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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.

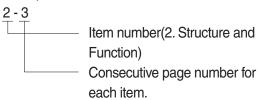
### Filing method

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				<b>(b)</b>			1mm =	0.03937 in
		0	1	2	3	4	5	6	7	8	9
	0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
	10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
	20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
	30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
	40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
							©				
a)	50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
	60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
	70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
	80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
	90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to inches 1mm = 0.03937in

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

Kilogram to Pound 1kg = 2.2046lb

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

Liter to U.S. Gallon 1 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon 1 t = 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

1kgf / cm<sup>2</sup> = 14.2233lbf / in<sup>2</sup>

kgf/	cm <sup>2</sup>	to	lbf/in2
------	-----------------	----	---------

	0 1 14.2 12.2 156.5	28.4	3	4	5	6	7	8	9
		28.4							
1	12.2 156.5		42.7	56.9	71.1	85.3	99.6	113.8	128.0
10 14	150.5	5 170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20 28	34.5 298.7	7 312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30 42	26.7 440.9	9 455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40 56	68.9 583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50 71	11.2 725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60 85	53.4 867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70 99	95.6 1010	1024	1038	1053	1067	1081	1095	1109	1124
80 11	138 1152	1166	1181	1195	1209	1223	1237	1252	1266
90 12	280 1294	1309	1323	1337	1351	1365	1380	1394	1408
	422 1437		1465	1479	1493	1508	1522	1536	1550
	565 1579		1607	1621	1636	1650	1664	1678	1693
	707 1721		1749	1764	1778	1792	1806	1821	1835
	849 2863		1892	1906	1920	1934	1949	1963	1977
140 19	991 2005	2020	2034	2048	2062	2077	2091	2105	2119
150 01	104 0140	0100	0170	0400	0005	0010	0000	0047	0000
	134 2148 276 2290		2176	2190 2333	2205 2347	2219	2233 2375	2247	2262 2404
	276 2290 418 2432		2318 2460	2475	2489	2361 2503	2518	2389 2532	2546
					2631				
180 25	560 2574	2589	5603	2617	2031	2646	2660	2674	2688
200 28	845 2859	2873	2887	2901	2916	2930	2944	2958	2973
	987 3001		3030	3044	3058	3072	3086	3101	3115
	129 3143		3172	3186	3200	3214	3229	3243	3257
230 32	271 3286	3300	3314	3328	3343	3357	3371	3385	3399
240 34	414 3428		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

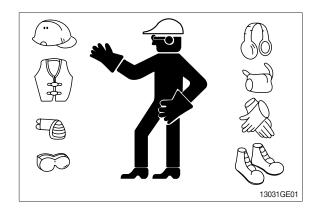
## **GROUP 1 SAFETY**

### FOLLOW SAFE PROCEDURE

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

#### WEAR PROTECTIVE CLOTHING

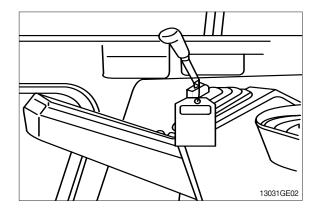
Wear close fitting clothing and safety equipment appropriate to the job.



#### 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.



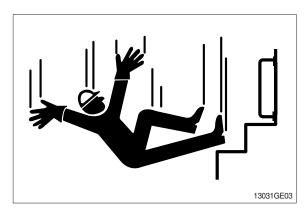
#### **USE HANDHOLDS AND STEPS**

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.

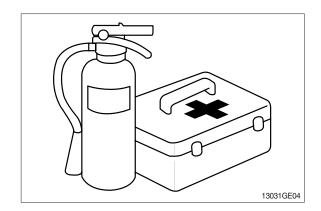


#### PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

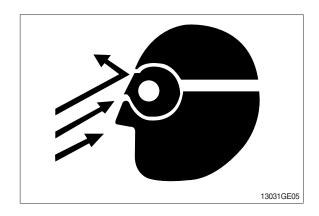
Keep a first aid kit and fire extinguisher handy.

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



#### PROTECT AGAINST FLYING DEBRIS

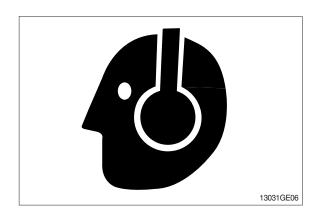
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



### PROTECT AGAINST NOISE

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

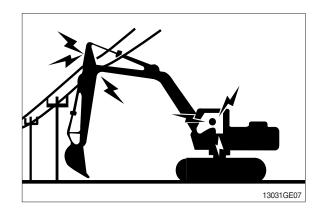
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



#### **AVOID POWER LINES**

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

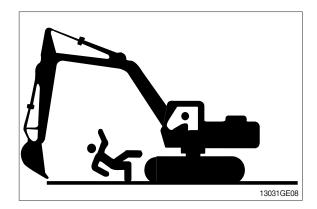
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



#### 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.

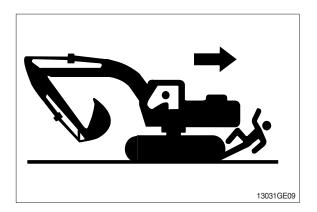


#### MOVE AND OPERATE MACHINE SAFELY

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.

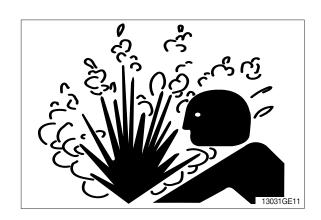
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



### SERVICE COOLING SYSTEM SAFELY

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

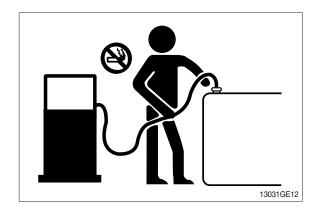
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



#### 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.

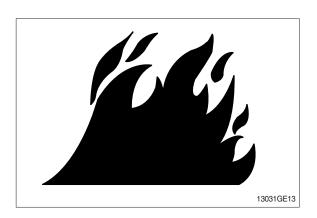
Fill fuel tank outdoors.



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.

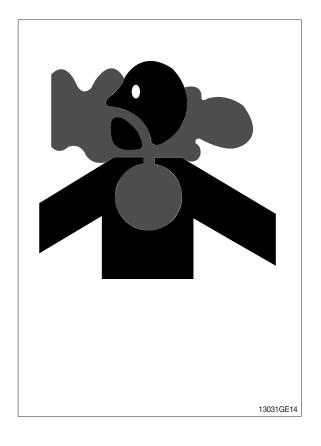
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

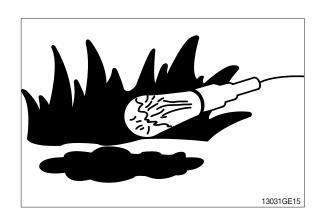
Remove paint before welding or heating:

- 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 WORK AREA SAFELY

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

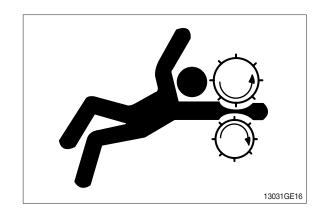




#### SERVICE MACHINE SAFELY

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

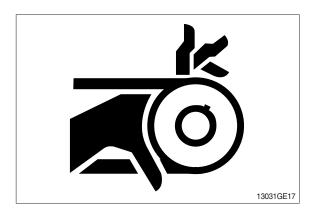
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



#### STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



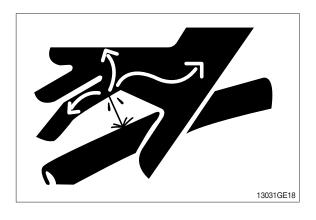
### **AVOID HIGH PRESSURE FLUIDS**

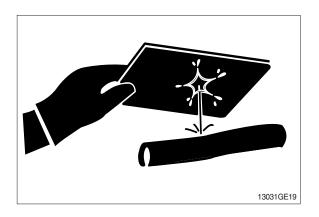
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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





# AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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



#### PREVENT BATTERY EXPLOSIONS

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

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

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



#### PREVENT ACID BURNS

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

#### Avoid the hazard by:

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

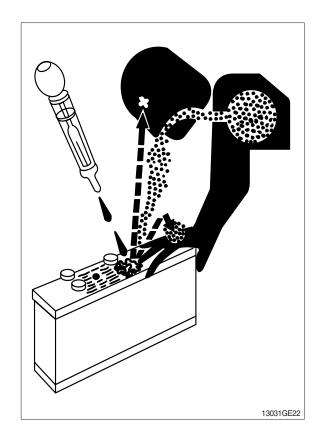
#### **USE TOOLS PROPERLY**

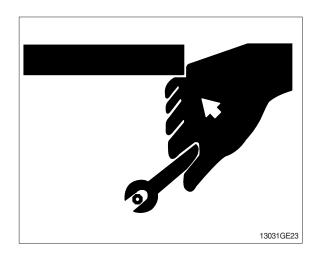
Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

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.)



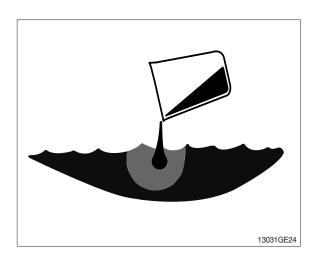


### **DISPOSE OF FLUIDS PROPERLY**

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.

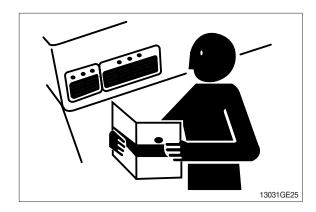
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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.

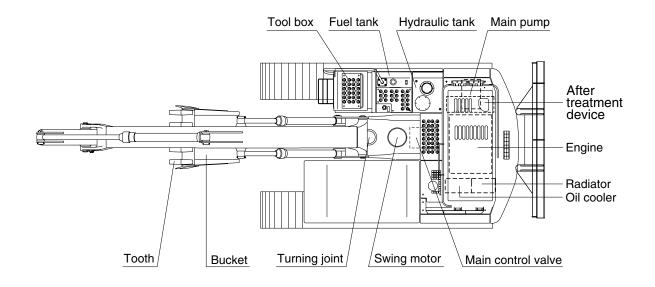


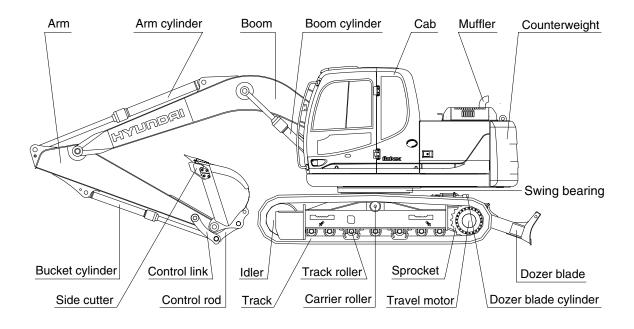
#### LIVE WITH SAFETY

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



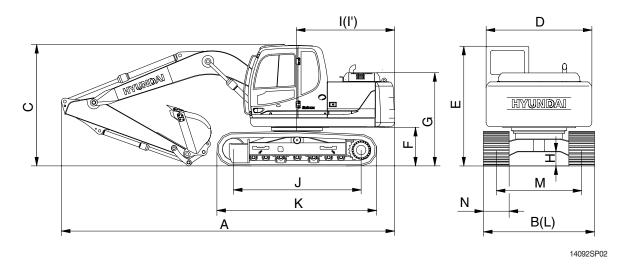


1409A2SP01

# 2. SPECIFICATIONS

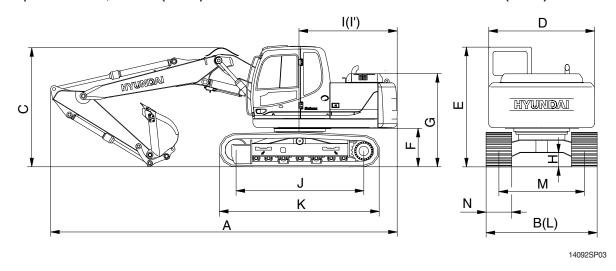
# 1) R140LC-9A

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



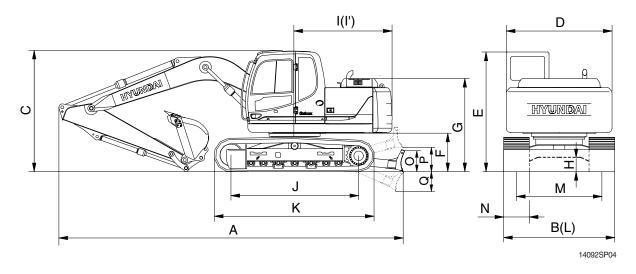
Description		Unit	Specification
Operating weight		kg (lb)	13980 (30820)
Bucket capacity (SAE heaped), standard		m³ (yd³)	0.58 (0.76)
Overall length	А		7810 (25' 7")
Overall width, with 600 mm shoe	В		2600 (8' 6")
Overall height	С		2780 (9' 1")
Superstructure width	D		2500 (8' 2")
Overall height of cab	E		2860 (9' 4")
Ground clearance of counterweight	F		935 (3' 1")
Engine cover height	G		2200 (7' 3")
Minimum ground clearance	Н	mm (ft-in)	440 (1' 5")
Rear-end distance	Rear-end distance		2280 (7' 6")
Rear-end swing radius	l'		2310 (7' 7")
Distance between tumblers	J		3000 (9' 10")
Undercarriage length	K		3750 (12' 4")
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)	0.36 (5.12)
Max traction force		kgf (lbf)	13300 (29320)

# 2) R140LC-9A, 4.90 m (16' 1") HYDRAULIC ADJUSTABLE BOOM and 2.10 m (6' 11") ARM



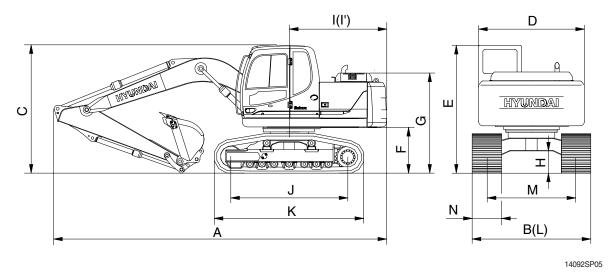
Description		Unit	Specification	
Operating weight		kg (lb)	13980 (30860)	
Bucket capacity (SAE heaped), standard		m³ (yd³)	0.58 (0.76)	
Overall length	Α		8170 (26' 8")	
Overall width, with 600 mm shoe	В		2600 (8' 6")	
Overall height	С		2940 (9' 8")	
Superstructure width	D		2500 (8' 2")	
Overall height of cab	Е		2860 (9' 4")	
Ground clearance of counterweight	F		935 (3' 1")	
Engine cover height	G		2200 (7' 3")	
Minimum ground clearance	Minimum ground clearance H		440 (1' 5")	
Rear-end distance	I		2280 (7' 6")	
Rear-end swing radius	Į'		2310 (7' 7")	
Distance between tumblers	J		3000 (9' 10")	
Undercarriage length	K		3750 (12' 4")	
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)	0.36 (5.12)	
Max traction force		kgf (lbf)	13300 (29320)	

# 3) R140LCD-9A



Description		Unit	Specification
Operating weight		kg (lb)	14800 (32630)
Bucket capacity (SAE heaped), standard		m³ (yd³)	0.58 (0.76)
Overall length	А		8210 (26' 11")
Overall width, with 600 mm shoe	В		2600 (8' 6")
Overall height	С		2780 (9' 1")
Superstructure width	D		2500 (8' 2")
Overall height of cab	E		2860 (9' 4")
Ground clearance of counterweight	F		935 (3' 1")
Engine cover height	G		2200 (7' 3")
Minimum ground clearance	Н		440 (1' 5")
Rear-end distance	I	mm (ft-in)	2280 (7' 6")
Rear-end swing radius	Rear-end swing radius		2310 (7' 7")
Distance between tumblers	J	-	3000 (9' 10")
Undercarriage length	K		3750 (12' 4")
Undercarriage width	L		2600 (8' 6")
Track gauge	М		2000 (6' 7")
Track shoe width, standard	N		600 (24")
Height of blade	0		550 (1' 8")
Ground clearance of blade up	Р		560 (1' 8")
Depth of blade down	Q		500 (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 (600 mm shoe)		kgf/cm²(psi)	0.38 (5.40)
Max traction force		kgf (lbf)	13300 (29320)

# 4) R140LCM-9A

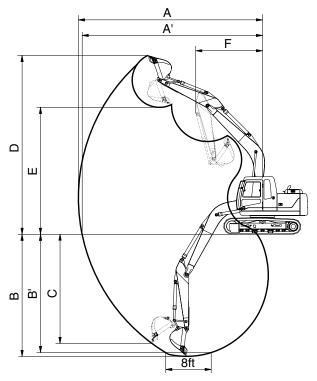


Description		Unit	Specification
Operating weight		kg (lb)	16880 (37210)
Bucket capacity (SAE heaped), standard		m³ (yd³)	0.58 (0.76)
Overall length	А		7790 (25' 6")
Overall width, with 800 mm shoe	В		2840 (9' 4")
Overall height	С		2830 (9' 3")
Superstructure width	D		2500 (8' 2")
Overall height of cab	E		3120 (10' 2")
Ground clearance of counterweight	F		1195 (3' 11")
Engine cover height	G		2460 (8' 1")
Minimum ground clearance	Н	mm (ft-in)	600 (2' 0")
Rear-end distance	Rear-end distance		2280 (7' 6")
Rear-end swing radius	ľ		2310 (7' 7")
Distance between tumblers	J		3030 (9' 6")
Undercarriage length	K		3860 (12' 8")
Undercarriage width	L		2840 (9' 4")
Track gauge	М		2040 (6' 8")
Track shoe width, standard	N		800 (32")
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 (800 mm shoe)		kgf/cm²(psi)	0.32 (4.55)
Max traction force		kgf (lbf)	13300 (29320)

# 3. WORKING RANGE

# 1) R140LC/LCD-9A

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

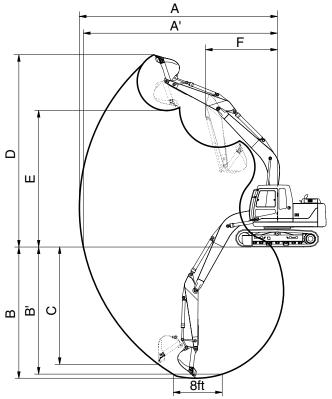


14092SP06

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	7750 mm (25' 5")	7920 mm (25'11")	8330 mm (27' 4")	8790 mm (28'10")
Max digging reach on ground	A'	7600 mm (24'11")	7770 mm (25' 6")	8180 mm (26'10")	8650 mm (28' 4")
Max digging depth	В	4950 mm (16' 2")	5150 mm (16' 10")	5550 mm (18' 3")	6050 mm (19' 10")
Max digging depth (8ft level)	B'	4680 mm (15' 4")	4900 mm (16' 1")	5340 mm (17' 6")	5870 mm (19' 3")
Max vertical wall digging depth	С	4650 mm (15' 3")	4900 mm (16' 1")	5330 mm (17' 6")	5850 mm (19' 2")
Max digging height	D	8100 mm (26' 7")	8180 mm (26' 10")	8500 mm (27'11")	8780 mm (28' 10")
Max dumping height	Е	5670 mm (18' 7")	5750 mm (18' 10")	6060 mm (19'11")	6330 mm (20' 9")
Min swing radius	F	2630 mm ( 8' 8")	2670 mm ( 8' 9")	2650 mm ( 8' 8")	2680 mm ( 8' 10")
		87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN
	SAE	8900 [9660] kgf	8900 [9660] kgf	8900 [9660] kgf	8900 [9660] kgf
Punket 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

# (2) 4.10 m (13' 5") MONO BOOM

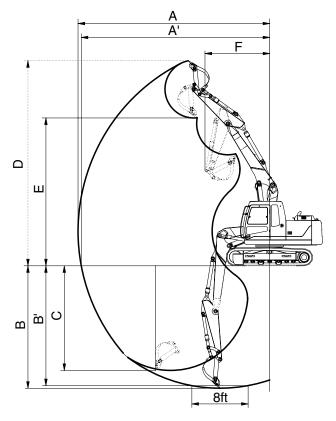


14092SP06

Description		1.90 m (6' 3") Arm	2.10 m (6' 11") Arm
Max digging reach	Α	7260 mm (23' 10")	7420 mm (24' 4")
Max digging reach on ground		7090 mm (23' 3")	7260 mm (23'10")
Max digging depth	В	4540 mm (14' 11")	4740 mm (15' 7")
Max digging depth (8ft level)	B'	4280 mm (14' 1")	4490 mm (14' 9")
Max vertical wall digging depth	С	4240 mm (13' 11")	4350 mm (14' 3")
Max digging height	D	7700 mm (25' 3")	7770 mm (25' 6")
Max dumping height	Е	5260 mm (17' 3")	5340 mm (17' 6")
Min swing radius	F	2350 mm ( 7' 9")	2460 mm ( 8' 1")
		87.3 [94.8] kN	87.3 [94.8] kN
	SAE	8900 [9660] kgf	8900 [9660] kgf
Bucket digging force		19620 [21300] lbf	19620 [21300] lbf
bucket digging force		102 [110.8] kN	102 [110.8] kN
	ISO	10400 [11290] kgf	10400 [11290] kgf
		22930 [24890] lbf	22930 [24890] lbf
		76.5 [83.1] kN	73.6 [79.9] kN
	SAE	7800 [8470] kgf	7500 [8140] kgf
Arm crowd force		17200 [18670] lbf	16530 [17950] lbf
Ann Glowd lorce		80.4 [87.3] kN	77.5 [84.1] kN
	ISO	8200 [8900] kgf	7900 [8580] kgf
		18080 [19630] lbf	17420 [18910] lbf

[ ]: Power boost

# (3) 4.90 m (16' 1") ADJUST BOOM



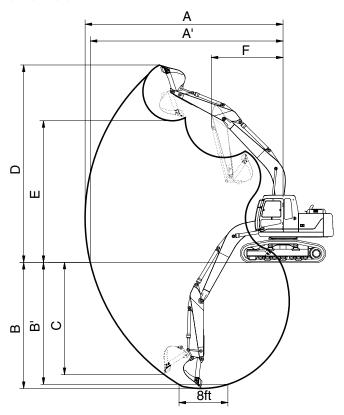
14092SP08

Description		1.90 m (6' 3") Arm	2.10 m (6' 11") Arm	2.50 m ( 8' 2") Arm
Max digging reach	Α	8140 mm (26' 8")	8320 mm (27' 4")	8720 mm (28' 7")
Max digging reach on ground	A'	8000 mm (26' 3")	8180 mm (26'10")	8590 mm (28' 2")
Max digging depth	В	5110 mm (16' 9")	5310 mm (17' 5")	5710 mm (18' 9")
Max digging depth (8ft level)	B'	5000 mm (16' 5")	5190 mm (17' 0")	5610 mm (18' 5")
Max vertical wall digging depth	С	4490 mm (14' 9")	4660 mm (15' 3")	5120 mm (16' 10")
Max digging height	D	8810 mm (28' 11")	8890 mm (29' 2")	9270 mm (30' 5")
Max dumping height	Е	6330 mm (20' 9")	6410 mm (21' 0")	6780 mm (22' 3")
Min swing radius	F	2670 mm ( 8' 9")	2830 mm ( 9' 3")	2690 mm ( 8' 10")
		87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN
	SAE	8900 [9660] kgf	8900 [9660] kgf	8900 [9660] kgf
Puelvet diaging force		19620 [21300] lbf	19620 [21300] lbf	19620 [21300] lbf
Bucket digging force		102 [110.8] kN	102 [110.8] kN	102 [110.8] kN
	ISO	10400 [11290] kgf	10400 [11290] kgf	10400 [11290] kgf
		22930 [24890] lbf	22930 [24890] lbf	22930[24890] lbf
		76.5 [83.1] kN	73.6 [79.9] kN	62.8 [68.2] kN
	SAE	7800 [8470] kgf	7500 [8140] kgf	6400 [6950] kgf
Arm around force		17200 [18670] lbf	16530 [17950] lbf	14110 [15320] lbf
Arm crowd force		80.4 [87.3] kN	77.5 [84.1] kN	65.7 [71.4] kN
	ISO	8200 [8900] kgf	7900 [8580] kgf	6700 [7270] kgf
		18080 [19630] lbf	17420 [18910] lbf	14770 [16040] lbf

[ ]: Power boost

# 2) R140LCM-9A

# (1) 4.6 m (15' 1") MONO BOOM



14092SP09

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	7750 mm (25' 5")	7920 mm (26' 0")	8330 mm (27' 4")	8790 mm (28'10")
Max digging reach on ground	A'	7540 mm (24' 9")	7710 mm (25' 4")	8110 mm (26' 7")	8580 mm (28' 2")
Max digging depth	В	4690 mm (15' 5")	4890 mm (16' 1")	5290 mm (17' 4")	5790 mm (19' 0")
Max digging depth (8ft level)	В'	4420 mm (14' 6")	4640 mm (15' 3")	5080 mm (16' 8")	5610 mm (18' 5")
Max vertical wall digging depth	С	4390 mm (14' 9")	4640 mm (15' 3")	5070 mm (16' 8")	5590 mm (18' 4")
Max digging height	D	8360 mm (27' 5")	8440 mm (27' 8")	8760 mm (28' 9")	9040 mm (29' 7")
Max dumping height	Е	5930 mm (19' 5")	6010 mm (19' 8")	6320 mm (20' 9")	6590 mm (21' 7")
Min swing radius	F	2630 mm ( 8' 8")	2670 mm ( 8' 9")	2650 mm ( 8' 8")	2680 mm ( 8' 10")
		87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN
	SAE	8900 [9660] kgf	8900 [9660] kgf	8900 [9660] kgf	8900 [9660] kgf
Puelset 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
Awar avanual favas		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

# 1) R140LC-9A, R140LCD-9A

ltom	R140	LC-9A	R140LCD-9A		
Item	kg	lb	kg	lb	
Upper structure assembly	5630	12420	+	_	
Main frame weld assembly	1160	2560	+	_	
Engine assembly	540	1190	+	_	
Aftertreatment	30	65	+	_	
Main pump assembly	100	220	+	_	
Main control valve assembly	140	310	+	_	
Swing motor assembly	120	260	+	_	
Hydraulic oil tank assembly	160	350	+	_	
Fuel tank assembly	130	290	+	_	
Counterweight	2000	4410	+	_	
Cab assembly	500	1100	+	_	
Lower chassis assembly	5340	11760	6160	13580	
Track frame weld assembly	1590	3510	1840	4060	
Swing bearing	190	410	+	_	
Travel motor assembly	480	1060	+	_	
Turning joint	50	110	+	_	
Track recoil spring	210	460	+	_	
Idler	250	550	+	_	
Carrier roller	40	90	+	_	
Track roller	490	1080	+	_	
Track-chain assembly (600 mm standard triple grouser shoe)	1010	2230	+	_	
Dozer blade assembly		-	550	1220	
Front attachment assembly (4.6 m boom, 2.5 m arm, 0.58 m³ SAE heaped bucket)	2420	5330	+	_	
4.6 m boom assembly	830	1830	+	_	
2.5 m arm assembly	435	960	←		
0.58 m³ SAE heaped bucket	480	1060	←		
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	

# 2) R140LCM-9A

lk	R140L	CM-9A
Item	kg	lb
Upper structure assembly	5630	12420
Main frame weld assembly	1160	2560
Engine assembly	540	1190
Aftertreatment	30	65
Main pump assembly	100	220
Main control valve assembly	140	310
Swing motor assembly	120	260
Hydraulic oil tank assembly	160	350
Fuel tank assembly	130	290
Counterweight	2000	4410
Cab assembly	480	1060
Lower chassis assembly	8700	19180
Track frame weld assembly	2180	4810
Swing bearing	190	410
Travel motor assembly	305	670
Turning joint	50	110
Tension cylinder assembly	280	620
Idler assembly	320	710
Carrier roller assembly	200	440
Track roller assembly	700	1540
Track-chain assembly (800 mm standard triple grouser shoe)	1370	3020
Front attachment assembly (4.6 m boom, 2.5 m arm, 0.58 m³ SAE heaped bucket)	2420	5330
4.6 m boom assembly	830	1830
2.5 m arm assembly	435	960
0.58 m³ SAE heaped bucket	480	1060
Boom cylinder assembly	130	290
Arm cylinder assembly	160	350
Bucket cylinder assembly	100	220
Bucket control rod assembly	90	200

### 5. LIFTING CAPACITIES

### 1) R140LC-9A

- (1) 4.60 m (15' 1") boom, 2.50 m (8' 2") arm equipped with 0.58 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.
  - : 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				J		Ů		J		Ū		m (ft)
6.0 m (20.0 ft)	kg lb									*2810 *6190	1920 4230	6.69 (21.9)
4.5 m (15.0 ft)	kg lb							*2770 *6110	2270 5000	2440 5380	1500 3310	7.53 (24.7)
3.0 m (10.0 ft)	kg lb			*4930 *10870	*4930 *10870	*3830 *8440	3570 7870	*3380 *7450	2190 4830	2170 4780	1310 2890	7.95 (26.1)
1.5 m (5.0 ft)	kg lb			*8030 *17700	6240 13760	*5010 *11050	3300 7280	3380 7450	2070 4560	2100 4630	1250 2760	8.03 (26.3)
Ground Line	kg lb			*8780 *19360	5800 12790	5200 11460	3090 6810	3270 7210	1970 4340	2180 4810	1300 2870	7.77 (25.5)
-1.5 m (-5.0 ft)	kg lb	*5740 *12650	*5740 *12650	*9910 *21850	5700 12570	5080 11200	2990 6590	3220 7100	1920 4230	2500 5510	1500 3310	7.15 (23.5)
-3.0 m (-10 ft)	kg lb	*8760 *19310	*8760 *19310	*9040 *19930	5770 12720	5100 11240	3000 6610			3340 7360	2030 4480	6.01 (19.7)
-4.5 m (-15.0 ft)	kg lb			*6590 *14530	6030 13290							, /

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 0.58 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

					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						Ū		J				m (ft)
6.0 m	kg					*3340	*3340			*3170	2350	5.95
(20.0 ft)	lb					*7360	*7360			*6990	5180	(19.5)
4.5 m	kg					*3550	*3550			2820	1760	6.90
(15.0 ft)	lb					*7830	*7830			6220	3880	(22.6)
3.0 m	kg			*6270	*6270	*4440	3510	3480	2170	2480	1520	7.37
(10.0 ft)	lb			*13820	*13820	*9790	7740	7670	4780	5470	3350	(24.2)
1.5 m	kg			*8490	6040	5400	3270	3380	2080	2390	1450	7.45
(5.0 ft)	lb			*18720	13320	11900	7210	7450	4590	5270	3200	(24.4)
Ground	kg			*8230	5790	5200	3100	3300	2000	2510	1520	7.17
Line	lb			*18140	12760	11460	6830	7280	4410	5530	3350	(23.5)
-1.5 m	kg	*6670	*6670	*9690	5800	5140	3050			2960	1810	6.48
(-5.0 ft)	lb	*14700	*14700	*21360	12790	11330	6720			6530	3990	(21.3)
-3.0 m	kg	*10970	*10970	*8330	5930	5220	3110			*3690	2670	5.15
(-10 ft)	lb	*24180	*24180	*18360	13070	11510	6860			*8140	5890	(16.9)

### 2) R140LC-9A, ADJUST BOOM

- (1) 4.90 m (16' 1") adjust boom, 1.90 m (6' 3") arm equipped with 0.58 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.
  - : Rating over-front : Rating over-side or 360 degree

				Load	radius			А	t max. reac	h
Load po	int	3.0 m	(10 ft)	4.5 m	(15 ft)	6.0 m	(20 ft)	Cap	Reach	
height				<b>F</b>		F		P		m (ft)
6.0 m	kg			*2900	*2900			*2880	2010	6.45
(20.0 ft)	lb			*6390	*6390			*6350	4430	(21.2)
4.5 m	kg			*3280	*3280	*3150	2220	2530	1540	7.33
(15.0 ft)	lb			*7230	*7230	*6940	4890	5580	3400	(24.0)
3.0 m	kg	*6420	*6420	*4230	3440	3470	2130	2240	1340	7.76
(10.0 ft)	lb	*14150	*14150	*9330	7580	7650	4700	4940	2950	(25.5)
1.5 m	kg			5310	3160	3340	2020	2170	1280	7.84
(5.0 ft)	lb			11710	6970	7360	4450	4780	2820	(25.7)
Ground	kg	*5430	*5430	5110	2980	3240	1930	2270	1340	7.58
Line	lb	*11970	*11970	11270	6570	7140	4250	5000	2950	(24.9)
-1.5 m	kg	*9210	5620	5050	2940	3220	1900	2630	1570	6.93
(-5.0 ft)	lb	*20300	12390	11130	6480	7100	4190	5800	3460	(22.7)
-3.0 m	kg	*8450	5780	5130	3000					,
(-10 ft)	lb	*18630	12740	11310	6610					

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) 4.90 m  $(16'\ 1")$  adjust boom, 2.10 m  $(6'\ 11")$  arm equipped with 0.58 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

				Load	radius			А	t max. reac	h
Load po	int	3.0 m	(10 ft)	0 ft) 4.5 m		6.0 m	(20 ft)	Capacity		Reach
height				<b>F</b>				P		m (ft)
6.0 m	kg			*2690	*2690			*2760	1900	6.68
(20.0 ft)	lb			*5930	*5930			*6080	4190	(21.9)
4.5 m	kg			*3080	*3080	*2990	2230	2420	1470	7.52
(15.0 ft)	lb			*6790	*6790	*6590	4920	5340	3240	(24.7)
3.0 m	kg	*5930	*5930	*4030	3460	*3360	2140	2150	1280	7.94
(10.0 ft)	lb	*13070	*13070	*8880	7630	*7410	4720	4740	2820	(26.0)
1.5 m	kg			*5140	3160	3340	2010	2080	1220	8.02
(5.0 ft)	lb			*11330	6970	7360	4430	4590	2690	(26.3)
Ground	kg	*5690	5540	5090	2960	3230	1910	2170	1270	7.77
Line	lb	*12540	12210	11220	6530	7120	4210	4780	2800	(25.5)
-1.5 m	kg	*8930	5560	5020	2900	3190	1870	2490	1470	7.14
(-5.0 ft)	lb	*19690	12260	11070	6390	7030	4120	5490	3240	(23.4)
-3.0 m	kg	*8650	5690	5070	2950					
(-10 ft)	lb	*19070	12540	11180	6500					

### 3) R140LCD-9A

- (1) 4.60 m (15' 1") boom, 1.9 m (6' 3") arm equipped with 0.58 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.
  - : Rating over-front : Rating over-side or 360 degree

					Load	adius				At	ch	
Load point height		1.5 m	(5 ft)	3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		Capacity		Reach
				H				H				m (ft)
6.0 m	kg					*3340	*3340			*3170	2490	5.95
(20.0 ft)	lb					*7360	*7360			*6990	5490	(19.5)
4.5 m	kg					*3550	*3550			3070	1870	6.90
(15.0 ft)	lb					*7830	*7830			6770	4120	(22.6)
3.0 m	kg			*6270	*6270	*4440	3700	3780	2300	2710	1620	7.37
(10.0 ft)	lb			*13820	*13820	*9790	8160	8330	5070	5970	3570	(24.2)
1.5 m	kg			*8490	6380	*5520	3460	3680	2210	2610	1550	7.45
(5.0 ft)	lb			*18720	14070	*12170	7630	8110	4870	5750	3420	(24.4)
Ground	kg			*8230	6130	5650	3290	3590	2130	2750	1630	7.17
Line	lb			*18140	13510	12460	7250	7910	4700	6060	3590	(23.5)
-1.5 m	kg	*6670	*6670	*9690	6140	5590	3240			3230	1930	6.48
(-5.0 ft)	lb	*14700	*14700	*21360	13540	12320	7140			7120	4250	(21.3)
-3.0 m	kg	*10970	*10970	*8330	6270	*5520	3300			*3690	2830	5.15
(-10 ft)	lb	*24180	*24180	*18360	13820	*12170	7280			*8140	6240	(16.9)

Note 1. Lifting

- 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, 2.50 m (8' 2") arm equipped with 0.58 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

				Load r	adius				At	max. rea	ch
Load point	1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		Capacity		Reach
height					<b>F</b>				F		m (ft)
6.0 m kg (20.0 ft) lb									*2810 *6190	2040 4500	6.69 (21.9)
4.5 m kg (15.0 ft) lb							*2770 *6110	2410 5310	2660 5860	1600 3530	7.53 (24.7)
3.0 m kg (10.0 ft) lb			*4930 *10870	*4930 *10870	*3830 *8440	3770 8310	*3380 *7450	2320 5110	2380 5250	1400 3090	7.95 (26.1)
1.5 m kg (5.0 ft) lb			*8030 *17700	6580 14510	*5010 *11050	3490 7690	3680 8110	2210 4870	2300 5070	1340 2950	8.03 (26.3)
Ground kg Line lb			*8780 *19360	6140 13540	5640 12430	3280 7230	3570 7870	2110 4650	2400 5290	1400 3090	7.77 (25.5)
-1.5 m kg (-5.0 ft) lb	*5740 *12650	*5740 *12650	*9910 *21850	6040 13320	5530 12190	3180 7010	3510 7740	2060 4540	2730 6020	1610 3550	7.15 (23.5)
-3.0 m kg (-10 ft) lb	*8760 *19310	*8760 *19310	*9040 *19930	6110 13470	5550 12240	3200 7050			*3540 *7800	2170 4780	6.01 (19.7)
-4.5 m kg (-15 ft) lb			*6590 *14530	6370 14040							

### 4) R140LCM-9A

- (1) 4.60 m (15' 1") boom, 1.90 m (6' 3") arm equipped with 0.58 m³ (SAE heaped) bucket and 800 mm (32") triple grouser shoe.
  - : Rating over-front : Rating over-side or 360 degree

					Load	radius				At	max. rea	ch
Load point		1.5 m	(5 ft)	3.0 m	(10 ft)	4.5 m	(15 ft)	6.0 m (20 ft)		Capacity		Reach
heigh	t					Ū						m (ft)
6.0 m	kg					*3310	*3310			*3180	2610	6.16
(20.0 ft)	lb					*7300	*7300			*7010	5750	(20.2)
4.5 m	kg					*3670	*3670	*2830	2640	3200	2050	7.01
(15.0 ft)	lb					*8090	*8090	*6240	5820	7050	4520	(23.0)
3.0 m	kg			*6820	*6820	*4620	4090	*3860	2580	2880	1820	7.41
(10.0 ft)	lb			*15040	*15040	*10190	9020	*8510	5690	6350	4010	(24.3)
1.5 m	kg			*7800	7120	*5680	3850	3930	2480	2820	1770	7.43
(5.0 ft)	lb			*17200	15700	*12520	8490	8660	5470	6220	3900	(24.4)
Ground	kg			*8700	6940	6050	3700	3850	2410	3020	1890	7.09
Line	lb			*19180	15300	13340	8160	8490	5310	6660	4170	(23.3)
-1.5 m	kg	*7330	*7330	*9540	6960	6010	3670			3630	2290	6.31
(-5.0 ft)	lb	*16160	*16160	*21030	15340	13250	8090			8000	5050	(20.7)
-3.0 m	kg			*7950	7130	*5200	3760					
(-10 ft)	lb			*17530	15720	*11460	8290					

Note

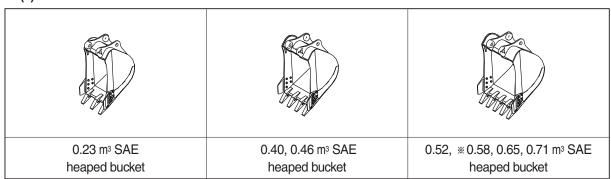
- 1. Lifting capacity are based on SAE J1097 and ISO 10567.
- 2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The load point is a hook located on the back of the bucket.
- 4. \*indicates load limited by hydraulic capacity.
- (2) 4.60 m (15' 1") boom, 2.50 m (8' 2") arm equipped with 0.58 m³ (SAE heaped) bucket and 800 mm (32") triple grouser shoe.

					Load	radius				At	max. rea	ch
Load po		1.5 m	1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		(20 ft)	Capacity		Reach
height				J		Ū		ľ		J		m (ft)
6.0 m (20.0 ft)	kg lb									*2830 *6240	2180 4810	6.87 (22.5)
4.5 m (15.0 ft)	kg lb					*3040 *6700	*3040 *6700	*2930 *6460	2690 5930	2790 6150	1770 3900	7.63 (25.0)
3.0 m	kg			*5460	*5460	*4030	*4030	*3470	2590	2540	1590	7.99
(10.0 ft) 1.5 m	lb kg			*12040 *8460	*12040 7290	*8880 *5200	*8880 3880	*7650 3930	5710 2480	5600 2490	3510 1540	(26.2) 8.01
(5.0 ft)	lb			*18650	16070	*11460	8550	8660	5470	5490	3400	(26.3)
Ground Line	kg lb	*3600 *7940	*3600 *7940	*8880 *19580	6920 15260	6030 13290	3680 8110	3820 8420	2380 5250	2630 5800	1630 3590	7.70 (25.3)
-1.5 m	kg	*6200	*6200	*9840	6850	5940	3600	3780	2340	3050	1900	7.00
(-5.0 ft)	lb	*13670	*13670	*21690	15100	13100	7940	8330	5160	6720	4190	(23.0)
-3.0 m	kg	*9390	*9390	*8770	6960	*5760	3640			*3520	2650	5.74
(-10 ft)	lb	*20700	*20700	*19330	15340	*12700	8020			*7760	5840	(18.8)

### **6. BUCKET SELECTION GUIDE**

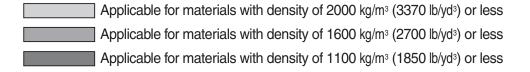
### 1) R140LC-9A, R140LCD-9A

### (1) General bucket



Conc	oit (	Width			Recommendation					
Capa	acity	VVI	ulli	Weight		4.6 m (15	1") boom		4.1 m (13	5") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")	3.0 m arm (9' 10")	1.9 m arm (6' 3")	2.1 m arm (6' 11")
0.23 m <sup>3</sup> (0.30 yd <sup>3</sup> )	0.20 m <sup>3</sup> (0.26 yd <sup>3</sup> )	520 mm (20.5")	620 mm (24.4")	335 kg (740 lb)						
0.40 m <sup>3</sup> (0.52 yd <sup>3</sup> )	0.35 m <sup>3</sup> (0.46 yd <sup>3</sup> )	760 mm (29.9")	860 mm (33.9")	410 kg (900 lb)						
0.46 m <sup>3</sup> (0.60 yd <sup>3</sup> )	0.40 m <sup>3</sup> (0.52 yd <sup>3</sup> )	850 mm (33.5")	950 mm (37.4")	435 kg (960 lb)						
0.52 m <sup>3</sup> (0.68 yd <sup>3</sup> )	0.45 m <sup>3</sup> (0.59 yd <sup>3</sup> )	935 mm (36.8")	1035 mm (40.8")	460 kg (1010 lb)						
* 0.58 m³ (0.76 yd³)	0.50 m <sup>3</sup> (0.65 yd <sup>3</sup> )		1130 mm (44.5")	480 kg (1060 lb)						
0.65 m <sup>3</sup> (0.85 yd <sup>3</sup> )	0.55 m <sup>3</sup> (0.72 yd <sup>3</sup> )	1110 mm (43.7")	1210 mm (47.6")	500 kg (1100 lb)						
0.71 m <sup>3</sup> (0.93 yd <sup>3</sup> )	0.60 m <sup>3</sup> (0.78 yd <sup>3</sup> )	1205 mm (47.4")	1305 mm (51.4")	540 kg (1190 lb)						

#### \* : Standard bucket



### (2) Special bucket



Cond	oit.	Width		Width		Width			Recommendation					
Capa	acity	VVI	ulli	Weight		4.6 m (15	1") boom		4.1 m (13	5") boom				
SAE heaped	CECE heaped	Without side cutter	With side cutter	vvoigin	1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")	3.0 m arm (9' 10")	1.9 m arm (6' 3")	2.1 m arm (6' 11")				
★0.45 m³ (0.59 yd³)		1520 mm (59.8")	-	410 kg (900 lb)										
⊙0.55 m³ (0.72 yd³)		1800 mm (70.9")	-	585 kg (1290 lb)										

★ : Ditch cleaning bucket⊙ : Slope finishing bucket

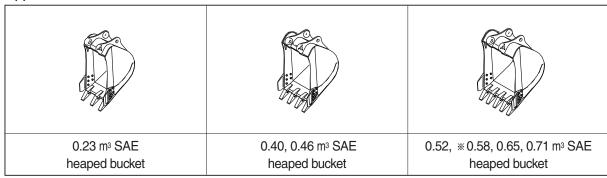
Applicable for materials with density of 2000 kgf/m³ (3370 lbf/yd³) or less

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

### 2) R140LC-9A, ADJUST BOOM

### (1) General bucket



Сар	acity	Width			4	Recommendation 4.9 m (16' 1") boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter	Weight	1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")
0.23 m <sup>3</sup> (0.30 yd <sup>3</sup> )	0.20 m <sup>3</sup> (0.26 yd <sup>3</sup> )	520 mm (20.5")	620 mm (24.4")	335 kg (740 lb)			
0.40 m <sup>3</sup> (0.52 yd <sup>3</sup> )	0.35 m <sup>3</sup> (0.46 yd <sup>3</sup> )	760 mm (29.9")	860 mm (33.9")	410 kg (900 lb)			
0.46 m <sup>3</sup> (0.60 yd <sup>3</sup> )	0.40 m <sup>3</sup> (0.52 yd <sup>3</sup> )	850 mm (33.5")	950 mm (37.4")	435 kg (960 lb)			
0.52 m <sup>3</sup> (0.68 yd <sup>3</sup> )	0.45 m <sup>3</sup> (0.59 yd <sup>3</sup> )	935 mm (36.8")	1035 mm (40.8")	460 kg (1010 lb)			
* 0.58 m³ (0.76 yd³)	0.50 m <sup>3</sup> (0.65 yd <sup>3</sup> )	1030 mm (40.6")	1130 mm (44.5")	480 kg (1060 lb)			
0.65 m <sup>3</sup> (0.85 yd <sup>3</sup> )	0.55 m <sup>3</sup> (0.72 yd <sup>3</sup> )	1110 mm (43.7")	1210 mm (47.6")	500 kg (1100 lb)			
0.71 m <sup>3</sup> (0.93 yd <sup>3</sup> )	0.60 m <sup>3</sup> (0.78 yd <sup>3</sup> )	1205 mm (47.4")	1305 mm (51.4")	540 kg (1190 lb)			

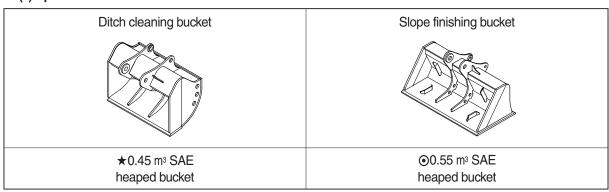
\* : Standard bucket

Applicable for materials with density of 2000 kg/m³ (3370 lb/yd³) or less

Applicable for materials with density of 1600 kg/m³ (2700 lb/yd³) or less

Applicable for materials with density of 1100 kg/m³ (1850 lb/yd³) or less

### (2) Special bucket



Capacity Width		Width		Recommendation					
Сар	acity	VVIGUT		v v i dti i		Weight	4	.9 m (16' 1") boor	m
SAE heaped	CECE heaped	Without side cutter	With side cutter	vvoigni	1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")		
★0.45 m³ (0.59 yd³)	0.40 m <sup>3</sup> (0.52 yd <sup>3</sup> )	1520 mm (59.8")	-	410 kg (900 lb)					
⊙0.55 m³ (0.72 yd³)	0.45 m <sup>3</sup> (0.59 yd <sup>3</sup> )	1800 mm (70.9")	-	585 kg (1290 lb)					

★ : Ditch cleaning bucket⊙ : Slope finishing bucket

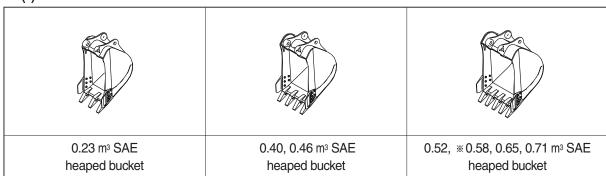
Applicable for materials with density of 2000 kgf/m³ (3370 lbf/yd³) or less

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

### 3) R140LCM-9A

### (1) General bucket



Con	ooit.	١٨/:	dth			Recomm	endation	
Сар	acity	Width		Weight		4.6 m (15'	1") boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter	vveignt	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 <sup>3</sup> (0.30 yd <sup>3</sup> )	0.20 m <sup>3</sup> (0.26 yd <sup>3</sup> )	520 mm (20.5")	620 mm (24.4")	335 kg (740 lb)				
0.40 m <sup>3</sup> (0.52 yd <sup>3</sup> )	0.35 m <sup>3</sup> (0.46 yd <sup>3</sup> )	760 mm (29.9")	860 mm (33.9")	410 kg (900 lb)				
0.46 m <sup>3</sup> (0.60 yd <sup>3</sup> )	0.40 m <sup>3</sup> (0.52 yd <sup>3</sup> )	850 mm (33.5")	950 mm (37.4")	435 kg (960 lb)				
0.52 m <sup>3</sup> (0.68 yd <sup>3</sup> )	0.45 m <sup>3</sup> (0.59 yd <sup>3</sup> )	935 mm (36.8")	1035 mm (40.7")	460 kg (1010 lb)				
* 0.58 m³ (0.76 yd³)	0.50 m <sup>3</sup> (0.65 yd <sup>3</sup> )	1030 mm (40.6")	1130 mm (44.5")	480 kg (1060 lb)				
0.65 m <sup>3</sup> (0.85 yd <sup>3</sup> )	0.55 m <sup>3</sup> (0.72 yd <sup>3</sup> )	1110 mm (43.7")	1210 mm (47.6")	500 kg (1100 lb)				
0.71 m <sup>3</sup> (0.93 yd <sup>3</sup> )	0.60 m <sup>3</sup> (0.78 yd <sup>3</sup> )	1205 mm (47.4")	1305 mm (51.4")	540 kg (1190 lb)				

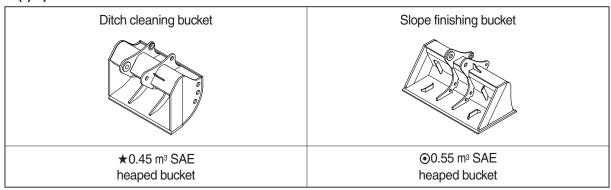
\* : Standard bucket

Applicable for materials with density of 2000 kg/m³ (3370 lb/yd³) or less

Applicable for materials with density of 1600 kg/m³ (2700 lb/yd³) or less

Applicable for materials with density of 1100 kg/m³ (1850 lb/yd³) or less

### (2) Special bucket



Capacity		\			Recommendation			
Сар	acity	Width		Weight	4	.9 m (16' 1") boor	m	
SAE heaped	CECE heaped	Without side cutter	With side cutter	vveignt	1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")	
★0.45 m³ (0.59 yd³)	0.40 m <sup>3</sup> (0.52 yd <sup>3</sup> )	1520 mm (59.8")	-	410 kg (900 lb)				
⊙0.55 m³ (0.72 yd³)	0.45 m <sup>3</sup> (0.59 yd <sup>3</sup> )	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

		_		Triple grouser				
Model	Shapes							
	Shoe width	mm (in)	500 (20)	<b>* 600 (24)</b>	700 (28)			
R140LC-9A	Operating weight	kg (lb)	13790 (30400)	13980 (30820)	14210 (31330)			
H 140LC-9A	Ground pressure	kgf/cm² (psi)	0.43 (6.11)	0.36 (5.12)	0.32 (4.55)			
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")			
	Shoe width	mm (in)	500 (20)	× 600 (24)	700 (28)			
R140LCD-9A	Operating weight	kg (lb)	14590 (32160)	14800 (32630)	15030			
N 140LOD-9A	Ground pressure	kgf/cm² (psi)	0.45 (6.40)	0.38 (5.40)	0.33 (4.70)			
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")			
	Shoe width	mm (in)	710 (28)	* 800 (32)	960 (38)			
R140LCM-9A	Operating weight	kg (lb)	16880 (37210)	16880 (37210)	17110 (37720)			
TTHOLONISA	Ground pressure	kgf/cm² (psi)	0.36 (5.12)	0.32 (4.55)	0.27 (3.84)			
	Overall width	mm (ft-in)	2750 (9' 0")	2840 (9' 4")	3000 (9' 10")			

\* : Standard

### 3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Qua	ntity	
item	R140LC/LCD-9A	R140LCM-9A	
Carrier rollers	1 EA	2 EA	
Track rollers	7 EA	7 EA	
Track shoes	46 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
600 mm triple grouser	Standard	А
500 mm triple grouser	Option	А
700 mm triple grouser	Option	В
710 mm triple grouser	R140LCM-9A only	В
810 mm triple grouser	R140LCM-9A only	В
960 mm single grouser	R140LCM-9A only	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	<ul> <li>These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees</li> <li>Travel at high speed only on flat ground</li> <li>Travel slowly at low speed if it is impossible to avoid going over obstacles</li> </ul>

### 8. SPECIFICATIONS FOR MAJOR COMPONENTS

### 1) ENGINE

Item	Specification
Model	Perkins 1204E
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 $\times$ stroke	105 × 127 mm (4.1" × 5.0")
Piston displacement	4400 cc (269 cu in)
Compression ratio	16.5 : 1
Rated gross horse power (SAE J1995)	124 Hp (92.7 kW) at 1950 rpm
Maximum torque	54 kgf · m (391 lbf · ft) at 1400 rpm
Engine oil quantity	10.5 l (2.8 U.S. gal)
Dry weight	507 kg (1118 lb)
High idling speed	$2000\pm50~\text{rpm}$
Low idling speed	$800\pm100~\text{rpm}$
Rated fuel consumption	163 g/Hp · hr at 1950 rpm
Starting motor	24 V-4.5 kW
Alternator	24 V-85 A
Battery	2 × 12 V × 100 Ah

### 2) MAIN PUMP

Item	Specification
Туре	Variable displacement axial 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 ½ /min (32.6 U.S. gpm / 27.2 U.K. gpm)
Rated speed	1900 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	28.5 ½ /min (7.5 U.S. gpm / 6.3 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 (3698 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	Minimum 30 kgf ⋅ m (217 lbf ⋅ ft)
Brake release pressure	15~50 kgf/cm² (213~711 psi)
Reduction gear type	2 - stage planetary

## 6) TRAVEL MOTOR

Item	Specification				
item	Type 1	Type 1 Type 2			
Туре	Variable displacement axial piston motor				
Relief pressure	350 kgf/cm² (4980 psi) 365 kgf/cm² (5190 psi) 350 kgf/cm² (4				
Capacity (max / min)	77/45 cc/rev 76.6/44.6 cc/rev 77/44.5 cc				
Reduction gear type	2-stage planetary				
Braking system	Automatic, spring applied hydraulic released				
Brake release pressure	9.5 kgf/cm² (135 psi) 8.75 kgf/cm² (125 psi) 14.3 kgf/cm² (205 ps				
Braking torque	Min. 19.7 kgf · m (140 lbf · ft)				

### 7) CYLINDER

Item		Specification
Doom culindor	Bore dia $\times$ Rod dia $\times$ Stroke	Ø 105 × Ø 75 × 1075 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
Dualect culinder	Bore dia $\times$ Rod dia $\times$ Stroke	Ø 100 × Ø 70 × 840 mm
Bucket cylinder	Cushion	Extend only
Dozor gulindor (ont)	Bore dia $\times$ Rod dia $\times$ Stroke	ø 100 × ø 70 × 250 mm
Dozer cylinder (opt)	Cushion	-
Adjust adjuder (ept)	Bore dia $\times$ Rod dia $\times$ Stroke	Ø 145 × Ø 90 × 613 mm
Adjust cylinder (opt)	Cushion	Extend only
Adjust been adjuden (ept)	Bore dia $\times$ Rod dia $\times$ Stroke	ø 105× ø 75× 975 mm
Adjust boom cylinder (opt)	Cushion	Extend only

<sup>\*</sup> 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		600 mm (24")	0.36 kgf/cm² (5.12 psi)	46	2600 mm ( 8' 6")
R140LC-9A	Ontion	500 mm (20")	0.43 kgf/cm² (6.11 psi)	46	2500 mm ( 8' 2")
	Option	700 mm (28")	0.31 kgf/cm² (4.41 psi)	46	2700 mm ( 8' 10")
	Standard	600 mm (24")	0.38 kgf/cm² (5.40 psi)	46	2600 mm ( 8' 6")
R140LCD-9A	Option	500 mm (20")	0.45 kgf/cm² (6.40 psi)	46	2500 mm ( 8' 2")
		700 mm (28")	0.33 kgf/cm² (4.70 psi)	46	2700 mm ( 8' 10")
	Standard	800 mm (32")	0.32 kgf/cm² (4.55 psi)	47	2840 mm ( 9' 4")
R140LCM-9A	Option	710mm (28")	0.36 kgf/cm² (5.12 psi)	47	2850 mm ( 9' 0")
		960mm (38")	0.27 kgf/cm² (3.84 psi)	47	3000 mm ( 9' 10")

### 9) BUCKET

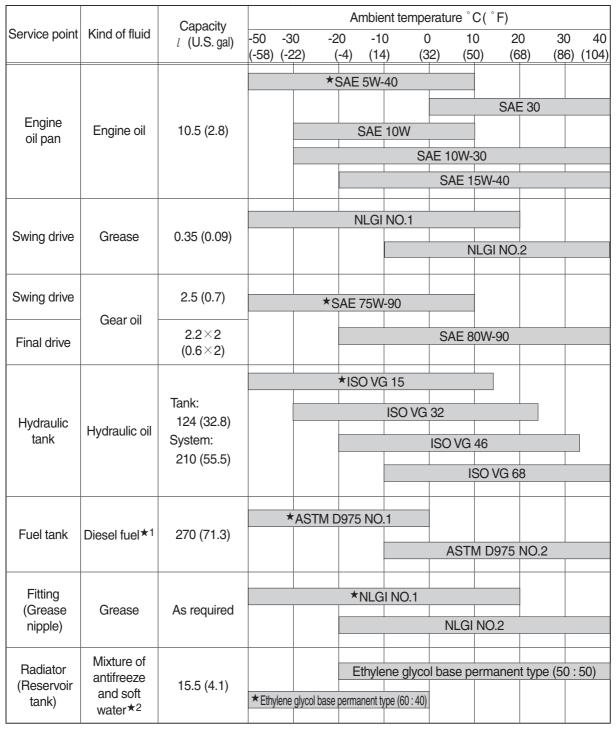
Item		Capacity		Tooth	Width	
		SAE heaped	CECE heaped	CECE heaped quantity		With side cutter
	Standard	* 0.58 m³ (0.76 yd³)	0.50 m <sup>3</sup> (0.65 yd <sup>3</sup> )	5	1000 mm (39.4")	1100 mm (43.3")
		0.23 m³ (0.30 yd³)	0.20 m³ (0.26 yd³)	3	520 mm (20.5")	620 mm (24.4")
		0.40 m³ (0.52 yd³)	0.35 m³ (0.46 yd³)	4	750 mm (29.5")	850 mm (33.5")
		0.46 m <sup>3</sup> (0.60 yd <sup>3</sup> )	0.40 m³ (0.52 yd³)	4	840 mm (33.1")	940 mm (37.0")
R140LC-9A	Ontion	0.52 m³ (0.68 yd³)	0.45 m³ (0.59 yd³)	5	915 mm (36.0")	1015 mm (40.0")
	Option	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 <sup>3</sup> (0.78 yd <sup>3</sup> )	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

<sup>\*</sup> 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 Materia

**UTTO**: Universal Tractor Transmission Oil

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

★2 : Soft water

City water or distilled water

★ : Cold region

Russia, CIS, Mongolia

# SECTION 2 STRUCTURE AND FUNCTION

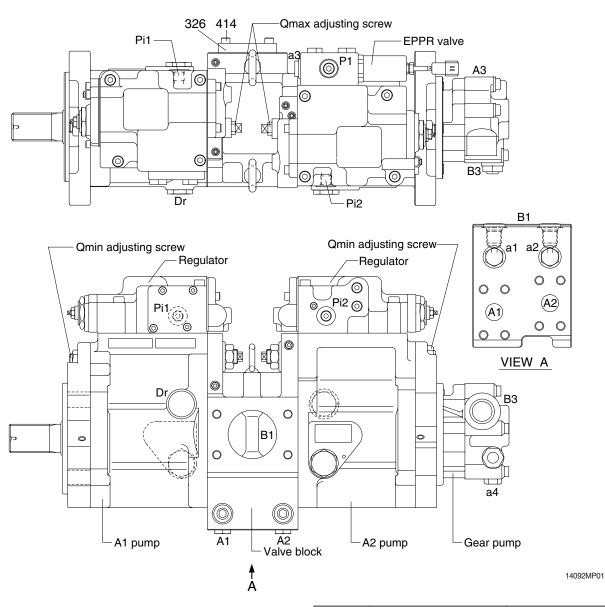
Group	1 Pump Device ·····	2-1
Group	2 Main Control Valve	2-19
Group	3 Swing Device	2-46
Group	4 Travel Device ·····	2-58
Group	5 RCV Lever ·····	2-83
Group	6 RCV Pedal ·····	2-90

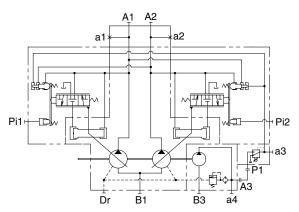
# **SECTION 2 STRUCTURE AND FUNCTION**

# **GROUP 1 PUMP DEVICE**

### 1. STRUCTURE

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

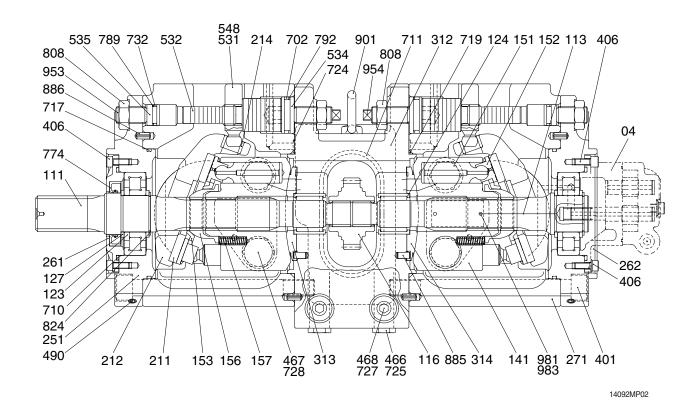




Port	Port name	Port size
A1, A2	Delivery port	SAE6000 psi 3/4"
B1	Suction port	SAE2500 psi 2 1/2"
Dr	Drain port	PF 1/2 - 19
Pi1, Pi2	Pilot port	PF 1/4 - 15
P1	EPPR port	PF 1/4 - 15
a1, a2, a3	Gauge port	PF 1/4 - 15
a4	Gauge port	PF 1/4-14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

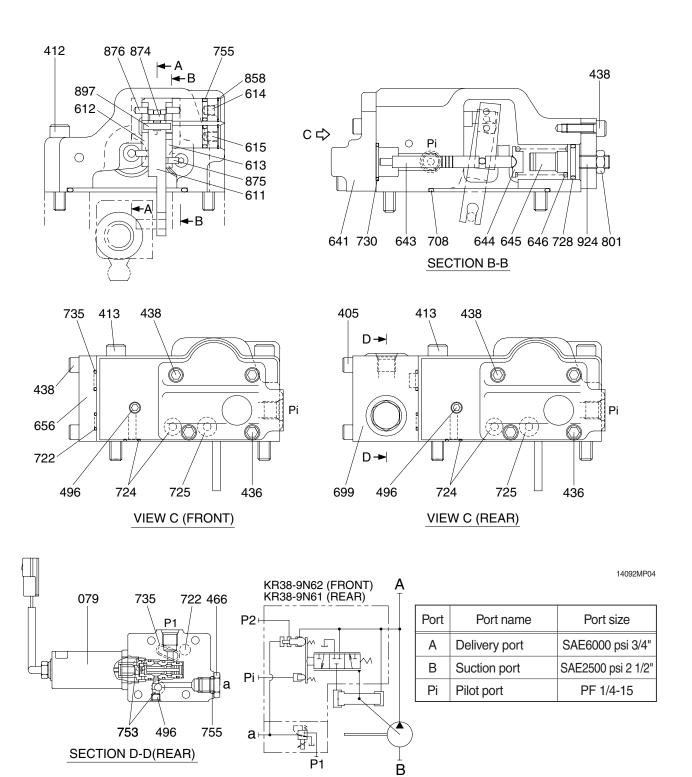
#### 1) MAIN PUMP (1/2)

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

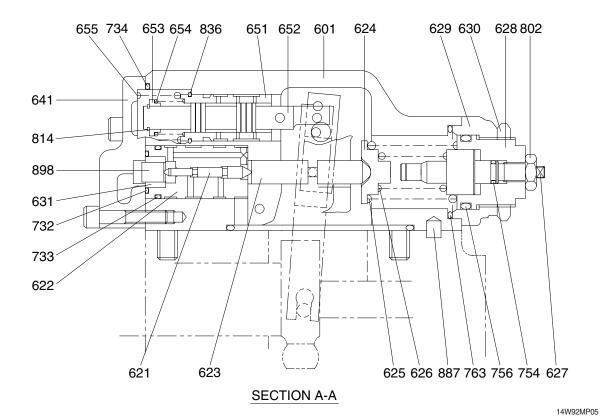


312 Valve block 04 Gear pump 717 O-ring 111 Drive shaft (F) 313 Valve plate (R) 719 O-ring 113 Drive shaft (R) 314 Valve plate (L) 724 O-ring 116 1st Gear 326 Cover 725 O-ring 123 Roller bearing 401 Hexagon socket bolt 727 O-ring 124 Needle bearing 728 O-ring 406 Hexagon socket bolt 127 Bearing spacer 414 Hexagon socket bolt 732 O-ring 141 Cylinder block 466 Plug 774 Oil seal 151 Piston 789 Back up ring 467 plug 468 Plug 152 Shoe 792 Back up ring 153 Set plate 490 Plug 808 Hexagon head nut 156 Bushing 531 Tilting pin 824 Snap ring 157 Cylinder spring 532 Servo piston 885 Pin 211 Shoe plate 534 Stopper (L) 886 Spring pin 212 Swash plate 535 Stopper (S) 901 Eye bolt 214 Bushing 548 Pin 953 Set screw 251 Support 702 O-ring 954 Set screw 981 Plate 261 Seal cover (F) 710 O-ring Pump casing 711 O-ring 983 Pin 271

### 2) **REGULATOR** (1/2)

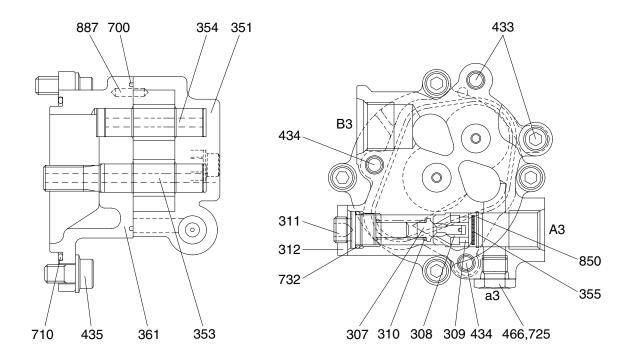


### REGULATOR (2/2)



079	EPPR valve assembly	629	Cover (C)	733	O-ring
405	Hexagon socket screw	630	Lock nut	734	O-ring
412	Hexagon socket screw	631	Sleeve, Pf	735	O-ring
413	Hexagon socket screw	641	Pilot cover	753	O-ring
436	Hexagon socket screw	643	Pilot piston	754	O-ring
438	Hexagon socket screw	644	Spring seat (Q)	755	O-ring
466	Plug	645	Adjust stem (Q)	756	O-ring
496	Plug	646	Pilot spring	763	O-ring
601	Casing	651	Sleeve	801	Nut
611	Feed back lever	652	Spool	802	Nut
612	Lever (1)	653	Spring seat	814	Snap ring
613	Lever (2)	654	Return spring	836	Snap ring
614	Center plug	655	Set spring	858	Snap ring
615	Adjust plug	656	Block cover	874	Pin
621	Compensator piston	699	Valve casing	875	Pin
622	Piston case	708	O-ring	876	Pin
623	Compensator rod	722	O-ring	887	Pin
624	Spring seat (C)	724	O-ring	897	Pin
625	Outer spring	725	O-ring	898	Pin
626	Inner spring	728	O-ring	924	Set screw
627	Adjust stem (C)	730	O-ring		
628	Adjust screw (C)	732	O-ring		

### 3) GEAR PUMP



14092MP06

307	Poppet	353	Drive gear	466	Plug
	Seat		Driven gear		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 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.

#### (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.

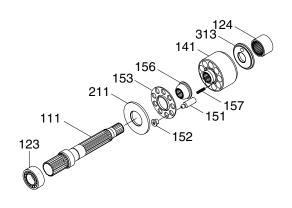
The shoe is caulked to the piston to from a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and the take hydraulic balance so that it slides lightly over the shoe plate (211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush. Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.

#### (2) Swash plate group

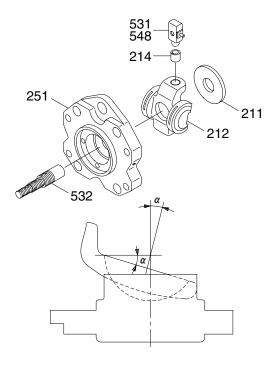
The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

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 and left as hydraulic force controlled by the regulator is admitted 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 ( $\alpha$ )



21092MP06



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#### (3) Valve block group

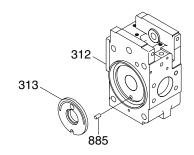
The valve block group consists of valve block (312), valve plate (313) and valve plate pin(885).

The valve plate having two melon-shaped 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.

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 (or 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.



21092MP07

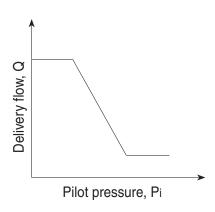
### 2) REGULATOR

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

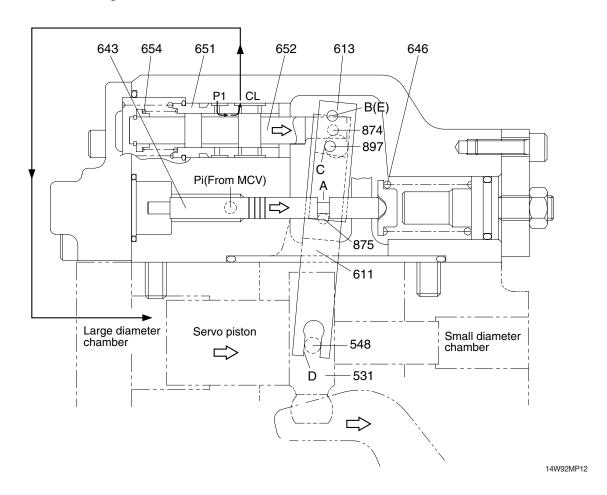
### (1) Negative flow control

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.

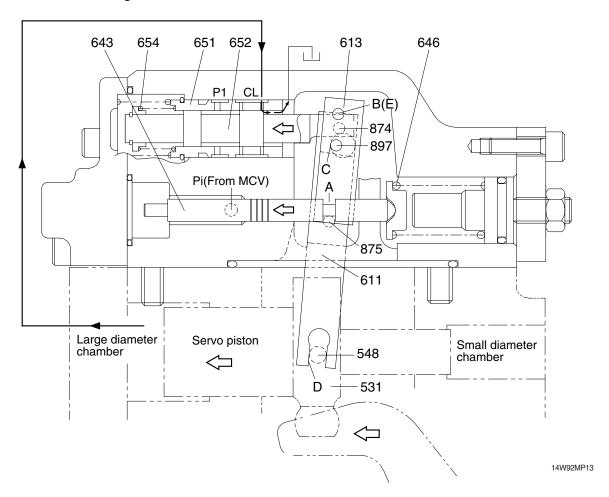
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

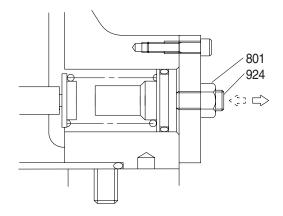
The flow control characteristic can be adjusted with the adjusting screw.

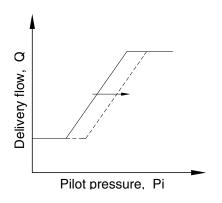
Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

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 screw (924)	Flow change amount				
(min <sup>-1</sup> )	(Turn)	(kgf/cm²)	( l /min)			
1900	+1/4	+1.6	+9			





21092MP11

### (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.

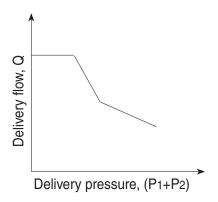
(The input horsepower is constant when the speed is constant.)

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.

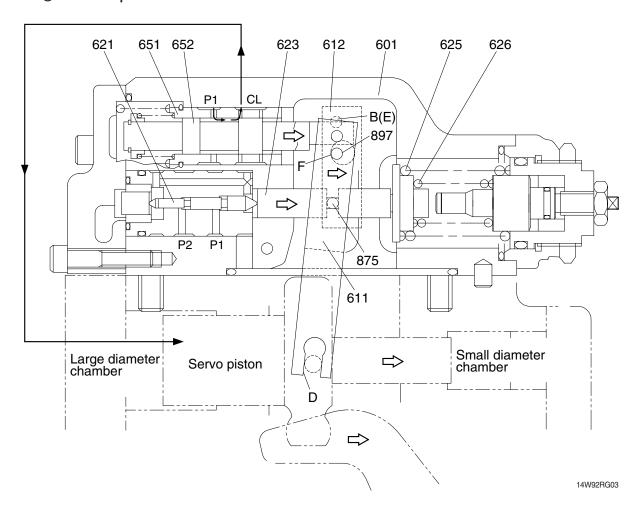
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation:

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

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

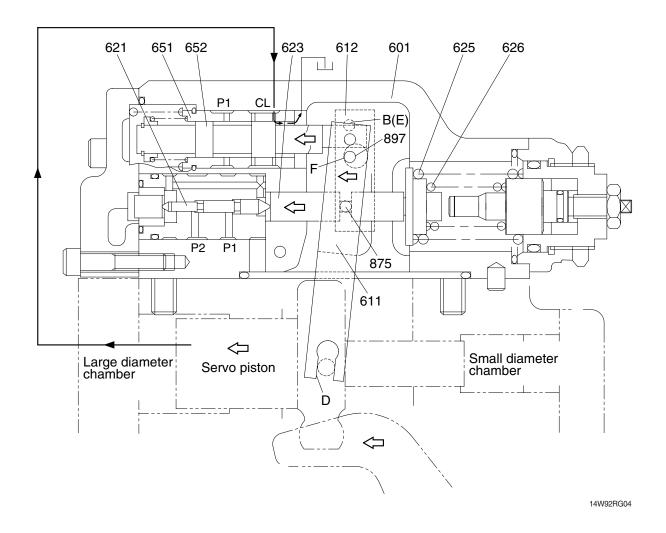


When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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



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.

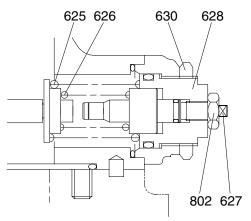
#### a. Adjustment of outer spring

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

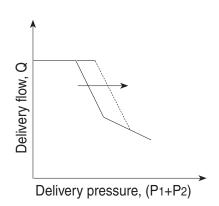
Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C (628) by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by  $N \times A$  turns at first. (A=1.73)

#### \* 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 <sup>-1</sup> )	(Turn)	(kgf/cm²)	(kgf · m)
1900	+1/4	+19.2	+3.4



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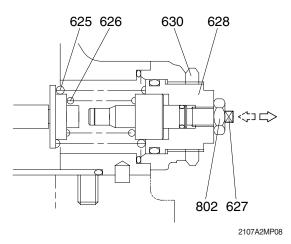
### b. Adjustment of inner spring

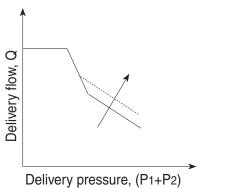
Adjust it by loosening the hexagon nut (802) and by tightening (or loosening) the adjusting stem C (627).

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

### \* Adjusting value

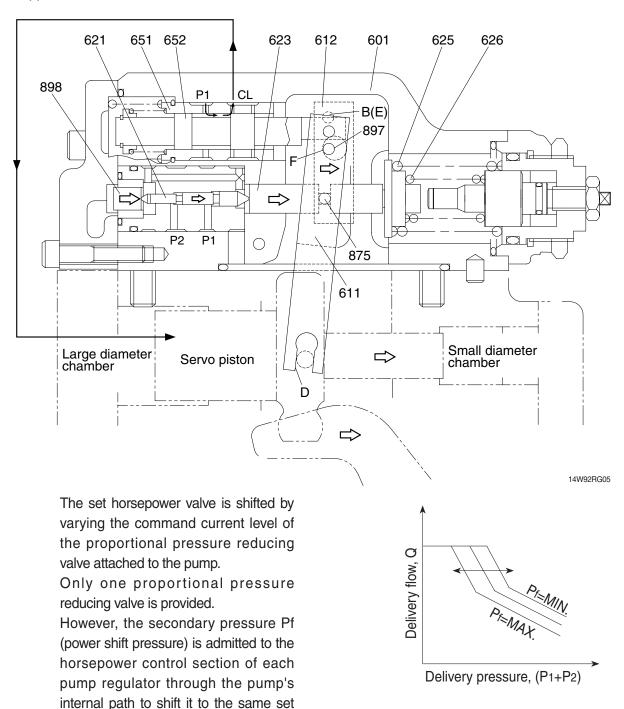
Speed	Adjustment of input horsepower			
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount	
(min <sup>-1</sup> )	(Turn)	( l /min)	(kgf · m)	
1900	+1/4	+8.6	+4.3	





#### (3) Power shift control

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.

