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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.

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your HD 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 HD HYUNDAI distributors.

Get the most up-to-date information before you start any work.

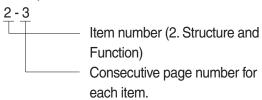
Filing method

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



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

8 - 4 8 - 4 - 1 Added pages

8 - 5

Revised edition mark (123...)

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

Revisions

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

Symbols

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

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

2. Convert 550 mm into inches.

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

 This gives 550 mm = 21.65 inches.

	Millimete	rs to inche	es				(b)			1 mm =	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

										0.00007111
	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound 1kg = 2.2046lb

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

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

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

Liter to U.K. Gallon 1 ℓ = 0.21997 U.K.Gal

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

 $\textbf{kgf} \cdot \textbf{m to lbf} \cdot \textbf{ft}$ $1 \text{kgf} \cdot \textbf{m} = 7.233 \text{lbf} \cdot \textbf{ft}$

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

 $1 \text{kgf} / \text{cm}^2 = 14.2233 \text{lbf} / \text{in}^2$

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

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

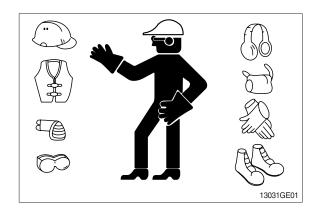
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

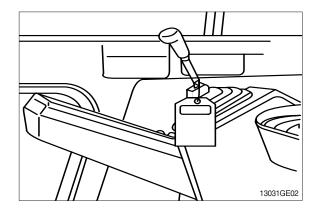
Wear close fitting clothing and safety equipment appropriate to the job.



WARN OTHERS OF SERVICE WORK

Unexpected machine movement can cause serious injury.

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



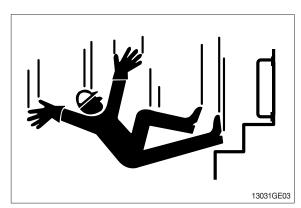
USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.

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

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

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

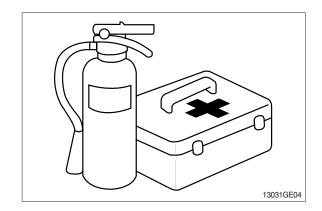


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

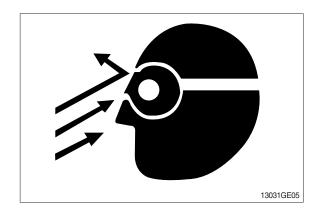
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

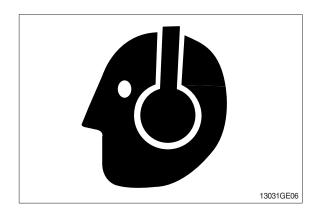
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

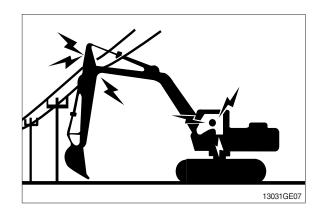
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

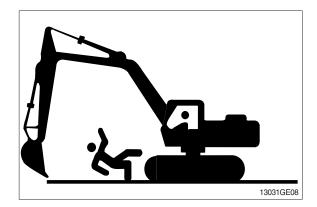
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



KEEP RIDERS OFF EXCAVATOR

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

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

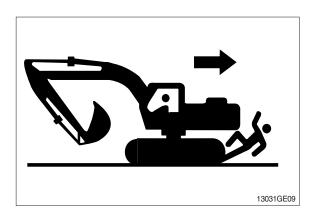


MOVE AND OPERATE MACHINE SAFELY

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

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

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



OPERATE ONLY FORM OPERATOR'S SEAT

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

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



PARK MACHINE SAFELY

Before working on the machine:

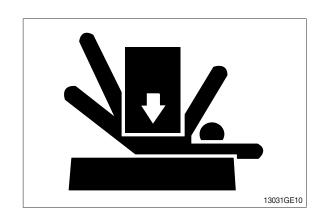
- · Park machine on a level surface.
- · Lower bucket to the ground.
- · Turn auto idle switch off.
- · Run engine at 1/2 speed without load for 2 minutes.
- Turn key switch to OFF to stop engine. Remove key from switch.
- · Move pilot control shutoff lever to locked position.
- · Allow engine to cool.

SUPPORT MACHINE PROPERLY

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

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

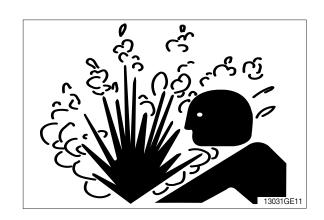
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



SERVICE COOLING SYSTEM SAFELY

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

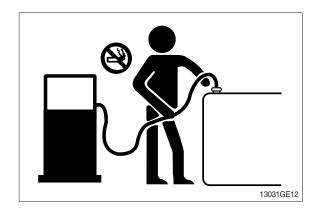
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



HANDLE FLUIDS SAFELY-AVOID FIRES

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

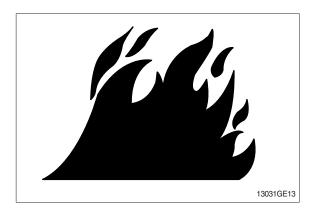
Fill fuel tank outdoors.



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

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

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



BEWARE OF EXHAUST FUMES

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

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

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

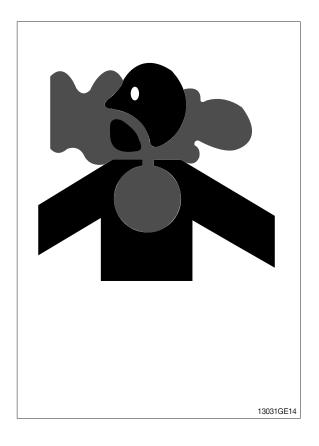
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

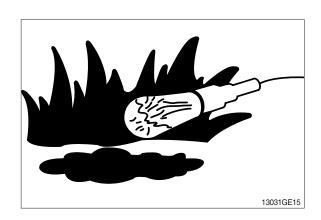
Remove paint before welding or heating:

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

ILLUMINATE 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.

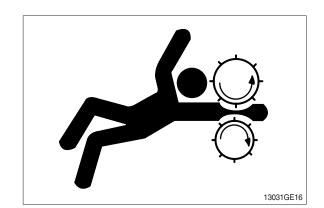




SERVICE MACHINE SAFELY

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.

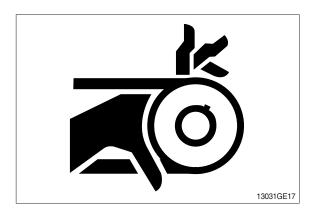
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



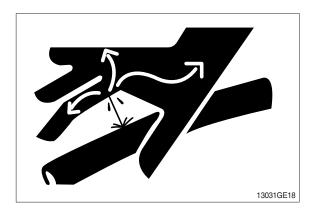
AVOID HIGH PRESSURE FLUIDS

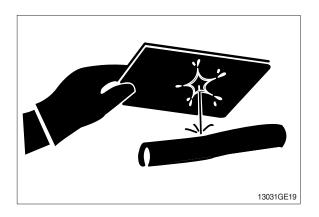
Escaping fluid under pressure can penetrate the skin causing serious injury.

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.

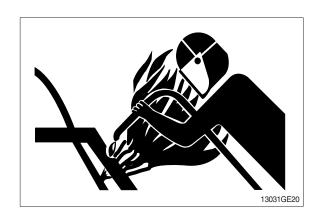




AVOID HEATING NEAR PRESSURIZED FLUID LINES

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.

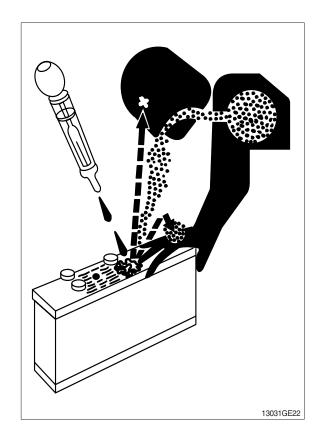
USE TOOLS PROPERLY

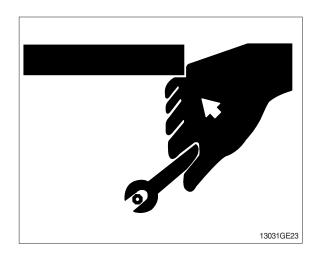
Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

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.)



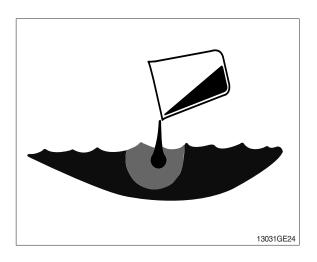


DISPOSE OF FLUIDS PROPERLY

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.

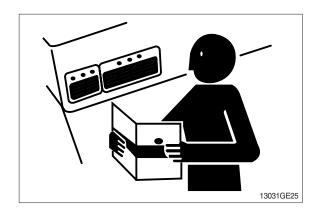
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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.

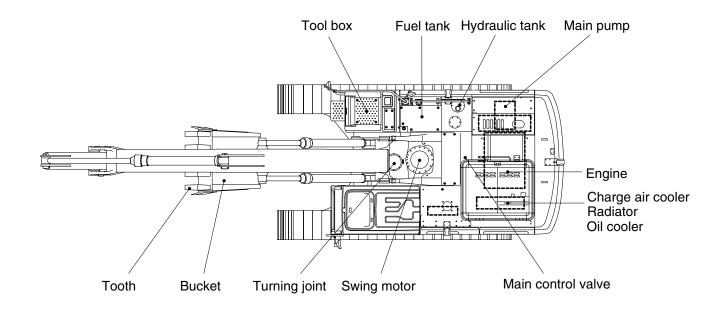


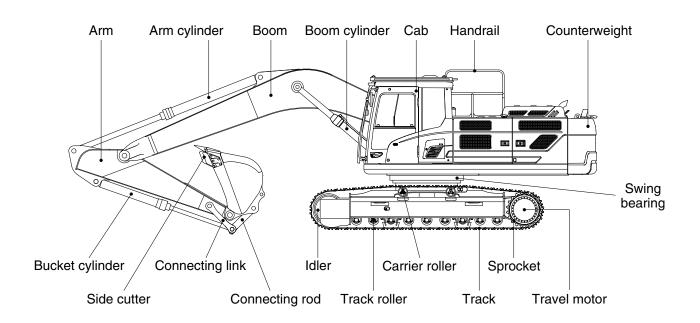
LIVE WITH SAFETY

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

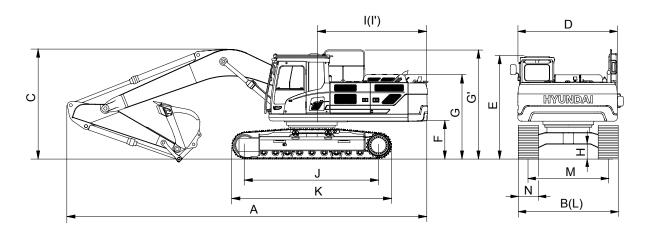




2. SPECIFICATIONS

1) HX360L

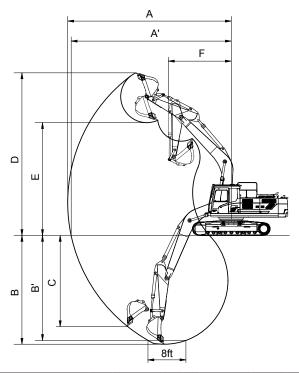
$6.45\,\mathrm{m}$ (21' 2") boom and 2.65m (8'8") arm



Description		Unit	Specification
Operating weight		kg (lb)	36070 (79521)
Bucket capacity (SAE heaped), standard		m³ (yd³)	1.44 (1.88)
Overall length	Α		11400 (37' 4")
Overall width, with 600 mm shoe	В		3230 (10' 9")
Overall height of boom	С		3360 (11' 0")
Superstructure width	D		2980 (9' 9")
Overall height of cab	Е		3190 (10' 4")
Ground clearance of counterweight	F		1250 (3' 11")
Overall height of engine hood	G		2672 (8' 9")
Overall height of handrail	G'	mm (ft in)	3350 (11' 0")
Minimum ground clearance	Н	mm (ft-in)	530 (1' 8")
Rear-end distance	I		3510 (11' 6")
Rear-end swing radius	l'		3570 (11' 9")
Distance between tumblers	J		4030 (13' 3")
Undercarriage length	K		4940 (16' 2")
Undercarriage width	L		3280 (10' 9")
Track gauge	М		2590 (8' 5")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.6/6.4 (2.11/3.98)
Swing speed		rpm	11.2
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm²(psi)	0.64 (9.03)
Max traction force		kg (lb)	32500 (71650)

3. WORKING RANGE

1) HX360L



Description		6.45 m (21' 2") Boom					
Description		2.2 m (7' 3") Arm	2.65 m (8' 8") Arm	3.2 m (10' 6") Arm			
Max digging reach	Α	10330 mm (33'11")	10730mm (35' 2")	11150 mm (36' 7")			
Max digging reach on ground	A'	10120 mm (33' 2")	10520mm (34' 6")	10950 mm (35'11")			
Max digging depth	В	6360 mm (20'10")	6830 mm (22' 5")	7360 mm (24' 2")			
Max digging depth (8ft level)	B'	6170 mm (20' 3")	6680 mm (21' 10")	7200 mm (23' 7")			
Max vertical wall digging depth	С	5970 mm (19' 7")	5050 mm (16' 7")	6330 mm (20' 9")			
Max digging height	D	10260 mm (33' 8")	10120 mm (33' 2")	10360 mm (34' 0")			
Max dumping height	Е	7060 mm (23' 2")	7040 mm (23'1")	7260 mm (23'10")			
Min swing radius	F	4630 mm (15' 2")	4740 mm (15' 7")	4360 mm (14' 4")			
	SAE	186.3 [203.3] kN	186.3 [203.3] kN	188.3 [205.5] kN			
		19000 [20730] kgf	19000 [20730] kgf	19200 [20950] kgf			
Bucket digging force		41890 [45700] lbf	41890 [45700] lbf	42330 [46190] lbf			
Bucket diggling lorce		214.8 [234.3] kN	214.8 [234.3] kN	216.7 [236.4] kN			
	ISO	21900 [23890] kgf	21900 [23890] kgf	22100 [24110] kgf			
		48280 [52670] lbf	48280 [52670] lbf	48720 [53150] lbf			
		195.2 [212.9] kN	156.9[171.2] kN	140.2 [153.0] kN			
	SAE	19900 [21710] kgf	16000 [17480] kgf	14300 [15600] kgf			
Arm crowd force		43870 [47860] lbf	35270 [38480] lbf	31530 [34390] lbf			
Aiiii Giowa iorce		205.0 [223.6] kN	162.8 [177.6] kN	145.1 [158.4] kN			
	ISO	20900 [22800] kgf	16600 [18080] kgf	14800 [16150] kgf			
		46080 [50270] lbf	36600[39930] lbf	32630 [35600] lbf			

[]: Power boost

4. WEIGHT

1) HX360L

House	HX360	OL .
Item	kg	lb
Upperstructure assembly	10714.71	23621.89
Main frame weld assembly	2919.22	6435.77
Engine assembly	730	1609.37
Main pump assembly	201	443
Main control valve assembly	220	485
Swing motor assembly	370	820
Hydraulic oil tank assembly	300	661
Fuel tank assembly	350	772
Counterweight	6000	13230
Cab assembly	515	1135.38
Radiator assy	230	510
Oil cooler assy	80	180
Lower chassis assembly	8917.23	19659.12
Track frame weld assembly	4951.13	10915.37
Swing bearing	468	1031.76
Travel motor assembly	380	837.75
Turning joint	53	116.85
Tension cylinder	225	496
Idler	261	575.4
Sprocket	83	183
Carrier roller	79.50	175.26
Track roller	40	88.18
Track-chain assembly (600 mm standard triple grouser shoe)	2196	4841.35
Front attachment assembly (6.45 m boom, 2.65 m arm	2879.52	6348.25
6.45 m boom assembly	272.68	601.15
2.65 m arm assembly	1219.68	2688.9
1.44 m³ SAE heaped bucket	1230	2710
Boom cylinder assembly	314.10	692.47
Arm cylinder assembly	434.70	958.34
Bucket cylinder assembly	266.3	587.09
Bucket control linkage assembly	372.06	820.25

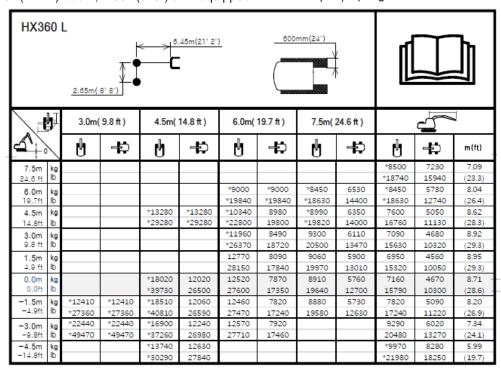
5. LIFTING CAPACITIES

- 1) 6.45m(21' 2") boom, 2.2m(7' 3") arm equipped with 2.10m³(SAE heaped) bucket and 600mm (24") triple grouser shoe.
 - Rating over-front Rating over-side or 360 degree

			Load radius								At max. reach		
Load point		3.0m	(10ft)	4.5m(15ft)		6.0m(20ft)		7.5m(25ft)		Capacity		Reach	
heigh	ıt	ľ		ď		ľ		Ů		ľ		m(ft)	
7.5m (25ft)	kg Ib									*6140 *13540	4950 10910	7.99 (26.2)	
6.0m (20ft)	kg Ib					*7290 *16070	*7290 *16070	*6760 *14900	5430 11970	*6200 *13670	3890 8580	8.87 (29.1)	
4.5m (15ft)	kg Ib			*11110 *24490	*11110 *24490	*8480 *18700	7790 17170	*7260 *16010	5230 11530	5520 12170	3340 7360	9.39 (30.8)	
3.0m (10ft)	kg l b					*9930 *21890	7200 15870	*7980 *17590	4960 10930	5180 11420	3080 6790	9.61 (31.5)	
1.5m (5ft)	kg Ib					*11150 *24580	6730 14840	7770 17130	4700 10360	5140 11330	3040 6700	9.56 (31.4)	
Ground Line	kg l b			*16550 *36490	10200 22490	10940 24120	6460 14240	7590 16730	4530 9990	5420 11950	3210 7080	9.23 (30.3)	
-1.5m (-5ft)	kg Ib			*16000 *35270	10250 22600	10870 23960	6400 14110	7540 16620	4490 9900	6150 13560	3680 8110	8.59 (28.2)	
-3.0m (-10ft)	kg Ib	*19750 *43540	*19750 *43540	*14600 *32190	10480 23100	*10920 *24070	6510 14350			*7140 *15740	4750 10470	7.54 (24.7)	
-4.5m (-15ft)	kg l b	*15770 *34770	*15770 *34770	*11820 *26060	10940 24120								

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) 6.45m(21' 2") boom, 2.65m(8' 8") arm equipped and 600mm(24") triple grouser shoe.

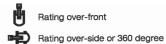


Note

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- 3. The load point is a hook located on the back of the bucket.
- 4. *indicates load limited by hydraulic capacity.

Boom : 6.45m (21' 2") Arm : 3.2 m (10' 8") Bucket : 2.1 m³ SAE heaped

Shoe 600mm Triple Grouser with 6.6 ton CWT



			Load radius											At max. reach		ach
Load po		1.5m	(5.0ft)	3.0m(15.0ft)		4.5m(4.5m(15.0ft)		6.0m(20.0ft)		7.5m(25.0ft)		30.0ft)	Capa	acity	Reach
(m/ft)		Ů	卓	U	中	Ů	中	Ü	中	U	丰	U	中	Ů	中	m (ft)
7.5 m	kg									*4880	*4880			*5500	1360	9.06
25.0 ft	lb										*10760			*12130	9610	(29.7)
6.0 m	kg									*6000	*6110			5730	3630	9.84
20.0 ft	lb										*13470			12630	8000	(32.3)
4.5 m	kg							*7490	*7490	*6640	5860	*5070	4150	5180	3220	10.31
15.0 ft	lb							*16510	*16510	*14640	12920	*11180	9140	11410	7100	(33.8)
3.0 m	kġ					*12430	12610	*9090	7980	*7490	5540	6350	4000	4910	3010	10.52
10.0 ft	lb					*27400	27800	*20040	17600	*16510	12210	14000	8810	10820	6630	(34.5)
1.5 m	kg					*15210	11540	*10610	7440	8360	5230	6180	3840	4860	2960	10.48
5.0 ft	lb					*33530	25440	23390	16400	18440	11530	13620	8470	10710	6520	(34.4)
Ground	kg			*9720	*9720	*16620	11010	11630	7070	8100	5010	6050	3710	5030	3060	10.19
Line	lb			*21430	*21430	*36640	24270	25630	15590	17860	11040	13340	8170	11080	6740	(33.4)
-1.5 m	kg	*10800	*10800	*13710	*13710	*16830	10870	11430	6890	7970	4880			5500	3380	9.63
-5.0 ft	lb	*23810	*23810	*30230	*30230	*37100	23970	25190	15190	17570	10760			12120	7450	(31.6)
-3.0 m	kg	*14530	*14530	*18410	*18410	*16100	10940	11420	6890	7970	4890			6480	4040	8.74
-10.0 ft	lb	*32030	*32030	*40590	*40590	*35490	24120	25170	15190	17570	10780			14290	8910	(28.7)
-4.5 m	kg			*20220	*20220	*14270	11220	10560	7070	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				*6880	5490	7.37
-15.0 ft	lb			*44580	*44580	*31460	24730	23280	15590					*15170	12100	(24.2)
-6.0 m	kg					*10450	10450									6.58
-20.0 ft	lb					*23040	23040									(21.6)

NOTES:

- 1. Lifting Capacity are based on SAE J1097, 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 (standard equipment) located on the back of the bucket.

4. (*) Indicates load limited by hydraulic capacity.

Boom : 6.45m (21' 2")
Arm : 3.2 m (10' 8")
Bucket : 1.44 m³ SAE heaped
Shoe 600mm Triple Grouser with 6.6 ton CWT



Rating over-front

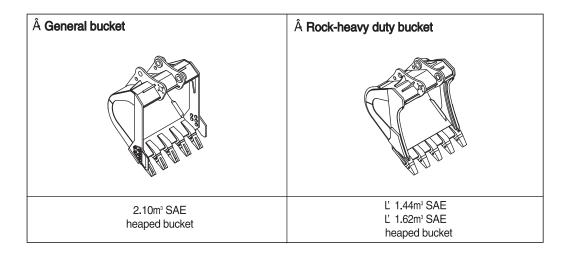
Rating over-side or 360 degree

			Load radius											At max. reach		ach
Load point height		1.5m	(5.0ft)	3.0m(15.0ft)		4.5m(4.5m(15.0ft)		6.0m(20.0ft)		7.5m(25.0ft)		30.0ft)	Capa	acity	Reach
(m/ft)		U	卓	Ů	卓	B	中	U	中	U	中	₽	中	U	中	m (ft)
7.5 m	kg									*4880	*4880			*5500	1360	9.06
25.0 ft	lb										*10760			*12130	9610	(29.7)
6.0 m	kg									*6000	*6110			5730	3630	9.84
20.0 ft	lb												***************************************	12630	8000	(32.3)
4.5 m	kg							*7490	*7490	*6640	5860	*5070	4150	5180	3220	10.31
15.0 ft	lb							*16510	*16510	*14640	12920	*11180	9140	11410	7100	(33.8)
3.0 m	kg					*12430	12610	*9090	7980	*7490	5540	6350	4000	4910	3010	10.52
10.0 ft	lb					*27400	27800	*20040	17600	*16510	12210	14000	8810	10820	6630	(34.5)
1.5 m	kg					*15210	11540	*10610	7440	8360	5230	6180	3840	4860	2960	10.48
5.0 ft	lb					*33530	25440	23390	16400	18440	11530	13620	8470	10710	6520	(34.4)
Ground	kg			*9720	*9720	*16620	11010	11630	7070	8100	5010	6050	3710	5030	3060	10.19
Line	lb			*21430	*21430	*36640	24270	25630	15590	17860	11040	13340	8170	11080	6740	(33.4)
-1.5 m	kg	*10800	*10800	*13710	*13710	*16830	10870	11430	6890	7970	4880			5500	3380	9.63
-5.0 ft	lb	*23810	*23810	*30230	*30230	*37100	23970	25190	15190	17570	10760			12120	7450	(31.6)
-3.0 m	kg	*14530	*14530	*18410	*18410	*16100	10940	11420	6890	7970	4890			6480	4040	8.74
-10.0 ft	lb	*32030	*32030	*40590	*40590	*35490	24120	25170	15190	17570	10780			14290	8910	(28.7)
-4.5 m	kg			*20220	*20220	*14270	11220	10560	7070					*6880	5490	7.37
-15.0 ft	lb			*44580	*44580	*31460	24730	23280	15590					*15170	12100	(24.2)
-6.0 m	kg					*10450	10450									6.58
-20.0 ft	lb					*23040	23040									(21.6)

NOTES:

- Lifting Capacity are based on SAE J1097, ISO 10567.
 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.
 The load point is a hook (standard equipment) located on the back of the bucket.
- 4. (*) Indicates load limited by hydraulic capacity.

6. BUCKET SELECTION GUIDE



Сара	Capacity		Width		6.45m (21' 2") boom					
SAE heaped	CECE heaped	Without side cutter	With side cutter	Weight	2.2m (7' 3") arm	2.65m (8' 8") arm	3.2m(10' 6") arm			
2.10m³ (2.75yd³)	1.90m³ (2.49yd³)	1710mm (67.3")	1830mm (72.0")	1505kg (3320lb)						
L' 1.44m³ (1.88yd³)	1.25m³ (1.64yd³)	1290mm (50.8")	-	1510kg (3330lb)						
Ľ 1.62m³ (2.12yd³)	1.43m³ (1.87yd³)	1590mm (62.6")	-	1540kg (3400lb)						

L': Rock - Heavy duty bucket

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

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

Applicable for materials with density of 1100kgf/m³ (1850lbf/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	Shape	s							
	Shoe width	mm (in)	600 (24)	700 (28)	800 (32)				
HASEU	Operating weight	kg (lb)	36070 (79521)	42081 (92774)	48093 (106026)				
HX360L	Ground pressure	kgf/cm² (psi)	0.64 (9.03)	0.55 (7.88)	0.49 (6.97)				
	Overall width	mm (ft-in)	3280 (10' 9")	3380 (11' 1")	3480 (11' 5")				

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2EA
Track rollers	8EA
Track shoes	48EA

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	A
700 mm triple grouser	Option	В
800 mm triple grouser	Option	С

X 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 or a wide range of general civil engineering work
В	Normal soil, soft ground	 These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees Travel at high speed only on flat ground Travel slowly at low speed if it is impossible to avoid going over obstacles
С	Extremely soft gound (swampy ground)	 Use the shoes only in the conditions that the machine sinks and it is impossible to use the shoes of category A or B These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees Travel at high speed only on flat ground Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE-1

Item	Specification	
Model	HD Hyundai HM8.3	
Туре	4-cycle turbocharged charger air cooled diesel engine	
Cooling method	Water cooling	
Number of cylinders and arrangement	6 cylinders, in-line	
Firing order	1-5-3-6-2-4	
Combustion chamber type	Direct injection type	
Cylinder bore × stroke	114 × 134.9 mm (4.49" × 5.31")	
Piston displacement	8290 cc (506 cu in)	
Compression ratio	18:1	
Rated net horse power (SAE J1349)	245 Hp (183 kW) at 2200 rpm	
Rated gross horse power (SAE J1995)	250 Hp (186 kW) at 2200 rpm	
Maximum torque	124 kgf · m (899 lbf · ft) at 1300 rpm	
Engine oil quantity	26.5 ℓ (7.0 U.S. gal)	
Wet weight	617 kg (1360 lb)	
High idling speed	2457+50 rpm	
Low idling speed	$850\pm100~\mathrm{rpm}$	
Rated fuel consumption	151 g/Hp · hr at 1400 rpm	
Starting motor	24V-7.2 kW	
Alternator	24V 90A	
Battery	2×12V×160Ah	

1) ENGINE -2

Item	Specification	
Model	HD Hyundai Construction Equipment / HM8.3	
Туре	4-cycle, turbocharged, charger air cooled, mechanical controlled diesel engine	
Cooling method	Water cooled	
Number of cylinders and arrangement	6 cylinders, in-line	
Firing order	1-5-3-6-2-4	
Combustion chamber type	Direct injection type	
Cylinder bore × stroke	114 $ imes$ 135 mm (4.49" $ imes$ 5.31")	
Piston displacement	8.3 ℓ (506 cu in)	
Compression ratio	18:1	
Gross power	260 Hp (194 kW) at 2200 rpm	
Net power	255 Hp (190 kW) at 2200 rpm	
Max. power	261 Hp (195 kW) at 2200 rpm	
Maximum torque	1150 N·m (848 lbf·ft) at 1300 rpm	
Engine oil quantity	26.5 ℓ (7.0 U.S. gal)	
Wet weight	604 kg (1332 lb)	
Starting motor	24 V-7.5 kW	
Alternator	24 V-90A	

2) MAIN PUMP

Item	Specification	
Type Variable displacement tandem axis piston pump		
Capacity	2 × 175 cc/rev	
Rated oil flow $2 \times 306 \ell$ /min (80.8 U.S. gpm / 67.3 U.K. gpm)		
Rated speed	1750 rpm	

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	26.3 ℓ /min (6.9 U.S. gpm/5.8 U.K. gpm)	

4) MAIN CONTROL VALVE

Item	Specification	
Type 10 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	Axial piston motor	
Capacity	156.9 cc/rev	
Relief pressure	300 kgf/cm² (4270 psi)	
Braking system	Automatic, spring applied hydraulic released	
Braking torque	84.4 kgf · m (610 lbf · ft)	
Brake release pressure	36.5 kgf/cm² (519 psi)	
Reduction gear type	2 - stage planetary	

6) TRAVEL MOTOR

Item	Specification	
Туре	Variable displacement axial piston motor	
Relief pressure	350 kgf/cm² (4980 psi)	
Capacity (max / min)	282.6/156.9 cc/rev	
Reduction gear type	2-stage planetary	
Braking system	Automatic, spring applied hydraulic released	
Brake release pressure	17 kgf/cm² (242 psi)	
Braking torque	134 kgf · m (969 lbf · ft)	

7) CYLINDER

Item		Specification	
Poom outlindor	Bore dia \times Rod dia \times Stroke	Ø150ר105×1480 mm	
Boom cylinder	Cushion	Extend only	
Arm cylinder	Bore dia \times Rod dia \times Stroke	Ø160ר110×1685 mm	
	Cushion	Extend and retract	
Bucket cylinder	Bore dia \times Rod dia \times Stroke	Ø140 × Ø100 × 1285 mm	
	Cushion	Extend only	

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

8) SHOE

Iten	า	Width	Ground pressure	Link quantity	Overall width
	Standard	☆ 600 mm (24")	0.64 kgf/cm² (9.03 psi)	48	3280 mm (10' 9")
HX360L Option	Ontion	☆ 700 mm (28")	0.55 kgf/cm² (7.88 psi)	48	3380 mm (11' 1")
	Ориоп	☆ 800 mm (32")	0.49 kgf/cm² (6.97 psi)	48	3480 mm (11' 5")

 $[\]stackrel{\wedge}{
ightharpoons}$: Triple grouser

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

SECTION 2 STRUCTURE AND FUNCTION

Group	1 Pump Device ·····	2-1
Group	2 Main Control Valve	2-22
Group	3 Swing Device ·····	2-58
Group	4 Travel Device ·····	2-69
Group	5 RCV Lever ·····	2-83
Group	6 RCV Pedal ·····	2-90

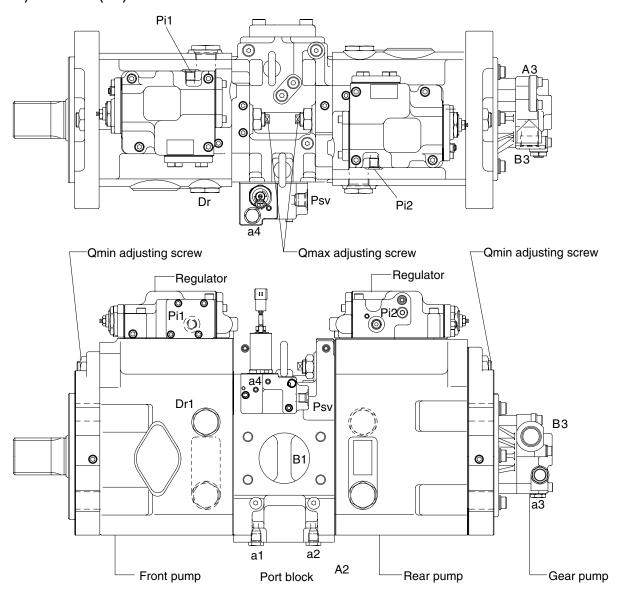
SECTION 2 STRUCTURE AND FUNCTION

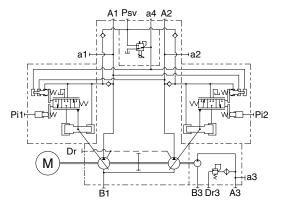
GROUP 1 PUMP DEVICE

1. STRUCTURE

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

1) OUTLINE (1/2) - WITHOUT PTO TYPE

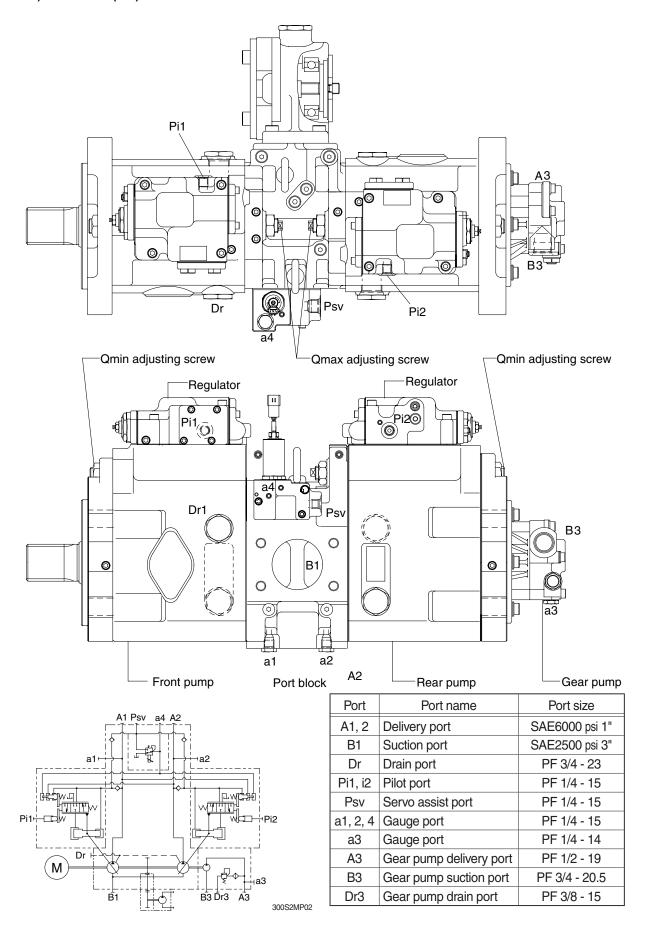




Port	Port name	Port size
A1, 2	Delivery port	SAE6000 psi 1"
B1	Suction port	SAE2500 psi 3"
Dr	Drain port	PF 3/4 - 23
Pi1, i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1, 2, 4	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4 - 14
A3	Gear pump delivery port	PF 1/2 - 19
В3	Gear pump suction port	PF 3/4 - 20.5
Dr3	Gear pump drain port	PF 3/8 - 15

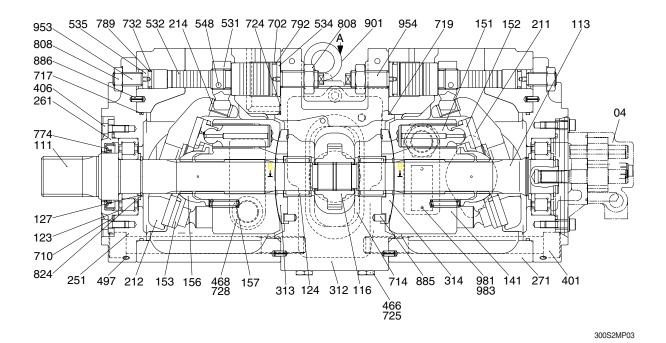
300S2MP01

2) OUTLINE (2/2) - WITH PTO TYPE



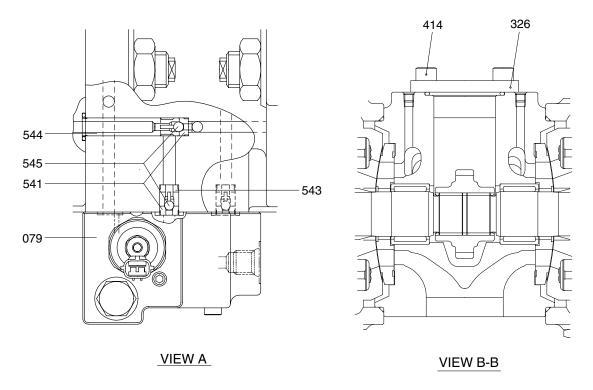
2) MAIN PUMP (1/3)

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



Gear pump 313 Valve plate (R) 717 O-ring 04 111 Drive shaft (F) 314 Valve plate (L) 719 O-ring 113 Drive shaft (R) 723 O-ring 401 Hexagon socket bolt 406 Hexagon socket bolt 724 Square ring 114 1st gear 123 Roller bearing 465 ROH plug 725 O-ring 466 VP plug 728 O-ring 124 Needle bearing 468 VP plug 127 Bearing spacer 732 O-ring 141 Cylinder block 497 MH plug 774 Oil seal 151 Piston 531 Tilting pin 789 Back up ring 152 Shoe 532 Servo piston 792 Back up ring 153 Set plate 534 Stopper (L) 806 Hexagon head nut 156 Spherical bushing 535 Stopper (S) 808 Hexagon head nut 157 Cylinder spring 541 Seat 824 Snap ring 543 Stopper 1 211 Shoe plate 885 Valve plate pin 212 Swash plate 544 Stopper 2 886 Spring pin 214 Tilting bushing 545 Steel ball 901 Eye bolt 548 Feedback pin 251 Swash plate support 953 Set screw 954 Set screw 261 Seal cover (F) 702 O-ring 271 Pump casing 710 O-ring 312 Valve block 714 O-ring

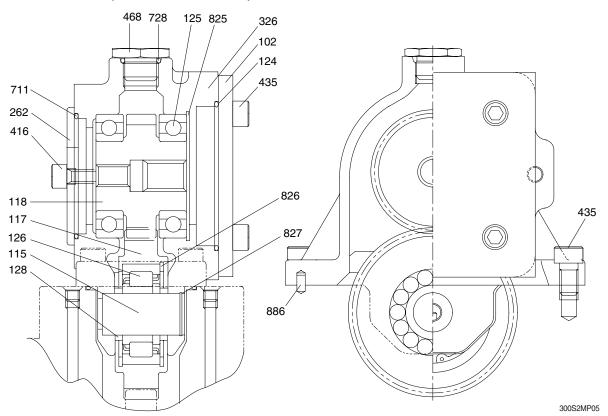
MAIN PUMP (2/3)



300S2MP04

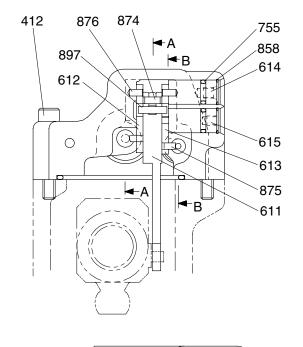
079	Proportional reducing valve	541	Seat	544	Stopper 2
326	Cover	543	Stopper 1	545	Steel ball
414	Hexagon socket bolt				

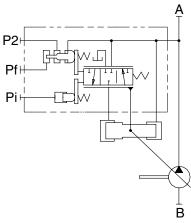
MAIN PUMP (3/3, WITH PTO TYPE)



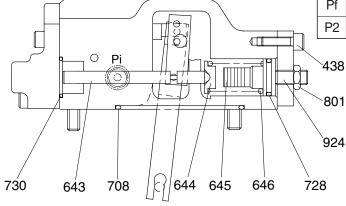
102	Cover	262	Cover	724	O-ring
115	Idler shaft	326	Gear case	728	O-ring
117	2nd gear	414	Hex socket screw	825	Retainer ring
118	3rd gear	435	Hex socket screw	826	Retainer ring
125	Ball bearing	468	Plug	885	Spring pin
126	Roller bearing	711	O-ring	886	Pin
128	Bearing spacer				

2) REGULATOR (1/2)

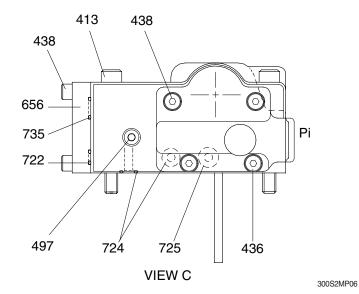




Port	Port name	Port size
Α	Delivery port	SAE 6000 PSI 1"
В	Suction port	SAE 2500 PSI 3"
Pi	Pilot port	PF 1/4-15
Pf	Power shift pressure	-
P2	Companion delivery pressure	-

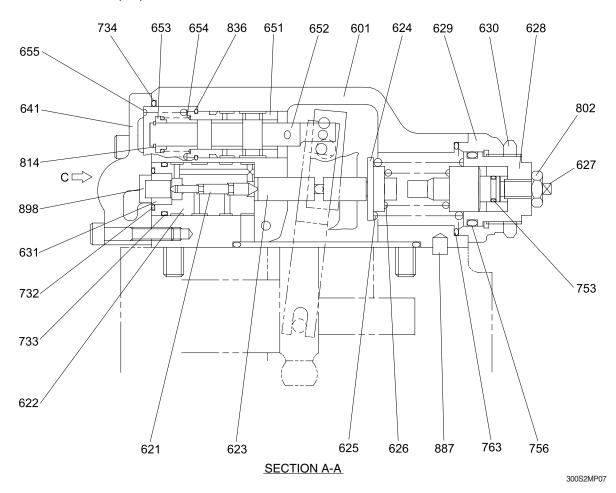


SECTION B-B



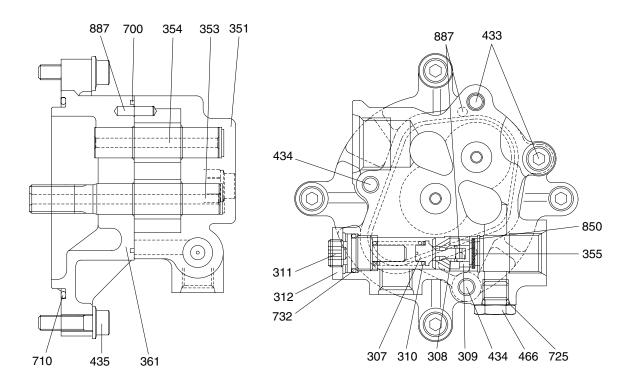
- 412 Hexagon socket screw
- 413 Hexagon socket screw
- 436 Hexagon socket screw
- 438 Hexagon socket screw
- 497 Plug
- 611 Feed back lever
- 612 Lever (1)
- 613 Lever (2)
- 614 Fulcrum plug
- 615 Adjust plug
- 643 Pilot piston
- 644 Spring seat (Q)
- 645 Adjust stem (Q)
- 646 Pilot spring
- 656 Block cover
- 708 O-ring
- 722 O-ring
- 724 O-ring
- 725 O-ring
- 728 O-ring
- 730 O-ring
- 735 O-ring
- 755 O-ring
- 801 Nut
- 858 Snap ring
- 874 Pin
- 875 Pin
- 876 Pin
- 897 Pin
- 924 Set screw

REGULATOR (2/2)



601	Casing	630	Lock nut	734	O-ring
621	Compensator piston	631	Sleeve, pf	753	O-ring
622	Piston case	641	Pilot cover	756	O-ring
623	Compensator rod	651	Sleeve	763	O-ring
624	Spring seat (C)	652	Spool	802	Nut
625	Outer spring	653	Spring seat	814	Snap ring
626	Inner spring	654	Return spring	836	Snap ring
627	Adjust stem (C)	655	Set spring	887	Pin
628	Adjust screw (C)	732	O-ring	898	Pin
629	Cover (C)	733	O-ring		

3) GEAR PUMP



300S2MP08

307	Poppet	353	Drive gear	466	Plug
308	Seat	354	Driven gear	700	Ring
309	Ring	355	Filter	710	O-ring
310	Spring	361	Front case	725	O-ring
311	Screw	433	Flange socket	732	O-ring
312	Lock 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 bush (156), and cylinder spring (157). The drive shaft is supported by bearing (123,124) at its both ends.

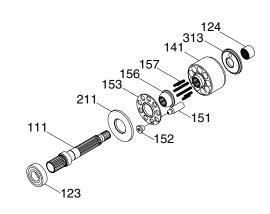
The shoe is caulked to the piston to from a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and the take hydraulic balance so that it slides lightly over the shoe plate (211). The sub group composed by a piston and a shoe is pressed against the shoe plate by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

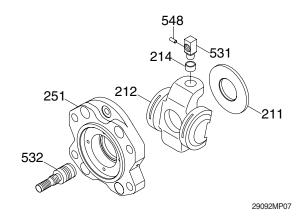
(2) Swash plate group

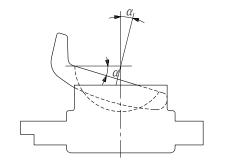
The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

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 (α)







2-7

(3) Valve block group

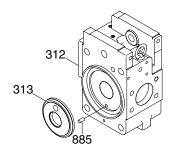
The valve block group consists of valve block (312), valve plate (313) and valve plate pin (885).

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.



29092MP08

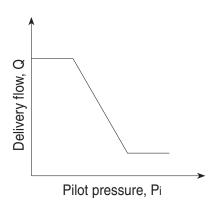
2) REGULATOR

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

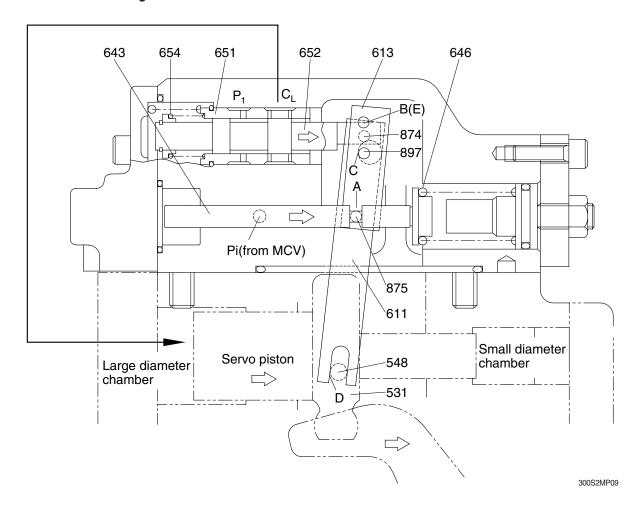
(1) Negative flow control

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.

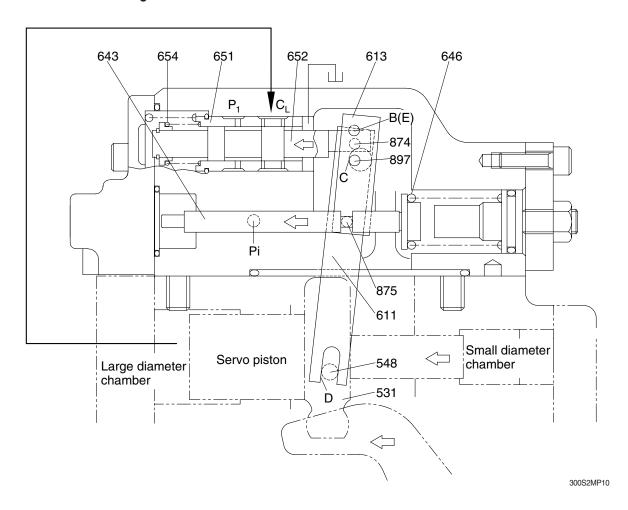
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

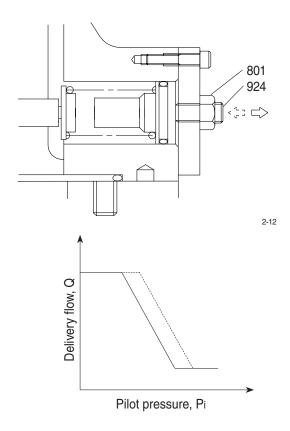
The flow control characteristic can be adjusted with the adjusting screw.

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 values are shown in table.

Speed	Adjustment of flow control characteristic			
Оросс	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount	
(min -1)	(Turn)	(kgf/cm²)	(ℓ /min)	
1800	+1/4	+1.5	+10.9	



(2) Total horsepower control

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

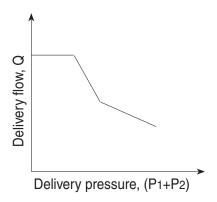
(The input horsepower is constant when the speed is constant.)

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

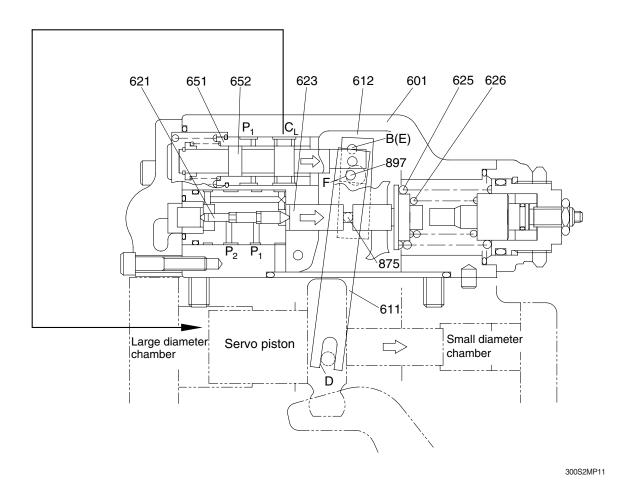
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation:

Tin = P1×q/2
$$\pi$$
 + P2×q/2 π
= (P1+P2)×q/2 π

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

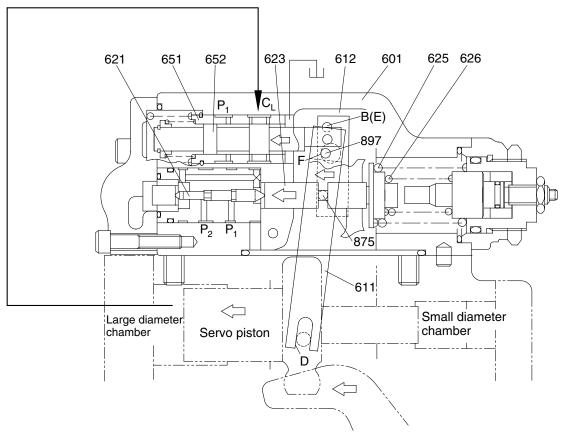


When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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



300S2MP12

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

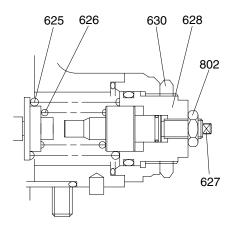
Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one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

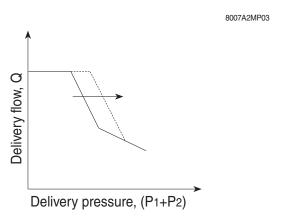
a. Adjustment of outer spring

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 by N turns changes the setting of the inner spring (626), return the adjusting screw QI (627) by N×A turns at first. (A=1.59)

Adjusting values are shown in table.

Cnood	Adjustment of outer spring				
Speed	Tightening amount of adjusting screw (C) (628)	Compensating control starting pressure change amount	Input torque change amount		
(min ⁻¹)	(Turn)	(kgf/cm²)	(kgf·m)		
1800	+1/4	+17.5	+6.1		





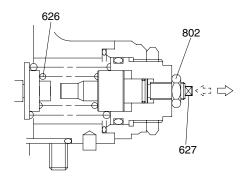
b. Adjustment of inner spring

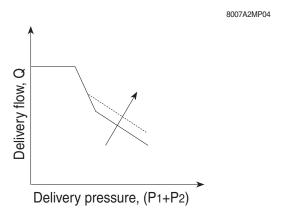
Adjust it by loosening the hexagon nut (802) and by tightening (or loosening) the adjusting screw QI (627).

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

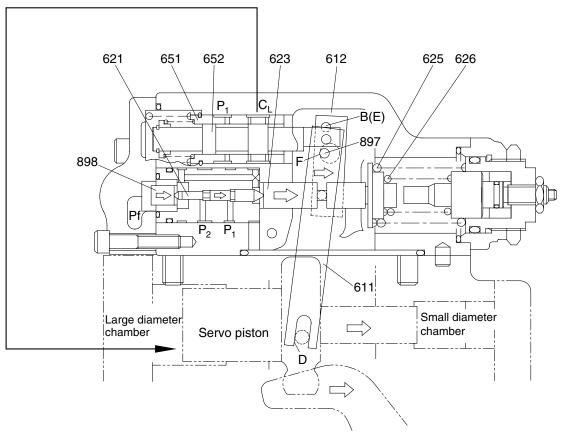
* Adjusting valves are shown in table.

Chood	Adjustment of inner spring					
Speed	Tightening amount of adjusting screw (QI) (627)	Flow change amount	Input torque change amount			
(min ⁻¹)	(Turn)	(kgf/cm²)	(kgf · m)			
1800	+1/4	+16.7	+6.6			





(3) Power shift control

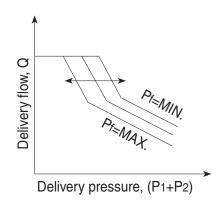


300S2MP13

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

Only one proportional pressure reducing valve is provided.

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



This function permits arbitrary setting of the

pump output power, thereby providing the optimum power level according to the operating condition.

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

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

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

(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

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

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

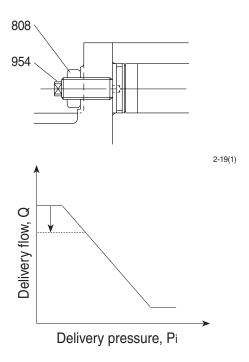
0	Adjustment of max flow				
Speed	Tightening amount of adjusting screw (954)	Flow change amount			
(min -1)	(Turn)	(½ /min)			
1800	+1/4	-6.9			

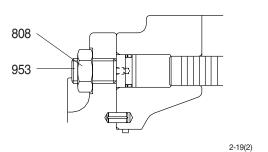
2 Adjustment of minimum flow

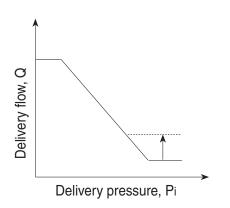
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

Casad	Adjustment of min flow					
Speed	Tightening amount of adjusting screw (953)	Flow change amount				
(min -1)	(Turn)	(ℓ /min)				
1800	+1/4	+6.9				

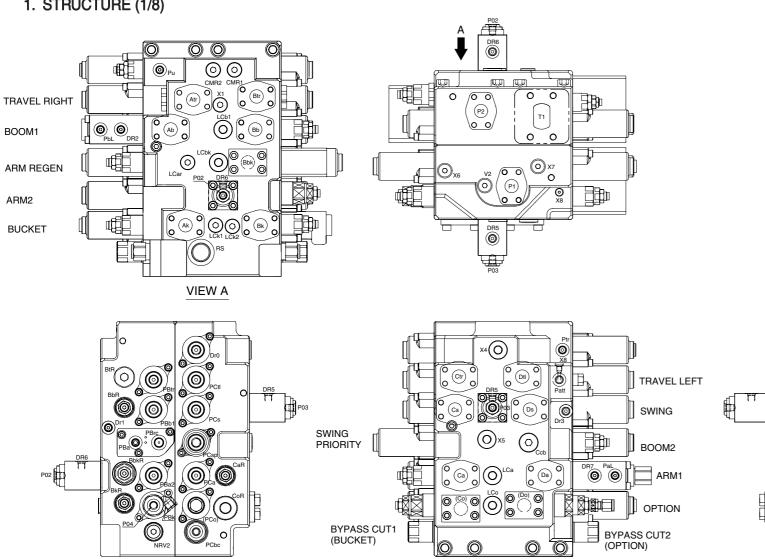


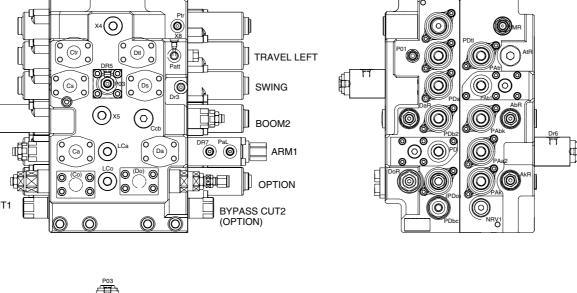


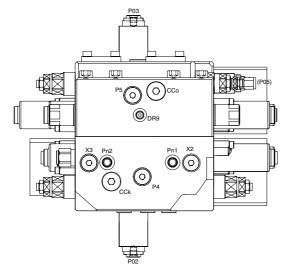


GROUP 2 MAIN CONTROL VALVE

1. STRUCTURE (1/8)

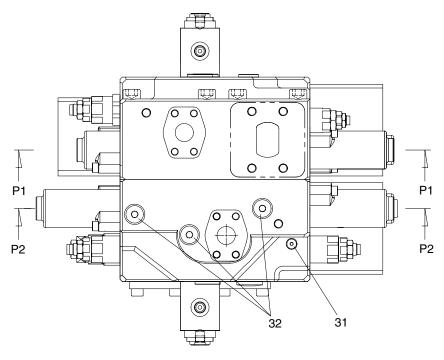




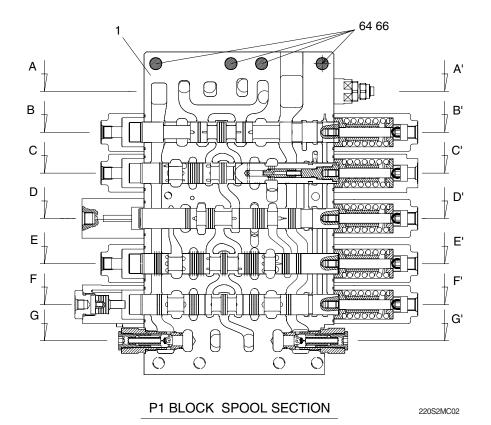


	D .		
Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	PF1	20~25 kgf · m (145~180 lbf · ft)
Patt PbL PCbc (PDbc) P01 P02 P03 P04 (P05) PaL Ptr Pu DR1 DR2 DR3 DR4 DR5 DR7	Auto idle signal-attachment Lock valve pilot port (boom) Bucket in confluence pilot port Option confluence pilot port Pilot signal port Pilot signal port Swing logic pilot port Bucket parallel orifice pilot port Option B confluence pilot port Lock valve pilot port (arm) Auto idle signal-travel Power boost Drain port	PF1/4	3.5~4.0 kgf · m (25.3~28.9 lbf · ft)
(P4) (P5)	-	PF1/2	10~12 kgf · m (72.3~86.8 lbf · ft)
PBrc PCa	Travel pilot port-RH (FW) Travel pilot port-RH (BW) Travel pilot port-LH (BW) Travel pilot port-LH (FW) Boom up pilot port Boom up confluence pilot port Boom down pilot port Swing pilot port (LH) Swing pilot port (RH) Arm in regen-cut signal selector port Arm in confluence pilot port Swing priority pilot port Option A pilot port (breaker) Arm in regeneration cut port Arm in pilot port Arm out pilot port Bucket in pilot port Bucket out pilot port Option B pilot port Option B pilot port Negative control signal port (A2 port side) Negative control signal port (A1 port side) Carry-over port	PF3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
Atr Btr Ctl Dtl Ab Bb Cs Ds Bbk Ca Da Ak Bk (Co) (Do) P1 P2	Travel motor port-LH (FW) Travel motor port-LH (BW) Travel motor port-RH (BW) Travel motor port-RH (FW) Boom up port Boom down port Swing motor port (LH) Swing motor port (RH) Option A port (breaker) Arm in port Arm out port Bucket in port Bucket out port Option B port Option B port Pump port (A2 side) Pump port (A1 side)	M10	5.0~6.5 kgf · m (36.2~47.0 lbf · ft)
T1	Return port	M12	8.0~11.0 kgf·m (57.9~79.6 lbf·ft)

STRUCTURE (2/8)

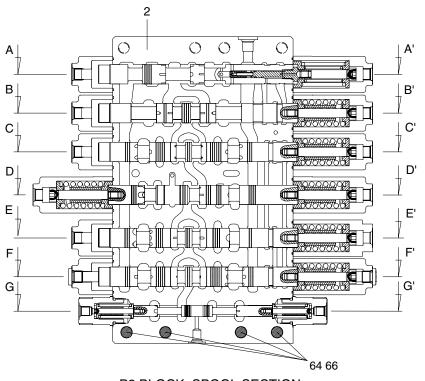


TOP VIEW

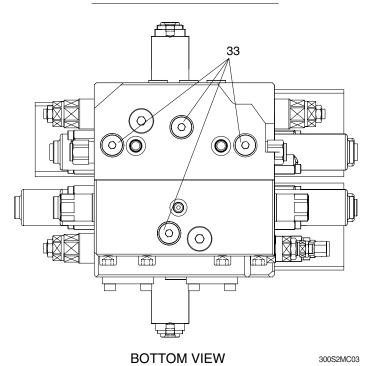


- 1 Housing P1
- 31 Plug
- 32 Plug
- 64 Hex socket head bolt
- 66 Spring washer

STRUCTURE (3/8)



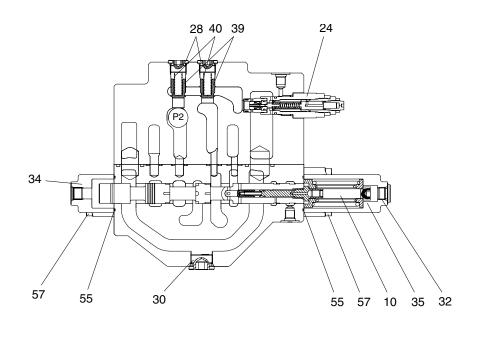
P2 BLOCK SPOOL SECTION



CONTACT FACE

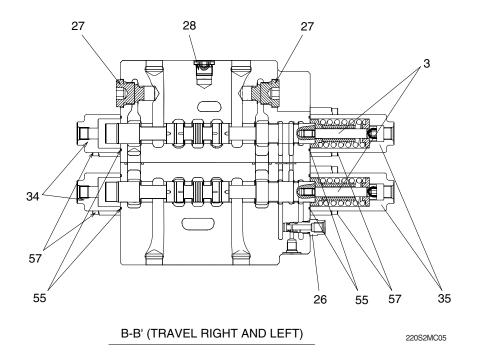
- 2 Housing 2
- 33 Plug
- 51 O-ring
- 52 O-ring
- 53 O-ring54 O-ring
- 54 O-ring56 O-ring
- 64 Hex socket head bolt
- 66 Spring washer

STRUCTURE (4/8)



A-A' (STRAIGHT TRAVEL AND SUPPLY)

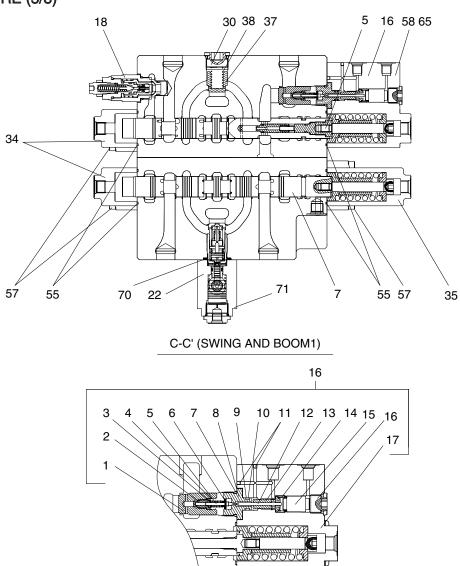
- 10 Travel straight spool kit
- 24 Main relief valve
- 28 Plug
- 30 Plug
- 32 Plug
- 34 Pilot cover A
- 35 Pilot cover B
- 39 Check valve poppet 2
- 40 Check valve spring 2
- 55 O-ring
- 57 Hex socket head bolt



- 3 Travel spool kit
- 26 Orifice signal plug
- 27 ORV plug
- 28 Plug

- 34 Pilot cover A
- 35 Pilot cover B
- 55 O-ring
- 57 Hex socket head bolt

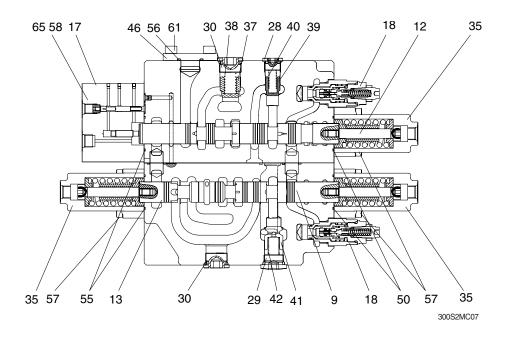
STRUCTURE (5/8)



5	Boom 1 spool kit	16-9	Back up ring	30	Plug
7	Swing spool kit	16-10	O-ring	34	Pilot cover A
16	Holding valve assy	16-11	Plug	35	Pilot cover B
16-1	Main poppet	16-12	Pilot piston	37	Check valve poppet 1
16-2	Restrictor	16-13	Piston guide	38	Check valve spring 1
16-3	Pilot spring	16-14	Spring	55	O-ring
16-4	C-ring	16-15	Main piston	57	Hex socket head bolt
16-5	Pilot poppet	16-16	Plug	58	Hex socket head bolt
16-6	Poppet guide	16-17	Block	65	Spring washer
16-7	O-ring	18	Overload relief valve	70	O-ring
16-8	Poppet seat	22	Swing logic valve	71	Hex socket head bolt

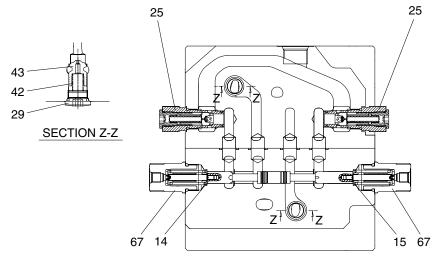
HOLDING VALVE

STRUCTURE (6/8)



D-D' (SWING PRI, BOOM 2 & ARM REGEN)

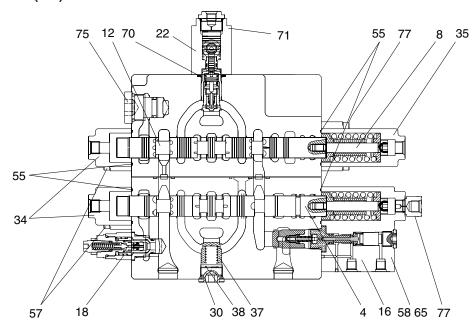
- 9 Boom 2 spool kit
- 12 Arm regen spool kit
- 13 Swing priority spool kit
- 17 Regen valve
- 18 Overload relief valve
- 28 Plug
- 29 Plug
- 30 Plug
- 35 Pilot cover B
- 37 Check valve poppet 1
- 38 Check valve spring 1
- 39 Check valve poppet 2
- 40 Check valve spring 2
- 41 Check valve poppet 3
- 42 Check valve spring 3
- 46 Flange
- 50 Gasket 3
- 55 O-ring
- 56 O-ring
- 57 Hex socket head bolt
- 58 Hex socket head bolt
- 61 Hex socket head bolt
- 65 Spring washer



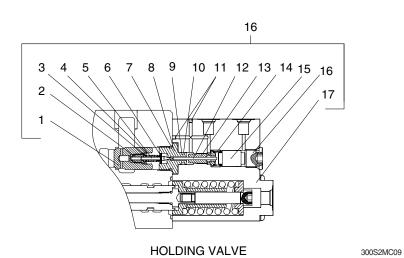
- 14 Bypass cut 1 spool kit (bucket)
- 15 Bypass cut 1 spool kit (option)
- 25 Negacon valve
- 29 Plug
- 42 Check valve spring 3
- 43 Check valve poppet 4
- 67 BC plug

G-G' (BYPASS CUT & NEGATIVE CONTROL)

STRUCTURE (7/8)

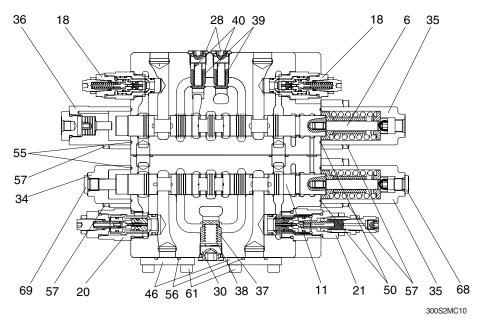


E-E' (ARM 1 & ARM 2)



4	Arm 1 spool kit	16-9	Back up ring	34	Pilot cover A
8	Arm 2 spool kit	16-10	O-ring	35	Pilot cover B
12	Arm regen spool kit	16-11	Plug	37	Check valve poppet 1
16	Holding valve assy	16-12	Pilot piston	38	Check valve spring 1
16-1	Main poppet	16-13	Piston guide	55	O-ring
16-2	Restrictor	16-14	Spring	57	Hex socket head bolt
16-3	Pilot spring	16-15	Main piston	58	Hex socket head bolt
16-4	C-ring	16-16	Plug	65	Spring washer
16-5	Pilot poppet	16-17	Block	70	O-ring
16-6	Poppet guide	18	Overload relief valve	71	Hex socket head bolt
16-7	O-ring	22	Swing logic valve	75	Plug
16-8	Poppet seat	30	Plug	77	Orifice plug

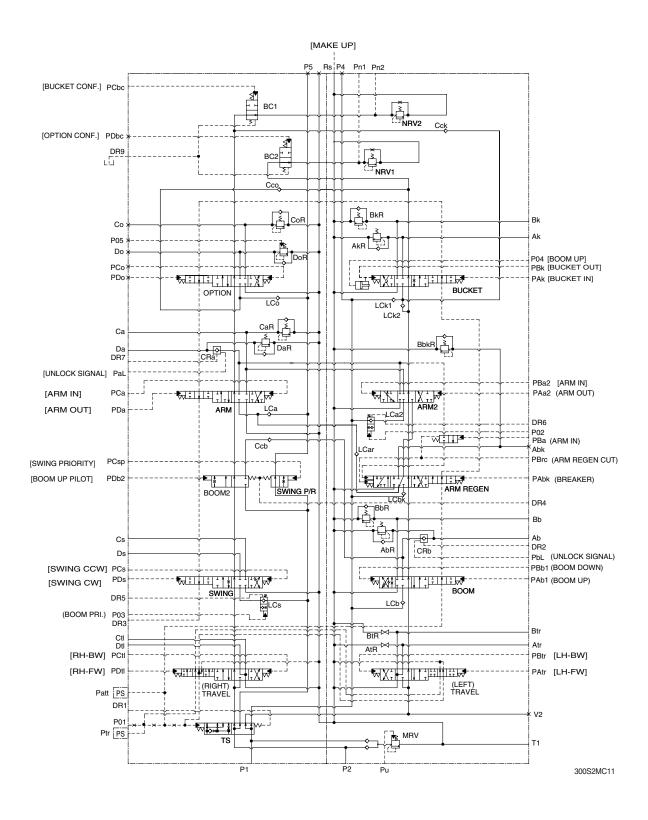
STRUCTURE (8/8)



F-F' (OPTION & BUCKET)

- 6 Bucket spool kit
- 11 Option spool kit
- 18 Overload relief valve
- 20 Overload relief valve
- 21 Overload relief valve
- 28 Plug
- 30 Plug
- 34 Pilot cover A
- 35 Pilot cover B
- 36 Pilot cover (stroke limit)
- 37 Check valve poppet 1
- 38 Check valve spring 1
- 39 Check valve poppet 2
- 40 Check valve spring 2
- 46 Flange
- 50 Gasket 3
- 55 O-ring
- 56 O-ring
- 57 Hex socket head bolt
- 61 Hex socket head bolt
- 68 Plug kit 1
- 69 Plug kit 2

2. HYDRAULIC CIRCUIT



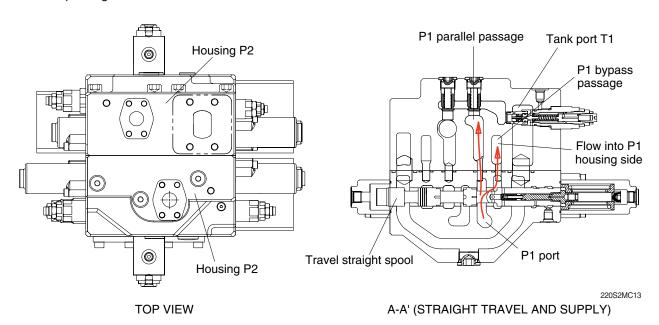
3. FUNCTION

1) CONTROL IN NEUTRAL POSITION

(1) P1 housing side

The pressurized oil discharged from hydraulic pump flows into the main control valve through the inlet port P1 and pass the land of the straight travel spool into the P1 bypass passage and P1 parallel passage.

When the straight travel spool is neutral, the P1 side bypass passage is not cut-off and the pressurized oil is directed to the tank port T1 through the bypass passage of spools (travel right -> boom 1 -> arm regeneration -> arm 2 -> bucket), the negative control valve of P1 and tank passage.



Travel right

Boom 1

Arm regen

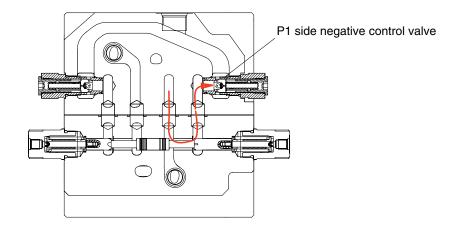
Arm 2

Bucket

P2 side negative control valve

2-31

P1 BLOCK SPOOL SECTION

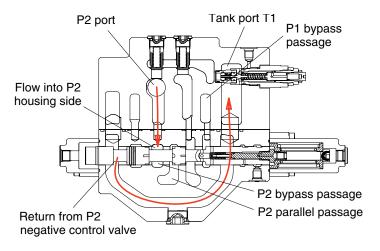


G-G' (BYPASS CUT & NEGATIVE CONTROL)

(2) P2 housing side

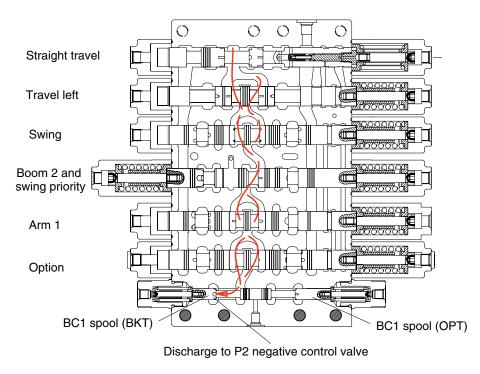
The pressurized oil discharged from hydraulic pump flows into the main control valve through the inlet port P2 and pass the land of the straight travel spool into the P2 bypass passage and P2 parallel passage.

When the straight travel spool is neutral, the P2 side bypass passage is not cut-off and the pressurized oil is directed to the tank port T1 through the bypass passage of spools (travel left -> swing -> boom 2 and swing priority -> arm 1 -> option), the negative control valve of P2 and tank passage.



A-A' (STRAIGHT TRAVEL AND SUPPLY)

220S2MC16



P2 BLOCK SPOOL SECTION

2) TRAVEL OPERATION

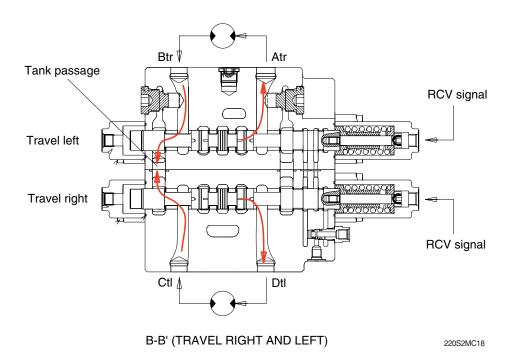
(1) Travel forward operation

During the travel forward operation, the pilot secondary pressure from the remote control valve is supplied to the spring side of pilot port and it shifts travel spools to the left direction.

The pressurized oil from the pump flows into the bypass passage of the travel spools through the land of the straight travel spool.

When the travel spools is shifted and the bypass passage is shut-off. The pressurized oil flowed into bypass passage is supplied to the travel motors through opened port Atr and Dtl.

On the other hand, the return oil from the travel motors flows into main control valve inside through the port Btr and Ctl and return to the tank passage.



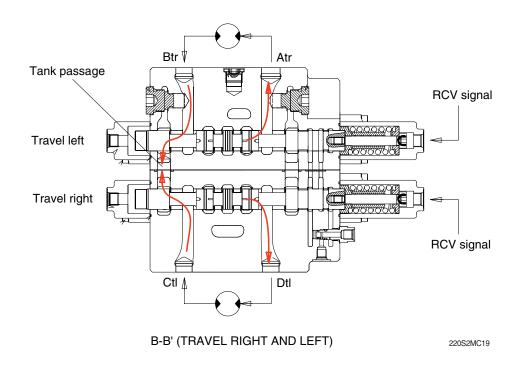
(2) Travel backward operation

During the travel backward operation, the pilot secondary pressure from the remote control valve is supplied to the against pilot port of the spring side and it shifts travel spools to the right direction.

The pressurized oil from the pump flows into the bypass passage of the travel spools through the land of the straight travel spool.

When the travel spools are shifted and the bypass passage is shut-off. The pressurized oil flowed into bypass passage is supplied to the travel motors through opened port Btr and Ctl.

On the other hand, the return oil from the travel motors flows into main control valve inside through the port Atr and Dtl and return to the tank passage.

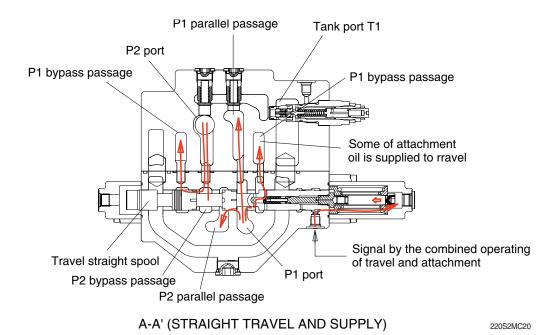


(3) Travel straight function

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

In normal conditions, travel straight spool keeps neutral conditions, the pressurized oil of the P1 and P2 pumps is supplied to each passage independently.

When the attachment spool is operated under the travel operation of both sides, the pilot pressure is supplied to the spring side port of the travel straight spool and then the travel straight spool is shifted to the left direction.



After changeover of the travel straight spool, the pressurized oil discharged from the P1 pump is connected with P2 port oil and is supplied to the attachment line through both parallel passage of the P1 and P2.

Also, some of the pressurized oil open the check valve of the spool inside through side of the travel straight spool and is connected with the bypass passage of the P2 side.

On the other hand, the pressurized oil discharged from the P2 pump is connected with P1 port oil and is supplied to the travel line through both parallel passage of the P1 and P2.

Accordingly the attachment spool is operated under the travel operation of both sides, the pressurized oil discharged from P2 pump is mainly supplied to left and right travel line and the pressurized oil discharged from P1 pump is mainly supplied to attachment line.

As a result, simultaneous operation of both travel spools and attachment is not influenced to the travel operation of the both sides and the machine keeps straight travel.

