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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 Construction Equipment 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 Construction Equipment distributors.

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

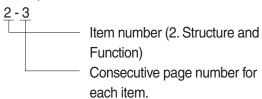
Filing method

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

File the pages in correct order.

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

Example 1



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

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
							c				
(a)	50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
	60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
	70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
	80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
	90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to inches 1mm = 0.03937in

	111111 - 0.00007111									
	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

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

kgf/cm² to **lbf/in²** 1 kgf/cm² = 14.2233 lbf/in²

Ngi/GII- to						$1 \text{kgf} / \text{cm}^2 = 14.2233 \text{lbf} / \text{in}^2$						
	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		
400	4.400	4.40=	1454	4.405	4.470		4500	4500	4500	4550		
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		
	<u> </u>	0.20	0	0.00	0 0	0.00	0.00			00.2		

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

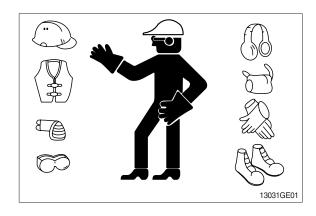
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

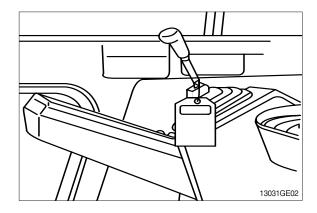
Wear close fitting clothing and safety equipment appropriate to the job.



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.



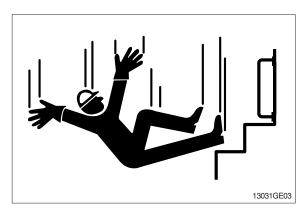
USE HANDHOLDS AND STEPS

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.

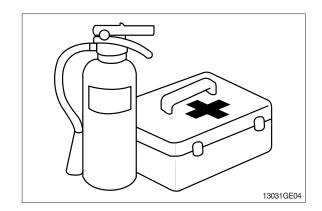


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

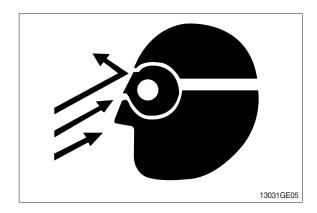
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

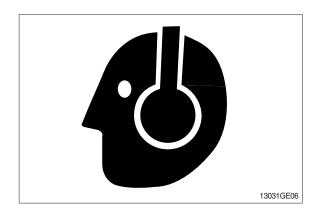
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

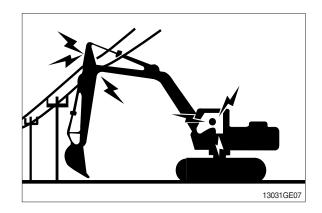
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

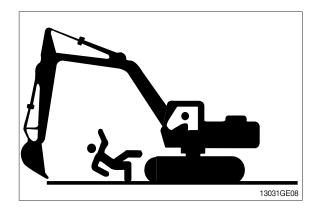
Never move any part of the machine or load closer to electric line than 3 m (10 ft) plus twice the line insulator length.



KEEP RIDERS OFF EXCAVATOR

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

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

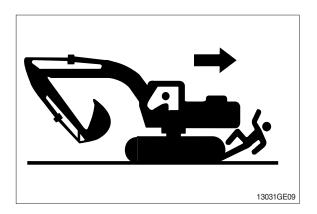


MOVE AND OPERATE MACHINE SAFELY

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

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

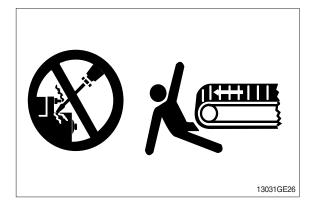
Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.



OPERATE ONLY FORM OPERATOR'S SEAT

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

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



PARK MACHINE SAFELY

Before working on the machine:

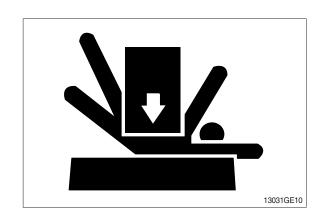
- · Park machine on a level surface.
- · Lower bucket to the ground.
- · Turn auto idle switch off.
- · Run engine at 1/2 speed without load for 2 minutes.
- Turn key switch to OFF to stop engine. Remove key from switch.
- · Move pilot control shutoff lever to locked position.
- · Allow engine to cool.

SUPPORT MACHINE PROPERLY

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

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

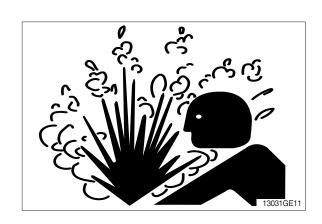
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



SERVICE COOLING SYSTEM SAFELY

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

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



HANDLE FLUIDS SAFELY-AVOID FIRES

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

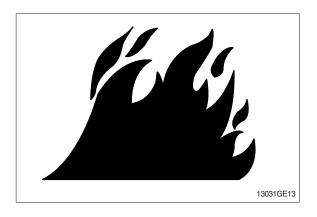
Fill fuel tank outdoors.



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

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

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



BEWARE OF EXHAUST FUMES

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

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

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

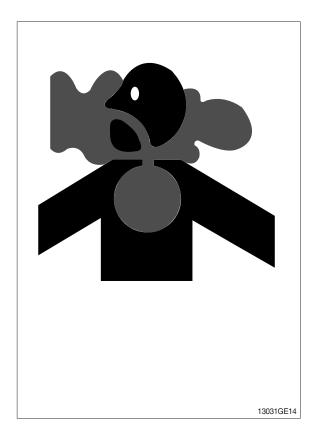
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

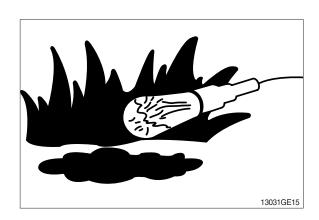
Remove paint before welding or heating:

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



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

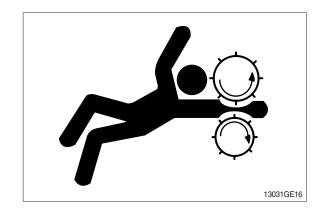




SERVICE MACHINE SAFELY

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

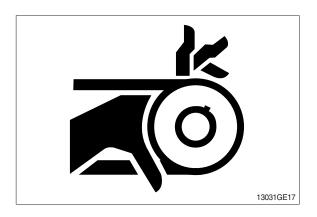
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



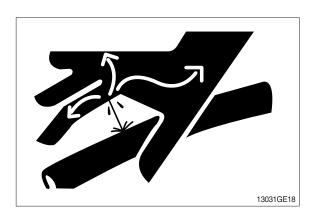
AVOID HIGH PRESSURE FLUIDS

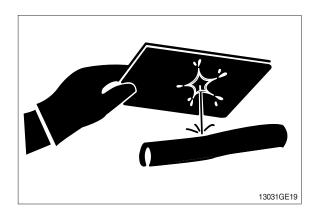
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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





AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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



PREVENT BATTERY EXPLOSIONS

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

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

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



PREVENT ACID BURNS

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

Avoid the hazard by:

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

If you spill acid on yourself:

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

If acid is swallowed:

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

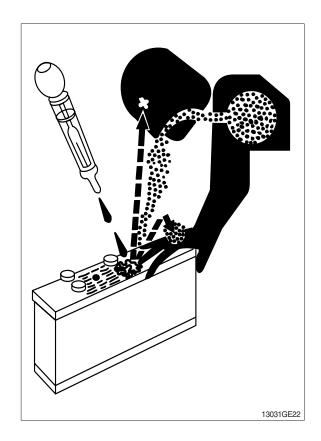
USE TOOLS PROPERLY

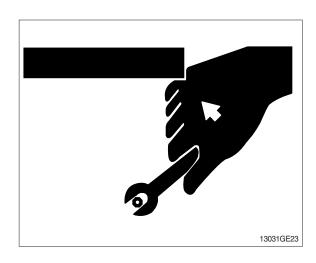
Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

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

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



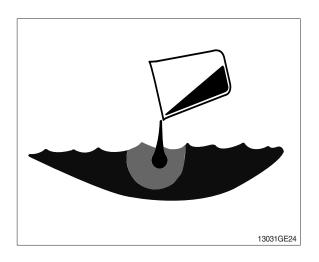


DISPOSE OF FLUIDS PROPERLY

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

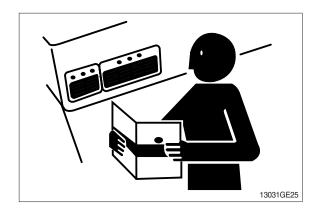
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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



REPLACE SAFETY SIGNS

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

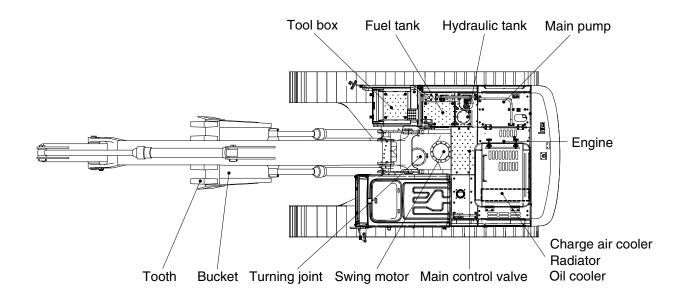


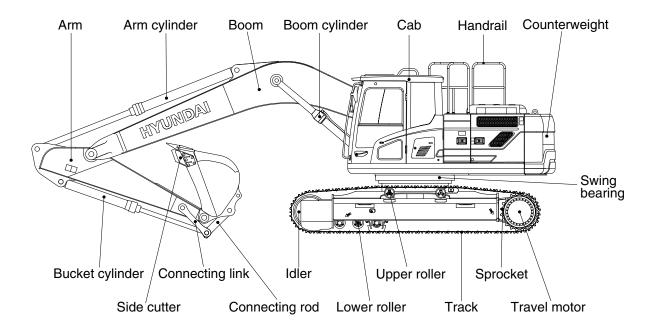
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

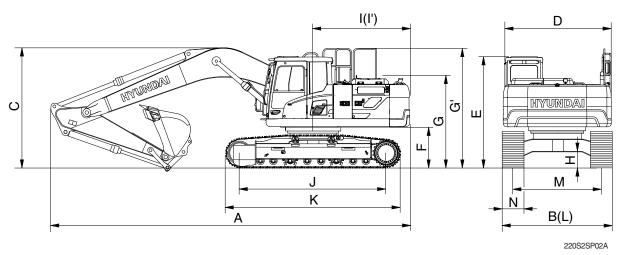




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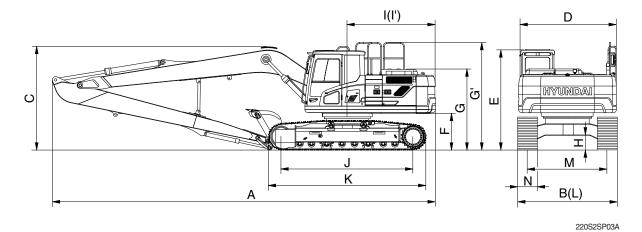
2. SPECIFICATIONS

1) HX225S L, MONO BOOM



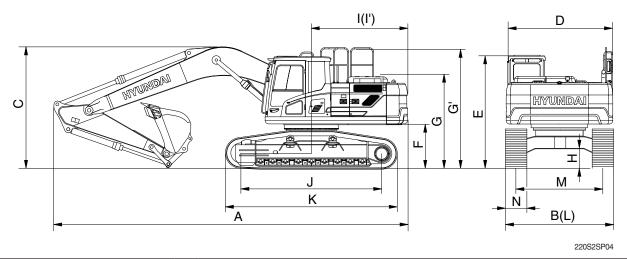
		Ur	nit		Specif	ication			
Description		(ft :)	Boom		5.70 (18' 8")			
Description	r	m (ft-in)	Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")	3.50 (11' 6")		
	r	mm (in)	Shoe		600 (24")				
Operating weight		kg ((lb)	22070 (45920)	22070 (45920)	22070 (45920)	22070 (45920)		
Bucket capacity (SAE heaped), stand	dard	m³ (yd³)	0.92 (1.20)	0.92 (1.20)	0.92 (1.20)	0.92 (1.20)		
Overall length	Α			9550 (31' 4")	9620 (31' 7")	9575 (31' 5")	9560 (31' 4")		
Overall width	В			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")		
Overall height of boom	С			2960 (9' 9")	3115 (10' 3")	3020 (9' 11")	3320 (10' 11")		
Superstructure width	D			2740 (9' 0")	2740 (9' 0")	2740 (9' 0")	2740 (9' 0")		
Overall height of cab	Е			3035 (9' 11")	3035 (9' 11")	3035 (9' 11")	3035 (9' 11")		
Ground clearance of counterweight	F			1095 (3' 7")	1095 (3' 7")	1095 (3' 7")	1095 (3' 7")		
Overall height of engine hood	G			2470 (8' 1")	2470 (8' 1")	2470 (8' 1")	2470 (8' 1")		
Overall height of handrail	G'	mm /	'# in\	3245 (10' 8") 3245 (10' 8") 3245 (10'	3245 (10' 8")	3245 (10' 8")			
Minimum ground clearance	Н	mm (ft-in)	it-in)	475 (1' 7")	475 (1' 7")	475 (1' 7")	475 (1' 7")		
Rear-end distance	I			2770 (9' 1")	2770 (9' 1")	2770 (9' 1")	2770 (9' 1")		
Rear-end swing radius	ľ			2890 (9' 5")	2890 (9' 5")	2890 (9' 5")	2890 (9' 5")		
Distance between tumblers	J			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")		
Undercarriage length	K			4395 (14' 5")	4395 (14' 5")	4395 (14' 5")	4395 (14' 5")		
Undercarriage width	L			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")		
Track gauge	М			2390 (7' 10")	2390 (7' 10")	2390 (7' 10")	2390 (7' 10")		
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")	600 (2' 0")	600 (2' 0")		
Travel speed (low/high) Swing speed Gradeability Ground pressure Max traction force		km/hr	(mph)	3.6/5.4 (2.2/3.4)	3.6/5.4 (2.2/3.4)	3.6/5.4 (2.2/3.4)	3.6/5.4 (2.2/3.4)		
		rp	m	12.5	12.5	12.5	12.5		
		Degre	e (%)	35 (70)	35 (70)	35 (70)	35 (70)		
		kgf/cm	² (psi)	0.47 (6.68)	0.47 (6.68)	0.47 (6.68)	0.47 (6.68)		
		kg ((lb)	20200 (44530)	20200 (44530)	20200 (44530)	20200 (44530)		

2) HX225S L LONG REACH



Specification 8.50 (27' 11") 6.20 (20' 4") 800 (32") 24830 (54740) 0.52 (0.68) 12345 (40' 6") 3190 (10' 6")		
6.20 (20' 4") 800 (32") 24830 (54740) 0.52 (0.68) 12345 (40' 6")		
800 (32") 24830 (54740) 0.52 (0.68) 12345 (40' 6")		
24830 (54740) 0.52 (0.68) 12345 (40' 6")		
0.52 (0.68) 12345 (40' 6")		
12345 (40' 6")		
2100 (10' 6")		
3190 (10 0)		
3365 (11' 0")		
2740 (9' 0")		
3035 (9' 11")		
1095 (3' 7")		
2470 (8' 1")		
3245 (10' 8")		
475 (1' 7")		
2770 (9' 1")		
2890 (9' 6")		
3650 (12' 0")		
4395 (14' 5")		
3190 (10' 6")		
2390 (7' 10")		
800 (2' 7")		
3.47/5.47 (2.16/3.40)		
12.69		
35 (70)		
0.40 (5.62)		
21100 (46517)		

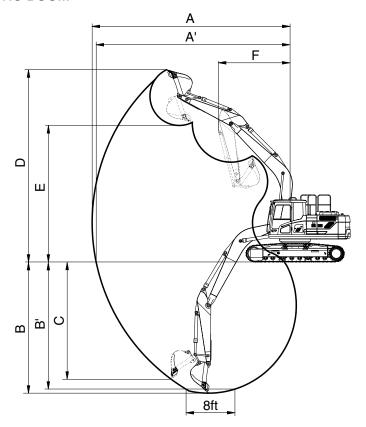
3) HX225S L HIGH WALKER



		Uı	nit		Specif	ication				
Description		/ft :\	Boom		5.70 (18' 8")				
Description		m (ft-in)	Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")	3.50 (11' 6")			
		mm (in)	Shoe		600 (24")					
Operating weight		kg	(lb)	24300 (53570)	24300 (53570)	24300 (53570)	24300 (53570)			
Bucket capacity (SAE heaped), stand	dard	m³ (yd³)	0.92 (1.20)	0.92 (1.20)	0.92 (1.20)	0.92 (1.20)			
Overall length	Α			9515 (31' 3")	9625 (31' 7")	9560 (31' 4")	9575 (31' 5")			
Overall width	В			3395 (11' 2")	3395 (11' 2")	3395 (11' 2")	3395 (11' 2")			
Overall height of boom	С			2975 (9' 9")	3195 (10' 6")	3090 (10' 2")	3275 (10' 9")			
Superstructure width	D			2740 (9' 0")	2740 (9' 0")	2740 (9' 0")	2740 (9' 0")			
Overall height of cab	Е			3230 (10' 7")	3230 (10' 7")	3035 (9' 11")	3035 (9' 11")			
Ground clearance of counterweight	F			1260 (4' 2")	1260 (4' 2")	1095 (3' 7")	1095 (3' 7")			
Overall height of engine hood	G			2670 (8' 8")	2670 (8' 8")	2670 (8' 8")	2670 (8' 8")			
Overall height of handrail	G'	mm (ft in)	3413 (11' 2")	3413 (11' 2")	3245 (10' 8")	3245 (10' 8")			
Minimum ground clearance	Н	111111	(11-111)	660 (2' 2")	660 (2' 2")	475 (1' 7")	475 (1' 7")			
Rear-end distance	ı			2770 (9' 1") 2770 (9' 1")	2770 (9' 1")	2770 (9' 1")				
Rear-end swing radius	ľ			2890 (9' 5")	2890 (9' 5")	2890 (9' 5")	2890 (9' 5")			
Distance between tumblers	J			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")			
Undercarriage length	K			4404 (14' 5")	4404 (14' 5")	4395 (14' 5")	4395 (14' 5")			
Undercarriage width	L			3395 (11' 2")	3395 (11' 2")	3395 (11' 2")	3395 (11' 2")			
Track gauge	М			2795 (9' 2")	2795 (9' 2")	2390 (7' 10")	2390 (7' 10")			
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")	600 (2' 0")	600 (2' 0")			
Travel speed (low/high) Swing speed		km/hr	(mph)	3.6/5.4 (2.2/3.4)	3.6/5.4 (2.2/3.4)	3.6/5.4 (2.2/3.4)	3.6/5.4 (2.2/3.4)			
		rp	m	12.5	12.5	12.5	12.5			
Gradeability		Degre	e (%)	35 (70)	35 (70)	35 (70)	35 (70)			
Ground pressure		kgf/cm	n² (psi)	0.57 (7.36)	0.57 (7.36)	0.57 (7.36)	0.57 (7.36)			
Max traction force		kg	(lb)	20200 (44530)	20200 (44530)	20200 (44530)	20200 (44530)			

3. WORKING RANGE

1) HX225S L, MONO BOOM

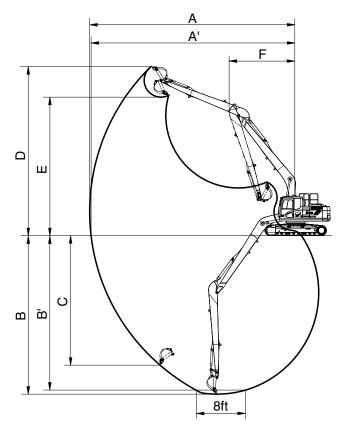


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Description	m (ft-in)	Boom		5.70 (18' 8")	
Description	111 (11-111)	Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")	3.50 (11' 6")
Max digging reach		Α	9945 (32' 8")	9145 (30' 0")	9525 (31' 3")	10450 (34' 3")
Max digging reach on ground		A'	9780 (32' 1")	8960 (29' 5")	9355 (30' 8")	10290 (33' 9")
Max digging depth		В	6500 (21' 4")	5585 (18' 4")	5990 (19' 8")	7090 (23' 3")
Max digging depth (8 ft level)	mm (ft in)	B'	6315 (20' 9")	5360 (17' 7")	5790 (19' 0")	6935 (22' 9")
Max vertical wall digging depth	mm (ft-in)	С	5960 (19' 7")	5070 (16' 8")	5445 (17' 10")	6330 (20' 9")
Max digging height		D	9750 (32' 0")	9370 (30' 9")	9625 (31' 7")	9890 (32' 5")
Max dumping height		Е	6990 (22' 11")	6580 (21' 7")	6830 (22' 5")	7160 (23' 6")
Min swing radius		F	3425 (11' 3")	3715 (12' 2")	3400 (11' 2")	3445 (11' 4")
	kN		130.4 [141.6]	130.4 [141.6]	130.4 [141.6]	130.4 [141.6]
	kgf	SAE	13300 [14440]	13300 [14440]	13300 [14440]	13300 [14440]
Bucket digging force	lbf		29320 [31830]	29320 [31830]	29320 [31830]	29320 [31830]
Ducket digging force	kN		152.3 [165.3]	152.3 [165.3]	152.3 [165.3]	152.3 [165.3]
	kgf	ISO	15530 [16860]	15530 [16860]	15530 [16860]	15530 [16860]
	lbf		34240 [37170]	34240 [37170]	34240 [37170]	34240 [37170]
	kN		102.8 [111.6]	144.3 [156.6]	119.3 [129.4]	92.2 [100.1]
	kgf	SAE	10480 [11380]	14710 [15970]	12160 [13200]	9400 [10210]
Arm diaging force	lbf		23100 [25090]	32430 [35210]	26810 [29100]	20720 [22510]
Arm digging force	kN	kN	106.9 [116.0]	152.0 [165.0]	124.7 [135.4]	95.4 [103.6]
	kgf	ISO	10900 [11830]	15500 [16830]	12720 [13810]	9730 [10560]
	lbf		24030 [26080]	34170 [37100]	28040 [30450]	21450 [23280]

[]: Power boost

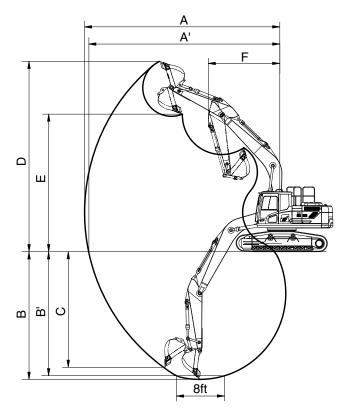
2) HX225S L LONG REACH



220S2SP06A

Description	m (ft-in)	Boom	8.50 (27' 11")
Description	111 (11-111)	Arm	6.20 (20' 4")
Max digging reach		Α	15425 (50' 7")
Max digging reach on ground		A'	15320 (50' 3")
Max digging depth		В	11500 (37' 9")
Max digging depth (8 ft level)	mm (ft in)	B'	11355 (37' 3")
Max vertical wall digging depth	mm (ft-in)	С	10265 (33' 8")
Max digging height		D	13445 (44' 1")
Max dumping height		E	11200 (36' 9")
Min swing radius		F	4705 (15' 5")
	kN		68.0
	kgf SAE		6930
Puokot digging force	lbf		15280
Bucket digging force	kN		80.3
	kgf	ISO	8190
	lbf		18060
	kN		49.5
	kgf	SAE	5050
Arm diaging force	lbf		11130
Arm digging force	kN		50.5
	kgf	ISO	5150
	lbf		11350

3) HX225S L HIGH WALKER



220S2SP07

Description	m (ft in)	Boom		5.70 (18' 8")	
Description	m (ft-in)	Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")	3.50 (11' 6")
Max digging reach		Α	9945 (32' 8")	9145 (30' 0")	9525 (31' 3")	10450 (34' 3")
Max digging reach on ground		A'	9740 (31' 11")	8920 (29' 3")	9310 (30' 7")	10255 (33' 8")
Max digging depth		В	6290 (20' 8")	5385 (17' 8")	5785 (19' 0")	6890 (22' 7")
Max digging depth (8 ft level)	mm (ft in)	B'	6115 (20' 1")	5160 (16' 11")	5590 (18' 4")	6735 (22' 1")
Max vertical wall digging depth	mm (ft-in)	С	5760 (18' 11")	4870 (16' 0")	5245 (17' 2")	6130 (20' 1")
Max digging height		D	9950 (32' 8")	9570 (31' 5")	9825 (32' 3")	10090 (33' 1")
Max dumping height		Е	7190 (23' 7")	6780 (22' 3")	7030 (23' 1")	7360 (24' 2")
Min swing radius		F	3425 (11' 3")	3715 (12' 2")	3340 (10' 11")	3445 (11' 4")
	kN		130.4 [141.6]	130.4 [141.6]	130.4 [141.6]	130.4 [141.6]
	kgf	SAE	13300 [14440]	13300 [14440]	13300 [14440]	13300 [14440]
Dualest diaging force	lbf		29320 [31830]	29320 [31830]	29320 [31830]	29320 [31830]
Bucket digging force	kN		152.3 [165.3]	152.3 [165.3]	152.3 [165.3]	152.3 [165.3]
	kgf	ISO	15530 [16860]	15530 [16860]	15530 [16860]	15530 [16860]
	lbf		34240 [37170]	34240 [37170]	34240 [37170]	34240 [37170]
	kN		102.8 [111.6]	144.3 [156.6]	119.3 [129.4]	92.2 [100.1]
	kgf	SAE	10480 [11380]	14710 [15970]	12160 [13200]	9400 [10210]
Arm diaging force	lbf		23100 [25090]	32430 [35210]	26810 [29100]	20720 [22510]
Arm digging force	kN		106.9 [116.0]	152.0 [165.0]	124.7 [135.4]	95.4 [103.6]
	kgf	ISO	10900 [11830]	15500 [16830]	12720 [13810]	9730 [10560]
	lbf		24030 [26080]	34170 [37100]	28040 [30450]	21450 [23280]

[]: Power boost

4. WEIGHT

1) HX225S L

	HX22	25S L
Item	kg	lb
Upperstructure assembly	9650	21270
Main frame weld assembly	1880	4140
Engine assembly	432	953
Main pump assembly	146	322
Main control valve assembly	220	485
Swing motor assembly	254	560
Hydraulic oil and fuel tank assembly	480	1058
Counterweight	3800	8380
Cab assembly	422	930
Lower chassis assembly	8060	17770
Track frame weld assembly	2545	5611
Swing bearing	290	640
Travel motor assembly	305	672
Turning joint	57	125
Sprocket	56	123
Track recoil spring	140	309
Idler	151	333
Upper roller	21	46
Lower roller	48	106
Track-chain assembly (600 mm standard triple grouser shoe)	1360	3000
Front attachment assembly (5.70 m boom, 2.90 m arm, 0.92 m³ SAE heaped bucket)	4030	8880
5.70 m boom assembly	1520	3350
2.90 m arm assembly	750	1650
0.92 m³ SAE heaped bucket	765	1690
Boom cylinder assembly	198	436
Arm cylinder assembly	273	602
Bucket cylinder assembly	161	355
Bucket control linkage total	200	441

2) HX225S L LONG REACH

ll	HX225S L LONG REACH				
ltem	kg	lb			
Upperstructure assembly	11150	24852			
Main frame weld assembly	1880	4140			
Engine assembly	432	953			
Main pump assembly	146	322			
Main control valve assembly	220	485			
Swing motor assembly	254	560			
Hydraulic oil and fuel tank assembly	480	1058			
Counterweight	5300	11680			
Cab assembly	422	930			
Lower chassis assembly	8815	19434			
Track frame weld assembly	2545	5611			
Swing bearing	290	640			
Travel motor assembly	305	672			
Turning joint	57	125			
Sprocket	56	123			
Track recoil spring	140	309			
Idler	151	333			
Upper roller	21	46			
Lower roller	48	106			
Track-chain assembly (800 mm standard triple grouser shoe)	1735	3825			
Front attachment assembly (8.50 m boom, 6.20 m arm, 0.52 m³ SAE heaped bucket)	4600	10140			
8.50 m boom assembly	2105	4640			
6.20 m arm assembly	1100	2430			
0.52 m³ SAE heaped bucket	465	1030			
Boom cylinder assembly	198	436			
Arm cylinder assembly	273	602			
Bucket cylinder assembly	161	355			
Bucket control linkage total	132	291			

3) HX225S L HIGH WALKER

lle	HX225S L HI	GH WALKER
Item	kg	lb
Upperstructure assembly	9686	21354
Main frame weld assembly	1950	4300
Engine assembly	432	953
Main pump assembly	146	322
Main control valve assembly	220	485
Swing motor assembly	254	560
Hydraulic oil and fuel tank assembly	480	1058
Counterweight	3800	8380
Cab assembly	422	930
Lower chassis assembly	10246	22589
Track frame weld assembly	3610	7960
Swing bearing	295	650
Travel motor assembly	305	672
Turning joint	57	125
Sprocket	56	123
Track recoil spring	163	360
Idler	151	333
Upper roller	48	106
Lower roller	48	106
Track-chain assembly (600 mm standard triple grouser shoe)	1451	3200
Front attachment assembly (5.70 m boom, 2.90 m arm, 0.92 m³ SAE heaped bucket)	4030	8880
5.70 m boom assembly	1520	3350
2.90 m arm assembly	750	1650
0.92 m³ SAE heaped bucket	765	1690
Boom cylinder assembly	198	436
Arm cylinder assembly	273	602
Bucket cylinder assembly	161	355
Bucket control linkage total	200	441

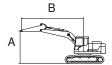
5. LIFTING CAPACITIES

1) HX225S L

Model	Туре	Boom	Arm	Counterweight	Shoe	Wheel	Do	zer	Outri	igger
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
NAZZOS L	BOOM	5700	2900	3800	600	-	-	-	-	-

· Rating over-front

· 🖶 : Rating over-side or 360 degree



			Lift-point radius (B)								At max. reach			
Lift-point height (A)		1.5 m ((4.9 ft)	3.0 m	(9.8 ft)	4.5 m (14.8 ft)	6.0 m (19.7 ft)	7.5 m (24.6 ft)	Capa	acity	Reach
			#	U	#	U	#		#	J	#	J	#	m (ft)
7.5 m	kg							*4920	*4920			*4330	*4330	6.21
(24.6 ft)	lb							*10850	*10850			*9550	*9550	(20.4)
6.0 m	kg							*4830	*4830			*4030	3730	7.34
(19.7 ft)	lb							*10650	*10650			*8880	8220	(24.1)
4.5 m	kg					*6130	*6130	*5330	5080	*4960	3560	*3960	3170	8.03
(14.8 ft)	lb					*13510	*13510	*11750	11200	*10930	7850	*8730	6990	(26.3)
3.0 m	kg					*7880	7390	*6120	4830	*5300	3450	*4060	2890	8.39
(9.8 ft)	lb					*17370	16290	*13490	10650	*11680	7610	*8950	6370	(27.5)
1.5 m	kg					*9500	6880	*6940	4590	5210	3340	*4320	2780	8.48
(4.9 ft)	lb					*20940	15170	*15300	10120	11490	7360	*9520	6130	(27.8)
0.0 m	kg			*4930	*4930	*10340	6600	7100	4420	5110	3250	4430	2830	8.29
(0.0 ft)	lb			*10870	*10870	*22800	14550	15650	9740	11270	7170	9770	6240	(27.2)
-1.5 m	kg	*5620	*5620	*9400	*9400	*10370	6530	7020	4340	5080	3220	4820	3060	7.80
(-4.9 ft)	lb	*12390	*12390	*20720	*20720	*22860	14400	15480	9570	11200	7100	10630	6750	(25.6)
-3.0 m	kg			*13630	12860	*9640	6590	7060	4380			5710	3610	6.96
(-9.8 ft)	lb			*30050	28350	*21250	14530	15560	9660			12590	7960	(22.8)
-4.5 m	kg			*10720	*10720	*7730	6810					*5820	5020	5.60
(-14.8 ft)	lb			*23630	*23630	*17040	15010					*12830	11070	(18.4)

Note 1. Lifting capacity are based on ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- * Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

Failure to comply to the rated load can cause possible personal injury or property damage.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Do	Dozer		igger
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
ΠΛ2233 L	BOOM	5700	2000	3800	600	-	-	-	-	-

· 🖟 : Rating over-front

· 🖶 : Rating over-side or 360 degree



					Lift-point	radius (B)				At	max. rea	ch
Lift-po		3.0 m	(9.8 ft)	4.5 m (14.8 ft)	6.0 m (19.7 ft)	7.5 m (24.6 ft)	Сар	acity	Reach
height	(A)	Ů	#	ŀ	#	Ů	#	·		U	#	m (ft)
7.5 m (24.6 ft)	kg lb									*6130 *13510	*6130 *13510	5.05 (16.6)
6.0 m (19.7 ft)	kg lb			*6170 *13600	*6170 *13600	*5780 *12740	5130 11310			*5810 *12810	4610 10160	6.39 (21.0)
4.5 m (14.8 ft)	kg lb			*7370 *16250	*7370 *16250	*6130 *13510	5000 11020			*5780 *12740	3780 8330	7.17 (23.5)
3.0 m	kg			10230	10230	*6820	4790	5330	3460	5250	3400	7.58
(9.8 ft) 1.5 m	lb kg					*15040 7290	10560 4600	11750 5250	7630 3380	11570 5080	7500 3280	(24.9) 7.67
(4.9 ft) 0.0 m	lb kg			*10600	6680	16070 7170	10140 4490	11570	7450	11200 5250	7230 3370	(25.2) 7.46
(0.0 ft)	lb			*23370	14730	15810	9900			11570	7430	(24.5)
-1.5 m (-4.9 ft)	kg lb			*10130 *22330	6700 14770	7160 15790	4480 9880			5850 12900	3730 8220	6.92 (22.7)
-3.0 m (-9.8 ft)	kg lb	*11600 *25570	*11600 *25570	*8810 *19420	6840 15080					*6360 *14020	4660 10270	5.95 (19.5)

Note 1. Lifting capacity are based on ISO 10567.

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- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- * Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

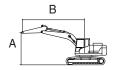
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

Failure to comply to the rated load can cause possible personal injury or property damage.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
ΠΛ2233 L	BOOM	5700	2400	3800	600	-	-	-	-	-

· Pating over-front

· 📥 : Rating over-side or 360 degree



				Lift-point i	radius (B)				At	max. rea	ch
Lift-point	3.0 m	(9.8 ft)	4.5 m (14.8 ft)	6.0 m (19.7 ft)	7.5 m (24.6 ft)	Cap	acity	Reach
height (A)	U	#	·	#	H		·		U	#	m (ft)
7.5 m kg									*5580	*5580	5.62
(24.6 ft) lb									*12300	*12300	(18.4)
6.0 m kg					*5340	5180			*5390	4140	6.85
(19.7 ft) lb					*11770	11420			*11880	9130	(22.5)
4.5 m kg			*6820	*6820	*5770	5030	*5380	3530	5320	3460	7.58
(14.8 ft) lb			*15040	*15040	*12720	11090	*11860	7780	11730	7630	(24.9)
3.0 m kg			*8560	7270	*6520	4800	5330	3450	4850	3140	7.97
(9.8 ft) lb			*18870	16030	*14370	10580	11750	7610	10690	6920	(26.1)
1.5 m kg			*9990	6830	*7250	4580	5220	3350	4700	3030	8.06
(4.9 ft) lb			*22020	15060	*15980	10100	11510	7390	10360	6680	(26.4)
0.0 m kg			*10530	6630	7130	4450	5150	3290	4830	3090	7.85
(0.0 ft) lb			*23210	14620	15720	9810	11350	7250	10650	6810	(25.8)
-1.5 m kg	*9270	*9270	*10280	6610	7080	4410			5320	3390	7.34
(-4.9 ft) lb	*20440	*20440	*22660	14570	15610	9720			11730	7470	(24.1)
-3.0 m kg	*12590	*12590	*9230	6720	*6790	4490			*6060	4110	6.44
(-9.8 ft) lb	*27760	*27760	*20350	14820	*14970	9900			*13360	9060	(21.1)
-4.5 m kg			*6620	*6620							, ,
(-14.8 ft) lb			*14590	*14590							

Note 1. Lifting capacity are based on ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- * Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

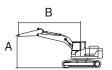
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

Failure to comply to the rated load can cause possible personal injury or property damage.

Model	Туре	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
ΠΛ2233 L	BOOM	5700	3500	3800	600	-	-	-	-	-

· Pating over-front

· 🖶 : Rating over-side or 360 degree



					L				At	max. rea	.ch			
Lift-po	int	1.5 m	(4.9 ft)	3.0 m	(9.8 ft)	4.5 m (14.8 ft)	6.0 m (19.7 ft)	7.5 m (24.6 ft)	Cap	acity	Reach
height	(A)	Ů	#	P	#	Ů		Ů		P	#	Ů	#	m (ft)
7.5 m (24.6 ft)	kg lb											*3630 *8000	*3630 *8000	6.89 (22.6)
6.0 m	kg									*4310	3650	*3420	3310	7.91
(19.7 ft)	lb									*9500	8050	*7540	7300	(26.0)
4.5 m	kg							*4750	*4750	*4490	3580	*3390	2840	8.56
(14.8 ft)	lb							*10470	*10470	*9900	7890	*7470	6260	(28.1)
3.0 m	kg			*10620	*10620	*6980	*6980	*5590	4870	*4890	3450	*3480	2600	8.90
(9.8 ft)	lb			*23410	*23410	*15390	*15390	*12320	10740	*10780	7610	*7670	5730	(29.2)
1.5 m	kg					*8770	6940	*6490	4580	5180	3300	*3710	2500	8.98
(4.9 ft)	lb					*19330	15300	*14310	10100	11420	7280	*8180	5510	(29.5)
0.0 m	kg			*6220	*6220	*9930	6550	7050	4360	5050	3180	4000	2530	8.80
(0.0 ft)	lb			*13710	*13710	*21890	14440	15540	9610	11130	7010	8820	5580	(28.9)
-1.5 m	kg	*5440	*5440	*9200	*9200	*10290	6400	6920	4240	4980	3120	4290	2700	8.35
(-4.9 ft)	lb	*11990	*11990	*20280	*20280	*22690	14110	15260	9350	10980	6880	9460	5950	(27.4)
-3.0 m	kg	*9040	*9040	*13720	12500	*9900	6410	6910	4240	5010	3150	4950	3110	7.57
(-9.8 ft)	lb	*19930	*19930	*30250	27560	*21830	14130	15230	9350	11050	6940	10910	6860	(24.8)
-4.5 m	kg			*12180	*12180	*8570	6560	*6170	4360			*5640	4060	6.34
(-14.8 ft)	lb			*26850	*26850	*18890	14460	*13600	9610			*12430	8950	(20.8)

Note 1. Lifting capacity are based on ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

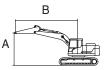
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

Failure to comply to the rated load can cause possible personal injury or property damage.

2) HX225S L LONG REACH

Model	Туре	Boom	Arm	Counterweight	Shoe	Wheel	Do	zer	Outr	igger
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
LR	BOOM	8500	6200	5300	800	-	-	-	-	-

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



									Lift	-point	radius	(B)								At max. reach		
Lift-p		1.5 m	(4.9 ft)	3.0 m	(9.8 ft)	4.5 m ((14.8 ft)	6.0 m	(19.7 ft)	7.5 m ((24.6 ft)	9.0 m ((29.5 ft)	10.5 m	(34.4 ft)	12.0 m	(39.4 ft)	13.5 m	(44.3 ft)	Сар	acity	Reach
heigh	t (A)		#		#	r de		U	#	·	#	Ů	#	ŀ	#	ŀ	#	U	#		#	m (ft)
12.0m	kg																			*970	*970	9.79
39.4ft	lb																			*2140	*2140	(32.1)
10.5m	kg													*1530	*1530					*880	*880	11.17
34.4ft	lb													*3370	*3370					*1940	*1940	(36.6)
9.0m	kg													*2000	*2000	*1090	*1090			*830	*830	12.21
29.5ft	lb													*4410	*4410	*2400	*2400			*1830	*1830	(40.0)
7.5m	kg													*2050	*2050	*1800	*1800			*810	*810	12.99
24.6ft	lb													*4520	*4520	*3970	*3970			*1790	*1790	(42.6)
6.0m	kg													*2170	*2170	*2110	2010	*880	*880	*800	*800	13.55
19.7ft	lb													*4780	*4780	*4650	4430	*1940	*1940	*1760	*1760	(44.5)
4.5m	kg											*2530	*2530	*2350	*2350	*2220	1940	*1430	*1430	*810	*810	13.94
14.8ft	lb											*5580	*5580	*5180	*5180	*4890	4280	*3150	*3150	*1790	*1790	(45.7)
3.0m	kg					*5420	*5420	*4030	*4030	*3300	*3300	*2850	*2850	*2560	2350	*2360	1850	*1770	1460	*840	*840	14.15
9.8ft	lb					*11950	*11950	*8880	*8880	*7280	*7280	*6280	*6280	*5640	5180	*5200	4080	*3900	3220	*1850	*1850	(46.4)
1.5m	kg					*6960	*6960	*4860	*4860	*3810	3680	*3180	2810	*2780	2200	*2510	1760	*1960	1410	*880	*880	14.20
4.9ft	lb					*15340	*15340	*10710	*10710	*8400	8110	*7010	6190	*6130	4850	*5530	3880	*4320	3110	*1940	*1940	(46.6)
0.0m	kg			*2670	*2670	*6320	*6320	*5550	4540	*4260	3380	*3490	2610	*2990	2070	*2650	1670	*1970	1360	*940	*940	14.08
0.0ft	lb			*5890	*5890	*13930	*13930	*12240	10010	*9390	7450	*7690	5750	*6590	4560	*5840	3680	*4340	3000	*2070	*2070	(46.2)
-1.5m	kg	*2530	*2530	*3460	*3460	*6060	*6060	*6000	4240	*4600	3160	*3740	2460	*3170	1970	2680	1600	*1670	1320	*1040	*1040	13.81
-4.9ft	lb	*5580	*5580	*7630	*7630	*13360	*13360	*13230	9350	*10140	6970	*8250	5420	*6990	4340	5910	3530	*3680	2910	*2290	*2290	(45.3)
-3.0m	kg	*3520	*3520	*4440	*4440	*6700	6150	*6220	4090	*4810	3020	*3900	2360	3180	1890	2640	1560			*1170	*1170	13.36
-9.8ft	lb	*7760	*7760	*9790	*9790	*14770	13560	*13710	9020	*10600	6660	*8600	5200	7010	4170	5820	3440			*2580	*2580	(43.8)
-4.5m	kg	*4540	*4540	*5560	*5560	*7810	6170	*6230	4050	*4860	2970	3900	2310	3150	1860	2630	1550			*1360	*1360	12.71
-14.8ft	lb	*10010	*10010	*12260	*12260	*17220	13600	*13730	8930	*10710	6550	8600	5090	6940	4100	5800	3420			*3000	*3000	(41.7)
-6.0m	kg	*5640	*5640	*6840	*6840	*8000	6290	*6020	4090	*4750	2980	*3870	2320	3170	1880					*1650	1620	11.84
-19.7ft	lb	*12430	*12430	*15080	*15080	*17640	13870	*13270	9020	*10470	6570	*8530	5110	6990	4140					*3640	3570	(38.8)
-7.5m	kg	*6860	*6860	*8360	*8360	*7280	6490	*5570	4210	*4430	3060	*3580	2390	*2850	1970					*2170	1930	10.68
-24.6ft	lb	*15120	*15120	*18430	*18430	*16050	14310	*12280	9280	*9770	6750	*7890	5270	*6280	4340					*4780	4250	(35.0)
-9.0m	kg			*8410	*8410	*6130	*6130	*4760	4410	*3760	3230	*2880	2550							*2800	2510	9.13
-29.5ft	lb			*18540	*18540	*13510	*13510	*10490	9720	*8290	7120	*6350	5620							*6170	5530	(30.0)

Note 1. Lifting capacity are based on ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

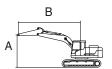
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

Failure to comply to the rated load can cause possible personal injury or property damage. Make adjustments to the rated load as necessory for non-standard configurations.

3) HX225S L HIGH WALKER

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Do	zer	Outrigger	
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
HW	BOOM	5700	2000	3800	600	-	-	-	-	-

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



					Lift-point	radius (B))			At	max. rea	ch
Lift-po	int	3.0 m	(9.8 ft)	4.5 m (14.8 ft)	6.0 m (19.7 ft)	7.5 m (24.6 ft)	Сар	acity	Reach
height	(A)		#			Ů			#	U	#	m (ft)
7.5 m (24.6 ft)	kg lb									*6050 *13340	*6050 *13340	5.27 (17.3)
6.0 m	kg			*6280	*6280	*5790	*5790			*5800	5750	6.52
(19.7 ft)	lb			*13850	*13850	*12760	*12760			*12790	12680	(21.4)
4.5 m	kg			*7590	*7590	*6210	*6210			*5780	4820	7.25
(14.8 ft)	lb			*16730	*16730	*13690	*13690			*12740	10630	(23.8)
3.0 m	kg					*6920	6220	5840	4500	5710	4400	7.61
(9.8 ft)	lb					*15260	13710	12870	9920	12590	9700	(25.0)
1.5 m	kg					*7550	6030	5760	4420	5580	4290	7.66
(4.9 ft)	lb					*16640	13290	12700	9740	12300	9460	(25.1)
0.0 m	kg			*10580	8990	*7800	5920			5820	4460	7.41
(0.0 ft)	lb			*23320	19820	*17200	13050			12830	9830	(24.3)
-1.5 m	kg			*10010	9030	*7500	5930			*6340	5010	6.81
(-4.9 ft)	lb			*22070	19910	*16530	13070			*13980	11050	(22.4)
-3.0 m	kg	*11230	*11230	*8540	*8540					*6330	*6330	5.78
(-9.8 ft)	lb	*24760	*24760	*18830	*18830					*13960	*13960	(18.9)

Note 1. Lifting capacity are based on ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

Failure to comply to the rated load can cause possible personal injury or property damage.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Do	zer	Outri	gger
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
HW	BOOM	5700	2400	3800	600	-	-	-	-	-

· 🖟 : Rating over-front

· 🖶 : Rating over-side or 360 degree



					Lift-point	radius (B)				At	max. rea	ch
Lift-po	int	3.0 m	(9.8 ft)	4.5 m (14.8 ft)	6.0 m (19.7 ft)	7.5 m (24.6 ft)	Cap	acity	Reach
height (A)				Ů	#	Ů	#	Ů	#	·	#	m (ft)
7.5 m (24.6 ft)	kg lb									*5540 *12210	*5540 *12210	5.82 (19.1)
6.0 m (19.7 ft)	kg lb					*5370 *11840	*5370 *11840			*5380 *11860	5190 11440	6.97 (22.9)
4.5 m (14.8 ft)	kg lb			*7040 *15520	*7040 *15520	*5860 *12920	*5860 *12920	*5390 *11880	4580 10100	*5320 *11730	4430 9770	7.65 (25.1)
3.0 m	kg			*8790	*8790	*6630	6230	*5650	4490	5280	4070	8.00
(9.8 ft) 1.5 m	lb kg			*19380 *10120	*19380 9110	*14620 *7330	13730 6010	*12460 5730	9900 4390	11640 5170	8970 3970	(26.2) 8.05
(4.9 ft) 0.0 m	lb kg			*22310 *10540	20080 8930	*16160 *7710	13250 5880	12630 5660	9680 4330	11400 5360	8750 4110	(26.4) 7.80
(0.0 ft) -1.5 m	lb	*10260	*10260	*23240 *10190	19690 8930	*17000 *7580	12960 5850	12480	9550	11820 5960	9060 4550	(25.6) 7.25
(-4.9 ft)	kg lb	*22620	*22620	*22470	19690	*16710	12900			13140	10030	(23.8)
-3.0 m (-9.8 ft)	kg lb	*12250 *27010	*12250 *27010	*9010 *19860	*9010 *19860	*6560 *14460	5960 13140			*6060 *13360	5620 12390	6.28 (20.6)

Note 1. Lifting capacity are based on ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- * Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

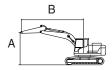
Failure to comply to the rated load can cause possible personal injury or property damage.

Make adjustments to the rated load as necessory for non-standard configurations.

Model	Туре	Boom	Arm	Counterweight	Shoe	Wheel	Do	zer	Outri	igger
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
HW	BOOM	5700	2900	3800	600	-	-	-	-	-

· 🖟 : Rating over-front

· 🖶 : Rating over-side or 360 degree



		Lift-point radius (B)										At	max. rea	.ch
Lift-po	int	1.5 m	(4.9 ft)	3.0 m	(9.8 ft)	4.5 m (14.8 ft)	6.0 m (19.7 ft)	7.5 m (24.6 ft)	Capa	acity	Reach
height (A)		Ů	#	U	#	Ů	#	Ů	#	b	#	Ů	#	m (ft)
7.5 m	kg							*4850	*4850			*4270	*4270	6.40
(24.6 ft)	lb							*10690	*10690			*9410	*9410	(21.0)
6.0 m	kg							*4870	*4870			*4010	*4010	7.45
(19.7 ft)	lb							*10740	*10740			*8840	*8840	(24.4)
4.5 m	kg					*6340	*6340	*5420	*5420	*5000	4600	*3970	*3970	8.09
(14.8 ft)	lb					*13980	*13980	*11950	*11950	*11020	10140	*8750	*8750	(26.6)
3.0 m	kg					*8120	*8120	*6240	*6240	*5350	4490	*4090	3760	8.42
(9.8 ft)	lb					*17900	*17900	*13760	*13760	*11790	9900	*9020	8290	(27.6)
1.5 m	kg					*9660	9160	*7040	6010	5710	4370	*4370	3670	8.47
(4.9 ft)	lb					*21300	20190	*15520	13250	12590	9630	*9630	8090	(27.8)
0.0 m	kg			*5470	*5470	*10390	8890	*7550	5840	5620	4280	*4890	3770	8.24
(0.0 ft)	lb			*12060	*12060	*22910	19600	*16640	12870	12390	9440	*10780	8310	(27.0)
-1.5 m	kg	*6250	*6250	*10100	*10100	*10320	8840	*7620	5780	5600	4270	5400	4120	7.71
(-4.9 ft)	lb	*13780	*13780	*22270	*22270	*22750	19490	*16800	12740	12350	9410	11900	9080	(25.3)
-3.0 m	kg			*13330	*13330	*9470	8920	*7000	5840			*5830	4930	6.81
(-9.8 ft)	lb			*29390	*29390	*20880	19670	*15430	12870			*12850	10870	(22.4)
-4.5 m	kg	_		*10170	*10170	*7310	*7310					*5780	*5780	5.36
(-14.8 ft)	lb			*22420	*22420	*16120	*16120					*12740	*12740	(17.6)

Note 1. Lifting capacity are based on ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

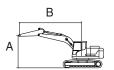
Failure to comply to the rated load can cause possible personal injury or property damage.

Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Do	zer	Outri	gger
HX225S L	MONO	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
HW	BOOM	5700	3500	3800	600	-	-	-	-	-

· 🖟 : Rating over-front

· 🖶 : Rating over-side or 360 degree



			Lift-point radius (B)									At	max. rea	.ch
Lift-po	int	1.5 m ((4.9 ft)	3.0 m	(9.8 ft)	4.5 m (14.8 ft)	6.0 m (19.7 ft)	7.5 m (24.6 ft)	Capa	acity	Reach
height (A)		Ů	#	ŀ	#	Ů	#	Ů	#	U	#	Ů	#	m (ft)
7.5 m	kg											*3590	*3590	7.05
(24.6 ft)	lb											*7910	*7910	(23.1)
6.0 m	kg							*4260	*4260	*4310	*4310	*3410	*3410	8.02
(19.7 ft)	lb							*9390	*9390	*9500	*9500	*7520	*7520	(26.3)
4.5 m	kg							*4850	*4850	*4530	*4530	*3400	*3400	8.62
(14.8 ft)	lb							*10690	*10690	*9990	*9990	*7500	*7500	(28.3)
3.0 m	kg					*7240	*7240	*5710	*5710	*4960	4480	*3510	3410	8.93
(9.8 ft)	lb					*15960	*15960	*12590	*12590	*10930	9880	*7740	7520	(29.3)
1.5 m	kg					*8970	*8970	*6600	6000	*5430	4330	*3750	3320	8.97
(4.9 ft)	lb					*19780	*19780	*14550	13230	*11970	9550	*8270	7320	(29.4)
0.0 m	kg			*6530	*6530	*10020	8830	*7260	5790	5560	4220	*4170	3390	8.76
(0.0 ft)	lb			*14400	*14400	*22090	19470	*16010	12760	12260	9300	*9190	7470	(28.7)
-1.5 m	kg	*5900	*5900	*9710	*9710	*10280	8690	*7520	5680	5500	4160	4810	3660	8.26
(-4.9 ft)	lb	*13010	*13010	*21410	*21410	*22660	19160	*16580	12520	12130	9170	10600	8070	(27.1)
-3.0 m	kg	*9580	*9580	*14270	*14270	*9790	8720	*7230	5690			*5470	4250	7.43
(-9.8 ft)	lb	*21120	*21120	*31460	*31460	*21580	19220	*15940	12540			*12060	9370	(24.4)
-4.5 m	kg			*11750	*11750	*8290	*8290	*5870	5850			*5650	*5650	6.13
(-14.8 ft)	lb			*25900	*25900	*18280	*18280	*12940	12900			*12460	*12460	(20.1)

Note 1. Lifting capacity are based on ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
- 4. *Indicates load limited by hydraulic capacity.
- Lifting capacities are based upon a standard machine conditions.

Lifting capacities will vary with different work tools, ground conditions and attachments.

The difference between the weight of a work tool attachment must be subtracted.

Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

Failure to comply to the rated load can cause possible personal injury or property damage.

Make adjustments to the rated load as necessory for non-standard configurations.

6. BUCKET SELECTION GUIDE

1) HX225S L, 3800 KG COUNTERWEIGHT







Heavy duty (without side cutter)



Rock heavy duty



Long reach

	Con	o oitr	Wi	d+b				MC	NO	
	Capa	acity	VVI	ulri				Recomm	nendation	
Туре	SAE Heaped	CECE heaped	Without side cutter	With side cutter	Weight	Tooth		5.70 m (18	8' 8") Boom	
	m³ (yd³)	m³ (yd³)	mm (in)	mm (in)	kg (lb)	EA	2.00 m (6' 7") Arm	2.40 m (7' 10") Arm	2.90 m (9' 6") Arm	3.50 m (11' 6") Arm
	0.92 (1.20)	0.81 (1.06)	1085 (42.7')	1230 (48.4')	750 (1650)	5	•	•	•	0
General	1.05 (1.37)	0.96 (1.26)	1220 (48.0")	1370 (53.9")	790 (1740)	5	•	•	0	
bucket	1.17 (1.53)	1.00 (1.31)	1340 (52.8")	1490 (58.7")	850 (1870)	6	0	•		•
	1.28 (1.67)	1.11 (1.45)	1455 (57.3")	1605 (63.2")	885 (1950)	6	0			•
Heavy	0.92 (1.20)	0.83 (1.09)	1050 (41.3")	1095 (43.1")	865 (1910)	5	•	•	•	•
duty	1.08 (1.41)	0.97 (1.27)	1200 (47.2")	1245 (49.0")	935 (2060)	5	•	•		
	0.91 (1.19)	0.83 (1.09)	1050 (41.3")	1095 (43.1")	1050 (2310)	4	•	•	0	Х
	1.07 (1.40)	0.97 (1.27)	1200 (47.2")	1245 (49.0")	1160 (2560)	5	•	•		Х
Rock heavy	1.23 (1.61)	1.11 (1.45)	1350 (53.1")	1395 (54.9")	1240 (2730)	5			•	X
duty	1.00 (1.31)	0.87 (1.14)	1240 (48.8")	1245 (49.0")	985 (2170)	5	•	•	0	Х
	0.87 (1.14)	0.75 (0.98)	1150 (45.3")	-	875 (1930)	5	•	•	•	Х
	1.20 (1.57)	1.00 (1.31)	1425 (56.1")	-	990 (2180)	5	•			Х

	Applicable for materials with density of 2100 kg/m³ (3500	lb/yd³) or less
	Applicable for materials with density of 1800 kg/m 3 (3000	lb/yd³) or less
	Applicable for materials with density of 1500 kg/m 3 (2500	lb/yd³) or less
	Applicable for materials with density of 1200 kg/m 3 (2000	lb/yd³) or less
Х	Not recommended	

^{*} These recommendations are for general conditions and average use.

Work tools and ground conditions have effects on machine performance.

Select an optimum combination according to the working conditions and the type of work that is being done.

Consult your HD Hyundai Construction Equipment dealer for information on selecting the correct boom-arm-bucket combination.

2) HX225S L, 4200 KG COUNTERWEIGHT







Heavy duty (without side cutter)



Rock heavy duty



Long reach

								MC	NO	
	Cap	acity	Wi	dth				-	nendation	
Туре	SAE Heaped	CECE heaped	Without side cutter	With side cutter	Weight	Tooth		5.70 m (18	8' 8") Boom	
	m³ (yd³)	m³ (yd³)	mm (in)	mm (in)	kg (lb)	EA	2.00 m (6' 7") Arm	2.40 m (7' 10") Arm	2.90 m (9' 6") Arm	3.50 m (11' 6") Arm
	0.92 (1.20)	0.81 (1.06)	1085 (42.7')	1230 (48.4')	750 (1650)	5	•	•	•	•
General	1.05 (1.37)	0.96 (1.26)	1220 (48.0")	1370 (53.9")	790 (1740)	5	•	•	0	
bucket	1.17 (1.53)	1.00 (1.31)	1340 (52.8")	1490 (58.7")	850 (1870)	6	•	0		
	1.28 (1.67)	1.11 (1.45)	1455 (57.3")	1605 (63.2")	885 (1950)	6	•	0		_
Heavy	0.92 (1.20)	0.83 (1.09)	1050 (41.3")	1095 (43.1")	865 (1910)	5	•	•	•	•
duty	1.08 (1.41)	0.97 (1.27)	1200 (47.2")	1245 (49.0")	935 (2060)	5	•	•	•	
	0.91 (1.19)	0.83 (1.09)	1050 (41.3")	1095 (43.1")	1050 (2310)	4	•	•	•	Х
	1.07 (1.40)	0.97 (1.27)	1200 (47.2")	1245 (49.0")	1160 (2560)	5	•	0		Х
Rock heavy	1.23 (1.61)	1.11 (1.45)	1350 (53.1")	1395 (54.9")	1240 (2730)	5	0			Х
duty	1.00 (1.31)	0.87 (1.14)	1240 (48.8")	1245 (49.0")	985 (2170)	5	•	•	0	Х
	0.87 (1.14)	0.75 (0.98)	1150 (45.3")	-	875 (1930)	5	•	•	•	Х
	1.20 (1.57)	1.00 (1.31)	1425 (56.1")	-	990 (2180)	5	•	•		X

	Applicable for materials with density of 2100 kg/m³ (3500	lb/yd³) or less
	Applicable for materials with density of 1800 kg/m 3 (3000	lb/yd³) or less
	Applicable for materials with density of 1500 kg/m 3 (2500	lb/yd³) or less
	Applicable for materials with density of 1200 kg/m 3 (2000	lb/yd³) or less
Χ	Not recommended	

* These recommendations are for general conditions and average use.

Work tools and ground conditions have effects on machine performance.

Select an optimum combination according to the working conditions and the type of work that is being done.

Consult your HD Hyundai Construction Equipment dealer for information on selecting the correct boom-arm-bucket combination.

3) HX225S L LONG REACH, 5300 KG COUNTERWEIGHT

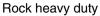






Heavy duty (without side cutter)







Long reach

	Сар	acity	Wie	dth			MONO Recommendation
Туре	SAE Heaped	CECE heaped	Without side cutter	With side cutter	Weight	Tooth	8.50 m (27' 11") Boom
	m ³ (yd ³)	m ³ (yd ³)	mm (in)	mm (in)	kg (lb)	EA	6.20 m (20' 4") Arm
LR	0.51 (0.67)	0.45 (0.59)	865 (34.1")	995 (39.2")	395 (870)	5	•

	Applicable for materials with density of 2100 kg/m³ (3500	lb/yd³) or less
0	Applicable for materials with density of 1800 kg/m³ (3000	lb/yd³) or less
	Applicable for materials with density of 1500 kg/m³ (2500	lb/yd³) or less
	Applicable for materials with density of 1200 kg/m 3 (2000	lb/yd³) or less
X	Not recommended	

^{*} These recommendations are for general conditions and average use.

Work tools and ground conditions have effects on machine performance.

Select an optimum combination according to the working conditions and the type of work that is being done.

Consult your HD Hyundai Construction Equipment dealer for information on selecting the correct boom-arm-bucket combination.

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

,	Model Shapes		Triple grouser			Double grouser		
Model								
	Shoe width	mm (in)	600 (24)	700 (28)	800 (32)	900 (36)	-	-
HX225S L	Operating weight	kg (lb)	22070 (48660)	22550 (49710)	22830 (50330)	23150 (51040)	-	-
11A2233 L	Ground pressure	kgf/cm² (psi)	0.47 (6.68)	0.41 (5.58)	0.36 (5.18)	0.33 (4.67)	-	-
	Overall width	mm (ft-in)	2990 (9' 10")	3090 (10' 2")	3190 (10' 6")	3290 (10' 10")	-	-
	Shoe width	mm (in)	-	-	800 (32)	-	-	-
HX225S L LONG	Operating weight	kg (lb)	-	-	24830 (54740)	-	-	-
REACH	Ground pressure	kgf/cm² (psi)	-	-	0.40 (5.64)	-	-	-
	Overall width	mm (ft-in)	-	-	3190 (10' 6")	-	-	-
	Shoe width	mm (in)	600 (24)	700 (28)	800 (32)	900 (36)	600 (24)	700 (28)
HX225S L HIGH WALKER	Operating weight	kg (lb)	24300 (53570)	24580 (54190)	24860 (54810)	25180 (55510)	24530 (54080)	24850 (54780)
	Ground pressure	kgf/cm² (psi)	0.52 (7.36)	0.45 (6.38)	0.40 (5.64)	0.36 (5.08)	0.52 (7.42)	0.45 (6.45)
	Overall width	mm (ft-in)	3395 (11' 2")	3495 (11' 6")	3595 (11' 10")	3695 (12' 1")	3395 (11' 2")	3495 (11' 6")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity	
Upper rollers	2 EA	
Lower rollers	8 EA	
Track shoes	49 EA	

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

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

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

% Table 1

Track shoe	Specification	Category
600 mm triple grouser	Standard	Α
700 mm triple grouser	Option	В
600,700 mm double grouser *1	Option	В
800 mm triple grouser	Option	С
800 mm triple grouser (long reach)	Standard	С
900 mm triple grouser	Option	С

^{*1:} HIGH WALKER ONLY

* Table 2

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

Item	Specification
Model	HD Hyundai Construction Equipment HM5.9
Туре	4-cycle, turbocharged, charge 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 borexstroke	102×120 mm (4.02 "×4.72 ")
Piston displacement	5900 cc (360 cu in)
Compression ratio	17.3:1
Rated net horse power (SAE J1349)	147 Hp at 1950 rpm (110 kW at 1950 rpm)
Rated gross horse power (SAE J1995)	150 Hp at 1950 rpm (112 kW at 1950 rpm)
Maximum torque at 1300 rpm	62.7 kgf · m (453 lbf · ft)
Engine oil quantity	20 ℓ (5.3 U.S. gal)
Dry weight	437 kg (963 lb)
High idling speed	2200 + 50 rpm
Low idling speed	1050 \pm 100 rpm
Min. fuel consumption	155 g/Hp · hr at 1500 rpm
Starting motor	Nippon denso (24 V-4.5 kW)
Alternator	Valeo (24 V-95 A)
Battery	2×12V×100Ah

2) MAIN PUMP

Item	Specification	
Туре	Variable displacement tandem axis piston pumps	
Capacity	2 × 130 cc/rev	
Maximum pressure	350 kgf/cm² (4980 psi) [380 kgf/cm² (5400 psi)]	
Rated oil flow	2 × 247 ℓ /min (65.2 U.S. gpm/ 54.3 U.K. gpm)	
Rated speed	1900 rpm	

[]: Power boost

3) GEAR PUMP

Item	Specification	
Туре	Fixed displacement gear pump single stage	
Capacity	10 cc/rev	
Maximum pressure	44.9 kgf/cm² (640 psi)	
Rated oil flow	19.0 ℓ/min (5.0 U.S. gpm/4.2 U.K. gpm)	

4) MAIN CONTROL VALVE

Itom		Specification		
Item		HX225S L Long re		
Туре		10 spools two-block		
Operating method		Hydraulic pilot system		
Main relief valve pressure		350 kgf/cm² (4980 psi) [380 kgf/cm² (5400 psi)] *1 350 kgf/cm² (4980 psi) [Not applied power boost]		
Boom		400 kgf/cm² (5690 psi)		
Port relief valve pressure Arm Bucket		400 kgf/cm² (5690 psi)	300 kgf/cm² (4270 psi)	
		400 kgf/cm² (5690 psi)	280 kgf/cm² (3980 psi)	

^{[]:} Power boost *1: Long reach only

5) SWING MOTOR

Item	Specification
Туре	Two fixed displacement axial piston motor
Capacity	142.8 cc/rev
Relief pressure	265 kgf/cm² (3770 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	63.4 kgf · m (459 lbf · ft)
Brake release pressure	35.5 kgf/cm² (500 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)	
Reduction gear type	2-stage planetary	
Braking system	Automatic, spring applied hydraulic released	
Brake release pressure	15.4 kgf/cm² (220 psi)	
Braking torque	65.4 kgf · m (473 lbf · ft)	

7) REMOTE CONTROL VALVE

Item		Specification	
Туре		Pressure reducing type	
	Minimum	6.5 kgf/cm² (92 psi)	
Operating pressure	Maximum	25 kgf/cm² (356 psi)	
O'anta an all'an atal	Lever	90 mm (3.5 in)	
Single operation stroke	Pedal	130 mm (4.4 in)	

8) CYLINDER

	Specification	
Doom audindor	Bore dia × Stroke	Ø120 × 1290 mm
Boom cylinder	Cushion	Extend only
Awar a dia day	Bore dia × Stroke	Ø140 × 1443 mm
Arm cylinder	Cushion	Extend and retract
Puokat aylindar	Bore dia × Stroke	Ø120 × 1060 mm
Bucket cylinder	Cushion	Extend only
Puelset eylinder (Leng reach)	Bore dia × Stroke	Ø 95 × 900 mm
Bucket cylinder (Long reach)	Cushion	Extend only

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

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

9. RECOMMENDED OILS

HD Hyundai Construction Equipment genuine lubricating oils have been developed to offer the best performance and service life for your equipment. These oils have been tested according to the specifications of HD Hyundai Construction Equipment and, therefore, will meet the highest safety and quality requirements. We recommend that you use only HD Hyundai Construction Equipment genuine lubricating oils and grease officially approved by HD Hyundai Construction Equipment.

Service		Capacity		Ambient temperature °C(°F)								
point	Kind of fluid	ℓ (U.S. gal)	-50	-30	-20		-	0	10	20	30	40
P			(-58)	(-22)	(-4)) (1	4)	(32)	(50)	(68)	(86)	(104)
					★ S/	AE 5W	-40					
										SAE 30)	
Engine	Engine oil	20 (5.3)				SAF	10W					
oil pan	go o	20 (0.0)				0, 12			0W-30			
								S.	AE 15W	/-40		
Swing		6.2 (1.6)										
drive	Gear oil	6.2 (1.6)			★ SA	E 75W	<i>I</i> -90					
Final	GGGI GII	4.5×2						S	AE 80W	/-90		
drive		(1.2×2)										
		Tank : 160 (42.3) System : 275			*	ISO V	G 15					
Hydraulic						ı	SO V	'G 32				
tank	Hydraulic oil							ISC) VG 46			
		(72.6)						130				
		, ,							ISO	VG 68		
				<u>+</u> ^ !	STM D9	75 NO	1					
Fuel tank	Diesel fuel	400 (106)		X A	פט ואוז פ	75 NO	. 1					
									ASTM [0975 NO.	.2	
Fitting						★NLG		1				
(grease	Grease	As required				AINLO	1110					
nipple)									NLGI NC).2		
Radiator	Mixture of antifreeze				Eth	nylene	glyco	l base p	ermane	nt type (5	0 : 50)	
(reservoir	and soft	31 (8.2)	A Educ	براه محمار			Ĭ					
tank)	water*1		*Ein	riene glyc	col base per	manent ty	pe (60)	(40)				

SAE: Society of Automotive Engineers

API: American Petroleum Institute

ISO: International Organization for Standardization

NLGI : National Lubricating Grease Institute

ASTM: American Society of Testing and Material

★ : Cold region

Russia, CIS, Mongolia

★1: Soft water

City water or distilled water

- * Using any lubricating oils other than HD Hyundai Construction Equipment genuine products may lead to a deterioration of performance and cause damage to major components.
- * Do not mix HD Hyundai Construction Equipment genuine oil with any other lubricating oil as it may result in damage to the systems of major components.
- * For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

SECTION 2 STRUCTURE AND FUNCTION

Group	1 Pump Device ·····	2-1
Group	2 Main Control Valve	2-23
Group	3 Swing Device	2-59
Group	4 Travel Device	2-70
Group	5 RCV Lever	2-84
Group	6 RCV Pedal ·····	2-91

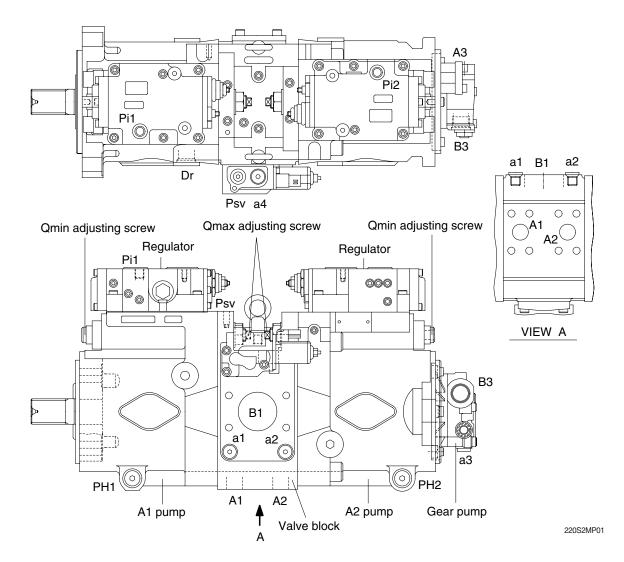
SECTION 2 STRUCTURE AND FUNCTION

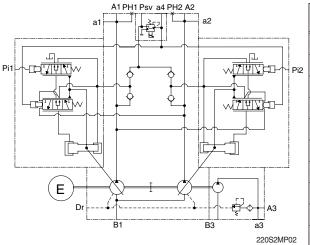
GROUP 1 PUMP DEVICE

1. STRUCTURE

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

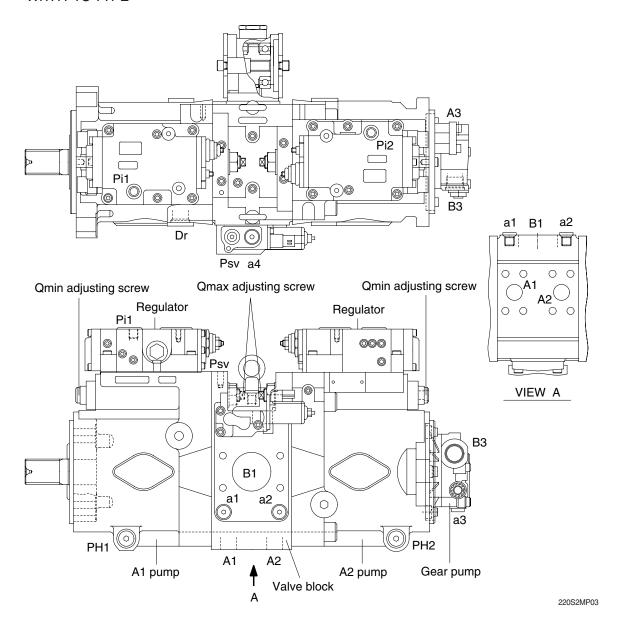
· WITHOUT PTO TYPE

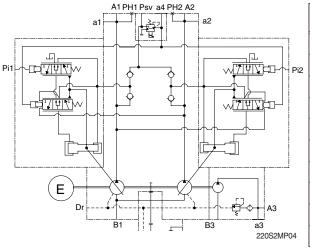




Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	PF 3/4 - 20
Pi1,i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1,2,4	Gauge port	PF 1/4 - 15
PH1,2	Pressure sensor port	PF 3/8-17
a3	Gauge port	PF 1/4-14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

· WITH PTO TYPE

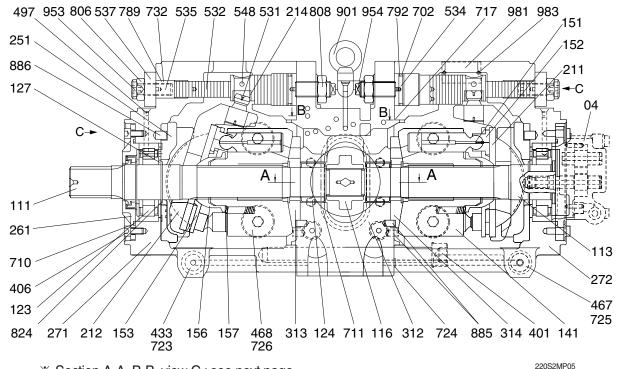




Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	PF 3/4 - 20
Pi1,i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1,2,4	Gauge port	PF 1/4 - 15
PH1,2	Pressure sensor port	PF 3/8-17
аЗ	Gauge port	PF 1/4-14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

1) MAIN PUMP (1/3)

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



※ Section A-A, B-B, view C : see next page.

