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1. STRUCTURE

This service manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This service manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into the following sections.

SECTION 1 GENERAL

This section explains the safety hints and gives the specification of the machine and major components.

SECTION 2 STRUCTURE AND FUNCTION

This section 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.

SECTION 3 HYDRAULIC SYSTEM

This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM

This section explains the electrical circuit, monitoring system and each component. It serves not only to give an understanding electrical system, but also serves as reference material for trouble shooting.

SECTION 5 MECHATRONICS SYSTEM

This section explains the computer aided power optimization system and each component.

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating **problems** to **causes**.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 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.

SECTION 9 COMPONENT MOUNTING TORQUE

This section shows bolt specifications and standard torque values needed when mounting components to the machine.

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.

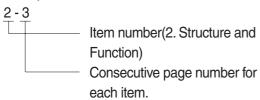
Filing method

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

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

Revised edition mark(1)23...)

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

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

2. Convert 550mm into inches.

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

 This gives 550mm = 21.65 inches.

	Millimete	rs to inche	es				<u> </u>	1mm = 0.03937 in			
		0	1	2	3	4	5	6	7	8	9
	0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
	10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
	20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
	30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
	40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
							©				
a	50	1.969	2.008	2.047	2.087	2.126	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

	111111 — 0.000									
	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound 1 kg = 2.2046 lb

	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 ι = 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	

	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** 1 kgf / cm² = 14.2233 lbf / in²

Ng/John to low/in-								ikgi	/ CIII ² = 14.	223310t / In ²
	0	1	2	3	4	5	6	7	8	9
		14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	2863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	5603	2617	2631	2646	2660	2674	2688
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

Group	1	Safety Hints	1-1
Group	2	Specifications	1-10

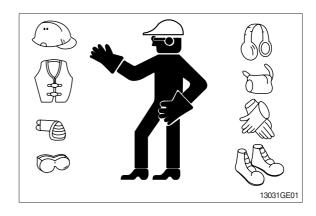
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

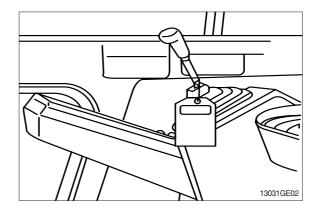
Wear close fitting clothing and safety equipment appropriate to the job.



WARN OTHERS OF SERVICE WORK

Unexpected machine movement can cause serious injury.

Before performing any work on the excavator, attach a 「Do Not Operate」 tag on the right side control lever.



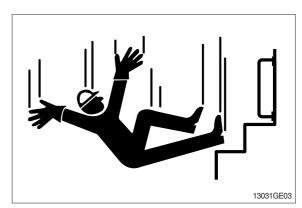
USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.

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

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

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

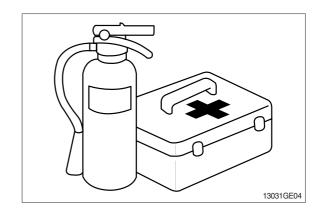


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

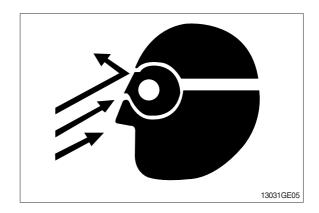
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

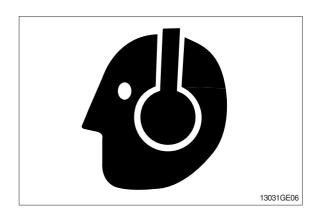
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

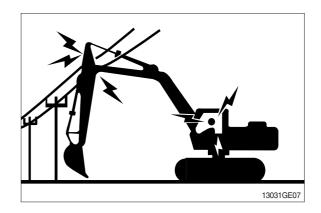
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

Serious injury or death can result from contact with electric lines.

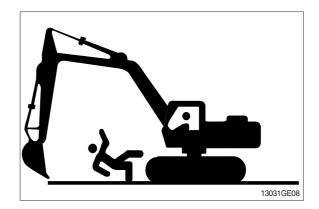
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



KEEP RIDERS OFF EXCAVATOR

Only allow the operator on the excavator. Keep riders off.

Riders on excavator are subject to injury such as being struck by foreign objects and being thrown off the excavator. Riders also obstruct the operator's view resulting in the excavator being operated in an unsafe manner.

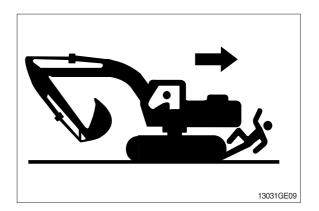


MOVE AND OPERATE MACHINE SAFELY

Bystanders can be run over. Know the location of bystanders before moving, swinging, or operating the machine.

Always keep the travel alarm in working condition. It warns people when the excavator starts to move.

Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.



OPERATE ONLY FORM OPERATOR'S SEAT

Avoid possible injury machine damage. Do not start engine by shorting across starter terminals.

NEVER start engine while standing on ground. Start engine only from operator's seat.



PARK MACHINE SAFELY

Before working on the machine:

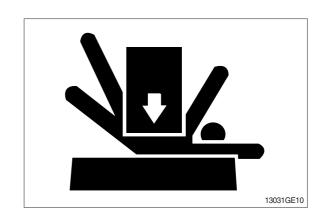
- · Park machine on a level surface.
- · Lower bucket to the ground.
- · Turn auto idle switch off.
- · Run engine at 1/2 speed without load for 2 minutes.
- Turn key switch to OFF to stop engine. Remove key from switch.
- · Move pilot control shutoff lever to locked position.
- · Allow engine to cool.

SUPPORT MACHINE PROPERLY

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

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

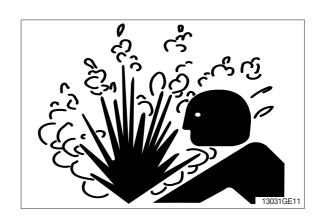
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



SERVICE COOLING SYSTEM SAFELY

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

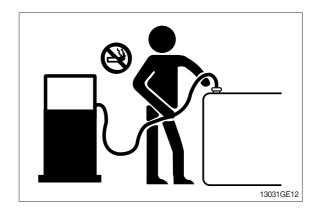
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



HANDLE FLUIDS SAFELY-AVOID FIRES

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

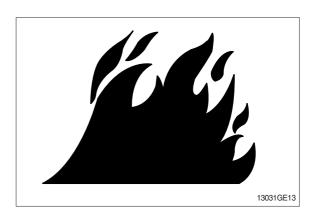
Fill fuel tank outdoors.



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

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

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



BEWARE OF EXHAUST FUMES

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

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

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

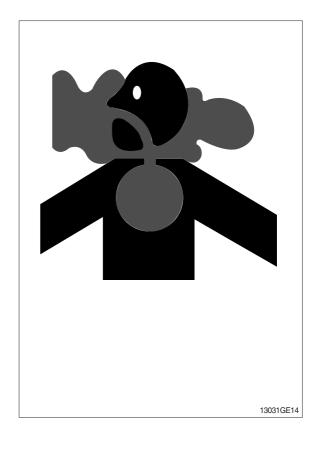
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

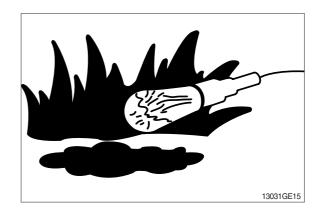
Remove paint before welding or heating:

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



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

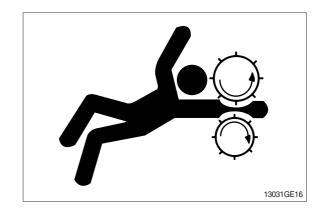




SERVICE MACHINE SAFELY

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

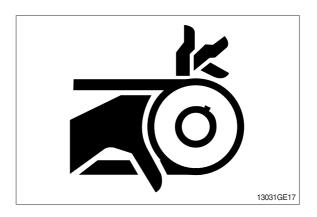
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



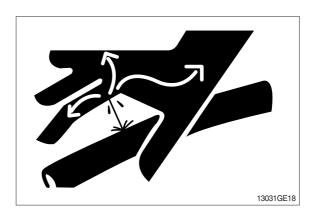
AVOID HIGH PRESSURE FLUIDS

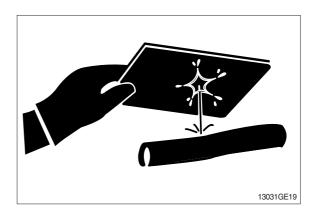
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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





AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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



PREVENT BATTERY EXPLOSIONS

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

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

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



PREVENT ACID BURNS

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

Avoid the hazard by:

- 1. Filling batteries in a well-ventilated area.
- 2. Wearing eye protection and rubber gloves.
- 3. Avoiding breathing fumes when electrolyte is added.
- 4. Avoiding spilling of dripping electrolyte.
- 5. Use proper jump start procedure.

If you spill acid on yourself:

- 1. Flush your skin with water.
- 2. Apply baking soda or lime to help neutralize the acid.
- Flush your eyes with water for 10-15 minutes. Get medical attention immediately.

If acid is swallowed:

- 1. Drink large amounts of water or milk.
- 2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
- 3. Get medical attention immediately.

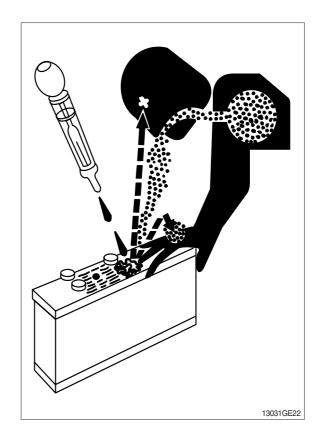
USE TOOLS PROPERLY

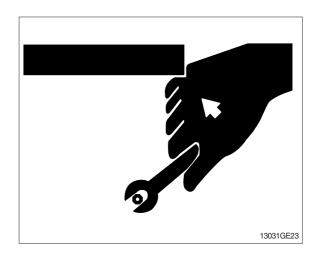
Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

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



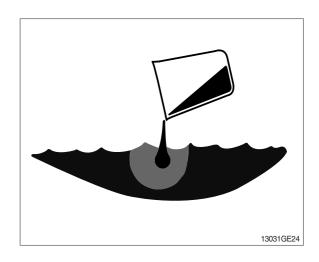


DISPOSE OF FLUIDS PROPERLY

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

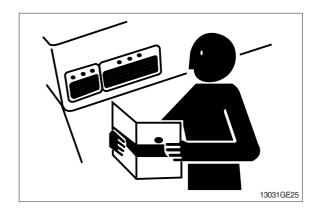
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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



REPLACE SAFETY SIGNS

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

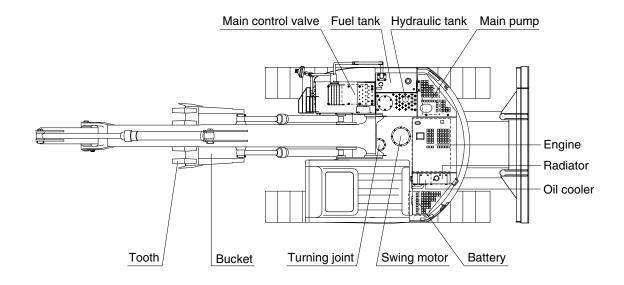


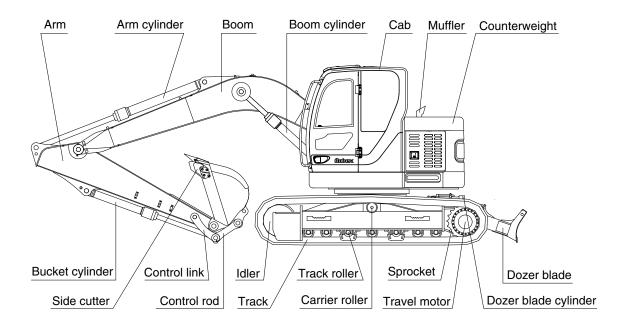
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT



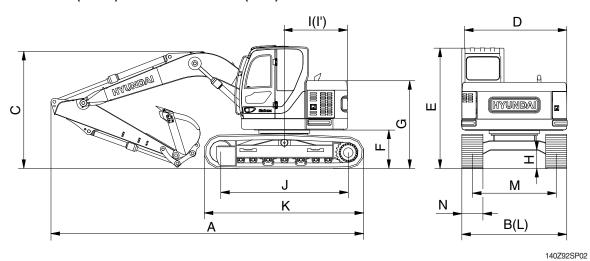


140Z92SP01

2. SPECIFICATIONS

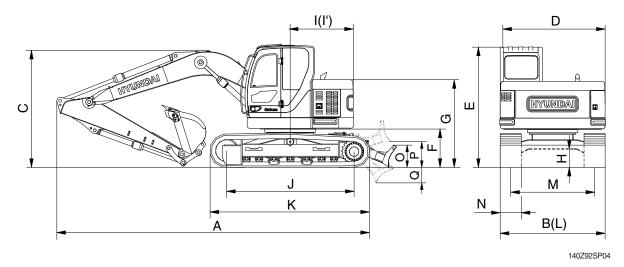
1) R145CR-9

\cdot 4.60 m (15' 1") BOOM and 2.50 m (8' 2") ARM



Description		Unit	Specification
Operating weight		kg (lb)	14600 (32190)
Bucket capacity (SAE heaped), standard		m³ (yd³)	0.52 (0.68)
Overall length	А		7270 (23' 10")
Overall width, with 500 mm shoe	В		2500 (8' 2")
Overall height	С		2860 (9' 5")
Superstructure width	D		2500 (8' 2")
Overall height of cab	E		2900 (9' 6")
Ground clearance of counterweight	F		930 (3' 1")
Engine cover height	G		2065 (6' 9")
Minimum ground clearance	Н	mm (ft-in)	440 (1' 5")
Rear-end distance	I		1480 (4' 10")
Rear-end swing radius	ľ		1480 (4' 10")
Distance between tumblers	J		2910 (9' 7")
Undercarriage length	K		3640 (11' 11")
Undercarriage width	L		2500 (8' 2")
Track gauge	М		2000 (6' 7")
Track shoe width, standard	N		500 (20")
Travel speed (low/high)		km/hr (mph)	3.2/5.5 (2.0/3.4)
Swing speed		rpm	12.0
Gradeability		Degree (%)	35 (70)
Ground pressure (500 mm shoe)		kgf/cm²(psi)	0.46 (6.54)
Max traction force		kg (lb)	13300 (29320)

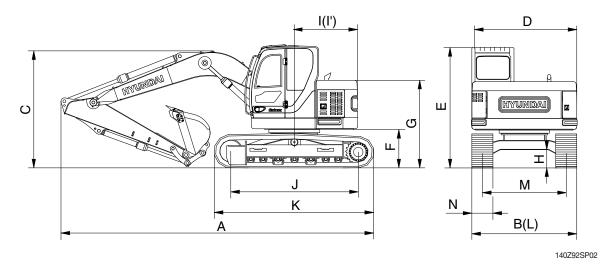
2) R145CRD-9



Description		Unit	Specification
Operating weight		kg (lb)	15400 (33950)
Bucket capacity (SAE heaped), standard		m³ (yd³)	0.52 (0.68)
Overall length	Α		7820 (25' 8")
Overall width, with 500 mm shoe	В		2500 (8' 2")
Overall height	С		2860 (9' 5")
Superstructure width	D		2500 (8' 2")
Overall height of cab	Е		2900 (9' 6")
Ground clearance of counterweight	F		930 (3' 1")
Engine cover height	G		2065 (6' 9")
Minimum ground clearance	Н		440 (1' 5")
Rear-end distance	I	mm /ft in)	1480 (4' 10")
Rear-end swing radius	ľ	mm (ft-in)	1480 (4' 10")
Distance between tumblers	J		2910 (9' 7")
Undercarriage length	K		3640 (11' 11")
Undercarriage width	L		2500 (8' 2")
Track gauge	М		2000 (6' 7")
Track shoe width, standard	N		500 (20")
Height of blade	0		575 (1' 8")
Ground clearance of blade up	Р		420 (1' 8")
Depth of blade down	Q		430 (1' 6")
Travel speed (low/high)		km/hr (mph)	3.2/5.5 (2.0/3.4)
Swing speed		rpm	12.0
Gradeability		Degree (%)	35 (70)
Ground pressure (500 mm shoe)		kgf/cm²(psi)	0.49 (6.97)
Max traction force		kg (lb)	13300 (29320)

3) R145LCR-9

\cdot 4.60 m (15' 1") BOOM and 2.50 m (8' 2") ARM

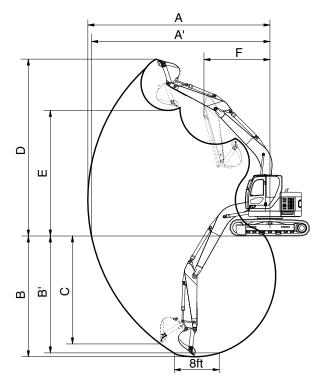


Description	'	Unit	Specification
Operating weight		kg (lb)	14980 (33030)
Bucket capacity (SAE heaped), standard		m³ (yd³)	0.52 (0.68)
Overall length	Α		7360 (24' 2")
Overall width, with 600 mm shoe	В		2600 (8' 6")
Overall height	С		2860 (9' 5")
Superstructure width	D		2500 (8' 2")
Overall height of cab	Е		2900 (9' 6")
Ground clearance of counterweight	F		930 (3' 1")
Engine cover height	G		2065 (6' 9")
Minimum ground clearance	Н	mm (ft-in)	440 (1' 5")
Rear-end distance	I		1480 (4' 10")
Rear-end swing radius	l'		1480 (4' 10")
Distance between tumblers	J		3090 (10' 2")
Undercarriage length	K		3820 (12' 6")
Undercarriage width	L		2600 (8' 6")
Track gauge	М		2000 (6' 7")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.2/5.5 (2.0/3.4)
Swing speed		rpm	12.0
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm²(psi)	0.37 (5.26)
Max traction force		kg (lb)	13300 (29320)

3. WORKING RANGE

1) R145CR/CRD/LCR-9

(1) 4.60 m (15' 1") MONO BOOM



140Z92SP06

Description		1.90 m (6' 3") Arm	2.10 m (6' 11") Arm	* 2.50 m (8' 2") Arm	3.00 m (9' 10") Arm
Max digging reach	Α	7730 mm (25' 4")	7900 mm (25'11")	8310 mm (27' 3")	8770 mm (28' 9")
Max digging reach on ground	A'	7580 mm (24'10")	7750 mm (25' 0")	8170 mm (26'10")	8630 mm (28' 4")
Max digging depth	В	4890 mm (16' 1")	5100 mm (16' 9")	5500 mm (18' 1")	5990 mm (19' 8")
Max digging depth (8ft level)	В'	4640 mm (15' 3")	4870 mm (16' 0")	5290 mm (17' 4")	5810 mm (19' 1")
Max vertical wall digging depth	С	4400 mm (14' 5")	4600 mm (15' 1")	5000 mm (16' 5")	5400 mm (17' 9")
Max digging height	D	8840 mm (29' 0")	8970 mm (29' 5")	9350 mm (30' 8")	9730 mm (31'11")
Max dumping height	Е	6350 mm (20'10")	6470 mm (21' 3")	6850 mm (22' 6")	7230 mm (23' 9")
Min swing radius	F	1860 mm (6' 1")	2030 mm (6' 8")	1980 mm (6' 6")	2260 mm (7' 5")
		87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN
	SAE	8900 [9670] kgf	8900 [9670] kgf	8900 [9670] kgf	8900 [9670] kgf
Pucket diaging force		19620 [21300] lbf	19620 [21300] lbf	19620 [21300] lbf	19620 [21300] lbf
Bucket digging force		102 [110.8] kN	102 [110.8] kN	102 [110.8] kN	102 [110.8] kN
	ISO	10400 [11290] kgf	10400 [11290] kgf	10400 [11290] kgf	10400 [11290] kgf
		22930 [24890] lbf	22930 [24890] lbf	22930[24890] lbf	22930 [24890] lbf
		76.5 [83.1] kN	73.6 [79.9] kN	62.8 [68.2] kN	55.9 [60.7] kN
	SAE	7800 [8470] kgf	7500 [8140] kgf	6400 [6950] kgf	5700 [6190] kgf
Arm around force		17200 [18670] lbf	16530 [17950] lbf	14110 [15320] lbf	12570 [13640] lbf
Arm crowd force		80.4 [87.3] kN	77.5 [84.1] kN	65.7 [71.4] kN	57.9 [62.8] kN
	ISO	8200 [8900] kgf	7900 [8580] kgf	6700 [7270] kgf	5900 [6410] kgf
		18080 [19630] lbf	17420 [18910] lbf	14770 [16040] lbf	13010 [14120] lbf

* : STD []: Power boost

4. WEIGHT

14	R145	CR-9	R1450	CRD-9	R145LCR-9		
Item	kg	lb	kg	lb	kg	lb	
Upper structure assembly	6950	15320	←		←		
Main frame weld assembly	1315	2900	+	_	←		
Engine assembly	420	930	+	_	+	_	
Main pump assembly	90	200	+	_	+	_	
Main control valve assembly	140	310	+	_	+	_	
Swing motor assembly	120	260	+	_	+	_	
Hydraulic oil tank assembly	150	330	+	_	+	_	
Fuel tank assembly	120	260	+	_	+	_	
Counterweight	2800	6170	+	_	+	_	
Cab assembly	450	990	+	_	+	_	
Lower chassis assembly	5230	11530	6030	13290	5600	12350	
Track frame weld assembly	1480	3260	1640	3620	1820	4010	
Swing bearing	215	470	+	_	←		
Travel motor assembly	240	530	←		←		
Turning joint	50	110	←		←		
Track recoil spring	105	230	←	_	←		
Idler	125	280	+	_	←		
Carrier roller	20	45	+	_	←		
Track roller	35	80	+	_	+	_	
Track-chain assembly (500 mm standard triple grouser shoe)	910	2010	+	_	940	2070	
Dozer blade assembly		-	465	1025		-	
Front attachment assembly (4.6 m boom, 2.5 m arm, 0.52 m³ SAE heaped bucket)	2420	5330	+	_	+	_	
4.6 m boom assembly	830	1830	←	_	+	_	
2.5 m arm assembly	435	960	+	_	+	_	
0.52 m³ SAE heaped bucket	460	1010	+	_	+	_	
Boom cylinder assembly	130	290	←		←		
Arm cylinder assembly	160	350	←		←		
Bucket cylinder assembly	100	220	←		←		
Bucket control rod assembly	90	200	+	_	←		
Dozer blade cylinder assembly		-	55	120		-	

5. LIFTING CAPACITIES

1) R145CR-9

- (1) 4.60 m (15' 1") boom, 2.50 m (8' 2") arm equipped with 0.52 m³ (SAE heaped) bucket and 500 mm (20") triple grouser shoe and 2800 kg (6170 lb) counterweight.
 - : Rating over-front : Rating over-side or 360 degree

					Load	radius				At	max. rea	ch
Load po	oint	1.5 m	(5 ft)	3.0 m (10 ft)		4.5 m	(15 ft)	6.0 m (20 ft)		Capacity		Reach
height				Į.		P				P		m (ft)
6.0 m (20.0 ft)	kg lb					*2960 *6530	*2960 *6530			2710 5970	1700 3750	6.50 (21.3)
4.5 m (15.0 ft)	kg lb					*3460 *7630	3310 7300	*2670 *5890	1930 4250	2120 4670	1280 2820	7.37 (24.2)
3.0 m	kg			*6090	*6090	*4480	3090	2990	1850	1870	1090	7.81
(10.0 ft) 1.5 m	lb kg			*13430 *8480	*13430 5380	*9880 4640	6810 2810	6590 2870	4080 1730	4120 1780	2400 1030	(25.6) 7.90
(5.0 ft) Ground	lb kg			*18700 9050	11860 4920	10230 4390	6190 2590	6330 2750	3810 1630	3920 1850	2270 1060	(25.9) 7.67
Line	lb			19950	10850	9680	5710	6060	3590	4080	2340	(25.2)
-1.5 m (-5.0 ft)	kg lb	*5850 *12900	*5850 *12900	*8700 *19180	4820 10630	4280 9440	2490 5490	2700 5950	1580 3480	2120 4670	1240 2730	7.07 (23.2)
-3.0 m	kg	*8930	*8930	*7030	4900	4300	2510	3330	0-100	*2400	1700	5.97
(-10 ft) -4.5 m	lb kg	*19690	*19690	*15500 *3750	10800 *3750	9480	5530			*5290	3750	(19.6)
(-15.0 ft)	lb			*8270	*8270							

Note

- 1. Lifting capacity are based on SAE J1097 and ISO 10567.
- 2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The load point is a hook located on the back of the bucket.
- 4. *indicates load limited by hydraulic capacity.
- (2) 4.60 m (15' 1") boom, 1.90 m (6' 3") arm equipped with 0.52 m³ (SAE heaped) bucket and 500 mm (20") triple grouser shoe and 2800 kg (6170 lb) counterweight.

					Load	radius				At	max. rea	ch
Load po	oint	1.5 m	(5 ft)	3.0 m (10 ft)		4.5 m	4.5 m (15 ft)		(20 ft)	Capacity		Reach
heigh	ıt	J		ľ		ð				Ū		m (ft)
6.0 m	kg					*3270	*3270			3360	2130	5.75
(20.0 ft)	lb					*7210	*7210			7410	4700	(18.9)
4.5 m	kg			*4960	*4960	*4310	3250			2500	1550	6.73
(15.0 ft)	lb			*10930	*10930	*9500	7170			5510	3420	(22.1)
3.0 m	kg			*7230	5970	4900	3050	2980	1850	2170	1310	7.22
(10.0 ft)	lb			*15940	13160	10800	6720	6570	4080	4780	2890	(23.7)
1.5 m	kg			*9120	5220	4620	2800	2880	1750	2070	1230	7.32
(5.0 ft)	lb			*20110	11510	10190	6170	6350	3860	4560	2710	(24.0)
Ground	kg			*8610	4970	4430	2640	2800	1680	2170	1290	7.06
Line	lb			*18980	10560	9770	5820	6170	3700	4780	2840	(23.2)
-1.5 m	kg	*6830	*6830	*8140	4970	4370	2580			2560	1540	6.40
(-5.0 ft)	lb	*15060	*15060	*17950	10960	9630	5690			5640	3400	(21.0)
-3.0 m	kg			*6010	5100	*4100	2650			*2250	*2250	5.12
(-10 ft)	lb			*13250	11240	*9040	5840			*4960	*4960	(16.8)

(3) 4.60 m (15' 1") boom, 3.0 m (9' 10") arm equipped with 0.52 m 3 (SAE heaped) bucket and 700 mm (20") triple grouser shoe and 2800 kg (6170 lb) counterweight.

						Load	radius					At ı	max. rea	ach
Load po	oint	1.5 m	(5 ft)	3.0 m	(10 ft)	4.5 m	(15 ft)	6.0 m	(20 ft)	7.0 m	(25 ft)	Cap	acity	Reach
heigh	ıt	ľ				H		I		ľ		Ū		m (ft)
6.0 m	kg lb					*2560 *5640	*2560 *5640	*1730 *3810	*1730 *3810			2350 5180	1450 3200	7.07 (23.2)
(20.0 ft) 4.5 m	kg					*2760	*2760	*2550	1980			1890	1120	7.86
(15.0 ft)	lb					*6080	*6080	*5620	4370			4170	2470	(25.8)
3.0 m	kg			*3690	*3690	*3690	3170	3030	1880	*1430	1180	1680	960	8.27
(10.0 ft)	lb			*8140	*8140	*8140	6990	6680	4140	*3150	2600	3700	2120	(27.1)
1.5 m	kg			*7740	5620	4720	2880	2890	1750	1950	1130	1610	910	8.36
(5.0 ft)	lb			*17060	12390	10410	6350	6370	3860	4300	2490	3550	2010	(27.4)
Ground	kg			9180	5020	4440	2630	2760	1630	*1830	1080	1660	930	8.14
Line	lb			20240	11070	9790	5800	6080	3590	*4030	2380	3660	2050	(26.7)
-1.5 m	kg	*5380	*5380	8930	4820	4280	2490	2680	1560			1860	1060	7.59
(-5.0 ft)	lb	*11860	*11860	19690	10630	9440	5490	5910	3440			4100	2340	(24.9)
-3.0 m	kg	*7860	*7860	*7790	4830	4250	2460	2680	1560			2380	1400	6.59
(-10 ft)	lb	*17330	*17330	*17170	10650	9370	5420	5910	3440			5250	3090	(21.6)
-4.5 m	kg	*8050	*8050	*5160	5020	*3260	2580							
(-15 ft)	lb	*17750	*17750	*11380	11070	*7190	5690							

2) R145CRD-9 (with dozer blade)

(1) 4.60 m (15' 1") boom, 2.50 m (8' 2") arm equipped with 0.52 m³ (SAE heaped) bucket and 500 mm (20") triple grouser shoe and 2800 kg (6170 lb) counterweight with dozer blade.

: Rating over-front : Rating over-side or 360 degree

				Load	adius				At max. reach		
Load point	1.5 m	1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		(20 ft)	Capacity		Reach
height			ľ		H				F		m (ft)
6.0 m kg					*2960	*2960			*2910	1820	6.50
(20.0 ft) lb					*6530	*6530			*6420	4010	(21.3)
4.5 m kg					*3460	*3460	*2670	2060	2340	1380	7.37
(15.0 ft) lb					*7630	*7630	*5890	4540	5160	3040	(24.2)
3.0 m kg			*6090	*6090	*4480	3280	3270	1980	2070	1190	7.81
(10.0 ft) lb			*13430	*13430	*9880	7230	7210	4370	4560	2620	(25.6)
1.5 m kg			*8480	5720	5060	3000	3150	1860	1980	1120	7.90
(5.0 ft) lb			*18700	12610	11160	6610	6940	4100	4370	2470	(25.9)
Ground kg			*9170	5260	4810	2780	3030	1760	2060	1160	7.67
Line lb			*20220	11600	10600	6130	6680	3880	4540	2560	(25.2)
-1.5 m kg	*5850	*5850	*8700	5160	4700	2680	2980	1710	2350	1340	7.07
(-5.0 ft) lb	*12900	*12900	*19180	11380	10360	5910	6570	3770	5180	2950	(23.2)
-3.0 m kg	*8930	*8930	*7030	5230	4720	2700			*2400	1830	5.97
(-10 ft) lb		*19690	*15500	11530	10410	5950			*5290	4030	(19.6)
-4.5 m kg			*3750	*3750							,
(-15.0 ft) lb			*8270	*8270							

Note 1. Lifting capacity are based on SAE J1097 and ISO 10567.

- 2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The load point is a hook located on the back of the bucket.
- 4. *indicates load limited by hydraulic capacity.

(2) 4.60 m (15' 1") boom, 3.0 m (9' 10") arm equipped with 0.52 m³ (SAE heaped) bucket and 700 mm (20") triple grouser shoe and 2800 kg (6170 lb) counterweight with dozer blade.

						Load	radius					At ı	max. rea	ach
Load po	oint	1.5 m	(5 ft)	3.0 m	3.0 m (10 ft) 4.5 m		(15 ft)	6.0 m	6.0 m (20 ft)		(25 ft)	Capacity		Reach
heigh	t	ľ		Ū		H						ľ		m (ft)
6.0 m	kg					*2560	*2560	*1730	*1730			2570	1560	7.07
(20.0 ft)	lb					*5640	*5640	*3810	*3810			5670	3440	(23.2)
4.5 m	kg					*2760	*2760	*2550	2110			2090	1220	7.86
(15.0 ft)	lb					*6080	*6080	*5620	4650			4610	2690	(25.8)
3.0 m	kg			*3690	*3690	*3690	3360	*3210	2020	*1430	1280	1860	1050	8.27
(10.0 ft)	lb			*8140	*8140	*8140	7410	*7080	4450	*3150	2820	4100	2310	(27.1)
1.5 m	kg			*7740	5950	*5030	3070	3170	1890	*1990	1230	1790	990	8.36
(5.0 ft)	lb			*17060	13120	*11090	6770	6990	4170	*4390	2710	3590	2180	(27.4)
Ground	kg			*9190	5360	4850	2820	3040	1770	*1830	1180	1850	1020	8.14
Line	lb			*20260	11820	10690	6220	6700	3900	*4030	2600	4080	2250	(26.7)
-1.5 m	kg	*5380	*5380	*9060	5160	4700	2680	2960	1690			2070	1160	7.59
(-5.0 ft)	lb	*11860	*11860	*19970	11380	10360	5910	6530	3730			4560	2560	(24.9)
-3.0 m	kg	*7860	*7860	*7790	5170	4670	2650	2960	1690			*2460	1520	6.59
(-10 ft)	lb	*17330	*17330	*17170	11400	10300	5840	6530	3730			*5420	3350	(21.6)
-4.5 m	kg	*8050	*8050	*5160	*5160	3260	2770							
(-15 ft)	lb	*17750	*17750	*11380	*11380	7190	6110							

3) R145LCR-9

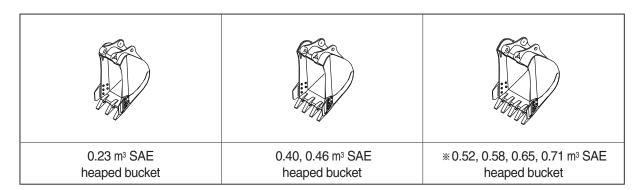
(1) 4.60 m (15' 1") boom, 2.50 m (8' 2") arm equipped with 0.52 m _3 (SAE heaped) bucket and 500 mm (20") triple grouser shoe and 2800 kg (6170 lb) counterweight.

					Load	adius				At	max. rea	ch
Load poir	nt	1.5 m	(5 ft)	3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		Capa	Reach	
height				ľ		H		ľ				m (ft)
1 1	kg lb					*2960 *6530	*2960 *6530			2870 6330	1710 3770	6.50 (21.3)
1	kg lb					*3460 *7630	3340 7360	*2670 *5890	1950 4300	2250 4960	1300 2870	7.37 (24.2)
3.0 m k	κg lb			*6090 *13430	*6090 *13430	*4480 *9880	3120 6880	3170 6990	1870 4120	1990 4390	1110 2450	7.81 (25.6)
1.5 m k	kg lb			*8480 *18700	5420 11950	4930 10870	2840 6260	3040 6700	1750 3860	1900 4190	1040 2290	7.90 (25.9)
Ground k	kg lb			*9170 *20220	4970 10960	4680 10320	2620 5780	2930 6460	1650 3640	1970 4340	1080 2380	7.67 (25.2)
-1.5 m k	kg lb	*5850 *12900	*5850 *12900	*8700 *19180	4870 10740	4570 10080	2520 5560	2870 6330	1600 3530	2260 4980	1250 2760	7.07 (23.2)
-3.0 m k	kg lb	*8930 *19690	*8930 *19690	*7030 *15500	4940 10890	4590 10120	2540 5600			*2400 *5290	1720 3790	5.97 (19.6)
-4.5 m k	kg lb			*3750 *8270	*3750 *8270							, ,

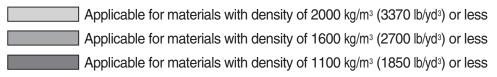
6. BUCKET SELECTION GUIDE

1) R145CR-9, R145CRD-9, R145LCR-9

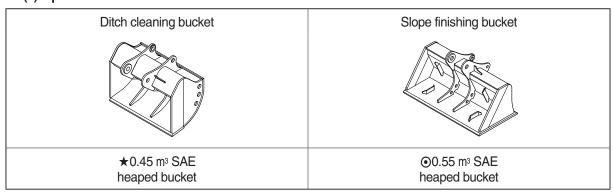
(1) General bucket



Capacity		Width			Recommendation			
σαρασιιγ		vvidiri		Weight	4.6 m (15' 1") boom			
SAE heaped	CECE heaped	Without side cutter	With side cutter	vveigni	1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")	3.0 m arm (9' 10")
0.23 m ³ (0.30 yd ³)	0.20 m ³ (0.26 yd ³)	520 mm (20.5")	620 mm (24.4")	335 kg (740 lb)				
0.40 m ³ (0.52 yd ³)	0.35 m ³ (0.46 yd ³)	750 mm (29.5")	850 mm (33.5")	410 kg (900 lb)				
0.46 m ³ (0.60 yd ³)	0.40 m ³ (0.52 yd ³)	840 mm (33.1")	940 mm (37.0")	435 kg (960 lb)				
0.52 m ³ (0.68 yd ³)	0.45 m ³ (0.59 yd ³)	915 mm (36.0")	1015 mm (40.0")	460 kg (1010 lb)				
0.58 m ³ (0.76 yd ³)	0.50 m ³ (0.65 yd ³)	1000 mm (39.4")	1100 mm (43.3")	480 kg (1060 lb)				
0.65 m ³ (0.85 yd ³)	0.55 m ³ (0.72 yd ³)	1105 mm (43.5")	1205 mm (47.4")	500 kg (1100 lb)				
0.71 m ³ (0.93 yd ³)	0.60 m ³ (0.78 yd ³)	1190 mm (46.9")	1290 mm (50.8")	540 kg (1190 lb)				



(2) Special bucket



Capacity		Width			Recommendation			
Capacity		VVIGUT		Weight	4.6 m (15' 1") boom			
SAE heaped	CECE heaped	Without side cutter	With side cutter	VVoign	1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")	3.0 m arm (9' 10")
★0.45 m³ (0.59 yd³)	0.40 m ³ (0.52 yd ³)	1520 mm (59.8")	-	410 kg (900 lb)				_
⊙0.55 m³ (0.72 yd³)	0.45 m ³ (0.59 yd ³)	1800 mm (70.9")	-	585 kg (1290 lb)				_

★ : Ditch cleaning bucket⊙ : Slope finishing bucket

Applicable for materials with density of 2000 kgf/m³ (3370 lbf/yd³) or less

Applicable for materials with density of 1600 kgf/m³ (2700 lbf/yd³) or less

Applicable for materials with density of 1100 kgf/m³ (1850 lbf/yd³) or less

7. UNDERCARRIAGE

1) TRACKS

X-leg type center frame is integrally welded with reinforced box-section track frames. The design includes dry tracks, lubricated rollers, idlers, sprockets, hydraulic track adjusters with shock absorbing springs and assembled track-type tractor shoes with triple grousers.

2) TYPES OF SHOES

	Shapes		Triple grouser			
Model						
	Shoe width	mm (in)	* 500 (20)	600 (24)	700 (28)	
R145CR-9	Operating weight	kg (lb)	14600/32190	14790 (32610)	15020 (33110)	
n 1450n-9	Ground pressure	kgf/cm² (psi)	0.46 (6.54)	0.39 (5.55)	0.34 (4.83)	
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")	
	Shoe width	mm (in)	* 500 (20)	600 (24)	700 (28)	
R145CRD-9	Operating weight	kg (lb)	15400 (33950)	15610 (34610)	15840 (34920)	
N 145CND-9	Ground pressure	kgf/cm² (psi)	0.49 (6.97)	0.41 (5.83)	0.36 (5.12)	
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")	
R145LCR-9	Shoe width	mm (in)	× 500 (20)	600 (24)	700 (28)	
	Operating weight	kg (lb)	14660 (32320)	14850 (32740)	15080 (33250)	
	Ground pressure	kgf/cm² (psi)	0.44 (6.26)	0.37 (5.26)	0.32 (4.55)	
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")	

* : Standard

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Itom	Quantity		
Item	R145CR-9/R145CRD-9	R145LCR-9	
Carrier rollers	1 EA	2 EA	
Track rollers	7 EA	7 EA	
Track shoes	45 EA	47 EA	

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

Confirm the category from the list of applications in **table 2**, then use **table 1** to select the shoe. Wide shoes (Categories B and C) have limitations on applications. Before using wide shoes, check the precautions, then investigate and study the operating conditions to confirm if these shoes are suitable.

Select the narrowest shoe possible to meet the required flotation and ground pressure. Application of wider shoes than recommendations will cause unexpected problem such as bending of shoes, crack of link, breakage of pin, loosening of shoe bolts and the other various problems.

* Table 1

Track shoe	Specification	Category
500 mm triple grouser	Standard	A
600 mm triple grouser	Option	Α
700 mm triple grouser	Option	В

* Table 2

Category	Applications	Applications
А	Rocky ground, river beds, normal soil	Travel at low speed on rough ground with large obstacles such as boulders or fallen trees
В	Normal soil, soft ground	 These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees Travel at high speed only on flat ground Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Mitsubishi D04FD-TAA
Туре	4-cycle turbocharged charge air cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	4 cylinders, in-line
Firing order	1-3-4-2
Combustion chamber type	Direct injection type
Cylinder bore × stroke	102×130 mm
Piston displacement	4250cc (260cu in)
Compression ratio	16.5 : 1
Rated gross horse power (SAE J1995)	119 Hp (89 kW) at 2000 rpm
Maximum torque	45.4 kgf ⋅ m (328 lbf ⋅ ft) at 1700 rpm
Engine oil quantity	17.5 l (4.6 U.S. gal)
Dry weight	420 kg (930 lb)
High idling speed	2100 ± 50 rpm
Low idling speed	800 ± 100 rpm
Rated fuel consumption	165 g/Hp · hr at 2000 rpm
Starting motor	24 V-5.0 kW
Alternator	24 V-50 A
Battery	2 × 12 V × 80 Ah

2) MAIN PUMP

Item	Specification
Туре	Variable displacement tandem axis piston pumps
Capacity	2 × 65 cc/rev
Maximum pressure	350 kgf/cm² (4980 psi) [380 kgf/cm² (5400 psi)]
Rated oil flow	2 × 123.5 / /min (32.6 U.S. gpm / 27.2 U.K. gpm)
Rated speed	2000 rpm

[]: Power boost

3) GEAR PUMP

Item	Specification		
Туре	Fixed displacement gear pump single stage		
Capacity	15cc/rev		
Maximum pressure	40 kgf/cm² (570 psi)		
Rated oil flow	30 ½ /min (7.9 U.S. gpm / 6.6 U.K. gpm)		

4) MAIN CONTROL VALVE

Item	Specification	
Туре	11 spools	
Operating method	Hydraulic pilot system	
Main relief valve pressure	350 kgf/cm² (4980 psi)[380 kgf/cm² (5400 psi)]	
Overload relief valve pressure	400 kgf/cm² (5690 psi)	

[]: Power boost

5) SWING MOTOR

Item	Specification		
Туре	Fixed displacement axial piston motor		
Capacity	72 cc/rev		
Relief pressure	260 kgf/cm² (3689 psi)		
Braking system	Automatic, spring applied hydraulic released		
Braking torque	25 kgf · m (181 lbf · ft)		
Brake release pressure	15~50 kgf/cm² (213~711 psi)		
Reduction gear type	2 - stage planetary		

6) TRAVEL MOTOR

Item	Specification
Туре	Variable displacement axial piston motor
Relief pressure	350 kgf/cm² (4970 psi)
Capacity (max / min)	77/45 cc/rev
Reduction gear type	2-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	9.5 kgf/cm² (135 psi)
Braking torque	19.7 kgf · m (280.2 lbf · ft)

7) CYLINDER

	Item	Specification		
Doom outlindor	Bore dia \times Rod dia \times Stroke	Ø 105 × Ø 75 × 1105 mm		
Boom cylinder	Cushion	Extend only		
Arm outlindor	Bore dia \times Rod dia \times Stroke	Ø 115 × Ø 80 × 1138 mm		
Arm cylinder	Cushion	Extend and retract		
Dualcat audindar	Bore dia \times Rod dia \times Stroke	ø 100 × ø 70 × 840 mm		
Bucket cylinder	Cushion	Extend only		
Dozor adinder (ention)	Bore dia \times Rod dia \times Stroke	ø 100 × ø 70 × 250 mm		
Dozer cylinder (option)	Cushion	-		

^{*} Discoloration of cylinder rod can occur when the friction reduction additive of lubrication oil spreads on the rod surface.

8) SHOE

Item		Width	Ground pressure Link quantity		Overall width
	Standard	500 mm (20")	0.46 kgf/cm² (6.54 psi)	45	2500 mm (8' 2")
R145CR-9	Ontion	600 mm (24")	0.39 kgf/cm² (5.55 psi)	45	2600 mm (8' 6")
	Option	700 mm (28")	0.34 kgf/cm² (4.83 psi)	45	2700 mm (8' 10")
	Standard	500 mm (20")	0.49 kgf/cm² (6.97 psi)	45	2500 mm (8' 2")
R145CRD-9	Option	600 mm (24")	0.41 kgf/cm² (5.81 psi)	45	2600 mm (8' 6")
		700 mm (28")	0.36 kgf/cm² (5.12 psi)	45	2700 mm (8' 10")
	Standard	500 mm (20")	0.47 kgf/cm² (6.68 psi)	46	2500 mm (8' 2")
R145LCR-9	Ontion	600 mm (24")	0.39 kgf/cm² (5.55 psi)	46	2600 mm (8' 6")
	Option	700 mm (28")	0.34 kgf/cm² (4.83 psi)	46	2700 mm (8' 10")

BUCKET

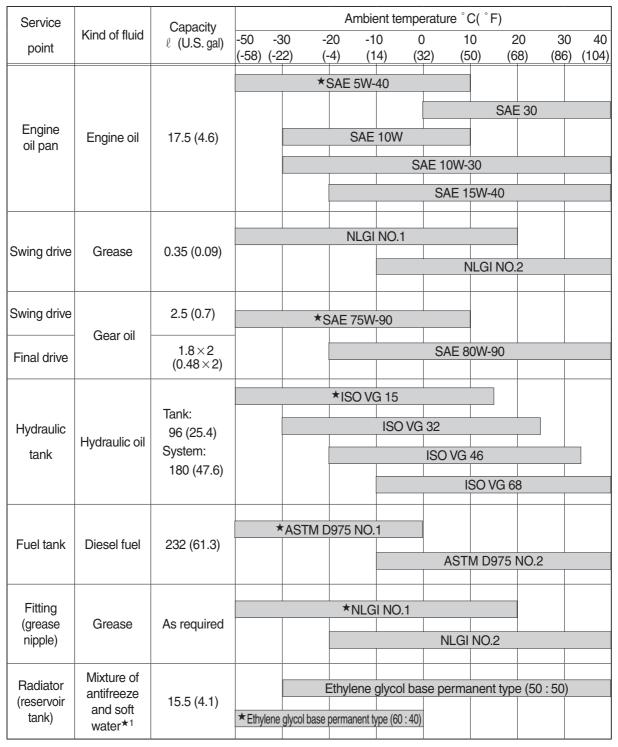
Itam	Capa	Tooth	Width		
Item	SAE heaped	CECE heaped	quantity	Without side cutter	With side cutter
	0.52 m³ (0.68 yd³)	0.45 m³ (0.59 yd³)	5	915 mm (36.0")	1015 mm (40.0")
	0.23 m³ (0.30 yd³)	0.20 m³ (0.26 yd³)	3	520 mm (20.5")	620 mm (24.4")
	0.40 m³ (0.52 yd³)	0.35 m³ (0.46 yd³)	4	750 mm (29.5")	850 mm (33.5")
	0.46 m³ (0.60 yd³)	0.40 m³ (0.52 yd³)	4	840 mm (33.1")	940 mm (37.0")
R145CR-9	0.58 m³ (0.76 yd³)	0.50 m³ (0.65 yd³)	5	1000 mm (39.4")	1100 mm (43.3")
	0.65 m³ (0.85 yd³)	0.55 m³ (0.72 yd³)	5	1105 mm (43.5")	1205 mm (47.4")
	0.71 m³ (0.93 yd³)	0.60 m ³ (0.78 yd ³)	5	1190 mm (46.9")	1290 mm (50.8")
	★0.45 m³ (0.59 yd³)	0.40 m³ (0.52 yd³)	-	1520 mm (59.8")	-
	●0.55 m³ (0.72 yd³)	0.45 m³ (0.59 yd³)	-	1800 mm (70.9")	-

★ : Ditch cleaning bucket⊙ : Slope finishing bucket

^{*} Discoloration does not cause any harmful effect on the cylinder performance.

9. RECOMMENDED OILS

Use only oils listed below. Do not mix different brand oil. Please use HYUNDAI genuine oil and grease.



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

★1 : Soft water

City water or distilled water

★ : Cold region

Russia, CIS, Mongolia

SECTION 2 STRUCTURE AND FUNCTION

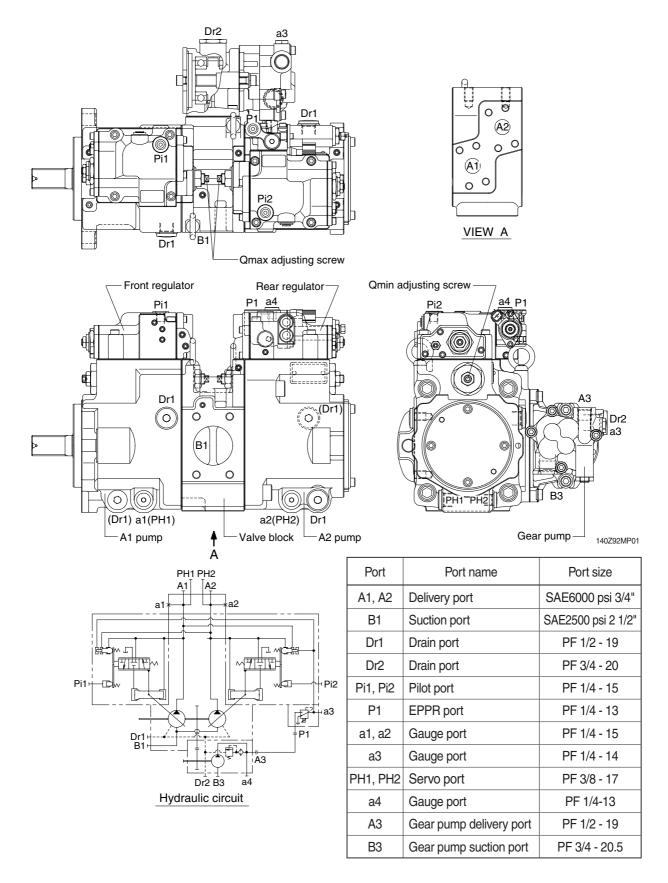
Group	1 Pump Device ·····	2-1
	2 Main Control Valve	
Group	3 Swing Device	2-47
Group	4 Travel Device ·····	2-59
Group	5 RCV Lever ·····	2-69
Group	6 RCV Pedal ·····	2-76

SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

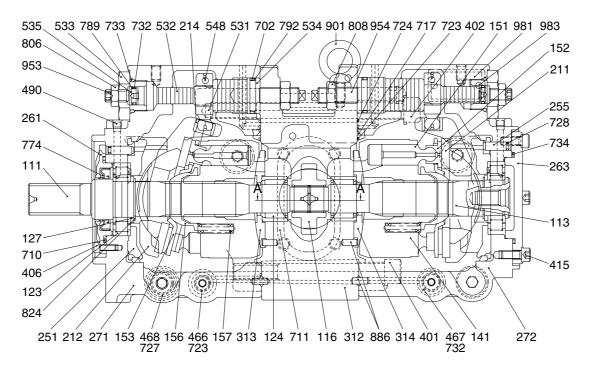
1. STRUCTURE

The pump device consists of main pump, regulator and gear pump.



1) MAIN PUMP (1/2)

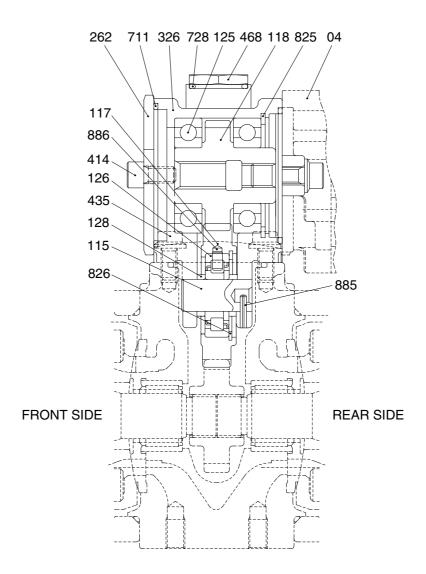
The main pump consists of two piston pumps (front & rear) and valve block.



140Z92MP02

111	Drive shaft (F)	272	Pump casing (R)	711	O-ring
113	Drive shaft (R)	312	Valve block	717	O-ring
116	1st Gear	313	Valve plate (R)	723	O-ring
123	Roller bearing	314	Valve plate (L)	724	O-ring
124	Needle bearing	401	Hexagon socket bolt	728	O-ring
127	Bearing spacer	402	Hexagon socket bolt	732	O-ring
141	Cylinder block	406	Hexagon socket bolt	733	O-ring
151	Piston	415	Hexagon socket bolt	734	O-ring
152	Shoe	466	Plug	774	Oil seal
153	Set plate	467	plug	789	Back up ring
156	Bushing	468	Plug	792	Back up ring
157	Cylinder spring	490	Plug	806	Nut
211	Shoe plate	531	Tilting pin	808	Hexagon head nut
212	Swash plate	532	Servo piston	824	Snap ring
214	Bushing	533	Plug	886	Spring pin
251	Support	534	Stopper (L)	901	Eye bolt
255	Lock pin	535	Stopper (S)	953	Set screw
261	Seal cover (F)	548	Pin	954	Set screw
263	Seal cover (R)	702	O-ring	981	Plate
271	Pump casing (F)	710	O-ring	983	Pin

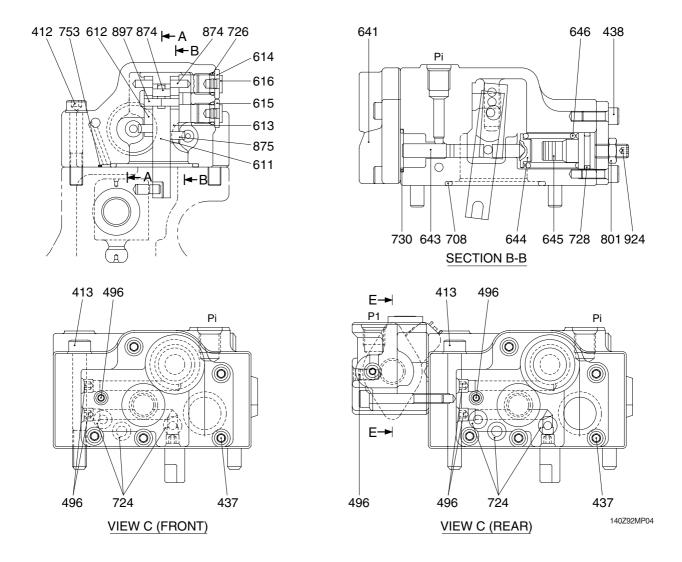
MAIN PUMP (2/2)

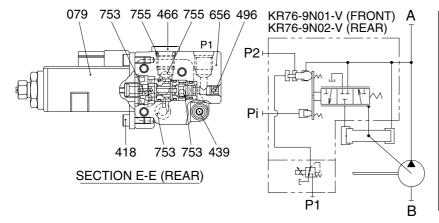


140Z92MP03

04	Gear pump	128	Bearing spacer	711	O-ring
115	Shaft	262	Cover	728	O-ring
117	Gear No. 2	326	Gear case	825	Retainer ring
118	Gear No. 3	414	Hexagon socket bolt	826	Retainer ring
125	Ball bearing	435	Flange socket bolt	885	Spring pin
126	Roller bearing	468	Plug	886	Pin

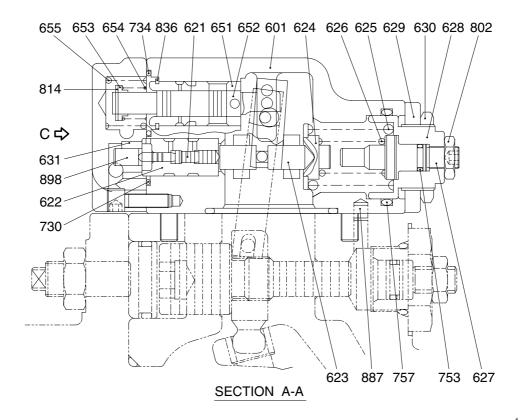
2) REGULATOR (1/2)





Port	Port name	Port size
А	Delivery port	SAE6000 psi 3/4"
В	Suction port	SAE2500 psi 2 1/2"
Pi	Pilot port	PF 1/4-15
P1	EPPR valve primary port	PF 1/4-13
P2	Companion delivery port	internal

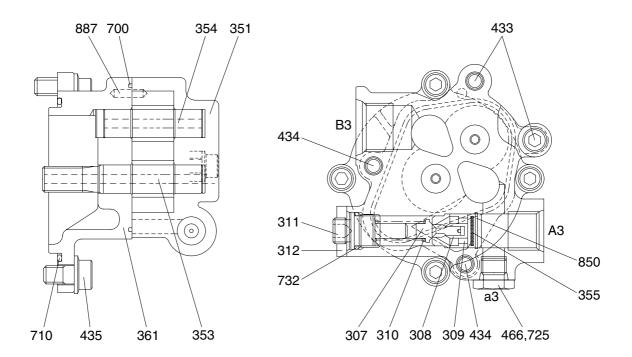
REGULATOR (2/2)



140Z92MP05

079	EPPR valve assembly	624	Spring seat (C)	708	O-ring
412	Hexagon socket screw	625	Outer spring	724	O-ring
413	Hexagon socket screw	626	Inner spring	725	O-ring
418	Hexagon socket screw	627	Adjust stem (C)	728	O-ring
437	Hexagon socket screw	628	Adjust screw (C)	730	O-ring
438	Hexagon socket screw	629	Cover (C)	734	O-ring
439	Hexagon socket screw	630	Lock nut	753	O-ring
466	Plug	631	Sleeve, Pf	755	O-ring
496	Plug	641	Pilot cover	757	O-ring
601	Casing	643	Pilot piston	801	Nut
611	Feed back lever	644	Spring seat (Q)	802	Nut
612	Lever (1)	645	Adjust stem (Q)	814	Snap ring
613	Lever (2)	646	Pilot spring	836	Snap ring
614	Center plug	651	Sleeve	874	Pin
615	Adjust plug	652	Spool	875	Pin
616	Plug	653	Spring seat	887	Pin
621	Compensator piston	654	Return spring	897	Pin
622	Piston case	655	Set spring	898	Pin
623	Compensator rod	656	Block cover	924	Set screw

3) GEAR PUMP



14092MP06

307	Poppet	353	Drive gear	466	Plug
308	Seat	354	Driven gear	700	Ring
309	Ring	355	Filter	710	O-ring
310	Spring	361	Front case	725	O-ring
311	Screw	433	Flange socket	732	O-ring
312	Nut	434	Flange socket	850	Snap ring
351	Gear case	435	Flange socket	887	Pin

2. FUNCTION

1) MAIN PUMP

The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge: and the PTO group that transfers drive shaft of gear pump.

(1) Rotary group

The rotary group consists of drive shaft (F) (111), cylinder block (141), piston shoes (151,152), set plate (153), spherical bushing (156) and cylinder spring (157). The drive shaft is supported by bearing (123,124) at its both ends.

The shoe is caulked to the piston to from a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and to take hydraulic balance so that it slides lightly over the shoe plate (211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via the set plate and a spherical bushing.

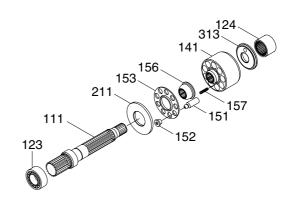
Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.

(2) Swash plate group

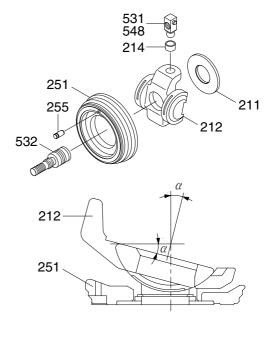
The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), lock pin (255), tilting bushing (214), tilting pin (531) and servo piston (532).

The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

If the servo piston moves to the right or left as hydraulic force controlled by the regulator connects to hydraulic chamber located on both sides of the servo piston, the swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle (α)



21092MP06



140Z92MP09

(3) Valve block group

The valve block group consists of valve block (312), valve plate (313, 314) and spring pin(886).

The valve plate having two kidmey ports is fixed to the valve block and feeds and collects oil to and from the cylinder block. The oil changed over by the valve plate is

connected to an external pipeline by way of the valve block.

(4) PTO group

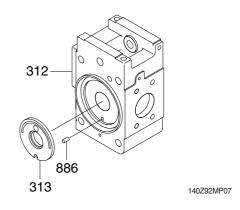
PTO group consist of 1st gear (116) and 2nd gear (117), 3rd gear (118).

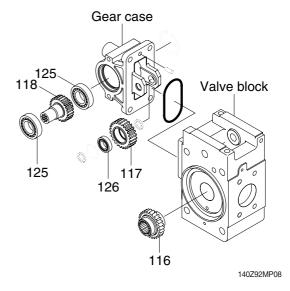
2nd gear and 3rd gear are supported by bearings (125, 126), and it can be mounted to the valve block.

Now, if the drive shaft is driven by a prime mover (electric motor, engine, etc), it rotates the cylinder block via a spline linkage at the same time. If the swash plate is tilted as in Fig (previous page) the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block.

If you pay attention to a single piston, it performs a motion away from the valve plate (oil sucking process) within 180 degrees, and makes a motion towards the valve plate (oil discharging process) in the rest of 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.

Concurrently, the auxiliary pump is driven by gears of PTO.





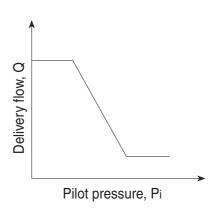
2) REGULATOR

Regulator consists of the negative flow control, total horse power control and power shift control function.

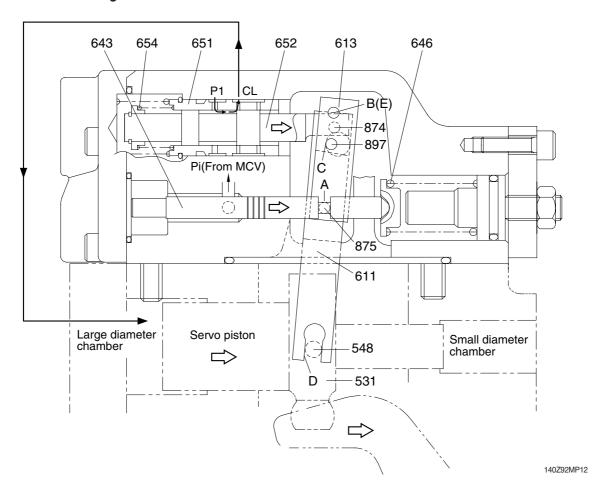
(1) Negative flow control

By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

This regulator is of the negative flow control in which the delivery flow Q decreases as the pilot pressure Pi rises. With this mechanism, when the pilot pressure corresponding to the flow required for the work is commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.



① Flow reducing function



As the pilot pressure Pi rises, the pilot piston (643) moves to the right to a position where the force of the pilot spring (646) balances with the hydraulic force.

The groove (A) in the pilot piston is fitted with the pin (875) that is fixed to lever 2 (613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B [fixed by the fulcrum plug (614) and pin (875)]. Since the large hole section (C) of lever 2 contains a protruding pin (897) fixed to the feedback lever (611), the pin (897) moves to the right as lever 2 rotates. Since the opposing-flat section (D) of the feedback lever is fitted with the pin (548) fixed by the tilting pin (531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin (897) moves.

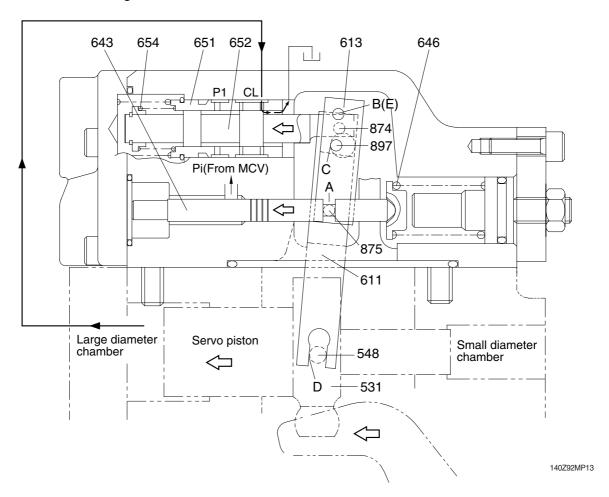
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

The movement of the spool causes the delivery pressure P1 to connect to port CL through the spool and to be admitted to the large diameter section of the servo piston. The delivery pressure P1 that is constantly admitted to the small diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.

When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring (654) and is tensioned to the left at all times, and so the pin (897) is pressed against the large hole section (C) of lever 2.

Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve (651) and spool (652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

② Flow increasing function



As the pilot pressure Pi decreases, the pilot piston (643) moves to the left by the action of the pilot spring (646) and causes lever 2 (613) to rotate around the fulcrum of point B. Since the pin (897) is pressed against the large hole section (C) of lever 2 by the action of the return spring (654) via the spool (652), pin (874), and feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 2 rotates, and shifts the spool to the left. Port CL opens a way to the tank port as the spool moves. This deprives the large diameter section of the servo piston of pressure, and shifts the servo piston to the left by the discharge pressure P1 in the small diameter section, resulting in an increase in the flow rate.

As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

3 Adjustment of flow control characteristic

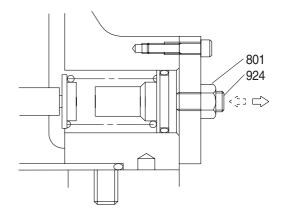
The flow control characteristic can be adjusted with the adjusting screw.

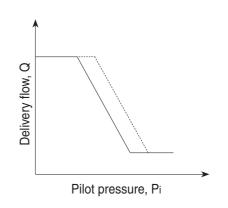
Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

Tightening the screw shifts the control chart to the right as shown in the figure.

* Adjusting value

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting pressure change amount		Flow change amount
(min ⁻¹)	(Turn)	(kgf/cm²)	(l /min)
1900	+1/4	+1.6	+9





(2) Total horsepower control

The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.

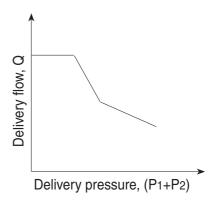
(The input horsepower is constant when the speed is constant.)

Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.

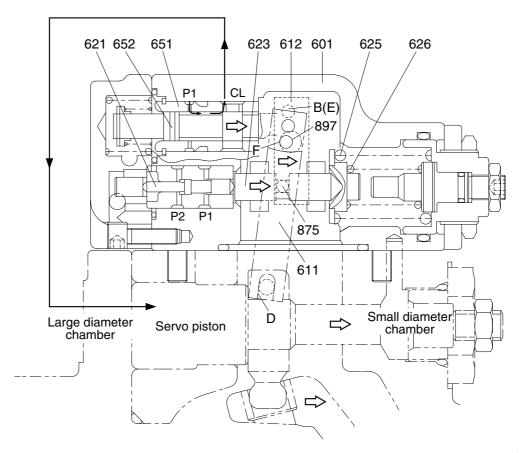
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation:

$$Tin = P1 \times q/2 \mathbf{J} + P2 \times q/2 \mathbf{J}$$
$$= (P1+P2) \times q/2 \mathbf{J}$$

The horsepower control function is the same as the flow control function and is summarized in the following. (For detailed behaviors of respective parts, refer to the section of flow control).



① Overload preventive function



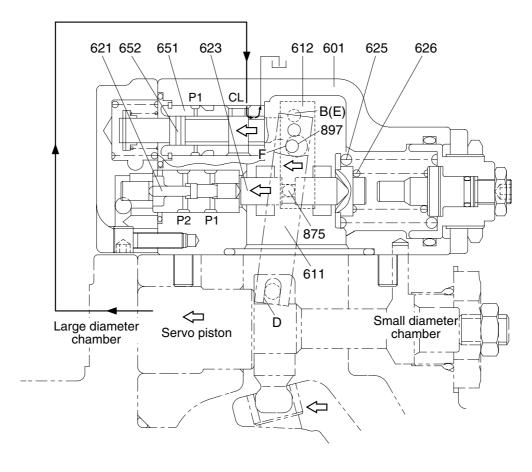
140Z92RG03

When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force. The movement of the compensating rod is transmitted to lever 1 (612) via pin (875).

Lever 1 rotates around the pin (875) (E) fixed to the casing (601).

Since the large hole section (F) of lever 1 contains a protruding pin (897) fixed to the feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 1 rotates, and then the spool (652) is shifted to the right. As the spool moves, the delivery pressure P1 is admitted to the large diameter section of the servo piston via port CL, causes the servo piston move to the right, reduces the pump delivery, flow rate, and prevents the prime mover from being overloaded. The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool (652) and sleeve (651) is closed.

② Flow reset function



140Z92RG04

As the self pump delivery pressure P1 or the companion pump delivery pressure P2 decreases, the compensating rod (623) is pushed back by the action of the springs (625 & 626) to rotate lever 1 (612) around point E. Rotating of lever 1 causes the feedback lever (611) to rotate around the fulcrum of point D and then the spool (652) to move to the left. As a result, port CL opens a way to the tank port.

This causes the servo piston to move to the left and the pump's delivery rate to increase.

The movement of the servo piston is transmitted to the spool by the action of the feedback mechanism to move it till the opening between the spool and sleeve is closed.

3 Low tilting angle (low flow) command preferential function

As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (\emptyset 4) protruding from the large hole (\emptyset 8), only the lever lessening the tilting angle contacts the pin (897); the hole (\emptyset 8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

4 Adjustment of input horsepower

Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one pump is loaded.

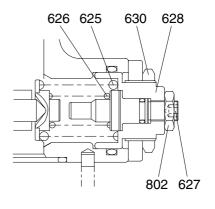
a. Adjustment of outer spring

Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628).

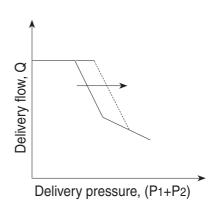
Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C (628) by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by $N \times A$ turns at first. (A=1.73)

* Adjusting value

Speed	Adjustment of input horsepower				
	Tightening amount of adjusting screw (C) (628)	Compensating control starting pressure change amount	Input torque change amount		
(min -1)	(Turn)	(kgf/cm ²)	(kgf · m)		
1900	+1/4	+19.2	+3.4		



140Z92RG07



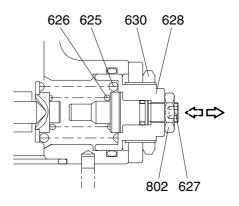
b. Adjustment of inner spring

Adjust it by loosening the hexagon nut (802) and by tightening (or loosening) the adjusting stem C (627).

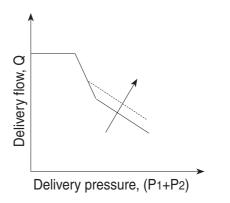
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

* Adjusting value

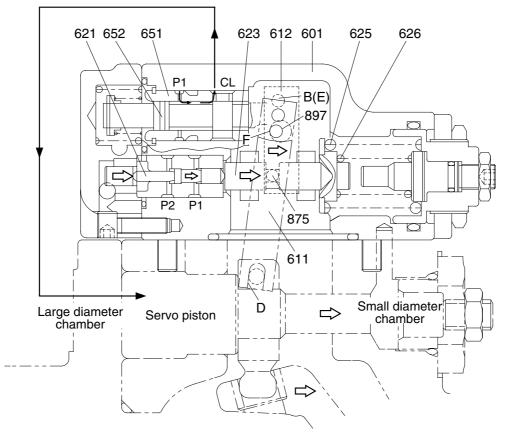
Speed	Adjustment of input horsepower				
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount		
(min ⁻¹)	(Turn)	(l /min)	(kgf · m)		
1900	+1/4	+8.6	+4.3		



140Z92RG08



(3) Power shift control

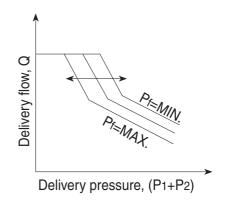


140Z92RG05

The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided.

However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level.



This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.

The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.

As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).

This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

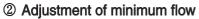
(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

The maximum flow only is adjusted without changing other control characteristics.

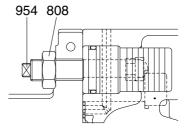
Speed	Adjustment of max flow			
	Tightening amount of adjusting screw (954)	Flow change amount		
(min ⁻¹)	(Turn)	(l /min)		
1900	+1/4	-3.0		

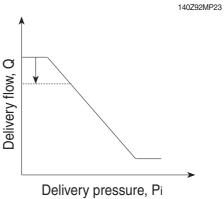


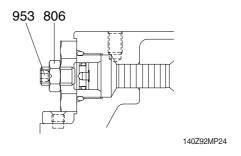
Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

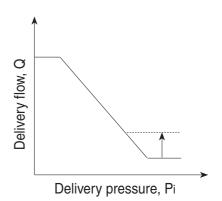
However, remember that, if tightened too much, the required horsepower during the maximum delivery pressure (or during relieving) may increase.

Speed	Adjustment of min flow		
	Tightening amount of adjusting screw (953)	Flow change amount	
(min ⁻¹)	(Turn)	(l /min)	
1900	+1/4	+3.0	



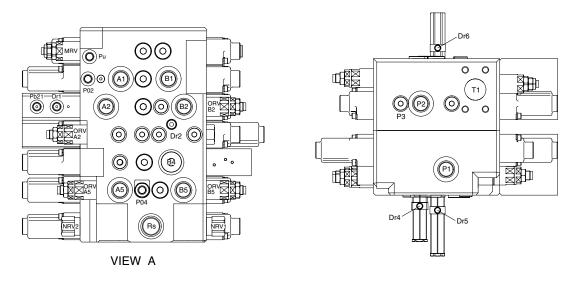


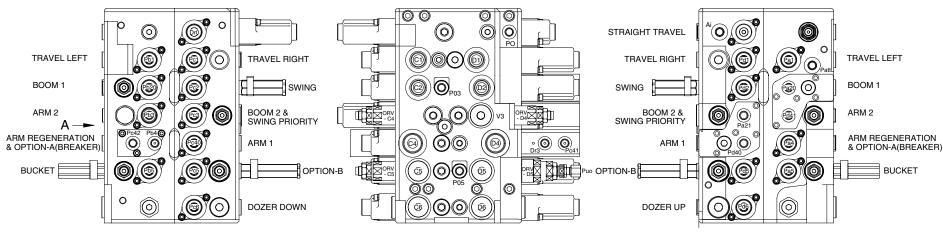


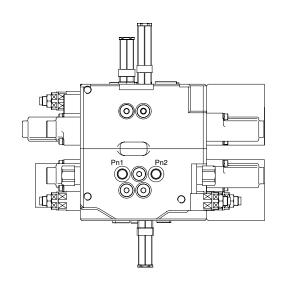


GROUP 2 MAIN CONTROL VALVE

1. STRUCTURE

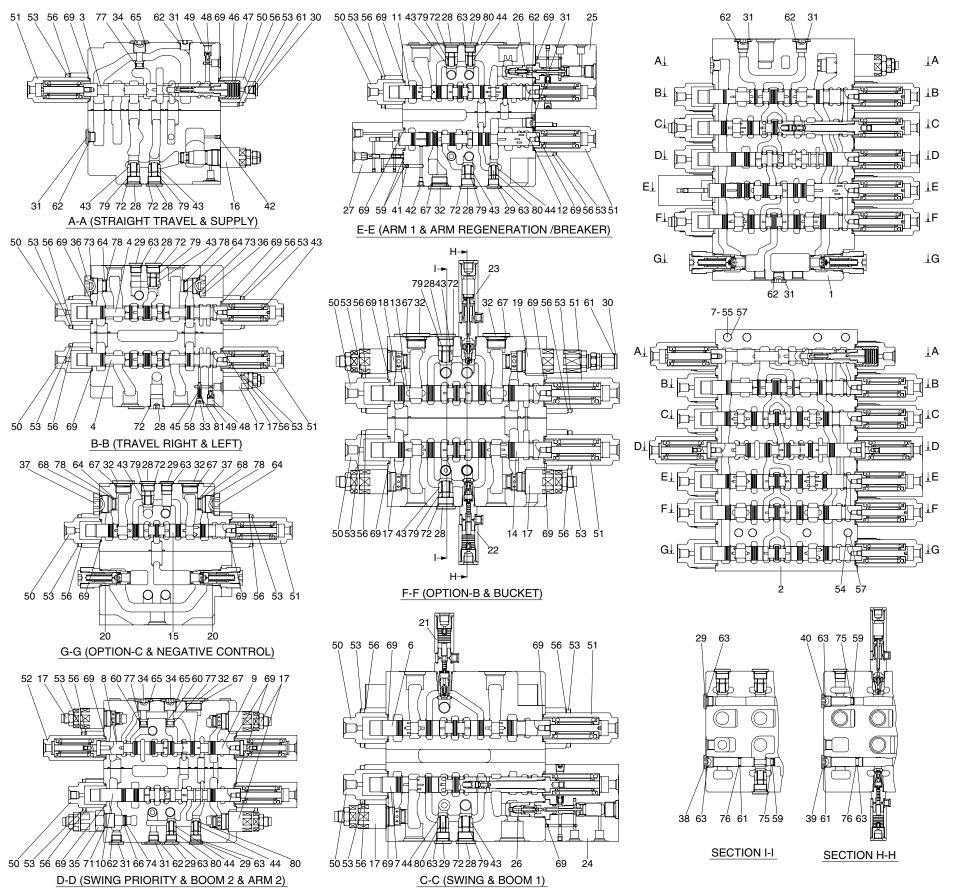






Mark	Port name	Port size	Tightening torque
Rs Pa1 Pb1 Pc1 Pd1 Pa20 Pa21 Pb20 Pb21 Pc2 Pb3 Pc3 Pa4 Pb4 Pc40 Pc41 Pc42 Pd40 Pd41 Pa5 Pc5 Pd5 Pc6 Pd6 P0 Pu Aitt P02 P03 P04 P05 P3 Puo Dr1 Dr2 Dr3 Pn1	Travel left pilot port (BW) Travel left pilot port (FW) Travel right pilot port (FW) Travel right pilot port (FW) Travel right pilot port (BW) Boom up pilot port Boom up confluence pilot port Boom down pilot port Lock valve pilot port (boom) Swing pilot port (RH) Swing pilot port (LH) Arm in confluence pilot port Swing priority pilot port Option A pilot port (breaker) Arm in regeneration cut port Arm in pilot port Lock valve pilot port (arm) Arm in regen-cut signal selector port Arm out confluence pilot port Bucket in pilot port Bucket in pilot port Option B pilot port Option B pilot port Option C pilot port (dozer blade down) Option C pilot port (dozer blade up) Pilot pressure port Main relief pressure up pilot port Auto idle signal port Auto idle signal-attachment Pilot signal port Boom parallel orifice pilot port Breaker summation pilot port Quick clamp port Prain port (travel straight) Drain port (boom holding valve) Drain port (arm holding valve) Negative control signal port (P1 port side)	UNF 1 3/16	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Pn2	Negative control signal port (P2 port side)	PF 3/8	(50.6~57.8 lbf ⋅ ft)
A1 B1 C1 D1 B2 C2 D2 B4 A5 B5 C5 D5 C6 D6 P1 P2	Travel motor left side port (BW) Travel motor left side port (FW) Travel motor right side port (FW) Travel motor right side port (BW) Boom rod side port Swing motor port (RH) Swing motor port (LH) Option A port (breaker) Bucket head side port Bucket rod side port Option B port Option B port Option C pilot port (dozer down port) Option C pilot port (dozer up port) Pump port (P1 side) Pump port (P2 side)	PF 3/4	15∼18 kgf · m (109∼130 lbf · ft)
A2 C4 D4	Boom head side port Arm head side port Arm rod side port	PF 1	20~25 kgf ⋅ m (115~180 lbf ⋅ ft)
Dr4 Dr5 Dr6	Drain port (swing logic valve) Drain port (flow summation) Drain port (bucket load check)	PF 1/8	1.5~1.9 kgf ⋅ m (10.8~13.7 lbf ⋅ ft)
T1	Return port	SAE3000, 1 1/2 (M12×1.75)	8.5~11.5 kgf ⋅ m (61.5~83.1 lbf ⋅ ft)

14092MC01



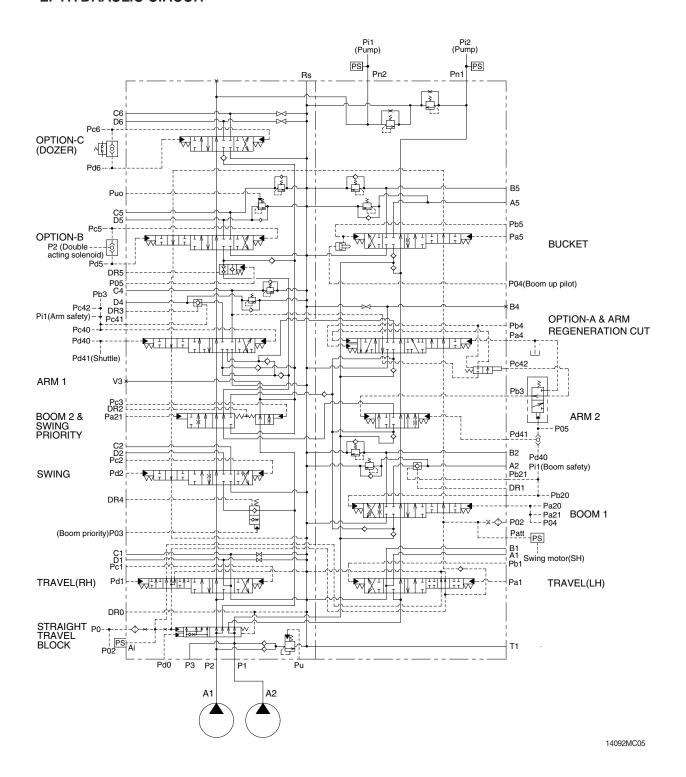
2	Housing-P2	44	Load check-poppet
3	Spool-straight travel	45	Signal-poppet
4	Spool-travel (LH, RH)	46	Travel straight-sleeve
6	Spool-swing	47	Travel straight-piston
7	Spool-boom 1	48	Orifice signal
8	Spool-swing priority	49	Coin type filter
9	Spool-boom 2	50	Pilot cap
10	Spool-arm 2	51	Pilot cap
11	Spool-arm 1	52	Pilot cap
12	Spool-arm regeneration	53	Socket bolt
13	Spool-option B	54	Socket bolt
14	Spool-bucket	55	Socket bolt
15	Spool-option C (dozer)	56	Washer
16	Main relief valve	57	Spring washer
17	Overload relief valve	58	O-ring
18	Overload relief valve	59	O-ring
19	Overload relief valve	60	O-ring
20	Negacon relief valve	61	O-ring
21	Swing logic valve	62	O-ring
22	Bucket logic valve	63	O-ring
23	Option on-off valve	64	O-ring
24	Holding valve kit A1	65	O-ring
25	Holding valve kit A2	66	O-ring
26	Holding valve kit B	67	O-ring
27	Regeneration block	68	O-ring
28	Plug	69	O-ring
29	Plug	70	O-ring
30	Plug	71	O-ring
31	Plug	72	O-ring
32	Plug	73	O-ring
33	Plug	74	Backup-ring
34	Plug-parallel	75	Backup-ring
35	Plug-relief cat	76	Backup-ring
36	Plug-relief cat	77	Backup-ring
37	Plug-relief cat	78	Backup-ring
38	Plug-bucket	79	Load check spring
39	Plug-bucket parallel	80	Load check spring
40	Plug-option	81	Poppet signal spring
41	Plug-orifice	82	Pin
42	Plug		

43 Load check-poppet

Housing-P1

14092MC02

2. HYDRAULIC CIRCUIT



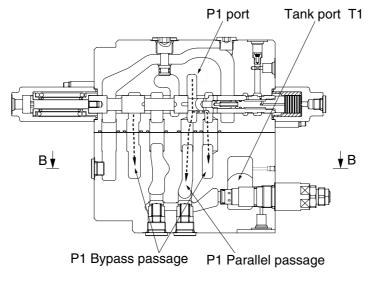
3. FUNCTION

1) CONTROL IN NEUTRAL

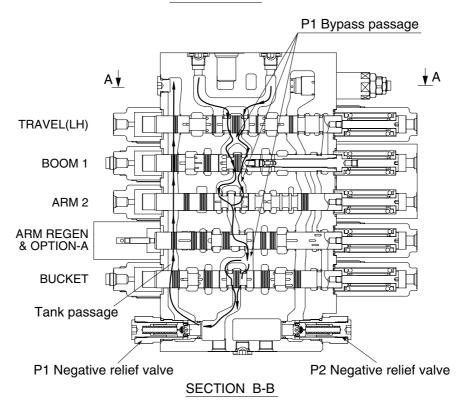
(1) P1 SIDE

The hydraulic fluid from pump A2 flows into the main control valve through the inlet port "P1", pass the straight travel spool into the P1 bypass passage and P1parallel passage.

