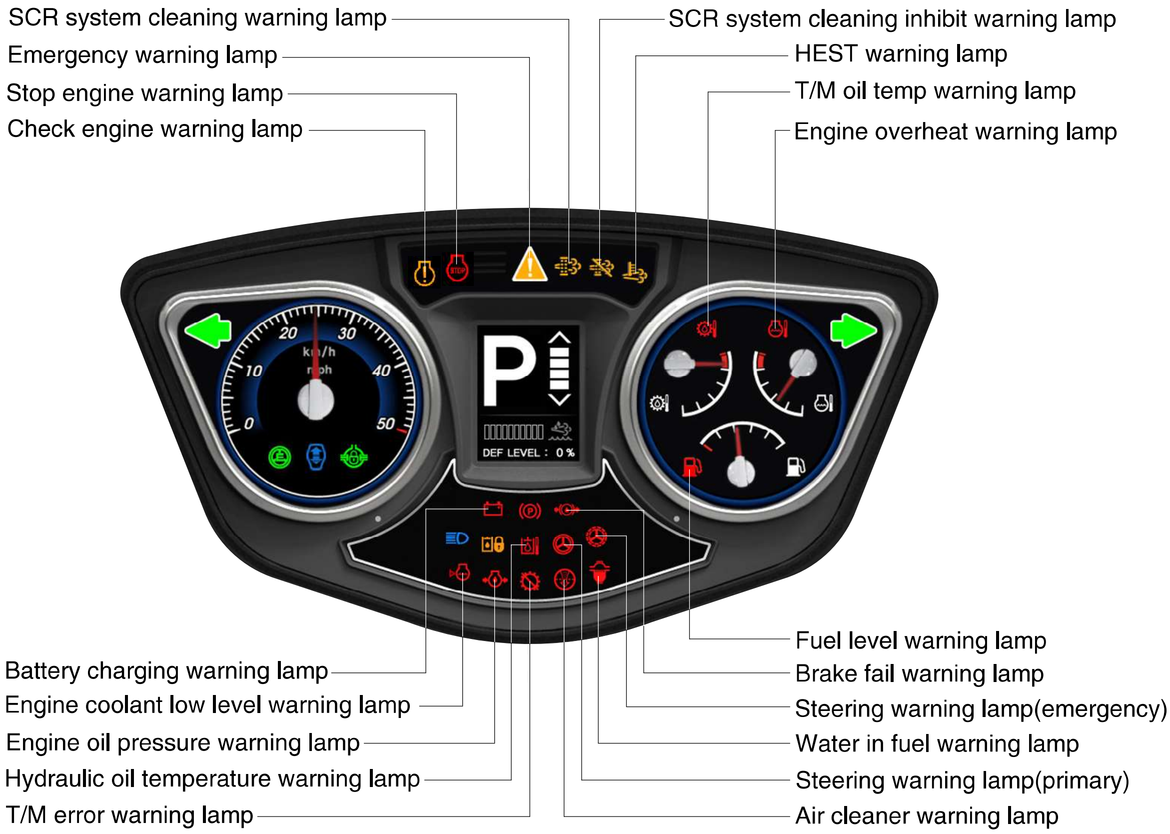

760F3CD06

① This gauge indicates the temperature of transmission oil.
- White range : 40~107˚C (104~225˚F)
- Red range : Above 107˚C (225˚F)

② If the indicator is in the red range or lamp blinks in red, it means the transmission is overheated. Be careful that the indicator does not move into the red range.

※ **If the gauge indicates red range even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

3) WARNING LAMPS



760F3CD09

(1) Emergency warning lamp

75793CD95

① This lamp blinks when each of the below warnings is happened.
- Warning lamps light ON
- MCU input voltage abnormal
- Monitor communication data error
- Engine ECM and TCU communication data error

② When this warning lamp blinks, machine must be checked and service immediately.

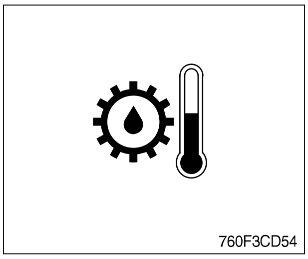
(2) Engine overheat warning lamp

760F3CD53

① This lamp is turned ON when the temperature of coolant is over the normal temperature (105˚C, 221˚F).

② Check the cooling system when the lamp is ON.

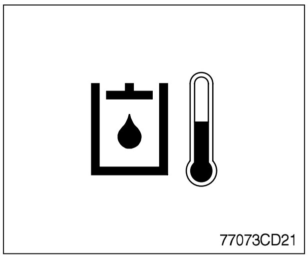
(3) Transmission oil temperature warning lamp



① This lamp is turned ON when the temperature of transmission oil is over the normal temperature (107˚C, 225˚F).

② When this lamp lights up during operation, stop the engine and check the machine.

(4) Hydraulic oil temperature warning lamp



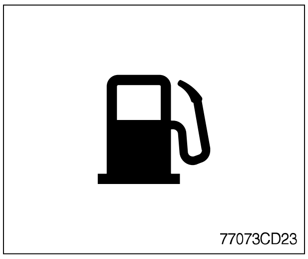
① This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 106˚C (223˚F).

② Check the hydraulic oil level when the lamp is turned ON and the buzzer sounds.

③ Check for debris between oil cooler and radiator.

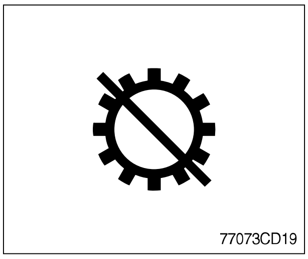
※ **If you want to stop buzzer sound, just touch the icon.**

(5) Fuel level warning lamp



① This warning lamp lights ON when the fuel level is low. Refuel the machine as soon as possible.

(6) Transmission error warning lamp



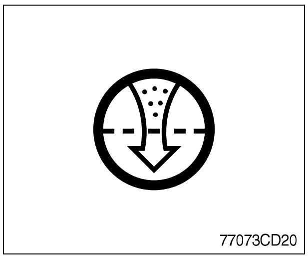
① This lamp lights ON and the LCD display show the error codes when an error occurs in the transmission.

② Immediately pull the machine to a convenient stop. Stop the engine. Investigate the cause.

※ **Consult a HYUNDAI dealer to investigate the cause.**

※ **Do not operate until the cause has been corrected.**

(7) Air cleaner warning lamp



① This lamp lights ON and the buzzer sounds when the filter of air cleaner is clogged.

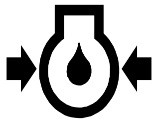
② When the air cleaner warning lamp is ON and the buzzer sounds, check and clean the primary element.

※ **If you want to stop buzzer sound, just touch the icon.**

※ **The primary element should be replaced if the warning lamp is ON after installation of a clean primary element.**

※ **Replace the primary element after 4 times cleanings.**

(8) Engine oil pressure warning lamp



77073CD18

① This lamp is comes ON and the buzzer sounds after starting the engine because of the low engine oil pressure.

② If the lamp comes ON and the buzzer sounds during engine operation, shut OFF engine immediately. Check engine oil level.

※ **If you want to stop buzzer sound, just touch the  icon.**

(9) Steering warning lamp

77073CD66

① Primary

This lamp indicates that the primary steering has failed. When the indicator comes ON and the action alarm sounds, steer the machine immediately to a convenient location and stop the machine. Stop the engine and investigate the cause.

※ **If you want to stop buzzer sound, just touch the  icon.**

※ **Do not operate the machine until the cause has been corrected.**

77073CD15

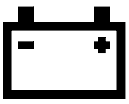
② Emergency

This lamp indicates the emergency steering system is active.

※ **Immediately pull the machine to a convenient stop and stop the engine.**

※ **The emergency steering system can be manually tested. Refer to page 7-65.**

(10) Battery charging warning lamp



77073CD22

① This lamp is ON and the buzzer sounds when key ON, it is turned OFF after starting the engine.

② Check the battery charging circuit when this lamp comes ON and the buzzer sounds, during engine operation.

※ **If you want to stop buzzer sound, just touch the  icon.**

(11) Brake fail warning lamp

77073CD16

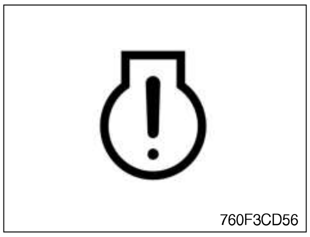
① The lamp lights ON and the buzzer sounds when the oil pressure of service brake drops below the normal range.

② When the lamp is ON and the buzzer sounds, stop the engine and check for its cause.

※ **If you want to stop buzzer sound, just touch the  icon.**

※ **Do not operate until any problems are corrected.**

(12) Check engine warning lamp

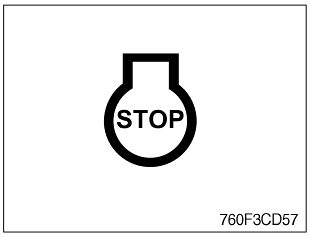


① This lamp lights ON and the buzzer sounds when the communication between MCU and engine ECM on the engine is abnormal, or if the cluster received specific fault code from engine ECM.

② Check the communication line between them.
If the communication line is OK, then check the fault codes on the monitor.

※ **If you want to stop buzzer sound, just touch the  icon.**

(13) Stop engine warning lamp



① This lamp lights ON when 30 minutes elapsed with empty condition of the DEF/AdBlue® tank, stop the engine immediately and check the DEF/AdBlue® tank.

② Fill the DEF/AdBlue® immediately in the DEF/AdBlue® tank.

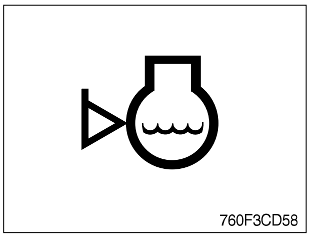
※ **Refer to page 7-30.**

③ This lamp lights ON when the stationary SCR system cleaning is not performed.

※ **Refer to page 7-28.**

※ **Please contact your Hyundai service center or local dealer.**

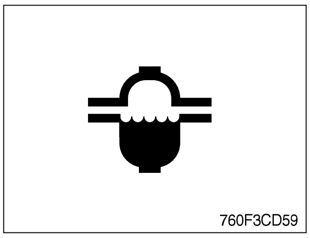
(14) Engine coolant low level warning lamp



① This warning lamp lights ON when the level of coolant is low.

② Fill the coolant immediately when the lamp is ON.

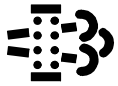
(15) Water in fuel warning lamp



① This warning lamp lights ON when the water separator is full of water or malfunctioning.

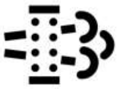
※ **When this lamp lights ON, stop the machine and spill water out of the separator.**

(16) SCR (selective catalytic reduction) system cleaning warning lamp

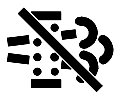


7609A3CD52

① This warning lamp lights ON or blinks when the SCR system cleaning is needed as table below.

Warning lamp			Description
SCR 	Check engine 	Stop engine 	
Off	Off	Off	· Automatic SCR system cleaning
Blink	Off	Off	· The status of a manual (stationary) SCR system cleaning when the SCR system cleaning switch has been activated. **※ Refer to page 7-29.**
On	On	Off	· The aftertreatment SCR system needs to be cleaned immediately. · Engine power will be reduced automatically if action is not taken. ※ The SCR system cleaning can be accomplished by : - Changing to more challengine duty cycle. - Performing a manual SCR system cleaning.
On	On	On	· These lamps will be ON when a stationary (manual) SCR system cleaning is not performed. · Stop the engine immediatary. · Please contact your Hyundai service center or local dealer.

(17) SCR system cleaning inhibit warning lamp

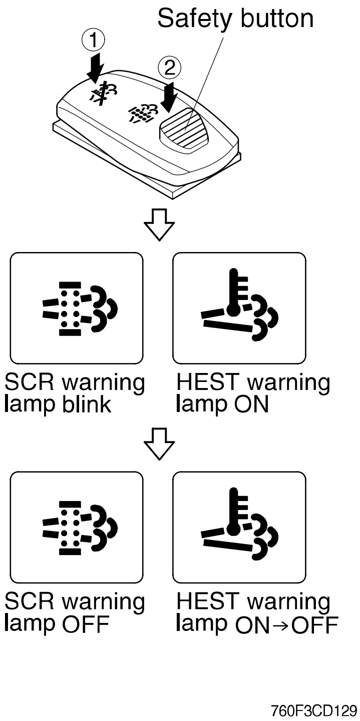


7609A3CD54

① This warning lamp indicates, when illuminated, the SCR system cleaning switch is pushed inhibit position, therefore automatic and manual SCR system cleaning can not occur.

※ **Refer to the page 7-66 for the SCR system cleaning switch.**

※ Manual SCR system cleaning



※ **Manual SCR system cleaning applies if the machine is in a fireproof area.**

※ **To stop a manual SCR system cleaning before it has completed, set to the SCR system cleaning switch to the inhibit position or turn OFF the engine.**

① Stop and park the machine.

② Pull the safety button and push the switch to position ② to initiate the manual SCR system cleaning.

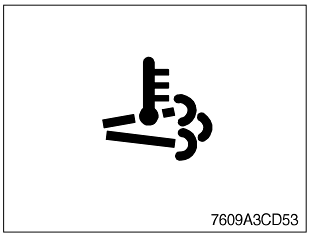
※ **Refer to the page 7-66 for the SCR system cleaning switch operation.**

※ **The engine speed may increase to 950~1050 rpm and SCR system cleaning begins and it will take approximately 20~60 minutes.**

③ The SCR system cleaning warning lamp will blink and HEST warning lamp will light ON during the SCR system cleaning is operating.

④ The SCR system cleaning and/or HEST warning lamp will light OFF when the SCR system cleaning is completed.

(18) **HEST** (High exhaust system temperature) **warning lamp**



① This warning lamp indicates, when illuminated, that exhaust temperatures are high due to SCR system cleaning.

② The lamp will also illuminate during a manual SCR system cleaning.

③ When this lamp is illuminated, be sure the exhaust pipe outlet is not directed at any surface or material that can melt, burn, or explode.

⚠ **When this lamp is illuminated, the exhaust gas temperature could reach 800˚C [1500˚F], which is hot enough to ignite or melt common materials, and to burn people.**

※ **The lamp does not signify the need for any kind of equipment or engine service; It merely alerts the equipment operator to high exhaust temperatures. It will be common for the lamp to illuminate on and off during normal equipment operation as the engine completes SCR system cleaning.**

(19) DEF/AdBlue® level warning lamp

760F3CD155

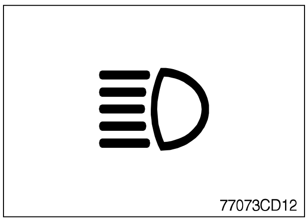
① This warning lamp indicates when ON or blinking, that the DEF/AdBlue® level is low as table below.

※ **It is recommended that the DEF/AdBlue® tank be filled completely full of the DEF/AdBlue® in order to correct any fault conditions.**

Warning lamp			Description
DEF/AdBlue® level 	Check engine 	Stop engine 	
On	Off	Off	· The DEF/AdBlue® level has fallen below the initial warning level (10%).
Blink	Off	Off	· The DEF/AdBlue® level has fallen below the critical warning level (5%).
Blink	On	Off	· The DEF/AdBlue® level has fallen below the initial derate level (2.5%). · The engine power will be limited automatically.
Blink	On	On	· This is happened when 30 minutes elapsed with empty conditions (0%) of the DEF/AdBlue® tank. · The engine will enter the final derate level which may include low idle lock or engine shutdown with restart limitations. · In order to remove the final derate, the DEF/AdBlue® tank must be filled to above 10 persent gauge reading.

4) PILOT LAMPS

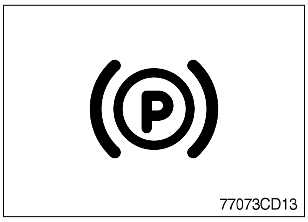
(1) High beam pilot lamp



① This lamp works when the illuminating direction is upward.

② This lamp comes ON when the dimmer switch is operated, e.g., when passing another vehicle.

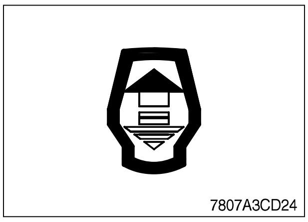
(2) Parking brake pilot lamp



① When the parking brake is actuated, the lamp lights ON.

※ **Check the lamp is OFF before driving.**

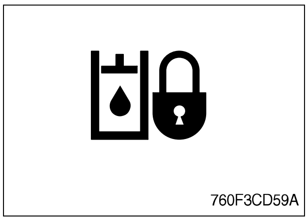
(3) FNR select pilot lamp (option)



① The lamp comes ON when FNR select button on the optional FNR remote control lever is pressed.

※ **Refer to page 7-67.**

(4) Pilot cut off pilot lamp

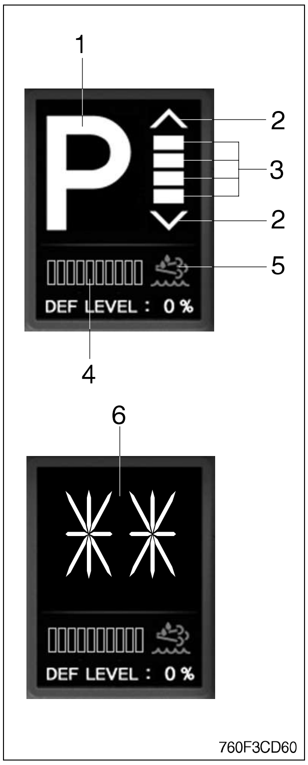


760F3CD59A

① This lamp lights ON when the pilot cut off switch is pressed.

※ Refer to page 7-65.

5) LCD



760F3CD60

(1) The LCD can be used with the gear selector.
It indicates speed, driving direction, DEF/AdBlue® level and transmission warning.

No	Symbol	Meaning	Remark
1	△, ▽, N	Actual gear display	Forward, reverse, neutral
	1, 2, 3, 4, 5		Actual gear
	P		Parking brake mode active
2	^, v	Forward, reverse	FWD 1 ~ FWD 5, REV 1 ~ REV 5
3		Gear range display	
4		DEF/AdBlue® level	Dispaly the amount of liquid in the DEF/AdBlue® tank
5		DEF/AdBlue® level warning lamp	Fill the DEF/AdBlue® when the lamp ON or blinks in red. - ON : DEF/AdBlue® level 5~10% - Blink : DEF/AdBlue® level below 5% ※ If the lamp ON or blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.
6	LF, LR	Limp home gear	-
	✳✳	Oil temperature too low, no gear available	Warm up engine / transmission
	WS	Warning sump temperature	Alternate between WS and actual gear / direction while driving, in neutral only displayed WS if no fault is detected ※ Cool down transmission
	WT	Warning torque converter temperature	Alternate between WS and actual gear / direction while driving, in neutral only displayed WS if no fault is detected ※ Cool down transmission

2. MONITOR (7 inch touch screen)

· The monitor is adjustable.
- Vertical : 30˚
- Horizontal : 15˚

760F3CD20-1

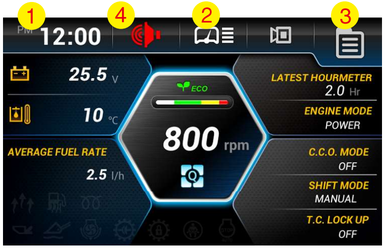
1) MAIN DISPLAY

※ You can select or set the menu by the switches or touch screen.
※ Please refer to switch, page 7-59 for selection and change of menu and input value.
※ Display type can be changed by operator. See page 7-54 for details.

760F3CD11-1

1	Clock	6	Machine monitoring	11	Engine rpm
2	Buzzer	7	Fuel rate	12	Quick menu
3	Wiper speed	8	Engine mode/Operation history	13	10 lamps
4	Camera screen	9	Transmission mode		
5	Menu	10	ECO gauge		

(1) Menu bar



760F3CD07-1

※ In main display, you can move to right side menu by touching each icon.

① **Clock setting**

Set the time (hour, minute and AM or PM)

② **Wiper speed**

Set the wiper speed (slow, normal, fast and very fast)

③ **Menu**

Move to main menu.

④ **Buzzer stop**

If you want to stop buzzer sound, just touch the icon.

① Clock setting

760F3CD07A-1

② Wiper speed

760F3CD07B-1

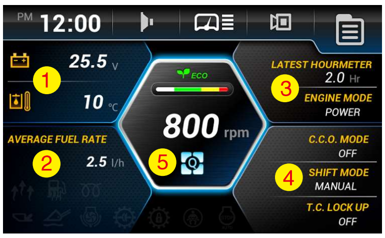
③ Menu

760F3CD07C-1

④ Buzzer stop

760F3CD07E-1

(2) Change display information



760F3CD08-1

※ In main display, you can check the data and setup what you want by touching each window area or icon.

① **Machine monitoring**

To display the item in main display, select two items of them.

※ **Priority in the machine monitoring display**

The priority of the weighing system is the highest.

If the weighing system is selected, the other items are not available.

To display the other items, the weighing system should not be selected.

※ **Weighing system : see page 7-42.**

① Machine monitoring

760F3CD08A-1

② Fuel rate

· Set average fuel rate or a days fuel used on main display screen.

· Refer to page 7-49.

② Fuel rate

760F3CD08B-1

③ Engine mode and operation history

· Set the engine mode (A).

· Refer to page 7-39.

· Set Hour meter / ODO meter (B).

· Refer to page 7-48.

③ Engine mode

A 760F3CD08D-1

B 760F3CD08K-1

④ Transmission mode

· Set the clutch cut off (A) and shift (B) mode.

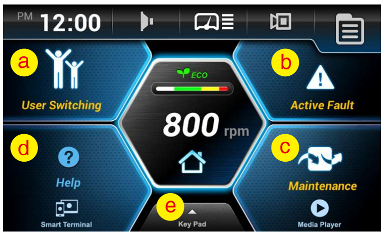
· Refer to page 7-40.

