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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 gives the general information of the machine and explains the safety hints for maintenance.

SECTION 2 REMOVAL & INSTALLATION OF UNIT
This section explains the procedures and techniques of removal and installation of each component.

SECTION 3 POWER TRAIN SYSTEM
This section explains the structure of the transmission as well as control valve and drive axle.

SECTION 4 BRAKE SYSTEM
This section explains the brake piping, each component and operation.

SECTION 5 STEERING SYSTEM
This section explains the structure of the steering unit, priority valve, trail axle as well as steering circuit and operation.

SECTION 6 HYDRAULIC SYSTEM
This section explains the structure of the gear pump, main control valve as well as work equipment circuit, each component and operation.

SECTION 7 ELECTRICAL SYSTEM
This section explains the electrical circuit and each component.
It serves not only to give an understanding electrical system, but also serves as reference material for troubleshooting.

SECTION 8 MAST
This section explains the structure of mast, carriage, backrest and forks.

The specifications contained in this service manual are subject to change at any time and without any advance notice. Contact your HYUNDAI distributor for the latest information.

2. HOW TO READ THE SERVICE MANUAL

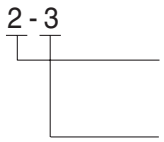
Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI distributors.

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

Filing method

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1



Item number (2. Structure and Function)

Consecutive page number for each item.

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

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

Revised edition mark (①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

1. Method of using the Conversion Table to convert from millimeters to inches

Convert 55 mm into inches.

(1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.

(2) Locate the number 5in the row across the top, take this as ⓑ, then draw a perpendicular line down from ⓑ.

(3) Take the point where the two lines cross as ⓒ. This point ⓒ gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.

2. Convert 550 mm into inches.

(1) The number 550 does not appear in the table, so divide by 10 (move the decimal point one place to the left) to convert it to 55 mm.

(2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.

(3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value.
This gives 550 mm = 21.65 inches.

Millimeters to inches

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
ⓐ 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

1 mm = 0.03937in

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

Kilogram to Pound

1 kg = 2.2046lb

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

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1 kgf · m = 7.233 lbf · ft

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

kgf/cm² to lbf/in²

1 kgf / cm² = 14.2233 lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

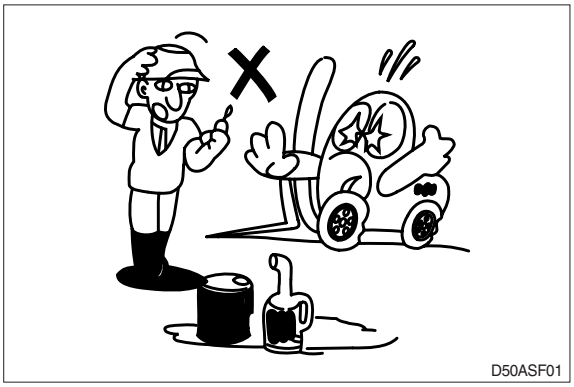
SECTION 1 GENERAL

Group 1 Safety hints 1-1
Group 2 Specifications 1-5
Group 3 Periodic replacement 1-13

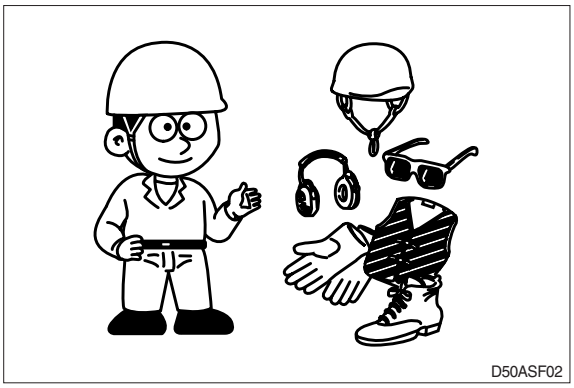
GROUP 1 SAFETY HINTS

Careless performing of the easy work may cause injuries.
Take care to always perform work safely, at least observing the following.

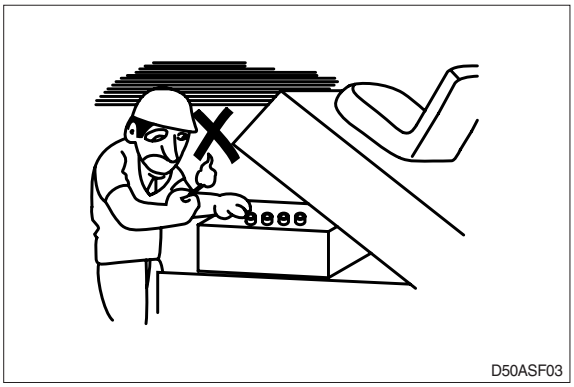
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D50ASF01

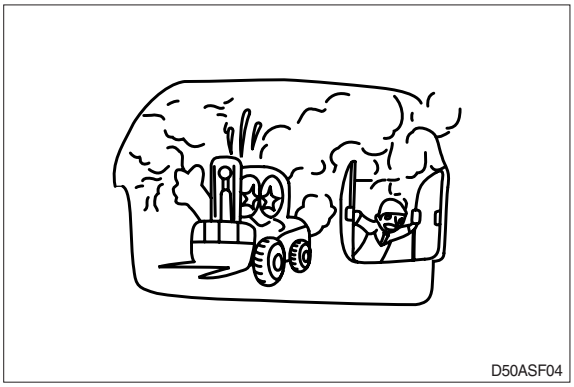
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.


D50ASF02

- Flames should never be used instead of lamps. Never use a naked flame to check leaks or the level of oil or electrolyte.

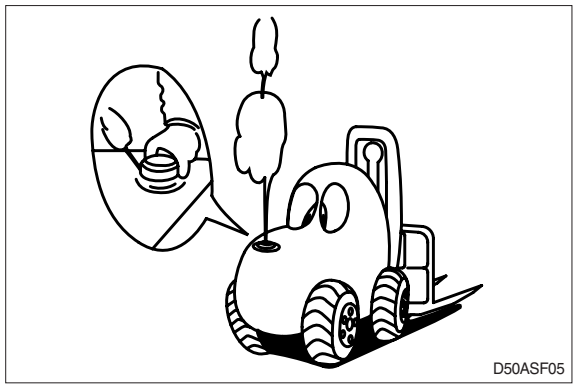

D50ASF03

- Exhaust gas is dangerous. Provide adequate ventilation when working a closed space.

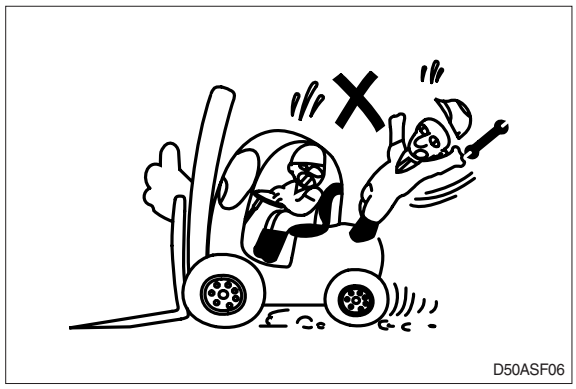

D50ASF04

⚠ Be particularly careful when removing the radiator cap and the hydraulic oil tank filler cap, if this is done immediately after using the machine, there is a danger that boiled oil may spurt out.

· The procedure for releasing the hydraulic pressure is as follows : lower the fork to the ground, and stop the engine (Motor), move the control levers to each position two or three times.

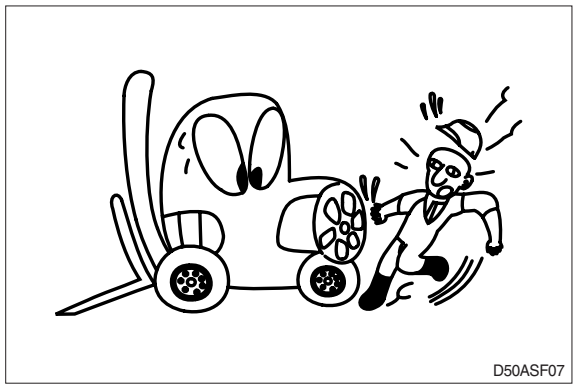

D50ASF05

· When working on top of the machine, be careful not to lose your balance and fall.


D50ASF06

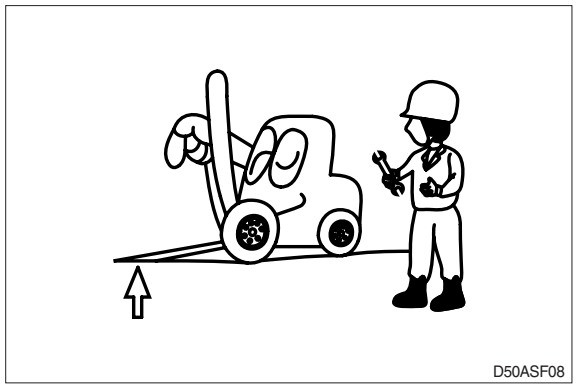
· Hand a caution sign in the operator's compartment (For example **Do not start** or **Maintenance in progress**).
This will prevent anyone from starting or moving the machine by mistake.

⚠ It is extremely dangerous to try to check the fan belt tension while he engine is running.

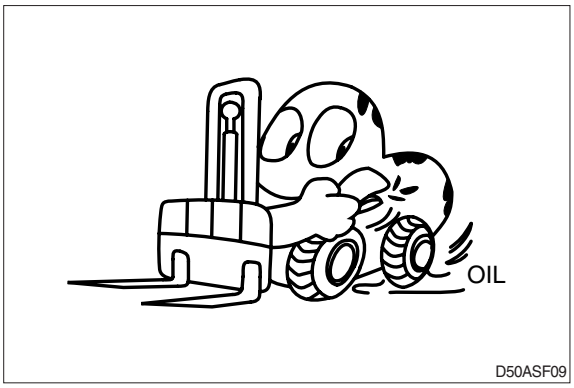

D50ASF07

When inspecting the engine is running parts, or near such parts, always stop the engine first.
Before checking or servicing accumulator or piping, depress brake pedal repeatedLy to release pressure.

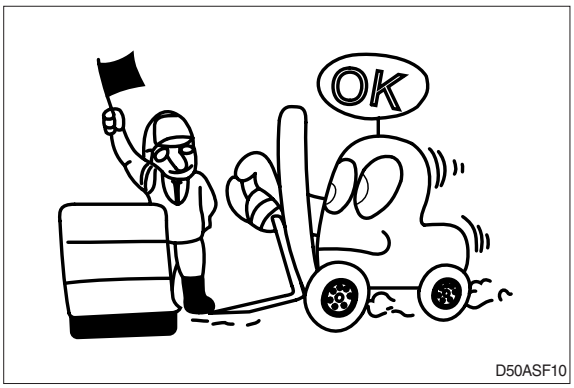
· Park the machine on firm, flat ground.
Lower the fork to the ground and stop the engine.
Return each lever to **NEUTRAL** and apply the brake lock.


D50ASF08

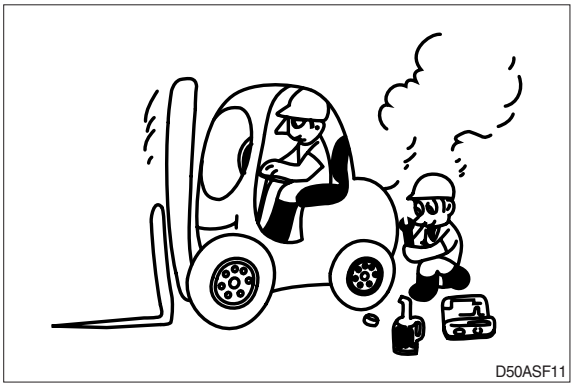
· Immediately remove any oil or grease on the floor of the operator's compartment, or on the handrail. It is very dangerous if someone slips while on the machine.



· When working with others, choose a group leader and work according to his instructions. Do not perform any maintenance beyond the agreed work.



· Always remember that the hydraulic oil circuit is under pressure. When feeding or draining the oil or carrying out inspection and maintenance, release the pressure first.



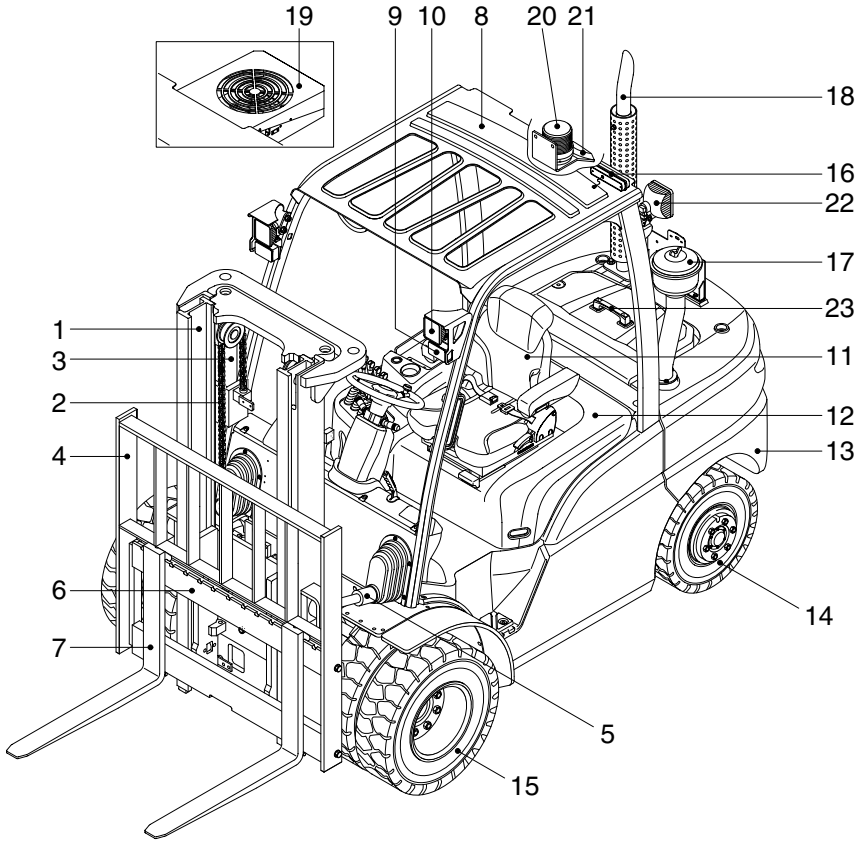
· Unless you have special instructions to the contrary, maintenance should always be carried out with the engine stopped. If maintenance is carried out with the engine running, there must be two men present : one sitting in the operator's seat and the other one performing the maintenance. In such a case, never touch any moving part.

- Thoroughly clean the machine. In particular, be careful to clean the filler caps, grease fittings and the area around the dipsticks. Be careful not to let any dirt or dust into the system.
- Always use HYUNDAI Forklift genuine parts for replacement.
- Always use the grades of grease and oil recommended by HYUNDAI Forklift.
  Choose the viscosity specified for the ambient temperature.
- Always use pure oil or grease, and be sure to use clean containers.
- When checking or changing the oil, do it in a place free of dust, and prevent any dirt from getting into the oil.
- Before draining the oil, warm it up to a temperature of 30 to 40°C.
- After replacing oil, filter element or strainer, bleed the air from circuit.
- When the strainer is located in the oil filler, the strainer must not be removed while adding oil.
- When changing the oil filter, check the drained oil and filter for any signs of excessive metal particles or other foreign materials.
- When removing parts containing O-ring, gaskets or seals, clean the mounting surface and replace with new sealing parts.
- After injecting grease, always wipe off the oil grease that was forced out.
- Do not handle electrical equipment while wearing wet places, as this can cause electric shock.
- During maintenance do not allow any unauthorized person to stand near the machine.
- Be sure you fully understand the contents of the operation. It is important to prepare necessary tools and parts and to keep the operating area clean.
- When checking an open gear case there is a risk of dropping things in. Before removing the covers to inspect such cases, empty everything from your pockets. Be particularly careful to remove wrenches and nuts.
- Way to use dipstick
  Push the dipstick fully into the guide, and then pull out.

Carrying out other difficult maintenance work carelessly can cause unexpected accidents. If you consider the maintenance is too difficult, always request the HYUNDAI Forklift distributor to carry out it.

GROUP 2 SPECIFICATIONS

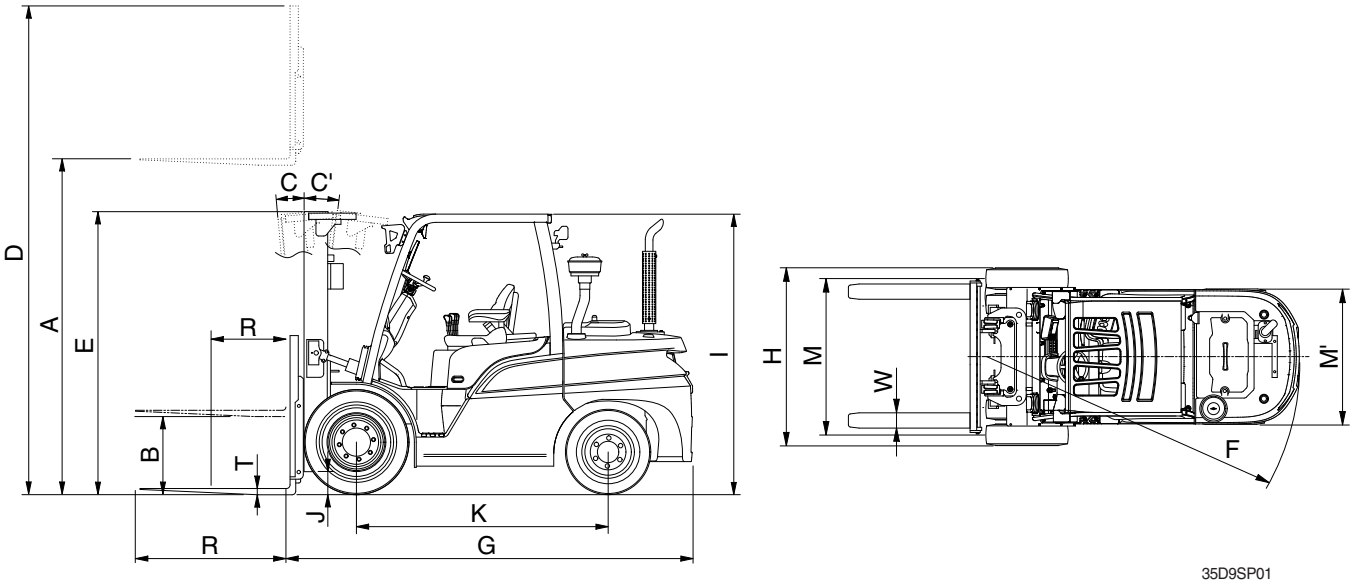
1. MAJOR COMPONENTS



35D9OM54

1	Mast	9	Turn signal lamp	17	Precleaner
2	Lift chain	10	Head lamp	18	Silencer
3	Lift cylinder	11	Operator's seat	19	Air conditioner (opt)
4	Backrest	12	Bonnet	20	Beacon lamp (opt)
5	Tilt cylinder	13	Counterweight	21	Camera (opt)
6	Lift bracket	14	Rear wheel	22	Rear work lamp (opt)
7	Forks	15	Front wheel	23	Rear handle with horn (opt)
8	Overhead guard	16	Rear combination lamp		

2. SPECIFICATIONS



35D9SP01

Model			Unit	35D-9	40D-9	45D-9	50DA-9
Capacity			kg (lb)	3500 (8000)	4000 (9000)	4500 (10000)	5000 (11000)
Load center		R	mm (in)	600 (24")	←	←	←
Weight (Unloaded)			kg (lb)	5934 (13080)	6484 (14290)	6900 (15210)	7317 (16130)
Fork	Lifting height	A	mm (ft·in)	3020 (9' 11")	←	←	2930 (9' 7")
	Free lift	B	mm (in)	120 (4.7")	←	←	←
	Lifting speed (Unload/Load)		mm/sec	540/520	540/510	540/500	460/420
	Lowering speed (Unload/Load)		mm/sec	500/500	←	←	←
	L × W × T	L,W,T	mm (in)	1070 × 122 × 50 (42 × 4.8 × 2)	1070 × 150 × 50 (42 × 5.9 × 2)	1220 × 150 × 50 (48 × 5.9 × 2)	1200 × 150 × 60 (47 × 5.9 × 2.4)
Mast	Tilt angle (forward/backward)	C/C'	degree	8/10	←	←	←
	Max height	D	mm (ft·in)	4235 (13' 11")	←	←	4147 (13' 7")
	Min height	E	mm (ft·in)	2235 (7' 4")	2220 (7' 3")	←	←
Body	Travel speed (Unload)		km/h (mph)	26.6 (16.5)	25.7 (16.0)	25.6 (15.9)	←
	Gradeability (Load)		%	40.9	36.4	33.2	30.6
	Min turning radius (Outside)	F	mm (ft·in)	3006 (9' 10")	3005 (9' 10")	3040 (10' 0")	←
ETC	Operating pressure		kgf/cm² (psi)	210 (2990)	←	←	←
	Hydraulic oil tank		ℓ (U.S. gal)	64 (16.9)	←	←	←
	Fuel tank		ℓ (U.S. gal)	72 (19.0)	←	←	←
Overall length		G	mm (ft·in)	3225 (10' 7")	←	3264 (10' 9")	3300 (10' 10")
Overall width		H	mm (ft·in)	1373 (4' 6")	1746 (5' 9")	←	←
Overhead guard height		I	mm (ft·in)	★1 2220 (7' 3") ★2 2350 (7' 7")	★1 2210 (7' 3") ★2 2340 (7' 7")	←	←
Ground clearance		J	mm (in)	170 (6.7")	155 (6.1")	←	←
Wheel base		K	mm (ft·in)	2000 (6' 7")	←	←	←
Wheel tread front/rear		M/M'	mm (ft·in)	1132/1140 (3' 9"/3' 9")	1282/1140 (4' 2"/3' 9")	←	←
Max drawbar pull (load)			kg (lb)	3970 (8750)	3994 (8810)	4000 (8820)	4006 (8830)

★1 : Low ★2 : High

3. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

Item	Unit	Specification
Model	-	Cummins QSF 3.8
Type	-	Vertical, 4 cycle DI, Tier 4 final diesel engine
Cooling Method	-	Water cooling
Number of cylinders and arrangement	-	4 cylinders, In-line
Firing order	-	1-3-4-2
Combustion chamber type	-	Direct injection
Cylinder bore X stroke	mm (in)	100 × 120 (3.94 × 4.72)
Piston displacement	cc (cu in)	3800 (232)
Compression ratio	-	17.5 : 1
Rated gross horse power	hp/rpm	102/2200
Maximum torque at rpm	kgf · m/rpm	42.3/1600
Engine oil quantity	ℓ (U.S.gal)	13.2 (3.49)
Dry weight	kg (lb)	316 (697)
High idling speed	rpm	2400
Low idling speed	rpm	900
Rated fuel consumption	g/kw.hr	231 (at 1700 rpm)
Starting motor	V-kW	24-3.2
Alternator	V-A	24-80
Battery	V-AH	24-75
Fan belt deflection	mm (in)	10~12 (0.40~0.47)

2) MAIN PUMP

Item	Unit	Specification
Type	-	Fixed displacement gear pump
Capacity	cc/rev	46.1
Maximum operating pressure	kgf/cm^2 (psi)	235 (3340)
Rated speed (Max/Min)	rpm	3000/600

3) MAIN CONTROL VALVE

Item	Unit	Specification
Type	-	Sectional
Operating method	-	Mechanical
Relief valve pressure (Main/Aux)	kgf/cm^2 (psi)	210/150 (2990/2130)
Flow capacity	lpm	125

(4) POWER TRAIN DEVICES

Item			Specification
Torque converter	Model		DE 280 (KAPEC)
	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.25 : 1
Transmission	Type		Power shift
	Gear shift(FWD/REV)		2/2
	Control		Electrical single lever type
	Overhaul ratio	FWD	1st : 2.550 2nd : 1.218
		REV	1st : 2.550 2nd : 1.218
Axle	Type		Front-wheel drive type, fixed location
	Gear ratio		11.692
Wheels	Q'ty(FR/RR)		Single : 2/2, Double : 4/2
	Front(drive)	Single	3.5 ton : 8.25-15-14 PR 4.0~5.0 ton : 300-15-18 PR
		Double	7.50-16-12 PR
	Rear(steer)		3.5/4 ton : 7.00-12-12 PR 4.5/5 ton : 7.00-12-14 PR
Brakes	Travel		Front wheel, wet disk brake
	Parking		Ratchet, drum brake
Steering	Type		Full hydraulic, power steering
	Steering angle		74.8˚ to both right and left angle, respectively
	Relief valve presssure		135 kgf/cm^2 (1920 psi)

4. TIGHTENING TORQUE FOR MAJOR COMPONENTS

NO	Item		Size	kgf · m	lbf · ft
1	Engine	Engine mounting bolt	M12×1.75	6.9±1.4	50±10
2		Engine bracket mounting nut	M10×1.5	6.9±1.4	50±10
3		Radiator mounting bolt, nut	M10×1.5	6.9±1.4	50±10
4	Hydraulic system	MCV mounting bolt, nut	M12×1.75	5±1.0	36.2±7.2
5		Steering unit mounting bolt	M10×1.5	4.0±0.5	28.9±3.6
6		Hydraulic pump mounting bolt	M14×1.5	9.5±1.3	68.7±9.5
7	Power train system	Transmission mounting bolt, nut	M16×2.0	7.5±1.5	54.2±10.8
8		Torque converter mounting bolt	M10×1.5	6.9±1.4	50±10
9		Drive axle mounting bolt, nut	M24×2.0	62.5±9.5	452±68.7
10		Drive shaft mounting bolt	3/8-24 UNF	7.0±0.7	50.6±5.1
11		Steering axle mounting bolt, nut	M14×2.0	19.6±2.9	142±21
12		Front wheel mounting nut	M22×1.5	62.0±9.3	448±67.3
13		Rear wheel mounting nut	M20×1.5	35.0±5.0	253±36.2
14	Others	Counterweight mounting bolt	M30×3.5	199±29.9	1439±216
15		Operator's seat mounting nut	M 8×1.25	2.5±0.5	18.1±3.6
16		Head guard mounting bolt	M12×1.75	12.8±3.0	93±22
17		Cabin mounting bolt	M12×1.75	12.8±3.0	93±22

5. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.73 ~ 4.12	19.7 ~ 29.8
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 79.5	9.8 ~ 15.8	71 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 167
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 343
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	350 ~ 457	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.5	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1655
M36 × 4.0	174 ~ 236	1261 ~ 1703	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.17 ~ 3.37	15.7 ~ 24.3	3.04 ~ 4.44	22.0 ~ 32.0
M10 × 1.25	4.46 ~ 6.66	32.3 ~ 48.2	5.93 ~ 8.93	42.9 ~ 64.6
M12 × 1.25	7.78 ~ 11.58	76.3 ~ 83.7	10.6 ~ 16.0	76.6 ~ 115
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 130	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 194	26.6 ~ 36.0	193 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 390	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 515	70.7 ~ 95.7	512 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 664	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1338	182 ~ 248	1314 ~ 1795
M36 × 3.0	192 ~ 260	1389 ~ 1879	262 ~ 354	1893 ~ 2561

2) PIPE AND HOSE(FLARE TYPE)

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

3) PIPE AND HOSE(ORFS TYPE)

Thread size	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130
1-7/16-12	41	21	152
1-11/16-12	50	35	253

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

6. RECOMMENDED LUBRICANTS

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C (°F) -50 (-58) -30 (-22) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Engine oil pan	Engine oil	12 (3.2)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Torque converter transmission	Transmission oil	12 (3.2)	ATF DEXRON III
Axle	Gear oil	10.5 (2.8)	SHELL DONAX TD
Hydraulic tank	Hydraulic oil	66 (17.4)	★ISO VG 15 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel★1	72 (19.0)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (Grease nipple)	Grease	-	★NLGI NO.1 NLGI NO.2
Brake reservoir tank	Brake oil	-	★AZOLLA ZS10 (Hydraulic oil, ISO VG10) AZOLLA ZS32 (Hydraulic oil, ISO VG32)
Radiator	Antifreeze : Water	21.5 (5.7)	Ethylene glycol base permanent type (50:50) ★Ethylene glycol base permanent type (60 : 40)
DEF/AdBlue® tank	Mixture of urea and deionized water	18.9 (5)	ISO 22241 (High-purity urea + deionized water (32.5:67.5))

NOTES :

- Engine oil should be API classification CJ-4.
- Change the type of engine oil according to the ambient temperature.
- When using oil of different brands from the previous one, be sure to drain all the previous oil before adding the new engine oil.

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

★ : Cold region
Russia, CIS, Mongolia

GROUP 3 PERIODIC REPLACEMENT

For operation safety, never fail to perform periodic maintenance or make periodic replacement of the consumable parts listed in the following.
These parts may deteriorate in time and are susceptible to wear. It is difficult to estimate the degree of wear at time of periodic maintenance; therefore, even if no apparent wear is found, always replace with new parts within the prescribed period of replacement (Or earlier if trouble is found).
Note that periodic replacement has nothing to do with guarantee service.

No.	Description	Period of replacement
1	Master cylinder and wheel cylinder caps, dust seals	Every 1 year
2	Brake hose or tube	Every 1 or 2 years
3	Brake reservoir tank and tube	Every 2 to 4 years
4	Power steering hose	Every 2 years
5	Stop lamp switch(Oil pressure type)	Every 2 years
6	Fuel hose	Every 2 to 4 years
7	Rubber parts of power steering	Every 2 to 4 years
8	Lift chain	Every 2 to 4 years
9	Hose of load handling	Every 1 or 2 years
10	Intake air line	Every 2 years
11	Coolant hose and clamps	Every 2 years

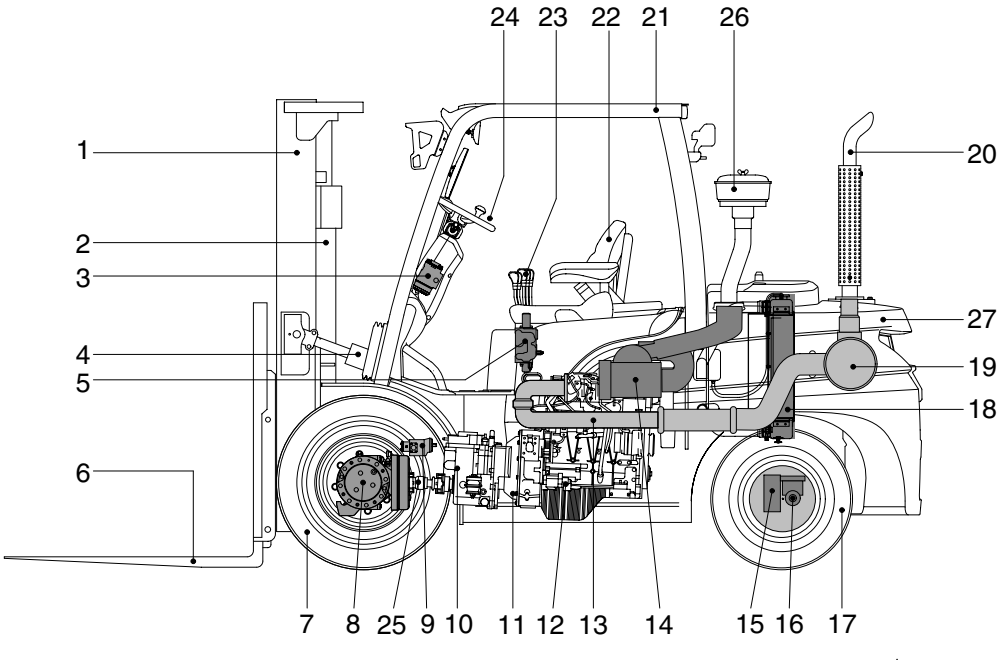
※ **Replace the O-ring and gasket at the same time when replacing the hose.**

※ **Replace clamp at the same time if the hose clamp is cracked when checking and replacing hose.**

SECTION 2 REMOVAL & INSTALLATION OF UNIT

Group 1 Major components 2-1
Group 2 Removal and installation of unit 2-2

GROUP 1 MAJOR COMPONENTS



35D9OM21

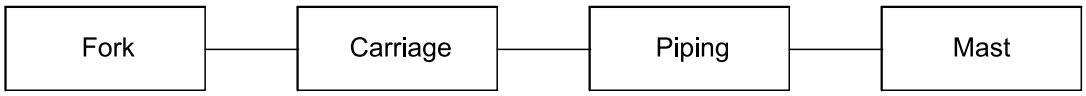
1	Mast	10	Transmission	19	Aftertreatment device
2	Lift cylinder	11	Torque converter	20	Silencer
3	Steering unit	12	Engine	21	Overhead guard
4	Tilt cylinder	13	Exhaust pipe	22	Seat
5	Control valve	14	Air cleaner	23	Control lever
6	Fork	15	Steering axle	24	Steering wheel
7	Front wheel	16	Steering cylinder	25	Drive shaft
8	Drive axle	17	Rear wheel	26	Precleaner
9	Hydraulic pump	18	Radiator	27	Counterweight

GROUP 2 REMOVAL AND INSTALLATION OF UNIT

Remove and install following units as explained in the flow chart.

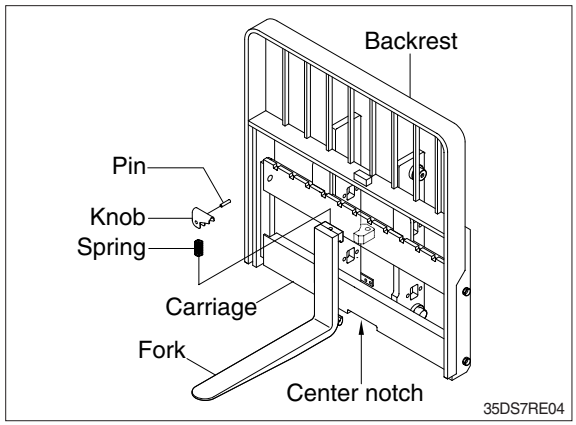
1. MAST

1) REMOVAL



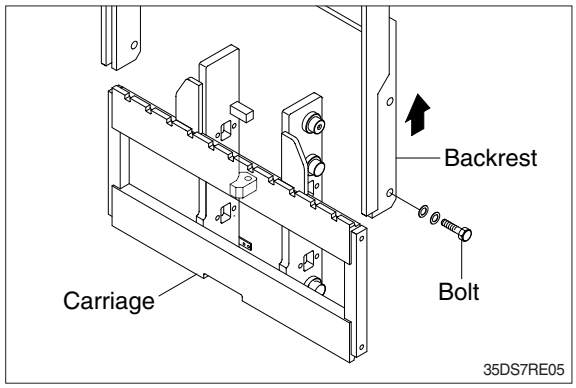
(1) Forks

① Lower the fork carriage until the forks are approximately 25mm (1in) from the floor.
② Turn knob up and slide one fork at a time toward the center of the carriage where a notch has been cut in the bottom plate for easy removal.
③ Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.



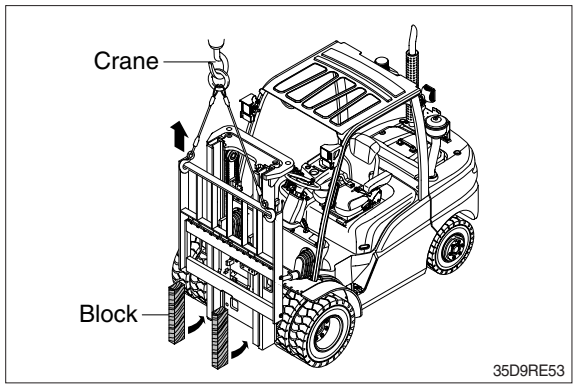
(2) Backrest (If necessary)

① Remove bolts securing backrest to fork carriage. Lift backrest straight up and remove it from carriage.

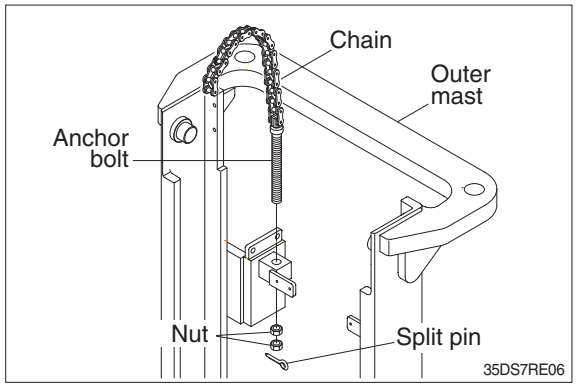


(3) Carriage

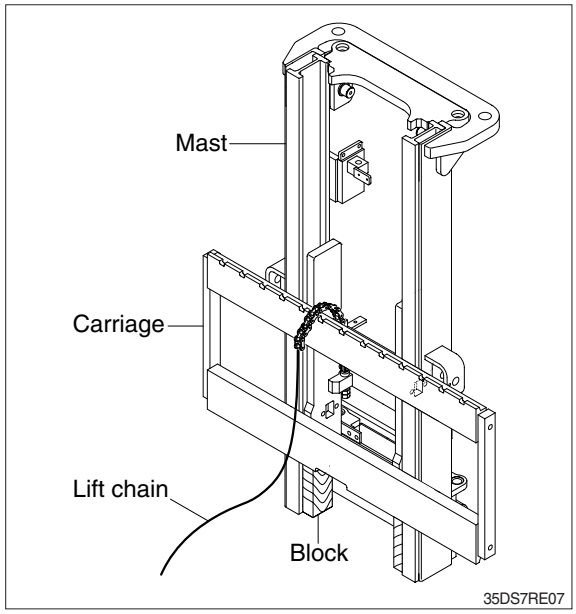
① With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is raised.



② While supporting lift chains, remove the split pin and nuts from the anchor bolt.



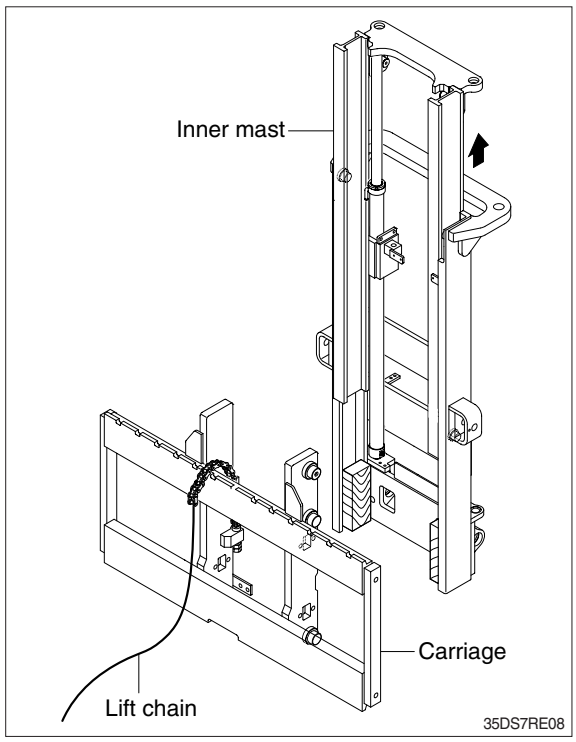
③ Pull the chains out of the sheaves and drape them over the front of the carriage.



④ Slowly raise inner mast upright until mast clears top of fork carriage. Move carriage to work area and lower the mast.

⚠ Make sure that carriage remains on floor and does not bind while mast is being raised.

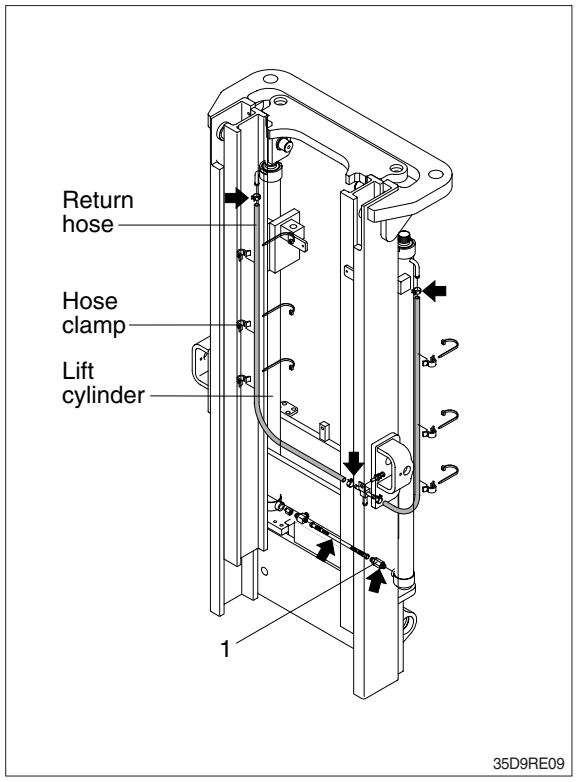
※ Inspect all parts for wear or damage. Replace all worn or damaged parts.



(4) Piping

① Remove the return hoses and clamps attached to the cylinder.
② Remove the return hose from the tee.
③ Remove hose assembly, tee and down safety valve (1).

※ Put blind plugs in the piping immediately after removing hoses.
This prevents the hydraulic oil from flowing out and also prevents dust and dirt from getting in.

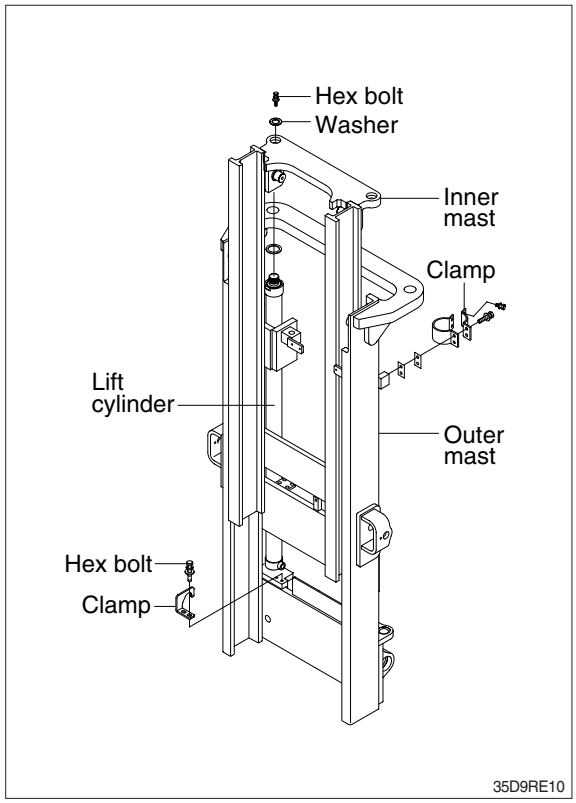


(5) Lift cylinder

① Loosen and remove hexagon bolts and washers securing lift cylinders to inner mast.
② Bind the lift cylinder with overhead hoist rope and pull up so that the rope has no slack or binding.

⚠ Make sure the lift cylinder be tightened firmly for safety.

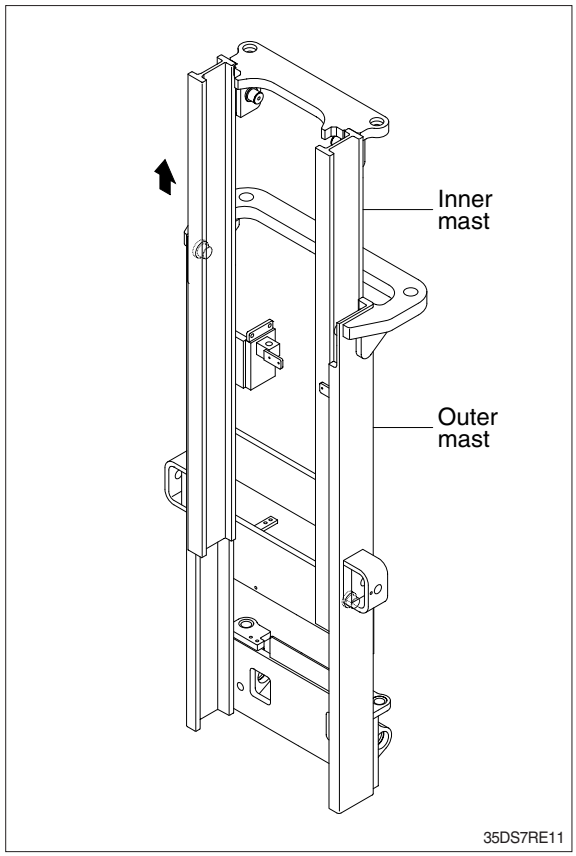
③ Loosen and remove hexagon bolts and clamp securing lift cylinders to outer mast.
④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.



(6) Inner mast

① Using an overhead hoist raise the inner mast straight and carefully draw out of outer mast section.

⚠ **Be careful the mast not to swing or fall.**



(7) Tilt cylinder pin

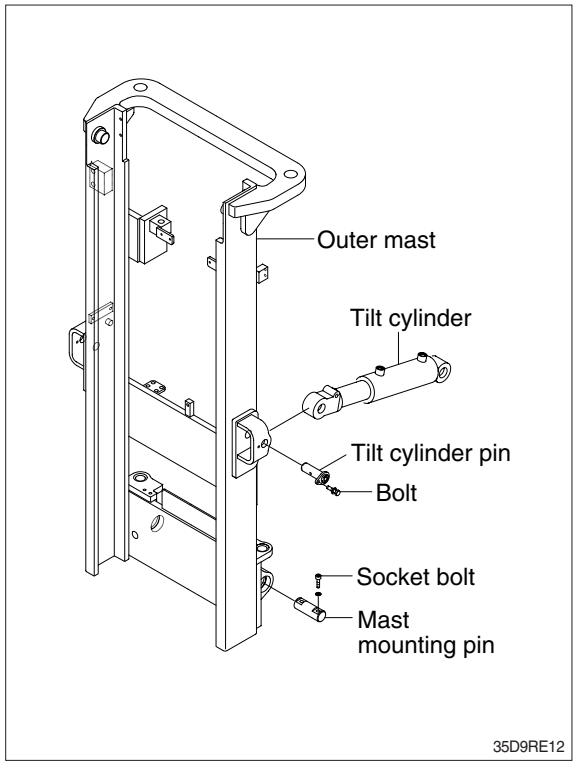
Loosen the bolt and remove the tilt cylinder pin.

(8) Mast mounting pin

① Attach a crane to the stay at the top of the outer mast, and raise enough to sustain jacked up truck.

② Loosen the mounting socket bolts and remove the mast mounting pins.
Then slowly raise the outer mast.

※ This operation is carried out under the truck, so use a pit, or if there is no pit, jack up the truck and loosen with an impact wrench.



2) INSTALLATION

After assembling mast components totally without piping connections, install mast assembly to the equipment.

※ Installation procedure for each of mast component is the reverse of the removal procedure.

(1) Mast mounting pin

① Check the mast mounting pins for wear, then install pins into the mast support bracket.

② Jack up the machine so that the front is raised and then using an overhead hoist assemble outer mast to frame.

③ Tighten mounting socket bolts to frame.

· Tightening torque : 35.1~47.5 kgf·m (254~344 lbf·ft)

(2) Tilt cylinder pin

Hold the mast with a crane, operate the tilt control lever and align the holes, then knock the pin.

(3) Lift cylinder installation and adjustment

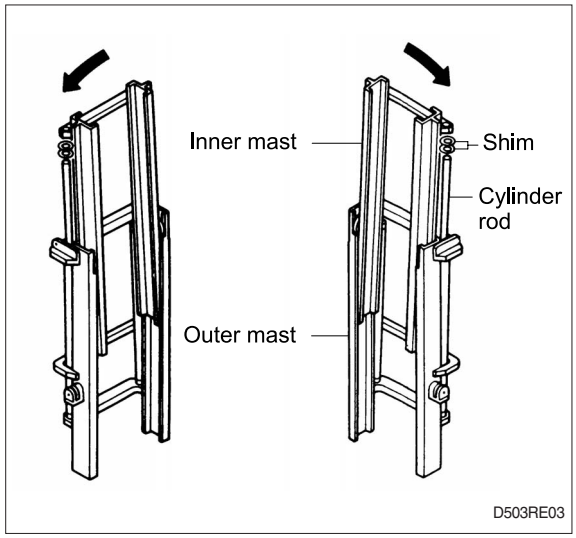
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

② Assemble the cylinder rod to the inner mast, and check the left-to-right play of the mast at the maximum lifting height.

※ If play is to LEFT, install adjustment shim to LEFT cylinder.

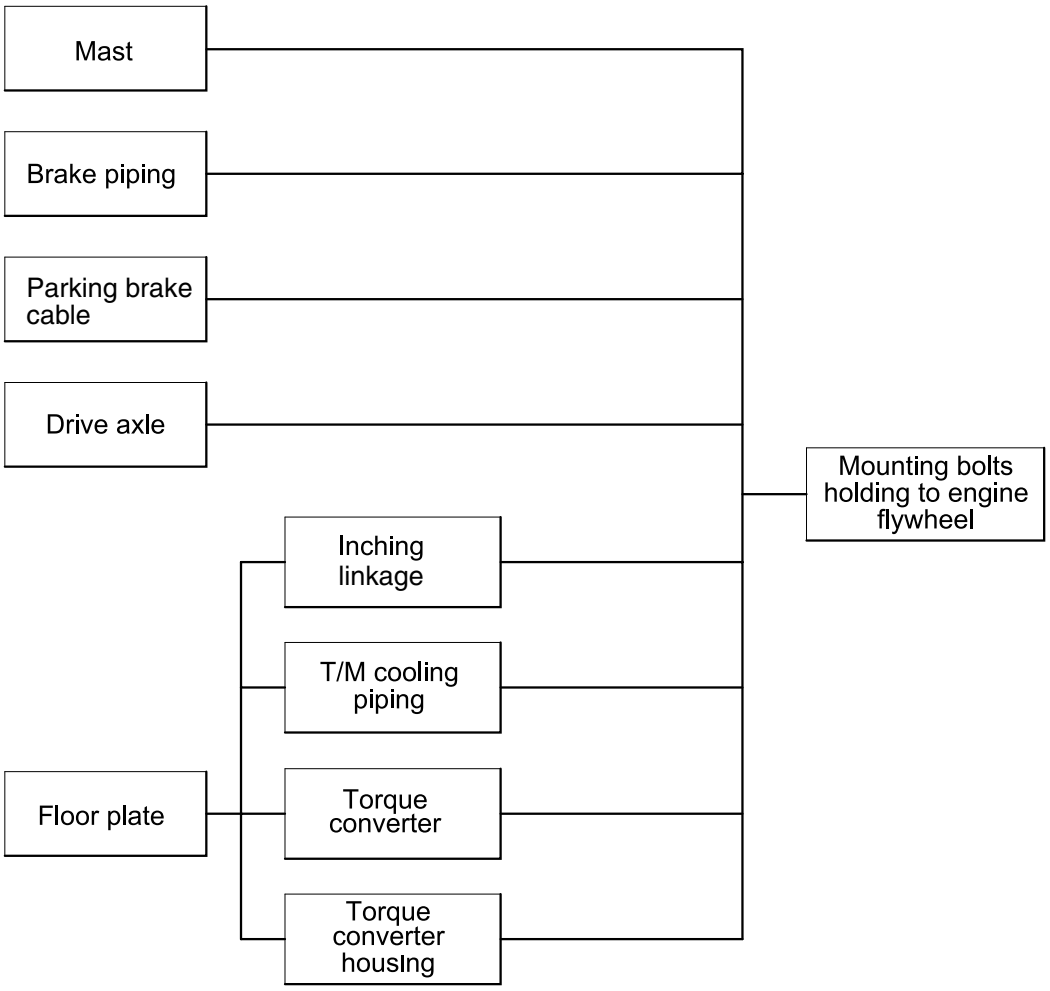
※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.

· Shim thickness : 1.0 mm (0.04 in)



2. POWER TRAIN ASSEMBLY

1) REMOVAL

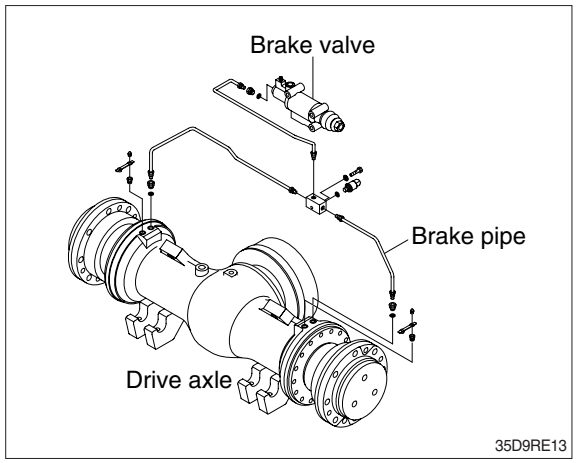


(1) Mast

Refer to section on mast (Page 2-2)

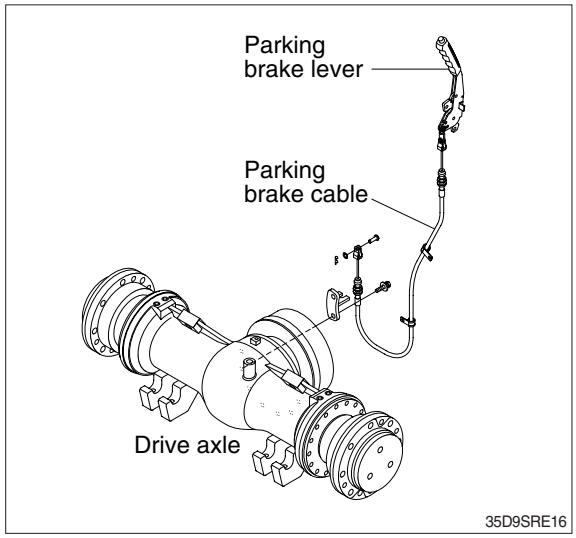
(2) Brake piping

Disconnect the brake piping from the brake housing of drive axle unit.



(3) Parking brake cable

Disconnect parking brake cable from the brake housing of drive axle unit.



(4) Drive axle

※ Before removing the drive axle unit, drain all of the oil from the axle.

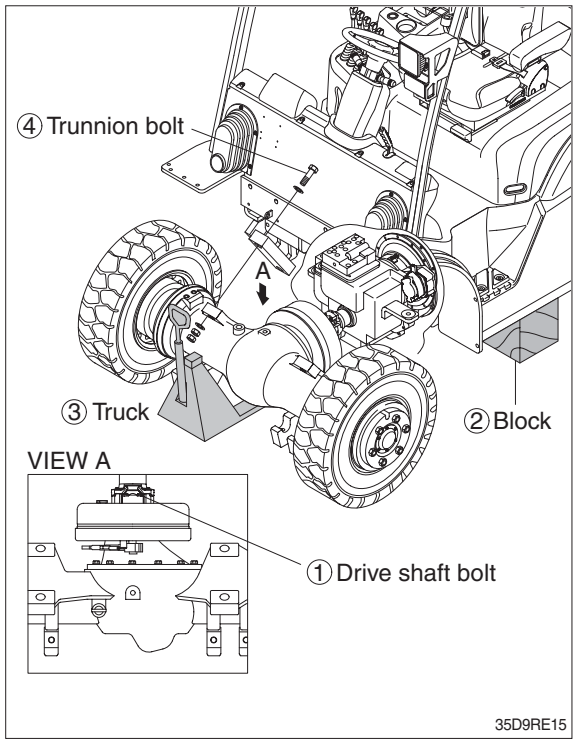
① Loosen hexagonal bolts connecting drive axle to the drive shaft.

※ If there is a pit, use the pit for safety.

② Jack up the truck and then put the block under the frame.

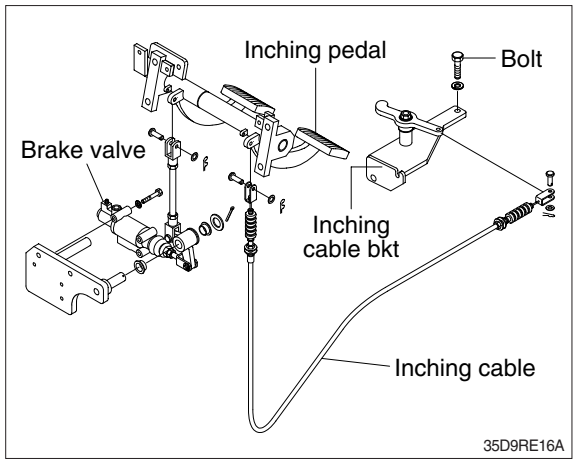
③ Prepare the truck under the drive axle unit to support it.

④ Remove trunnion bolts fixing the axle to the frame and then carefully draw the truck out of the vehicle with the drive axle unit.



(5) Inching linkage

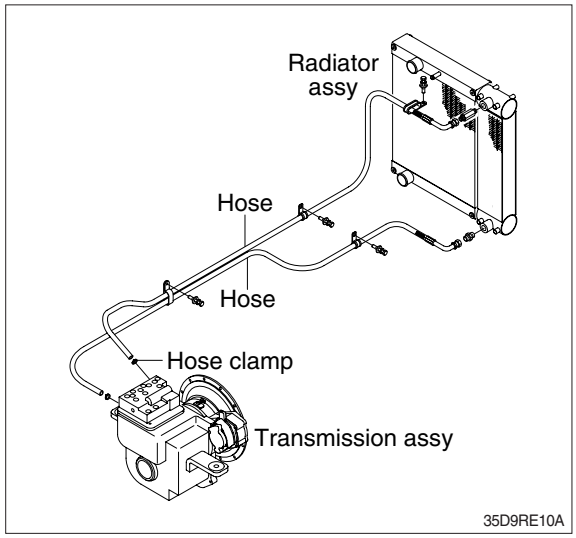
Remove the bolt fixing the inching cable bracket to T/M control valve.



(6) Transmission cooling piping

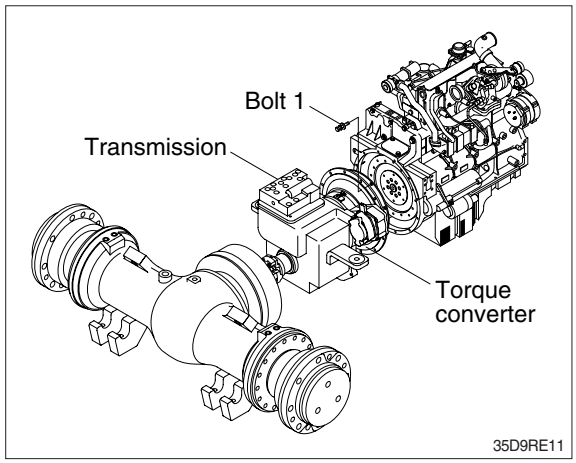
① Loosen the hose clamp and disconnect the cooling hose from the transmission.

※ Make sure that the coolant be drained from the hose.



(7) Torque converter

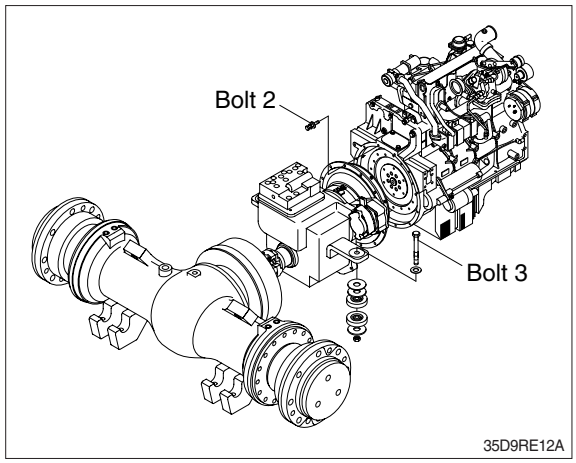
① Remove the cover on top face of the engine flywheel housing then remove the 8 mounting bolts 1 installed on the engine flywheel. To rotate the flywheel, remove 1 mounting bolt, then insert a turning tool in the mounting hole. One man must turn the engine fan by hand while the other turns the flywheel.



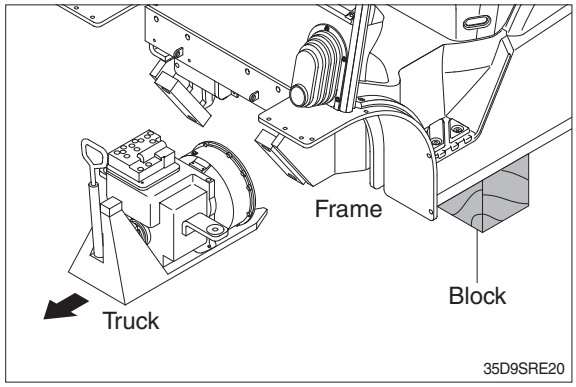
(8) Mounting bolts holding to flywheel housing

① Loosen the mounting bolts 2 to disconnect the transmission assembly from the engine flywheel.

② Loosen the mounting bolts 3 to disconnect the transmission assembly from the main frame.



③ Using a moving truck slowly pull out transmission assembly to the front.



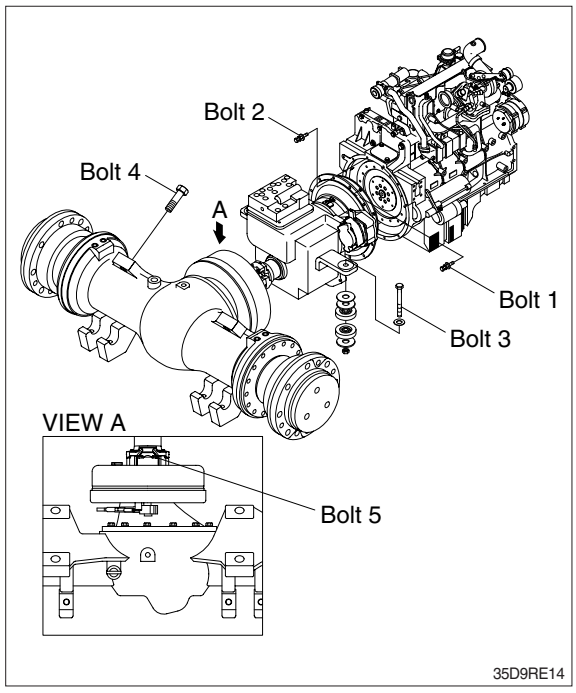
2) INSTALLATION

(1) Installation is the reverse order to removal, but be careful of the following points.

(2) Tightening torque

- Bolt 1 : 5.5~8.3 kgf·m (39.8~60.0 lbf·ft)
- Bolt 2 : 5.5~8.3 kgf·m (39.8~60.0 lbf·ft)
- Bolt 3 : 7.5 kgf·m (54.2 lbf·ft)
- Bolt 4 : 53~72 kgf·m (383~521 lbf·ft)
- Bolt 5 : 6.3~7.7 kgf·m (45.6~55.7 lbf·ft)

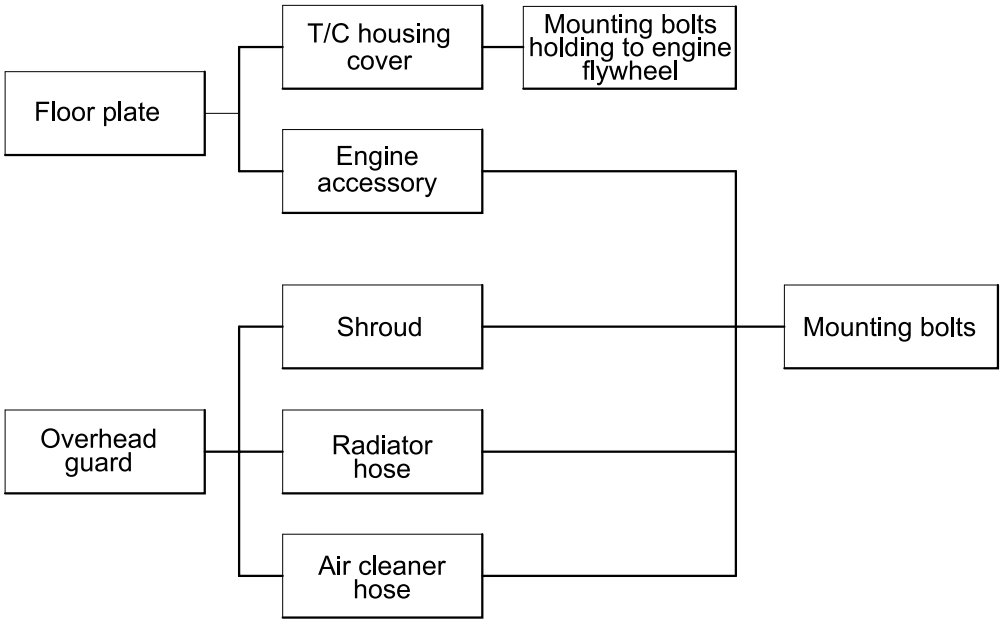
※ Apply loctite #243 on the thread of the bolt 4 before tightening.



3. ENGINE

Lever the torque converter, transmission and front axle inside the frame, then remove the engine assembly.

1) REMOVAL



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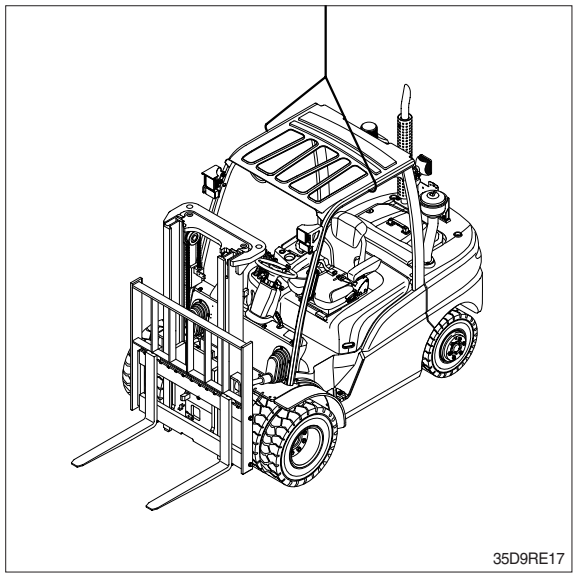
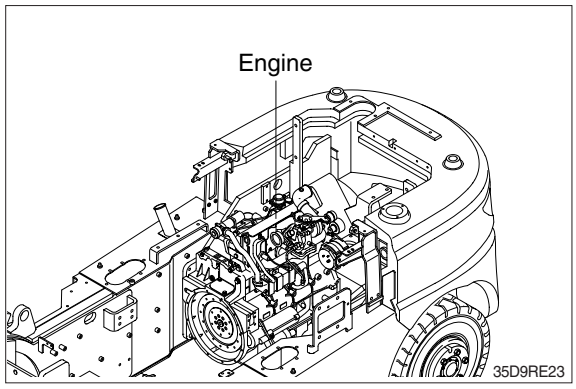
(1) Overhead guard

Remove the wiring for rear combination lamp, working lamp, head lamp and flasher lamp on the stay of the overhead guard and then raise it. Then remove the bonnet with seat.