272 Pump casing (R) 711 O-ring 312 Valve block 717 O-ring 313 Valve plate (R) 723 O-ring 314 Valve plate (L) 724 Square ring 401 Hexagon socket bolt 725 O-ring 406 Hexagon socket bolt 726 O-ring 466 Plug 732 O-ring 774 Oil seal 467 Plug 468 Plug 789 Back up ring 497 MH Plug 792 Back up ring 531 Tilting pin 806 Hexagon head nut

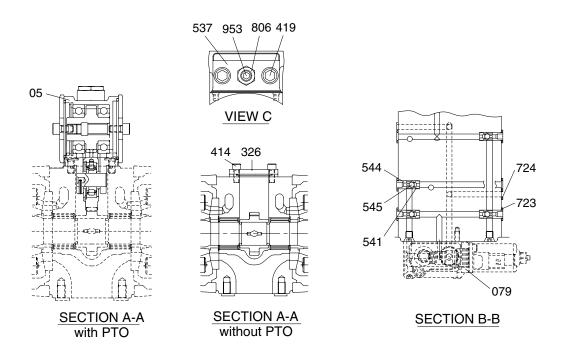
532Servo piston808Hexagon head nut534Stopper (L)824Snap ring535Stopper (S)885Pin537Servo cover (S)886Pin548Feed-back pin901Eye bolt702O-ring953Set screw710O-ring954Set screw

111 Drive shaft (F) 113 Drive shaft (R) 116 1st gear 123 Roller bearing 124 Needle bearing 127 Bearing spacer 141 Cylinder block 151 Piston 152 Shoe 153 Set plate 156 Spherical bushing 157 Cylinder spring 211 Shoe plate 212 Swash plate 214 Tilting Bushing 251 Support Seal cover (F) 261 271 Pump casing (F)

Gear pump

04

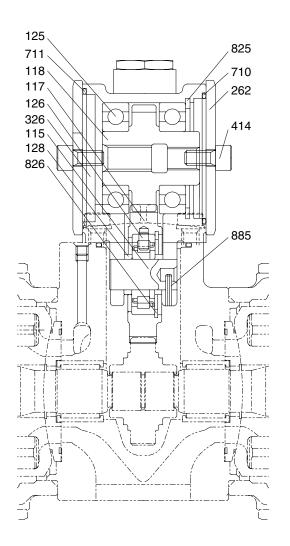
MAIN PUMP (2/3)

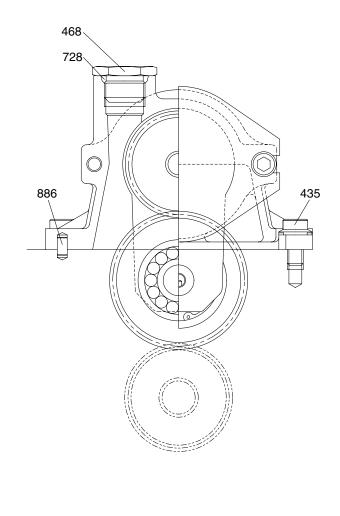


220S2MP06

05	PTO unit (with PTO)	537	Servo cover (S)	724	Square ring
079	Proportional reducing valve	541	Seat	806	Hexagon head nut
326	Cover (without PTO)	544	Stopper 1	953	Set screw
414	Hexagon socket bolt (without PTO)	545	Steel ball		
419	Hexagon socket bolt	723	O-ring		

MAIN PUMP (3/3, WITH PTO TYPE)

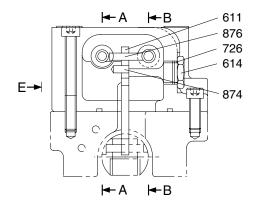


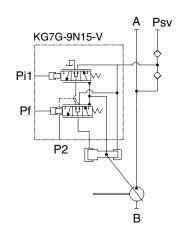


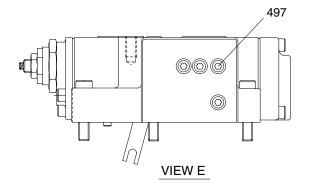
220S2MP07

115	Idler shaft	262	Cover	711	O-ring
117	Gear No. 2	326	Gear case	728	O-ring
118	Gear No. 3	414	Socket head screw	825	Retainer ring
125	Ball bearing	435	Flange head socket bolt	826	Retainer ring
126	Roller bearing	468	Plug	885	Spring pin
128	Bearing spacer	710	O-ring	886	Pin

2) REGULATOR (1/2)







220S2MP08

412 Hexagon socket screw

413 Hexagon socket screw

436 Hexagon socket screw

437 Hexagon socket screw

497 Plug

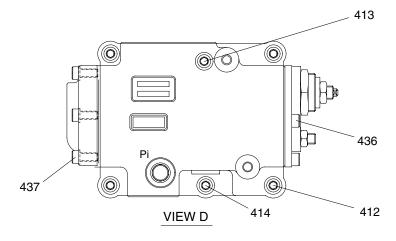
611 Feed back lever

614 Adjust plug

726 O-ring

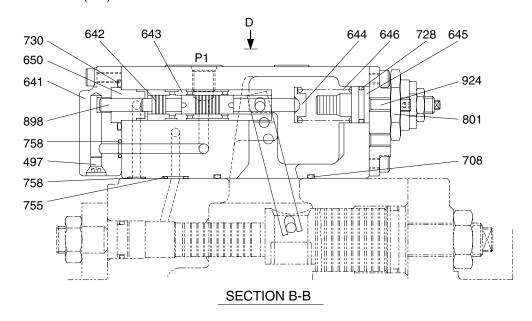
874 Pin

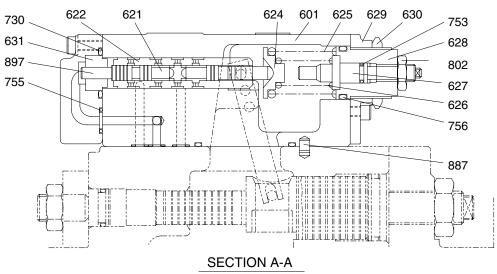
876 Pin



Port	Port name	Port size
Α	Delivery port	SAE 6000 psi 1"
В	Suction port	SAE 2500 psi 2 1/2"
Pi	Pilot port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

REGULATOR (2/2)

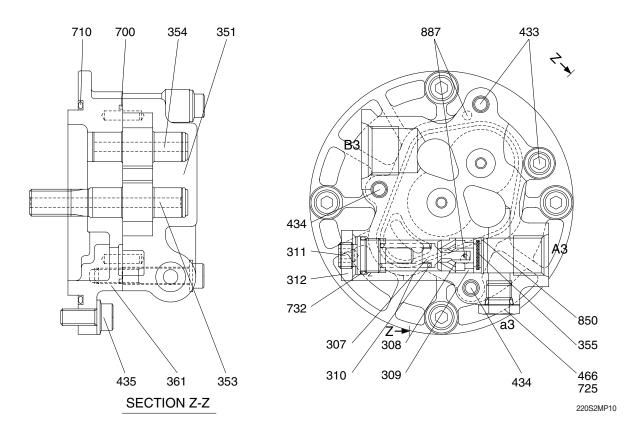




220S2MP09

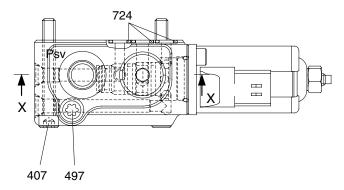
414	Hexagon socket screw	630	Lock nut	730	O-ring
497	Plug	631	Sleeve, pf	753	O-ring
601	Casing	641	Pilot cover	755	O-ring
621	Compensator piston	642	Pilot spool	756	O-ring
622	Compensator sleeve	643	Pilot sleeve	758	Square ring
624	Spring seat (C)	644	Spring seat (Q)	801	Nut
625	Outer spring	645	Adjust stem (Q)	802	Nut
626	Inner spring	646	Pilot spring	887	Pin
627	Adjust stem (C)	650	Sleeve, pi	897	Piston, pf
628	Adjust screw (C)	708	O-ring	898	Piston, pi
629	Cover (C)	728	O-ring	924	Set screw

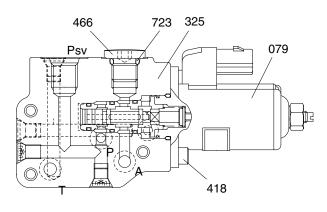
3) GEAR PUMP



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	Adjusting screw	433	Flange socket	732	O-ring
312	Lock nut	434	Flange socket	850	Snap ring
351	Gear case	435	Flange socket	887	Pin

4) PROPORTIONAL REDUCING VALVE AND CASING ASSY



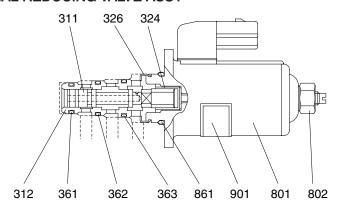


SECTION X-X 220S2MP11

220S2MP12

Proportional reducing valve
 Valve casing
 Plug
 Plug
 Square ring
 Hexagon socket head bolt
 Plug

5) PROPORTIONAL REDUCING VALVE ASSY



 311
 Spool
 361
 O-ring
 802
 Seal nut

 312
 Sleeve
 362
 O-ring
 861
 O-ring

 324
 Spring
 363
 O-ring
 901
 Name plate

 326
 Retaining ring
 801
 Solenoid

2. MAIN PUMP

The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery flow: and the valve block group that changes over oil suction and discharge: and the PTO group to attach on auxiliary gear pump.

1) ROTARY GROUP

The rotary group consists of drive shaft (F) (111), bearing spacers (127), cylinder block (141), piston shoes (151,152), set plates (153), spherical bushings (156) and cylinder springs (157). The drive shaft is supported by bearings (123,124) at its both ends.

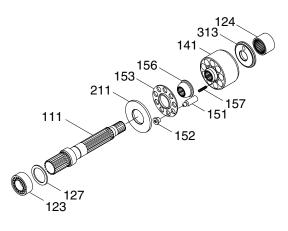
The shoe is caulked to the piston to form a spherical joint for lessening thrust force generated by load pressure and has grooves to slide on the shoe plate (211) smoothly and hydraulically balanced. The piston-shoe sub group is pushed onto the shoe plate by the cylinder springs through the set plate and spherical bushing for enabling smooth sliding on the shoe plate. Similarly, the cylinder block is pushde onto the valve plate (313, 314) by the cylinder springs.

2) SWASH PLATE GROUP

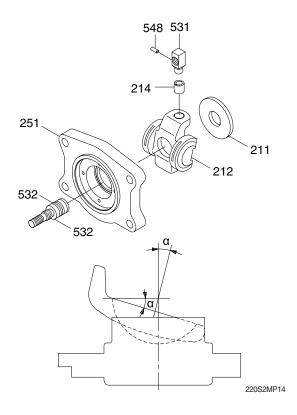
The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

The swash plate is supported by the swash plate support at the cylindrical portion formed on the opposite side of the shoe sliding face.

When the servo piston is moved to the left or right by introducing the hydraulic force controlled by the regulator into the hydraulic chamber provided on both ends of the servo piston, the swash plate slides over the swash plate support through the spherical portion of the tilting pin and can vary the tilting angle (α).



220S2MP13

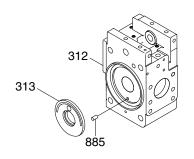


3) VALVE BLOCK GROUP

The valve block group consists of valve block (312), valve plate (313, 314) and valve plate pin(885).

The valve plate having two arc ports is attached to the valve block and feeds and collects oil to and from the cylinder block.

The oil exchanged by the valve plate is connected to an external piping through the valve block.



220S2MP15

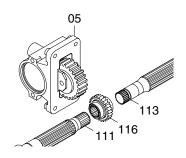
4) PTO GROUP

The PTO group is composed of the PTO unit (05), 1st gear (116), front drive shaft (111) and rear drive shaft (113).

The front and rear shafts are supported by the bearings, respectively and attached to the valve block.

Now, suppose the drive shaft is rotated by the motor or engine, the cylinder block is also rotated through the spline conection. If the swash plate is tilted, the pistons arranged inside the cylinder reciprocate relatively to the cylinder, rotating with the cylinder block. Accordingly, if a piston is focused on, its motion is separating from the valve plate (oil suction process) for 180 degrees, and approaching the valve plate (oil delivery process) for the remaining 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.

In the meantime, the rotation of the drive shaft is pickde up by the 1st gear (116), transmitted to the 3rd gear throught the 2nd gear, and drives the auxiliary pump connected to the 3rd gear.



220S2MP15

3. REGULATOR

1) OUTLINE

The regulator for the K7V series axial piston pump has various models to satisfy various kinds of specifications required.

(1) Horsepower control

The pump tilting angle is automatically decreased as the discharge pressure Pd1, Pd2 rises, and restricts the input torque below a designated value. (The input horsepower is constant when the speed is constant.)

In case of tandem type double pump, the control is total horsepower control. During the horsepower control, the regulators of the respective pumps are controlled at the same tilting angle. Therefore, overload of the motor is automatically prevented regardless of load of the two pumps.

(2) Power shift control

The power shift command pressure Pf is shifted by the input current to the solenoid-operated proportional reducing valve. And, the horsepower setting is shifted by the command pressure Pf. The power shift command pressure Pf (secondary pressure of the solenoid-operated proportional reducing valve) is led to the horsepower control portion of the regulator fo each pump through the pump internal passage, and shifted to the same horsepower setting.

(3) Flow control

By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily. This regulator is the negative flow control in which the delivery flow Q decreases as the pilot pressure Pi raises.

With this mechanism, when the pilot pressure corresponding to the required for the work is commanded, the pump discharges the required flow only, and so does not consume the power uselessly.

This rugulator has the above three contol mechanisms, but in case of combined operation of these controls, priority is given to the lower tilting angle (lower flow) command as described later.

2) FUNTION

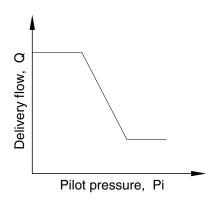
Regulator consists of the negative flow control, horse power control, power shift control and priority mechanism for lower tilting (lower flow) command function.

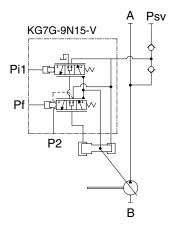
(1) Negative flow control

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.



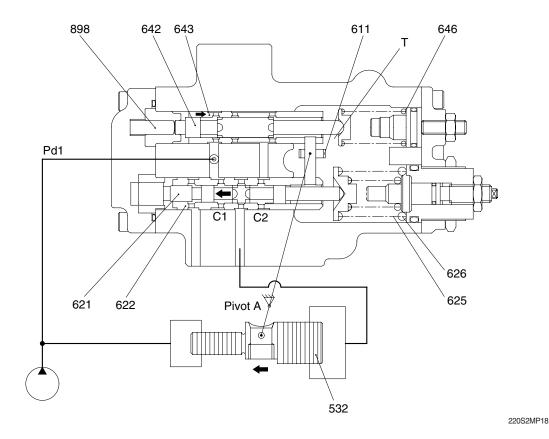


220S2MP17

① Flow decreasing funtion

As the pilot pressure Pi increases, the pilot spool (642) through the pilot piston (898) moves to right direction, and stops at the position where the force of the pilot spring (646) and hydraulic pressure balances.

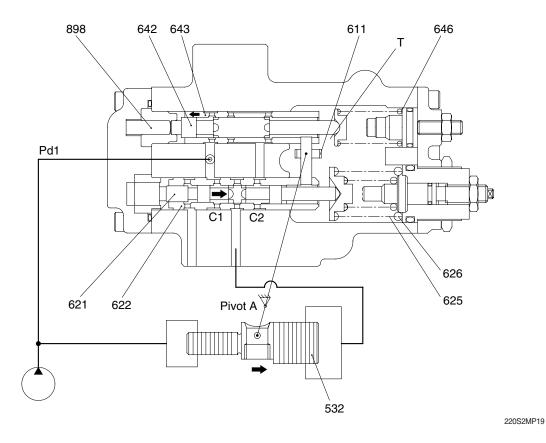
The movement of the pilot spool (642) causes the delivery pressure Pd1 to connect to the port Q1 through the pilot spool spool (642) and to be admitted to the large-diameter section of the servo piston (532). Although the delivery pressure Pd1 is constantly admitted to small-diameter section fo servo piston (532), the servo piston (532) moves to left direction because of its difference of the area between large and small-diameter section. As a result, the tilting angle is decreased. As the servo piston (532) moves, the feedback lever (611) rotates around the pivot. A, and pilot sleeve (643) moves to right direction till the opening between the spool and sleeve being closed.



2-14

② Flow increasing funtion

As the pilot pressure Pi decreases, the pilot spool (642) moves to left direction. The movement of the spool causes the port Q2 connects to the tank port. This deprives the large-diameter section of the servo piston (532) of pressure, and moves the servo piston (532) to right direction by the discharge pressure Pd1 in the small-diameter section, resulting in the flow rate increase.

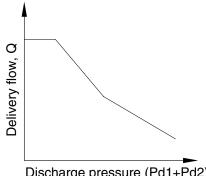


(2) Horsepower control

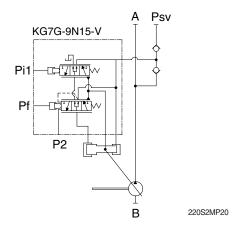
As shown in the figure, when the discharge pressure increases, overloading of the motor is prevented by decreasing the pump tilting angle.

The operation of the horsepower control is similar to that of the flow control, and explained below briefly.

Pf = Pd1+Pd2



Discharge pressure (Pd1+Pd2)



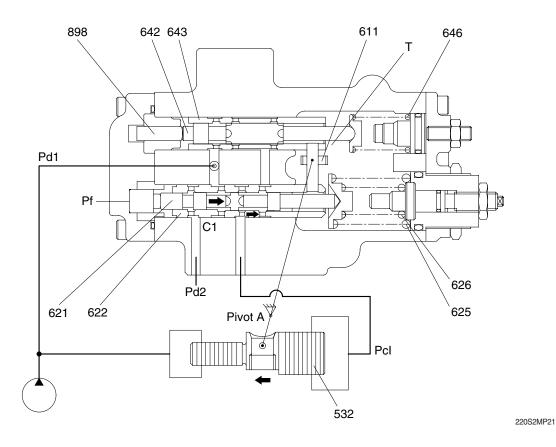
① Overload prevention function

As own pump discharges pressure Pd1, or partner pump discharges pressure Pd2 increase, Pd1, and Pd2 work on the stepped section of the compensator spool (621), and spool moves toward right direction. And stops at the position where the force of the outer spring (625) and inner spring (626) and hydraulic pressure balances.

The movement of the compensator spool (621) causes the delivery pressue Pd1 to connect to the port C1 and to be admitted to the large-diameter section of the servo piston (532).

Although the delivery pressure Pd1 is constantly admitted to small diameter section of servo piston (532), the serve piston (532) moves to the left because of its difference of the area between large and small-diameter section.

As a result, the tilting angle is decreased. As the servo piston (532) moves, the feedback lever (611) rotates around the pivot A, and the compensator sleeve (622) moves to right direction till the opening between the spool and sleeve being closed.



② Flow return function

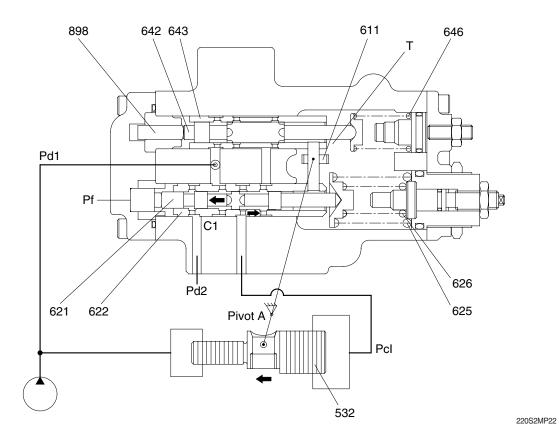
As own pump discharges pressure Pd1, or partner pump discharges pressure Pd2 decrease, the compensator spool (621) moves to left direction by the outer spring (625) and inner spring (626).

And the spool stops at the position where the force of their springs and hydraulic pressure balances.

The movement of the compensator spool causes the delivery pressure Pd1, to connect to the port C1 through the compensator spool (621) and to be admitted to the large-diameter section of the servo piston (532). Although the delivery pressure Pd1, is constantly admitted to small-diameter section of servo piston (532), the servo piston moves to the left direction because of its difference of the area between large and small-diameter section. As a result, the tilting angle is decreased. As the servo piston (532) moves, the feedback lever (611) rotates around the pivot A, and the compensator sleeve (622) moves to right direction fill the opening between the spool and compensator sleeve being closed.

Priority mechanism for lower tilting (lower flow) command

As described above, flow and horsepower control commands are generated independently. In case if the flow and horsepower control commands are generated simultaneously, lower tilting command is selected hydro-mechanically to prevent overload.



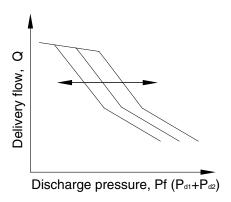
(3) Priority mechanism for lower tilting (lower flow) command

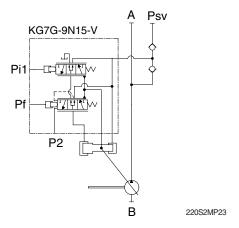
As described previous, flow and horsepower control commands are generated independently. In case if the flow and horsepower control commands are generated simultaneously, lower tilting command is selected hydro-mechanically to prevent overload.

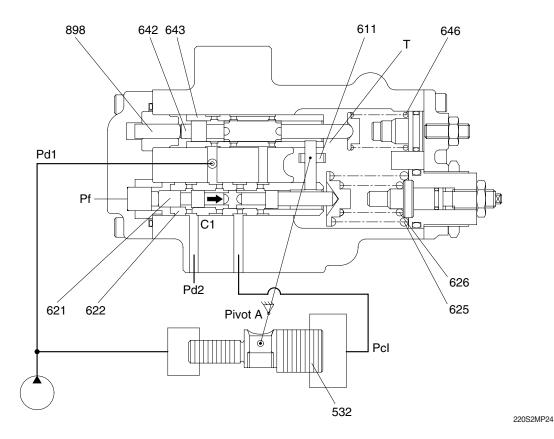
(4) Power shift control (horsepower reduction control)

The pump horsepower control setting is controlled by the power shift pressure Pf (Pd1 + Pd2) as shown in the figure.

When the power shift pressure Pf increases, the compensator spool (621) moves right direction through the Pf piston (897), so the pump tilting angle decreases and horsepower setting decreases, as explained in the overload prevention operation. Conversely, if the power shift pressure Pf decrease, the horsepower setting rises.





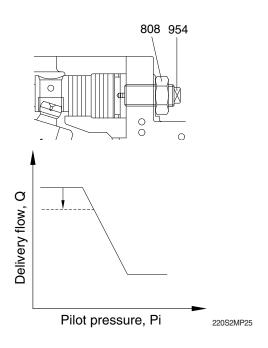


4. ADJUSTMENT OF PUMP AND REGULATOR

The maximum flow and minimum flow can be adjusted with the adjusting screws (954, 953) of the pump. The flow control characteristics can be adjusted with the hexagon socket head cap (924). The horsepower control characteristics can be adjusted with the adjusting screw (C, 628) and adjusting stem (C, 627) of the regulator. The maximum flow and minimum flow can be adjusted with the adjusting screws of the pump.

1) ADJUSTMENT OF MAXIMUM FLOW (MAIN PUMP SIDE)

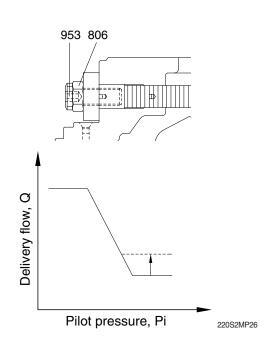
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head screw (954). As tightening the flow decreases, as loosening the flow increases. Only the maxinum flow can be adjusted without changing other control characteristics.



2) ADJUSTMENT OF MINIMUM FLOW (MAIN PUMP SIDE)

Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagon socket head set screw (953). As tightening the flow increases, as loosening the flow decreases.

Similarly to the adjustment of the maximum flow, other characteristics are not changed. However, remember that, if tightened too much, the required horsepower at the maximum delivery pressure (or during relieving) may increase.



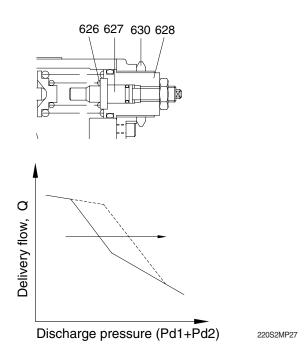
3) ADJUSTMENT OF INPUT HORSEPOWER

This regulator is 2 pump total horsepower control system, so when you change horsepower set, please adjust the adjust stem (C, 627) and the adjust screw (C) (628) both front and rear pumps. In addition, changes of pressure values by adjustments are values when 2 pump pressure risings are simultaneously.

(1) Adjustment of outer spring

Loosen the hexagon nut (630), and make adjustment by tightening (or loosening) the adjusting screw (C, 628).

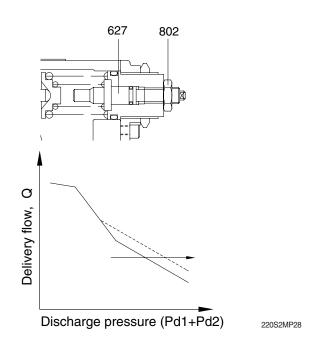
When the adjusting screw (C, 628) is tightening, the control diagram moves right, and input horsepower increases as shown in the drawing right. However, if the adjusting screw (C, 628) is turned, the setting of the inner spring (626) also changes, so temporarily turn the adjusting ring (C, 627) reversely.



2) Adjustment of inner spring

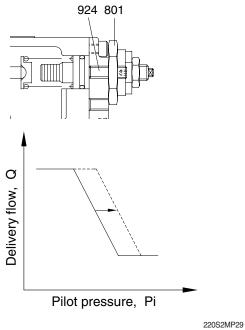
Loosen the hexagon nut (802), and make adjustment by tightening (or loosening) the adjusting stem (C, 627).

When the adjusting stem (C, 627) is tightening, flow increases, and input horsepower increases as shown in the drawing right.



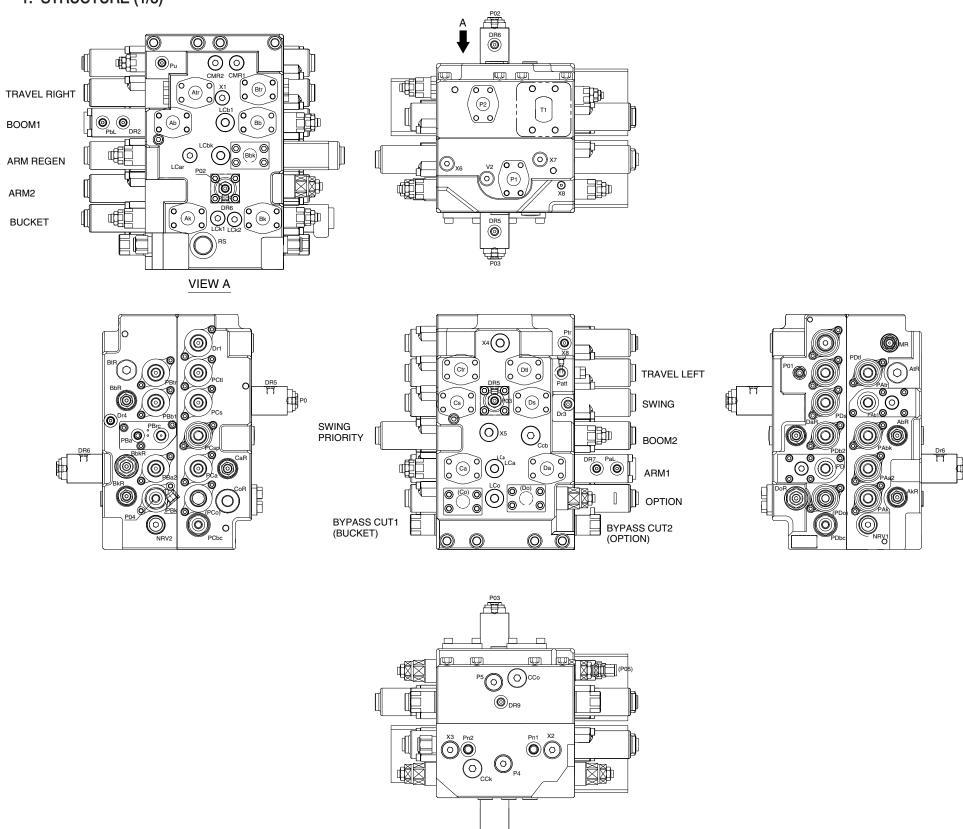
4) Adjustment of flow control characteristic

The flow control characteristic can be adjusted with the adjusting screw. Adjust it by tightening (or loosening) the hexagonal socket head screw (924) after loosening the hexagon nut (801). Tightening the screw shifts control chart to right as shown in the figure.



GROUP 2 MAIN CONTROL VALVE

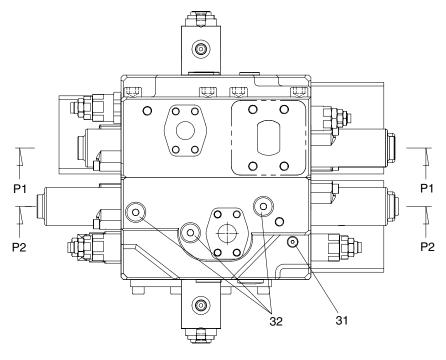
1. STRUCTURE (1/8)



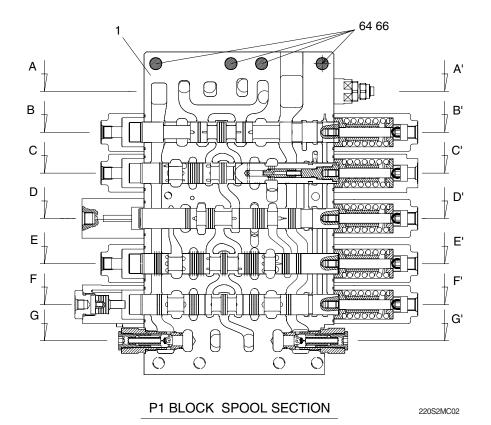
Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	PF1	20~25 kgf · m (145~180 lbf · ft)
Patt PbL PCbc PDbc P01 P02 P03 P04 P05 P06 PaL Ptr Pu DR1 DR2 DR3 DR4 DR5 DR7 DR9	Auto idle signal-attachment Lock valve pilot port (boom) Bucket in confluence pilot port Option confluence pilot port Pilot signal port Pilot signal port Swing logic pilot port Bucket parallel orifice pilot port Option B confluence pilot port Option B 2 stage relief valve 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)
PAtr PBtr PCtl PDtl PDb2 PBb1 PCS PBsa PBsa PBsa PCsp PAsk PBrc PCa PAsk PBrc PCa PAsk PBrc PCa PAsk PCS PDS PDS PDS PDS PDS PDS PDS PDS PDS PD	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 out 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 Ab Bb Cs Abk Ca Ak Bk (Co) 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)

220S2MC01

STRUCTURE (2/8)

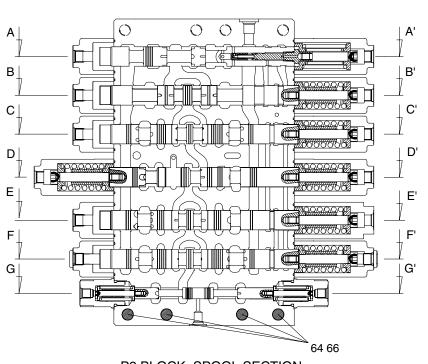


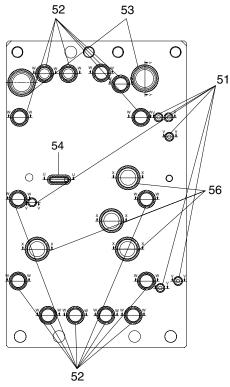
TOP VIEW



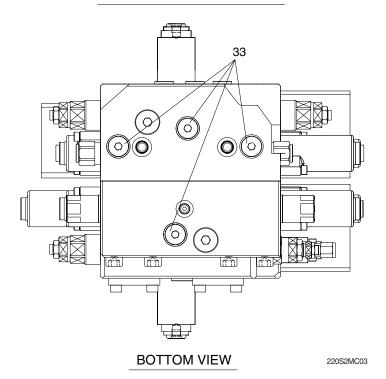
- 1 Housing P1
- 31 Plug
- 32 Plug
- 64 Hex socket head bolt
- 66 Spring washer

STRUCTURE (3/8)





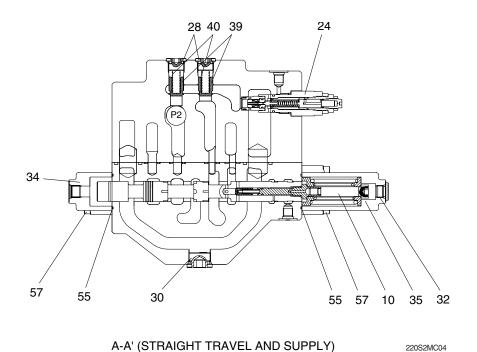
P2 BLOCK SPOOL SECTION



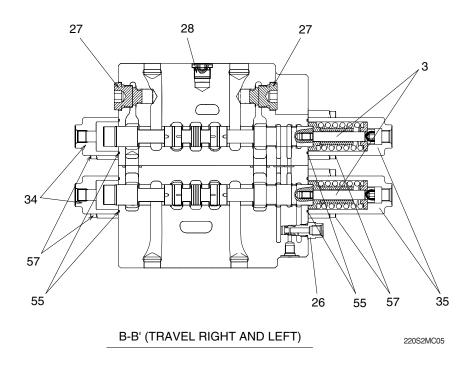
CONTACT FACE

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

STRUCTURE (4/8)



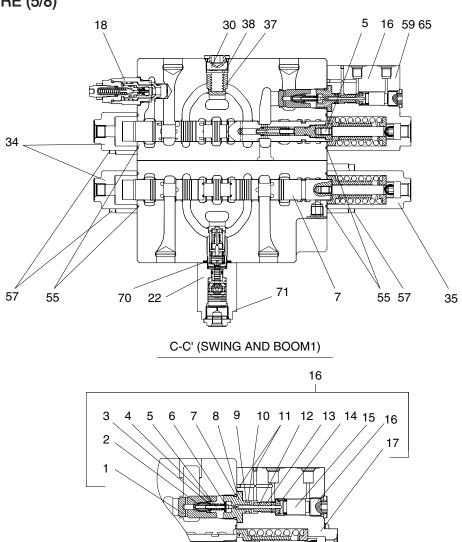
- 10 Travel straight spool kit
- Main relief valve 24
- 28 Plug
- Plug 30
- 32 Plug
- 34 Pilot cover A
- Pilot cover B 35
- Check valve poppet 2 39
- 40 Check valve spring 2
- 55 O-ring
- 57 Hex socket head bolt



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

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

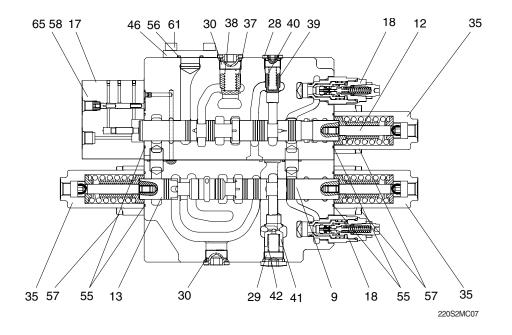
STRUCTURE (5/8)



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

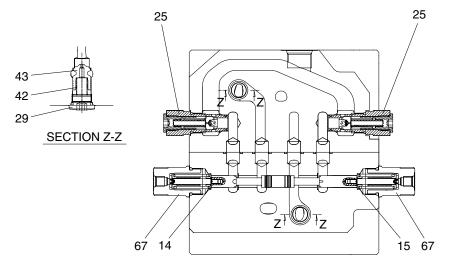
HOLDING VALVE

STRUCTURE (6/8)



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

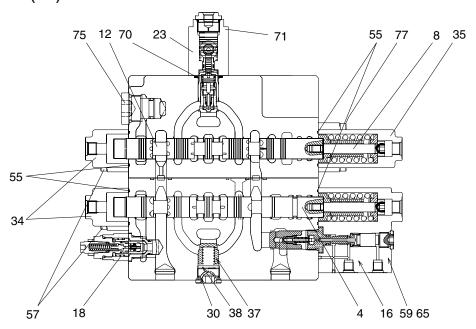
- 9 Boom 2 spool kit
- 12 Arm regen spool kit
- 13 Swing priority spool kit
- 17 Regen valve
- 18 Overload relief valve
- 28 Plug
- 29 Plug
- 30 Plug
- 35 Pilot cover B
- 37 Check valve poppet 1
- 38 Check valve spring 1
- 39 Check valve poppet 2
- 40 Check valve spring 2
- 41 Check valve poppet 3
- 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



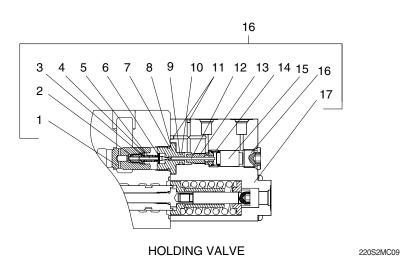
- 14 Bypass cut 1 spool kit (bucket)
- 15 Bypass cut 1 spool kit (option)
- 25 Negacon valve
- 29 Plug
- 42 Check valve spring 3
- 43 Check valve poppet 4
- 67 BC plug

G-G' (BYPASS CUT & NEGATIVE CONTROL)

STRUCTURE (7/8)

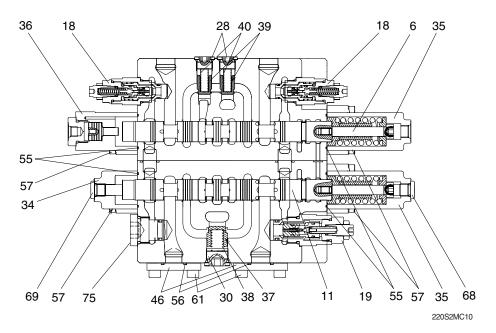


E-E' (ARM 1 & ARM 2)



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		

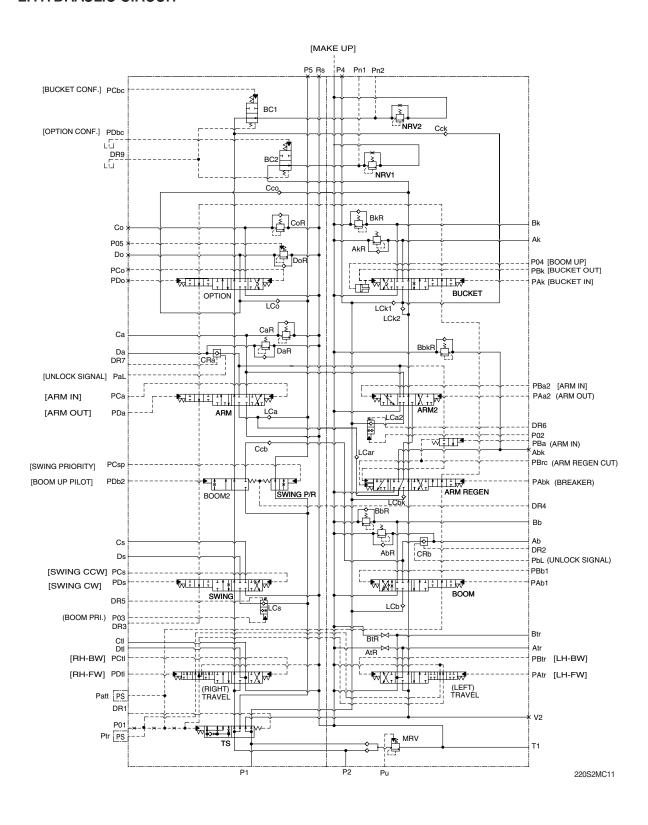
STRUCTURE (8/8)



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



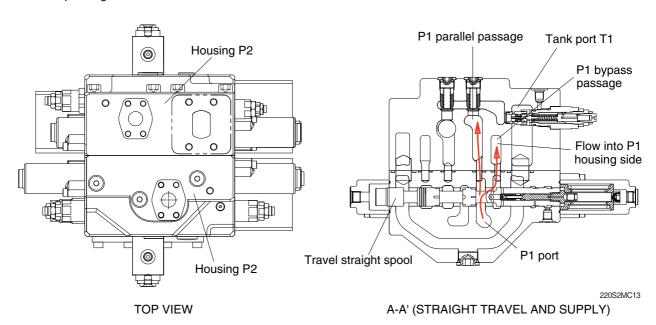
3. FUNCTION

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

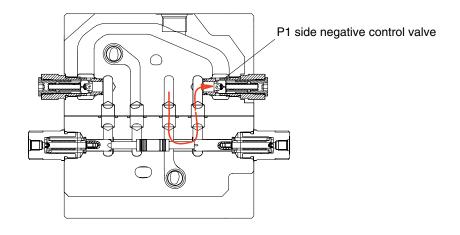
Arm regen

Arm 2

Bucket

P2 side negative control valve

P1 BLOCK SPOOL SECTION

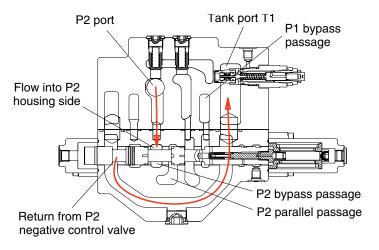


G-G' (BYPASS CUT & NEGATIVE CONTROL)

(2) P2 housing side

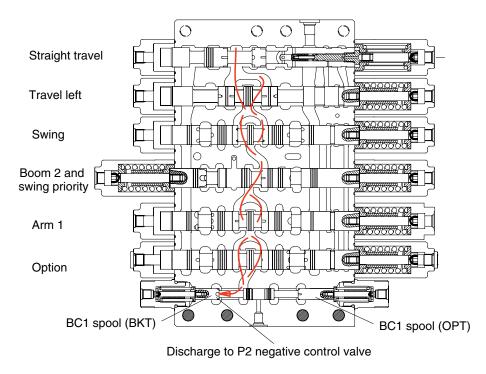
The pressurized oil discharged from hydraulic pump flows into the main control valve through the inlet port P2 and pass the land of the straight travel spool into the P2 bypass passage and P2 parallel passage.

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

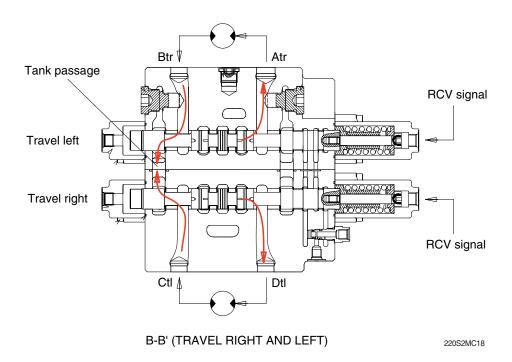
(1) Travel forward operation

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.



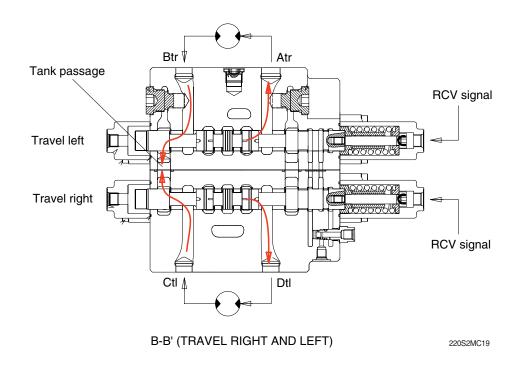
(2) Travel backward operation

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.

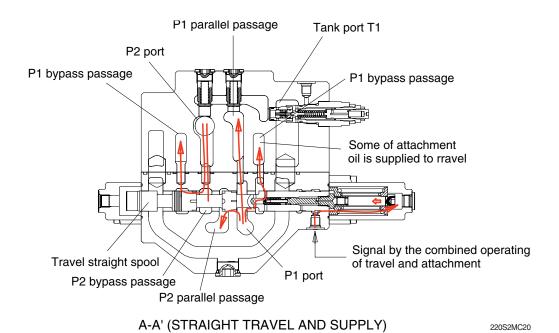


(3) Travel straight function

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

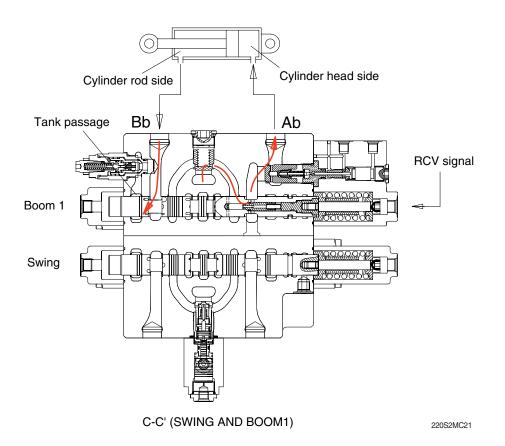
(1) Boom up operation

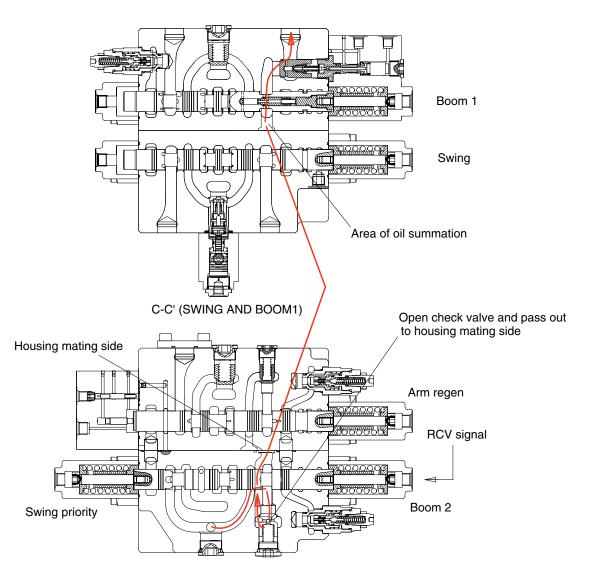
During the boom up operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the boom 1 spool to the left direction. The P1 bypass passage is shut off by the movement of the boom 1 spool and the pressurized oil from P2 port is entered P1 parallel passage 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)

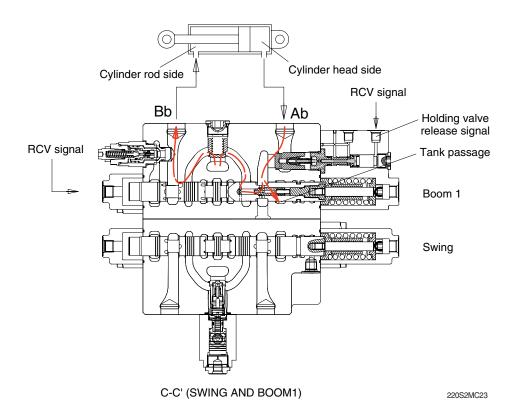
(2) Boom down operation

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

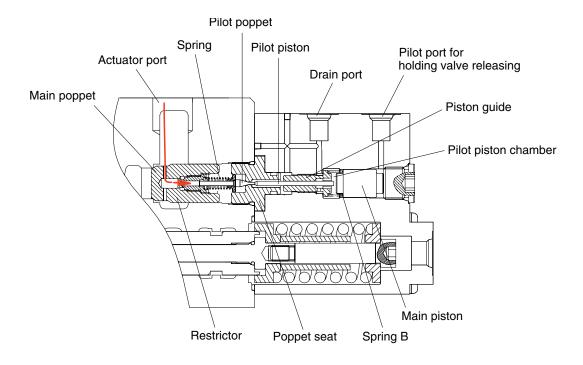
(1) Holding operation

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.



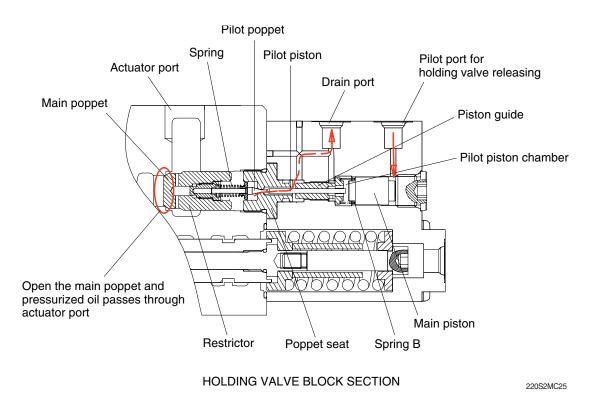
HOLDING VALVE BLOCK SECTION

(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.

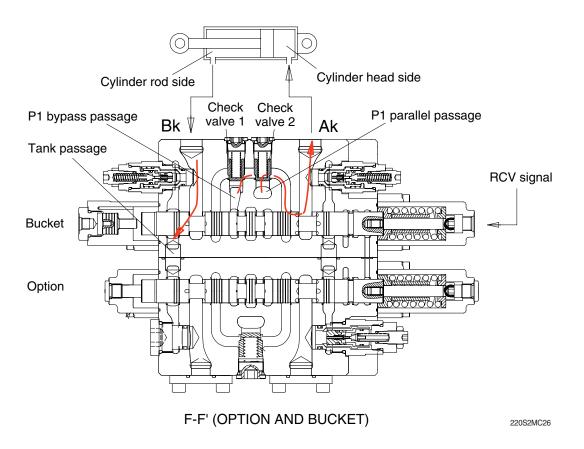
The P1 bypass passage is shut off by the movement of the bucket spool and the pressurized oil from P1 port entered P1 parallel passage and is directed to the Ak port through the check valve 2. At the same time, the pressurized oil from P1 bypass passage is directed to the AK port through the check valve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

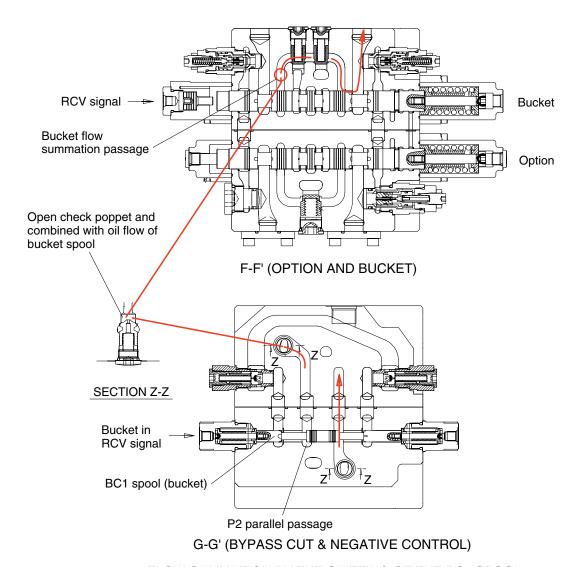
This function is used to speed up of the boom or arm by reducing the bucket speed when the bucket operation with boom or arm operation simultaneously.

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

(3) Bucket out operation

① Bucket operation only

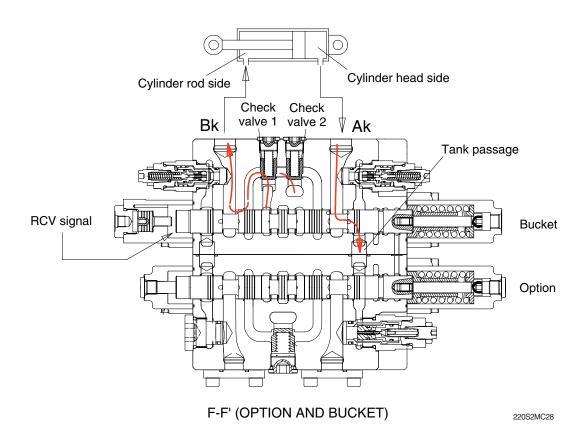
During the bucket out operation, the pilot secondary pressure from the RCV is supplied to against port of the spring side and shifts the bucket spool to the right direction.

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

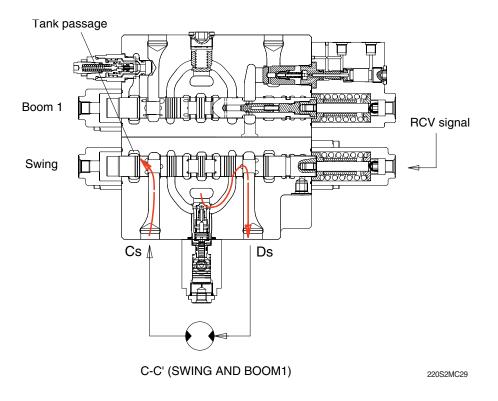
(1) Swing left and right operation

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.

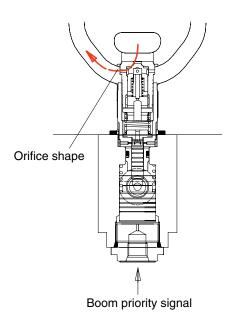
Accordingly, the pressurized oil from P2 parallel passage flows into swing motor through the Cs port and returns to the hydraulic oil tank through the Ds port and the tank passage.



(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

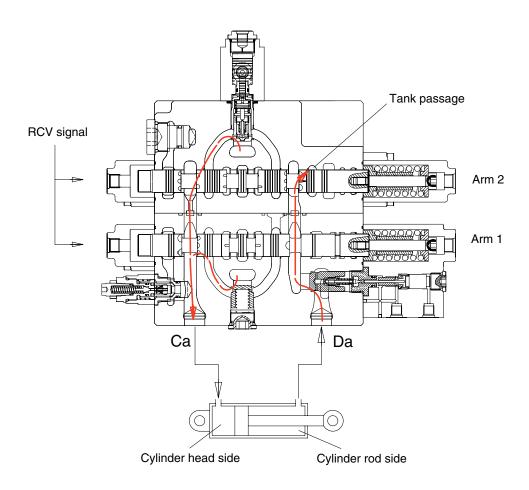
7) ARM OPERATION

(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)

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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.

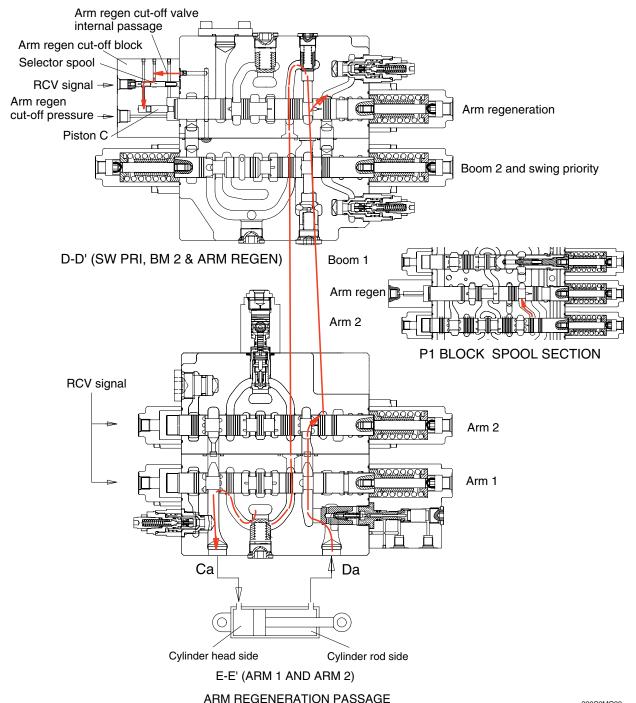
This is called the arm regeneration function.

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) Arm out operation

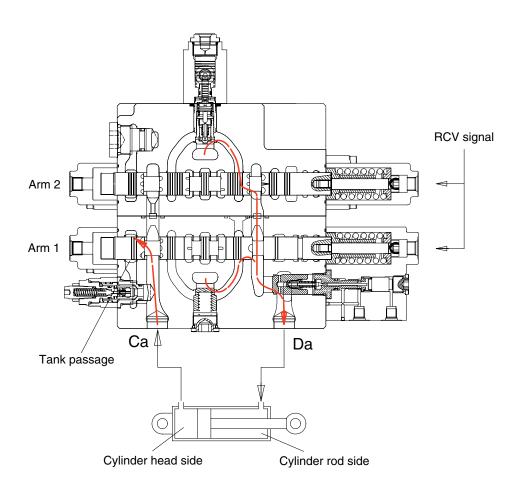
During arm out operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the arm 1 spool to the left direction.

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)

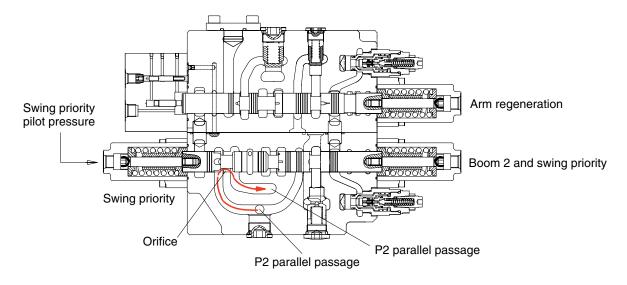
8) OPERATION OF SWING PRIORITY SPOOL

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)

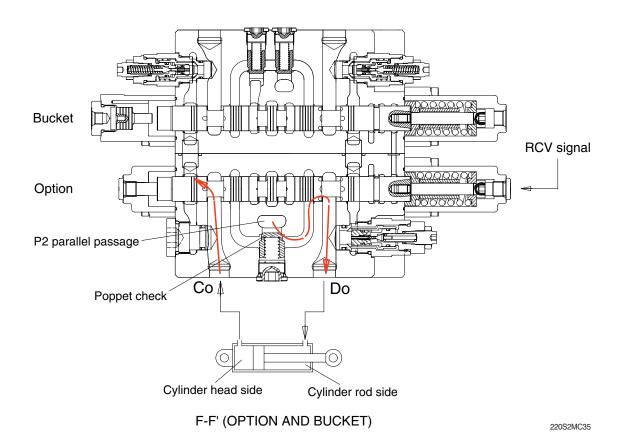
9) OPERATION OF OPTION SPOOL

(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

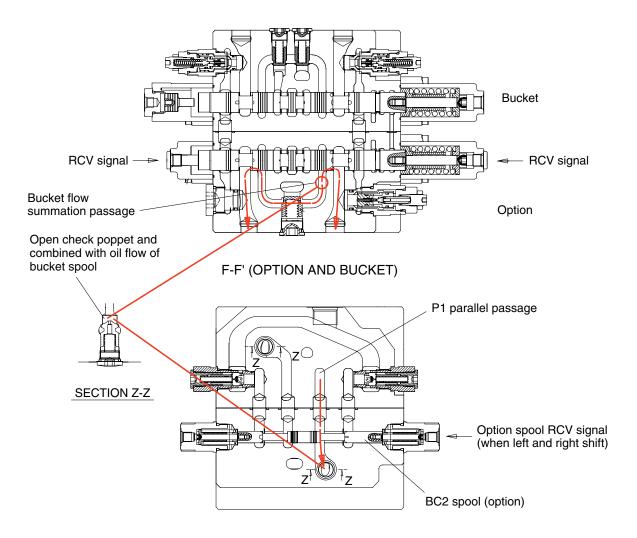
- Shifts spool to the left and right direction.
- When the spool shifts to the left, same as 1-way operation.
- When the spool shifts to the right, the pressurized oil from the P2 port flows into the actuator through the P2 parallel passage, the check valve, bridge passage and the Co port.



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)



G-G' (BYPASS CUT & NEGATIVE CONTROL)

FLOW SUMMATION BY THE SHIFTING OF THE BC2 SPOOL

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.

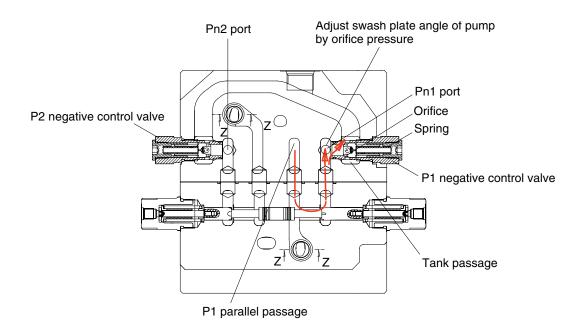
This pressure controls the swash plate angle of the pump to the minimum and minimize the flow of the P1 side.

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

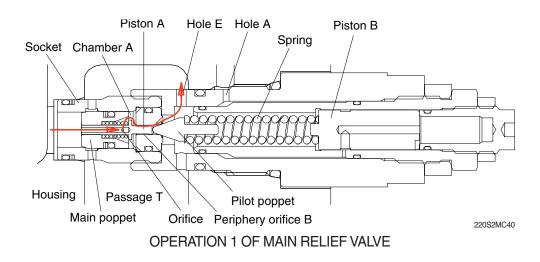
11) OPERATION OF MAIN RELIEF VALVE

(1) Neutral

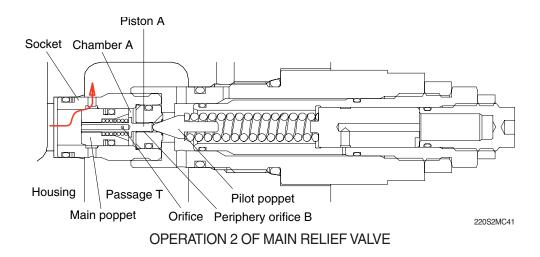
The pressurized oil passes through the internal passage of the piston A, fitted in the main poppet and the orifice A and is filled up in the chamber A of the inside and seats the main poppet against socket and socket against the housing securely.

(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.



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.



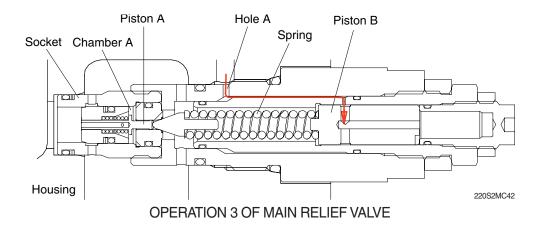
(3) When retraction (return)

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.

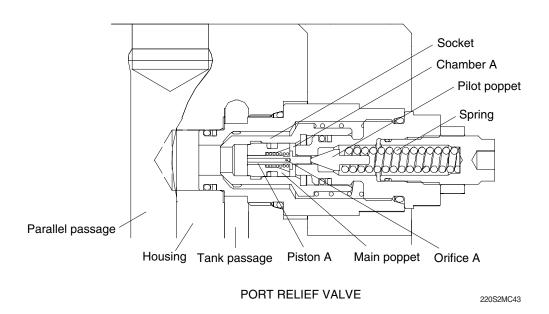
It pushes the piston to the left direction and the set pressure of the spring is increased.



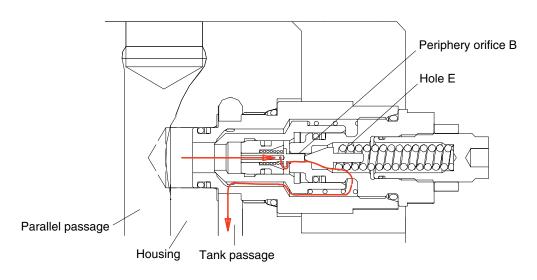
12) OPERATION OF PORT RELIEF VALVE

(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.

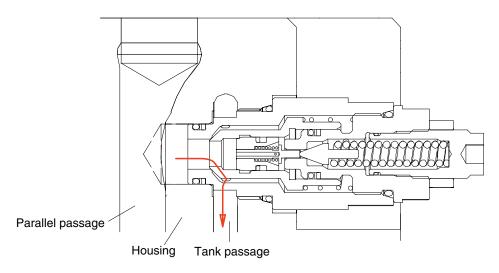


② When the pressurized oil from the actuators becomes equal to the set pressure of the spring, the hydraulic oil apply to the pilot poppet and pushes the pilot poppet to the right direction and flows to tank passage through the piston A internal passage, orifice A, chamber A, periphery orifice B and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



OPERATION 1 OF PORT RELIEF VALVE

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.



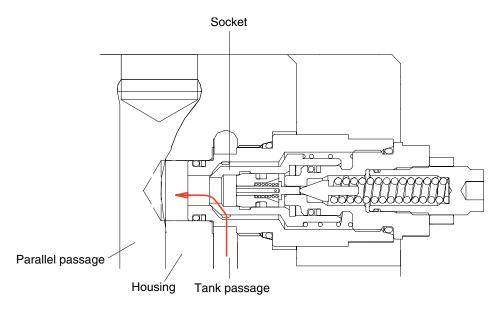
OPERATION 2 OF PORT RELIEF VALVE

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.



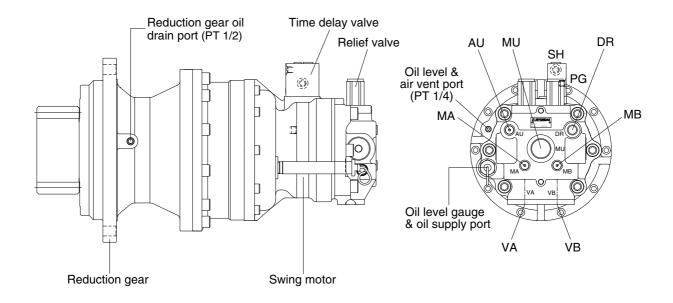
MAKE UP FUNCTION OF PORT RELIEF VALVE

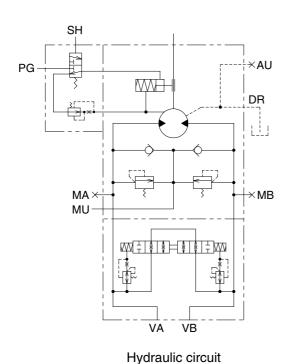
GROUP 3 SWING DEVICE (TYPE 1, 2)

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.

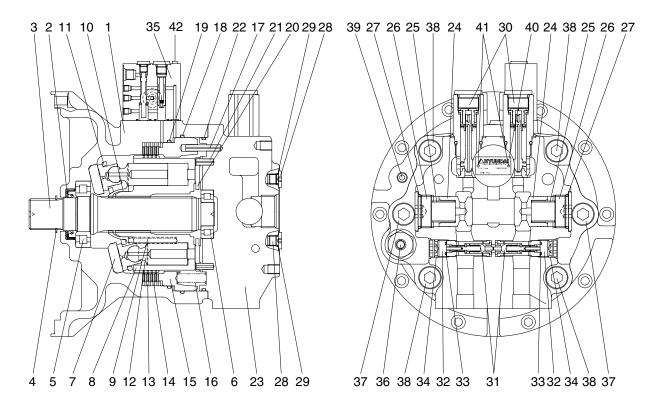




Port	Port name	Port size
VA	Main port	Ø 20
VB	Main port	Ø20
DR	Drain port	PF 1/2
MU	Make up port	PF 1 1/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4
MA, MB	Gauge port	PF 1/4
AU	Air vent port	PF 1/4

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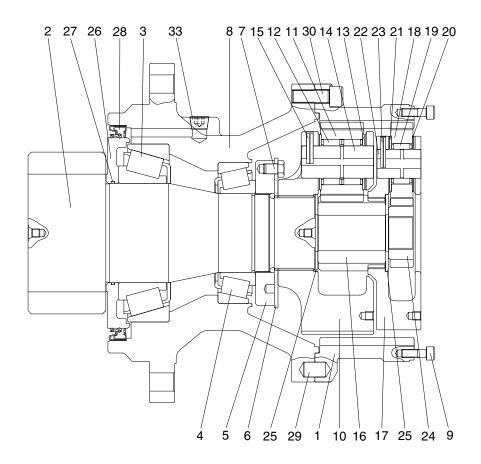
1) SWING MOTOR



220L2SM02

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



220L2SM03

1 2 3 4 5 6 7 8	Ring gear Drive shaft Taper bearing Taper bearing Ring nut Lock plate Hexagon bolt Casing Socket bolt	11 12 13 14 15 16 17 18	Planetary gear 2 Needle bearing 2 Thrust washer 2 Carrier pin 2 Spring pin 2 Sun gear 2 Carrier 1 Planetary gear 1 Needle bearing 1	21 22 23 24 25 26 27 29 30	Thrust washer 1 Carrier pin 1 Spring pin 1 Sun gear 1 Thrust plate Sleeve O-ring Parallel pin Socket bolt
9 10	Socket bolt Carrier 2	19 20	Needle bearing 1 Thrust washer 1	30 33	Socket bolt 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 (23), 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).

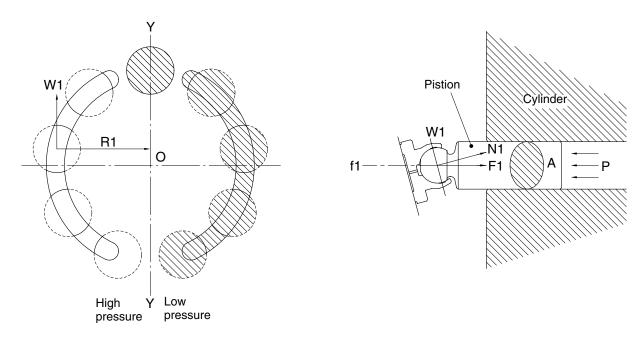
The high hydraulic can generate the force, $F1=P\times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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.



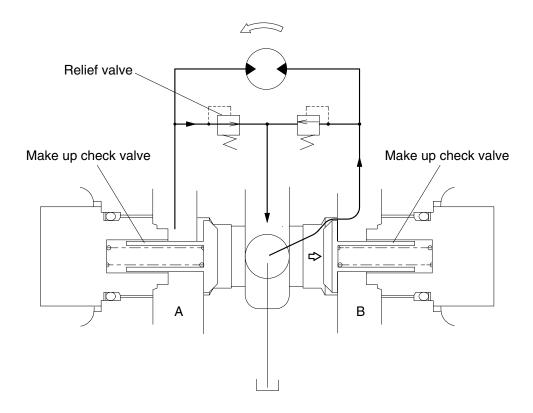
2) MAKE UP VALVE

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.

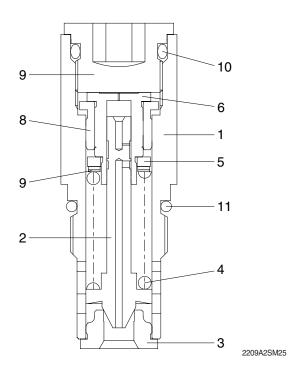
Pressurized oil into the port B, the motor rotate counterclockwise.

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.



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3) RELIEF VALVE



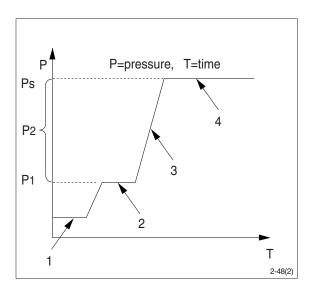
- 1 Sleeve
- 2 Poppet
- 3 Poppet seat
- 4 Spring
- 5 Spring seat
- 6 Shim
- 7 Piston
- 8 Stopper
- 9 Plug
- 10 O-ring
- 11 O-ring

(1) Construction of relief valve

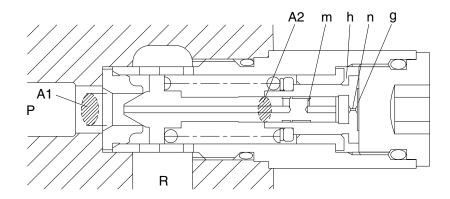
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.



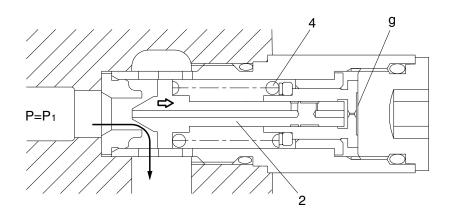
① Ports (P, R) at tank pressure.



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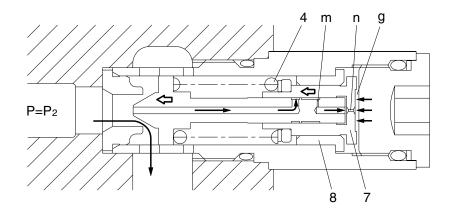
$$P1 \times A1=Fsp+Pg \times A2$$

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



2209A2SM27

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 (7) moves left and stop the piston (7) hits the bottom of bushing (8).

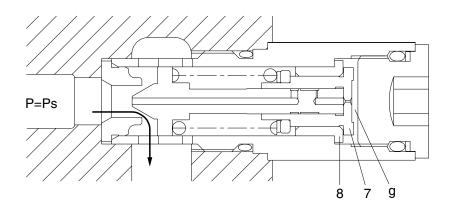


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④ When piston (7) hits the bottom of bushing (8), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

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

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



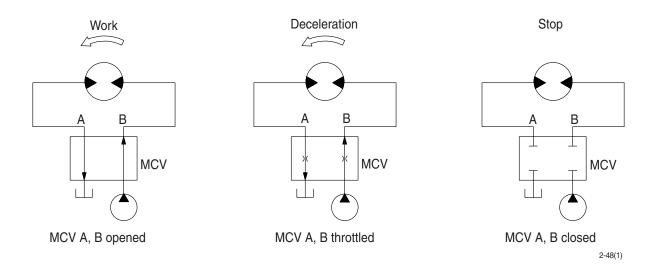
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4) BRAKE SYSTEM

(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.



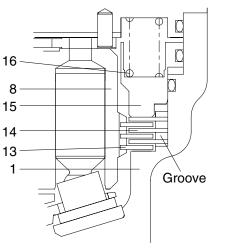
(2) Mechanical swing parking brake system

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 (14) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (16) through friction plate (13), separate plate (14) and parking piston (15), friction force occurs there.

Cylinder block (8) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



2209A2SM35

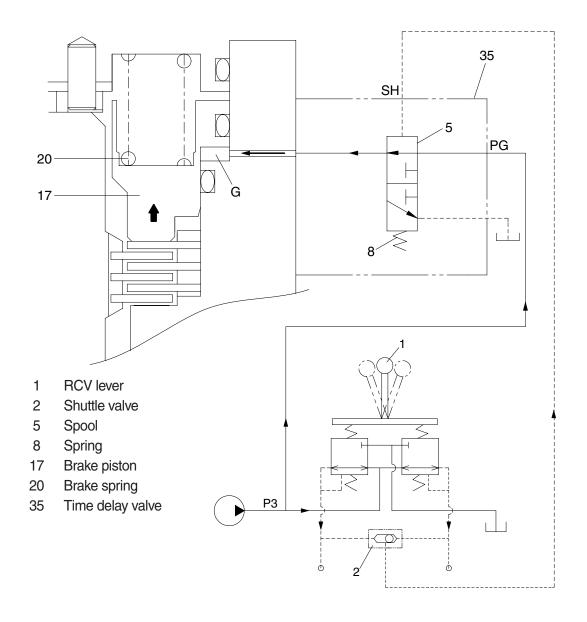
Casing
 Separate plate
 Cylinder block
 Parking piston
 Friction plate
 Brake spring

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).

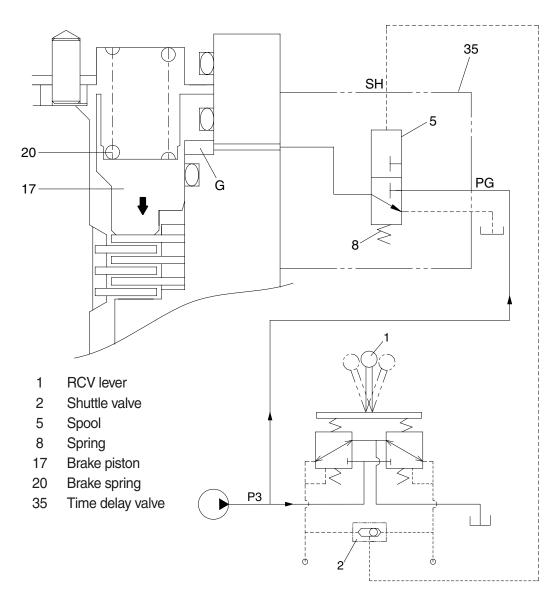
This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.

This pressure is applied to move the parking piston (15) to the upward against the force of the brake spring (16). 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 parking piston (15) 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.



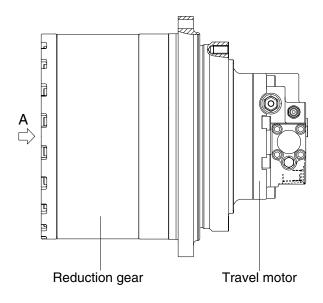
300L2SM05

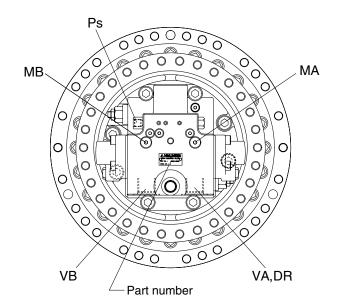
GROUP 4 TRAVEL DEVICE (TYPE 1, 2)

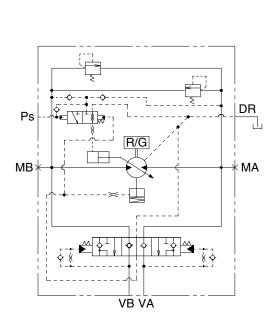
1. CONSTRUCTION

Travel device consists travel motor and gear box.