④ Transmission mode

A 760F3CD08C-1

B 760F3CD08L-1

⑤ Quick menu



760F3CD08F-1

※ Move the quick menu screen by touching .

ⓐ User switching

· When multiple users share a machine, it allows users to switch user settings of machine.

· User can apply or save the setting of monitor easily.

ⓑ Active fault

· Display the fault code of MCU/ECU/TCU.

· Refer to page 7-49.

ⓒ Maintenance

· Elapsed time, change or replace cycle can be changed.

· Refer to page 7-51.

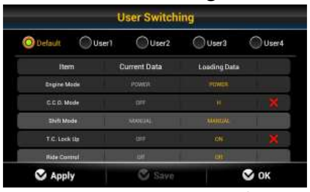
ⓓ Help

· Read the monitor manual as a PDF file on the monitor.

※ Smart terminal

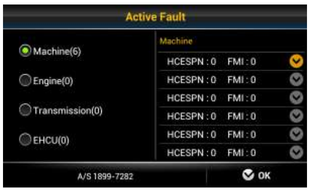
· The menu features a smartphone and operates the miracast.

ⓐ User switching



760F3CD08H-1

ⓑ Active fault

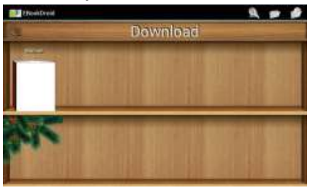


760F3CD16-1

ⓒ Maintenance

760F3CD08J-1

ⓓ Help



760F3CD08K

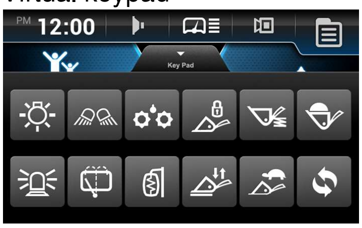
ⓔ Virtual keypad

To display the virtual keypad, drag the button ( ) to top of the screen.

※ **Refer to the page 7-59 for details.**

760F3CD68A-1

Virtual keypad

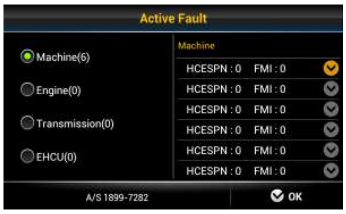


760F3CD68B-1

(3) Fault and maintenance warning

760F3CD14-1

760F3CD15-1



760F3CD16-1

① If you touch the warning sign (red icon), move to the quick menu.

② You can check the fault message and move the maintenance screen by touching relevant area.

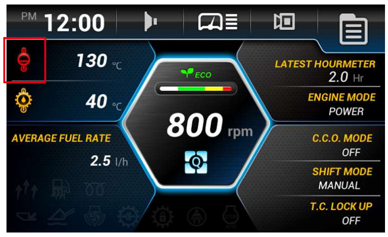
760F3CD17-1

(4) Machine monitoring warning

① Warning sign (red icon) will be shown when the temperature of hydraulic oil, cooling water, transmission oil or battery voltage is not normal state.

② Case of warning sign

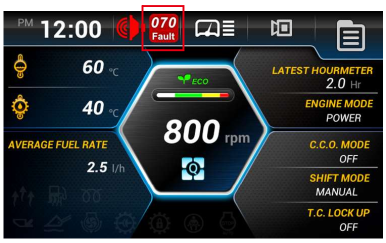
Icon	Description
	Above 106˚C of hydraulic oil temperature
	Above 105˚C of cooling water temperature
	Above 107˚C of transmission oil temperature
	Below 24.5 voltage of battery (for 3 minutes)



760F3CD18-1

(5) Communication error

① MCU could not communicate with monitor over 10 seconds, error message will be show on the screen.



760F3CD19-1

(6) Eco gauge

① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel economy.

② The fuel consumption rate or machine load is high, the segment is increased.

③ The color of Eco gauge indicates operation status.

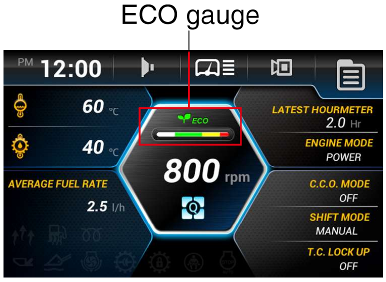
·White : Idle operation

·Green : Economy operation

·Yellow : Non-economy operation at a medium level.

·Red : Non-economy operation at a high level.

ECO gauge



760F3CD113-1

2) MAIN AND SUB MENU

(1) Structure

No	Main menu	Sub menu	Description
1	Mode  760F3CD25A	Engine setting Kick down C.C.O mode Shift mode Work load Boom/bucket detent mode Speedometer frequency setting Cooling fan reverse mode Wiper level setting Calibration Engine auto shutdown	Engine mode, Engine speed Mode 1 (down/up), Mode 2 (down only) Clutch cut off mode (Off, L, M, H) Transmission shift mode (manual, AL, AN, AH) Weighing system, Weighing display, Error detection Boom/bucket detent ON/OFF, Save position Speedometer setting Off, Manual, Automatic Slow, Normal, Fast, Very fast Boom/bucket angle, Boom pressure, Brake pedal sensor, AEB Once, Always, Disable, ESL system setting
2	Monitoring  760F3CD25B	Machine monitoring Operation history Fault history Fuel consumption history Machine information	Hyd, Coolant and T/M oil temp, Battery voltage Hour meter, ODO meter Active/Logged fault (MCU, ECU, TCU) General record, Hourly record, Daily record, Mode record TCU, ECU, MCU, RMCU, Monitor, Cluster
3	Management  760F3CD25C	Machine security Maintenance Service menu Change A/S phone number Software update	ESL system setting, Change password, Smart key Elapsed time, Cycle, Maintenance history Sensor monitoring, Speed limit setting, Weighing system compensation Check and change of contact information Update file in USB memory
4	Preference  760F3CD25D	Brightness setting Clock setting Unit setting Display style/Language Sound output setting Camera setting	Manual, Automatic Clock setting Temp (˚F/˚C), Speed (km/h,mph), Weight (ton, lb), Pressure (bar, Mpa, kgf/m², psi) Type A, Type B, 13 multiple language Internal speaker, External speaker (Aux) Acive camera, Display order, Reverse mode
5	Multimedia  760F3CD25E	Multimedia	Play video and audio files in USB.

(2) Mode

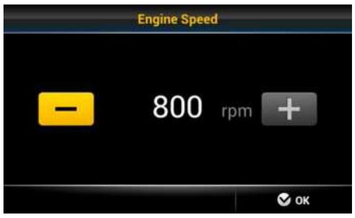
① Engine setting mode

760F3CD24A

760F3CD24B-1

760F3CD24C

760F3CD24F-1



760F3CD24G

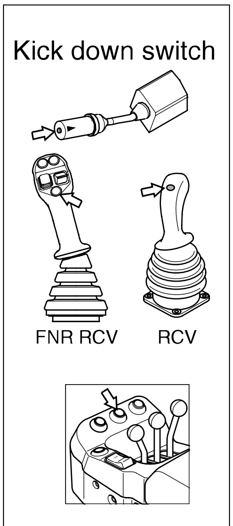
- **Engine mode**
  The operator can adjust the machine's performance.
  - Econo : Maximum fuel efficiency for general loading.
  - Standard : General digging and loading operation.
  - Power : Maximum power output for hard digging operation or hill climb.
- **Engine speed**
  Setting engine low idle rpm.

② Kick down mode

760F3CD29A

→

760F3CD29B



740F3CD29C

· **Manual mode** (shift mode : manual)
It is effective 2nd speed to 1st speed only and recover to 2nd speed quickly when push the switch one more time.

· **Automatic mode** (shift mode : AL, AN, AH)
- **Mode 1** (down/up)
  It shifts down quickly from current gear to one step lower speed by pushing the switch and recover to current speed quickly when push the switch one more time.
- **Mode 2** (down only)
  It shifts down from current gear to one step lower speed when push the switch every time.
  The kick down function is released in only 1st speed.

※ **The normal autoshift function continues after the kick down switch is released.**

③ Clutch cut off (C.C.O) mode

760F3CD26A

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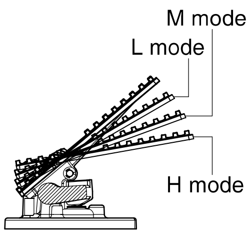
760F3CD26B



Left brake pedal
760F3CD27

· Four modes are available for operator's preference and job condition.
- OFF : The clutch cut off function is disable.
- L (Low) : The clutch is disengaged early for short-distance and rapid loading.
- M (Medium) : The clutch is disengaged normally for general digging and loading operation.
- H (High) : The clutch cut off function is automatically adjusted depending on slope angle or machine load, And inching fuction becomes possible by using the brake pedal.

· The clutch cut off functions of the left brake pedal depend on the position of the left brake pedal and the setting of the clutch cut off mode.

Positions for clutch cut off function			
Clutch cut off mode	L	M	H
Left brake pedal	L, M	M	H

④ Shift mode

760F3CD28A

→

760F3CD28B

· Four modes are available for operator's preference and job condition.
- Manual : Machine is operated by selected gear on lever.
- AL (Auto Light) : Automatic shifting point is fast for long-distance transportation and fuel efficiency.
- AN (Auto Normal) : Automatic shifting point is normal without automatic kick-down to 1st gear for general digging and loading operation.
- AH (Auto Heavy) : Automatic shifting point is normal with automatic kick-down to 1st gear for more powerful operation.

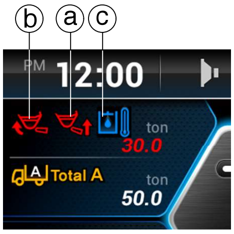
⑤ Work load mode

760F3CD33A

→

760F3CD33B-1

· Weighing system : Set the workload measurements.
· Weighing display : Set the display on main display screen.
· Initialization : Workload initialization.
· Error detection : Set error detection ON/OFF.
  - OFF : Errors are not displayed.
  - ON : ⓐ,ⓑ and ⓒ are displayed on main display screen.
    ⓐ The boom lift was performed too fast.
    ⓑ The bucket was not in the fully tilted back position while bucket was in the weigh range.
    ⓒ The hydraulic temperature is low (below 40 ˚C).

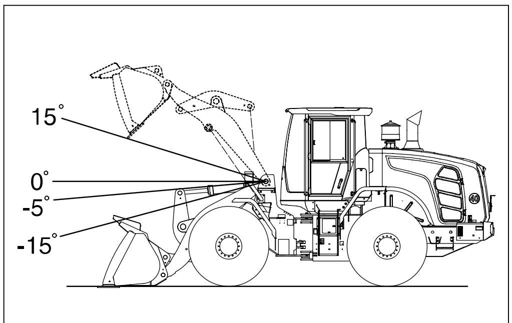


760F3CD33CK

· Boom pressure calibration : See the page 7-46 for details.

※ **Refer to page 7-62 for details.**

※ Weighing system



740F3CD126

  - The weight indication in bucket is calculated by measuring boom position and boom pressure.
    ⓐ The weight is '0.0 ton' when the boom is placed at below -15˚.
    ⓑ The weight is indicated when the boom is placed at the range (-5˚→15˚).
    ⓒ The weight is calculated when the boom is placed at above -5˚ and boom is lowered below -15˚ after dumping operation.

    In order to recheck weight, go to the ⓑ after changing boom position (below -15˚).
  - Dump operation : It is checked by bucket cylinder's stroke change.
    (HL940, HL940XT : below 250 mm, HL940TM : over 250 mm)

※ The temperature for the hydraulic oil must be raised to at least 40 ˚C (104 ˚F) before operation.

⑥ Boom/bucket detent mode

760F3CD35A

760F3CD35B

- OFF : Detent functions are not operated.
- ON : Boom or bucket detent functions are operated.
- Save position : See page 6-56.

⑦ Speedometer frequency setting mode

760F3CD73A-1

760F3CD73B

- Press speedometer setting bar (or) for 3 seconds.

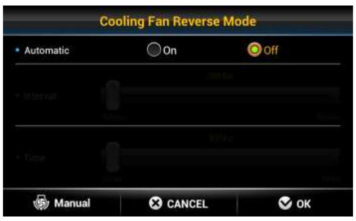
※ **Only for the service person. Do not adjust arbitrary.**

※ **Using button**

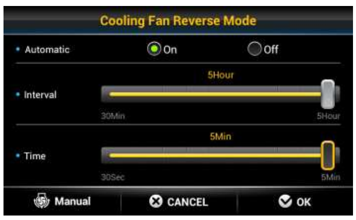
- To change the pulse value, press ◀ or ▶.
- To change the position, press .

⑧ Cooling fan reverse mode

760F3CD40A-1



760F3CD40B-01



Automatic 760F3CD40D-1

- **Manual** : Rotate the fan with reverse direction while pressing the button "Excute".
- **Automatic** : Rotate the fan with reverse direction by preset cycle.
  - Interval : 30 min ~ 5 hrs
  - Time : 30 sec ~ 5 min

※ **Default : Interval (60 min), time (120 sec)**

Manual 760F3CD40C-1

⑨ Wiper level setting mode

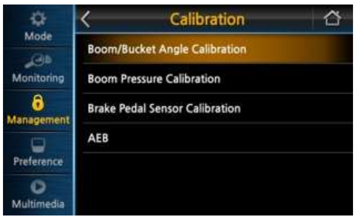
760F3CD36E-1

760F3CD36F

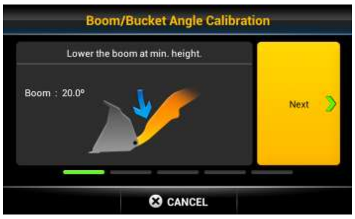
· Setting wiper speed (slow, normal, fast and very fast).

⑩ Calibration

760F3CD49A-1



760F3CD49B

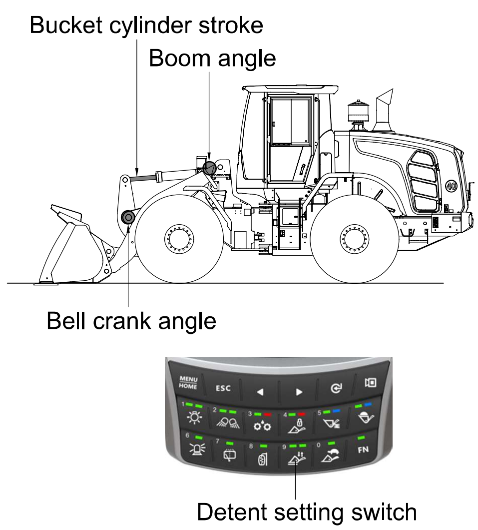


760F3CD49C-1

· Press NEXT button after following the instruction at each step.
· If correction is right, NEXT button will be activated, then go to next stage.
· After following each step correctly, the message "Calibration is done" will be shown.
  Press complete button, then process be ended.

※ **Using switch**
  - Using ↵ instead of NEXT, complete button.

· **Boom / Bucket angle calibration**
- MCU get sensing signal from boom angle and bell crank angle and calculate bucket cylinder stroke and boom link position angle from ground real time basis.
- Boom angle position and bucket cylinder stroke is set by detent setting switch on monitor.
- Individual setting position is done by lever (detent, release operation).
- Angle sensor calibration is basically carried out before delivery of the machine.
  When angle sensor is replaced or actual value is different compared to setting value, this function can be done.

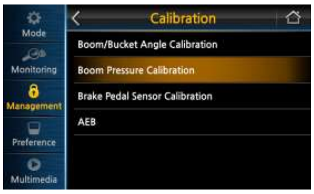


740F3CD128

- The calibration must be carried out as follows :

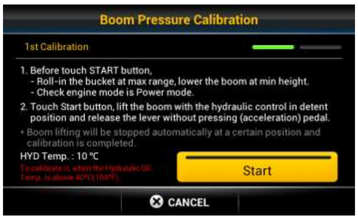
① Lower the boom at maximum low position and press NEXT button or ↵ (bucket must be max tilting position).
② Raise boom at maximum high position and press NEXT button (or ↵).
③ Position boom at -5° and press NEXT button (or ↵).
④ Retract bucket cylinder length (to minimum position) at -5° boom position and press NEXT button (or ↵).
⑤ Extend bucket cylinder length (to maximum position) at -5° boom position and press NEXT button (or ↵).
⑥ In case above steps are carried normally, "Calibration is done" message is shown. Then angle sensor calibration is finished.

· Boom pressure calibration



760F3CD70A

→



Display A 760F3CD70B-1

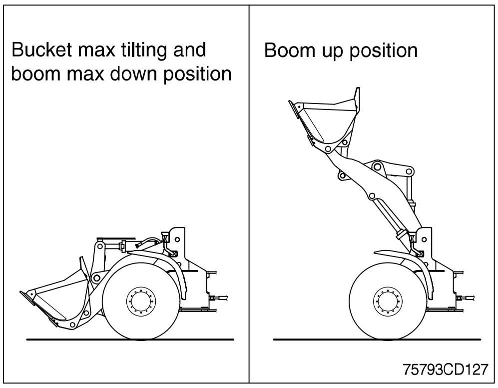
- Press START button after following the instruction.
- After a few minutes, "Calibration fail" or "Calibration success" message will be shown. Press complete button then process be ended.

※ Using button
- Using instead of NEXT, complete button.

· Boom pressure calibration

- It is used when bucket weight is changed or measured weight is inaccurate.
- The calibration must be carried out as follows :

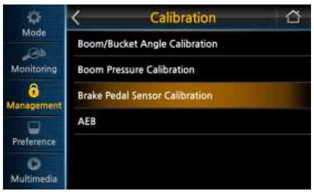
① Increase hydraulic temperature (about 40~60˚C).
② Select "Boom-pressure".
③ Roll-in the bucket at maximum range and lower the boom at minimum height.
④ Press START button.
⑤ Raise boom to maximum position. Boom up must be finished before stepping advance in "display A".
⑥ If it show "Calibration success" message in a moment, press complete button (or).



75793CD127

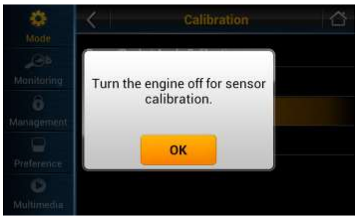
※ **Raise hydraulic temperature enough when checking work load / boom pressure sensor calibration (recommendation : about 40 ~ 60˚C).**
※ **Check if pressure sensor or angle sensor is in normal condition for accurate work load algorism or pressure sensor calibration [pressure sensors at boom cylinder head area and rod area, boom angle sensor (CD-80), bell crank angle sensor (CD-81)].**
※ **Sensor error message during pressure sensor calibration : sensor need to be checked.**

· Brake pedal sensor calibration



760F3CD71A

→

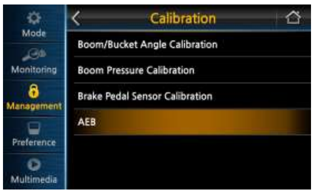


760F3CD71B-1

- Turn the engine OFF and turn the starting switch ON position.
- Press OK button, then calibration will be started.
- When display " IP " on main display, press slowly the brake pedal completely.
- Release the brake pedal when display " IP " on main display.
- For cancel, press MENU/HOME switch.

※ When the brake pedal or sensor is replaced, **brake pedal sensor calibration must be performed.**

· **AEB**



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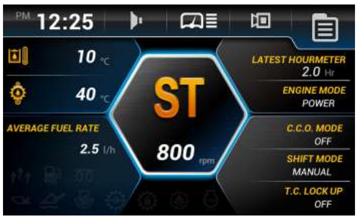


760F3CD72B-1

- AEB mode controls the disk clearance of the transmission, automatically.
- To start AEB setting, press AEB bar (or ⏎) for 3 seconds.
- To cancel AEB setting, press ⏎.
- If "OK" in actual gear window, press ⏎ to complete AEB setting.
- **Display during AEB mode**

Symbol	Meaning
ST	Start AEB
K1~K4, KV, KR	Calibrating clutch K1~K4, KV or KR respectively
OK*	Calibration for all clutches finished
Spanner and Kx*	Kx couldn't be calibrated, AEB finished
△E	Engine speed too low - Raise engine speed
▽E	Engine speed too high - Lower engine speed
△T	Transmission oil temperature too low - Heat up transmission
▽T	Transmission oil temperature too high - Cool down transmission
FO*	Output speed not zero
FN*	Shift lever not in neutral position
FP*	Parking brake not applied

* : Transmission stays in neutral, you have to restart the TCU (starting switch off/on).

⑪ Engine auto shutdown mode

760F3CD37A-1

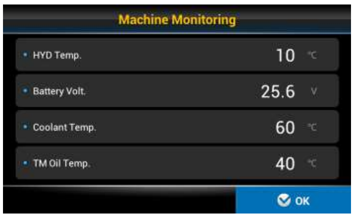
760F3CD37B

· The engine auto shutdown function can be activated or cancelled.
· Engine runs for the setting time (2~40 minutes) and then shuts down.

(3) Monitoring

① Machine monitoring

760F3CD41A-1



760F3CD41B-1

· Monitor the status of the machine.

② Operation history

760F3CD42A-1

760F3CD42B-1

· Hour meter / ODO meter

· Total

- Total distance (this item cannot be initialized).

- Total working hour can check on service meter.

· Latest

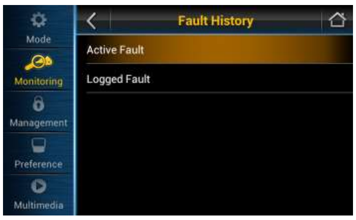
- Working hour/distance after reset.

- If you select **Initialization**, working hour/distance start zero.

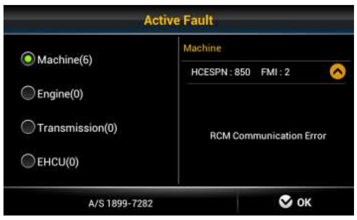
· To display the item in main display, select the item in main display. See the page 7-53.