35D9RE17

(2) Remove the torque converter housing cover, mounting bolts installed to flywheel housing.
For details, see page 2-9.



(3) Engine accessory

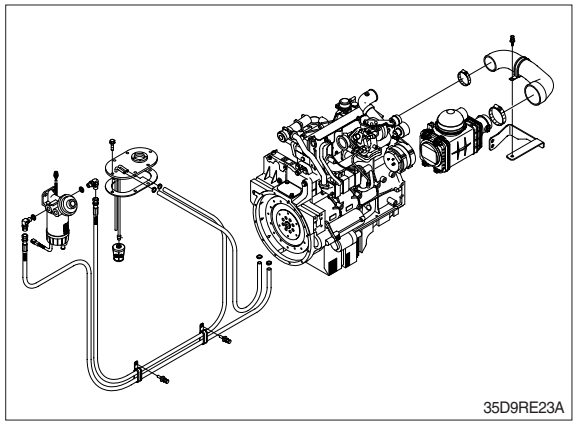
Remove all wiring harnesses, cables and hoses around the engine, dashboard and frame.

① Wiring harness to alternator and starter.

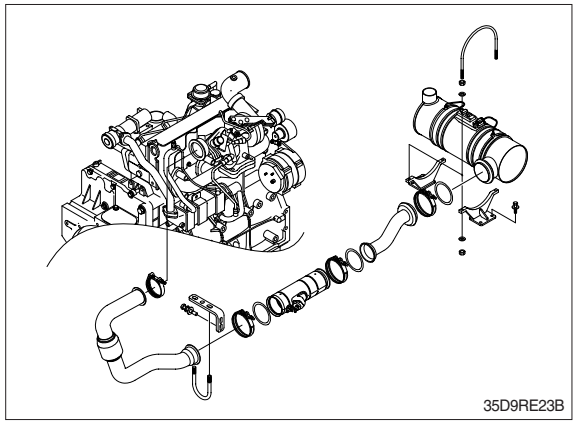
② Wiring harness for oil pressure and engine water temperature gauges.

③ Cables for meters, buttons and accelerator pedal.

④ Hoses to fuel tank and air cleaner.
Loosen the clamps and disconnect the hoses from the engine.

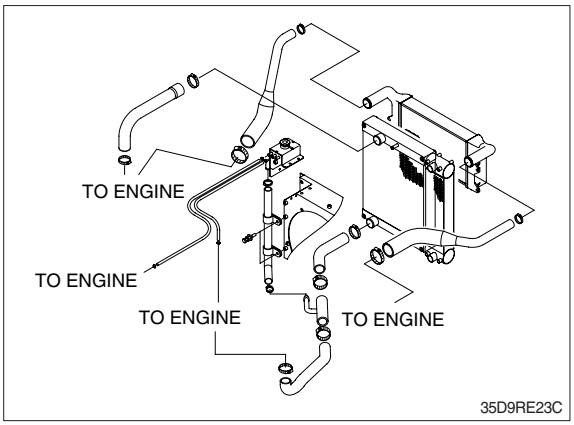


⑤ Exhaust pipe.
Loosen the V-band clamp and disconnect the pipe from the engine.



(4) Radiator hose

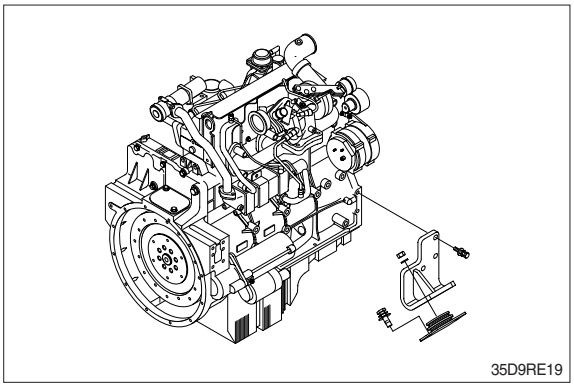
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.



(5) Mounting bolt

Attach a crane to the engine hook and raise, then remove mounting bolts. Raise the engine slightly, slide towards the radiator, then lift up.

※ When sliding the engine, be careful of the collision engine and radiator.



2) INSTALLATION

Installation is the reverse order of removal, but be careful of the following points.

(1) Tighten the engine mounting bolts and nuts.

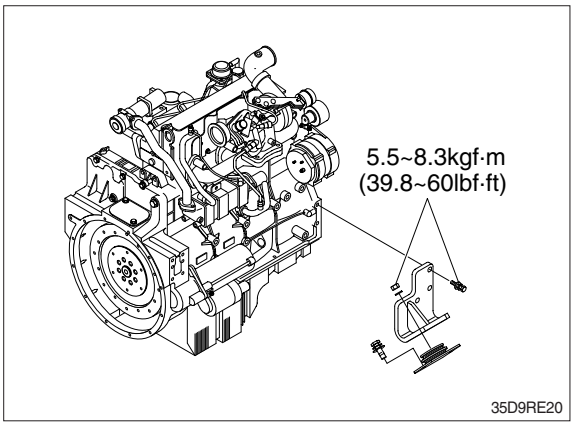
(2) Tighten the engine mounting bracket bolts.

※ Do not remove the bolts unless necessary. Loctite is coated over the threads of bolt. So, once the bolts were removed, coat them with loctite (#243) when installing.

※ Before installing the bolts, loctite in the holes should be removed by a tap.

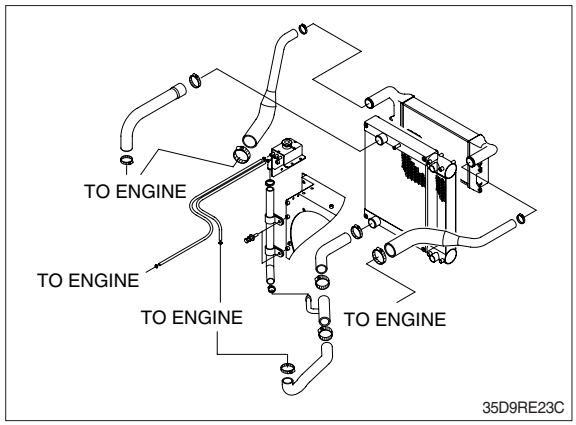
(3) Tightening torque of mounting bolt installing to torque converter housing.

· 5.5~8.3 kgf·m (39.8~60.0 lbf·ft)



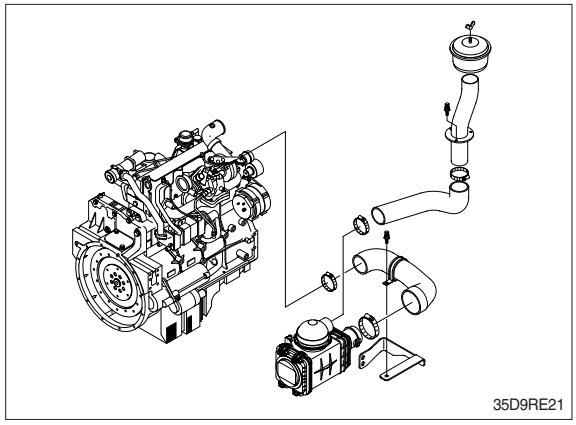
(4) Radiator hoses

Insert the radiator hoses securely and fit the clamps.



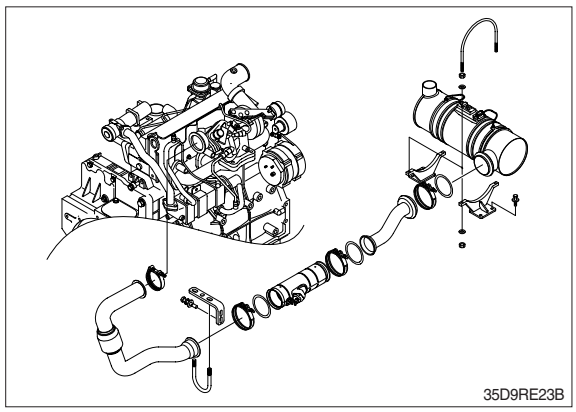
(5) Air cleaner hose

Insert the air cleaner hose securely and fit a clamp.



(6) Exhaust pipe

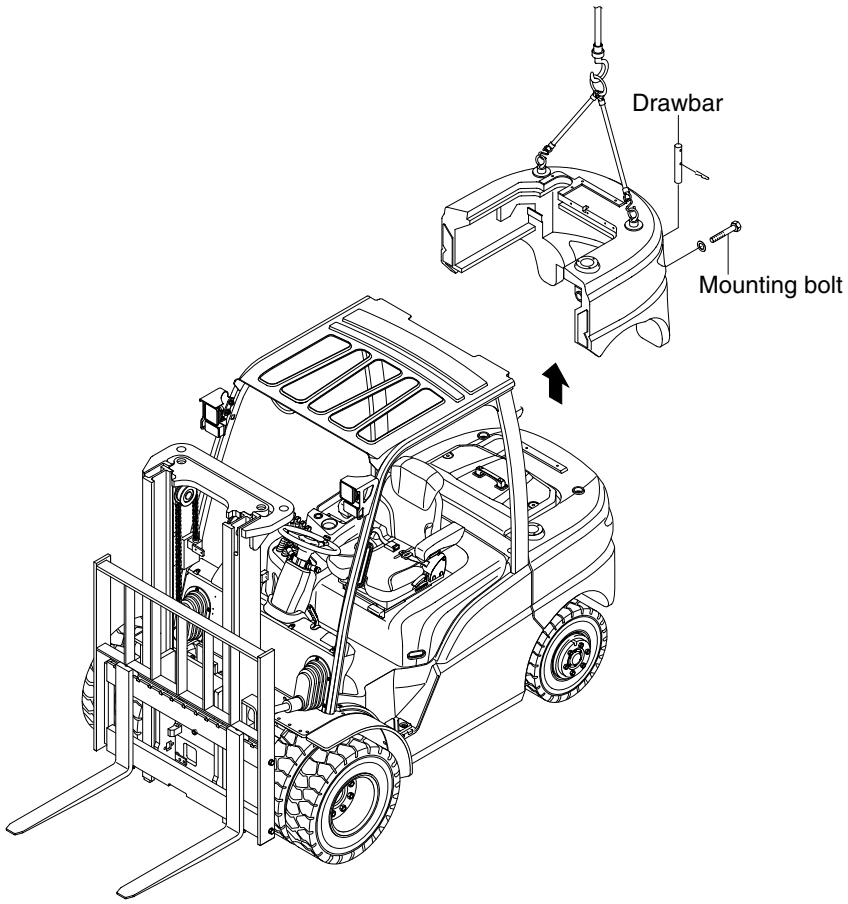
Insert the exhaust pipe to the engine securely and fit a V-band clamp.



5. STEERING AXLE

1) REMOVAL

Counterweight — Rear wheel — Hose and pipe — Mounting bolt



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(1) Counterweight

Hold the counterweight with hoist bars, and raise it with a crane.

Remove the mounting bolts, raise slightly and move it slowly to rear side.

· Weight of counterweight(standard)

35D-9	1820 kg (4010 lb)	45D-9	2540 kg (5600 lb)
40D-9	2180 kg (4810 lb)	50DA-9	2880 kg (6350 lb)

· Tightening torque : 199±29.9 kgf·m (1440±216 lbf·ft)

(2) Rear wheel

Remove mounting bolt and hub nut with socket wrench and then carefully take out the tire assembly.

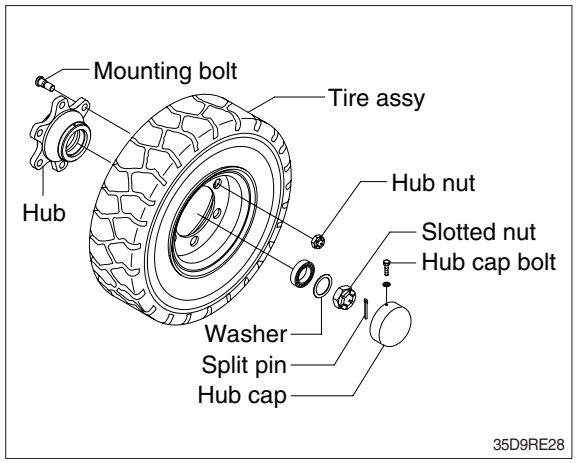
· Tightening torque

- Hub nut

  35.0±3.5 kgf·m (253±25.3 lbf·ft)

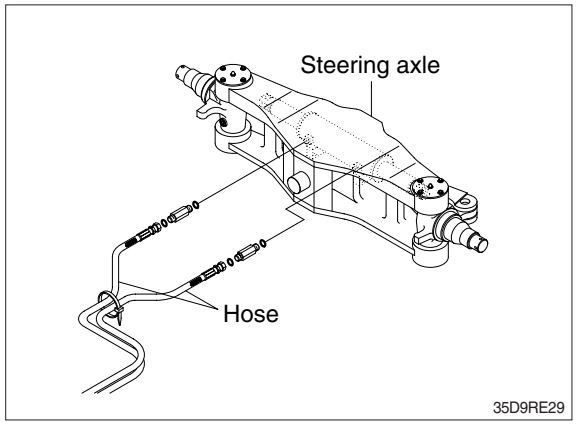
- Hub cap bolt

  1.15±0.15 kgf·m (8.3±1.1 lbf·ft)



(3) Hose

Disconnect the hoses from the steering axle.



(4) Mounting bolt

Put a block under the steering axle, support on a truck, an raise the frame with a crane. Remove the mounting bolts installing to the frame, and pull out to the rear.

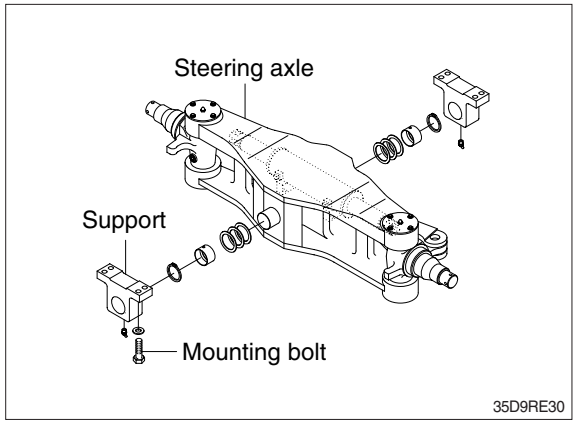
There are shims between the support and steering axle to prevent play.

· Mounting bolt tightening torque

19.6±2.9 kgf·m (142±18.1 lbf·ft)

※ Apply loctite #277 on the thread before tightening.

※ Tighten the slotted nut to the torque 20 kgf·m and loosen it to adjust the preload (0.3~0.4 kgf·m) and fit the split pin.



SECTION 3 POWER TRAIN SYSTEM

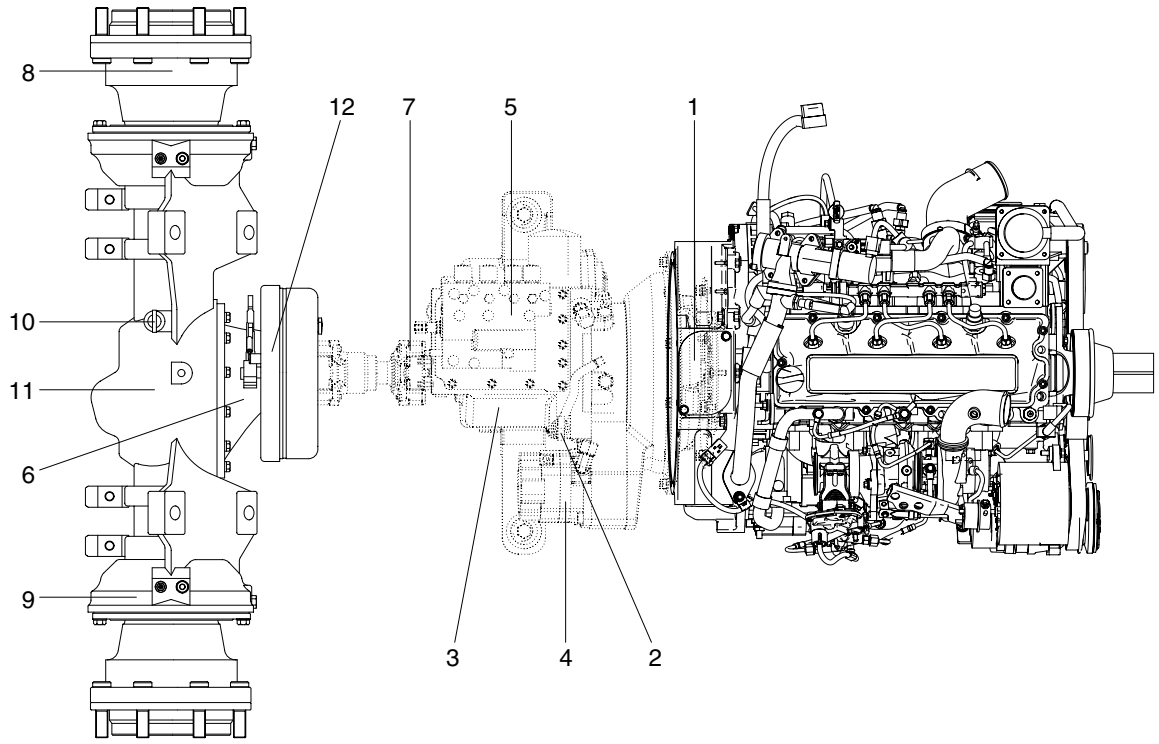
Group 1 Structure and operation ····· 3-1
Group 2 Inspection and troubleshooting ····· 3-13
Group 3 Disassembly and assembly ····· 3-21

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN COMPONENT OVERVIEW

1) STRUCTURE



35D9TA01

1	Torque converter	5	T/M control valve	9	Disk brake (service)
2	T/M oil level gauge	6	Differential	10	Drive axle oil level gauge
3	Transmission	7	Drive shaft	11	Drive axle
4	T/M oil pump	8	Drive wheel	12	Parking brake

2) OPERATION

Power train system consists of engine, torque converter (1), transmission (3), drive shaft (7), drive axle (11) and drive wheel (8).

Engine power is transmitted to the transmission (3) through the torque converter (1).

Transmission (3) which operates as a type of regularly and continuously engaged counter shaft shifting by 2 stage both forward and reverse consists of 4 hydraulic clutch packs.

Clutch piston is released by tension of spring.

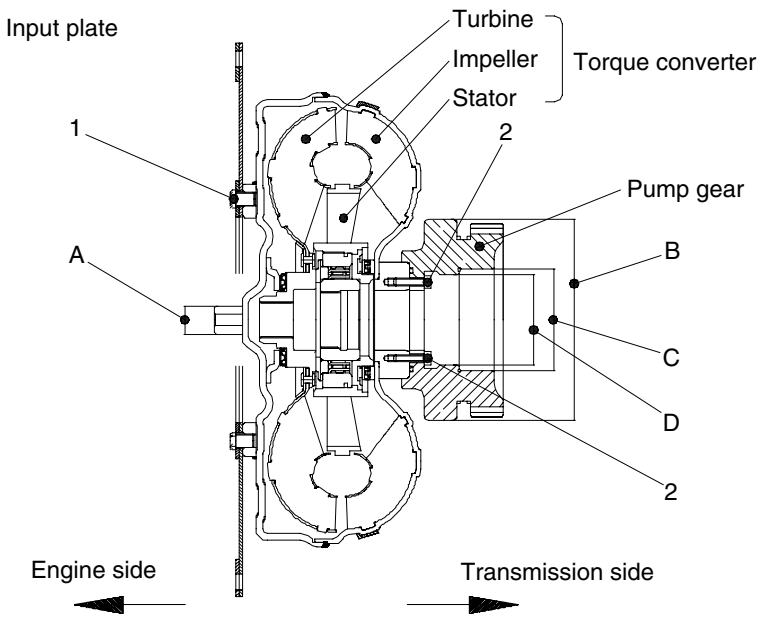
The power is transmitted to spiral gear and bevel gear set of differential through the output gear and then goes to the drive wheel via drive axle.

3) SPECIFICATION

Item			Unit	Specification
Torque converter	Type		-	3 elements 2 phase 1 stage
	Power transmit		-	Torque converter
Transmission	Type/Gear shift		-	Power shift / F2 : R2
	Gear ratio	FR/RR 1 stage	-	2.550
		FR/RR 2 stage	-	1.218
	P.T.O system		-	Included
	T/M oil		-	ATF DEXRON III
	Oil quantity		ℓ	12
T/M valve	Type		-	Electric
Charging pump	Displacement		cc/rev	20.6
Drive axle	Gear ratio	Differential	-	2.923
		Planetary	-	4
		Total	-	11.692
	Axle oil		-	SHELL DONAX TD
	Oil quantity		ℓ	10.5
Brake	Service brake		-	Wet disk brake
	Brake oil		-	AZOLLA ZS32
	Parking brake		-	Seperated drum brake
Differential	Gear type		-	Spiral bevel gear
	Differential type		-	4 pinions

2. TORQUE CONVERTER

1) STRUCTURE



D357TA02

No	Item	Specification
1	Torque converter input plate	4.5±0.3 kg·m (32.5±2.2 lbf·ft)
2	Torque converter pump gear	2.0±0.3 kg·m (14.5±2.2 lbf·ft)
A	Pilot boss outer diameter	19.959 - 19.980 mm (0.786 - 0.787 in)
B	Oil seal outer diameter	134.9 - 135.0 mm (5.311 - 5.315 in)
C	Needle bearing outer diameter	68.000 - 68.019 mm (2.677 - 2.678 in)
D	Seal ring inner diameter	60.333 - 60.363 mm (2.375 - 2.376 in)

2) OPERATION

The torque converter is working according to the Trilok-system, i.e. it assumes at high turbine speed the characteristics, and therefore the favorable efficiency of a hydraulic clutch.

The converter will be defined according to the engine power so that the most favorable operating conditions for each installation case are given.

The Torque converter is composed of 3 main components :

Pump wheel - turbine wheel - stator (Reaction member)

These 3 impeller wheels are arranged in such a ring-shaped system that the fluid passes through the circulating components in the indicated order.

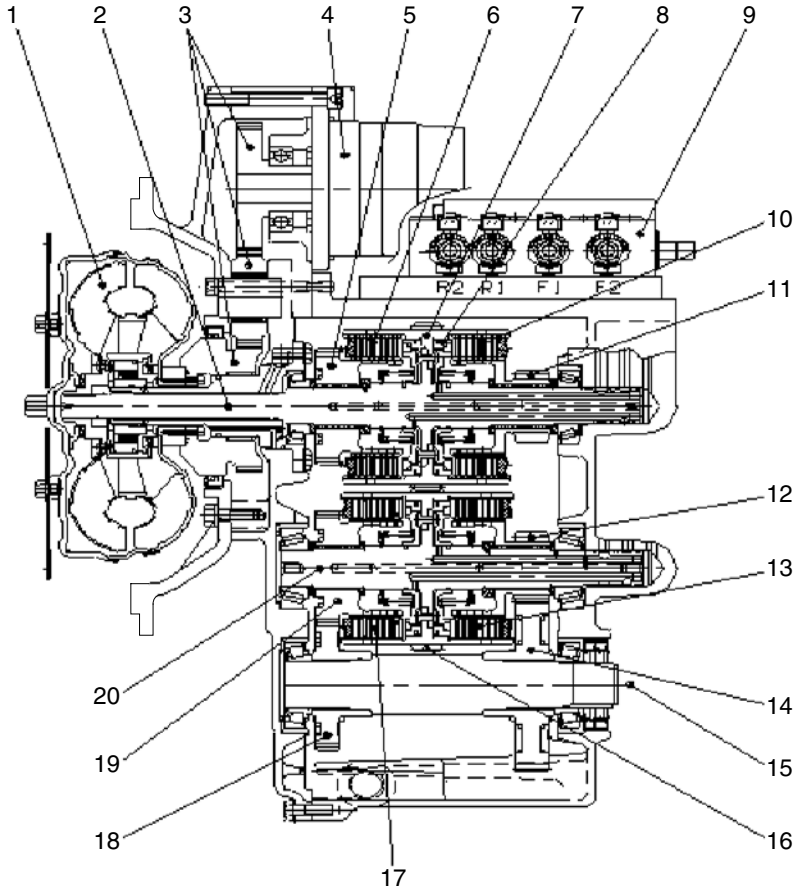
Pressure oil is constantly pressing out of the transmission pump through the converter. In this way, the converter can fulfill its task to multiply the torque of the engine, and at the same time, the heat created in the converter is absorbed through the escaping oil.

The oil, escaping out of the pump wheel, enters the turbine wheel and where the direction of flow is inversed.

According to the rate of inversion, the turbine wheel and with it also the output shaft, receives a more or less high reaction moment. The stator (Reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge direction to the pump wheel.
The stator receives a reaction moment, due to the inversion.
The relation between turbine and pump moment is called torque conversion. The conversion is increasing in correspondence with the speed difference of the pump and the turbine wheel.
Finally the maximum conversion will be broken down at turbine wheel.
With increasing output speed, the torque conversion is decreasing. The adoption of the output speed to a certain required output moment is infinitely variable and automatically achieved by the torque converter.

3. TRANSMISSION

1) STRUCTURE



35D9TA03

1	Torque converter	8	Clutch piston	15	Output shaft
2	Input shaft	9	Valve assembly	16	Clutch drum (FR)
3	3 P.T.O gears	10	Clutch (RR, 1 stage)	17	Clutch (FR, 2 stage)
4	Pump assembly	11	Gear (RR, 1 stage)	18	Gear (Output, 2 stage)
5	Gear (RR, 2 stage)	12	Gear (FR, 1 stage)	19	Gear (FR, 2 stage)
6	Clutch (RR, 2 stage)	13	Clutch (FR, 1 stage)	20	Counter shaft
7	Clutch drum(RR)	14	Gear (Output, 1 stage)		

2) OPERATION

Transmission enables to a power transmission and a gearshift by the operation of hydraulic friction clutch pack which is controlled through the torque converter.

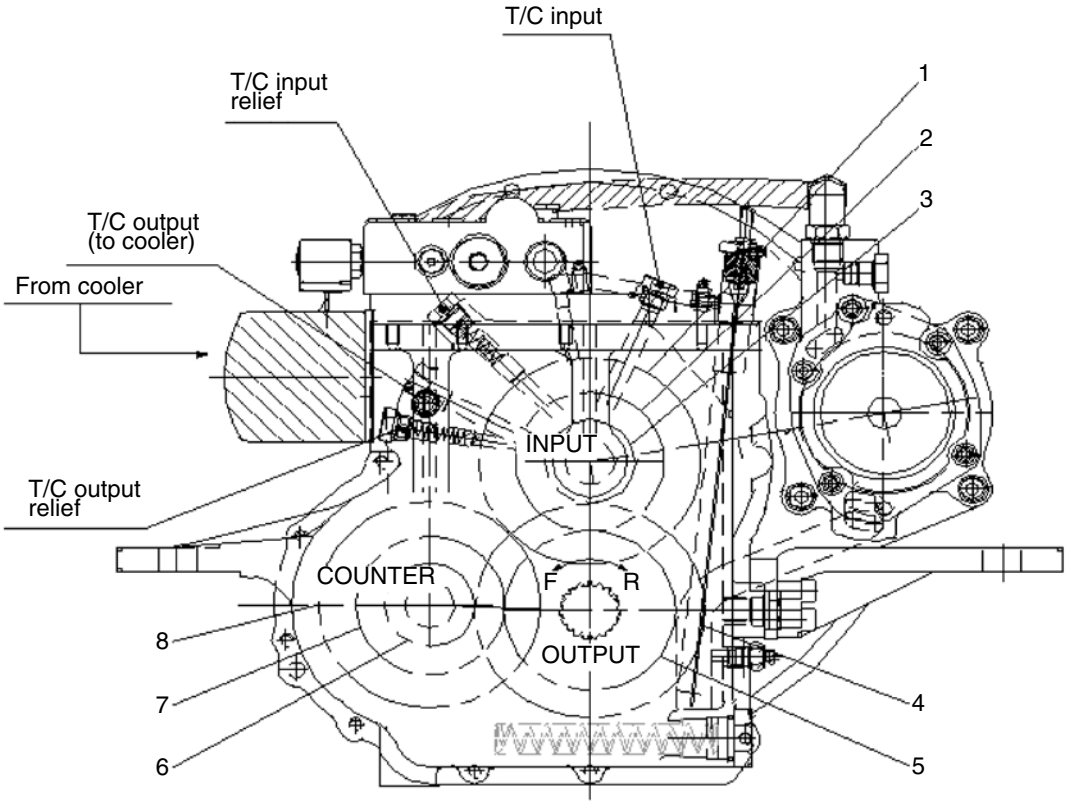
In accordance with the drive speed of vehicle, transmission shifts the gear to the optimal stage for a stable drive.

T/M transmits the power to drive axle by 2 stage each of forward and reverse gear selections.

T/M consists of 4 hydraulic clutches and it is released by spring tension.

Direction and gear stage are electrically changed. The power from the transmission is transmitted to all of the powertrain components.

3) TRANSMISSION GEAR ARRAY

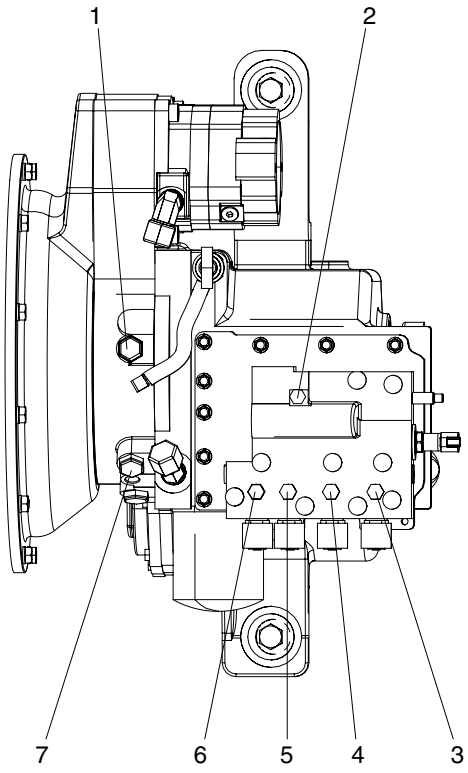


35D7ETA04

1	Cylinder clutch (RR)	4	Gear (Output, 1st stage)	7	Gear (FR, 2nd stage)
2	Gear (RR, 2nd stage)	5	Gear (Output, 2nd stage)	8	Gear clutch (FR)
3	Gear (RR, 1st stage)	6	Gear (FR, 1st stage)		

※ Selection of either forward or reverse gear makes all of the parts inside the T/M operate.

4) TRANSMISSION INPUT PORT



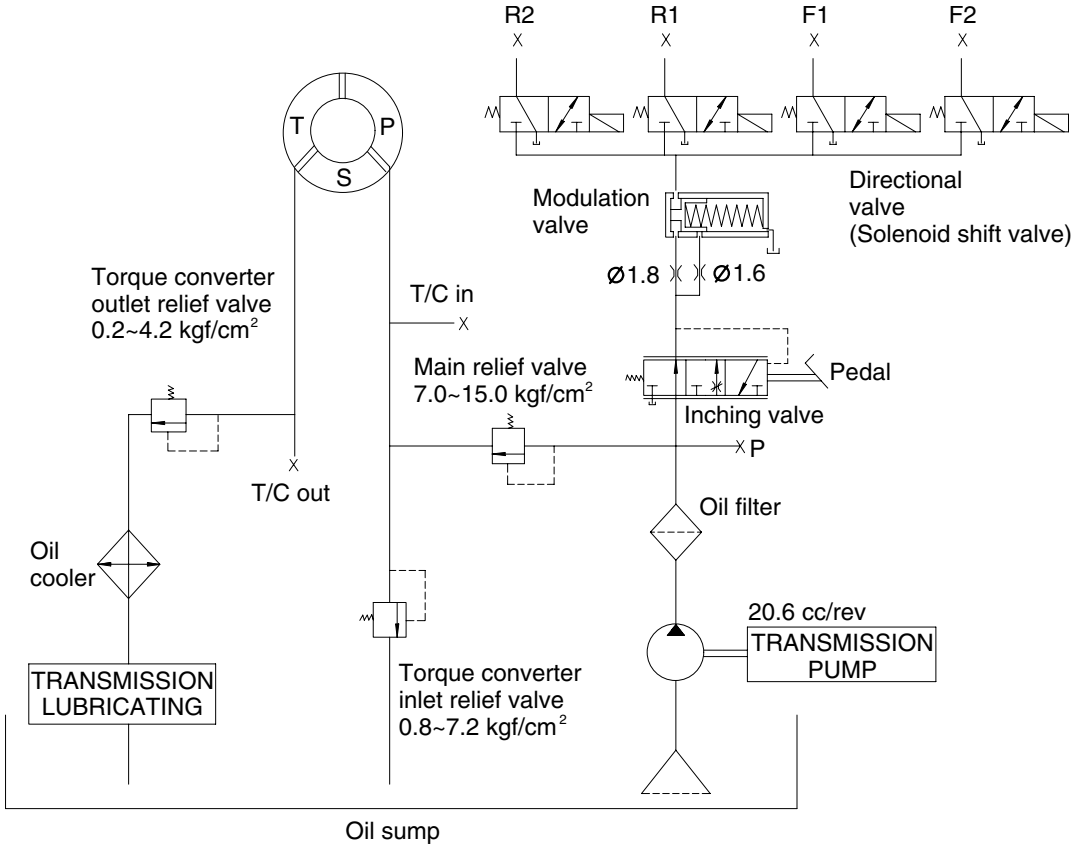
35D9TA05

1 T/C input port pressure
2 Main line pressure
3 FR 2nd stage pressure
4 FR 1st stage pressure
5 RR 1st stage pressure
6 RR 2nd stage pressure
7 T/C output port pressure

· Transmission pressure

Engine rpm	Unit	Main line (Neutral)	T/C input port (Neutral)	T/C output port (Neutral)	FR 1,2 stage clutch	RR 1,2 stage clutch
Idle	kgf/cm² (psi)	6.5~13.2 (92.5~187.7)	0.7~4.2 (9.9~59.7)	0.2~1.2 (2.8~17.1)	6.5~13.2 (92.5~187.7)	6.5~13.2 (92.5~187.7)
1300	kgf/cm² (psi)	7.5~14.5 (106.7~206.2)	1.5~9.1 (21.3~129.4)	0.7~2.5 (10.0~35.6)	7.5~14.5 (106.7~206.2)	7.5~14.5 (106.7~206.2)
2200	kgf/cm² (psi)	7.5~15.0 (106.7~213.4)	2.6~11.1 (37.0~157.9)	1.0~4.2 (14.2~59.7)	7.5~15.0 (106.7~213.4)	7.5~15.0 (106.7~213.4)

5) TRANSMISSION INPUT PORT



D357TA06

(1) Specification

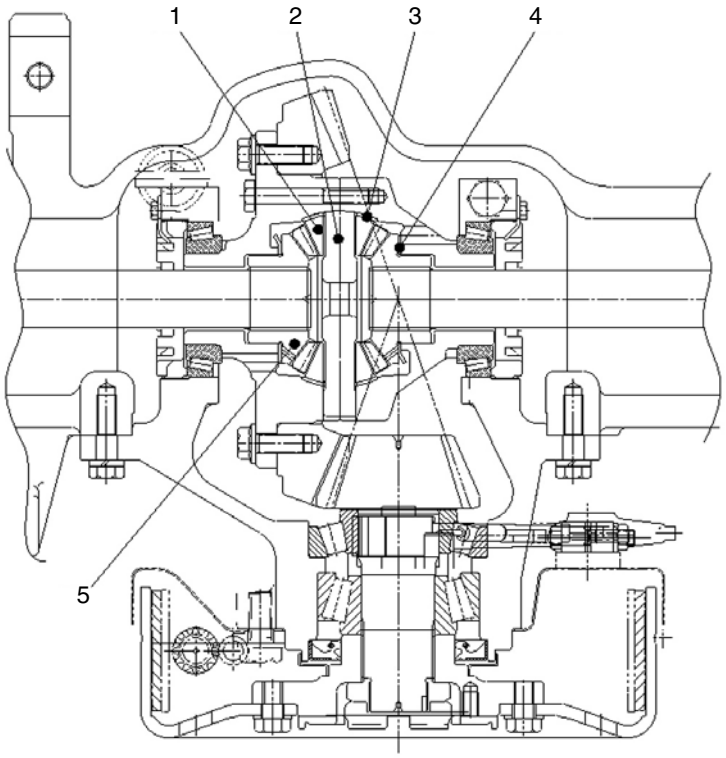
Item	Unit	Specification
Rated flow	ℓ /rpm	37.4 / 2200
Main relief pressure	kgf/cm²(psi)	7.0 ~ 15.0 (99.6~213.4)
T/C relief pressure	kgf/cm²(psi)	0.8 ~ 7.2 (11.4~102.4)
Clutch pressure	kgf/cm²(psi)	7.0 ~ 15.0 (99.6~213.4)
Residual pressure (Clutch release condition)	kgf/cm²(psi)	Max. 0.3(4.3)

(2) Electric input data

Item	Unit	Specification
Initial coil current at 20°C	A / VDC	0.7/24
Resistance at 20°C	Ω	39.3
Shifting time	sec	1.0 ~ 1.6
Connector	-	DR/D Models With Diode

4. DIFFERENTIAL CARRIER ASSEMBLY

1) STRUCTURE



35D7ETA07

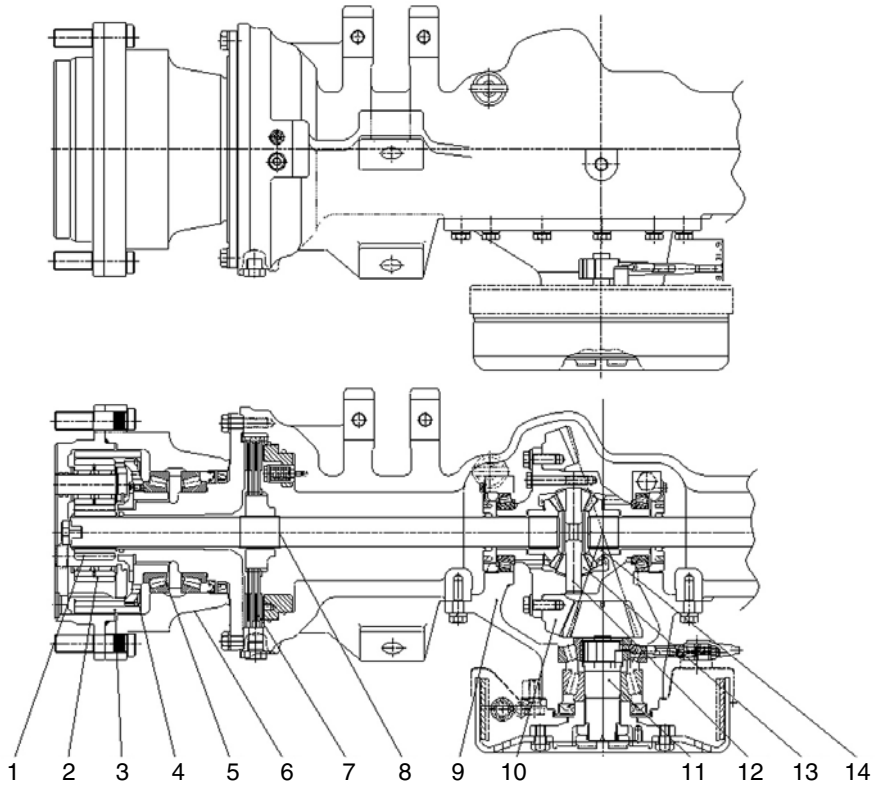
No	Item	Unit	Specification
1	Differential pinion gear inner diameter	mm (in)	20.000 - 20.021 (0.787~0.788)
2	Spider outer diameter	mm (in)	19.959 - 19.980 (0.786~0.787)
3	Pinion gear washer	mm (in)	1.92 - 2.08 (0.076~0.082)
4	Side gear washer	mm (in)	1.95 - 2.05 (0.077~0.081)
5	Side gear	-	-

2) OPERATION

Differential transmits the power from the transmission to drive wheel.
When the vehicle is running one side wheel rotates slower than the other side wheel.
Differential is composed of 4 pinions (1), 2 side gears (5) and 1 spider (2).
The spider is meshed vertically between 4 pinions (1) and 2 side gear (5), so the engagement become a right angle.

5. DRIVE AXLE

1) STRUCTURE



35D7ETA08

1	Sun gear	6	Hub assy	11	Pinion shaft
2	Planetary gear	7	Disk brake	12	Spider
3	Inner gear	8	Drive shaft	13	Differential pinion gear
4	Inner gear carrier	9	Differential carrier assy	14	Differential side gear
5	Tapered bearing	10	Ring gear		

2) OPERATION

Drive axle which consists of differential carrier assembly (9), drive shaft (8) and hub assembly (6) transmits the drive force from transmission to drive wheel.

Pinion shaft (11) is connected to transmission output shaft and spline.

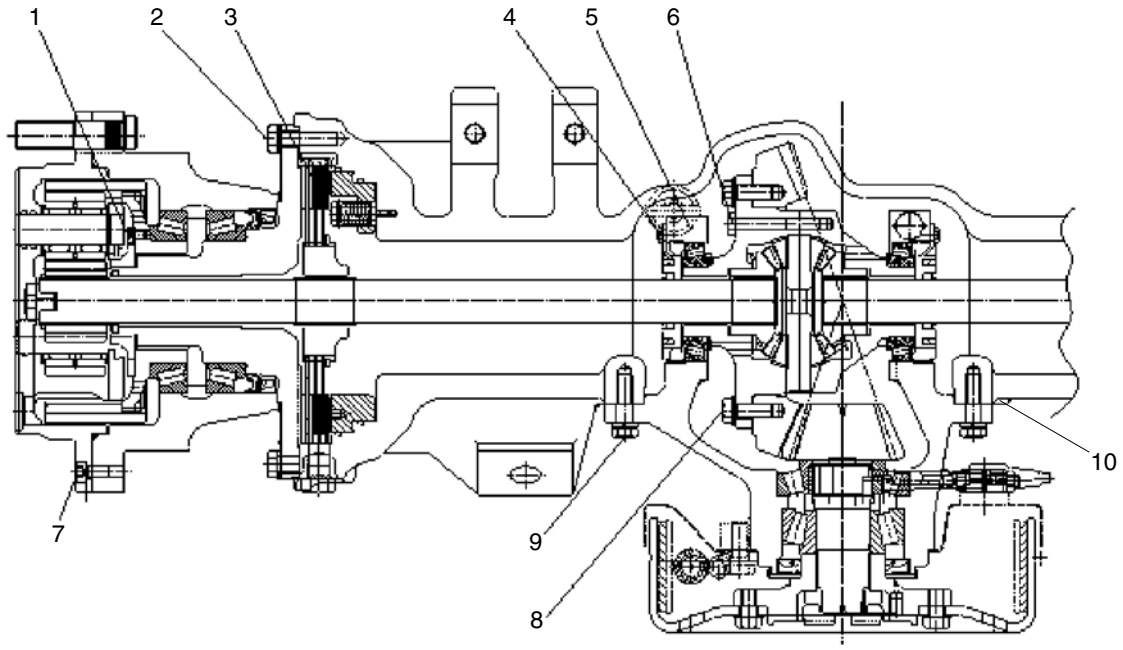
The power of transmission is transmitted to differential which consists of pinion shaft (11) and ring gear (10) and the differential rotates the drive shaft.

The differential transmits the drive force from transmission to wheels and one wheel's rotation speed is differ from the other.

The differential consists of 4 pinions (13) , 2 side gears (14) and spider and the engagement between 4 pinions (13) and side gear (14) makes a right angle.

Side gear (14) and drive shaft (8) are connected with spline and the drive shaft (8) consists of planetary gear (2), inner gear (3), wheel hub (6) and drive wheels.

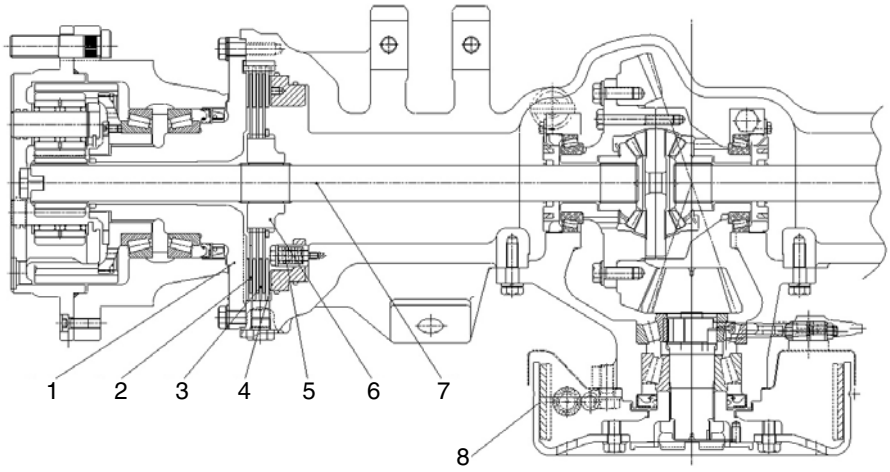
3) DRIVE AXLE TIGHTENING TORQUE



35D7ETA09

No	Item	Specification
1	Inner carrier	2.2±0.3 kgf·m (15.9±2.2 lbf·ft)
2	Spindle	12±0.5 kgf·m (86.8±3.6 lbf·ft)
3	Adjust bolt for service piston	1.5±0.1 kgf·m (10.8±0.7 lbf·ft)
4	Adjuster nut	1.0±0.2 kgf·m (7.2±1.4 lbf·ft)
5	Differential cap	16±0.5 kgf·m (115.7±3.6 lbf·ft)
6	Differential case	6±0.5 kgf·m (43.4±3.6 lbf·ft)
7	Wheel hub	3.0±0.3 kgf·m (21.7±2.2 lbf·ft)
8	Ring gear	13.5±0.5 kgf·m (97.6±3.6 lbf·ft)
9	Differential carrier assembly	11.5±0.5 kgf·m (83.2±3.6 lbf·ft)
10	Connection between differential carrier and drive axle	LOCTITE #5127

4) DISK BRAKE



35D7ETA10

1	Spindle	4	Service piston	7	Drive shaft
2	Steel plate	5	Service piston adjust bolt	8	Parking brake
3	Disk plate	6	Spline collar		

Sealed up structure of hydraulic multi-disk brake system secures good brake performance even in the high humid or dusty area.
Because it is possible to use the brake semi-permanently, there is no need to replace or change the lining as drum type brake do. Also with self-adjust of friction plate clearance, it's easy to prevent the break performance drop due to friction material wear.

Major components are 3 disk plates (3), 4 steel plates (2), service piston (4) and 4 piston adjust bolts (5).
Braking take places when the discs and plates are pressed each other which make rotation resistance to the collar (6) and the drive shaft (7).

GROUP 2 INSPECTION AND TROUBLESHOOTING

1. INSPECTION

To check the problems of transmission, operate the machine and test its performance.
Check and record the abnormal noise and if the machine doesn't operate perfectly, refer to problem and possible cause in the troubleshooting table.

1) VISUAL CHECK

(1) Start engine and check T/M oil level at the neutral gear shift.
(2) Check any kind of damage or leakage on the oil piping, hose, connection, etc.
(3) Operate the Forward/Reverse lever to both of directions.
(4) Check the contamination in the strainer and filter inside the transmission.
① If rubbed paper particles detected, check clutch defects.
② If metal particles detected inside the filter, check metallic friction inside the T/M or mechanical faults.
③ If rubber particles detected, check seal or hose defects.
④ If Aluminum particles detected, check converter or control valve damage.
(5) If metal or rubber particles found, clean all of the T/M hydraulic parts.
(6) Replace damaged parts with the new one.

2) DRIVE CHECK

Fill T/M oil to the proper level before starting the machine.
Improper oil level can cause the damages on the components.

(1) After starting engine, step on the brake pedal and then operate the Forward/Reverse lever to both of directions.
(2) If the machine moves to each of directions, it will operates normally but check noise and cause and then note them.
In case of abnormal operation, refer to troubleshooting table.

2. TROUBLESHOOTING

1) TRANSMISSION

(1) Check list during operation list

No	Condition	Possible causes	Correction
1	Transmission does not operate in any speed or does not engage(slips) in all speeds	(1) Low oil pressure or no oil pressure caused by : a. Low oil, no oil, or thick oil. b. Inching control valve linkage loose, broken or adjustment is not correct. c. Inching valve spool stuck (held) open. d. Failure of the oil pump or a defect in the oil pump. e. Converter drive tangs worn off or not engaged into pump or broken bolt. f. Main regulator valve stuck open. g. Restriction in the oil flow circuit such as dirty oil screen.	(1) Check to oil level. a. Check to mix another oil. b. Check to tightening bolt or changing a control valve ass'y. c. Changing a spool of the control valve ass'y or check it. d. Changing the oil pump or have to check. e. Check to tightening torque of bolt from Torque Converter Gear. f. Check to Control Valve Ass'y. g. Check to suction filter due to a clogged from a mixed foreign materal.
2	Transmission does not shift	(1) Low oil pressure. (2) Main regulator valve will not move (stuck). (3) Solenoids or related electric components are out of order.	(1) Check to oil level. (2) Check Control Valve Ass'y. (3) Check to Solenoids Valve or related electric components.
3	Transmission gets hot.	(1) Restriction in cooling circuit. (2) Oil level too high or too low. (3) Low pump pressure -worn or damaged pump. (4) Converter one way clutch worn and slipping. (5) Air mixed in the oil. Air leaks on the intake side of the pump. (6) Low oil flow through converter. (7) Wrong application for vehicle (loads are too heavy for the lift truck). (8) Too much inching operation (slipping the clutch plates and discs). (9) Too much stalling of torque converter. (10) Cooler bypass valve stuck(held) open, full oil flow does not go through oil cooler.	(1) Check to Restriction in cooling circuit of transmission. (2) Check to oil level or replacement. (5) Check to transmission inside cover. (6) A plugged(restriction) oil flow passage. (7) Check to reliable work place under circumstance. (8) Check to Control Valve Ass'y. (9) Check to Torque Converter Ass'y or replacement.

No	Condition	Possible causes	Correction
4	Clutch engagement is slow or loss of power during engagement.	(1) Low oil pressure. (2) Low converter pressure. (3) Air mixed in the oil. a. Air leaks on suction side of pump. b. Low oil level also causes aeration. (4) Inching valve linkage adjustment is not correct.	(1) Check to oil level. (2) Check touque converter assy. (3) Check to transmission inside cover. a. Air mixed in the oil air on the intake side of the pump. b. Thin oil level.
5	Transmission operates in forward speeds only.	(1) Discs and plates have too much wear in forward direction clutches. (2) Leakage at the seals. (3) Forward clutch components have damage. a. Leakage caused by worn or broken seal around metal sealing rings. b. Leakage caused by worn or broken seal around clutch piston. c. Failure of other components. (4) Solenoids or related electric components are out of order.	(1) Check to disc and plate in clutch assy. (2) Replace to seal. (3) Replace to relate with other component. (4) Check to solenoids valve in control valve.
6	Transmission operates in reverse speeds only.	(1) Discs and plates have too much wear in forward direction clutches. (2) Leakage at the seals. (3) Foward clutch components have damage. a. Leakage caused by worn or broken seal around metal sealing rings. b. Leakage caused by worn or broken seal around clutch piston. c. Failure of other components. (4) Solenoids or related electric components are out of order.	(1) Check to disc and plate in clutch assy. (2) Replace to seal. (3) Replace to relate with other component. (4) Check to solenolds valve in control valve.
7	Low stall speed.	(1) Engine performance is not correct. (2) The one-way clutch of the torque converter does not hold.	(1) Check to engine component. (2) Check to torque converter or replacement.
8	High stall speed in all transmission speeds and directions.	(1) Low oil level. (2) Air in the oil. (3) Clutches slip(clutch plates slide in relation to one another). (4) Torque converter failure.	(1) Check to oil level. (2) Check to mix another oil. (3) Check to inner disc and plate. (4) Replace to torque converter.

No	Condition	Possible causes	Correction
9	High stall speed in one speed or one direction.	(1) There is a leak in that clutch circuit. (2) There is a failure if the clutch in that speed or direction.	(1) Check to clutch assy and then replace to relate with other comonent. (2) Replace the clutch assy.
10	Clutch engagement is slow and makes rough shifts.	(1) Inching valve adjustment is not correct. (2) Inching valve is not completely closed or orifice has dirt(plugged). (3) Low main pressure. (4) Low directional clutch pressure. (5) Internal oil leaks. (6) Valve spool springs are weak or have damage.	(1) Adjust to inching valve (2) Check to orifice has dirt(plugged) and then remove to foregin materal. (3) Check to the oil flow circuit in the transmission. (4) Check to oil flow circuit of clutch. (5) Replace to a leak component. (6) Replace to spring.
11	Vehicle operates in one direction and creeps in that direction in NEUTRAL. Engine stalls when shifted to the other direction.	(1) Failure of clutch in the direction the lift truck moves. Clutch discs or plates are warped(damaged) or held together because of too much heat. (2) Failure of the valve spool in the direction the lift truck moves. The spool stuck(held) in the engaged position possibly caused by metal burrs(particles) or dirt.	(1) Raplace have to relate with other component. (2) Replace have to relate with other component.

(2) Check list from operation noises

No	Condition	Possible causes	Correction
1	Noise in NEUTRAL only.	(1) Worn bushing in pump assembly. (2) Worn one-way clutch in torque (3) converter. (4) Oil level low. Converter housing or converter tangs not in alignment with engine or transmission pump.	(1) Changing is related with other componrent of charging. (2) Charging to Torque Converter Ass'y. (3) Check to oil level. (4) Should be alignment with engine or transmission pump.
2	Pump noise not normal.	(1) A loud sound at short time periods gives an indication that foreign material is in the transmission hydraulic system. (2) A constant loud noise is an indication of pump failure.	(1) Charging to the Oil Pump. (2) Charging to the Oil Pump.
3	Noise in the transmission that is not normal.	(1) Converter housing or converter tangs not in alignment with engine or transmission pump. (2) Transmission components have wear or damage. a. Damaged gears. b. Worn teeth or clutch plates and/ or clutch discs and slipping clutch plates and discs noise. c. Failure of the thrust washers. d. Other component parts have wear or damage.	(1) Should be alignment with engine or transmission pump. (2) Transmission components have wear or damage. a. Charging to Gear. b. Charging to Plate and Disc. c. Charging to Thrust washer. d. Charging to other component.
4	Noise in the control valve.	(1) Air in the hydraulic system. a. Air leakage on suction side of the pump or Low oil level that causes aeration. (2) Restrictions in oil passage. (3) Valve spools movement has restriction.	(1) Charging to Control Valve Ass'y (2) Charging to Control Valve Ass'y (3) Charging to Control Valve Ass'y

(3) Check list from pressure test

No	Condition	Possible causes	Correction
1	Low pressure to FORWARD and REVERSE clutches.	(1) Inching valve linkage adjustment is not correct. (2) Inching valve spool held(stuck) open. (3) Clutch piston seals cause leakages. (4) A defective regulator valve spring. (5) Low oil pressure, see Probable Cause for Low oil pressure. (6) Cooler external lines are not connected correctly.	(1) Adjust to inching valve. (2) Change to inching spool. (3) Change to Clutch and Piston Seal. (4) Change to the spring of the Regulator. (5) Check to oil flow circuit of the transmission. (6) Check to the Cooler external lines.
2	Clutch pressure and main pressure are high.	(1) Pressure regulator valve is not free to move (stuck). (2) A restriction in the hydraulic circuit.	(1) Check to adjusting pressure valve. (2) Check to the hydraulic circuit.
3	Pressure to one clutch is low.	(1) Clutch piston seal alignment is not correct, oil leaks through. (2) Seal rings on shaft or clutch piston seals are broken or worn. (3) Control valve surface not flat or gasket has damage.	(1) Change to clutch piston seal. (2) Change to shaft sealing and clutch piston seal. (3) Change to the control valve gasket.
4	Low main line pressure.	(1) Low oil level. (2) Main regulator valve movement is restricted. (3) Transmission pump is worn. (4) Inner oil leakage. (5) Low oil pressure.	
5	High converter pressure.	(1) Main regulator valve stuck open so most of the flow goes to the converter. (2) A restriction inside the converter assembly. (3) A plugged (restriction) oil flow passage.	(1) Checjk to adjusting main valve. (2) Change to Torque converter ass'y. (3) Check to the oil flow hole of the transmisson.
6	Low converter pressure.	(1) Main regulator valve movement is restricted (plugged).	(1) Check to main regulator valve or change.
7	Converter outlet pressure or cooler inlet pressure is low.	(1) Low oil pressure. (2) Cooler bypass valve stuck open.	(1) Check to the oil level. (2) Cooler bypass valve stuck open.
8	Converter outlet pressure or cooler inlet pressure too high.	(1) Restriction (plugging) in oil cooler lines or a plugged oil cooler.	(1) Check to the oil cooler lines

2) DRIVE AXLE

No	Condition	Possible causes	Correction
1	Constant noise in differential.	(1) Oil is not enough (Replace interval : 50 hrs first, then every 500hrs).	· Refueling lubricating oil
		(2) Wrong kind of oil.	· Exchange lubricating oil
		(3) Wheel bearings out of adjustment or have a defect.	· Exchange bearing
		(4) Drive gear and pinion not in adjustment for correct tooth contact.	· Re-assemble
		(5) Teeth of drive gear and pinion have been damage or worn.	· Exchange dameged gear
		(6) Gear backlash is too much or too little.	· Exchange differential gear set
		(7) Loose or worn on pinion bearings.	· Exchange bearing
		(8) Loose or worn on side bearing.	· Exchange bearing
2	Noise at different intervals.	(1) Ring gear does not run even.	
		a. Bolts on drive gear are not tightened correctly.	· Tighten bolts
		b. Drive gear has a defect (warped)	· Exchange dameged drive gear set
		(2) Loose or broken differential bearings.	· Exchange bearing
3	Noise on turns only.	(1) Differential pinion gears are tight on the spider.	· Exchange differential pinion gear or spider
		(2) Side gears are tight in differential case.	· Exchange differential side gear
		(3) Differential pinion or side gears have a defect.	· Exchange differential gear set
		(4) Thrust washers worn or have a damage.	· Exchange differential washer
		(5) Too much clearance (backlash) between side gears and pinions.	· Exchange differential gear set
4	Leakage of the oil.	(1) Leakage through axle hub carrier	
		a. Too much oi	· Adjust oil level
		b. Wrong kind of oil.	· Exchange lubricating oil
		c. Much restriction on air eather.	· Exchange air breather
		(2) Leakage around pinion shaft.	
		a. Too much oil.	· Adjust oil level
		b. Wrong kind of oil.	· Exchange lubricating oil
		c. Much restriction on air eather.	· Exchange air breather
		d. Oil seal worn or not installed correctly.	· Exchange oil seal

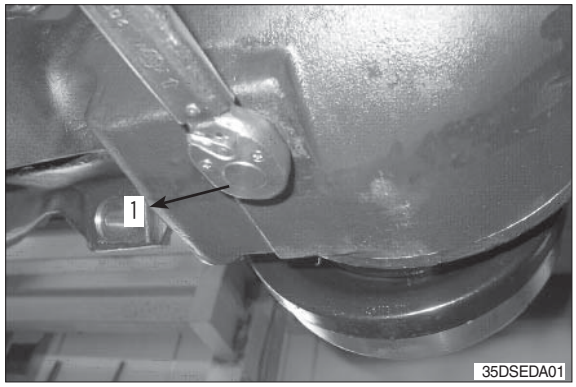
No	Condition	Possible causes	Correction
5	Drive wheels do not rotate	(1) Broken axle shaft. a. Loose wheel bearings. b. Axle shaft too short. c. Loose flange studs or nuts. (2) Drive gear teeth have been damaged. (3) Side gear on differential damaged. (4) Differential pinion shaft or spider broken	 · Re-assemble wheel bearings. · Replace drive shaft · Tighten studs or nuts · Exchange damaged drive gear set · Exchange damaged gear · Exchange damaged gear

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. DISASSEMBLY OF DRIVE AXLE

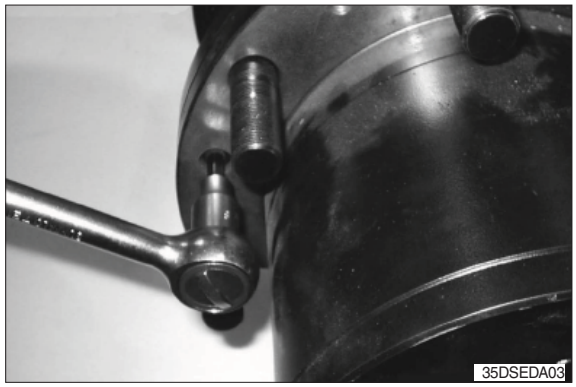
1) DISASSEMBLE WHEEL HUB SUB ASSEMBLY

(1) Loosen oil drain plug using torque wrench (1) in axle housing and drain oil..

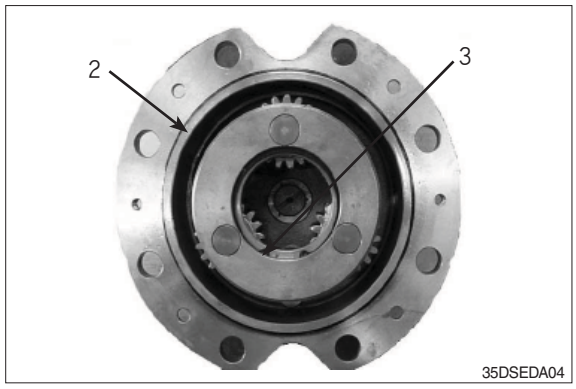


(2) Loosen oil drain plug in planetary housing and drain oil.

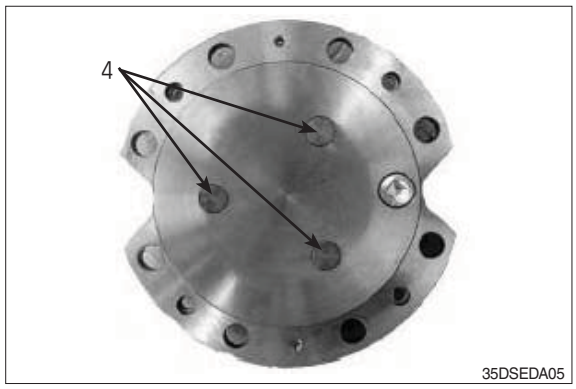
(3) Loosen 4 socket head bolts and remove the planetary carrier.



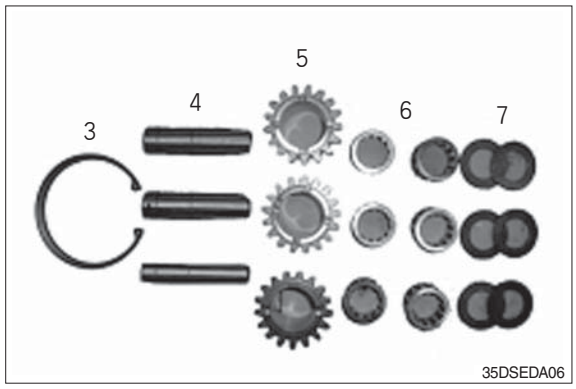
(4) Remove o-ring (2) and snap ring (3) from the housing of planetary.



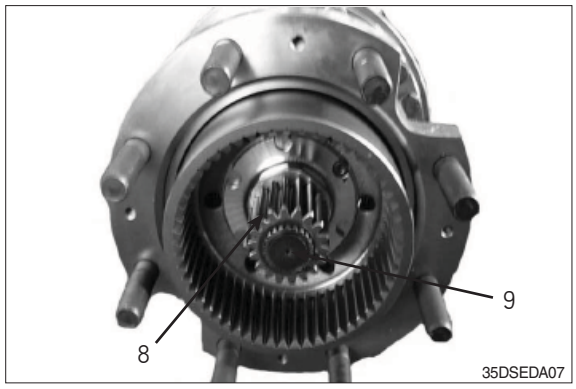
(5) Remove 3 pins (6) with a plastic hammer.



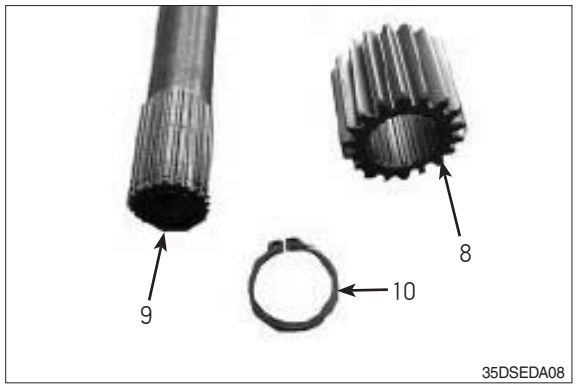
(6) Remove needle bearings (6), planet gears (5) and thrust washers (7).



(7) Remove sun gear (8) and drive shaft (9).

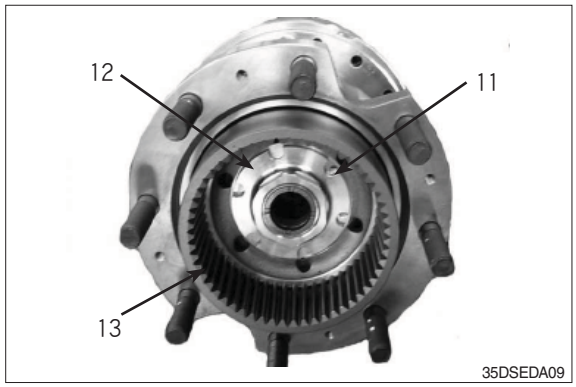


(8) Remove snap ring (10) and then remove sun gear from the shaft (9).

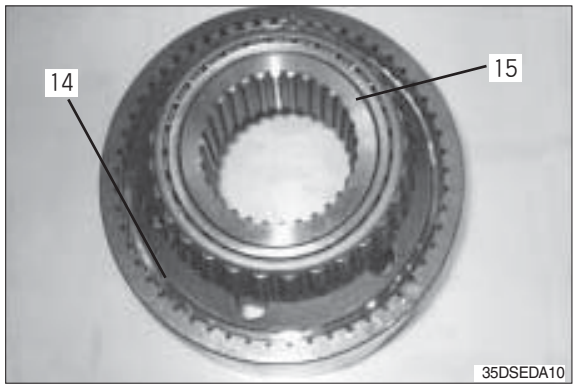


(9) After removing bolt (11), remove ring gear (13) and torque plate assembly (12) from the spindle.