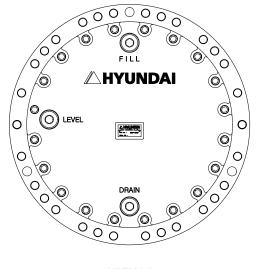
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







Hydraulic circuit



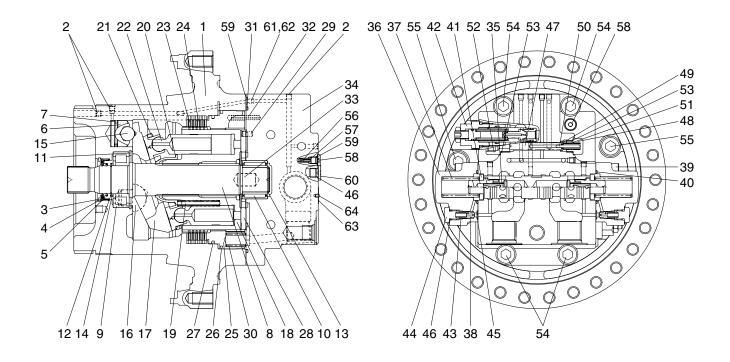
VIEW A

2209A2TM20

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	Gauge port	PF 1/4

2. SPECIFICATION

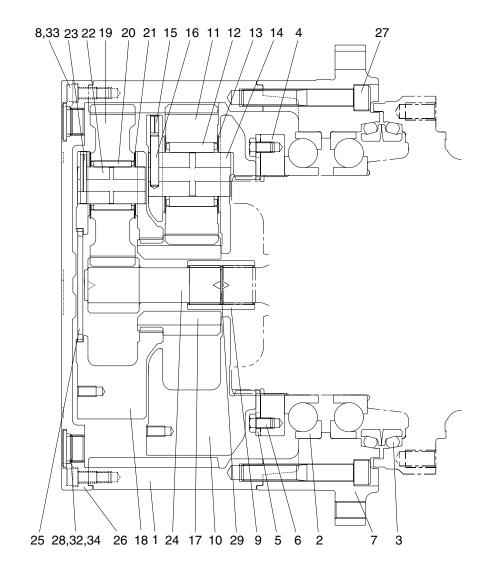
1) TRAVEL MOTOR



2209A2TM21

1	Casing	23	Friction plate	44	Plug
2	Plug	24	Separated plate	45	O-ring
3	Oil seal	25	Parking piston	46	O-ring
4	Thrust plate	26	D-ring	47	Spool
5	Snap ring	27	D-ring	48	Plug
6	Swash piston	28	Valve plate	49	Spring seat
7	Piston seal	29	Parallel pin	50	Parallel pin
8	Shaft	30	Brake spring	51	Spring
9	Cylinder roller bearing	31	O-ring	52	Connector
10	Needle bearing	32	Spring pin	53	O-ring
11	Snap ring	33	Parallel pin	54	Hexagon socket head bolt
12	Snap ring	34	Rear cover	55	Hexagon socket head bolt
13	Snap ring	35	Main spool assy	56	Check valve
14	Thrust plate	36	Spool cover	57	Spring
15	Steel ball	37	Spring	58	Plug
16	Pivot	38	Restrictor	59	O-ring
17	Swash plate	39	Hexagon socket head bolt	60	Plug
18	Cylinder block	40	O-ring	61	Restrictor
19	Spring	41	Spring seat	62	Restrictor
20	Ball guide	42	Relief valve assy	63	Name plate
21	Retainer plate	43	Spring	64	Rivet
22	Piston assy				

2) TRAVEL REDUCTION GEAR



220S2TM22

1	Ring gear	13
2	Ball bearing	14
3	Floating seal assy	15
4	Nut ring	16
5	Lock plate	17
6	Hexagon bolt	18
7	Housing	19
8	Hexagon socket head bolt	20
9	Coupling	21
10	Carrier 2	22
11	Planetary gear 2	23
12	Needle bearing 2	24

Thrust washer 2
Carrier pin 2
Spring pin 2
Solid pin 2
Sun gear 2
Carrier 1
Planetary gear 1
Needle bearing 1
Thrust washer 1
Carrier pin 1
Spring pin 1
Sun gear 1

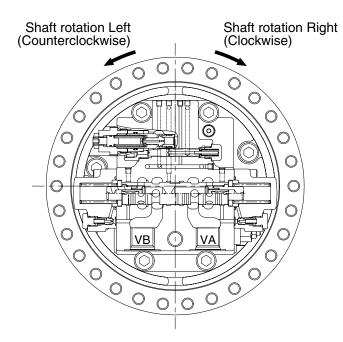
25	Thrust plate
26	Cover
27	Hexagon socket head bolt
28	Plug
29	Snap ring
30	Name plate
31	Rivet
32	O-ring
33	Rubber cap
34	Rubber cap

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)

25092TM23

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.

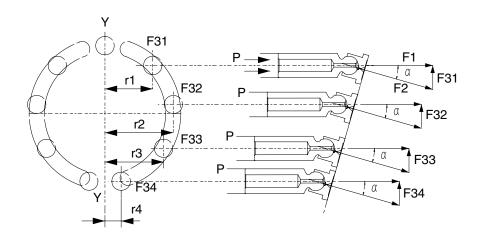
 $F1 = P \times A$ (P : pressure, A : area of piston section)

The swash plate (17) with inclined angle of $^{\alpha}$ 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 (8).



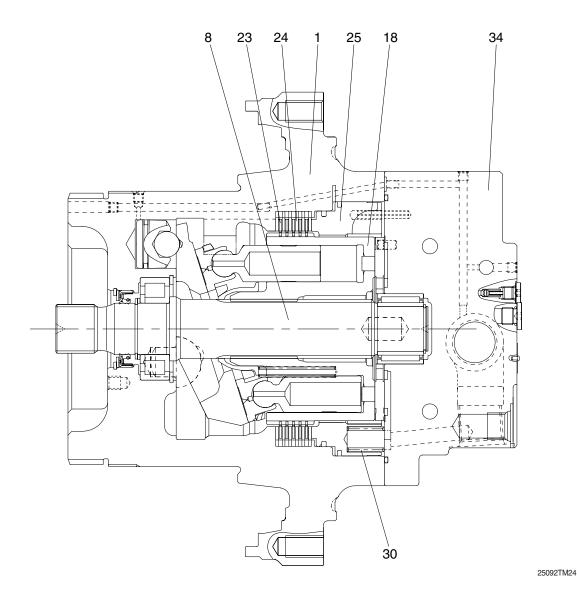
2) PARKING BRAKE

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 (8).



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 (51), the spring (51) is compressed and spool (47) 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 (6). 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.

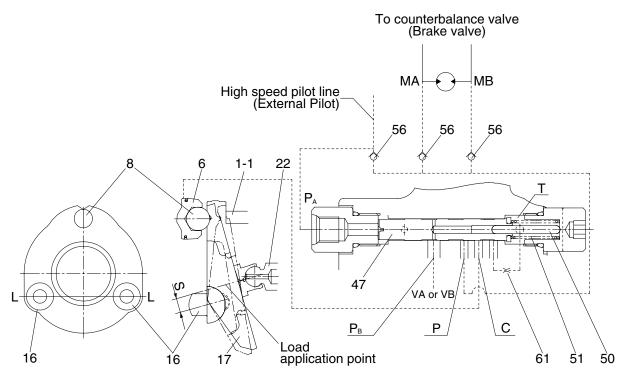
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

When no pressure is in the high speed pilot line P_A , spool (35) is pushed back by the spring (51) and pressure that pressed the shifter piston (6) is released to the hydraulic tank through restrictor (61).

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 $P_{\rm B}$ and this pressure activate on pin (50). When the pressure at $P_{\rm B}$ exceeds predetermined value, spool (47) returns to the left by the counter-pressure against pin (50) and the pressure on the shifter piston (6) through port C is released to the tank and the motor comes to low speed.

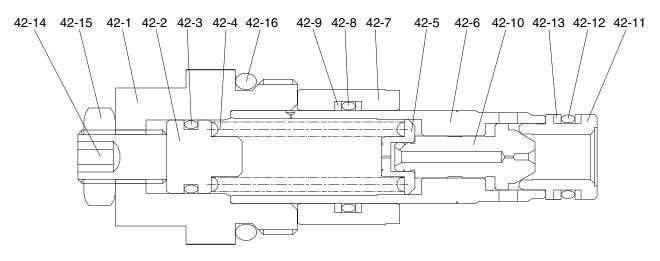
When P_B goes down, the spool (47) moves to the right and the speed become high.



4) OVERLOAD RELIEF VALVE

(1) Structure

This valve is screwed in the motor rear cover (34) and consists of : plug (42-1) that is screwed and fixed in the rear cover (34), poppet (42-10) and supports the poppet seat (42-11), spring (42-4) that is operating relief valve setting pressure and supports the spring seat (42-5), that is inserted in the sleeve (42-6), screw (42-14) that is adjust the spring force, nut (42-15) that fix screw (42-14), piston (42-7) that reduce the shock.



42-1 Plug	42-7 Piston	42-12 O-ring
42-2 Guide	42-8 O-ring	42-13 Back-up ring
42-3 O-ring	42-9 Back-up ring	42-14 Socket screw
42-4 Spring	42-10 Poppet	42-15 Hexagon nut
42-5 Spring seat	42-11 Poppet seat	42-16 O-ring
42-6 Sleeve		

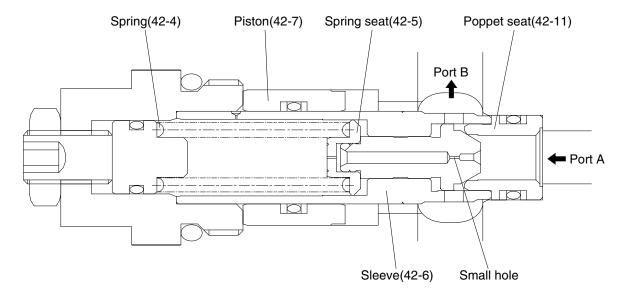
(2) Operation

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 (42-10) which seats on the poppet seat (42-11) and, at the same time, is delivered, via small hole, to the spring seat (42-5) located inside the sleeve (42-6) and the seat bore pressure increases up to "A" port pressure. The poppet (42-10) opposes to spring (42-4) 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 (42-7) is at the left position by the driving pressure, and when "A" port pressure increases, the pressure is applied also to the piston (42-7) through the small hole in the poppet (42-10) and piston (42-7) moves rightward until it touches the stopper in rear cover. In this while, the poppet (42-10) maintains "A" port pressure at comparatively low against the spring (42-4) force and exhaust oil to "B" port side. After the piston reached to the plug, the valve acts the same as at starting.



5) BRAKE VALVE

(1) Structure

The brake valve portion mainly consists of the following parts:

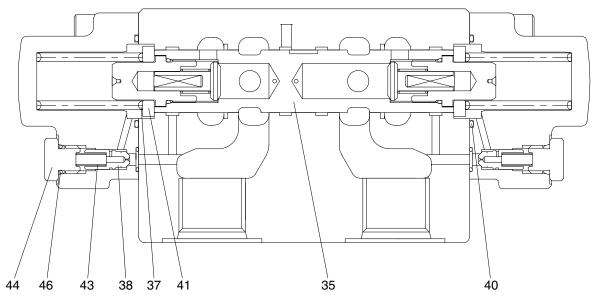
① Spool

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.



25092TM28

35	Main	spool
----	------	-------

37 Spring

38 Restrictor

40 O-ring

41 Spring seat

43 Restrictor spring

44 Plug

46 O-ring

(2) Operation

① Holding operation

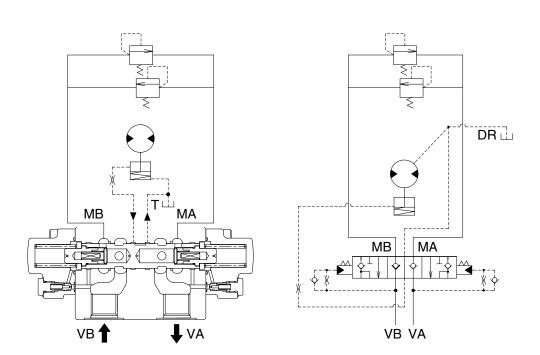
When the control valve is at neutral position, VA and VB ports are connected to the tank, and the spring (37) located on both spool ends holds the spool (35) at central position.

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.

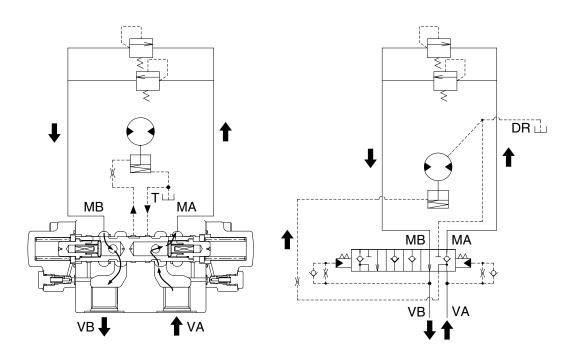


2 Accelerating operation

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 (37) 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.

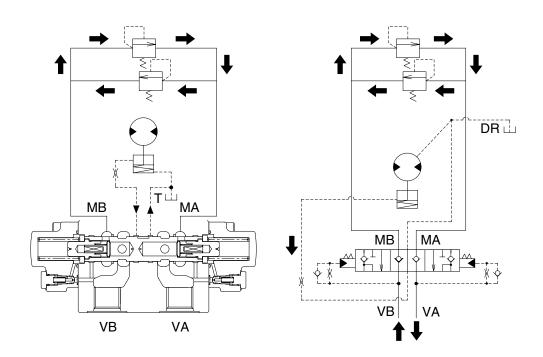


3 Stopping operation

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 (37) 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.

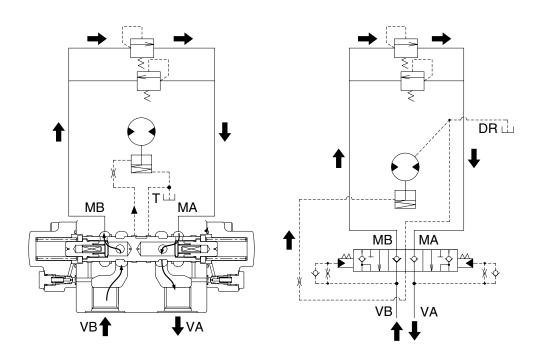
Consequently, the pilot chamber pressure on MB to VB side decreases and the spring (37) force moves the spool (35) leftwards towards neutral position.

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 (38) 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.

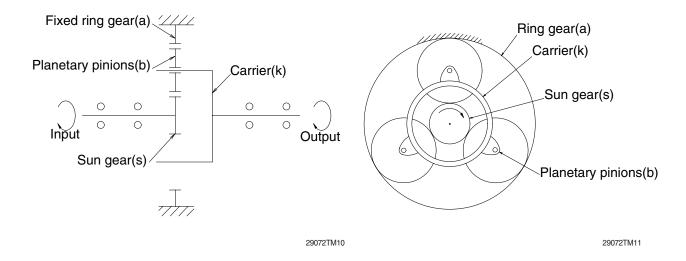
This reduction unit utilizes two stages, planetary reduction system.

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).

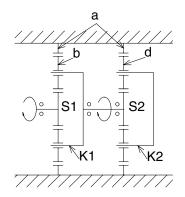
This movement is transferred to carrier (k) and deliver the torque.

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.



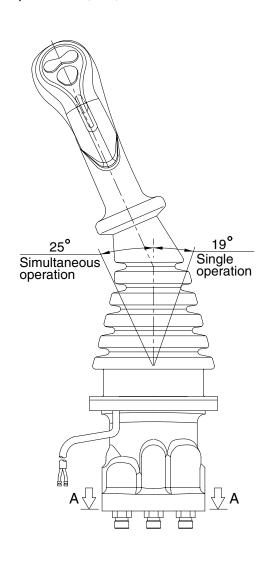
GROUP 5 RCV LEVER

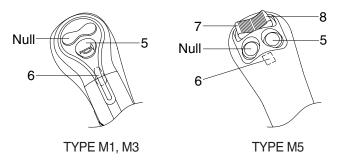
1. STRUCTURE

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

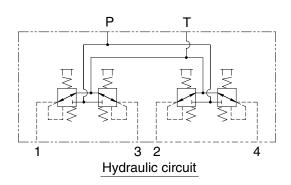


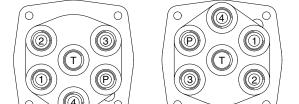


Switches

Туре	No.	LH	RH			
N44 N40	5	One touch decel	Horn			
M1, M3	6	Power boost	Breaker			
	5	One touch decel	Horn			
M5	6	Power boost	Null			
CIVI	7	CCW rotation	Close			
	8	CW rotation	Open			

* Number 7 and 8 : Option attachment





LH

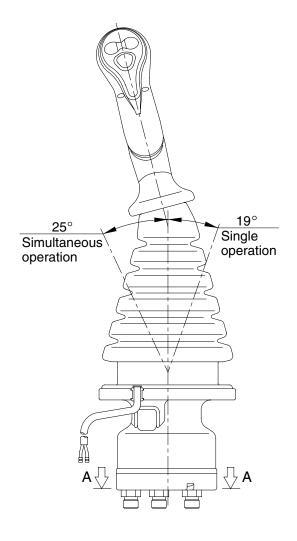
RH VIEW A-A

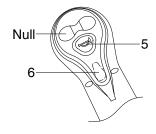
Pilot ports

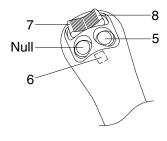
Port	LH	RH	Port size
Р	Pilot oil inlet port	Pilot oil inlet port Pilot oil inlet port	
Т	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	PF 3/8
2	Arm out port	Boom up port	FF 3/0
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	

300L2RL01

2) TYPE M2, M4, M6







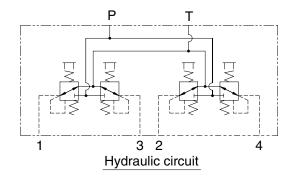
TYPE M2, M4

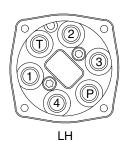
TYPE M6

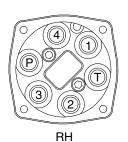
Switches

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

* Number 7 and 8 : Option attachment







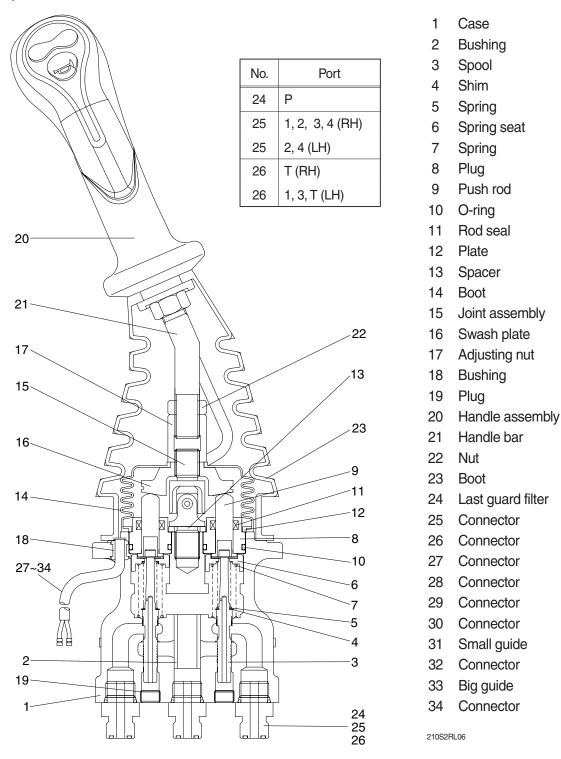
VIEW A-A

Pilot ports

Port	LH	RH	Port size	
Р	Pilot oil inlet port	Pilot oil inlet port	PF 3/8	
Т	Pilot oil return port	Pilot oil return port		
1	Left swing port	Bucket out port		
2	Arm out port	Boom up port		
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.

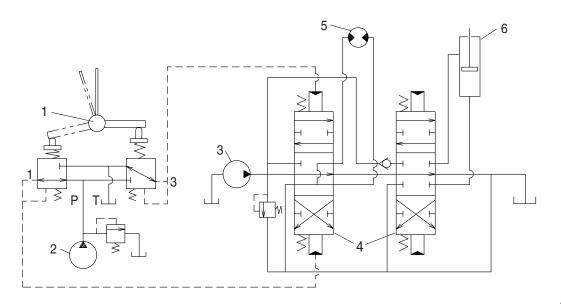
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

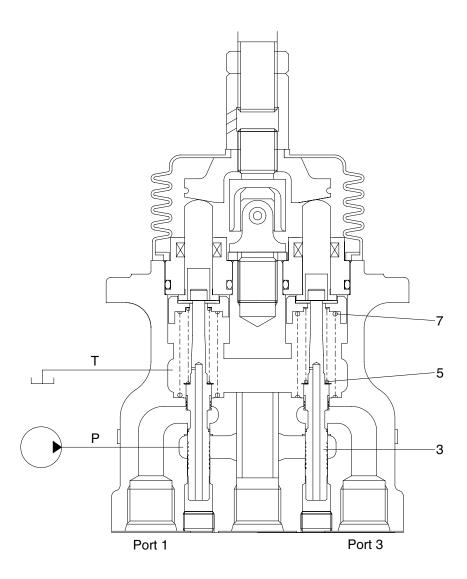
The diagram shown below is the typical application example of the pilot valve.



2-70

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

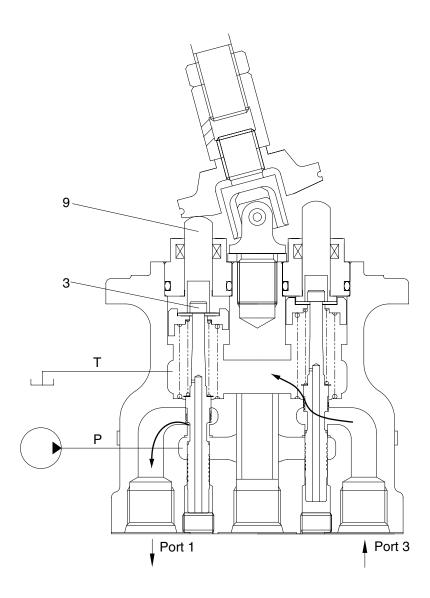
(1) Case where handle is in neutral position



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.

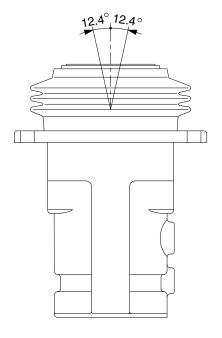
In this manner the secondary pressure is kept at the constant value.

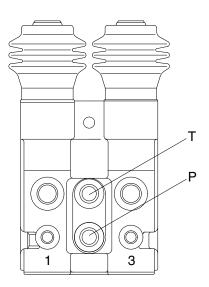
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

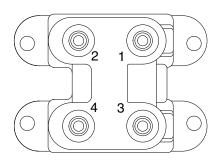
GROUP 6 RCV PEDAL

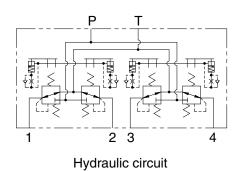
1. STRUCTURE

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 Ρ Pilot oil inlet port Τ Pilot oil return port 1 Travel (LH, Forward) PF 1/4 2 Travel (LH, Backward) 3 Travel (RH, Forward) 4 Travel (RH, Backward)

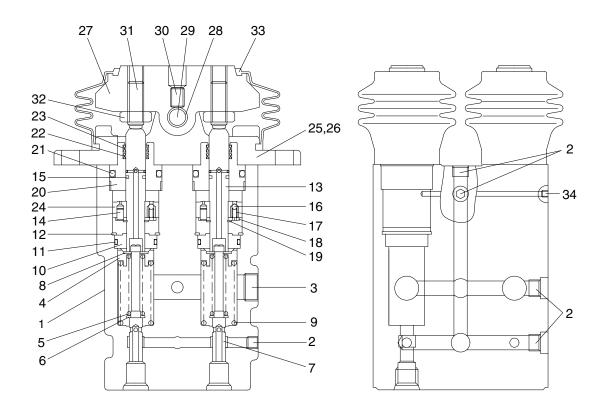
130ZF2RP01

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

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

The change the deflection of this spring, the push rod (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.

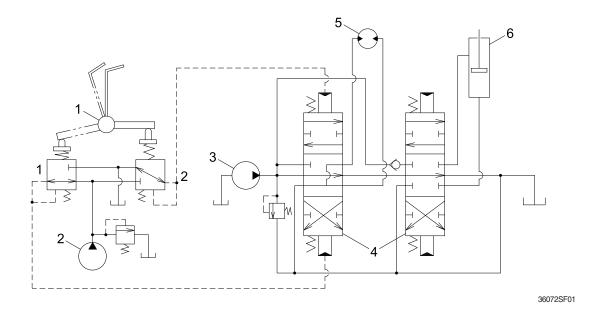
The spring (9) works on the body (1) and spring seat (6) and tries to return the push rod (13) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

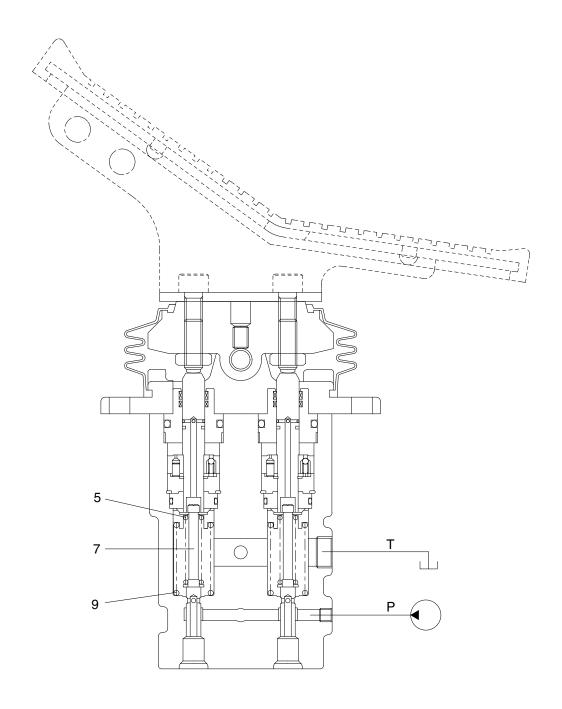
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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

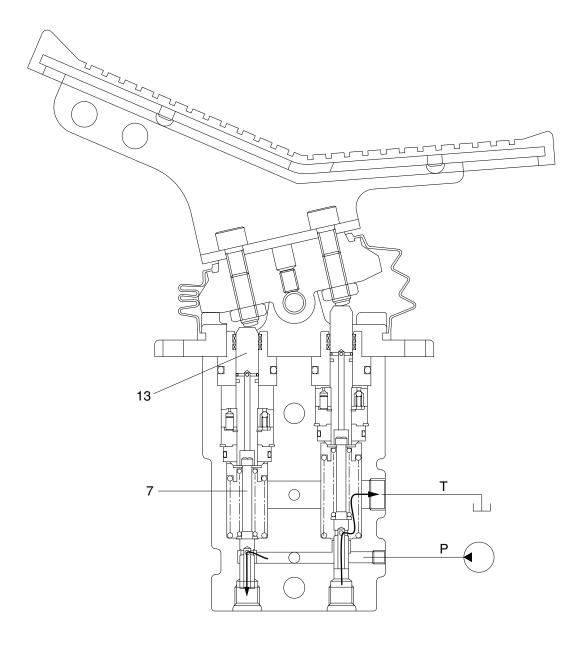
(1) Case where pedal is in neutral position



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



130ZF2RP04

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.

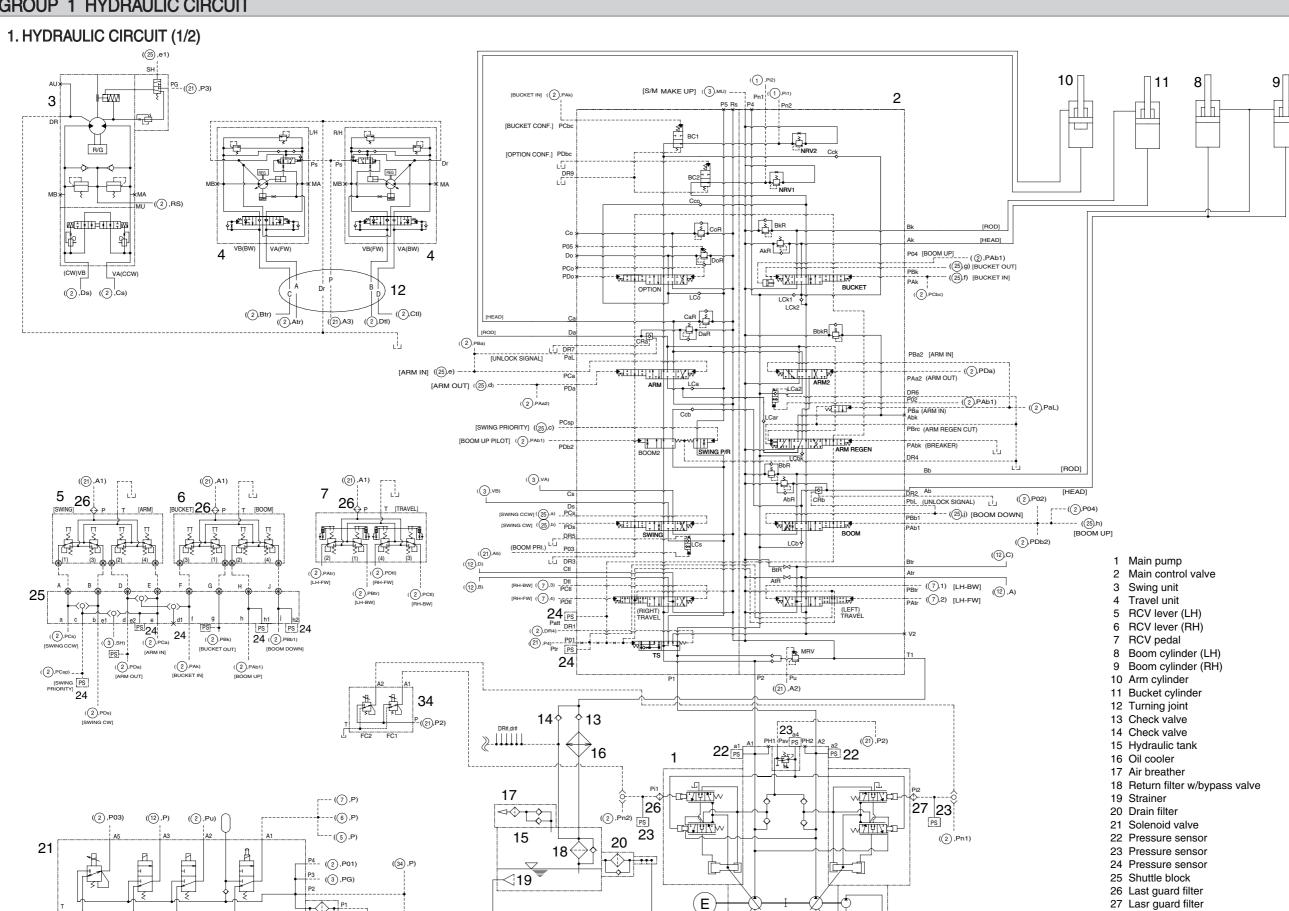
In this manner the secondary pressure is kept at the constant value.

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



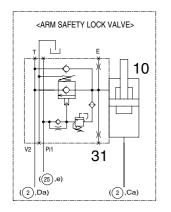
27 Lasr guard filter 28 Coupling screw

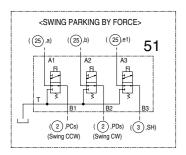
34 2-EPPR valve

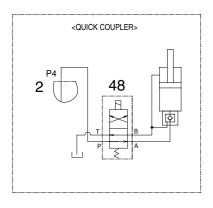
a3 8 28

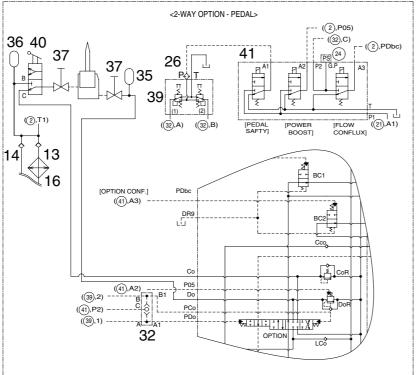
(1,A3) (1,Psv)

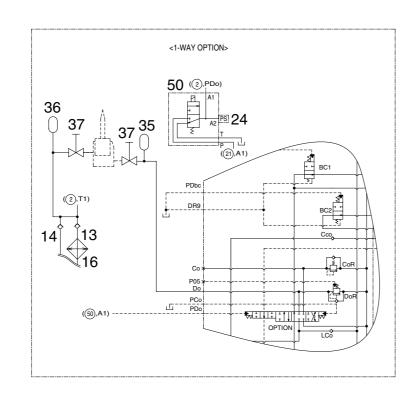
2. HYDRAULIC CIRCUIT (2/2)

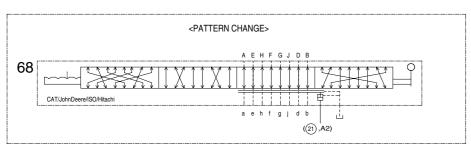


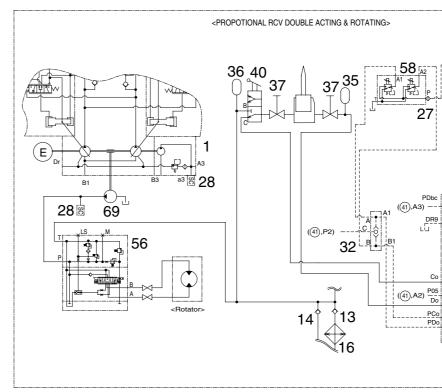


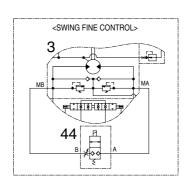


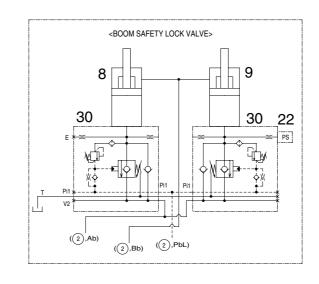












- Main pump Main control valve

- ((32),C) PS 24

BC1

(21),A1)

- 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
 28 Coupling screw
 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)
- 41 Solenoid valve (option) 44 Solenoid valve (option)
- 48 Solenoid valve (option)
- 50 Solenoid valve (option)
- Solenoid valve (option)
- 56 Proportional valve (option)
- 58 2-EPPR valve (option)
- 68 Pattern change valve (option)
- 69 Gear pump (option)

30Q6-47100-00 2OF2

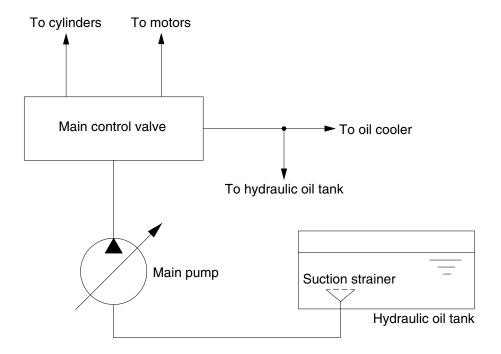
GROUP 2 MAIN CIRCUIT

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 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



140L3CI01

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

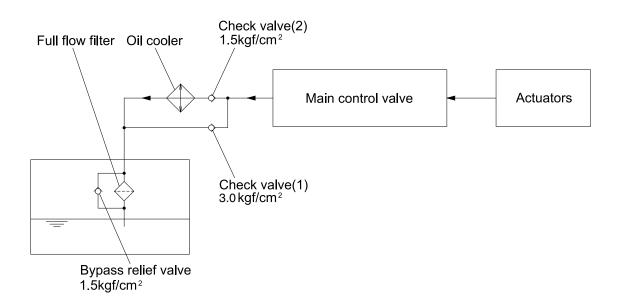
The oil discharged from the main pump flows to the actuators through the main control valve.

The main control valve controls the hydraulic functions.

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

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

2. RETURN CIRCUIT



220S3CI01

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

The bypass check valves are provided in the return circuit.

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

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

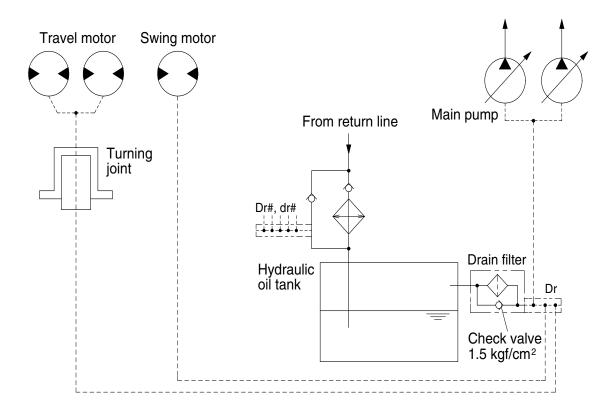
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1). The full-flow filter and bypass relief valve are provided in the hydraulic tank.

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

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

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

3. DRAIN CIRCUIT



220NL3CI02

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

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

1) TRAVEL MOTOR DRAIN CIRCUIT

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

2) SWING MOTOR DRAIN CIRCUIT

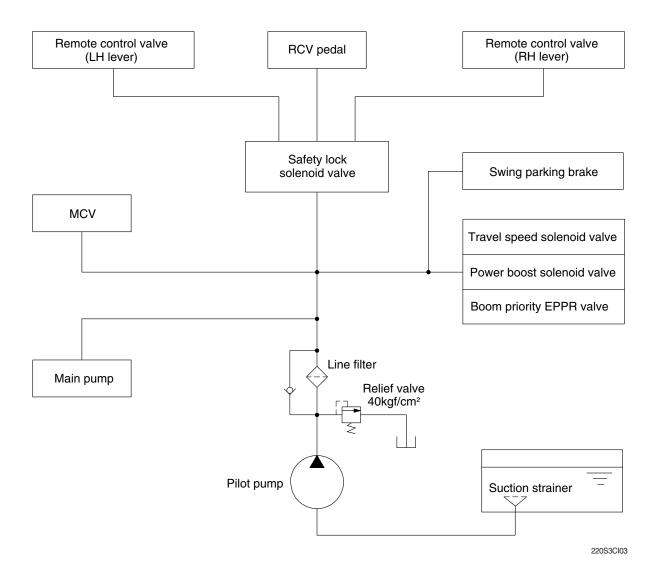
Oil leaked from the swing motor returns to the hydraulic tank passing through drain filter.

3) MAIN PUMP DRAIN CIRCUIT

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

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

GROUP 3 PILOT CIRCUIT



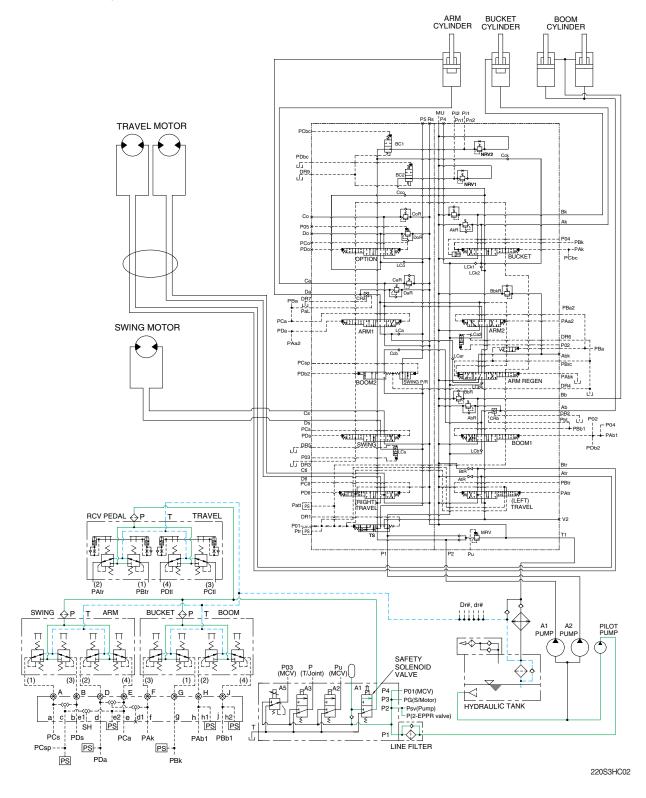
The pilot circuit consists of suction circuit, delivery circuit and return circuit.

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

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

1. SUCTION, DELIVERY AND RETURN CIRCUIT



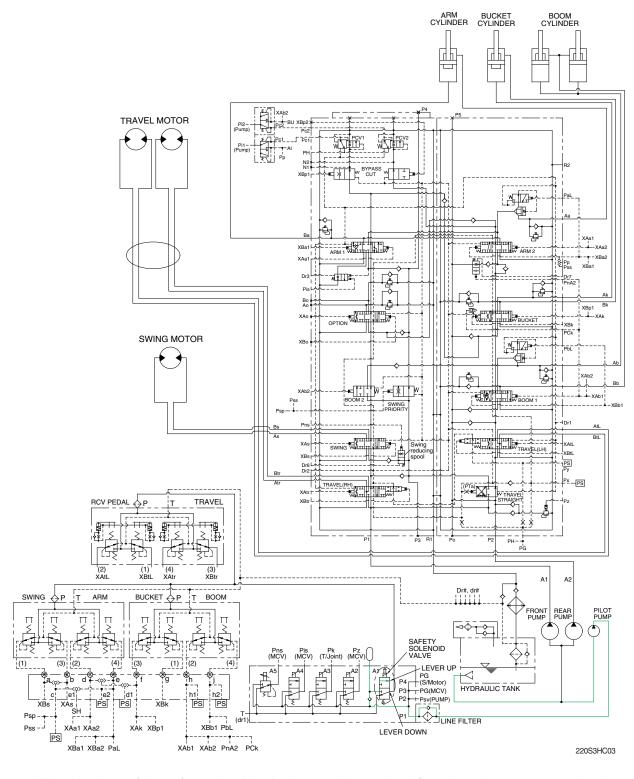
The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

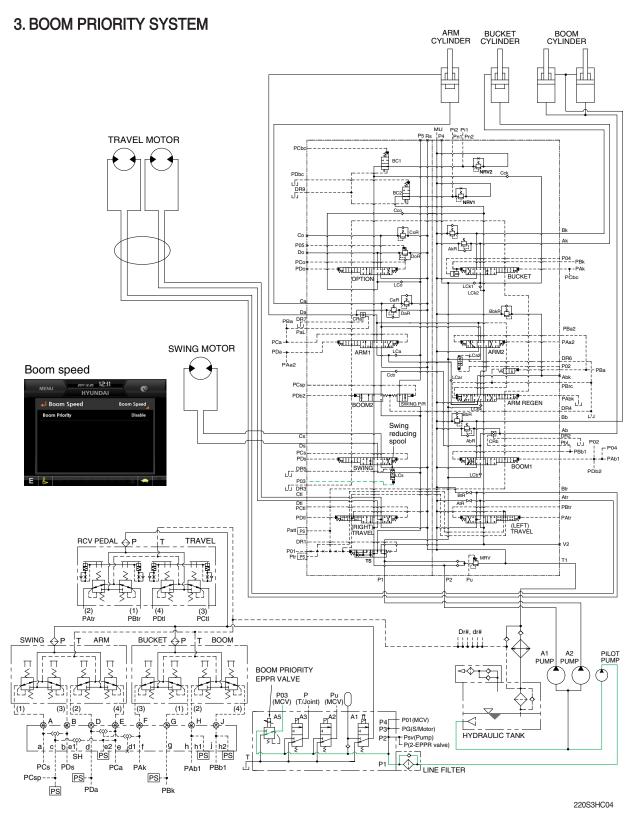
2. SAFETY VALVE (SAFETY LEVER)



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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.



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

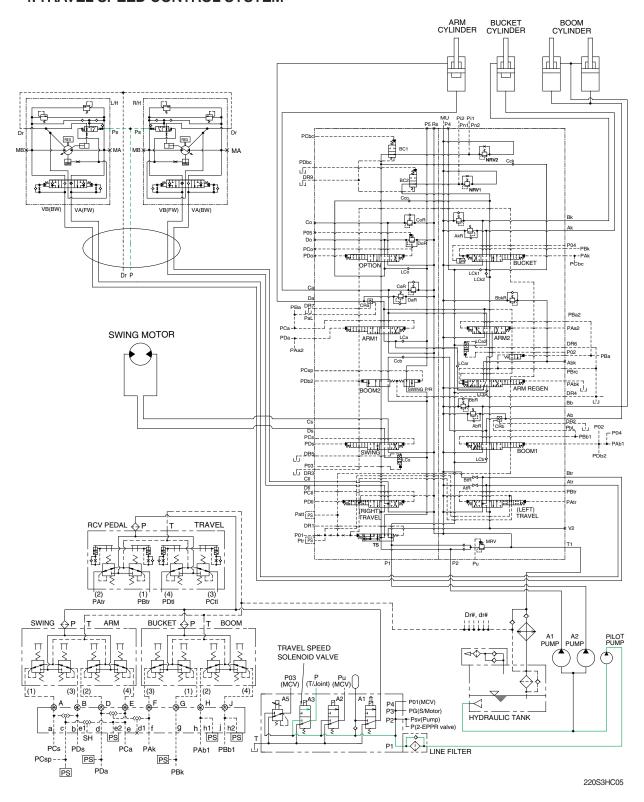
To increase working efficiency, swing speed reducing system is used.

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

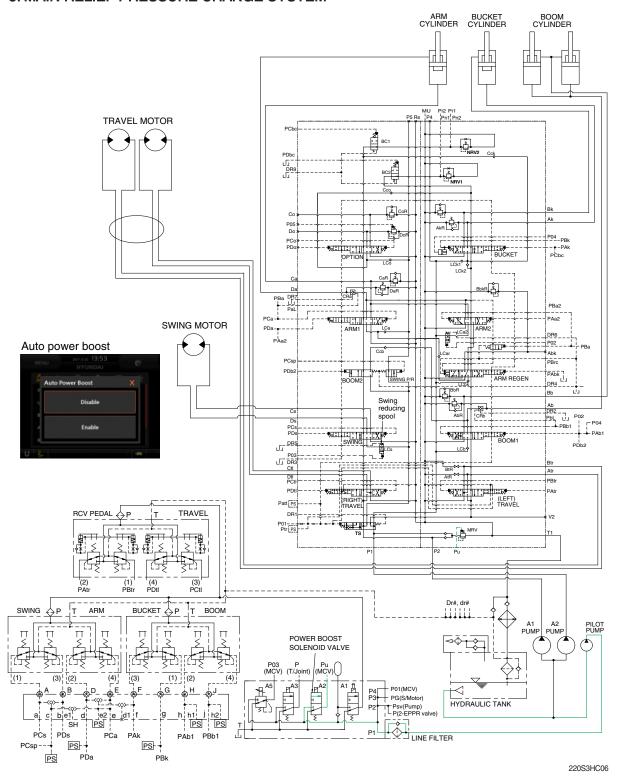


When the travel speed solenoid valve was placed in the Hi position, the pressure oil from pilot pump through line filter flows to port **Ps** of travel speed change over valve, and the control piston is pushed, thus minimizing the displacement.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

5. MAIN RELIEF PRESSURE CHANGE SYSTEM

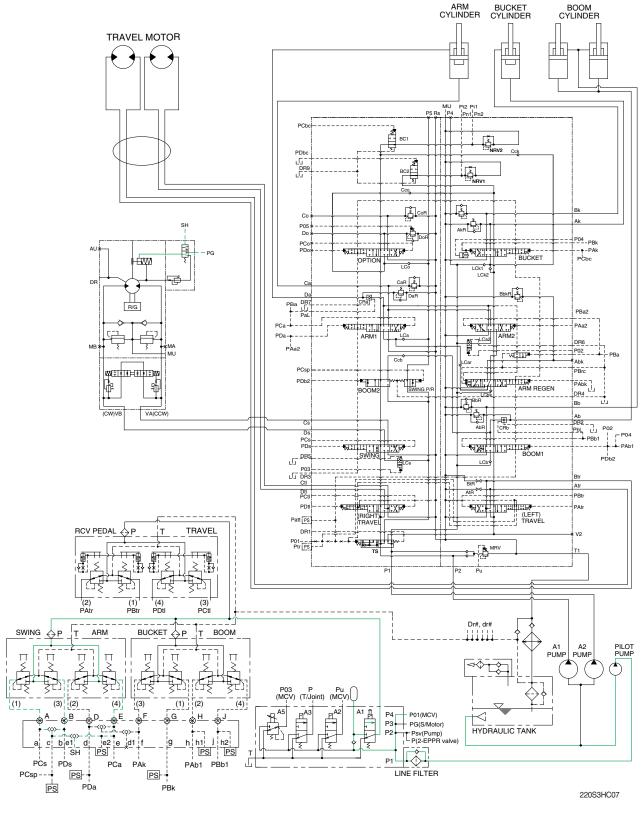


When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into **Pu** port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 350 kgf/cm² (4980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

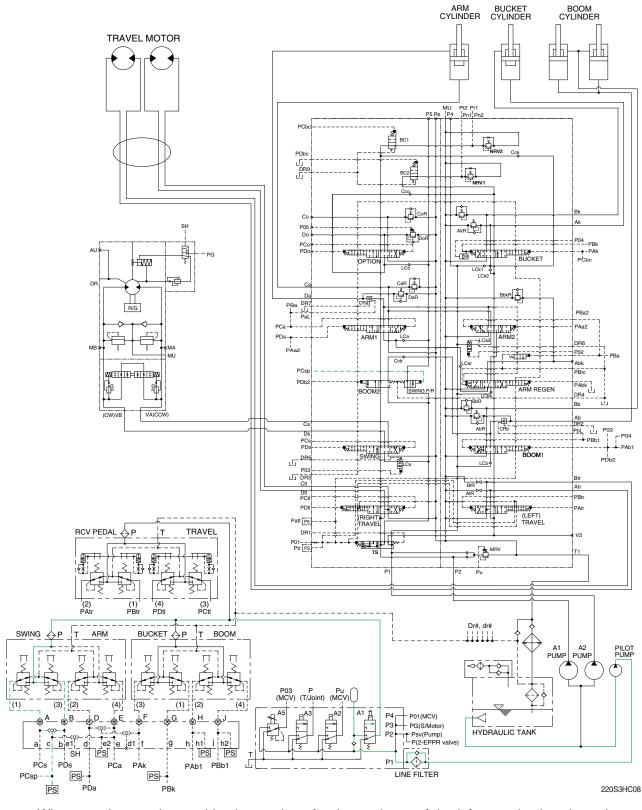
6. SWING PARKING BRAKE RELEASE



When the RCV lever (swing or arm in) is tilted, the pilot oil flows into SH port through shuttle 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 the RCV lever (swing or arm in) is set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

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.

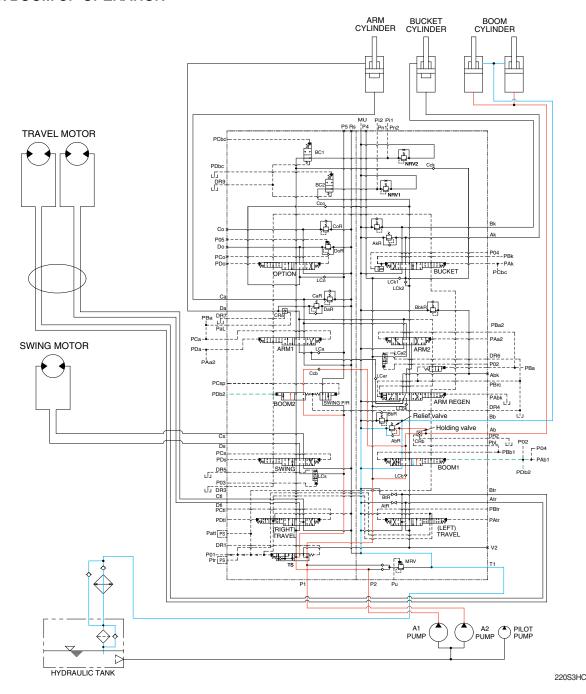
PCsp pressure from the swing shuttle block change the swing priority spool and decreases the oil flow rate to the next section to make the swing operation most preferential.

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.

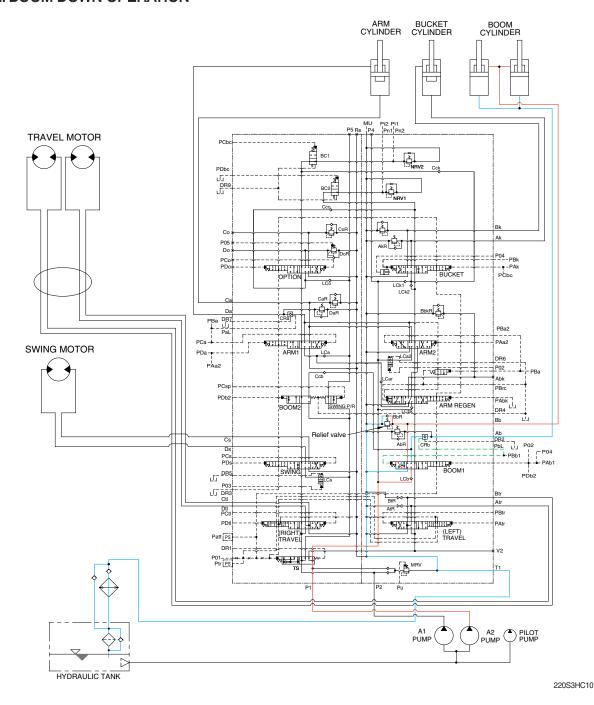
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom 1 spool in the main control valve. When this happens, the boom goes up.

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.

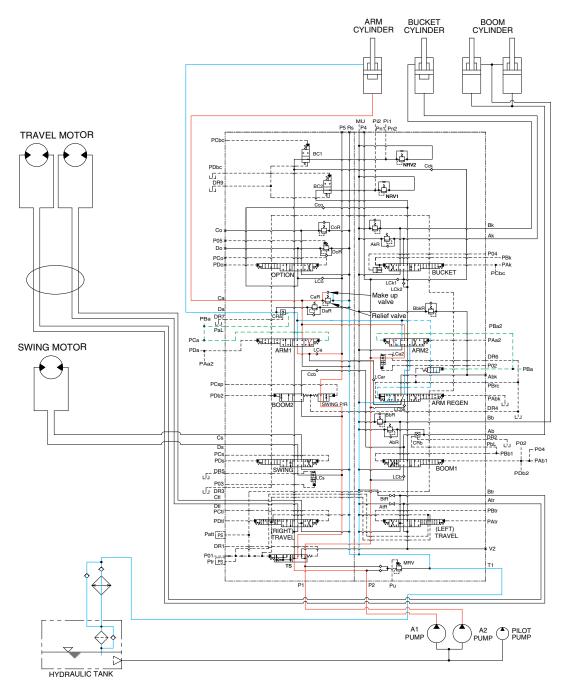
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1 spool in the main control valve.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

3. ARM IN OPERATION



220S3HC11

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.

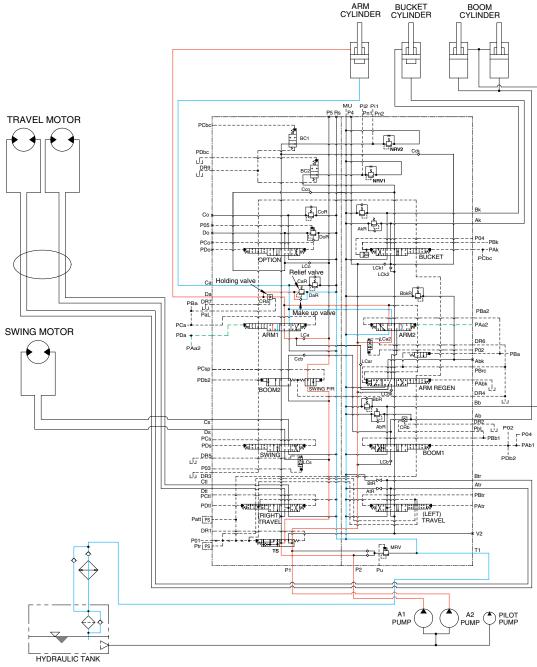
At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 2 spool in the main control valve. When this happens, the arm rolls in.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

4. ARM OUT OPERATION



220S3HC12

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.

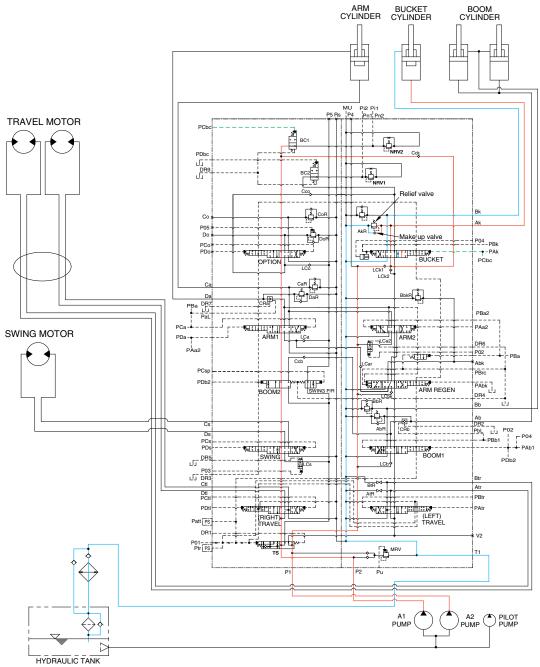
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spools in the main control valve. When this happens, the arm rolls out.

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



220S3HC13

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).

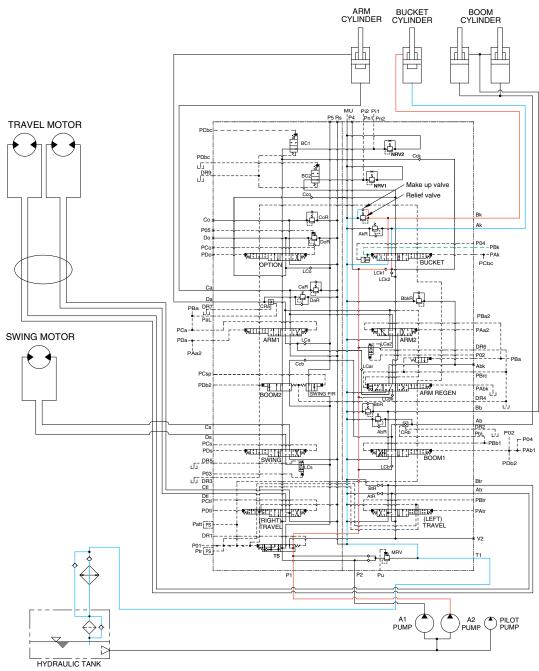
At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

6. BUCKET OUT OPERATION



220S3HC14

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.

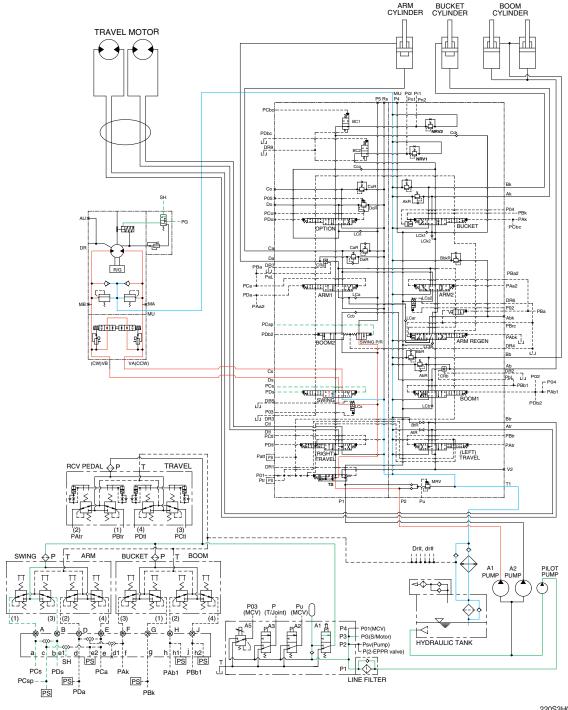
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

7. SWING OPERATION



220S3HC15

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).

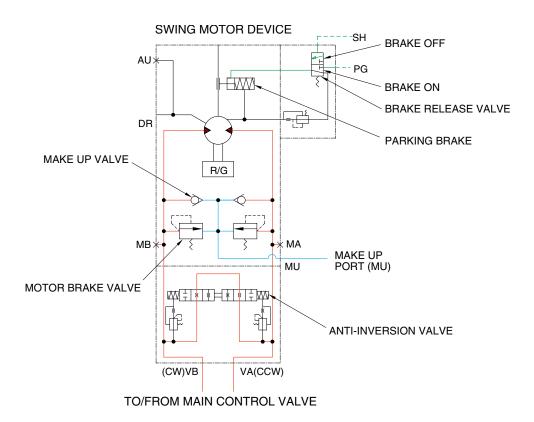
The oil from the A1 pump flows into the main control valve and then goes to the swing motor.

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 265 kgf/cm² (3770 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 all of the RCV lever (except travel pedal) are not operated.

PARKING BRAKE "OFF" OPERATION

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

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

PARKING BRAKE "ON" OPERATION

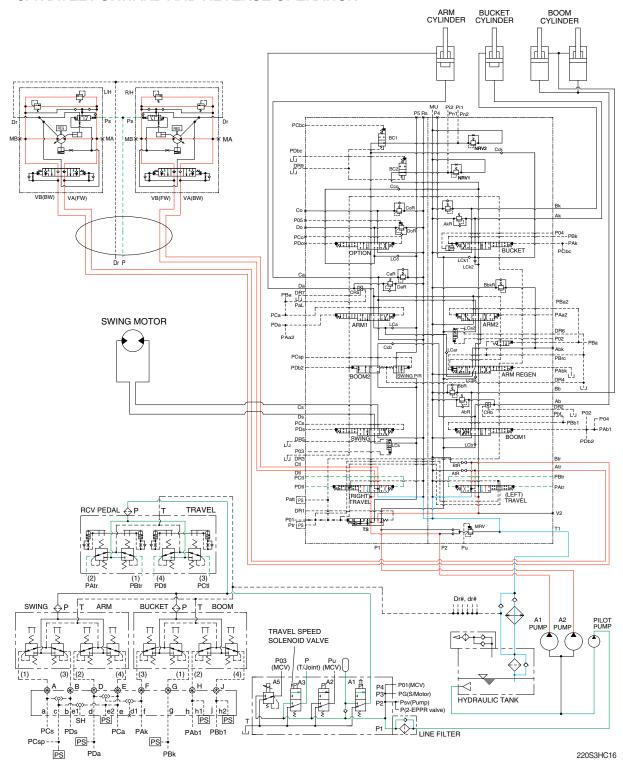
When all of the RCV lever placed in the neutral position, the pressure of the pilot oil passage down. Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the tank. And the brake is set to "ON".

4) ANTI-INVERSION VALVE

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

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

8. TRAVEL FORWARD AND REVERSE OPERATION



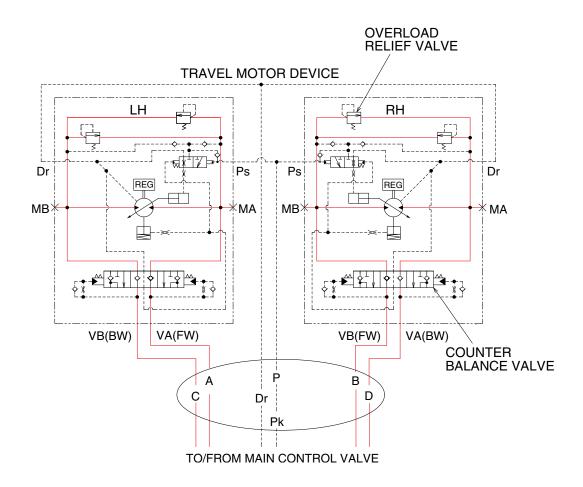
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

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.

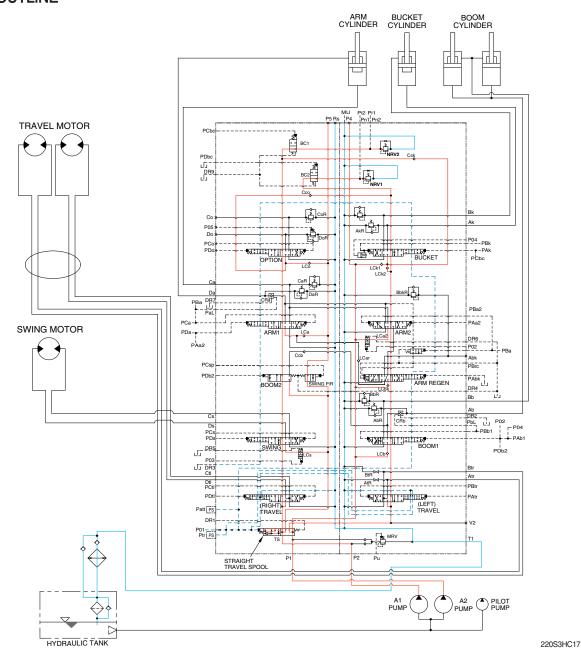
2) OVERLOAD RELIEF VALVE

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

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.

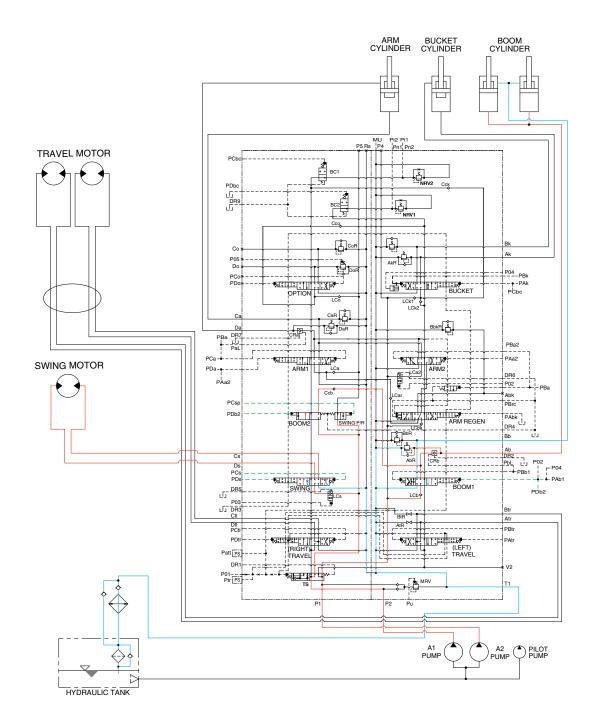
STRAIGHT TRAVEL SPOOL

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



220S3HC18

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.

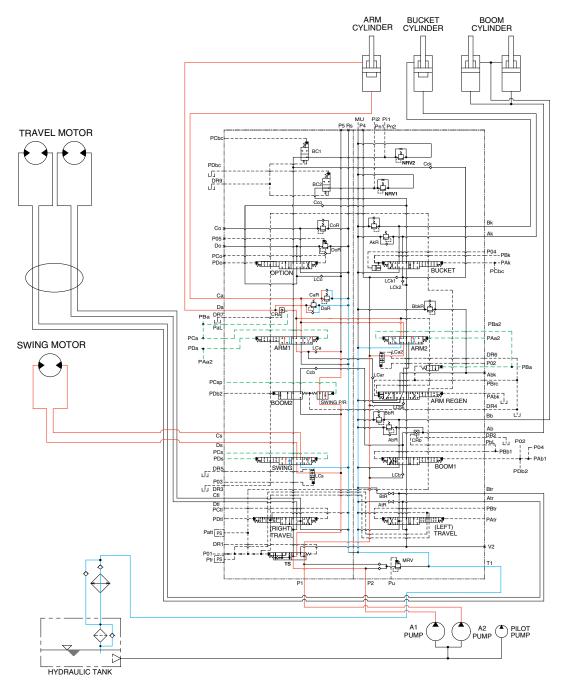
The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

3. COMBINED SWING AND ARM OPERATION



220S3HC19

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.

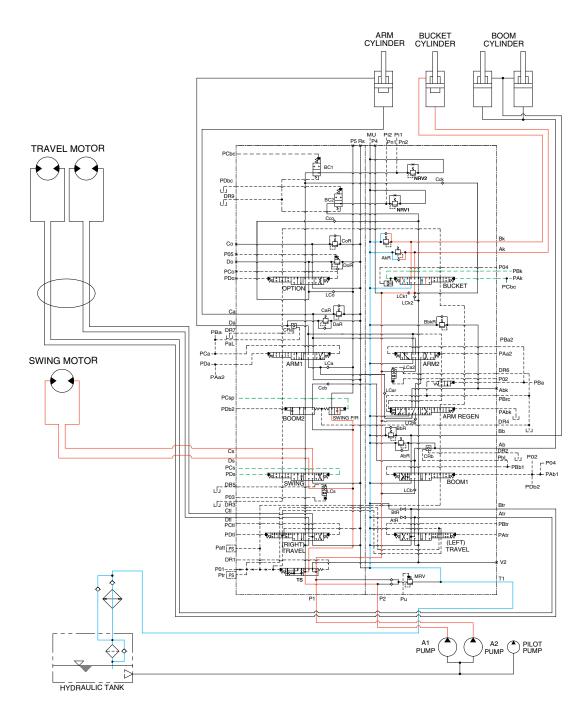
The oil from the A1 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

4. COMBINED SWING AND BUCKET OPERATION



220S3HC20

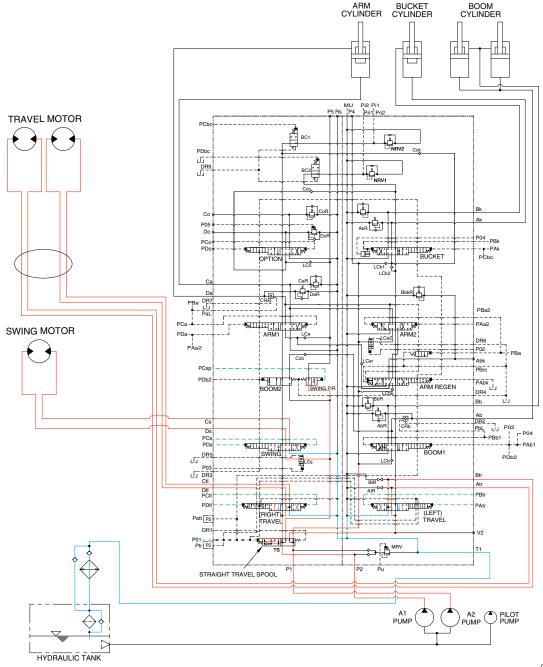
When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

5. COMBINED SWING AND TRAVEL OPERATION



220S3HC21

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.

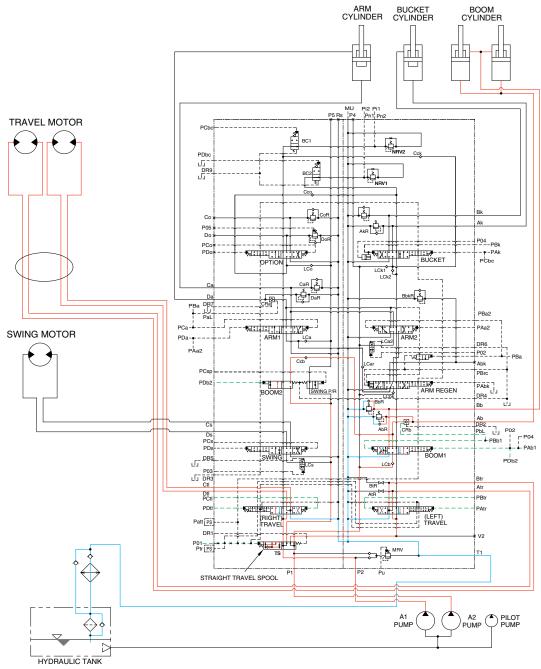
The oil from the A2 pump flows into the swing motor in the straight travel spool.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

6. COMBINED BOOM AND TRAVEL OPERATION



220S3HC22

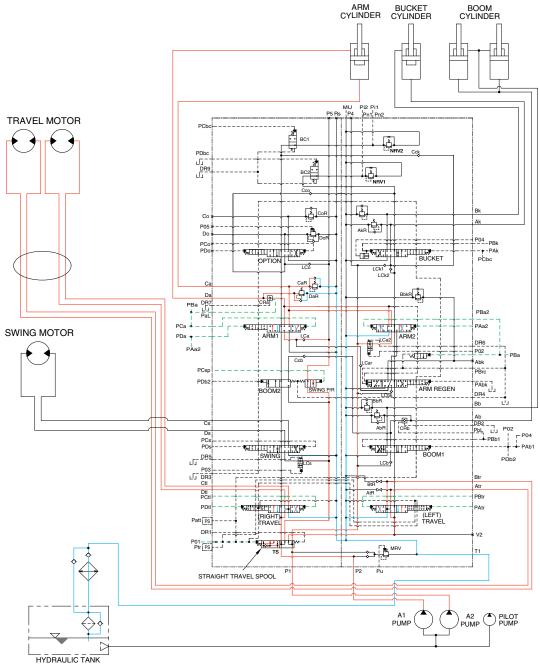
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot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



220S3HC23

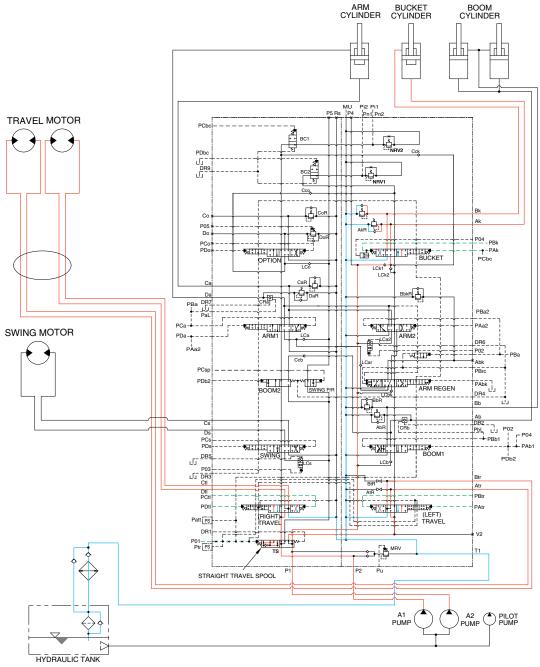
When the arm and travel functions are operated, simultaneously the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

8. COMBINED BUCKET AND TRAVEL OPERATION



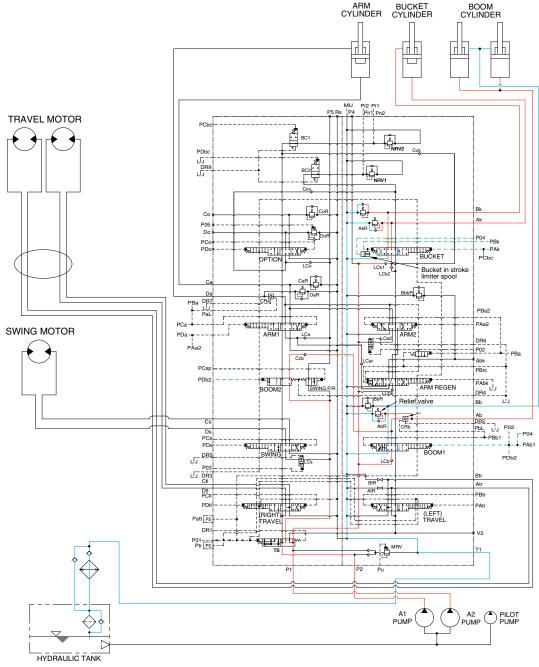
220S3HC24

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



220S3HC25

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.