3) BOOM OPERATION

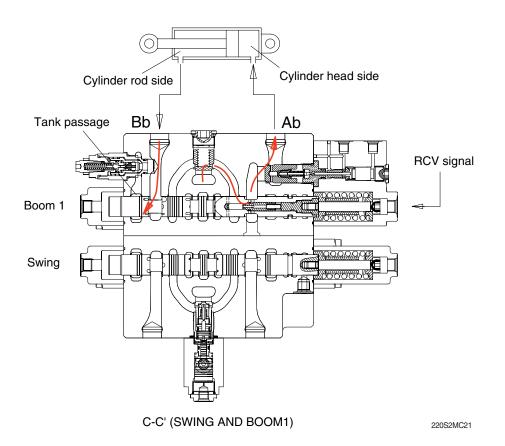
(1) Boom up operation

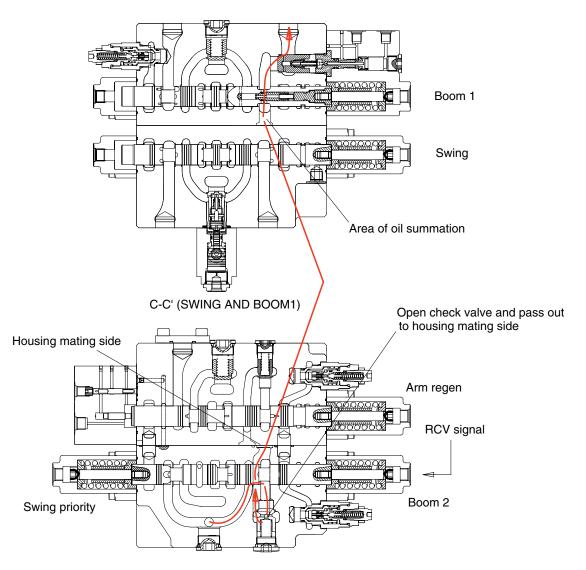
During the boom up operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the boom 1 spool to the left direction. The P1 bypass passage is shut off by the movement of the boom 1 spool and the pressurized oil from P2 port is entered P1 parallel passage and then passes through the load check valve, bridge passage and boom holding valve then flows into the head side of the boom cylinder via Ab port. (In this case, the boom holding valve is free flow condition)

At the same time, the pilot secondary pressure from RCV is supplied to the port 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 pressurized oil from P2 port entered boom summation passage via the P2 parallel passage, notch of the boom 2 spool, the check valve.

The oil from boom 2 spool combined with the boom 1 spool oil and is supplied Ab port.

At the same time, the return oil from rod side of the boom cylinders flows the boom 1 spool through the Bb port and return to the hydraulic oil tank through the tank passage.





D-D' (SWING PRI, BOOM 2 & ARM REGEN)

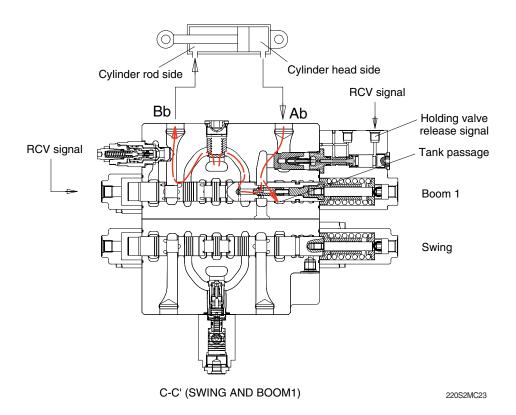
(2) Boom down operation

During the boom down operation, the pilot secondary pressure from the RCV is supplied to the against port of the spring side and shifts the boom 1 spool to the right direction. The P1 bypass passage is shut off by the movement of the boom 1 spool and the pressurized oil from P1 port is entered P1 parallel passage and then passes through the load check valve and bridge passage then flows into the rod side of the boom cylinder via Bb port.

At the same time, the return oil from head side of the boom cylinders flows the boom 1 spool through the Ab port and the boom holding valve and return to the hydraulic oil tank through the tank passage.

At this time, some of the return oil from the boom head side passes to the connected passage of the boom 1 spool inside and flows into the P1 parallel passage. (Boom spool inside regeneration function). At this time, the boom holding valve is open status and the operation principles are described following page.

During the boom down operation, the flow is not combined.



4) HOLDING VALVE OPERATION

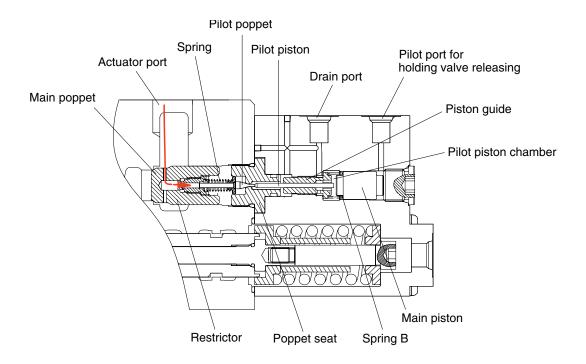
(1) Holding operation

At neutral condition, the pilot piston chamber is connected to drain port through the pilot port. And the main piston is seated by the spring B.

Also, the pressurized oil from the actuator entered to inside of the holding valve through the periphery hole of the main poppet, crevice of the main poppet and the restrictor and the periphery hole of the restrictor.

Then, this pressured oil pushed the pilot poppet to the poppet seat and the main poppet to the seat of body.

So the pressurized oil from the holding side of the actuator is not escaped and the actuator is not moved.



HOLDING VALVE BLOCK SECTION

220S2MC24

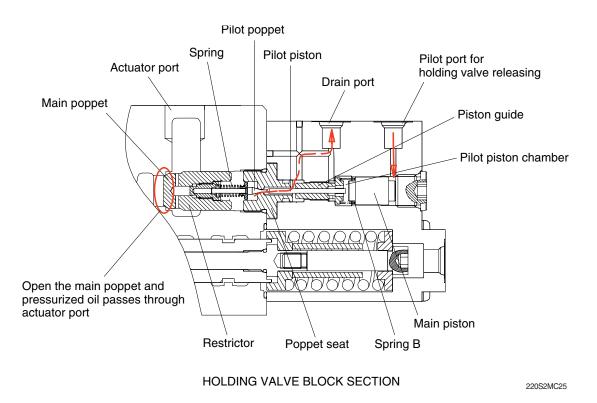
2-40

(2) Releasing holding operation

The pilot pressure is supplied to the pilot port for releasing holding valve and shifts the main piston to the left direction against the spring B and shifts the pilot poppet to the left direction through the pilot piston and open the passage for the drain.

At same time, the return oil from actuator returns to the drain port through the periphery hole of main poppet, crevice of the main poppet and the restrictor, the periphery hole of the restrictor, inside of holding valve, crevice of the pilot poppet and the drain passage of the holding valve.

After above operation, pressure of inside of holding valve is decreased and the main poppet is opened by the return oil of the actuator and the return oil from actuator returns to the tank passage through the notch of spool.



5) BUCKET OPERATION

(1) Bucket in operation

① Bucket operation only

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

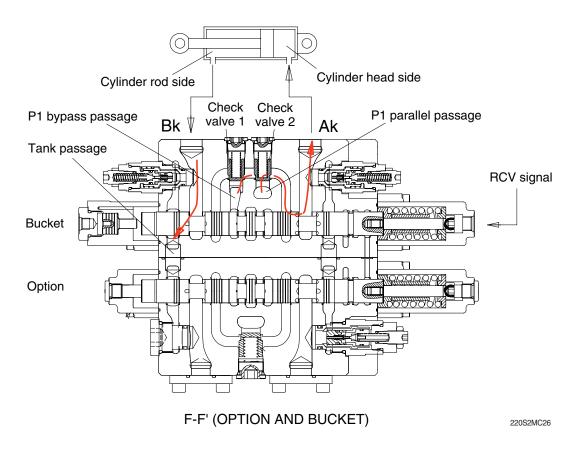
The P1 bypass passage is shut off by the movement of the bucket spool and the pressurized oil from P1 port entered P1 parallel passage and is directed to the Ak port through the check valve 2. At the same time, the pressurized oil from P1 bypass passage is directed to the AK port through the check valve 1.

The return oil from the rod side of the bucket cylinder (Bk port) returns to the hydraulic oil tank through the tank passage.

2 Combined operation

When combined operation of the bucket and other actuators, mostly same as above operation but the fluid from P1 bypass passage is empty by the upstream operation such as the arm or boom operation.

So only the fluid from P1 parallel passage is supplied to the Ak port.



(2) Bucket slow operation (incase bucket in)

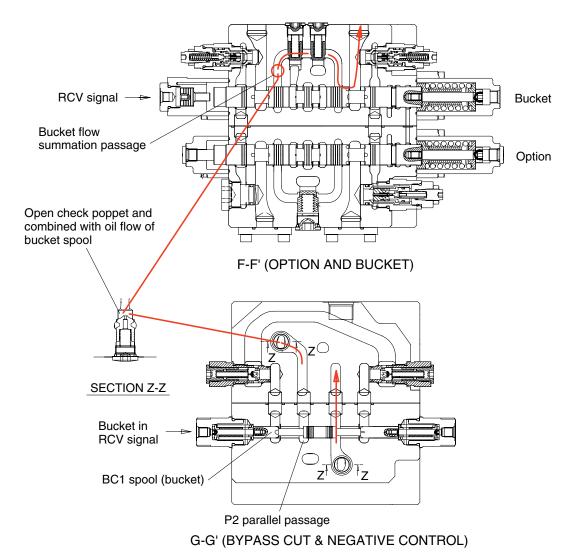
This function is used to speed up of the boom or arm by reducing the bucket speed when the bucket operation with boom or arm operation simultaneously.

The bucket slow pilot pressure is supplied the pilot port of the BC1 spool and the piston is shifted to the right and then the bucket spool stroke is limited and the oil passage from P1 to the bucket cylinder is reduced and the oil flow of the bucket spool is reduced.

Bucket flow summation function, bypass cut-off 1 spool

During the bucket in operation, the pilot secondary pressure from the RCV is supplied to port of the spring side and shifts the BC1 (bucket) spool to the right direction.

The P2 parallel passage is shut off by the movement of the BC1 spool and the pressurized oil from P2 port opens the check poppet and combined with the flow of the bucket spool. (Only bucket in operation)



FLOW SUMMATION BY THE SHIFTING OF THE BC1 SPOOL

220S2MC27

(3) Bucket out operation

① Bucket operation only

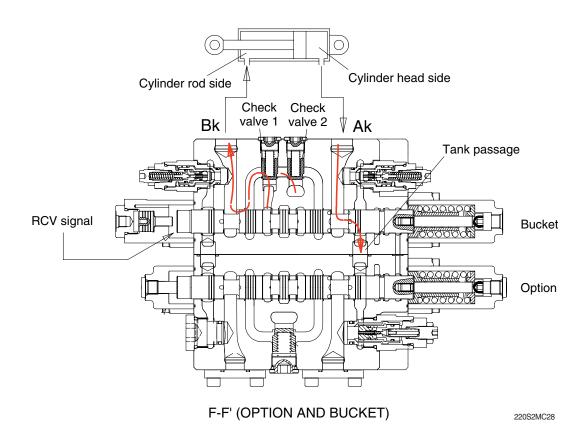
During the bucket out operation, the pilot secondary pressure from the RCV is supplied to against port of the spring side and shifts the bucket spool to the right direction.

The P1 bypass passage is shut off by the movement of the bucket spool and the pressurized oil from P1 port entered P1 parallel passage and is directed to the Bk port through the check valve 2. At the same time, the pressurized oil from P1 bypass passage is directed to the Bk port through the check valve 1.

The return oil from the head side of the bucket cylinder (Ak port) returns to the hydraulic oil tank through the tank passage.

② Combined operation

When combined operation of the bucket and other actuators, exactly same as above operation.



6) SWING OPERATION

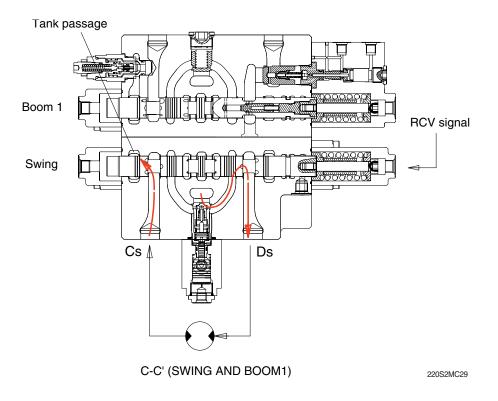
(1) Swing left and right operation

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the swing spool in left direction. The P2 bypass passage is shut off by the movement of the swing spool and the pressurized oil from P2 port flows into the P2 parallel passage and open the load check valve and is supplied to swing motor through the Ds port.

As the result, the return oil from the swing motor flows into the main control inside through Cs port and returns to the hydraulic oil tank through the 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 of the spring opposite side.

Accordingly, the pressurized oil from P2 parallel passage flows into swing motor through the Cs port and returns to the hydraulic oil tank through the Ds port and the tank passage.

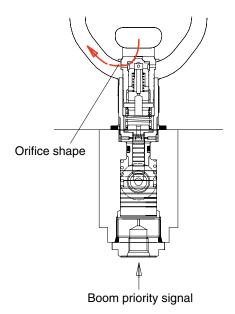


(2) Boom priority function

This function is used to speed up of the boom by reducing the swing speed when the swing operation with boom operation simultaneously.

The boom priority signal is supplied the pilot port and the poppet of the swing logic valve is closed and then the pressurized oil from P2 port is reduced by the oil leaking through the orifice.

As a result, the swing speed is slowed.



SWING LOGIC VALVE

220S2MC30

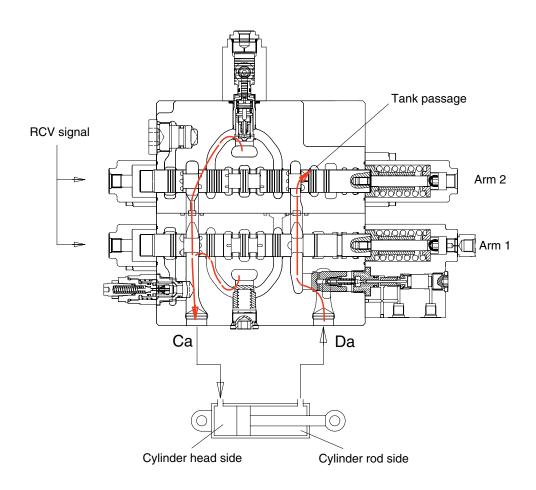
7) ARM OPERATION

(1) Arm in operation

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

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

At the same time, the pilot secondary pressure from the RCV is supplied to the port of spring opposite side and shifts the arm 2 spool in the right direction. The P2 bypass passage is shut off by the movement of the arm 2 spool and the pressurized oil from the P1 port flows into the arm summation passage through P1 parallel passage, the check valve and the notch of the arm 2 spool.



E-E' (ARM 1 AND ARM 2)

300S2MC31

ARM REGENERATION

The return oil from the arm cylinder rod side passes the arm holding valve (open condition) through the Da port and the notch of the arm 1 and arm 2, and swing priority spool. And some of the oil return to the tank passage through the notch of the arm regeneration spool and most of the oil is supplied to the head side of the arm cylinder through internal summation passage.

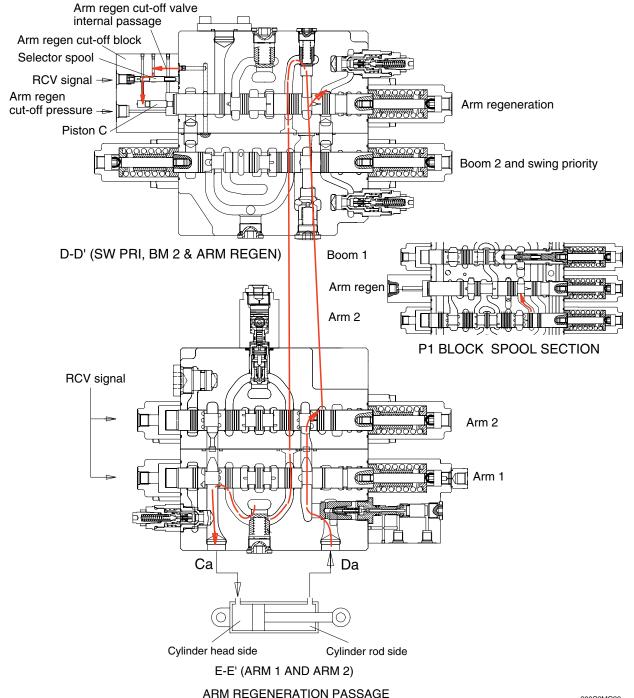
This is called the arm regeneration function.

The amount of regeneration fluid is changed by movement of the arm regeneration spool. A few fluids of the oil that is supplied to the head side of the arm cylinder passes the selector spool (in this case, the selector spool is opened by the arm in pilot pressure) built in the arm regeneration block through internal passage and is pushed the piston C.

The amount of the regeneration oil from the rod side of the arm cylinder to the tank passage is increased by the movement of the piston C and the arm regeneration spool to the right direction and the arm regeneration flow is decreased as much increased oil.

The pressure of the arm cylinder head increases, then, the arm regeneration flow decreases.

Furthermore, the arm regeneration cut-off pressure is supplied to the port of the spring opposite side and the arm regeneration spool is moved to the right direction fully. The flow from the arm cylinder rod to the tank passage is maximum condition.



2-48

(2) Arm out operation

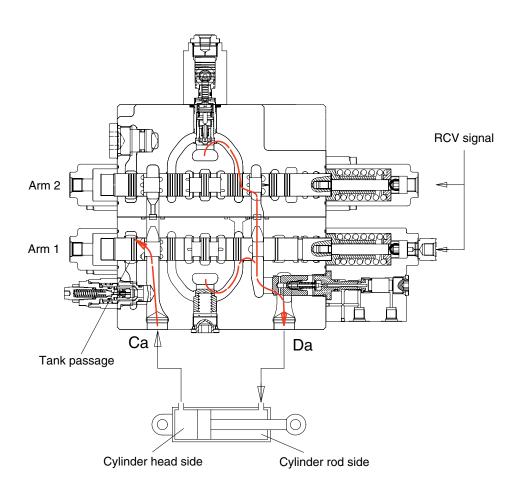
During arm out operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the arm 1 spool to the left direction.

The bypass passage is shut off by the movement of the arm 1 spool and the pressurized oil from the P2 port 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 (oped status) and the port Da.

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

The bypass passage is shut off by the movement of the arm 2 spool and the pressurized oil from the P2 port through the P2 parallel passage. Then it combined with the flow of the arm 1 passage through P1 parallel passage, the check valve, bridge passage, the notch of the arm 1 and the arm holding valve (open status).

On the other hand, the return flow from the arm cylinder head side returns to the hydraulic tank through the port Ca, the notch of the arm 1 spool and tank passage.



E-E' (ARM 1 AND ARM 2)

300S2MC33

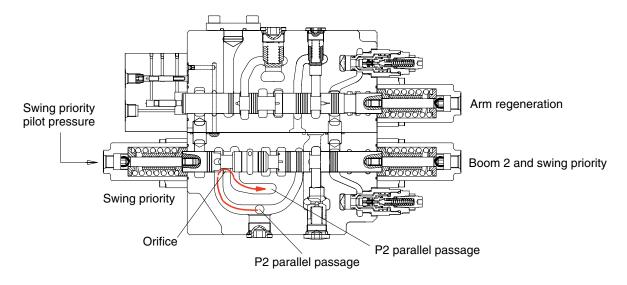
8) OPERATION OF SWING PRIORITY SPOOL

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

The pressurized oil from the P2 port flows into the P2 parallel passage through the notch of the swing priority 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 orifice is formed between the notch of the swing priority spool and the land of the block housing and then the fluid to the swing side more then the downstream of the swing spool such as the arm 1 and option spool.

As a result, the flow is supplied to the swing operation most preferential.



D-D' (SWING PRI, BOOM 2 & ARM REGENERATION)

220S2MC34

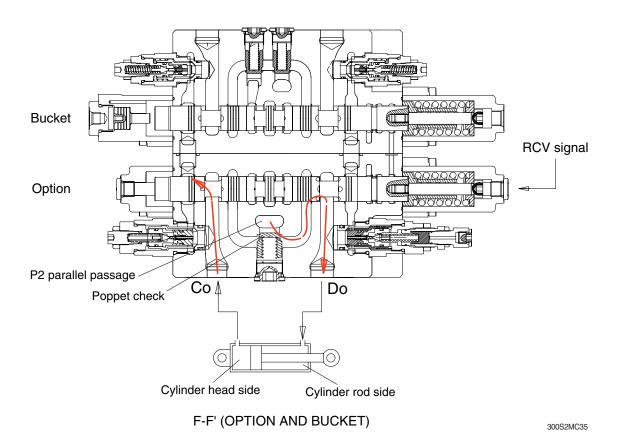
9) OPERATION OF OPTION SPOOL

(1) 1-way operation

** The pilot pressure is supplied to the port of the spring side and shifts spool to the left direction. The pilot secondary pressure from the RCV is supplied to the port of the spring opposite side of the option spool, the P2 bypass passage is shut off by the movement of the option spool and the pressurized oil from the P2 port flows into the actuator through the P2 parallel passage, the check valve, bridge passage and the Do port.

(2) 2-way operation

- Shifts spool to the left and right direction.
- When the spool shifts to the left, same as 1-way operation.
- When the spool shifts to the right, the pressurized oil from the P2 port flows into the actuator through the P2 parallel passage, the check valve, bridge passage and the Co port.

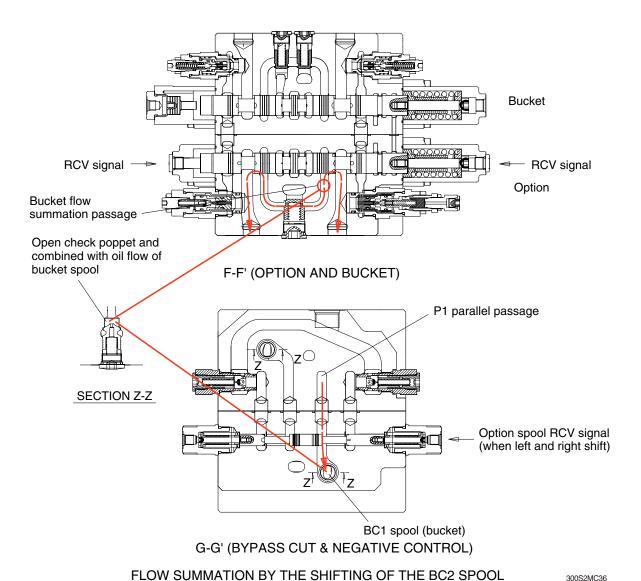


2-51

Option flow summation function, bypass cut-off 2 spool

During the 2-way option operation, the pilot secondary pressure from the RCV is supplied to port of the spring side and shifts the BC2 (option) spool.

The P1 parallel passage is shut off by the movement of the BC2 spool and the pressurized oil from P1 port opens the check poppet and combined with flow of the option spool. (Only bucket in operation)



2-52

10) OPERATION OF NEGATIVE CONTROL VALVE

When no function is being actuated on P1 side, the hydraulic fluid from the P2 port, flows into the tank passage through the P1 bypass passage and the orifice of the negative control valve.

The negative control pressure caused by this operation is transferred to the regulator of the piston pump through the Pn1 port.

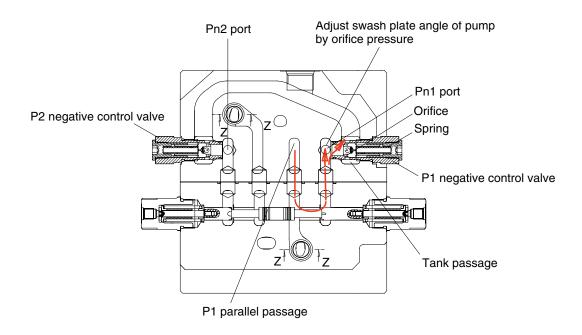
This pressure controls the swash plate angle of the pump to the minimum and minimize the flow of the P1 side.

When one or more spools are shifted, the P1 bypass passage is shut-off and the flow is almost zero.

Accordingly, the negative control pressure that is supplied to the pump through Pn1 port is lowered and the swash plate angle becomes maximum and the flow of the P1 side becomes maximum.

On the other hand, the negative control pressure is increased and high than the setting pressure of the spring, the negative control valve is opened and the flow passes to the hydraulic tank and functions as a relief valve.

The operation of the negative control valve of the P2 side is same as that of the P1 side.



OPERATION OF NEGATIVE CONTROL VALVE

220S2MC37

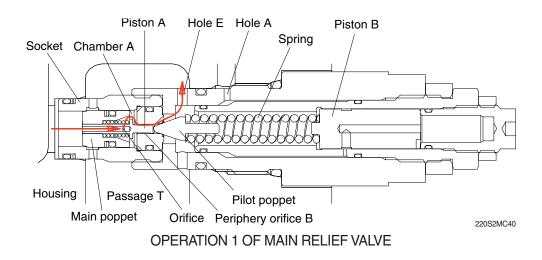
11) OPERATION OF MAIN RELIEF VALVE

(1) Neutral

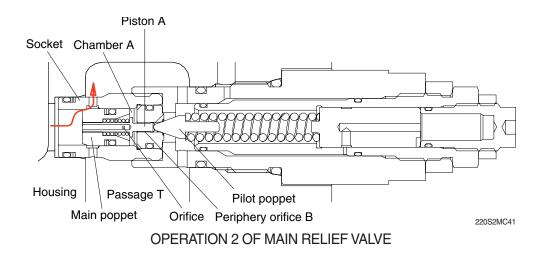
The pressurized oil passes through the internal passage of the piston A, fitted in the main poppet and the orifice A and is filled up in the chamber A of the inside and seats the main poppet against socket and socket against the housing securely.

(2) When operation (relief)

① When the pressurized oil flowed in the chamber A through the orifice becomes equal to the set pressure of the spring, the hydraulic oil apply to the main poppet through the piston and pushes open the pilot poppet and flows to tank passage through the piston A internal passage, orifice A, chamber A, periphery orifice B and the hole E.



② The pressure in chamber A is lowered by moving of the pilot poppet and the main poppet is opened. As a result, the pressurized oil flows out to the tank passage through the hole of the socket side.



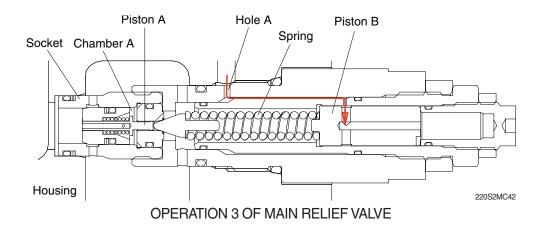
(3) When retraction (return)

On the other hand, the pressure of the pressurized oil becomes lower than set pressure of the spring, the main poppet is seated by spring force. Then the pressure of the chamber A becomes equal to the pressure of the P port and the main poppet is seated to the seat of the socket. The valve returns to the initial condition.

Power boost function

During power boost operation, the pilot pressure for the power boost enters inside of the piston B through the hole A, the crevice passage and the side hole of the piston B.

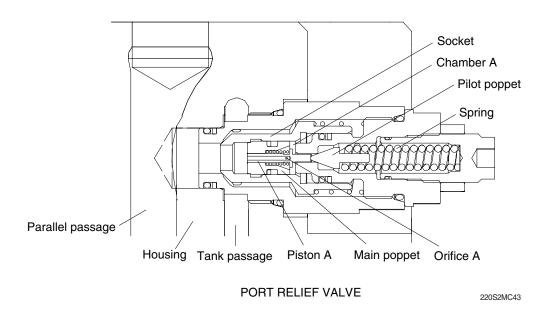
It pushes the piston to the left direction and the set pressure of the spring is increased.



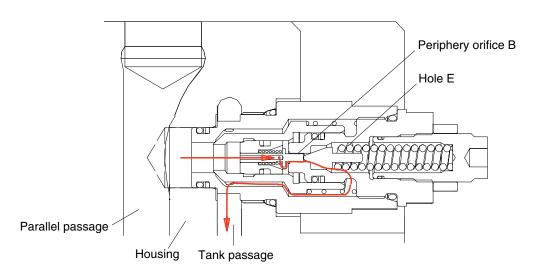
12) OPERATION OF PORT RELIEF VALVE

(1) Function as relief valve

① The pressurized oil passes through the internal passage of the piston A, fitted in the main poppet and the orifice A and is filled up in the chamber A of the inside and seats the main poppet against socket and socket against the housing securely.



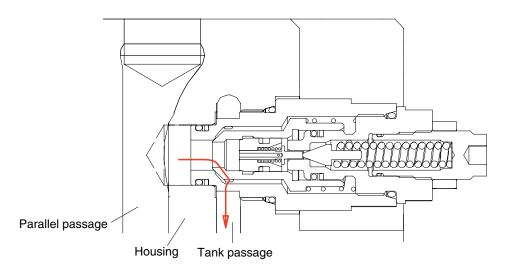
② When the pressurized oil from the actuators becomes equal to the set pressure of the spring, the hydraulic oil apply to the pilot poppet and pushes the pilot poppet to the right direction and flows to tank passage through the piston A internal passage, orifice A, chamber A, periphery orifice B and the hole E.



OPERATION 1 OF PORT RELIEF VALVE

220S2MC44

The pressure in chamber A is lowered by moving of the pilot poppet and the main poppet is opened. As a result, the pressurized oil from the actuator port flows out to the tank passage through the hole of the socket side.



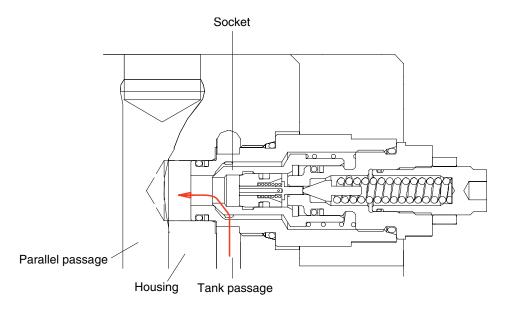
OPERATION 2 OF PORT RELIEF VALVE

220S2MC45

④ On the other hand, the pressure of the actuator becomes lower than set pressure of the spring, the pilot poppet is seated by spring force. Then the pressure of the chamber A becomes equal to the pressure of the actuator port and the main poppet is seated to the seat of the socket. The valve returns to the initial condition.

Make up function

When negative pressure exists at the actuator port, the oil is supplied through tank passage. When the pressure at tank passage becomes higher than that of at the actuator port, it pushed the socket moves in the right direction. Then, the gap between the housing and socket is opened and pressurized oil from the tank passage flows into parallel passage side.



MAKE UP FUNCTION OF PORT RELIEF VALVE

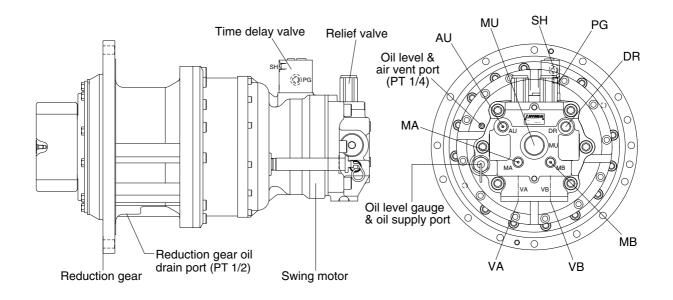
220S2MC46

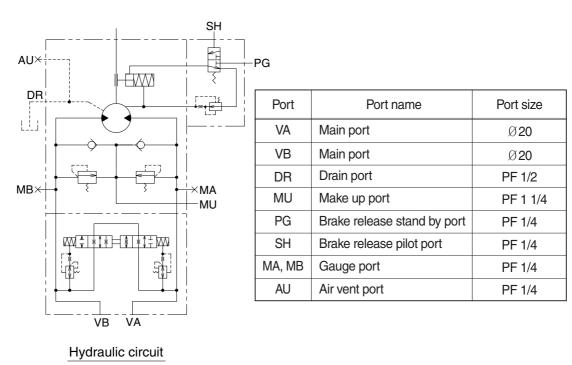
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

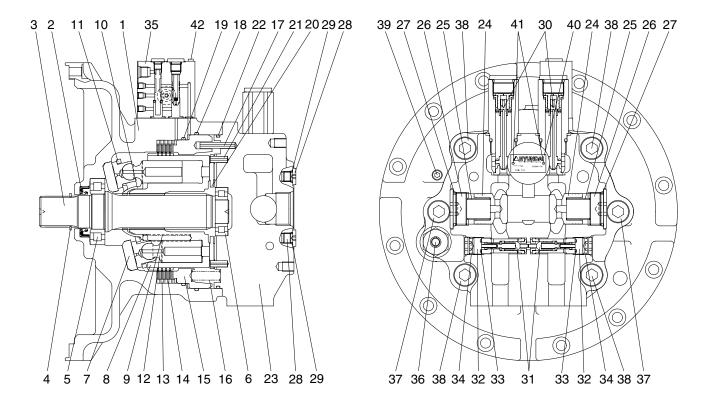
Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.





300L2SM01

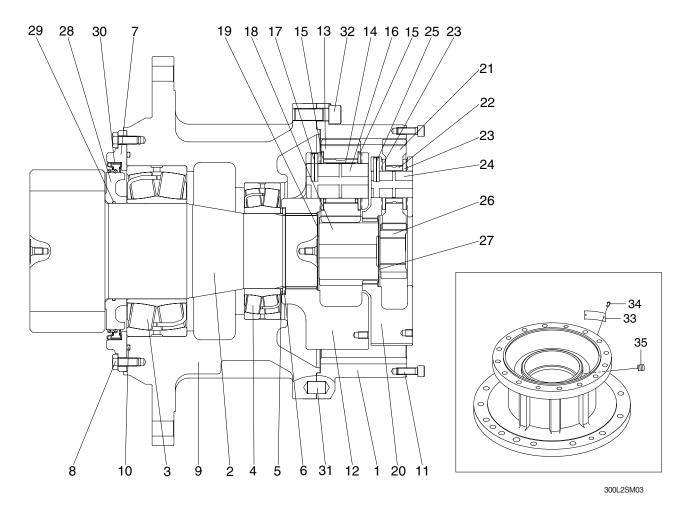
1) SWING MOTOR



300L2SM02

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Brake spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Reactionless valve assy
4	Snap ring	18	O-ring	32	Plug
5	Roller bearing	19	O-ring	33	O-ring
6	Needle bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Time delay valve assy
8	Cylinder block	22	O-ring	36	Level gauge
9	Spring	23	Valve casing	37	Socket bolt
10	Ball guide	24	Check valve	38	Socket bolt
11	Retainer plate	25	Spring	39	Plug
12	Piston assy	26	Plug	40	Name plate
13	Friction plate	27	O-ring	41	Rivet
14	Separate plate	28	Plug	42	Socket bolt

2) REDUCTION GEAR



- 1 Ring gear2 Drive shaft
- 3 Bearing
- 4 Bearing
- 5 Thrust plate
- 6 Snap ring
- 7 Cover
- 8 Hex head bolt
- 9 Casing
- 10 O-ring
- 11 Hex socket head bolt
- 12 Carrier 2

- 13 Planetary gear 2
- 14 Needle bearing 2
- 15 Thrust washer 2
- 16 Carrier pin 2
- 17 Spring pin 2
- 18 Sun gear 2
- 19 Thrust plate 2
- 20 Carrier 1
- 21 Planetary gear 1
- 22 Needle bearing 1
- 23 Thrust washer 1
- 24 Carrier pin 1

- 25 Spring pin 1
- 26 Sun gear 1
- 27 Thrust plate 1
- 28 Sleeve
- 29 O-ring
- 30 Oil seal
- 31 Parallel pin
- 32 Hex socket head bolt
- 33 Name plate
- 34 Rivet
- 35 Plug

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder block (8) through valve casing of motor (1), and valve plate (20).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (12).

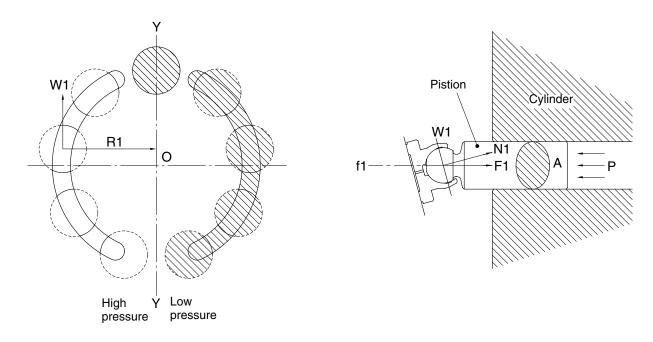
The high hydraulic can generate the force, $F1=P\times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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

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

This torque transfers the turning force to a cylinder (8) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.



21078TM05

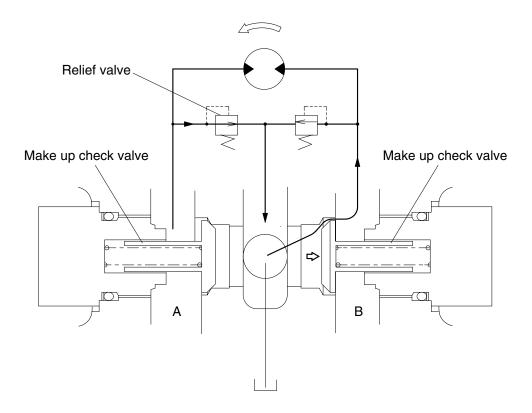
2) MAKE UP VALVE

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

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

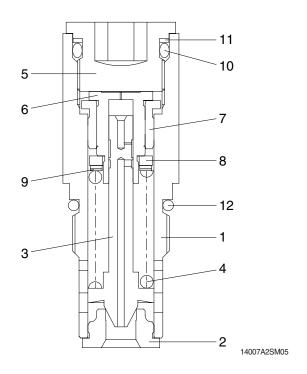
Pressurized oil into the port B, the motor rotate counterclockwise.

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



21092SM04

3) RELIEF VALVE



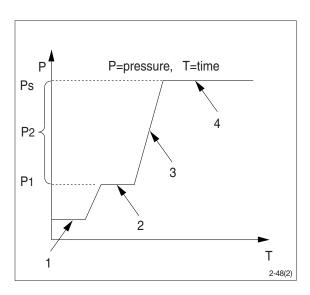
- 1 Body
- 2 Seat
- 3 Plunger
- 4 Spring
- 5 Adjusting screw
- 6 Piston
- 7 Bushing
- 8 Spring seat
- 9 Shim
- 10 O-ring
- 11 Back up ring
- 12 O-ring

(1) Construction of relief valve

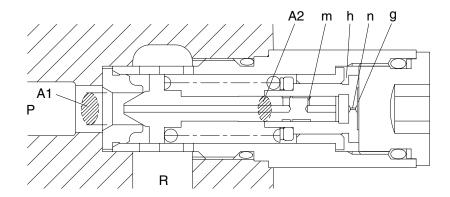
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



① Ports (P,R) at tank pressure.

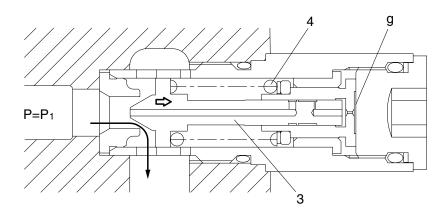


14007A2SM06

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

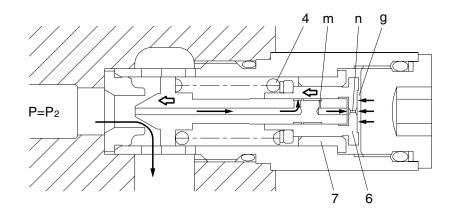
$$P1 \times A1=Fsp+Pg \times A2$$

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



14007A2SM07

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

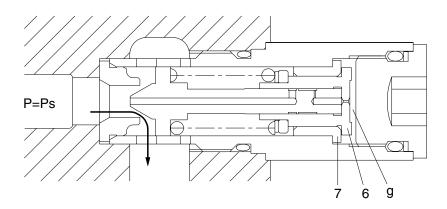


14007A2SM08

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

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

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



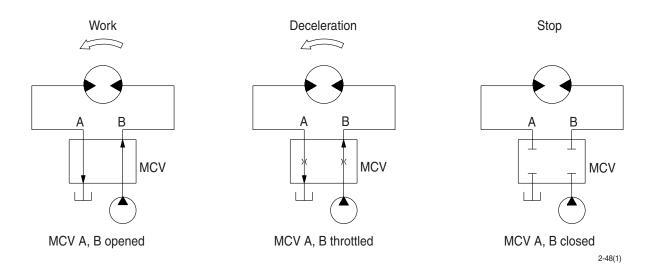
14007A2SM09

4) 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.



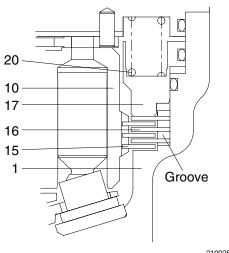
(2) Mechanical swing parking brake system

This is function as a parking brake only when all of the RCV lever (except swing, arm in) are not operated.

① Brake assembly

Circumferential rotation of separate plate (16) is constrained by the groove located at housing (1). When housing is pressed down by brake spring (20) through friction plate (15), separate plate (16) and brake piston (17), friction force occurs there.

Cylinder block (10) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



21092SM15

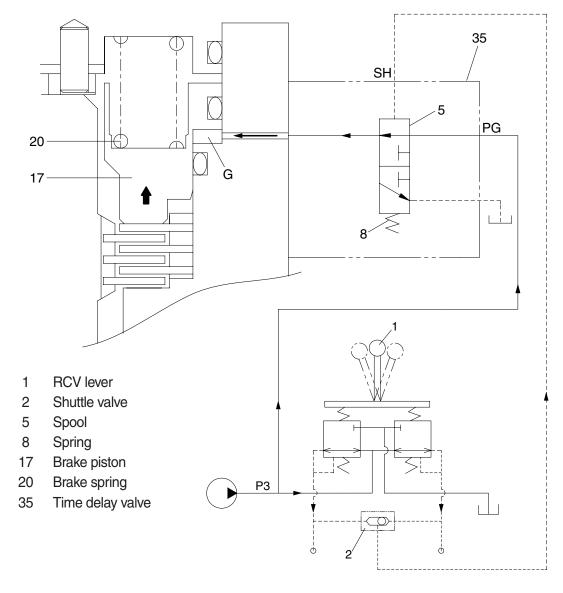
1	Housing	16	Separate plate
10	Cylinder block	17	Brake piston
15	Friction plate	20	Spring

2 Operating principle

a. When the RCV lever (1) is set to the swing or arm in operating position, the pilot oil go to SH of the time delay valve (35).

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 (17) to the upward against the force of the spring (20). Thus, it releases the brake force.

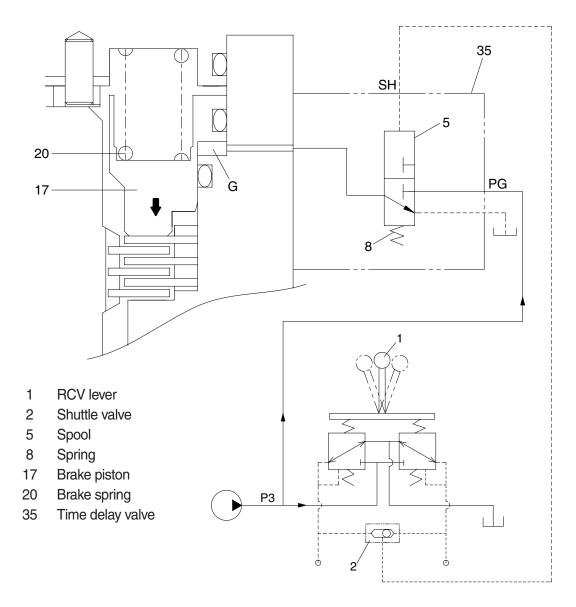


300L2SM04

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to the top.

Then, the brake piston (17) 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.



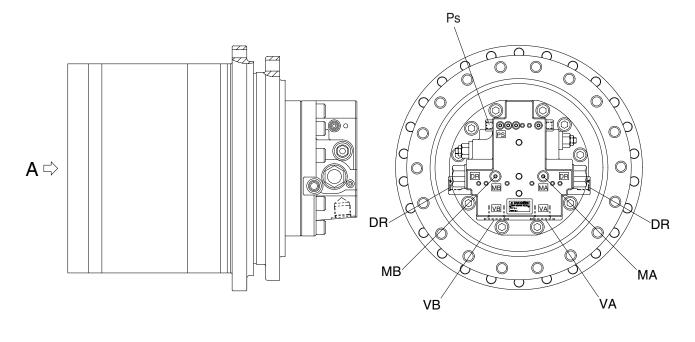
300L2SM05

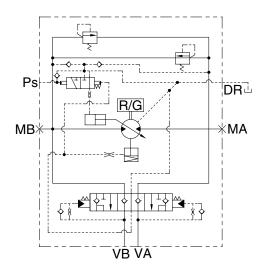
GROUP 4 TRAVEL DEVICE (TYPE 1 & 2)

1. CONSTRUCTION

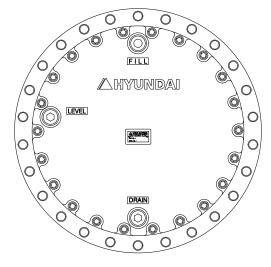
Travel device consists travel motor and gear box.

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









VIEW A

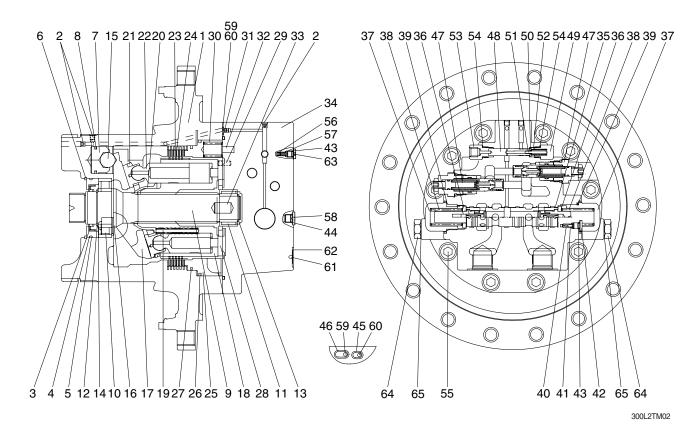
300L2TM01

Port	Port name	Port size
VA, VB	Valve port	PF 1
Ps	Pilot port	PF 1/4
DR	Drain port	PF 1/2
MA, MB	MA, MB Gauge port	

2. SPECIFICATION

1) TRAVEL MOTOR

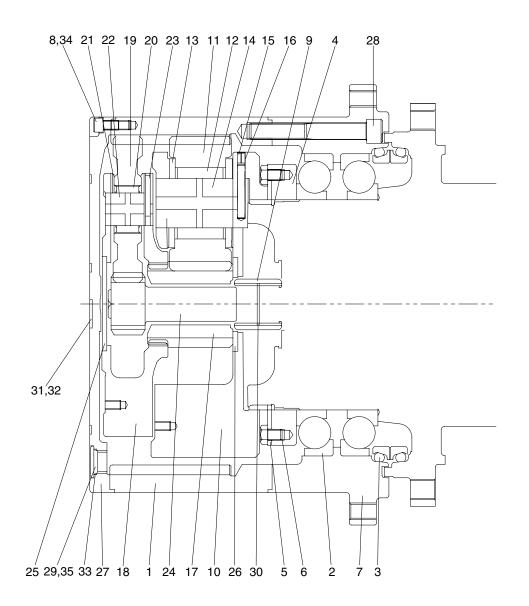
22 Piston assy



1	Casing	23	Friction plate	45	O-ring
2	Plug	24	Separate plate	46	O-ring
3	Oil seal	25	Parking piston	47	Relief valve assy
4	Thrust block	26	D-ring	48	Spool
5	O-ring	27	D-ring	49	Plug
6	Snap ring	28	Valve plate	50	Spring seat
7	Piston	29	Parallel pin	51	Parallel pin
8	Piston seal	30	Spring	52	Spring
9	Shaft	31	O-ring	53	Connector
10	Cylinder roller bearing	32	Spring pin	54	O-ring
11	Needle bearing	33	Parallel pin	55	Hexagon socket head bolt
12	Snap ring	34	Rear cover	56	Check valve
13	Snap ring	35	Main spool assy	57	Spring
14	Thrust plate	36	Spring seat	58	Plug
15	Steel ball	37	Plug	59	Restrictor
16	Pivot	38	Spring	60	Restrictor
17	Swash plate	39	O-ring	61	Name plate
18	Cylinder block	40	Restrictor	62	Rivet
19	Spring	41	Spring	63	Plug
20	Ball guide	42	Plug	64	Plug
21	Retainer plate	43	O-ring	65	O-ring

44 O-ring

2) TRAVEL REDUCTION GEAR



300S2TM03

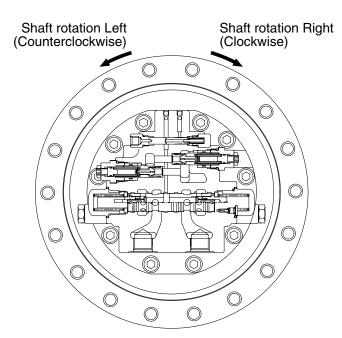
1	Gear ring	13	Thrust washer 2	25	Thrust plate
2	Ball bearing	14	Carrier pin 2	26	Thrust plate
3	Floating seal assy	15	Spring pin 2	27	Cover
4	Nut ring	16	Solid pin 2	28	Hexagon socket head bolt
5	Lock plate	17	Sun gear 2	29	Plug
6	Hexagon socket head bolt	18	Carrier 1	30	Snap ring
7	Housing	19	Planetary gear 1	31	Name plate
8	Hexagon socket head bolt	20	Needle bearing 1	32	Rivet
9	Coupling	21	Thrust washer 1	33	O-ring
10	Carrier 2	22	Carrier pin 1	34	Rubber cap
11	Planetary gear 2	23	Spring pin 1	35	Rubber cap
12	Needle bearing 2	24	Sun gear 1		

3. OPERATION

1) MOTOR

High pressure oil delivered form hydraulic pump is led to inlet port that is provided in the brake valve portion and, through the rear cover (34) and valve plate (28), led to cylinder block (18).

The oil flow and direction of shaft rotation are indicated in table.



Inlet port	Outlet port	Direction of shaft rotation (viewing from rear cover)
VB	VA	Right (clockwise)
VA	VB	Left (counterclock wise)

300L2TM04

As shown in below figure, high pressure oil is supplied to the pistons which are on one side of the line Y-Y that connects upper and lower dead points and produces force F1.

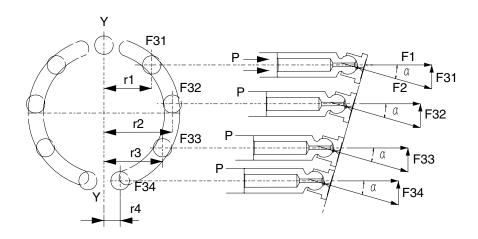
 $F1 = P \times A$ (P: pressure, A: area of piston section)

The swash plate (17) with inclined angle of α divides this force F1 into thrust force F2 and radial force F31-34.

This radial force is applied to axis Y-Y as turning force and generate drive torque of T.

$$T = r_1 \cdot F31 + r_2 \cdot F32 + r_3 \cdot F33 + r_4 \cdot F34$$

This drive torque is transmitted via cylinder block (18) to driving shaft (9).



29092TM07

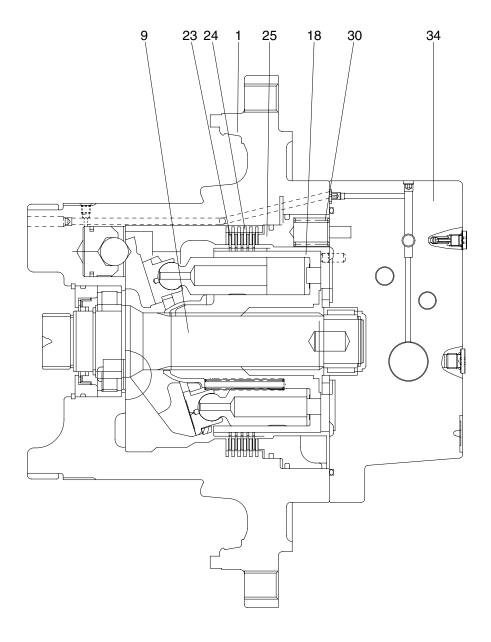
2) PARKING BRAKE

Parking brake is released when high pressure oil selected by the brake valve portion that is connected directly to the rear cover (34), is applied to the parking piston (25).

Otherwise the braking torque is always applied.

This braking torque is generated by the friction between the separated plates (24), inserted into the casing (1), and friction plates (23), coupled to cylinder block (18) by the outer splines.

When no pressure is activated on the parking piston (25), it is pushed by the brake springs (30) and it pushes friction plates (23) and separated plates (24) towards casing (1) and generates the friction force which brakes the rotation of cylinder block (18) and hence the shaft (9).



2609A2TM05

3) CAPACITY CONTROL MECHANISM

Figure typically shows the capacity control mechanism.

When high speed pilot line is charged with the pressure P_A that overcome the spring (52), the spring (52) is compressed and spool (48) shifts to the right to connect the port P and port C.

Then, the highest pressure is selected by the check valve (56) from inlet and outlet pressure of the motor and high speed pilot line pressure and pushes shifter piston (7). As a result, swash plate (17) turns around the line L which connect the two pivots (16) as shown by dotted lines. The turn stops at the stopper (1-1) of casing and swash plate (17) keeps the position.

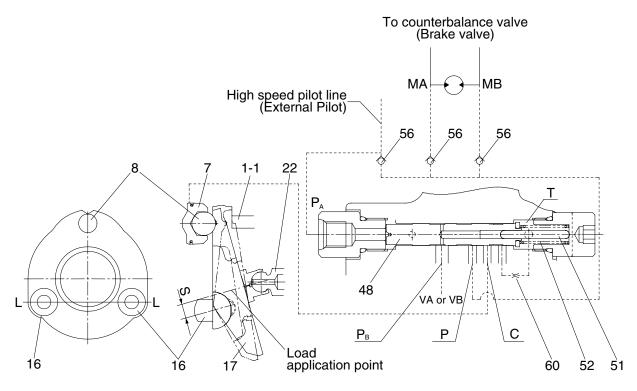
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

When no pressure is in the high speed pilot line P_A , spool (35) is pushed back by the spring (52) and pressure that pressed the shifter piston (7) is released to the hydraulic tank through restrictor (60).

Here, nine pistons are there and they equally spaced on the swash plate (17). The force that summed up those of pistons comes to almost the center of the swash plate (17) as shown. Since the pivots (16) are off-set by S from the center, the rotating force of product S and the force moves swash plate (17) to the former position and the speed returns to low.

When the power demand exceeds the engine power, such as in steep slope climbing or turning at high speed mode, the system step down to the low speed automatically. The mechanism is that: pump pressure is led to the port P_B and this pressure activate on pin (51). When the pressure at P_B exceeds predetermined value, spool (48) returns to the left by the counter-pressure against pin (51) and the pressure on the shifter piston (7) through port C is released to the tank and the motor comes to low speed.

When $P_{\scriptscriptstyle B}$ goes down, the spool (48) moves to the right and the speed become high.

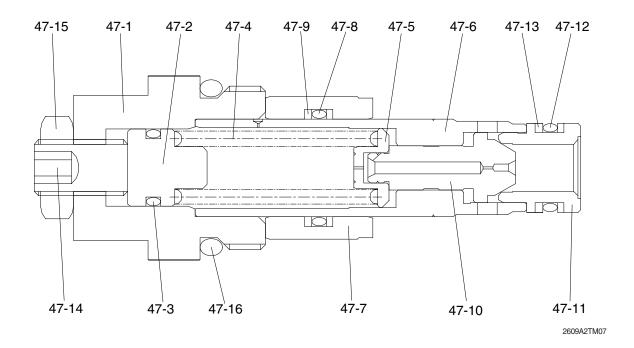


2609A2TM06

4) OVERLOAD RELIEF VALVE

(1) Structure

This valve is screwed in the motor rear cover (34) and consists of : plug (47-1) that is screwed and fixed in the rear cover (34), poppet (47-10) and supports the poppet seat (47-11), spring (47-4) that is operating relief valve setting pressure and supports the spring seat (47-5), that is inserted in the sleeve (47-6), screw (47-14) that is adjust the spring force, nut (47-15) that fix screw (47-14), piston (47-7) that reduce the shock.



47-1 Plug	47-7 Piston	47-12 O-ring
47-2 Guide	47-8 O-ring	47-13 Back-up ring
47-3 O-ring	47-9 Back-up ring	47-14 Socket screw
47-4 Spring	47-10 Poppet	47-15 Hexagon nut
47-5 Spring seat	47-11 Poppet seat	47-16 O-ring
47-6 Sleeve		

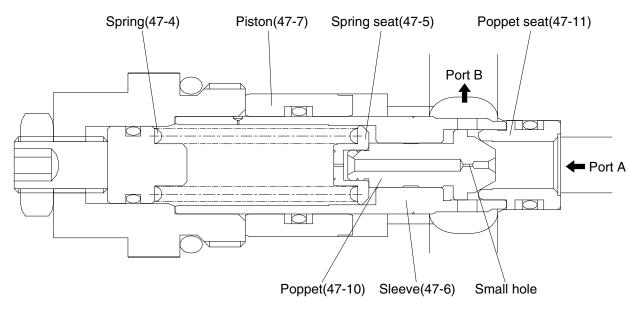
(2) Operation

Two pieces of overload valves are located at cross-over position in the counterbalance circuit of brake valve and have the following functions:

- ① When hydraulic motor starts, keep the driving pressure below predetermined value and while accelerating, bypasses surplus oil to return line.
- ② When stopping the motor, keep the brake pressure, that develops on the outlet side of motor, under the predetermined value to stop the inertial force.
- ③ To accelerate sharply while starting, and to mitigate the braking shock while stopping. For these purposes, the developed pressure is kept comparatively low for a short period, then keep the line pressure as normal value. While the pressure is low, meshing of reduction gears, crawler and sprocket etc. can be smoothly done and the shock are absorbed.

When starting, "A" port pressure of overload valve increases, this pressure is applied to the effective diameter of poppet (47-10) which seats on the poppet seat (47-11) and, at the same time, is delivered, via small hole, to the spring seat (47-5) located inside the sleeve (47-6) and the seat bore pressure increases up to "A" port pressure. The poppet (47-10) opposes to spring (47-4) by the force of the pressure exerted on the area difference between poppet seat's effective diameter and spring seat bore and keep the predetermined pressure.

When hydraulically braking, the piston (47-7) is at the left position by the driving pressure, and when "A" port pressure increases, the pressure is applied also to the piston (47-7) through the small hole in the poppet (47-10) and piston (47-7) moves rightward until it touches the stopper in rear cover. In this while, the poppet (47-10) maintains "A" port pressure at comparatively low against the spring (47-4) force and exhaust oil to "B" port side. After the piston reached to the plug, the valve acts the same as at starting.



2609A2TM08

5) BRAKE VALVE

(1) Structure

The brake valve portion mainly consists of the following parts:

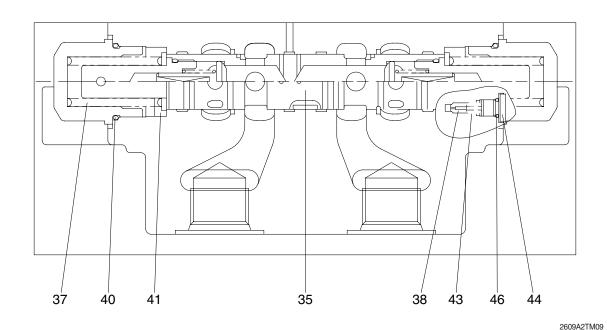
① Spool

By shifting the spool (35), the discharged oil from hydraulic motor is automatically shut off or restricted according to the condition and give the effect of holding, accelerating, stopping and counterbalance operations.

(See page 2-74, (2) Operation)

② Check valve (built in the spool)

This valve is located in the oil supplying passage to hydraulic motor, and at the same time functions to lock oil displacement. Therefore, this valve serves as not only a suction valve but also a holding valve for hydraulic motor.



35 Main spool 40 O-ring 44 O-ring 37 Spring 41 Spring seat 46 Plug

8 Restrictor 43 Restrictor spring

(2) Operation

① Holding operation

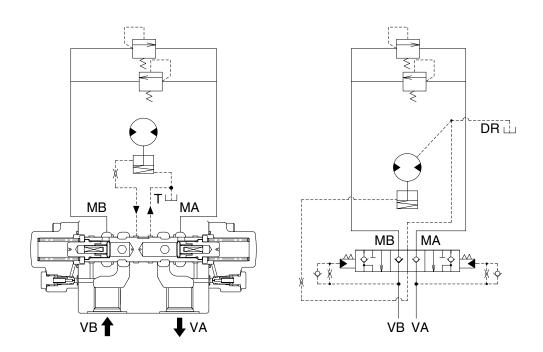
When the control valve is at neutral position, VA and VB ports are connected to the tank, and the spring (38) located on both spool ends holds the spool (35) at central position.

Therefore, the passages from VA to MA and VB to MB are closed, which result in closing MA and MB ports connected to hydraulic motor.

Since the passage to parking brake is connected to the tank line, the brake cylinder pressure is equal to the tank pressure and the brake is applied by the springs. Thus, the rotation of the motor is mechanically prevented.

If external torque is exerted on the motor shaft, the motor would not rotate as usual by this negative parking brake.

In case the brake should be released for some reason, pressure is built on MA or MB port. But, due to oil leakage inside hydraulic motor or so, high-pressure oil escapes from the closed circuit and motor rotates a bit. So, the cavitation tends to occur in the lower pressure side of the closed circuit. Then, the check valve, built in the spool (35), operates to avoid the cavitation and opens the passage from VA to MA or from VB to MB. Then the oil equivalent to the leakage is sucked from the tank line to the closed circuit.

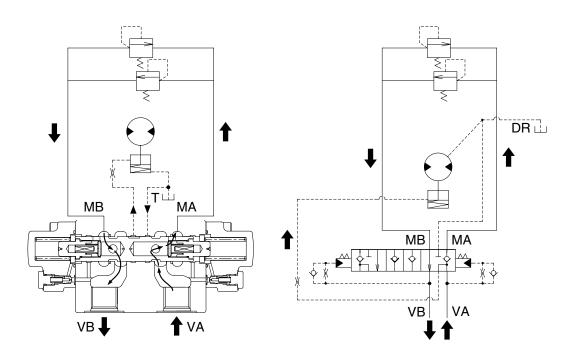


2 Accelerating operation

When VA and VB ports are connected respectively to pump and tank by operating the control valve, hydraulic oil from pump is forwarded through VA port to push open the check valve provided inside spool (35), and oil flows to motor via MA port to rotate the motor.

Therefore, the pressure increases and negative brake is released by the pressure supplied from pump. At the same time, the pressure of pilot chamber increases to push and move the spool (35) leftwards, overcoming the spring (38) force. Thus, the return line from MB to VB opens to rotate the motor.

In case inertia load is too big to start rotation, accelerating pressure reaches the set pressure of relief valve and high pressure oil is being relieved while the motor gains the rotational speed. As the rotational speed goes up, the relieved volume decreases, and finally the motor rotates at a fixed speed.

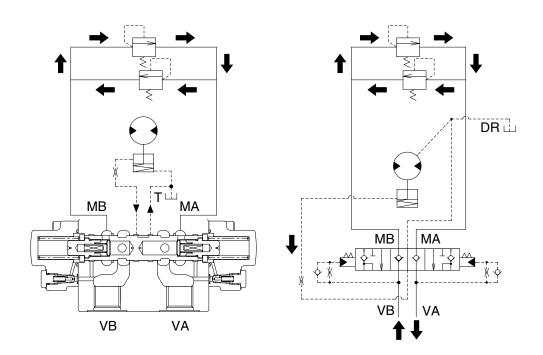


3 Stopping operation

Returning the control valve to neutral position while running the motor, the oil supply is cut off and VA and VB ports are connected to the tank line. Then the pressure of the pilot chamber located on both spool ends become equal, and the spool (35) returns to the neutral position by spring (38) force. Thus, the passage from MA to VA is closed.

Owing to the inertia force of the load, the hydraulic motor tends to continue the rotation. Here, the motor functions as a pump and forwards the oil to MB port but the passage is blocked and MB port pressure increases. Then the relief valve opens to relieve the pressure and rotational speed decelerates and at last the motor stops.

Negative brake release pressure is gradually lowered due to the restrictor and finally the brake works and the motor is mechanically stopped.



4 Counterbalance operation

Counterbalance operation is required to decelerate slowly the hydraulic motor while absorbing inertia force.

In case the hydraulic oil is gradually decreased from pump to VB port, the drive shaft of hydraulic motor tends to rotate faster than that matched to the volume of oil supply.

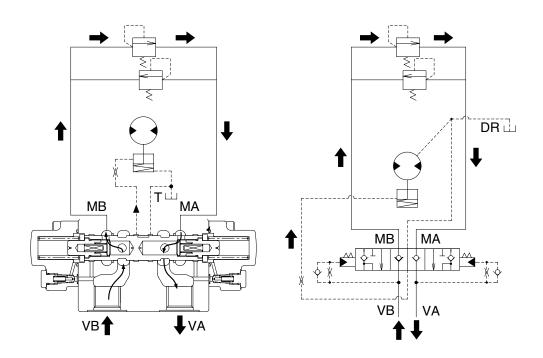
Consequently, the pilot chamber pressure on MB to VB side decreases and the spring (38) force moves the spool (35) leftwards towards neutral position.

Therefore, the area of passage from MA to VA becomes smaller and the pressure on MA side rises due to increased resistance in the passage and the motor receives hydraulic braking effect.

If the motor rotates slower than that matched to the volume of supplied oil, the pilot chamber pressure on VB port increases, and spool (35) moves rightwards to enlarge the area of passage from MA to VA. Therefore the braking effect becomes smaller and the rotational speed of motor is controlled to correspond to the volume of supplied oil.

In order to give stable counterbalance operation, the restrictors (40) are set in the pilot chamber to damp the spool (35) movement.

The parking brake is released during pressure adjusting action of the spool (35).



6) REDUCTION GEAR

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

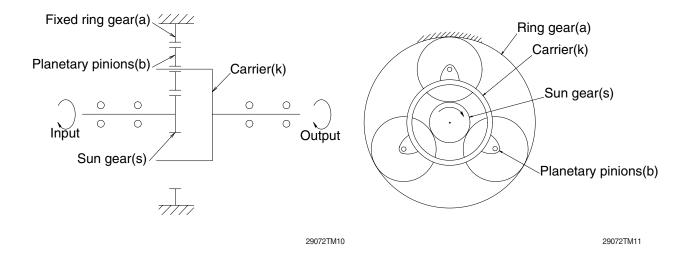
This reduction unit utilizes two stages, planetary reduction system.

Planetary reduction system consists of sun gear, planetary gears, (planetary) 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 gear (s).

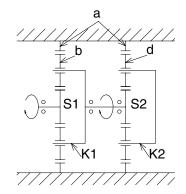
This movement is transferred to carrier (k) and deliver the torque.

This mechanism is called planetary gear mechanism.



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.



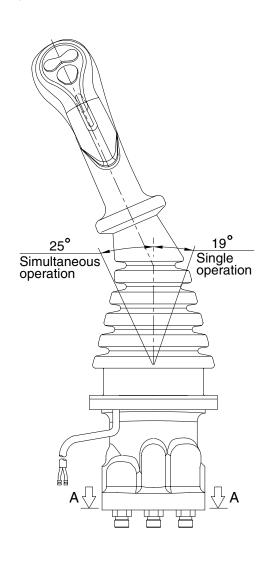
GROUP 5 RCV LEVER

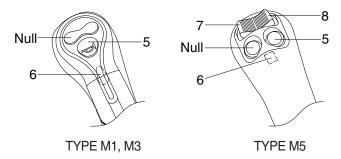
1. STRUCTURE

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.

* Refer to the parts manual for the types of the RCV lever.

1) TYPE M1, M3, M5

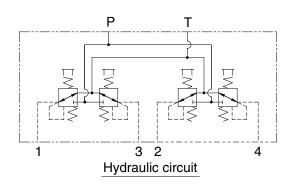


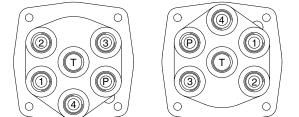


Switches

Туре	No.	LH	RH
M4 M2	5	One touch decel	Horn
M1, M3	6	Power boost	Breaker
	5	One touch decel	Horn
M5	6	Power boost	Null
IVIO	7	CCW rotation	Close
	8	CW rotation	Open

* Number 7 and 8 : Option attachment





LH

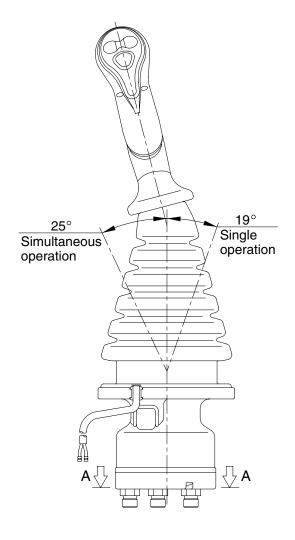
NH VIEW A-A

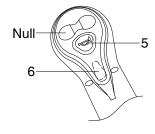
Pilot ports

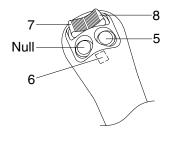
Port	LH	RH	Port size
Р	Pilot oil inlet port	Pilot oil inlet port	
Т	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	PF 3/8
2	Arm out port	Boom up port	FF 3/0
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	

300L2RL01

2) TYPE M2, M4, M6







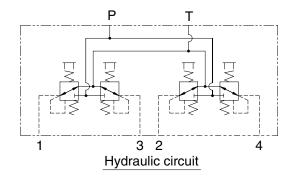
TYPE M2, M4

TYPE M6

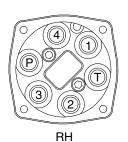
Switches

Туре	No.	LH	RH
M2, M4	5	One touch decel	Horn
	6	Power boost	Breaker
	5	One touch decel	Horn
Me	6	Power boost	Null
M6	7	CCW rotation	Close
	8	CW rotation	Open

* Number 7 and 8 : Option attachment







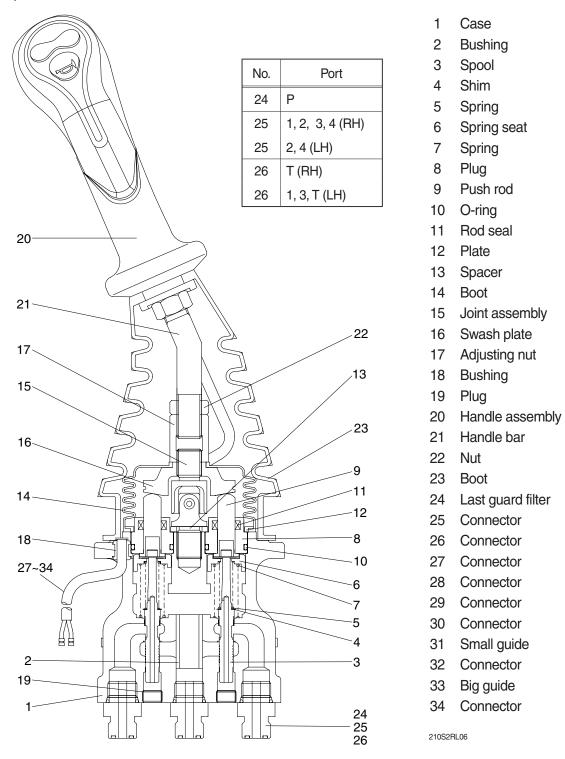
VIEW A-A

Pilot ports

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

300L2RL05

3) CROSS SECTION



Item numbers are based on the type M1.

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 (7), spring seat (6) 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 (9) 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.

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

Item numbers are based on the type M1.

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 (9) is inserted and can slide in the plug (8).

For the purpose of changing the displacement of the push rod through the swash plate (16) and adjusting nut (17) are provided the handle assy (20) that can be tilted in any direction around the fulcrum of the universal joint (15) center.

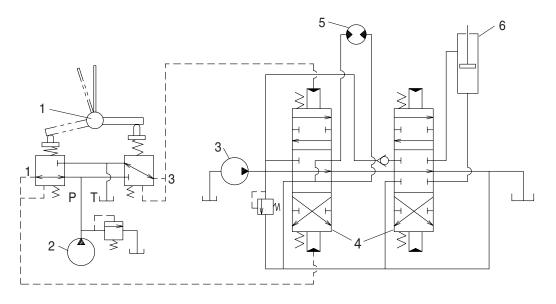
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

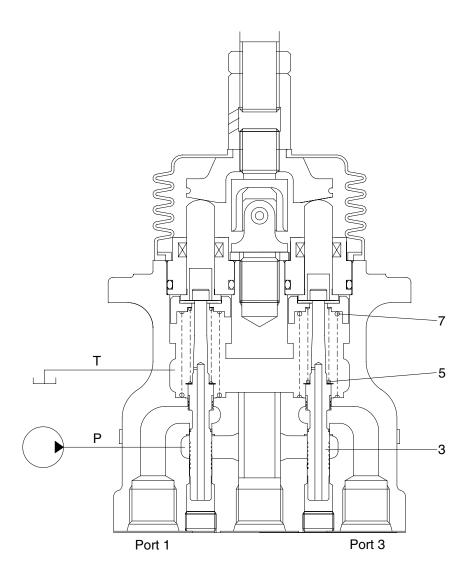
The diagram shown below is the typical application example of the pilot valve.



2-70

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

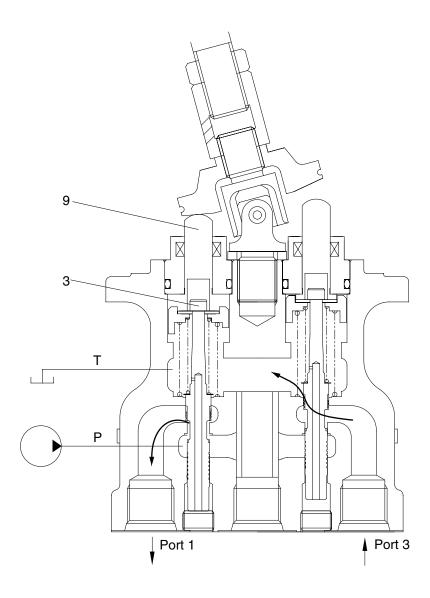
(1) Case where handle is in neutral position



300L2RL03

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 (7) 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



300L2RL04

When the push rod (9) 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.

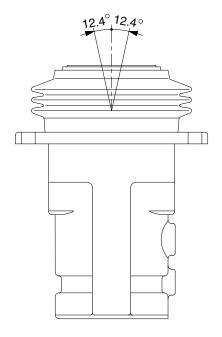
In this manner the secondary pressure is kept at the constant value.

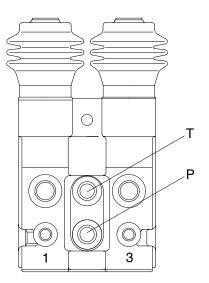
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

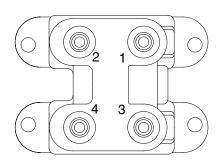
GROUP 6 RCV PEDAL

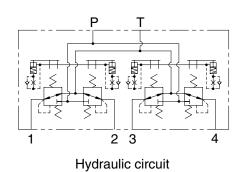
1. STRUCTURE

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.









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

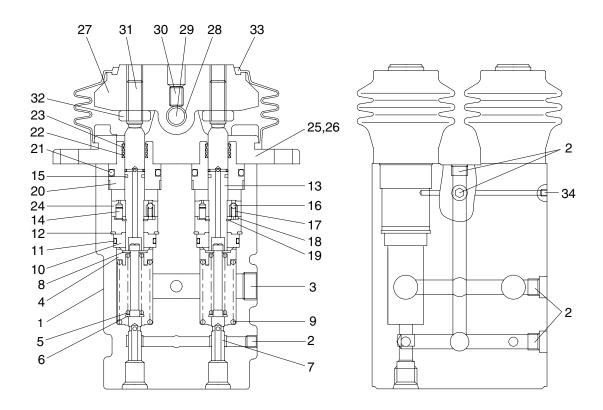
130ZF2RP01

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 (7), spring (5) for setting secondary pressure, return spring (9), stopper (8), and spring seat (6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 6.3 ± 1 to 24.9 ± 1.5 kgf/cm² (depending on the type). The spool is pushed against the push rod (13) 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.



130ZF2RP02

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

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

The change the deflection of this spring, the push rod (13) is inserted and can slide in the plug (20). 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.

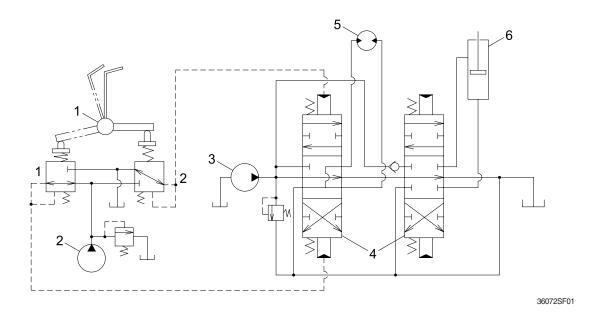
The spring (9) works on the body (1) and spring seat (6) and tries to return the push rod (13) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

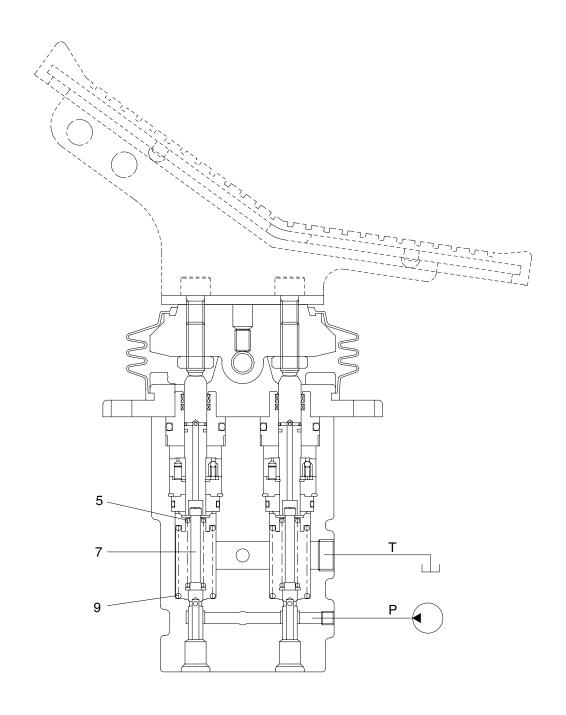
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



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

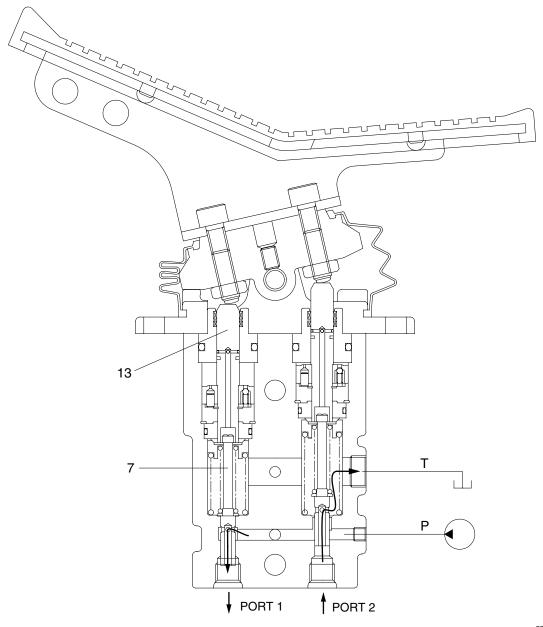
(1) Case where pedal is in neutral position



130ZF2RP03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (7). Therefore, the spool is pushed up by the spring (9) to the position of 1 and port 2. 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



220F2RP04

When the push rod (13) is stroked, the spool (7) 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.