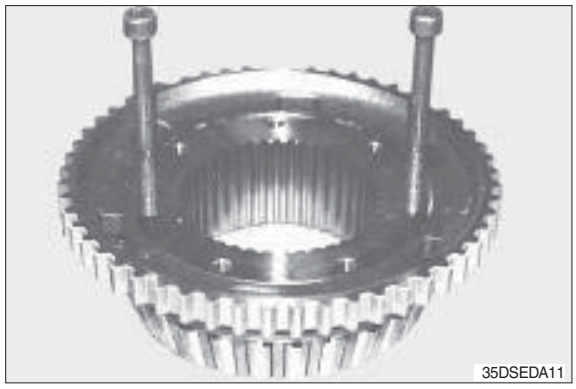
⚠ **Must Measure the rolling resistance of tapered roller bearing.**



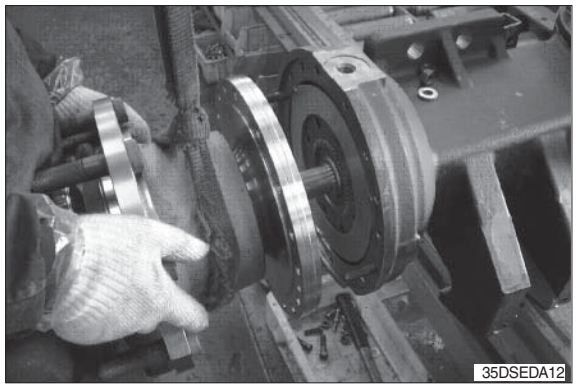
(10) Remove c-ring (14) from the ring gear and pull the spindle (15) out of the ring gear.



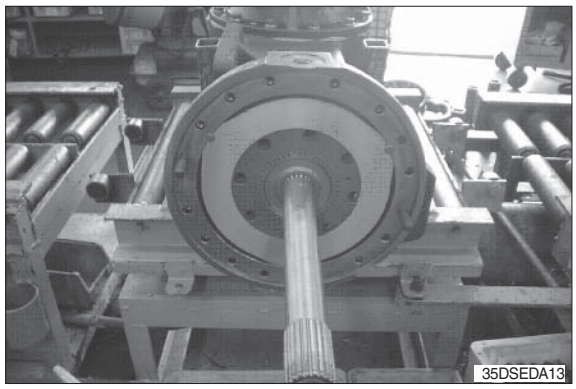
(11) Pull out bearing inner race on flange using 2 × M8 bolts.

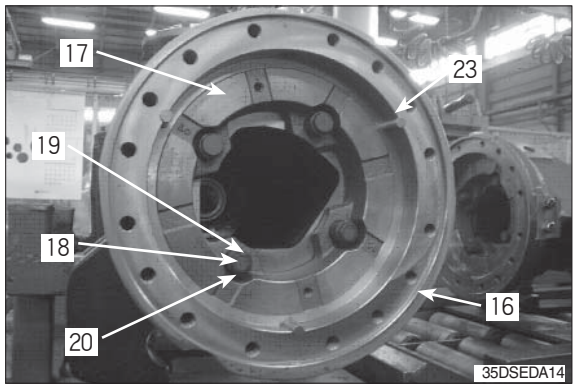


(12) Remove wheel hub from the axle housing after loosen 14 bolts and 2 nuts.



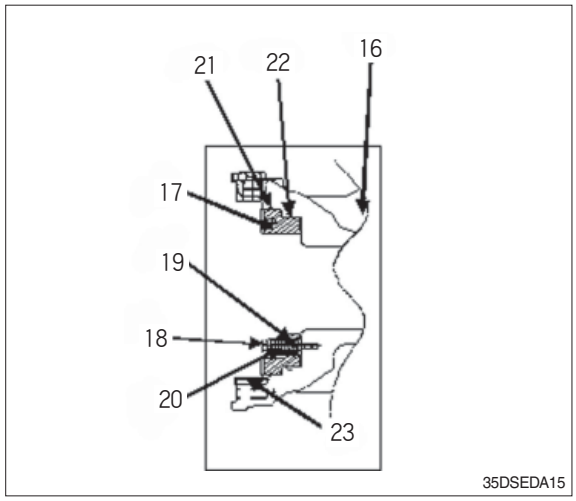
(13) Disassemble drive shaft and disc & plate assembly.



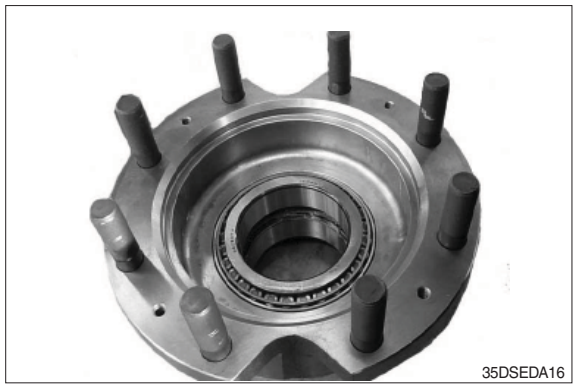


(14) After loosening 4 self adjust bolt (18), disassemble self adjust spring (20) from self adjust bushing (19).
Then disassemble piston (17) from axle housing (16).
After removing 3 pins (23), then finally remove square ring (21), (22)

⚠ **Do not reuse damaged square ring.**

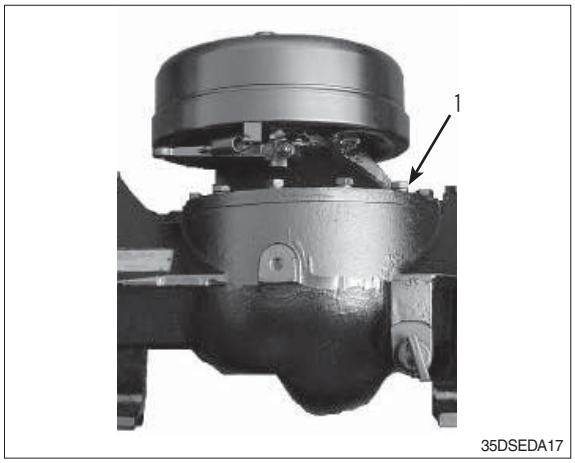


(15) Remove bearing cup from the wheel hub by using jig and hamer. Shaft seal may be damaged.

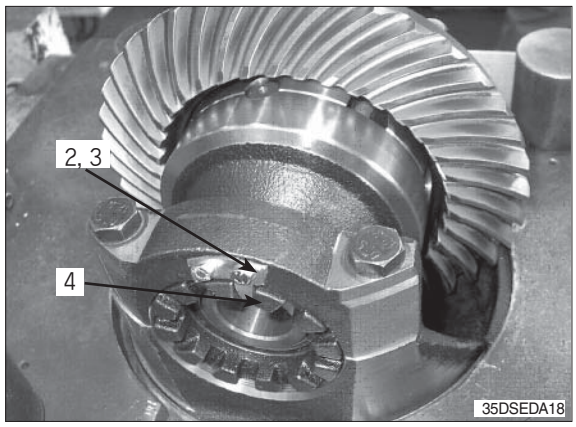


2) DISASSEMBLY OF THE DIFFERENTIAL CARRIER ASSEMBLY

(1) Loosen 12 bolts (1) and then remove carrier from the housing by using a lifting machine.

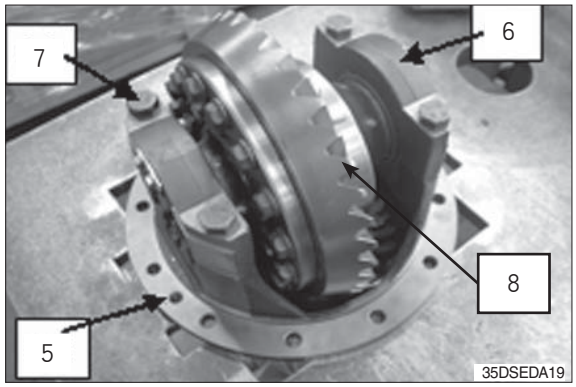


(2) For the reassembly, check rolling resistance and record it.
After loosen 2 bolt (2), washer (3) and then remove backing plate (4).



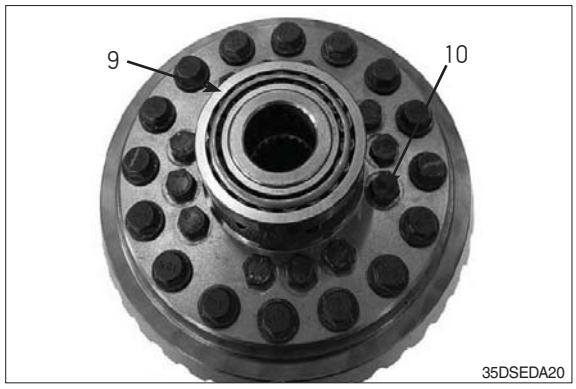
(3) Before removing differential assembly from carrier (5), check the location of cap (6) and mark it for reassembly.

(4) Remove 4 hexagon bolts (7) and cap (6).

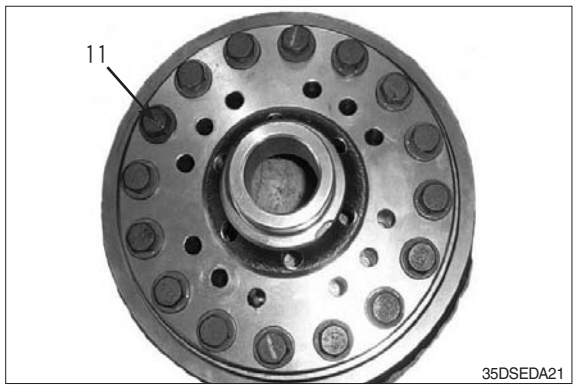


(5) Remove diffrential assembly (8) from the carrier.

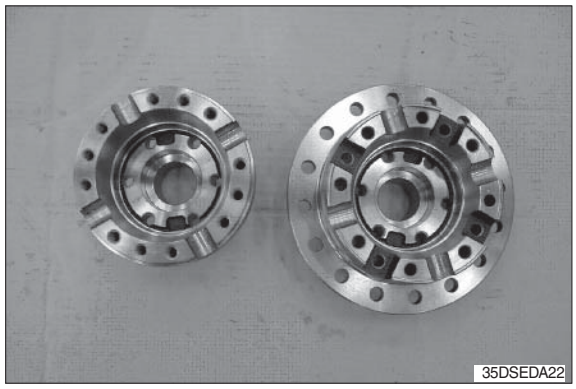
(6) Disassemble bearing (9) from the differential housing and remove 12 bolts (10).



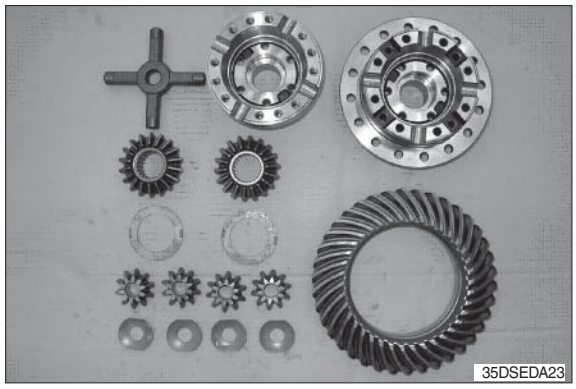
(7) After removing 12 mounting bolts (11) from the housing and then disassemble the ring gear.



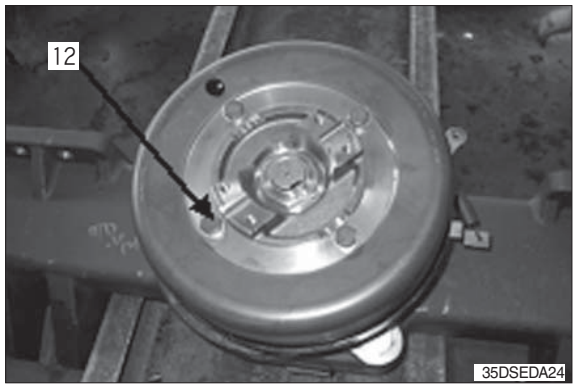
(8) Check the mark on the housing and separate the housing from the differential.
If there is no mark, be sure to mark on the housing.
When reassembling, it must be placed at the same position as before.



(9) Remove thrust washers, side gears, pinion gears and spider and then place them on the clean place.



(10)Loosen 4 bolts (12) and then remove drum from the parking brake.

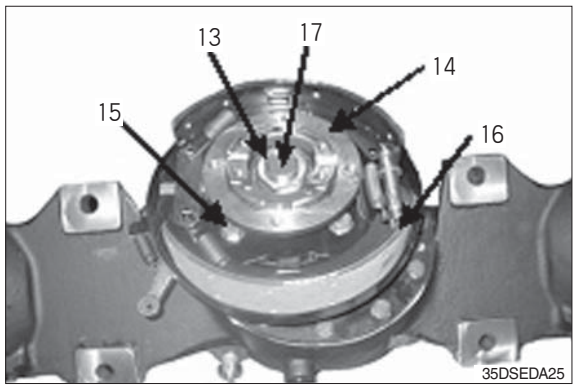


(11)After removing lock nut (13) and then remove the yoke (14).

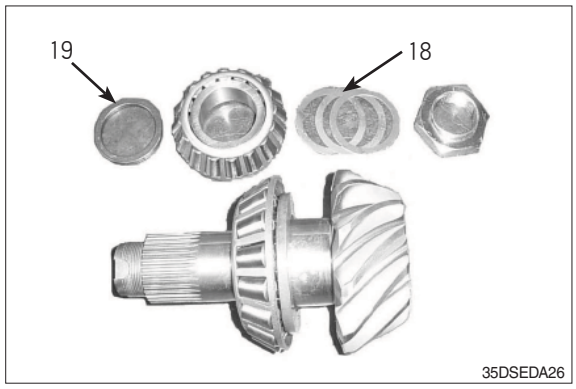
(12)Loosen 4 bolts (15) and then remove parking brake (16) from the carrier housing.

(13)Remove the drive bevel pinion shaft (17) carefully by using a plastic hammer.

⚠ **Be careful not to damage bevel pinion shaft.**



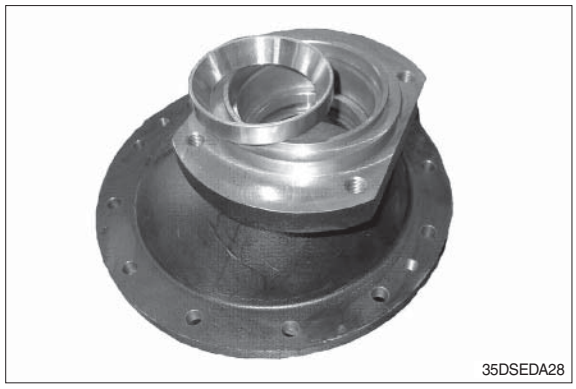
(14)Remove shim (18) and spacer (19) from pinion shaft.
Using a bearing puller, disassemble inner race of taper roller bearing from the pinion shaft.



(15)Remove outer race of taper roller bearing and shim from the housing by using a jig and hammer.

⚠ **Do not reuse damaged shims.**

(16) Remove outer race of taper roller bearing on the opposite side.



2. REASSEMBLY OF DRIVE AXLE

Clean every parts with cleanser and then remove remained loctite.

⚠ Be careful not to spill cleanser on your body.
Avoid drinking cleanser or breathing its fumes.
Wear protective clothing, glasses and gloves.
If spilled on the skin, flush your skin with water immediately.
If swallowed, get medical attention immediately.

- Check wear, damage or crack for all the parts and replace if needed.
- If the teeth of gear are damageed, replace it as a set.
- Replace damaged tapered roller bearing.
- Do not reuse deformed shims or worn thrust washers.
- Polish the surface on which seal contacted if needed.

1) ADJUSTMENT OF BEVEL PINION SHAFT

Adjusting shim of bevel pinion shaft.

(1) Adjust shim thickness and bevel pinion shaft with following method.

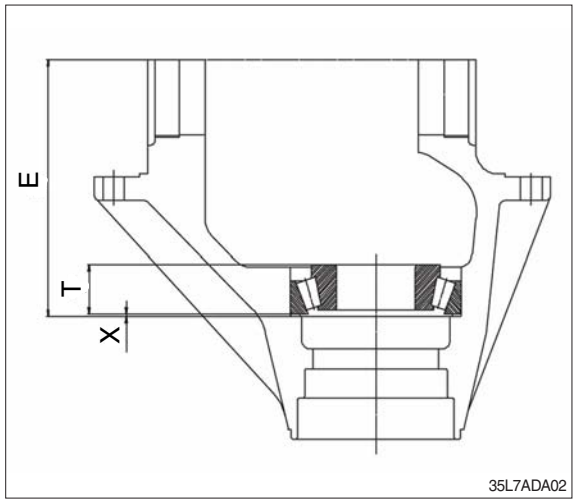
① Measure "**E**" at the housing.

② By the equation " **X = E - B - T ± C** ", define the the shim thickness(1).

B : Mounting dimension of bevel pinion shaft , 133.20mm (5.2 in)

T : Height of bearing.

C : Dimension of carved seal on the pinion. If there's no carved seal **C**=0.



EX) : From the housing
"**E**" = 162.85 mm
B is factory dimension
"**B**" = 131.20 mm
From the bearing
"**T**" = 31.5 mm
Mark on the pinion
"**C**" = 0.05 mm
Shim thickness :
"**X**" = 162.85 -131.20 - 31.5 - 0.05
= 0.10 mm

※ **If teeth are damaged, replace it as a set (Bevel gear and shaft). Do not reuse damaged shims and bearing.**

(2) Using different kinds of shims, adjust shim thickness as measured by previous equation.
Place shims at the bearing place.
Using a jig, assemble drive bearing so that the outer race contact with the bearing place.

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(3) Heat the inner race of bearing to max 100°C and then assemble it to the pinion shaft.
Also inner race should contact with bearing place.

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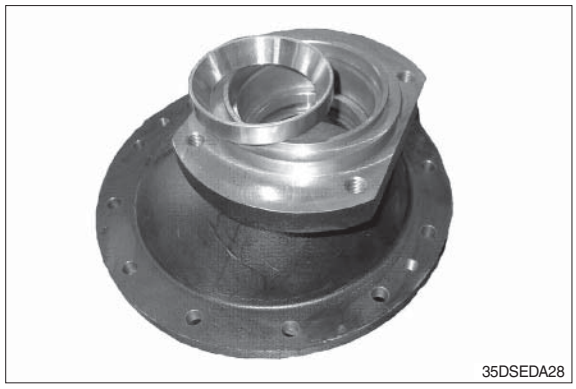
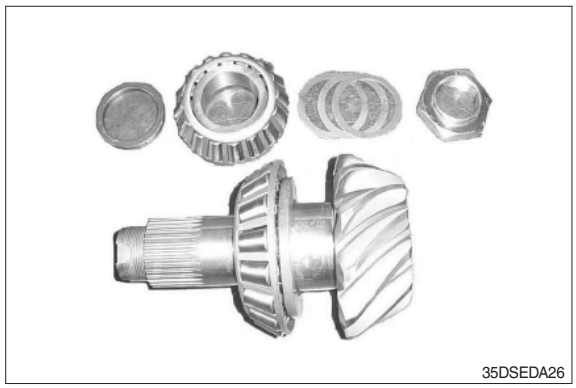
2) ADJUSTMENT OF PINION SHAFT

(1) Assemle bearing cup.

Assemble spacer to the pinion shaft and then install measured shims onto the spacer.





(2) Insert pinion shaft into the carrier.

After assemble bearing cone and lock nut.
Apply grease on the outer bearing.
Apply loctite #271 or #277 on the thread of pinion and then tighten lock nut.

· Tightening torque : 45~51 kg·m

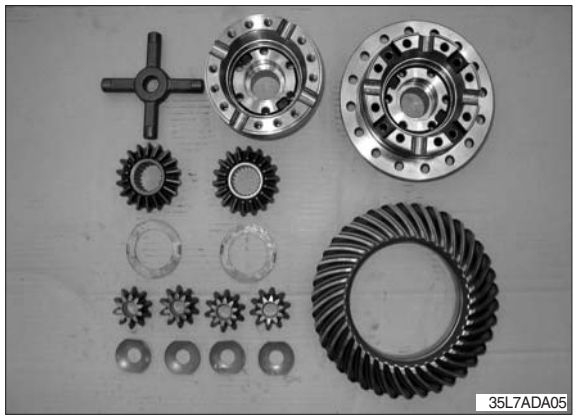
Measure rolling resistance of pinion shaft.

· Rolling resistance : 0.20~0.41 kg·m

Coke lock nut into the pinion shaft slot.

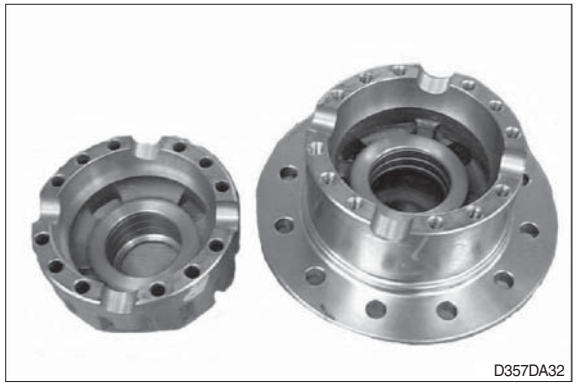
3) ASSEMBLY OF DIFFERENTIAL ASSY

(1) Assemble thrust washer, side gear and spider with gears and then install them to the differential housing.
Apply grease on the bevel gear and thrust washer.



(2) Assemble differential housing.

※ **Check marks on the housing.**
Match two marks at the same position.



(3) Tighten 12 bolts (1) to the differential housing.
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 5.0~7.5 kg·m

(4) Assemble ring gear by tightening 12 bolts (2).
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 12.5~14.5 kg·m

(5) Install differential assembly into the carrier.
Place the bearing cup and screw into the housing.
At that moment, using a screw adjust rotation backlash.
Install the dial gauge on the gear tooth and measure the backlash while rotating bevel gear.

※ Rotation backlash : 0.18~0.23 mm

(6) Assemble bearing cap.

※ **Fix bearing cap with hexagon bolt.**
· Tightening torque : 15~17 kg·m

Measure rolling resistance of tapered roller bearing.
The following table shows the relation between preload (P) of bevel pinion shaft and rollring resistance (Z).
(Calculated at ADJUSTMENT OF PINION SHAFT ②)

Unit : kgf·m

P	Z
0.20 (1.45)	0.44~0.47
0.25 (1.81)	0.49~0.52
0.30 (2.17)	0.55~0.58
0.35 (2.53)	0.59~0.62

(7) Confirm that the screw contacts with bearing.

(8) After complete assembly of bearing, measure rotation backlash once more and readjust with a screw if needed.

(9) Apply loctite #271 to the thread of bearing cap bolt and then assemble it with tightening torque of 15~17 kgf·m.

(10) Assemble plate with hexagon bolts. Apply loctite #271 or #277 to the tapped side of bolt and then assemble at the tightening torque of 0.80~1.20 kg·m.

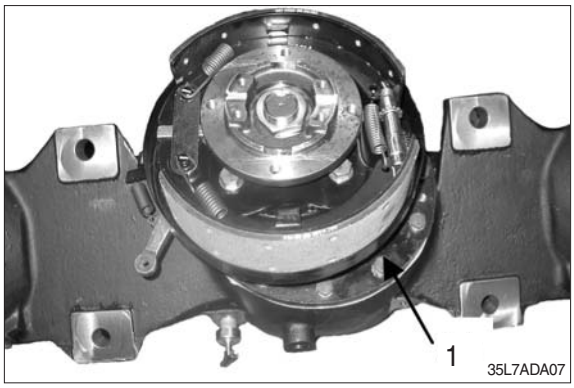
※ **Assemble opposite side with the same methods.**

(11) Apply marking liquid on 3~4 teeth of the ring gear and then rotate pinion gear to check gear contact.
Check out the contacted shape.

4) ASSEMBLY OF CARRIER

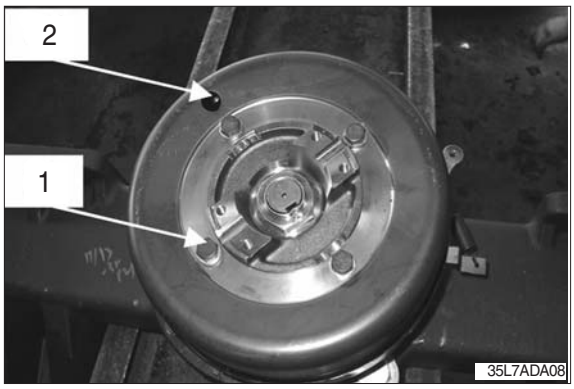
(1) Assemble carrier assembly into the axle housing.

(2) Fix the carrier assembly with hexagon bolt (1).
Apply loctite #271 or #277 to thread of bolt and then assemble it with tightening torque of 11~13 kgf·m.



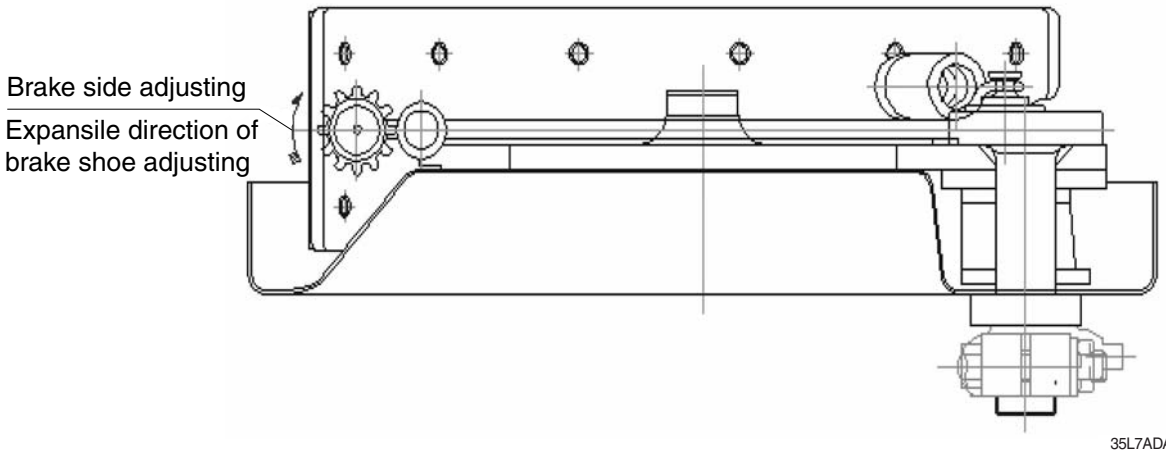
(3) Assemble BRAKE DRUM to YOKE with tighting 4 bolts (1).
Apply loctite #271 or #277 to thread of bolt and then assemble it with tightening torque of 11~13 kgf·m.

(4) Close hole (2) with rubber plug.



5) ADJUSTMENT OF PARKING BRAKE

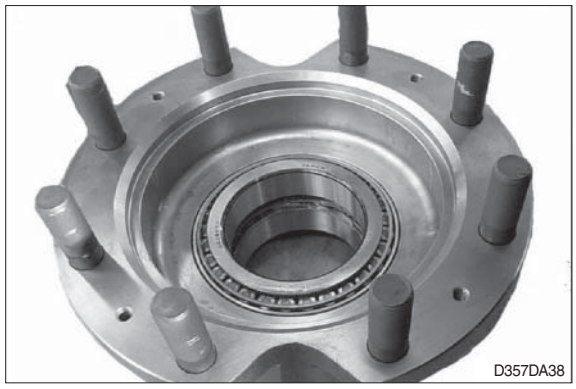
(1) The following procedures should be applied for brake shoe adjustment
① Open rubber plug on (2).
② Adjuster should be turned accoring to arrow direction until occuring drum drug.
③ Adjuster should be turned to opposite direction of the arrow sign by four click.
At that case, lining clearance is 0.1~0.25 mm.
④ Check drum drag after operating lever several times.
(Repeat from begining if drag is occured)



6) ASSEMBLY OF WHEEL HUB ASSY

(1) Insert bearing into wheel hub.
Confirm that the bearing and wheel hub contact completely.

※ **Apply grease or oil to shaft seal and then assemble it with proper direction (Out side of wheel hub).**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(2) Install wheel hub assembly to the spindle completely.

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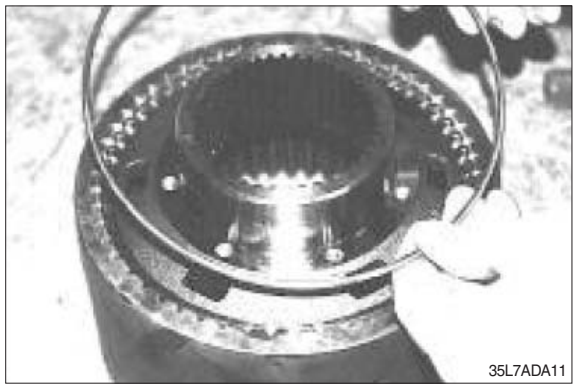
(3) Insert the spindle into ring gear and secure with circlip.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(4) Place heated tapered roller bearing inner race onto the spindle until contact take places.
Install it on the wheel hub after cooling down.

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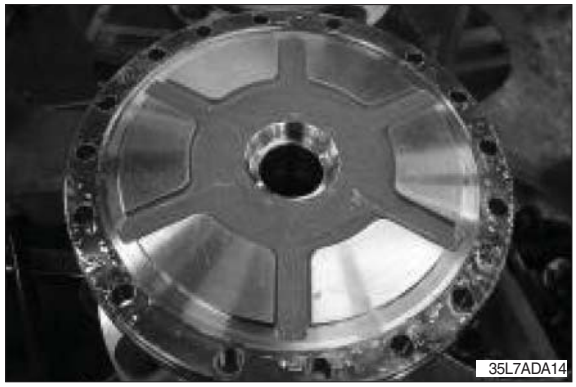
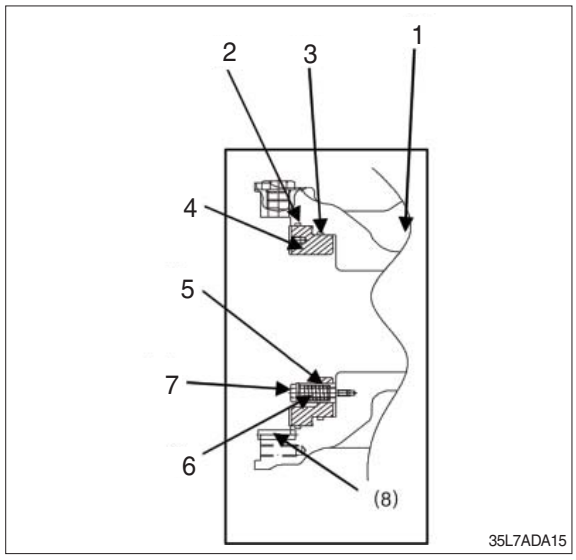
(5) Install the torque plate to fix the spindle.
Apply loctite #5127 to axle housing surface which contact to the spindle.



(6) Assemble square ring (2), (3) to the Axle housing (1) then apply the oil (MOBILFLUID #424).
Assemble bushing (5) to piston (2) and then assemble piston (2) to axle housing after applying oil sufficiently and then assemble the spring (6) to the bushing (5).
Also, apply loctite #271 to 4 bolts (7) then assemble them with tightening torque : 1.4~1.6 kg·m.
Assemble 3 brake pins (8) to axle housing

⚠ Check the status of square ring and replace if damaged.

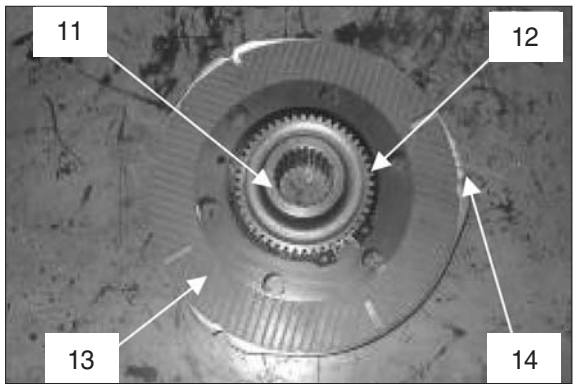


Assembly of plate and inspection

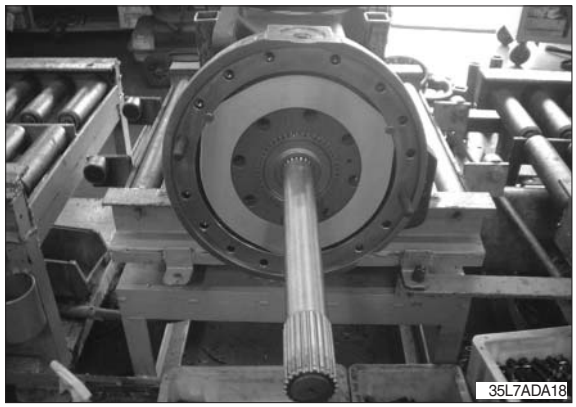
① Assemble 4 plates (9) and 3 disks (10) with spline collar (11) and then lock with snap ring (12).
Disc must be assembled after the oil immersion during 12 hours (MOBILFLUID #424)

② Install assembled the spline collar to the axle housing with the drive shaft.
Before assembling, clean all of the parts completely and remove burrs.

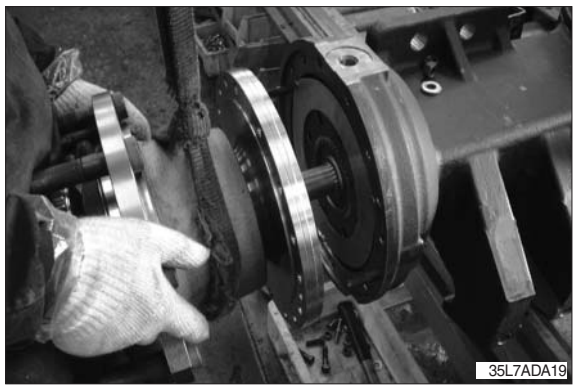
③ After assembling, confirm that the clearance between the outer plate and and the axle housing surface is 2.1~2.6 mm.



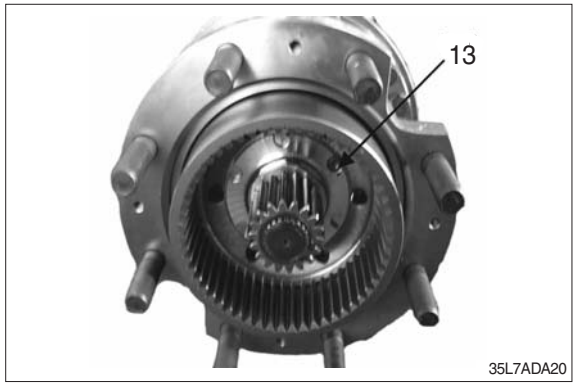
35L7ADA17


35L7ADA18

(7) Push pre-assembled wheel hub to the axle housing until contact take places.

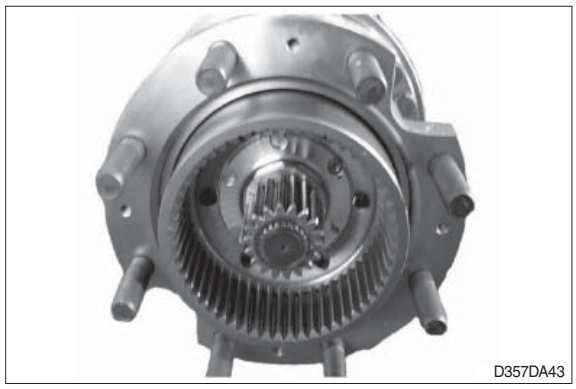

35L7ADA19

(8) Tighen the torque plate until the wheel hub assembly has the same rolling resistance as before.
Apply loctite #271 or #277 to thread of bolt (13) and then assemble it with tightening torque of 1.8~2.2 kg·m.

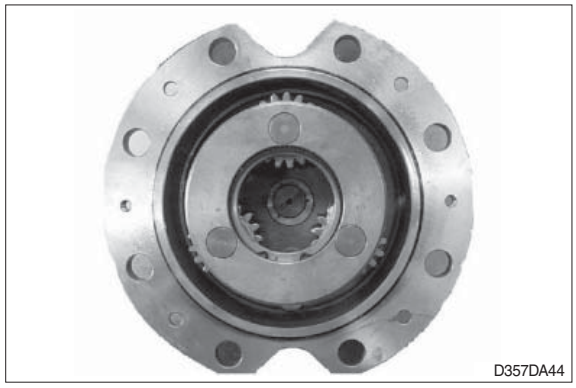


35L7ADA20

(9) After assemble sun gear to axle shaft and fix it with a snap ring.
Apply grease on the shaft where bushing contacts.
Apply grease on teeth of the planetary gear.


D357DA43

(10) Assemble internal components of planetary carrier with the reverse order of disassembly.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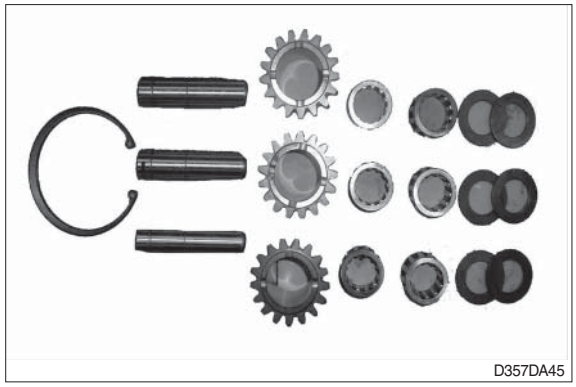
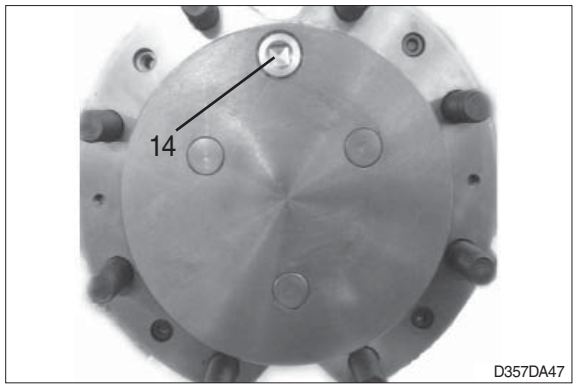

D357DA45

(11) Install planetary carrier assembly to wheel hub and tighten bolt (2)
· Tightening torque : 2.5~4.0 kg·m

35L7ADA21

(12)Assemble the wheel hub and tighten the plug (14).

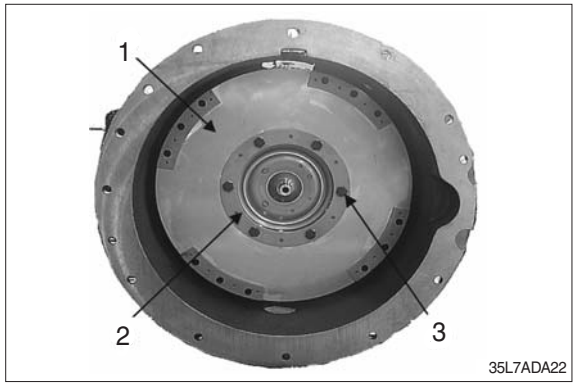
· Tightening torque : 3.5~6.0kg·m



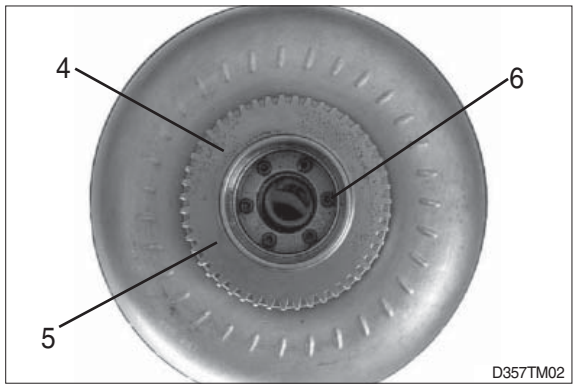
3. DISASSEMBLY OF TRANSMISSION

1) Pull torque converter (1) straight forward and remove from the converter housing.

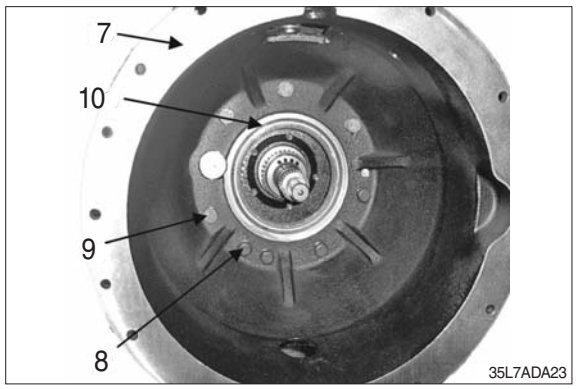
   Remove six bolts (3) and flexible plate (1), plate (2) from the torque converter.



2) Remove six socket bolts (3) and then gear P.T.O input from the the torque converter.



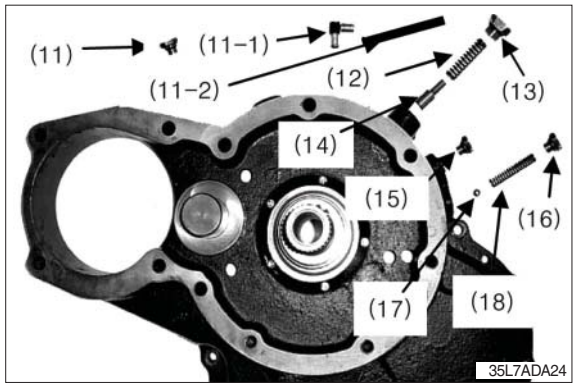
3) Remove four bolts (9) and bolts (8), washes, oil seal (10) from the housing converter (7).



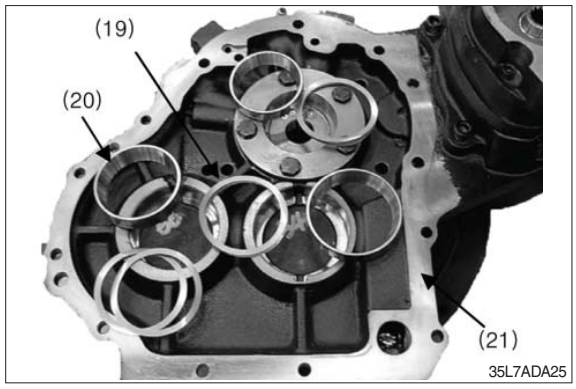
4) Remove plug (16) and o-ring, spring (18) and ball (17) from the bearing plate.

5) Remove plug (13) and spring (12), valve (14).

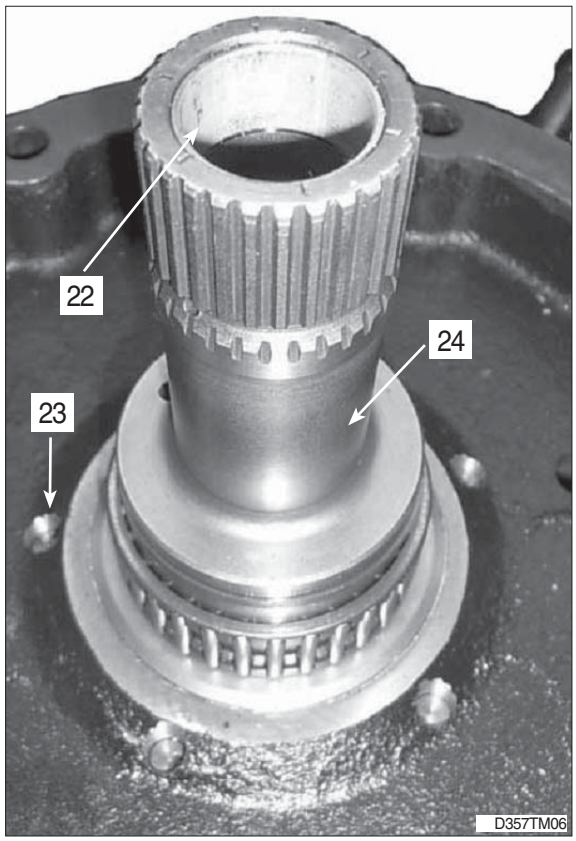
6) Remove plug (11).



※ Bearing cups and their shims will be in cover or on the shafts in transmission case. Put identification on each of bearing cups and shims as to their location on transmission cover or shaft in transmission case.



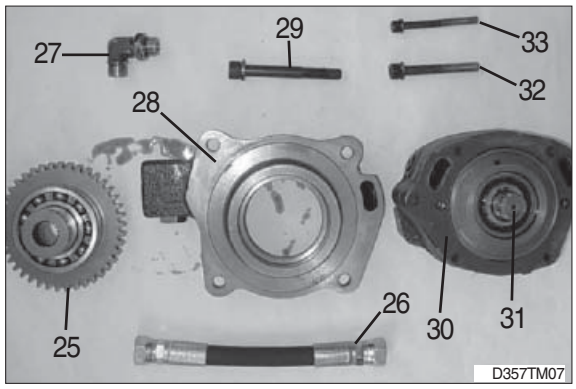
7) Remove fasten five bolts (23) from fixed stator hub (24) and bearing plate. In this time, use the plastic hammer.



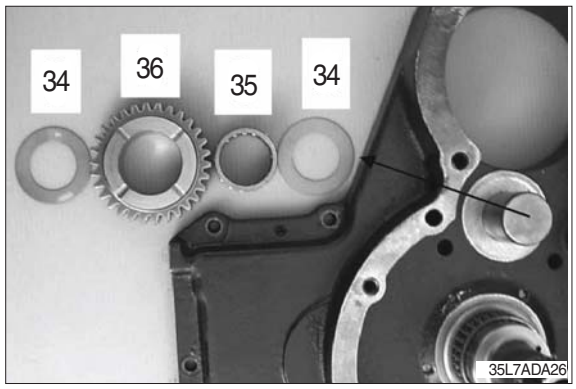
8) Remove four socket bolts (21), flange pump (28) from bearing plate (21).

Remove a socket bolt (32) and four socket bolt (33) from flange pump.

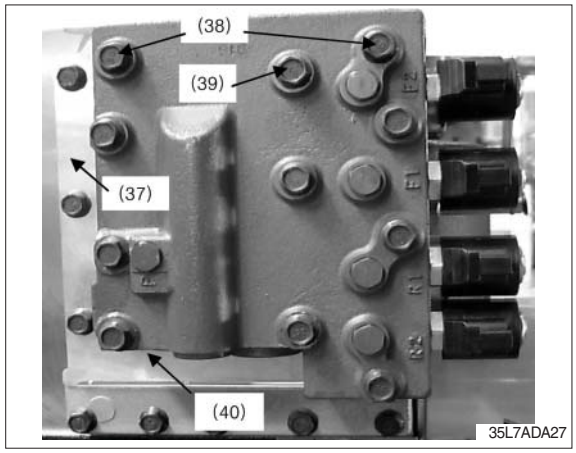
Remove charging pump (31) and pump gasket, then seperate to gear-P.T.O output (23) and ball bearing, 90° elbow (27).



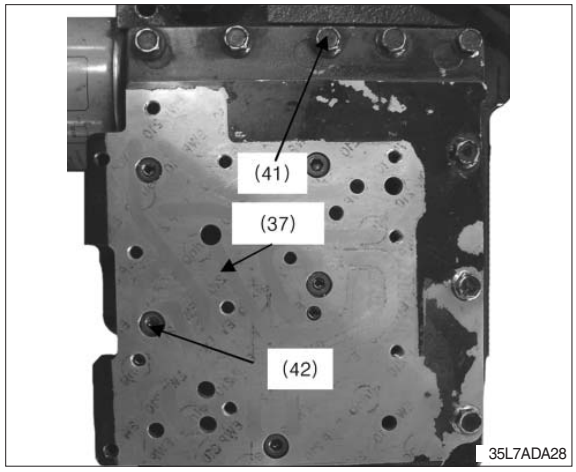
9) Separate to two thrust washer's (34), needle Bearing (35), gear- P.T.O Idle (36) from bearing plate.



10) Remove two bolt's (38), nine bolt's (39), valve gasket (40).

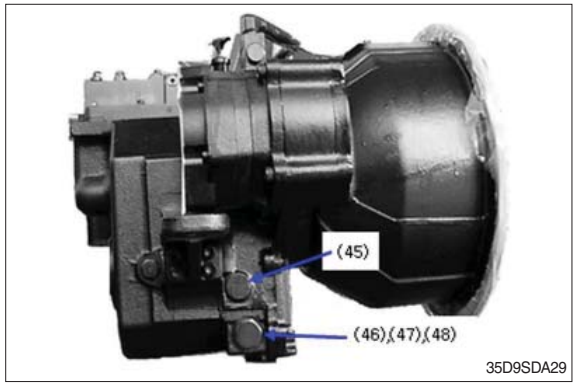


11) Remove eight bolt's (41), five socket bolt (42), then separate valve plate from transmission case.

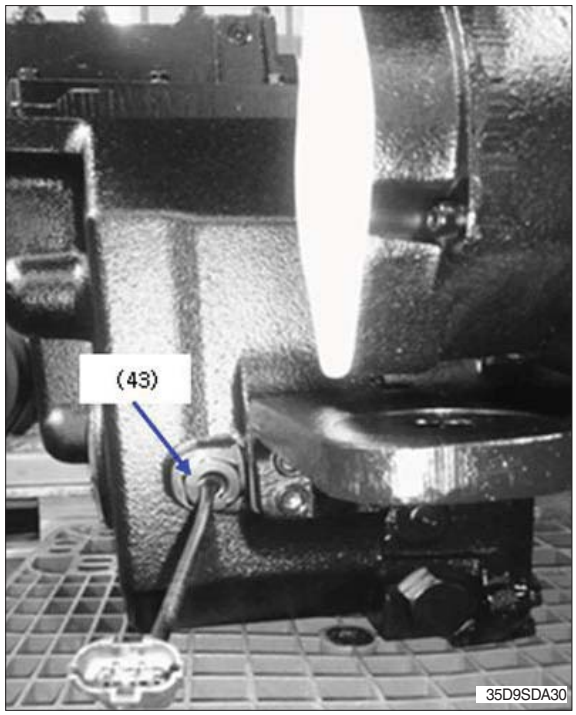


12) Remove O-ring, plug (46) then spring (47), Oil screen (48) from transmisson case.

13) Remove temperature sensor (45) from transmisson case.

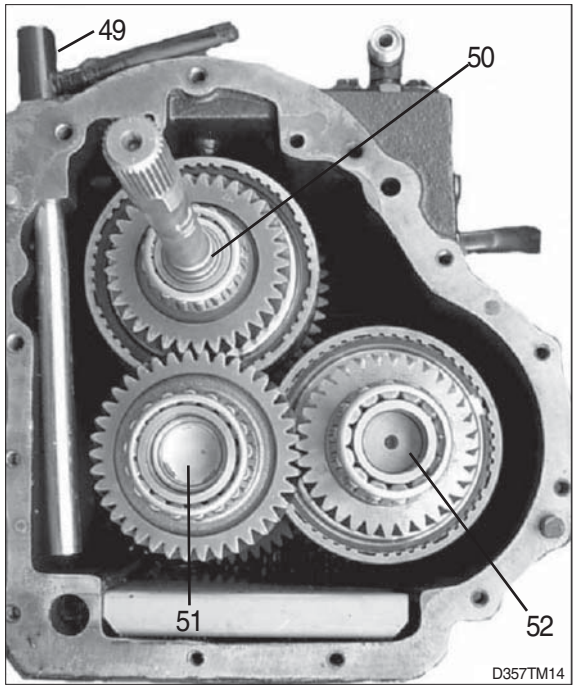


14) Remove the speed sensor (43) from the transmission case.

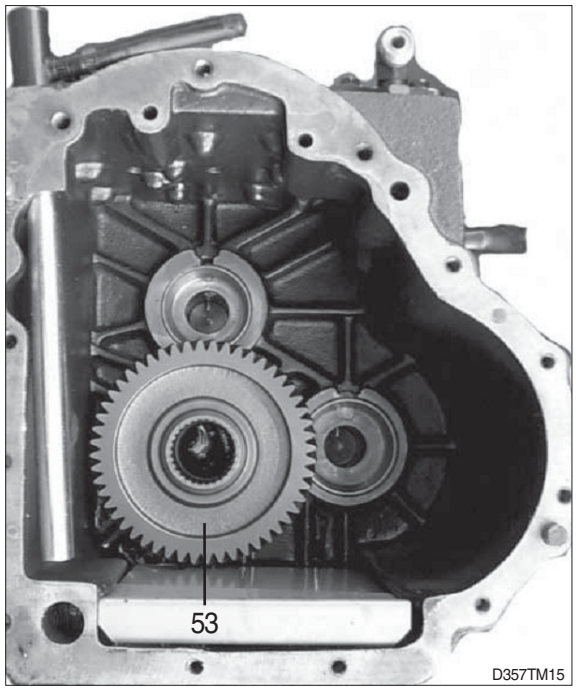


15) Use the plastic hammer to push tube (49) out of the transmission case. Remove the tube.

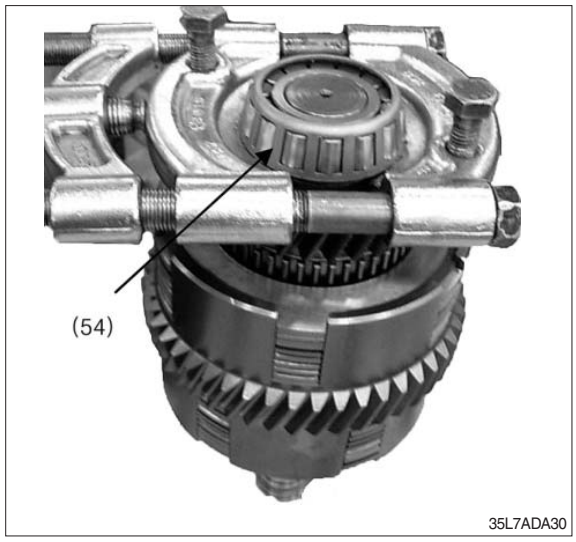
16) Remove output shaft assembly (51), input shaft assembly (50), and counter shaft assembly (52).



17) Remove the output gear (53) from the transmission case.

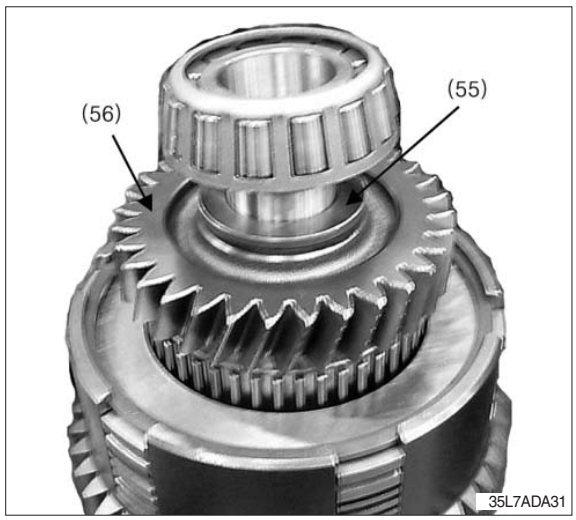


18) For high speed forward clutch assembly, remove bearing cone (54) with gear pulley.

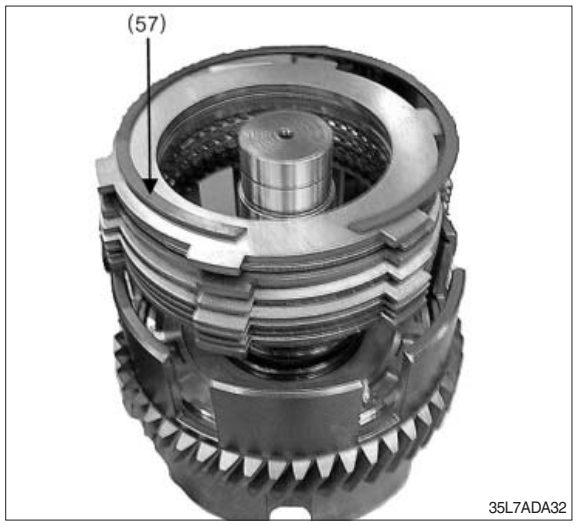


19) Remove two thrust washes (55) and gear (56).

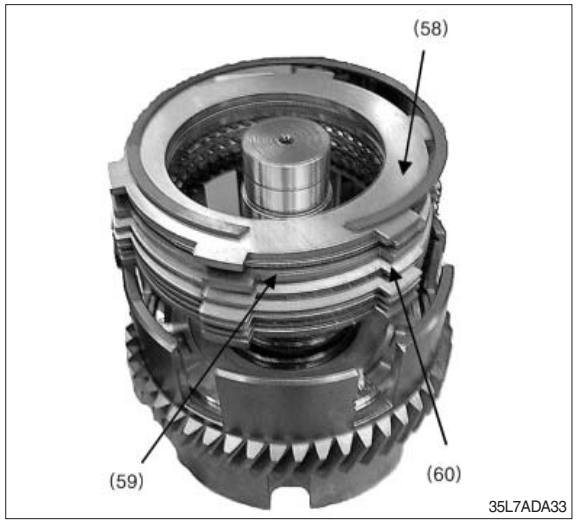
20) Remove needle bearings and thrust washer from the forward shaft of high speed clutch side.



21) Use a screwdriver and remove snap ring (57) from the cylinder.



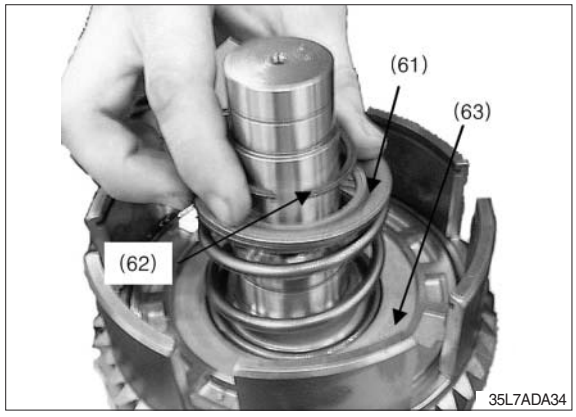
22) Remove a five clutch discs and three 4T clutch plates (58), four 2T clutch plates (60), one bending plate (59) from the cylinder.



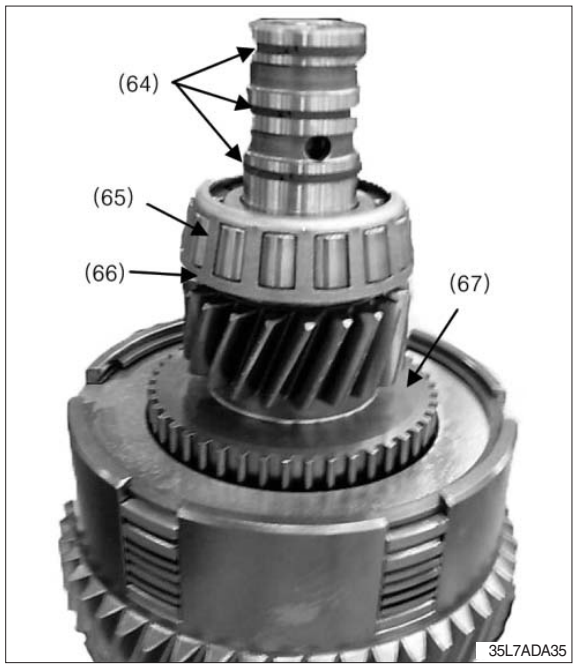
23) Push down on the retainer (61) by a press and remove snap ring (62) with a screwdriver. Slowly release the tension on the spring assembly.

24) Remove retainer (61) and spring assembly from cylinder.

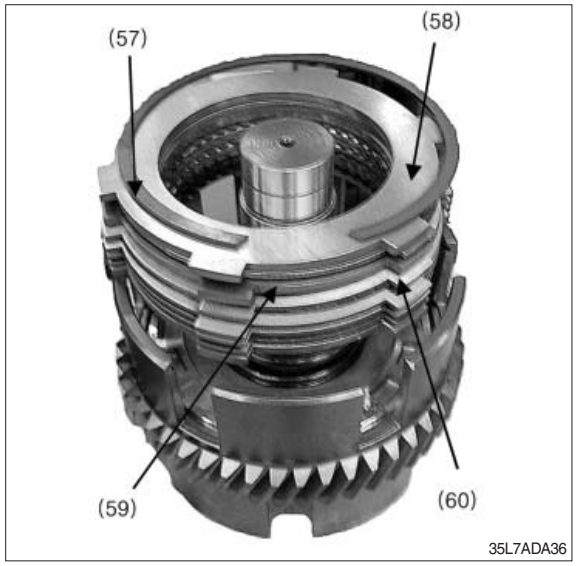
25) Remove piston (63) by using compressed air, then remove O-ring from the shaft.



26) For low speed forward clutch assembly, remove seal rings (64) from shaft.
Remove bearing (65), thrust washer (66), gear (67), needle bearing, spacer and sealing (64).



27) Remove snap ring (57), then remove a five clutch discs and three 4T clutch plates (58) and four 2T clutch plates (60), one bending plate (59) from the cylinder.

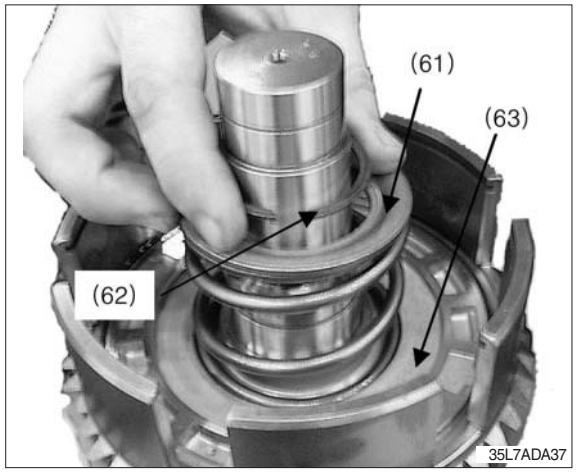


28) Remove two thrust washes and pin.

29) Push down on the retainer (61) by a press and remove snap ring (62).
Slowly release the tension on the spring assembly, then remove retainer and spring assembly.

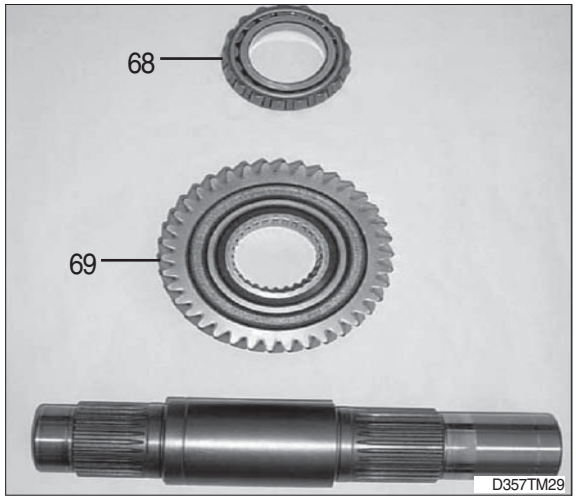
30) Remove piston (60) by using compressed air, then remove O-ring from the shaft.

※ Disassembling procedure of input shaft assembly is the same as counter shaft assembly.



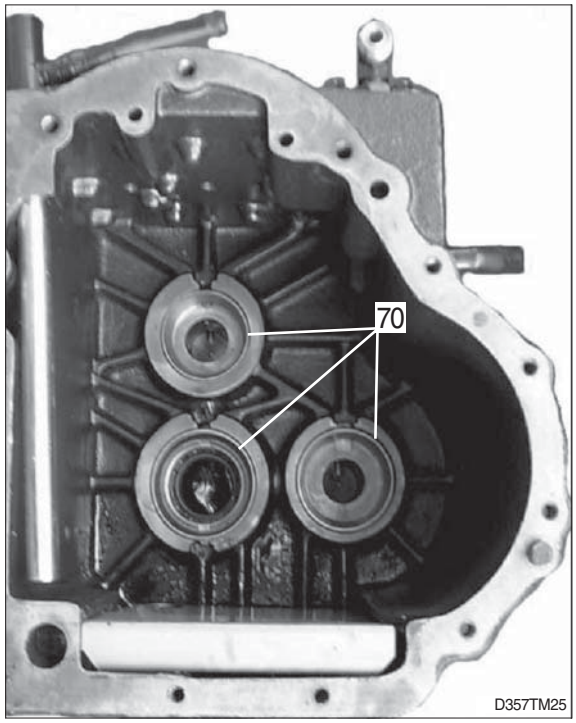
31) Disassemble input shaft assembly.

32) For output shaft assembly (51), remove the bearing (68) and gear (69).

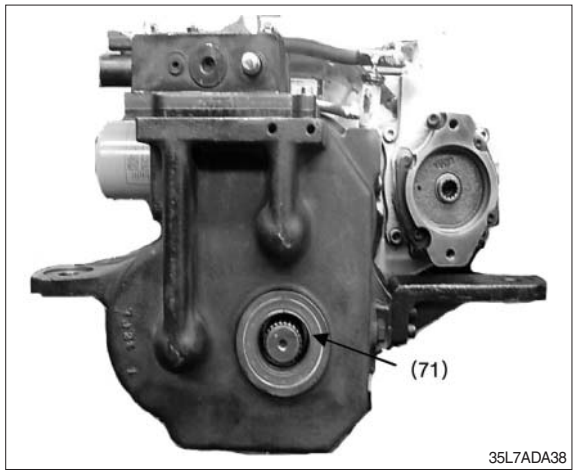


33) Remove bearing cups (70) from the transmission case.

※ Put identification on bearing cups to use at assembly.



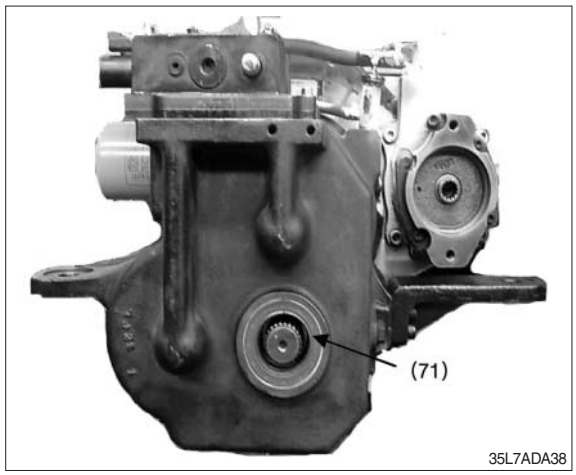
34) Remove two lip type oil seals (71) from the transmission case.