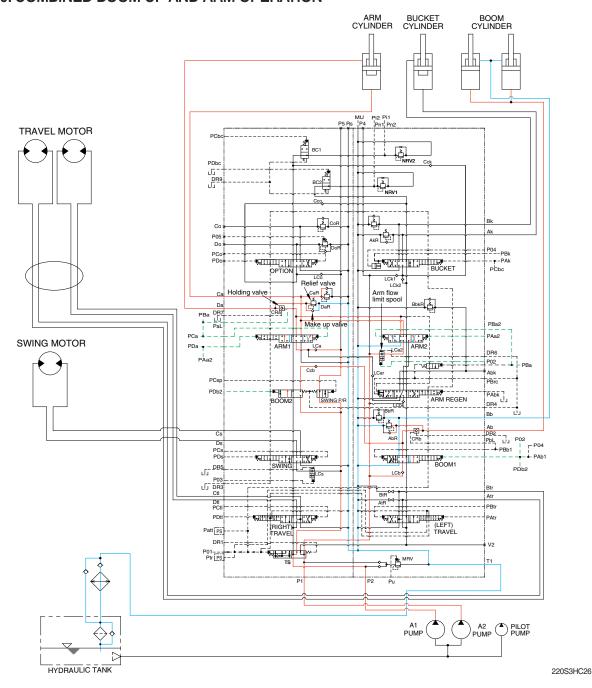
The oil from the A1 pump flows into the boom cylinders through the boom 2 spool in the left control valve. The oil from the A2 pump flows into the boom cylinders and bucket cylinder through the boom 1 spool, bucket spool and the parallel and confluence oil passage in the right control valve.

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 2-44). 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.

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

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.

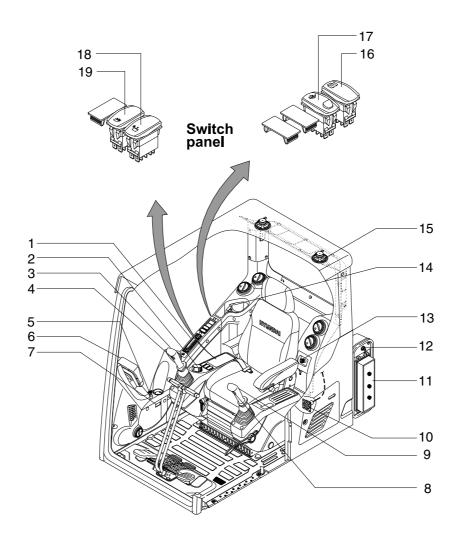
^{*} The circuit diagram may differ from the equipment, so please check before a repair.

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

GROUP 1 COMPONENT LOCATION

1. LOCATION 1

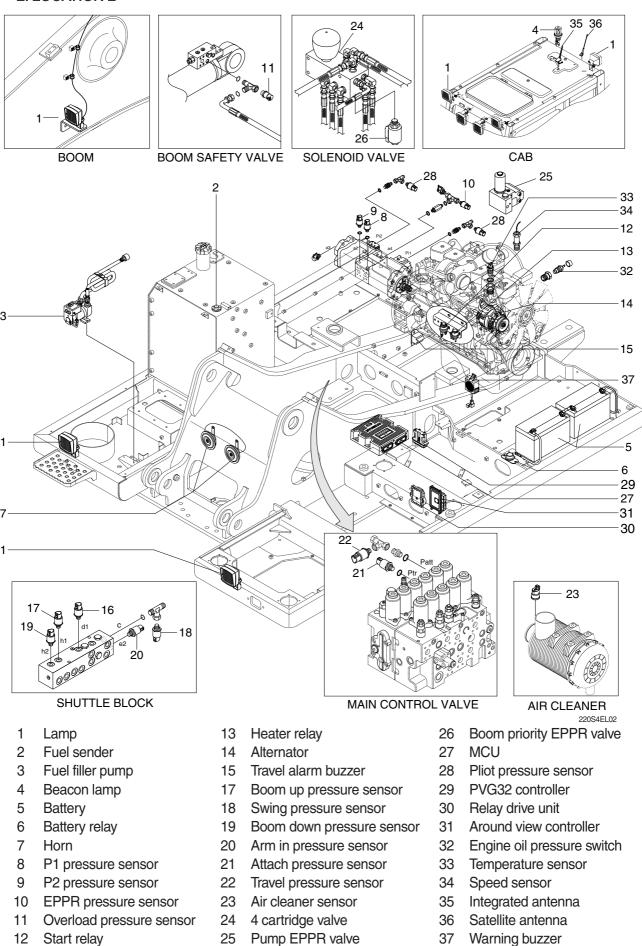


- 1 Radio & USB player
- 2 Accel dial
- 3 Horn switch
- 4 Breaker operation switch
- 5 Starting switch
- 6 Cluster
- 7 Service meter

- 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

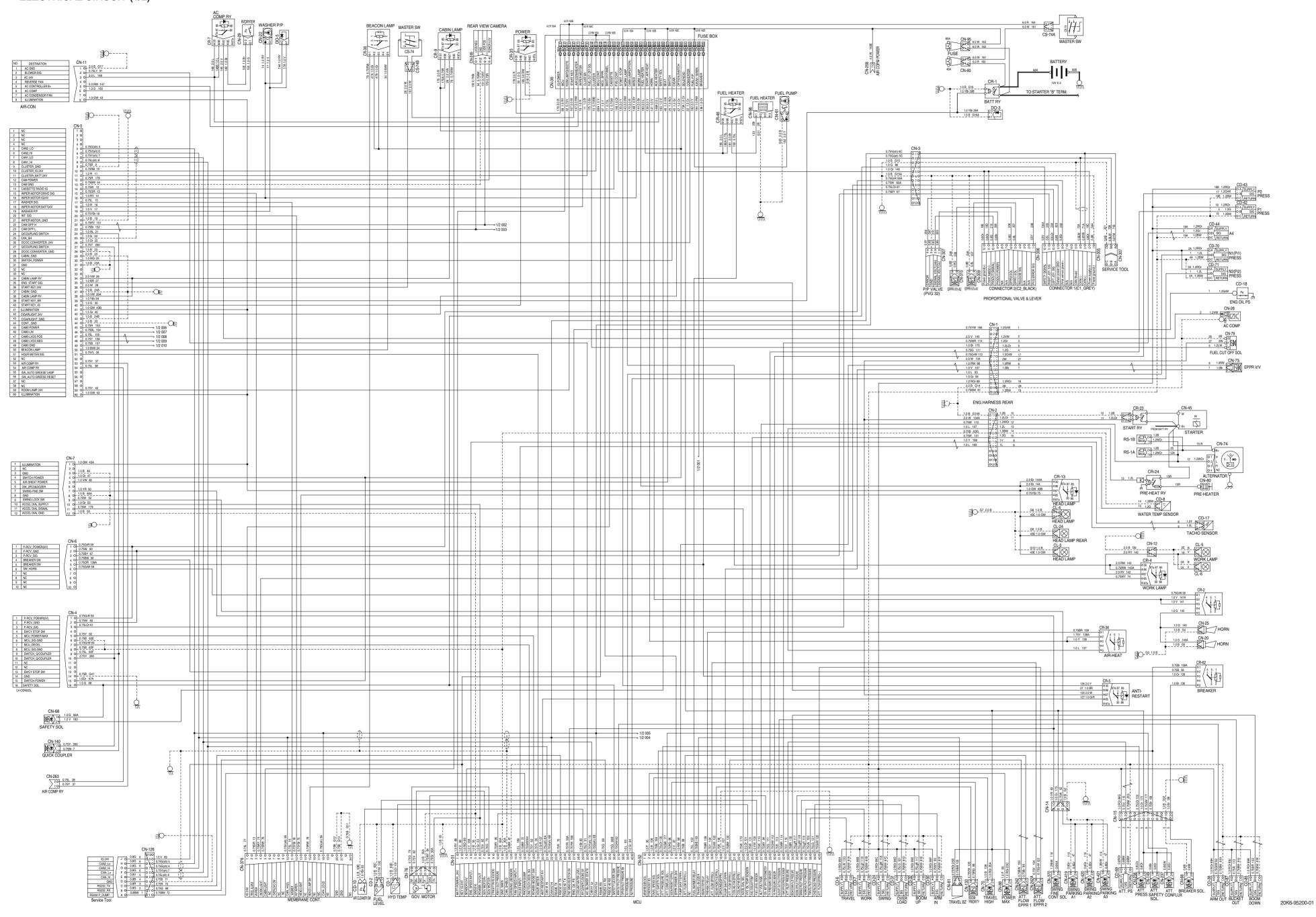
- 15 Speaker
- 16 Air compressor switch
- 17 Quick clamp switch
- 18 Swing fine switch
- 19 Swing lock switch

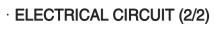
2. LOCATION 2

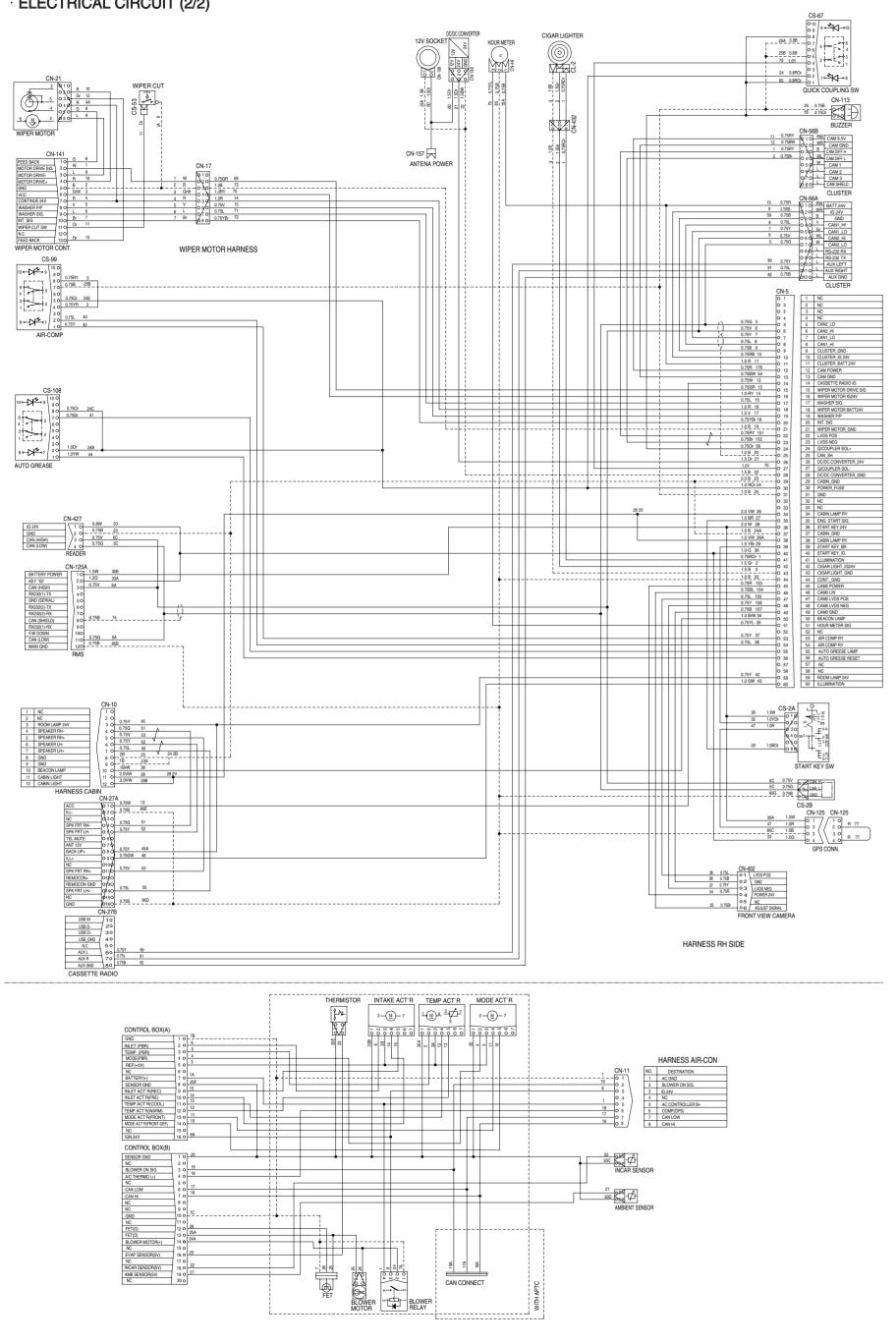


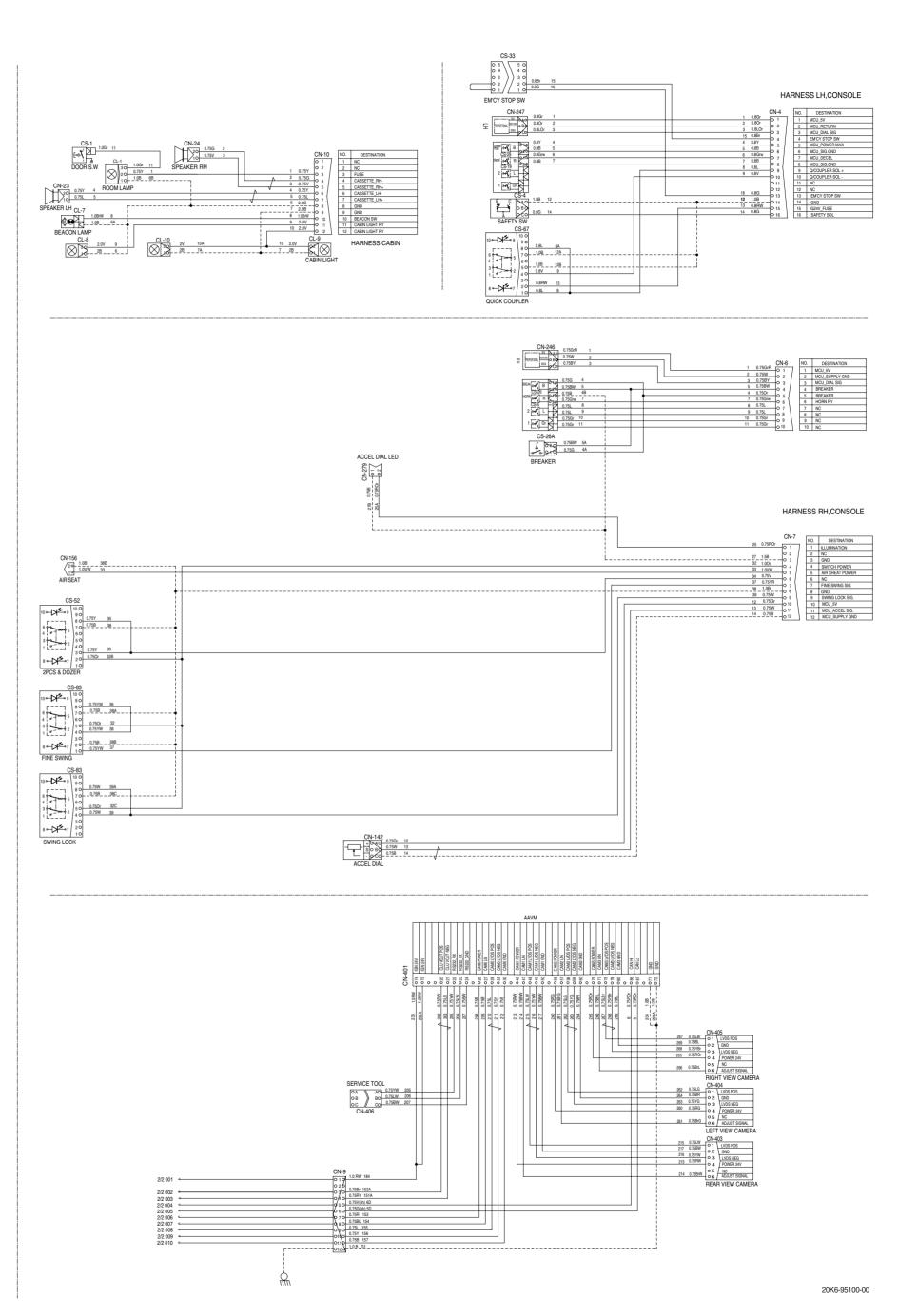
GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/2)









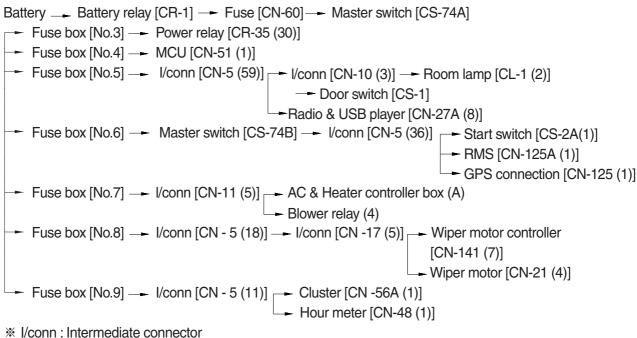
MEMORANDUM

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



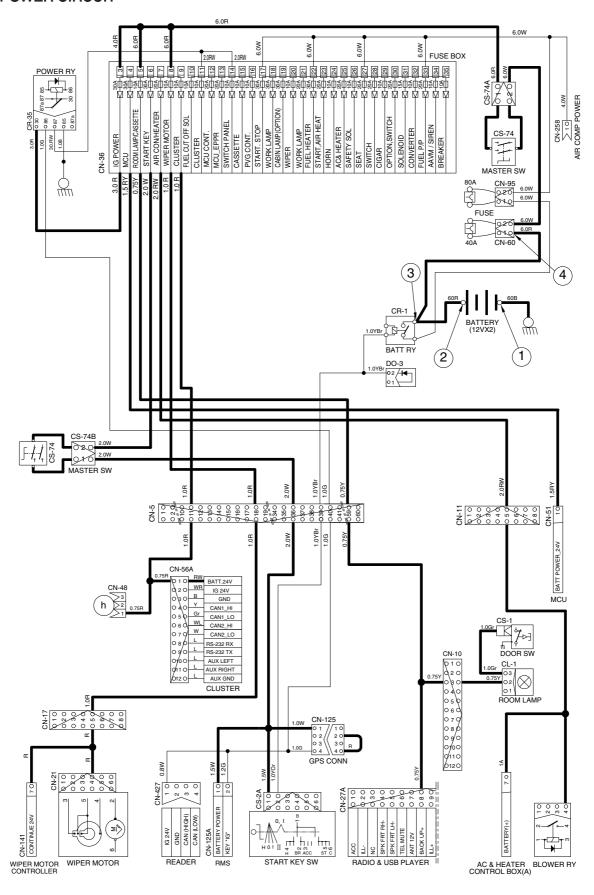
2) CHECK POINT

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

*** GND: Ground**

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

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) → (4)]

— I/conn [CN-5 (40)] — Power relay [CR-35 (86) → (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)]

— RMS [CN-125A (2)]
```

(2) When start switch is in START position

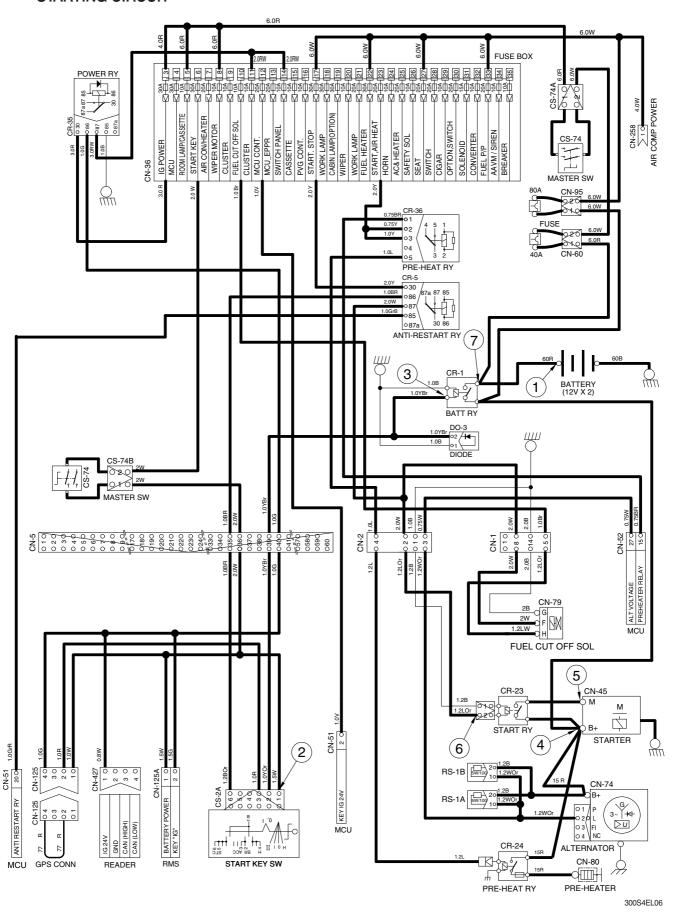
```
Start switch START [CS-2A (6)] \longrightarrow I/conn [CN-5 (35)] \longrightarrow Anti-restart relay [CR-5 (86) \rightarrow (87)] \longrightarrow I/conn CN-2 (2) \longrightarrow Start relay [CR-23] \longrightarrow Starter motor operating I/conn [CN-1 (8)] \longrightarrow Fuel cut off solenoid [CN-79(F)]
```

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)		

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

STARTING CIRCUIT



^{*} The circuit diagram may differ from the equipment, so please check before a repair.

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)]
```

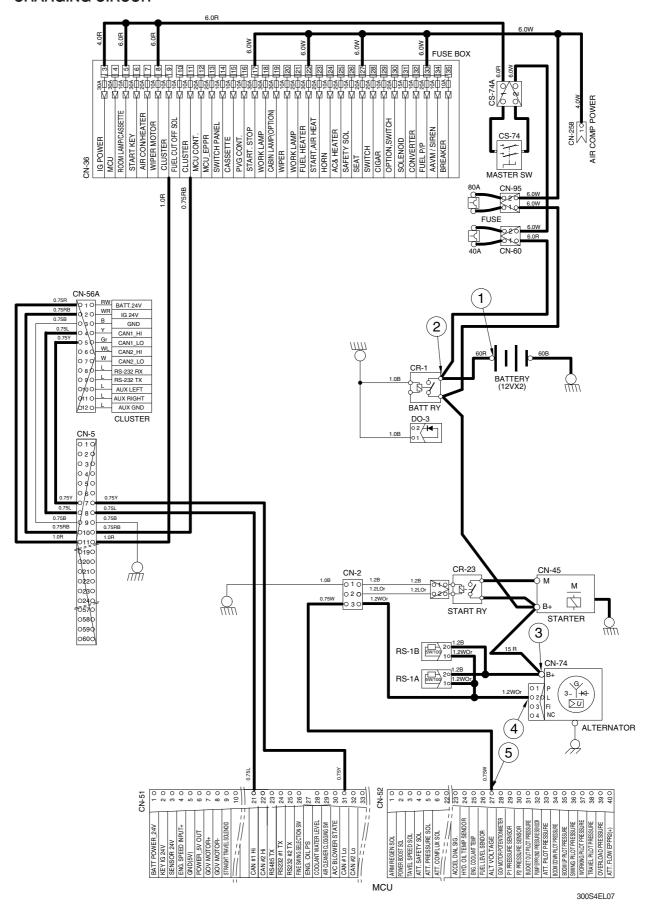
2) CHECK POINT

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

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

CHARGING CIRCUIT



^{*} The circuit diagram may differ from the equipment, so please check before a repair.

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)]

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

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

Hodge light switch ON [CN-5 (41)] → I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]

Hodge light switch ON [CN-5 (41)] → Accel dial LED [CN-279 (2)]
```

(2) Work light switch ON

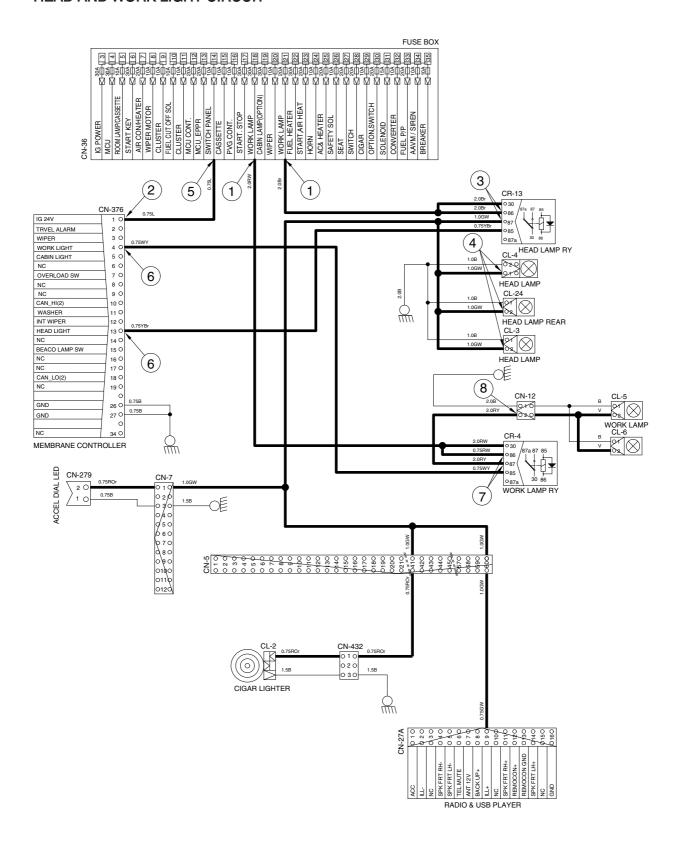
```
Work light switch ON [CN-376 (4)] \longrightarrow Work light relay [CR-4 (85) \rightarrow (87)] \longrightarrow l/conn [CN-12 (1)] \longrightarrow Work light ON [CL-5 (2), CL-6 (2)]
```

2) CHECK POINT

Engine	Start switch	Check point	Voltage	
		① - GND (fuse box)		
		② - GND (switch power input)		
	ON (4) (5) (6) (7)	③ - GND (head light relay)		
OTOD			④ - GND (head light)	00.05//
STOP		⑤ - GND (fuse box)	20~25V	
		⑥ - GND (switch power output)		
		7 - GND (work light relay)		
		8 - GND (work light)		

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

HEAD AND WORK LIGHT CIRCUIT



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)]
```

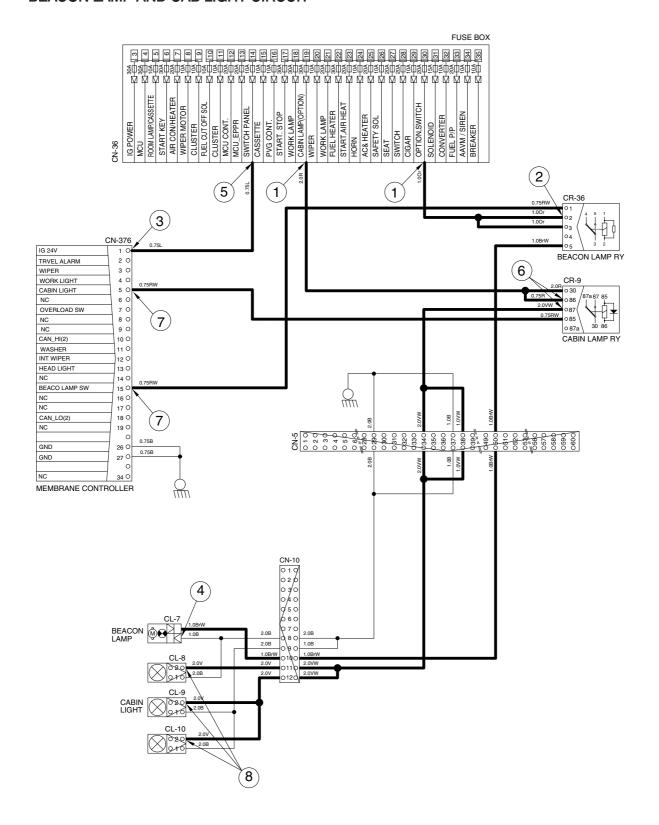
2) CHECK POINT

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

***** GND : Ground

^{*} The circuit diagram may differ from the equipment, so please check before a repair.

BEACON LAMP AND CAB LIGHT CIRCUIT



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)] / Viconn [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) \rightarrow (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

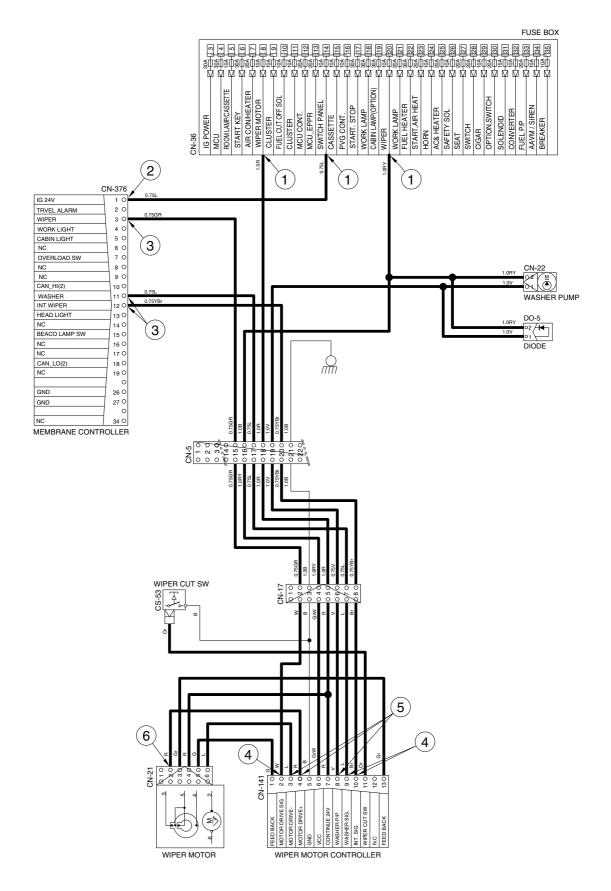
3) CHECK POINT

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

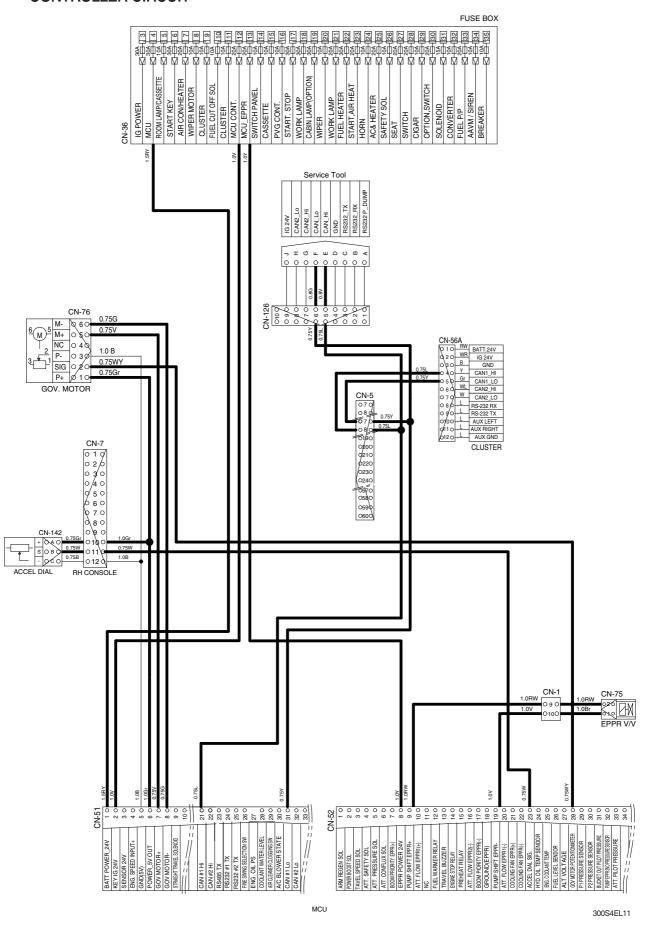
***** GND : Ground

The circuit diagram may differ from the equipment, so please check before a repair.

WIPER AND WASHER CIRCUIT

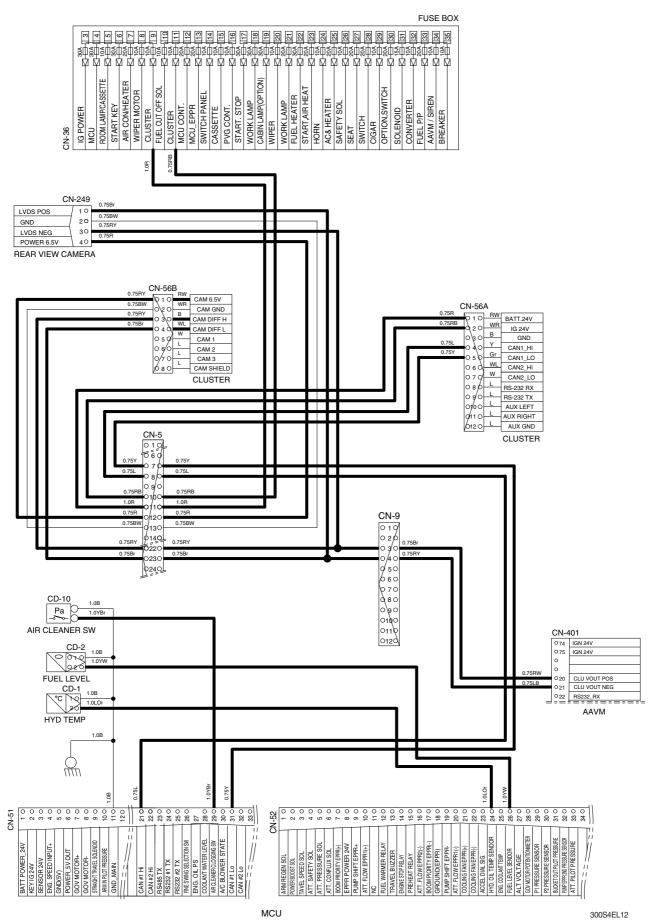


CONTROLLER CIRCUIT



^{*} The circuit diagram may differ from the equipment, so please check before a repair.

MONITORING CIRCUIT



* The circuit diagram may differ from the equipment, so please check before a repair.

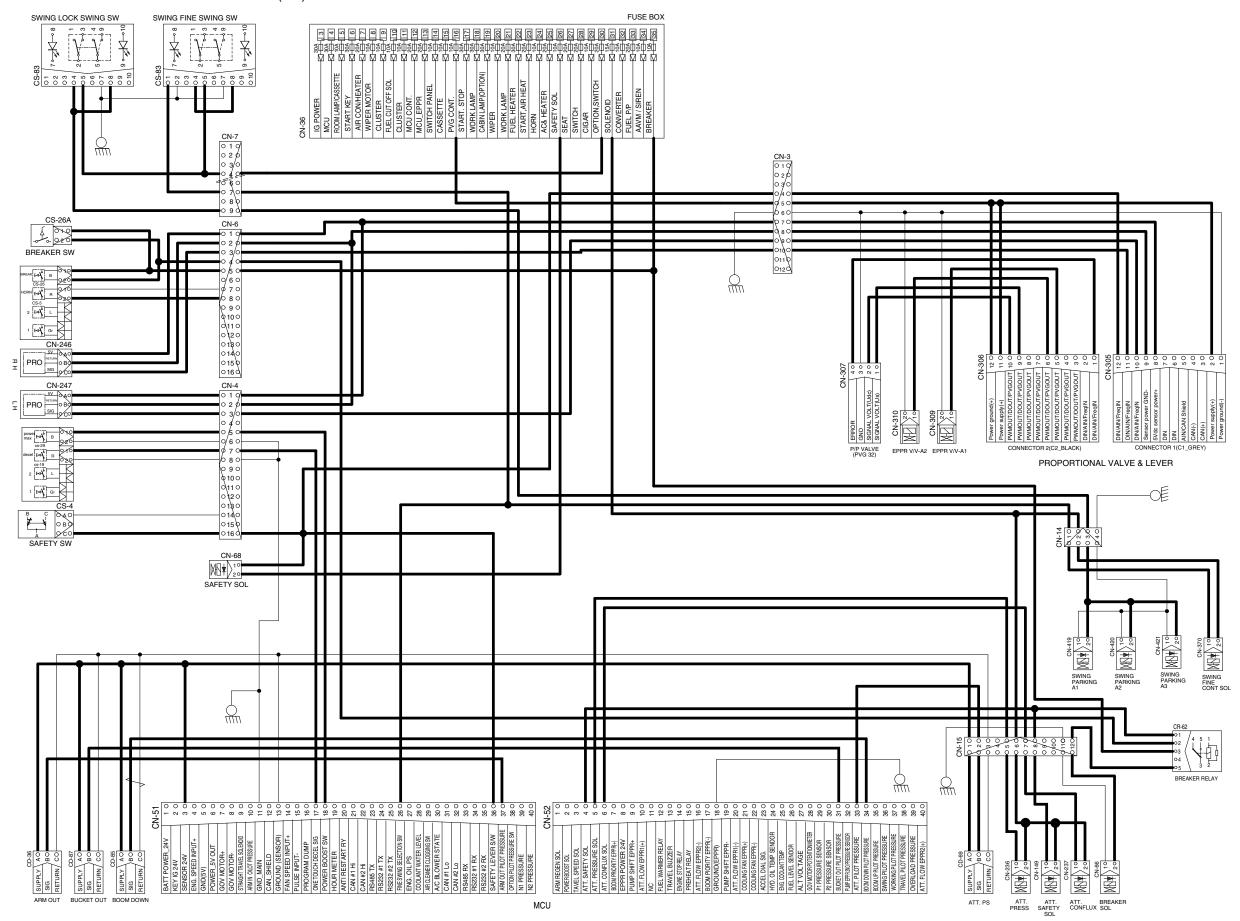
ELECTRIC CIRCUIT FOR HYDRAULIC (1/2) AUTO GREASE SW QUICK CLAMP SW QUICK CLAMP SOL 0 6 0 0 7 0 0 8 0 0 9 0 0 10 0 0 11 0 0 12 0 AIR COMP RY 6250 CN-81 30-TRAVEL BZ 0550 CN-133 CN-70 TRAVEL-HIGH POWER MAX CN-242 CN-242A O1 ATT EPPR2

ACA SIG SIG RETURN

300S4EL13

BATT POWER 24V
KEY 16 24V
SENSOR 24V
SENSOR 24V
SENSOR 24V
GND(5V)
POWER, 5V OUT
GOOV MOTORGOV WOTORGOV MOTORGOV MO

ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)



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 50 Ω Check contact Normal : ∞ Ω
Preheat relay	CR-24	24V 200A	** Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start switch	CS-2A	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	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 2 2 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 (for terminal 1-2)
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 : 0Ω (one pin to ground)
Receiver dryer	○ 2	24V 2.5A	\Re Check contact Normal : $∞$ Ω
Radio & USB player	CN-72-0 0 10 0 10 0 10 0 10 0 10 0 10 0 10 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	B+ O 1 P C 2 P L S 3 P NC CN-74	Valeo 24V 95A	* Check contact Normal : 0Ω (for terminal B ⁺ -L) Normal : 24~27.5V
Starter	M M M CN-45	24V 4.5kW	% Check contact Normal : 0.1Ω
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	20 <u>M</u>	24V 9.5A	% Check resistance Normal : 2.5Ω (for terminal 1-2)
Thermistor	20	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 CD-45	-	-
Proportional valve sensor	PROPORTIONAL SIG CO	-	-
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)	S816-012002	368301-1
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	S816-112002
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	TE	4	Swing parking & fine control	174257-2	174259-2
CN-15	-	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	-	-	Circuit breaker	21K9-03271	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	-	2	Fuel heater	1530 0001	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	6	Rear view camera	DT06-6S-EP06	DT04-6P-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-EP06	DT04-3P-E005
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	Time	No. of	Dostination	Connector part No.		
number	Type	pin	Destination	Female	Male	
CN-376	TYCO	23	Membrane controller	7706087-2	-	
CN-401	FCI	-	AAVM controller	-	-	
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-EP06	DT04-3P-E005	
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						
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	

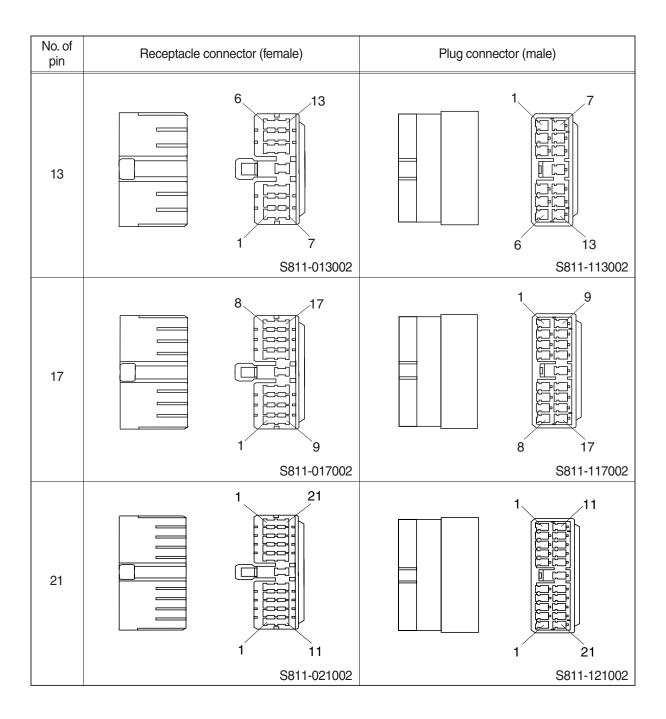
Connector	T	No. of	Destruction	Connecto	or part No.
number	Type	pin	Destination	Female	Male
CS-52	CARLING	10	Adjust & dozer switch	VC2-01	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	CARLING	10	Quick clamp switch	VC2-01	-
CS-73	CARLING	10	Swing fine switch	VC2-01	-
CS-74A	KET/AMP	2	Master switch	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
· Sensor, se	endor				
CD-1	AMP	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 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	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-

Connector	Typo	No. of	Destination	Connector part No.	
number	Type	pin	Destination	Female	Male
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 in pressure 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 conne	ector (female)	Plug connector (male)
5		2 5 1 3	1 3
		S811-005002	S811-105002
7		3 7	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

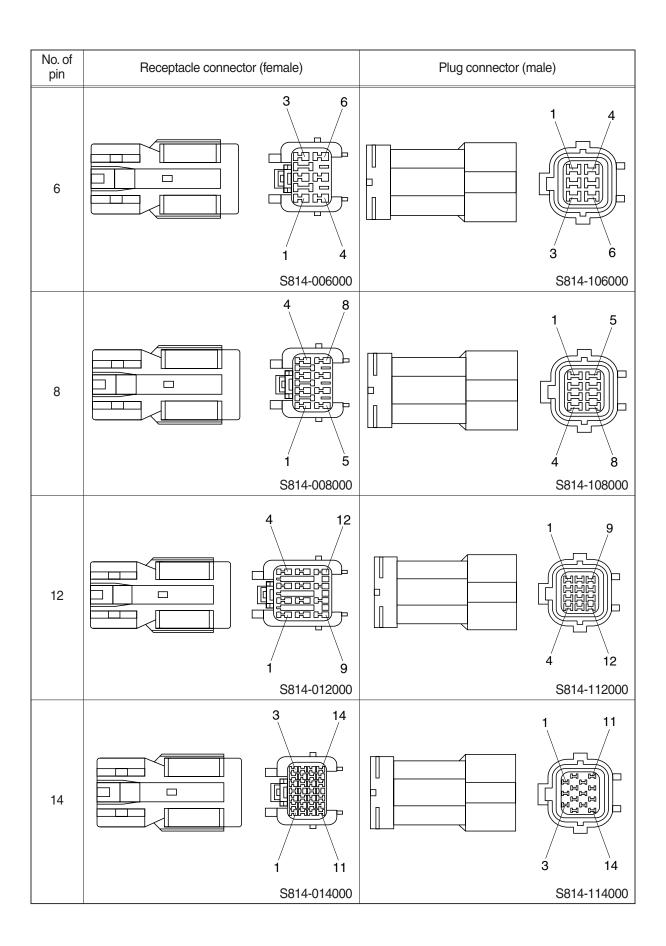


2) J TYPE CONNECTOR

No. of pin	Receptacle conne	ector (female)	Plug connector	r (male)
2		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

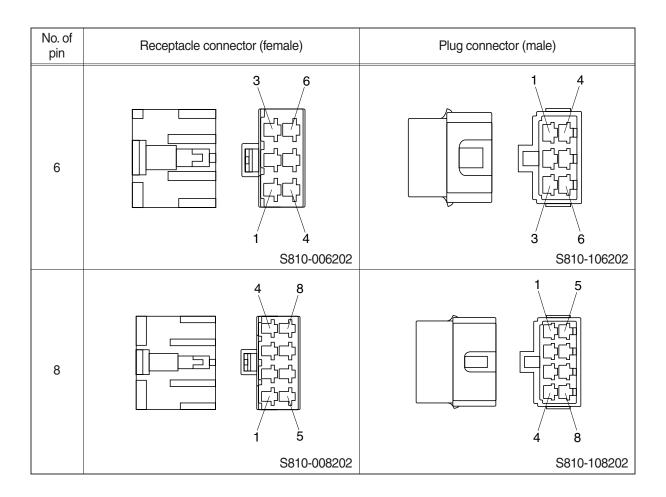
3) SWP TYPE CONNECTOR

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



4) CN TYPE CONNECTOR

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



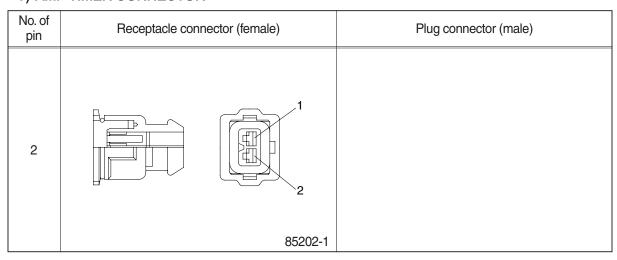
5) 375 FASTEN TYPE CONNECTOR

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



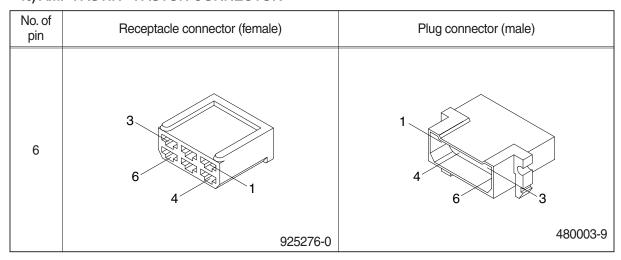
8) AMP 040 MULTILOCK CONNECTOR

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	
	1/3852	

10) AMP FASTIN - FASTON CONNECTOR



11) KET 090 CONNECTOR

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

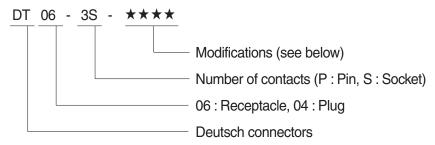
12) KET 090 WP CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
2	1 2 MG640605	
	8	
2	1 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		4 3
	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 \$816-104002

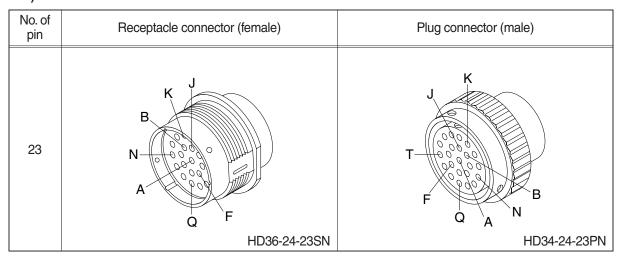
No. of pin	Receptacle connector (female)	Plug connector (male)
6	3 4 6 S816-006002	3 1 6 4 S816-106002
8	5010 000002 1 4 5 8 8 S816-008002	4 1 8 5 \$816-108002
10	5 6 10 S816-010002	5 10 6 S816-110002
12	7 12 S816-012002	6 1 12 7 S816-112002

No. of pin	Receptacle connector (female)	Plug connector (male)
15	3 15 HERELEAN 1 13	15 3
	368301-1	2-85262-1

19) METRI-PACK TYPE CONNECTOR

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

20) DEUTSCH HD30 CONNECTOR



21) DEUTSCH MCU CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
40	11 21 31 35 36 40 30	
	DRC26-40SA/B	

22) DEUTSCH SERVICE TOOL CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
9	E	

23) AMP FUEL WARMER CONNECTOR

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

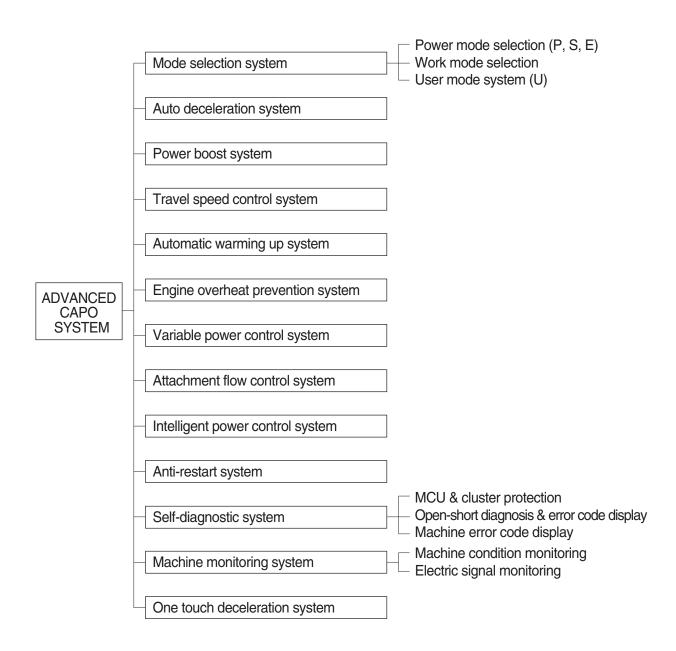
Group	1	Outline ····	5-1
Group	2	Mode Selection System ·····	5-3
Group	3	Automatic Deceleration System	5-6
Group	4	Power Boost System ····	5-7
Group	5	Travel Speed Control System	5-8
Group	6	Automatic Warming Up System	5-9
Group	7	Engine Overheat Prevention System ·····	5-10
Group	8	Variable Power Control System	5-11
Group	9	Attachment Flow Control System	5-12
Group	10	Intelligent Power Control System	5-13
Group	11	Anti-Restart System	5-15
Group	12	Self-Diagnostic System	5-16
Group	13	Engine Control System ····	5-40
Group	14	EPPR Valve	5-41
Group	15	Monitoring System ····	5-46
Group	16	Fuel Warmer System ·····	5-80

SECTION 5 MECHATRONICS SYSTEM

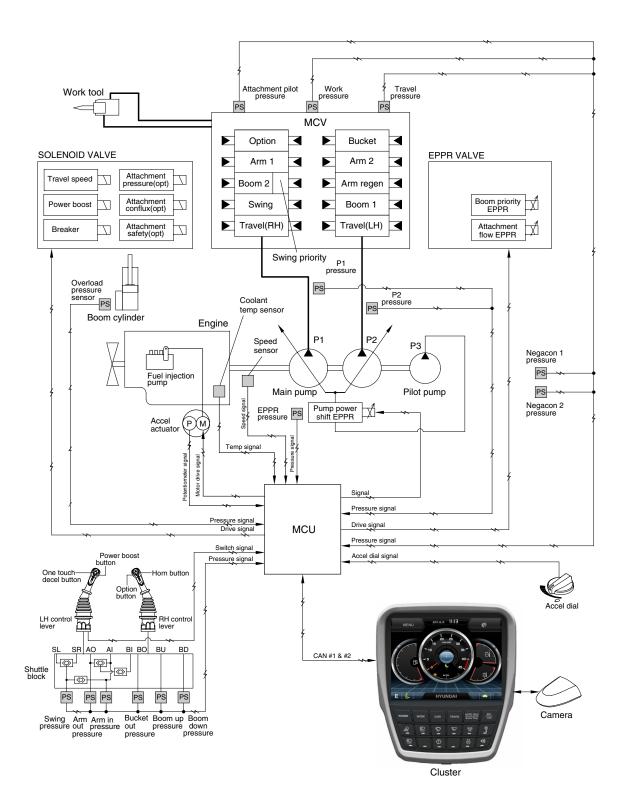
GROUP 1 OUTLINE

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.



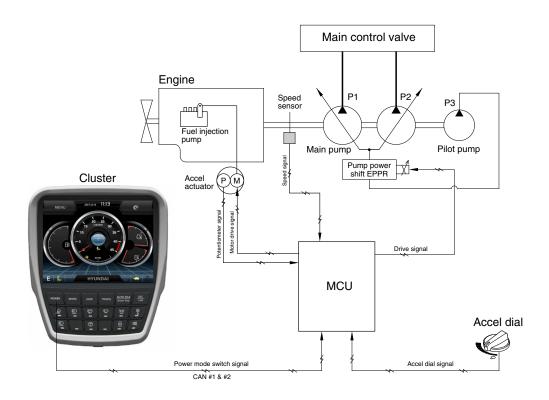
SYSTEM DIAGRAM



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.

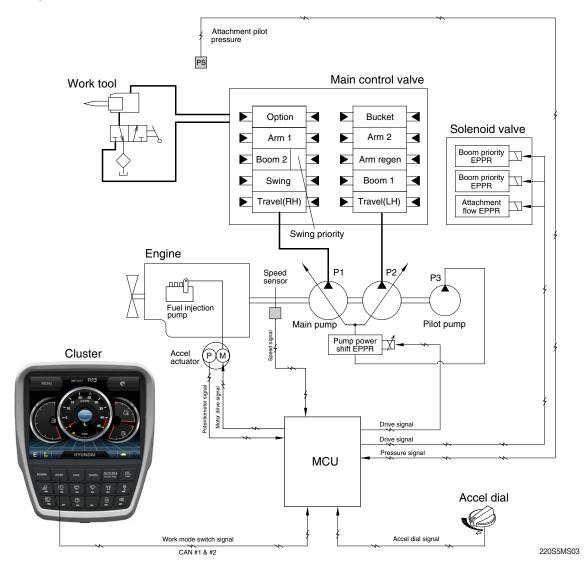
	Application	Engine rpm			Power shift by EPPR valve				
Power		Standard		Option		Standard		Option	
mode		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm²)	Current (mA)	Pressure (kgf/cm²)
Р	Heavy duty power	1900±50	1700±50	2000±50	1800±50	330±30	10 (~5)	190±30	3 (~3)
S	Standard power	1800±50	1600±50	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	10 (~5)±3
AUTO DECEL	Engine deceleration	1200±100	-	1200±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	1100±100	-	1100±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	1100±100	-	1100±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.

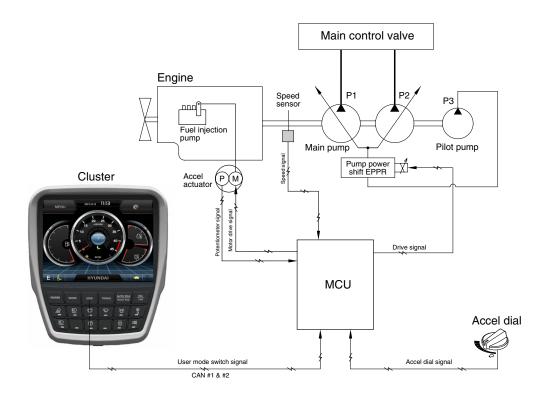
2) ATT WORK MODE (breaker, crusher)

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

Description	General mode	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



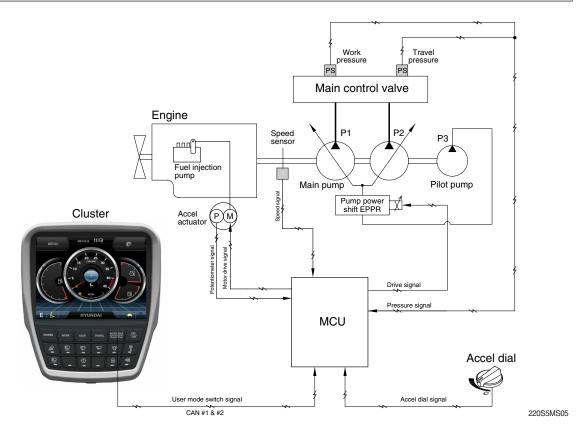
220S5MS04

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	3
3	1600	1080	6
4	1700	1100	9
5	1750	1150	12
6	1800	1200 (auto decel)	16
7	1850	1230	20
8	1900	1250	26
9	1950	1300	32
10	2000	1350	38

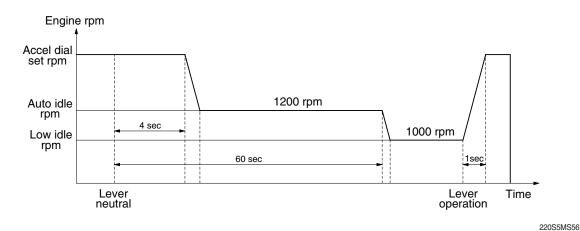
GROUP 3 AUTOMATIC DECELERATION SYSTEM



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.

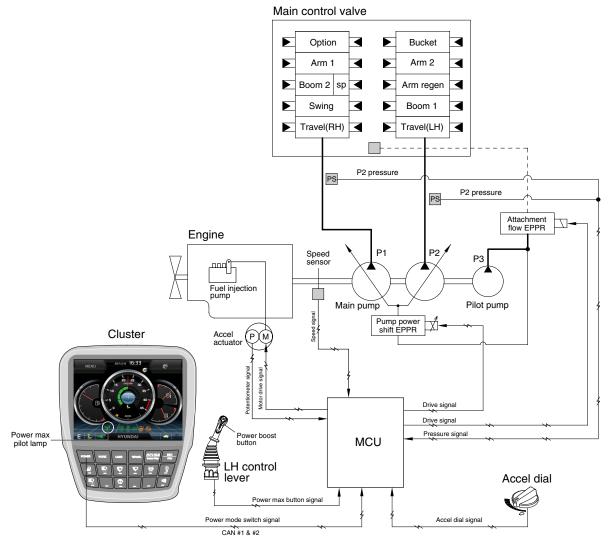


2. WHEN AUTO IDLE PILOT LAMP OFF

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



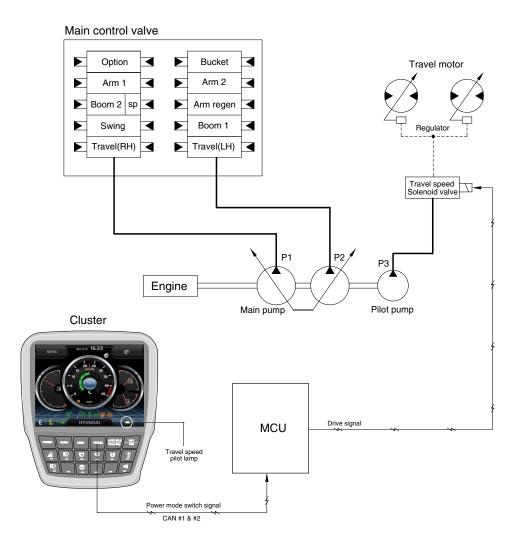
220S5MS06

- 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



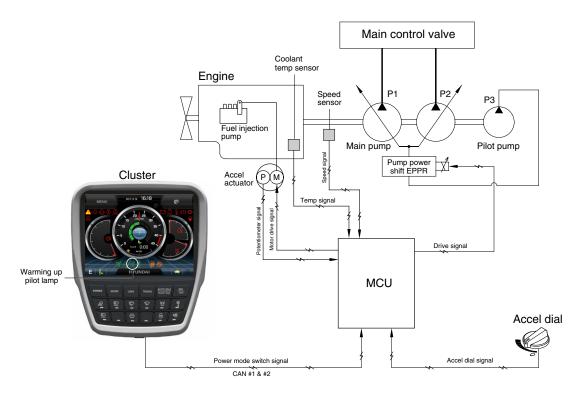
220S5MS10

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



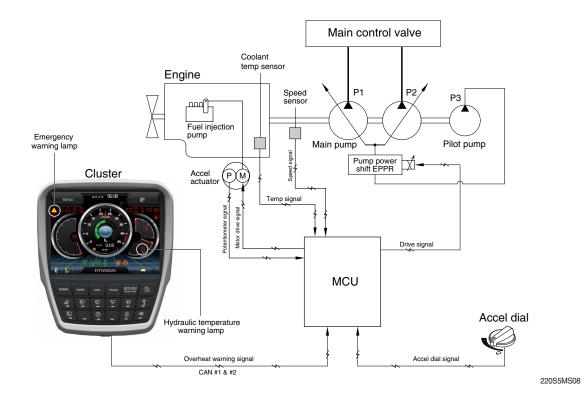
220S5MS07

- 1. 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

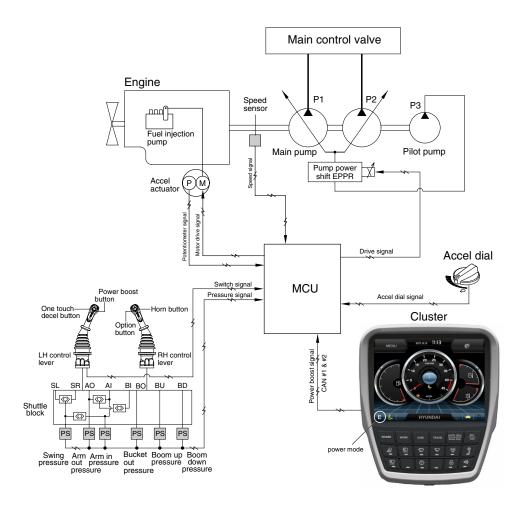


1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 100°C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

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		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.
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

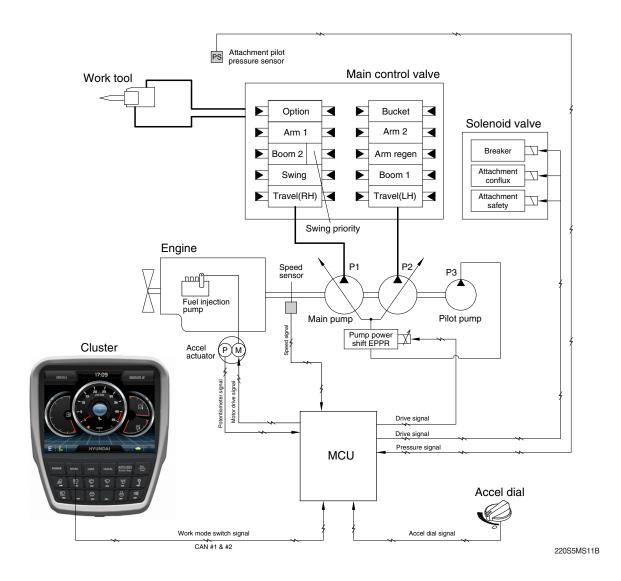
The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.

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

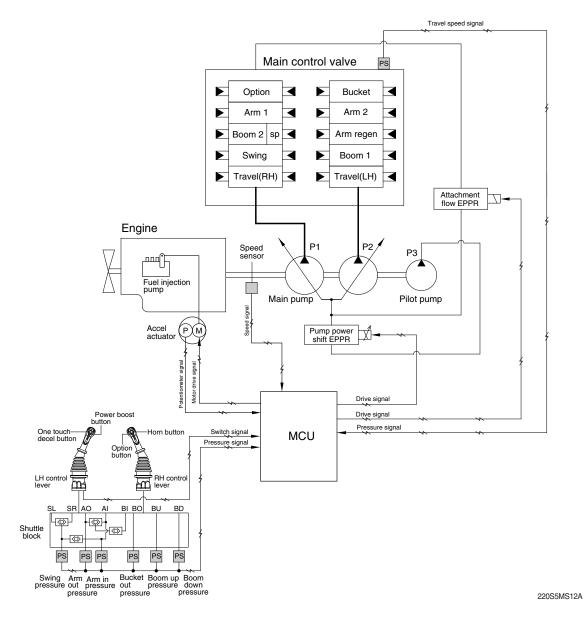


• The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

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

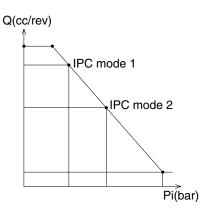
^{★1} AND condition

^{★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"

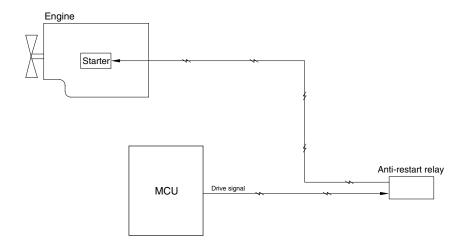




220S5MS19

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.

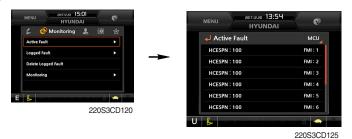
GROUP 12 SELF-DIAGNOSTIC SYSTEM

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



· 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		5, ,, ,,	Application		
HCESPN	FMI	Diagnostic Criteria	G	С	W
101	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.8V	•		
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3V	•		
	(Results / Symptoms)				
	1. Monitor – Hydraulic oil temperature display failure				
	2. Control Function – Fan revolutions control failure				
	(Checking list)				
	1. CD-1 (#2) – CN-52 (#24) Checking Open/Short				
	2. CD-1 (#1) – CN-51 (#11) Checking Open/Short				
105	0	10 seconds continuous, Working Press. Sensor			
	0	Measurement Voltage > 5.2V			
	1	10 seconds continuous, 0.3V≤ Working Press. Sensor Measurement			
		Voltage < 0.8V			
	4	10 seconds continuous, Working Press. Sensor			
		Measurement Voltage < 0.3V			
	(Results / Symptoms)				
	1. Monitor – Working Press. display failure				
	2. Control Function – Auto Idle operation failure, Engine variable horse power control operation				
	failure				
	(Checking list)				
	1. CD-7 (#B) – CN-52 (#37) Checking Open/Short 2. CD-7 (#A) – CN-51 (#3) Checking Open/Short				
	2. CD-7 (#A) – CN-51 (#3) Checking Open/Short 3. CD-7 (#C) – CN-51 (#13) Checking Open/Short				
	0. OD	10 seconds continuous, Travel Oil Press. Sensor			
108	1	Measurement Voltage > 5.2V			
		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			
	(Results / Symptoms)				
	1. Monitor – Travel Oil Press. display failure				
	2. Control Function – Auto Idle operation failure, Engine variable horse power control operation				
	failure, IPC operation failure, Driving alarm operation failure				
	(Checking list)				
	1. CD-6 (#B) – CN-52 (#38) Checking Open/Short				
	2. CD-6 (#A) – CN-51 (#3) Checking Open/Short				
	3. CD-6 (#C) – CN-51 (#13) Checking Open/Short				

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

G : General C : Crawler Type W : Wheel Type

DTC	;	D:	Ap	plicat	ion
HCESPN	FMI	Diagnostic Criteria	G	С	W
	0	10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement 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 Voltage < 0.3V	•		
120	1. Mor 2. Cor (Chec 1. CD-	Its / Symptoms) nitor – Main Pump 1 (P1) Press. display failure ntrol Function – Automatic voltage increase operation failure, Overload at composition failure king list) -42 (#B) – CN-52 (#29) Checking Open/Short -42 (#A) – CN-51 (#3) Checking Open/Short	ensat	ion co	ontrol
	3. CD	-42 (#C) - CN-51 (#13) Checking Open/Short			
	0	10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage > 5.2V	•		
	1	10 seconds continuous, $0.3V \le$ Main Pump 2 (P2) Press. Sensor Measurement Voltage < $0.8V$	•		
	4	10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.3V	•		
121	(Resu	lts / Symptoms)			
121	2. Cor	nitor – Main Pump 2 (P2) Press. display failure htrol Function – Automatic voltage increase operation failure, Overload at comp	ensat	ion co	ntrol
	1. CD- 2. CD-	king list) -43 (#B) – CN-52 (#30) Checking Open/Short -43 (#A) – CN-51 (#3) Checking Open/Short -43 (#C) – CN-51 (#13) Checking Open/Short			
	1	(when you had conditions mounting pressure sensor) $ 10 \ \ \text{seconds continuous}, \ 0.3V \leq \text{Overload Press. Sensor Measurement} $ $ \ \ \text{Voltage} < 0.8V $	•		
	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Overload Press. Sensor Measurement Voltage < 0.3V	•		
122		lts / Symptoms)			
		nitor – Overload Press. display failure			
		ntrol Function – Overload warning alarm failure			
	,	king list) -31 (#B) – CN-52 (#39) Checking Open/Short			
ı		-31 (#A) – CN-52 (#39) Checking Open/Short			
		-31 (#C) – CN-51 (#13) Checking Open/Short			

DTC	;		Ар	plicat	ion					
HCESPN	FMI	Diagnostic Criteria	G	С	W					
	0	10 seconds continuous, Negative 1 Press. Sensor								
	U	Measurement Voltage > 5.2V								
	1	10 seconds continuous, $0.3V \le$ Negative 1 Press. Sensor Measurement Voltage $< 0.8V$	•							
	4	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V	•							
123	(Resu	Its / Symptoms)								
	1. Mor	nitor – Negative 1 Press. display failure								
	2. Cor	ntrol Function – IPC operation failure, Option attachment flow control operation f	ailure)						
	(Chec	king 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								
	0	10 seconds continuous, Negative 2 Press. Sensor								
		Measurement Voltage > 5.2V								
	1	10 seconds continuous, 0.3V≤ Negative 2 Press. Sensor Measurement								
		Voltage < 0.8V								
	4	10 seconds continuous, Negative 2 Press. Sensor								
	<u> </u>	Measurement Voltage < 0.3V								
124	(Results / Symptoms)									
		1. Monitor – Negative 2 Press. display failure								
		2. Control Function – Option attachment flow control operation failure								
	,	(Checking list)								
		-71 (#B) – CN-51 (#40) Checking Open/Short								
		-71 (#A) – CN-51 (#3) Checking Open/Short								
	3. CD	-71 (#C) – CN-51 (#13) Checking Open/Short								
	0	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement Voltage > 5.2V								
	1	10 seconds continuous, 0.3V≤ Boom Up Pilot Press. Sensor Measurement Voltage < 0.8V	•							
	4	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement < 0.3V	•							
	(Resu	Its / Symptoms)								
127	,	nitor – Boom Up Pilot Press. display failure								
		ntrol Function – Engine/Pump variable horse power control operation failure, IPC	Cone	ration	ı					
		failure, Boom first operation failure	opo							
	(Chec	king list)								
	,	-32 (#B) – CN-52 (#35) Checking Open/Short								
		-32 (#A) – CN-51 (#3) Checking Open/Short								
		-32 (#C) – CN-51 (#13) Checking Open/Short								

G : General C : Crawler Type W : Wheel Type

DTC	;	Di vi O'i i	Application		
HCESPN	FMI	Diagnostic Criteria	G	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			
	3. CD	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 10 seconds continuous,	•		
	4	0.3V≤ Arm In/Out & Bucket In Pilot Press. Sensor Measurement Voltage < 0.8V 10 seconds continuous,	•		
133	(Resu 1. Mor 2. Cor (Chec 1. CD- 2. CD-	Arm In/Out & Bucket In Pilot Press. Sensor Measurement Voltage < 0.3V 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.

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

DTC	;	Discounting Office in	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	l ,	Its / Symptoms)			
		nitor – Swing Pilot Press. display failure			
		ntrol Function – IPC operation, Boom first operation failure			
	,	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 Monitor – Select Attachment(breaker / crusher)			
	1	10 seconds continuous, 0.3V≤ Attachment Pilot Press. Sensor			
	'	Measurement Voltage < 0.8V			
		Monitor – Select Attachment(breaker / crusher)			
	4	10 seconds continuous, Attachment Pilot Press. Sensor Measurement			
138	_	Voltage < 0.3V			
	(Resu	Its / Symptoms)			
	l ,	nitor – Attachment Pilot Press. display failure			
		ntrol Function – Option attachment flow control operation failure			
		king list)			
	1. CD	-69 (#B) - CN-52 (#33) Checking Open/Short			
	2. CD	-69 (#A) – CN-51 (#3) Checking Open/Short			
	3. CD	-69 (#C) – CN-51 (#13) Checking Open/Short			
	4	10 seconds continuous, 0.3V≤ Option Pilot Press. Sensor Measurement			
	1	Voltage < 0.8V			
	4	10 seconds continuous, Option Pilot Press. Sensor			
	_ '	Measurement Voltage < 0.3V			
139	(Resu	Its / Symptoms)			
(NA)		nitor – Option Pilot Press. display failure			
(14/1)		ntrol Function – Auto Idle operation failure			
	l ,	king list)			
		-100 (#B) – CN-52 (#21) Checking Open/Short			
		-100 (#A) – CN-51 (#3) Checking Open/Short			
	3. CD	-100 (#C) – CN-1 (#6) Checking Open/Short			

G : General C : Crawler Type W : Wheel Type

DTC	;	Diagnacatic Criteria	Ap	plicat	ion
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 > 1.0 A (Cancellation) 3 seconds continuous, Pump EPPR drive current ≤ 1.0 A 	•		
	,	lts / Symptoms) htrol Function – Pump horse power setting specification difference			
	1. CN	(Fuel efficiency/speed specification failure) king list) -75 (#2) – CN-52 (#9) Checking Open/Short -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) Introl Function – Boom first control operation failure Eking list) -133 (#2) – CN-52 (#7) Checking Open/Short -133 (#1) – CN-52 (#17) Checking Open/Short			

,		Diagnostic Critaria	Ap	plicat	ion
HCESPN	FMI	Diagnostic Criteria	G	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			•
	6	 (Detection) 10 seconds continuous, Travel EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Travel EPPR drive current ≤ 1.0 A 			•
	(Resu	lts / Symptoms)			
		ntrol Function – cruise control operation failure			
	`	king list) -246 (#2) – CN-54 (#39) Checking Open/Short			
		-246 (#1) – CN-51 (#40) Checking Open/Short			
145	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 (Detection)	•		
145 (NA)	6	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	lts / 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	;	Dia was astic Criteria	Ap	plicat	ion
HCESPN	FMI	Diagnostic Criteria	G	С	W
	4	(Detection) (When Working Cutoff Relay is Off) 10 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Working Cutoff Relay is Off) 3 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage > 3.0V			•
164 (NA)	6	(Detection) (When Working Cutoff Relay is On) 10 seconds continuous, Working Cutoff Relay drive current > 6.5 A (Cancellation) (When Working Cutoff Relay is On) 3 seconds continuous, Working Cutoff Relay drive current ≤ 6.5 A			•
	(Resu	Its / Symptoms)			
	,	ntrol Function – (Wheel Excavator) In driving mode, attachment hydraulic pilot p	ressu	ire cut	t off
	,	king list)			
		-47 (#85) – CN-54 (#9) Checking Open/Short			
	2. CR	-47 (#30, #86) – Fuse box (#28) Checking Open/Short			
	4	(Detection) (When Power Max Solenoid is Off) 10 seconds continuous, Power Max Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Power Max Solenoid is Off) 3 seconds continuous, Power Max Solenoid drive unit Measurement Voltage > 3.0V	•		
166	6	(Detection) (When Power Max Solenoid is On) 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	•		
	1. Cor (Chec 1. CN	Its / Symptoms) htrol Function – Voltage increase operation failure king list) -88 (#1) – CN-52 (#2) Checking Open/Short -88 (#2) – Fuse box (#30) Checking Open/Short			

※ 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 HCESPN FMI 4		Diagnostia Critoria		Application		
HCESPN	FMI	Diagnostic Criteria	G	С	W	
167		(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		•		
	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 (Chec 1. CN	olts / Symptoms) Its / Symptoms Its / Symptoms) Its / Symptoms				
	2. CN	-70 (#2) – Fuse box (#30) Checking Open/Short				

DTC	;	Diognostic Criteria	Ap	plicati	on
HCESPN	FMI	Diagnostic Criteria	G	С	W
169	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	•		
	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)			
	l '	ntrol Function – Option attachment flow control – Joining operation failure			
		breaker mode, crusher mode)			
	,	king list)			
	l ,	-237 (#1) – CN-52 (#6) Checking Open/Short			
		-237 (#2) – Fuse box (#30) 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			

DTC		Diagnostic Criteria		plicat	ion				
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	(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	Its / Symptoms)							
	1. Co	ntrol Function - Option attachment flow control - Option spool pilot pressur	e cut	off fa	ilure				
	(crusher mode)								
	(Chec	king list)							
	1. CN	-149 (#1) – CN-52 (#4) Checking Open/Short							
	2. CN-	-149 (#2) – Fuse box (#30) 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	•						
	1. Cor (Chec 1. CN	lts / Symptoms) ntrol Function – Option attachment flow control – Breaker operation failure (breaking list) -66 (#1) – CN-15 (#10) Checking Open/Short -66 (#2) – CN-62 (#5) Checking Open/Short	ker m	node)					

DTC HCESPN FMI 4		Dia was satis Criteria	Ap	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	•		
	(Resu	lts / 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	olts / Symptoms) Introl Function – IPC operation failure, Option attachment flow control operation folions list) -242 (#2) – CN-52 (#10) Checking Open/Short -242 (#1) – CN-52 (#20) Checking Open/Short	failure)	

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

G : General C : Crawler Type W : Wheel Type

DTC	;	Discounting Office in	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) ntrol 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 10 seconds continuous, 0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V			
196 (NA)	,	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V lts / Symptoms)			
	(Chec 1. CD- 2. CD-	ntrol 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. Moi 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) eking 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		Diagnostic Criteria		Application		
HCESPN	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. Mo 2. Con (Chec 1. CD 2. CD	onitor – Boom Cylinder Rod Press. display failure Introl Function – Boom floating control operation failure Eximg list) Introl Function – Boom floating control operation failure Introl Function – Boom floating control operation failure Introl Function – Boom floating Control operation failure Introl Function – CN-53 (#5) Checking Open/Short Introl Function – CN-53 (#5) Checking Open/Short Introl Function – Boom Cylinder Rod Press. display failure Introl Function – Boom floating Control operation failure Introl Function failure Introl Function failure Introl Function failure Introl Function				
	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	lits / Symptoms) Introl Function – Boom floating control operation failure Eking list) -368 (#1) – CN-53 (#20) Checking Open/Short -368 (#2) – Fuse box (#17) Checking Open/Short				

DTC		Diagnostia Critoria		Application		
HCESPN	FMI	FMI Diagnostic Criteria G		С	W	
	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	•			
220 (NA)	6	(Detection) (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	•			
	(Results / Symptoms) 1. Control Function – Boom floating control operation failure (Checking list) 1. CN-369 (#1) – CN-53 (#35) Checking Open/Short					
	5 5	-369 (#2) – Fuse box (#17) Checking Open/Short 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	•			
	(Results / Symptoms) 1. Control Function – Option attachment flow control – P1 relief pressure setting failure (Checking list) 1. CN-365 (#2) – CN-53 (#39) Checking Open/Short 2. CN-365 (#1) – CN-53 (#40) Checking Open/Short					

G : General C : Crawler Type W : Wheel Type

DTC		D:	Ap	plicat	ion
HCESPN	FMI	Diagnostic Criteria			W
	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	•		
222 (NA)	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A	•		
	1. Cor (Chec 1. CN	lts / Symptoms) htrol Function – Option attachment flow control – P2 relief pressure setting failuring list) -366 (#2) – CN-53 (#32) Checking Open/Short -366 (#1) – CN-53 (#33) Checking Open/Short	ure		
	3	10 seconds continuous, Fuel Level Measurement Voltage > 3.8V			
	4	10 seconds continuous, Fuel Level Measurement Voltage < 0.3V			
301	1. Moi (Chec 1. CD	lts / 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	,	(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 lts / Symptoms) ntrol Function – Fuel heater operation failure	•		
	1. CR	king list) -46 (#85) – CN-52 (#12) Checking Open/Short -46 (#86) – Fuse box (#21) Checking Open/Short			

DTC		Diagnostia Critoria			ion		
HCESPN	FMI Diagnostic Criteria G			С	W		
	0	Voltage > 5.2V					
	1	10 seconds continuous, $0.3V \le Transmission Oil Press. Sensor Measurement Voltage < 0.8V$			•		
501	4	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage < 0.3V			•		
(NA)	1. Mo (Chec 1. CD 2. CD	ults / Symptoms) nitor – Transmission Oil Press. display failure, Transmission Oil low pressure wasking list) -5 (#B) – CN-54 (#27) Checking Open/Short -5 (#A) – CN-54 (#3) Checking Open/Short -5 (#C) – CN-54 (#13) Checking Open/Short	arninç	g failu	re		
	0	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage > 5.2V 10 seconds continuous, 0.3V≤ Brake Oil Press. Sensor Measurement			•		
503	4	Voltage < 0.8V 10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage < 0.3V			•		
(NA)	(Results / Symptoms) 1. Monitor – Brake Oil Press. display failure, Brake Oil low pressure warning failure (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 (#13) Checking Open/Short						
	0	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage > 5.2V 10 seconds continuous, 0.3V≤ Working Brake Press. Sensor Measurement			•		
	1	Voltage < 0.8V 10 seconds continuous, 0.5v≤ Working Brake Press. Sensor Measurement			•		
505	4	Voltage < 0.3V					
(NA)	1. Mo (Chec 1. CD 2. CD	ults / Symptoms) nitor – Working Brake Oil Press. display failure, Working Brake Oil low pressure sking list) -38 (#B) – CN-54 (#5) Checking Open/Short -38 (#A) – CN-54 (#3) Checking Open/Short -38 (#C) – CN-54 (#13) Checking Open/Short	warr	ning fa	ilure		

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

※ Some error codes are not applied to this machine.