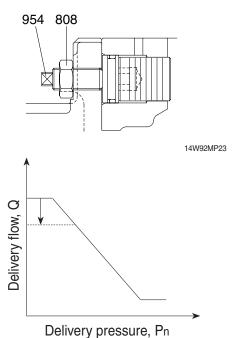
Speed	Adjustment of max flow		
	Tightening amount of adjusting screw (954)	Flow change amount	
(min <sup>-1</sup> )	(Turn)	( l /min)	
1900	+1/4	-3.0	

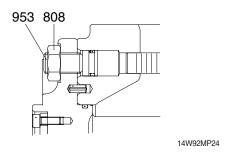


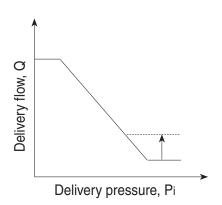
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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 <sup>-1</sup> )	(Turn)	( l /min)	
1900	+1/4	+3.0	

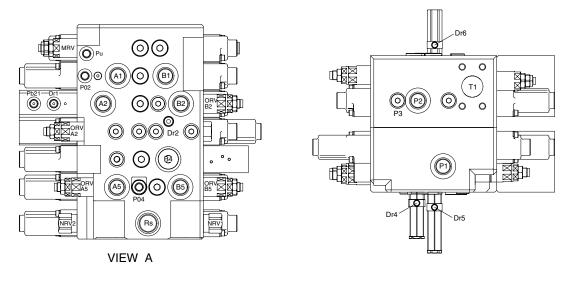


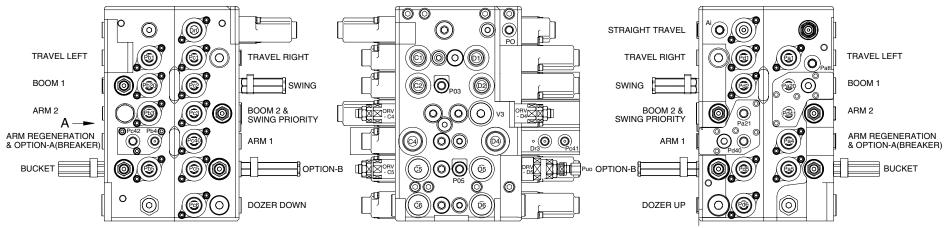


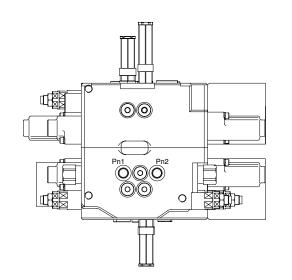


### **GROUP 2 MAIN CONTROL VALVE**

### 1. STRUCTURE

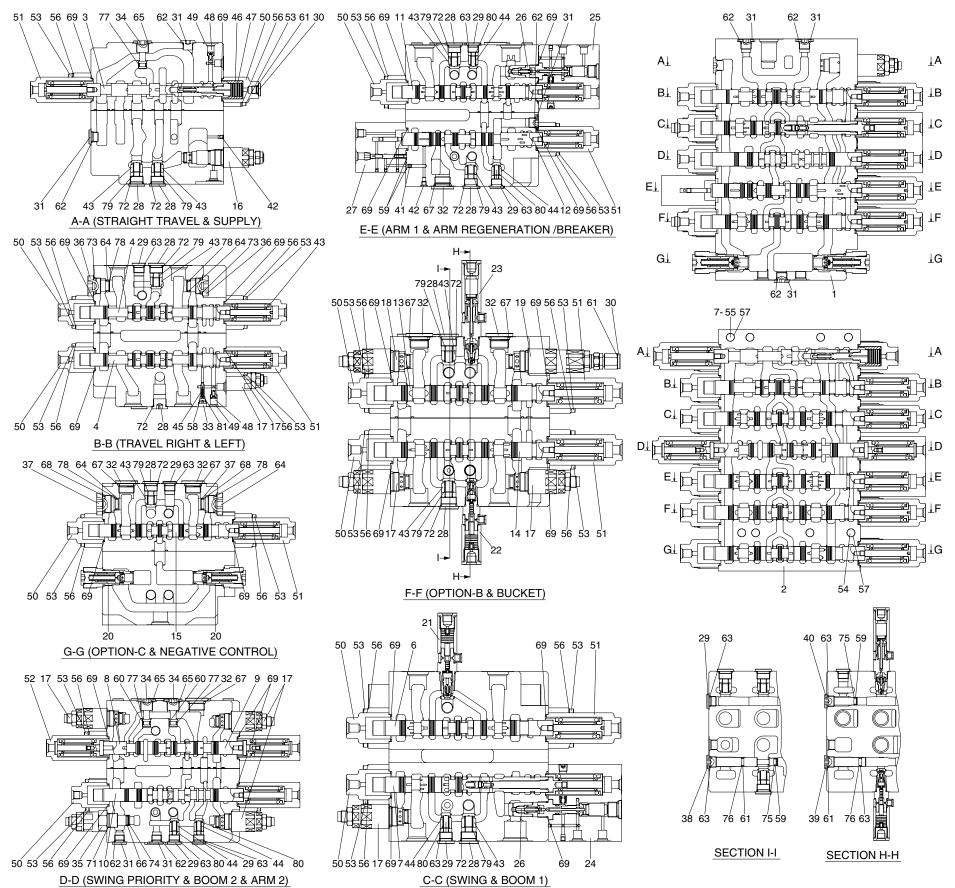






Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	UNF 1 3/16	18 kgf · m (130 lbf · ft)
Pa1 Pb1 Pb1 Pc1 Pd1 Pa20 Pa21 Pb20 Pb21 Pc2 Pb3 Pc3 Pc4 Pc40 Pc41 Pc5 Pc5 Pc5 Pc6 Pd6 Pd Ai Patt Pc2 Pd3 Pc4 Pc7 Pc5 Pc6 Pd6 Pd7	Travel left pilot port (BW) Travel left pilot port (FW) Travel right 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 (LH) 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 pilot port Bucket in pilot port Bucket out 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 Pilot pressure port Drain port (travel straight) Drain port (boom 12 & swing priority) Drain port (arm holding valve)	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Pn1 Pn2	Negative control signal port (P1 port side) Negative control signal port (P2 port side)	PF 3/8	7~8 kgf · m (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



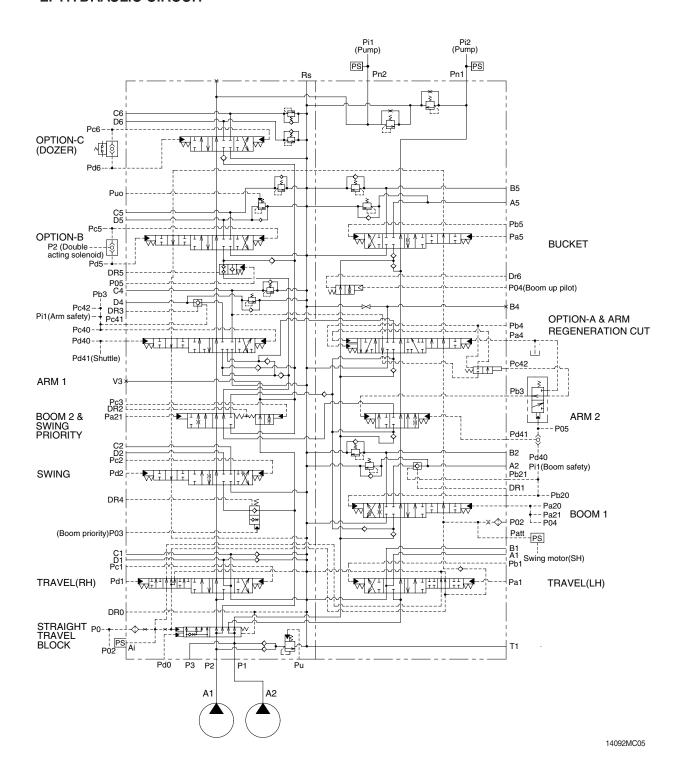
- 1	i lousing-i i	40	Load Check-popper
2	Housing-P2	44	Load check-poppet
3	Spool-straight travel	45	Signal-poppet
4	Spool-travel (LH, RH)	46	Travel straight-sleeve
6	Spool-swing	47	Travel straight-piston
7	Spool-boom 1	48	Orifice signal
8	Spool-swing priority	49	Coin type filter
9	Spool-boom 2	50	Pilot 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



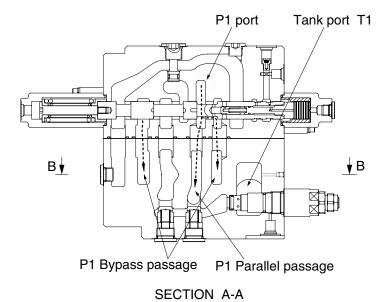
#### 3. FUNCTION

### 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"



P1 Bypass passage

TRAVEL(LH)

BOOM 1

ARM 2

ARM REGEN & OPTION-A

BUCKET

Tank passage

P1 Negative relief valve

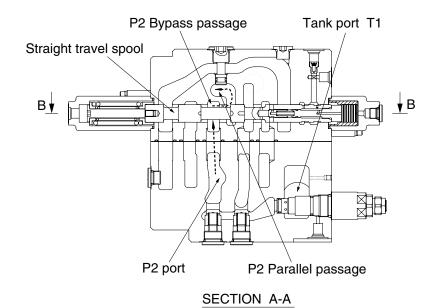
SECTION B-B

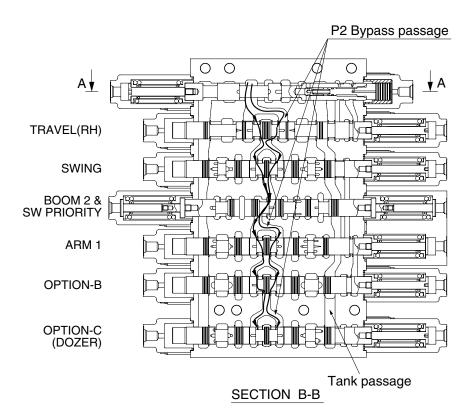
14092MC11

### (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".

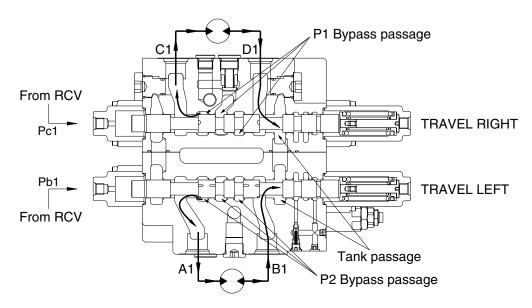




14092MC12

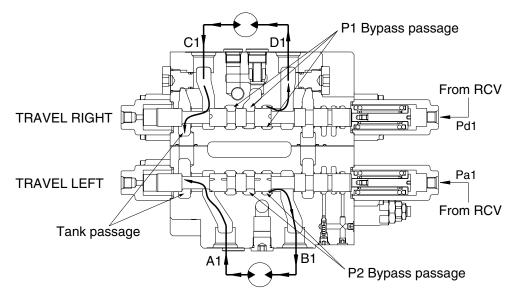
## 2) TRAVEL OPERATION

#### (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.

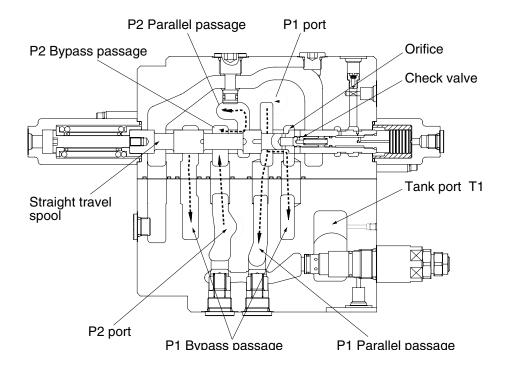
The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pb1, pc1).

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.

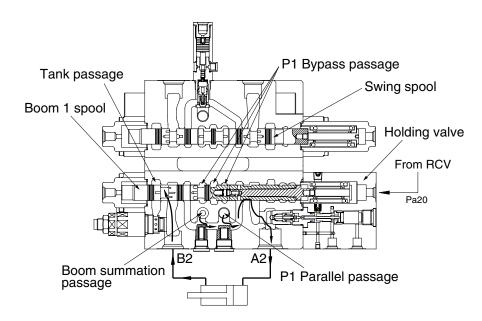
#### 3) BOOM OPERATION

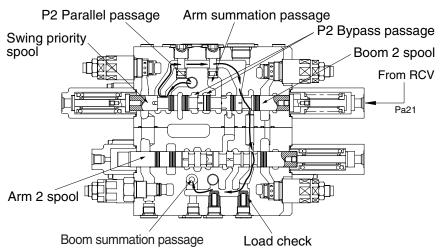
#### (1) BOOM UP OPERATION

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.

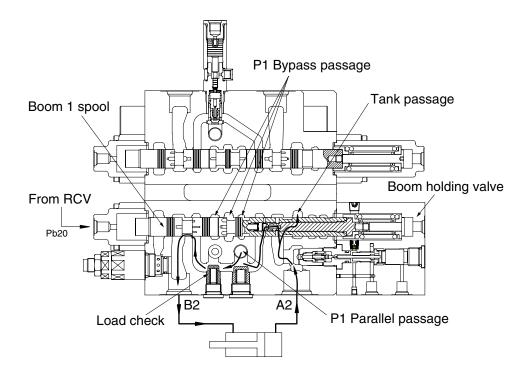
The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check. Following this, it flows into the rod side of the boom cylinder.

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.

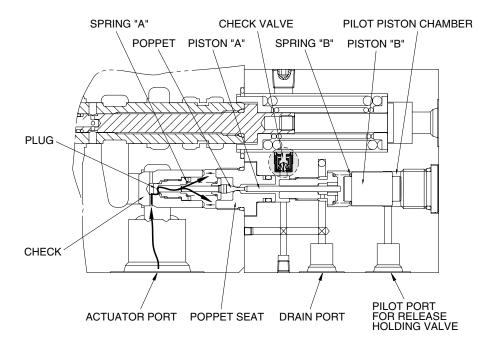


## 4) HOLDING VALVE OPERATION

## (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.

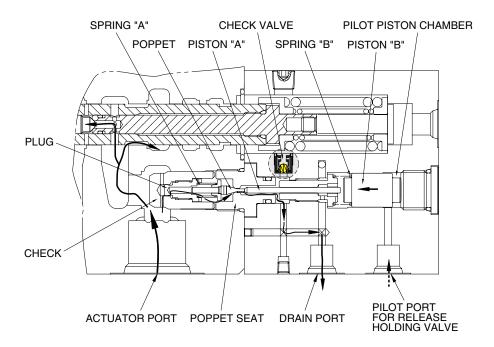


#### (2) RELEASE HOLDING OPERATION

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

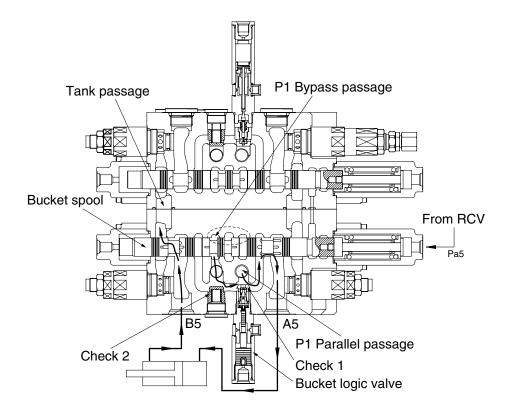
During the bucket in operation, the pilot secondary pressure from RCV is supplied to port Pa5 of the spring side and shifts the bucket spool in the left direction.

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.



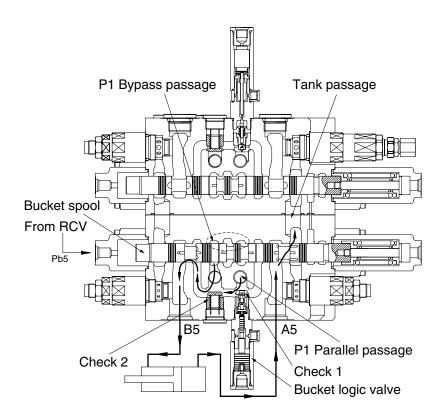
## (2) BUCKET OUT OPERATION

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.

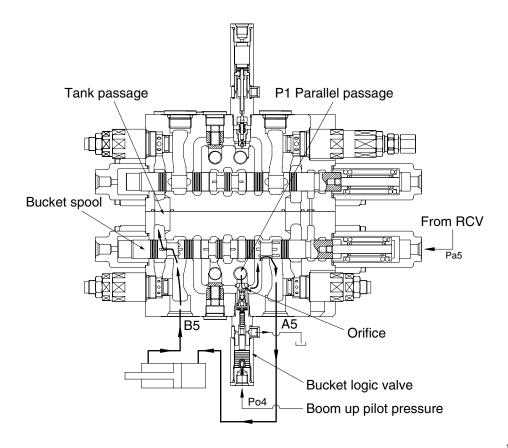
The return flow from the head side of the bucket cylinder returns to the hydraulic oil tank through the port A5 and the tank passage.



## (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 operation, operation is similar.



## 6) SWING OPERATION

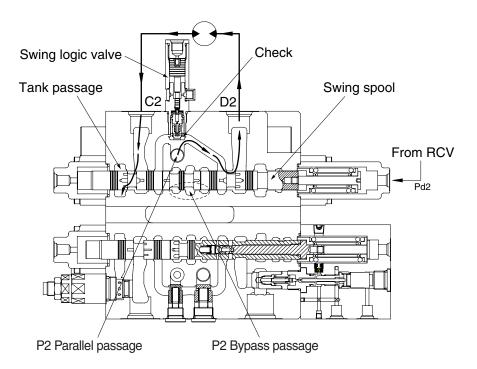
#### (1) SWING LEFT & RIGHT OPERATION

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.

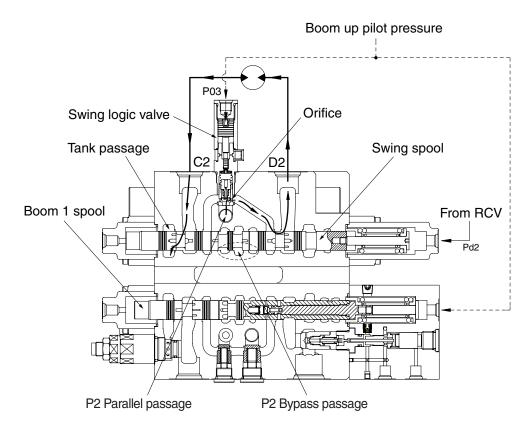
Accordingly, the hydraulic fluid from pump A1 flows into swing motor through the port C2 and returns to the hydraulic oil tank through the port D2 and the tank passage.



## (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 operation, operation is similar.



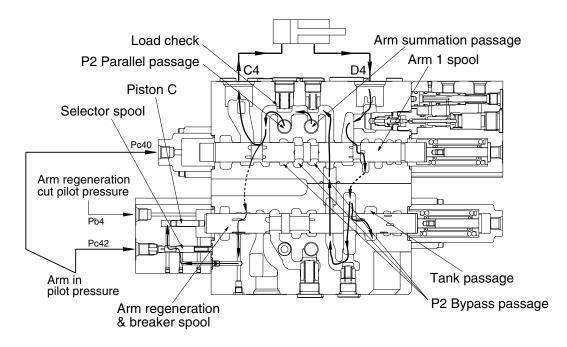
## 7) ARM OPERATION

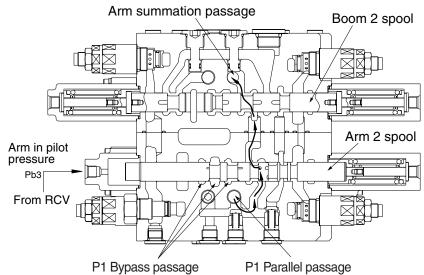
### (1) ARM IN OPERATION

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.





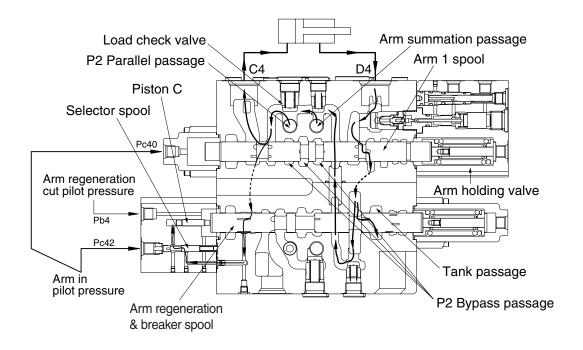
#### **ARM REGENERATION**

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.

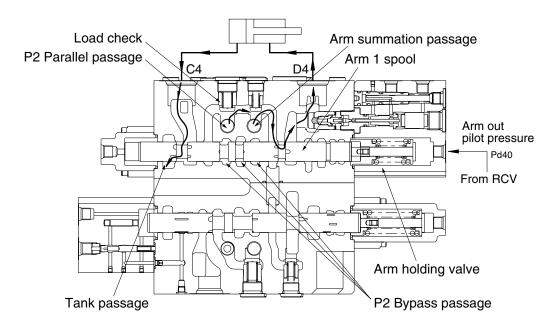
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic fluid from pump A1 flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve and the port D4.

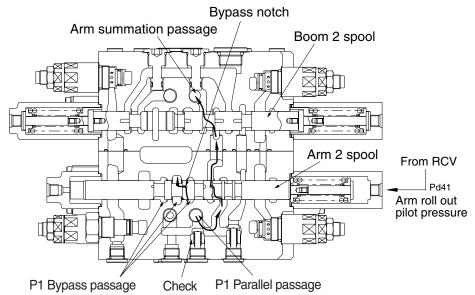
Also, the pilot secondary pressure from RCV is supplied to the port Pd41 of spring side and shifts arm 2 spool in the left direction.

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.



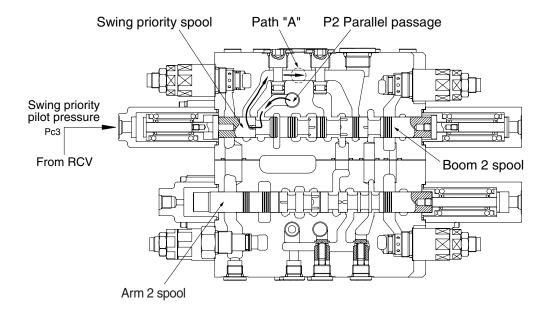


#### 8) SWING PRIORITY FUNCTION

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.

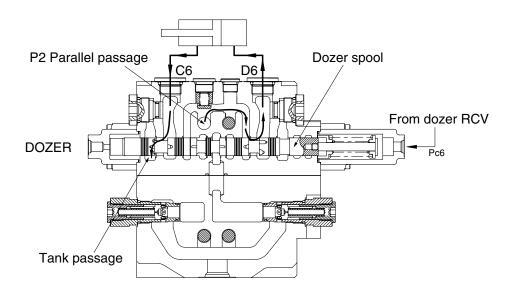
The hydraulic fluid from P2 parallel passage flows into the parallel passage of arm 1 side through swing priority spool and the path "A" and also flows into the boom 2 spool.

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.



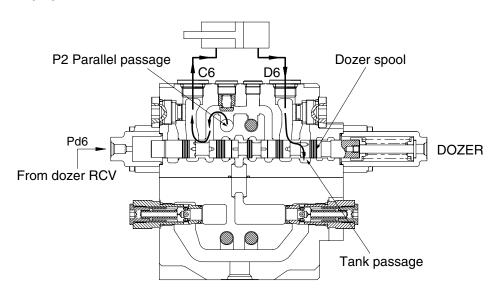
## 9) DOZER OPERATION

## (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

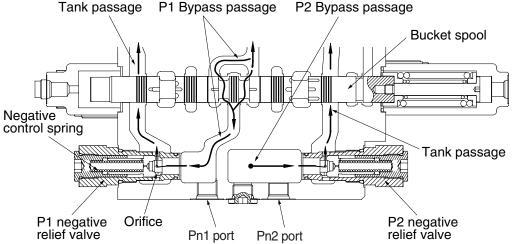
When no function is being actuated on P1 side, the hydraulic fluid from the pump A2, flows into the tank passage through the P1 bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump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

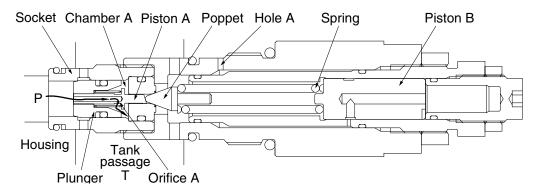
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump A1 the same negative control principle.



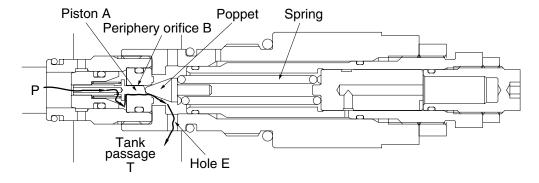
#### 11) OPERATION OF MAIN RELIEF VALVE

(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.



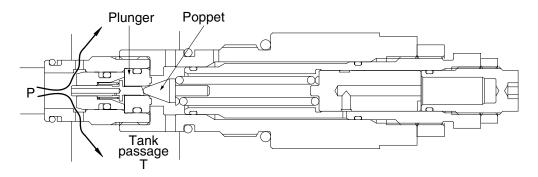
14W92MC36

(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).

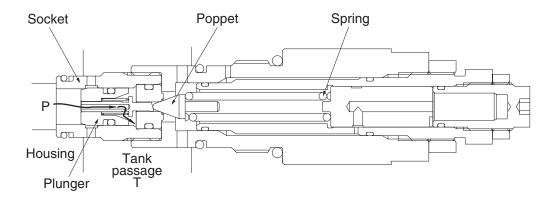


14W92MC37

(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).

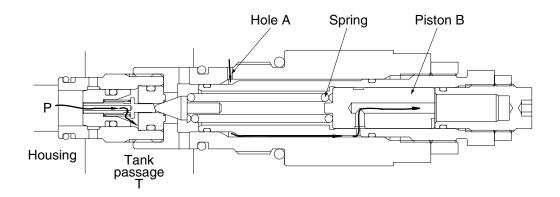


(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



14W92MC39

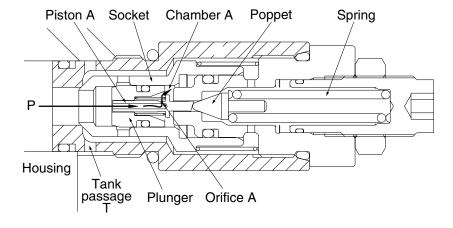
(5) When the power boost switch is ON, the pilot pressure enters through hole A.
It pushes the piston (B) in the left direction to increase the force of the spring and change the relief set pressure to the high pressure.



## 12) OPERATION OF OVERLOAD RELIEF VALVE

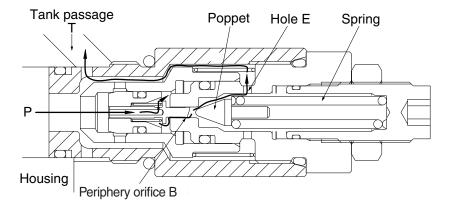
#### **FUNCTION AS RELIEF VALVE**

(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.

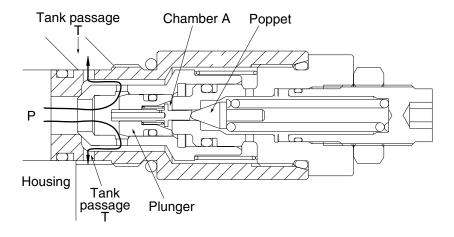


14W92MC41

(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.

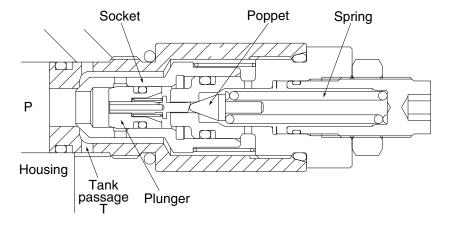


(3) Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



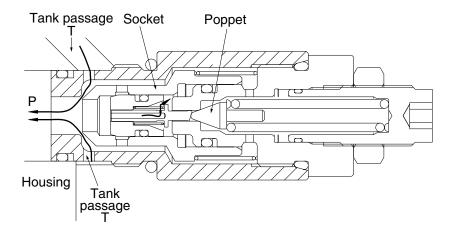
14W92MC43

(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.

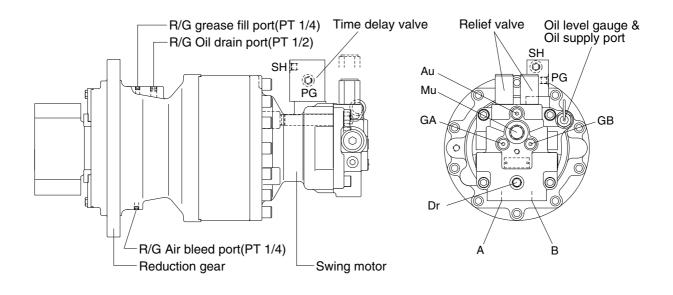


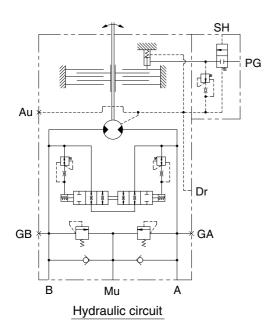
# **GROUP 3 SWING DEVICE**

## 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.

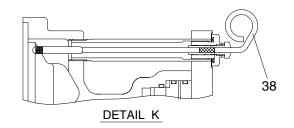


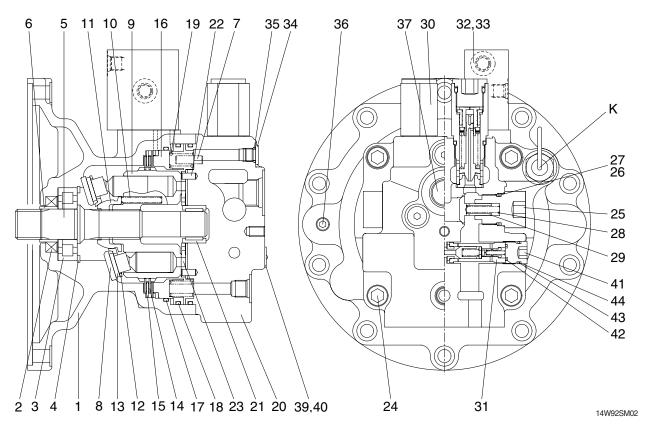


14W92SM01

	1		
Port	Port name	Port size	
А	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
^	Outlined and all and a

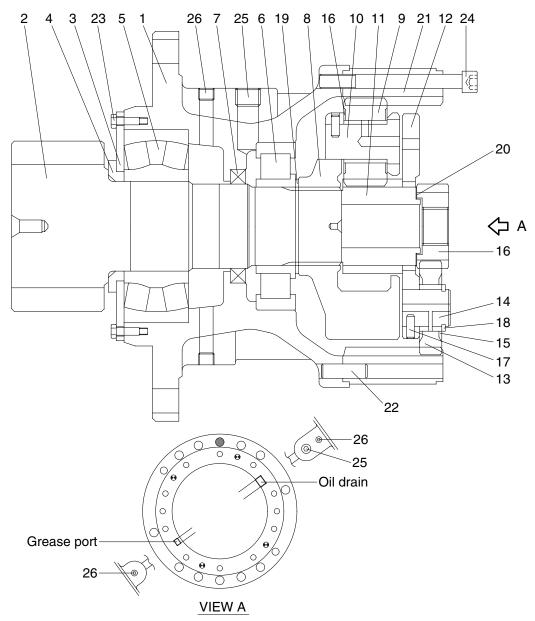
U	Dustiling
7	Pin
8	Shoe plate
9	Cylinder block
10	Spring
11	Ball guide
12	Set plate
13	Piston assembly
14	Friction plate
15	Separate plate

16	Brake piston
17	O-ring
18	O-ring
19	Brake spring
20	Rear cover
21	Needle bearing
21 22	Needle bearing Pin
	•
22	Pin

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

31	Anti-rotating valve
32	Time delay valve
33	Wrench bolt
34	Plug
35	O-ring
36	Plug
37	Plug
38	Level gauge
40	Rivet
41	Plug
42	O-ring
43	O-ring
44	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).

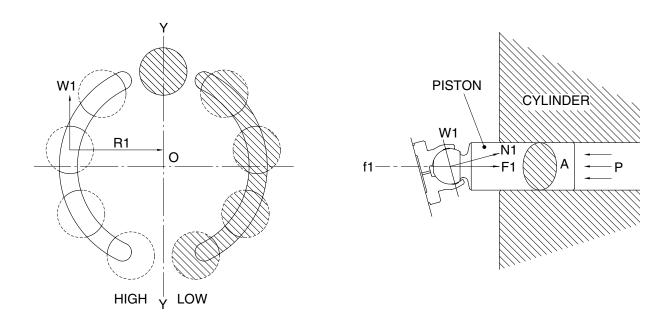
The high hydraulic can generate the force,  $F1=P\times A$  (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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 ( $\Sigma$ 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

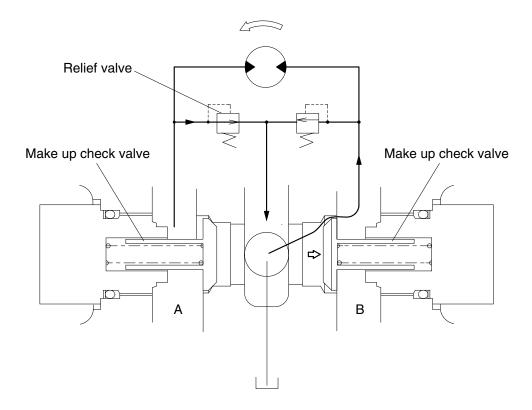
#### 2) MAKE UP VALVE

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.

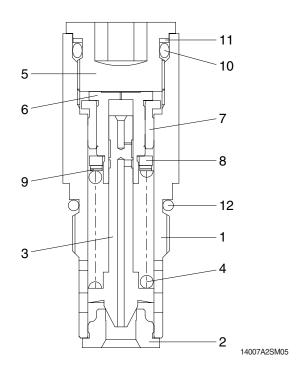
Pressurized oil into the port B, the motor rotate counterclockwise.

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



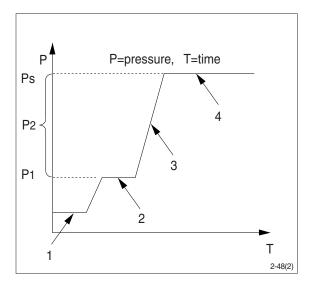
- 1 Body
- 2 Seat
- 3 Plunger
- 4 Spring
- 5 Adjusting screw
- 6 Piston
- 7 Bushing
- 8 Spring seat
- 9 Shim
- 10 O-ring
- 11 Back up ring
- 12 O-ring

## (1) Construction of relief valve

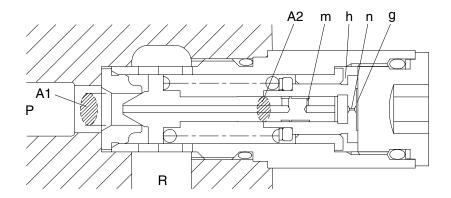
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

## (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.

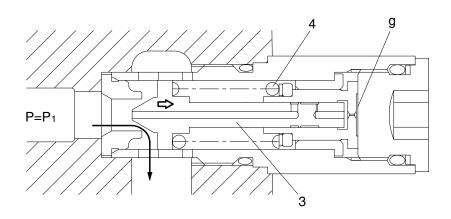


14007A2SM0

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

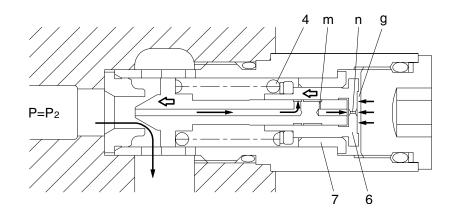
$$P1 \times A1=Fsp+Pg \times A2$$

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



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).

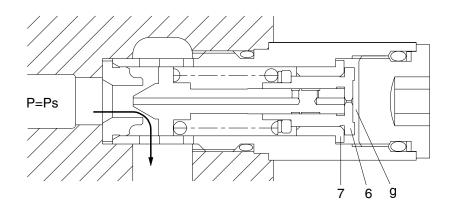


14007A2SM08

<sup>(4)</sup> 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).

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

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



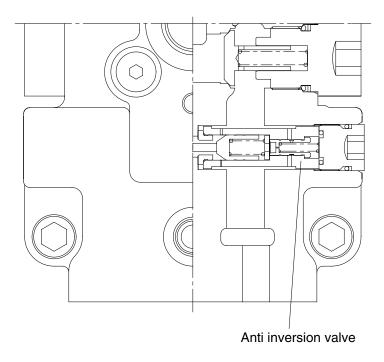
14007A2SM09

## 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.

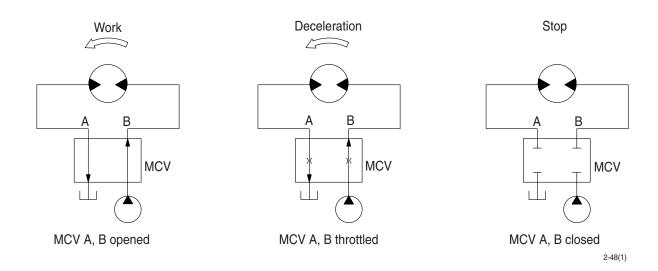


14W92SM10

#### 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.

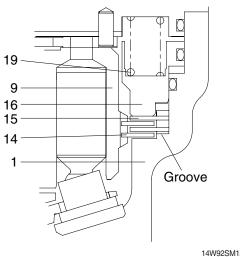


#### (2) Mechanical swing parking brake system

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

### ① Brake assembly

Circumferential rotation of separate plate (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.



14W92SM15

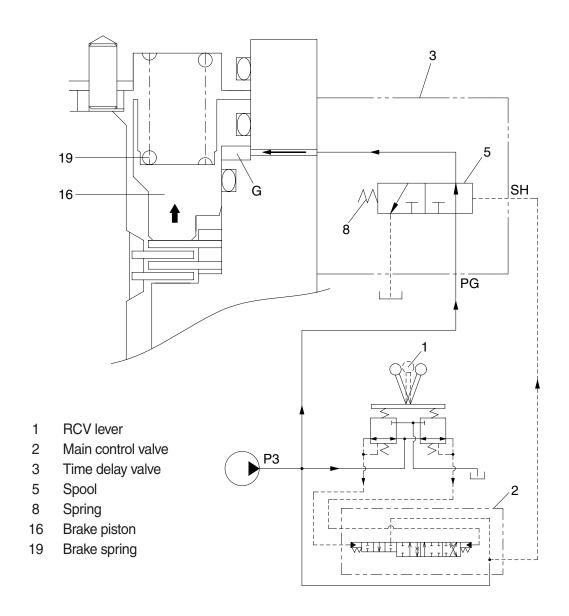
1 Housing 15 Separate plate 9 Cylinder block 16 Brake piston Friction plate 19 Spring

## 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.

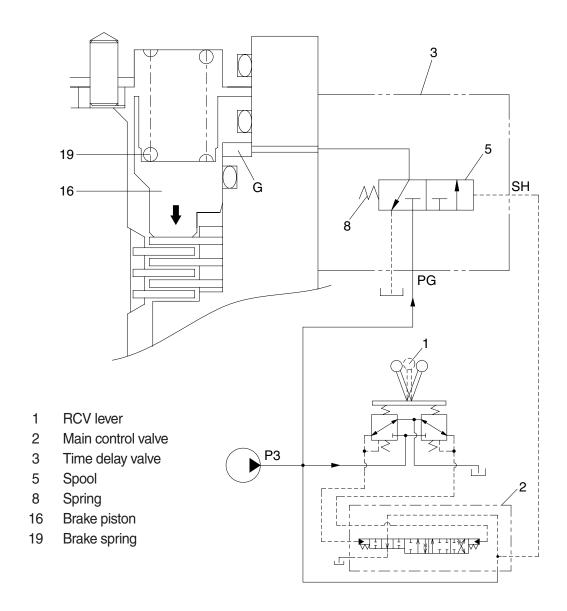
This pressure is applied to move the piston (16) to the upward against the force of the spring (19). Thus, it releases the brake force.



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.



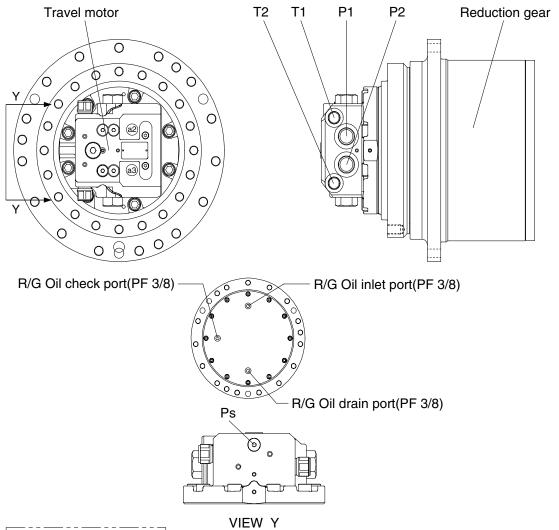
14W92SM17

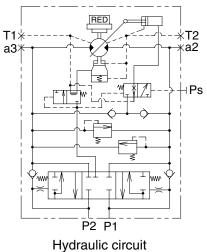
# **GROUP 4 TRAVEL DEVICE (TYPE 1)**

## 1. CONSTRUCTION

Travel device consists travel motor and gear box.

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

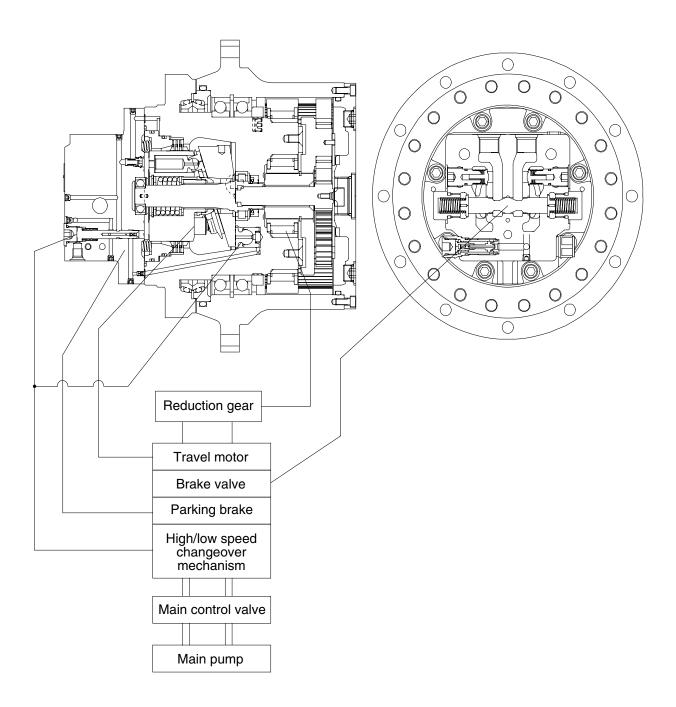




Port	Port name	Port size
P1	Main port	PF 3/4
P2	Main port	PF 3/4
a2, a3	Gauge port	PF 1/4
T1, T2	Drain port	PF 1/2
Ps	Parking brake release port	PF 1/4

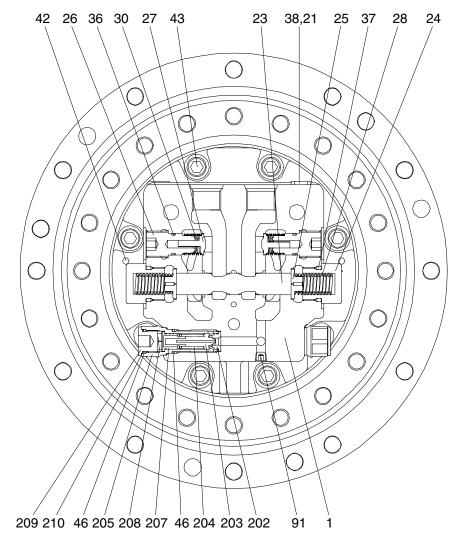
14092TM01A

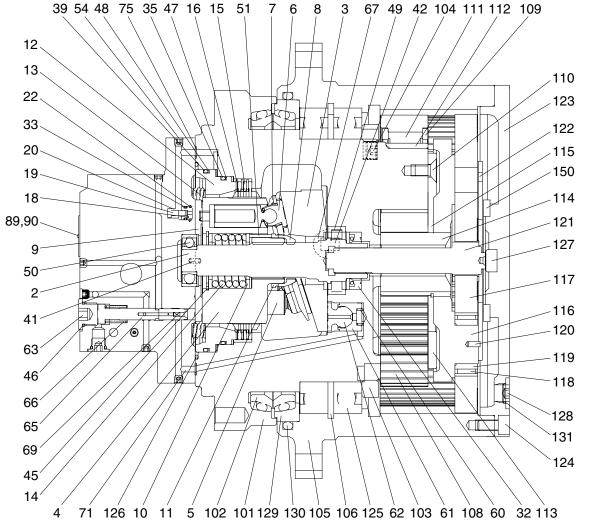
## 1) BASIC STRUCTURE

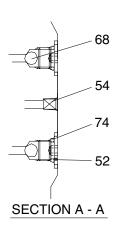


14092TM02

# 2) STRUCTURE







14092TM03

1	Rear flange	19	Valve	39	O-ring	65	2 Speed spool	108	Planetary gear
2	Shaft	20	Spring	41	Parallel pin	66	2 Speed spring	109	Thrust washer
3	Swash plate	21	Plug	42	Parallel pin	67	Pivot	110	Screw
4	Cylinder block	22	Ring	43	Socket bolt	68	Steel ball	111	Needle bearing
5	Piston	23	Main spool	45	Snap ring	69	Set screw	112	Collar
6	Shoe	24	Main plug	46	O-ring	71	Orifice	113	Thrust plate
7	Retainer plate	25	Retainer spring	47	Back up-ring	74	O-ring	114	Sun gear
8	Thrust ball	26	Check plug	48	Back up-ring	75	O-ring	115	Snap ring
9	Timing plate	27	Check valve	49	Roller bearing	89	Name plate	116	Holder
10	Washer	28	Main spring	50	Ball bearing	90	Set screw	117	Planetary gear
11	Washer-collar	30	Check spring	51	Roller	91	Plug	118	Needle bearing
12	Piston-parking	32	Oil seal	52	Plug	101	Spindle	119	Inner race
13	Spring	33	O-ring	54	Plug	102	Floating seal	120	Spring pin
14	Spring	35	O-ring	60	Spring	103	Nut ring	121	Drive gear
15	Friction plate	36	O-ring	61	Piston	104	Plug	122	Thrust plate
16	Mating plate	37	O-ring	62	Shoe	105	Hub	123	Cover
18	Seat valve	38	O-ring	63	Plug	106	Snap ring	124	Socket bolt

#### 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

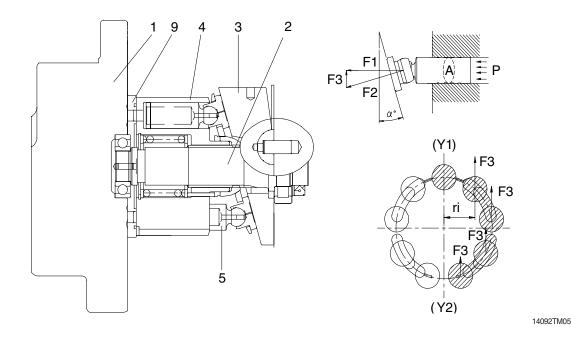
The parking brake prevents overrunning or slippage upon parking or stopping the machine on a slope with friction plate type brake mechanism, and combined with the hydraulic motor assembly into an integral structure.

#### (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 ( $\alpha$ °) 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.

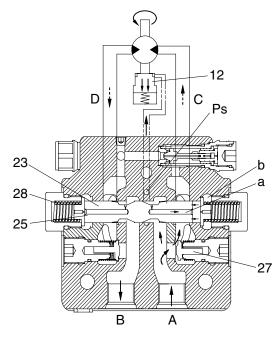
### (2) Brake valve

#### 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.

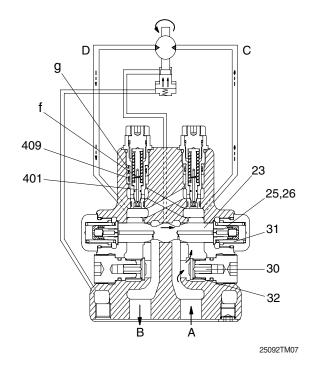
Moreover, sliding of spool (23) causes the pressurized oil to flow into ports (P) and (S). The pressurized oil admitted into port (P) activates piston (12) of the parking brake to release the parking brake force. (For details, refer to description of the parking brake.) When the pressurized oil is supplied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



14092TM06

### 2 Stopping and stalling (brake applied)

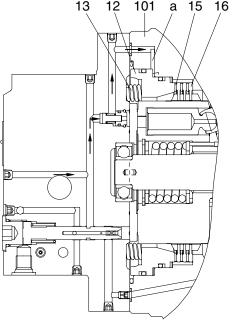
When the pressurized oil supplied from port (A) is stopped during traveling, no hydraulic pressure is applied and spool (23) which has slid to the left will return on the right (neutral) via stopper (25, 26) by the force of spring (31). At the same time, the hydraulic motor will rotate by the inertia 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

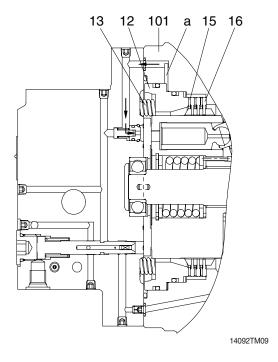
When the pressurized oil is supplied from the valve, the spool of brake valve in the hydraulic motor assembly actuates to open the passage to the parking brake and the pressurized oil is introduced into cylinder chamber (a) which is composed of the spindle of reduction gear assembly and piston (12). When the hydraulic pressure reaches 9.5 kgf/cm<sup>2</sup> 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

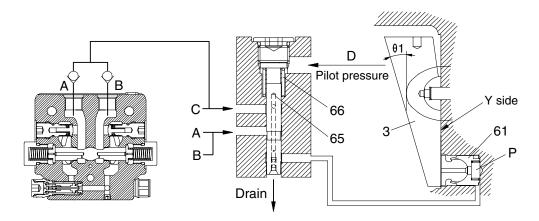
When the pressurized oil from the brake valve is shut off and the pressure in cylinder chamber (a) drops 9.5 kgf/cm² or less, piston (12) will return by the force of spring (13). Piston (12) is pushed by this force of spring (13), and mating plate (16) and friction plate (15) in free condition are pressed 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/cm<sup>2</sup>

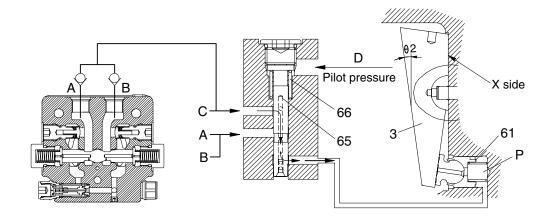
When no pilot pressure is supplied from (D) (at a pressure of 10 kgf/cm² or less), valve (65) is pressed toward the top by the force of spring (66) and (A) port or (B) port, the pressurized oil supply port (C) is shut off, and oil in chamber (P) is released into the motor case via valve(65). Consequently, swash plate (3) is tilted at a maximum angle ( $\theta$  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

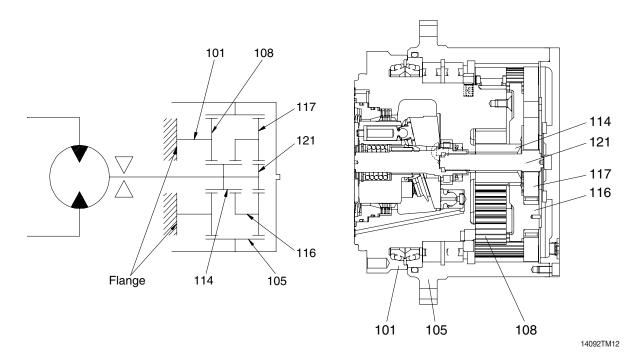
When a pilot pressure is supplied from port (D) (at a pressure of 20 kgf/cm² or more), the pressure overcomes the force of spring (66) and (A) port or (B) port of valve (65) is pressed toward the down. The pressurized oil at supply port (C) is then introduced into chamber (P) via valve (65). Piston (61) 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 ( $\theta$ 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:

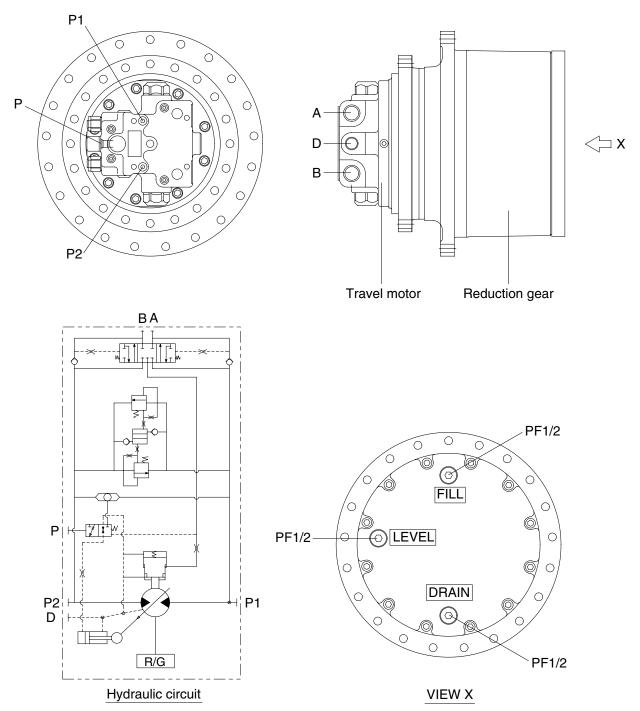
· Reduction ratio (I) = (Hub teeth / Drive gear teeth + 1) x (Hub teeth / Sun gear teeth + 1) - 1

# ■ TRAVEL MOTOR (TYPE 2)

# 1. CONSTRUCTION

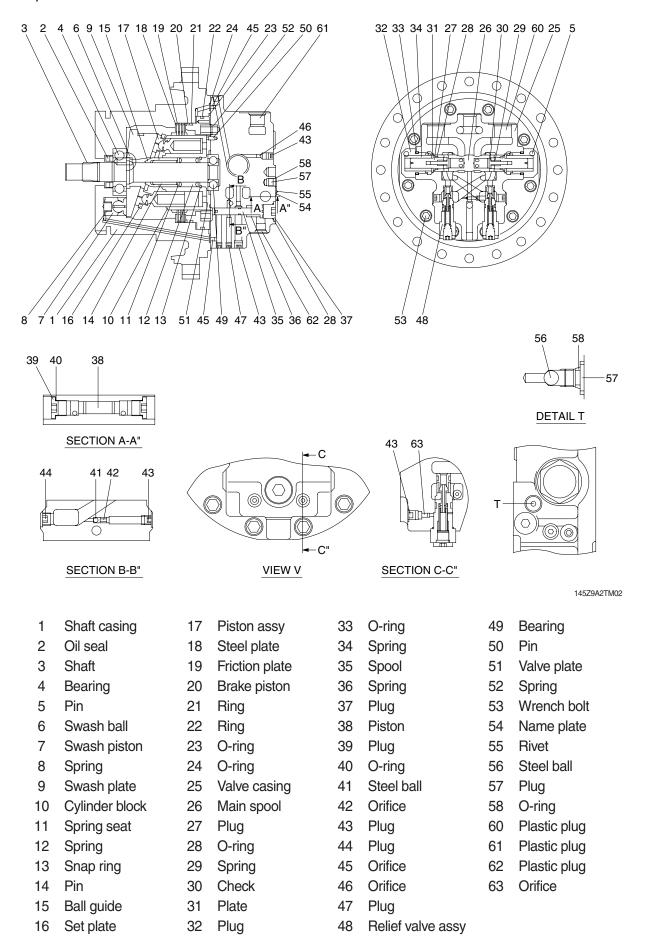
Travel device consists travel motor and gear box.

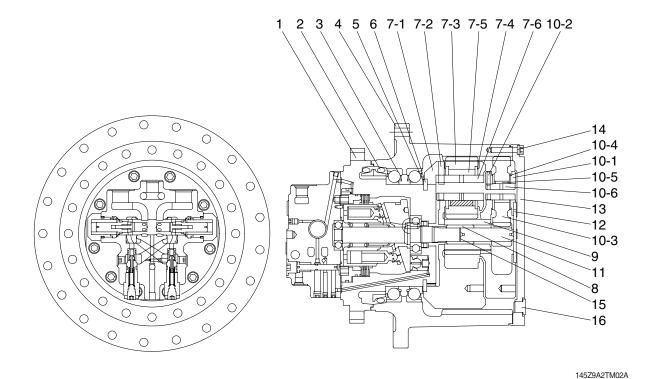
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.



Port	Port name	Port size
A, B	Main port	PF 3/4
Р	Two speed control port	PF 1/4
D	Drain port	PF 1/2
P1, P2	Gage port	PF 1/8

## 1) STRUCTURE





Spindle 7-4 Washer 2 10-5 Bearing 1 1 10-6 Pin 1 2 Floating sesal 7-5 Bearing 2 3 Ball bearing 7-6 Pin 2 11 Sun gear 1 4 Housing 8 Coupling Plate 1 12 5 Shim 9 Sun gear 2 Cover 13 6 Shim 10 Carrier assy 1 14 Bolt 7 Carrier assy 2 10-1 Carrier 1 Snap ring 7-1 Carrier 2 10-2 Spring pin 1 Plug 16 7-2 Spring pin 2 10-3 Planetary gear 1

10-4 Washer 1

7-3 Planetary gear 2

### 3. PRINCIPLE OF DRIVING

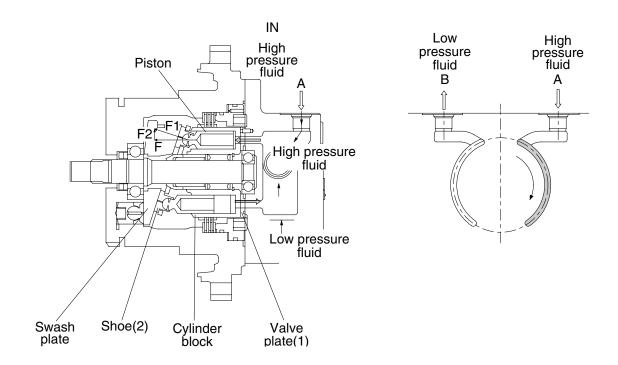
Travel motor comprises with rotary, relief valve, parking brake, counterbalance valve and 2-speed control.

### 1) WORKING OF ROTARY PART

In the figure below, axis directional force F1 occurs when the high pressure oil flows into the cylinder block through to the valve plate (1) port, and the piston moves to the left hand side.

This force F1, which takes shoe (3) as a medium, split into axial force F which is parallel with a shaft, and radial force F2 which is perpendicular to the shaft. By the reaction force F2, cylinder block rotate with piston and shoe, while shoe (2) moves on the shoe plate with piston.

There are 9 pistons inserted into the cylinder block and they rotate with the cylinder block by taking high pressure oil in order at the entrance. When the oil flow is reversed, piston and cylinder block rotate in the opposite direction.

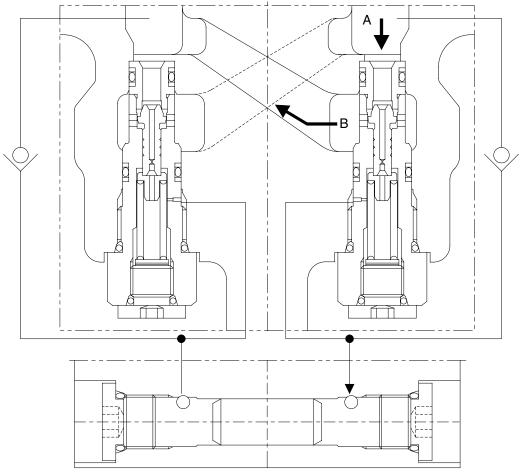


# 2) WORKING OF RELIEF VALVE

When the control valve spool is returned to neutral, the circuit between control valve and motor is blocked, and traveling movement stops.

However, motor continues rotating because of the traveling inertia of the excavator's heavy weight. Then the motor will act as a pump, and oil blocked between control valve and motor will be pressured sharply and the increased oil pressure will damage internal parts.

To prevent this damage, relief valve discharge the high pressure oil from A to B which has lower pressure.



145Z9A2TM04

Setting pressure : 350 kgf/cm²
 Back pressure : 5 kgf/cm²

· Cracking pressure: 315 kgf/cm² over

#### - AT THE BEGINNING OF TRAVELING

#### **RELIEF VALVE A**

When travel control lever moves, high pressure oil works to rise the pressure of RA port up. This pressurized oil press plunger to the right, and then sustain the power of the spring, the plunger moves to the right and release the pressure oil of RA port to RB port (Stage 1)

The plunger moves slowly by the pressure oil which flows into chamber 1 through orifice 1. The pressure oil flowed into chamber 1 flows into chamber 2 through orifice 2, and at this point, the plunger moves to the left again, when the spring is compressed by the flowed pressure oil which press the spool to the left. (Stage 2)

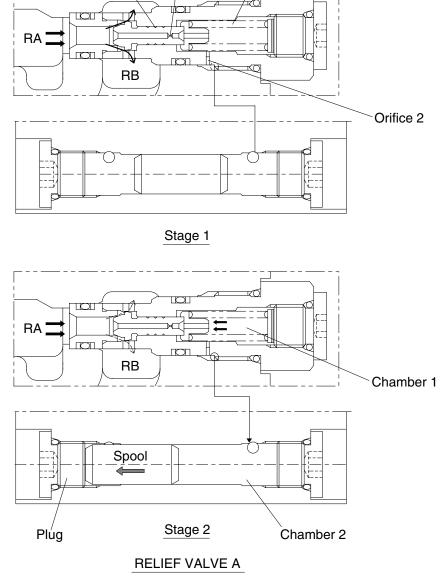
When the RA port pressure goes up much more and the set pressure overcome the power of the compressed spring again, the plunger moves to the right and the pressure has of RA port is released to RB port.

Thus, at the early stage of the relief valve operation, it works primarily at lower pressure, after then, shock is reduced during rotating at the set pressure as the secondary operation.

Spring

Orifice 1

Plunger

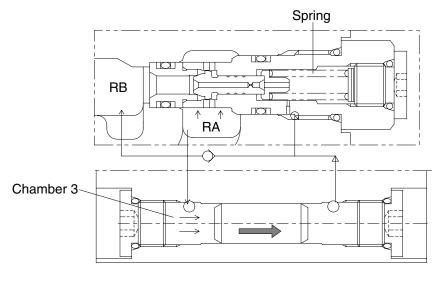


#### - DURING TRAVELING OPERATION

### **RELIEF VALVE B**

During traveling operation, RA port pressure goes up and RB port pressure goes down.

Thus RA port pressure oil flows into chamber 3, and pushes plunger to the left with a high pressure and the power of the spring.



RELIEF VALVE B

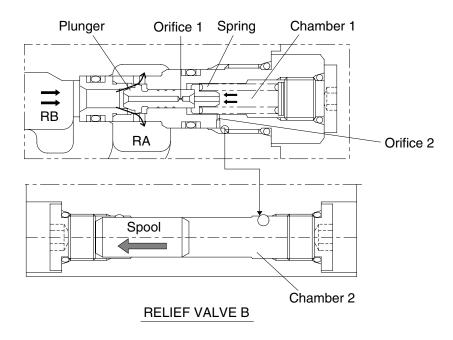
145Z9A2TM06

### - WHEN IT STOP

#### **RELIEF VALVE B**

When it stops or operates reversely, RA port pressure is decreased and RB port pressure suddenly goes up by the inertia of the machine heavy structure.

Relief valve B operates as the same order as relief valve A, and maintains the set pressure by releasing the high pressure of RB port to RA port.



### 3) WORKING OF PARKING BRAKE

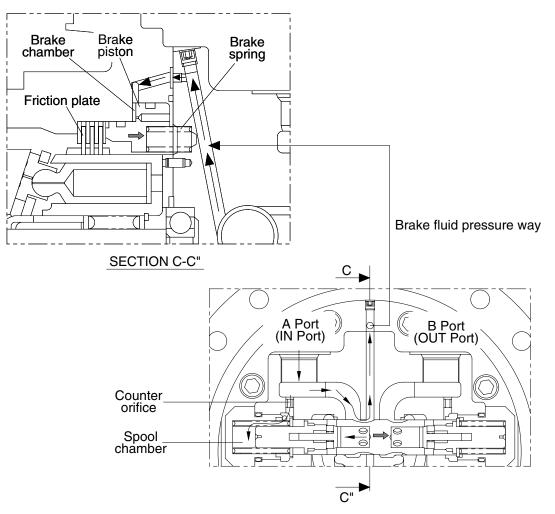
Parking brake system consists of a brake piston, springs, friction plates and separating plates, and some orifices to control responsibility of the brake piston. The brake is usually held with the force of compressed spring, and it is released automatically by traveling oil pressure coming from inlet A, or B when the motor starts to run.

### Parking brake OFF

When operator moves the traveling control lever, traveling working pressurized oil into IN PORT flows from spool chamber through counter orifice.

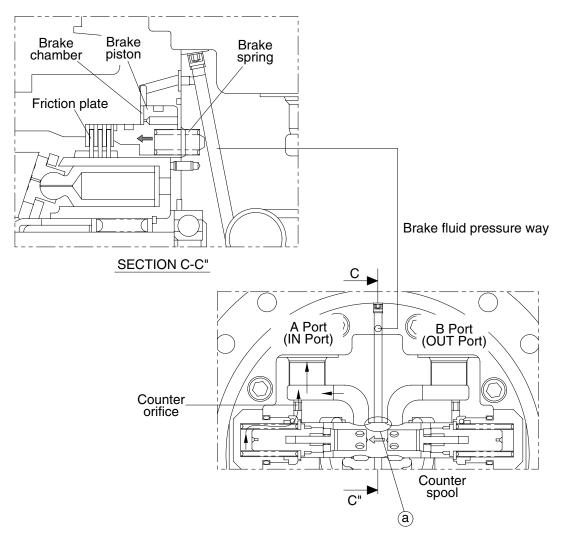
Pressurized oil pushes counter balance spool to right.

Then notch of spool opens the brake line. At the same time, pressurized oil flows to the brake chamber of motor through a brake passage, and makes brake piston move against brake spring force to allow clearance between fiction plates and separate plates thereby releasing the brake.



## • Parking brake ON

When the control lever is returned to neutral position, the circuit between control valve and motor is blocked. As oil pressure in spool chamber drops to zero and the counter balance spool returns to neutral position. At the spool neutral position, notch (a) is disconnected from oil supply port A, instead, brake chamber oil is drained to tank through brake orifice which is center opened.

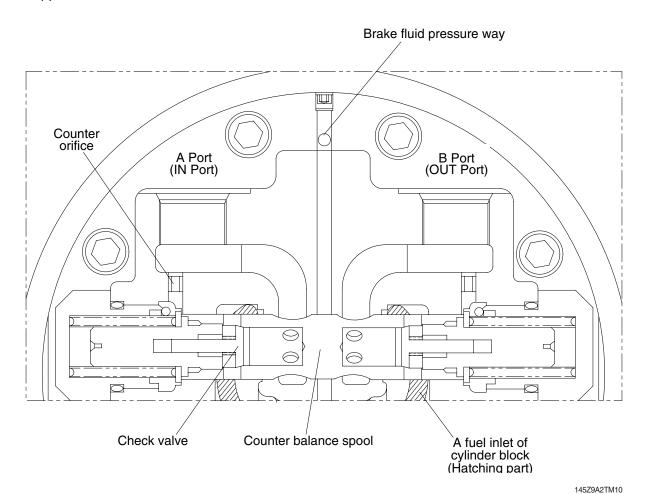


# 4) COUNTERBALANCE VALVE

# (1) Function

- ① Control oil flow in the action of mechanical parking brake operation.
- ② Prevent overrun while traveling on down slope.
- ③ Work as a hydraulic brake when motor stops, and prevent motor not to slip on slope.

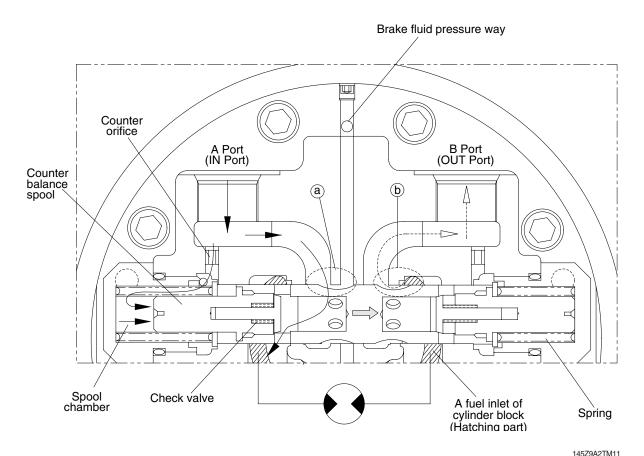
# (2) NEUTRAL



## (3) How to work

#### ① When motor travel

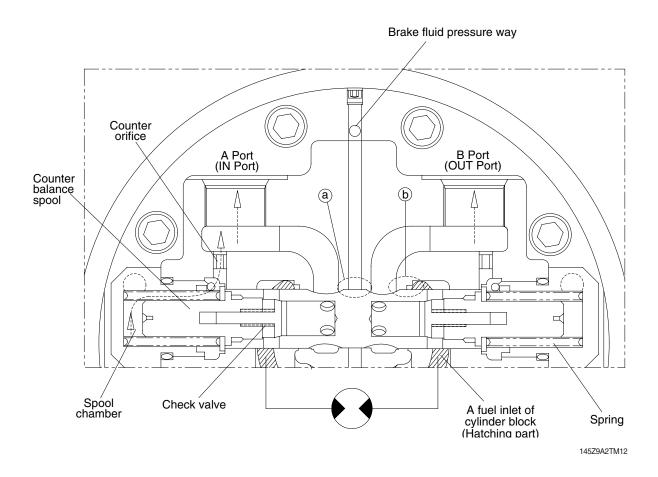
When operator moves a traveling control lever, pressurized oil flows from pump to motor inlet A, and passes into spool chamber through counter orifice, and hydraulic force moves counter balance spool to the right, it makes pump oil flow into cylinder block through check poppet and kidney port. At that time spool notch is opened and pump oil also go through line ⓐ and passes into parking brake chamber, and it releases parking brake. At the same time, return oil from cylinder block flows to outlet B through the line ⓑ.



### ② When motor stop

When operator moves a travel control lever to neutral position, pump oil flow is blocked. It reduce oil pressure of supply line down to zero, and oil in the spool chamber moves back to oil tank through counter orifice by the return force of spring in opposite side, and then counter balance spool returns to neutral position.

As the counter balance spool moves to left, line ⓐ is blocked, parking brake line is connected to drain passage designed in the center of counter balance spool, and oil in the parking brake chamber return to tank, finally brake piston return to parking ON position.

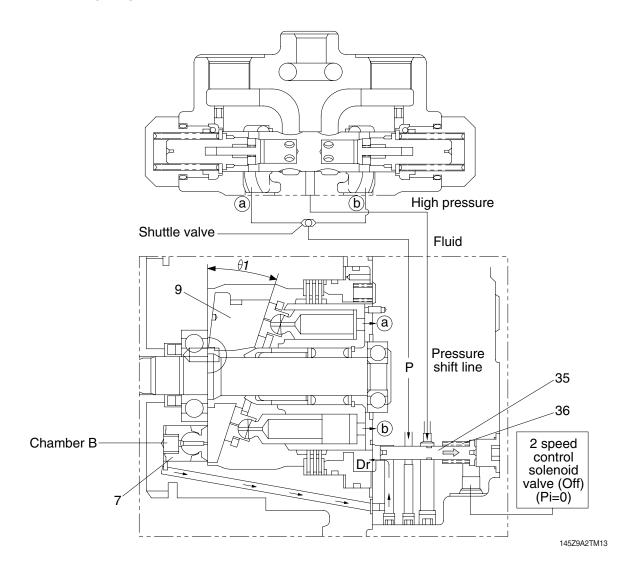


## 5) TWO SPEED (LOW SPEED - HIGH SPEED) CHANGEOVER EQUIPMENT

Rotating speed of the motor depends on slope angle of swash plate (9). Motor rotates slow when the angle is large, and rotates fast when the angle is small.

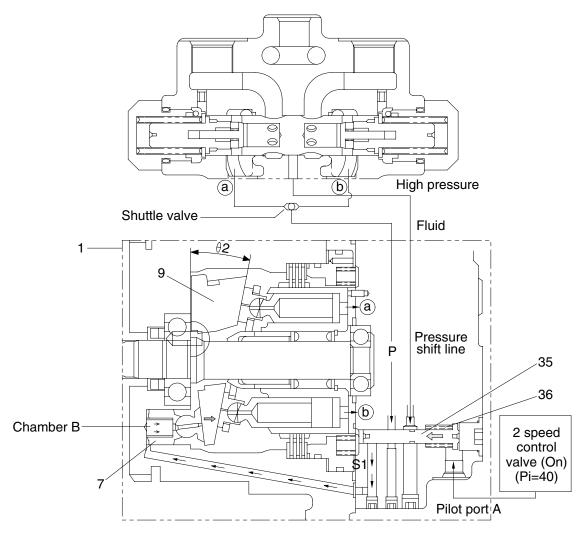
### Low speed

When pilot pressure signal Pi=0, spool (35) is located at right side by the spring (36) force and chamber A is connected to casing drain through hole S1. At this spool position, swash plate (9) sustain large angle, and motor rotate at low speed.



# High speed

When pilot pressure signal Pi is activated on spool (31), the spool moves to left hand end, and high pressure oil from Port ⓐ or ⓑ is transferred to S1 which is connected to chamber A. The high pressure transferred to chamber A lift the piston (5) up, then the swash plate (12) tilts to smaller angle, and the motor rotates higher speed.



### 4. REDUCTION GEAR

### 1) PLANETARY GEAR MECHANISM

Reduction unit slows down the rotating speed of motor and converts motor torque to strong rotating force.

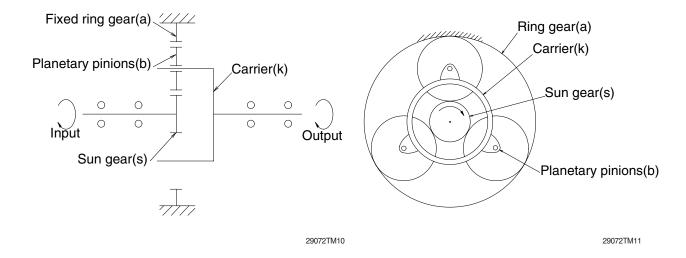
This reduction unit utilizes two stages, planetary reduction system.

Planetary reduction system consists of sun gear, planetary gears, carriers and ring gear.

When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gears (s).

This movement is transferred to carrier (k) and deliver the torque.

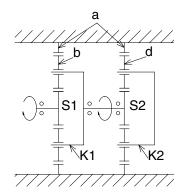
This mechanism is called planetary gear mechanism.



### 2) TWO STAGES REDUCTION GEAR

When the sun gear S1 is driven by input shaft, planetary action occurs among gears S1, a and b and revolution of gear b transfers the rotation of carrier K1 to second sun gear S2, and also evokes planetary action between gear S2, a and d.

This time, because carrier K2 is fixed to frame, gear d drives ring gear a and then ring gear a rotates to drive sprocket.