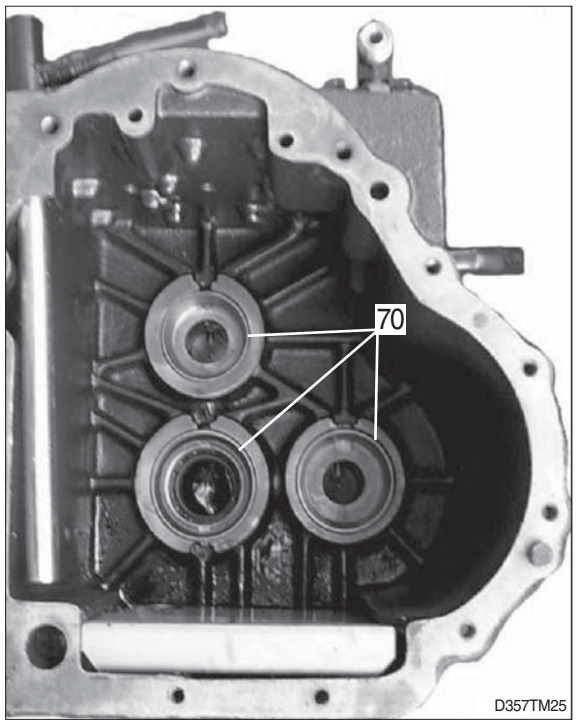
4. ASSEMBLY OF TRANSMISSION

1) Thoroughly clean all the parts of the transmission.
   Put clean transmission oil on all of the inner parts.

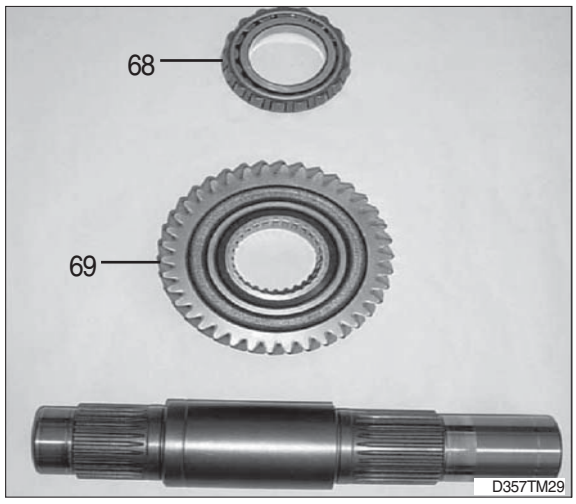
2) Put lip type oil seal (71) in position on the case with the spring loaded lip of the inside seal toward the inside of the transmission case and with the lip of the outside seal (71) toward the outside of the transmission case.



3) Install bearing cups (70) in position on the transmission case.



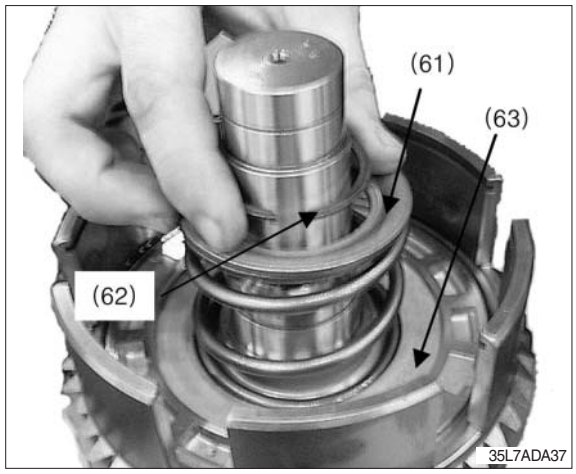
4) Install gear (69) and bearing (68) on the output shaft assembly (51).



5) Install seal ring on the piston (60).
Put clean transmission oil on the seal ring.

6) Install piston with seal ring in cylinder.

※ Be extra careful during installation of the piston.
Broken seal rings can be the result.

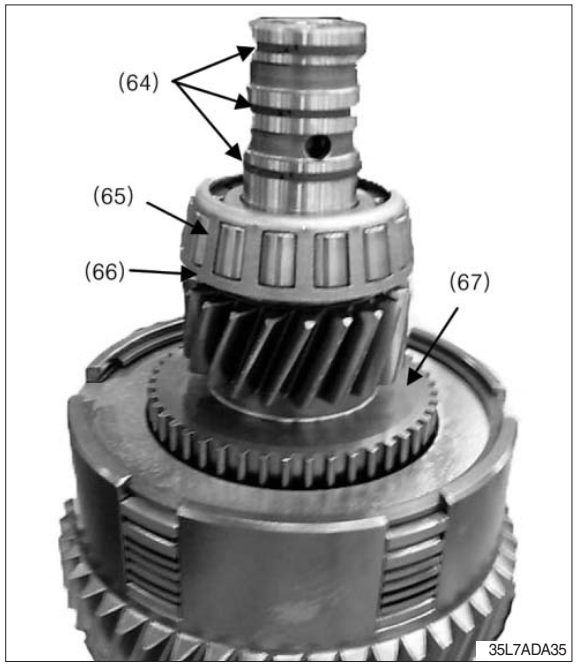


7) Put spring assembly and retainer (61) in position in the cylinder.

8) Put the shaft assembly in a press. Push down on the retainer and install snap ring (62) with a screwdriver.

9) Install pin and two thrust washes in the counter shaft of low speed clutch side.

10) Install needle bearing, spacer, needle bearing gear (67), thrust washer (66) and bearing (65) and seal ring (64).



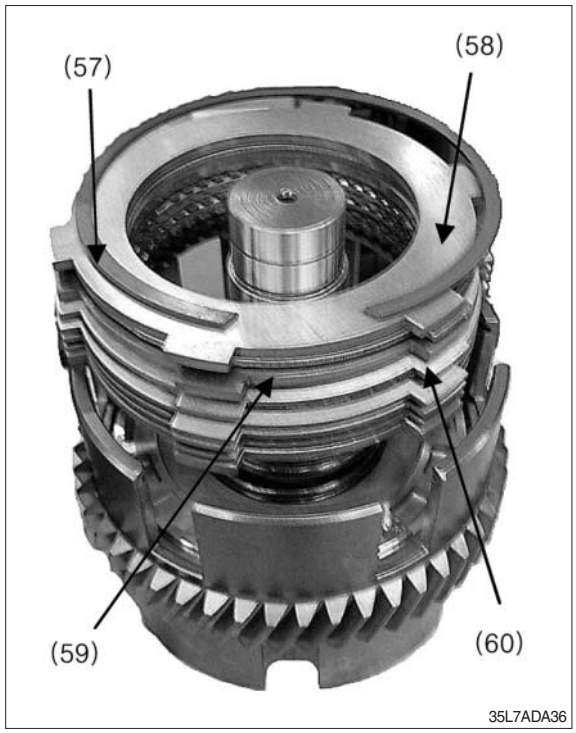
11) Put clean transmission oil on each side of the clutch plates and clutch discs. Install four 2T clutch plates, three 4T clutch plates, five clutch discs and one bending plate in the cylinder with the following procedure.
   (1) Install a clutch plate first, that has guide shape on its outside diameter.
   (2) Next, install a clutch disc that has teeth on its inside diameter.
   (3) Follow steps a and b again until all of four the 2T clutch plates and discs are installed in the cylinder.
   (4) Install a 4T clutch plate, then install a bending plate. In following procedure, bending plate shape will be downward.
   (5) Finaly, install a 4T cluch plate.

12) Use a screwdriver and install snap ring (57) that check all of them in position in the cylinder.

13) Install a three seal rings on the shaft.
※ Be carefully, Do not damage to the seal rings on the counter shaft.

14) For the other side of the counter shaft assembly, follow the procedure in steps 5 through 8.

15) Put clean transmission oil on each side of the clutch plates and clutch discs. Install four 2T clutch plates, three 4T clutch plates, five clutch discs and one bending plate in the cylinder with the following procedure.
   (1) First, install a 4T cluch plate.
   (2) Install a 4T clutch plate, then install a bending plate. In following procedure, bending plate shape will be downward.
   (3) Follow steps a and b again until all of four the 2T clutch plates and discs are installed in the cylinder.
   (4) Next, install a clutch disc that has teeth on its inside diameter.
   (5) Finally, Install a clutch plate first, that has guide shape on its outside diameter.



16) Use a screwdriver and install snap ring (57) that check all of them in position in the cylinder.

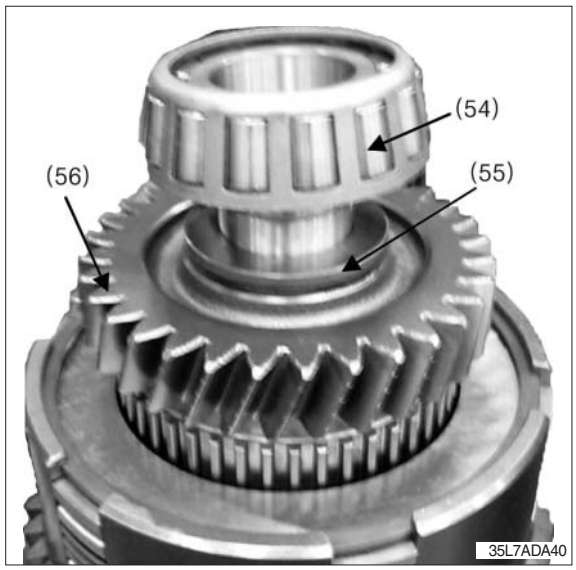
17) Install three seal rings on the shaft.

※ Be careful not to cause damage to the seal rings.

18) Install thrust washer and needle bearings on the counter shaft of high speed clutch side.

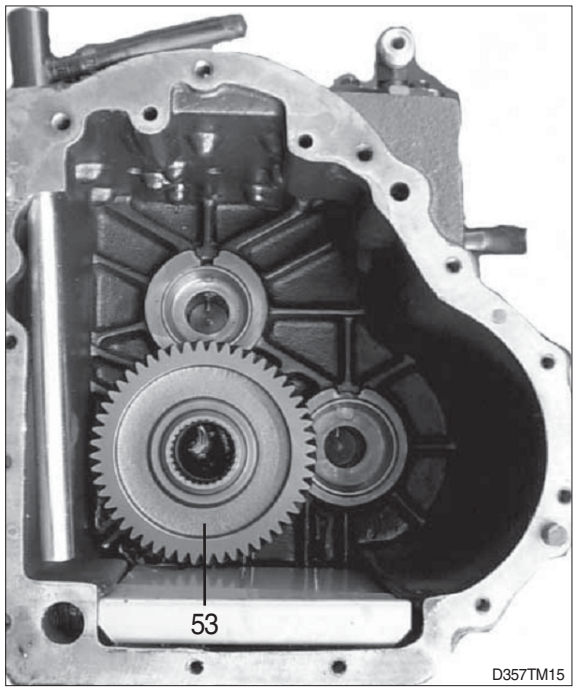
19) Install gear (56), thrust washes (55) and bearing cone (54) with tool.

※ Do not use force to install the gear.
Move the gear backward and forward while the gear is pushed into the clutch assembly until the teeth on the clutch discs are in alignment with the splines on the gear.



20) Assemble input shaft assembly with the same procedure as counter shaft assembly.

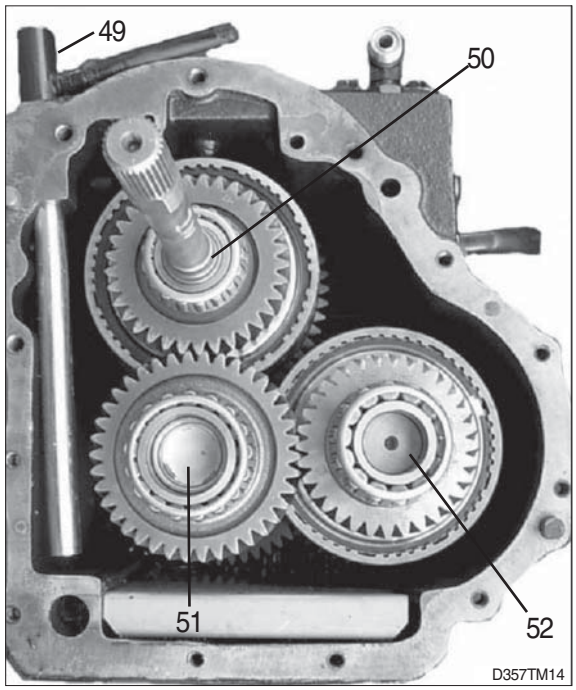
21) Install the gear assembly (53) into transmission case.



22) Carefully put the counter shaft assembly (52) in position in the transmission case.

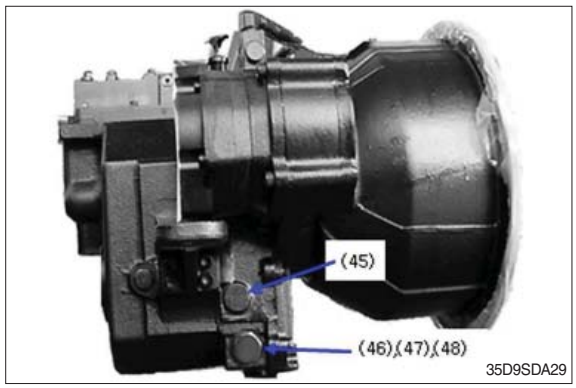
23) Carefully put the input shaft assembly (50) in position in the transmission case.
Install output shaft assembly (51) into output gear assembly.
Turn the gear until the teeth are in alignment with gears of another shaft assembly.

24) Use the plastic hammer and install tube (49) in the transmission case.

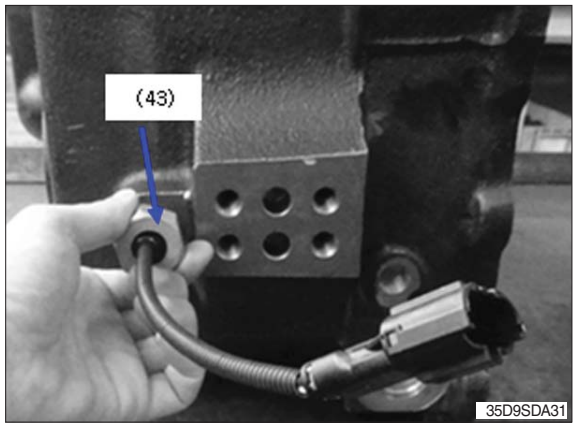


25) Install screen (48), spring (47) and plug, (46), o-ring in the transmission case.

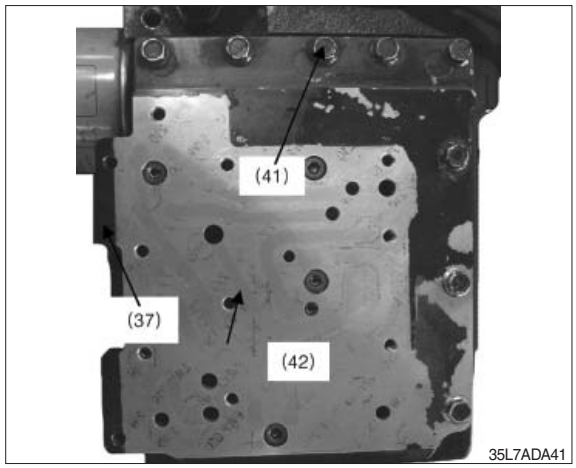
26) Install temperature sensor (45) in the transmission case.



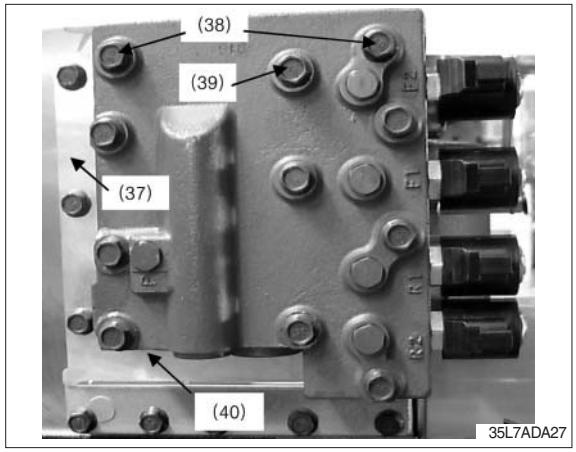
27) Install speed sensor (43) in the transmission case.



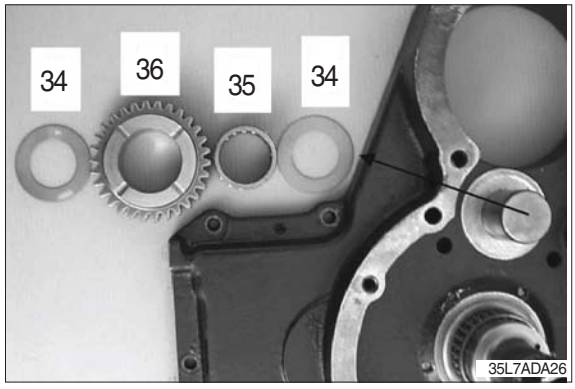
28) First, apply to Loctite 5172 on the transmiss case then, fixed.
Install valve plate by using a eight bolts and an five socket bolt



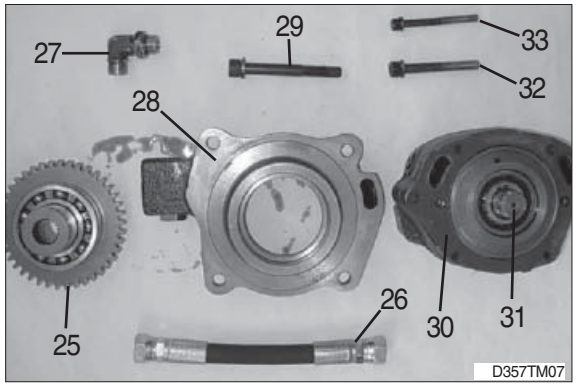
29) Install sticks to gasket on the transmisson case and then install two bolt (38), nine bolt (39) on the control valve.



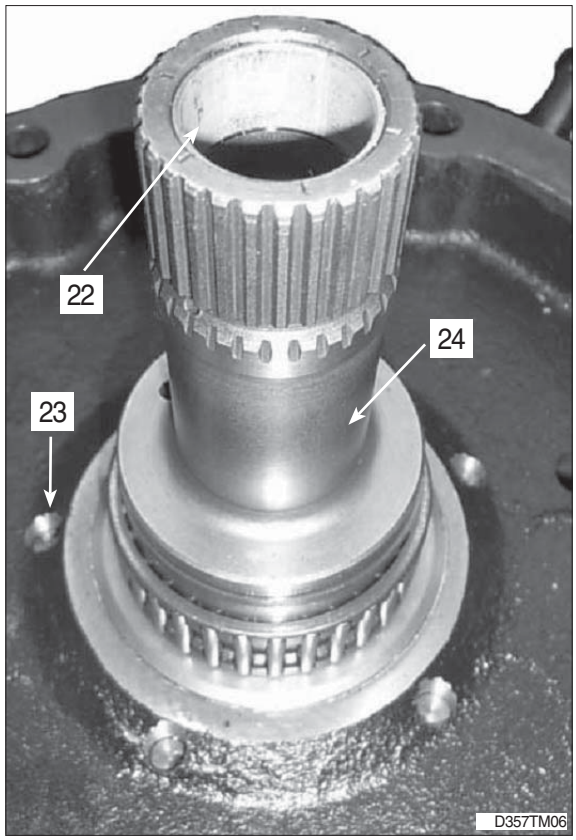
30) Install a two thrust washer (34), a needle bearing (35), gear-P.T.O Idle (36) in the bearing plate (21).



31) Install a gear-P.T.O output (25), two ball bearings on the flange pump (28) by using the jig then, install four bolts on the bearing plate.
Then, charging pump (31) and gasket (30) on the flange Pump by install a bolt (32) and four bBolt's (33). Install a 90 degree Elbow.



32) Install the sator hub assembly (24) due to Bearing plate assy (21).
- Install bush (22), piston ring, bolt (23) which assembling by each six's.
  Then install Bearing plate



33) Install plug (11) and o-ring in the bearing plate.

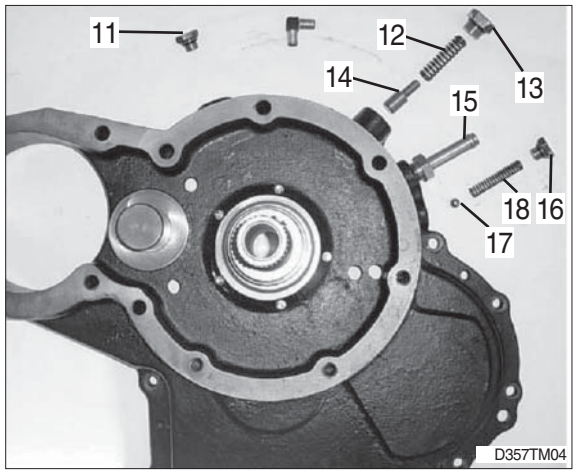
34) Install valve (14), spring (12), plug (13) and o-ring in the bearing plate.

35) Install plug (15) in the bearing plate.

36) Install ball (17), spring (18), plug (16) and o-ring in the bearing plate.

37) Put bearing cups and their shims in the bearing plate.

※ Bearing cups and their shims should be put into their location on transmission cover so as to fit on their shafts in transmission case.

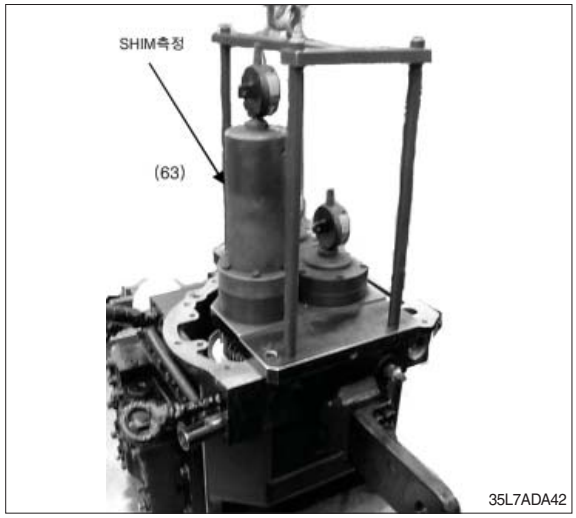


38) When new parts are used, required shim thickness should be calculated as follows .

(1) Assemble shaft assembly (including taper bearing cone and cup).

(2) Insert shaft assembly into transmission case.

※ Use depth gage and block gage because the height of bearing cup is higher than surface of transmission case.



· Method of the shaft shim measure

: Measure the dimension "depth" from surface of bearing plate to bottom of bore where bearing cup is installed.

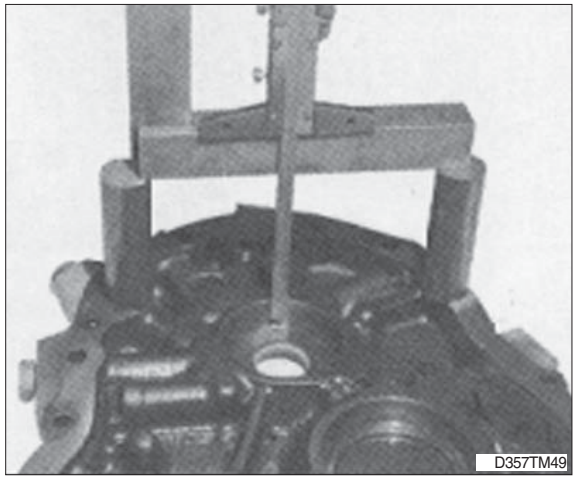
Item	Shim thickness
Input shaft	**Y-X**-0.01
Counter shaft	**Y-X**-0.05
Output shaft	**Y-X**-0.05

(3) Select shims to have 0 to 0.05 mm (0 to 0.002 inch) of axial tightness.

(4) Assemble transmission case, cover and gasket.

(5) Set up transmission assembly vertically.

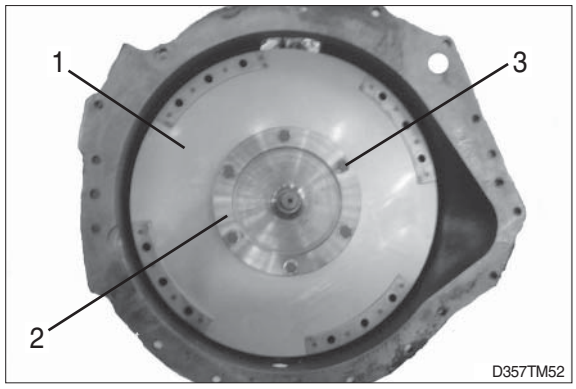
(6) If you reshim input shaft or counter shaft, turn transmission input shaft by hand. It should be turned smoothly. If you reshim output shaft, turn output shaft by hand. It should be turned smoothly.



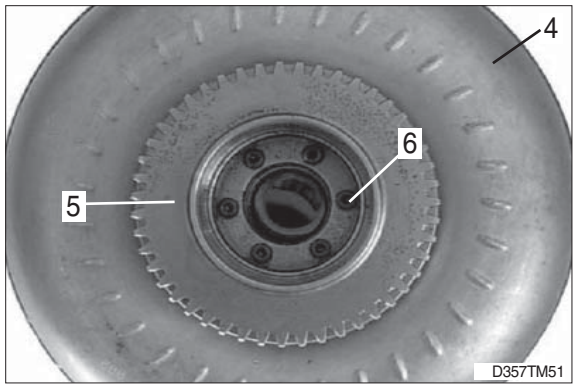
(7) If the input shaft or output shaft does not turn smoothly, remove shims about 0.025 - 0.05 mm.

※ Be extra careful during installation of the cover.Do not tilt the cover during installation, damage to the seal rings on the input shaft can be result.

39) Install torque converter housing in position. Install four bolts (9) and washes, oil seal (10), four bolts (8) that hold torque converter housing to the transmission.

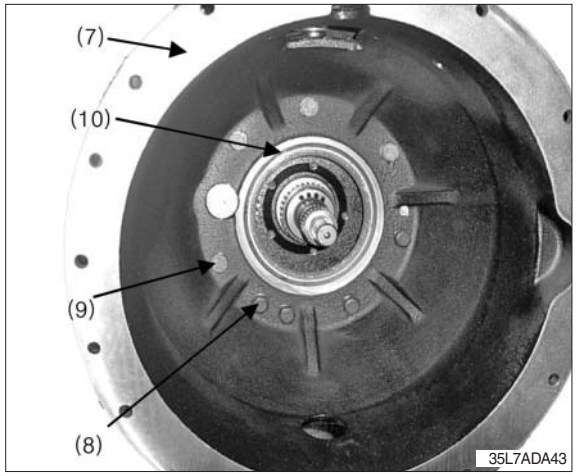


40) Install gear P.T.O input(5) to torque converter, then tighten six socket bolts (6) in postion.



41) Install torque converter in postion. Install flexible plate (1) with six bolts (3) and plate (2).

Then, Install torque converter housing in position.



SECTION 4 BRAKE SYSTEM

Group 1 Structure and function 4-1
Group 2 Operational checks and troubleshooting 4-8
Group 3 Tests and adjustments 4-10

SECTION 4 BRAKE SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

There are two brake systems, the foot brake system and the hand brake system.

In the foot brake system, oil pressure is generated in the master cylinder by treading on the brake pedal. This pressure causes the wheel cylinder pistons to extend, expanding the brake shoes and pressing them against the brake drums to attain braking force.

In the hand (parking) brake system, the brake shoes are expanded by operating the brake lever. Force from the lever is transmitted to the brake shoes through the hand brake cables and a lever arm in each disk brake assembly.

2. SPECIFICATION

1) SERVICE BRAKE

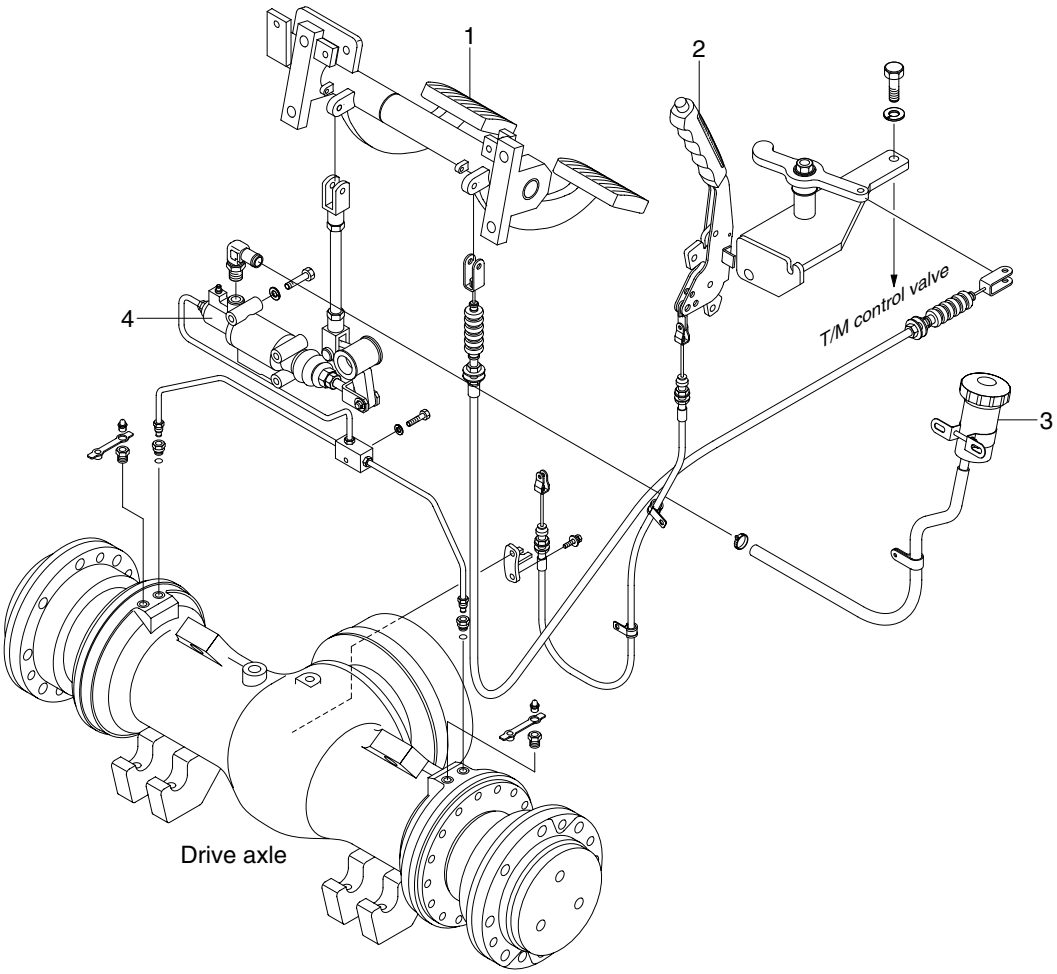
Item		Specification
Type		Wet disk brake
Brake valve step/bore piston diameter		40 mm (1.6 in) / 30 mm (1.2 in)
Pedal adjustment	Pedal height	126~134 mm (5.0~5.3 in)
	Play	2~4 mm (0.08~0.16 in)
Brake oil		Azolla ZS32 (ISO VG32 hydraulic oil)

2) PARKING BRAKE

Item	Specification
Type	Ratchet, internal expanding mechanical type
Parking lever stroke	23˚
Parking cable stroke	28 mm (1.1 in)

3. BRAKE PEDAL AND PIPING

1) STRUCTURE

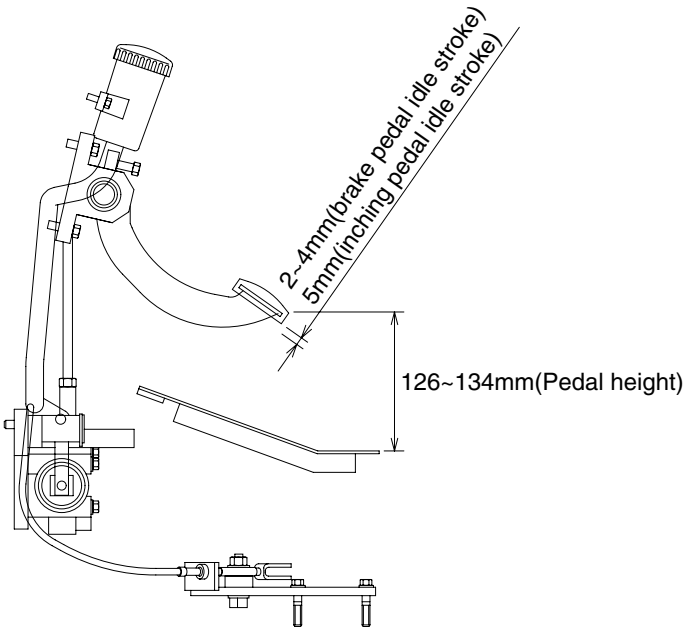


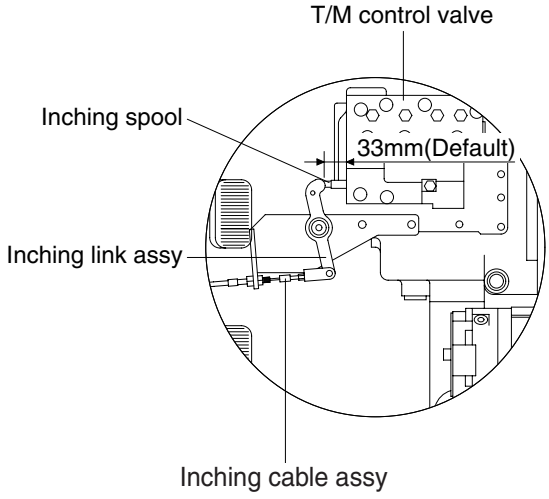
35D9BS03

1 Brake pedal & bracket assembly
2 Parking lever assembly
3 Reservoir tank assembly
4 Brake valve

4. INCHING PEDAL AND LINKAGE

The brake pedal serves to actuate the hydraulic brakes on the front axle. At the beginning of the pedal stroke, the inching spool of the transmission control valve is actuated to shift the hydraulic clutch to neutral and turn off the driving force. By treading the pedal further, the brake is applied.

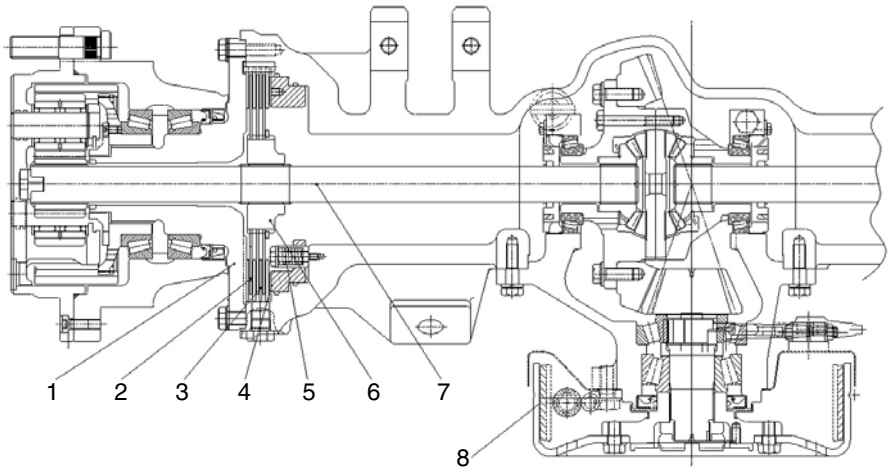




35D9BS04

5. WET DISK BRAKE

1) STRUCTURE



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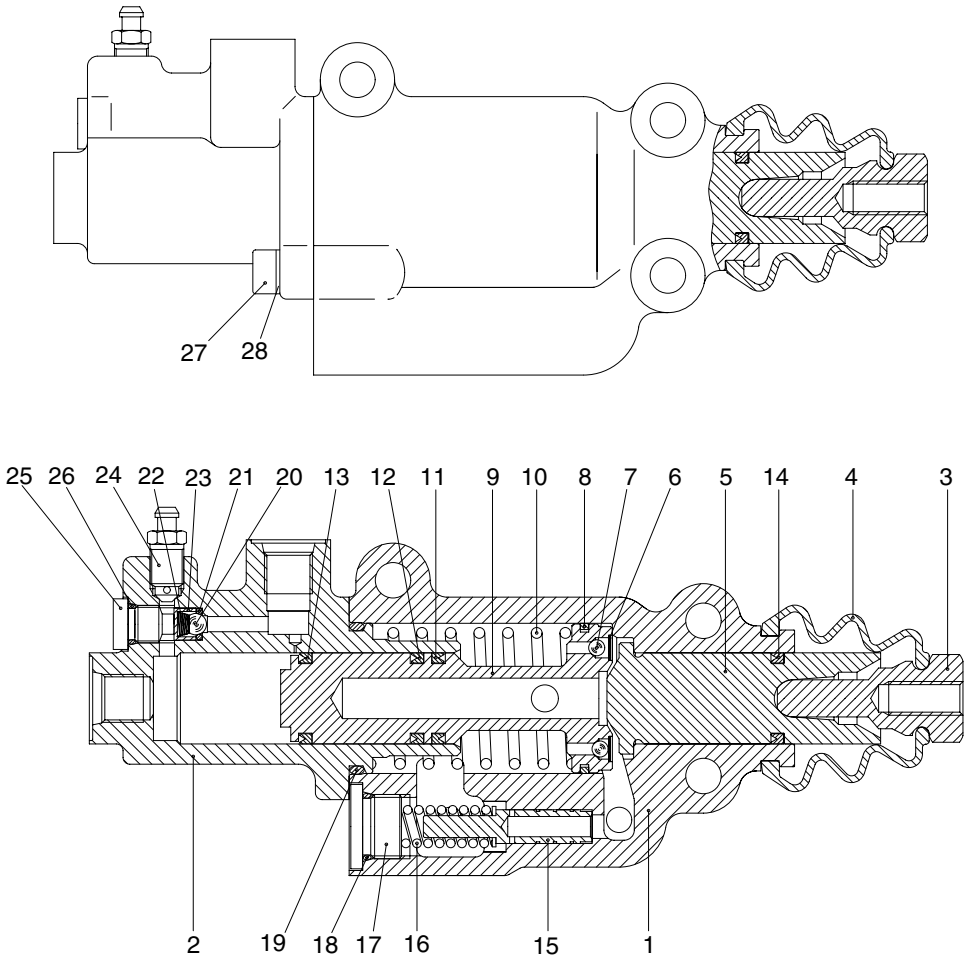
1	Spindle	4	Service piston	7	Drive shaft
2	Steel plate	5	Service piston adjust bolt	8	Parking brake
3	Disk plate	6	Spline collar		

Sealed up structure of hydraulic multi-disk brake system secures good brake performance even in the high humid or dusty area.
Because it is possible to use the brake semi-permanently, there is no need to replace or change the lining as drum type brake do. Also with self-adjust of friction plate clearance, it's easy to prevent the break performance drop due to friction material wear.

Major components are 3 disk plates (3), 4 steel plates (2), service piston (4) and 4 piston adjust bolts (5).
Braking take places when the discs and plates are pressed each other which make rotation resistance to the collar (6) and the drive shaft (7).

6. BRAKE VALVE

1) STRUCTURE



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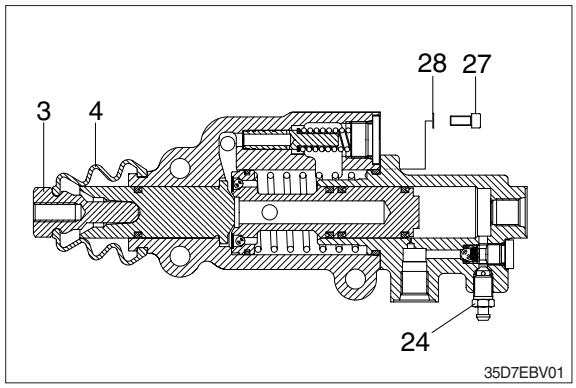
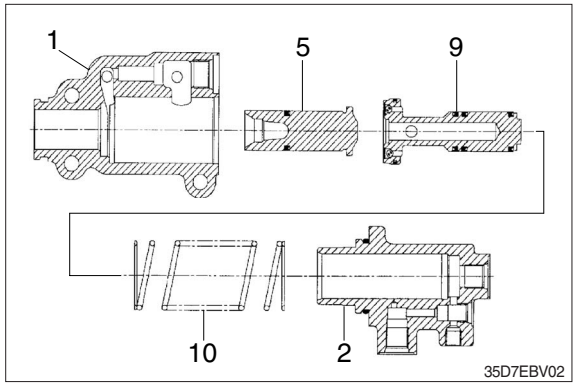
1	Front housing	11	U-cup seal	21	O-ring
2	Rear housing	12	U-cup seal	22	Spring
3	Push rod	13	U-cup seal	23	Gauge
4	Bellows	14	U-cup seal	24	Air bent
5	Master piston	15	Relief piston	25	Plug
6	Lock washer	16	Relief spring	26	O-ring
7	Piston ball	17	Relief plug	27	Bolt
8	Piston ring	18	O-ring	28	Spring washer
9	Servo piston	19	O-ring		
10	Servo spring	20	Ball		

2) DISASSEMBLY

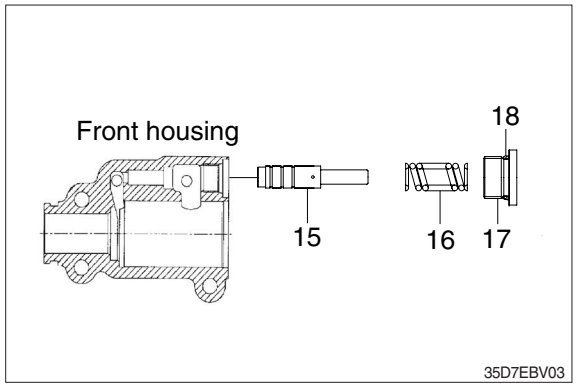
(1) Remove push rod (3), bellows (4), air vent (24), bolt (27) and washer (28).



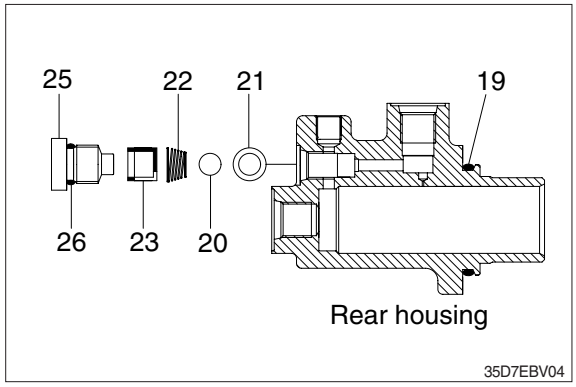
(2) Remove front housing (1), rear housing (2), servo spring (10), servo piston (9) and master piston (5).



(3) Remove relief plug (17) with O-ring (18), relief spring (16) and relief piston (15).



(4) Remove O-ring (19), check plug (25) with O-ring (26), cage (23), check spring (22), check ball (20) and O-ring (21).



3) INSPECTION AND ASSEMBLY

(1) Clean all parts thoroughly and lubricate the parts either with mineral or with hydraulic oil, according to their use destination.

(2) All single parts are to be checked for damage and replaced, if required.

(3) Assembly is in opposite order to disassembly.

(4) Seal kit : XKAU-00176

⚠ Use only brake fluid (Azolla ZS32) into the compensation reservoirs.

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

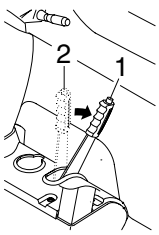
1. OPERATIONAL CHECKS

1) BRAKE PIPING

(1) Check pipes, hoses and joints for damage, oil leakage or interference.
(2) Operate brake pedal and check operating force when pedal in depressed. Check also change in operating force, and change in position of pedal when pedal is kept depressed.

2) PARKING BRAKE

(1) Operating force of parking lever is 35 ~ 40 kgf·m (253 ~ 290 lbf·ft).
(2) Check that parking brake can hold machine in position when loaded on 20% slope. If there is no slope available, travel at low speed and check braking effect of parking brake.



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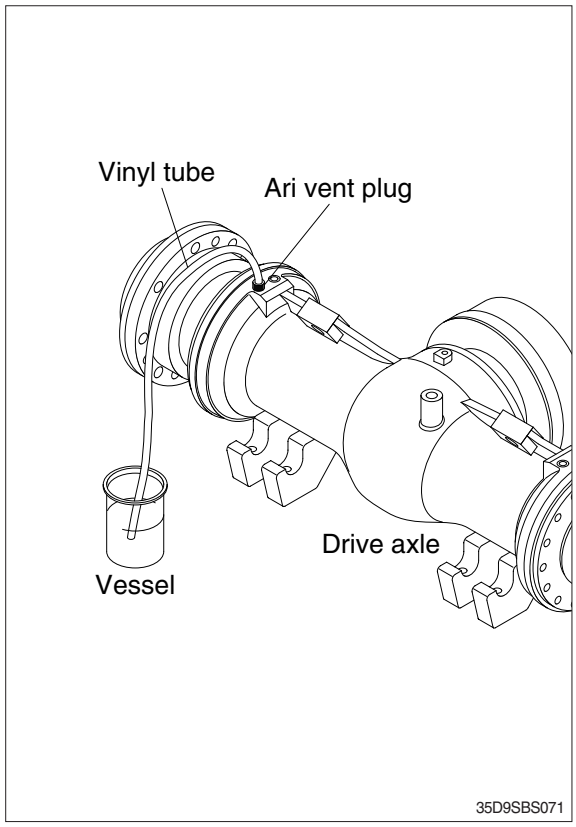
2. TROUBLESHOOTING

Problem	Cause	Remedy
Insufficient braking force	· Hydraulic system leaks oil. · Hydraulic system leaks air. · Disk worn. · Brake valve malfunctioning. · Hydraulic system clogged.	· Repair and add oil. · Bleed air. · Replace. · Repair or replace. · Clean.
Brake acting unevenly. (Machine is turned to one side during braking.)	· Tires unequally inflated. · Brake out of adjustment. · Disk surface roughened. · Wheel bearing out of adjustment. · Hydraulic system clogged.	· Adjust tire pressure. · Adjust. · Repair by polishing or replace. · Adjust or replace. · Clean.
Brake trailing.	· Pedal has no play. · Piston cup faulty. · Brake valve return port clogged. · Hydraulic system clogged. · Wheel bearing out of adjustment.	· Adjust. · Replace. · Clean. · Clean. · Adjust or replace.
Brake chirps	· Brake trailing. · Piston fails to return. · Disk worn. · Disk surface roughened.	· See above. Brake trailing. · Replace. · Replace. · Repair by polishing or replace.
Brake squeaks	· Disk surface roughened. · Disk worn. · Excessively large friction between disk plate.	· Repair by polishing or replace. · Replace. · Clean and apply brake grease.
Large pedal stroke	· Brake out of adjustment. · Hydraulic line sucking air. · Oil leaks from hydraulic line, or lack of oil. · Disk worn.	· Adjust. · Bleed air. · Check and repair or add oil. · Replace.
Pedal dragging.	· Twisted push rod caused by improperly fitted brake valve. · Brake valve seal faulty.	· Adjust. · Replace.

1. AIR BLEEDING OF BRAKE SYSTEM

1) Air bleeding should be performed by two persons :
   One rides on truck for depressing and releasing brake pedal : the other person is on the ground and removes cap from air vent plug on wheel cylinder.
2) Block the front wheel securely and apply parking brake.
3) Start the engine.
4) Attach a vinyl tube to air vent plug and immerse other end of tube into a vessel filled with hydraulic oil.
5) Loosen air vent plug by turning it 3/4 with a wrench. Depress brake pedal to drain oil mixed with air bubbles from plug hole.
6) Depress brake pedal until no air bubbles come out of air vent plug hole.
7) After completion of air bleeding, securely tighten air vent plug. Install cap on plug.



2. ADJUSTMENT OF PEDAL

1) BRAKE PEDAL

(1) Pedal height from floor plate

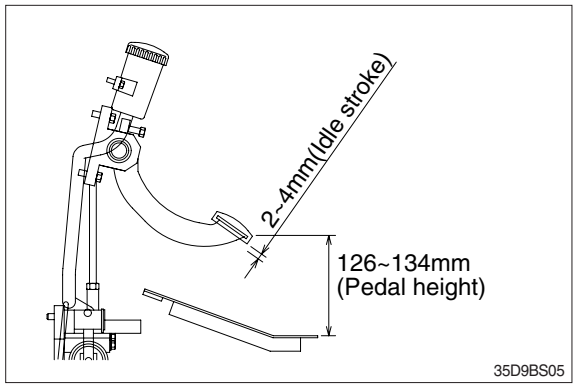
Adjust with stopper bolt.

· Pedal height : 126~134 mm (5.0~5.3 in)

(2) Idle stroke

Adjust with rod of brake valve

· Play : 2~4 mm (0.08~0.16 in)



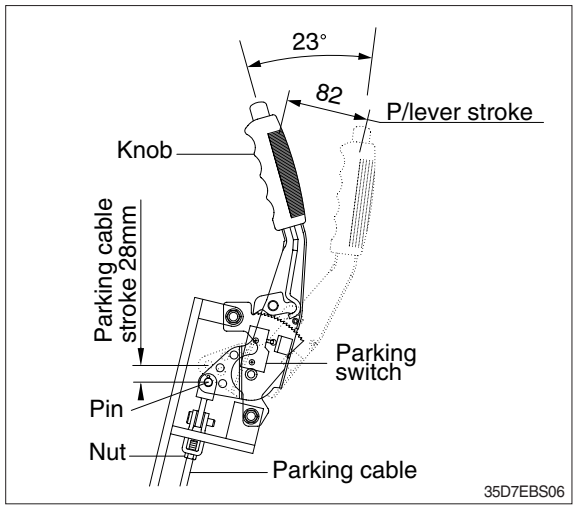
(3) Micro switch for parking brake (if equipped)

① After assembling parking brake and parking cable, put the parking brake lever released.

② Loosen the nut for parking brake plate to play up and down.

③ Move up the plate so that the stopper can be contacted with the pin and then reassemble nut.

· Micro switch stroke when parking brake is applied : 2~3 mm (0.08~0.1 in)



2) INCHING PEDAL

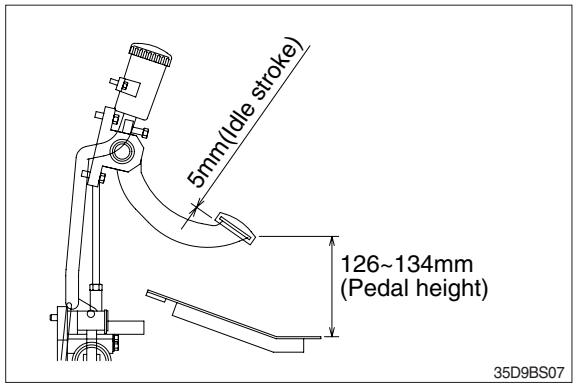
(1) Pedal height from floor plate

Adjust with stopper bolt.

· Pedal height : 126~134 mm (5.0~5.3 in)

(2) Adjust bolt so that brake pedal interconnects with inching pedal.

· Idle stroke: 5 mm (0.2 in)

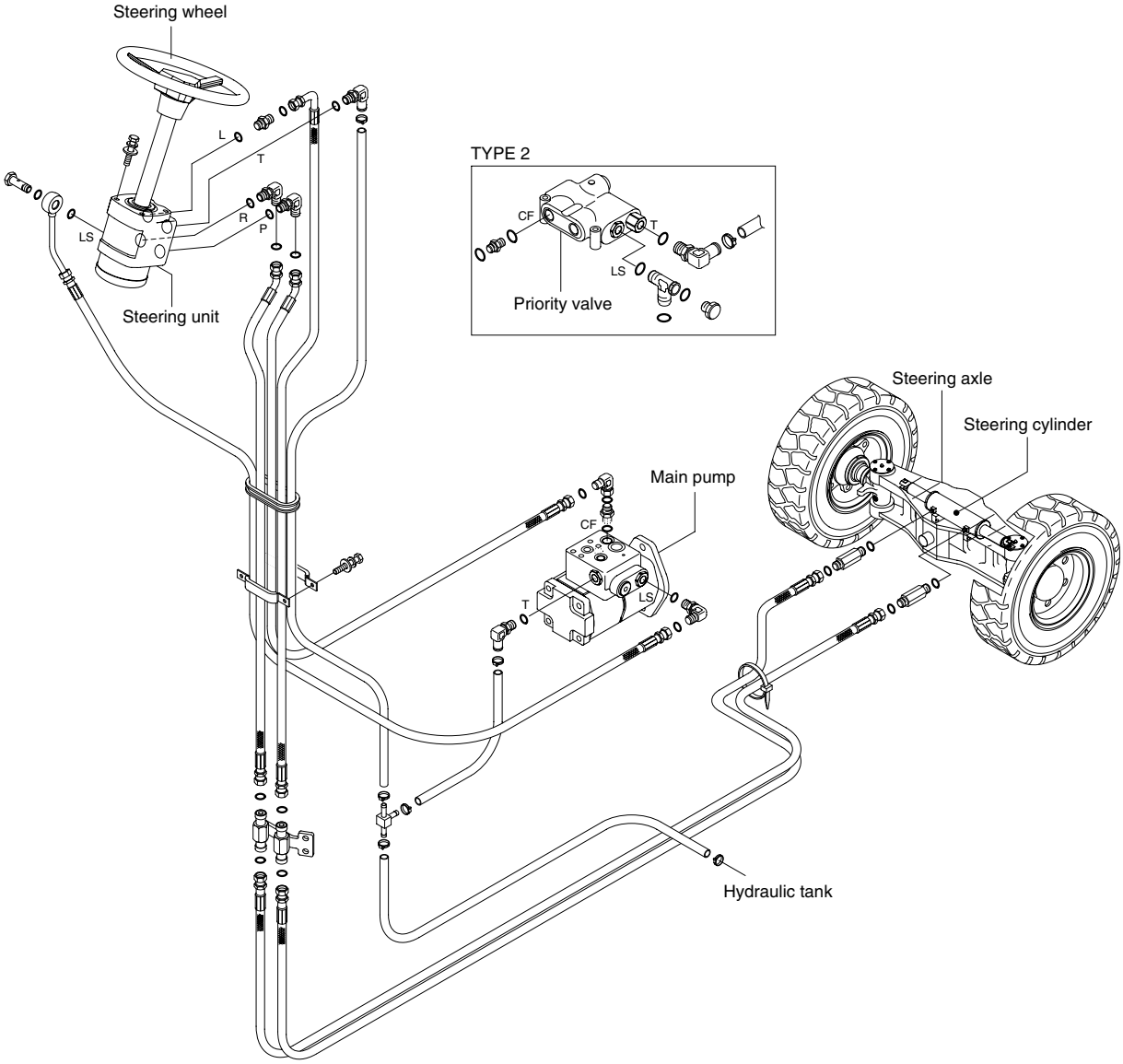


SECTION 5 STEERING SYSTEM

Group 1 Structure and Function ····· 5-1
Group 2 Operational Checks and Troubleshooting ····· 5-12
Group 3 Disassembly and Assembly ····· 5-14

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE



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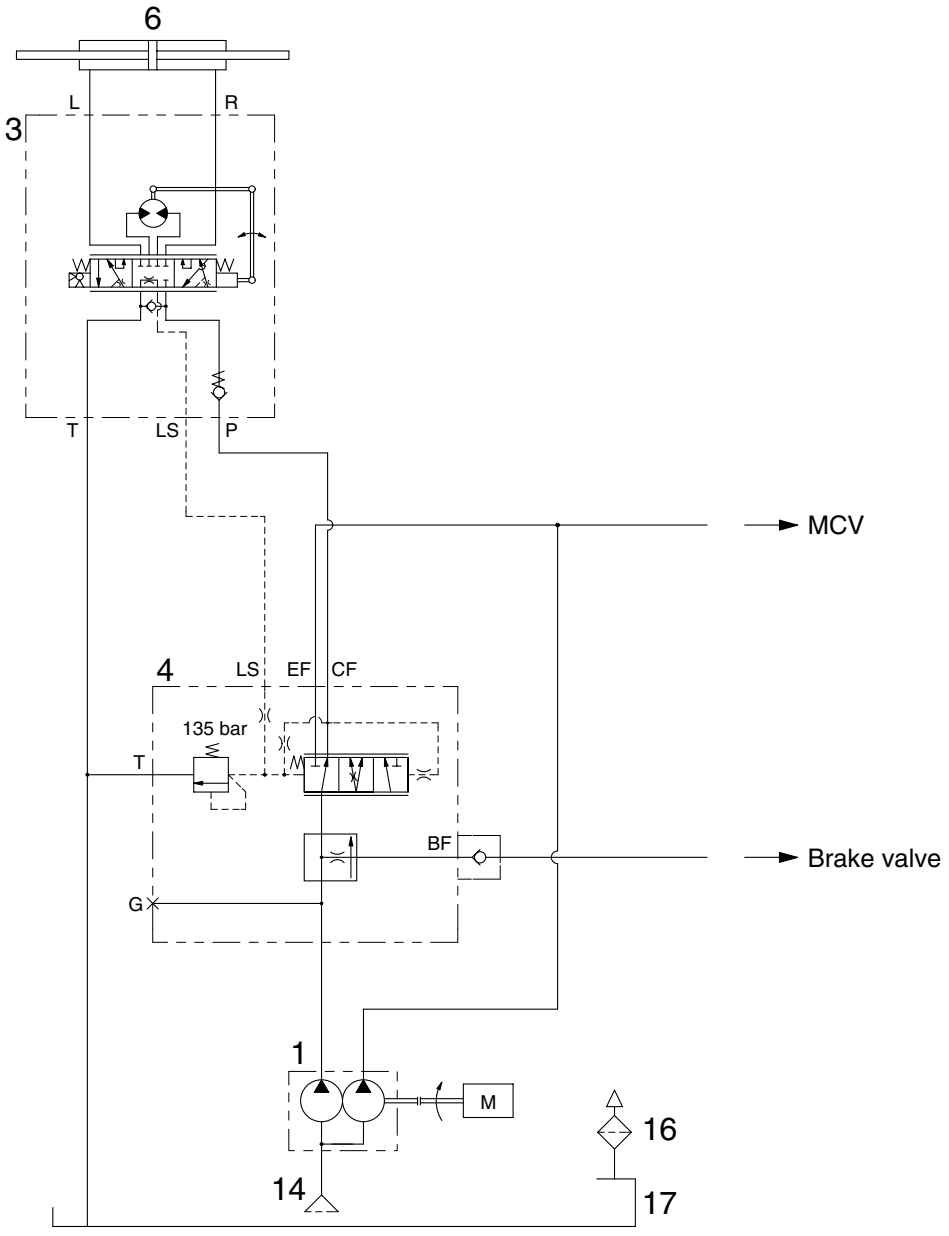
The steering system for this machine is composed of steering wheel assembly, steering unit, priority valve steering cylinder, steering axle and piping. The steering force given to the steering wheel enters the steering unit through the steering column. The required oil flow is sensed by the function of the control section of the unit, and pressurized oil delivered from the hydraulic pump is fed to the steering cylinder. The force produced by the steering cylinder moves the knuckle of steering tires through the intermediate link.

The axle body is unit structure having steering knuckles installed to its both ends by means of kingpins. Hub and wheel are mounted through bearing to spindle of knuckle.

2. HYDRAULIC CIRCUIT

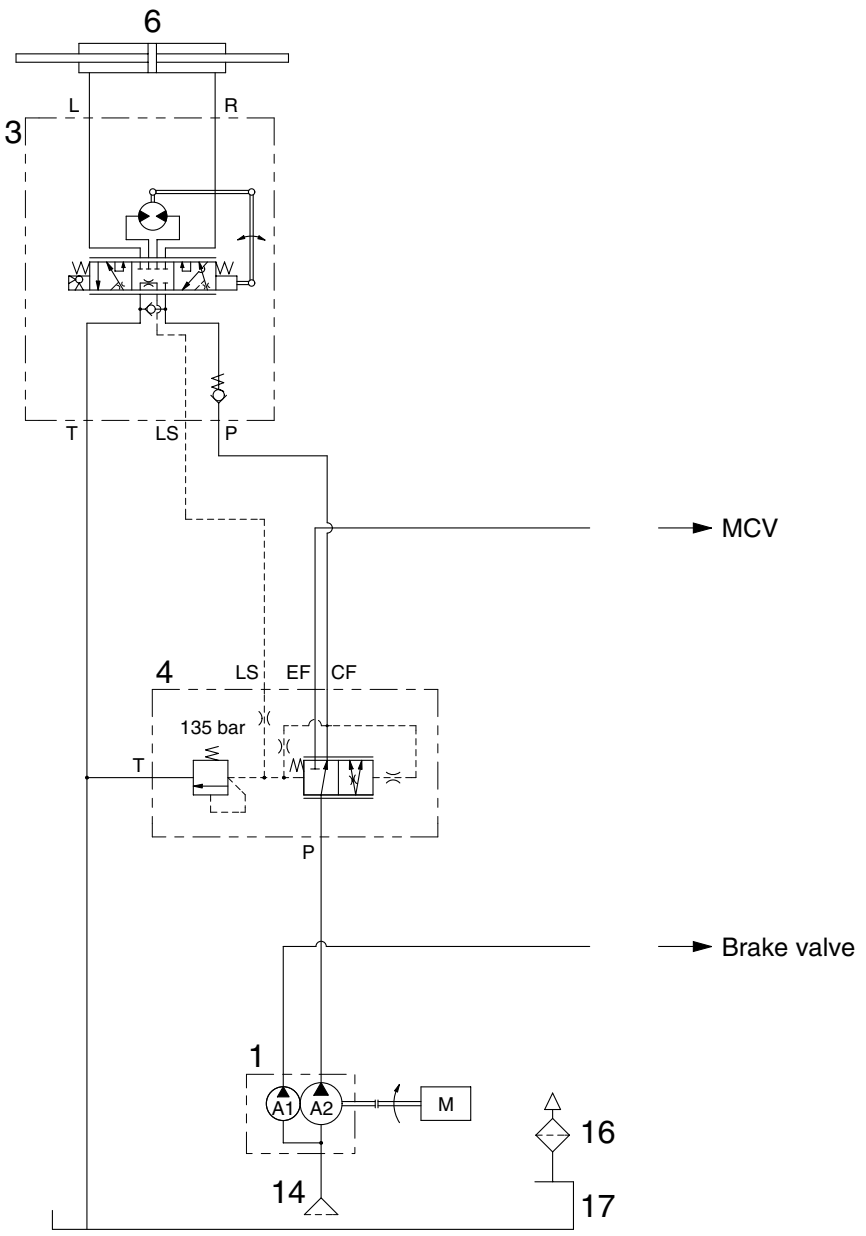
· **TYPE 1** (Pump with dual flow divider)



35D9SE02

1 Hydraulic gear pump
3 Steering unit
4 Dual flow divider
6 Steering cylinder
14 Suction filter
16 Air breather
17 Hydraulic tank

· **TYPE 2** (Pump without priority valve)

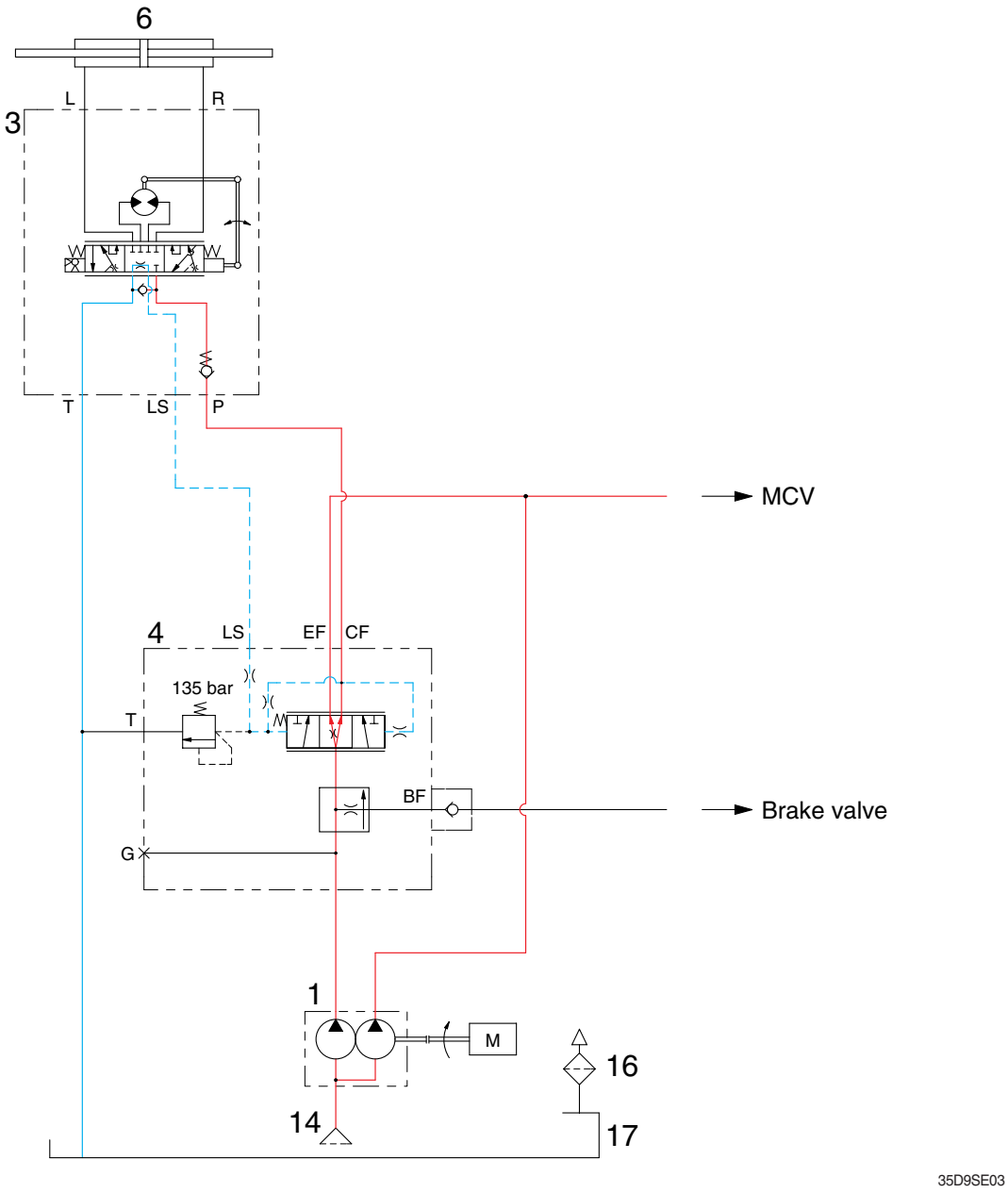


35D9SE02-1

1 Hydraulic gear pump
3 Steering unit
4 Priority valve
6 Steering cylinder
14 Suction filter
16 Air breather
17 Hydraulic tank

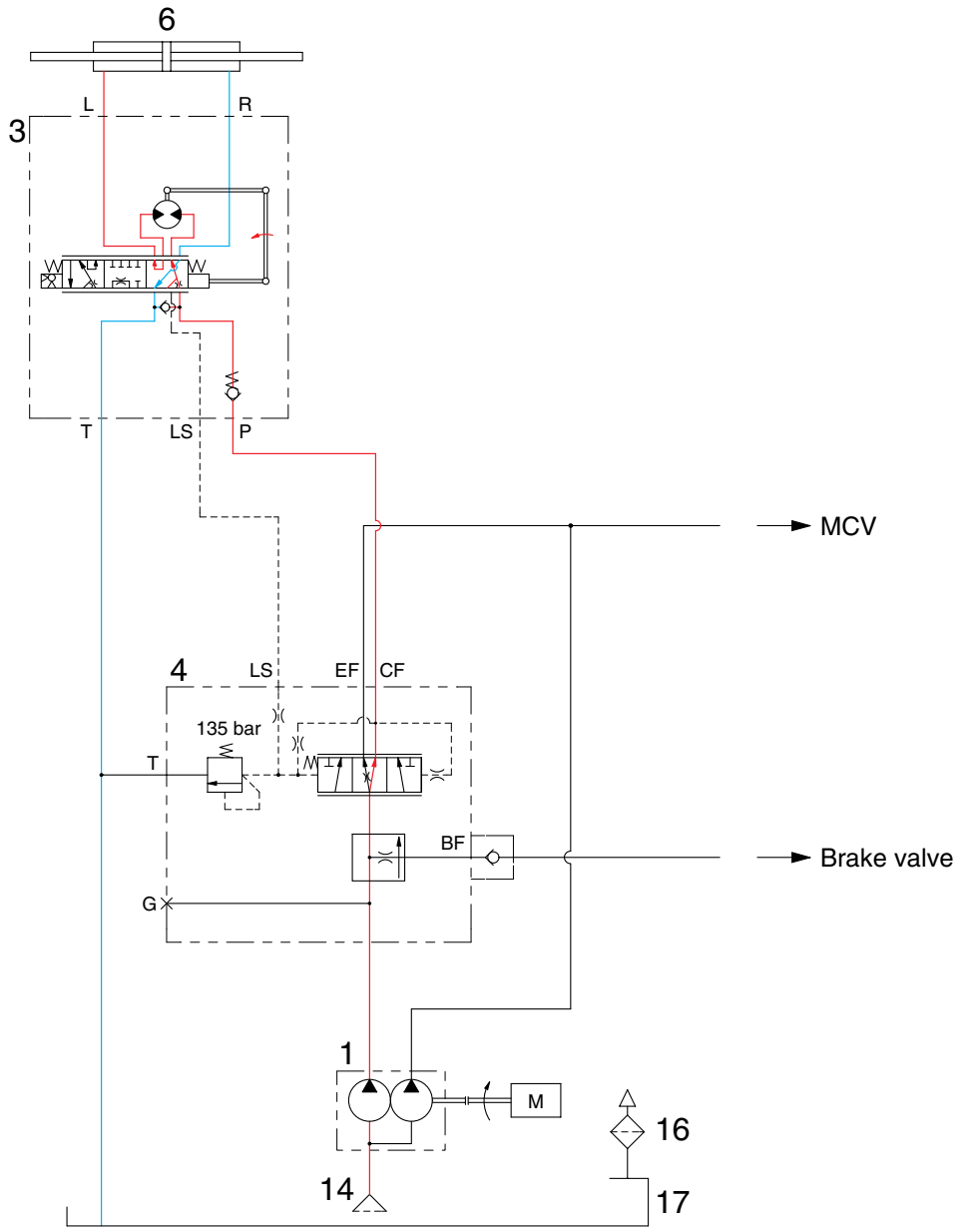
1) NEUTRAL

※ The operation explanations are based on the pump with dual flow divider.