DTC		Diagnostic Criteria		Application		
HCESPN	FMI Diagnostic Criteria		G	С	W	
	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			•	
525 (NA)	6	(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			•	
	(Results / Symptoms)					
	1. Cor					
	l ,	king list)				
		-69 (#1) – CN-54 (#8) Checking Open/Short				
	2. CIN	-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)	6	10 seconds continuous, Creep Solenoid drive current > 6.5 A				
		(Cancellation)				
		(When Creep Solenoid is On)				
		3 seconds continuous, Creep Solenoid drive current ≤ 6.5 A				
	l ,	Its / Symptoms)				
		ntrol Function – Creep mode operation failure				
	l ,	king list)				
		-206 (#1) – CN-54 (#7) Checking Open/Short				
	2. CN	-206 (#2) – Fuse box (#30) Checking Open/Short				

* Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Critoria			ion			
HCESPN	FMI Diagnostic Criteria		G	С	W			
	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage > 5.2V							
	Voltage > 5.2V							
	1	10 seconds continuous, 0.3V≤ Travel Forward Press. Sensor Measurement Voltage < 0.8V			•			
	4	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage < 0.3V			•			
530	(Resu	Its / Symptoms)						
(NA)	1. Mor	nitor – Travel Forward Press. display failure						
	2. Cor	ntrol Function – Driving interoperability power control operation failure						
	(Chec	king list)						
	1. CD	73 (#B) – CN-54 (#6) Checking Open/Short						
	2. CD	73 (#A) – CN-54 (#3) Checking Open/Short						
	3. CD-	-73 (#C) – CN-54 (#13) Checking Open/Short						
	1	10 seconds continuous, 0.3V≤ Travel Reverse Press. Sensor Measurement Voltage < 0.8V			•			
	4	10 seconds continuous, Travel Reverse Press. Sensor Measurement Voltage < 0.3V			•			
	(Resu	Its / Symptoms)						
531	Monitor – Travel Reverse Press. display failure							
(NA)		ntrol Function – Driving interoperability power control operation failure						
		king list)						
	1. CD	-74 (#B) – CN-54 (#23) Checking Open/Short						
	2. CD-74 (#A) – CN-54 (#3) Checking Open/Short							
	3. CD-	-74 (#C) – CN-54 (#13) Checking Open/Short						
	0	10 seconds continuous, Battery input Voltage > 35V						
	1	10 seconds continuous, Battery input Voltage < 18V						
705	(Resu	Its / Symptoms)						
7.00	Control Function – Startup impossibility							
	(Chec	king list)						
	1. CS-	74A (#1) – CN-51 (#1) Checking Open/Short						
		(When Engine is equal or more than 400 rpm) 10 seconds continuous,						
	1	Alternator Node L Measurement Voltage < 18V						
		(In case 12v goods, Alternator Node L Measurement Voltage < 9V)						
707	(Resu	Its / Symptoms)						
	1. Cor	ntrol Function – Battery charging circuit failure						
	,	king list)						
	1. CS-	74A (#1) – CN-51 (#2) Checking Open/Short						

G : General C : Crawler Type W : Wheel Type

DTC HCESPN FM		Diagnostic Criteria	Application					
HCESPN	FMI	Diagnostic Officia			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. Mo	nitor – Acc. Dial Voltage display failure						
	2. Cor	ntrol Function – Engine rpm control failure						
	(Chec	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	$Measurement\ Voltage \leq 3.0V$						
	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	6	10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive						
		current > 4.5 A						
		(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)						
	1. CN	-81 (#1) – CN-52 (#13) Checking Open/Short						
	2. CN	-81 (#2) – Fuse box (#30) Checking Open/Short						
		(When mounting the A/C Controller)						
	2	60 seconds continuous, A/C Controller Communication Data Error						
	(Resu	Its / Symptoms)						
831	'	ntrol Function – A/C Controller operation failure						
		king list)						
	1. CN							
		-11 (#7) – CN-51 (#32) Checking Open/Short						
	2	60 seconds continuous, Cluster Communication Data Error						
		Its / Symptoms)	-					
	'	ntrol Function – Cluster operation failure						
840		·						
	(Checking list) 1. CN-56 (#7) – CN-51 (#32) Checking Open/Short							
		-56 (#7) – CN-51 (#32) Checking Open/Short						
	2. UN	ου (πο) Οιν-ο ι (πεε) οπουλιτία Οροτβοποιτ						

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

C : Crawler Type G : General

W : Wheel Type 5-37

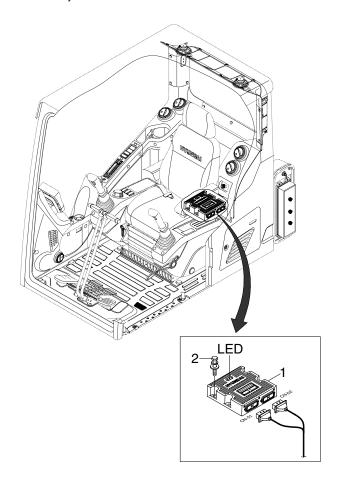
DTC		Diagnostic Criteria		Applicati	
HCESPN	FMI	G	С	W	
	2	10 seconds continuous, ECM Communication Data Error	•		
	(Resu	Its / Symptoms)			
841	1. Cor	ntrol Function – ECM operation failure			
(NA)	(Chec	king list)			
	1. CN	-93 (#17) – CN-51 (#21) Checking Open/Short			
	2. CN-	-93 (#18) – CN-51 (#31) Checking Open/Short			
	2	(When mounting the I/O Controller 1)			
		60 seconds continuous, I/O Controller 1 Communication Data Error			
845	(Resu	lts / 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			
(1.1.1)	· '	king list)			
		-8 (#2) – CN-51 (#22) Checking Open/Short			
	2. CN-	-8 (#3) – CN-51 (#32) Checking Open/Short			
	2	(When mounting the RMCU)			
		60 seconds continuous, RMCU communication Data Error			
	,	luts / Symptoms)			
850		ntrol Function – RMCU operation failure			
	l `	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)			
	(D	60 seconds continuous, I/O Controller 2 communication Data Error			
861	١,	Its / Symptoms)			
(NA)		ntrol Function – I/O Controller 2 operation failure			
	,	king list) 52 (#21) CN 51 (#22) Checking Open/Short			
		-53 (#21) – CN-51 (#23) Checking Open/Short			
	2. UN	-53 (#31) – CN-51 (#33) Checking Open/Short			

G : General C : Crawler Type W : Wheel Type

DTC			Ар	ion					
HCESPN	FMI	Diagnostic Criteria	G	С	W				
	2	(When mounting the AAVM)							
		60 seconds continuous, AAVM communication Data Error							
	(Resu	Its / 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	(Checking list)								
	1. CN								
	2. CN-376 (#11) – CN-51 (#32) Checking Open/Short								
	2	60 seconds continuous, Switch Controller communication Data Error							
	(Resu								
868	Control Function – Switch Controller operation failure								
	(Chec	king list)							
	1. CN	-56 (#7) – CN-51 (#32) Checking Open/Short							
	2. CN	-56 (#6) – CN-51 (#22) Checking Open/Short							
	2	(When mounting the BKCU)							
		60 seconds continuous, BKCU communication Data Error							
	(Resu	Its / Symptoms)							
869	1. Control Function – BKCU operation failure								
	(Checking list)								
	1. CS-2B (#A) – CN-51 (#22) Checking Open/Short								
	2. CS-	-2B (#B) – CN-51 (#32) Checking Open/Short							

GROUP 13 ENGINE CONTROL SYSTEM

1. MCU (Machine Control Unit)



220S5MS13

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	sure	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
(Stage 1 110)	Е	12 ± 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
(0.030 12.0)	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

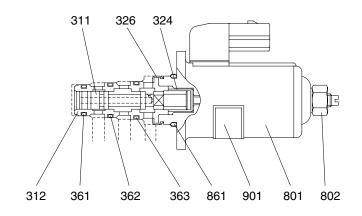
· Service menu



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

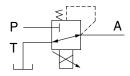
3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



220S2MP12

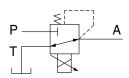
311	Spool	361	O-ring	801	Seal nut
312	Sleeve	362	O-ring	861	O-ring
324	Spring	363	O-ring	901	Name plate
326	Retaining ring	801	Solenoid		

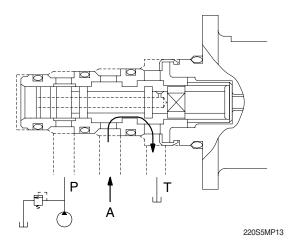


- P Pilot oil supply line (pilot pressure)
- T Return to tank
- A Secondary pressure to flow regulator at main pump

(2) Neutral

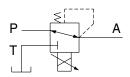
Pressure line is blocked and A oil returns to tank.

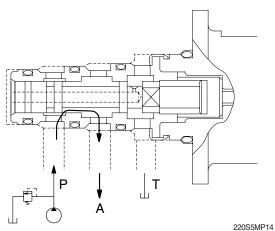




(3) Operating

Secondary pressure enters into A.

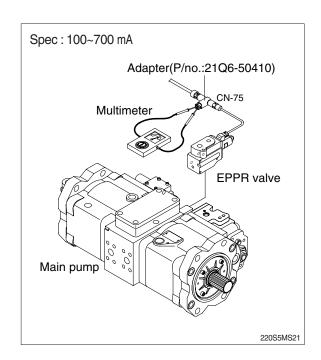




4) EPPR VALVE CHECK PROCEDURE

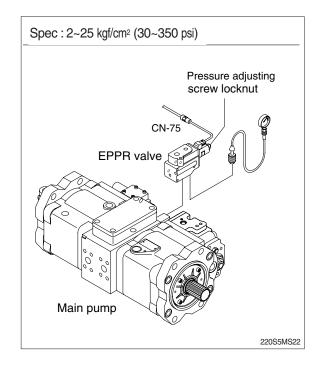
(1) Check electric current value at EPPR valve

- ① Disconnect connector CN-75 from EPPR valve.
- ② Insert the adapter to CN-75 and install multimeter as figure.
- ③ Start engine.
- Set S-mode and cancel auto decel mode.
- 5 Position the accel dial at 10.
- 6 If rpm display show approx 1700 \pm 50 rpm check electric current at bucket circuit relief position.
- ⑦ Check electric current at bucket circuit relief position.



(2) Check pressure at EPPR valve

- ① Remove plug and connect pressure gauge as figure.
 - · Gauge capacity: 0 to 50 kgf/cm² (0 to 725 psi)
- ② Start engine.
- ③ Set S-mode and cancel auto decel mode.
- 4 Position the accel dial at 10.
- 6 If pressure is not correct, adjust it.
- 7 After adjust, test the machine.



2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

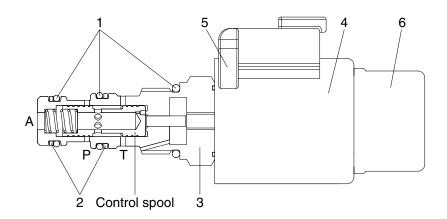
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

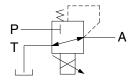
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

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.

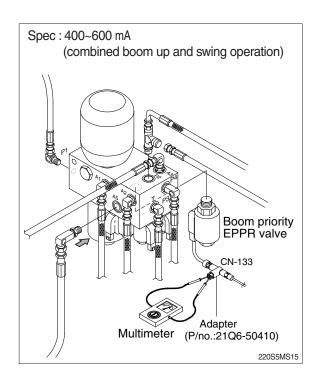
2) EPPR VALVE CHECK PROCEDURE

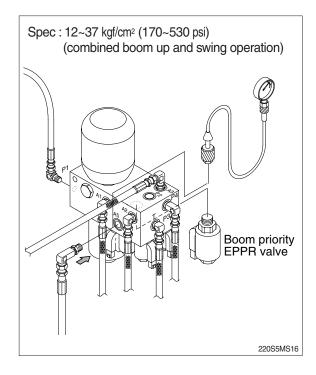
- (1) Check electric current value at EPPR valve
 - ① Disconnect connector CN-133 from EPPR valve.
 - ② Insert the adapter to CN-133 and install multimeter as figure.
 - ③ Start engine.
 - Set S-mode and cancel auto decel mode.

 - 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 1700±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 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

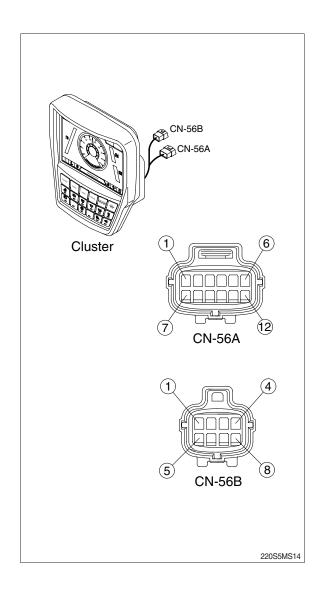
(1) CN-56A

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



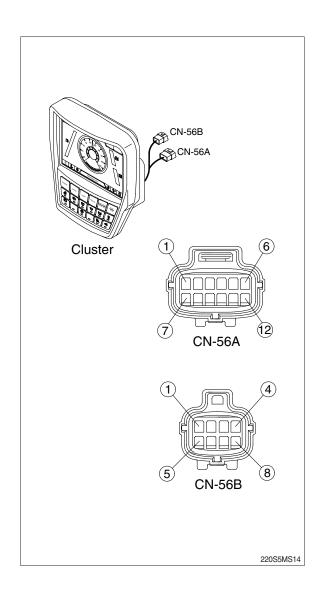
2) PREMIUM TYPE (1) CN-56A

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



Option

MENU

201712.20 12:10

5

10:10

3

ACCEL

HYUNDAI

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.

Premium type



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)

- $\ \ \,$ 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.
- 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.

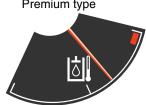
220S3CD553

(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)
- ② If the indicator is in the red range or limit 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 of the problem.
- \divideontimes If the gauge indicates the red range or $\boxed{\updelta}$ lamp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.

(5) Fuel level gauge





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 except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when; the buzzer stop switch is pushed the lamp of the LCD is touched
POWM.	Warning lamp pops up on the center of the LCD and the buzzer sounds	 Cluster displays this pop-up when it has communication error with MCU. If communication with MCU become normal state, it will disappear automatically.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	* Refer to page 5-54 for details.

(1) Engine coolant temperature warning lamp



290F3CD61

- ① Engine coolant temperature warning is indicated two steps.
 - -100° C over : The \bigcirc lamp pops up and the buzzer sounds.
 - -102° C over: The /\(\)\lambda lamp pops up and the buzzer sounds.
- when the buzzer stop switch with is pushed. And the buzzer stops and \bigcirc , \triangle lamps keep $\overline{\text{blink}}$.
- 3 Check the cooling system when the lamps keep blink.

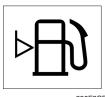
(2) Hydraulic oil temperature warning lamp



290F3CD62

- ① Hydraulic oil temperature warning is indicated two steps.
 - -100° C over : The $| \dot{b} | |$ lamp pops up and the buzzer sounds.
 - -105° C over: The /\(\)\lambda 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 $|\dot{b}|$, \hat{l} 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 31 ℓ (8.2 U.S. gal).
- ② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp



290F3CD64

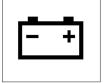
- ① This warning lamp pops up and the buzzer sounds when each of the below warnings is happened.
 - Engine coolant overheating (over 102°C)
 - Hydraulic oil overheating (over 105°C)
 - MCU input voltage abnormal
 - Cluster communication data error
 - Engine ECM communication data error
- The pop-up warning lamp moves to the original position and blinks when the buzzer stop switch witch 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



- 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	
1	Power mode	P S E	Heavy duty power work mode Standard power mode	
			Economy power mode	
2	User mode	User preferable power mode		
3	Work tool mode		General operation - IPC speed mode General operation - IPC balance mode General operation - IPC efficiency mode Breaker operation mode Crusher operation mode	
4	Travel mode	*	Low speed traveling High speed traveling	
5	Auto idle mode		Auto idle	

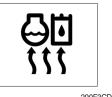
(2) Power max pilot lamp



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.

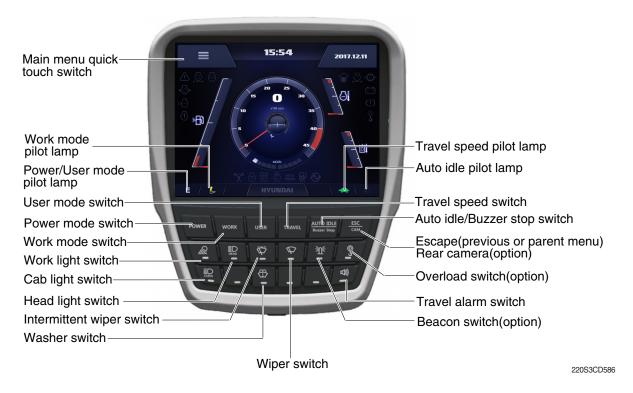
(8) Smart key pilot lamp (premium type, opt)



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

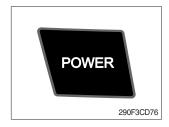


Premium type



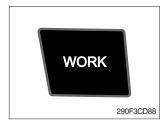
* When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-56 for details.

(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)
 - · 🖟 : Crusher 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



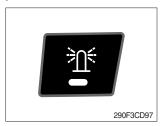
- ① The washer liquid is sprayed and the wiper is operated only while pressing this switch.
- ② The pilot lamp is turned ON when operating the switch.

(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)

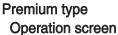


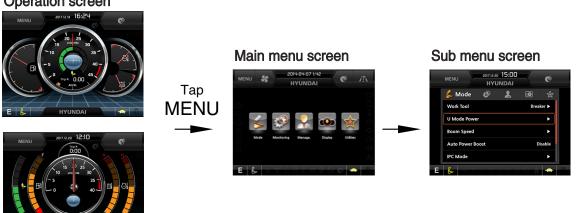
- ① This switch is to activate the entertainment control menu in the cluster.
- * Refer to the page 5-77.

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	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 sepa-

· 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	3
3	1600	1080	6
4	1700	1100	9
5	1750	1150	12
6	1800	1200 (auto decel)	16
7	1850	1230	20
8	1900	1250	26
9	1950	1300	32
10	2000	1350	38

※ One touch decel & low idle: 1000 rpm

3 Boom speed

rately in U-mode.



· 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

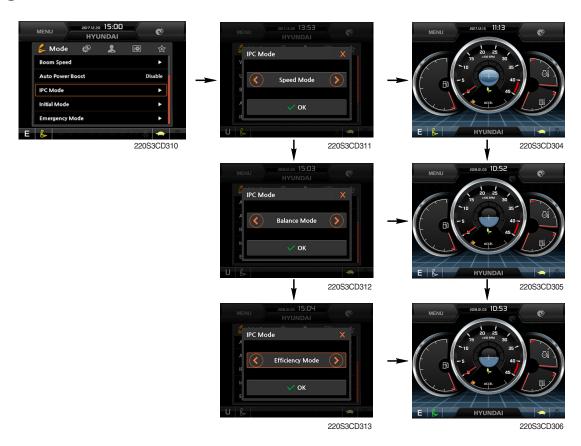


220S3CD117

- · 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



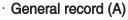
- The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu (Analog input).
- The switch status or output status can be confirmed by this menu (Digital input & Digital output).
- The activated switch or output pilot lamps are light ON.

(4) Management

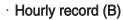
① Fuel rate information







- Average fuel rate (left) (from "Reset" to now)
 Fuel consumption devided by engine run time (service meter time).
- A days fuel used (right)
 Fuel consumption from 24:00 (or "Reset" time) to now (MCU real time).



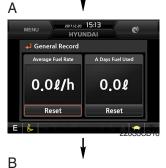
- Hourly fuel rates for past 12 hours (service meter time).
- No record during key-off time.
- One step shift to the right for every one hour.
- Automatic deletion for 12 hours earlier data.
- All hourly records deletion by "Reset".

· 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

220S3CD17

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 setting

- ESL: Engine Starting Limit
- ESL mode is desingned to be a theft deterrent or will prevent the unauthorized operation of the machine.
- When you Enable the ESL mode, the password will be required when the starting switch is turned to the on position.
- Machine security

Disable: ESL function is disabled and password is not required to start engine.

Enable (always): The password is required whenever the operator starts engine.

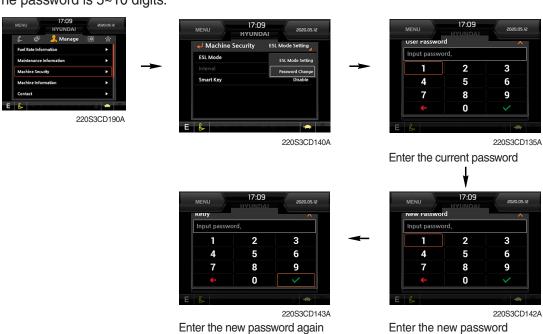
 Interval: The password is required when the operator starts engine first. But the operator can restart the engine within the interval time without inputting the password. The interval time can be set to a maximum 4 hours.

※ Default password : 00000 +
✓

- Smart key (option) : Refer to next page.

Password change

- The password is 5~10 digits.



* Before first use, please set user password and owner password in advance for machine security.

- Smart key



- 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 is needed.
- · Tag management menu is activated when the Smart key menu is Enabled.

You can register and delete the tags.

- Tag management

- · When registering a tag : Only the tag you want to register must be in the cabin.
- · When deleting a tag: All registered tags are deleted.







Registering 235F3CD004



235F3CD005

Engine Starting Condition

Case	ESL Mode	Smart Key	Condition	
1			With registered tag: Engine can be started without password input.Without registered tag: Engine can be started without password input.	
2	Disable Enable		If Smart Key is enabled, ESL Mode is automatically enabled. This Case 2 work the same as the Case 4.	
3			With registered tag: Engine can be started with password input.Without registered tag: Engine can be started with password input.	
4	// Engnia Engnia		With registered tag: Engine can be started without password input.Without registered tag: Engine can be started with password input.	

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)



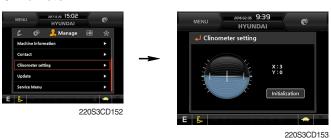
Enter the new A/S phone number

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 (null)
- · EPPR current level (attach flow EPPR 1 & 2)
- · Overload pressure: 100 ~ 350 bar

Clinometer

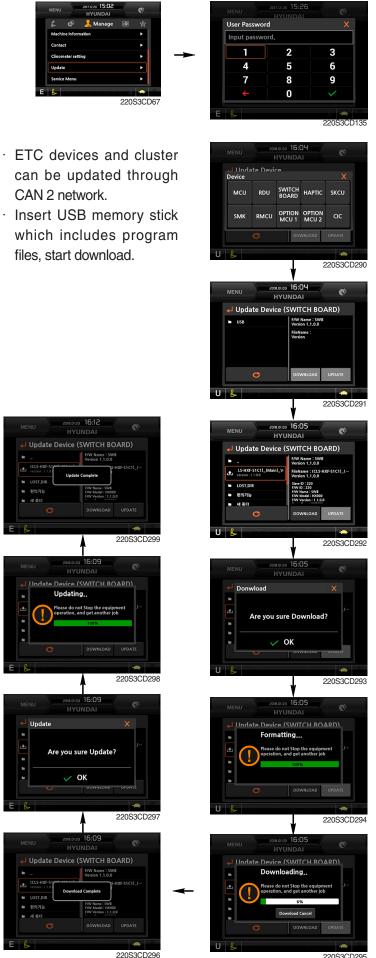


- · When the machine is on the flatland, if tap the "initialization", the values of X, Y reset "0".
- · You can confirm tilt of machine in cluster's operating screen.

® Update (cluster & ETC devices)



- files, start download.





(5) Display

① Display item



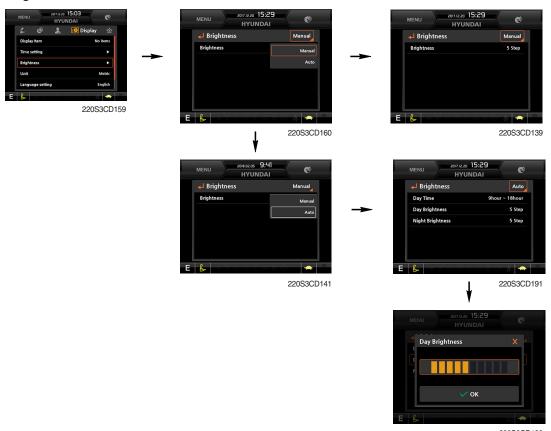
- · The center display type of the LCD can be selected by this menu.
- · The engine speed or each of the tripmeter (A,B,C) is displayed on the center display.

2 Clock



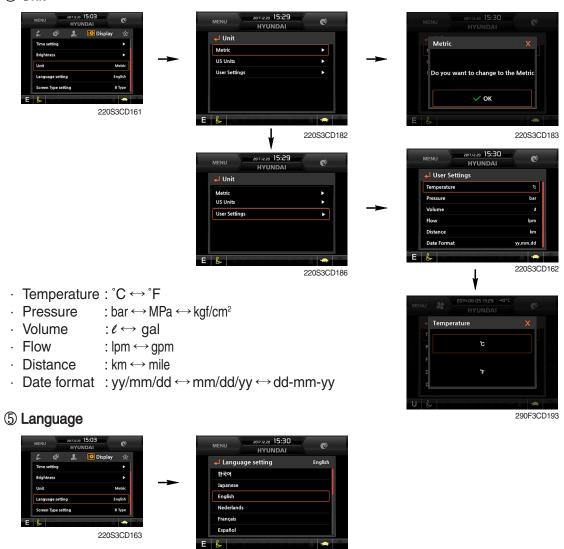
- The first line's three spots "**/***" represent Year/Month/Day each.
- The second line shows the current time. (0:00~23:59)

③ Brightness



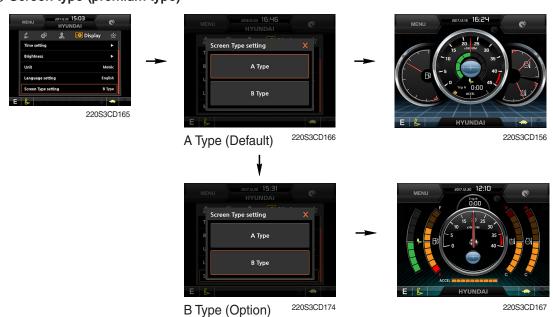
· If "Auto" is chosen, brightness for day and night can be differently set up. Also by using the bar in lower side, users can define which time interval belongs to day and night. (in bar figure, white area represents night time while orange shows day time)

4 Unit



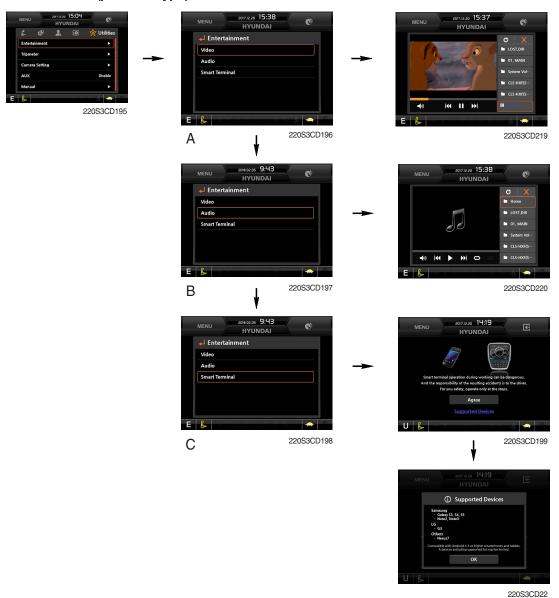
· User can select preferable language and all displays are changed the selected language.

6 Screen type (premium type)



(6) Utilities

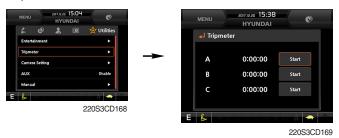
① Entertainment (premium type)



220000

- 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 immediately, 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

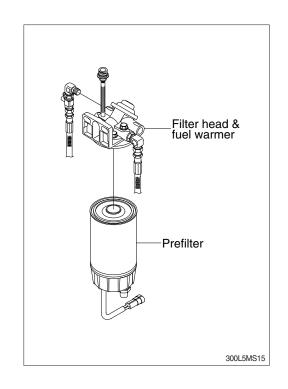
1) Operating voltage: 24±4 V

2) Power: 350±50 W 3) Current: 15 A

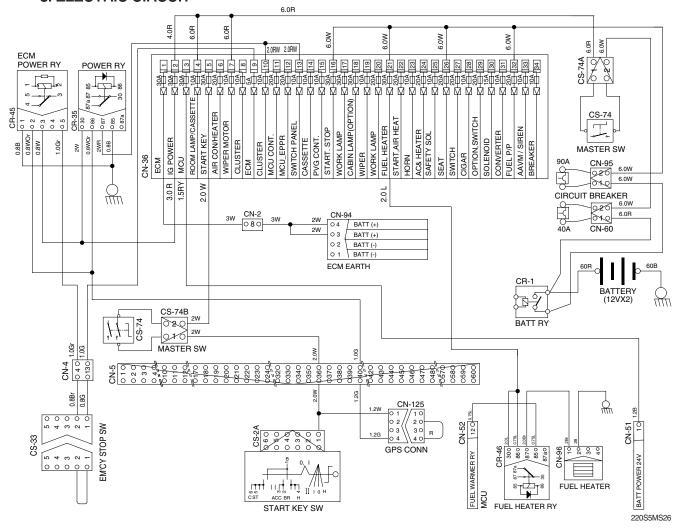
2. OPERATION

- 1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
- 2) At the first state, the 15 A current flows to the fuel warmer and engine may be started in 1~2 minutes.
- 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

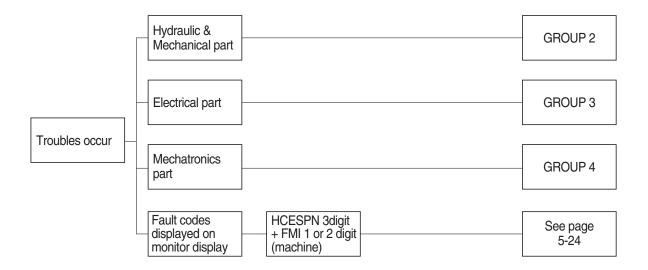
GROUP 1 BEFORE TROUBLESHOOTING

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.



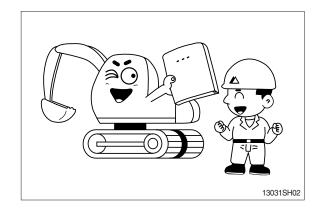
2. DIAGNOSING PROCEDURE

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.

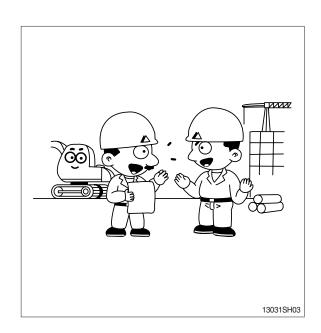
Especially, deepen the knowledge for the related parts of the trouble.



STEP 2. Ask the operator

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

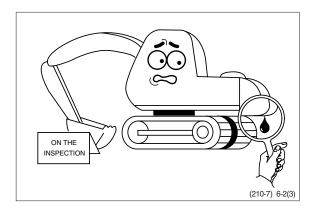
- 1) How the machine is used and when it is serviced?
- 2) When the trouble was noticed and what work the machine was doing at that time?
- 3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
- 4) Did the machine have any troubles previously?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

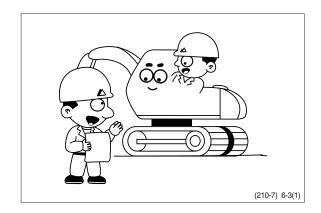
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



STEP 4. Inspect the trouble actually on the machine

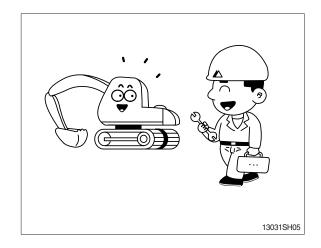
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.

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



STEP 5. Perform troubleshooting

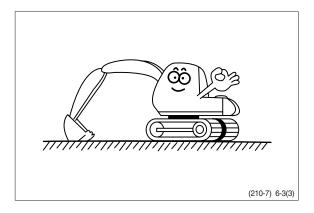
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.



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.





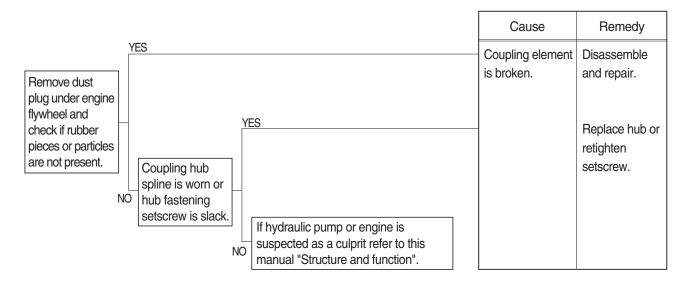
Analog 2 _{220S6HS01}

(2) Specification

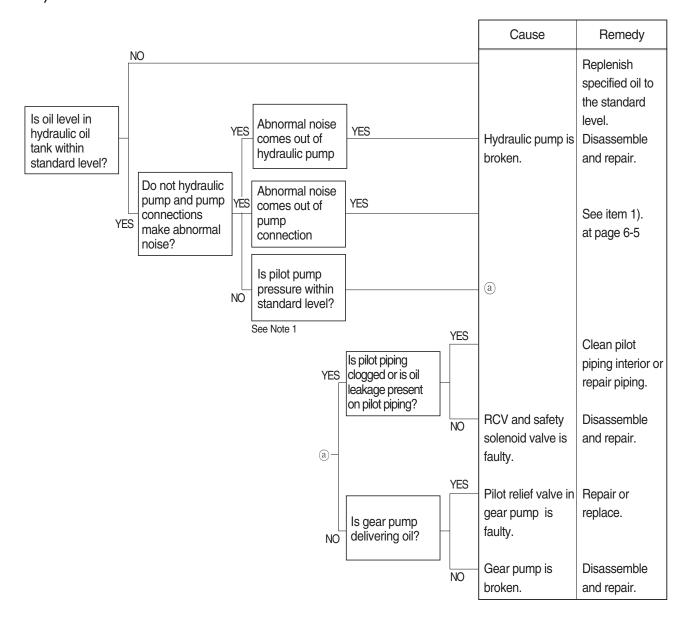
No.	Description	Specification
Note 1	Work pilot pressure	40 ⁺² bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

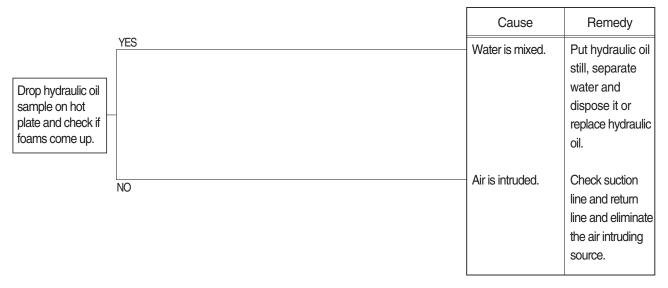


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

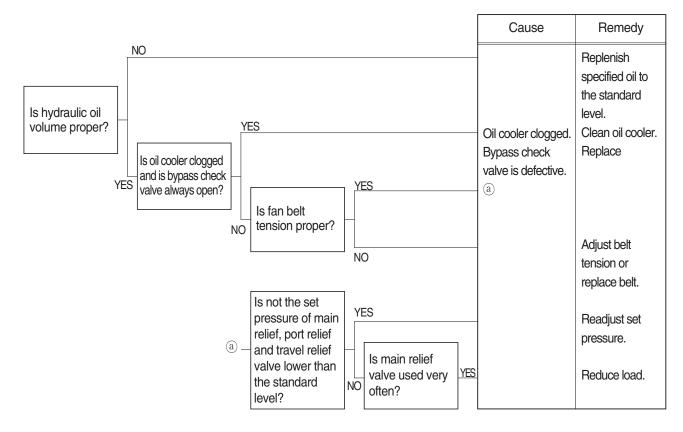


3. HYDRAULIC SYSTEM

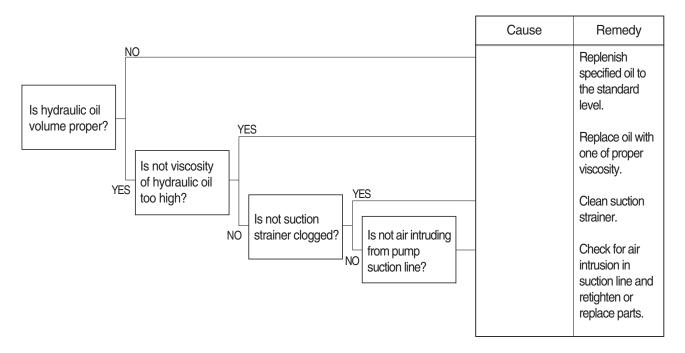
1) HYDRAULIC OIL IS CLOUDY



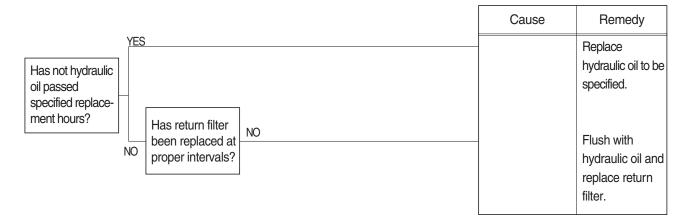
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

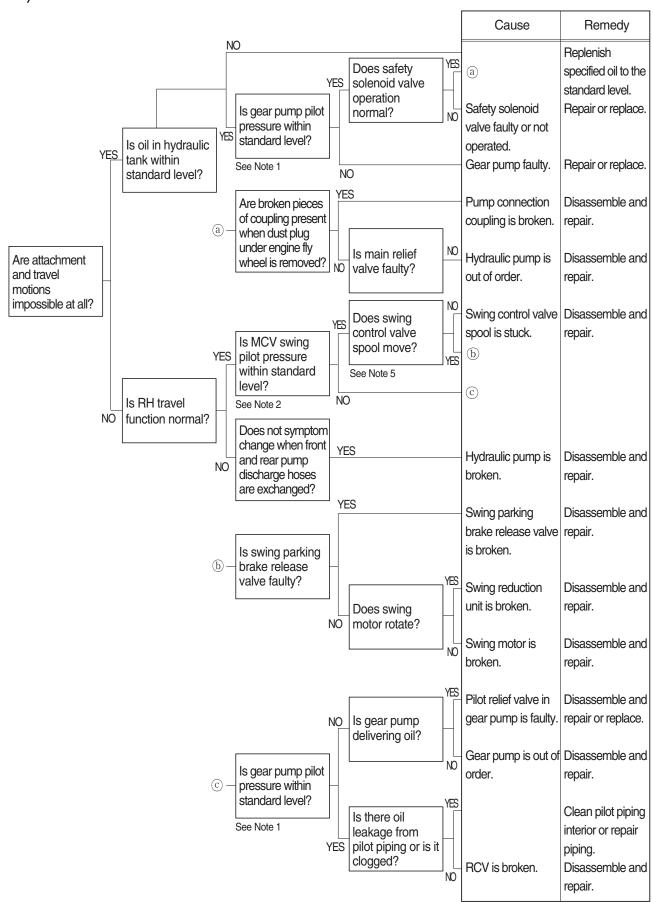


4) HYDRAULIC OIL IS CONTAMINATED

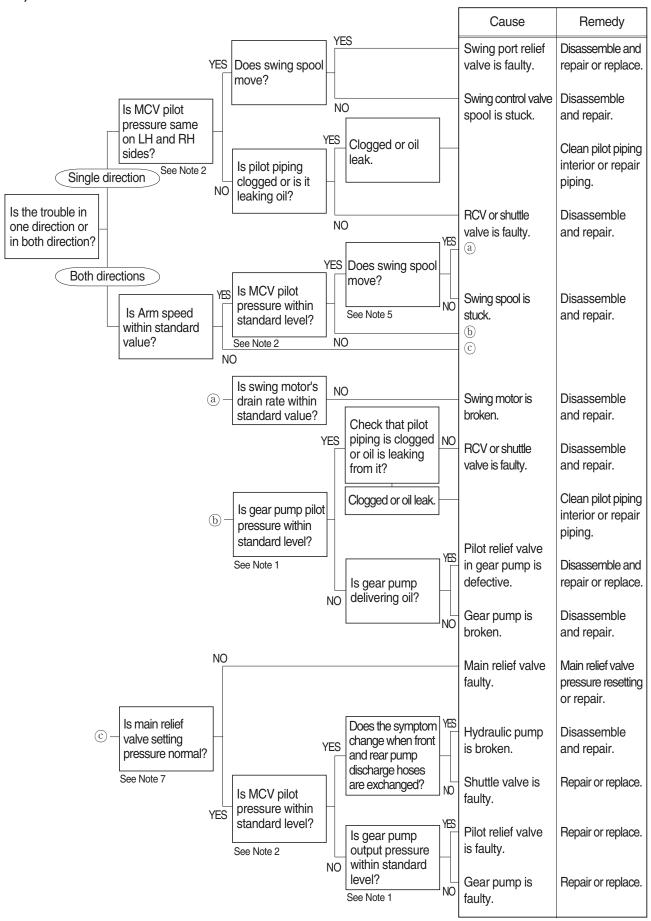


4. SWING SYSTEM

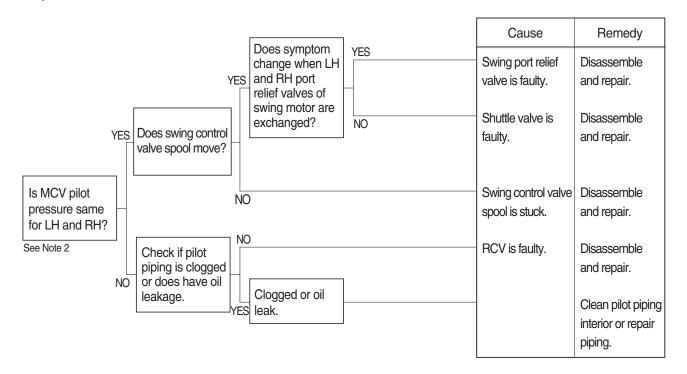
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



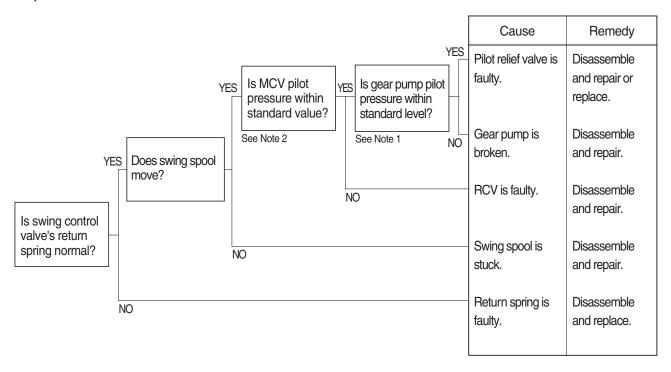
2) SWING SPEED IS LOW



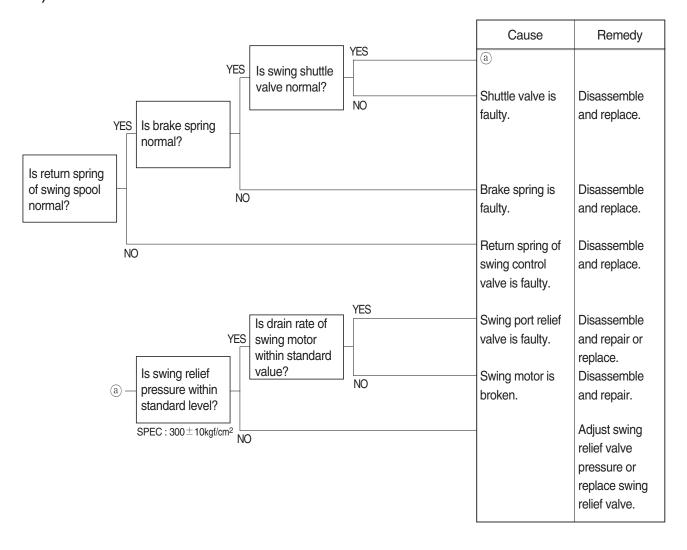
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

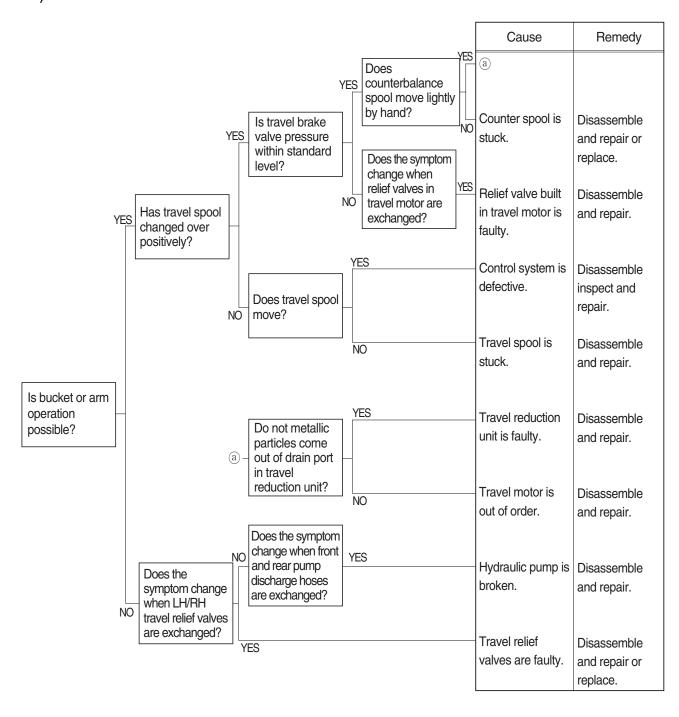


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

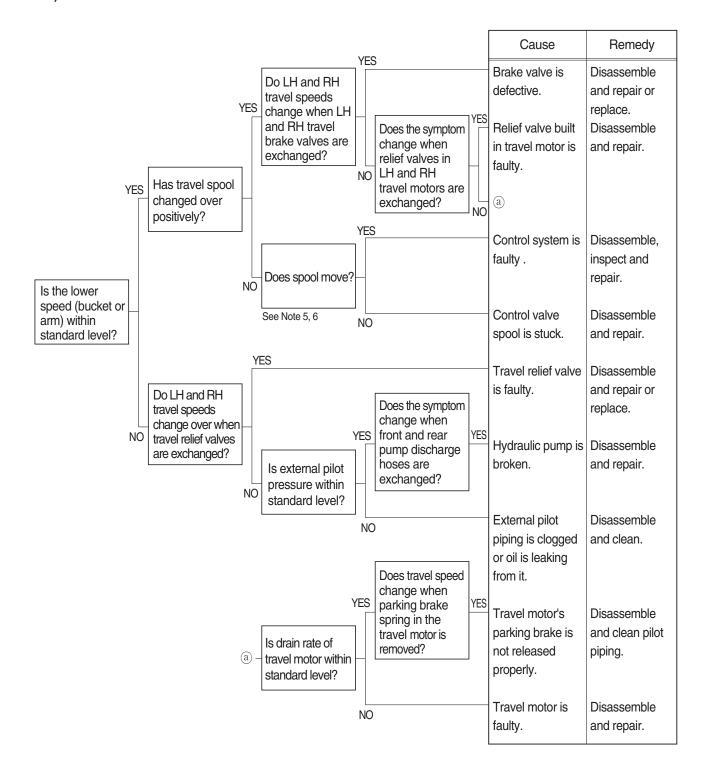


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

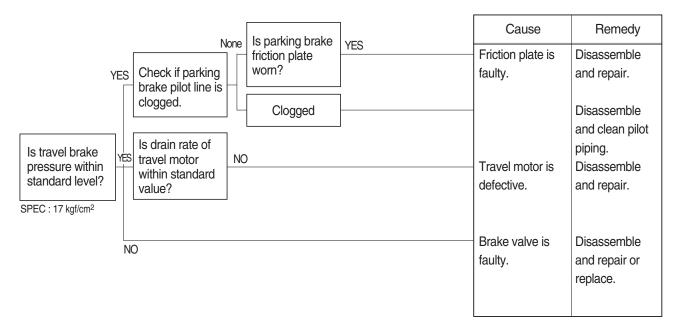


2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

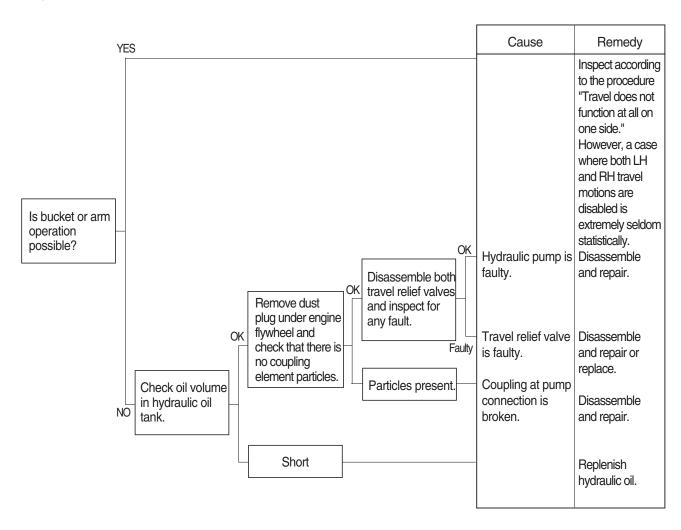


3) MACHINE DOES NOT STOP ON A SLOPE

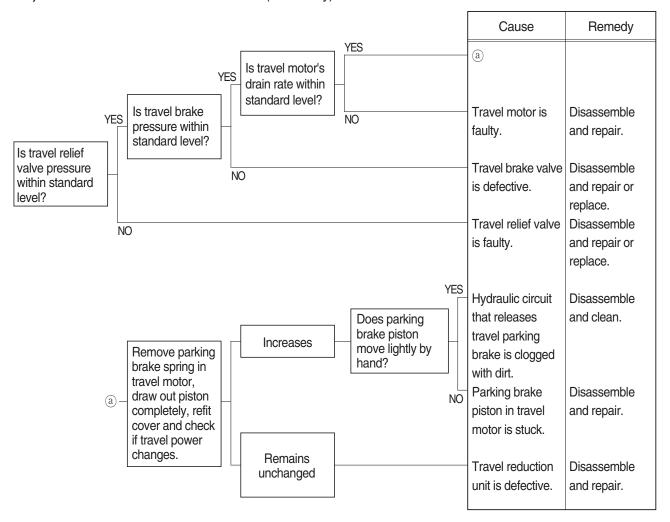
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



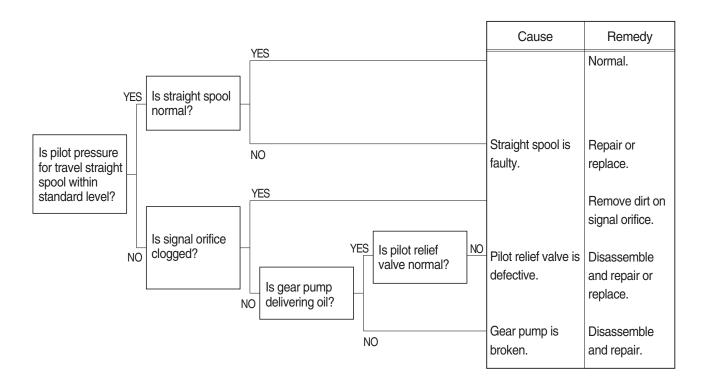
5) TRAVEL ACTION IS POWERLESS (travel only)



6) MACHINE RUNS RECKLESSLY ON A SLOPE

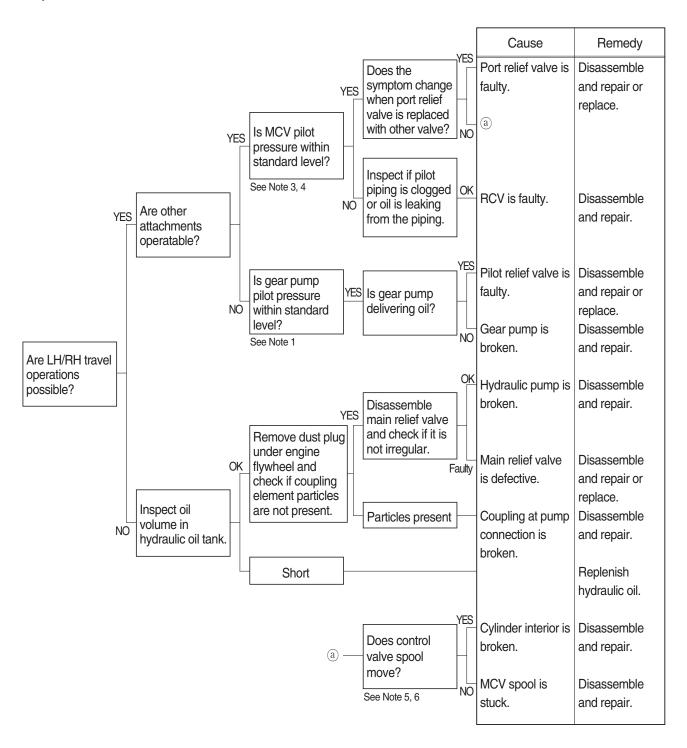


7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME

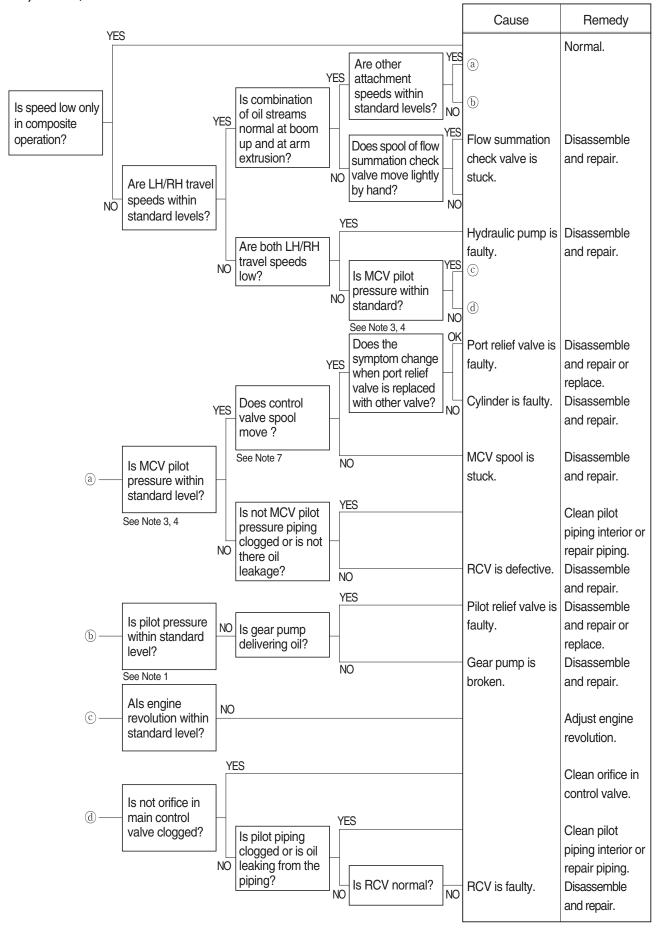


6. ATTACHMENT SYSTEM

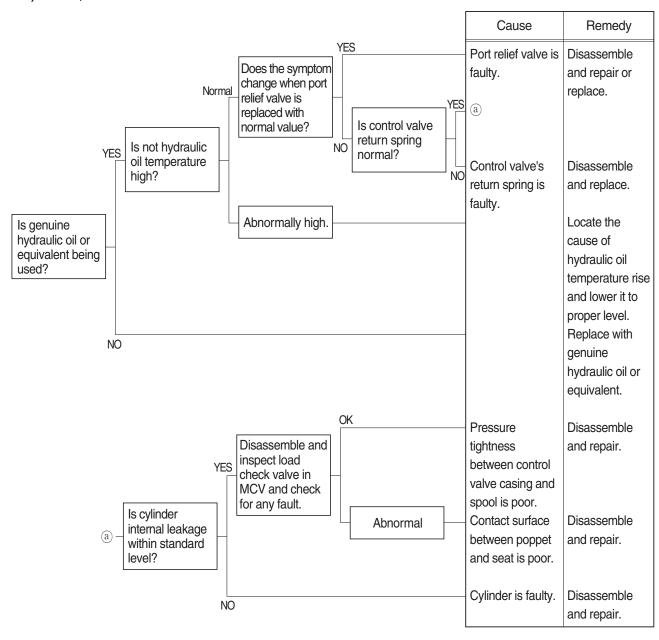
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



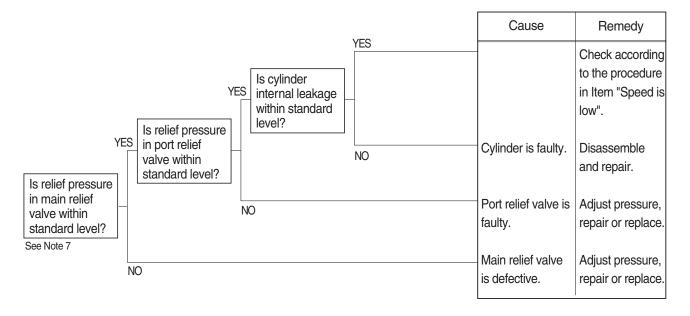
2) BOOM, ARM OR BUCKET SPEED IS LOW



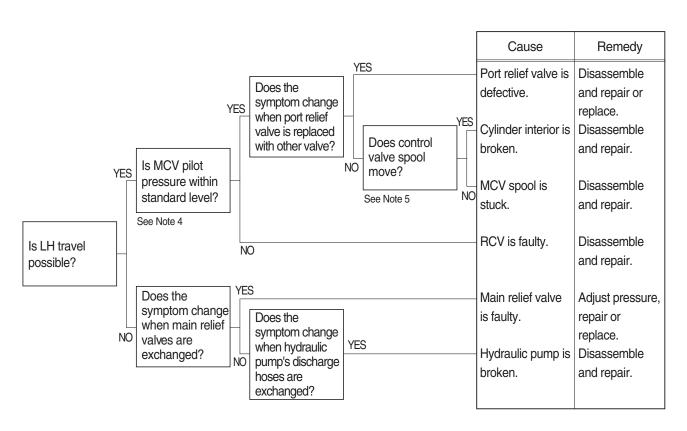
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



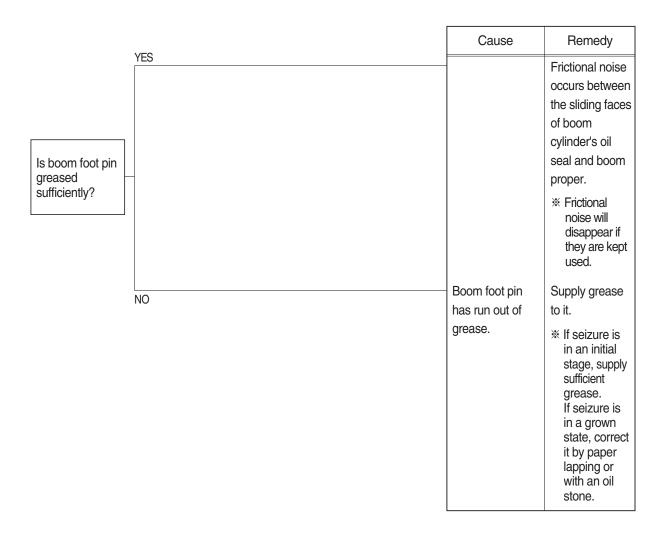
4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

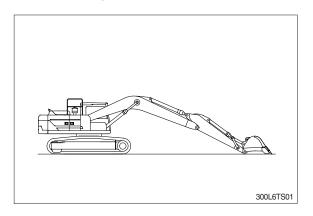


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

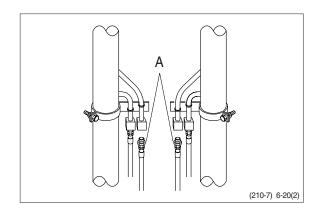


**** HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE**

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



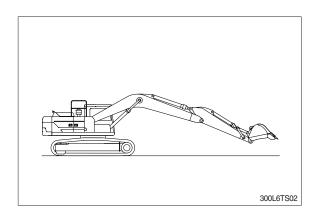
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



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.

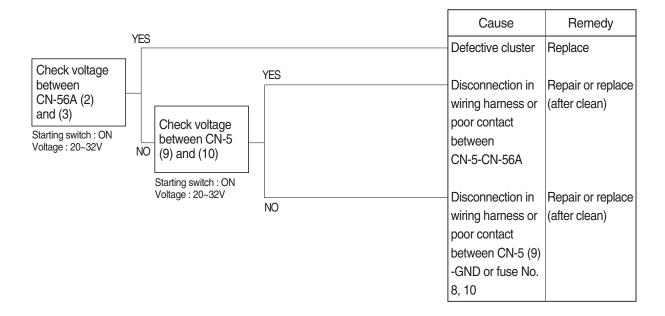
If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



GROUP 3 ELECTRICAL SYSTEM

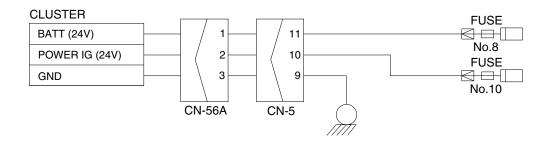
1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

- · 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. 8, 10.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



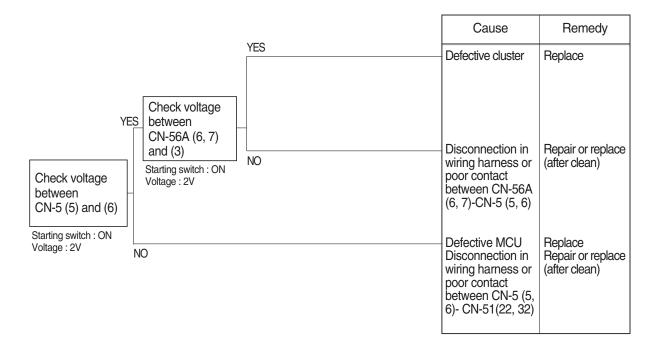
Check voltage

YES	20~32V
NO	0V



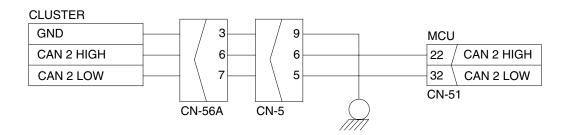
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

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



Check voltage

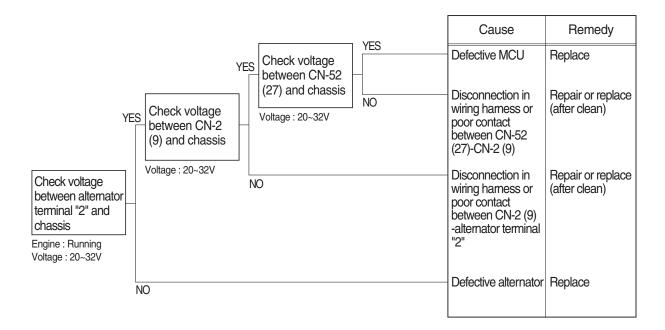
YES	2V
NO	0V



300L6ES02

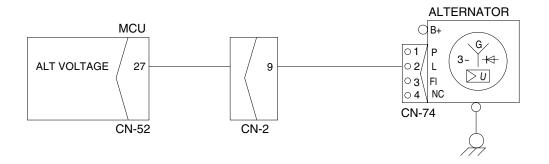
3. F + BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

- · 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.



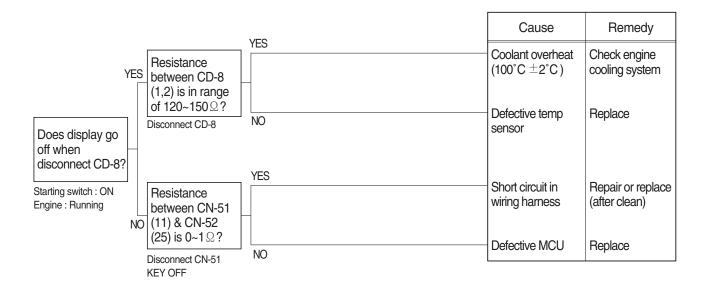
Check voltage

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.



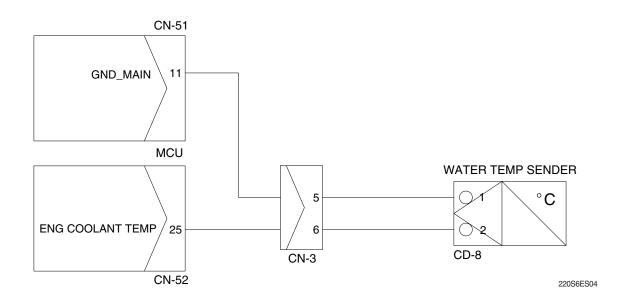
Normal type



Check Table

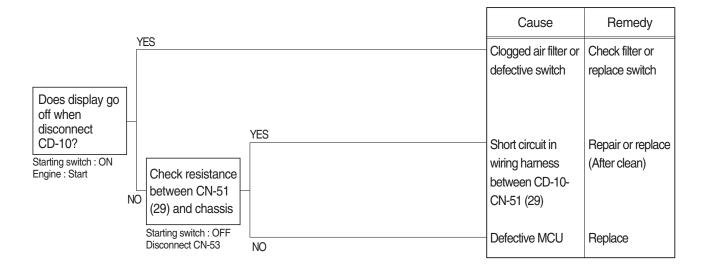
Temperature (°C)	0	25	50	80	95
Resistance ($k\Omega$)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8





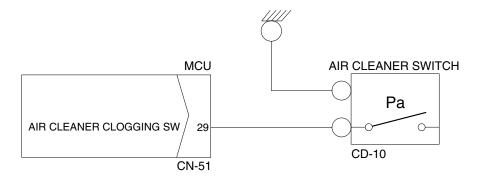
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

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



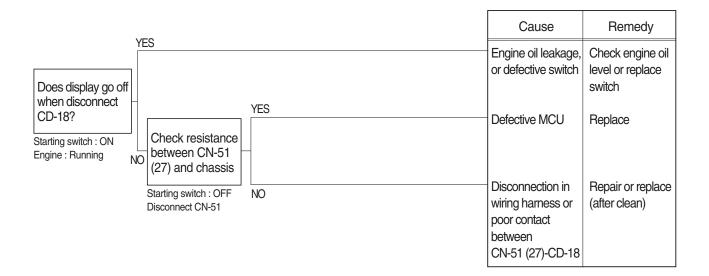
Check resistance

YES	MAX 1 Ω	
NO	MIN 1MQ	



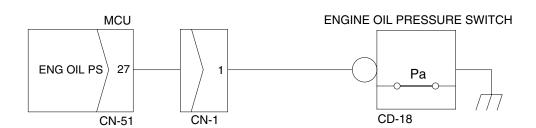
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

- · 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.



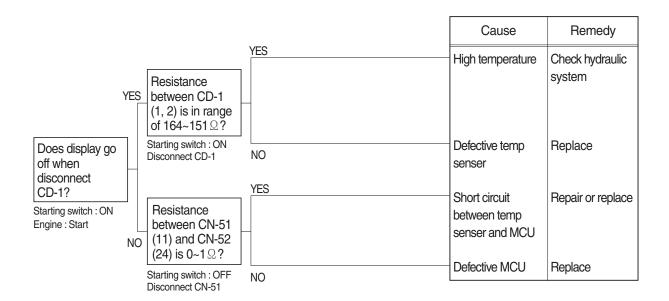
Check resistance

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.

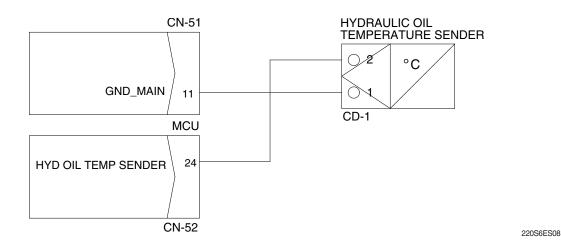


Normal type

Check Table

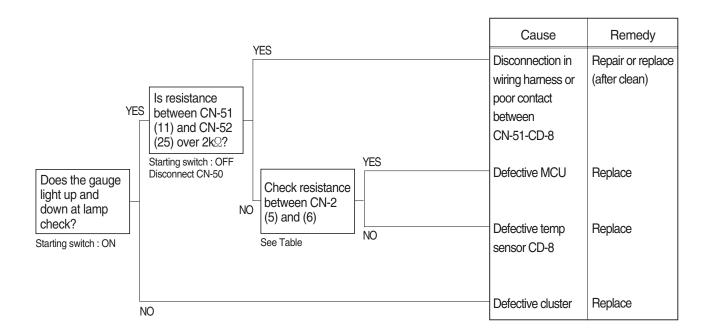
Temperature (°C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Posistanos (k ()	22.22	8.16	5.18	1.06	0.39	0.298	0.219	0.167	0.151
Resistance ($k\Omega$)	~31.78	~10.74	~ 6.6	~1.28	~0.476	~0.322	~0.243	~0.185	~0.164





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

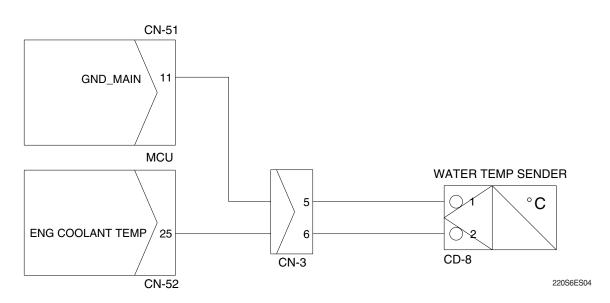


Check Table

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

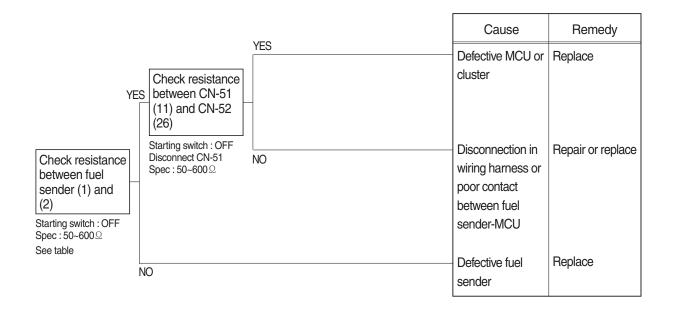






9. WHEN FUEL GAUGE DOES NOT OPERATE (HCESPN 301, FMI 3 or 4)

- · 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.