③ Fault history

760F3CD44A-1

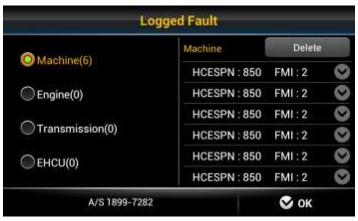


760F3CD44B-1



760F3CD44C-1

760F3CD44D-1



760F3CD44E-1

· Display the fault code of MCU/ECU/TCU and delete logged fault.

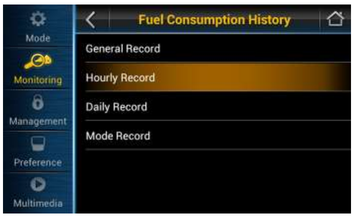
※ Refer to service manual for HCESPN/FMI of engine and transmission.

※ Not define will be indicated in case of that there's no fault.

④ Fuel consumption history

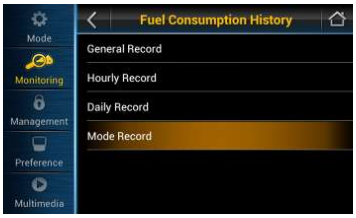
760F3CD141

760F3CD141A



760F3CD141C

760F3CD141E



760F3CD141G

· Dispaly the fuel consumption history.
  - General record (average fuel rate and a days fuel used)
  - Hourly record
  - Daily record
  - Mode record

⑤ Machine information

760F3CD46A-1

760F3CD46B

· Software versions of MCU, ECU, TCU, Cluster and monitor can be checked.

(4) Management

① Machine security

760F3CD47A-1

760F3CD47B

760F3CD47C

· ESL system setting
- ESL : Engine Starting Limit
- ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
- If the ESL mode was selected ON, the password will be required when the start switch is turned ON.
- Disable : Not used ESL function
  ON, Always : The password is required whenever the operator start engine.
  ON, After specific time : The password is required when the operator start engine first. But the operator can restart the engine within the specific time without inputting the password. The specific time can be set maximum 2 days.

760F3CD47D

760F3CD47E

· Specific time
- If set specific time to 5 minutes, ESL system is activated after 5 minutes. Therefore, the password does not need to restart engine within 5 minutes.

※ Default password : 00000

· Change password
- Input 5 to 10 digits.

· Smart key (opt)
- Manage usage : Set the using or not of smart key.
  If you using smart key, ESL function always be activated.
- Manage tag : Register or delete user tag and display registered user tag.
  When delete user tag, all user tag will be deleted.

※ Using smart key
- Verification success
  Green smart key icon is displayed on the main display screen.
  Verification failure
- Red smart key icon and password input screen is displayed.

7609A3M50D

Verification success

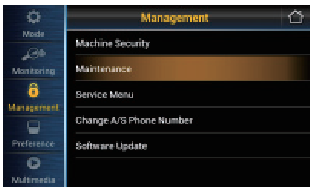
7609A3M50E

Verification failure

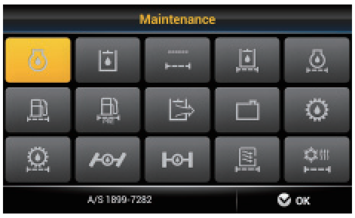
· Engine Starting Condition

Case	ESL Mode	Smart Key	Condition
1	Disable	Disable	- With registered tag : Engine can be started without password input. - Without registered tag : Engine can be started without password input.
2	Disable	Enable	If Smart Key is enabled, ESL Mode is automatically enabled. This Case 2 work the same as the Case 4.
3	Enable	Disable	- With registered tag : Engine can be started with password input. - Without registered tag : Engine can be started with password input.
4	Enable	Enable	- With registered tag : Engine can be started without password input. - Without registered tag : Engine can be started with password input.

② Maintenance



760F3CD48A-1



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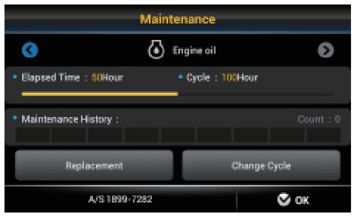


760F3CD48C-1

· Replacement : The elapsed time will be reset to zero (0).
  Change cycle : The change or replace cycle can be changed in the unit of 50 hours.
· Show the maintenance history below 10.
  When history have more than 10, delete the old item.
· Change or replace interval

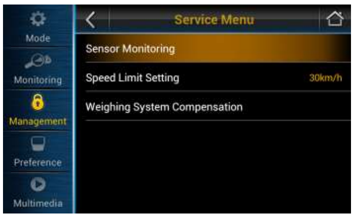
No	Item	Interval
1	Engine oil	500
2	Hydraulic oil	★1 2000 ★2 5000
3	Pilot line filter element	1000
4	Hydraulic oil return filter	1000
5	Engine oil filter	500
6	Fuel filter element	500
7	Fuel pre-filter	500
8	Hydraulic tank air breather	1000
9	Radiator coolant	2000
10	Transmission oil and filter	1000
11	Axle oil (front and rear)	1500
12	Aircon & heater outer filter	1000
13	Crankcase Breather filter	2000
14	DEF/AdBlue® supply moudule filter	4500
15	DEA/AdBlue® tank filter	4000

★1 : Conventional hydraulic oil

★2 : Hyundai genuine long life hydraulic oil

③ Service menu

760F3CD75A-1



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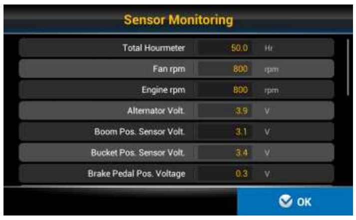

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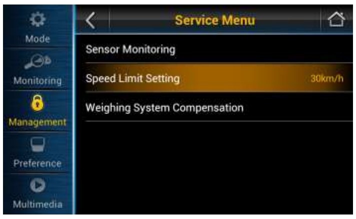
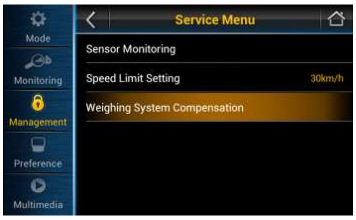


740F3CD75D-1

760F3CD75E

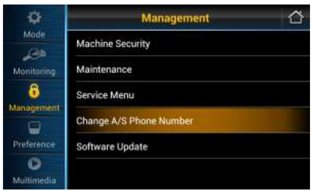


740F3CD75F-1

760F3CD75G-1

· **Sensor monitoring** : Display information of each sensors.
· **Speed limit setting** : 20~40 km/h (5 km/h intervals)
· **Weighing system compensation**
- Calibration workload depending on work tool.
※ **Only for the service person. Do not adjust arbitrary.**

④ Change A/S phone number and software update



760F3CD74A-1

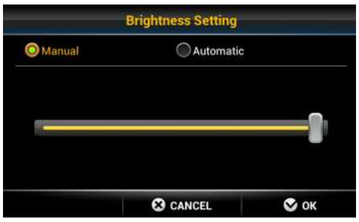
760F3CD74B-1

· Change A/S phone number : Check and change of contact information for customer service.
· Software update : Update file in USB memory.

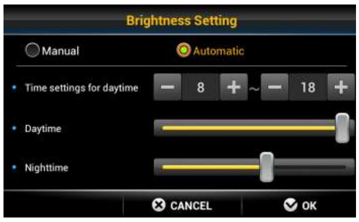
(5) Preference

① Brightness setting

760F3CD76A-1



760F3CD76B-1



760F3CD76C-1

- **Manual**
  - Manual setting for LCD brightness.
- **Automatic**
  - Automatic control of LCD brightness as set level of day/night.
- **Setting day time**
  - Set the time for daylight.
  - If you set the time for daylight, the rest time will be night.

※ **Using button**

- Changing brightness by ◀ or ▶, input data by .

② Clock setting

760F3CD77A-1

760F3CD77B

- Set the time (hour, minute and AM or PM)

③ Unit setting

760F3CD78A-1

760F3CD78B-1

- Temperature : ˚C ↔ ˚F
- Speed : km/h ↔ mph
- Weight : ton ↔ lb
- Pressure : bar ↔ Mpa ↔ kgf/m^2 ↔ psi

※ **Using button**

- Move to other item by .

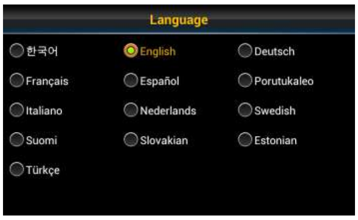
④ Display style/ Language

760F3CD81A-1

760F3CD81B

760F3CD81C-1

760F3CD81D



760F3CD81E-1

· Set the display type A or B.
· User can select preferable language and all display are changed the selected language.
· 13 multiple language available.

⑤ Sound output setting

760F3CD79A-1

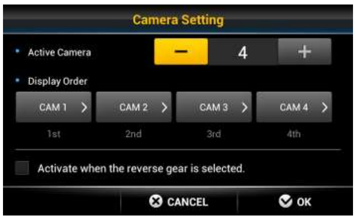
760F3CD79B

· Internal
  - Use speaker of monitor.
· External
  - Use cab speaker. User should put radio mode into Aux mode.

⑥ Camera setting

760F3CD39A-1

→



760F3CD39B-1

- **Active camera**
  - Four cameras can be installed on the machine.
- **Display order**
  - Set the channel sequence of each camera.
- **Active when the reverse gear is selected**
  - If transmission engages the reverse gear (R1~R3), the camera mode is displayed automatically in main display.

- If the camera was not equipped, this menu is not useful.
- In main display, if the icon is touched (or switch is pushed), the first ordered display camera will be viewed.

(12) Mutimedia

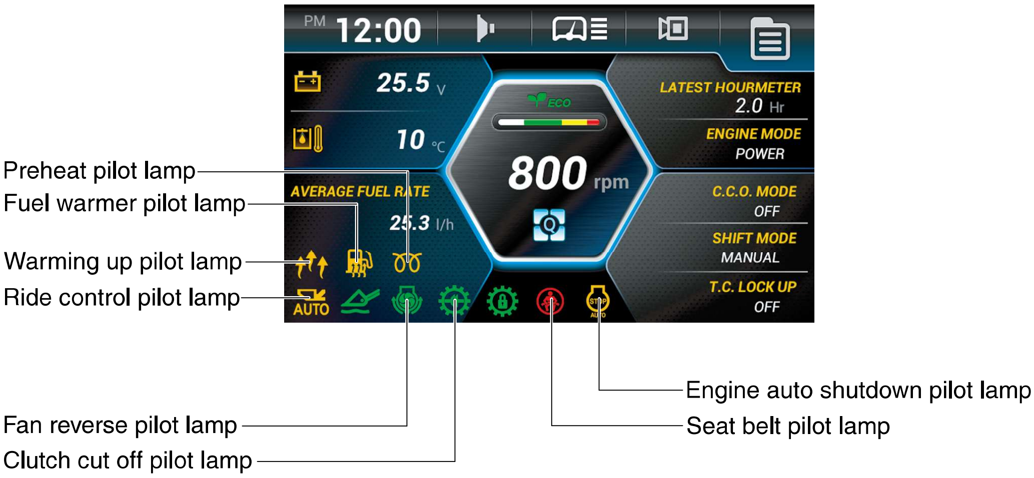
760F3CD83A

→

760F3CD83B

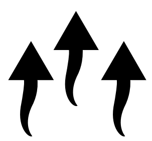
- Play video files in USB (mp4, mkv, avi, 3gp, divx, f4v, flv, mpeg, mov, vob, wmv, webm, xvid).
- Play audio files in USB (mp3, mp4, ogg, wma, wav, flac, aac).

3) PILOT LAMPS



740F3CD90-1

(1) Warming up pilot lamp



75793CD31

① This lamp lights ON when the coolant temperature is below 30˚C (86˚F).

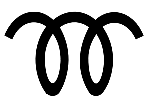
② The automatic warming up is cancelled when the engine coolant temperature is above 30˚C, or when 10 minutes have passed since starting the engine.

(2) Seat belt pilot lamp

75793CD17

① This lamp lights ON for the first five seconds after starting the engine.

(3) Preheat pilot lamp

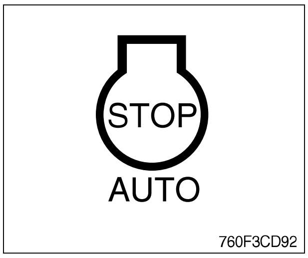


77073CD14

① This lamp lights ON when start switch is turned clockwise to the ON position. Light will turn off after approximately 5~45 seconds, depending on engine temperature, indicating that preheating is completed.

② When the lamp goes out the operator should start cranking the engine.

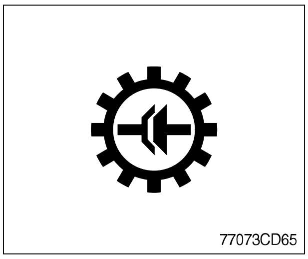
(4) Engine auto shutdown pilot lamp



① This lamp lights ON when the engine auto shutdown function is activated.

※ **Refer to page 7-47.**

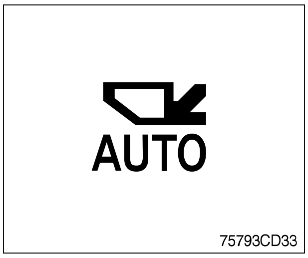
(5) Clutch cut off pilot lamp



① This lamp lights ON when clutch cut off mode is set L, M, H.

※ **Refer to page 7-40.**

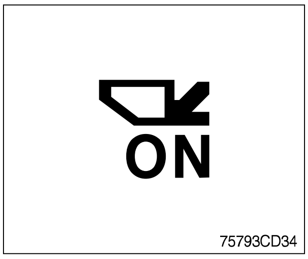
(6) Ride control pilot lamp (option)



① Auto ride control

This lamp lights ON when the automatic ride control function is activated (**ON, Conditional speed** setting).

※ **Refer to page 7-61.**

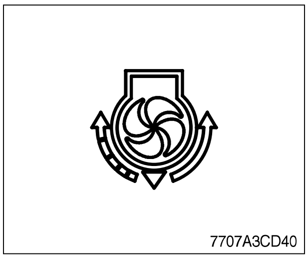


② Manual ride control

This lamp lights ON when the manual ride control function is activated (**ON, Always** setting).

※ **Refer to page 7-61.**

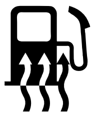
(7) Fan reverse pilot lamp



① This lamp lights ON when the cooling fan reverse mode is activated

※ **Refer to page 7-43.**

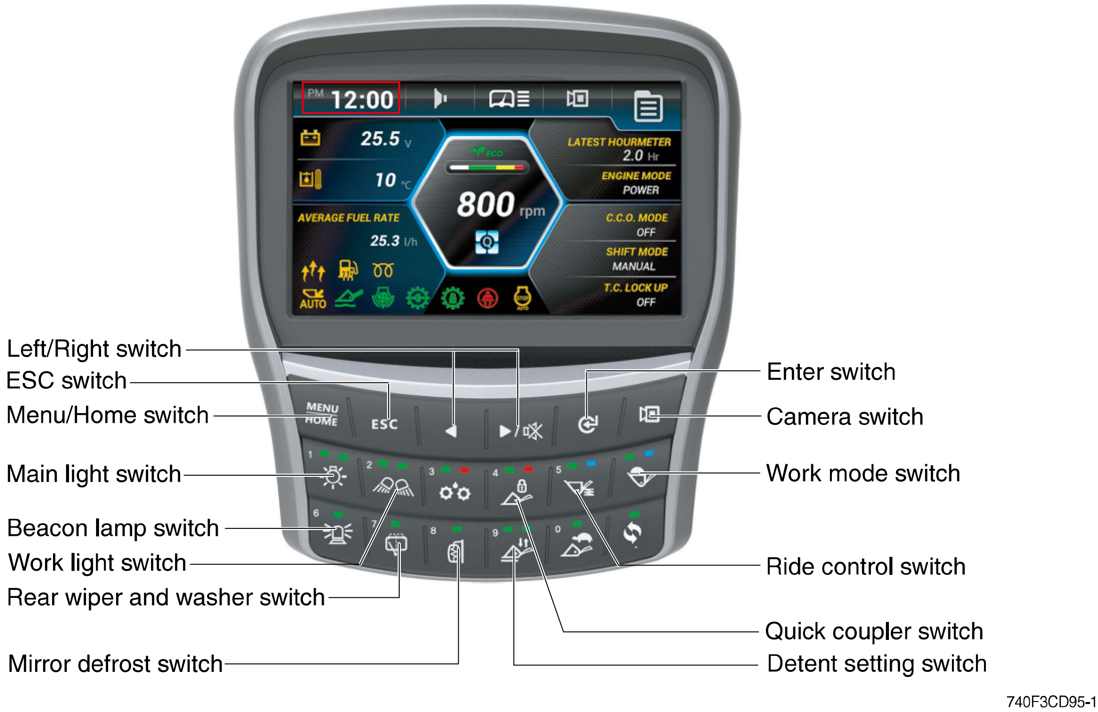
(8) Fuel warmer pilot lamp



21093CD43

① This lamp is turned ON when the coolant temperature is below 10˚C (50˚F) or the hydraulic oil temperature 20˚C (68˚F).
② The automatic fuel warming is cancelled when the engine coolant temperature is above 60˚C and the hydraulic oil temperature is above 45˚C since the start switch was ON position.

3) SWITCHES



※ If you push left or right switch (◀ ▶) on main display, show the select box on current time.
Move to next item in order by using left / right button.
(① Time → ② Buzzer → ③ Wiper → ④ Camera → ⑤ Menu → ⑥ Machine monitoring → ⑦ Fuel rate → ⑧ Engine mode/Operation history → ⑨ Transmission mode → ⑩ Quick menu)

※ Move to selected setting screen by using enter switch ( ).

※ When keypad is not pressed for 3 seconds, convert screen to main display.

※ If you push left and right switch (◀ ▶) at the same time, move language settings.

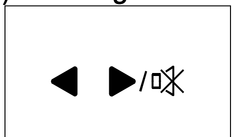
(1) Menu / Home switch

① Main display to main menu, main menu to main display.

(2) ESC switch

① For other menu, this is used for cancellation (move to previous menu).
② AEB cancel or finish button in AEB.

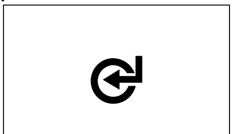
(3) Left / Right move switch



760F3CD22

① Move in menu (left, up / right, down).
② Decrease / Increase input value.
③ Stop buzzer sound when sound is on.

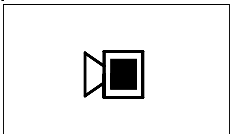
(4) Enter switch



75793CD94

① Select menu (enter).

(5) Camera switch



760F3CD24

① Enter rear camera mode in main display.

(6) Main light switch

760F3CD83-1

① This switch use to operates the clearance lamp and head light.
- **Position lamp** : Clearance lamp and cluster illumination lamp come ON. The green pilot lamp is turned ON.
- **Head lamp + Position lamp** : Clearance lamp, cluster illumination lamp and head light come ON. The green pilot lamp is turned ON.

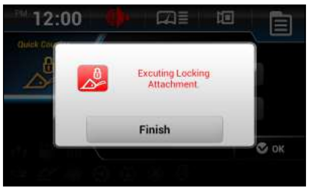
(7) Work lamp switch

760F3CD84-1

① This switch use to operates the front and rear work lamps.
- **Front** : Front work lamp located on the cab comes ON. The green pilot lamp is turned ON.
- **Front + Rear** : Front work lamp located on the cab and rear work lamp located on the cowl come ON. The green pilot lamp is turned ON.

(8) Quick coupler switch (option)

760F3CD86A-1



760F3CD86B-1

760F3CD86C-1

① **Locking attachment**

- The quick coupler pins move in the engaged position and buzzer sounds.
- The green pilot lamp is turned ON.

※ **Check for engagement as followings.**

a. Put down pressure on the attachment.

b. Back up the machine and make sure that there is no movement between the quick coupler and attachment.

② **Unlocking attachment**

- The quick coupler pins move in the disengaged position and buzzer sounds.
- The red pilot lamp is turned ON.

⚠ **Always check that the attachment is properly secured to the attachment quick coupler by pressing the front part of the attachment against the ground.**

⚠ **Never use an attachment before you have checked its mounting.**

(9) Ride control switch (option)

760F3CD87A-1

760F3CD87B-1

① **ON, Conditional speed**

- Select **ON, conditional speed** in order to turn on the automatic ride control. The automatic ride control automatically turns on when the travel speed exceeds a preset speed.
  (forward / backward 1~15 km/h)
- The blue pilot lamp is turned ON.

② **ON, Always**

- Select **ON, Always** in order to turn on the system for ride control regardless speed. The ride control will smooth the ride of the machine during travel.
- The green pilot lamp is turned ON.

③ **OFF**

Select **OFF** in order to turn off the system for the ride control.

(10) Work mode switch

760F3CD115A-1

760F3CD115B-1

① Weighing system

- Manual

  Accumulate the weight in memory A, B, C manually.

  The green pilot lamp is turned ON.

  ※ Refer to the page 7-68 for workload button.

- Automatic

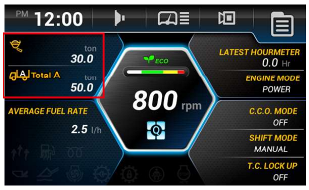
  Accumulate the weight in memory A, B, C automatically.

  The blue pilot lamp is turned ON.

※ Refer to the page 7-42 for weighing system.

※ Refer to the page 7-46 for boom pressure calibration.

760F3CD115C-1



760F3CD115E-1

② Weighing display

Selected item is shown in main display.

	Work weight (today)
	Work weight (previous day)
	Total weight accumulated in memory A, B, C individually redardless of date
	Current weight

※ Initialization daily, tatal A, B, C

Initialize accumuilated value at memory daily, A, B and C.

760F3CD115D-1

③ Error detection

Set error detection ON/OFF.

※ Refer to the page 7-42 for details.