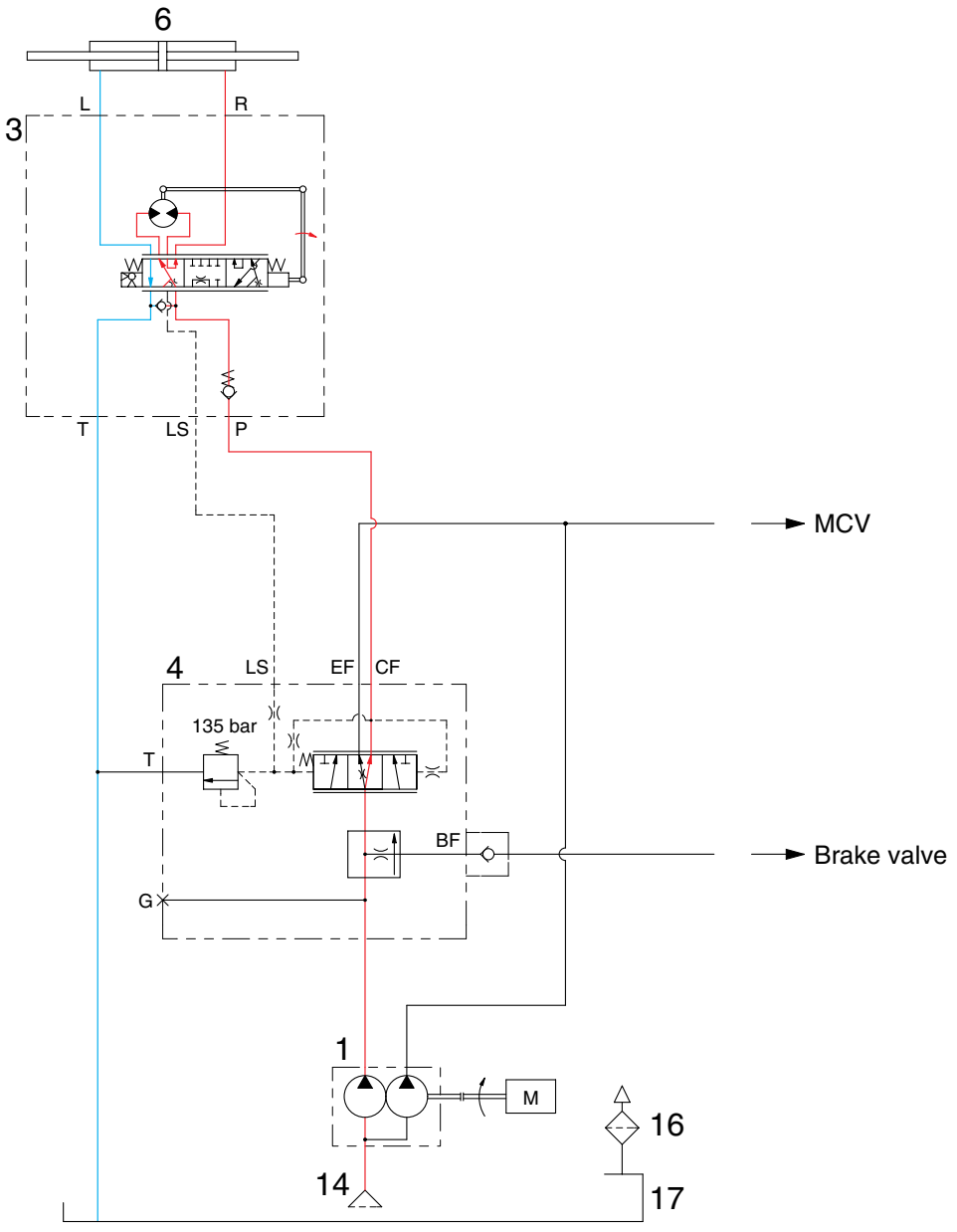
The steering wheel is not being operated, so control spool (G) does not move.
The oil from hydraulic gear pump (1) enters the port P of priority valve (4) and the inlet pressure oil moves the spool (D) to the left.
Oil flow into LS port to the hydraulic oil tank (17).
So, the pump flow is routed to the main control valve.

2) LEFT TURN



When the steering wheel is turned to the left, the spool (G) within the steering unit (3) connected with steering column turns in left hand direction.
At this time, the oil discharged from the hydraulic gear pump flows into the spool (G) within the steering unit (3) through the spool (D) of priority valve (4) and flows the gerotor (H).
Oil flow from the gerotor (H) flows back into the spool (G) and it flows into the left work port (L).
Oil returned from cylinder returns to hydraulic tank (17) through the spool (G).
When the above operation is completed, the truck turns to the left.

3) RIGHT TURN

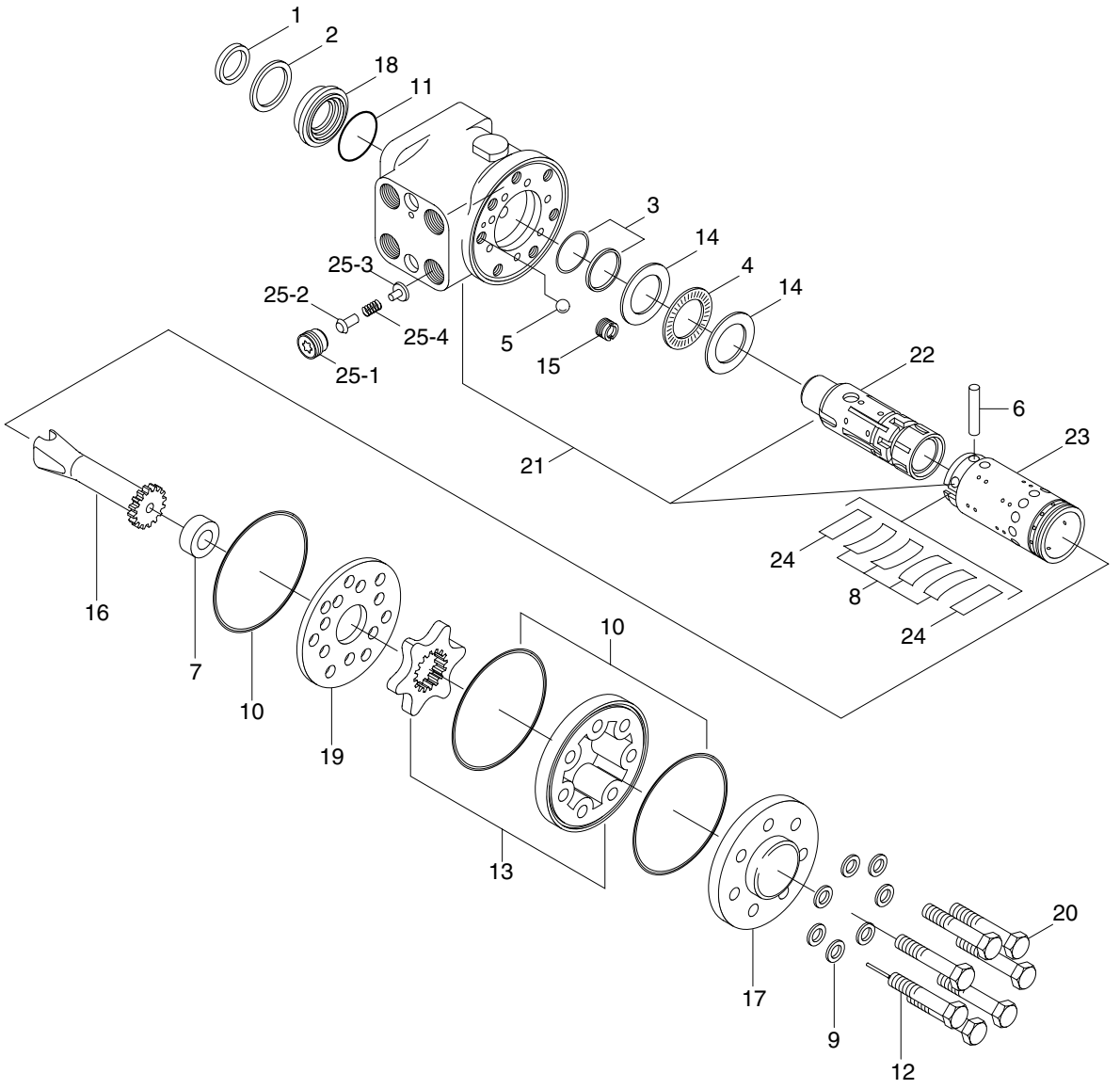


35D9SE05

When the steering wheel is turned to the right, the spool (G) within the steering unit (3) connected with steering column turns in right hand direction.
At this time, the oil discharged from the hydraulic gear pump flows into the spool (G) within the steering unit (3) through the spool (D) of priority valve (4) and flows the gerotor (H).
Oil flow from the gerotor (H) flows back into the spool (G) and it flows into out the right work port (R).
Oil returned from cylinder returns to hydraulic tank (17) through the spool (G).
When the above operation is completed, the truck turns to the right.

3. STEERING UNIT

1) STRUCTURE



20D7SS06

1	Dust seal	11	O-ring	21	Housing
2	Retaining ring	12	Rolled screw	22	Spool
3	Cap seal	13	Gerotor set	23	Sleeve
4	Thrust bearing	14	Bearing race	24	Plate spring
5	Ball	15	Bore screw	25	P-port check valve
6	Pin	16	Drive	25-1	Plug
7	Spacer	17	End cap	25-2	Poppet
8	Center spring	18	Gland bushing	25-3	Spring seat
9	Washer	19	Plate	25-4	Spring
10	O-ring	20	Cap screw		

2) OPERATION

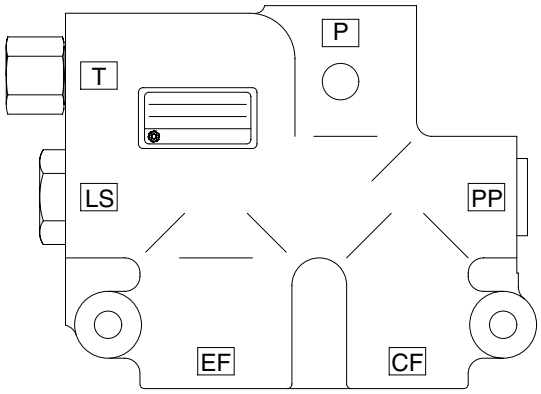
The steering unit is composed of the control valve (rotary valve) and the metering device. The control valve controls the flow of oil from the pump in the interior of the unit depending on the condition of the steering wheel. The metering device is a kind of hydraulic motor composed of a stator and a rotor. It meters the required oil volume, feeds the metered oil to the power cylinder and detects cylinder's motion value, that is, cylinder's motion rate.

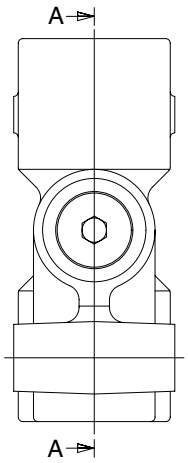
When the steering wheel is turned, the spool turns, the oil path is switched and the oil is fed into the metering device. As a result, the rotor is caused to run by oil pressure, and the sleeve is caused to run through the drive shaft and cross pin. Therefore, when the spool is turned, the spool turns by the same value in such a manner that it follows the motion of the spool. Steering motion can be accomplished when this operation is performed in a continuous state.

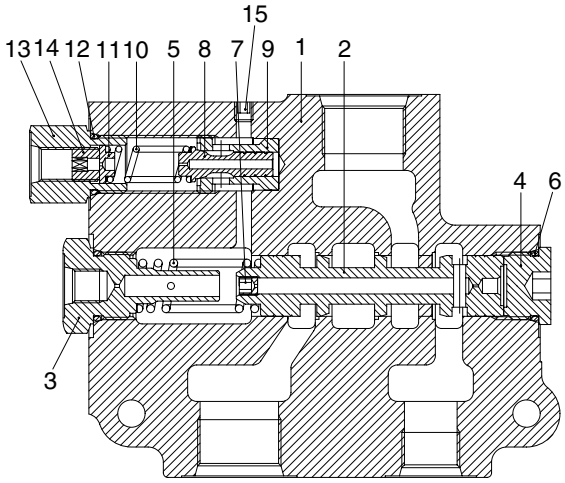
⚠ If the hoses of the steering system are incorrectly connected, the steering wheel can turn very rapidly when the engine is started. Keep clear of the steering wheel when starting the engine.

The centering spring for the spool and sleeve is provided to cause the valve to return to the neutral position. It is therefore possible to obtain a constant steering feeling, which is transmitted to the hands of the driver. Return to the center position occurs when the steering wheel is released.

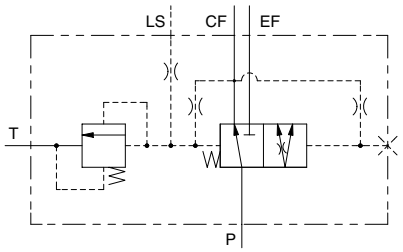
4. PRIORITY VALVE







SECTION "A-A"



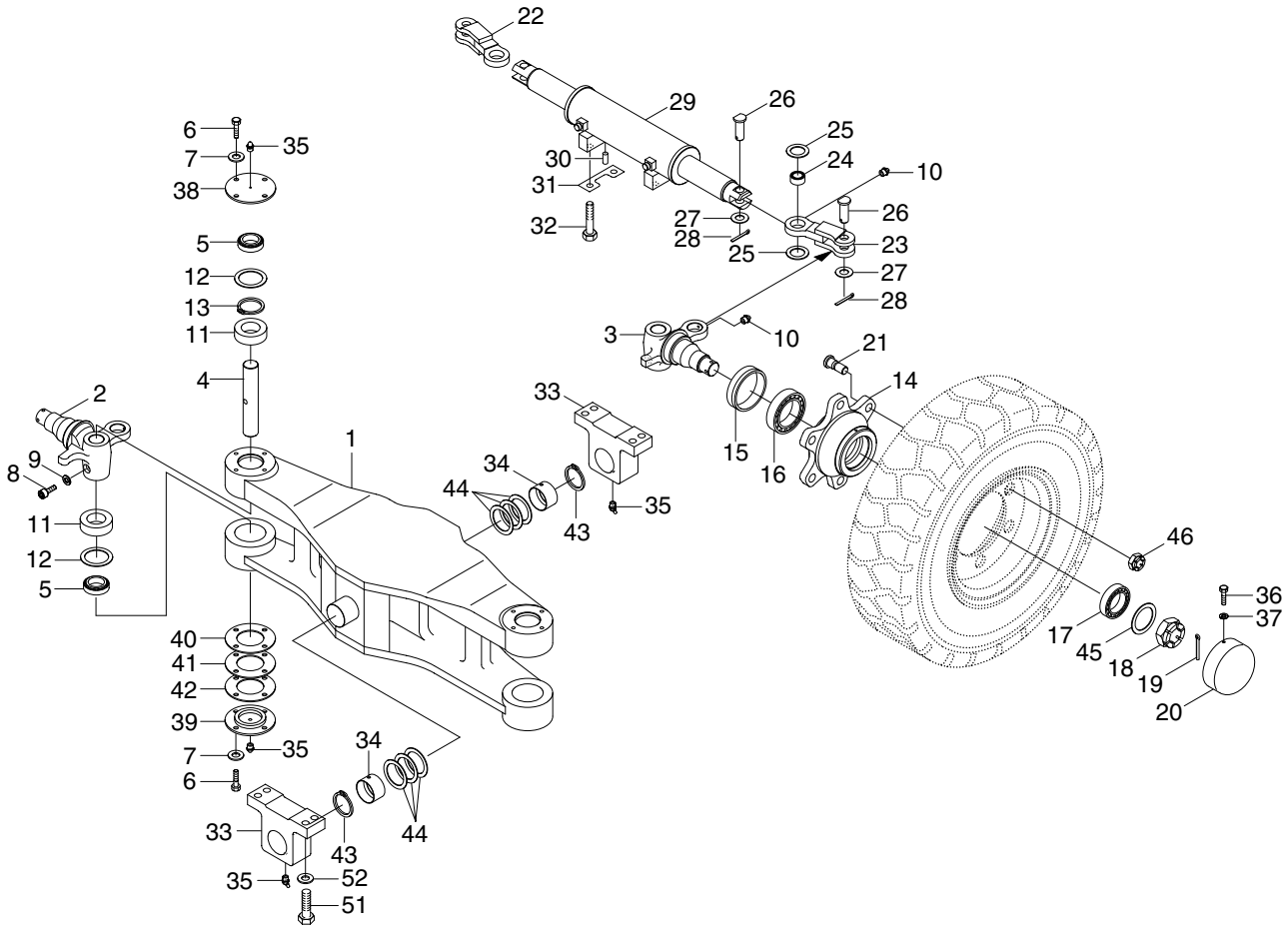
HYD. CIRCUIT

35D9SE05A

1	Body	6	O-ring	11	Orifice
2	Spool	7	Orifice	12	O-ring
3	Spring plug	8	Spool	13	End plug
4	End plug	9	Bushing	14	Control screw
5	Spring	10	Spring	15	Plug

5. STEERING AXLE

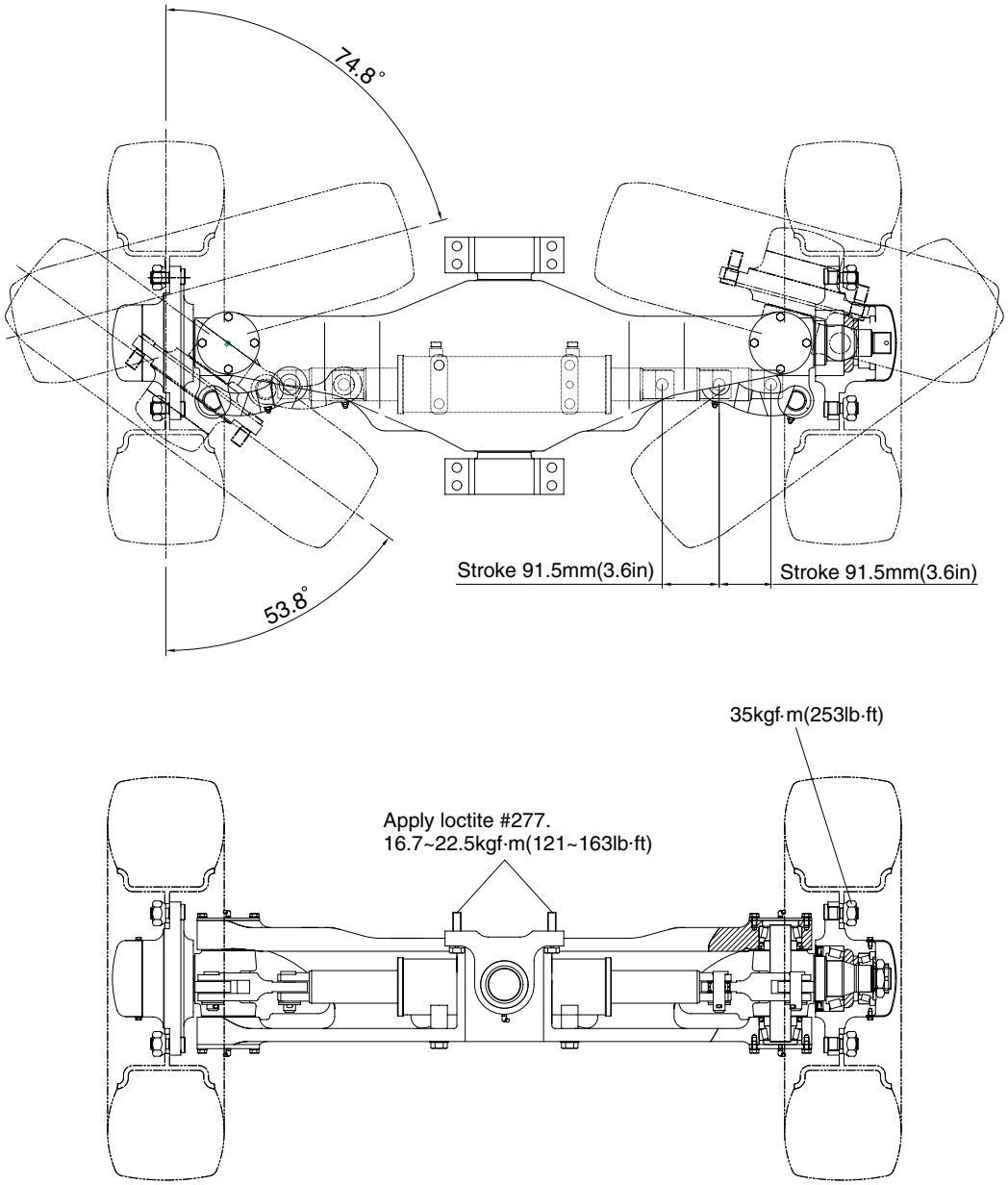
1) STRUCTURE



35D9SSE06

1	Axle center	13	Retaining ring	25	Thrust washer	37	Spring washer
2	Knuckle-RH	14	Hub	26	Clevis pin	38	Upper cover
3	Knuckle-LH	15	Oil seal	27	Plain washer	39	Lower cover
4	King pin	16	Taper roller bearing	28	Split pin	40	Shim (0.1t)
5	Taper roller bearing	17	Taper roller bearing	29	Steering cylinder	41	Shim (0.15t)
6	Hexagon bolt	18	Slotted nut	30	Pin	42	Shim (0.3t)
7	Spring washer	19	Split pin	31	Lock plate	43	Retaining ring
8	Special bolt	20	Hub cap	32	Hexagon bolt	44	Shim (0.5t)
9	Spring washer	21	Serration bolt	33	Support	45	Plain washer
10	Grease nipple	22	Link-RH	34	Bushing	46	Hub nut
11	Collar	23	Link-LH	35	Grease nipple	51	Hexagon bolt
12	Oil seal	24	SPH plain bearing	36	Hexagon bolt	52	Spring washer

2) GREASING AND SPECIFICATION

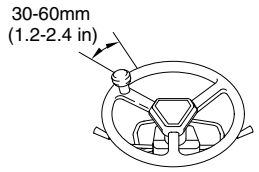


35DS7SE07

Type	Unit	Center pin support single shaft
Structure of knuckle	-	Elliott type
Toe-in	degree	0
Camber	degree	0
Caster	degree	0
King pin angle	degree	0
Max steering angle of wheels(Inside/Outside)	degree	74.8/53.8
Tread	mm (ft·in)	1140 (3' 9")

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

<table>
<tr><th>Check item</th><th>Checking procedure</th></tr>
<tr><td>Steering wheel
 
</td><td>· Set rear wheels facing straight forward, then turn steering wheel to left and right. Measure range of steering wheel movement before rear wheel starts to move. Range should be 30~60 mm at rin of steering wheel. If play is too large, adjust at gear box.
Test steering wheel play with engine at idling.</td></tr>
<tr><td>Knuckle</td><td>· Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.</td></tr>
<tr><td>Steering axle</td><td>· Put camber gauge in contact with hub and measure camber.
If camber is not within 0±0.5° ; rear axle is bent.
· Ask assistant to drive machine at minimum turning radius.
· Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius.
· If minimum turning radius is not within±100 mm (±4 in)of specified value, adjust turning angle stopper bolt.
Min turning radius (Outside)
<table>
<tr><td>35D-9</td><td>3006 mm (118 in)</td><td>45D-9</td><td>3040 mm (120 in)</td></tr>
<tr><td>40D-9</td><td>3005 mm (118 in)</td><td>50DA-9</td><td>3040 mm (120 in)</td></tr>
</table></td></tr>
<tr><td>Hydraulic pressure of power steering</td><td>Remove screw coupling from CF port of priority valve and install oil pressure gauge. Turn steering wheel fully and check oil pressure.
※ Oil pressure : 135 kgf/cm² (1920 psi)</td></tr>
</table>

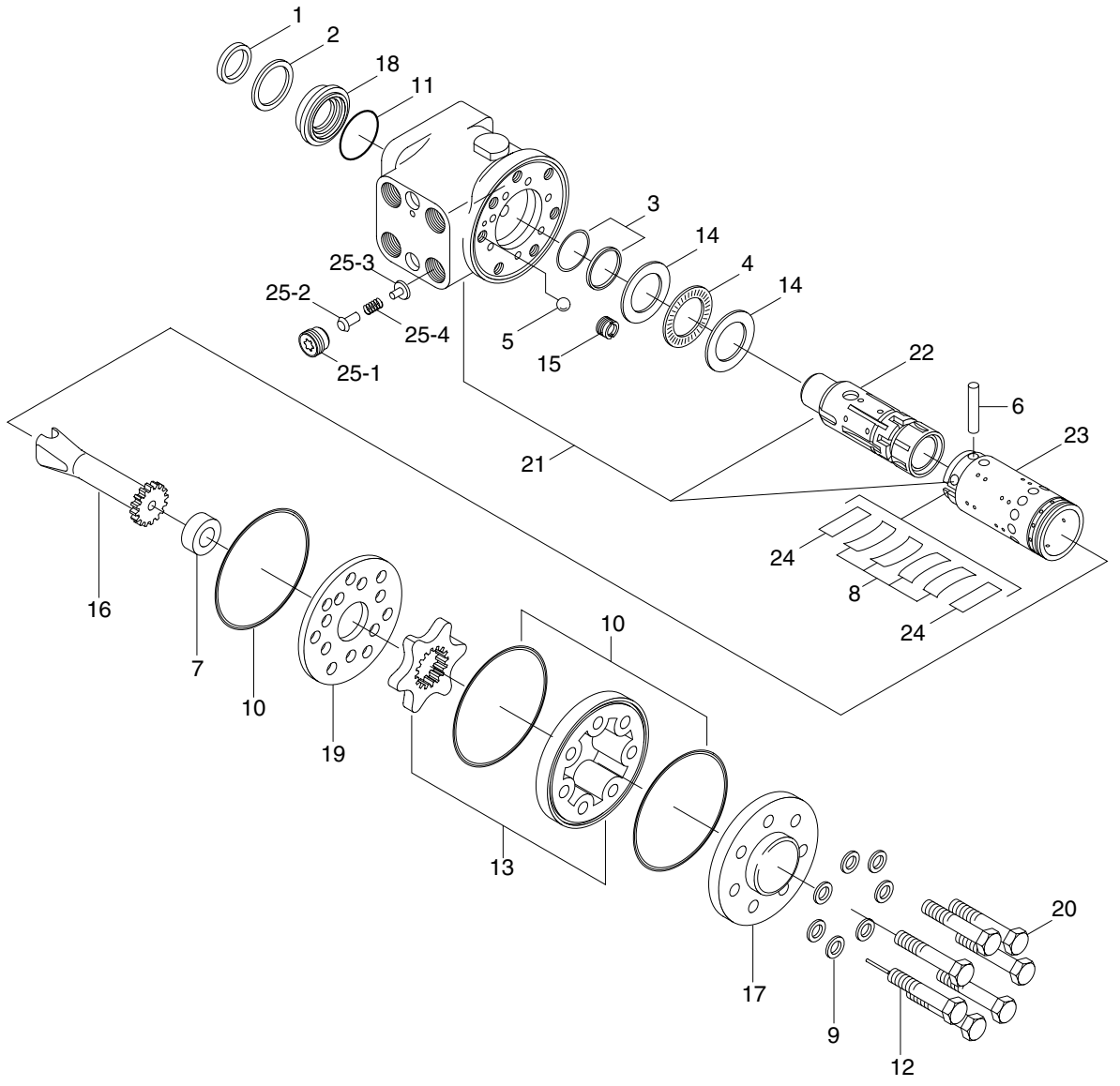
2. TROUBLESHOOTING

Problem	cause	Remedy
Steering wheel drags.	· Low oil pressure. · Bearing faulty. · Spring spool faulty. · Reaction plunger faulty. · Ball-and-screw assembly faulty. · Sector shaft adjusting screw excessively tight. · Gears poorly meshing. · Flow divider coil spring fatigued.	· Check lockout. Repair. · Clean or replace. · Clean or replace. · Replace. · Clean or replace. · Adjust. · Check and correct meshing. · Replace.
Steering wheel fails to return smoothly.	· Bearing faulty. · Reaction plunger faulty. · Ball-and-screw assy faulty · Gears poorly meshing.	· Clean or replace. · Replace. · Clean or replace. · Check and correct meshing.

Problem	cause	Remedy
Steering wheel turns unsteadily. Steering system makes abnormal sound or vibration.	· Lockout loosening. · Metal spring deteriorated. · Gear backlash out of adjustment. · Lockout loosening. · Air in oil circuit.	· Retighten. · Replace. · Adjust. · Retighten. · Bleed air.
Abnormal sound heard when steering wheel is turned fully	Valve · Faulty. (Valve fails to open.) Piping · Pipe (from pump to power steering cylinder) dented or clogged.	· Adjust valve set pressure and check for specified oil pressure. · Repair or replace.
Piping makes abnormal sounds.	Oil pump · Lack of oil. · Oil inlet pipe sucks air. · Insufficient air bleeding.	· Add oil. · Repair. · Bleed air completely.
Valve or valve unit makes abnormal sounds.	Oil pump · Oil inlet pipe sucks air. Valve · Faulty. (Unbalance oil pressure) Piping · Pipe (from pump to power steering) dented or clogged. · Insufficient air bleeding.	· Repair or replace. · Adjust valve set pressure and check specified oil pressure. · Repair or replace. · Bleed air completely.
Insufficient or variable oil flow.	· Flow control valve orifice clogged.	· Clean
Insufficient or variable discharge pressure.	Piping · Pipe (from tank to pipe) dented or clogged.	· Repair or replace.
Steering cylinder head leakage (Piston rod)	· Packing foreign material. · Piston rod damage. · Rod seal damage and distortion. · Chrome gilding damage.	· Replace · Grind surface with oil stone. · Replace · Grind
Steering cylinder head thread (A little bit leak is no problem)	· O-ring damage.	· Replace
Welding leakage	· Cylinder tube damage.	· Tube replace.
Rod	· Tube inside damage. · Piston seal damage and distortion	· Grind surface with oil store. · Replace
Piston rod bushing inner diameter excessive gap	· Bushing wear.	· Replace

1. STEERING UNIT

1) STRUCTURE

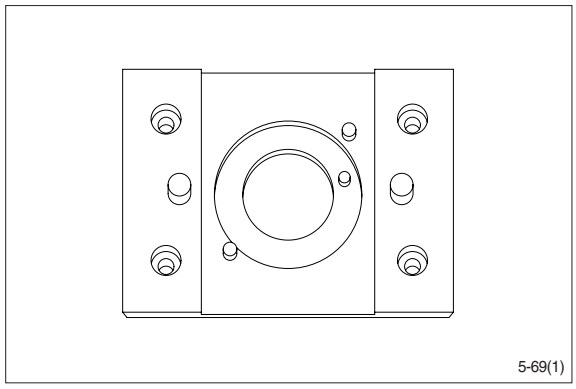


20D7SS06

1	Dust seal	11	O-ring	21	Housing
2	Retaining ring	12	Rolled screw	22	Spool
3	Cap seal	13	Gerotor set	23	Sleeve
4	Thrust bearing	14	Bearing race	24	Plate spring
5	Ball	15	Bore screw	25	P-port check valve
6	Pin	16	Drive	25-1	Plug
7	Spacer	17	End cap	25-2	Poppet
8	Center spring	18	Gland bushing	25-3	Spring seat
9	Washer	19	Plate	25-4	Spring
10	O-ring	20	Cap screw		

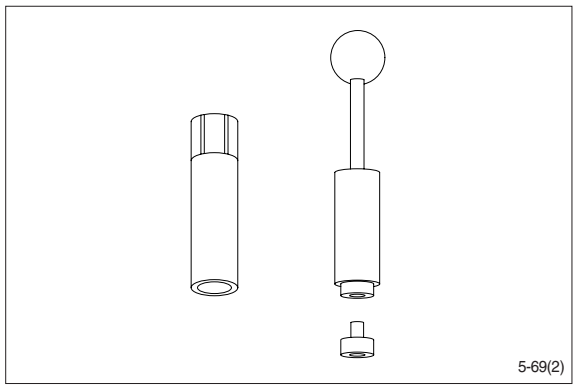
2) TOOLS

(1) Holding tool.



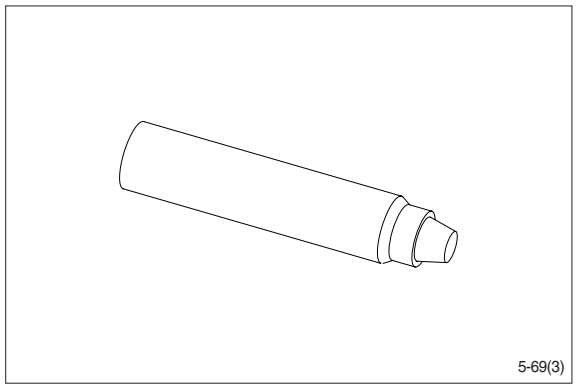
5-69(1)

(2) Assembly tool for O-ring and kin-ring.



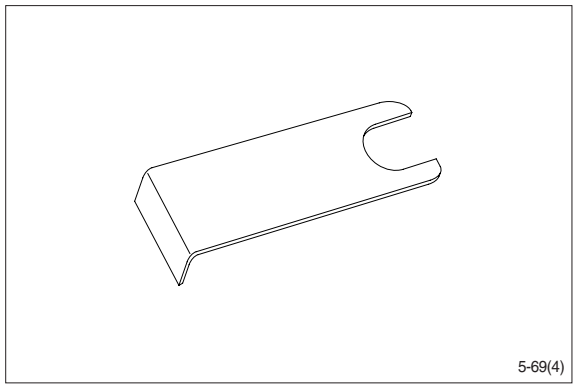
5-69(2)

(3) Assembly tool for lip seal.



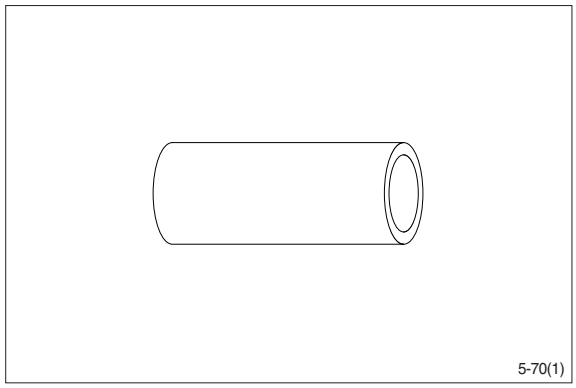
5-69(3)

(4) Assembly tool for cardan shaft.

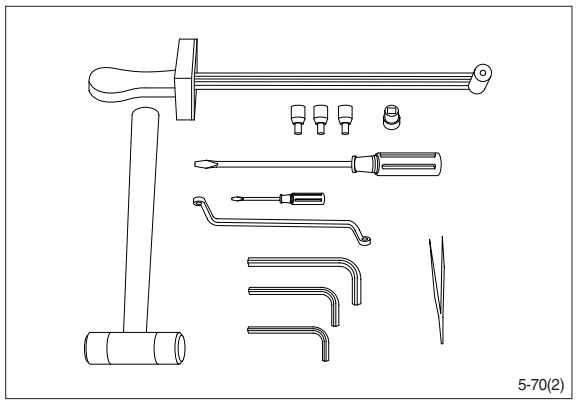


5-69(4)

(5) Assembly tool for dust seal.

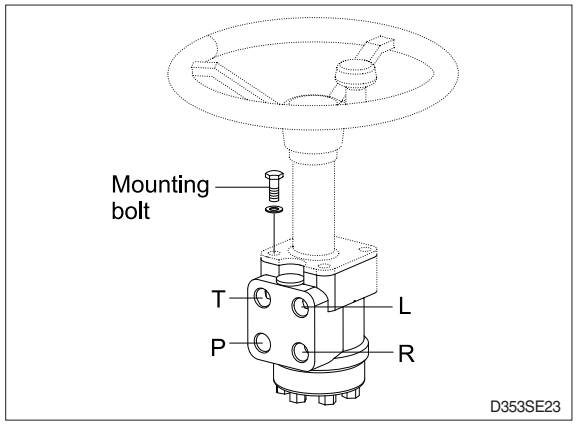


(6) Torque wrench 0~7.1 kgf · m
(0~54.4 lbf · ft)
13 mm socket spanner
6, 8 mm and 12 mm hexagon sockets
12 mm screwdriver
2 mm screwdriver
13 mm ring spanner
6, 8 and 12 mm hexagon socket spanners
Plastic hammer
Tweezers



3) TIGHTENING TORQUE

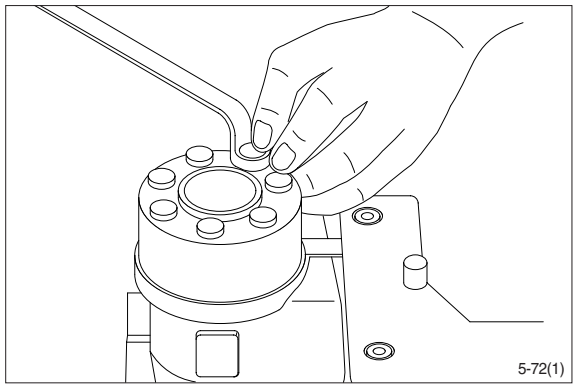
L : Left port
R : Right port
T : Tank
P : Pump



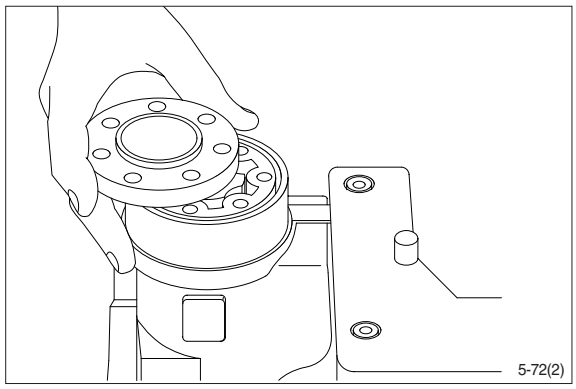
Port	Size	Torque [kgf · m (lbf · ft)]
L	3/4 UNF - 16	6.1 ±0.6 (44.1±4.3)
R	3/4 UNF - 16	6.1 ±0.6 (44.1±4.3)
T	3/4 UNF - 16	6.1 ±0.6 (44.1±4.3)
P	3/4 UNF - 16	6.1 ±0.6 (44.1±4.3)
Mounting bolt	M10×1.5	4.0 ±0.5 (29±3.6)

4) DISASSEMBLY

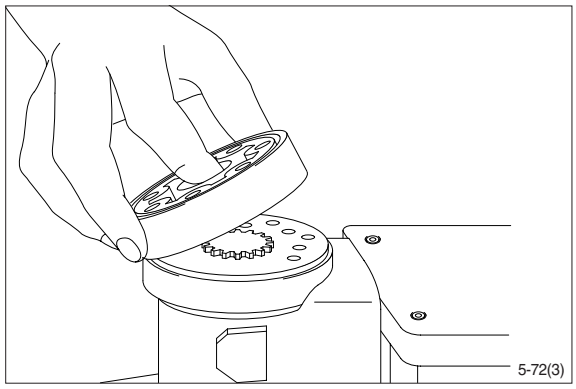
(1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover (6-off plus one special screw).


5-72(1)

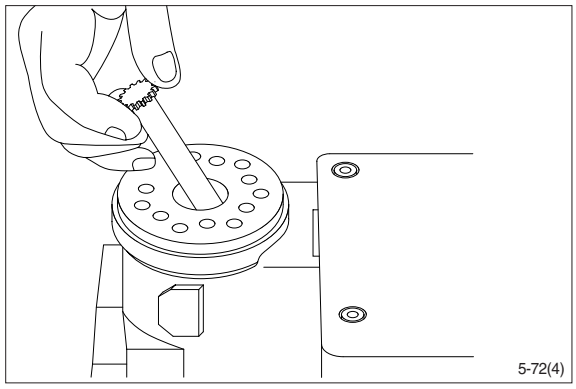
(2) Remove the end cover, sideways.


5-72(2)

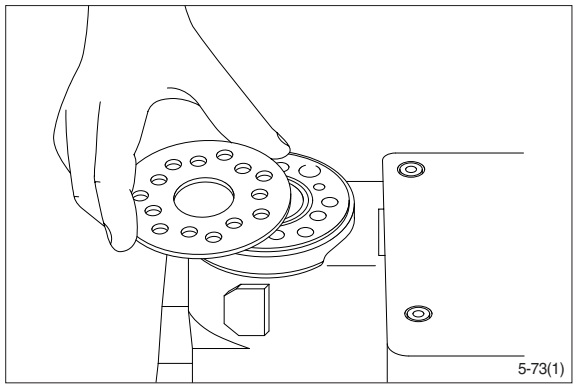
(3) Lift the gearwheel set (With spacer if fitted) off the unit.
Take out the two O-rings.


5-72(3)

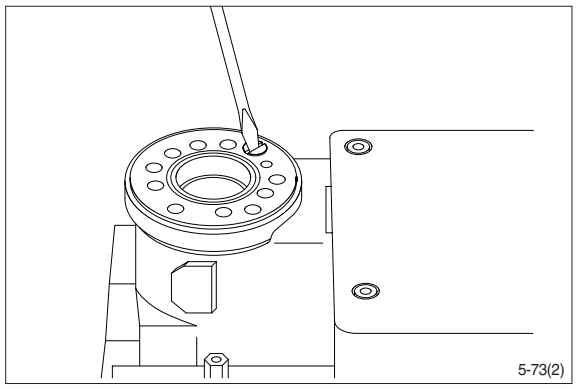
(4) Remove cardan shaft.


5-72(4)

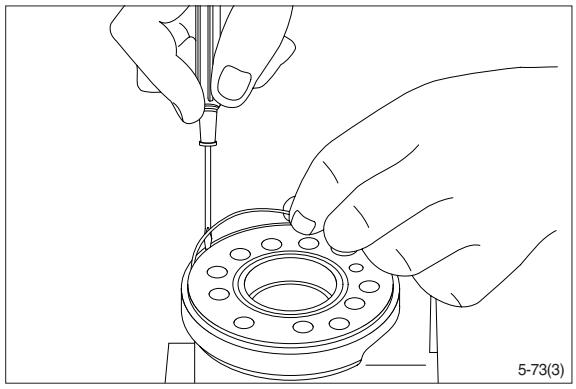
(5) Remove distributor plate.



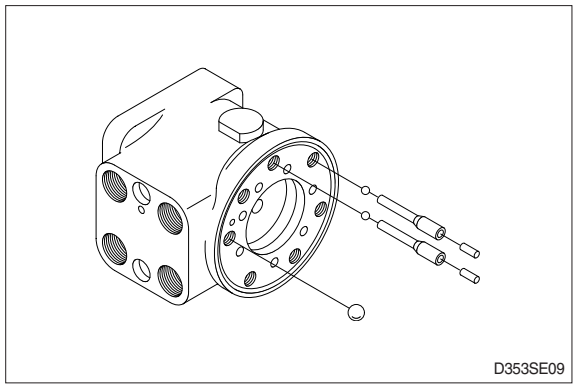
(6) Screw out the threaded bush over the check valve.



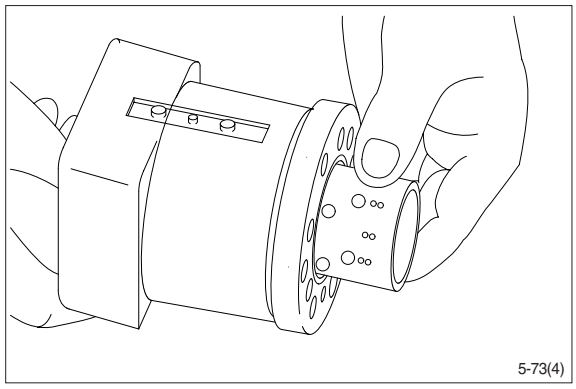
(7) Remove O-ring.



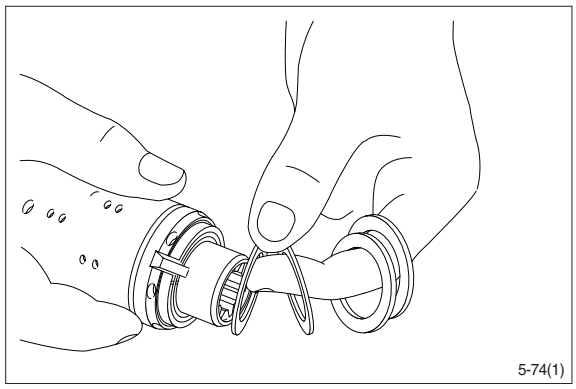
(8) Shake out the check valve ball and suction valve pins and balls.



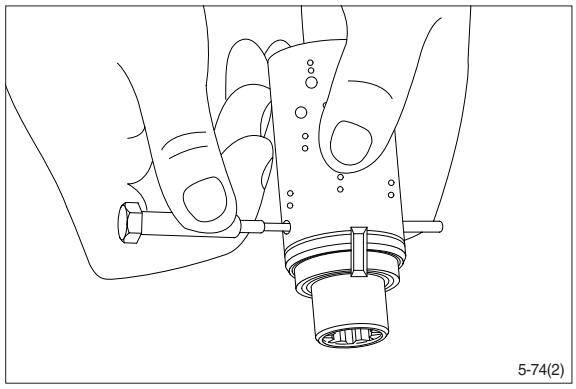
(9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and thrust bearing will be pushed out of the housing together.


5-73(4)

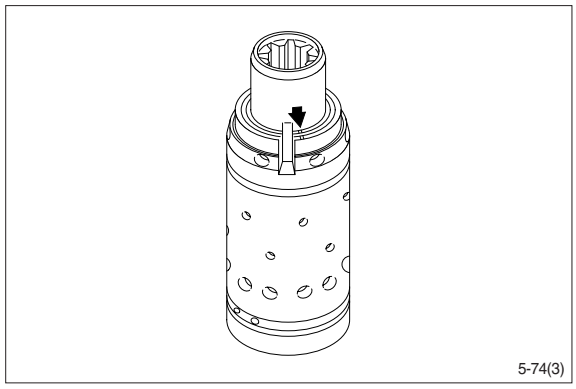
(10) Take ring, bearing races and thrust bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.


5-74(1)

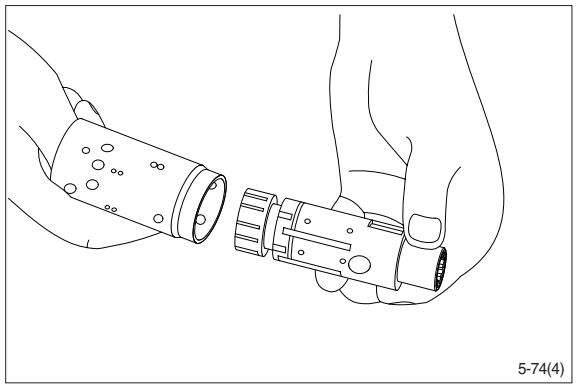
(11) Press out the cross pin. Use the special screw from the end cover.


5-74(2)

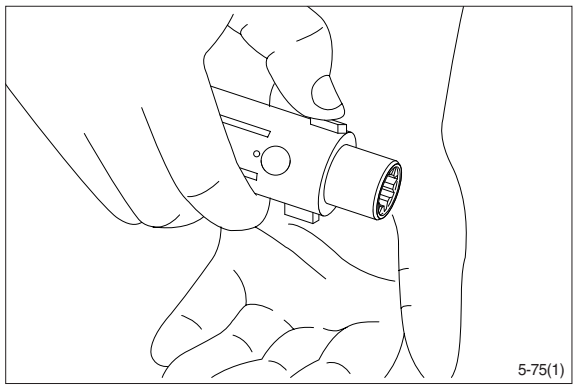
※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs (See drawing).
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.


5-74(3)

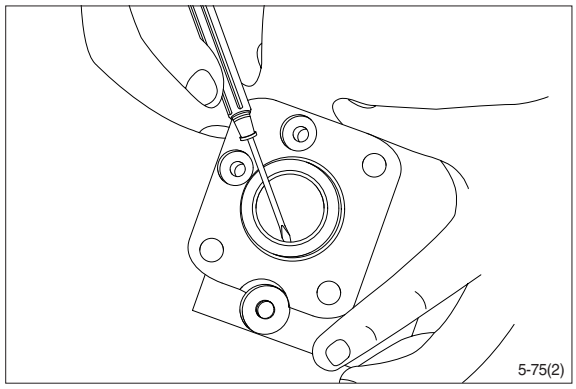
(12) Carefully press the spool out of the sleeve.



(13) Press the neutral position springs out of their slots in the spool.

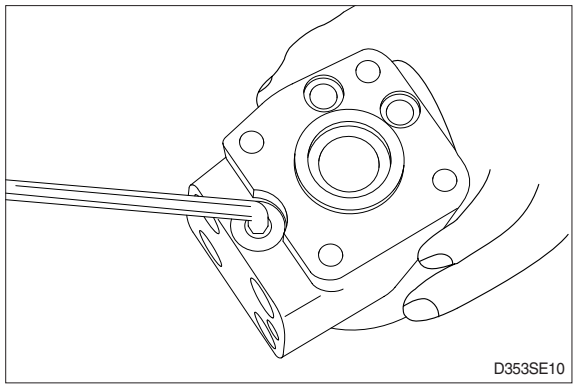


(14) Remove dust seal and O-ring.

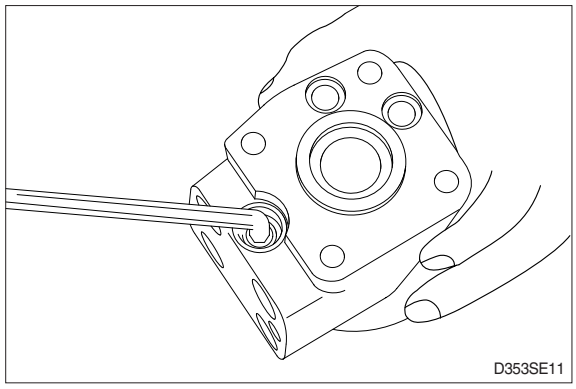


Disassembling the pressure relief valve

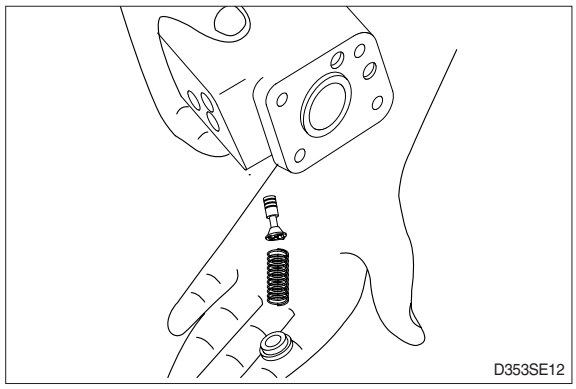
(15) Screw out the plug using an 8㎜ hexagon socket spanner.
Remove seal washers.



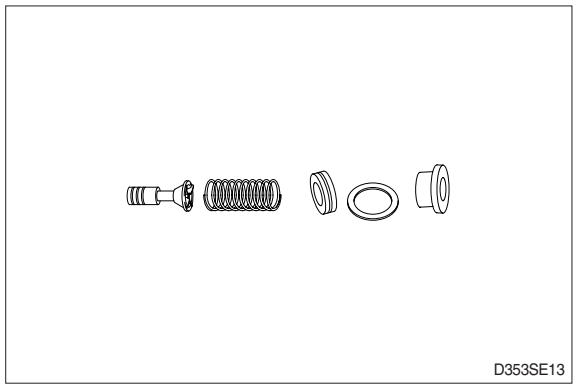
(16) Unscrew the setting screw using an 8mm hexagon socket spanner.



(17) Shake out spring and piston. The valve seat is bonded into the housing and cannot be removed.



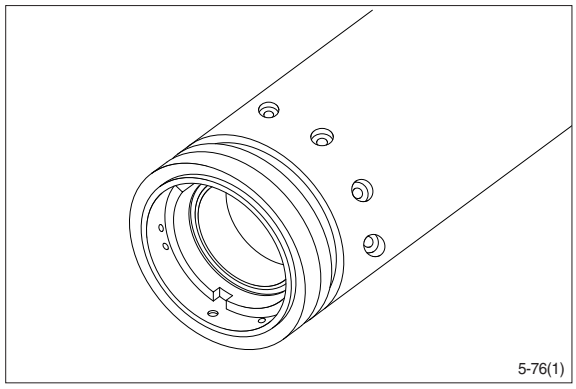
(18) The pressure relief valve is now disassembled.



5) ASSEMBLY

(1) Assemble spoon and sleeve.

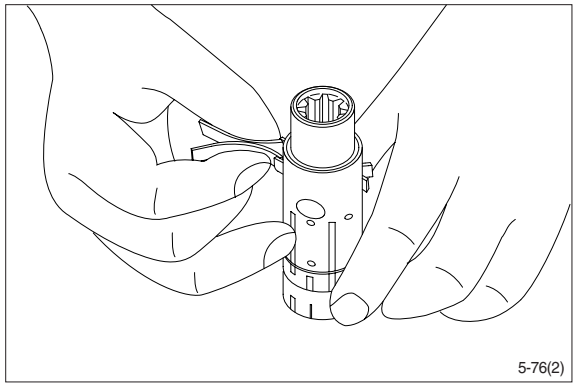
※ When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.



5-76(1)

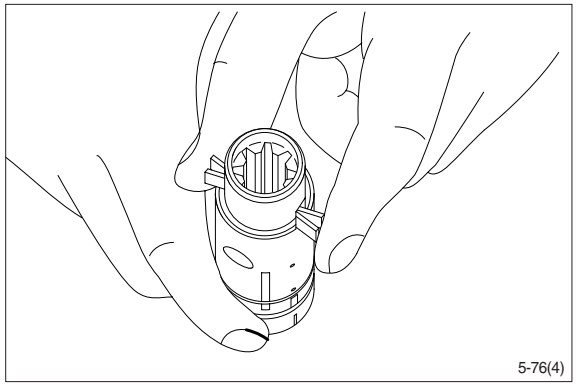
(2) Place the two flat neutral position springs in the slot.

Place the curved springs between the flat ones and press them into place (see assembly pattern).



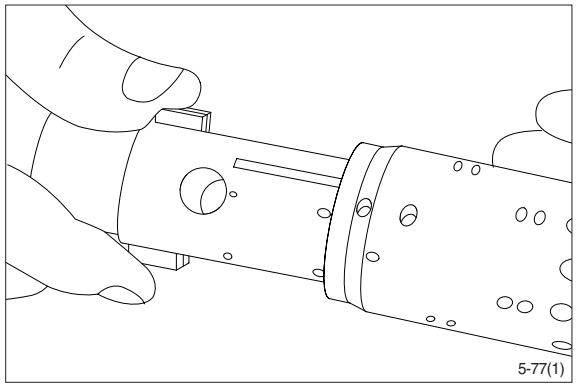
5-76(2)

(3) Line up the spring set.



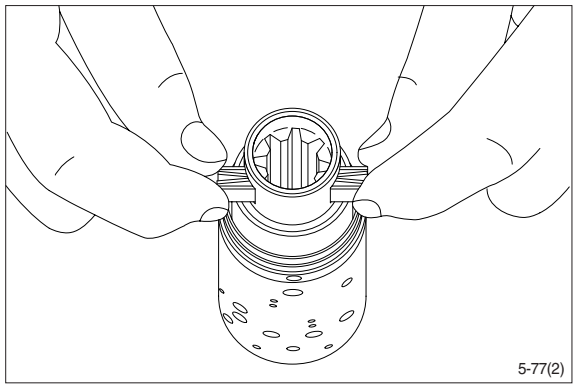
5-76(4)

(4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other.

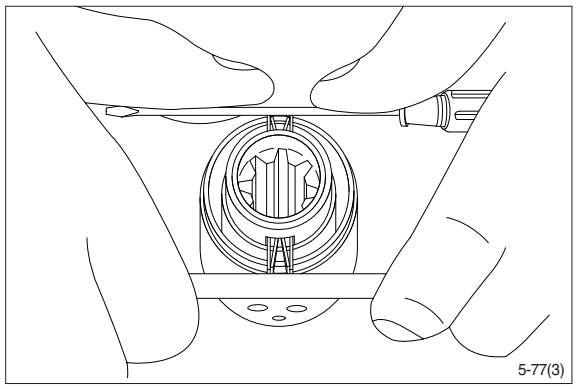


5-77(1)

(5) Press the springs together and push the neutral position springs into place in the sleeve.

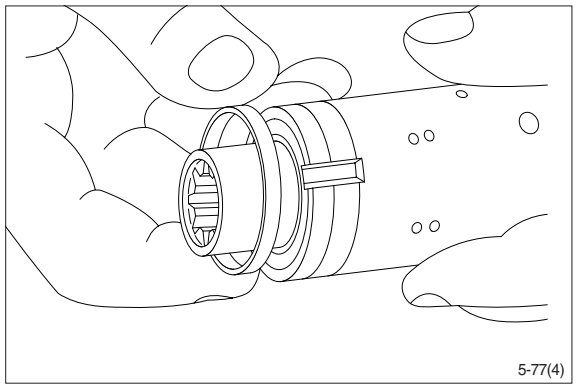

5-77(2)

(6) Line up the springs and center them.

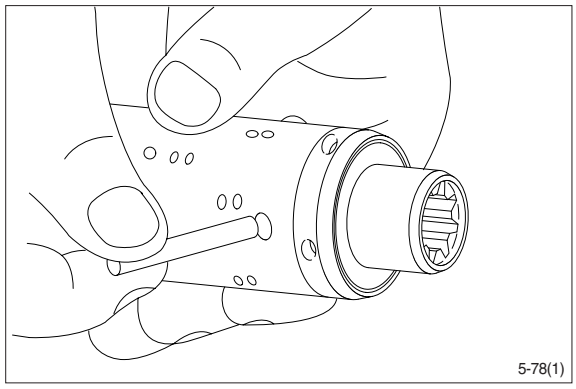

5-77(3)

(7) Guide the ring down over the sleeve.

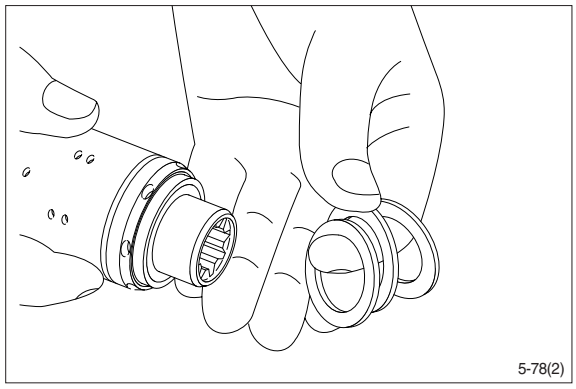
※ The ring should be able to rotate free of the springs.


5-77(4)

(8) Fit the cross pin into the spool / sleeve.

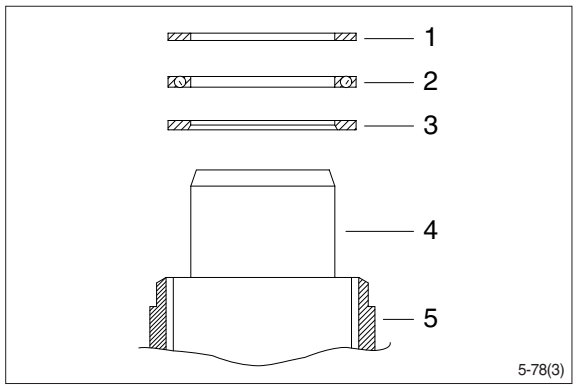

5-78(1)

(9) Fit bearing races and needle bearing as shown on below drawing.



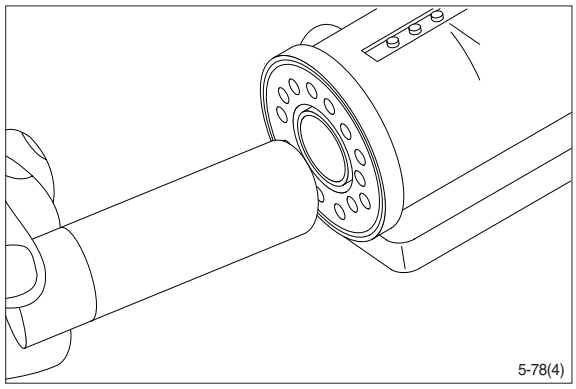
※ **Assembly pattern for standard bearings**

1 Outer bearing race
2 Thrust bearing
3 Inner bearing race
4 Spool
5 Sleeve

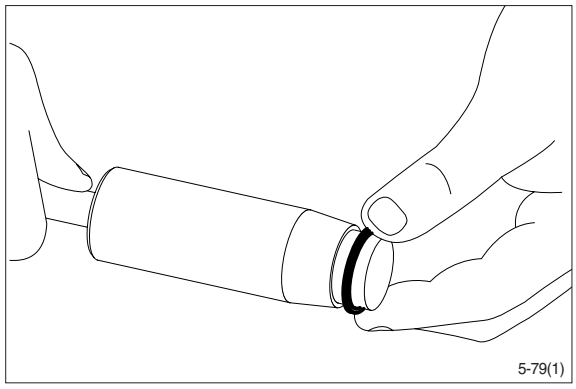


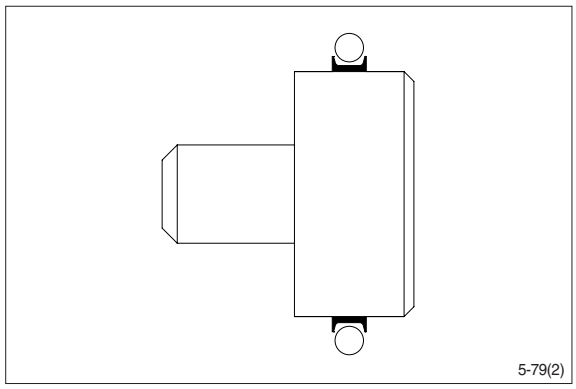
Installation instruction for O-ring

(10) Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool / sleeve.

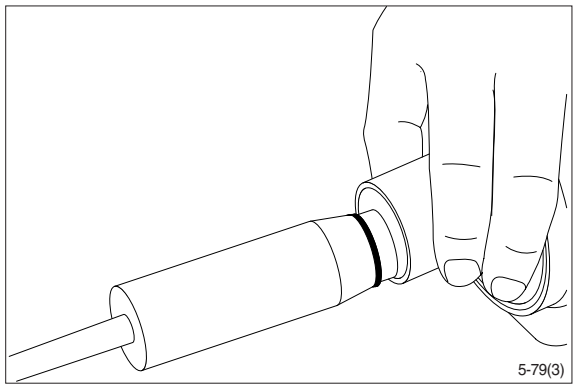


(11) Grease O-ring with hydraulic oil and place them on the tool.