The hydraulic fluid from the pump A2 is directed to the tank through the bypass passage of spools: travel left, boom 1, arm 2, arm regeneration & option A and bucket, the negative relief valve of P1, tank passage, and the tank port "T1"



SECTION A-A

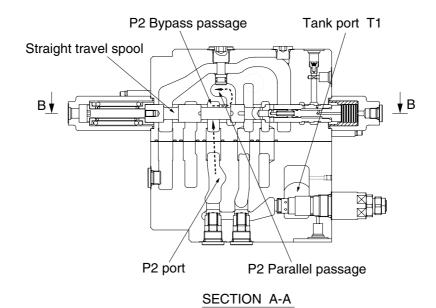


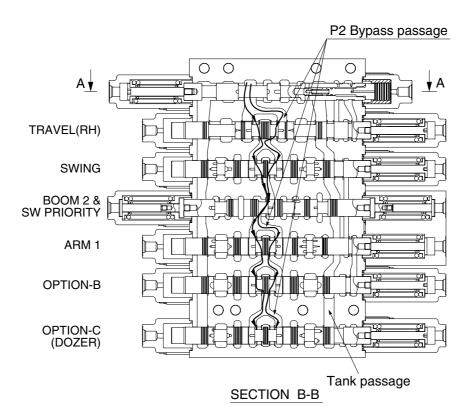
14092MC11

(2) P2 SIDE

The hydraulic fluid from pump A1 flows into the main control valve through the inlet port "P2", into the P2 bypass passage and P2 parallel passage.

The hydraulic fluid from the pump A1 is directed to the tank through the bypass passage of spools: travel right, swing, boom 2 & swing priority, arm 1, option "B" and option "C" (dozer), the negative relief valve of P2, tank passage and the tank port "T1".

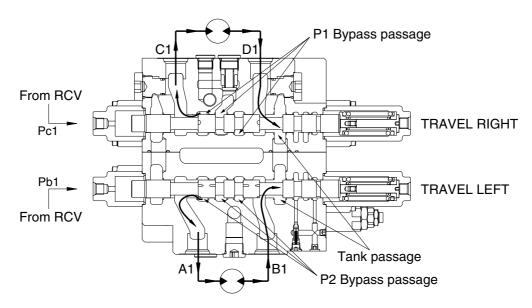




14092MC12

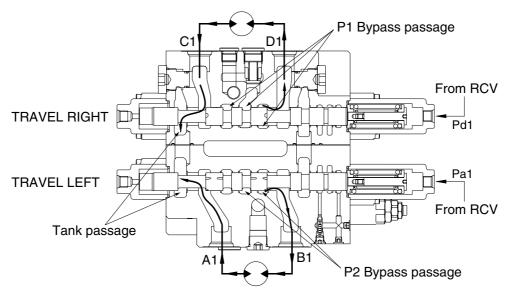
2) TRAVEL OPERATION

(1) TRAVEL FORWARD OPERATION



14092MC18

(2) TRAVEL BACKWARD OPERATION



14092MC17

During the travel forward operation, the hydraulic fluid of the pump A2 is supplied to the travel left motor and the hydraulic fluid of the pump A1 is supplied to the other travel right motor.

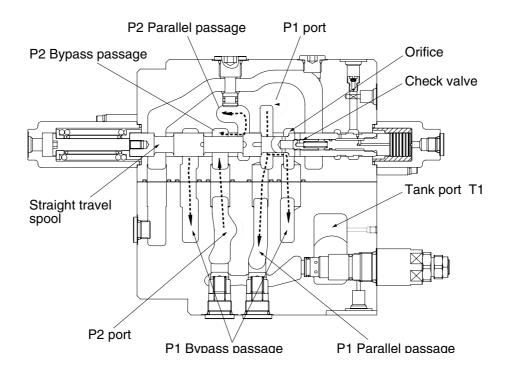
The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pb1, pc1).

And it shifts travel right and left spools in the left direction against springs. Hydraulic fluid from the pump A1 flow into the travel right spool through the bypass passage and hydraulic fluid from the pump A2 flow into the travel left spool through the bypass passage.

Then they are directed to the each travel motor through port A1 and C1. As a result, the travel motors turn and hydraulic fluid returns to the tank passage through the travel spools.

In case of the reverse operation, the operation is similar.

(3) TRAVEL STRAIGHT FUNCTION



14092MC19

This function keeps straight travel in case of simultaneous operation of other actuators (boom, arm, bucket, swing) during a straight travel.

① During travel only:

The hydraulic fluid of the pump A1 is supplied to the travel right motor and the pump A2 is supplied to the travel left motor.

Thus, the machine keep travel straight.

② The other actuator operation during straight travel operation:

When the other actuator spool (s) is selected under straight travel operation, the straight travel spool is moved.

The hydraulic fluid from pump A2 is supplied actuator through P2 and P1 parallel pass and travel motors through orifice at side of straight travel spool.

The hydraulic oil fluid from pump A1 is supplied to travel motors (left/right).

Therefore, the other actuator operation with straight travel operation, hydraulic oil fluid from pump A2 is mainly supplied to actuator, and the hydraulic oil fluid form pump A1 is mainly supplied to travel motors (left/right).

Then the machine keeps straight travel.

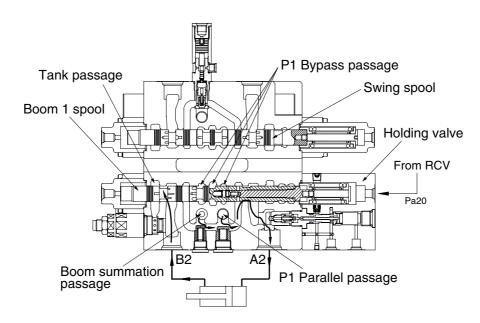
3) BOOM OPERATION

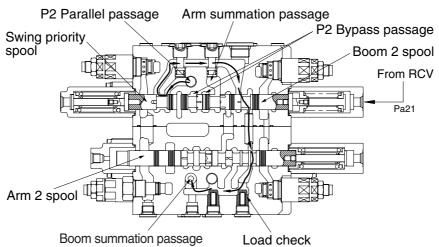
(1) BOOM UP OPERATION

During boom up operation, the pilot secondary pressure from RCV is supplied to the port Pa20 of the spring side and shifts the boom 1 spool in the left direction. The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic oil fluid from pump A2 is entered P1 parallel passage and then passes through the load check, bridge passage and boom holding valve then flows into the port A2. Following this it flows into the head side of the boom cylinder. (In this case, the boom holding valve is free flow condition)

At the same time, the pilot pressure from RCV is supplied to the port Pa21 of the spring side of boom 2 and shifts the boom 2 spool. The bypass passage is shut off by the movement of the boom 2 spool and the hydraulic oil fluid from pump A1 entered boom summation passage via the P2 parallel passage, the land of the swing priority spool, notch of the boom 2 spool, arm 2 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder.

At the same time, the flow from rod side of the boom cylinder return to the boom 1 spool through the port B2. Thereafter it is directed to the hydraulic oil tank through the tank passage.





(2) BOOM DOWN OPERATION

During the boom lowing operation, the pilot pressure from RCV is supplied to the port Pb20 of the spring opposite side and shifts the boom 1 spool in the right direction.

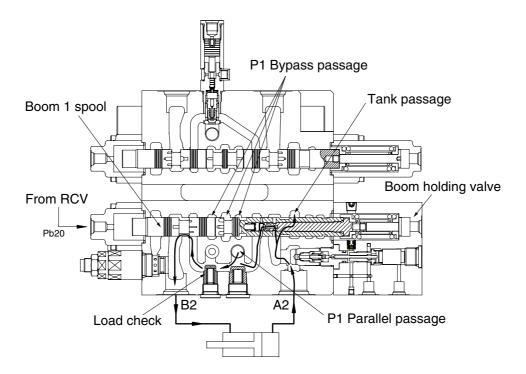
The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check. Following this, it flows into the rod side of the boom cylinder.

At the same time, the return flow from the head side of the boom cylinder returns to the port A2 and boom holding valve. And it is directed to the hydraulic oil tank through opened tank passage by movement of the boom 1 spool.

Meanwhile some of return flow is directed to P1 parallel passage through the internal passage of the boom 1 spool. (boom regeneration)

In this case, the holding valve is open condition, for details of the boom holding valve, see page following page.

During the boom lowering operation, the fluid from A1 pump is not summation.

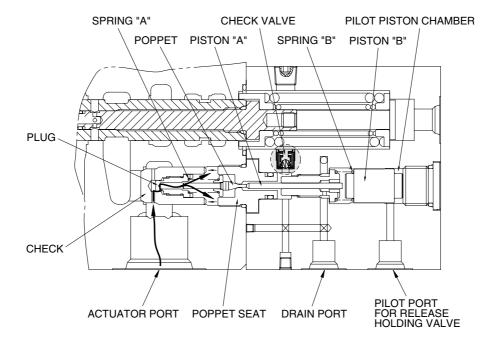


4) HOLDING VALVE OPERATION

(1) HOLDING OPERATION

At neutral condition, the pilot piston chamber is connected to drain port through the pilot port. And the piston "B" is supported with spring "B".

Also, the pressured fluid from actuator entered to inside of the holding valve through the periphery hole of check, crevice of the check and the plug and the periphery hole of plug. Then, this pressured oil pushed the poppet to the poppet seat and the check to the seat of body. So the hydraulic fluid from actuator is not escaped and the actuator is not moved.

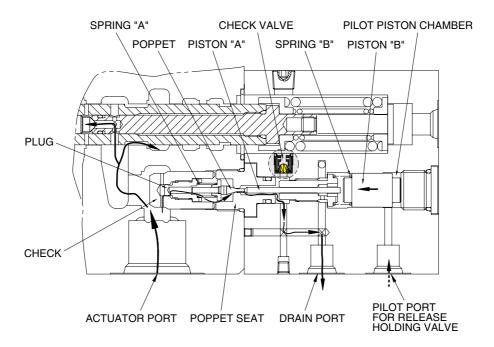


(2) RELEASE HOLDING OPERATION

The pilot pressure is supplied to the pilot port for release holding valve and shifts the piston "B" in the left direction against the spring "B", and shifts the poppet in the left direction through piston "B" and piston "A" against spring "B" and shifts the spool in the left side.

At same time, the return fluid from actuator returns to the drain port through the periphery hole of check, crevice of the check and the plug, the periphery hole of the plug, in side of holding valve, crevice of the poppet and the poppet seat, the periphery hole of the poppet seat, crevice of socket and spool and internal passage of spool.

When the poppet is opened, pressure of inside of holding valve is decreased and the return fluid from actuator returns to the tank passage through the notch of spool.



5) BUCKET OPERATION

(1) BUCKET IN OPERATION

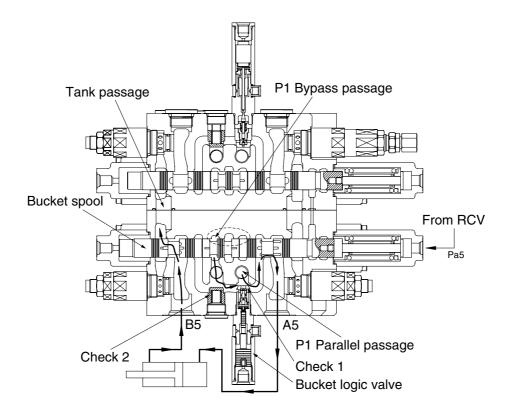
During the bucket in operation, the pilot secondary pressure from RCV is supplied to port Pa5 of the spring side and shifts the bucket spool in the left direction.

The bypass passage is shut off by the movement of the bucket spool and the hydraulic fluid from pump A2 entered P1 parallel passage and is directed to the port A5 through the check 1 of bucket logic valve.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port A5 through the check 2.

Following this it flows into the head side of the bucket cylinder.

The return flow from the rod side of the bucket cylinder returns to the bucket spool through the port B5. Thereafter it is directed to the hydraulic oil tank through the tank passage.



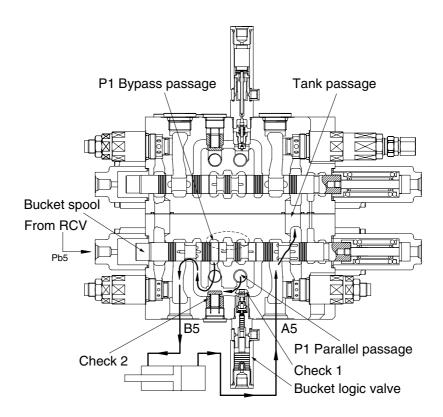
(2) BUCKET OUT OPERATION

During the bucket out operation, the pilot secondary pressure from RCV is supplied to port Pb5 of the spring opposite side and shifts the bucket spool in the right direction.

The bypass passage is shut off by the movement of the bucket spool and the hydraulic fluid from pump A2 entered P1 parallel passage and is directed to the port B5 through the check 1 of bucket logic valve.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port B5 through the check 2.

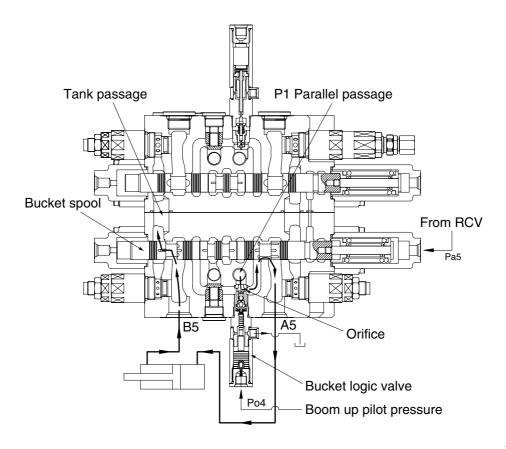
The return flow from the head side of the bucket cylinder returns to the hydraulic oil tank through the port A5 and the tank passage.



(3) BUCKET IN OPERATION WITH BOOM OPERATION

When combined operation, mostly same as previous page but the fluid from P1 bypass passage is empty.

So only the fluid from P1 parallel passage is supplied to the bucket cylinder. Also, parallel passage is installed the orifice of bucket logic valve for supplying the fluid from pump A2 to the boom operation prior to the bucket operation. In case of the bucket out operation with boom



6) SWING OPERATION

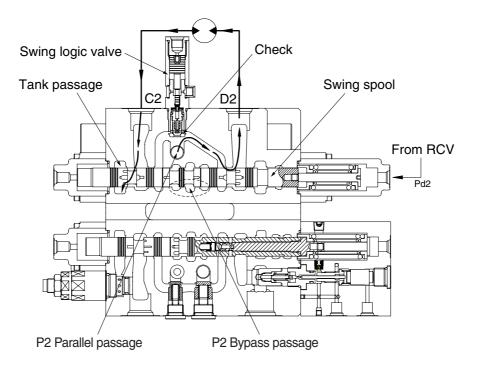
(1) SWING LEFT & RIGHT OPERATION

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port Pd2 of the spring side and shift the swing spool in left direction. The bypass passage is shut off by the movement of the swing spool and the hydraulic fluid from pump A1 flows into swing spool through the P2 parallel passage. Then it is directed to swing motor through the port D2.

As the result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port C2, swing spool and the tank passage.

In case of swing right operation, the operation is similar to swing left operation but the pilot secondary pressure from the RCV is supplied to the port Pc2 of the spring opposite side.

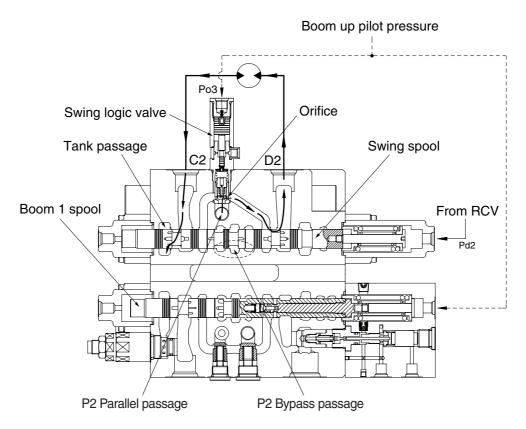
Accordingly, the hydraulic fluid from pump A1 flows into swing motor through the port C2 and returns to the hydraulic oil tank through the port D2 and the tank passage.



(2) SWING LEFT OPERATION WITH ARM OR BOOM OPERATION

When combined operation, mostly same as previous page but the fluid from P2 bypass passage is empty.

So only the fluid from parallel passage is supplied to the swing motor. Also, parallel passage is installed the orifice of swing logic valve for supplying the fluid from pump A1 to the boom or the arm operation prior to the swing operation. In case of the swing right operation with arm or boom



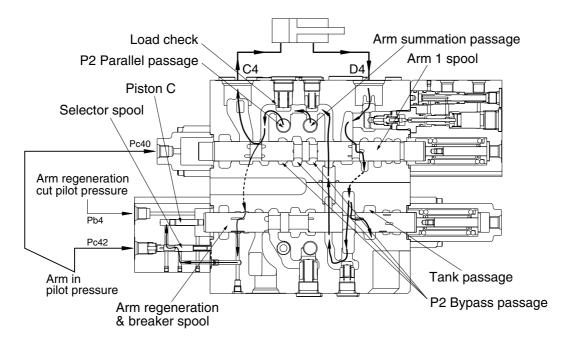
7) ARM OPERATION

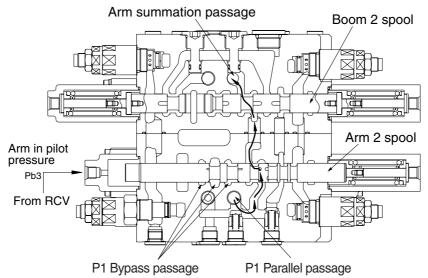
(1) ARM IN OPERATION

During arm in operation, the pilot secondary pressure from the RCV is supplied to the port Pc40 of spring opposite side and shifts arm 1 spool in the right direction.

The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic oil from the pump A1 flows into the arm cylinder head side through P2 parallel passage, the load check valve, bridge passage and the port C4.

At same time, the pilot secondary pressure from the RCV is supplied to the port Pb3 of spring opposite side and shifts arm 2 spool in the right direction. The bypass passage is shut off by the movement of the arm 2 spool and the hydraulic fluid from the pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, the arm 2 spool and the boom 2 spool. Then it entered the arm cylinder head side with hydraulic fluid from arm 1 spool.





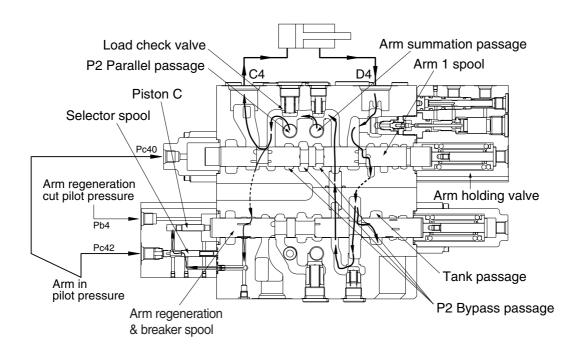
ARM REGENERATION

The return flow from the arm cylinder rod side is pressurized by self weight of arm and so, returns to port D4. The pressurized oil returning to port D4 enters the arm regeneration & breaker spool through the arm holding valve and the arm 1 spool. It is supplied the arm cylinder head through internal passage. This is called the arm regeneration function.

The amount of regeneration fluid is changed by movement of the arm regeneration spool. A few fluids after P2 parallel passage is push piston "C" through the notch of arm regeneration spool and selector spool. At this time, the selector spool is opened by pilot pressure from RCV.

Then, the arm regeneration spool shifts to right side and flow to tank pass increases and regeneration flow decreases. Therefore, pressure of arm cylinder head increases, then, arm regeneration flow decreases.

Furthermore, the arm regeneration cut pressure is supplied to the port Pb4 of spring opposite side and arm regeneration spool is move into the right direction fully. The flow from the arm cylinder rod is returned to the hydraulic oil tank and regeneration function is not activated. (The return fluid is maximum condition)



(2) ARM OUT OPERATION

During arm out operation, the pilot secondary pressure from RCV is supplied to the port Pd40 of spring side and shifts arm 1 spool in the left direction.

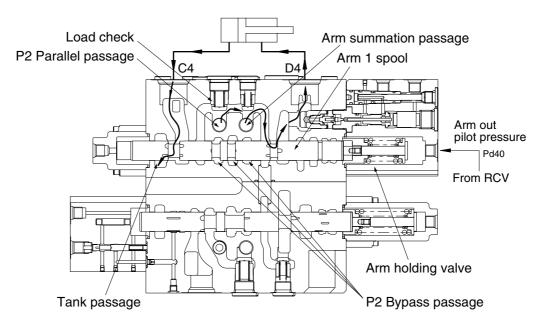
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic fluid from pump A1 flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve and the port D4.

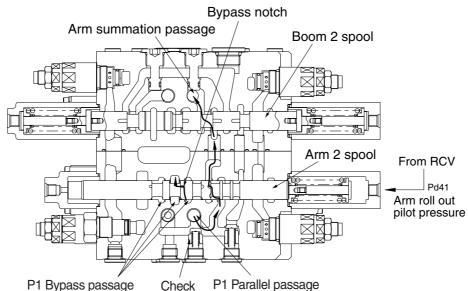
Also, the pilot secondary pressure from RCV is supplied to the port Pd41 of spring side and shifts arm 2 spool in the left direction.

The bypass passage is shut off by the movement of the arm 2 spool and some of the hydraulic fluid from pump A2 bypassed through bypass notch. The rest of hydraulic fluid from pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, arm 2 spool and boom 2 spool.

Then it enters into the arm cylinder rod side with the fluid from the arm 1 spool.

The return flow from the arm cylinder head side returns to the hydraulic tank through the port C4, the arm 1 spool and tank passage.



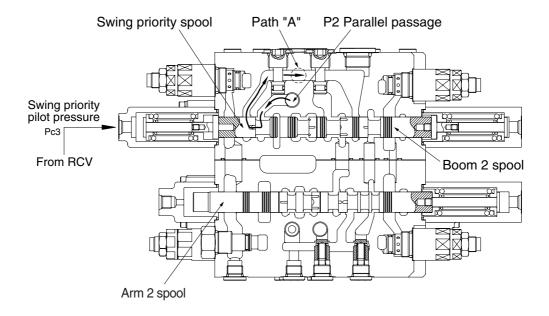


8) SWING PRIORITY FUNCTION

During swing priority operation, the pilot secondary pressure is supplied to the port Pc3 of the spring side of the swing priority spool and shift swing priority spool in the right direction.

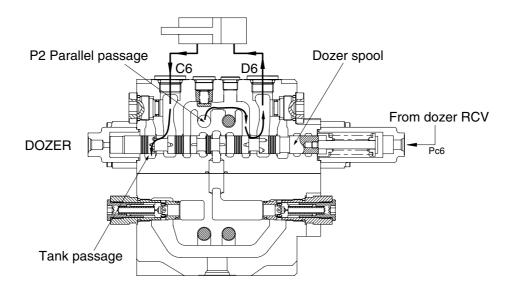
The hydraulic fluid from P2 parallel passage flows into the parallel passage of arm 1 side through swing priority spool and the path "A" and also flows into the boom 2 spool.

When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the fluid from pump A1 flows to swing side more then the boom 2, arm 1, option B and dozer spools to make the swing operation most preferential.



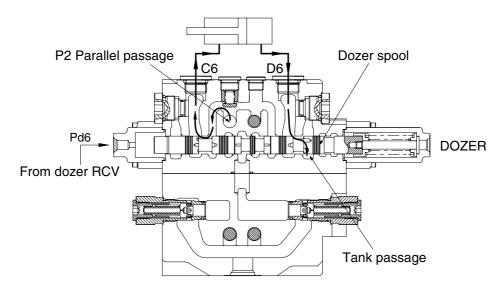
9) DOZER OPERATION

(1) Dozer down operation



14W92MC30

(2) Dozer up operation



14W92MC31

During the dozer down operation, the pilot pressure from the dozer control valve is supplied into the port Pc6 of the spring side and it shifts the dozer spool in the left direction.

The hydraulic fluid from the pump A1 enters the parallel passage and is direction to the head side of the dozer cylinder through port D6.

The return flow from the rod side of the dozer cylinder returns to the dozer spool through C6 port. Thereafter it is directed to the hydraulic tank through tank passage.

In case of the dozer up operation, operation is similar.

10) NEGATIVE RELIEF VALVE OPERATION

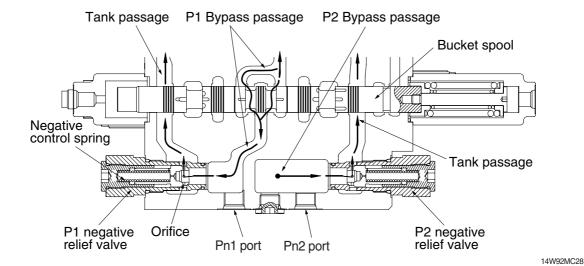
When no function is being actuated on P1 side, the hydraulic fluid from the pump A2, flows into the tank passage through the P1 bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump A2 regulator.

It controls the pump regulator so as to minimize the discharge of the pump A2.

The bypass passage is shut off when the shifting of one or more spools and the flow through bypass passage became zero. The pressure of negative control signal becomes zero and the discharge of the pump A2 becomes maximum.

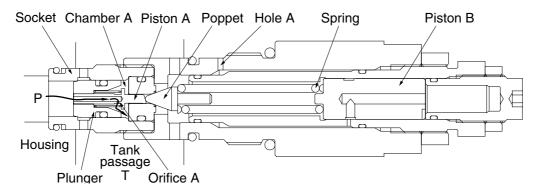
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump A1 the same negative control principle.



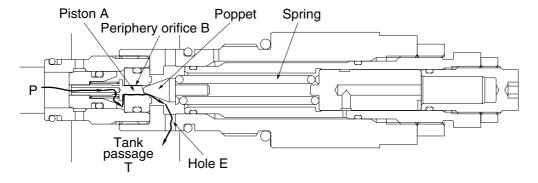
11) OPERATION OF MAIN RELIEF VALVE

(1) The pressurized oil passes through the orifice (A) of the plunger is filled up in chamber A of the inside space, and seats the plunger against the housing securely.



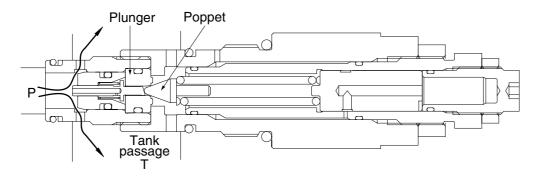
14W92MC36

(2) When the pressure at (P) becomes equal to the set pressure of the spring the hydraulic oil passes through the piston (A) pushes open the poppet and flows to tank passage (T) through the plunger internal passage, periphery orifice A, chamber A, periphery orifice B and the hole (E).

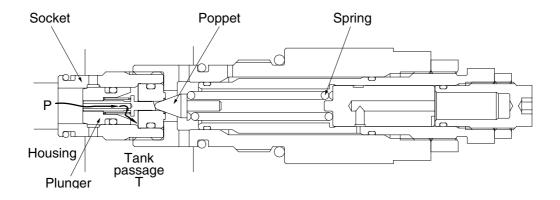


14W92MC37

(3) Opening the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).

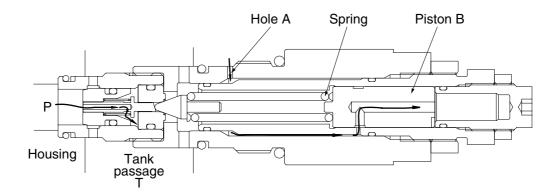


(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



14W92MC39

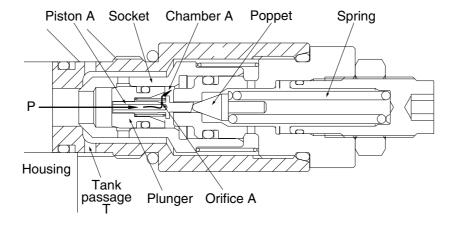
(5) When the power boost switch is ON, the pilot pressure enters through hole A.
It pushes the piston (B) in the left direction to increase the force of the spring and change the relief set pressure to the high pressure.



12) OPERATION OF OVERLOAD RELIEF VALVE

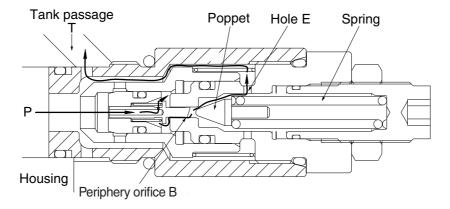
FUNCTION AS RELIEF VALVE

(1) The pressurized oil passes through the piston A and orifice A is filled up in chamber A of the inside space and seat the plunger against the socket and the socket against the housing securely.

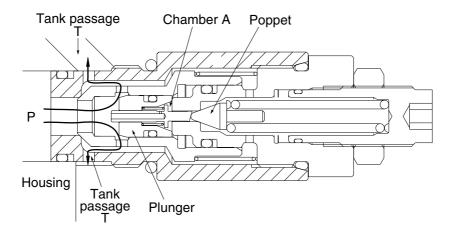


14W92MC41

(2) When the pressure at port P becomes equal to the set pressure of the spring, the pressurized oil pushes open the poppet and flows to tank passage (T) through the plunger internal passage, orifice A, chamber A, periphery orifice B and hole E.

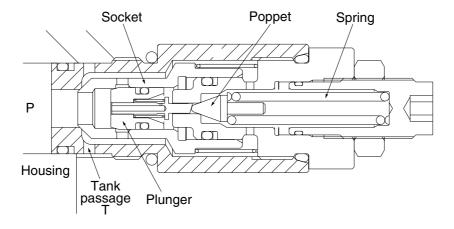


(3) Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



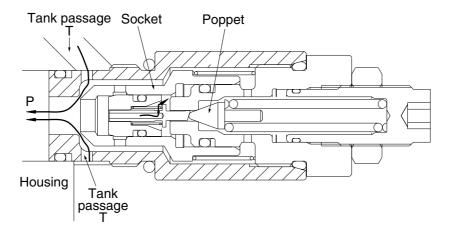
14W92MC43

(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



MAKE-UP FUNCTION

(5) When negative pressure exists at port P, the oil is supplied through tank passage (T). When the pressure at tank passage (T) becomes higher than that of at port P, the socket moves in the right direction. Then, sufficient oil passes around the socket from tank passage (T) to port P and fills up the space.

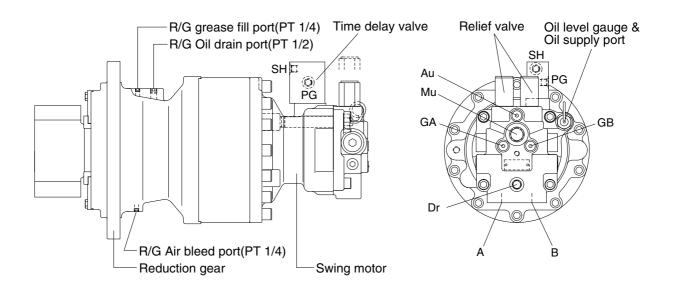


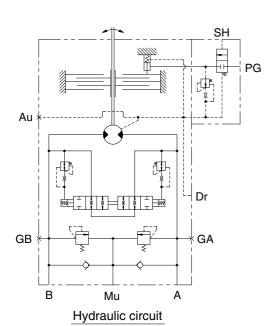
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.

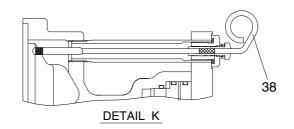


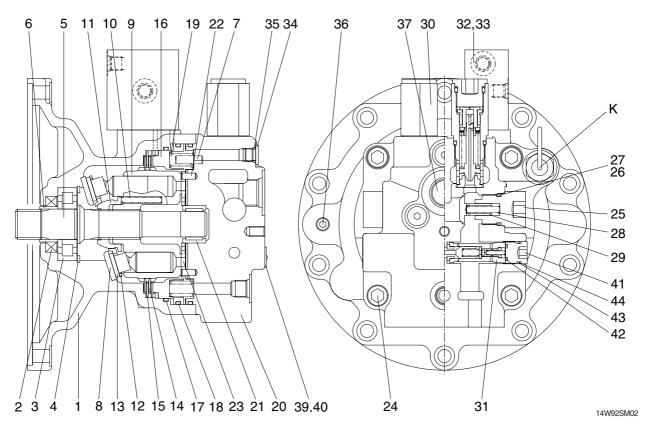


14W92SM01

Port	Port name	Port size	
Α	Main port	ø 13	
В	Main port	ø 13	
Dr	Drain port	PF 3/8	
Mu	Make up port	PF 3/4	
SH	Brake release pilot port	PF 1/4	
PG	Brake release stand by port	PF 1/4	
GA, GB	Gage port	PF 1/4	
Au	Air vent port	PF 1/4	

1) SWING MOTOR





1	Body	
2	Oil seal	
3	Roller bearing	
4	Snap ring	
5	Drive shaft	
6	Bushing	
7	Pin	
8	Shoe plate	

U	Office plate
9	Cylinder block
10	Spring
11	Ball guide
12	Set plate
13	Piston assembly

	1 101011 400011101
14	Friction plate
15	Separate plate

23 Valve plate 24 Wrench bolt 25 Plug Back up ring 26 27 O-ring Spring 28 29 Check 30 Relief valve

Pin

Brake piston

Brake spring

Needle bearing

Rear cover

O-ring

O-ring

16

17

18

19

20

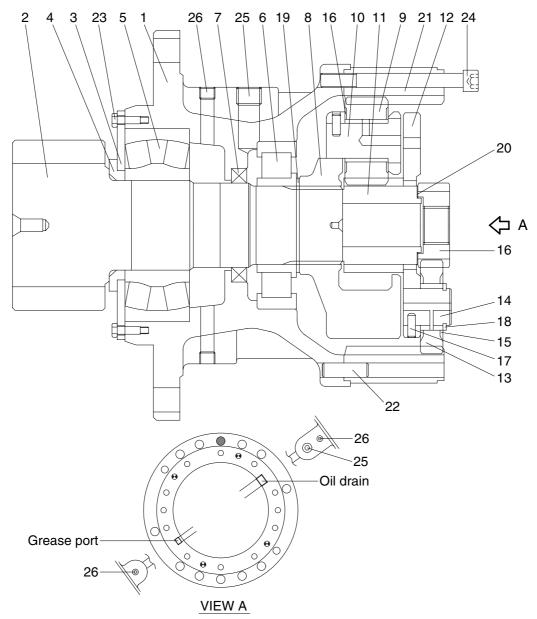
21

22

Anti-rotating valve 31 32 Time delay valve 33 Wrench bolt Plug 34 35 O-ring 36 Plug 37 Plug 38 Level gauge 40 Rivet 41 Plug 42 O-ring O-ring 43

Back up ring

2) REDUCTION GEAR



14W92SM03

1	Casing	10	Pin No.2 assembly	19	Stop ring
2	Drive shaft	11	Sun gear No. 2	20	Side plate No. 1
3	Cover plate	12	Carrier No. 1	21	Ring gear
4	Spacer	13	Planet gear No. 1	22	Knock pin
5	Roller bearing	14	Pin No.1	23	Hexagonal bolt
6	Roller bearing	15	Thrust washer (B)	24	Socket head bolt
7	Oil seal	16	Sun gear No. 1	25	Plug
8	Carrier No. 2	17	Spring pin	26	Plug
9	Planet gear No. 2	18	Stop ring		

2. PRINCIPLE OF DRIVING

1) GENERATING THE TURNING FORCE

The high hydraulic supplied from a hydraulic pump flows into a cylinder (9) through valve cover of motor (20), and valve plate (23).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (13).

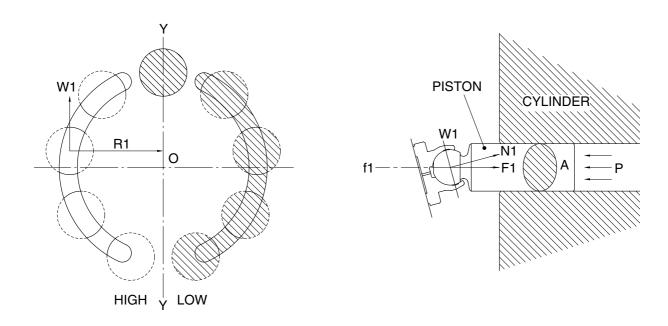
The high hydraulic can generate the force, $F1=P\times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α .

W1 generates torque, T=W1+R1, for Y-Y line connected by the upper and lower sides of the piston as following pictures.

The sum of torque (Σ W1×R1), generated from each piston (4~5 pieces) on the side of a high hydraulic, generates the turning force.

This torque transfers the turning force to a cylinder (9) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.



14072NEWSM03

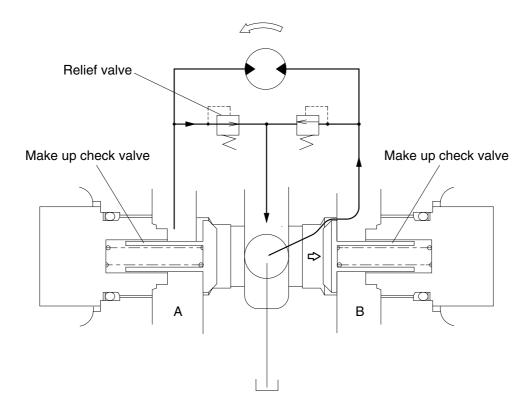
2) MAKE UP VALVE

In the system using this type of motor, there is no counter balance functioning valve and there happens the case of revolution exceeding hydraulic supply of motor. To prevent the cavitation caused by insufficient oil flow there is a make up valve to fill up the oil insufficiency.

A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

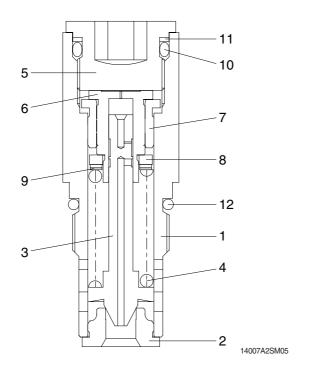
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, the oil in the motor is drain via left relief valve, the drain oil run into motor via right make up valve, which prevent the cavitation of motor.



21092SM04

3) RELIEF VALVE



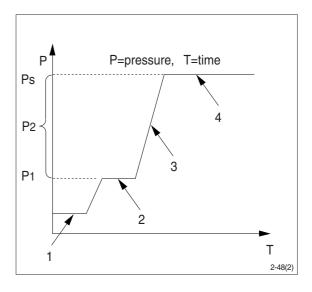
- 1 Body
- 2 Seat
- 3 Plunger
- 4 Spring
- 5 Adjusting screw
- 6 Piston
- 7 Bushing
- 8 Spring seat
- 9 Shim
- 10 O-ring
- 11 Back up ring
- 12 O-ring

(1) Construction of relief valve

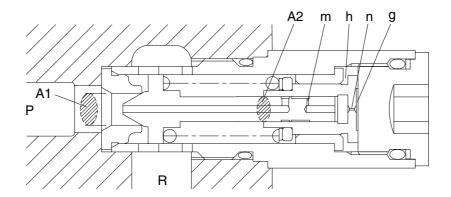
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

Figure illustrates how the pressure acting on the relief valve is related to its rising process. Here is given the function, referring to the figure following page.



① Ports (P,R) at tank pressure.

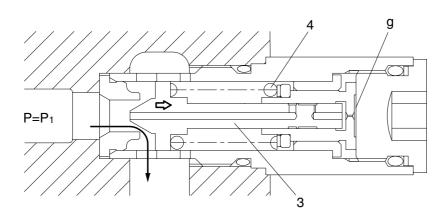


14007A2SM06

 $\@Displayskip$ When hydraulic oil pressure (P \times A1) reaches the preset force (FSP) of spring (4), the plunger (3) moves to the right as shown.

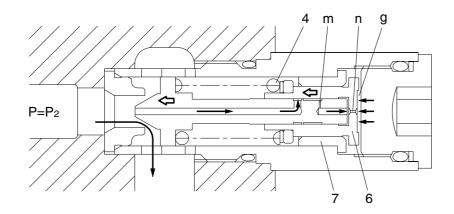
$$P1 \times A1=Fsp+Pg \times A2$$

$$P1 = \frac{Fsp + Pg \times A2}{A1}$$



14007A2SM07

③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force (FSP) of spring (4), the piston (6) moves left and stop the piston (6) hits the bottom of bushing (7).

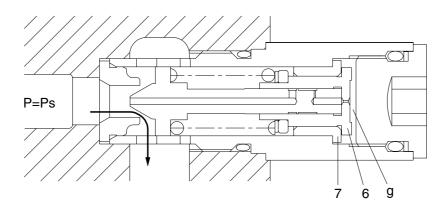


14007A2SM08

④ When piston (6) hits the bottom of bushing (7), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

 $Ps \times A1=Fsp+Ps \times A2$

$$Ps = \frac{Fsp}{A_1 - A_2}$$



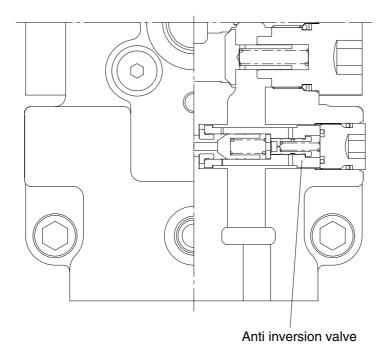
14007A2SM09

4) ANTI-INVERSION VALVE

In the event of swing motor operates switch part to drive and stop the swing part. By the action of pump on motor, there is brake on both-side of port because of the block on both sides.

Swing part is stopped by pressure of brake (in order words, 4-5 times of inversion)

Under the operating condition, the side of anti-inversion blocks off both ports but bypassing compressed oil which is blocked in processing of anti-inversion fixed time and amount to inverse port, prevent increasing pressure of motor and decrease inversing action.

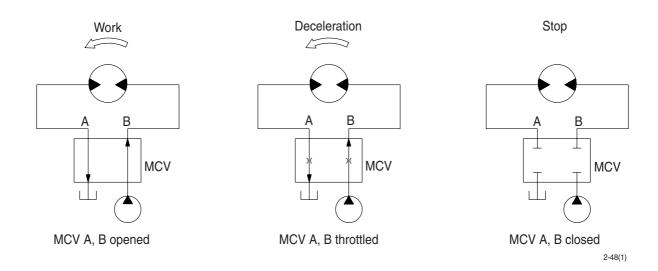


14W92SM10

5) BRAKE SYSTEM

(1) Control valve swing brake system

This is the brake system to stop the swing motion of the excavator during operation. In this system, the hydraulic circuit is throttled by the swing control valve, and the resistance created by this throttling works as a brake force to slow down the swing motion.



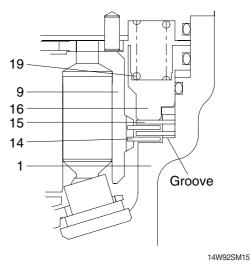
(2) Mechanical swing parking brake system

This is function as a parking brake only when all of the RCV lever (except travel pedal) are not operated.

① Brake assembly

(15) is constrained by the groove located at housing (1). When housing is pressed down by brake spring (19) through friction plate (14), separate plate (15) and brake piston (16), friction force occurs there. Cylinder block (9) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

Circumferential rotation of separate plate



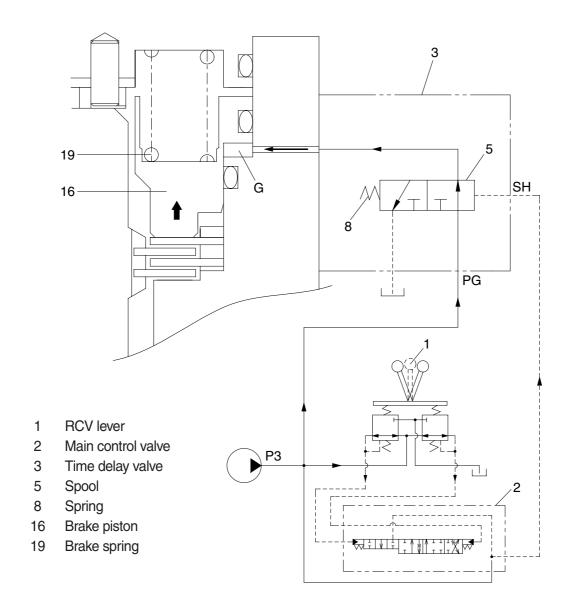
Housing
Separate plate
Cylinder block
Brake piston
Friction plate
Spring

② Operating principle

a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (3).

This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.

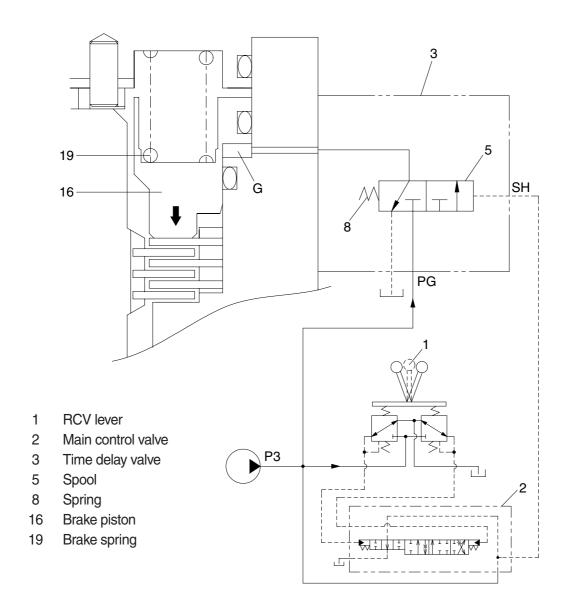
This pressure is applied to move the piston (16) to the upward against the force of the spring (19). Thus, it releases the brake force.



14W92SM16

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right. Then, the piston (16) is moved lower by spring force and the return oil from the chamber G flows back to tank port.

At this time, the brake works.



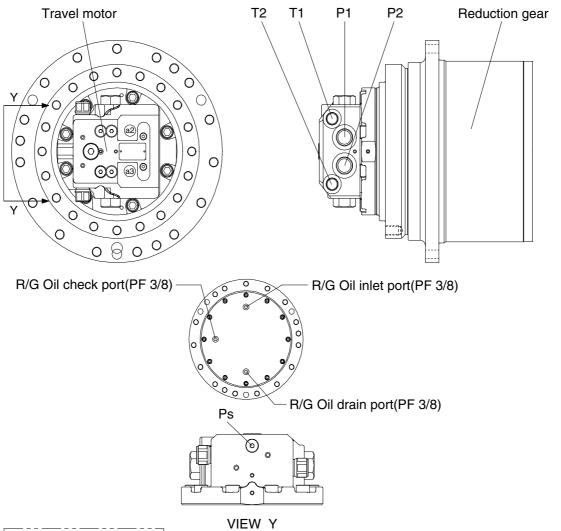
14W92SM17

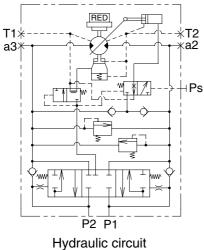
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION

Travel device consists travel motor and gear box.

Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.

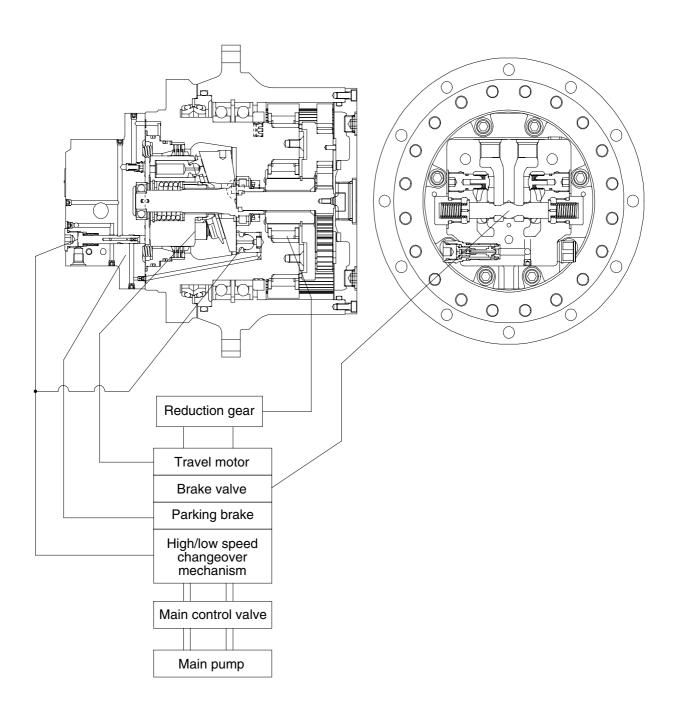




Port	Port name	Port size
P1	Main port	PF 3/4
P2	Main port	PF 3/4
a2, a3	Gauge port	PF 1/4
T1, T2	Drain port	PF 1/2
Ps	Parking brake release port	PF 1/4

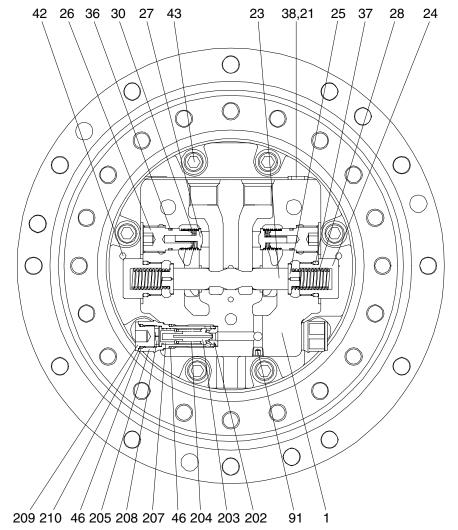
14092TM01A

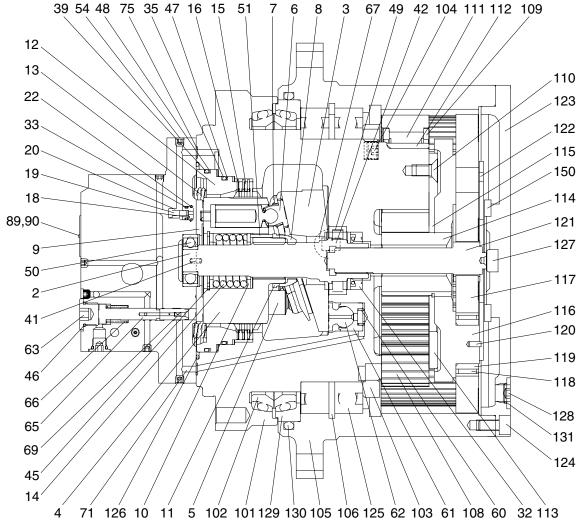
1) BASIC STRUCTURE

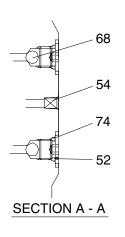


14092TM02

2) STRUCTURE







14092TM03

1	Rear flange	19
	•	
2	Shaft	20
3	Swash plate	2
4	Cylinder block	22
5	Piston	23
6	Shoe	24
7	Retainer plate	25
8	Thrust ball	26
9	Timing plate	27
10	Washer	28
11	Washer-collar	30
12	Piston-parking	32
13	Spring	33
14	Spring	35
15	Friction plate	36
16	Mating plate	37
18	Seat valve	38

19	Valve
20	Spring
21	Plug
22	Ring
23	Main spool
24	Main plug
25	Retainer spring
26	Check plug
27	Check valve
28	Main spring
30	Check spring
32	Oil seal
33	O-ring
35	O-ring
36	O-ring
37	O-ring
38	O-ring

39	O-ring
41	Parallel pin
42	Parallel pin
43	Socket bolt
45	Snap ring
46	O-ring
47	Back up-ring
48	Back up-ring
49	Roller bearing
50	Ball bearing
51	Roller
52	Plug
54	Plug
60	Spring
61	Piston
62	Shoe
63	Plug

65	2 Speed spool
66	2 Speed spring
67	Pivot
68	Steel ball
69	Set screw
71	Orifice
74	O-ring
75	O-ring
89	Name plate
90	Set screw
91	Plug
101	Spindle
102	Floating seal
103	Nut ring
104	Plug
105	Hub
106	Snap ring

108	Planetary gear
109	Thrust washer
110	Screw
111	Needle bearing
112	Collar
113	Thrust plate
114	Sun gear
115	Snap ring
116	Holder
117	Planetary gear
118	Needle bearing
119	Inner race
120	Spring pin
121	Drive gear
122	Thrust plate
123	Cover
124	Socket bolt

125	Angular bearing
126	O-ring
127	Thrust washer
128	Plug
129	Seal ring
130	O-ring
131	O-ring
150	Thrust plate
205	Body
206	Shim
207	Piston
208	Rod
209	Plug
210	•
	. 0

2. HYDRAULIC MOTOR ASSEMBLY

With brake valve, parking brake and high/low speed changeover mechanism.

1) FUNCTION

(1) Hydraulic motor

This hydraulic motor is a swash plate type piston motor and converts the force of pressurized oil delivered from the pump into a rotational movement.

(2) Brake valve

This brake valve is incorporated in the hydraulic motor assembly and has the following four functions.

- ① Smoothly brakes and stops the motor by controlling inertial rotation of the motor due to inertia of the main body.
- ② Check valve function to prevent cavitation of the hydraulic motor.
- ③ Relief valve function to control the brake pressure of hydraulic motor and anti-cavitation valve function to prevent cavitation.
- ④ Opens a port which releases the parking brake force upon running of the motor and closes the upon stopping.

(3) Parking brake

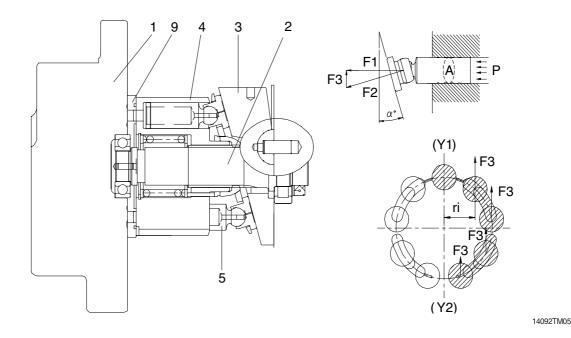
The parking brake prevents overrunning or slippage upon parking or stopping the machine on a slope with friction plate type brake mechanism, and combined with the hydraulic motor assembly into an integral structure.

(4) High/low speed changeover mechanism

This mechanism changes over the tilt angle of swash plate between high-speed/low-torque rotation and low-speed/high-torque rotation with the changeover valve and control piston.

2) OPERATING PRINCIPLE

(1) Hydraulic motor



The pressurized oil delivered from the hydraulic pump flows to rear flange (1) of the motor, passes through the brake valve mechanism and is introduced into cylinder block (4) via timing plate (9). This oil constructively introduced only to one side of (Y1) - (Y2) connecting the upper and lower dead points of stroke of piston (5). The pressurized oil fed to one side in cylinder block (4) pushes each piston (5) (four or five) and generates a force (F kgf = P kgf/cm² × A cm²). This force acts on swash plate (3) and is resolves into components (F2 and F3) because swash plate (3) is fixed at an angle (α °) with the axis of drive shaft (2). Radial component (F3) generates respective torques (T = F3 × ri) for (Y1) - (Y2). This residual of torque (T = S (F3 × ri)) rotates cylinder block (4) via piston (5). Cylinder block (4) is spline coupled with drive shaft (2). So the drive shaft (2) rotates and the torque is transmitted.

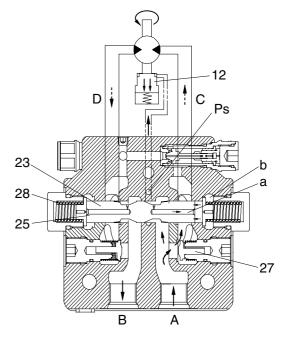
(2) Brake valve

① Brake released

When the pressurized oil supplied from port (A), the oil opens valve (27) and flows into port (C) at the suction side of hydraulic motor to rotate motor.

At the same time, the pressurized oil passes through pipe line (a) from a small hole in spool (23) and flow into chamber (b). The oil acts on the end face of spool (23) which is put in neutral position by the force of spring (28), thus causing spool (23) to slide to the left. When spool (23) slides, port (D) on the passage return side of hydraulic motor, which is closed by the spool groove during stoppage, communicates with port (B) at the tank side and the return oil from the hydraulic motor runs into the tank. In consequence, the hydraulic motor rotates.

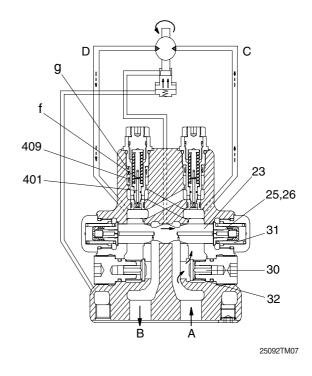
Moreover, sliding of spool (23) causes the pressurized oil to flow into ports (P) and (S). The pressurized oil admitted into port (P) activates piston (12) of the parking brake to release the parking brake force. (For details, refer to description of the parking brake.) When the pressurized oil is supplied from port (B), spool (23) and valve (27) move reversely and the hydraulic motor also rotates reversely.



14092TM06

2 Stopping and stalling (brake applied)

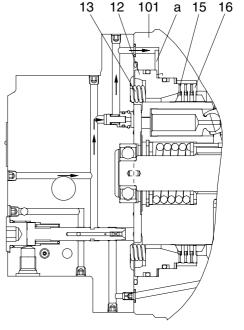
When the pressurized oil supplied from port (A) is stopped during traveling, no hydraulic pressure is applied and spool (23) which has slid to the left will return on the right (neutral) via stopper (25, 26) by the force of spring (31). At the same time, the hydraulic motor will rotate by the inertia even if the pressurized oil stopped, so the port (D) of the motor will become high pressure. This pressurized oil goes from chamber (f) to chamber (g) through the left-hand valve (401). When the oil enters chamber (g), the piston (409) slides to the right so as not to rise the pressure, as shown in the figure. Meanwhile, the lefthand valve (401) is pushed open by the pressurized oil in port (D). Therefore, the pressurized oil in port (D) flows to port (C) at a relatively low pressure, controlling the pressure in port (D) and preventing cavitation in port (C). When the piston (409) reaches the stroke end, the pressure in chamber (g) and (f) increase and the lefthand valve (401) closes again, allowing the oil pressure in port (D) to increase further. Then, the right-hand valve opens port (C) with pressure higher than that machine relief set pressure. In this way, by controlling the pressure in port (D) in two steps, the hydraulic motor is smoothly braked and to a stop.



(3) Parking brake

① Running

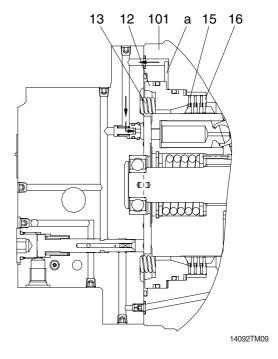
When the pressurized oil is supplied from the valve, the spool of brake valve in the hydraulic motor assembly actuates to open the passage to the parking brake and the pressurized oil is introduced into cylinder chamber (a) which is composed of the spindle of reduction gear assembly and piston (12). When the hydraulic pressure reaches 9.5 kgf/cm² or more, it overcomes the force of spring (13) and shifts piston (12). With shift of piston (12), no pressing force is applied to mating plate (16) and friction plate (15) and movement of friction plate (15) becomes free. Whereby the brake force to the cylinder in the hydraulic motor assembly is released.



14092TM08

2 Stopping

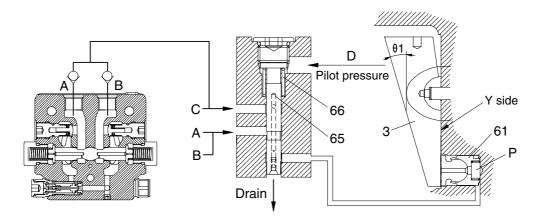
When the pressurized oil from the brake valve is shut off and the pressure in cylinder chamber (a) drops 9.5 kgf/cm² or less, piston (12) will return by the force of spring (13). Piston (12) is pushed by this force of spring (13), and mating plate (16) and friction plate (15) in free condition are pressed against the spindle of reduction gear assembly. The friction force produced by this pressing stops rotation of the cylinder and gives a braking torque 19.7 kgf·m to the hydraulic motor shaft. Note that oil control through a proper oil passage ensures smooth operation.



(4) High/low speed changeover mechanism

① At low speed - pilot pressure of less than 10 kgf/cm²

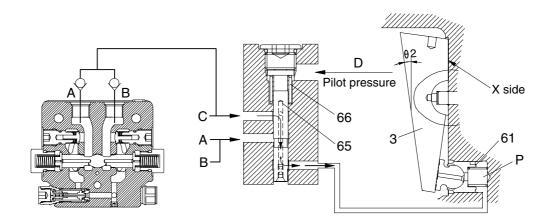
When no pilot pressure is supplied from (D) (at a pressure of 10 kgf/cm² or less), valve (65) is pressed toward the top by the force of spring (66) and (A) port or (B) port, the pressurized oil supply port (C) is shut off, and oil in chamber (P) is released into the motor case via valve(65). Consequently, swash plate (3) is tilted at a maximum angle (θ 1) and the piston displacement of hydraulic motor becomes maximum, thus leading to low-speed rotation.



14092TM10

② At high speed - pilot pressure of 10 kgf/cm² or more

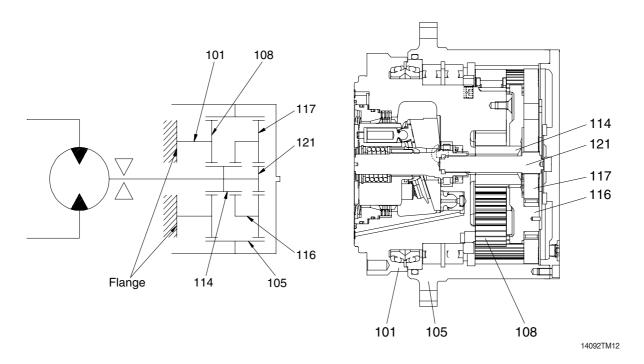
When a pilot pressure is supplied from port (D) (at a pressure of 20 kgf/cm² or more), the pressure overcomes the force of spring (66) and (A) port or (B) port of valve (65) is pressed toward the down. The pressurized oil at supply port (C) is then introduced into chamber (P) via valve (65). Piston (61) pushes up swash plate (3) until it touches side Y of the spindle. At this time, swash plate (3) is tilted at a minimum angle (θ 2) and the piston displacement of hydraulic motor becomes minimum, thus leading to high-speed rotation.



14092TM11

3. REDUCTION GEAR

1) The reduction gear is composed of a two-stage planetary gear mechanism shown in the following figure.



2) The rotating motion of the hydraulic motor is transmitted to drive gear (121) of 1st stage, and the drive gear rotate planetary gears (R, 117). Then planetary gears (R, 117) revolves inside fixed hub (105). This rotation becomes the output of 1st stage and is transmitted to carrier No.1 and sun gear (114). Similarly the revolution of planetary gears (F, 108) are transmitted to spindle (101). Then planetary gears (F, 108) do not revolve, but rotate to hub (105). Therefore, the rotating case is driven by the overall driving torque of hub (105).

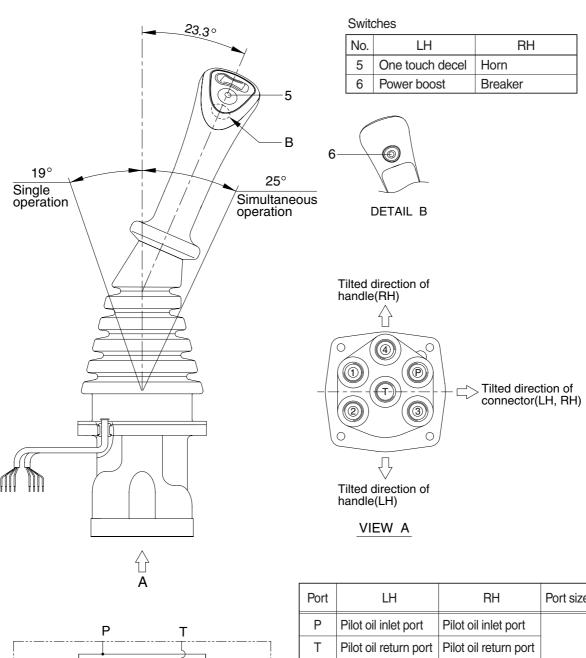
This reduction ratio is expressed as shown below:

· Reduction ratio (I) = (Hub teeth / Drive gear teeth + 1) x (Hub teeth / Sun gear teeth + 1) - 1

GROUP 5 RCV LEVER

1. STRUCTURE

The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.



	Р	Т		
T _M	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		\	
1	3	2	4	
Hydraulic circuit				

Port	LH	RH	Port size
Р	Pilot oil inlet port	Pilot oil inlet port	
Т	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	PF 1/4
2	Arm in port	Boom down port	FF 1/4
3	Right swing port	Bucket in port	
4	Arm out port	Boom up port	

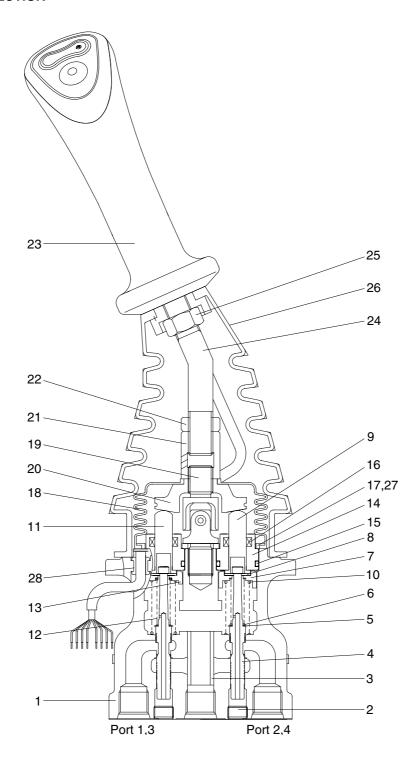
21092RL01

CROSS SECTION

The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (4), spring (6) for setting secondary pressure, return spring (10), stopper (8), spring seat (7, 13) and shim (5). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5 kgf/cm² (depending on the type). The spool is pushed against the push rod (9, 11) by the return spring. When the push rod is pushed down by tilting the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

CROSS SECTION



32092RL01

1	Case	8	Stopper	15	O-ring	22	Lock nut
2	Plug	9	Push rod	16	Rod seal	23	Handle assembly
3	Bushing	10	Spring	17	Plate	24	Handle bar
4	Spool	11	Push rod	18	Boot	25	Nut
5	Shim	12	Spring	19	Joint assembly	26	Boot
6	Spring	13	Spring seat	20	Swash plate	27	Spring pin
7	Spring seat	14	Plug	21	Adjusting nut	28	Bushing

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve that controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure (secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

- (1) Inlet port (P) where oil is supplied from hydraulic pump.
- (2) Output ports (1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.
- (3) Tank port (T) necessary to control the above output pressure.
- (4) Spool to connect output port to inlet port or tank port.
- (5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (4) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output port pressure oil to tank port T.

The spring (6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (9,11) is inserted and can slide in the plug (14).

For the purpose of changing the displacement of the push rod through the swash plate (20) and adjusting nut (21) are provided the handle (23) that can be tilted in any direction around the fulcrum of the universal joint (19) center.

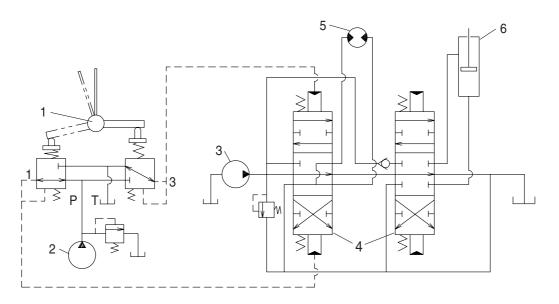
The spring (10) works on the case (1) and spring seat (7, 13) and tries to return the push rod (9,11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

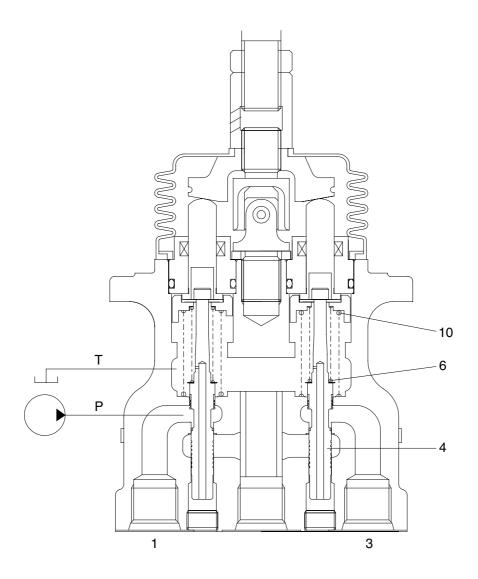
The diagram shown below is the typical application example of the pilot valve.



2-70

- 1 Pilot valve
- 2 Pilot pump
- 3 Main pump
- 4 Main control valve
- 5 Hydraulic motor
- B Hydraulic cylinder

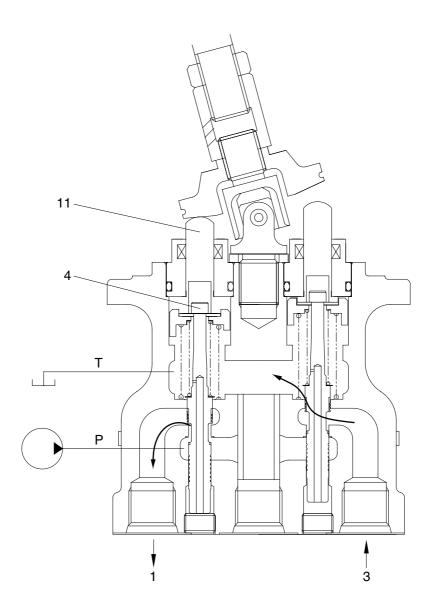
(1) Case where handle is in neutral position



21092RL03

The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (4). Therefore, the spool is pushed up by the spring (10) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



21092RL04

When the push rod (11) is stroked, the spool (4) moves downwards.

Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.

When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port (1) increases higher than the set pressure, port P is disconnected from port (1) and port T is connected with port (1). If it decreases lower than the set pressure, port P is connected with port (1) and port T is disconnected from port 1.

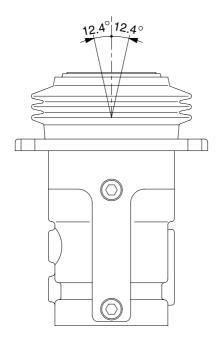
In this manner the secondary pressure is kept at the constant value.

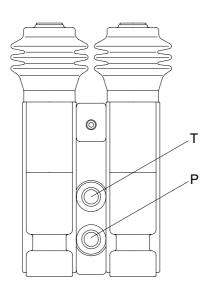
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

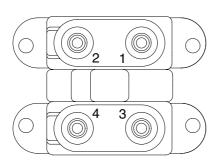
GROUP 6 RCV PEDAL

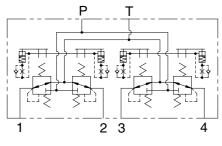
1. STRUCTURE

The casing (spacer) has the oil inlet port P (primary pressure), and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1,2,3 and 4 provided at the bottom face.









Hydraulic circuit

Port	Port	Port size
Р	Pilot oil inlet port	
Т	Pilot oil return port	
1	Travel (LH, Forward)	PF 1/4
2 Travel (LH, Backward)		111/4
3	3 Travel (RH, Forward)	
4	Travel (RH, Backward)	

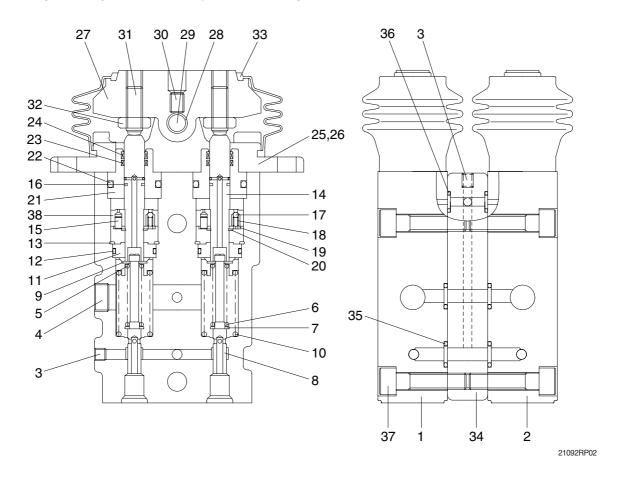
21092RP01

CROSS SECTION

The construction of the RCV pedal is shown in the below drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (8), spring (6) for setting secondary pressure, return spring (10), stopper (9), and spring seat (7). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 19 kgf/cm² (depending on the type). The spool is pushed against the push rod (14) by the return spring.

When the push rod is pushed down by tilting pedal, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.



Body(1)	14	Push rod	27	Cam
Body(2)	15	Spring pin	28	Bushing
Plug	16	Seal	29	Cam shaft
Plug	17	Steel ball	30	Set screw
Spring seat	18	Spring	31	Set screw
Spring	19	Plate	32	Nut
Spring seat	20	Snap ring	33	Bellows
Spool	21	Plug	34	Space
Stopper	22	O-ring	35	O-ring
Spring	23	Rod seal	36	O-ring
Rod guide	24	Dust seal	37	Socket bolt
O-ring	25	Cover	38	Piston
Snap ring	26	Socket bolt		
	Body(2) Plug Plug Spring seat Spring Spring seat Spool Stopper Spring Rod guide O-ring	Body(2) 15 Plug 16 Plug 17 Spring seat 18 Spring 19 Spring seat 20 Spool 21 Stopper 22 Spring 23 Rod guide 24 O-ring 25	Body(2) 15 Spring pin Plug 16 Seal Plug 17 Steel ball Spring seat 18 Spring Spring 19 Plate Spring seat 20 Snap ring Spool 21 Plug Stopper 22 O-ring Spring 23 Rod seal Rod guide 24 Dust seal O-ring 25 Cover	Body(2) 15 Spring pin 28 Plug 16 Seal 29 Plug 17 Steel ball 30 Spring seat 18 Spring 31 Spring 19 Plate 32 Spring seat 20 Snap ring 33 Spool 21 Plug 34 Stopper 22 O-ring 35 Spring 23 Rod seal 36 Rod guide 24 Dust seal 37 O-ring 25 Cover 38

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure (secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

- (1) Inlet port (P) where oil is supplied from hydraulic pump.
- (2) Output port (1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.
- (3) Tank port (T) necessary to control the above output pressure.
- (4) Spool to connect output port to inlet port tank port.
- (5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (8) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output spool to determine the output pressure.

The spring (6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (14) is inserted and can slide in the plug (21). For the purpose of changing th displacement of the push rod through the cam (27) and adjusting nut (32) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.

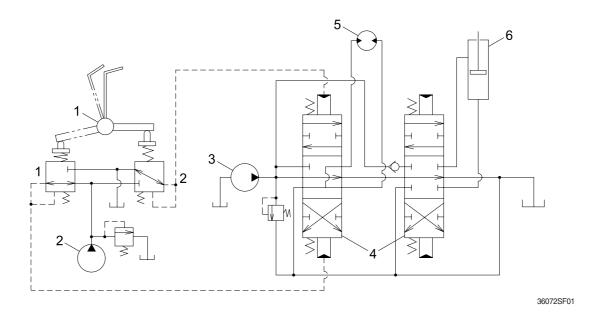
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

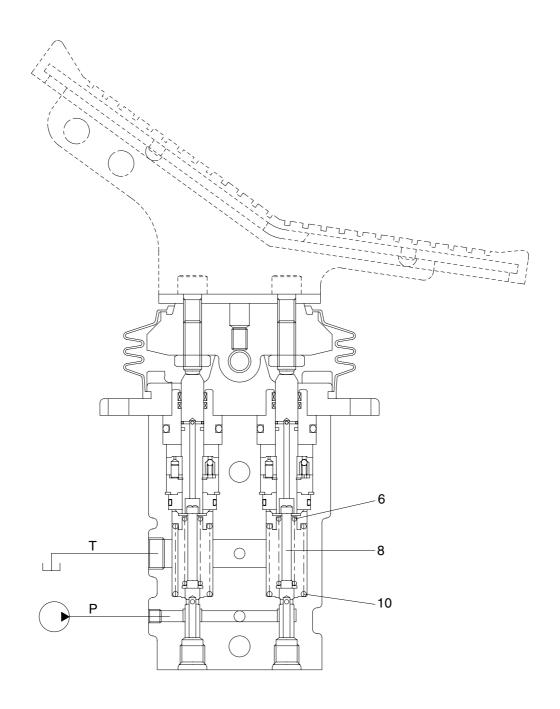
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

The diagram shown below is the typical application example of the pilot valve.



- 1 Pilot valve
- 2 Pilot pump
- 3 Main pump
- 4 Main control valve
- 5 Hydraulic motor
- 6 Hydraulic cylinder

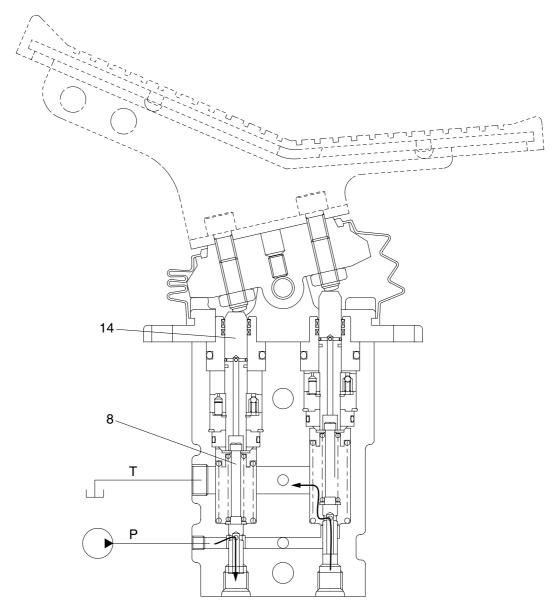
(1) Case where pedal is in neutral position



21092RP03

The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (8). Therefore, the spool is pushed up by the spring (10) to the position of port 2 in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where pedal is tilted



21092RP04

When the push rod (14) is stroked, the spool (8) moves downwards.

Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.

When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.

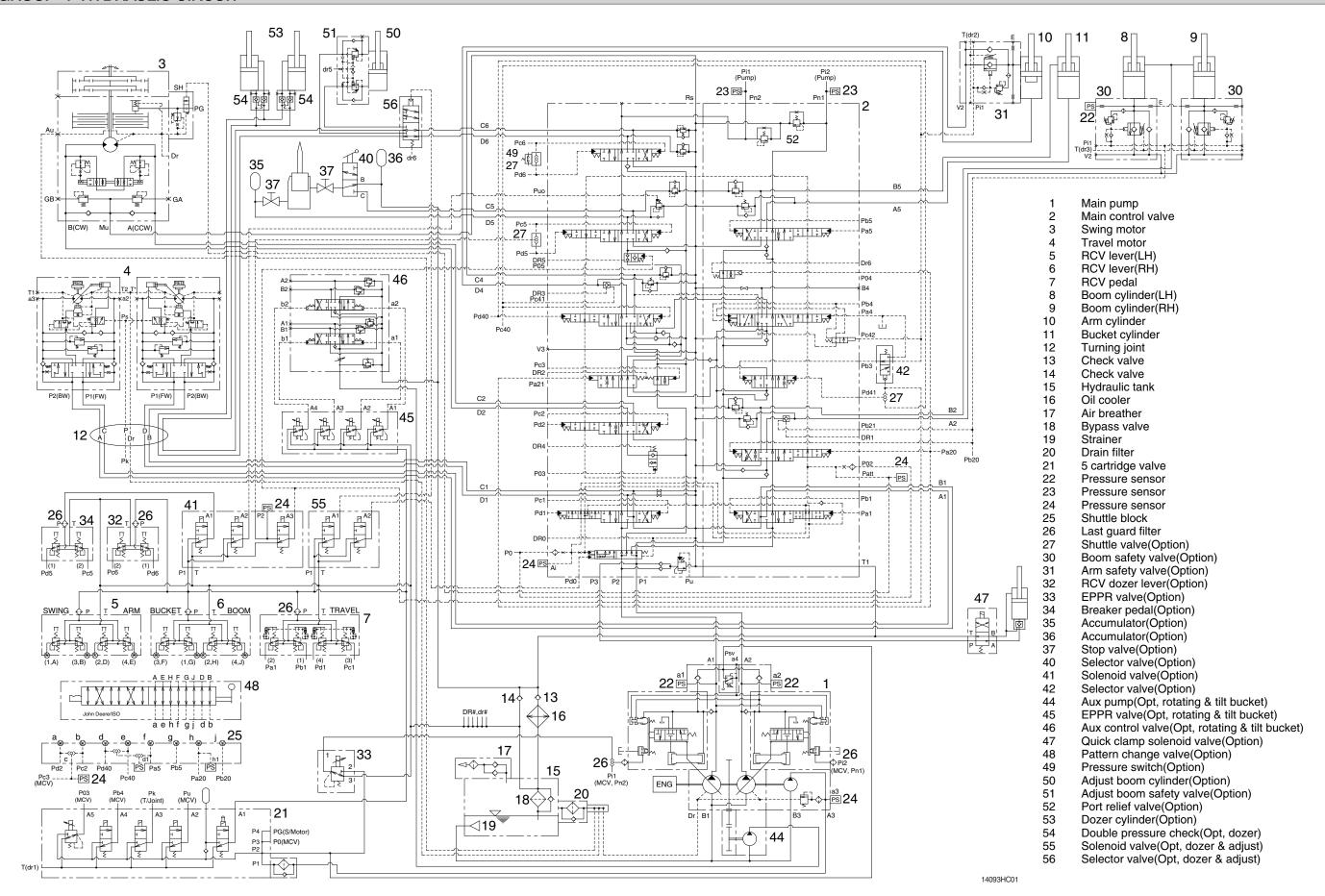
In this manner the secondary pressure is kept at the constant value.

Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

SECTION 3 HYDRAULIC SYSTEM

Group	1	Hydraulic Circuit	3-1
Group	2	Main Circuit ·····	3-2
Group	3	Pilot Circuit ·····	3-5
Group	4	Single Operation	3-13
Group	5	Combined Operation ·····	3-25

GROUP 1 HYDRAULIC CIRCUIT



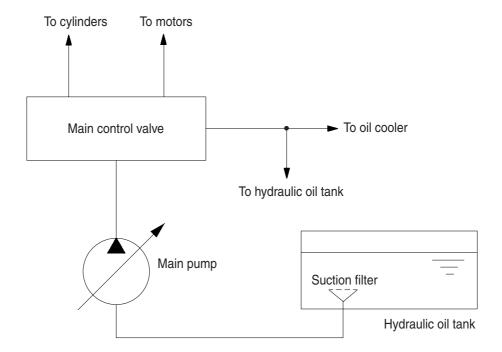
GROUP 2 MAIN CIRCUIT

The main hydraulic circuit consists of suction circuit, delivery circuit, return circuit and drain circuit.

The hydraulic system consists of one main pump, one control valve, one swing motor, four cylinders and two travel motors.

The swash plate type variable displacement axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

1. SUCTION AND DELIVERY CIRCUIT



(210-7) 3-03

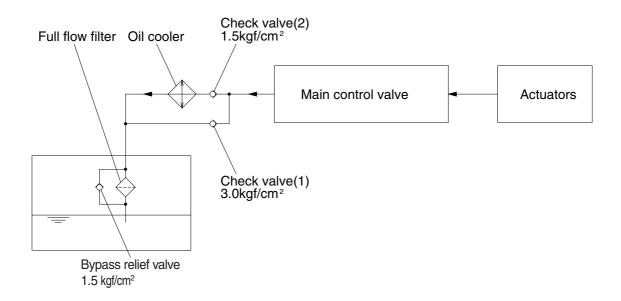
The pumps receive oil from the hydraulic tank through a suction filter. The discharged oil from the pump flows into the control valve and goes out the tank ports.