(11) Rear wiper and washer switch

760F3CD89-1

① This switch use to operates the rear wiper and washer.

When pressing the switch, the mode is changed sequence base.

(OFF → intermittent → Low → OFF)

· **Intermittent** : The rear wiper operates intermittently.

· **Low** : The rear wiper is operated lower speed.

· **Washer** : The washer liquid is sprayed while long pressing the button.

② The green pilot lamp is turned ON.

(12) Beacon lamp switch (option)

760F3CD88

① This switch turns ON the rotary light on the cab.

② The green pilot lamp is turned ON.

(13) Mirror defrost switch (option)

760F3CD65

① ON
- In condition of ON, it operates for 15 minutes. After 15 minutes, the defrost function stops automatically.
- The green pilot lamp is turned ON.

② OFF
- Stops defrost function.

(14) Detent setting switch

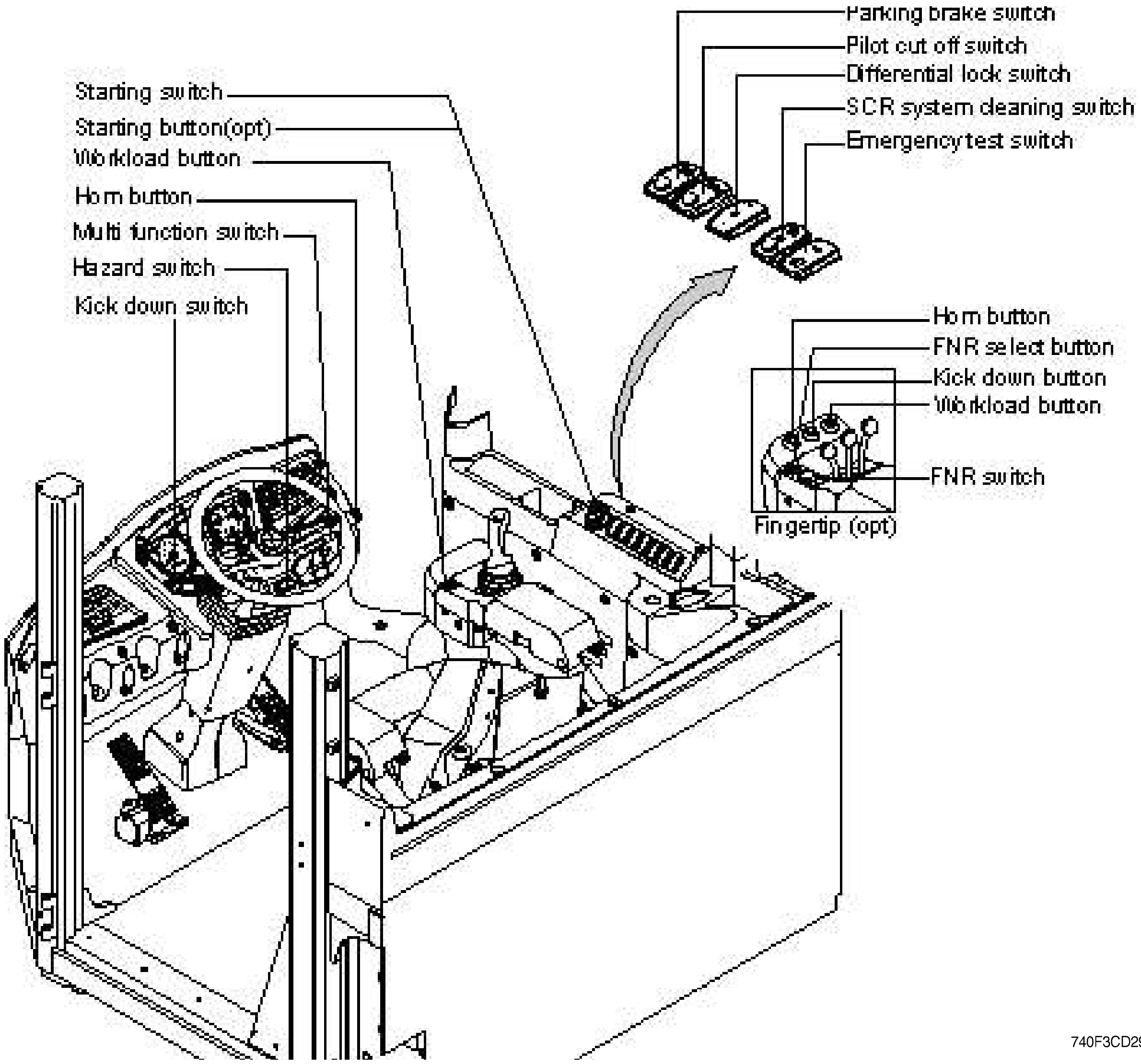
760F3CD66

① Boom and bucket
- Set the boom and bucket detent function ON/OFF.

② Save position
- Set the boom kickout and bucket leveler.

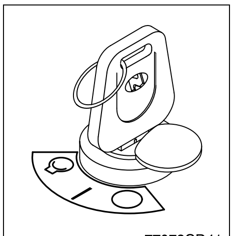
※ The green pilot lamps are turned ON.

3. SWITCHES

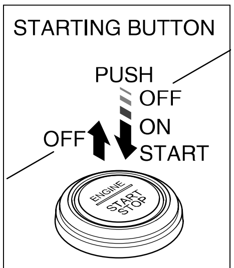


740F3CD29

1) STARTING SWITCH & STARTING BUTTON (OPT)



77073CD41



2609A3CD142

Starting button with smart key tag (opt)

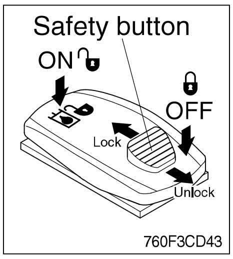
(1) There are three positions, OFF, ON and START.

- · ○ (OFF) : None of electrical circuits activate.
- · | (ON) : All the systems of machine operate.
- · (START) : Use when starting the engine.
  Release key immediately after starting.

※ **If you turn ON the starting switch in cold weather, the fuel warmer is automatically operated to heat the fuel by sensing the coolant temperature. Start the engine in 1~2 minutes after turning ON the starting switch. More time may take according to ambient temperature.**

※ **Key must be in the ON position with engine running maintain electrical and hydraulic function and prevent serious machine damage.**

2) PILOT CUT OFF SWITCH

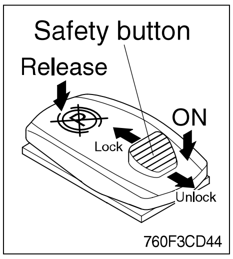


(1) When the switch is pressed to OFF position, the hydraulic pilot line will be cut off, so the work equipment will not operate.

(2) Press the ON position in order to unlock the hydraulic pilot line.

※ **This switch can be set to ON or OFF position only when the safety button is pulled to the unlock position.**

3) PARKING BRAKE SWITCH



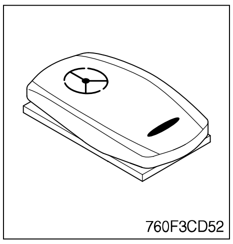
(1) When the switch is pressed to ON position, the parking brake will start to operate and the cluster warning lamp will comes ON.

(2) Press the release position in order to disengage the parking brake.

※ **When operating the gear selector lever, be sure to release the parking brake. If the machine is operated with the parking brake engaged, the brake will overheat and may cause the brake system to go out of order.**

※ **This switch can be set to ON or Release position only when the safety button is pulled to the unlock position.**

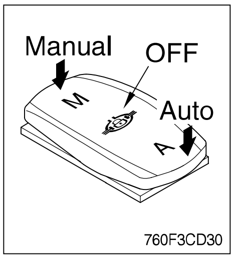
4) EMERGENCY TEST SWITCH (option)



(1) The emergency steering system can be manually tested. Push the switch in order to determine if the emergency steering and the emergency steering lamp are functional.

(2) When the switch is pressed, the emergency steering pump motor will run. The emergency steering lamp will light. If the emergency steering lamp does not light, do not operate the machine.

5) DIFFERENTIAL LOCK SWITCH (option)



(1) This switch is used to apply differential lock.
The differential lock gives equal power to both front wheels and is used in conditions when traction is poor.

(2) Manual mode

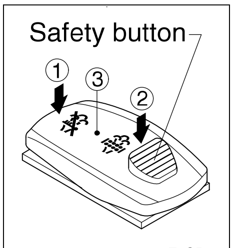
Press the M of the switch for the manual mode of the differential lock function. You press the switch, the differential lock will engage immediately and differential lock pilot lamp lights ON. Manual mode is temporarily engaged as long as the operator pushes the switch.
When the switch is released, differential lock function is disengaged and the switch returns to OFF position.

(3) Auto mode

Press the A of the switch for auto mode of the differential lock function. If you press the switch, the axle differential lock will automatically engage when the differential function is used.

※ **While the axle differential lock function is operating, the differential lock pilot lamp lights ON.**

6) SCR (selective catalytic reduction) SYSTEM CLEANING SWITCH



290F3CD06

(1) This switch is used to select the SCR system cleaning.

(2) Inhibit position (①)

① The inhibit position disallows any automatic or manual SCR system cleaning.

② This may be used by operator to prevent SCR system cleaning when the machine is operating in a hazardous environment is concerned about high temperature.

③ It is strongly recommended that this position is only activated when high temperatures may cause a hazardous condition.

(3) Automatic SCR system cleaning position (③)

This position will initate a automatic SCR system cleaning.

(4) Manual SCR system cleaning position (②)

① This position will only initate a manual SCR system cleaning when the machine is in non-mission condition, engine must run at low idle speed and SCR system levels are high enough to allow cleaning.

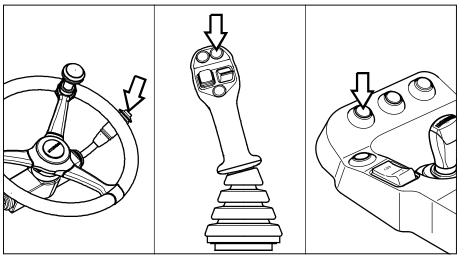
② HEST lamp will be illuminated during the entire SCR system cleaning.

※ **Refer to the page 7-29 for ditails.**

※ **This switch can be move to the SCR system cleaning position (②) only when the safety button is pulled to backward.**

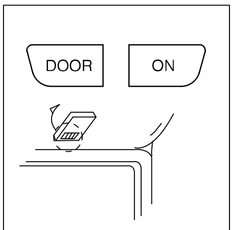
※ **Also, this switch return to the OFF position when released the manual SCR system cleaning position (②).**

7) HORN BUTTON


760F3CD104

(1) If you press the button, the horn will sound.

8) CAB LAMP SWITCH



75793CD63

(1) This switch turns ON the cab room lamp.

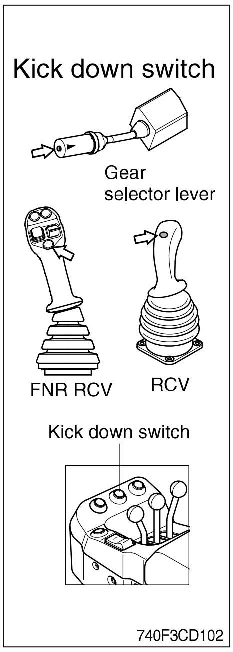
① **DOOR**

The lamp comes ON when the door is opened.
When the door is closed the lamp is OFF.

② **ON**

This switch is used to turn the lamp ON or OFF.

9) KICK DOWN SWITCH



(1) Manual mode
It is effective 2nd speed to 1st speed only and recover to 2nd speed quickly when push the switch one more time.

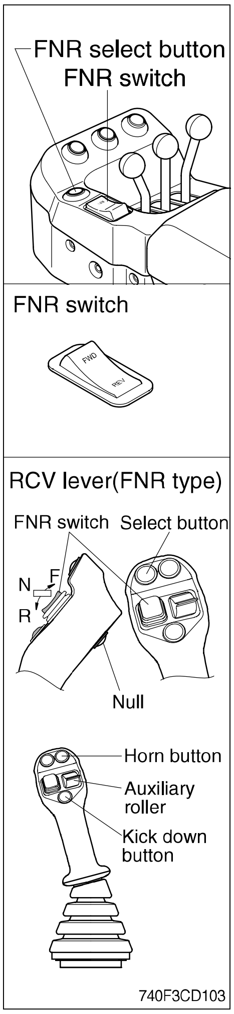
(2) Automatic mode

① **Mode 1** (down/up)
It shifts down quickly from current gear to one step lower speed by pushing the switch and recover to current speed quickly when push the switch one more time.

② **Mode 2** (down)
It shifts down from current gear to one step lower speed when push the switch every time.
The kick down function is released in only 1st speed.

※ **Refer to page 7-40 for the kick down mode.**
※ **The normal autoshift function continues after the kick down switch is released.**

10) FNR SELECT BUTTON AND SWITCH



(1) These button and switch are used for froward and backward drive.
※ **Gear range can be selected by gear selector lever.**

(2) FNR select button

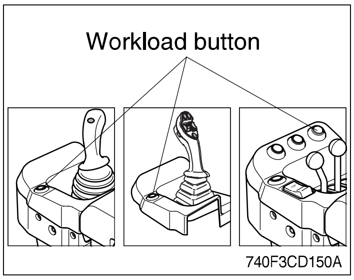
① If the select button is pressed, the indication lamp on the cluster will be ON and this FNR switch will start to operate.
※ **When the engine is running, the machine is on standstill (0 speed), parking brake is released, gear selector lever is in the neutral position, you can use this function after pressing the select button.**

(3) FNR switch
· F : Forward drive
· N : Neutral
· R : Reverse drive

① If the upper side (F, FWD) of this switch is pushed, the machine moves forward.
② If the down side (R, REV) of this switch is pushed, the machine moves backward.
③ This function is automatically released when the engine is stopped, parking brake is ON or gear selector lever is out of neutral.

(4) Auxiliary roller : If the machine is equipped with auxiliary hydraulics, this roller is used for the attachments.

11) WORKLOAD BUTTON

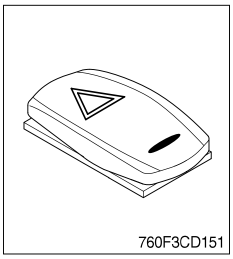


(1) This button is used to calculate the weight manually.
If the button is not pushed, the weight of the weighing system is not calculated.

(2) This button is pushed for one second more, calculated weight will be accumulated.

※ **Refer to the page 7-42, weighing system.**

12) HAZARD SWITCH

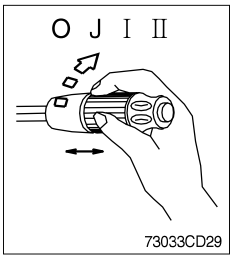


(1) Use for parking or loading the machine.

(2) Both turn signal lights will flash simultaneously.

※ **If the switch is left ON for a long time, the battery may be discharged.**

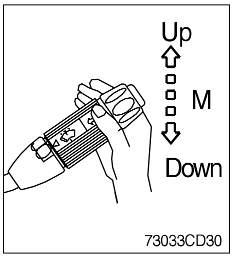
13) MULTI FUNCTION SWITCH



(1) Front wiper and washer switch

① When the switch is in J position, the wiper moves intermittently.
② When placed in Ⅰ or Ⅱ position, the wiper moves continuously.
③ If you push the grip of the lever, washer liquid will be sprayed and the wiper will be activated 2-3 times.

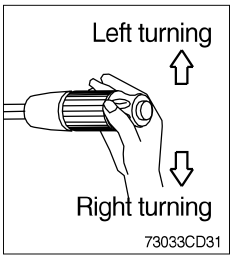
※ **Check the quantity of washer liquid in the tank. If the level of the washer liquid is LOW, add the washer liquid (in cold, winter days) or water. The capacity of the tank is 1 liter.**
※ **If the wiper does not operate with the switch in ON (J, Ⅰ, Ⅱ) position, turn the switch OFF (O) immediately and check the cause. If the switch remains ON, motor failure can result.**



(2) Dimmer switch

① This switch is used to turn the head lights direction.
② Switch positions
- Up : To flash for passing
- Middle : Head lights low beam ON
- Down : Head lights high beam ON

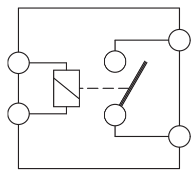
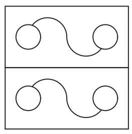
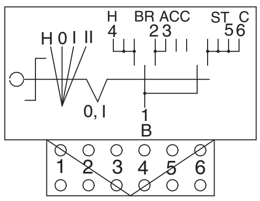
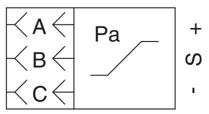
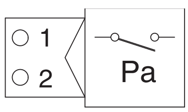
③ If you release the switch when it's in up position, the switch will return to middle.

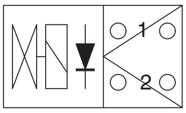
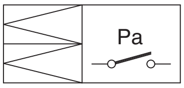
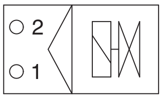
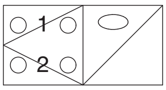
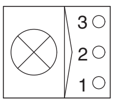
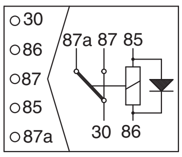


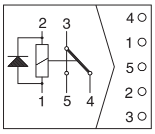
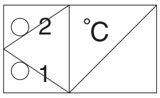
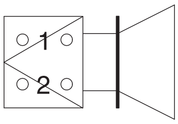
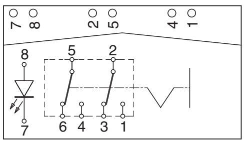
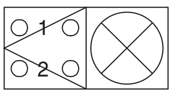
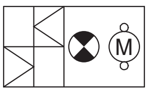
(3) Turning switch

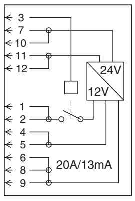
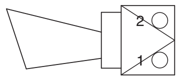
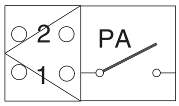
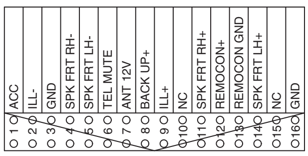
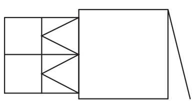
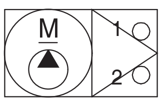
① This switch is used to warn or signal the turning direction of the machine to other vehicles or equipment.
② Push the lever up for turning left, pull the lever down for turning right.

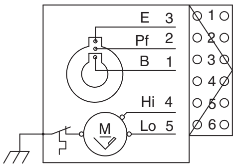
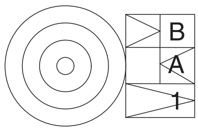
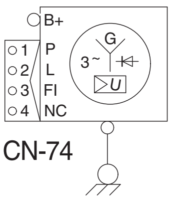
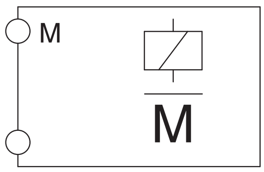
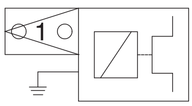
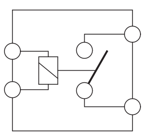
GROUP 4 ELECTRICAL COMPONENT SPECIFICATION

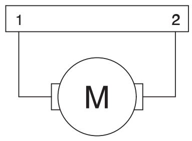
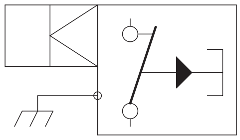
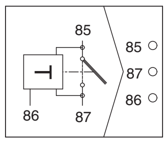
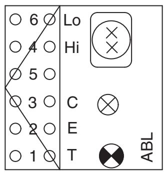
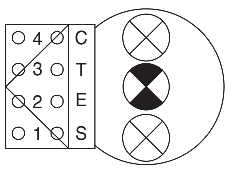
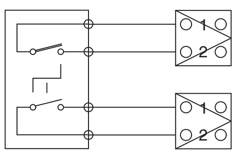
Part name	Symbol	Specifications	Check item
Battery		12V × 120Ah (2EA)	Gravity 1.280 over : over charged 1.280 ~ 1.250 : normal 1.250 below : discharged
Battery relay	 CR-1 CR-39	Rated load : 24V 100A (continuity) 1000A (30seconds)	Coil resistance breaked : approx 50 Ω connected : ∞ Ω
Maxi fuse	 CN-351 (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 sensor	 CD-3 CD-26 CD-31 CD-39 CD-40 CD-58 CD-79 CD-80 CD-81	24V	Voltage A.C : 24V B.C : 1~5V
Pressure switch	 CD-48 CD-129	N.O Type	Resistance ∞ Ω : normal (open)

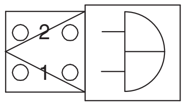
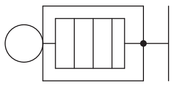
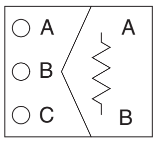
Part name	Symbol	Specifications	Check item
Pilot cut off, parking brake, attach lock, unlock solenoid	 CN-68 CN-177 CN-71 CN-178 CN-79	24V 1A	Resistance normal : 15~25 Ω
Air cleaner pressure switch	 CD-10	Max load : 6W N.O Type	Resistance ∞ Ω : normal (open)
Ride control valve / Fan solenoid	 CN-136 CN-154 CN-155	24V 1.2A	※ Check LED lamp ※ Check resistance about 24 Ω
Fuel sender	 CD-2	-	Resistance at fuel levels full level : 200 Ω 9/12 level : 500 Ω 6/12 level : 800 Ω 3/12 level : 1100 Ω empty : 1300 Ω
Room lamp	 CL-1	24V 10W	Resistance normal : 1.2 Ω
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 160 Ω (for pin 85~86) 0 Ω (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-78 CR-115 CR-117 CR-136 CR-177 CR-178 CR-203 CR-302 CR-303 CR-304 CR-305 CR-306	24V 20A	Resistance normal : about 160 Ω (for pin 1~2) 0 Ω (for pin 3~4) ∞ Ω (for pin 3~5)
Hydraulic, transmission temperature	 CD-1 CD-49	-	Resistance normal : ∞ Ω 105˚ C over : 0 Ω
Speaker	 CN-123 (LH) CN-124 (RH)	4 Ω 20W	Resistance normal : 4 Ω
Switch (Locking type)	 CS-4 CS-17 CS-75	24V 8A	Resistance at switch off position ∞ Ω between pin 1-5 and 2-6 0 Ω 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 : 1.2 Ω
Beacon lamp	 CL-117	24V 70W (H1 TYPE)	Resistance normal : 1.1 Ω