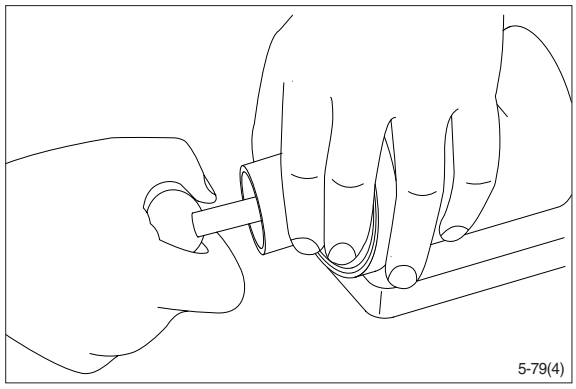

5-79(1)


5-79(2)

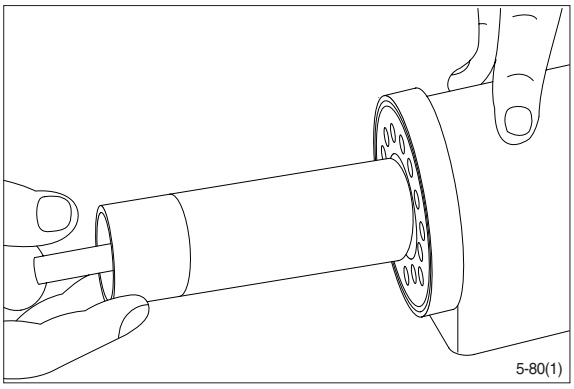
(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


5-79(3)

(13) Press and turn the O-ring into position in the housing.

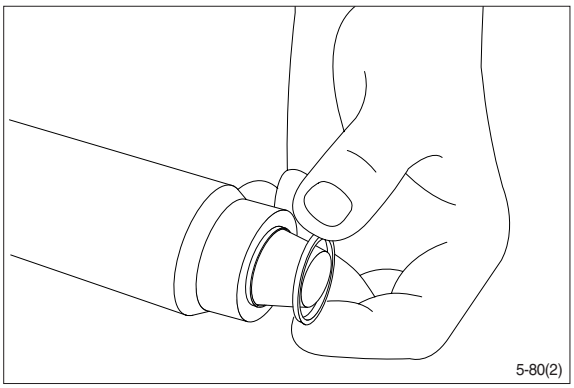

5-79(4)

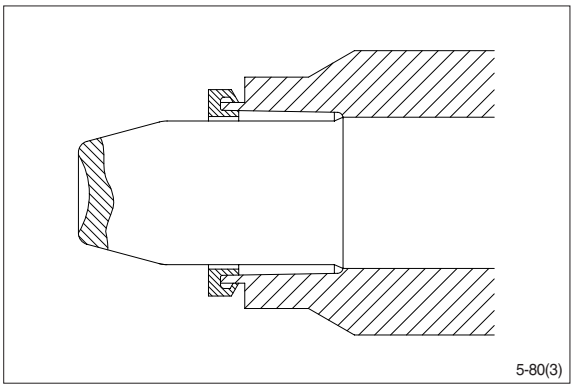
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



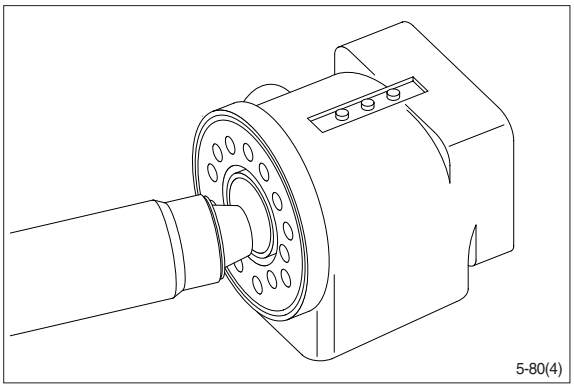
Installation instructions for lip seal

(15) Lubricate the lip seal with hydraulic oil and place it on the assembly tool.

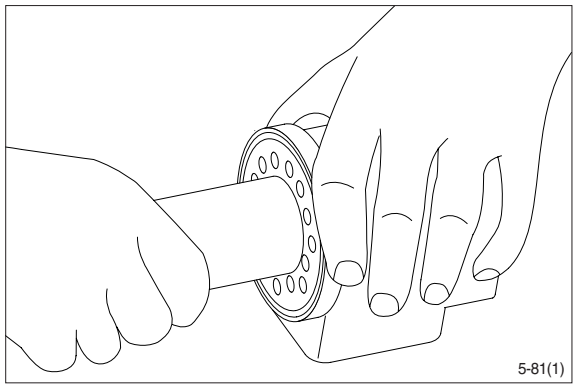




(16) Guide the assembly tool right to the bottom.

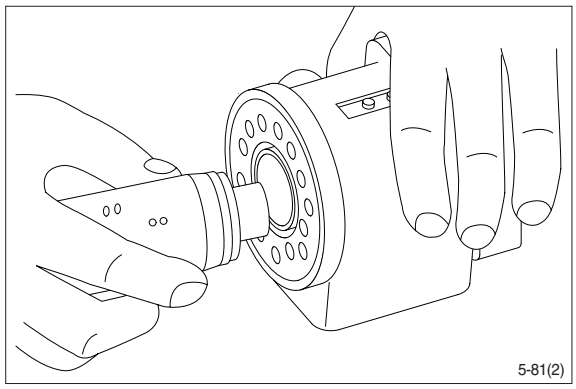


(17) Press and turn the lip seal into place in the housing.

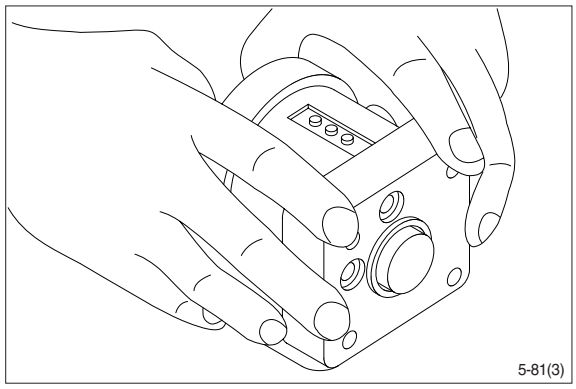


(18) With a light turning movement, guide the spool and sleeve into the bore.

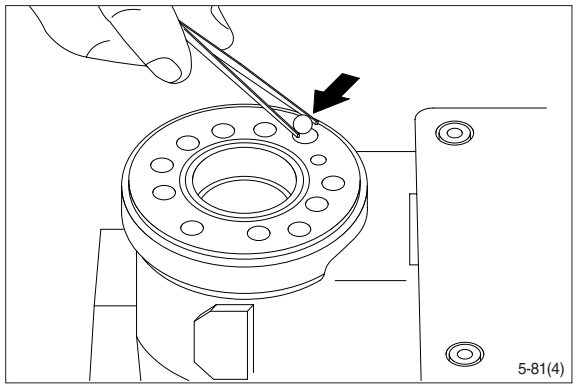
※ Fit the spool set holding the cross pin horizontal.



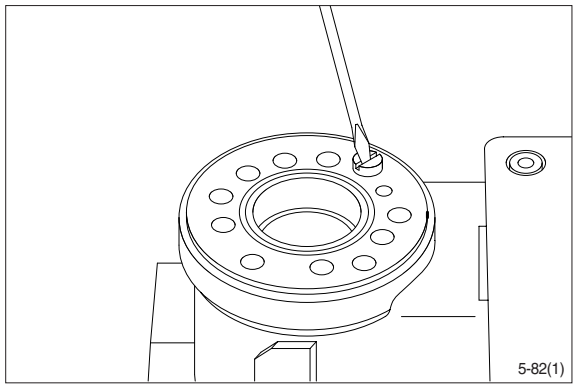
(19) The spool set will push out the assembly tool guide.
The O-ring are now in position.



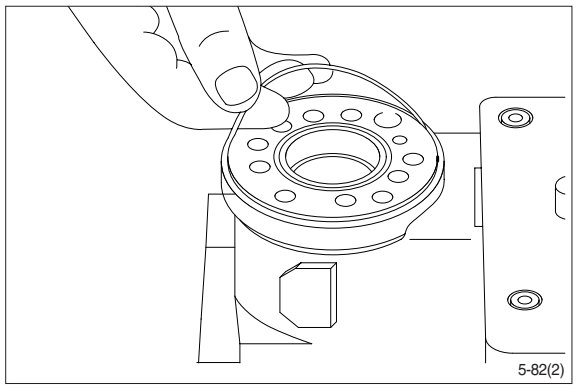
(20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



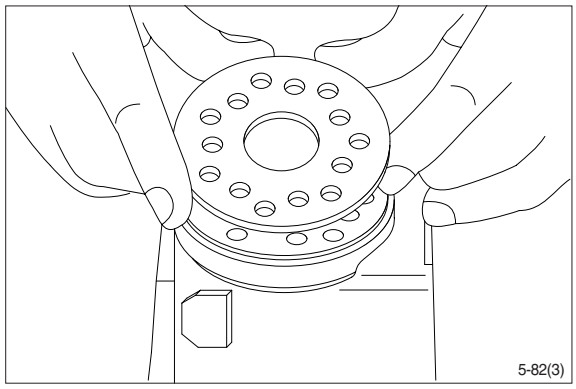
(21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



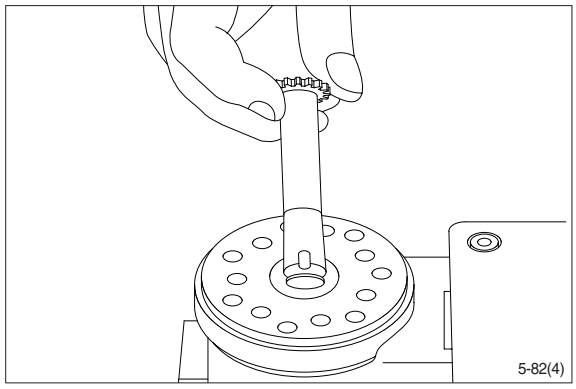
(22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20°C.



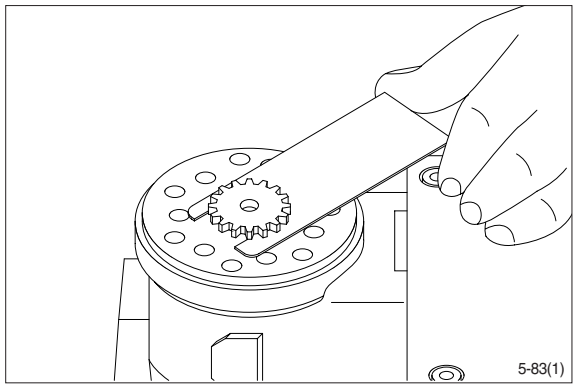
(23) Place the distributor plate so that the channel holes match the holes in the housing.



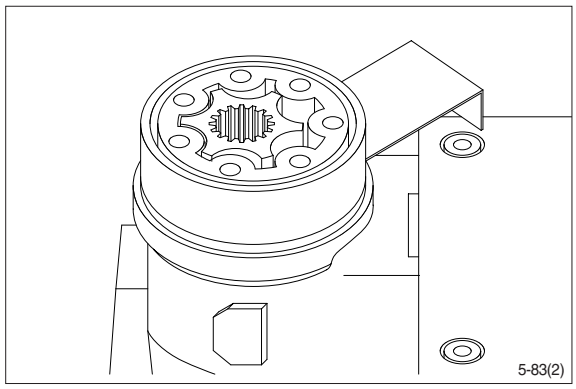
(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



(25) Place the cardan shaft as shown - so that it is held in position by the mounting fork.



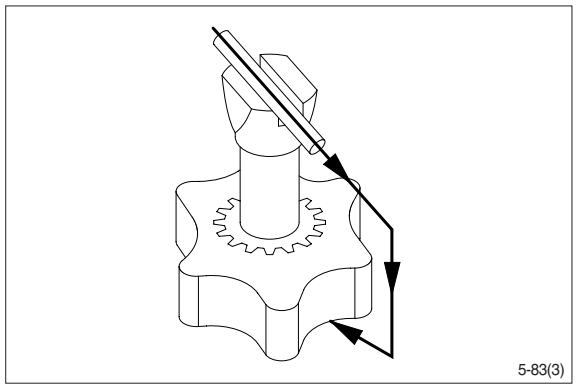
(26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20°C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



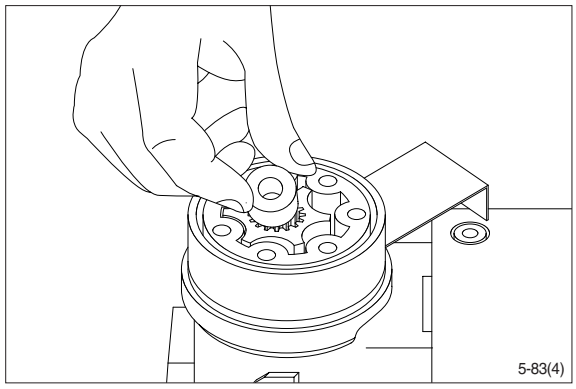
(27) Important

Fit the gearwheel (Rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown.

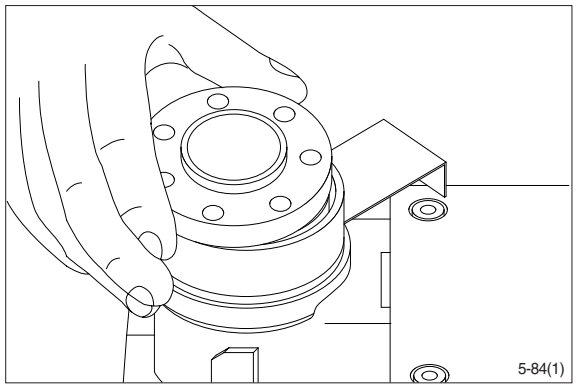
Turn the gear rim so that the seven through holes match the holes in the housing.



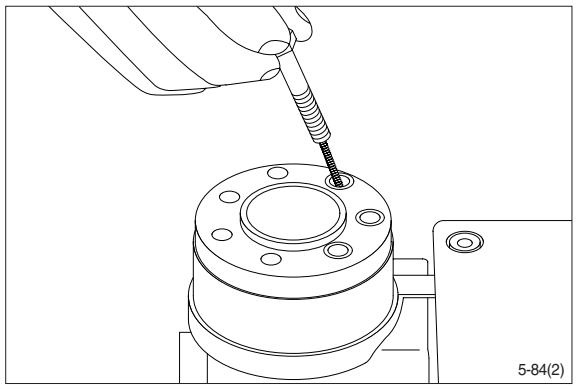
(28) Fit the spacer, if any.



(29) Place the end cover in position.

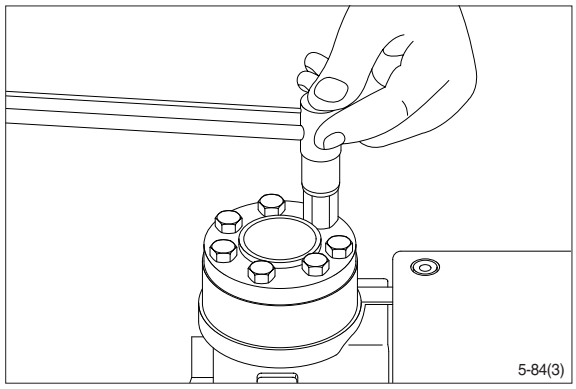

5-84(1)

(30) Fit the special screw with washer and place it in the hole shown.

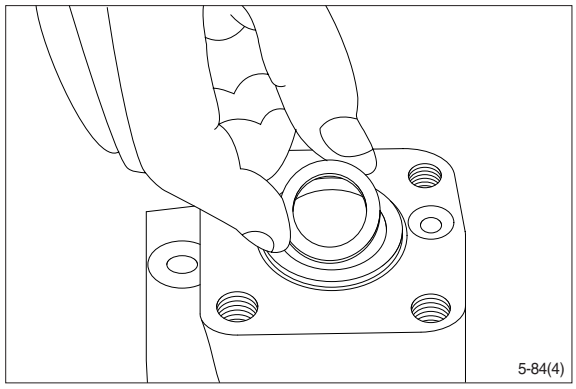

5-84(2)

(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

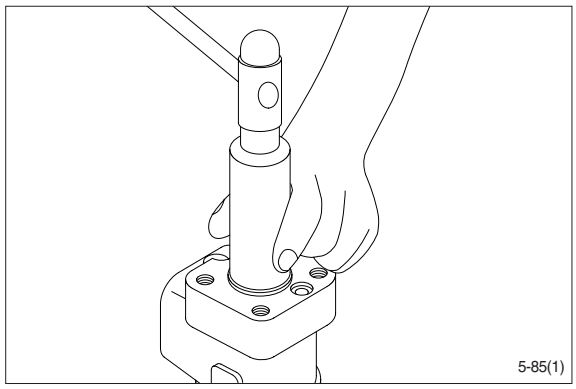
· Tightening torque : 4.0±0.5 kgf · m
(28.9±3.6 lbf · ft)


5-84(3)

(32) Place the dust seal ring in the housing.

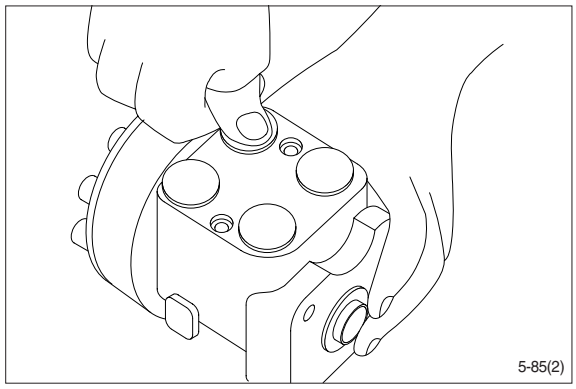

5-84(4)

(33) Fit the dust seal ring in the housing.


5-85(1)

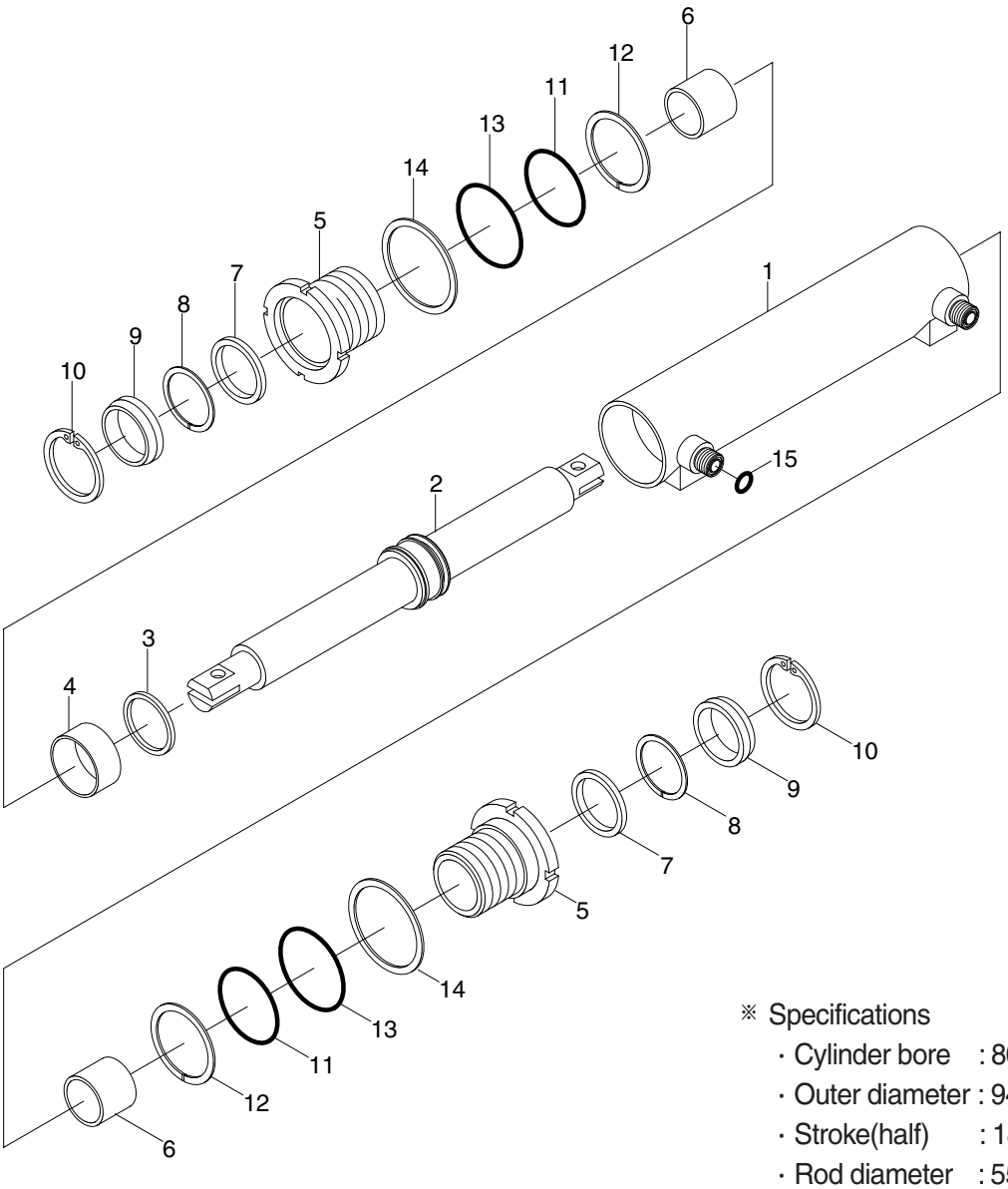
(34) Press the plastic plugs into the connection ports.

※ Do not use a hammer!


5-85(2)

2. STEERING CYLINDER

1) STRUCTURE



※ Specifications
- Cylinder bore : 80 mm
- Outer diameter : 94 mm
- Stroke(half) : 180 mm
- Rod diameter : 55 mm

D357SE21

1	Tube assy	6	DU bushing	11	O-ring
2	Rod assy	7	Rod seal	12	Back up ring
3	Piston seal	8	Back up ring	13	O-ring
4	Wear ring	9	Dust wiper	14	Lock washer
5	Gland	10	Snap ring	15	O-ring

2) DISASSEMBLY

※ Before disassembling steering cylinder, release oil in the cylinder first.

(1) Put wooden blocks against the cylinder tube, then hold in & vice.

(2) Remove the cover by hook a wrench in the notch of cylinder head and turn counter-clockwise.

(3) Remove the cylinder rod and piston from the tube.

(4) Check wear condition of the sealing parts (O-ring, oil seal, dust seal, U-packing, bush). If there are some damage, replace with new parts.

3) CHECK AND INSPECTION

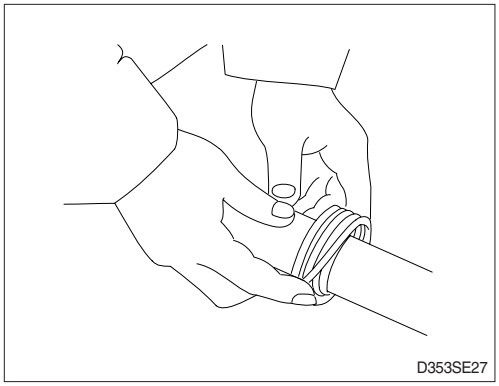
mm (in)

Check item	Criteria		Remedy
	Standard size	Repair limit	
Clearance between piston & cylinder tube	0.05~0.25 (0.002~0.01)	0.4 (0.02)	Replace piston seal
Clearance between cylinder rod & bushing	0.05~0.18 (0.002~0.007)	0.3 (0.01)	Replace bushing
Seals, O-ring	Damage		Replace
Cylinder rod	Dents		Replace
Cylinder tube	Biting		Replace

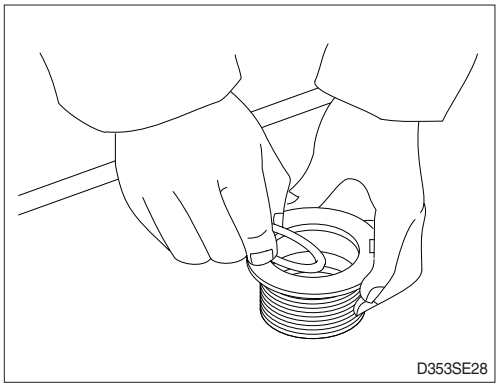
4) ASSEMBLY

(1) Install a new piston seal around the groove on the piston.

※ Be careful not to scratch the seal too much during installation or it could not be seated properly.

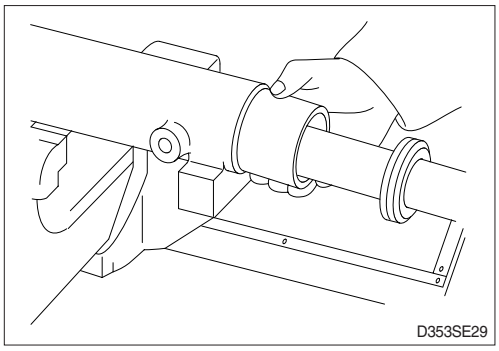

D353SE27

(2) Install the rod seal to the position in the gland applying a slight coat with grease prior to install.

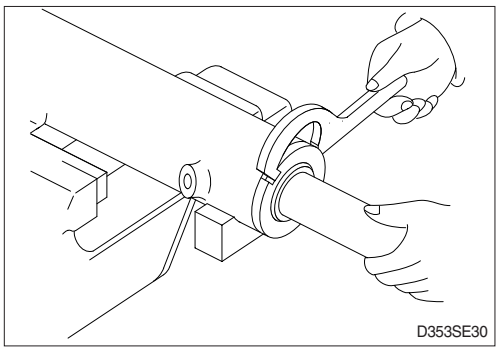

D353SE28

(3) Install the dust wiper to the gland using a special installing tool. Coat the dust wiper with grease slightly before installing.

(4) Using a special tool, install gland assembly into the cylinder tube.

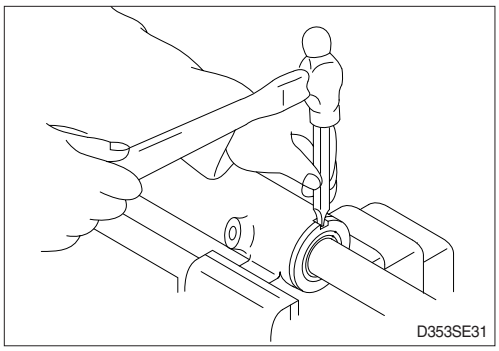


(5) Using a hook spanner, install the gland assembly, and tighten it with torque 60±6 kgf·m (434±43 lbf·ft).



(6) After the gland assembly was installed to the cylinder tube, calk at the tube end into the groove on the gland to prevent screw loosening.

※ If it is needed to calk again, never calk on the same place.



(7) Move the piston rod back and forth several times for the full distance of its stroke. This helps to seat the ring and seals before applying full hydraulic pressure to the cylinder.

(8) Install cylinder into trail axle.

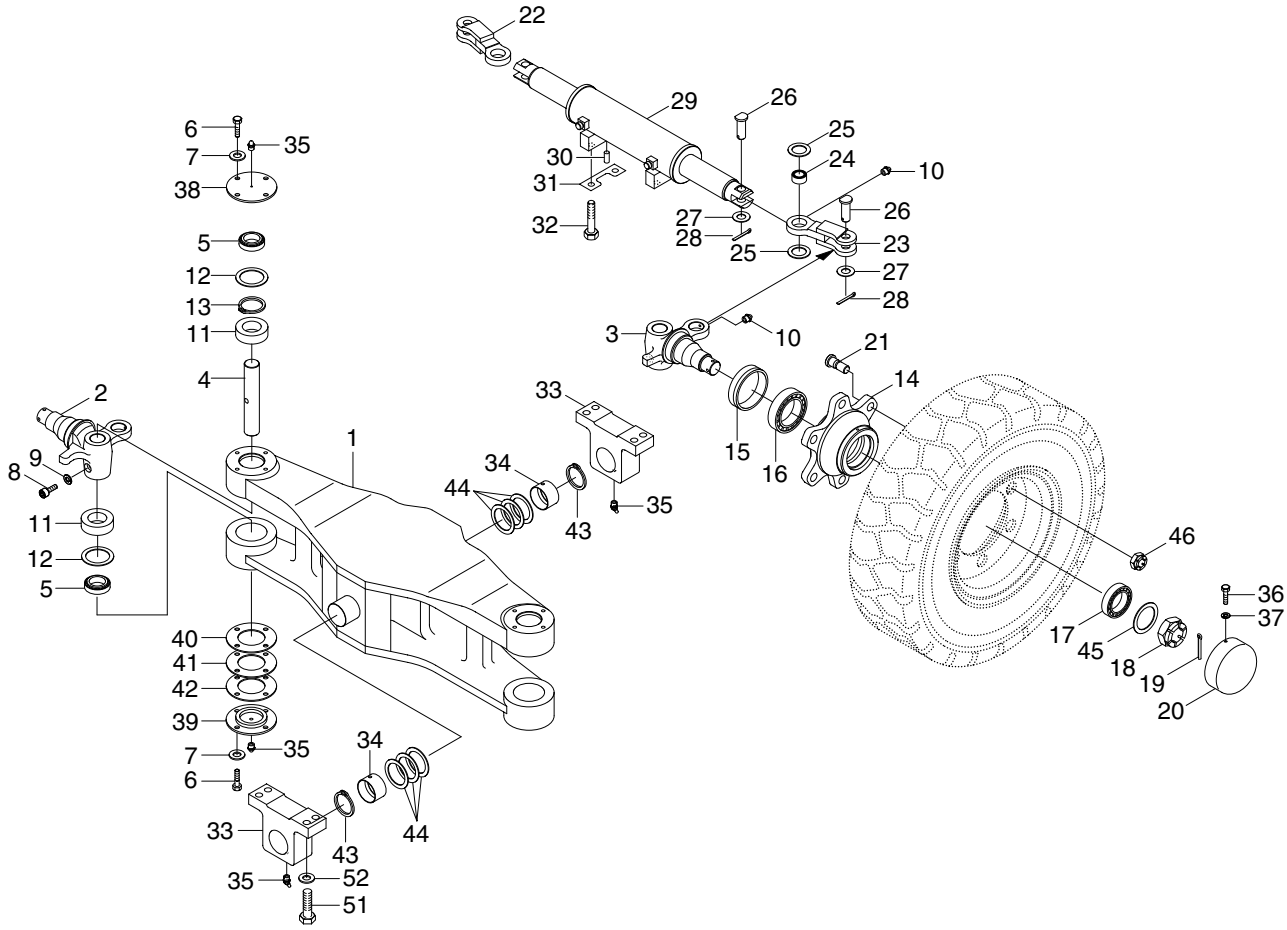
(9) While idling the engine with the rear wheels off the ground, operate the steering wheel left and right alternately.

※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

(10) Stop the engine, lower the floating rear wheels, and check pump joints for oil leaks and looseness and retighten, them as required.

3. STEERING AXLE

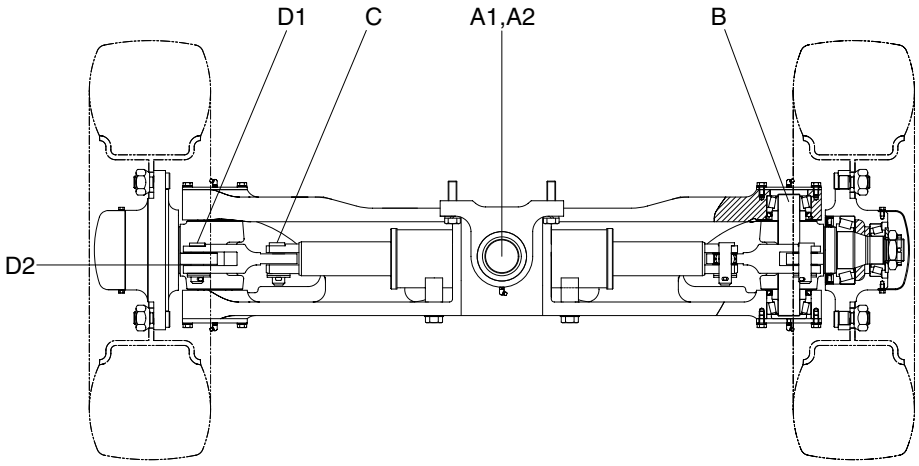
1) STRUCTURE



35D9SE06

1	Axle center	13	Retaining ring	25	Thrust washer	37	Spring washer
2	Knuckle-RH	14	Hub	26	Clevis pin	38	Upper cover
3	Knuckle-LH	15	Oil seal	27	Plain washer	39	Lower cover
4	King pin	16	Taper roller bearing	28	Split pin	40	Shim (0.1t)
5	Taper roller bearing	17	Taper roller bearing	29	Steering cylinder	41	Shim (0.15t)
6	Hexagon bolt	18	Slotted nut	30	Pin	42	Shim (0.3t)
7	Spring washer	19	Split pin	31	Lock plate	43	Retaining ring
8	Special bolt	20	Hub cap	32	Hexagon bolt	44	Shim (0.5t)
9	Spring washer	21	Serration bolt	33	Support	45	Plain washer
10	Grease nipple	22	Link-RH	34	Bushing	46	Hub nut
11	Collar	23	Link-LH	35	Grease nipple	51	Hexagon bolt
12	Oil seal	24	SPH plain bearing	36	Hexagon bolt	52	Spring washer

2) CHECK AND INSPECTION



35DS7SE08

unit : mm (in)

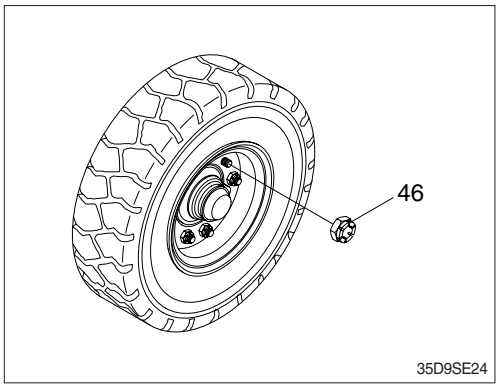
No.	Check item			Criteria		Remedy
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	55 (2.2)	54.5 (2.1)	Replace
		A2	ID of bushing	55 (2.2)	55.5 (2.2)	
B	OD of king pin			35 (1.4)	34.5 (1.4)	
C	OD of steering cylinder pin			20 (0.8)	19.5 (0.8)	
D	Knuckle	D1	OD of pin	20 (0.8)	19.5 (0.8)	
		D2	Vertical play	-	-	Adjust with shims

· OD : Outer diameter
· ID : Inner diameter

3) DISASSEMBLY

※ Servicing work on the knuckle part can be carried out without removing the axle assy from chassis. The work can be done by jacking up the counter weight part of the truck.

(1) Loosen the hub nut (46) and take off the steering wheel tire.



(2) Remove hub cap (20).

(3) Pull out split pin (19) and remove slotted nut (18) and washer (45).

(4) Using the puller, take off the hub (14) together with the taper roller bearing (16, 17).

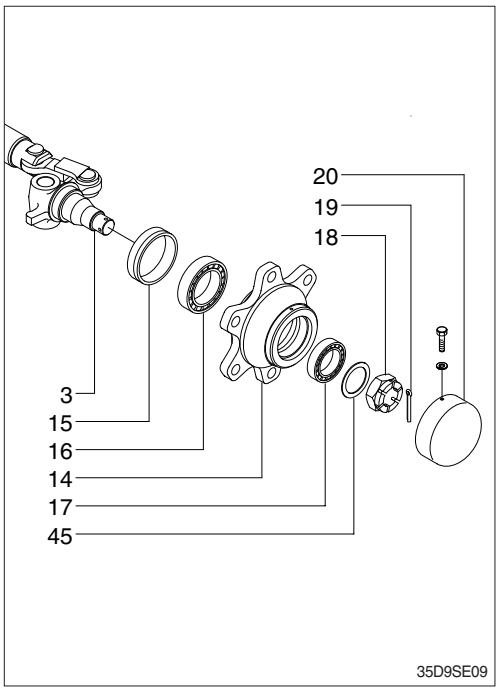
※ Be very careful because just before the hub comes off, taper roller bearing will fall out.

(5) After hub (14) is removed take off the inner race of the taper roller bearing (16, 17).

(6) Pull out oil seal (15).

※ Don't use same oil seal twice.

(7) Repeat the same procedure for the other side. Moreover, when disassembling is completed, part the slotted nut in the knuckle to protect the threaded portion.



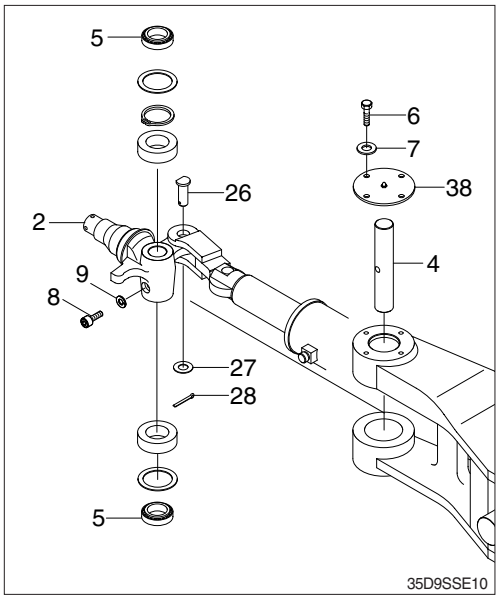
(8) Loosen special bolt (8) and spring washer (9).

(9) Remove hexagon bolt (6) and upper cover (38).

(10) Push out the king pin (4) without damaging the knuckle arm (2).

(11) If defect is observed in taper roller bearing (5), pull it out by using extractor.

(12) Remove spilt pin (28), plain washer (27) and clevis pin (26).



4) ASSEMBLY

※ In reassembling, have all parts washed, grease applied to lubricating parts, and all expendable items such as oil seal and spring washers replaced by new ones.

Perform the disassembly in reverse order.

(1) Tighten the special bolt (8) and washer (9) of king pin (4).

(2) There is a notch in the middle of the king pin (4), make sure that this notch is on the special bolt side.

(3) Do not hammer to drive in taper roller bearing (5) because it will break.
Always use drive-in tool.
Be sure that the fixed ring of the bearing is placed in position facing the knuckle (3).

(4) Hub

① Mount oil seal (15) and inner race of taper roller bearing (16) on the knuckle. The bearing should be well greased before assembling.

② Install the outer race of the taper roller bearing (17) in the wheel center and assemble to the knuckle.

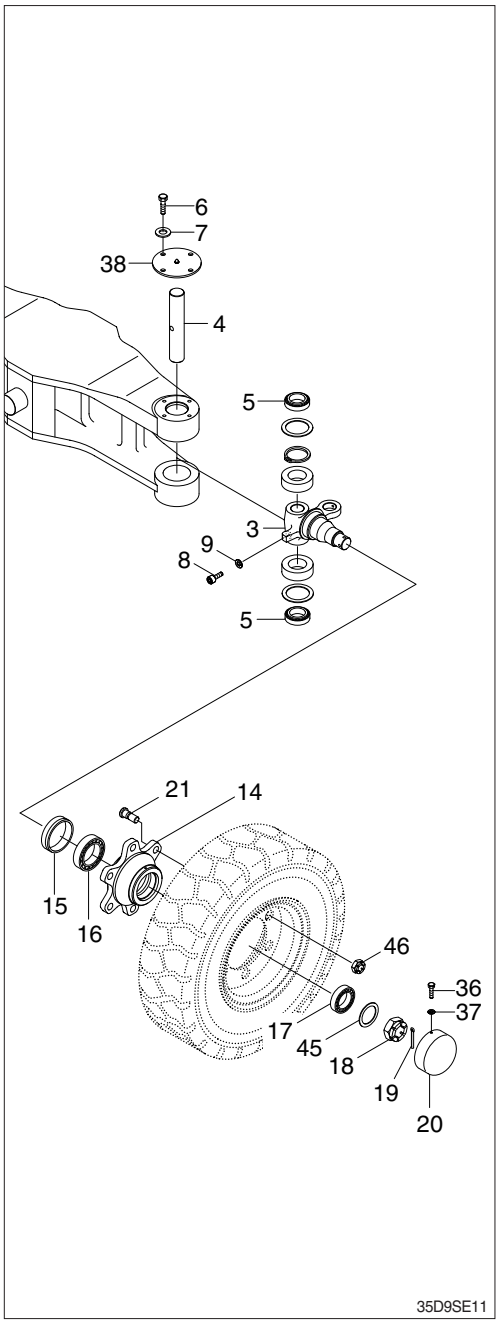
③ Put the plain washer (45) in place, tighten the slotted nut (18) and lock with split pin (19). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn. Adjust the preload of bearing.

④ Mount the hub cap (20) and tighten with bolt (36).

※ Apply loctite #609 on the contact surface of the hub cap (20).

※ Apply loctite #277 on the thread of the bolt (36).

※ Bearing should be well greased before assembling.



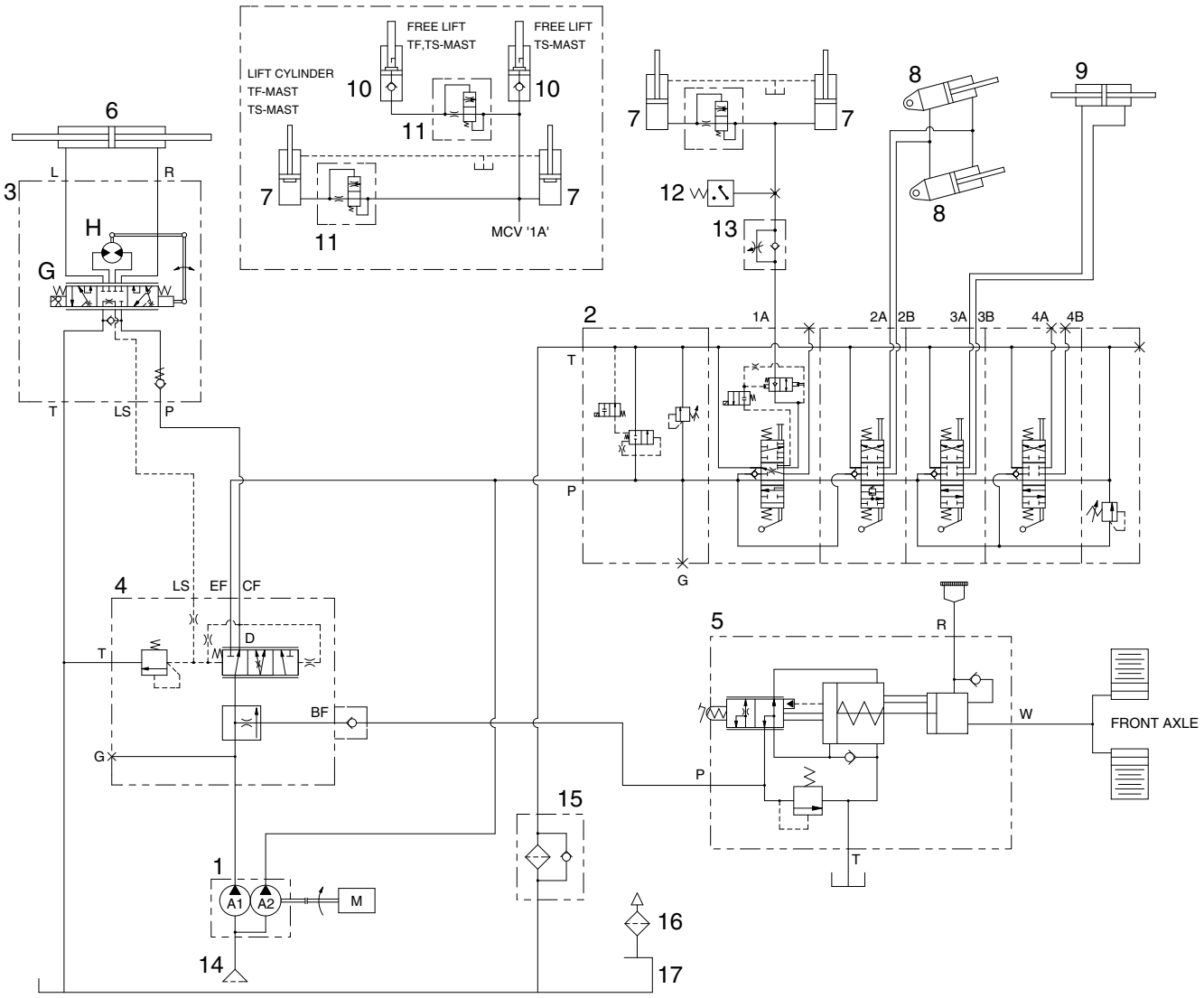
SECTION 6 HYDRAULIC SYSTEM

Group 1 Structure and function 6-1
Group 2 Operational checks and troubleshooting 6-17
Group 3 Disassembly and assembly 6-22

GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC CIRCUIT

· **TYPE 1** (Pump with dual flow divider)

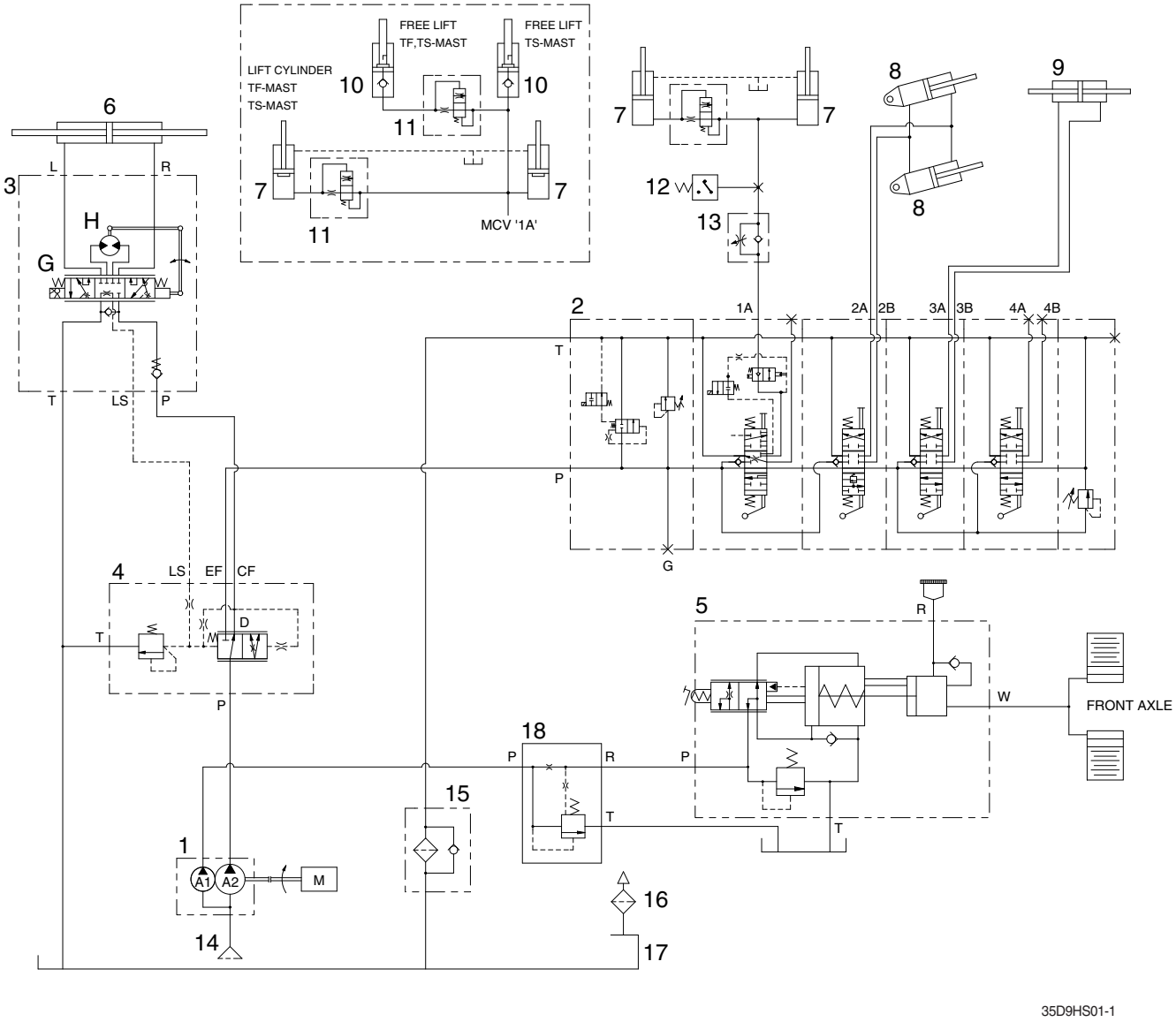


35D9HS01

1	Hydraulic gear pump	10	Free lift cylinder
2	Main control valve	11	Down safety valve
3	Steering unit	12	Load sensor
4	Priority valve	13	Flow control valve
5	Brake valve	14	Suction filter
6	Steering cylinder	15	Return filter
7	Lift cylinder	16	Air breather
8	Tilt cylinder	17	Hydraulic oil tank
9	Side shift cylinder		

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

· **TYPE 2** (Pump without priority valve)



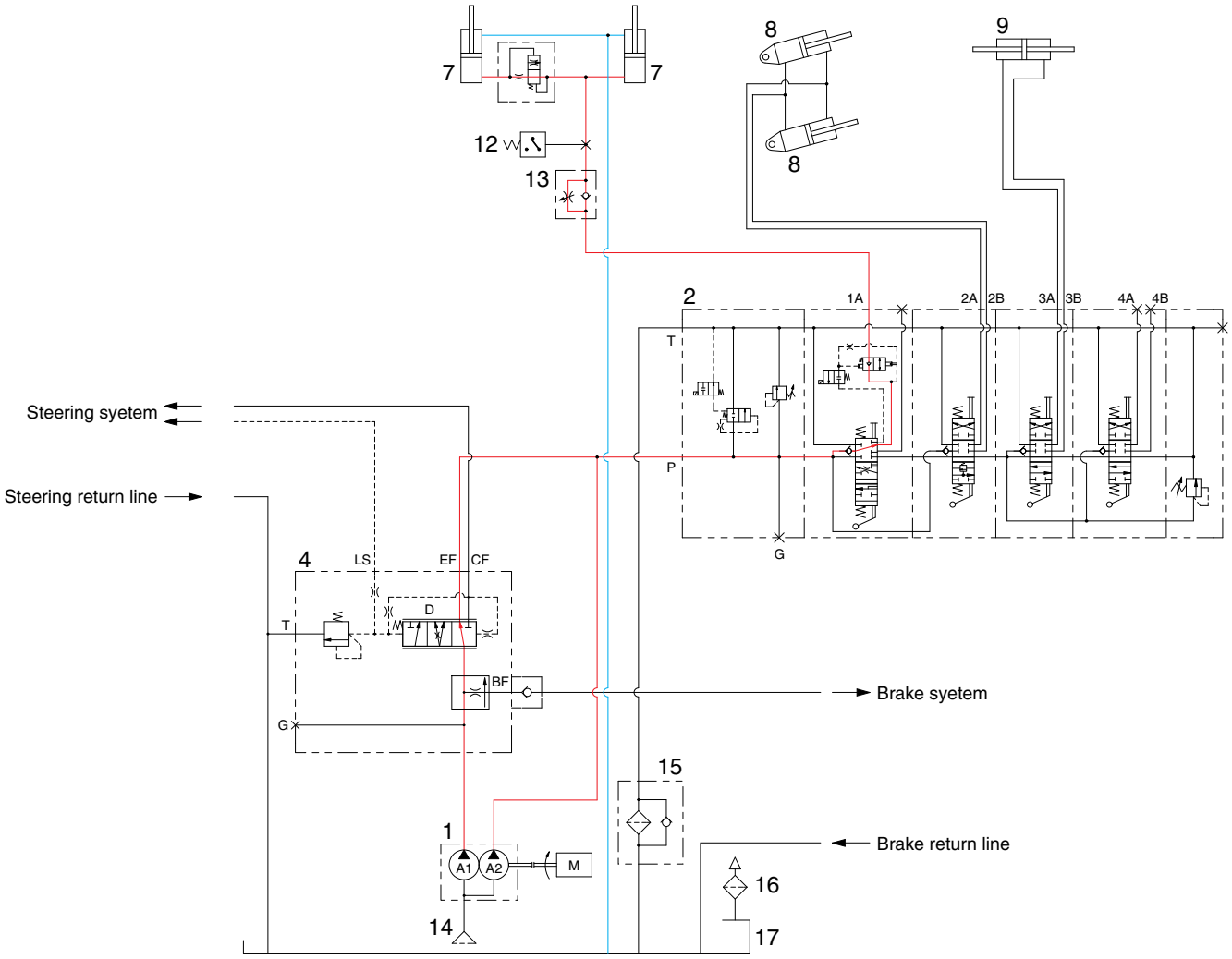
35D9HS01-1

1	Hydraulic gear pump	10	Free lift cylinder
2	Main control valve	11	Down safety valve
3	Steering unit	12	Load sensor
4	Priority valve	13	Flow control valve
5	Brake valve	14	Suction filter
6	Steering cylinder	15	Return filter
7	Lift cylinder	16	Air breather
8	Tilt cylinder	17	Hydraulic oil tank
9	Side shift cylinder	18	Flow control valve

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

1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION

※ The operation explanations are based on the pump with dual flow divider.

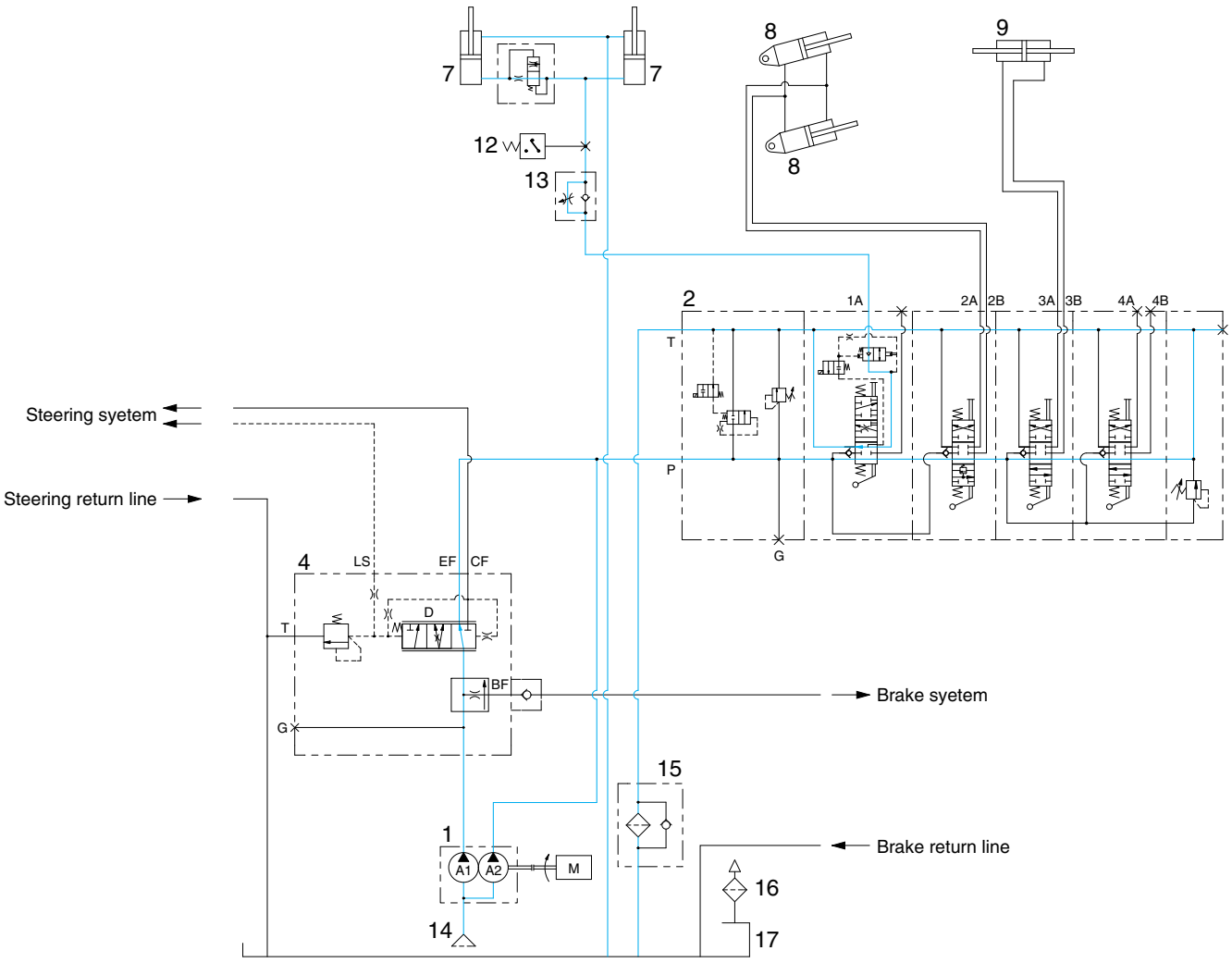


35D9HS02

When the lift control lever is pulled back, the spool in the first block is moves to lift position.
The oil from the A2 pump of the hydraulic gear pump (1) is joined the oil from the A1 pump through the priority valve in the dual flow divider (4) and it flows into main control valve (2) and then goes to the large chamber of lift cylinder (7) by pushing the load check valve of the spool.
The oil from the small chamber of lift cylinder (7) returns to hydraulic oil tank (17) at the same time.
When this happens, the forks go up.

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

2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION

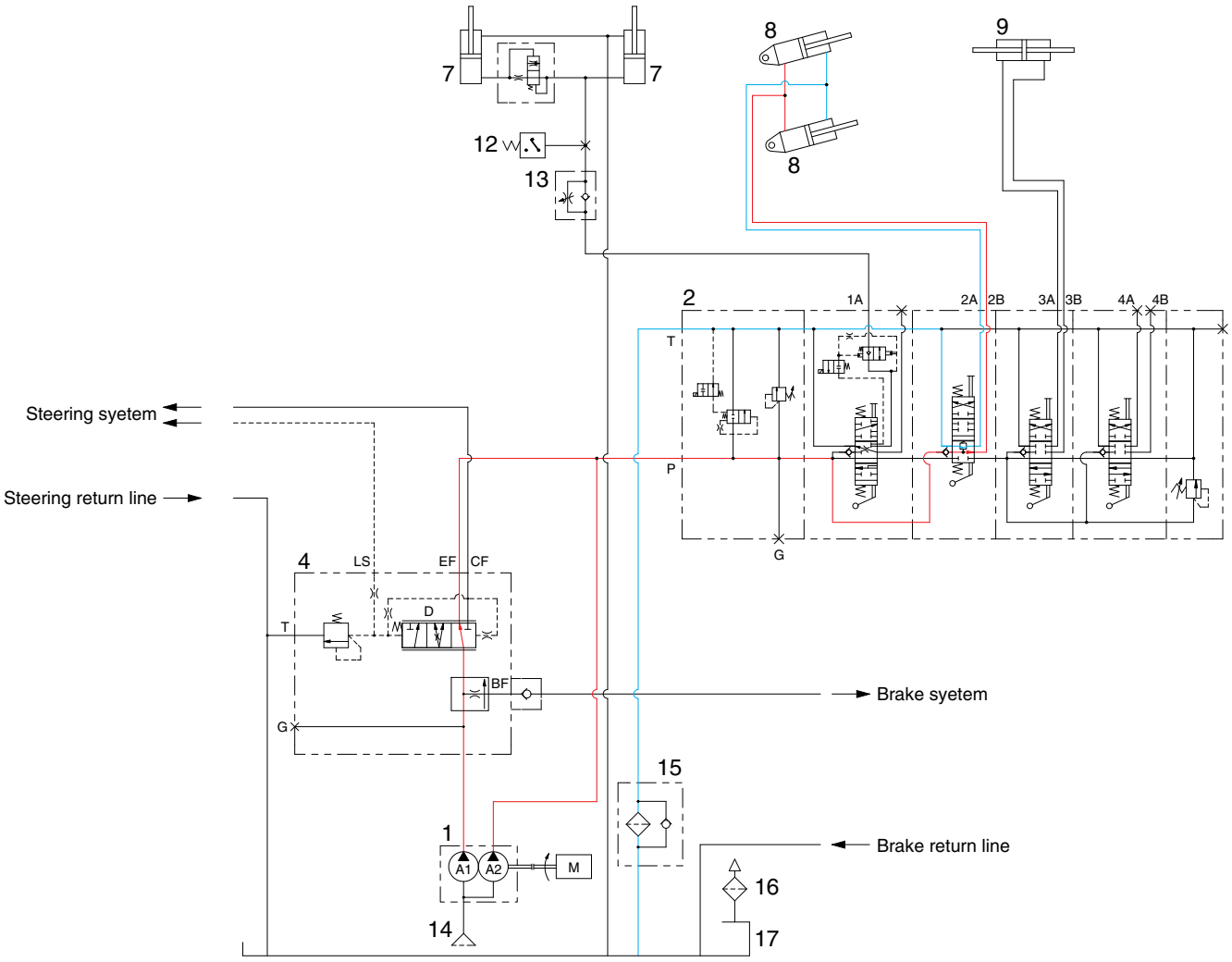


35D9HS03

When the lift control is pushed forward, the spool in the first block is moved to lower position.
The work port (B1) and the small chamber and the large chamber are connected to the return passage, so the forks will be lowered due to its own weight.

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

3) WHEN THE TILT CONTROL LEVER IS IN THE FORWARD POSITION

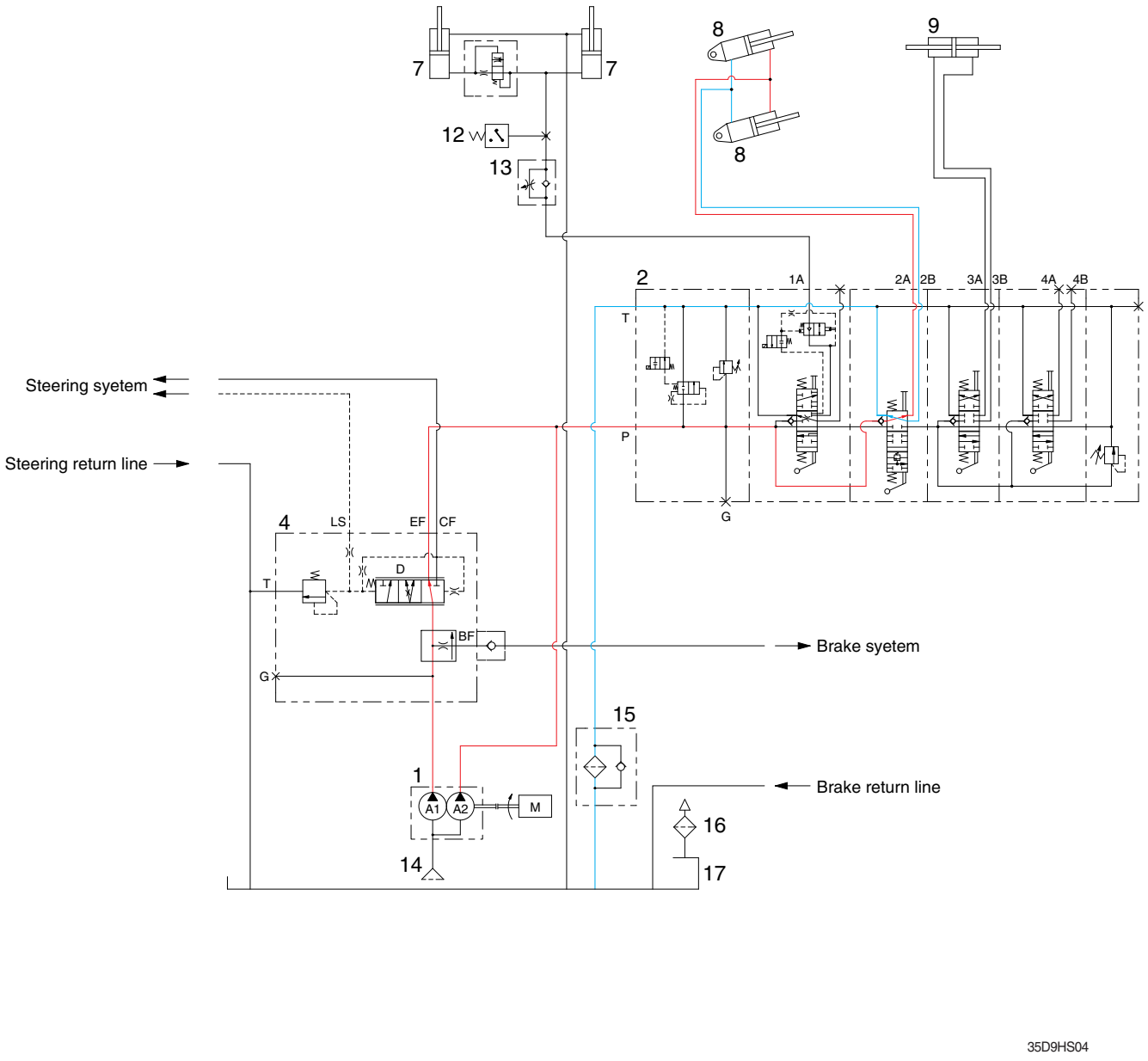


35D9HS05

When the tilt control lever is pushed forward, the spool in the second block is moved to tilt forward position.
The oil from the A2 pump of the hydraulic gear pump (1) is joined the oil from the A1 pump through the priority valve in the dual flow divider (4) and it flows into main control valve (2) and then goes to the large chamber of tilt cylinder (8) by pushing the load check valve of the spool.
The oil at the small chamber of tilt cylinder (8) returns to hydraulic oil tank (17) at the same time.
When this happens, the mast tilt forward.

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

4) WHEN THE TILT CONTROL LEVER IS IN THE BACKWARD POSITION



When the tilt control lever is pulled back, the spool in the second block is moved to tilt backward position.

The oil from the A2 pump of the hydraulic gear pump (1) is joined the oil from the A1 pump through the priority valve in the dual flow divider (4) and it flows into main control valve (2) and then goes to the small chamber of tilt cylinder (8) by pushing the load check valve of spool.

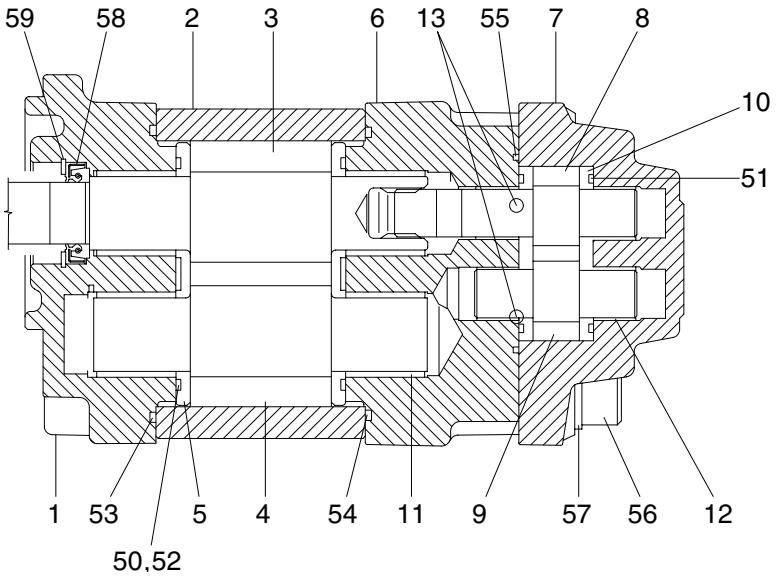
The oil at the large chamber of tilt cylinder (8) returns to hydraulic oil tank (17) at the same time.