The oil discharged from the main pump flows to the actuators through the main control valve.

The main control valve controls the hydraulic functions.

The return oil from the actuators flows to the hydraulic tank through the main control valve and the oil cooler.

2. RETURN CIRCUIT



21073CI01

All oil returned from each actuator returns to the hydraulic tank through the main control valve.

The bypass check valves are provided in the return circuit.

The setting pressure of bypass check valves are 1.5 kgf/cm² (21 psi) and 3.0 kgf/cm² (43 psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.

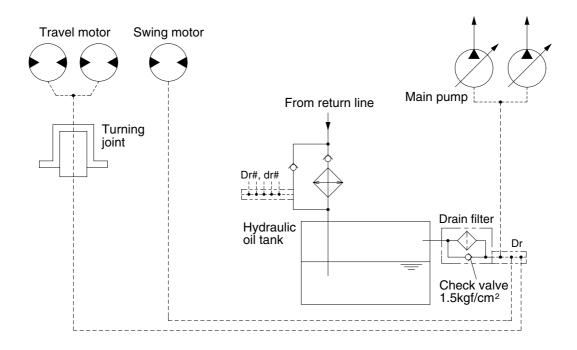
When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. When the oil pressure exceeds 3.0 kgf/cm² (43 psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1). The full-flow filter and bypass relief valve are provided in the hydraulic tank.

The oil returned from right and left side of control valve is combined and filtered by the full-flow filter. A bypass relief valve is provided in the full-flow filter.

When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm² (21 psi) differential pressure.

3. DRAIN CIRCUIT



21093Cl02

Besides internal leaks from the motors and main pump, the oil for lubrication circulates. These oil have to be fed to the hydraulic tank passing through drain filter.

When the drain oil pressure exceed 1.5 kgf/cm² (21 psi), the oil returns to the hydraulic tank directly.

1) TRAVEL MOTOR DRAIN CIRCUIT

Oil leaked from the right and left travel motors comes out of the drain ports provided in the respective motor casing and join with each other. These oils pass through the turning joint and return to the hydraulic tank after being filtered by drain filter.

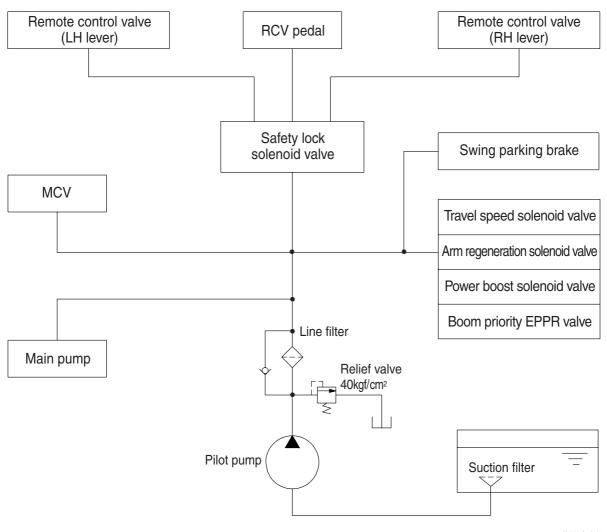
2) SWING MOTOR DRAIN CIRCUIT

Oil leaked from the swing motor returns to the hydraulic tank passing through a drain filter.

3) MAIN PUMP DRAIN CIRCUIT

Oil leaked from main pump returns to the hydraulic tank passing through drain filter.

GROUP 3 PILOT CIRCUIT



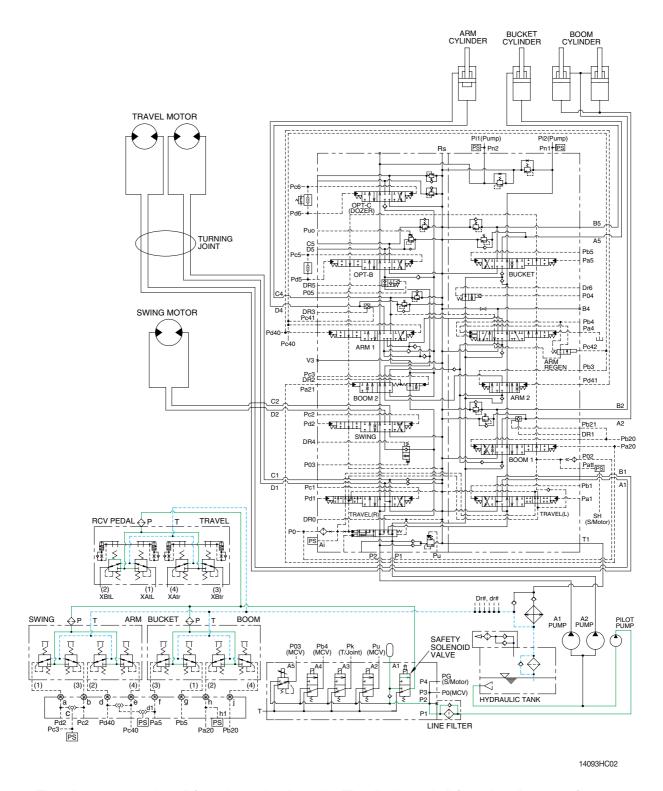
(210-7) 3-05

The pilot circuit consists of suction circuit, delivery circuit and return circuit.

The pilot pump is provided with relief valve, receives the oil from the hydraulic tank through the suction filter.

The discharged oil from the pilot pump flows to the remote control valve through line filter, EPPR valve, solenoid valve assemblies, swing parking brake, main control valve and safety lock solenoid valve.

1. SUCTION, DELIVERY AND RETURN CIRCUIT

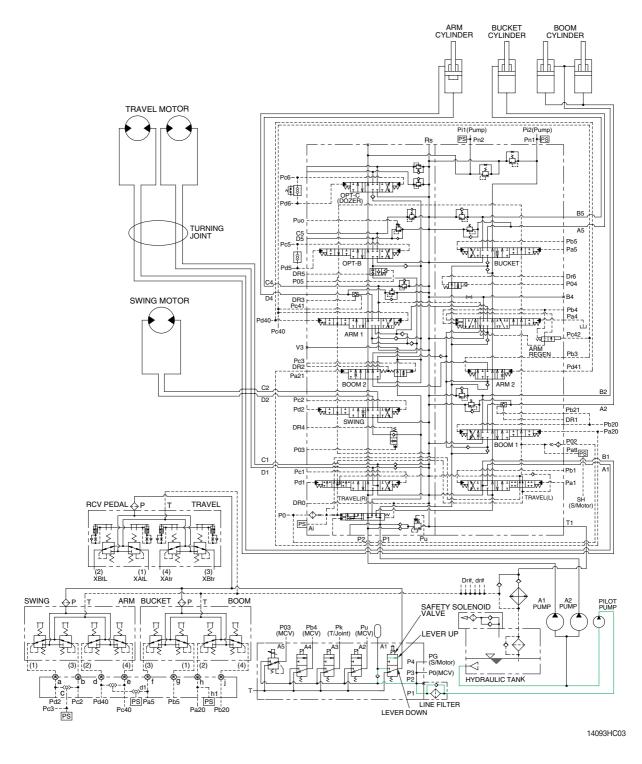


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

The oil filtered by line filter flows remote control valve through safety solenoid valve.

The return oil flow from remote control valve is returned to the hydraulic tank.

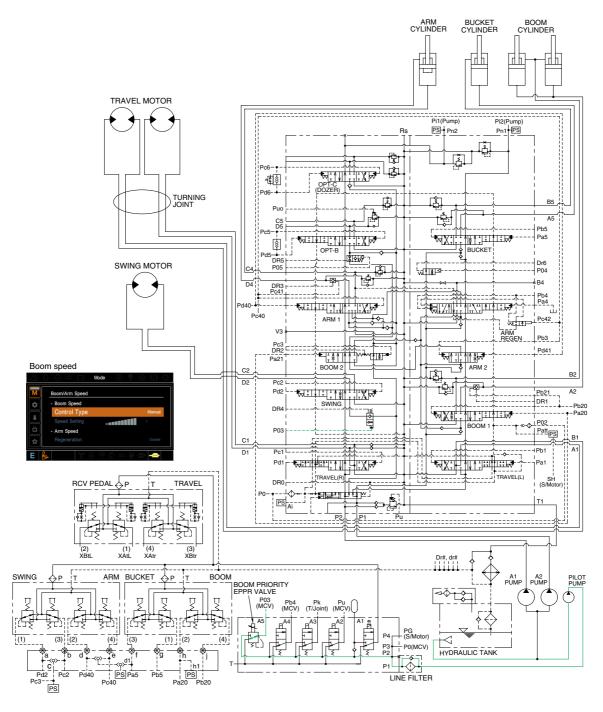
2. SAFETY SOLENOID VALVE (SAFETY LEVER)



When the lever of the safety solenoid valve is moved upward, oil flows into the remote control valve through solenoid valve and line filter.

When the lever of the safety solenoid valve is moved downward, oil does not flows into the remote control valve, because of the blocked port.

3. BOOM PRIORITY SYSTEM



14093HC04

When carrying out the combined operation of swing and boom up, the boom up operating speed is lowered than normal operation.

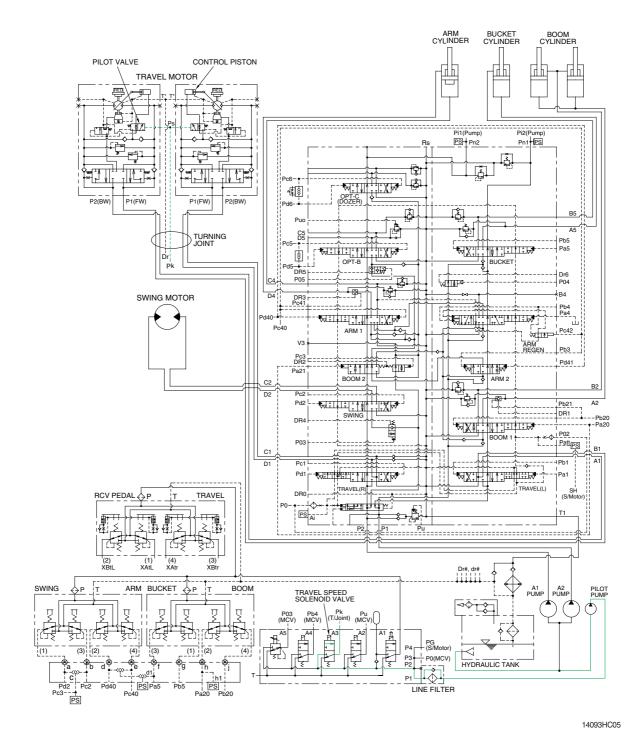
To increase working efficiency, swing speed reducing system is used.

The pilot oil from pilot pump flow into **P03** port in main control valve through boom priority EPPR valve. **P03** oil pressure moves swing reducing spool to lower position and oil flow rate to the swing motor decreased.

Then, the boom up speed is increased. This is called the boom priority system.

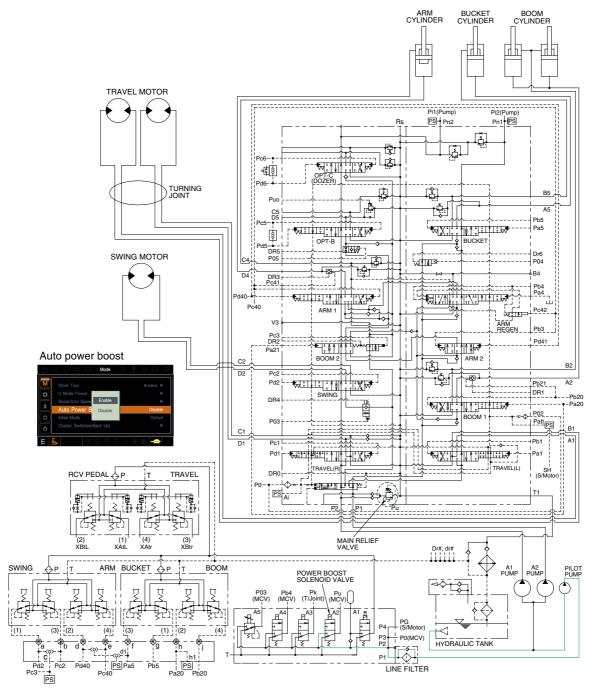
The boom up speed can be adjusted by the cluster. Refer to page 3-12 of the operator's manual.

4. TRAVEL SPEED CONTROL SYSTEM



When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the **Ps** port of pilot valve in the travel motors. As a result, the control piston is pushed by the main oil flow, thus the displacement is minimized. When the travel speed switch is pushed once more, the travel speed solenoid valve is return to original position by the force of spring, the hydraulic oil of **Ps** port returns to the hydraulic tank. As a result, the control piston is returned by the main oil flow, thus the displacement is maximized.

5. MAIN RELIEF PRESSURE CHANGE SYSTEM



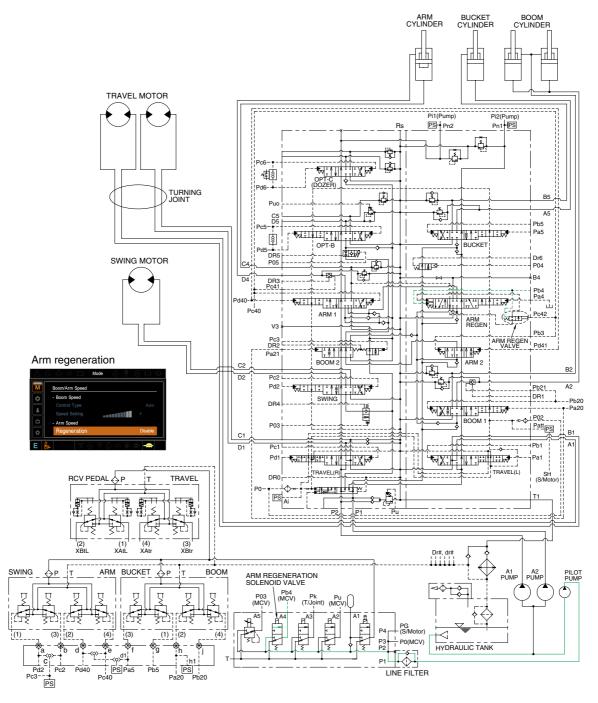
14093HC06

When the power switch on the left control lever is pushed ON, the power solenoid valve is actuated, the discharged oil from the pilot pump flows into **Pu** port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 350 kgf/cm² to 380 kgf/cm² for increasing the digging power.

And even when pressed continuously, it is canceled after 8 seconds.

When the auto power function is selected to enable on the cluster, the pressure of the main relief pressure is automatically increased to 380 kgf/cm² as working condition by the MCU. It is operated max 8 seconds.

6. ARM REGENERATION CUT SYSTEM



14093HC07

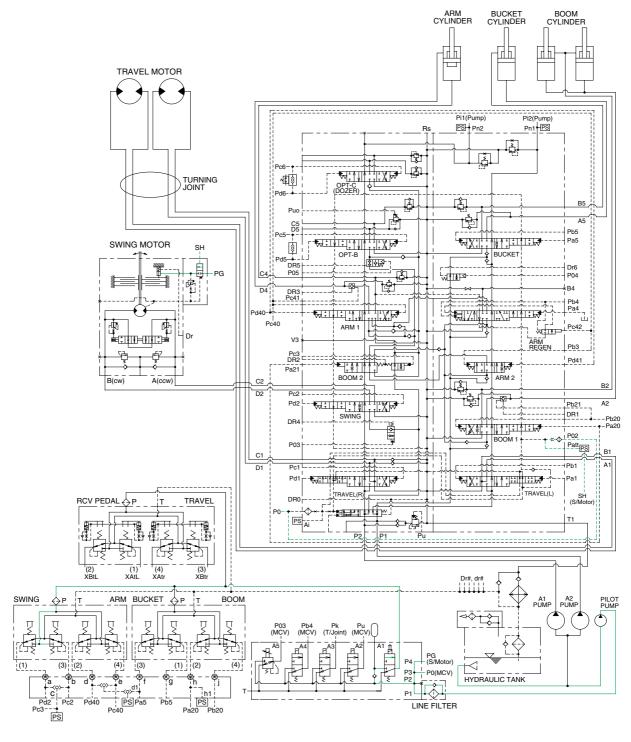
When the arm regeneration is selected to disable on the cluster, the arm regeneration solenoid valve is activated. The pilot oil from pilot pump flows into **Pb4** port in main control valve through solenoid valve and the arm regeneration spool is shifted to left.

Then, the oil from arm regeneration passage returns to tank and the arm regeneration function is deactivated.

When the arm regeneration is selected to enable on the cluster, the arm regeneration function is activated and arm in operation speed is increased.

Refer to page 2-36 for the arm regeneration function.

7. SWING PARKING BRAKE RELEASE



14093HC08

When one of the RCV lever (except travel lever) is tilted, the pilot oil flows into SH port through main control valve.

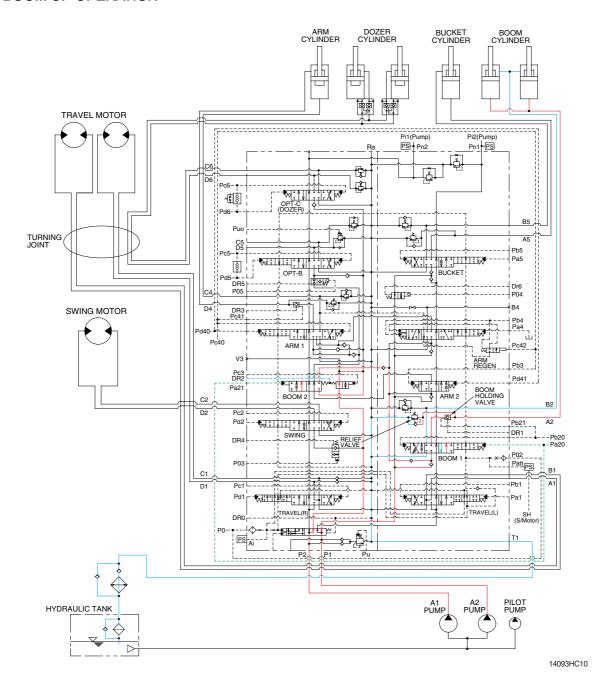
This pressure moves spool so, discharged oil from pilot pump flows into swing motor PG port.

This pressure is applied to swing motor disc, thus the brake is released.

When all of the RCV lever are set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

GROUP 4 SINGLE OPERATION

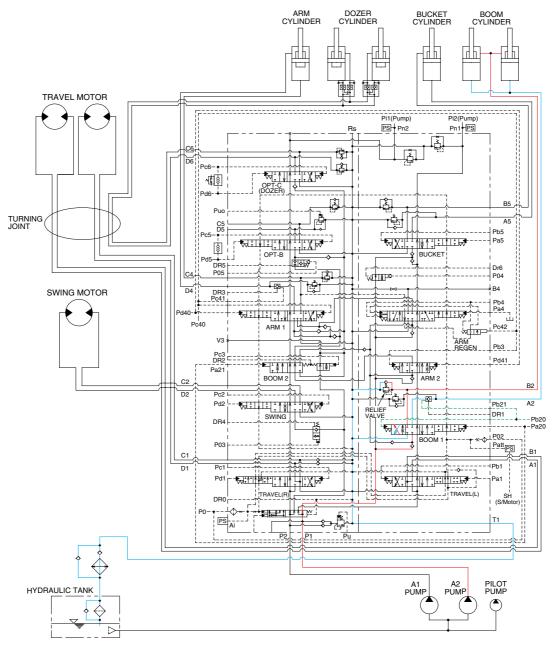
1. BOOM UP OPERATION



When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinders. At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up. The excessive pressure in the boom cylinder head side is prevented by relief valve. When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the head side of the boom cylinder is closed by the boom holding valve. This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



14093HC11

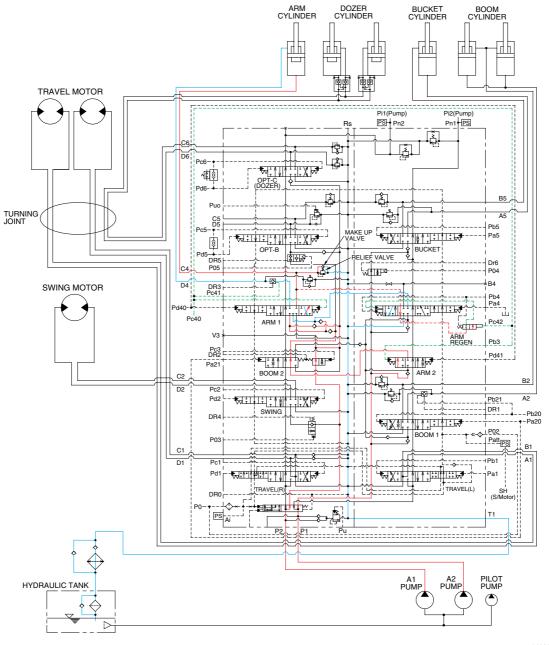
When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure from the remote control valve.

The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1 spool in the main control valve.

When the down speed of boom is faster, the oil returned from the large chamber of boom cylinder combines with the oil from the A2 pump, and flows into the small chamber of the cylinder.

This prevents cylinder cavitation by the negative pressure when the A2 pump flow can not match the boom down speed. And the excessive pressure in the boom cylinder rod side is prevented by the relief valve.

3. ARM IN OPERATION



14093HC12

When the left control lever is pulled back, the arm spools in the main control valve are moved to the arm in position by the pilot oil pressure from the remote control valve.

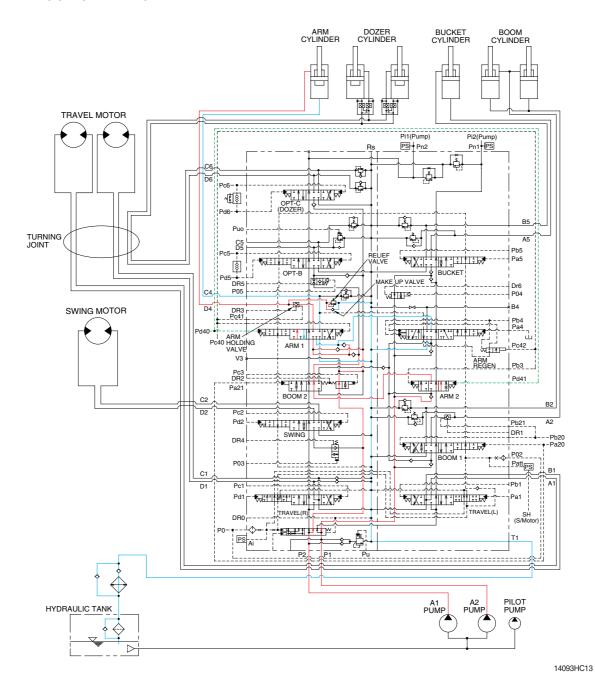
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls in.

The excessive pressure in the arm cylinder head side is prevented by relief valve.

The cavitation which will happen to the head side of the arm cylinder is also prevented by the makeup valve in the main control valve.

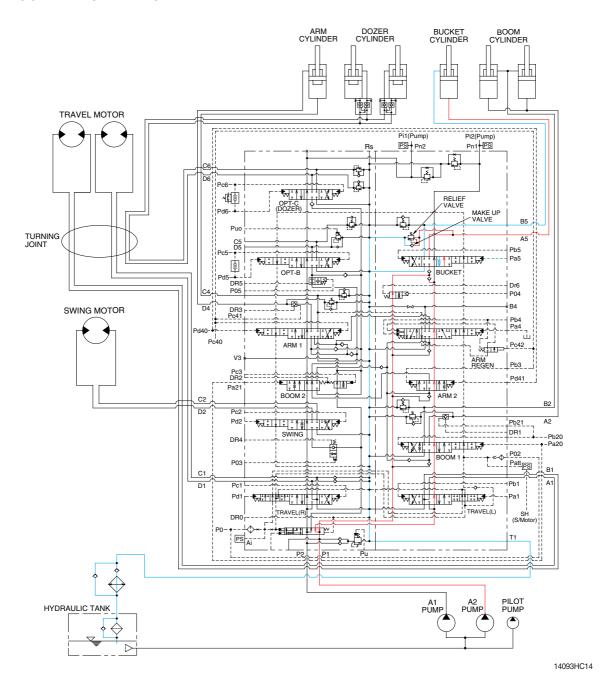
4. ARM OUT OPERATION



When the left control lever is pushed forward, the arm spools in the main control valve are moved to the arm out position by the pilot oil pressure from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the small chamber of arm cylinder. At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls out. The cavitation which will happen to the rod side of the arm cylinder is also prevented by the make-up valve in the main control valve. When the arm is roll out and the control lever is returned to neutral position, the circuit for the holding pressure at the rod side of the arm cylinder is closed by the arm holding valve. This prevent the hydraulic drift of arm cylinder.

5. BUCKET IN OPERATION



When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure from the remote control valve.

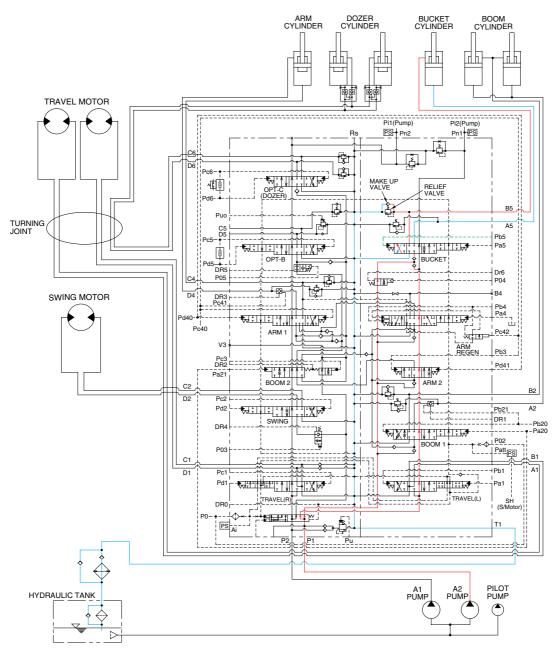
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

The excessive pressure in the bucket cylinder head side is prevented by relief valve.

The cavitation which will happen to the head side of the bucket cylinder is also prevented by the make-up valve in the main control valve.

6. BUCKET OUT OPERATION



14093HC15

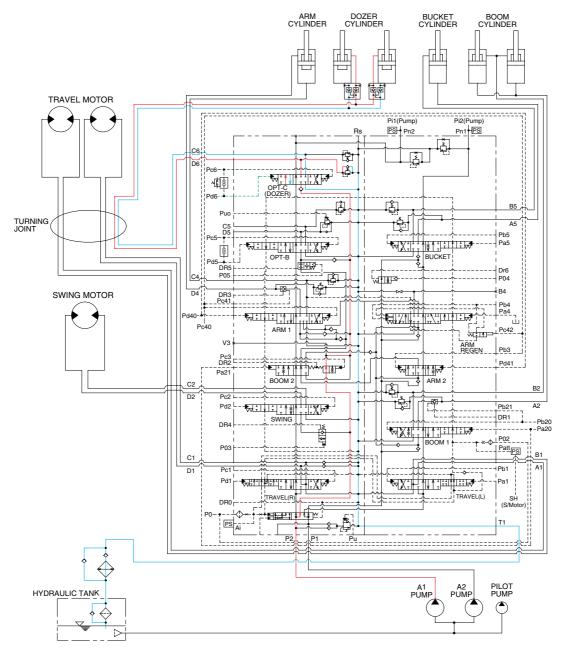
When the right control lever is pushed right, the bucket spool in the main control valve is moved to the bucket out position by the pilot oil pressure from the remote control valve.

The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.

The cavitation which will happen to the rod side of the bucket cylinder is also prevented by the make-up valve in the main control valve.

7. DOZER UP OPERATION



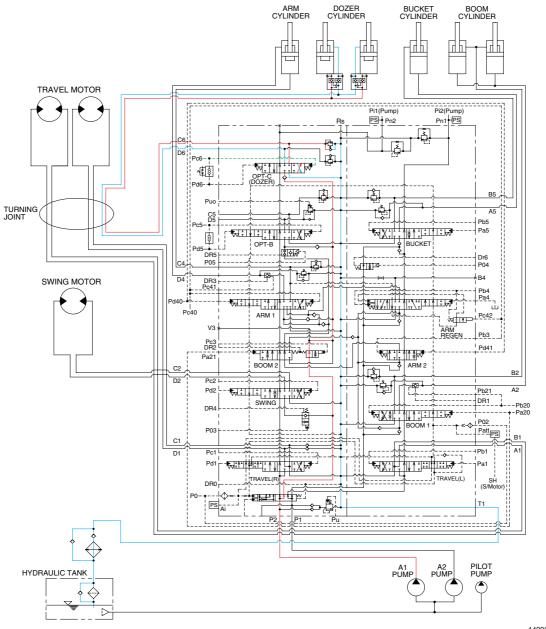
14093HC16

When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the main control valve and then goes to the small chamber of dozer cylinder.

At the same time, the oil from the large chamber of dozer cylinders returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer goes up.

8. DOZER DOWN OPERATION



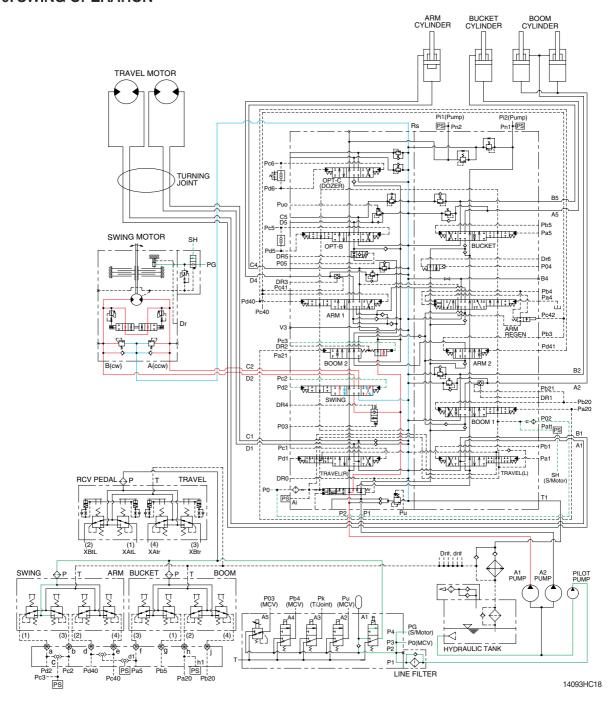
14093HC17

When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the main control valve and then goes to the large chamber of dozer cylinder.

At the same time, the oil from the small chamber of dozer cylinders returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer goes down.

9. SWING OPERATION



When the left control lever is pushed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure from the remote control valve.

Also the swing operation preference function is operated by the pilot pressure Pc3 (refer to page 2-38).

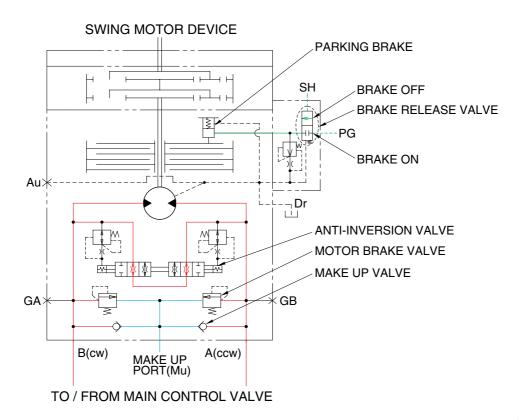
The oil from the A1 pump flows into the main control valve and then goes to the swing motor.

At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

When this happens, the upper structure swings to the left or right.

The swing parking brake, make up valve and the motor brake valve are provided in the swing motor. The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



14W93HC18A

1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation and controls the swing motor operating pressure.

2) MAKE UP VALVE

The make up valves prevent cavitation by supplying return oil to the vacuum side of the motor.

3) PARKING BRAKE

This is function as a parking brake only when all of the RCV lever (except dozer lever and travel pedal) are not operated.

PARKING BRAKE "OFF" OPERATION

The parking brake is released by the pilot pressure oil from the pilot pump.

When the RCV lever placed in the operating position, the pilot oil flows into SH port through the MCV. This pressure transferred to the brake release valve and the brake release valve is change over. Then the pilot oil pressure PG lift the brake piston and release the parking brake.

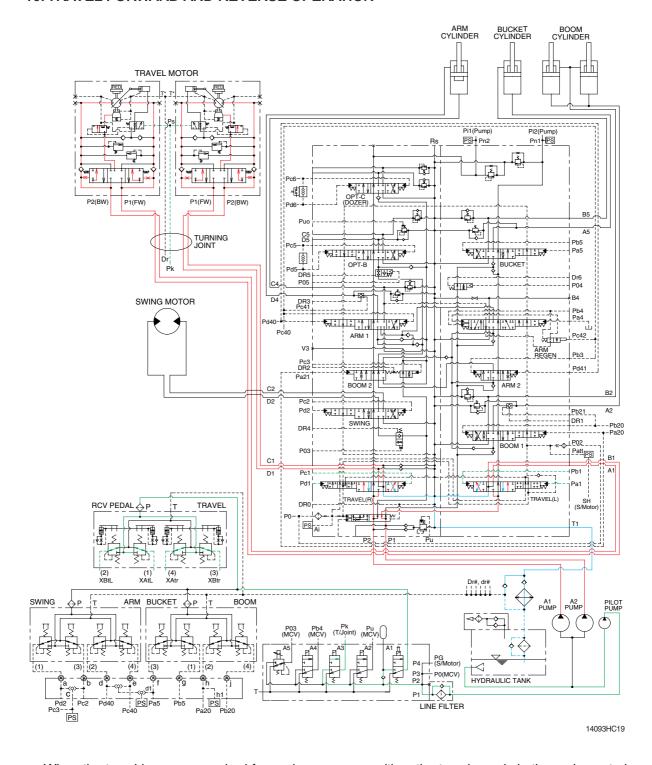
PARKING BRAKE "ON" OPERATION

When all of the RCV lever placed in the neutral position, the pressure of the pilot oil passage down. Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the tank. And the brake is set to 'ON".

4) ANTI-INVERSION VALVE

This anti-inversion valve absorbs shocks produced as swing motion stops and reduced oscillation cause by swing motion.

10. TRAVEL FORWARD AND REVERSE OPERATION



When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

The oil from the each pump flows into the main control valve and then goes to the each travel motor through the turning joint.

The return oil from both travel motors returns to the hydraulic oil tank through the turning joint and the travel spools in the main control valve.

When this happens, the machine moves to the forward or reverse.

TRAVEL CIRCUIT OPERATION

TRAVEL MOTOR DEVICE PS P1(FW) P1(FW) P2(BW) P2(BW) TO/FROM MAIN CONTROL VALVE

14093HC19A

Valves are provided on travel motors to offer the following functions.

1) COUNTER BALANCE VALVE

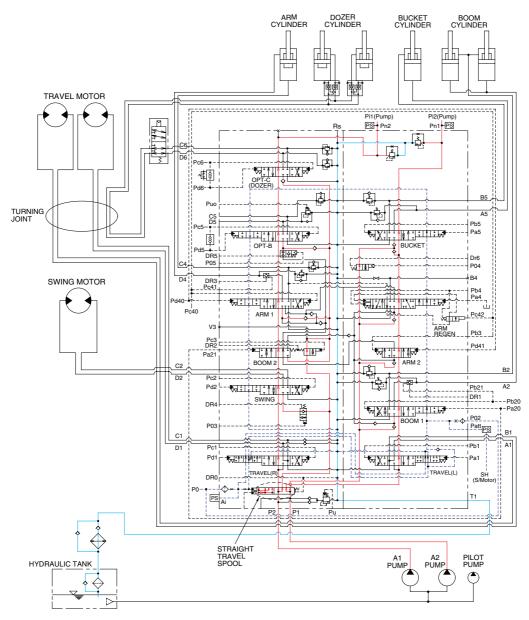
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 350 kgf/cm² to prevent high pressure generated at a time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

GROUP 5 COMBINED OPERATION

1. OUTLINE



14093HC23

The oil from the A1 and A2 pump flows through the neutral oil passage, bypass oil passage and confluence oil passage in the main control valve. Then the oil goes to each actuator and operates them. Check valves and orifices are located on these oil passage in the main control valve. These control the oil from the main pumps so as to correspond to the operation of each actuator and smooth the combined operation.

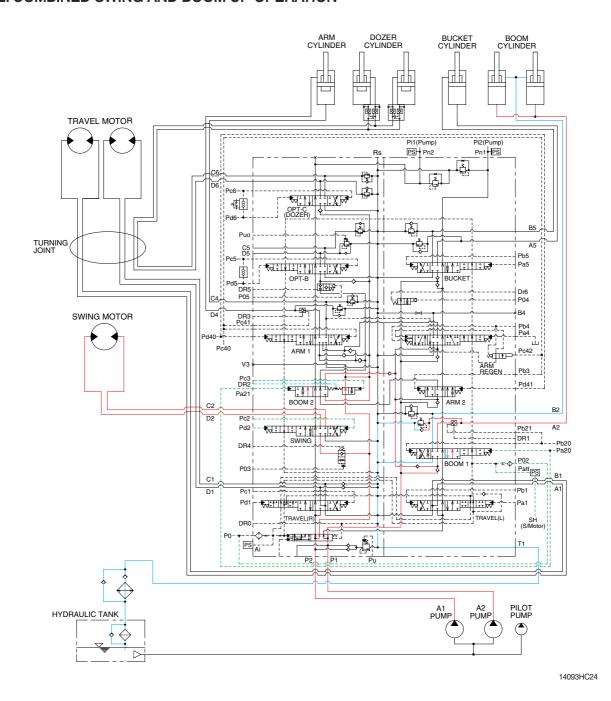
STRAIGHT TRAVEL SPOOL

This straight travel spool for straight travel is provided in the main control valve.

If any actuator is operated when traveling, the straight travel spool is pushed to the right by the pilot oil pressure.

Consequently, the left and right travel oil supply passage are connected, and equivalent amount of oil flows into the left and right travel motors. This keeps the straight travel.

2. COMBINED SWING AND BOOM UP OPERATION



When the swing and boom up functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

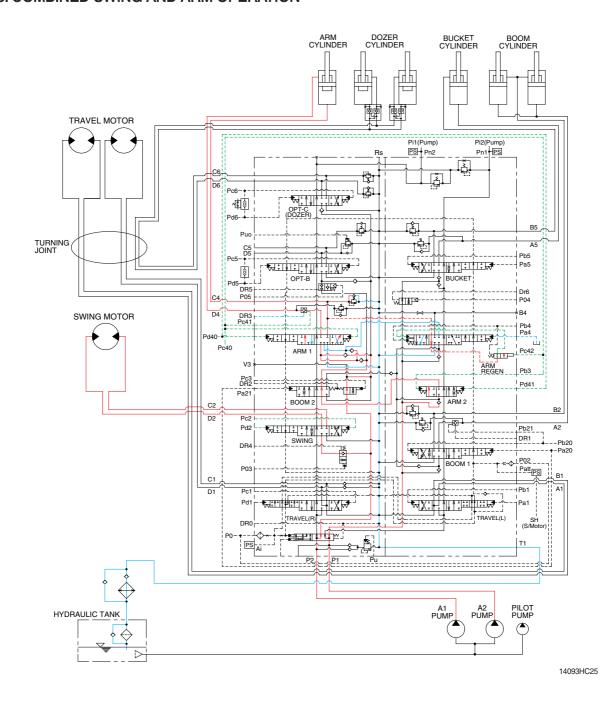
The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

The oil from the A2 pump flows into the boom cylinders through the boom 1 spool in the right control valve.

The super structure swings and the boom is operated.

Refer to page 3-8 for the boom priority system.

3. COMBINED SWING AND ARM OPERATION



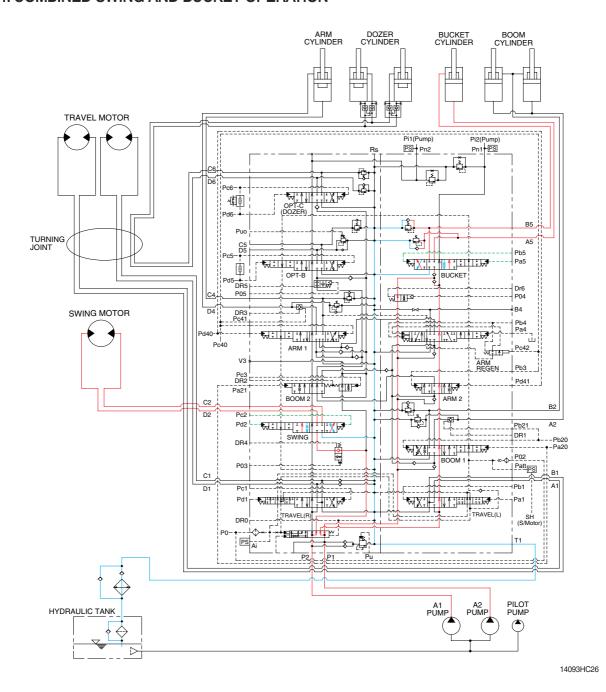
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

The oil from the A2 pump flows into the arm cylinder through the arm 2 spool of the right control valve.

The super structure swings and the arm is operated.

4. COMBINED SWING AND BUCKET OPERATION

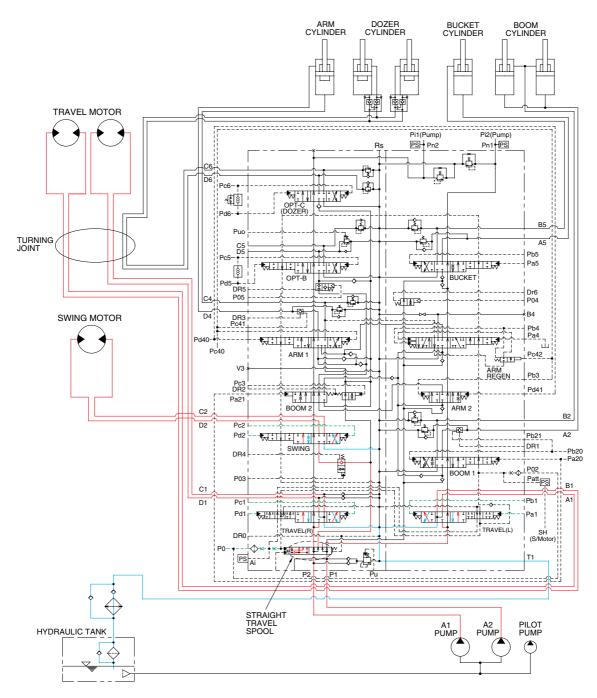


When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the swing motor through the swing spool in the left control valve. The oil from the A2 pump flows into the bucket cylinder through the bucket spool in the right control valve.

The super structure swings and the bucket is operated.

5. COMBINED SWING AND TRAVEL OPERATION



14093HC27

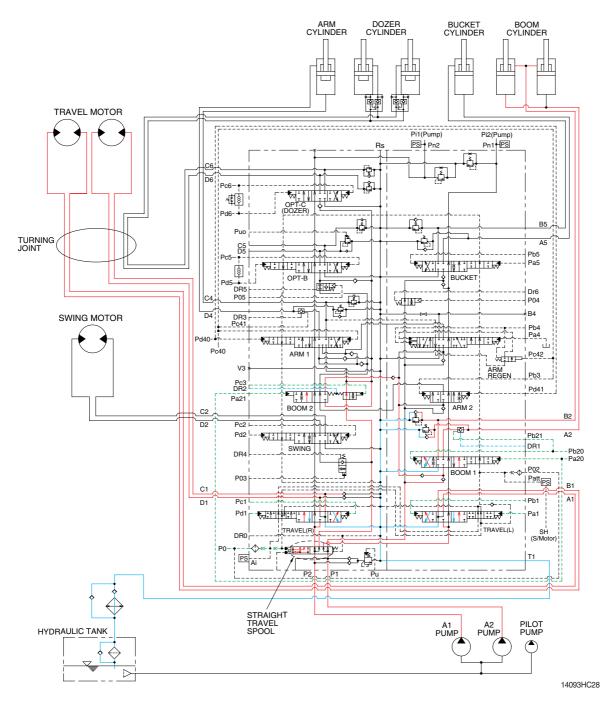
When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and straight travel spool is pushed to the right by the pilot oil pressure from the pilot pump.

The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the swing motor through the swing spool and travel motor through the LH travel spool via the check valve and orifice in the straight travel spool.

The upper structure swings and the machine travels straight.

6. COMBINED BOOM AND TRAVEL OPERATION



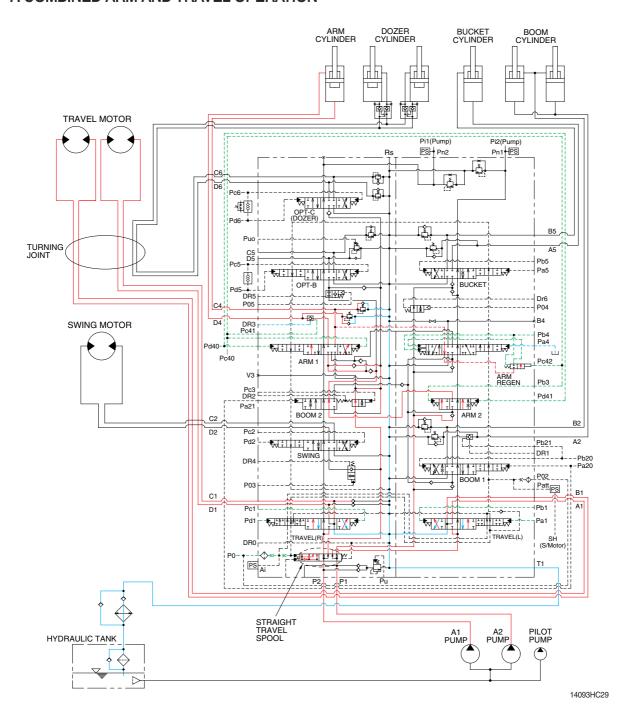
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the boom cylinders through the boom 2 spool and boom 1 spool via the parallel and confluence oil passage in case boom up operation. Also, the oil from the A2 pump flows into the travel motors through the LH travel spool via the check valve and orifice in the straight travel spool.

The boom is operated and the machine travels straight.

7. COMBINED ARM AND TRAVEL OPERATION



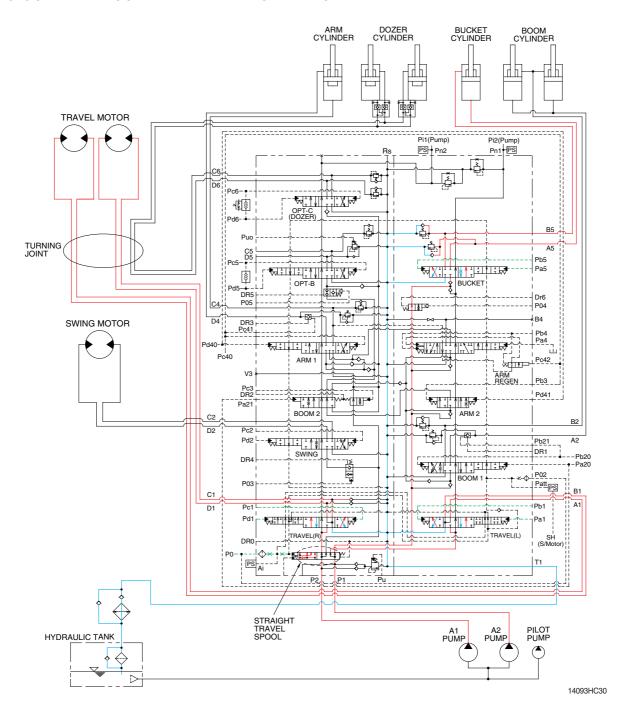
When the arm and travel functions are operated, simultaneously the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the arm cylinders through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage. Also, the oil from the A2 pump flows into the travel motors through the LH travel spool via the check valve and orifice in the straight travel spool.

The arm is operated and the machine travels straight.

8. COMBINED BUCKET AND TRAVEL OPERATION



When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve, and the straight travel spool is pushed to the right by the oil pressure from pilot pump. The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool of the control valve.

The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage. Also, the oil from the A2 pump flows into the travel motors through the LH travel spool via the check valve and orifice in the straight travel spool.

The bucket is operated and the machine travels straight.

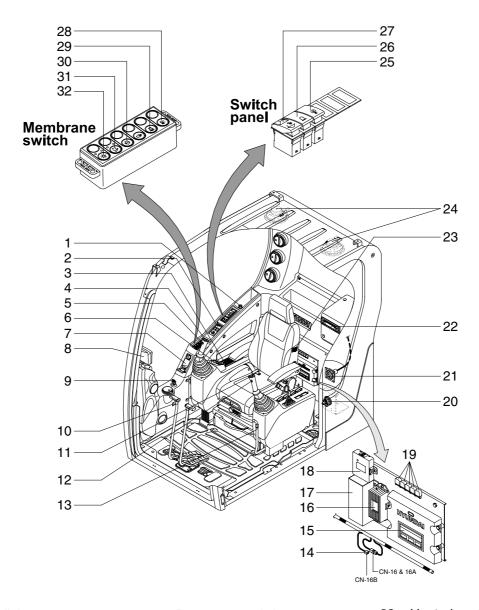
SECTION 4 ELECTRICAL SYSTEM

Group	1	Component Location ·····	4-1
Group	2	Electrical Circuit ·····	4-3
Group	3	Electrical Component Specification	4-21
Group	4	Connectors ·····	4-28

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

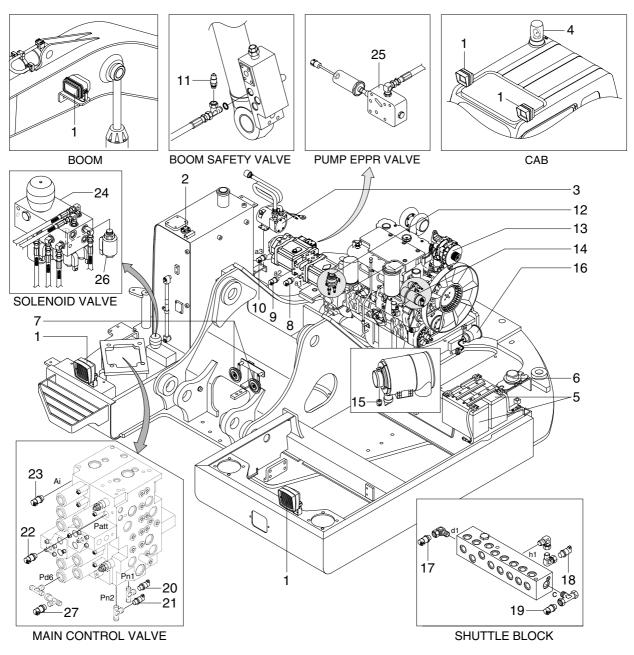
1. LOCATION 1



140Z94EL01

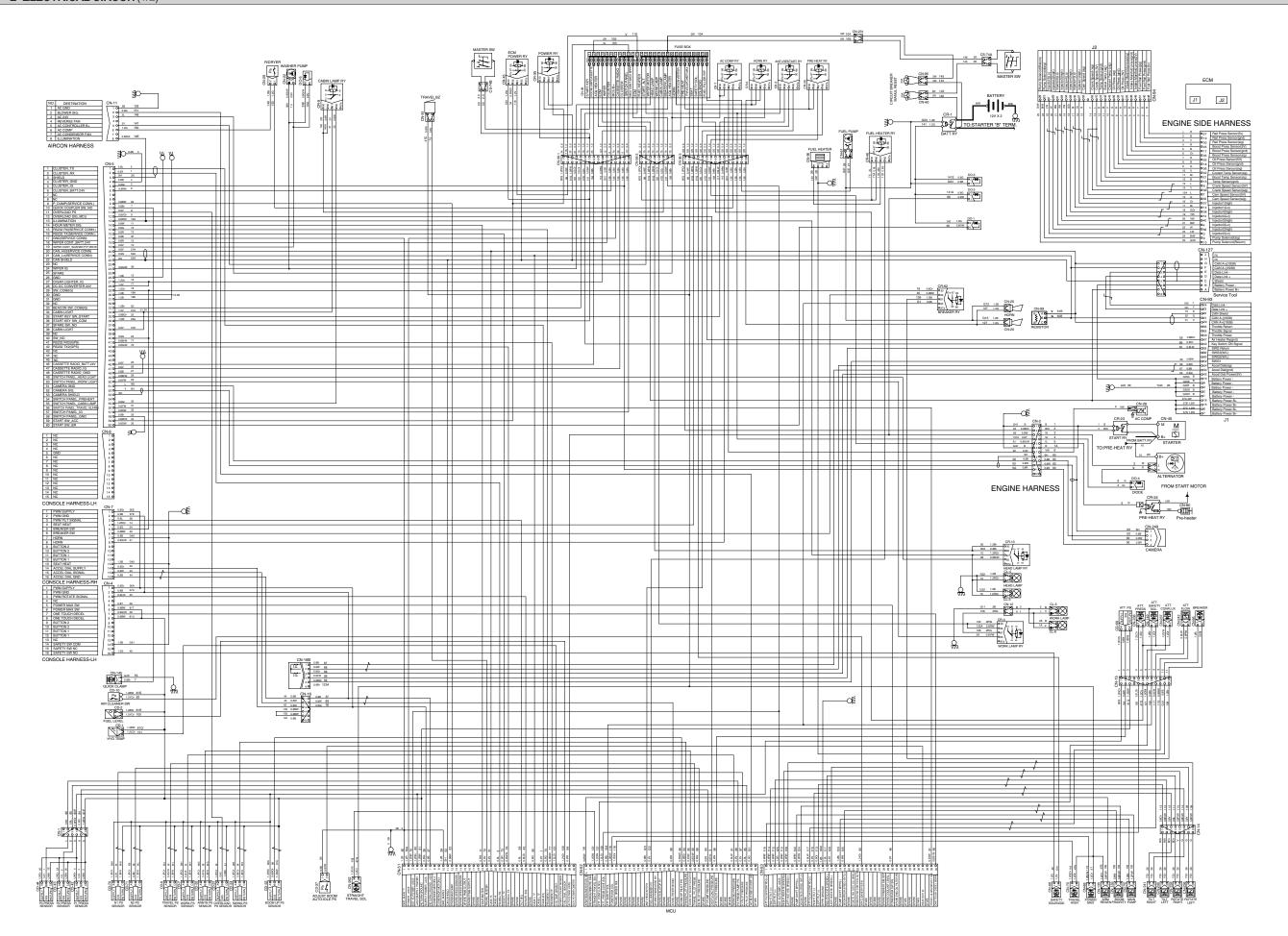
1	Cigar lighter	12	Power max switch	23	Heated seat switch
2	Remote controller	13	Safety lever	24	Speaker
3	Air conditioner switch	14	Emergency engine connector	25	Overload switch
4	Horn switch	15	Machine control unit	26	Beacon switch
5	Breaker operation switch	16	DC-DC converter	27	Quick clamp switch
6	Accel dial switch	17	Remote control unit	28	Cab light switch
7	Handsfree	18	Handsfree control unit	29	Travel alarm switch
8	Cluster	19	Fuse & relay box	30	Washer switch
9	Start switch	20	Master switch	31	Wiper switch
10	Hour meter	21	RS232 & J1939 service socket	32	Main light switch
11	One touch decel switch	22	Radio & CD/MP3 player		

2. LOCATION 2



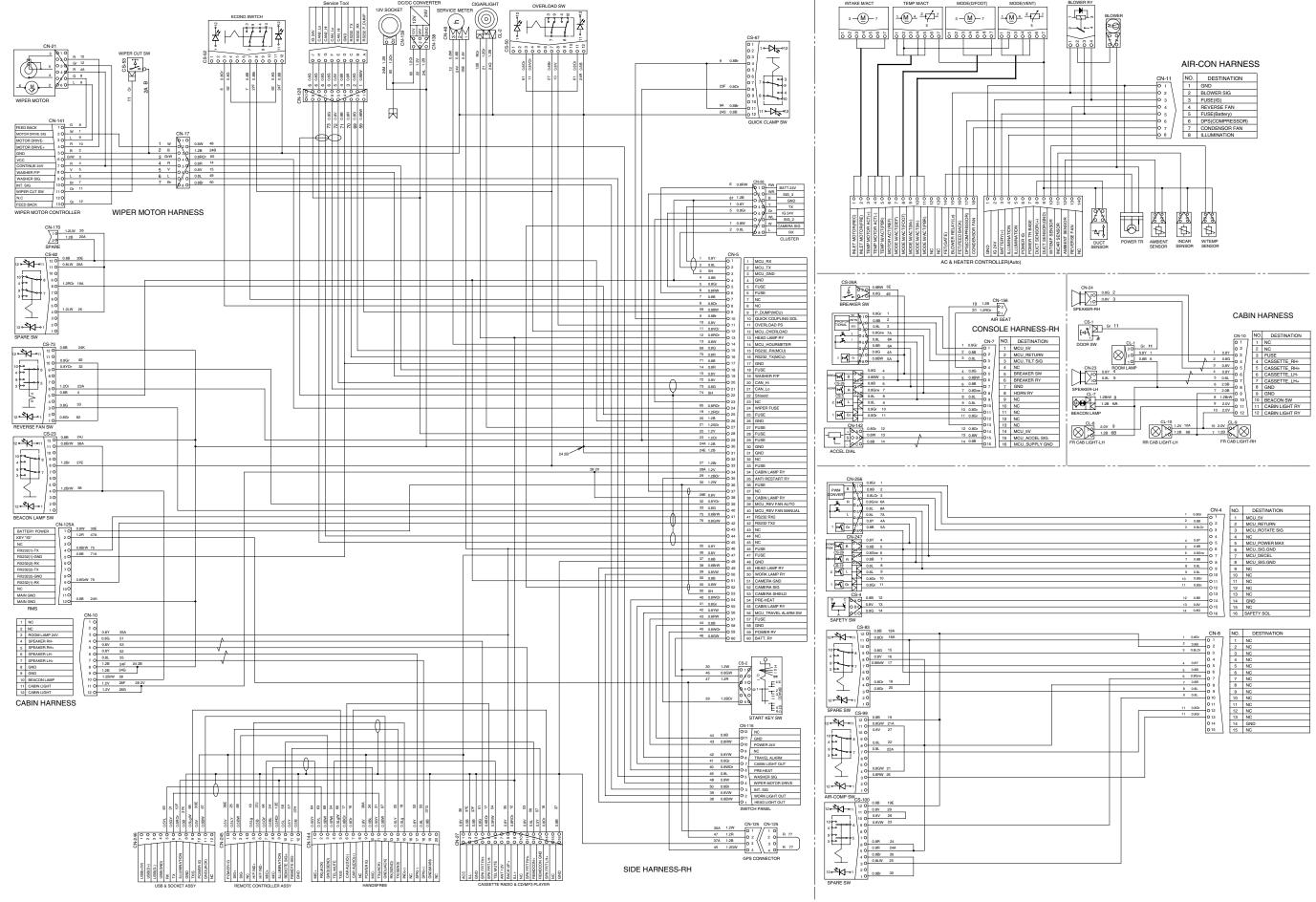
140Z94EL02

1	Lamp	10	P3 pressure sensor	19	Swing pressure sensor
2	Fuel sender	11	Overload pressure sensor	20	Negative 1 pressure sensor
3	Fuel filler pump	12	Heater relay	21	Negative 2 pressure sensor
4	Beacon lamp	13	Alternator	22	Attach pressure sensor
5	Battery	14	Start relay	23	Travel pressure sensor
6	Battery relay	15	Air cleaner switch	24	Solenoid valve
7	Horn	16	Travel alarm buzzer	25	Pump EPPR valve
8	P1 pressure sensor	17	Arm/Bucket in pressure sensor	26	Boom priority EPPR valve
9	P2 pressure sensor	18	Boom up pressure sensor	27	Dozer pressure switch



140Z94EC01

· ELECTRICAL CIRCUIT(2/2)



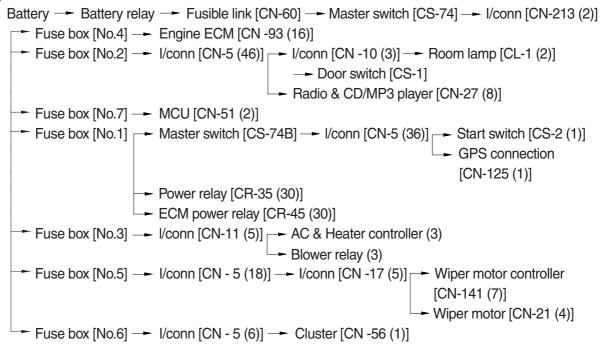
MEMORANDUM

HYUNDAI HEAVY INDUSTRIES CO., LTD CONSTRUCTION EQUIPMENT DIV.

1. POWER CIRCUIT

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

1) OPERATING FLOW



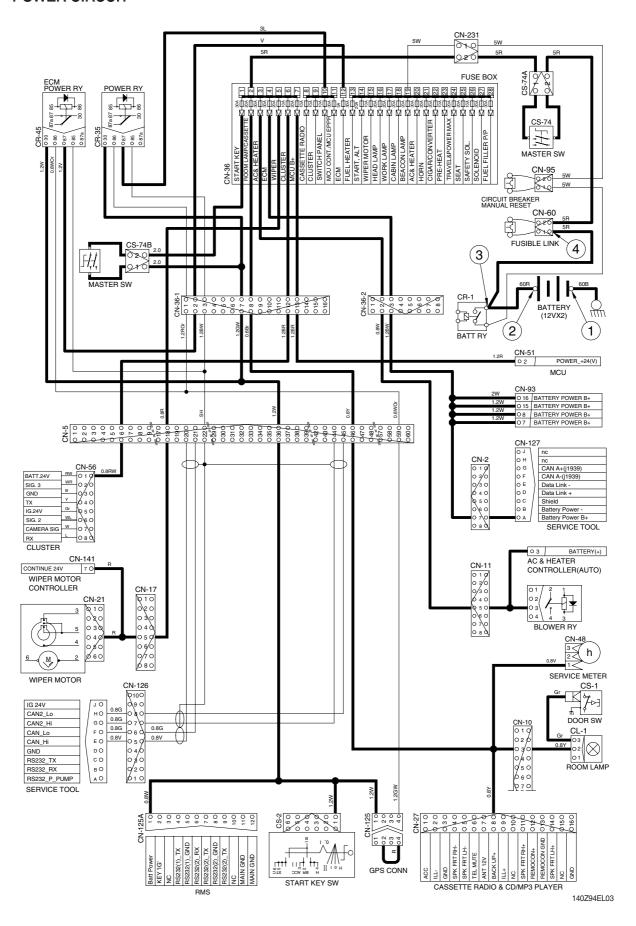
※ I/conn : Intermediate connector

2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (battery 1EA)	10~12.5V
OFF	OFF	② - GND (battery 2EA)	20~25V
OFF	OFF	③ - GND (battery 2EA)	20~25V
		④ - GND (fusible link)	20~25V

* GND: Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

```
Battery(+) terminal — Battery relay [CR-1] — Fusible link [CN-60] — Master switch [CS-74] — I/conn [CN-231 (2)] — Fuse box [No.1] — Master switch [CS-74B] — I/conn [CN-36-1 (7)] — I/conn [CN-5(36)] — Start switch [CS-2(1)]
```

(1) When start key switch is in ON position

```
Start switch ON [CS-2 (2)] → I/conn [CN-5 (60)] → Battery relay [CR-1]
→ Battery relay operating (all power is supplied with the electric component)

Start switch ON [CS-2 (3)] → GPS connector [CN-125 (2) → (4)] → I/conn [CN-5 (59)]
→ Power relay [CR-35 (86) → (87)] → Fuse box [No.10]

ECM power relay [CR-45 (86) → (87)] → Fuse box [No.12]
```

(2) When start key switch is in START position

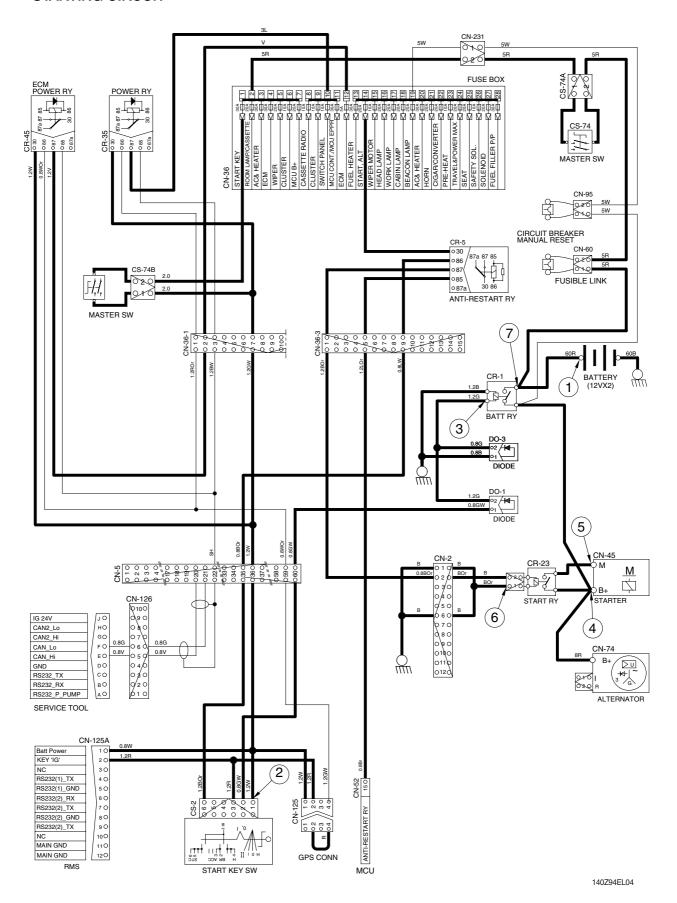
Start switch START [CS-2 (6)] \longrightarrow I/conn [CN-5 (35)] \longrightarrow Anti-restart relay [CR-5 (86) \rightarrow (87)] \longrightarrow I/conn [CN-2 (2)] \longrightarrow Start relay [CR-23]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (battery)	
		② - GND (start key)	
		③ - GND (battery relay M4)	
OPERATING	START	④ - GND (starter B+)	20~25V
		⑤ - GND (starter M)	
		⑥ - GND (start relay)	
		⑦ - GND (battery relay M8)	

* GND: Ground

STARTING CIRCUIT



3. 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-1].

The current also flows from alternator to each electrical component and controller through the fuse box.

1) OPERATING FLOW

(1) Warning flow

Alternator "I" terminal — I/conn [CN-2 (3)] — MCU alternator voltage level [CN-51 (39)] Cluster charging warning lamp(Via serial interface)

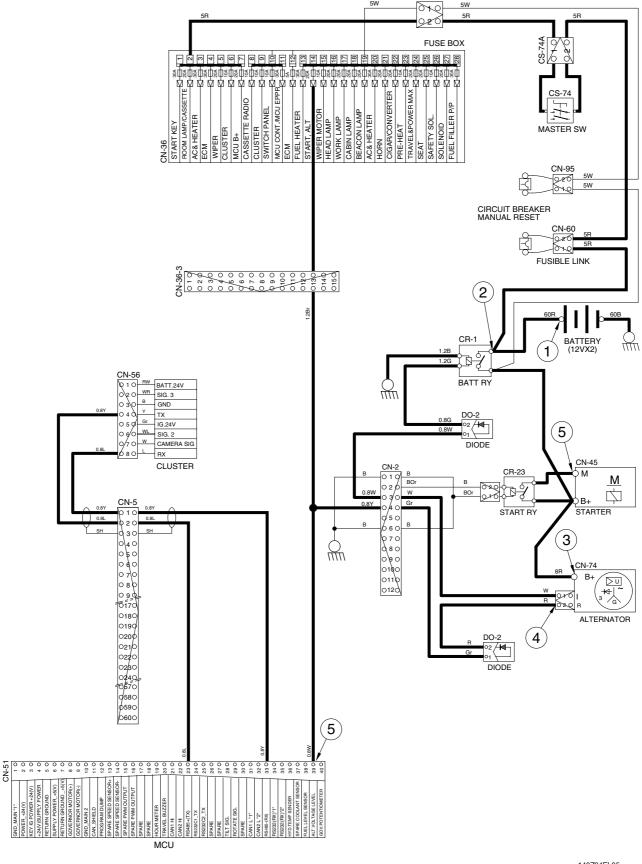
(2) Charging flow

2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (battery voltage)	
		② - GND (battery relay)	
Run	ON	③ - GND (alternator B ⁺ terminal)	20~30V
		④ - GND (alternator I terminal)	
		⑤ - GND (MCU)	

* GND: Ground

CHARGING CIRCUIT



140Z94EL05

4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.16) — Head light relay [CR-13 (30,86)] Fuse box (No.17) — Work light relay [CR-4 (30,86)]

(1) Head light switch ON

Head light switch ON [CN-116 (1)] → I/conn [CN-5 (49)] → Head light relay [CR-13 (85) → (87)]

Head light ON [CL-3 (1)], [CL-4 (1)]

I/conn [CN-11 (8)] → AC & Heater controller illumination ON [4]

I/conn [CN-5 (13)] → Remote controller illumination ON [CN-245 (9)]

Cigar light [CL-2]

USB & Socket illumination ON [CN-246 (7)]

Radio & CD/MP3 player illumination ON [CN-27 (9)]

(2) Work light switch ON

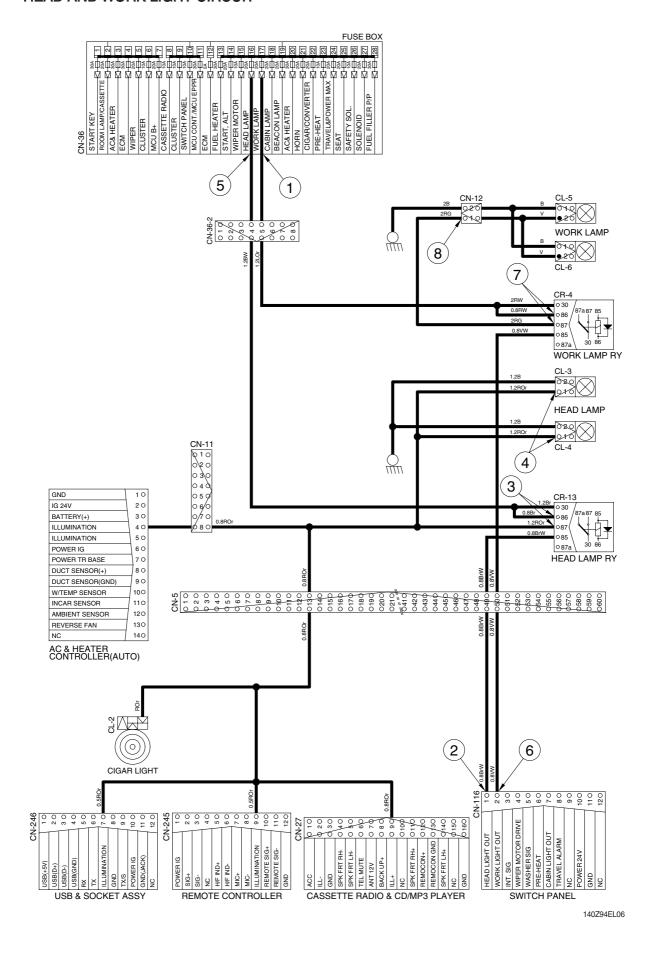
Work light switch ON [CN-116 (2)] \longrightarrow I/conn [CN-5 (50)] \longrightarrow Work light relay [CR-4 (85) \rightarrow (87)] \longrightarrow I/conn [CN-12 (1)] \longrightarrow Work light ON [CL-5 (2), CL-6 (2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (fuse box)	
		② - GND (switch power output)	
		③ - GND (head light relay)	
OTOD	ONL	④ - GND (head light)	00.051/
STOP	ON	⑤ - GND (fuse box)	20~25V
		⑥- GND (switch power output)	
		⑦ - GND (work light relay)	
		® - GND (work light)	

* GND: Ground

HEAD AND WORK LIGHT CIRCUIT



5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

```
Fuse box (No.19) → I/conn [CN-5 (33)] → Beacon lamp switch [CN-23 (8)] Fuse box (No.18) → Cab light relay [CR-9 (30, 86)]
```

(1) Beacon lamp switch ON

```
Beacon lamp switch ON [CS-23 (4)] Switch indicator lamp ON [CS-23 (11)] I/conn [CN-10 (10)] - Beacon lamp ON [CL-7]
```

(2) Cab light switch ON

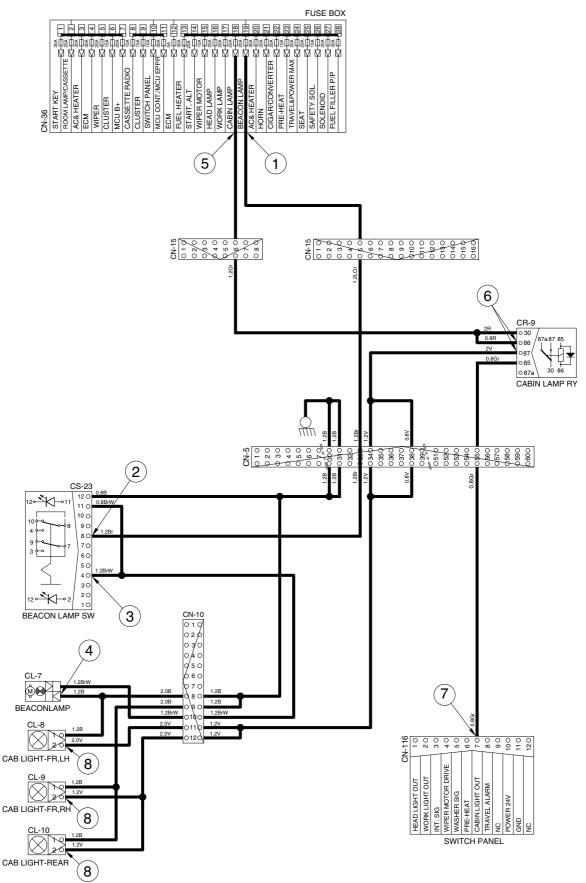
```
Cab light switch ON [CN-116 (7)] \longrightarrow I/conn [CN-5 (55)] \longrightarrow Cabin lamp relay [CR-9 (85) \longrightarrow (87)] \longrightarrow I/conn [CN-10 (11)] \longrightarrow Front cab light ON [CL-8 (2)] \longrightarrow I/conn [CN-10 (12)] \longrightarrow Front cab light ON [CL-9 (2)] \longrightarrow Rear cab light ON [CL-10 (2)]
```

2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (fuse box)	
STOP	ON	② - GND (switch power input)	20~25V
3106	ON	③ - GND (switch power output)	20~25V
		④ - GND (beacon lamp)	
		⑤ - GND (fuse box)	
STOP	ON	⑥ - GND (cabin light relay)	20~25V
5106		⑦ - GND (switch power output)	20~25V
		® - GND (cab light)	

* GND: Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



140Z94EL07

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.10) — I/conn [CN-5 (57)] — Switch panel [CN-116 (10)]

Fuse box (No.5) — I/conn [CN-5 (18)] — I/conn [CN-17 (5)] — Wiper motor controller [CN-141(7)]

Fuse box (No.15) — I/conn [CN-5 (24)] — I/conn [CN-17 (4)] — Wiper motor controller [CN-141 (6)]

Washer pump [CN-22 (2)]

(2) Wiper switch ON: 1st step (Intermittent)

Wiper switch ON [CN-116 (3)] → I/conn [CN-17 (8)] → Wiper motor controller [CN-141 (10) → (3)] → Wiper motor intermittently operating [CN-21 (6)]

(3) Wiper switch ON: 2nd step (continual)

Wiper switch ON [CN-116(4)] → I/conn[CN-17(2)] → Wiper motor controller [CN-141(2) → (4)] → Wiper motor operating [CN-21(2)]

(4) Washer switch ON

Washer switch ON [CN-116 (5)] — I/conn [CN-17 (7)] — Wiper motor controller [CN-141 (9) \rightarrow (8)] — I/conn [CN-17 (6)] — I/conn [CN-5 (19)] — Washer pump [CN-22 (1)] — Washer operating Wiper switch ON [CN-116 (4)] — I/conn[CN-17 (2)] — Wiper motor controller [CN-141 (2) \rightarrow (4)] — Wiper motor operating [CN-21 (2)]

(5) Auto parking (when switch OFF)

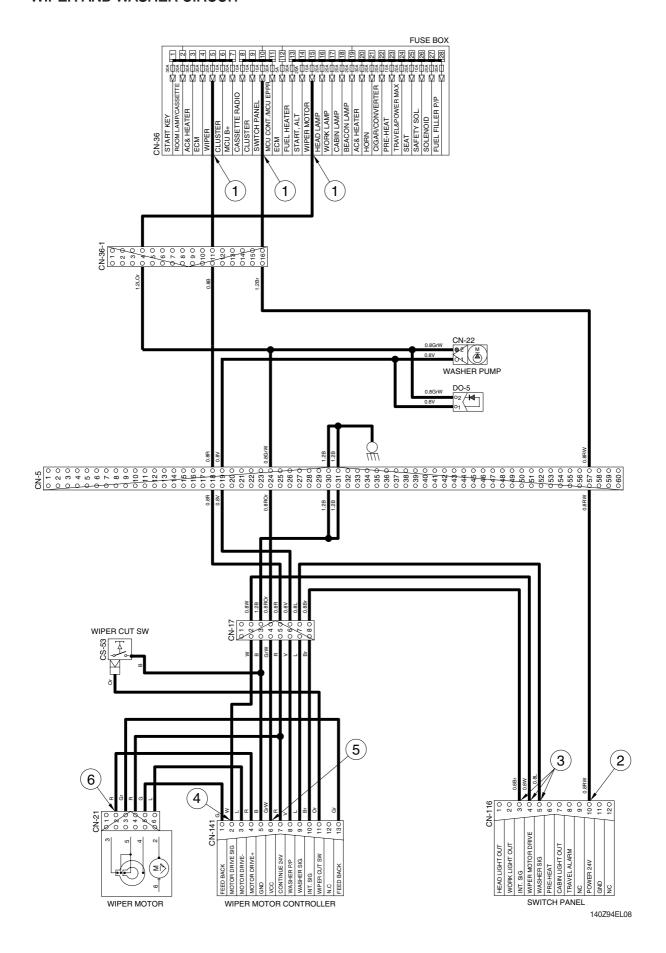
Switch OFF [CN-116 (4)] — Wiper motor parking position by wiper motor controller

2) CHECK POINT

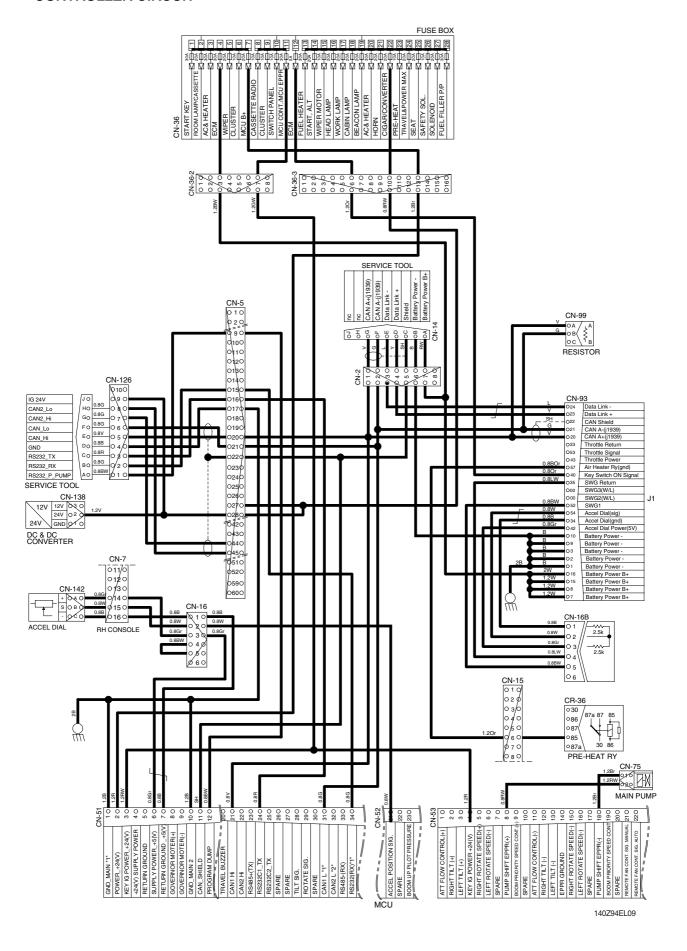
Engine	Start switch	Check point	Voltage
		① - GND (fuse box)	24V
		② - GND (switch power input)	24V
CTOD	ON	③ - GND (switch power output)	0 ~ 5V
STOP	ON	④ - GND (wiper power input)	0 ~ 5V
		⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

* GND: Ground

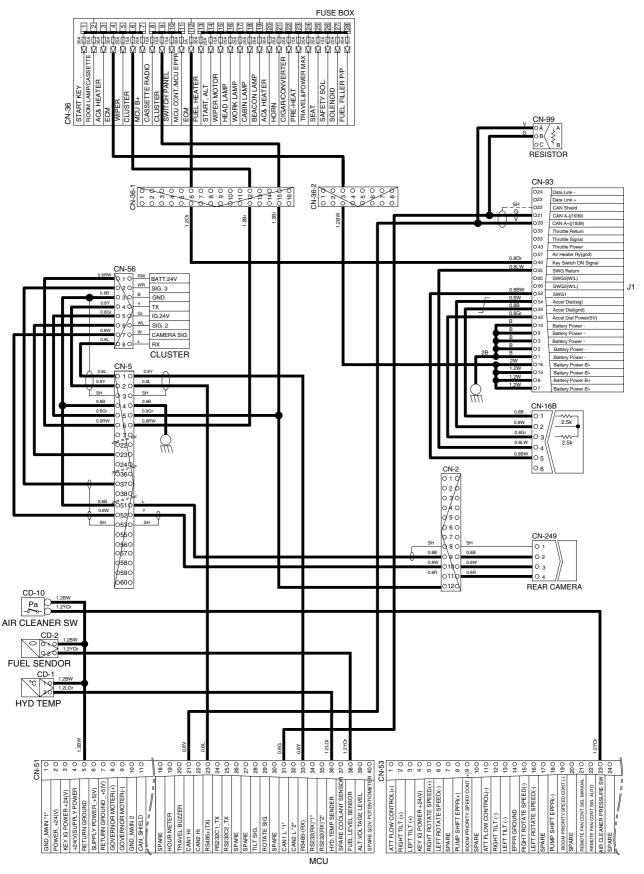
WIPER AND WASHER CIRCUIT



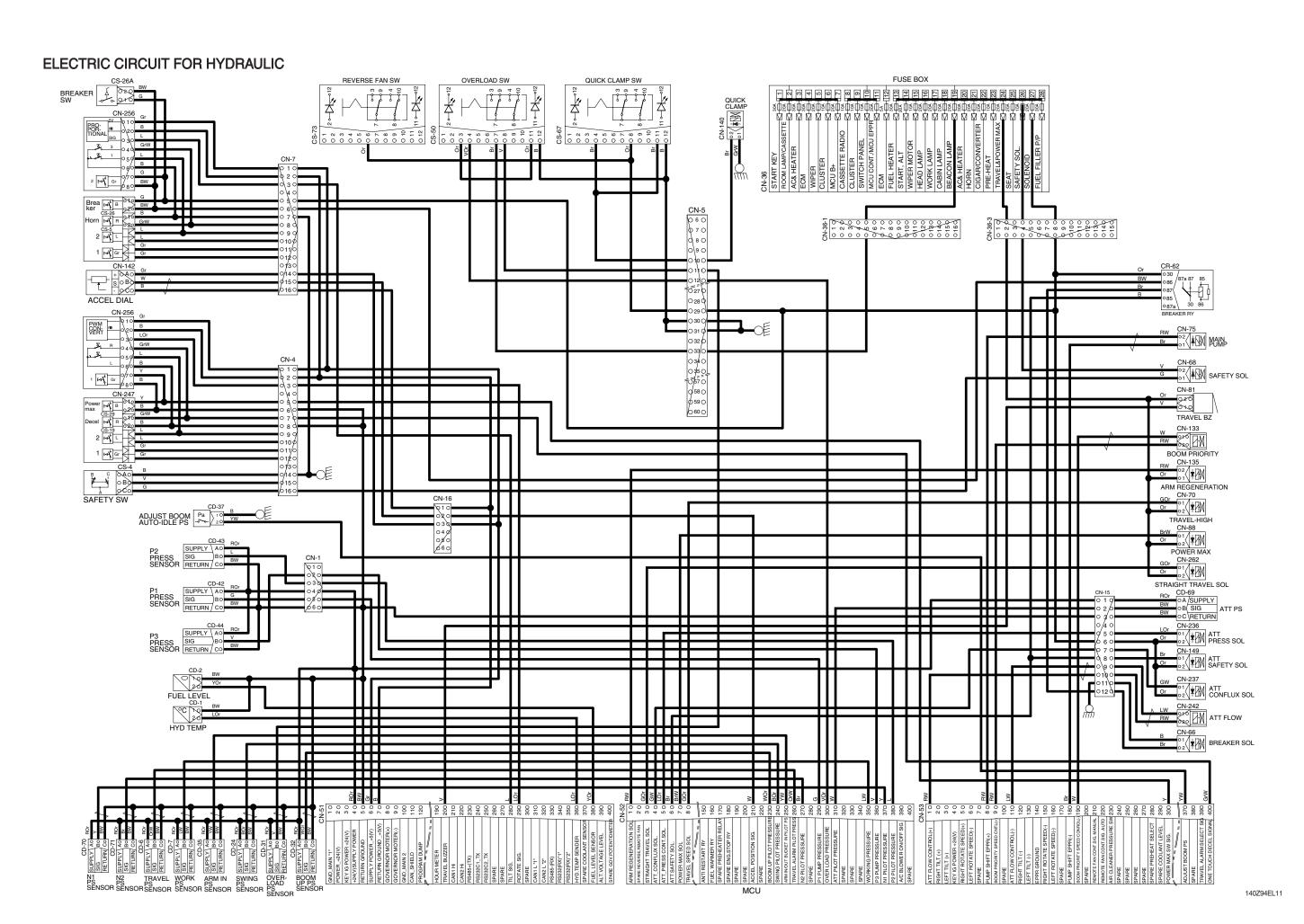
CONTROLLER CIRCUIT



MONITORING CIRCUIT



140Z94EL10



GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

Part name	Symbol	Specifications	Check
Battery		12V × 80Ah (2EA)	 Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	CR-1	Rated load: 24V 100A (continuity) 1000A (30seconds)	 Check coil resistance(M4 to M4) Normal : About 50 Ω Check contact Normal : ∞ Ω
Glow plug relay	CR-24	24V 200A	* Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start key	CS-2	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	* Check contact OFF: $\infty \Omega$ (for each terminal) ON: 0Ω (for terminal 1-3 and 1-2) START: 0Ω (for terminal 1-5)
Pressure sensor	O A SUPPLY O B SIG O C RETURN CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-42 CD-43 CD-44 CD-69 CD-70 CD-71	8~30V	* Check contact Normal : 0.1 Ω
Resistor	○ A	4W	* Check resistance A-B : 120 Ω