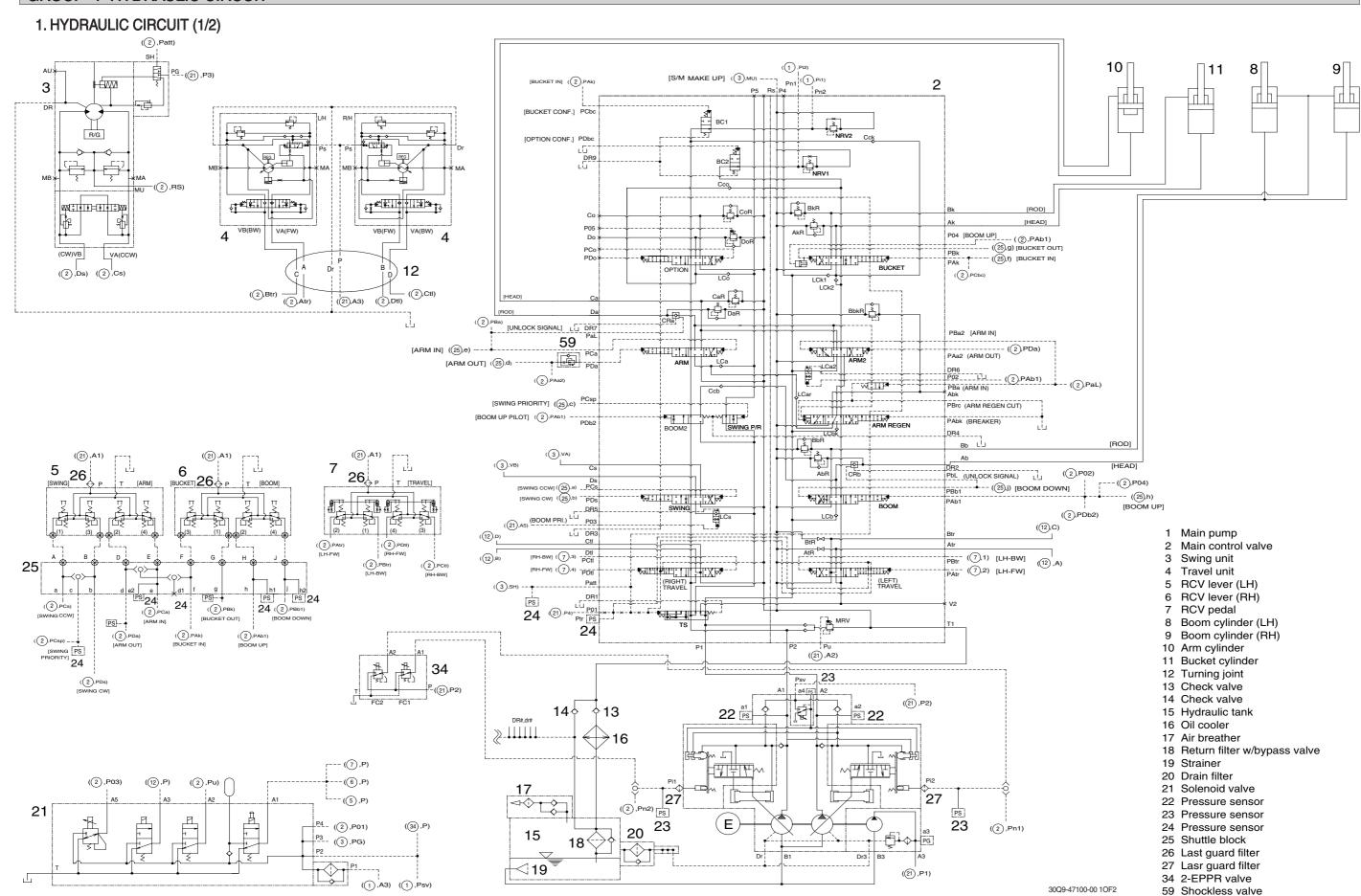
In this manner the secondary pressure is kept at the constant value.

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.

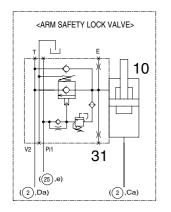
SECTION 3 HYDRAULIC SYSTEM

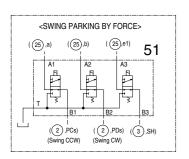
Group	1	Hydraulic Circuit	3-1
Group	2	Main Circuit ·····	3-3
Group	3	Pilot Circuit ·····	3-6
Group	4	Single Operation	3-14
Group	5	Combined Operation	3-24

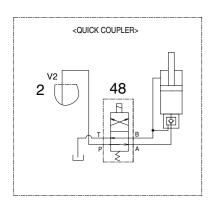
GROUP 1 HYDRAULIC CIRCUIT

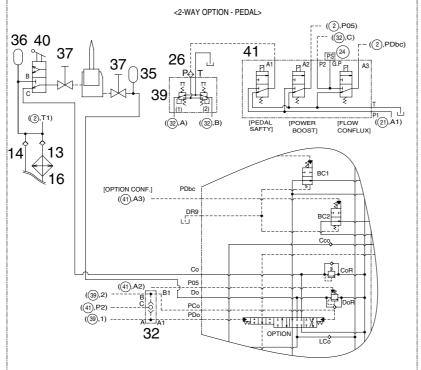


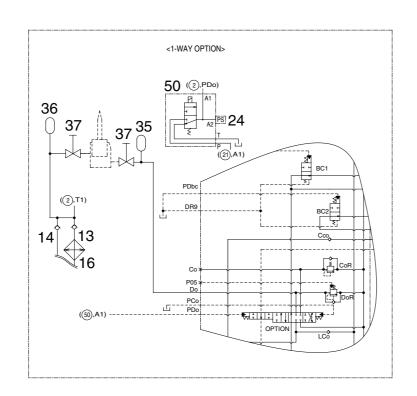
2. HYDRAULIC CIRCUIT (2/2)

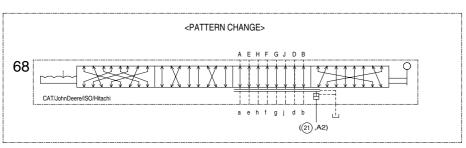


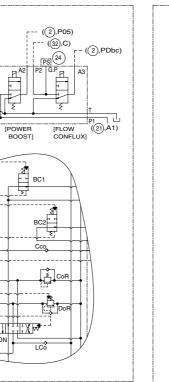


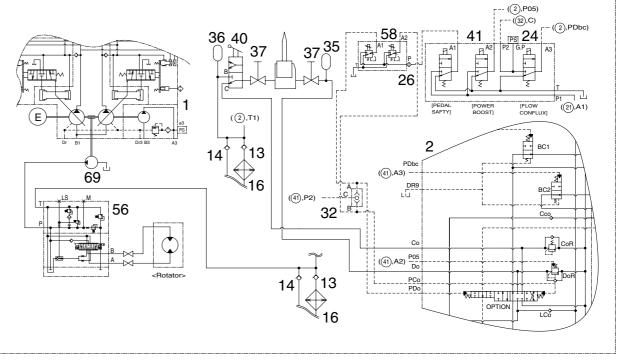




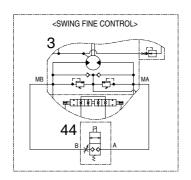








<PROPOTIONAL RCV DOUBLE ACTING & ROTATING>



<BOOM SAFETY LOCK VALVE> 30 30 22

- Main pump Main control valve
- Swing unit
- Boom cylinder (LH)
- Boom cylinder (RH)
- 10 Arm cylinder
- 13 Check valve
- 14 Check valve
- 16 Oil cooler
- 22 Pressure sensor
- 24 Pressure sensor 26 Last guard filter
- 27 Lasr guard filter
- 30 Boom safety lock valve (LH, option) 31 Boom safety lock valve (RH, option)
- 32 Arm safety lock valve (option)
- 35 Accumulator (option) 36 Accumulator (option)

- 37 Stop valve (option)
- 39 2-way pedal (option) 40 3-way joint (option)
- Solenoid valve (option) 41
- 44 Solenoid valve (option)
- 48 Solenoid valve (option)
- Solenoid valve (option) 50
- 51 Solenoid valve (option)
- 56 Proportional valve (option)
- 58 2-EPPR valve (option)
- 68 Pattern change valve (option)
- 69 Gear pump (option)

30Q9-47100-00 2OF2

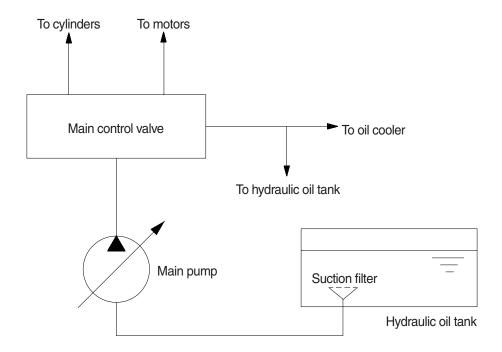
GROUP 2 MAIN CIRCUIT

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 tandem 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



3-02

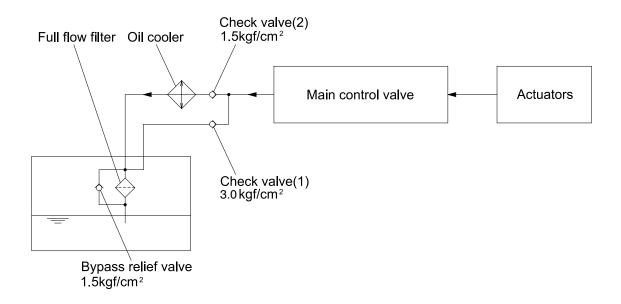
The pumps receive oil from the hydraulic tank through a suction filter. The discharged oil from the pump flows into the control valve and goes out the tank ports.

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

The control valve controls the hydraulic functions.

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

2. RETURN CIRCUIT



220F3CI01

All oil from each actuator returns to the hydraulic tank through the 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. 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.

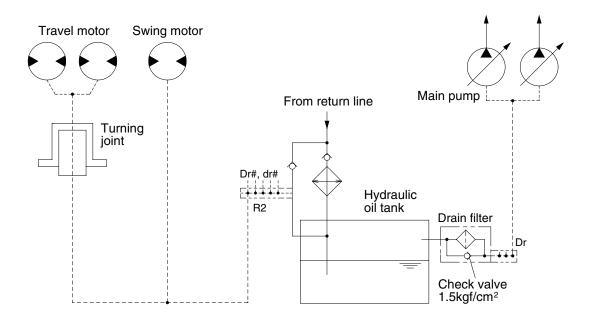
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

The full-flow filter and bypass relief valve are provided in the hydraulic tank.

The oil from right and left side of control valve is combined and filtered by the return 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



300S3CI02

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 and return filter.

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

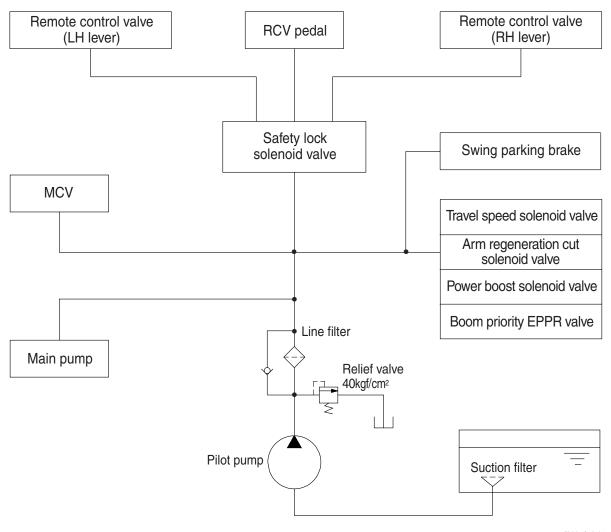
1) TRAVEL AND SWING MOTOR DRAIN CIRCUIT

Oil leaking 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 join with oil leak line of the swing motor and return to the hydraulic tank after being filtered by return filter.

2) MAIN PUMP DRAIN CIRCUIT

Oil leaking from main pump come out and return to the hydraulic tank passing through drain filter.

GROUP 3 PILOT CIRCUIT



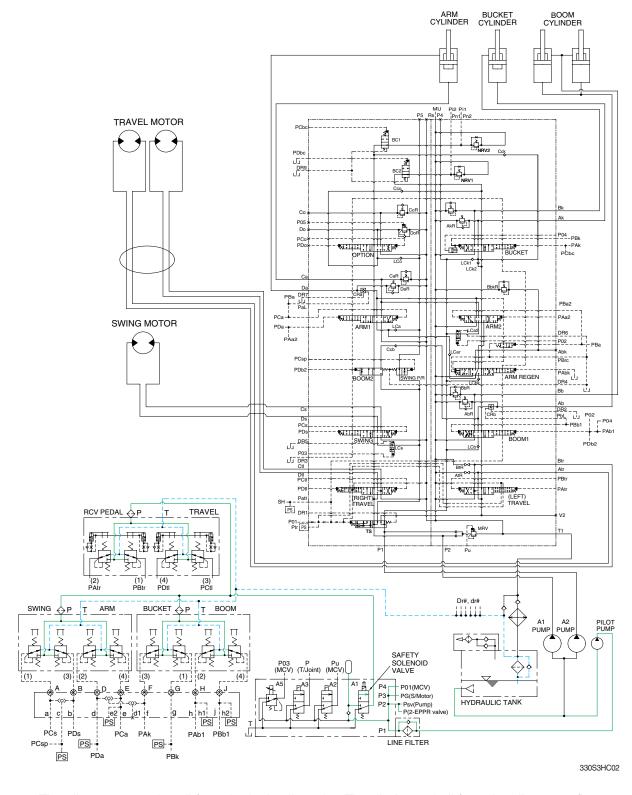
(210-7) 3-05

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

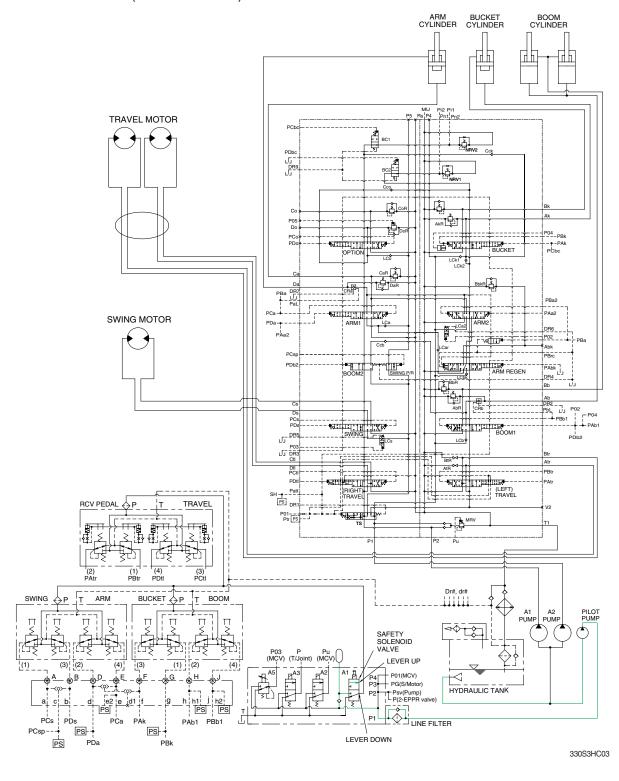


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

The return oil flow into the hydraulic tank through return filter.

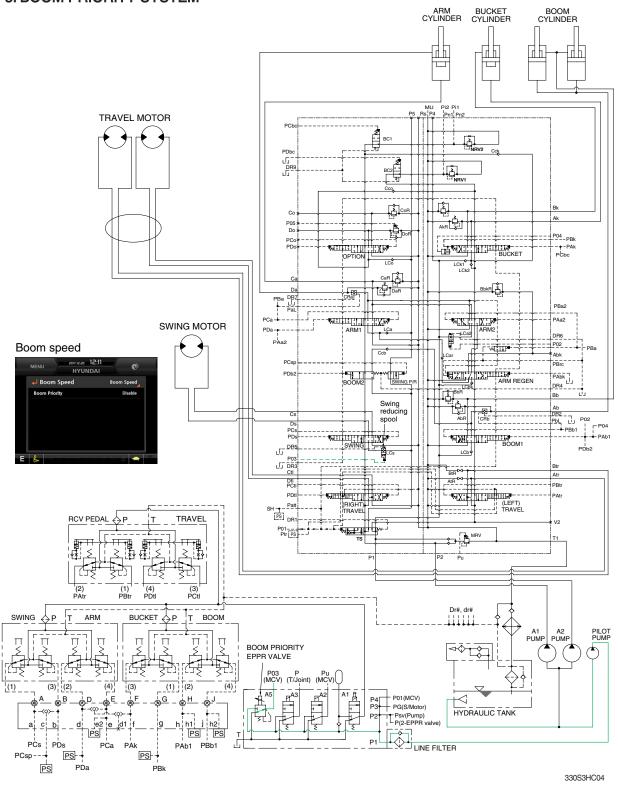
2. SAFETY VALVE (SAFETY LEVER)



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 flow 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 then normal operation.

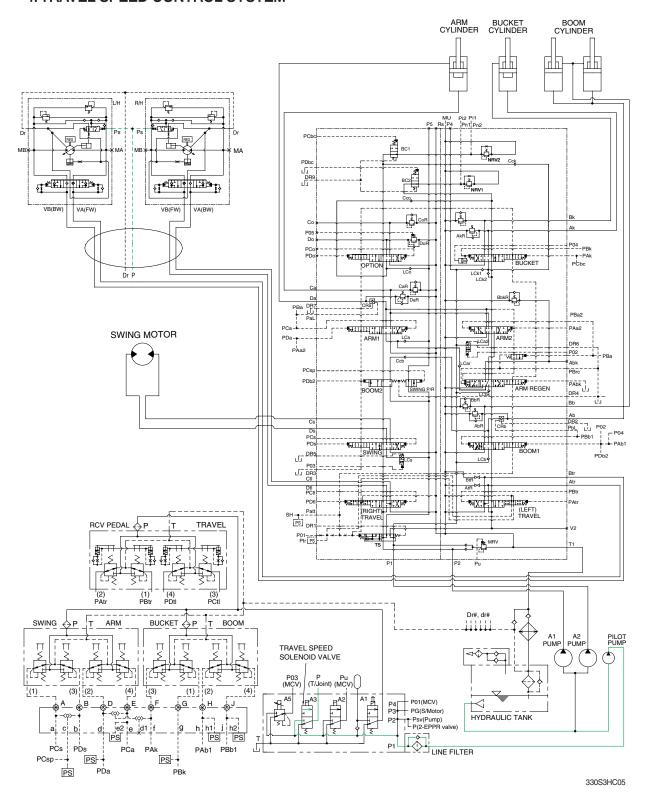
To increase working efficiency, swing speed reducing system is used.

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 3-19 of the operator's manual.

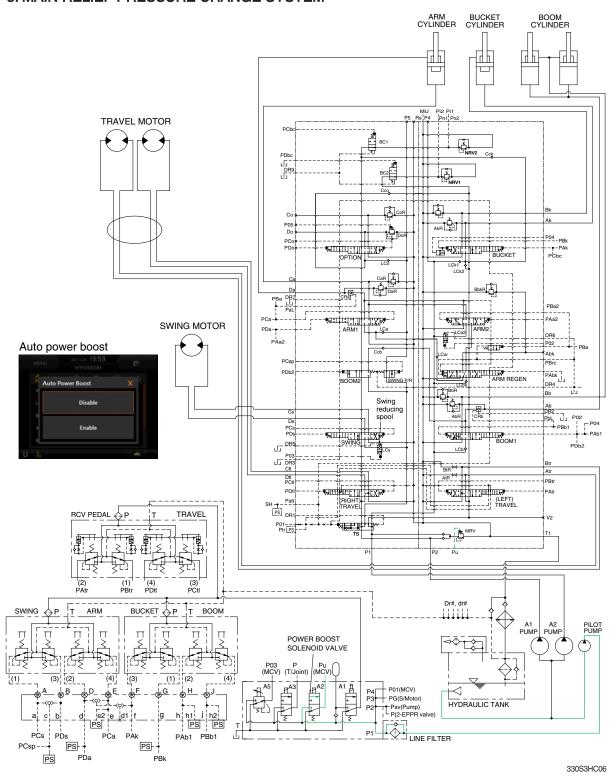
4. TRAVEL SPEED CONTROL SYSTEM



When the travel speed solenoid valve was placed in the Hi position, the pressure oil from pilot pump through line filter flows to port **Ps** of travel speed change over valve, and the control piston is pushed, thus minimizing the displacement.

When the travel speed solenoid valve was placed in the Lo position, the oil of **Ps** port return to the tank and the control piston is returned, thus maximizing the displacement.

5. MAIN RELIEF PRESSURE CHANGE SYSTEM

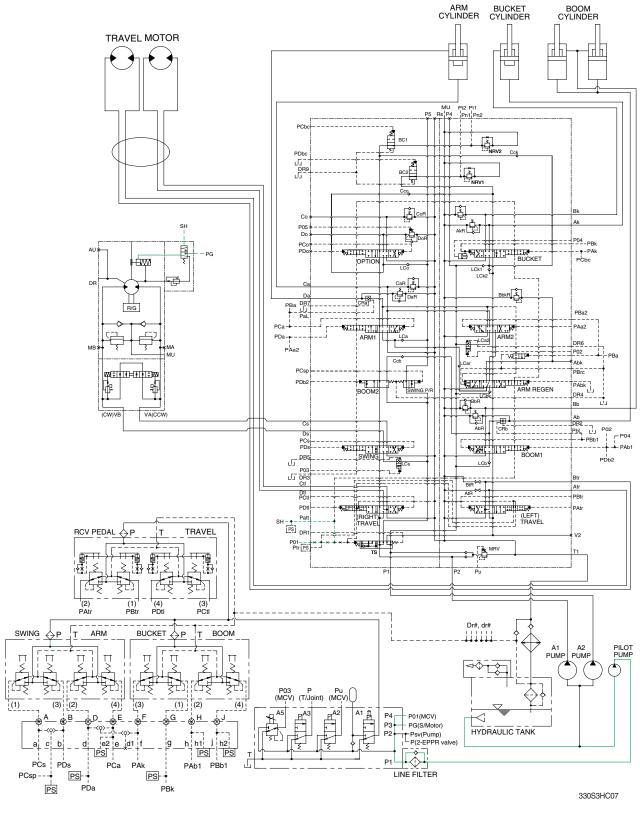


When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into **Pu** port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 350 kgf/cm² (4980 psi) to 380 kgf/cm² (5400 psi) for increasing the digging power.

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

When the auto power boost 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. SWING PARKING BRAKE RELEASE

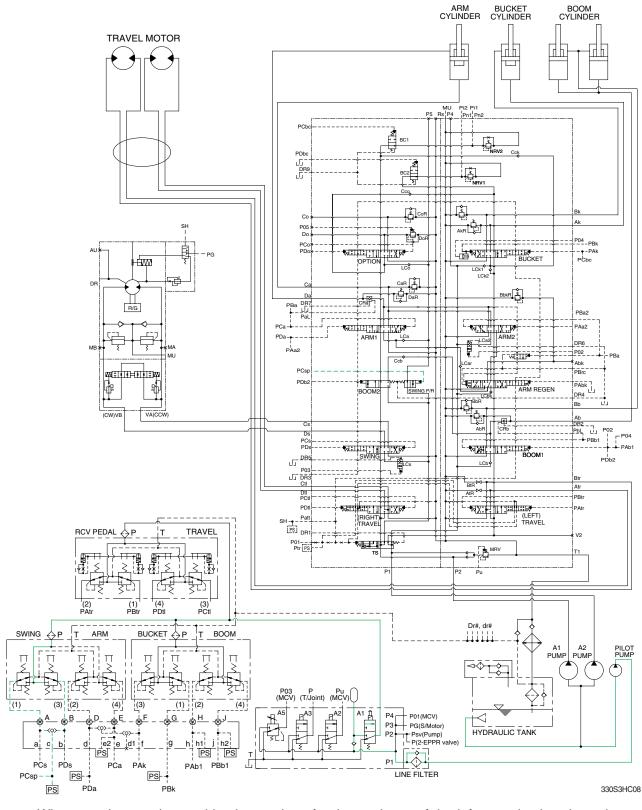


When one of the RCV lever (except travel lever) is tilted, the pilot oil flows into SH port through main control valve.

This pressure moves spool of the swing brake valve so, discharged oil from pilot valve flows to swing motor PG port. This pressure is applied to swing motor disc, thus the brake is released.

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

7. SWING PRIORITY SYSTEM



When carrying out the combined operation of swing and arm of the left control valve, the swing speed can be lowered than operating speed of arm.

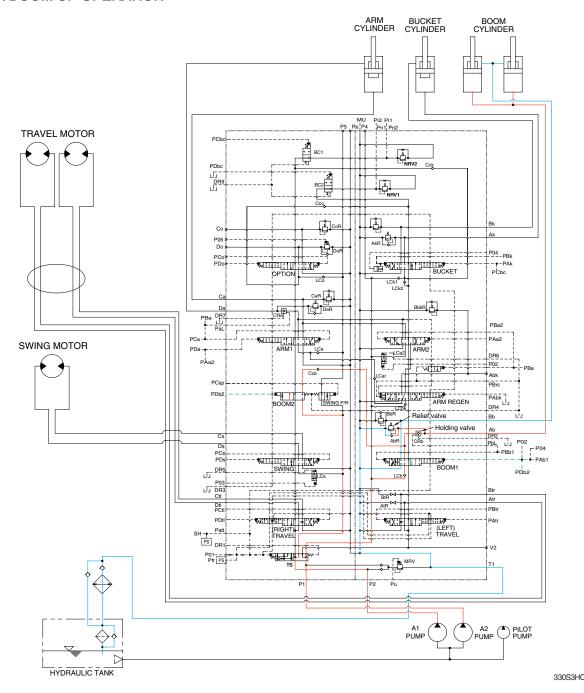
PCsp pressure from the swing shuttle block change the swing priority spool and decreases the oil flow rate to the next section to make the swing operation most preferential.

This is called the swing priority system.

For details, refer to page 2-51.

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.

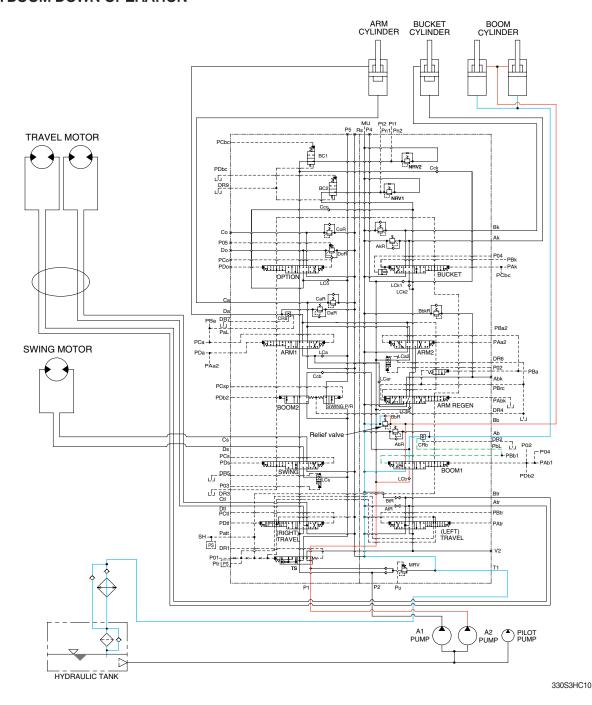
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom 1 spool in the main control valve. When this happens, the boom goes up.

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 bottom end of the boom cylinder is closed by the boom holding valve.

This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



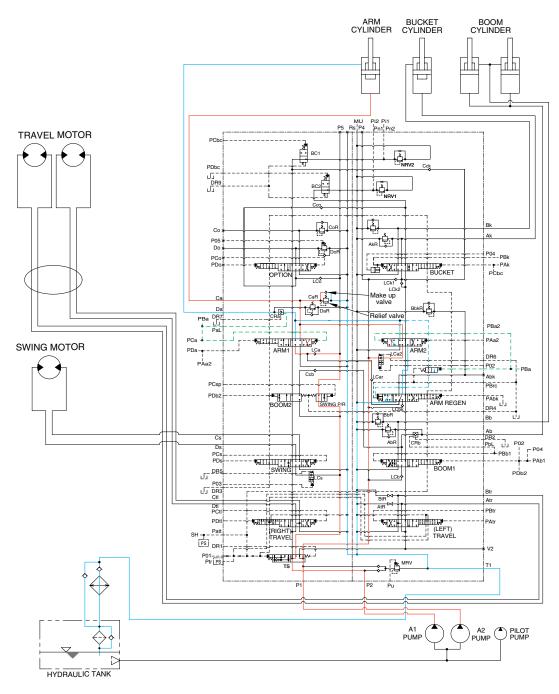
When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure from the remote control valve.

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



330S3HC11

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

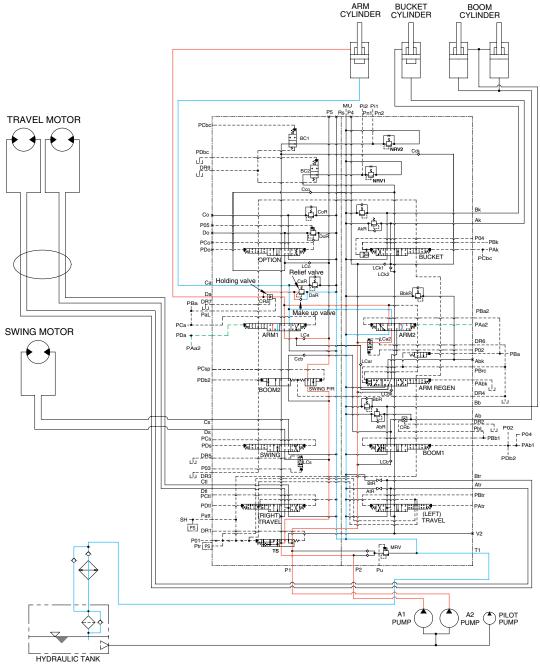
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 2 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



330S3HC12

When the left control lever is pushed forward, the arm spools in the main control valve are moved to the roll 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.

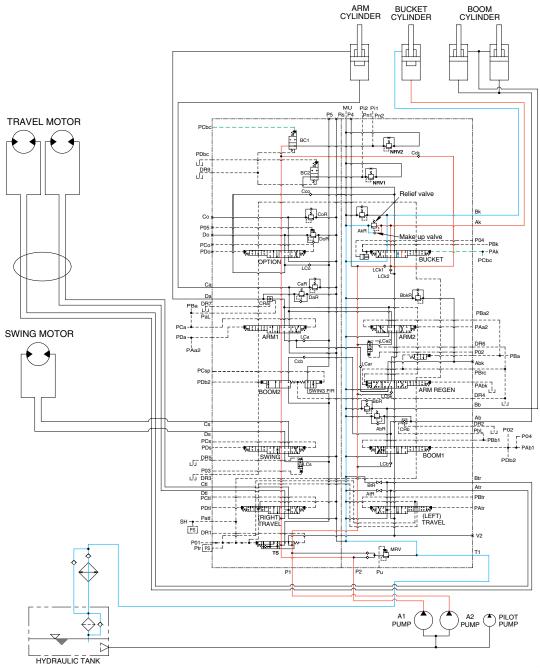
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spools in the main control valve. When this happens, the arm rolls out.

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

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

5. BUCKET IN OPERATION



330S3HC13

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.

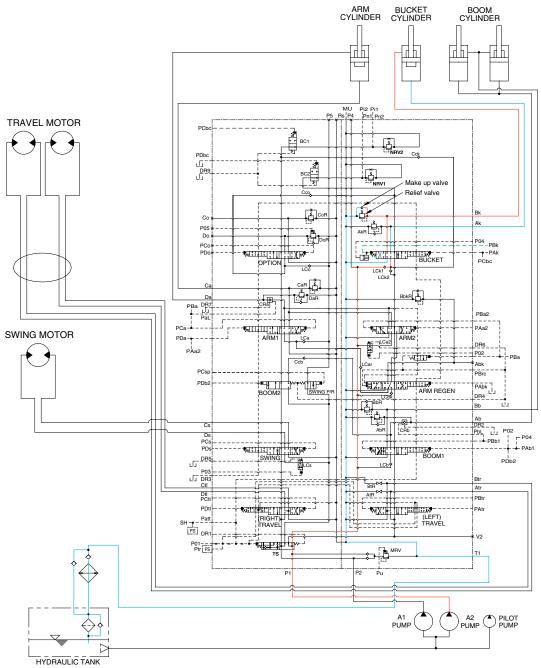
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder. The oil form the A1 pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (PCbc).

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



330S3HC14

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

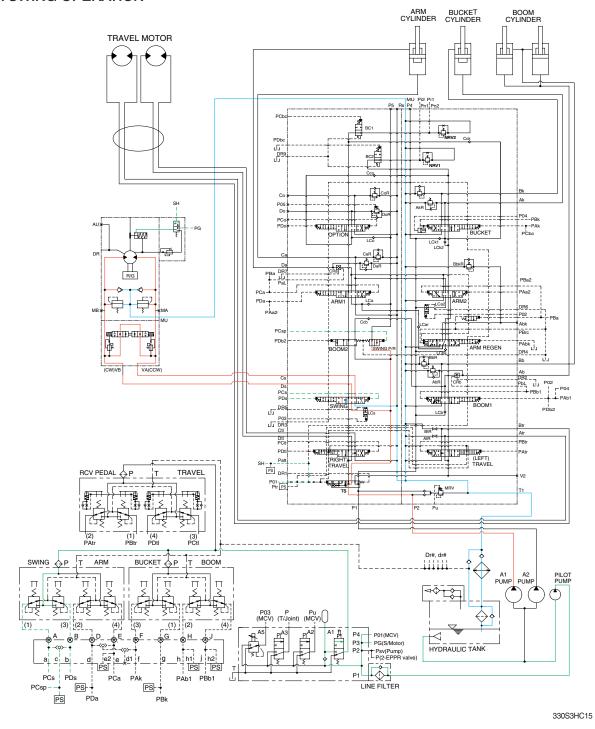
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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

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

7. 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 PCsp (refer to page 2-51).

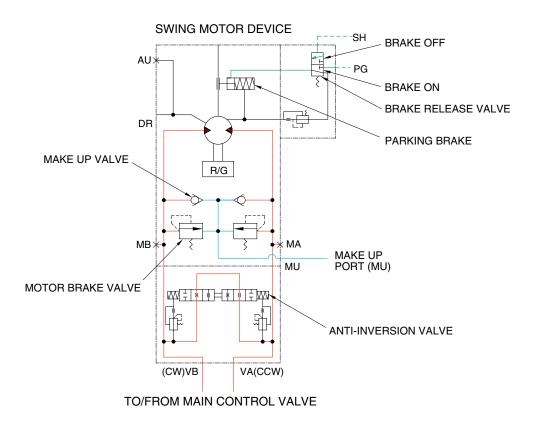
The oil from the A1 pump flows into the main control valve and then goes to the swing motor.

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



220S3HC15A

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 to 300 kgf/cm² (4270 psi).

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 the swing control lever and arm in control lever are not operated.

PARKING BRAKE "OFF" OPERATION

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

When the swing control lever or arm in control 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.

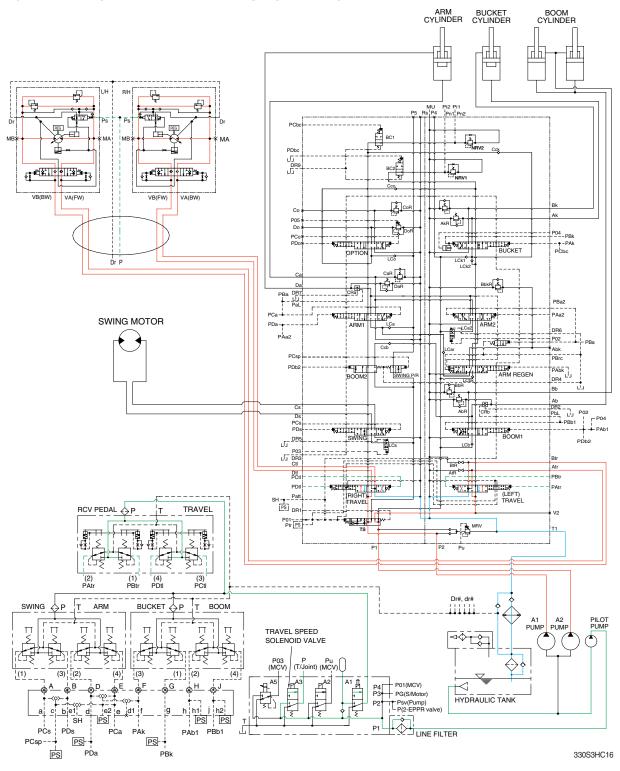
PARKING BRAKE "ON" OPERATION

When the swing control lever and arm in control 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



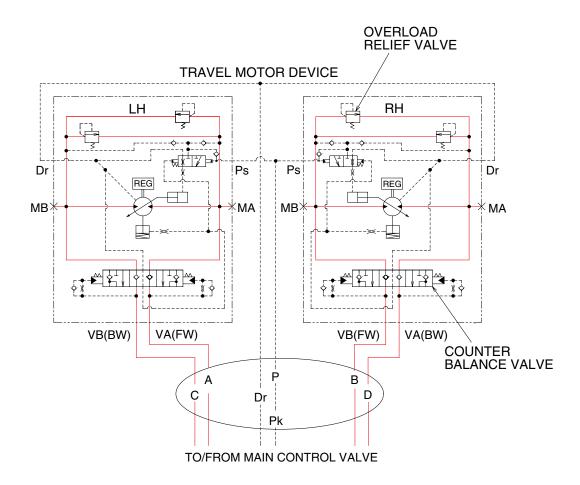
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

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



260L3HC16A

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

1) COUNTER BALANCE VALVE

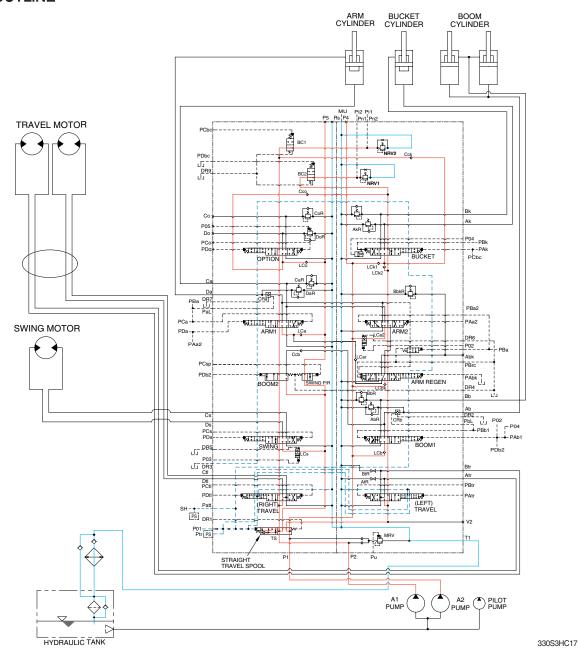
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 350 kgf/cm² (4980 psi) 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



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.

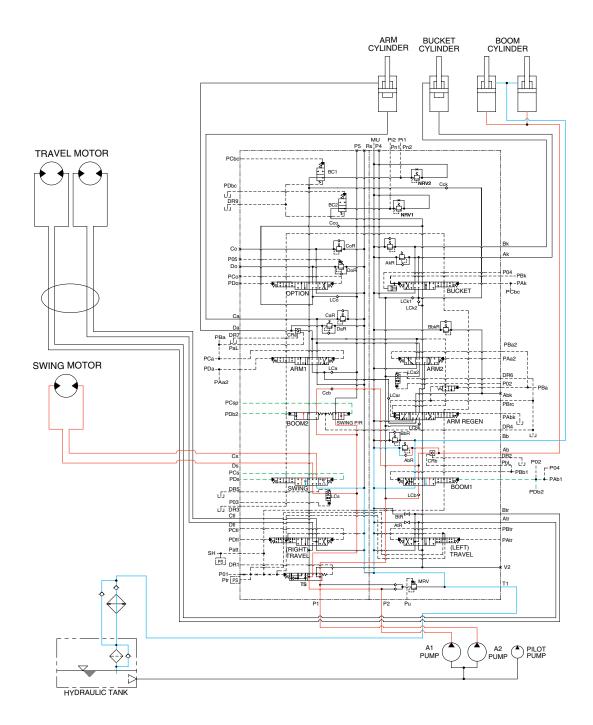
STRAIGHT TRAVEL SPOOL

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



330S3HC18

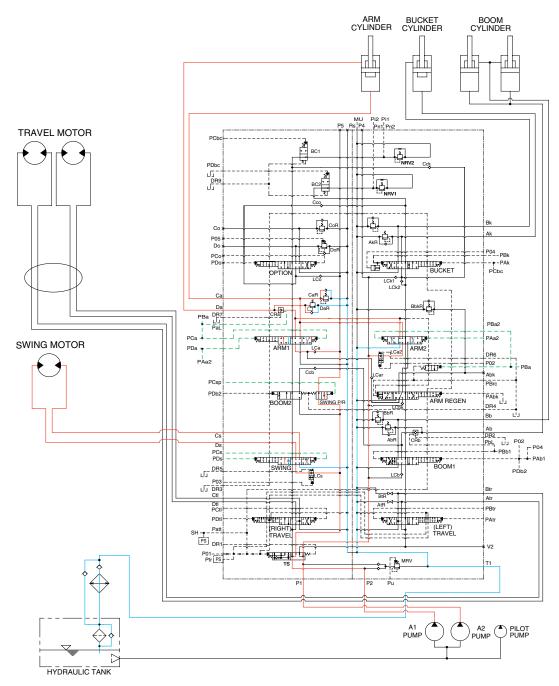
When the swing and boom up functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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 upper structure swings and the boom is operated.

Refer to page 3-9 for the boom priority system.

3. COMBINED SWING AND ARM OPERATION



330S3HC19

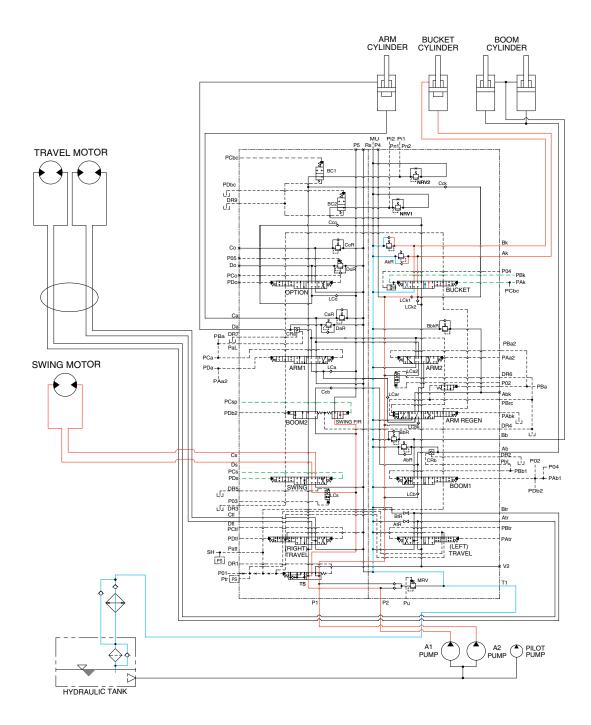
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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 upper structure swings and the arm is operated.

Refer to page 2-51 for the swing operation preference function.

4. COMBINED SWING AND BUCKET OPERATION



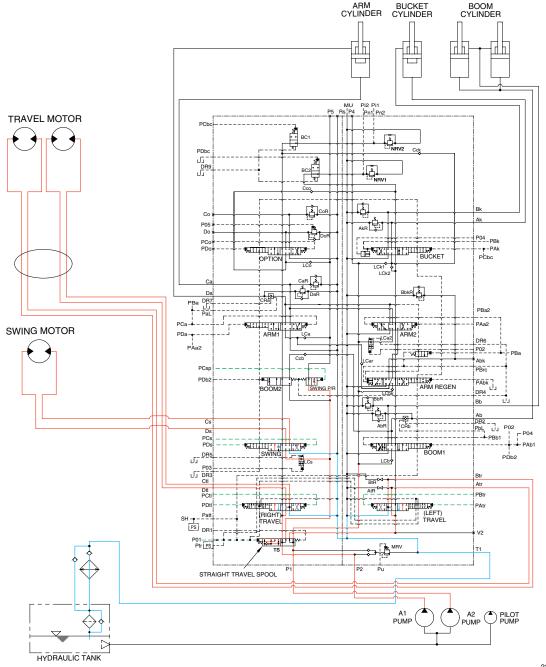
330S3HC20

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 upper structure swings and the bucket is operated.

5. COMBINED SWING AND TRAVEL OPERATION



330S3HC21

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.

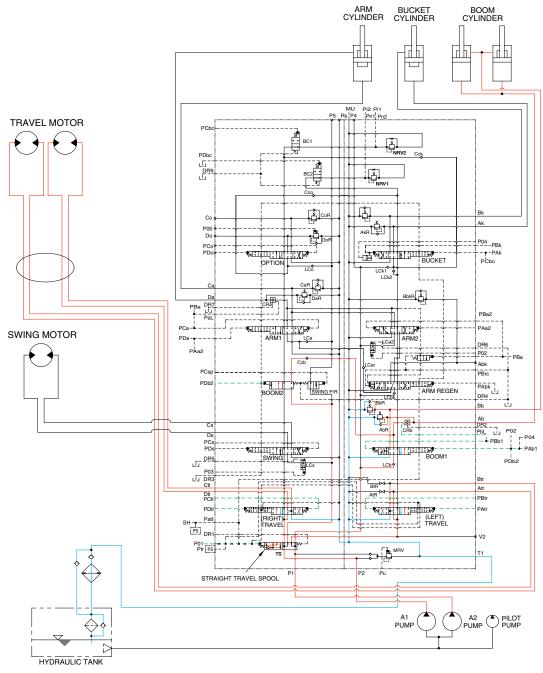
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the swing motor in the straight travel spool.

When the pressure of the travel motors is lower than the pressure of the swing motor, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The upper structure swings and the machine travels straight.

6. COMBINED BOOM AND TRAVEL OPERATION



330S3HC22

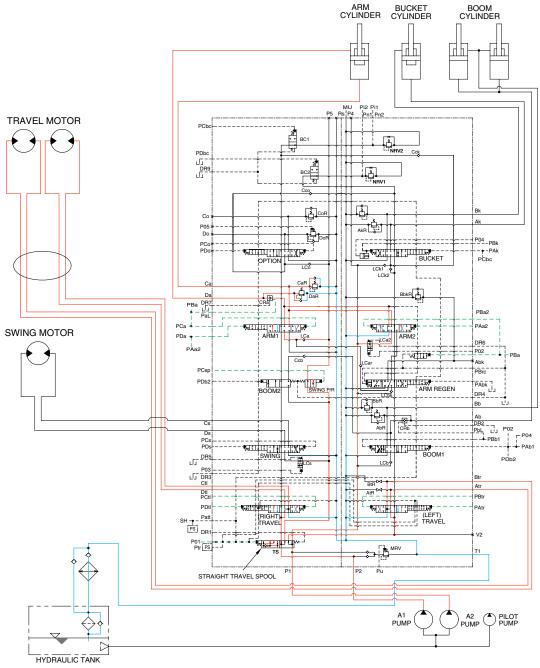
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot 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. When the pressure of the travel motors is lower than the pressure of the boom cylinders, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The boom is operated and the machine travels straight.

7. COMBINED ARM AND TRAVEL OPERATION



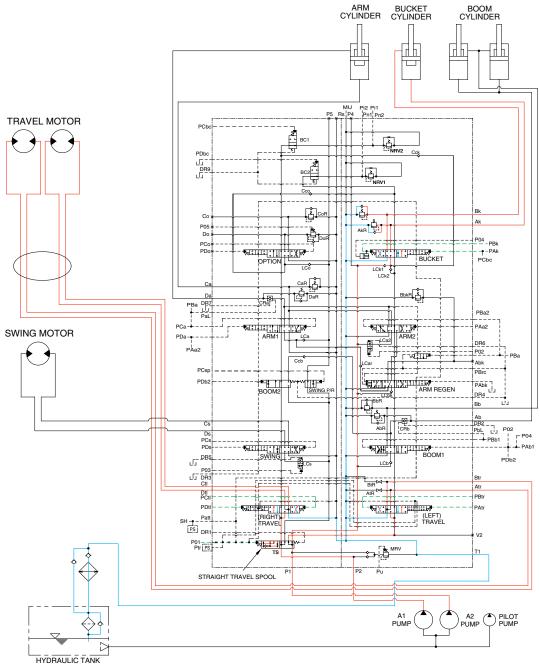
330S3HC23

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. When the pressure of the travel motors is lower than the pressure of the arm cylinder, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel. The arm is operated and the machine travels straight.

8. COMBINED BUCKET AND TRAVEL OPERATION



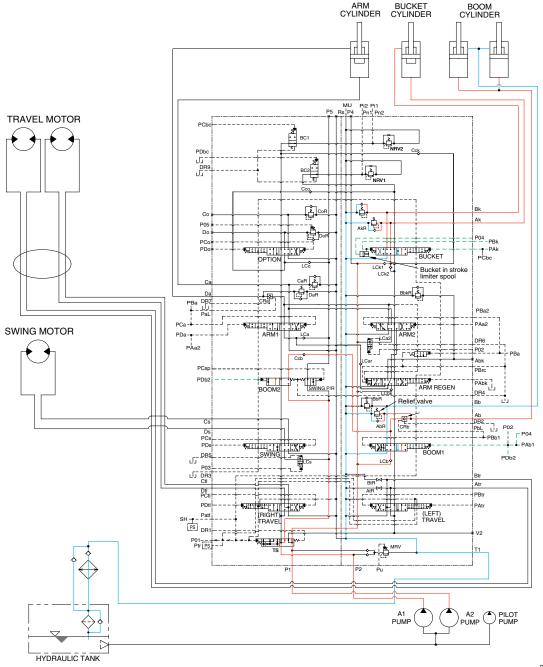
330S3HC24

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. When the pressure of the travel motors is lower than the pressure of the bucket cylinder, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The bucket is operated and the machine travels straight.

9. COMBINED BOOM UP AND BUCKET OPERATION



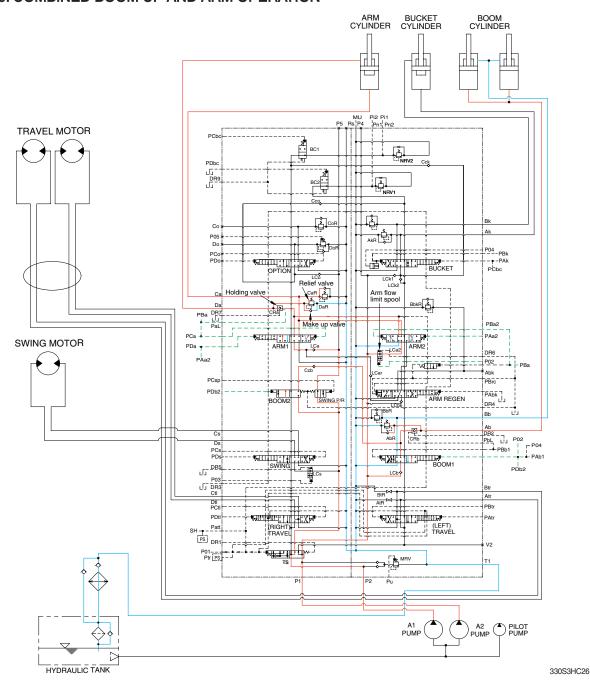
330S3HC25

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

The oil from the A1 pump flows into the boom cylinders through the boom 2 spool in the left control valve. The oil from the A2 pump flows into the boom cylinders and bucket cylinder through the boom 1 spool, bucket spool and the parallel and confluence oil passage in the right control valve.

Also, when the boom up and bucket in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure P04 and then the bucket spool transfers in the half stroke not full stroke (refer to page 2-43). Therefore, the most of pressurized oil flows into boom 1 spool than the bucket spool to make the boom up operation more preferential. The boom and bucket are operated.

10. COMBINED BOOM UP AND ARM OPERATION



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

The oil from the A1 pump flows into the boom cylinders and arm cylinder through the boom 2 spool and arm 1 spool in the left control valve. The oil from the A2 pump flows into the boom cylinders and arm cylinder through the boom 1 spool, arm 2 spool and the parallel and confluence oil passage in the right control valve.

Also, when the boom up and arm in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure P02 and then the flow into arm 2 spool is reduced by shifting of the arm in flow limit spool. Therefore, the most of pressurized oil flows into boom 1 spool than the arm 2 spool to make the boom up operation more preferential.

The boom and arm are operated.

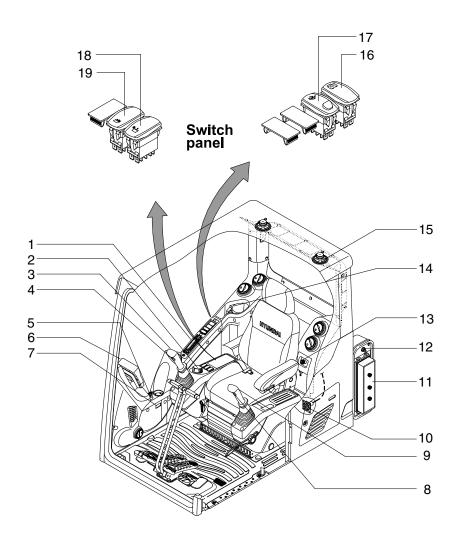
SECTION 4 ELECTRICAL SYSTEM

Group	1	Component Location ·····	4-1
Group	2	Electrical Circuit	4-3
Group	3	Electrical Component Specification	4-22
Group	4	Connectors ·····	4-31

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

1. LOCATION 1



300S4EL01

- 1 Radio & USB player
- 2 Accel dial
- 3 Horn switch
- 4 Breaker operation switch
- 5 Starting switch
- 6 Cluster
- 7 Service meter

- 8 Power max switch
- 9 One touch decel switch
- 10 RS232 service socket
- 11 Fuse & relay box
- 12 Master switch
- 13 Cigar lighter
- 14 12V socket

- 15 Speaker
- 16 Air compressor switch
- 17 Quick clamp switch
- 18 Swing fine switch
- 19 Swing lock switch

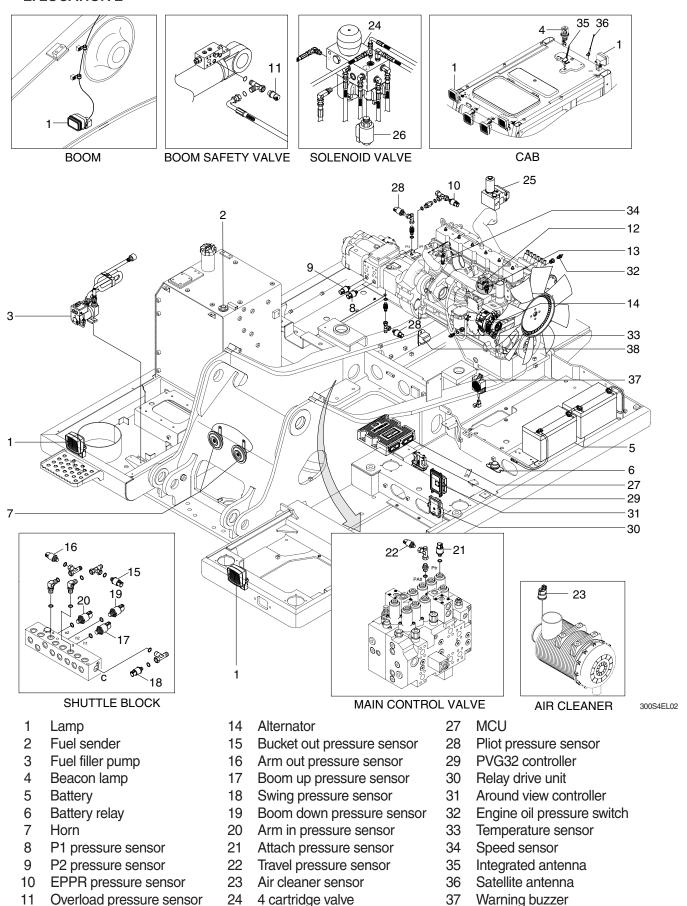
2. LOCATION 2

Start relay

Heater relay

12

13



Boom priority EPPR valve

Travel alarm buzzer

38

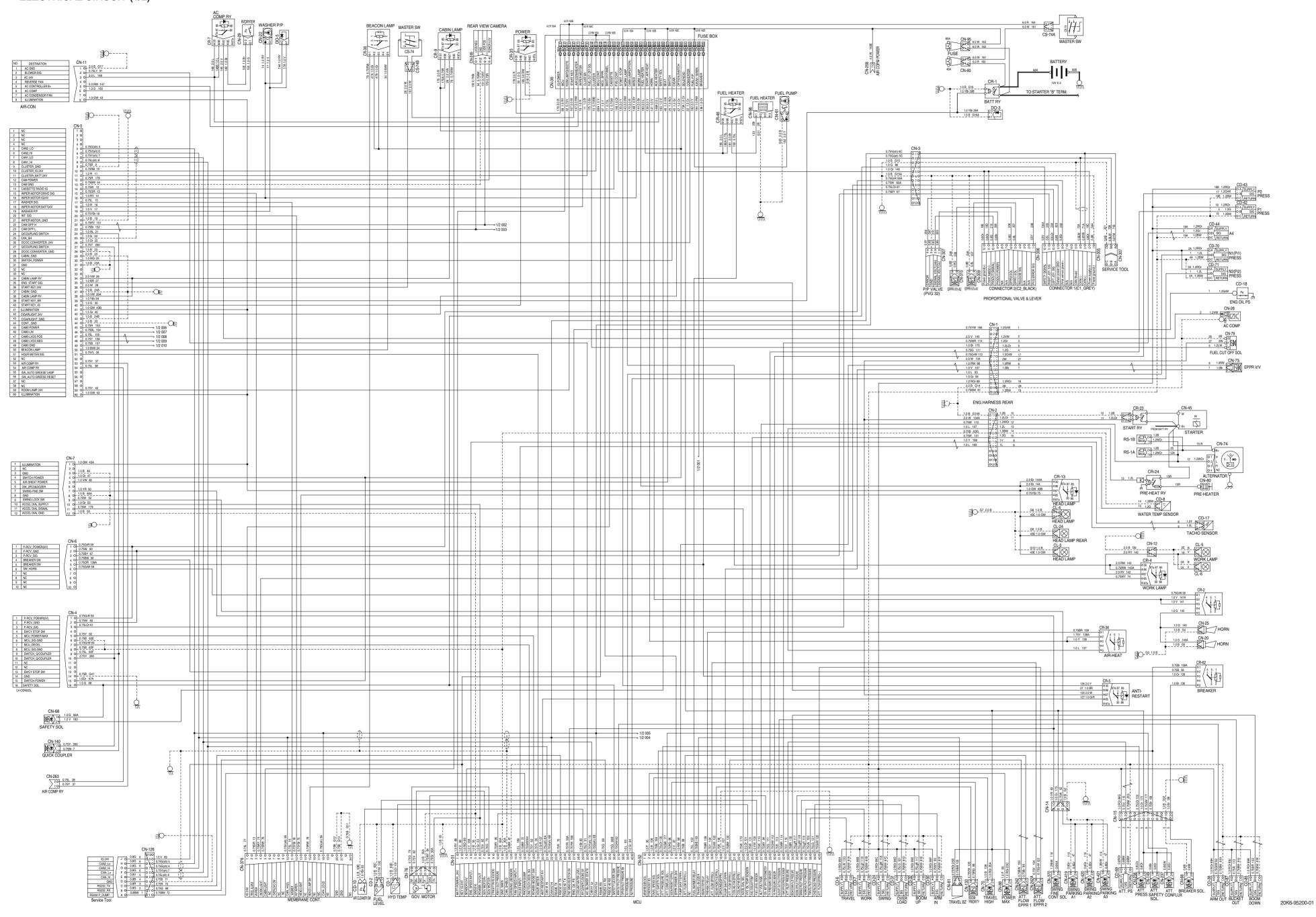
Pump EPPR valve

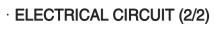
25

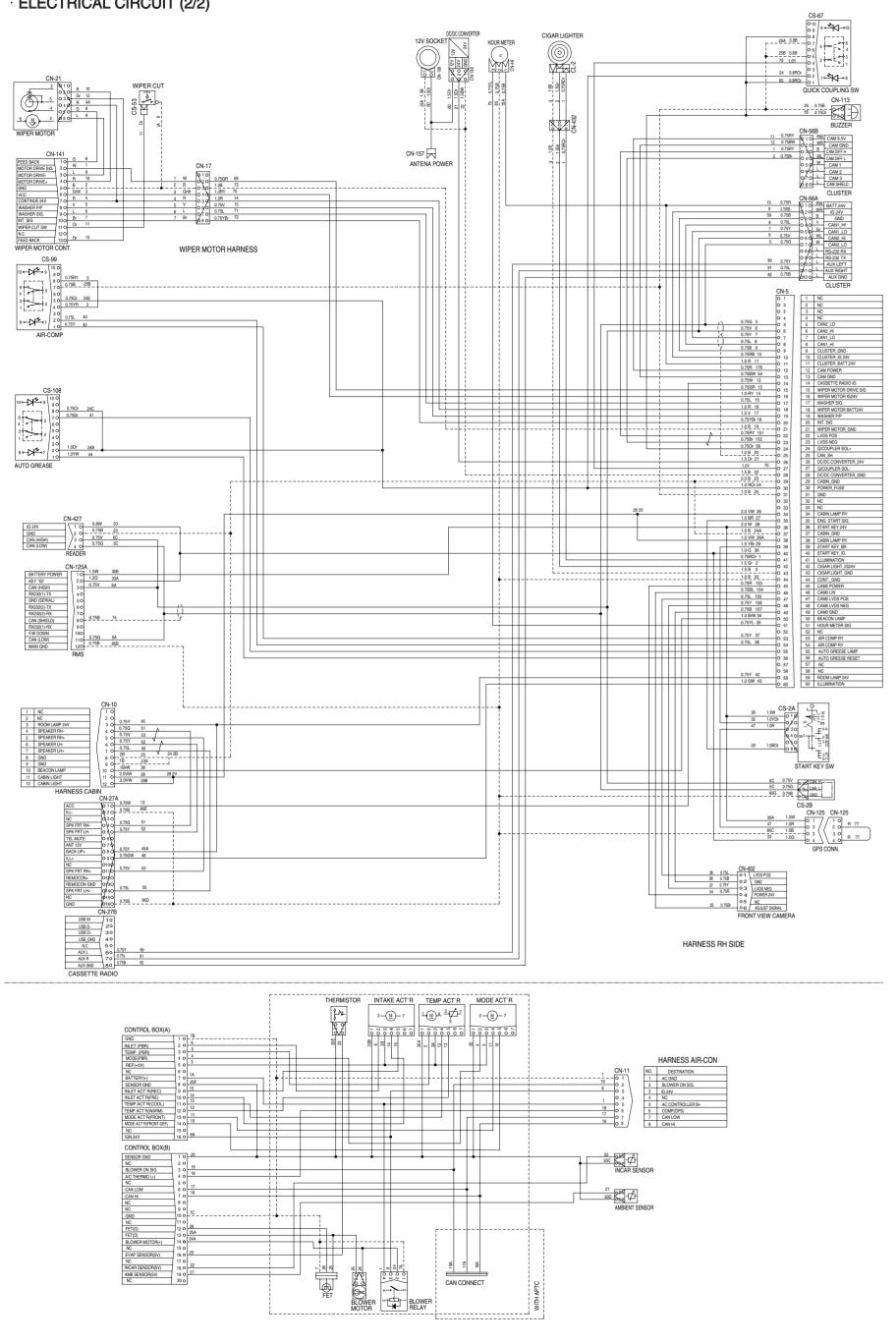
26

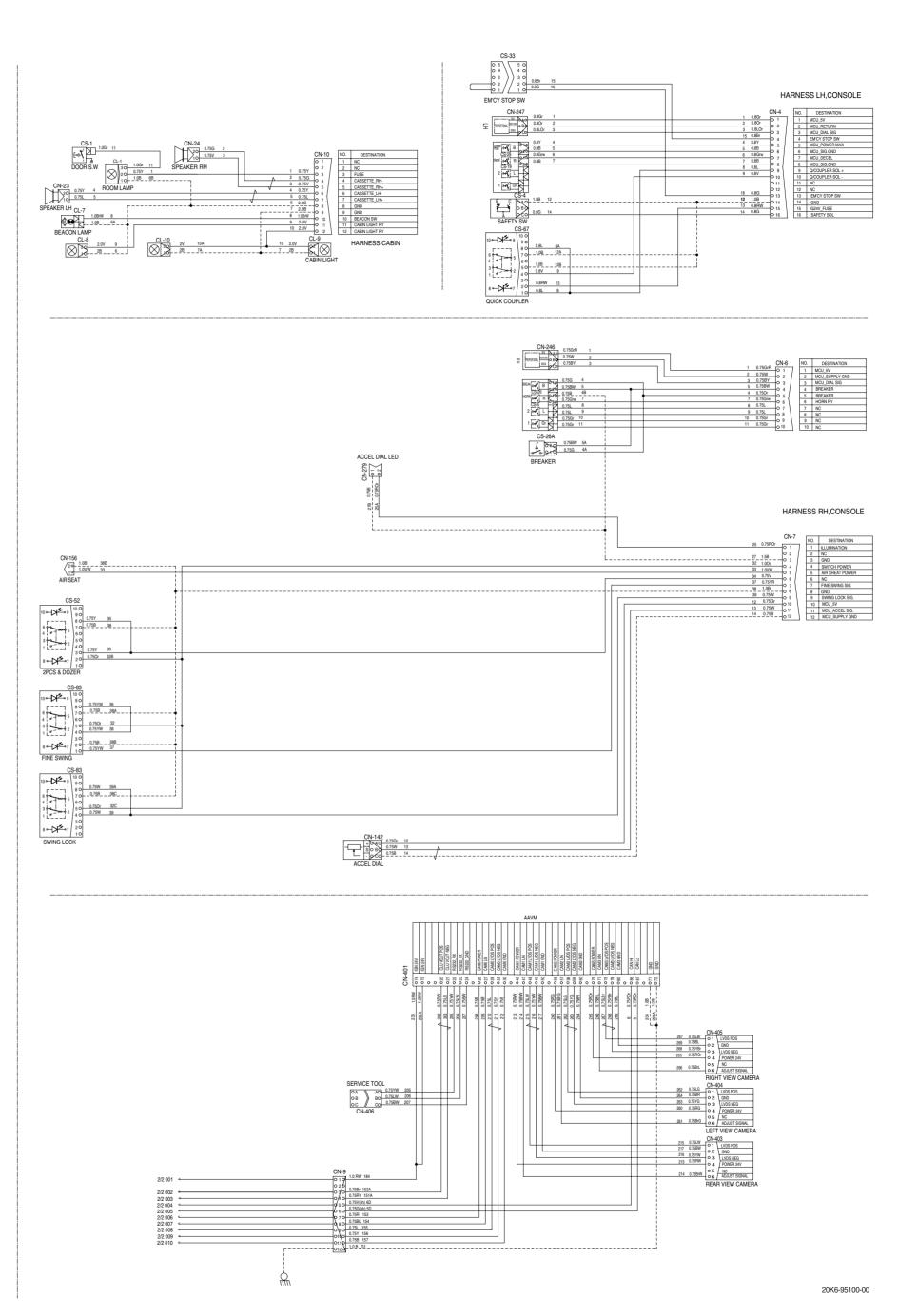
GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/2)







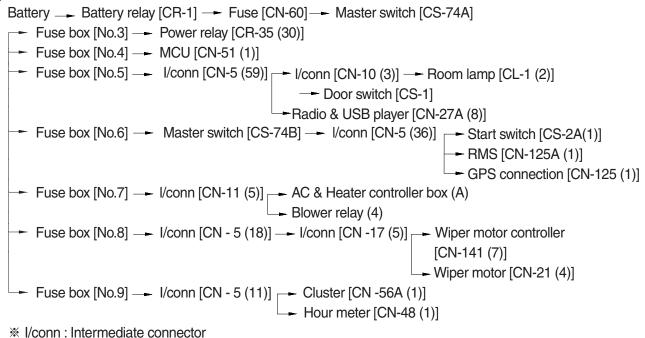


1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis directly.

When the start switch is in the OFF position, the current flows from the positive battery terminal as shown below.

1) OPERATING FLOW

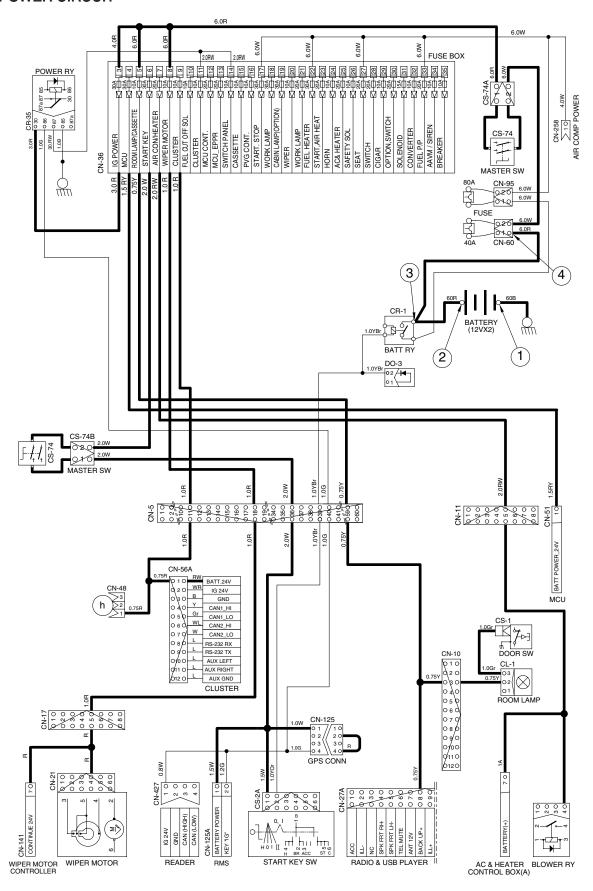


2) CHECK POINT

Engine	Start switch	Check point	Voltage
	OFF	① - GND (battery 1EA)	10~12.5V
STOD		② - GND (battery 2EA)	20~25V
STOP	OFF	③ - GND (battery relay)	20~25V
		④ - GND (fuse)	20~25V

*** GND: Ground**

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

```
Battery (+) terminal → Battery relay [CR-1] → Fuse [CN-60] → Master switch [CS-74A]
-- Fuse box [No.5] -- Master switch [CS-74B] -- I/conn [CN-5 (36)] -- Start switch [CS-2A (1)] -- Power relay [CR-35 (30)]
```

(1) When start switch is in ON position

```
Start switch ON [CS-2A (2)] → I/conn [CN-5 (39)]

→ Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)

→ Start switch ON [CS-2A (3)] GPS conn [CN-125 (2) \rightarrow (4)]
    \rightarrow I/conn [CN-5 (40)] \rightarrow Power relay [CR-35 (86) \rightarrow (87)]
                               Fuse box [No.11] → MCU [CN-51 (1)]
                                → Fuse box [No.10] → I/conn [CN-1 (5)]
                                   Fuel cut off solenoid [CN-79 (H)]
    - Reader [CN-427 (1)]
    → RMS [CN-125A (2)]
```

(2) When start switch is in START position

```
Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (86) → (87)]

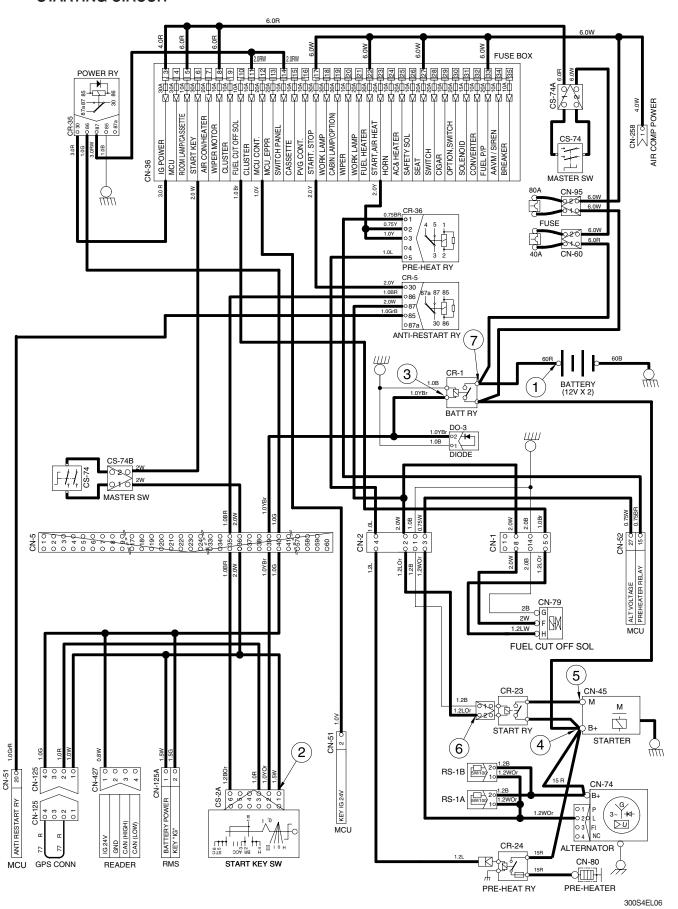
    I/conn CN-2 (2)
    Start relay [CR-23]
    Starter motor operating

→ I/conn [CN-1 (8)] → Fuel cut off solenoid [CN-79(F)]
```

2) CHECK POINT

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

STARTING CIRCUIT



3. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator releases the start 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 [CN-74 (2)] — I/conn [CN-2 (3)] — MCU alternator voltage [CN-52 (27)] — Cluster charging warning lamp (Via CANbus interface)

(2) Charging flow

```
Alternator [CN-74 (B<sup>+</sup>)] — Battery relay(M8)

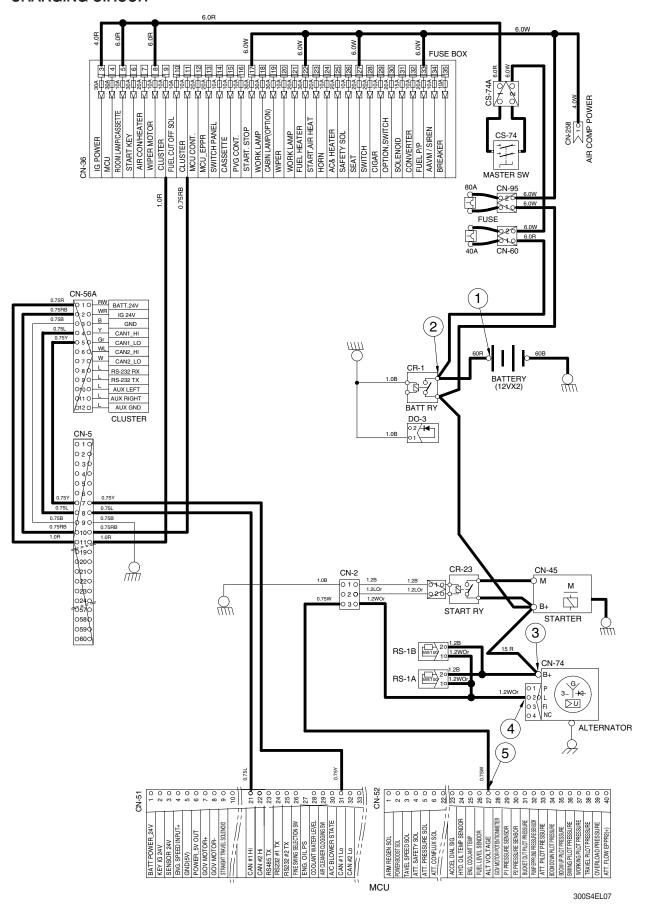
Battery (+) terminal
Fuse [CN-60] — Master switch [CS-74A] — Fuse box [No.3~9]
Fuse [CN-95] — Fuse box [No.17~35]
Air compressor power [CN-258 (1)]
```

2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (battery voltage)	
		② - GND (battery relay)	
RUN	ON	③ - GND (alternator B ⁺ terminal)	20~25V
		④ - GND (alternator 2 terminal)	
		⑤ - GND (MCU)	

*** GND: Ground**

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

```
Fuse box (No.21) — Head light relay [CR-13 (30, 86)]
Fuse box (No.18) — Work light relay [CR-4 (30, 86)]
Fuse box (No.14) — Membrane controller [CN-376 (1)]
```

(1) Head light switch ON

```
Head light switch ON [CN-376 (13)] → Head light relay [CR-13 (85) → (87)]

Head light ON [CL-3 (2), CL-4 (1), CL-24 (2)]

I/conn [CN-5 (41)] → I/conn [CN-432 (1)] → Cigar lighter [CL-2]

I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]

I/conn [CN-7 (1)] → Accel dial LED [CN-279 (2)]
```

(2) Work light switch ON

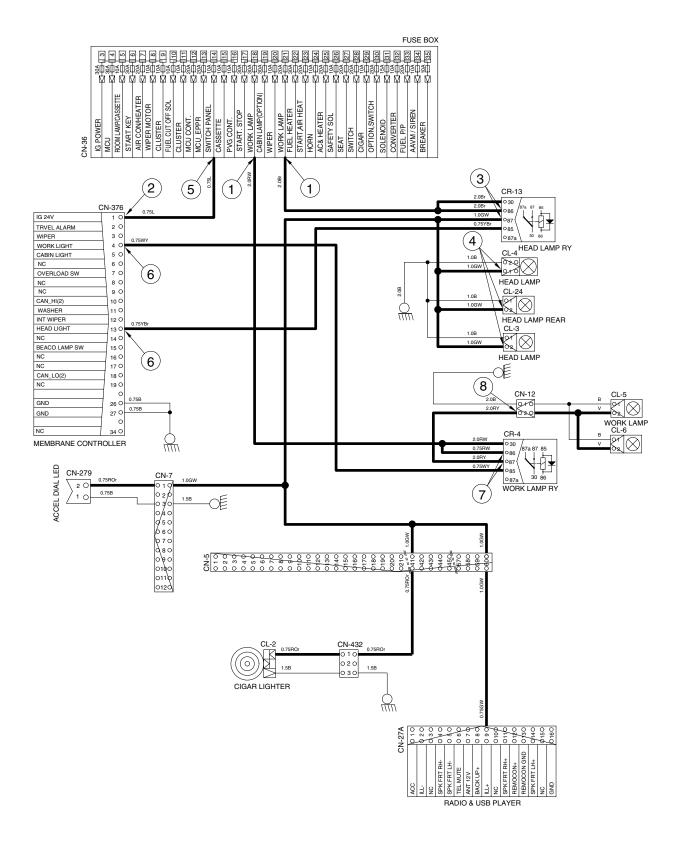
```
Work light switch ON [CN-376 (4)] \longrightarrow Work light relay [CR-4 (85) \rightarrow (87)] \longrightarrow l/conn [CN-12 (1)] \longrightarrow Work light ON [CL-5 (2), CL-6 (2)]
```

2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (fuse box)	
		② - GND (switch power input)	
		③ - GND (head light relay)	00.057
OTOD	ON	④ - GND (head light)	
STOP	ON	⑤ - GND (fuse box)	20~25V
		⑥ - GND (switch power output)	
		⑦ - GND (work light relay)	
		8 - GND (work light)	

***** GND : Ground

HEAD AND WORK LIGHT CIRCUIT



300S4EL08

5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

```
Fuse box (No.30) → Beacon lamp relay [CR-36 (2, 3)]
Fuse box (No.19) → Cab light relay [CR-9 (30, 86)]
Fuse box (No.14) → Membrane controller [CN-376 (1)]
```

(1) Beacon lamp switch ON

```
Beacon lamp switch ON [CN-376 (15)] → Beacon lamp relay [CR-36 (1)→(5)] → I/conn [CN-5 (50)] → I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]
```

(2) Cab light switch ON

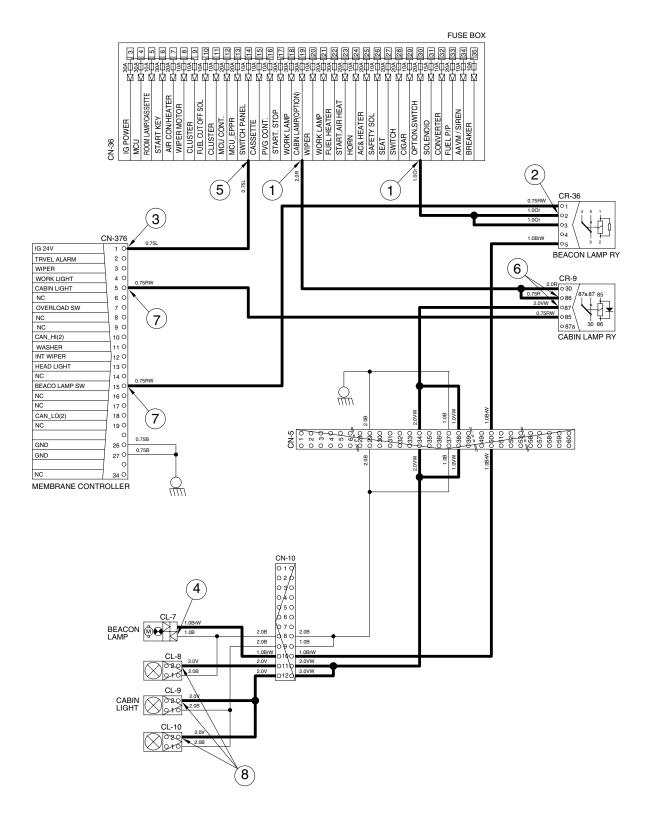
```
Cab light switch ON [CN-376 (5)] — Cab lamp relay [CR-9 (85) → (87)]
— I/conn [CN-10 (11)] — Cab light ON [CL-8 (2)]
— I/conn [CN-10 (12)] — Cab light ON [CL-9 (2), CL-10 (2)]
```

2) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (fuse box)	
		② - GND (beacon lamp relay)	
		③ - GND (switch power input)	
CTOD	ON	④ - GND (beacon lamp)	00.057
STOP	ON	⑤ - GND (fuse box)	20~25V
		⑥ - GND (cabin light relay)	
		⑦ - GND (switch power output)	
		8 - GND (cab light)	

***** GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



300S4EL09

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Start switch ON

Fuse box (No.14) → Membrance controller [CN-376 (1)]

Fuse box (No.8) — I/conn [CN-5 (18)] — I/conn [CN-17 (5)] — Wiper motor controller [CN-141 (7)] — Wiper motor [CN-21 (4)]

Fuse box (No.20) / I/conn [CN-5 (16)] / I/conn [CN-17 (4)] Wiper motor controller [CN-141 (6)] Washer pump [CN-22 (2)]

(2) Wiper switch ON (Intermittent)

Wiper switch ON [CN-376 (12)] → I/conn [CN-5 (20)] → I/conn [CN-17 (8)]

→ Wiper motor controller [CN-141 (10)→(3)] → Wiper motor [CN-21 (6)] → Intermittently operating

(3) Wiper switch ON (continual)

Wiper switch ON [CN-376 (3)] → I/conn[CN-5 (15)] → I/conn[CN-17 (2)]

→ Wiper motor controller [CN-141 (2) → (4)] → Wiper motor [CN-21 (2)] → Continual operating

(4) Washer switch ON

Washer switch ON [CN-376 (11)] → I/conn [CN-5 (17)] → I/conn [CN-17 (7)]

- → Wiper motor controller [CN-141 (9) → (8)] → I/conn [CN-17 (6)] → I/conn [CN-5 (19)]
- → Washer pump [CN-22 (1)] → Washer operating

Wiper switch ON [CN-376 (3)] → I/conn[CN-5 (15)] → I/conn[CN-17 (2)]

— Wiper motor controller [CN-141 (2) → (4)] — Wiper motor [CN-21 (2)] — Continual operating

(5) Auto parking (when switch OFF)

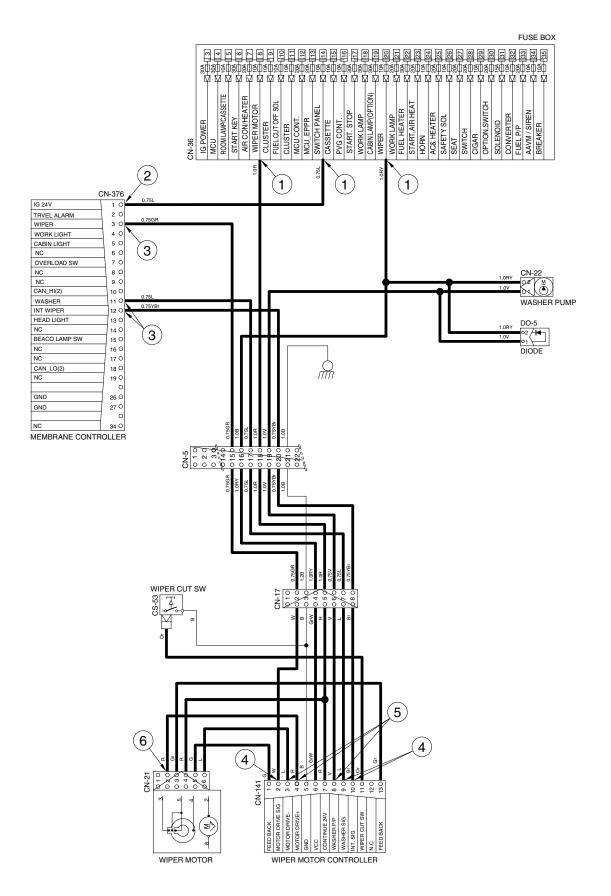
Switch OFF [CN-376 (3)] - Wiper motor parking position by wiper motor controller

3) CHECK POINT

Engine	Start switch	Check point	Voltage
		① - GND (fuse box)	20~25V
		② - GND (switch power input)	
STOP	ON	③ - GND (switch power output)	0 ~ 5V
		④ - GND (wiper switch power input)	0 00
		⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

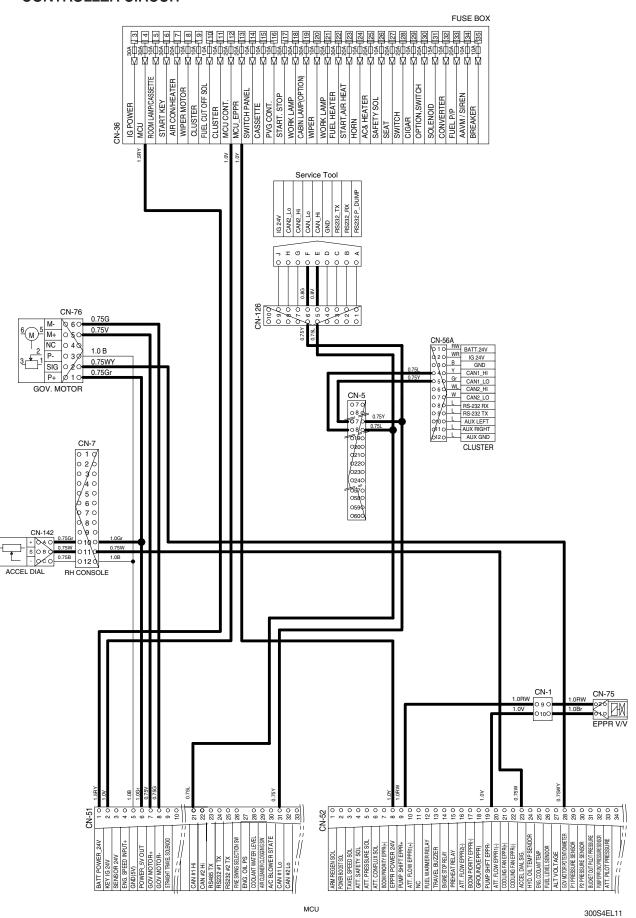
***** GND : Ground

WIPER AND WASHER CIRCUIT

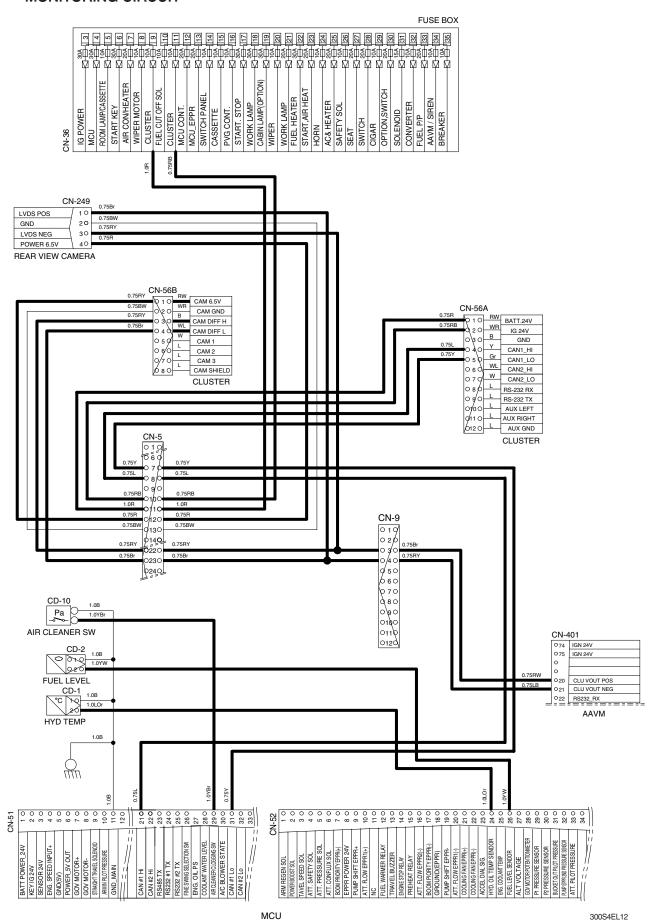


300S4EL10

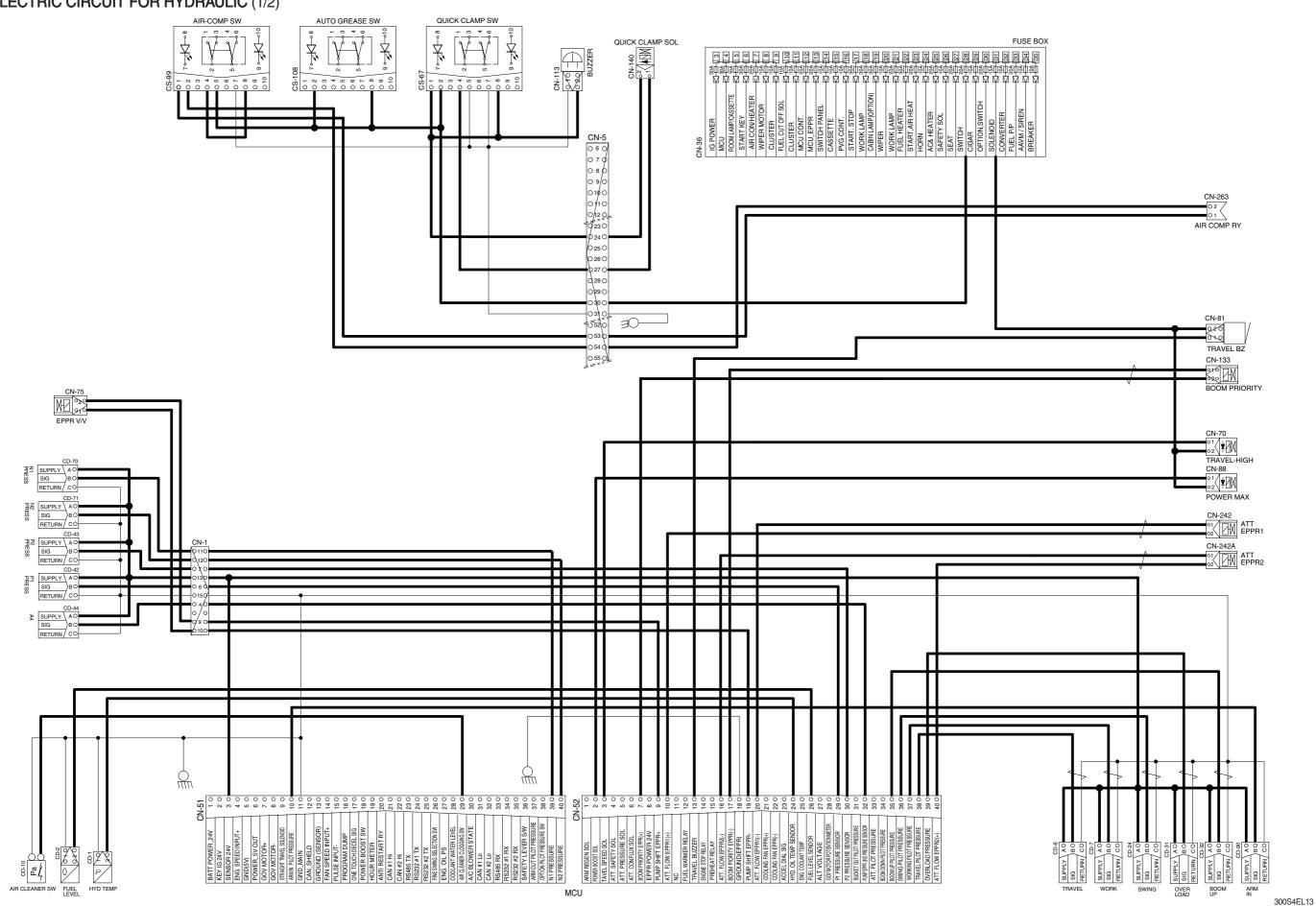
CONTROLLER CIRCUIT



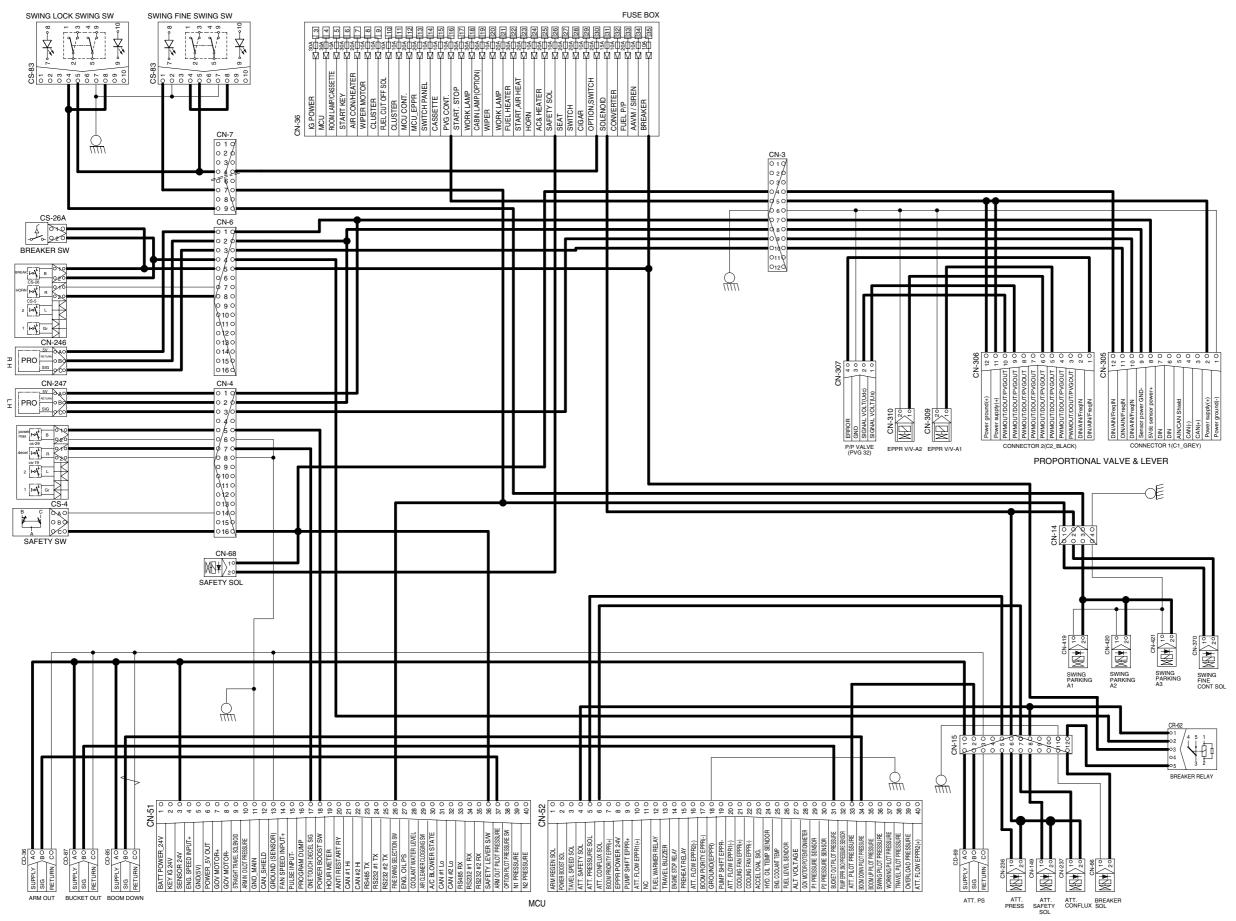
MONITORING CIRCUIT



ELECTRIC CIRCUIT FOR HYDRAULIC (1/2)



ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)



300S4EL14

GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	 Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	CR-1	Rated load: 24V 100A (continuity) 1000A (30seconds)	** Check coil resistance(M4 to M4) Normal : About 50Ω ** Check contact Normal : $\infty\Omega$
Preheat relay	CR-24	24V 200A	* Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start switch	0.0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	B-BR : 24V 1A B-ACC: 24V 10A B-ST : 24V 40A	** Check contact OFF: $\infty \Omega$ (for each terminal) ON: 0Ω (for terminal 1-3 and 1-2) START: 0Ω (for terminal 1-6)
Pressure sensor	CD-6 CD-7 CD-24 CD-31 CD-32 CD-36 CD-70 CD-71 CD-85 CD-87 CD-90	8~30V	% Check contact Normal : 0.1Ω
Speed sensor	2 (df) CD-17	-	** Check resistance Normal : 300 Ω (For terminal 1-2)

Part name	Symbol	Specifications	Check
Pre-heater	CN-80	24V 200A	** Check resistance 0.25~0.12 \text{\Omega}
Temperature sensor (hydraulic, water)	°C 20 CD-1 CD-8	-	 Check resistance 50°C : 804Ω 80°C : 310Ω 100°C : 180Ω
Air cleaner pressure switch	Pa CD-10	N.O TYPE	\divideontimes Check contact High level : $∞$ $Ω$ Low level : 0 $Ω$
Fuel level sender	CD-2	-	** Check resistance Full:50 Ω 6/12:350 Ω 11/12:100 Ω 5/12:400 Ω 10/12:150 Ω 4/12:450 Ω 9/12:200 Ω 3/12:500 Ω 8/12:250 Ω 2/12:550 Ω 7/12:300 Ω 1/12:600 Ω Empty warning:700 Ω
Relay (air con blower)	3 4 40 30 20 1 2 10	24V 20A	% Check resistance Normal : About 200Ω (for terminal 1-3) $\infty\Omega$ (for terminal 2-4)
Relay	CR-2 CR-36 CR-45 CR-62	24V 16A	** Check resistance Normal : About 160 Ω (for terminal 1-2) 0Ω (for terminal 3-4) $\infty\Omega$ (for terminal 3-5)

Part name	Symbol	Specifications	Check
Relay	CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	% Check resistance Normal : About 160 Ω (for terminal 85-86) 0Ω (for terminal 30-87a) $\infty\Omega$ (for terminal 30-87)
Solenoid valve	CN-66 CN-68 CN-70 CN-88 CN-140 CN-149 CN-236 CN-237 CN-370 CN-419 CN-420 CN-421	24V 1A	** Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	1 O 2 O CN-75 CN-133 CN-242 CN-242A CN-309 CN-310	700mA	** Check resistance Normal: 15~25
Speaker	O 1 O 2 CN-23 (LH) CN-23 (RH)	20W	
Switch (locking type)	CS-52 CS-67 CS-83 CS-99 CS-108	24V 8A	% Check contact Normal ON : 0 Ω (for terminal 2-3, 5-6) $\infty \Omega$ (for terminal 1-2, 4-5) OFF: $\infty \Omega$ (for terminal 2-3, 5-6) 0 Ω (for terminal 1-2, 4-5)
Room lamp	3 O 2 O 1 O CL-1	24V 10W	% Check disconnection Normal : 1.0Ω ON : 0Ω (For terminal 1-2) Ω (For terminal 1-3) OFF : Ω (For terminal 1-2) Ω (For terminal 1-3)

Part name	Symbol	Specifications	Check
Head lamp, Work lamp, Cab lamp	CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 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 ℓ /min	* Check resistance Normal: 1.0 Ω
Hour meter	3 2 h 1 CN-48	16~32V	 Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	CN-20 CN-25	DC22~28V 2A	Check operation Supply power(24V) to each terminal and connect ground.
Safety switch	B C 0 0 B 0 C 0 CS-4	24V 15A (N.C TYPE)	% Check contact Normal : 0Ω (for terminal A-B) $\infty\Omega$ (for terminal A-C) Operating : $\infty\Omega$ (for terminal A-B) 0Ω (for terminal A-C)

Part name	Symbol	Specifications	Check
Wiper cut switch	CS-53	24V (N.O TYPE)	% Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	○ 2	24V 2.5A	** Check contact Normal: ∞ Ω
Radio & USB player	ACC ILL Q 2 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0	24V 2A	** Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	© 2 M 0 1 CN-22	24V 3.8A	% Check contact Normal : 10.7Ω (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 : 7Ω (for terminal 2-6)
DC/DC Converter	0 3 12V 12V 24V GND 24V CN-138	12V 3A	Check voltage24V (for terminal 1-2)12V (for terminal 1-3)

Part name	Symbol	Specifications	Check
Cigar lighter	CL-2	24V 5A 1.4W	 Check coil resistance Normal : About 1M Ω Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	DH	Valeo 24V 95A	** Check contact Normal : 0Ω (for terminal B+-L) Normal : 24~27.5V
Starter	M M	24V 4.5kW	Check contact Normal: 0.1 Ω
Travel alarm	CN-81	24V 0.5A	** Check contact Normal : 5.2 Ω
Aircon compressor	CN-28 =	24V 79W	% Check contact Normal : 13.4 Ω
Start relay	CR-23	24V 300A	% Check contact Normal : 0.94Ω (for terminal 1-2)

Part name	Symbol	Specifications	Check
Blower motor	2 <u>M</u>	24V 9.5A	** Check resistance Normal: 2.5 Ω (for terminal 1-2)
Thermistor	200	1°C OFF 4°C ON	** Check resistance Normal : 0 \(\Omega\$ (for terminal 1-2), the atmosphere temp : Over 4°C *C
Door switch	CS-1	24V 2W	** Check resistance Normal : About 5M Ω
Switch (power max, one touch decel, horn, breaker)	CS-5 CS-19 CS-26 CS-29	24V 6A	\Re Check resistance Normal : $∞$ Ω
Fuse	CN-60 CN-95	CN-60 : 40A CN-95 : 80A	 ※ Check disconnection Normal: 0 Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	CS-74A, CS-74B	6-36V	% Check disconnection Normal: 0.1 Ω

Part name	Symbol	Specifications	Check
Quick clamp buzzer	CN-113	24V 200mA 107±4dB	-
Socket	O1 O2 CN-139	12V 10A	-
Fuel heater	CN-96	-	-
WIF sensor	©2 ⊙1	-	-
Proportional valve sensor	PROPORTIONAL RETURN B SIG	-	-
Fuel cut off solenoid	G F H CN-79	24V	※ Check resistance Normal: 15~25 Ω

Part name	Symbol	Specifications	Check
Pressure switch (for engine oil)	Pa	0.5kgf/cm ² (N.C TYPE)	** Check resistance Normal : 0 Ω (CLOSE)
Governor motor	6 M 5 M- 0 6 0 M 0 0 4 0 P- 0 3 0 SIG P+ 0 1 0 CN-76	-	% Check resistance Normal : $1~2~\Omega$ (for terminal 5-6) $0.8~1.2~\Omega$ (for terminal 1-2)

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector	Time	No. of	Doctination	Connecto	or part No.
number	Type	pin	Destination	Female	Male
CN-1	TE/AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-2	TE/AMP	12	I/conn (Frame harness-Engine harness)	S816-01200	S368301-1
CN-3	TYCO	12	I/conn (Frame harness-Pro vlv harness)	174661-2	S816-112001
CN-4	AMP	10	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-6	AMP/TE	10	I/conn (Console harness RH-Frame harness)	S816-010002	174655-2
CN-7	AMP/TE	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-120002
CN-9	DEUTSCH	12	I/conn (Frame harness-AAVM harness)	DT06-12SA-P021	DT04-12PA-P021
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12PA-P021
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-13	-	4	Swing parking & fine control	-	174259-2
CN-15	TE	12	I/conn (Frame harness-Breaker sol)	S816-012002	S816-112002
CN-17	AMP	8	I/conn (Wiper harness-Side harness RH)	S816-008002	S816-108002
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	S810-006202	-
CN-22	KET	2	Washer tank 1	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	Radio & USB player	-	174984-2
CN-28	KET	2	Aircon compressor	S814-002100	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B+	S820-108000	-
CN-48	KET	1	Hour 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-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	-	2	Circuit breaker	21K9-03270	21LM-03140
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	-

Connector	T	No. of	Destruction	Connecto	or part No.
number	Type	pin	Destination	Female	Male
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	-	4	Alternator terminal	1218 6568	-
CN-75	AMP	2	Pump EPPR valve	S816-002002	-
CN-76	DEUTSCH	6	Accel actuator	DT06-6S-EP06	-
CN-79	PACKARD	3	Fuel cutoff solenoid	1212 4685	-
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-95	-	-	Circuit breaker	21K9-03271	21LM-03180
CN-113	KET	2	Buzzer	MG651205-5	-
CN-125	Econoseal J	4	RMS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	RMS	DT06-12S-P021	DT04-12PA-P021
CN-126	TE/AMP	10	Service tool	174259-2	S816-110002
CN-133	DEUTSCH	2	Boom priority 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	-
CN-147	AMP	2	Fuel heater	1530 0027	1500 0027
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat	DT06-2S-EP06	DT04-2P
CN-157	AMP	1	Antena power	S822-014002	-
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 EPPR 1 (A1)	DT06-2S-EP06	DT04-2P-E0005
CN-242A	DEUTSCH	2	Attach EPPR 2 (A2)	DT06-2S-EP06	DT04-2P-E0005
CN-246	DEUTSCH	3	Proportional valve-RH	DT06-3S	DT04-3P
CN-247	DEUTSCH	3	Proportional valve-LH	DT06-3S	DT04-3P
CN-249	DEUTSCH	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005
CN-258	KET	1	Air compressor power	MG640944-5	MG650943-5
CN-263	DEUTSCH	2	Air compressor relay	DT06-2S-EP06	DT04-2P-E005
CN-279	AMP	2	Accel dial LED	S816-002002	-
CN-305	DEUTSCH	12	AAVM-Connector-1	DTM06-12SA	-
CN-306	DEUTSCH	12	AAVM-Connector-2	DTM06-12SB	-
CN-307	DEUTSCH	3	Proportional-Service tool	DT06-3S-E005	DT04-3P-EP06
CN-307	AMP	4	Proportional-PVG32	2-967059-1	-
CN-309	DEUTSCH	2	Proportional-EPPR valve-A1	DT06-2S-EP06	-
CN-310	DEUTSCH	2	Proportional-EPPR valve-A2	DT06-2S-EP06	-
CN-370	DEUTSCH	2	Swing fine control solenoid	DT06-2S-EP06	DT04-2P-E005

Connector	T	No. of	Dastinsting	Connecto	or part No.
number	Type	pin	Destination	Female	Male
CN-376	TYCO	23	Membrane controller	7706087-2	-
CN-401	FCI	90	AAVM controller	211PC902S0009	-
CN-402	DEUTSCH	6	Front view camera	DT06-6S-P021	DT04-6P-P021
CN-403	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P-EP14
CN-404	DEUTSCH	6	LH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-405	DEUTSCH	6	RH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-406	DEUTSCH	3	RS 232	DT06-3S-E005	DT04-3P-EP06
CN-408	FCI	4	Washer tank	MG640795	-
CN-419	DEUTSCH	2	Swing parking-A3	DT06-2S-EP06	-
CN-420	DEUTSCH	2	Swing parking-A2	DT06-2S-EP06	-
CN-421	DEUTSCH	2	Swing parking-A1	DT06-2S-EP06	-
CN-427	MOLEX	4	Reader-RMS	039012040	026013096
CN-432	AMP	3	Cigar & power	174357-2	-
· Relay		I.		1	
CR-1	RING-TERM	-	Battery relay	ST710289-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-23	KET	2	Start relay	MG610320	S814-102001
CR-24	RING TERM	1	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-36	-	5	Beacon lamp relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2A	WP	6	Start key switch	S814-006100	-
CS-2B	DEUTSCH	3	BKCU	DT06-3S-EP06	DT04-3P-E005
CS-4	DEUTSCH	3	Safety switch	DT06-3S	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P
CS-26	DEUTSCH	2	Breaker switch	DT06-2S	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S	-
CS-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002

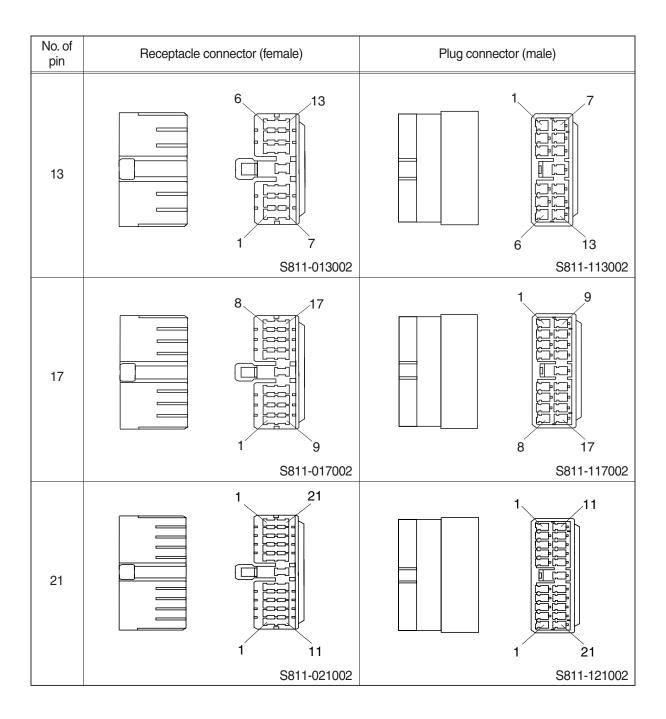
Connector	T	No. of	Destination	Connecto	or part No.
number	Type	pin	Destination	Female	Male
CS-52	CARLING	10	Adjust & dozer switch	VC2-01	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	CARLING	10	Quick clamp switch	VC2-01	-
CS-73	CARLING	10	Swing fine switch	VC2-01	-
CS-74A	KET/AMP	2	Master switch	MG610557-5	S813-130201
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	DT04-2P-E005
CS-83	CARLING	10	Swing lock switch	VC2-01	-
CS-99	CARLING	10	Air compressor switch	VC2-01	-
CS-108	CARLING	10	Auto grease switch	VC2-01	-
CS-142	DEUTSCH	3	Accel dial	DT06-3S	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	DT04-2P
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab light	DT06-2S-EP06	DT04-2P
CL-24	DEUTSCH	2	Head lamp	DT06-2S-EP06	DT04-2P-E005
CL-36	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	-
CL-37	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	-
· Sensor, se	endor				
CD-1	TE	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	-
CD-8	-	2	Water temp sensor	85202-1	-
CD-10	AMP	2	Air cleaner switch	85202-1	-
CD-17	-	2	Tacho sensor	-	S818-120221
CD-18	RING-TERM	1	Engine oil pressure sensor	-	S820-104000
CD-24	DEUTSCH	3	Swing pressure sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT04-3P-E005
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-EP06	-
CD-36	DEUTSCH	3	Arm out pressure sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-

Connector	Time	No. of	Destination	Connecto	r part No.
number	Type	pin	Destination	Female	Male
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-
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-85	DEUTSCH	3	Boom down pressure sensor	DT06-3S-EP06	-
CD-87	DEUTSCH	3	Bucket out pressure sensor	DT06-3S-EP06	-
CD-90	DEUTSCH	3	Arm pressure in sensor	DT06-3S-EP06	-
CD-124	DEUTSCH	3	Boom cylinder rod pressure snensor	DT06-3S-EP06	-

2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

No. of pin	Receptacle connecto	or (female)	Plug connector (male)
5		2 5 1 3	1 3
		S811-005002	S811-105002
7		1 4	3 7
		S811-007002	S811-107002
9		4 9 1 5	1 5
		S811-009002	3S811-109002
11		5 11	5 11
		S811-011002	S811-111002

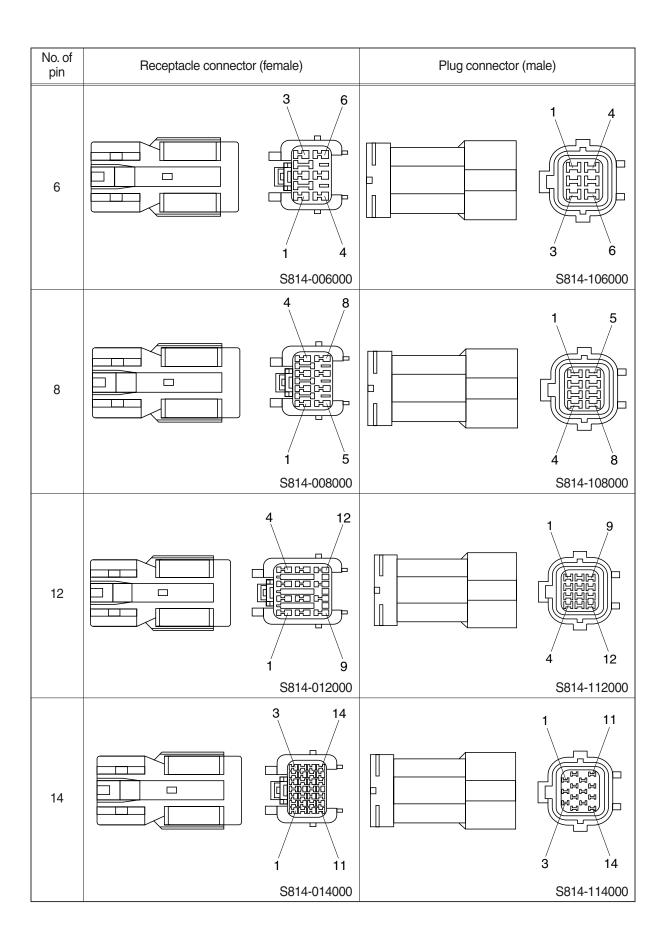


2) J TYPE CONNECTOR

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 0000 6 3 1 S816-108001

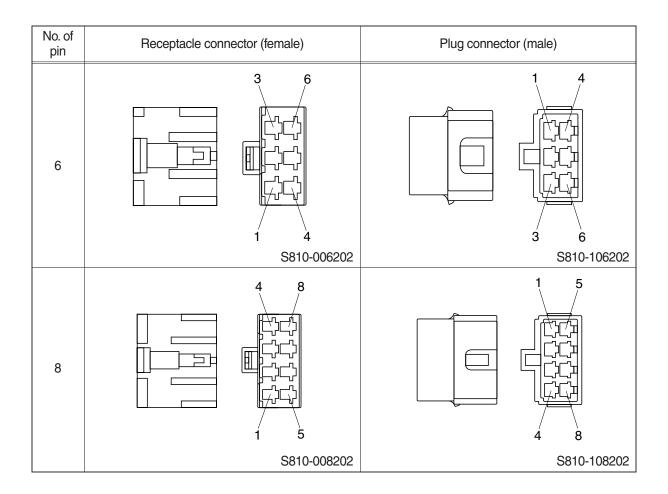
3) SWP TYPE CONNECTOR

No. of pin	Receptacle connector	(female)	Plug connector (n	nale)
1		S814-001000		S814-101000
2		2 1 S814-002000		1 2 S814-102000
3		3 2 1 S814-003000		1 2 3 S814-103000
4		2 4 1 3 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 2 4
		S810-004202		S810-104202



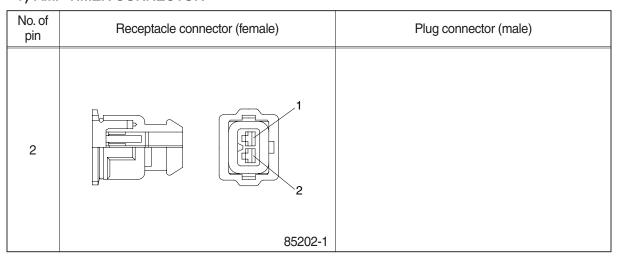
5) 375 FASTEN TYPE CONNECTOR

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

6) AMP ECONOSEAL CONNECTOR

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

7) AMP TIMER CONNECTOR



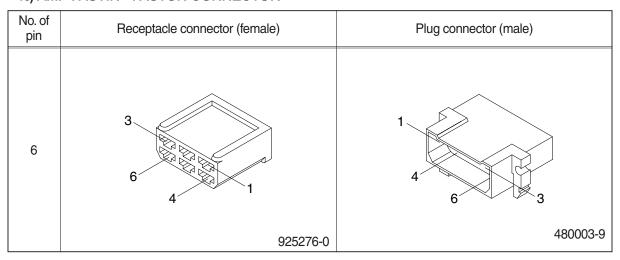
8) AMP 040 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
12	7	
	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



11) KET 090 CONNECTOR

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

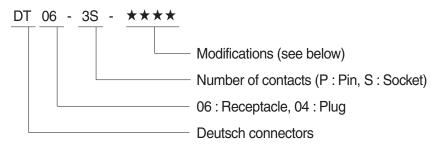
12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
14	7	
	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 connector (female)	Plug connector (male)
2		1 2
	DT06-2S	DT04-2P
3	1 2	2 1 3
	DT06-3S	DT04-3P
4	2 3	3 2
	DT06-4S	DT04-4P

No. of pin	Receptacle connector (female)	Plug connector (male)
6		
	DT06-6S	DT04-6P
8	5 4 8 1	5 1 8
	DT06-8S	DT04-8P
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	S816-003002	3 2 1 S816-103002
4	3 4 S816-004002	2 1 4 3 S816-104002

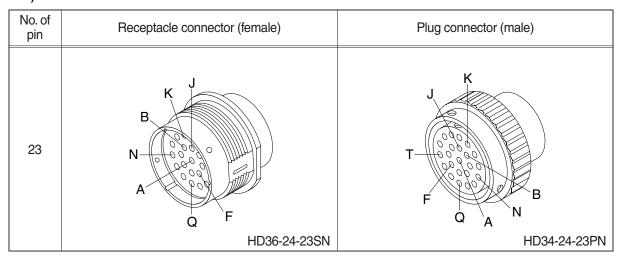
No. of pin	Receptacle connector (female)	Plug connector (male)
6	3 4 6 S816-006002	3 1 6 4 S816-106002
8	5010 000002 1 4 5 8 8 8816-008002	4 1 8 5 \$816-108002
10	5 6 10 S816-010002	5 10 6 S816-110002
12	7 12 S816-012002	6 1 12 7 S816-112002

No. of pin	Receptacle connector (female)	Plug connector (male)
15	3 15 HERELE B 1 13	15 3 18 18 19 19 10 10 10 10 10 10 10 10 10 10
	368301-1	2-85262-1

19) METRI-PACK TYPE CONNECTOR

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

20) DEUTSCH HD30 CONNECTOR



21) DEUTSCH MCU CONNECTOR (SERIAL NO.: -#0773)

No. of pin	Receptacle connector (Female)	Plug connector (Male)
40	1 11 21 21 31 35 36 40	
	DRC26-40SA/B	

22) DEUTSCH SERVICE TOOL CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
9	F HD10-9-96P	

23) AMP FUEL WARMER CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
4	3 2 4	
	2-967325-3	

24) DEUTSCH ENGINE ECM CONNECTOR

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

25) DEUTSCH INTERMEDIATE CONNECTOR

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

SECTION 5 MECHATRONICS SYSTEM

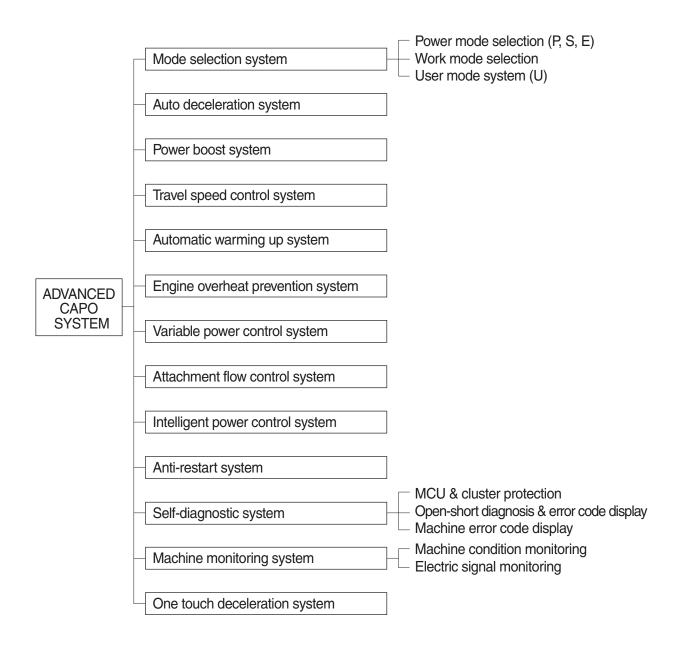
Group	1	Outline	5-1
Group	2	Mode Selection System ·····	5-3
Group	3	Automatic Deceleration System	5-6
Group	4	Power Boost System	5-7
Group	5	Travel Speed Control System	5-8
Group	6	Automatic Warming Up System	5-9
Group	7	Engine Overheat Prevention System	5-10
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SECTION 5 MECHATRONICS SYSTEM

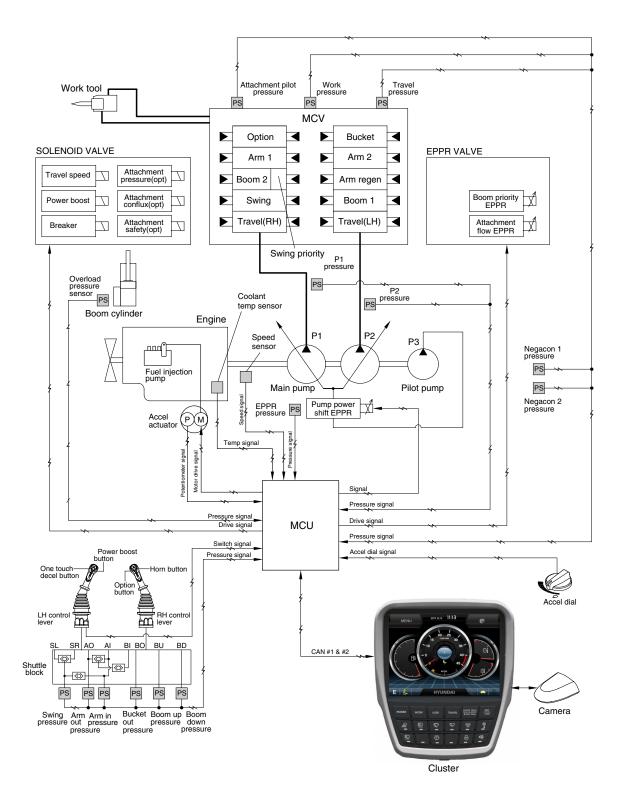
GROUP 1 OUTLINE

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 accel actuator, 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.



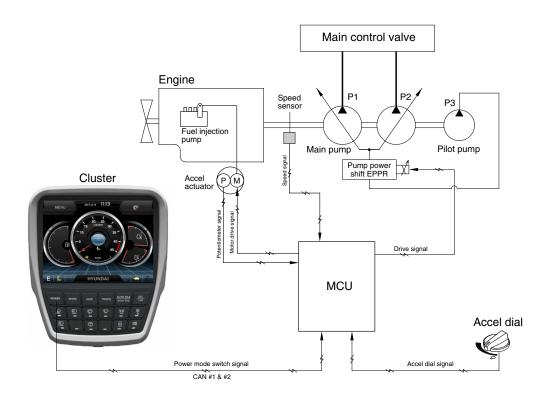
SYSTEM DIAGRAM



220S5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



220S5MS02

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 acceleration mode (10 set) of haptic controller 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.

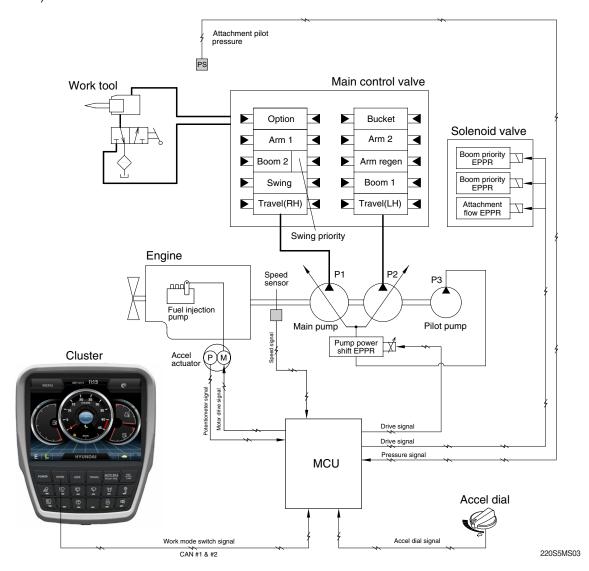
		Engine rpm			Power shift by EPPR valve				
Power	Application	Standard		Option		Standard		Option	
mode		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm²)	Current (mA)	Pressure (kgf/cm²)
Р	Heavy duty power	1900±50	1700±50	2000±50	1800±50	330±30	10 (~5)	190±30	3 (~3)
S	Standard power	1800±50	1600±50	1900±50	1700±50	360±30	12 (~7)±3	250±30	5 (~5)±3
Е	Economy operation	1700±50	1500±50	1800±50	1600±50	360±30	12 (~7)±3	330±30	5 (~5)±3
AUTO DECEL	Engine deceleration	1200±100	-	1200±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

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

※ (~*): Load

2. WORK MODE SELECTION SYSTEM

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



1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

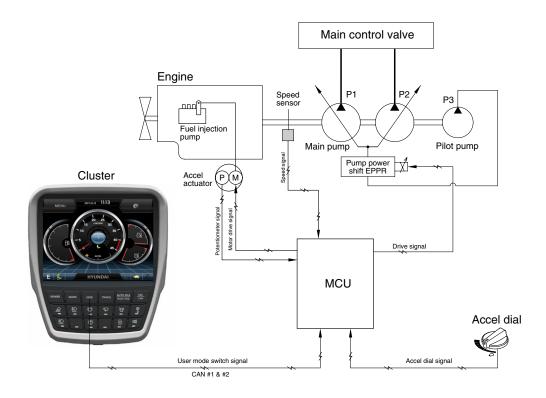
2) ATT WORK MODE (breaker, crusher)

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

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

[★] When breaker operating button is pushed.

3. USER MODE SELECTION SYSTEM



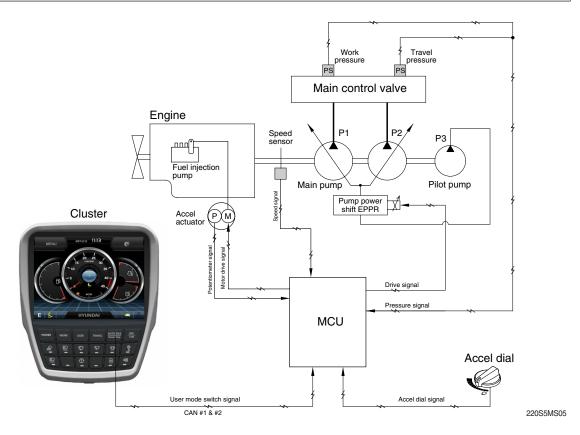
220S5MS04

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	1400	1000	0
2	1500	1050 (auto idle)	3
3	1550	1100	6
4	1650	1150	9
5	1700	1200	12
6	1750	1250	16
7	1800	1300	20
8	1850	1350	26
9	1900	1400	32
10	1950	1450	38

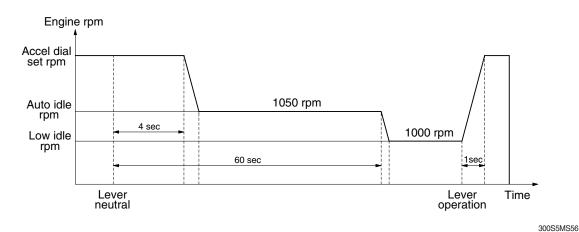
GROUP 3 AUTOMATIC DECELERATION SYSTEM



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 drive the governor moter to reduce the engine speed to 1200 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.

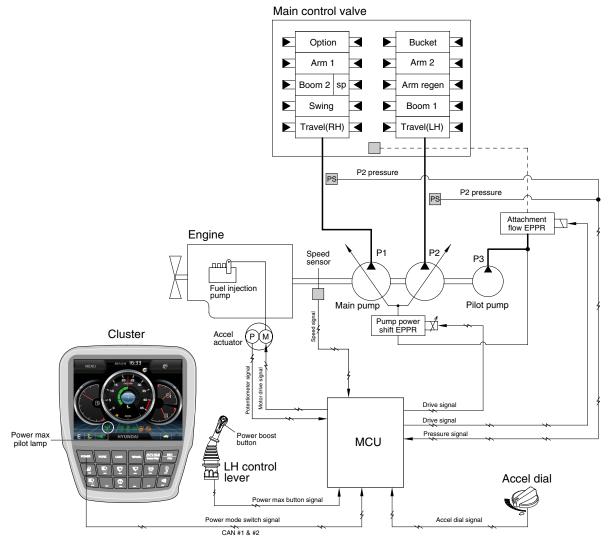


2. WHEN AUTO IDLE PILOT LAMP OFF

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



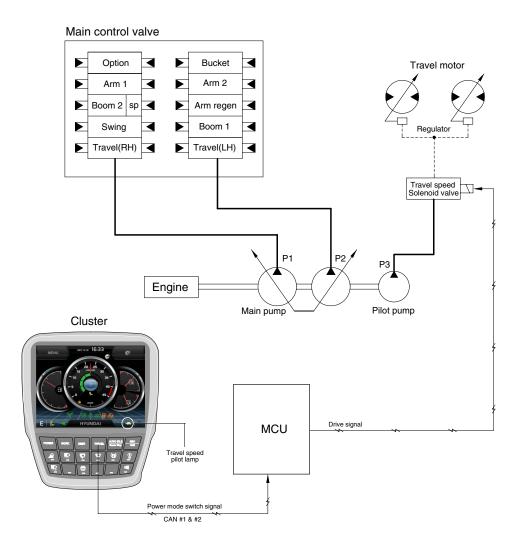
220S5MS06

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

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

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



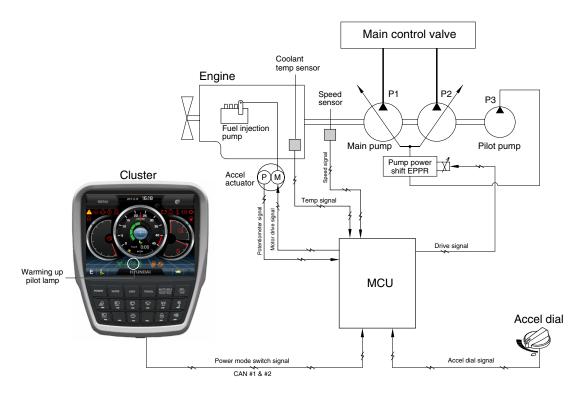
220S5MS10

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



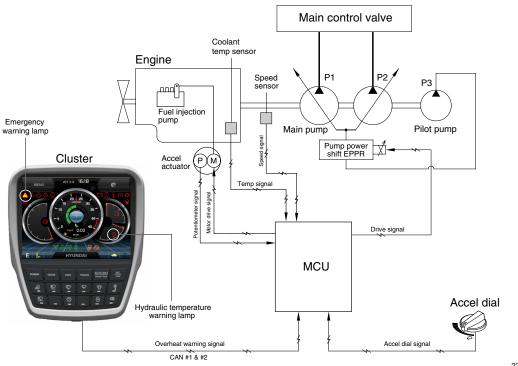
220S5MS07

- The MCU receives the engine coolant temperature thought the temperature sensor, and if the coolant temperature is below 30°C, it increases the engine speed from key start rpm to 1200 rpm. 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



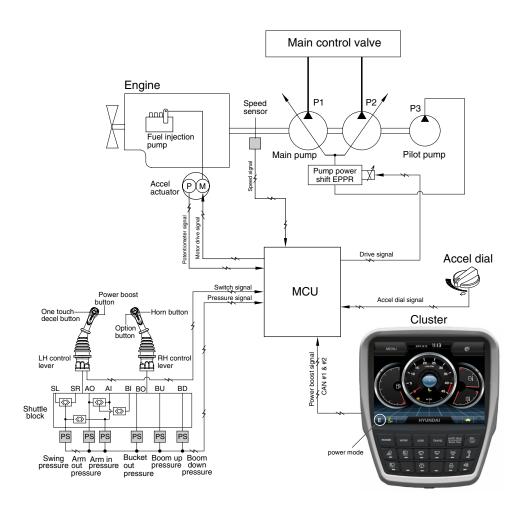
220S5MS08

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

Descrip	otion	Condition	Function
	Activated	- Coolant temperature : Above 103°C	- Warning lamp : ON , buzzer : OFF - Pump input torque is reduced.
First step	Activated	- Hydraulic oil temperature : Above 100°C	Warning lamp & buzzer : ONPump 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.
Second step 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



220S5MS09

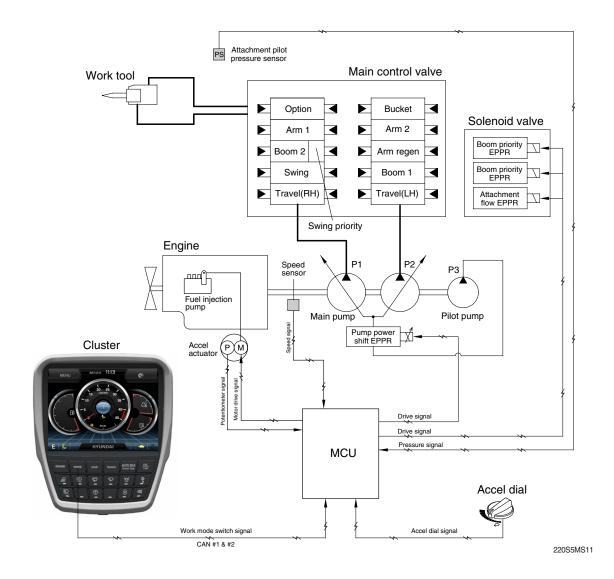
The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.

It makes fuel saving and smooth control at precise work.

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

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

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM

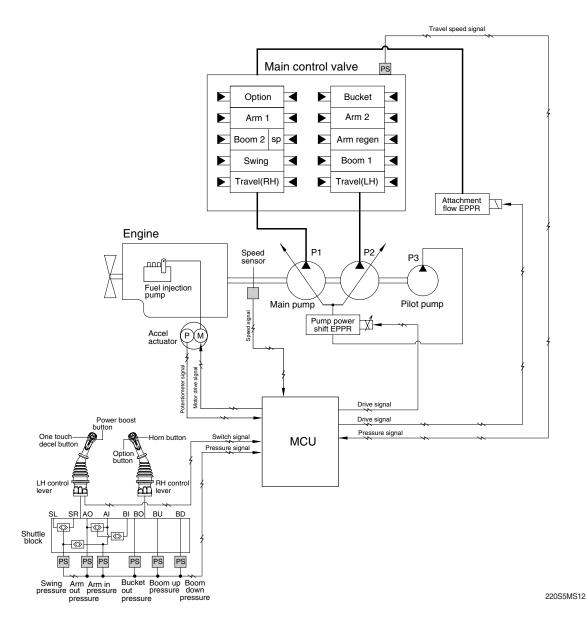


• The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool			
Description	Breaker	Crusher		
Flow level	100 ~ 180 lpm	100 ~ 440 lpm		
Attach safety solenoid	-	ON		
Attach conflux solenoid	ON/OFF	ON/OFF		
Breaker solenoid*	ON	-		

- * Refer to the page 5-79 for the attachment kinds and max flow.
- ★ When breaker operating button is pushed.

GROUP 10 INTELLIGENT POWER CONTROL SYSTEM



1. When the requirement of pump flow rate is low, IPC mode controls pump flow rate to improve fuel efficiency.

Condition★1	Function			
IPC mode : ON*2				
Boom up				
Arm in	Limitation of pump flow rate : Activated			
Not travel motion				
Not swing motion				
None of upper condition	Limitation of pump flow rate : Canceled			

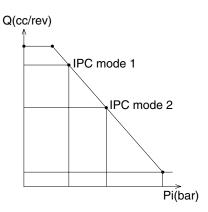
^{*1} AND condition

^{*2} IPC mode ON/OFF is selected at "Mode setup > IPC mode". See next page.

2. IPC MODE SELECTION

IPC mode ON/OFF and the levels of flow rate limit can be selected at "Mode setup > IPC mode"

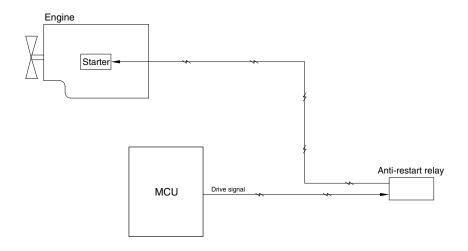




220S5MS19

IPC mode	Description
Balance mode (default)	IPC mode ON, limit level 1
Efficiency mode	IPC mode ON, limit level 2
Speed mode	IPC mode OFF

GROUP 11 ANTI-RESTART SYSTEM



220S5MS18

1. ANTI-RESTART FUNCTION

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

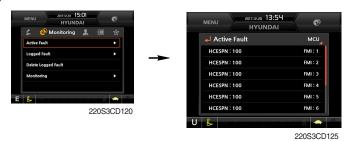
GROUP 12 SELF-DIAGNOSTIC SYSTEM

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



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

2) Logged fault



220S3CD124

· The logged faults of the MCU, can be checked by this menu.

3) Delete logged fault



· The logged faults of the MCU, can be deleted by this menu.

3. MACHINE ERROR CODES TABLE

DTC	;		Ap	plicat	ion		
HCESPN	FMI	Diagnostic Criteria		С	W		
	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.8V	•				
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3V					
101	(Resu	ults / Symptoms)					
	1. Mo	nitor – Hydraulic oil temperature display failure					
	2. Coi	ntrol Function – Fan revolutions control failure					
	(Chec	cking list)					
		-1 (#2) – CN-52 (#24) Checking Open/Short					
	2. CD	-1 (#1) – CN-51 (#11) Checking Open/Short					
_	0	10 seconds continuous, Working Press. Sensor					
		Measurement Voltage > 5.2V					
	1	10 seconds continuous, 0.3V≤ Working Press. Sensor Measurement					
		Voltage < 0.8V					
	4	10 seconds continuous, Working Press. Sensor					
	(Pool	Measurement Voltage < 0.3V					
105	(Results / Symptoms)						
	Monitor – Working Press. display failure Control Function. Auto Jale energiting failure. Engine veriable bares never central energiting.						
	Control Function – Auto Idle operation failure, Engine variable horse power control operation failure						
	(Chec	sking list)					
	٠,	-7 (#B) – CN-52 (#37) Checking Open/Short					
	2. CD-7 (#A) – CN-51 (#3) Checking Open/Short						
		-7 (#C) – CN-51 (#13) Checking Open/Short					
		10 seconds continuous, Travel Oil Press. Sensor					
	0	Measurement Voltage > 5.2V					
	1	10 seconds continuous, 0.3V ≤ Travel Oil Press. Sensor Measurement					
		Voltage < 0.8V					
	4	10 seconds continuous, Travel Oil Press. Sensor					
		Measurement Voltage < 0.3V					
108	,	ılts / Symptoms)					
100	1. Monitor – Travel Oil Press. display failure						
	2. Control Function – Auto Idle operation failure, Engine variable horse power control operation						
	(Ol	failure, IPC operation failure, Driving alarm operation failure					
	٠,	king list)					
	1. CD-6 (#B) – CN-52 (#38) Checking Open/Short						
		-6 (#A) – CN-51 (#3) Checking Open/Short					
	J. UD	-6 (#C) – CN-51 (#13) Checking Open/Short					

 $\ensuremath{\,\%\,}$ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC	;		Ар	plicat	ion			
HCESPN	FMI	Diagnostic Criteria	G	С	W			
	0	10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement						
	U	Voltage > 5.2V						
	1	10 seconds continuous, 0.3V ≤ Main Pump 1 (P1) Press. Sensor						
		Measurement Voltage < 0.8V						
	4	10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement						
	/Deau	Voltage < 0.3V						
120	,	lts / Symptoms) nitor – Main Pump 1 (P1) Press. display failure						
		inor – Main Fump T (FT) Fress. display lallure htrol Function – Automatic voltage increase operation failure, Overload at compe	neati	on co	ntrol			
	2.001	failure	i isati	011 00	TitiOi			
	(Chec	king list)						
	,	-42 (#B) – CN-52 (#29) Checking Open/Short						
		-42 (#A) – CN-51 (#3) Checking Open/Short						
	3. CD-	-42 (#C) – CN-51 (#13) Checking Open/Short						
	0	10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement						
	0	Voltage > 5.2V						
	1	10 seconds continuous, 0.3V≤ Main Pump 2 (P2) Press. Sensor						
		Measurement Voltage < 0.8V						
	4	10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.3V	•					
	(Results / Symptoms)							
121	1. Mor	nitor – Main Pump 2 (P2) Press. display failure						
	2. Cor	ntrol Function – Automatic voltage increase operation failure, Overload at compe	ensat	ion co	ontrol			
	failure							
	(Chec	king list)						
		-43 (#B) – CN-52 (#30) Checking Open/Short						
		-43 (#A) – CN-51 (#3) Checking Open/Short						
	3. CD-	43 (#C) – CN-51 (#13) Checking Open/Short			1			
		(when you had conditions mounting pressure sensor)						
	1	10 seconds continuous, 0.3V ≤ Overload Press. Sensor Measurement						
		Voltage < 0.8V (when you had conditions mounting pressure sensor)						
	4	10 seconds continuous, Overload Press. Sensor						
	7	Measurement Voltage < 0.3V						
122	(Resu	Its / Symptoms)						
	1. Monitor – Overload Press. display failure							
	Control Function – Overload warning alarm failure							
		king list)						
	1. CD-	-31 (#B) – CN-52 (#39) Checking Open/Short						
	2. CD-31 (#A) – CN-51 (#3) Checking Open/Short							
	3. CD-	-31 (#C) – CN-51 (#13) Checking Open/Short						

HCESPN FMI 0 10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage > 5.2V 1 10 seconds continuous, 0.3V≤ Negative 1 Press. Sensor Measurement Voltage < 0.8V 4 10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V 123 (Results / Symptoms) 1. Monitor – Negative 1 Press. display failure)	С	W					
0 Measurement Voltage > 5.2V 1 10 seconds continuous, 0.3V≤ Negative 1 Press. Sensor Measurement Voltage < 0.8V 4 10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V (Results / Symptoms)								
Measurement Voltage > 5.2V 1 10 seconds continuous, 0.3V≤ Negative 1 Press. Sensor Measurement Voltage < 0.8V 4 10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V (Results / Symptoms)	4							
1 Voltage < 0.8V 4 10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V 123 (Results / Symptoms)								
Measurement Voltage < 0.3V (Results / Symptoms)								
123 (Results / Symptoms)								
2. Control Function – IPC operation failure, Option attachment flow control operation failu	re							
(Checking list)								
1. CD-70 (#B) – CN-51 (#39) Checking Open/Short								
2. CD-70 (#A) – CN-51 (#3) Checking Open/Short								
3. CD-70 (#C) – CN-51 (#13) Checking Open/Short								
10 seconds continuous, Negative 2 Press. Sensor								
0 Measurement Voltage > 5.2V								
10 seconds continuous, 0.3V≤ Negative 2 Press. Sensor Measurement								
Voltage < 0.8V								
10 seconds continuous, Negative 2 Press. Sensor								
Measurement Voltage < 0.3V								
	(Results / Symptoms)							
	1. Monitor – Negative 2 Press. display failure							
2. Control Function – Option attachment flow control operation failure								
(Checking list)								
1. CD-71 (#B) – CN-51 (#40) Checking Open/Short								
2. CD-71 (#A) – CN-51 (#3) Checking Open/Short								
3. CD-71 (#C) – CN-51 (#13) Checking Open/Short			1					
10 seconds continuous, Boom Up Pilot Press. Sensor								
Measurement Voltage > 5.2V 10 seconds continuous, 0.3V≤ Boom Up Pilot Press. Sensor Measurement	+							
1 Voltage < 0.8V								
4 10 seconds continuous, Boom Up Pilot Press. Sensor Measurement < 0.3V								
(Results / Symptoms)								
127 1. Monitor – Boom Up Pilot Press. display failure								
2. Control Function – Engine/Pump variable horse power control operation failure, IPC op	Control Function – Engine/Pump variable horse power control operation failure, IPC operation							
failure, Boom first operation failure								
(Checking list)								
1. CD-32 (#B) – CN-52 (#35) Checking Open/Short								
2. CD-32 (#A) – CN-51 (#3) Checking Open/Short								
3. CD-32 (#C) – CN-5 1(#13) Checking Open/Short								

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostia Critoria	Ар	plicat	ion
HCESPN	FMI	Diagnostic Criteria		С	W
	0	(when you had conditions mounting pressure sensor) 10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage > 5.2V	•		
	1	(when you had conditions mounting pressure sensor) 10 seconds continuous, 0.3V≤ Boom Down Pilot Press. Sensor Measurement Voltage < 0.8V	•		
128	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage < 0.3V	•		
	1. Mor 2. Cor (Chec 1. CD- 2. CD-	Its / Symptoms) nitor – Boom Down Pilot Press. display failure ntrol Function – Boom floating operation failure king list) -85 (#B) – CN-52 (#34) Checking Open/Short -85 (#A) – CN-51 (#3) Checking Open/Short -85 (#C) – CN-51 (#13) Checking Open/Short			
	0	10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage > 4.8V	•		
	1	10 seconds continuous, 0.3V≤ Arm In Pilot Press. Sensor Measurement Voltage < 0.8V	•		
	4	10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage < 0.3V	•		
129	1. Mor 2. Cor (Chec 1. CD- 2. CD-	Its / Symptoms) nitor – Arm In Pilot Press. display failure ntrol Function – IPC operation failure king list) 90 (#B) – CN-51 (#10) Checking Open/Short 90 (#A) – CN-51 (#3) Checking Open/Short 90 (#C) – CN-51 (#13) Checking Open/Short			
	0	10 seconds continuous, Arm In/Out & Bucket In Pilot Press. Sensor Measurement Voltage > 5.2V	•		
	1	10 seconds continuous, 0.3V≤ Arm In/Out & Bucket In Pilot Press. Sensor Measurement Voltage < 0.8V	•		
133	4	10 seconds continuous, Arm In/Out & Bucket In Pilot Press. Sensor Measurement Voltage < 0.3V	•		
	1. Mor 2. Cor (Chec 1. CD- 2. CD-	Its / Symptoms) nitor – Arm In/Out & Bucket In Pilot Press. display failure ntrol Function – Engine variable horse power control operation failure king list) 35 (#B) – CN-52 (#28) Checking Open/Short 35 (#A) – CN-51 (#3) Checking Open/Short 35 (#C) – CN-51 (#13) Checking Open/Short			

* Some error codes are not applied to this machine.

DTC	;	Di u O'i i	Ар	plicat	ion
HCESPN	FMI	Diagnostic Criteria	G	С	W
	0	10 seconds continuous, Swing Pilot Press. Sensor			
	0	Measurement Voltage > 5.2V			
	1	10 seconds continuous, 0.3V≤ Swing Pilot Press. Sensor Measurement			
		Voltage < 0.8V			
	4	10 seconds continuous, Swing Pilot Press. Sensor			
		Measurement Voltage < 0.3V			
135	١,	lts / Symptoms)			
		nitor – Swing Pilot Press. display failure			
		ntrol Function – IPC operation, Boom first operation failure			
	l ,	king list)			
		24 (#B) – CN-52 (#36) Checking Open/Short			
		24 (#A) – CN-51 (#3) Checking Open/Short			
	3. CD-	24 (#C) – CN-51 (#13) Checking Open/Short			
		Monitor – Select Attachment(breaker / crusher)	_		
	0	10 seconds continuous, Attachment Pilot Press. Sensor Measurement			
		Voltage > 5.2V			
	1	Monitor – Select Attachment(breaker / crusher)			
		10 seconds continuous, 0.3V≤ Attachment Pilot Press. Sensor			
		Measurement Voltage < 0.8V			
	4	Monitor – Select Attachment(breaker / crusher)			
138		10 seconds continuous, Attachment Pilot Press. Sensor Measurement			
	(D	Voltage < 0.3V			
	l ,	Its / Symptoms)			
		nitor – Attachment Pilot Press. display failure			
		ntrol Function – Option attachment flow control operation failure			
	l '	king list)			
		69 (#B) – CN-52 (#33) Checking Open/Short			
		69 (#A) – CN-51 (#3) Checking Open/Short 69 (#C) – CN-51 (#13) Checking Open/Short			
	3.00				
	1	10 seconds continuous, 0.3V≤ Option Pilot Press. Sensor Measurement			
		Voltage < 0.8V 10 seconds continuous, Option Pilot Press. Sensor			
	4	Measurement Voltage < 0.3V			
	/Rocu	Its / Symptoms)			
139 (NA)	l ,	nitor – Option Pilot Press. display failure			
		ntrol Function – Auto Idle operation failure			
		king list)			
	l ,	v100 (#B) – CN-52 (#21) Checking Open/Short			
		100 (#A) – CN-52 (#21) Checking Open/Short			
		100 (#A) – CN-31 (#3) Checking Open/Short			
	J. UD.	100 (#0) - 014-1 (#0) OHEOMING OPEN/OHUIT			

G : General C : Crawler Type W : Wheel Type

DTC	;	Dia was akin Oritaria	Ap	Application		
HCESPN	FMI	Diagnostic Criteria	G	С	W	
	5	(Detection) (When Pump EPPR Current is more than 10 mA) 10 seconds continuous, Pump EPPR drive current < 0 mA (Cancellation) (When Pump EPPR Current is more than 10 mA) 3 seconds continuous, Pump EPPR drive current ≥10 mA	•			
140	6	 (Detection) 10 seconds continuous, Pump EPPR drive current > 1.0A (Cancellation) 3 seconds continuous, Pump EPPR drive current ≤ 1.0 A 	•			
	1. Cor	lts / Symptoms) htrol Function – Pump horse power setting specification difference (Fuel efficiency/speed specification failure) king list) -75 (#2) – CN-52 (#9) Checking Open/Short				
	2. CN	-75 (#1) - CN-52 (#19) Checking Open/Short				
	5	 (Model Parameter) mounting Boom Priority EPPR (Detection) (When Boom Priority EPPR Current is more than 10 mA) 10 seconds continuous, Boom Priority EPPR drive current < 0 mA (Cancellation) (When Boom Priority EPPR Current is more than 10 mA) 3 seconds continuous, Boom Priority EPPR drive current ≥ 10 mA 	•			
141	6	(Detection) 10 seconds continuous, Boom Priority EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Boom Priority EPPR drive current ≤ 1.0 A	•			
	1. Cor (Chec 1. CN	olts / Symptoms) Its / Symptoms) Itrol Function – Boom first control operation failure Itsihing list) Itsihing list) Itsihing list) Itsihing list) Itsihing list) Itsihing list) Itsihing list Itsihin				

DTC	;	Dia supportin Cuitavia	Ap	plicat	ion
HCESPN	FMI	Diagnostic Criteria		С	W
	5	(Detection) (When Travel EPPR Current is more than 10 mA) 10 seconds continuous, Travel EPPR drive current = 0 mA (Cancellation) (When Travel EPPR Current is more than 100 mA) 3 seconds continuous, Travel EPPR drive current ≥ 10 mA			•
143 (NA)	6	 (Detection) 10 seconds continuous, Travel EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Travel EPPR drive current ≤ 1.0 A 			•
	1. Cor (Chec 1. CN	lts / Symptoms) htrol Function – cruise control operation failure king list) -246 (#2) – CN-54 (#39) Checking Open/Short -246 (#1) – CN-51 (#40) Checking Open/Short			
	5	(Model Parameter) mounting Remote Cooling Fan EPPR (Detection) (When Remote Cooling Fan EPPR Current is more than 10 mA) 10 seconds continuous, Remote Cooling Fan EPPR drive current = 0 mA (Cancellation) (When Remote Cooling Fan EPPR Current is more than 10 mA) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≥ 10 mA	•		
145 (NA)	6	 (Detection) 10 seconds continuous, Remote Cooling Fan EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≤ 1.0 A 	•		
	1. Cor (Chec 1. CD	Its / Symptoms) htrol Function – Remote fan control operation failure king list) -385 (#3) – CN-51 (#9) Checking Open/Short -385 (#1) – CN-51 (#14) Checking Open/Short			

DTC HCESPN FMI		Dia manakin Orkania	Ap	plicat	ion				
HCESPN	FMI	Diagnostic Criteria	G	С	W				
		(Detection)							
		(When Working Cutoff Relay is Off)							
		10 seconds continuous, Working Cutoff Relay drive unit Measurement							
	4	Voltage ≤ 3.0V							
		(Cancellation)							
		(When Working Cutoff Relay is Off)							
		3 seconds continuous, Working Cutoff Relay drive unit Measurement							
		Voltage > 3.0V (Detection)							
164		(When Working Cutoff Relay is On)							
164		10 seconds continuous, Working Cutoff Relay drive current > 6.5 A							
(NA)	6	(Cancellation)							
		(When Working Cutoff Relay is On)							
		3 seconds continuous, Working Cutoff Relay drive current ≤ 6.5 A							
	(Resu	Its / Symptoms)		1					
	`	ntrol Function – (Wheel Excavator) In driving mode, attachment hydraulic pilot pi	ressu	re cut	off				
	failure								
	(Checking list)								
	1. CR-47 (#85) – CN-54 (#9) Checking Open/Short								
	2. CR-47 (#30, #86) – Fuse box (#28) Checking Open/Short								
		(Detection)							
		(When Power Max Solenoid is Off)							
		10 seconds continuous, Power Max Solenoid drive unit Measurement							
	4	Voltage ≤ 3.0V							
		(Cancellation)							
		(When Power Max Solenoid is Off)							
		3 seconds continuous, Power Max Solenoid drive unit							
		Measurement Voltage > 3.0V							
		(Detection)							
166		(When Power Max Solenoid is On)							
	6	5 seconds continuous, Power Max Solenoid drive current > 4.5 A (Cancellation)							
		(When Power Max Solenoid is On)							
		3 seconds continuous, Power Max Solenoid drive current ≤ 4.5 A							
	(Resu	Its / Symptoms)							
	· '	ntrol Function – Voltage increase operation failure							
		king list)							
	· '	-88 (#1) – CN-52 (#2) Checking Open/Short							
		-88 (#2) – Fuse box (#31) Checking Open/Short							
		, , (-) - 3-m-9 - France							

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

 $\mbox{G : General} \qquad \qquad \mbox{C : Crawler Type} \qquad \qquad \mbox{W : Wheel Type}$

DTC	;	Dia manatia Critaria	Ap	plicati	on
HCESPN	FMI	Diagnostic Criteria	G	С	W
		(Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V		•	
167	4	(When Parking mode is not) (Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V			•
	6	(Detection) (When Travel Speed Solenoid is On) 10 seconds continuous, Travel Speed Solenoid drive current > 4.5 A (Cancellation) (When Travel Speed Solenoid is On) 3 seconds continuous, Travel Speed Solenoid drive current ≤ 4.5 A	•		
	1. Cor	olts / Symptoms) htrol Function – driving in 1/2 transmission operation failure			
	`	king list) -70 (#1) – CN-52 (#3) Checking Open/Short			
		-70 (#2) – Fuse box (#31) Checking Open/Short			

* Some error codes are not applied to this machine.

 $\mbox{$G:$ General } \mbox{$C:$ Crawler Type} \mbox{$W:$ Wheel Type}$

1. Co (Ecc (Che		Diagnachia Cuitaria	Ap	Application				
HCESPN	FMI	Diagnostic Criteria	G	С	W			
	4	Monitor – Selecting attachment(breaker / crusher) (Detection) (When Attachment Conflux Solenoid is Off) 10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Attachment Conflux Solenoid is Off) 3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement	•					
169	6	Voltage > 3.0V (Detection) (When Attachment Conflux Solenoid is On) 10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A (Cancellation) (When Attachment Conflux Solenoid is On) 3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A	•					
	(Resu	Its / symptoms)						
	,	ntrol Function – Option attachment flow control – Joining operation failure						
	(Eco breaker mode, crusher mode)							
	,	king list)						
	,	-237 (#1) – CN-52 (#6) Checking Open/Short						
		-237 (#2) – Fuse box (#31) Checking Open/Short						
	4	(Model Parameter) mounting Arm Regenerating Solenoid (Detection) (When Arm Regeneration Solenoid is Off) 10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Arm Regeneration Solenoid is Off) 3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V	•					
170 (NA)	6	(Detection) (When Arm Regeneration Solenoid is On) 10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A (Cancellation) (When Arm Regeneration Solenoid is On) 3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A	•					
	(Resu	Its / symptoms)						
	1. Cor	ntrol Function – Arm regeneration operation failure						
	(Chec	king list)						
	1. CN-	-135 (#1) – CN-52 (#1) Checking Open/Short						
	2. CN-	-135 (#2) – Fuse box (#28) Checking Open/Short						

1. Co (crus (Che 1. CN		— Diagnostic Critoria		Application					
HCESPN	FMI	Diagnostic Criteria	G	С	W				
	4	Monitor – Selecting attachment(crusher) (Detection) (When Attachment Safety Solenoid is Off) 10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Attachment Safety Solenoid is Off) 3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≥ 3.0V	•						
171	6	Voltage > 3.0V (Detection) (When Attachment Safety Solenoid is On) 10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A (Cancellation) (When Attachment Safety Solenoid is On) 3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A	•						
	(Resu	lts / Symptoms)							
	1. Control Function – Option attachment flow control – Option spool pilot pressure cut off failure								
	(crusher mode)								
	(Checking list)								
	1. CN-	-149 (#1) – CN-52 (#4) Checking Open/Short							
	2. CN-	-149 (#2) – Fuse box (#31) Checking Open/Short							
	4	Monitor – Selecting attachment(breaker / crusher) (Detection) (When Breaker Operating Solenoid is Off) 10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Breaker Operating Solenoid is Off) 3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V	•						
179	6	(Detection) (When Breaker Operating Solenoid is On) 10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A (Cancellation) (When Breaker Operating Solenoid is On) 3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A	•						
	(Results / Symptoms)								
	Control Function – Option attachment flow control – Breaker operation failure (breaker mode)								
	(Chec	king list)							
	1. CN-	-66 (#1) – CN-15 (#11) Checking Open/Short							
	2. CN-	-66 (#2) – CR-62 (#5) Checking Open/Short							

DTC	;	Diagnostia Critoria	Ар	plicat	ion
HCESPN	FMI	Diagnostic Criteria	G	С	W
181	4	(Model Parameter) mounting Reverse Cooling Fan Solenoid (Detection) (When Reverse Cooling Fan Solenoid is Off) 10 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Reverse Cooling Fan Solenoid is Off) 3 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage > 3.0V	•		
(NA)	6	(Detection) (When Reverse Cooling Fan Solenoid is On) 10 seconds continuous, Reverse Cooling Fan Solenoid drive current > 4.5 A (Cancellation) (When Reverse Cooling Fan Solenoid is On) 3 seconds continuous, Reverse Cooling Fan Solenoid drive current ≤ 4.5 A	•		
	(Results / Symptoms)				
	1. Cor	ntrol Function – Cooling Fan reverse control operation failure (not applicable)			
	5	(Detection) (When Attachment Flow EPPR 1 current is equal or more than 300 mA) 10 seconds continuous, Attachment Flow EPPR drive current < 100 mA (Cancellation) (When Attachment Flow EPPR 1 current is equal or more than 300 mA) 3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA	•		
188	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 1 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 1 drive current ≤ 1.0 A	•		
	1. Cor (Chec 1. CN	lts / Symptoms) htrol Function – IPC operation failure, Option attachment flow control operation fi king list) -242 (#2) – CN-52 (#10) Checking Open/Short -242 (#1) – CN-52 (#20) Checking Open/Short	ailure		

 $[\]ensuremath{\,\%\,}$ Some error codes are not applied to this machine.