When this happens, the mast tilt backward.

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

2. HYDRAULIC GEAR PUMP (without priority valve)

1) STRUCTURE



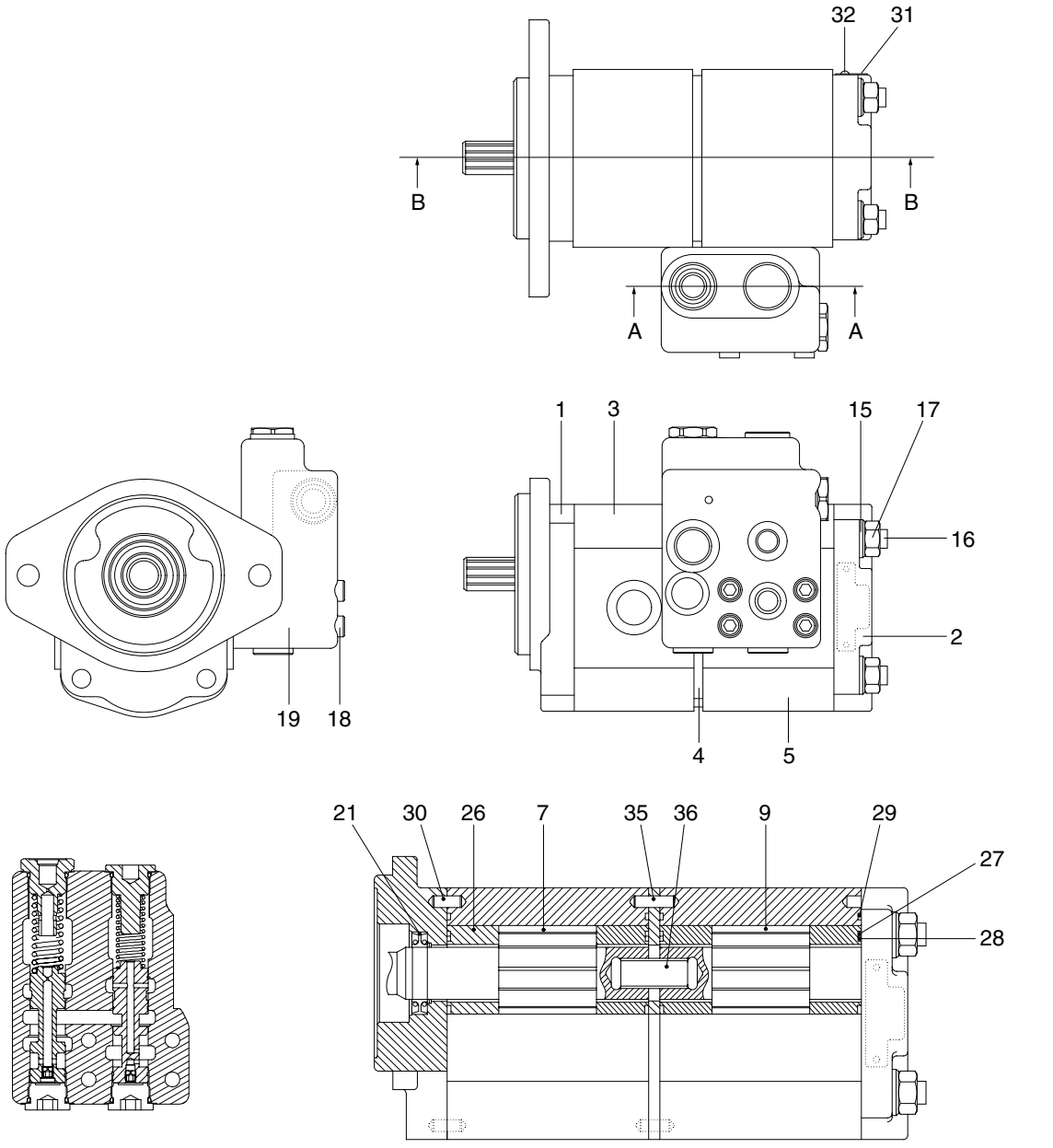
35D9HS14-1

1	Front cover	9	Driven gear	53	Gasket
2	Body	10	Side plate	54	Gasket
3	Drive gear	11	Bushing	55	Gasket
4	Driven gear	12	Bushing	56	Socket bolt
5	Side plate	13	Steel ball	57	Washer
6	Adapter plate	50	Gasket (3 shaped)	58	Oil seal
7	Body	51	Gasket (3 shaped)	59	Retainer ring
8	Drive gear	52	Back up ring		

2) OPERATION

This pump is comprised of a front cover (1), 1st pump body (2), a adapter plate (6) and a 2nd pump body (7) bolted together with through bolts (56). The drive gears (3, 8) and driven gears (4, 9) are supported by bushings (11, 12) and side plates (5, 10) to give high volumetric and mechanical efficiencies.

HYDRAULIC GEAR PUMP (with dual flow divider)



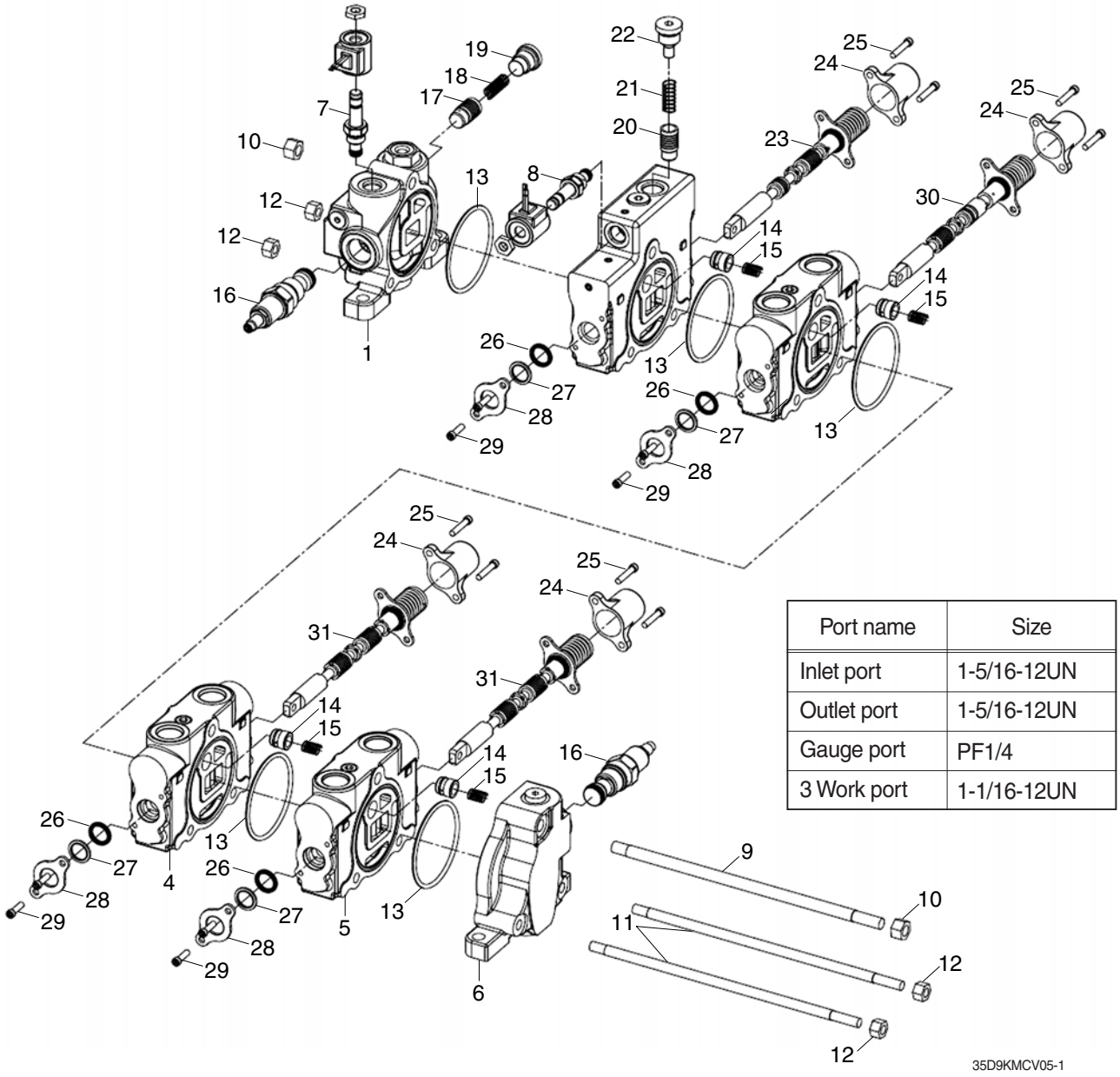
1	SEC housing	9	Gear set	21	Double seal lip	31	Name plate
2	PEC housing	15	Washer	26	Bushing	32	Screw
3	Gear housing	16	Stud bolt	27	Seal	35	Dowel pin
4	Mid plate	17	Nut	28	Backup seal	36	Connection shaft
5	Gear housing	18	Bolt	29	Seal		
7	Gear shaft set	19	Dual flow divider	30	Dowel pin		

OPERATION

This pump is comprised of a SEC housing (1), two gear housing (3, 5), a mid plate (4) and a PEC housing (2) bolted with together through bolts (16) and equipped with a dual flow divider (19). The gear shaft set (7) and gear set (9) are supported by bushings (26) to give high volumetric and mechanical efficiencies.

3. MAIN CONTROL VALVE

1) STRUCTURE (4 Spool)

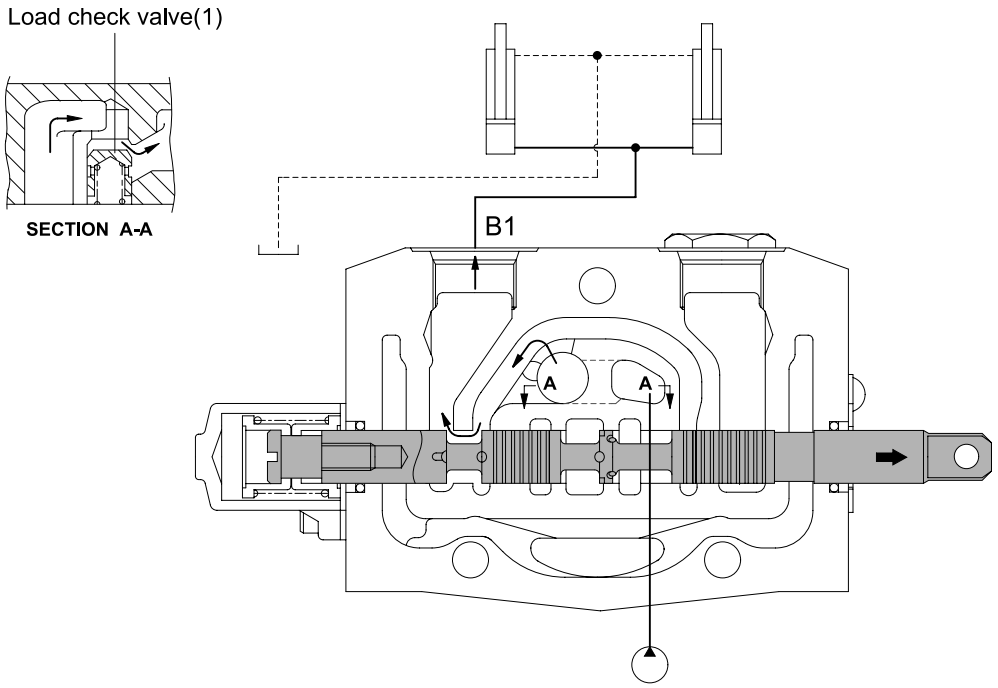


Port name	Size
Inlet port	1-5/16-12UN
Outlet port	1-5/16-12UN
Gauge port	PF1/4
3 Work port	1-1/16-12UN

1	Main block	12	Nut	23	Lift spool assy
2	Lift section	13	O-ring	24	Cap
3	Tilt section	14	Inlet poppet	25	Bolt
4	Aux1 section	15	Spring	26	Quad ring
5	Aux2 section	16	Relief valve	27	Back up ring
6	Cover	17	Unload poppet	28	Plate
7	Main solenoide valve	18	Spring	29	Bolt
8	Lift solenoide valve	19	Plug	30	Tilt spool assy
9	Bolt	20	Safety poppet	31	Aux spool assy
10	Nut	21	Spring		
11	Bolt	22	Plug		

2) LIFT SECTION OPERATION

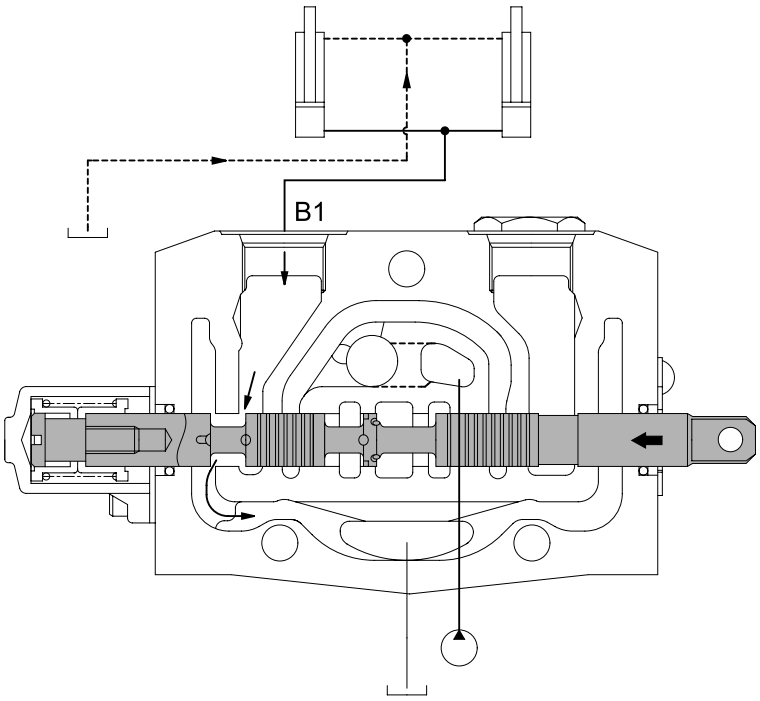
(1) Lift position



D353HS08

When the lift control lever is pulled back, the spool moves to the right and the neutral passage is closed.
The oil supplied from the pump pushes up the load check valve (1) and flow into lift cylinder port (B1).
The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.
The return oil from cylinder flows into the tank.

(2) Lower position

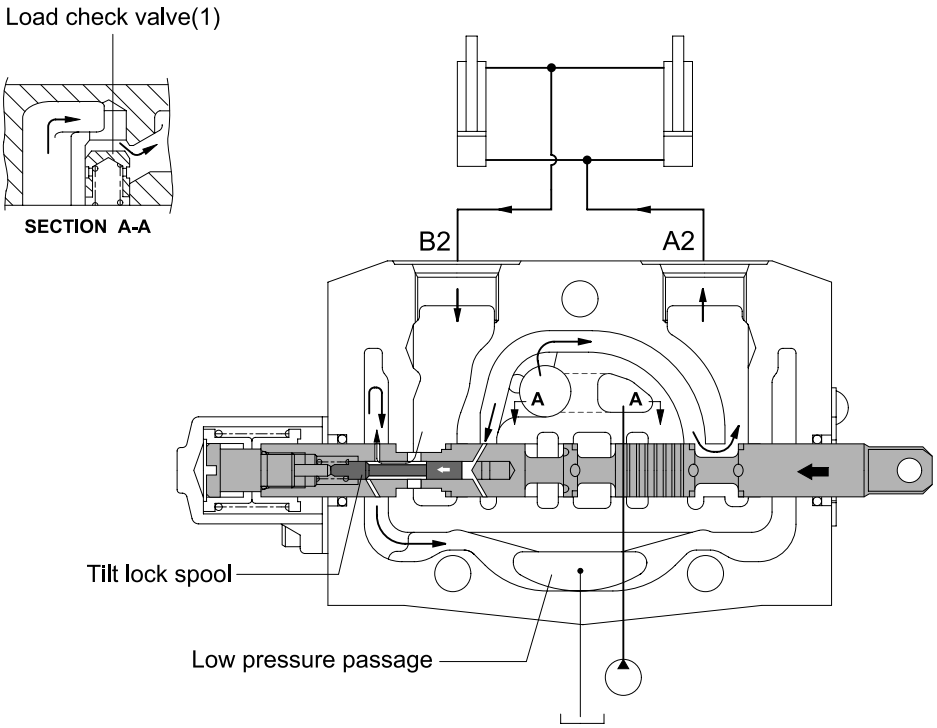


D353HS09

When the lift control lever is pushed forward, the spool moves to the left and the neutral passage is closed.
The spool moves to the lift lower position, opening up the neutral passage to tank and (B1) → T.
In lift lower position the fork drops due to its own weight.

3) TILT SECTION OPERATION

(1) Tilt forward position



D353HS10

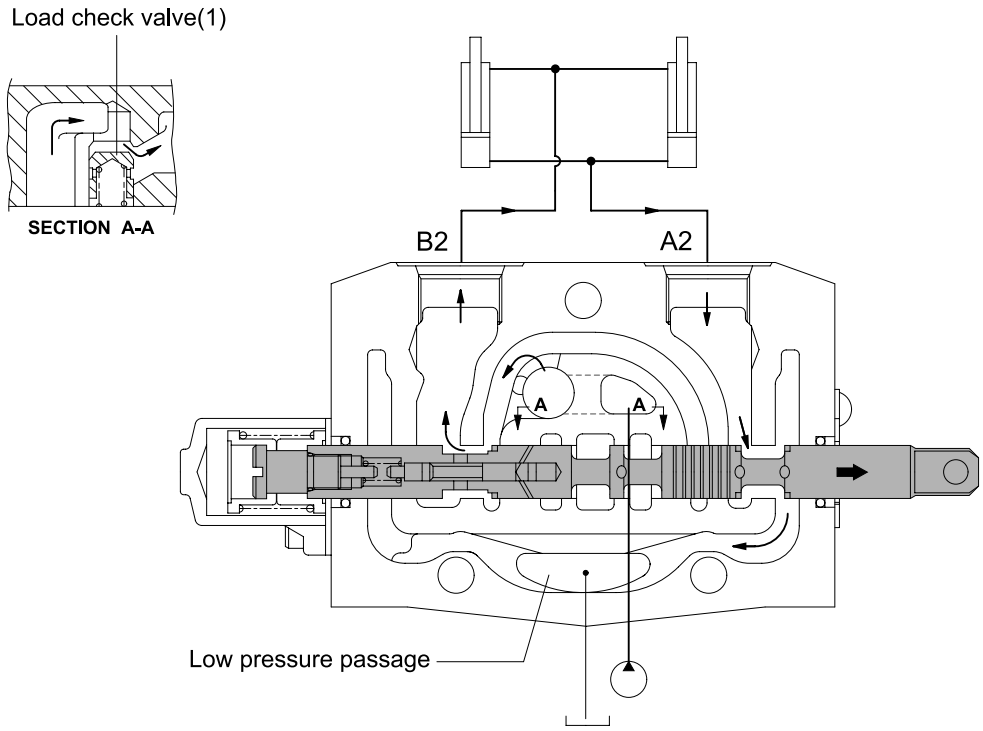
When the tilt control lever is pushed forward, the spool moves to the left and the neutral passage is closed.

The oil supplied from the pump pushes up the load check valve (1) and flow into tilt cylinder port (A2).

The pump pressure reaches proportionally the load of cylinders and fine control finished by closing the neutral passage.

The return oil from cylinder port (B2) flows into the tank through the hole of the tilt lock spool.

(2) Tilt backward position



D353HS11

When the tilt control lever is pulled back, the spool moves to the right and the neutral passage is closed.
The oil supplied from the pump pushes up the load check valve (1) and flows into tilt cylinder port (B2). The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.
The return oil from cylinder port (A2) flows into the tank via the low pressure passage.

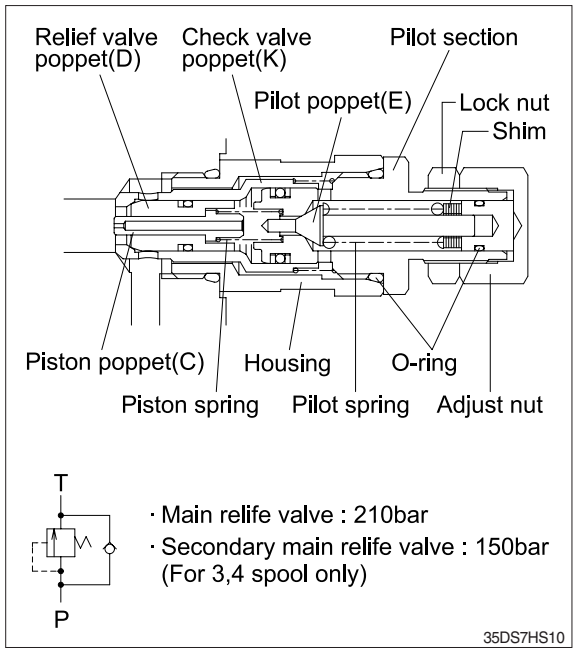
4) MAIN RELIEF VALVE

(1) Pressure setting

A good pressure gauge must be installed in the line which is in communication with the work port relief. A load must be applied in a manner to reach the set pressure of the relief unit.

Procedure

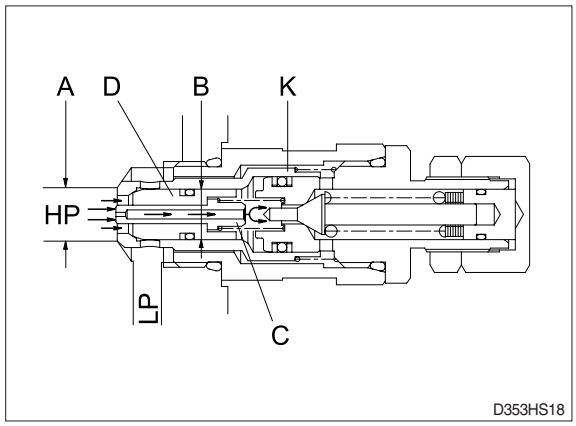
① Loosen lock nut.
② Set adjusting nut to desired pressure setting.
③ If desired pressure setting cannot be achieved, add or remove shims as required.
④ Tighten lock nut.
⑤ Retest in similar manner as above.



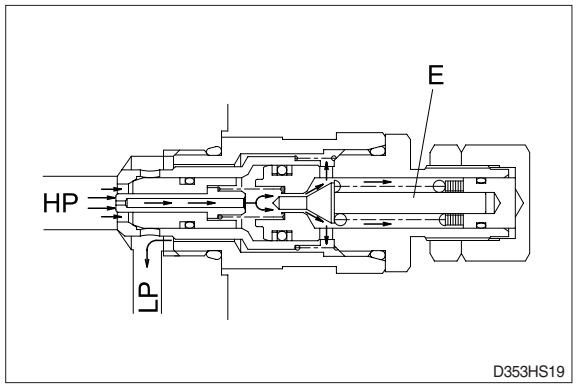
(2) Function

① As work port relief

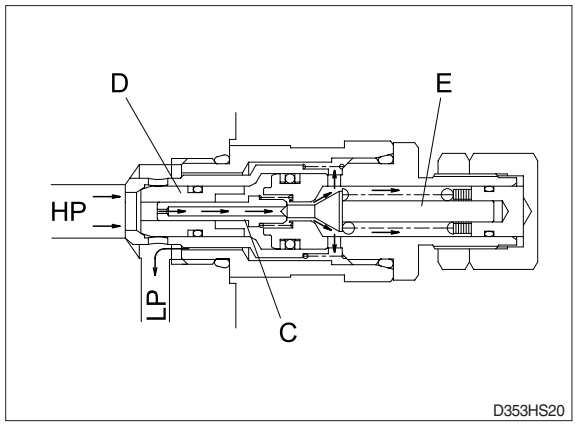
The relief valve is in communication between the high pressure port HP and low pressure LP. Oil is admitted through the hole in poppet C and because of the differential area between diameters A and B relief valve poppet D and check valve poppet K are tightly seated as shown.



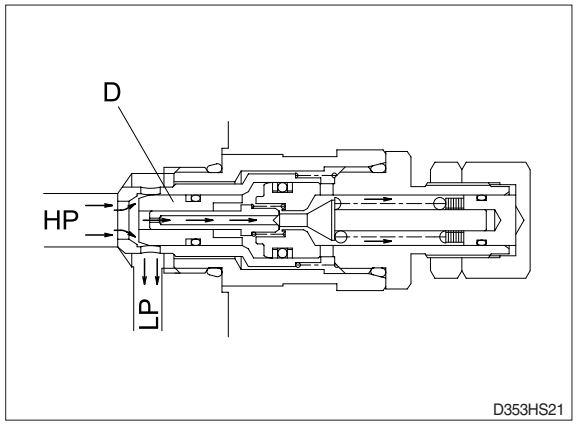
The oil pressure in the high pressure port HP has reached the setting of the pilot poppet spring force and unseats the pilot poppet E and oil flows around the poppet through the cross drilled holes and to the low pressure area LP.



The loss of oil behind poppet C, effected by the opening of pilot poppet E, causes poppet C to move back and seat against pilot puppet E. This shuts off the oil flow to the area behind relief valve poppet D, and causes a low pressure area internally.

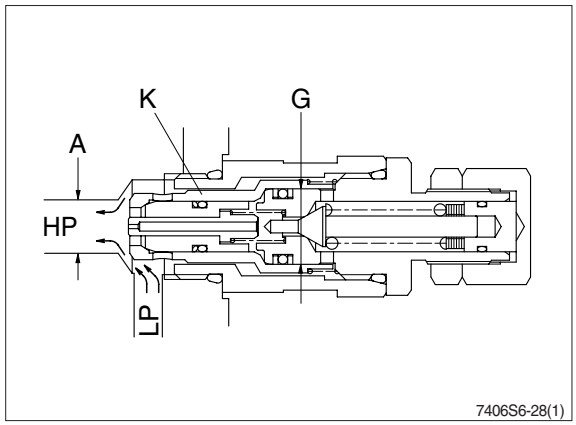


The imbalance of pressure on the inside as compared to that of the high pressure port HP, forces the relief valve poppet D to open and relieve the oil directly to the low pressure chamber LP in the valve.

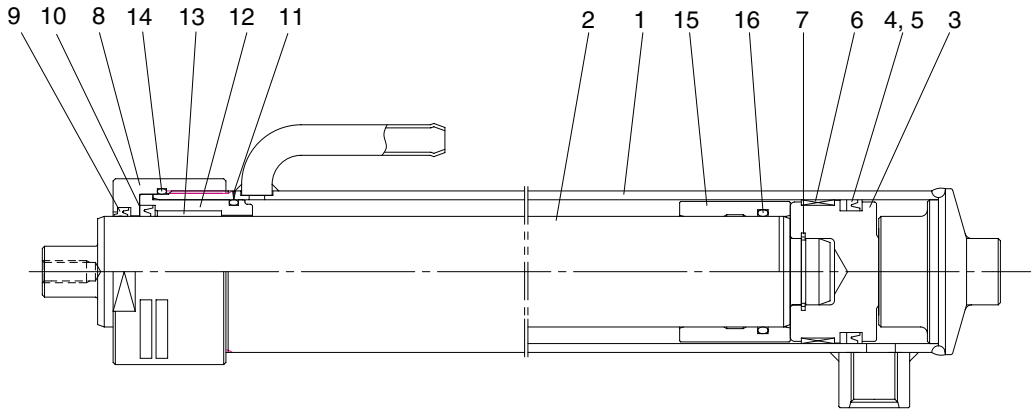


② As anti void

The anti-void unit supplies oil to the high pressure port HP when cavitation has occurred. A lower pressure exists in the port HP compared to the low pressure chamber LP. The difference between the effective area of diameter A and G causes imbalance of the check valve poppet K which unseats, thus allowing oil from the low pressure chamber LP to enter the port HP and fill the void.



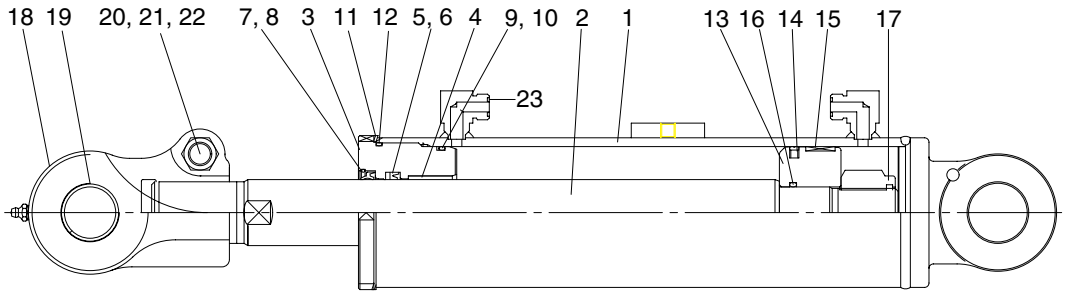
4. LIFT CYLINDER



D357HS12

1	Tube assy	7	Retaining ring	13	DU busing
2	Rod	8	Gland	14	O-ring
3	Piston	9	Dust wiper	15	Spacer
4	Piston seal	10	Rod seal	16	O-ring
5	Back up ring	11	O-ring		
6	Wear ring	12	Guide		

5. TILT CYLINDER



D357HS13

1	Tube assy	9	O-ring	17	Nylon nut
2	Rod	10	Back up ring	18	Rod eye
3	Gland	11	Lock washer	19	DU bushing
4	DU bushing	12	O-ring	20	Hexagon bolt
5	Rod seal	13	Piston	21	Hexagon nut
6	Back up ring	14	Glyd ring	22	Spring washer
7	Dust wiper	15	Wear ring	23	O-ring
8	Snap ring	16	O-ring		

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

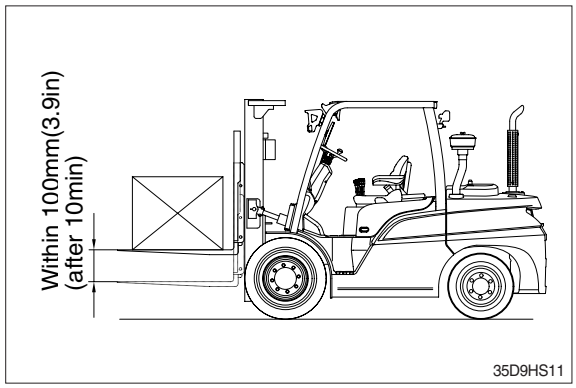
(1) Check visually for deformation, cracks or damage of rod.

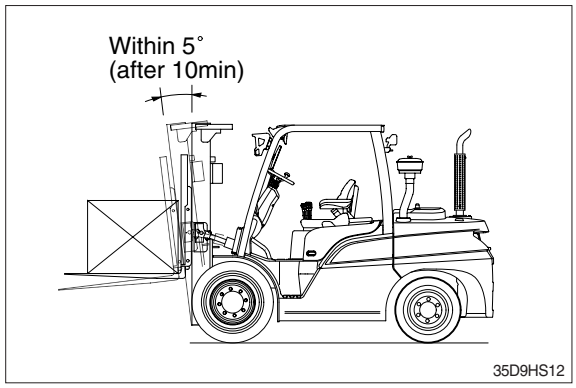
(2) Load maximum load, set mast vertical and raise 1m from ground. Wait for 10 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

· **Hydraulic drift**

- Down (Downward movement of forks)
  : Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
  : Within 5°

If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.





(3) Check that clearance between tilt cylinder bushing and mounting pin is within standard range.

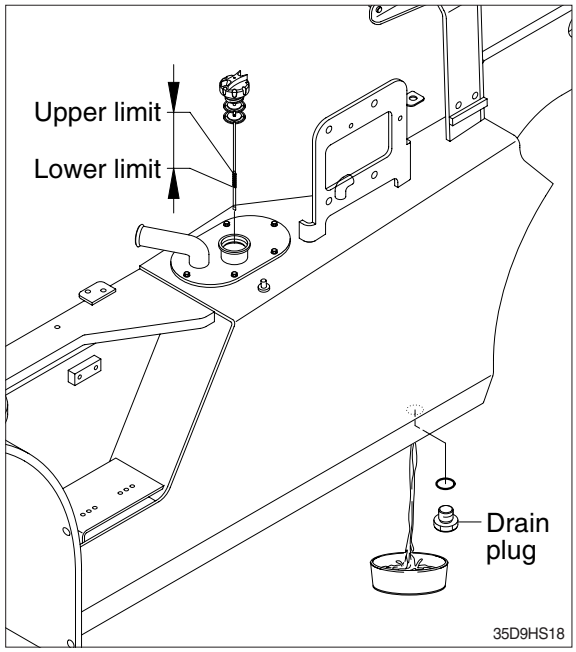
mm (in)

Standard	Under 0.6 (0.02)

2) HYDRAULIC OIL

(1) Using dipstick, measure oil level, and oil if necessary.

(2) When changing hydraulic oil, clean suction strainer (screwed into outlet port pipe).



3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure.
Check that oil pressure is 210 kgf/cm^2.
(2990 psi)

2. TROUBLESHOOTING

1) SYSTEM

Problem	Cause	Remedy
Large fork lowering speed	· Seal inside control valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective.	· Replace spool or valve body. · Replace. · Replace packing.
Large spontaneous tilt of mast	· Tilting backward : Check valve defective. · Tilting forward : tilt lock valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective.	· Clean or replace. · Clean or replace. · Replace. · Replace seal.
Slow fork lifting or slow mast tilting	· Lack of hydraulic oil. · Hydraulic oil mixed with air. · Oil leaks from joint or hose. · Excessive restriction of oil flow on pump suction side. · Relief valve fails to keep specified pressure. · Poor sealing inside cylinder. · High hydraulic oil viscosity. · Mast fails to move smoothly. · Oil leaks from lift control valve spool. · Oil leaks from tilt control valve spool.	· Add oil. · Bleed air. · Replace. · Clean filter. · Adjust relief valve. · Replace packing. · Change to SAE10W, class CD engine oil. · Adjust roll to rail clearance. · Replace spool or valve body. · Replace spool or valve body.
Hydraulic system makes abnormal sounds	· Excessive restriction of oil flow pump suction side. · Gear or bearing in hydraulic pump defective.	· Clean filter. · Replace gear or bearing.
Control valve lever is locked	· Foreign matter jammed between spool and valve body. · Valve body defective.	· Clean. · Tighten body mounting bolts uniformly.
High oil temperature	· Lack of hydraulic oil. · High oil viscosity. · Oil filter clogged.	· Add oil. · Change to SAE10W, class CD engine oil. · Clean filter.

Problem	Cause	Remedy
Actuator (cylinder or motor) works slowly or does not operate.	· Shortage of oil in oil tank. · Decrease of relief valve pressure. · Spool got stuck. · Shortage of oil flow to the valve.	· Check the oil level in the oil tank. · Install pressure gauge on the circuit, and check the pressure with it by handling the lever. · Check that manual lever moves smoothly. · Check that lever stroke is enough. · Check that oil flow of the pump is within specified rate.
Cylinder lowers considerably under normal circumstance.	· Internal leakage of cylinder happens frequently. · Excessive leakage from spool of the valve. · Spool got stuck. · Leakage in a part of the circuit.	· Fit the stop valve on the pipe between valve and cylinder, observe the internal leakage of cylinder. · Check the oil viscosity is not too low. · Check that manual lever moves smoothly. · Check the circuit. · Observe leakage from pipes.
Pressure does not increase sufficiently.	· Defect of relief valve. · Leakage in a part of the circuit.	· Check the relief valve. · Check the circuit. · Observe leakage from pipes.
Temperature rising of the hydraulic oil.	· Working with higher pressure than rated pressure. · Low viscosity of oil. · Leakage from a part of the circuit. · Oil leakage in the pump. · Insufficient suction of the pump.	· Check the flow pressure. · Check the sort of oil and viscosity. · Check if the circuit is relieved at all times. · Check if the temperature of pump surface higher 30˚C than oil temperature. · Check the oil tank volume. · Check if the suction strainer is blocked.
Steering force is heavy.	· Defect of steering relief valve.	· Check the steering relief valve.

2) HYDRAULIC GEAR PUMP

Problem	Cause	Remedy
Pump does not develop full pressure	· System relief valve set too low or leaking. · Oil viscosity too low. · Pump is worn out.	· Check system relief valve for proper setting. · Change to proper viscosity oil. · Repair or replace pump.
Pump will not pump oil	· Reservoir low or empty. · Suction strainer clogged.	· Fill reservoir to proper level. · Clean suction strainer.
Noisy pump caused by cavitation	· Oil too thick. · Oil filter plugged. · Suction line plugged or too small.	· Change to proper viscosity. · Clean filters. · Clean line and check for proper size.
Oil heating	· Oil supply low. · Contaminated oil. · Setting of relief valve too high or too low. · Oil viscosity too low.	· Fill reservoir to proper level. · Drain reservoir and refill with clean oil. · Set to correct pressure. · Drain reservoir and fill with proper viscosity.
Foaming oil	· Low oil level. · Air leaking into suction line. · Wrong kind of oil.	· Fill reservoir to proper level. · Tighten fittings, check condition of line. · Drain reservoir, fill with non-foaming oil.
Shaft seal leakage	· Worn shaft seal. · Worn shaft in seal area.	· Replace shaft seal. · Replace drive shaft and seal.

3) MAIN RELIEF VALVE

Problem	Cause	Remedy
Can't get pressure	· Poppet stuck open or contamination under seat.	· Check for foreign matter of poppets and their mating parts. Parts must slide freely.
Erratic pressure	· Pilot poppet seat damaged. · Poppet C sticking in D.	· Replace the relief valve. · Clean and remove surface marks for free movement.
Pressure setting not correct	· Normal wear. Lock nut & adjust screw loose.	· See ★How to set pressure on work main relief.
Leaks	· Damaged seats. · Worn O-rings. · Parts sticking due to contamination.	· Replace the relief valve. · Install seal and spring kit. · Disassemble and clean.

★ A good pressure gauge must be installed in the line which is in communication with the main relief. A load must be applied in a manner to reach the set pressure of the main relief unit. Then, follow these steps:

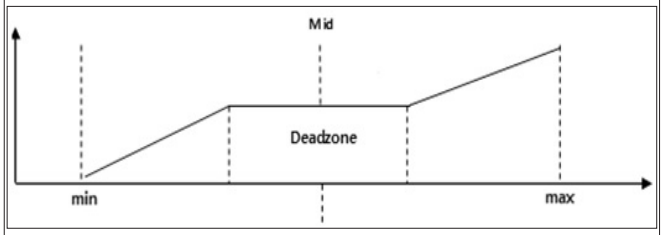
- Loosen lock nut.
- Set adjusting nut to desired pressure setting.
- If desired pressure setting cannot be achieved, tighten or loosen the adjusting screw as required.
- Tighten lock nut.
- Retest in similar manner as above.

4) LIFT CYLINDER

Problem	Cause	Remedy
Oil leaks out from rod cover through rod	· Foreign matters on packing. · Unallowable score on rod. · Unusual distortion of dust seal. · Chrome plating is striped.	· Replace packing. · Smooth rod surface with an oil stone. · Replace dust seal. · Replace rod.
Oil leaks out from cylinder rod cover thread	· O-ring damaged.	· Replace O-ring.
Rod spontaneously retract	· Scores on inner surface of tube. · Unallowable score on the inner suface of tube. · Foreign matters in piston seal.	· Smooth rod surface with an oil stone. · Replace cylinder tube. · Replace piston seal.
Wear (clearance between cylinder tube and wear ring)	· Excessive clearance between cylinder tube and wear ring.	· Replace wear ring.
Abnormal noise is produced during tilting operation	· Insufficient lubrication of anchor pin or worn bushing and pin. · Bent tilt cylinder rod.	· Lubricate or replace. · Replace.

5) FINGER TIP (OPTION)

(1) DTC Error code and Trouble shooting

Category	DTC Error Code	Action
Lever setting error	· Lift Lever Setting Error · Tilt Lever Setting Error · Aux1 Lever Setting Error · Aux2 Lever Setting Error  * VCU : Valve Control Unit (HAWE "CANIO14+") **DTC : Diagnostic Trouble Code	Check Lever Setting Value is correct like below values, and retry lever setting correctly. Min = 0.3~0.7 Mid = 2.3~2.7 Max = 4.3~4.7 (Voltage) If the Lever Value doesn't change from "0", Check fingertip levers. It might parts failure or Electric wire failure.
Valve open error	· Lift up (down) Valve 0 (1) Open · Tilt in (out) Valve 2 (3) Open · Aux1 in (out) Valve 4 (5) Open · Aux2 in (out) Valve 6 (7) Open	Check Valve Electric wire open circuit.
Valve short error	· Lift up (down) Valve 0 (1) Short · Tilt in (out) Valve 2 (3) Short · Aux1 in (out) Valve 4 (5) Short · Aux2 in (out) Valve 6 (7) Short	Check Valve Electric wire short circuit.
Valve VCC missing error	· Lift up (down) Valve 0 (1) VCC missing · Tilt in (out) Valve 2 (3) VCC missing · Aux1 in (out) Valve 4 (5) VCC missing · Aux2 in (out) Valve 6 (7) VCC missing	Check VCU VCC(Supply Voltage). About 24V must be supplied for A1, A8, B5 Pin.

(2) Equipment setup - Finger Tip(option)

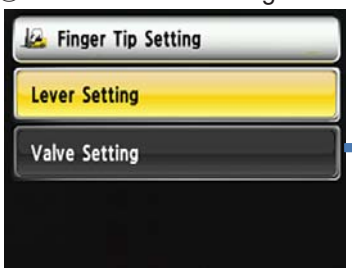
※ How to set the "Finger Tip Lever Position"

① Press the "Equipment" button

② Enter password : Defult "0000"

③ Press the"Finger Tip Setting" button

④ Press the"Lever Setting" button



⑤ Press the"Lift Lever" button

⑥ You can enter "Lift Lever" display

⑦ Activate the "Min" button

⑧ Pull the lever backwards as much as possible and set Min. voltage value

⑨ Place the lever in neutral and set the Mid value

⑩ Push the lever forwards as much as possible and set the Max value

⑪ Lift lever setting is completed

⑫ Repeat the same process for "Tilt, Aux1, Aux2 Lever"as 5-11

※ How to set the "Finger Tip Lever Deadzone"

① Press the "Lever Deadzone" button

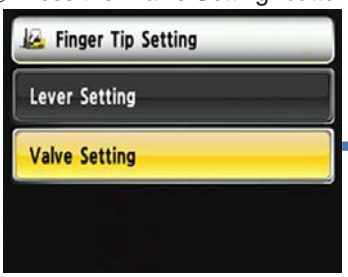
② Press the "Upper Zone" button

③ Set the upper deadzone value

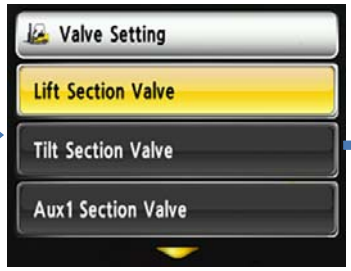
④ Repead for "Lower Zone" as 2-3

※ How to set the "Finger Tip Lift Section Valve"

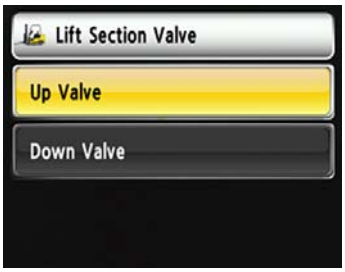
① Press the "Valve Setting" button



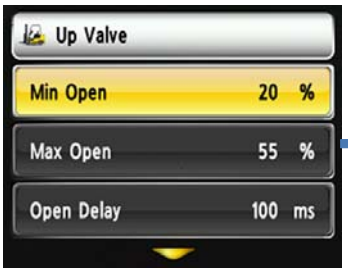
② Press the "Lift Section Valve" button



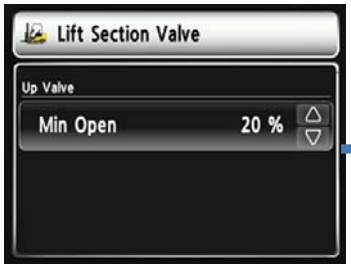
③ Press "Up valve" or "Down Valve" button



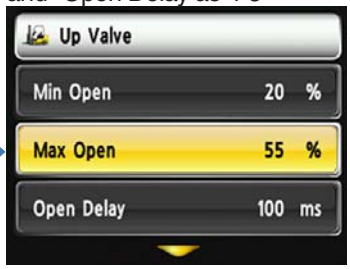
④ Press the "Min Open" button



⑤ Set the mininum open value

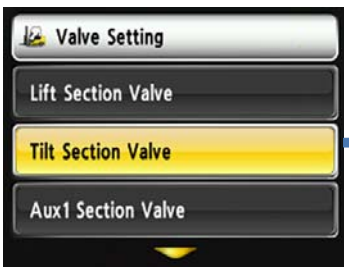


⑥ Set the "Maximum Opening" and "Open Delay as 4-5

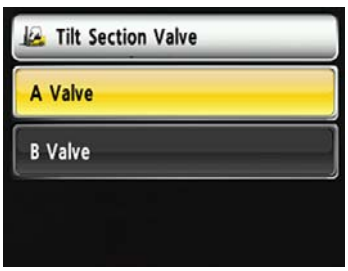


※ How to set the "Finger Tip Tilt, Aux1, Aux2 Section Valve"

① Press "Tilt Section Valves" or "Aux1 Section Valve" or "Aux2 Section Valve" button

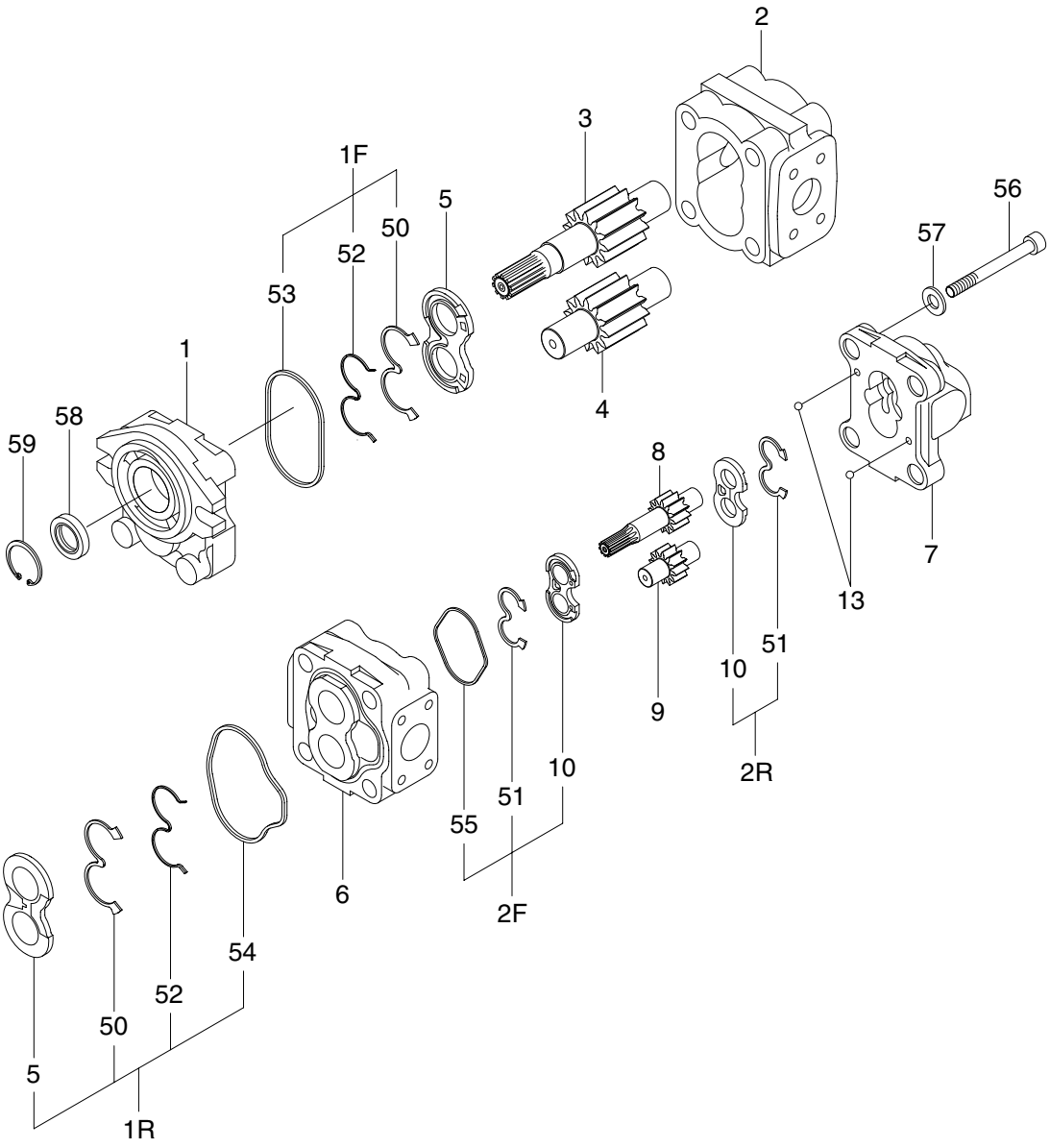


② Press "A Valve" or "B Valve"and set the value



1. MAIN PUMP

1) STRUCTURE (without priority valve)



35D9HS14-2

1	Front cover	9	Driven gear	53	Gasket
2	Body	10	Side plate	54	Gasket
3	Drive gear	11	Bushing	55	Gasket
4	Driven gear	12	Bushing	56	Socket bolt
5	Side plate	13	Steel ball	57	Washer
6	Adapter plate	50	Gasket (3 shaped)	58	Oil seal
7	Body	51	Gasket (3 shaped)	59	Retainer ring
8	Drive gear	52	Back up ring		

2) DISASSEMBLY AND ASSEMBLY

(1) Safety precautions

※ The installation, piping, maintenance disassembling, inspection, etc. of this product are requsted to be executed by the workers who have technical knowledge, or under the instruction of such workers.

※ For detaching, interrupt the operation of system including this product and detach it for the piping and equipment after the temperature on the surface of product has been cooled down completely (approx 40˚C or less).
Otherwise, there is a danger of an oil leak or getting burned.

※ When the reassembled product fails to recover its performance, do not attempt to use it.
If it is used forcibly, the equipment or system may be broken.

※ When disaposing the product, discharge the oil and dispose, it as an industrial waste.

※ To use the product safely, be sure to relevant laws regarding safety.

※ Hyundai can not guarantee the performance if the pump is disassembled.

(2) Disassembly

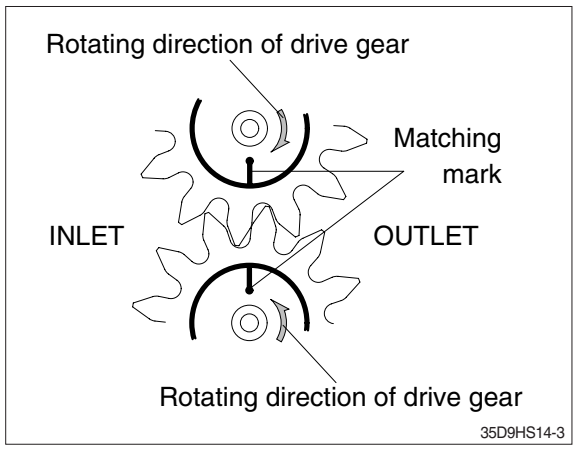
① Fix the mounting parts of front cover with the body side up to the vice.

② Mark on the joints between the front cover (1) and 1st body (2), 1st body (2) and adapter plate (6), adapter plate (6) and 2nd body before disassembling.

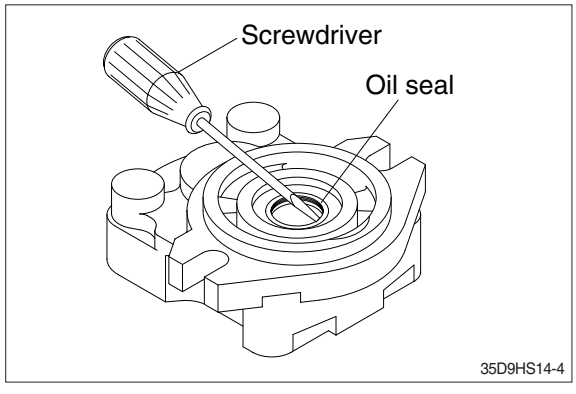
③ Remove the four bolts (56) and disassemble the parts (item 7 → 6 → 2).
Please see the instructions below.

④ Mark on the shaft ends of the body side.

⑤ Since the pair of side plates (5, 10), 3-shape gaskets (50, 51) and back-ups (52) are assembled in different directions, put the tag on each pair to distinguish where the part is used for. (They are shown as "F" and "R" in the structure drawing.)



⑥ After removing the C-shape retaining ring, apply the end of screwdriver, etc. to the inner side of oil seal to detach.



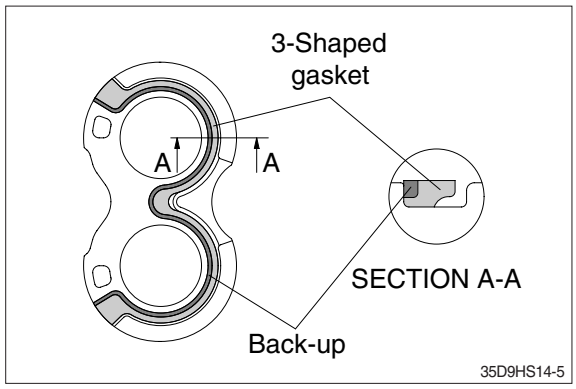
(3) Assembly

① Replace these items (50, 51, 52, 53, 54, 55, 58, 59) with new ones.

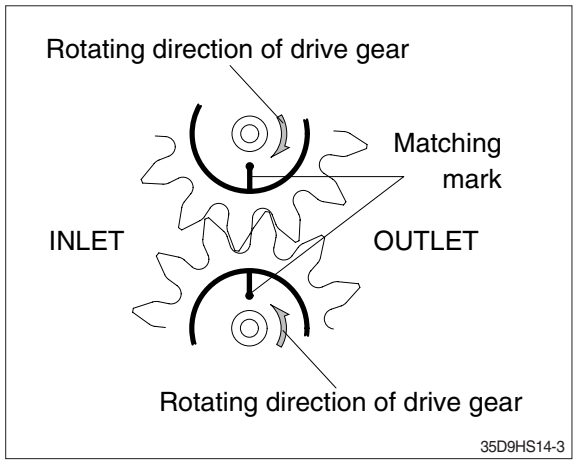
② Clean each part to remove dust before reassembling.

③ Reassemble the parts in order except for oil seal, retaining ring and bolts.

· Fix the 3-shaped gasket (50, 51) and back-up (52) to the side plate (5, 10) by using grease to prevent them from being twisted or caughts.



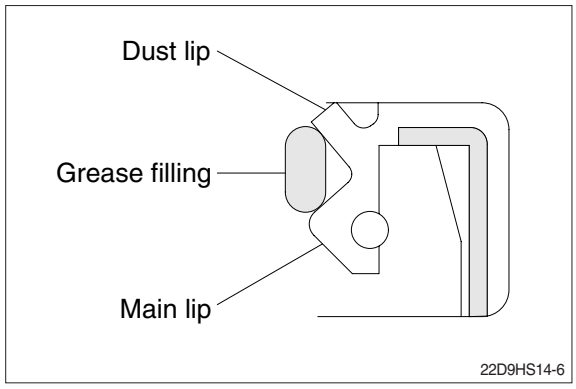
· Fix the drive gear and driven gear by matching each mark.



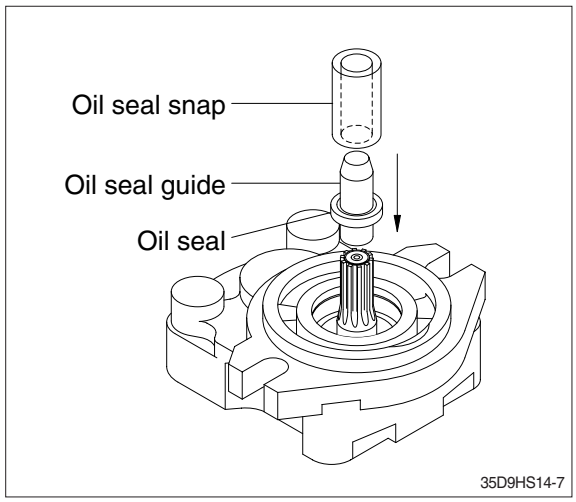
④ Tighten 4 bolts evenly by 13.3~14.3 kgf·m (96.2~103 lbf·ft) torque.

⑤ Invert the assembled pump to make the front cover up and fix the 2nd body to the vice.

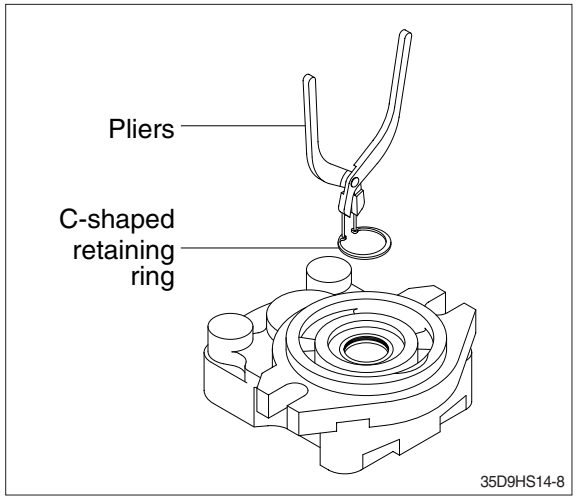
⑥ Fill the dent between the main lip and dust lip of oil seal with grease.



⑦ Fill the oil seal into the hole by using a oil seal guide and oil seal snap.



⑧ Attach the C-shaped retaining ring for hole.



3) TROUBLESHOOTING

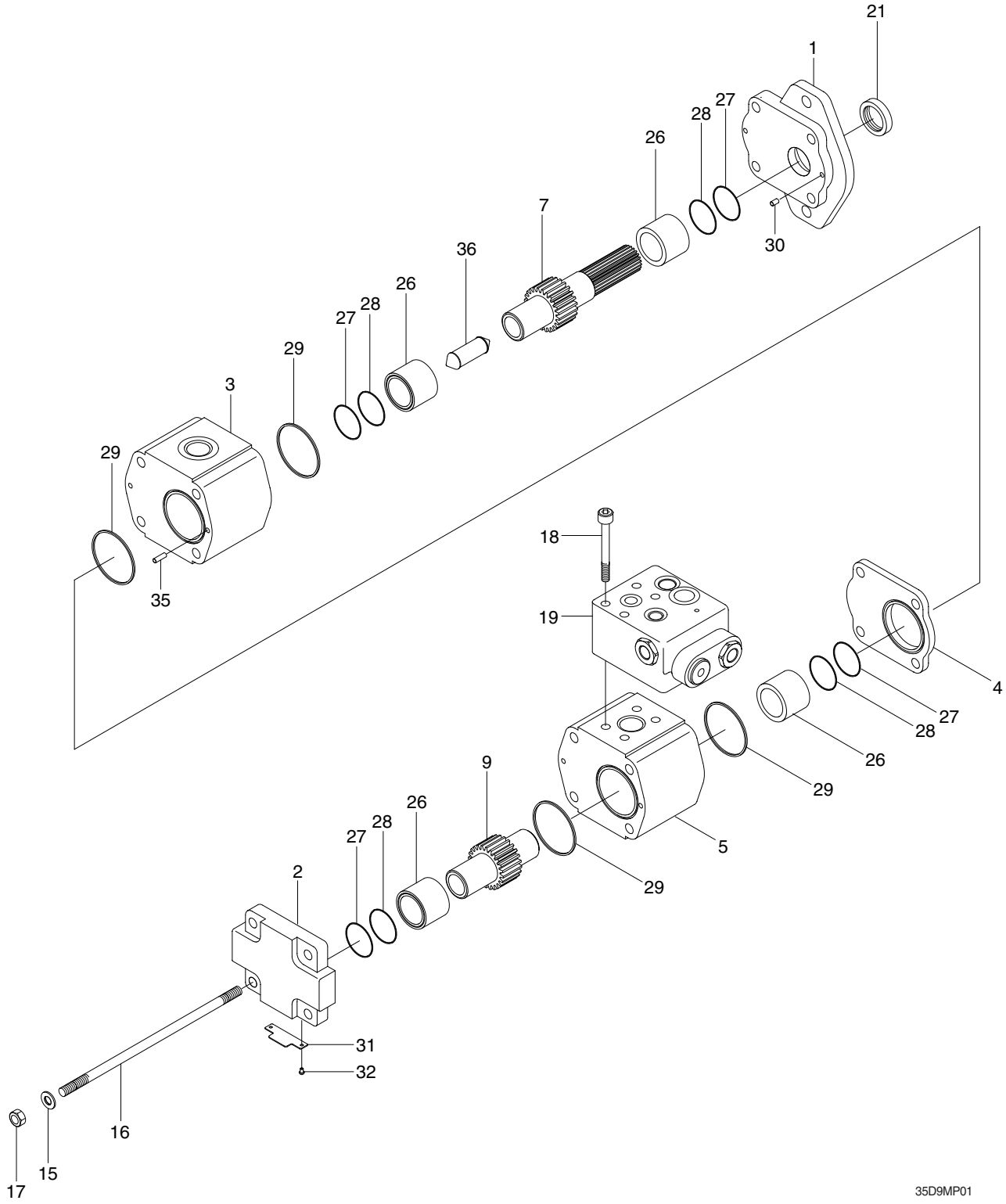
Status	Possible factors	Solutions
Leakage from the oil seal	· Reverse rotation. · Abnormal high pressure in the inlet. · Seal lips damaged by wastes. · Sealed parts of the shaft damaged or worn out. · Poor shaft centering.	· Rotate the pump to the right way. · Keep the designated pressure. · Replace the oil seal with new one. · Adjust centering. · Change the pump.
Oil leakage from the joint of cover or body	· Looseness of the bolts or breakage of the cover and body. · Degradation or damage of the oil seal caused hy heat curing of the gasket.	· Tighten bolt and keep the designated pressure. · Replace the gasket with new one. · Change the pump.
Oil leakage from port	· Looseness of breakage of the port fittings. · Breakage of the seals for fittings. · Breakage of the ports.	· Tighten the fittings and keep the designated pressure. · Replace the seals for fittings with new ones. · Change the pump.
Reduction of the oil amount getting out from the outlet or no pressure produced	· Shortage of the oil in the tank. · Intermal leakage due to abnormal high-temperature or inappropriate viscosity of oil. · Degradation of the performance due to the oil contamination. · Cavitations due to negative pressure. · Breakage of the internal parts. · Reverse rotation.	· Apply the appropriate kind and amount of oil in the tank and change the cooling system. · Change the contamination oil. · Make sure if the the appropriate length and width of inlet pipe are applied and avoid prducing negative pressure by replacing the filter with new one. · Open the inlet valve. · Change the pump. · Rotate the pump to the pump to the right way and avoid prducing the abnormal high-temperature in the inlet.
Rising temperature of pump or oil	· Abnormal generation of heat due to the frequent operation of the pressure control valves. · Lack of capacity or breakdown of the cooling system. · Damage of the internal parts.	· Set the pressure appropriately. · Change the cooling system. · Change the pump.
Noise and vibration	· Poor installation. · Cavitations. · Intake of air. · Vibration of the pipes and mounting flanges. · Chattering of the relief valves. · Damage of the internal parts.	· Adjust centering. · Make sure if the the appropriate length and width of inlet pipe are applied and avoid prducing negative pressure by replacing the filter with new one. · Fill the tank with oil and avoid taking air into the inlet pipes. · Reinforce the pipes and mounting flange and prevent resonating. · Replace the relief valve with new one. · Change the pump.

※ Once you disassemble the pump, its performance may not recover after the reassembly.

※ Change the assembly if the pump breaks down.

※ If the disassembly is inevitable, you need to consult the Hyundai service center or dealer.

HYDRAULIC GEAR PUMP (with dual flow divider)



1	SEC housing	9	Gear set	21	Double seal lip	31	Name plate
2	PEC housing	15	Washer	26	Bushing	32	Screw
3	Gear housing	16	Stud bolt	27	Seal	35	Dowel pin
4	Mid plate	17	Nut	28	Backup seal	36	Connection shaft
5	Gear housing	18	Bolt	29	Seal		
7	Gear shaft set	19	Dual flow divider	30	Dowel pin		

2) DISASSEMBLY

(1) General precautions

① If prying off sections becomes necessary, take extreme care not to mar or damage machined surfaces.

② Excessive force while prying can result in misalignment and seriously damage parts. If parts are difficult to fit during assembly, tap gently with a soft hammer (never use an iron hammer).

③ Gears are closely matched, therefore they must be kept together as sets when removed from a unit. Handle with care to avoid damage to the journals or teeth. Avoid touching gear journals.

(2) Disassembly

① Place the pump in a vise with the drive shaft pointing down.

※ Do not grip on or near any machined surfaces during assembly or disassembly.

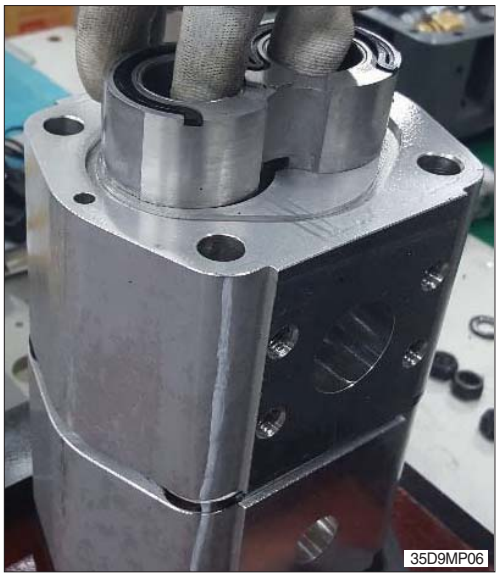
※ Match-mark all sections.
Be sure to align these marks when reassembling.

② Use a socket wrench to remove the 4 cap screws on single units or the 4 hex nuts, studs and washers of multiple units.

③ If prying is necessary, be careful not to damage the machined surfaces.

④ Remove the bush block . Examine and replace if necessary.

※ Detail see page 6-32, 33.