Part name	Symbol	Specifications	Check
Glow plug	CN-80	24V 200A	* Check resistance0.25~0.12 Ω
Temperature sensor (hydraulic)	°C 10 20 CD-1	-	 Check resistance 50°C : 804 Ω 80°C : 310 Ω 100°C : 180 Ω
Air cleaner pressure switch	Pa CD-10	(N.O TYPE)	% Check contact High level : $\infty \Omega$ Low level : 0Ω
Fuel sender	CD-2	-	* Check resistance Full : 50Ω 6/12 : 350Ω 11/12 : 100Ω 5/12 : 400Ω 10/12 : 150Ω 4/12 : 450Ω 9/12 : 200Ω 3/12 : 500Ω 8/12 : 250Ω 2/12 : 550Ω 7/12 : 300Ω 1/12 : 600Ω Empty warning : 700Ω
Relay (air con blower)	3 4 4 0 3 0 2 0 1 2 1 0	24V 20A	* Check resistance Normal : About 200 Ω (for terminal 1-3) 0 Ω (for terminal 2-4)
Relay	CR-2 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-36 CR-45 CR-46	24V 16A	% Check resistance Normal : About 160 Ω (for terminal 85-86) 0Ω (for terminal 30-87a) $\infty\Omega$ (for terminal 30-87)

Part name	Symbol	Specifications	Check
Solenoid valve	CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-236 CN-237 CN-262	24V 1A	 Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	CN-75 CN-133 CN-238 CN-239 CN-240 CN-241 CN-242	700mA	* Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	O 1 O 2 CN-23(LH) CN-24(RH)	20W	* Check resistance Normal : A few Ω
Switch (locking type)	CS-23 CS-50 CS-67 CS-82 CS-83 CS-99 CS-100	24V 8A	* Check contact Normal ON : 0 Ω (for terminal 3-7, 4-8) Ω (for terminal 7-9, 8-10) OFF: Ω (for terminal 3-7, 4-8) Ω (for terminal 7-9, 8-10)
Accel dial	OAO + BOS - CN-142	-	** Check resist Normal : About 5k Ω (for terminal A-C) ** Check voltage Normal : About 5V (for terminal A-C) : 2~4.5V (for terminal C-B)
Room lamp	3 O 2 O 1 O CL-1	24V 10W	* Check disconnection Normal : 1.0Ω ON : 0Ω (For terminal 1-2) $\infty \Omega$ (For terminal 1-3) OFF : $\infty \Omega$ (For terminal 1-2) 0Ω (For terminal 1-3)

Part name	Symbol	Specifications	Check
Head lamp, Work lamp, Cab lamp	CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10	24V 65W (H3 Type)	* Check disconnection Normal : 1.2 Ω
Beacon lamp	CL-7	21V 70W (H1 Type)	* Check disconnection Normal : A few Ω
Fuel filler pump	○1 ○	24V 10A 35 <i>l</i> /min	* Check resistance Normal : 1.0 Ω
Service meter	3 h 2 h 1 CN-48	16~32V	 Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	CN-20 CN-25	DC22~28V 2A	* Check operation Supply power(24V) to each terminal and connect ground.
Safety switch	2 3 0 1 0 0 2 0 1 1 CS-4	24V 15A (N.C TYPE)	% Check contact Normal : 0 Ω (for terminal 1-2) ∞ Ω (for terminal 1-3) Operating : ∞ Ω (for terminal 1-2) Ω Ω (for terminal 1-3)

Part name	Symbol	Specifications	Check
Wiper cut switch	CS-53	24V (N.O TYPE)	* Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	P 2 0 CN-29	24V 2.5A	* Check contact Normal : ∞ Ω
Radio & CD/MP3 plalyer	OBIO OBIO OBIO OBIO OBIO OBIO OBIO OBIO	24V 2A	* Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	© 2 M ○ 1 CN-22	24V 3.8A	* Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	24V 2A	* Check disconnection Normal : 7 Ω (for terminal 2-6)
DC/DC Converter	0 3 0 12V 12V 0 2 0 24V 0 10 GND 24V CN-138	12V 3A	24V (1-2) 12V (1-3)

Part name	Symbol	Specifications	Check
Cigar lighter	CL-2	24V 5A 1.4W	 * Check coil resistance Normal : About 1M Ω * Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	B+ UU ++ 3~ G R CN-74	24V 55A	* Check contact Normal : 0 Ω (for terminal B ⁺ -I) Normal : 24~27.5V
Starter	M M M CN-45	Denso 24V 4.5kW	* Check contact Normal : 0.1 Ω
Travel alarm	CN-81	24V 0.5A	* Check contact Normal : 5.2 Ω
Aircon compressor	CN-28 =	24V 79W	* Check contact Normal : 13.4 Ω
Start relay	CR-23	24V 300A	« Check contact Normal: 0.94 Ω (for terminal 1-2)

Part name	Symbol	Specifications	Check
Blower motor	0 1 0 <u>M</u> 0 2 0	24V 9.5A	* Check resistance Normal : 2.5 Ω (for terminal 1-2)
Duct sensor (switch)		1°C OFF 4°C ON	* Check resistance Normal : 0 Ω (for terminal 1-2), the atmosphere temp : Over 4°C
Door switch	CS-1	24V 2W	* Check resistance Normal : About 5M Ω
Switch (power max, one touch decal, horn, breaker)	CS-5 CS-19 CS-26 CS-29	24V 6A	* Check resistance Normal: ∞ Ω
Fusible link	CN-60 CN-95	60A	* Check disconnection normal : 0 \Omega (connect ring terminal and check resist between terminal 1 and 2)
Master switch	CS-74	6-36V	* Check disconnection Normal : 0.1 Ω

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector	T	No. of	Destruction	Connecto	or part No.
number	Type	pin	Destination	Female	Male
CN-1	AMP	6	I/conn (Frame harness-Pump PS harness)	S816-006002	S816-106002
CN-2	AMP	12	I/conn (Frame harness-Engine harness)	S816-012002	S816-112002
CN-4	AMP	16	Vconn (Console harness LH-Frame harness)	S816-016002	S816-116002
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-8	AMP	12	Vconn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-9	AMP	12	I/conn (Console harness LH)	S816-012002	S816-112002
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12P-BE02
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P
CN-14	AMP	8	I/conn (Frame harness)	S816-008002	-
CN-15	AMP	12	I/conn (Frame harness)	S816-012002	S816-112002
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	DEUTSCH	8	I/conn (Wiper harness)	DT06-8S-EP06	DT04-8P
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-22	KET	2	Washer pump	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27	KUM	16	Radio & CD/MP3 player	PK145-16017	-
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse box	21Q7-10910	-
CN-36-1	AMP	16	I/conn (Fuse box-Frame harness)	368047-1	368050-1
CN-36-2	AMP	8	I/conn (Fuse box-Frame harness)	S816-008002	-
CN-36-3	AMP	15	I/conn (Fuse box-Frame harness)	-	368301-1
CN-45	RING-TERM	-	Starter motor B+	S820-308000	DT04-4P-E005
CN-48	KET	1	Service meter	GP890469	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU	DRC26-40SC	-
CN-56	AMP	8	Cluster	-	S816-108002
CN-60	AMP	2	Fusible link	21N4-01320	S813-130201
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-

Connector	Tires	No. of	Destination	Connecto	or part No.
number	Type	pin	Destination	Female	Male
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	KET	2	Alternator "I" terminal	MG640-188-4	-
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-93	DEUTSCH	64	Engine ECM	15488667	-
CN-94	DEUTSCH	64	Engine ECM	15488668	-
CN-95	YAZAKI	2	Fusible link	21N4-01311	7122-4125-50
CN-96	AMP	4	Fuel warmer	2-967325-3	-
CN-99	DEUTSCH	3	Resister	DT06-3S-P012	-
CN-116	AMP	12	Switch panel	176116	-
CN-125	Econoseal J	4	GPS connector	S816-004002	S816-104002
CN-126	AMP	10	Service tool	S816-010002	S816-110002
CN-133	DEUTSCH	2	Boom priority solenoid	DT06-2S-EP06	-
CN-135	DEUTSCH	2	Arm regeneration solenoid	DT06-2S-EP06	-
CN-138	FASTEN	3	DC/DC Converter	S810-003202	-
CN-139	FASTEN	2	12V socket	S810-002202	-
CN-140	DEUTSCH	2	Quick clamp solenoid	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	DT04-3P-EP10
CN-142	DEUTSCH	3	Accel dial	DT06-3S-EP06	-
CN-144	KET	20	Handsfree	MG610240	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat	DT04-2P-E005	-
CN-170	AMP	2	Heated seat	12052641	-
CN-231	DEUTSCH	2	I/conn (Master switch-Fuse box)	DT06-2S-EP06	
CN-236	DEUTSCH	2	Attach pressure solenoid	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach flow solenoid	DT06-2S-EP06	DT04-2P-E005
CN-245	AMP	12	Remote controller assy	368542-1	-
CN-246	AMP	12	USB & Socket assy	174045-2	-
CN-247	DEUTSCH	8	Proportional	DT06-08SA-EP06	DT04-8P
CN-249	DEUTSCH	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005
CN-256	AMP	8	PWM convert	-	S816-108002
CN-262	DEUTSCH	2	Straight travel solenoid	DT06-2S-EP06	-

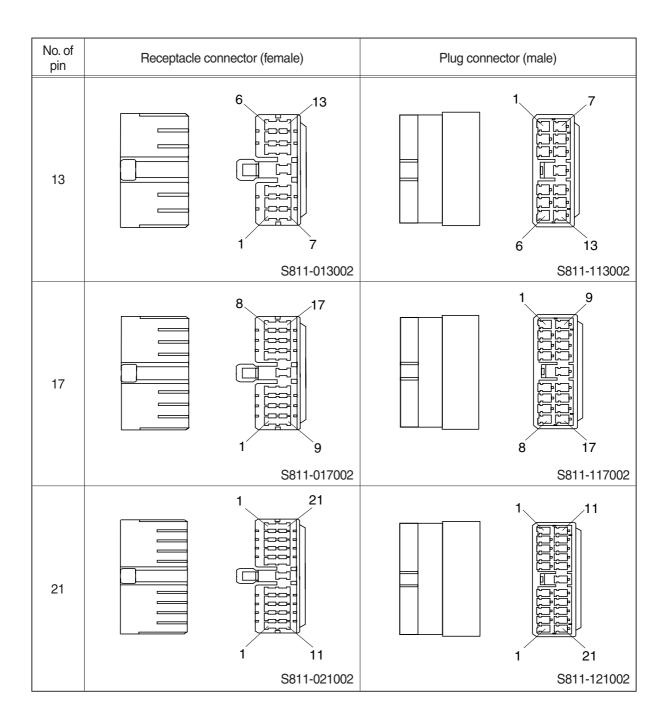
Connector	Type	No. of	Destination	Connecto	or part No.
number	туре	pin	Destination	Female	Male
· Relay					
CR-1	RING-TERM	-	Battery relay	ST730135-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Work lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-23	RING TERM	-	Start relay	-	S820-105000
CR-24	RING TERM	-	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-45	AMP	5	ECM power relay	BJA003526-001	24L1-05100
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	WP	6	Start key switch	S816-006000	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E005
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P-E005
CS-23	SWF	12	Beacon lamp switch	SWF589790	-
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-EP06	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
CS-50	SWF	12	Overload switch	SWF589790	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	SWF	12	Quick clamp switch	SWF 589790	-
CS-73	SWF	12	Reverse fan switch	SWF 589790	-
CS-74	AMP	2	Master switch	S813-030201	-
CS-82	SWF	12	Heated seat switch	SWF 589790	-
CS-83	SWF	12	Spare switch	SWF589790	-
CS-99	SWF	12	Air compressor switch	SWF 589790	-
CS-100	SWF	12	Spare switch	SWF 589790	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar light	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	-	DT04-2P-E005
CL-4	DEUTSCH	2	Head lamp-RH	-	DT04-2P-E005

Connector	Time	No. of	Doctination	Connecto	or part No.
number	Type	pin	Destination	Female	Male
CL-5	DEUTSCH	2	Work lamp-LH	-	DT04-2P
CL-6	DEUTSCH	2	Work lamp-RH	-	DT04-2P
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Front cab light-LH	DT04-2S	DT04-2P-E005
CL-9	DEUTSCH	2	Front cab light-RH	DT04-2S	DT04-2P-E005
CL-10	DEUTSCH	2	Rear cab light-LH	DT04-2S	DT04-2P-E005
· Sensor, se	endor				
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel level sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure sensor	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure sensor	DT06-3S-EP06	-
CD-10	RING TERM	-	Air cleaner switch	ST730135-2	-
CD-24	DEUTSCH	3	Swing sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload sensor	DT06-3S-EP06	-
CD-32	DEUTSCH	3	Boom up sensor	DT06-3S-EP06	-
CD-35	DEUTSCH	3	Arm & bucket in sensor	DT06-3S-EP06	-
CD-37	DEUTSCH	2	Adjust boom pressure switch	DT06-2S-EP06	DT04-2P-E005
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-
CD-50	DEUTSCH	2	Dozer pressure switch	DT06-2S-EP06	DT04-2P-E005
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-

2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

No. of pin	Receptacle connec	etor (female)	Plug connector (male)
5		2 5 5 1 3	2 5
7		S811-005002 3	\$811-105002 1 4 3 7 \$811-107002
9		4 9 1 5 S811-009002	1 5 4 9 3\$811-109002
11		5 11 1 6 S811-011002	1 6 5 11 S811-111002

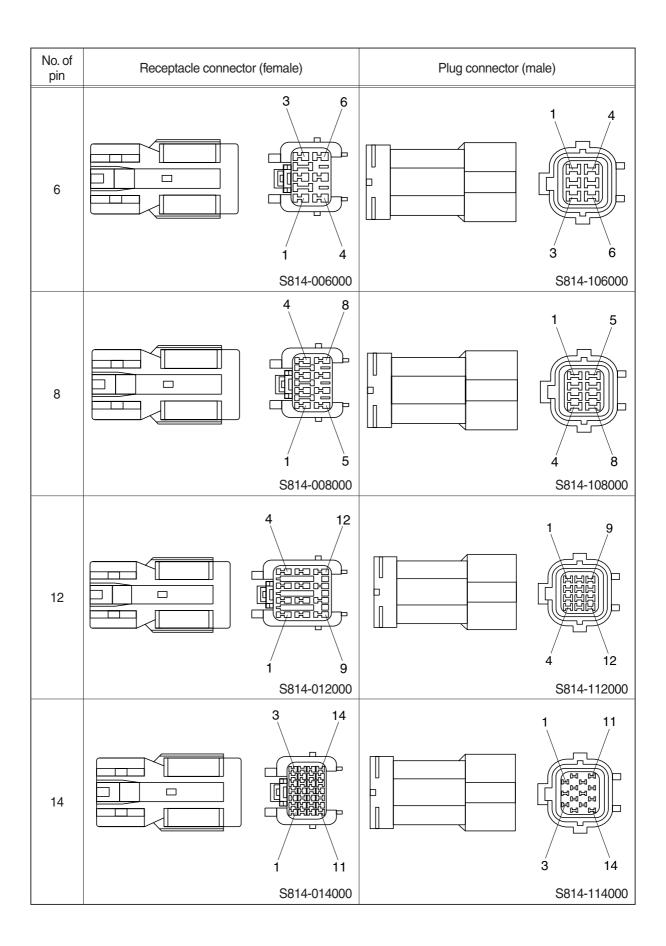


2) J TYPE CONNECTOR

No. of pin	Receptacle conne	ector (female)	Plug connector	r (male)
2		2 S816-002001		2 1 S816-102001
3		3 1 S816-003001		3 1 2 S816-103001
4		3 1 4 2 S816-004001		3 1 S816-104001
8		6 3 1 8 5 2 S816-008001		8 5 2 6 3 1 S816-108001

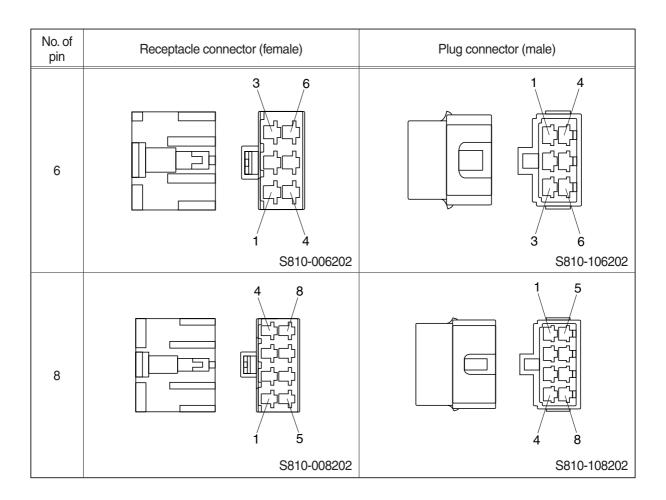
3) SWP TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (n	nale)
1		S814-001000		S814-101000
2		2 1 S814-002000		1 2 S814-102000
3		3 2 1 S814-003000		1 2 3 S814-103000
4		2 4 1 3 \$814-004000		1 3 2 4 S814-104000



4) CN TYPE CONNECTOR

No. of pin	Receptacle connecto	or (female)	Plug connector (male)
1		1		1
		S810-001202		S810-101202
2		1		1
		S810-002202		S810-102202
3		1 2		1 3
		S810-003202		S810-103202
4		2 4		1 3
		S810-004202		S810-104202



5) 375 FASTEN TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	1 2 S810-002402	S810-102402

6) AMP ECONOSEAL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
36	12 24 36 13	13 25 12 24
	344111-1	344108-1

7) AMP TIMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	85202-1	

8) AMP 040 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
12	1 +++++ 12	
	174045-2	

9) AMP 070 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
14	1 7 14 173852	

10) AMP FASTIN - FASTON CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
6	6 4	
	925276-0	

11) KET 090 CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	1	
	MG610070	

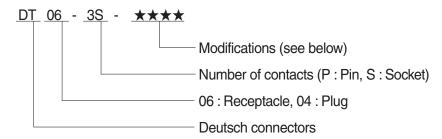
12) KET 090 WP CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
2	1	
	MG640605	
2	1 2	
	MG640795	

13) KET SDL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
14	7 14 6 MG610406	

14) DEUTSCH DT CONNECTORS



* 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

	PU12: Front seal enhancement - connectors color to black for 2, 3, 4 & opin		
No. of pin	Receptacle connector (female)	Plug connector (male)	
2		1 2	
	DT0	DT04-2F	
3	1 2	2 1 1 3	
	DTO	06-3S DT04-3F	
4	2 3	3 2	
	DT0	DT04-4F	

No. of pin	Receptacle connector (female)	Plug connector (male)
6	3 4	
	DT06-6S	DT04-6P
8	5 8 1 DT06-8S	DT04-8P
	D106-8S	D104-8P
12	7 6	1 12
	DT06-12S	DT04-12P

15) MOLEX 2CKTS CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	1 2	
	35215-0200	

16) ITT SWF CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
10	1 9	
	SWF593757	

17) MWP NMWP CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	1	
	NMWP01F-B	

18) ECONOSEAL J TYPE CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
1	S816-001002	S816-101002
2	1 2 S816-002002	2 1 S816-102002
3	1 2 3 S816-003002	3 2 1 S816-103002
4	3 4 S816-004002	2 1 4 3 S816-104002

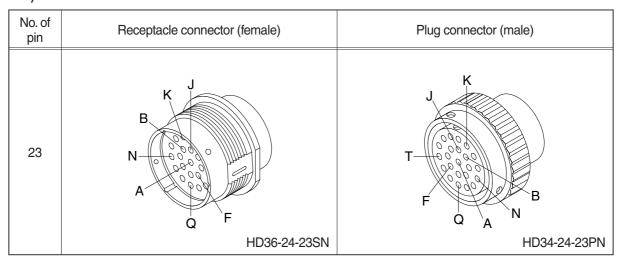
No. of pin	Receptacle connector (female)	Plug connector (male)
6	3 4 6 S816-006002	3 1 6 4 S816-106002
8	5010 303032 1 4 5 8 8 8816-008002	4 1 8 5 S816-108002
10	5 6 10 S816-010002	5 10 6 S816-110002
12	7 12 S816-012002	6 1

No. of pin	Receptacle connector (female)	Plug connector (male)
15	3 15 HEREE E E E E E E E E E E E E E E E E E	15 3
	368301-1	2-85262-1

19) METRI-PACK TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	1 12040753	

20) DEUTSCH HD30 CONNECTOR



21) DEUTSCH MCU CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
40	1 5 6 10 21 35 36 40 30	
	DRC26-40SA/B	

22) DEUTSCH SERVICE TOOL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
9	E	

23) AMP FUEL WARMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
4	2-967325-3	

24) DEUTSCH ENGINE ECM CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
50	11 5 6 10 21 20 20 41 45 46 50 40 DRC26-50S-04	

25) DEUTSCH INTERMEDIATE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
60	1 13 25 31 37 49 24 30 36 49 48 60 DRB16-60SAE-L018	

SECTION 5 MECHATRONICS SYSTEM

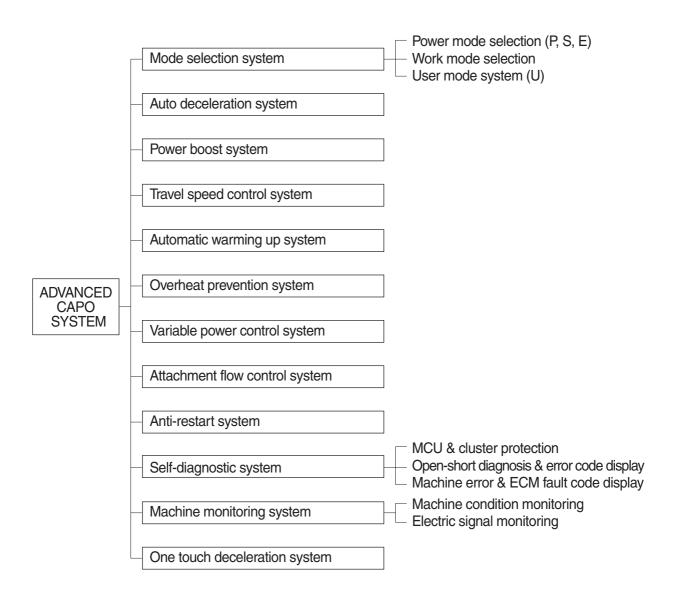
Group	1	Outline	5-1
Group	2	Mode Selection System ·····	5-3
Group	3	Automatic Deceleration System	5-6
Group	4	Power Boost System	5-7
Group	5	Travel Speed Control System	5-8
Group	6	Automatic Warming Up System	5-9
Group	7	Engine Overheat Prevention System ·····	5-10
Group	8	Variable Power Control System ·····	5-11
Group	9	Attachment Flow Control System	5-12
Group	10	Anti-Restart System	5-13
Group	11	Self-Diagnostic System	5-14
Group	12	Engine Control System ·····	5-20
Group	13	EPPR Valve	5-21
Group	14	Monitoring System ····	5-26
Group	15	Fuel Warmer System	5-49

SECTION 5 MECHATRONICS SYSTEM

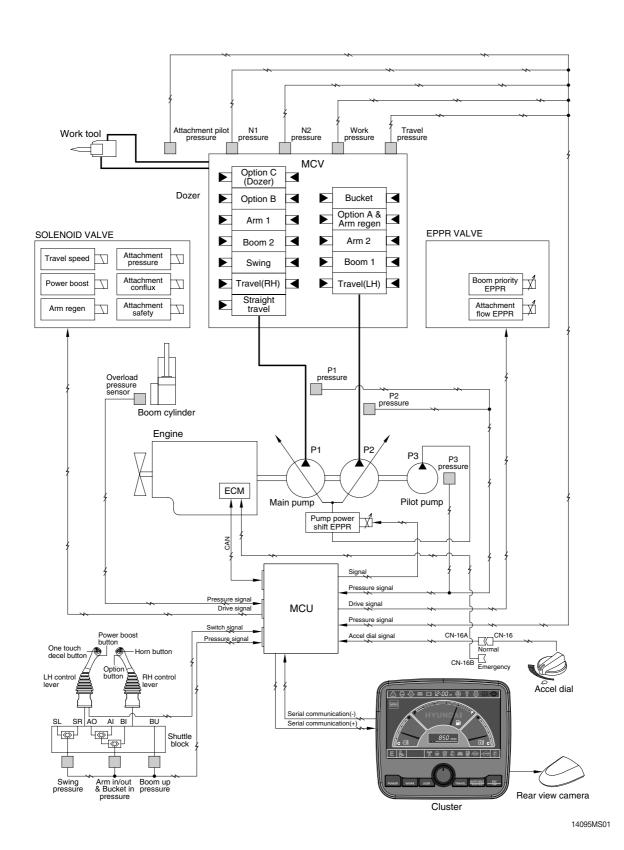
GROUP 1 OUTLINE

The ADVANCED CAPO (Computer Aided Power Optimization) system controls engine and pump mutual power at an optimum and less fuel consuming state for the selected work by mode selection, auto-deceleration, power boost function, etc. It monitors machine conditions, for instance, engine speed, coolant temperature, hydraulic oil temperature, and hydraulic oil pressure, etc.

It consists of a MCU, a cluster, an ECM, EPPR valves, and other components. The MCU and the cluster protect themselves from over-current and high voltage input, and diagnose malfunctions caused by short or open circuit in electric system, and display error codes on the cluster.

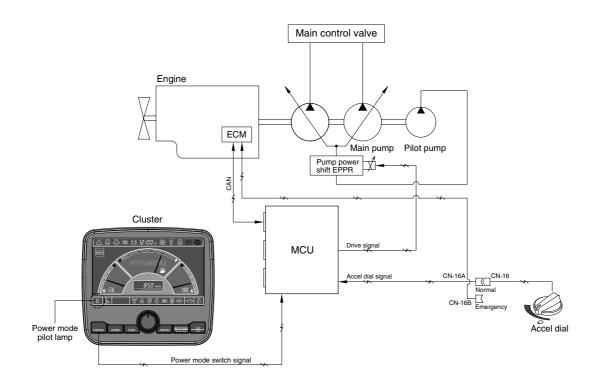


SYSTEM DIAGRAM



GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



21095MS02

Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

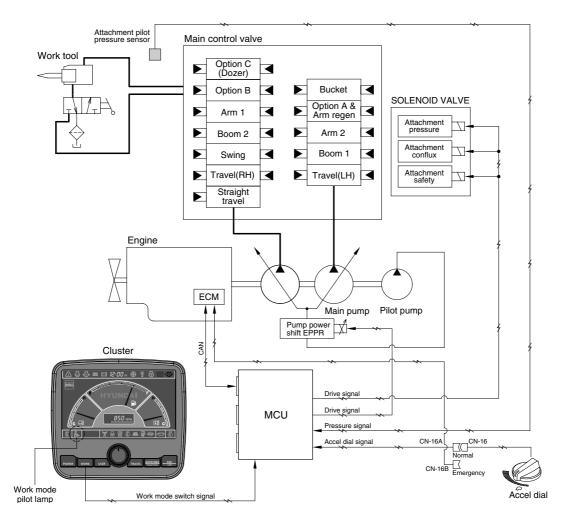
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

		Engine rpm			Power shift by EPPR valve				
Power mode	Application	Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm²)	Current (mA)	Pressure (kgf/cm²)
Р	Heavy duty power	2000±50	1900±50	2000±50	1900±50	250±30	5	160±30	0
S	Standard power	1800±50	1700±50	1900±50	1800±50	290±30	8±3	250±30	5±3
Е	Economy operation	1650±50	1700±50	1750±50	1800±50	365±30	13±3	320±30	10±3
AUTO DECEL	Engine deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	900±100	-	900±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	900±100	-	900±100	-	700±30	38±3	700±30	38±3

^{**} Power shift (Standard/Option) can be changed by "Service menu" in "Management" on the cluster.

2. WORK MODE SELECTION SYSTEM

Work mode consists of the general operation (bucket) and the optional attachment (breaker, crusher).



14095MS03

1) GENERAL WORK MODE (bucket)

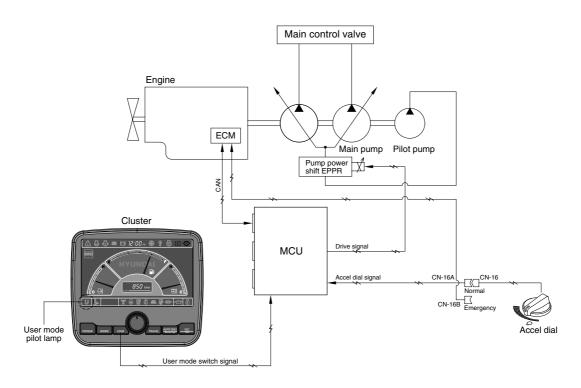
This mode is used to general digging work.

2) ATT WORK MODE (breaker, crusher)

It controls the pump flow and system pressure according to the operation of breaker or crusher.

Description	General mode	Work	c tool	
Description	Bucket	Breaker	Crusher	
Attachment safety solenoid	OFF	ON	ON	
Attachment pressure solenoid	OFF	OFF	ON	
Attachment conflux solenoid	OFF	OFF	ON/OFF	
Attachment flow EPPR current	100 mA	100~700 mA	100~700 mA	

3. USER MODE SELECTION SYSTEM



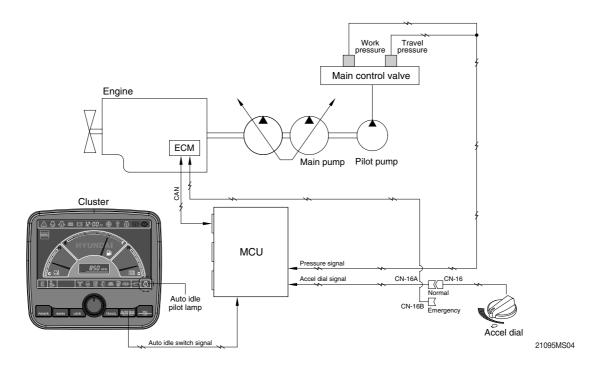
21095MS03A

1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1550	800	0
2	1600	850	3
3	1650	900 (low idle)	6
4	1700	950	9
5	1750	1000 (decel rpm)	12
6	1800	1050	16
7	1850	1100	20
8	1900	1150	26
9	1950	1200	32
10	2000	1250	38

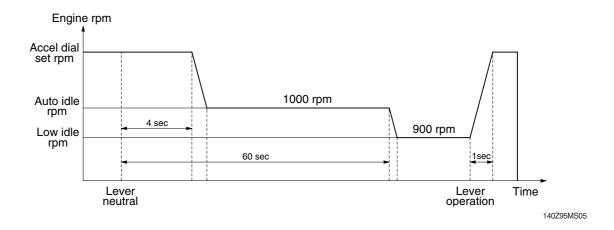
GROUP 3 AUTOMATIC DECELERATION SYSTEM



1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 900 rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

When the Auto idle pilot lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed before deceleration in a second.

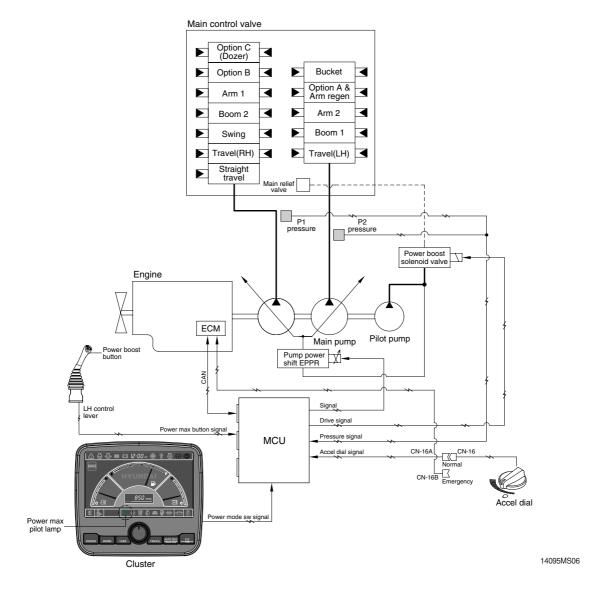


2. WHEN AUTO IDLE PILOT LAMP OFF

The engine speed can be set as desired using the accel dial switch, and even if the control levers are neutral, the engine speed is not reduced.

* Auto idle function can be activated when accel dial position is over 4.

GROUP 4 POWER BOOST SYSTEM

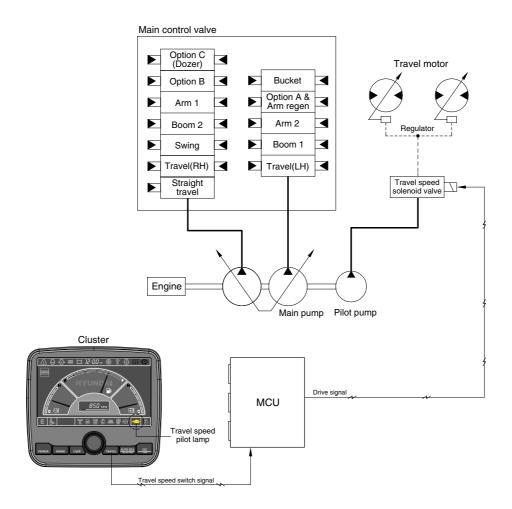


- When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.
- When the power boost function is activated, the power boost solenoid valve pilot pressure raises the set pressure of the main relief valve to increase the digging power.

Description	Condition	Function
Activated	Power boost switch : ON Accel dial : over 8	- Power mode : P - Accel dial power : 9 - Power boost solenoid : ON - Power boost pilot Imap : ON - Operating time : max 8 seconds
Canceled Power boost switch : OFF		- Pre-set power mode- Power boost solenoid : OFF- Power boost pilot lamp : OFF

* When the auto power boost is set to Enable and power mode is set to P mode on the cluster, the digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds.

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



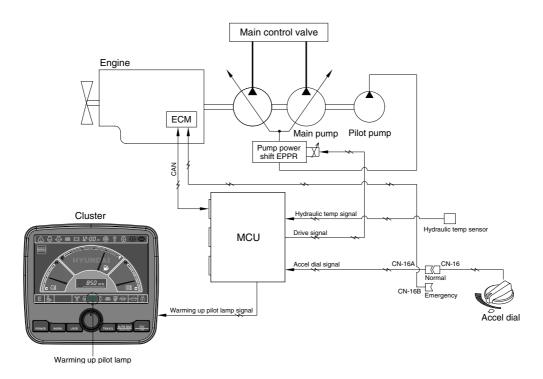
14095MS07

Travel speed can be switched manually by pressing the travel speed switch on the cluster.

Speed	Travel speed solenoid valve	Lamp on cluster	Operation
Low	OFF	Turtle	Low speed, high driving torque in the travel motor
High	ON	Rabbit	High speed, low driving torque in the travel motor

* Default: Turtle (Low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



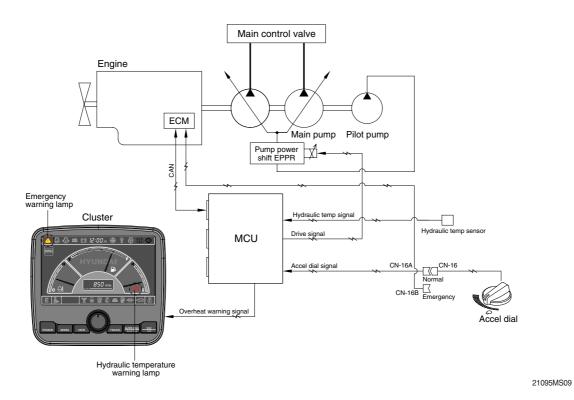
21095MS08

- The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30°C, it increases the engine speed from key start rpm to 1200rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.
- 2. In case of the coolant temperature increases up to 30°C, the engine speed is decreased to key start speed. And if an operator changes power mode set during the warming up function, the MCU cancels the automatic warming up function.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : below 30°C (after engine run)	- Power mode : Default (E mode) - Warming up time : 10 minutes (max) - Warming up pilot lamp : ON
Canceled	- Coolant temperature: Above 30°C - Warming up time: Above 10 minutes - Changed power mode set by operator - RCV lever or pedal operating - Auto idle cancel * If any of the above conditions is applicable, the automatic warming up function is canceled	- Power mode : set mode - Warming up pilot lamp : OFF

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM

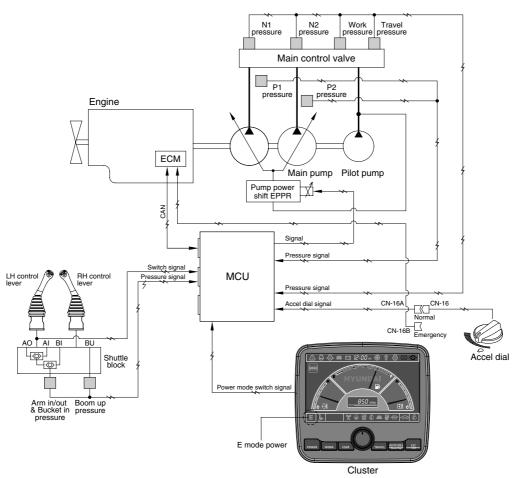


1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 100°C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant temperature : Above 103°C - Hydraulic oil temperature : Above 100°C	 Warning lamp: ON, buzzer: OFF Pump input torque is reduced. Warning lamp & buzzer: ON Pump input torque is reduced.
	Canceled	- Coolant temperature : Less than 100°C - Hydraulic oil temperature : Less than 95°C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant or hydraulic oil temperature : Above 105°C	Emergency warning lamp pops up on the center of LCD and the buzzer sounds.Engine speed is reduced after 10 seconds.
	Canceled	- Coolant temperature : Less than 103°C - Hydraulic oil temperature : Less than 100°C	Return to pre-set the engine speed.Hold pump absorption torque on the first step warning.

GROUP 8 VARIABLE POWER CONTROL SYSTEM



21095MS10

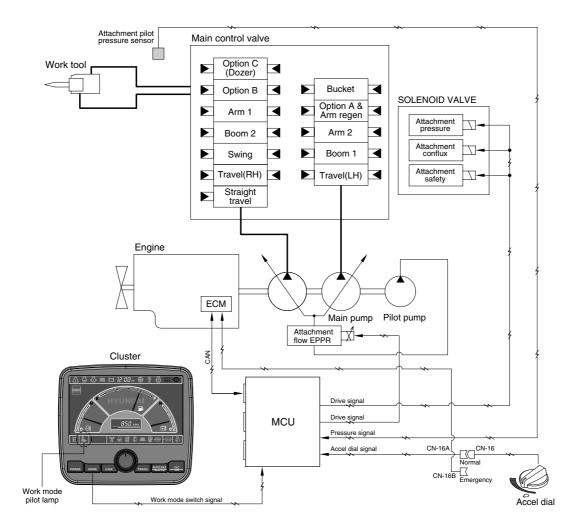
• The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.

It makes fuel saving and smooth control at precise work.

Description	Working condition
Power mode	E
Work mode	General (bucket)
Pressure sensor	Normal

* The variable power control function can be activated when the power mode is set to E mode.

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



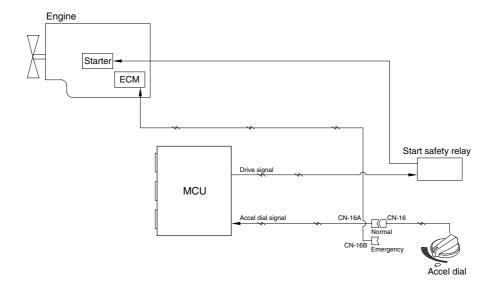
14095MS11

· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool		
Description	Breaker	Crusher	
Flow level	Max 7 step, reduced 10 lpm each step	Max 4 step, reduced 20 lpm each step	
Attach safety solenoid	ON	ON	
Attach pressure solenoid	OFF	ON	
Attach conflux solenoid	OFF	ON/OFF	

* Refer to the page 5-38 for the attachment kinds and max flow.

GROUP 10 ANTI-RESTART SYSTEM



21095MS12

1. ANTI-RESTART FUNCTION

After a few seconds from the engine starts to run, MCU turns off the start safety relay to protect the starter from inadvertent restarting.

2. When a replacement or taking-off of the MCU is needed, connect CN-16 and CN-16B to ensure the engine start without the MCU.

GROUP 11 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

When any abnormality occurs in the NEW CAPO system caused by electric parts malfunction and by open or short circuit, the MCU diagnoses the problem and sends the error codes to the cluster and also stores them in the memory.

2. MONITORING

1) Active fault



 $\cdot\,$ The active faults of the MCU or engine ECM can be checked by this menu.

2) Logged fault



• The logged faults of the MCU or engine ECM can be checked by this menu.

3) Delete fault



· The logged faults of the MCU or engine ECM can be deleted by this menu.

3. MACHINE ERROR CODES TABLE

Error code HCESPN FMI		Description
	3	Hydraulic oil temperature sensor circuit - Voltage above normal, or shorted to high source.
101	4	Hydraulic oil temperature circuit - Voltage below normal, or shorted to low source.
	0	Working pressure sensor data above normal range.
105	1	Working pressure sensor data below normal range.
105	2	Working pressure sensor data error.
	4	Working pressure sensor circuit - Voltage below normal, or shorted to Low source.
	0	Travel oil pressure sensor data above normal range.
108	1	Travel oil pressure sensor data below normal range.
100	2	Travel oil pressure sensor data error.
	4	Travel oil pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Main pump 1 (P1) pressure sensor data above normal range.
	1	Main pump 1 (P1) pressure sensor data below normal range.
120	2	Main pump 1 (P1) pressure sensor data error.
	4	Main pump 1 (P1) pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Main pump 2 (P2) pressure sensor data above normal range.
	1	Main pump 2 (P2) pressure sensor data below normal range.
121	2	Main pump 2 (P2) pressure sensor data error.
	4	Main pump 2 (P2) pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Overload pressure sensor data above normal range.
122	1	Overload pressure sensor data below normal range.
122	2	Overload pressure sensor data error.
	4	Overload pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Negative 1 pressure sensor data above normal range.
123	1	Negative 1 pressure sensor data below normal range.
120	2	Negative 1 pressure sensor data error.
	4	Negative 1 pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Negative 2 Pressure sensor data above normal range.
124	1	Negative 2 Pressure sensor data below normal range.
	2	Negative 2 Pressure sensor data error.
	4	Negative 2 Pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Pilot pump (P3) pressure sensor data above normal range.
125	1	Pilot pump (P3) pressure sensor data below normal range.
	2	Pilot pump (P3) pressure sensor data error.
	4	Pilot pump (P3) pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Boom up pilot pressure sensor data above normal range.
127	1	Boom up pilot pressure sensor data below normal range.
	2	Boom up pilot pressure sensor data error.
	4	Boom up pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Arm in/out & bucket in pilot pressure sensor data above normal range.
133	1	Arm in/out & bucket in pilot pressure sensor data below normal range.
	2	Arm in/out & bucket in pilot pressure sensor data error.
	4	Arm in/out & bucket in pilot pressure sensor circuit - Voltage below normal, or shorted to low source.

Error code		Description
HCESPN FMI		Description
	0	Swing pilot pressure sensor data above normal range.
405	1	Swing pilot pressure sensor data below normal range.
135	2	Swing pilot pressure sensor data error.
	4	Swing pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Attachment pilot pressure sensor data above normal range.
400	1	Attachment pilot pressure sensor data below normal range.
138	2	Attachment pilot pressure sensor data error.
	4	Attachment pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
110	5	Pump EPPR valve circuit - Current below normal, or open circuit.
140	6	Pump EPPR valve circuit - Current above normal.
	5	Boom priority EPPR valve circuit - Current below normal, or open circuit.
141	6	Boom priority EPPR valve circuit - Current above normal.
	5	Travel EPPR valve circuit - Current below normal, or open circuit.
143	6	Travel EPPR valve circuit - Current above normal.
	5	Attachment flow EPPR valve circuit - Current below normal, or open circuit.
144	6	Attachment flow EPPR valve circuit - Current above normal.
	5	Remote cooling fan EPPR valve circuit - Current below normal, or open circuit.
145	6	Remote cooling fan EPPR valve circuit - Current above normal.
	5	Left rotate EPPR valve circuit - Current below normal, or open circuit.
150	6	Left rotate EPPR valve circuit - Current above normal.
	5	Right rotate EPPR valve circuit - Current below normal, or open circuit.
151	6	Right rotate EPPR valve circuit - Current above normal.
	5	Left tilt EPPR valve circuit - Current below normal, or open circuit.
152	6	Left tilt EPPR valve circuit - Current above normal.
	5	Right tilt EPPR valve circuit - Current below normal, or open circuit.
153	6	
	5	Right tilt EPPR valve circuit - Current above normal. Power max solenoid circuit - Current below normal, or open circuit.
166	6	Power max solenoid circuit - Current above normal.
	5	
167	6	Travel speed solenoid circuit - Current below normal, or open circuit.
		Travel speed solenoid circuit - Current above normal.
168	5	Attachment pressure solenoid circuit - Current below normal, or open circuit.
	6	Attachment pressure solenoid circuit - Current above normal.
169	5	Attachment conflux solenoid circuit - Current below normal, or open circuit.
	6	Attachment conflux solenoid circuit - Current above normal.
170	5	Arm regeneration solenoid circuit - Current below normal, or open circuit.
	6	Arm regeneration solenoid circuit - Current above normal.
171	5	Attachment safety solenoid circuit - Current below normal, or open circuit.
	6	Attachment safety solenoid circuit - Current above normal.
181	5	Remote cooling fan reverse solenoid circuit - Current below normal, or open circuit.
	6	Remote cooling fan reverse solenoid circuit - Current above normal.
301	3	Fuel level sensor circuit - Voltage above normal, or shorted to high source.
	4	Fuel level sensor circuit - Voltage below normal, or shorted to low source.
	3	Engine coolant temperature sensor circuit - Voltage above normal, or shorted to high
304		Source.
	4	Engine coolant temperature sensor circuit - Voltage below normal, or shorted to low source.
310	8	Engine speed signal error - Abnormal frequency or pulse width.
310	3	Engine speed signal error - Abriormal frequency or pulse width. Engine preheat relay circuit - Voltage above normal, or shorted to high source.
322		
	4	Engine preheat relay circuit - Voltage below normal, or shorted to low source.
325	3	Fuel warmer relay circuit - Voltage above normal, or shorted to high source.
	4	Fuel warmer relay circuit - Voltage below normal, or shorted to low source.

HOESPN FMI 340 A Potentiometer (G/A) circuit - Voltage above normal, or shorted to high source. 4 Potentiometer (G/A) circuit - Voltage above normal, or shorted to low source. 5 Governor actuator circuit - Current above normal, or open circuit. 6 Governor actuator circuit - Current above normal or open circuit. 7 Governor actuator circuit - Current above normal range. 7 Transmission oil pressure sensor data above normal range. 7 Transmission oil pressure sensor data above normal range. 8 Transmission oil pressure sensor circuit - Voltage below normal, or shorted to low source. 9 Brake pressure sensor data above normal range. 1 Brake pressure sensor data above normal range. 2 Brake pressure sensor data above normal range. 3 Brake pressure sensor data above normal range. 4 Brake pressure sensor data above normal range. 5 Brake pressure sensor circuit - Voltage below normal, or shorted to low source. 9 Working brake pressure sensor data above normal range. 1 Working brake pressure sensor data above normal range. 2 Working brake pressure sensor data error. 4 Working brake pressure sensor data error. 5 Ram look lamp circuit - Voltage above normal, or shorted to lingh source. 5 Ram look solenoid circuit - Current below normal, or shorted to low source. 6 Ram look solenoid circuit - Current above normal and or shorted to low source. 7 Travel F pilot pressure sensor data above normal and or shorted to low source. 8 Travel F pilot pressure sensor data above normal range. 1 Travel R pilot pressure sensor data above normal range. 1 Travel R pilot pressure sensor data above normal range. 1 Travel R pilot pressure sensor data above normal range. 1 Travel R pilot pressure sensor data above normal range. 1 Travel R pilot pressure sensor data above normal range. 1 Travel R pilot pressure sensor data above normal range. 1 Travel R pilot pressure sensor data below normal range. 1 Travel R pilot p	Error code		Description
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4 Potentiometer (GA) circuit - Voltage below normal, or shorted to low source. 6 Governor actuator circuit - Current above normal, or open circuit. 7 Transmission oil pressure sensor data above normal range. 1 Transmission oil pressure sensor data above normal range. 2 Transmission oil pressure sensor data below normal, or shorted to low source. 8 Brake pressure sensor data above normal range. 1 Brake pressure sensor data below normal range. 1 Brake pressure sensor data below normal range. 2 Brake pressure sensor data below normal range. 1 Brake pressure sensor data error. 4 Brake pressure sensor data error. 4 Brake pressure sensor circuit - Voltage below normal, or shorted to low source. 8 Working brake pressure sensor data below normal range. 2 Working brake pressure sensor data below normal range. 2 Working brake pressure sensor data below normal range. 3 Working brake pressure sensor data below normal, or shorted to low source. 4 Working brake pressure sensor circuit - Voltage below normal, or shorted to low source. 3 Working brake lamp circuit - Voltage above normal, or shorted to low source. 4 Working brake lamp circuit - Voltage below normal, or shorted to low source. 5 Ram lock lamp circuit - Voltage above normal, or shorted to low source. 5 Ram lock solenoid circuit - Current below normal, or shorted to low source. 6 Ram lock solenoid circuit - Current above normal. 7 Travel F pilot pressure sensor data above normal range. 1 Travel F pilot pressure sensor data below normal range. 1 Travel F pilot pressure sensor data below normal range. 1 Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source. 4 Travel R pilot pressure sensor data below normal range. 1 Travel R pilot pressure sensor data below normal range. 1 Travel R pilot pressure sensor data below normal range. 1 Travel R pilot pressure sensor data below normal, or shorted to low source. 3 Travel R pilot pressure sensor data below normal, or shorted to low source. 4 Rocuit adicircuit -	340	3	Potentiometer (G/A) circuit - Voltage above normal, or shorted to high source.
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1 Transmission oil pressure sensor data below normal range. 2 Triansmission oil pressure sensor data error. 4 Transmission oil pressure sensor data error. 503 Brake pressure sensor data above normal range. 504 Brake pressure sensor data above normal range. 505 Brake pressure sensor data below normal range. 506 Working brake pressure sensor data below normal, or shorted to low source. 507 Working brake pressure sensor data below normal range. 508 Working brake pressure sensor data below normal range. 509 Working brake pressure sensor data below normal range. 500 Working brake pressure sensor data below normal range. 501 Working brake pressure sensor data below normal range. 502 Working brake pressure sensor circuit - Voltage below normal, or shorted to low source. 503 Working brake lamp circuit - Voltage above normal, or shorted to ligh source. 504 Working brake lamp circuit - Voltage below normal, or shorted to ligh source. 505 Ram lock lamp circuit - Voltage below normal, or shorted to low source. 506 Ram lock solenoid circuit - Current below normal, or open circuit. 507 Ram lock solenoid circuit - Current below normal range. 508 Travel F pilot pressure sensor data above normal range. 509 Travel F pilot pressure sensor data below normal range. 510 Travel F pilot pressure sensor data error. 520 Travel F pilot pressure sensor data error. 530 Travel F pilot pressure sensor circuit - Voltage below normal, or shorted to low source. 540 Travel R pilot pressure sensor data above normal range. 551 Travel R pilot pressure sensor data error. 552 Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source. 553 Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source. 554 Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source. 555 Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source. 566 Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source. 577 Travel R pilot pre	O+1	6	Governor actuator circuit - Current above normal.
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2 Transmission oil pressure sensor data error. 4 Transmission oil pressure sensor circuit - Voltage below normal, or shorted to low source. 8 Brake pressure sensor data above normal range. 2 Brake pressure sensor data below normal range. 3 Brake pressure sensor data error. 4 Brake pressure sensor circuit - Voltage below normal, or shorted to low source. Working brake pressure sensor data above normal range. 4 Working brake pressure sensor data below normal range. 4 Working brake pressure sensor data below normal range. 5 Working brake pressure sensor data below normal, or shorted to low source. 5 Working brake pressure sensor circuit - Voltage below normal, or shorted to low source. 5 Working brake lamp circuit - Voltage below normal, or shorted to low source. 5 Ram lock lamp circuit - Voltage below normal, or shorted to low source. 5 Ram lock solenoid circuit - Current below normal, or shorted to low source. 5 Ram lock solenoid circuit - Current below normal, or shorted to low source. 5 Ram lock solenoid circuit - Current below normal range. 5 Travel F pilot pressure sensor data above normal range. 6 Travel F pilot pressure sensor data below normal range. 7 Travel F pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 7 Travel R pilot pressure sensor data below normal range. 8 Hourmeter circuit - Voltage below normal, or shorted to low source. 9 MCU input voltage low. 9 MCU input voltage low. 9 Hourmeter circuit - Voltage above normal, or shorted to high source. 9 Acc. dial circuit - Voltage above normal, or shorted to high source. 9 Rotate signal input circu	501	1	Transmission oil pressure sensor data below normal range.
Brake pressure sensor data above normal range.	301	2	Transmission oil pressure sensor data error.
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Working brake pressure sensor data above normal range.	303	2	Brake pressure sensor data error.
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841 2 ECM communication data error. 843 2 Option #1 (CAN 2) communication data error.			
843 2 Option #1 (CAN 2) communication data error.			

4. ENGINE FAULT CODE

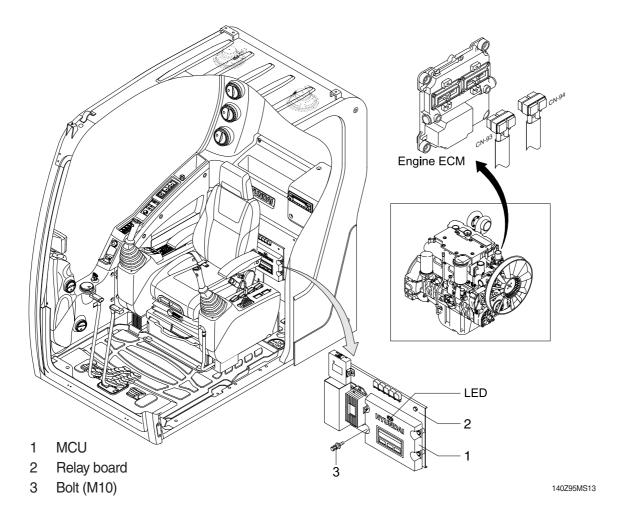
SPN	FMI	Fault code No.	Description
91	2	SPN91-FMI2	Throttle Position Sensor Data Erratic, Intermittent, or Incorrect
	3	SPN91-FMI3	(Secondary) Throttle Position Sensor Voltage Above Normal or Shorted High
	4	SPN91-FMI4	(Secondary) Throttle Position Sensor Voltage Below Normal or Shorted Low
	8	SPN91-FMI8	(Secondary) Throttle Position Sensor Abnormal Frequency or Period
	12	SPN91-FMI12	(Secondary) Throttle Position Sensor Bad Device or Component
100	1	SPN100-FMI1	Engine Oil pressure Low-Warning
	2	SPN100-FMI2	Engine Oil Pressure Low-Derate
	3	SPN100-FMI3	Engine Oil Pressure Sensor Voltage Above Normal or Shorted High(Shutdown)
	4	SPN100-FMI4	Engine Oil Pressure Sensor Voltage Below Normal or Shorted Low
105	10	SPN100-FMI10	Engine Oil Pressure Sensor 5V Supply Connection Open Circuit
	1	SPN105-FMI1	Inlet Manifold Air Temp High-Warning
	2	SPN105-FMI2	Inlet Manifold Air Temp High-Derate
	3	SPN105-FMI3	Inlet Manifold Air Temp Sensor Voltage Above Normal or Shorted High
	4	SPN105-FMI4	Inlet Manifold Air Temp Sensor Voltage Below Normal or Shorted Low
106	3	SPN106-FMI3	Inlet Manifold Pressure Sensor Voltage Above Normal or Shorted High
	4	SPN106-FMI4	Inlet Manifold Pressure Sensor Voltage Below Normal or Shorted Low
	10	SPN106-FMI10	Inlet Manifold Pressure Sensor 5V Supply Connection Open Circuit
110	1	SPN110-FMI1	Engine Coolant Temp High-Warning
	2	SPN110-FMI2	Engine Coolant Temp High-Derate
	3	SPN110-FMI3	Engine Coolant Temp Sensor Voltage Above Normal or Shorted High(Shutdown)
	4	SPN110-FMI4	Engine Coolant Temp Sensor Voltage Below Normal or Shorted Low
157	3	SPN157-FMI3	Fuel Rail Pressure Sensor Voltage Above Normal or Shorted High
	4	SPN157-FMI4	Fuel Rail Pressure Sensor Voltage Below Normal or Shorted Low
157	2	SPN158-FMI2	Keyswitch Data Erratic, Intermittent, or Incorrect
168	0	SPN168-FMI0	Engine ECM Battery Power Excessive
	1	SPN168-FMI1	Engine ECM Battery Power Low
	2	SPN168-FMI2	Engine ECM Battery Power Intermittent
190	1	SPN190-FMI1	Engine Overspeed - Warning
	8	SPN190-FMI8	Speed/Timing Sensor Abnormal Signal Frequency
558	2	SPN558-FMI2	(Secondary) Throttle Position Sensor Idle Validation Switch
630	2	SPN630-FMI2	Customer or System Parameters Data Incorrect
631	2	SPN631-FMI2	Engine Software Data Incorrect
637	11	SPN637-FMI11	Primary to Secondary Engine Speed Signal Calibration Fault
639	9	SPN639-FMI9	SAE J1939 Data Link Abnormal Update
646	5	SPN646-FMI5	Turbo Wastegate Solenoid Current Low
	6	SPN646-FMI6	Turbo Wastegate Solenoid Current High
651	5	SPN651-FMI5	Cylinder #1 Injector Current Low

** SPN : Suspect Parameter Number FMI : Failure Mode Identifier

SPN	FMI	Fault code No.	Description
651	6	SPN651-FMI6	Cylinder #1 Injector Current High
	7	SPN651-FMI7	Cylinder #1 Injector Not Responding
652	5	SPN652-FMI5	Cylinder #2 Injector Current Low
	6	SPN652-FMI6	Cylinder #2 Injector Current High
	7	SPN652-FMI7	Cylinder #2 Injector Not Responding
653	5	SPN653-FMI5	Cylinder #3 Injector Current Low
	6	SPN653-FMI6	Cylinder #3 Injector Current High
	7	SPN653-FMI7	Cylinder #3 Injector Not Responding
654	5	SPN654-FMI5	Cylinder #4 Injector Current Low
	6	SPN654-FMI6	Cylinder #4 Injector Current High
	7	SPN654-FMI7	Cylinder #4 Injector Not Responding
655	5	SPN655-FMI5	Cylinder #5 Injector Current Low
	6	SPN655-FMI6	Cylinder #5 Injector Current High
	7	SPN655-FMI7	Cylinder #5 Injector Not Responding
656	5	SPN656-FMI5	Cylinder #6 Injector Current Low
	6	SPN656-FMI6	Cylinder #6 Injector Current High
	7	SPN656-FMI7	Cylinder #6 Injector Not Responding
676	5	SPN676-FMI5	Glow Plug Start Aid Relay Current Low
	6	SPN676-FMI6	Glow Plug Start Aid Relay Current High
678	3	SPN678-FMI3	Engine ECM 8V DC Supply Voltage Above Normal or Shorted High
	4	SPN678-FMI4	Engine ECM 8V DC Supply Voltage Below Normal or Shorted Low
723	8	SPN723-FMI8	Secondary Engine Speed Sensor Abnormal Signal Frequency
1079	3	SPN1079-FMI3	5V Sensor DC Supply Voltage Above Normal or Shorted High
	4	SPN1079-FMI4	5V Sensor DC Supply Voltage Below Normal or Shorted Low
1188	7	SPN1188-FMI7	Turbo Wastegate Not Responding
1347	5	SPN1347-FMI5	Fuel Rail Pump Output Current Low
	6	SPN1347-FMI6	Fuel Rail Pump Output Current High
	7	SPN1347-FMI7	Fuel Rail Pump Output Not Responding

GROUP 12 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



2. MCU ASSEMBLY

- 1) To match the pump absorption torque with the engine torque, MCU varies EPPR valve output pressure, which control pump discharge amount whenever feedbacked engine speed drops under the reference rpm of each mode set.
- 2) Three LED lamps on the MCU display as below.

LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on MCU	· Change the MCU
G and Y are turned ON	Trouble on serial	· Check if serial communication
	communication line	lines between controller and cluster are
		disconnected
Three LED are turned OFF	Trouble on MCU power	· Check if the input power wire (24 V, GND) of
		controller is disconnected
		· Check the fuse

G: green, R: red, Y: yellow

GROUP 13 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

EPPR (Electro Proportional Pressure Reducing) valve consists of electro magnet and spool valve installed at main pump.

(1) Electro magnet valve

Receive electric current from MCU and move the spool proportionally according to the specific amount of electric current value.

(2) Spool valve

Is the two way direction control valve for pilot pressure to reduce main pump flow. When the electro magnet valve is activated, pilot pressure enters into flow regulator of main pump.

(3) Pressure and electric current value for each mode

Mode		Pres	Pressure		Engine rpm
Iviode	Mode			(mA)	(at accel dial 10)
	Р	5	71	250 ± 30	2000 ± 50
Standard (Stage : 1.0)	S	8 ± 3	114 ± 40	290 ± 30	1800 ± 50
(Otago: 1.0)	Е	13 ± 3	185 ± 40	365 ± 30	1650 ± 50
O all'a a	Р	0	0	160 ± 30	2000 ± 50
Option (Stage : 2.0)	S	5 ± 3	71 ± 40	250 ± 30	1900 ± 50
	Е	10 ± 3	142 ± 40	320 ± 30	1750 ± 50

2) HOW TO SWITCH THE STAGE (1.0 ↔ 2.0) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the stage $(1.0 \leftrightarrow 2.0)$.

- Management

· Service menu

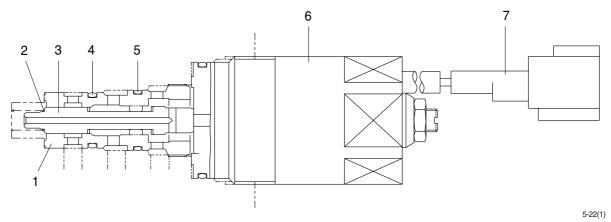


21093CD67ZZ

· Power shift (standard/option): Power shift pressure can be set by option menu.

3) OPERATING PRINCIPLE (pump EPPR valve)

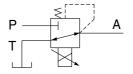
(1) Structure



- 1 Sleeve
- 2 Spring
- 3 Spool

- 4 O-ring
- 5 O-ring

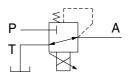
- 6 Solenoid valve
- 7 Connector

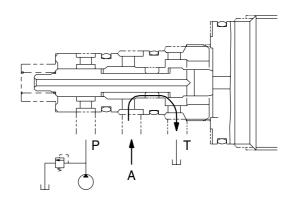


- P Pilot oil supply line (pilot pressure)
- T Return to tank
- A Secondary pressure to flow regulator at main pump

(2) Neutral

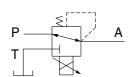
Pressure line is blocked and A oil returns to tank.

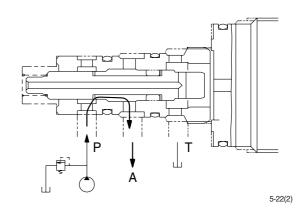




(3) Operating

Secondary pressure enters into A.



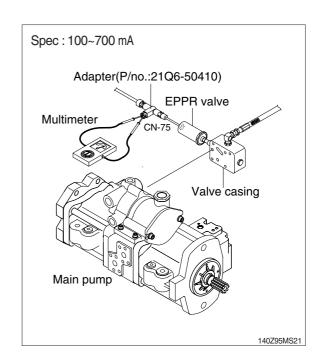


5-22

4) EPPR VALVE CHECK PROCEDURE

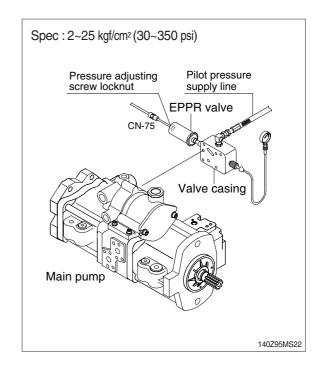
(1) Check electric current value at EPPR valve

- ① Disconnect connector CN-75 from EPPR valve.
- ② Insert the adapter to CN-75 and install multimeter as figure.
- ③ Start engine.
- 4 Set S-mode and cancel auto decel mode.
- (5) Position the accel dial at 10.
- 6 If rpm display show approx 1800 ± 50 rpm check electric current at bucket circuit relief position.



(2) Check pressure at EPPR valve

- ① Remove plug and connect pressure gauge as figure.
 - Gauge capacity: 0 to 50 kgf/cm²
 (0 to 725 psi)
- ② Start engine.
- ③ Set S-mode and cancel auto decel mode.
- 4 Position the accel dial at 10.
- ⑤ If rpm display approx 1800±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
- 6 If pressure is not correct, adjust it.
- ⑦ After adjust, test the machine.



2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

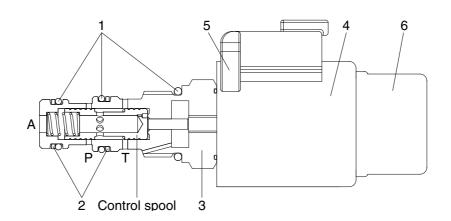
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

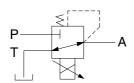
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30 Ω and 24 V.

3) OPERATING PRINCIPLE

(1) Structure



21095MS14



P : Pilot supply line

T : Return to tank

A: Secondary pressure to flow MCV

1 O-ring

3 Valve body

5 Connector

2 Support ring

4 Coil

6 Cover cap

(2) Operation

In de-energized mode the inlet port (P) is closed and the outlet port (A) is connected to tank port (T).

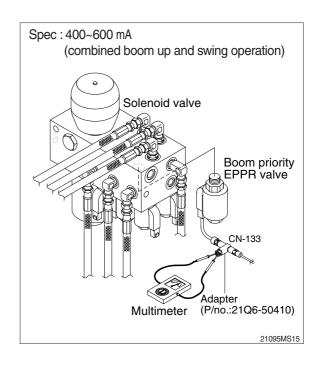
In energized mode the solenoid armature presses onto the control spool with a force corresponding to the amount of current. This will set a reduced pressure at port A. The setting is proportional to the amount of current applied.

(3) Maximum pressure relief

If a pressure from outside is applied on port A the valve may directly switch to tank port (T) and protect the system before overload.

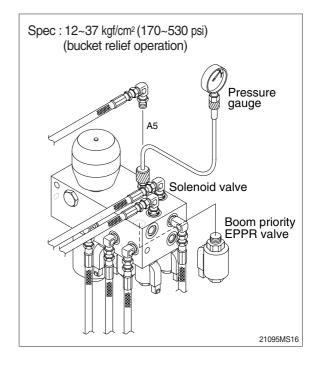
2) EPPR VALVE CHECK PROCEDURE

- (1) Check electric current value at EPPR valve
 - ① Disconnect connector CN-133 from EPPR valve.
 - ② Insert the adapter to CN-133 and install multimeter as figure.
 - 3 Start engine.
 - ④ If rpm display approx 1800±50 rpm check electric current in case of combined boom up and swing operation.



(2) Check pressure at EPPR valve

- ① Remove hose from A5 port and connect pressure gauge as figure.
 - Gauge capacity: 0 to 50 kgf/cm²
 (0 to 725 psi)
- ② Start engine.
- ④ If pressure is not correct, adjust it.
- ⑤ After adjust, test the machine.



GROUP 14 MONITORING SYSTEM

1. OUTLINE

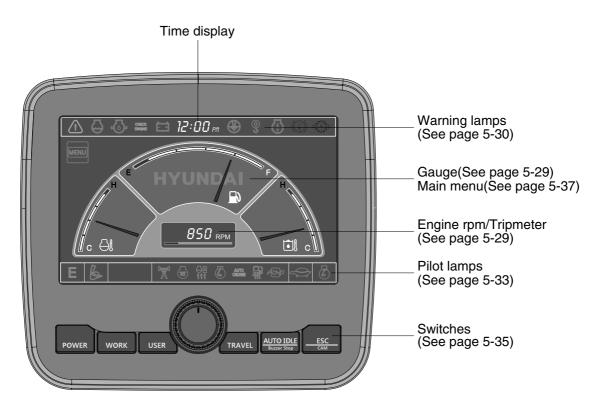
Monitoring system consists of the monitor part and switch part.

The monitor part gives warnings when any abnormality occurs in the machine and informs the condition of the machine.

Various select switches are built into the monitor panel, which act as the control portion of the machine control system.

2. CLUSTER

1) MONITOR PANEL



14095MS30

2) CLUSTER CHECK PROCEDURE

(1) Start key: ON

① Check monitor

- a. Buzzer sounding for 4 seconds with HYUNDAI logo on cluster.
- * If the ESL mode is set to the enable, enter the password to start engine.
- ② After initialization of cluster, the operating screen is displayed on the LCD. Also, self diagnostic function is carried out.
 - a. Engine rpm display: 0 rpm
 - b. Engine coolant temperature gauge: White range
 - c. Hydraulic oil temperature gauge: White range
 - d. Fuel level gauge: White range

③ Indicating lamp state

- a. Power mode pilot lamp: E mode or U mode
- b. Work mode pilot lamp : General operation mode (bucket)
- c. Travel speed pilot lamp: Low (turtle)

(2) Start of engine

① Check machine condition

- a. RPM display indicates at present rpm
- b. Gauge and warning lamp: Indicate at present condition.
- * When normal condition : All warning lamp OFF
- c. Work mode selection : General work
- d. Power mode selection: E mode or U mode
- e. Travel speed pilot lamp: Low (turtle)

② When warming up operation

- a. Warming up pilot lamp: ON
- b. After engine started, engine speed increases to 1000 rpm.
- * Others same as above.

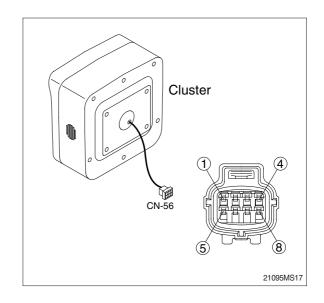
③ When abnormal condition

- a. The warning lamp lights up and the buzzer sounds.
- b. If BUZZER STOP switch is pressed, buzzer sound is canceled but the lamp warning lights up until normal condition.
- * The pop-up warning lamp moves to the original position and blink when the select switch is pushed. Also the buzzer stops.

3. CLUSTER CONNECTOR

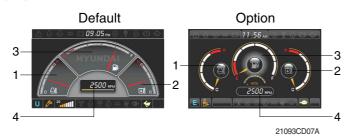
No.	Name	Signal
1	Battery 24V	20~32V
2	Signal 3	NTSC
3	GND	-
4	Serial + (TX)	0~5V
5	Power IG (24V)	20~32V
6	Signal 2	NTSC
7	Camera signal	NTSC
8	Serial - (RX)	0~5V

NTSC : the united states National Television Systems Committee



2) GAUGE

(1) Operation screen



- 1 Engine coolant temperature gauge
- 2 Hydraulic oil temperature gauge
- 3 Fuel level gauge
- 4 RPM / Tripmeter display
- * Operation screen type can be set by the screen type menu of the display. Refer to page 5-47 for details.

(2) Engine coolant temperature gauge



- ① This gauge indicates the temperature of coolant.
 - 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, turn OFF the engine and check the engine cooling system.
- * If the gauge indicates the red range or lamp 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.

(3) Hydraulic oil temperature gauge



- ① This gauge indicates the temperature of hydraulic oil.
 - 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 is red, reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.
- * If the gauge indicates the red range or lamp 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.

(4) Fuel level gauge



21093CD07F

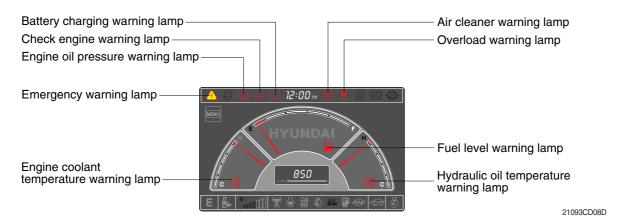
- 1) This gauge indicates the amount of fuel in the fuel tank.
- ② Fill the fuel when the red range, or R lamp blinks in red.
- * If the gauge indicates the red range or \(\bigcap \) lamp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.

(5) RPM / Tripmeter display



- ① This displays the engine speed or the tripmeter.
- * Refer to page 5-47 for details.

3) WARNING LAMPS



Each warning lamp on the top of the LCD pops up on the center of LCD and the buzzer sounds when the each warning is happened. The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. And the buzzer stops.
Refer to page 5-36 for the select switch.

(1) Engine coolant temperature



21093CD08A

- ① Engine coolant temperature warning is indicated two steps.
 - 103°C over : The → lamp blinks and the buzzer sounds.
 - 107°C over : The <u>(1)</u> lamp pops up on the center of LCD and the buzzer sounds.
- ② The pop-up (i) lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.
- ③ Check the cooling system when the lamp keeps ON.

(2) Hydraulic oil temperature



21093CD08C

- ① Hydraulic oil temperature warning is indicated two steps.
 - 100°C over : The lamp blinks and the buzzer sounds.
 - 105°C over : The \(\hat{\omega}\) lamp pops up on the center of LCD and the buzzer sounds.
- ② The pop-up <u>1</u> lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.
- ③ Check the hydraulic oil level and hydraulic oil cooling system.

(3) Fuel level



- ① This warning lamp blinks and the buzzer sounds when the level of fuel is below 31 ι (8.2 U.S. gal).
- ② Fill the fuel immediately when the lamp blinks.

21093CD08B

(4) Emergency warning lamp



21093CD30

- ① This lamp pops up and the buzzer sounds when each of the below warnings is happened.
 - Engine coolant overheating (over 107°C)
 - Hydraulic oil overheating (over 105°C)
 - Pump EPPR circuit abnormal or open
 - Attachment flow EPPR circuit abnormal or open
 - MCU input voltage abnormal
 - Accel dial circuit abnormal or open
 - Cluster communication data error
 - Engine ECM communication data error
- ** The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. Also the buzzer stops. This is same as following warning lamps.
- ② When this warning lamp blinks, machine must be checked and serviced immediately.

(5) Engine oil pressure warning lamp



21093CD32

- ① This lamp blinks when the engine oil pressure is low.
- ② If the lamp blinks, shut OFF the engine immediately. Check oil level.

(6) Check engine warning lamp

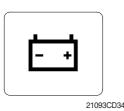


21093CD33



- This lamp blinks when the communication between MCU and engine ECM on the engine is abnormal, or if the cluster received any 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 cluster.
- 3 This lamp blinks when "Engine check water in fuel" is displayed in the message box then check water separator.

(7) Battery charging warning lamp



- ① This lamp blinks when the battery charging voltage is low.
- ② Check the battery charging circuit when this lamp blinks.

(8) Air cleaner warning lamp



21093CD35

- $\ensuremath{\textcircled{1}}$ This lamp blinks when the filter of air cleaner is clogged.
- ② Check the filter and clean or replace it.

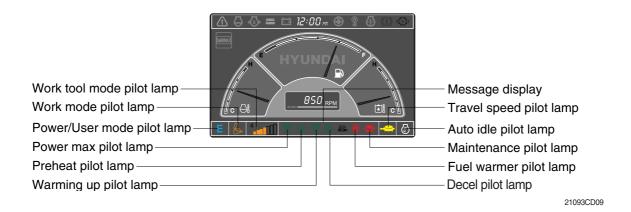
(9) Overload warning lamp (opt)



21093CD36

- ① When the machine is overload, the overload warning lamp blinks during the overload switch is ON. (if equipped)
- ② Reduce the machine load.

4) PILOT LAMPS



(1) Mode pilot lamps

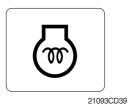
No	Mode	Pilot lamp	Selected mode
		P	Heavy duty power work mode
1	Power mode	S	Standard power mode
		E	Economy power mode
2	User mode	U	User preferable power mode
			General operation mode
3	Work mode		Breaker operation mode
			Crusher operation mode
4	Travel mode		Low speed traveling
4	maver mode	*	High speed traveling
5	Auto idle mode	\bigcirc	Auto idle
6	Work tool mode	4	Oil flow level of breaker or crusher mode
7	Message display		"Setting is completed" display after selection

(2) Power max pilot lamp



- ① The lamp will be ON when pushing power max switch on the LH RCV lever.
- ② The power max function is operated maximum 8 seconds.
- * Refer to the operator's manual page 3-26 for power max function.

(3) Preheat pilot lamp



- ① Turning the start key switch ON position starts preheating in cold weather.
- ② Start the engine after this lamp is OFF.

(4) Warming up pilot lamp



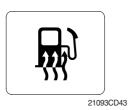
- ① This lamp is turned ON when the coolant temperature is below 30°C(86°F).
- ② The automatic warming up is cancelled when the engine coolant temperature is above 30°C, or when 10 minutes have passed since starting the engine.

(5) Decel pilot lamp



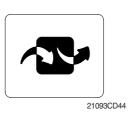
- ① Operating one touch decel switch on the RCV lever makes the lamp ON.
- ② Also, the lamp will be ON and engine speed will be lowered automatically to save fuel consumption when all levers and pedals are at neutral position, and the auto idle function is selected.
- * One touch decel is not available when the auto idle pilot lamp is turned ON.
- * Refer to the operator's manual page 3-26.

(6) Fuel warmer pilot lamp



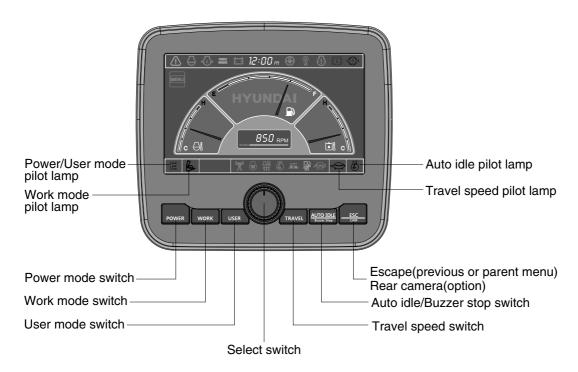
- ① This lamp is turned ON when the coolant temperature is below 10°C (50°F) or the hydraulic oil temperature 20°C (68°F).
- ② The automatic fuel warming is cancelled when the engine coolant temperature is above 60°C, or the hydraulic oil temperature is above 45°C since the start switch was ON position.

(7) Maintenance pilot lamp



- ① This lamp will be ON when the consuming parts are needed to change or replace. It means that the change or replacement interval of the consuming parts remains below 30 hours.
- ② Check the message in maintenance information of main menu. Also, this lamp lights ON for 3 minutes when the start switch is ON position.

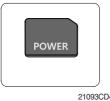
5) SWITCHES



21093CD45

* When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-40 for details.

(1) Power mode switch



21093CD45A

- ① This switch is to select the machine power mode and selected power mode pilot lamp is displayed on the pilot lamp position.
 - · P : Heavy duty power work.
 - · S : Standard power work.
 - · E : Economy power work.
- ② The pilot lamp changes $E \rightarrow S \rightarrow P \rightarrow E$ in order.

(2) Work mode switch



- ① This switch is to select the machine work mode, which shifts from general operation mode to optional attachment operation mode.
 - · 🖒 : General operation mode
 - · 🔊 : Breaker operation mode (if equipped)
 - · 🖟 : Crusher operation mode (if equipped)
 - · Not installed : Breaker or crusher is not installed.
- * Refer to the operator's manual page 4-6 for details.

(3) User mode switch



21093CD45D

- 1) This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.
 - · Memory: Push more than 2 seconds.
 - · Action : Push within 2 seconds.
 - · Cancel: Push this switch once more within 2 seconds.
- ② Refer to the page 5-38 for another set of user mode.

(4) Select switch



21093CD45E

- ① This switch is used to select or change the menu and input value.
- 2 Knob push
 - · Long (over 2 sec) : Return to the operation screen
 - · Medium (0.5~2 sec): Return to the previous screen
 - · Short (below 0.5 sec) : Select menu
- (3) Knob rotation

This knob changes menu and input value.

- · Right turning: Down direction / Increase input value
- · Left turning : Up direction / Decreased input value

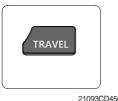
(5) Auto idle/ buzzer stop switch



21093CD45F

- ① This switch is used to activate or cancel the auto idle function.
 - · Pilot lamp ON : Auto idle function is activated.
 - · Pilot lamp OFF : Auto idle function is cancelled.
- ② The buzzer sounds when the machine has a problem. In this case, push this switch and buzzer stops, but the warning lamp blinks until the problem is cleared.

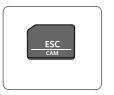
(6) Travel speed control switch



21093CD45G

- ① This switch is used to select the travel speed alternatively.
 - : High speed : Low speed

(7) Escape/Camera switch



21093CD45H

- ① This switch is used to return to the previous menu or parent menu.
- ② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
 - Please refer to page 5-48 for the camera.
- ③ If the camera is not installed, this switch is used only ESC function.

6) MAIN MENU



* Please refer to select switch, page 5-36 for selection and change of menu and input value.