DTC	;	Dia manatia Oritaria	Ap	plicat	ion
HCESPN	FMI	Diagnostic Criteria	G	С	W
	5	(Detection) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 10 seconds continuous, Attachment Flow EPPR drive current < 100 mA (Cancellation) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA	•		
189	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 2 drive current ≤ 1.0 A	•		
	1. Cor (Chec 1. CN-	lts / Symptoms) htrol Function – Option attachment flow control operation failure king list) -242A (#2) – CN-52 (#40) Checking Open/Short -242A (#1) – CN-52 (#16) Checking Open/Short			
	0	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V HW145			
196	4	10 seconds continuous, 0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V HW145 10 seconds continuous,			
(NA)	1. Cor (Chec 1. CD- 2. CD-	Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V Its / Symptoms) Itrol Function – Driving second pump joining function operation failure king list) -93 (#B) – CN-52 (#34) Checking Open/Short -93 (#A) – CN-51 (#32) Checking Open/Short -93 (#C) – CN-51 (#31) Checking Open/Short			
200	0 1 4 (Resu 1. Mor 2. Cor (Fuel (Chec 1. CD- 2. CD-	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage > 5.2V 10 seconds continuous, 0.3V≤ Pump EPPR Press. Sensor Measurement Voltage < 0.8V 10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage < 0.3V Its / Symptoms) nitor – Pump EPPR Press. display failure ntrol Function – Pump input horse power control failure, Overload at compensat operation failure efficiency/speed performance failure) king list) -44 (#B) – CN-52 (#32) Checking Open/Short -44 (#A) – CN-51 (#3) Checking Open/Short -44 (#C) – CN-51 (#13) Checking Open/Short		ontrol	

DTC	;	Diamenatia Cuitaria	Ap	plicat	ion
HCESPN	FMI	Diagnostic Criteria	G	С	W
	0	(Mounting pressure sensor) 10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage > 5.2V	•		
	1	(Mounting pressure sensor) 10 seconds continuous, 0.3V≤ Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.8V	•		
205 (NA)	4	(Mounting pressure sensor) 10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.3V	•		
	1. Mor 2. Cor (Chec 1. CD- 2. CD-	Its / Symptoms) nitor – Boom Cylinder Rod Press. display failure ntrol Function – Boom floating control operation failure king list) 124 (#B) – CN-53 (#5) Checking Open/Short 124 (#A) – CN-53 (#3) Checking Open/Short 124 (#C) – CN-53 (#13) Checking Open/Short			
	4	Mounting pressure sensor (HCESPN128 or HCESPN 205) (Detection) (When Boom Up Floating Solenoid is Off) 10 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Boom Up Floating Solenoid is Off) 3 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage > 3.0V	•		
218 (NA)	6	(Detection) (When Boom Up Floating Solenoid is On) 10 seconds continuous, Boom Up Floating Solenoid drive current > 6.5 A (Cancellation) (When Boom Up Floating Solenoid is On) 3 seconds continuous, Boom Up Floating Solenoid drive current ≤ 6.5 A	•		
	1. Cor (Chec 1. CN-	lts / Symptoms) atrol Function – Boom floating control operation failure king list) 368 (#1) – CN-53 (#20) Checking Open/Short 368 (#2) – Fuse box (#17) Checking Open/Short			

DTC	;	Diagnostia Critaria	Application		
HCESPN	FMI	Diagnostic Criteria	G	С	W
220	4	Mounting pressure sensor (HCESPN 128 or 205) (Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage > 3.0V (Detection)	•		VV
(NA)	6	(When Boom Down Pilot Pressure Cutoff Solenoid is On) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current > 6.5 A (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current ≤ 6.5 A	•		
	1. Cor (Chec 1. CN-	Its / Symptoms) htrol Function – Boom floating control operation failure king list) -369 (#1) – CN-53 (#35) Checking Open/Short -369 (#2) – Fuse box (#17) Checking Open/Short			
	5	Monitor – Selecting attachment(breaker / crusher) (Detection) (When ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current = 0 mA (Cancellation) ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current ≥ 10 mA	•		
221 (NA)	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current ≤ 1.0 A	•		
	1. Cor (Chec 1. CN-	lts / Symptoms) htrol Function — Option attachment flow control — P1 relief pressure setting failur king list) -365 (#2) — CN-53 (#39) Checking Open/Short -365 (#1) — CN-53 (#40) Checking Open/Short	е		

G : General C : Crawler Type W : Wheel Type

DTC	;	D: " O " :	Ap	plicat	ion
HCESPN	FMI	Diagnostic Criteria	G	С	W
222 (NA)	5	Monitor – Selecting attachment(crusher) (Detection) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current = 0 mA (Cancellation) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≥ 10mA (Detection) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A	•		
(v y	1. Cor (Chec 1. CN- 2. CN-	(Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A lts / Symptoms) ntrol Function – Option attachment flow control – P2 relief pressure setting fail king list) -366 (#2) – CN-53 (#32) Checking Open/Short -366 (#1) – CN-53 (#33) Checking Open/Short	ure		
301	1. Mor (Chec 1. CD-	10 seconds continuous, Fuel Level Measurement Voltage > 3.8V 10 seconds continuous, Fuel Level Measurement Voltage < 0.3V Its / Symptoms) nitor – Fuel remaining display failure king list) -2 (#2) – CN-52 (#26) Checking Open/Short -2 (#1) – CN-51 (#11) Checking Open/Short	•		
	4	(Model Parameter) mounting Fuel Heater Relay (Detection) (When Fuel Heater Relay is Off) 10 seconds continuous, Fuel Heater Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Fuel Heater Relay is Off) 3 seconds continuous, Fuel Heater Relay drive unit Measurement Voltage > 3.0V	•		
325	1. Cor (Chec 1. CR	(Detection) (When Fuel Heater Relay is On) 10 seconds continuous, Fuel Heater Relay drive current > 4.5 A (Cancellation) (When Fuel Heater Relay is On) 3 seconds continuous, Fuel Heater Relay drive current ≤ 4.5 A Its / Symptoms) htrol Function – Fuel heater operation failure king list) -46 (#85) – CN-52 (#12) Checking Open/Short -46 (#86) – Fuse box (#22) Checking Open/Short	•		

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Critoria	Application							
HCESPN	FMI	Diagnostic Criteria	G	С	W					
	_	10 seconds continuous, Transmission Oil Press. Sensor Measurement								
	0	Voltage > 5.2V								
	1	10 seconds continuous, 0.3V≤ Transmission Oil Press. Sensor								
	<u>'</u>	Measurement Voltage < 0.8V								
	4	10 seconds continuous, Transmission Oil Press. Sensor Measurement								
501		Voltage < 0.3V								
(NA)	`	ılts / Symptoms)								
		nitor – Transmission Oil Press. display failure, Transmission Oil low pressure war	ning	failure	;					
	l ,	cking list)								
		-5 (#B) – CN-54 (#27) Checking Open/Short								
		-5 (#A) – CN-54 (#3) Checking Open/Short								
	3. CD	-5 (#C) – CN-54 (#13) Checking Open/Short								
	0	10 seconds continuous, Brake Oil Press. Sensor								
	1	Measurement Voltage > 5.2V								
		10 seconds continuous, 0.3V≤ Brake Oil Press. Sensor Measurement								
	4	Voltage < 0.8V 10 seconds continuous, Brake Oil Press. Sensor								
		Measurement Voltage < 0.3V								
503	/Poor	Ilts / Symptoms)								
(NA)	`									
		Monitor – Brake Oil Press. display failure, Brake Oil low pressure warning failure (Charling list)								
	(Checking list)									
		1. CD-3 (#B) – CN-54 (#4) Checking Open/Short 2. CD-3 (#A) – CN-54 (#3) Checking Open/Short								
	3. CD-3 (#C) – CN-54 (#3) Checking Open/Short									
	0.00	10 seconds continuous, Working Brake Press. Sensor Measurement								
	0	Voltage > 5.2V								
		10 seconds continuous, 0.3V≤ Working Brake Press. Sensor Measurement								
	1	Voltage < 0.8V								
	4	10 seconds continuous, Working Brake Press. Sensor Measurement								
505	4	Voltage < 0.3V								
(NA)	(Resu	ults / Symptoms)								
, ,	1. Mo	nitor – Working Brake Oil Press. display failure, Working Brake Oil low pressure	warni	ng fai	lure					
	(Chec	king list)								
	1. CD	-38 (#B) – CN-54 (#5) Checking Open/Short								
	2. CD	-38 (#A) – CN-54 (#3) Checking Open/Short								
	3. CD	-38 (#C) – CN-54 (#13) Checking Open/Short								

DTC		Diagnostia Critaria		Application		
HCESPN	FMI	Diagnostic Criteria G				
		(Detection)				
		(When Parking Relay is Off)				
		10 seconds continuous, Parking Relay drive unit				
	4	Measurement Voltage ≤ 3.0V				
	4	(Cancellation)				
		(When Parking Relay is Off)				
		3 seconds continuous, Parking Relay drive unit				
		Measurement Voltage > 3.0V				
E4.4		(Detection)				
514		(When Parking Relay is On)				
(NA)	6	10 seconds continuous, Parking Relay drive current > 6.5 A				
	0	(Cancellation)				
		(When Parking Relay is On)				
		3 seconds continuous, Parking Relay drive current ≤ 6.5 A				
	(Resu	Its / Symptoms)				
	1. Cor	ntrol Function – Parking Relay operation failure				
	(Chec	king list)				
	1. CR-	-66 (#1) – CN-54 (#20) Checking Open/Short				
	2. CR-	-66 (#2) – Fuse box (#30) Checking Open/Short				
		(Detection)				
		(When Traveling Cutoff Relay is Off)				
		10 seconds continuous, Traveling Cutoff Relay drive unit Measurement				
	4	Voltage ≤ 3.0V				
	7	(Cancellation)				
		(When Traveling Cutoff Relay is Off)				
	3 second	3 seconds continuous, Traveling Cutoff Relay drive unit Measurement				
		Voltage > 3.0V				
517		(Detection)				
(NA)		(When Traveling Cutoff Relay is On)				
(14/4)	6	10 seconds continuous, Traveling Cutoff Relay drive current > 6.5 A				
		(Cancellation)				
		(When Traveling Cutoff Relay is On)				
		3 seconds continuous, Traveling Cutoff Relay drive current ≤ 6.5 A				
	,	Its / Symptoms)				
		ntrol Function – Traveling Cutoff Relay operation failure				
	`	king list)				
		-47 (#85) – CN-54 (#9) Checking Open/Short				
	2. CR-	-47 (#86) – Fuse box (#28) Checking Open/Short				

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

 ${\sf G:General} \qquad \qquad {\sf C:Crawler\,Type} \qquad \qquad {\sf W:Wheel\,Type}$

DTC		Diagnacatic Cuitagia	Application		
HCESPN	FMI			С	W
525 (NA)	4	(Detection) (When Ram Lock Solenoid is Off) 10 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Ram Lock Solenoid is Off) 3 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage > 3.0V (Detection) (When Ram Lock Solenoid is On) 10 seconds continuous, Ram Lock Solenoid drive current > 6.5 A			
		(Cancellation) (When Ram Lock Solenoid is On) 3 seconds continuous, Ram Lock Solenoid drive current ≤ 6.5 A			
	,	Its / Symptoms)			
		ntrol Function – Ram lock control operation failure			
	`	king list)			
		69 (#1) – CN-54 (#8) Checking Open/Short			
	2. CN-	69 (#2) – Fuse box (#33) Checking Open/Short			
		(Detection)			
		(When Creep Solenoid is Off) 10 seconds continuous, Creep Solenoid drive unit			
		Measurement Voltage ≤ 3.0V			
	4	(Cancellation)			
		(When Creep Solenoid is Off)			
		3 seconds continuous, Creep Solenoid drive unit			
	•	Measurement Voltage > 3.0V			
		(Detection)			
527		(When Creep Solenoid is On)			
(NA)	_	10 seconds continuous, Creep Solenoid drive current > 6.5 A			
	6	(Cancellation)			
		(When Creep Solenoid is On)			
		3 seconds continuous, Creep Solenoid drive current ≤ 6.5 A			
	(Resu	Its / Symptoms)			
	1. Cor	ntrol Function – Creep mode operation failure			
	(Chec	king list)			
	1. CN-	-206 (#1) – CN-54 (#7) Checking Open/Short			
	2. CN	206 (#2) – Fuse box (#30) Checking Open/Short			

 $\ensuremath{\,\%\,}$ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Dia una antia Ovitavia		Application		
HCESPN	FMI	Diagnostic Criteria	G	С	W	
	0	10 seconds continuous, Travel Forward Press. Sensor Measurement			•	
	1	Voltage > 5.2V 10 seconds continuous, 0.3V≤ Travel Forward Press. Sensor Measurement Voltage < 0.8V			•	
500	4	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage < 0.3V			•	
530 (NA)	1. Mor 2. Cor (Chec 1. CD- 2. CD-	Its / Symptoms) nitor – Travel Forward Press. display failure ntrol Function – Driving interoperability power control operation failure king list) 73 (#B) – CN-54 (#6) Checking Open/Short 73 (#A) – CN-54 (#3) Checking Open/Short				
	3. CD-73 (#C) – CN-54 (#13) Checking Open/Short 1				•	
531 (NA)	1. Monitor – Iravel Reverse Press, display failure					
	0	10 seconds continuous, Battery input Voltage > 35V 10 seconds continuous, Battery input Voltage < 18V	•			
705	(Results / Symptoms) 1. Control Function – Startup impossibility (Checking list) 1. CS-74A (#1) – CN-51 (#1) Checking Open/Short					
	1	(When Engine is equal or more than 400 rpm) 10 seconds continuous, Alternator Node I Measurement Voltage < 18V (In case 12v goods, Alternator Node I Measurement Voltage < 9V)	•			
707	1. Cor (Chec	Its / Symptoms) htrol Function – Battery charging circuit failure king list) 74A (#1) – CN-51 (#2) Checking Open/Short				

 $\ensuremath{\,\%\,}$ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC	,	Diagnostic Criteria		Application		
HCESPN	FMI	Diagnostic Chteria	G	С	W	
	3	(Model Parameter) Mounting Acc. Dial				
	3	10 seconds continuous, Acc. Dial Measurement Voltage > 5.2V				
	4	(Model Parameter) Mounting Acc. Dial				
		10 seconds continuous, Acc. Dial Measurement Voltage < 0.3V				
714	(Resu	Its / Symptoms)				
	1. Moi	nitor – Acc. Dial Voltage display failure				
	2. Cor	ntrol Function – Engine rpm control failure				
	`	king list)				
	1. CN	-142 (#B) – CN-52 (#23) Checking Open/Short				
		(Detection)				
		(When Travel Alarm (Buzzer) Sound is Off)				
		10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit				
	4	Measurement Voltage ≤ 3.0V				
	4	(Cancellation)				
		(When Travel Alarm (Buzzer) Sound Relay is Off)				
		3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit				
		Measurement Voltage > 3.0V				
		(Detection)				
		(When Travel Alarm (Buzzer) Sound is On)				
722		10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive				
	6	current > 4.5 A				
	0	(Cancellation)				
		(When Travel Alarm (Buzzer) Sound is On)				
		3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive				
		current ≤ 4.5 A				
	(Resu	Its / Symptoms)			-	
	1. Cor	ntrol Function – Driving alarm operation failure				
	(Chec	king list)				
	,	-81 (#1) – CN-52 (#13) Checking Open/Short				
		-81 (#2) – Fuse box (#31) Checking Open/Short				
		(When mounting the A/C Controller)				
	2	60 seconds continuous, A/C Controller Communication Data Error				
	(Resu	lts / Symptoms)				
831	`	ntrol Function – A/C Controller operation failure				
(NA)		king list)				
	`	-11 (#8) – CN-51 (#22) Checking Open/Short				
		-11 (#7) – CN-51 (#32) Checking Open/Short				
	2	60 seconds continuous, Cluster Communication Data Error				
		Its / Symptoms)				
	'	ntrol Function – Cluster operation failure				
840		king list)				
	'	-56A (#7) – CN-51 (#32) Checking Open/Short				
		-56A (#6) – CN-51 (#22) Checking Open/Short				
	2. UN	JOH (#0) - OIV-01 (#22) OHEONING OPEN/OHOIT				

^{*} Some error codes are not applied to this machine.

C : Crawler Type G: General

DTC		Dia was astic College		Application			
HCESPN	FMI	Diagnostic Criteria	G	С	W		
	2	10 seconds continuous, ECM Communication Data Error	•				
	(Resu	Its / Symptoms)					
841	1. Cor	ntrol Function – ECM operation failure					
(NA)	(Chec	king list)					
	1. CN-	93 (#17) – CN-51 (#21) Checking Open/Short					
	2. CN-	93 (#18) – CN-51 (#31) Checking Open/Short					
	2	(When mounting the I/O Controller 1)					
		60 seconds continuous, I/O Controller 1 Communication Data Error					
845	(Resu	Its / Symptoms)					
(NA)	1. Cor	ntrol Function – I/O Controller 1 operation failure					
(IVA)	(Chec	king list)					
	1. CN-	-53 (#21) – CN-51 (#23) Checking Open/Short					
	2. CN-53 (#31) - CN-51 (#33) Checking Open/Short						
	2	(When mounting the Haptic Controller)					
		60 seconds continuous, Haptic Controller Communication Data Error					
848	,	Its / Symptoms)					
(NA)		ntrol Function – Haptic Controller operation failure					
(147.1)	,	king list)					
		8 (#2) – CN-51 (#22) Checking Open/Short					
	2. CN-	8 (#3) – CN-51 (#32) Checking Open/Short	1		1		
	2	(When mounting the RMCU)					
		60 seconds continuous, RMCU communication Data Error					
	٠,	luts / Symptoms)					
850	1. Control Function – RMCU operation failure						
	`	king list)					
		125A (#3) – CN-51 (#22) Checking Open/Short					
	2. CN-	-125A (#11) – CN-51 (#32) Checking Open/Short					
	2	(When mounting the I/O Controller 2)					
		60 seconds continuous, I/O Controller 2 communication Data Error					
861	,	Its / Symptoms)					
(NA)		ntrol Function – I/O Controller 2 operation failure					
	,	king list)					
		53 (#21) – CN-51 (#23) Checking Open/Short					
	2. CN-	53 (#31) – CN-51 (#33) Checking Open/Short					

 $\ensuremath{\,\%\,}$ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

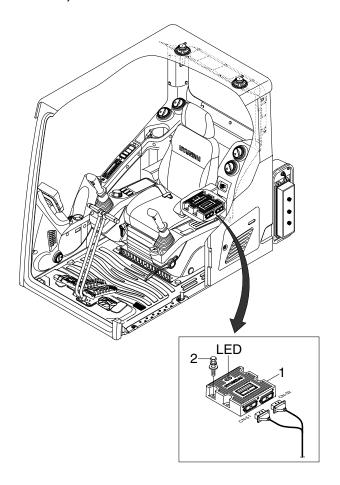
DTC		D:		Application				
HCESPN	FMI	Diagnostic Criteria	G	С	W			
	2	(When mounting the AAVM)						
		60 seconds continuous, AAVM communication Data Error						
	(Resu	lts / Symptoms)						
866	1. Cor	ntrol Function – AAVM operation failure						
	(Chec	king list)						
	1. CN-	-401 (#86) – CN-51 (#22) Checking Open/Short						
	2. CN-	-401 (#87) – CN-51 (#32) Checking Open/Short						
	2	60 seconds continuous, RDU communication Data Error						
	(Resu	Its / Symptoms)						
867	1. Cor	ntrol Function – RDU operation failure						
007	(Chec	(Checking list)						
	1. CN-376 (#10) – CN-51 (#22) Checking Open/Short							
	2. CN-	-376 (#11) – CN-51 (#32) Checking Open/Short						
	2	60 seconds continuous, Switch Controller communication Data Error	•					
	(Resu	Its / Symptoms)						
868	1. Control Function – Switch Controller operation failure							
	(Chec	king list)						
	1. CN-	-56A (#7) – CN-51 (#32) Checking Open/Short						
	2. CN-56A (#6) - CN-51 (#22) Checking Open/Short							
	2	(When mounting the BKCU)						
		60 seconds continuous, BKCU communication Data Error						
	(Results / Symptoms)							
869	1. Cor	ntrol Function – BKCU operation failure						
	(Chec	king list)						
	1. CS-2B (#A) – CN-51 (#22) Checking Open/Short							
	2. CS-	2B (#B) – CN-51 (#32) Checking Open/Short						

 $\ensuremath{\,\%\,}$ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

GROUP 13 ENGINE CONTROL SYSTEM

1. MCU (Machine Control Unit)



300S5MS13

2. MCU ASSEMBLY

- 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 MCU and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	· Check if the input power wire (24 V, GND) of MCU
		is disconnected
		· Check the fuse

G: green, R: red, Y: yellow

GROUP 14 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

Mada	Pres	ssure	Electric current	Engine rpm	
Mode	kgf/cm ²	psi	(mA)	(at accel dial 10)	
	Р	10	142	330 ± 30	1900 ± 50
Standard (Stage : 1.0)	S	12 ± 3	171 ± 40	360 ± 30	1800 ± 50
(etage :)	E	12 \pm 3	171 ± 40	360 ± 30	1700 ± 50
	Р	3	43	190 ± 30	2000 ± 50
Option (Stage : 2.0)	S	5 ± 3	71 ± 40	250 ± 30	1900 ± 50
(5.5.35 / 2.0)	Е	10 ± 3	142 ± 40	330 ± 30	1800 ± 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

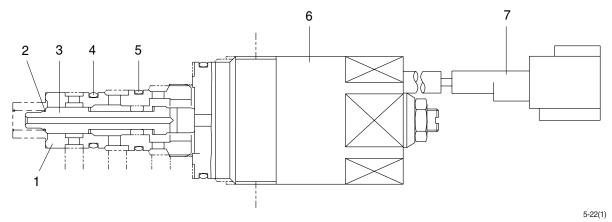
· Service menu



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

3) OPERATING PRINCIPLE (pump EPPR valve)

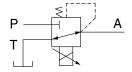
(1) Structure



- 1 Sleeve
- 2 Spring
- 3 Spool

- O-ring
- O-ring

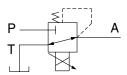
- 6 Solenoid valve
- 7 Connector

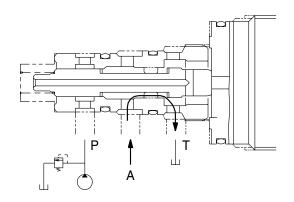


- Pilot oil supply line (pilot pressure)
- Return to tank
- Secondary pressure to flow regulator at main pump

(2) Neutral

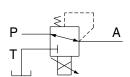
Pressure line is blocked and A oil returns to tank.

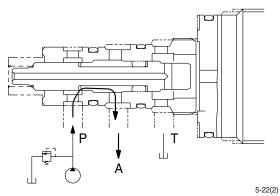




(3) Operating

Secondary pressure enters into A.

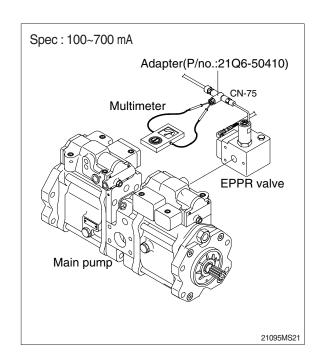




4) EPPR VALVE CHECK PROCEDURE

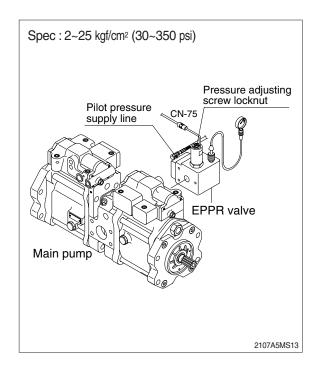
(1) Check electric current value at EPPR valve

- 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 multimodal dial at 10.
- 6 If rpm display show approx 1850 \pm 50 rpm check electric current at bucket circuit relief position.
- Theck 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 multimodal dial at 10.
- ⑤ If tachometer show approx 1850±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

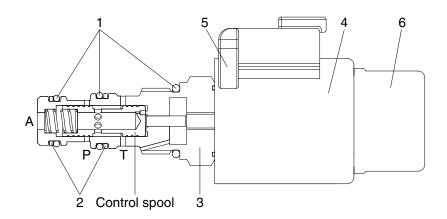
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

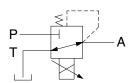
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30 \,\Omega\$ and 24 V.

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.

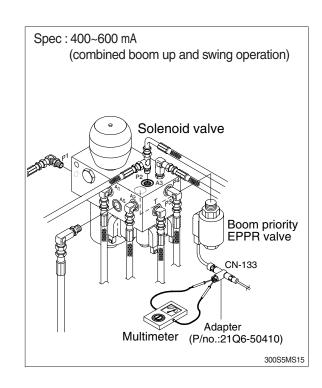
2) EPPR VALVE CHECK PROCEDURE

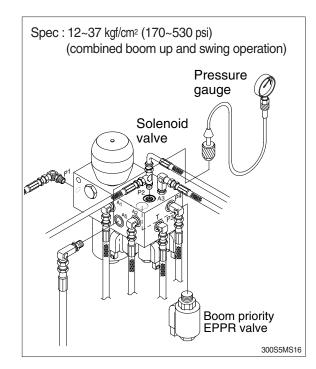
- (1) Check electric current value at EPPR valve
 - ① Disconnect connector CN-133 from EPPR valve.
 - ② Insert the adapter to CN-133 and install multimeter as figure.
 - ③ Start engine.
 - Set S-mode and cancel auto decel mode.

 - ⑥ 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.
- 3 Set S-mode and cancel auto decel mode.
- ④ If rpm display approx 1850±50 rpm check pressure (In case of combined boom up and swing operation).
- (5) If pressure is not correct, adjust it.
- 6 After adjust, test the machine.





GROUP 15 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



220S3CD501



* 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 3-6 for details.

2) CLUSTER CHECK PROCEDURE

(1) Start key: ON

① Check monitor

- a. Buzzer sounding for 4 seconds with HD 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)

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 buzzer stop switch is pushed. Also the buzzer stops.

3. CLUSTER CONNECTOR

1) NORMAL TYPE

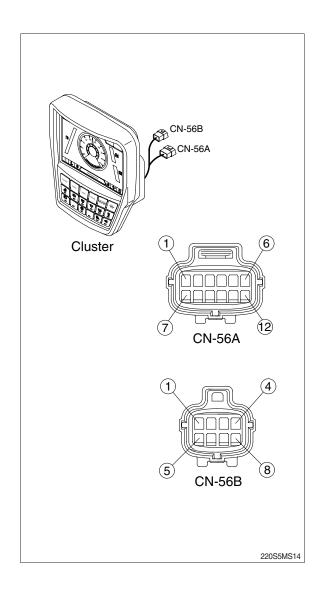
(1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32Vdc
2	Power IG {24V}	20~32Vdc
3	GND	-
4	N.C	-
5	N.C	-
6	CAN 2 (H)	0~5Vdc
7	CAN 2 (L)	dc
8	N.C	-
9	N.C	-
10	N.C	-
11	N.C	-
12	N.C	-

(2) CN-56B

No.	Name	Signal
1	CAM + 6.5V	6.3~6.7Vdc
2	CAM GND	-
3	CAM DIFF (H)	0~5Vdc
4	CAM DIFF (L)	0~5Vdc
5	CAM 1	NTSC signal
6	CAM 2	NTSC signal
7	CAM 3	NTSC signal
8	CAM shield	0~5Vdc

NTSC: National Television System Committee



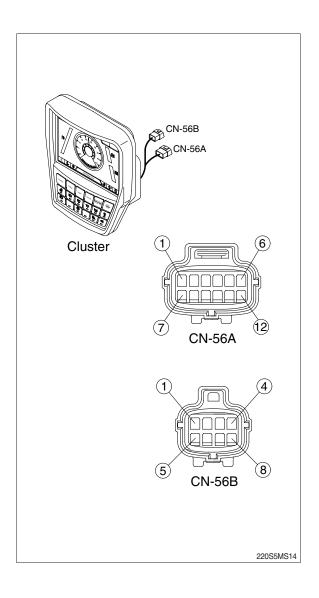
2) PREMIUM TYPE (1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32Vdc
2	Power IG {24V}	20~32Vdc
3	GND	-
4	CAN 1 (H)	0~5Vdc
5	CAN 1 (L)	0~5Vdc
6	CAN 2 (H)	0~5Vdc
7	CAN 2 (L)	20~32Vdc
8	N.C	-
9	N.C	-
10	Aux left	0~5V
11	Aux right	0~5V
12	Aux GND	-

(2) CN-56B

No.	Name	Signal
1	CAM + 6.5V	6.3~6.7Vdc
2	CAM GND	-
3	CAM DIFF (H)	0~5V
4	CAM DIFF (L)	0~5V
5	CAM 1	NTSC signal
6	CAM 2	NTSC signal
7	CAM 3	NTSC signal
8	CAM shield	0~5Vdc





2) GAUGE

(1) Operation screen

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

Normal type



220S3CD551

Premium type



220S3CD151

- 1 RPM / Speed gauge
- 2 Engine coolant temperature gauge
- 3 Hydraulic oil temperature gauge
- 4 Fuel level gauge

- 5 Tripmeter display
- 6 Eco guage
- 7 Accel dial gauge

* Operation screen type can be set by the screen type menu of the display (premium type).
Refer to page 5-76 for details.

(2) RPM / Speed gauge

Normal type



① This display the engine speed.





290F3CD549

(3) Engine coolant temperature gauge

Normal type



Premium type



① This gauge indicates the temperature of coolant.

White range : 40-100°C (104-212°F)
 Red range : Above 100°C (212°F)

- ② If the indicator is in the red range or lamp pops up and the buzzer sounds 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.

220S3CD553

(4) Hydraulic oil temperature gauge

Normal type



Premium type



220S3CD554

- ① This gauge indicates the temperature of hydraulic oil.
 - White range : 40-100°C(104-212°F)Red range : Above 100°C(212°F)

of the problem.

- ② If the indicator is in the red range or lamp pops up and the buzzer sounds reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause
- * If the gauge indicates the red range or limits 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) Fuel level gauge

Normal type



Premium type



- ① This gauge indicates the amount of fuel in the fuel tank.
- ② Fill the fuel when the red range, or | lamp pops up and the buzzer sounds.
- * If the gauge indicates the red range or amp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.

(6) Tripmeter display



220S3CD555

- ① This displays the engine the tripmeter.
- * Refer to page 5-78 for details.

(7) Eco gauge



- ① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel econo-
- 2 The fuel consumption rate or machine load is higher, the number of segment is increased.
- 3 The color of Eco gauge indicates operation status.
 - · White: Idle operation
 - · Green: Economy operation
 - · Yellow : Non-economy operation at a medium level.
 - · Red : Non-economy operation at a high level.

(8) Accel dial gauge



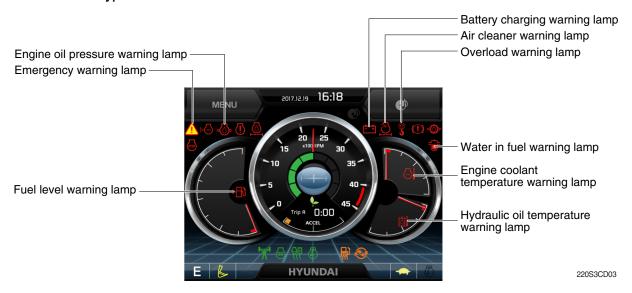
① This gauge indicates the level of accel dial.

3) WARNING LAMPS

Normal type



Premium type



* Warning lamps and buzzer

Warnings	When error happened	Lamps and buzzer
All warning lamps	Warning lamp pops up on	· The pop-up warning lamp moves to the original position and
except below	the center of the LCD and	blinks, and the buzzer stops when ;
	the buzzer sounds	- the buzzer stop switch
		- the lamp of the LCD is touched
_	Warning lamp pops up on	* Refer to page 5-54 for details.
	the center of the LCD and	
	the buzzer sounds	

* Refer to page 5-60 for the buzzer stop switch.

(1) Engine coolant temperature warning lamp

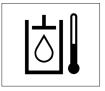


290F3CD61

- ① Engine coolant temperature warning is indicated two steps.

 - 102°C over : The \bigcirc lamp pops up and the buzzer sounds.
- ② The pop-up ♠, ♠ lamps move to the original position and blinks when the buzzer stop switch with is pushed. And the buzzer stops and , 1 lamps keep blink.
- 3 Check the cooling system when the lamps keep blink.

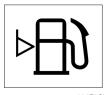
(2) Hydraulic oil temperature warning lamp



290F3CD62

- ① Hydraulic oil temperature warning is indicated two steps.
 - -100° C over : The | $\frac{1}{100^{\circ}}$ | lamp pops up and the buzzer sounds.
 - -105° C over: The /i lamp pops up and the buzzer sounds.
- ② The pop-up $|\dot{a}|$, \hat{N} lamps move to the original position and blinks when the buzzer stop switch is pushed. And the buzzer stops and |o| , / lamps keep blink.
- 3 Check the hydraulic oil level and hydraulic oil cooling system.

(3) Fuel level warning lamp



290F3CD63

- ① This warning lamp pops up and the buzzer sounds when the level of fuel is below 55 ℓ (14.5 U.S. gal).
- ② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp



290F3CD64

- ① This warning lamp pops up and the buzzer sounds when each of the below warnings is happened.
 - Engine coolant overheating (over 104°C)
 - Hydraulic oil overheating (over 105°C)
 - MCU input voltage abnormal
 - Cluster communication data error
- The pop-up warning lamp moves to the original position and blinks when the buzzer stop switch size is pushed. And the buzzer stops.
- 2 When this warning lamp blinks, machine must be checked and serviced immediately.

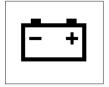
(5) Engine oil pressure warning lamp



290F3CD65

- ① This warning lamp pops up and the buzzer sounds when the engine oil pressure is low.
- ② If the lamp blinks, shut OFF the engine immediately. Check oil level.

(6) Battery charging warning lamp



290F3CD67

- ① This warning lamp pops up and the buzzer sounds when the battery charging voltage is low.
- ② Check the battery charging circuit when this lamp blinks.

(7) Air cleaner warning lamp



290F3CD68

- ① This warning lamp pops up and the buzzer sounds when the filter of air cleaner is clogged.
- ② Check the filter and clean or replace it.

(8) Overload warning lamp (opt)



290F3CD69

- ① When the machine is overload, the overload warning lamp pops up and the buzzer sounds during the overload switch is ON. (if equipped)
- ② Reduce the machine load.

4) PILOT LAMPS

Normal type



220S3CD574

Premium type



220S3CD74

(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 - IPC speed mode
			General operation - IPC balance mode
3	Work tool mode		General operation - IPC efficiency mode
			Breaker operation mode
		Á	Crusher operation mode
4	Travel mode		Low speed traveling
-	navernioue	(4)	High speed traveling
5	Auto idle mode		Auto idle

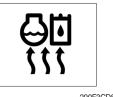
(2) Power max pilot lamp



290F3CD78

- 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 3-36 for power max function.

(3) Warming up pilot lamp



290F3CD80

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

(4) Decel pilot lamp



290F3CD81

- 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 3-36.

(5) Fuel warmer pilot lamp



290F3CD82

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

(6) Maintenance pilot lamp



290F3CD83

- 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 5-71.

(7) Entertainment pilot lamp (premium type)



290F3CD84

- ① This lamp is on when audio or video files are playing.
- * Refer to the page 5-77.

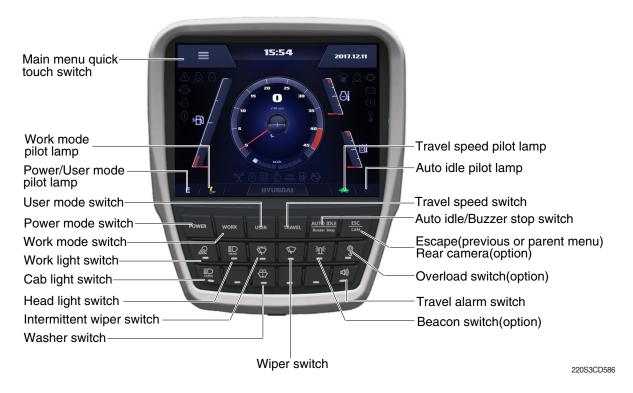
(8) Smart key pilot lamp (premium type, opt)



290F3CD214

- 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 5-72.

5) SWITCHES Normal type

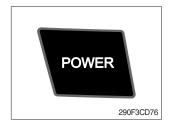


Premium type



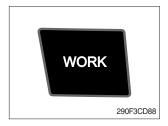
* When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-56 for details.

(1) Power mode switch



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

(2) Work mode switch



- ① This switch is to select the machine work mode, which shifts from general operation mode to optional attachment operation mode.
 - · 🖒 : General operation mode
 - · S : 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



- ① This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.
 - · Memory: Push more than 2 seconds.
 - · Action : Push within 2 seconds.
 - · Cancel : Push this switch once more within 2 seconds.
- ② Refer to the page 3-19 for another set of user mode.

(4) Travel speed switch



- ① This switch is used to select the travel speed alternatively.
 - · Low speed · High speed
- * Do not change the setting of the travel speed switch. Machine stability may be adversely affected.
- ▲ Personal injury can result from sudden changes in machine stability.

(5) Auto idle/buzzer stop switch



- 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) Escape/Camera switch



- 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 5-78 for the camera.
- ③ If the camera is not installed, this switch is used only ESC function.

(7) Work light switch



- ① This switch is used to operate the work light.
- ② The pilot lamp is turned ON when operating the switch.

(8) Head light switch



- ① This switch is used to operate the head light.
- ② The pilot lamp is turned ON when operating the switch.

(9) Intermittent wiper switch



- ① This switch is used to wipe operates intermittently.
- ② The pilot lamp is turned ON when operating the switch.

(10) Wiper switch



- ① This switch is used to operate the window wiper.
- ② Note that the wiper will self-park when switched off.
- ③ The pilot lamp is turned ON when operating the switch.
- If the wiper does not operate with the switch in ON position, turn the switch OFF immediately. Check the cause.
 If the switch remains ON, motor failure can result.

(11) Washer switch



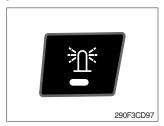
- ① The washer liquid is sprayed and the wiper is operated only while pressing this switch.
- ② The pilot lamp is turned ON when operating the switch.

(12) Cab light switch



- ① This switch turns ON the cab light on the cab.
- ② The pilot lamp is turned ON when operating the switch.

(13) Beacon switch



- ① This switch turns ON the rotary light on the cab.
- ② The pilot lamp is turned ON when operating the switch.

(14) Overload switch



- ① When this switch turned ON, buzzer makes sound and overload warning lamp comes ON in case that the machine is overload.
- ② When it turned OFF, buzzer stops and warning lamp goes out.
- ♠ Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard could result in serious injury or death. Always activate the overload warning device before you handle or lift objects.

(15) Travel alarm switch



- ① This switch is to activate travel alarm function surrounding when the machine travels to forward and backward.
- ② On pressing this switch, the alarm operates only when the machine is traveling.
- ③ The pilot lamp is turned ON when operating the switch.

(16) Main menu quick touch switch



- ① This switch is to activate the main menu in the cluster.
- * Refer to the page 5-65.

(17) Entertainment quick touch switch (premium type, opt)

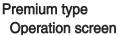


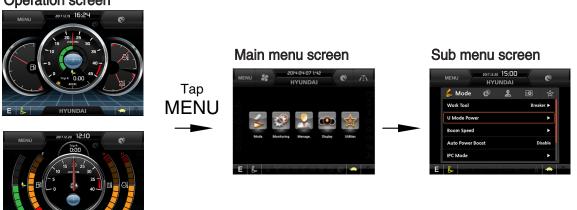
- ① This switch is to activate the entertainment control menu in the cluster.
- * Refer to the page 5-77.

6) MAIN MENU

* On the operation screen, tap MENU to access the main menu screen.
On the sub menu screen, you can tap the menu bar to access functions or applications.







220S3CD102

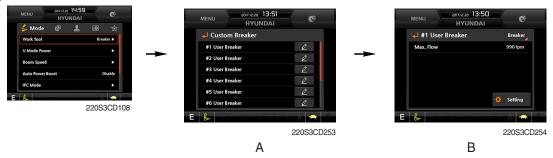
(1) Structure

No	Main menu	Sub menu	Description
1	Mode 290S3CD103	Work tool U mode power Boom/Arm speed Auto power boost IPC mode Auto engine shutdown (option) Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Boom speed Enable, Disable Speed mode, Balance mode, Efficiency mode One time, Always, Disable Key on initial mode, Accel initial mode / step Switch function
2	Monitoring 290S3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU MCU All logged fault delete, Initialization canceled Machine information, Switch status, Output status,
3	Management 290S3CD105	Fuel rate information Maintenance information Machine security Machine information Contact Service menu Clinometer Update	General record, Hourly, Daily, Mode record Replacement, Change interval oils and filters ESL mode setting, Password change Model, MCU, Monitor RMCU, Relay drive unit, AAVM (opt) A/S phone number, A/S phone number change Power shift, Operating hour, Breaker mode pump acting, EPPR current level, Overload pressure Clinometer setting Cluster, ETC device
4	Display 290S3CD106	Display item Clock Brightness Unit setup Language selection Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Distance, Date format Korean, English, Chinese, ETC A type, B type★
5	Utilities 290S3CD107	Entertainment ★ Tripmeter Camera setting AUX Manual	Play Video, Audio, Smart terminal.★ 3 kinds (A, B, C) Number of active, Display order, AAVM (opt)★

★ : premium type

(2) Mode setup

- * Illustrations are based on the premium type cluster.
- ① Work tool



- · Select on installed optional attachment
 - A: It can set the user's attachment. It is available in setting #1~#10.
 - B : Max flow Set the maximum flow for the attachment. Relief pressure Set the relief pressure.

2 U mode power



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

Step (■)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)			
1	1400	1000	0			
2	1500	1050 (auto idle)	3			
3	1550	1100	6			
4	1650	1150	9			
5	1700	1200	12			
6	1750	1250	16			
7	1800	1300	20			
8	1850	1350	26			
9	1900	1400	32			
10	1950	1450	38			
W O t						

% One touch decel & low idle: 1000 rpm

3 Boom speed



· Boom speed

Boom priority function can be activated or cancelled
 Enable - Boom up speed is automatically adjusted as working conditions by the MCU.
 Disable - Normal operation

4 Auto power boost

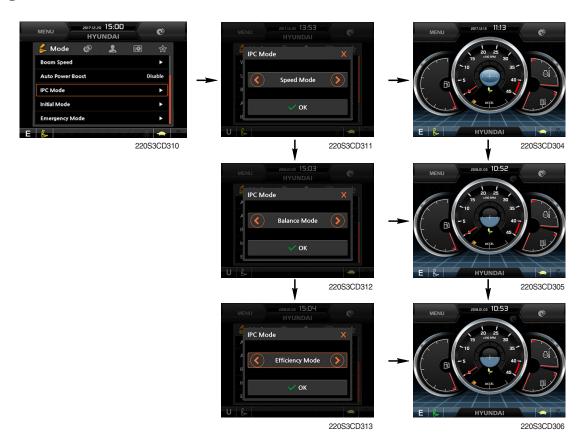


· The power boost function can be activated or cancelled.

Enable - The digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds.

Disable - Not operated.

⑤ IPC mode



- The IPC mode can be selected by this menu.
 - Speed mode
 - Balance mode (default)
 - Efficiency mode
- · This mode is applied only general operation mode of the work tool mode.
- Please update the cluster programs if this mode is not displayed in the mode setup menu. Refer to the page 3-27.

6 Automatic engine shutdown (option)



- · The automatic engine shutdown function can be set by this menu.
 - One time
 - Always
 - Disable
 - Wait time setting : Max 40 minutes, min 2 minutes

7 Initial mode



- · Key on initial mode
 - Selected the power mode is activated when the engine is started.

® Emergency mode



- · This mode can be used when the switches are abnormal on the cluster.
- · The cluster switches will be selected by touched each icon.

(3) Monitoring

① Active fault



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

② Logged fault



220S3CD124

· The logged faults of the MCU can be checked by this menu.

3 Delete logged fault



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

4 Monitoring



- The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu (Analog input).
- The switch status or output status can be confirmed by this menu (Digital input & Digital output).
- The activated switch or output pilot lamps are light ON.

(4) Management

① Fuel rate information







220S3CD16





· General record (A)

(service meter time). - A days fuel used (right)

now (MCU real time).

- Hourly fuel rates for past 12 hours (service meter time).

Fuel consumption devided by engine run time

Fuel consumption from 24:00 (or "Reset" time) to

- No record during key-off time.
- One step shift to the right for every one hour.

- Average fuel rate (left) (from "Reset" to now)

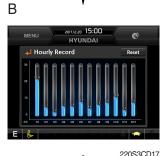
- Automatic deletion for 12 hours earlier data.
- All hourly records deletion by "Reset".

· Daily record (C)

- Daily fuel consumption for past seven days (MCU real time).
- No record during key-off time.
- One step shift to the right at 24:00 for every day.
- Automatic deletion for 7 days earlier data.
- All daily records deletion by "Reset".

· Mode record (D)

- Average fuel rate for each power mode/accel dial (at least 7) from "Reset" to now.
- No record during idle.
- All mode records deletion by "Reset".







220S3CD19

2 Maintenance information



- · Alarm lamp () is ON when oil or filter needs to be changed or replaced.
- · Replacement : The elapsed time will be reset to zero (0).
- · Change interval: The change or replace interval can be changed in the unit of 30 hours.
- · 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	1000
12	Air cleaner (inner & outer)	2000
13	Radiator coolant	2000
14	Swing gear pinion grease	1000

3 Machine security



ESL Mode

Interval

220S3CD137

220S3CD138

· 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.

 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 +

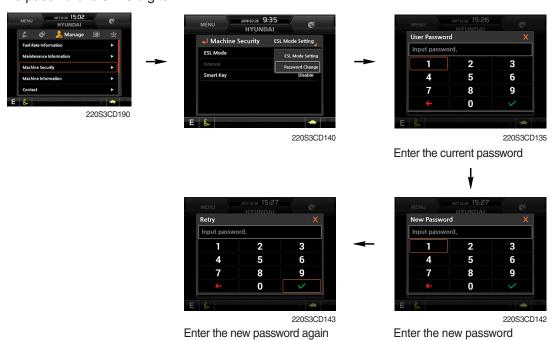
※ Password length: (5~10 digit) +

✓

- Smart key (premium type, opt): Smart key is registered when equipped with optional smart key. 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.



5-72

4 Machine Information



· This can confirm the identification of the model information (ECU), MCU, monitor, switch controller, RMCU, relay driver unit, AAVM (opt).

(5) Contact (A/S phone number)



Enter the new A/S phone number

6 Service menu



- · Power shift (standard/option): Power shift pressure can be set by option menu.
- · Operating hours: Operating hours since the machine line out can be checked by this menu.
- · Breaker mode pump acting (1 pump/2 pump)
- · EPPR current level (attach flow EPPR 1 & 2)
- · Overload pressure: 100 ~ 350 bar

Clinometer



220S3CD153

- · 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.

® Update (cluster & ETC devices)

· Insert USB memory stick



220S3CD296



(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



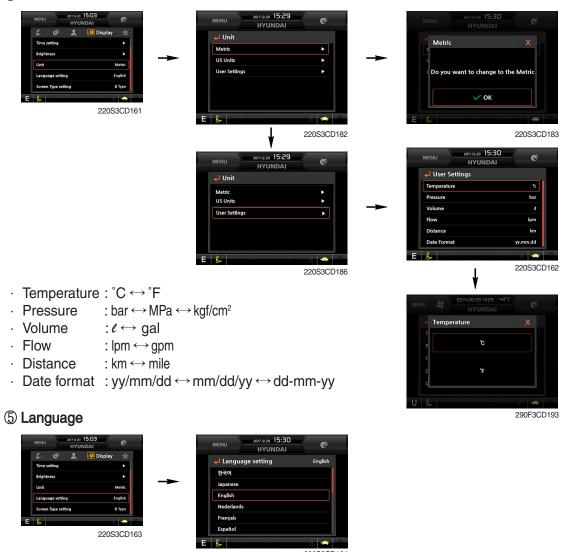
- The first line's three spots "**/***" represent Year/Month/Day each.
- The second line shows the current time. (0:00~23:59)

③ Brightness



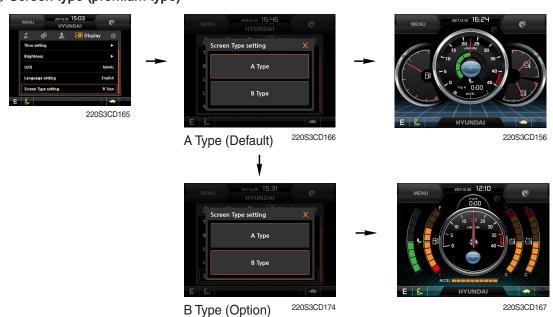
· If "Auto" is chosen, brightness for day and night can be differently set up. Also by using the bar in lower side, users can define which time interval belongs to day and night. (in bar figure, white area represents night time while orange shows day time)

4 Unit



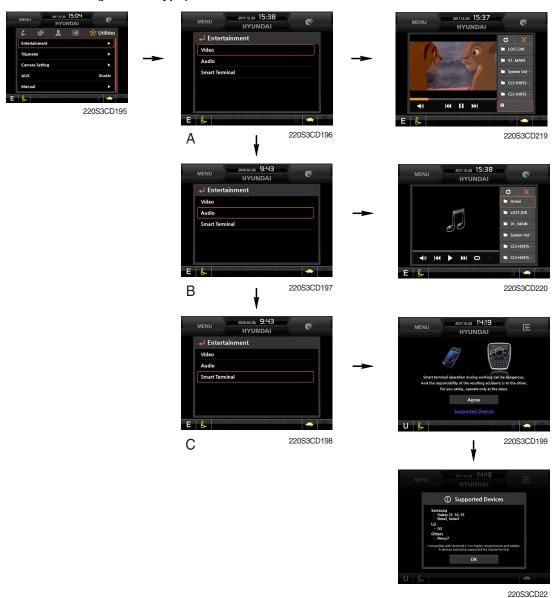
· User can select preferable language and all displays are changed the selected language.

6 Screen type (premium type)



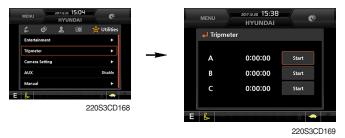
(6) Utilities

① Entertainment (premium type)



- Video (A): This menu operates the video play function. mp4, mkv, avi files and so on.
- Audio (B): This menu operates the play music. mp3, mp4 files and so on.
- Smart terminal (C): The menu features a smartphone and operates the miracast.

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

- · If the rear camera is not installed on the machine, set disable.
- · If the rear camera installed on the machine, set enable.



· In the operation screen, rear camera screen show up when ESC/CAM button is pushed.



- **4 AAVM** (All Around View Monitoring, premium type, opt)
- · The AAVM buttons of the cluster consist of ESC/CAM and AUTO IDLE/Buzzer stop.



- Escape button
- · It will enter into the AAVM mode from the beginning screen if the AAVM is installed.
- · While in the AAVM mode, select the ESC button to return to the beginning screen.



- Buzzer stop button
- In AAVM mode, it detects surrounding pedestrians or objects and the warning buzzer sounds.
- · User can turn OFF the warning sound by pressing buzzer stop button.



290F3CD246

- · When the worker or pedestrian go to the blue line (radius 5 m), an external danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the blue rectangular box for the recognition of the worker and pedestrian. At this time, the operator should stop work imme
 - diately, and stop the buzzer by pressing the buzzer stop button. And then, please work after you check whether the danger factors are solved.



290F3CD247

- When the worker or pedestrian go inside of red line (radius 3 m), an internal danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the red rectangular box for the recognition of the worker and pedestrian.
 - At this time, the operator should stop work immediately, and stop the buzzer by pressing the buzzer stop button. And then, please work after you check whether the danger factors are solved.
- In AAVM mode, a touch screen of the LCD is available only. The multimodal dial of the haptic controller is not available.

GROUP 16 FUEL WARMER SYSTEM

1. SPECIFICATION

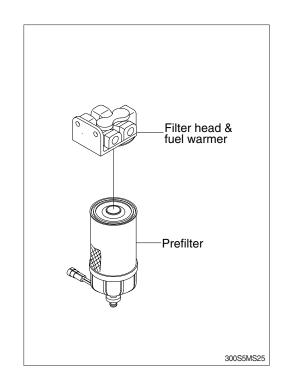
1) Operating voltage: 24±4 V

2) Power: 350±50 W 3) Current: 15 A

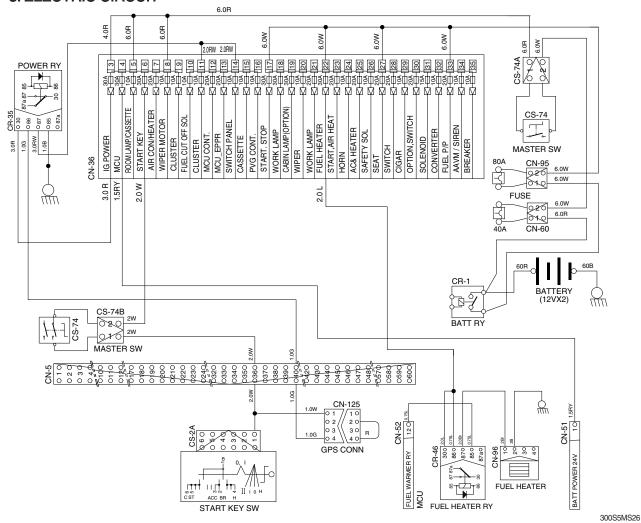
2. OPERATION

- 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

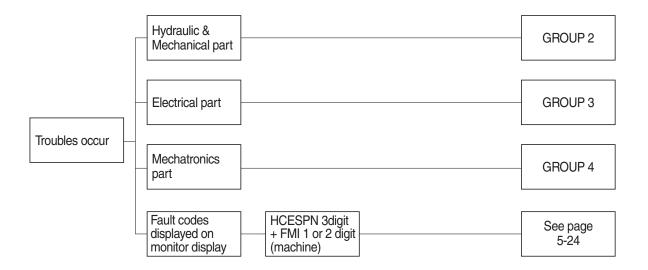
GROUP 1 BEFORE TROUBLESHOOTING

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.



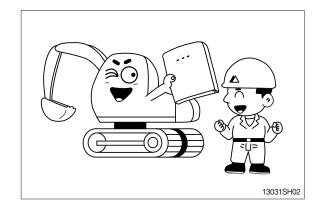
2. DIAGNOSING PROCEDURE

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.

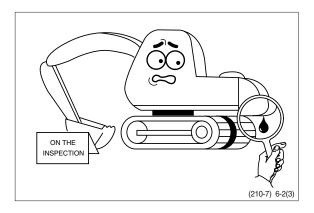
- 1) How the machine is used and when it is serviced?
- 2) When the trouble was noticed and what work the machine was doing at that time?
- 3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
- 4) Did the machine have any troubles previously?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

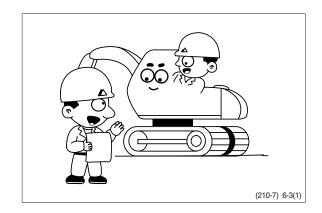
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



STEP 4. Inspect the trouble actually on the machine

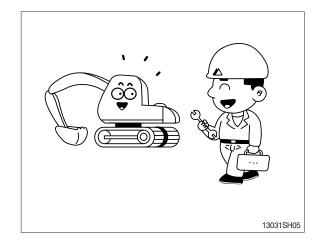
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.

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



STEP 5. Perform troubleshooting

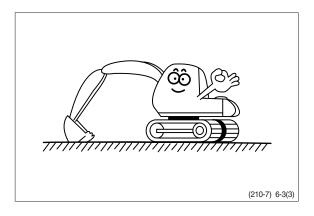
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.



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

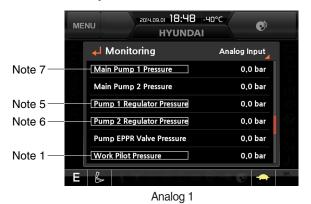
1. INTRODUCTION

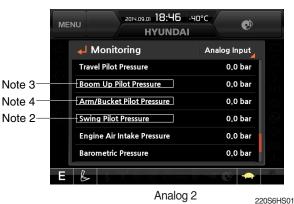
1) MACHINE IN GENERAL

- (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.



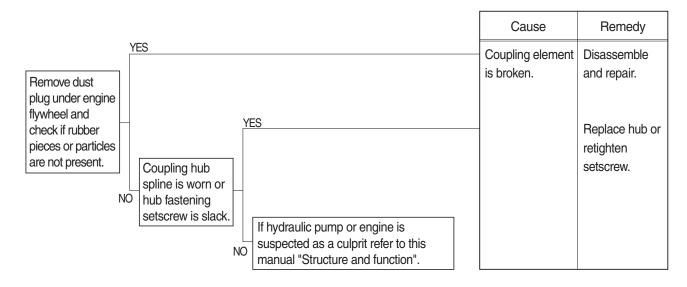


(2) Specification

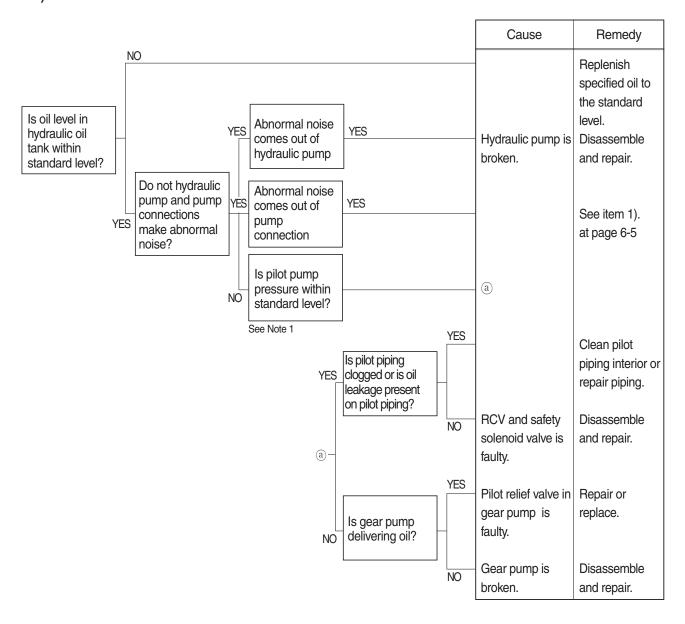
• •			
No.	Description	Specification	
Note 1	Work pilot pressure	40 ⁺² ₀ bar	
Note 2	Swing pilot pressure	0~40 bar	
Note 3	Boom up pilot pressure	0~40 bar	
Note 4	Arm/bucket pilot pressure	0~40 bar	
Note 5	Pump 1 regulator pressure	0~50 bar	
Note 6	Pump 2 regulator pressure	0~50 bar	
Note 7	Pump 1 pressure	350 bar	

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

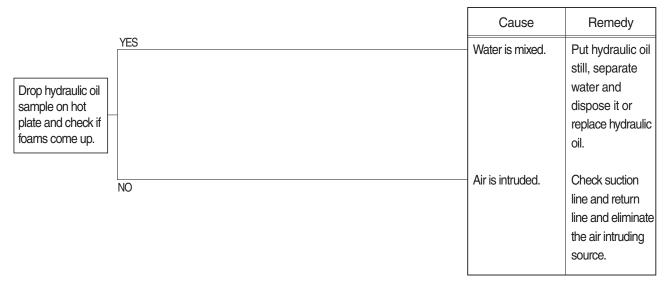


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

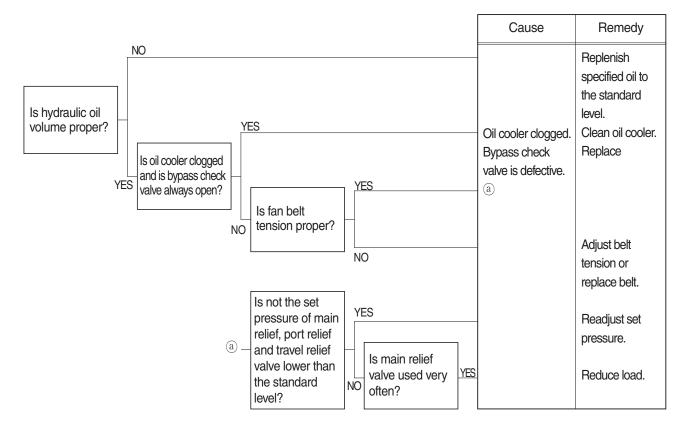


3. HYDRAULIC SYSTEM

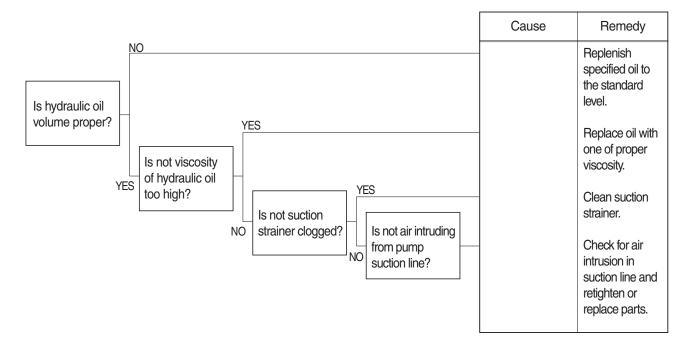
1) HYDRAULIC OIL IS CLOUDY



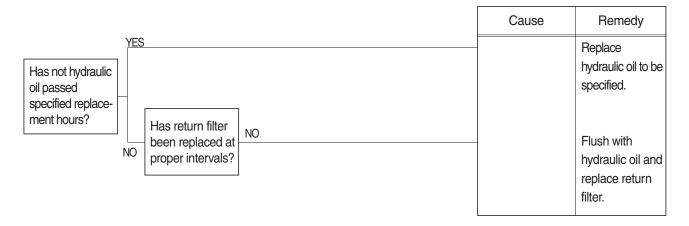
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

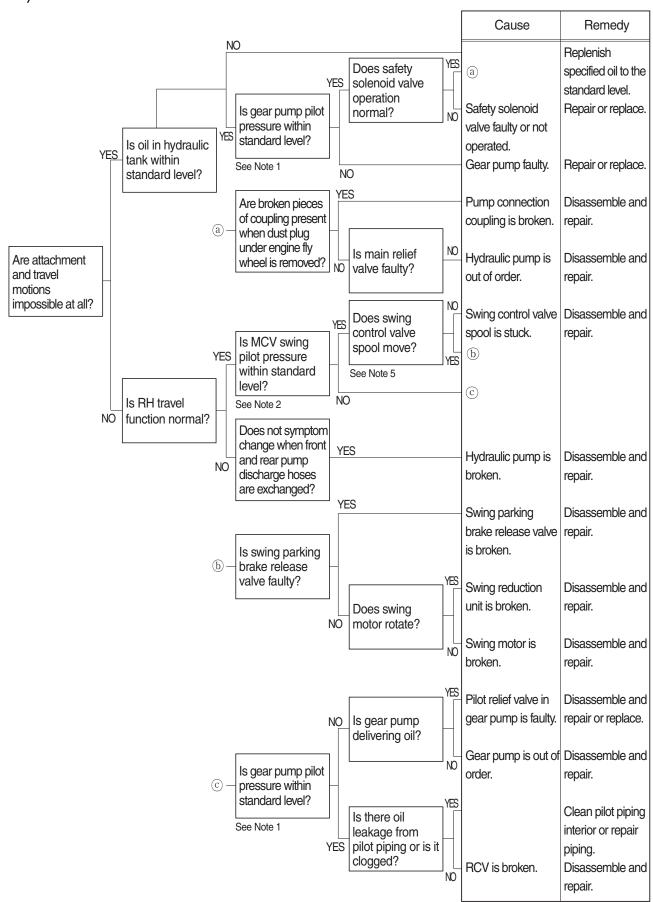


4) HYDRAULIC OIL IS CONTAMINATED

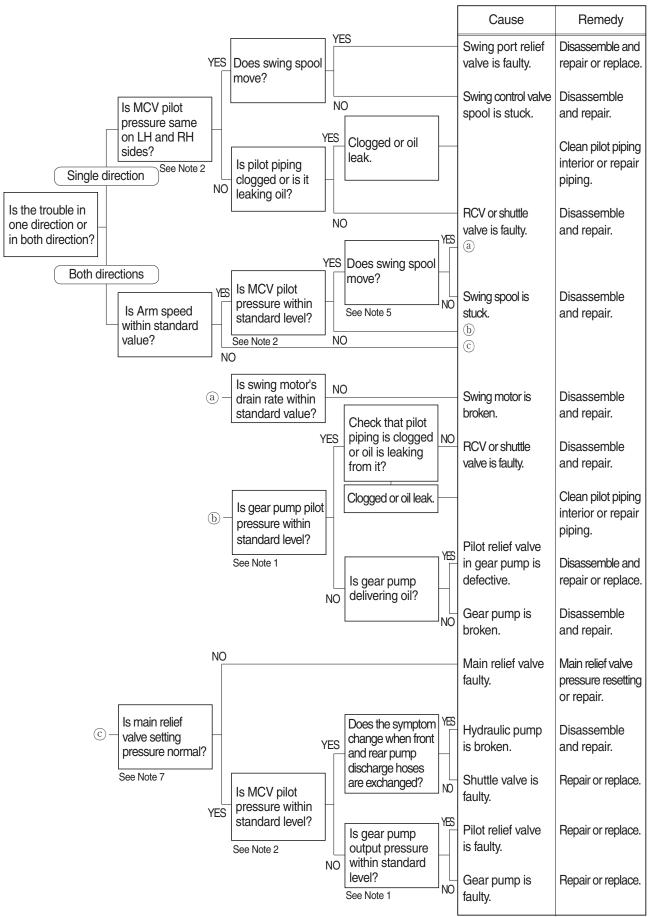


4. SWING SYSTEM

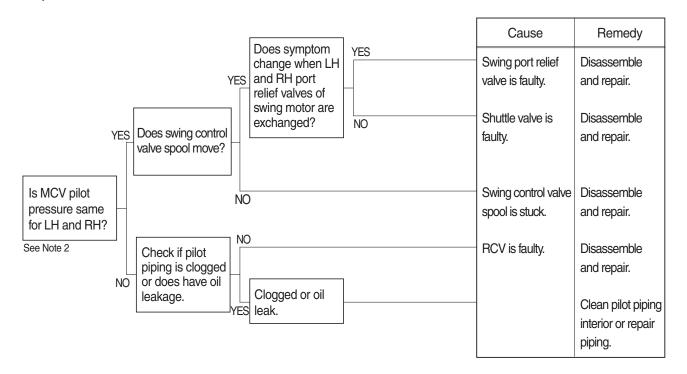
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



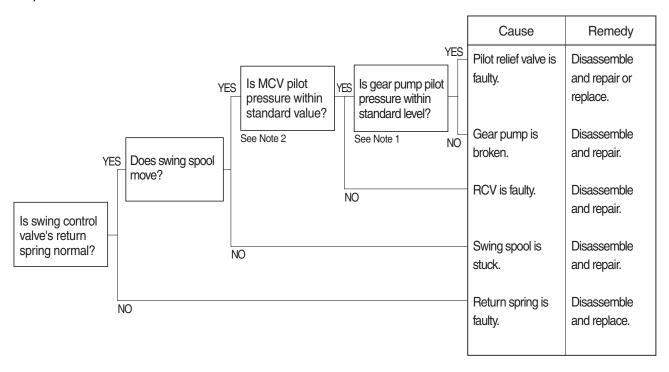
2) SWING SPEED IS LOW



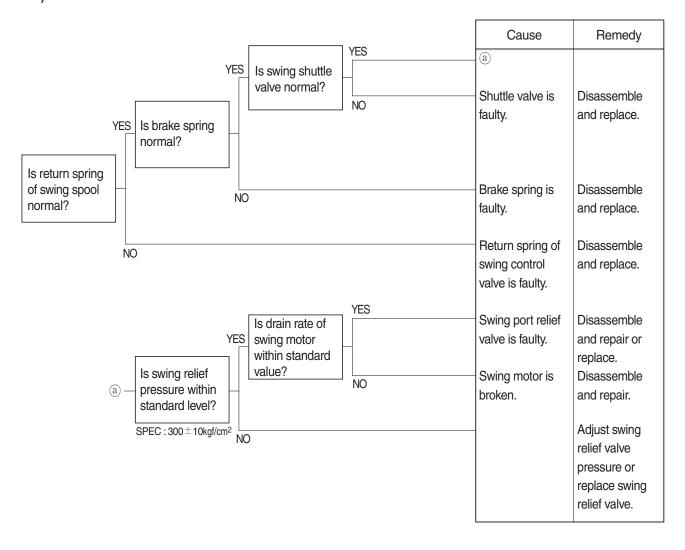
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

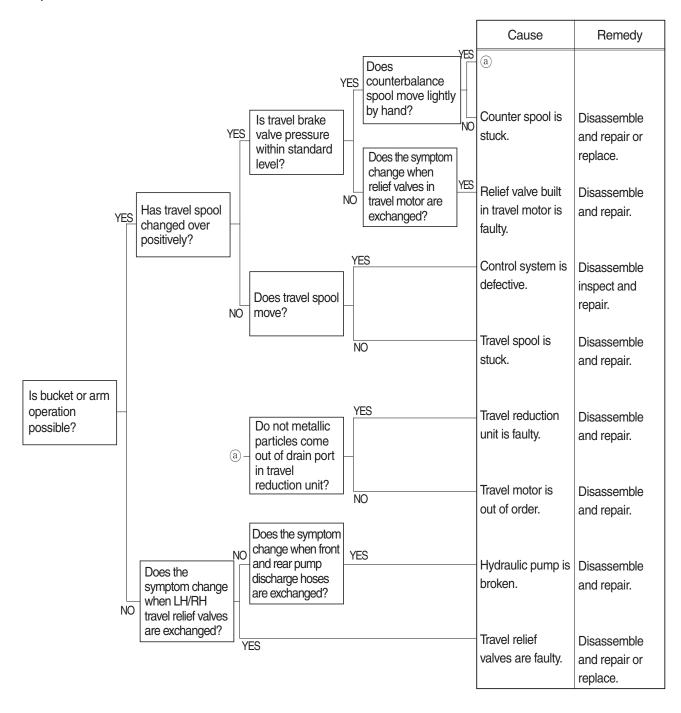


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

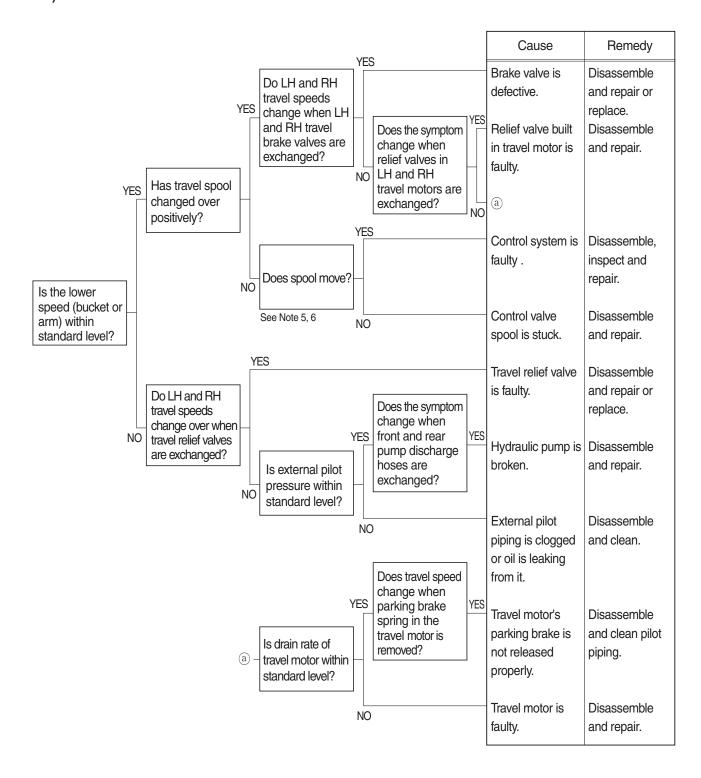


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

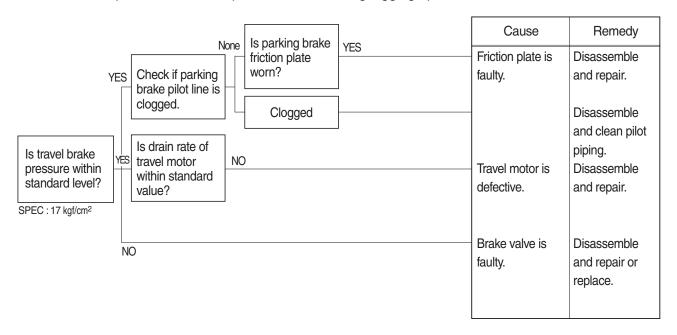


2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

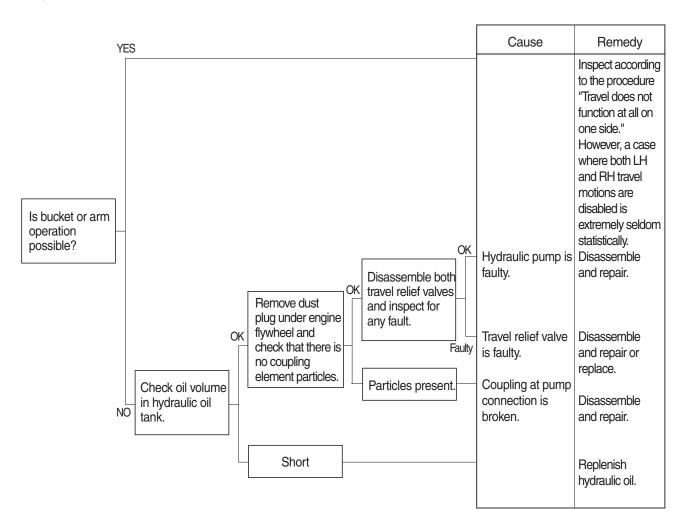


3) MACHINE DOES NOT STOP ON A SLOPE

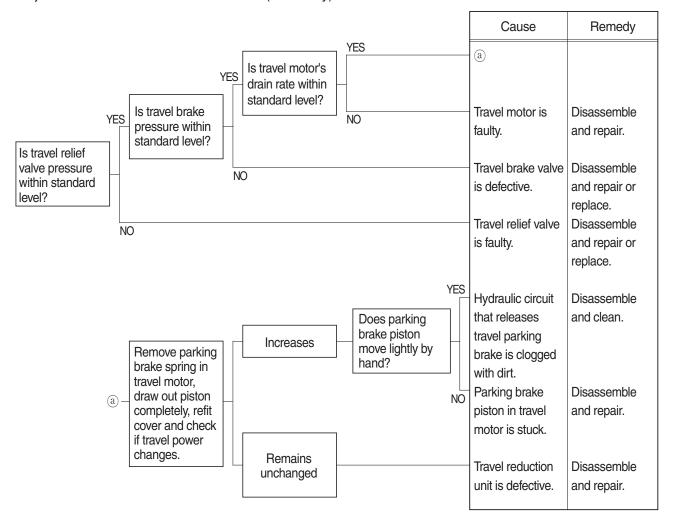
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



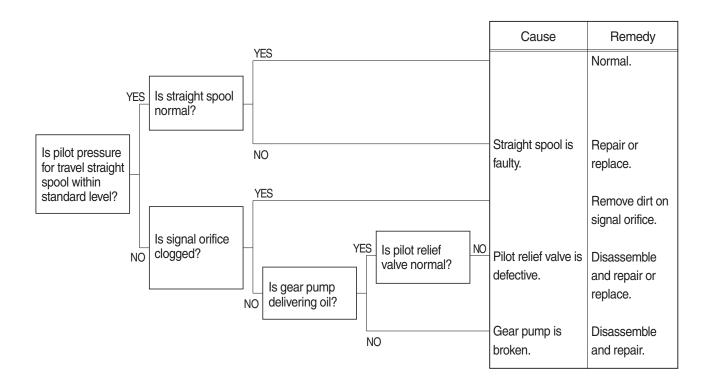
5) TRAVEL ACTION IS POWERLESS (travel only)



6) MACHINE RUNS RECKLESSLY ON A SLOPE

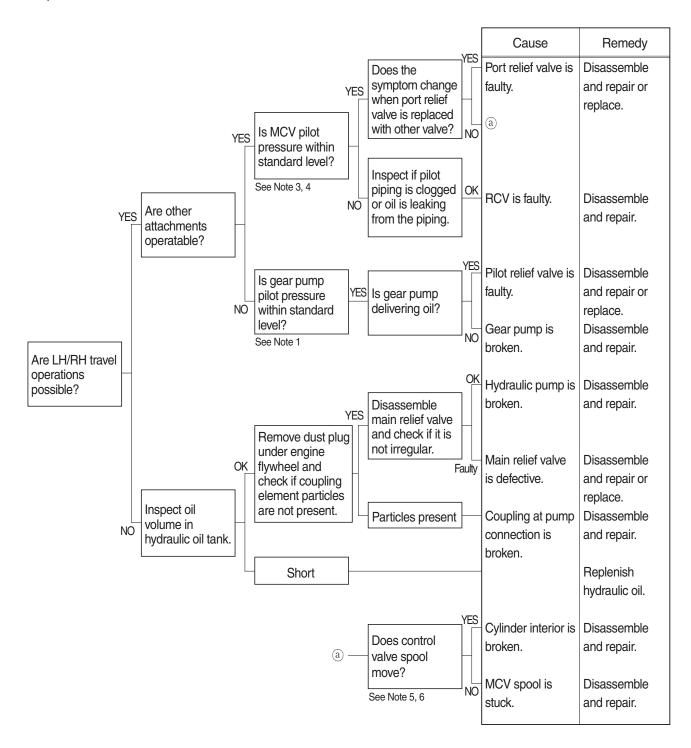


7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME

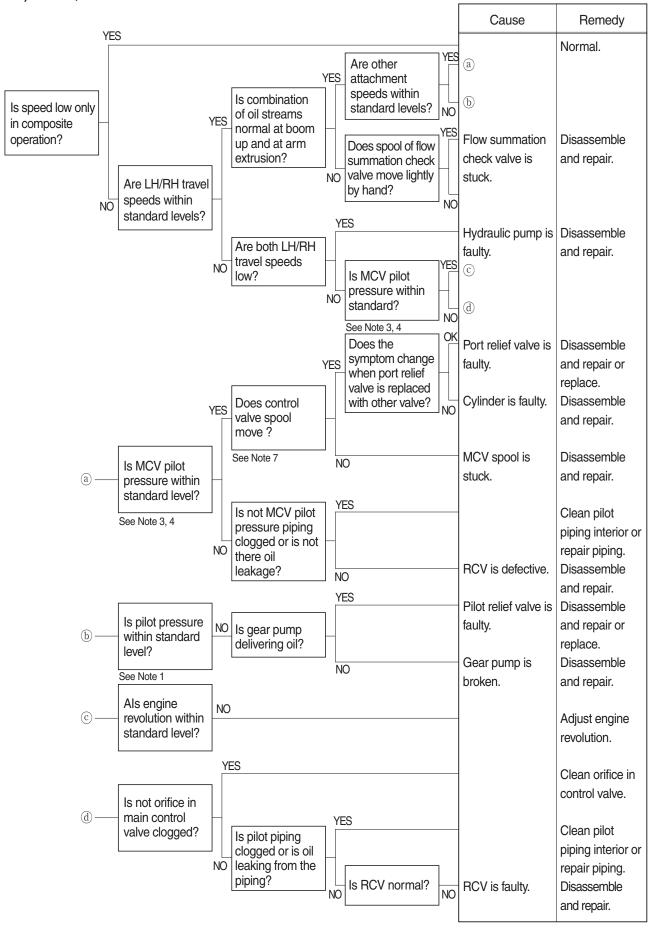


6. ATTACHMENT SYSTEM

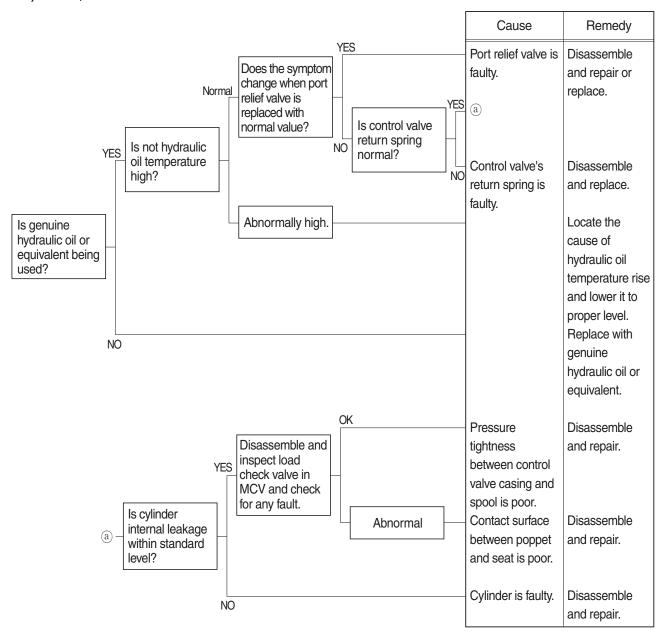
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



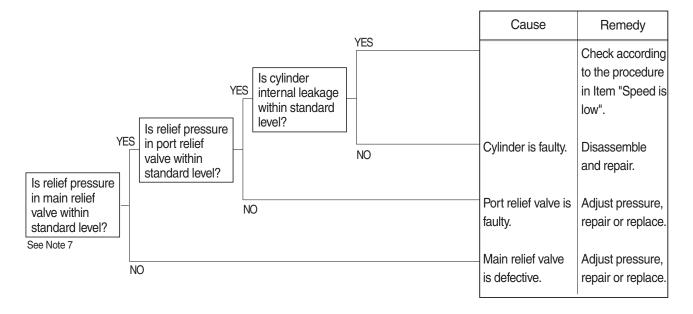
2) BOOM, ARM OR BUCKET SPEED IS LOW



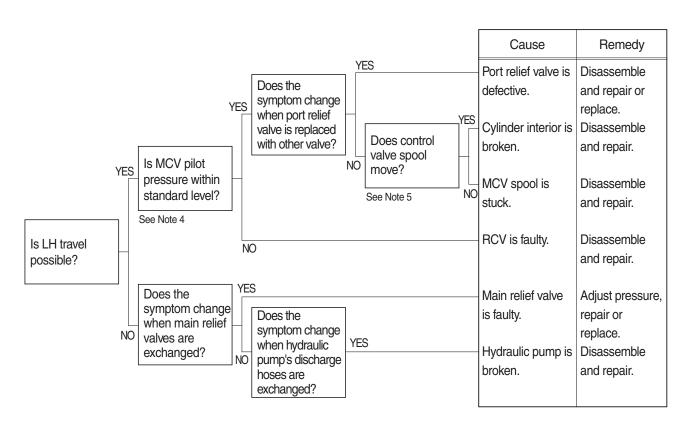
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



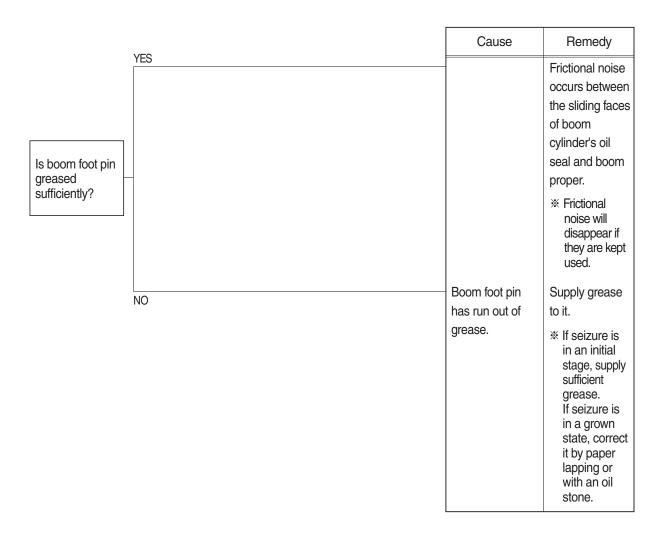
4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

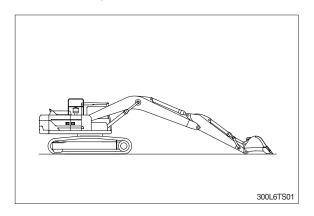


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

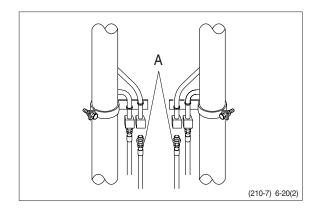


**** HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE**

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



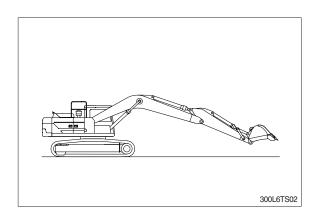
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



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.