Part name	Symbol	Specifications	Check item
DC/DC Converter	 CN-138	12V 3A	Resistance 8.8 Ω (for pin A-B) 7.7 Ω (for pin B-C)
Horn	 CN-120 CN-121	24V 2A	Operation by external power source - conncet 24V power to (+) terminal - ground the (-) terminal
Receiver dryer	 CN-29	24V 2.5A	Resistance 0 Ω : 2.1±0.3~27±2kgf/cm² ∞ Ω : ~2.1±0.3, 27±2~kgf/cm²
Radio & USB player	 CN-27	24V 20W+20W	Resistance Power ON : 4 Ω +4 Ω (for pin 1-6, 4-8)
Back up buzzer	 CN-65	24V 0.5A 110dB	Resistance normal : 5.2 Ω
Washer pump	 CN-102 (FR) CN-103 (RR)	24V 2.5A	Resistance normal : 26.4 Ω (for pin1-2)

Part name	Symbol	Specifications	Check item
Wiper motor	 CN-21 (FR) CN-203 (RR)	24V 1.5A 2-speed Auto parking	-
Cigar lighter	 CL-2	24V 5A 1.4W	Coil resistance normal : about 1M Ω
Alternator	 CN-74	Denso 24V 95A	Voltage normal : 24~28V
Starter	 CN-45	Denso PA90L (24V-7.8kW)	Operating or not
Aircon compressor	 CN-28	24V 79W	Resistance normal : 13.4 Ω
Start relay	 CR-23	24V 300A	Coil resistance normal : 1-2 Ω Switch connection ∞ Ω at normal open position 0 Ω when engaged

Part name	Symbol	Specifications	Check item
Blower motor		24V 9.5A	Resistance at each switch position normal : 0.5-2 Ω
Door switch	 CS-1	24V 2W	Resistance normal : about 5M Ω
Flasher unit	 CR-11	24V 85 ~ 190 C/M 50dB	-
Head lamp	 CL-3 CL-4	24V 75W/70W (H4 TYPE) 24V 4W (T4W)	Resistance normal : a few Ω
Combi lamp (rear)	 CL-15 CL-16	24V 5W (R5W) 2 × 24V 21W (P21W)	-
Master switch	 CS-74 CS-75	Continuous capacity : 180Amp Push in capacity : 1000Amp	-

Part name	Symbol	Specifications	Check item
Warning buzzer	 CN-26	24V 200mA 90±5dB (ℓ m)	-
Preheater	 CN-80	24V 200A	Resistance 0.25~0.12 Ω
Resistor	 R01-A1 R04-A2	4W	Resistance A - B : 120 Ω

GROUP 5 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-2	DEUTSCH	60	I/conn (Front harness-Main harness)	DRB12-60SBE-L018	DRB12-60PBE-L018
CN-3	DEUTSCH		Tool box EXT harness	DT06-6S	-
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)	DRB16-60SAE-L018	DRB12-60PAE-L018
CN-6	DEUTSCH	60	I/conn (Frame 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-11	AMP	15	I/conn (Main harness-Aircon harness)	2-85262-1	368301-1
CN-12	AMP	15	I/conn (Front harness-Bottom harness)	2-85262-1	368301-1
CN-14	DEUTSCH	12	I/conn (Frame harness-Grill harness)	DT06-12S	DT04-12P
CN-16	KET	14	I/conn (RH console harness-Main harness)	MG651110	MG641113
CN-19	Econoseal J	6	I/conn (Emer steer harness-Frame harness)	S816-006002	S816-106602
CN-20	DEUTSCH	12	Aftertreatment harness	DT06-12S	-
CN-21	AMP	6	Front wiper motor	936257-2	-
CN-22	DEUTSCH	12	Aftertreatment harness	-	DT04-12P
CN-24	DEUTSCH	2	Grill harness	DT06-12S	-
CN-25	Molex	2	Horn	36825-0211	-
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	21WD-12051	-
CN-45	Ring term	-	Starter	R14-12	ST 710246-2
CN-48	AMP	1	Hour meter	2-520193-2	-
CN-56	KUM	12	Cluster	KPK145-16017	-
CN-57	AMP	20	Monitor	174047-2	-
CN-58A	DEUTSCH	40	MCU	DRC26-40-SA	-
CN-58B	DEUTSCH	40	MCU	DRC26-40-SB	-
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	-
CN-74	PACKARD	4	Alternator	1218-6568	-
CN-79	DEUTSCH	2	Differential lock solenoid	-	DT06-2S-EP06
CN-79A	AMP	6	Differential lock solenoid	S816-106002	-
CN-80	-	1	Pre-heater	R14-6	-
CN-83	NMWP	2	Aircon fan	PB625-02027	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-96	AMP	4	I/conn (Frame harness-Fuel warmer harness)	-	2-967402-2
CN-96A	AMP	4	Fuel warmer	2-967325-2	-
CN-96B	AMP	3	Fuel warmer	368523-1	-
CN-100	DEUTSCH	3	Boom kick out	DT06-3S-EP06	-
CN-101	DEUTSCH	3	Bucket leveler	DT06-3S-EP06	-
CN-102	KET	2	Front washer tank	MG640605	-
CN-103	KET	2	Rear washer tank	MG640605	-
CN-110	-	6	RCV lever	1-480704-0	-
CN-112	-	16	Gear box	21L7-60290	-
CN-114	KET	6	Fingertip lever	DT06-6S	-
CN-115	DEUTSCH	6	Auto grease	DT06-6S-EP06	DT06-6P-E005
CN-120	MOLEX	2	Horn	26825-0211	-
CN-121	MOLEX	2	Horn	26825-0211	-
CN-122	DEUTSCH	9	Data link (machine)	HD10-9-96P	-
CN-123	KET	2	Speaker (LH)	7123-1520	-
CN-124	KET	2	Speaker (RH)	7123-1520	-
CN-125	DEUTSCH	12	Remote management	DT06-12S	DT04-12P
CN-126	DEUTSCH	9	Data link (engine)	HD10-9-96P	-
CN-127B	DEUTSCH	4	Service tool monitor	DT04-4P-E005	DT06-4S-EP06
CN-128	NMWP	1	Aircon compressor	PB625-01027	-
CN-129	KET	2	Receiver drier	MG640795	-
CN-134	AMP	6	Diagnostic (TCU)	1-480705-0	-
CN-136	TYCO	2	Ride control solenoid	85202-1	-
CN-136A	Econoseal J	2	I/conn (Ride control harness-Front harness)	S816-002002	S816-102002
CN-137	AMP	1	12V socket	174198-1	-
CN-138	AMP	12	DC/DC Converter	1-967622-1	-
CN-139	AMP	1	12V socket	174198-1	-
CN-140	AMP	3	I/conn (Frame harness-Quick coupler)	-	S816-103002
CN-141	TYCO	2	I/conn (Front harness-Ride control)	174352-2	-
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)	DT06-2S	DT04-2P
CN-157	AMP	68	T/M control unit	962175	-
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 switch	LC3-01	-
CN-162	AMP	6	Pedal	174262-2	-

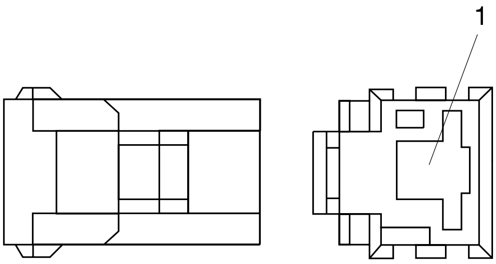
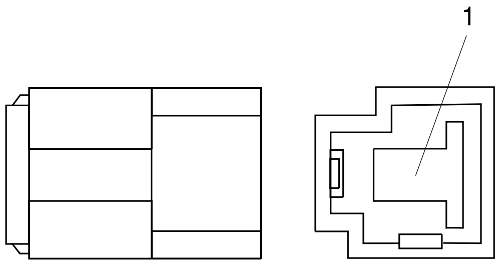
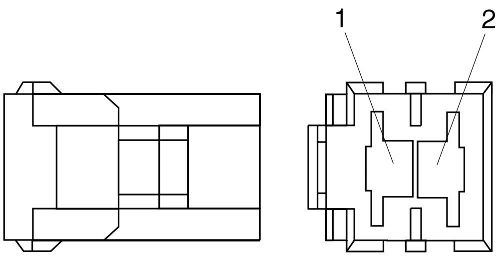
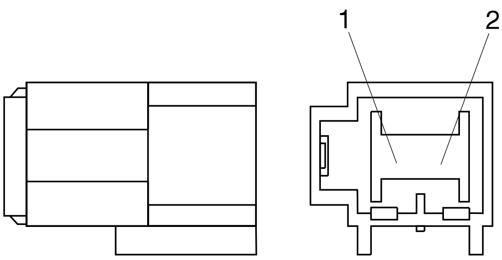
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-162	AMP	6	Pedal	174262-2	-
CN-163	AMP	2	ECO feeling switch	174352-2	-
CN-171	AMP	1	Service socket	174198-1	-
CN-177	DEUTSCH	2	Quick coupler unlock solenoid	-	DT06-2S-EP04
CN-177A	AMP	3	I/conn (Front harness-Quick coupler harness)	S816-003002	S816-103002
CN-177B	AMP	3	Quick coupler	S816-003002	S816-103002
CN-178	DEUTSCH	2	Quick coupler lock solenoid	-	DT06-2S-EP04
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	4	Camera	DT06-4S	DT04-4P
CN-250	Econoseal J	4	Rear view camera	S816-004002	S816-104002
CN-252	TYCO	6	Differential lock	S816-006602	S816-106602
CN-271	DEUTSCH	3	AUX	DT06-3S	-
CN-351	MTA	2	Fuse maxi 40A	10.01005	07.00960
CN-352	MTA	2	Fuse maxi 80A	10.01005	07.00910
CN-399	AMP	4	DEF sensor	1-967325-1	-
CN-641	KET	3	Button start switch	-	MG641035
CN-J2	DELPHI	96	ECM	13964572	-
CN-J5	DEUTSCH	3	CAN I resister	DT04-3P-EP10	DT06-3S-E008
CN-J7A	AMP	4	Nox sensor engine inlet	2-1418390-1	-
CN-J7B	AMP	4	Nox sensor turbo pipe	1-1418390-1	-
CN-J10	AMP	4	SCR temp sensor	3-1418390-1	-
CN-J17	AMP	4	DOC temp sensor	4-1418390-1	-
CN-J26	BOSCH	12	DEF supply module	2-1703639-1	-
CN-J27	DEUTSCH	2	DEF heater valve	DT06-2S	-
CN-J28	BOSCH	2	Hose heating PR line	1-928-403-874	-
CN-J29	BOSCH	2	Hose heating back line	1-928-403-874	-
CN-J30	BOSCH	2	Hose heating suction line	1-928-403-874	-
CN-J31	BOSCH	2	DEF dosing inlet valve	1-928-403-874	-
CN-J78	DEUTSCH	2	Water in fuel	DT06-2S	-
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

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
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	DEUTSCH	2	Emergency steering pump relay	DT06-2S	DT06-2P
CR-40	KET	5	EHCU power relay	MG610047-1	-
CR-46	OMRON	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	-
Switch					
CS-1	AMP	1	Door switch	S822-014004	-
CS-2	SWP	6	Start key switch	S814-006000	-
CS-02A	AMP	6	BKCU	S814-006000	-
CS-02B	DEUTSCH	3	BKCU	DT06-3S-E008	-
CS-02C	KET	3	BKCU	MG651032	-
CS-4	VC2-01	10	Pilot cut off switch	21HN-56300	-
CS-11	SWP	8	Multi function switch	S814-008000	-
CS-12	SWP	6	Multi function switch	S814-006000	-
CS-17	VC2-01	10	Parking switch	21HN-56300	-
CS-41	VC2-01	10	Hazard switch	21HN-56300	-
CS-74	DEUTSCH	2	Master switch	DT06-2S	-
CS-75	VC2-01	10	Emergency steering test switch	21HN-56300	-
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	VC2-01	10	DPF switch	21HN-56300	-
Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	KET	3	Cigar lighter	S822-014000	S822-114000
CL-3	DEUTSCH	6	Head light (LH)	DT06-6S-EP06	-
CL-4	DEUTSCH	6	Head light (RH)	DT06-6S-EP06	-
CL-15	SWP	4	Combi lamp (RR, LH)	S814-004000	-
CL-16	SWP	4	Combi lamp (RR, RH)	S814-004000	-
CL-21	SWP	2	Numberplate lamp	S814-002000	-
CL-32	DEUTSCH	2	Rear work light (LH)	DT06-2S	DT04-2P
CL-33	DEUTSCH	2	Rear work light (RH)	DT06-2S	DT04-2P

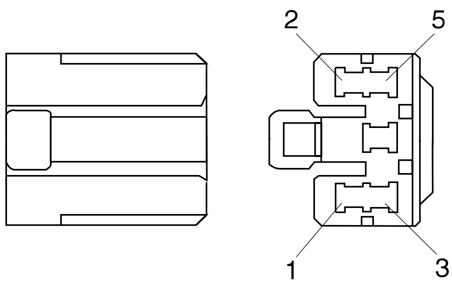
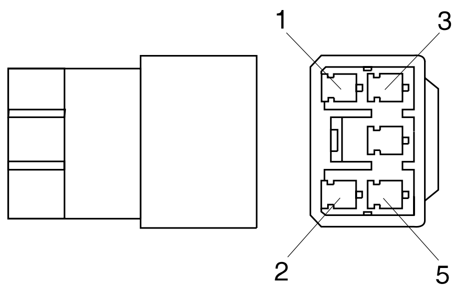
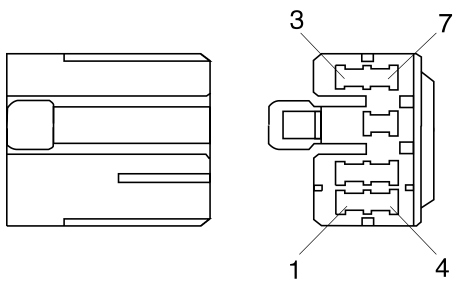
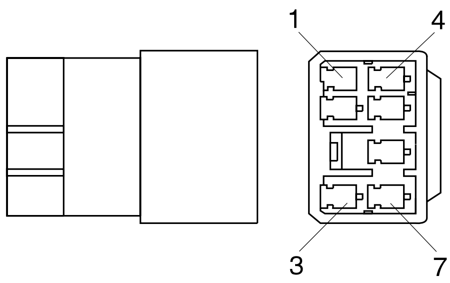
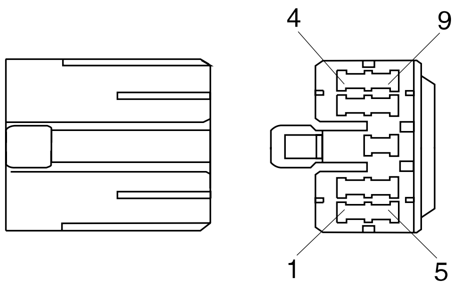
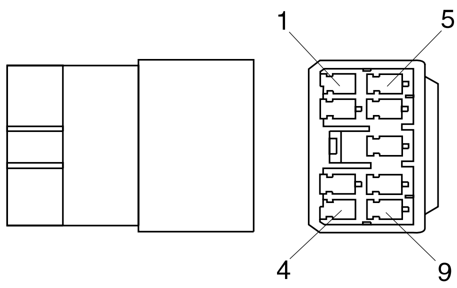
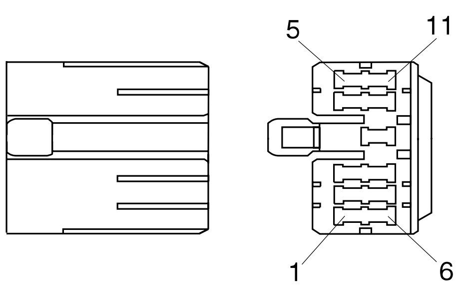
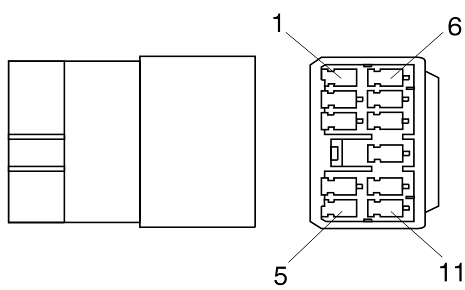
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CL-35	DEUTSCH	2	Rear work light (LH, opt)	DT06-2S	DT04-2P
CL-36	DEUTSCH	2	Rear work light (RH, opt)	DT06-2S	DT04-2P
CL-42	DEUTSCH	2	Rear work light (LH, opt)	DT06-2S	DT04-2P
CL-43	DEUTSCH	2	Rear work light (RH, opt)	DT06-2S	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	-
Sensor, sender					
CD-1	AMP	2	Hyduaulic oil temp sendor	85202-2	-
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	85202-2	-
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-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-EP06	-
CD-46	AMP	3	Output speed sensor	282087	-
CD-47	AMP	2	Inter gear pickup sensor	85202-5	-
CD-48	AMP	2	Oil filter restriction sensor	282080	-
CD-49	AMP	2	Converter temp sensor	85202-1	-
CD-73	AMP	2	Speed sendsor	174352-2	-
CD-79	DEUTSCH	3	Diff lock feed back sensor	-	DT06-3S-EP06
CD-80	DEUTSCH	3	Boom positioner sensor (Boom up)	DT06-3S-EP06	-
CD-81	DEUTSCH	3	Boom positioner sensor (Boom down)	DT06-3S-EP06	-
CD-96	PACKARD	3	Coolant level sensor	12110293	-
CD-96A	DEUTSCH	3	Coolant level sensor (EXT harness)	DT06-4S	DT04-4P
CD-101	SUMITOMO	4	TBAT sensor	6098-0144	-
CD-112	-	16	Gear box	21L7-60290	-
Diode					
DO-02	-	2	Diode	S816-002002	21EA-50550
DO-03	-	2	Diode	S816-002002	21EA-50550
J					
JP-01	-	4	TBAP EXT	54200415	-

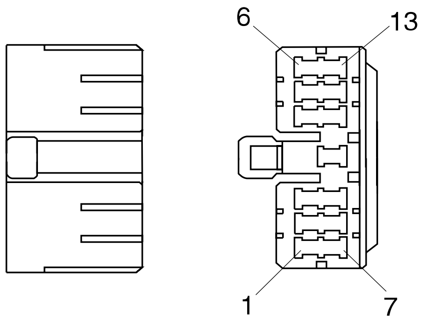
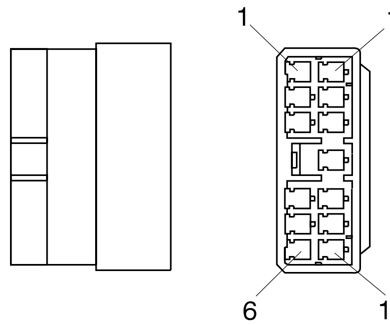
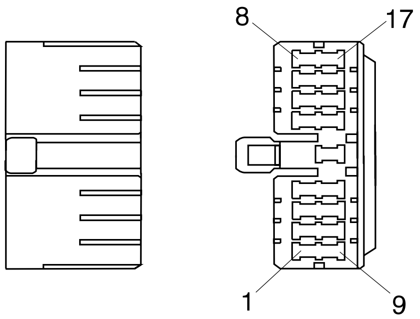
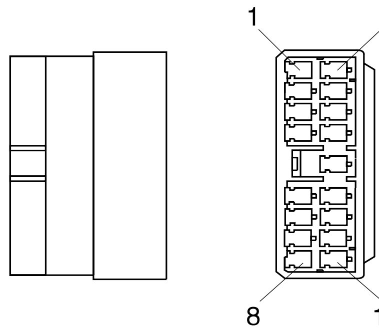
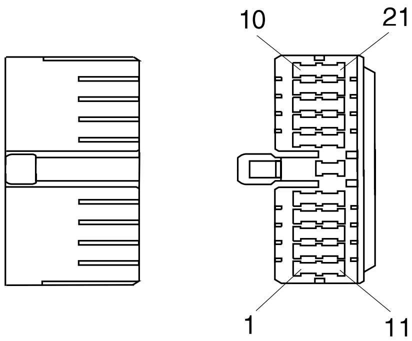
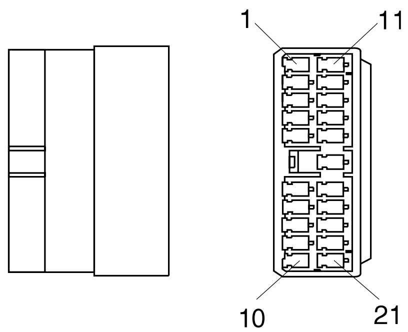
2. CONNECTION TABLE FOR CONNECTORS