(1) Structure

No	Main menu	Sub menu	Description
1	Mode 21093CD64D	Work tool U mode power Boom/Arm speed Auto power boost Initial mode Cluster switch (back up)	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable Default, U mode Switch function
2	Monitoring 21093CD64E	Active fault Logged fault Delete logged fault Monitoring (analog) Monitoring (digital) Operating hours	MCU, Engine ECM MCU, Engine ECM All logged fault delete, Initialization canceled Machine information Switch status, Output status Operating hours for each mode
3	Management 21093CD64F	Maintenance information Machine security Machine Information A/S phone number Service menu	Replacement, Change interval oils and filters ESL mode setting, Password change Cluster, MCU, Engine, Machine A/S phone number, A/S phone number change Power shift, Hourmeter, Replacement history, Update
4	Display 21093CD64G	Display item Clock Brightness Unit Language Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Date format Korean, English, Chinese A type, B type
5	Utilities 21093CD64H	Tripmeter DMB Entertainment Camera setting Message box	3 kinds (A, B, C) DMB select, DAB select, Channel scan, Exit Play MP4, codec. Basic direction, Display switching, Full screen Record for fault, attachment etc.

(2) Mode setup

① Work tool



- · A : Select one installed optional attachment.
- · B : Max flow Set the maximum flow for the attachment.

Flow level - Reduce the operating flow from maximum flow.

Breaker - Max 7 steps, Reduced 10 lpm each step.

Crusher - Max 4 steps, Reduced 20 lpm each step.

* The flow level is displayed with the work mode pilot lamp.

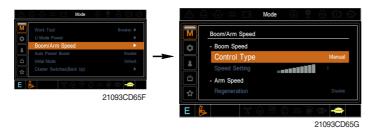
2 U mode power



- Engine high idle rpm, auto idle rpm and pump torque (power shift) can be modulated and memorized separately in U-mode.
- · U-mode can be activated by user mode switch.

Step (■)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1550	800	0
2	1600	850	3
3	1650	900 (low idle)	6
4	1700	950	9
5	1750	1000 (decel rpm)	12
6	1800	1050	16
7	1850	1100	20
8	1900	1150	26
9	1950	1200	32
10	2000	1250	38

3 Boom/Arm speed



Boom speed

- Control type

Manual - Boom up speed is fixed as set steps.

Auto - Boom up speed is automatically adjusted as working conditions by the MCU.

- Speed setting - Boom up speed is increased as much as activated steps.

· Arm speed

- Regeneration - Arm regeneration function can be activated or cancelled.

Enable - Arm in speed is up.

Disable - Fine operation.

4 Auto power boost



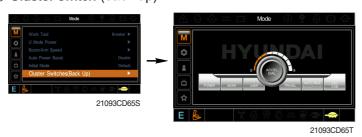
- · The power boost function can be activated or cancelled.
- Enable The digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds.
- · Disable Not operated.

⑤ Initial mode



- · Default The initial power mode is set E mode when the engine is started.
- · U mode The initial power mode is set U mode when the engine is started.

6 Cluster switch (back up)



- The cluster switch can be selected and changed by this menu when the switches are abnormal on the cluster.
- In order to exit "Cluster switch" mode, please put the cursor on the ESC/CAM switch by turning the select switch and push the select switch.
- In "Cluster switch", other switches except "Select switch" do not work.

(3) Monitoring

① Active fault



· The active faults of the MCU or engine ECM can be checked by this menu.

② Logged fault



• The logged faults of the MCU or engine ECM can be checked by this menu.

3 Delete logged fault



• The logged faults of the MCU or engine ECM can be deleted by this menu.

4 Monitoring (analog)



• The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu.

⑤ Monitoring (digital)



- · The switch status or output status can be confirmed by this menu.
- · The activated switch or output pilot lamps 🐥 are light ON.

⑥ Operating hours



· The operating hour of each mode can be confirmed by this menu.

(4) Management

① Maintenance information



· Alarm(🜣 🌞): Gray 🜣 - Normal

Yellow 🐈 - First warning

Red - Second warning

· Replacement : The elapsed time will be reset to zero (0).

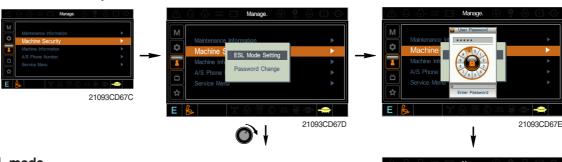
· Change interval : The change or replace interval can be changed in the unit of 50 hours.

OK: Return to the item list screen.

· Change or replace interval

No	Item	Interval
1	Engine oil	500
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	5000
5	Pilot line filter	1000
6	Drain filter	1000
7	Hydraulic oil return filter	1000
8	Engine oil filter	500
9	Fuel filter	500
10	Pre-filter	500
11	Hydraulic tank breather	250
12	Air cleaner (inner)	500
13	Radiator coolant	2000
14	Swing gear pinion grease	1000

2 Machine security

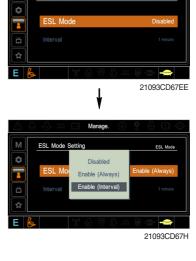


· ESL mode

- 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 Enable, the password will be required when the start switch is turned ON.
- Disable: Not used ESL function
 - Enable (always) : The password is required whenever the operator start engine.

Enable (interval): The password is required when the operator start engine first. But the operator can restart the engine within the interval time without inputting the password.

The interval time can be set maximum 4 hours.







Enter the current password ^{21093CD67V}

^

· Password change

- The password is 5~10 digits.



Enter the new password 21093CD67VV



21093CD67X



Enter the new password again

The new password is stored in the MCU.

(3) Machine Information



· This can confirm the identification of the cluster, MCU, engine and machine.

(4) A/S phone number



⑤ Service menu



- 21093CD67ZZ
- · Power shift (standard/option): Power shift pressure can be set by option menu.
- · Hourmeter: Operating hours since the machine line out can be checked by this menu.
- Replacement history: Replacement history of the MCU and cluster can be checked by this menu.
- · Update : Firm ware can be upgraded by this menu. (the USB port is located under the cluster)

(5) Display

① Display item



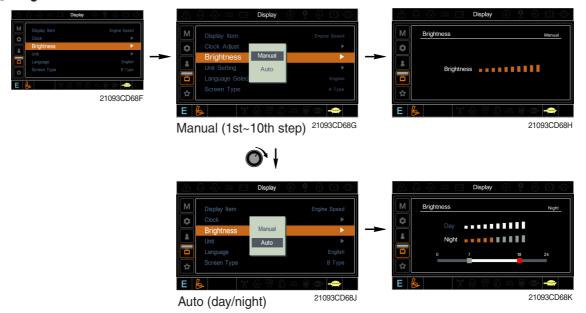
- · The center display type of the LCD can be selected by this menu.
- · The engine speed or each of the tripmeter (A,B,C) is displayed on the center display.

2 Clock



- The first line's three spots "**/***" represent Month/Day/Year each.
- The second line shows the current time. (0:00~23:59)

③ Brightness



If "Auto" is chosen, brightness for day and night can be differently set up. Also by using the bar in lower side, users can define which time interval belongs to day and night.

(in bar figure, gray area represents night time while white shows day time)

4 Unit



· Temperature : $^{\circ}C \leftrightarrow ^{\circ}F$

· Pressure : bar \leftrightarrow MPa \leftrightarrow kgf/cm²

· Flow : $lpm \leftrightarrow gpm$

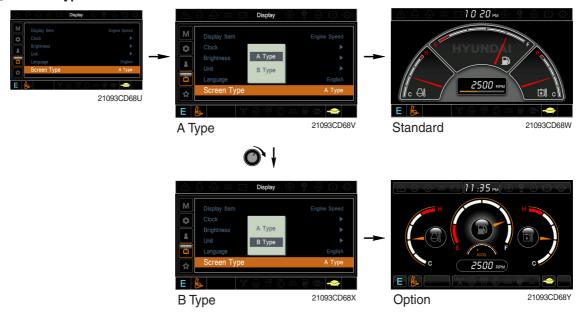
· Date format : $yy/mm/dd \leftrightarrow mm/dd/yy \leftrightarrow dd-Mar-yy$

⑤ Language



· User can select preferable language and all displays are changed the selected language.

6 Screen type



(6) Utilities

① Tripmeter



- · Maximum 3 kinds of tripmeters can be used at the same time.
- Each tripmeter can be turned on by choosing "Start" while it also can be turned off by choosing "Stop".
- · If the tripmeter icon is activated in the operation screen, it can be controlled directly there.

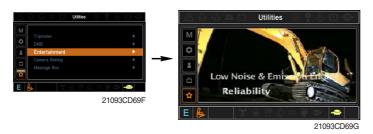
2 DMB



- · DMB select : TV channel can be selected by this menu.
- · DAB select : Audio channel can be selected by this menu.
- · Channel scan: This menu can be used other region for TV/Audio.
- · Exit : Exit DMB menu

③ Entertainment

- · Play MP4 or codec file of external hard disk through USB port.
- · The USB port is located under the cluster.



4 Camera setting



- · Three cameras can be installed on the machine.
- · The display order can be set by this menu.



- · If the camera was not equipped, this menu is not useful.
- · In the operation screen, if the ESC/CAM switch is pushed, the first ordered display camera will be viewed.
- Turning the select switch in clockwise direction, the next ordered will be shown and in counter-clockwise direction, the previously ordered will be shown.
- · Push the select switch, the displayed screen will be enlargement.

⑤ Message box

• The history of the machine operating status can be checked by this menu.



GROUP 15 FUEL WARMER SYSTEM

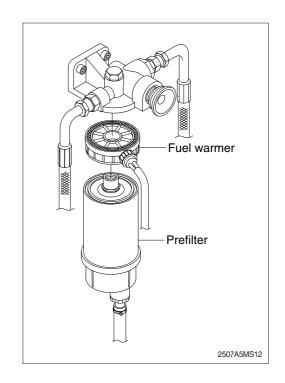
1. SPECIFICATION

1) Operating voltage: 24 ± 4 V

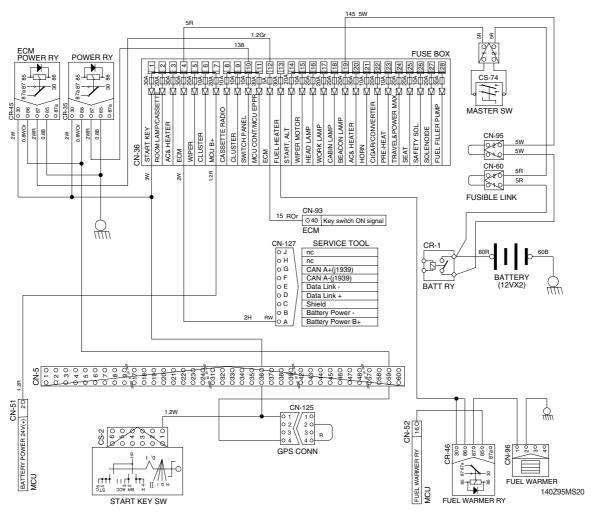
2) Power: 350±50 W 3) Current: 15 A

2. OPERATION

- 1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
- 2) At the first state, the 15 A 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 1.5 A.
 - So, fuel is protected from overheating by this mechanism.



3. ELECTRIC CIRCUIT



SECTION 6 TROUBLESHOOTING

Group	1 Before Troubleshooting	6-1
Group	2 Hydraulic and Mechanical System	6-4
Group	3 Electrical System	6-24
Group	4 Mechatronics System	6-40

SECTION 6 TROUBLESHOOTING

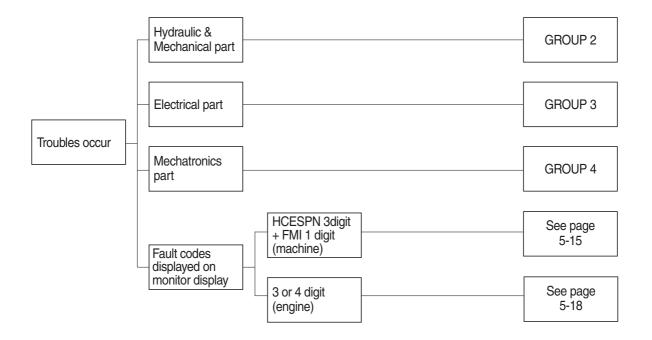
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

When a trouble is occurred in the machine, this section will help an operator to maintain the machine with easy.

The trouble of machine is parted Hydraulic & Mechanical system, Electrical system and Mechatronics system. At each system part, an operator can check the machine according to the troubleshooting process diagram.

* Before carring out troubleshooting procedure, check monitoring menu in the cluster.



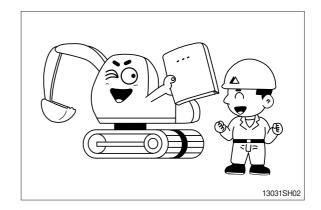
2. DIAGNOSING PROCEDURE

To carry out troubleshooting efficiently, the following steps must be observed.

STEP 1. Study the machine system

Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.

Especially, deepen the knowledge for the related parts of the trouble.



STEP 2. Ask the operator

Before inspecting, get the full story of malfunctions from a witness --- the operator.

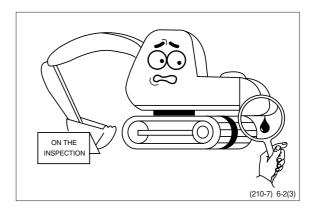
- 1) How the machine is used and when it is serviced?
- 2) When the trouble was noticed and what work the machine was doing at that time?
- 3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
- 4) Did the machine have any troubles previously? If so, which parts were repaired before.



STEP 3. Inspect the machine

Before starting troubleshooting, check the machine for the daily maintenance points as shown in the operator's manual.

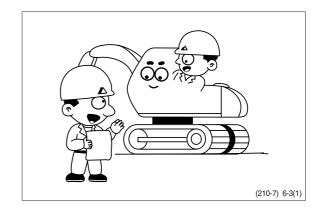
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



STEP 4. Inspect the trouble actually on the machine

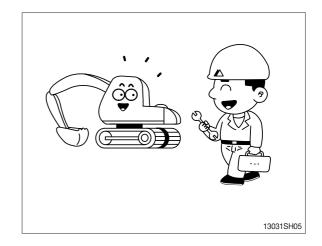
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.

Also, check if there are any in complete connections of the wire harnesses are or not.



STEP 5. Perform troubleshooting

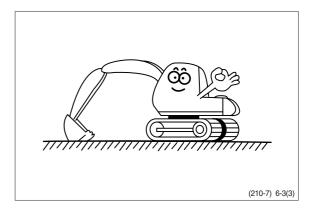
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.



STEP 6. Trace a cause

Before reaching a conclusion, check the most suspectible causes again. Try to trace what the real cause of the trouble is.

Make a plan of the appropriate repairing procedure to avoid consequential malfunctions.



GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

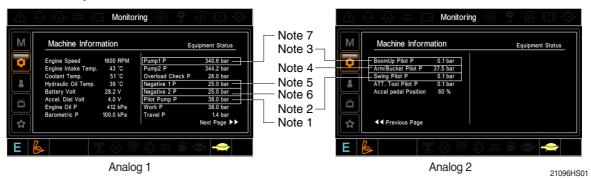
1. INTRODUCTION

1) MACHINE IN GENERAL

- (1) If even a minor fault is left intact and operation is continued, a fatal failure may be caused, entailing a large sum of expenses and long hours of restoration.
 - Therefore when even a small trouble occurs, do not rely on your intuition and experience, but look for the cause based on the troubleshooting principle and perform maintenance and adjustment to prevent major failure from occurring. Keep in mind that a fault results from a combination of different causes.
- (2) The following lists up commonly occurring faults and possible causes with this machine. For the troubleshooting of the engine, refer to the coming troubleshooting and repair.
- (3) When carrying out troubleshooting, do not hurry to disassemble the components. It will become impossible to find the cause of the problem.
- (4) Ask user or operator the following.
- ① Was there any strange thing about machine before failure occurred?
- ② Under what conditions did the failure occur?
- 3 Have any repairs been carried out before the failure?
- (5) Check before troubleshooting.
- ① Check oil and fuel level.
- ② Check for any external leakage of oil from components.
- ③ Check for loose or damage of wiring and connections.

2) MACHINE STATUS MONITORING ON THE CLUSTER

(1) The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu.

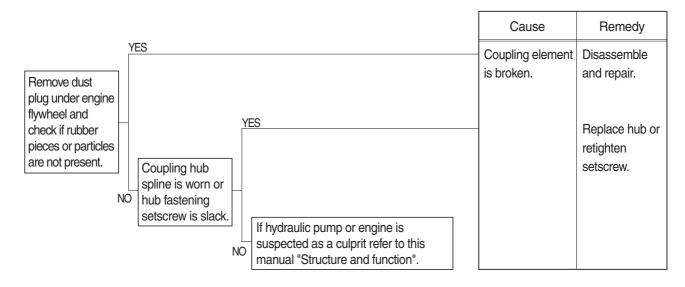


(2) Specification

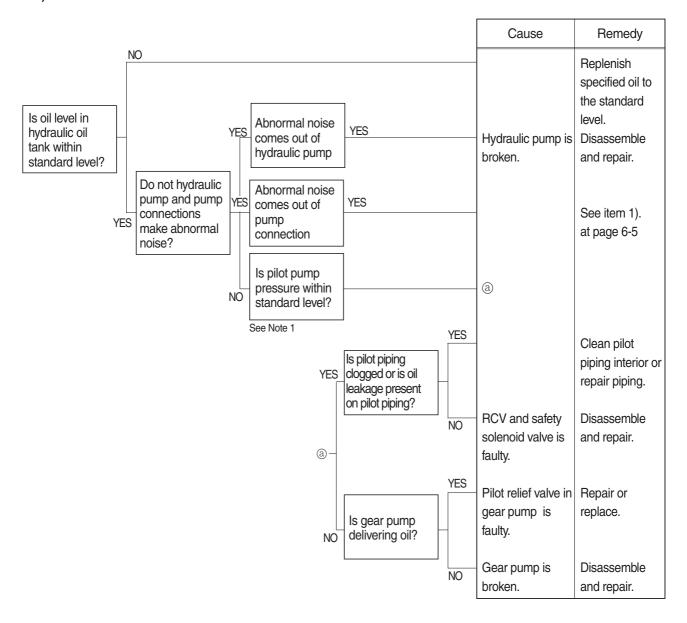
No.	Description	Specification
Note 1	Pilot pump pressure	40 ⁺² bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	P1 pump control pressure	0~25 bar
Note 6	P2 pump control pressure	0~25 bar
Note 7	Pump 1 pressure	350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

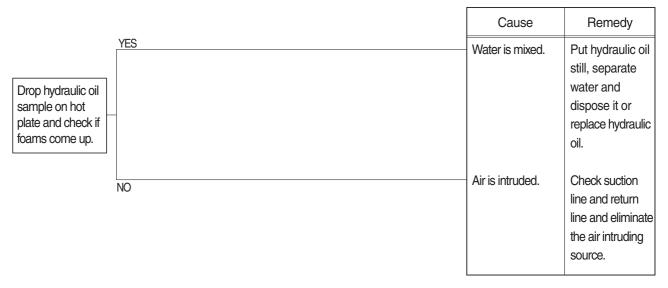


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

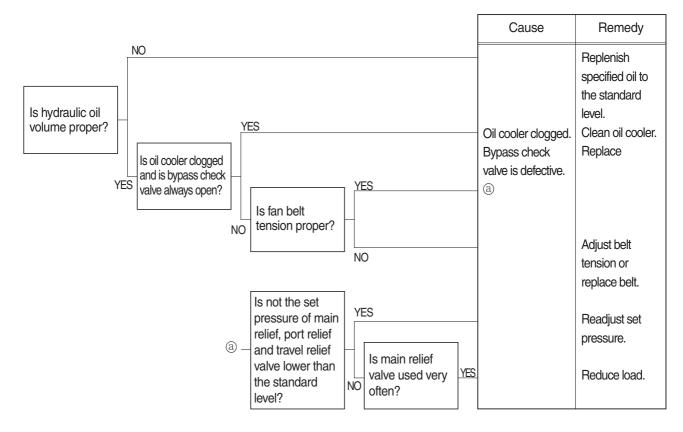


3. HYDRAULIC SYSTEM

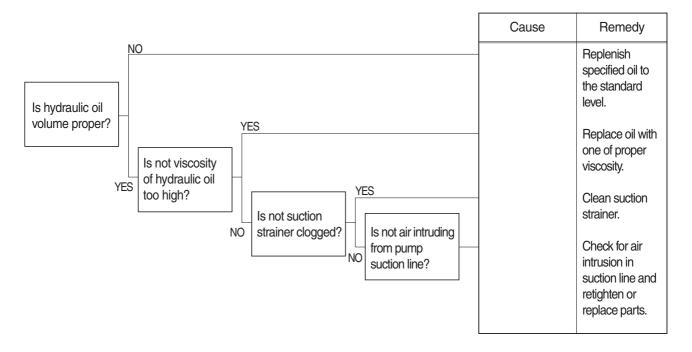
1) HYDRAULIC OIL IS CLOUDY



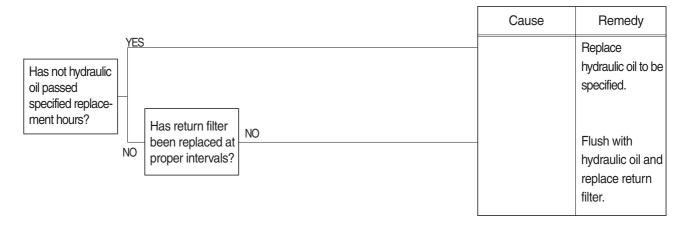
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

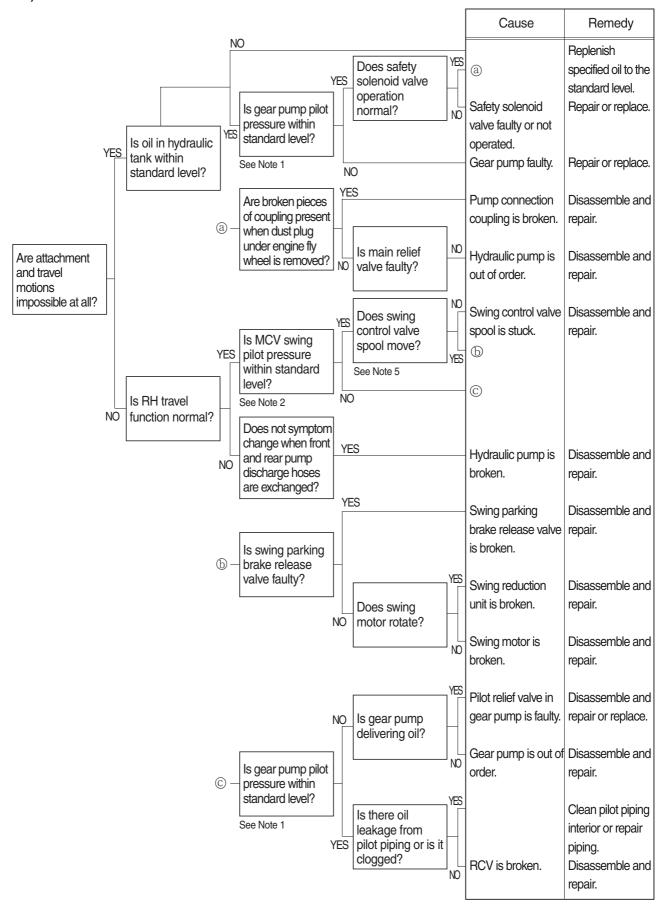


4) HYDRAULIC OIL IS CONTAMINATED

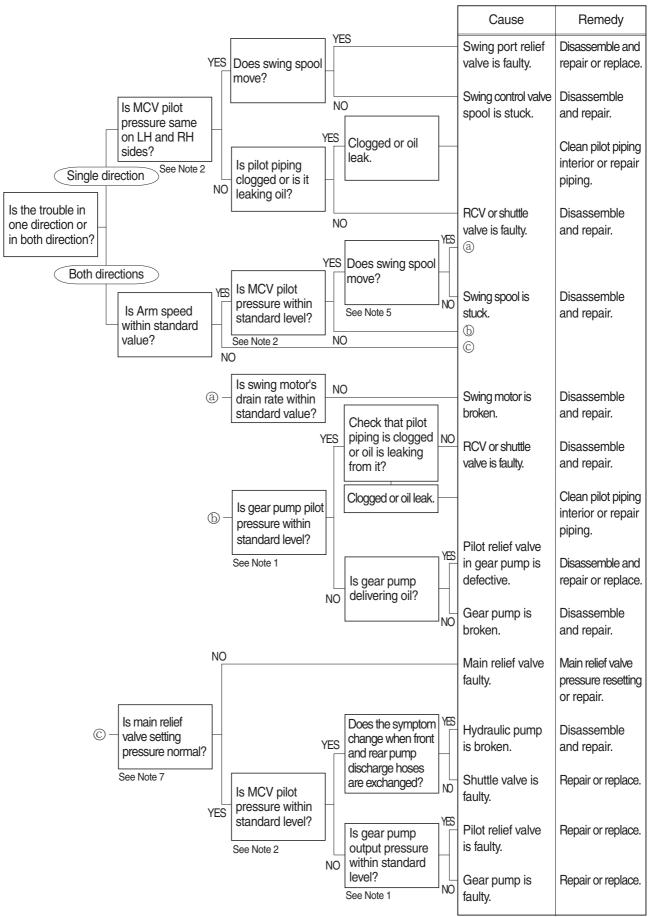


4. SWING SYSTEM

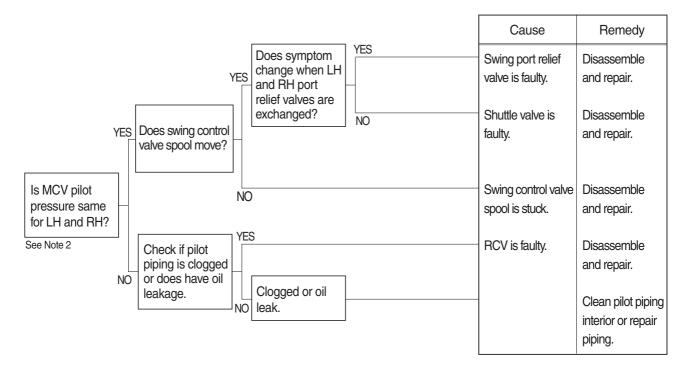
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



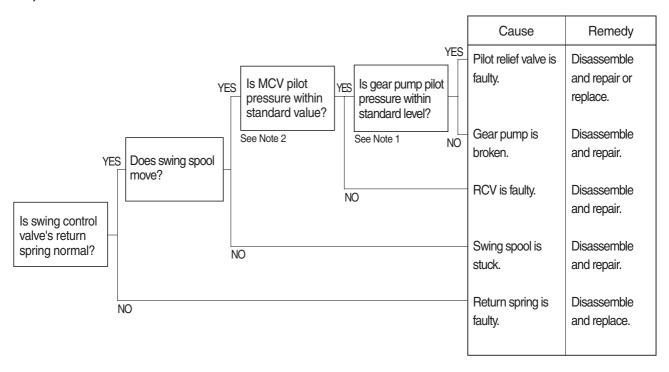
2) SWING SPEED IS LOW



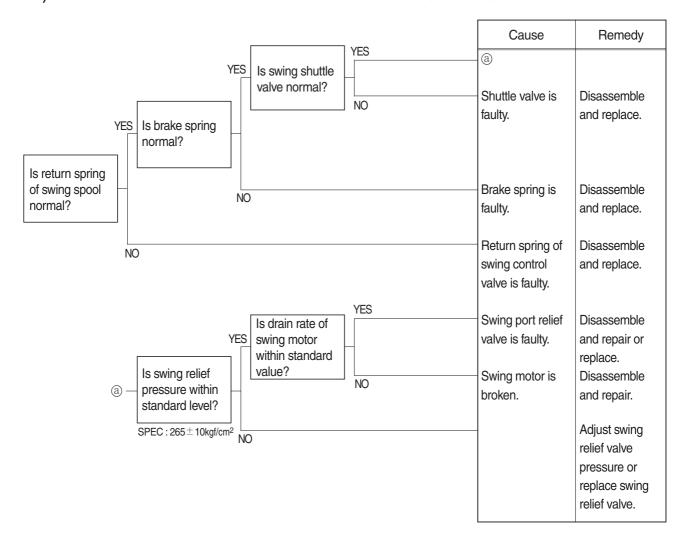
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

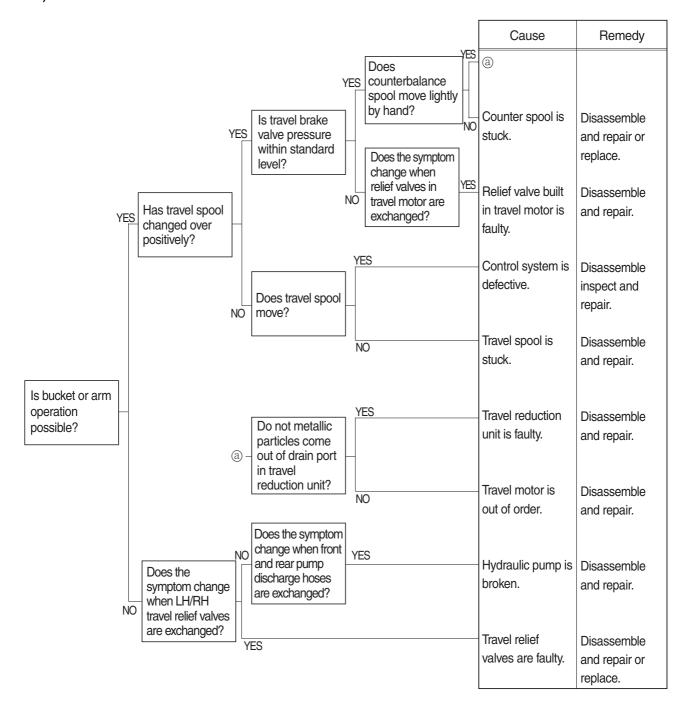


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

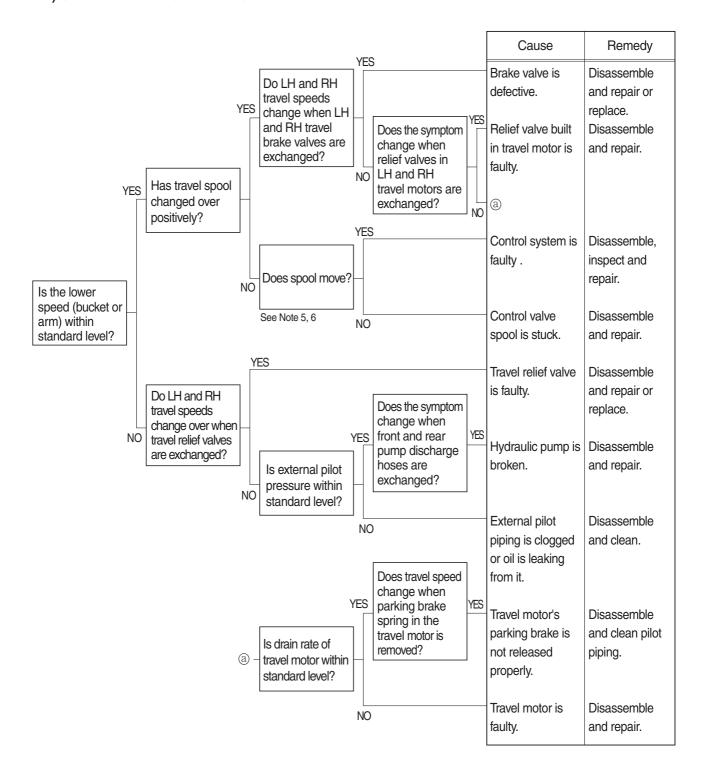


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

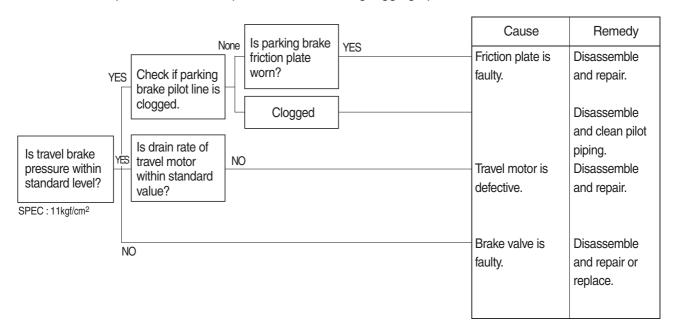


2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

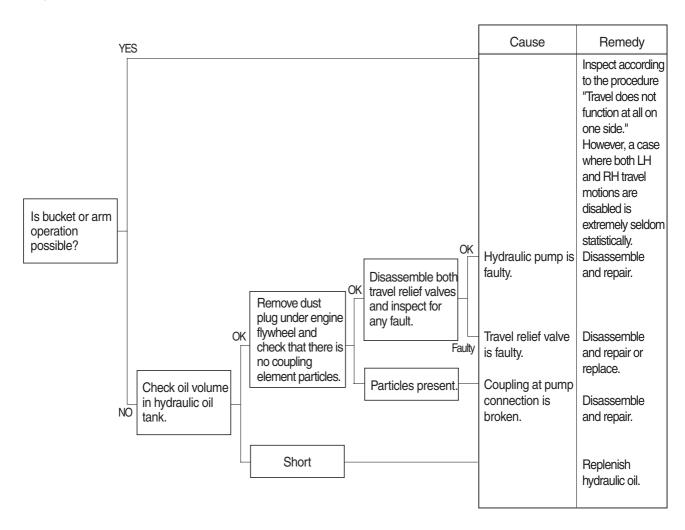


3) MACHINE DOES NOT STOP ON A SLOPE

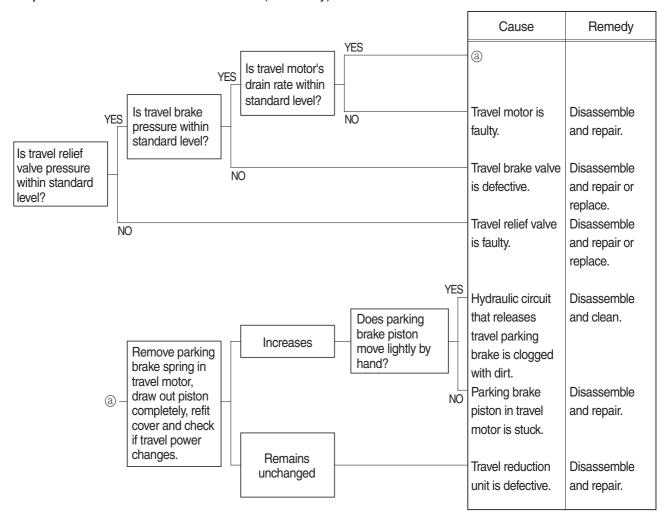
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



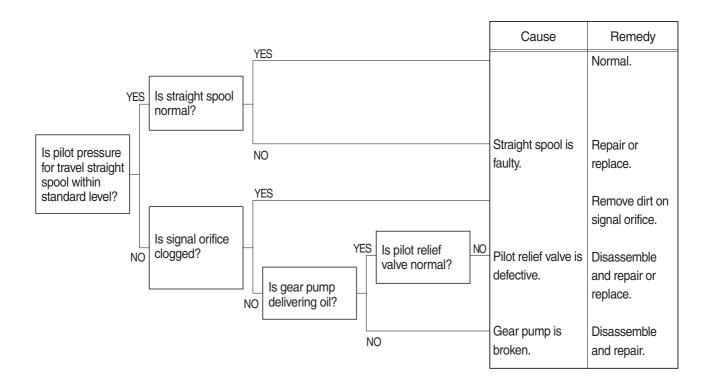
5) TRAVEL ACTION IS POWERLESS (travel only)



6) MACHINE RUNS RECKLESSLY ON A SLOPE

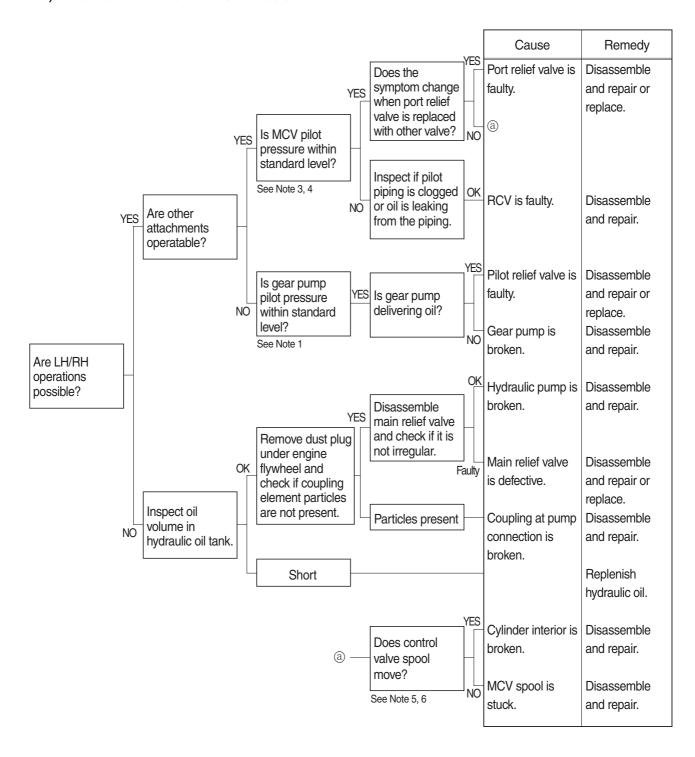


7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME

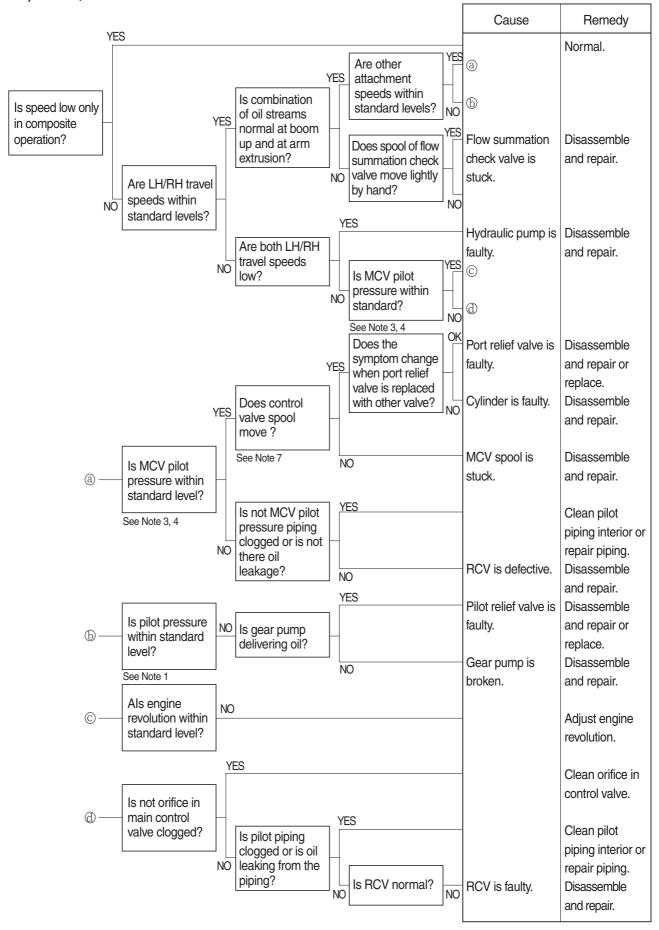


6. ATTACHMENT SYSTEM

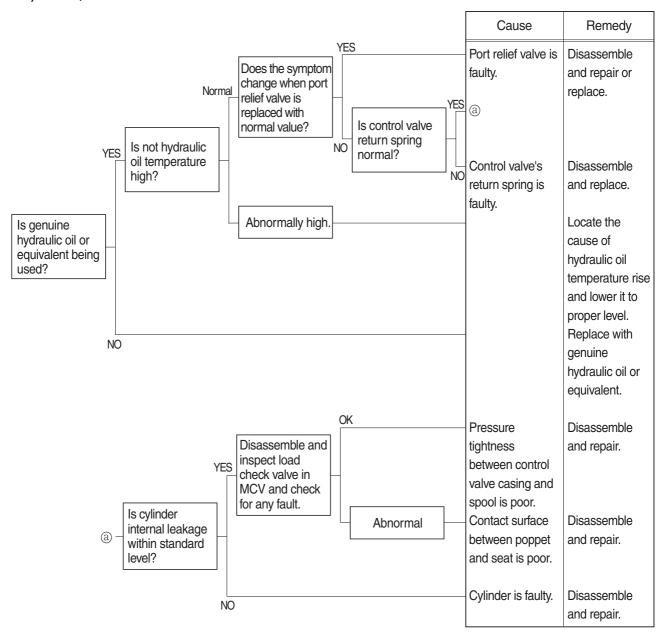
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



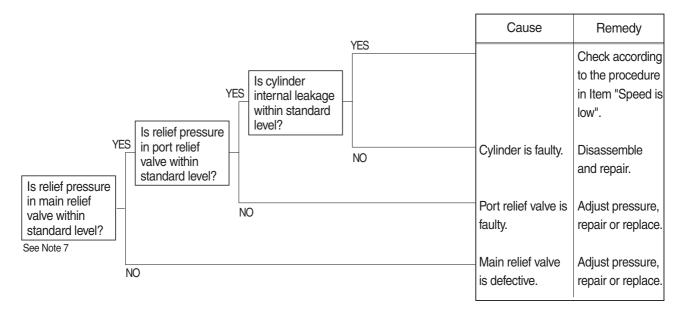
2) BOOM, ARM OR BUCKET SPEED IS LOW



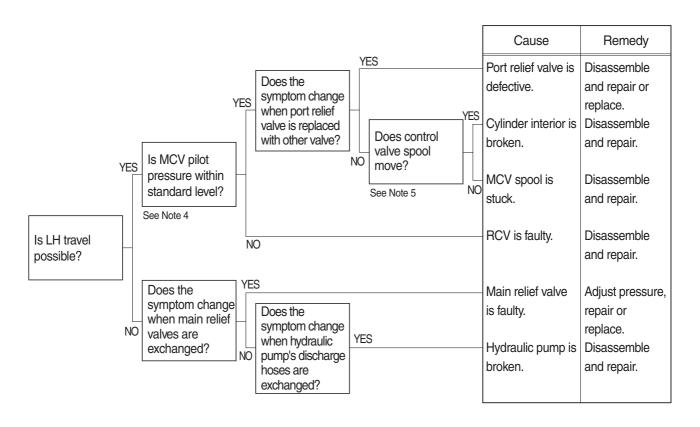
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



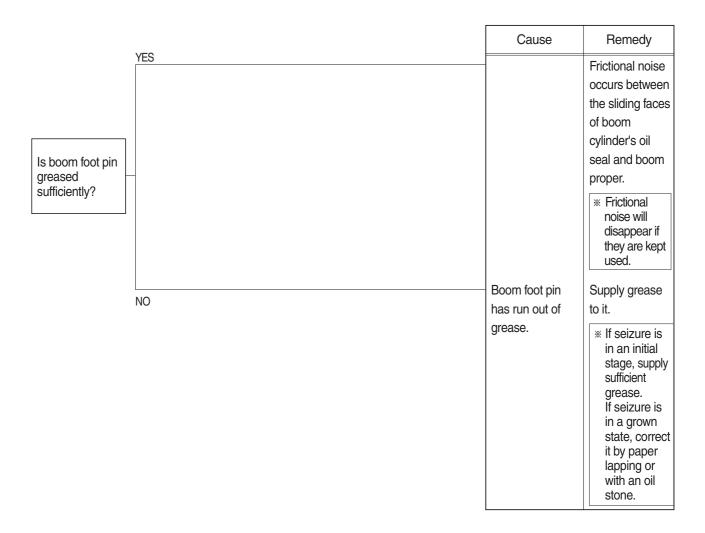
4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

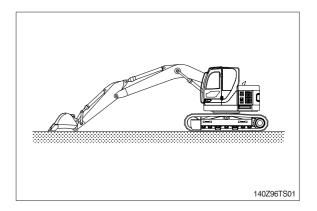


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

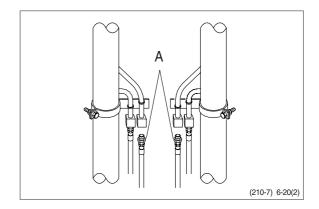


**** HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE**

1. Lower the bucket teeth to the ground with bucket cylinder fully retracted and arm cylinder rod retracted almost in full.



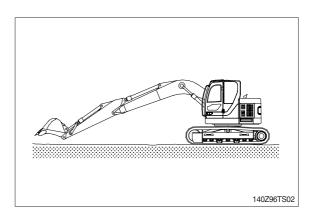
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



3. Raise bucket OFF the ground by retracting the arm cylinder rod.

If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.

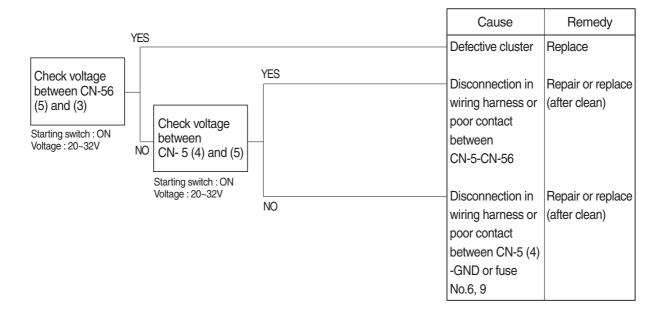
If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



GROUP 3 ELECTRICAL SYSTEM

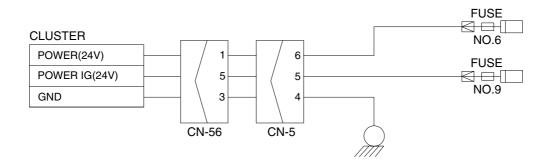
1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.6 and 9 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check voltage

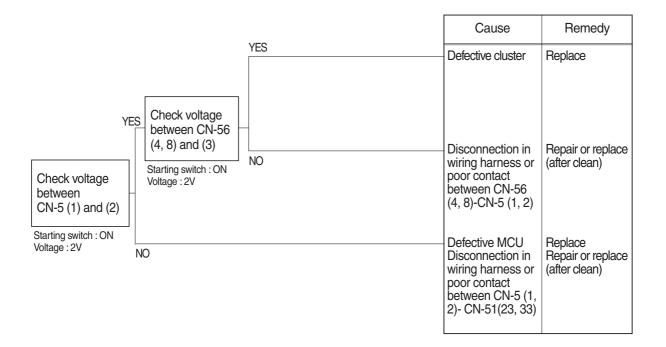
YES	20~32V
NO	0V



140Z96ES01

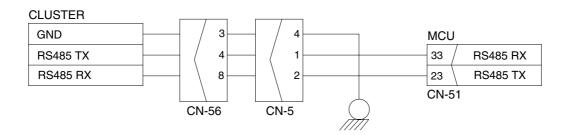
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check voltage

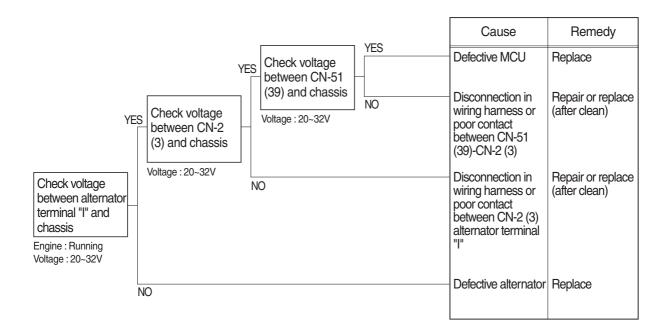
YES	2V
NO	0V



140Z96ES02

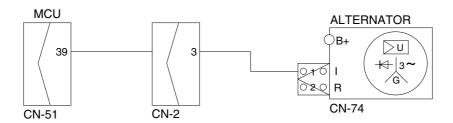
3. Fig. 1. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



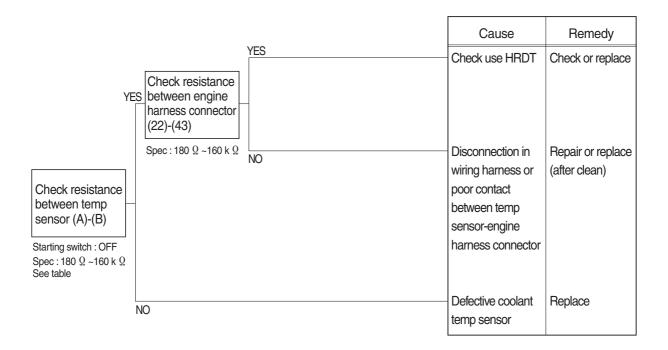
Check voltage

YES	20~32V
NO	0V



4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

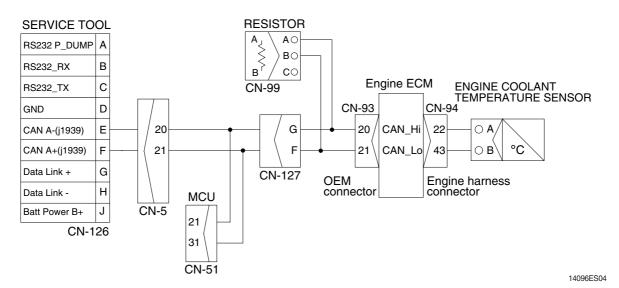
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





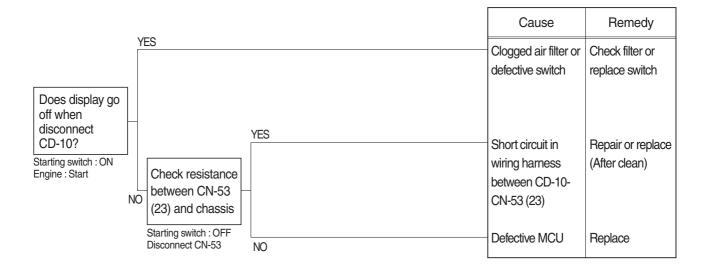
Check Table

Temperature (°C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



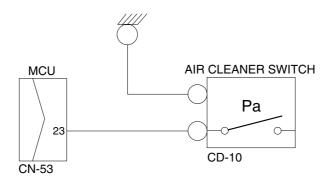
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



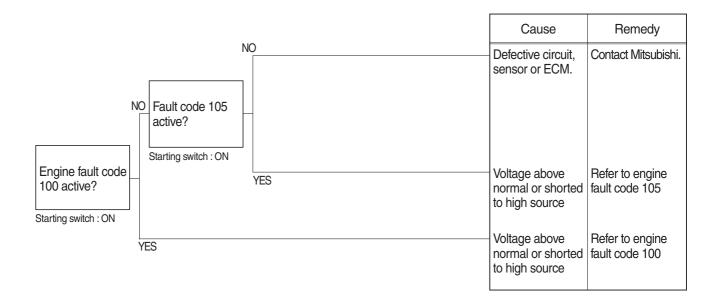
Check resistance

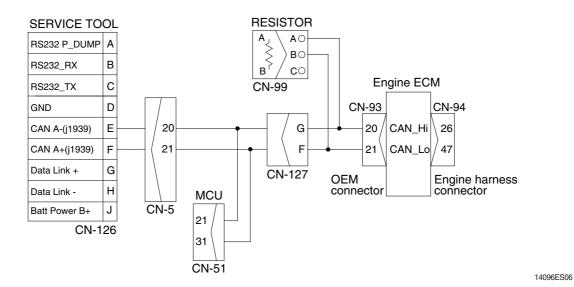
YES	MAX 1Ω
NO	MIN 1MΩ



6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

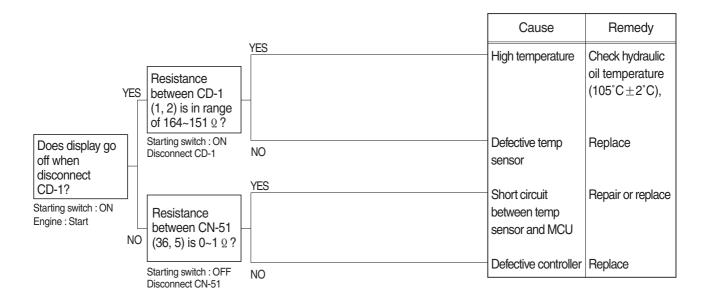
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





7. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP (engine is started)

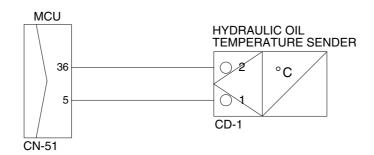
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





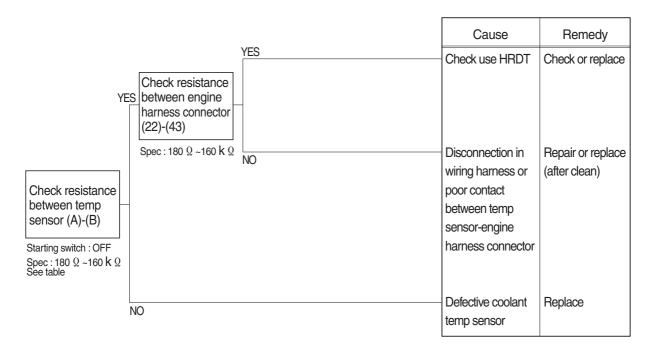
Check Table

Temperature (°C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (k Ω)		8.16 ~10.74							



8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE (HCESPN 304, FMI 3 or 4)

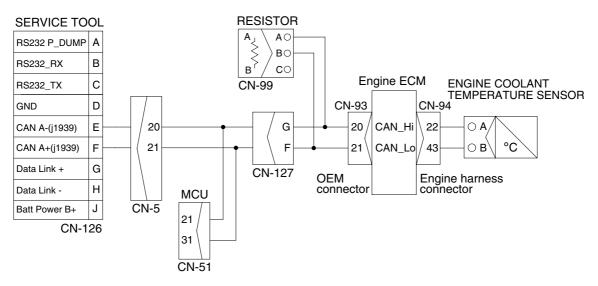
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





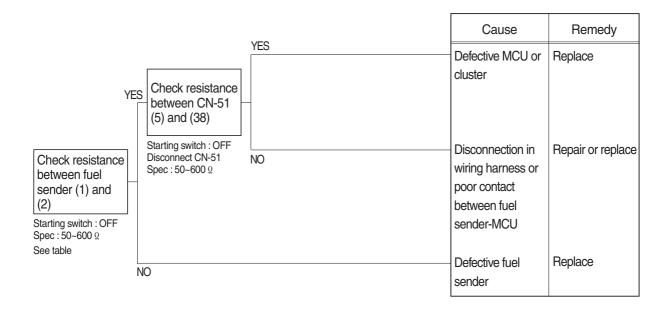
Check Table

Temperature (°C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



9. WHEN FUEL GAUGE DOES NOT OPERATE(HCESPN 301, FMI 3 or 4)

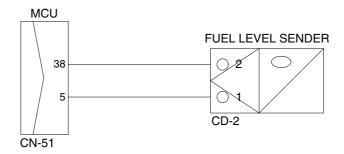
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





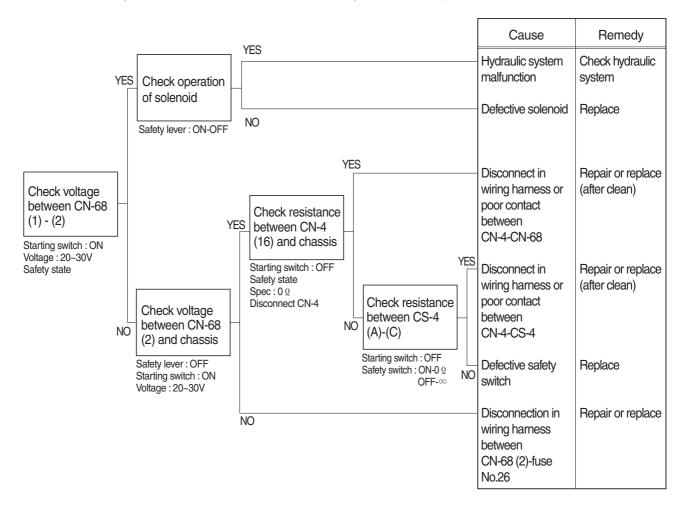
Check Table

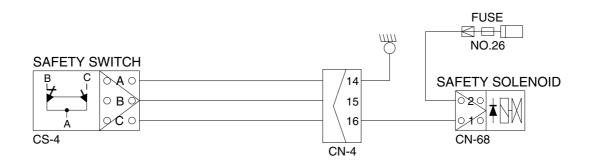
Range	Resistance (Ω)	Range	Resistance (Ω)	
Full	50	5/12	400	
11/12	100	4/12	450	
10/12	150	3/12	500	
9/12	200	2/12	550	
8/12	250	1/12	600	
7/12	300	Empty warning	700	
6/12	350	-	-	



10. WHEN SAFETY SOLENOID DOES NOT OPERATE

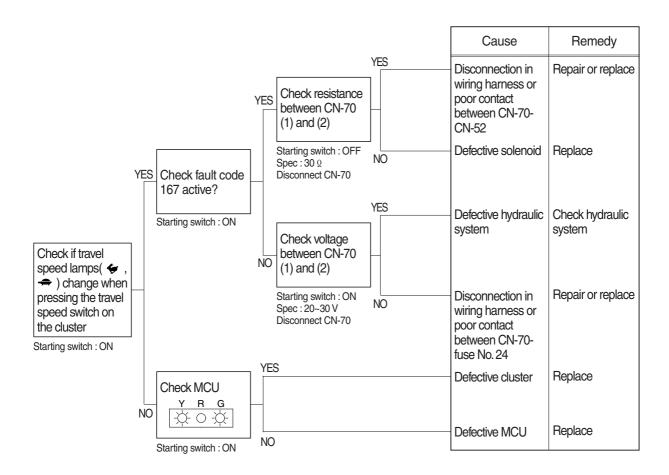
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.26 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

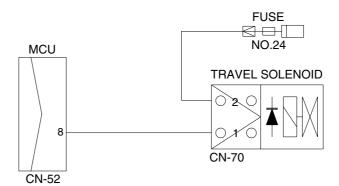




11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 5 or 6)

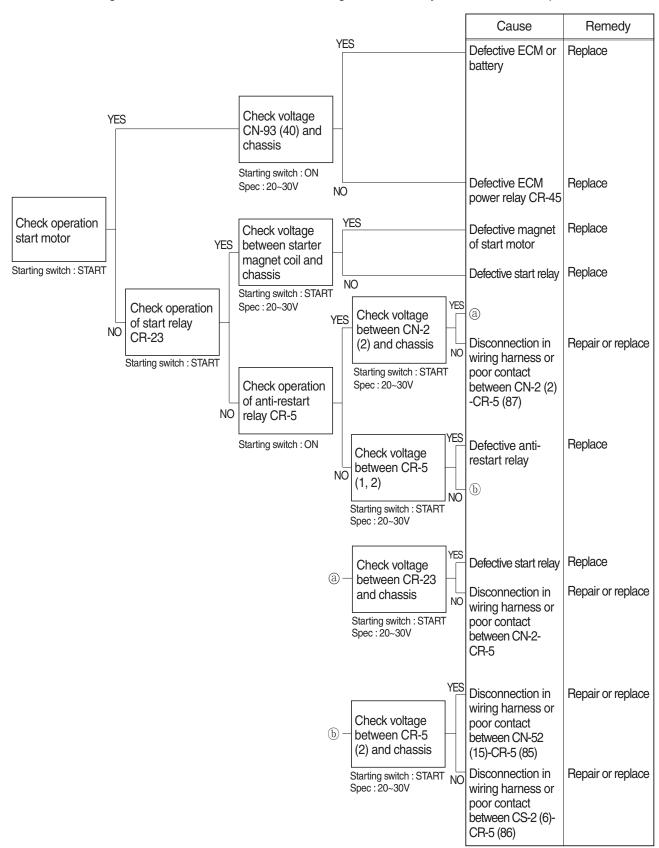
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.24 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

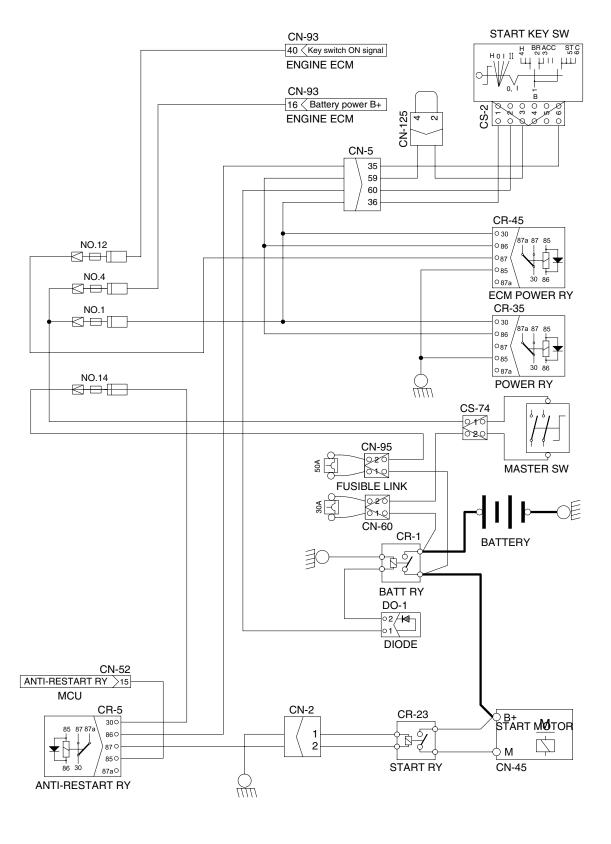




12. WHEN ENGINE DOES NOT START (| lights up condition)

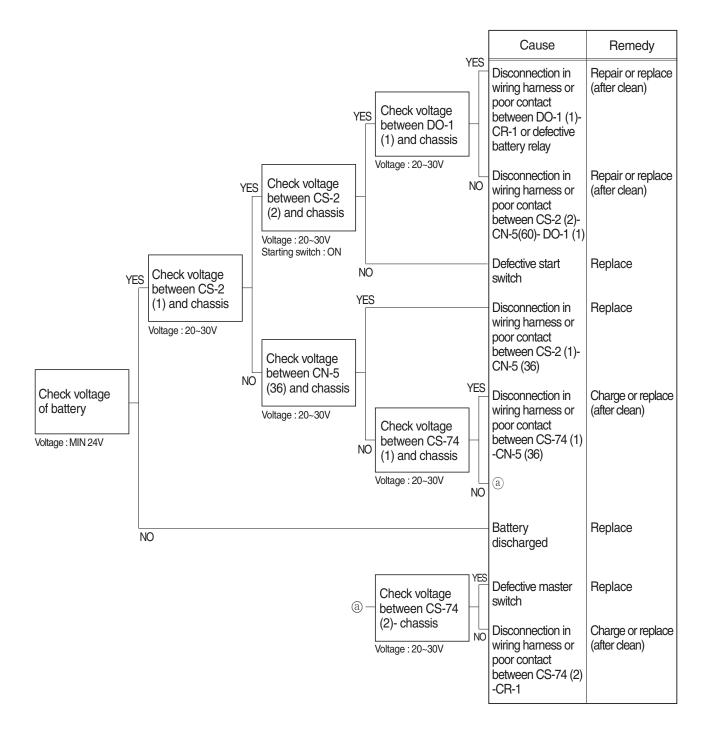
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 1, 4, 12 and 14 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

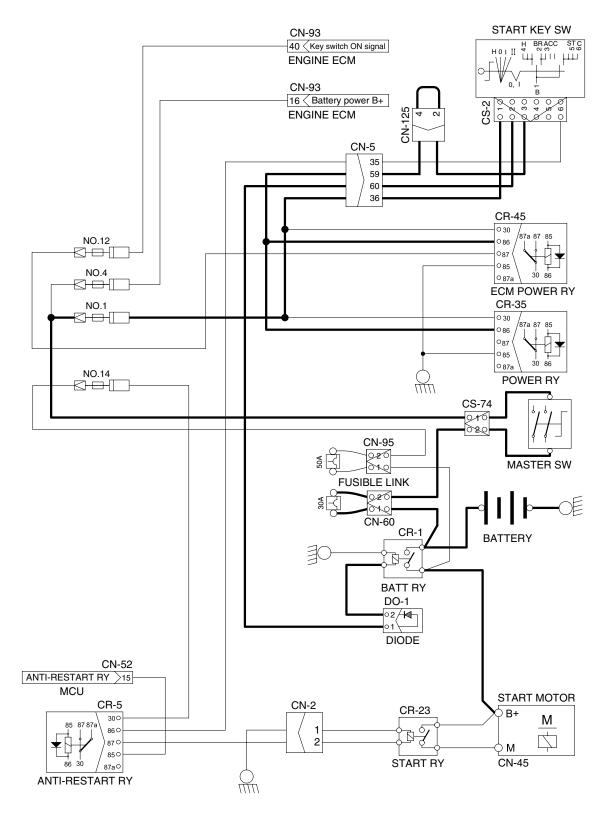




13. WHEN STARTING SWITCH ON DOES NOT OPERATE

- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check open circuit of fusible link (CN-60).
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



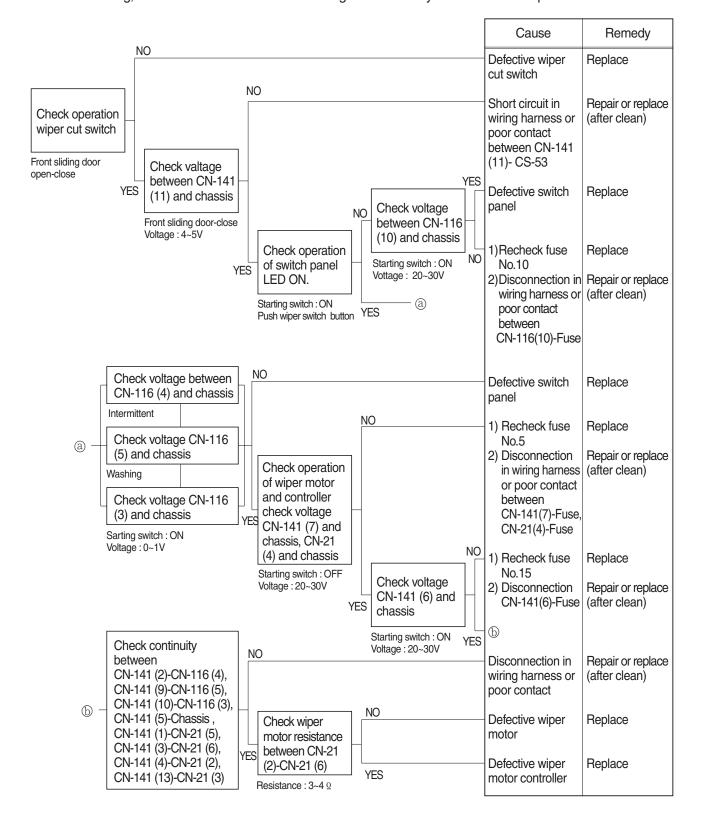


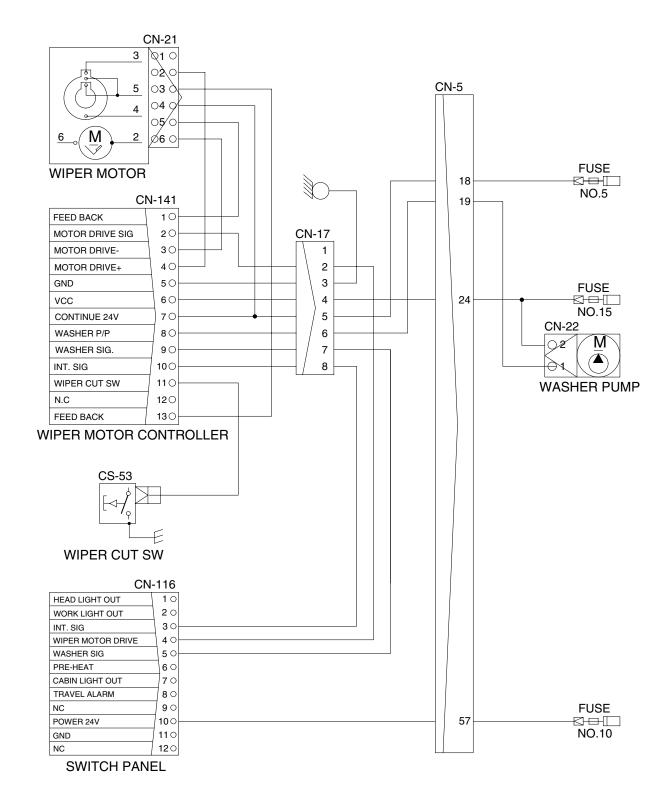
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6-36

14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

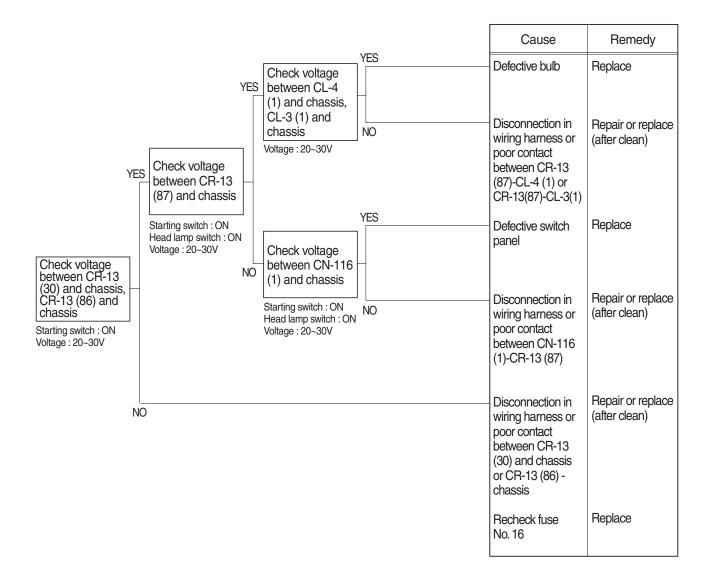
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 5, 10 and 15 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

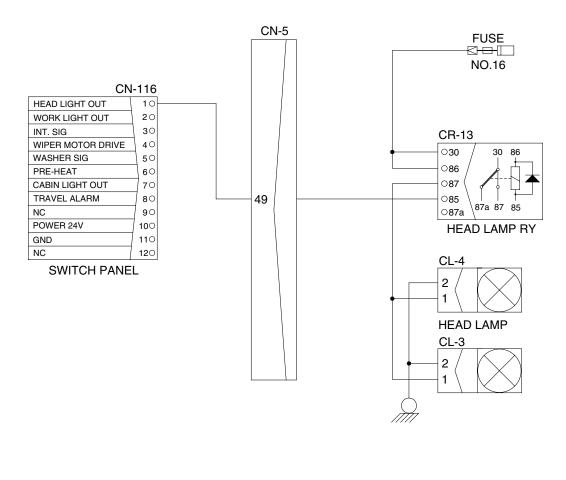




15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.16 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



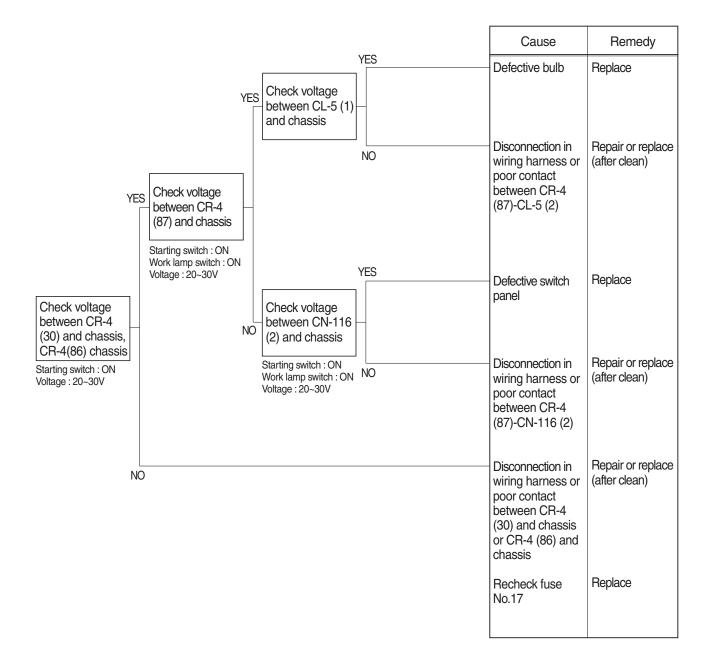


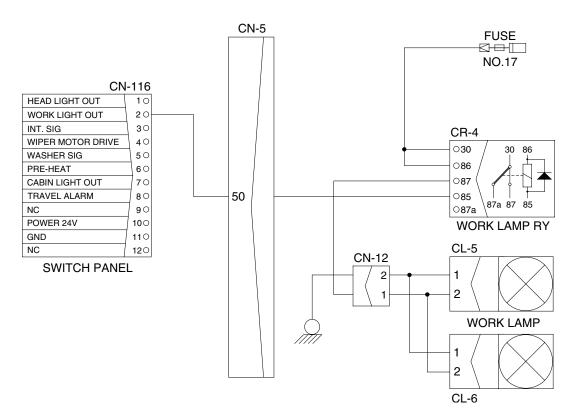
140Z96ES15

6-38

16. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.17 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





140Z96ES16

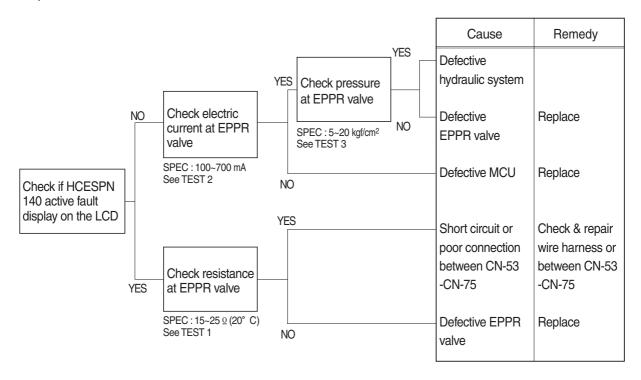
6-39

GROUP 4 MECHATRONICS SYSTEM

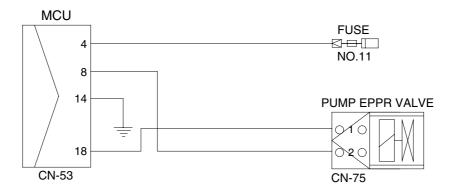
1. ALL ACTUATORS SPEED ARE SLOW

- * Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
- st Spec : P-mode 2000 \pm 50 rpm S -mode 1800 \pm 50 rpm E-mode 1650 \pm 50 rpm
- * Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE

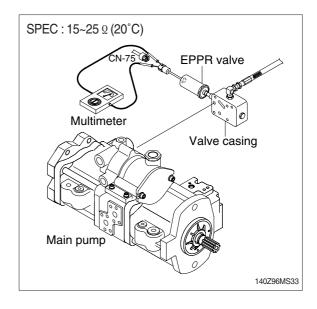


Wiring diagram

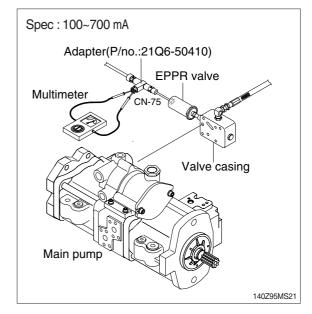


140Z96MS01

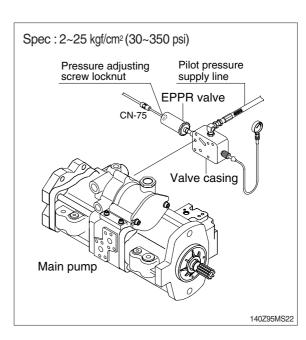
- (1) **Test 1**: Check resistance at connector CN-75.
- ① Starting key OFF.
- ② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.
- ③ Check resistance between 2 lines as figure.



- (2) Test 2 : Check electric current at EPPR valve.
- ① Disconnect connector CN-75 from EPPR valve.
- ② Insert the adapter to CN-75 and install multimeter as figure.
- ③ Start engine.
- Set S-mode and cancel auto decel mode.
- ⑤ Position the accel dial at 10.
- ⑥ If rpm display approx 1800±50 rpm check electric current at bucket circuit relief position.



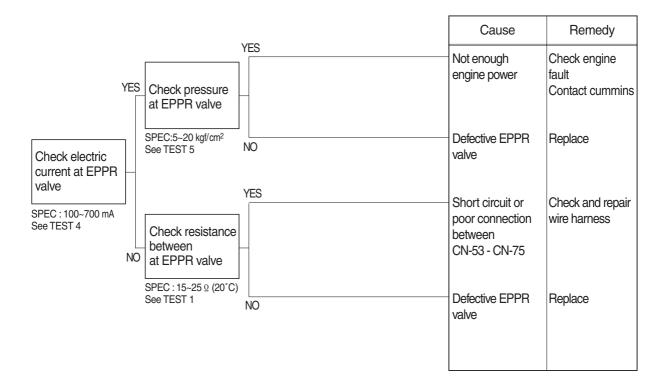
- (3) Test 3: Check pressure at EPPR valve.
 - Remove plug and connect pressure gauge as figure.
 - · Gauge capacity: 0 to 50 kgf/cm² (0 to 710 psi)
 - ② Start engine.
 - 3 Set S-mode and cancel auto decel mode.
 - 4 Position the accel dial at 10.
 - If rpm display approx 1800 ± 50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
 - 6 If pressure is not correct, adjust it.
- ⑦ After adjust, test the machine.



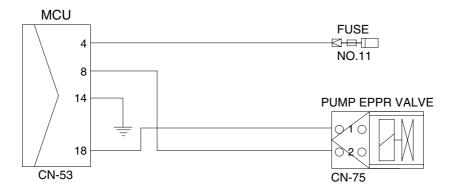
2. ENGINE STALL

* Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE

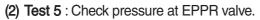


Wiring diagram

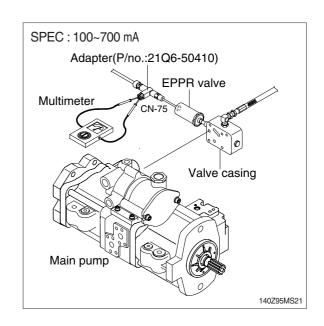


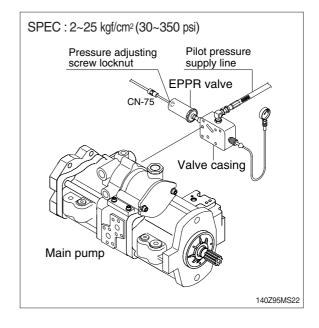
140Z96MS01

- (1) **Test 4**: Check electric current at EPPR valve.
 - ① Disconnect connector CN-75 from EPPR valve.
 - ② Insert the adapter to CN-75 and install multimeter as figure.
 - ③ Start engine.
 - ④ Set S-mode and cancel auto decel mode.
 - ⑤ Position the accel dial at 10.
 - 6 If rpm display approx 1800 \pm 50 rpm check electric current at bucket circuit relief position.



- ① Remove plug and connect pressure gauge as figure.
 - Gauge capacity: 0 to 50 kgf/cm² (0 to 710 psi)
- ② Start engine.
- ③ Set S-mode and cancel auto decel mode.
- 4) Position the accel dial at 10.
- If rpm display approx 1800 ± 50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
- ⑥ If pressure is not correct, adjust it.
- ⑦ After adjust, test the machine.

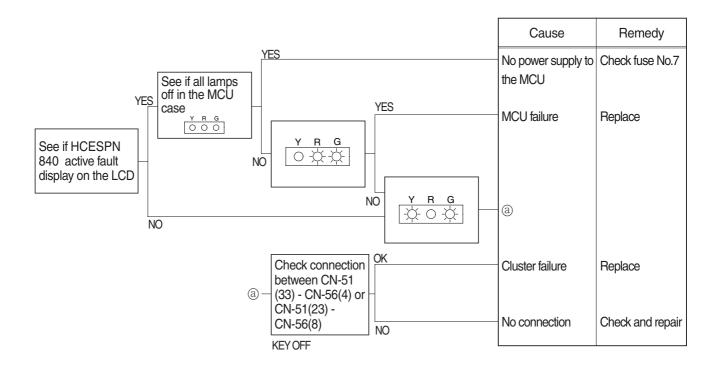




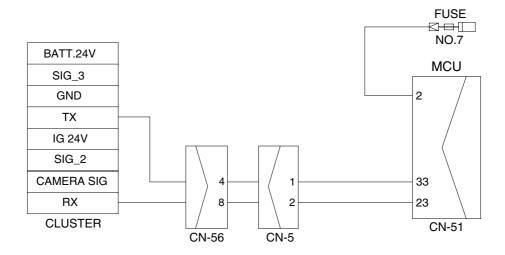
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

* Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

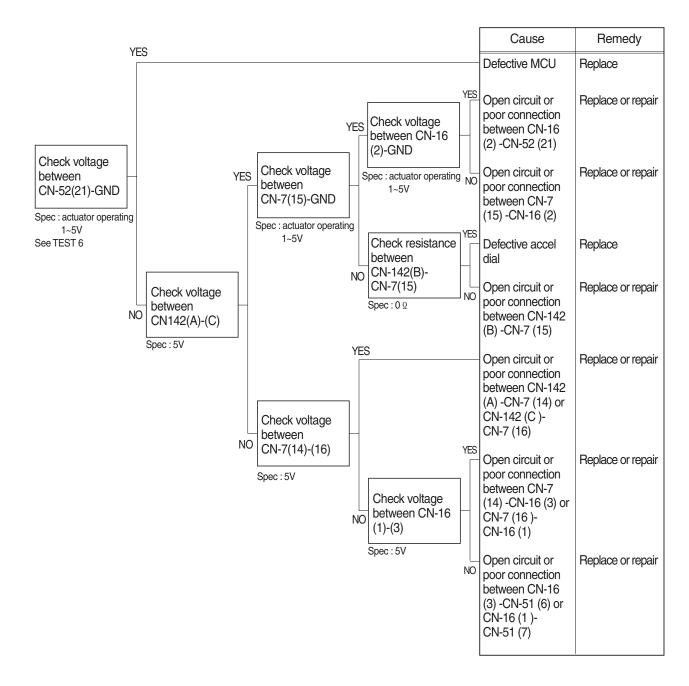


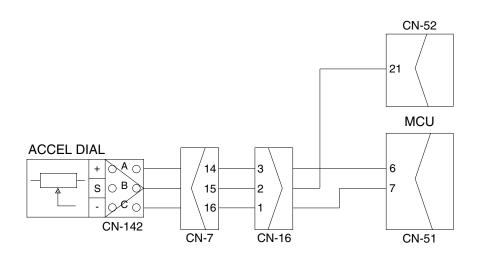
140Z96MS03

4. MALFUNCTION OF ACCEL DIAL

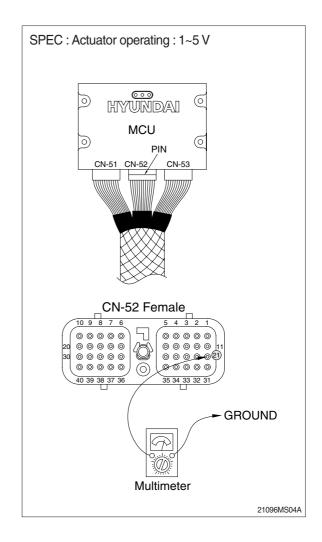
* Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE





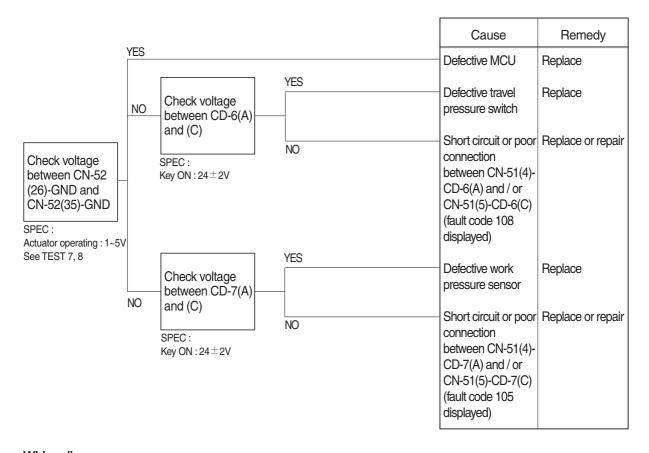
- (1) Test 6: Check voltage at CN-52(21) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (21) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



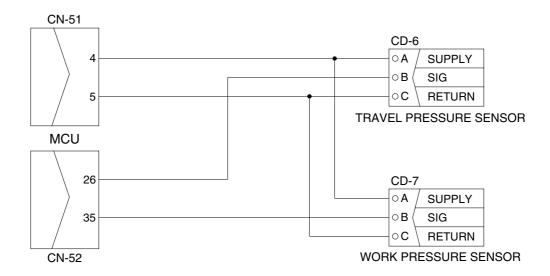
5. AUTO DECEL SYSTEM DOES NOT WORK

- Fault code: HCESPN 105, FMI 0~4 (work pressure sensor)
 HCESPN 108, FMI 0~4 (travel oil pressure sensor)
- * Before carrying out below procedure, check all the related connectors are properly inserted.