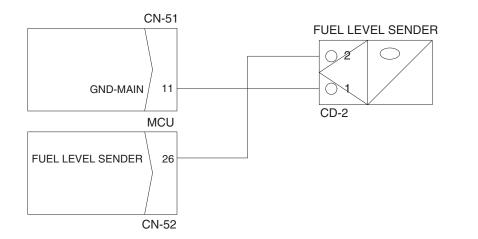


Premium type



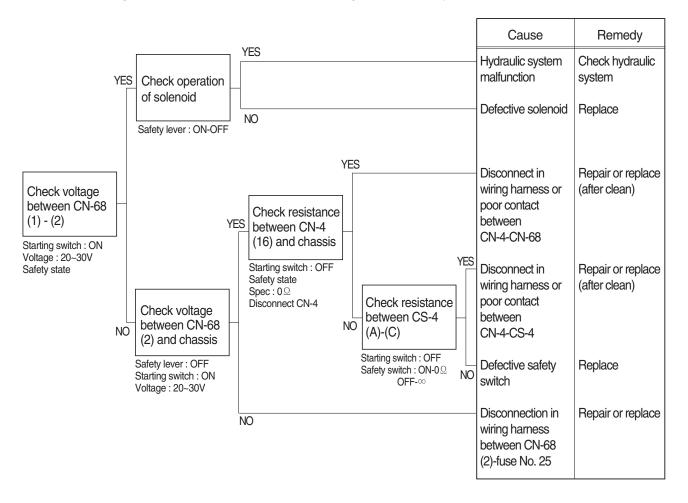
Check Table

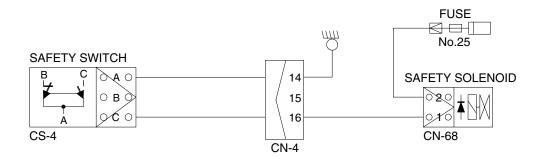
Range	Resistance (Ω)	Range	Resistance (Ω)	
Full	ıll 50 5/12		400	
11/12	11/12 100 4/12		450	
10/12	150	3/12	500	
9/12	200	2/12	550	
8/12	250	1/12	600	
7/12	300	Empty warning	700	
6/12	350	-	-	



10. WHEN SAFETY SOLENOID DOES NOT OPERATE

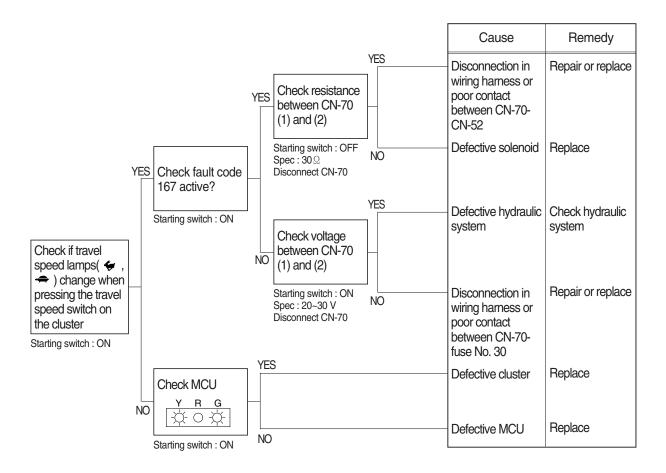
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 25.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

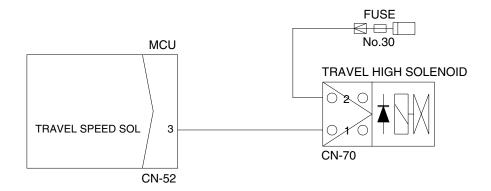




11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 4 or 6)

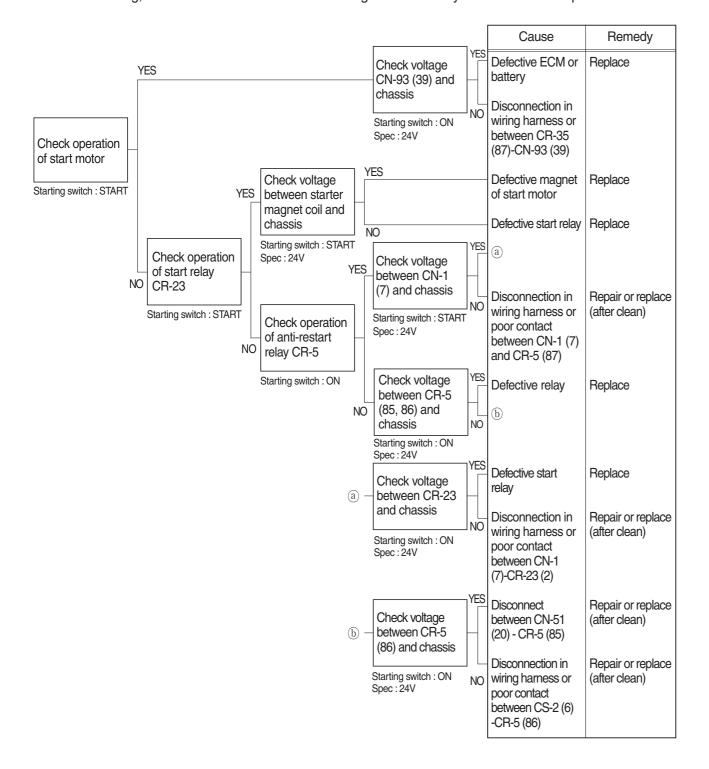
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 30.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

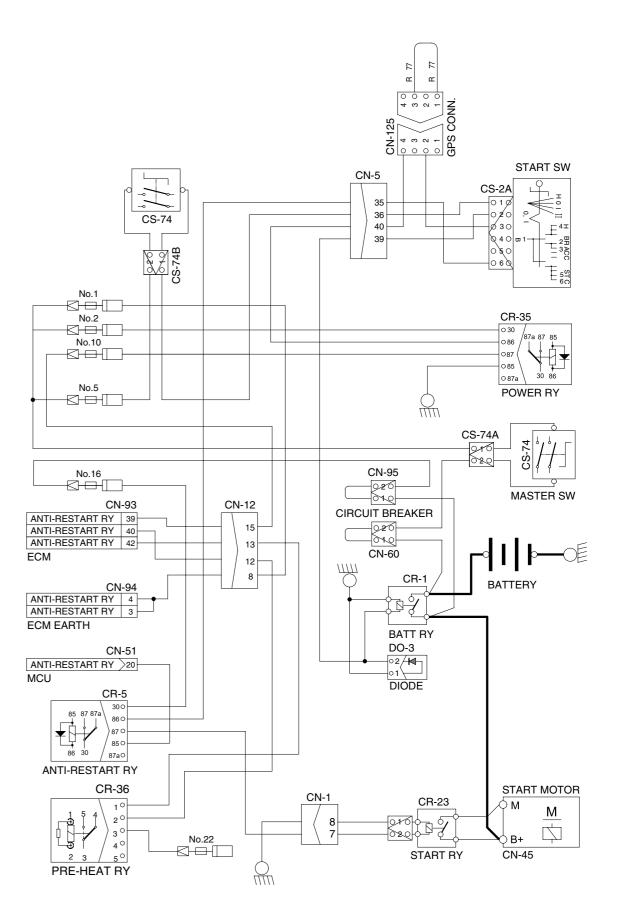




12. WHEN ENGINE DOES NOT START (| lights up condition)

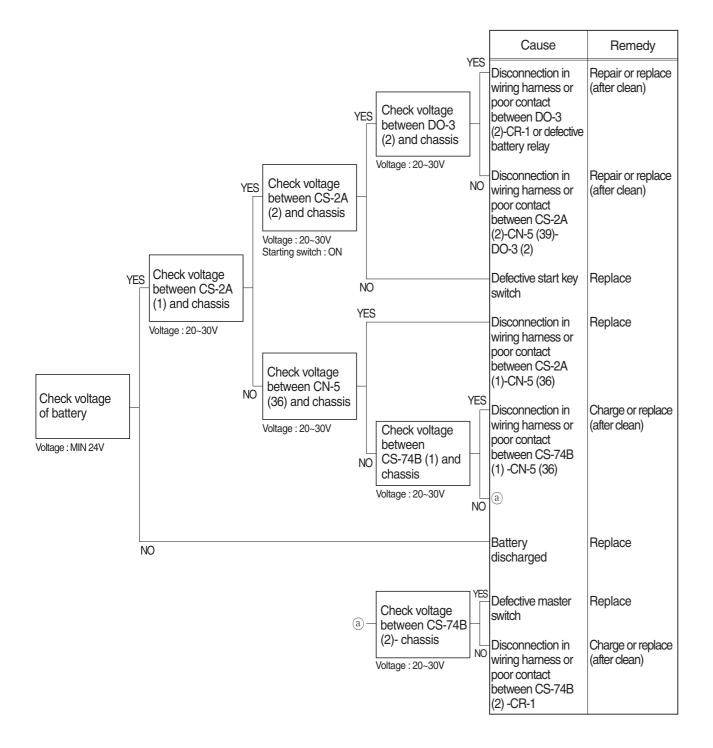
- · Check supply of the power at engine stop solenoid while starting switch is ON.
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 1, 2, 5, 10 and 16 burnt out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

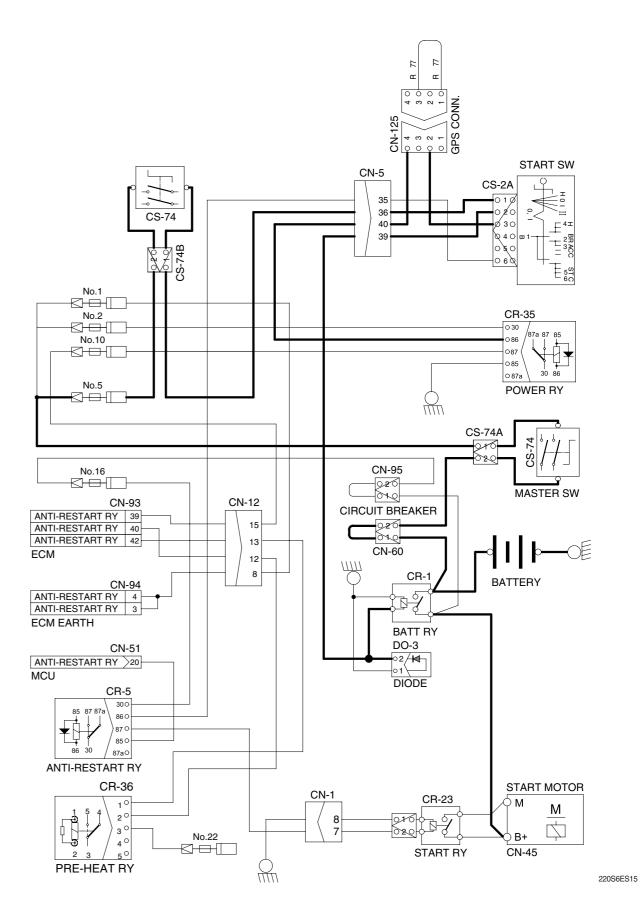




13. WHEN STARTING SWITCH ON DOES NOT OPERATE

- · 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.

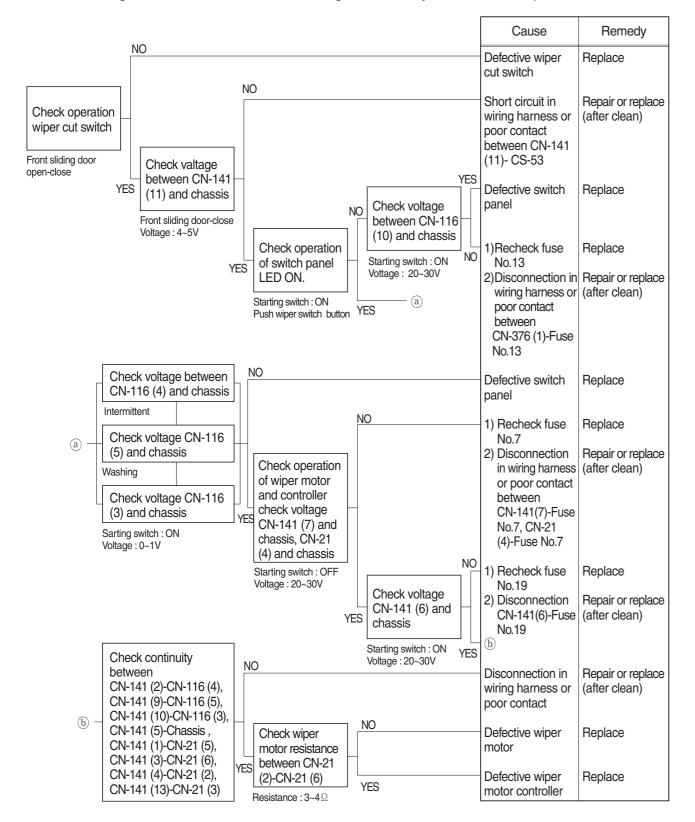


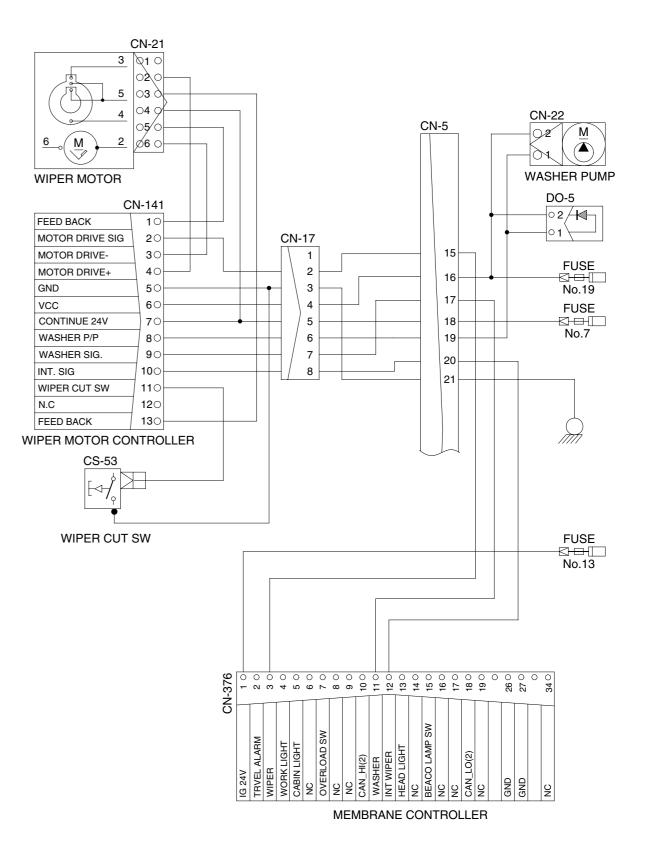


6-36

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

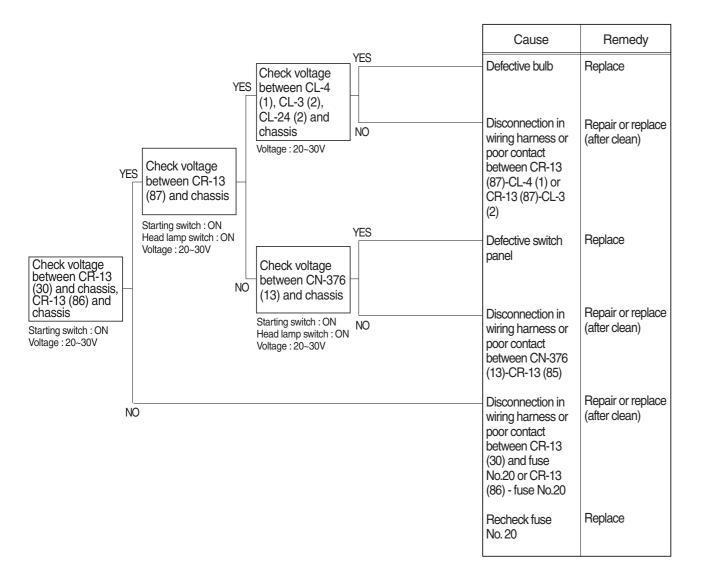
- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 7, 13 and 19 is not blown out.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.

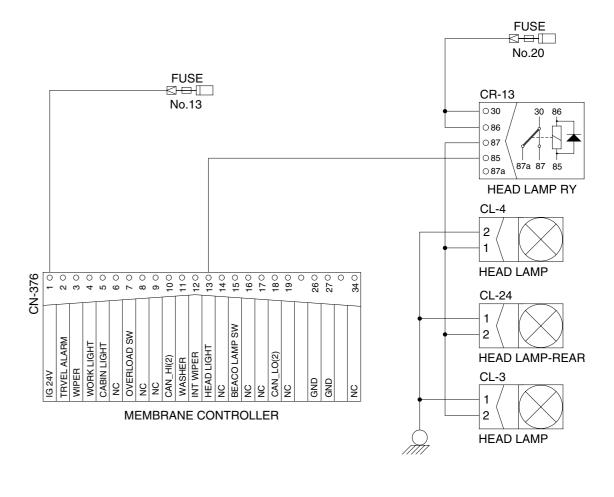




15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

- · 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.13 and 20.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



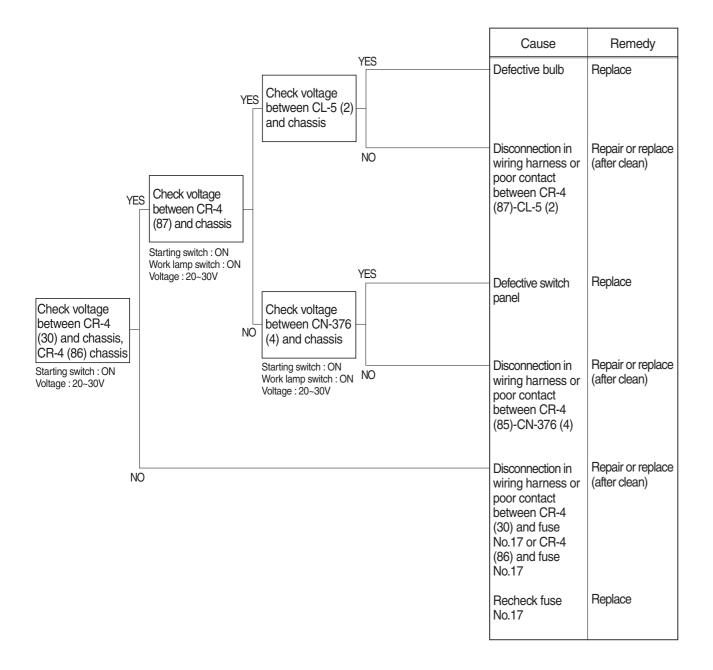


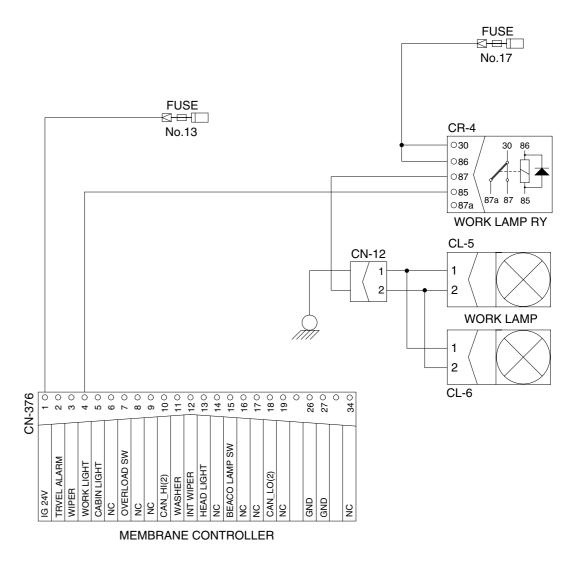
220S6ES17

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 13 and 17.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





220S6ES18

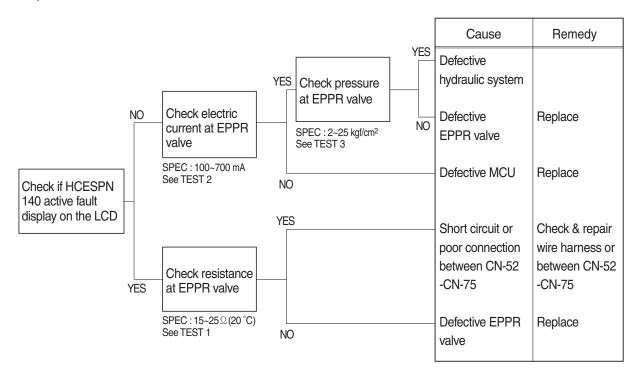
6-39

GROUP 4 MECHATRONICS SYSTEM

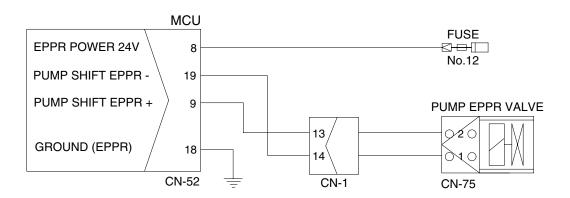
1. ALL ACTUATORS SPEED ARE SLOW

- * Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
- lpha Spec : P-mode 1900 \pm 50 rpm S -mode 1800 \pm 50 rpm E-mode 1700 \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



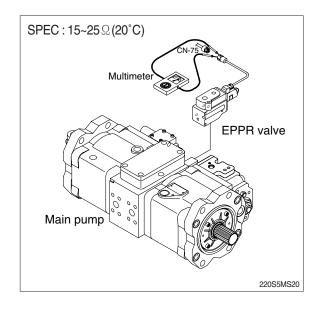
Wiring diagram



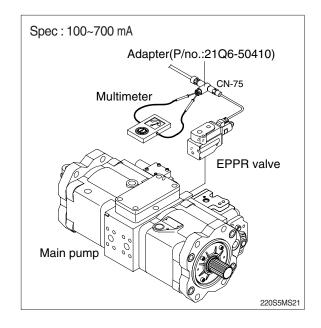
220S6MS01

2) TEST PROCEDURE

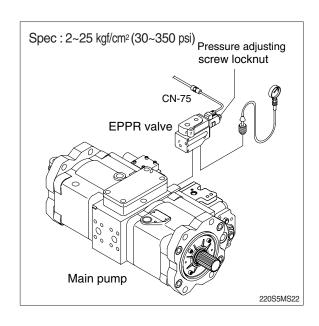
- (1) **Test 1**: Check resistance at connector CN-75.
- ① Starting key OFF.
- ② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.
- ③ Check resistance between 2 lines as figure.



- (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 1800 \pm 50 rpm disconnect one wire harness from EPPR valve.
- ⑦ Check electric current at bucket circuit relief position.



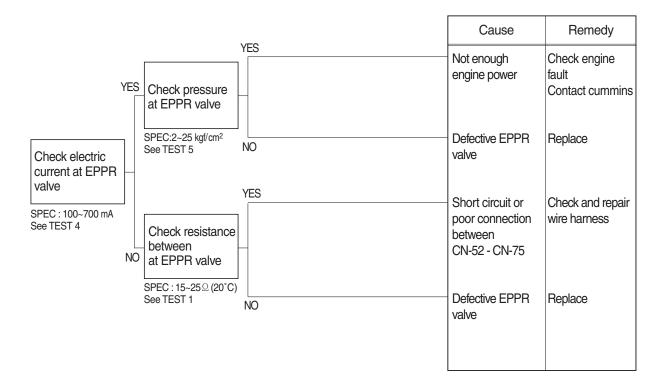
- (3) Test 3: Check pressure at EPPR valve.
 - ① Remove plug and connect pressure gauge as figure.
 - · Gauge capacity: 0 to 50 kgf/cm² (0 to 725 psi)
 - ② Start engine.
 - 3 Set S-mode and cancel auto decel mode.
 - 4 Position the accel dial at 10.
 - ⑤ If tachometer show approx 1800±50 rpm check pressure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



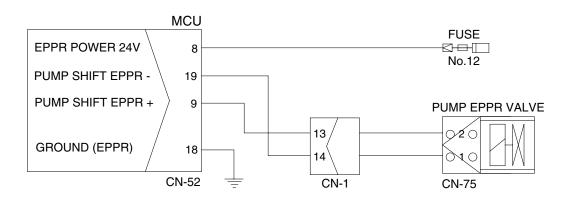
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



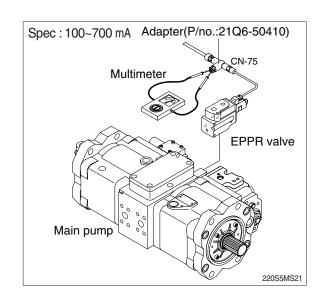
Wiring diagram



220S6MS01

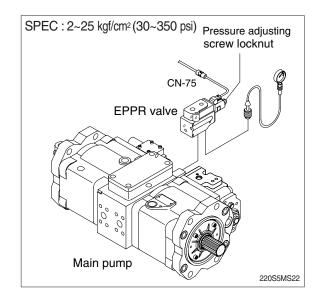
2) TEST PROCEDURE

- (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 1800±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.

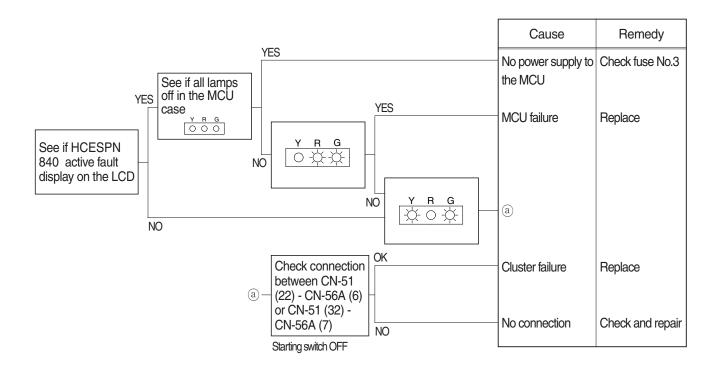
- ① Remove plug and connect pressure gauge as figure.
 - · Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)
- ② Start engine.
- ③ Set S-mode and cancel auto decel mode.
- 4 Position the accel dial at 10.
- ⑤ If rpm show approx 1800±50 rpm check pressure at relief position of bucket circuit by operating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



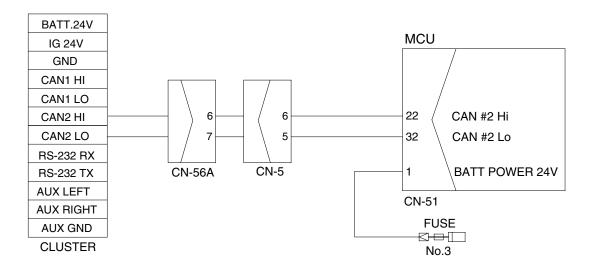
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



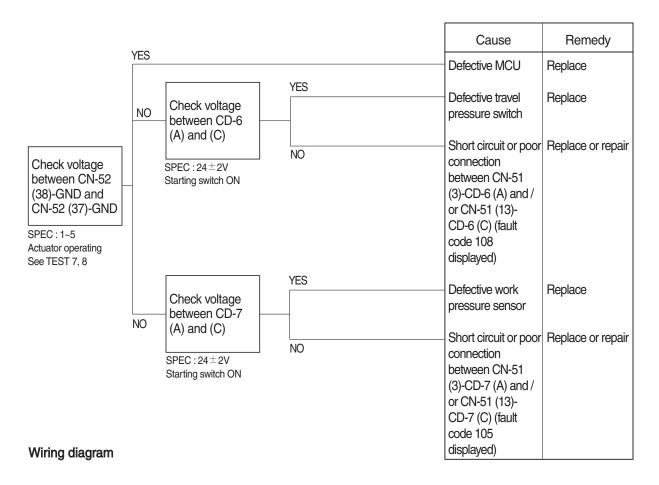
Wiring diagram

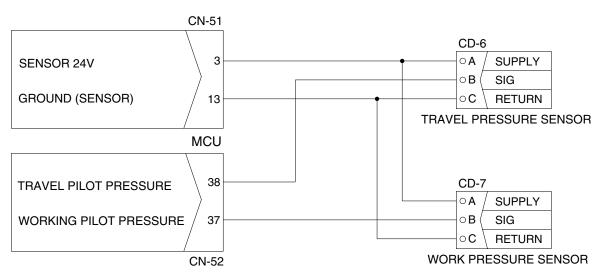


4. AUTO DECEL SYSTEM DOES NOT WORK

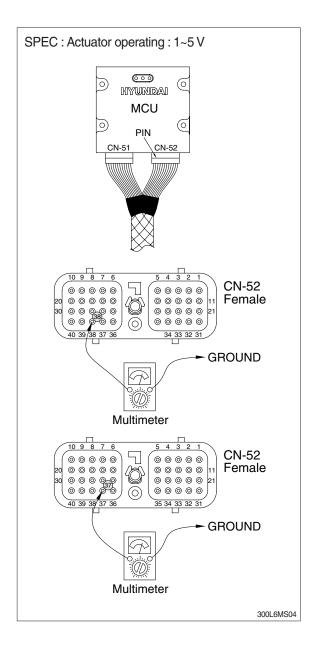
- Fault code: HCESPN 105, FMI 0~4 (work pressure sensor)
 HCESPN 108, FMI 0~4 (travel oil pressure sensor)
- * Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE





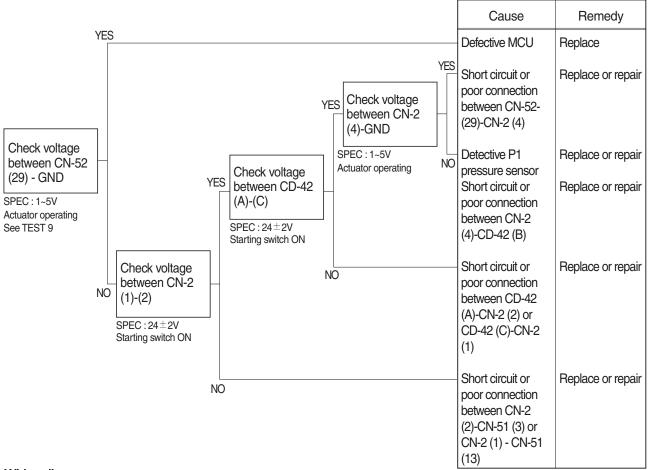
- (1) Test 7: Check voltage at CN-52 (38) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (38) of CN-52.
- 3 Starting switch key ON.
- 4 Check voltage as figure.
- (2) Test 8: Check voltage at CN-52 (37) and ground.
-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



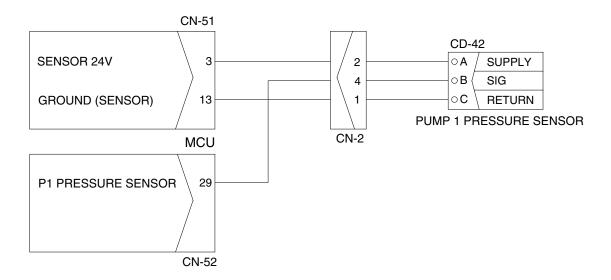
5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

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

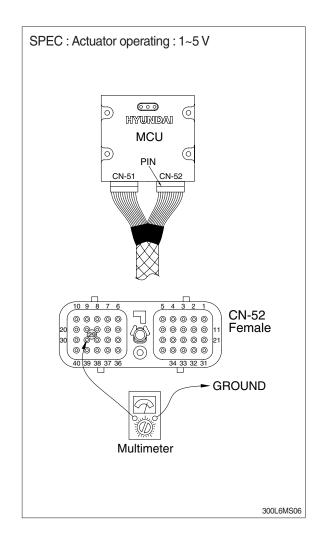
1) INSPECTION PROCEDURE



Wiring diagram



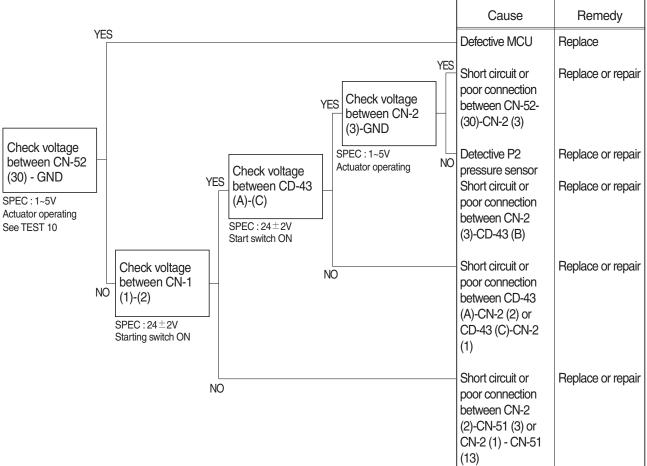
- (1) Test 9: Check voltage at CN-52 (29) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (29) of CN-52.
- ③ Starting switch ON.
- ④ Check voltage as figure.



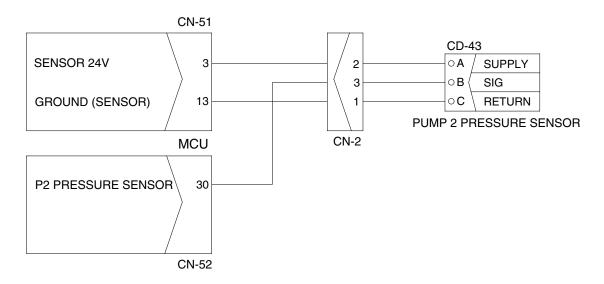
6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

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

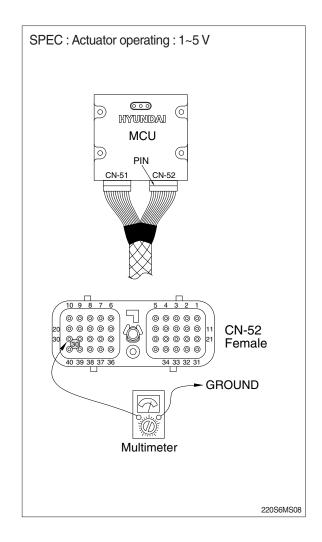
1) INSPECTION PROCEDURE



Wiring diagram



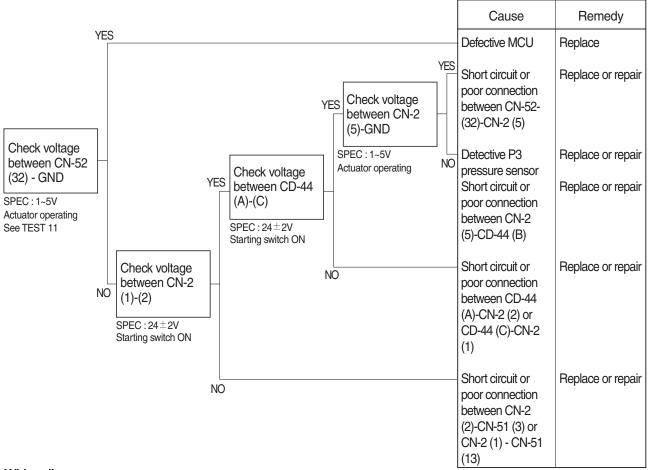
- (1) Test 10: Check voltage at CN-52 (30) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (30) of CN-52.
- ③ Starting switch ON.
- 4 Check voltage as figure.



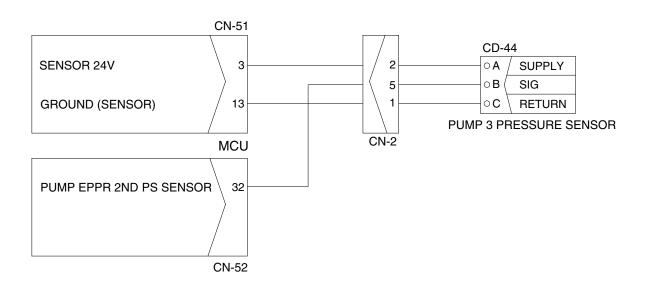
7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

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

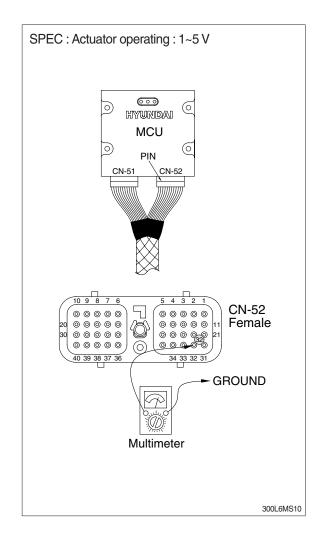
1) INSPECTION PROCEDURE



Wiring diagram



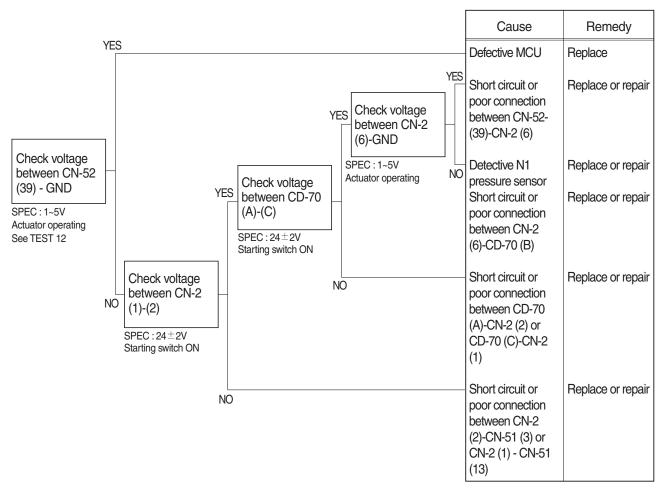
- (1) Test 11: Check voltage at CN-52 (32) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (32) of CN-52.
- ③ Starting switch ON.
- ④ Check voltage as figure.



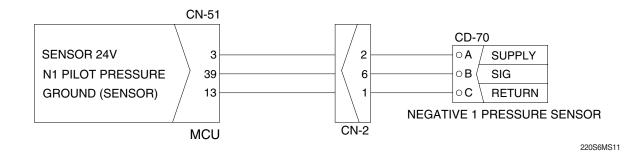
8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

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

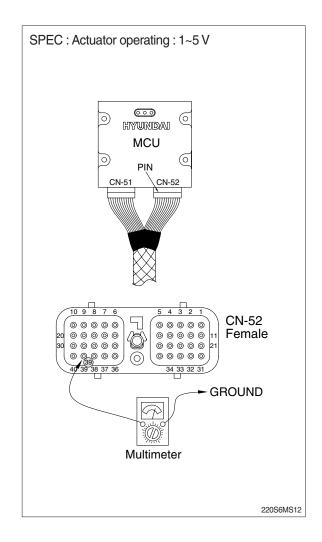
1) INSPECTION PROCEDURE



Wiring diagram



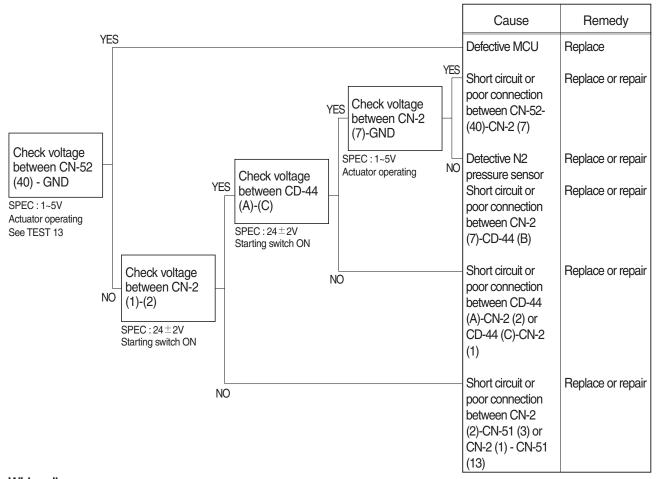
- (1) Test 12: Check voltage at CN-52 (39) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (39) of CN-52.
- ③ Starting switch ON.
- 4 Check voltage as figure.



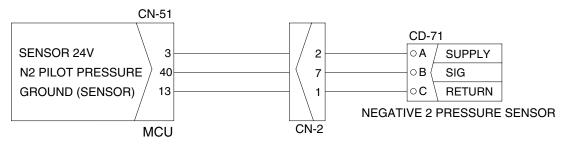
9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

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

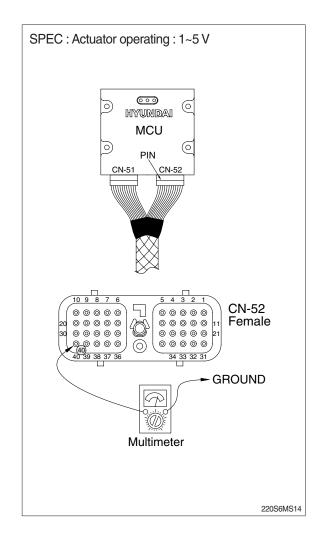
1) INSPECTION PROCEDURE



Wiring diagram



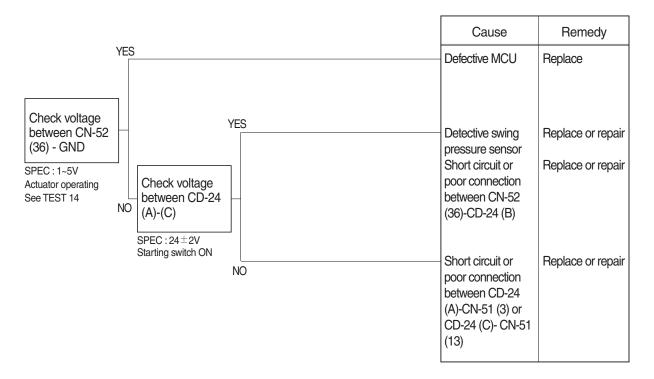
- (1) Test 13: Check voltage at CN-52 (40) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (40) of CN-52.
- ③ Starting switch ON.
- ④ Check voltage as figure.



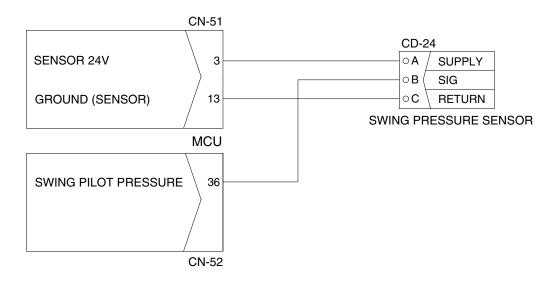
10. MALFUNCTION OF SWING PRESSURE SENSOR

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

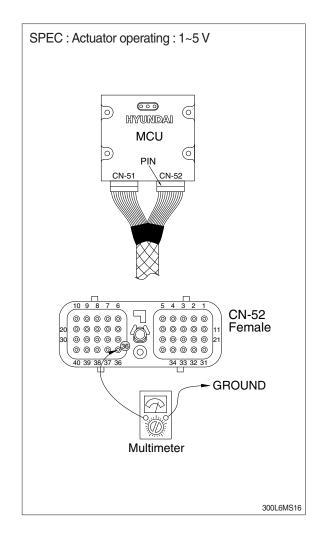
1) INSPECTION PROCEDURE



Wiring diagram



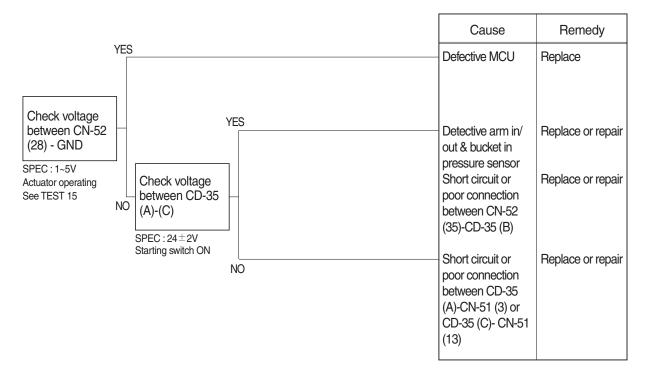
- (1) Test 14: Check voltage at CN-52 (36) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (36) of CN-52.
- ③ Starting switch ON.
- 4 Check voltage as figure.



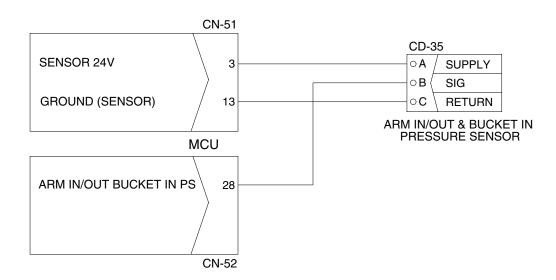
11. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

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

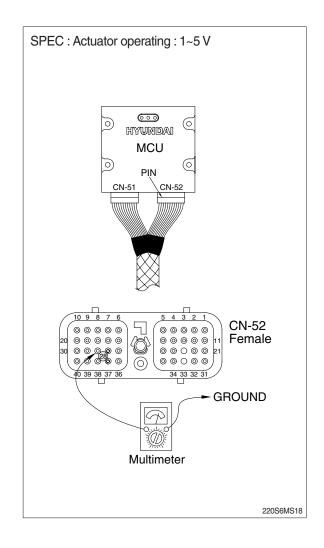
1) INSPECTION PROCEDURE



Wiring diagram



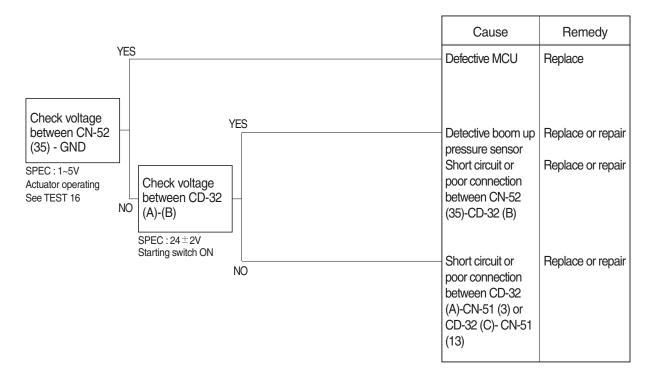
- (1) Test 15: Check voltage at CN-52 (28) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (28) of CN-52.
- ③ Starting key ON.
- ④ Check voltage as figure.



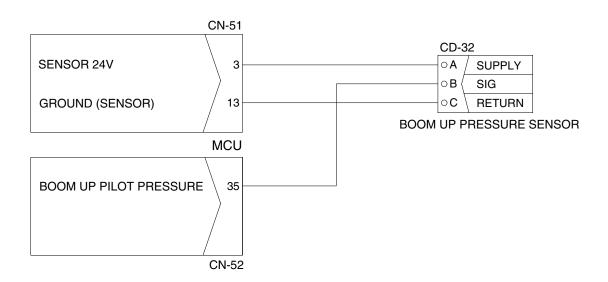
12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

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

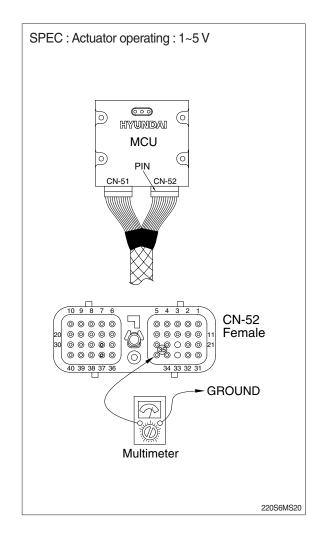
1) INSPECTION PROCEDURE



Wiring diagram



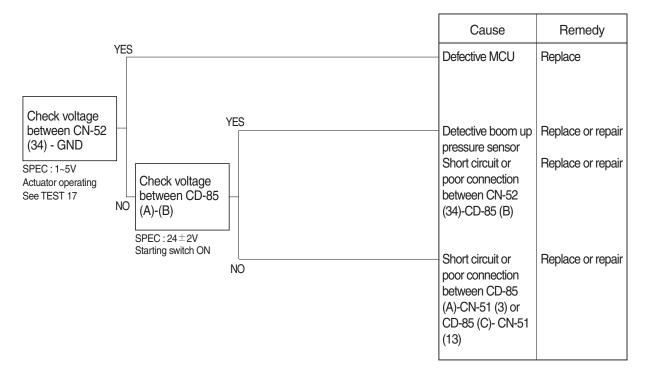
- (1) Test 16: Check voltage at CN-52 (35) and ground.
- ① Prepare 1 piece of thin sharp pin, steel or copper.
- ② Insert prepared pin to rear side of connectors: One pin to (35) of CN-52.
- ③ Starting switch ON.
- ④ Check voltage as figure.



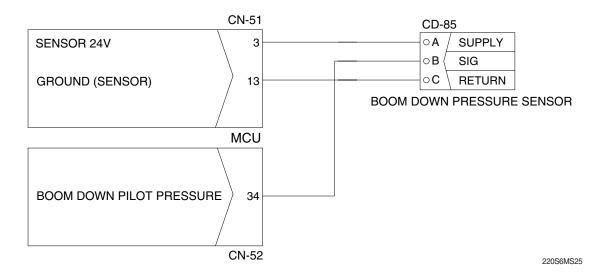
13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

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

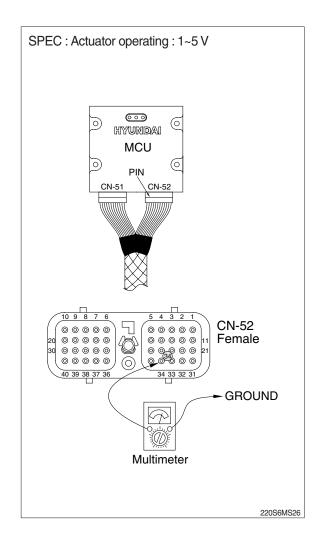
1) INSPECTION PROCEDURE



Wiring diagram



- (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.

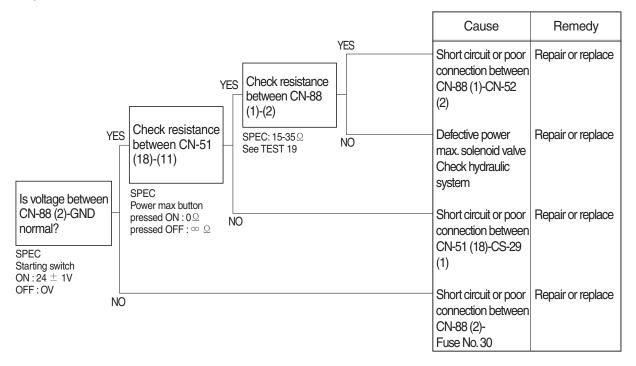


14. MALFUNCTION OF POWER MAX

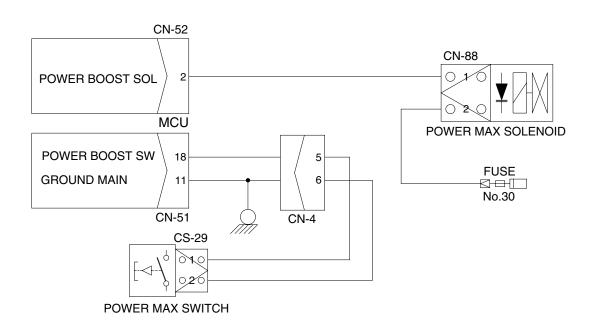
· Fault code: HCESPN 166, FMI 4 or 6

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

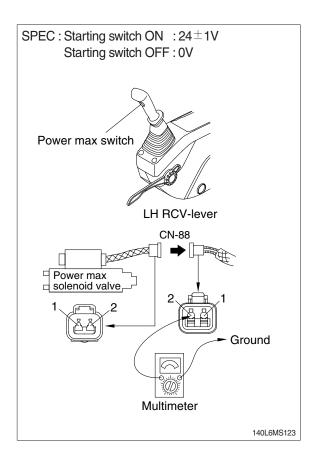
1) INSPECTION PROCEDURE



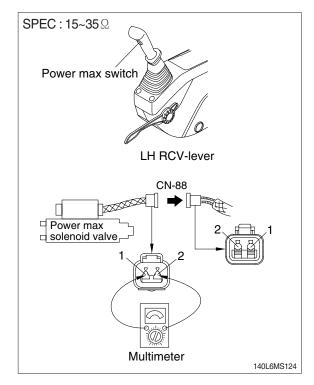
Wiring diagram



- (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.

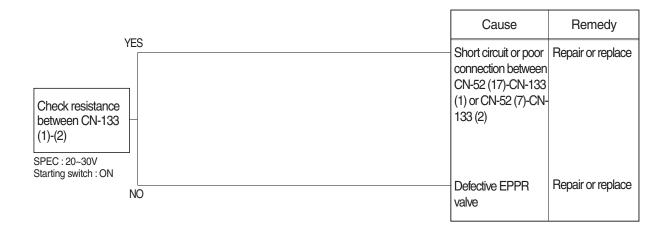


15. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

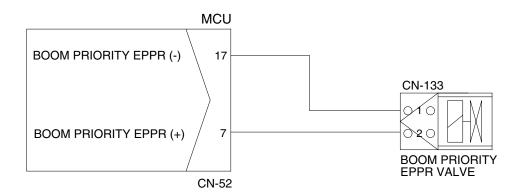
· Fault code: HCESPN 141, FMI 5 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram



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 Construction Equipment spec.

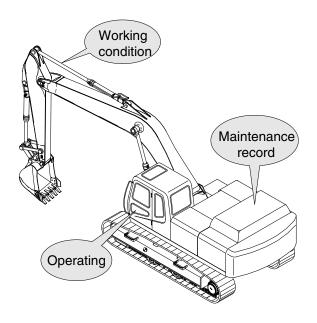
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

With the passage of time, the machine's operational performance deteriorates, so that the machine needs to be serviced periodically to restore it to its original performance level.

Before servicing the machine, conduct performance tests to check the extent of deterioration, and to decide what kind of service needs to be done(by referring to the "Service Limits" in this manual).

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

After the machine is repaired or serviced, it must be tested to confirm that its operational performance was restored by the repair and/or service work done.

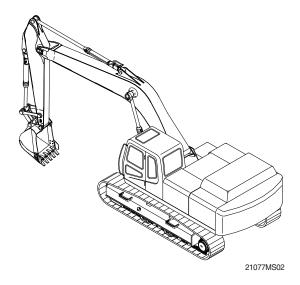


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2. TERMINOLOGY

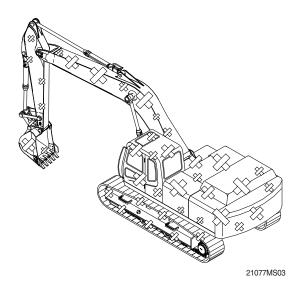
1) STANDARD

Specifications applied to the brand-new machine, components and parts.



2) SERVICE LIMIT

The lowest acceptable performance level. When the performance level of the machine falls below this level, the machine must be removed from work and repaired. Necessary parts and components must be replaced.



3. OPERATION FOR PERFORMANCE TESTS

 Observe the following rules in order to carry out performance tests accurately and safely.

(1) The machine

Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(2) Test area

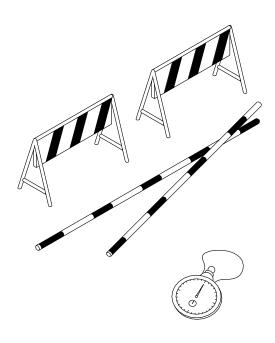
- ① Select a hard, flat surface.
- ② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.
- ③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions

- ① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.
- ② Operate the machine carefully and always give first priority to safety.
- ③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.
- 4 Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

- Accurately calibrate test instruments in advance to obtain correct data.
- ② Carry out tests under the exact test conditions prescribed for each test item.
- ③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.



(290-7TIER) 7-3

2) ENGINE SPEED

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

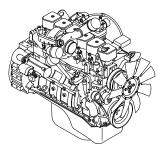
(2) Preparation

- ① Warm up the machine, until the engine coolant temperature reaches 50°C or more, and the hydraulic oil is 50±5°C.
- ② Set the accel dial at 10 (Max) position.
- 3 Measure the engine RPM.

(3) Measurement

- ① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.
- ② Measure and record the engine speed at each mode (P, S, E).
- 3 Select the P-mode.
- 4 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.





220S7MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit:rpm

Model	Engine speed	Standard	Remarks
	Start idle	850±100	
	P mode	1900±50	
LIVOOFO	S mode	1800±50	
HX225S L	E mode	1700±50	
	Auto decel	1200±100	
	One touch decel	1000±100	

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

3) TRAVEL SPEED

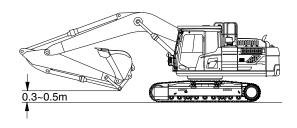
(1) Measure the time required for the excavator to travel a 20 m test track.

(2) Preparation

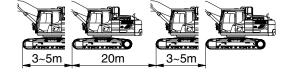
- ① Adjust the tension of both tracks to be equal.
- ② Prepare a flat and solid test track 20 m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- ③ Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- 4 Keep the hydraulic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



- 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.



260A7MS02



260A7MS03

(4) Evaluation

The average measured time should meet the following specifications.

Unit: Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX225S L	1 Speed	18.9±2.0	23.6	
HA2255 L	2 Speed	13.1 ± 1.0	16.4	

4) TRACK REVOLUTION SPEED

(1) Measure the track revolution cycle time with the track raised off ground.

(2) Preparation

- ① Adjust the tension of both side tracks to be equal.
- ② On the track to be measured, mark one shoe with chalk.
- ③ Swing the upperstructure 90° and lower the bucket to raise the track off ground. Keep the boom-arm angle between 90 to 110° as shown. Place blocks under machine frame.
- 4 Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.



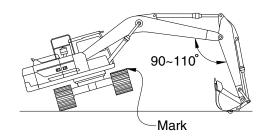
- ① Select the following switch positions.
- · Travel mode switch : 1 or 2 speed
- · Power mode switch : P mode
- · Auto idle switch : OFF
- ② Operate the travel control lever of the raised track in full forward and reverse.
- ③ Rotate 1 turn, then measure time taken for next 3 revolutions.
- ④ Raise 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		
HX225S L	1 Speed	27.0±2.0	33.4		
ПЛ2205 L	2 Speed	17.9±2.0	22.4		



300L7MS04

5) TRAVEL DEVIATION

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

(2) Preparation

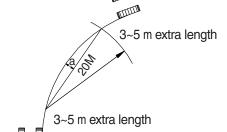
- ① Adjust the tension of both tracks to be equal.
- ② Provide a flat, solid test yard 20 m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- 3 Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- 4 Keep the hydraulic oil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



- 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

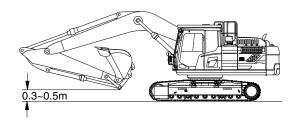
Mistrack should be within the following specifications.



(210-7) 7-7(2)



Model	Standard	Maximum allowable	Remarks
HX225S L	200 below	240	-



260A7MS02

6) SWING SPEED

(1) Measure the time required to swing three complete turns.

(2) Preparation

- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- ③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
- 4 Keep the hydraulic oil temperature at $50\pm5^{\circ}\text{C}$.



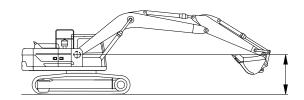
- ① Select the following switch positions.
- · Power mode switch : P mode
- ② Operate swing control lever fully.
- ③ Swing 1 turn and measure time taken to swing next 3 revolutions.
- ④ Repeat steps ② and ③ three time and calculate the average values.



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

Unit: Seconds / 3 revolutions

Model Power mode switch HX225S L P mode		Standard	Maximum allowable
		14.4±1.5	18.0



300L7MS05

7) SWING FUNCTION DRIFT CHECK

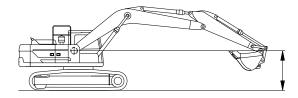
 Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

(2) Preparation

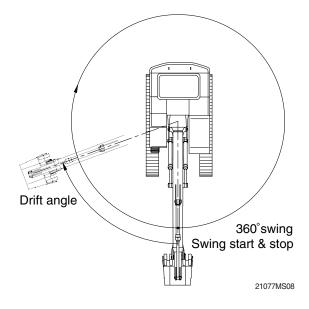
- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot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

(3) Measurement

- ① Conduct this test in the M mode.
- ② Select the following switch positions.
- · Power mode switch : P mode
- ③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360°
- Measure the distance between the two marks.
- ⑤ Align the marks again, swing 360°, then test the opposite direction.
- ⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



300L7MS05



(4) Evaluation

The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX225S L	P mode	90 below	128.8	

8) SWING BEARING PLAY

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

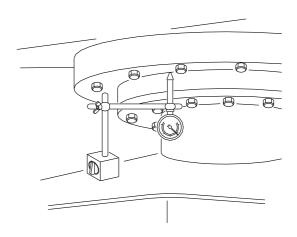
(2) Preparation

- 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.

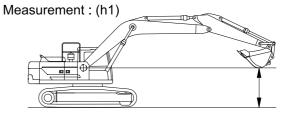
(3) Measurement

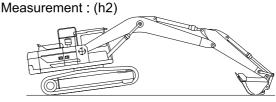
- ① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.

 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
HX225S 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.

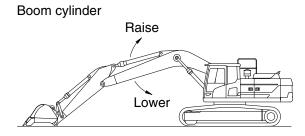
(2) Preparation

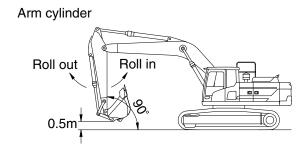
- ① To measure the cycle time of the boom cylinders:
 - With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.
- ② To measure the cycle time of the arm cylinder.
 - With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5 m above the ground.
- 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 $50\pm5^{\circ}\text{C}$.

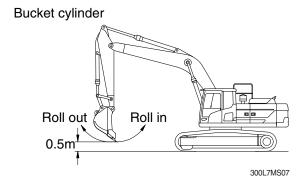
(3) Measurement

- 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	3.5±0.4	4.4	
	Boom lower	2.2±0.3	2.8	
HX225S L	Arm in	2.5±0.3	3.1	
	Arm out	2.7±0.3	3.4	
	Bucket in	2.2±0.3	2.8	
	Bucket out	2.1±0.3	2.6	

10) DIG FUNCTION DRIFT CHECK

(1) Measure dig function drift, which can be caused by oil leakage in the control valve and boom, standard arm, and standard bucket cylinders, with the loaded bucket. When testing the dig function drift just after cylinder replacement, slowly operate each cylinder to its stroke end to purge air.

(2) Preparation

- 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

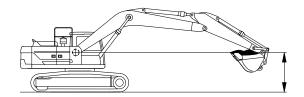
- ② Position the arm cylinder with the rod 20 to 30 mm extended from the fully retracted position.
- ③ Position the bucket cylinder with the rod 20 to 30 mm retracted from the fully extended position.
- With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin 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/5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
	Boom cylinder	10 below	20	
HX225S L	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	60	



300L7MS08

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

(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.
- ① Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.
- ⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit: kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
	Boom lever	1.7 or below	2.0	
	Arm lever	1.7 or below	2.0	
HX225S L	Bucket lever	1.4 or below	2.0	
	Swing lever	1.4 or below	2.0	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

- (1) Measure each lever stroke at the lever top using a ruler.
- When the lever has play, take a half of this value and add it to the measured stroke.

(2) Preparation

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

(3) Measurement

- $\ensuremath{\textcircled{1}}$ Stop the engine.
- ② Measure each lever stroke at the lever top from neutral to the stroke end using a ruler.
- ③ Repeat step ② three times and calculate the average values.

(4) Evaluation

The measured drift should be within the following specifications.

Unit: mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
	Boom lever	112±10	134	
	Arm lever	112±10	134	
HX225S L	Bucket lever	90±10	112	
	Swing lever	90±10	112	
	Travel lever	139±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

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



220S7MS13

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit: kgf/cm²

Model	Engine speed	Standard	Allowable limits	Remarks
HX225S 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.
- \bigcirc Keep the hydraulic oil temperature at 50 \pm 5°C.

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Travel mode switch : 1 speed

2 speed

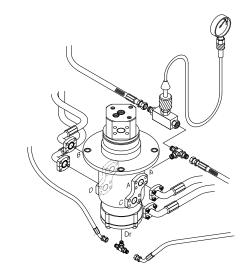
- ② Measure the travel speed selecting pressure in the Hi or Lo mode.
- ③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.
- ④ Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit: kgf/cm2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HVOOECI	1 Speed	0	-	
HX225S L	2 Speed	40±5	-	



220S7MS14

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



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

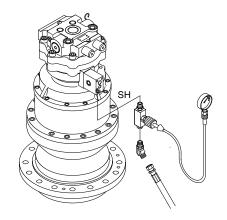
Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit: kgf/cm2

				- · · · · · · · · · · · · · · · · · · ·
Model	Description	Standard	Allowable limits	Remarks
HX225S L	Brake disengaged	40	Over 9	
	Brake applied	0	-	



220S7MS15

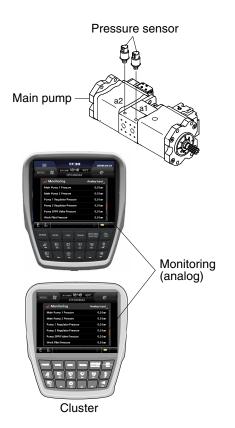
16) MAIN PUMP DELIVERY PRESSURE

(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).



220S7MS16

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit: kgf/cm2

Model	Engine speed	Standard	Allowable limits	Remarks
HX225S L	High idle	40±5	-	

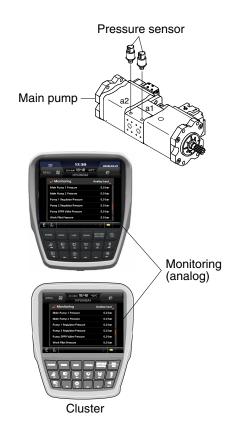
17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(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.



220S7MS16

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit: kgf/cm2

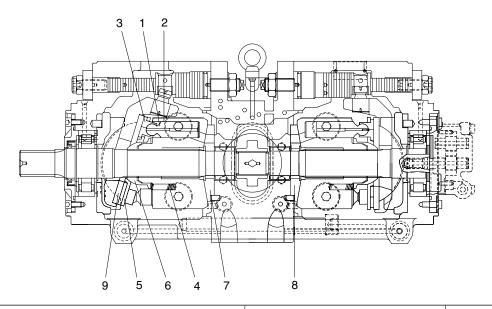
Model	Function to be tested	Standard	Port relief setting
	Boom	350 (380)±10	400±10
HX225S L	Arm	350±10	-
	Bucket	265±10	-
	Boom	350±10	400±10
HX225S L LONG REACH	Arm	300±10	300±10
LONGITLACIT	Bucket	280±10	280±10

): Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP

1) MAINTENANCE CRITERIA



220S7MP01

Part name & inspection item		Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)	d D	0.57	Replace piston or cylinder.
Play between piston (1) & shoe caulking section (3)		0.3	Replace
Thickness of shoe (t)	t h	4.8	assembly of piston & shoe.
Free height of cylinder spring (4)		41.0	Replace cylinder spring.
Combined height of set plate (5) & spherical bushing (6) (H-h)	h H	24.0	Replace retainer or set plate.
Surface roughness for valve plate (sliding face) (7,8),	Surface roughness necessary to be corrected	3z	Lanning
swash plate (shoe plate area) (9), & cylinder (2) (sliding face)	Standard surface roughness (corrected value)	0.4z or lower	Lapping

2) TROUBLESHOOTING

(1) Overload of prime mover

Cause	Countermeasure	Caution
The speed or pressure is higher than their specified values.	Set them as specified.	
The torque setting of the regulator is higher than specified value.	Adjust the regulator.	See the pump device of the section 2.
Seizure or damage of a part inside the pump.	Replace the damaged part.	Check the filter and drain oil for abnormal worn metal particles.
Wrong fitting of the regulator piping.	Correct the regulator piping.	

(2) Extreme decrease of pump delivery flow or delivery pressure does not increase.

Cause	Countermeasure	Caution
Failure of the regulator.	Repair the regulator.	See the pump device of the section 2.
Seizure or damage of a part inside the pump.	Replace the damaged parts.	Check the filters and drain oil.
Failure of the attached pump.	Replace the damaged parts.	Remove the attached pump and check the shaft coupling.
Failure of the accessory valve.	Replace the accessory valves. Especially, check the poppets, seats and springs.	See the pump device of the section 2.
Wrong fitting of the regulator piping.	Correct the regulator piping.	

(3) Abnormal noise and abnormal vibrations

Cause	Countermeasure	Caution
Cavitation	Prevention from cavitation Check working oil for emulsion.	Low boost press.
Damage in the caulking section of the shoe.	Replace the piston, shoe, shoe plate, etc.	Failure of the attached pump.
Cracking of the cylinder.	Replace the cylinder.	Air leakage at the suction pipe.
Wrong installation of the pump.	Correct installation.	Increased suction resistance.
Hunting of the regulator.	Repair the regulator.	See the pump device of the section 2.
Hunting of the relief valve of the accessory valve.	Repair the accessory valve.	See the pump device of the section 2.
Damage of the gear.	Replace the gear.	

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, travel, and port. 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).	
	Insert spool into casing hole, rotate and reciprocate it.	Correction or replacement when O-ring is damaged or when spool does not move smoothly.	
	· Damage of load check valve or spring.	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. for spool		· Correction or replacement.	
Main relief valve,	· External rusting or damage.	· Replacement.	
port relief valve & negative control relief valve	· Contacting face of valve seat.	Replacement when damaged.	