1) 58-L TYPE CONNECTOR

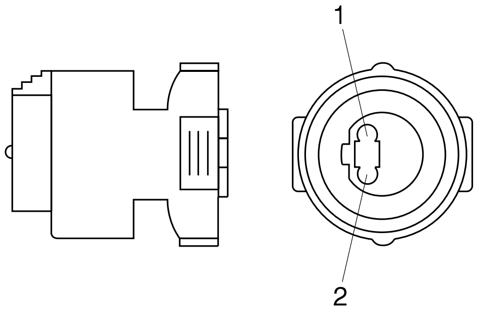
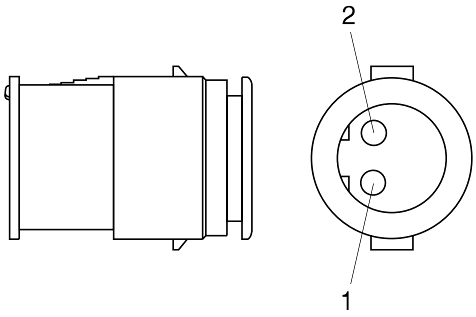
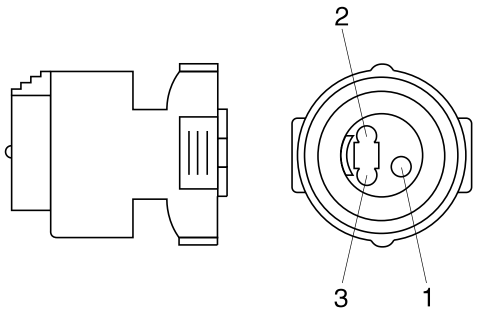
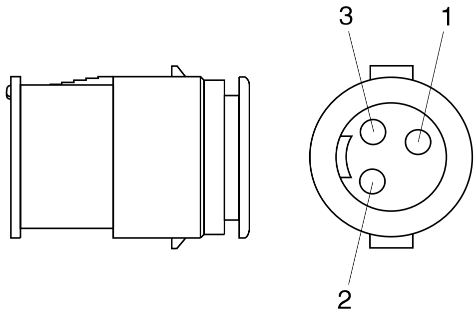
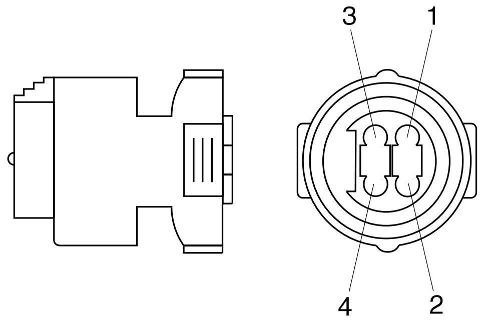
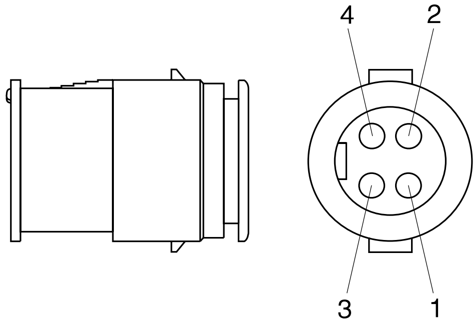
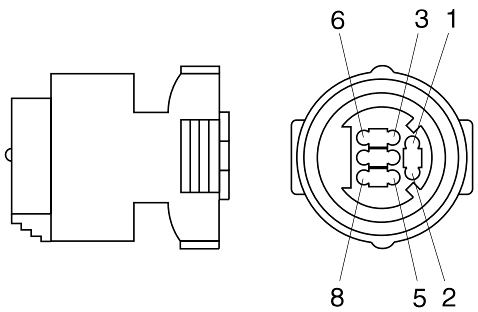
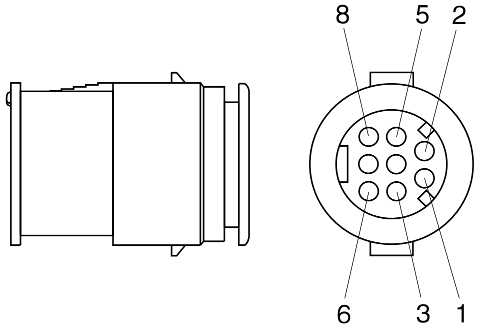
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S813-030100	 S813-130100
2	 S813-030200	 S813-130200

2) PA TYPE CONNECTOR

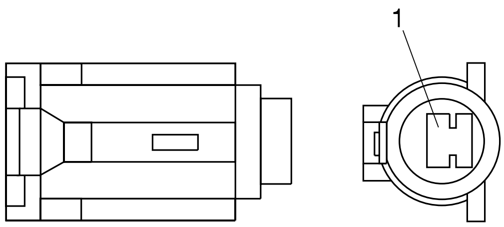
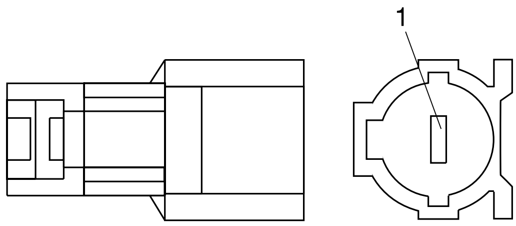
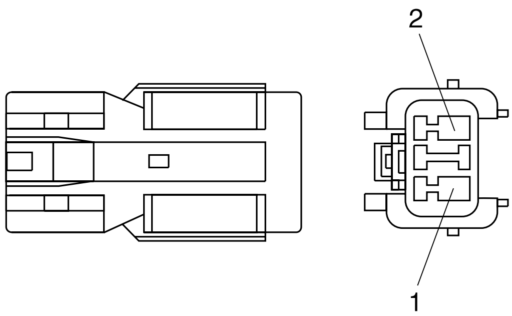
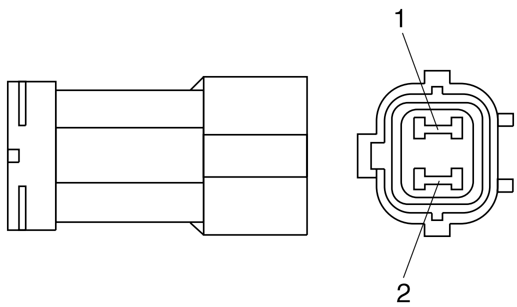
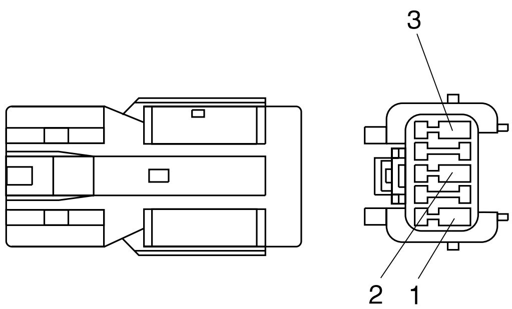
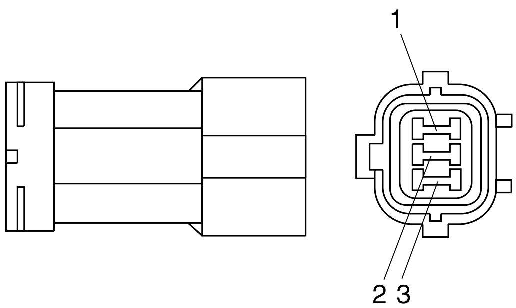
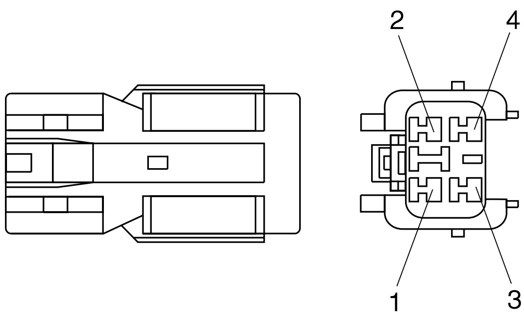
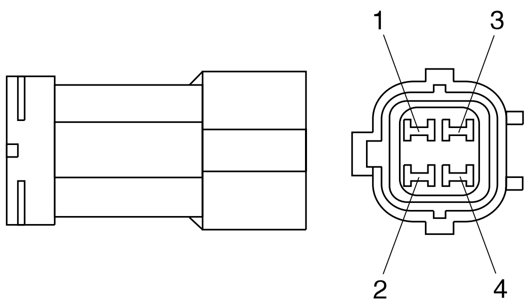
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 S811-109002
11	 S811-011002	 S811-111002

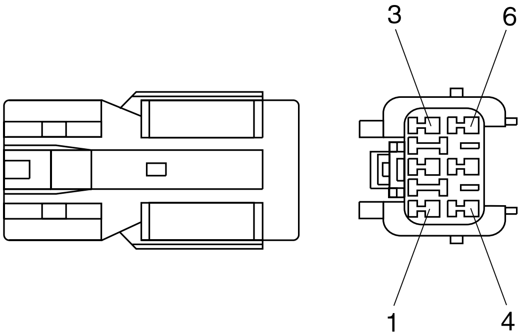
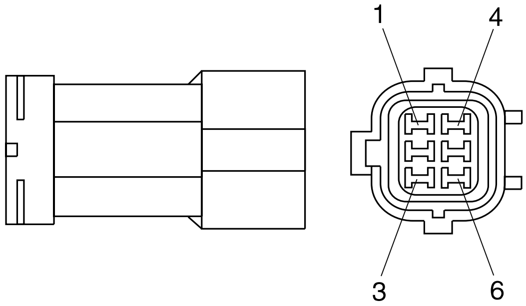
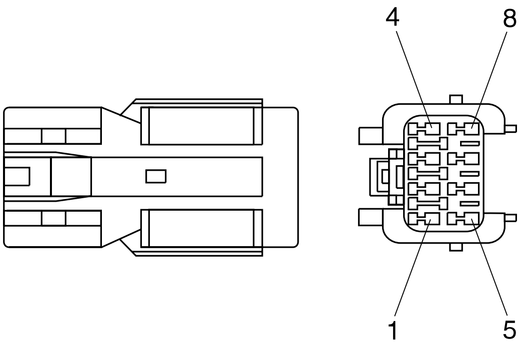
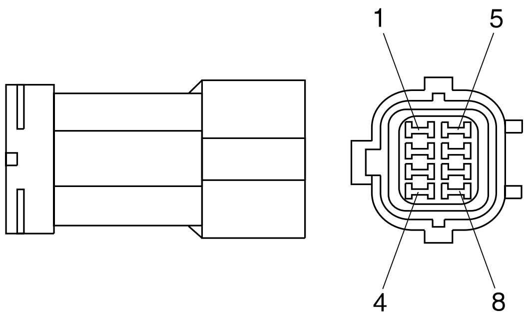
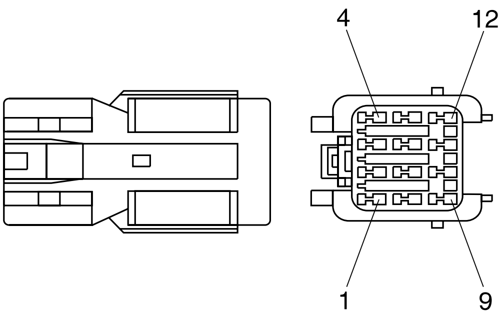
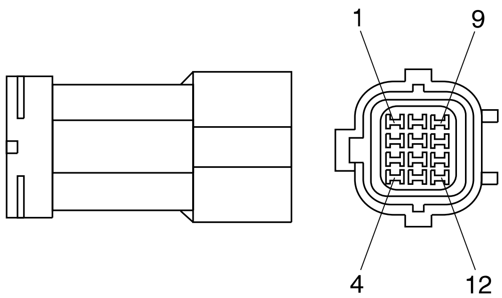
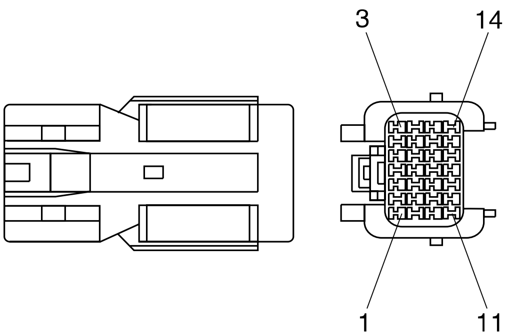
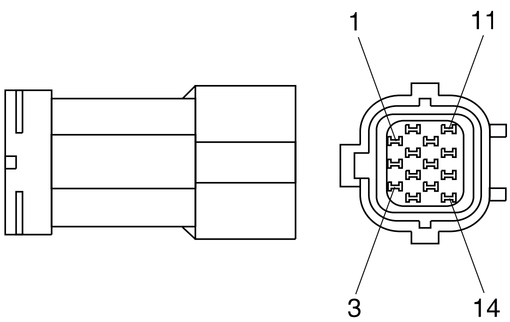
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

3) J TYPE CONNECTOR

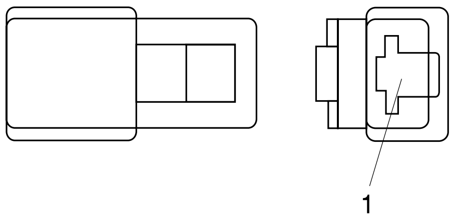
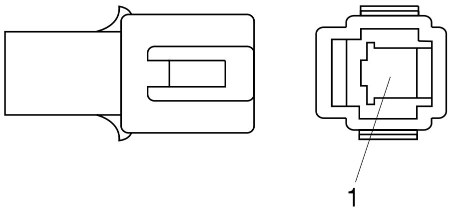
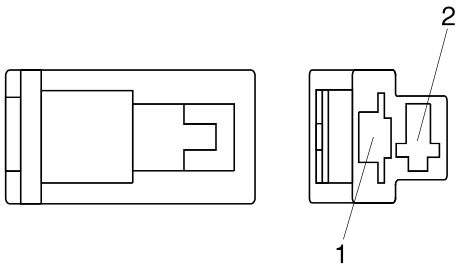
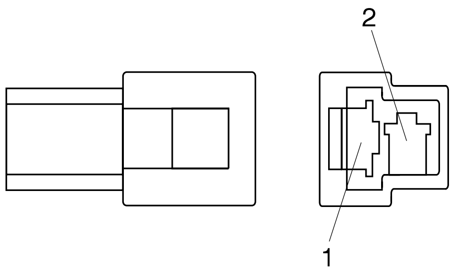
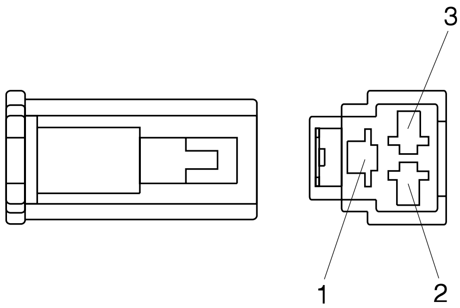
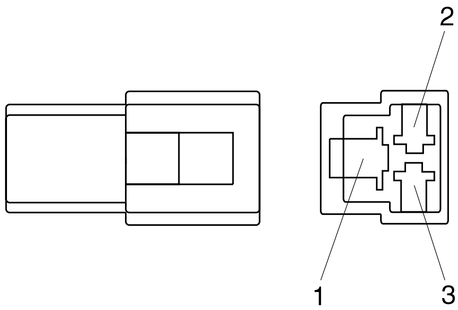
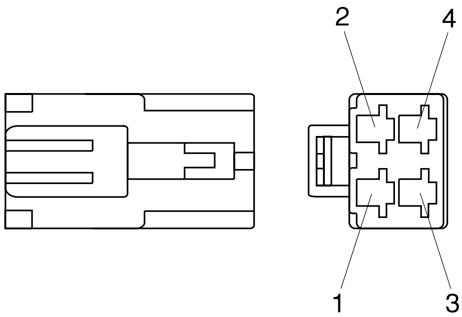
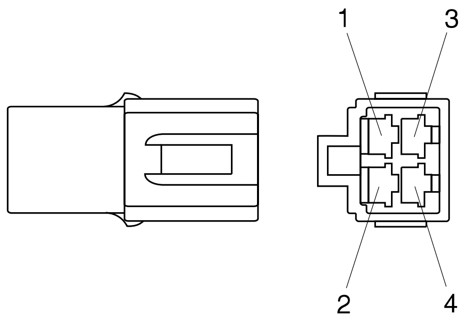
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

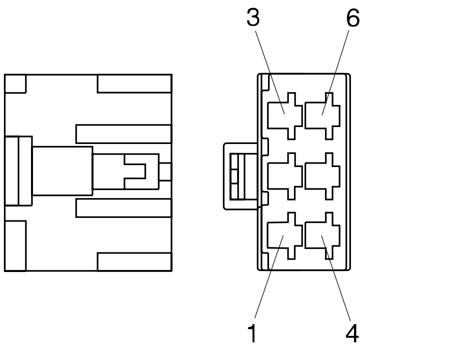
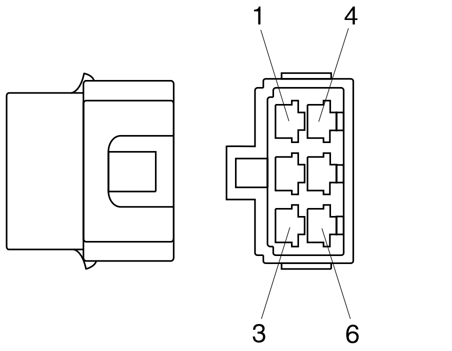
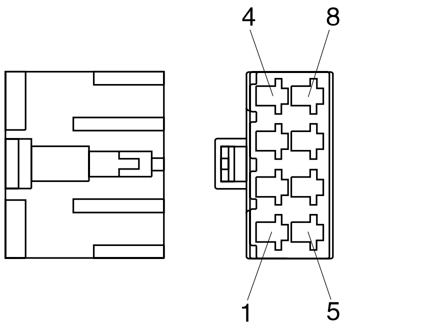
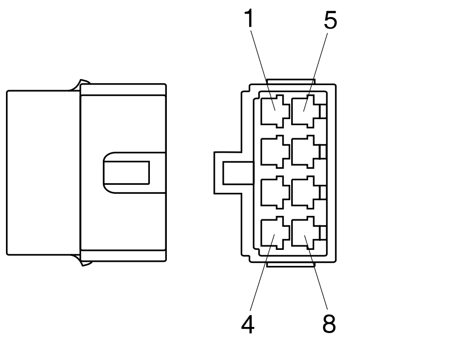
4) SWP TYPE CONNECTOR

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

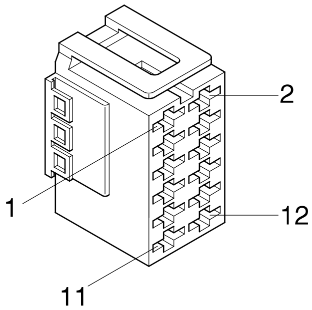
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

5) CN TYPE CONNECTOR

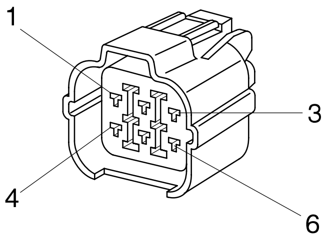
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S810-006202	 S810-106202
8	 S810-008202	 S810-108202

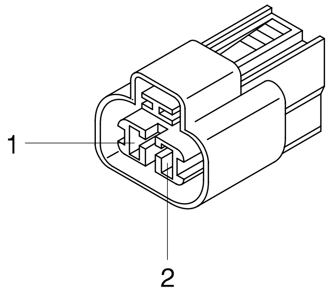
6) ITT SWF CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF589790	

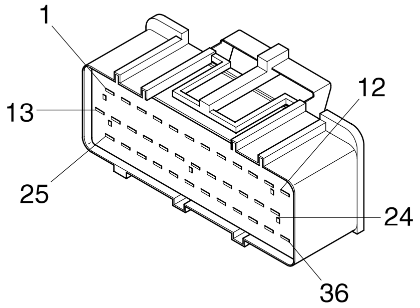
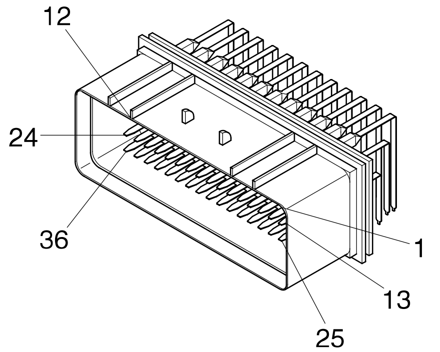
7) HW090 SEALED CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 6189-0133	

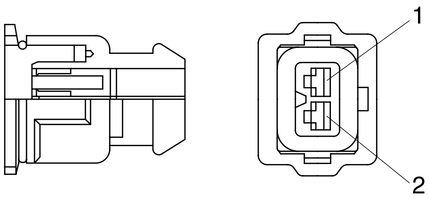
8) MWP02F-B CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 PH805-02028	

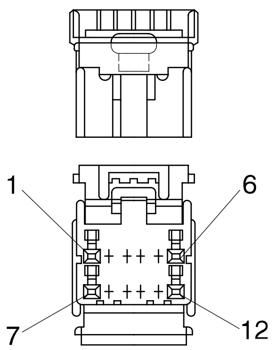
9) AMP ECONOSEAL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
36	 344111-1	 344108-1

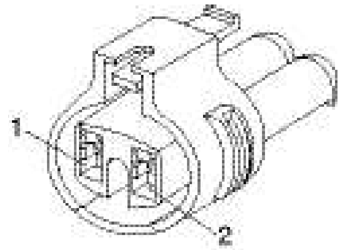
10) AMP TIMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 85202-1	

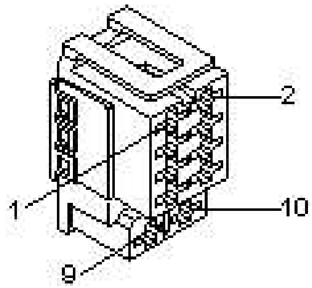
11) AMP 040 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
12	 174045-2	

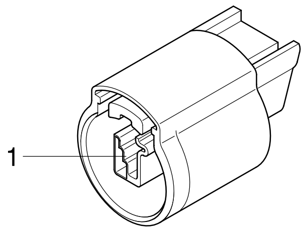
12) KET 090 WP CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 MG640795	