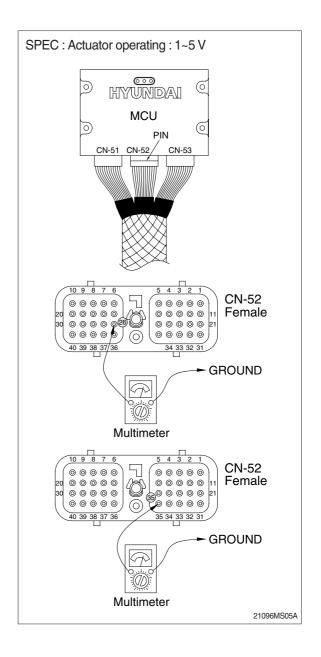
1) INSPECTION PROCEDURE



Wiring diagram



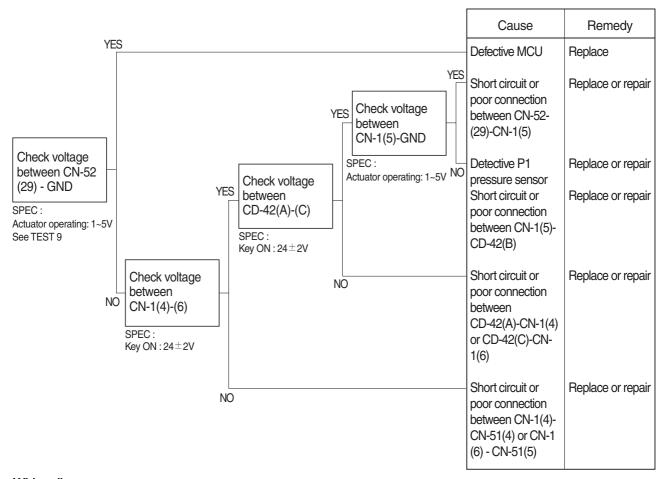
- (1) Test 7: Check voltage at CN-52(26) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (26) of CN-52.
- 3 Starting key ON.
- ④ Check voltage as figure.
- (2) Test 8: Check voltage at CN-52(35) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper
- ② Insert prepared pin to rear side of connectors: One pin to (35) of CN-52.
- 3 Starting key ON.
- ④ Check voltage as figure.



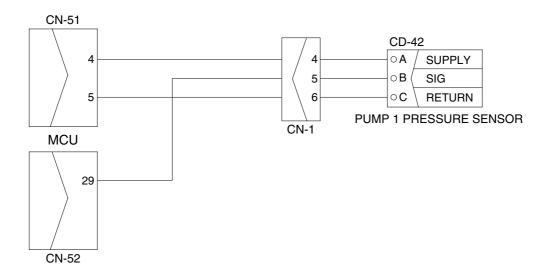
6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

- · Fault code: HCESPN 120, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

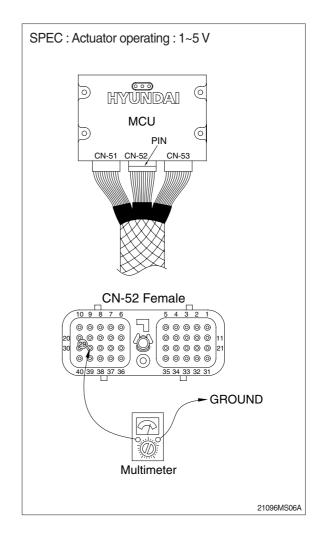
1) INSPECTION PROCEDURE



Wiring diagram



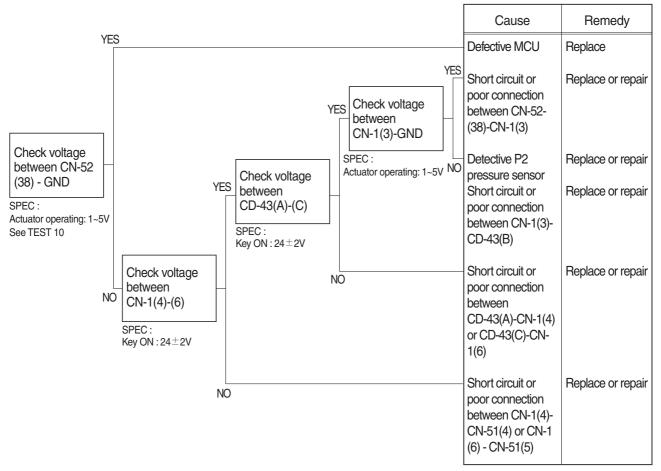
- (1) Test 9: Check voltage at CN-52(29) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (29) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



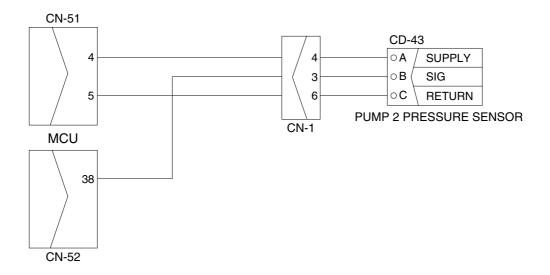
7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

- · Fault code: HCESPN 121, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

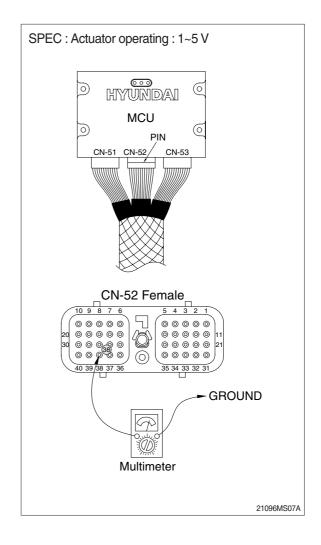
1) INSPECTION PROCEDURE



Wiring diagram



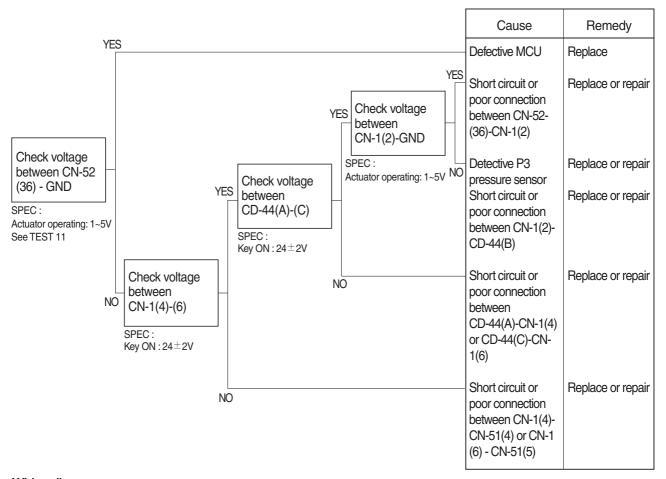
- (1) Test 10 : Check voltage at CN-52(38) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (38) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



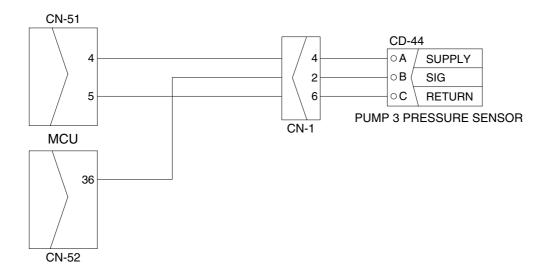
8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

- · Fault code: HCESPN 125, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

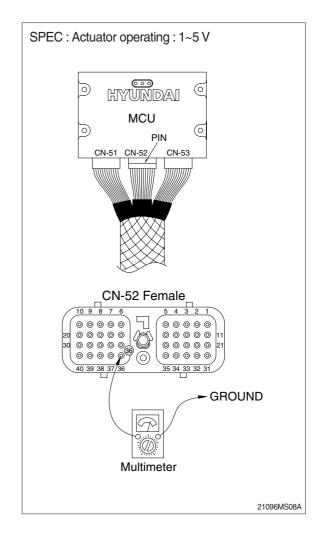
1) INSPECTION PROCEDURE



Wiring diagram



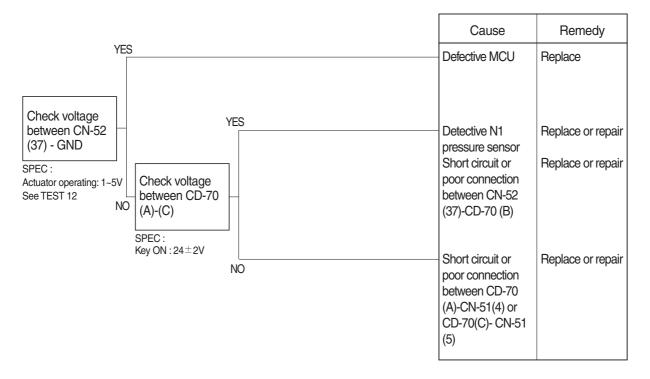
- (1) Test 11: Check voltage at CN-52(36) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (36) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



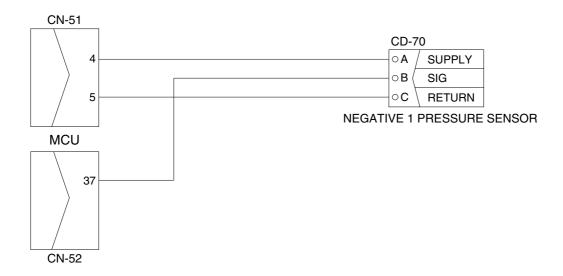
9. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

- · Fault code: HCESPN 123, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

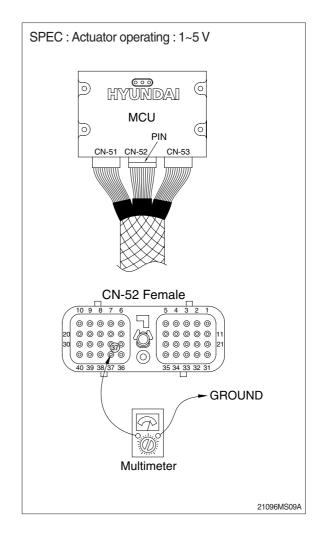
1) INSPECTION PROCEDURE



Wiring diagram



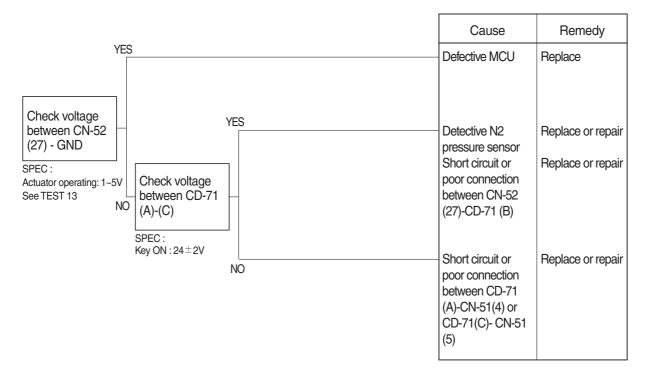
- (1) Test 12: Check voltage at CN-52(37) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (37) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



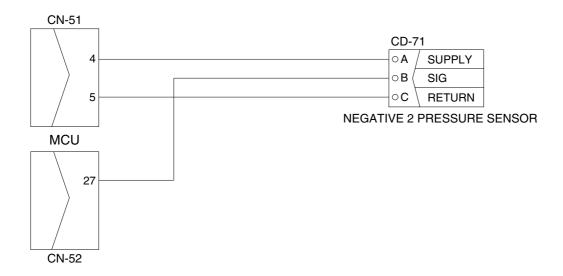
10. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

- · Fault code: HCESPN 124, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

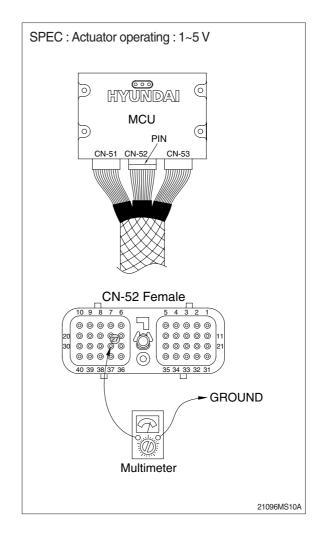
1) INSPECTION PROCEDURE



Wiring diagram



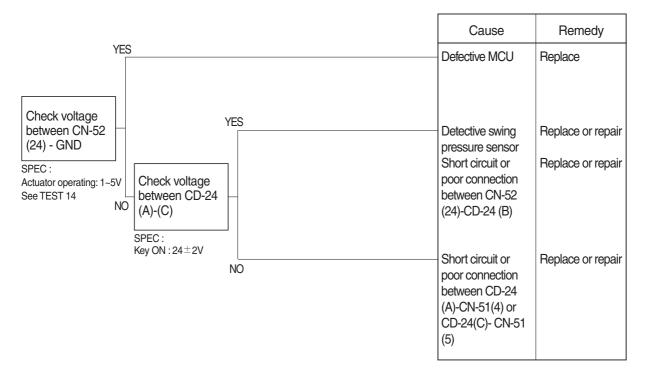
- (1) Test 13: Check voltage at CN-52(27) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (27) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



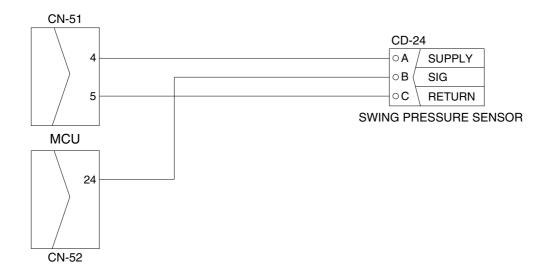
11. MALFUNCTION OF SWING PRESSURE SENSOR

- · Fault code: HCESPN 135, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

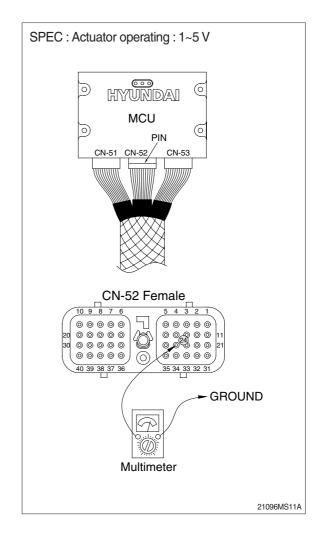
1) INSPECTION PROCEDURE



Wiring diagram



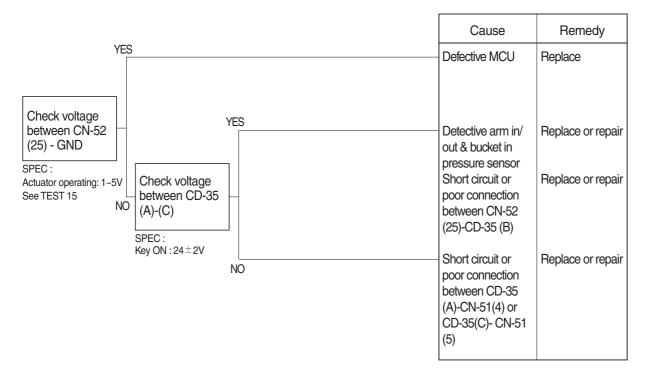
- (1) Test 14: Check voltage at CN-52(24) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (24) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



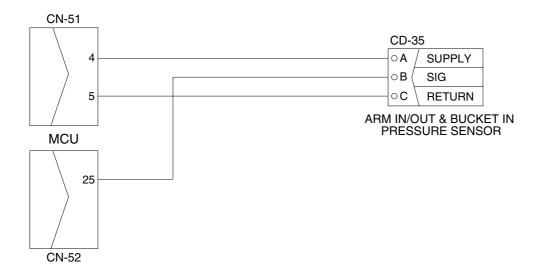
12. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

- · Fault code: HCESPN 133, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

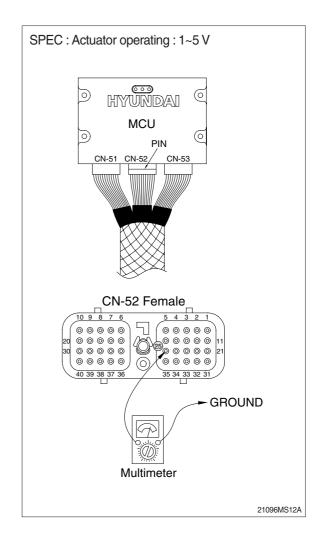
1) INSPECTION PROCEDURE



Wiring diagram



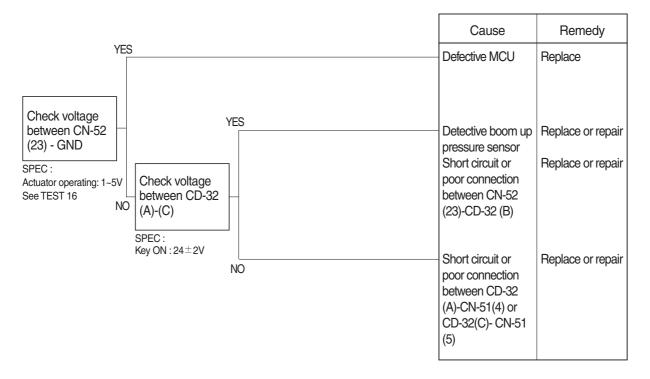
- (1) Test 15: Check voltage at CN-52(25) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (25) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



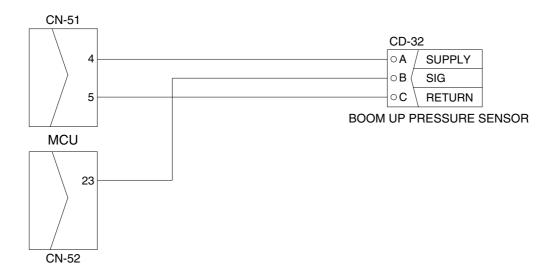
13. MALFUNCTION OF BOOM UP PRESSURE SENSOR

- · Fault code: HCESPN 127, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

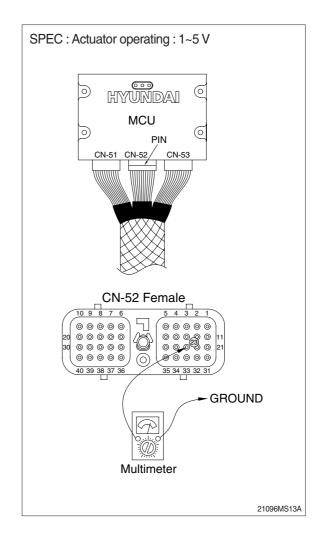
1) INSPECTION PROCEDURE



Wiring diagram



- (1) Test 16: Check voltage at CN-52(23) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (23) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.

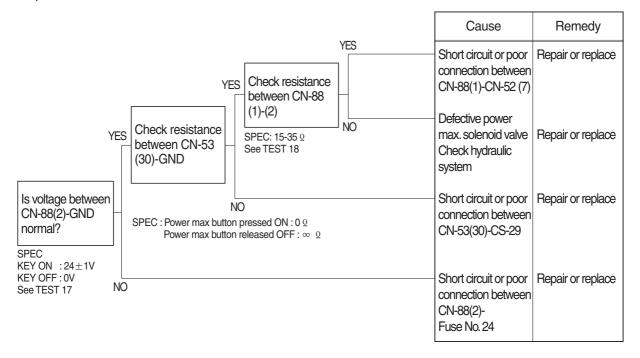


14. MALFUNCTION OF POWER MAX

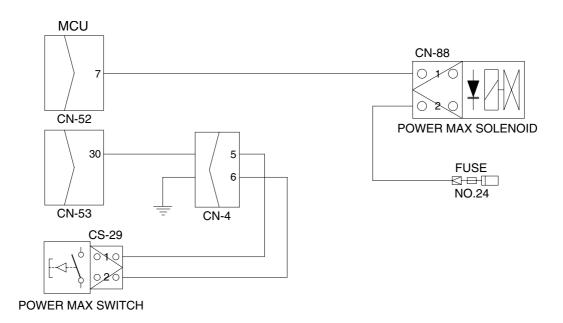
· Fault code: HCESPN 166, FMI 4 or 6

* Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE

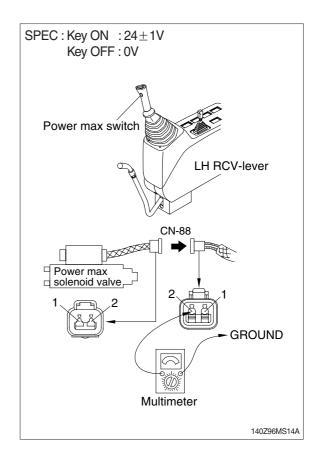


Wiring diagram

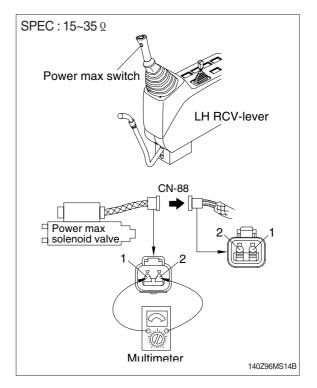


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- (1) Test 17: Check voltage between connector CN-88(2) GND.
- ① Disconnect connector CN-88 from power max solenoid valve.
- ② Start key ON.
- ③ Check voltage as figure.



- (2) Test 18: Check resistance of the solenoid valve between CN-88(1)-(2).
- ① Starting key OFF.
- ② Disconnect connector CN-88 from power max solenoid valve.
- ③ Check resistance as figure.

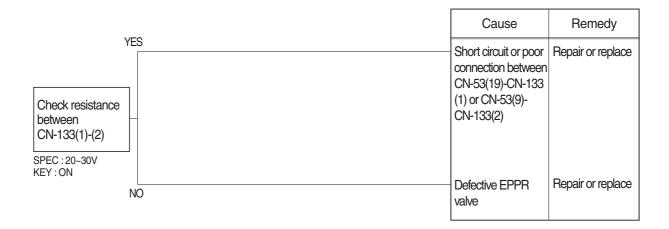


15. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

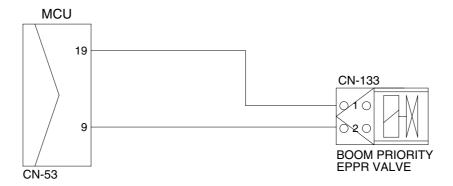
· Fault code: HCESPN 141, FMI 5 or 6

* Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

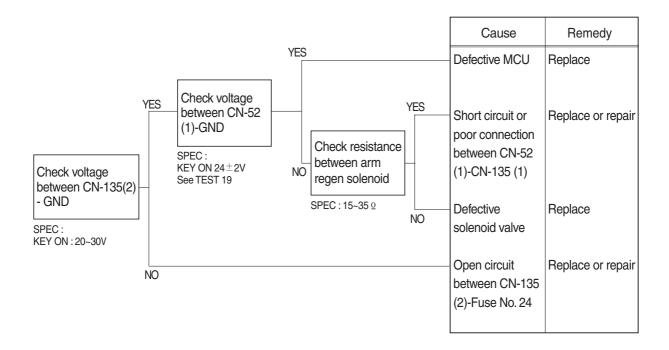


16. MALFUNCTION OF ARM REGENERATION SOLENOID

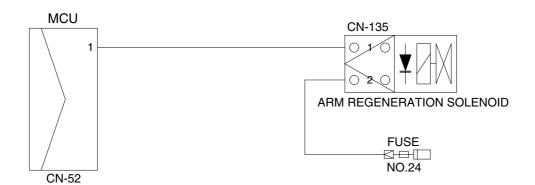
· Fault code: HCESPN 170, FMI 4 or 6

* Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



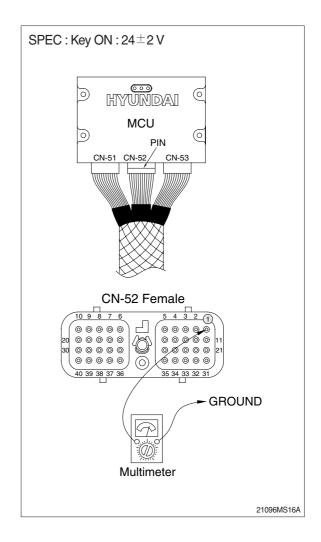
Wiring diagram



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2) TEST PROCEDURE

- (1) Test 19: Check voltage at CN-52(1) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (1) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



SECTION 7 MAINTENANCE STANDARD

Group	1	Operational Performance Test ·····	7-1
Group	2	Major Components ·····	7-21
Group	3	Track and Work Equipment	7-29

SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

Whenever a new machine is delivered in parts and reassembled at a customer's site, it must be tested to confirm that the operational performance of the machine meets Hyundai spec.

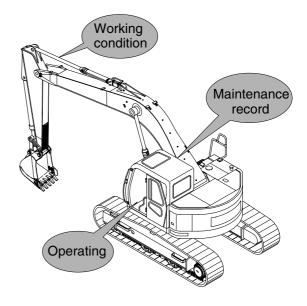
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

With the passage of time, the machine's operational performance deteriorates, so that the machine needs to be serviced periodically to restore it to its original performance level.

Before servicing the machine, conduct performance tests to check the extent of deterioration, and to decide what kind of service needs to be done(by referring to the "Service Limits" in this manual).

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

After the machine is repaired or serviced, it must be tested to confirm that its operational performance was restored by the repair and/or service work done.

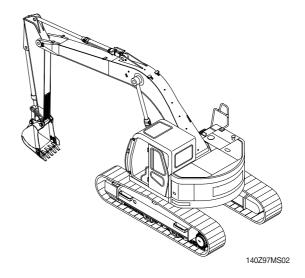


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2. TERMINOLOGY

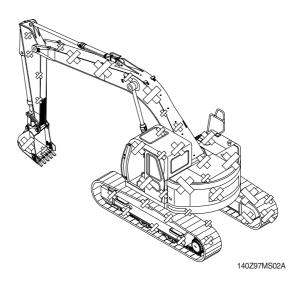
1) STANDARD

Specifications applied to the brand-new machine, components and parts.



2) SERVICE LIMIT

The lowest acceptable performance level. When the performance level of the machine falls below this level, the machine must be removed from work and repaired. Necessary parts and components must be replaced.



3. OPERATION FOR PERFORMANCE TESTS

1) Observe the following rules in order to carry out performance tests accurately and safely.

(1) The machine

Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(2) Test area

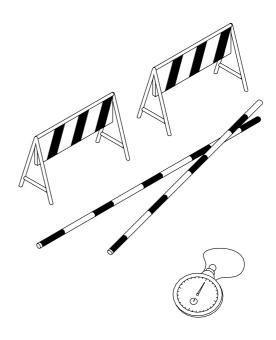
- ① Select a hard, flat surface.
- ② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.
- ③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions

- ① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.
- ② Operate the machine carefully and always give first priority to safety.
- ③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.
- 4 Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

- ① Accurately calibrate test instruments in advance to obtain correct data.
- ② Carry out tests under the exact test conditions prescribed for each test item.
- ③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.



(290-7TIER) 7-3

2) ENGINE SPEED

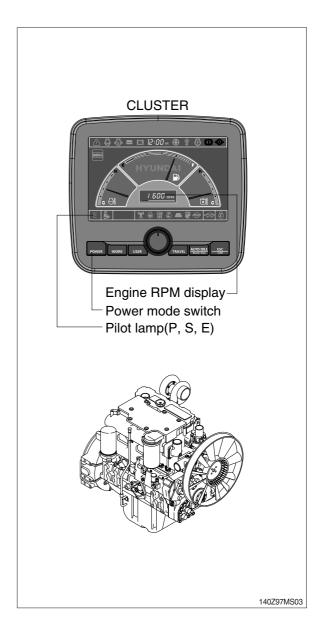
- (1) Measure the engine speed at each power mode
- ** The engine speed at each power mode must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

(2) Preparation

- ① Warm up the machine, until the engine coolant temperature reaches 50°C or more, and the hydraulic oil is 50±5°C.
- ② Set the accel dial at 10 (Max) position.
- ③ Measure the engine RPM.

(3) Measurement

- ① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.
- ② Measure and record the engine speed at each mode (P, S, E).
- ③ Select the P-mode.
- ① Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.
- ⑤ Measure and record the auto deceleration speed.



(4) Evaluation

The measured speeds should meet the following specifications.

Unit: rpm

Model	Engine speed	Standard	Remarks
	Start idle	900±100	
	P mode	2000±50	
D1450D 0	S mode	1800±50	
R145CR-9	E mode	1650±50	
	Auto decel	1000±100	
	One touch decel	900±100	

Condition: Set the accel dial at 10 (Max) position.

3) TRAVEL SPEED

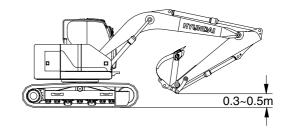
(1) Measure the time required for the excavator to travel a 20 m test track.

(2) Preparation

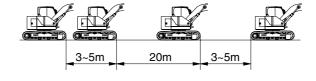
- ① Adjust the tension of both tracks to be equal.
- ② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- 3 Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- 4 Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.

(3) Measurement

- ① Measure both the low and high speeds of the machine.
- ② Before starting either the low or high speed tests, adjust the travel mode switch to the speed to be tested, then select the following switch positions.
- · Power mode switch : P mode
- ③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.
- ④ Measure the time required to travel 20 m.
- S After measuring the forward travel speed, turn the upperstructure 180° and measure the reverse travel speed.
- ⑥ Repeat steps ④ and ⑤ three times in each direction and calculate the average values.



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(4) Evaluation

The average measured time should meet the following specifications.

Unit: Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
R145CR-9	1 Speed	21.8±2.0	27.0	
	2 Speed	14.1 ± 1.0	17.6	

4) TRACK REVOLUTION SPEED

 Measure the track revolution cycle time with the track raised off ground.

(2) Preparation

- ① Adjust the tension of both side tracks to be equal.
- ② On the track to be measured, mark one shoe with chalk.
- ③ Swing the upperstructure 90° and lower the bucket to raise the track off ground. Keep the boom-arm angle between 90 to 110° as shown. Place blocks under machine frame.
- 4 Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.



① Select the following switch positions.

· Travel mode switch : 1 or 2 speed

· Power mode switch : P mode

· Auto idle switch : OFF

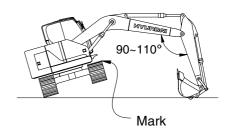
- ② Operate the travel control lever of the raised track in full forward and reverse.
- ③ Rotate 1 turn, then measure time taken for next 3 revolutions.
- ④ Raise the other side of machine and repeat the procedure.
- ⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The revolution cycle time of each track should meet the following specifications.

Unit: Seconds / 3 revolutions

Model Travel speed		Standard	Maximum allowable
D4.450D.0	1 Speed	25.0±2.0	32.0
R145CR-9	2 Speed	15.0±2.0	20.0



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5) TRAVEL DEVIATION

(1) Measure the deviation by the tracks from a 20m straight line.

(2) Preparation

- ① Adjust the tension of both tracks to be equal.
- ② Provide a flat, solid test yard 20 m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- ③ Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- 4 Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.

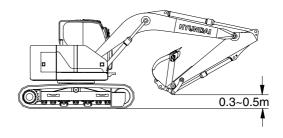
(3) Measurement

- ① Measure the amount of mistracking at high and low travel speeds.
- ② Before beginning each test, select the following switch positions.
- · Power mode switch : P mode
- Start traveling the machine in the acceleration zone with the travel levers at full stroke.
- ④ Measure the distance between a straight 20 m line and the track made by the machine. (Dimension a)
- S After measuring the tracking in forward travel, turn the upperstructure 180° and measure that in reverse travel.
- ⑥ Repeat steps ④ and ⑤ three times and calculate the average values.

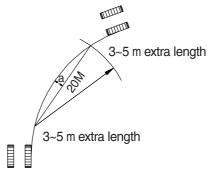
(4) Evaluation

Mistrack should be within the following specifications.

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140Z97MS04



(210-7) 7-7(2)

Unit: mm/20 m

Model	Standard	Maximum allowable	Remarks
R145CR-9	200 below	240	

6) SWING SPEED

(1) Measure the time required to swing three complete turns.

(2) Preparation

- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- ③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
- 4 Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.



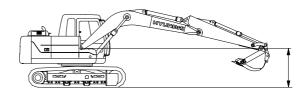
- ① Select the following switch positions.
- · Power mode switch: P mode
- ② Operate swing control lever fully.
- ③ Swing 1 turn and measure time taken to swing next 3 revolutions.
- ④ Repeat steps ② and ③ three time and calculate the average values.



The time required for 3 swings should meet the following specifications.

Unit: Seconds / 3 revolutions

Model Power mode switch		Standard	Maximum allowable
R145CR-9	P mode	13.7±1.5	16.8



140Z97MS07

7) SWING FUNCTION DRIFT CHECK

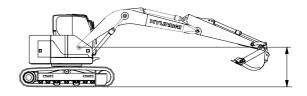
 Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

(2) Preparation

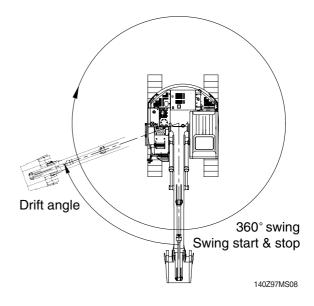
- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- ③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
- Make two chalk marks: one on the swing bearing and one directly below it on the track frame.
- (5) Swing the upperstructure 360°.
- \odot Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

(3) Measurement

- ① Conduct this test in the M mode.
- ② Select the following switch positions.
- · Power mode switch : P mode
- ③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360°
- ④ Measure the distance between the two marks.
- ⑤ Align the marks again, swing 360°, then test the opposite direction.
- Repeat steps
 and
 three times each and calculate the average values.



140Z97MS07



(4) Evaluation

The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R145CR-9	P mode	90 below	157.5	

8) SWING BEARING PLAY

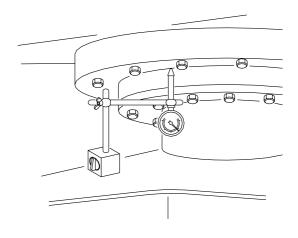
(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.

(2) Preparation

- ① Check swing bearing mounting cap screws for loosening.
- ② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.
- ③ Install a dial gauge on the track frame as shown, using a magnetic base.
- ④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.
- ⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.
- 6 Bucket should be empty.

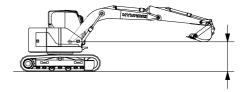
(3) Measurement

- With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.
 Record the dial gauge reading (h1).
- ② Lower the bucket to the ground and use it to raise the front idler 50cm. Record the dial gauge reading (h2).
- ③ Calculate bearing play (H) from this data (h1 and h2) as follows. H=h2-h1

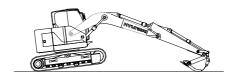


(210-7) 7-10(1)

Measurement: (h1)



Measurement: (h2)



(4) Evaluation

The measured drift should be within the following specifications.

Unit: mm

Model Standard		Maximum allowable	Remarks
R145CR-9	0.5 ~ 1.5	3.0	

9) HYDRAULIC CYLINDER CYCLE TIME

 Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

(2) Preparation

- ① To measure the cycle time of the boom cylinders:
 - With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.
- ② To measure the cycle time of the arm cylinder.
 - With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5 m above the ground.
- ③ To measure the cycle time of the bucket cylinder.
 - The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.
- ① Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

(3) Measurement

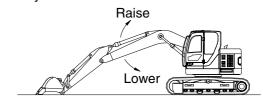
- ① Select the following switch positions.
- · Power mode switch : P mode
- ② To measure cylinder cycle times.
 - -Boom cylinders.

Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.

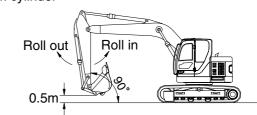
-Arm cylinder.

Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

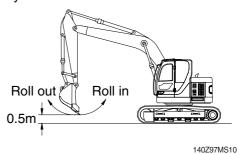
Boom cylinder



Arm cylinder



Bucket cylinder



-Bucket cylinders

Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

-Repeat each measurement 3 times and calculate the average values.

(4) Evaluation

The average measured time should meet the following specifications.

Unit: Seconds

Model	Function		Standard	Maximum allowable	Remarks
	Boom raise		3.01 ± 0.4	3.9	
	Boom lower		2.80±0.4	3.9	
	Arm in	Regen ON	2.56±0.4	4.1	
R145CR-9		Regen OFF	2.88 ± 0.4	3.9	
	Arm out		2.48±0.3	3.5	
	Bucket in		3.18±0.4	4.1	
	Bucket out		1.96±0.3	2.6	

10) DIG FUNCTION DRIFT CHECK

(1) Measure dig function drift, which can be caused by oil leakage in the control valve and boom, standard arm, and standard bucket cylinders, with the loaded bucket. When testing the dig function drift just after cylinder replacement, slowly operate each cylinder to its stroke end to purge air.

(2) Preparation

- ① Load bucket fully. Instead of loading the bucket, weight(W) of the following specification can be used.
 - · W=M³×1.5

Where:

M³ = Bucket heaped capacity (m³)

1.5=Soil specific gravity

- ② Position the arm cylinder with the rod 20 to 30mm extended from the fully retracted position.
- ③ Position the bucket cylinder with the rod 20 to 30mm retracted from the fully extended position.
- With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin.
- $^{\circ}$ Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

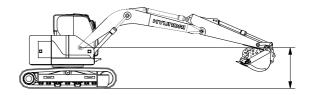
(3) Measurement

- ① Stop the engine.
- ② Five minutes after the engine has been stopped, measure the changes in the positions of the boom, arm and bucket cylinders.
- ③ Repeat step ② three times and calculate the average values.
- (4) The measured drift should be within the following specifications.



Unit: mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
	Boom cylinder	10 below	20	
R145CR-9	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	50	



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11) CONTROL LEVER OPERATING FORCE

 Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

(2) Preparation

① Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

(3) Measurement

- ① Start the engine.
- ② Select the following switch positions.
- · Power mode switch: P mode
- ③ Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.
- ④ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.
- ⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit: kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
	Boom lever	1.7 or below	2.0	
	Arm lever	1.7 or below	2.0	
R145CR-9	Bucket lever	1.4 or below	2.0	
	Swing lever	1.4 or below	2.0	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

- (1) Measure each lever stroke at the lever top using a ruler.
- When the lever has play, take a half of this value and add it to the measured stroke.

(2) Preparation

Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

(3) Measurement

- ① Stop the engine.
- ② Measure each lever stroke at the lever top from neutral to the stroke end using a ruler.
- ③ Repeat step ② three times and calculate the average values.

(4) Evaluation

The measured drift should be within the following specifications.

Unit: mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
	Boom lever	112±10	134	
	Arm lever	112±10	134	
R145CR-9	Bucket lever	90±10	112	
	Swing lever	90±10	112	
	Travel lever	139±10	178	

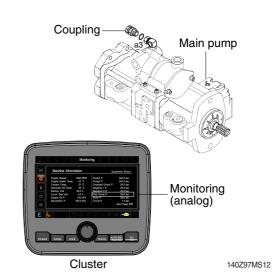
13) PILOT PRIMARY PRESSURE

(1) Preparation

① Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.

(2) Measurement

- ① Select the following switch positions.
 - · Power mode switch : P mode
 - · Auto decel switch : OFF
- ② Measure the primary pilot pressure by the monitoring menu of the cluster.



(3) Evaluation

The average measured pressure should meet the following specifications:

Unit: kgf/cm2

Model	Engine speed	Standard	Allowable limits	Remarks
R145CR-9	P mode	40 +2	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

- ① Stop the engine.
- ② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
- ③ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.
- 4 Start the engine and check for on leakage from the adapter.
- (5) Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

(2) Measurement

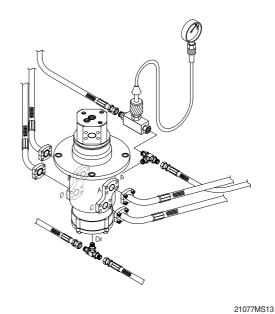
① Select the following switch positions.

Travel mode switch: 1 speed

2 speed

· Mode selector : P mode

- 2 Measure the travel speed selecting pressure in the Hi or Lo mode.
- ③ Repeat step ② three times and calculate the average values.



(3) Evaluation

The average measured pressure should be within the following specifications.

Unit: kgf/cm2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R145CR-9	1 Speed	0	-	
111-3011-9	2 Speed	40±5	-	

15) SWING PARKING BRAKE RELEASING PILOT PRESSURE

(1) Preparation

- ① Stop the engine.
- ② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
- ③ The pressure release L wrench to bleed air.
- ④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
- ⑤ Start the engine and check for oil leakage from the adapter.
- 6 Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.



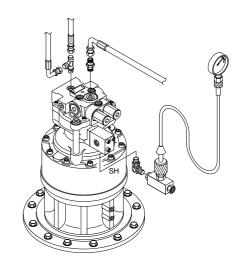
- ① Select the following switch positions.
 - · Power mode switch : P mode
- ② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
- ③ Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit: kgf/cm2

				Offit . kgi / Gff²
Model	Description	Standard	Allowable limits	Remarks
R145CR-9	Brake disengaged	40	Over 9	
	Brake applied	0	_	



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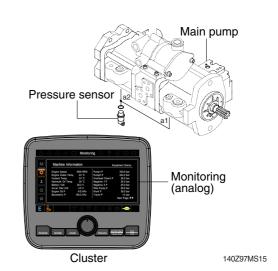
16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

① Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.

(2) Measurement

- ① Select the following switch positions.
 - · Power mode switch : P mode
- ② Measure the main pump delivery pressure in the P mode (high idle).



(3) Evaluation

The average measured pressure should meet the following specifications.

Unit: kgf/cm2

Model	Engine speed	Standard	Allowable limits	Remarks
R145CR-9	High idle	40 +2	-	

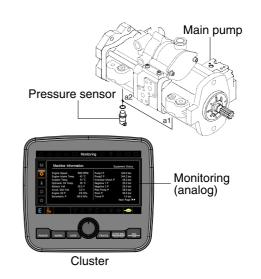
17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

(2) Measurement

- ① Select the following switch positions.
 - · Power mode switch : P mode
- ② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.
- ③ In the swing function, place bucket against an immovable object and measure the relief pressure.
- ④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.



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(3) Evaluation

The average measured pressure should be within the following specifications.

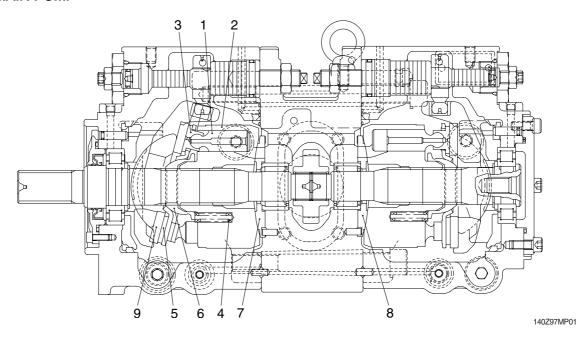
Unit: kgf/cm2

Model	Function to be tested	Standard	Port relief setting at 20 lpm
	Boom, Arm, Bucket	350 (380)±10	400±10
R145CR-9	Travel	365±10	-
	Swing	240±10	-

): Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



Part name & i	nspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)	d D	0.032	0.056	Replace piston or cylinder.
Play between piston (1) & shoe caulking section (3) (δ)	*	0-0.1	0.3	Replace
Thickness of shoe (t)	δ · · · · · · · · · · · · · · · · · · ·	3.9	3.7	assembly of piston & shoe.
Free height of cylinder spring (4) (L)		41.1	40.3	Replace cylinder spring.
Combined height of set plate (5) (H) & spherical bushing (6) (h) (H-h)	h H	17.0	15.8	Replace set plate or spherical bushing.
Surface roughness for valve plate (Sliding face) (7,8), swash plate (shoe plate	Surface roughness necessary to be corrected	3	Z	Longing
area) (9), & cylinder (2) (Sliding face)	Standard surface roughness (Corrected value)	0.4z o	r lower	Lapping

2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	In case of damage in following section, replace part.
		 Sliding sections of casing fore and spool, especially land sections applied with holded pressure. Seal pocket section where spool is inserted. Seal section of port where O-ring contacts. Seal section of each relief valve for main, travel, and port. Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion.	 Replacement when its outside sliding section has scratch (especially on seals-contacting section).
	· O-ring seal sections at both ends.	Replacement when its sliding section has scratch.
	· Insert spool in casing hole, rotate and reciprocate it.	 Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of poppet or spring	Correction or replacement when sealing is incomplete.
	Insert poppet into casing and function it.	Normal when it can function lightly without being caught.
Around spring	 Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover. 	Replacement for significant damage.
Around seal	· External oil leakage.	· Correction or replacement.
for spool	Rusting, corrosion or deformation of seal plate.	Correction or replacement.
Main relief valve,	· External rusting or damage.	· Replacement.
port relief valve & negative control	· Contacting face of valve seat.	· Replacement when damaged.
relief valve	· Contacting face of poppet.	· Replacement when damaged.
	· Abnormal spring.	· Replacement.
	· O-rings, back up rings and seals.	· 100% replacement in general.

3. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Standard dimension	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section (δ)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	5.5	5.3	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	6.5	6.0	Replace set of retainer plate and spherical bushing
Thickness of friction plate	4.0	3.6	Replace
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t			Ţ Ţ 2507

2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z (Ra=0.2) (LAPPING)	3-Z (Ra=0.8)	
Shoe plate	0.4-Z (Ra=0.1) (LAPPING)	3-Z (Ra=0.8)	
Cylinder	1.6-Z (Ra=0.4) (LAPPING)	12.5-Z (Ra=3.2)	
Valve plate	0.8-Z (Ra=0.2) (LAPPING)	6.3-Z (Ra=1.6)	

4. TRAVEL MOTOR

Pro	oblem	Cause	Remedy
Does not start	Pressure is not developed	Pump failure Control valve malfunction	 Check if action other than traveling is available. If faulty, repair. Check if spool moves correctly. Repair if necessary.
	Pressure is developed	 Brake valve failure -Sleeve stick -Check valve stick Motor failure -Valve seat seizure Gear broken and fragment locked Overloaded 	 Replace brake valve Replace Check hydraulic oil for contamination Replace reduction gear Reduce load
Oil leakage	Leakage from engaging surfaces	Scratch on engaging surfacesLoosening by poor bolt tightening	Correct surfaces by oilstone or sandpa- per or replace Check after retightening
	Leakage from casing	Plug loosenedCrack formed by stone	Retighten Replace reduction gear
	Leakage from floating seal	· Sliding surfaces worn · Creep on O-ring	Replace reduction gear Replace floating seal
	Leakage from hydraulic motor	Bolt loosenedO-ring damagedSealing surface scratched	 Tighten properly Replace O-ring Correct by oilstone or sandpaper
Coasts on sl	ope excessively	 Poor volumetric efficiency of hydraulic motor Increase of internal leakage of brake valve Parking brake not actuated Spring breakage Wear of friction plate 	
Excessive te reduction ge	emperature on ar case	Pitting on bearingLack of gear oilHydraulic oil introduced to gear case	Replace reduction gearSupply gear oil properlyCheck motor and replace oil seal
Meanders	Meanders at low pressure	 Delivery rate is different between right and left Motor drain rate is different between right and left 	
	Meanders at high pressure	 Delivery rate is different between right and left Motor drain rate is different between right and left 	
	Meanders at high pressure	 Relief pressure dropped at right and left brake valve Main relief pressure dropped at right or left of control valve 	·
Pump delive	ry is poor	Regulator operation poorExternal leakage of pump is excessive	· Repair regulator · Repair pump
External leal excessive	kage of motor is	-	· Replace motor

5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000 cc/m at neutral handle position, or more than 2000 cc/m during operation.	Conditions: Primary pressure: 40 kgf/cm² Oil viscosity: 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μ m, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	This is to be replaced when the top end has worn more than 1mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	' '
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6 troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

6. RCV PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	Conditions: Primary pressure: 40 kgf/cm² Oil viscosity: 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10μ m, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

7. TURNING JOINT

F	Part name	Maintenance standards	Remedy
	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and	Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
Body, Stem	stem other than sealing section.	Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface	Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
	with thrust plate.	· Worn less than 0.5 mm (0.02 in).	Smooth
		Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
	Sliding surface	Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
Cover	with thrust plate.	· Worn less than 0.5 mm (0.02 in).	Smooth
		Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
	-	Extruded excessively from seal groove square ring. Extrusion Square ring	Replace
Seal set	-	Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring. 1.5mm (max.) (0.059 in)	Replace
	-	• Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in)	Replace

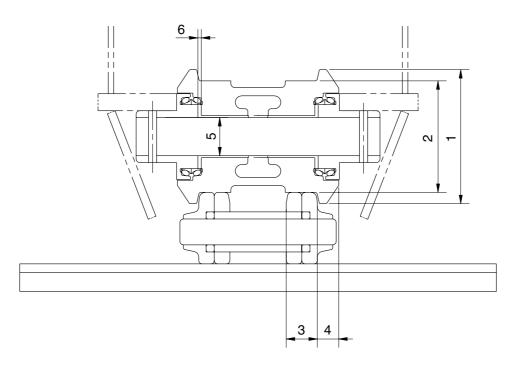
8. CYLINDER

Part name	Inspecting section	Inspection item	Remedy	
Piston rod	· Neck of rod pin	· Presence of crack	· Replace	
	· Weld on rod hub	Presence of crack	· Replace	
	Stepped part to which piston is attached.	· Presence of crack	· Replace	
	· Threads	· Presence of crack	· Recondition or replace	
	· Plated surface	Plating is not worn off to base metal.	· Replace or replate	
		Rust is not present on plating.	· Replace or replate	
		· Scratches are not present.	· Recondition, replate or replace	
	· Rod	· Wear of O.D.	· Recondition, replate or replace	
	· Bushing at mounting part	· Wear of I.D.	· Replace	
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace	
	· Weld on head	· Presence of crack	· Replace	
	· Weld on hub	· Presence of crack	· Replace	
	Tube interior	· Presence of faults	· Replace if oil leak is seen	
	· Bushing at mounting part	· Wear on inner surface	· Replace	
Gland	· Bushing	· Flaw on inner surface	Replace if flaw is deeper than coating	

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER

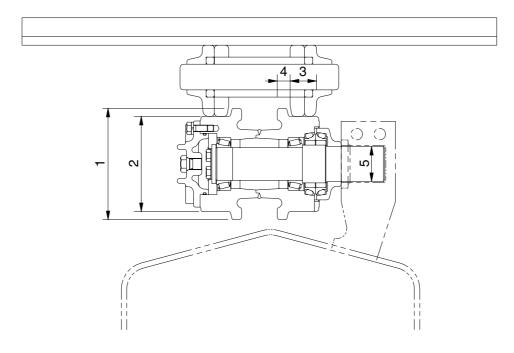


21037MS01

Unit:mm

No.	Check item		Criteria				
	Outside dispostant of floores	Standard size			Repair limit		Rebuild or replace
	Outside diameter of flange	ø 190		-			
2	Outside diameter of tread	ø 150			ø 138		
3	Width of tread	36.5			42.5		
4	Width of flange	26.5			-		
	Clearance between shaft and bushing	Standard	tolerance		Standard	Clearance	
5		size	Shaft	Hole	clearance	limit	Replace
		ø 65	-0.25 -0.35	+0.12 +0.075	0.325 to 0.47	2.0	bushing
6	Side clearance of roller	Standard clearance		Clearance limit		Replace	
0	(both side)	0.1 to 1.3		2.0			

2) CARRIER ROLLER

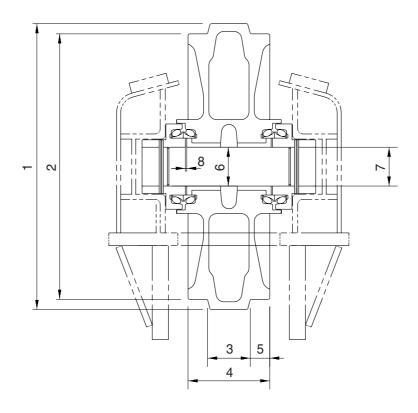


21037MS02

Unit:mm

No.	Check item		Criteria					
4	Outside dismeter of flance	Standard size		Repair limit				
'	1 Outside diameter of flange		ø 175		-			
2	Outside diameter of tread	ø.	151	ø 141		Rebuild or replace		
3	Width of tread	37	.25	42.25				
4	Width of flange	18	.25					
		Standard size & Tolerance		Standard	Clearance			
5	Clearance between shaft and bushing	Shaft	Hole	clearance	limit	Replace bushing		
		ø 41.27 0 +0.05	ø 41.5 ^{+0.2} _{-0.1}	0.13 to 0.48	1.2			

3) IDLER

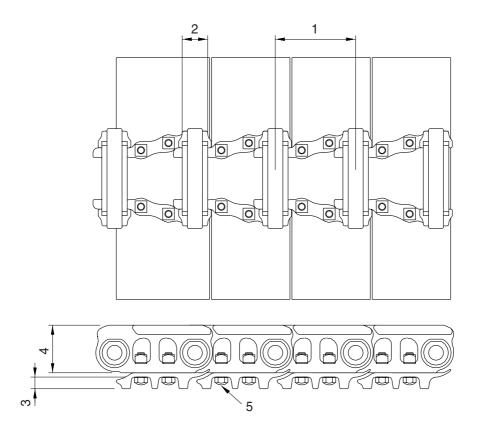


21037MS03

Unit:mm

No.	Check item		Criteria				
4	Outside dismeter of flance	Standard size		Repair limit			
'	Outside diameter of flange	ø 552		-			
2	Outside diameter of tread	ø !	507	ø 497		Rebuild or	
3	Width of protrusion	67		-		replace	
4	Total width	135		-			
5	Width of tread	34		39			
	Clearance between shaft	Standard size & Tolerance		Standard	Clearance		
6		Shaft	Hole	clearance	limit	Replace	
	and bushing	ø 70 0 -0.03	ø 70.3 ^{+0.05}	0.3 to 0.38	2.0	bushing	
7	Clearance between shaft and support	ø 70 0 0 0 +0.07 +0.03		0.03 to 0.1	1.2	Replace	
8	Side clearance of idler (both side)	Standard clearance 0.25 to 1.15		Clearance limit 2.0		Replace bushing	

4) TRACK

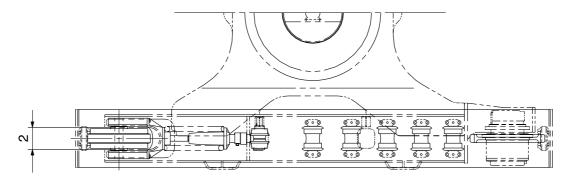


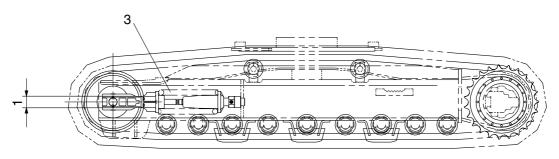
21037MS04

Unit:mm

No.	Check item	Crit	Remedy		
4	Link nitah	Standard size Repair limit		Turn or	
'	Link pitch	171.45	175.65	replace	
2	Outside diameter of bushing				
3	Height of grouser	25	16	Rebuild or replace	
4	Height of link	94.5	86.5		
5	Tightening torque (Tightening angle method)	Initial tightening torque : 42 ± Additional tightening angle :	Retighten		

5) TRACK FRAME AND RECOIL SPRING



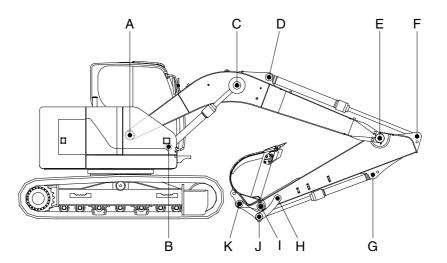


21037MS05

Unit: mm

No.	Check item		Criteria					
	Vertical width of idler guide		Standar	d size	Tolerance	Repair limit		
1		Track frame	e 103	3	+2 0	107		
		Idler support)	0 - 0.5	98	Rebuild or replace	
	The Control of Miles (College College	Track frame	e 192	2	+2 0	196	replace	
2	2 Horizontal width of idler guide		rt 190)	-	188		
		,	Standard siz	е	Re	pair limit		
3	Recoil spring	Free length	Installation length	Installati load		Installation load	Replace	
		ø 192×470	405	8,497k	kg -	6,978kg		

2. WORK EQUIPMENT



140Z97MS20

Unit:mm

	Measuring point (Pin and Bushing)		Pin		Bushing		Domodu
Mark		Normal value	Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	Remedy & Remark
Α	Boom Rear	70	69	68.5	70.5	71	Replace
В	Boom Cylinder Head	70	69	68.5	70.5	71	"
С	Boom Cylinder Rod	70	69	68.5	70.5	71	"
D	Arm Cylinder Head	70	69	68.5	70.5	71	"
E	Boom Front	70	69	68.5	70.5	71	"
F	Arm Cylinder Rod	70	69	68.5	70.5	71	"
G	Bucket Cylinder Head	70	69	68.5	70.5	71	"
Н	Arm Link	65	64	63.5	65.5	66	"
1	Bucket and Arm Link	65	64	63.5	65.5	66	"
J	Bucket Cylinder Rod	70	69	68.5	70.5	71	"
K	Bucket Link	65	64	63.5	65.5	66	"

SECTION 8 DISASSEMBLY AND ASSEMBLY

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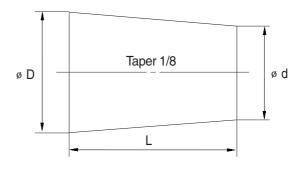
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

- Lower the work equipment completely to the ground.
 If the coolant contains antifreeze, dispose of it correctly.
- 2) After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
- 3) When draining oil, prepare a container of adequate size to catch the oil.
- 4) Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- 5) To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.
- 6) Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
- 7) Check the number and thickness of the shims, and keep in a safe place.
- 8) When raising components, be sure to use lifting equipment of ample strength.
- 9) When using forcing screws to remove any components, tighten the forcing screws alternately.
- 10) Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.
- 11) When removing hydraulic equipment, first release the remaining pressure inside the hydraulic tank and the hydraulic piping.
- 12) If the part is not under hydraulic pressure, the following corks can be used.

Nominal	Dimensions					
number	D	d	L			
06	6	5	8			
08	8	6.5	11			
10	10	8.5	12			
12	12	10	15			
14	14	11.5	18			
16	16	13.5	20			
18	18	15	22			
20	20	17	25			
22	22	18.5	28			
24	24	20	30			
27	27	22.5	34			



2. INSTALL WORK

- 1) Tighten all bolts and nuts (sleeve nuts) to the specified torque.
- 2) Install the hoses without twisting or interference.
- 3) Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- 4) Bend the cotter pin or lock plate securely.
- 5) When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.
- 6) When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- 7) Clean all parts, and correct any damage, dents, burrs, or rust.
- 8) Coat rotating parts and sliding parts with engine oil.
- 9) When press fitting parts, coat the surface with antifriction compound (LM-P).
- 10) After installing snap rings, check that the snap ring is fitted securely in the ring groove (Check that the snap ring moves in the direction of rotation).
- 11) When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- 12) When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.
- 13) When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.
- 14) When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:
- (1) Start the engine and run at low idling.
- (2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100mm before the end of the stroke.
- (3) Next, operate the piston rod to the end of its stroke to relieve the circuit. (The air bleed valve is actuated to bleed the air.)
- (4) After completing this operation, raise the engine speed to the normal operating condition.
- * If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to the work equipment.
- * Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

3. COMPLETING WORK

- 1) If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- 2) If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- 3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.
- 4) Add the specified amount of grease (molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

Na	Descriptions		Bolt size	Torque		
No.		·		kgf ⋅ m	lbf ⋅ ft	
1		Engine mounting bolt (engine-bracket)	M12 × 1.75	10 ± 1.0	72.3 ± 7.2	
2		Engine mounting bolt (bracket-frame, FR)	M16 × 2.0	30 ± 3.5	217 ± 25.3	
3	Engine	Engine mounting bolt (bracket-frame, RR)	M20 × 2.5	55 ± 3.5	398 ± 25.3	
4	Engine	Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5	
5		Coupling mounting socket bolt	M16 × 2.0	22 ± 1.0	159 ± 7.2	
6		Main pump housing mounting bolt	M10 × 1.5	6.0 ± 0.3	43.4 ± 2.2	
7		Main pump mounting socket bolt	M16 × 2.0	22 ± 1.0	159 ± 7.2	
8		Main control valve mounting bolt	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4	
9	Hydraulic system	Fuel tank mounting bolt	$M20 \times 2.5$	46 ± 5.1	333 ± 36.9	
10	9,0.0	Hydraulic oil tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 36.9	
11		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	88.9 ± 9.4	
12		Swing motor mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1	
13	Power	Swing bearing upper part mounting bolt	M18 × 2.5	41.3 ± 4.5	299 ± 32.5	
14	train	Swing bearing lower part mounting bolt	M16 × 1.5	31.3 ± 3.2	226 ± 23.1	
15	system	Travel motor mounting bolt	M16 × 2.0	25.7 ± 4.0	186 ± 28.9	
16		Sprocket mounting bolt	M16 × 2.0	23 ± 2.5	166 ± 18.1	
17		Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 4.4	215 ± 31.8	
18		Track roller mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1	
19	Under carriage	Track tension cylinder mounting bolt	M16 × 2.0	21.9 ± 3.3	158 ± 23.9	
20]	Track shoe mounting bolt, nut	5/8 - 18UNF	42 ± 4.0	304 ± 28.9	
21		Track guard mounting bolt	M16 × 2.0	29.6 ± 3.2	214± 23.1	
22		Counterweight mounting bolt	M36 × 3.0	308 ± 46	2228 ± 333	
23	Others	Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7	
24		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8	

^{*} For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

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

(2) Fine thread

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

2) PIPE AND HOSE (FLARE TYPE)

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

3) PIPE AND HOSE (ORFS TYPE)

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

4) FITTING

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

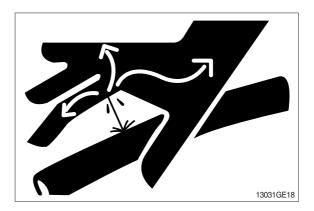
GROUP 3 PUMP DEVICE

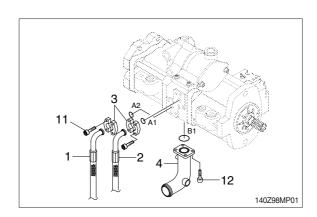
1. REMOVAL AND INSTALL

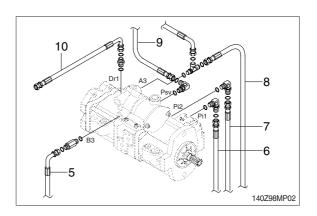
1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.
- (4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.
 - Hydraulic tank quantity : 96 / (25.4 U.S. gal)
- (5) Remove socket bolts (11) and disconnect hoses (1,2).
- (6) Disconnect pilot line hoses (5, 6, 7, 8, 9, 10).
- (7) Remove socket bolts (12) and disconnect pump suction pipe (4).
- When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (8) Sling the pump assembly and remove the pump mounting bolts.
 - · Weight: 90 kg (200 lb)
- * Pull out the pump assembly from housing.

When removing the pump assembly, check that all the hoses have been disconnected.





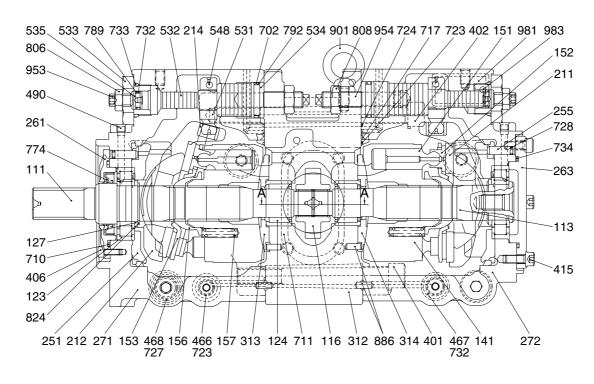


2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- (2) Remove the suction strainer and clean it.
- (3) Replace return filter with new one.
- (4) Remove breather and clean it.
- (5) After adding oil to the hydraulic tank to the specified level.
- (6) Bleed the air from the hydraulic pump.
- ① Remove the air vent plug (2EA).
- ② Tighten plug lightly.
- ③ Start the engine, run at low idling, and check oil come out from plug.
- 4 Tighten plug.
- (7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.
- (8) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. MAIN PUMP (1/3)

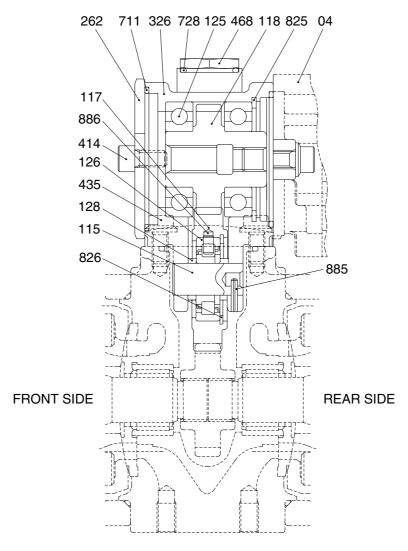
1) STRUCTURE



140Z92MP02

111	Drive shaft (F)	272	Pump casing (R)	711	O-ring
113	Drive shaft (R)	312	Valve block	717	O-ring
116	1st Gear	313	Valve plate (R)	723	O-ring
123	Roller bearing	314	Valve plate (L)	724	O-ring
124	Needle bearing	401	Hexagon socket bolt	728	O-ring
127	Bearing spacer	402	Hexagon socket bolt	732	O-ring
141	Cylinder block	406	Hexagon socket bolt	733	O-ring
151	Piston	415	Hexagon socket bolt	734	O-ring
152	Shoe	466	Plug	774	Oil seal
153	Set plate	467	plug	789	Back up ring
156	Bushing	468	Plug	792	Back up ring
157	Cylinder spring	490	Plug	806	Nut
211	Shoe plate	531	Tilting pin	808	Hexagon head nut
212	Swash plate	532	Servo piston	824	Snap ring
214	Bushing	533	Plug	886	Spring pin
251	Support	534	Stopper (L)	901	Eye bolt
255	Lock pin	535	Stopper (S)	953	Set screw
261	Seal cover (F)	548	Pin	954	Set screw
263	Seal cover (R)	702	O-ring	981	Plate
271	Pump casing (F)	710	O-ring	983	Pin

MAIN PUMP (2/3)



04 Gear pump 128 Bearing spacer 711 O-ring 115 Shaft 262 Cover 728 O-ring 117 Gear No. 2 326 Gear case 825 Retainer ring 118 Gear No. 3 414 Hexagon socket bolt 826 Retainer ring 435 Flange socket bolt 125 Ball bearing 885 Spring pin 126 Roller bearing 468 Plug 886 Pin

140Z92MP03

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

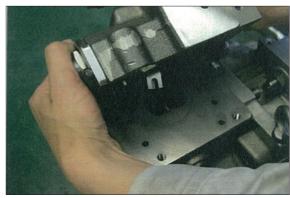
Tool name & size	Part name							
Name	В	Hexagon socket head bolt		PT plug T thread)	ROH/VP/UNF plug (PF screw)		Hexagon socket head setscrew	
Allen wrench	4	M 5	Е	3P-1/16	-		M 8	
	5	M 6	ı	BP-1/8	-		M10	
	6	M 8	ı	BP-1/4	PF-1/4		M12, M14	
- B	8	M10	ı	BP-3/8	PF-3/8	}	M16, M18	
	10	M12	ı	BP-1/2	PF-1/2)	M20	
	14	M16, M18	ı	BP-3/4	PF-3/4		-	
	17	M20, M22		BP-1	PF-1		-	
Double ring spanner,	-	Hexagon bolt		Hexagon nut			VP plug (PF screw)	
socket wrench, double (single) open end spanner	19	19 M12 24 M16 27 M18		M12			PF-1/4	
open end spanner	24			M	16		-	
В	27			M18		PF-1/2		
	30	M20		M20			-	
	41	-			-		PF-1	
Adjustable angle wrench		Medium size, 1 set						
Screw driver		Minus type screw driver, Medium size, 2 sets						
Hammer	Plastic hammer, 1 set							
Pliers	For snap ring, TSR-160							
Steel bar	Steel bar of key material approx. 10 × 8 × 200							
Torque wrench		Capable of tightening with the specified torques						

(2) Tightening torque

Dort name	Dolt oize	Torque		Wrenc	ch size
Part name	Bolt size	kgf ⋅ m	lbf ⋅ ft	in	mm
Hexagon socket head bolt	M 5	0.7	5.1	0.16	4
(material : SCM435)	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (material : S45C) *Wind a seal tape 1.5 to 2	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
turns round the plug	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 3/8	7.55	54.6	0.31	8
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

- (1) Select place suitable to disassembling.
- * Select clean place.
- Spread rubber sheet, cloth or so on overhaul workbench top to prevent parts from being damaged.
- (2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.
- (3) Remove drain port plug (468) and drain oil pump casing (271, 272).
- (4) Remove hexagon socket head bolts (412, 413) and remove regulator.



140Z98MP11

- (5) Place pump horizontally on workbench with its regulator fitting surface down, and remove flange socket (435) and remove PTO unit (05).
- * Be careful about the attaching direction of the PTO unit (05).
- ** Before bringing regulator fitting surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.
- (6) In case the pump is provided without the PTO unit (05), remove the cover (262) with the hexagon socket head cap screws (414).



140Z98MP12



140Z98MP13

(7) Remove flange socket (435) and remove gear pump (04).



1/0708MP1/

(8) Loosen hexagon socket head bolt (401) which tighten pump casing (271, 272) and valve block (312).



140Z98MP15

- (9) Place pump horizontally on workbench with its regulator fitting surface down, and separate pump casing (271,272) from valve block (312).
- * Remove 1st gear (116) when separating pump casing from valve block (312) too.



140Z98MP16

- (10) Pull out cylinder (141), pistons (151), set screw (153), spherical bush (156) and cylinder springs (157) simultaneously from pump casing (271, 272) straightly over drive shaft (111, 113).
- * Take care not to damage sliding surface of cylinder (141), spherical bush (156), shoes (152), swash plate (212), etc.



140Z98MP17

- (11) Remove hexagon socket head bolts (406) and then seal cover (F, 261).
- * In the case removing it is difficult, and hooking pull thin rod into notch, and the cover can be removed easily.
- * Since oil seal is fitted on seal cover (F) (261), take care not to damage it at removing the cover.



140Z98MP18

(12) Tapping shaft ends of drive shaft (111, 113) lightly with plastic hammer, remove it from pump casing (271, 272).



140Z98MP19

(13) Remove shoe plate (211) and swash plate (212) from pump casing (271, 272).



140Z98MP20

- (14) Insert thin steel bar into the hole and remove the lock pin (255) from pump casing (271, 272).
- * When holding with thin steel bar, do not confuse the unlocking hole with the arc shaped oil passage.



140Z98MP21

- (15) Remove valve plate (313, 314) from valve block (312).
- * These may be removed in Work 8.



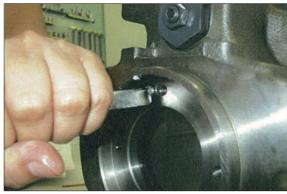
140Z98MP22

If necessary, remove stopper (L) (534), Qmin. plug (533), servo piston (532) and tilting pin (531) from pump casing (271, 272), and needle bearing (124) from valve block.

- When removing tilting pin, use a protector to prevent pin head from being damaged.
- Since lock tight is applied to fitting areas of tilting pin (531) and servo piston (532), take care not to damage servo piston (532).
- ** Do not remove needle bearing (124) as far as possible, except the case that considered to be out of its life span.
- Do not loosen hexagon nuts of valve block (312) and Qmin. plug (533).
 If loosened, flow setting will be changed.

4) ASSEMBLY

- (1) For reassembling reverse the disassembling procedures, paying attention to the following items.
- ① Do not fail to repair the parts damaged during disassembling, and repair replacement parts in advance.
- 2 Clean each part fully with cleaning oil and dry it with compressed air.
- 3 Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.
- ④ In principle, replace seal parts, such as O-rings, oil seals, etc.
- 5 For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.
- 6 For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.
- (2) Insert the lock pin (255) after the swash plate support (251) into the pump casing (271, 272), and fit the lock pin (255) into the hole of the swash plate support (251).
- * In case the servo piston, tilting pin, stopper (L), stopper (S), and Qmin. plug have been removed, attached then to the pump casing in advance.
- * In the tightening work of the servo piston and the tilting pin, use the tool not to damaged the head of the tilting pin and the feed back pin. Besides, apply loctite (of medium strength) to the thread portion.



- (3) Fit tilting bush (214) of swash plate (212) to tilting pin (531), and fit swash plate (212) with shoe plate (211) to swash plate support (251) correctly.
- * Confirm with fingers of both hands that swash plate can be removed smoothly.
- ** Apply grease to sliding sections of swash plate (212) and swash plate support (251), and drive shaft (111, 113) can be fitted easily.
- * Take care not to damage shoe plate (211) surface.



140Z98MP24

(4) To pump casing (271, 272), fit drive shaft (111, 113) set with bearing (123), bearing spacer (127) and stop ring (824).



140Z98MP25

- (5) In assemble of front pump, assemble seal cover (F) (261) to pump casing (271) and fix it with hexagon socket head bolt (406).
- ** Apply grease lightly to oil seal in seal cover (F) (261).
- * For assemble oil seal (774), taking full care not to damage it.



140Z98MP26

(6) Assemble piston cylinder subassembly [cylinder (141), piston subassembly (151, 152), set plate (153), spherical bush (156) and cylinder spring (157)]. Fitting spline phases of cylinder, spherical bush (156) and drive shaft (111, 113), insert piston cylinder subassembly into pump casing (271, 272).



140Z98MP27

- (7) Fit valve plate (313, 314) to valve block (312), spring pin (886) into pin hole.
- * Take care not to mistake suction/delivery direction of valve plate (312).



140Z98MP28

- (8) Place pump horizontally on workbench with its regulator fitting surface down, and attach pump casing (271, 272) to valve block (312). Fit 1st gear (116) simultaneously.
- * Before bringing regulator fitting surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.
- * Take care not to mistake direction of valve block (312). [Clockwise rotation (viewed from input shaft side)]. Fit the valve block (312) with suction flange left when regulator side below, viewed from front side.
- (9) Fix valve block (312) to pump casing (271, 272) with hexagon socket head bolts (401).





140Z98MP30

(10) Fit gear pump (04) to pump casing (272) with hexagon socket head bolts (435).



(11) Attach the PTO unit (05) by fastening the flange socket (435) to the valve block (312).



140Z98MP32

(12) In case the pump is not provided with the PTO unit (05), attach the cover (262) with the hexagon socket head cap screw (414).



140Z98MP33

- (13) Putting feedback lever (611) of regulator into feedback pin (548) of tilting pin (531), fit regulator with hexagon socket head bolt (415).
- * Take care not to mix up regulator of front pump and that of rear pump.



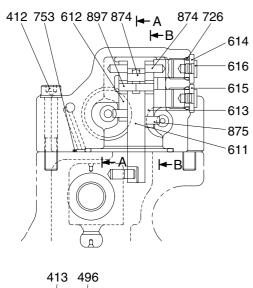
140Z98MP34

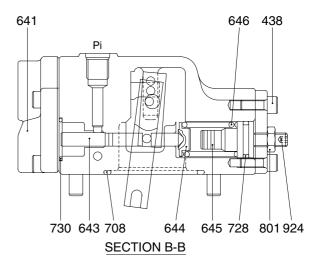
(14) Fit drain port plug (468).

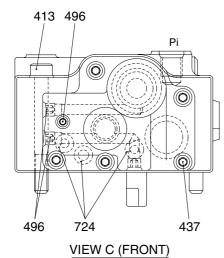
This is the end of reassembling procedures.

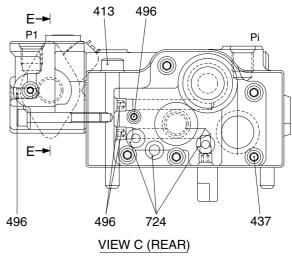
3. REGULATOR

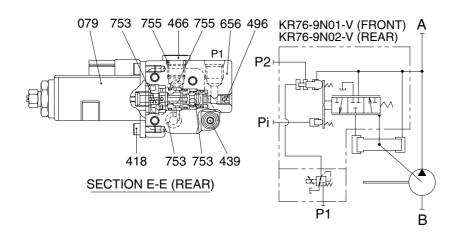
1) STRUCTURE (1/2)





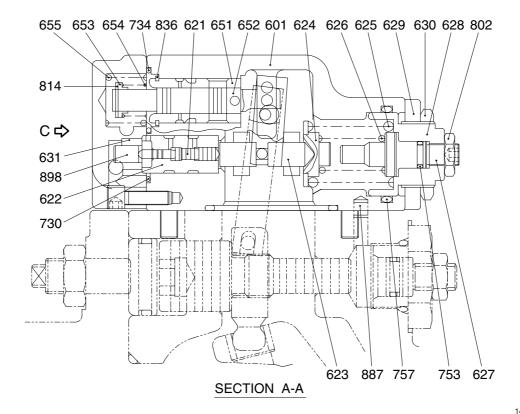






140Z92MP04

REGULATOR (3/3)



140Z92MP05

079	EPPR valve assembly	624	Spring seat (C)	708	O-ring
412	Hexagon socket screw	625	Outer spring	724	O-ring
413	Hexagon socket screw	626	Inner spring	725	O-ring
418	Hexagon socket screw	627	Adjust stem (C)	728	O-ring
437	Hexagon socket screw	628	Adjust screw (C)	730	O-ring
438	Hexagon socket screw	629	Cover (C)	734	O-ring
439	Hexagon socket screw	630	Lock nut	753	O-ring
466	Plug	631	Sleeve, Pf	755	O-ring
496	Plug	641	Pilot cover	757	O-ring
601	Casing	643	Pilot piston	801	Nut
611	Feed back lever	644	Spring seat (Q)	802	Nut
612	Lever (1)	645	Adjust stem (Q)	814	Snap ring
613	Lever (2)	646	Pilot spring	836	Snap ring
614	Center plug	651	Sleeve	874	Pin
615	Adjust plug	652	Spool	875	Pin
616	Plug	653	Spring seat	887	Pin
621	Compensator piston	654	Return spring	897	Pin
622	Piston case	655	Set spring	898	Pin
623	Compensator rod	656	Block cover	924	Set screw

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Tool name & size	Part name							
Name	В	Hexagon socket head bolt		PT plug T thread)	PO plug (PF thread)		Hexagon socket head setscrew	
Allen wrench	4	M5	BP-1/16		-		M 8	
	5	M6		BP-1/8	-		M10	
		M8	BP-1/4		PO-1/4		M12, M14	
Double ring spanner, socket wrench, double (single) open end spanner	-	Hexagon hea bolt	d	Hexagon nut		VP plug (PF thread)		
	6	M 8		М	M 8		-	
Adjustable angle wrench	Small size, Max 36 mm							
Screw driver	Minus type screw driver, Medium size, 2 sets							
Hammer	Plastic hammer, 1 set							
Pliers	For snap ring, TSR-160							
Steel bar	4×100 mm							
Torque wrench	Capable of tightening with the specified torques							
Pincers	-							
Bolt	M4, Length: 50 mm							

(2) Tightening torque

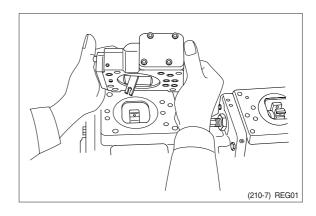
Dort name	Bolt size	Тог	que	Wrench size		
Part name	Boil size	kgf ⋅ m	lbf ⋅ ft	in	mm	
Hexagon socket head bolt	M 5	0.7	5.1	0.16	4	
(material : SCM435)	M 6	1.2	8.7	0.20	5	
	M 8	3.0	21.7	0.24	6	
	M10	5.8	42.0	0.31	8	
	M12	10.0	72.3	0.39	10	
	M14	16.0	116	0.47	12	
	M16	24.0	174	0.55	14	
	M18	34.0	246	0.55	14	
	M20	44.0	318	0.67	17	
PT Plug (material : S45C) **Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4	
	PT 1/8	1.05	7.59	0.20	5	
	PT 1/4	1.75	12.7	0.24	6	
	PT 3/8	3.5	25.3	0.31	8	
	PT 1/2	5.0	36.2	0.39	10	
PF Plug (material : S35C)	PF 1/4	3.0	21.7	0.24	6	
	PF 1/2	10.0	72.3	0.39	10	
	PF 3/4	15.0	109	0.55	14	
	PF 1	19.0	137	0.67	17	
	PF 1 1/4	27.0	195	0.67	17	
	PF 1 1/2	28.0	203	0.67	17	

3) DISASSEMBLY

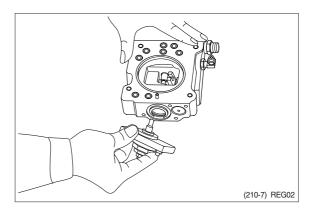
Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

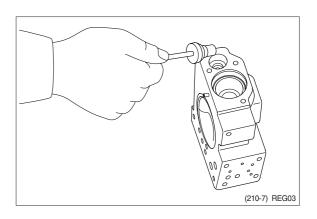
- (1) Choose a place for disassembly.
- * Choose a clean place.
- * Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.
- (2) Remove dust, rust, etc. from surfaces of regulator with clean oil.
- (3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.
- * Take care not to lose O-ring.

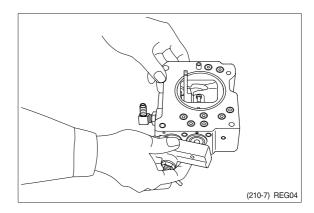


- (4) Remove hexagon socket head screw (438) and remove cover (C,629)
- ** Cover (C) is fitted with adjusting screw (C, 628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
- * Do not loosen these screws and nuts.
 If they are loosened, adjusted pressure-flow setting will vary.

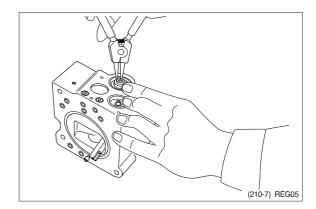


- (5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
 - Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
- * Adjusting ring (Q,645) can easily be drawn out with M4 bolt.
- (6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641). After removing pilot cover, take out set spring (655) from pilot section.

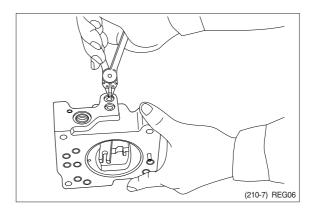


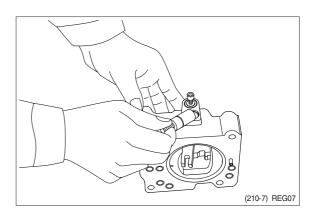


- (7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
- * Sleeve (651) is fitted with snap ring (836).
- When removing snap ring (814), return spring (654) may pop out.
 Take care not to lose it.

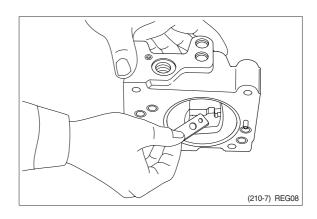


- (8) Remove prevention plug (616) and take out center plug (614) and adjusting plug (615).
- * Center plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.



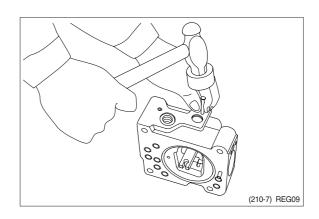


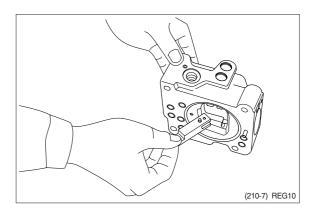
- (9) Remove lever (2, 613). Do not draw out pin (875).
- Work will be promoted by using pincers or so on.