3. SWING DEVICE (TYPE 1, 2)

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures	
Clearance between piston and cylinder block bore	0.041	0.041 0.060 Replace pisto 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 \$\delta \tag{\delta}{\delta} \delta \tag{\delta}{\delta}	fig.	Traum.	↓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 (TYPE 1, 2)

Pr	oblem	Cause	Remedy	
Does not start Pressure is not developed		Pump failure Control valve malfunction	 Check if action other than traveling is available. If faulty, repair. Check if spool moves correctly. Repair if necessary. 	
	Pressure in developed -Sleeve stick -Check valve stick - Motor failure -Valve seat seizure - Gear broken and fragment locked - Overloaded		 Replace brake valve Replace -Check hydraulic oil for contamination Replace reduction gear Reduce load 	
Oil leakage	Leakage from engaging surfaces	Scratch on engaging surfacesLoosening by poor bolt tightening	Correct surfaces by oilstone or sandpaper or replaceCheck after retightening	
	Leakage from casing	Plug loosenedCrack formed by stone	· Retighten · Replace reduction gear	
	Leakage from floating seal · Sliding surfaces worn · Creep on O-ring		Replace reduction gear Replace floating seal	
Leakage from hydraulic motor		Bolt loosened O-ring damaged Sealing surface scratched	Tighten properly Replace O-ring Correct by oilstone or sandpaper	
Coasts on s	lope excessively	 Poor volumetric efficiency of hydraulic motor Increase of internal leakage of brake valve Parking brake not actuated Spring breakage Wear of friction plate 		
Excessive to reduction ge	emperature on ear case	Pitting on bearingLack of gear oilHydraulic oil introduced to gear case	Replace reduction gear Supply gear oil properly Check motor and replace oil seal	
Meanders	Meanders at low pressure	 Delivery rate is different between right and left Motor drain rate is different between right and left 		
	Meanders at high pressure	 Delivery rate is different between right and left Motor drain rate is different between right and left 		
	Meanders at high pressure	 Relief pressure dropped at right and left brake valve Main relief pressure dropped at right or left of control valve 	·	
Pump delivery is poor		Regulator operation poor External leakage of pump is excessive	Repair regulator Repair pump	
External leal excessive	kage of motor is	-	· Replace motor	

5. RCV LEVER

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

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

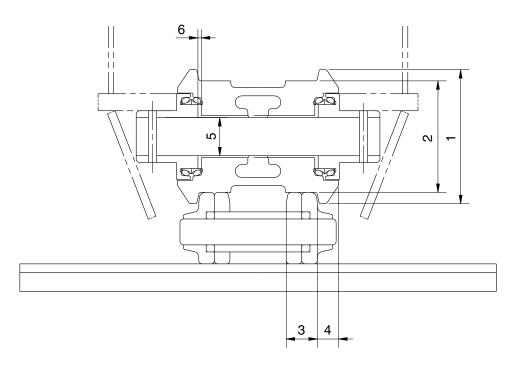
8. CYLINDER

Part name	Inspecting section	Inspection item	Remedy	
Piston rod	· Neck of rod pin	· Presence of crack	· Replace	
· Weld on rod hub		· Presence of crack	· Replace	
	· Stepped part to which piston is attached.	· Presence of crack	· Replace	
	· Threads	· Presence of crack	· Recondition or replace	
	· Plated surface	· Plating is not worn off to base metal.	· Replace or replate	
		· Rust is not present on plating.	· Replace or replate	
		· Scratches are not present.	· Recondition, replate or replace	
	· Rod	· Wear of O.D.	· Recondition, replate or replace	
	· Bushing at mounting part	· Wear of I.D.	· Replace	
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace	
	· Weld on head	· Presence of crack	· Replace	
	· Weld on hub	· Presence of crack	· Replace	
	· Tube interior	· Presence of faults	· Replace if oil leak is seen	
	· Bushing at mounting part	· Wear on inner surface	· Replace	
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating	

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER (-#0063)

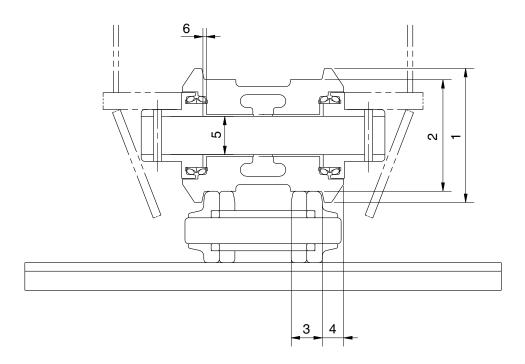


21037MS01

Unit:mm

No.	Check item		Criteria				
4	Outside dispersion of florers	Standard size		Repair limit			
'	Outside diameter of flange	Ø1	95	_			
2	Outside diameter of tread	Ø1	60	Ø.	148	Rebuild or replace	
3	Width of tread	44		50			
4	Width of flange	33	3.3	-			
		Standard size	e & tolerance	Standard Clearance	Clearance		
5	Clearance between shaft	Shaft	Hole	clearance	limit	Replace	
	and bushing	Ø70 0 -0.03	Ø70 +0.35 +0.3	0.32 ~ 0.38	2.0	bushing	
6	Side clearance of roller	Standard clearance		Clearance limit		Replace	
0	(both side)			2	2.0		

TRACK ROLLER (#0064-)

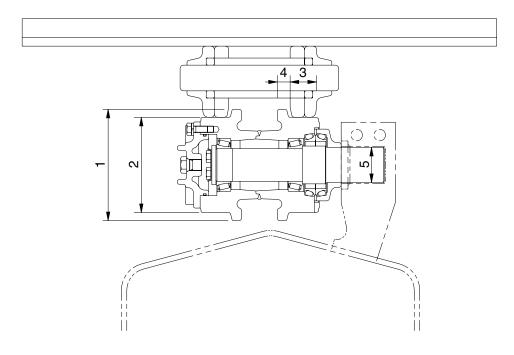


21037MS01

Unit: mm

No.	Check item		Criteria				
4	Outside dismeter of flance	Standard size		Repair limit			
'	Outside diameter of flange	Ø1	85	_		1	
2	Outside diameter of tread	Ø1	50	Ø.	138	Rebuild or replace	
3	Width of tread	45		51		-	
4	Width of flange	29		-			
		Standard size	e & tolerance	Standard Clearance			
5	Clearance between shaft	Shaft	Hole	clearance	limit	Replace	
	and bushing	Ø65 0 -0.03	Ø65 +0.37 +0.32	0.32 ~ 0.4	2.0	bushing	
6	Side clearance of roller	Standard clearance		Clearance limit		Davis	
0	(both side)	0.23 ~ 1.32		2	.0	Replace	

2) CARRIER ROLLER

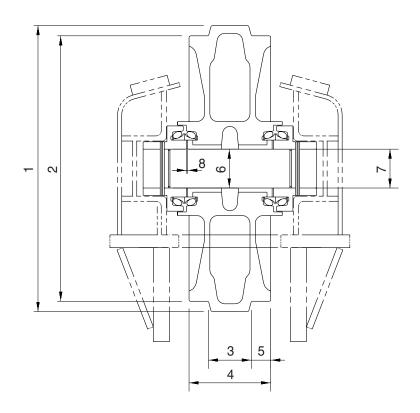


21037MS02

Unit:mm

No.	Check item		Criteria					
4	Outside diameter of flance	Standa	Standard size		tandard size Repair limit		ir limit	
	Outside diameter of flange	Ø	Ø169			_	D . ".	
2	Outside diameter of tread	Ø144		Ø134		Rebuild or replace		
3	Width of tread	44		49		'		
4	Width of flange		17			_		
		Standard size	Toler	ance	Standard	Clearance		
5 CI	5 Clearance between shaft and hole	Standard Size	Shaft	Hole	clearance	limit	Replace	
		Ø 5 5	-0.05 -0.1	+0.3 +0.1	0.15 to 0.4	1.2	bushing	

3) IDLER

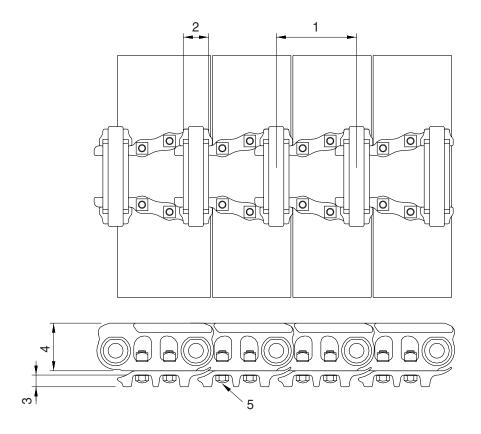


21037MS03

Unit:mm

No.	Check item		Criteria			
_	Outside dispositor of most musical	Standard size		Repa	Repair limit	
1	Outside diameter of protrusion	Ø	560		_	
2	Outside diameter of tread	Ø	520	Ø	Ø510	
3	Width of protrusion	8	32		_	replace
4	Total width	160		_		
5	Width of tread	3	39	44		
		Standard siz	e & tolerance	Standard	Clearance	
6	Clearance between shaft	Shaft	Hole	clearance	limit	Replace
	and bushing	Ø75 ⁰	Ø75 +0.42 +0.35	0.35 to 0.45	2.0	bushing
7	Clearance between shaft and support	Ø75 ⁰	Ø75 +0.07 +0.03	0.03 to 0.1	1.2	Replace
8	Side clearance of idler	Standard	clearance	Clearan	ice limit	Replace
ď	(both side)	0.4 t	o 1.2	2.0		bushing

4) TRACK

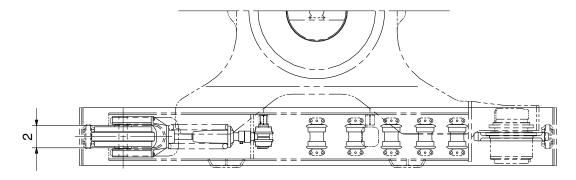


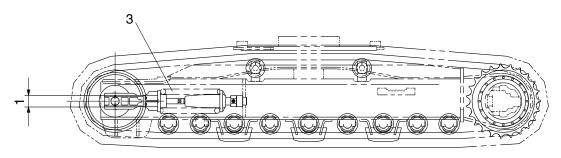
21037MS04

Unit:mm

No.	Check item	Crit	Remedy		
1	Link pitch	Standard size	Repair limit	Turn or	
'	LITIK PILOT	190	194.4	replace	
2	Outside diameter of bushing	Ø 59	Ø51		
3	Height of grouser	26	16	Rebuild or replace	
4	Height of link	105	97	. 5	
5	Tightening torque	Initial tightening torque : 78 \pm	Retighten		

5) TRACK FRAME AND RECOIL SPRING





21037MS05

Unit:mm

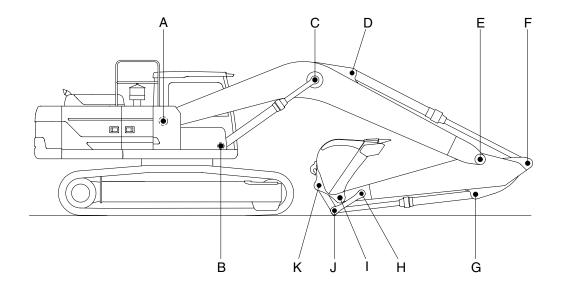
No.	Check item	Criteria					Remedy
	Vertical width of idler guide				Tolerance	Repair limit	
1			frame	113	2.0 0	117	
		Idler support		110	-0.5 -1.0	106	Rebuild or replace
2	Llevizoptel width of idler guide	Track frame		272	2.0 0	276	
	Horizontal width of idler guide	ldler s	upport	270	0.5 -0.5	267	
		,	Standard size		Repa	Repair limit	
3	Recoil spring	Free length	Installation length	Installation load	Free length	Installation load	Replace
		515	431	13716 kg	_	10973 kg	

(Mahcine Serial No. #1978-)

Unit: mm

No.	Check item		Criteria				
				Standard size	Tolerance	Repair limit	
1	1 Vertical width of idler guide		Track frame		2.0 0	116	
			Idler support		0 -0.5	106	Rebuild or replace
2			Track frame		2.0 0	224	
2	Horizontal width of idler guide	Idlers	upport	217	0.5 -1.0	214	
			Standard size		Repa	ir limit	
3	Recoil spring	Free length	Installation length	Installation load	Free length	Installation load	Replace
		568	472	13310 kg	_	10648 kg	

2. WORK EQUIPMENT



260L7MS20

Unit:mm

			Р	in	Bushing		Pomody
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	90	89	88.5	90.5	91	Replace
В	Boom Cylinder Head	80	79	78.5	80.5	81	"
С	Boom Cylinder Rod	80	79	78.5	80.5	81	"
D	Arm Cylinder Head	80	79	78.5	80.5	81	"
Е	Boom Front	90	89	88.5	90.5	91	"
F	Arm Cylinder Rod	80	79	78.5	80.5	81	"
G	Bucket Cylinder Head	80	79	78.5	80.5	81	"
Н	Arm Link	70	69	68.5	70.5	71	"
I	Bucket and Arm Link	80	79	78.5	80.5	81	"
J	Bucket Cylinder Rod	80	79	78.5	80.5	81	"
K	Bucket Link	80	79	78.5	80.5	81	"

SECTION 8 DISASSEMBLY AND ASSEMBLY

Group	1	Precaution	8-1
Group	2	Tightening Torque ·····	8-4
Group	3	Pump Device ····	8-7
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Group	9	Boom, Arm and Bucket Cylinder	8-132
Group	10	Undercarriage	8-151
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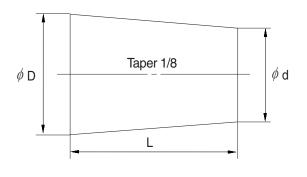
SECTION 8 DISASSEMBLY AND ASSEMBLY

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.		Descriptions	Bolt size	Tor	que
No.		Descriptions		kgf · m	lbf ⋅ ft
1		Engine mounting bolt (engine-bracket)	M12 × 1.75	11.45 ± 1.0	82.8 ± 7.2
2		Engine mounting bolt (bracket-frame, FR)	M20 × 2.5	52.1 ± 5.0	377 ± 36.2
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	32 ±1.0	231 ±7.2
6		Fuel tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 36.9
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	42 ± 4.5	304 ± 32.5
9	Hydraulic system	Main control valve mounting nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
10	Gyotom	Hydraulic oil tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 36.9
11		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
12		Swing motor mounting bolt	M20 × 2.5	57.9 ± 5.8	419 ± 42
13		Swing bearing upper part mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
13-1	Power	Swing bearing upper part mounting bolt-HW	M24 × 3.0	100 ± 10	723 ± 72.3
14	train	Swing bearing lower part mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
14-1	system	Swing bearing lower part mounting bolt-HW	M24 × 3.0	100 ± 10	723 ± 72.3
15		Travel motor mounting bolt	M16 × 2.0	23 ± 2.5	166 ± 18.1
16		Sprocket mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
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	camage	Track shoe mounting bolt, nut	M20 × 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.

[※] H/W : High walker

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Polt oizo	8.8T		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	436 ~ 588	612 ~ 824	102 ~ 137	738 ~ 991
M30 × 3.5	120 ~161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
Boil 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

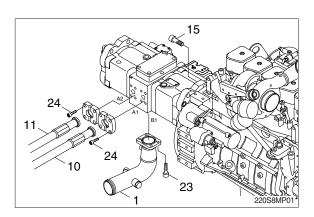
GROUP 3 PUMP DEVICE

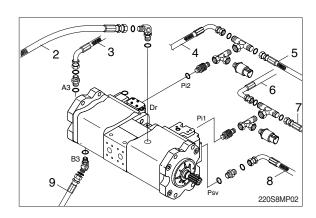
1. REMOVAL AND INSTALL

1) REMOVAL

- (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) 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 : 160 ℓ
- (6) Remove socket bolts (24) and disconnect pipe (10, 11).
- (7) Disconnect pilot line hoses (2, 3, 4, 5, 6, 7, 8, 9).
- (8) Remove socket bolts (23) and disconnect pump suction tube (1).
- When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (9) Sling the pump assembly and remove the pump mounting bolts (15).
 - Weight: 146 kg (322 lb)
 - \cdot Tightening torque : 42 \pm 4.5 kgf·m (304 \pm 32.5 lbf·ft)
- When removing the pump assembly, check that all the hoses have been disconnected.





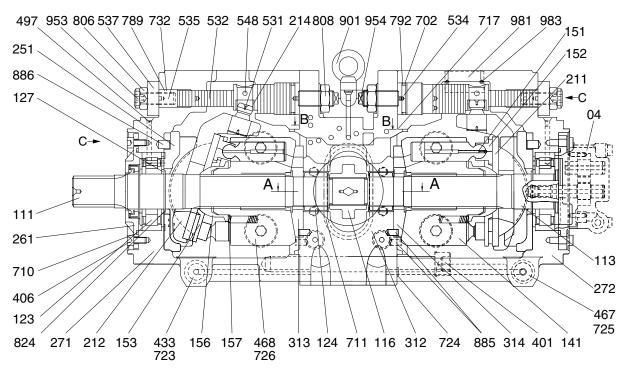


2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- (2) Remove the suction strainer and clean it.
- (3) Replace return filter with new one.
- (4) Remove breather and clean it.
- (5) After adding oil to the hydraulic tank to the specified level.
- (6) Bleed the air from the hydraulic pump.
- $\ensuremath{\mathbb{1}}$ Remove the air vent plug (2EA).
- ② Tighten plug lightly.
- 3 Start the engine, run at low idling, and check oil come out from plug.
- 4 Tighten plug.
- (7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.
- (8) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. MAIN PUMP (1/3)

1) STRUCTURE

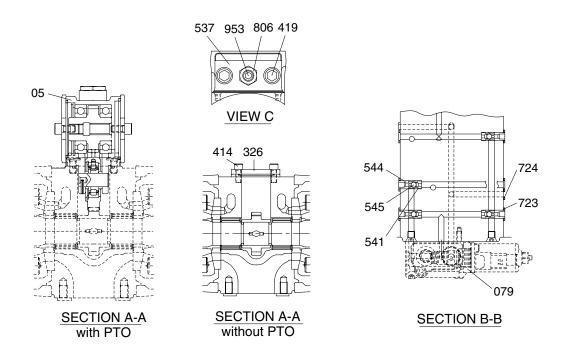


Section A-A	B-B, view C: see	e next page.
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22	0S	21	ΛP	05

04	Gear pump	272	Pump casing (R)	711	O-ring
111	Drive shaft (F)	312	Valve block	717	O-ring
113	Drive shaft (R)	313	Valve plate (R)	723	O-ring
116	1st gear	314	Valve plate (L)	724	Square ring
123	Roller bearing	401	Hexagon socket bolt	725	O-ring
124	Needle bearing	406	Hexagon socket bolt	726	O-ring
127	Bearing spacer	466	Plug	732	O-ring
141	Cylinder block	467	Plug	774	Oil seal
151	Piston	468	Plug	789	Back up ring
152	Shoe	497	MH Plug	792	Back up ring
153	Set plate	531	Tilting pin	806	Hexagon head nut
156	Spherical bushing	532	Servo piston	808	Hexagon head nut
157	Cylinder spring	534	Stopper (L)	824	Snap ring
211	Shoe plate	535	Stopper (S)	885	Pin
212	Swash plate	537	Servo cover (S)	886	Pin
214	Tilting Bushing	548	Feed-back pin	901	Eye bolt
251	Support	702	O-ring	953	Set screw
261	Seal cover (F)	710	O-ring	954	Set screw
271	Pump casing (F)				

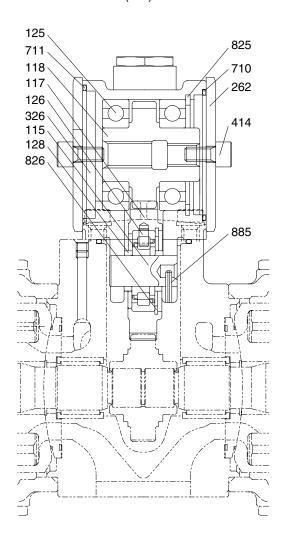
MAIN PUMP (2/3)

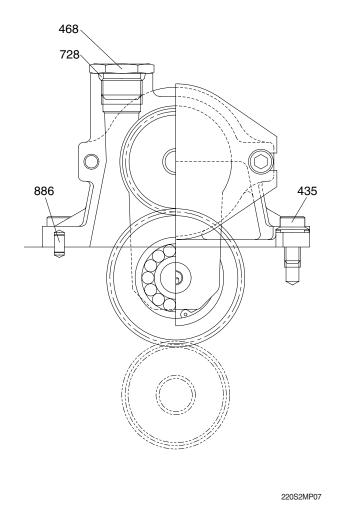


220S2MP06

05	PTO unit (with PTO)	537	Servo cover (S)	724	Square ring
079	Proportional reducing valve	541	Seat	806	Hexagon head nut
326	Cover (without PTO)	544	Stopper 1	953	Set screw
414	Hexagon socket bolt (without PTO)	545	Steel ball		
419	Hexagon socket bolt	723	O-ring		

MAIN PUMP (3/3)





115	Idler shaft	262	Cover	711	O-ring
117	Gear No. 2	326	Gear case	728	O-ring
118	Gear No. 3	414	Socket head screw	825	Retainer ring
125	Ball bearing	435	Flange head socket bolt	826	Retainer ring
126	Roller bearing	468	Plug	885	Spring pin
128	Bearing spacer	710	O-ring	886	Pin

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

Tool name & size		Part name			
Name B		Hexagon socket ROH, VP plug head bolt (Parallel thread)		Hexagon socket head setscrew	
	6	M 8	PF 1/4	M12, M14	
Allen wrench	8	M10	PF 3/8	M16, M18	
B	10	M12	PF 1/2	M20	
	14	M16, M18 PF 3/4		-	
, v	17	M20, M22	PF 1	-	
Adjustable angle wrench		Medium size, 1 set			
Screw driver		Minus type screw driver, Medium size, 2 pieces			
Hammer		Plastic hammer, 1 pieces			
Pliers		For snap ring, TSR-160			
Torque wrench		Capable of tightening with the specified torques			

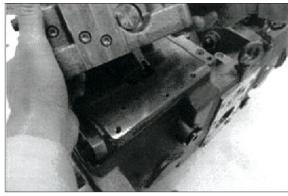
(2) Tightening torque

Dout name	Dallad a	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	16.3	118	0.47	12
	M16	23.5	170	0.55	14
	M18	33.7	244	0.55	14
	M20	43.8	317	0.67	17
ROH Plug	PF 1/4	3.0	21.7	0.24	6
PF 3/8 or under : S45C	PF 3/8	7.5	54.2	0.31	8
PF 1/2 or under : SCM435	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.3	111	0.47	12

3) DISASSEMBLY

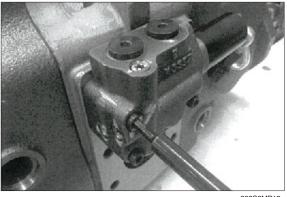
For disassembling the pump, read this section thoughly and then disassemble it in the following sequence. The figure in parentheses after part names show the item in structure drawing.

- (1) Select place suitable to disassembling.
- Select clean place.
- Spread rubber sheet, cloth or so on. Make workbench top clean 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 the oil out from pump casing (271, 272).
- (4) Remove hexagon socket head bolts (412, 413, 414) and remove regulator.
- Refer to page 8-28 for disassemble regulator.



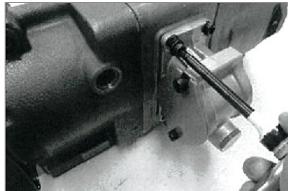
220S8MP11

(5) Remove hexagon socket head bolts and remove proportional valve block (079).



220S8MP12

- (6) Place the pump horizontally on workbench with its regulator-fitting surface down, and remove PTO unit from valve block.
- Before bringing regulator-fitting surface down, spread rubber sheet on workbench to avoid damaging the surface.



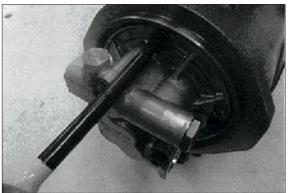
220C9MD12

In case the pump is provided without PTO unit, remove the cover (326) with the hexagon socket head cap screws.



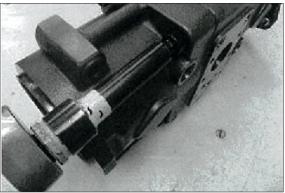
220S8MP14

(7) Remove flange sockets (435) and the gear pump (04).



220S8MP15

(8) Loosen hexagon socket head bolts (401) which tighten pump casing (F, 271) pump casing (R, 272), and valve block (312).



220S8MP16

- (9) Separate pump casing (F, 271), pump casing (272), from valve block (312)
- * Remove the 1st gear (116), when pump casings are separated from valve block.



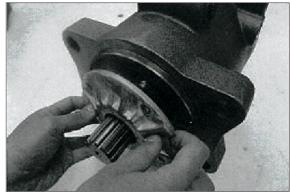
220S8MP17

- (10) Pull out cylinder block (141), piston-shoes (011), set plate (153), spherical bush (156), and cylinder springs (157) simultaneously from pump casing (F, 271) and (R, 272), straightly over drive shaft (111, 113)
- ** Take care not to damage sliding surface of cylinder block (141), spherical bush (156), piston-shoes (011), swash plate (212), drive shaft (111, 113), etc.



220S8MP18

- (11) Remove hexagon socket head bolts (406) and seal cover (F, 261)
- In the case it is difficult to remove, put flatblade screwdriver into the notch of seal cover. Then the cover can be removed easily.
- Since oil seal is fitted on seal cover (F, 261), take care not to damage it while removing cover.



220S8MP19

- (12) Remove the drive shafts (111, 113) from the pump casing (271, 272).
- In the case it is difficult to remove, tap the end of the drive shaft lightly with plastic hammer.

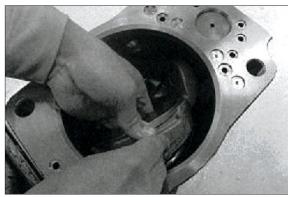


220S8MP20

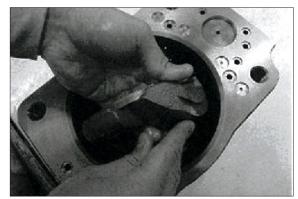
(13) Remove the swash plates (212) and shoe plates (211) from swash plate support (251), and pull out the swash plates with turning shown in this picture from casing.



220S8MP21

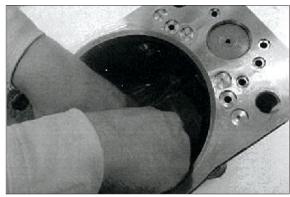


220S8MP22



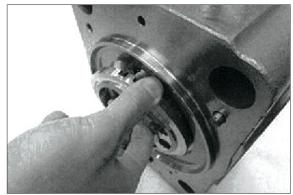
220S8MP23

- (14) Remove swash plate supports (251) from pump casing.
- In this case it is difficult to remove, tap the opposite side of the swash plate support (251) with plastic hammer to remove it from pump casing easily.



220S8MP24

- (15) Remove valve plates (313, 314) from valve block (312)
- * There may be removed in work (8).

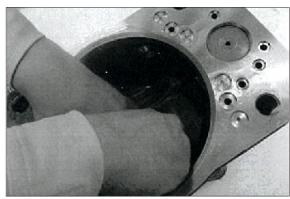


220S8MP25

- (16) If necessary, remove the servo covers (537), stopper (L, 534), stopper (S, 535), and servo piston sub (530) from pump casing (271, 272).
- Do not remove needle bearing (124) as far as possible, except the case that the bearing is considered to be out of its lifetime.
- Do not loosen hexagon nuts of valve block (312) and servo cover (537). If loosened, flow setting will be changed.

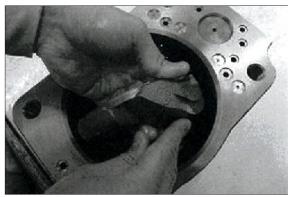
4) REASSEMBLY

- For reassembling reverse the disassembling procedures, paying attention to the following.
- ① Do not fail to repair the parts damaged during dissassembling, and repair replacement part in advance.
- ② Clean each part fully with cleaning oil and dry it with compressed air.
- ③ Apply clean working oil to sliding sections, bearings, etc. before assembling them.
- ④ In general rule, replace the sealing parts, such as O-ring, oil seal, etc.
- ⑤ For fitting bolts, plug, etc. prepare a torque wrench or so on, and tighten them with torque shown at page 8-13.
- ⑥ For the tandem type pump, take care not to mix up parts of the front pump with those of the rear pump
- (2) Insert swash plate supports (251) into the casing (271) and (R, 272) with fitting.
- If the servo piston, stopper (L), stopper (S), and servo cover are removed, fit them to pump casing in advance for reassembling.

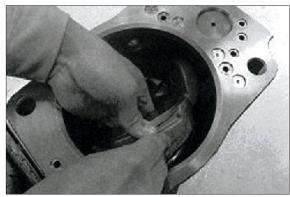


220S8MP24

- (3) Attach shoe plate (211) to swash plate (212) and insert tilting pin (531) to tilting bush (214) of servo piston (532). As shown in the right figure, attach to swash plate support (251) correctly, leaning swash plate and shoe plate.
- Confirm that swash plate can moved smoothly with fingers of both hands.
- Apply grease to sliding sentions of swash plate and swash plate support, to assemble the drive shaft easily.
- * Take care not to damage the sliding surface of the shoe plate.



220S8MP23



220S8MP22



220S8MP21

(4) Fit drive shaft (111, 113) where bearing (123), bearing spacer (127), snap ring (824) were set to pump casing (271, 272).



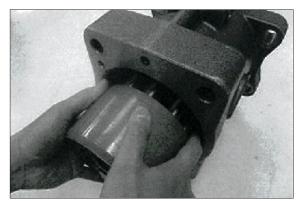
220S8MP20

- (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.



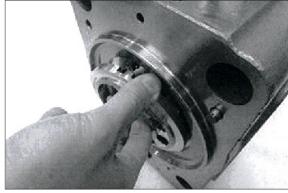
220S8MP26

- (6) Assemble piston cylinder sub assembly [cylinder (141), piston sub assembly (151, 152), set plate (153), spherical bush (156) and cylinder spring (157)].
- Fit spline phases of spherical bush and cylinder.
- * Then, insert piston cylinder subassembly into pump casing.



220S8MP18

- (7) Fit valve plate (313) to valve block (312) according to pin (885).
- * Take care not to mistake suction/delivery directions of valve plate.



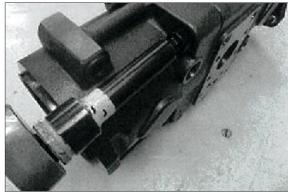
220S8MP27

- (8) Place pump horizontally on workbench with its regulator-fitting surface down, and attach pump casing (271) to valve block (312).
- Before bringing regulator-fitting surface down, spread rubber sheet on workbench and do not damage this surface.
- * Take care not to mistake direction of valve block. [clockwise rotation (viewed from input shaft side)]. Fit the valve block with suction flange left when regulator side below, viewed from front side.
- Fit 1st gear simultaneously.



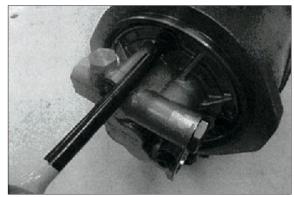
220S8MP17

(9) Fit valve block (312) to pump casing (271, 272) with hexagon socket head bolts (401, 402).



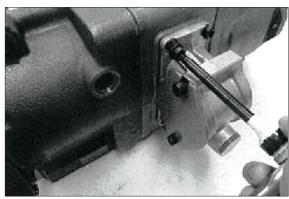
220S8MP16

(10) Fit gear pump (04) to pump casing (271) with hexagon socket head bolts.



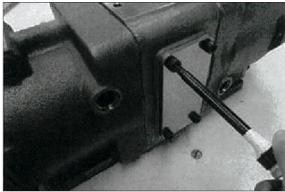
220S8MP15

- (11) Attach the PTO unit (05) by fastening the flange socket to the valve block (312).
- Be careful about the attaching direction of the PTO unit.



220S8MP13

In case the pump is not provided with the PTO unit (05), attach the cover (326) with the hexagon socket head cap screws (414).



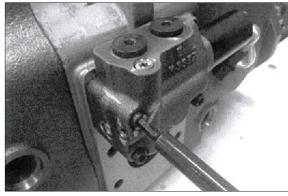
220S8MP14

- (12) Putting feedback lever of regulator into feedback pin (548) of servo piston (532), fit regulator with hexagon socket head bolts.
- * Take care not to mix up regulator of front pump with another.



220S8MP28

(13) Fit proportional valve block (079) to valve block (312) with hexagon socket head bolts.



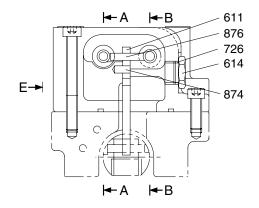
220S8MP29

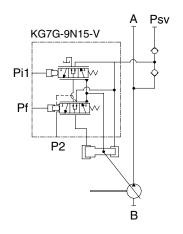
(14) Fit drain port plug (467).

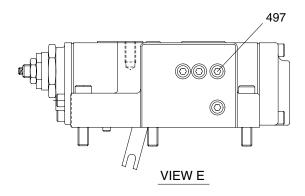
This is the end of reassembling procedure.

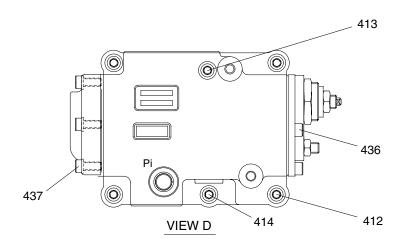
3. REGULATOR

1) STRUCTURE (1/2)





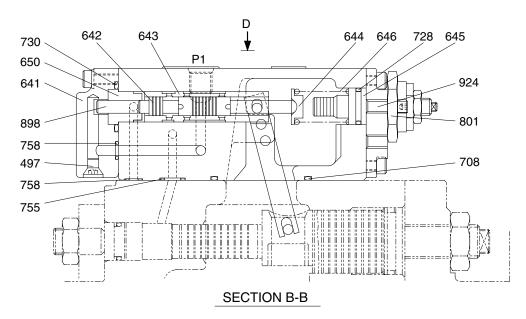


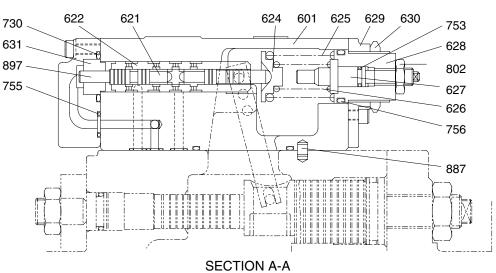


220S2MP08

412	Hexagon socket screw	497	Plug	874	Pin
413	Hexagon socket screw	611	Feed back lever	876	Pin
436	Hexagon socket screw	614	Adjust plug		
437	Hexagon socket screw	726	O-ring		

REGULATOR (2/2)





220S2MP09

414	Hexagon socket screw	630	Lock nut	730	O-ring
497	Plug	631	Sleeve, pf	753	O-ring
601	Casing	641	Pilot cover	755	O-ring
621	Compensator piston	642	Pilot spool	756	O-ring
622	Compensator sleeve	643	Pilot sleeve	758	Square ring
624	Spring seat (C)	644	Spring seat (Q)	801	Nut
625	Outer spring	645	Adjust stem (Q)	802	Nut
626	Inner spring	646	Pilot spring	887	Pin
627	Adjust stem (C)	650	Sleeve, pi	897	Piston, pf
628	Adjust screw (C)	708	O-ring	898	Piston, pi
629	Cover (C)	728	O-ring	924	Set screw

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

Tool name & size		Part name				
Name	Name B		ROH, VP, UNF (Parallel thread)	Hexagon socket head setscrew		
Allen wrench 5		M 5	-	M8		
		M 6	-	M10		
B	6	M 8	ROH 1/4	M12, M14		
	19	-	-	-		
, v	22	-	VP 3/8	-		
Adjustable angle wrench		Medium size, 1 set				
Torque wrench		Capable of tightening with the specified torques				
Hexagon socket head bolt		M4, Length: 50 mm				

(2) Tightening torque

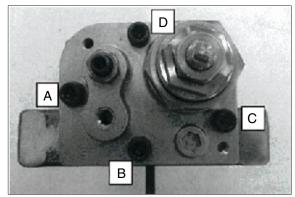
Devil manua	5 " '	Tor	que	Wrench size		
Part name	Bolt size	kgf · m	lbf ⋅ ft	in	mm	
Hexagon socket head bolt	M 5	0.7	5.1	0.16	4	
(Material : SCM435)	M 6	1.2	8.7	0.20	5	
	M 7	3.0	21.7	0.24	6	
	M 8	5.8	42	0.31	8	
	M 9	10.0	72.3	0.39	10	
	M14	16.3	118	0.47	12	
	M16	23.5	170	0.55	14	
	M18	33.7	244	0.55	14	
	M20	43.8	317	0.67	17	
	M22	64.2	464	0.67	17	
PT Plug (Material : S45C)	PT 1/8	1.2	8.7	0.20	5	
※Wind a seal tape 1 1/2 to	PT 1/4	2.2	15.9	0.24	6	
2 turns round the plug	PT 3/8	4.5	32.5	0.31	8	
	PT 1/2	6.6	47.7	0.39	10	
ROH Plug	PF 1/4	3.5	25.3	0.24	6	
PF 3/8 or under : S45C	PF 3/8	7.5	54.2	0.31	8	
PF 1/2 or over : SCM435	PF 1/2	11.2	81.0	0.39	10	
	PF 3/4	17.3	125	0.55	14	
UNF plug (Material : S45C)	PPU916 W	1.6	11.6	0.75	19	

3) DISASSEMBLY

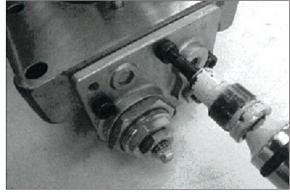
(1) Preparation for disassembling

- ① Since the regulator consists of small, precision, and well-finished parts, disassembling and assembling are rather complicated. For this reason, replacement of a regulator assembly is recommended, unless there is a special reason. If in case disassembling is necessary for an unavoidable special reason, read through this manual to the end before starting disassembling.
- ② Since the regulators on the front pump and the rear pump are set at different pressure and flow values, mark each of them so as not to mix up one of front pump with another.
- 3 The numbers in parentheses after part names represent those in the crosssectional drawings (on page 8-24, 25)
- (2) Select a place for assembling.
- Select clean place.
- Spread rubber sheet or cloth to over the workbench to prevent parts from being damaged.
- (3) Remove dust, rust, etc. from surfaces of regulator with clean oil.
- Since the regulators on the front side and the rear side set at different pressure and flow values, mark each of them so as not to mix up one of drive shaft side with another.
- (4) Remove hexagon socket head cap screws (412, 413, 414) and remove regulator from the pump.
- If the pump is disassembled, check the page 7-21 for this axial piston pump.
- * Take care not to lose O-ring while removing regulator.

- (5) Remove hexagon socket head cap screw (436). Then remove cover (C, 629).
- Adjusting screw (C, 628), adjust stem (C, 627), hexagon nut (801, 802), set screw (924) are fixed to cover (C, 629).
- ** Do not loosen each screw and nut. If they are loosened, adjusted pressure-flow setting will be changed.
- At first, remove A·B hexagon socket head cap screws (436) equally, then remove C·D hexagon socket head cap screws (436) equally.
 - * As spring force is strong, casting (601) and adjust stem (C, 627) may be damaged if cover (C, 629) is inclined.



220S8MP30

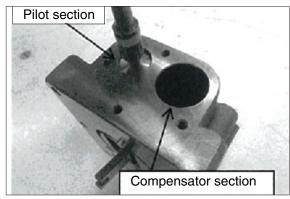


220S8MP31



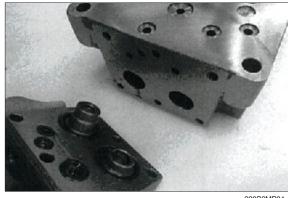
220S8MP32

- (6) Remove the adjusting stem (Q, 645) the pilot spring (646), and the spring seat (Q, 644) from pilot section of the regulator.
- Adjusting stem (Q, 645) can easily be pull out with M4 screw.
- * Take care not to lose the pilot spring (646) and the spring stem (Q, 644) which they fall from casing when the adjusting stem (Q, 645) is removed.



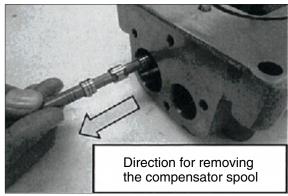
220S8MP33

- (7) Remove hexagon socket head cap screw (437) and remove pilot cover (641).
- * Then remove Pf piston (897), Pf sleeve (631), Pi pistion (898), and Pi sleeve (650) from pilot cover.
- * If the regulator was used for a long time, the Pf sleeve (631) or the Pf sleeve (650) may stuck with pliot cover. Take care not to damage these sleeves while removing them from the pilot cover. (641).



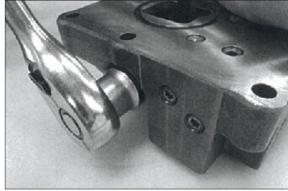
220S8MP34

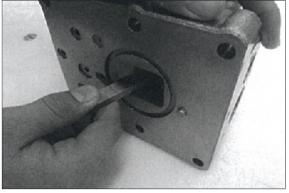
- (8) Remove the compensator spool (621) and the pilot spool (642) from casing.
- Remove the compensator spool (621) from the casing by one direction shown in left picture. Regulator parts will be damaged and breken, if the spool is pushed to counter direction shown in left picture.



220S8MP35

- (9) Remove the adjusting plug (614) and feedback lever (611) from the casing.
- Be careful not to damage regulator casing (601) while loosening the adjusting plug (614).
- * Do not remove the pin (876) from the feedback lever (611).





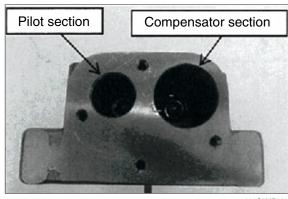
220S8MP37

- (10) Remove the compensator sleeve (622) and the pilot sleeve (643) from the casing (601).
- * This completes operation.

Since component parts are small, take care not to lose them.

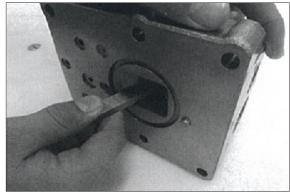
4) REASSEMBLY

- For assembling, reverse disassembling procedures. But pay attention to the following.
- ① Repair parts that were damaged at disassembling.
 - Prepare replacement parts beforehand.
- ② Contamination will cause malfunction. Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.
- 3 Tighten screws, plugs, etc. with their specified torques.
- ④ Replace seals such as O-ring with new ones as a general rule.
- (2) Select a place for assembling.
- Select clean place.
- Spread rubber sheet or cloth to cover the workbench to prevent parts from being damaged.
- (3) Fit the compensator sleeve (622) and the pilot sleeve (643) into the casing (601).
- Make sure that the position of the compensator sleeve (622) and the pilot sleeve (643) are correct.
- Confirm that these sleeves slide smoothly in casing without sticking.



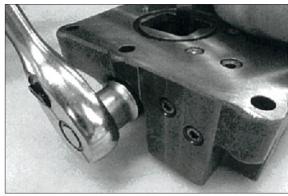
220S8MP38

- (4) Insert the pin (876) fixed on feedback lever (611) to the oval shaped hole of the pilot sleeve (643). Then, fit the hole of the feedback lever to the pin (874) fixed inside the casing (601). At the same time, insert the pin (876) to the oval shaped hole of the compensator sleeve (622).
- If the pilot spool (642) is in the pilot sleeve (643), the pin (876) cannot be inserted to the pilot sleeve.



220S8MP37

- (5) Tighten the adjusting plug (614) to the casing (601).
- Be careful not to damage regulator casing (601) while tightening the adjusting plug (614)
- * Confirm that the sleeves slide smootly in casing with sticking or excess play among parts.



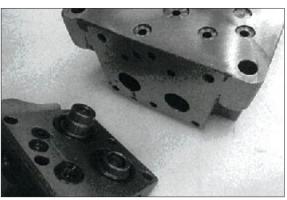
220S8MP39

- (6) Fit the compensator spool (621) into the compensator (622) and the pilot spool (642) into the pilot sleeve (643).
- Fit the compensator spool (621) into the compensator sleeve (642) by direction shown in left picture.



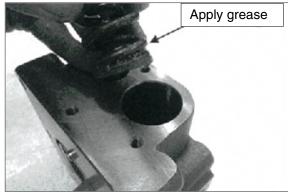
220S8MP40

- (7) Put the piston (897), the Pf sleeve (631), the pilot piston (898) and the pilot sleeve (650) into pilot cover (641). Then fit the cover to the casing (601).
- Make sure that the direction of Pf piston and Pi piston are correct.
- Make sure that the pisition of Pf piston and Pi piston are correct.
- Be careful not to fall Pf piston and other parts.



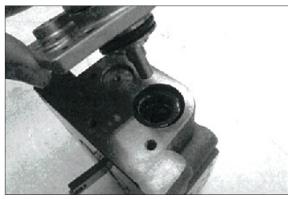
220S8MP34

- (8) Put the spring seat (C, 624) the outer spring (625), and the inner spring (626) into compensator section of the casing. By the same way, put the spring seat (Q, 644) into pilot section of the casing.
- The spring seat (C, 624) may fall. Apply grease to the spring seat (C, 624), the outer spring (625) and the inner spring (626) to prevent falling. Also the pilot spring seat (Q, 644) and the pilot spring (646) should be assembled as well.

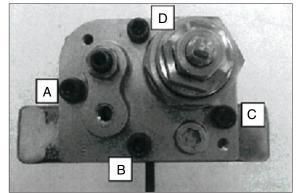


220S8MP41

- (9) Tighten cover (C, 629) with hexagon socket head cap screws (436).
- Adjusting screw (C, 628), adjust stem (C, 627), hexagon nut (801, 802), set screw (924) are fixed on cover (C, 629).
 Do not loosen screw and nut. If they are loosened, adjusted pressure-flow setting will be changed.
- At first, tighten C·D hexagon socket head cap screws (436) equally, then tighten A·B hexagon socket head cap screws (436) equally.
- At spring force is strong, casing (601) and adjust stem (C, 627) may be damaged if cover (C, 629) inclined.



220S8MP32



220S8MP30

(10) Put the regulator to the pump. Tighten regulat-or with hexagon socket head cap screws (412, 413, 414).

This completes assembling.

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

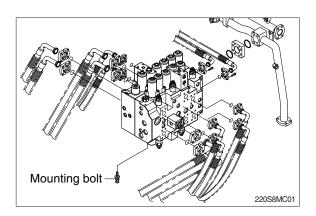
▲ Escaping fluid under pressure can penetrate the skin causing serious injury.

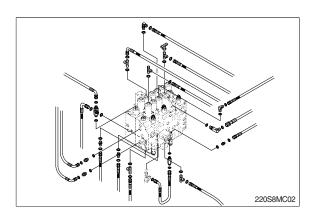
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Remove the wirings for the pressure sensor and so on.
- (5) Remove bolts and disconnect pipe.
- (6) Disconnect pilot line hoses.
- (7) Disconnect pilot piping.
- (8) Sling the control valve assembly and remove the control valve mounting bolt and bracket.
 - · Weight: 220 kg (485 lb)
 - \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.

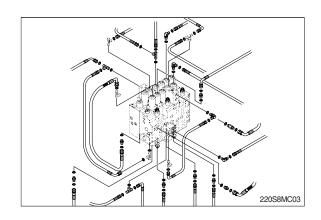
2) INSTALL

- (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.

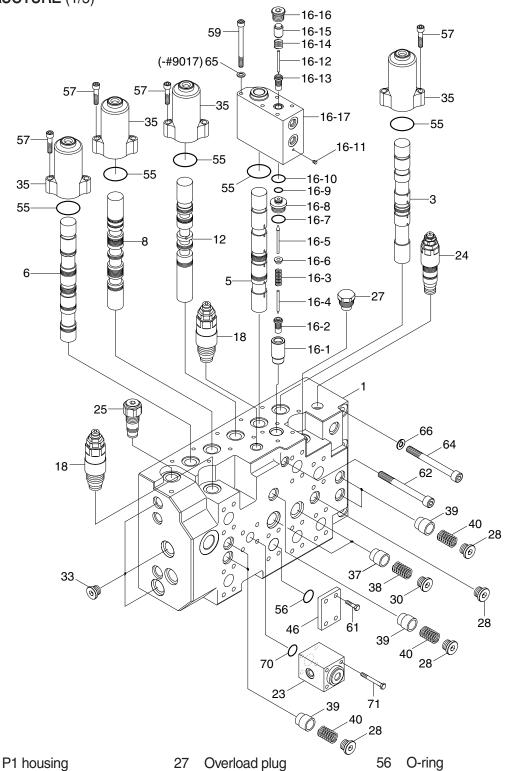








2. STRUCTURE (1/5)



-	
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

30 Load check plug 33 Plug 35 Spool cap 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

Plug

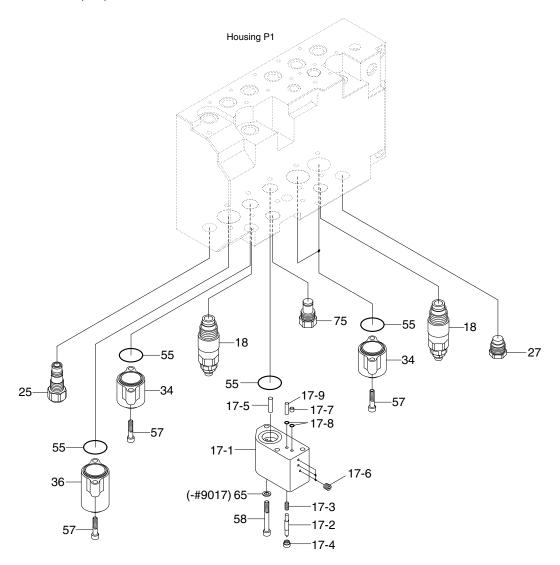
28

57 Socket bolt
59 Socket bolt
61 Socket bolt
62 Socket bolt
64 Socket bolt
66 Spring washer
70 O-ring
71 Socket bolt

220S8MC04

8-36

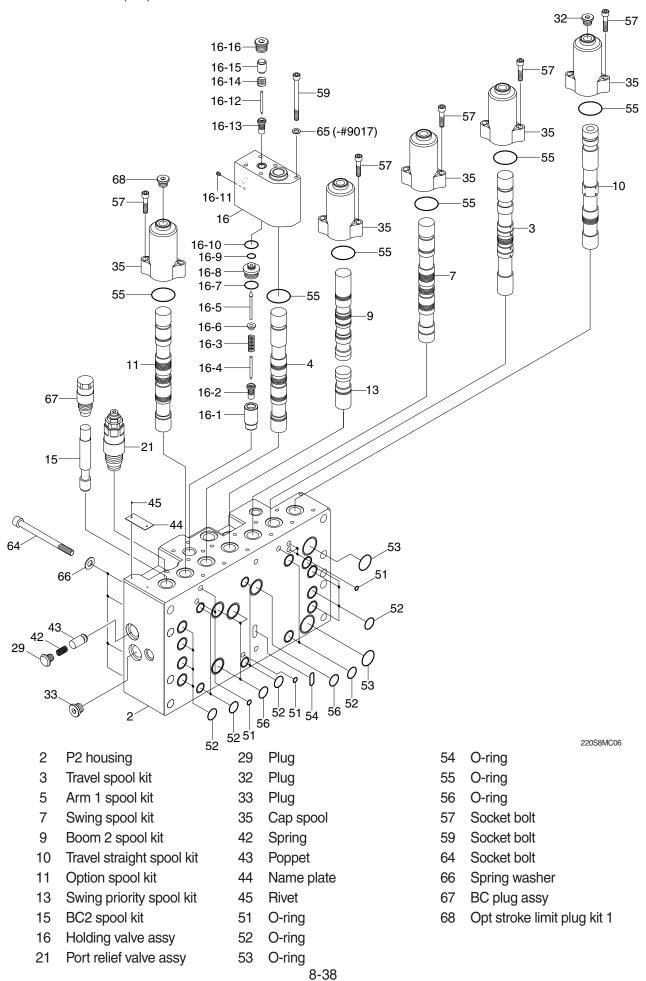
STRUCTURE (2/5)



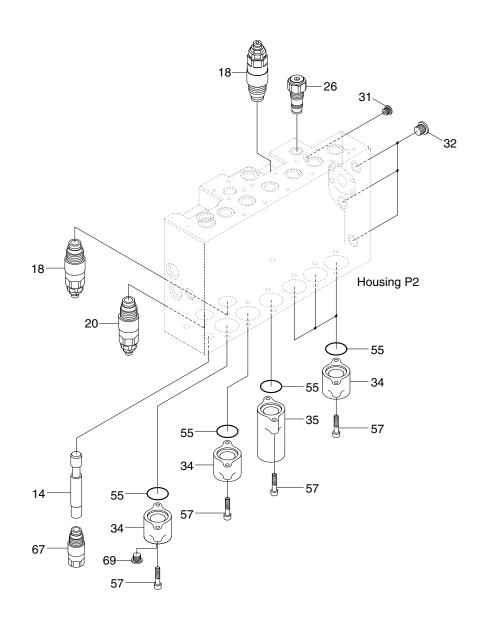
220S8MC05

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)



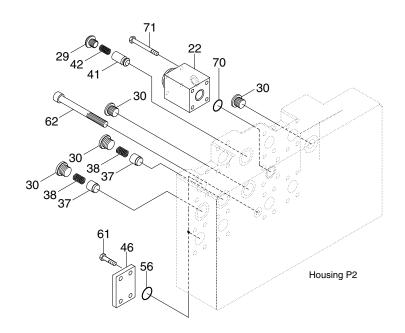
STRUCTURE (4/5)



220S8MC07

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]





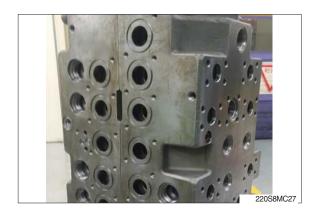
(14) Main spool disassembly

① Fix the spool to the dedicated jig and take it apart.

(Spacer bolt, spring, stopper, spring seat)

[Hexagon key wrench 8 mm]

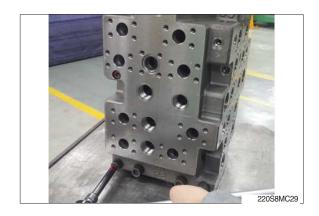




(15) Disassembling of housing

- 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 (TYPE 1, 2)

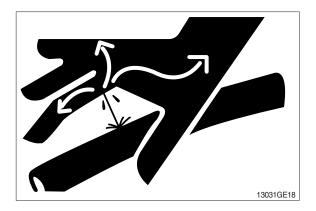
1. REMOVAL AND INSTALL OF MOTOR

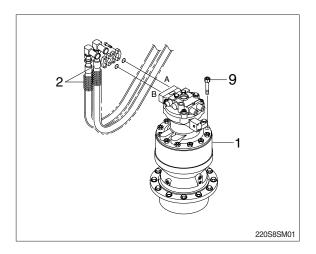
1) REMOVAL

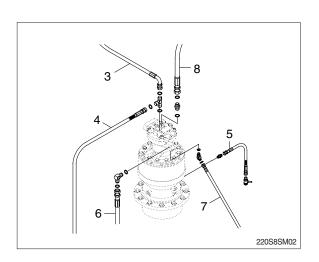
- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure 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 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.
- 4 Start the engine, run at low idling and check oil come out from plug.
- 5 Tighten plug fully.
- (3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

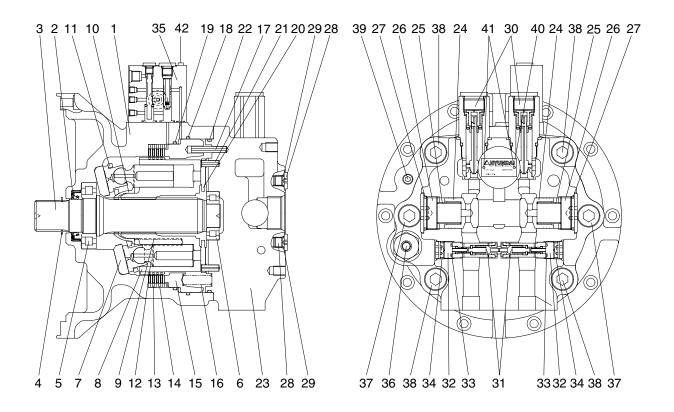






2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



220S2SM02

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	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).



2209A8SM52

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

⑤ Disassemble swash plate (7) from casing (1).



2209A8SM56

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).



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)



2209A8SM66

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 \times 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 \times 2EA
 - · O-ring \times 2EA



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



2209A8SM73

- ③ Using a torque wrench, assemble relief valve (30) 2 sets into valve casing (23).
 - · Relief valve (30)×2EA



2209A8SM74

- ④ Assemble plug (28) and O-ring (27) into valve casing (23).
 - · Plug (28) \times 3EA
 - · O-ring (27) \times 3EA



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



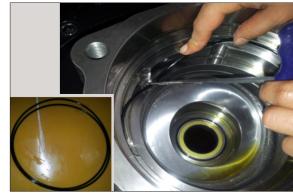
2209A8SM80

- 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) × 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

 Lift up valve casing (23) on casing (1) by a crane and assemble it with socket bolts (37, 38).



22001281186

Assemble level gauge (36) and plug (39) into casing (1).



2209A8SM87

- ① Assemble time delay valve assy (35) into valve casing (23) with socket bolt (42).
 - · Time delay valve \times 1EA
 - · Socket bolt × 3EA



2209A8SM88

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

13 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

Mount test bench

Mounting motor a test bench, test the availability of each part.

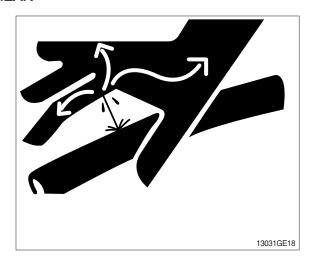


2209A8SM91

3. REMOVAL AND INSTALL OF REDUCTION GEAR

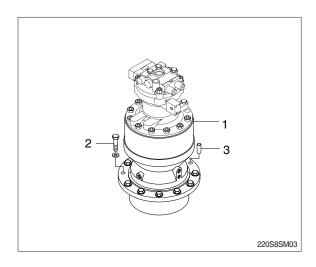
1) REMOVAL

- Remove the swing motor assembly.
 For details, see removal of swing motor assembly.
- (2) Sling reduction gear assembly (1) and remove dowel pin (3) and mounting bolts (2).
- (3) Remove the reduction gear assembly.
 - · Reduction gear device weight : 75 kg (165 lb)



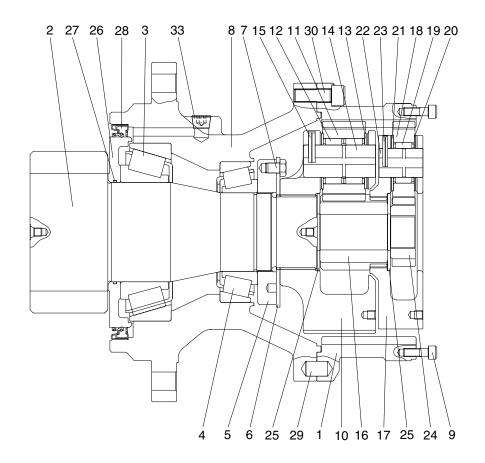
2) INSTALL

- (1) Carry out installation in the reverse order to removal.
 - \cdot Tightening torque : 57.9 \pm 5.8 kgf·m (419 \pm 42 lbf·ft)



3. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



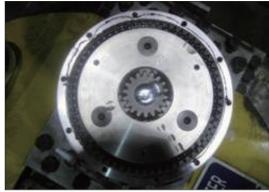
220L2SM03

1 2 3 4 5	Ring gear Drive shaft Taper bearing Taper bearing Ring nut	11 12 13 14 15	Planetary gear 2 Needle bearing 2 Thrust washer 2 Carrier pin 2 Spring pin 2	21 22 23 24 25	Spring pin 1 Sun gear 1 Thrust plate
6 7	Lock plate Hexagon bolt	16 17	Sun gear 2 Carrier 1	26 27	Sleeve O-ring
8	Casing	18	Planetary gear 1	29	Parallel pin
9 10	Socket bolt Carrier 2	19 20	Needle bearing 1 Thrust washer 1	30 33	Socket bolt Plug

2) DISASSEMBLY

(1) Preparation

- 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 disassembling.
- 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.



2209A8SM01

(2) Disassembly

- ① Remove every "Socket bolt (M10)" that secure swing motor and reduction gear.
- ② Removing carrier sub assy & sun gear
 - a. Removing No.1 sun gear from No.1 carrier sub assy.
 - Be sure maintaining it vertical with ground when disassembling No.1 sun gear.



2209A8SM02

- b. Removing No.1 carrier sub assy screwing I-bolt to tab hole (M10) in No.1 carrier.
 Lifting it gradually maintaining it vertical with ground.
- It's impossible to disassemble No.1 spring pin. If No.1 spring pin has problem, change whole No.1 carrier sub assy.



2209A8SM03

- c. Removing No.2 sun gear from No.2 carrier sub assy.
- Be sure maintaining it vertical with ground when disassembling No.2 sun gear.



2209A8SM04

- d. Removing No.2 carrier sub assy screwing I-bolt to tab hole (M10) in No.2 carrier.
 Lifting it gradually maintaining it vertical with ground.
- It's impossible to disassemble No.2 spring pin. If No.2 spring pin has problem, change whole No.2 carrier sub assy.



2209A8SM05

③ Removing ring gear

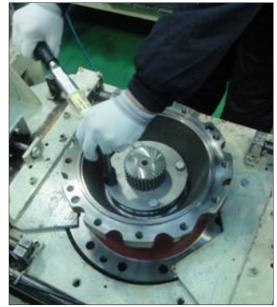
- After unscrewing every socket bolt (M16), remove ring gear from casing.
- Because of liquid gaskets between ring gear and casing, put sharp punch between ring gear and casing and tapping it to remove them.



2209A8SM06

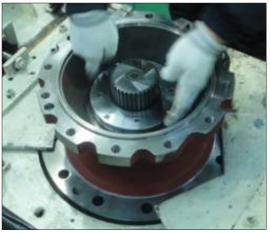
④ Removing drive shaft sub assy

a. Unscrew every hex head bolt (M12) to remove lock plate.



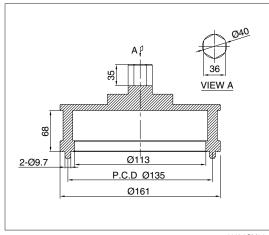
2209A8SM07

b. Rolling ring nut for removing them from drive shaft sub assy.



2209A8SM08

We Use special tool to roll ring nut to counter clockwise.



220L8SM01

- c. Remove drive shaft sub assy from casing.
- Set a rack for flange of casing, and remove drive shaft sub assy from casing by using press.



2209A8SM09

- d. Remove oil seal & taper bearing (small) from casing.
- % Do not re-use oil seal. It is impossible to disassemble drive shaft sub assy.



2209A8SM10



2209A8SM11

4. ASSEMBLY REDUCTION UNIT

1) GENERAL NOTES

- (1) Clean every part by kerosene and dry them in a cool and dry place.
- (2) Loctite on surface must be removed by solvent.
- (3) Check every part for any abnormal.
- (4) Each hexagon socket head bolt should be used with loctite #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 assembling.

Thrust washer

- · Check the seizure, abnormal wear or uneven wear.
- · Check the unallowable wear.

Gear

- · Check the pitting or seizure on tooth surface.
- · Check the cracks on the root of tooth.

Bearing

· Rotate it by hands to check such noise or uneven rotation.

2) ASSEMBLING NO.1 CARRIER SUB ASSY

- (1) Put thrust plate firmly in No.1 carrier.
- (2) After assembling No.1 needle bearing to No.1 planetary gear, put a pair of No.1 thrust washer on both sides of bearing and install them to No.1 carrier.



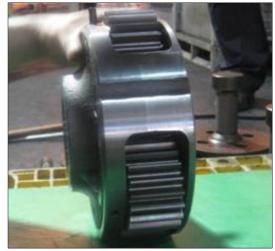
2209A8SM12



2209A8SM13

(3) Make of spring pin hole No.1 pin and No.1 carrier of spring pin hole in line, press No.1 spring pin into the holes.

Make No.1 spring pin hole head for No.1 planetary gear.



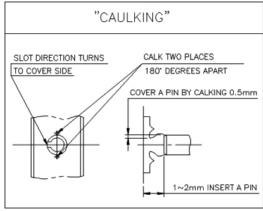
2209A8SM14

(4) Caulk carrier holes to make No.1 spring pin settle down stably.



2209A8SM15

Refer to "Caulking details"Use paint marker for marking after caulking.



2209A8SM16

2) ASSEMBLING NO.2 CARRIER SUB ASSY

(1) Put thrust plate in firmly No.2 carrier.



2209A8SM17

(2) After assembling No.2 needle bearing to No.2 planetary gear, put 2 pieces of No.2 thrust washer on both sides of bearing and install them to No.2 carrier.



2209A8SM18

(3) Align No.2 spring pin hole and No.2 carrier spring pin hole, put No.2 spring pin into the holes.

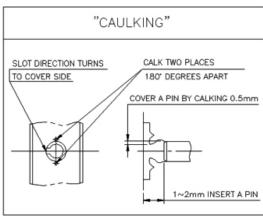
Make No.2 spring pin cutting line face to No.2 planetary gear.



2209A8SM19

- (4) Caulk carrier holes to make No.2 spring pin settle down stably.
- Refer to "Caulking details"

Use paint marker for marking after caulking.



2209A8SM20

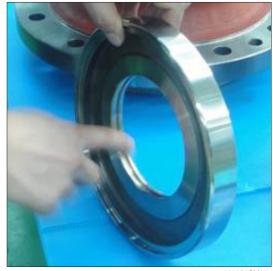
3) ASSEMBLING PINION GEAR SUB ASSY

(1) Prepare drive shaft pinion gear vertical with ground.



2209A8SM21

- (2) Fully apply grease (albania EP02) to O-ring groove of sleeve.
- Be sure to maintain it vertical with ground when assembling it.
- (3) Put O-ring into O-ring groove of sleeve. Fully apply grease on O-ring.



2209A8SM22

(4) Assemble taper bearing and sleeve into drive shaft using press jig. Use special jig for pressing. Leave no space

between sleeve and taper bearing.



2209A8SM23



2209A8SM24

4) ASSEMBLING BEARING CUP & OIL SEAL (PRESSING)

- (1) Put top, bottom bearing cup into casing. Use special jig for pressing. Pay attention to foreign materials while assembling bearing cup.
- * Flip over casing to assemble oil seal.



2209A8SM25



2209A8SM26

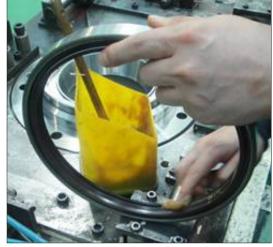
(2) Assemble oil seal to casing. Use special jig for pressing. Pay attention to direction of dust seal and dent.



2209A8SM27

***WHILE ASSEMBLING OIL SEAL**

- 1. Be sure to set dust seal to gear oil.
- 2. Before assembling, charge enough grease in oil seal.
- 3. Before assembling, apply enough grease inside and outside of oil seal.



2209A8SM28

5) ASSEMBLING SHAFT SUB ASSY & RING NUT

(1) After assembling casing & drive shaft sub assy, flip it over.



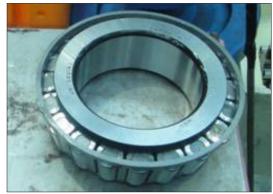
2209A8SM29

- (2) Put drive shaft sub assy into casing.
- Be sure to maintain it vertical with ground when assembling it.



2209A8SM30

(3) Put taper bearing into it. Rotate bearing by hands for checking after assembly.



2209A8SM31

(4) Put ring nut into drive shaft sub assy by using special jig.

The tightening torque (M95) = 3.5 ± 0.4 kgf·m (25.3 ±2.9 lbf·ft)



2209A8SM32

** Apply enough loctite #242 before screwing bolts.



2209A8SM33

(5) Align bolt screw of ring nut with lock plate's hole.

In case of misalign between bolt screw ring nut and lock plate's hole, put lock plate as near as possible to hole of bolt screw of ring nut and make it in line by increasing tightening torque.



2209A8SM34



2209A8SM35

- (6) Screw 4 bolts (M12×16) to connect ring nut and lock plate by using torque wrench. Bolt (M12, 4EA) = 10.9TThe tightening torque = 8.8 ± 0.9 kgf·m $(63.7 \pm 6.5 \, lbf \cdot ft)$
- Apply enough loctite #242 before screwing bolts.



2209A8SM36

(7) Use paint marker for checking surplus parts after assembling.



2209A8SM37

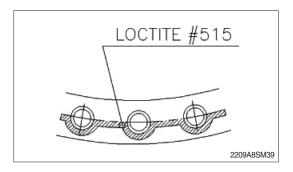
6) ASSEMBLING RING GEAR

(1) Apply loctite #515 bottom of casing sub assy contacting with ring gear without disconnection.



2209A8SM38

Refer to loctite detail.



(2) Put parallel pin into hole of casing sub assy. Mark parallel pin position using paint marker.



2209A8SM40

- (3) Align ring gear with parallel pin to put them into casing sub assy.
- Be sure to maintain them vertical with ground while using press.



2209A8SM41

(4) Screw 12 bolts (M16 \times 45) to connect casing sub assy and ring gear (01) by using torque wrench.

Bolt (M16, 12EA) = 12.9T The tightening torque = 27 ± 2.7 kgf·m (195 \pm 19.5 lbf·ft)

- % Apply enough loctite #242 before screwing bolts.
- (5) Use paint marker for checking surplus parts after assembling.



2209A8SM42



2209A8SM43



2209A8SM44

7) ASSEMBLING CARRIER SUB ASSY & SUN GEAR

- (1) Put No.2 carrier sub assy along spline of drive shaft spline.
- Screw M10 I-bolt to No.2 carrier sub assy.
- Lifting up No.2 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.2 carrier sub assy by hands to fit No.2 carrier sub assy into drive shaft spline.



2209A8SM45

(2) Put No.2 sun gear into No.2 carrier sub assy.



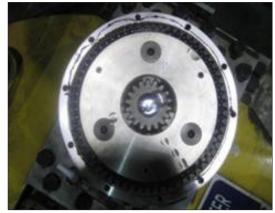
2209A8SM46

- (3) Put No.1 carrier sub assy into No.2 sun gear along spline.
- Screw M10 I-bolt to No.1 carrier sub assy.
- Lifting up No.1 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.1 carrier sub assy by hands to fit No.1 carrier into No.2 sun gear spline.



2209A8SM47

- (4) Put No.1 sun gear into No.1 carrier sub assy. Be sure to maintain it vertical with ground. And align with No.1 planetary gear spline.
- (5) Rotate No.1 carrier sub assy by hands to check noise.



2209A8SM4

8) MEASURING CLEARANCE & ASSEMBLING NAME PLATE

(1) Check the clearance between ring gear and No.1 sun gear using a tool with dial gauge.

Check the clearance Dial gauge = -0.3 ~ +2.95



2209A8SM49

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.

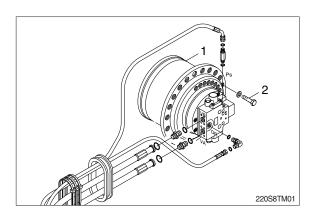
▲ Escaping fluid under pressure can penetrate the skin causing serious injury.

- 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: 305 kg (670 lb)
 - \cdot Tightening torque : 23 \pm 2.5 kgf \cdot m (166 \pm 18.1 lbf \cdot ft)

2) INSTALL

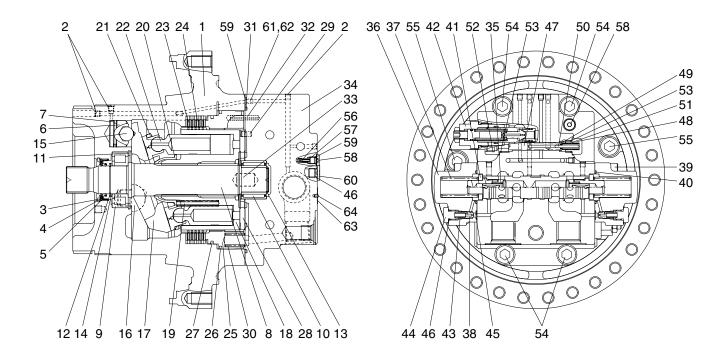
- (1) Carry out installation in the reverse order to removal.
- (2) Bleed the air from the travel motor.
- Remove the air vent plug.
- ② Pour in hydraulic oil until it overflows from the port.
- 3 Tighten plug lightly.
- ④ Start the engine, run at low idling, and check oil come out from plug.
- ⑤ Tighten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





2. TRAVEL MOTOR

1) STRUCTURE



2209A2TM21

1	Casing	23	Friction plate	44	Plug
2	Plug	24	Separated plate	45	O-ring
3	Oil seal	25	Parking piston	46	O-ring
4	Thrust plate	26	D-ring	47	Spool
5	Snap ring	27	D-ring	48	Plug
6	Piston	28	Valve plate	49	Spring seat
7	Piston seal	29	Parallel pin	50	Parallel pin
8	Shaft	30	Spring	51	Spring
9	Cylinder roller bearing	31	O-ring	52	Connector
10	Needle bearing	32	Spring pin	53	O-ring
11	Snap ring	33	Parallel pin	54	Hexagon socket head bolt
12	Snap ring	34	Rear cover	55	Hexagon socket head bolt
13	Snap ring	35	Main spool assy	56	Check valve
14	Thrust plate	36	Cover	57	Spring
15	Steel ball	37	Spring	58	Plug
16	Pivot	38	Restrictor	59	O-ring
17	Swash plate	39	Hexagon socket head bolt	60	Plug
18	Cylinder block	40	O-ring	61	Restrictor
19	Spring	41	Spring seat	62	Restrictor
20	Ball guide	42	Relief valve assy	63	Name plate
21	Retainer plate	43	Spring	64	Rivet
22	Piston assy				

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark			
Hexagon wrench	Width across flat 5, 6, 8, 10, 14 mm			
Snap ring prier	For shaft Ø60~80 mm			
Snap ring prier	For bore Ø32~58 mm			
Plastic hammer	1 piece			
Screw dirver	Minus (-), medium size, 2 pieces			
Torque wrench	10 kgf·m (72.3 lbf·ft), 33 kgf·m (238.6 lbf·ft), 45 kgf·m (325.4 lbf·ft)			
Gig for inserting oil seal	Ø Ø 58			
Gig for inserting parking piston (M10×100 bolt 2EA, M12×100 bolt 1EA)	230 49 8 187 25098TM32			
Gig for pulling out brake piston	30 20 24.5° 24.5° 24.5° 25.5°			

(2) Tightening torque

Item	Name	Size	Torque		
		Size	kgf · m	lbf ⋅ ft	
2	Plug	NPTF 1/16	1.1±0.1	7.9±0.72	
39	Hexagon socket head bolt	M12	1.0±1.0	72.3±7.2	
42	Relief valve	1 5/16	34±3.4	246±24.6	
44	Plug	PF 1/4	2.8±0.3	20.3±2.17	
48	Plug	PF 3/8	5.5±0.5	39.8±3.6	
52	Connector	PF 3/8	5.5±0.5	39.8±3.6	
54	Hexagon socket head bolt	M18	38±3.8	275±27.5	
55	Hexagon socket head bolt	M18	38±3.8	275±27.5	
58	Plug	PF 1/8	1.5±0.1	10.8±0.72	
60	Plug	PF 1/4	3±0.3	21.7±2.17	

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.

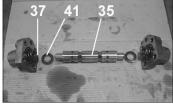
Consult with the parts manual in advance.

- (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.

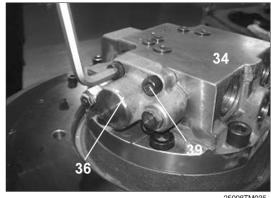
2) DISASSEMBLING TRAVEL MOTOR

(1) Disassemble the wrench bolt (39) to tighten the spool cover (36) and rear cover (34) by using the L-wrench or impact wrench and then disassemble the spring (37), spring seat

(41) and main spool assy (35) in order.



25098TM03



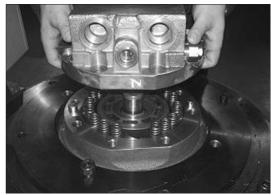
25098TM035

(2) Disassemble the wrench bolt (54, 55) to tighten the casing (1) and rear cover (34) by using the L-wrench or impact wrench.



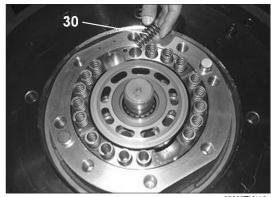
25098TM036

(3) Separate the casing (1) and rear cover (34).



25098TM037

(4) Disassemble the brake spring (30, 18EA) from the piston.

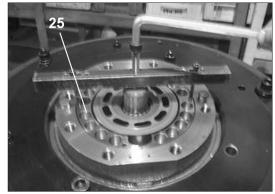


25098TM118

(5) Disassemble the parking piston (25) by using the jig for disassembling parking piston.

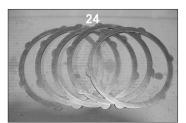


25098TM039



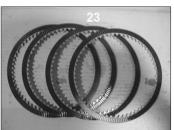
25098TM040

(6) Disassemble the separated plate (24, 5EA) and friction plate (23, 4EA) from the casing.



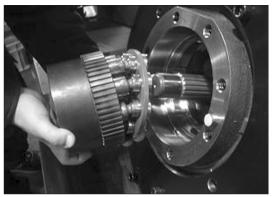


25098TM042





(7) Turn the casing (1) horizontal by using the assemble truck and disassemble the cylinder block kit form the casing (1).



25098TM045

(8) Disassemble the cylinder block (18), retainer plate (21), piston assy (22), ball guide (20) and spring (19) from the cylinder block kit.







25098TM046

25098TM049

25098TM050

(9) Disassemble the swash plate (17) from the casing.

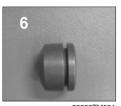


25098TM051



(10) Disassemble the steel ball (15) and swash piston (6) from the casing.

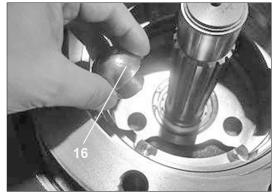






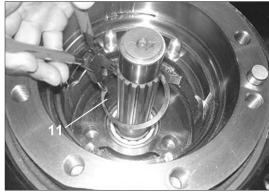
8-88

(11) Disassemble the pivot (16, 2EA) from the casing.



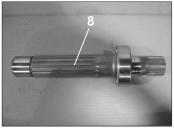
25098TM056

(12) Disassemble the snap ring (11) from the shaft (8) with the pryer for retaining ring.



25098TM057

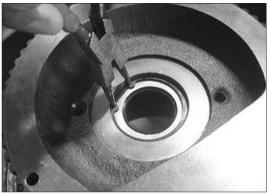
(13) Disassemble the shaft (8) from the casing (1).



25098TM058

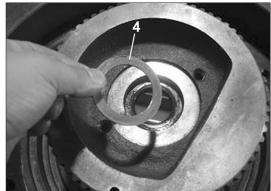
25098TM05

(14) Disassemble the snap ring (5) from the casing (1) with the pryer for retaining ring.



25098TM060

(15) Disassemble the thrust plate (4) from the casing (1).



25098TM061

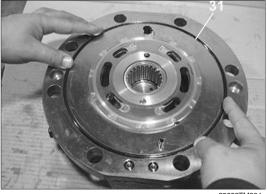
(16) Disassemble the oil seal (3) from the casing (1) with suitable tool.



25098TM062

25098TM063

(17) Disassemble the O-ring (31) from the casing (1).



25098TM064

(18) Disassemble the valve plate (28) from the casing (1).



25098TM065

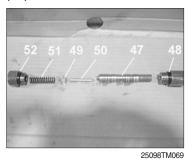
(19) Disassemble the relief valve (42, 2EA) from the rear cover (34) by using the torque wrench.



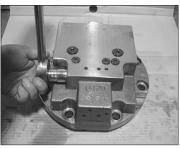




(20) Disassemble both side of the plug (48) and connector (52) from the rear cover (34) by using the torque wrench and then disassemble the spring (51), spring seat (49), parallel pin (50) and spool (47) in order.







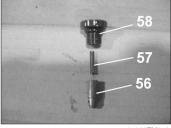
25098TM071

(21) Disassemble the plug (60) from the rear cover.

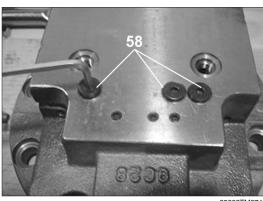


25098TM072

(22) Disassemble the plug (58) and then disassemble the spring (57) and check valve (56) from the rear cover in order.



25098TM073

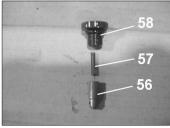


4. REASSEMBLING

1) ASSEMBLING MOTOR

- REAR COVER ASSY

(1) Assemble the check valve (56) and the spring (57) to the rear cover and then tighten the plug (60) by using the L-wrench.

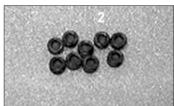


25098TM075



25098TM076

(2) Apply the loctite #242 on the NPTF 1/16 plug (2, 12EA) and tighten it.

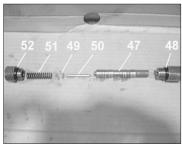


25098TM077



25098TM078

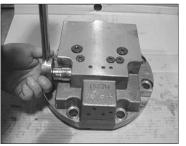
(3) Assemble the spool (47), parallel pin (50), spring seat (49) and spring (51) into the rear cover (34) and tighten both side of the plug (48) and connector (52) into the rear cover (34).



25098TM079



25098TM080



(4) Assemble the relief valve (42, 2EA) into rear cover (34).



25098TM082



25098TM083



25098TM084

(5) Tight fit the needle bearing (10) into rear cover (34) by using pressing jig.



25098TM085

(6) Assemble the spring pin (32) and parallel pin (29) into rear cover (34) by using round bar or small hammer.



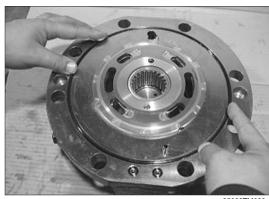
25098TM086

(7) Assemble the valve plate (28) into rear cover (34).Before assembling, apply some grease on contact surface of the valve plate.