13) ITT SWF CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

14) MWP NMWP CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 NMWP01F-B	

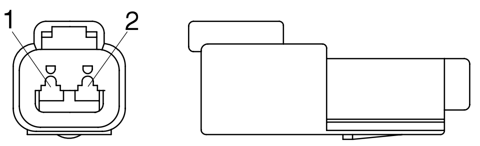
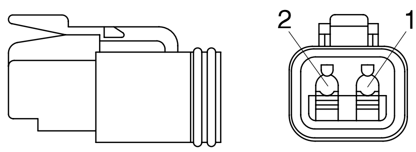
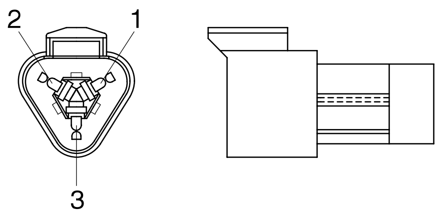
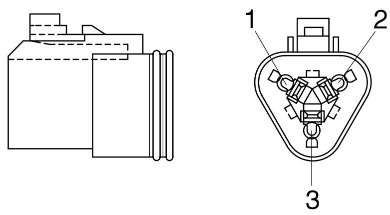
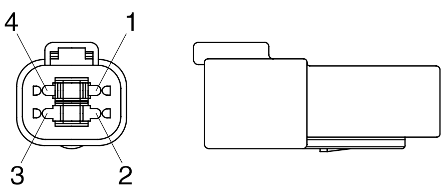
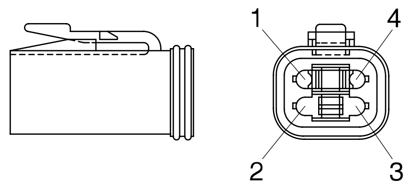
15) DEUTSCH DT CONNECTORS

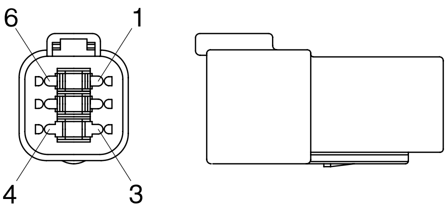
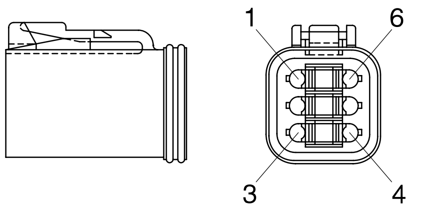
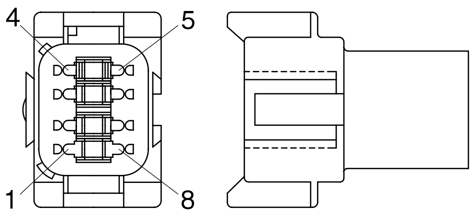
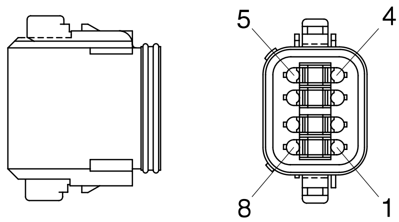
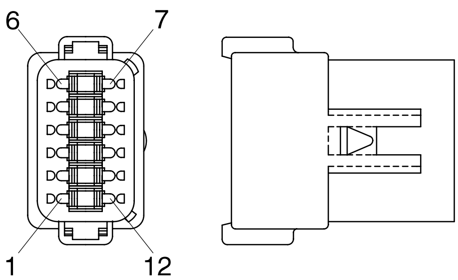
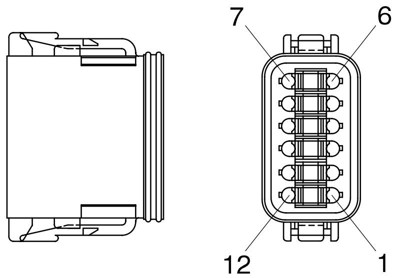
DT 06 - 3S - ★★★★

- ★★★★ : Modifications (see below)
- 3S : Number of contacts (P : Pin, S : Socket)
- 06 : 04 : Receptacle, 06 : Plug
- DT : Deutsch connetors

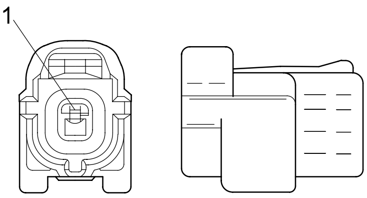
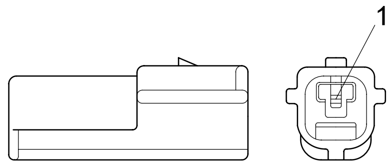
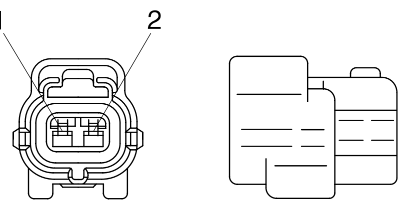
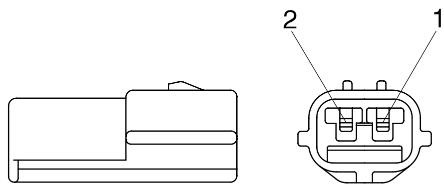
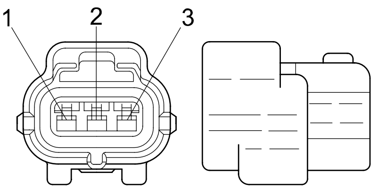
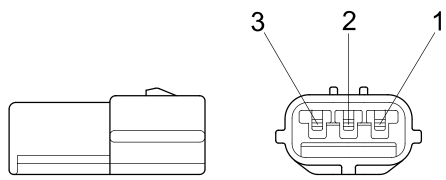
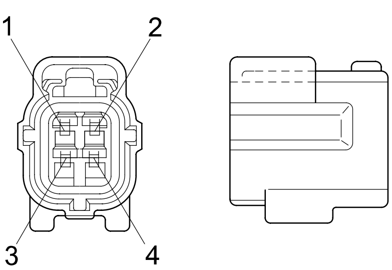
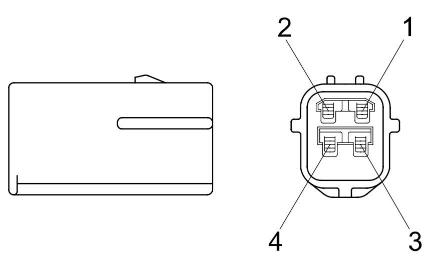
※ Modification

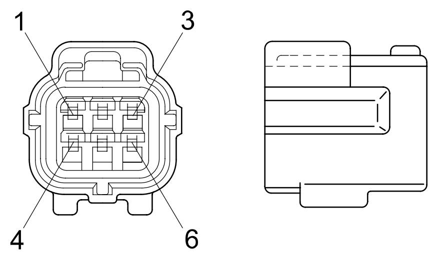
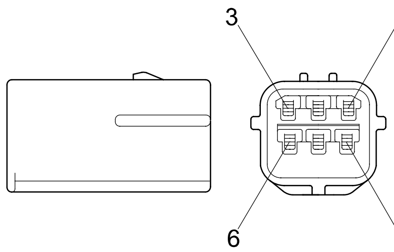
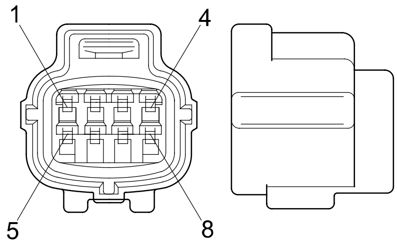
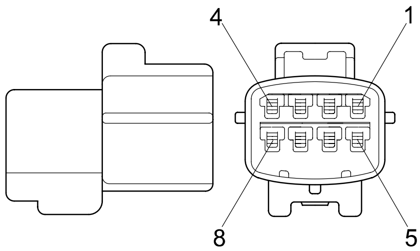
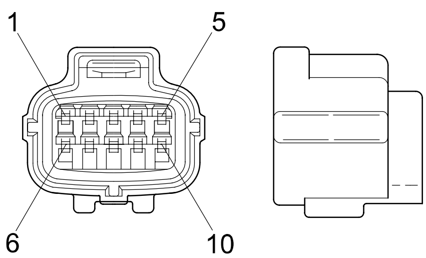
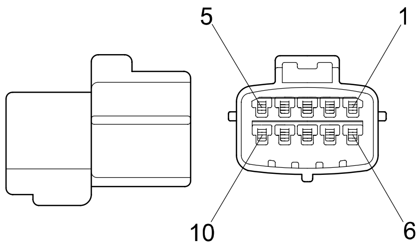
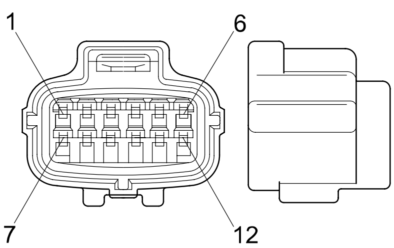
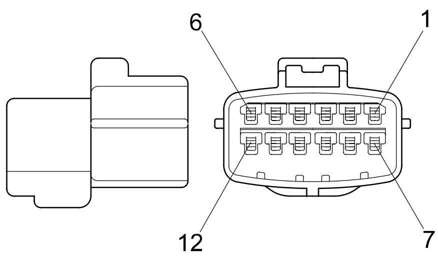
E003 : Standard end cap - gray
E004 : Color of connector to be black
E005 : Combination - E004 & E003
EP04 : End cap
EP06 : Combination P012 & EP04
P012 : Front seal enhancement - connectors color to black for 2, 3, 4 & 6pin

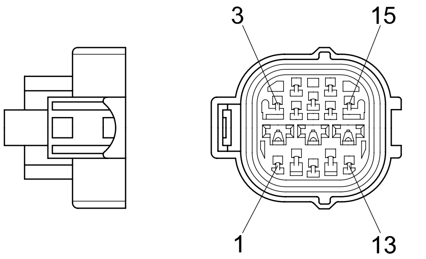
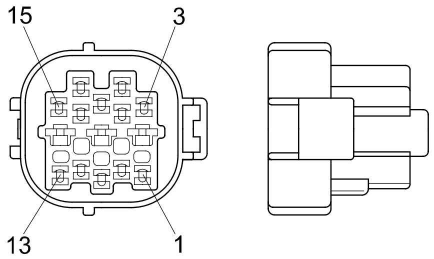
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 DT06-6S	 DT04-6P
8	 DT06-8S	 DT04-8P
12	 DT06-12S	 DT04-12P

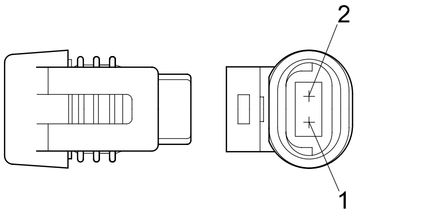
16) ECONOSEAL J TYPE CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S816-001002	 S816-101002
2	 S816-002002	 S816-102002
3	 S816-003002	 S816-103002
4	 S816-004002	 S816-104002

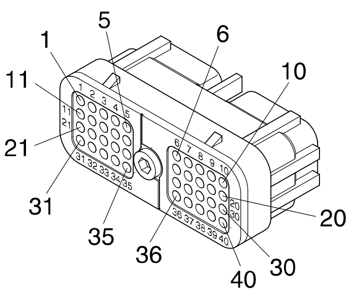
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

No. of pin	Receptacle connector (female)	Plug connector (male)
15	 368301-1	 2-85262-1

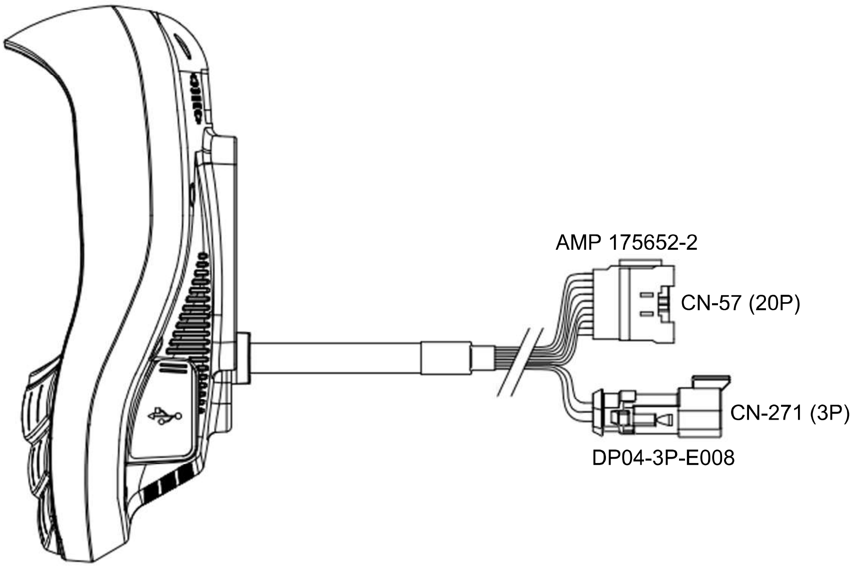
17) METRI-PACK TYPE CONNECTOR

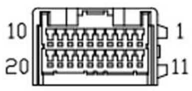
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 12040753	

18) DEUTSCH MCU CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
40	 DRC26-40SA/B/C	

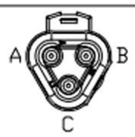
19) MONITOR CONNECTOR (21WD-11100, 21WD-11101, 21WD-11102)





PART NO. : AMP 175652-2

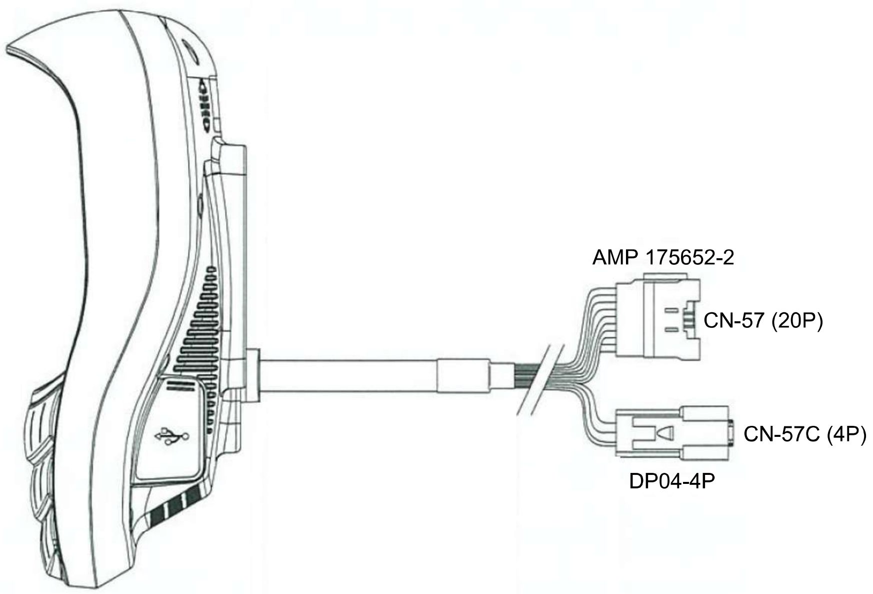
NO	PIN NAME	NO	PIN NAME
1	IG 24V	11	GND
2	BATTERY 24V	12	GND
3	BATTERY 24V	13	CAN1 H
4	CAMERA CH0	14	CAN2 L
5	CAMERA CH0 SIDE	15	CAN2 H
6	6.5V OUTPUT	16	CAN2 SHIELD
7	AVX LEFT	17	CAMERA SHIELD
8	AVX RIGHT	18	CAN1 LOW
9	CAMERA CH1	19	GND
10	CAMERA CH2	20	CAMERA CH3

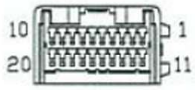


PART NO. : DP04-3P-E008

NO	PIN NAME	NO	PIN NAME
A	AUX GND	C	AUX RIGHT
B	AUX LEFT		

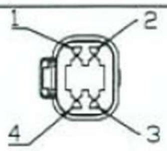
MONITOR CONNECTOR (21WD-11103, 21WD-11104)





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	CAN1 H
4	CAMERA CH0	14	CAN2 L
5	CAMERA CH3 DIFF−	15	CAN2 H
6	6.5V OUTPUT	16	CAN2 SHIELD
7	N.C	17	CAMERA SHIELD
8	N.C	18	CAN1 L
9	CAMERA CH1	19	N.C
10	CAMERA CH2	20	CAMERA CH3 DIFF+



PART NO. : DT04−4P

NO	PIN NAME	NO	PIN NAME
1	CAM VCC	3	CAM CH3 +
2	CAM GND	4	CAM CH3 −

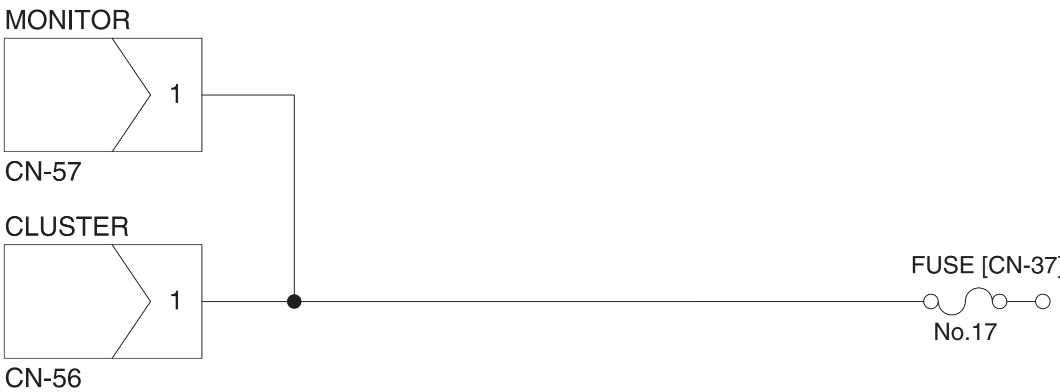
GROUP 6 TROUBLESHOOTING

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.17 is not blown out and ON/OFF of bulb.

· After checking, connect the disconnected connectors again immediately unless otherwise specified.

Check	Result	Cause	Remedy
Check voltage between CN-56 (1), CN-57(1) and chassis	YES	Defective cluster Defective monitor	Replace Replace
	NO	Disconnection in wiring harness or poor contact between CN-56 (1), CN-57 (1) and fuse No. 17	Repair or replace (after clean)



Check voltage

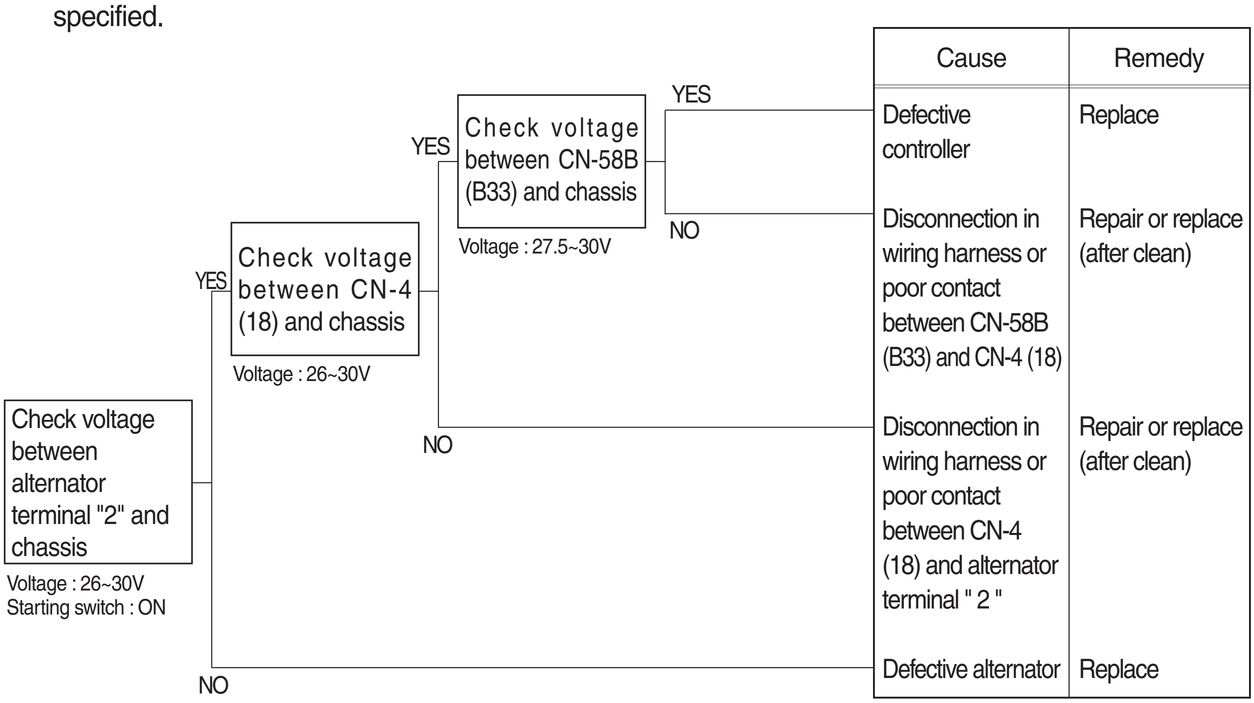
YES	20 ~ 30 V
NO	0 V

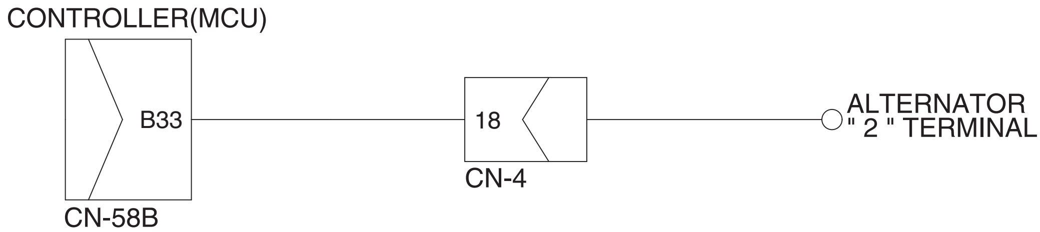
760F7EL24

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.