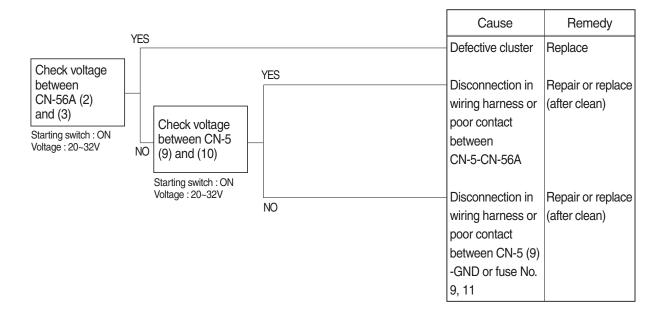
If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



GROUP 3 ELECTRICAL SYSTEM

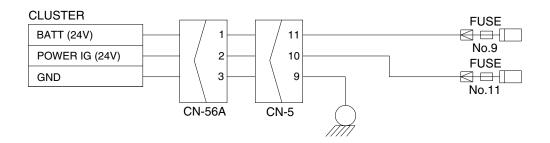
1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 9, 11.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check voltage

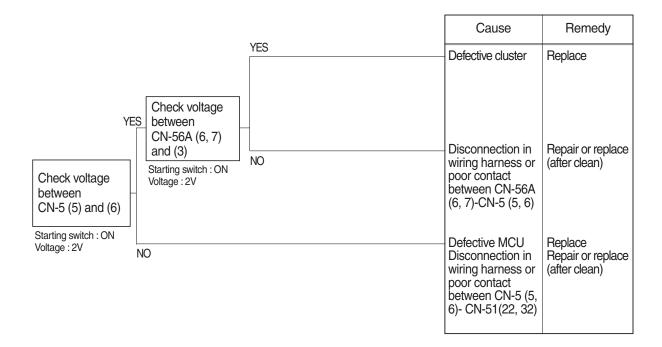
YES	20~32V
NO	0V



300S6ES01

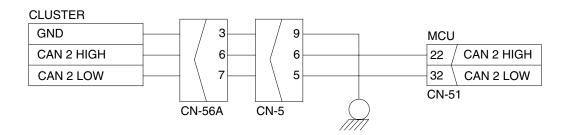
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

- · 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

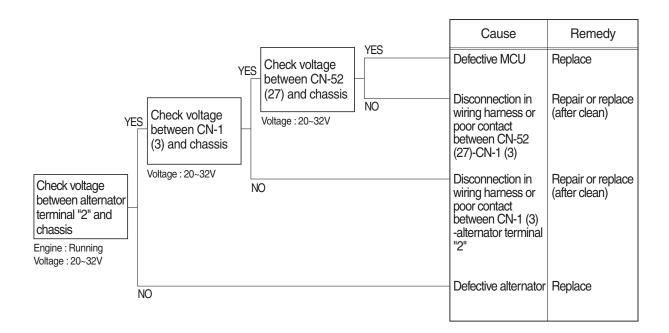
YES	2V	
NO	0V	



300L6ES02

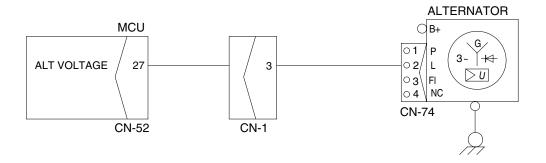
3. - BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

- · 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.



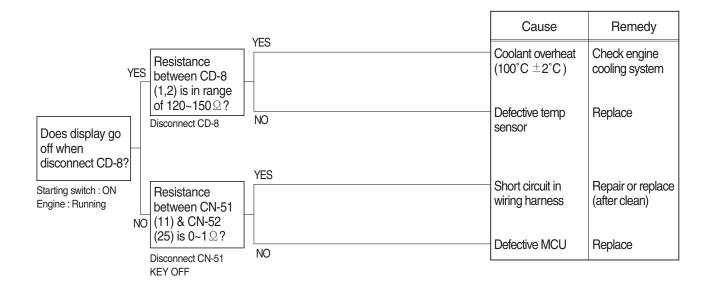
Check voltage

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.

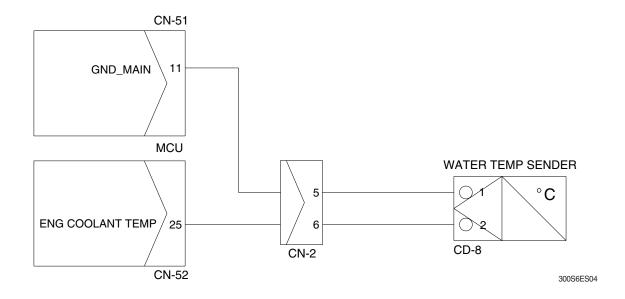


Normal type



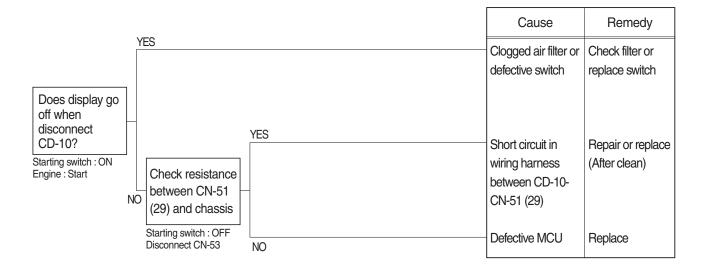
Temperature (°C)	0	25	50	80	95
Resistance ($k\Omega$)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8





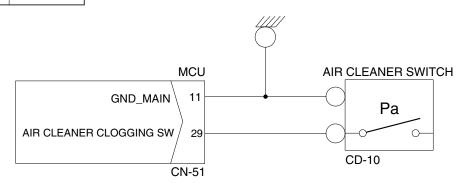
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

- · 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.



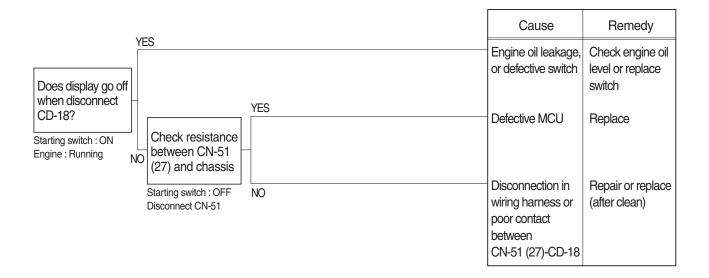
Check resistance

YES	MAX 1 Ω	
NO	MIN 1MΩ	



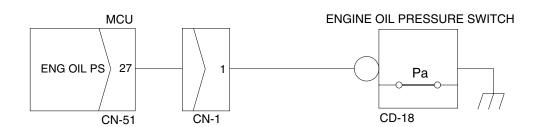
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

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



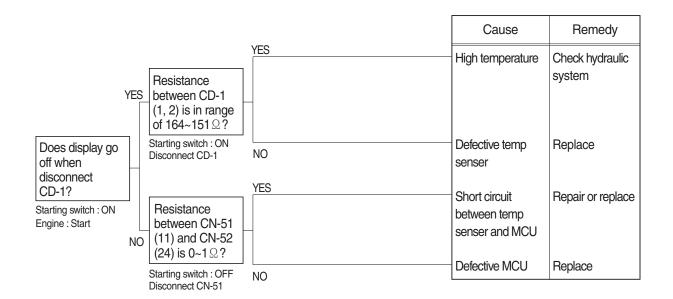
Check resistance

YES	MAX 1 Ω
NO	MIN 1MΩ



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

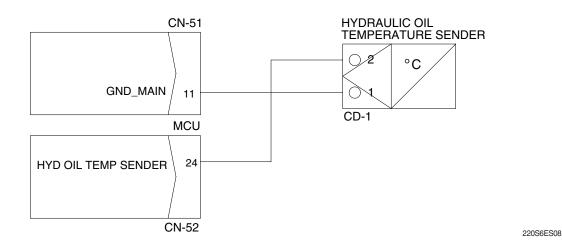
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



Normal type

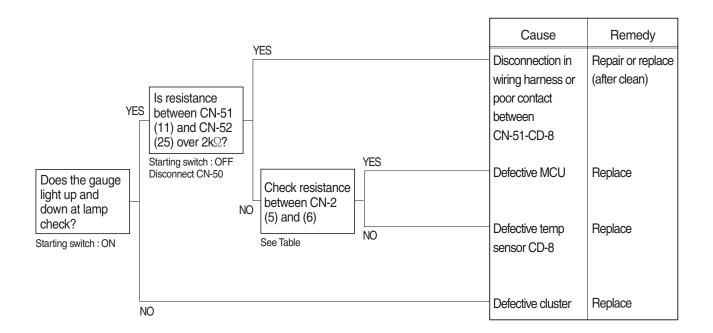
Temperature (°C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Decistance (Ir ()	22.22	8.16	5.18	1.06	0.39	0.322	0.243	0.185	0.164
Resistance (k Ω)	~31.78	~10.74	~ 6.6	~1.28	~0.476	~0.298	~0.219	~0.167	0.151





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.



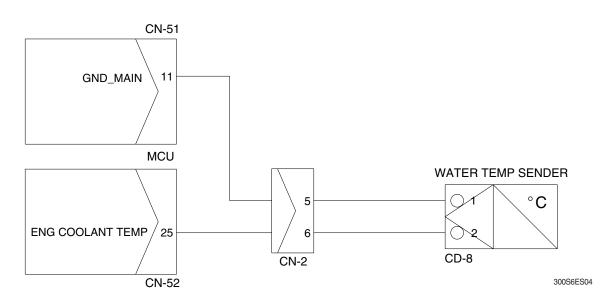
Normal type



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

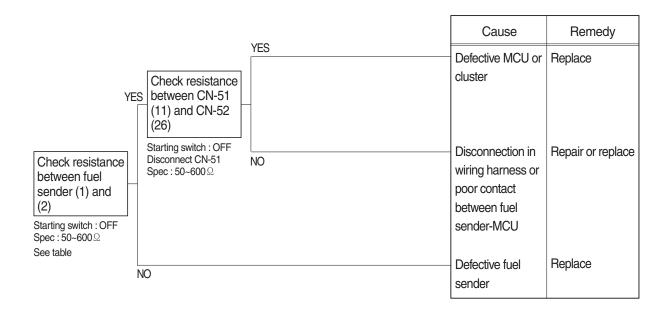






9. WHEN FUEL GAUGE DOES NOT OPERATE (HCESPN 301, FMI 3 or 4)

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



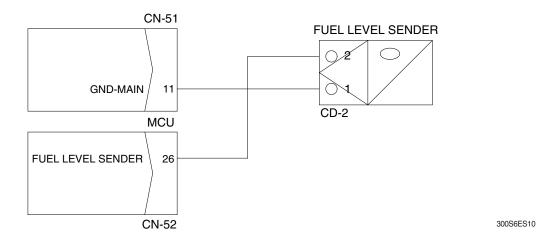




Premium type

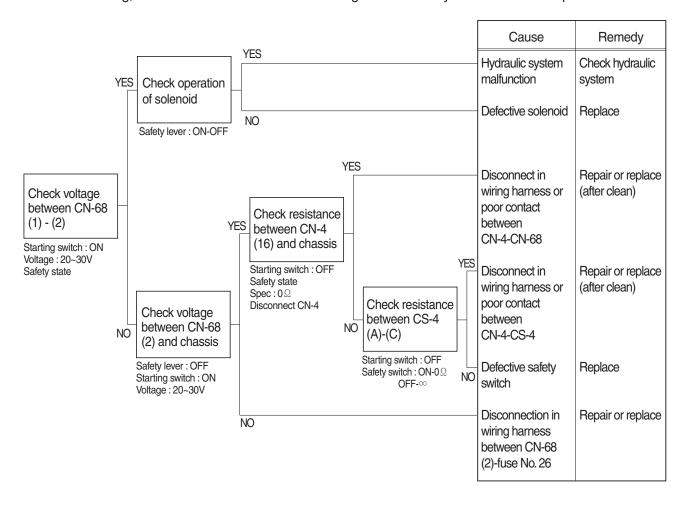


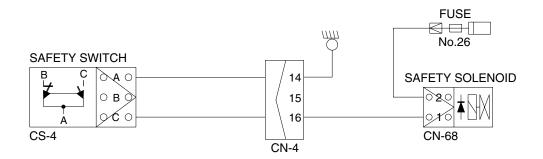
Range	Resistance (Ω)	Range	Resistance (Ω)	
Full	50	5/12	400	
11/12	100	4/12	450	
10/12	150	3/12	500	
9/12	200	2/12	550	
8/12	250	1/12	600	
7/12	300	Empty warning	700	
6/12	350	-	-	



10. WHEN SAFETY SOLENOID DOES NOT OPERATE

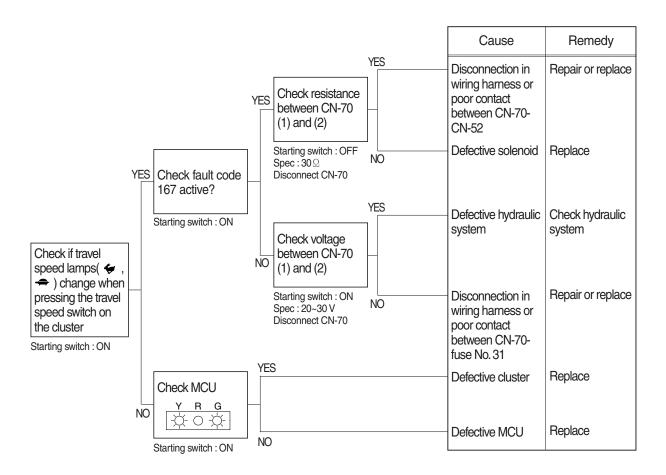
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 26.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

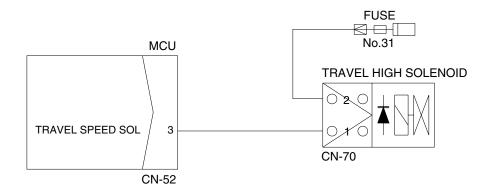




11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 4 or 6)

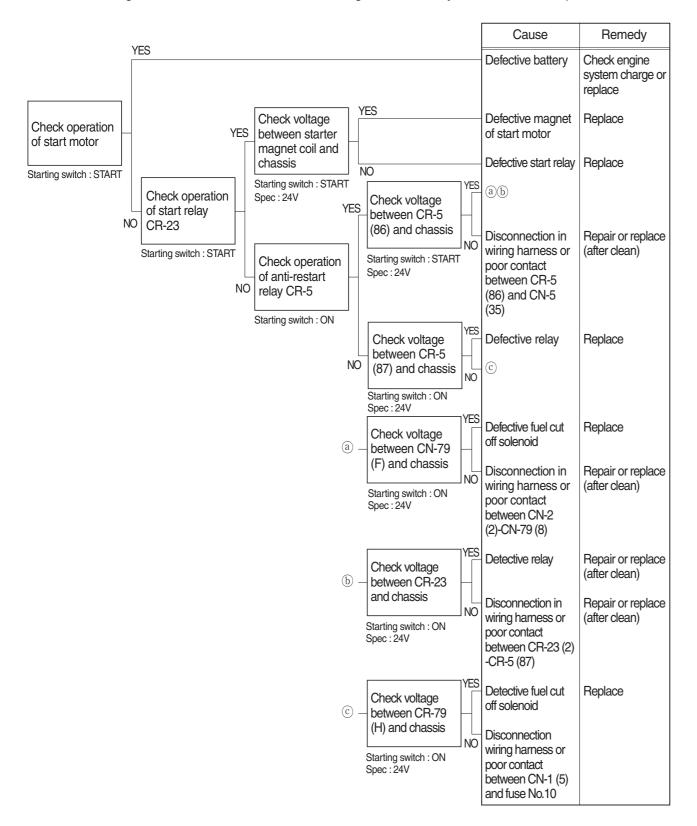
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 31.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

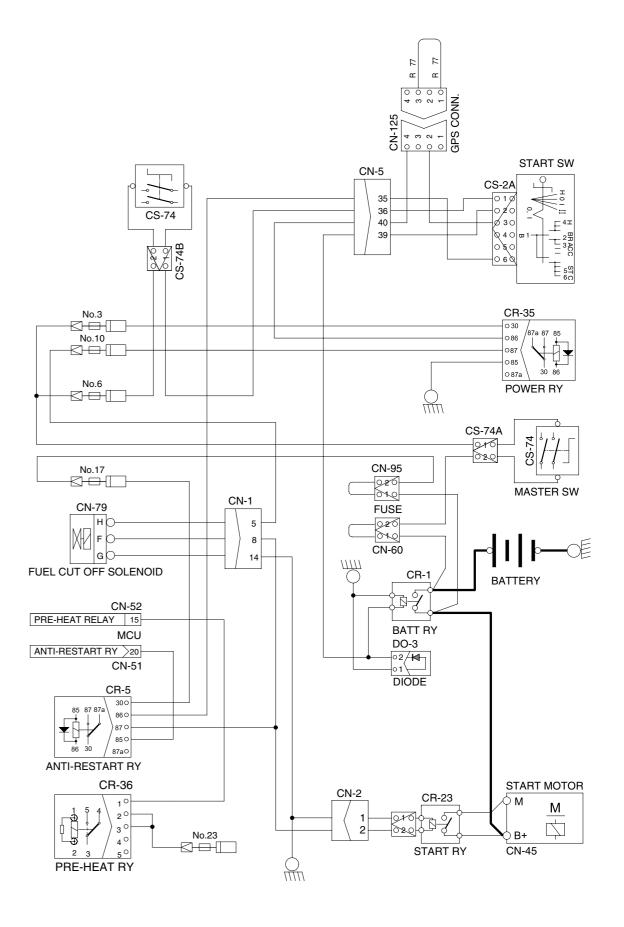




12. WHEN ENGINE DOES NOT START (| lights up condition)

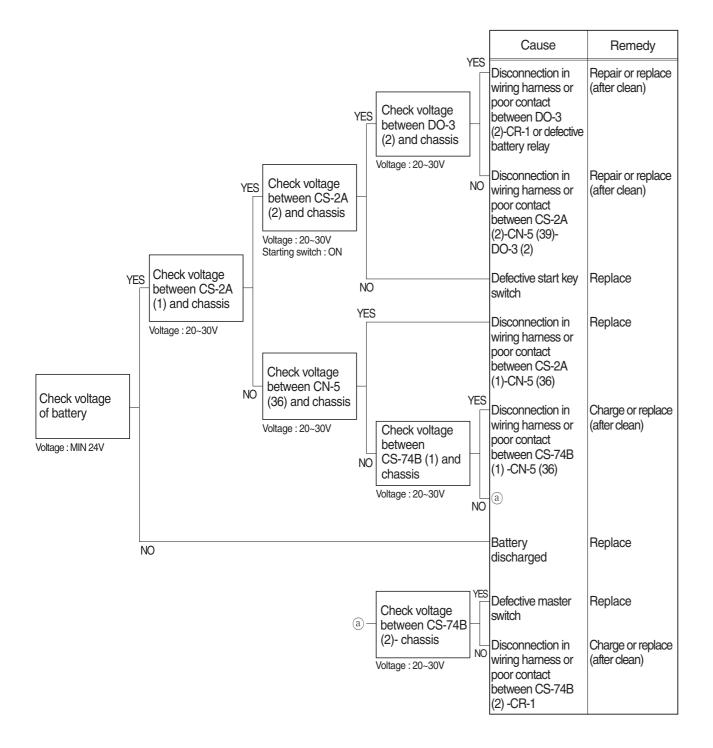
- · Check supply of the power at engine stop solenoid while starting switch is ON.
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 3, 6, 10, 17 and 23 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

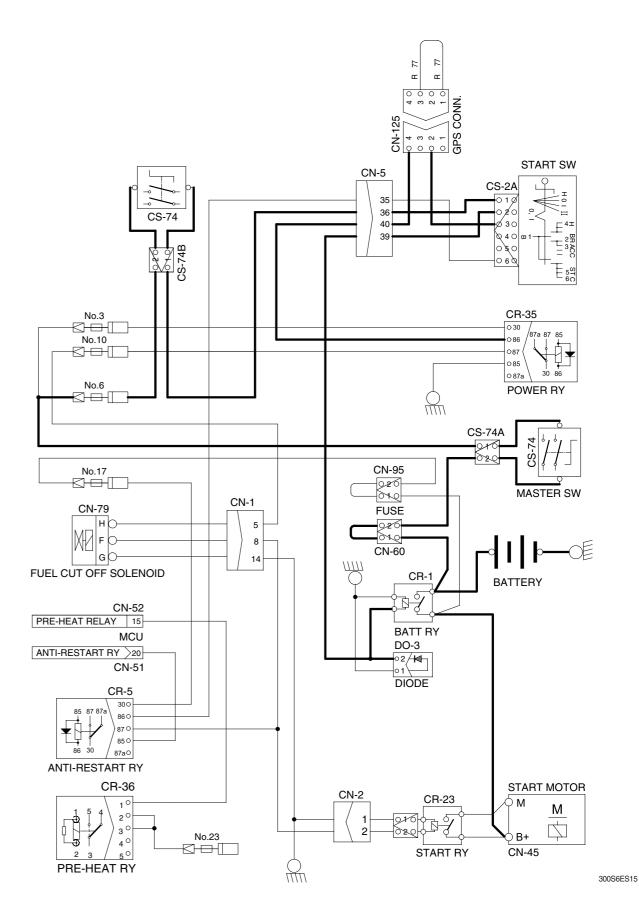




13. WHEN STARTING SWITCH ON DOES NOT OPERATE

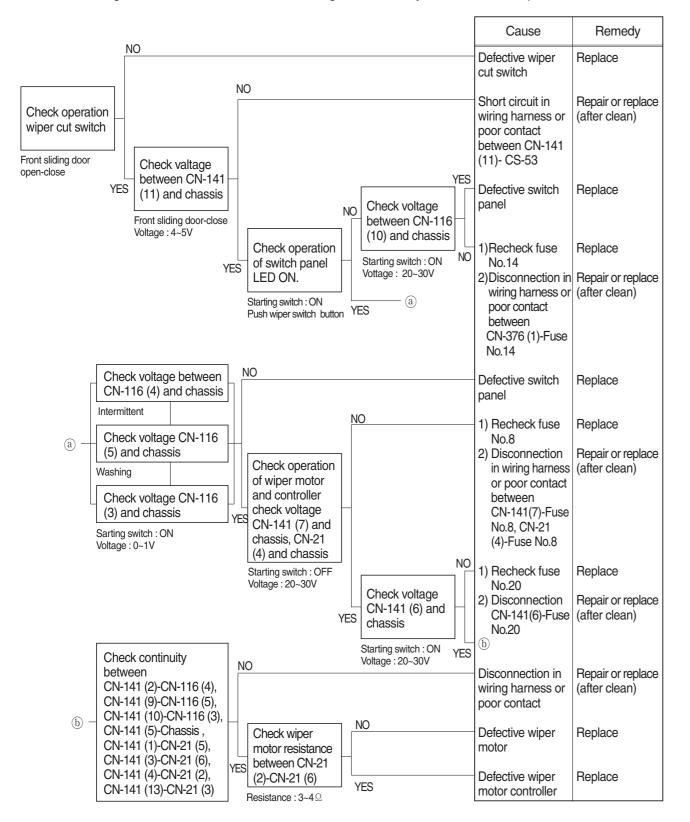
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check open circuit of circuit breaker (CN-60).
- · After checking, insert the disconnected connectors again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

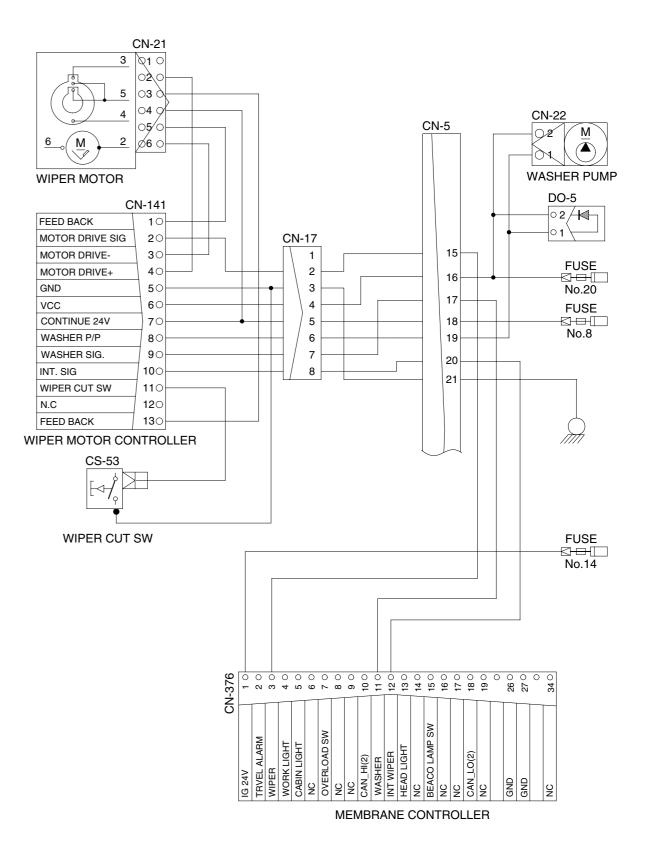




14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

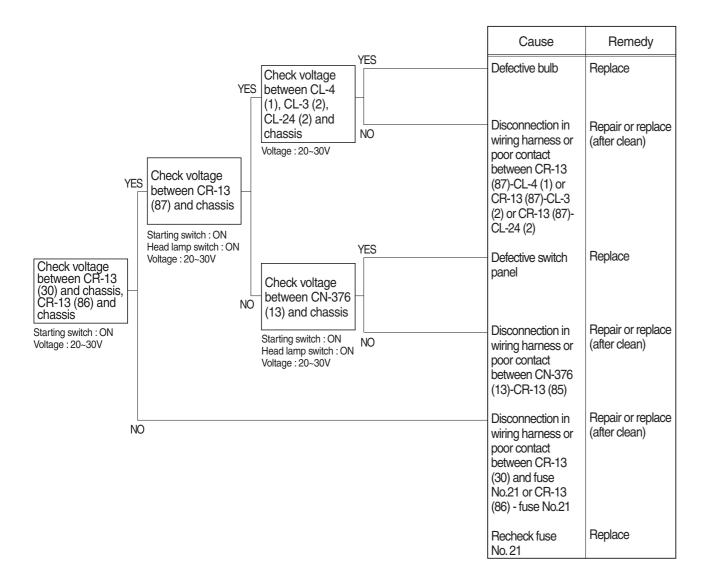
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 8, 14 and 20 is not blown out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

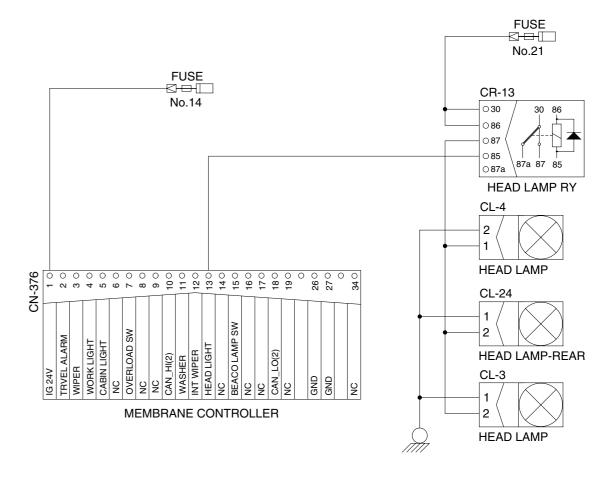




15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.14 and 21.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



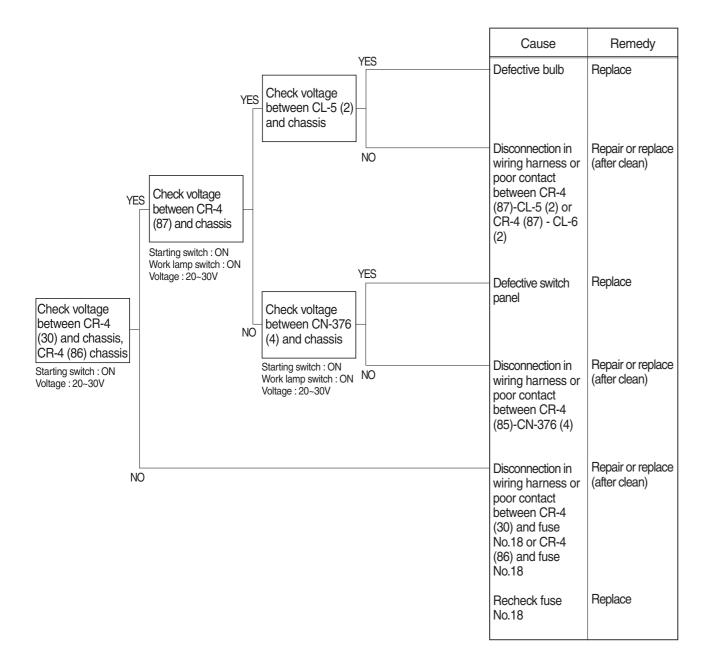


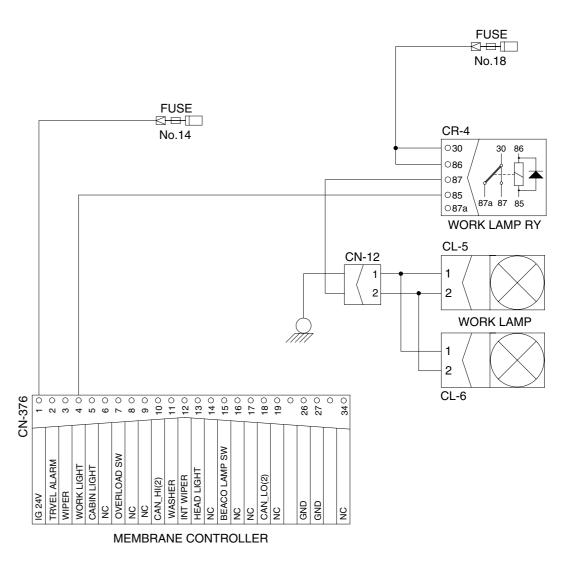
300S6ES17

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 short of fuse 14 and 18.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





300S6ES18

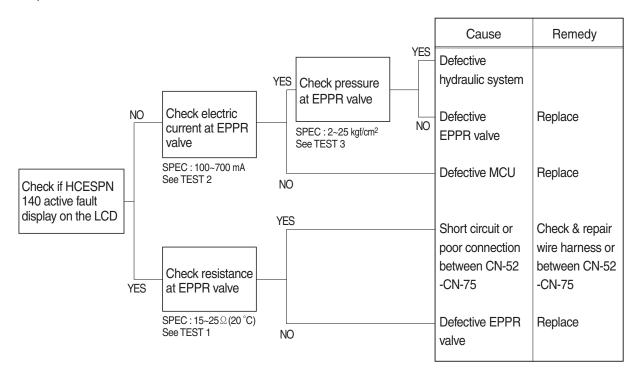
6-39

GROUP 4 MECHATRONICS SYSTEM

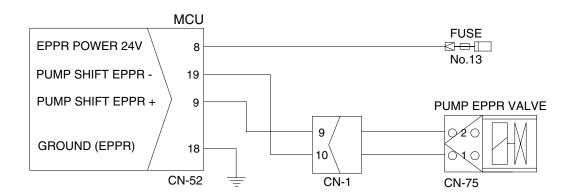
1. ALL ACTUATORS SPEED ARE SLOW

- * Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
- lpha Spec : P-mode 1950 \pm 50 rpm S -mode 1850 \pm 50 rpm E-mode 1750 \pm 50 rpm
- * Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

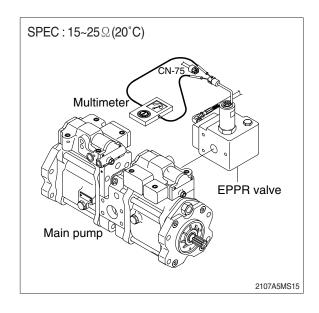
1) INSPECTION PROCEDURE



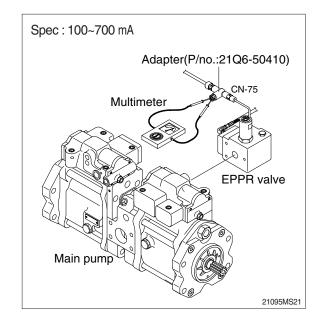
Wiring diagram



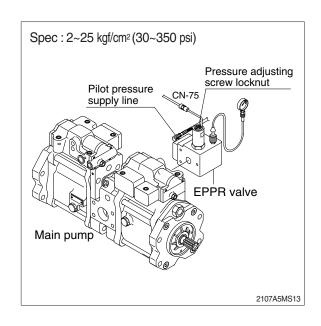
- (1) **Test 1**: Check resistance at connector CN-75.
- ① Starting key OFF.
- ② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.
- ③ Check resistance between 2 lines as figure.



- (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.
- 4 Set S-mode and cancel auto decel mode.
- (5) Position the accel dial at 10.
- 6 If tachometer show approx 1850 \pm 50 rpm disconnect one wire harness from EPPR valve.
- ⑦ Check electric current at bucket circuit relief position.



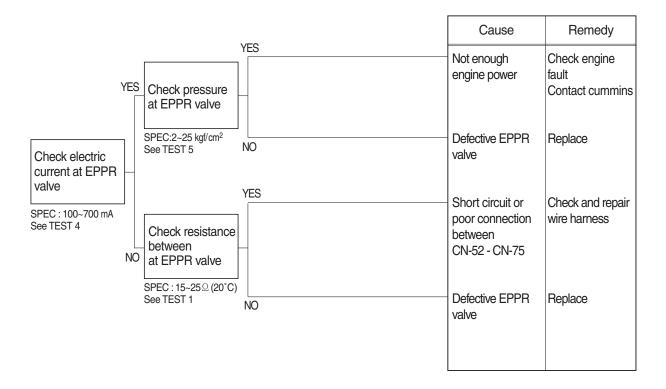
- (3) Test 3: Check pressure at EPPR valve.
 - ① Remove plug and connect pressure gauge as figure.
 - · Gauge capacity: 0 to 50 kgf/cm² (0 to 725 psi)
 - ② Start engine.
 - 3 Set S-mode and cancel auto decel mode.
 - 4 Position the accel dial at 10.
- ⑤ If tachometer show approx 1850±50 rpm check pressure 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.



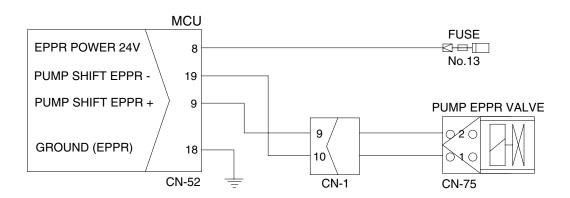
2. ENGINE STALL

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

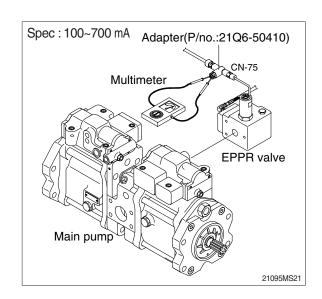
1) INSPECTION PROCEDURE



Wiring diagram

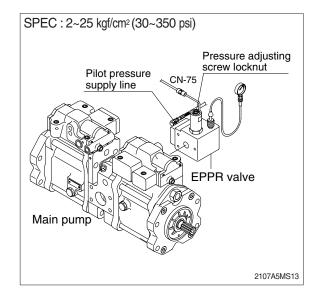


- (1) **Test 4**: Check electric current at EPPR valve.
 - ① Disconnect connector CN-75 from EPPR valve.
 - ② Insert the adapter to CN-75 and install multimeter as figure.
 - ③ Start engine.
 - Set S-mode and cancel auto decel mode.
 - 5 Position the accel dial at 10.
 - ⑥ If rpm show approx 1850±50 rpm disconnect one wire harness from EPPR valve.
 - Theck electric current at bucket circuit relief position.



(2) Test 5 : Check pressure at EPPR valve.

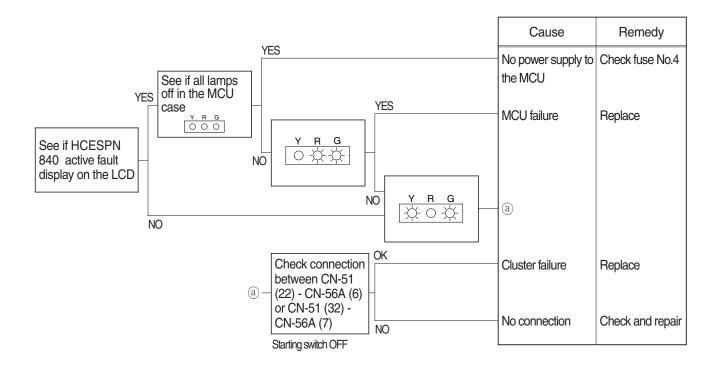
- ① Remove plug and connect pressure gauge as figure.
 - · Gauge capacity: 0 to 50 kgf/cm² (0 to 725 psi)
- ② Start engine.
- ③ Set S-mode and cancel auto decel mode.
- 4 Position the accel dial at 10.
- ⑤ If rpm show approx 1850±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
- 6 If pressure is not correct, adjust it.
- 7 After adjust, test the machine.



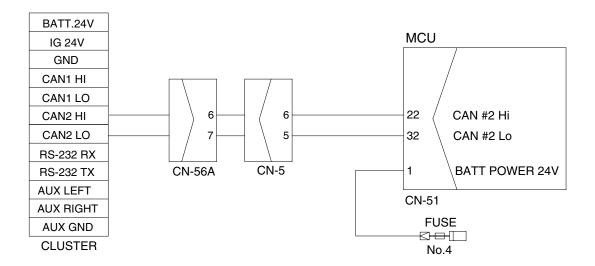
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



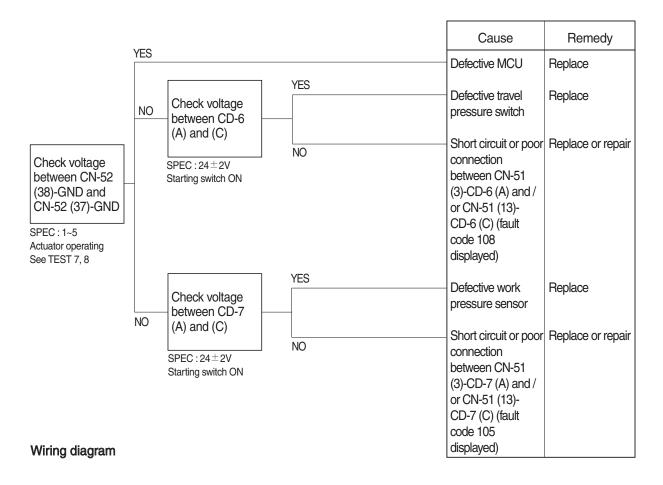
Wiring diagram

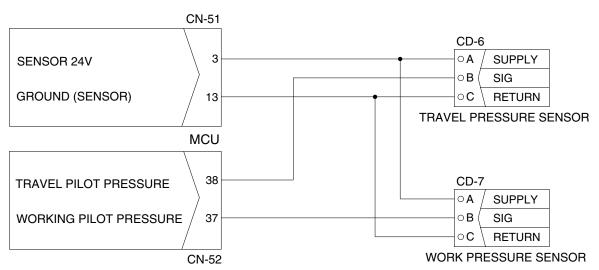


4. AUTO DECEL SYSTEM DOES NOT WORK

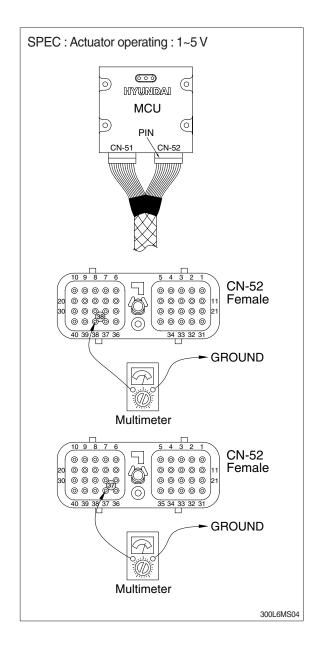
- Fault code: HCESPN 105, FMI 0~4 (work pressure sensor)
 HCESPN 108, FMI 0~4 (travel oil pressure sensor)
- * Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE





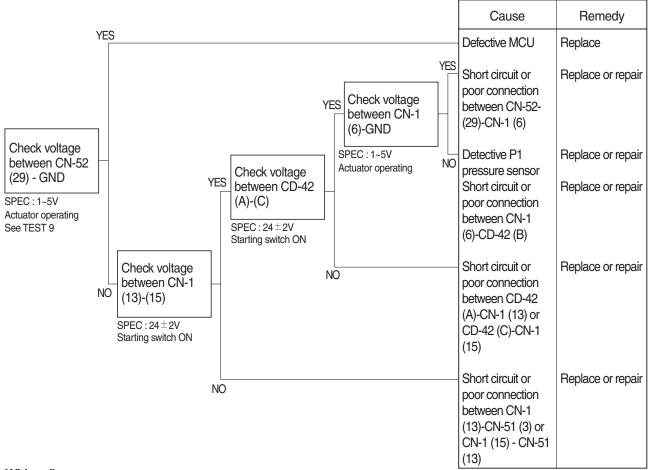
- (1) Test 7: Check voltage at CN-52 (38) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (38) of CN-52.
- 3 Starting switch key ON.
- 4 Check voltage as figure.
- (2) Test 8: Check voltage at CN-52 (37) and ground.
- 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 switch ON.
- ④ Check voltage as figure.



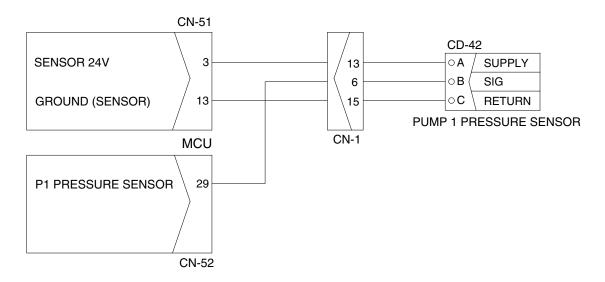
5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

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

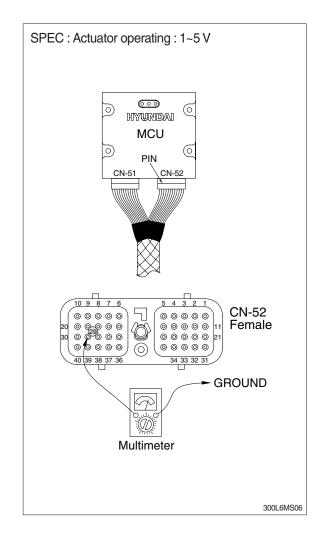
1) INSPECTION PROCEDURE



Wiring diagram



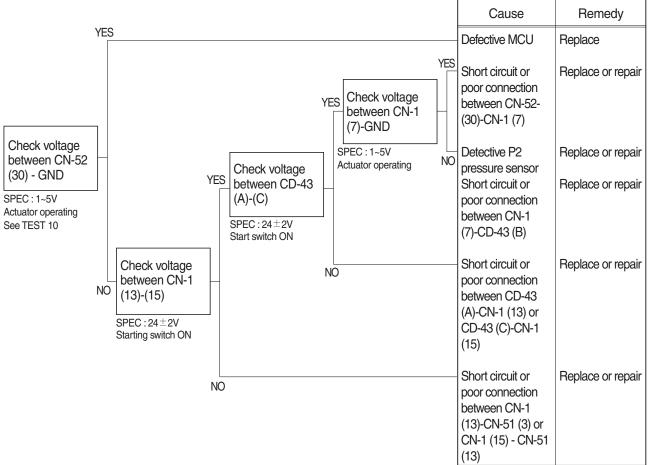
- (1) Test 9: Check voltage at CN-52 (29) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (29) of CN-52.
- ③ Starting switch ON.
- ④ Check voltage as figure.



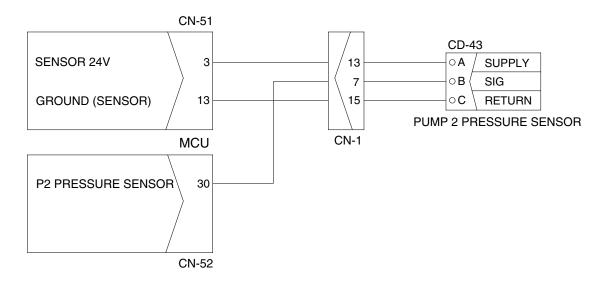
6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

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

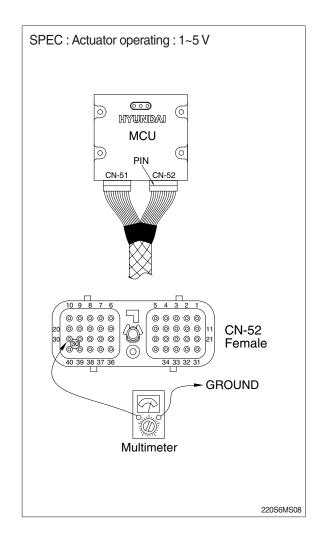
1) INSPECTION PROCEDURE



Wiring diagram



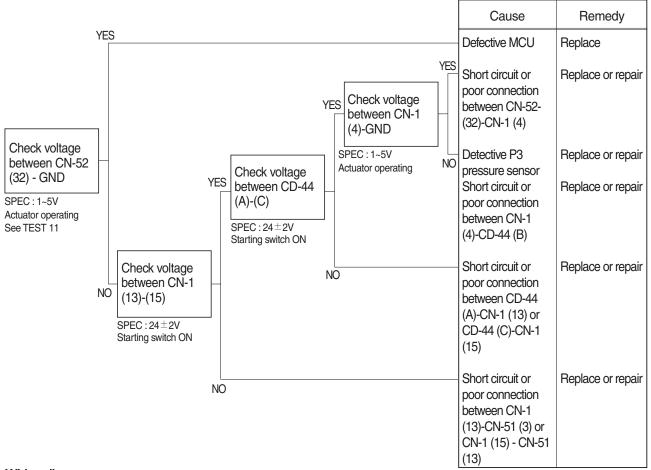
- (1) Test 10: Check voltage at CN-52 (30) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (30) of CN-52.
- ③ Starting switch ON.
- 4 Check voltage as figure.



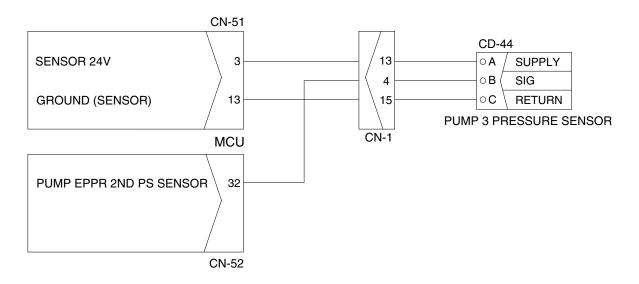
7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

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

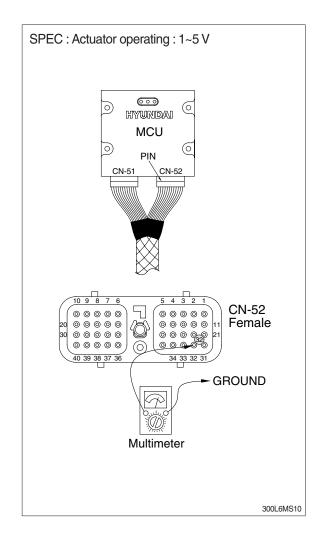
1) INSPECTION PROCEDURE



Wiring diagram



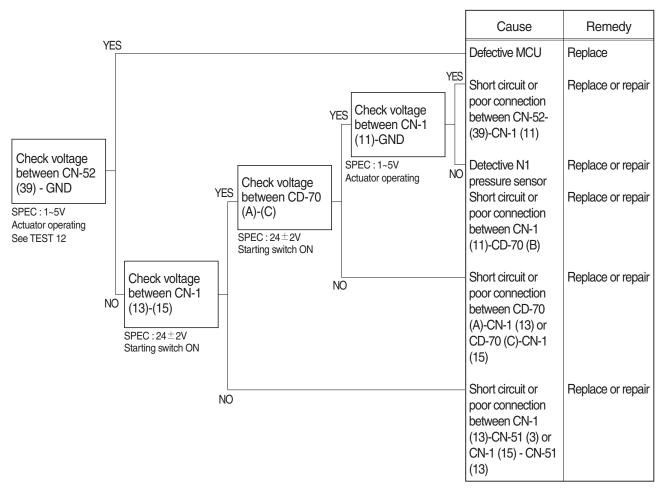
- (1) Test 11: Check voltage at CN-52 (32) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (32) of CN-52.
- ③ Starting switch ON.
- ④ Check voltage as figure.



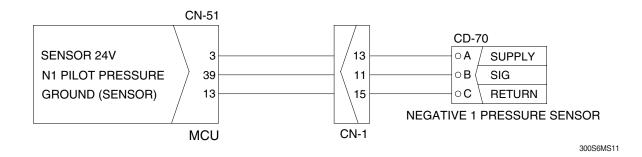
8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

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

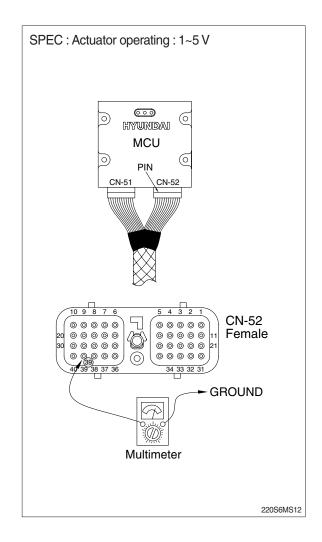
1) INSPECTION PROCEDURE



Wiring diagram



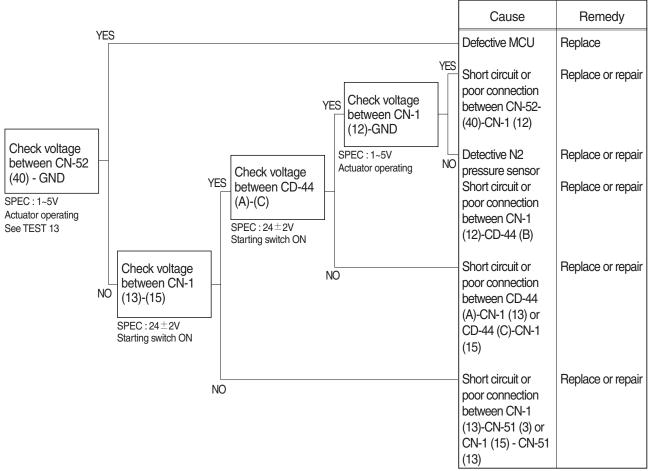
- (1) Test 12: Check voltage at CN-52 (39) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (39) of CN-52.
- ③ Starting switch ON.
- 4 Check voltage as figure.



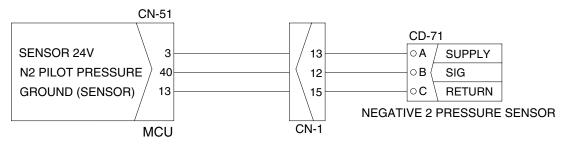
9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

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

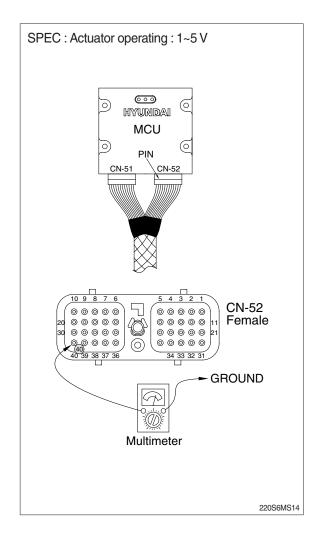
1) INSPECTION PROCEDURE



Wiring diagram



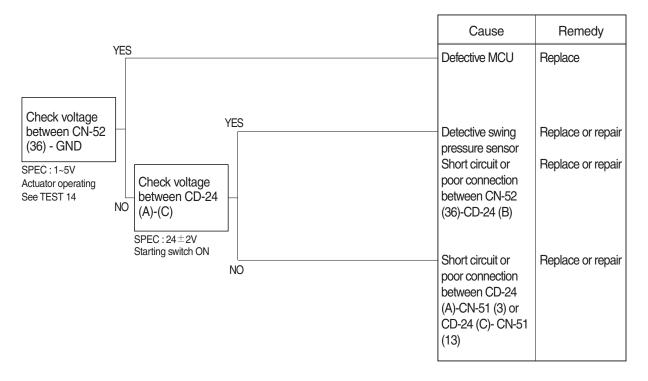
- (1) Test 13: Check voltage at CN-52 (40) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (40) of CN-52.
- ③ Starting switch ON.
- ④ Check voltage as figure.



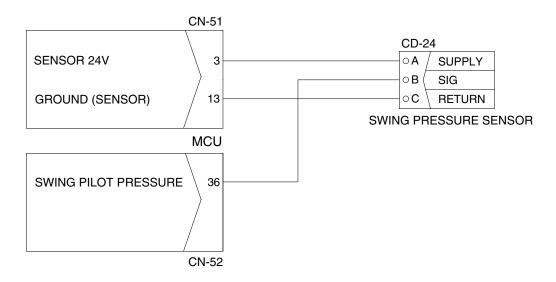
10. MALFUNCTION OF SWING PRESSURE SENSOR

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

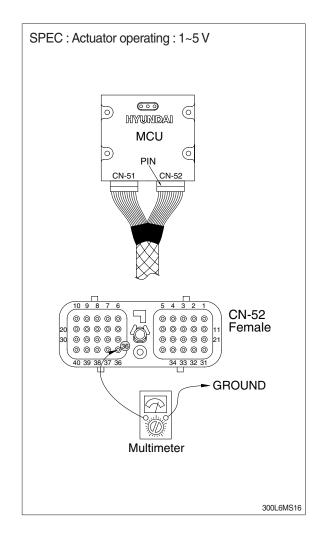
1) INSPECTION PROCEDURE



Wiring diagram



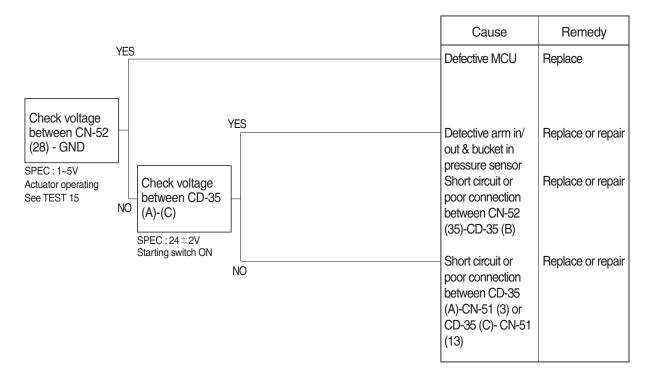
- (1) Test 14: Check voltage at CN-52 (36) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (36) of CN-52.
- ③ Starting switch ON.
- 4 Check voltage as figure.



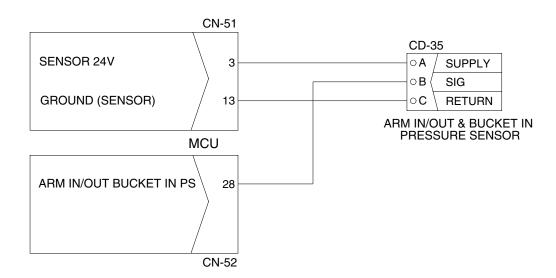
11. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR (NA)

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

1) INSPECTION PROCEDURE

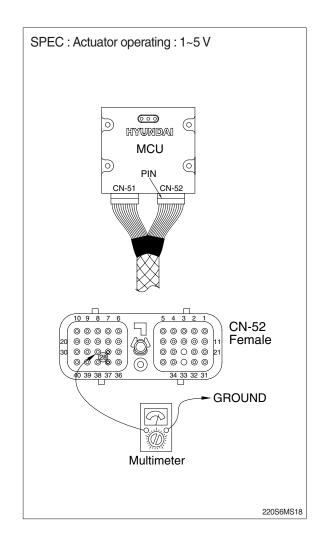


Wiring diagram



2) TEST PROCEDURE (NA)

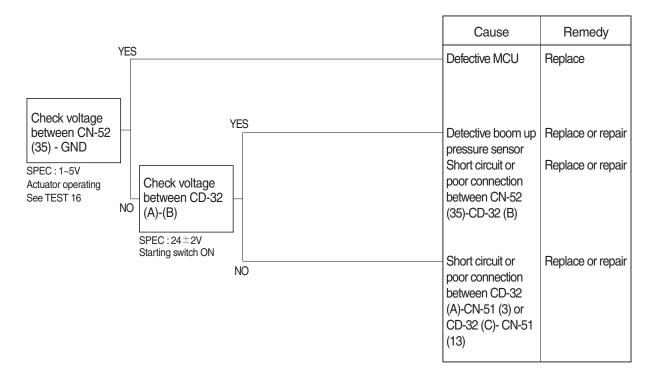
- (1) Test 15: Check voltage at CN-52 (28) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (28) of CN-52.
- ③ Starting key ON.
- 4 Check voltage as figure.



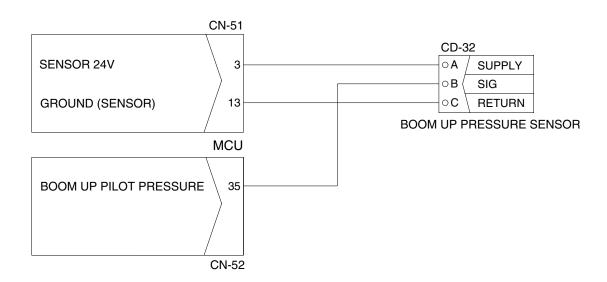
12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

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

1) INSPECTION PROCEDURE



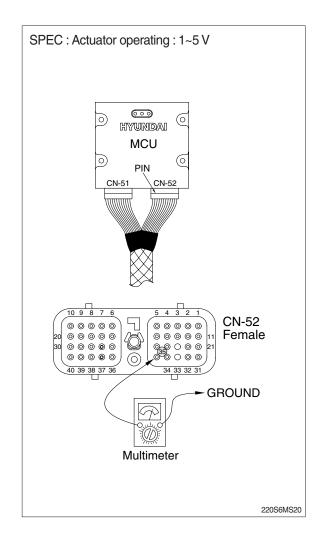
Wiring diagram



220S6MS19

2) TEST PROCEDURE

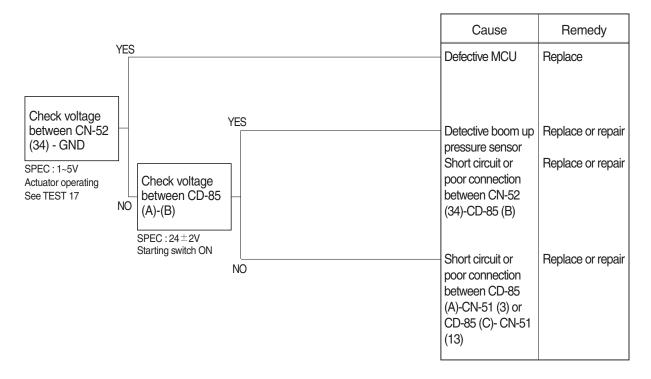
- (1) Test 16: Check voltage at CN-52 (35) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (35) of CN-52.
- ③ Starting switch ON.
- ④ Check voltage as figure.



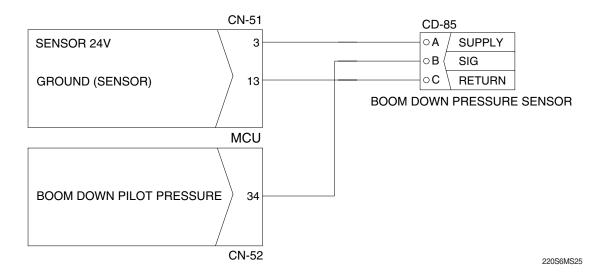
13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

- · Fault code: HCESPN 128, FMI 0~4
- * Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE

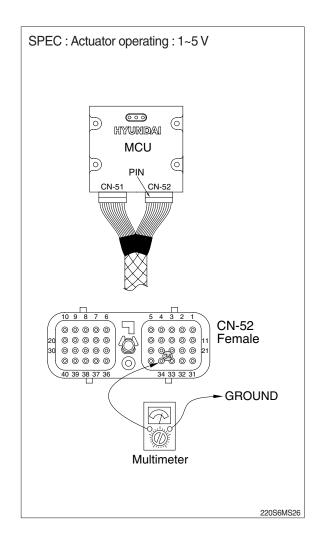


Wiring diagram



2) TEST PROCEDURE

- (1) Test 17: Check voltage at CN-52 (34) 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 (34) of CN-52.
- ③ Starting switch ON.
- 4 Check voltage as figure.

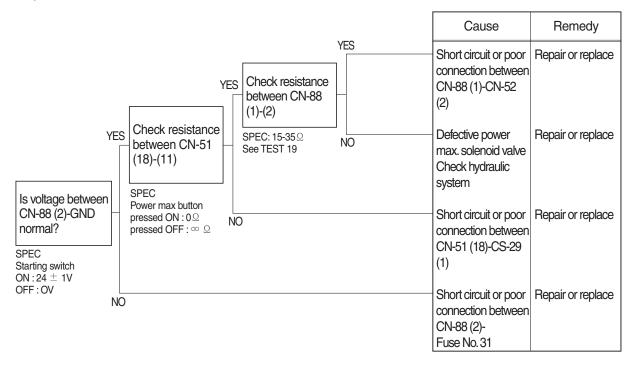


14. MALFUNCTION OF POWER MAX

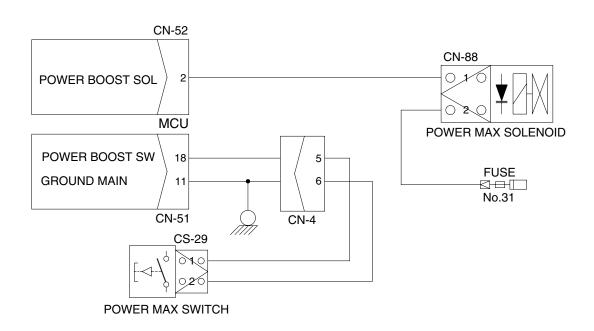
· Fault code: HCESPN 166, FMI 4 or 6

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

1) INSPECTION PROCEDURE



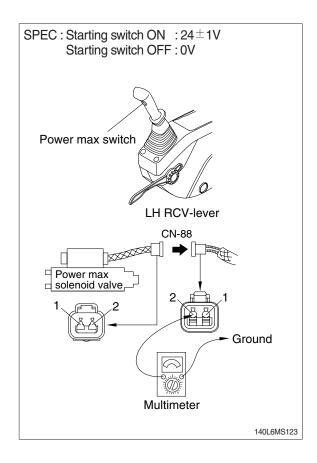
Wiring diagram



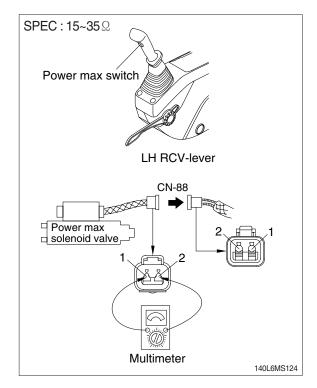
300S6MS21

2) TEST PROCEDURE

- (1) Test 18: Check voltage between connector CN-88 (2) GND.
- ① Disconnect connector CN-88 from power max solenoid valve.
- ② Start switch ON.
- ③ Check voltage as figure.



- (2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).
- ① Starting switch OFF.
- ② Disconnect connector CN-88 from power max solenoid valve.
- ③ Check resistance as figure.



15. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

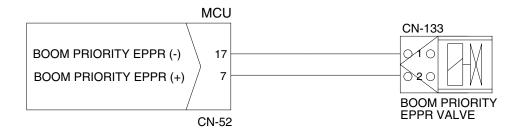
· Fault code: HCESPN 141, FMI 5 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram



300S6MS23

SECTION 7 MAINTENANCE STANDARD

Group	1 Operational Performance Test ·····	7-1
Group	2 Major Components ·····	7-21
Group	3 Track and Work Equipment	7-30

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 HD Hyundai spec.

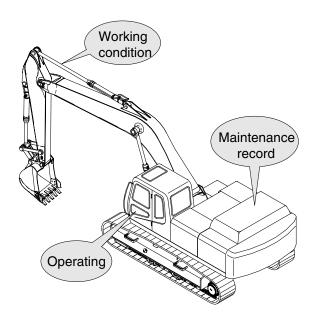
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

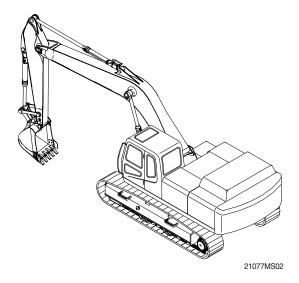


21077MS01

2. TERMINOLOGY

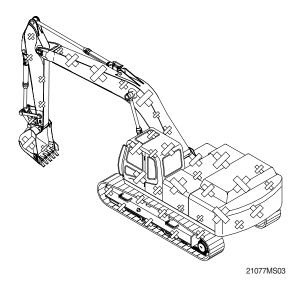
1) STANDARD

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

 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

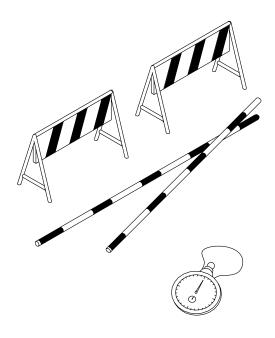
- ① Select a hard, flat surface.
- ② Secure enough space to allow the machine to run straight more than 20 m, and to make a full swing with the front attachment extended.
- ③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(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.
- 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

- 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.



(210-7) 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.

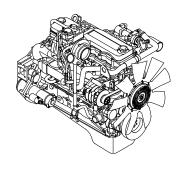
(2) Preparation

- 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.
- Measure and record the auto deceleration speed.





300L7MS01

(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	
LIVOGO I	S mode	1750±50	
HX360 L	E mode	1650±50	
	Auto decel	1200±100	
	One touch decel	1000±100	

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

3) TRAVEL SPEED

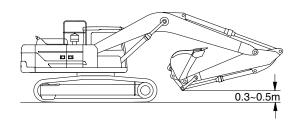
(1) Measure the time required for the excavator to travel a 20 m test track.

(2) Preparation

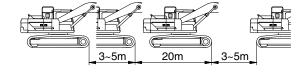
- ① Adjust the tension of both tracks to be equal.
- ② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- 3 Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- 4 Keep the hydraulic oil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



- 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.



300L7MS02



300L7MS03

(4) Evaluation

The average measured time should meet the following specifications.

Unit: Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX360L	1 Speed	20±2.0	26.1	
HASOUL	2 Speed	10.9±1.0	15.3	

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



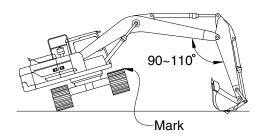
- ① Select the following switch positions.
- · Travel mode switch : 1 or 2 speed
- · Power mode switch : P mode
- · Auto idle switch : OFF
- ② Operate the travel control lever of the raised track in full forward and reverse.
- 3 Rotate 1 turn, then measure time taken for next 3 revolutions.
- ④ Raise 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
LIVOGO I	1 Speed	31±2.0	40.5
HX360 L	2 Speed	17.5±2.0	24



5) TRAVEL DEVIATION

(1) Measure the deviation by the tracks from a 20 m straight line.

(2) Preparation

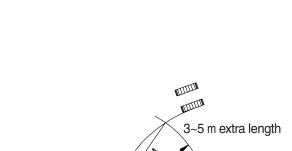
- ① Adjust the tension of both tracks to be equal.
- ② Provide a flat, solid test yard 20 m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- 3 Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- 4 Keep the hydraulic oil 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
- Start traveling the machine in the acceleration zone with the travel levers at full stroke.
- ④ Measure the distance between a straight 20 m line and the track made by the machine. (Dimension a)
- S After measuring the tracking in forward travel, turn the upperstructure 180 °and measure that in reverse travel.
- 6 Repeat steps 4 and 5 three times and calculate the average values.

(4) Evaluation

Mistrack should be within the following specifications.

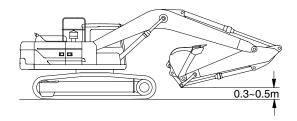


3~5 m extra length

(210-7) 7-7(2)



Model	Standard	Maximum allowable	Remarks
HX360 L	200 below	250	-



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.
- 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 $50\pm5^{\circ}$ C.



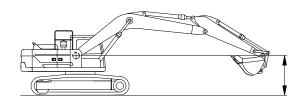
- ① Select the following switch positions.
- · Power mode switch : P mode
- Operate swing control lever fully.
- ③ Swing 1 turn and measure time taken to swing next 3 revolutions.
- ④ Repeat steps ② and ③ three time and calculate the average values.



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

Unit: Seconds / 3 revolutions

Model Power mode switch		Standard	Maximum allowable
HX360 L	P mode	15.8±1.5	19.7



7) SWING FUNCTION DRIFT CHECK

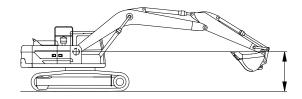
 Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

(2) Preparation

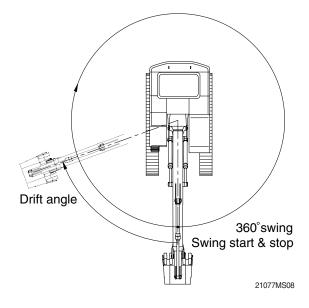
- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- ③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
- Make two chalk marks: one on the swing bearing and one directly below it on the track frame.
- Swing the upperstructure 360°.
- 6 Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.

(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.
- S 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.



300L7MS05



(4) Evaluation

The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX360 L	P mode	90 below	112.5	

8) SWING BEARING PLAY

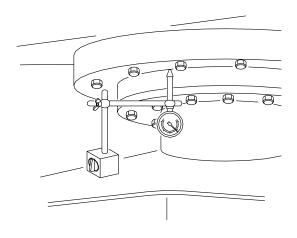
(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.

(2) Preparation

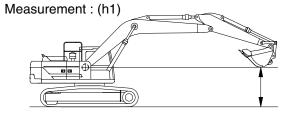
- ① Check swing bearing mounting cap screws for loosening.
- ② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.
- ③ Install a dial gauge on the track frame as shown, using a magnetic base.
- ④ Position the upperstructure so that the boom aligns with 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.

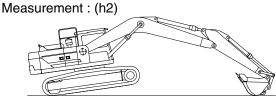
(3) Measurement

- 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 50 cm. Record the dial gauge reading (h2).
- ③ Calculate bearing play (H) from this data (h1 and h2) as follows.
 H=h2-h1



(210-7) 7-10(1)





300L7MS06

(4) Evaluation

The measured drift should be within the following specifications.

Unit: mm

Model	Standard	Maximum allowable	Remarks
HX360 L	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.
- 4 Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.

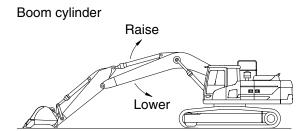
(3) Measurement

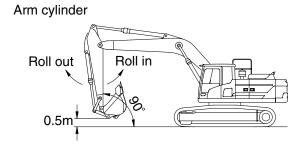
- ① Select the following switch positions.
- · Power mode switch : P mode
- ② To measure cylinder cycle times.
- Boom cylinders.

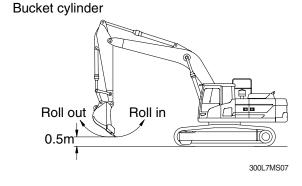
Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.

- 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.







-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	4.0±0.4	4.4	
	Boom lower	3.1±0.4	3.2	
LIVOGOL	Arm in Regen ON	3.3±0.4	3.9	
HX360 L	Arm out	3.3±0.3	3.9	
	Bucket load	2.7±0.4	3.1	
	Bucket dump	2.6±0.3	2.8	

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=M³ × 1.5

Where:

M³ = Bucket heaped capacity (m³)

1.5 = Soil specific gravity

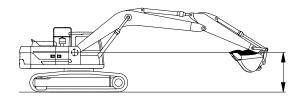
- ② Position the arm cylinder with the rod 20 to 30 mm extended from the fully retracted position.
- ③ Position the bucket cylinder with the rod 20 to 30 mm retracted from the fully extended position.
- With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin 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

Model	Drift to be measured	Standard	Maximum allowable	Remarks
	Boom cylinder	10 below	15	
HX360 L	Arm cylinder	10 below	15	
	Bucket cylinder	40 below	50	



11) CONTROL LEVER OPERATING FORCE

(1) 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	1.3 or below	1.7	
	Arm lever	1.3 or below	1.7	
HX360 L	Bucket lever	1.3 or below	1.7	
	Swing lever	1.3 or below	1.7	
	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	90±10	115	
	Arm lever	90±10	115	
HX360 L	Bucket lever	90±10	115	
	Swing lever	90±10	115	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

① Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

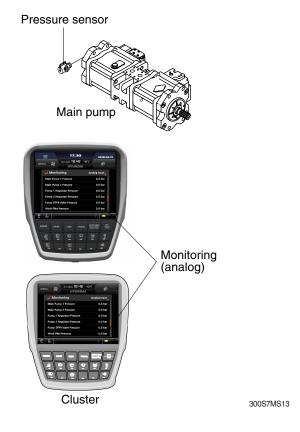
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

② Measure the primary pilot pressure by the monitoring menu of the cluster.



(3) Evaluation

The average measured pressure should meet the following specifications:

Unit: kgf/cm2

Model	Engine speed	Standard	Allowable limits	Remarks
HX360 L	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
- 4 assembly to turning joint P port as shown. Start the engine and check for on leakage from the adapter.
- ⑤ Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Travel mode switch : 1 speed

2 speed

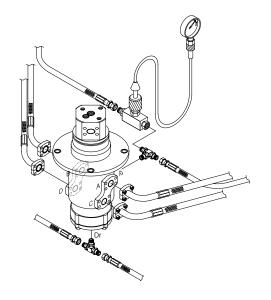
- ② Measure the travel speed selecting pressure in the Hi or Lo mode.
- ③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.
- ④ Repeat steps ② and ③ three times and calculate the average values.



The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HV260 I	1 Speed	0	-	
HX360 L	2 Speed	40±5	-	



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15) SWING PARKING BRAKE RELEASING 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.
- The pressure release L wrench to bleed air.
- ④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
- ⑤ Start the engine and check for oil leakage from the adapter.
- ⑥ Keep the hydraulic oil temperature at $50\pm5^{\circ}$ C.



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

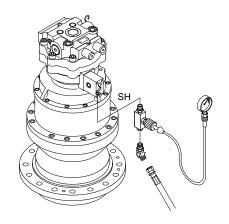
Repeat step ② three times and calculate the average values.



The average measured pressure should be within the following specifications.

Unit: kgf/cm2

Model	Description	Standard	Allowable limits	Remarks
HV360 I	Brake disengaged	40	31~49	
HX360 L	Brake applied	0	-	



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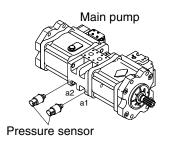
16) MAIN PUMP DELIVERY PRESSURE

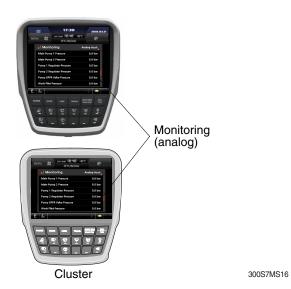
(1) Preparation

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 Measure the main pump delivery pressure in the P mode (high idle).





(3) Evaluation

The average measured pressure should meet the following specifications.

Unit: kgf/cm²

Model	Engine speed	Standard	Allowable limits	Remarks
HX360 L	High idle	40±5	-	

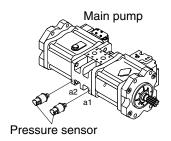
17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(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.