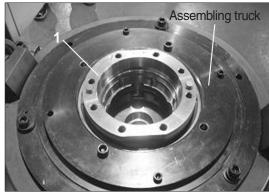
25098TM087

(8) Apply some grease on the O-ring and fit it into groove.



25098TM088

(9) Assemble the casing (1) on the assembling truck.



25098TM089

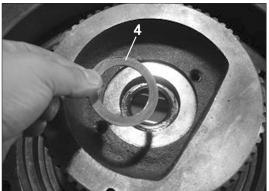
- (10) Tight fit the oil seal (3) into the casing (1) by using jig.
- $\ensuremath{\, \times \,}$ Be careful direction of the oil seal.



25098TM090

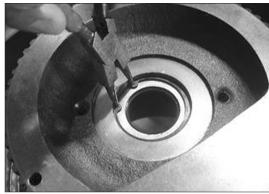
25098TM091

(11) Assemble the thrust plate (4) into the casing (1).



25098TM092

(12) Assemble the snap ring (5) into the casing (1) with the plier for retaining ring.



25098TM093

- (13) Heat the roller bearing (9) and fit it into the shaft with shrink fitting.
 - a. Shrink fitting can be used induction heating system and set the temperature at 100°C.
 - b. Be careful not to damage the sliding surface of the oil seal of the shaft.







(14) Assemble the heat-fitted shaft (8) into casing (1).



25098TM097

(15) Assemble the snap ring (11) into the casing (1) with the plier for retaining ring.



25098TM098

(16) Apply a little grease on the pivot (16, 2EA) and assemble it into the casing (1).



25098TM099

(17) Heat the piston seal (7) and fit it into the swash piston (6) and then tighten it a few minutes by band or tie. Loosen the band or tie and assemble it to the casing (1).

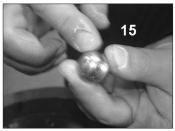


25098TM100

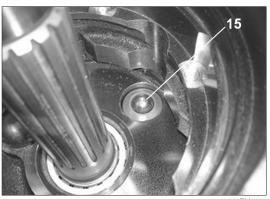


25098TM101

(18) Apply a little grease on the steel ball (15) and assemble it into the swash plate (17).



25098TM102

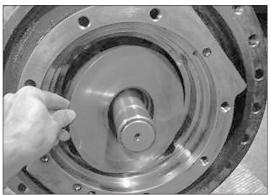


25098TM103

(19) Apply some grease on the steel ball hole of the swash plate (17) and assemble it casing (1).

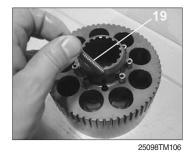


25098TM104



25098TM105

(20) Assemble the spring (19), ball guide (20), retainer plate (21) and piston assy (22) into cylinder block (18) in order.







25098TM108





25098TM110

(21) Tilt the casing (1) sideways and assemble the cylinder block kit into the casing (1).

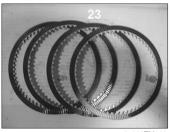


25098TM111

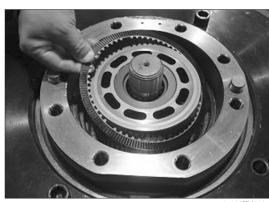
(22) Assemble the separated plate (24) and friction plate (23) into the cylinder block alternately.

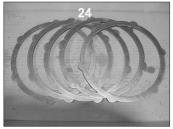
Friction plate: 4EA

Separated plate: 5EA



25098TM112





25098TM114

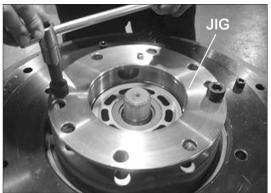


(23) Apply some grease on the D-ring and assemble it parking piston.



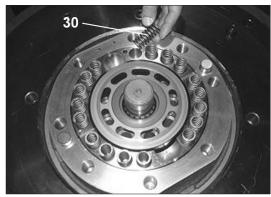
25098TM116

(24) Insert the parking piston into the casing and assemble it by using jig.



25098TM117

(25) Assemble the brake spring (30, 18EA) into the piston.



25098TM118

(26) Place the rear cover (34) on the casing (1).



(27) Tighten the casing (1) and rear cover (34) specified torque with wrench bolt (54, 55) by using the impact wrench and torque wrench.

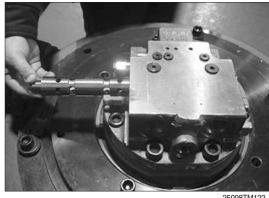


25098TM120

- (28) Confirm the insert direction of the main spool assy (35) exactly and assemble it into the rear cover (34).
- * Assure that four balance hole is directed VA port.

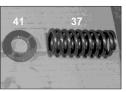


25098TM121



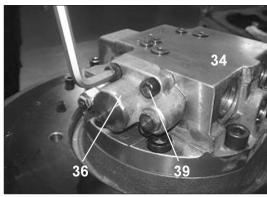
25098TM122

(29) Assemble the spring seat (41), spring (37) and main spool cover (36) into valve plate and tighten the wrench bolt (39, M12x35) by using L-wrench or impact wrench.



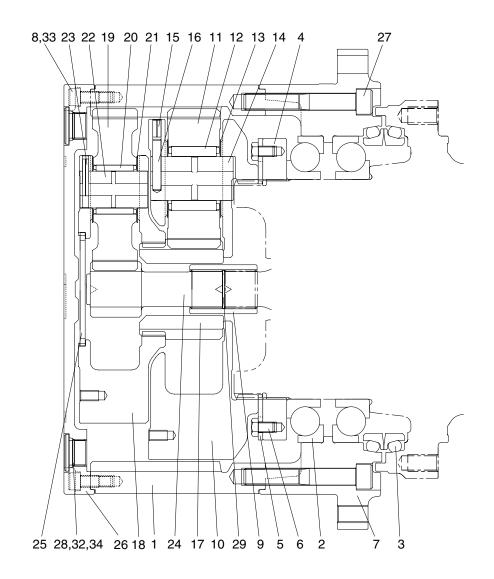
25098TM123





25098TM125

2) TRAVEL REDUCTION GEAR



220S8TM02

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

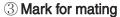
Consult with the parts manual in advance.

▲ 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.



Put marks on each mating parts when disassembling so as to reassemble correctly as before.



(2) Setting reduction unit (or whole propelling unit) on work stand for disassembling

- 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 the rest of 7/16-14UNC hexagon socket head bolts that secure cover and ring gear. Loosen all the socket bolts and then, disassemble cover.
- ② As the cover is adhered to ring gear, disassemble ring gear and cover by lightly hammering slantwise upward using sharpen punch inserted between the cover and ring gear.



(4) Removing No.1 carrier sub assembly

① Screw three M10 eye-bolt in No.1 carrier and lift up and remove No.1 carrier assy.



25098TM129

- ② Remove No.1 sun gear.
- Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.



25098TM130

(5) Removing No.2 carrier sub assembly

① Screw three M10 eye-bolt in No.2 carrier and lift up and remove No.2 carrier assy.



25098TM131

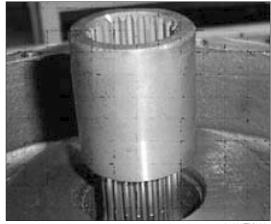
- ② Remove No.2 sun gear.
- Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.



25098TM132

(6) Removing coupling

① Remove coupling.



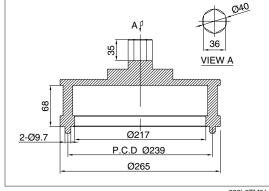
25098TM133

(7) Removing ring nut & lock plate

- ① Remove M12 hexagon head bolts that secure ring nut and lock plate.
- ② Remove lock plate.



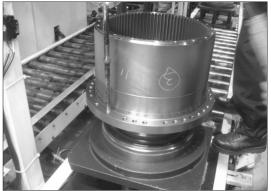
- ③ Remove ring nut from motor casing.
- * Remove the ring nut by using the special tool for removing the ring nut.



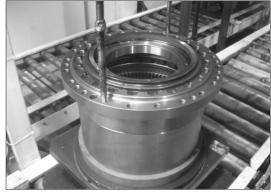
220L8TM01

(8) Removing housing sub assembly & ring gear

① Screw 7/16-14UNC eye bolt in housing and lift up ring gear and housing assembly including anguler bearing and floating seal.

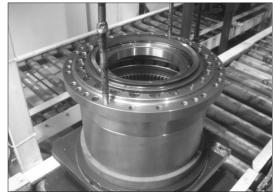


② Setting reduction unit on work stand for disassembling. Remove M16 hexagon socket head bolts that secure ring gear and housing assembly.



25098TM136

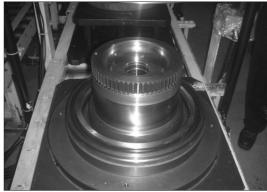
③ As the ring gear is adhered to housing assy, disassemble housing assy and ring gear by lightly hammering slantwise upward using sharpen punch inserted between the housing assy and ring gear.



25098TM137

(9) Removing floating seal

① Lift up a piece of floating seal of motor side.



25098TM138

(10) Removing housing sub assembly

- ① Setting housing assembly on work stand for disassembling.
- ② After setting housing, lift up a piece of floating seal from housing and then remove it.
- » Don't disassemble angular bearing.



25098TM139

(11) Disassembling No.1 carrier

① Remove thrust plate.



25098TM140

② Knock spring pin fully into No.1 pin.



25098TM141

③ Remove planetary, thrust washer, No.1 pin, bearing from carrier.



25098TM142

(12) Disassembling No.2 carrier

- ① Knock spring pin fully into No.2 pin.
- ② Remove No.2 solid pin.
- ③ Remove planetary, thrust washer, No.2 pin, bearing from carrier.



25098TM143

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 ASSY

- (1) Put No.1 carrier on a flat place.
- (2) Install No.1 needle bearing into No.1 planetary gear, put 2EA of No.1 thrust washer on both sides of planetary gear, and then, install it into carrier.



25098TM144

(3) Install No.1 pin into No.1 carrier where the holes for No.1 pin are to be in line with those of No.1 carrier, and then, install spring pins into the holes.



25098TM145

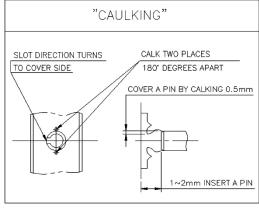
(4) Caulk carrier holes as shown on the picture.



25098TM146

3) ASSEMBLING CARRIER 2 ASSY

- (1) Put No.2 carrier on a flat place.
- (2) Install No.2 needle bearing into No.2 planetary gear, put 2EA of No.2 thrust washer on both sides of planetary gear, and then, install it into carrier.



25098TM147

- (3) After install solid pin into the holes, install No.2 pin into No.1 carrier where the holes for No.1 pin are to be in line with those of No.1 carrier, and then, install spring pins into the holes.
- (4) Caulk carrier holes as shown on the picture.



25098TM148

4) ASSEMBLING FLOATING SEAL

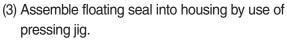
- (1) Assemble floating seal into motor by use of pressing jig.
 - Grease the contact parts for floating seal which is assembled into motor.
- * Be sure to maintain it vertical with the ground when assembling bearing and floating seal.



25098TM149

5) ASSEMBLING HOUSING

- (1) Heat housing at 60~70°C while clearing it out and then, assemble floating seal into housing by use of pressing jig.
- (2) Setting housing assembly on work stand for assembling.
 - Assemble angular bearing into housing by use of pressing jig.



Do not reuse the disassembling O-ring. Grease the contact parts for floating seal which is assembled into housing.

* Be sure to maintain it vertical with the ground when assembling bearing and floating seal.



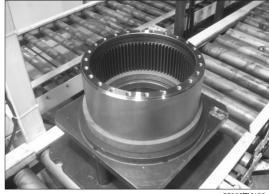


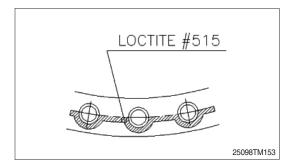
25098TM151

6) ASSEMBLING HOUSING ASSY AND RING **GEAR**

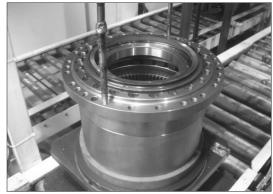
(1) Setting ring gear on work stand for assembling.

Apply loctite #515 on ring gear for housing without gap.





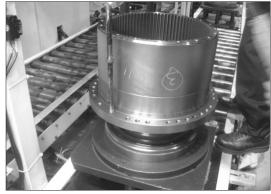
- (2) Install M16 eye-bolt on the tap of housing.
- (3) Lift housing and then, assemble into housing in order for bolt hole of ring gear and bolt hole of housing to be in line.
- (4) Apply loctite #242 on M16 hexagon socket head bolt, and then, bolt.



25008TM15/

7) ASSEMBLING HOUSING ASSY AND MOTOR

- (1) Install 7/16-14UNC eye-bolt on the tap of ring gear.
- (2) Assemble housing assembly into motor by use of hoist and eye-bolt.
- Be sure to tighten eye-bolt deep enough.



25098TM155

8) ASSEMBLING MAIN BEARING

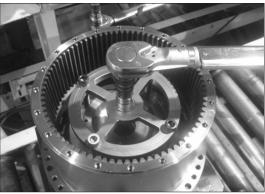
- (1) Assemble angular bearing into housing by use of pressing jig.
- Be sure to maintain it vertical with the ground when assembling bearing.



25098TM156

9) ASSEMBLING NUT RING AND LOCK PLATE

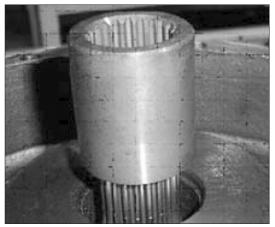
- (1) Tighten nut ring to specified torque, utilizing special tool.
 - · Tightening torque : 60.3 kgf·m (436 lbf·ft)
- (2) After install lock plate, apply loctite #242 on M12 hexagon head bolt, and then, bolt. Tighten M12 hexagon head bolt to specified torque, with torque wrench.



25098TM157

10) ASSEMBLING COUPLING

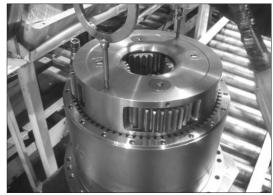
(1) Install coupling on spline of the motor.



25098TM158

11)ASSEMBLING NO.2 CARRIER SUB ASSEMBLY

- (1) Install M10 eye-bolt on No.2 carrier assembly.
- (2) Lift No.2 carrier assembly and then, slowly put it down on ring gear.
- (3) Rotate planetary gear by hands and install on ring gear.
- (4) Rotate No.2 carrier assembly by hands and install on motor.
- Match pin hole of No.2 carrier with main (A, B) port of motor.



25098TM159

12) ASSEMBLING NO.2 SUN GEAR

(1) Install No.2 sun gear on the No.2 planetary gear, matching teeth of them.



25098TM160

13) ASSEMBLING NO.1 CARRIER SUB ASSEMBLY

- (1) Install M10 eye-bolt on No.1 carrier assembly.
- (2) Lift No.1 carrier assembly and then, slowly put it down on ring gear.
- (3) Rotate planetary gear by hands and install on ring gear.
- (4) Rotate No.1 carrier assembly by hands and install on No.2 sun gear.



25098TM16

14) ASSEMBLING NO.1 SUN GEAR

- (1) Put down No.1 sun gear on No.1 carrier, maintaining it vertical with spline of coupling.
- (2) Install No.1 sun gear on No.1 planetary gear, matching their teeth.



15) ASSEMBLING THRUST PLATE

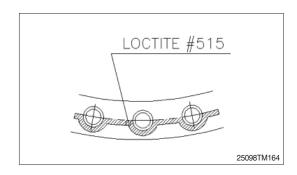
- (1) Assembly thrust plate into No.1 carrier.
- * Edge of thrust plate direction turns to cover side.



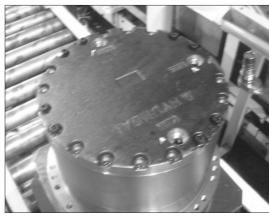
25098TM163

16) ASSEMBLING COVER

(1) Apply loctite #515 on the ring gear for cover without gap.



- (2) Put cover on ring gear, apply loctite #242 on 7/16-14UNC hexagon socket head bolt, and then, bolt.
 - Tighten 7/16-14UNC hexagon socket head bolt to specified torque, with torque wrench.
- (3) Fill gear oil (6 liter) into drain port.
- (4) Apply gear oil on PF3/4 hydraulic plug and then, bolt.



GROUP 7 RCV LEVER

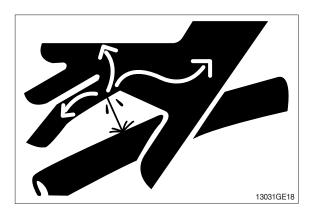
1. REMOVAL AND INSTALL

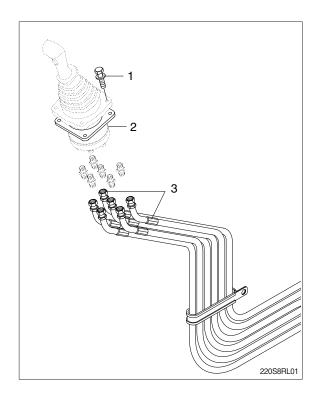
1) REMOVAL

- (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). Tightening torque : 1.05 \pm 0.2 kgf \cdot m (7.6 \pm 1.45 lbf \cdot ft)
- (5) Remove the cover of the console box.
- (6) Disconnect pilot line hoses (3).
- (7) Remove the pilot valve assembly (2).
- When removing the pilot valve assembly, check that all the hoses have been disconnected.

2) INSTALL

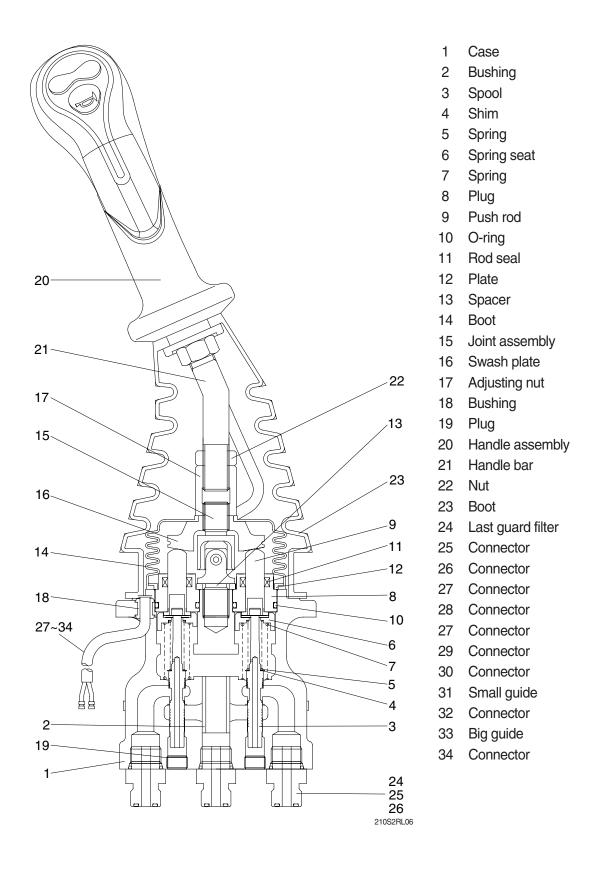
- Carry out installation in the reverse order to removal.
- (2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.





2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



2) TOOLS AND TIGHTENING TORQUE

(1) Tools

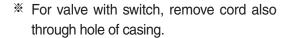
Tool name	Remark			
Allen wrench	6 <u>B</u>			
Channe	22			
Spanne	27			
(+) Driver	Length 150			
(-) Driver	Width 4~5			
Torque wrench	Capable of tightening with the specified torques			

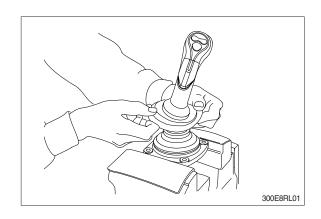
(2) Tightening torque

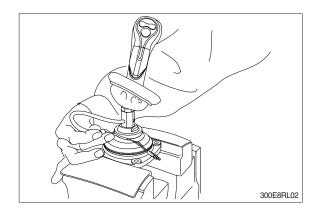
Part name	Item	Size	Torque		
			kgf · m	lbf ⋅ ft	
Joint	15	M14	3.5	25.3	
Swash plate	16	M14	5.0±0.35	36.2±2.5	
Adjusting nut	17	M14	5.0±0.35	36.2±2.5	
Lock nut	22	M14	5.0±0.35	36.2±2.5	

3) DISASSEMBLY

- * Procedures are based on the type M1.
- (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.



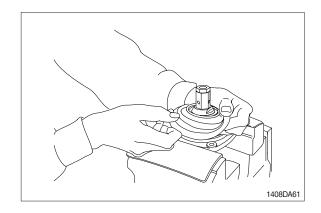




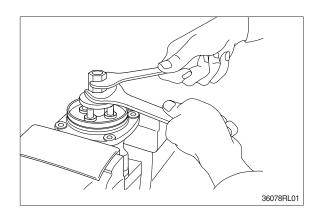
(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.

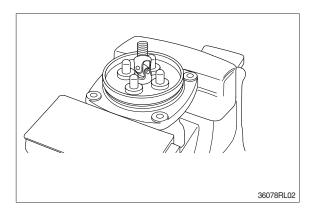


(5) Remove the boot (14).

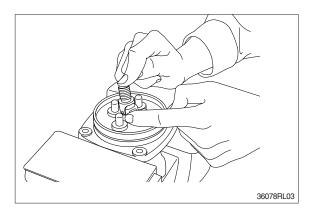


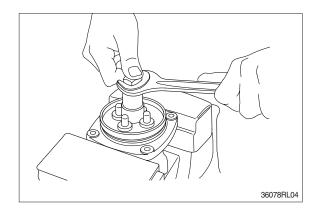
(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.



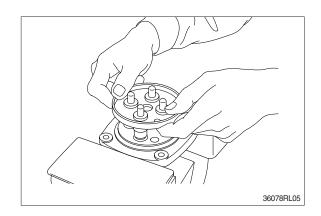


- (7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).
- When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint. Pay attention to this.

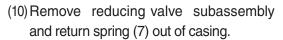




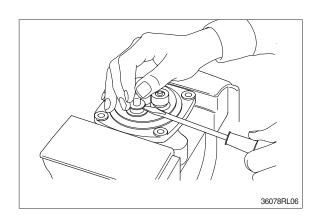
(8) Remove plate (12).

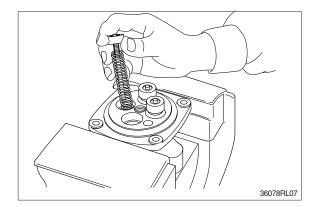


- (9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.
- * Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.
- During taking out, plug may jump up due to return spring (7) force.
 Pay attention to this.

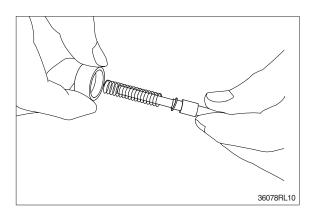


** Record relative position of reducing valve subassembly and return springs.

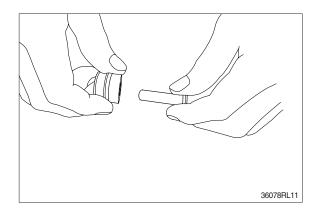




- (11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.
- Pay attention not to damage spool surface.
- * Record original position of spring seat (6).
- W Until being assembled, they should be handled as one subassembly group.

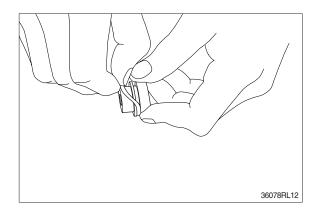


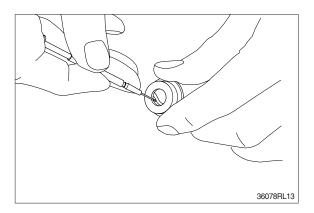
(12) Take push rod (9) out of plug (8).



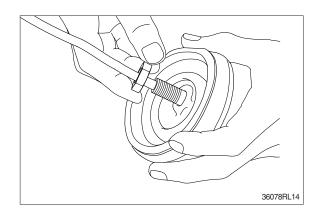
(13) Remove O-ring (10) and seal (11) from plug (8).

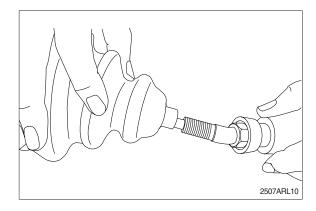
Use small minus screwdriver or so on to remove this seal.





(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.

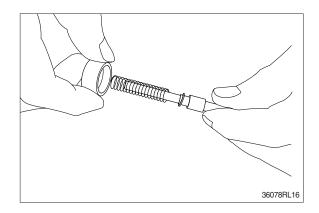
(16) Rust prevention of parts

Apply rust-preventives to all parts.

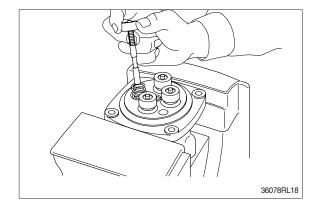
If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

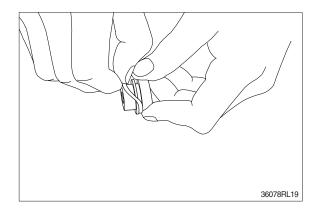
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



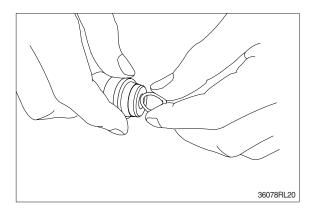
- (2) Assemble spring (7) into casing (1).
 Assemble reducing valve subassembly into casing.
- * Assemble them to their original positions.



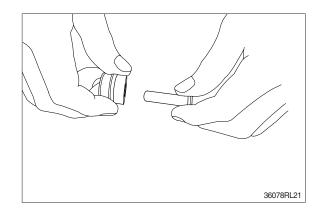
(3) Assemble O-ring (10) onto plug (8).



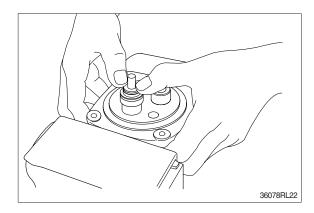
- (4) Assemble seal (11) to plug (8).
- Assemble seal in such lip direction as shown below.



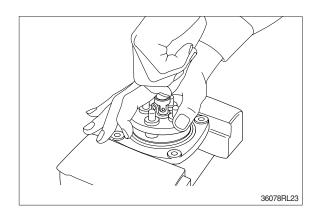
- (5) Assemble push rod (9) to plug (8).
- * Apply working oil on push-rod surface.



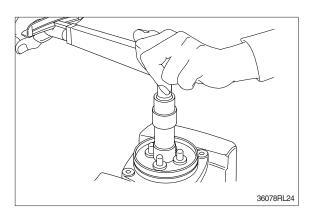
- (6) Assemble plug subassembly to casing.
- When return spring is weak in force, subassembly stops due to resistance of O-ring.



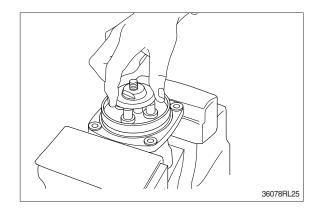
(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.



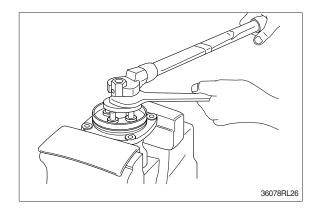
- (8) Fit plate (12).
- (9) Tighten joint (15) with the specified torque to casing, utilizing jig.



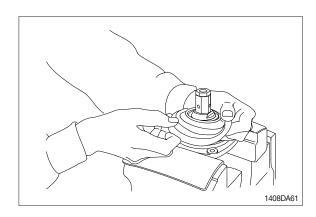
- (10) Assemble swash plate (16) to joint (15).
- Screw it to position that it contacts with 4 push rods evenly.
- Do not screw it over.



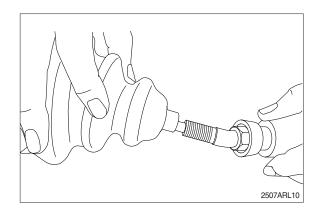
- (11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.
- During tightening, do not change position of disk.

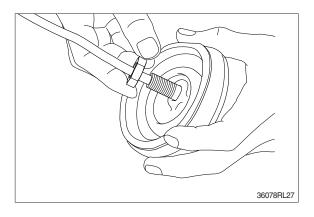


(12) Fit boot (14) to plate.

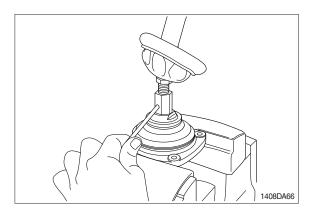


(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.

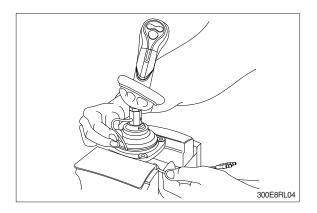




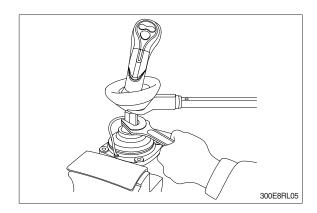
(14) Pull out cord and tube through adjusting nut hole provided in direction 60 $^{\circ}$ to 120 $^{\circ}$ from casing hole.



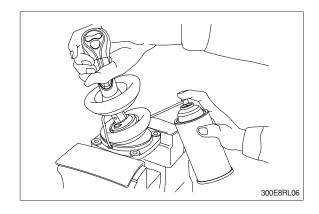
- (15) Assemble bushing (18) to plate and pass cord and tube through it.
- Provide margin necessary to operation.



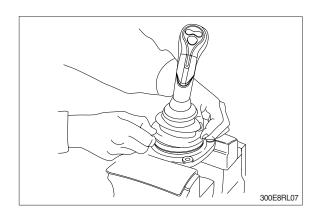
(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



(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

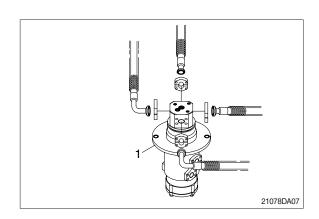
1) REMOVAL

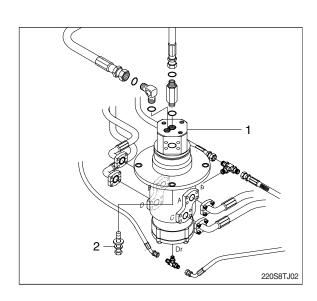
- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Disconnect all hoses.
- (5) Sling the turning joint assembly (1) and remove the mounting bolt (2).
 - · Weight: 57 kg (125 lb)
 - \cdot Tightening torque : 12.3 \pm 1.3 kgf \cdot m (90.0 \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.

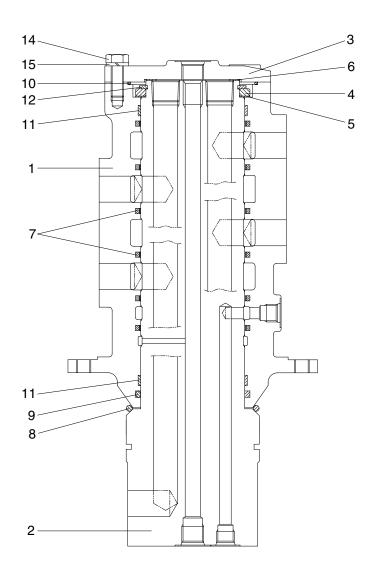






2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



21098TJ01

2	Shaft
3	Cover
4	Spacer

Hub

4 Spacer 5 Shim 6 Shim7 Slipper seal8 O-ring9 O-ring10 O-ring

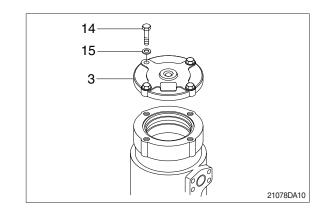
12 Retainer ring13 Plug14 Hexagon bolt15 Spring washer

Wear ring

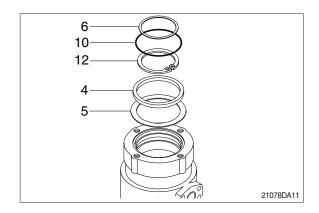
11

2) DISASSEMBLY

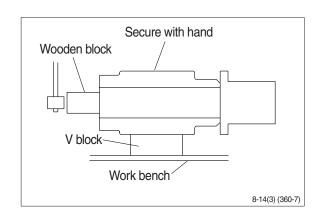
- Before the disassembly, clean the turning joint.
- (1) Remove bolts (14), washer (15) and cover (3).



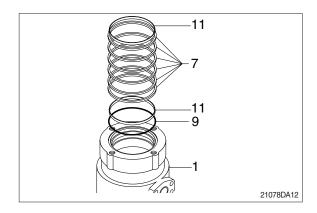
- (2) Remove shim (6) and O-ring (10).
- (3) Remove retainer ring (12), spacer (4) and shim (5).



- (4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft(2) to about 1/2 from the body with a hammer.
- * Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.
- Put a fitting mark on hub (1) and shaft (2).

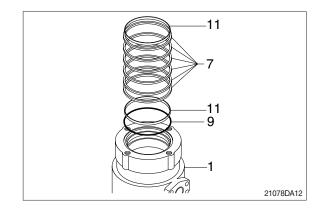


(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).

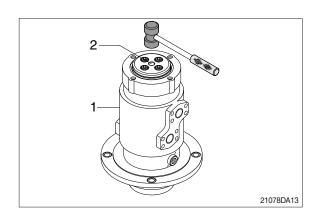


3) ASSEMBLY

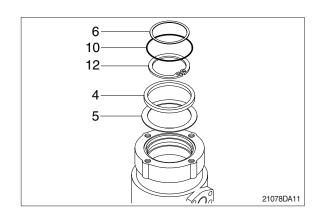
- Clean all parts.
- As a general rule, replace oil seals and O-ring.
- Coat the sliding surfaces of all parts with engine oil or grease before installing.
- (1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).
- (2) Fit O-ring (8) to shaft (2).



(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

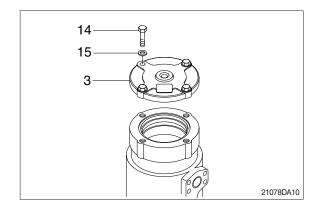


- (4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).
- (5) Fit O-ring (10) to hub (1).
- (6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

 \cdot Torque : 10~12.5 kgf \cdot m $(72.3{\sim}90.4 \text{ lbf} \cdot \text{ft})$



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

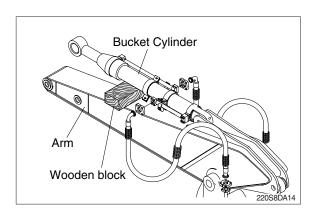
1. REMOVAL AND INSTALL

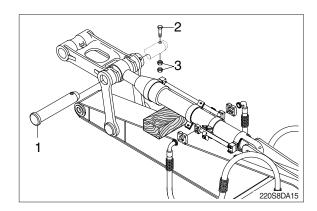
1) BUCKET CYLINDER

(1) Removal

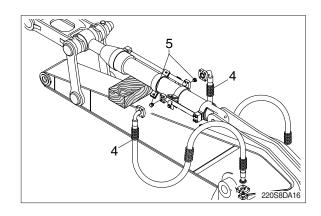
- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- Mean of the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ♠ Escaping 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.



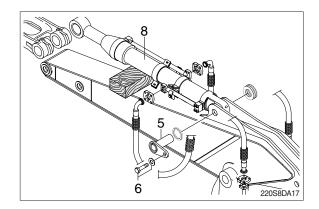




③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



- ④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).
- Remove bucket cylinder assembly (8). Weight: 175 kg (390 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.

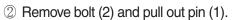
2) ARM CYLINDER

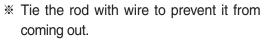
(1) Removal

- 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.

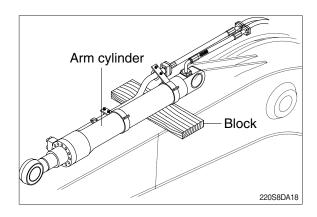
▲ Escaping fluid under pressure can penetrate the skin causing serious injury.

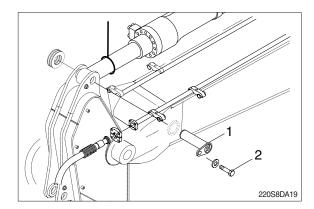
- Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Set block between arm cylinder and boom.



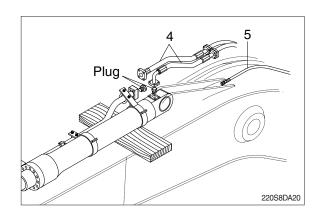




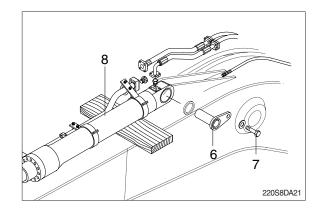




- ③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.
- 4 Disconnect greasing pipings (5).



- ⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).
- Remove arm cylinder assembly (8). Weight: 290 kg (640 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

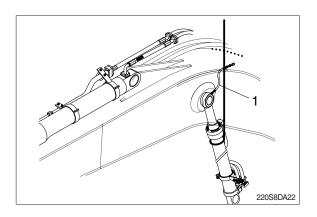
- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- Mean of the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- Loosen the breather slowly to release the pressure inside the hydraulic tank.

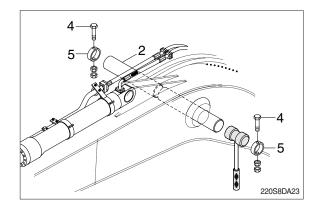
♠ Escaping fluid under pressure can penetrate the skin causing serious injury.

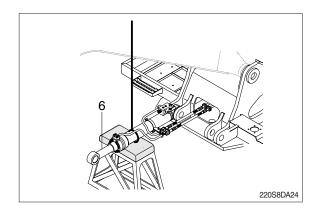
- Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Disconnect greasing hoses (1).
- ② Sling boom cylinder assembly.
- ③ Remove bolt (4), stopper (5) and pull out pin (2).
- Tie the rod with wire to prevent it from coming out.

4 Lower the boom cylinder assembly (6) on a stand.

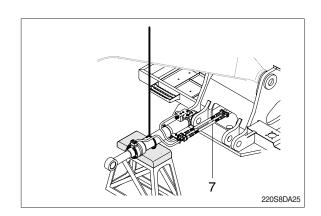




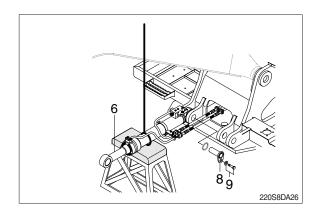




⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



- 6 Remove bolt (9) and pull out pin (8).
- ? Remove boom cylinder assembly (6).
 - · Weight: 198 kg (436 lb)



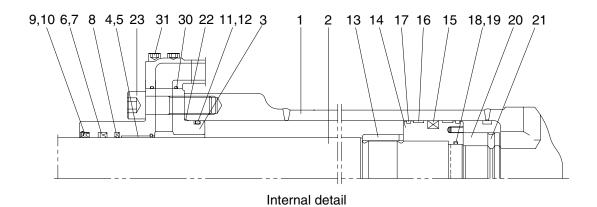
(2) Install

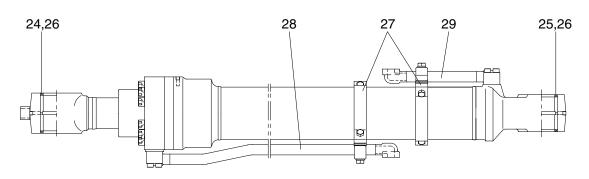
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- * Bleed the air from the boom cylinder.
- Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

- (1) Bucket cylinder
- ① Standard

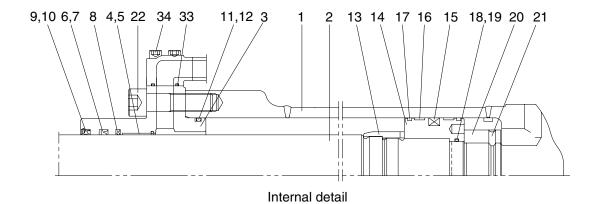


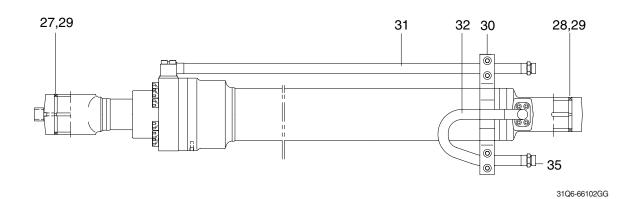


21098CY01

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	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

② Long reach



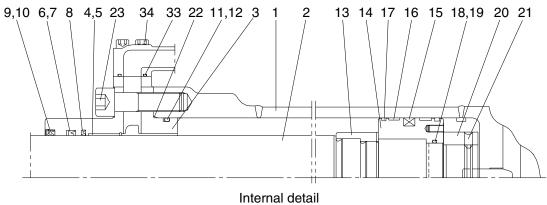


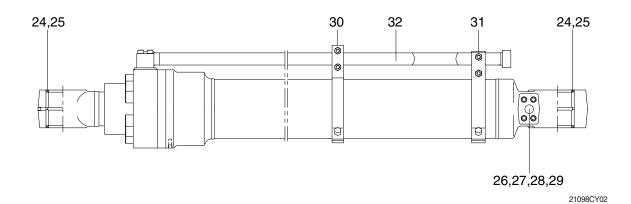
1	Tube assembly	12	Back up ring	27	Pin bushing
2	Rod assembly	13	Cushion ring	28	Pin bushing
3	Gland	14	Piston	29	Dust seal
4	DD2 bushing	15	Piston seal	30	Band assembly
5	Snap ring	16	Wear ring	31	Pipe assembly-R
6	Rod seal	17	Dust ring	32	Pipe assembly-B
7	Back up ring	18	O-ring	33	O-ring
8	Buffer 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

12 Back up ring

① Without safety valve

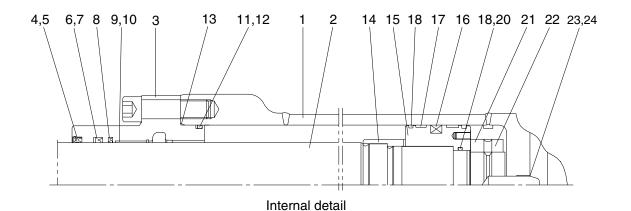


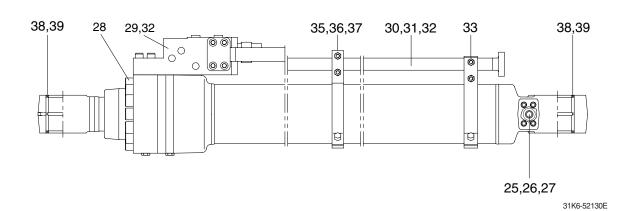


1	Tube assembly	13	Cushion ring	25	Dust seal
2	Rod assembly	14	Piston	26	Check valve
3	Gland	15	Piston seal	27	Coil spring
4	DD2 bushing	16	Wear ring	28	O-ring
5	Snap ring	17	Dust ring	29	Plug
6	Rod seal	18	O-ring	30	Band assembly-R
7	Back up ring	19	Back up ring	31	Band assembly-B
8	Buffer ring	20	Lock nut	32	Pipe assembly-R
9	Dust wiper	21	Hexagon socket set screw	33	O-ring
10	Snap ring	22	O-ring	34	Hexagon socket head bolt
11	O-ring	23	Hexagon socket head bolt		

24 Pin bushing

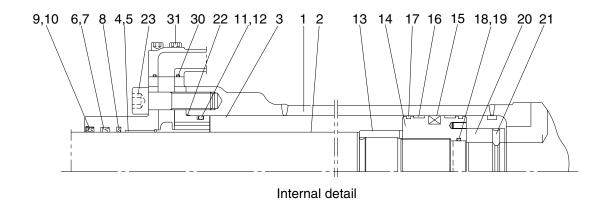
② With safety valve

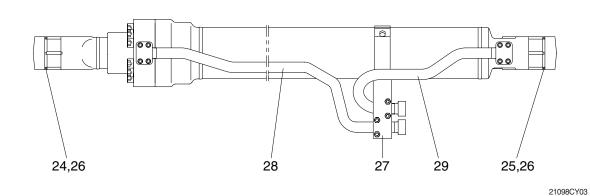




1	Tube assembly	14	Cushion ring	27	Plug
2	Rod assembly	15	Piston	28	Hexagon socket head bolt
3	Gland	16	Piston seal	29	Safety lock valve
4	Dust wiper	17	Wear ring	30	Pipe assembly-RV
5	Retaining ring	18	Dust ring	31	O-ring
6	Rod seal	19	O-ring	32	Hexagon socket head bolt
7	Back up ring	20	Back up ring	33	Band assembly-B
8	Buffer ring	21	Lock nut	34	Band assembly-R
9	Dry bearing	22	Hexagon socket set screw	35	U-bolt
10	Retaining ring	23	Cushion spear	36	Hexagon nut
11	O-ring	24	Stop ring	37	Spring washer
12	Back up ring	25	Check valve	38	Pin bushing
13	O-ring	26	Coil spring	39	Dust seal

(3) Boom cylinder





1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tools	Remark			
	4			
Allen wrongh	5 B			
Allen wrench	8			
	10			
	14			
Coopper	7			
Spanner	8			
(-) Driver	Small and large sizes			
Torque wrench	Capable of tightening with the specified torques			

(2) Tightening torque

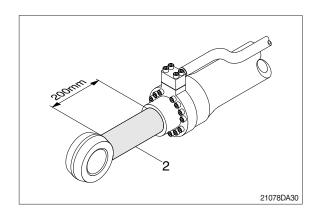
Part name		Item	Cina	Torque	
r	Size		kgf · m	lbf · ft	
	Pugkat gylindar	★ 1 ₂₃	M16	23±2.0	166±14.5
	Bucket cylinder	31	M10	5.4±0.5	39.1±3.6
Socket head bolt	Boom cylinder	★ 1 ₂₃	M16	23±2.0	166±14.5
Socket flead boil	Bootii Cyllindei	31	M10	5.4±0.5	39.1±3.6
	Arm outlindor	★ 1 ₂₃	M18	32±3.0	232±21.7
	Arm cylinder	34	M12	9.4±1.0	68±7.2
	Bucket cylinder	20	-	100±10	723±72.3
Lock nut	Boom cylinder	20	-	100±10	723±72.3
	Arm cylinder	20	-	150±15	1085±108
	Bucket cylinder	14	-	150±15	1085±108
Piston	Boom cylinder	14	-	150±15	1085±108
	Arm cylinder	14	-	200±20	1447±145
	Bucket cylinder	21	M8	2.7±0.3	19.5±2.2
Socket set screw	Boom cylinder	21	M8	2.7±0.3	19.5±2.2
	Arm cylinder	21	M10	5.4±0.5	39.1±3.6

^{★1:} Apply loctite #243 on the thread of bolt.

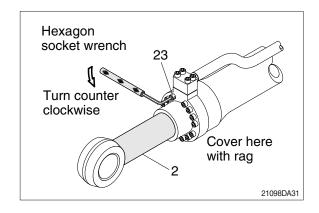
3) DISASSEMBLY

(1) Remove cylinder head and piston rod

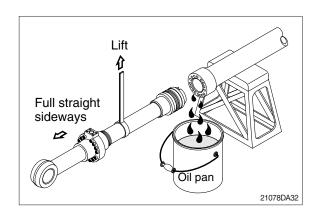
- Procedures are based on the bucket cylinder.
- ① Hold the clevis section of the tube in a vise.
- We use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.
- ② Pull out rod assembly (2) about 200 mm (7.1 in). Because 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.

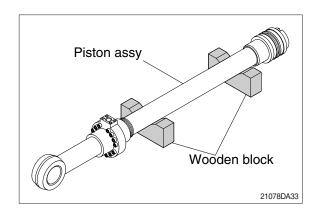


- ① Draw out cylinder head and rod assembly together from tube assembly (1).
- Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



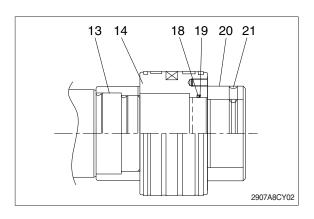
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

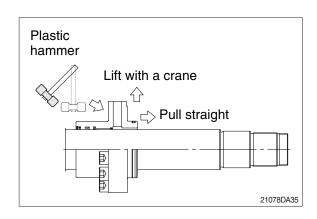
- ⑤ Place the removed rod assembly on a wooden V-block that is set level.
- Cover a V-block with soft rag.



(2) Remove piston and cylinder head

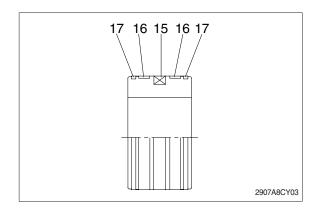
- ① Remove set screw (21).
- ② Remove lock nut (20).
- Since piston (14) and lock nut (20) are tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the piston (14) and lock nut (20).
- ③ Remove piston assembly (14), back up ring (19), and O-ring (18).
- 4 Remove cushion ring (13).
- (5) 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).





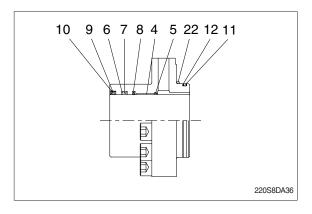
(3) Disassemble the piston assembly

- 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

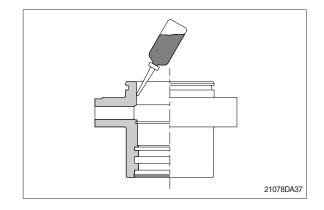
- ① Remove back up ring (12), O-ring (11) and O-ring (22).
- ② Remove snap ring (10), dust wiper (9).
- ③ Remove back up ring (7), rod seal (6) and buffer ring (8).
- Exercise care in this operation not to damage the grooves.
- Do not remove seal and ring, if does not damaged.
- Do not remove bushing (4).



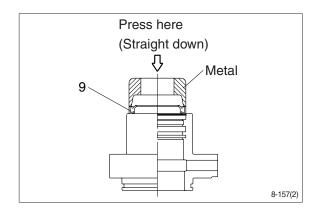
3) ASSEMBLY

(1) Assemble cylinder head assembly

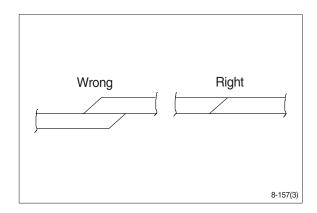
- * Check for scratches or rough surfaces if found smooth with an oil stone.
- ① Coat the inner face of gland (3) with hydraulic oil.



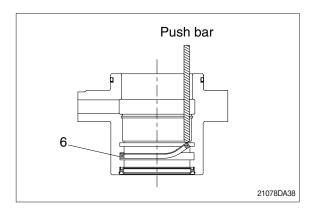
- ② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
 - At this time, press a pad metal to the metal ring of dust seal.
- ③ Fit snap ring (10) to the stop face.



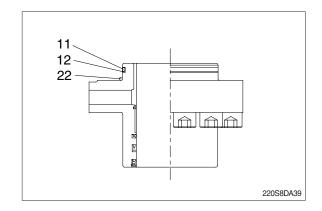
- Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.
- * Coat each packing with hydraulic oil before fitting it.
- Insert the backup ring until one side of it is inserted into groove.



- ** 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.

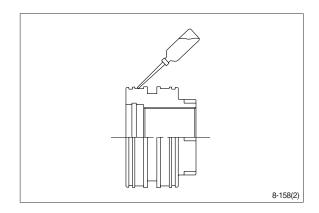


- ⑤ Fit back up ring (12) to gland (3).
- Put the backup ring in the warm water of 30~50°C.
- ⑥ Fit O-ring (11) and O-ring (22) to gland (3).

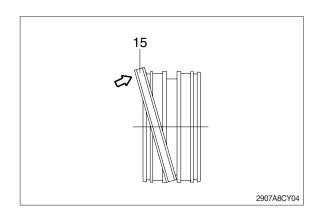


(2) Assemble piston assembly

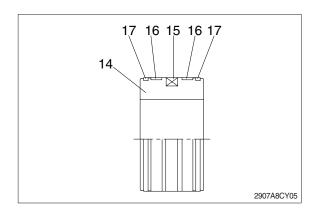
- * Check for scratches or rough surfaces.
 If found smooth with an oil stone.
- ① Coat the outer face of piston (14) with hydraulic oil.



- ② Fit piston seal (15) to piston.
- № Put the piston seal in the warm water of 60~100°C for more than 5 minutes.
- * After assembling the piston seal, press its outer diameter to fit in.

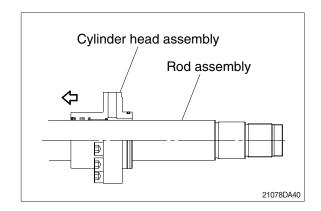


3 Fit wear ring (16) and dust ring (17) to piston (14).

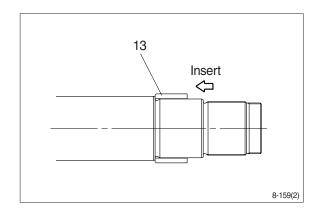


(3) Install piston and cylinder head

- ① Fix the rod assembly to the work bench.
- ② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
- ③ Insert cylinder head assembly to rod assembly.



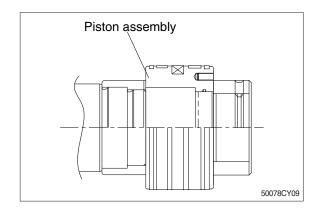
- ④ Insert cushion ring (13) to rod assembly.
- Note that cushion ring (13) has a direction in which it should be fitted.



 $\ensuremath{\mbox{\Large \sc 5}}$ Fit piston assembly to rod assembly.

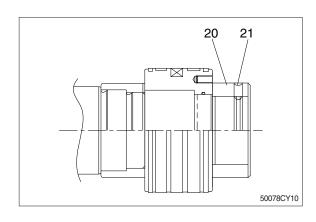
· Tightening torque :

Item		kgf · m	lbf · ft
	Bucket	150±15	1085 ± 108
14	Boom	150±15	1085 \pm 108
	Arm	200±20	1447±145



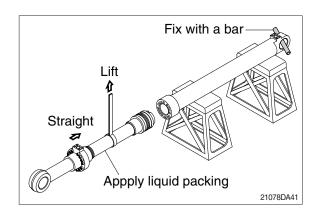
- ⑥ Fit lock nut (20) and tighten the screw (21).
 - · Tightening torque:

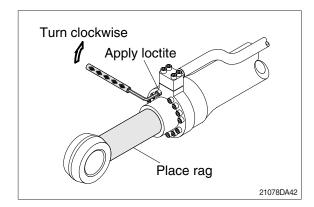
Item		kgf · m	lbf · ft	
	Bucket	100±10	723±72.3	
20	Boom	100±10	723±72.3	
	Arm	150±15	1085±108	
	Bucket	2.7±0.3	19.6±2.2	
21	Boom	2.7 ± 0.3	19.5±2.2	
	Arm	5.4±0.5	39.1±3.6	



(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

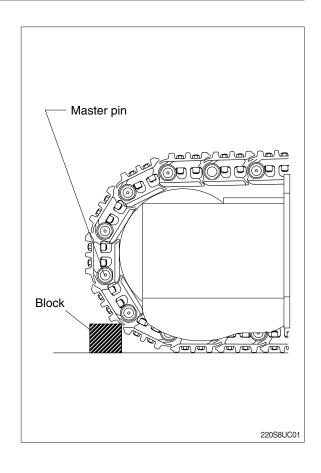
1. TRACK LINK

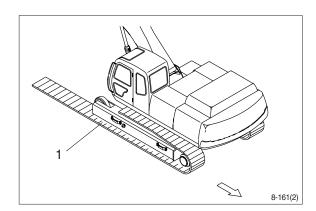
1) REMOVAL

- (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.

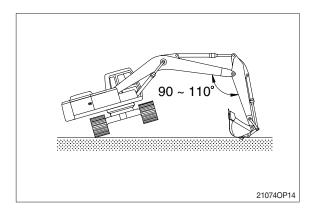
- (4) Move the machine slowly in reverse, and lay out track link assembly (1).
- ¾ Jack up the machine and put wooden block under the machine.
- Don't get close to the sprocket side as the track shoe plate may fall down on your feet.





2) INSTALL

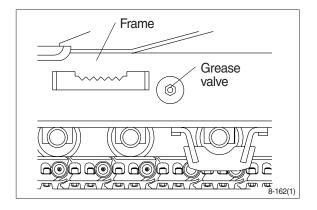
- (1) Carry out installation in the reverse order to removal.
- Adjust the tension of the track link.



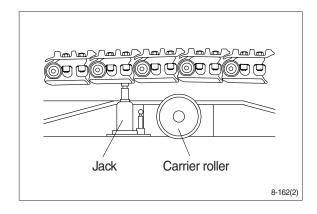
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



(2) Jack up the track link height enough to permit carrier roller removal.

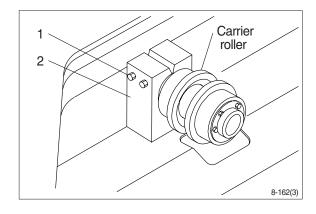


- (3) Loosen the lock nut (1).
- (4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight: 21 kg (46 lb)

· Tightening torque : 29.7 ± 4.5 kgf·m

(215 \pm 32.5 lbf \cdot ft)



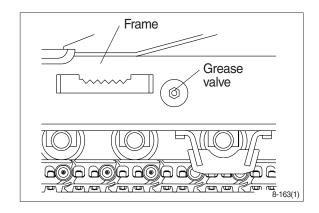
2) INSTALL

(1) Carry out installation in the reverse order to removal.

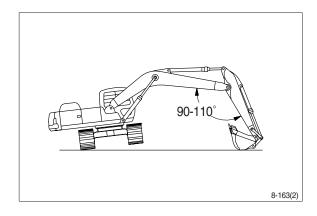
3. TRACK ROLLER

1) REMOVAL

(1) Loosen tension of the track link.

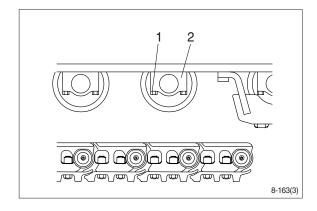


- (2) Using the work equipment, push up track frame on side which is to be removed.
- After jack up the machine, set a block under the unit.



- (3) Remove the mounting bolt (1) and draw out the track roller (2).
 - · Weight: 46 kg (106 lb)
 - · Tightening torque: 57.9±8.7 kgf⋅m

 $(419\pm62.9 \, lbf \cdot ft)$



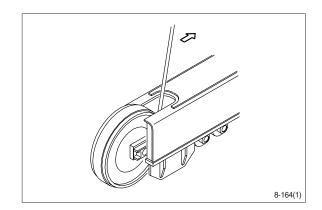
2) INSTALL

(1) Carry out installation in the reverse order to removal.

4. IDLER AND RECOIL SPRING

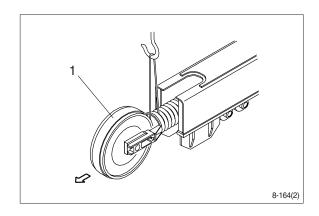
1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.



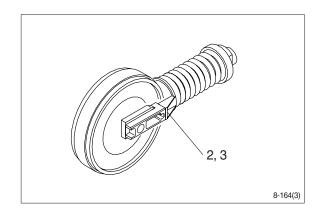
(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.

· Weight: 310 kg (680 lb)



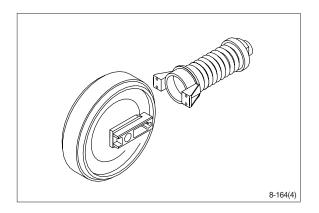
(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.

 \cdot Tightening torque : 29.7 \pm 4.5 kgf·m (215 \pm 32.5 lbf \cdot ft)



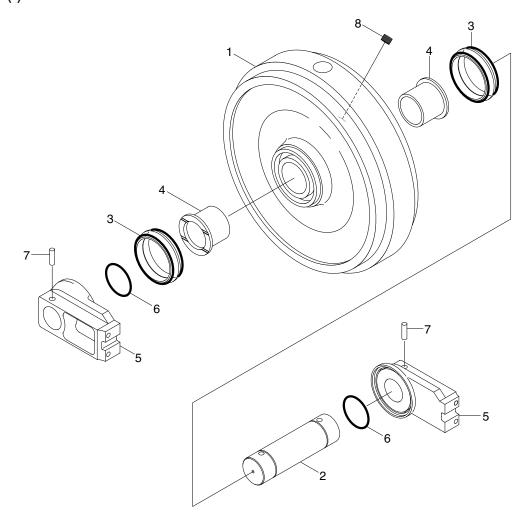
2) INSTALL

- (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



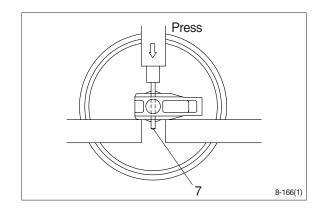
220S8DA43

- 1 Shell
- 2 Shaft
- 3 Seal assembly
- 4 Bushing
- 5 Bracket
- 6 O-ring

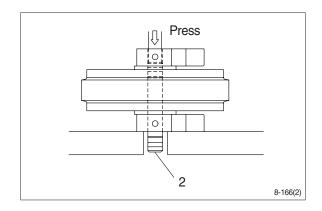
- 7 Spring pin
- 8 Plug

(2) Disassembly

- ① Remove plug and drain oil.
- ② Draw out the spring pin (7), using a press.

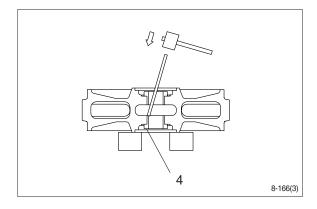


- 3 Pull out the shaft (2) with a press.
- ④ Remove seal (3) from idler (1) and bracket (5).
- ⑤ Remove O-ring (6) from shaft.



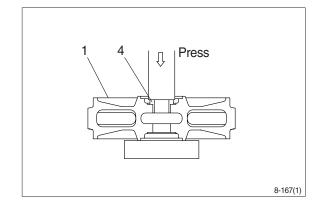
⑥ Remove the bushing (4) from idler, using a special tool.

Only remove bushing if replacement is necessity.

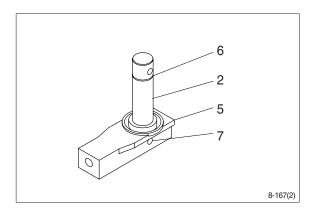


(3) Assembly

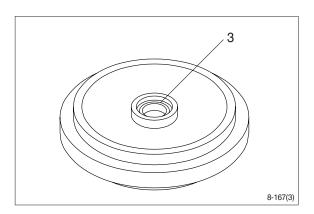
- Before assembly, clean the parts.
- Coat the sliding surfaces of all parts with oil.
- Cool up bushing (4) fully by some dry ice and press it into shell (1).
 Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



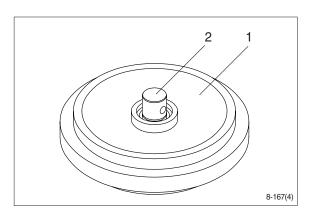
- ② Coat O-ring (6) with grease thinly, and install it to shaft (2).
- ③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



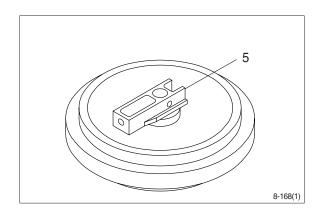
④ Install seal (3) to shell (1) and bracket (5).



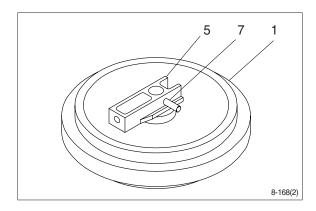
5 Install shaft (2) to shell (1).



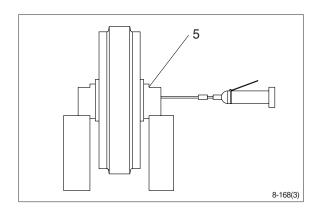
⑥ Install bracket (5) attached with seal (3).



Knock in the spring pin (7) with a hammer.

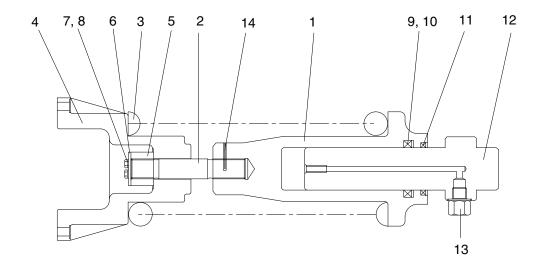


8 Lay bracket (5) on its side. Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure (standard)



220L8UC100

1	Body			
2	Tie bar			

3 Spring

4 Bracket

5 Lock nut

6 Lock plate

7 Bolt

8 Spring washer

9 Rod seal

10 Back up ring

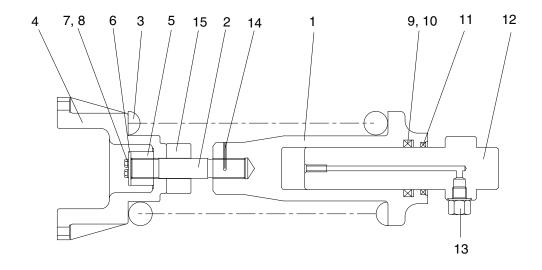
11 Dust seal

12 Rod

13 Grease valve

14 Spring pin

Structure (high walker)

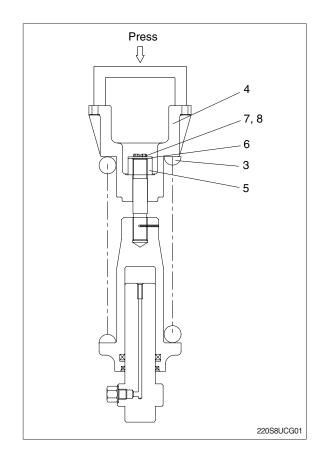


220L8UC101

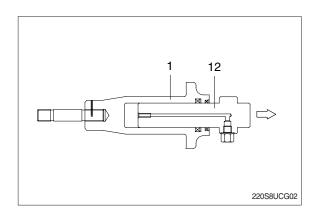
1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal	14	Spring pin
5	Lock nut	10	Back up ring	15	Stopper

(2) Disassembly

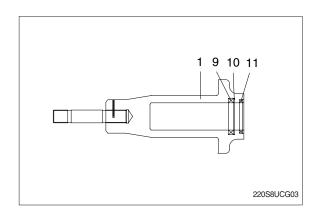
- The illustrations are base on the standard.
- ① Apply pressure on spring (3) with a press.
- ** The spring is under a large installed load. This is dangerous, so be sure to set properly.
- ② Remove bolt (7), spring washer (8) and lock plate (6).
- ③ Remove lock nut (5).
 Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.
- ① Lighten the press load slowly and remove bracket (4) and spring (3).



- ⑤ Remove rod (12) from body (1).
- 6 Remove grease valve (13) from rod (12).



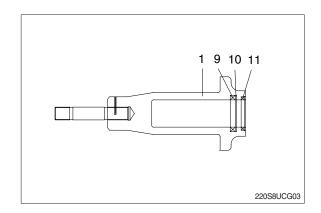
7 Remove rod seal (9), back up ring (10) and dust seal (11).



(3) Assembly

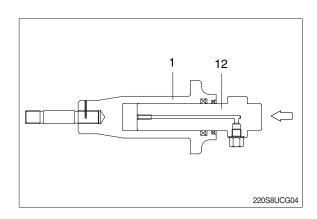
Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.

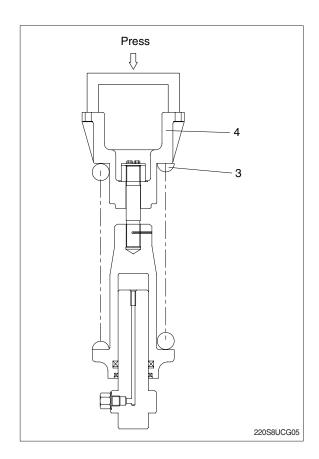


- ② Pour grease into body (1), then push in rod (12) by hand.
 After take grease out of grease valve mounting hole, let air out.
- If air letting is not sufficient, it may be difficult to adjust the tension of crawler.
- ③ Fit grease valve (13) to rod (12).
 - · Tightening torque

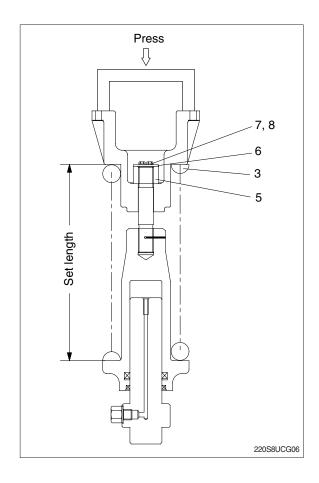
Standard : 13 \pm 1.0 kgf·m (94 \pm 7.2 lbf·ft) Option : 13 \pm 0.5 kgf·m (94 \pm 3.6 lbf·ft)



- (4) Install spring (3) and bracket (4) to body(1).
- ⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).
 - · Spring set load
 - Standard: 13716 kg (30239 lb)
 - High walker: 16315 kg (35968 lb)
- Apply sealant before assembling.
- During the operation, pay attention specially to prevent the press from slipping out.



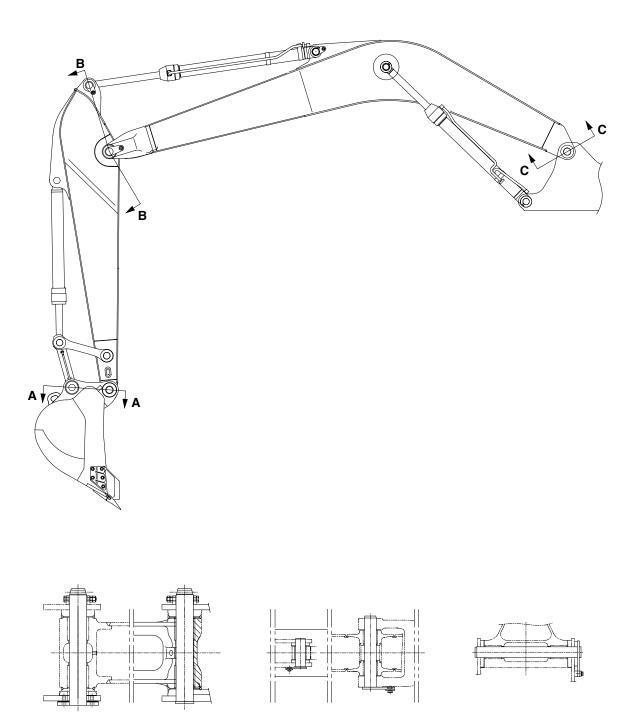
- ⑤ Lighten the press load and confirm the set length of spring (3).
 - Standard : 431 \pm 1.5 mm High walker : 508 \pm 1.5 mm
- After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).
 - \cdot Tightening torque : 15 \pm 0.5 kgf \cdot m $(108 \pm 3.6 \ lbf \cdot ft)$



GROUP 11 WORK EQUIPMENT

SECTION A

1. STRUCTURE



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SECTION C

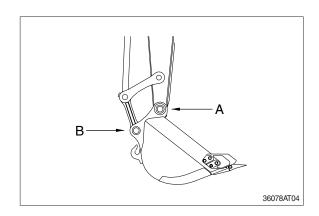
SECTION B

2. REMOVAL AND INSTALL

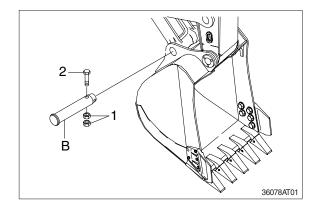
1) BUCKET ASSEMBLY

(1) Removal

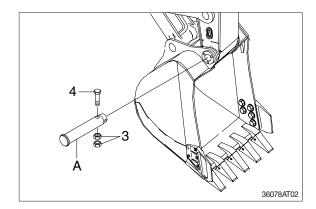
① Lower the work equipment completely to ground with back of bucket facing down.



- ② Remove nut (1), bolt (2) and draw out the pin (A).
 - \cdot Tightening torque (1) : 29.7 \pm 45 kgf \cdot m (215 \pm 32.5 lbf \cdot ft)

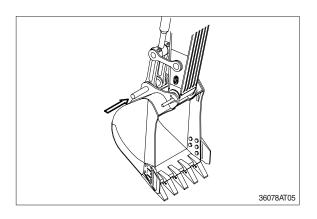


- ③ Remove nut (3), bolt (4) and draw out the pin (B).
 - \cdot Tightening torque (3) : 29.7 \pm 45 kgf \cdot m (215 \pm 32.5 lbf \cdot ft)



(2) Install

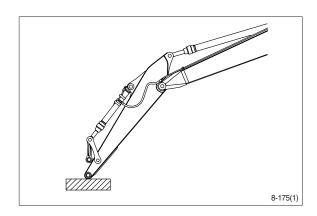
- ① Carry out installation in the reverse order to removal.
- ♠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- Adjust the bucket clearance.
 For detail, see operation manual.

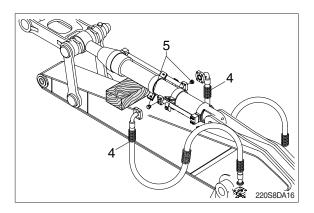


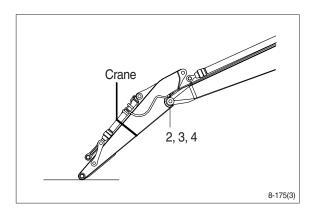
2) ARM ASSEMBLY

(1) Removal

- Loosen the breather slowly to release
 the pressure inside the hydraulic tank.
- ♠ Escaping fluid under pressure can penetrated the skin causing serious injury.
- Remove bucket assembly.
 For details, see removal of bucket assembly.
- ② Disconnect bucket cylinder hose (1).
- ♠ Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.
- 3 Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.
- Tie the rod with wire to prevent it from coming out.
- For details, see removal of arm cylinder assembly.
 - Place a wooden block under the cylinder and bring the cylinder down to it.
- ⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.
 - · Weight: 1095 kg (2410 lb)
 - \cdot Tightening torque (2) : 29.7 \pm 45 kgf \cdot m (215 \pm 32.5 lbf \cdot ft)
- When lifting the arm assembly, always lift the center of gravity.







(2) Install

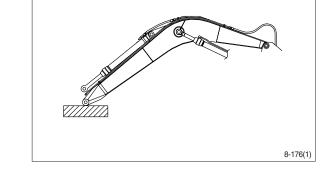
- ① Carry out installation in the reverse order to removal.
- A When lifting the arm assembly, always lift the center of gravity.
- * Bleed the air from the cylinder.

3) BOOM ASSEMBLY

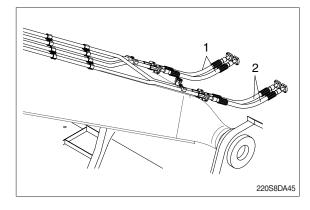
(1) Removal

- Remove arm and bucket assembly.
 For details, see removal of arm and bucket assembly.
- ② Remove boom cylinder assembly from boom.

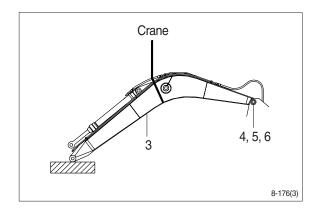
For details, see removal of boom cylinder assembly.



- 3 Disconnect head lamp wiring.
- 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).



- ⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
 - · Weight :1950 kg (4300 lb)
 - \cdot Tightening torque (4) : 29.7 \pm 45 kgf \cdot m (215 \pm 32.5 lbf \cdot ft)
- 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.