Check valtage

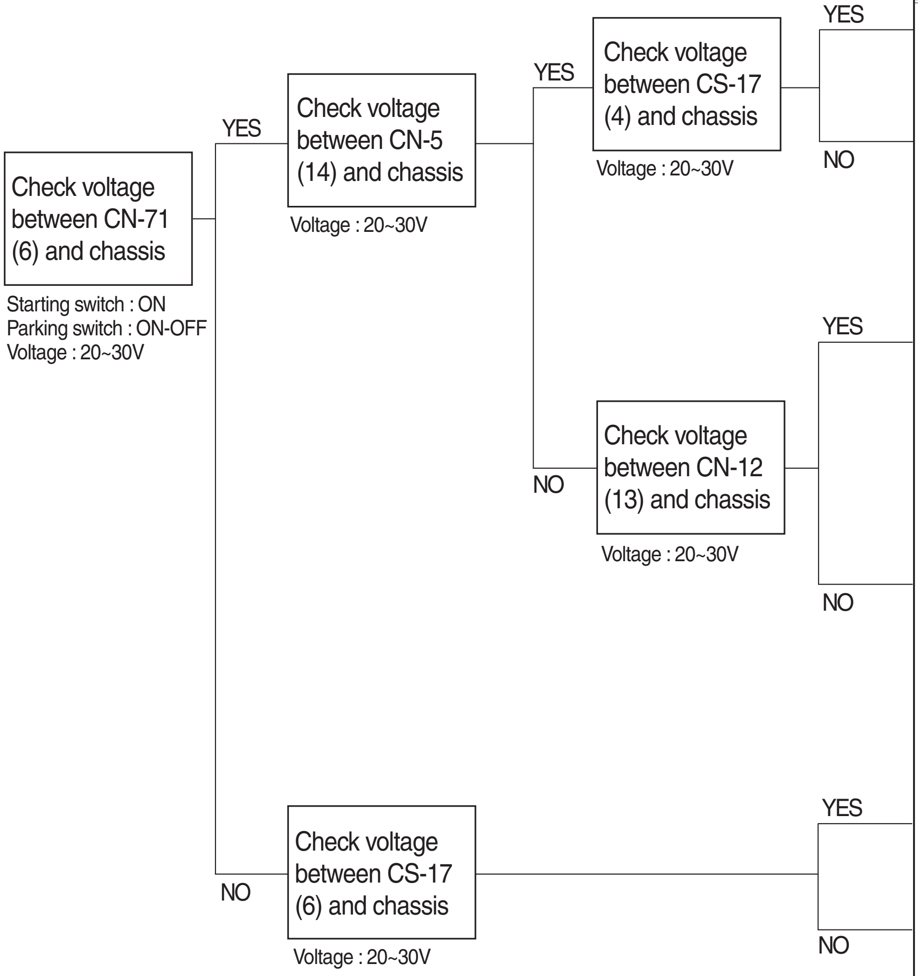
YES	20 ~ 30 V
NO	0 V

760F7EL38

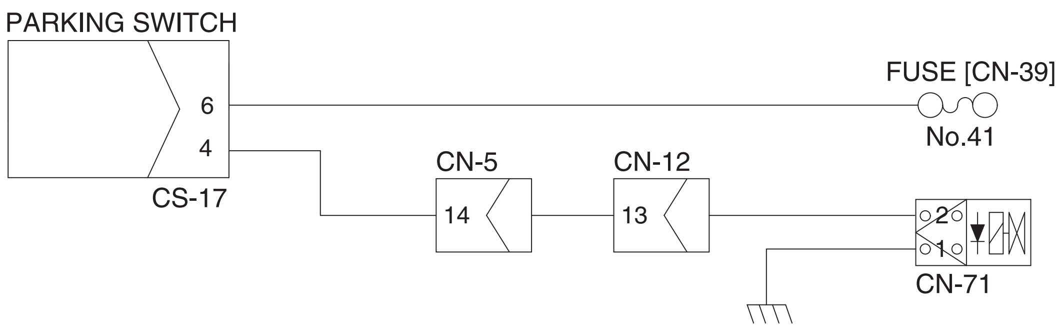
3. WHEN PARKING SOLENOID DOES NOT WORK

· 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.



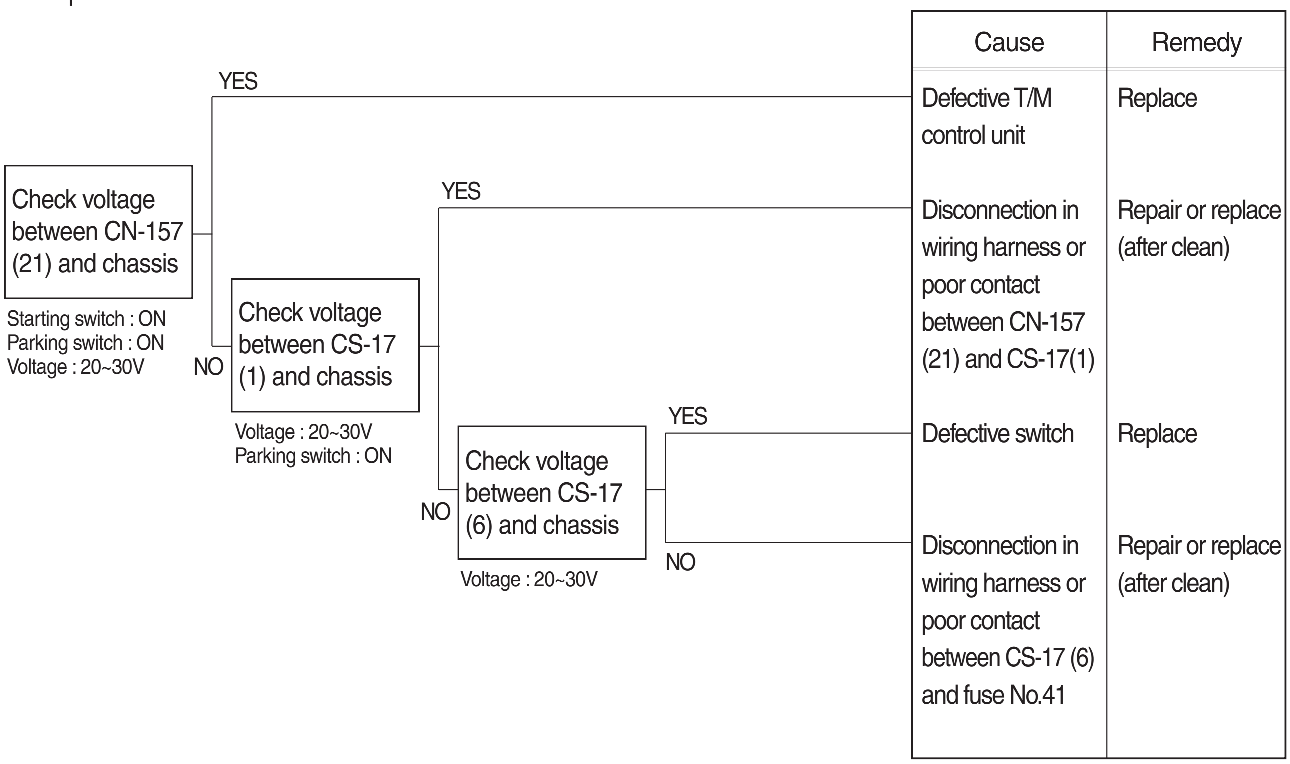
Cause	Remedy
Defective parking brake solenoid	Replace
Disconnection in wiring harness or poor contact between CS-17 (4) and CN-5 (14)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-12 (13) and CN-5 (14)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-12 (13) and CN-71 (2)	Repair or replace (after clean)
Difective parking switch	Replace
Disconnection in wiring harness or poor contact between CS-17 (6) and Fuse No.41	Repair or replace (after clean)

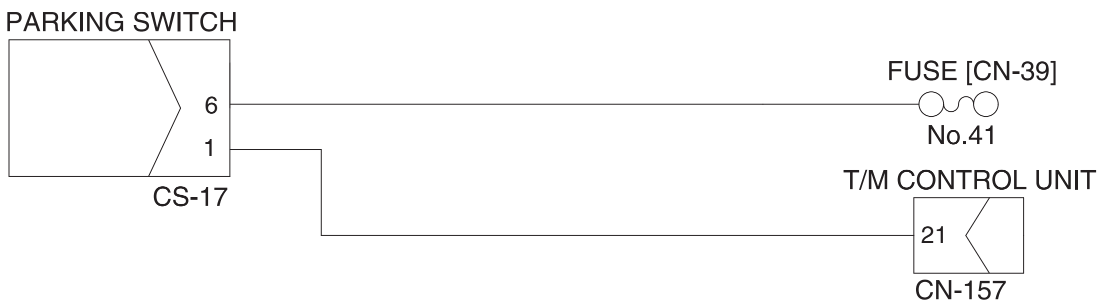


740F7EL39

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.





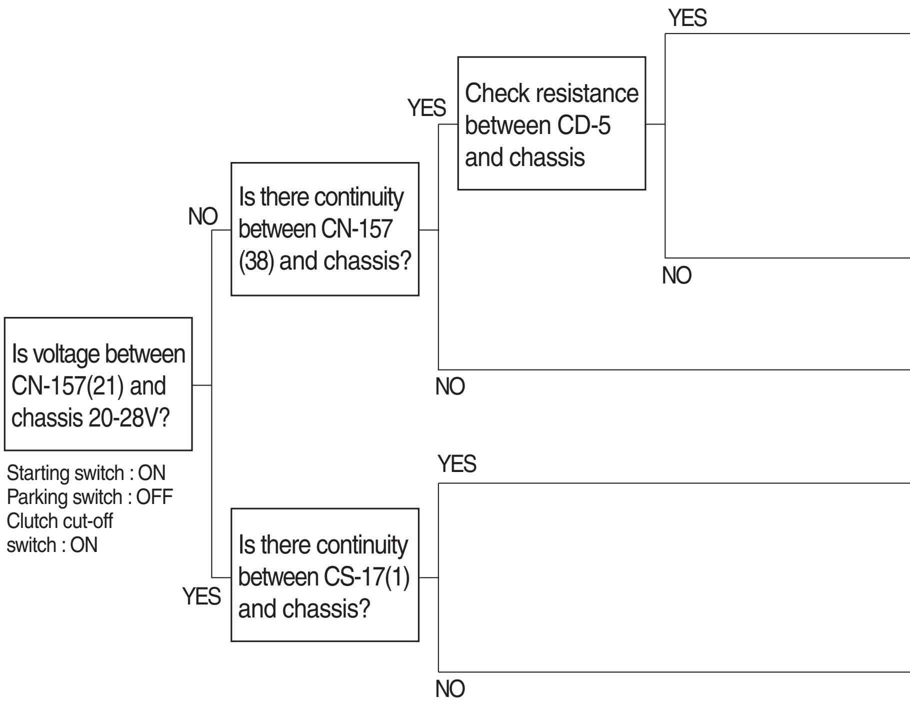
Check resistance

YES	MAX 1 Ω
NO	MIN 1M Ω

740F7EL40

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.



Cause	Remedy
Defective clutch cut-off mode switch	Replace
Defective T/M control unit	Replace
Defective T/M control unit	Replace
Defective parking switch	Replace
Disconnection wiring harness or poor contact between CN-157 (21) and CS-17 (1)	Repair or replace (after clean)

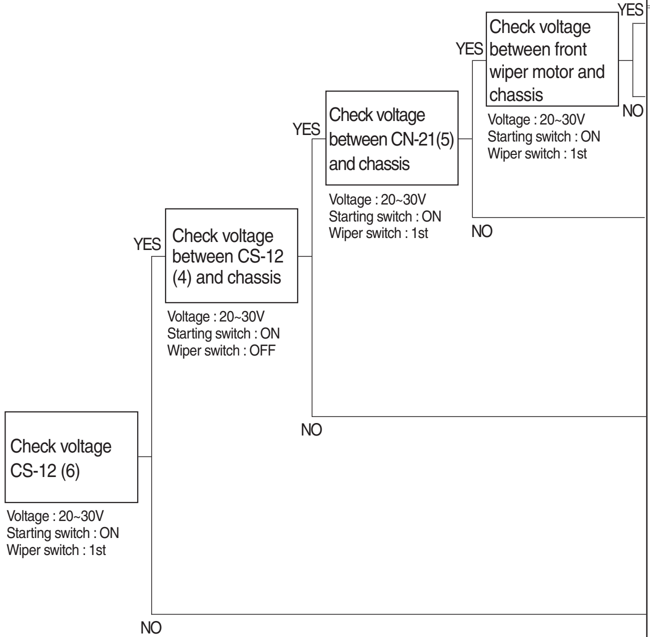
Check resistance

YES	MAX 1 Ω
NO	MIN 1M Ω

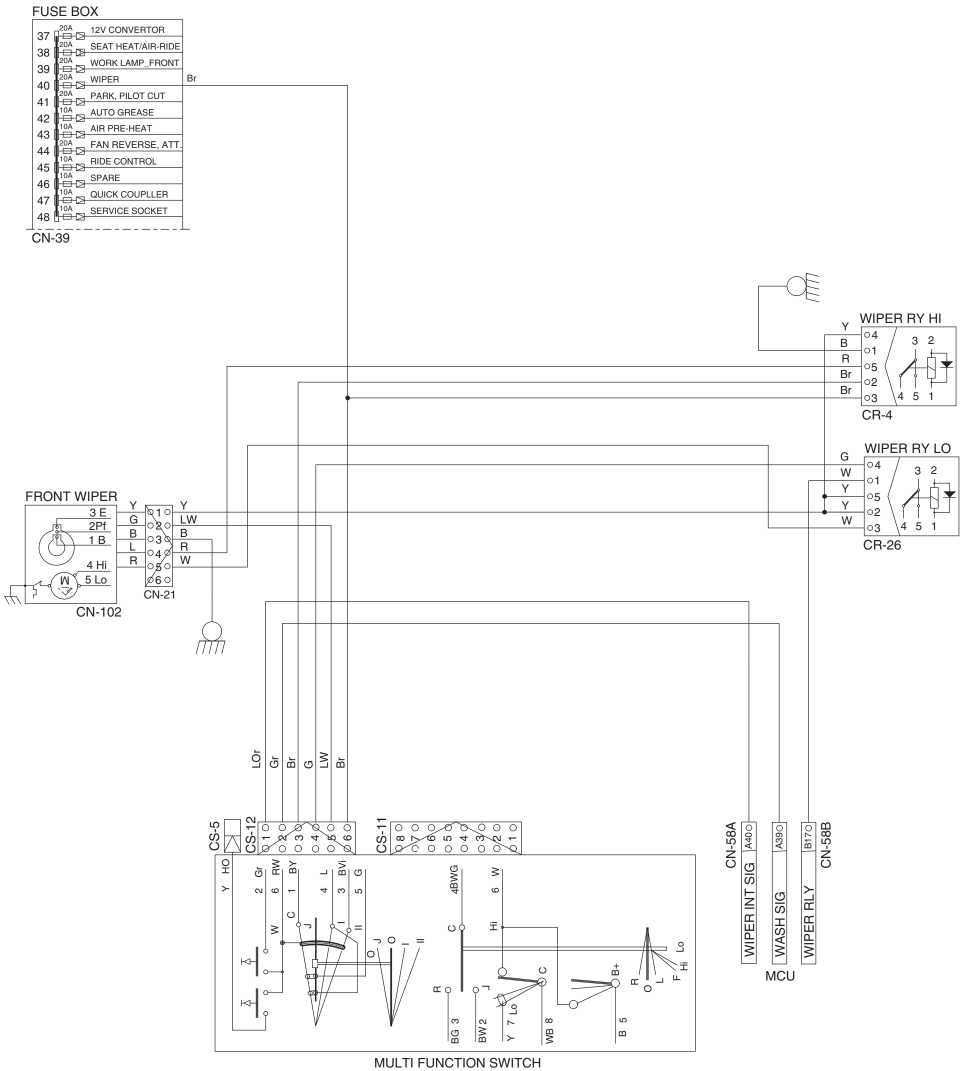
6. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

· 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.

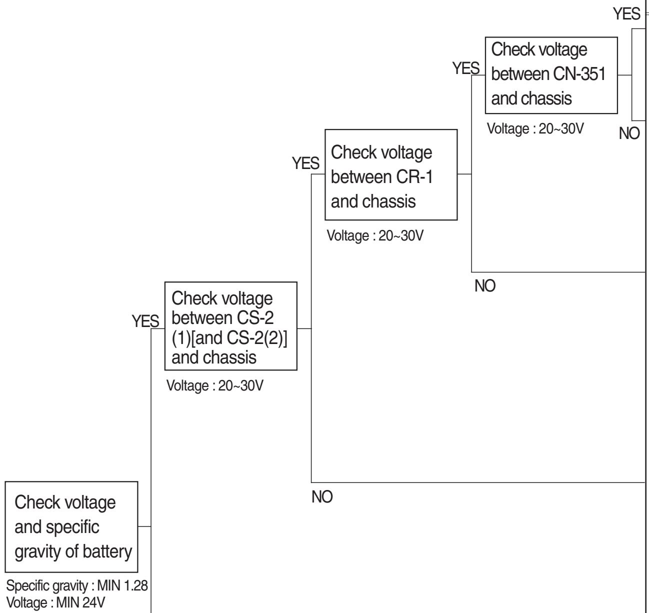


Cause	Remedy
Defective front wiper motor	Replace
Poor connection of chassis	Replace
Disconnection in wiring harness or poor contact between CN-21(5) and CR-26(3)	Repair or replace (after clean)
Defective wiper switch or disconnection in wiring harness or poor contact between CS-12(4) and CR-26(4)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-12(6) and fuse [CN-39] No.40	Repair or replace (After clean)

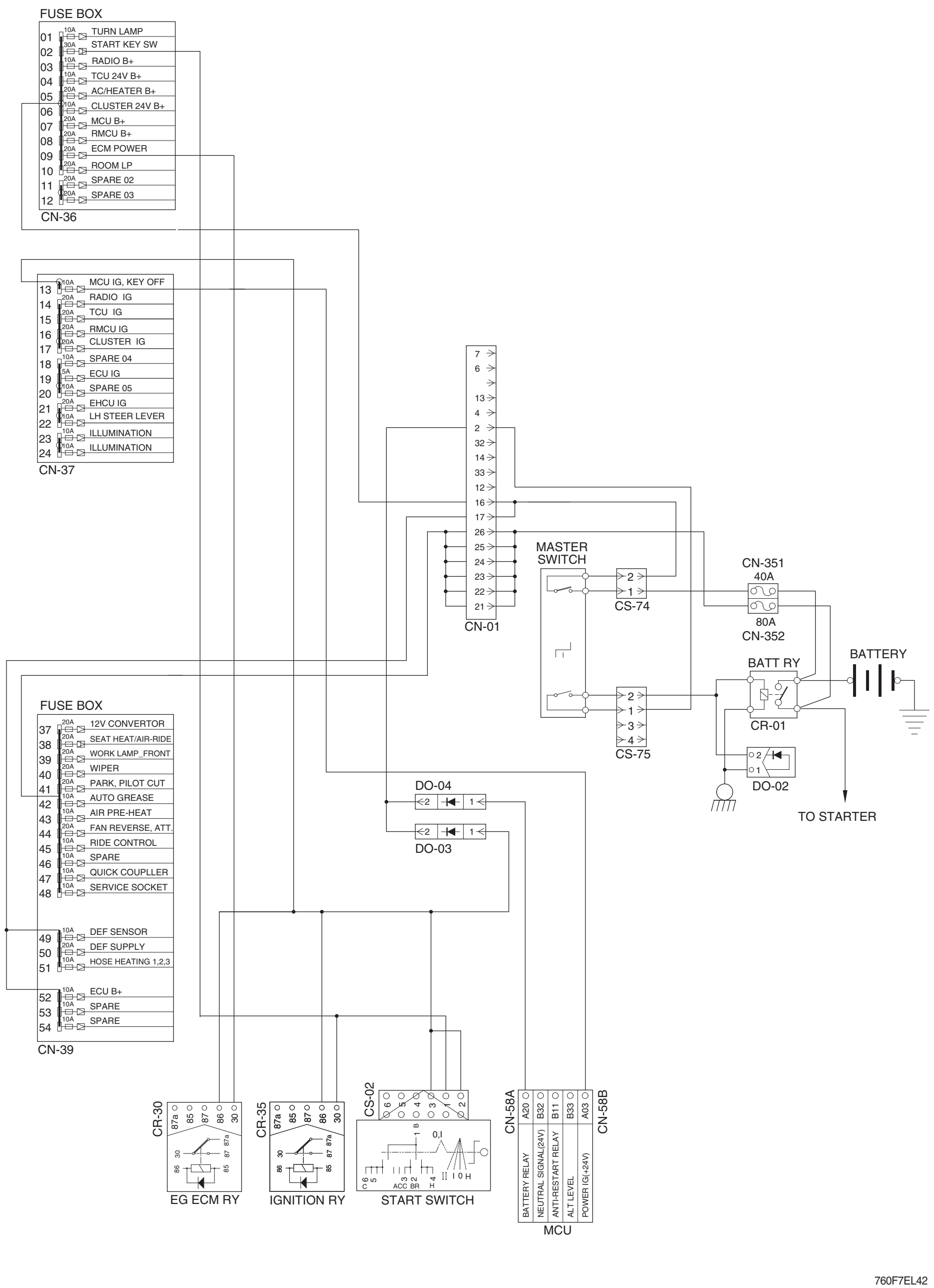


7. WHEN STARTING SWITCH "ON" DOES NOT OPERATE

- 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.



Cause	Remedy
Defective cable assembly	Repair or replace (after clean)
Short circuit or defect of fusible link or defective battery relay	Replace
Disconnection in wiring harness or poor contact between CS-2 (2) - CN-1(2)-CS-75-CR-1.	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between fuse No. 2 and CS-2 (1) or defect of start switch	Repair or replace (after clean)
Battery capacity too low	Repair or replace (after clean)



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.