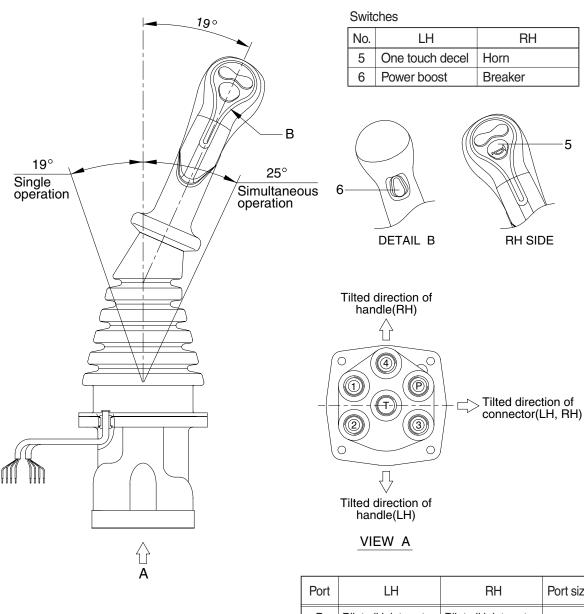


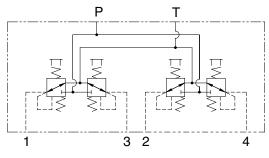
29072TM12

# 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.





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 3/8	
2	Arm in port	Boom down port	FF 3/0	
3	Right swing port	Bucket in port		
4	Arm out port	Boom up port		

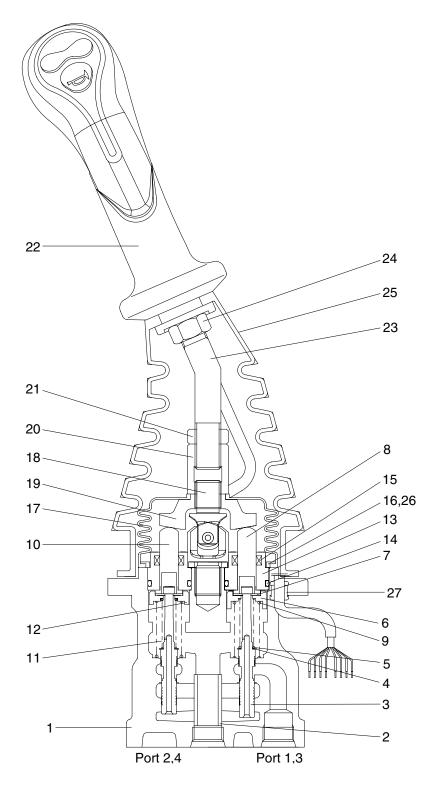
1409S2RL01

### **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 (3), spring (5) for setting secondary pressure, return spring (9), stopper (7), spring seat (6, 12) and shim (4). 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 (8, 10) 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**



1409S2RL02

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

#### 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 (3) 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 (5) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (8,10) is inserted and can slide in the plug (13).

For the purpose of changing the displacement of the push rod through the swash plate (19) and adjusting nut (20) are provided the handle (22) that can be tilted in any direction around the fulcrum of the universal joint (18) center.

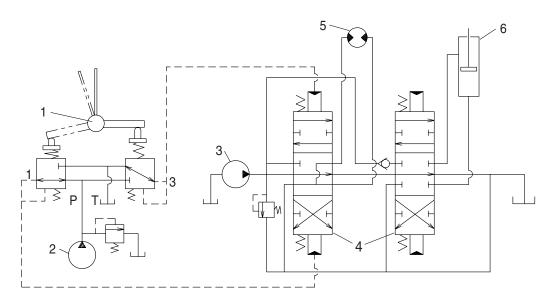
The spring (9) works on the case (1) and spring seat (6, 12) and tries to return the push rod (8,10) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

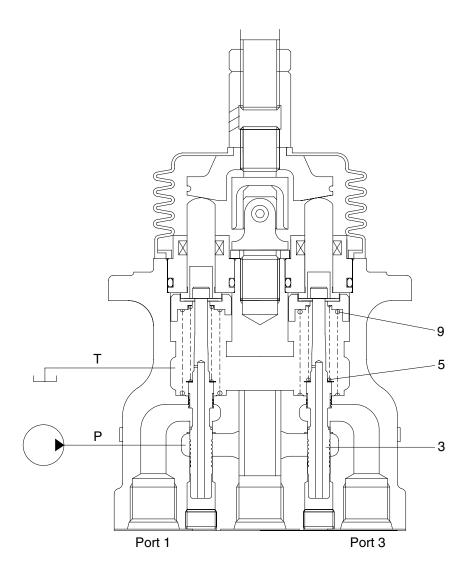
The diagram shown below is the typical application example of the pilot valve.



2-70

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

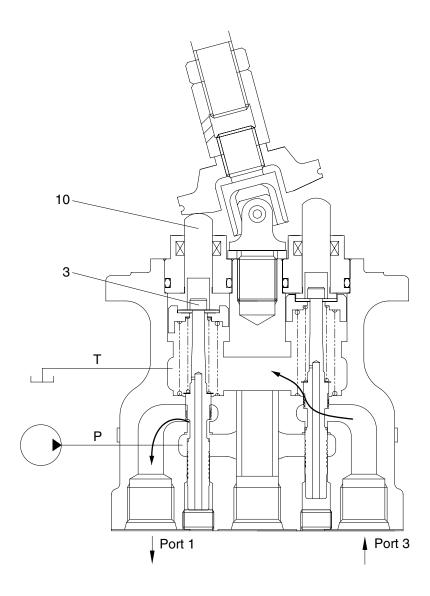
# (1) Case where handle is in neutral position



1409S2RL03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (3). Therefore, the spool is pushed up by the spring (9) 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



1409S2RL04

When the push rod (10) is stroked, the spool (3) 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.

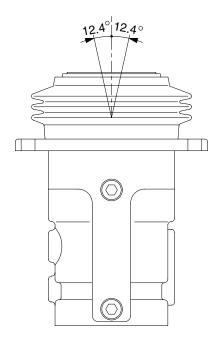
In this manner the secondary pressure is kept at the constant value.

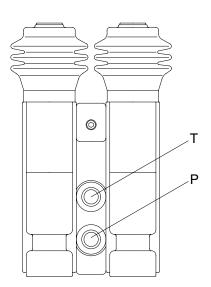
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

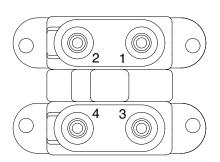
# **GROUP 6 RCV PEDAL**

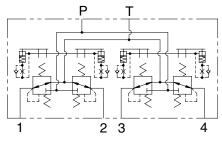
# 1. STRUCTURE

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	1 Travel (LH, Forward)			
2	2 Travel (LH, Backward)			
3	3 Travel (RH, Forward)			
4	Travel (RH, Backward)			

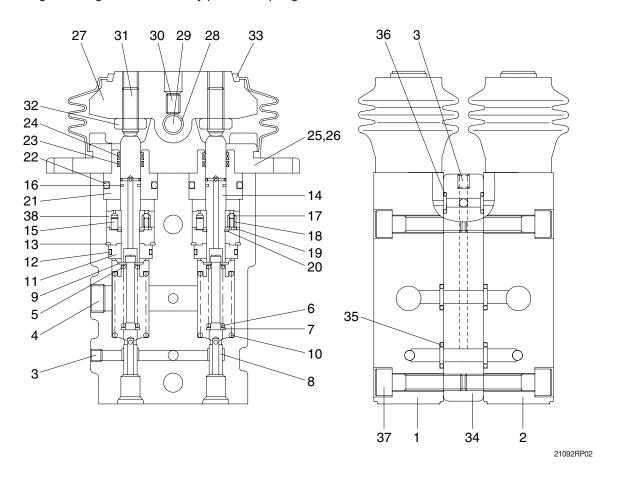
21092RP01

### **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.



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

#### 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.

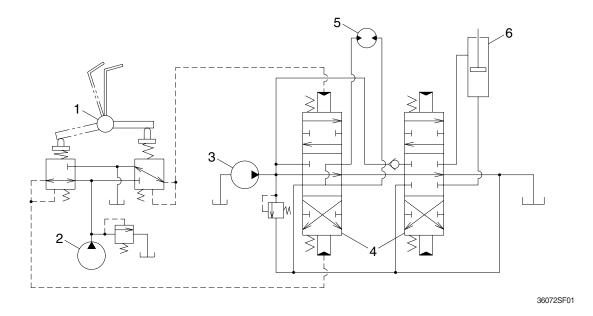
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

# 3) OPERATION

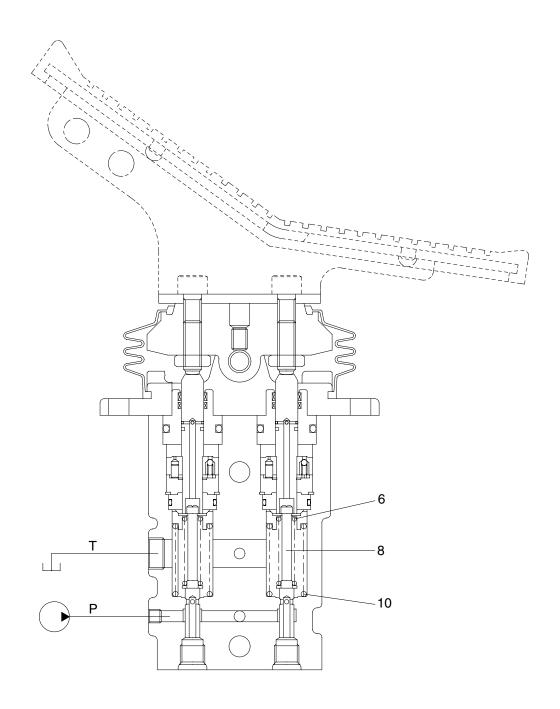
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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

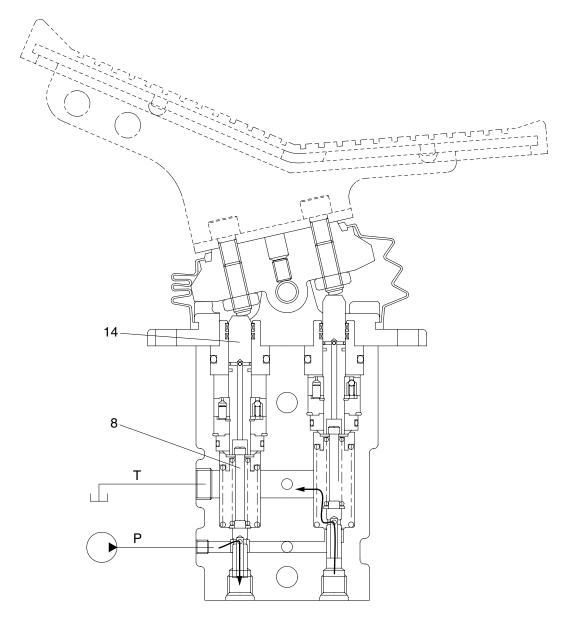
# (1) Case where pedal is in neutral position



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.

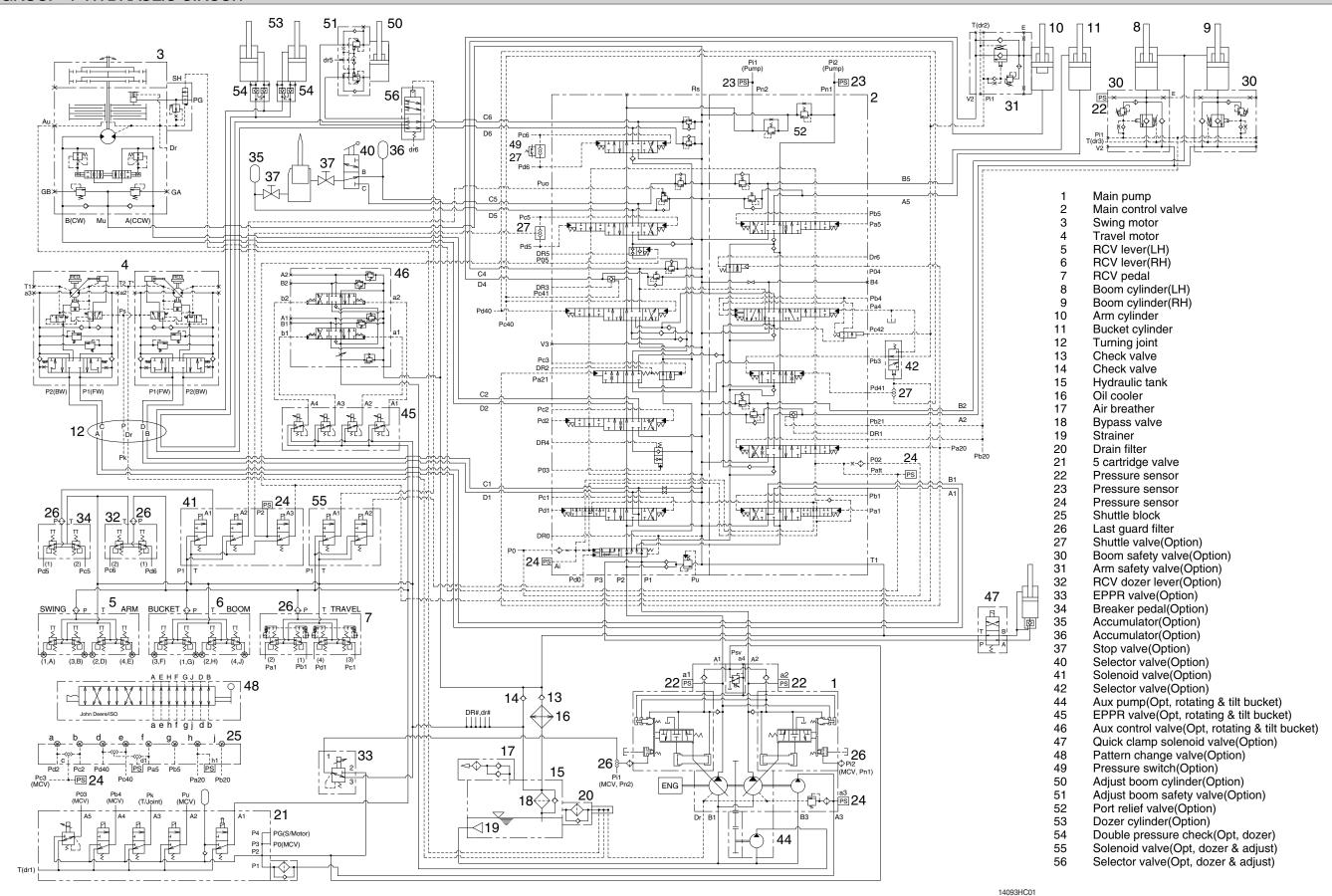
In this manner the secondary pressure is kept at the constant value.

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**



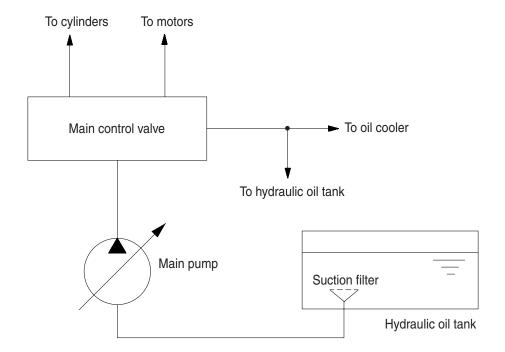
# **GROUP 2 MAIN CIRCUIT**

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

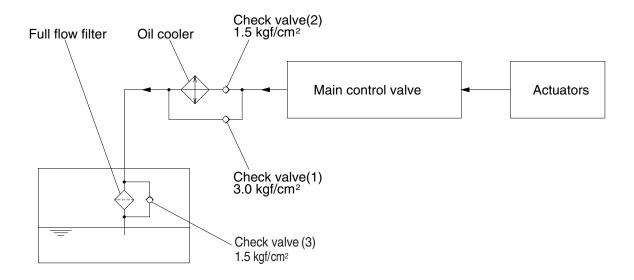
The pumps receive oil from the hydraulic tank through a suction filter. The discharged oil from the pump flows into the control valve and goes out the tank ports.

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



14093CI01

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.

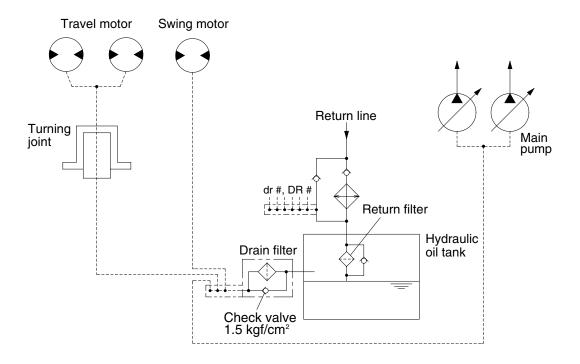
When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. When the oil pressure exceeds 3.0 kgf/cm² (43 psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

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



14093Cl02

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.

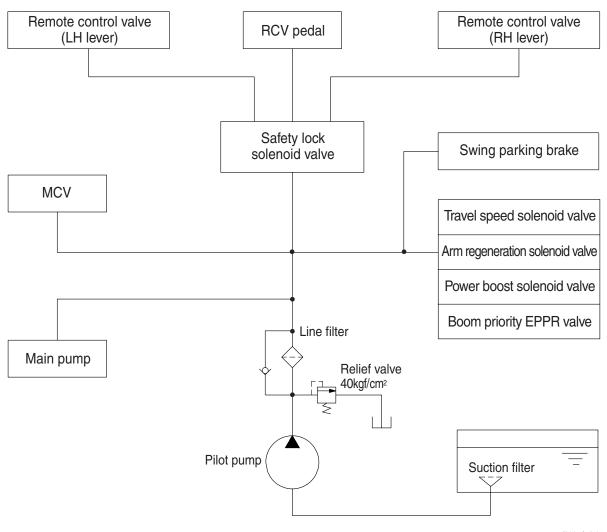
### 2) SWING MOTOR DRAIN CIRCUIT

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**



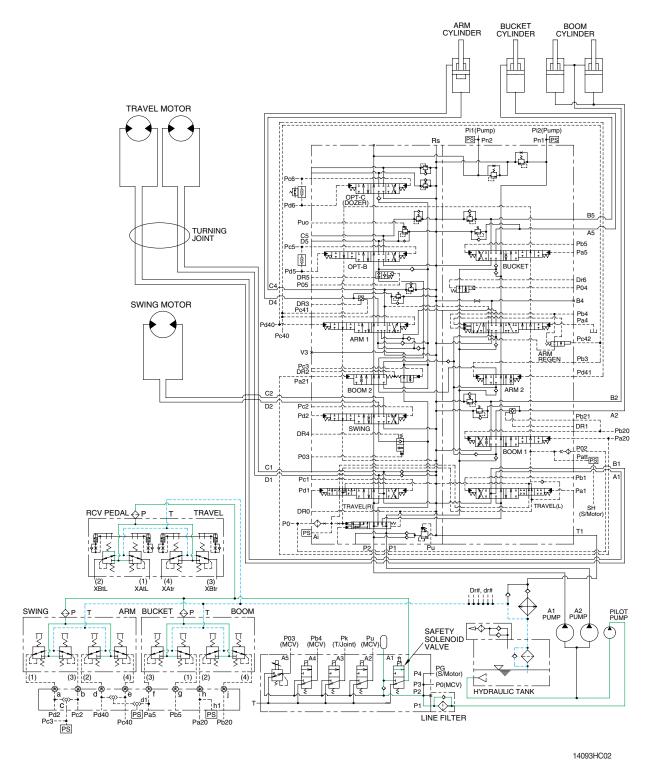
(210-7) 3-05

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

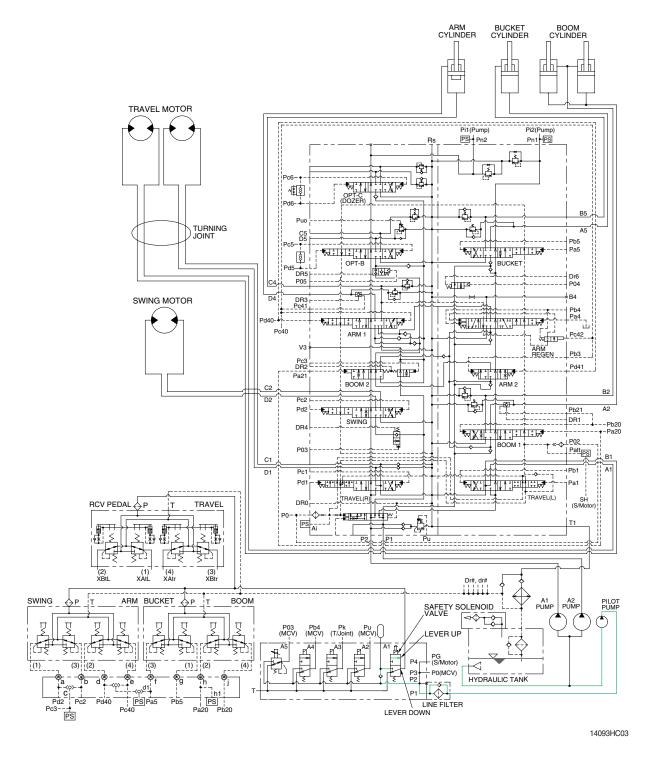


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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.

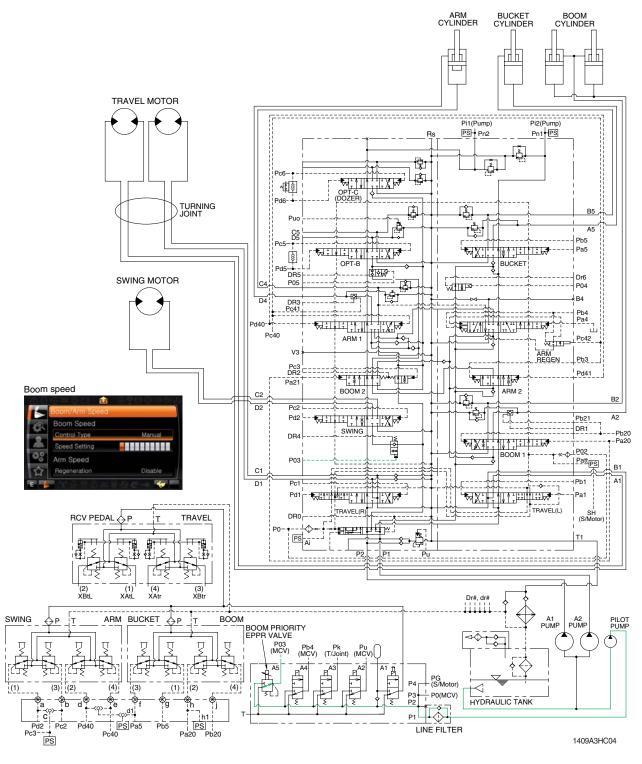
# 2. SAFETY SOLENOID VALVE (SAFETY LEVER)



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



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

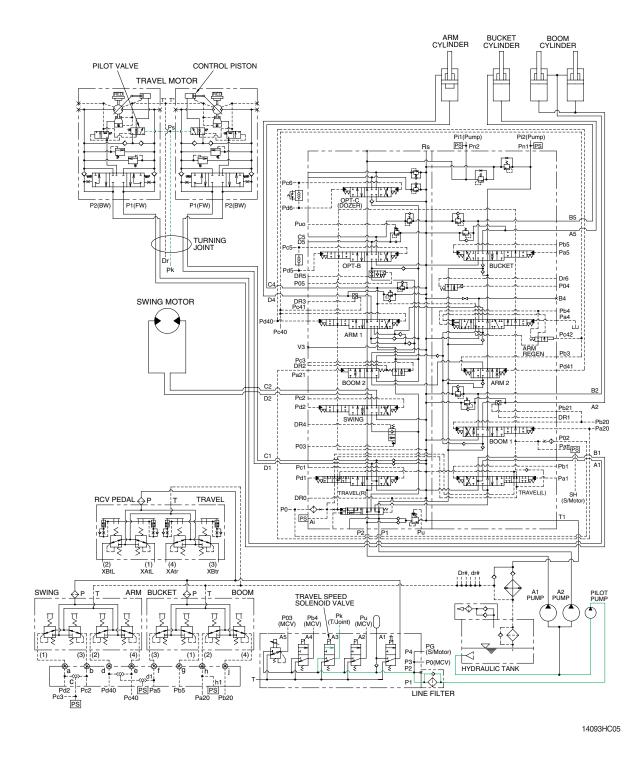
To increase working efficiency, swing speed reducing system is used.

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.

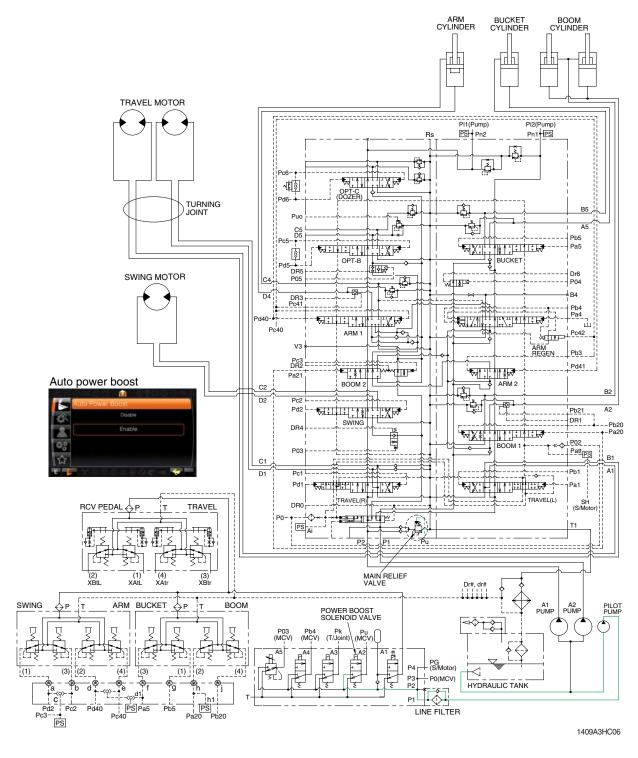
### 4. TRAVEL SPEED CONTROL SYSTEM



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

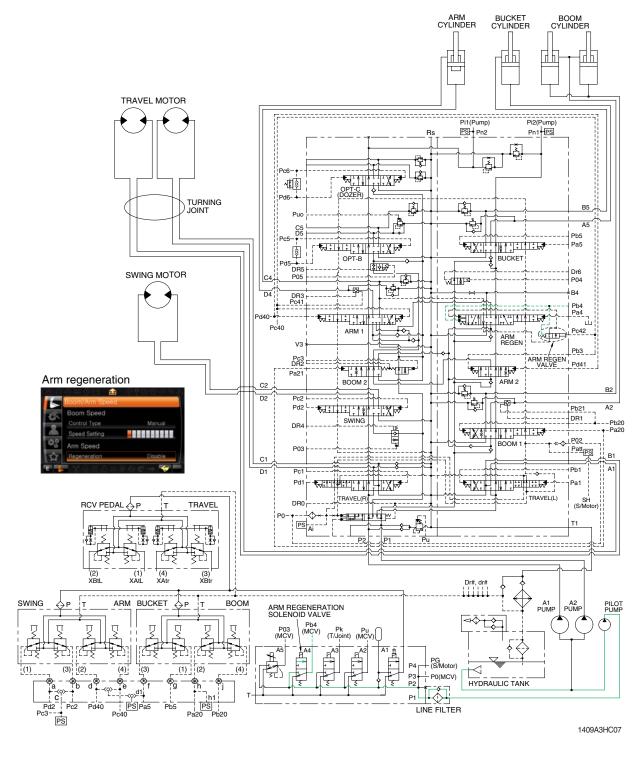


When the power switch on the left control lever is pushed ON, the power solenoid valve is actuated, the discharged oil from the pilot pump flows into **Pu** port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 350 kgf/cm² to 380 kgf/cm²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



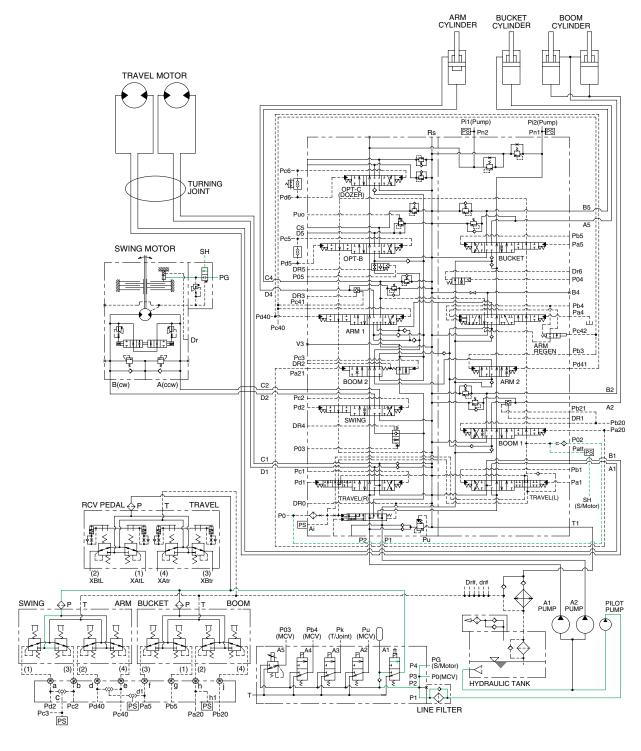
When the arm regeneration is selected to disable on the cluster, the arm regeneration solenoid valve is activated. The pilot oil from pilot pump flows into **Pb4** port in main control valve through solenoid valve and the arm regeneration spool is shifted to left.

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.

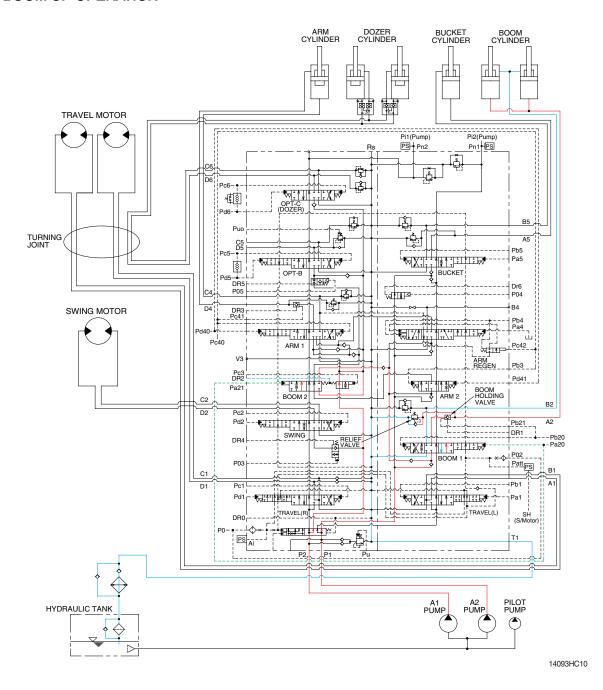
This pressure moves spool so, discharged oil from pilot pump flows into swing motor PG port.

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**

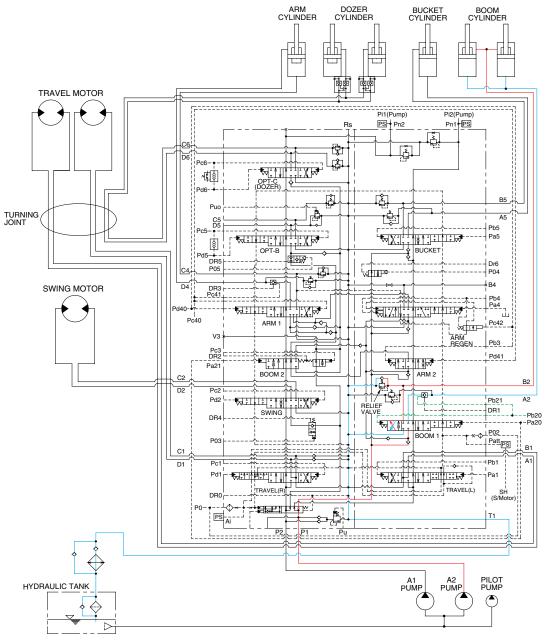
### 1. BOOM UP OPERATION



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

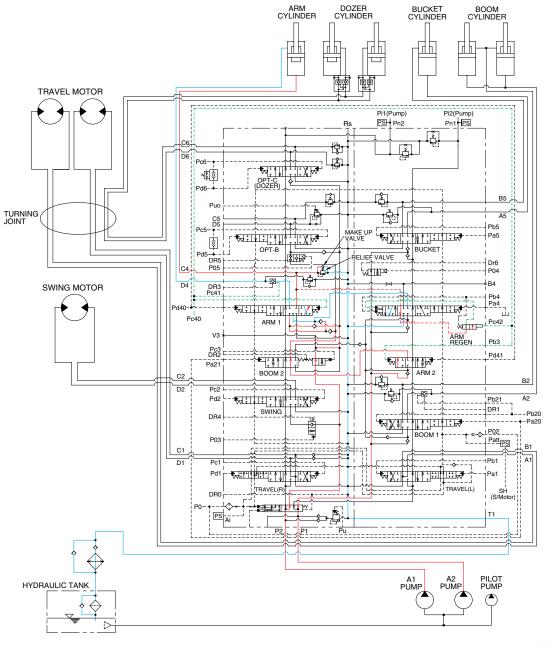
When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure from the remote control valve.

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.

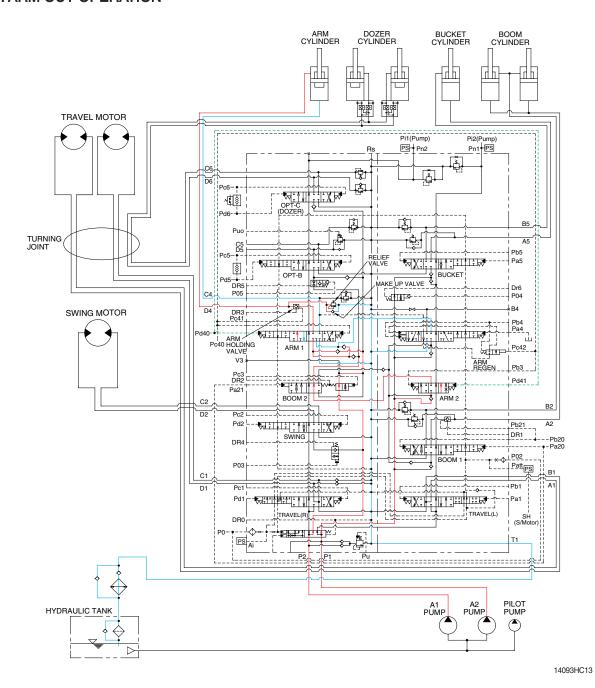
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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.

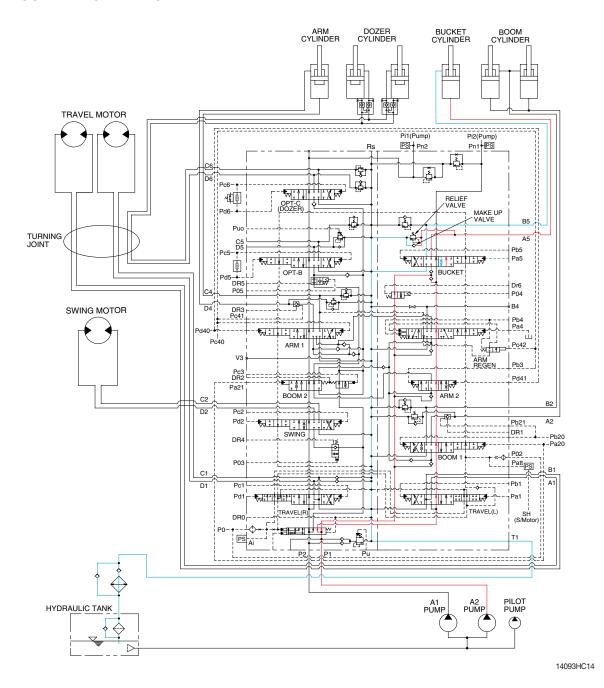
### 4. ARM OUT OPERATION



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.

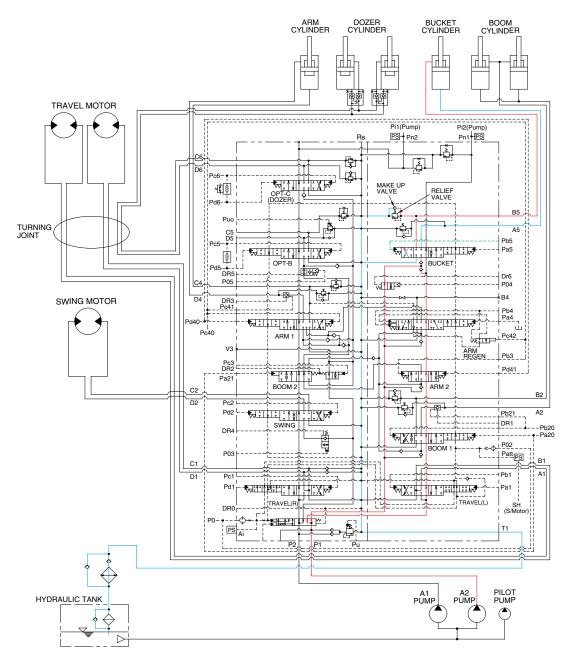
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

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

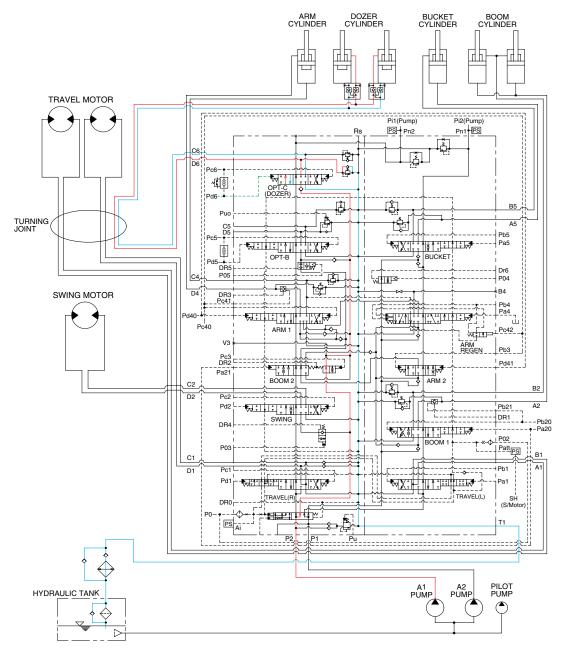
When the right control lever is pushed right, the bucket spool in the main control valve is moved to the bucket out position by the pilot oil pressure from the remote control valve.

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



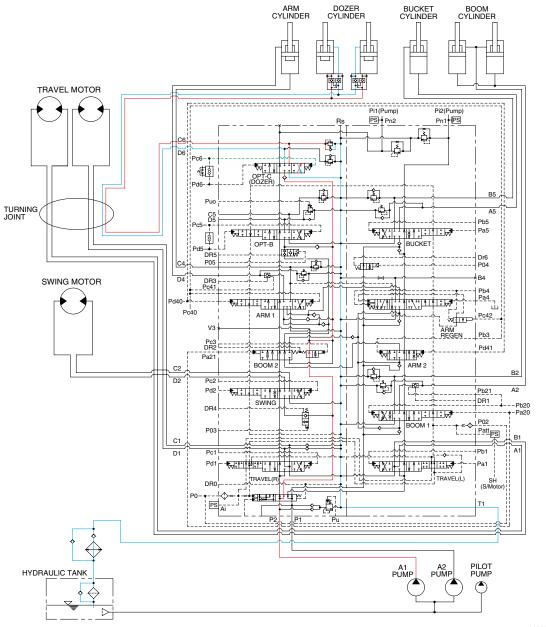
14093HC16

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



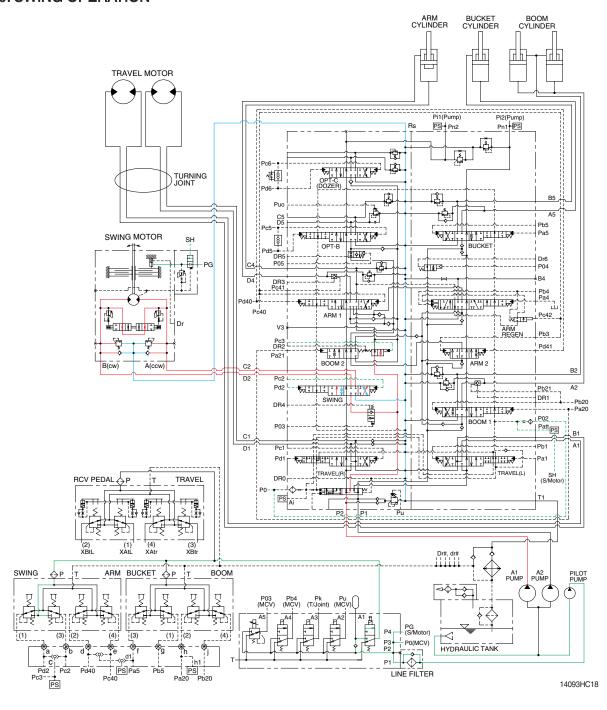
14093HC17

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).

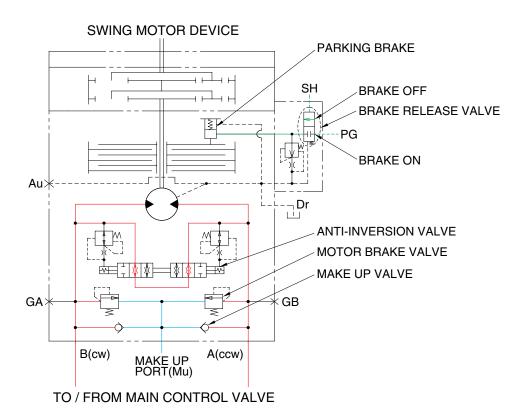
The oil from the A1 pump flows into the main control valve and then goes to the swing motor.

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.

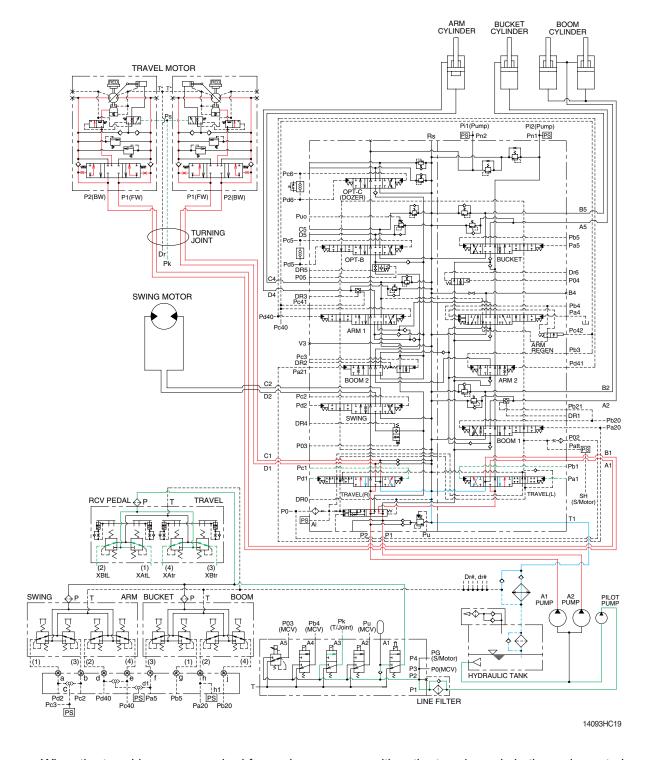
### PARKING BRAKE "ON" OPERATION

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.

### 8. 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

# P2(BW) P1(FW) P1(FW) P2(BW) P1(FW) P2(BW) TO/FROM MAIN CONTROL VALVE

14093HC19A

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

# 1) COUNTER BALANCE VALVE

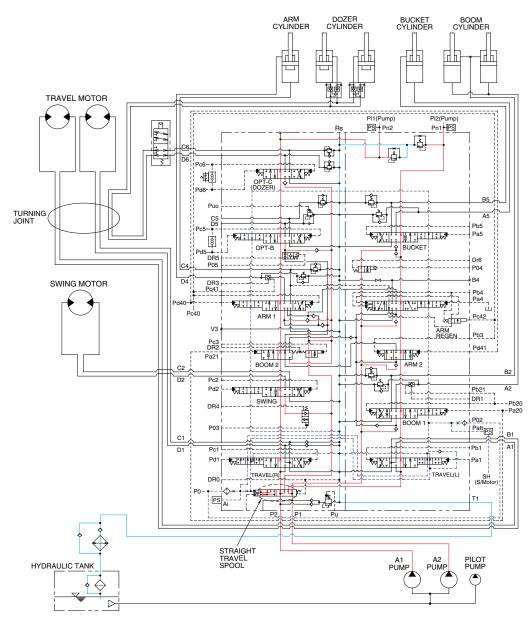
When stopping the motor of slope descending, this valve to prevent the motor over run.

# 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.

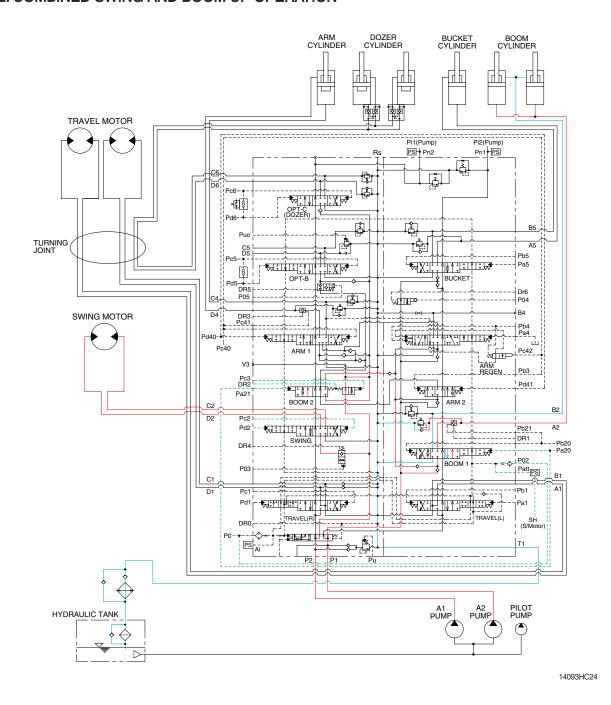
### STRAIGHT TRAVEL SPOOL

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.

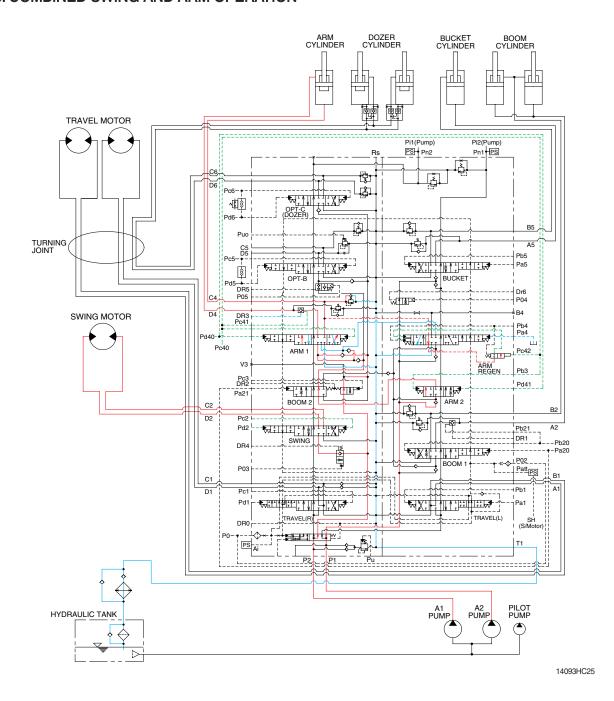
The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

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



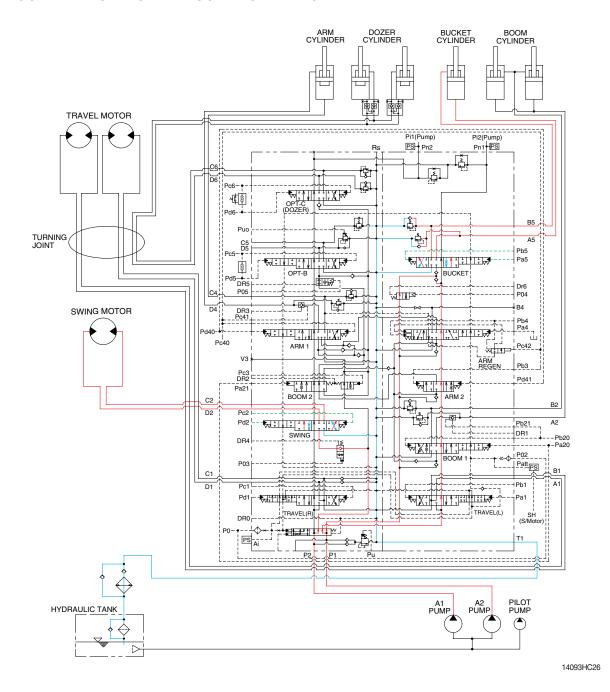
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

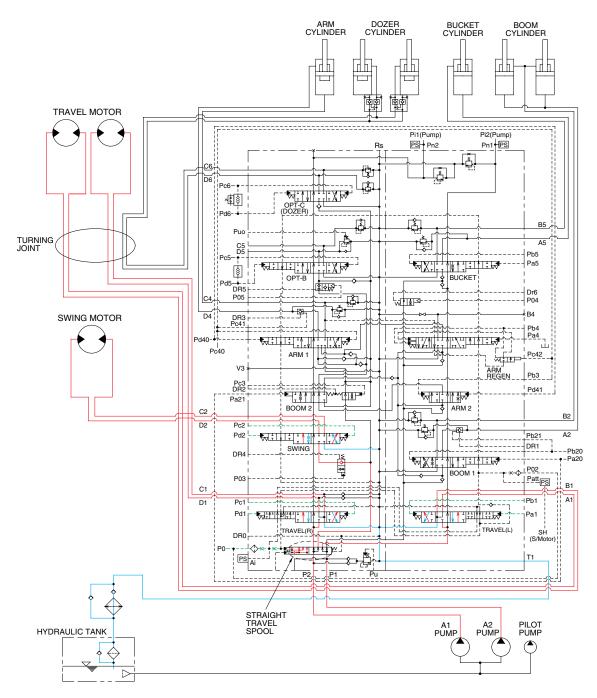


When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

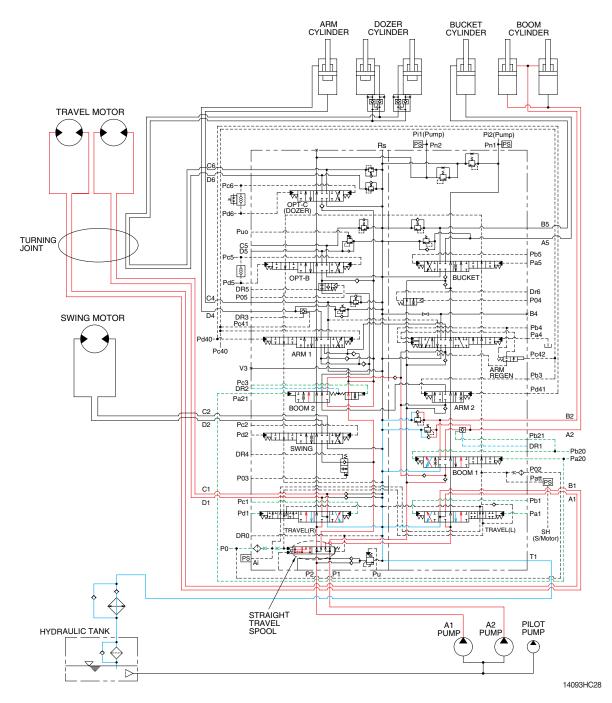
When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and straight travel spool is pushed to the right by the pilot oil pressure from the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



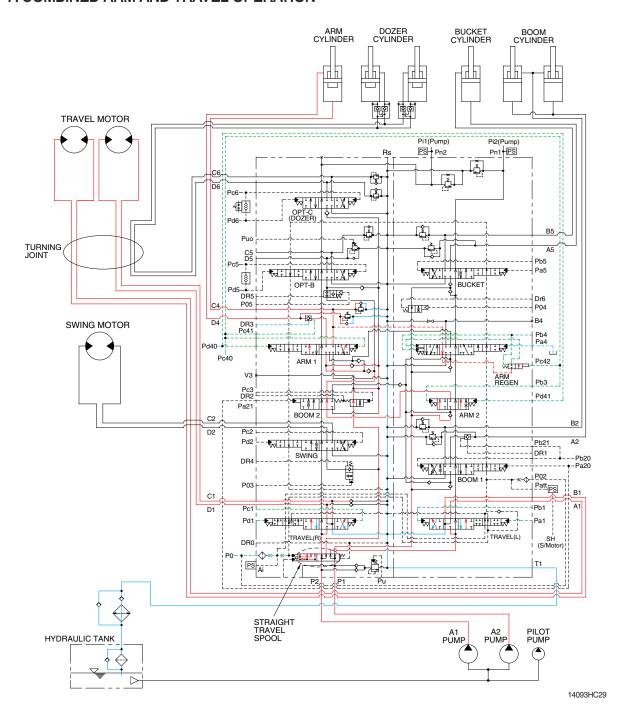
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot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



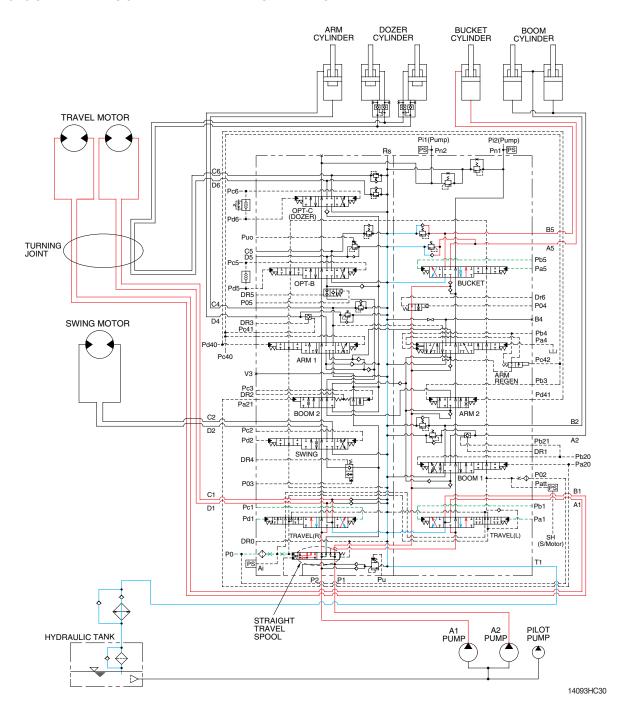
When the arm and travel functions are operated, simultaneously the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

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.

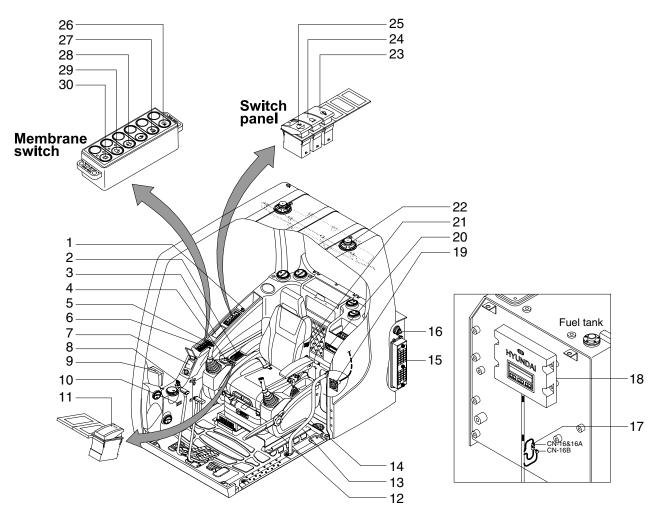
# SECTION 4 ELECTRICAL SYSTEM

Group	1	Component Location ·····	4-1
Group	2	Electrical Circuit ·····	4-3
Group	3	Electrical Component Specification	4-21
Group	4	Connectors ····	4-29

# **SECTION 4 ELECTRICAL SYSTEM**

# **GROUP 1 COMPONENT LOCATION**

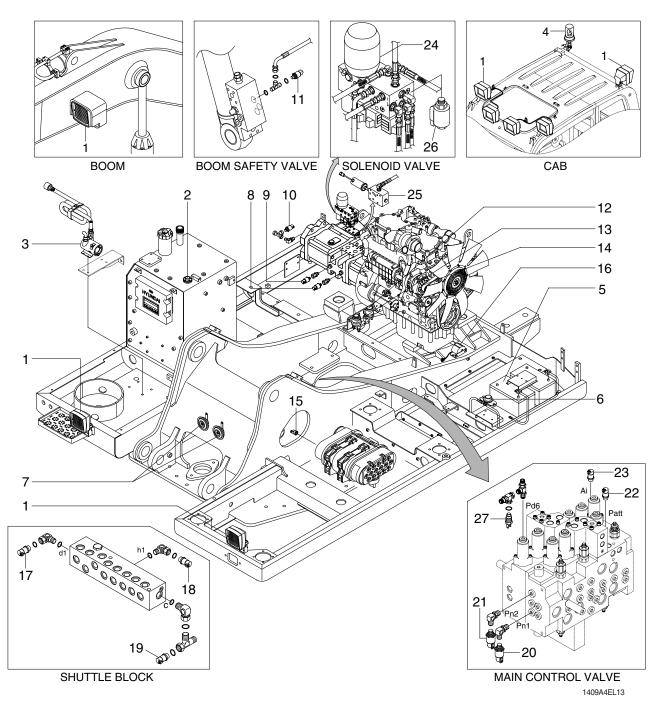
# 1. LOCATION 1



1409A4EL12

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

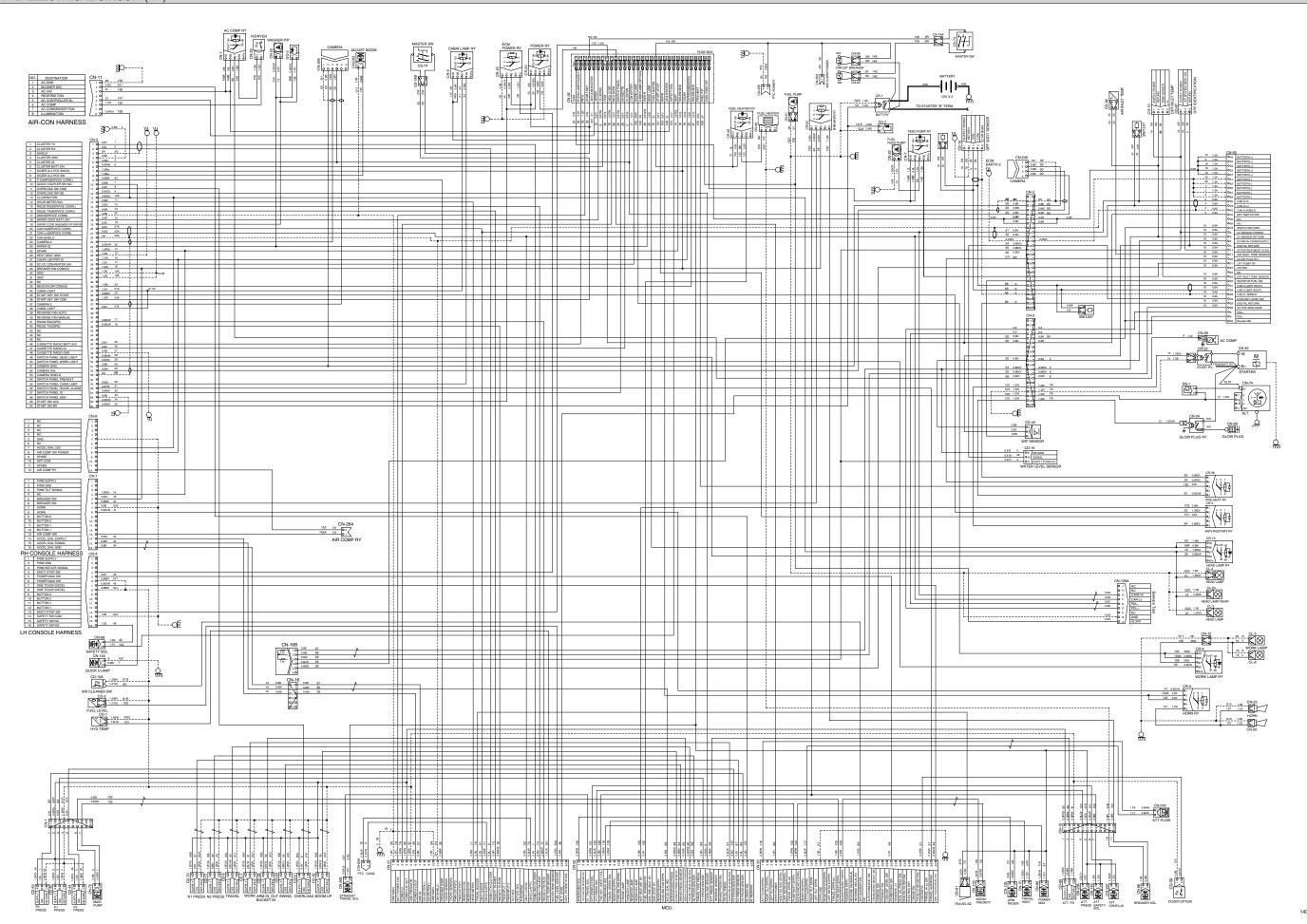
# 2. LOCATION 2



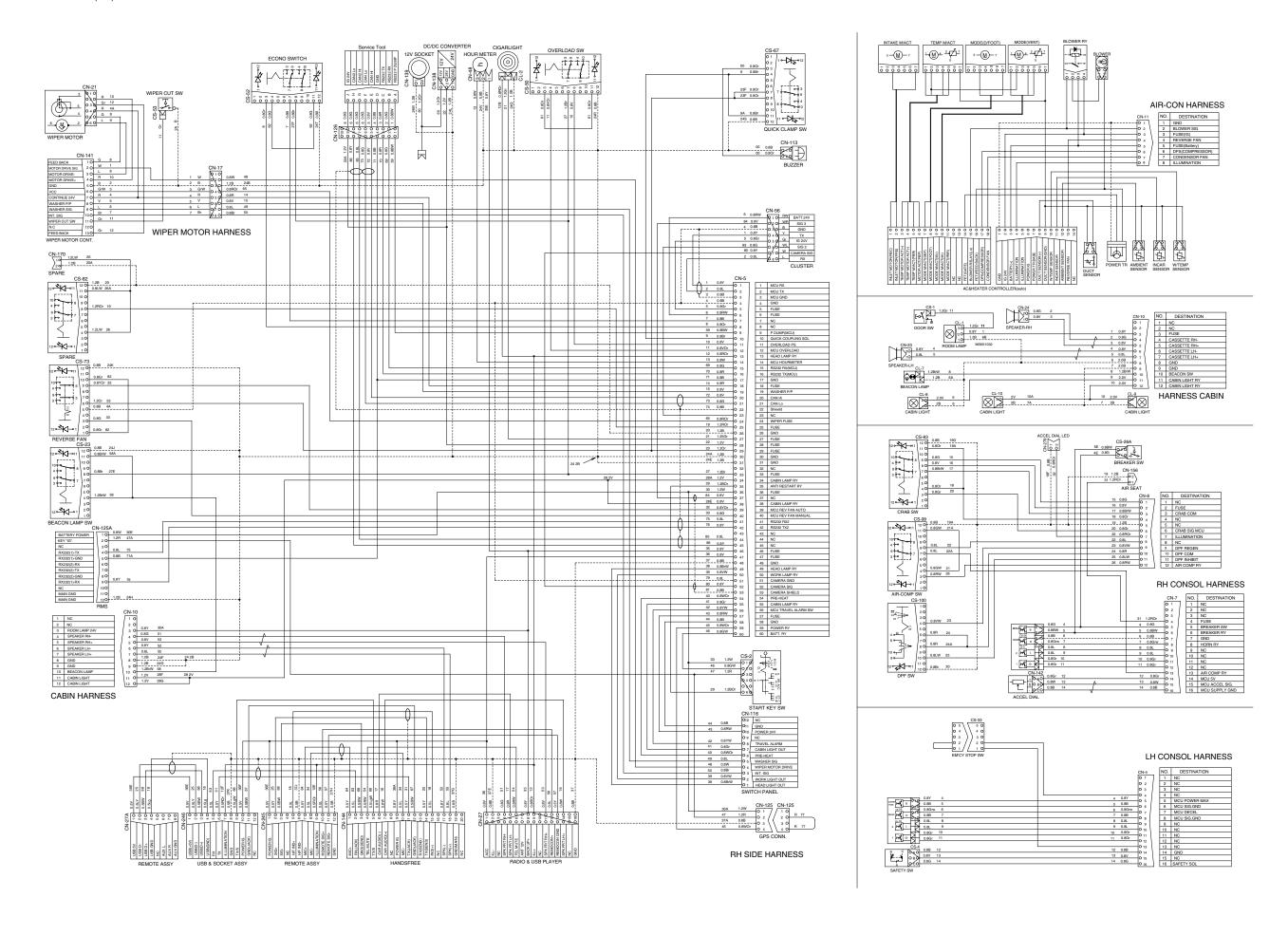
- 1 Lamp
- 2 Fuel sender
- 3 Fuel filler pump
- 4 Beacon lamp
- 5 Battery
- 6 Battery relay
- 7 Horn
- 8 P1 pressure sensor
- 9 P2 pressure sensor

- 10 P3 pressure sensor
- 11 Overload pressure sensor
- 12 Heater relay
- 13 Alternator
- 14 Start relay
- 15 Air cleaner switch
- 16 Travel alarm buzzer
- 17 Arm/Bucket in pressure sensor
- 18 Boom up pressure sensor

- 19 Swing pressure sensor
- 20 Negative 1 pressure sensor
- 21 Negative 2 pressure sensor
- 22 Attach pressure sensor
- 23 Travel pressure sensor
- 24 Solenoid valve
- 25 Pump EPPR valve
- 26 Boom priority EPPR valve
- 27 Dozer pressure switch



## · ELECTRICAL CIRCUIT (2/2)



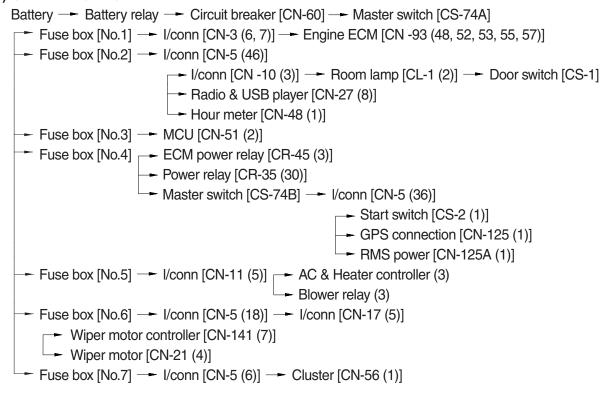
# **MEMORANDUM**

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

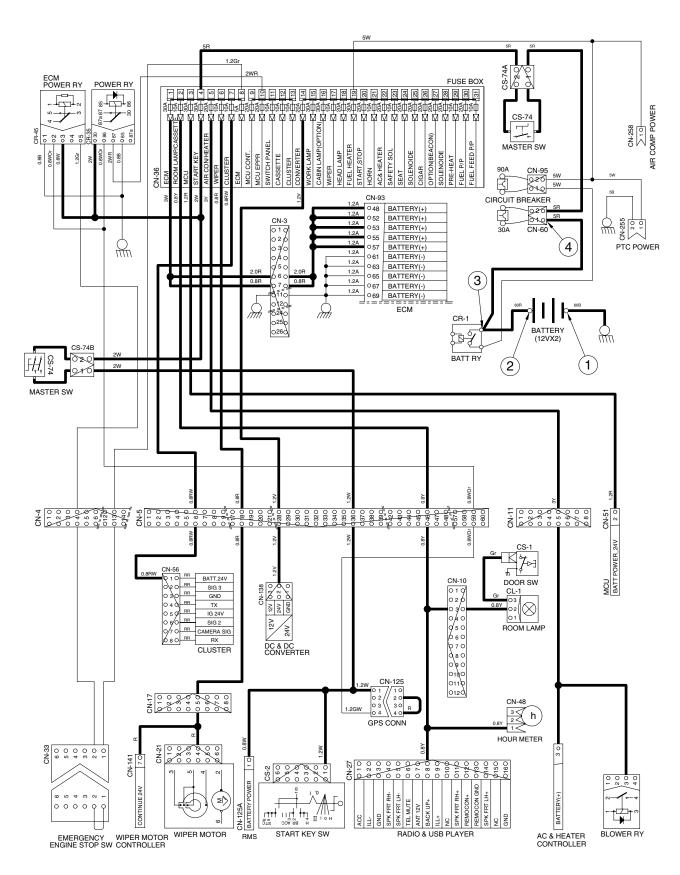


I/conn : Intermediate connector

## 2) CHECK POINT

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

## **POWER CIRCUIT**



## 2. STARTING CIRCUIT

#### 1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74] → Fuse box [No.4] → Master switch [CS-74B] → 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)

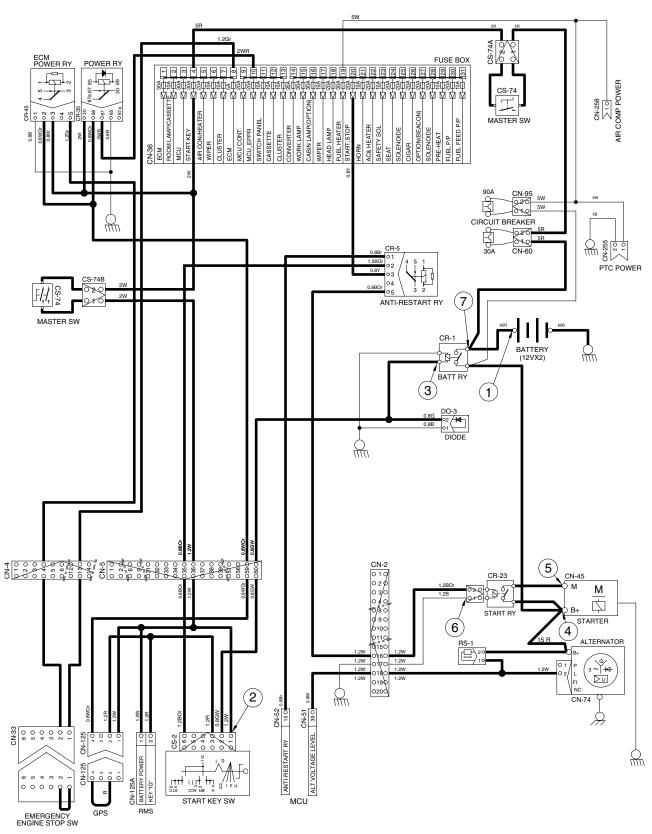
  Start switch ON [CS-2 (3)] → GPS connector [CN-125 (2) → (4)] → I/conn [CN-5 (59)]
  → Power relay [CR-35 (86) → (87)] → Fuse box [No.10]
  → ECM power relay [CR-45 (2) → (5)] → I/conn [CN-4 (4)] → Emergency engine stop switch [CS-33 (2) → (1)] → I/conn [CN-4 (13)] → Fuse box [No.8]
- (2) When start key switch is in START position

Start switch START [CS-2 (6)]  $\longrightarrow$  I/conn [CN-5 (35)]  $\longrightarrow$  Anti-restart relay [CR-5 (2)  $\rightarrow$  (5)]  $\longrightarrow$  I/conn [CN-2 (16)]  $\longrightarrow$  Start relay [CR-23]

## 2) CHECK POINT

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

## 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

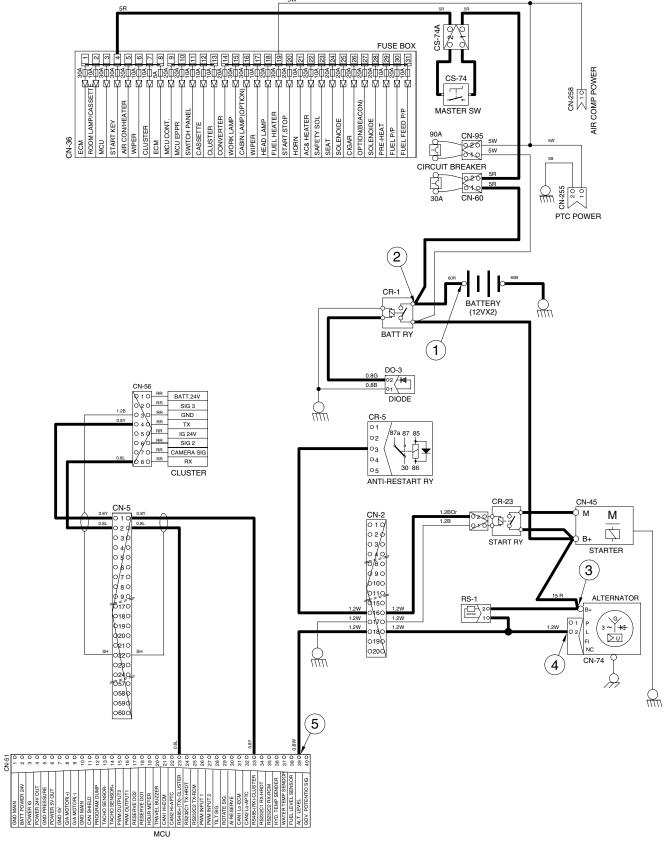
Alternator "L" terminal [CN-74 (2)] — I/conn [CN-2 (18)] — MCU alternator voltage level [CN-51 (39)] — Cluster charging warning lamp (via serial interface)

## (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 <sup>+</sup> terminal)	20~30V
		④ - GND (alternator L terminal)	
		⑤ - GND (MCU)	

## **CHARGING CIRCUIT**

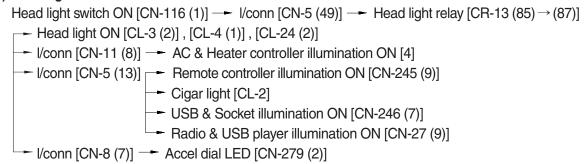


## 4. HEAD AND WORK LIGHT CIRCUIT

## 1) OPERATING FLOW

Fuse box (No.18) → Head light relay [CR-13 (30,86)] Fuse box (No.15) → Work light relay [CR-4 (30,86)]

## (1) Head light switch ON



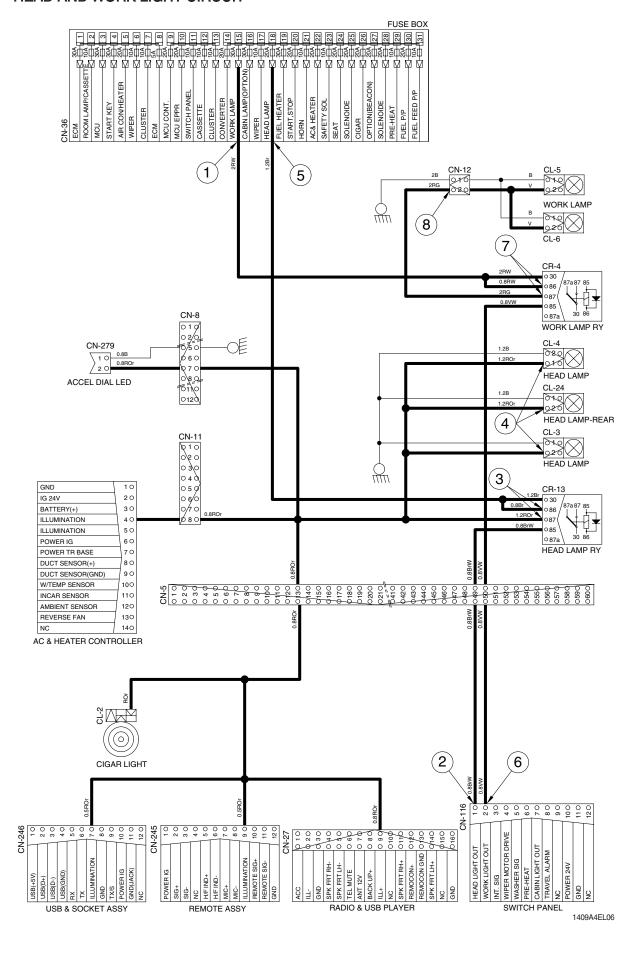
## (2) Work light switch ON

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 (2)]  $\longrightarrow$  Work light ON [CL-5 (2), CL-6 (2)]

## 2) CHECK POINT

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

## **HEAD AND WORK LIGHT CIRCUIT**



## 5. BEACON LAMP AND CAB LIGHT CIRCUIT

## 1) OPERATING FLOW

```
Fuse box (No.27) → I/conn [CN-5 (33)] → Beacon lamp switch [CN-23 (8)] Fuse box (No.16) → 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]
```

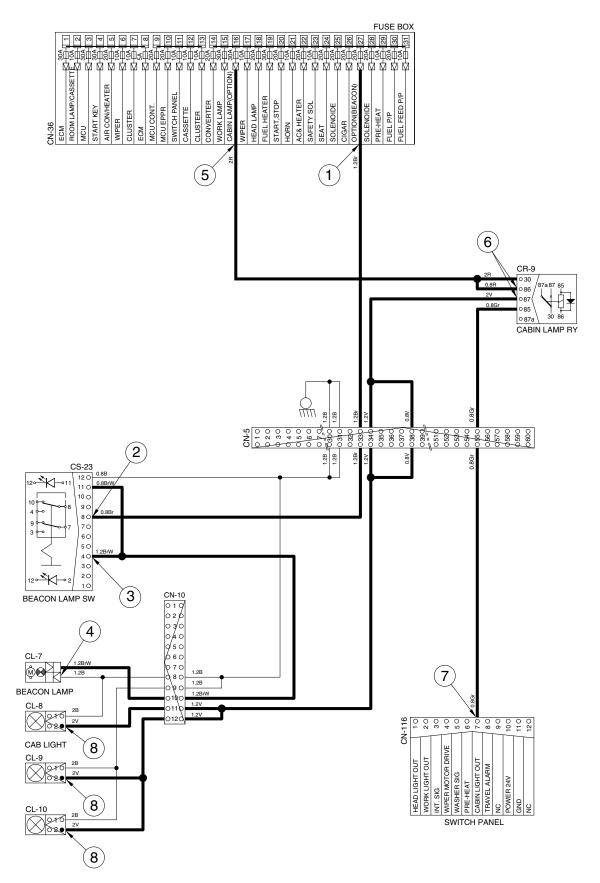
## (2) Cab light switch ON

```
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 (12)] \longrightarrow Front cab light ON [CL-9 (2), CL-10 (2)] \longrightarrow I/conn [CN-10 (11)] \longrightarrow Rear cab light ON [CL-8 (2)]
```