(10) Draw out pin (874) and remove feedback lever (611).

Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).



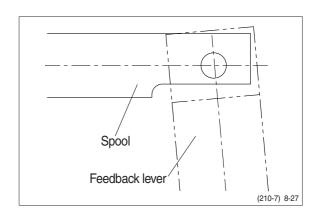


- (11) Remove lever (1, 612). Do not draw out pin (875).
- (12) Draw out pilot piston (643) and spool (652).
- (13) Draw out piston case (622), compensating piston (621) and compensating rod (623).
- * Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

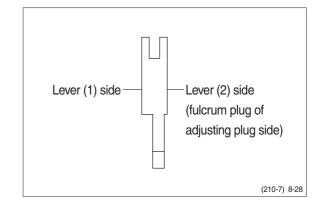
This completes disassembly.

4) ASSEMBLY

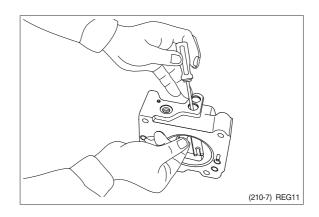
- For assembly, reverse disassembly procedures, but pay attention to the following items.
- ① Always repair parts that were scored at disassembly.
- ② Get replacement parts ready beforehand. Mixing of foreign matter will cause malfunction.
 - Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.
- 3 Always tighten bolts, plugs, etc. to their specified torques.
- ④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.
- ⑤ Replace seals such as O-ring with new ones as a rule.
- (2) Put compensating rod (623) into compensating hole of casing (601).
- (3) Put pin force-fitted in lever (1, 612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.
- (4) Fit spool (652) and sleeve (651) into hole in spool of casing.
- * Confirm that spool and sleeve slide smoothly in casing without binding.
- * Pay attention to orientation of spool.



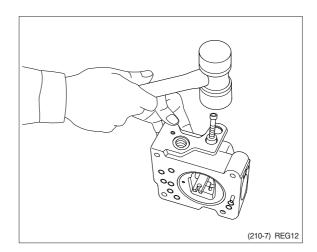
- (5) Fit feedback lever (611), matching its pin hole with pin hole in spool. Then insert pin (874).
- * Insert pin in feedback lever a little to ease operation.
- * Take care not to mistake direction of feedback lever.

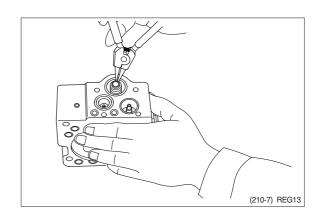


- (6) Put pilot piston (643) into pilot hole of casing.
- * Confirm that pilot piston slides smoothly without binding.
- (7) Put pin force-fitted in lever (2, 613) into groove of pilot piston. Then fix lever (2).



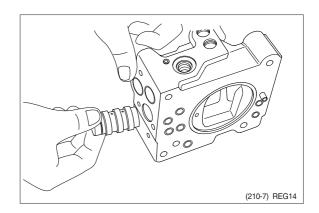
- (8) Fit center plug (614) so that pin forcefitted in center plug (614) can be put into pin hole of lever (2). Then install prevention plug (858).
 - men install prevention plug (656).
- (9) Insert adjusting plug (615) and fit locking ring.
- * Take care not to mistake inserting holes for fulcrum plug and adjusting plug. At this point in time move feedback lever to confirm that it has no large play and is free from binding.
- (10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).



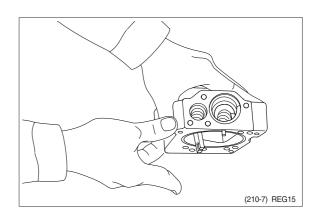


compensating piston (621) and piston case (622) into compensating hole. Fit pilot cover (641) and tighten it with hexagonal socket head screws (437, 438).

(11) Fit set spring (655) to spool hole and put

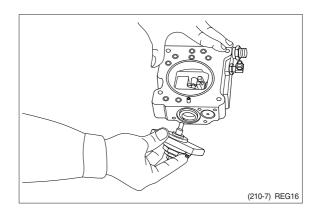


- (12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole. Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
- When fitting spring seat, take care not to mistake direction of spring seat.



(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

Then tighten them with hexagonal socket head screws (438).



This completes assembly.

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

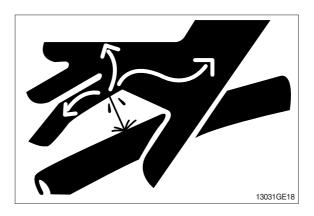
- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

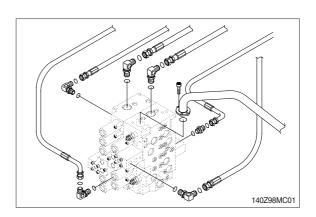
A Escaping fluid under pressure can penetrate the skin causing serious injury.

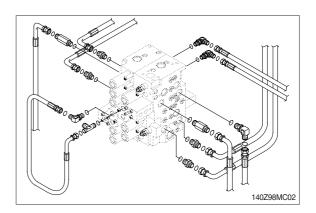
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Remove the wirings for the pressure sensor and so on.
- (5) Remove bolts and disconnect pipe.
- (6) Disconnect pilot line hoses.
- (7) Disconnect pilot piping.
- (8) Sling the control valve assembly and remove the control valve mounting bolt and bracket.
 - · Weight: 80kg(175lb)
- (9) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

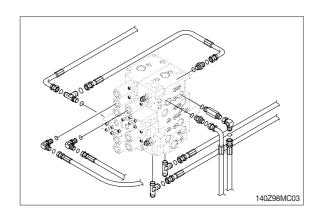
2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- (2) Bleed the air from below items.
- ① Cylinder (Boom, arm, bucket)
- ② Swing motor
- ③ Travel motor
- * See each item removal and install.
- (3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

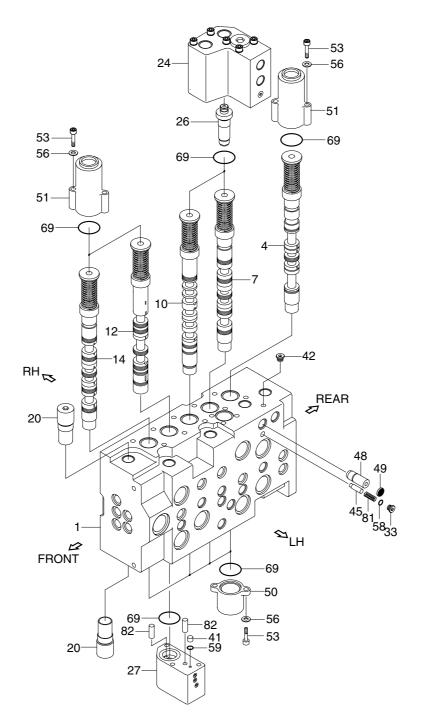








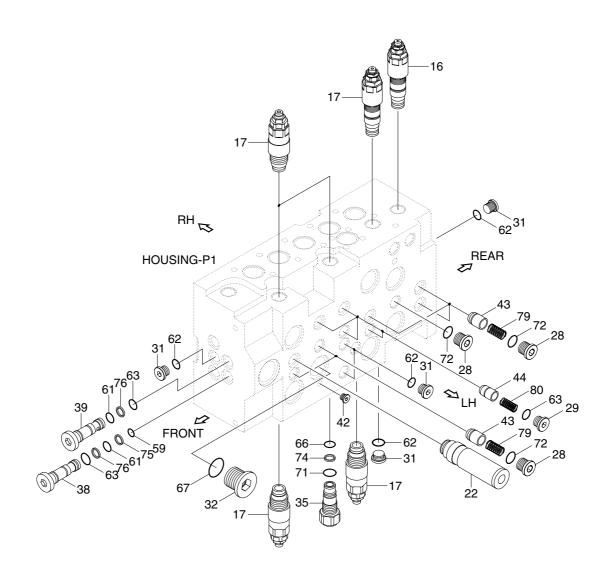
2. STRUCTURE (1/4)



1	Housing-P1	27	Regeneration block	53	Socket head bolt
4	Spool assy-travel(LH)	33	Plug	56	Plain washer
7	Spool assy-boom 1	41	Orifice	58	O-ring
10	Spool assy-arm 2	42	Plug	59	O-ring
12	Spool assy-arm regen	45	Poppet	69	O-ring
14	Spool assy-bucket	48	Orifice	81	Spring
20	Nega con relief valve	49	Coin type filter	82	Pin
24	Holding valve kit A1	50	Pilot A cap		
26	Lock valve kit B	51	Pilot B1 cap		

14098MC04

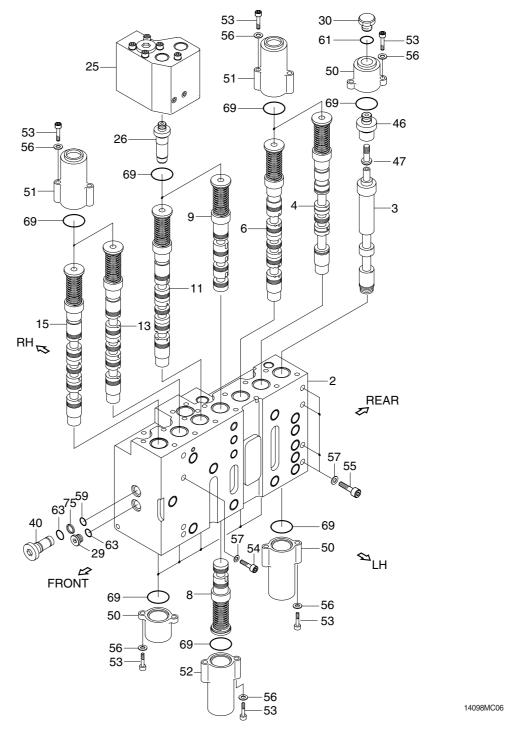
STRUCTURE (2/4)



14W98MC05

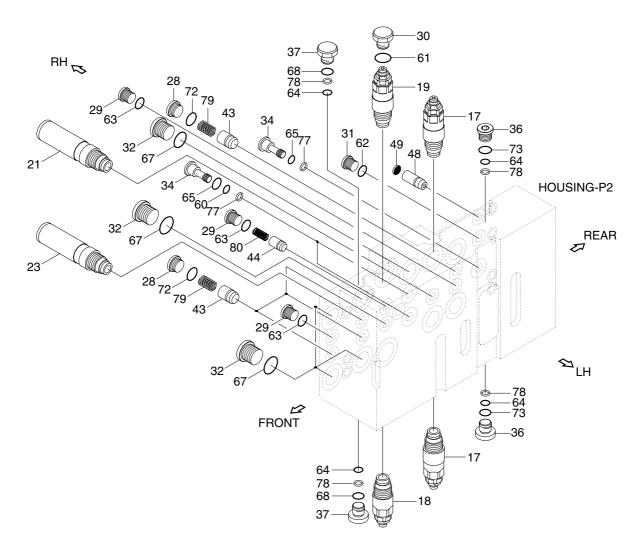
16	Main relief valve	39	Plug	67	O-ring
17	Overload relief valve	42	Plug	71	O-ring
22	Bucket logic valve	43	Poppet 1	72	O-ring
28	Plug	44	Poppet 2	74	Back up ring
29	Plug	59	O-ring	75	Back up ring
31	Plug	61	O-ring	76	Back up ring
32	Plug	62	O-ring	79	Spring
35	Plug	63	O-ring	80	Spring
38	Plug	66	O-ring		

STRUCTURE (3/4)



2	Housing-P2	26	Lock valve kit B	54	Socket head bolt
3	Spool assy-straight travel	29	Plug	55	Socket head bolt
4	Spool assy-travel(RH)	30	Plug	56	Plain washer
6	Spool assy-swing	40	Plug	57	Spring washer
8	Spool assy-swing priority	46	Sleeve	59	O-ring
9	Spool assy-boom 2	47	Piston	61	O-ring
11	Spool assy-arm 1	50	Pilot A cap	63	O-ring
13	Spool assy-option B	51	Pilot B1 cap	69	O-ring
15	Spool assy-option C	52	Pilot B2 cap	75	Back up ring
25	Holding valve kit A2	53	Socket head bolt		

STRUCTURE (4/4)



14098MC07

17	Overload relief valve	36	Plug	65	O-ring
18	Overload relief valve	37	Plug	67	O-ring
19	Overload relief valve	43	Poppet 1	68	O-ring
21	Swing logic valve	44	Poppet	72	O-ring
23	ON/OFF valve-option	48	Orifice	73	O-ring
28	Plug	49	Coin type filter	77	Back up ring
29	Plug	60	O-ring	78	Back up ring
30	Plug	61	O-ring	79	Spring
31	Plug	62	O-ring	80	Spring
32	Plug	63	O-ring		
34	Plug	64	O-ring		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

- (1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.
- (2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.
- (3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.
- (4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.
- (5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

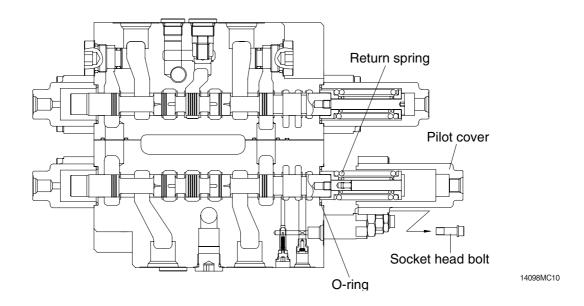
Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Hexagon wrench	Each 1 piece	5, 6, 10, 12 and 14
Socket wrench	Each 1 piece	27 and 32
Spanner	Each 1 piece	32 (main relief valve, overload relief valve, negative relief valve) 26 (holding valve)

3) DISASSEMBLY

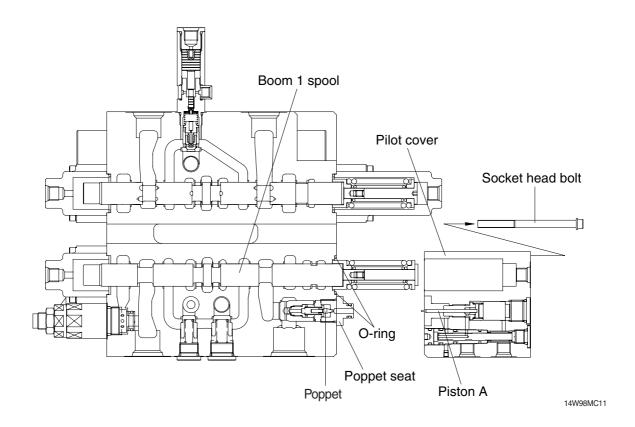
(1) Disassembly of spools without holding valve (travel right, travel left)

- ① Loosen hexagon socket head bolts with washer. (hexagon wrench: 5 mm)
- ② Remove the pilot cover.
- * Pay attention not to lose the O-ring under the pilot cover.
- ③ Remove the spool assembly from the body by hand slightly.
- * When extracting each spool from its body, pay attention not to damage the body.
- * When extracting each spool assembly, it must be extracted from spring side only.
- * When any abnormal parts are found, replace it with completely new spool assembly.
- * When disassembled, tag the components for identification so that they can be reassembled correctly.



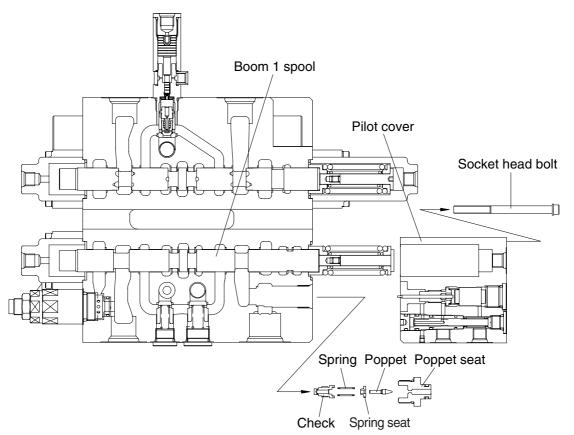
(2) Disassembly of spools with holding valve (boom 1, Arm 1 spool)

- ① Loosen hexagon socket head bolts with washer. (hexagon wrench: 5 mm)
- ② Remove the pilot cover with internal parts.
- * Pay attention not to lose the O-ring and the poppet under the pilot cover.
- * Pay attention not to damage the "piston A" under pilot cover.
- ③ Remove the spool assembly from the body by hand slightly.
- * When extracting each spool from its body, pay attention not to damage the body.
- * When extracting each spool assembly, it must be extracted from spring side only.
- * When any abnormal parts are found, replace it with completely new spool assembly.
- * When disassembled, tag the components for identification so that they can be reassembled correctly.



(3) Disassembly of the holding valve

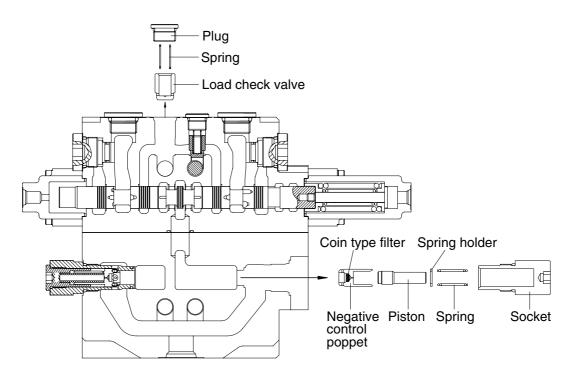
- ① Remove the pilot cover with the holding valve as described on previous page.
- * Do not disassembled internal parts of the pilot cover.
- ② Loosen the poppet seat and remove the poppet, spring seat, spring and check. (spanner: 26 mm)
- * Pay attention not to lose the poppet.
- * Do not disassembled internal parts of the check.



14W98MC12

(4) Disassembly of the load check valve and the negative relief valve

- ① The load check valve
 - a. Fix the body to suitable work bench.
 - * Pay attention not to damage the body.
 - b. Loosen the plug (hexagon wrench: 10 mm).
 - c. Remove the spring and the load check valve with pincers or magnet.
- ② The negative relief valve
 - a. Loosen the socket (spanner: 32 mm).
 - b. Remove the spring, spring holder, piston and negative control poppet.



14W98MC13

(5) Disassembly of the main and overload relief valve

① Fix the body to suitable work bench.

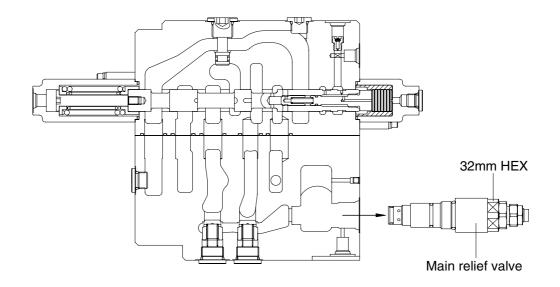
② Remove the main relief valve.

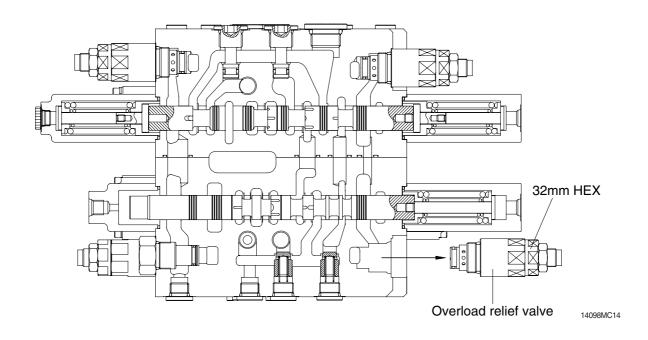
(spanner: 32 mm)

③ Remove the overload relief valve.

(spanner: 32 mm)

- * When disassembled, tag the relief valve for identification so that they can be reassembled correctly.
- * Pay attention not to damage seat face.
- * When any abnormal parts are found, replace it with completely new relief valve assembly.





(6) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

Control valve

- a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
- b. Confirm that seal groove faces of body and block are smooth and free of dust, dent, rust etc.
- c. Correct dents and damages and check seat faces within the body, if any, by lapping.
- * Pay careful attention not to leave any lapping agent within the body.
- d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and path's are free foreign matter.
- e. If any spring is broken or deformed, replace it with new one.
- f. When a relief valve does not function properly, repair it, following it's the prescribed disassembly and assembly procedures.
- g. Replace all seals and O-rings with new ones.

② Relief valve

- a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
- b. Confirm manually that main poppet and seat can slide lightly and smoothly.
- c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so
- d. Confirm that springs are free from breakage, deformation, and wear.
- e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
- f. Replace all O-rings with new ones.
- g. When any light damage is found in above inspections, correct it by lapping.
- h. When any abnormal part is found, replace it with a completely new relief valve assembly.

4) ASSEMBLY

(1) General precaution

- ① In this assembly section, explanation only is shown.
 - For further understanding, please refer to the figures shown in the previous structure & disassembly section.
- ② Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.
- ③ Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly.Do not stretch seals so much as to deform them permanently.
- ④ In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted
- ⑤ O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.
- ⑥ Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque.
- ⑦ Do not reuse removed O-rings and seals.

(2) Load check valve

- Assemble the load check valve and spring.
- ② Put O-rings on to plug.
- ③ Tighten plug to the specified torque.
 - · Hexagon wrench: 10 mm
 - Tightening torque: 6~7 kgf ⋅ m (43.4~50.6 lbf ⋅ ft)

(3) Negative control relief valve

- ① Assemble the nega-con poppet, piston, spring holder and spring together into body.
- ② Put O-ring on to plug and tighten the latter to its specified torque.
 - Hexagon wrench: 12 mm
 - · Tightening torque: 8~9 kgf · m (57.8~65.1 lbf · ft)

(4) Main relief, overload relief valves

Install main relief valve, overload relief valve into the body and tighten to the specified torque.

Component	Tools	Tightening torque		
Component	10015	kgf ⋅ m	lbf ⋅ ft	
Main relief valve	Spanner 32 mm	8~9	57.8~65.1	
Overload relief valve	Spanner 32 mm	8~9	57.8~65.1	

(5) Main spools

- ① Carefully insert the previously assembled spool assemblies into their respective bores within of body.
- Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.

(6) Pilot covers

- ① Fit spool covers to the non-spring assembly end of the spool, and tighten the hexagonal socket head bolts to the specified torque.
 - · Hexagon wrench: 5 mm
 - Tightening torque : $1.0\sim1.1 \text{ kgf} \cdot \text{m} (7.2\sim7.9 \text{ lbf} \cdot \text{ft})$
- * Confirm that O-rings have been fitted.
- ② Fit spring covers to the spring end for the spools, and tighten hexagon socket head bolts to the specified torque.
 - · Hexagon wrench: 5mm
 - · Tightening torque: 1.0~1.1 kgf·m (7.2~7.9 lbf·ft)
- * Confirm that O-rings have been fitted.

(7) Holding valves

- ① Assemble the check, spring seat and poppet together into body.
- ② Tighten the poppet seat to the specified torque.
 - · Spanner: 26 mm
 - · Tightening torque : 6~7 kgf · m (43.4~50.6 lbf · ft)
- ③ Fit the "piston A" under pilot cover with internal parts into hole on the poppet seat.
- ④ Tighten hexagon socket head bolt to specified torque.
 - · Hexagon wrench: 5mm
 - · Tightening torque : 1.0~1.1 kgf · m (7.2~7.9 lbf · ft)

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

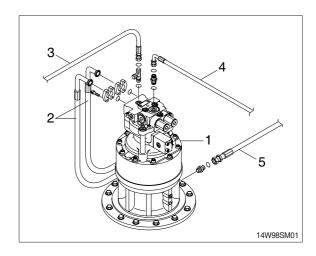
1) REMOVAL

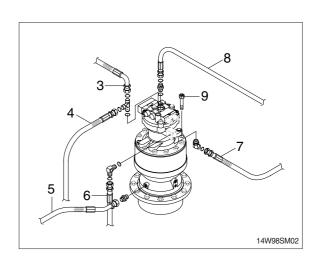
- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Disconnect hose assembly (2).
- (5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 9).
- (6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (10).
 - Motor device weight: 32kg (71lb)
- (7) Remove the swing motor assembly.
- When removing the swing motor assembly, check that all the piping have been disconnected.

2) INSTALL

- Carry out installation in the reverse order to removal.
- (2) Bleed the air from the swing motor.
- ① Remove the air vent plug.
- ② Pour in hydraulic oil until it overflows from the port.
- ③ Tighten plug lightly.
- ④ Start the engine, run at low idling and check oil come out from plug.
- ⑤ Tighten plug fully.
- (3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

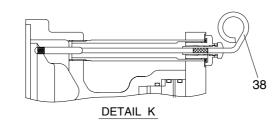


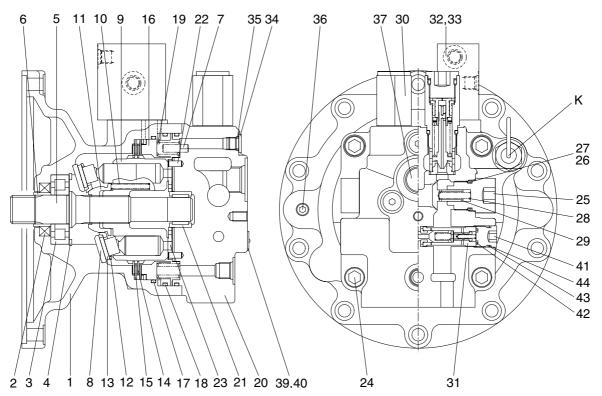




2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE





14W92SM02

1	Body
2	Oil seal
3	Roller bearing
4	Snap ring
5	Drive shaft
6	Bushing
7	Pin
8	Shoe plate
9	Cylinder block
10	Spring
11	Ball guide
12	Set plate

13 Piston assembly14 Friction plate

15

Separate plate

16	Brake piston
17	O-ring
18	O-ring
19	Brake spring
20	Rear cover
21	Needle bearing
22	Pin
23	Valve plate
24	Wrench bolt
25	Plug
26	Back up ring
27	O-ring
28	Spring
29	Check

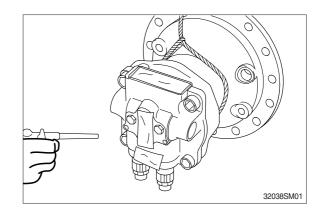
Relief valve

30

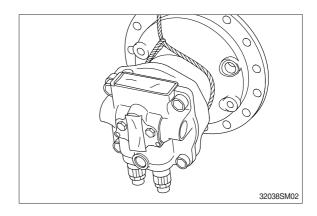
3	1	Anti-rotating valve
3	2	Time delay valve
3	3	Wrench bolt
3	4	Plug
3	5	O-ring
3	6	Plug
3	7	Plug
3	8	Level gauge
4	0	Rivet
4	1	Plug
4	2	O-ring
4	3	O-ring
4	4	Back up ring

2) DISASSEMBLY

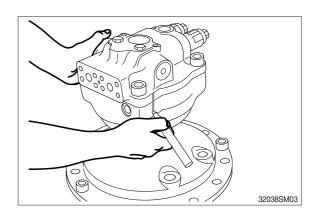
- (1) Lift the motor out. Clean the motor in kerosene and dry with compressed air.
- * To avoid dust inside the motor, mask all the ports of the motor with tapes.



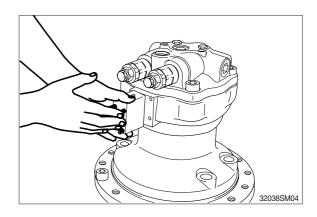
(2) Loosen the drain plug to discharge oil in the body(1).



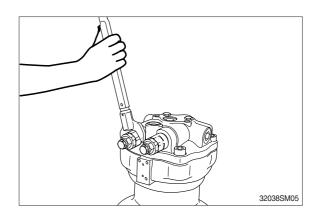
(3) Fix the drive shaft (5) on the workbench with the end of output shaft down. Put matching marks on body (1) and valve rear cover (20) for easy reassembly.



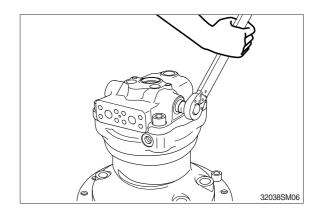
(4) Remove the valve (32).



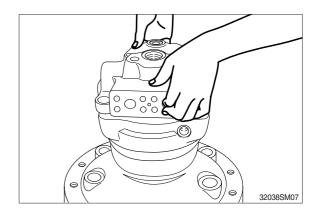
(5) Remove the relief valve (30) from rear cover (20).



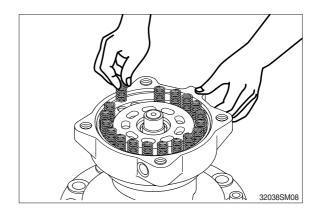
- (6) Remove plug (25) from rear cover (20) and spring (28), check (29).
- ** Be careful not to damage the check seat assembly.



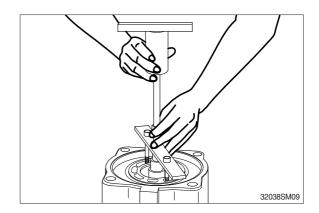
(7) Remove rear cover (20) from body (1). Then, remove the valve plate (23) from rear cover (20) with care.



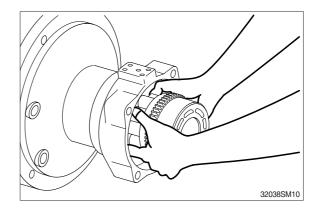
(8) Remove the brake spring (19) from brake piston (16).



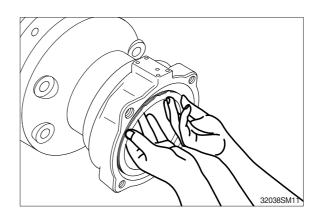
(9) Remove brake piston (16) from body (1).



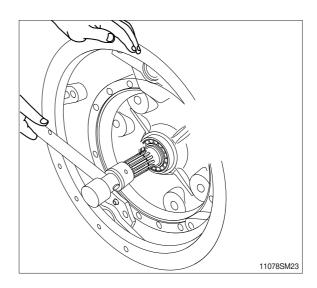
(10) Remove the cylinder (9) from the drive shaft (5) with the motor positioned horizontally. Remove ball guide (11), set plate (12), piston (13) and shoe plate (8).



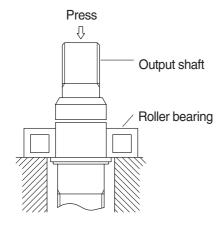
(11) Remove friction plate (14) and separate plate (15) from body (1).

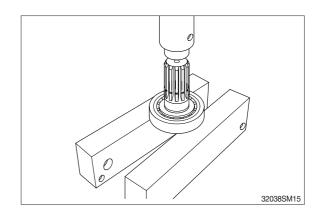


(12) Remove snap ring (4) and remove drive shaft (5) from body (1).

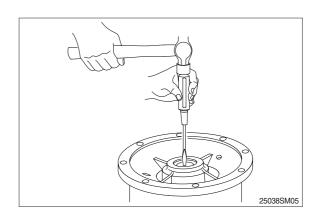


- (13) Remove the cone of roller bearing (3) by press.
- * Do not reuse bearings.

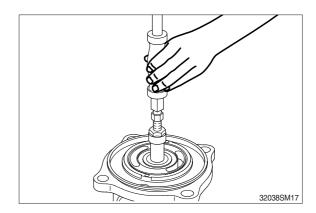




(14) Remove bushing (6) and oil seal (2) from body (1).

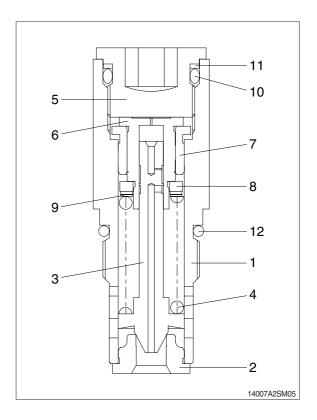


(15) Remove the needle bearing (21) from the rear cover (20) by using slide hammer bearing puller.



(16) When disassembling the relief valve, release the adjusting screw (5).

Remove the piston (6), spring seat (8), spring (4) and plunger (3) with the body (1) downwards.

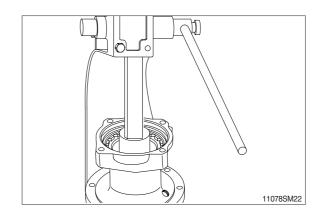


This completes disassembly.

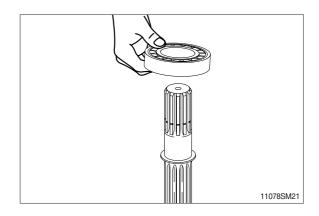
3) ASSEMBLY

Do the reassembly in the reverse procedure of the disassembly.

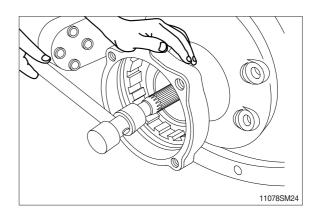
(1) Apply three bond of white color on outer surface of oil seal (2) and insert it to the body (1).



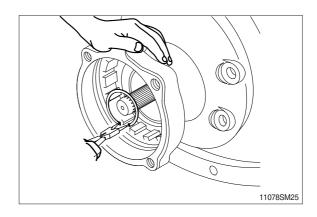
(2) Install the roller bearing (3) to the drive shaft (5).



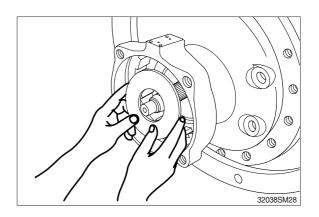
(3) Insert the drive shaft (5) into the body (1) with the plastic hammer lightly.



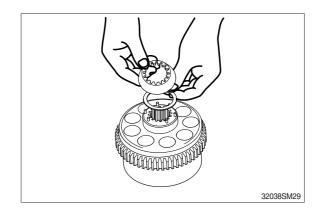
(4) Install the snap ring (4) to the body (1).



(5) Insert the shoe plate (8) with the body (1) position horizontally.



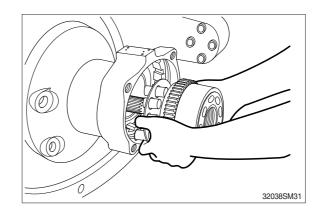
(6) Insert the ball guide (11) into the cylinder (9).



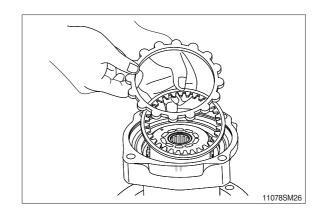
(7) Install the piston sub-assembly (13) to the set plate (12).



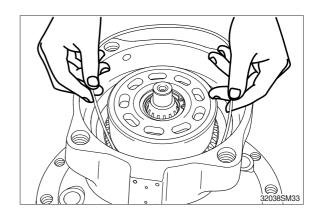
(8) Reassemble the piston assembly (9) to the body (1).



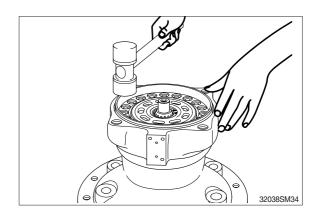
(9) Assembly friction plate (14) and separate plate (15) to the body (1).



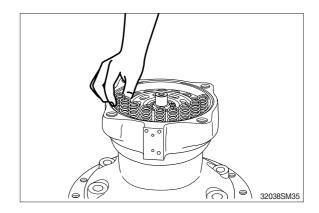
(10) Insert O-ring (17) inside the body (1).



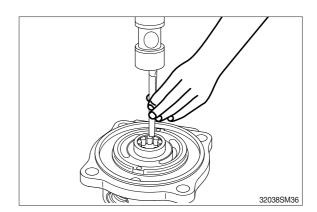
(11) Reassemble brake piston (16) to the body (1).



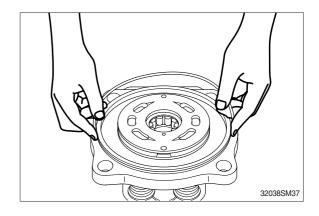
(12) Reassemble brake spring (19) to the brake piston (16).



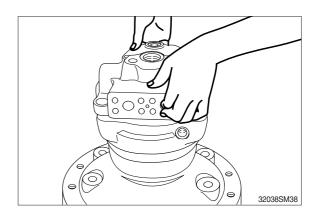
(13) When assembling the needle bearing (21), insert the needle bearing (21) into rear cover (20) by hammering.



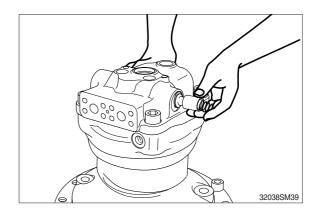
(14) Reassemble valve plate (23) to the rear cover (20) and reassemble O-ring (18).



(15) Connect the rear cover (20) with the body (1) and tighten the wrench bolt (24).

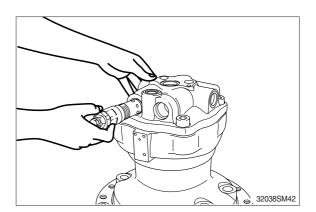


(16) Insert check (29) and spring (28) in the valve casing and install O-ring (27) and back up ring (26). Tighten plug (25) to the rear cover (20).



(17) Insert O-rings to the relief valve (30) and reassemble them to rear cover (20).

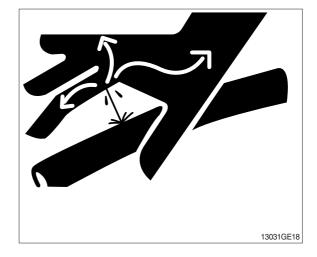
This completes assembly.



3. REMOVAL AND INSTALL OF REDUCTION GEAR

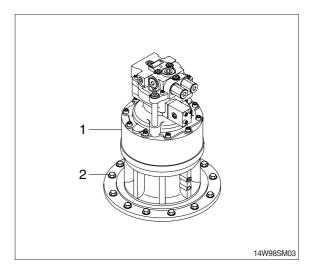
1) REMOVAL

- Remove the swing motor assembly.
 For details, see removal of swing motor assembly.
- (2) Sling reduction gear assembly (1) and remove mounting bolts (2).
- (3) Remove the reduction gear assembly.Reduction gear device weight: 60 kg (132 lb)



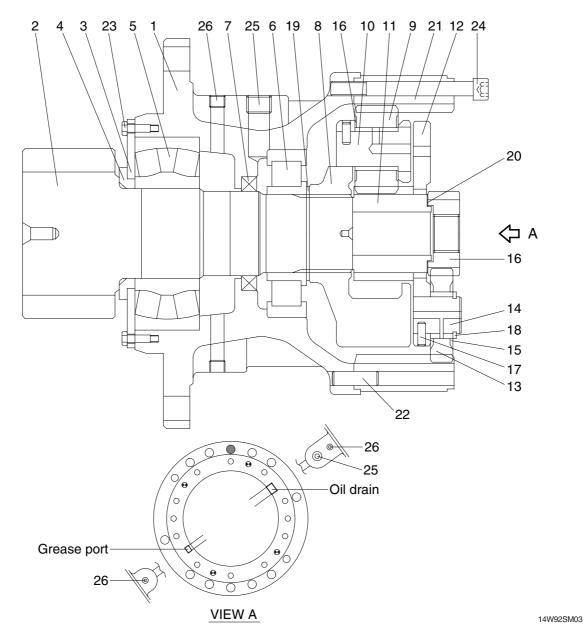
2) INSTALL

- (1) Carry out installation in the reverse order to removal.
 - Tightening torque : $29.6 \pm 3.2 \text{ kgf} \cdot \text{m}$ (214 $\pm 23.1 \text{ lbf} \cdot \text{ft}$)



4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

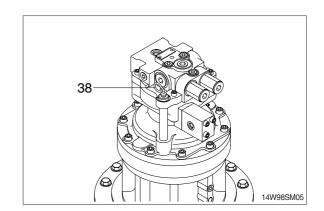
1) STRUCTURE



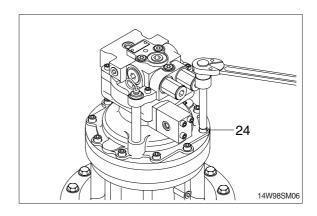
1	Casing	10	Pin No.2 assembly	19	Stop ring
2	Drive shaft	11	Sun gear No. 2	20	Side plate No. 1
3	Cover plate	12	Carrier No. 1	21	Ring gear
4	Spacer	13	Planet gear No. 1	22	Knock pin
5	Roller bearing	14	Pin No.1	23	Hexagonal bolt
6	Roller bearing	15	Thrust washer (B)	24	Socket head bolt
7	Oil seal	16	Sun gear No. 1	25	Plug
8	Carrier No. 2	17	Spring pin	26	Plug
9	Planet gear No. 2	18	Stop ring		

2) DISASSEMBLY

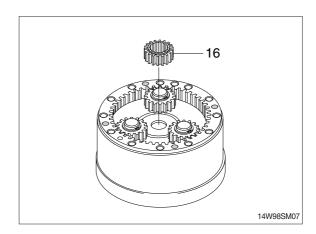
- (1) Remove level gauge (38) from the swing motor casing.
- * Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



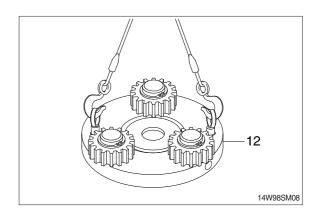
(2) Loosen the socket bolts (24) to separate swing motor from reduction gear.



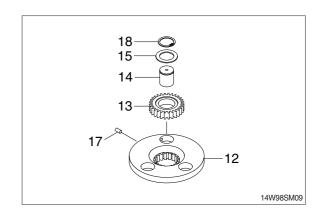
(3) Remove sun gear 1 (16).

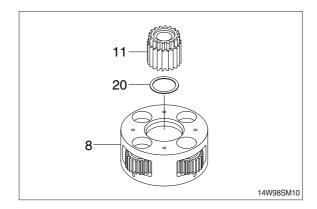


(4) Tighten two M10 eye bolts to carrier 1 (12) and lift up and remove carrier 1 (12) as subassembly.

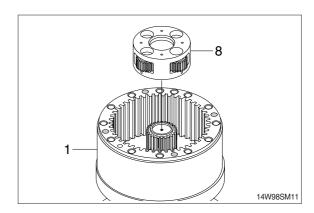


- (5) Disassembling carrier 1 (12) assembly.
- ① Remove stop ring (18).
- ② Remove thrust washer (15) and planet gear 1(13) from the carrier 1 (12).
- ③ Using M8 solid drill, crush spring pin (17) so that the pin 1 (14) can be removed by hammering.
- * Do not reuse spring pin (17).
- * Do not remove pin 1 (14), carrier 1 (12) and spring pin (17) but in case of replacement.
- Put matching marks on the planet gear 1 (13) and the pin 1 (14) for easy reassembly.
- (6) Remove sun gear 2 (11) and side plate 1 (20) from carrier 2 (8).

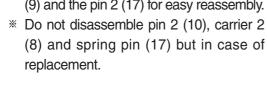


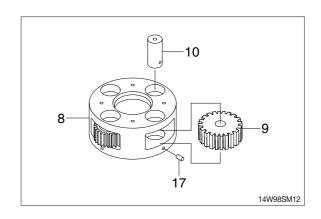


(7) Remove carrier 2 (8) assembly from casing (1).

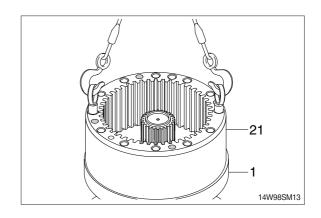


- (8) Disassembling carrier 2 (8) assembly.
- ① Using M8 solid drill, crush spring pin (17) so that the pin 2 (10) can be removed.
- * Do not reuse spring pin (17).
- ② Remove pin 2 (10) and planet gear 2 (9) from the carrier 2 (8).
- Put matching marks on the planet gear 2(9) and the pin 2 (17) for easy reassembly.

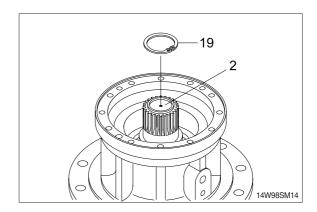




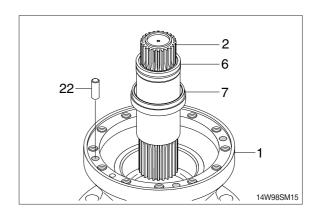
(9) Tighten two M16 eyebolt to the ring gear (21) and then lift the ring gear (21) out of casing (1).



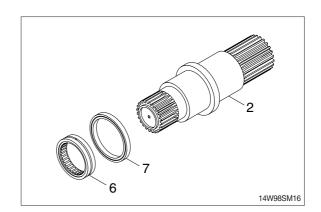
(10) Remove stop ring (19) from the drive shaft (2).



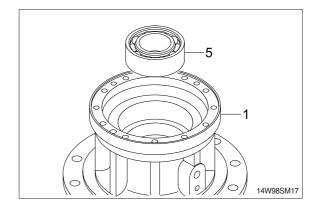
(11) Remove drive shaft (2) with roller bearing(6) and oil seal (7) assembled.Remove knock pin (22) from the casing(1).



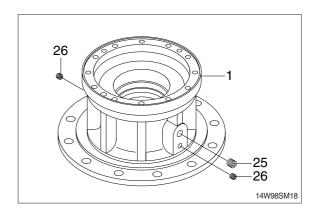
- (12) Remove roller bearing (6) and oil seal (7) from the drive shaft (2).
- * Do not reuse oil seal (20) once removed.



(13) Using the bearing disassembly tool, remove roller bearing (5).

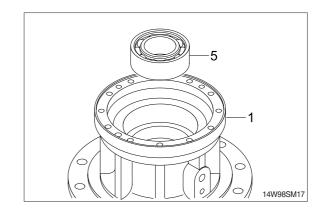


(14) Remove plugs (25, 26) from the casing (1).

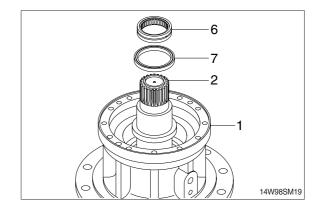


3) ASSEMBLY

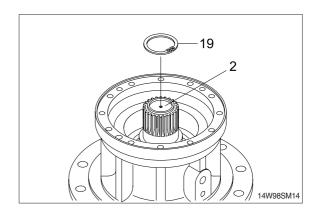
(1) Assemble roller bearing (5) inside the casing (1).



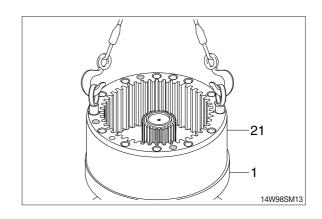
(2) Assemble the drive shaft (2) into the casing(1) and then install oil seal (7) and roller bearing (6).



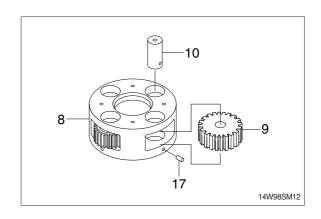
(3) Install stop ring (19) on top of drive shaft (2).

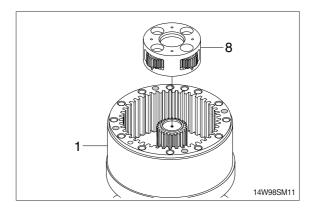


- (4) Apply loctite to the tapped holes of casing (1).
- (5) Tighten 2 M16 eye bolts to the ring gear (21) and lift up and then assemble it onto the casing (1).
- * Don't fail to coincide the knock pin (22) holes.

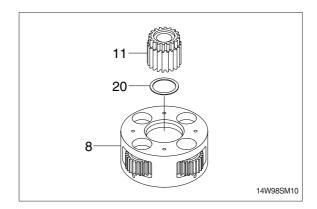


- (6) Assembling carrier 2 (8) assembly.
- ① Install the planet gear 2 (9) inside the carrier 2 (8).
- ② Assemble the pin 2 (10) to the carrier 2 (8) and then press the spring pin (17) by hammering.
- ③ Punch 2 points of the spring pin (17) lip.
- * Take care not to mistake the matching marks of each part.
- (7) Assemble carrier 2 (8) assembly correctly to the casing (1).

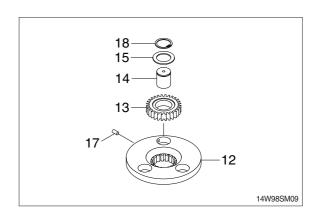




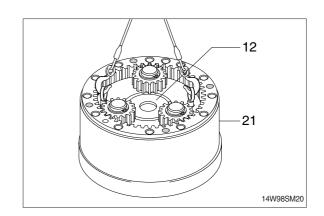
(8) Assemble sun gear 2 (11) and side plate 1 (20) to the center of the carrier 2 (8) assembly.



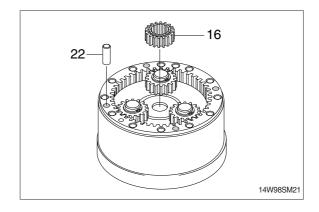
- (9) Assembling carrier 1 (12) assembly.
- ① Assemble the pin1 (14) to the carrier 1 (12) and then press the spring pin (17) by hammering.
- ② Punch 2 points of the spring pin's (17) lip.
- ③ Assemble thrust washer (15), planet gear 1 (13), and then stop ring (18) to the pin 1 (11).
- * Take care not to mistake the matching marks of each part.



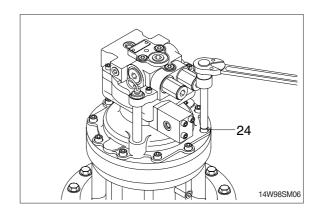
(10) Assemble carrier 1 (12) assembly into the ring gear (21).



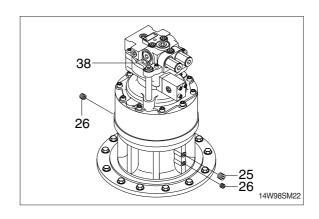
- (11) Hammer 4 knock pins (22) around the ring gear (21).
- (12) Assemble sun gear 1 (16) to the drive shaft of the swing reduction gear.



- (13) Apply loctite to the tapped holes of the ring gear (21) and then mount swing motor onto the ring gear (21).
- » Don't fail to coincide the gauge bar hole.
- (14) Tighten socket bolts (24) around the swing motor assembly.
 - · Tightening torque : 13.5 kgf · m (98 lbf · ft)



(15) Assemble plugs (25, 26) and level gauge (38).



GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

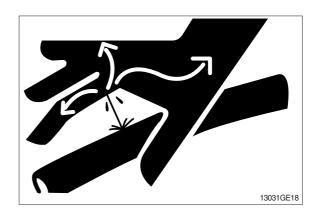
- (1) Swing the work equipment 90° and lower it completely to the ground.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

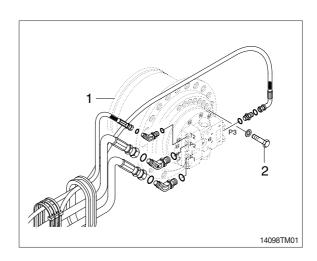
A Escaping fluid under pressure can penetrate the skin causing serious injury.

- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Remove the track shoe assembly.
 For details, see removal of track shoe assembly.
- (5) Remove the cover.
- (6) Remove the hose.
- * Fit blind plugs to the disconnected hoses.
- (7) Remove the bolts and the sprocket.
- (8) Sling travel device assembly (1).
- (9) Remove the mounting bolts (2), then remove the travel device assembly.
 - · Weight: 240 kg (530 lb)

2) INSTALL

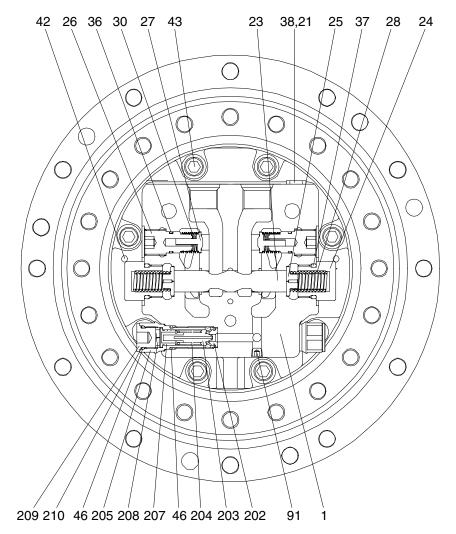
- (1) Carry out installation in the reverse order to removal.
- (2) Bleed the air from the travel motor.
- ① Remove the air vent plug.
- ② Pour in hydraulic oil until it overflows from the port.
- ③ Tighten plug lightly.
- ④ Start the engine, run at low idling, and check oil come out from plug.
- ⑤ Tighten plug fully.
- (3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

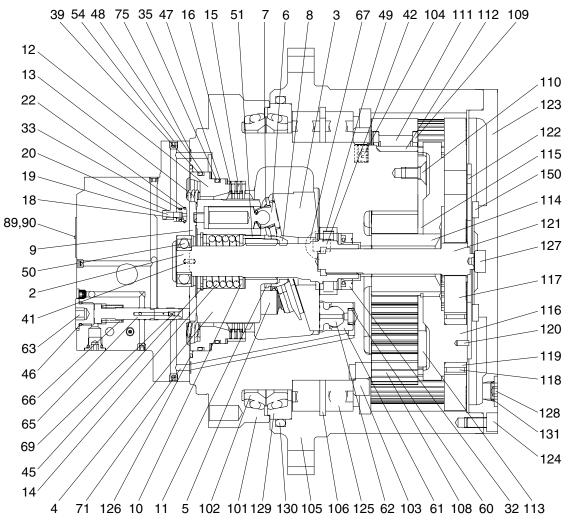


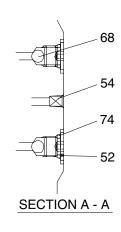


2. TRAVEL MOTOR

1) STRUCTURE







1	Rear flange	19	Valve
2	Shaft	20	Spring
3	Swash plate	21	Plug
4	Cylinder block	22	Ring
5	Piston	23	Main spool
6	Shoe	24	Main plug
7	Retainer plate	25	Retainer spring
8	Thrust ball	26	Check plug
9	Timing plate	27	Check valve
10	Washer	28	Main spring
11	Washer-collar	30	Check spring
12	Piston-parking	32	Oil seal
13	Spring	33	O-ring
14	Spring	35	O-ring
15	Friction plate	36	O-ring
16	Mating plate	37	O-ring
18	Seat valve	38	O-ring

39 O-ring 41 Parallel pin 42 Parallel pin 43 Socket bolt 45 Snap ring 46 O-ring 47 Back up-ring 48 Back up-ring 49 Roller bearing 50 Ball bearing 51 Roller 52 Plug 54 Plug 60 Spring 61 Piston 62 Shoe 63 Plug

65 2 Speed spool 66 2 Speed spring 67 Pivot 68 Steel ball 69 Set screw 71 Orifice 74 O-ring 75 O-ring 89 Name plate 90 Set screw 91 Plug 101 Spindle 102 Floating seal 103 Nut ring 104 Plug 105 Hub 106 Snap ring

108 Planetary gear 109 Thrust washer 110 Screw 111 Needle bearing 112 Collar 113 Thrust plate 114 Sun gear 115 Snap ring 116 Holder 117 Planetary gear 118 Needle bearing 119 Inner race 120 Spring pin 121 Drive gear 122 Thrust plate 123 Cover 124 Socket bolt

125 Angular bearing
126 O-ring
127 Thrust washer
128 Plug
129 Seal ring
130 O-ring
131 O-ring
150 Thrust plate
205 Body
206 Shim
207 Piston
208 Rod
209 Plug
210 Back up-ring

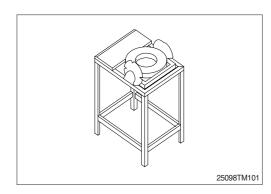
2) TOOLS

(1) Standard tools

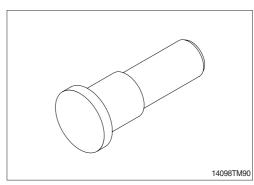
Name	Description/Size	Qty
Hexagon wrench	6 (M8) (PT1/4), 8 (M10)	each 1
	10 (M12) (PF1/2)	each 1
(010 15 4000)	4 (M6)	1
Socket wrench	-	1
	Nominal 30 kgf ⋅ m dial type	1
Torque wrench	Nominal 90 kgf ⋅ m dial type	1
Adoptor for torque wrongh	Socket 26, 27, 36	each 1
Adapter for torque wrench	Bar 4, 5, 6, 8, 10	each 1
Extension bar (JIS B 4637)	150 mm	1
Hammer (JIS B 4613)	12	1
Plastic hammer	L=300	1
(-) driver	150 mm	1
Snap ring plier	For shaft, For hole	1
Hanger	Weight : over 300 kgf	1
	Eye bolt (M16)	2
	Eye bolt (M10)	2
	Eye bolt (PF 1/2)	2
	Wire	1
Press	Press capacity above 200 kgf	1
Compressed air	3~5 kgf/cm², nozzle	1
Vessel	General vessel : W450 × D300 × H120	2
Hooting vocasi	Heating capacity : over 100 °C	1
r realing vesser	Volume : 500 × 500 × 500	I
Depth micro-meter	Measuring range: 0.04 ~ 0.3 mm	1
Air hammer	BRH-8 (compressed air 5~6 kgf/cm²)	1
Sealant	Silicone rubber (780-RTV)	1
	(JIS B 4650) Socket wrench Torque wrench Adapter for torque wrench Extension bar (JIS B 4637) Hammer (JIS B 4613) Plastic hammer (-) driver Snap ring plier Hanger Press Compressed air Vessel Heating vessel Depth micro-meter Air hammer	Hexagon wrench (JIS B 4650) 10 (M12) (PF1/2) 4 (M6) Socket wrench -

(2) Special tools

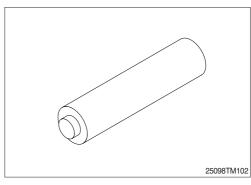
① Inversion working bench



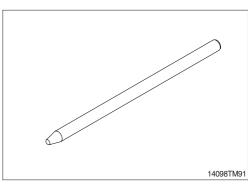
 $\ensuremath{\textcircled{2}}$ Pressurize jig ($\ensuremath{\ensuremath{\texttt{I}}}$)



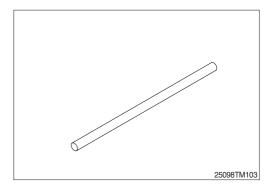
③ Pressurize jig (Ⅱ)



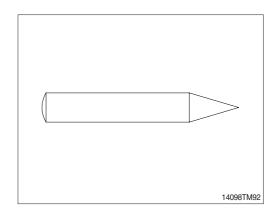
4 Aluminum bar



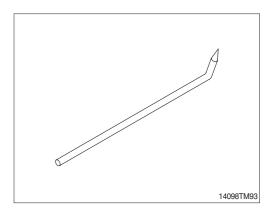
⑤ Steel bar



6 Sharp punch



7 Draw bar



3) TIGHTENING TORQUE

Item No.	Parts name	Size	Otr	Tightening torque		
item No.			Qty	kgf ⋅ m	lbf ⋅ ft	
21	Plug	PF 3/8	1	10 ± 2	72.3 ±14.5	
24	Plug	M30×1.5	2	36 ± 7.2	260 ±52.1	
26	Plug	M24×1.5	2	17 ± 3.4	123 ±24.6	
43	Socket bolt	M10×1.5	8	5.9 ± 1.2	42.7 ±8.7	
52	RO plug	PF 1/4	4	3.0 ± 0.5	21.7 ±3.6	
54	Plug	NPTF 1/16	7	1.0 ± 0.25	7.2 ±1.8	
63, 209	Plug	PF 1/2	1	3.0 ± 0.5	21.7 ±3.6	
91	Plug	PT 1/8	4	1.25 ± 0.2	9 ±1.4	
104	Plug	PT 3/8	3	6.0 ± 0.9	43 ±6.5	
110	Screw	M6	4	0.83 ± 0.12	6 ±0.9	
128	Plug	PF 3/8	3	6.0 ± 0.9	43 ±6.5	
124	Socket bolt	M8	12	1.25 ± 0.2	9 ±1.4	
205	Body	M20	1	12 ± 1.5	86.8 ±10.8	
301	Plug	PF 1 1/2	1	26 ± 5.2	188 ±37.6	

3. DISASSEMBLY

3.1 GENERAL PRECAUTIONS

- 1) Spread rubber or vinyl cover on the work bench.
- 2) When disassembling the travel motor, provide a match mark on the mating face or each part.
- 3) Arrange the detached parts to prevent them from being damaged or lost.
- 4) The disassembled seals must be replaced with new ones as a rule even if they are free from damage. For disassembly, therefore, prepare new seals in advance.

3.2 DISASSEMBLY PROCEDURE

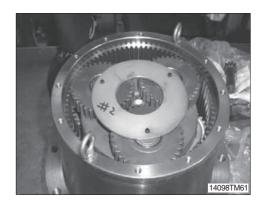
- 1) When inspecting or repairing the travel motors, use the disassembling procedures described below.
- 2) Numerals in brackets () following the part name denote the item numbers used in the structure drawing at page 8-68.
- 3) Prior to disassembly, install the travel motor on a inversion working bench.

3.3 DISASSEMBLING ORDER

1) DISASSEMBLING THE REDUCTION GEAR PART

- (1) Remove plugs (128, 3EA) and drain the reduction gear oil.
- (2) Loosen socket bolts (124, 16EA) and remove the cover (123).
- ** Remove the cover (123), after hook it, fit the eye bolt in a screw hole for use of the plug (128). If it's impossible, please remove the cover using the rod.
- * You can have difficulty removing it because loctite is spread in the socket bolt (124).
- * Tools
 - · Hexagon wrench 6, 8
- (3) Remove thrust plate R (122) and drive gear (121).





(4) Remove planetary gear R (117), needle bearing, inner race (119) and holder (116) from hub (105).



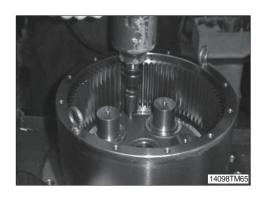
(5) Remove sun gear (114), screw (110) and thrust plate F (113).



(6) Remove the thrust washer (109), planetary gears F (108), needle bearings (111) and collar (112) from hub (105).



(7) Remove the plugs (104, 3EA).



(8) Remove the nut ring (103) from hub (105).



- (9) Remove the spindle (101) from the hub (105).
- * Remove it using a crane after eye bolt is assembled at the hub (105).



(10) Remove the floating seal (102), seal ring (129), angular bearings (125, 2EA), snap ring (106) and O-ring (130) from the hub (105).



- (11) Remove the floating seal (102) from the spindle (101).
- W User can remove easily if using () drivers.



(12) Remove the oil seal (32) from spindle (101).

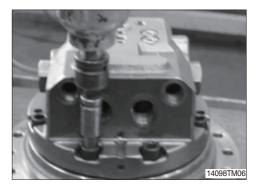


2) DISASSEMBLING THE HYDRAULIC MOTOR PART

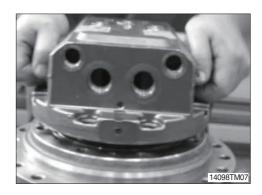
- (1) Remove the relief valve (70, 2EA) from rear flange (1).
- * Tools
 - · Hexagon socket
 - · Torque wrench



- (2) Remove hexagon socket head bolts (43, 8EA) from the rear flange (1).
- * Tools
 - · Hexagon wrench 8



- (3) Remove the rear flange (1) from the spindle (101).
- (4) Remove the springs (13, 10EA) form the rear flange [1].
- ** Remove the rear flange (1) carefully after taken using hands. Be careful not to detach the timing plate (9) and the spring (13) if twisted or beated by constraint.



(5) Remove the parallel pin (42) from the spindle (101).



- (6) Remove the O-ring (126) from the spindle (101).
- * Do not reuse the O-ring (126).



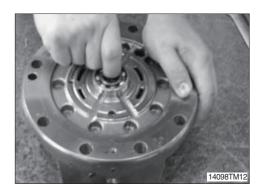
(7) Disassembling the rear flange (1) part

- ① Place the rear flange with the contact surface of the spindle upward.
- ② Remove the timing plate (9) from the rear flange (1).
- When removing the timing plate, user can have difficulty of the removal due to the close adhesion of rear flange (1) and oil. Remove it after fitting a rod through the hole which is used when a casting is detached.
- * Be careful of the leakage due to both surface scratch if using a sharp tool.
- ③ Remove the paralell pin (41) from the rear flange (1).



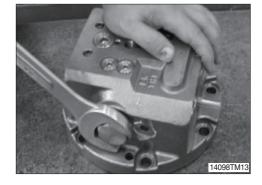


4 Remove the ball bearing (50) from the rear flange (1).

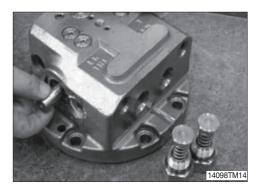


(8) Disassembling the brake valve part

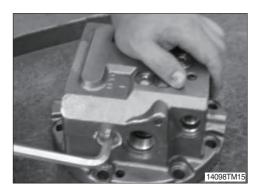
- ① Remove two plugs (24) from the rear flange (1).
- We User can work easily if sub-disassembly was done on the reversal table.
- * Tools
 - · Hexagon wrench 36
 - · Torque wrench



- ② Take out two spring retainers (25), two springs (28) from the rear flange (1).
- ③ Remove the spool (23) from the rear flange (1).
- * Be careful not to damage the outer surface of the spool (23) and the sliding surface of the rear flange (1).
- Since the rear flange (1) and the spool (23) are of the selective fitting type, replace them together as a kit even if only one of the two parts is damaged.



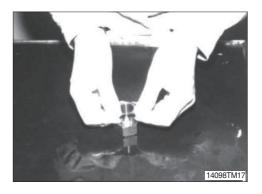
- ④ Remove two plugs (26) from the rear flange (1).
- * User can work easily if sub-disassembly was done on the reversal table.
- * Tools
 - · Hexagon wrench 10



⑤ Remove the springs (30, 2EA), valves (27, 2EA) from rear flange (1).



- 6 Remove the O-ring (37) from plug (24).
- ※ Do not reuse the O-ring (37).

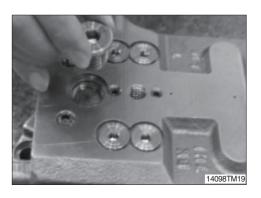


- 7 Remove the O-ring (36) from plug (26).
- * Do not reuse the O-ring (36).

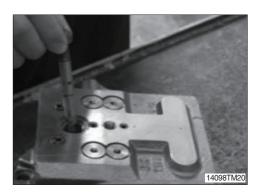


(9) Disassembling the two speed change valve

- ① Remove the plug (63) from the rear flange (1).
- * User can work easily if sub-disassembly was done on the reversal table.
- * Tools
 - · Hexagon wrench 10



② Remove the spool (65) and spring (66) from rear flange (1).



(10) Disassembling the plug (52).

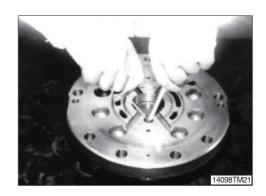
- ① Do not remove plug (52) if it not to be necessary.

 Disassembling the plug (52) if it was malfunction because of get mixed with dust.

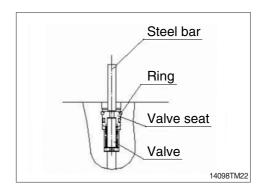
 Clean the plug (52) after disassembled.
- * Be careful not to drop the steel ball (68).

(11) Disassembling the parking brake valve (19)

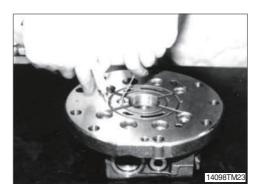
- ① Mount the rear flange (1) on a working bench that the mounting side of the spindle (101) faces upward.
- ② Pushing valve seat (18) by a steel bar, disassemble ring (22) from rear flange (1).



- Do not remove ring (22) if it not to be replace.
- Do not reuse the ring (22), valve seat (18) and Oring (33).



③ Remove the valve seat (18) by injecting compressed air from the access hole in the spindle (101) after caulking the hole of valve seat (18).



④ Remove the valve (19) and spring (20) from rear flange (1) downside hole with shaking lightly.

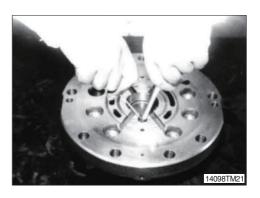


- ⑤ Remove the O-ring (33) and valve seat (18).
- * Do not reuse the O-ring (33).



(12) Disassembling the parking brake

- ① Remove the piston (12) by injecting compressed air from the parking brake access hole in the spindle (101).
- We use the protection cover on the upper part of spindle (101) when users put the pressed air into suddenly. Otherwise part damage and accident might go on because the piston (12) is rushed out of the spindle (101).

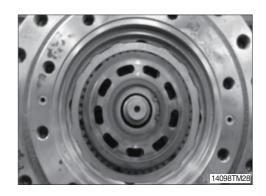


- ② Remove the O-rings (35, 39) and backup rings (47, 48) from the piston (12).
- * Do not reuse O-rings (35, 39) and backup rings (47, 48) after removal.



(13) Disassembling the hydraulic motor part

- ① Lay the travel motor body on the side.
- ② Drain out the oil from the travel motor.
- ** Place an oil receptacle under the travel motor to receive the oil flowing out as the motor is being laid on the side.



- ③ Hold the cylinder block (4) with both hands, and remove it from the shaft (2).
- ④ Remove the mating plates (16) and friction plates (15) from the cylinder block (4).
- ** Before removal, hold the cylinder block (4) with both hands and turn it two to three times in a clockwise and a counterclockwise direction alternately to detach the shoe (6) from the swash plate (3).
- ** Be careful that if an attempt is made to remove the cylinder block (4) without detaching the shoe (6) from the swash plate (3), then the piston, shoe and other parts that are connected to the cylinder block may come the cylinder loose and fall into the spindle (101).



(14) Disassembling the cylinder block kit

① Piston assembly [piston (5), shoe (6)] from the removed cylinder block (4).



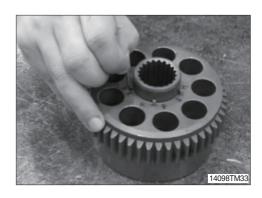
② Piston (5) and shoe (6) from the removed retainer plate (7).



③ Thrust ball (8) from the removed cylinder block (4).

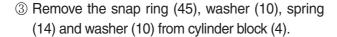


④ Roller (51, 5EA) from the removed cylinder block (204).

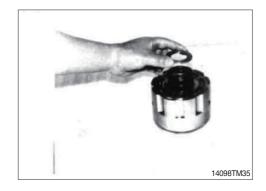


(15) Disassembling the spring of the cylinder block

- ① Put the cylinder block (4) on the pressurize jig.
- ② Press the washer (10) with pressurize jig, and remove the spring (14) after snap ring (45) removed.
- We Put a vinyl cover on the sliding surface of cylinder block (4) for protection.
- * Do not remove spring (14) if it not to be replace.

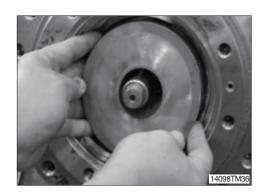






(16) Disassembling the shaft

- ① Remove swash plate (3) from the shaft (2).
- ② Remove shaft (2) from the spindle (101).
- When separating the swash plate, separate and turn it by using hands to free from intervention of the stopper.



- ③ Remove speed selector piston assembly [piston (61) and shoe (62)] form the spindle [101] by feeding compressed air into the access hole in spindle (101).
- ④ Remove parallel pins (42, 2EA) and pivots (67, 2EA) from the spindle (101).
- ⑤ Remove roller bearing (49) from the spindle (101).
- Piston assembly; Piston (61), Shoe (62)
- Compressed air; 3~5 kgf/cm² (43~71 psi)
- When piston (61) or shoe (62) is damaged, if exchange is necessary, they have to be exchanged together because the separation is impossible. Use the protection cover on the upper part spindle when users put the compressed air into suddenly. Otherwise part damage and accident might go on because the piston is rushed out of the spindle.



4. REASSEMBLY

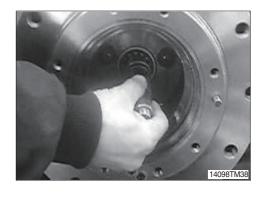
4.1 GENERAL PRECAUTIONS

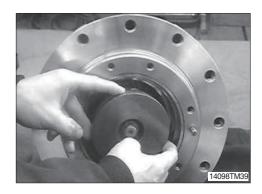
- 1) Reassemble in a work area that is clean and free from dust and dirt.
- 2) Handle parts with bare hands to keep them free of linty contaminants.
- Repair or replace the damaged parts.
 Each parts must be free of burrs its corners.
- 4) Do not reuse O-ring, oil seal and floating seal that were removed in disassembly. Provide the new parts.
- 5) Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air. Do not use the cloths.
- 6) When reassembling oil motor components of travel motor, be sure to coat the sliding parts of the motor and valve with fresh hydraulic oil. (NAS class 9 or above)
- 7) Use a torque wrench to tighten bolts and plugs, to the torque specified as follows.

4.2 REASSEMBLY PROCEDURE

1) REASSEMBLE THE HYDRAULIC MOTOR PART

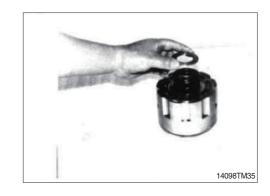
- (1) Install roller bearing (49) into the spindle (101).
- (2) Install pivots (67, 2EA), parallel pin (42, 2EA) and two speed piston assembly (61, 62) into the spindle (101).
- (3) Install shaft (2) into the roller bearing (49) assembled spindle (101).
- Be careful not to damage the seal (3) of assembling part.
- (4) Lay the travel motor body on the side.
- (5) Apply lithium grease to the shaft (2)'s spline part.
- (6) Install swash plate (3) to the spindle (101).





(7) Reassembe the cylinder block kit

- ① Install washer (10), spring (14, 9EA), washer (10) and snap ring (45) in that order, into the cylinder block (4) inner part.
- 2) Put the cylinder block (4) on the pressurize jig.



- While pressing washer (10) by pressurize jig, install snap ring (45).
- We Put a vinyl cover on the sliding surface of the cylinder block (4) and timing plate (9) for protection.

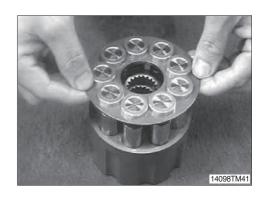


(8) Reassembe the hydraulic motor

- ① Install roller (51, 5EA) to the pin hole of cylinder block (4).
- ② Install thrust ball (8) to the cylinder block (4).
- ③ Insert piston assembly [piston (61) and shoe (62),9 set] into retainer plate (7).
- After mounting, immerse the entire them in a working fluid.



- Mount the piston assembly (9 set) into the cylinder block (4).
- ** The retainer plate (7) must be in contact with the round part of thrust ball (8).

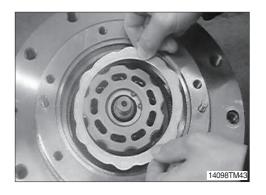


- ⑤ Install cylinder block (4) assembly to the shaft (2).
- After fitting splines of both cylinder block (4) and shaft (2), assemble them.
- * After installing the cylinder (4), confirm whether it revolves or not by turning using both hands.
- * Motor is malfunction when it isn't revolve.



(9) Reassembe the parking brake

- ① Install mating plate (16) first and then a friction plate (15), one by one, into the grooves of the outer surface of the cylinder block (4).
- * Immerse the friction plates (15) in a working fluid before fitting them into the grooves.



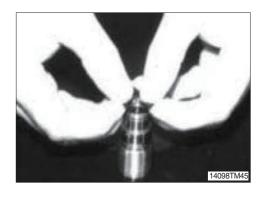
- ② Install two O-rings (35, 39) and two back up ring (47, 48) into O-ring grooves.
- ③ Mount a piston (12) in the spindle (101).
- * Apply a thin coat of grease to the O-rings (35, 39).
- If the piston (12) does not fit into the spindle (101) because of the resistance of the O-ring, tap the edge of the piston (12) lightly and equally with a plastic hammer.
- ** Be careful not to damage the O-ring and back up ring at this time.



2) REASSEMBLE THE REAR FLANGE (1) PART

(1) Reassemble the check valve

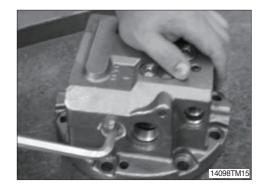
- ① Install O-ring (36, 2EA) on the plug (26, 2EA).
- * Apply grease to the O-ring (36).



- ② Install spring (30) and valve (27) into the plug (26).
- ③ Install plug (26) into the rear flange (1).
- ** Install spring (30) and valve (27) into the plug (26), and then grease the spring (30) and the valve (27) and hand-lock the former.



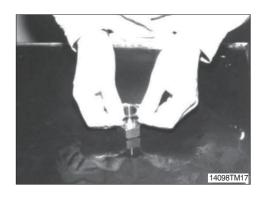
- ④ Install plug (26) in conjunction with the spring (30) and the valve (27) into the rear flange (1), and tighten the plug to the required torque.
- * Tightening torque: $17\pm2.6 \text{ kgf} \cdot \text{m} (123\pm18.8 \text{ lbf} \cdot \text{ft})$
- * Tools
 - · Adapter for hexagon wrench 10
 - · Torque wrench



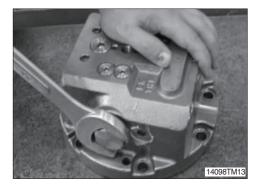
- ⑤ Install spool (23) into the rear flange (1).
- ** Before installing the spool (23), apply hydraulic oil to the spool. Be careful not to damage the spool's surface and the inner of rear flange (1).



⑤ Install O-ring (37) on the plug (24). Apply grease to the O-ring (37).

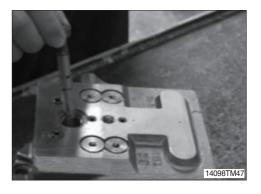


- 7 Install spring retainer (25) and spring (28) into the plug (24).
- ® Install plug (24) into the rear flange (1).
- Tighten the plug (24) to the required torque.
- * Tightening torque: 36 ± 5.4 kgf·m (260 ± 39 lbf·ft)
- * Socket (#36) / Torque for hexagon wrench.
- * Tools
 - · Hexagon socket 36
 - · Torque wrench



(2) Reassembe the two speed change valve

- ① Install spring (66) into the valve (65).
- ② Insert the valve (65) into the rear flange (1).



- ③ Insert a plug (63) into the rear flange (1).
- * Tightening torque : 13 \pm 2.6 kgf \cdot m (94 \pm 18.8 lbf \cdot ft)
- * Tools
 - · Adapter for hexagon wrench 10
 - · Torque wrench



(3) Reassembe the parking brake valve

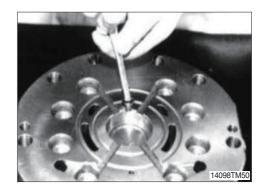
- ① Install O-ring (33) on the valve seat (18).
- * Do not reuse the O-ring (33).



- ② Mount the rear flange (1) on a working bench that the mounting side of the spindle (101) faces upward.
- ③ Install valve (19), spring (20) and valve seat (18) in that order.



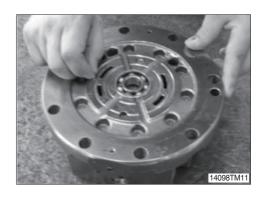
- ④ After new ring (22) bend somewhat and put the valve seat (18), then into the rear flange (1) ring's groove.
- * Do not reuse the ring (22).



- ⑤ Install ball bearing (50) into the rear flange (1).
- * Apply hydraulic oil to the ball bearing (50).



⑥ Install parallel pin (41) into the pin hole of rear flange (1).



- 7 Install timing plate (9) into the rear flange (1).
- * Apply hydraulic oil to the contact surface of rear flange.



(4) Reassembe the rear flange (1) and spindle (101)

- ① Tilt the work bench 90° for travel motor reassembling.
- ② Insert the O-ring (75, 126) on the spindle (101).
- * Apply grease to the O-rings (75, 126) thinly.



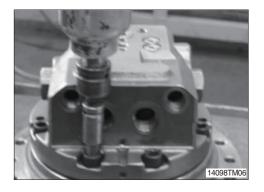
③ Install parallel pins (42, 2EA) into the spindle (101).



- ④ Mount the rear flange (1) on the spindle (101).
- When the rear flange (1) is mounted on the spindle (101), fix the spring (13) applied grease to not drop.



- ⑤ Tighten the socket bolt (43) into the spindle (101) to the required torque.
- * Tightening torque : $5.9 \pm 1.0 \text{ kgf} \cdot \text{m} (42.7 \pm 7.2 \text{ lbf} \cdot \text{ft})$
- * Tools
 - · Adapter for hexagon wrench 8
 - · Torque wrench



- ⑤ Tighten the plug (24) into the rear flange (1) to the required torque.
- * Tightening torque: $13\pm4.0 \text{ kgf} \cdot \text{m}(94\pm28.9 \text{ lbf} \cdot \text{ft})$
- * Tools
 - · Hexagon socket 36
 - · Torque wrench



- 7 Tighten the plug (26) into the rear flange (1) to the required torque.
- ** Tightening torque : 36 ± 1.5 kgf \cdot m (260 \pm 10.8 lbf \cdot ft)
- * Tools
 - · Hexagon socket 10
 - · Torque wrench



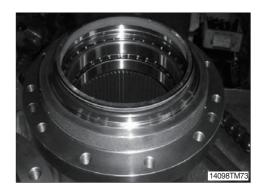
- 3) REASSEMBLE THE REDUCTION GEAR ASSEMBLY
- (1) Install floating seal (102) on the spindle (101).
- * Apply grease to the floating seal (102).



- (2) Install angular bearing (125) and snap ring (106) into the hub (105).
- * Be careful for the insert direction.



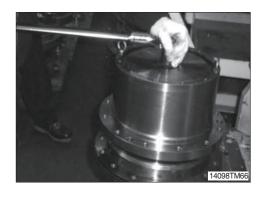
- (3) Insert the O-ring (130), the sealing (129) and floating seal (102) in the hub (105).
- * Apply grease to the floating seal (102) thinly.



(4) Install the spindle (101) into the hub (105) assembly.



- (5) Tighten the nut ring (103) and plug (104) into the hub (105) to the required torque.
- * Do not wind the seal tape to the plug (104).
- * Punch two place for not to loosen the plug (104).
- \divideontimes Tightening torque : 3.5 \pm 0.7 kgf \cdot m (25.3 \pm 5.1 lbf \cdot ft)
 - · Hexagon socket 8
 - · Torque wrench



(6) Install thrust washer (109) and collar (112) into the hub (105).



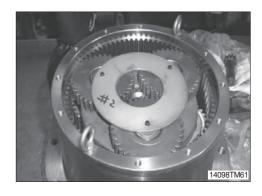
- (7) Install needle bearing (111) planetary gear F (108), thrust washer (109), thrust plate F (113) and screw (110) into the hub (105).
- ※ Tightening torque: 0.83 kgf ⋅ m (6.0 lbf ⋅ ft)
 - · Hexagon socket 5
 - · Torque wrench



- (8) Install sun gear (114) and holder assembly, then insert needle bearing (118) and planetary gear R (117) into the hub (105).
- * Holder assembly : holder (116) + spring pin (120) + inner race (119)



(9) Install drive gear (121) and thrust plate R (122) into the hub (105).

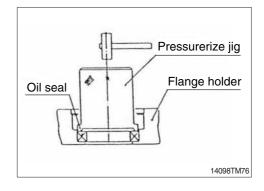


- (10) Install cover (123), thrust plate (150), plug (301, 128) and socket bolt (124) into the hub (105).
- Apply grease to the cover (123) after installed O-ring (127).



(11) Pressing the oil seal

- ① Insert the oil seal (32) by hit the pressurize jig with plastic hammer.
- * Apply grease to the seat of oil seal (32).



3.4 CHECKING FACTS AFTER ASSEMBLY

1) AIR TEST OF REDUCTION GEAR

Disassemble plug (128) of reduction gear part. When compressed air (0.3 kgf/cm^2) is inserted that in water during the 2 minutes, it should be not happened air bubble.

Fill the gear oil.

· Oil amount : 3.0 liter (0.79 U.S.gallon)

2) AIR TEST OF HYDRAULIC MOTOR

One port should be opened, the others port should be closed. When compressed air (3 kgf/cm²) is inserted opened port in water during the 2 minutes, it should be not happened air bubble. Fill the hydraulic oil.