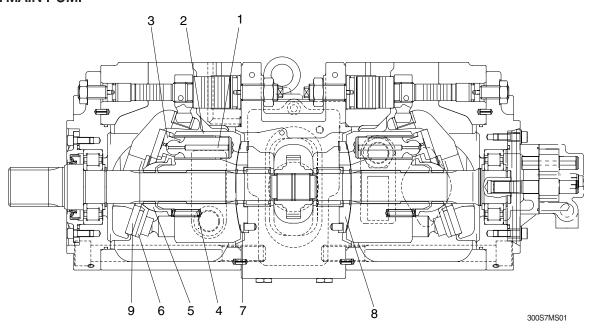
Unit: kgf/cm2

Model	Function to be tested	Standard	Port relief setting
	Boom, Arm, Bucket	350 (380)±10	390±10
HX360 L	Travel	350±10	-
	Swing	300±10	-

): Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston(1) & cylinder bore(2) (D-d)		0.043	0.070	Replace piston or cylinder.
Play between piston(1) & shoe caulking section(3) (δ)		0-0.1	0.3	Replace assembly of
Thickness of shoe (t)	t state of the sta	5.4	5.0	piston & shoe.
Free height of cylinder spring(4)		47.9	47.1	Replace cylinder spring.
Combined height of set plate(5) & spherical bushing(6) (H-h)	h H	23.8	22.8	Replace retainer or set plate.
Surface roughness for valve plate (sliding face)	Surface roughness necessary to be corrected	3	3z	
(7,8), swash plate (shoe plate area) (9), & cylinder(2) (sliding face)	Standard surface roughness (corrected value)	0.4z c	or lower	Lapping

2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratches, rust or corrosion.	In case of damage in following section, replace casing.
		 Sliding sections of casing hole and spool, especially land sections applied with held pressure. Seal pocket section where spool is inserted. Sealing section of port where O-ring contacts. Sealing section of each relief valve for main and port. Sealing section of plug. Other damages that may damage normal function.
Spool	· Existence of scratch, gnawing, rusting or corrosion.	Replacement when its outside sliding section has scratch (especially on seals-contacting section).
	· O-ring seal sections at both ends.	· Replacement when its sliding section has scratch.
	Insert spool into casing hole, rotate and reciprocate it.	Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of spring	· Replacement.
	· Damage of poppet	Correction or replacement when sealing is incomplete.
	· Insert poppet into casing and function it.	Normal when it can function lightly and smoothly without sticking.
Spring and related parts	· Rusting, corrosion, deformation or breakage 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.
valve	· Contacting face of poppet.	· Replacement when damaged.
	· O-rings and back up rings.	· Replacement in principle.

3. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.041	0.060	Replace piston or cylinder block
Thickness of valve plate	6	5.88	Replace
Play between piston and shoe caulking section (δ)	0.025	0.1	Replace assembly of piston and shoe
Thickness of shoe (t)	6.6	6.5	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	17.6	17.3	Replace set of retainer plate and sperical bushing
Thickness of friction plate	2.94	2.7	Replace
t s	550		↓h H ↑ ↑
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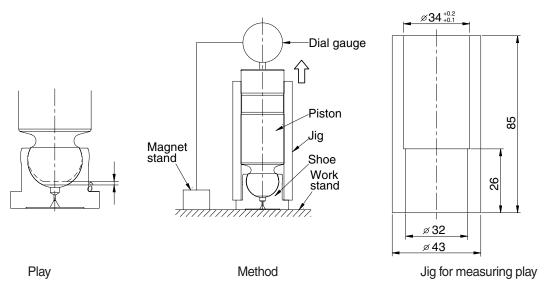
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	Rmax=1S (Ra=0.2a) (LAPPING)	4S (Ra=0.1a)	
Shoe plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Cylinder	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Valve plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	2S (Ra=0.5a)	

4. TRAVEL MOTOR

The followings are the general maintenance standards. However, it is the most important to determine which parts should be replaced, depending on the characteristics before disassembling, damages and discoloration of exterior view, the purpose of disassembling, the expected remaining service life. etc..

Check item		Measuring method	Criteria	Allowable	Remedy
Sliding surface of cylinder block, valve plate and swash plate	Surface roughness of cylinder block, valve plate and swas plate	Measure the surface roughness by roughness tester	Below 0.4 Z μ	Below 3.0 Z μ	Replace or repair ** Lap together the surfaces of both cylinder block and valve plate to remedy their roughness (# 1200 power)
	Swash plate - hardness of sliding surface	Measure the surface hardness of swash plate by hardness tester	Over HS78	HS74	Replace
Clearance between piston and cylinder block	Outer dia of piston d max - d min	Measure outer dia of piston and bore of cylinder block at least 3	0.01 mm	0.05 mm	Replace piston or cylinder block
	Inner dia of cylinder bore D max - D min	places in the longitudinal direction with microme- ter and obtain : max outer dia = d max	0.01 mm	0.022 mm	* In exchanging pistons, replace all of nine pis-
Measurement position	Clearance D-d	min outer dia = d min max inner dia = D max min inner dia = D min	0.037~ 0.047 mm	0.065 mm	tons at the same time
Play between pis- ton and shoe	Play between calked piston and shoe (δ)	With the jig, hold down the shoe on work stand and pull up the piston vertical direction to measure the play between piston and shoe	0~0.1 mm	0.3 mm	Replace piston



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Check item	Measuring method	Criteria	Allowable	Remedy
Parking brake torque	After completion of assembly, set the torque wrench on the shaft end, and measure the braking torque generat- ed when the shaft starts to rotate	92.6 kgf · m (670 lbf · ft)		Replace all of separator, friction plates and springs
Standard of replacing friction and separating plate. When measuring parking brake torque, it needs to disassemble traveling unit to motor and reduction gear portion, and it's so hard. The right allowable value is a standard of replacing friction and separating plate. If it is impossible to disassemble traveling unit, refer to the right value.	Measure the total thickness of 4 pieces of friction plate and 5 pieces of separating plate.	22.76 mm	Thickness: 21.3 mm	Replace all separating and friction plates and springs.

Check item	Measuring method	Judging criteria and remedy
Shaft	Measure the wear at contacting surface of oil seal (3) with the surface roughness tester	If the depth of shaft wear is less than 0.05 mm, the shaft is reusable. ** In case of replacing the shaft (9), replace oil seal (3) at the same time.
Bearings	Replace bearings (10, 51) after decided hours	Replace bearings (10, 51) before hour meter of host machine indicates 10,000 hours. In case replacing the bearings (10, 51), replace both inner and outer races at the same time. Also the bearing shims (52) must be readjusted when replaced shaft (9) and/or bearings (10, 51). Contact dealers for jigs and tools required.
Splines	Replace if the wear of splines exceeds the allowable value	If the wear of splines is less than 0.3 mm, the spline is reusable.
Overload relief valve	Do not try to adjust the valve, since special hydraulic test bench is required for inspecting and adjusting the pressure	Replace relief valve part as an assembly each time the host machine works for 10,000 hours.

5. RCV LEVER

Maintenance check item	Criteria	Remark	
Leakage	The valve is to be replaced when the leakage becomes more than 1000 cc/m at neutral handle position, or more than 2000 cc/m during operation.	Conditions : Primary pressure : 40 kgf/cm² Oil viscosity : 23 cSt	
Spool	This is to be replaced when the sliding surface has worn more than 10 μ m, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.	
Push rod	1 mm		
	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.

2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

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 μ m, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	1 mm	
	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

Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· 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
Cover	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set		· Extruded excessively from seal groove square ring.	Replace
	-	Square ring Extrusion	
	-	Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring.	Replace
		1.5 mm (max.)	
	-	· Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in)	Replace

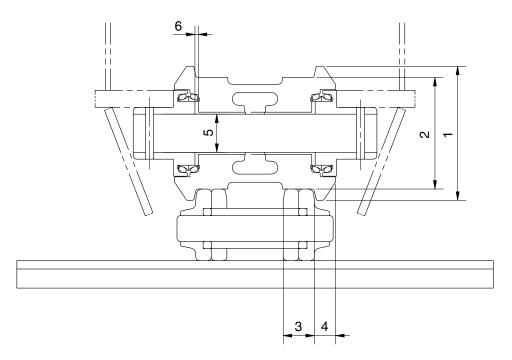
8. CYLINDER

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

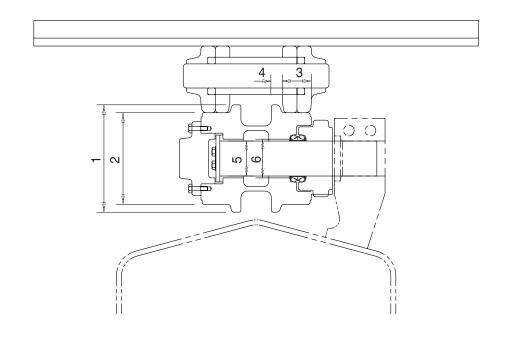
1) TRACK ROLLER



Unit:mm

No.	Check item		Criteria				
4	Outside diameter of flange	Standard size		Repair limit			
'	Outside diameter of flarige	Ø	216		_	Rebuild or	
2	Outside diameter of tread	Ø	180	Ø	168	replace	
3	Width of tread	į	50	56			
4	Width of flange	į	57	21			
		Standard siz	e & tolerance	Standard	Clearance		
5	Clearance between shaft	Shaft	Hole	clearance	limit	Replace	
	and bushing	Ø75 -0.03 Ø75.35 +0.05 0		0.35 to 0.40	2.0	bushing	
6	Side clearance of roller	Standard	clearance	Clearance limit		Replace	
0	(both side)	0.16	0.16~1.24		2.0		

2) CARRIER ROLLER

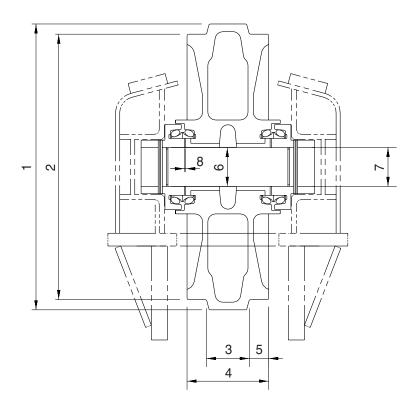


32037MA37

Unit:mm

No.	Check item		Criteria				
_	Outside dismeter of flance	Standard size		Repair limit			
'	Outside diameter of flange	Ø	Ø200 –		_	Rebuild or	
2	Outside diameter of tread	Ø.	168	Ø.	158	replace	
3	Width of tread	5	5 4	59			
4	Width of flange	1	9	_			
		Standard size	e & tolerance	Standard	Clearance		
5	Clearance between shaft	Shaft	Hole	clearance	limit	Replace	
	and bushing	Ø55 +0.085 +0.066	Ø55 +0.37 +0.33	0.245 to 0.304	2.0	bushing	
6	Clearance between shaft and support	Ø58 ⁰ -0.1	Ø58 +0.5 +0.3	0.3 to 0.6	1.2	Replace	

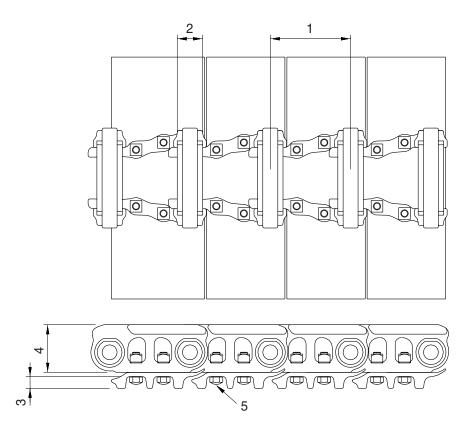
3) IDLER



Unit:mm

No.	Check item		Criteria					
1	Outside diameter of protrusion	Standa	ard size	Repa	Repair limit			
ľ	Outside diameter of protrusion	Ø	646	-	_			
2	Outside diameter of tread	Ø	594	Ø	588	Rebuild or		
3	Width of protrusion	1	02	-	_	replace		
4	Total width	2	03	_				
5	Width of tread	50.5		56.5				
		Standard siz	e & tolerance	Standard	Clearance			
6	Clearance between shaft	Shaft	Hole	clearance	limit	Replace		
	and bushing	Ø90 ⁰ -0.035	Ø90.35 ^{+0.05}	0.35 to 0.435	2.0	bushing		
7	Clearance between shaft and support	Ø90 ⁰ _{-0.035} Ø90 ^{+0.09} _{+0.036} (0.036 to 0.125	1.2	Replace		
8	Side clearance of idler (both side)	Standard clearance 0.4 to 1.2		Clearan 2.		Replace		

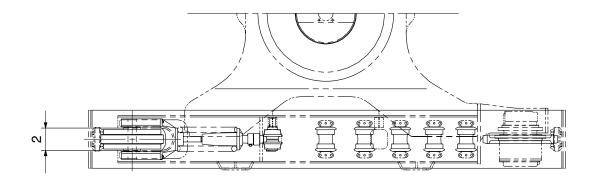
4) TRACK

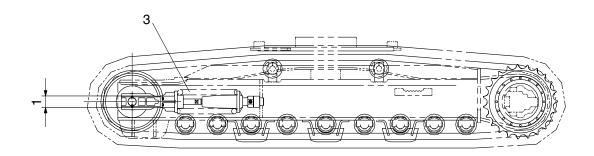


Unit:mm

No.	Check item	Crit	Remedy			
1	Link pitch	Standard size	Repair limit	Turn or		
'	LITIK PITCH	216	221	replace		
2	Outside diameter of bushing	Ø 66.5	Ø 60.9	5		
3	Height of grouser	30	23	Rebuild or replace		
4	Height of link	116	111			
5	Tightening torque	Initial tightening torque: 115	Initial tightening torque : 115 \pm 5 kgf \cdot m			

5) TRACK FRAME AND RECOIL SPRING

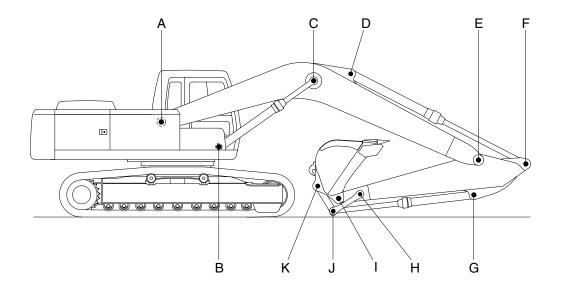




Unit:mm

								011111
No.	Check item		Criteria					Remedy
	Vertical width of idler guide		Standar	d size	Tole	erance	Repair limit	
1			e 132	2		-2 0	136	
		Idler suppo	rt 130		0 - 1.5		126	Rebuild or replace
2	Horizontal width of idler guide	Track frame	e 292	2		-2 0	297	Теріасе
	Tionzontal water or later guide	Idler suppo	rt 290)		-	288	
		S	tandard siz	e		Re	pair limit	
3	3 Recoil spring		Installation length	Installa		Free length	Installation load	Replace
			580	19012	2 kg	-	15210 kg	

2. WORK EQUIPMENT



Unit:mm

			Pi	in	Busl	ning	Damada
Mark	Measuring point (Pin and Bushing)	Normal value	Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	Remedy & Remark
Α	Boom Rear	110	109	108.5	110.5	111	Replace
В	Boom Cylinder Head	90	89	88.5	90.5	91	"
С	Boom Cylinder Rod	100	99	98.5	100.5	101	"
D	Arm Cylinder Head	90	89	88.5	90.5	91	"
Е	Boom Front	100	99	98.5	100.5	101	"
F	Arm Cylinder Rod	90	89	88.5	90.5	91	"
G	Bucket Cylinder Head	90	89	88.5	90.5	91	"
Н	Arm Link	80	79	78.5	80.5	81	"
I	Bucket and Arm Link	90	89	88.5	90.5	91	"
J	Bucket Cylinder Rod	80	79	78.5	80.5	81	"
K	Bucket Link	90	89	88.5	90.5	91	"

SECTION 8 DISASSEMBLY AND ASSEMBLY

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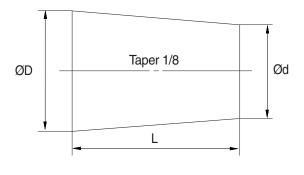
SECTION 8 DISASSEMBLY AND ASSEMBLY

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

NI.		D	Dallada a	Tor	que
No.		Descriptions	Bolt size	kgf · m	lbf ⋅ ft
1	Engine mounting bolt (engine-bracket)		M12 × 1.75	11.5 ± 1.0	83.2 ± 7.2
2		Engine mounting bolt (bracket-frame, FR)	M24 × 3.0	90 ± 9.0	651 ± 65.1
3	Facino	Engine mounting bolt (bracket-frame, RR)	M24 × 3.0	90 ± 9.0	651 ± 65.1
4	Engine	Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
5		Coupling mounting socket bolt	M18 × 2.5	46.5 ±2.5	336 ±18.1
6		Fuel tank mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
7		Main pump housing mounting bolt	M10 × 1.5	6.5 ± 0.7	47 ± 5.1
8		Main pump mounting socket bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
9	Hydraulic system	Main control valve mounting nut	M12 × 1.75	12.3 \pm 1.3	89.0 ± 9.4
10	- Cycloni	Hydraulic oil tank mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
11		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
12		Swing motor mounting bolt	M20 × 2.5	57.9 ± 5.8	419 ± 42
13	Power	Swing bearing upper part mounting bolt	$M24 \times 3.0$	100 \pm 10	723 ± 72.3
14	train	Swing bearing lower part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
15	system	Travel motor mounting bolt	$M24 \times 3.0$	84 \pm 8.0	608 ± 57.9
16		Sprocket mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
17		Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18		Track roller mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
19	Under carriage	Track tension cylinder mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
20	3411490	Track shoe mounting bolt, nut	M22 × 1.5	78 ± 8.0	564 ± 57.9
21		Track guard mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
22		Counterweight mounting bolt	M36 × 3.0	337 ± 33	2440 ± 239
23	Others	Cab mounting bolt	M12 × 1.75	12.8 \pm 3.0	92.6 ± 21.7
24		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8

^{**} For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Dolt oize	8.8	ВТ	10.	.9T	12.9T	
Bolt size	kgf · m	lbf ⋅ ft	kgf · m	lbf ⋅ ft	kgf · m	lbf ⋅ ft
M 6×1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8×1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10×1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12×1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14×2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16×2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18×2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20×2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22×2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24×3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30×3.5	120 ~161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Dalt size	8.	.8T	10	.9T	12.9T	
Bolt size	kgf · m	lbf ⋅ ft	kgf · m	lbf · ft	kgf · m	lbf ⋅ ft
M 8×1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10×1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12×1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14×1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16×1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18×1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20×1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22×1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24×2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30×2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

2) PIPE AND HOSE (FLARE TYPE)

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

3) PIPE AND HOSE (ORFS TYPE)

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

4) FITTING

Thread size	Width across flat (mm)	kgf⋅m	lbf-ft
1/4"	19	4	28.9
3/8"	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

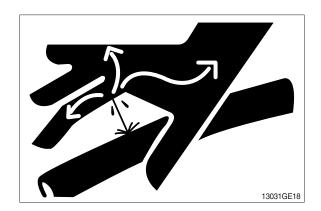
1) REMOVAL

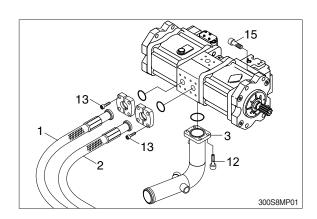
- Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.
- (4) Remove the wirings for the pressure sensors and so on.
- (5) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.
 - · Hydraulic tank quantity : 190 $\,\ell\,$
- (6) Remove bolts (13) and disconnect horse (1,2).
- (7) Disconnect pilot line hoses (4, 5, 6, 7, 8, 9, 10).
- (8) Remove pressure switches and accessory items if necessary.
- (9) Remove bolts(12) and disconnect pump suction tube (3).
- When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (10) Sling the pump assembly and remove the pump mounting bolts (15).
 - · Weight : 201 kg (443 lb)
 - · Tightening torque : 57.9 ± 8.7 kgf · m

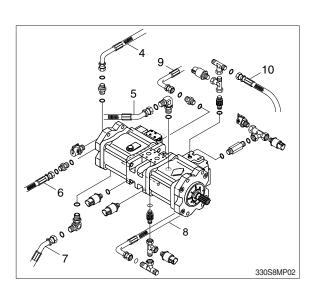
 $(419 \pm 62.9 \, lbf \cdot ft)$

Pull out the pump assembly from housing.

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





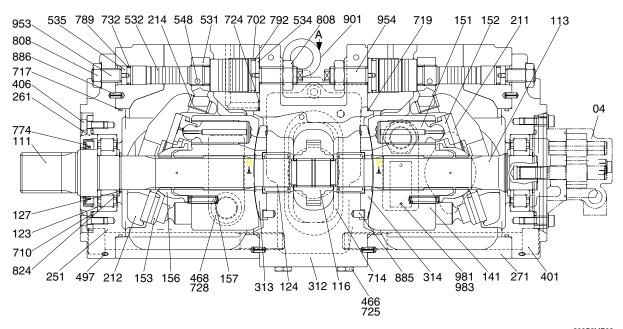


2) INSTALL

- (1) Carry out installation in the reverse order to removal
- (2) Remove the suction strainer and clean it.
- (3) Replace the return filter with a 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) Confirmed the hydraulic oil level and check the hydraulic oil leaks or not.

2. MAIN PUMP (1/2)

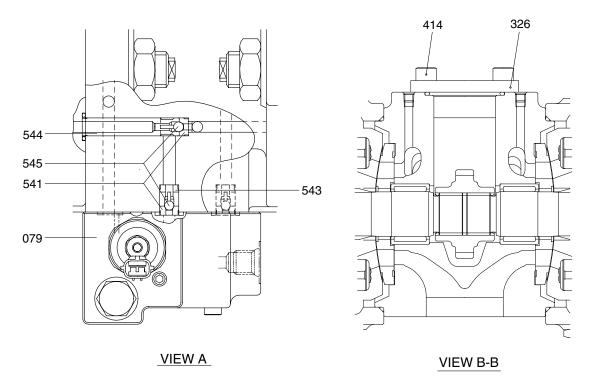
1) STRUCTURE



300S2MP03

04	Gear pump	313	Valve plate (R)	717	O-ring
111	Drive shaft (F)	314	Valve plate (L)	719	O-ring
113	Drive shaft (R)	401	Hexagon socket bolt	723	O-ring
114	1st gear	406	Hexagon socket bolt	724	Square ring
123	Roller bearing	465	ROH plug	725	O-ring
124	Needle bearing	466	VP plug	728	O-ring
127	Bearing spacer	468	VP plug	732	O-ring
141	Cylinder block	497	MH plug	774	Oil seal
151	Piston	531	Tilting pin	789	Back up ring
152	Shoe	532	Servo piston	792	Back up ring
153	Set plate	534	Stopper (L)	806	Hexagon head nut
156	Spherical bushing	535	Stopper (S)	808	Hexagon head nut
157	Cylinder spring	541	Seat	824	Snap ring
211	Shoe plate	543	Stopper 1	885	Valve plate pin
212	Swash plate	544	Stopper 2	886	Spring pin
214	Tilting bushing	545	Steel ball	901	Eye bolt
251	Swash plate support	548	Feedback pin	953	Set screw
261	Seal cover (F)	702	O-ring	954	Set screw
271	Pump casing	710	O-ring		
312	Valve block	714	O-ring		

MAIN PUMP (2/2)



300S2MP04

079	Proportional reducing valve	541	Seat	544	Stopper 2
326	Cover	543	Stopper 1	545	Steel ball
414	Hexagon socket bolt				

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

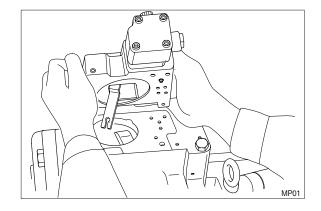
		Г					
Tool name & size		Part name					
Allen wrench	В	•		PT plug PO plug T thread) (PF thread		-	Hexagon socket head setscrew
B	4	M 5		3P-1/16	-		M 8
	5	M 6		BP1/8	-		M10
	6	M 8		BP-1/4	PO-1/4		M12, M14
	8	M10		BP-3/8	PO-3/8	}	M16, M18
	17	M20, M22		BP-1	PO-1, 1 1/4,	1 1/2	-
Double ring spanner, socket wrench, double	-	Hexagon head bolt		Hexagon head bolt		VP plug (PF thread)	
(single) open end spanner	19	M12		M12		VP-1/4	
_	24	M16		M16		_	
B	27	M18		M18		VP-1/2	
	30	M20		M20		-	
	36	-		-		VP-3/4	
Adjustable angle wrench		Medium size, 1 set					
Screw driver		Minus type screw driver, Medium size, 2 sets					
Hammer	Plastic hammer, 1 set						
Pliers	For snap ring, TSR-160						
Steel bar		Steel bar of key material approx. 10×8×200					
Torque wrench		Capable of tightening with the specified torques					

(2) Tightening torque

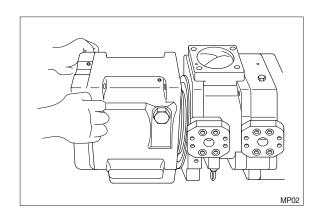
Dort name	Dolt size	Tor	que	Wrench size		
Part name	Bolt size	kgf · m	lbf · ft	in	mm	
Hexagon socket head bolt	M 5	0.7	5.1	0.16	4	
(material : SCM435)	M 6	1.2	8.7	0.20	5	
	M 8	3.0	21.7	0.24	6	
	M10	5.8	42.0	0.31	8	
	M12	10.0	72.3	0.39	10	
	M14	16.0	115.7	0.47	12	
	M16	24.0	173.6	0.55	14	
	M18	34.0	245.9	0.55	14	
	M20	44.0	318.3	0.67	17	
PT plug (material : S45C)	PT 1/16	0.7	5.1	0.16	4	
Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/ 8	1.05	7.59	0.20	5	
2 tamo round the plag	PT 1/ 4	1.75	12.66	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	108.5	0.55	14	
	PF 1	19.0	137.4	0.67	17	
	PF 1 1/4	27.0	195.3	0.67	17	
	PF 1 1/2	28.0	202.5	0.67	17	

3) DISASSEMBLY

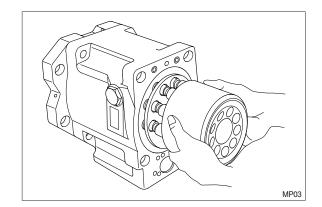
- (1) Select place suitable to disassembling.
- Select clean place.
- Spread rubber sheet, cloth or so on, on overhaul workbench top to prevent parts from being damaged.
- (2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.
- (3) Remove drain port plug (468) and let oil out of pump casing. (front and rear pump).
- (4) Remove hexagon socket head bolts (412, 413) and remove regulator. Remove flange socket bolts (435) and remove gear pump.



- (5) Loosen hexagon socket head bolts (401) fixing swash plate support (251), pump casing (271) and valve block (312).
- (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 failing to prevent this surface from being damaged.

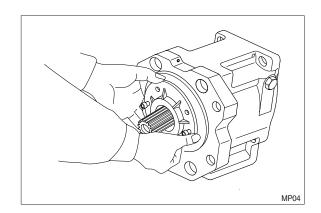


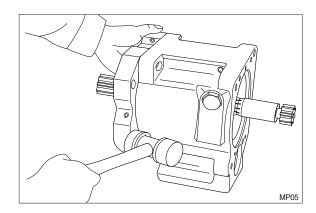
- (7) Pull cylinder (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.
- * Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.



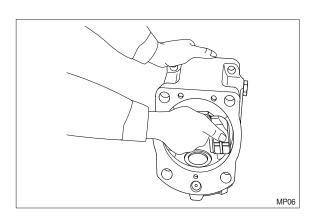
- (8) Remove hexagon socket head bolts (406) and then seal cover (F) (261).
 Fit bolt into pulling out tapped hole of seal cover (F), and cover can be removed.
- cover (F), and cover can be removed easily.Since oil seal is fitted on seal cover (F),
- take care not to damage it when removing cover.

 (9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).
 - In case of 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.

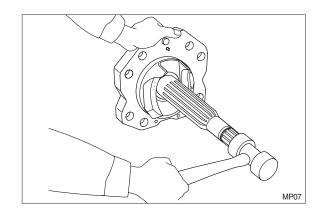




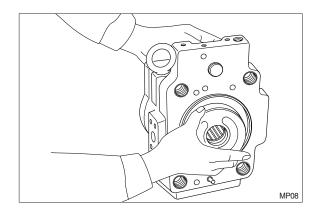
(11) Remove shoe plate (211) and swash plate (212) from pump casing (271).



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



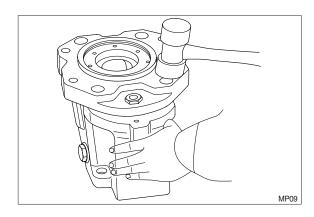
- (13) Remove valve plates (313, 314) from valve block (312).
- These may be removed in work 6.



- (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 gear (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. Once loosened, flow setting will be changed.

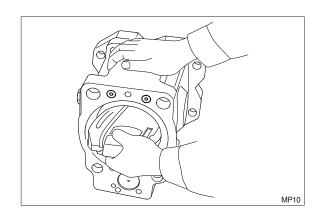
4) ASSEMBLY

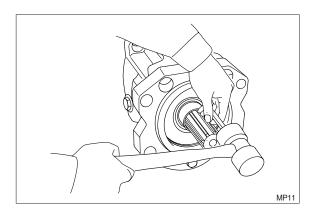
- (1) For reassembling reverse the disassembling procedures, paying attention to the following items.
- ① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.
- ② Clean each part fully with cleaning oil and dry it with compressed air.
- 3 Do not fail 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 Section 2-3.
- 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 lock-tight (medium strength) to their threaded sections.

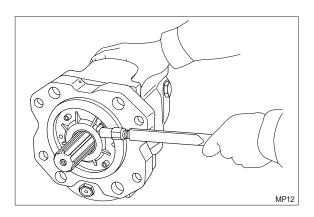


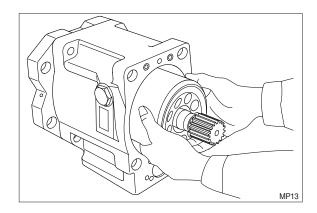
- (3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531), and fit swash plate (212) to swash plate support (251) correctly.
- * Confirm with fingers of both hands that swash plate can be removed smoothly.
- Apply grease to sliding sections 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.
- (5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).
- 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).
- (6) Assemble piston cylinder subassembly [Cylinder (141), piston subassembly (151, 152), set plate (153), spherical bush (156), spacer (158) and cylinder spring (157).]

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

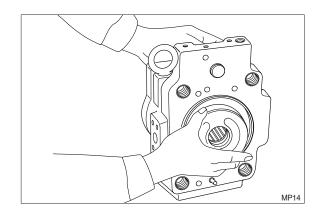




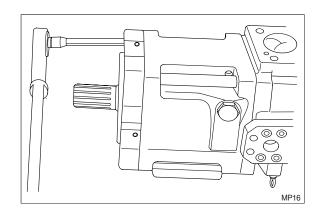




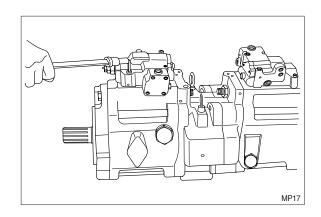
- (7) Fit valve plate (313) to valve block (312), entering pin into pin hole.
- * Take care not to mistake suction / delivery directions of valve plate.



- (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.
- (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.

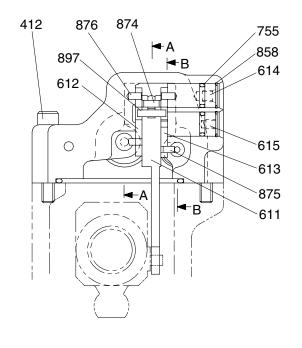


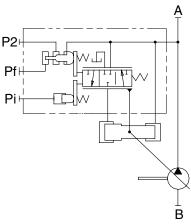
(10) Fit drain port plug (468).

This is the end of reassembling procedures.

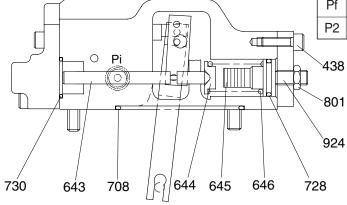
3. REGULATOR

1) STRUCTURE(1/2)

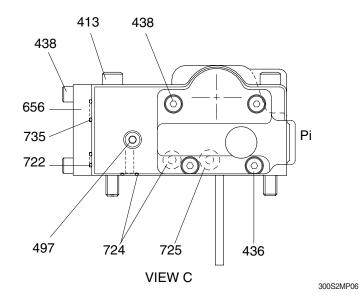




Port	Port name	Port size
Α	Delivery port	SAE 6000 PSI 1"
В	Suction port	SAE 2500 PSI 3"
Pi	Pilot port	PF 1/4-15
Pf	Power shift pressure	-
P2	Companion delivery pressure	-

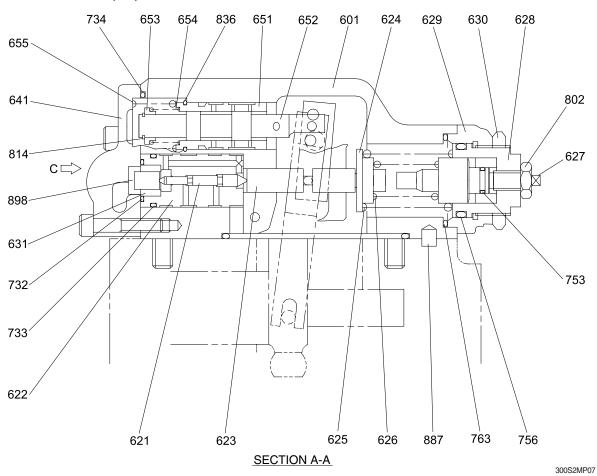


SECTION B-B



- 412 Hexagon socket screw
- 413 Hexagon socket screw
- 436 Hexagon socket screw
- 438 Hexagon socket screw
- 497 Plug
- 611 Feed back lever
- 612 Lever (1)
- 613 Lever (2)
- 614 Fulcrum plug
- 615 Adjust plug
- 643 Pilot piston
- 644 Spring seat (Q)
- 645 Adjust stem (Q)
- 646 Pilot spring
- 656 Block cover
- 708 O-ring
- 722 O-ring
- 724 O-ring
- 725 O-ring
- 728 O-ring
- 730 O-ring 735 O-ring
- 755 O-ring
- 801 Nut
- 858 Snap ring
- 874 Pin 875 Pin
- 876 Pin
- 897 Pin
- 924 Set screw

REGULATOR (2/2)



601	Casing	630	Lock nut	734	O-ring
621	Compensator piston	631	Sleeve, pf	753	O-ring
622	Piston case	641	Pilot cover	756	O-ring
623	Compensator rod	651	Sleeve	763	O-ring
624	Spring seat (C)	652	Spool	802	Nut
625	Outer spring	653	Spring seat	814	Snap ring
626	Inner spring	654	Return spring	836	Snap ring
627	Adjust stem (C)	655	Set spring	887	Pin
628	Adjust screw (C)	732	O-ring	898	Pin
629	Cover (C)	733	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							
Allen wrench		Hexagon socket head bolt		PT plug T thread)	PO plug (PF thread)		Hexagon socket head setscrew	
	4	M 5	Е	3P-1/16	-		M 8	
	5	M 6		BP1/8	-		M10	
	6	M 8	I	BP-1/4	PO-1/4	ļ	M12, M14	
Socket wrench, double (single) open end	-	Hexagon head bolt Hexag		gon nut		VP plug (PF thread)		
	6	M 8		M	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		Steel bar of key material approx. $10 \times 8 \times 200$						
Torque wrench		Capable of tightening with the specified torques.						
Pincers	-							
Bolt		M4, Length: 50 mm						

(2) Tightening torque

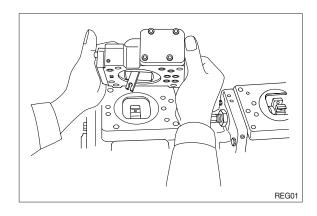
Part name	D !! .	Tor	que	Wrench size		
Part name	Bolt size	kgf · m	lbf ⋅ ft	in	mm	
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4	
	M 6	1.2	8.7	0.20	5	
	M 8	3.0	21.7	0.24	6	
	M10	5.8	42.0	0.31	8	
	M12	10.0	72.3	0.39	10	
	M14	16.0	115.7	0.47	12	
PT plug (material : S45C)	PT 1/16	0.7	5.1	0.16	4	
Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/ 8	1.05	7.59	0.20	5	
	PT 1/ 4	1.75	12.66	0.24	6	
PF plug (material : S45C)	PT 1/ 4	3.0	21.7	0.24	6	

3) DISASSEMBLY

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

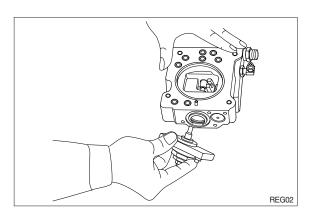
For this reason, replacement of a regulator assembly is not recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

- (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.

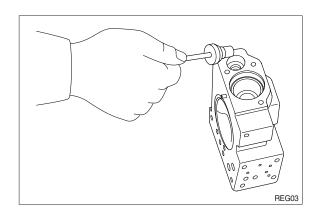


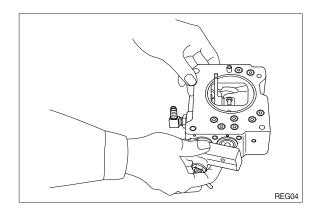
- (4) Remove hexagon socket head screw (438) and remove cover (C, 629).
- ** Cover (C) is fitted with adjusting screw (C, 628), adjusting stem (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

Do not loosen these screws and nuts. If they are loosened, adjusted pressureflow setting will vary.

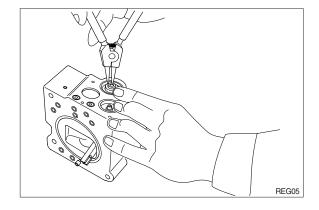


- (5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section. Then draw out adjusting stem (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
- Adjusting stem (Q, 645) can easily be drawn out with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

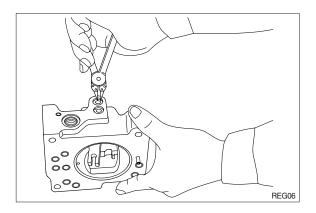


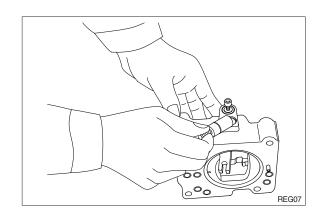


- (7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
 - Sleeve (651) is fitted with snap ring (836).
- When removing snap ring (814), return spring (654) may pop out.
- * Take care not to lose it.

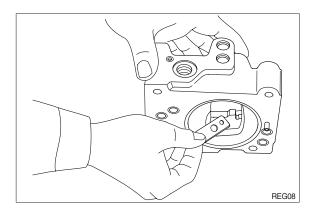


- (8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).
- Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.

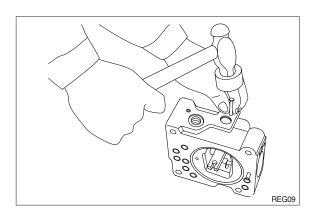


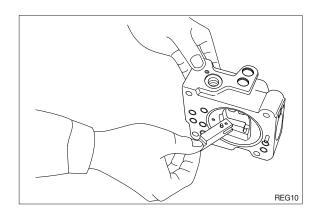


- (9) Remove lever (2, 613). Do not draw out pin (875).
- Work will be promoted by using pincers or so on.



- (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).



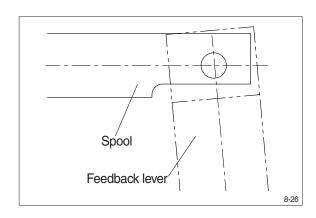


- (11) Remove lever (1, 612). Do not draw out pin (875).
- (12) Draw out pilot piston (643) and spool (652).
- (13) Draw out piston case (622), compensating piston (621) and compensating rod (623).
- Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

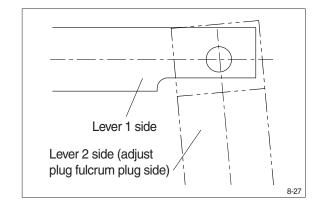
This completes operation.

4) ASSEMBLY

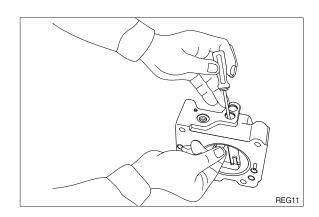
- (1) For assembly, reverse disassembly procedures, but pay attention to the following items.
- ① Always repair parts that were scored at disassembly.
 - Get replacement parts ready beforehand.
- 2 Mixing of foreign matter will cause malfunction.
 - Therefore, wash parts well with cleaning oil, let them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



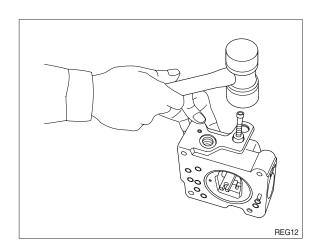
- (5) Fit feedback lever (611), matching its pin hole with pin hole in spool. Then insert pin (874).
- Insert pin in feedback lever a little to ease operation.
- * Take care not to mistake direction of feedback lever.

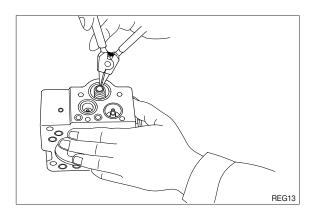


- (6) Put pilot piston (643) into pilot hole of casing.
- Confirm that pilot piston slides smoothly without binding.
- (7) Put pin force-fitted in lever (2, 613) into groove of pilot piston. Then fix lever (2).



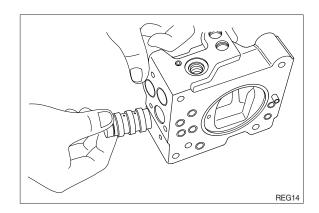
- (8) Fit fulcrum plug (614) so that pin forcefitted in fulcrum plug(614) can be put into pin hole of lever (2). Then fix locking ring (858).
- (9) Insert adjusting plug (615) and fit locking ring.
- * Take care not to mistake inserting holes for fulcrum plug and adjusting plug. At this point in time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



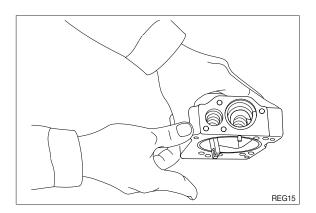


(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.

Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).



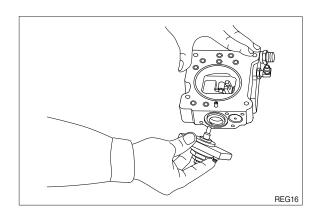
- (12) Put spring seat (644), pilot spring (646) and adjusting stem (Q, 645) into pilot hole. Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
- When fitting spring seat, take care not to mistake direction of spring seat.



(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting stem (C, 627), lock nut (630), hexagon nut (802) and adjusting screw (924).

Then tighten them with hexagonal socket head screws (438).

This completes assembly.



GROUP 4 MAIN CONTROL VALVE

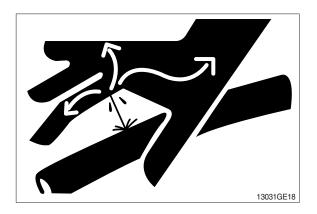
1. REMOVAL AND INSTALL OF MOTOR

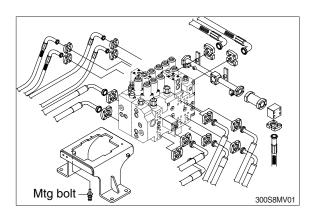
1) REMOVAL

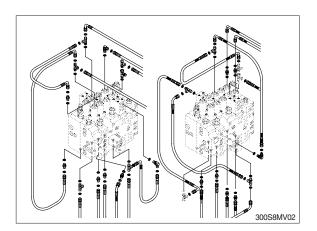
- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure 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.
 - · Weight: 220 kg (485lb)
 - \cdot Tightening torque : 12.3 \pm 1.3 kgf \cdot m (89.0 \pm 9.4 lbf \cdot ft)
- (9) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

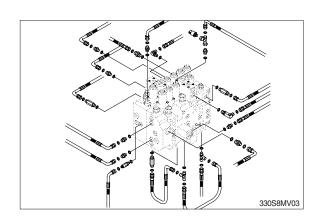
2) INSTALL

- (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.

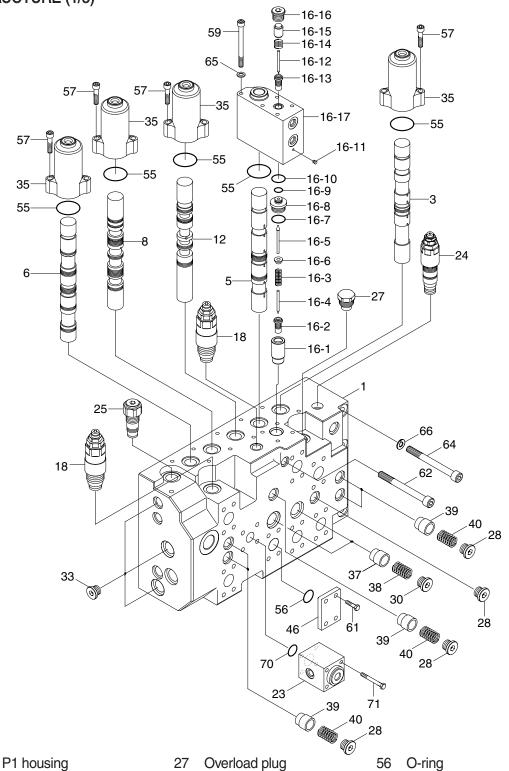








2. STRUCTURE (1/5)

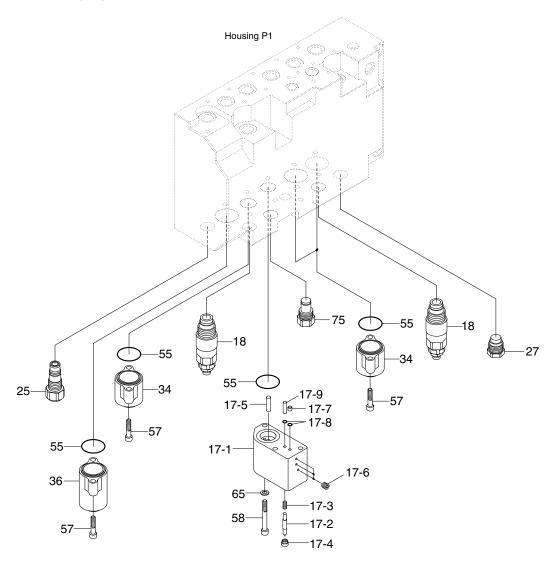


ı	Pinousing
3	Travel spool kit
5	Boom 1 spool kit
6	Bucket spool kit
8	Arm 2 spool kit
12	Arm regen spool kit
16	Holding valve assy
18	Port relief valve assy
23	Arm 2 logic valve assy
24	Main relief valve assy
25	Negacon relief valve

28 Plug Load check plug 30 33 Plug Spool cap 35 37 L/C poppet 1 38 L/C spring 1 39 L/C poppet 2 40 L/C spring 2 46 Port plug flange 55 O-ring

300S8MC04 56 O-ring Socket bolt 57 59 Socket bolt 61 Socket bolt 62 Socket bolt 64 Socket bolt 66 Spring washer 70 O-ring Socket bolt

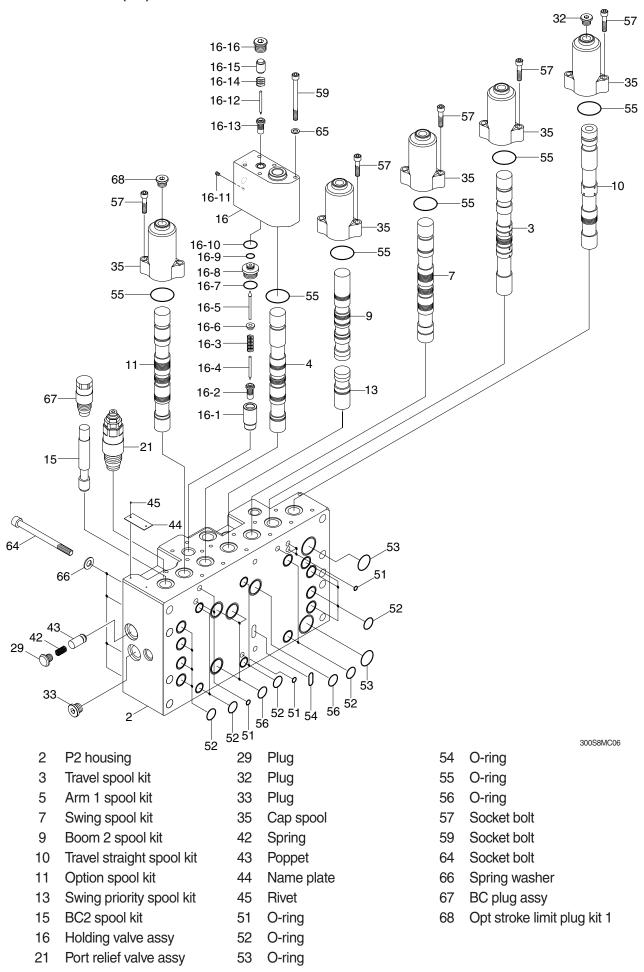
STRUCTURE (2/5)



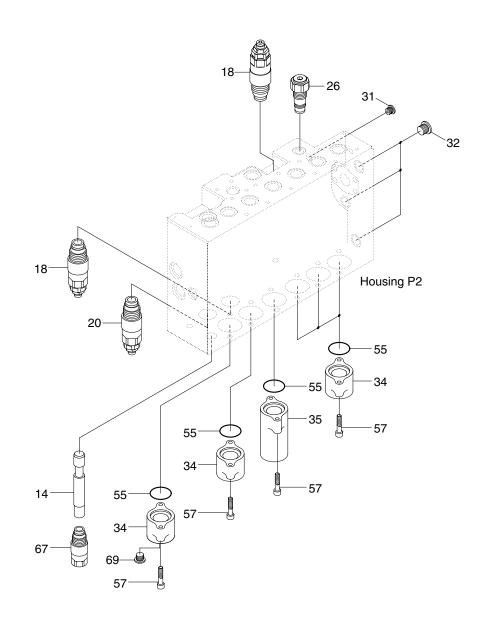
300S8MC05

17	Regen valve assy	34	Spool cap	58	Socket bolt
18	Port relief valve assy	36	Bucket stroke limit	75	Plug assy
25	Negacon relief valve	55	O-ring		
27	Overload plug	57	Socket bolt		

STRUCTURE (3/5)



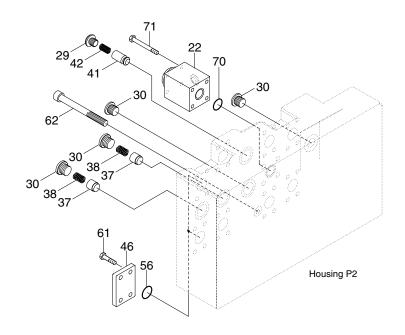
STRUCTURE (4/5)



300S8MC07

14	BC1 spool kit	31	Plug	55	O-ring
18	Port relief valve assy	32	Plug	57	Socket bolt
20	Port relief valve assy	34	Spool cap	67	BC plug assy
26	Orifice signal plug assy	35	Spool cap	69	Opt stroke limit plug kit 2

STRUCTURE (5/5)



220S8MC08

22	Swing logic valve assy	41	Poppet	62	Socket bolt
29	Plug	42	Spring	70	O-ring
30	Load check valve	46	Port plug flange	71	Socket bolt
37	L/C poppet 1	56	O-ring		
38	L/C spring 1	61	Socket bolt		

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. In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.
- (2) When a control valve is to be removed 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.
- (3) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.
- (4) 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)
Torque wrench	1	-
Extension bar	1	-
Hexagon bit socket	Each 1	6, 8, 10
Hex socket	1	36
Spanner	Each 1	32, 34, 38
Loctite #262	1	-

3) DISASSEMBLY

The figure in () shown after the part name in explanation sentence shows its number in the construction figures (8-31)

(1) Place main control valve on working bench

- Disassemble it in clean place and pay attention not to damage flange faces and plate faces.
- (2) Disassembling of orifice signal plug
- ① Loosen and remove orifice signal plug (25).



- (3) Disassembling of main spool assy 1 (Pilot cover B side) (Travel R/L (3), Swing (7), Boom 2 (9), Arm regen (12), Arm 2 (8), Bucket (6), Option (11))
- ① Loosen the hexagon socket head bolts (45) 2EA and remove the pilot cover B (33) and O-ring (43).

 [Hexagon key wrench 6 mm]
- ② Pull out the main spool, spring, spring seat stopper and spacer bolt in the spool assembly condition from the housing P1 & P2.



(4) Disassembling of main spool assy 2 (Pilot cover B side)(Boom 1 (5), Arm 1 (4))

- ① Loosen the hexagon socket head bolts (47) 5EA and remove the O-ring (44) and holding valve block assy (16)
 [Hexagon key wrench : 6 mm]
- ② Pull out the main spool, spring, spring seat stopper and spacer bolt in the spool assembly condition from the housing P1 & P2.
- When you disassemble holding valve block assy, pay attention not to miss the pilot poppet.



(5) Disassembling of bypass cut spool (=BC) (Bucket BC (14), Option BC (15))

- ① Loosen bypass cut plug assy [36mm socket wrench]
- ② Pull out the bypass cut spool
- Option BC spool (14) and bucket BC spool (15) are different lengths. So when you reassemble, be careful of length. (length: option BC > bucket BC)



(6) Disassembling of pilot cover (Bucket stroke limiter)

- ① Loosen the hexagon socket head bolts (45) 2EA.
 [Hexagon key wrench 6 mm]
- ② Remove the pilot cover (34) and O-ring (43).

- (7) Disassembling of swing priority spool & pilot cover A
 - (Travel R/L (3), Swing (7), Boom1 (5), Arm 1 (4), Bucket (6), Option (11), Boom2 (9), Arm 2 (8))
- ① Loosen the hexagon socket head bolts (45) 2EA and remove the pilot cover A (32) and O-ring (43).
- ② Pull out the swing priority spool (13).
- ③ Remove the pilot cover A (32).





(8) Disassembling of regen valve block assy

- ① Loosen the hexagon socket head bolts (46) 3EA.
 [Hexagon key wrench 6 mm]
- ② Remove plug (551) or (552) and take out poppet (511) or (515, 516) and spring (521) or (523).
- ③ When you disassemble regen valve block assy, pay attention not to miss the piston and O-ring (43).



(9) Disassembling of main relief valve

① Loosen and remove the main relief valve (23).

[Spanner 32 mm]



(10) Disassembling of port relief valve (Except the option side)

① Loosen and remove the port relief valve (18).

[Spanner 34 mm]



(11) Disassembling of port relief valve (Option side)

(1-stage (19), 2-stage (20))

① Loosen and remove the port relief valve. [Spanner 38 mm]



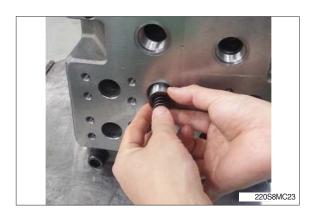
- (12) Disassembling of logic valve(Arm logic valve (22), Swing logic valve (21))
 - ① Loosen the hexagon socket head bolts (56) 4EA and remove the logic valve.
 [Hexagon key wrench 8 mm]



② Remove the swing logic poppet.

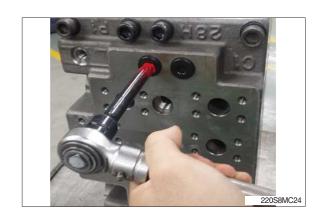


③ Remove the Arm logic poppet and spring by same method.



(13) Disassembling of check valve (Plug (27) 2EA)

① Loosen the plug (27) and remove the poppet (37), spring (38).
[Hexagon key wrench 10 mm]





(14) Main spool disassembly

① Fix the spool to the dedicated jig and take it apart.

(Spacer bolt, spring, stopper, spring seat)

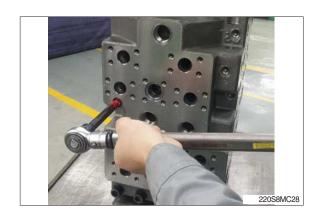
[Hexagon key wrench 8 mm]





(15) Disassembling of housing

- ① Loosen the hexagon socket head bolts (49, 50) each 2EA, 8EA
- Except when required specially, do not disassemble housing P1&P2 for sanitation.





(16) 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 the seal groove faces of the housing and the covers are smooth and free of dust, dent, rust etc.
- c. Correct dents and damages on check seat faces of housing, if any, by lapping.
- Pay attention not to leave lapping agent in the housing.
- d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from 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 its inspection procedures.
- g. Replace all the 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 are uniform 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
 on.
- d. Confirm that orifices of the main poppet and seat section are not clogged with foreign matter.
- e. Replace all O-rings with new ones.
- f. When any light damage is found in above inspections, correct it by lapping.
- g. When any abnormal part is found, replace it with a relief valve assembly.

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

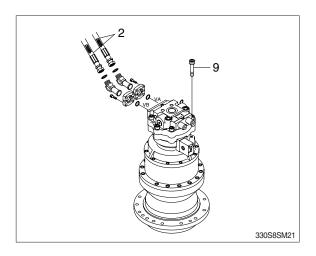
1) REMOVAL

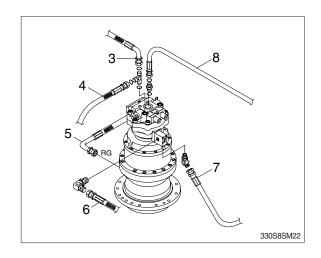
- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure 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, 8).
- (6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).
 - · Motor device weight: 61 kg (135 lb)
 - \cdot Tightening torque : 57.9 \pm 5.8 kgf \cdot m (419 \pm 42.0 lbf \cdot ft)
- (7) Remove the swing motor assembly.
- When removing the swing motor 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 the swing 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.

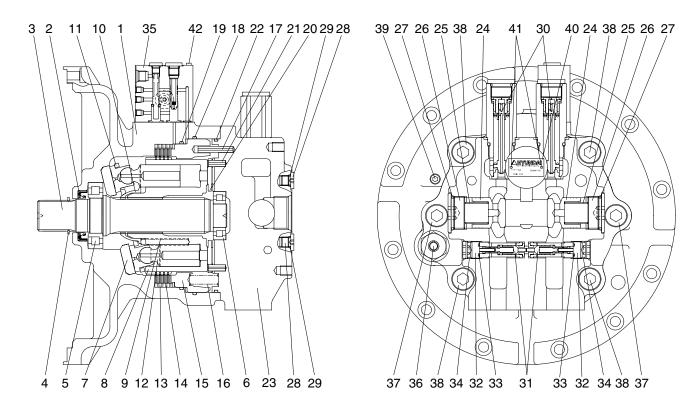






2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



300L2SM02

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Brake spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Reactionless valve assy
4	Snap ring	18	O-ring	32	Plug
5	Roller bearing	19	O-ring	33	O-ring
6	Needle bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Time delay valve assy
8	Cylinder block	22	O-ring	36	Level gauge
9	Spring	23	Valve casing	37	Socket bolt
10	Ball guide	24	Check valve	38	Socket bolt
11	Retainer plate	25	Spring	39	Plug
12	Piston assy	26	Plug	40	Name plate
13	Friction plate	27	O-ring	41	Rivet
14	Separate plate	28	Plug	42	Socket bolt

2) DISASSEMBLY

(1) Disassemble drive shaft

① Unloosing socket bolt (time delay valve, 42) and disassemble time delay valve assy (35) from casing (1).



2209A8SM51

2 Disassemble level gauge (36) from casing (1).



③ Hang valve casing (23) on hoist, unloose socket bolt (37, 38) and disassemble from casing (1).



④ Disassemble spring (16) and using a jig, disassemble parking piston (15) from casing (1).



⑤ Disassemble respectively cylinder block sub (8), friction plate (13), separate plate (14) from casing (1).



2209A8SM55

⑥ Disassemble swash plate (7) from casing (1).



2209A8SM5

① Using a plier jig, disassemble snap ring (4) from casing (1).



2209A8SM57

® Disassemble shaft assy (3), oil seal (2) and O-ring (18, 22) from casing (1).



2209A8SM58

(2) Disassemble cylinder block sub

① Disassemble piston assy (12) from cylinder block (8).



2209A8SM59

- ② Disassemble ball guide (10) and spring (cylinder block, 9) from cylinder block (8).
 - · Ball guide \times 1EA
 - · Spring \times 9EA



2209A8SM60

(3) Disassemble valve casing sub

① Disassemble spring pin (17, 21), valve plate (20), O-ring (22) from valve casing (23).



② Using a torque wrench, disassemble relief valve (30) from valve casing (23).



2209A8SM62

③ Using a torque wrench, disassemble plug (32) from valve casing (23) and disassemble O-ring (33, 34) and reactionless valve assy (31).



2209A8SM63

④ Using a torque wrench, disassemble check valve (24) from valve casing (23).



2209A8SM64

⑤ Disassemble plug (28), O-ring (29) from valve casing (23).



2209A8SM65

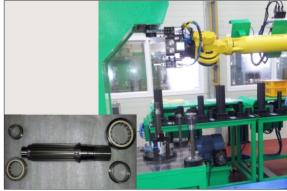
3) ASSEMBLING

(1) Assemble shaft sub

① Put roller bearing (3) on preheater and provide heat to inner race. (Temperature in conveyor: 120°C for 3~5 minutes)



2 Using a robot machine, assemble and press preheated roller bearing (3) into shaft (5).



2209A8SM67

(2) Assemble cylinder block sub

- ① Assemble 9 springs (cylinder block, 9) into cylinder block (8).
 - · Spring \times 9EA



2209A8SM68

- ② Assemble ball guide (10) into cylinder block (8).
 - · Ball guide×1EA



2209A8SM69

- 3 Assemble 9 piston assy (12) into retainer plate (11).
 - · Piston assy×9EA
 - · Retainer plate × 1EA



2200A8SM70

④ Assemble parts of procedure ② and ③.



2209A8SM71

(3) Assemble valve casing sub

- ① Assemble make up check valve sub Assemble check valve (24), O-ring (27), plug (26) in that order and then screw it torque wrench.
 - · Make up check valve × 2EA
 - · Spring×2EA
 - · Plug×2EA
 - · O-ring \times 2EA
 - Tightening torque : $38\pm3.8 \text{ kgf} \cdot \text{m}$ (275 \pm 27.5 lbf · ft)



2209A8SM72

② Assemble reactionless valve assy

Assemble reactionless valve assy (31), plug (32), O-ring (33, 34) in that order and then screw it a torque wrench.

- · Reactionless valve assy (31) × 2EA
- Plug (32) × 2EA
- · O-ring (33, 34) × 2EA
- Tightening torque : $22\pm1.5 \text{ kgf} \cdot \text{m}$ (159 $\pm11 \text{ lbf} \cdot \text{ft}$)



2209A8SM73

- ③ Using a torque wrench, assemble relief valve (30) 2 sets into valve casing (23).
 - · Relief valve (30) × 2EA
 - \cdot Tightening torque : 18 \pm 1.8 kgf \cdot m

 $(130 \pm 13 \, lbf \cdot ft)$



2209A8SM74

- ④ Assemble plug (28) and O-ring (27) into valve casing (23).
 - · Plug (28) \times 3EA
 - O-ring (27) × 3EA
 - Tightening torque : 4.5 ± 0.4 kgf · m (32.5 ± 2.9 lbf · ft)



2209A8SM75

- Assemble needle bearing (6) into valve casing (23) and assemble spring pin (17, 21) into valve casing (23).
 - · Needle bearing (6) × 1EA
 - · Spring pin (17, 21) \times 1EA



2209A8SM76

⑥ Apply some grease valve plate (20) and assemble it into valve casing (23).



2209A8SM77

(4) Assemble drive shaft sub

① Using a jig, assemble oil sealing (2) into casing (1).



2209A8SM78

② Fit shaft sub (shaft+roller bearing) into casing (1).



2209A8SM79

- ③ Using a plier jig, assemble snap ring (4) to shaft (3).
 - · Snap ring \times 1EA



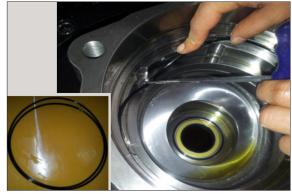
2209A8SM80

- ④ Apply some grease swash plate (7) and assemble it into casing (1).
 - · Swash plate \times 1EA



2209A8SM81

- ⑤ Insert O-ring (18, 19) into casing (1).
 - · O-ring (18)×1EA
 - · O-ring (19) \times 1EA



2209A8SM82

Assemble cylinder block (8) into casing (1).



2209A8SM83

- Assemble separate plate (14) and friction plate (13) 4 sets into casing (1) and fit parking piston (15) into casing (1) by a jig or a press.
 - · Separate plate × 4EA
 - · Friction plate \times 4EA
 - · Parking piston × 1EA



2209A8SM84

- Assemble spring (parking piston, 16) into parking piston (15).
 - · Spring×26EA



2209A8SM85

⑤ Lift up valve casing (23) on casing (1) by a crane and assemble it with socket bolts (37, 38).

• Tightening torque : $33\pm3.3 \text{ kgf} \cdot \text{m}$ (239 $\pm23.9 \text{ lbf} \cdot \text{ft}$)



2209A8SM8

Assemble level gauge (36) and plug (39) into casing (1).

 \cdot Tightening torque (36) : 15 \pm 1.0 kgf \cdot m (108.5 \pm 7.2 lbf \cdot ft)

• Tightening torque (39) : 3 ± 0.3 kgf • m

 $(21.7 \pm 2.2 lbf \cdot ft)$



2209A8SM87

- ① Assemble time delay valve assy (35) into valve casing (23) with socket bolt (42).
 - · Time delay valve \times 1EA
 - $\cdot \; \text{Socket bolt} {\times} 3\text{EA}$
 - \cdot Tightening torque (42) : 1.3 \pm 0.1 kgf \cdot m $(9.4 \pm 0.72 \text{ lbf} \cdot \text{ft})$



2209A8SM88

12 Air pressing test

Be sure of leakage, after press air into assembled motor and put it in water for 1 minute (pressure : 2 kgf/cm²).



2209A8SM89

(3) Leakage check

Place motor on a bench tester and after cleaning motor by color check No.1, paint No.3 and be sure of leakage.



2209A8SM90

4 Mount test bench

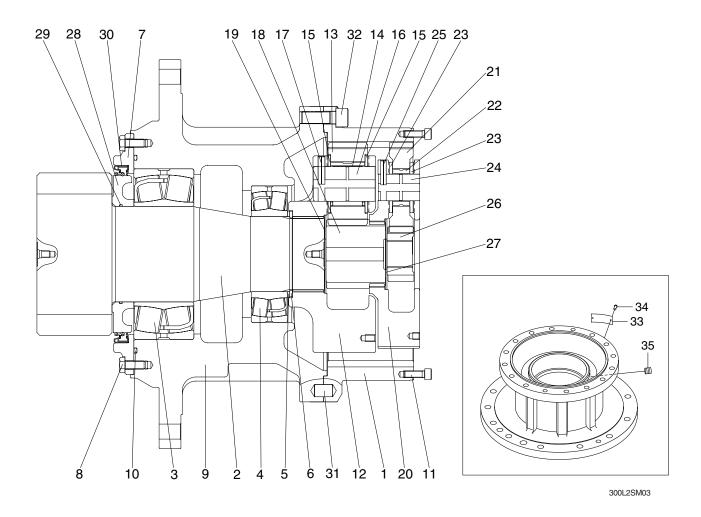
Mounting motor a test bench, test the availability of each part.



2200485M0

3. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



- 1 Ring gear
- 2 Drive shaft
- 3 Bearing
- 4 Bearing
- 5 Thrust plate
- 6 Snap ring
- 7 Cover
- 8 Hex head bolt
- 9 Casing
- 10 O-ring
- 11 Hex socket head bolt
- 12 Carrier 2

- 13 Planetary gear 2
- 14 Needle bearing 2
- 15 Thrust washer 2
- 16 Carrier pin 2
- 17 Spring pin 2
- 18 Sun gear 2
- 19 Thrust plate 2
- 20 Carrier 1
- 21 Planetary gear 1
- 22 Needle bearing 1
- 23 Thrust washer 1
- 24 Carrier pin 1

- 25 Spring pin 1
- 26 Sun gear 1
- 27 Thrust plate 1
- 28 Sleeve
- 29 O-ring
- 30 Oil seal
- 31 Parallel pin
- 32 Hex socket head bolt
- 33 Name plate
- 34 Rivet
- 35 Plug

2) DISASSEMBLY REDUCTION GEAR

(1) Preparation

disassembling.

- ① The reduction gear removed from machine is usually covered with mud. Wash out side of reduction gear and dry it.
- 2 Setting reduction gear on work stand for
- 3 Mark for mating Put marks on each mating parts when disassembling so as to reassemble correctly as before.
- ▲ Take great care not to pinch your hand between parts while disassembling not let fall parts on your foot while lifting them.

(2) Disassemble the swing motor

① Loosen the hex wrench bolt (11, M10), and remove the swing motor.



(3) Disassemble the carrier No.1 assy

① Disassemble gear-sun No.1 (26), tightening eye-bolt (M10) to screw holes for disassembly in carrier No.1 (20), then disassemble carrier No.1 assy.



(4) Disassemble the carrier No.2 assy

① Disassemble gear-sun No.2 (18), tighten eye-bolt (M10) to screw holes for disassembly in carrier No.2 (12), then disassemble carrier No.2 assy.



300L8SR03

(5) Disassemble carrier No.1 assy

- ① Hold jig to spring pin No.1 (26), then tap jig with a hammer, so that place spring pin in the center of carrier pin No.1 (24).
- Do not reuse spring pin.
- Disassemble method of carrier No.2 assy is same.



300L8SR04

② Disassemble carrier pin No.1 (24), then disassemble planetary gear No.1 (21), thrust washer No.1 (23) from the carrier No.1 (20).



300L8SR0

- (6) Disassemble the ring gear (1).
- ① Separate ring gear (1) from casing (9).
- Separate casing (9) by using the groove area because loctite is spread on joining surface of ring gear (1) and casing (9) to prevent oil leakage.



300L8SR06

- (7) Disassemble the drive shaft (2).
- ① Using the snapring plier, disassemble snapring (6),then disassemble thrust plate (5).



300L8SR07

② Turn casing (9) over to face pinion gear upward. Then unscrew hex.head bolt (8) 12ea by using the tool.



300L8SR0

- ③ Disassemble drive shaft sub assy by using the press machine.
- The drive shaft sub assy fall all together, so becareful when removing it.



300L8SR09

- ④ Disassemble sph. roller bearing (3), cover (7), oil seal (30), and sleeve (28) from the drive shaft (2).
- * Do not reuse oil seal (30).



300L8SR10

(8) Separate sph. roller bearing (4) from casing (9) by using the press machine.



300L8SR11

3) ASSEMBLY REDUCTION GEAR

- (1) Even though assembly is accomplished by reversing disassembly steps, be careful of the following.
 - ① Repair the damaged part when disassembling, prepare parts for the exchange in advance.
 - 2 All parts should be cleaned with cleaner, and dried with compressed air.
 - ③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
 - (4) Replacement O-ring and oil seal with new parts is generally recommended.
 - ⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values.
 - 6 When assembling bolt, spread Loctite.
- (2) Assemble drive shaft (2).
- ① After heating sleeve (28) for 5 minutes at 80 ~ 90°C, assemble O-ring (29).
- Apply grease to the O-ring (29) to prevent damage.



300L8SR12

- ② Apply grease to the oil seal (30), placed on the jig and then assemble it to cover (7) by using the press machine.
- ※ Apply grease to oil seal lip portion.
- * Be careful of damage of oil seal.



300L8SR13

- ③ Assemble sleeve (28) and cover (7) to drive shaft (2).
- Be careful of the direction of cover (7), sleeve (28).
- * Be careful of damage of oil seal.



300L8SR14

4 After heating sph. roller bearing (3) for 13 minutes at 80~90°C and doing demagnetization, then assemble it to drive shaft (2).



300L8SR15

⑤ After assembling O-ring (10) on casing (9), assemble drive shaft sub assy by using a press machine.



300L8SR16

- ⑥ After spreading loctite #262 on hex.head bolt (8), screw them to fix casing (9) and cover (7).
- % Tightening torque : 8.8 \pm 0.9 kgf \cdot m (63.7 \pm 6.51 lbf \cdot ft)
- Screwing when rust inhibitor is not remove.



300L8SR17

- (3) Assemble sph. roller bearing (4).
- ① Assemble sph. roller bearing (4) to casing (9) by using the press machine.



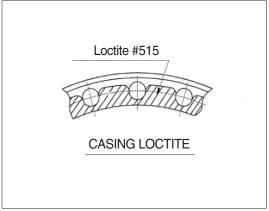
300L8SR18

- ② After assembling thrust plate (5), assemble snap ring (6) to assembly groove of drive shaft (2).
- Assemble selected thrust plate (5) to make gap (0.1~0.3 mm) between snap ring (6) and sph. roller bearing (4).



300L8SR19

- (4) Assemble ring gear (1).
- ① Spread the loctite #515 on the casing (9) with reference to the right detail view.
- * Loctite should not flow into casing (9).



300L8SR20

- ② After press-fitting parallel pin (31) with a hammer on the casing (9). Then spreading loctite #262 on hex.head bolt (32), screw them.
- % Tightening torque : 33 \pm 3.3 kgf \cdot m

(239 \pm 23.9 lbf \cdot ft)

* Screwing when rust inhibitor is not removed.



300L8SR21

(5) Assemble carrier No.1 assy

- ① After assembling thrust plate No.1 (27) on carrier No.1 (20), assemble thrust washer No.1 (23), planetary gear No.1 (21), then assemble carrier pin No.1 (24) by using the hammer.
- Assembly method of carrier No.2 assy is same.



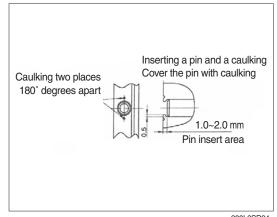
300L8SR22

2 Assemble spring pin No.1 (25) to fix carrier No.1 (20) and spring pin No.1 (25) by using the jig.



300L8SR23

- 3 Caulking is performed on the assembled spring pin unit.
- * To cover pins, implement the caulking in two places that are located direction of 180 degrees around assembled spring pin No.1 (25).



300L8SR24

(6) Assemble carrier No.2 assy

- ① Lift pre-assembled carrier No.2 assy. Shaking it from side to side, assemble it to ring gear (1) to engage with ring gear (1). Then, press-fit it with polyurethane hammer.
- Check caulking and rotating state before assembly.



300L8SR25

- (7) Assemble sun gear No.2 (18).
- ① Shaking sun gear No.2 (18) from side to side, assemble it to carrier No.2 assy to engage with planetary gear No.2 (13).



300L8SR26

- (8) Assemble carrier No.1 assy. Lift carrier No.1 assy. Shaking it from side to side, assemble it to ring gear (1) to engage with ring gear (1).
- Check rotating state before assembly.



300L8SR27

- (9) Assemble sun gear No.1 (26).
- ① Shaking sun gear No.1 (26) from side to side, assembleit to engage planetary gear No.1 (21). Then fill with gear oil 11 liter.



300L8SR28

GROUP 6 TRAVEL DEVICE (TYPE 1 & 2)

1. REMOVAL AND INSTALL

1) REMOVAL

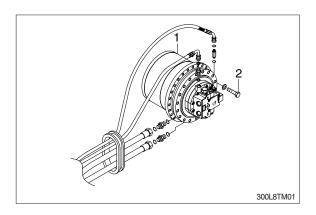
- (1) Swing the work equipment 90° and lower it completely to the ground.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Remove the track shoe assembly.
 For details, see removal of track shoe assembly.
- (5) Remove the cover.
- (6) Remove the hoses.
- 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: 430 kg (950 lb)
 - Tightening torque: 84 ± 8.0 kgf·m

 $(608 \pm 57.9 \, lbf \cdot ft)$

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.

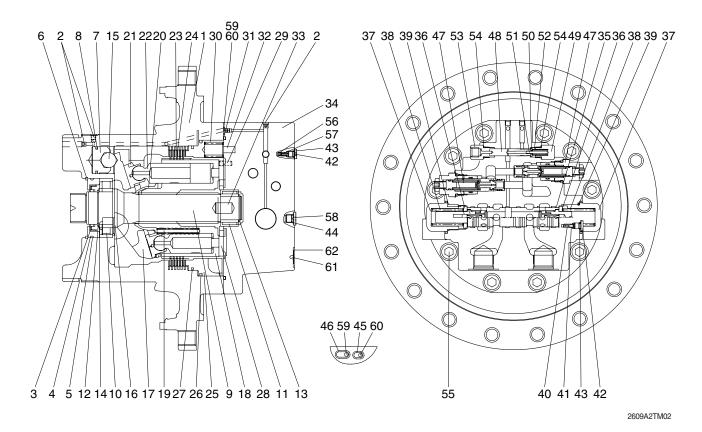




2. SPECIFICATION

1) TRAVEL MOTOR

21 Retainer plate



1	Casing	22	Piston assy	43	O-ring
2	Plug	23	Friction plate	44	O-ring
3	Oil seal	24	Separated plate	45	O-ring
4	Thrust block	25	Parking piston	46	O-ring
5	O-ring	26	D-ring	47	Relief valve
6	Snap ring	27	D-ring	48	Spool
7	Piston	28	Valve plate	49	Plug
8	Piston seal	29	Parallel pin	50	Spring seat
9	Shaft	30	Spring	51	Parallel pin
10	Cylinder roller bearing	31	O-ring	52	Spring
11	Needle bearing	32	Spring pin	53	Connector
12	Snap ring	33	Parallel pin	54	O-ring
13	Snap ring	34	Rear cover	55	Hexagon socket head bolt
14	Thrust plate	35	Main spool assy	56	Check valve
15	Steel ball	36	Spring seat	57	Spring
16	Pivot	37	Plug	58	Plug
17	Swash plate	38	Spring	59	Restrictor
18	Cylinder block	39	O-ring	60	Restrictor
19	Spring	40	Restrictor	61	Name plate
20	Ball guide	41	Spring	62	Rivet

42 Plug

2) TOOL AND TIGHTENING TORQUE

(1) Tools

Name of tools	B-size	Name of part applied		
	4	Plug (2), Orifice screw (3, 4, 38)		
Hexagonal	8	Hex socket bolt (50), Lock screw (62, 72), Plug (65)		
L-Wrench	10	Hex socket bolt (49)		
	46	Hex (57)		
	19	Hp plug (54)		
Socket wrench/ spanner	24	Hex nut (63)		
Spariner	27	Hp plug (56)		
Snap-ring plier (for holes, axis) Solder hammer Torque wrench Jig for assembling oil seal Induction heating apparatus for bearing		Ring stop (14), Ring lock (74)		
		Needle bearing (34), Pin (5, 6, 36)		
		Size: 500, 3000		
		Oil seal (73)		
		Roller bearing (13)		

(2) Tightening torque

NO	Part name	Olevelend	0: -	Torque			
NO.		Standard	Size	kgf · m	lbf ⋅ ft		
2	Plug	NPTF 1/16	4	0.9±0.2	6.51±1.45		
3, 4, 38	Orifice screw	NPTF 1/16	4	0.7	5.06		
49	Hex socket bolt	M12	10	10	72.33		
50	Hex socket bolt	M10	8	6.7	48.46		
54	Plug	PF 1/4	19	3.7	26.76		
56	Plug	PF 1/2	27	11	79.56		
57	Relief valve	HEX 27	1 5/16	34±3.4	246±24.6		
63	Nut	M16	24	24	173.59		
65	Plug	PF 3/8	8	7.5	54.25		
70, 72	Hex socket bolt	M16	14	24	173.59		
71	Hex socket bolt	M16	14	24	173.59		

3. DISASSEMBLING

1) GENERAL INSTRUCTIONS

♠ Combustibles such as white kerosene are used for washing parts. These combustibles are easily ignited, and could result in fire or injury. Be very careful when using.

▲ Internal parts are coated with hydraulic fluid during disassembling and are slippery.
If a part slips out of your hand and fails, it could result in bodily injury or could damage the park.

Be very careful when handling.

- (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) Bofore 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 TRAVEL MOTOR

(1) Disassemble main spool cover (36) into rear cover (34) using spanner and torque wrench and then disassemble spring (37), main spool assy (35).