## 2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (fuse box)	
		② - GND (switch power input)	
		③ - GND (switch power output)	
STOP	ON	④ - GND (beacon lamp)	20~25V
3101		⑤ - GND (fuse box)	20~25V
		⑥ - GND (cabin light relay)	
		⑦ - GND (switch power output)	
		® - GND (cab light)	

## BEACON LAMP AND CAB LIGHT CIRCUIT



#### 6. WIPER AND WASHER CIRCUIT

#### 1) OPERATING FLOW

## (1) Key switch ON

Fuse box (No.11) — I/conn [CN-5 (57)] — Switch panel [CN-116 (10)]

Fuse box (No.6) — I/conn [CN-5 (18)] — I/conn [CN-17 (5)] — Wiper motor controller [CN-141(7)]

Fuse box (No.17) — 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)]  $\longrightarrow$  I/conn [CN-17 (7)]  $\longrightarrow$  Wiper motor controller [CN-141 (9)  $\rightarrow$  (8)]  $\longrightarrow$  I/conn [CN-17 (6)]  $\longrightarrow$  I/conn [CN-15 (19)]  $\longrightarrow$  Washer pump [CN-22 (1)]  $\longrightarrow$  Washer operating Wiper switch ON [CN-116 (4)]  $\longrightarrow$  I/conn[CN-17 (2)]  $\longrightarrow$  Wiper motor controller [CN-141 (2)  $\rightarrow$  (4)]  $\longrightarrow$  Wiper motor operating [CN-21 (2)]

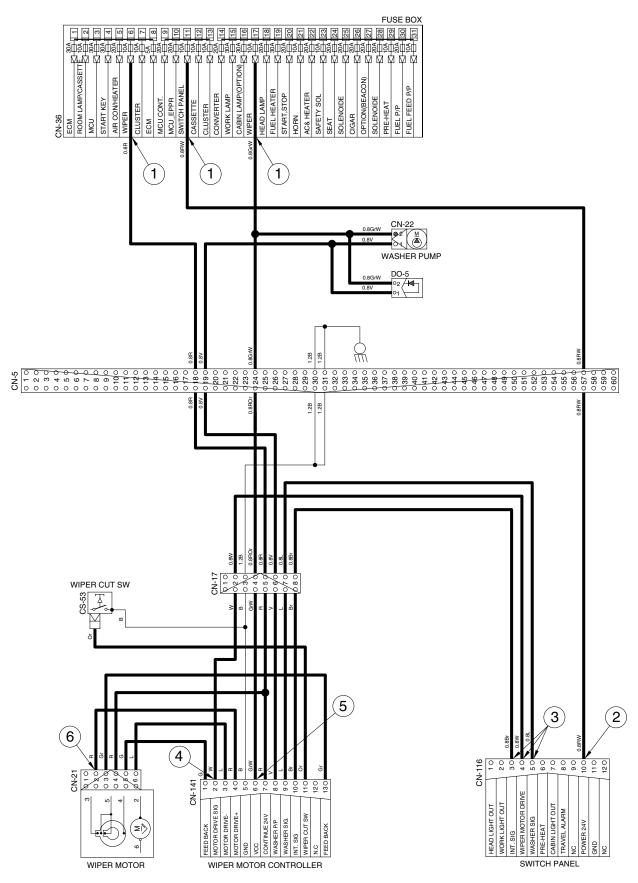
## (5) Auto parking (when switch OFF)

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

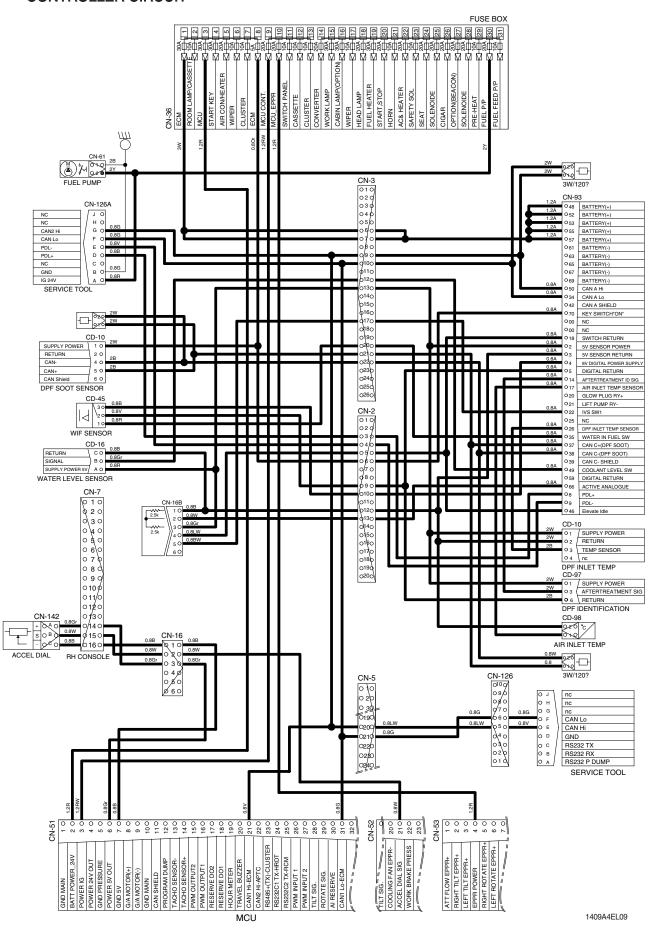
## 2) CHECK POINT

Engine	Start switch	Check point	Voltage	
		① - GND (fuse box)	24V	
		② - GND (switch power input)	241	
CTOD	ON	③ - GND (switch power output)	0 51/	
STOP		④ - GND (wiper power input)	0 ~ 5V	
		⑤ - GND (wiper power output)	24V	
		⑥ - GND (wiper motor)	0 or 24V	

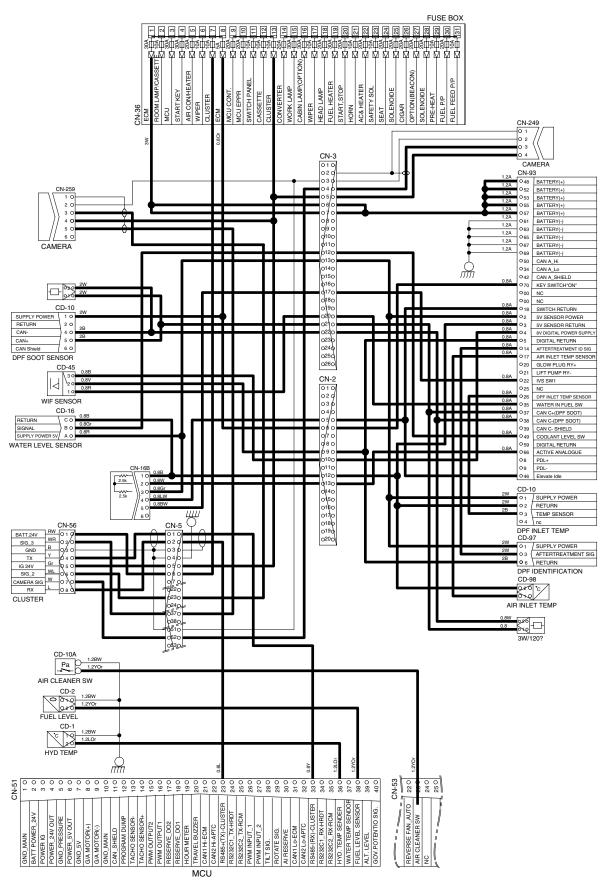
## WIPER AND WASHER CIRCUIT



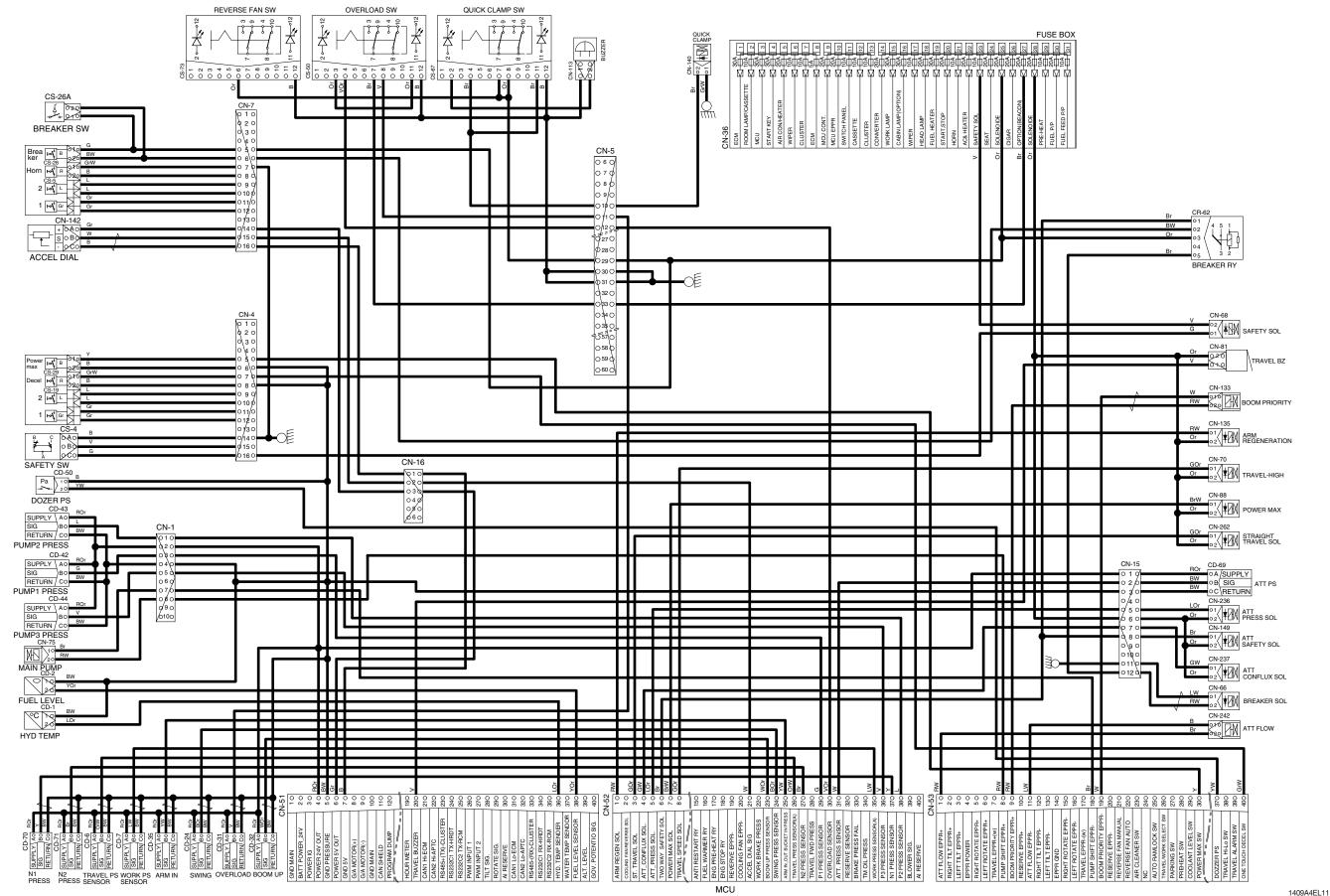
## **CONTROLLER CIRCUIT**



#### MONITORING CIRCUIT



## **ELECTRIC CIRCUIT FOR HYDRAULIC**



# GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2 EA)	<ul> <li>* Check specific gravity</li> <li>1.280 over : Over charged</li> <li>1.280 ~ 1.250 : Normal</li> <li>1.250 below : Recharging</li> </ul>
Battery relay	CR-1	Rated load : 24V 100A (continuity) 1000A (30 seconds)	<ul> <li>Check coil resistance (M4 to M4)</li> <li>Normal : About 50 Ω</li> <li>Check contact</li> <li>Normal : ∞ Ω</li> </ul>
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: $0$ $\Omega$ (for terminal 1-3 and 1-2) START: $0$ $\Omega$ (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 resistance 0.25~0.12 Ω
Temperature sensor (hydraulic)	°C 10 20 CD-1	-	<ul> <li>Check resistance</li> <li>50°C : 804 Ω</li> <li>80°C : 310 Ω</li> <li>100°C : 180 Ω</li> </ul>
Air cleaner pressure switch	Pa ————————————————————————————————————	(N.O TYPE)	% Check contact High level : $\infty \Omega$ Low level : $0 \Omega$
Fuel sender	CD-2	-	$ \begin{tabular}{lllllllllllllllllllllllllllllllllll$
Relay (air con blower)	3 4 4 0 3 0 2 0 1 2 1 0	24V 20A	% Check resistance Normal : About 200 $\Omega$ (for terminal 1-3) 0 $\Omega$ (for terminal 2-4)
Relay	CR-2 CR-5 CR-36 CR-45 CR-62	24V 16A	% Check resistance Normal : About 160 $\Omega$ (for terminal 1-2) $0\Omega$ (for terminal 3-4) $\infty\Omega$ (for terminal 3-5)

Part name	Symbol	Specifications	Check
Relay	030 086 087 085 087 085 087 087 085 087 087 087 087 087 087 087 087	24V 16A	* Check resistance Normal : About 160 $\Omega$ (for terminal 85-86) $0\Omega$ (for terminal 30-87a) $\infty\Omega$ (for terminal 30-87)
Solenoid valve	CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-236 CN-237 CN-262 CN-263	24V 1A	* Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	1 O 2 O CN-75 CN-133 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-52 CS-67 CS-73 CS-82 CS-83 CS-99 CS-100	24V 8A	* Check contact Normal ON : 0 $\Omega$ (for terminal 3-7, 4-8) $\Omega$ (for terminal 7-9, 8-10) OFF: $\Omega$ (for terminal 3-7, 4-8) $\Omega$ (for terminal 7-9, 8-10)
Accel dial	OAO + BOS - CN-142	-	** Check resist     Normal : About 5k Ω

Part name	Symbol	Specifications	Check
Room lamp	3 O 2 O 1 O CL-1	24V 10W	* Check disconnection Normal : $1.0 \Omega$ ON : $0 \Omega$ (For terminal 1-2) $\Omega \Omega$ (For terminal 1-3) OFF : $\Omega \Omega$ (For terminal 1-2) $\Omega \Omega$ (For terminal 1-3)
Head lamp, Work lamp, Cab lamp	CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24	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	CN-61	24V 10A 35 / /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.

Part name	Symbol	Specifications	Check
Safety switch	2 3 1 0 2 0 1 CS-4	24V 15A (N.C TYPE)	$ \begin{tabular}{ll} $\times$ Check contact \\ Normal : 0 $\Omega$ (for terminal 1-2) \\ $\infty$ $\Omega$ (for terminal 1-3) \\ Operating : $\infty$ $\Omega$ (for terminal 1-2) \\ $0$ $\Omega$ (for terminal 1-3) \\ \end{tabular} $
Wiper cut switch	CS-53	24V (N.O TYPE)	* Check contact Normal : 0 $\Omega$ (one pin to ground)
Receiver dryer	P 2 0 CN-29	24V 2.5A	* Check contact     Normal : ∞ Ω
Radio & USB plalyer	OSIO OSIO OSIO OSIO OSIO OSIO OSIO OSIO	24V 2A	* Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	M 2 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)

Part name	Symbol	Specifications	Check
DC/DC Converter	0 3 0 12V 12V 24V 0 10 GND 24V CN-138	12V 3A	<ul><li>* Check voltage</li><li>24V (for terminal 1-2)</li><li>12V (for terminal 1-3)</li></ul>
Cigar lighter	CL-2	24V 5A 1.4W	<ul> <li>* Check coil resistance</li> <li>Normal : About 1M Ω</li> <li>* Check contact</li> <li>Normal : ∞ Ω</li> <li>Operating time : 5~15sec</li> </ul>
Alternator	B+ O 1 O 2 D A D A D A D A D A D A D A D A D A D A	24V 85A	* Check contact  Normal : 0 Ω (for terminal B <sup>+</sup> -P)  Normal : 24~27.5V
Starter	M M B+ 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

Part name	Symbol	Specifications	Check
Start relay	CR-23	24V 300A	$\ast$ Check contact Normal : 0.94 $\Omega$ (for terminal 1-2)
Blower motor	O T O M O 2 O O	24V 9.5A	% Check resistance Normal : 2.5 $\Omega$ (for terminal 1-2)
Duct sensor (switch)	20	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 : ∞ $Ω$
Circuit breaker	CN-60 CN-95	CN-60 (30A) CN-95 (60A)	* Check disconnection normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)

Part name	Symbol	Specifications	Check
Master switch	CS-74A CS-74B	6-36V	* Check disconnection Normal : 0.1 Ω
Quick clamp buzzer	CN-113	24V 200mA 107±4dB	-
Socket	O1 O2 CN-139	12V 10A	-
WIF sensor	©2 ©1	-	Check contact     Normal: 68.8 ~ 4.94 Ω

# **GROUP 4 CONNECTORS**

## 1. CONNECTOR DESTINATION

Connector	Туре	No. of	Destination	Connecto	or part No.
number	туре	pin	Destination	Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	AMP	20	I/conn (Frame harness-Engine harness)	936777-2	936780-2
CN-3	AMP	26	I/conn (Frame harness-Engine harness)	1897009-2	1897013-2
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-7	AMP	16	l/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-8	AMP	12	l/conn (Console harness RH-Frame harness)	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	-
CN-12	DEUTSCH	2	l/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-15	AMP	12	l/conn (Frame harness-Two way harness)	S816-012002	S816-112002
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	AMP	8	I/conn (Wiper harness)	S816-006002	S816-108202
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	S816-006202	-
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 & USB player	PK145-16017	-
CN-27A	AMP	8	USB player	S816-008002	S816-108002
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse box	21Q7-10920	-
CN-45	RING-TERM	-	Starter motor B+	S820-308000	-
CN-48	KET	1	Service meter	2-520193-2	-
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	YAZAKI	2	Circuit breaker	-	S813-130201
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
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	RING-TERM	-	Alternator "L" terminal	-	S820-105000

Connector	Type	No. of	Destination	Connecto	or part No.
number	туре	pin	Destination	Female	Male
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	776469-1	-
CN-95	AMP	2	Circuit breaker	-	S813-130201
CN-96	AMP	4	Fuel warmer	15300027	-
CN-113	KET	2	Buzzer	MG651205-5	-
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	172434-2	-
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-145	DEUTSCH	2	Fuel pump	DT06-2S-EP06	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat	DT04-2S-E005	DT06-2P-EP06
CN-157	AMP	1	Antena power	S822-014002	-
CN-170	AMP	2	Heated seat	S816-002002	S816-102002
CN-173	AMP	2	Resistor	S816-002002	-
CN-231	DEUTSCH	2	I/conn (Master switch-Fuse box)	S813-030201	
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-244	DEUTSCH	3	CAN 2	-	DT04-3P-EP06
CN-245	AMP	12	Remote controller assy	368542-1	-
CN-246	AMP	12	USB & Socket assy	174045-2	-
CN-249	AMP	4	Rear view camera	S816-004002	S816-104002
CN-255	AMP	12	PTC power	S813-030201	-
CN-259	AMP	6	Camera	S816-006002	-
CN-262	DEUTSCH	2	Straight travel solenoid	DT06-2S-EP06	-
CN-263	DEUTSCH	2	Adjust boom solenoid	DT06-2S-EP06	-
CN-279	AMP	2	Accel dial LED	S816-002002	S816-102002

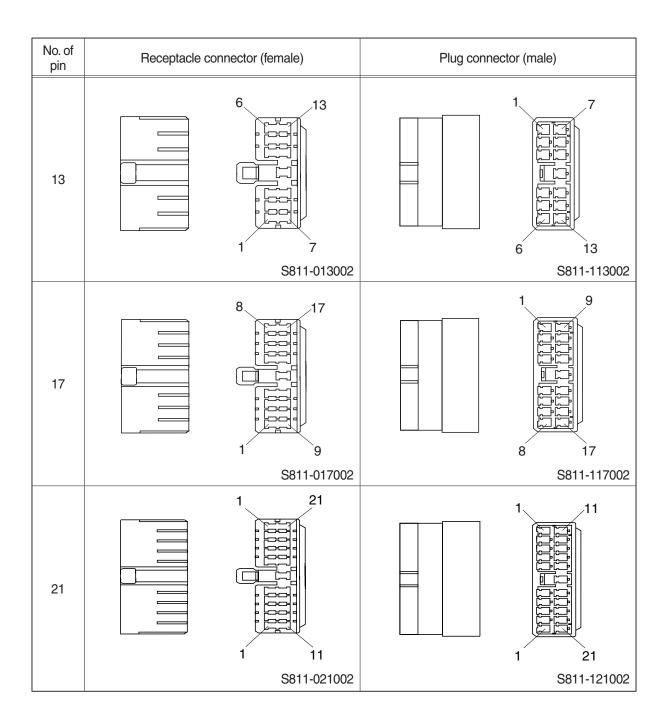
Connector	Tuno	No. of	Destination	Connecto	or part No.
number	Type	pin	Destination	Female	Male
$\cdot$ Relay					
CR-1	RING-TERM	-	Battery relay	ST710285-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Work lamp relay	BJA003526-001	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	BJA003526-001	-
CR-9	-	5	Cabin lamp relay	BJA003526-001	-
CR-13	-	5	Head lamp relay	BJA003526-001	-
CR-23	RING TERM	-	Start relay	S814-002001	S814-102001
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	BJA003526-001	-
CR-62	-	5	Breaker relay	BJA003526-001	-
· Switch		I			l
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	WP	6	Start key switch	S816-006100	-
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-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
CS-50	SWF	12	Overload switch	SWF589790	-
CS-52	SWF	12	Econo 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	SWF 589790	-
CS-74A	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-74B	AMP	2	Master switch	S813-030201	-
CS-82	SWF	12	Heated seat switch	SWF 589790	-
CS-83	SWF	12	Spare switch	SWF 589790	-
CS-99	SWF	12	Air compressor switch	SWF 589790	-
CS-100	SWF	12	Spare switch	SWF 589790	-

Connector	Typo	No. of	Destination	Connecto	or part No.	
number	Туре	pin	Destination	Female	Male	
· Light	· 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	DT06-2S-EP06	DT04-2P-E005	
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P-E005	
CL-5	AMP	2	Work lamp-LH	180923-0	-	
CL-6	AMP	2	Work lamp-RH	180923-0	-	
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002	
CL-8	DEUTSCH	2	Front cab light-LH	DT06-2S-EP06	DT04-2P	
CL-9	DEUTSCH	2	Front cab light-RH	DT06-2S-EP06	DT04-2P	
CL-10	DEUTSCH	2	Rear cab light-LH	DT06-2S-EP06	DT04-2P	
CL-24	DEUTSCH	2	Work lamp-rear	DT06-2S-EP06	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	AMP	4	DPF inlet temp sensor	776487-2	-	
CD-10A	AMP	2	Air cleaner switch	85202-1	-	
CD-16	DELPHI	3	Water level sensor	12110293	-	
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-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	AMP	3	WIF sensor	776429-3	-	
CD-50	KET	2	Dozer pressure switch	MG640795	-	
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	-	
CD-97	AMP	6	Aftertreatment	776433-3	-	
CD-98	AMP	2	Air intake temp sensor	776427-1	-	
CD-107	AMP	6	DPF soot sensor	776433-3	-	

## 2. CONNECTION TABLE FOR CONNECTORS

# 1) PA TYPE CONNECTOR

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

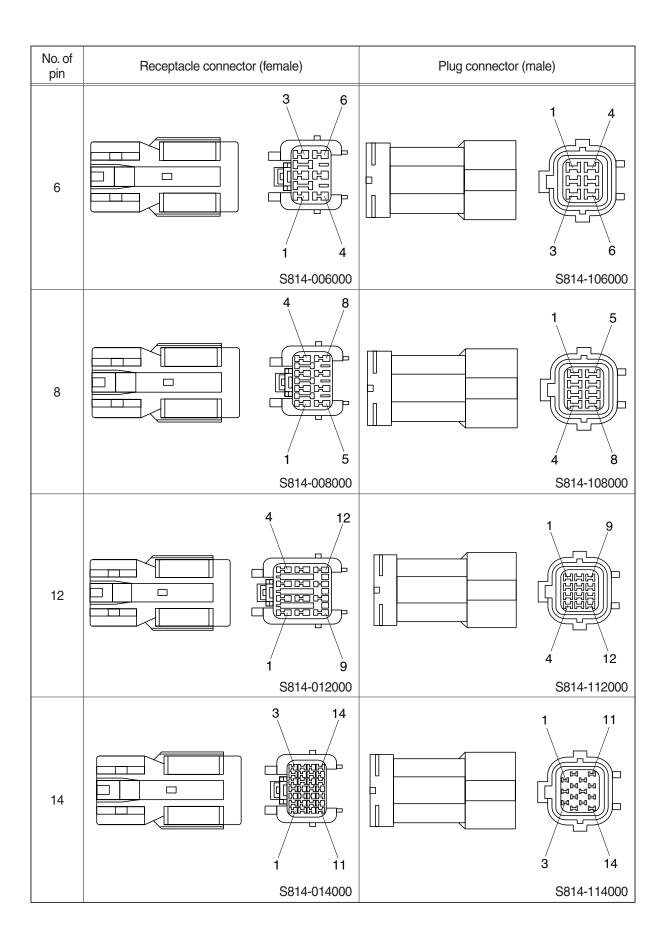


# 2) J TYPE CONNECTOR

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 2 000 6 3 1 S816-108001

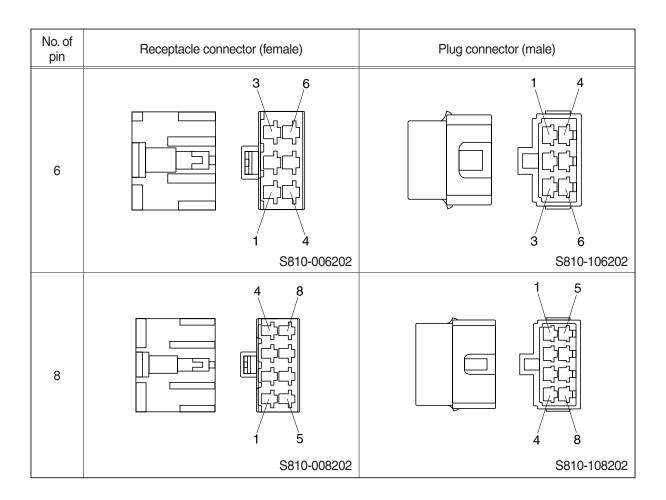
# 3) SWP TYPE CONNECTOR

No. of pin	Receptacle connector (for	emale)	Plug connector (m	nale)
1		S814-001000		S814-101000
2		2 1 S814-002000		2 S814-102000
3		3 2 1 S814-003000		2 3 S814-103000
4		2 4 1 3 S814-004000		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	1 13 25 25 36
	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 6 +++++ 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	

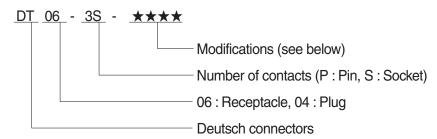
# 12) KET 090 WP CONNECTORS

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

No. of pin	Receptacle conne	ector (female)	Plug	connector (male)
2		2 1	1 2	
		DT06-2S		DT04-2P
3		1 2 3	2 1	
		DT06-3S		DT04-3P
4		1 4 2 3	3 2	
		DT06-4S		DT04-4P

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

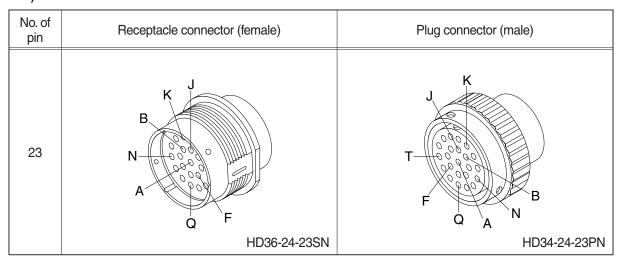
No. of pin	Receptacle connector (female)	Plug connector (male)
6	3 4 6 S816-006002	3 1 6 4 S816-106002
8	5816-008002	4 1 8 5 S816-108002
10	5 6 10 S816-010002	5 10 6 S816-110002
12	7 12 S816-012002	6 9 9 9 9 9 9 7 S816-112002

No. of pin	Receptacle connector (female)	Plug connector (male)
15	3 15 	15
	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	11 21 21 31 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

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 30 0000 000 000 000 000 000 000 000 00	

# 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

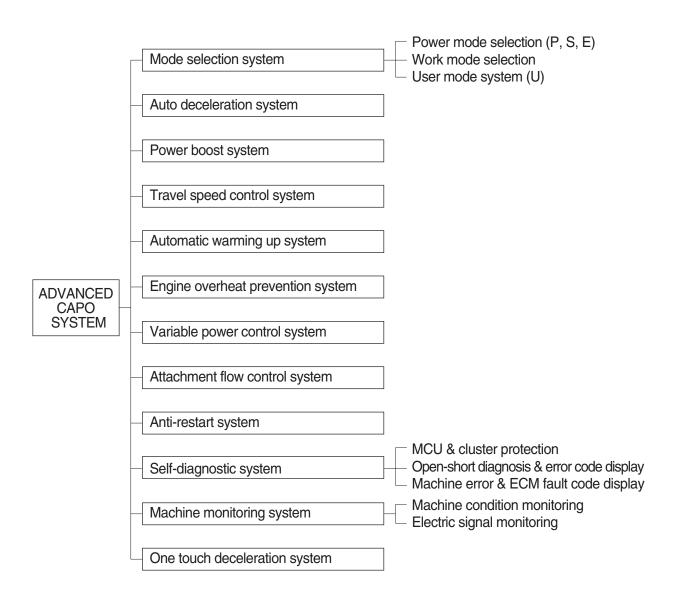
Group	1	Outline	5-1
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### SECTION 5 MECHATRONICS SYSTEM

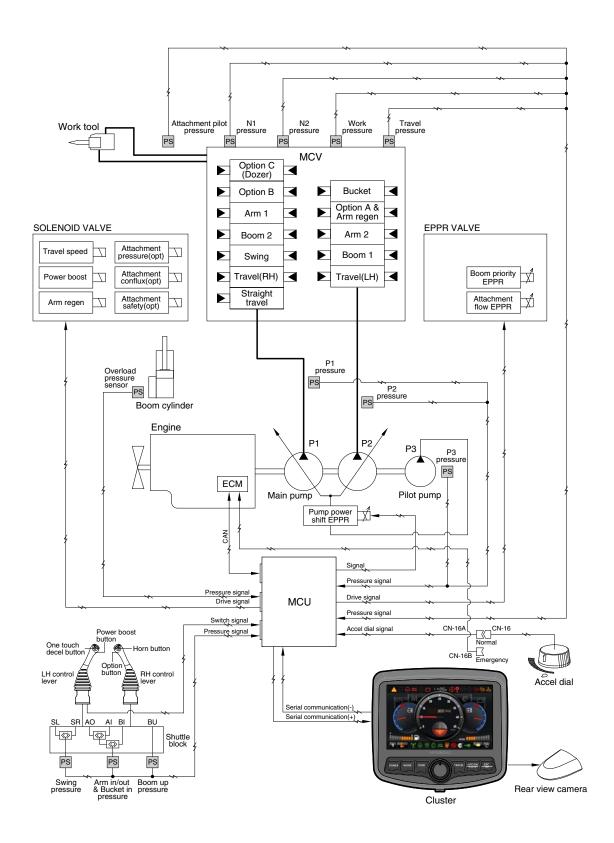
#### **GROUP 1 OUTLINE**

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.



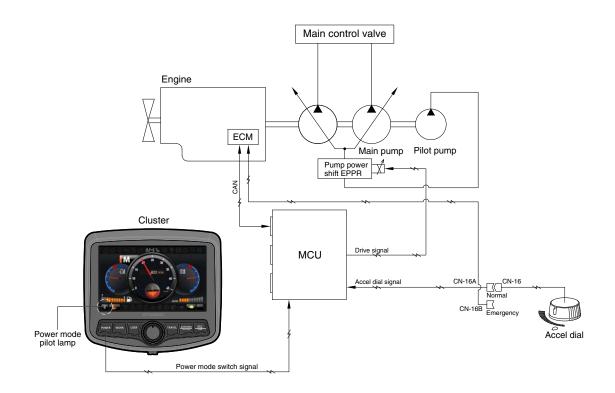
#### SYSTEM DIAGRAM



145Z9A5MS01

### **GROUP 2 MODE SELECTION SYSTEM**

#### 1. POWER MODE SELECTION SYSTEM



2609A5MS02

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

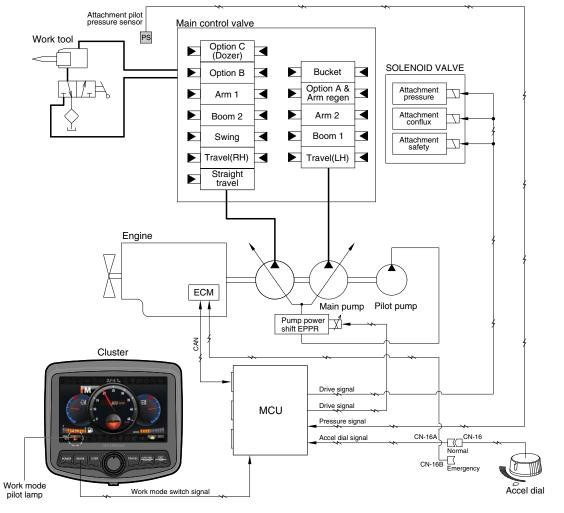
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

		Engine rpm			Power shift by EPPR valve				
Power	Application	Standard		Option		Standard		Option	
mode		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm²)	Current (mA)	Pressure (kgf/cm²)
Р	Heavy duty power	1850±50	1950±50	1950±50	2050±50	290±30	10	160±30	0
S	Standard power	1750±50	1850±50	1850±50	1950±50	360±30	13±3	250±30	5±3
Е	Economy operation	1650±50	1750±50	1750±50	1850±50	360±30	15±3	280±30	10±3
AUTO DECEL	Engine deceleration	1100±100	-	1100±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3

<sup>\*</sup> 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).



#### 145Z9A5MS02

#### 1) GENERAL WORK MODE (bucket)

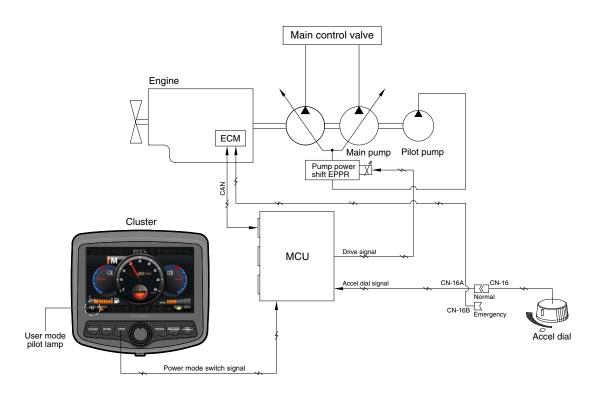
This mode is used to general digging work.

#### 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 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



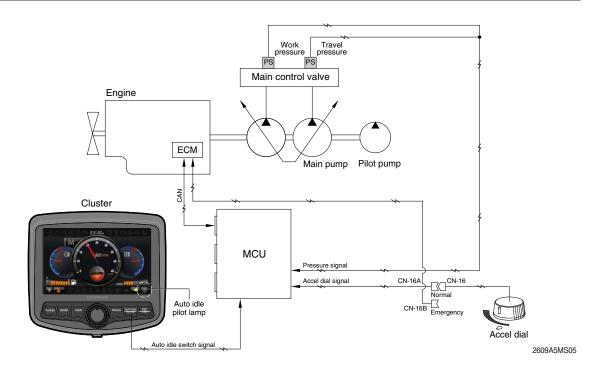
2609A5MS04

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	1300	800	0
2	1400	850	3
3	1500	900	6
4	1600	950	9
5	1700	1000 (low idle)	12
6	1800	1050	16
7	1900	1100 (decel rpm)	20
8	2000	1150	26
9	2050	1200	32
10	2100	1250	38

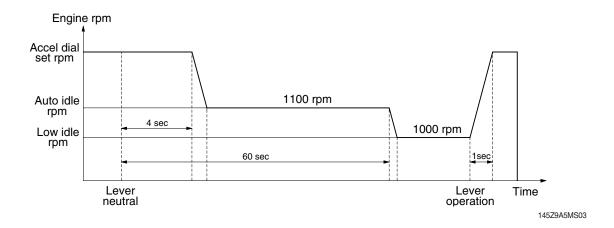
### **GROUP 3 AUTOMATIC DECELERATION SYSTEM**



#### 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 1100 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 1000 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.

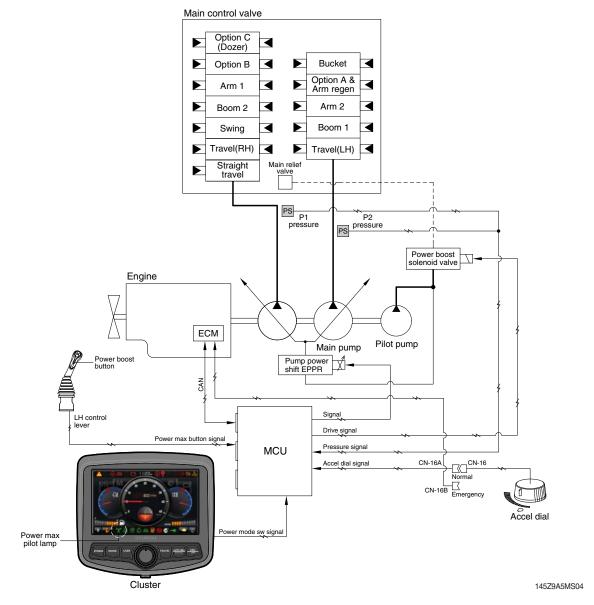


#### 2. WHEN AUTO IDLE PILOT LAMP OFF

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**

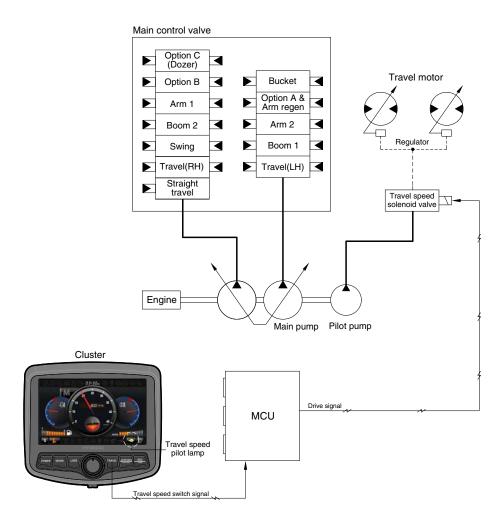


- When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.
- When the power boost function is activated, the power boost solenoid valve pilot pressure raises the set pressure of the main relief valve to increase 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	<ul><li>- Pre-set power mode</li><li>- Power boost solenoid : OFF</li><li>- Power boost pilot lamp : OFF</li></ul>

\* 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**



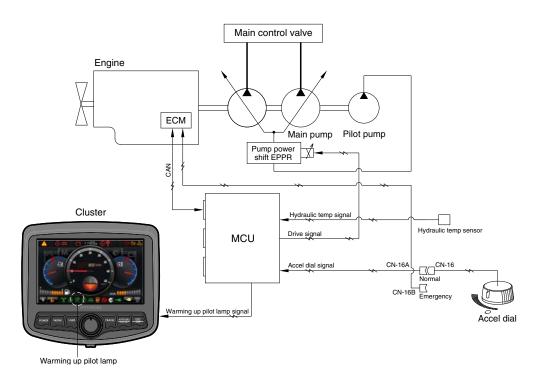
145Z9A5MS05

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**



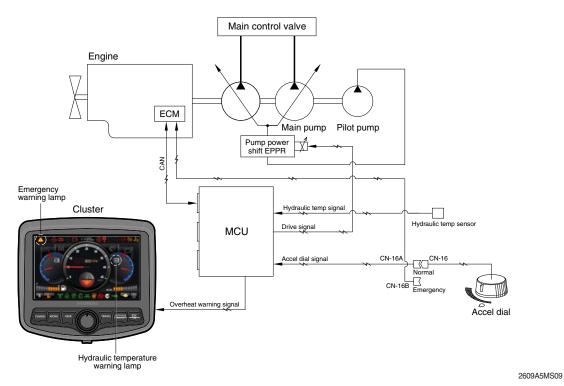
2609A5MS08

- 1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30°C, engine speed increases to 1200 rpm after 1 minute from engine start. 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**

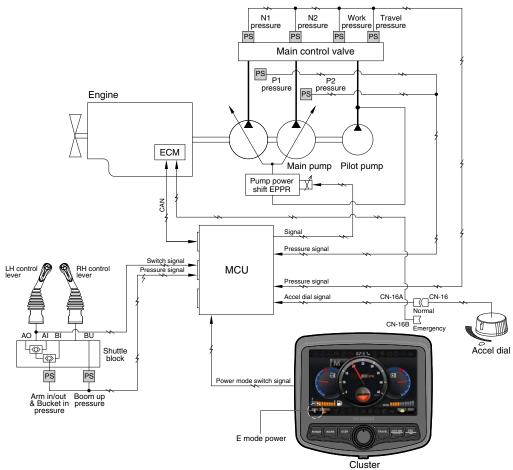


1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 100°C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

#### 2. LOGIC TABLE

Description		Condition	Function
First step	Activated	- Coolant temperature : Above 103°C - Hydraulic oil temperature : Above 100°C	- Warning lamp : ON, buzzer : OFF - Pump input torque is reduced.
warning	Canceled	- Coolant temperature : Less than 100°C - Hydraulic oil temperature : Less than 95°C	- Return to pre-set the pump absorption torque.
Second step	Activated	- Coolant temperature : Above 107°C - 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.
warning	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**



2609A5MS10

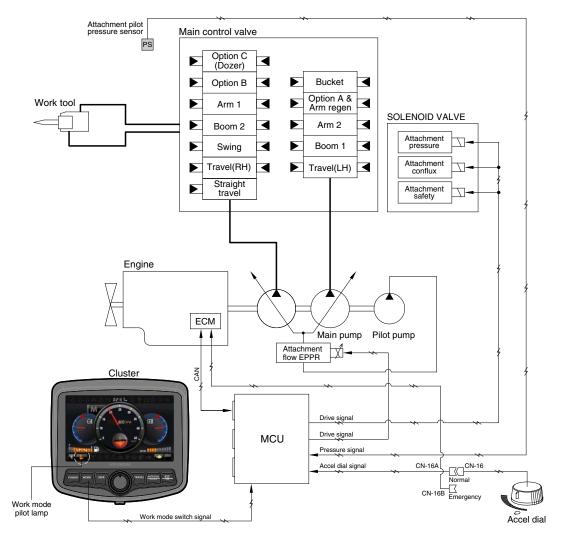
 The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.

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**



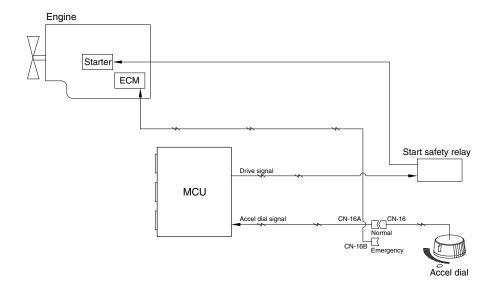
145Z9A5MS06

• 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**



2609A5MS12

#### 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 ADVANCED 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



· 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 co	de FMI	Description
TIOLOI IN	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.
	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.
	1	Travel oil pressure sensor data below normal range.
108	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.
.20	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.
100	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.

\* Some error codes are not applied to this machine.\* SPN : Suspect Parameter Number FMI: Failure Mode Identifier

Error co	de	Description
HCESPN	FMI	Description
	0	Swing pilot pressure sensor data above normal range.
135	1	Swing pilot pressure sensor data below normal range.
133	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.
138	1	Attachment pilot pressure sensor data below normal range.
130	2	Attachment pilot pressure sensor data error.
	4	Attachment pilot pressure sensor circuit-Voltage below normal, or shorted to low source.
140	5	Pump EPPR valve circuit - Current below normal, or open circuit.
140	6	Pump EPPR valve circuit - Current above normal.
1.11	5	Boom priority EPPR valve circuit - Current below normal, or open circuit.
141	6	Boom priority EPPR valve circuit - Current above normal.
140	5	Travel EPPR valve circuit - Current below normal, or open circuit.
143	6	Travel EPPR valve circuit - Current above normal.
444	5	Attachment flow EPPR valve circuit - Current below normal, or open circuit.
144	6	Attachment flow EPPR valve circuit - Current above normal.
4.45	5	Remote cooling fan EPPR valve circuit - Current below normal, or open circuit.
145	6	Remote cooling fan EPPR valve circuit - Current above normal.
450	5	Left rotate EPPR valve circuit - Current below normal, or open circuit.
150	6	Left rotate EPPR valve circuit - Current above normal.
454	5	Right rotate EPPR valve circuit - Current below normal, or open circuit.
151	6	Right rotate EPPR valve circuit - Current above normal.
4=0	5	Left tilt EPPR valve circuit - Current below normal, or open circuit.
152	6	Left tilt EPPR valve circuit - Current above normal.
4=0	5	Right tilt EPPR valve circuit - Current below normal, or open circuit.
153	6	Right tilt EPPR valve circuit - Current above normal.
400	5	Power max solenoid circuit - Current below normal, or open circuit.
166	6	Power max solenoid circuit - Current above normal.
4.0=	5	Travel speed solenoid circuit - Current below normal, or open circuit.
167	6	Travel speed solenoid circuit - Current above normal.
	5	Attachment pressure solenoid circuit - Current below normal, or open circuit.
168	6	Attachment pressure solenoid circuit - Current above normal.
	5	Attachment conflux solenoid circuit - Current below normal, or open circuit.
169	6	Attachment conflux solenoid circuit - Current above normal.
	5	Arm regeneration solenoid circuit - Current below normal, or open circuit.
170	6	Arm regeneration solenoid circuit - Current above normal.
. <del>-</del> - د	5	Attachment safety solenoid circuit - Current below normal, or open circuit.
171	6	Attachment safety solenoid circuit - Current above normal.
101	5	Remote cooling fan reverse solenoid circuit - Current below normal, or open circuit.
181	6	Remote cooling fan reverse solenoid circuit - Current above normal.
00.1	5	Fuel level sensor circuit - Voltage above normal, or shorted to high source.
301	6	Fuel level sensor circuit - Voltage below normal, or shorted to low source.
		Engine coolant temperature sensor circuit - Voltage above normal, or shorted to high
004	3	source.
304	4	Engine coolant temperature sensor circuit - Voltage below normal, or shorted to low
	4	source.
310	8	Engine speed signal error - Abnormal frequency or pulse width.
322	3	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.
323	4	Fuel warmer relay circuit - Voltage below normal, or shorted to low source.

\* Some error codes are not applied to this machine.

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

Error co		Description
HCESPN	FMI	
340	3	Potentiometer (G/A) circuit - Voltage above normal, or shorted to high source.
	4	Potentiometer (G/A) circuit - Voltage below normal, or shorted to low source.
341	5	Governor actuator circuit - Current below normal, or open circuit.
	6	Governor actuator circuit - Current above normal.
	0	Transmission oil pressure sensor data above normal range.
501	1	Transmission oil pressure sensor data below normal range.
	2	Transmission oil pressure sensor data error.
	4	Transmission oil pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Brake pressure sensor data above normal range.
503	1	Brake pressure sensor data below normal range.
	2	Brake pressure sensor data error.
	4	Brake pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Working brake pressure sensor data above normal range.
505	1	Working brake pressure sensor data below normal range.
	2	Working brake pressure sensor data error.
	4	Working brake pressure sensor circuit - Voltage below normal, or shorted to low source.
506	3	Working brake lamp circuit - Voltage above normal, or shorted to high source.
	4	Working brake lamp circuit - Voltage below normal, or shorted to low source.
520	3	Ram lock lamp circuit - Voltage above normal, or shorted to high source.
	4	Ram lock lamp circuit - Voltage below normal, or shorted to low source.
525	5	Ram lock solenoid circuit - Current below normal, or open circuit.
	6	Ram lock solenoid circuit - Current above normal.
	0	Travel F pilot pressure sensor data above normal range.
530	1	Travel F pilot pressure sensor data below normal range.
	2	Travel F pilot pressure sensor data error.
	4	Travel F pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
	0	Travel R pilot pressure sensor data above normal range.
531	1	Travel R pilot pressure sensor data below normal range.
	2	Travel R pilot pressure sensor data error.
	4	Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
701	3	Hourmeter circuit - Voltage above normal, or shorted to high source.
	4	Hourmeter circuit - Voltage below normal, or shorted to low source.
705	0	MCU input voltage high.
707	1	MCU input voltage low.
707	1	Alternator node I voltage low.
714	3	Acc. dial circuit - Voltage above normal, or shorted to high source.
	4	Acc. dial circuit - Voltage below normal, or shorted to low source.
715	3	Rotate signal input circuit - Voltage above normal, or shorted to high source.
	4	Rotate signal input circuit - Voltage below normal, or shorted to low source.
716	3	Tilt signal input circuit - Voltage above normal, or shorted to high source.
	4	Tilt signal input circuit - Voltage below normal, or shorted to low source.
722	3	Travel alarm (buzzer) circuit - Voltage above normal, or shorted to high source.
	4	Travel alarm (buzzer) circuit - Voltage below normal, or shorted to low source.
830	12	MCU internal memory error.
840	2	Cluster communication data error.
841	2	ECM communication data error.
843	2	Option #1 (CAN 2) communication data error.
850	2	RMCU communication data error.

 $\ensuremath{\mathrm{\#}}$  Some error codes are not applied to this machine.

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

### 4. ENGINE FAULT CODE

J1939 Code	Description	Refer to Procedure
27-3	Engine Exhaust Gas Recirculation Valve Position Sensor : Voltage Above Normal	Valve Position Sensor - Test
27-4	Engine Exhaust Gas Recirculation Valve Position Sensor : Voltage Below Normal	Valve Position Sensor - Test
29-2	Accelerator Pedal Position 2 : Erratic, Intermittent, or Incorrect (Engines equipped with a throttle switch)	Throttle Switch Circuit - Test
29-2	Accelerator Pedal Position 2 : Erratic, Intermittent or Incorrect (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
29-3	Accelerator Pedal Position 2 : Voltage Above Normal (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
29-3	Accelerator Pedal Position 2 : Voltage Above Normal (Engines equipped with a digital throttle)	Digital Throttle Position Sensor Circuit - Test
29-4	Accelerator Pedal Position 2 : Voltage Below Normal (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
29-4	Accelerator Pedal Position 2 : Voltage Below Normal (Engines equipped with a digital throttle)	Digital Throttle Position Sensor Circuit - Test
29-8	Accelerator Pedal Position 2 : Abnormal Frequency, Pulse Width or Period	Digital Throttle Position Sensor Circuit - Test
91-2	Accelerator Pedal Position 1 : Erratic, Intermittent, or Incorrect (Engines equipped with a throttle switch)	Throttle Switch Circuit - Test
91-2	Accelerator Pedal Position 1 : Erratic, Intermittent or Incorrect (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
91-3	Accelerator Pedal Position 1 : Voltage Above Normal (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
91-3	Accelerator Pedal Position 1 : Voltage Above Normal (Engines equipped with a digital throttle)	Digital Throttle Position Sensor Circuit - Test
91-4	Accelerator Pedal Position 1 : Voltage Below Normal (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
91-4	Accelerator Pedal Position 1 : Voltage Below Normal (Engines equipped with a digital throttle)	Digital Throttle Position Sensor Circuit - Test
91-8	Accelerator Pedal Position 1 : Abnormal Frequency, Pulse Width or Period	Digital Throttle Position Sensor Circuit - Test
97-15	Water In Fuel Indicator : High - least severe (1)	Fuel System Water Separator Has Water
97-16	Water In Fuel Indicator : High - moderate severity (2)	Fuel System Water Separator Has Water
100-1	Engine Oil Pressure : Low - most severe (3)	Low Engine Oil Pressure
100-3	Engine Oil Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
100-4	Engine Oil Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
100-17	Engine Oil Pressure : Low - least severe (1)	Low Engine Oil Pressure
100-21	Engine Oil Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
102-16	Engine Intake Manifold #1 Pressure : High - moderate severity (2)	Intake Manifold Air Pressure Is High
102-18	Engine Intake Manifold #1 Pressure : Low - moderate severity (2)	Intake Manifold Air Pressure Is Low

J1939 Code	Description	Refer to Procedure
105-3	Engine Intake Manifold #1 Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
105-4	Engine Intake Manifold #1 Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
105-15	Engine Intake Manifold #1 Temperature : High - least severe (1)	Intake Manifold Air Temperature Is High
105-16	Engine Intake Manifold #1 Temperature : High - moderate severity (2)	Intake Manifold Air Temperature Is High
107-15	Engine Air Filter 1 Differential Pressure : High - least severe (1)	Inlet Air Is Restricted
108-3	Barometric Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
108-4	Barometric Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
108-21	Barometric Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
110-0	Engine Coolant Temperature : High - most severe (3)	Coolant Temperature Is Too High
110-3	Engine Coolant Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
110-4	Engine Coolant Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
110-15	Engine Coolant Temperature : High - least severe (1)	Coolant Temperature Is Too High
110-16	Engine Coolant Temperature : High - moderate severity (2)	Coolant Temperature Is Too High
111-1	Engine Coolant Level : Low - most severe (3)	Coolant Level Is Low
157-3	Engine Injector Metering Rail #1 Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
157-4	Engine Injector Metering Rail #1 Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
157-15	Engine Injector Metering Rail #1 Pressure : High - least severe (1)	Fuel Rail Pressure Problem
157-17	Engine Injector Metering Rail #1 Pressure : Low - least severe (1)	Fuel Rail Pressure Problem
168-2	Battery Potential / Power Input 1 : Erratic, Intermittent or Incorrect	Ignition Keyswitch Circuit and Battery Supply Circuit - Test
168-3	Battery Potential / Power Input 1 : Voltage Above Normal	Ignition Keyswitch Circuit and Battery Supply Circuit - Test
168-4	Battery Potential / Power Input 1 : Voltage Below Normal	Ignition Keyswitch Circuit and Battery Supply Circuit - Test
172-3	Engine Air Inlet Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
172-4	Engine Air Inlet Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
174-3	Engine Fuel Temperature 1 : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
174-4	Engine Fuel Temperature 1 : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)

J1939 Code	Description	Refer to Procedure
174-15	Engine Fuel Temperature 1 : High - least severe (1)	Fuel Temperature Is High
174-16	Engine Fuel Temperature 1 : High - moderate severity (2)	Fuel Temperature Is High
190-8	Engine Speed : Abnormal Frequency, Pulse Width or Period	Engine Speed/Timing Sensor Circuit - Test
190-15	Engine Speed : High - least severe (1)	Engine Overspeeds
412-3	Engine Exhaust Gas Recirculation Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
412-4	Engine Exhaust Gas Recirculation Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
412-15	Engine Exhaust Gas Recirculation Temperature : High - least severe (1)	NRS Exhaust Gas Temperature Is High
412-16	Engine Exhaust Gas Recirculation Temperature : High - moderate severity (2)	NRS Exhaust Gas Temperature Is High
558-2	Accelerator Pedal 1 Low Idle Switch : Erratic, Intermittent or Incorrect	Idle Validation Switch Circuit - Test
626-5	Engine Start Enable Device 1 : Current Below Normal	Ether Starting Aid - Test
626-6	Engine Start Enable Device 1 : Current Above Normal	Ether Starting Aid - Test
630-2	Calibration Memory : Erratic, Intermittent or Incorrect	Flash Programming
631-2	Calibration Module : Erratic, Intermittent or Incorrect	ECM Memory - Test
637-11	Engine Timing Sensor : Other Failure Mode	Engine Speed/Timing Sensor Circuit - Test
639-9	J1939 Network #1 : Abnormal Update Rate	CAN Data Link Circuit - Test
649-3	Engine Exhaust Back Pressure Regulator Solenoid : Voltage Above Normal	Motorized Valve - Test
649-5	Engine Exhaust Back Pressure Regulator Solenoid : Current Below Normal	Motorized Valve - Test
649-6	Engine Exhaust Back Pressure Regulator Solenoid : Current Above Normal	Motorized Valve - Test
649-7	Engine Exhaust Back Pressure Regulator Solenoid : Not Responding Properly	Motorized Valve - Test
651-2	Engine Injector Cylinder #01 : Erratic, Intermittent or Incorrect	Injector Data Incorrect - Test
651-5	Engine Injector Cylinder #01 : Current Below Normal	Injector Solenoid Circuit - Test
651-6	Engine Injector Cylinder #01 : Current Above Normal	Injector Solenoid Circuit - Test
652-2	Engine Injector Cylinder #02 : Erratic, Intermittent or Incorrect	Injector Data Incorrect - Test
652-5	Engine Injector Cylinder #02 : Current Below Normal	Injector Solenoid Circuit - Test
652-6	Engine Injector Cylinder #02 : Current Above Normal	Injector Solenoid Circuit - Test
653-2	Engine Injector Cylinder #03 : Erratic, Intermittent or Incorrect	Injector Data Incorrect - Test

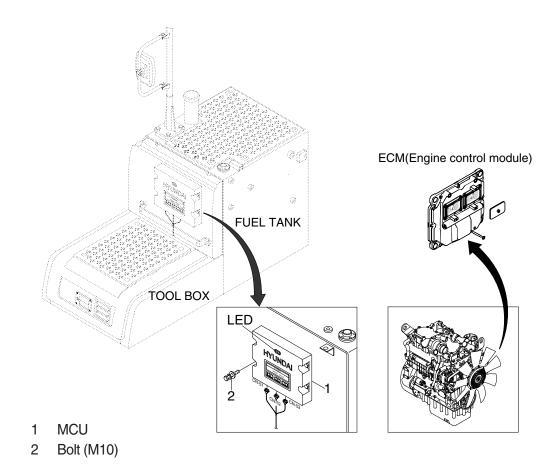
J1939 Code	Description	Refer to Procedure
653-5	Engine Injector Cylinder #03 : Current Below Normal	Injector Solenoid Circuit - Test
653-6	Engine Injector Cylinder #03 : Current Above Normal	Injector Solenoid Circuit - Test
654-2	Engine Injector Cylinder #04 : Erratic, Intermittent or Incorrect	Injector Data Incorrect - Test
654-5	Engine Injector Cylinder #04 : Current Below Normal	Injector Solenoid Circuit - Test
654-6	Engine Injector Cylinder #04 : Current Above Normal	Injector Solenoid Circuit - Test
655-2	Engine Injector Cylinder #05 : Erratic, Intermittent or Incorrect (1206E-E66 Engine Only)	Injector Data Incorrect - Test
655-5	Engine Injector Cylinder #05 : Current Below Normal (1206E-E66 Engine Only)	Injector Solenoid Circuit - Test
655-6	Engine Injector Cylinder #05 : Current Above Normal (1206E E66 Engine Only)	Injector Solenoid Circuit - Test
656-2	Engine Injector Cylinder #06 : Erratic, Intermittent or Incorrect (1206E-E66 Engine Only)	Injector Data Incorrect - Test
656-5	Engine Injector Cylinder #06 : Current Below Normal (1206E-E66 Engine Only)	Injector Solenoid Circuit - Test
656-6	Engine Injector Cylinder #06 : Current Above Normal (1206E-E66 Engine Only)	Injector Solenoid Circuit - Test
676-6	Engine Glow Plug Relay : Current Above Normal	Starting Aid (Glow Plug) Relay Circuit - Test
678-3	ECU 8 Volts DC Supply : Voltage Above Normal	Digital Throttle Position Sensor Circuit - Test
678-4	ECU 8 Volts DC Supply : Voltage Below Normal	Digital Throttle Position Sensor Circuit - Test
723-8	Engine Speed Sensor #2 : Abnormal Frequency, Pulse Width or Period	Engine Speed/Timing Sensor Circuit - Test
1075-5	Engine Electric Lift Pump For Engine Fuel Supply : Current Below Normal	Fuel Pump Relay Circuit - Test
1075-6	Engine Electric Lift Pump For Engine Fuel Supply : Current Above Normal	Fuel Pump Relay Circuit - Test
1076-5	Engine Fuel Injection Pump Fuel Control Valve : Current Below Normal	Solenoid Valve - Test
1076-6	Engine Fuel Injection Pump Fuel Control Valve : Current Above Normal	Solenoid Valve - Test
1188-3	Engine Turbocharger 1 Wastegate Drive : Voltage Above Normal	Solenoid Valve - Test
1188-5	Engine Turbocharger 1 Wastegate Drive : Current Below Normal	Solenoid Valve - Test
1188-6	Engine Turbocharger 1 Wastegate Drive : Current Above Normal	Solenoid Valve - Test
1196-9	Anti-theft Component Status States : Abnormal Update Rate	Data Link Circuit - Test
1239-0	Engine Fuel Leakage 1: High - most severe (3)	Fuel Rail Pressure Problem
2659-15	Engine Exhaust Gas Recirculation (EGR) Mass Flow Rate : High - least severe (1)	ТВА
2791-3	Engine Exhaust Gas Recirculation (EGR) Valve Control : Voltage Above Normal	Motorized Valve - Test

J1939 Code	Description	Refer to Procedure
2791-5	Engine Exhaust Gas Recirculation (EGR) Valve Control : Current Below Normal	Motorized Valve - Test
2791-6	Engine Exhaust Gas Recirculation (EGR) Valve Control : Current Above Normal	Motorized Valve - Test
2791-7	Engine Exhaust Gas Recirculation (EGR) Valve Control : Not Responding Properly	Motorized Valve - Test
2882-2	Engine Alternate Rating Select : Erratic, Intermittent, or Incorrect	Mode Selection Circuit - Test
2970-2	Accelerator Pedal 2 Low Idle Switch : Erratic, Intermittent, or Incorrect	Idle Validation Switch Circuit - Test
3242-3	Particulate Trap Intake Gas Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Active Sensors)
3242-4	Particulate Trap Intake Gas Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Active Sensors)
3242-17	Particulate Trap Intake Gas Temperature : Low - least severe (1)	Diesel Particulate Filter Temperature Is High
3242-18	Particulate Trap Intake Gas Temperature : Low - moderate severity (2)	Diesel Particulate Filter Temperature Is Low
3358-3	Engine Exhaust Gas Recirculation Inlet Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
3358-4	Engine Exhaust Gas Recirculation Inlet Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
3358-13	Engine Exhaust Gas Recirculation Inlet Pressure : Calibration Required	Sensor Calibration Required - Test
3358-21	Engine Exhaust Gas Recirculation Inlet Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
3509-3	Sensor Supply Voltage 1 : Voltage Above Normal	5 V Sensor Supply Circuit - Test
3509-4	Sensor Supply Voltage 1 : Voltage Below Normal	5 V Sensor Supply Circuit - Test
3510-3	Sensor Supply Voltage 2 : Voltage Above Normal	5 V Sensor Supply Circuit - Test
3510-4	Sensor Supply Voltage 2 : Voltage Below Normal	5 V Sensor Supply Circuit - Test
3563-3	Engine Intake Manifold #1 Absolute Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
3563-4	Engine Intake Manifold #1 Absolute Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
3563-13	Engine Intake Manifold #1 Absolute Pressure : Calibration Required	Sensor Calibration Required - Test
3563-21	Engine Intake Manifold #1 Absolute Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
3719-0	Particulate Trap #1 Soot Load Percent : High - most severe (3)	Diesel Particulate Filter Collects Excessive Soot
3719-16	Particulate Trap #1 Soot Load Percent : High - moderate severity (2)	Diesel Particulate Filter Collects Excessive Soot
4783-3	Diesel Particulate Filter #1 Mean Soot Signal : Voltage Above Normal	Soot Sensor - Test
4783-4	Diesel Particulate Filter #1 Mean Soot Signal : Voltage Below Normal	Soot Sensor - Test

J1939 Code	Description	Refer to Procedure
4783-9	Diesel Particulate Filter #1 Mean Soot Signal : Abnormal Update Rate	Soot Sensor - Test
4783-12	Diesel Particulate Filter #1 Mean Soot Signal : Failure	Soot Sensor - Test
4783-13	Diesel Particulate Filter #1 Mean Soot Signal : Calibration Required	Soot Sensor - Test
4783-19	Diesel Particulate Filter #1 Mean Soot Signal : Data Error	Soot Sensor - Test
4783-21	Diesel Particulate Filter #1 Mean Soot Signal : Data Drifted Low	Soot Sensor - Test
5019-3	Engine Exhaust Gas Recirculation Outlet Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
5019-4	Engine Exhaust Gas Recirculation Outlet Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
5019-13	Engine Exhaust Gas Recirculation Outlet Pressure : Calibration Required	Sensor Calibration Required - Test
5019-21	Engine Exhaust Gas Recirculation Outlet Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
5571-0	High Pressure Common Rail Fuel Pressure Relief Valve : Active	Fuel Rail Pressure Problem
5576-2	Aftertreatment #1 Identification Number Module : Erratic, Intermittent or incorrect	Diesel Particulate Filter Identification Signal - Test
5576-8	Aftertreatment #1 Identification Number Module : Abnormal Frequency, Pulse Width, or Period	Diesel Particulate Filter Identification Signal - Test
5576-14	Aftertreatment #1 Identification Number Module : Special Instruction	Diesel Particulate Filter Identification Signal - Test
5625-3	Exhaust Back Pressure Regulator Position : Voltage Above Normal	Valve Position Sensor - Test
5625-4	Exhaust Back Pressure Regulator Position : Voltage Below Normal	Valve Position Sensor - Test
5629-31	Particulate Trap Active Regeneration Inhibited Due To Low Exhaust Gas Pressure - least severe (1)	Diesel Particulate Filter Collects Excessive Soot

# **GROUP 12 ENGINE CONTROL SYSTEM**

#### 1. MCU and Engine ECM (Electronic Control Module)



1409A5MS13

#### 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 -		Pressure		Electric current	Engine rpm
		kgf/cm²	psi	(mA)	(at accel dial 10)
	Р	10	142	290 ± 30	1850 ± 50
Standard (Stage : 1.0)	S	13 ± 3	185 ± 40	360 ± 30	1750 ± 50
(Clage: 1.0)	Е	15 ± 3	213 ± 40	360 ± 30	1650 ± 50
0 "	Р	0	0	160 ± 30	1950 ± 50
Option (Stage : 2.0)	S	5 ± 3	71 ± 40	250 ± 30	1850 ± 50
	Е	10 ± 3	142 ± 40	280 ± 30	1750 ± 50

#### 2) HOW TO SWITCH THE STAGE (1.0 $\leftrightarrow$ 2.0) ON THE CLUSTER

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

#### - Management

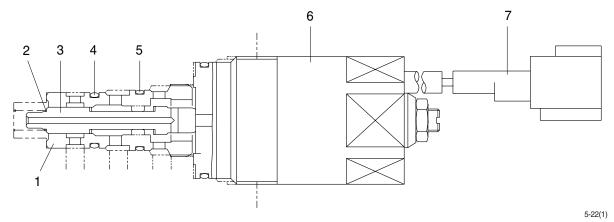
· Service menu



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

# 3) OPERATING PRINCIPLE (pump EPPR valve)

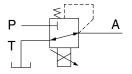
# (1) Structure



- 1 Sleeve
- 2 Spring
- 3 Spool

- 4 O-ring
- 5 O-ring

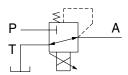
- 6 Solenoid valve
- 7 Connector

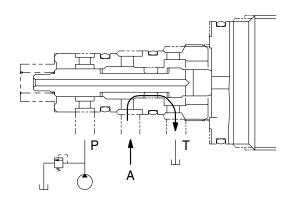


- P Pilot oil supply line (pilot pressure)
- T Return to tank
- A Secondary pressure to flow regulator at main pump

### (2) Neutral

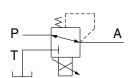
Pressure line is blocked and A oil returns to tank.

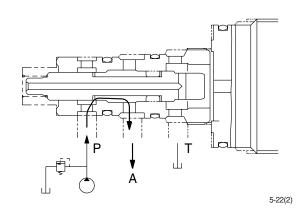




# (3) Operating

Secondary pressure enters into A.

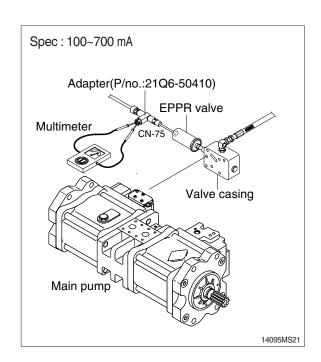




#### 4) EPPR VALVE CHECK PROCEDURE

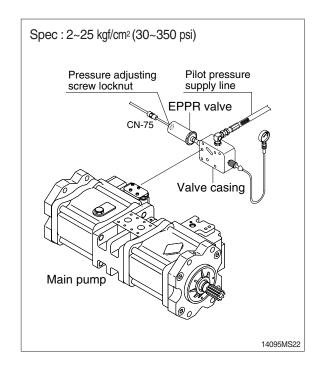
#### (1) Check electric current value at EPPR valve

- 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 1750 $\pm$ 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 1750±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

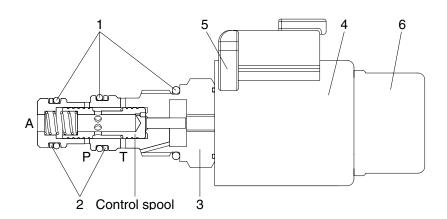
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

#### 2) CONTROL

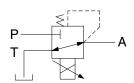
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30  $\Omega$  and 24 V.

#### 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.

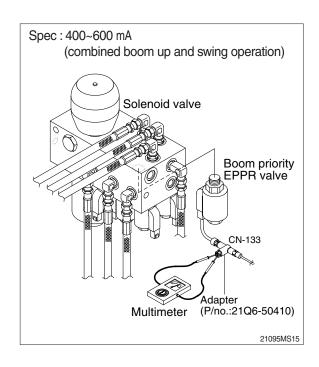
#### (3) Maximum pressure relief

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

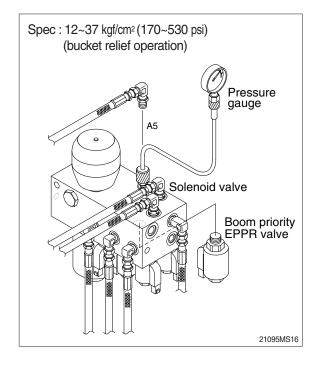
# (1) Check electric current value at EPPR valve

- 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 1750±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.
- $\ \ \,$  If rpm display approx 1750 $\pm 50$  rpm check pressure at relief position of bucket circuit by operating bucket control lever.
- ④ If pressure is not correct, adjust it.
- ⑤ After adjust, test the machine.



#### **GROUP 14 MONITORING SYSTEM**

#### 1. OUTLINE

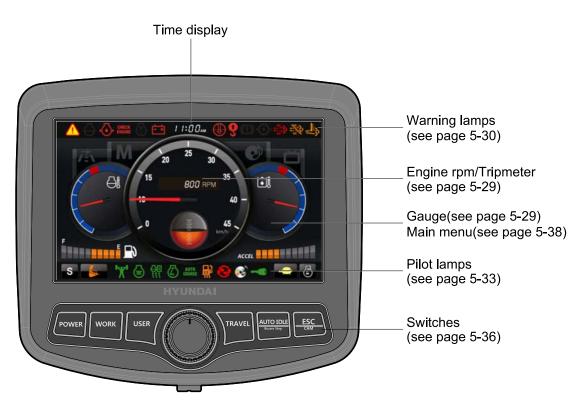
Monitoring system consists of the monitor part and switch part.

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

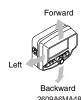


145Z9A5MS14

\* The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.

The warning lamp blinks until the problem is cleared. Refer to page 5-49 for details.

- \* This cluster is adjustable.
  - · Vertical (forward/backward) : each 15°
  - · Horizontal (left only): 15°



#### 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 1200 rpm.
- \* Others same as above.

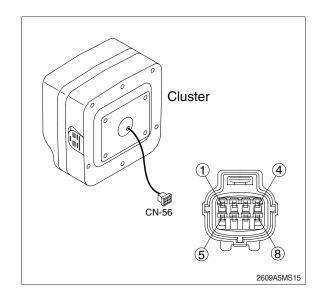
#### ③ When abnormal condition

- 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	Camera signal 3	NTSC
3	GND	-
4	Serial + (TX)	0~5V
5	Power IG (24V)	20~32V
6	Camera signal 2	NTSC
7	Camera signal 1	NTSC
8	Serial - (RX)	0~5V

NTSC : the united states National Television System Committee



#### 2) GAUGE

#### (1) Operation screen

When you first turn starting switch ON, the operation screen will appear.



- 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 5-46 for details.
- (2) Engine coolant temperature gauge



2609A3CD14

- 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 All 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



2609A3CD15

- 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



- 2609A3CD16
- ① This gauge indicates the amount of fuel in the fuel tank.
- ② Fill the fuel when the red range, or 🦳 lamp blinks in red.
- If the gauge indicates the red range or name 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 5-49 for details.

#### 3) WARNING LAMPS



2209A3CD18

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 5-37 for the select switch.

#### (1) Engine coolant temperature warning lamp



21093CD08A

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

#### (2) Hydraulic oil temperature warning lamp



21093CD08C

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

#### (3) Fuel level warning lamp



- ① This warning lamp blinks and the buzzer sounds when the level of fuel is below 31  $\ell$  (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

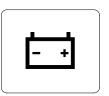


21093CD33

- ① 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.

#### (7) Battery charging warning lamp



21093CD34

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

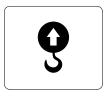
# (8) Air cleaner warning lamp



21093CD35

- 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)
- $\ensuremath{\textcircled{2}}$  Reduce the machine load.

#### 4) PILOT LAMPS



#### (1) Mode pilot lamps

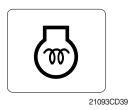
No	Mode	Pilot lamp	Selected mode
		P	Heavy duty power work mode
1	Power mode	S	Standard power mode
		E	Economy power mode
2	User mode	U	User preferable power mode
			General operation mode
3	Work mode		Breaker operation mode
			Crusher operation mode
4	Travel mode		Low speed traveling
4	Travel mode		High speed traveling
5	Auto idle mode	$\bigcirc$	Auto idle
6	Work tool mode	594	Oil flow level of breaker or crusher mode

## (2) Power max pilot lamp



- 21093CD38
- 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 3-28 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



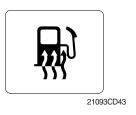
- ① This lamp is turned ON after 1 minute from engine start when the coolant temperature is below 30°C(86°F).
- ② The automatic warming up is cancelled when the engine coolant temperature is above 30°C, or when 10 minutes have passed since starting the engine.

#### (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 3-28.

#### (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



2609A3CD23

- 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.
- \* Refer to the page 5-42.

# (8) Entertainment pilot lamp



2609A3CD133

- ① This lamp is on when MP3 or video files are playing.
- \* Refer to the page 5-48.

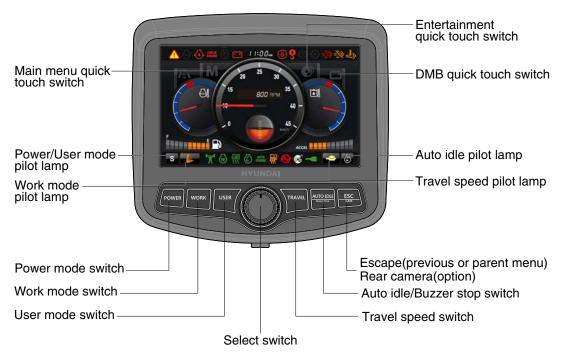
#### (9) Smart key pilot lamp (opt)



2609A3CD132

- ① This lamp is ON when the engine is started by the start button.
- ② This lamp is red when the a authentication fails, green when succeeds.
- \* Refer to the page 5-44.

#### 5) SWITCHES



2609A3CD24

When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-52 for details.

#### (1) Power mode switch



2609A3CD25

- 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



2609A3CD26

- 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)
  - : Grusher operation mode (if equipped)
  - · Not installed : Breaker or crusher is not installed.
- \* Refer to the operator's manual page 4-7 for details.

#### (3) User mode switch



2609A3CD27

- 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.

#### (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



2609A3CD28

- 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



2609A3CD29

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

#### (7) Escape/Camera switch



2609A3CD30

- 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 5-49 for the camera.
- ③ If the camera is not installed, this switch is used only ESC function.

#### 6) MAIN MENU

- You can select or set the menu by the select switch or touch screen (M).
   On the operation screen, tap M to access the main menu screen.
   On the sub menu screen, you can tap the menu bar to access functions or applications
   To return to the parent menu screen, tap the top menu bar. To return to operation screen, tap (1) icon.
- · Operation screen



\* Please refer to select switch, page 5-56 for selection and change of menu and input value.