· Oil amount : 0.55 liter (0.15 U.S.gallon)

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

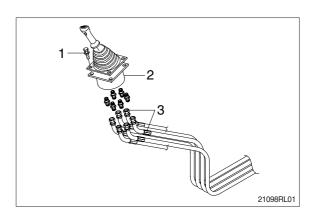
1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.
- (4) Loosen the socket bolt (1).
- (5) Remove the cover of the console box.
- (6) Disconnect pilot line hoses (3).
- (7) Remove the pilot valve assembly (2).
- When removing the pilot valve assembly, check that all the hoses have been disconnected.

2) INSTALL

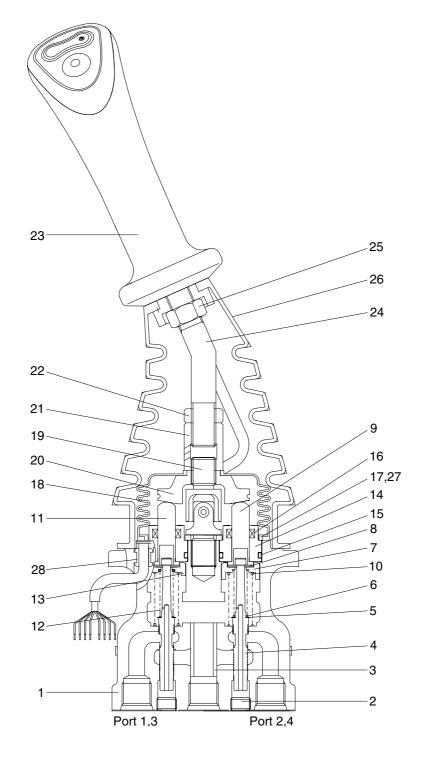
- (1) Carry out installation in the reverse order to removal.
- (2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.





2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



32092RL01

1	Case	8	Stopper	15	O-ring	22	Lock nut
2	Plug	9	Push rod	16	Rod seal	23	Handle assembly
3	Bushing	10	Spring	17	Plate	24	Handle bar
4	Spool	11	Push rod	18	Boot	25	Nut
5	Shim	12	Spring	19	Joint assembly	26	Boot
6	Spring	13	Spring seat	20	Swash plate	27	Spring pin
7	Spring seat	14	Plug	21	Adjusting nut	28	Bushing

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

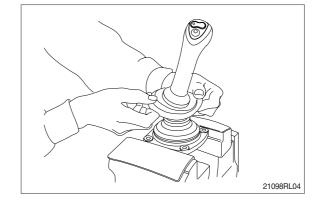
Tool name	Remark			
Allen wrench	6	B		
Channer	22			
Spanner	27			
(+) Driver		Length 150		
(-) Driver		Width 4~5		
Torque wrench		Capable of tightening with the specified torques		

(2) Tightening torque

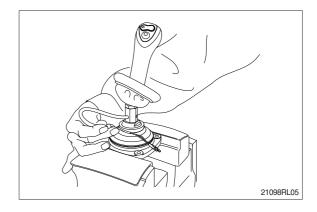
Part name	Item	Size	Torque		
Fait name	item	Size	kgf ⋅ m	lbf ⋅ ft	
Plug	2	PT 1/8	3.0	21.7	
Joint	19	M14	3.5	25.3	
Swash plate	20	M14	5.0±0.35	36.2±2.5	
Adjusting nut	21	M14	5.0±0.35	36.2±2.5	
Lock nut	22	M14	5.0±0.35	36.2±2.5	

3) DISASSEMBLY

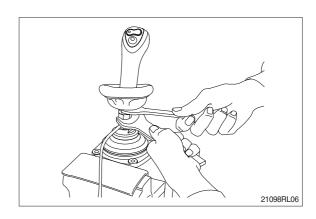
- (1) Clean pilot valve with kerosene.
- * Put blind plugs into all ports
- (2) Fix pilot valve in a vise with copper (or lead) sheets.
- (3) Remove end of boot (26) from case (1) and take it out upwards.



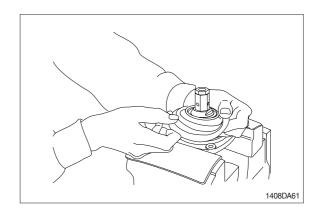
* For valve with switch, remove cord also through hole of casing.



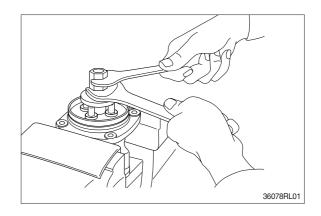
(4) Loosen lock nut (22) and adjusting nut (21) with spanners on them respectively, and take out handle section as one body.

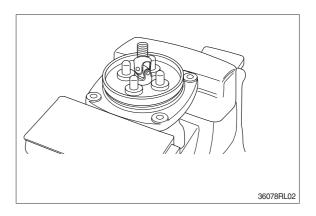


(5) Remove the boot (18).

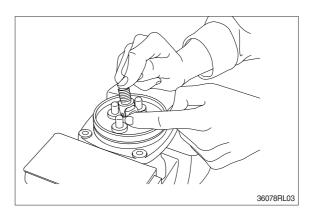


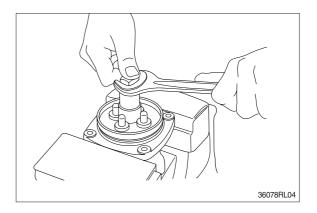
(6) Loosen adjusting nut (21) and swash plate (20) with spanners on them respectively, and remove them.



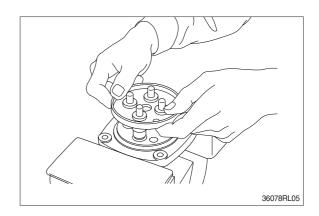


- (7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).
- When return spring (10) is strong in force, plate (17), plug (14) and push rod (11) will come up on loosening joint. Pay attention to this.

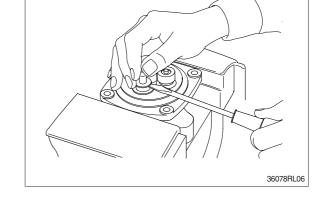




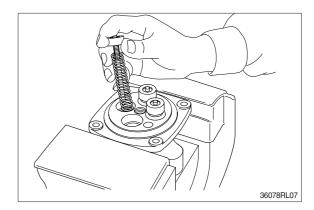
(8) Remove plate (17).



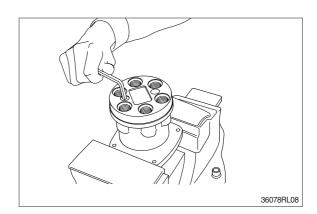
- (9) When return spring (10) is weak in force, plug (14) stays in casing because of sliding resistance of O-ring.
- * Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.
- During taking out, plug may jump up due to return spring (10) force.
 Pay attention to this.



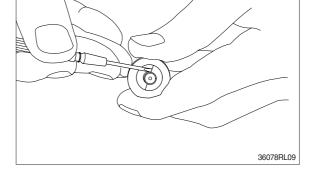
- (10) Remove reducing valve subassembly and return spring (10) out of casing.
- ** Record relative position of reducing valve subassembly and return springs.



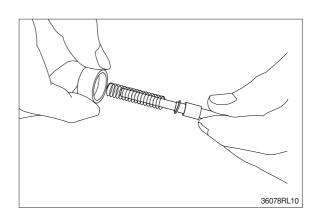
(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.



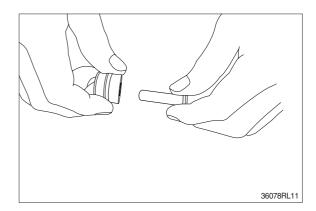
- (12) For disassembling reducing valve section, stand it vertically with spool (4) bottom placed on flat workbench. Push down spring seat (7) and remove two pieces of semicircular stopper (8) with tip of small minus screwdriver.
- * Pay attention not to damage spool surface.
- * Record original position of spring seat (7).
- * Do not push down spring seat more than 6mm.



- (13) Separate spool (4), spring seat (7), spring (6) and shim (5) individually.
- We until being assembled, they should be handled as one subassembly group.

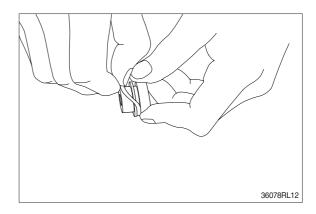


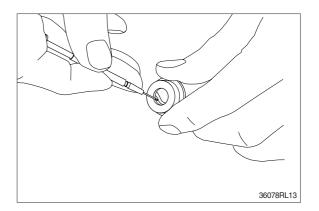
(14) Take push rod (11) out of plug (14).



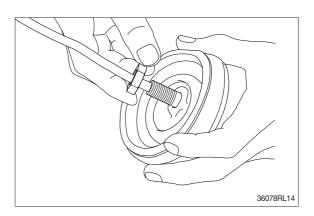
(15) Remove O-ring (15) and seal (16) from plug (14).

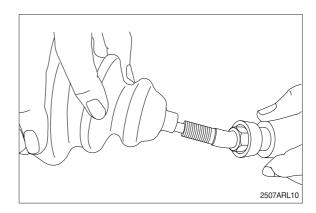
Use small minus screwdriver or so on to remove this seal.





(16) Remove lock nut (22) and then boot (26).





(16) Cleaning of parts

- ① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).
- If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.
- If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
 - Therefore, control cleanliness of kerosene fully.
- ② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).
- * Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

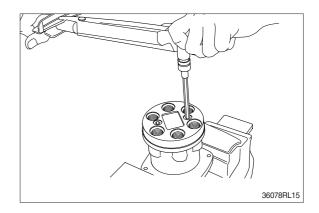
(17) Rust prevention of parts

Apply rust-preventives to all parts.

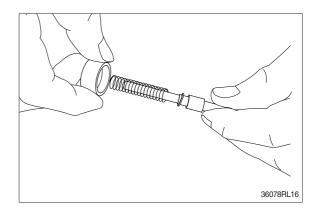
If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

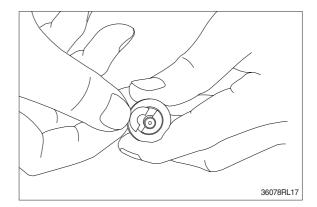
- (1) Tighten hexagon socket head plug (2) to the specified torque.
- * Tighten two bolts alternately and slowly.



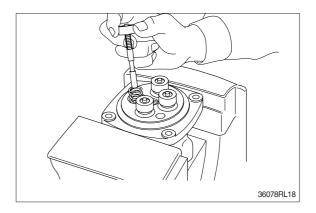
(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



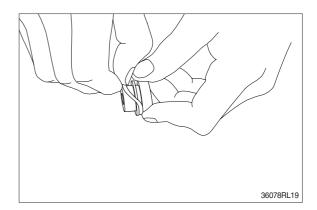
- (3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (8) on spring seat without piling them on.
- * Assemble stopper (8) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.



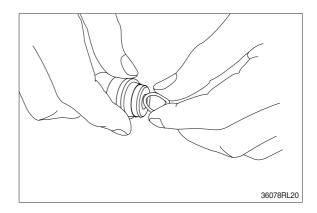
- (4) Assemble spring (10) into casing (1).
 Assemble reducing valve subassembly into casing.
- * Assemble them to their original positions.



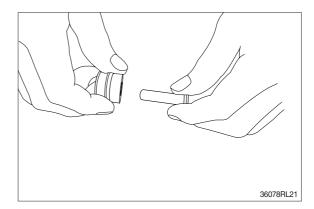
(5) Assemble O-ring (15) onto plug (14).



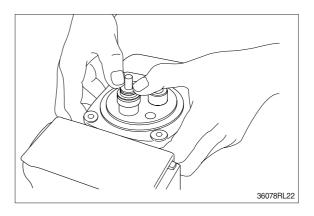
- (6) Assemble seal (16) to plug (14).
- * Assemble seal in such lip direction as shown below.



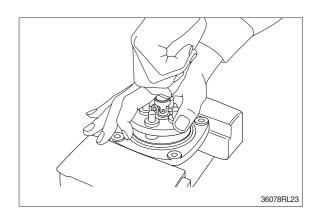
- (7) Assemble push rod (11) to plug (14).
- * Apply working oil on push-rod surface.



- (8) Assemble plug subassembly to casing.
- When return spring is weak in force, subassembly stops due to resistance of O-ring.

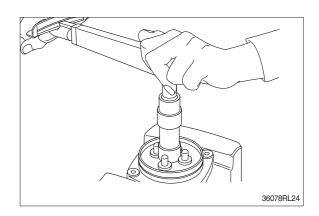


(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (17), and tighten joint (19) temporarily.



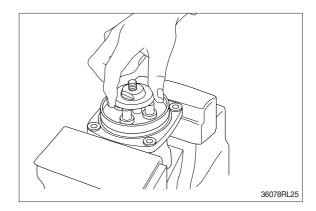
(10) Fit plate (17).

(11) Tighten joint (19) with the specified torque to casing, utilizing jig.

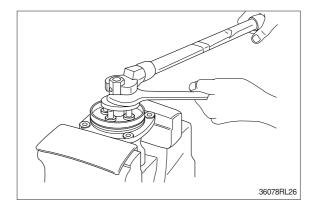


(12) Assemble swash plate (20) to joint (19).

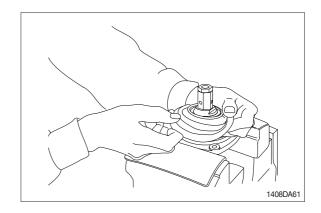
- Screw it to position that it contacts with 4 push rods evenly.
- * Do not screw it over.



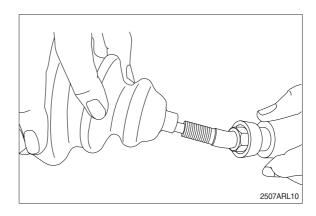
- (13) Assemble adjusting nut (21), apply spanner to width across flat of plate (20) to fix it, and tighten adjusting nut to the specified torque.
- * During tightening, do not change position of disk.

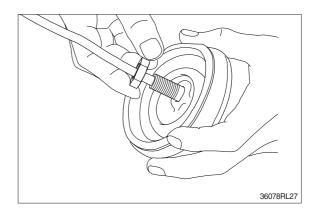


(14) Fit boot (18) to plate.

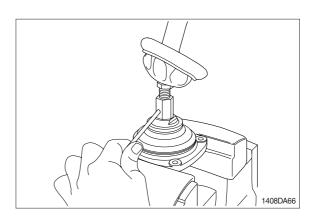


(15) Fit boot (26) and lock nut (22), and handle subassembly is assembled completely.

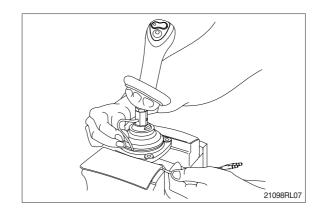




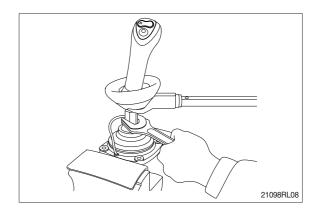
(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



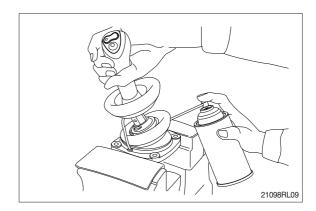
- (17) Assemble bushing (28) to plate and pass cord and tube through it.
- * Provide margin necessary to operation.



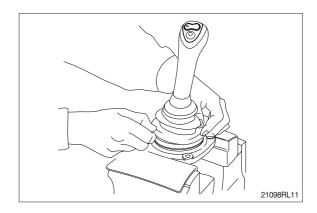
(18) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



- (20) Assemble lower end of bellows to casing.
- (21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Disconnect all hoses.
- (5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

· Weight: 50 kg (110 lb)

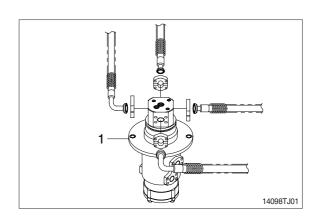
 \cdot Tightening torque : 12.3 \pm 1.3 kgf \cdot m (88.9 \pm 9.4 lbf \cdot ft)

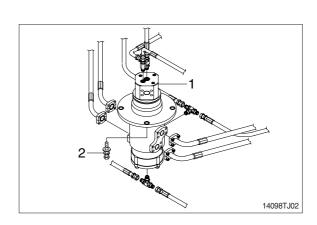
- (6) Remove the turning joint assembly.
- When removing the turning joint, check that all the hoses have been disconnected.

2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- * Take care of turning joint direction.
- * Assemble hoses to their original positions.
- * Confirm the hydraulic oil level and check the hydraulic oil leak or not.

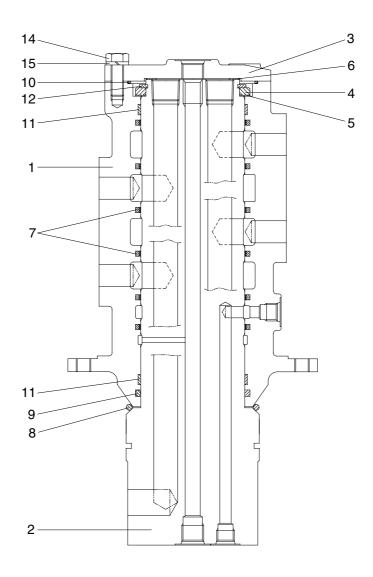






2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

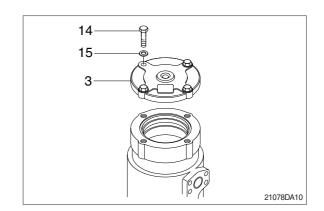


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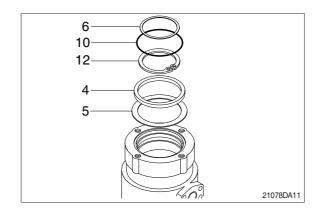
1	Hub	6	Shim
2	Shaft	7	Slipper seal
3	Cover	8	O-ring
4	Spacer	9	O-ring
5	Shim	10	O-ring

2) DISASSEMBLY

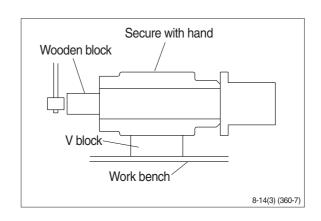
- * Before the disassembly, clean the turning joint.
- (1) Remove bolts (14), washer (15) and cover (3).



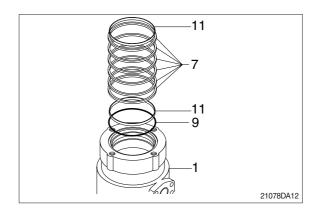
- (2) Remove shim (6) and O-ring (10).
- (3) Remove retainer ring (12), spacer (4) and shim (5).



- (4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft(2) to about 1/2 from the body with a hammer.
- * Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.
- * Put a fitting mark on hub (1) and shaft (2).

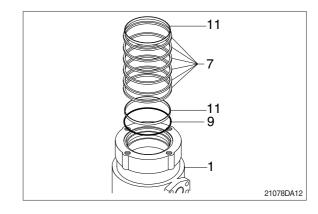


(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).

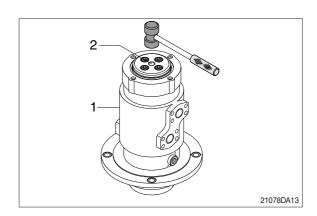


3) ASSEMBLY

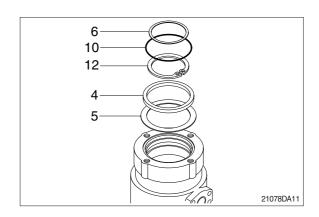
- * Clean all parts.
- * As a general rule, replace oil seals and O-ring.
- * Coat the sliding surfaces of all parts with engine oil or grease before installing.
- (1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).
- (2) Fit O-ring (8) to shaft (2).



(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

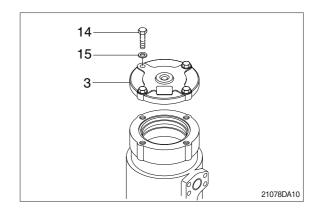


- (4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).
- (5) Fit O-ring (10) to hub (1).
- (6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

 \cdot Torque : 10~12.5 kgf \cdot m $(72.3{\sim}90.4 \text{ lbf} \cdot \text{ft})$



GROUP 9 BOOM, ARM AND BUCKET CYLINDERS

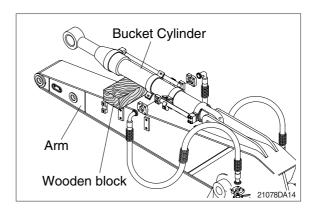
1. REMOVAL AND INSTALL

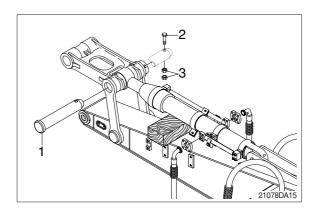
1) BUCKET CYLINDER

(1) Removal

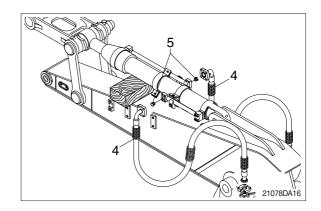
- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- ** Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- * Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Set block between bucket cylinder and arm.
- ② Remove bolt (2), nut (3) and pull out pin (1).
- * Tie the rod with wire to prevent it from coming out.



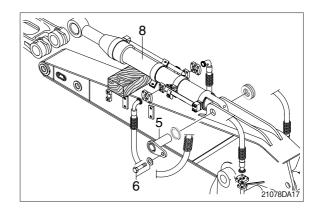




③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



- ④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).
- ⑤ Remove bucket cylinder assembly (8).
 - · Weight: 100 kg (220 lb)



(2) Install

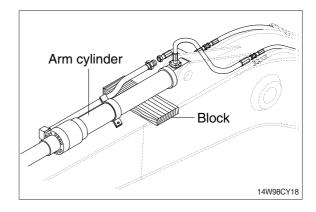
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- * Bleed the air from the bucket cylinder.
- * Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

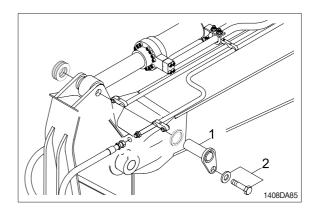
(1) Removal

- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- * Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- * Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ♠ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- $\ensuremath{\bigcirc}$ Set block between arm cylinder and boom.

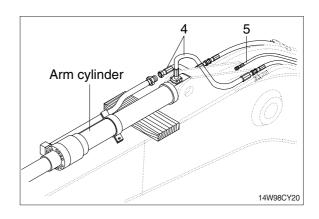




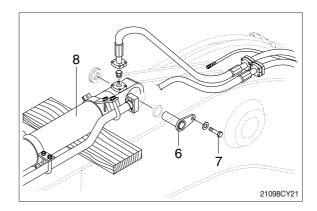
- ② Remove bolt (2) and pull out pin (1).
- * Tie the rod with wire to prevent it from coming out.



- ③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.
- ④ Disconnect greasing pipings (5).



- ⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).
- 6 Remove arm cylinder assembly (8).
 - · Weight: 160 kg (350 lb)



(2) Install

- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- * Bleed the air from the arm cylinder.
- * Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

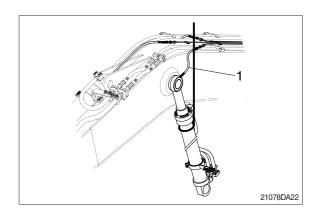
- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- ** Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- * Loosen the breather slowly to release the pressure inside the hydraulic tank.

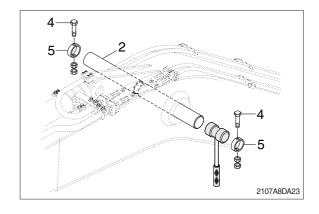
▲ Escaping fluid under pressure can penetrate the skin causing serious injury.

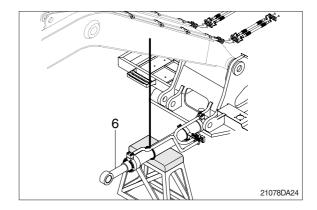
- Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Disconnect greasing hoses (1).
- ② Sling boom cylinder assembly.
- ③ Remove bolt (4), stopper (5) and pull out pin (2).
- * Tie the rod with wire to prevent it from coming out.

④ Lower the boom cylinder assembly (6) on a stand.

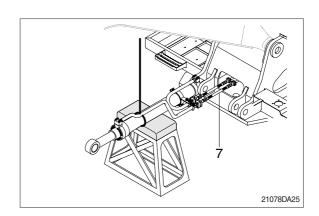




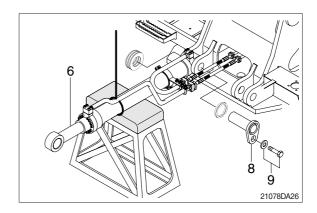




⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



- 6 Remove bolt (9) and pull out pin (8).
- ? Remove boom cylinder assembly (6).
 - · Weight: 130 kg (285 lb)



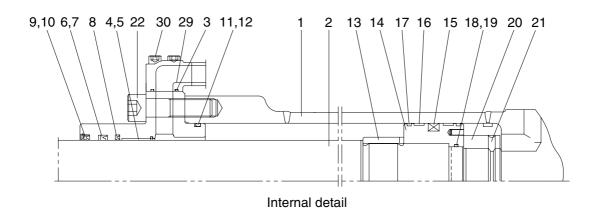
(2) Install

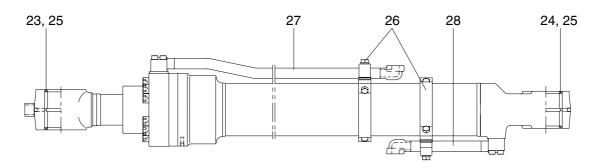
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- * Bleed the air from the boom cylinder.
- * Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

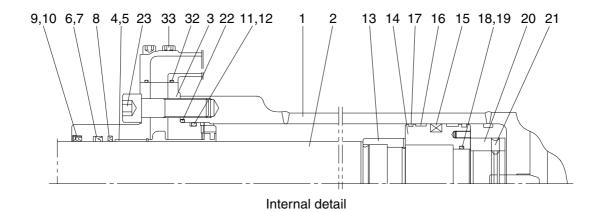


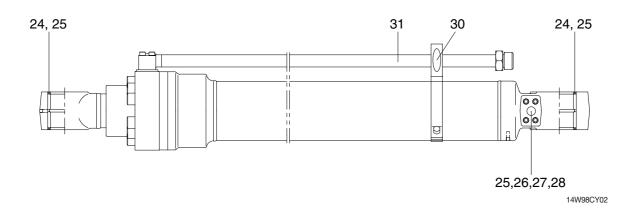


14W98CY01

1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Pin bushing
5	Snap ring	15	Piston seal	25	Dust seal
6	Rod seal	16	Wear ring	26	Band assembly
7	Back up ring	17	Dust ring	27	Pipe assembly-R
8	Buffer ring	18	O-ring	28	Pipe assembly-B
9	Dust wiper	19	Back up ring	29	O-ring
10	Snap ring	20	Lock nut	30	Hexagon socket head bolt

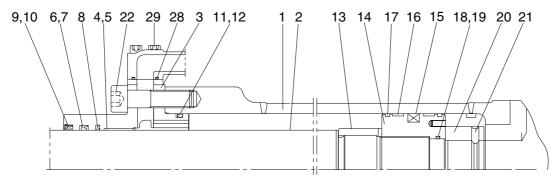
(2) Arm cylinder



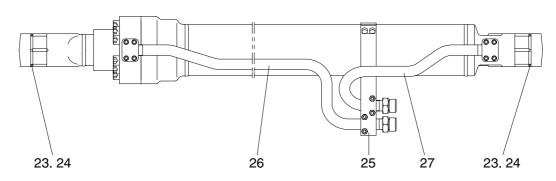


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Dust seal
4	DD2 bushing	15	Piston seal	26	Check valve
5	Snap ring	16	Wear ring	27	Coil spring
6	Rod seal	17	Dust ring	28	O-ring
7	Back up ring	18	O-ring	29	Plug
8	Buffer ring	19	Back up ring	30	Band assembly
9	Dust wiper	20	Lock nut	31	Pipe assembly-R
10	Snap ring	21	Hexagon socket set screw	32	O-ring
11	O-ring	22	O-ring	33	Hexagon socket head bolt

(3) Boom cylinder



Internal detail



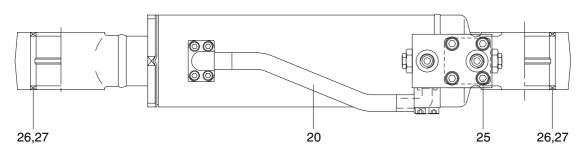
14W98CY03

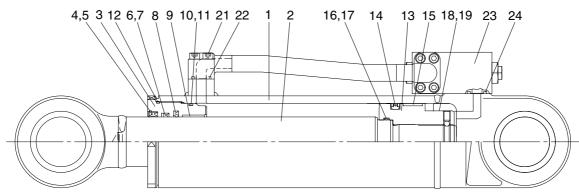
4	Tida a a a a a salah i
1	Tube assembly
2	Rod assembly
3	Gland
4	DD2 bushing
5	Snap ring
6	Rod seal
7	Back up ring
8	Buffer ring
9	Dust wiper
10	Snap ring

11	O-ring
12	Back up ring
13	Cushion ring
14	Piston
15	Piston seal
16	Wear ring
17	Dust ring
18	O-ring
19	Back up ring
20	Lock nut

21	Hexagon socket set screw
22	Hexagon socket head bolt
23	Pin bushing
24	Dust seal
25	Band assembly
26	Pipe assembly-R
27	Pipe assembly-B
28	O-ring
29	Hexagon socket head bolt

(4) Dozer cylinder





14098CY05

Tube assembly	10	O-ring	19	Set screw
Rod assembly	11	Back up ring	20	Pipe assembly
Gland	12	O-ring	21	Hexagon socket head bolt
Dust wiper	13	Piston	22	O-ring
Retainer ring	14	Piston seal	23	Check valve assembly
Rod seal	15	Wear ring	24	O-ring
Back up ring	16	O-ring	25	Hexagon socket head bolt
Buffer ring	17	Back up ring	26	Pin bushing
DU bushing	18	Steel ball	27	Dust seal
	Rod assembly Gland Dust wiper Retainer ring Rod seal Back up ring Buffer ring	Rod assembly 11 Gland 12 Dust wiper 13 Retainer ring 14 Rod seal 15 Back up ring 16 Buffer ring 17	Rod assembly Gland 12 O-ring Dust wiper 13 Piston Retainer ring 14 Piston seal Rod seal 15 Wear ring Back up ring 16 O-ring Buffer ring 17 Back up ring	Rod assembly 11 Back up ring 20 Gland 12 O-ring 21 Dust wiper 13 Piston 22 Retainer ring 14 Piston seal 23 Rod seal 15 Wear ring 24 Back up ring 16 O-ring 25 Buffer ring 17 Back up ring 26

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark		
	6		
Namand	8 B		
Allen wrench	14		
	17		
	7		
Spanner	8		
(-) Driver	Small and large sizes		
Torque wrench	Capable of tightening with the specified torques		

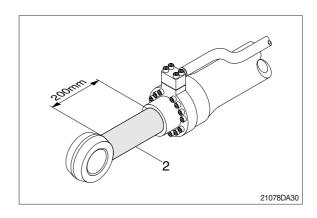
(2) Tightening torque

	Dowl no ma	lkama	Cino	Torque	
'	Part name	Item	Size	kgf · m	lbf ⋅ ft
	Bucket cylinder	00	M14	15±2.0	108±14.5
	Boom cylinder	22	M14	15±2.0	108±14.5
Socket head bolt	Arm cylinder	23	M16	23±2.0	166±14.5
	Donor or dividor	21	M8	2.7±0.3	19.5±2.2
	Dozer cylinder	25	M10	5.4±0.5	39.1±3.6
	Bucket	30	M10	5.4±0.5	39.1±3.6
Pipe mounting socket head bolt	Boom	29	M8	2.7±0.3	19.6±2.2
COOKET HOUSE DOK	Arm	33	M10	5.4±0.5	39.1±3.6
	Bucket cylinder		M45	100±10.0	723±72.3
Lock nut	Boom cylinder	20	M50		
	Arm cylinder		M55		
	Bucket cylinder				
Dieter	Boom cylinder	14	-	150±15.0	1085±109
Piston	Arm cylinder				
	Dozer cylinder - Rear	13	M52		

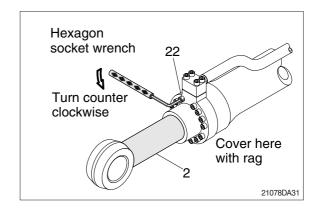
3) DISASSEMBLY

(1) Remove cylinder head and piston rod

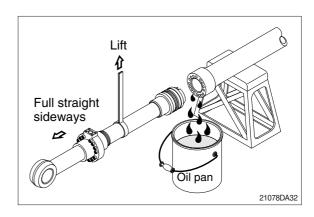
- * Procedures are based on the bucket cylinder.
- ① Hold the clevis section of the tube in a vise.
- We use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.
- ② Pull out rod assembly (2) about 200mm (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



- 3 Loosen and remove socket bolts (22) of the gland in sequence.
- ** Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.

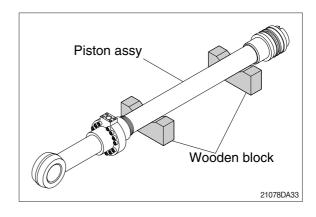


- ① Draw out cylinder head and rod assembly together from tube assembly (1).
- Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



Note that the plated surface of rod assembly (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.

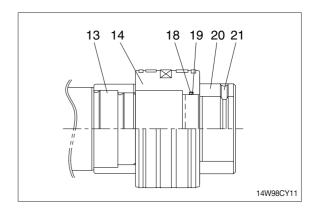
- ⑤ Place the removed rod assembly on a wooden V-block that is set level.
- * Cover a V-block with soft rag.

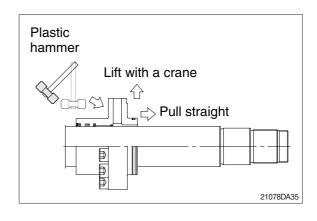


(2) Remove piston and cylinder head

- ① Remove set screw (21).
- Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock set screw (21) and lock nut (20).
- ② Remove piston assembly (14), back up ring (19), and O-ring (18).
- 3 Remove the cylinder head assembly from rod assembly (2).
- * If it is too heavy to move, move it by striking the flanged part of cylinder head 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 (5,6,7,8,9,10) by the threads of rod

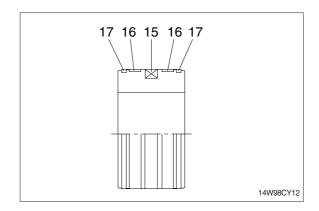
assembly (2).





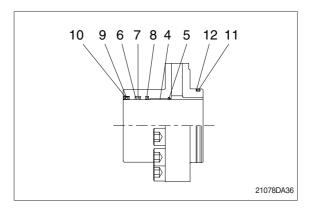
(3) Disassemble the piston assembly

- ① Remove wear ring (16).
- ② Remove dust ring (17) and piston seal (15).
- Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

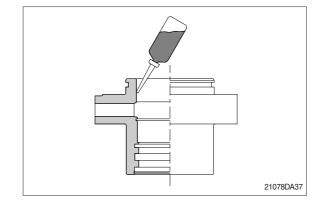
- ① Remove back up ring (12) and O-ring (11).
- ② Remove snap ring (10), dust wiper (9).
- ③ Remove back up ring (7), rod seal (6) and buffer ring (8).
- Exercise care in this operation not to damage the grooves.
- * Do not remove seal and ring, if does not damaged.
- * Do not remove bushing (4).



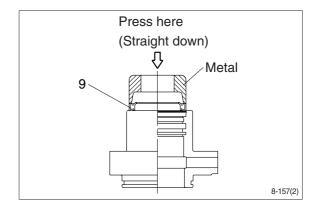
3) ASSEMBLY

(1) Assemble cylinder head assembly

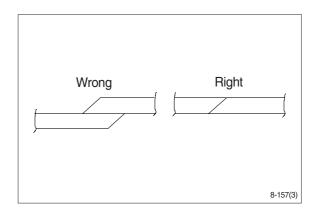
- * Check for scratches or rough surfaces if found smooth with an oil stone.
- ① Coat the inner face of gland (3) with hydraulic oil.



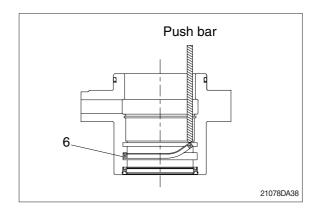
- ② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
 - At this time, press a pad metal to the metal ring of dust seal.
- ③ Fit snap ring (10) to the stop face.



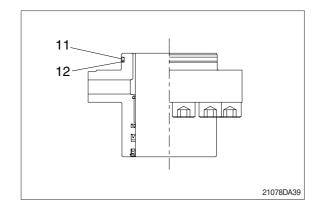
- ④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.
- * Coat each packing with hydraulic oil before fitting it.
- ** Insert the backup ring until one side of it is inserted into groove.



- ** Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.
- * Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

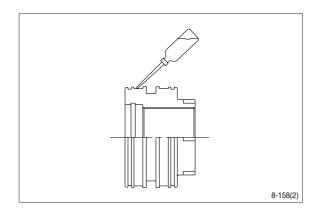


- 5 Fit back up ring (12) to gland (3).
- Put the backup ring in the warm water of 30~50°C.
- ⑥ Fit O-ring (11) to gland (3).

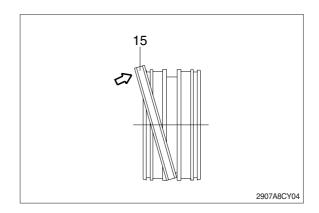


(2) Assemble piston assembly

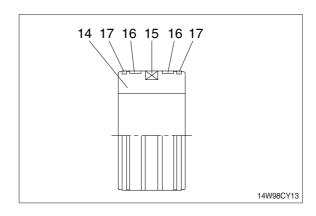
- * Check for scratches or rough surfaces. If found smooth with an oil stone.
- ① Coat the outer face of piston (14) with hydraulic oil.



- 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.

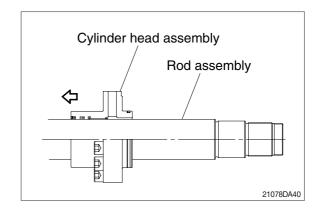


③ Fit wear ring (16) and dust ring (17) to piston (14).

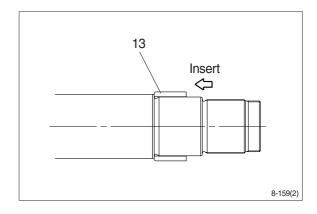


(3) Install piston and cylinder head

- ① Fix the rod assembly to the work bench.
- ② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
- ③ Insert cylinder head assembly to rod assembly.

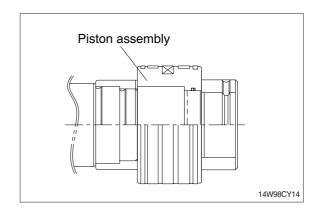


- ④ Insert cushion ring (13) to rod assembly.
- * Note that cushion ring (13) has a direction in which it should be fitted.



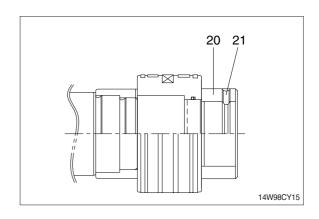
- ⑤ Fit piston assembly to rod assembly.
 - · Tightening torque : 150±15 kgf · m

 $(1085\pm108 \text{ lbf} \cdot \text{ft})$



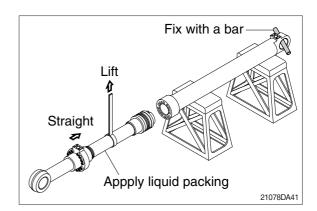
- ⑥ Fit lock nut (20) and tighten the screw (21).
 - · Tightening torque :

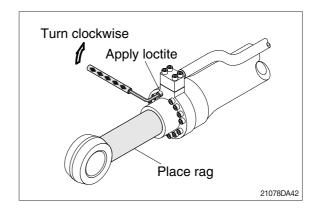
Item		kgf ⋅ m	lbf ⋅ ft
	Bucket		
20	Boom	100 ± 10	723 ± 72.3
	Arm		
21		2.7±0.3	19.6±2.2



(3) Overall assemble

- ① Place a V-block on a rigid work bench. Mount the 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 rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.
- ** Be careful not to damage piston seal by thread of tube assembly.
- ③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.
- * Refer to the table of tightening torque.





GROUP 10 UNDERCARRIAGE

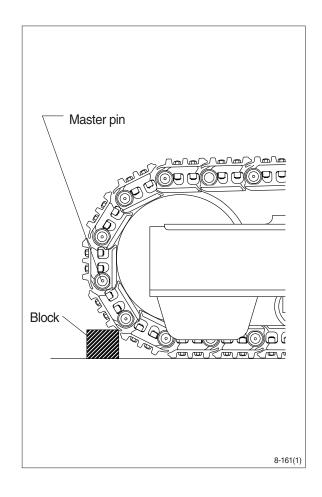
1. TRACK LINK

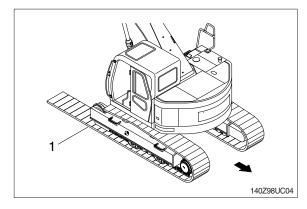
1) REMOVAL

- (1) Move track link until master pin is over front idler in the position put wooden block as shown.
- (2) Loosen tension of the track link.
- If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.
- ** Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required. Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease
- pressurized grease.
 (3) Push out master pin by using a suitable

nipple can be suddenly popped out by

- (4) Move the machine slowly in reverse, and lay out track link assembly (1).
- * Jack up the machine and put wooden block under the machine.
- ** Don't get close to the sprocket side as the track shoe plate may fall down on your feet.

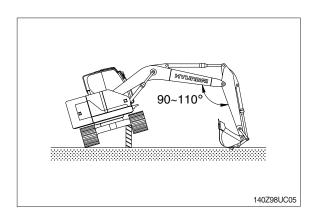




2) INSTALL

tool.

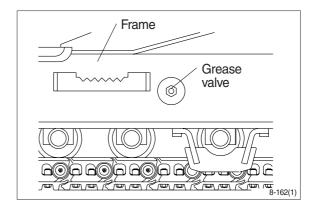
- (1) Carry out installation in the reverse order to removal.
- * Adjust the tension of the track link.



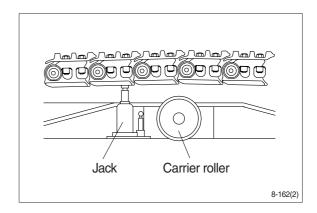
2. CARRIER ROLLER

1) REMOVAL

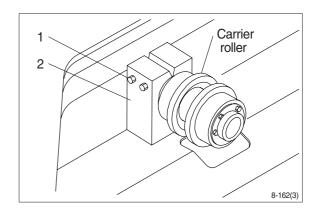
(1) Loosen tension of the track link.



(2) Jack up the track link height enough to permit carrier roller removal.



- (3) Loosen the lock nut (1).
- (4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.
 - · Weight: 21 kg (46 lb)



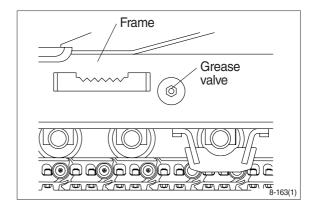
2) INSTALL

(1) Carry out installation in the reverse order to removal.

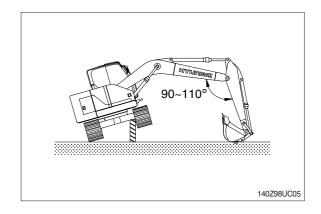
3. TRACK ROLLER

1) REMOVAL

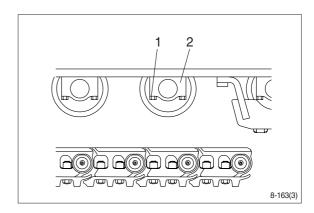
(1) Loosen tension of the track link.



- (2) Using the work equipment, push up track frame on side which is to be removed.
- * After jack up the machine, set a block under the unit.



- (3) Remove the mounting bolt (1) and draw out the track roller (2).
 - · Weight : 38.3 kg (84.4 lb)



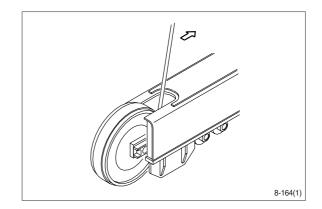
2) INSTALL

(1) Carry out installation in the reverse order to removal.

4. IDLER AND RECOIL SPRING

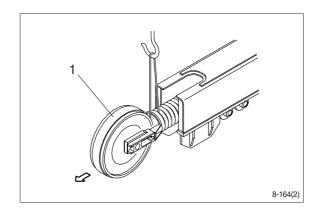
1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.

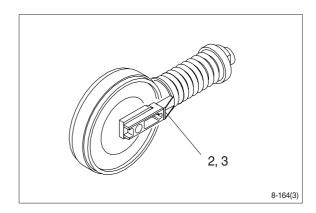


(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.

· Weight: 192 kg (423 lb)

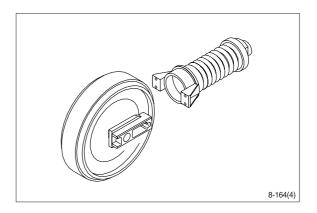


(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.



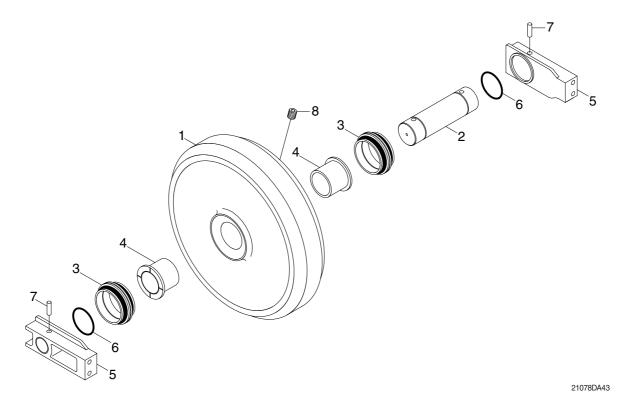
2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- * Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

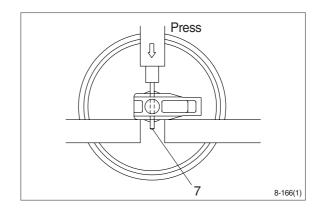


- 1 Shell
- 2 Shaft
- 3 Seal assembly
- 4 Bushing
- 5 Bracket
- 6 O-ring

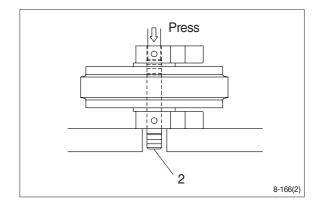
- 7 Spring pin
- 8 Plug

(2) Disassembly

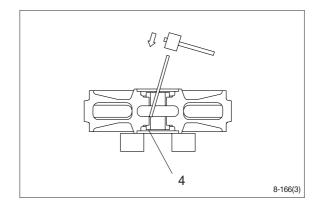
- Remove plug and drain oil.
- ② Draw out the spring pin (7), using a press.



- ③ Pull out the shaft (2) with a press.
- ④ Remove seal (3) from idler (1) and bracket (5).
- ⑤ Remove O-ring (6) from shaft.

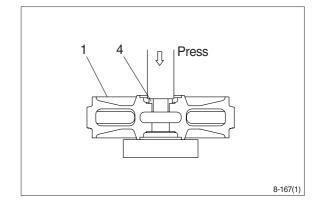


⑤ Remove the bushing (4) from idler, using a special tool. Only remove bushing if replacement is necessity.

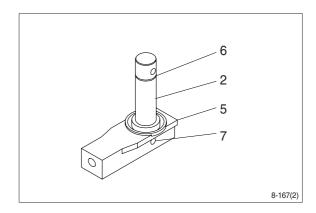


(3) Assembly

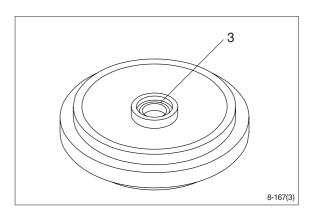
- * Before assembly, clean the parts.
- * Coat the sliding surfaces of all parts with oil.
- Cool up bushing (4) fully by some dry ice and press it into shell (1).
 Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



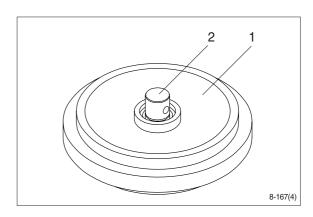
- ② Coat O-ring (6) with grease thinly, and install it to shaft (2).
- ③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



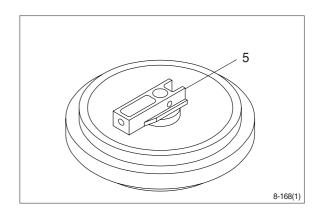
④ Install seal (3) to shell (1) and bracket (5).



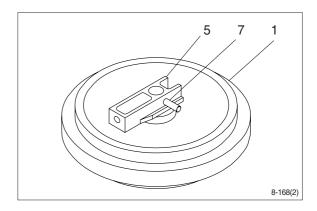
⑤ Install shaft (2) to shell (1).



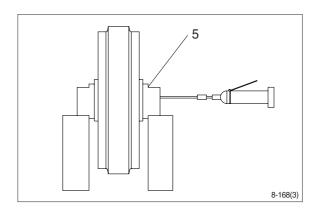
⑥ Install bracket (5) attached with seal (3).



⑦ Knock in the spring pin (7) with a hammer.

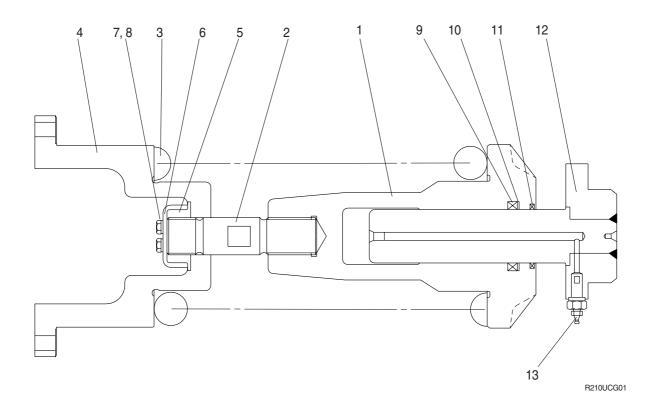


Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



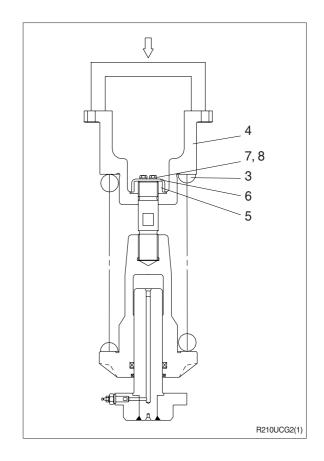
- 1 Body
- 2 Tie bar
- 3 Spring
- 4 Bracket
- 5 Lock nut

- 6 Lock plate
- 7 Bolt
- 8 Spring washer
- 9 Rod seal
- 10 Back up ring

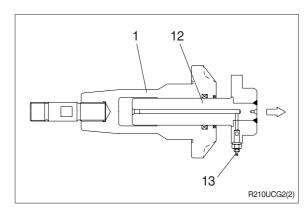
- 11 Dust seal
- 12 Rod assembly
- 13 Grease valve

(2) Disassembly

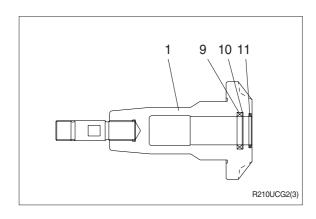
- ① Apply pressure on spring (3) with a press.
- ** The spring is under a large installed load. This is dangerous, so be sure to set properly.
 - · Spring set load : 11132 kg (24542 lb)
- ② Remove bolt (7), spring washer (8) and lock plate (6).
- ③ Remove lock nut (5). Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.
- ④ Lighten the press load slowly and remove bracket (4) and spring (3).



- ⑤ Remove rod (12) from body (1).
- ⑥ Remove grease valve (13) from rod (12).

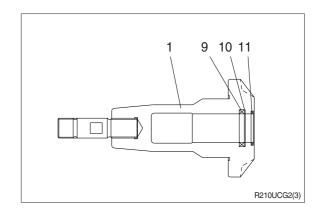


⑦ Remove rod seal (9), back up ring (10) and dust seal (11).

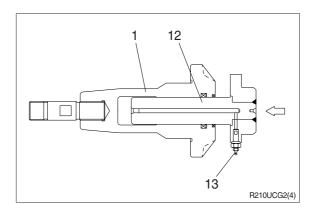


(3) Assembly

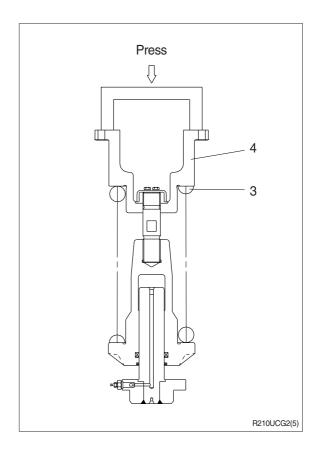
- Install dust seal (11), back up ring (10) and rod seal (9) to body (1).
- When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



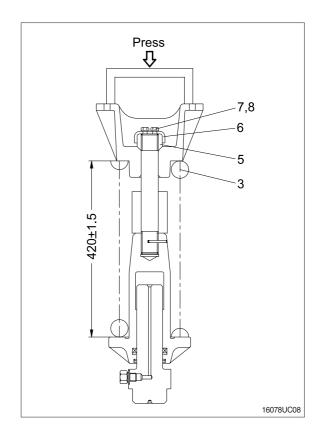
- ② Pour grease into body (1), then push in rod (12) by hand. After take grease out of grease valve mounting hole, let air out.
- If air letting is not sufficient, it may be difficult to adjust the tension of crawler.
- 3 Fit grease valve (13) to rod (12).
 •Tightening torque: 13±1.0 kgf·m (94±7.2 lbf·ft)



- (4) Install spring (3) and bracket (4) to body (1).
- (5) Apply pressure to spring (3) with a press and tighten lock nut (5).
- * Apply sealant before assembling.
- During the operation, pay attention specially to prevent the press from slipping out.

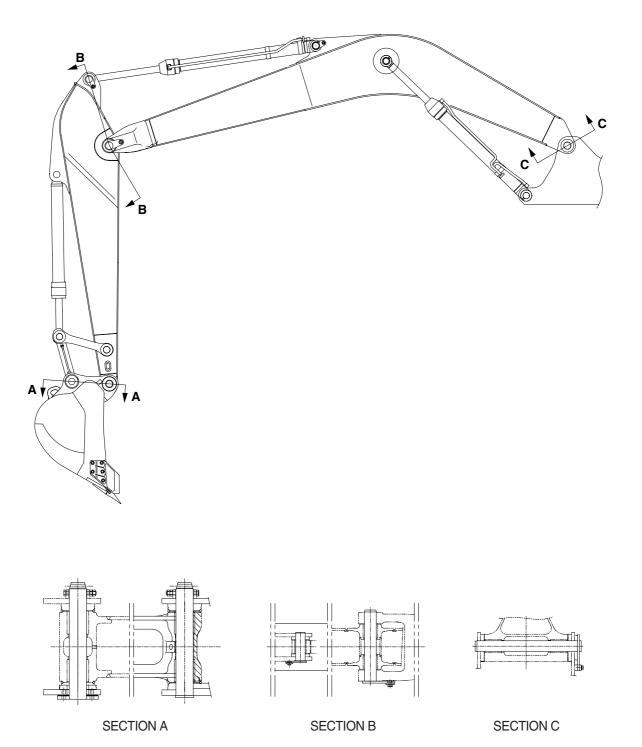


- © Lighten the press load and confirm the set length of spring (3).
- After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).



GROUP 11 WORK EQUIPMENT

1. STRUCTURE



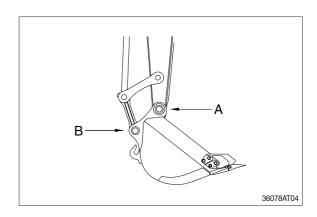
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2. REMOVAL AND INSTALL

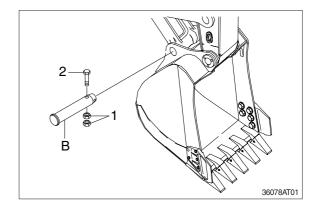
1) BUCKET ASSEMBLY

(1) Removal

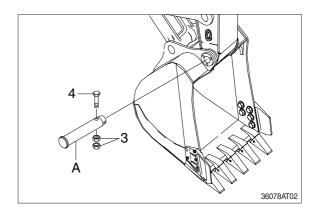
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut (1), bolt (2) and draw out the pin (B).

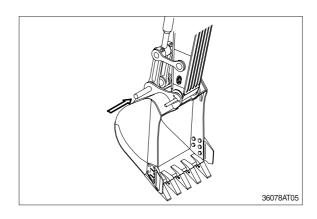


③ Remove nut (3), bolt (4) and draw out the pin (A) then remove the bucket assembly.· Weight: 480 kg (1060 lb)



(2) Install

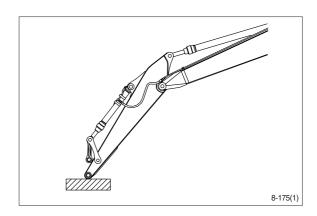
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- * Adjust the bucket clearance.
 For detail, see operation manual.

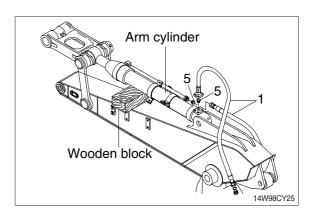


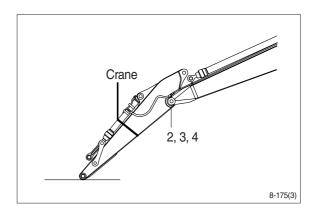
2) ARM ASSEMBLY

(1) Removal

- * Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ♠ Escaping fluid under pressure can penetrated the skin causing serious injury.
- Remove bucket assembly.
 For details, see removal of bucket assembly.
- ② Disconnect bucket cylinder hose (1).
- ♠ Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.
- ③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.
- * Tie the rod with wire to prevent it from coming out.
- ④ For details, see removal of arm cylinder assembly.
 - Place a wooden block under the cylinder and bring the cylinder down to it.
- ⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.
- * Weight: 385 kg (850 lb)
 When lifting the arm assembly, always lift the center of gravity.







(2) Install

- ① Carry out installation in the reverse order to removal.
- A When lifting the arm assembly, always lift the center of gravity.
- * Bleed the air from the cylinder.

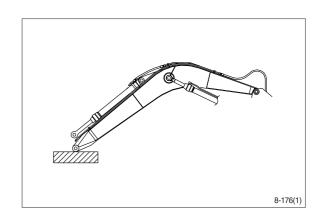
3) BOOM CYLINDER

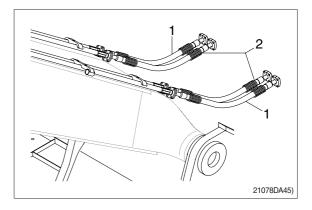
(1) Removal

- Remove arm and bucket assembly.
 For details, see removal of arm and bucket assembly.
- ② Remove boom cylinder assembly from boom.
 - For details, see removal of arm cylinder assembly.

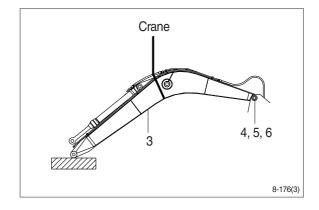


- ④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).
- When the hose are disconnected, oil may spurt out.
- ⑤ Sling boom assembly (3).



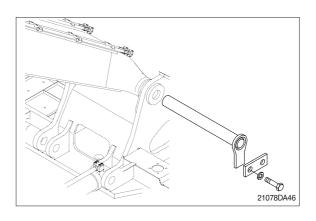


- Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
 Weight: 760 kg (1675 lb)
- When lifting the boom assembly always lift the center of gravity.



(2) Install

- ① Carry out installation in the reverse order to removal
- ♠ When lifting the arm assembly, always lift the center of gravity.
- * Bleed the air from the cylinder.



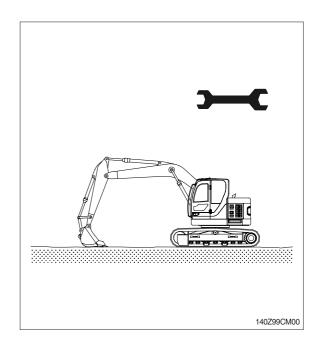
SECTION 9 COMPONENT MOUNTING TORQUE

Group	1 Introduction guide ·····	9-1
Group	2 Engine system ·····	9-2
Group	3 Electric system ····	9-4
Group	4 Hydraulic system ·····	9-6
Group	5 Undercarriage	9-9
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SECTION 9 COMPONENT MOUNTING TORQUE

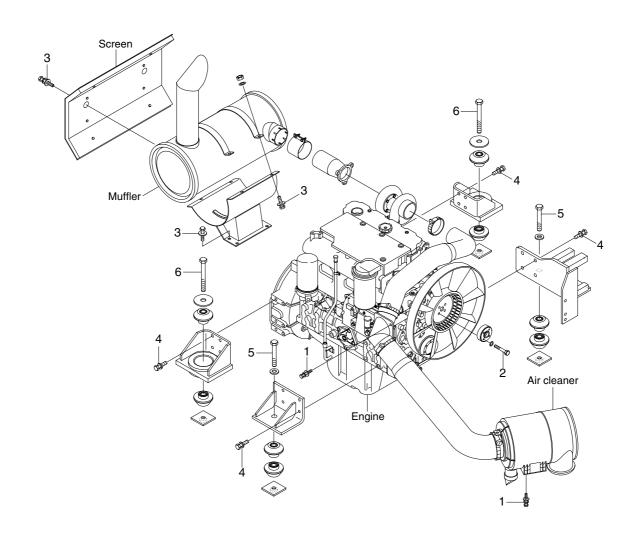
GROUP 1 INTRODUCTION GUIDE

- 1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
- Use genuine Hyundai spare parts.
 We expressly point out that Hyundai will not accept any responsibility for defects resulted from non-genuine parts.
 In such cases Hyundai cannot assume liability for any damage.
- * Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.
- ** Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.



GROUP 2 ENGINE SYSTEM

1. ENGINE AND ACCESSORIES MOUNTING

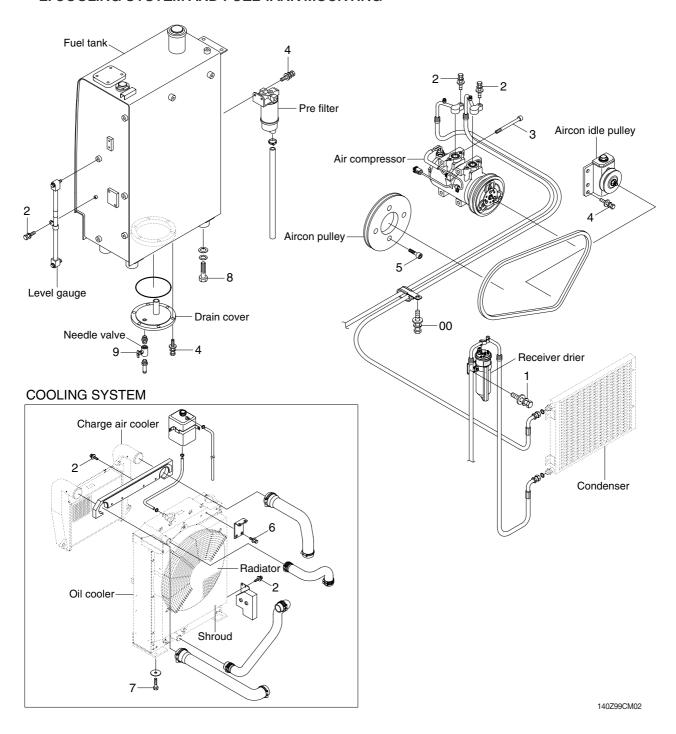


140Z99CM01

Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	4.4±0.9	31.8±6.5
3	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf ⋅ m	lbf ⋅ ft
4	M12×1.75	10.0±1.0	72.3±7.2
5	M16×2.0	30±3.5	217±25.3
6	M20×2.5	55±3.5	398±25.3

2. COOLING SYSTEM AND FUEL TANK MOUNTING

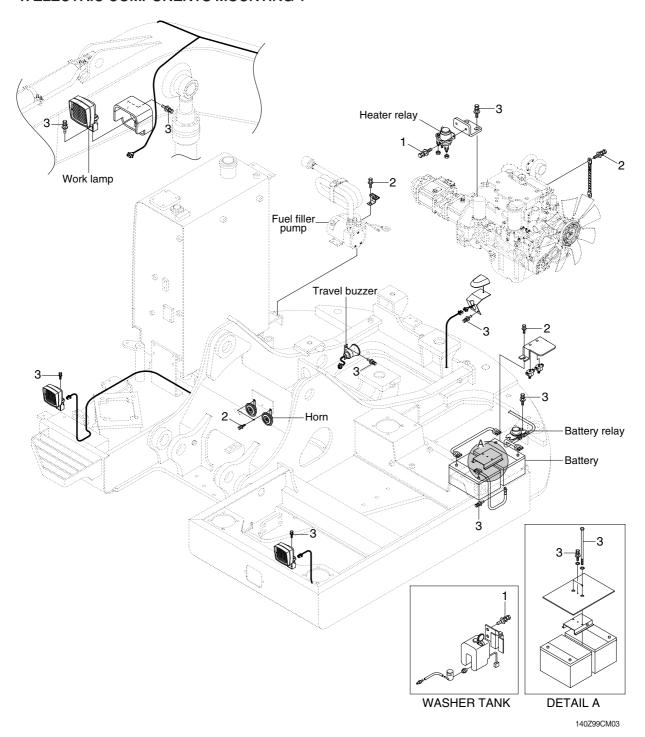


Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.8±5.1
4	M10×1.5	6.9±1.4	49.9±10.1
5	M10×1.5	8.3±1.7	60.0±12.3

Item	Size	kgf ⋅ m	lbf ⋅ ft
6	M12×1.75	12.8±3.0	92.6±21.7
7	M16×2.0	29.7 ± 4.5	215±32.5
8	M20×2.5	46±5.1	333±36.9
9	-	2.3±0.6	16.6±4.3

GROUP 3 ELECTRIC SYSTEM

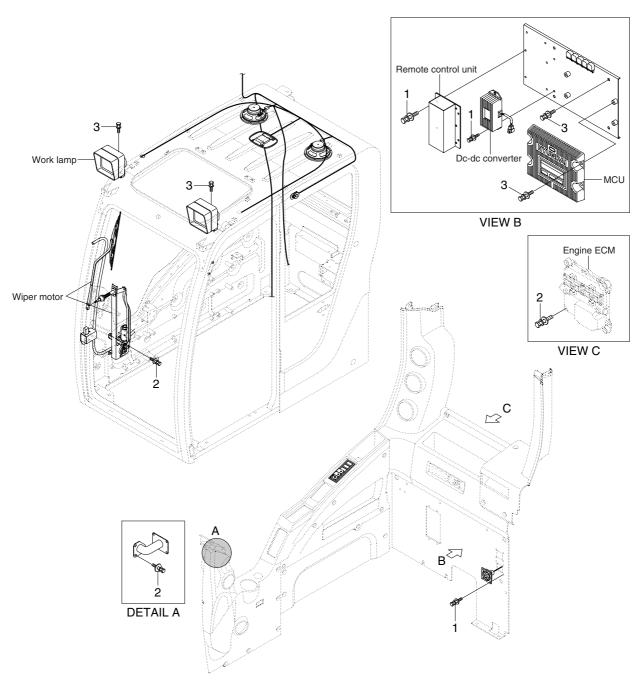
1. ELECTRIC COMPONENTS MOUNTING 1



Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf ⋅ m	lbf ⋅ ft
3	M10×1.5	6.9±1.4	49.9±10.1

2. ELECTRIC COMPONENTS MOUNTING 2

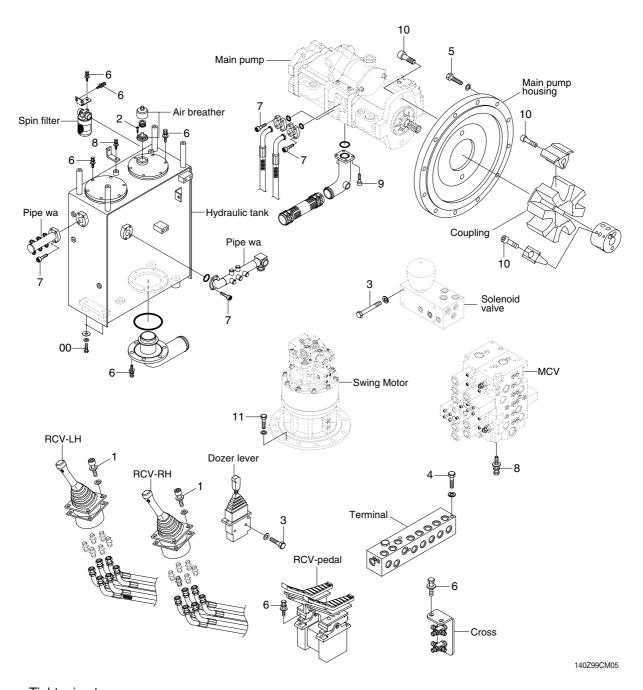


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Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	6.9±1.4	49.9±10.1

GROUP 4 HYDRAULIC SYSTEM

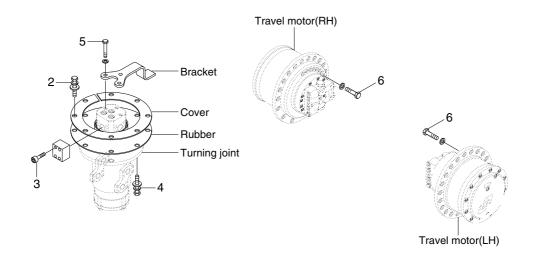
1. HYDRAULIC COMPONENTS MOUNTING 1

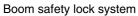


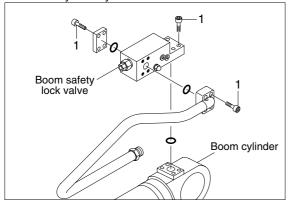
Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 6×1.0	1.44 ± 0.3	10.4±2.2
3	M 8×1.25	2.5 ± 0.5	18.1±3.6
4	M 8×1.25	4.05 ± 0.8	29.3±5.8
5	M10×1.5	6.0±0.3	43.4±2.2
6	M10×1.5	6.9±1.4	49.9±10.1

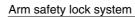
Item	Size	kgf ⋅ m	lbf ⋅ ft
7	M10×1.5	8.27±1.7	59.8±12.3
8	M12×1.75	12.2±1.3	88.2±9.4
9	M12×1.75	14.7±2.2	106±15.9
10	M16×2.0	22±1.0	159±7.2
11	M16×2.0	29.6±3.2	214±23.1
12	M20×2.5	46±5.1	333±36.9

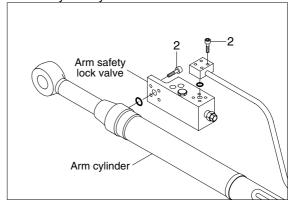
2. HYDRAULIC COMPONENTS MOUNTING 2









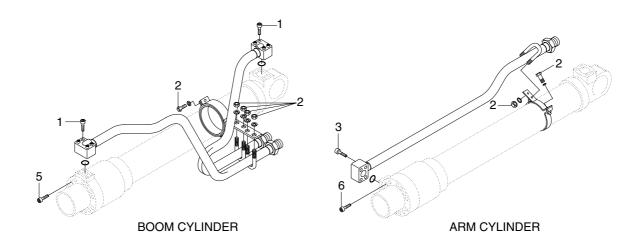


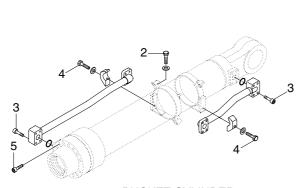
140Z99CM06

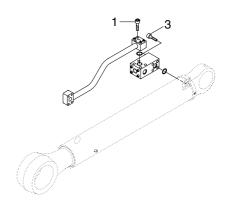
Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 8×1.25	4.05±0.8	29.3±5.8
2	M10×1.5	6.9±1.4	49.9±10.1
3	M10×1.5	8.27±1.7	59.8±12.3

Item	Size	kgf ⋅ m	lbf ⋅ ft
4	M12×1.75	12.3±1.3	88.9±9.4
5	M14×2.0	19.6±2.9	142±21.0
6	M16×2.0	25.7±4.0	186±28.9

3. HYDRAULIC COMPONENTS MOUNTING 3







BUCKET CYLINDER

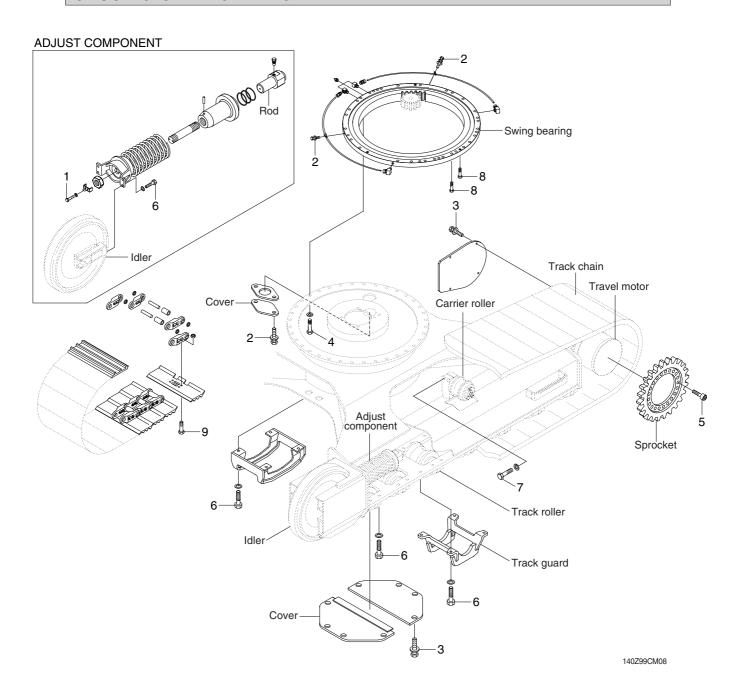
DOZER BLADE CYLINDER

140Z99CM07

Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 8×1.25	2.7±0.3	19.5±2.2
2	M10×1.5	3.2±0.3	23.1±2.2
3	M10×1.5	5.4±0.5	39.1±3.6

Item	Size	kgf ⋅ m	lbf ⋅ ft
4	M12×1.75	9.3±1.9	67.3±13.7
5	M14×2.0	15±2.0	108±14.5
6	M16×2.0	23±2.0	166±14.5

GROUP 5 UNDERCARRIAGE

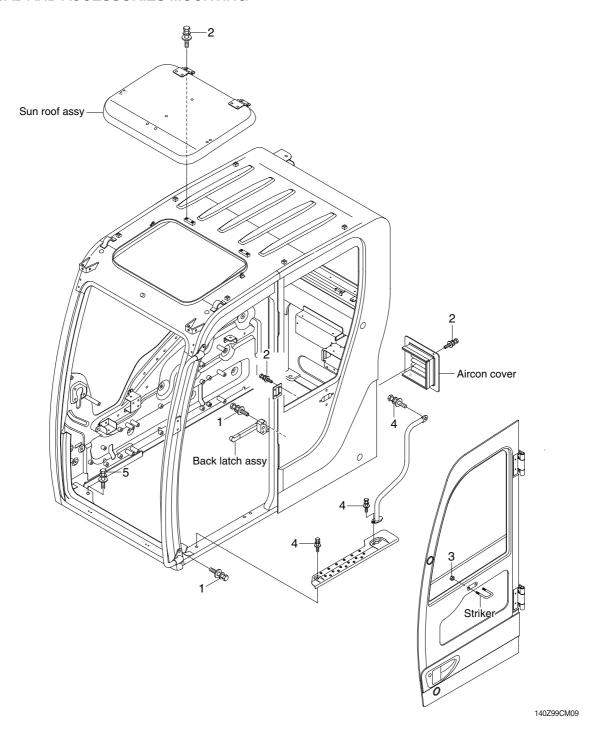


Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 8×1.0	3.74±0.7	27.1±5.1
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	12.8±3.0	92.6±21.7
4	M16×1.5	31.3±3.2	226±23.1
5	M16×2.0	23±2.5	166±18.1

Item	Size	kgf ⋅ m	lbf ⋅ ft
6	M16×2.0	29.6±3.2	214±23.1
7	M16×2.0	29.7±4.4	215±31.8
8	M18×2.5	41.3±4.5	299±32.5
9	5/8-18 UNF	42±4.0	304±29

GROUP 6 STRUCTURE

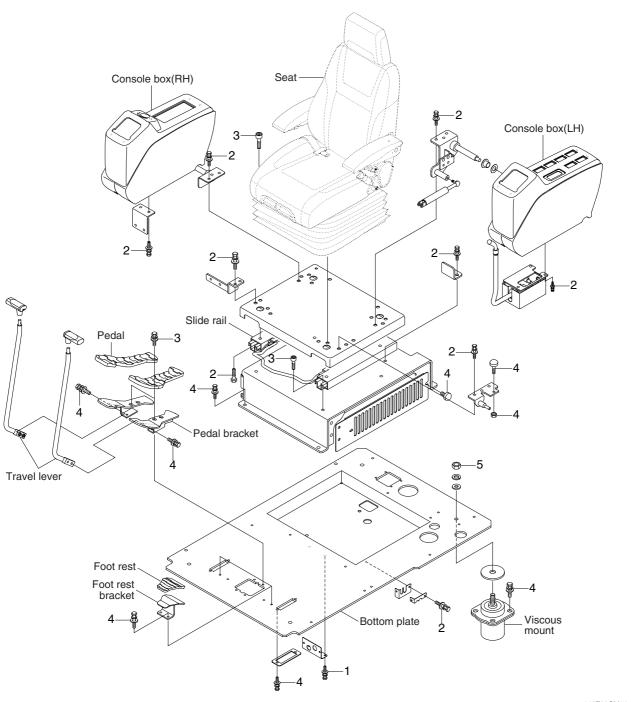
1. CAB AND ACCESSORIES MOUNTING



Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 6×1.0	1.44±0.3	10.4±2.2
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	4.7±0.9	34±6.5

Item	Size	kgf⋅m	lbf ⋅ ft
4	M10×1.5	6.9±1.4	49.9±10.1
5	M12×1.75	12.8±3.0	92.6±21.7

2. CAB INTERIOR MOUNTING

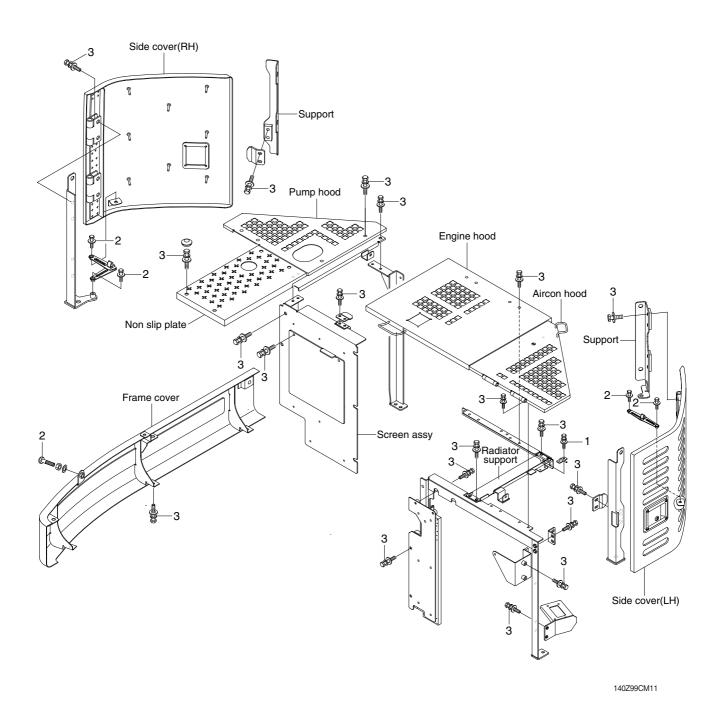


140Z99CM10

Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 6×1.0	1.05±0.2	7.6±1.4
2	M 8×1.25	3.43±0.7	24.8±5.1
3	M 8×1.25	4.05±0.8	29.3±5.8

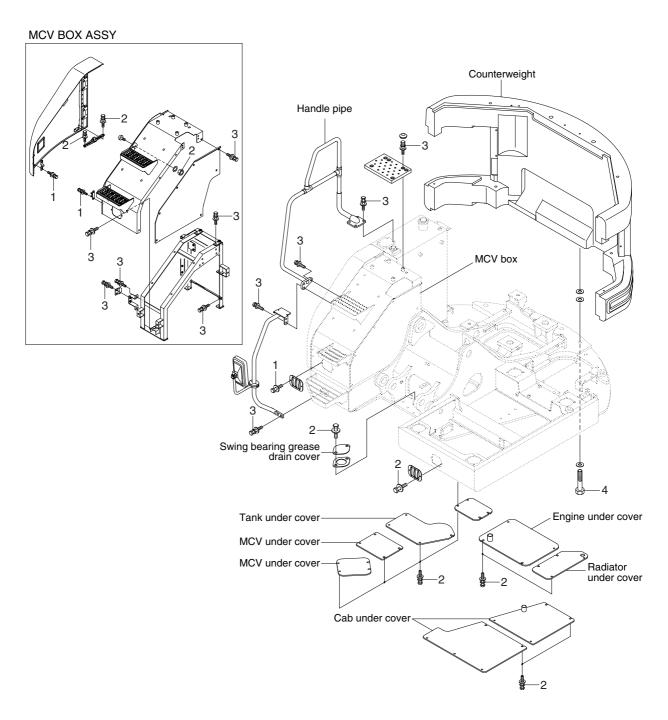
Item	Size	kgf ⋅ m	lbf ⋅ ft
4	M10×1.5	6.9±1.4	49.9±10.1
5	M16×2.0	29.7±4.5	215±32.5

3. COWLING MOUNTING



Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	12.8±3.0	92.6±21.7

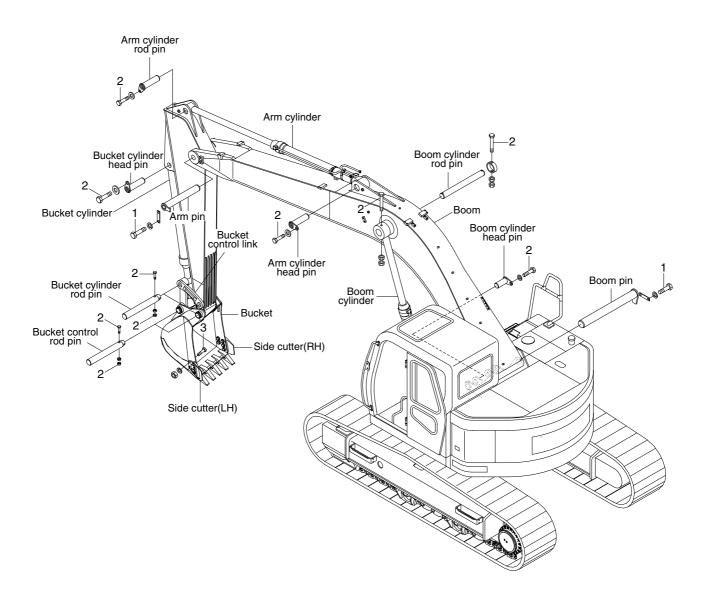
4. COUNTERWEIGHT AND COVERS MOUNTING



140Z99CM12

Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	12.8±3.0	92.6±21.7
4	M36×3.0	308±46	2228±333

GROUP 7 WORK EQUIPMENT



140Z99CM13

Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M12×1.75	12.8±3.0	92.6±21.7
2	M16×2.0	29.7±4.5	215±32.5
3	M20×2.5	57.9±8.7	419±62.9