(2) Disassemble wrench bolt (54) using torque wrench.



2609A8TM04

(3) Take out rear cover (34) into casing (1).



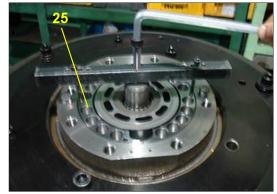
(4) Remove brake spring (30, 14EA)



(5) Disassemble parking piston (25) using jig.



2609A8TM07



2609A8TM08

(6) Disassemble separate plate (24, 5EA) and friction plate (23, 4EA).









2609A8TM12

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



2609A8TM13

(8) Disassemble cylinder block (18), retainer plate (21), piston assy (22), ball guide (20) and spring (19) into cylinder block kit.







2609A8TM15



2609A8TM16



2609A8TM17



2609A8TM18

(9) Disassemble swash plate (17) into casing (1).





2609A8TM20

- (10) Disassemble steel ball (15), swash piston (7) into casing (1).
- Hole in the Casing(1) of two speed line is decomposed by injecting air.



2609A8TM21



2609A8TM22



2609A8TM23

(11) Disassemble pivot (16, 2EA) into casing (1).



2609A8TM24

(12) Disassemble snap ring (6) using pliers.



(13) Disassemble trust block (4) and oil-seal (3) into casing (1).



2609A8TM26



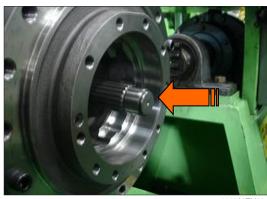
2609A8TM27

(14) In the casing (1), the arrow part of the shaft (8) using a rubber mallet taps and then disassemble the shaft (8) and bearing-roller

(10) to the other side.



2609A8TM28



2609A8TM29

(15) Disassemble valve plate (28) into rear cover (34).



2609A8TM30

(16) Disassemble relief valve (46, 2EA) into rear cover (34) using the torque wrench.

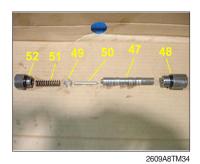






2609A8TM3

(17) Disassemble plug (48), connector (52) into rear cover (34) using the torque wrench and then disassemble spring (51), spring seat (49), parallel pin (50) and spool (47) in regular sequence.





2609A8TM35



2609A8TM36

(18) Disassemble plug (57) into rear cover (34).



2609A8TM37

(19) Disassemble plug (57) into rear cover (34) and then disassemble spring (56), check valve (55) into rear cover (34) in regular

sequence.





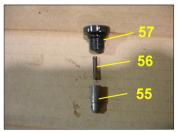
2609A8TM39

4. REASSEMBLING

1) ASSEMBLING MOTOR

- REAR COVER ASSY

(1) Assemble check valve (55), spring (56) into rear cover (34) and then assemble plug (57) using L-wrench.



2609A8TM40



2609A8TM41

(2) Apply loctite #242 on the NPTF 1/16 plug (2) and then assemble 12-NPTF 1/16 Plug (2) into rear cover(34).

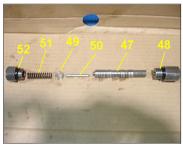


2609A8TM42



2609A8TM43

(3) Assemble spool (47), parallel pin (50), spring seat (49) and spring (51) into rear cover (34) in regular sequence and then assemble plug (48) and connector (52).



2609A8TM44



2609A8TM45



(4) Assemble relief valve (42, 2EA) into rear cover (34).



2609A8TM47



2609A8TM48



2609A8TM49

(5) Press needle bearing (11) into rear cover (34) using jig.



2609A8TM50

(6) Assemble spring pin (32) and parallel pin (29) using small hammer.



- (7) Assemble valve plate (28) into rear cover (34).
- * Apply grease to the valve plate contact and then assemble valve plate into rear cover (34).

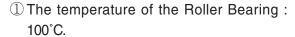


(8) Apply grease to the O-ring and then assemble O-ring into rear cover (34).



(9) Install casing (1) into assembling jig.





Using tool: Heater.

* Be careful not to damage the sliding surface for the Oil seal on the shaft.







2609A8TM57

(11) Assemble the heated needle bearing inner ring on the shaft (8).



2609A8TM58

2609A8TM56



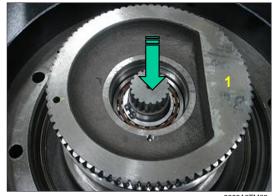
2609A8TM59

(12) Assemble snap ring (13) into Shaft (8) using pliers.



(13) Insert assembled shaft assy in the direction of the arrow into casing (1) using a rubber mallet.

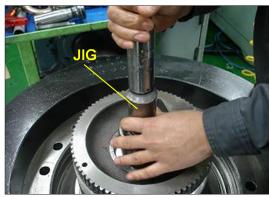




(14) Assemble oil seal(3) into trust block (4) with a assembling jig and press it into casing (1). Caution the direction of oil seal (3).



2609A8TM63



(15) Assemble snap ring(6) into casing(1) using pliers.



2609A8TM65

(16) Apply the grease to pivot (16, 2EA) and then assemble pivot (16) into casing(1).



2609A8TM66

(17) Warm piston seal (8) and assemble it on swash piston (7) and then bind the piston seal (8) with a bend for a minute.

Remove the bend and assemble it into

casing (1).



2609A8TM67

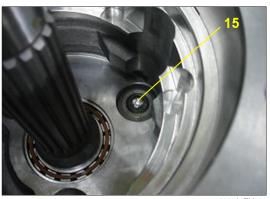


2609A8TM68

(18) Apply the grease to steel ball(15) and then assemble steel ball(15) into casing(1).



2609A8TM69



2609A8TM70

(19) Apply the grease to swash plate(17) and then assemble swash plate(17) into casing(1).



2609A8TM71



2609A8TM72

(20) Assemble spring (19), ball guide((20), retainer plate (21), piston assy (22) into cylinder block (18) in regular sequence.

















2609A8TM77

(21) Stant the casing (1) and then assemble cylinder block kit into casing (1).



2609A8TM78

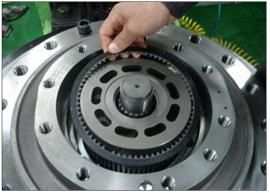
(22) Assemble separated plate (24), friction plate (23) into cylinder block in regular sequence.

Friction plate: 4EA Separated plate: 5EA



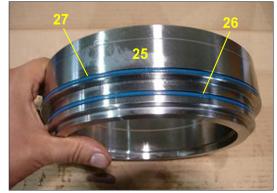






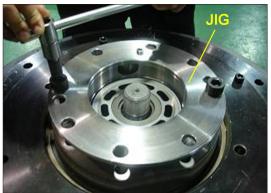
2609A8TM82

(23) Apply the grease to D-ring (26, 27) and then assemble D-ring (26, 27) into parking piston (25).



2609A8TM83

(24) Assemble parking piston into casing using jig.



2609A8TM84

(25) Assemble brake spring (30, 18EA).



2609A8TM85

(26) Put on the rear cover (34) on the casing (1).



2609A8TM86

(27) Assemble rear cover (34) into casing (1) and then tighten the wrench bolt (54, 55) using torque wrench.

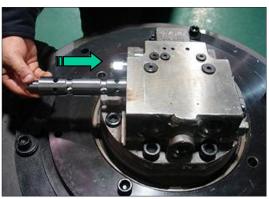


2609A8TM87

(28) Assemble main spool assy (35) into rear cover (34) after checking the direction to be correct.



2609A8TM88



2609A8TM89

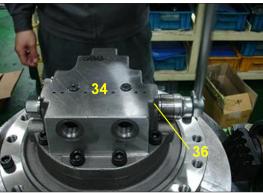
(29) Assemble spring (37), plug (36) into rear cover (34) in regular sequence and then plug (36) into rear cover (34) using torque wrench.



2609A8TM90

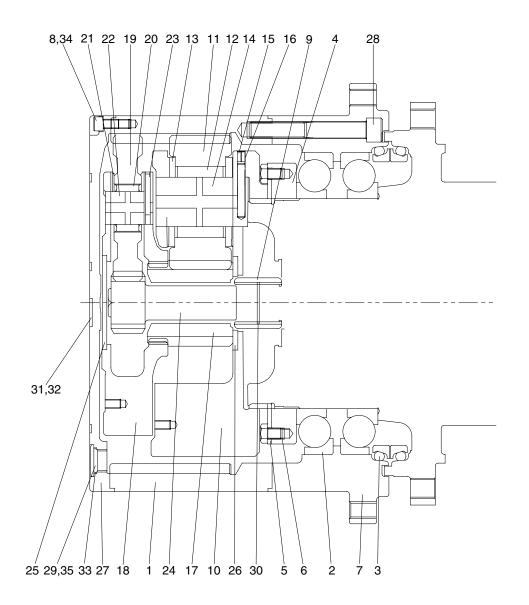


2609A8TM91



2609A8TM92

2) TRAVEL REDUCTION GEAR



300S2TM03

1	Gear ring	13	Thrust washer 2	25	Thrust plate
2	Ball bearing	14	Carrier pin 2	26	Thrust plate
3	Floating seal assy	15	Spring pin 2	27	Cover
4	Nut ring	16	Solid pin 2	28	Hexagon socket head bolt
5	Lock plate	17	Sun gear 2	29	Plug
6	Hexagon socket head bolt	18	Carrier 1	30	Snap ring
7	Housing	19	Planetary gear 1	31	Name plate
8	Hexagon socket head bolt	20	Needle bearing 1	32	Rivet
9	Coupling	21	Thrust washer 1	33	O-ring
10	Carrier 2	22	Carrier pin 1	34	Rubber cap
11	Planetary gear 2	23	Spring pin 1	35	Rubber cap
12	Needle bearing 2	24	Sun gear 1		

6. DISASSEMBLING

1) GENERAL INSTRUCTIONS

▲ Combustibles such as white kerosene are used for washing parts.

These combustibles are easily ignited, and could result in fire or injury.

Be very careful when using.

▲ Internal parts are coated with gear oil during disassembling and are slippery.
If a part slips off from your hand and fails, it could result in bodily injury or could damage the park.

Be very careful when handling.

(1) 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) Bofore 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.

▲ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

2) DISASSEMBLING TRAVEL REDUCTION GEAR

(1) Preparation for disassembling

- ① The reduction units removed from excavator are usually covered with mud. Wash outside of propelling unit and dry it.
- 2 Locate reducer in order for drain port to be at the lowest level loosen taper screw plug of drain port, and drain oil from reduction gear.
- * While oil is still hot, inside of the unit may be pressurized.
- ▲ Take care of the hot oil gushing out of the unit when loosening the plug.
- 3 Mark for mating

Put marks on each mating parts when disassembling so as to reassemble correctly as before.

(2) Set the reduction unit on table

- ① Remove 7/16-14UNC hexagon socket head bolts at 3 places from cover almost equally apart each other, and then install 7/16-14UNC eye bolts.
- ▲ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

(3) Removing cover

- ① Remove 22 socket bolts (7/16-14UNC) those are attached to ring gear.
- 2 Cover is stuck (27) to ring gear (1). So use sharp chisel for removing cover (27) from ring gear (1).



2609A8TM02

(4) Removing sun gear No.1

Pull sun gear No.1 (24) vertically slow after removing thrust plate (25).



(5) Removing carrier No.1 sub assembly

Pull away carrier No.1 (18) with attached eyebolt (M10) that is assembled to hole on carrier sub-assembly.



(6) Removing sun gear No.2 Pull away sun gear No.2 (17) for removing.



2609A8TM05

- (7) Deassembleing carrier No.2 sub-assembly Attach eye-bolt (M10) to the hole of carrier No.2 (10), and remove the carrier No.2 sub-assembly to lift up slowly.
- * Keep horizontal to ground and make sure the eye-bolts to be safe operation.



2609A8TM06

(8) Take away coupling

Take away the coupling (9) from casing (1).



2609A8TM07

(9) Lock plate

Release four hex head bolts (6, M12) and remove lock plate (5).



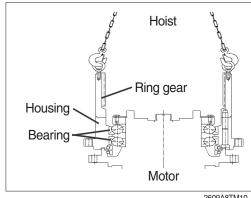
(10) Nut ring

Release nut ring with removing jig.



(11) Housing sub-assembly

Lift up housing part slowly with hoist after attaching eye-bolt (7/16-14UNC) on it If you hit softly the center of motor with hammer and particular jig, you can remove the device easily.



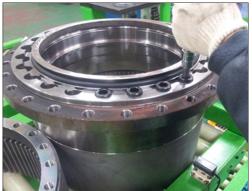
2609A8TM10

(12) Ring gear

① Reverse the housing sub-assembly part with machine, and remove floating seal (3) from the inside.

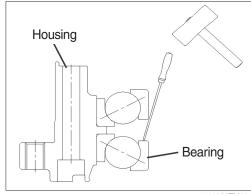


2 Release 25 hex wrench bolts (28. M18) and remove ring gear (1) from housing (7).



(13) Angular Bearing

Put the housing sub-assembly (7) like this figure. And hit each opposite side of bearing with driver and hammer.



2609A8TM13

(14) Carrier No.1 sub-assembly

① Lay it on deassemblig jig. And remove pin No.1 (22) with press machine.



2609A8TM14

2 Then remove planet gear No.1 (19) and thrust washer No.1 (21) from carrier No.1 (18).



2609A8TM15

(15) Carrier No.2 sub-assembly

Same as carrier No.1 (12) sub-asembly.



2609A8TM16

(16) Coupling

Remove snap ring (30) inside coupling (9) with nipper.



2609A8TM17

7. ASSEMBLY REDUTION UNIT

1) GENERAL NOTES

- (1) Clean every part by kerosene and dry them by air blow.
- (2) Surfaces to be applied by loctite must be decreased by solvent.
- (3) Check every part for any abnormal.
- (4) Each hexagon socket head bolt should be used with loctite No.242 applied on its threads.
- (5) Apply gear oil slightly on each part before assembling.
- ▲ Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.

Inspection before reassembling.

Thrust washer

- · Check if there are seizure, abnormal wear or uneven wear.
- · Check if wear is over the allowable limit.

Gear

- · Check if there are pitting or seizure on the tooth surface.
- · Check if there are cracks on the root of tooth by die check.

Bearing

· Rotate by hand to see if there are something unusual such as noise or uneven rotation.

Floating seal

· Check flaw or score on sliding surfaces or O-ring.

2) ASSEMBLING CARRIER 1 SUB-ASSY

- (1) Put carrier No.1 (18) on the flat table.
- (2) Insert needle bearing No.1 (20) in planet gear No.1 (20), and attach 2 thrust washers No.1 (21) on the both side of planet gear No.1. then assemble them in carrier No.1 (18).
- When assembling thrust washer, rounded edgeside should be facing casting side of carrier.



2609A8TM18

- (3) Insert pin No.1 (22) into pinhole of carrier correctly.
- Insert careful the pin not to scratch thrust washer and needle bearing.



2609A8TM19

- (4) Press spring pin No.1 (23) with jig and strike round spring pinhole (2 symmetrical point) with tool.
- * After striking, draw the line by marker pen.
- Check swinging condition of planet gears.
- (5) Press two more pins and spring pins on the same way.



2609A8TM20

3) ASSEMBLING CARRIER 2 SUB-ASSY

(1) Put thrust plate (26) inside of carrier No.2 (10).



2609A8TM21

- (2) Insert needle bearing No.2 (12) in planet gear No.2 (11) and attach 2 thrust washers No.2 (13) on the both side of planet gear No.2. Then assemble them in carrier No.2 (10).
- When assembling thrust washer, rounded edgeside should be facing casting side of carrier.
- (3) Insert pin No.2 (14) into pinhole of carrier No.2 correctly.
- Insert careful pin No.2 not to scratch thrust washer and needle bearing.



2609A8TM22

- (4) Insert solid pin No.2 (16) with pressing jig and insert spring pin No.2 (15) in the same position. When insertion is done, strike inner circle of spring pin (2 symmetrical point) with tool.
- After striking, draw the line by marker pen.
- Check the spining condition of planet gear.
- (5) Insert two more pins and spring pins on the same way.



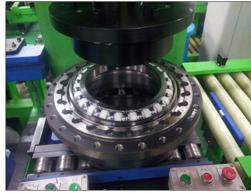
2609A8TM23

4) ANGULAR BEARING

- (1) Put the jig on housing (7) and insert angular bearing (2) into it with pressing machine, and turn down the upside of housing (7) by reversing machine.
- * Check the direction of bearing when inserting it.



(2) Insert angular bearing (2) into reversed housing (7) on the same way.



5) ASSEMBLING FLOATING SEAL

(1) Paint alchole on floating seal (3) and polish it.



- (2) Put floating seal (3) on the right position of housing (3) and insert it by pressing jig. After complete, check the condition by lifting with hand softly.
- * Keep clean on surface of floating seal while assembling.



2609A8TM27

- (3) Put the gauge for seal measurement on floating seal (3) and check the horizontal angle by gauge scale.
- * Two gauge scales should be same. (pass inspection)

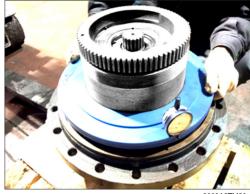


2609A8TM28

(4) Attach floating seal to motor that will be assembled with housing (on the same way to (1), (2))



- (5) Put the measuring jig on floating seal (3) and check the horizontal angle condition with both gauge scale.
- * Two gauge scales should be same. (pass inspection)



6) ASSEMBLING RING GEAR

- (1) Put ring gear (1) on contact surface (should be upside) of housing (7).
- (2) Paint loctite #515 on ring gear (1) and put on housing (7). Then assemble 25 hexwrench bolts (28, M18)
- Paint loctite #262 on hex-wrench bolts (28) before assembling.
- ※ Tightening torque: 38.5 ± 3.8 kgf⋅m $(278.5\pm27.5 \, lbf \cdot ft)$
- * Bolts should be assembled with lust preventing oil.



7) ASSEMBLING NUT RING

- (1) Put housing (7) sub-assembly upside down (ring gear side is up), and attach it to motor by lifting with hoist. (shaking it lightly)
- (2) When housing (7) sub-assembly is set, put nut ring (4) on it, and assemble with jig.
- Tightening torque for assembling nut ring : $66\pm6.0 \text{ kgf} \cdot \text{m} (477.3\pm43.3 \text{ lbf} \cdot \text{ft})$
- * Floating seal should not be damaged or separated while assembling.



2609A8TM32

8) ASSEMBLING LOCK PLATE

- (1) Put lock plate (5) on nut ring (4) to fit to M12 bolt hole. Then assemble 4 he head bolts (6, M12)
- * Paint loctite #262 on hex-head bolts.
- ※ Tightening torque: 6.05±0.6 kgf⋅m $(43.8 \pm 4.3 \, lbf \cdot ft)$
- Bolts should be assembled with lust preventing oil.



2609A8TM33

9) ASSEMBLING COUPLING

(1) Attach snap ring (3) into coupling (9) with nipper.



2609A8TM34

(2) Put coupling (9) on motor shaft to fit.



2609A8TM35

10) ASSEMBLING NO.2 CARRIER SUB-ASSY

- Lift carrier No.2 subassembly and put on ring gear (1), and fit it into internal side of ring gear (1). Then hit urethan hammer to fit.
- Check turning and cocking condition before assembling.



2600A8TM36

11) ASSEMBLING NO.2 SUN GEAR

(1) Insert sun gear No.2 (17) in the middle of carrier No.2 sub assembly and make it fit in carrier No.2.



2609A8TM37

12) ASSEMBLING NO.1 CARRIER SUB-ASSY

- Lift carrier No.1 sub-assembly and put it into ring gear (1) and shake carrier No.1 to fit into ring gear.
- Check turning and cocking condition before assembling.



2609A8TM38

13) SWINGING TORQUE INSPECTION

(1) Attach inspection jig before assembling sun gear No.1 (24).



2609A8TM39

- (2) Attach torque wrench to the jig, check the torque when it swings.
- ※ Swinging torque: below 3.0 kgf⋅m (21.7 lbf⋅ft)



2609A8TM40

14) ASSEMBLING NO.1 SUN GEAR

(1) Remove the jig and wrench after torque inspection complete. And assemble sun gear No.1 (24) with pushing round to fix to the center of carrier No.1



2609A8TM41

15) ASSEMBLING THRUST PLATE

- (1) Put thrust plate (25) on carrier No.1 sub assembly. And paint loctite #515 on flat side of ring gear (1).
- * When assembling thrust washer, rounded edgeside should be facing casting side of carrier.



2609A8TM42

16) ASSEMBLING COVER

- (1) Attach cover on ring gear (1) with assembling 22 hex-wrench bolts (8, 7/16-16UNC).
- Paint loctite #262 on screw of hex bolts.
- X Tightening torque: 8.1 ± 0.8 kgf⋅m $(58.6 \pm 5.8 \, lbf \cdot ft)$
- * Bolts should be assembled with lust preventing oil.



2609A8TM43

17) ASSEMBLING OIL INJECTION

(1) Inject the oil (10 ℓ) through PF3/4 hole on cover (27).



2609A8TM44

18) ASSEMBLING PLUG

- (1) Assemble 3 plugs (29, PF3/4) after oil injection complete.
- % Tightening torque : $10\pm1.0~\text{kgf}\cdot\text{m}$ (72.3 \pm 7.2 lbf · ft)



2609A8TM45

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

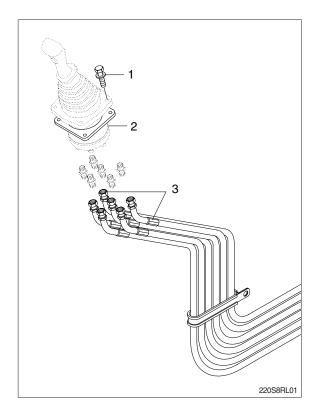
1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.
- (4) Loosen the socket bolt (1).
- (5) Remove the cover of the console box.
- (6) Disconnect pilot line hoses (3).
- (7) Remove the pilot valve assembly (2).
- When removing the pilot valve assembly, check that all the hoses have been disconnected.

2) INSTALL

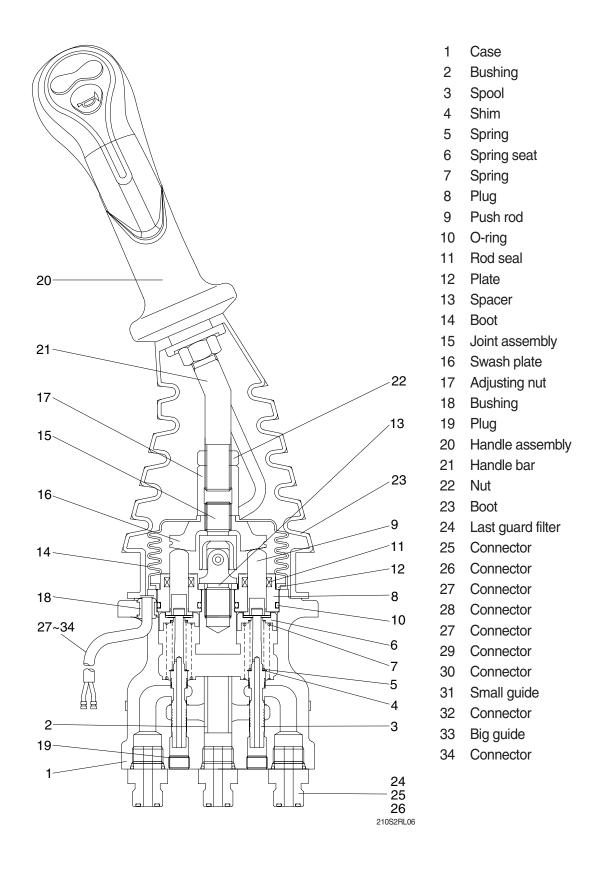
- (1) Carry out installation in the reverse order to removal.
- (2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.





2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



2) TOOLS AND TIGHTENING TORQUE

(1) Tools

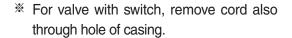
Tool name	Remark			
Allen wrench	6 B			
Spanne	22			
	27			
(+) Driver	Length 150			
(-) Driver	Width 4~5			
Torque wrench	Capable of tightening with the specified torques			

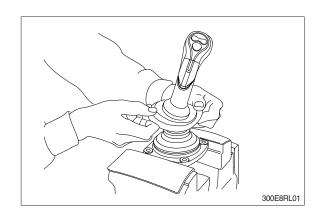
(2) Tightening torque

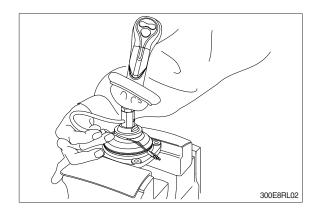
Part name	Item	Cino	Torque			
	Item Size		kgf · m	lbf ⋅ ft		
Joint	15	M14	3.5 25.3			
Swash plate	16	M14	5.0±0.35 36.2±2.5			
Adjusting nut	17	M14	5.0±0.35	36.2±2.5		
Lock nut	22	M14	5.0±0.35	36.2±2.5		

3) DISASSEMBLY

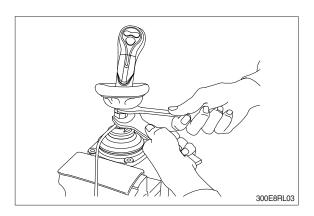
- * Procedures are based on the type L1.
- (1) Clean pilot valve with kerosene.
- Put blind plugs into all ports
- (2) Fix pilot valve in a vise with copper (or lead) sheets.
- (3) Remove end of boot (23) from case (1) and take it out upwards.



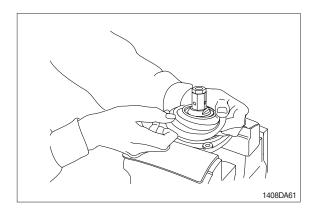




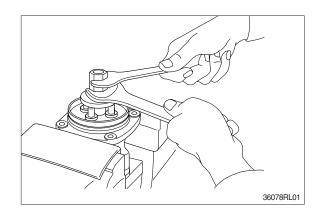
(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.

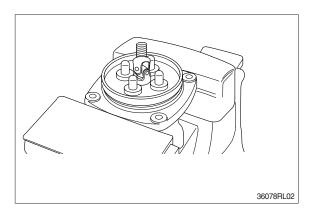


(5) Remove the boot (14).

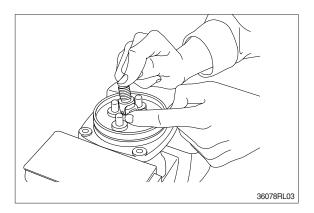


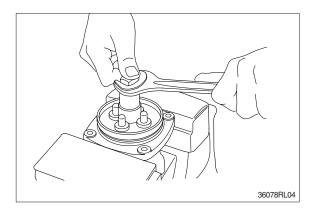
(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.



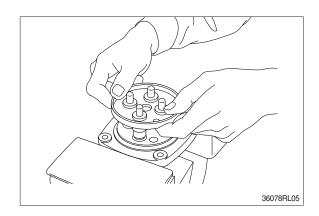


- (7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).
- When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint. Pay attention to this.

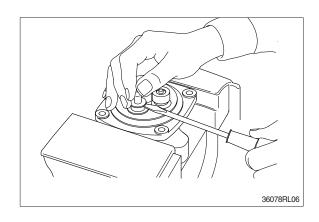


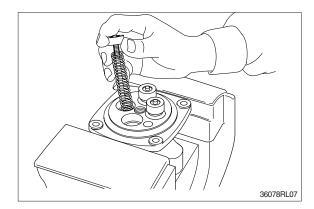


(8) Remove plate (12).

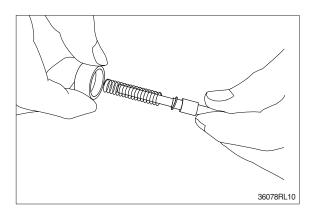


- (9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.
- * Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.
- During taking out, plug may jump up due to return spring (7) force.
 Pay attention to this.
- (10) Remove reducing valve subassembly and return spring (7) out of casing.
- Record relative position of reducing valve subassembly and return springs.

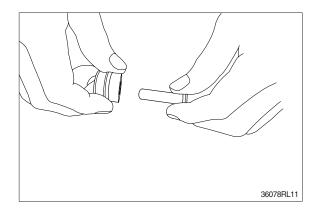




- (11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.
- Pay attention not to damage spool surface.
- * Record original position of spring seat (6).
- W Until being assembled, they should be handled as one subassembly group.

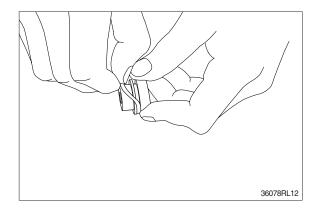


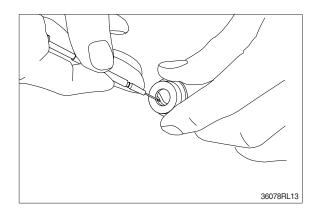
(12) Take push rod (9) out of plug (8).



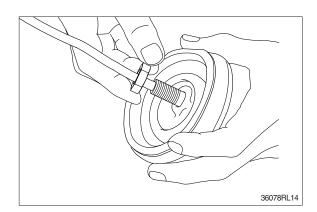
(13) Remove O-ring (10) and seal (11) from plug (8).

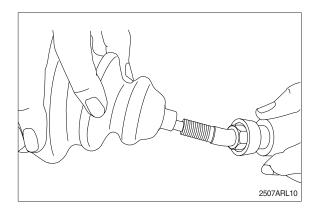
Use small minus screwdriver or so on to remove this seal.





(14) Remove lock nut (22) and then boot (23).





(15) 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.

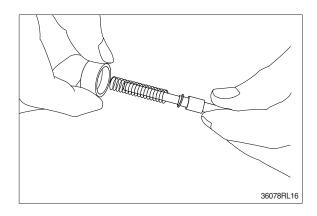
(16) Rust prevention of parts

Apply rust-preventives to all parts.

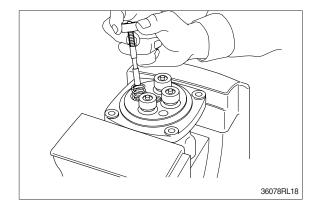
If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

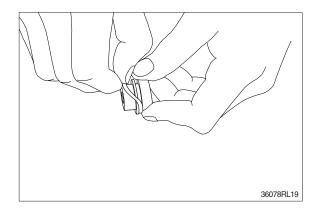
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



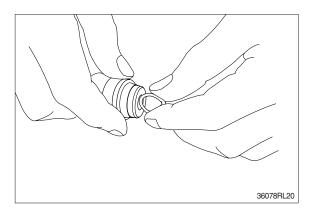
- (2) Assemble spring (7) into casing (1).
 Assemble reducing valve subassembly into casing.
- * Assemble them to their original positions.



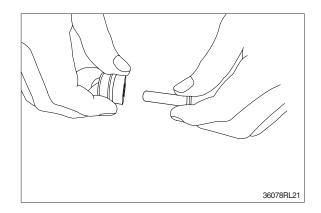
(3) Assemble O-ring (10) onto plug (8).



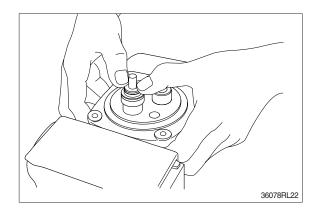
- (4) Assemble seal (11) to plug (8).
- Assemble seal in such lip direction as shown below.



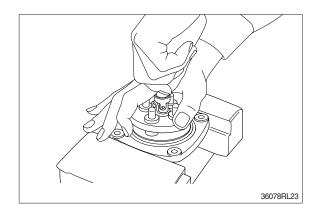
- (5) Assemble push rod (9) to plug (8).
- * Apply working oil on push-rod surface.



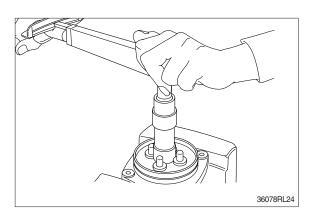
- (6) Assemble plug subassembly to casing.
- When return spring is weak in force, subassembly stops due to resistance of O-ring.



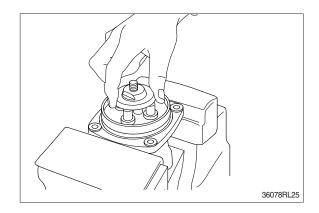
(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.



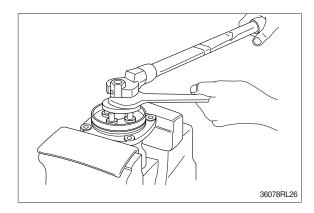
- (8) Fit plate (12).
- (9) Tighten joint (15) with the specified torque to casing, utilizing jig.



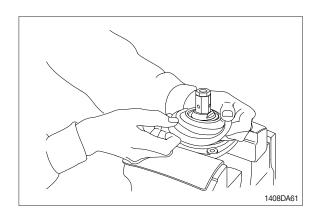
- (10) Assemble swash plate (16) to joint (15).
- Screw it to position that it contacts with 4 push rods evenly.
- Do not screw it over.



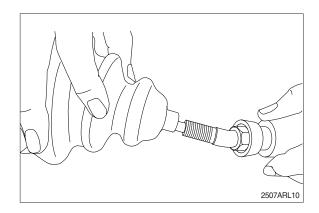
- (11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.
- During tightening, do not change position of disk.

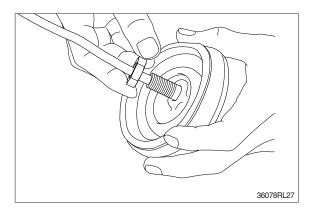


(12) Fit boot (14) to plate.

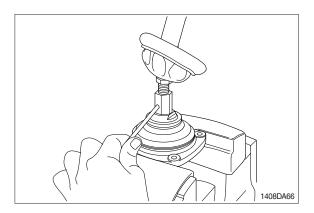


(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.

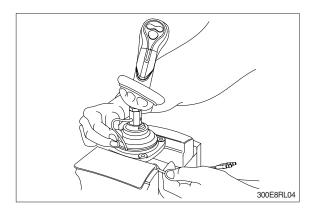




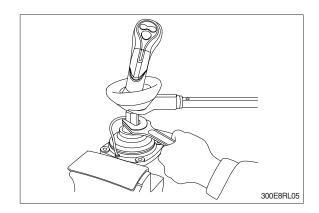
(14) Pull out cord and tube through adjusting nut hole provided in direction 60 °to 120 °from casing hole.



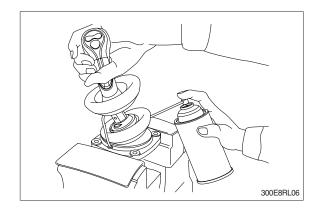
- (15) Assemble bushing (18) to plate and pass cord and tube through it.
- Provide margin necessary to operation.



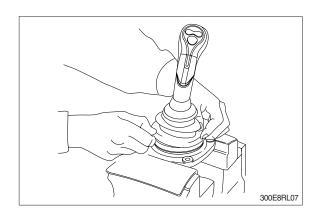
(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



- (18) Assemble lower end of bellows to casing.
- (19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

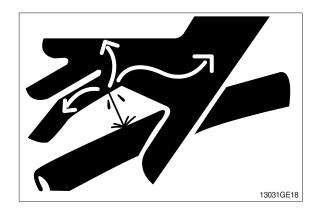
1. REMOVAL AND INSTALL

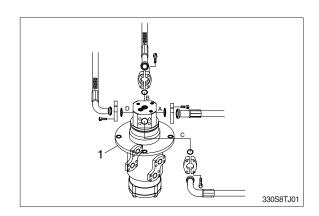
1) REMOVAL

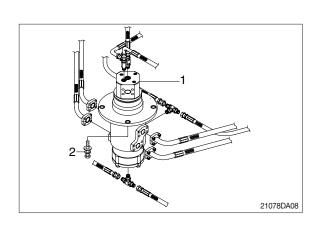
- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ♠ Escaping fluid under pressure 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: 55 kg (120 lb)
 - \cdot Tightening torque : 12.3 \pm 1.3 kgf \cdot m (89 \pm 9.4 lbf \cdot ft)
- (6) Remove the turning joint assembly.
- When removing the turning joint, check that all the hoses have been disconnected.

2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- * Take care of turning joint direction.
- Assemble hoses to their original
- positions.
 - Confirm the hydraulic oil level and check the hydraulic oil leak or not.

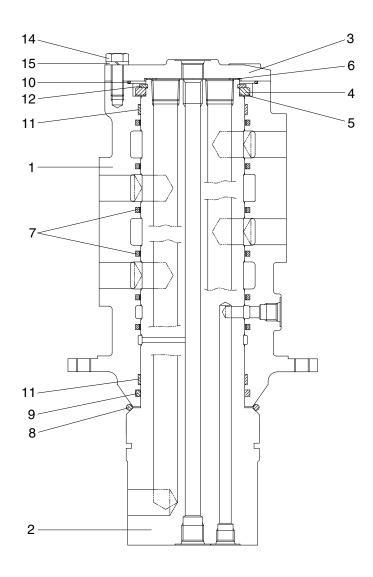






2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

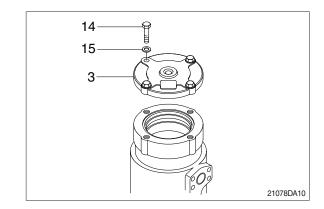


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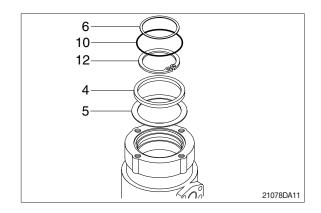
1	Hub	6	Snim	11	vvear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

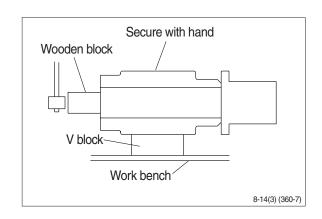
- Before the disassembly, clean the turning joint.
- (1) Remove bolts (14), washer (15) and cover (3).



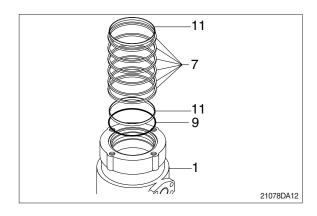
- (2) Remove shim (6) and O-ring (10).
- (3) Remove retainer ring (12), spacer (4) and shim (5).



- (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).

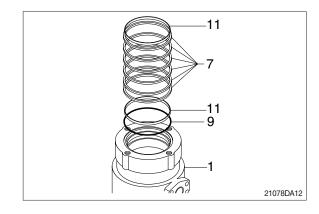


(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).

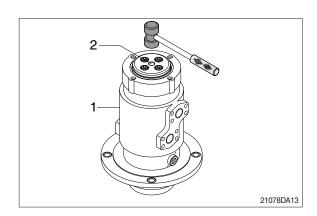


3) ASSEMBLY

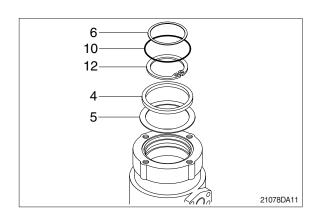
- Clean all parts.
- As a general rule, replace oil seals and O-ring.
- Coat the sliding surfaces of all parts with engine oil or grease before installing.
- (1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).
- (2) Fit O-ring (8) to shaft (2).



(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

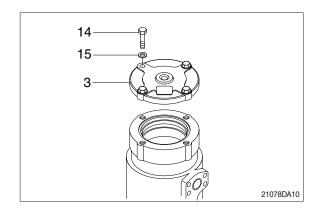


- (4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).
- (5) Fit O-ring (10) to hub (1).
- (6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

Torque : 10~12.5 kgf \cdot m (72.3~90.4 lbf \cdot ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

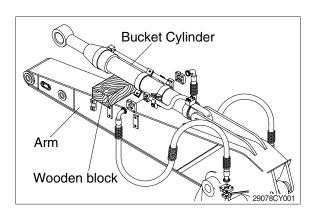
(1) Removal

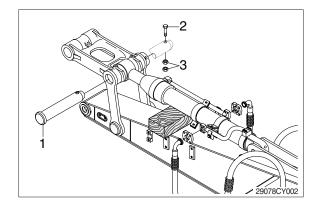
- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- Mean of the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

▲ Loosen the breather slowly to release the pressure inside the hydraulic tank.

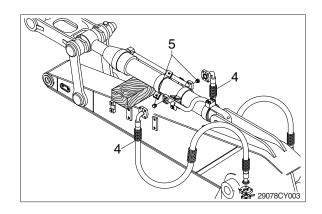
- Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Set block between bucket cylinder and arm.
- ② Remove bolt (2), nut (3) and pull out pin (1).
- Tie the rod with wire to prevent it from coming out.



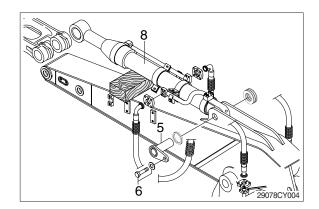




③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



- ④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).
- Remove bucket cylinder assembly (8).Weight: 265 kg (580 lb)



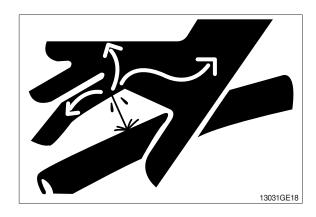
(2) Install

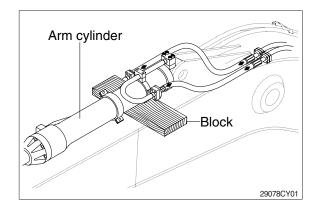
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- * Bleed the air from the bucket cylinder.
- Confirm the hydraulic oil level and check
 the hydraulic oil leak or not.

2) ARM CYLINDER

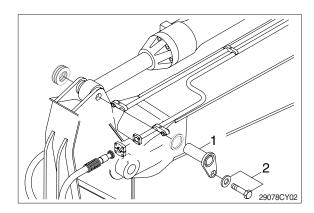
(1) Removal

- 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.

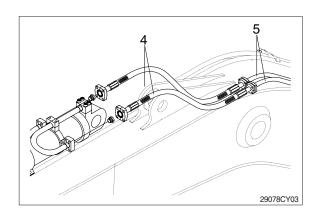




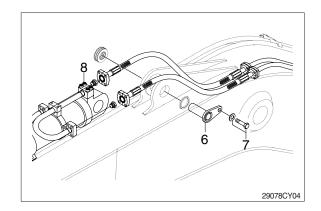
- ② Remove bolt (2) and pull out pin (1).
- Tie the rod with wire to prevent it from coming out.



- ③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.
- 4 Disconnect greasing pipings (5).



- ⑤ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).
- ⑥ Remove arm cylinder assembly (8).
 - · Weight: 360 kg (790 lb)



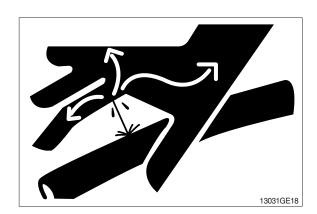
(2) Install

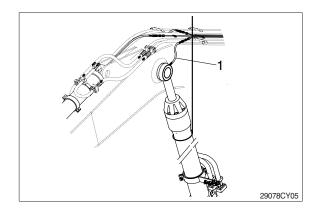
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- * Bleed the air from the arm cylinder.
- Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

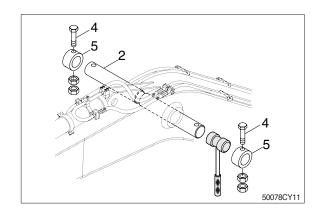
(1) Removal

- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- Mean of 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.

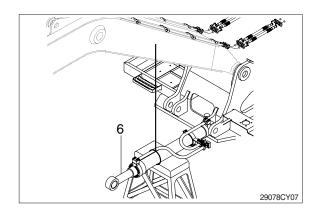




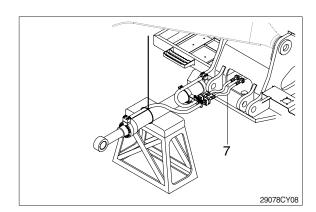
- ③ Remove bolt (4), pin stopper (5) and pull out pin (2).
- Tie the rod with wire to prevent it from coming out.



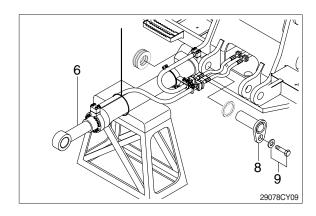
① Lower the boom cylinder assembly (6) on a stand.



⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



- 6 Remove bolt (9) and pull out pin (8).
- ? Remove boom cylinder assembly (6).
 - · Weight: 305 kg (670 lb)



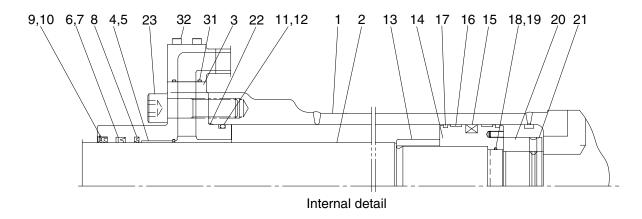
(2) Install

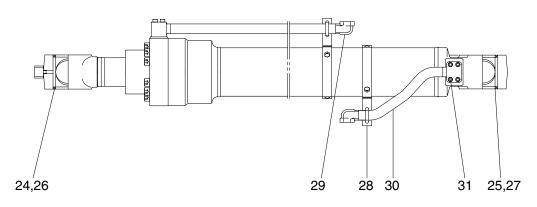
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- Bleed the air from the boom cylinder.
- Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

- (1) Bucket cylinder
- ① Standard

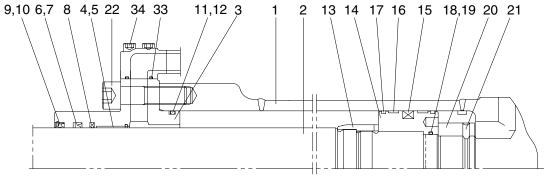




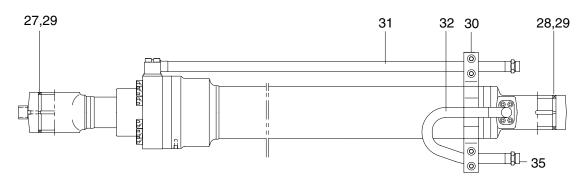
300L8BY01

Tube assembly	12	Back up ring	23	Hexagon socket head bolt
Rod assembly	13	Cushion ring	24	Pin bushing
Gland	14	Piston	25	Pin bushing
DD2 bushing	15	Piston seal	26	Dust seal
Snap ring	16	Wear ring	27	Dust seal
Rod seal	17	Dust ring	28	Band assembly
Back up ring	18	O-ring	29	Pipe assembly
Buffer ring	19	Back up ring	30	Pipe assembly
Dust wiper	20	Lock nut	31	O-ring
Snap ring	21	Hexagon socket set screw	32	Hexagon socket head bolt
O-ring	22	O-ring		
	Rod assembly Gland DD2 bushing Snap ring Rod seal Back up ring Buffer ring Dust wiper Snap ring	Rod assembly 13 Gland 14 DD2 bushing 15 Snap ring 16 Rod seal 17 Back up ring 18 Buffer ring 19 Dust wiper 20 Snap ring 21	Rod assembly Gland 14 Piston DD2 bushing 15 Piston seal Snap ring 16 Wear ring Rod seal 17 Dust ring Back up ring 18 O-ring Buffer ring 19 Back up ring Dust wiper 20 Lock nut Snap ring 21 Hexagon socket set screw	Rod assembly 13 Cushion ring 24 Gland 14 Piston 25 DD2 bushing 15 Piston seal 26 Snap ring 16 Wear ring 27 Rod seal 17 Dust ring 28 Back up ring 18 O-ring 29 Buffer ring 19 Back up ring 30 Dust wiper 20 Lock nut 31 Snap ring 21 Hexagon socket set screw 32

② Long reach



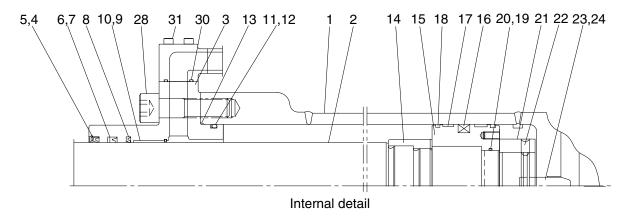
Internal detail

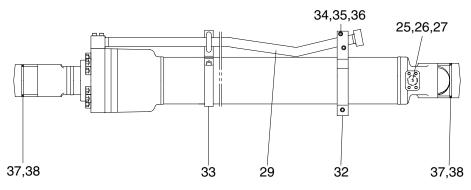


31Q6-66102GG

1	Tube assembly	12	Back up ring	27	Pin bushing
2	Rod assembly	13	Cushion ring	28	Pin bushing
3	Gland	14	Piston	29	Dust seal
4	DD2 bushing	15	Piston seal	30	Band assembly
5	Snap ring	16	Wear ring	31	Pipe assembly-R
6	Rod seal	17	Dust ring	32	Pipe assembly-B
7	Back up ring	18	O-ring	33	O-ring
8	Buffer ring	19	Back up ring	34	Hexagon socket head bolt
9	Dust wiper	20	Lock nut	35	O-ring
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	Hexagon socket head bolt		

(2) Arm cylinder

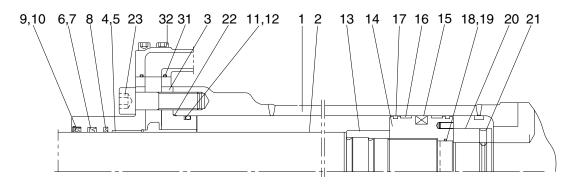




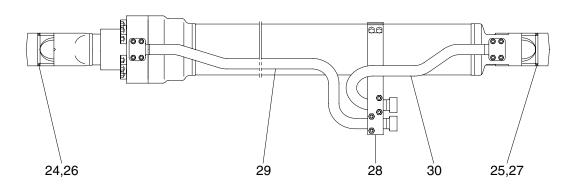
31K9-50150E

Tube assembly	14	Ring	27	Hyd plug
Rod assembly	15	Piston	28	Hexagon socket bolt
Gland	16	Piston seal	29	Pipe assy-R
Dust wiper retaining	17	Wear ring	30	O-ring
Snap ring	18	Dust ring	31	Hexagon socket bolt
Rod seal	19	O-ring	32	Band assy-B
Back up ring	20	Back up ring	33	Band assy-R
Buffer ring	21	Lock nut	34	U-bolt
Dust bearing	22	Set screw	35	Hexagon bolt
Retaining ring	23	Cushion plunger	36	Spring washer
O-ring	24	Stop ring	37	Pin bushing
Back up ring	25	Check valve	38	Dust seal
O-ring	26	Coil spring		
	Rod assembly Gland Dust wiper retaining Snap ring Rod seal Back up ring Buffer ring Dust bearing Retaining ring O-ring Back up ring	Rod assembly 15 Gland 16 Dust wiper retaining 17 Snap ring 18 Rod seal 19 Back up ring 20 Buffer ring 21 Dust bearing 22 Retaining ring 23 O-ring 24 Back up ring 25	Rod assembly Gland 16 Piston seal Dust wiper retaining 17 Wear ring Snap ring 18 Dust ring Rod seal 19 O-ring Back up ring 20 Back up ring Buffer ring 21 Lock nut Dust bearing 22 Set screw Retaining ring 23 Cushion plunger O-ring Back up ring 25 Check valve	Rod assembly 15 Piston 28 Gland 16 Piston seal 29 Dust wiper retaining 17 Wear ring 30 Snap ring 18 Dust ring 31 Rod seal 19 O-ring 32 Back up ring 20 Back up ring 33 Buffer ring 21 Lock nut 34 Dust bearing 22 Set screw 35 Retaining ring 23 Cushion plunger 36 O-ring 24 Stop ring 37 Back up ring 25 Check valve 38

(3) Boom cylinder



Internal detail



300L8BO01

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	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Dust seal
6	Rod seal	17	Dust ring	28	Band assembly
7	Back up ring	18	O-ring	29	Pipe assembly
8	Buffer ring	19	Back up ring	30	Pipe assembly
9	Dust wiper	20	Lock nut	31	O-ring
10	Snap ring	21	Hexagon socket set screw	32	Hexagon socket head bolt
11	O-ring	22	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tools	Remark			
	6			
Aller	8 B			
Allen wrench	14			
	17			
Channer	7			
Spanner	8			
(-) Driver	Small and large sizes			
Torque wrench	Capable of tightening with the specified torques			

(2) Tightening torque

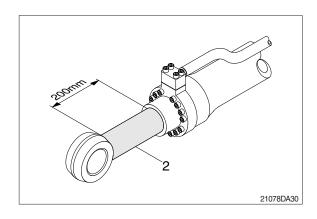
Part name		ltem	Size	Torque		
			Size	kgf · m	lbf · ft	
	Bucket cylinder	₂₃ ★1	M18	32.0±3.0	232±21.7	
Socket head bolt	Boom cylinder	₂₃ ★1	M20	46.0±3.0	232±21.7	
	Arm cylinder	₂₈ ★1	M22	69.4±6.9	502±49.9	
	Bucket cylinder	31	M12	9.4±1.0	68.0±7.2	
Socket head bolt	Boom cylinder	31	M12	9.4±1.0	68.0±7.2	
	Arm cylinder	31	M12	11.3±1.1	81.7±8.0	
	Bucket cylinder	20	-	100±10.0	723±72.3	
Lock nut	Boom cylinder	20	-	100±10.0	723±72.3	
	Arm cylinder	21	-	150±15.0	1085±108	
	Bucket cylinder	14	-	150±15.0	1085±108	
Piston	Boom cylinder	14	-	150±15.0	1085±108	
	Arm cylinder	15	-	200±20.0	1447±145	
Set screw	Bucket cylinder	21	M10	5.4±0.5	39.1±3.6	
	Boom cylinder	21	M10	5.4±0.5	39.1±3.6	
	Arm cylinder	22	M10	2.5±0.3	18.1±2.2	

^{★1:} Apply loctite #243 on the thread of bolt.

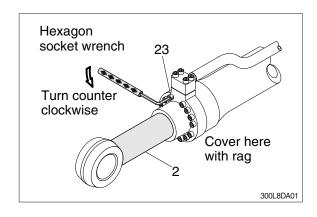
3) DISASSEMBLY

(1) Remove cylinder head and piston rod

- Procedures are based on the bucket cylinder.
- ① Hold the clevis section of the tube in a vise.
- We use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.
- ② Pull out rod assembly (2) about 200 mm (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.

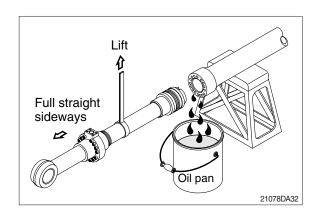


- 3 Loosen and remove socket bolts (23) of the gland in sequence.
- Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



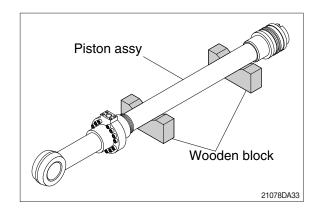
- ① Draw out cylinder head and rod assembly together from tube assembly
- % (1).
 Since

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.



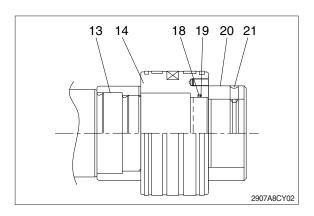
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

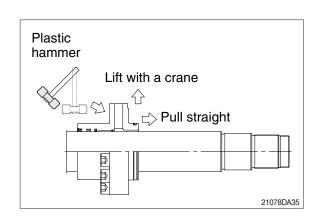
- ⑤ Place the removed rod assembly on a wooden V-block that is set level.
- ※ Cover a V-block with soft rag.



(2) Remove piston and cylinder head

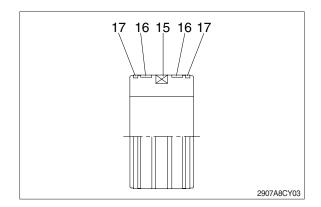
- ① Remove set screw (21).
- Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the set screw (21) lock nut (20).
- ② Remove piston assembly (14), back up ring (19), and O-ring (18).
- ③ Remove the cylinder 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).





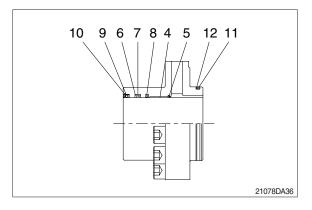
(3) Disassemble the piston assembly

- 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

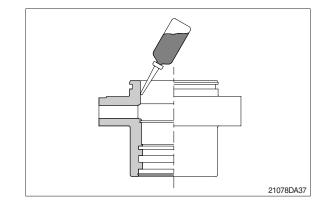
- ① Remove back up ring (12) and O-ring (11).
- ② Remove snap ring (10), dust wiper (9).
- ③ Remove back up ring (7), rod seal (6) and buffer ring (8).
- Exercise care in this operation not to damage the grooves.
- Do not remove seal and ring, if does not damaged.



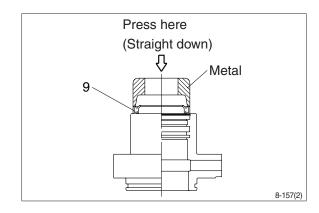
3) ASSEMBLY

(1) Assemble cylinder head assembly

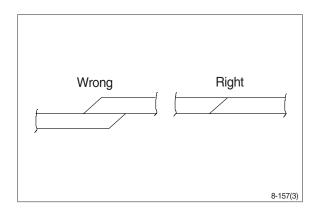
- * Check for scratches or rough surfaces if found smooth with an oil stone.
- ① Coat the inner face of gland (3) with hydraulic oil.



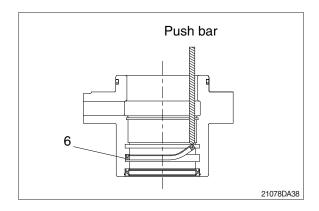
- ② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
 - At this time, press a pad metal to the metal ring of dust seal.
- ③ Fit snap ring (10) to the stop face.



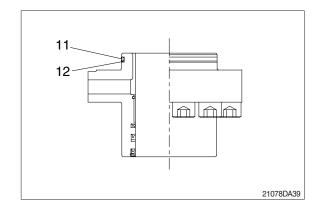
- ④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.
- * Coat each packing with hydraulic oil before fitting it.
- Insert the backup ring until one side of it is inserted into groove.



- ** Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.
- Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

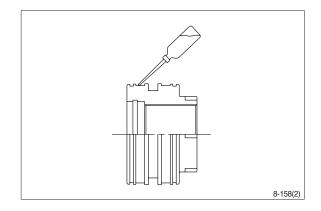


- 5 Fit back up ring (12) to gland (3).
- Put the backup ring in the warm water of 30~50°C.
- 6 Fit O-ring (11) to gland (3).

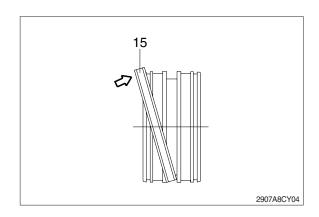


(2) Assemble piston assembly

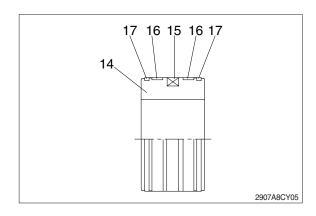
- * Check for scratches or rough surfaces.
 If found smooth with an oil stone.
- ① Coat the outer face of piston (14) with hydraulic oil.



- ② Fit piston seal (15) to piston.
- Put the piston seal in the warm water of 60~100°C for more than 5 minutes.
- After assembling the piston seal, press its outer diameter to fit in.

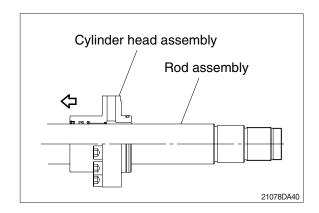


③ Fit wear ring (16) and dust ring (17) to piston (14).

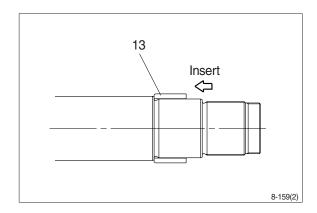


(3) Install piston and cylinder head

- ① Fix the rod assembly to the work bench.
- ② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
- ③ Insert cylinder head assembly to rod assembly.



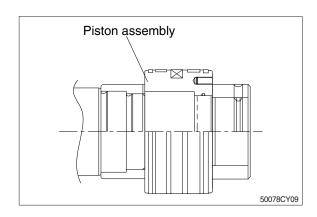
- ④ Insert cushion ring (13) to rod assembly.
- Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

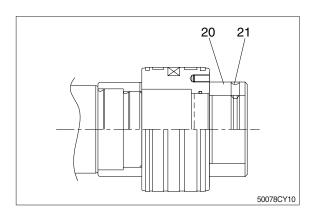
· Tightening torque :

Item		kgf · m	lbf · ft
Bucket	14	150±15	1085 ± 108
Boom	14	150 \pm 15	1085 ± 108
Arm	15	200±20	1447±145



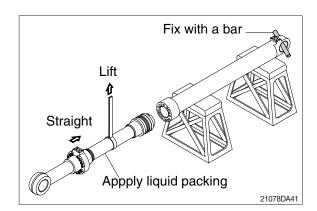
- 6 Fit lock nut (20) and tighten the screw (21).
 - · Tightening torque:

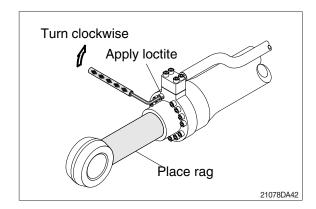
Item		kgf · m	lbf ⋅ ft
Bucket	20	100±10	723±72.3
Boom	21	5.4 ± 0.5	39.1±3.6
A rm	21	150±15	1085±108
Arm	22	2.5±0.3	18.1±2.2



(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

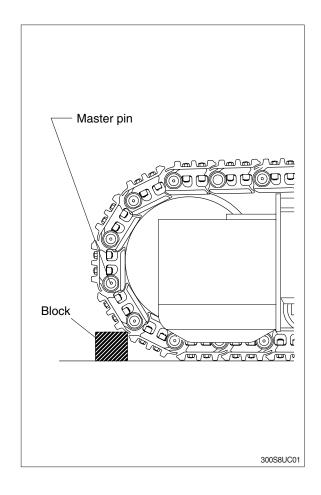
1. TRACK LINK

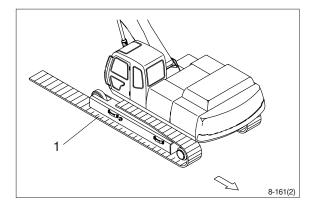
1) REMOVAL

- (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.
- We Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required. Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease nipple can be suddenly popped out by
- (3) Push out master pin by using a suitable tool.

pressurized grease.

- (4) Move the machine slowly in reverse, and lay out track link assembly (1).
- ¾ 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.

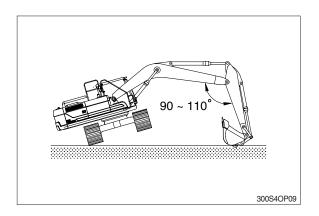




2) INSTALL

(1) Carry out installation in the reverse order to removal.

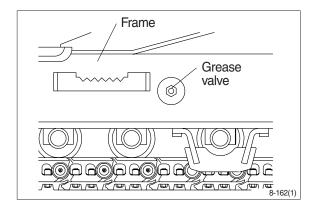
Adjust the tension of the track link.



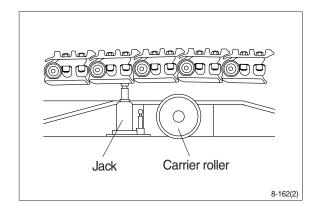
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



(2) Jack up the track link height enough to permit carrier roller removal.

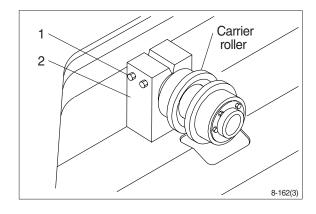


- (3) Loosen the lock nut (1).
- (4) Open bracket (2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight: 35 kg (80 lb)

· Tightening torque : 29.7 ± 4.5 kgf · m

(215 \pm 32.5 lbf \cdot ft)



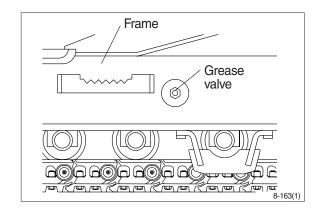
2) INSTALL

(1) Carry out installation in the reverse order to removal.

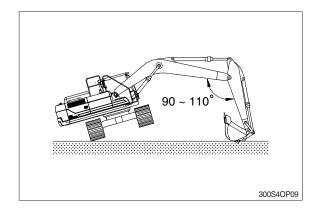
3. TRACK ROLLER

1) REMOVAL

(1) Loosen tension of the track link.

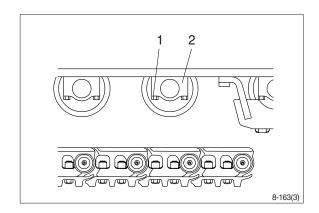


- (2) Using the work equipment, push up track frame on side which is to be removed.
- * After jack up the machine, set a block under the unit.



- (3) Remove the mounting bolt (1) and draw out the track roller (2).
 - · Weight: 56 kg (120 lb)
 - · Tightening torque : 57.9±8.7 kgf·m

(419±62.9 lbf·ft)



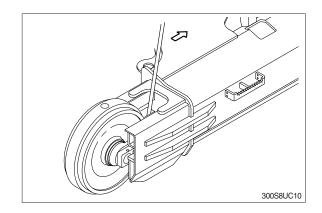
2) INSTALL

(1) Carry out installation in the reverse order to removal.

4. IDLER AND RECOIL SPRING

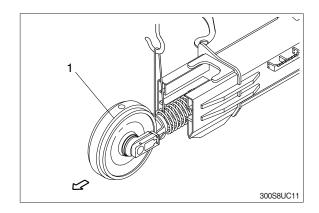
1) REMOVAL

(1) Remove the track link.
For detail, see **removal of track link**.



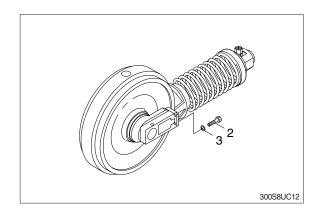
(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.

· Weight: 457 kg (1010 lb)



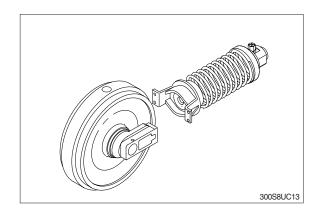
(3) Remove the bolts (2), washers (3) and separate idler from recoil spring.

· Tightening torque : 31.3±4.7 kgf·m (226±34.0 lbf·ft)



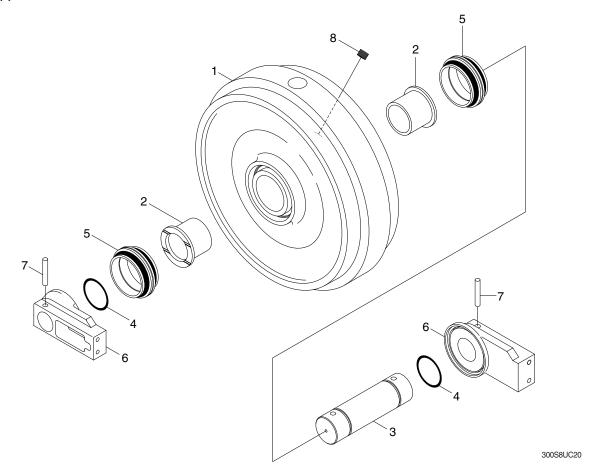
2) INSTALL

- (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



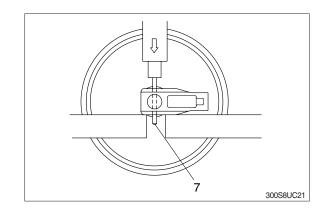
- 1 Shell
- 2 Bushing
- 3 Shaft

- 4 O-ring
- 5 Seal assembly
- 6 Bracket

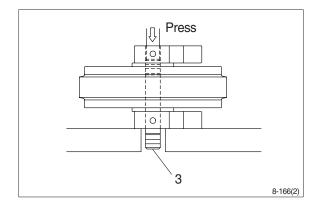
- 7 Spring pin
- 8 Plug

(2) Disassembly

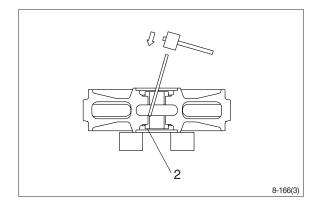
- ① Remove plug and drain oil.
- ② Draw out the spring pin (7), using a press.



- ③ Pull out the shaft (2) with a press.
- ④ Remove seal (5) from shell (1) and bracket (6).
- 5 Remove O-ring (4) from shaft.

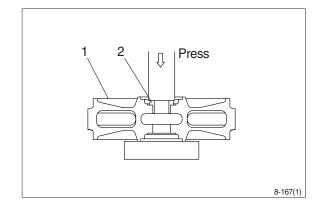


- ⑥ Remove the bushing (2) from idler, using a special tool.
- * Only remove bushing if replacement is necessity.

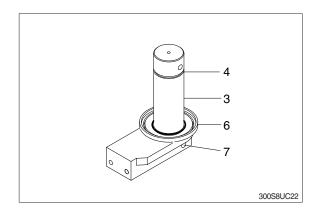


(3) Assembly

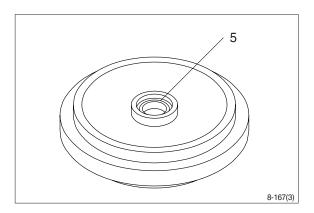
- Before assembly, clean the parts.
- Coat the sliding surfaces of all parts with oil.
- Cool up bushing (2) fully by some dry ice and press it into shell (1).
 Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



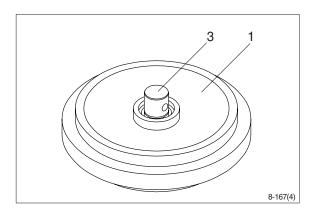
- ② Coat O-ring (4) with grease thinly, and install it to shaft (3).
- ③ Insert shaft (3) into bracket (6) and drive in the spring pin (7).



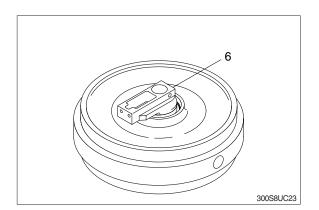
④ Install seal (5) to shell (1) and bracket (6).



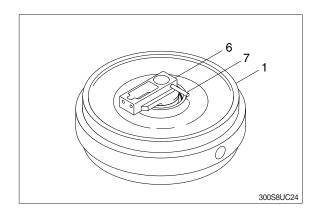
5 Install shaft (3) to shell (1).



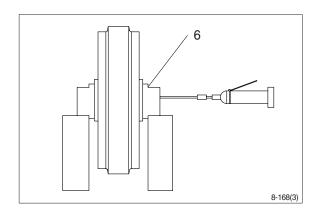
⑥ Install bracket (6) attached with seal (5).



Knock in the spring pin (7) with a hammer.

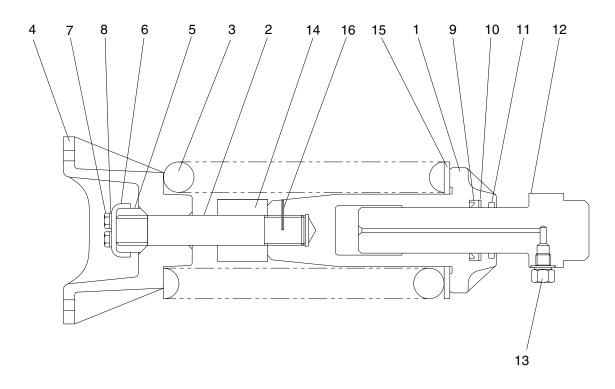


8 Lay bracket (6) on its side.
 Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



300S8UC30

1	Body		
2	Tie ha		

Tie bar

3 Spring

Bracket 4

Lock nut 5

Lock plate 6

7 Bolt

Spring washer 8

Rod seal

Back up ring 10

Dust seal

12 Adjust rod

13 Grease valve

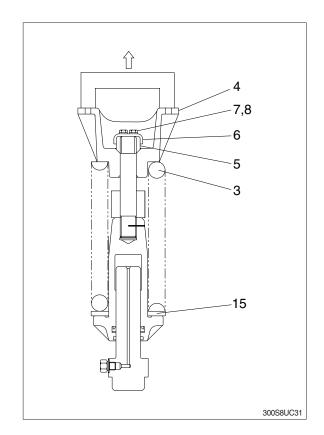
14 Stopper tube

15 Spacer

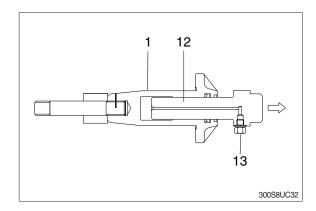
16 Spring pin

(2) Disassembly

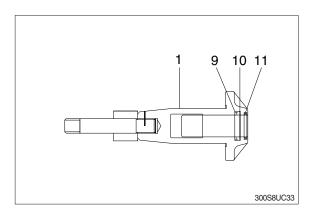
- * The illustrations are base on the type 1.
- ① Apply pressure on spring (3) with a press.
- * The spring is under a large installed load. This is dangerous, so be sure to set properly.
- ② Remove bolt (7), spring washer (8) and lock plate (6).
- ③ Remove lock nut (5).
 Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.
- ④ Lighten the press load slowly and remove bracket (4), spring (3) and spacer (15).



- ⑤ Remove rod (12) from body (1).
- 6 Remove grease valve (13) from rod (12).

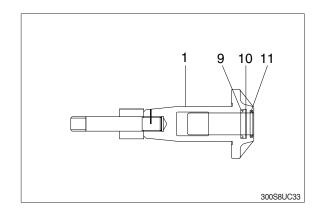


7 Remove rod seal (9), back up ring (10) and dust seal (11).

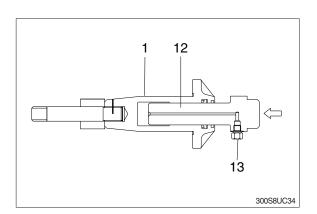


(3) Assembly

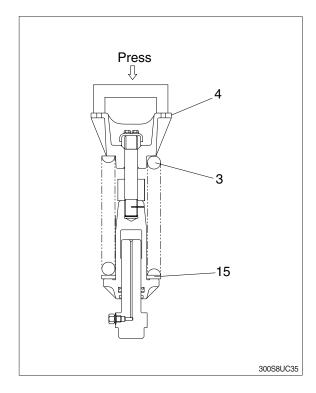
- ① Install dust seal (11), back up ring (10) and rod seal (9) to body (1).
- When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



- 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 : $13.0\pm1.0 \text{ kgf} \cdot \text{m}$ (94 $\pm7.2 \text{ lbf} \cdot \text{ft}$)



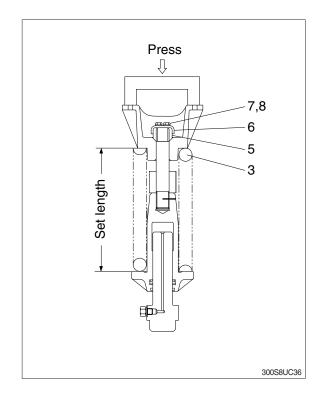
- (4) Install spacer (15), spring (3) and bracket(4) to body (1).
- ⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).
 - · Spring set load 22285 kg (49130 lb)
- * Apply sealant before assembling.
- During the operation, pay attention specially to prevent the press from slipping out.



⑥ Lighten the press load and confirm the set length of spring (3).

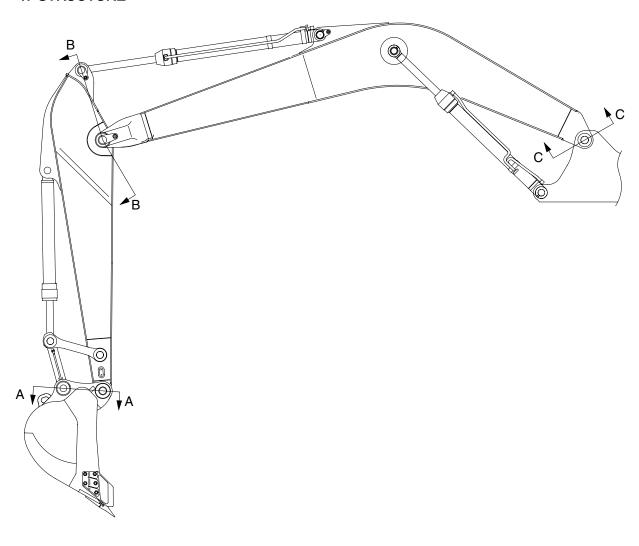
565 \pm 1.5 mm

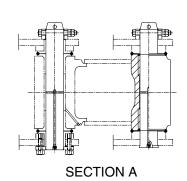
After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).
•Tightening torque: 15±0.5 kgf·m
(108±3.6 lbf·ft)

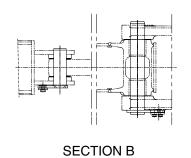


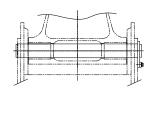
GROUP 11 WORK EQUIPMENT

1. STRUCTURE









SECTION C

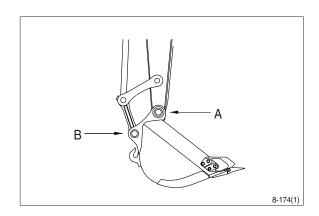
300S8WE01

2. REMOVAL AND INSTALL

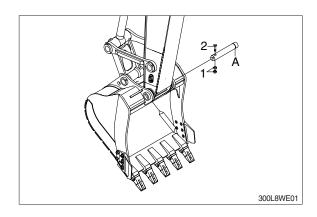
1) BUCKET ASSEMBLY

(1) Removal

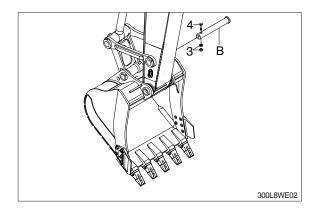
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut (1), bolt (2) and draw out the pin (A).

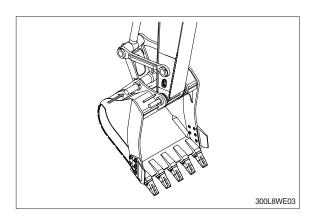


3 Remove nut (3), bolt (4) and draw out the pin (B).



(2) Install

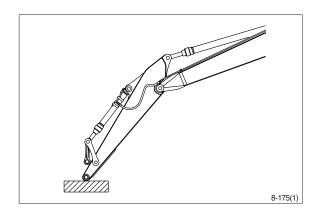
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- Adjust the bucket clearance.
 For detail, see operation manual.

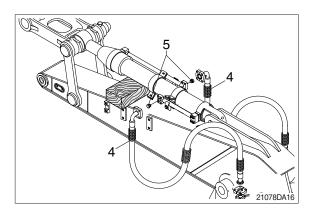


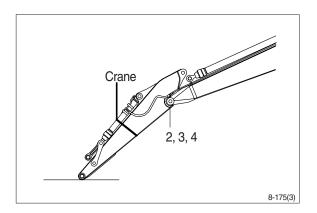
2) ARM ASSEMBLY

(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.
- ① Remove bucket assembly.
 For details, see removal of bucket assembly.
- ② Disconnect bucket cylinder hose (1).
- A Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.
- Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.
- Tie the rod with wire to prevent it from coming out.
- Tor 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: 1160 kg (2560 lb)
- When lifting the arm 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.

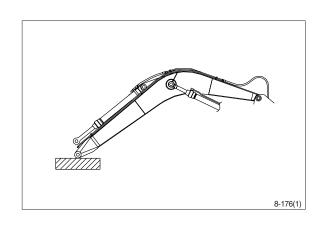
3) BOOM CYLINDER

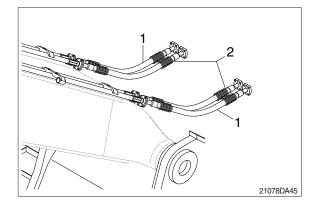
(1) Removal

- 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.**

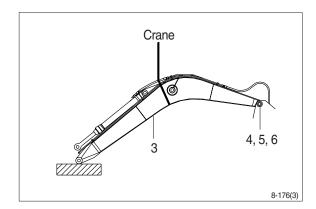


- ④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).
- When the hose are disconnected, oil may spurt out.
- 5 Sling boom assembly (3).





- Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.Weight: 2540 kg (5600 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.