#### (1) Structure

No	Main menu	Sub menu	Description
1	Mode 2609A3CD33	Work tool U mode power Boom/Arm speed Auto power boost Initial mode	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable Default, U mode, P mode
2	Monitoring 2609A3CD34	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 2609A3CD35	Maintenance information Machine security Machine Information A/S phone number Service menu Clinometer	Replacement, Change interval oils and filters ESL mode setting, Password change Cluster, MCU, Engine, Machine A/S phone number, A/S phone number change grade Power shift, Hourmeter, Replacement history, Lock lever, Upgrade, EPPR current level Clinometer setting
4	Display 2609A3CD36	Display item Clock Brightness,Touch calibration Unit setup Language selection Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto, Calibrating the touch screen Temperature, Pressure, Flow, Distance, Date format Korean, English, Chinese A type, B type
5	Utilities 2609A3CD37	Entertainment Tripmeter Camera FMT DMB	Play MP4, codec. 3 kinds (A, B, C) Number of active, Display order, Camera No. FMT setting DMB select, DAB select, Channel scan, Exit

#### (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.

Owner May 4 stone Deduced 10 lpm cook stop

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

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

#### 2 U mode power



2609A3CD42

- 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 ( <b>▮</b> )	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	800	0
2	1400	850	3
3	1500	900	6
4	1600	950	9
5	1700	1000	12
6	1800	1050	16
7	1900	1100 (auto decel)	20
8	2000	1150	26
9	2050	1200	32
10	2100	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.

#### (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).

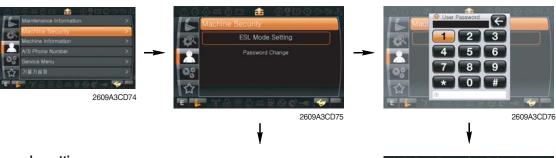
· Change interval : The change or replace interval can be changed in the unit of 50 hours.

· OK : Return to the item list screen.

#### · Change or relpace 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 & outer)	4000
13	Radiator coolant	2000
14	Swing gear pinion grease	1000

#### 2 Machine security



- · ESL mode setting
  - ESL: Engine Starting Limit
  - ESL mode is desingned 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.
  - Machine security

Disable: Not used ESL function

Enable (always) : The password is required whenever the

operator starts engine.



2609A3CD78

 Interval: The password is required when the operator starts 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.

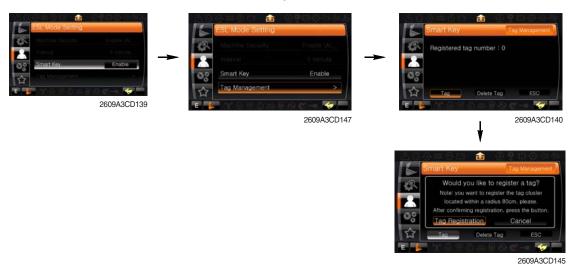
Default password: 00000 \*

% Password length : (5~10 digit) + \*



2609A3CD138

- Smart key (option) : Smart key is registered when the operator starts engine by start button first. If smart key is not inside of the cabin, authentication process fails and the password entering is needed.



#### · Password change

- The password is 5~10 digits.



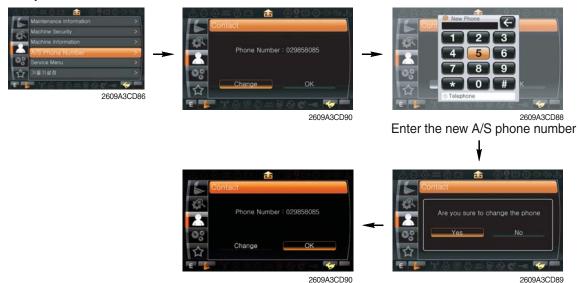
Enter the new password again

#### ③ Machine Information



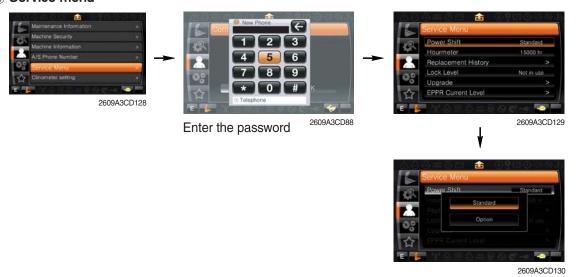
· This can confirm the identification of the cluster, MCU, engine and machine.

#### 4 A/S phone number



The new phone number is stored in MCU

#### **5** Service menu



- 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.
- · Lock level (not in use/in use)
- Upgrade : Firm ware can be upgraded by this menu. (the USB port is located under the cluster)
- · EPPR current level (attach EPPR/boom priority EPPR)

#### **6 Clinometer**



- · When the machine is on the flatland, if tap the "initialization", the values of X, Y reset "0".
- · You can confirm tilt of machine in cluster's operating screen.

#### (5) Display

① Display item



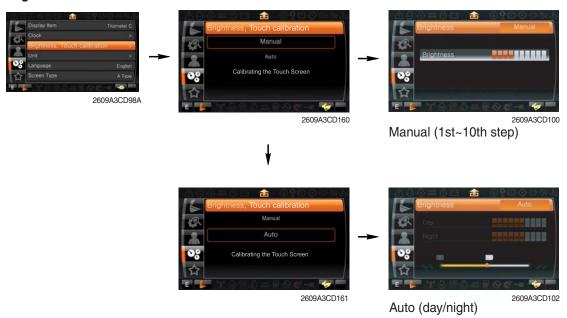
- · The center display type of the LCD can be selected by this menu.
- The engine speed or each of the tripmeter (A,B,C) is displayed on the center display.

#### 2 Clock

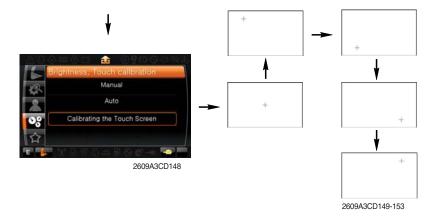


- The first line's three spots "\*\*/\*\*\*" represent Month/Day/Year each.
- The second line shows the current time. (0:00~23:59)

#### 3 Brightness and touch calibration



- · 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, white area represents night time while orange shows day time)
- Touch calibration When touch awareness goes wrong, this function use.
   Fall in the next step if touches the middle point of cross with fingernail.
   If touches total five points as follows, the setting is completed.



#### 4 Unit



Temperature : °C ↔ °F

Pressure : bar ← MPa ← kgf/cm²

Flow : lpm ← gpmDistance : km ← mile

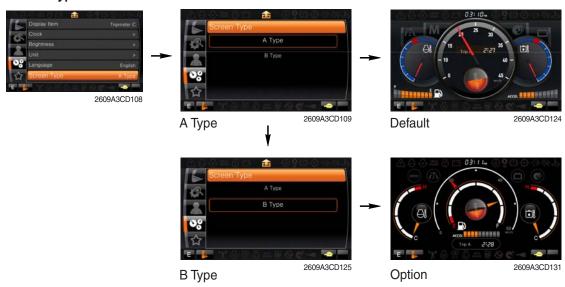
Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-Mar-yy

#### **5** Language



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

#### 6 Screen type



#### (6) Utilities

#### ① Entertainment

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



· Over 1100 engine rpm, the screen turns into the operation screen with MP4 or codec file playing for the safety.

#### 2 Tripmeter



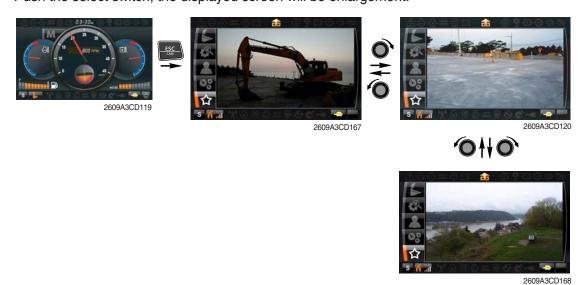
- · Maximum 3 kinds of tripmeters can be used at the same time.
- · Each tripmeter can be turned on by choosing "Start" while it also can be turned off by choosing "Stop".
- · If the tripmeter icon is activated in the operation screen, it can be controlled directly there.

#### 3 Camera setting

- · Three cameras can be installed on the machine and the display order can be set by this menu.
- · If the camera was not equipped, this menu is not useful.



- Turnning 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.



#### 4 FMT setting



- The function that can listen cluster's occurrence sound by inside speaker of cabin making frequency of audio identical in cluster's frequency and machine.
- Turn on the FMT function and sets frequency equally with frequency of audio in cabin.
  - Not in use: Cluster speaker only
  - In use (FMT only) : Cabin speaker only
  - In use (FMT+Built) : Cabin speaker + Cluster speaker

# ⑤ DMB (option)



#### **GROUP 15 FUEL WARMER SYSTEM**

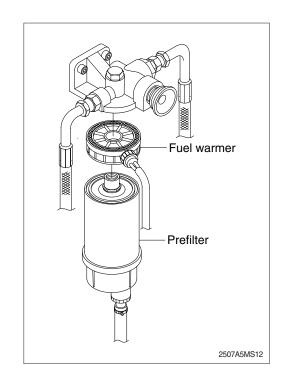
#### 1. SPECIFICATION

1) Operating voltage :  $24 \pm 4 \text{ V}$ 

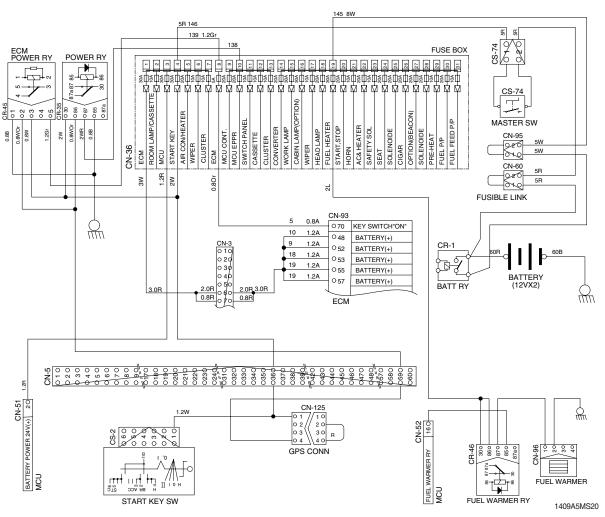
2) Power: 350±50 W3) Current: 15 A

#### 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

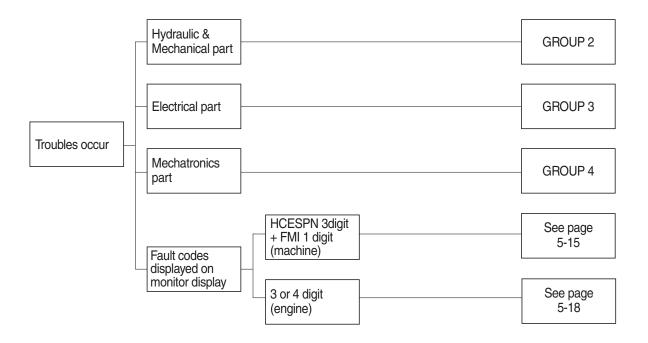
# **GROUP 1 BEFORE TROUBLESHOOTING**

#### 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.



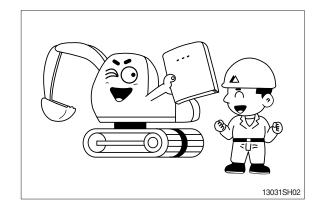
#### 2. DIAGNOSING PROCEDURE

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.

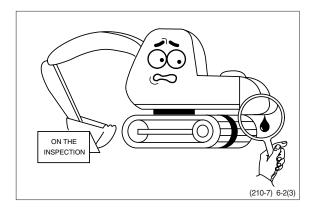
- 1) How the machine is used and when it is serviced?
- 2) When the trouble was noticed and what work the machine was doing at that time?
- 3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
- 4) Did the machine have any troubles previously?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

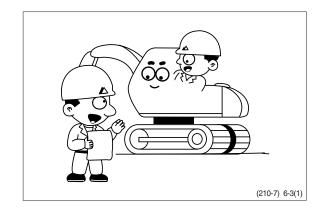
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



# STEP 4. Inspect the trouble actually on the machine

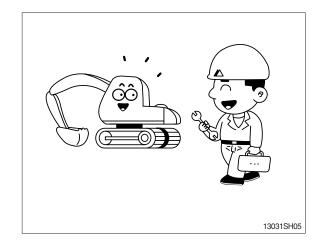
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.

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



#### STEP 5. Perform troubleshooting

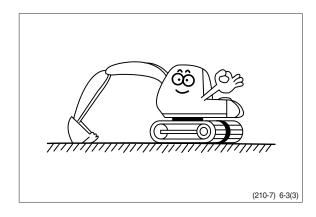
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.



#### 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**

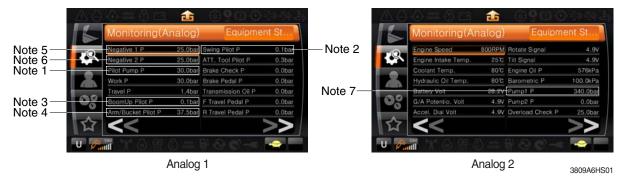
#### 1. INTRODUCTION

#### 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.

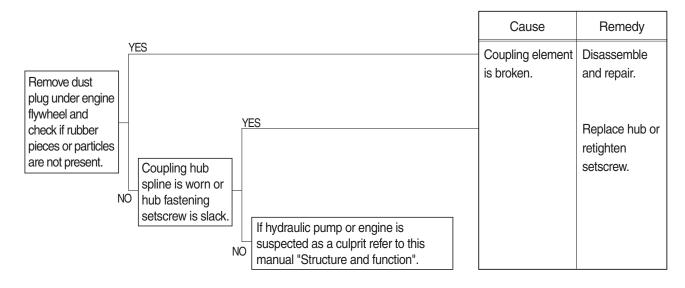


#### (2) Specification

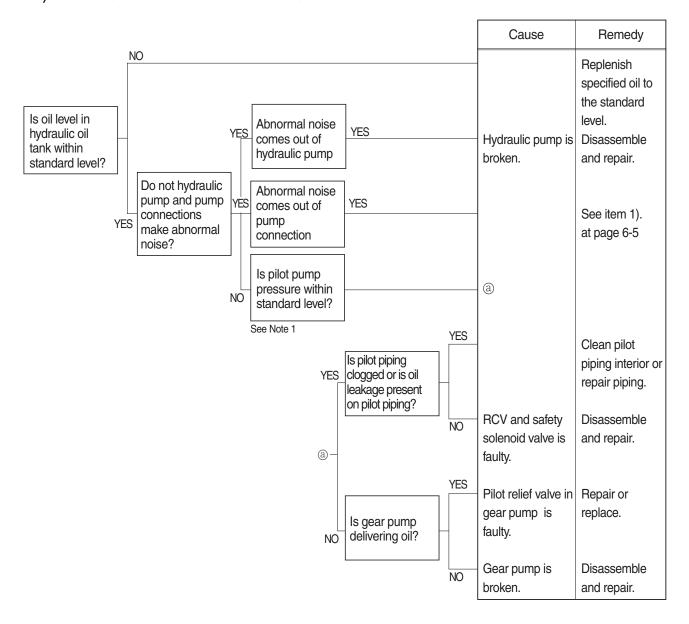
No.	Description	Specification
Note 1	Pilot pump pressure	40 <sup>+2</sup> bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	P1 pump control pressure	0~25 bar
Note 6	P2 pump control pressure	0~25 bar
Note 7	Pump 1 pressure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

#### 2. DRIVE SYSTEM

### 1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

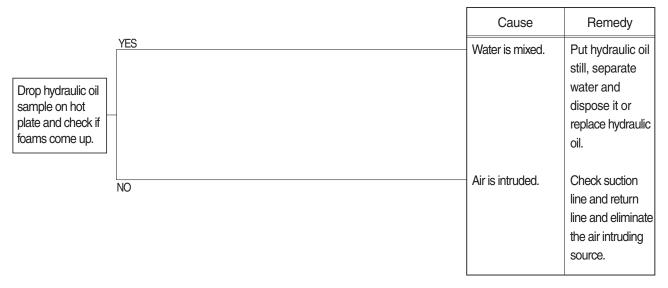


### 2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

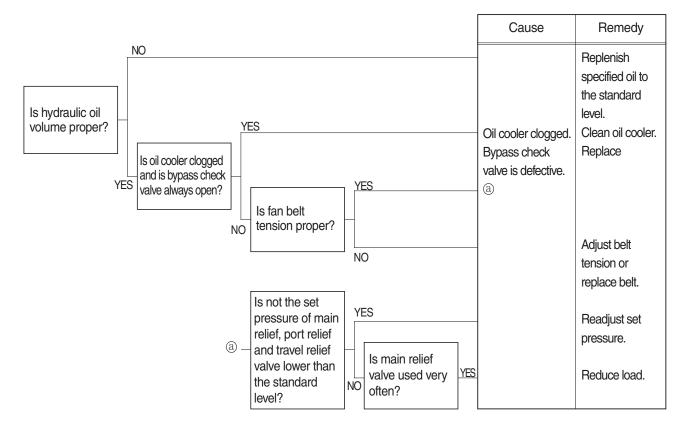


#### 3. HYDRAULIC SYSTEM

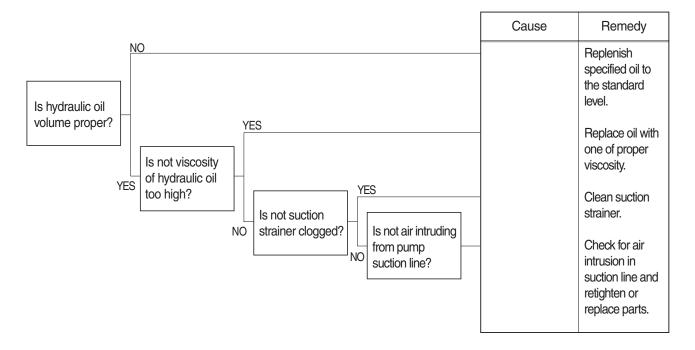
### 1) HYDRAULIC OIL IS CLOUDY



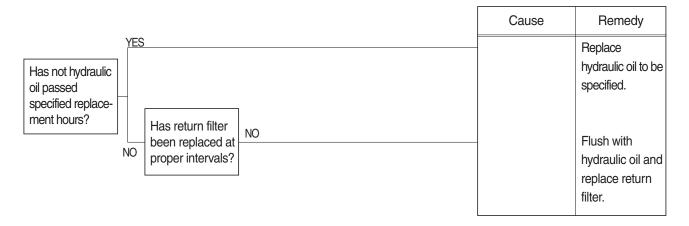
#### 2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



#### 3) CAVITATION OCCURS WITH PUMP

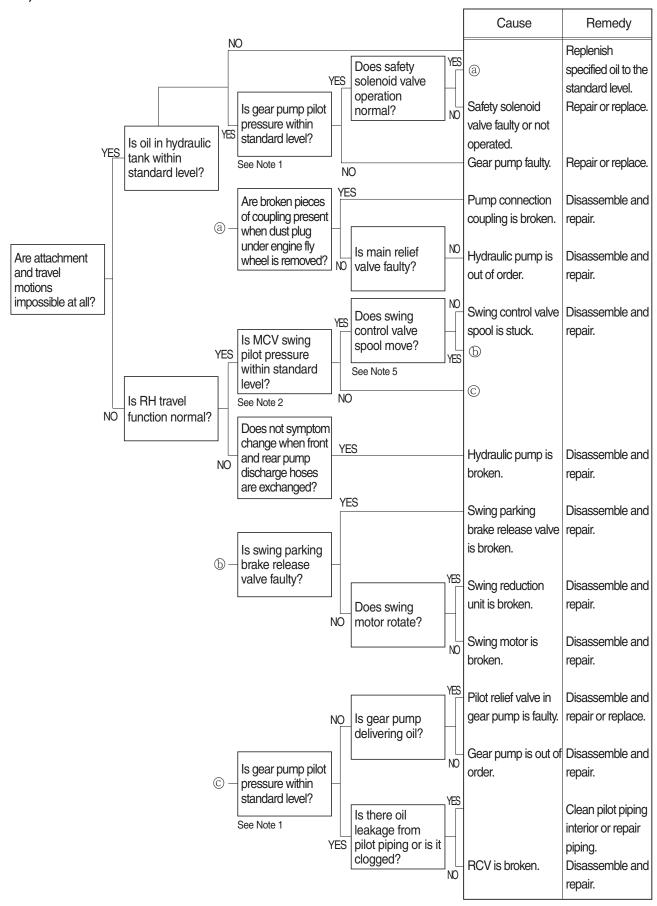


#### 4) HYDRAULIC OIL IS CONTAMINATED

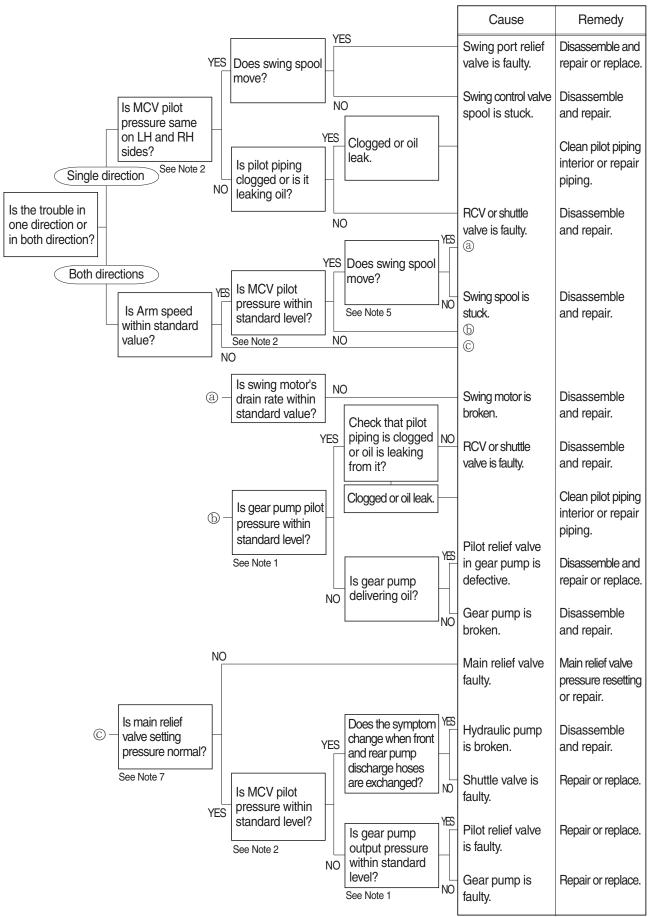


#### 4. SWING SYSTEM

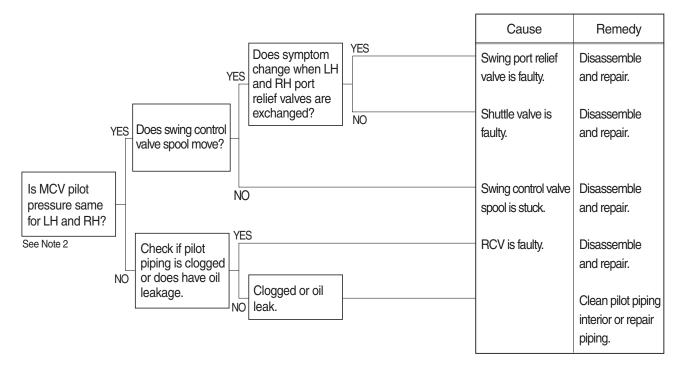
#### 1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



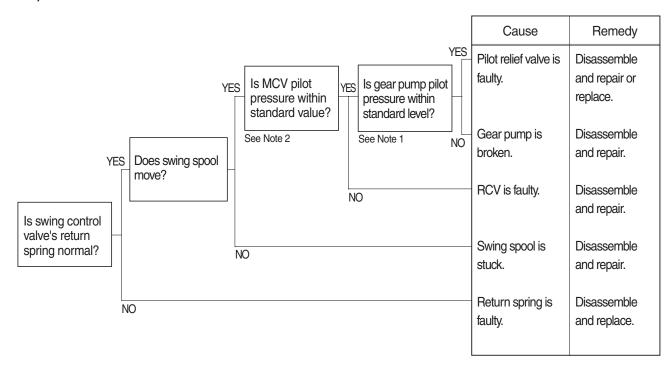
#### 2) SWING SPEED IS LOW



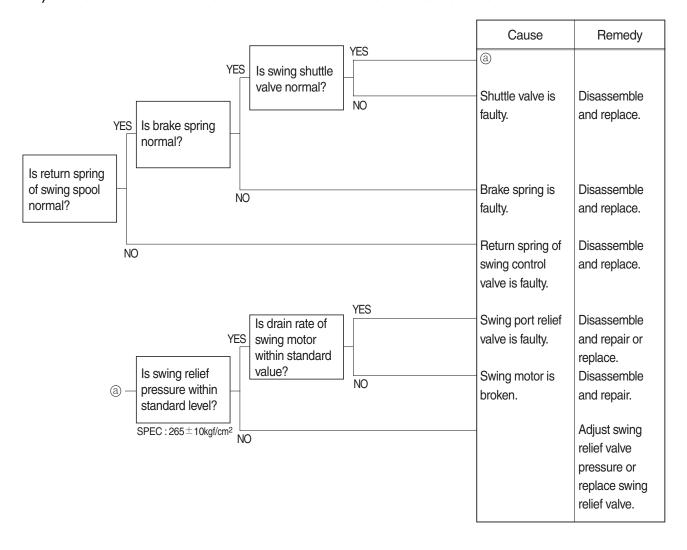
#### 3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



#### 4) MACHINE SWINGS BUT DOES NOT STOP

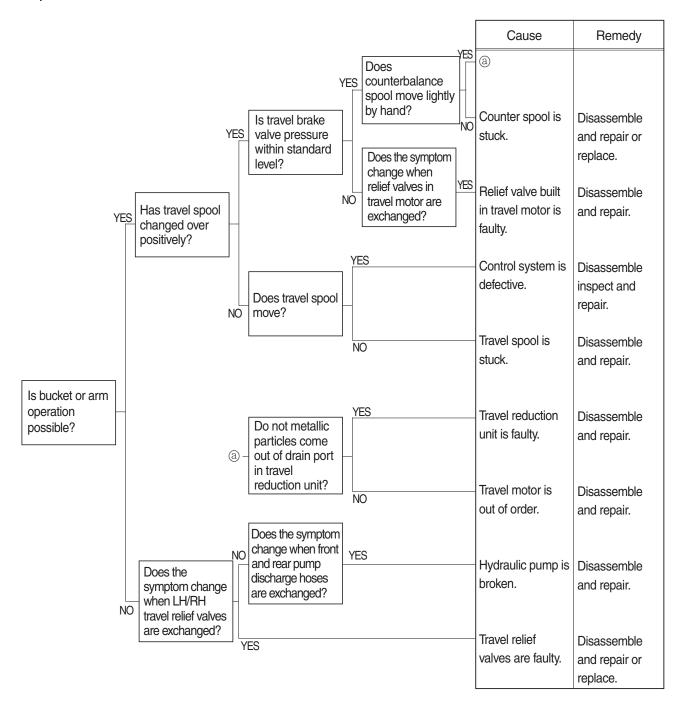


## 5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

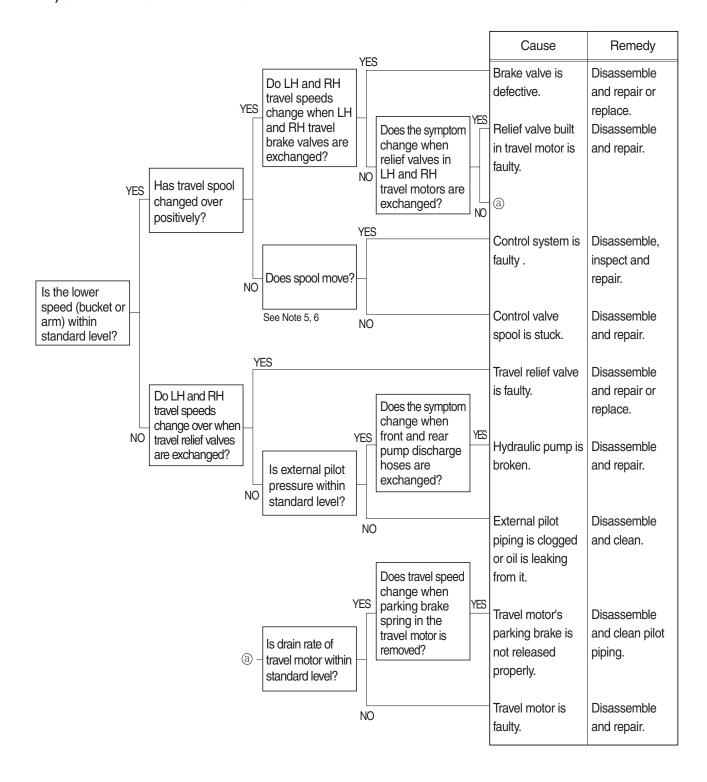


#### 5. TRAVEL SYSTEM

#### 1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

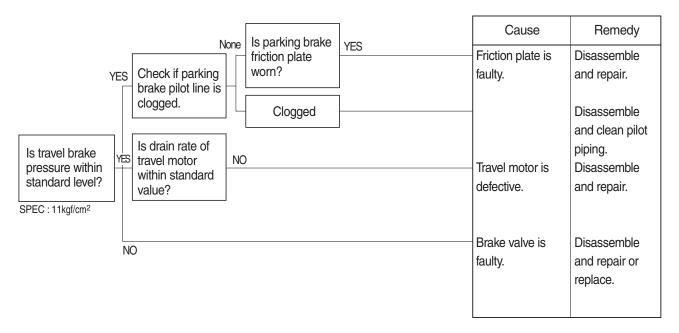


#### 2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

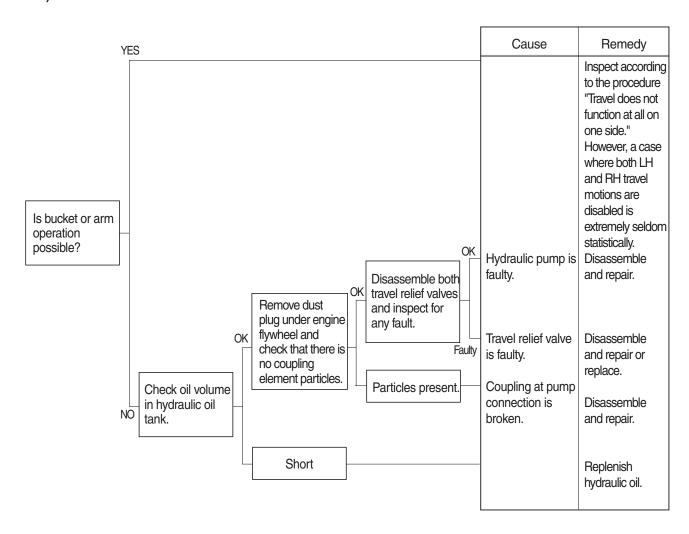


#### 3) MACHINE DOES NOT STOP ON A SLOPE

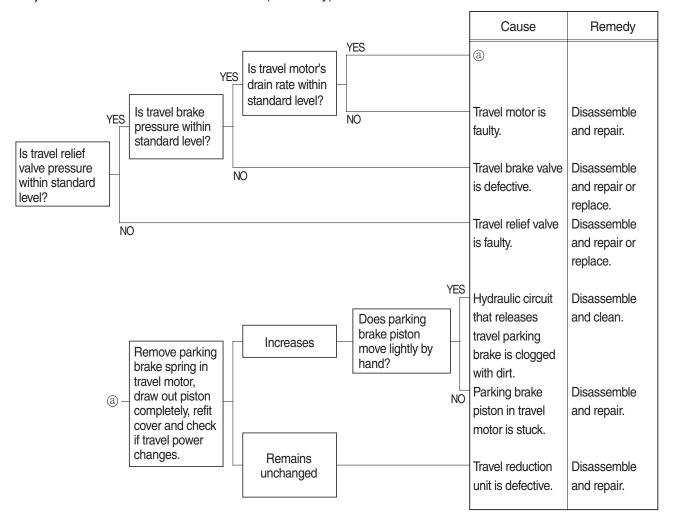
Machine is pulled forward as sprocket rotates during digging operation.



#### 4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



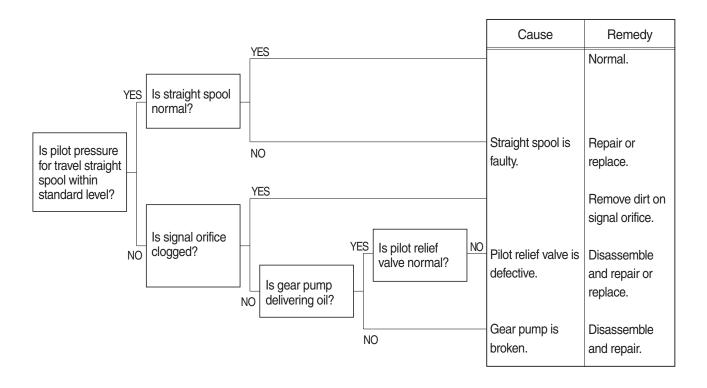
#### 5) TRAVEL ACTION IS POWERLESS (travel only)



#### 6) MACHINE RUNS RECKLESSLY ON A SLOPE

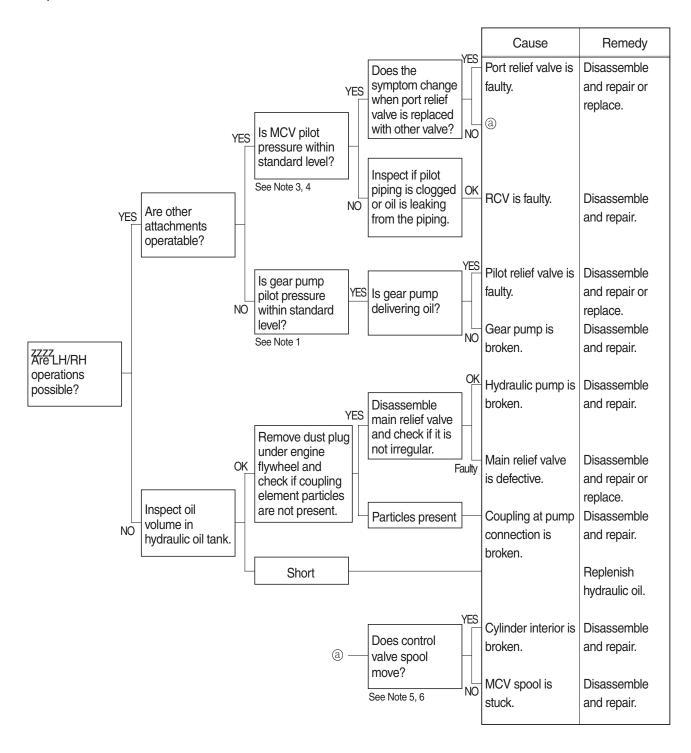


# 7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME

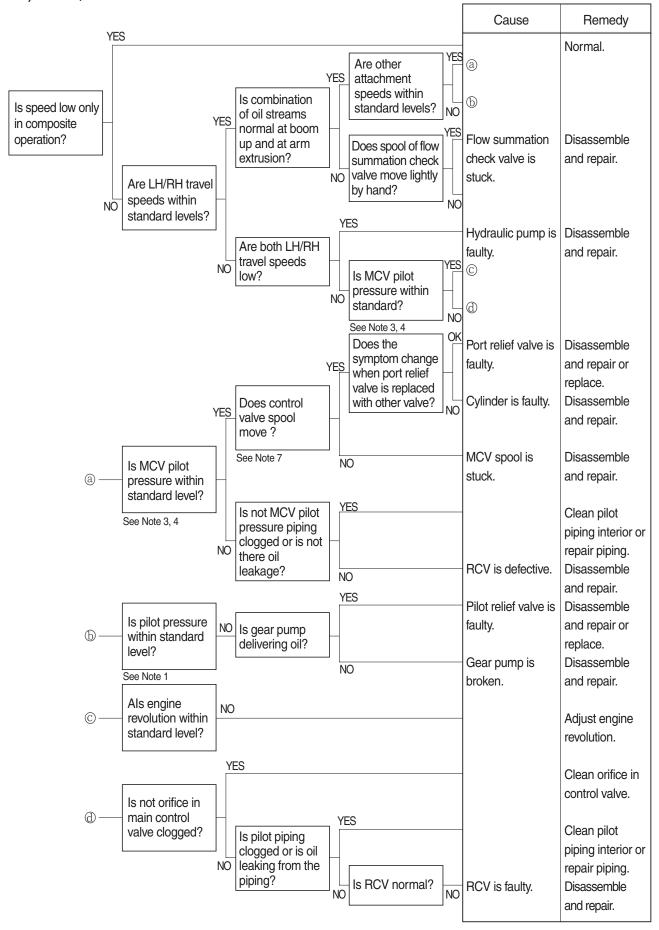


#### 6. ATTACHMENT SYSTEM

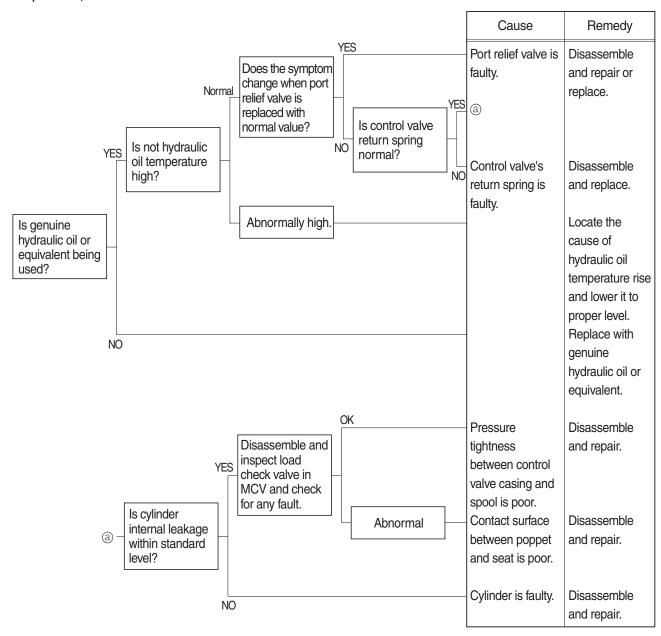
#### 1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



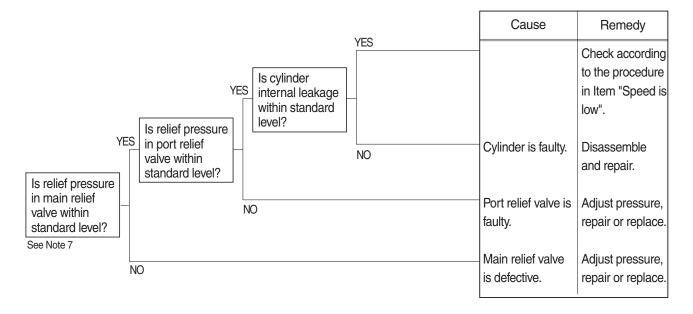
#### 2) BOOM, ARM OR BUCKET SPEED IS LOW



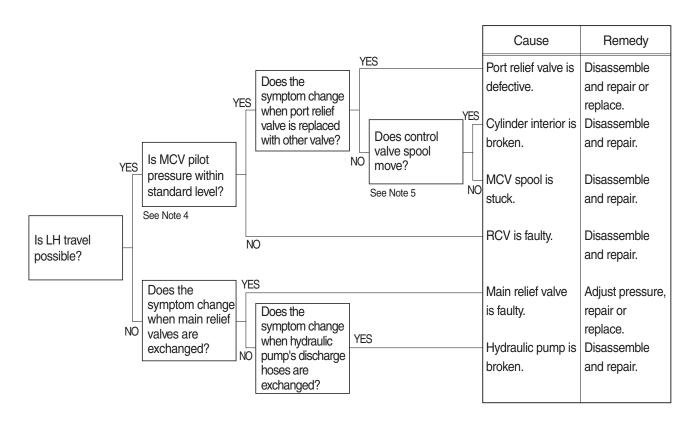
### 3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



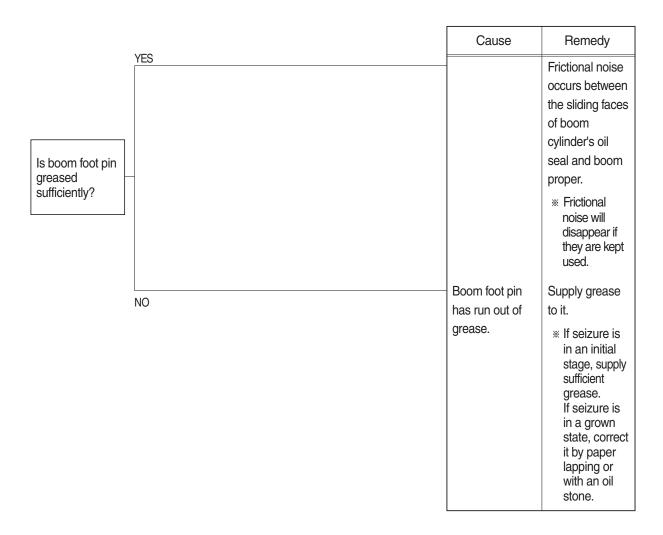
#### 4) BOOM, ARM OR BUCKET POWER IS WEAK



#### 5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

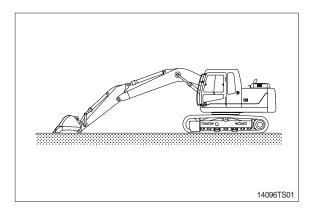


### 6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

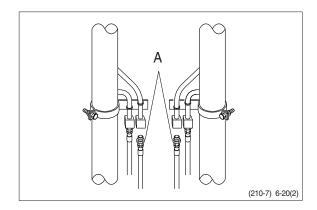


#### **\*\* HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE**

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



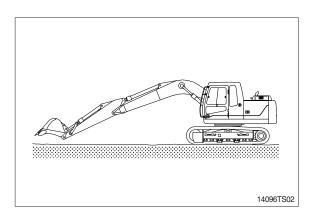
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



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.

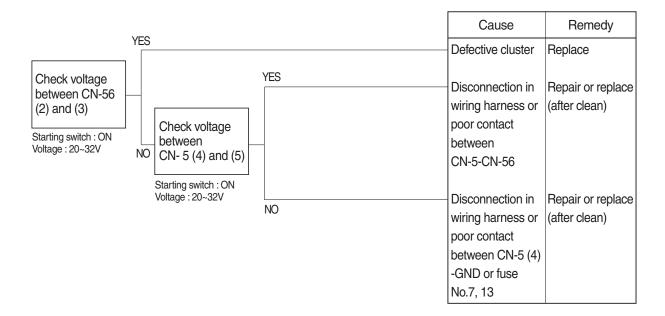
If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



#### **GROUP 3 ELECTRICAL SYSTEM**

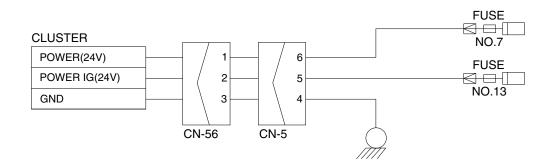
#### 1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

- · 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.7 and 13 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



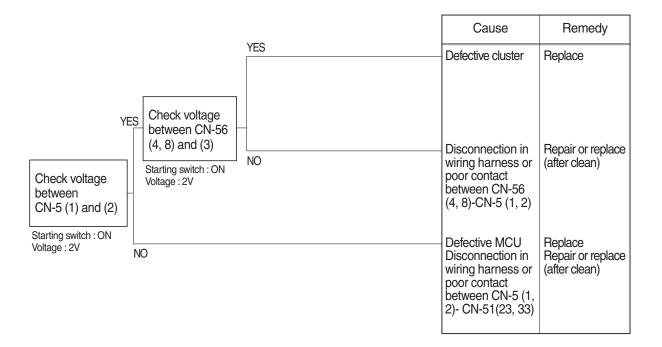
#### Check voltage

YES	20~32V		
NO	0V		



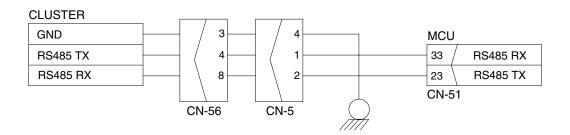
# 2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

- · 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

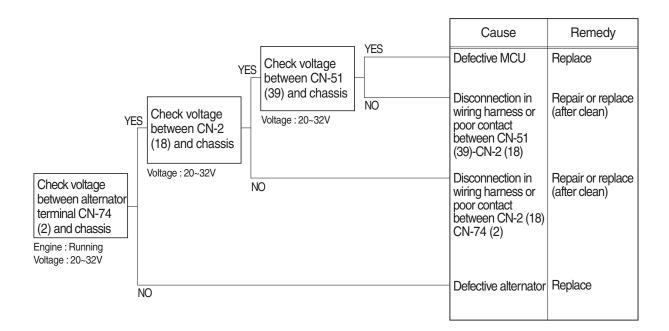
YES	2V	
NO	0V	



140Z96ES02

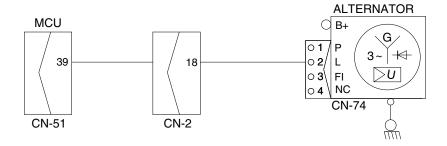
## 3. Fig. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

- · 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.



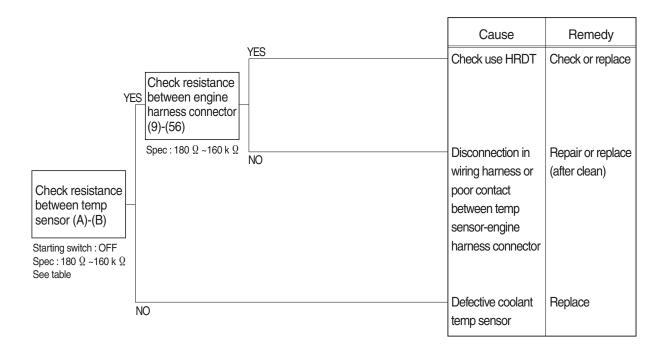
#### Check voltage

YES	20~32V
NO	0V



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

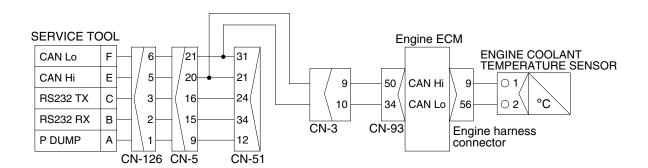
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





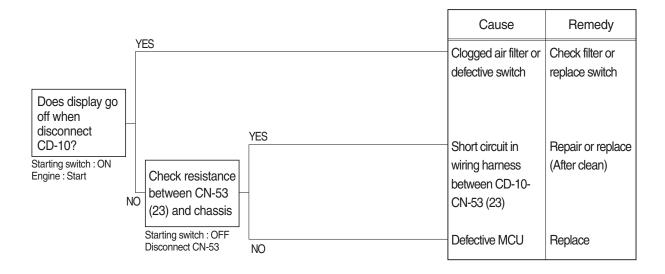
#### **Check Table**

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



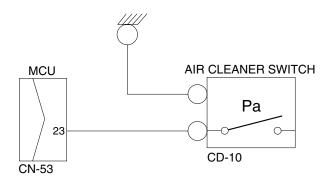
# 5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

- · 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

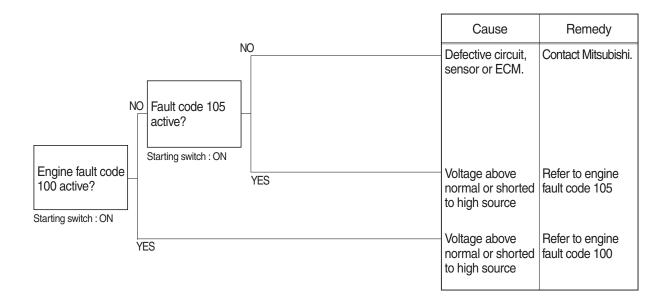
YES	MAX 1Ω	
NO	MIN 1MΩ	

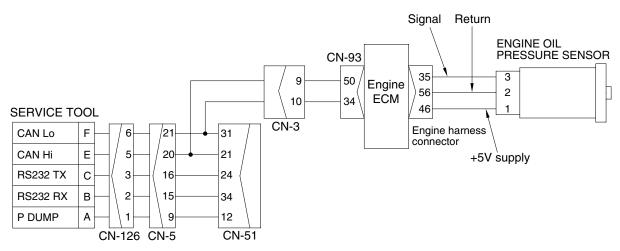


21096ES05

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

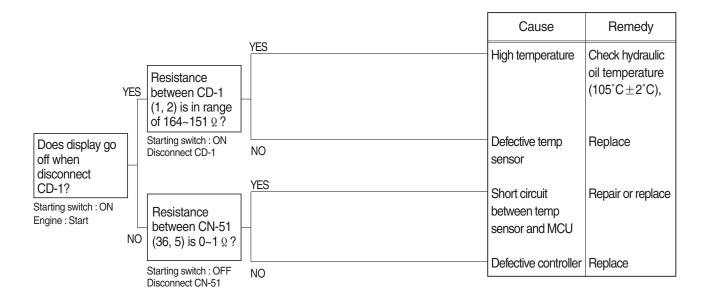
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





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

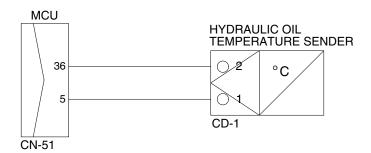
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





#### **Check Table**

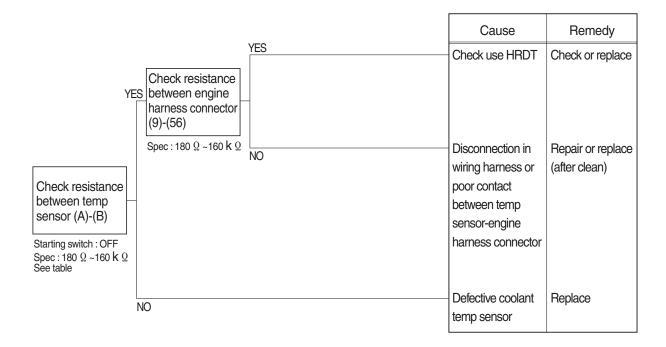
Temperature (°C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (k $\Omega$ )		8.16 ~10.74							



21096ES07

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

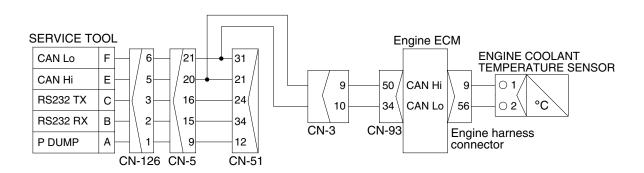
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





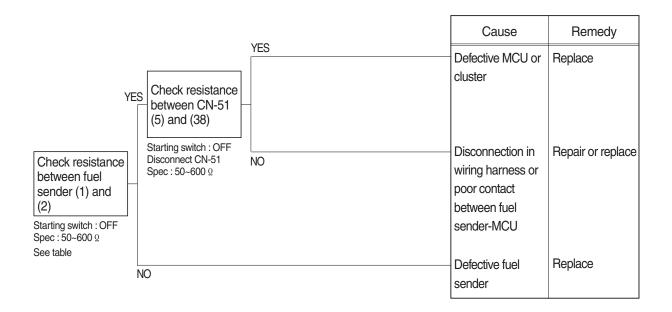
#### **Check Table**

Temperature (°C)	0	25	50	80	95
Resistance (k $\Omega$ )	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 5 or 6)

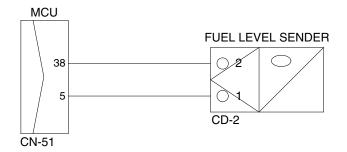
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





#### **Check Table**

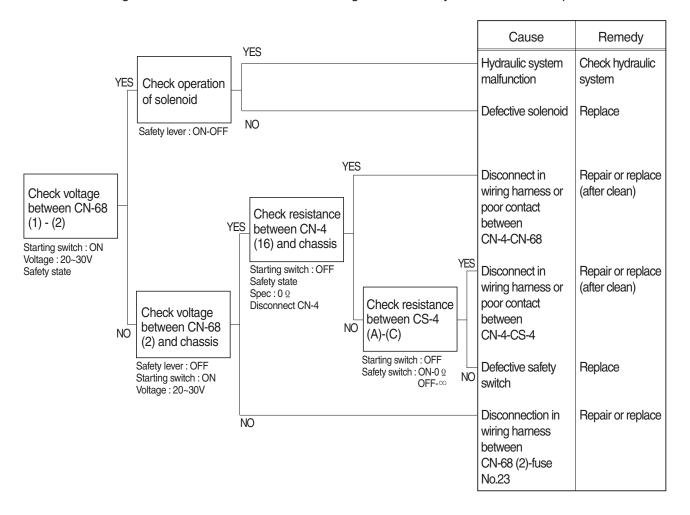
Range	Resistance ( $\Omega$ )	Range	Resistance ( $\Omega$ )
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

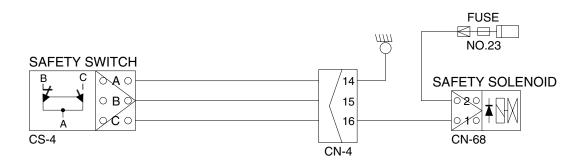


21096ES09

#### 10. WHEN SAFETY SOLENOID DOES NOT OPERATE

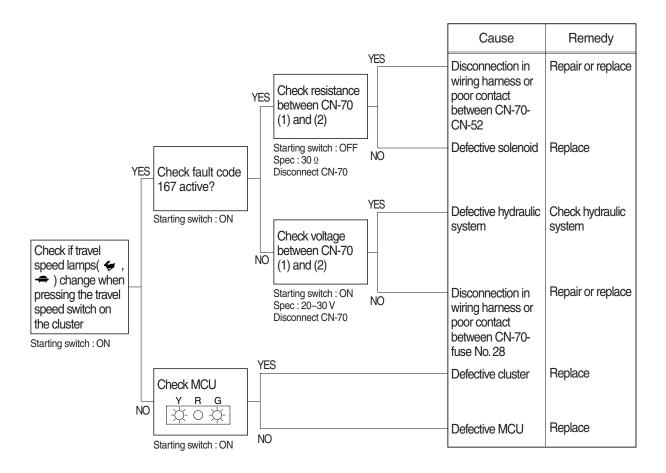
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.23 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

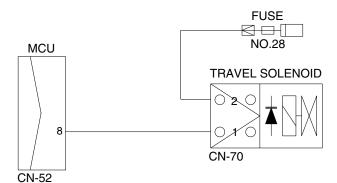




#### 11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 5 or 6)

- · 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. 28 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

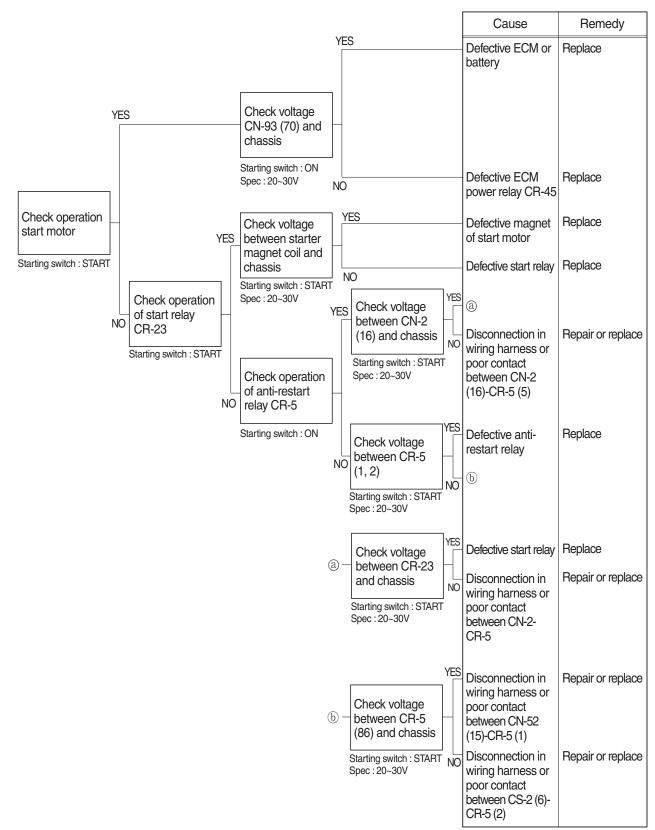


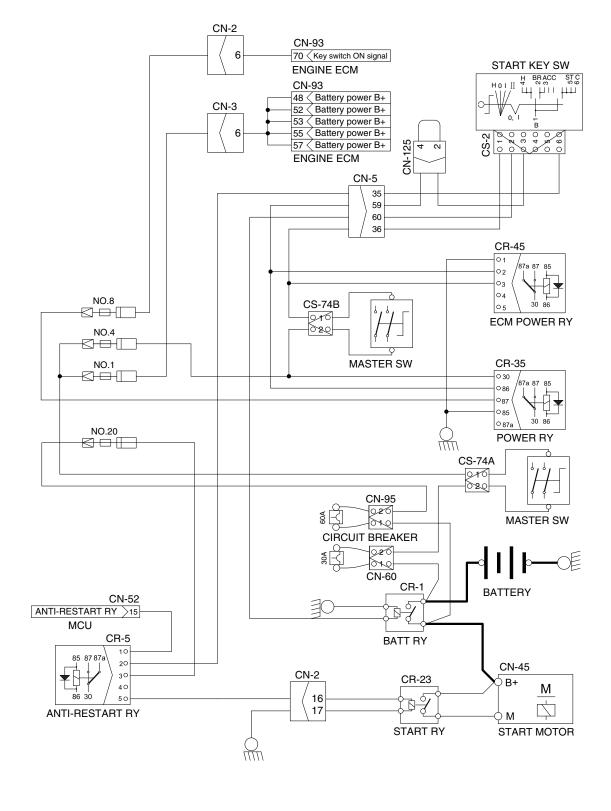


21096ES11

## 12. WHEN ENGINE DOES NOT START ( - + lights up condition)

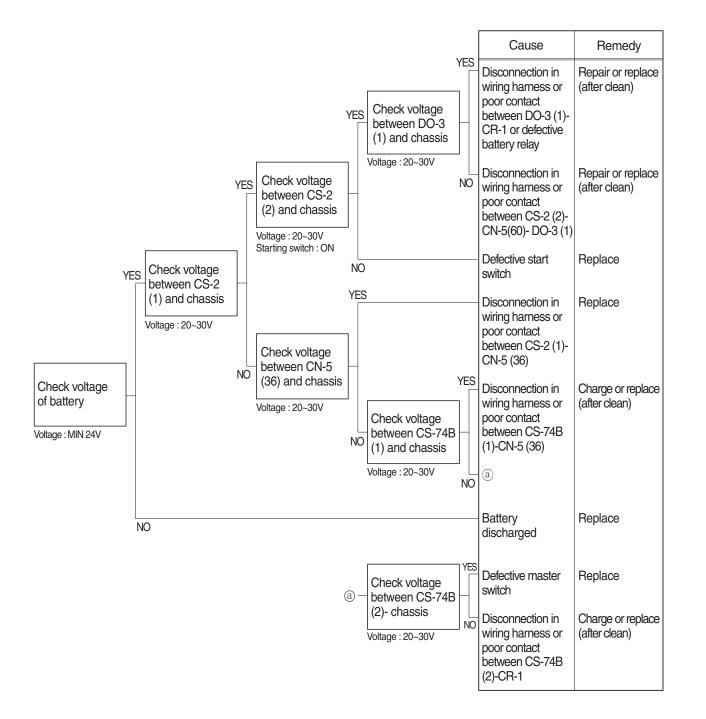
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 1, 4, 8 and 20 burnt out.
- $\cdot \ \text{After checking, insert the disconnected connectors again immediately unless otherwise specified.}$

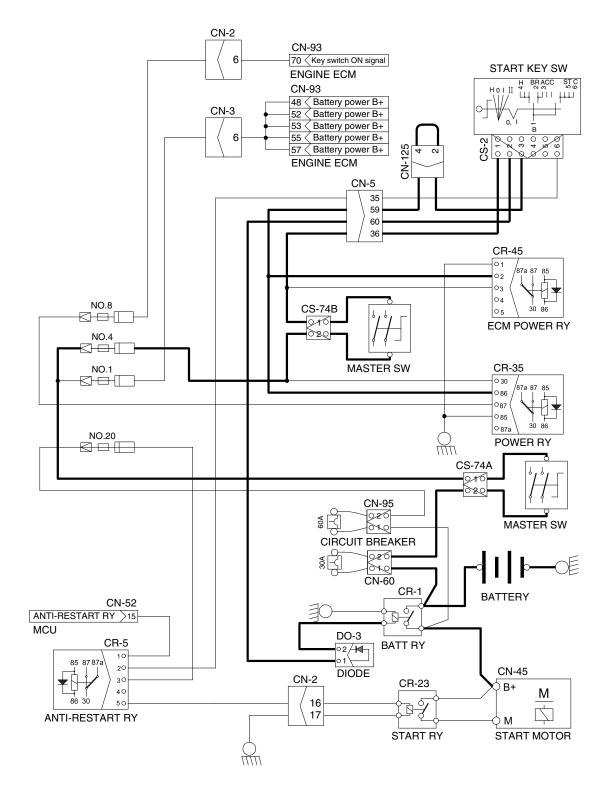




#### 13. WHEN STARTING SWITCH ON DOES NOT OPERATE

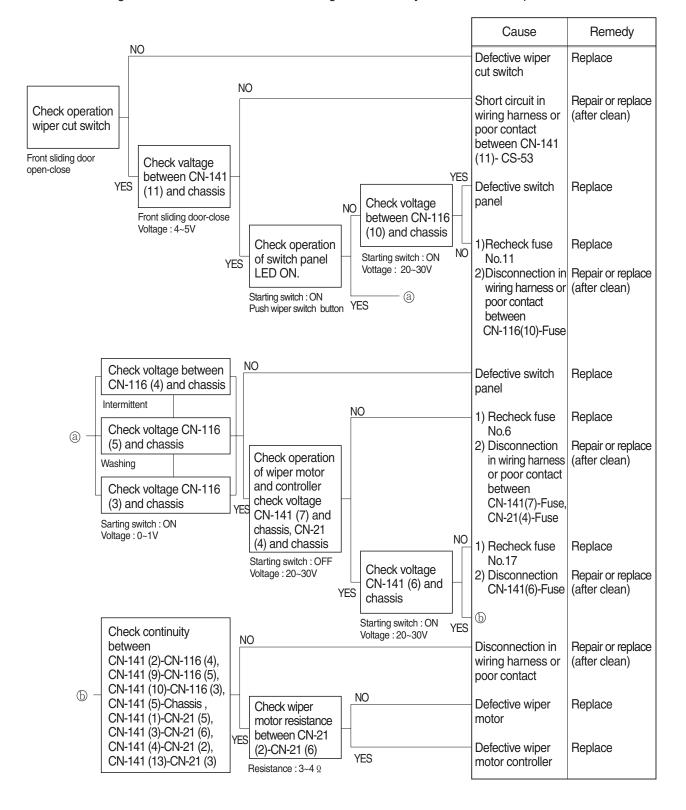
- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check open circuit of fusible link (CN-60).
- · After checking, insert the disconnected connectors again immediately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

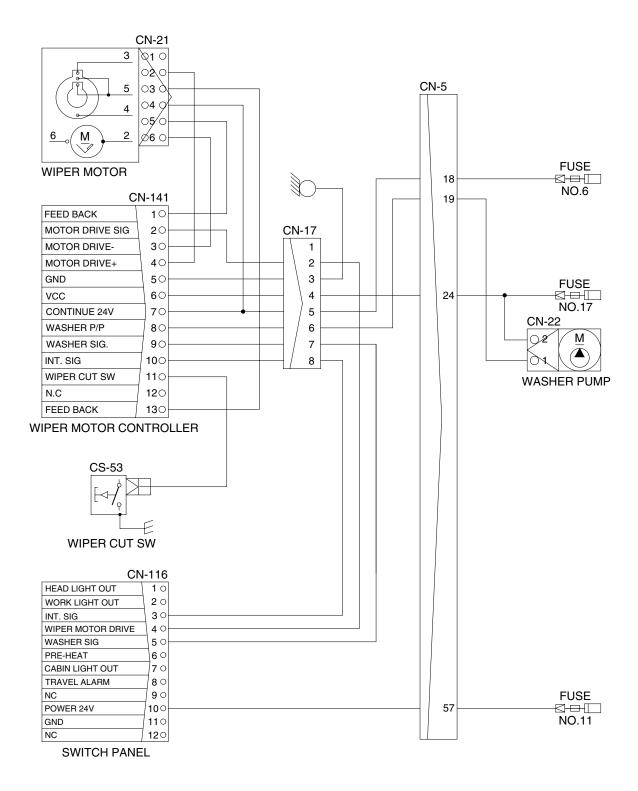




#### 14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

- · 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. 6, 11 and 17 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

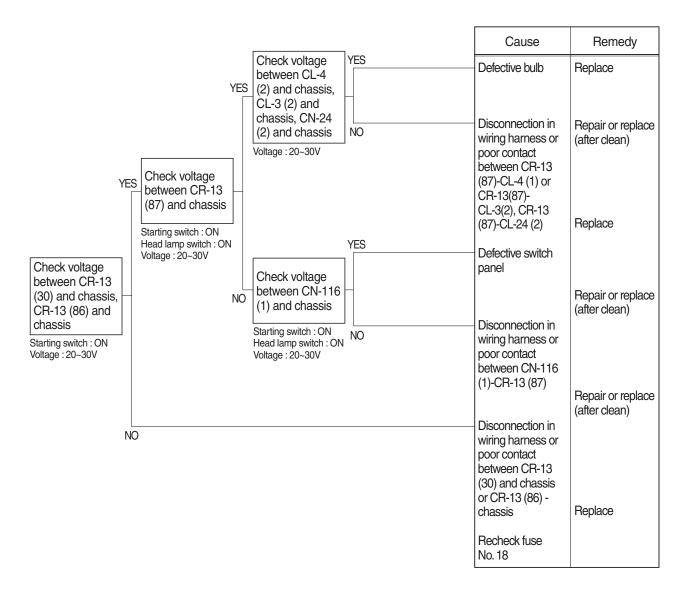


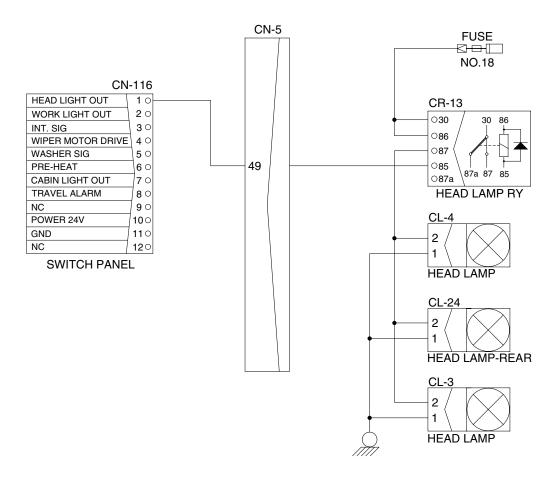


21096ES14

#### 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.18 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



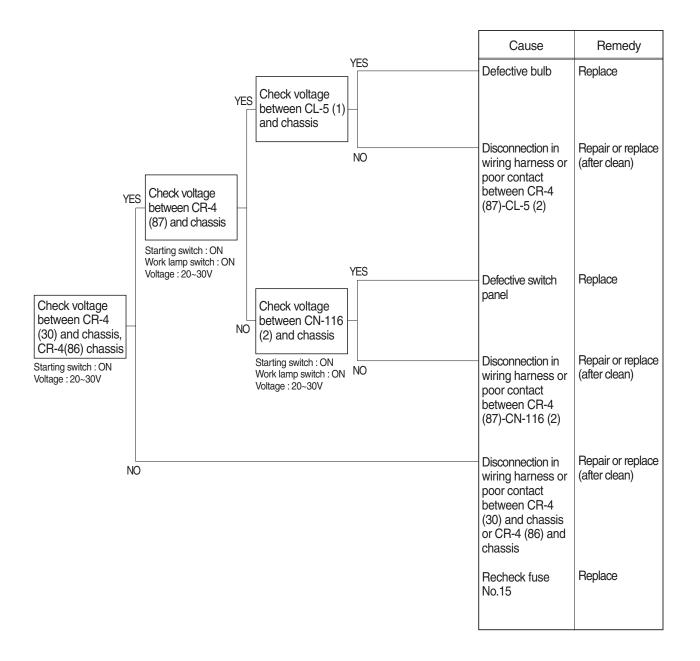


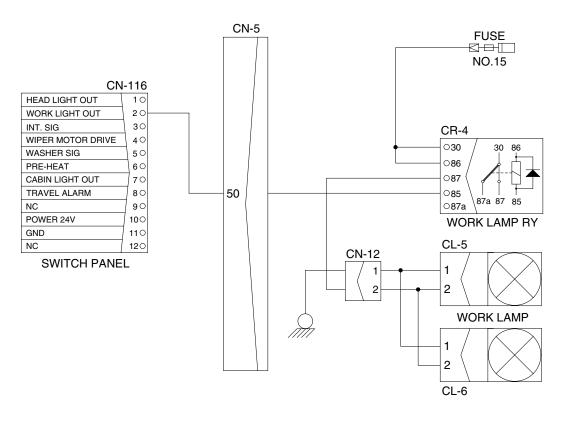
1409A6ES07

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.15 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





1409A6ES08

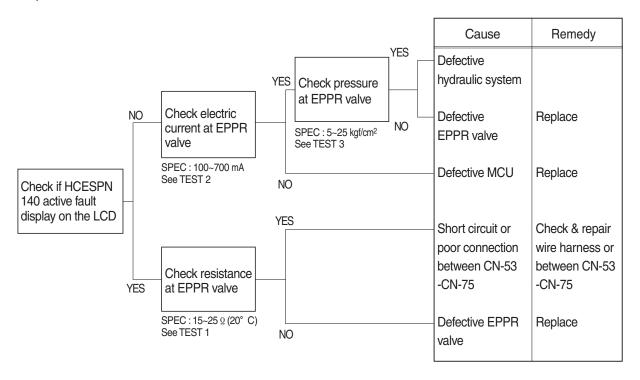
6-39

# **GROUP 4 MECHATRONICS SYSTEM**

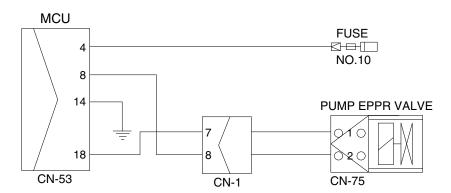
# 1. ALL ACTUATORS SPEED ARE SLOW

- \* Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
- st Spec : P-mode 1850  $\pm$  50 rpm S -mode 1750  $\pm$  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

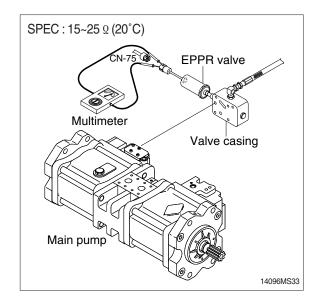


#### Wiring diagram

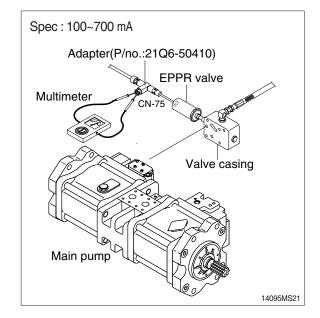


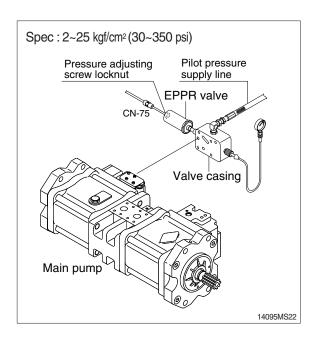
1409A6MS01

- (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 tachometer show approx 1750±50 rpm disconnect one wire harness from EPPR valve.
- ⑦ 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.
  - ⑤ If tachometer show approx 1750±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.

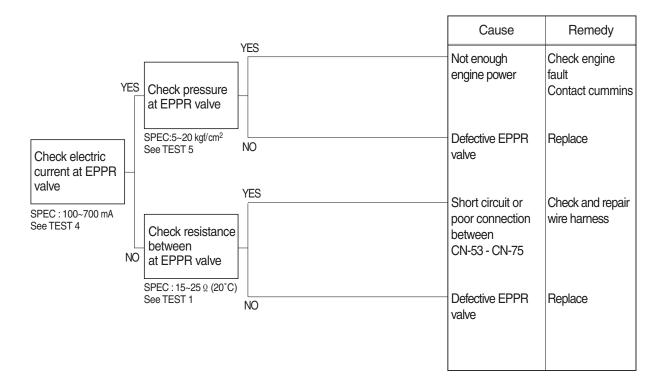




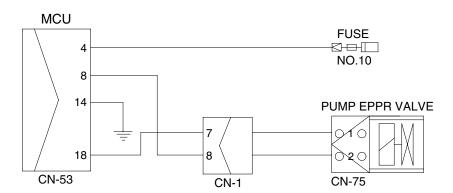
#### 2. ENGINE STALL

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

# 1) INSPECTION PROCEDURE

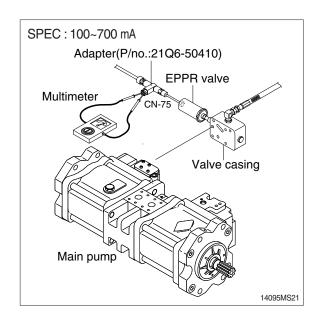


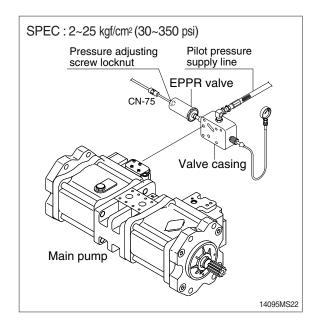
# Wiring diagram



1409A6MS01

- (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 tachometer show approx 1750 $\pm$ 50 rpm disconnect one wire harness from EPPR valve.
  - ⑦ Check electric current at bucket circuit relief position.
- (2) Test 5: Check pressure at EPPR valve.
  - 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.
  - ⑤ If tachometer show approx 1750±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.

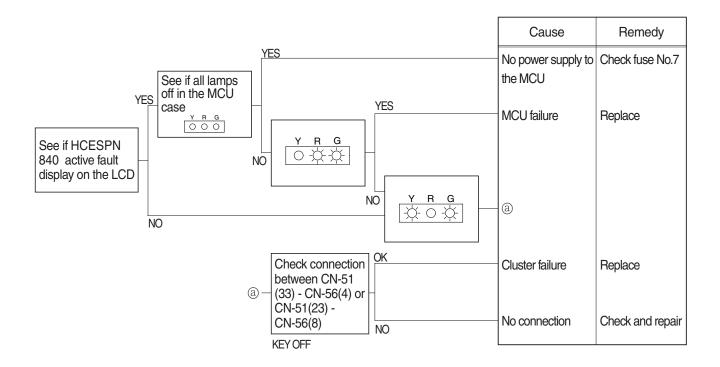




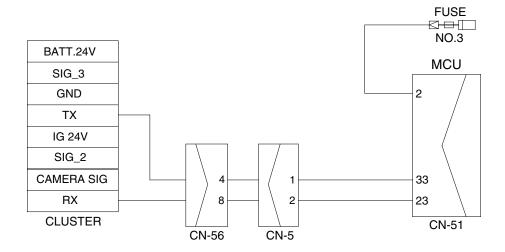
#### 3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

# 1) INSPECTION PROCEDURE



#### Wiring diagram

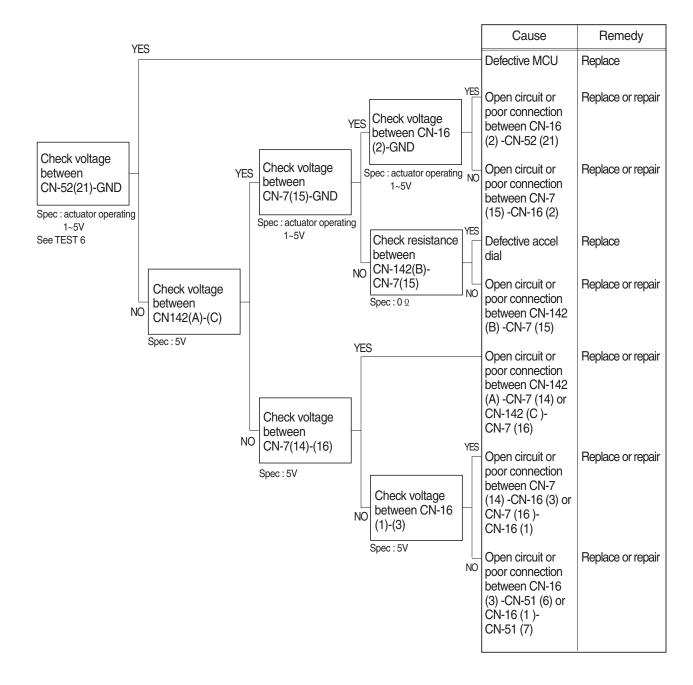


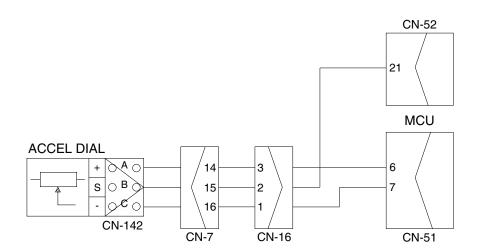
1409A6MS03

#### 4. MALFUNCTION OF ACCEL DIAL

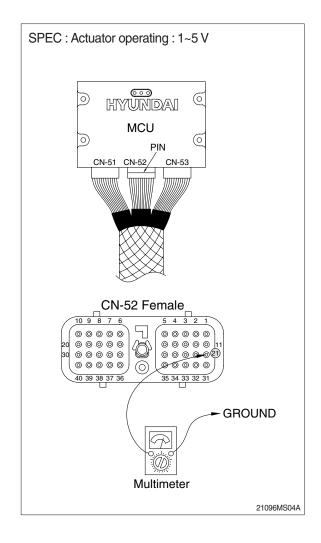
\* Before carrying out below procedure, check all the related connectors are properly inserted.

# 1) INSPECTION PROCEDURE





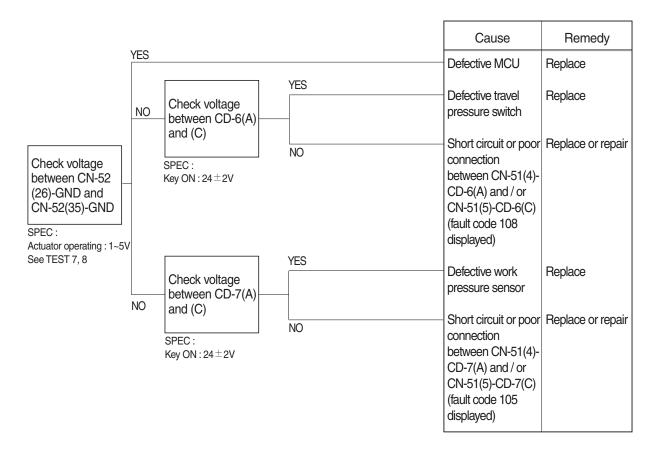
- (1) Test 6: Check voltage at CN-52(21) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (21) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



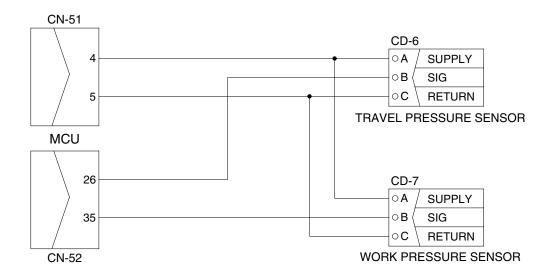
#### 5. AUTO DECEL SYSTEM DOES NOT WORK

- 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.

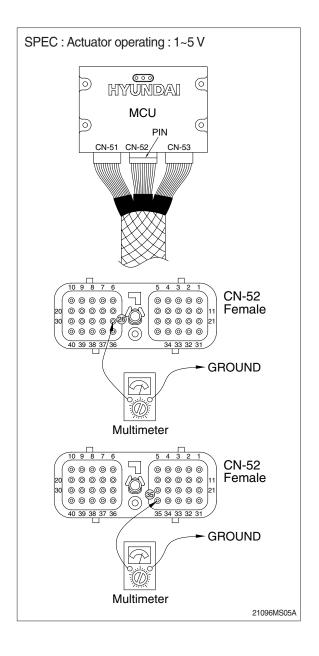
#### 1) INSPECTION PROCEDURE



# Wiring diagram



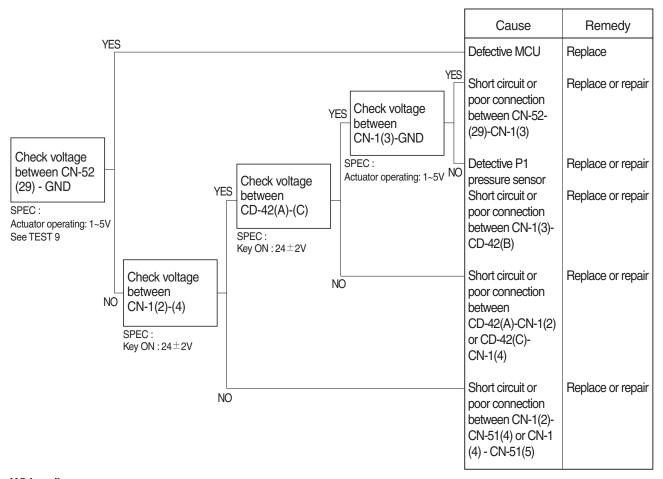
- (1) Test 7: Check voltage at CN-52(26) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (26) of CN-52.
- 3 Starting key ON.
- ④ Check voltage as figure.
- (2) Test 8: Check voltage at CN-52(35) and ground.
- Prepare 1 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.



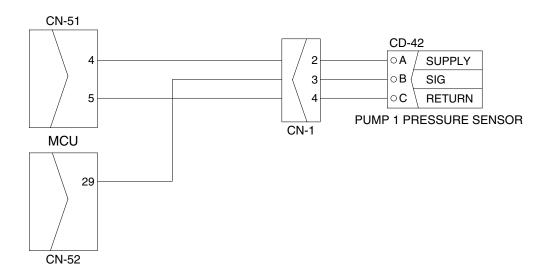
#### 6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

- · Fault code: HCESPN 120, FMI 0~4
- \* Before carrying out below procedure, check all the related connectors are properly inserted.

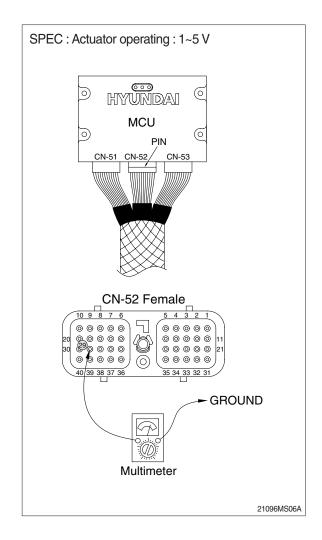
# 1) INSPECTION PROCEDURE



#### Wiring diagram



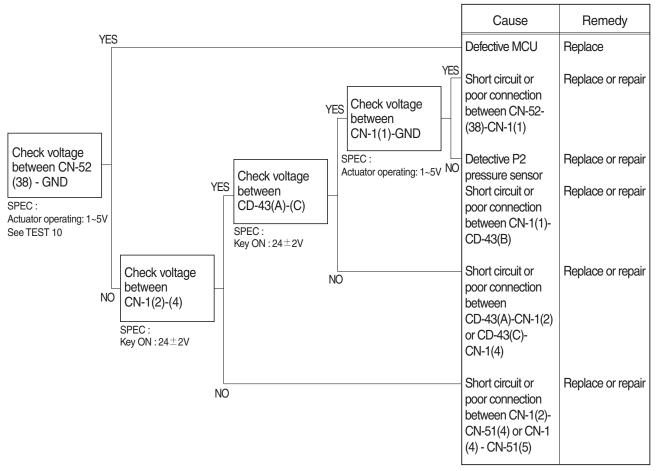
- (1) Test 9: Check voltage at CN-52(29) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (29) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



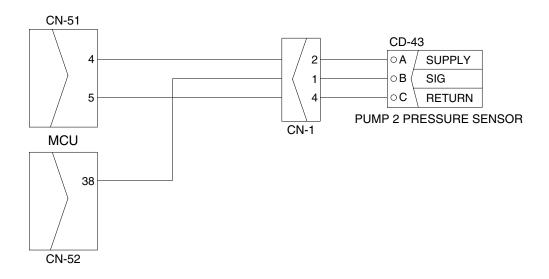
#### 7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

- · Fault code: HCESPN 121, FMI 0~4
- \* Before carrying out below procedure, check all the related connectors are properly inserted.

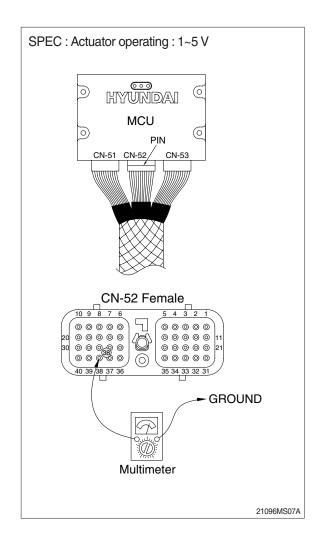
# 1) INSPECTION PROCEDURE



#### Wiring diagram



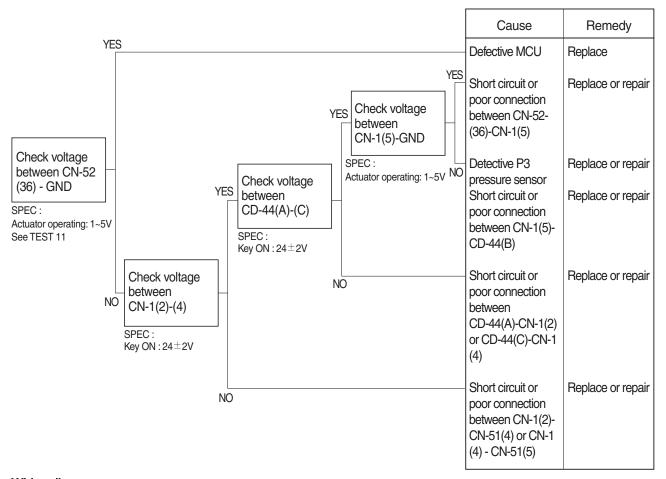
- (1) Test 10 : Check voltage at CN-52(38) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (38) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



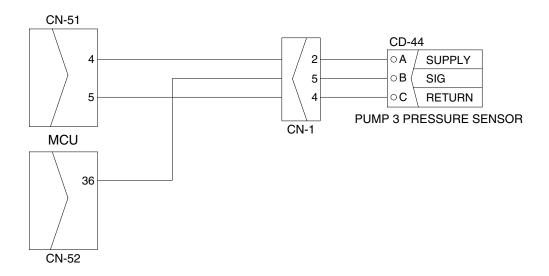
#### 8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

- · Fault code: HCESPN 125, FMI 0~4
- \* Before carrying out below procedure, check all the related connectors are properly inserted.

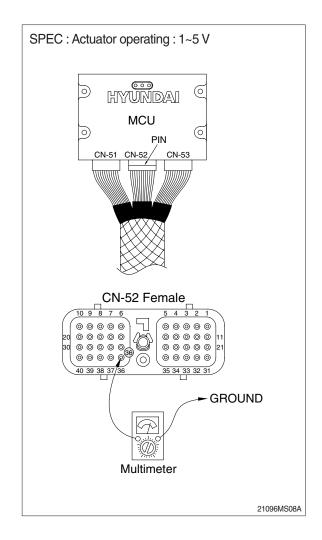
# 1) INSPECTION PROCEDURE



#### Wiring diagram



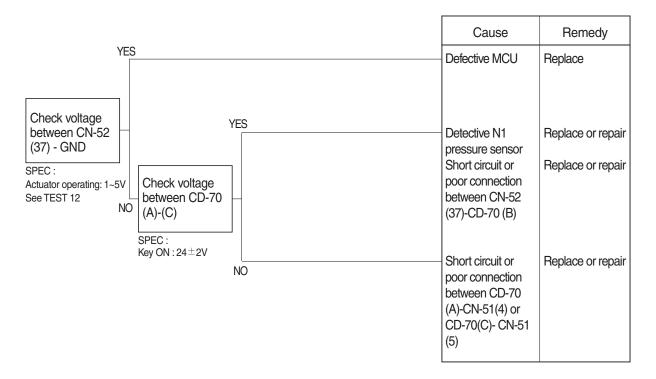
- (1) Test 11: Check voltage at CN-52(36) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (36) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



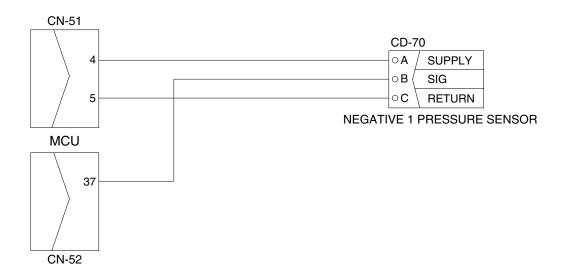
#### 9. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

- · Fault code: HCESPN 123, FMI 0~4
- \* Before carrying out below procedure, check all the related connectors are properly inserted.

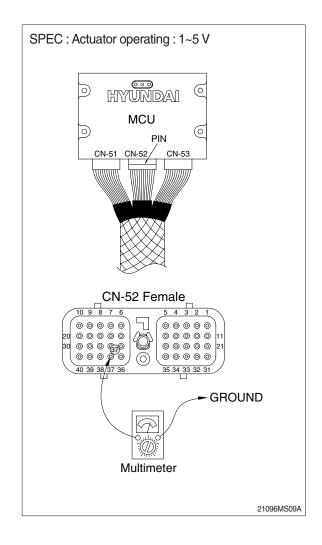
#### 1) INSPECTION PROCEDURE



#### Wiring diagram



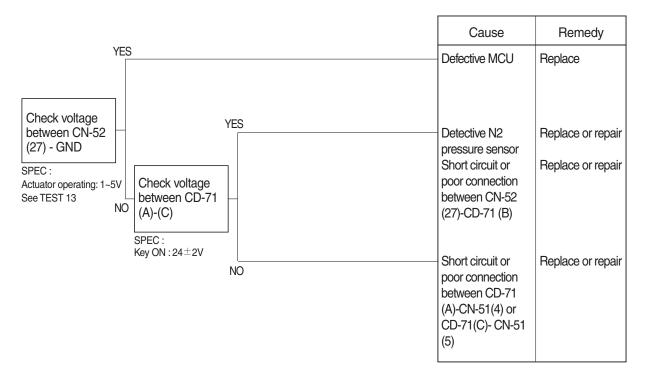
- (1) Test 12: Check voltage at CN-52(37) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (37) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



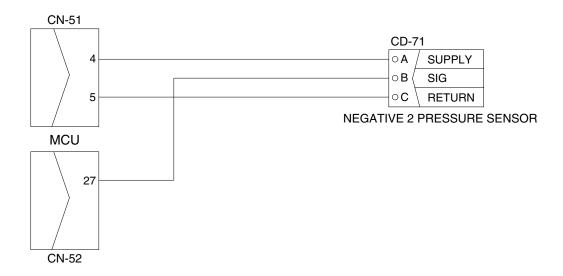
#### 10. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

- · Fault code: HCESPN 124, FMI 0~4
- \* Before carrying out below procedure, check all the related connectors are properly inserted.

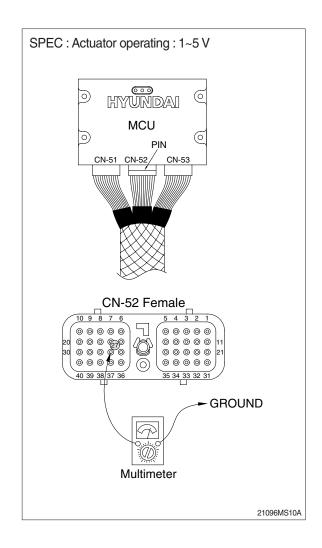
# 1) INSPECTION PROCEDURE



#### Wiring diagram



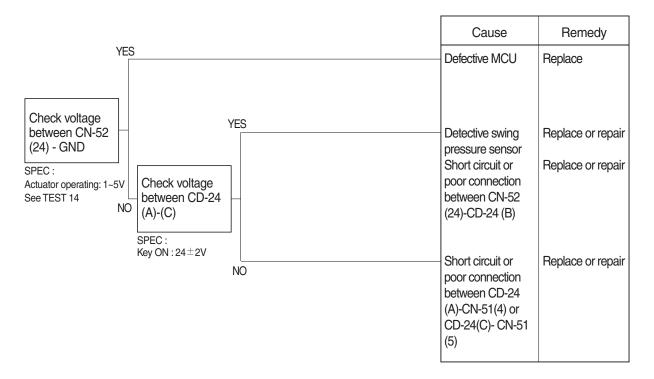
- (1) Test 13: Check voltage at CN-52(27) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (27) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



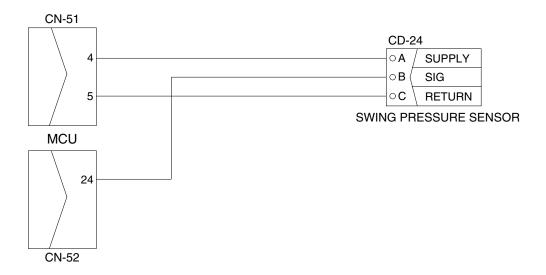
#### 11. MALFUNCTION OF SWING PRESSURE SENSOR

- · Fault code: HCESPN 135, FMI 0~4
- \* Before carrying out below procedure, check all the related connectors are properly inserted.

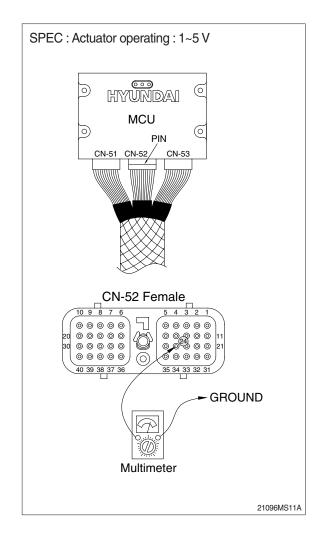
#### 1) INSPECTION PROCEDURE



#### Wiring diagram



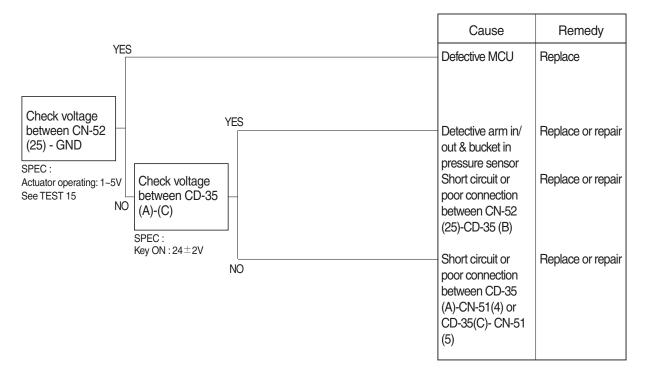
- (1) Test 14: Check voltage at CN-52(24) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (24) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



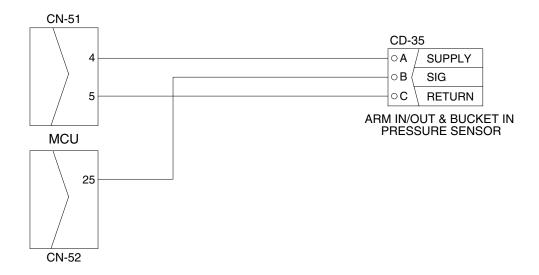
#### 12. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

- · Fault code: HCESPN 133, FMI 0~4
- \* Before carrying out below procedure, check all the related connectors are properly inserted.

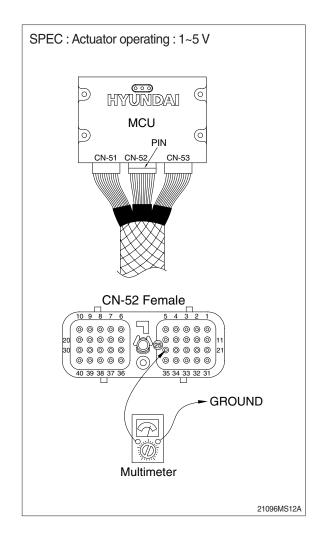
#### 1) INSPECTION PROCEDURE



#### Wiring diagram



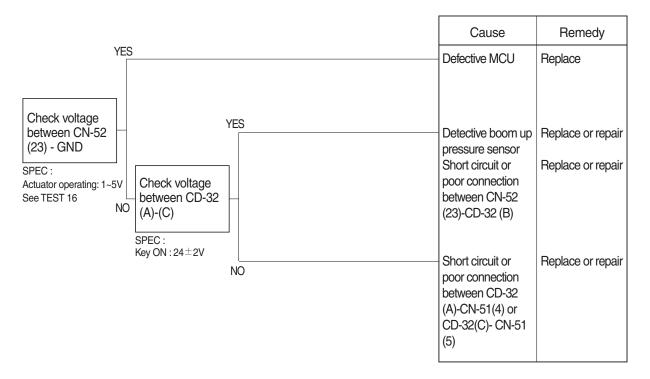
- (1) Test 15: Check voltage at CN-52(25) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (25) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



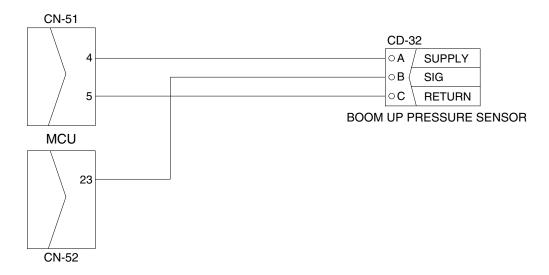
#### 13. MALFUNCTION OF BOOM UP PRESSURE SENSOR

- · Fault code: HCESPN 127, FMI 0~4
- \* Before carrying out below procedure, check all the related connectors are properly inserted.

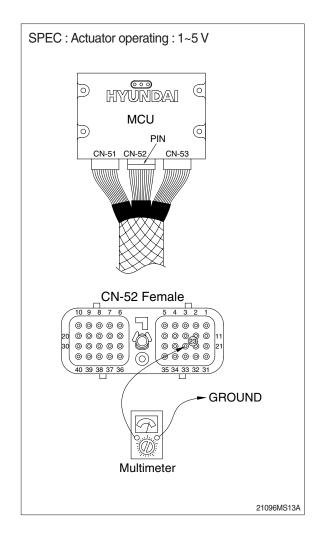
#### 1) INSPECTION PROCEDURE



#### 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.

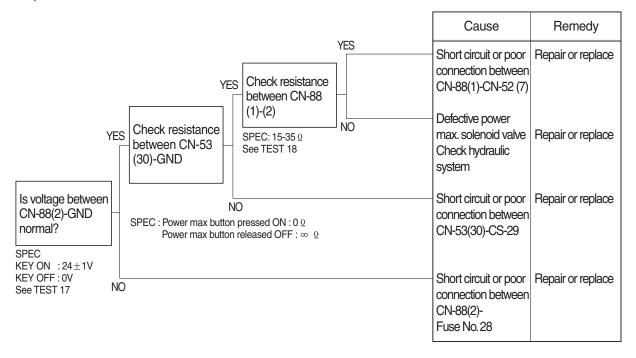


#### 14. MALFUNCTION OF POWER MAX

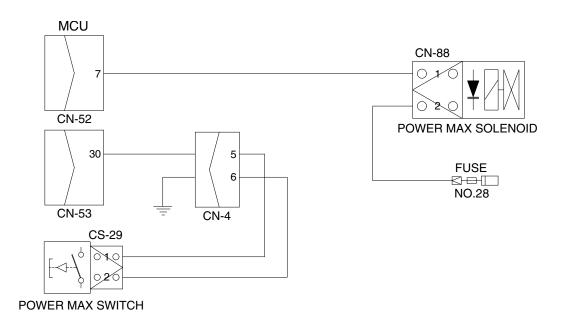
· Fault code: HCESPN 166, FMI 5 or 6

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

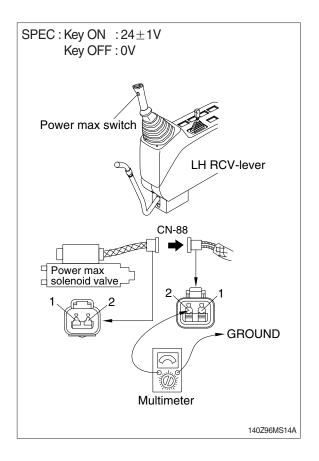
# 1) INSPECTION PROCEDURE



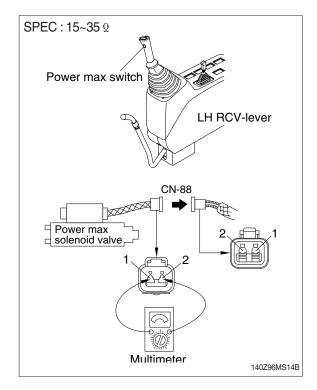
#### Wiring diagram



- (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.

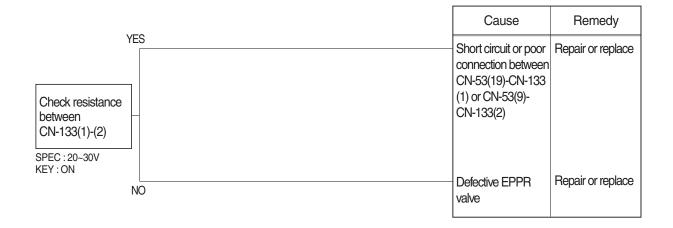


# 15. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

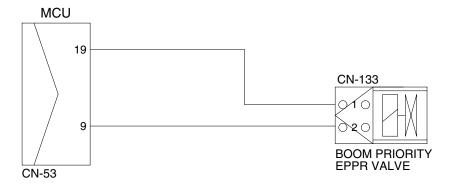
· Fault code: HCESPN 141, FMI 5 or 6

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

# 1) INSPECTION PROCEDURE



#### Wiring diagram

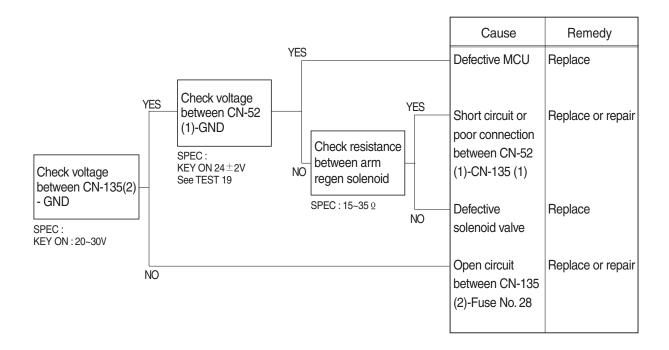


#### 16. MALFUNCTION OF ARM REGENERATION SOLENOID

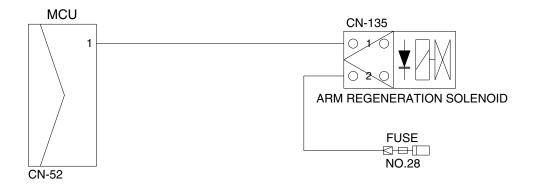
· Fault code: HCESPN 170, FMI 5 or 6

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

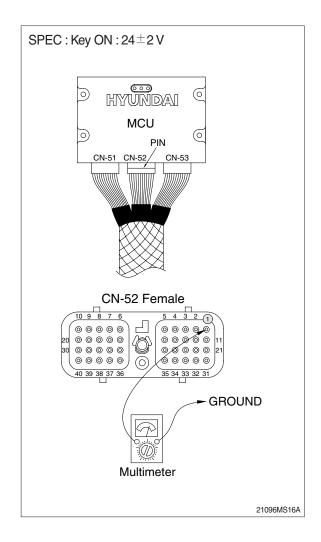
# 1) INSPECTION PROCEDURE



# Wiring diagram



- (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.
- ① 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	7-32

# 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.

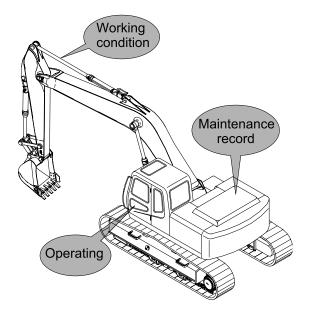
# 2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

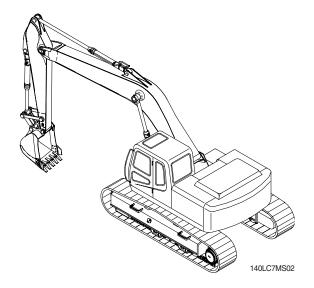


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# 2. TERMINOLOGY

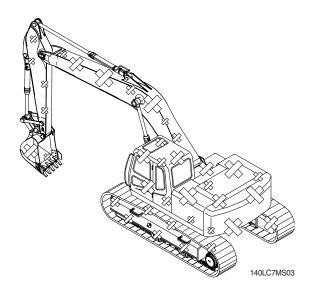
# 1) STANDARD

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

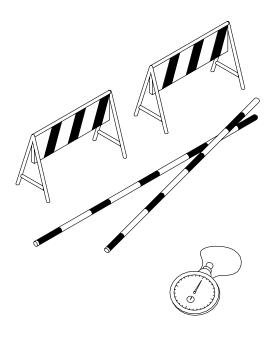
- ① Select a hard, flat surface.
- ② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.
- ③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

#### (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

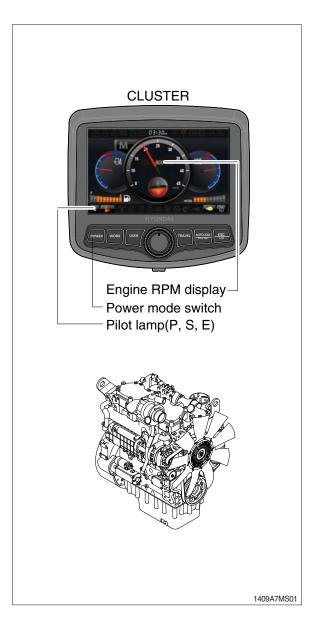
- (1) Measure the engine speed at each power mode
- \*\* The engine speed at each power mode must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

#### (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	1000±100	
	P mode	1850±50	
D140LC 0A	S mode	1750±50	
R140LC-9A	E mode	1650±50	
	Auto decel	1100±100	
	One touch decel	1000±100	

Condition: Set the accel dial at 10 (Max) position.

## 3) TRAVEL SPEED

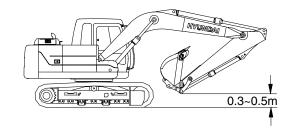
(1) Measure the time required for the excavator to travel a 20 m test track.

#### (2) Preparation

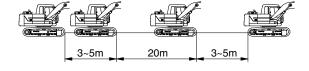
- ① Adjust the tension of both tracks to be equal.
- ② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- 3 Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- 4 Keep the hydraulic oil temperature at  $50\pm5^{\circ}$ 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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14097MS05

#### (4) Evaluation

The average measured time should meet the following specifications.

Unit: Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
R140LC-9A	1 Speed	22.5±2.0	27.9	
111.020 071	2 Speed	14±1.0	17.4	

## 4) TRACK REVOLUTION SPEED

(1) 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

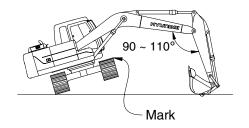
- ② Operate the travel control lever of the raised track in full forward and reverse.
- ③ Rotate 1 turn, then measure time taken for next 3 revolutions.
- ④ Raise the other side of machine and repeat the procedure.
- ⑤ Repeat steps ③ and ④ three times and calculate the average values.

### (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 401 O 0A	1 Speed	26.6±2.0	34.6
R140LC-9A	2 Speed	15.8±2.0	20.5



14097MS06

## 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  $50\pm5^{\circ}$ 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
- ③ 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

R140LC-9A

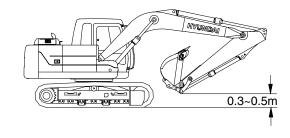
Mistrack should be within the following specifications.

Unit: mm / 20 m

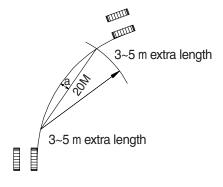
Model Standard Maximum allowable Remarks

240

200 below



14097MS04



(210-7) 7-7(2)

## 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  $50\pm5^{\circ}\text{C}$ .



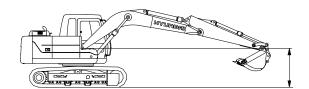
- ① Select the following switch positions.
- · Power mode switch: P mode
- ② Operate swing control lever fully.
- ③ Swing 1 turn and measure time taken to swing next 3 revolutions.
- ④ Repeat steps ② and ③ three time and calculate the average values.

#### (4) Evaluation

The time required for 3 swings should meet the following specifications.

Unit: Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
R140LC-9A	P mode	15.4±1.5	18.9



14097MS07

## 7) SWING FUNCTION DRIFT CHECK

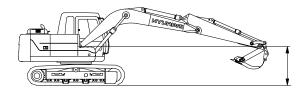
 Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

## (2) Preparation

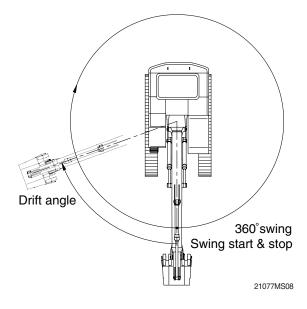
- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot 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°.
- **(6)** 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°
- Measure the distance between the two marks.
- ⑤ Align the marks again, swing 360°, then test the opposite direction.
- ⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



14097MS07



#### (4) Evaluation

The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R140LC-9A	P mode	90 below	157.5	

## 8) SWING BEARING PLAY

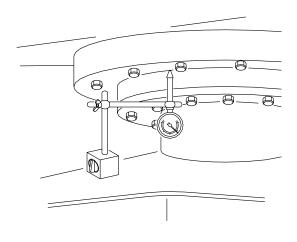
(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.

## (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.

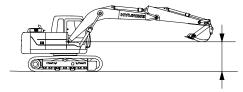
## (3) Measurement

- 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

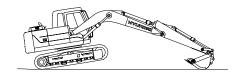


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Measurement: (h2)



(4) Evaluation

The measured drift should be within the following specifications.

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Model	Standard	Maximum allowable	Remarks
R140LC-9A	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

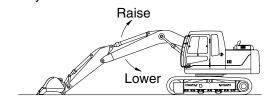
- ① Select the following switch positions.
- · Power mode switch: P mode
- ② To measure cylinder cycle times.
  - -Boom cylinders.

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.

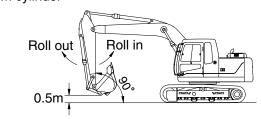
- Arm cylinder.

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.

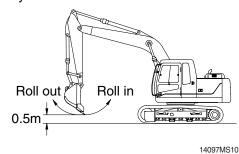
#### Boom cylinder



#### 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		3.31±0.4	4.3	
	Boom lowe	r	3.10±0.4	4.3	
	A was in	Regen ON	2.86±0.4	4.5	
R140LC-9A	Arm in	Regen OFF	$3.18 \pm 0.4$	4.3	
	Arm out		2.78±0.3	3.9	
	Bucket in		3.48±0.4	4.5	
	Bucket out		2.26±0.3	3.0	

#### 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

- Load bucket fully. Instead of loading the bucket, weight(W) of the following specification can be used.
  - · W= $M^3 \times 1.5$

Where:

M<sup>3</sup> = Bucket heaped capacity (m<sup>3</sup>)

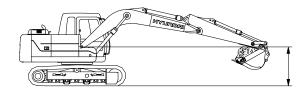
1.5 = Soil specific gravity

- 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.
- (5) 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 Drift to be measured Model Standard Maximum allowable Remarks Boom cylinder 10 below 20 R140LC-9A Arm cylinder 20 10 below 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	
R140LC-9A	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	
R140LC-9A	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  $50\pm5^{\circ}\text{C}$ .

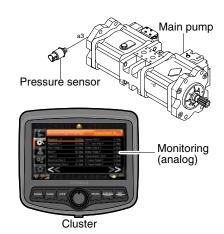
## (2) Measurement

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.



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## (3) Evaluation

The average measured pressure should meet the following specifications:

Unit: kgf/cm2

Model	Engine speed	Standard	Allowable limits	Remarks
R140LC-9A	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.
- $\$  Keep the hydraulic oil temperature at  $50\pm5^{\circ}$  C.

#### (2) Measurement

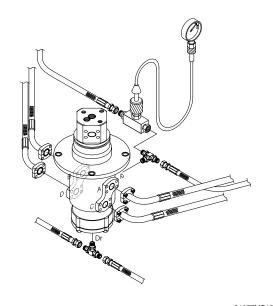
① Select the following switch positions.

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.



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#### (3) Evaluation

The average measured pressure should be within the following specifications.

Unit: kgf/cm2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R140LC-9A	1 Speed	0	-	
1117020-9A	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.



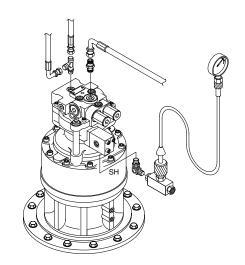
- ① Select the following switch positions.
  - · Power mode switch : P mode
- ② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is 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

Model	Description	Standard	Allowable limits	Remarks
R140LC-9A	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).



1409A7MS13

# (3) Evaluation

The average measured pressure should meet the following specifications.

Unit: kgf/cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R140LC-9A	High idle	40 +2	-	

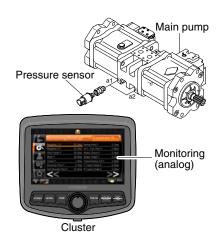
## 17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

#### (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.

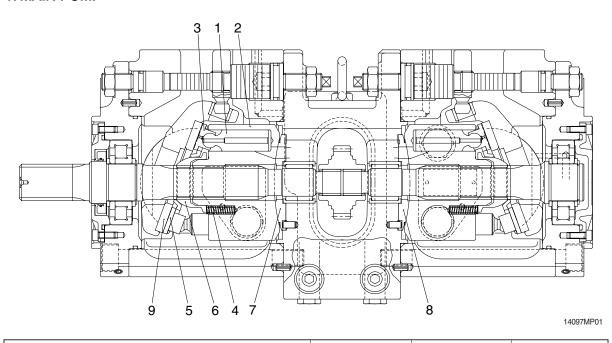
Unit: kgf/cm2

Model	Function to be tested	Standard	Port relief setting at 20 lpm
	Boom, Arm, Bucket	350 (380)±10	400±10
R140LC-9A	Travel	350±10	-
	Swing	285±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	0.028	0.056	Replace piston or cylinder.
Play between piston (1) & shoe caulking section (3) (δ)	<b>‡</b>	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)	1999999999999 0000000000000000000000000	31.3	30.5	Replace cylinder spring.
Combined height of set plate(5)(H) & spherical bushing(6)(h) (H-h)	h H	19.0	18.3	Replace retainer or set plate.
Surface roughness for valve plate (Sliding face)(7,8), swash plate (shoe plate	Surface roughness necessary to be corrected	3	Z	Lanning
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.
		<ul> <li>Sliding sections of casing fore and spool, especially land sections applied with holded pressure.</li> <li>Seal pocket section where spool is inserted.</li> <li>Seal section of port where O-ring contacts.</li> <li>Seal section of each relief valve for main, travel, and port.</li> <li>Other damages that may damage normal functions.</li> </ul>
Spool	Existence of scratch, gnawing, rusting or corrosion.	<ul> <li>Replacement when its outside sliding section has scratch (especially on seals-contacting section).</li> </ul>
	· O-ring seal sections at both ends.	<ul> <li>Replacement when its sliding section has scratch.</li> </ul>
	· Insert spool in casing hole, rotate and reciprocate it.	<ul> <li>Correction or replacement when O-ring is damaged or when spool does not move smoothly.</li> </ul>
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 ( $\delta$ )	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
t → δ 2507A7MS04			2507A7MS05

# 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

# 1) TYPE 1

Pro	oblem	Cause	Remedy
Does not start	Pressure is not developed	Pump failure     Control valve malfunction	<ul> <li>Check if action other than traveling is available. If faulty, repair.</li> <li>Check if spool moves correctly. Repair if necessary.</li> </ul>
	Pressure is developed	<ul> <li>Brake valve failure</li> <li>-Sleeve stick</li> <li>-Check valve stick</li> <li>Motor failure</li> <li>-Valve seat seizure</li> <li>Gear broken and fragment locked</li> <li>Overloaded</li> </ul>	<ul> <li>Replace brake valve</li> <li>Replace</li> <li>Check hydraulic oil for contamination</li> <li>Replace reduction gear</li> <li>Reduce load</li> </ul>
Oil leakage	Leakage from engaging surfaces	<ul><li>Scratch on engaging surfaces</li><li>Loosening by poor bolt tightening</li></ul>	Correct surfaces by oilstone or sandpa- per or replace     Check after retightening
	Leakage from casing	<ul><li>Plug loosened</li><li>Crack formed by stone</li></ul>	· 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	<ul><li>Bolt loosened</li><li>O-ring damaged</li><li>Sealing surface scratched</li></ul>	Tighten properly     Replace O-ring     Correct by oilstone or sandpaper
Coasts on si	ope excessively	<ul> <li>Poor volumetric efficiency of hydraulic motor</li> <li>Increase of internal leakage of brake valve</li> <li>Parking brake not actuated</li> <li>Spring breakage</li> <li>Wear of friction plate</li> </ul>	<ul><li>Replace hydraulic motor</li><li>Replace brake valve</li><li>Replace spring</li><li>Replace parking brake</li></ul>
Excessive to reduction ge	emperature on ear case	<ul><li>Pitting on bearing</li><li>Lack of gear oil</li><li>Hydraulic oil introduced to gear case</li></ul>	<ul><li>Replace reduction gear</li><li>Supply gear oil properly</li><li>Check motor and replace oil seal</li></ul>
Meanders	Meanders at low pressure	<ul> <li>Delivery rate is different between right and left</li> <li>Motor drain rate is different between right and left</li> </ul>	Repair pump     Replace motor
	Meanders at high pressure	<ul> <li>Delivery rate is different between right and left</li> <li>Motor drain rate is different between right and left</li> </ul>	Repair regulator or pump     Replace motor
	Meanders at high pressure	<ul> <li>Relief pressure dropped at right and left brake valve</li> <li>Main relief pressure dropped at right or left of control valve</li> </ul>	Replace brake valve     Replace main relief valve
Pump delive	ry is poor	<ul><li>Regulator operation poor</li><li>External leakage of pump is excessive</li></ul>	· Repair regulator · Repair pump
External leal excessive	kage of motor is	-	· Replace motor

# 2) TYPE 2

# (1) Troubleshooting

# ① The motor does not rotate

Problem	Cause	Remedy
The pressure of a motor	· The oil is bypassed at relief valve	- Fix or exchange relief valve
does not increase	Malfunction of relief valve     Stick of plunger     Malfunction of plunger seat part     Cut of Spring	<ul><li>Modify of stick part</li><li>Disassembly, clean</li><li>Exchange a parts</li><li>Exchange the relief valve</li></ul>
	The cracks happens at the inner path of valve casing	- Exchange the check valve
	Abrasion and abnormality on the adhered surface of check	- Fix or exchange the abnormal parts
Although the pressure increases, a hydraulic	Unmeasured external resistance	- Exchange friction plate and separated Plate
motor does not rotate	· Stick of counter balance spool	- Check of counter balance spool
	· Do not become break off	Check and exchange the orifice (4)     Check of brake piston ring
	· Stick of brake piston	- Disassembly and check
	· Stick of friction plate	- Fix or exchange the abnormal parts
	· Damage of traveling reduction gear	- Exchange the traveling reduction gear

# ${\ensuremath{@}} \textbf{Rotate very slow}$

Problem	Cause	Remedy
Lack of the number of	· Shortage of supplied oil	- Check the oil circuit up to a motor
rotation	· Oil Temperature is too higher	- Make the temperature down of the oil
	· Abnormal oil leakage	- Fix or exchange the abnormal parts
	Two speed is late     Stick of swash piston	- Fix or exchange the abnormal parts

# $\ensuremath{\mathfrak{B}}$ To control or adjust a brake is hard

Problem	Cause	Remedy
Brake torque is low	Abrasion of friction and separated plate	- Fix or exchange the abnormal parts
	· Damage of brake spring	
	· Damage of brake piston	

# $\ensuremath{\textcircled{4}}$ Shortage of rotating force at the standard value

Problem	Cause	Remedy
Brake is released, but the turning force is low	Excavator main relief valve is not set correctly	- Resetting the main relief valve
	Pressure down of motor relief valve	- Resetting the relief valve pressure - Exchange the relief valve
	Malfunction of check valve	- Exchange the check valve
	· Scratch of valve plate	- Fix or exchange the abnormal parts

# **5 Many slip**

Problem	Cause	Remedy
Brake is released, but the	Malfunction of relief valve	- Fix or exchange the abnormal parts
turning force is week	· Check valve error	
	· Stick of counter balance spool	
	Valve plate scratch / copper peeling phenomena	

# $\ensuremath{\mathfrak{G}}$ It is not two speed changeover

Problem	Cause	Remedy
It is not variable speed	· Pilot Line error	- Fix or exchange the abnormal parts
(low/high 2- stage speed) changeover	· Two speed changeover spool stick	
3	· Swash piston stick	

# ⑦ Oil leakage

Problem	Cause	Remedy
Leakage at oil seal	· Drain pressure is high	- Remove the abnormal substances after exchanging the damaged part
	· Seal error	- Check a drain line of an equip
Leakage on a assembled	· Damage of a O-ring	- Exchange O-ring
surface	· Bolt or plug is released	- Tighten the parts with fixed torque

# (2) Wwaring parts

Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Piston and cylinder block bore tolerance (space = D - d)	0.05 mm	0.065 mm	D : Cylinder block bore dia d : Piston out dia
Piston and shoe tolerance (space = k)	0	0.3 mm	After pulling the piston and the shoe, measures the distance
Thickness of shoe (t)	5.5 mm	5.2 mm	-
Thickness of shoe plate (h)	3.3 mm	3.0 mm	-
Thickness of set plate (t1)	6 mm	5.8 mm	If the plate thickness is below 5.8 mm, change the set plate and ball guide at the same time
Set plate and the ball guide height of the assembly (height of the assembly H – h)	13.5 mm	13.3 mm	If assembly height is below 13.3 mm, change the set plate and ball guide at the same time
3809A7TM041	t1 Shoe	Ball quide	h H Set plate

# 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.	
Spool	This is to be replaced when the sliding surface has worn more than 10 $\mu$ m, compared with the non-sliding surface.	
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 $10\mu$ 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		
Body	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).			
		Extruded excessively from seal groove square ring.	Replace		
	-	Square ring Extrusion			
Seal set		Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring.	Replace		
Geal Set	-	1.5mm (max.) (0.059 in)			
		• Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in)	Replace		
	-				

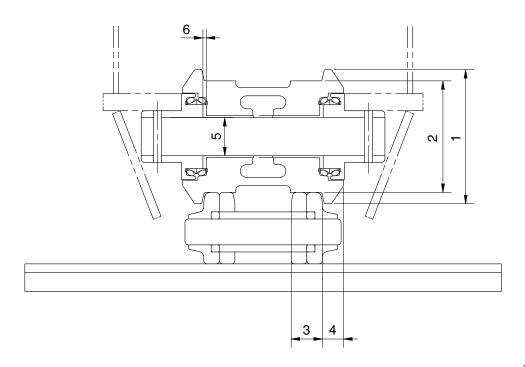
# 8. CYLINDER

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

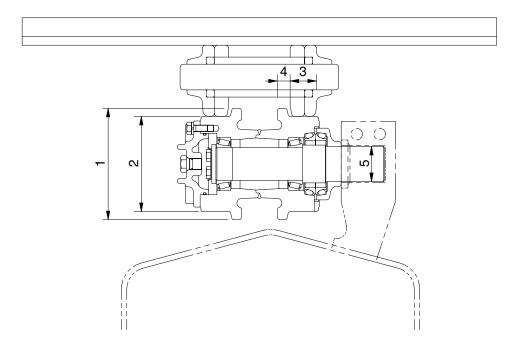


21037MS01

Unit:mm

No.	Check item		Criteria				
1	Outside dismeter of flance	Standard size		Repair limit			
'	Outside diameter of flange	Ø	190		-		Rebuild or replace
2	Outside diameter of tread	Ø	150		ø 138		
3	Width of tread	36.5		42.5		. Topiado	
4	Width of flange	26.5		-			
		Standard	toler	ance	Standard	Clearance	
5	Clearance between shaft	Shall Ho	Hole	clearance limit	limit	Replace	
	and bushing	ø 65	-0.25 -0.35	+0.12 +0.075	0.325 to 0.47	2.0	bushing
6	Side clearance of roller	Standard	Standard clearance		Clearance limit		Danlass
0	(both side)	0.1 t	o 1.3		2	.0	Replace

# 2) CARRIER ROLLER

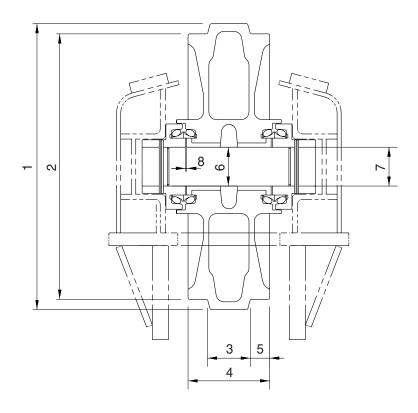


21037MS02

Unit:mm

No.	Check item		Criteria				
4	Outside dispersion of florers	Standard size		Repa			
'	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	Standard size & Tolerance		Clearance		
5		Shaft	Hole	clearance	limit	Replace bushing	
	and bushing	ø 41.27 0 +0.05	ø 41.5 +0.2 - 0.1	0.13 to 0.48	1.2	busiling	

# 3) IDLER

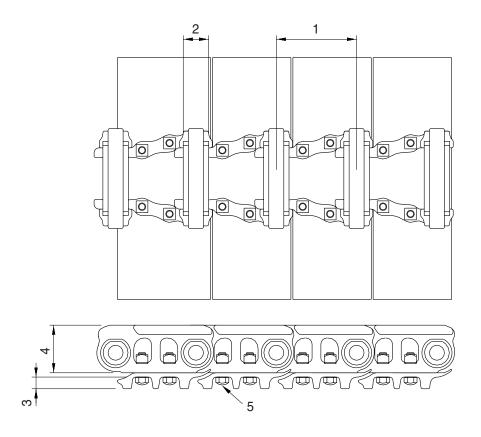


21037MS03

Unit: mm

No.	Check item		Criteria				
	Outside dispostant of floress	Standard size		Repair limit			
1	Outside diameter of flange	ø!	552		-		
2	Outside diameter of tread	ø!	507	Ø 4	ø 497		
3	Width of protrusion	6	67		-	replace	
4	Total width	135		-			
5	Width of tread	34		39			
		Standard size	e & Tolerance	Standard	Clearance	Replace	
6	Clearance between shaft	Shaft	Hole	clearance	clearance limit		
	and bushing	ø 70 0 -0.03	ø 70.3 <sup>+0.05</sup>	0.3 to 0.38	2.0	bushing	
7	Clearance between shaft and support	ø 70 0 0 0 +0.07 +0.03		0.3 to 0.1	1.2	Replace	
8	Side clearance of idler		clearance		nce limit	Replace	
-	(both side)	0.25	to 1.15	2	.0	bushing	

# 4) TRACK

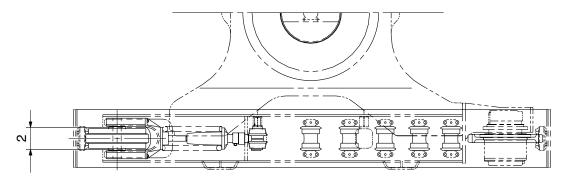


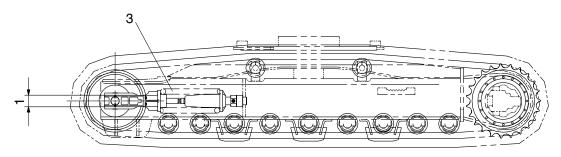
21037MS04

Unit:mm

	T				
No.	Check item	Crit	eria	Remedy	
4	Link nitch	Standard size	Repair limit	Turn or	
'	I Link pitch	Link pitch 171.45		175.65	replace
2	Outside diameter of bushing	ameter of bushing ø 53.75 ø 43.95			
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



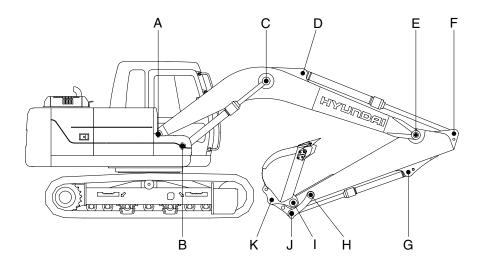


21037MS05

Unit: mm

No.	Check item		Criteria				
			Standar	d size	Tolerance	Repair limit	
1	Vertical width of idler guide		100	3	+2 0	107	
		Idler suppo	rt 100	)	0 - 0.5	98	Rebuild or replace
2	Llovizontal width of idlay guida	Track frame	9 192	2	+2 0	196	replace
	Horizontal width of idler guide	Idler suppo	rt 190	)	-	188	
		Standard size		е	Repair limit		
3	Recoil spring	Free length	Installation length	Installation load		Installation load	Replace
		ø 192×470	405	8,497k	kg -	6,978kg	

# 2. WORK EQUIPMENT



14097MS01

Unit:mm

	Measuring point (Pin and Bushing)	Normal value	Pin		Bushing		Deved
Mark			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	"
Е	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

Group	1	Precaution	8-1
Group	2	Tightening Torque ·····	8-4
Group	3	Pump Device ····	8-7
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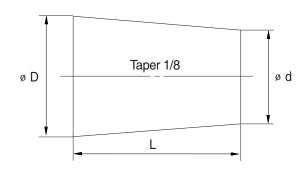
# SECTION 8 DISASSEMBLY AND ASSEMBLY

## **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

No	Descriptions		Bolt size	Torque		
No.		Descriptions		kgf ⋅ m	lbf ⋅ ft	
1		Engine mounting bolt (engine-bracket, FR)	M12 × 1.75	11.2 ± 1.1	81 ± 8.0	
2		Engine mounting bolt (engine-bracket, RR)	M12 × 1.75	7.9 ± 2.0	57.1 ± 14.5	
3		Engine mounting bolt (bracket-frame, FR)	M20 × 2.5	52.1 ± 5.0	377 ± 36.2	
4	Engine	Engine mounting bolt (bracket-frame, RR)	M30 × 3.0	90 ± 9.0	651 ± 65.1	
5		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5	
6		Coupling mounting socket bolt	M16 × 2.0	22 ± 1.0	159 ± 7.2	
7		Main pump housing mounting bolt	M10 × 1.5	6.0 ± 0.3	43.4 ± 2.2	
8		Main pump mounting socket bolt	M16 × 2.0	22.5 ± 0.5	163 ± 3.6	
9		Main control valve mounting bolt	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4	
10	Hydraulic system	Fuel tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 36.9	
11	System	Hydraulic oil tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 36.9	
12		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	88.9 ± 9.4	
13		Swing motor mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1	
14	Power	Swing bearing upper part mounting bolt	M18 × 2.5	41.3 ± 4.5	299 ± 32.5	
15	train	Swing bearing lower part mounting bolt	M16 × 1.5	31.3 ± 3.2	226 ± 23.1	
16	system	Travel motor mounting bolt	M16 × 2.0	25.7 ± 4.0	186 ± 28.9	
17		Sprocket mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7	
18		Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7	
19		Track roller mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7	
20	Under	Track roller mounting bolt (R140LCM-9A)	M 20× 2.5	57.9 ± 6.0	419 ± 43.4	
21	carriage	Track tension cylinder mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5	
22		Track shoe mounting bolt, nut	5/8 - 18UNF	42 ± 4.0	304 ± 28.9	
23		Track guard mounting bolt	M16 × 2.0	29.6 ± 3.2	214± 23.1	
24		Counterweight mounting bolt	M27 × 3.0	140 ± 15	1013 ± 108	
25	Others	Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7	
26		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8	

<sup>\*</sup> 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

Daltaine	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

Bolt size	8	Т	10T		
Boil 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"	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

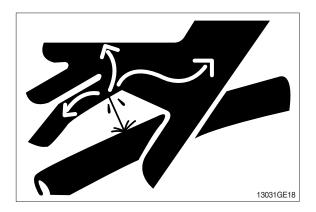
## **GROUP 3 PUMP DEVICE**

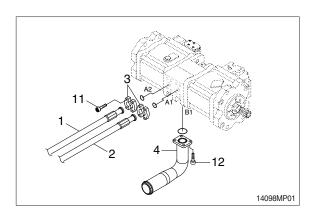
#### 1. REMOVAL AND INSTALL

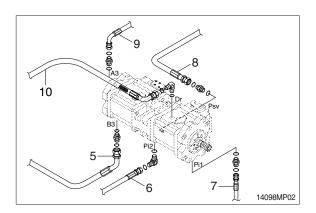
#### 1) REMOVAL

- 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.
- (4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.
  - $\cdot$  Hydraulic tank quantity : 124 l (32.8 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: 100 kg (220 lb)
- \* Pull out the pump assembly from housing.

When removing the pump assembly, check that all the hoses have been disconnected.





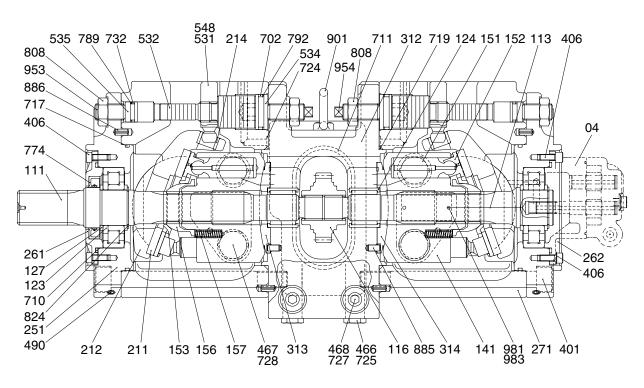


#### 2) INSTALL

- (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 (1/2)

#### 1) STRUCTURE



14092MP02

04	Gear pump	312	Valve block	717	O-ring
111	Drive shaft (F)	313	Valve plate (R)	719	O-ring
113	Drive shaft (R)	314	Valve plate (L)	724	O-ring
116	1st Gear	326	Cover	725	O-ring
123	Roller bearing	401	Hexagon socket bolt	727	O-ring
124	Needle bearing	406	Hexagon socket bolt	728	O-ring
127	Bearing spacer	414	Hexagon socket bolt	732	O-ring
141	Cylinder block	466	Plug	774	Oil seal
151	Piston	467	plug	789	Back up ring
152	Shoe	468	Plug	792	Back up ring
153	Set plate	490	Plug	808	Hexagon head nut
156	Bushing	531	Tilting pin	824	Snap ring
157	Cylinder spring	532	Servo piston	885	Pin
211	Shoe plate	534	Stopper (L)	886	Spring pin
212	Swash plate	535	Stopper (S)	901	Eye bolt
214	Bushing	548	Pin	953	Set screw
251	Support	702	O-ring	954	Set screw
261	Seal cover (F)	710	O-ring	981	Plate
271	Pump casing	711	O-ring	983	Pin

## 2) TOOLS AND TIGHTENING TORQUE

## (1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

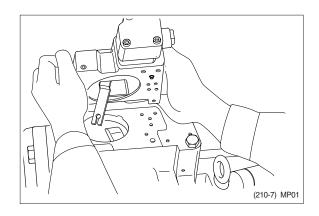
(P1	Part PT plug F thread)	name PO pluç			
(P1		PO plug	. 1		
R	i iiiioaa,	PO plug (PF thread)		Hexagon socket head setscrew	
_ D	8P-1/16	-		M 8	
Е	3P-1/8	-		M10	
Е	BP-1/4	PO-1/4		M12, M14	
Е	3P-3/8	PO-3/8	}	M16, M18	
	BP-1	PO-1, 1 1/4,	1 1/2	-	
Hexagon bolt		Hexagon nut		VP plug (PF thread)	
	M12		VP-1/4		
	M16		-		
	M18		VP-1/2		
	M20		-		
	-			VP-3/4	
Medium size, 1 set					
Minus type screw driver, Medium size, 2 sets					
Plastic hammer, 1 set					
For snap ring, TSR-160					
Steel bar of key material approx. 10 × 8 × 200					
Capable of tightening with the specified torques					
3	et et driver, 1 set R-160 nateria	BP-1/8 BP-3/8 BP-3/8 BP-1 It Hexag M M M M M M It M M M M M M M M M M M M M M M M M M M	BP-1/8 - BP-1/4 PO-1/4 BP-3/8 PO-3/8 BP-1 PO-1, 1 1/4, It Hexagon nut M12 M16 M18 M20 - et driver, Medium size, 2 sets 1 set R-160 naterial approx. 10×8×200	BP-1/8 - BP-1/4 PO-1/4 BP-3/8 PO-3/8 BP-1 PO-1, 1 1/4, 1 1/2 It Hexagon nut M12 M16 M18 M20 - et driver, Medium size, 2 sets 1 set R-160 naterial approx. 10×8×200	

## (2) Tightening torque

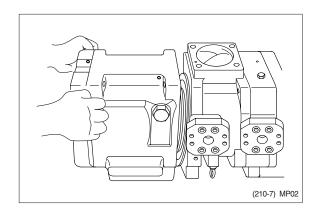
Dout name	Doltoine	Tore	que	Wrench size		
Part name	Bolt size	kgf ⋅ m	lbf ⋅ ft	in	mm	
Hexagon socket head bolt	M 5	0.7	5.1	0.16	4	
(material : SCM435)	M 6	1.2	8.7	0.20	5	
	M 8	3.0	21.7	0.24	6	
	M10	5.8	42.0	0.31	8	
	M12	10.0	72.3	0.39	10	
	M14	16.0	116	0.47	12	
	M16	24.0	174	0.55	14	
	M18	34.0	246	0.55	14	
	M20	44.0	318	0.67	17	
PT Plug (material : S45C)	PT1/16	0.7	5.1	0.16	4	
*Wind a seal tape 1 1/2 to 2	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 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

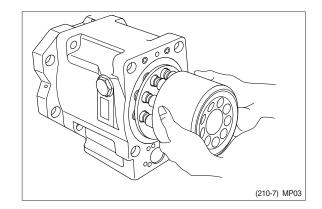
- (1) Select place suitable to disassembling.
- Select clean place.
- Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.
- (2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.
- (3) Remove drain port plug (468) and let oil out of pump casing (front and rear pump).
- (4) Remove hexagon socket head bolts (412, 413) and remove regulator.



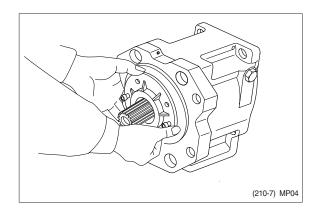
- (5) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve block (312).
- \* If gear pump and so on are fitted to rear face of pump, remove them before starting this work.
- (6) Place pump horizontally on workbench with its regulator-fitting surface down and separate pump casing (271) from valve block (312).
- Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.

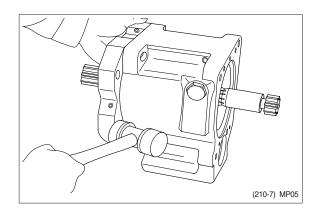


- (7) Pull cylinder block (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.
- \* Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

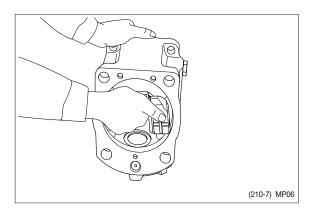


- (8) Remove hexagon socket head bolts (406) and then seal cover (F, 261).
- Fit bolt into pulling out tapped hole of seal cover (F), and cover can be removed easily.
- \* Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover.
- (9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).In case fitting a gear pump, first, remove gear pump.
- (10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.

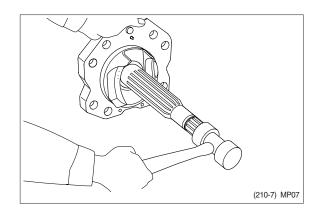




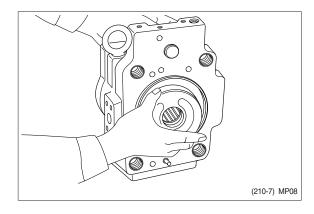
(11) Remove shoe plate (211) and swash plate (212) from pump casing (271).



(12) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



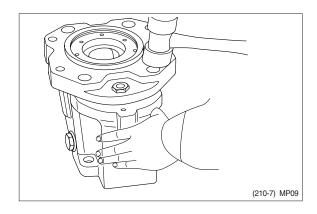
- (13) Remove valve plates (313, 314) from valve block (312).
- \* These may be removed in work (6).



- (14) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) and splined coupling (114) from valve block (312).
- In removing tilting pin, use a protector to prevent pin head from being damaged.
- Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.
- \* Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.
- \*\* Do not loosen hexagon nuts of valve block and swash plate support. If loosened, flow setting will be changed.

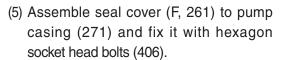
#### 4) ASSEMBLY

- (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 prepare 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.
- 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.
- ⑤ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.
- (2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.
- \*\* After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.
- In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (Medium strength) to their threaded sections.

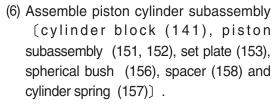


- (3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.
- \* Confirm with fingers of both hands that swash plate can be removed smoothly.
- \* Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.
- (4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).
- \* Do not tap drive shaft with hammer or so on.
- \* Assemble them into support, tapping outer race of bearing lightly with plastic hammer.

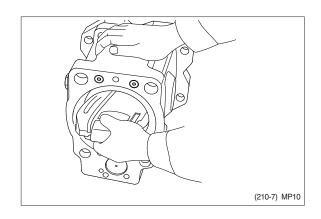
Fit them fully, using steel bar or so on.

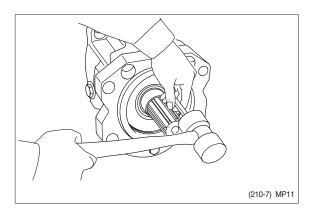


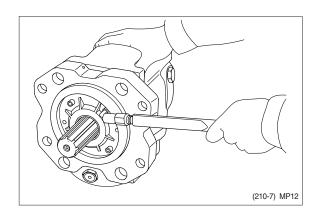
- \* Apply grease lightly to oil seal in seal cover (F).
- \* Assemble oil seal, taking full care not to damage it.
- For tandem type pump, fit rear cover (263) and seal cover (262) similarly.

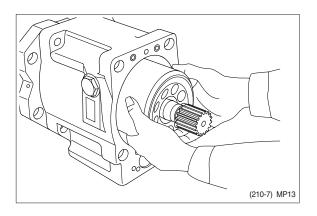


Fit spline phases of retainer and cylinder. Then, insert piston cylinder subassembly into pump casing.

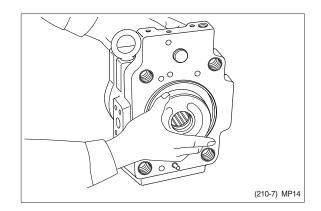




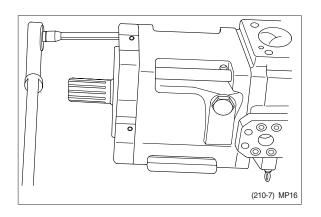


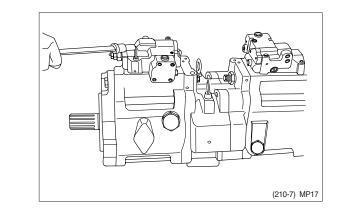


- (7) Fit valve plate (313) to valve block (312), entering pin into pin hole.
- \* Take care not to mistake suction / delivery directions of valve plate.



- (8) Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).
- \* At first assemble this at rear pump side, and this work will be easy.
- \* Take care not to mistake direction of valve block.
- \*\* Clockwise rotation (Viewed from input shaft side) - Fit block with regulator up and with delivery flange left, viewed from front side.
- \*\* Counter clockwise rotation (Viewed from input shaft side) - Fit block with delivery flange right, viewed from front side.
- (9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).
- \* Take care not to mistake regulator of front pump for that of rear pump.



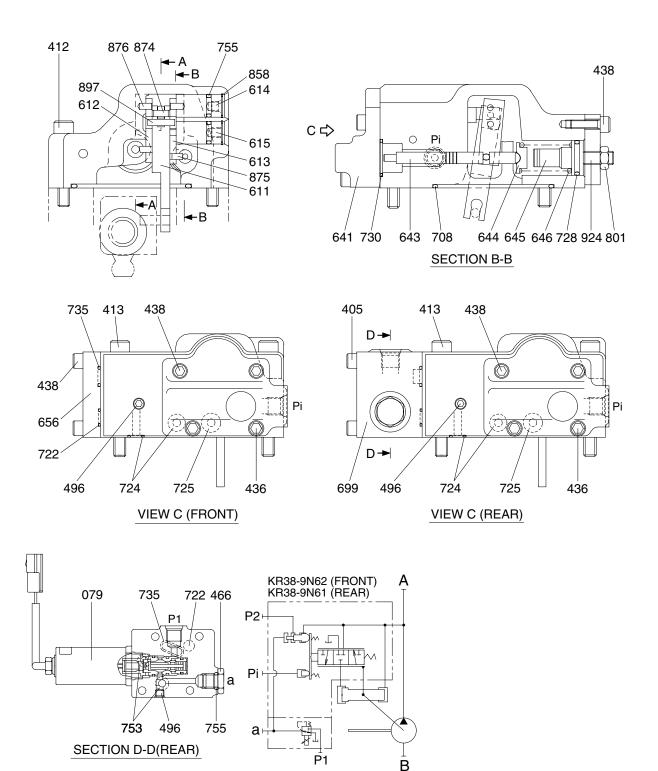


(10) Fit drain port plug (468).

This is the end of reassembling procedures.

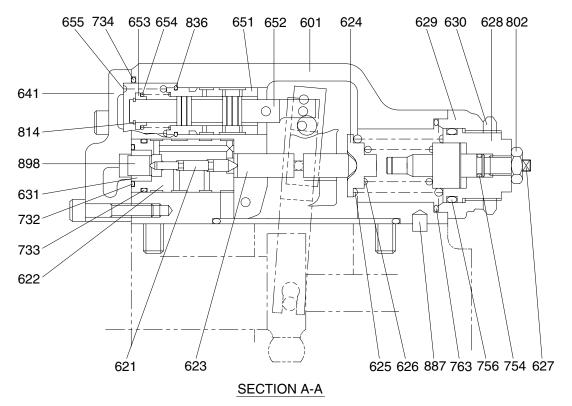
### 3. REGULATOR

## 1) STRUCTURE (1/2)



14092MP04

## **REGULATOR** (2/2)



14092MP05

079	EPPR valve assembly	629	Cover (C)	733	O-ring
405	Hexagon socket screw	630	Lock nut	734	O-ring
412	Hexagon socket screw	631	Sleeve, Pf	735	O-ring
413	Hexagon socket screw	641	Pilot cover	753	O-ring
436	Hexagon socket screw	643	Pilot piston	754	O-ring
438	Hexagon socket screw	644	Spring seat (Q)	755	O-ring
466	Plug	645	Adjust stem (Q)	756	O-ring
496	Plug	646	Pilot spring	763	O-ring
601	Casing	651	Sleeve	801	Nut
611	Feed back lever	652	Spool	802	Nut
612	Lever (1)	653	Spring seat	814	Snap ring
613	Lever (2)	654	Return spring	836	Snap ring
614	Fulcrum plug	655	Set spring	858	Snap ring
615	Adjust plug	656	Block cover	874	Pin
621	Compensator piston	699	Valve casing	875	Pin
622	Piston case	708	O-ring	876	Pin
623	Compensator rod	722	O-ring	887	Pin
624	Spring seat (C)	724	O-ring	897	Pin
625	Outer spring	725	O-ring	898	Pin
626	Inner spring	728	O-ring	924	Set screw
627	Adjust stem (C)	730	O-ring		
628	Adjust screw (C)	732	O-ring		

## 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 B				PT plug T thread)	PO plug (PF threa		Hexagon socket head setscrew	
Allen wrench	4	M5	Е	3P-1/16	-		M 8	
B	5	M6	I	3P-1/8	-		M10	
	6	M8	I	3P-1/4	PO-1/4	ļ	M12, M14	
Double ring spanner, socket wrench, double (single) open end spanner	-	Hexagon head bolt		Hexagon nut			VP plug (PF thread)	
	6	M 8		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

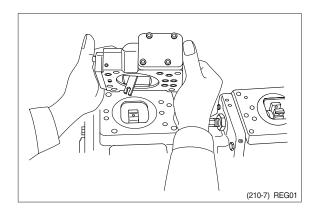
Part name	Bolt size	Tor	que	Wren	Wrench size		
Fait name	DOIL SIZE	kgf ⋅ m	lbf ⋅ ft	in	mm		
Hexagon socket head bolt	M 5	0.7	5.1	0.16	4		
(material : SCM435)	M 6	1.2	8.7	0.20	5		
	M 8	3.0	21.7	0.24	6		
	M10	5.8	42.0	0.31	8		
	M12	10.0	72.3	0.39	10		
	M14	16.0	116	0.47	12		
	M16	24.0	174	0.55	14		
	M18	34.0	246	0.55	14		
	M20	44.0	318	0.67	17		
PT Plug (material : S45C)	PT1/16	0.7	5.1	0.16	4		
*Wind a seal tape 1 1/2 to 2	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 : 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

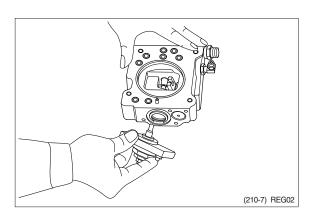
Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

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.

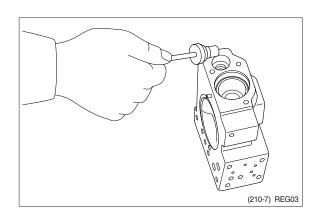
- (1) Choose a place for disassembly.
- \* Choose a clean place.
- Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.
- (2) Remove dust, rust, etc. from surfaces of regulator with clean oil.
- (3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.
- \* Take care not to lose O-ring.

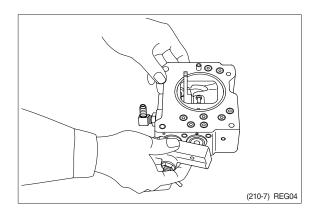


- (4) Remove hexagon socket head screw (438) and remove cover (C,629)
- \*\* Cover (C) is fitted with adjusting screw (C, 628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
- \* Do not loosen these screws and nuts.
  If they are loosened, adjusted pressure-flow setting will vary.

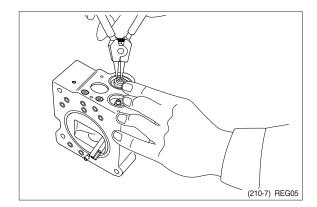


- (5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
  - Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
- \* Adjusting ring (Q,645) can easily be drawn 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.

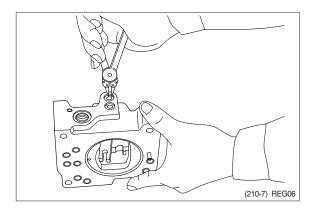


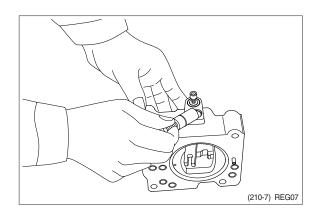


- (7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
- \* Sleeve (651) is fitted with snap ring (836).
- When removing snap ring (814), return spring (654) may pop out.
   Take care not to lose it.

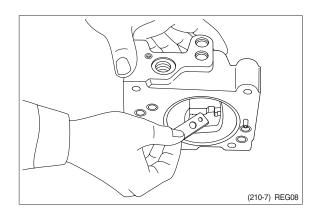


- (8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).
- Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.

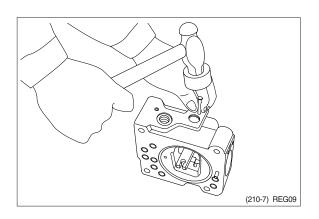


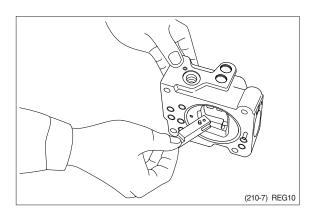


- (9) Remove lever (2, 613). Do not draw out pin (875).
- Work will be promoted by using pincers or so on.



- (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).



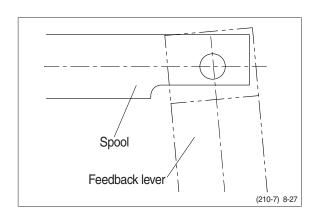


- (11) Remove lever (1, 612). Do not draw out pin (875).
- (12) Draw out pilot piston (643) and spool (652).
- (13) Draw out piston case (622), compensating piston (621) and compensating rod (623).
- \* Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

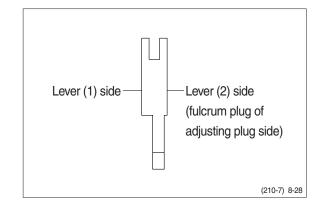
This completes disassembly.

#### 4) ASSEMBLY

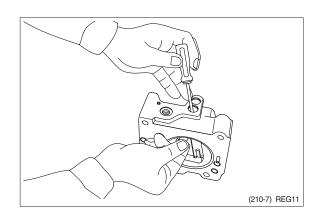
- For assembly, reverse disassembly procedures, but pay attention to the following items.
- ① Always repair parts that were scored at disassembly.
- ② Get replacement parts ready beforehand. Mixing of foreign matter will cause malfunction.
  - Therefore, wash parts well with cleaning oil, let them dry 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.



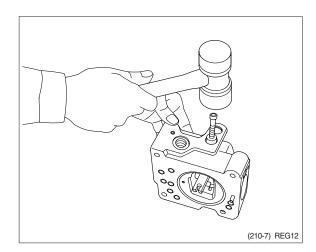
- (5) Fit feedback lever (611), matching its pin hole with pin hole in spool. Then insert pin (874).
- \*\* Insert pin in feedback lever a little to ease operation.
- \* Take care not to mistake direction of feedback lever.

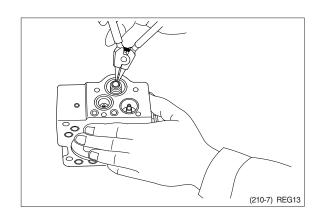


- (6) Put pilot piston (643) into pilot hole of casing.
- \* Confirm that pilot piston slides smoothly without binding.
- (7) Put pin force-fitted in lever (2, 613) into groove of pilot piston. Then fix lever (2).



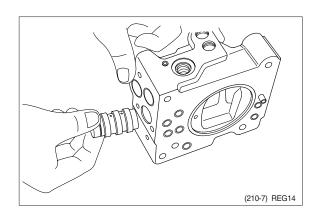
- (8) Fit fulcrum plug (614) so that pin forcefitted in fulcrum plug (614) can be put into pin hole of lever (2). Then fix locking ring (858).
- (9) Insert adjusting plug (615) and fit locking ring.
- \*\* Take care not to mistake inserting holes for fulcrum plug and adjusting plug. At this point in 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).



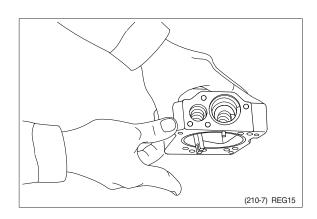


compensating piston (621) and piston case (622) into compensating hole. Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).

(11) Fit set spring (655) to spool hole and put

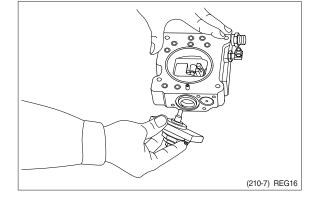


- (12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole. Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
- When fitting spring seat, take care not to mistake direction of spring seat.



(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.

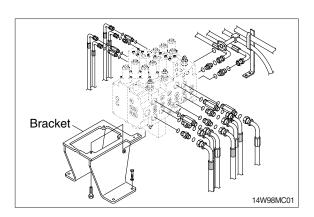
# ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.

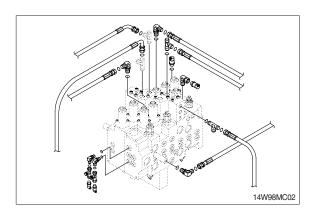
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Remove the wirings for the pressure sensor and so on.
- (5) Remove bolts and disconnect pipe.
- (6) Disconnect pilot line hoses.
- (7) Disconnect pilot piping.
- (8) Sling the control valve 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.

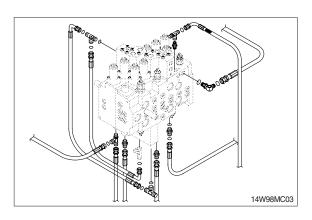
#### 2) INSTALL

- (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.

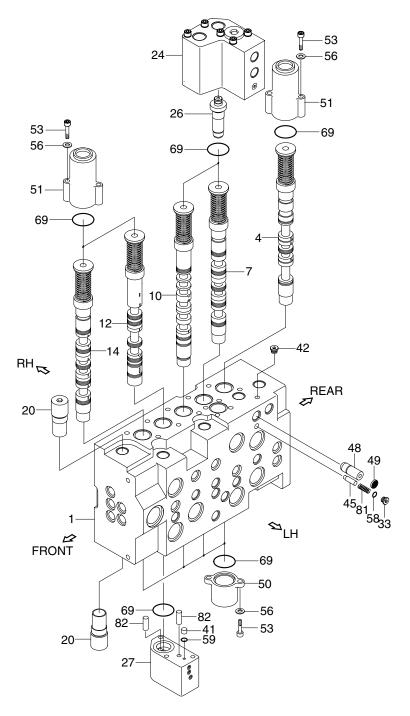








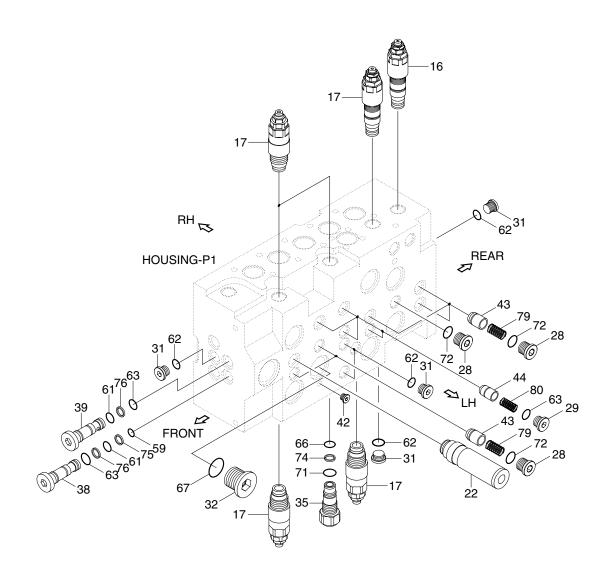
## 2. STRUCTURE (1/4)



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 R1 can		

14098MC04

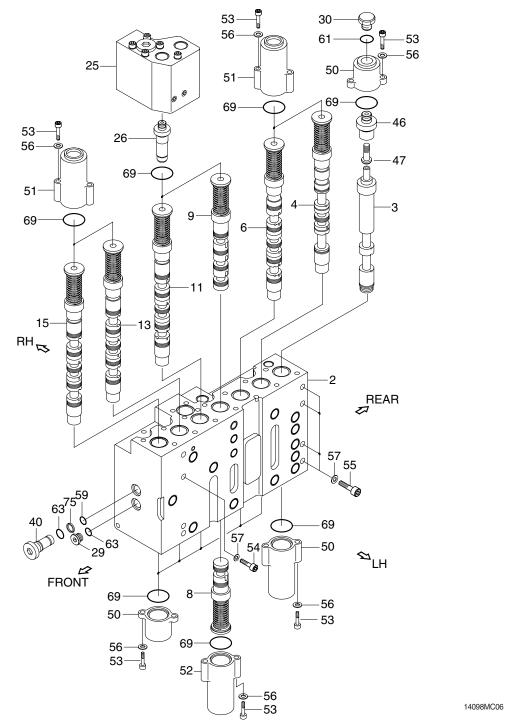
## STRUCTURE (2/4)



14W98MC05

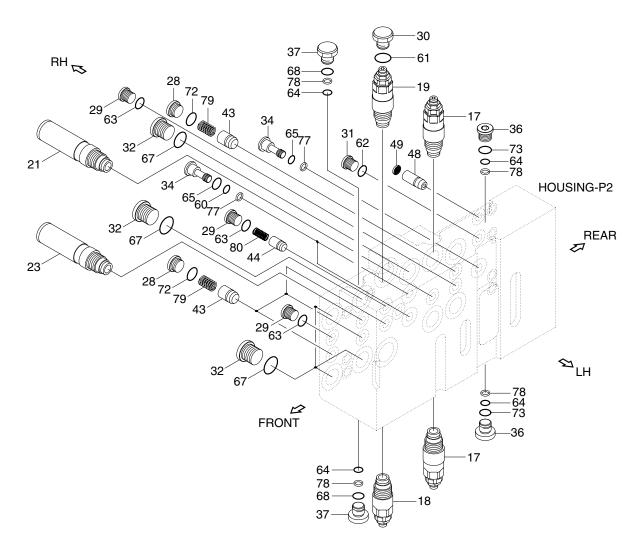
16	Main relief valve	39	Plug	67	O-ring
17	Overload relief valve	42	Plug	71	O-ring
22	Bucket logic valve	43	Poppet 1	72	O-ring
28	Plug	44	Poppet 2	74	Back up ring
29	Plug	59	O-ring	75	Back up ring
31	Plug	61	O-ring	76	Back up ring
32	Plug	62	O-ring	79	Spring
35	Plug	63	O-ring	80	Spring
38	Plug	66	O-ring		

## 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	75	Back up ring

# 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

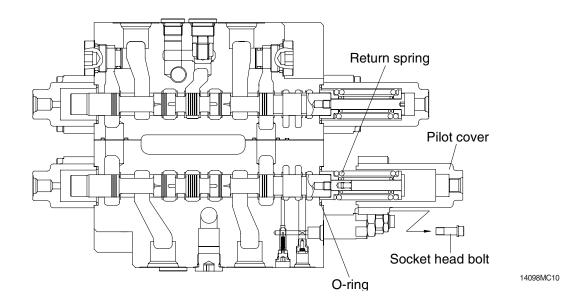
Before disassembling the control valve, prepare the following tools beforehand.

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

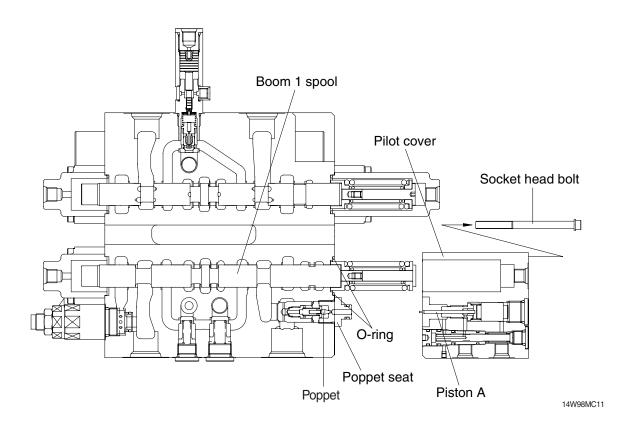
#### (1) Disassembly of spools without holding valve (travel right, travel left)

- 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.



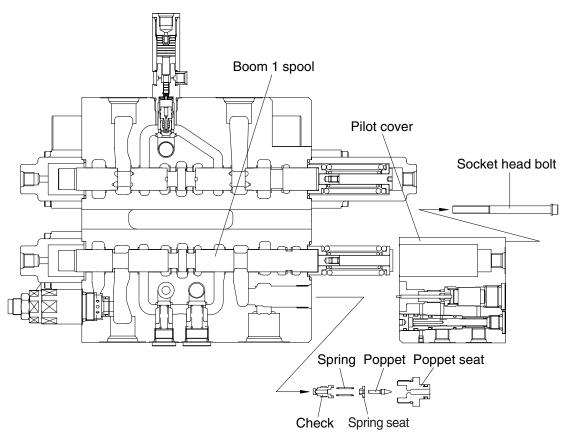
#### (2) Disassembly of spools with holding valve (boom 1, Arm 1 spool)

- 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

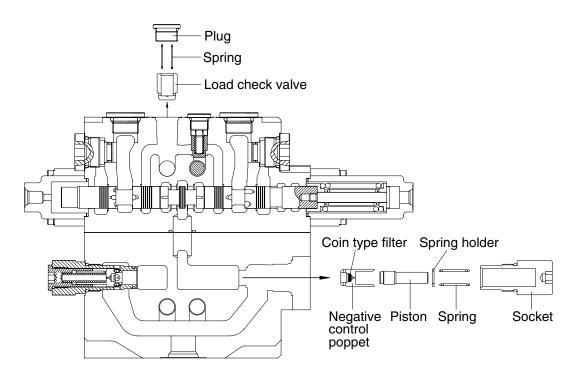
- ① Remove the pilot cover with the holding valve as described on previous page.
- \* Do not disassembled internal parts of the pilot cover.
- ② Loosen the poppet seat and remove the poppet, spring seat, spring and check. (spanner: 26 mm)
- \* Pay attention not to lose the poppet.
- \* Do not disassembled 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.

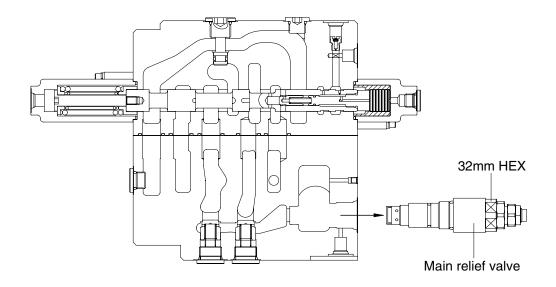
② Remove the main relief valve.

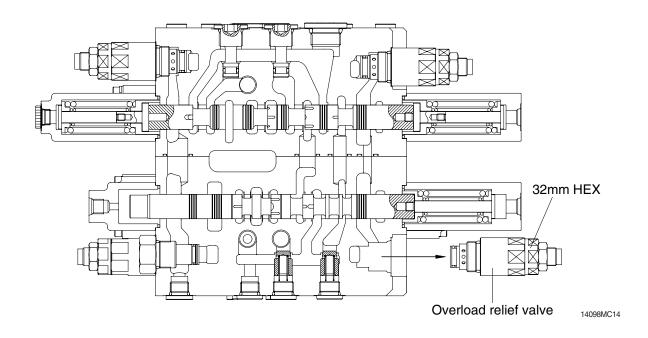
(spanner: 32 mm)

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.

#### ① 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		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 :  $1.0\sim1.1 \text{ kgf} \cdot \text{m} (7.2\sim7.9 \text{ lbf} \cdot \text{ft})$

## **GROUP 5 SWING DEVICE**

#### 1. REMOVAL AND INSTALL OF MOTOR

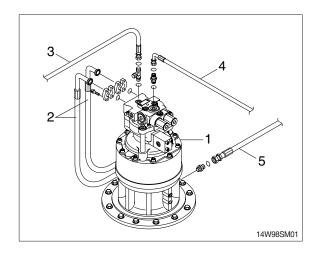
## 1) REMOVAL

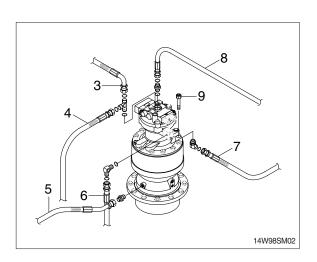
- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ♠ Escaping fluid under pressure 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.

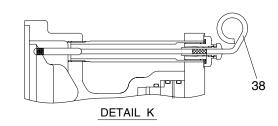


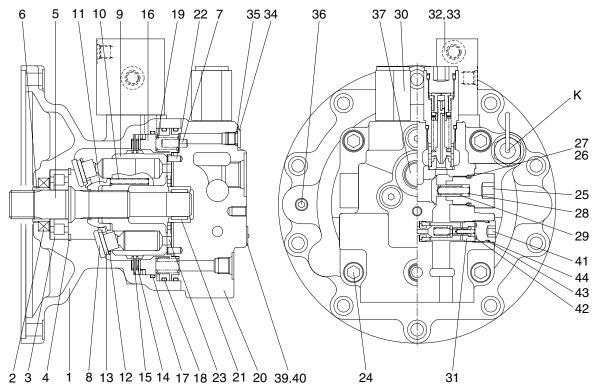




## 2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

## 1) STRUCTURE





14W92SM	02

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 assembly

14 Friction plate

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

Check

Relief valve

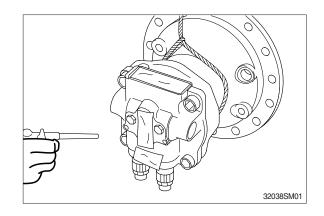
29

30

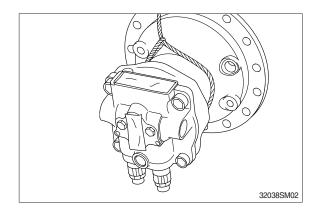
31	Anti-rotating valve
32	Time delay valve
33	Wrench bolt
34	Plug
35	O-ring
36	Plug
37	Plug
38	Level gauge
40	Rivet
41	Plug
42	O-ring
43	O-ring
44	Back up ring

## 2) DISASSEMBLY

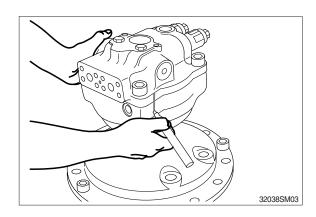
- (1) Lift the motor out. Clean the motor in kerosene and dry with compressed air.
- \* To avoid dust inside the motor, mask all the ports of the motor with tapes.



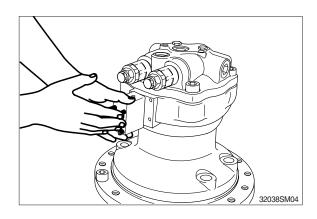
(2) Loosen the drain plug to discharge oil in the body(1).



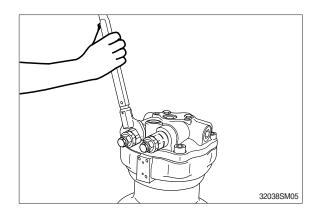
(3) Fix the drive shaft (5) on the workbench with the end of output shaft down. Put matching marks on body (1) and valve rear cover (20) for easy reassembly.



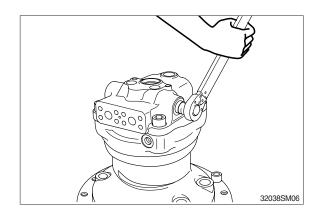
(4) Remove the valve (32).



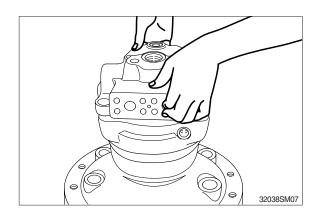
(5) Remove the relief valve (30) from rear cover (20).



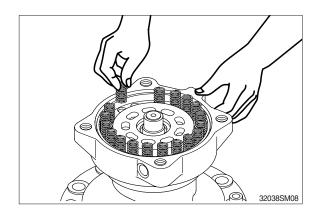
- (6) Remove plug (25) from rear cover (20) and spring (28), check (29).
- \* Be careful not to damage the check seat assembly.



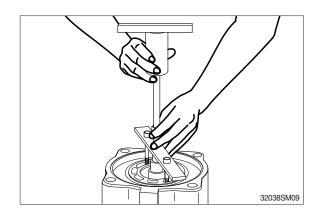
(7) Remove rear cover (20) from body (1). Then, remove the valve plate (23) from rear cover (20) with care.



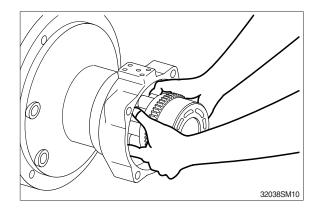
(8) Remove the brake spring (19) from brake piston (16).



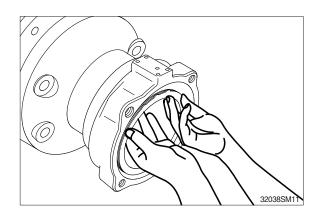
(9) Remove brake piston (16) from body (1).



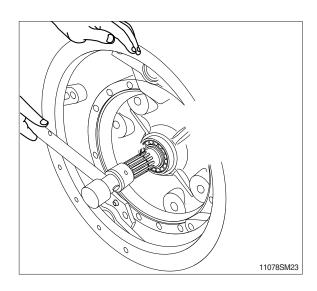
(10) Remove the cylinder (9) from the drive shaft (5) with the motor positioned horizontally. Remove ball guide (11), set plate (12), piston (13) and shoe plate (8).



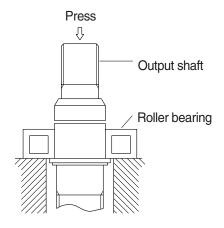
(11) Remove friction plate (14) and separate plate (15) from body (1).

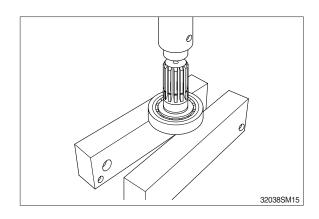


(12) Remove snap ring (4) and remove drive shaft (5) from body (1).

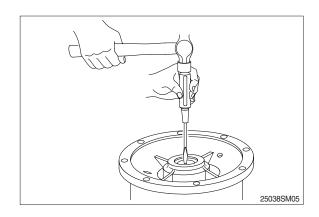


- (13) Remove the cone of roller bearing (3) by press.
- \* Do not reuse bearings.

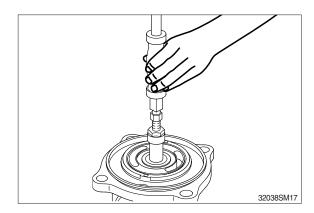




(14) Remove bushing (6) and oil seal (2) from body (1).

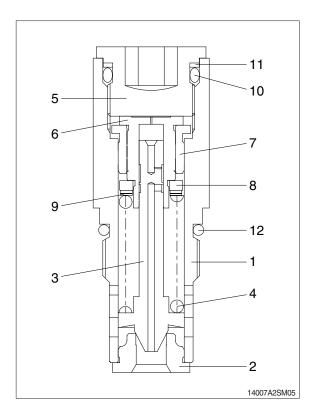


(15) Remove the needle bearing (21) from the rear cover (20) by using slide hammer bearing puller.



(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.

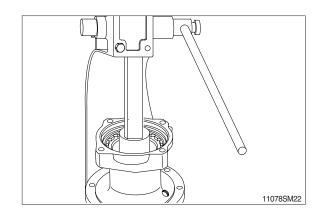


This completes disassembly.

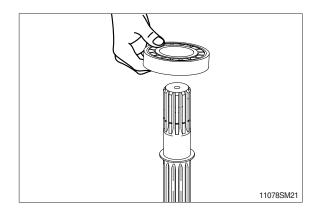
## 3) ASSEMBLY

Do the reassembly in the reverse procedure of the disassembly.

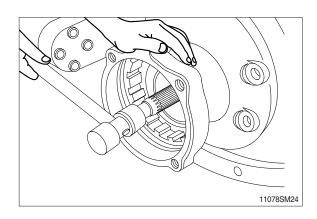
(1) Apply three bond of white color on outer surface of oil seal (2) and insert it to the body (1).



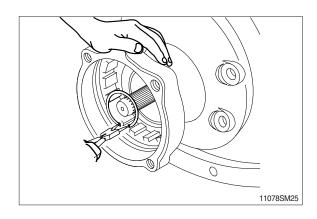
(2) Install the roller bearing (3) to the drive shaft (5).



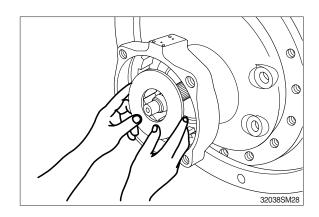
(3) Insert the drive shaft (5) into the body (1) with the plastic hammer lightly.



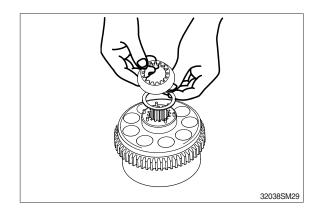
(4) Install the snap ring (4) to the body (1).



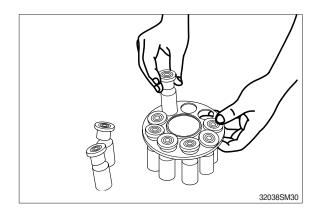
(5) Insert the shoe plate (8) with the body (1) position horizontally.



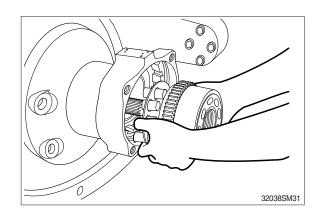
(6) Insert the ball guide (11) into the cylinder (9).



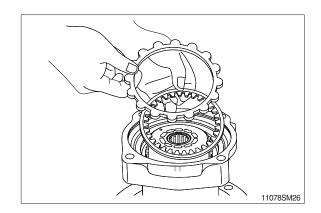
(7) Install the piston sub-assembly (13) to the set plate (12).



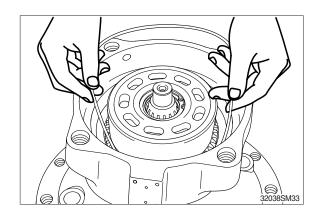
(8) Reassemble the piston assembly (9) to the body (1).



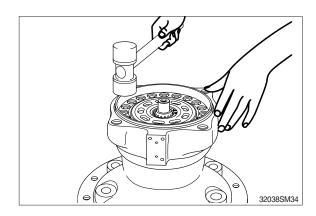
(9) Assembly friction plate (14) and separate plate (15) to the body (1).



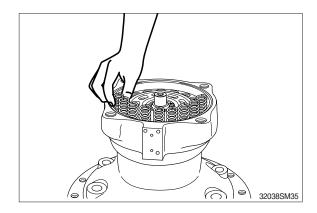
(10) Insert O-ring (17) inside the body (1).



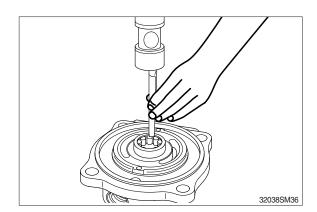
(11) Reassemble brake piston (16) to the body (1).



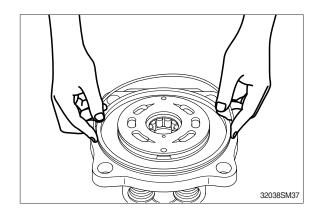
(12) Reassemble brake spring (19) to the brake piston (16).



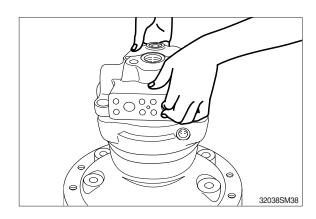
(13) When assembling the needle bearing (21), insert the needle bearing (21) into rear cover (20) by hammering.



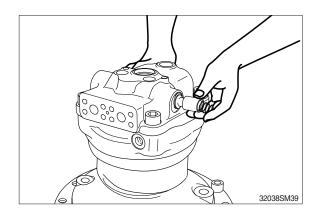
(14) Reassemble valve plate (23) to the rear cover (20) and reassemble O-ring (18).



(15) Connect the rear cover (20) with the body (1) and tighten the wrench bolt (24).

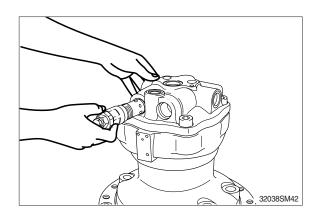


(16) Insert check (29) and spring (28) in the valve casing and install O-ring (27) and back up ring (26). Tighten plug (25) to the rear cover (20).



(17) Insert O-rings to the relief valve (30) and reassemble them to rear cover (20).

This completes assembly.



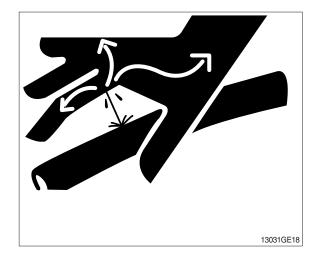
## 3. REMOVAL AND INSTALL OF REDUCTION GEAR

## 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.

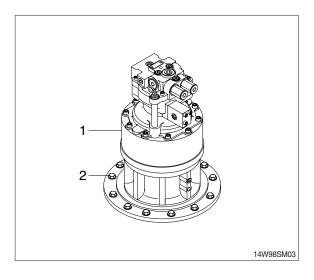
   Reduction gear device weight : 60 kg

  (132 lb)



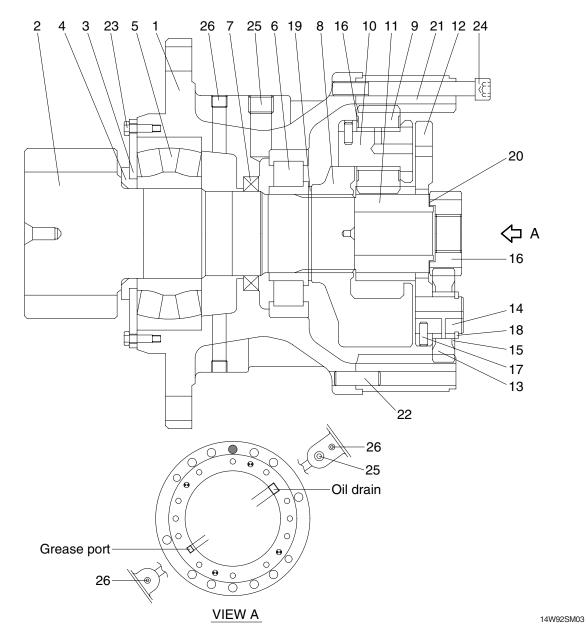
## 2) INSTALL

- (1) Carry out installation in the reverse order to removal.
  - $\cdot$  Tightening torque : 29.6  $\pm$  3.2 kgf  $\cdot$  m (214  $\pm$  23.1 lbf  $\cdot$  ft)



## 4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

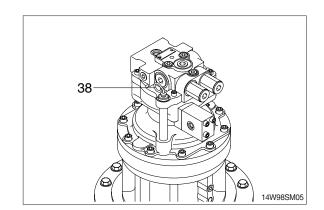
## 1) STRUCTURE



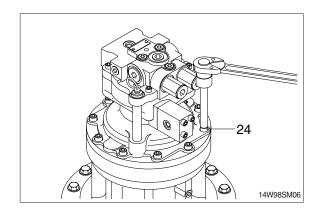
1	Casing	10	Pin No.2 assembly	19	Stop ring
2	Drive shaft	11	Sun gear No. 2	20	Side plate No. 1
3	Cover plate	12	Carrier No. 1	21	Ring gear
4	Spacer	13	Planet gear No. 1	22	Knock pin
5	Roller bearing	14	Pin No.1	23	Hexagonal bolt
6	Roller bearing	15	Thrust washer (B)	24	Socket head bolt
7	Oil seal	16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

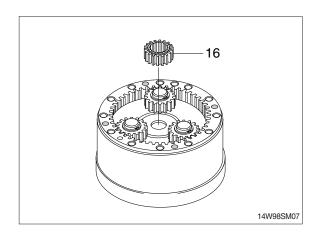
- (1) Remove level gauge (38) from the swing motor casing.
- \* Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



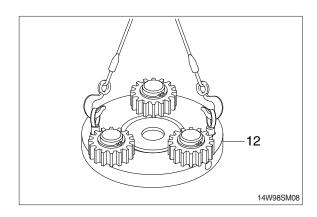
(2) Loosen the socket bolts (24) to separate swing motor from reduction gear.



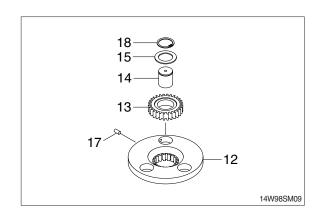
(3) Remove sun gear 1 (16).

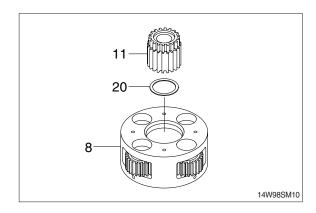


(4) Tighten two M10 eye bolts to carrier 1 (12) and lift up and remove carrier 1 (12) as subassembly.

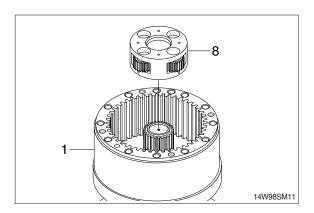


- (5) Disassembling carrier 1 (12) assembly.
- ① Remove stop ring (18).
- ② Remove thrust washer (15) and planet gear 1(13) from the carrier 1 (12).
- ③ Using M8 solid drill, crush spring pin (17) so that the pin 1 (14) can be removed by hammering.
- \* Do not reuse spring pin (17).
- \* Do not remove 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).

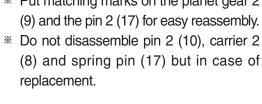


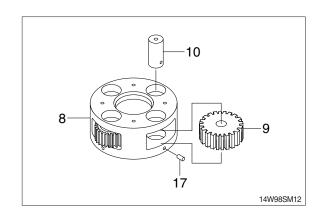


(7) Remove carrier 2 (8) assembly from casing (1).

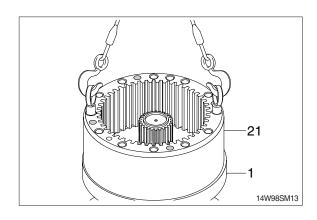


- (8) Disassembling carrier 2 (8) assembly.
- ① Using M8 solid drill, crush spring pin (17) so that the pin 2 (10) can be removed.
- \* Do not reuse spring pin (17).
- ② Remove pin 2 (10) and planet gear 2 (9) from the carrier 2 (8).
- Put matching marks on the planet gear 2

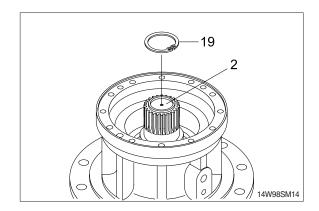




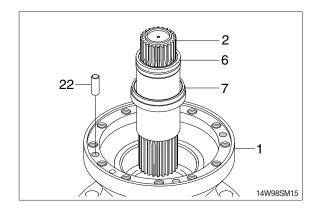
(9) Tighten two M16 eyebolt to the ring gear (21) and then lift the ring gear (21) out of casing (1).



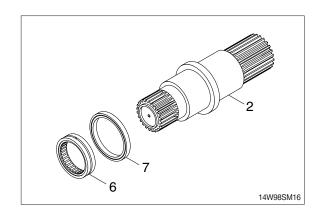
(10) Remove stop ring (19) from the drive shaft (2).



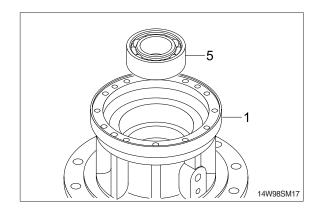
(11) Remove drive shaft (2) with roller bearing (6) and oil seal (7) assembled. Remove knock pin (22) from the casing (1).



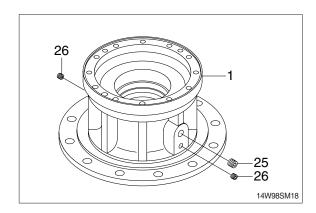
- (12) Remove roller bearing (6) and oil seal (7) from the drive shaft (2).
- \* Do not reuse oil seal (20) once removed.



(13) Using the bearing disassembly tool, remove roller bearing (5).

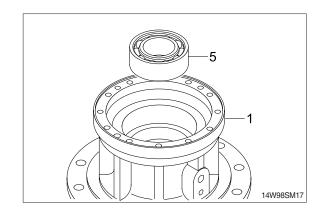


(14) Remove plugs (25, 26) from the casing (1).

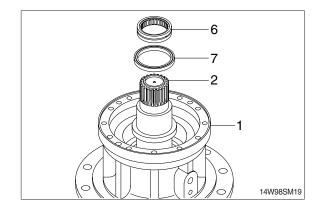


## 3) ASSEMBLY

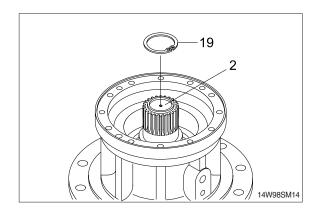
(1) Assemble roller bearing (5) inside the casing (1).



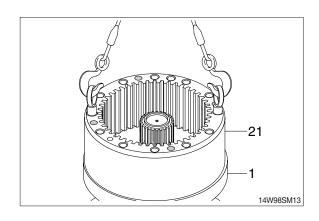
(2) Assemble the drive shaft (2) into the casing(1) and then install oil seal (7) and roller bearing (6).



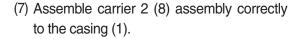
(3) Install stop ring (19) on top of drive shaft (2).

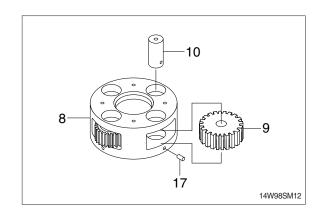


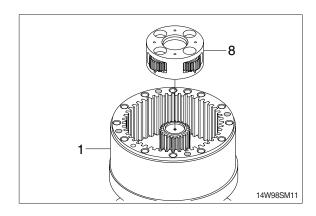
- (4) Apply loctite to the tapped holes of casing (1).
- (5) Tighten 2 M16 eye bolts to the ring gear (21) and lift up and then assemble it onto the casing (1).
- \* Don't fail to coincide the knock pin (22) holes.



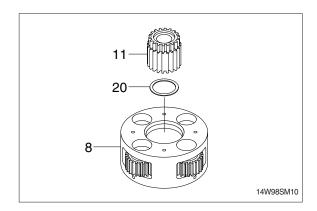
- (6) Assembling carrier 2 (8) assembly.
- ① Install the planet gear 2 (9) inside the carrier 2 (8).
- ② Assemble the pin 2 (10) to the carrier 2 (8) and then press the spring pin (17) by hammering.
- ③ Punch 2 points of the spring pin (17) lip.
- \* Take care not to mistake the matching marks of each part.



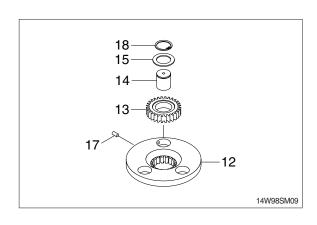




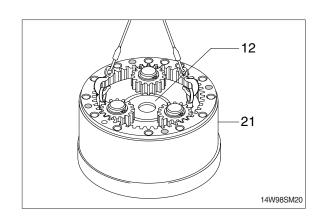
(8) Assemble sun gear 2 (11) and side plate 1 (20) to the center of the carrier 2 (8) assembly.



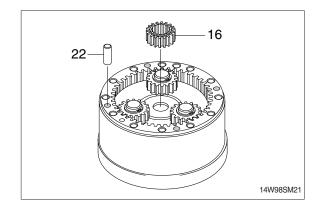
- (9) Assembling carrier 1 (12) assembly.
- ① Assemble the pin1 (14) to the carrier 1 (12) and then press the spring pin (17) by hammering.
- ② Punch 2 points of the spring pin's (17) lip.
- 3 Assemble thrust washer (15), planet gear 1 (13), and then stop ring (18) to the pin 1 (11).
- \* Take care not to mistake the matching marks of each part.



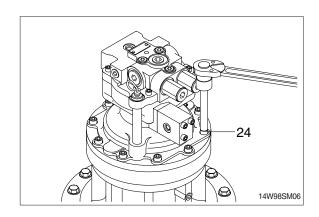
(10) Assemble carrier 1 (12) assembly into the ring gear (21).



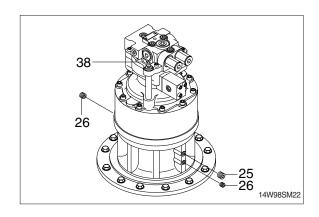
- (11) Hammer 4 knock pins (22) around the ring gear (21).
- (12) Assemble sun gear 1 (16) to the drive shaft of the swing reduction gear.



- (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**

## ■ TRAVEL MOTOR (TYPE 1)

## 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.

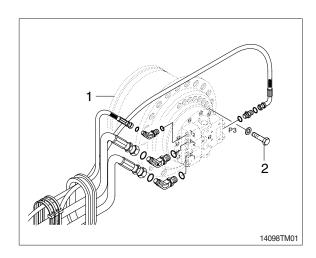
# ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.

- 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

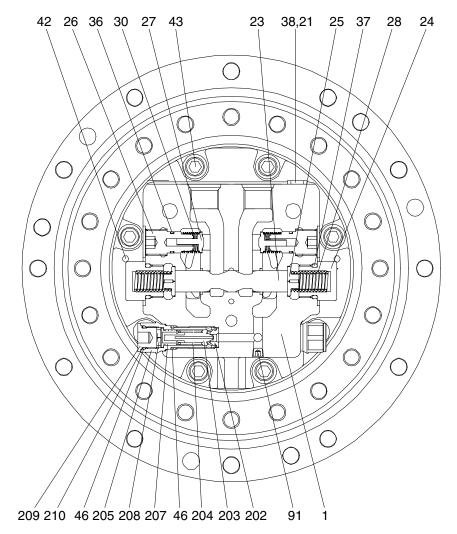
- (1) Carry out installation in the reverse order to removal.
- (2) Bleed the air from the travel motor.
- ① Remove the air vent plug.
- ② Pour in hydraulic oil until it overflows from the port.
- ③ Tighten plug lightly.
- ④ Start the engine, run at low idling, and check oil come out from plug.
- ⑤ Tighten plug fully.
- (3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

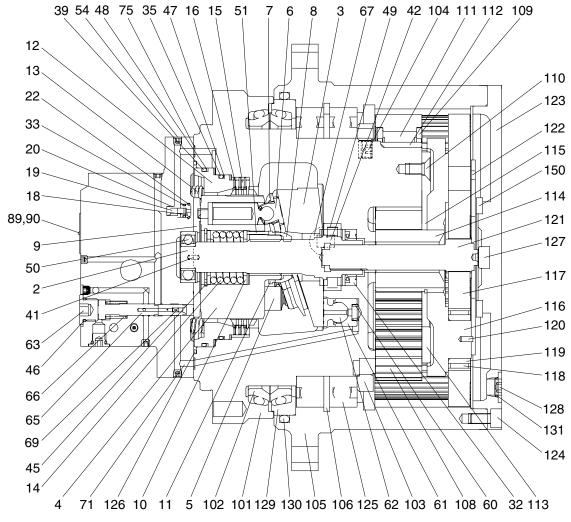


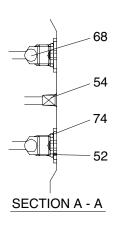


## 2. TRAVEL MOTOR

## 1) STRUCTURE







14	ŧυ	92	ш	IVI	l
	14	140	14092	140921	14092TM

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

2 Speed spool
2 Speed spring
Pivot
Steel ball
Set screw
Orifice
O-ring
O-ring
Name plate
Set screw
Plug
Spindle
Floating seal
Nut ring
Plug
Hub
Snap ring

)	62 10	03 61 108 60 32 11
	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

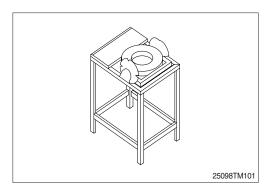
# 2) TOOLS

## (1) Standard tools

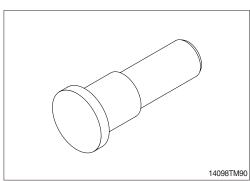
No.	Name	Description/Size	Qty	
1	Hexagon wrench (JIS B 4650)	6 (M8) (PT1/4), 8 (M10)	each 1	
		10 (M12) (PF1/2)	each 1	
	(010 12 4000)	4 (M6)	1	
2	Socket wrench	-	1	
3	Torque wrench	Nominal 30 kgf ⋅ m dial type	1	
		Nominal 90 kgf · m dial type	1	
4	Adapter for torque wrench	Socket 26, 27, 36	each 1	
		Bar 4, 5, 6, 8, 10	each 1	
5	Extension bar (JIS B 4637)	150 mm	1	
6	Hammer (JIS B 4613)	12	1	
7	Plastic hammer	L=300	1	
8	( - ) driver	150 mm	1	
9	Snap ring plier	For shaft, For hole	1	
	Hanger	Weight : over 300 kgf	1	
		Eye bolt (M16)	2	
10		Eye bolt (M10)	2	
		Eye bolt (PF 1/2)	2	
		Wire	1	
11	Press	Press capacity above 200 kgf	1	
12	Compressed air	3~5 kgf/cm², nozzle	1	
13	Vessel	General vessel : W450 × D300 × H120	2	
14	Heating vessel	Heating capacity: over 100°C	1	
		Volume : 500 × 500 × 500		
15	Depth micro-meter	Measuring range: 0.04 ~ 0.3 mm	1	
16	Air hammer	BRH-8 (compressed air 5~6 kgf/cm²)	1	
17	Sealant	Silicone rubber (780-RTV)		

# (2) Special tools

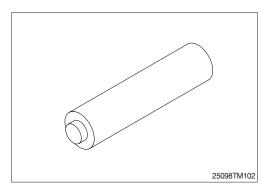
① Inversion working bench



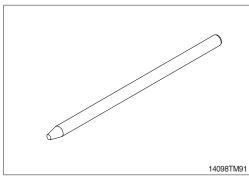
 $\ensuremath{\textcircled{2}}$  Pressurize jig (  $\ensuremath{\mbox{I}}$  )



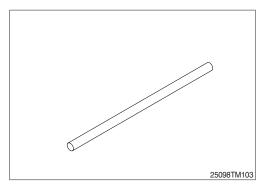
 $\ensuremath{\mathfrak{J}}$  Pressurize jig (  $\ensuremath{\mathbb{I}}$  )



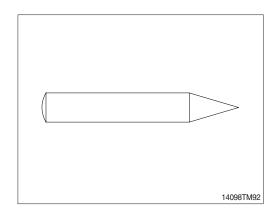
4 Aluminum bar



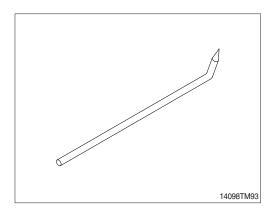
⑤ Steel bar



⑥ Sharp punch



⑦ Draw bar



# 3) TIGHTENING TORQUE

Item No.	Parts name	Size	Qty	Tightening torque	
item No.				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).



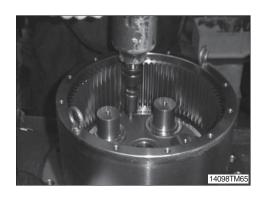
(5) Remove sun gear (114), screw (110) and thrust plate F (113).



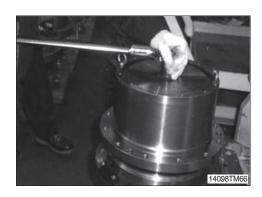
(6) Remove the thrust washer (109), planetary gears F (108), needle bearings (111) and collar (112) from hub (105).



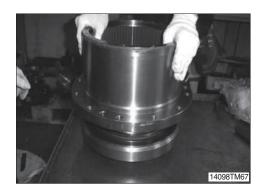
(7) Remove the plugs (104, 3EA).



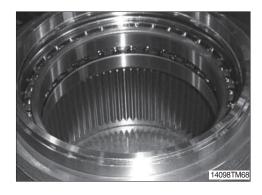
(8) Remove the nut ring (103) from hub (105).



- (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

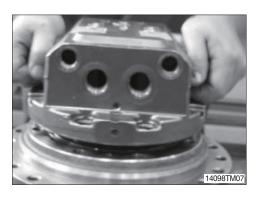
- (1) Remove the relief valve (70, 2EA) from rear flange (1).
- \* Tools
  - · Hexagon socket
  - · Torque wrench



- (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).

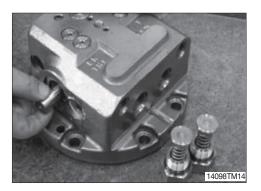


## (8) Disassembling the brake valve part

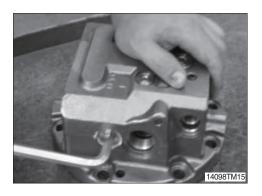
- ① Remove two plugs (24) from the rear flange (1).
- \* User can work easily if sub-disassembly was done on the reversal table.
- \* Tools
  - · Hexagon wrench 36
  - · Torque wrench



- 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.



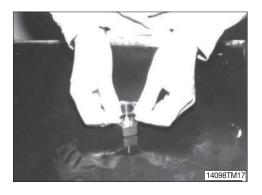
- ④ Remove two plugs (26) from the rear flange (1).
- \* User can work easily if sub-disassembly was done on the reversal table.
- \* Tools
  - · Hexagon wrench 10



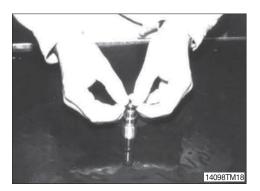
⑤ Remove the springs (30, 2EA), valves (27, 2EA) from rear flange (1).



- 6 Remove the O-ring (37) from plug (24).
- \* Do not reuse the O-ring (37).

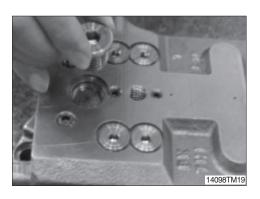


- 7 Remove the O-ring (36) from plug (26).
- \* Do not reuse the O-ring (36).

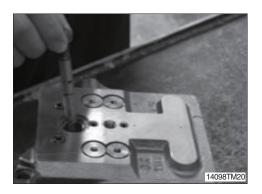


# (9) Disassembling the two speed change valve

- 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).

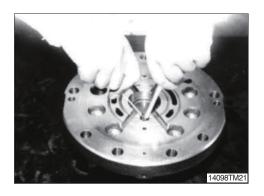
- ① Do not remove plug (52) if it not to be necessary.

  Disassembling the plug (52) if it was malfunction because of get mixed with dust.

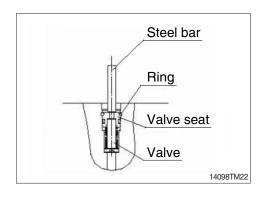
  Clean the plug (52) after disassembled.
- \* Be careful not to drop the steel ball (68).

### (11) Disassembling the parking brake valve (19)

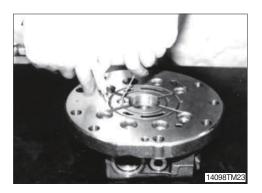
- ① Mount the rear flange (1) on a working bench that the mounting side of the spindle (101) faces upward.
- ② Pushing valve seat (18) by a steel bar, disassemble ring (22) from rear flange (1).



- \* 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).



Remove the valve (19) and spring (20) from rear flange (1) downside hole with shaking lightly.

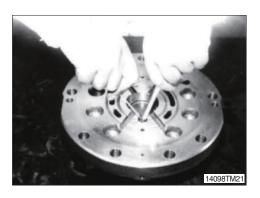


- ⑤ Remove the O-ring (33) and valve seat (18).
- \* Do not reuse the O-ring (33).



### (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).



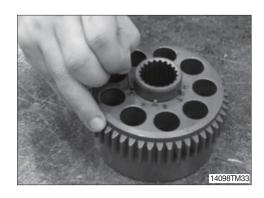
② Piston (5) and shoe (6) from the removed retainer plate (7).



③ Thrust ball (8) from the removed cylinder block (4).

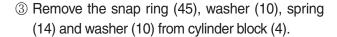


④ Roller (51, 5EA) from the removed cylinder block (204).



#### (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.
- \*\* 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.

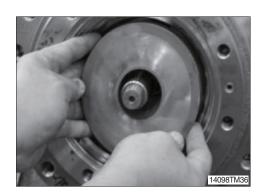






### (16) Disassembling the shaft

- 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

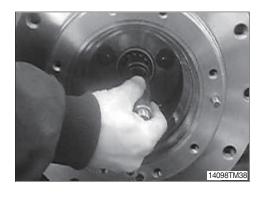
#### **4.1 GENERAL PRECAUTIONS**

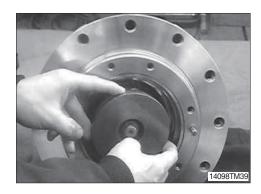
- 1) Reassemble in a work area that is clean and free from dust and dirt.
- 2) Handle parts with bare hands to keep them free of linty contaminants.
- Repair or replace the damaged parts.
   Each parts must be free of burrs its corners.
- 4) Do not reuse O-ring, oil seal and floating seal that were removed 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

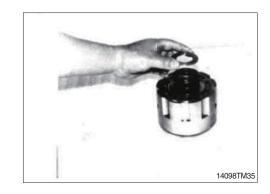
- (1) Install roller bearing (49) into the spindle (101).
- (2) Install pivots (67, 2EA), parallel pin (42, 2EA) and two speed piston assembly (61, 62) into the spindle (101).
- (3) Install shaft (2) into the roller bearing (49) assembled spindle (101).
- Be careful not to damage the seal (3) of assembling 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).
- \*\* Put a vinyl cover on the sliding surface of the cylinder block (4) and timing plate (9) for protection.

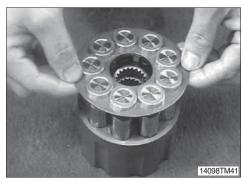


#### (8) Reassembe the hydraulic motor

- 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).

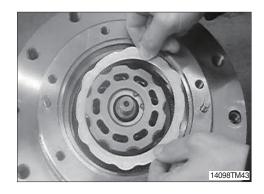


- ⑤ Install cylinder block (4) assembly to the shaft (2).
- \* After fitting splines of both cylinder block (4) and shaft (2), assemble them.
- \* After installing the cylinder (4), confirm whether it revolves or not by turning using both hands.
- \* Motor is malfunction when it isn't revolve.



#### (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.



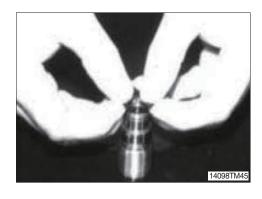
- ② Install two O-rings (35, 39) and two back up ring (47, 48) into O-ring grooves.
- ③ Mount a piston (12) in the spindle (101).
- \* Apply a thin coat of grease to the O-rings (35, 39).
- If the piston (12) does not fit into the spindle (101) because of the resistance of the O-ring, tap the edge of 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

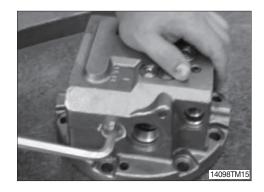
- ① Install O-ring (36, 2EA) on the plug (26, 2EA).
- \* Apply grease to the O-ring (36).



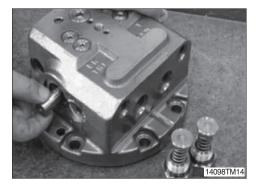
- ② Install spring (30) and valve (27) into the plug (26).
- ③ Install plug (26) into the rear flange (1).
- \*\* Install spring (30) and valve (27) into the plug (26), and then grease the spring (30) and the valve (27) and hand-lock the former.



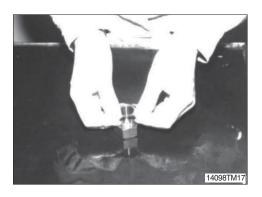
- ④ Install plug (26) in conjunction with the spring (30) and the valve (27) into the rear flange (1), and tighten the plug to the required torque.
- \* Tightening torque:  $17\pm2.6 \text{ kgf} \cdot \text{m} (123\pm18.8 \text{ lbf} \cdot \text{ft})$
- \* Tools
  - · Adapter for hexagon wrench 10
  - · Torque wrench



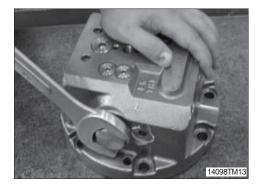
- ⑤ Install spool (23) into the rear flange (1).
- \*\* Before installing the spool (23), apply hydraulic oil to the spool. Be careful not to damage the spool's surface and the inner of rear flange (1).



⑤ Install O-ring (37) on the plug (24). Apply grease to the O-ring (37).

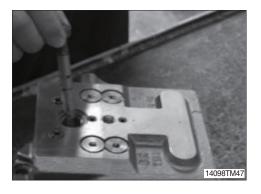


- ⑦ Install spring retainer (25) and spring (28) into the plug (24).
- ® Install plug (24) into the rear flange (1).
- Tighten the plug (24) to the required torque.
- \* Tightening torque:  $36\pm5.4$  kgf·m ( $260\pm39$  lbf·ft)
- \* Socket (#36) / Torque for hexagon wrench.
- \* Tools
  - · Hexagon 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 :  $13\pm2.6 \text{ kgf} \cdot \text{m} (94\pm18.8 \text{ lbf} \cdot \text{ft})$
- \* Tools
  - · Adapter for hexagon wrench 10
  - · Torque wrench



## (3) Reassembe the parking brake valve

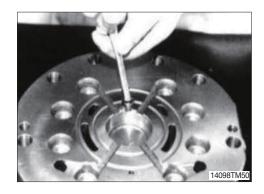
- ① Install O-ring (33) on the valve seat (18).
- \* Do not reuse the O-ring (33).



- 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.



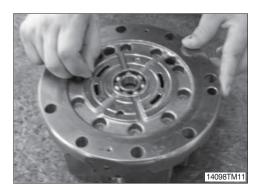
- 4 After new ring (22) bend somewhat and put the valve seat (18), then into the rear flange (1) ring's groove.
- \* Do not reuse the ring (22).



- 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).



- ② 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)

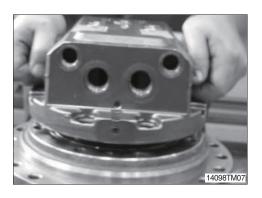
- ① Tilt the work bench 90° for travel motor reassembling.
- ② Insert the O-ring (75, 126) on the spindle (101).
- \* Apply grease to the O-rings (75, 126) thinly.



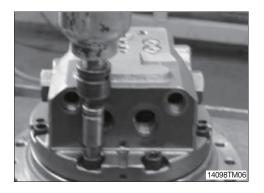
③ Install parallel pins (42, 2EA) into the spindle (101).



- 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



- ⑥ 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



- Tighten the plug (26) into the rear flange (1) to the required torque.
- \*\* Tightening torque :  $36\pm1.5$  kgf  $\cdot$  m (260  $\pm$  10.8 lbf  $\cdot$  ft)
- \* Tools
  - · Hexagon socket 10
  - · Torque wrench



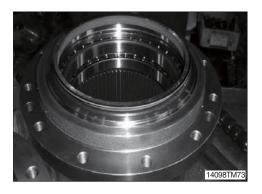
- 3) REASSEMBLE THE REDUCTION GEAR ASSEMBLY
- (1) Install floating seal (102) on the spindle (101).
- \* Apply grease to the floating seal (102).



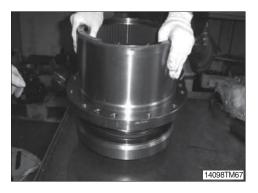
- (2) Install angular bearing (125) and snap ring (106) into the hub (105).
- \* Be careful for the insert direction.



- (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.



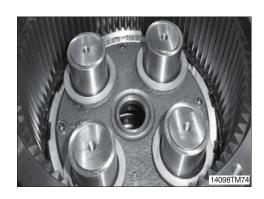
(4) Install the spindle (101) into the hub (105) assembly.



- (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).

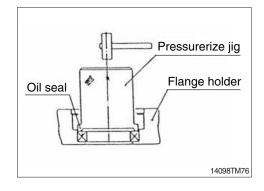


- (10) Install cover (123), thrust plate (150), plug (301, 128) and socket bolt (124) into the hub (105).
- Apply grease to the cover (123) after installed O-ring (127).



#### (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  $(0.3 \text{ kgf/cm}^2)$  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)

## ■ TRAVEL MOTOR (TYPE 2)

#### 1. REMOVAL AND INSTALL

#### 1) REMOVAL

- 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.

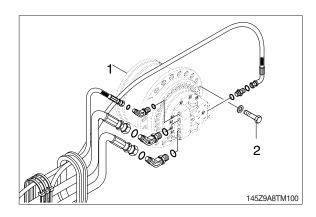
# ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.

- 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: 185 kg (410 lb)

### 2) INSTALL

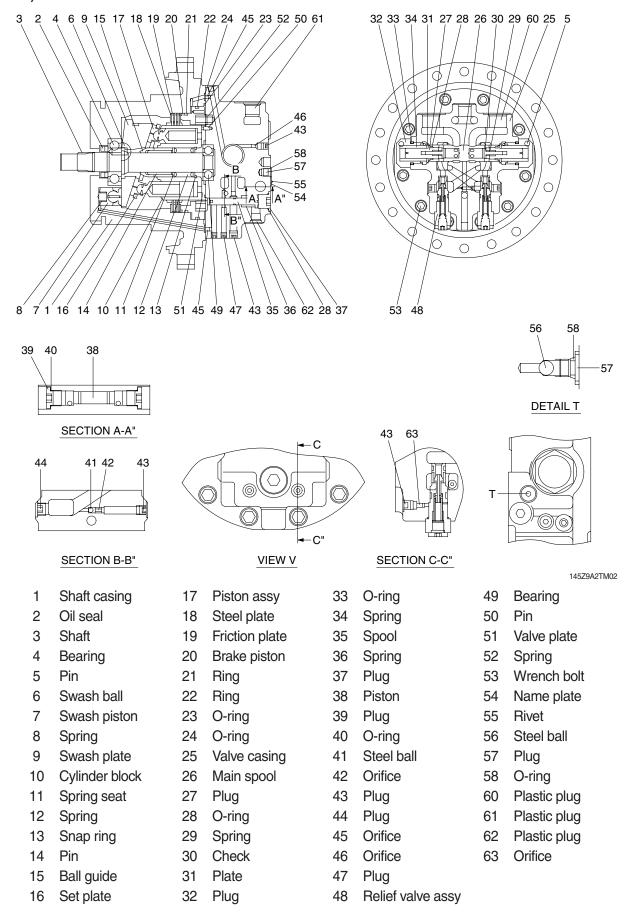
- Carry out installation in the reverse order to removal.
- (2) Bleed the air from the travel motor.
- Remove the air vent plug.
- ② Pour in hydraulic oil until it overflows from the port.
- 3 Tighten plug lightly.
- Start the engine, run at low idling, and check oil come out from plug.
- 5 Tighten plug fully.
- (3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

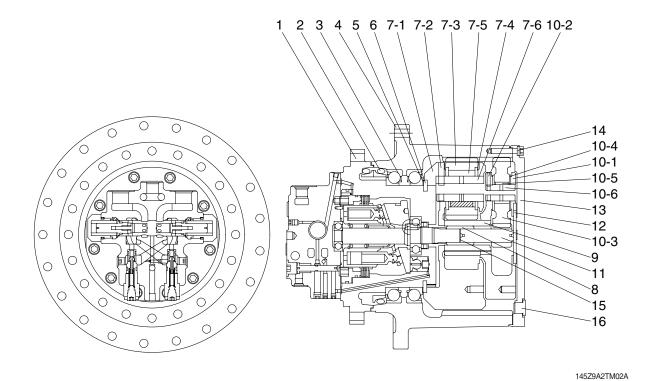




#### 2. SPECIFICATION

### 1) STRUCTURE





1	Spindle	7-4	Washer 2	10-5	Bearing 1
2	Floating sesal	7-5	Bearing 2	10-6	Pin 1
3	Ball bearing	7-6	Pin 2	11	Sun gear 1
4	Housing	8	Coupling	12	Plate 1
5	Shim	9	Sun gear 2	13	Cover
6	Shim	10	Carrier assy 1	14	Bolt
7	Carrier assy 2	10-1	Carrier 1	15	Snap ring
7-1	Carrier 2	10-2	Spring pin 1	16	Plug
7-2	Spring pin 2	10-3	Planetary gear 1		

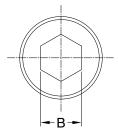
10-4 Washer 1

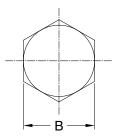
7-3 Planetary gear 2

# 2) TOOL AND TIGHTENING TORQUE

# (1) Tools

Name of tools B (mm)		Name of part applied		
	4	Plug (42, 45, 46, 47)		
Hexagonal	6	Plug (43, 44)		
L-Wrench	8	Plug (39)		
	10	Plug (37, 57), Wrench bolt (53)		
Socket wrench/	24	Relief plug (48)		
spanner	41	Main spool plug (32)		
Snap ring plier (for holes, axis)		ø 42 (13)		
Hammer		Ball bearing (49), Pin (50)		
Torque wrench		Size: 5 kgf·m, 100 kgf·m		
Jig for oil seal assembling	g	Oil seal (2)		
Heating tool for bearing		Parking spring (20)		





Size B

145Z9A8TM99

# (2) Tightening torque

Item no.	Part name	Size	D (mm)	Torque		
item no.	Fait name	Size	B (mm)	kgf · m	lbf ⋅ ft	
25	Wrench bolt	-	-	68	491.8	
32	Main spool plug	M36	41	45	325.5	
37	Plug	PF 3/8	10	6	43.4	
39	Plug	PF 1/4	8	3	21.7	
42, 45, 46, 47	Plug	PT 1/16	4	0.7~1.1	5.1~8.0	
43	Plug	PT 1/8	6	1.25	9.0	
48	Relief valve plug	PF 1/2	24	10	72.3	
53	Wrench bolt	M12×30	10	10.4	75.2	

#### 2. DISASSEMBLING AND ASSEMBLING

#### 1) GENERAL INSTRUCTIONS

- (1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.
- (2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.
- (3) Before disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
  - Seals, O-rings, etc., if once disassembled, are not reusable.
  - There are some parts that should be replaced as a subassembly.
  - Consult with the parts manual in advance.
- (4) The piston can be inserted to whichever cylinder block for the initial assembling. However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.
- ▲ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

# 2) DISASSEMBLING MOTOR UNIT

(1) Disassemble relief valve (48) from valve casing (25) using a torque wrench.



145Z9A8TM01



145Z9A8TM02

(2) Disassemble wrench bolt (53) (M12 $\times$ 30) and take out valve casing sub assembly.



145Z9A8TM03

(3) Remove parking spring (52) - 12EA.



145Z9A8TM04

(4) Remove O-ring (23).



145Z9A8TM05

(5) Disassemble brake piston (20) using a jig.





00 140237

(6) Disassemble friction plate (19)-3EA, steel plate (18)-4EA.











145Z9A8TM10

- (7) Remove the cylinder block kit (II).
- It is easier to work by placing the shaft casing (1) horizontal.





145Z9A8TM11

(8) Disassemble cylinder block (10), ball guide (15), set plate (16), piston assy (17), pin (14) from cylinder block kit (II).

Press spring (12) using a jig and take out snap ring (14) using a plier.

Disassemble snap ring (13), spring seat (11), spring (12) from cylinder block kit (II).





TM13 145Z9A87









(9) Disassemble swash plate (9).



(10) Disassemble swash ball (6).



145Z9A8TM20

# (11) Disassemble shaft (3) from shaft casing (1).





- After disassembled shaft (3) is placed on a jig, top of shaft is pressed down using a press. It can remove ball bearing (4) portion.
- \* Remove ball bearing (4) in case it is replaced only.
- Dismantled bearing can't be reused.



145Z9A8TM23

JIG

145Z9A8TM24

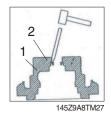
(12) Disassemble swash piston (7), spring (8) into shaft casing(1).





145Z9A8TM26

(13) Disassemble oil seal (2) from shaft casing (1) using a tool.







(14) Disassemble valve plate (51) and ball bearing (49) from valve casing (25).





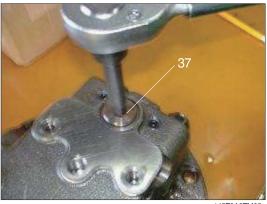
25 145Z9A8TM32

(15) Disassemble plug (47) from valve casing (25).



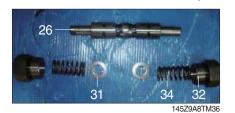
(16) Disassemble plug (37) from valve casing (25) using a torque wrench and disassemble two speed control spool (35), spring (36) in regular sequence.





145Z9A8TM35

(17) Disassemble main spool plug (32) from valve casing (25) using a torque wrench and disassemble spring (34), plate (31), main spool (26) in regular sequence.





145Z9A8TM37

(18) Disassemble plug (43) from valve casing (25) and then disassemble orifice (42), steel ball (41) one by one.



145Z9A8TM38



145Z9A8TM39

(19) Disassemble plug (39), relief valve damping piston (38) from valve casing (25).



39

145Z9A8TM41

(20) Disassemble plug (43) from valve casing (25) and disassemble orifice (63).



145Z9A8TM42

(21) Disassemble plug (57), steel ball (56) from valve casing (25).



# 3) ASSEMBLING MOTOR UNIT

- (1) Put oil seal into shaft casing (1) using a jig.
- \* Caution direction of oil seal.





145Z9A8TM46

(2) Assemble swash spring (8) into shaft casing (1) and put swash piston (7) into shaft casing (1).





145Z9A8TM47



- (3) Press the ball bearing (4) into shaft (3) after preheating of ball bearing (4).
- ① Induction heating apparatus temperature : 100°C
- ② Be careful not to damage the sliding surface for the seal on the shaft.



145Z9A8TM49



145Z9A8TM50



145Z9A8TM51

(4) Assemble shaft into shaft casing (1).





145Z9A8TM53

## (5) Assemble swash ball (6)-2EA.



145Z9A8TM54

(6) Apply grease to swash plate (9) and assemble swash plate (9) into shaft casing (1).



145Z9A8TM56

- (7) Slant the shaft casing (1) and then assemble cylinder block kit (II).
  - Assemble spring seat (11), spring (12), spring seat (11) into cylinder block kit (II) in regular sequence.

Push down spring(12) and then assemble snap ring (13) into gap of cylinder block(10) using a plier.

- Assemble pin (14), ball guide (15), set plate (16), piston assy (17) into cylinder block (10) in regular sequence.



145Z9A8TM5







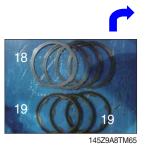


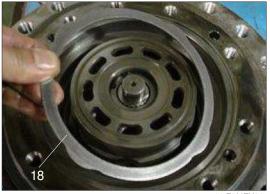




(8) Assemble friction plate (19), steel plate (18) into cylinder block in regular sequence.

Friction plate: 3 EA Steel Plate: 4 EA





145Z9A8TM64



(9) Assemble parking piston (20) into shaft casing (1) using a jig.





145Z9A8TM67

(10) Put O-ring (23) into shaft casing (1). Apply the grease to O-ring.



8-105

(11) Put spring (36), two speed control spool (35) into valve casing (25) in regular sequence and assemble plug (37) into valve casing (25) using a torque wrench.

· Tighten torque: 10 kgf-m (72.3 lbf-ft)



145Z9A8TM70



145Z9A8TM71

(12) Assemble check (30), spring (29), plug (27) into main spool (26) in regular sequence.







145Z9A8TM74

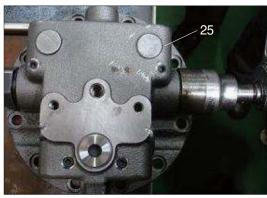


145Z9A8TM75

(13) Put the main spool (26) into valve casing (25) and assemble plate (31), spring (29) into it. Tighten main spool plug (32) using a torque wrench.

· Tighten torque: 45 kgf-m (325.5 lbf-ft)





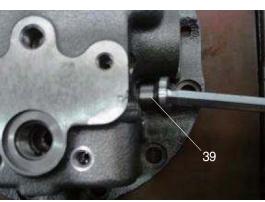
145Z9A8TM77

(14) Put relief valve damping piston (38) into valve casing (25) and assemble plug (39) into valve casing (25).

· Tighten torque: 6 kgf-m (43.4 lbf-ft)



145Z9A8TM78



145Z9A8TM79

(15) Put steel ball (41), orifice (42) into valve casing (25) and tighten the plug (43).

· Tighten torque: 1.25 kgf-m (9.0 lbf-ft)



145Z9A8TM80



145Z9A8TM81

(16) Put steel ball (56) into valve casing (25) and tighten the plug (57).

· Tighten torque: 1.25 kgf-m (9.0 lbf-ft)



145Z9A8TM82



145Z9A8TM83

(17) Assemble orifice (63) into valve casing (25) and tighten the plug (43).

· Tighten torque: 1.25 kgf-m (9.0 lbf-ft)



145Z9A8TM84

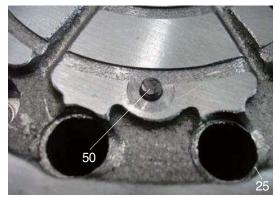
(18) Assemble orifice (63) into valve casing (25) and tighten the plug (47).

• Tighten torque : 0.7~1.1 kgf-m (5.1~8.0 lbf-ft)



145Z9A8TM85

(19) Assemble pin (50) into valve casing (25).



145Z9A8TM86

(20) Assemble pin (5) into valve casing (25).



145Z9A8TM87

(21) Assemble ball bearing (49) into valve casing (25).



145Z9A8TM88

(22) Apply grease on the face of valve plate and assemble valve plate (51) into valve casing (25).



145Z9A8TM90

(23) Apply grease to brake spring (52)-12EA and assemble brake spring (52)-12EA into valve casing (25).



145Z9A8TM91

- (24) Assemble valve casing (25) into shaft casing (1) and tighten the wrench bolt (53) using a torque wrench.
  - · Tighten torque : 10.4 kgf-m (75.2 lbf-ft)



145Z9A8TM92

- (25) Assemble relief valve (48) into valve casing (25) using a torque wrench.
  - · Tighten torque: 10 kgf-m (72.3 lbf-ft)



145Z9A8TM93



145Z9A8TM94

# 4) DISASSEMBLING REDUCTION GEAR

(1) Loose plug (26)-3EA and drain reduction oil.



14579A8TR02

(2) Loose wrench bolt (25) using a tool.



145Z9A8TR03

(3) Disassemble end cover (24).



145Z9A8TR04

(4) Disassemble trust plate (23).



23

145Z9A8TR06

#### (5) Disassemble driver gear (16).



145Z9A8TR07



145Z9A8TR08

- (6) Disassemble carrier No.1 (17) sub assy.
- \* Assemble eyebolt into carrier No.1 tap hole and disassemble carrier No.1 (17) sub assy using a hoist.



145Z9A8TR09

- (7) Disassemble carrier No.1 sub assy.
- \*\* Remove spring pin No.1 (22) from carrier No.1 (17) and planetary gear No.1 (18), washer No.1 (19), needle bearing No.1 (20), carrier pin No.1 (21) in regular sequence.



145Z9A8TR10









- (8) Disassemble carrier No.2 (7) sub assy.
- \* Assemble eyebolt into carrier No.2 tap hole and disassemble carrier No.2 (7) sub assy using a hoist.



145Z9A8TR15

- (9) Disassemble carrier No.2 (7) sub assy.
- \*\* Remove spring pin No.2 (12) from carrier No.2 (7) and disassemble planetary gear No.2 (8), washer No.2 (9), needle bearing No.2 (10), carrier pin No.2 (11) in regular sequence.









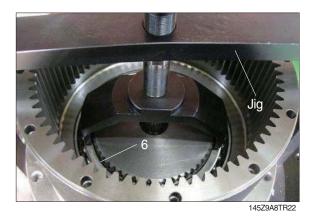






(10) Push down ring gear (4) using a jig and disassemble shim (6).





- (11)Disassemble ring gear sub assy (4) into motor assy.
- \* Assemble eye bolt into tap hole of ring gear sub assy (4) and disassemble ring gear sub assy (4) using a hoist.



145Z9A8TR23

(12)Disassemble floating seal (2) from ring gear sub assy (4).

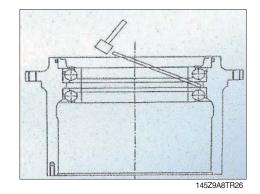


145Z9A8TR24



145Z9A8TR25

- (13) Disassemble angular bearing (3) from ring gear sub assy (4).
- \* Be careful not to damage the parts using a hammer.



8-113

#### 4) ASSEMBLING REDUCTION GEAR

Before assembing please observe following item.

- Wash all parts cleanly using solvent and dry all parts perfectly using compressed air.
- Check metal dust in casing and cleansing solution.
- Before application packing, please remove oil certainly.
- Before insert needle bearing, apply grease to bearing inlet enough.
- Apply lubricant to rotation part and sliding part.
- Damaged part or discolored part exchanges by new parts.

#### (1) Assemble hub

① Place the motor assy on the bench and assemble floating seal (2) into motor (1) using a jig.

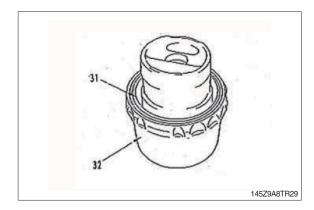


145Z9A8TR27



145Z9A8TR28

- ② Remove completely the oil of surface that O-ring and O-ring contact.
  - Dry completely the floating seal.
  - After assembling the floating seal, coat lubricant to the sliding surface of the floating seal.



(2) Press angular bearing (3) into ring gear (4) using a jig.



Press

145Z9A8TR31

(3) Assemble floating seal(2) into ring gear(4) using a jig.



145Z9A8TR32



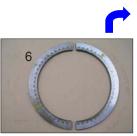
145Z9A8TR33

(4) Assemble ring gear sub assy (4) into motor assy using a assembly epuipment.



145Z9A8TR34

(5) Push down ring gear (4) using a jig and assemble shim (6).



145Z9A8TR35



145Z9A8TR36

#### (6) Assemble carrier No.2 sub assy.

- Assemble planetary gear No.2 (8), washer No.2 (9), needle bearing No.2 (10) and carrier pin No.2 (11) into carrier No.2 (7) in regular sequence.
  - Assemble spring pin No.2 (12).
- Assemble spring pin No.2 (12) and caulk spring pin into pin hole.



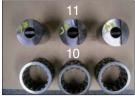
145Z9A8TR37





145Z9A8TR39





#### (7) Disassemble carrier No.2 (7) sub assy.

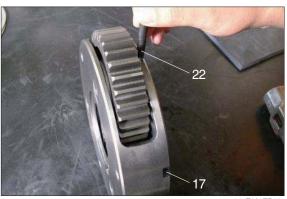
- Assemble eyebolt into carrier No.2 and assemble carrier No.2 (7) sub assy into ring gear using hoist.



145Z9A8TR42

#### (8) Disassemble carrier No.2 (7) sub assy.

- Assemble planetary gear No.1 (18), washer No.1 (19), needle bearing No.1 (20) and carrier pin No.1 (21) into carrier No.1 (17) in regular sequence. Assemble spring pin No.1 (22)
- Assemble spring pin No.1 (22) and caulk spring pin into pin hole.



145Z9A8TR43





145Z9A8TR45





- (9) Assemble carrier No.1 (17) sub assy.
  - Assemble eyebolt into carrier No.1 and assemble carrier No.1 (17) sub assy into ring gear using hoist.



145Z9A8TR48

#### (10) Assemble driver gear(16).



145Z9A8TR50

(11)Assemble trust plate (23).



23 145Z9A8TR52

(12) Assemble end cover (24).



145Z9A8TR53

(13) Tighten wrench bolt (25) using a air impact.

· Tighten torque: 68 kgf-m (491.8 lbf-ft)



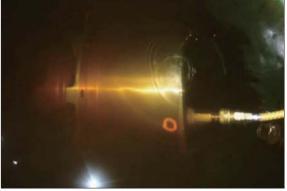
14579A8TR54

(14)Adjust control lever to be sunk the product under the test oil and then check the air leak.

\*TEST : Air pressure 0.7 kgf/cm $^2 \times$  30sec



145Z9A8TR55



145Z9A8TR56

(15)Inject gear oil and assemble plug (26)-3EA.

- Volume of gear oil : 2.2  $\ell$ 

· Tightening torque: 10 kgf-m (72.3 lbf-ft)



145Z9A8TR57

#### **GROUP 7 RCV LEVER**

#### 1. REMOVAL AND INSTALL

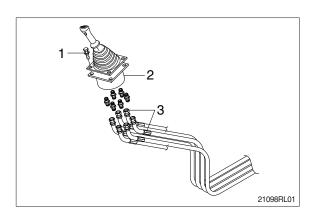
#### 1) REMOVAL

- (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

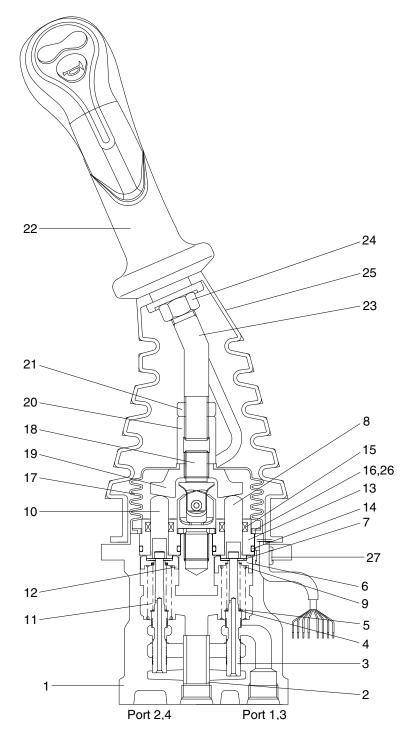
- Carry out installation in the reverse order to removal.
- (2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.





#### 2. DISASSEMBLY AND ASSEMBLY

# 1) STRUCTURE



1409S2RL02

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

# 2) TOOLS AND TIGHTENING TORQUE

# (1) Tools

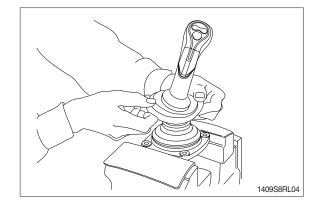
Tool name	Remark			
Allen wrench	6 B			
Cranner	22			
Spanner	27			
(+) Driver	Length 150			
(-) Driver	Width 4~5			
Torque wrench	Capable of tightening with the specified torques			

# (2) Tightening torque

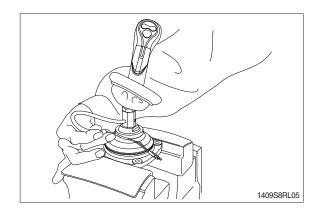
Part name	Item	Size	Torque		
Farthame	nem	Size	kgf ⋅ m	lbf ⋅ ft	
Joint	18	M14	3.5	25.3	
Swash plate	19	M14	5.0±0.35	36.2±2.5	
Adjusting nut	20	M14	5.0±0.35	36.2±2.5	
Lock nut	21	M14	5.0±0.35	36.2±2.5	

# 3) DISASSEMBLY

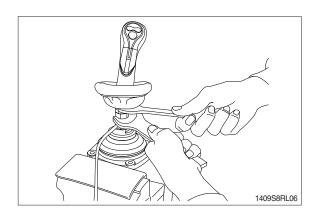
- (1) Clean pilot valve with kerosene.
- \* Put blind plugs into all ports
- (2) Fix pilot valve in a vise with copper (or lead) sheets.
- (3) Remove end of boot (25) from case (1) and take it out upwards.



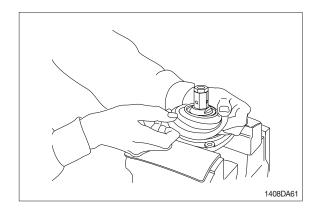
\*\* For valve with switch, remove cord also through hole of casing.



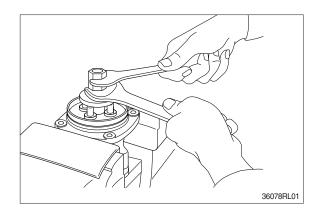
(4) Loosen lock nut (21) and adjusting nut (20) with spanners on them respectively, and take out handle section as one body.

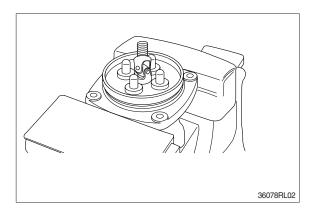


(5) Remove the boot (17).

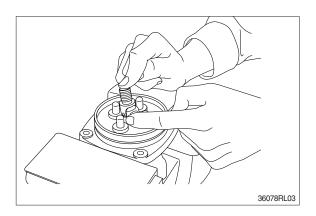


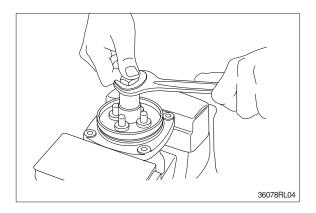
(6) Loosen adjusting nut (20) and swash plate (19) with spanners on them respectively, and remove them.



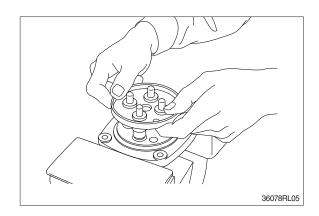


- (7) Turn joint anticlockwise to loosen it, utilizing jig (special tool).
- When return spring (9) is strong in force, plate (16), plug (13) and push rod (10) will come up on loosening joint. Pay attention to this.

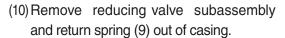




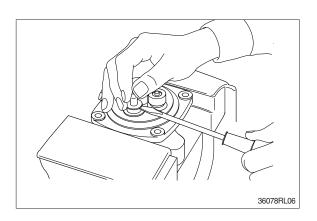
(8) Remove plate (16).

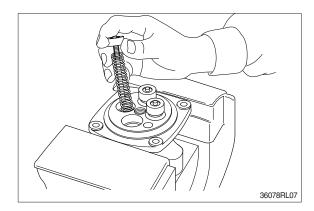


- (9) When return spring (9) is weak in force, plug (13) stays in casing because of sliding resistance of O-ring.
- \* Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.
- During taking out, plug may jump up due to return spring (9) force.
   Pay attention to this.

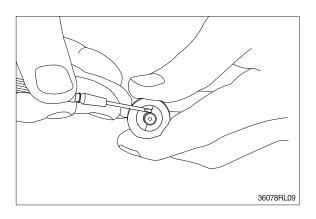


\* Record relative position of reducing valve subassembly and return springs.

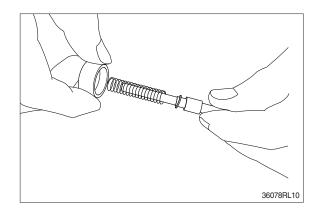




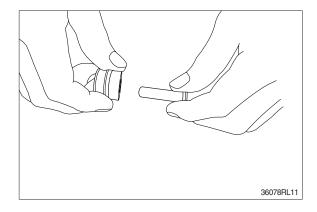
- (11) For disassembling reducing valve section, stand it vertically with spool (3) bottom placed on flat workbench. Push down spring seat (6) and remove two pieces of semicircular stopper (7) with tip of small minus screwdriver.
- \* Pay attention not to damage spool surface.
- \* Record original position of spring seat (6).
- \* Do not push down spring seat more than 6mm.



- (12) Separate spool (3), spring seat (6), spring (5) and shim (5) individually.
- W Until being assembled, they should be handled as one subassembly group.

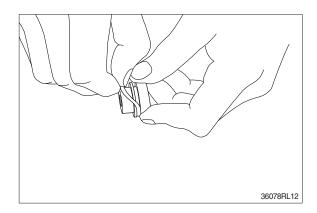


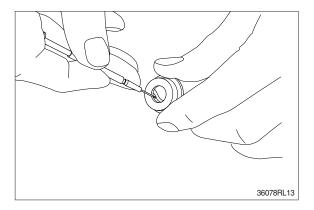
(13) Take push rod (10) out of plug (13).



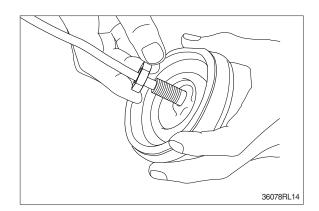
(14) Remove O-ring (14) and seal (15) from plug (13).

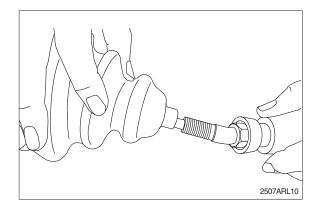
Use small minus screwdriver or so on to remove this seal.





(15) Remove lock nut (21) and then boot (25).





#### (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.

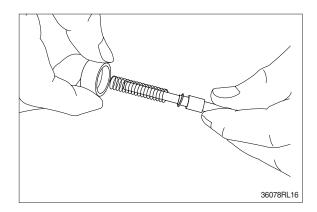
#### (17) Rust prevention of parts

Apply rust-preventives to all parts.

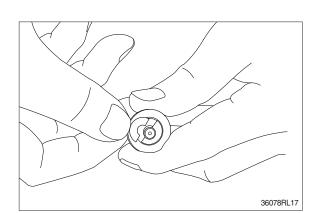
If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

#### 4) ASSEMBLY

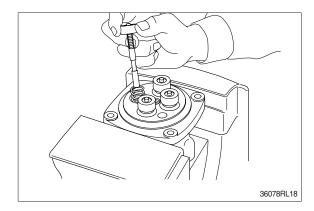
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



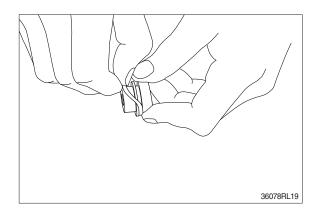
- (2) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (7) on spring seat without piling them on.
- \*\* Assemble stopper (7) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.



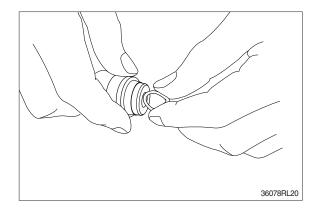
- (3) Assemble spring (9) into casing (1). Assemble reducing valve subassembly into casing.
- \* Assemble them to their original positions.



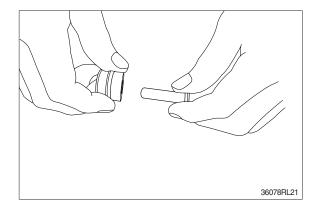
(4) Assemble O-ring (14) onto plug (13).



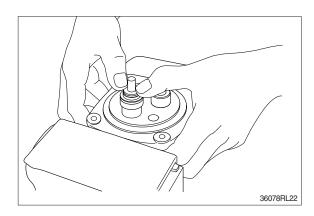
- (5) Assemble seal (15) to plug (13).
- \* Assemble seal in such lip direction as shown below.



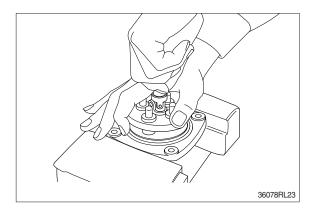
- (6) Assemble push rod (10) to plug (13).



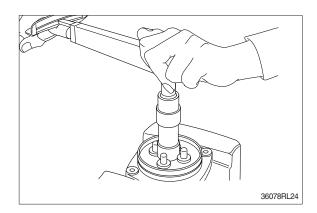
- (7) Assemble plug subassembly to casing.
- When return spring is weak in force, subassembly stops due to resistance of O-ring.



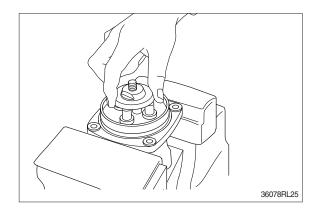
(8) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (16), and tighten joint (18) temporarily.



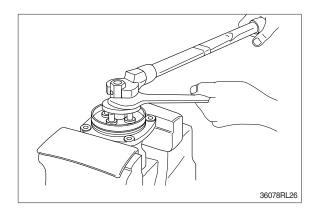
- (9) Fit plate (16).
- (10) Tighten joint (18) with the specified torque to casing, utilizing jig.



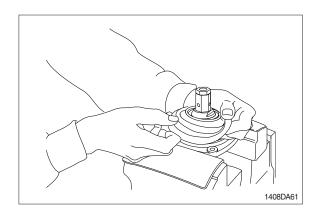
- (11) Assemble swash plate (19) to joint (18).
- Screw it to position that it contacts with 4 push rods evenly.
- \* Do not screw it over.



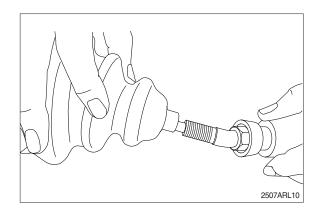
- (12) Assemble adjusting nut (20), apply spanner to width across flat of plate (19) to fix it, and tighten adjusting nut to the specified torque.
- During tightening, do not change position of disk.

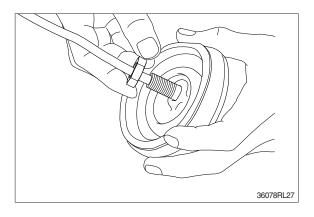


(13) Fit boot (17) to plate.

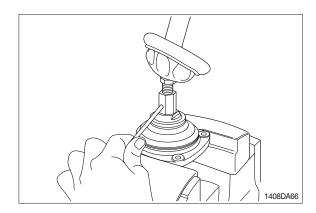


(14) Fit boot (25) and lock nut (21), and handle subassembly is assembled completely.

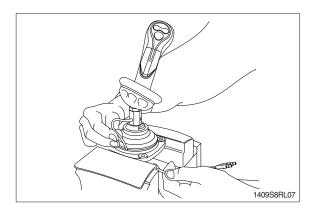




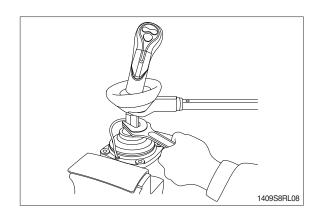
(15) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



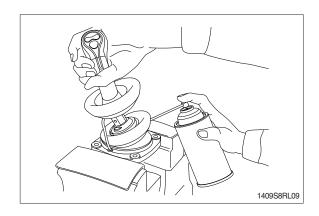
- (16) Assemble bushing (27) to plate and pass cord and tube through it.
- \* Provide margin necessary to operation.



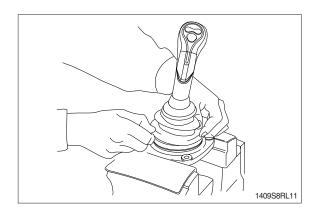
(17) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



(18) Apply grease to rotating section of joint and contacting faces of disk and push rod.



- (19) Assemble lower end of bellows to casing.
- (20) 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.

# ▲ 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)

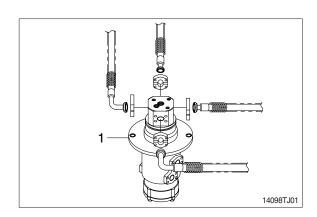
 $\cdot$  Tightening torque : 12.3  $\pm$  1.3 kgf  $\cdot$  m (88.9  $\pm$  9.4 lbf  $\cdot$  ft)

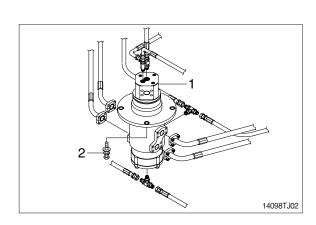
- (6) Remove the turning joint assembly.
- When removing the turning joint, check that all the hoses have been disconnected.

#### 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.

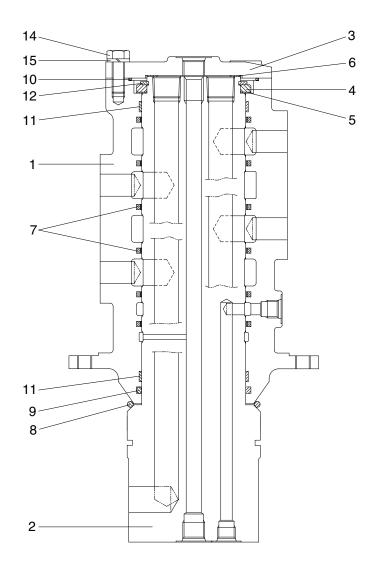






#### 2. DISASSEMBLY AND ASSEMBLY

## 1) STRUCTURE



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1	Hub
2	Shaft

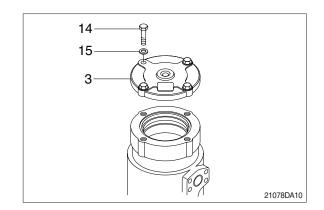
- 3 Cover
- 4 Spacer
- 5 Shim

- 6 Shim
- 7 Slipper seal
- 8 O-ring
- 9 O-ring
- 10 O-ring

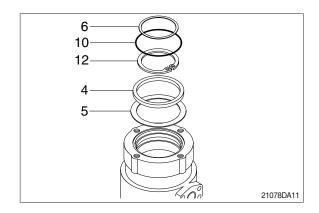
- 11 Wear ring
- 12 Retainer ring
- 13 Plug
- 14 Hexagon bolt
- 15 Spring washer

#### 2) DISASSEMBLY

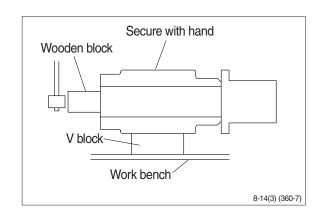
- \*\* Before the disassembly, clean the turning joint.
- (1) Remove bolts (14), washer (15) and cover (3).



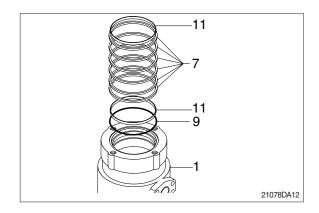
- (2) Remove shim (6) and O-ring (10).
- (3) Remove retainer ring (12), spacer (4) and shim (5).



- (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).

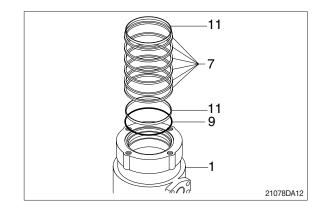


(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).

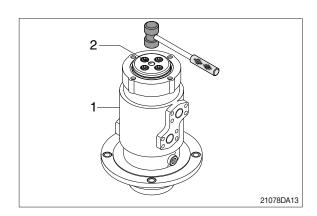


#### 3) ASSEMBLY

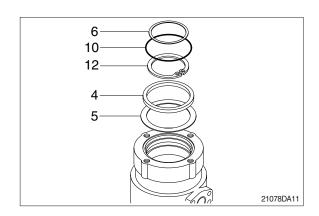
- \* Clean all parts.
- \* As a general rule, replace oil seals and O-ring.
- \* Coat the sliding surfaces of all parts with engine oil or grease before installing.
- (1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).
- (2) Fit O-ring (8) to shaft (2).



(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

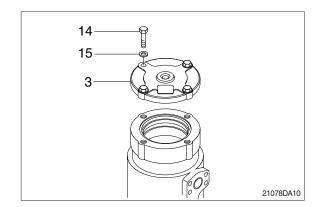


- (4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).
- (5) Fit O-ring (10) to hub (1).
- (6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

 $\cdot$  Torque : 10~12.5 kgf  $\cdot$  m (72.3~90.4 lbf  $\cdot$  ft)



### GROUP 9 BOOM, ARM AND BUCKET CYLINDERS

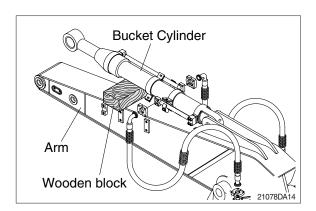
#### 1. REMOVAL AND INSTALL

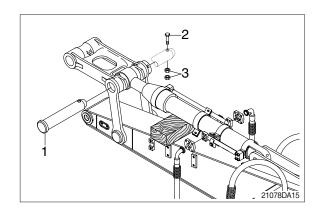
#### 1) BUCKET CYLINDER

#### (1) Removal

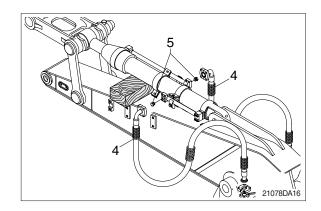
- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- \* Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- \* Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping 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.



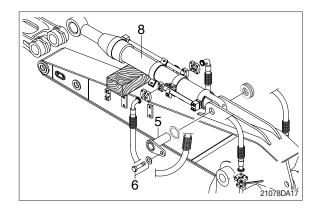




③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



- 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

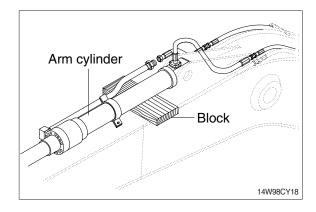
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- \* Bleed the air from the bucket cylinder.
- \* Confirm the hydraulic oil level and check the hydraulic oil leak or not.

#### 2) ARM CYLINDER

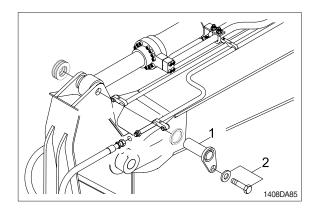
#### (1) Removal

- 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.
- ① Set block between arm cylinder and boom.

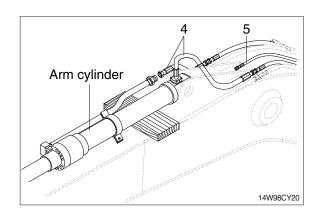




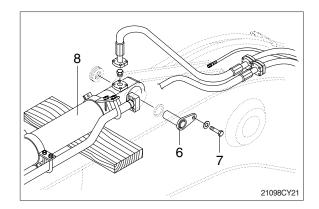
- ② Remove bolt (2) and pull out pin (1).
- \* Tie the rod with wire to prevent it from coming out.



- 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).
- © 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

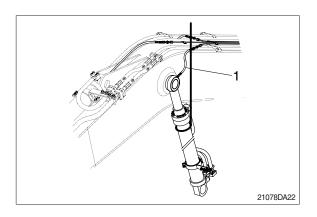
- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- \* Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- \* Loosen the breather slowly to release the pressure inside the hydraulic tank.

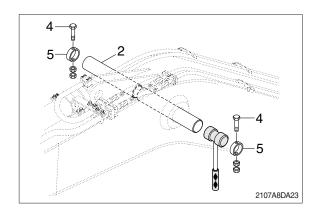
# ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.

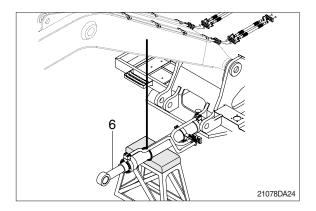
- Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Disconnect greasing hoses (1).
- ② Sling boom cylinder assembly.
- 3 Remove bolt (4), stopper (5) and pull out pin (2).
- \* Tie the rod with wire to prevent it from coming out.

4 Lower the boom cylinder assembly (6) on a stand.

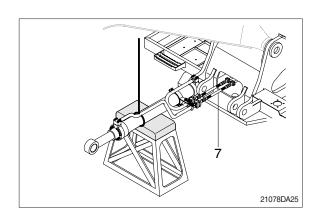




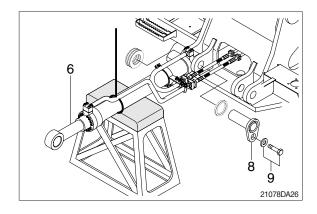




⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



- 6 Remove bolt (9) and pull out pin (8).
- ${ \ensuremath{ \bigcirc } }$  Remove boom cylinder assembly (6).
  - · Weight: 130 kg (285 lb)



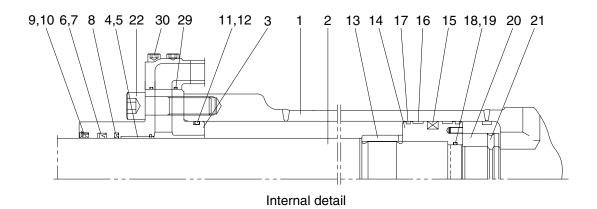
#### (2) Install

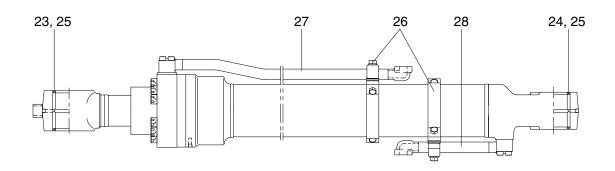
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- \* Bleed the air from the boom cylinder.
- \* Conformed the hydraulic oil level and check the hydraulic oil leak or not.

#### 2. DISASSEMBLY AND ASSEMBLY

#### 1) STRUCTURE

#### (1) Bucket cylinder

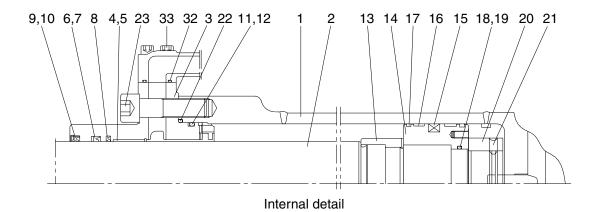


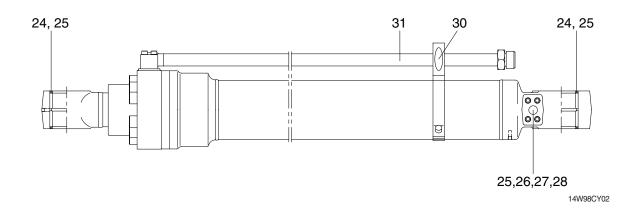


1 Tube assembly 11 O-ring 21 Hexagon socket set screw 2 Rod assembly 12 Back up ring 22 Hexagon socket head bolt Cushion ring 3 Gland Pin bushing 13 23 4 DD2 bushing 14 Piston 24 Pin bushing 5 Snap ring 15 Piston seal 25 Dust seal 6 26 Band assembly Rod seal 16 Wear ring 7 Back up ring 17 **Dust ring** 27 Pipe assembly-R 8 Buffer ring 18 O-ring 28 Pipe assembly-B 9 O-ring **Dust wiper** 19 Back up ring 29 10 Snap ring 20 Lock nut 30 Hexagon socket head bolt

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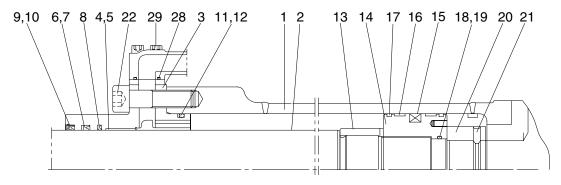
#### (2) Arm cylinder



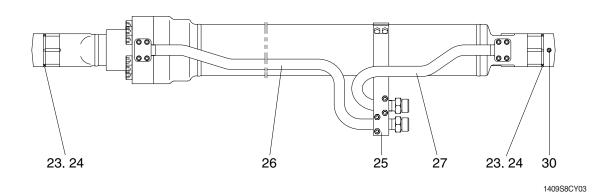


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Dust seal
4	DD2 bushing	15	Piston seal	26	Check valve
5	Snap ring	16	Wear ring	27	Coil spring
6	Rod seal	17	Dust ring	28	O-ring
7	Back up ring	18	O-ring	29	Plug
8	Buffer ring	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

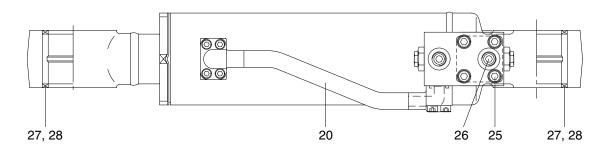


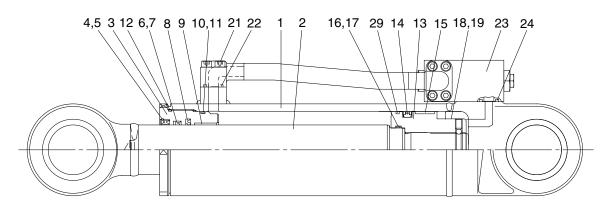
Internal detail



1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12Bac	k up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Dust seal
5	Snap ring	15	Piston seal	25	Band assembly
6	Rod seal	16	Wear ring	26	Pipe assembly-R
7	Back up ring	17	Dust ring	27	Pipe assembly-B
8	Buffer ring	18	O-ring	28	O-ring
9	Dust wiper	19	Back up ring	29	Hexagon socket head bolt
10	Snap ring	20	Lock nut	30	Plug

# (4) Dozer cylinder





1409S8CY05

Tube assembly	11	Back up ring	21	Hexagon socket head bolt
Rod assembly	12	O-ring	22	O-ring
Gland	13	Piston	23	Check valve assembly
Dust wiper	14	Piston seal	24	O-ring
Retainer ring	15	Wear ring	25	Hexagon socket head bolt
Rod seal	16	O-ring	26	Hexagon socket head bolt
Back up ring	17	Back up ring	27	Pin bushing
Buffer ring	18	Steel ball	28	Dust seal
DU bushing	19	Set screw	29	Dust ring
O-ring	20	Pipe assembly		
	Rod assembly Gland Dust wiper Retainer ring Rod seal Back up ring Buffer ring DU bushing	Rod assembly 12 Gland 13 Dust wiper 14 Retainer ring 15 Rod seal 16 Back up ring 17 Buffer ring 18 DU bushing 19	Rod assembly Gland 13 Piston Dust wiper 14 Piston seal Retainer ring 15 Wear ring Rod seal 16 O-ring Back up ring 17 Back up ring Buffer ring 18 Steel ball DU bushing 19 Set screw	Rod assembly       12       O-ring       22         Gland       13       Piston       23         Dust wiper       14       Piston seal       24         Retainer ring       15       Wear ring       25         Rod seal       16       O-ring       26         Back up ring       17       Back up ring       27         Buffer ring       18       Steel ball       28         DU bushing       19       Set screw       29

# 2) TOOLS AND TIGHTENING TORQUE

# (1) Tools

Tool name	Remark	
	6	
Allen uweneb	8 B	
Allen wrench	14	
	17	
Spanner	7	
armer	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

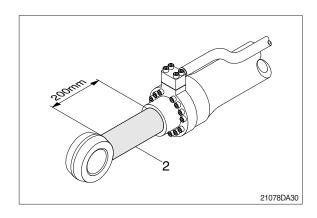
# (2) Tightening torque

	Dort name It	lkowa	Ci-ro	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
	Danes estimates	21	M8	2.7±0.3	19.5±2.2
	Dozer cylinder	25, 26	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
COOKOT HOUG 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				1085±109
Dieter	Boom cylinder	14	-	450   450	
Piston	Arm cylinder			$150 \pm 15.0$	
	Dozer cylinder - Rear	13	M52		

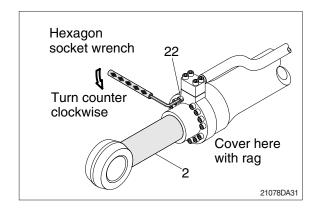
#### 3) DISASSEMBLY

### (1) Remove cylinder head and piston rod

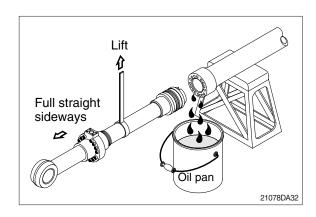
- \* Procedures are based on the bucket cylinder.
- ① Hold the clevis section of the tube in a vise.
- \* Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.
- ② Pull out rod assembly (2) about 200mm (7.1in). Because 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.

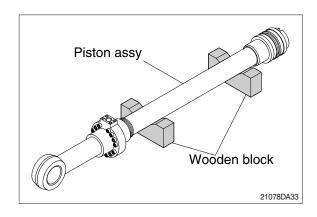


- ① Draw out cylinder head and rod assembly together from tube assembly (1).
- Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift 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.

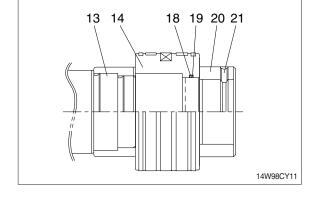
- ⑤ Place the removed rod assembly on a wooden V-block that is set level.
- \* Cover a V-block with soft rag.

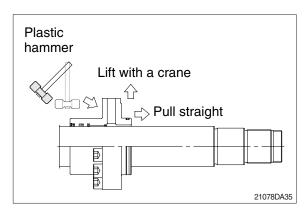


### (2) Remove piston and cylinder head

- 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

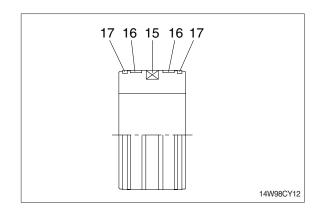
lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).





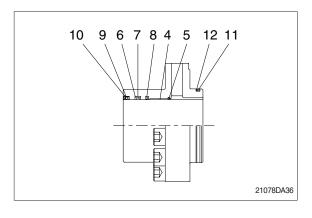
### (3) Disassemble the piston assembly

- 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

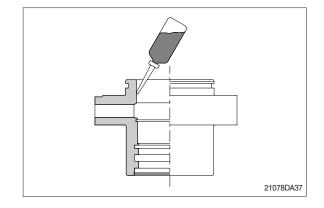
- ① Remove back up ring (12) and O-ring (11).
- ② Remove snap ring (10), dust wiper (9).
- ③ Remove back up ring (7), rod seal (6) and buffer ring (8).
- Exercise care in this operation not to damage the grooves.
- \* Do not remove seal and ring, if does not damaged.
- \* Do not remove bushing (4).



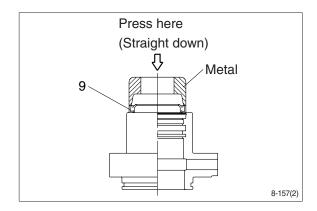
### 3) ASSEMBLY

### (1) Assemble cylinder head assembly

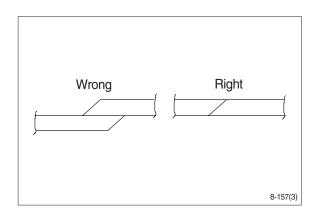
- \* Check for scratches or rough surfaces if found smooth with an oil stone.
- ① Coat the inner face of gland (3) with hydraulic oil.



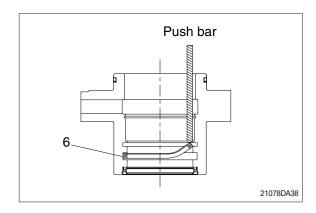
- ② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
  - At this time, press a pad metal to the metal ring of dust seal.
- ③ Fit snap ring (10) to the stop face.



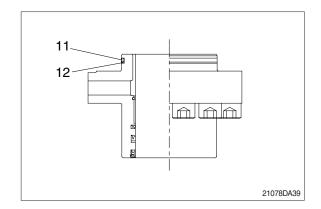
- ④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.
- \* Coat each packing with hydraulic oil before fitting it.
- \*\* Insert the backup ring until one side of it is inserted into groove.



- \*\* 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.

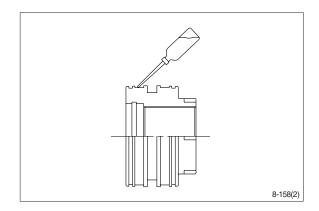


- 5 Fit back up ring (12) to gland (3).
- \* Put the backup ring in the warm water of 30~50°C.
- ⑥ Fit O-ring (11) to gland (3).

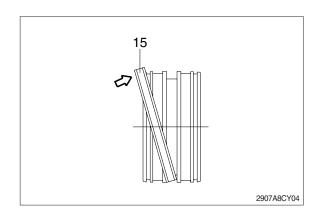


### (2) Assemble piston assembly

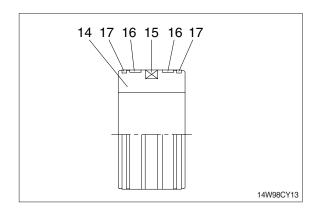
- \* Check for scratches or rough surfaces. If found smooth with an oil stone.
- ① Coat the outer face of piston (14) with hydraulic oil.



- 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.

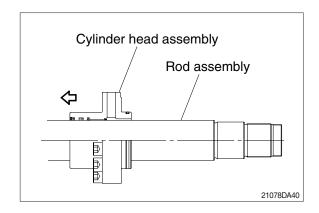


③ Fit wear ring (16) and dust ring (17) to piston (14).

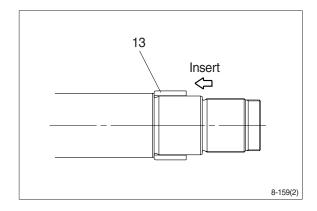


### (3) Install piston and cylinder head

- 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.

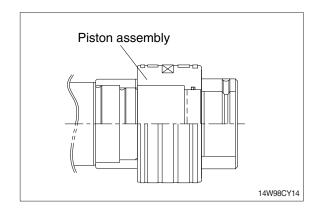


- ④ Insert cushion ring (13) to rod assembly.
- \* Note that cushion ring (13) has a direction in which it should be fitted.



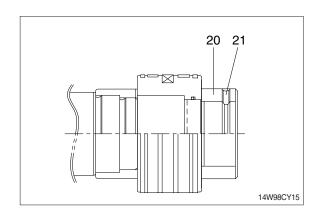
- $\ensuremath{\mbox{\Large \sc 5}}$  Fit piston assembly to rod assembly.
  - · Tightening torque : 150±15 kgf · m

 $(1085\pm108 \text{ lbf} \cdot \text{ft})$ 



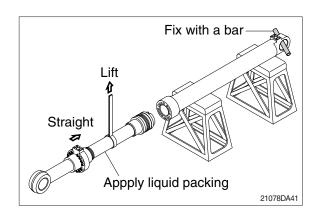
- ⑥ Fit lock nut (20) and tighten the screw (21).
  - · Tightening torque :

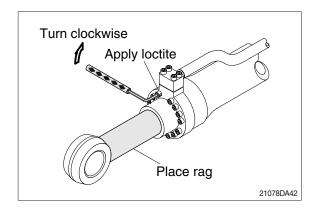
	Item	kgf ⋅ m	lbf ⋅ ft
	Bucket		
20	Boom	100±10	$723 \pm 72.3$
	Arm		
21		2.7±0.3	19.6±2.2



### (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.



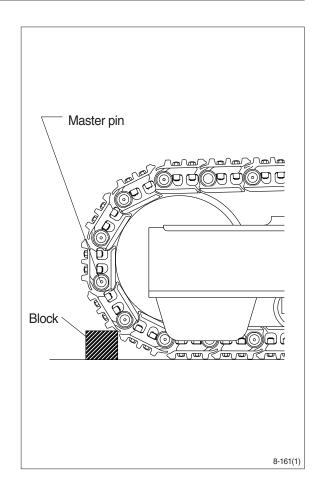


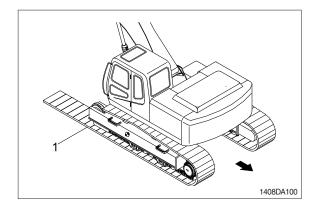
### **GROUP 10 UNDERCARRIAGE**

#### 1. TRACK LINK

#### 1) REMOVAL

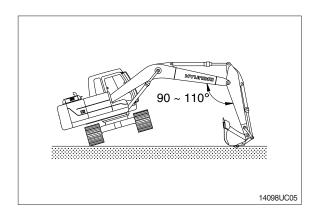
- (1) Move track link until master pin is over front idler in the position put wooden block as shown.
- (2) Loosen tension of the track link.
- If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.
- \*\* Unscrew the grease nipple after release the 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
  - is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease nipple can be suddenly popped out by pressurized grease.
- (3) Push out master pin by using a suitable tool.
- (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

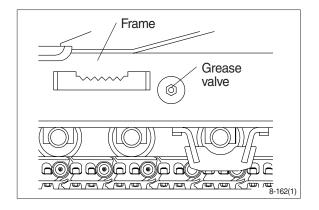
- (1) Carry out installation in the reverse order to removal.
- \* Adjust the tension of the track link.



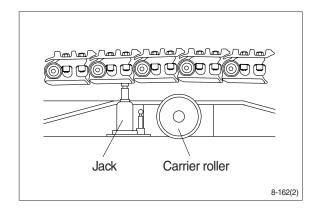
### 2. CARRIER ROLLER

## 1) REMOVAL

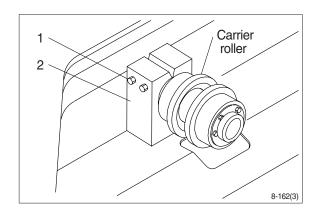
(1) Loosen tension of the track link.



(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)



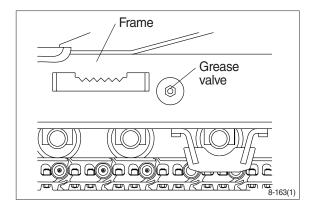
### 2) INSTALL

(1) Carry out installation in the reverse order to removal.

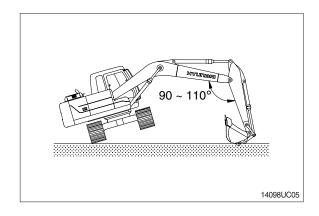
### 3. TRACK ROLLER

## 1) REMOVAL

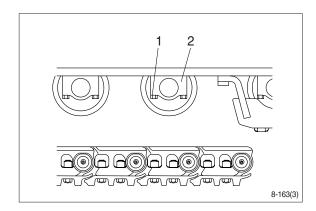
(1) Loosen tension of the track link.



- (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)



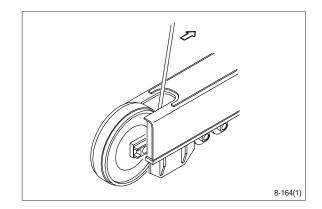
## 2) INSTALL

(1) Carry out installation in the reverse order to removal.

### 4. IDLER AND RECOIL SPRING

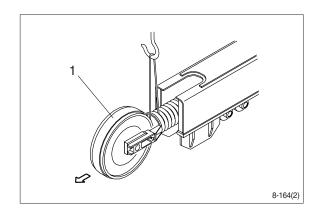
## 1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.

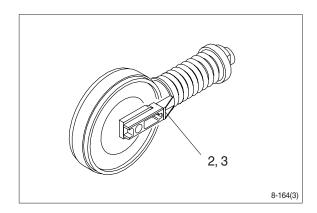


(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.

· Weight: 192 kg (423 lb)

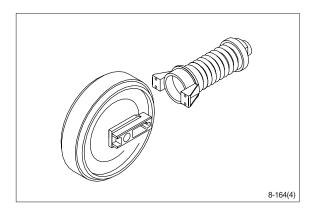


(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.



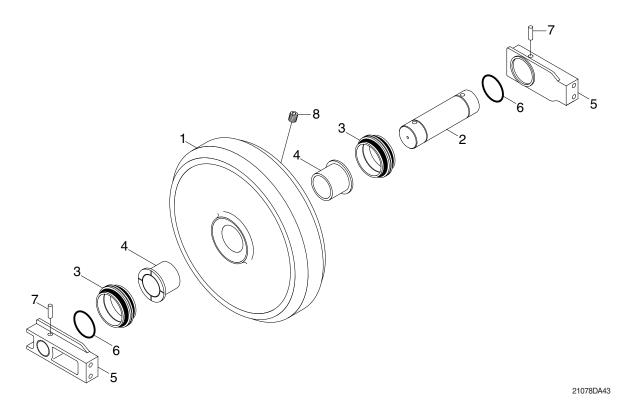
### 2) INSTALL

- (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

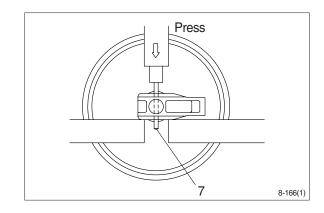


- 1 Shell
- 2 Shaft
- 3 Seal assembly
- 4 Bushing
- 5 Bracket
- 6 O-ring

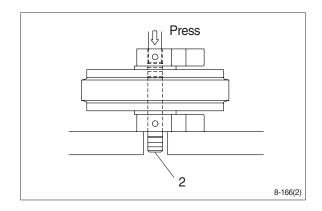
- 7 Spring pin
- 8 Plug

## (2) Disassembly

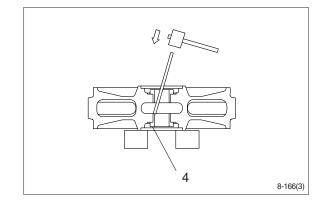
- Remove plug and drain oil.
- ② Draw out the spring pin (7), using a press.



- 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.

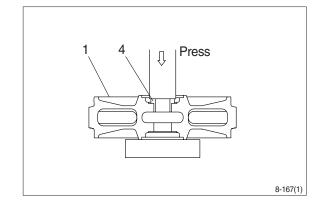


⑥ Remove the bushing (4) from idler, using a special tool. Only remove bushing if replacement is necessity.

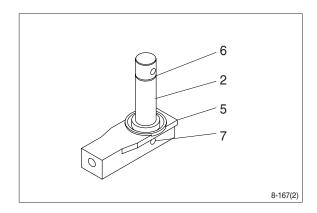


### (3) Assembly

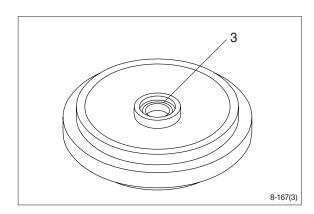
- \* Before assembly, clean the parts.
- \* Coat the sliding surfaces of all parts with oil.
- Cool up bushing (4) fully by some dry ice and press it into shell (1).
   Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



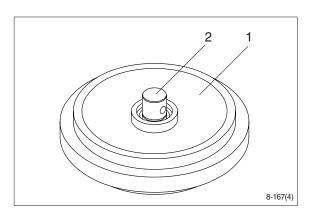
- ② Coat O-ring (6) with grease thinly, and install it to shaft (2).
- ③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



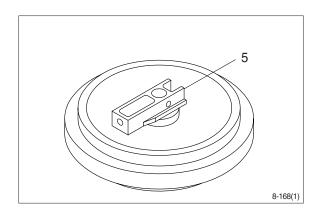
④ Install seal (3) to shell (1) and bracket (5).



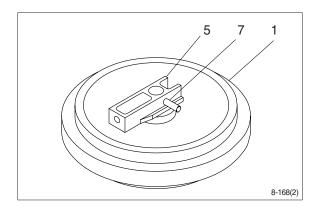
⑤ Install shaft (2) to shell (1).



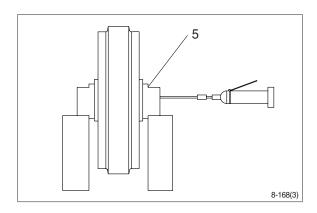
 $\ensuremath{\textcircled{6}}$  Install bracket (5) attached with seal (3).



⑦ Knock in the spring pin (7) with a hammer.

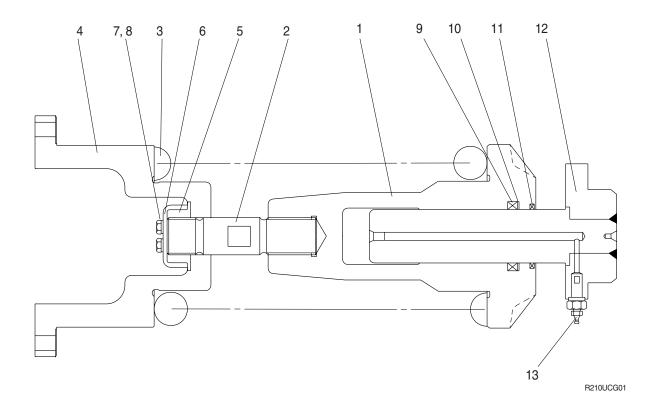


Supply engine oil to the specified level, and tighten plug.



# 4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

# (1) Structure



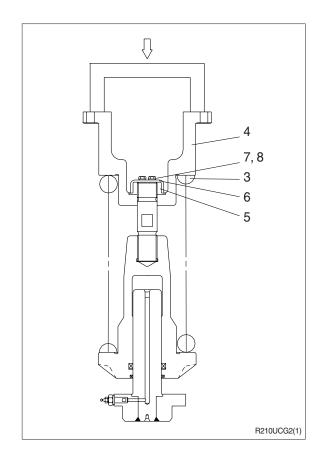
- 1 Body
- 2 Tie bar
- 3 Spring
- 4 Bracket
- 5 Lock nut

- 6 Lock plate
- 7 Bolt
- 8 Spring washer
- 9 Rod seal
- 10 Back up ring

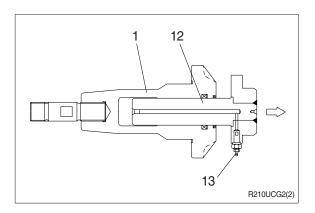
- 11 Dust seal
- 12 Rod assembly
- 13 Grease valve

### (2) Disassembly

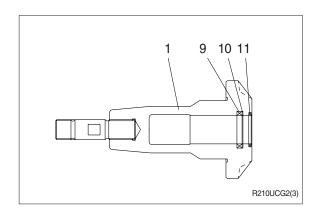
- ① Apply pressure on spring (3) with a press.
- \*\* The spring is under a large installed load. This is dangerous, so be sure to set properly.
  - · Spring set load : 11132 kg (24542 lb)
- ② Remove bolt (7), spring washer (8) and lock plate (6).
- ③ Remove lock nut (5). Take enough notice so that the 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).



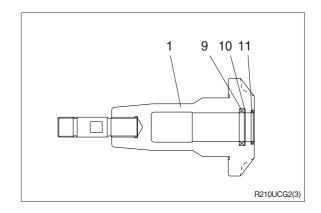
⑦ Remove rod seal (9), back up ring (10) and dust seal (11).



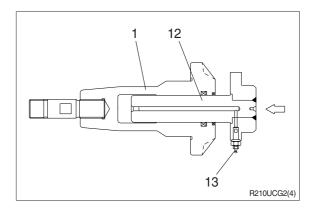
### (3) Assembly

Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

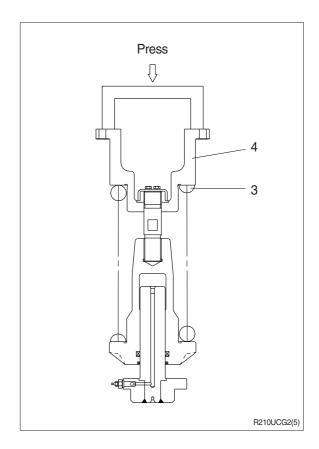
When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



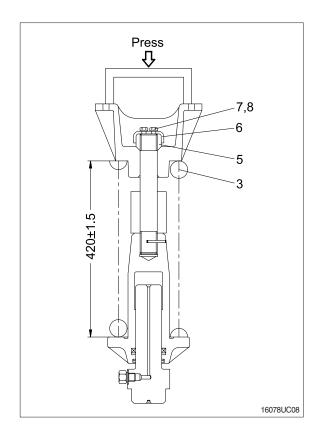
- ② Pour grease into body (1), then push in rod (12) by hand. After take grease out of grease valve mounting hole, let air out.
- If air letting is not sufficient, it may be difficult to adjust the tension of crawler.
- 3 Fit grease valve (13) to rod (12).
  •Tightening torque: 13±1.0 kgf·m (94±7.2 lbf·ft)



- (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.



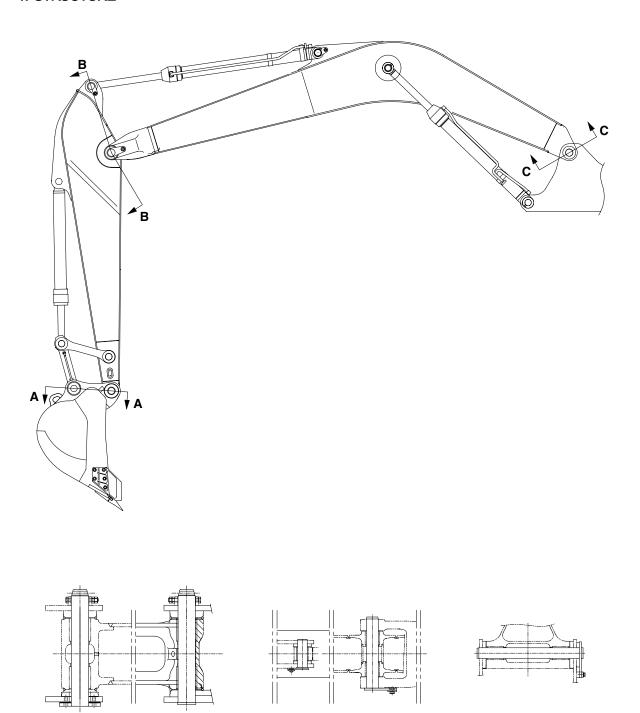
- © Lighten the press load and confirm the set length of spring (3).
- After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).



# **GROUP 11 WORK EQUIPMENT**

SECTION A

## 1. STRUCTURE



21078DA44

SECTION C

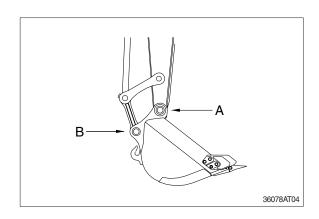
SECTION B

### 2. REMOVAL AND INSTALL

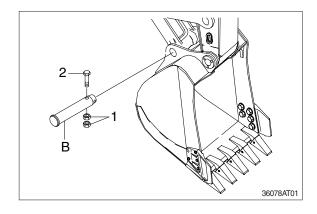
# 1) BUCKET ASSEMBLY

### (1) Removal

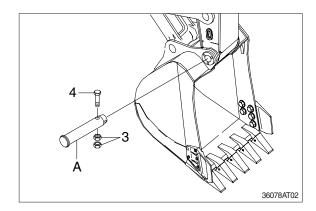
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut (1), bolt (2) and draw out the pin (B).

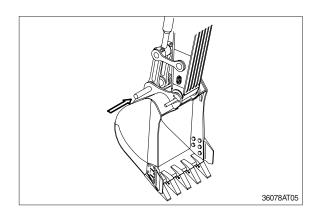


③ Remove nut (3), bolt (4) and draw out the pin (A) then remove the bucket assembly.· Weight: 480 kg (1060 lb)



### (2) Install

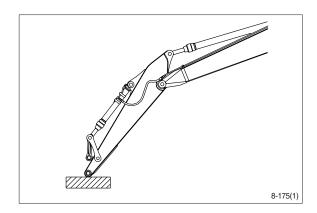
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- \* Adjust the bucket clearance.
  For detail, see operation manual.

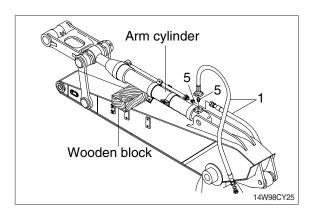


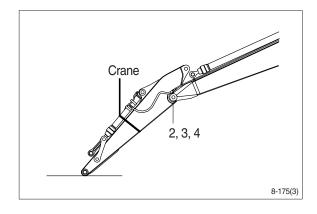
### 2) ARM ASSEMBLY

#### (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.

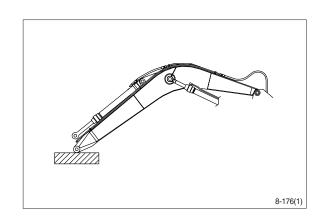
### 3) BOOM CYLINDER

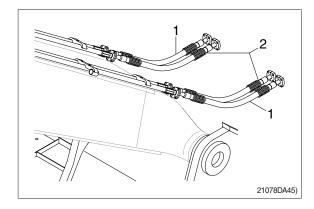
#### (1) Removal

- 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.

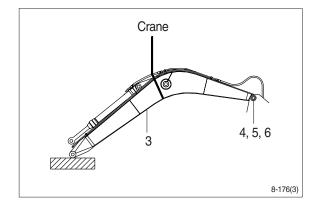


- ④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).
- When the hose are disconnected, oil may spurt out.
- ⑤ Sling boom assembly (3).



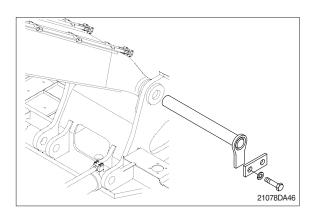


- ® Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.• Weight :760 kg (1675 lb)
- When lifting the boom assembly always lift the center of gravity.



### (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.



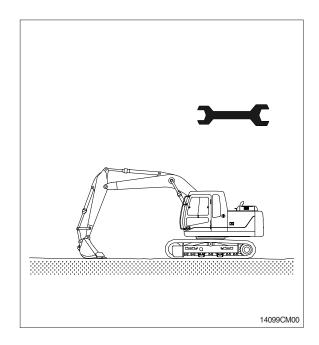
# SECTION 9 COMPONENT MOUNTING TORQUE

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
Group	6	Structure	9-10
Group	7	Work equipment ·····	9-14

# SECTION 9 COMPONENT MOUNTING TORQUE

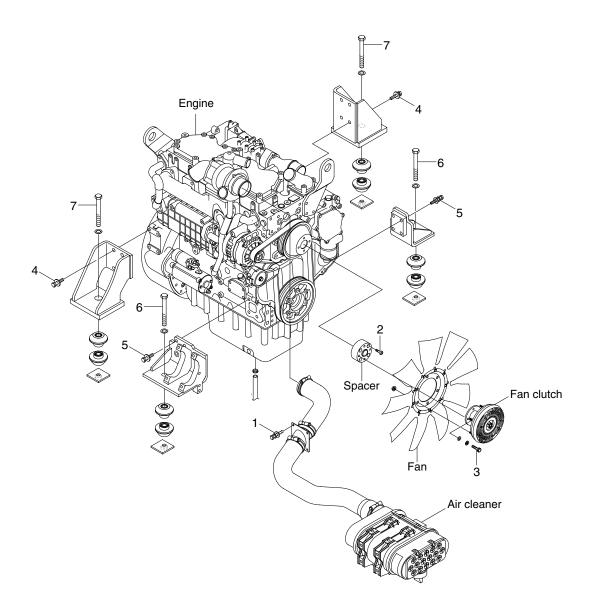
# **GROUP 1 INTRODUCTION GUIDE**

- 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

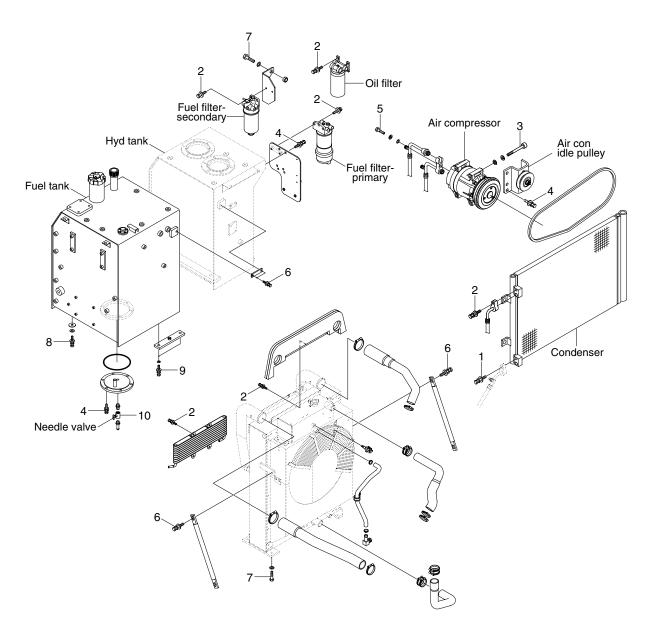


14099ACM01

Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M10×1.5	4.4±0.9	31.8±6.5
4	M12×1.75	7.9±2.0	57.1 ± 14.5

Item	Size	kgf ⋅ m	lbf ⋅ ft
5	M12×1.75	11.2±1.1	81±8.0
6	M20×2.5	52.1±5.0	377±36.2
7	M30×3.0	90±9.0	651±65.1

# 2. COOLING SYSTEM AND FUEL TANK MOUNTING



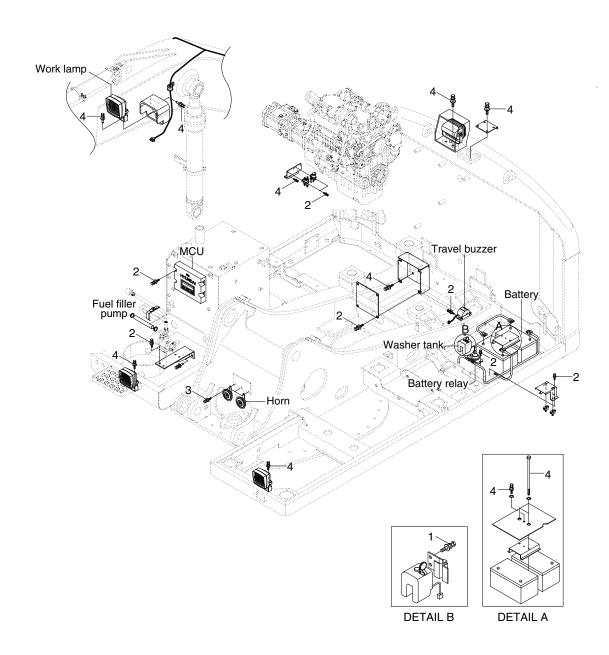
14099ACM02

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	4.05±0.8	29.3±5.8
4	M10×1.5	6.9±1.4	49.9±10.1
5	M10×1.25	7.4±1.5	53.5±10.8

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	M20×2.5	57.9±8.7	419±62.9
10	-	2.3±0.6	16.6±4.3

# **GROUP 3 ELECTRIC SYSTEM**

## 1. ELECTRIC COMPONENTS MOUNTING 1

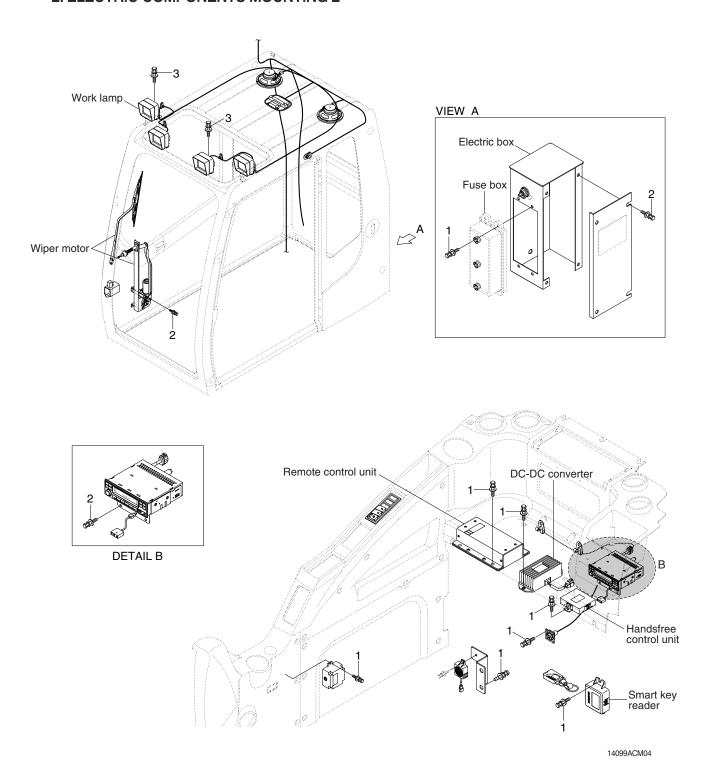


14099ACM03

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	M 8×1.25	3.43±0.7	24.8±5.1
4	M10×1.5	6.9±1.4	49.9±10.1

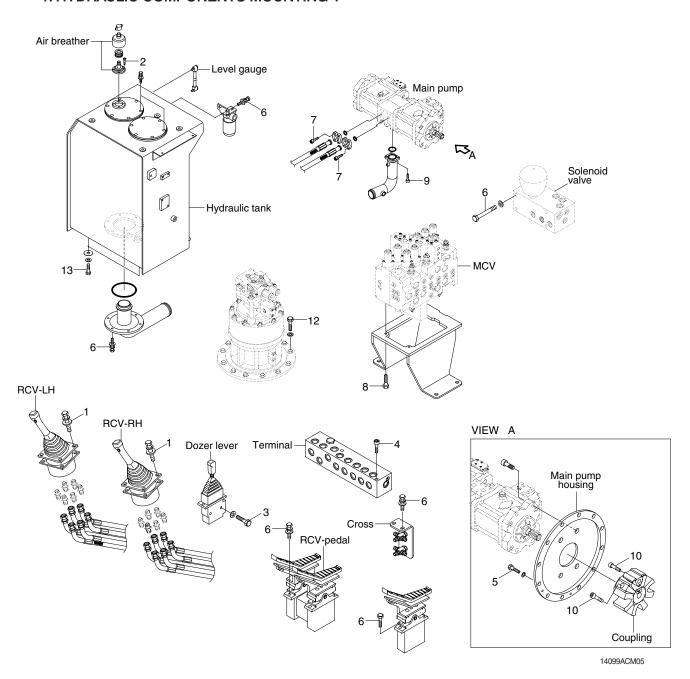
## 2. ELECTRIC COMPONENTS MOUNTING 2



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**

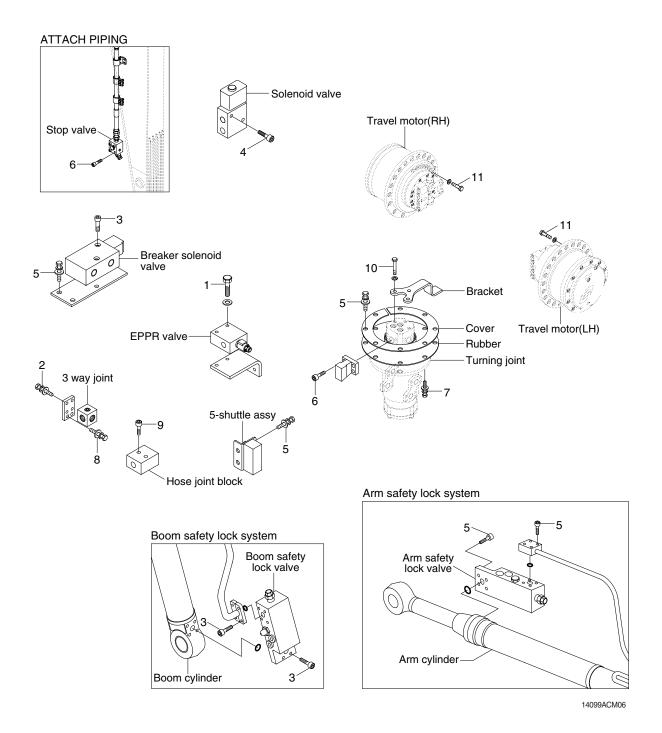
### 1. HYDRAULIC COMPONENTS MOUNTING 1



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
7	M10×1.5	8.27±1.7	59.8±12.3

Item	Size	kgf ⋅ m	lbf ⋅ ft
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	22.5±0.5	163±3.6
12	M16×2.0	29.6±3.2	214±23.1
13	M20×2.5	46±5.1	333±36.9
-	-	-	-

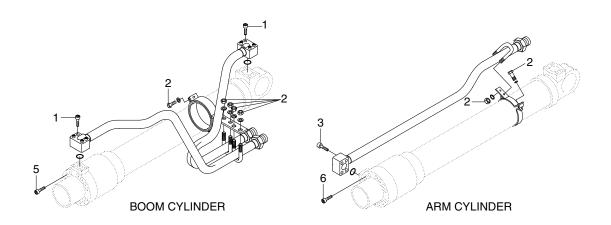
### 2. HYDRAULIC COMPONENTS MOUNTING 2

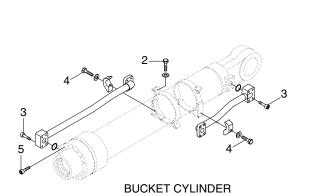


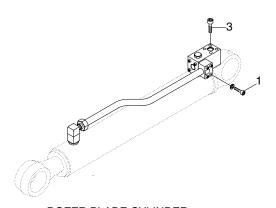
Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 6×1.0	1.44±0.3	10.4±2.2
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.8±5.1
4	M 8×1.25	4.05±0.8	29.3±5.8
5	M10×1.5	6.9±1.4	49.9±10.1
6	M10×1.5	8.27±1.7	59.8±12.3

Item	Size	kgf ⋅ m	lbf ⋅ ft
7	M12×1.75	12.3±1.3	88.9±9.4
8	M12×1.75	12.8±3.0	92.6±21.7
9	M12×1.75	14.7±2.2	106±15.9
10	M14×2.0	19.6±2.9	142±21.0
11	M16×2.0	25.7±4.0	186±28.9
-	-	-	-

# 3. HYDRAULIC COMPONENTS MOUNTING 3







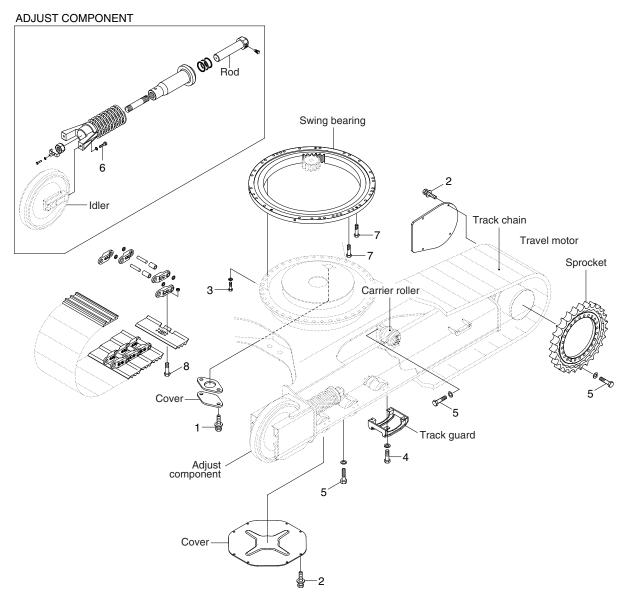
DOZER BLADE CYLINDER

14099CM07

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**



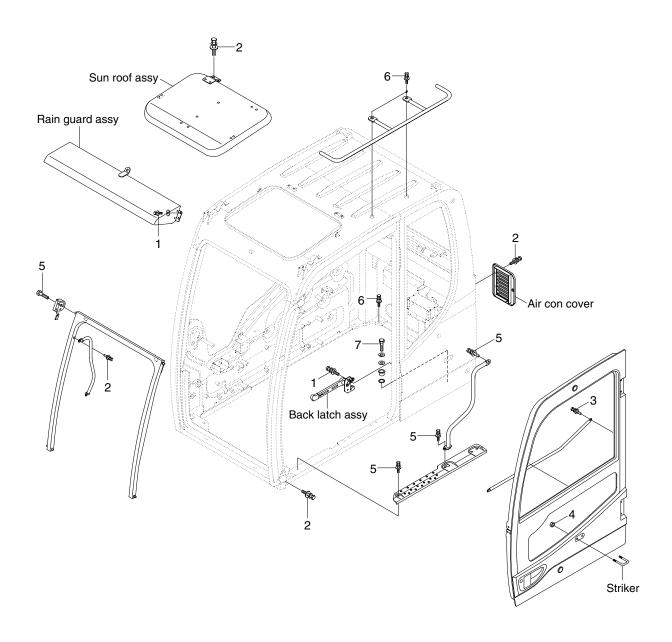
14099ACM08

Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M16×1.5	31.3±3.2	226±23.1
4	M16×2.0	29.6±3.2	214±23.1

Item	Size	kgf ⋅ m	lbf ⋅ ft
5	M16×2.0	29.3±3.0	215±21.7
6	M16×2.0	29.7±4.5	215±32.5
7	M18×2.5	41.3±4.5	299±32.5
8	5/8"-18 UNF	42±4.0	304±29

# GROUP 6 STRUCTURE

# 1. CAB AND ACCESSORIES MOUNTING

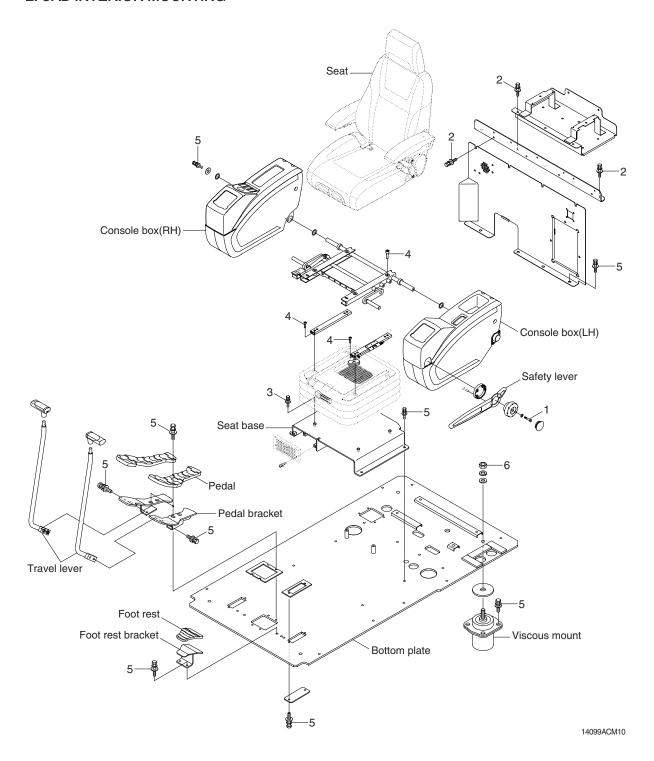


14099ACM09

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	4.7±0.9	34±6.5

Item	Size	kgf ⋅ m	lbf ⋅ ft
5	M10×1.5	6.9±1.4	49.9±10.1
6	M12×1.75	12.8±3.0	92.6±21.7
7	M30×3.5	199±30	1439±217
-	-	-	-

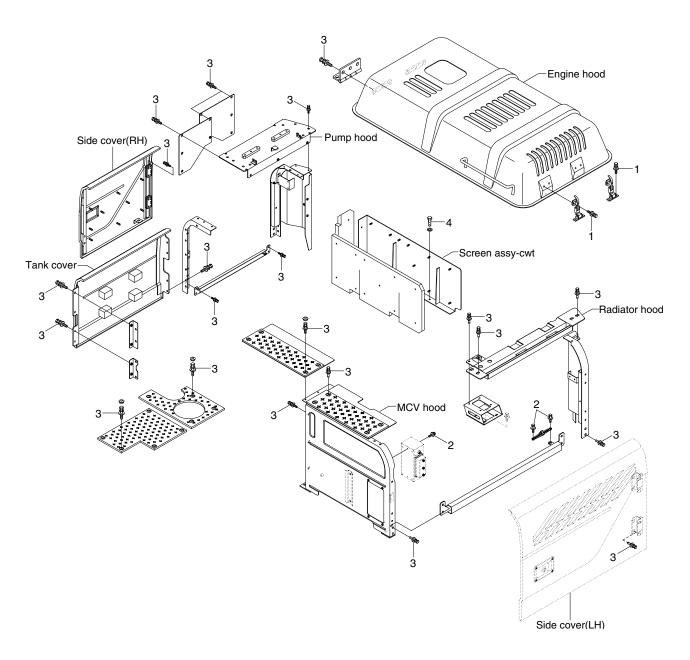
### 2. CAB INTERIOR MOUNTING



Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M 6×1.0	1.05±0.2	7.6±1.4
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

Item	Size	kgf ⋅ m	lbf ⋅ ft
4	M 8×1.25	4.05±0.8	29.3±5.8
5	M10×1.5	6.9±1.4	49.9±10.1
6	M16×2.0	29.7±4.5	215±32.5

# 3. COWLING MOUNTING

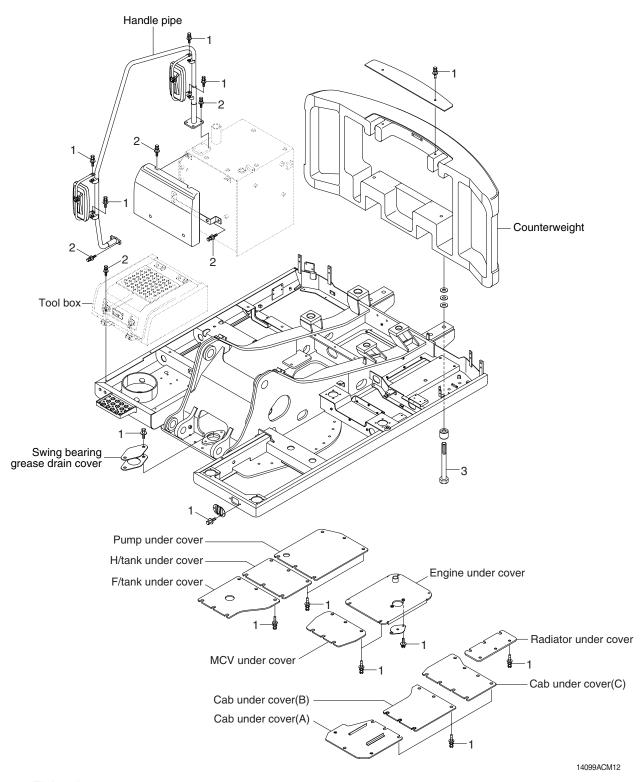


14099ACM11

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

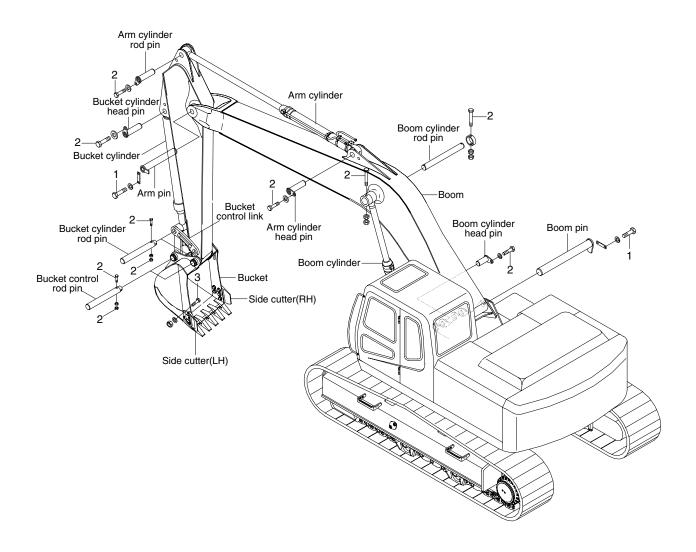
Item	Size	kgf ⋅ m	lbf ⋅ ft
3	M12×1.75	12.8±3.0	92.6±21.7
4	M16×2.0	29.7±4.5	215±32.5

### 4. COUNTERWEIGHT AND COVERS MOUNTING



Item	Size	kgf ⋅ m	lbf ⋅ ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M27×3.0	140±15	1013±108

# **GROUP 7 WORK EQUIPMENT**



14099CM13

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