⑤ Carefully remove the drive and driven gears.
Avoid tapping the gear teeth together or against other hardened surfaces.
Keep these gears together because they are a matched set.
Examine and replace if necessary.
Remove the bush block from the gear housing.
Examine and replace if necessary.

⑥ Lift the gear housing from the mid plate.
If prying is necessary, take care not to damage machined surfaces.
Examine and replace if necessary.
Dowel pins will remain in either the rear gear housing or the front gear housing.

⑦ Remove the mid pate.

⑧ Lift the gear housing from the shaft end cover to prevent damage to contact face and edges.
Dowel pins will remain in either the gear housing or port end cover.
Do not remove them.

⑨ Remove the bush block.
Examine and replace if necessary.

※ Detail see page 6-32, 33.

⑩ Carefully remove the drive and driven gears.
Avoid tapping the gear teeth together or against other hardened surfaces.
Keep these gears together because they are a matched set. Examine and replace if necessary.
Remove the bush block from the gear housing. Examine and replace if necessary.

35D9MP12

3) ASSEMBLY

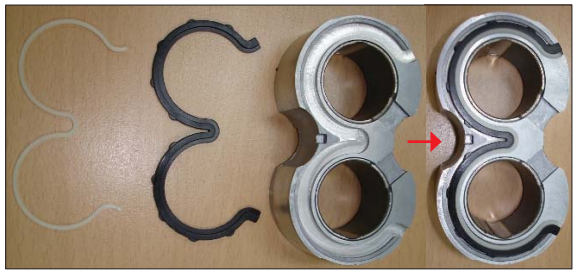
① Press it into the mounting flange side of the shaft end cover with an air press. Be careful not to damage the lip of the seal. Press in until flush with the recess.

35D9MP13

② Insert dowel pin.
Examine all of the dowels. Before inserting, make certain that the hole is clean and free from burrs.
Gently start the pin straight into the hole and tap lightly with a soft hammer.

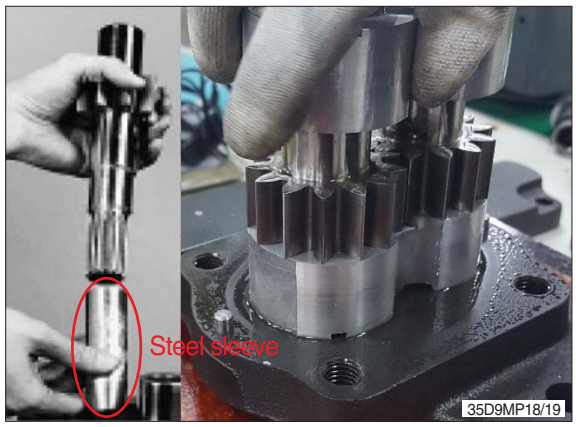
35D9MP14

③ Assemble the channel seals into the grooves in the bush blocks with the flat side of the seal facing away from the bush block such as picture.


35D9MP15/16

④ Gently the bush block assemble on the shaft end cover.
The channel seal from step ③ should face the shaft end cover.
The relief groove in the plate should face the outlet side of the pump.

⑤ Slide the driven gear into the bushing.
Coat the steel sleeve tool with grease.
Place the lightly-greased drive shaft inside the sleeve and slide both through the shaft end cover with a twisting motion, until the integral gear rests against the bush block.
Avoid damaging the double lip seal.
Remove the steel sleeve.
Bush block assemble on the gears.



⑥ Slip the bush block with the seal over the gear journals.
The flat side of the seal should face up with the relief groove facing the outlet side.

⑦ Place the gear housing onto the journals of the drive and driven gears.
Be sure to line up the dowel holes over the dowel pins.
When the parts are parallel, squeeze them together or alternately tap over each dowel until the parts are together.

⑧ Place the mid plate on the gear housing.
Be sure to set driver gear and large hole, and inlet hole and small hole.

⑨ Insert the connecting shaft into the spline of the drive gear.

⑩ Place the gear housing on the mid plate.
Be sure to line up the dowel holes over the dowel pins.
When the parts are parallel, squeeze them together or alternately tap over each dowel until the parts are together.
Slide the bush block through the gear housing on the mid plate.

⑪ Insert the drive and driven gears of the second section in their respective bush block.
Make certain the gears are in contact with the bush block.

※ Detail see page 6-32, 33.

⑫ Slip the bush block with the seal over the gear journals.
The flat side of the seal should face up with the relief groove facing the outlet side.

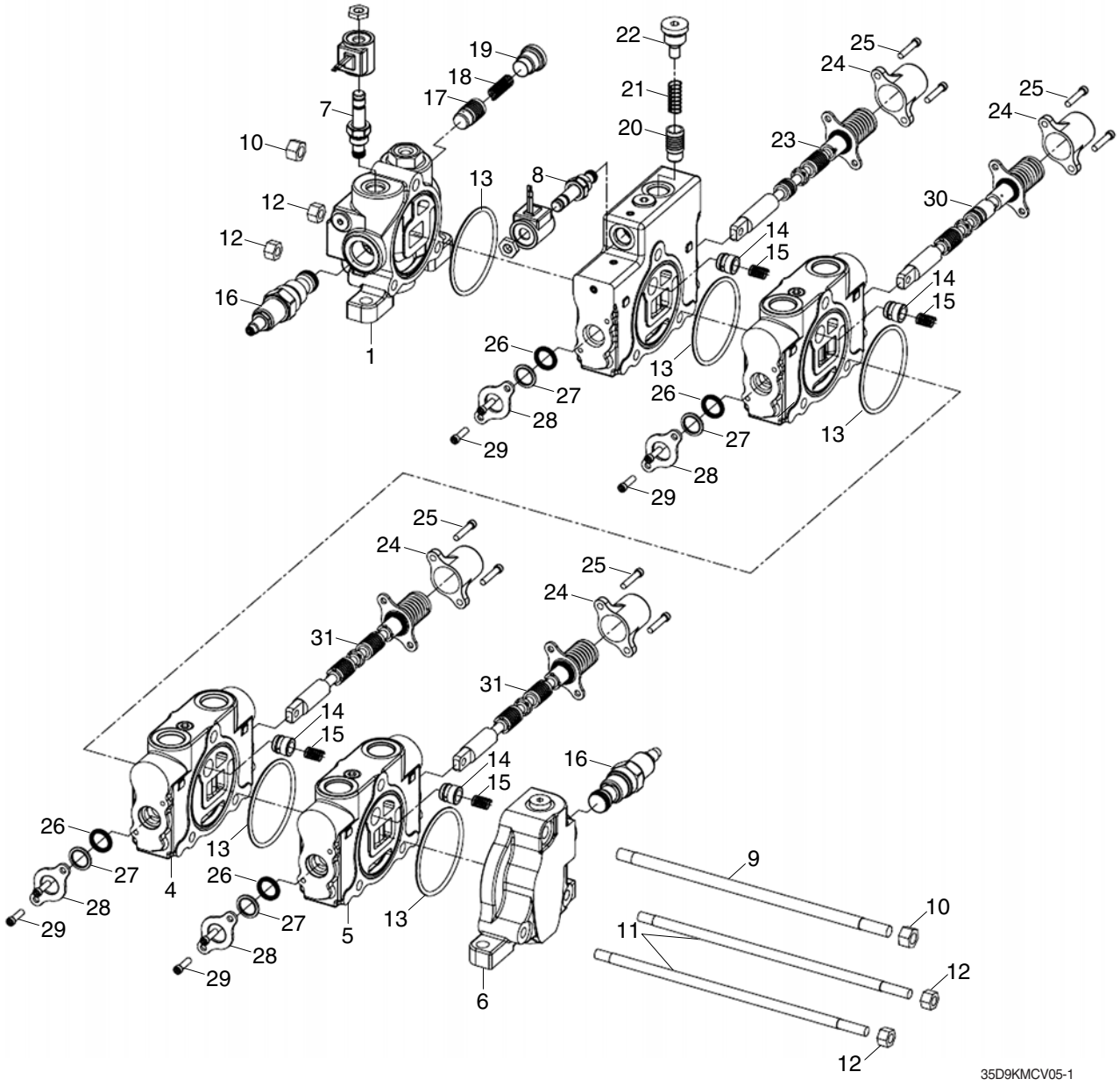
※ Detail see page 6-32, 33.

⑬ Place the port end cover over the gear housing

⑭ Thread the fasteners into the shaft end cover and tighten alternately or cross corner.
Rotate the drive shaft with “pre-rotate jig” to check for binding.
If there is no internal binding, tighten torque diagonally to 10.2 kgf·m (73.8 lbf·ft).

MAIN CONTROL VALVE

1) STRUCTURE (4 Spool)



1	Main block	12	Nut	23	Lift spool assy
2	Lift section	13	O-ring	24	Cap
3	Tilt section	14	Inlet poppet	25	Bolt
4	Aux1 section	15	Spring	26	Quad ring
5	Aux2 section	16	Relief valve	27	Back up ring
6	Cover	17	Unload poppet	28	Plate
7	Main solenoide valve	18	Spring	29	Bolt
8	Lift solenoide valve	19	Plug	30	Tilt spool assy
9	Bolt	20	Safety poppet	31	Aux spool assy
10	Nut	21	Spring		
11	Bolt	22	Plug		

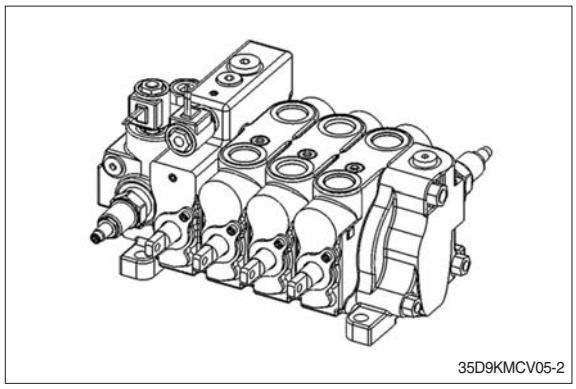
2) DISASSEMBLY AND ASSEMBLY

(1) Removal

- Remove the main control valve assy from the truck.
- Precaution for disassembly

① Lower the mast to the flat floor and stop the engine.
Release the remaining pressure inside the hydraulic system. Escaping fluid or spring off parts under pressure can cause serious injury when disassembling.

② Make match marks on the necessary places before removal to prevent any mistake when assembling. Clean the surrounding area of the main control valve to prevent dirt or dust from entering and remove the hoses and fit blind plugs to the ports.


35D9KMCV05-2

(2) Precautions for disassembly and assembly

① Clean the surrounding area of the main control valve to prevent dirt or dust from entering when disassembling.

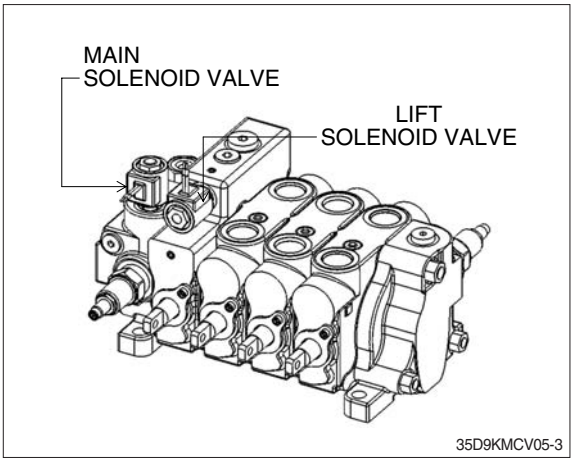
② Arrange the removed parts on a shelf not to mistake the original position when reassembling.

③ Do not hit or drop the parts to reuse except replacing parts.

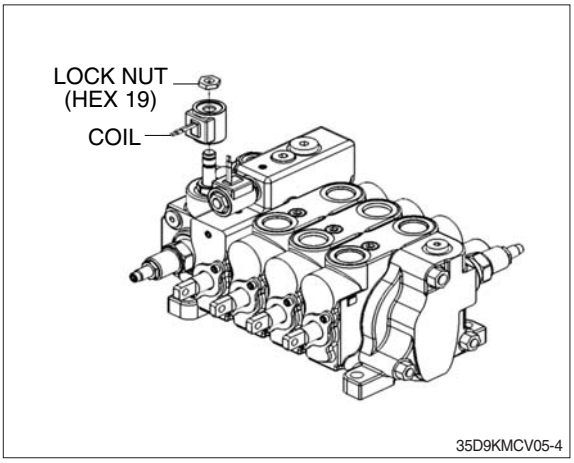
④ Take care not to shock or damage for seal seat of the each section when disassembling.

(3) Replacing each part of the MCV (disassembly and assembly)

① Replacement of the solenoid valve (Main / lift solenoid valve)



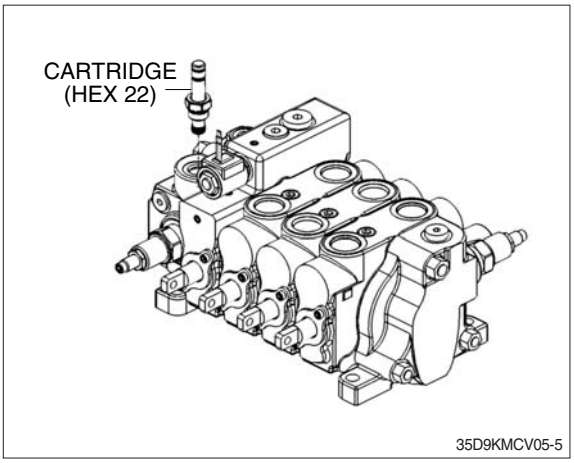
a. Loosen the lock nut (hex 19) and remove the coil from the cartridge of the solenoid valve.



b. Loosen the cartridge (hex 22) and remove it from the MCV.
Apply a few oil to the new O-ring and backup ring and assemble to the new cartridge and fit it into the port of the MCV.
- Cartridge tightening torque (hex 22)
  2.6~2.9 kgf · m (18.8~21.0 lbf · ft)

※ Take care not to damage the O-ring boss of the port.

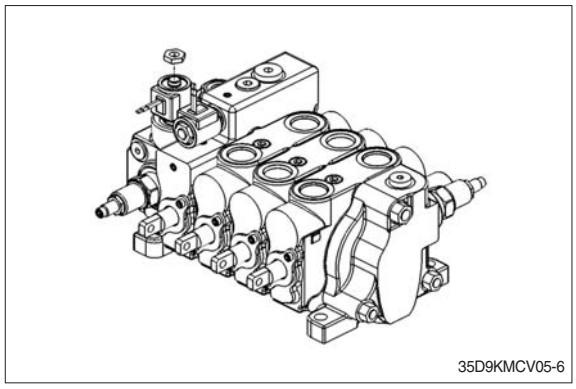
※ Check that the assembly area is free from foreign matter.



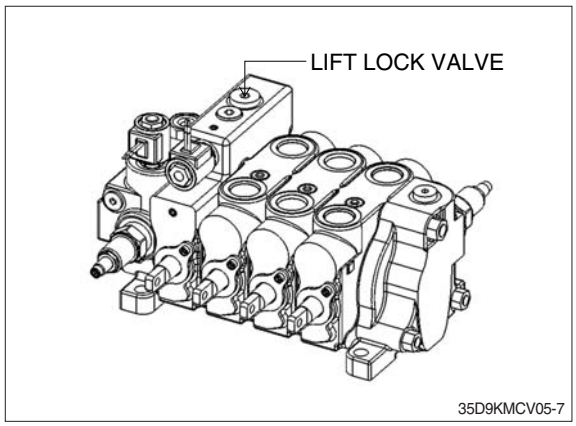
c. Insert the coil into the cartridge and tighten the lock nut.
   · Lock nut tightening torque (hex 19)
   0.55~0.7 kgf · m (4.0~5.1 lbf · ft)

※ Check that the contact surfaces of the cartridge and coil are free from foreign matter.

※ Bring imprinted letter of the manufacturer to top position when assembling the coil.

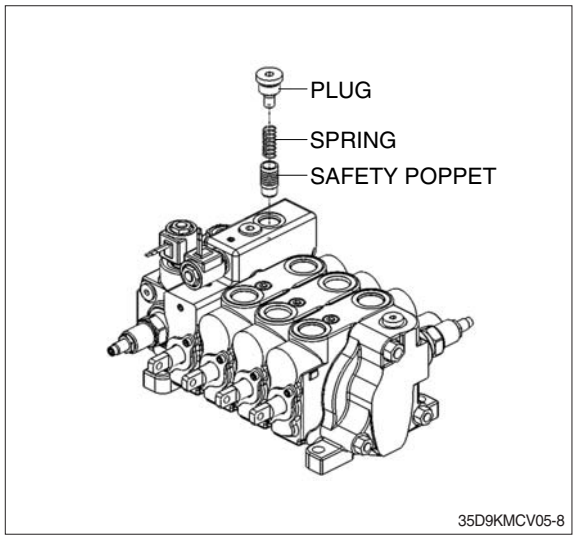

35D9KMCV05-6

② **Replacement of the lift lock valve**



35D9KMCV05-7

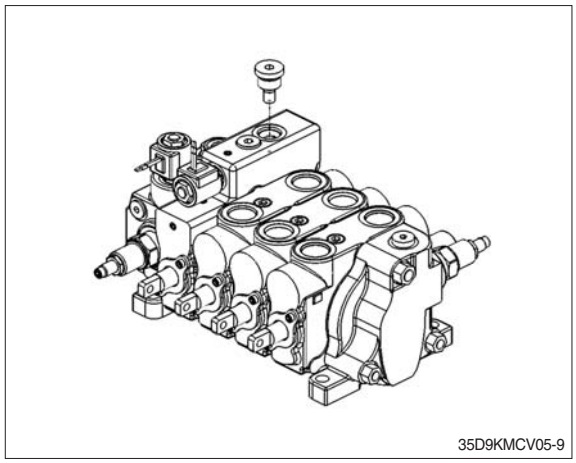
a. Loosen the plug and remove the spring and safety poppet from the MCV.



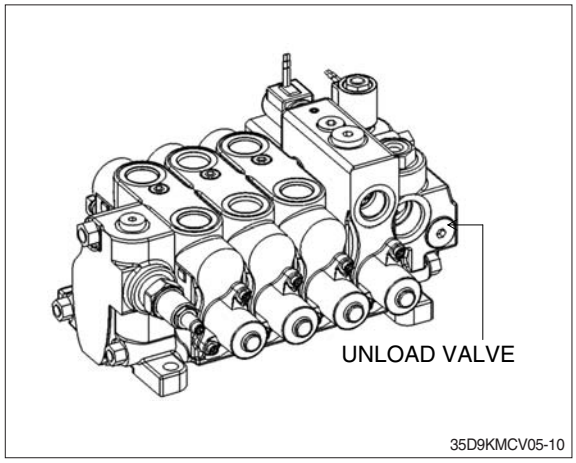
35D9KMCV05-8

b. Assemble the new safety poppet and spring into the MCV in reverse order of the disassembly.
   · Plug tightening torque (socket 8)
   5.1±0.25 kgf · m (36.9±1.8 lbf · ft)

※ Check that the assembly area is free from foreign matter.
※ Check that the poppet slide smooth into the hole.
※ Take care not to damage the O-ring boss of the port.

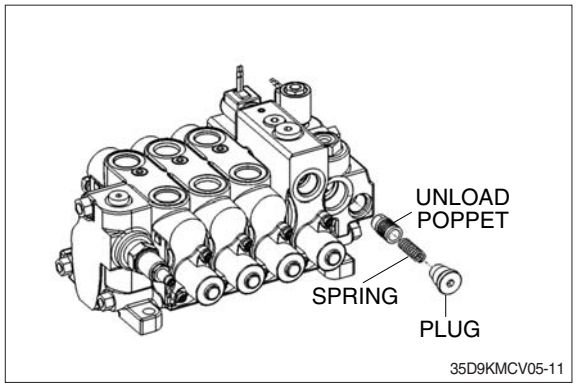

35D9KMCV05-9

③ Replacement of the unload valve



35D9KMCV05-10

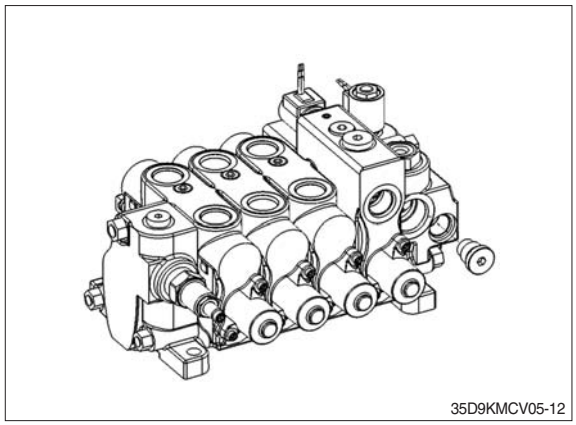
a. Loosen the plug and remove the spring and unload poppet from the MCV.



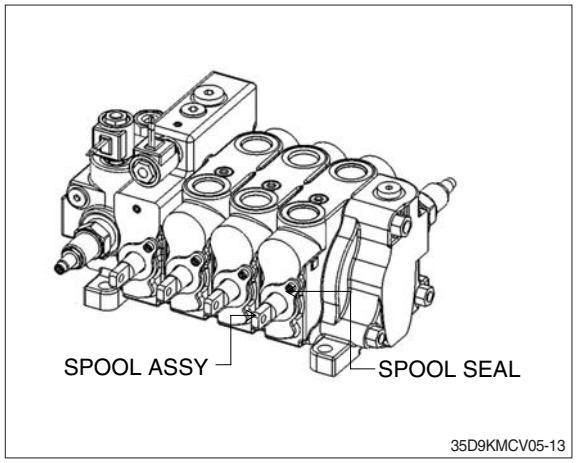
35D9KMCV05-11

b. Assemble the new unload poppet and spring into the MCV in reverse order of the disassembly.
   · Plug tightening torque (socket 8)
   5.1±0.25 kgf · m (36.9±1.8 lbf · ft)

※ Check that the assembly area is free from foreign matter.
※ Check that the poppet slide smooth into the hole.
※ Take care not to damage the O-ring boss of the port.

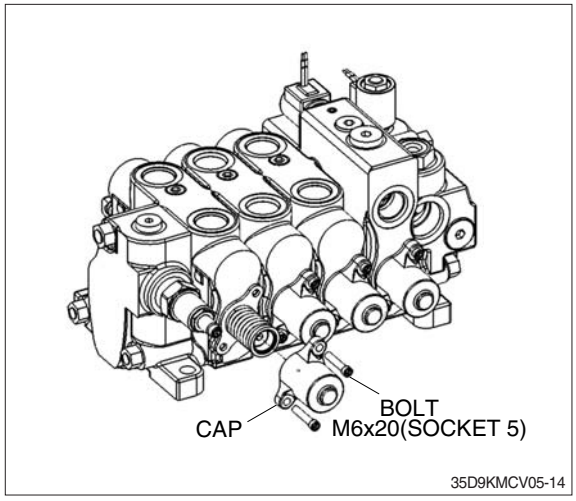

35D9KMCV05-12

④ **Replacement of the spool seal and spool assy**



35D9KMCV05-13

a. Loosen the bolt and remove the cap from the MCV.

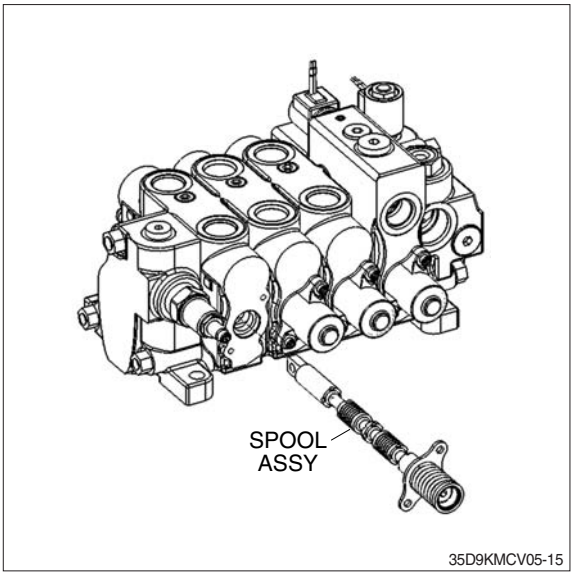


35D9KMCV05-14

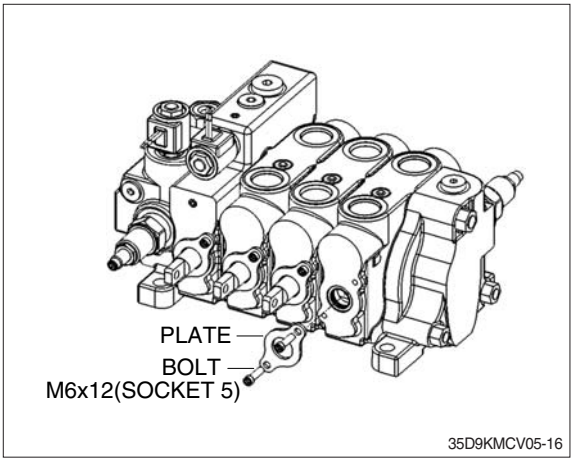
b. Remove the spool assy from the MCV.
   - Install the spool assy and go to the clause f if replacing the spool assy only.

※ Check that the hole of the spool is free from foreign matter.

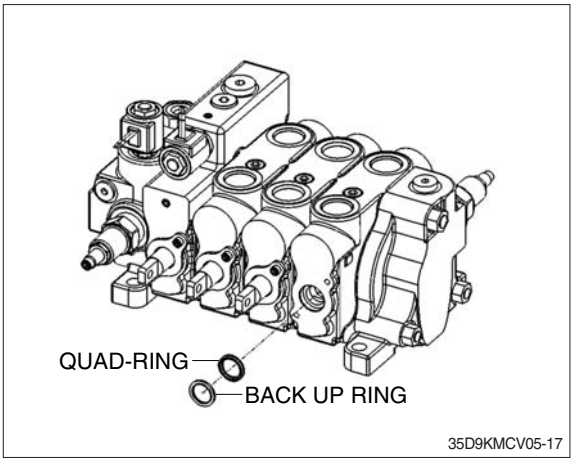
※ Take care not to hit the spool. This can cause stuck of the spool after the spool reassembling.



c. Loosen the bolt that opposite side of removed the spool assy and dissemble the plate.



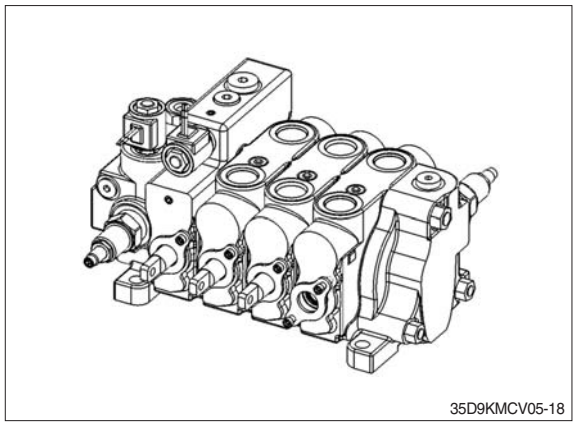
d. Replace the quad-ring and backup ring with a new one.



e. Insert the quad-ring and backup ring into the MCV and assemble the plate with tightening the bolt.
   · Tightening torque (M6×12)
   1.5±0.1 kgf·m (10.8±0.7 lbf·ft)

※ Check that the seat surface of the seal is free from foreign matter before assembling.

※ Apply a few oil on the seal surface before assembling.

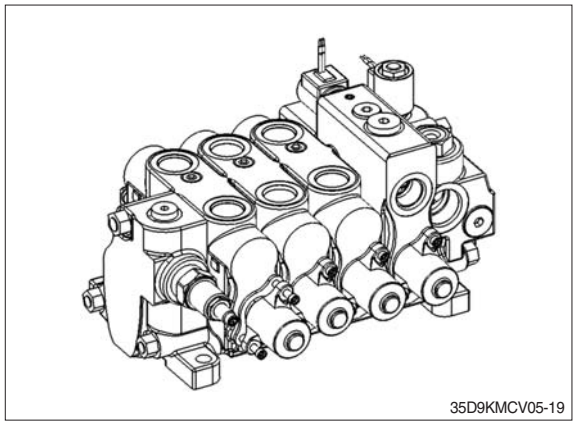


35D9KMCV05-18

f. Insert the spool assy into opposite side of the MCV and assemble the cap with tightening the bolt.
   · Tightening torque (M6×12)
   1.5±0.1 kgf·m (10.8±0.7 lbf·ft)

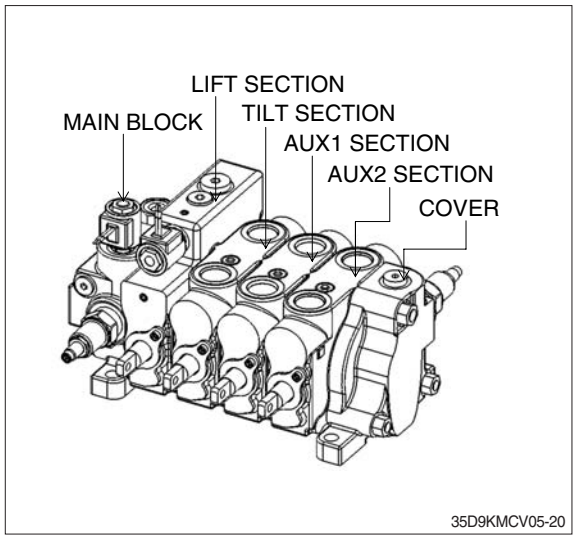
※ Check that the seat surface of the seal is free from foreign matter before assembling.

※ Check that the spool is free from scoring.



35D9KMCV05-19

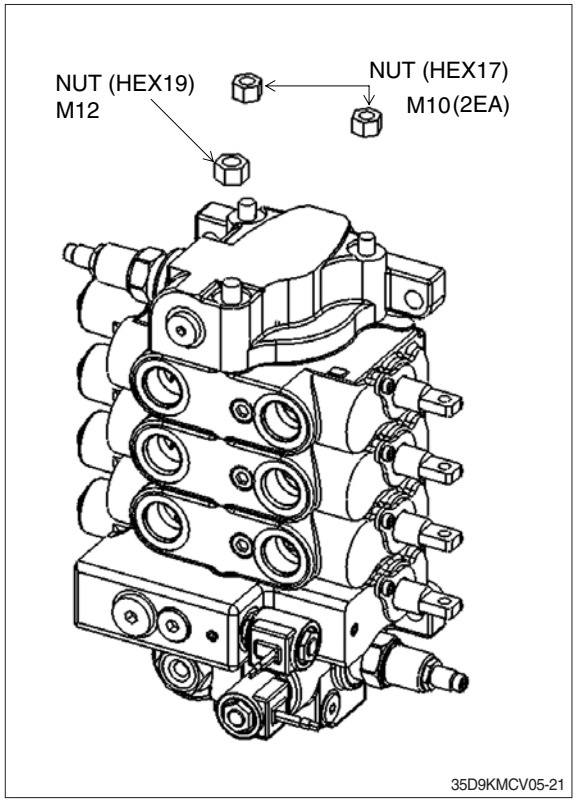
⑤ Replacement of the section assy



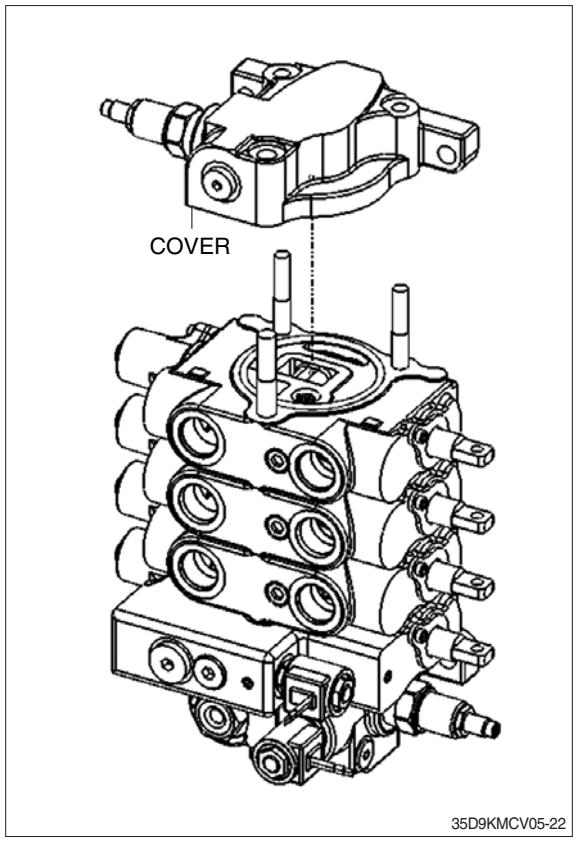
a. Replacement of the lift section

ⓐ Loosen the nut (3EA) a little and place the MCV on the flat table with the main block facing the bottom.

ⓑ Remove the nut (3EA) from the bolt.

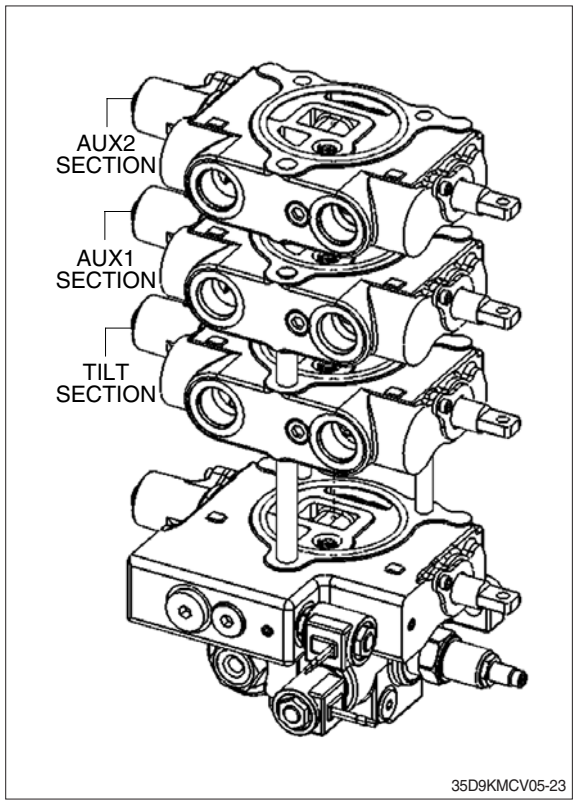


ⓒ Remove the cover form the MCV.



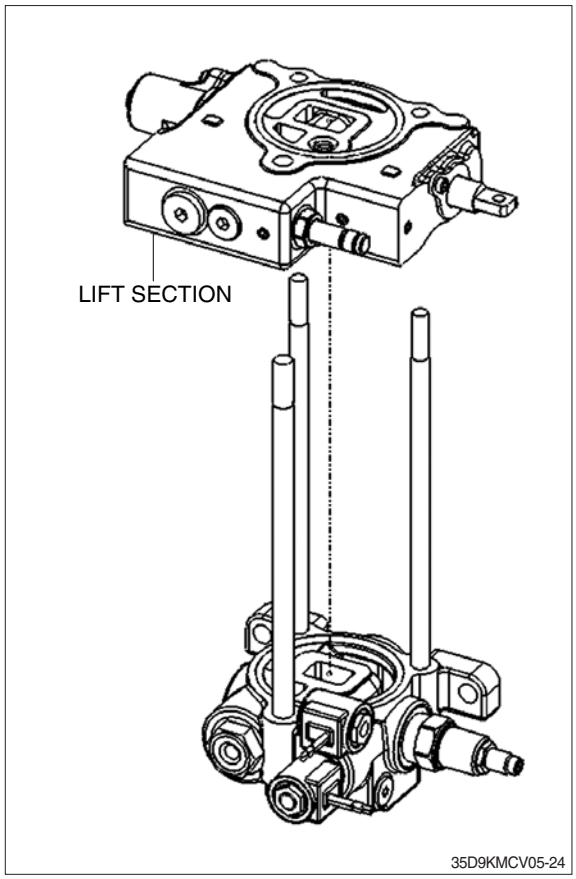
ⓓ Remove the aux2 section, aux1 section and tilt section from the MCV in order.

※ Take care not to lose the O-ring, spring and inlet poppet.



ⓔ Remove the lift section kit and replace it with a new one.

※ Take care not to lose the O-ring, spring and inlet poppet.



ⓕ Replace the lift section and assemble the each section in reverse order of above procedures and tighten the bolt.

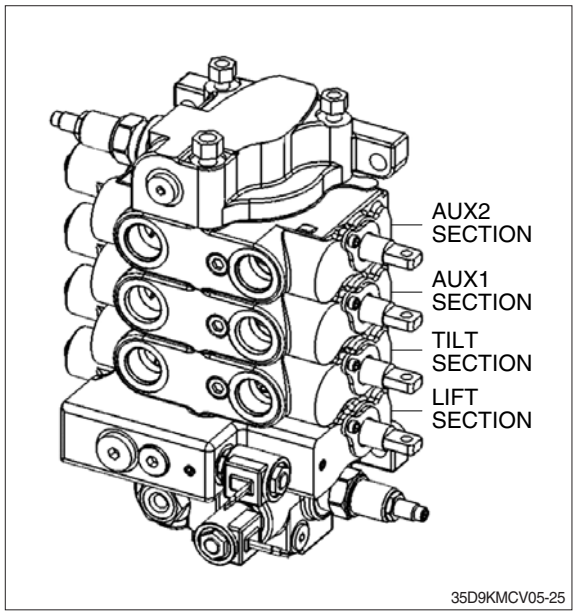
· Tightening torque

M10 : 6.0±0.3 kgf · m
(43.4±2.2 lbf · ft)

M12 : 9.0±0.45 kgf · m
(65.1±3.3 lbf · ft)

※ Check that the contact surface of the blocks is free from foreign matter before assembling.

※ Confirm the imprinted letter on the block in order to place each section located original positions.



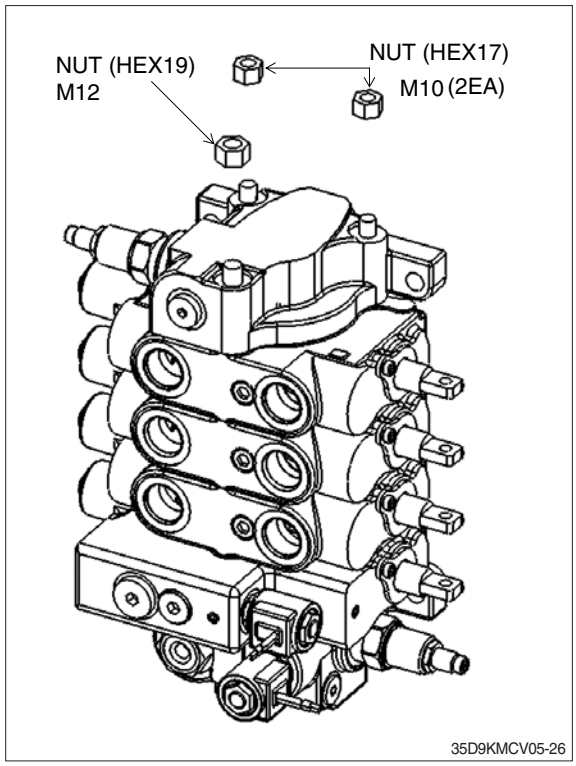
b. Replacement of the other sections

ⓐ Replace the aux2, aux1 and tilt section same method as the lift section.

⑥ Replacement of the inlet check valve and block seal

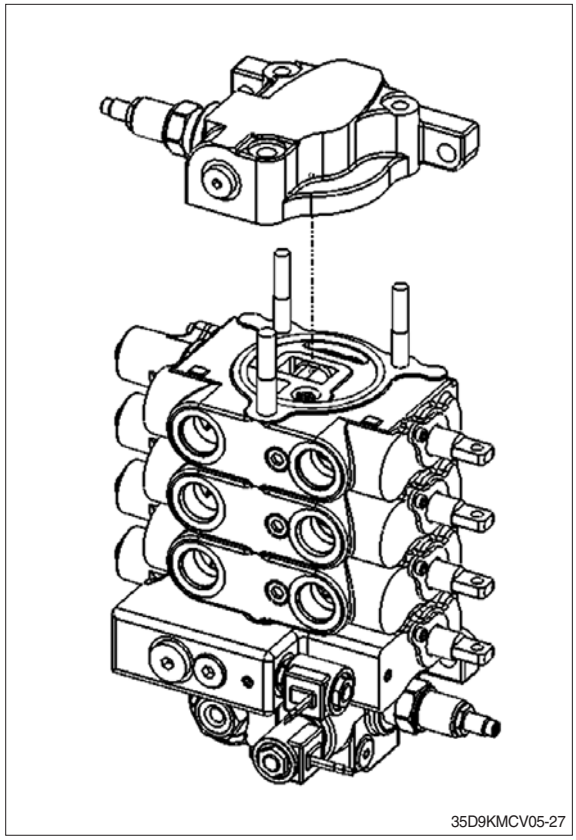
a. Loosen the nut (3EA) a little and place the MCV on the flat table with the main block facing the bottom.

b. Remove the nut (3EA) from the bolt.

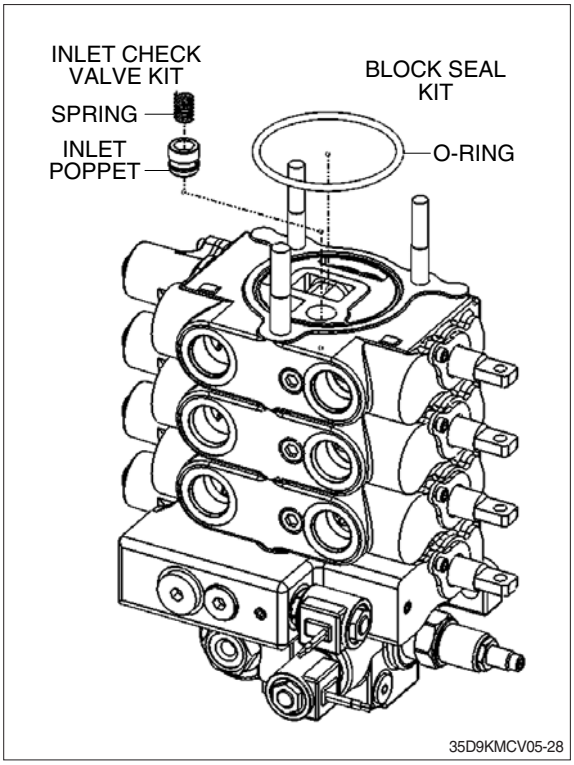


35D9KMCV05-26

c. Remove the cover form the MCV.


35D9KMCV05-27

d. Replace the inlet poppet (or block seal) with a new one.



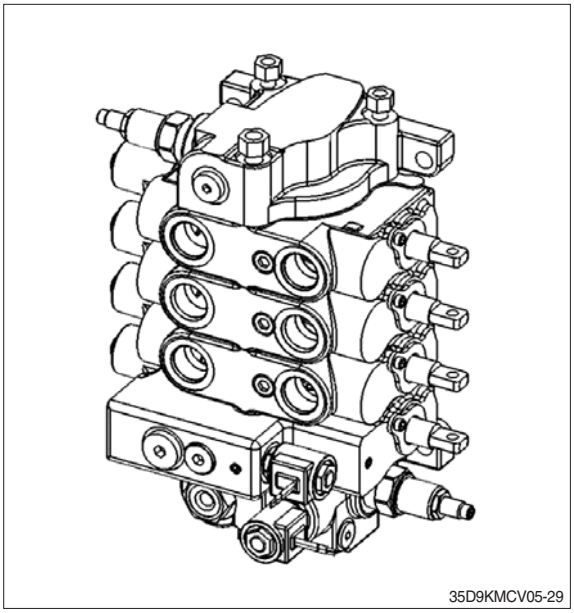
e. Assemble it with a new one in reverse order of above procedures and tighten the bolt.

· Tightening torque

M10 : 6.0±0.3 kgf · m
(43.4±2.2 lbf · ft)

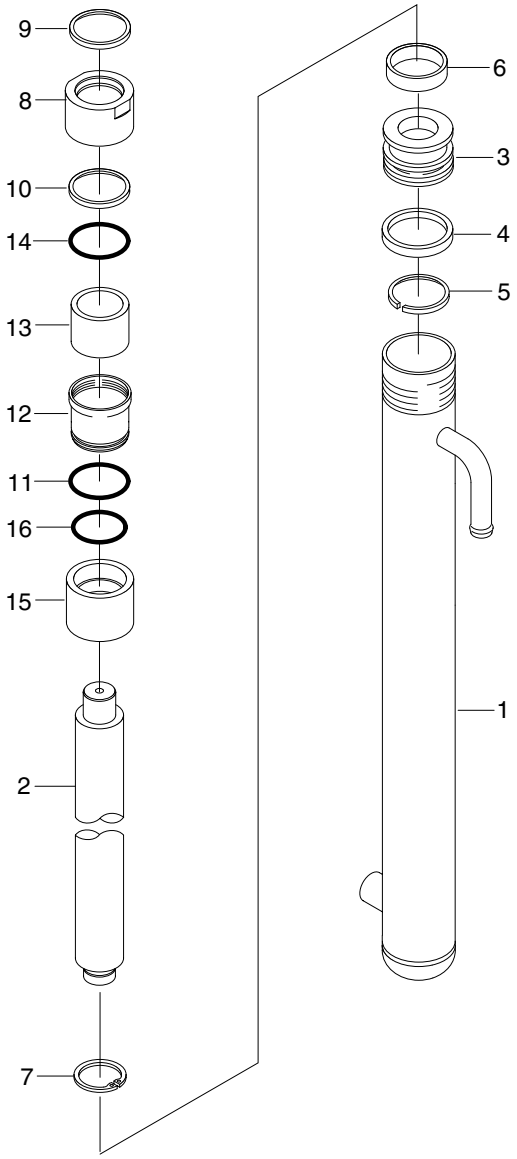
M12 : 9.0±0.45 kgf · m
(65.1±3.3 lbf · ft)

※ Check that the contact surface of the sections is free from foreign matter before assembling.



4. LIFT CYLINDER

1) STRUCTURE



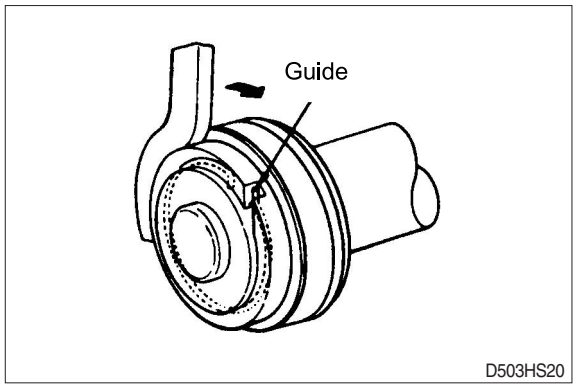
- I.D × O.D × stroke (standard)
  65 × 73 × 1335 mm
  (2.6 × 2.9 × 52.6 in)
- Rod O.D : 50 mm (2.0 in)

D357HS19

1	Tube assy	9	Dust wiper
2	Rod	10	Rod seal
3	Piston	11	O-ring
4	Piston seal	12	Guide
5	Back up ring	13	DU busing
6	Wear ring	14	O-ring
7	Retaining ring	15	Spacer
8	Gland	16	O-ring

2) DISASSEMBLY

(1) Hold the cylinder tube in a vice, loosen the cylinder head and remove it.
Remove the spacer from the cylinder tube and knock out the bushing. Hook a wrench in the hole in the retainer at the piston end and turn. Lever up the edge of the guide, then turn the guide in again and the guide can be removed.



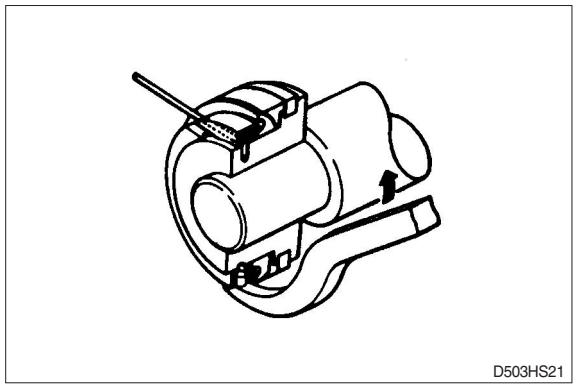
3) CHECK AND INSPECTION

mm (in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.05~0.25 (0.002~0.01)	0.4 (0.0015)	Replace bushing
Clearance between piston ring & tube	0.05~0.35 (0.002~0.013)	0.5 (0.02)	Replace piston ring

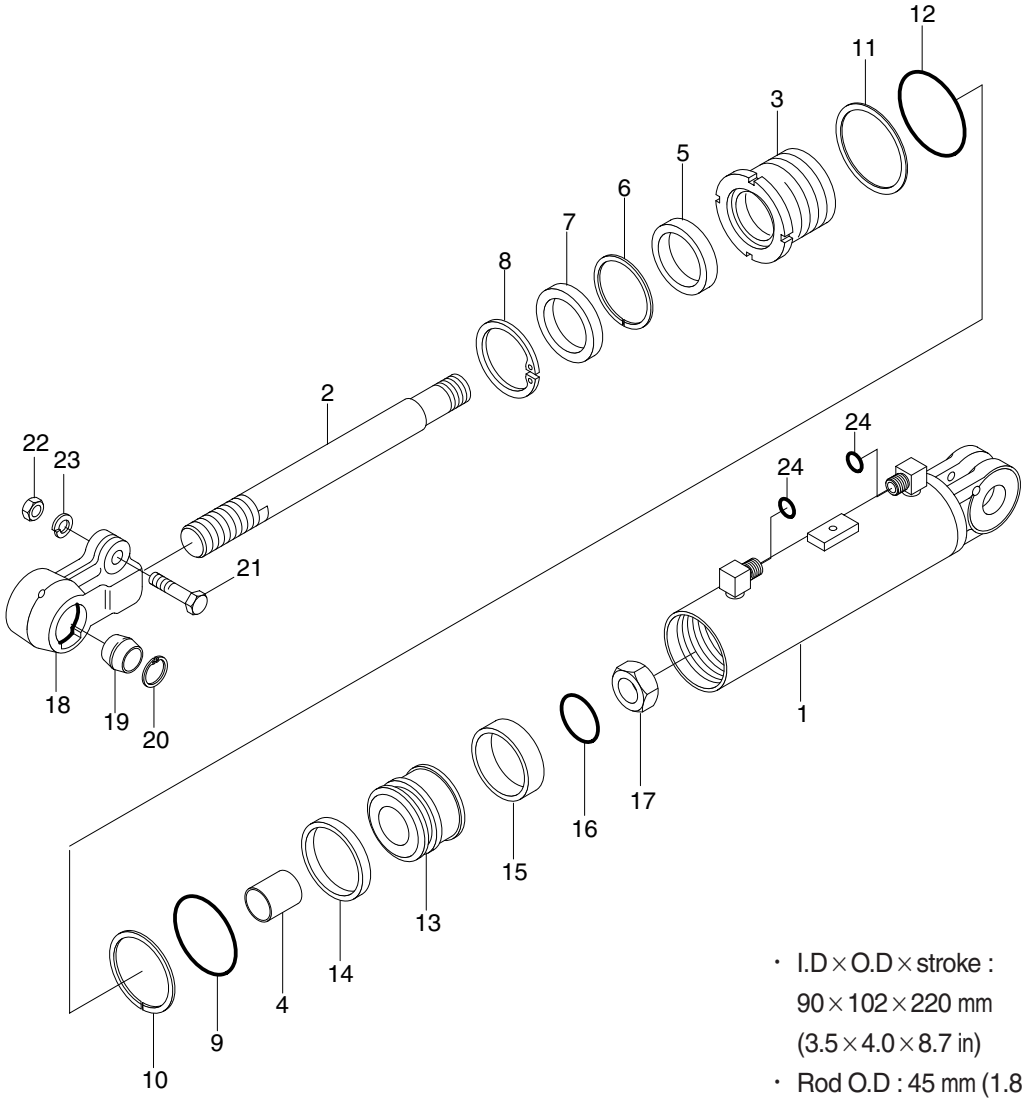
4) ASSEMBLY

(1) Soak the piston ring in hydraulic oil at a temperature of 40 to 50℃, expand the inside diameter and assemble on the piston. Install a piston seal.
Bend the edge of the guide and rotate it to install the guide completely.



5. TILT CYLINDER

1) STRUCTURE



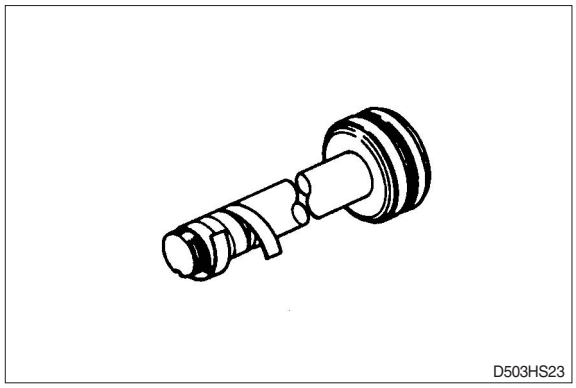
- I.D × O.D × stroke : 90 × 102 × 220 mm (3.5 × 4.0 × 8.7 in)
- Rod O.D : 45 mm (1.8 in)

35DS7HS16

1	Tube assy	9	O-ring	17	Nylon nut
2	Rod	10	Back up ring	18	Rod eye
3	Gland	11	Lock washer	19	Spherical bearing
4	DU bushing	12	O-ring	20	Retaining ring
5	Rod seal	13	Piston	21	Hexagon bolt
6	Back up ring	14	Glyd ring	22	Hexagon nut
7	Dust wiper	15	Wear ring	23	Spring washer
8	Snap ring	16	O-ring	24	O-ring

2) DISASSEMBLY

(1) Hold the parallel parts of the cylinder tube bottom in a vice and mark the rod head end to show how much it is screwed in, then remove the rod head. Next, hook a wrench into the notch at the cylinder head and remove the cylinder head from cylinder tube.
When doing this, wind tape round the threaded part of the rod and be careful not to damage the dust seal and rod seal inside cylinder head.



3) CHECK AND INSPECTION

mm (in)

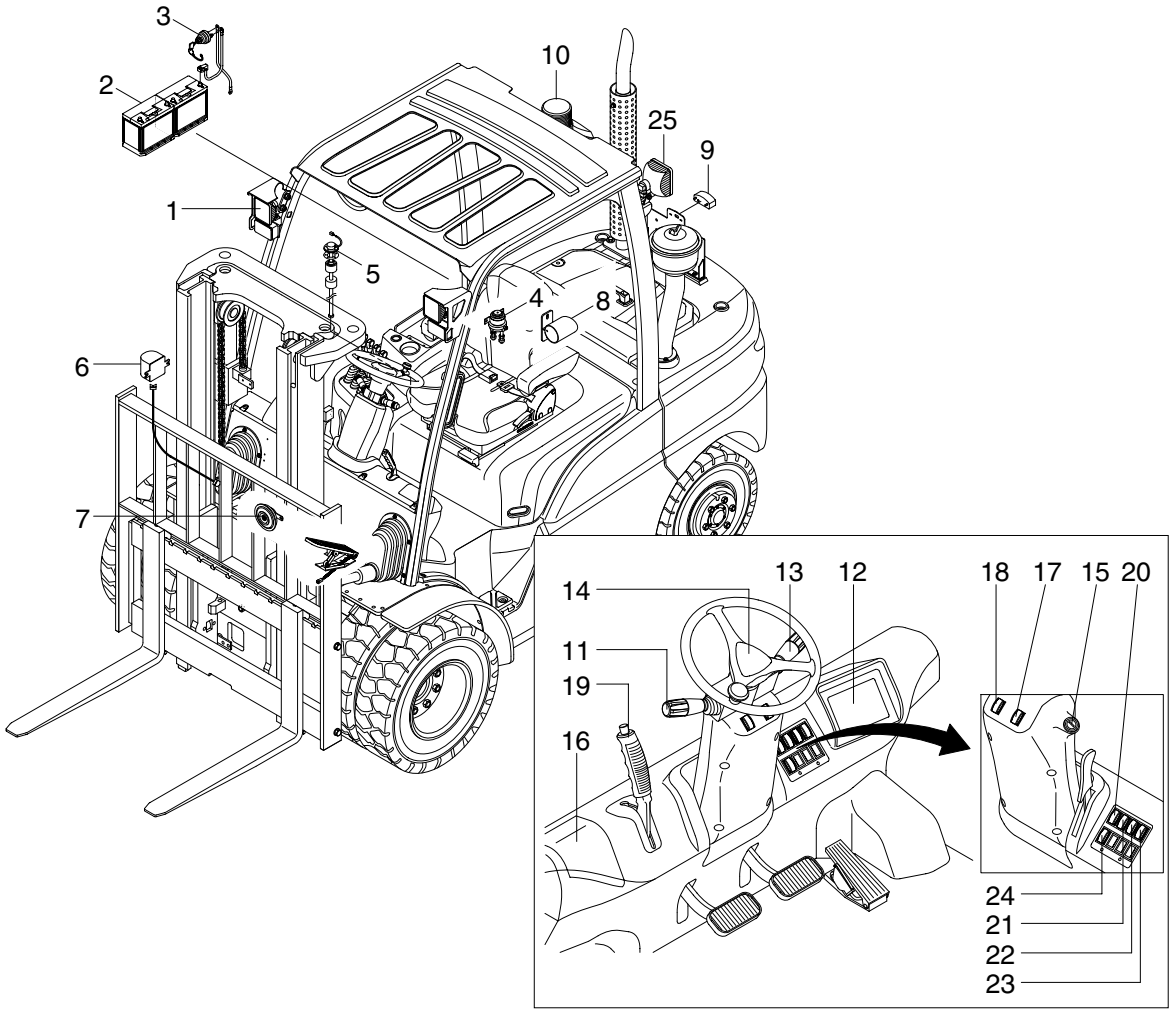
Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.072~0.288 (0.003~0.011)	0.5 (0.020)	Replace bushing
Clearance between rod head bushing & pin	0.10~0.35 (0.004~0.014)	0.6 (0.024)	Replace bushing

SECTION 7 ELECTRICAL SYSTEM

Group 1 Component location 7-1
Group 2 Electrical circuit 7-2
Group 3 Component specification 7-18
Group 4 Connector destination 7-19
Group 5 Troubleshooting 7-23

SECTION 7 ELECTRICAL SYSTEM

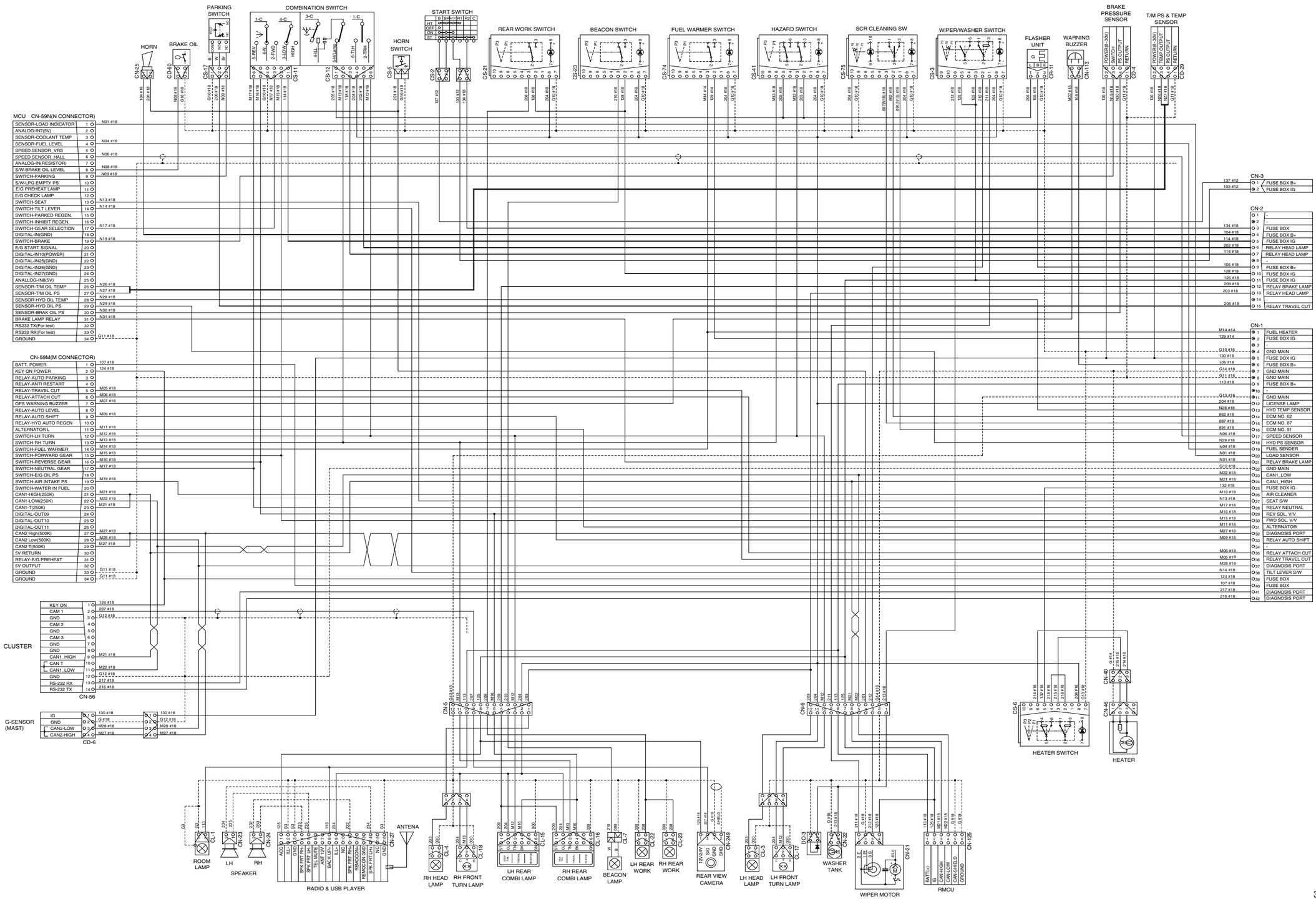
GROUP 1 COMPONENT LOCATION



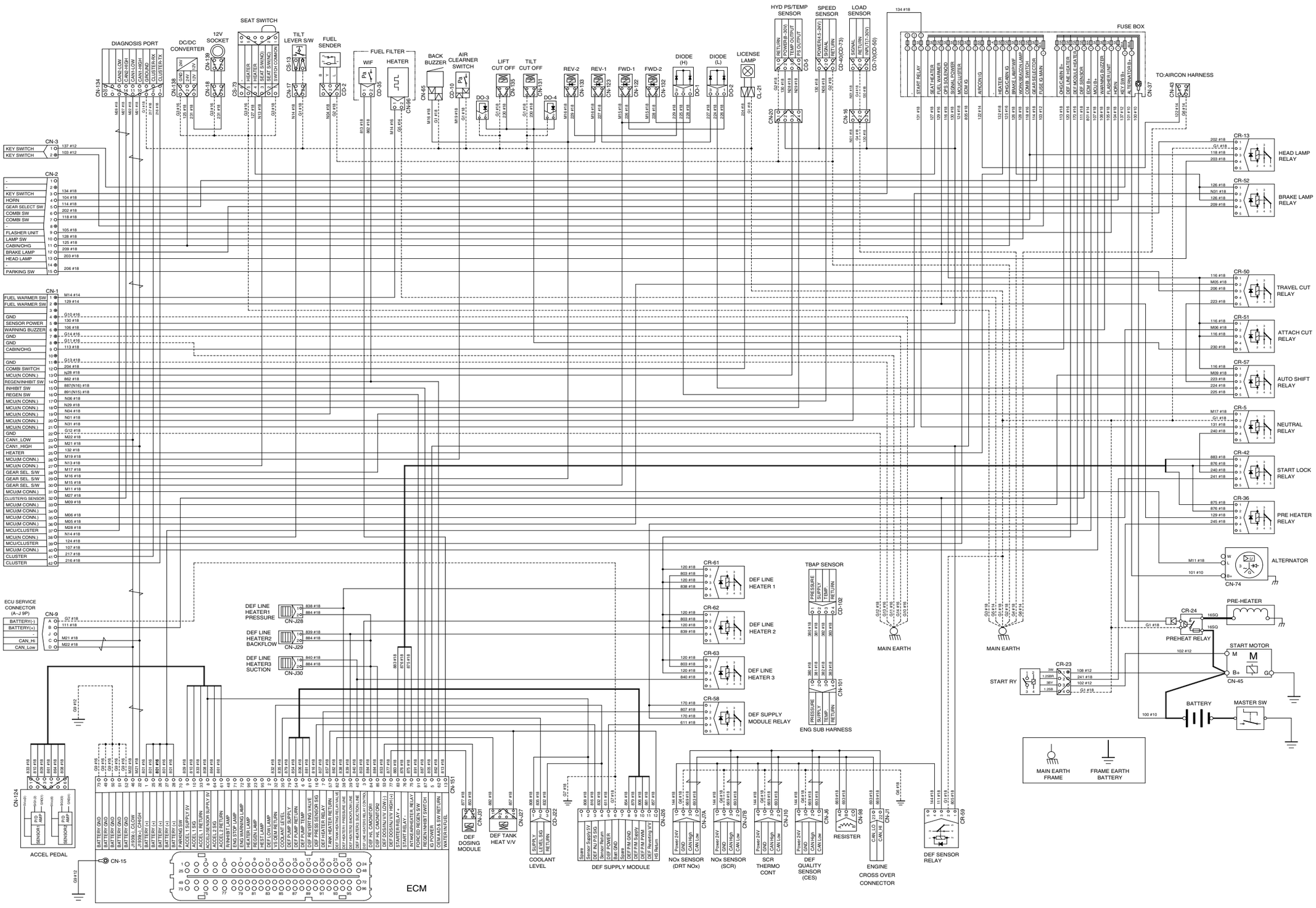
35D9EL01

1	Work lamp	10	Beacon lamp	17	Rear work lamp switch (opt)
2	Battery	11	Forward-reverse lever	18	Hazard lamp switch (opt)
3	Master switch	12	Cluster	19	Parking brake lever
4	Start relay	13	Head lamp switch	20	SCR cleaning switch
5	Fuel sender		Illumination lamp	21	Fuel warmer switch
6	Air heater relay		Turn signal switch	22	Beacon lamp switch (opt)
7	High horn	14	Horn button	23	Front wiper/washer switch (opt)
8	Back buzzer	15	Start switch	24	Heater switch
9	Combination lamp	16	Fuse box	25	Rear work lamp

· ELECTRICAL CIRCUIT (1/26, STD 1/2, 35D-9 : -#0043, 40D-9 : -#0010, 45D-9 : -#0134, 50DA-9 : -#0029)

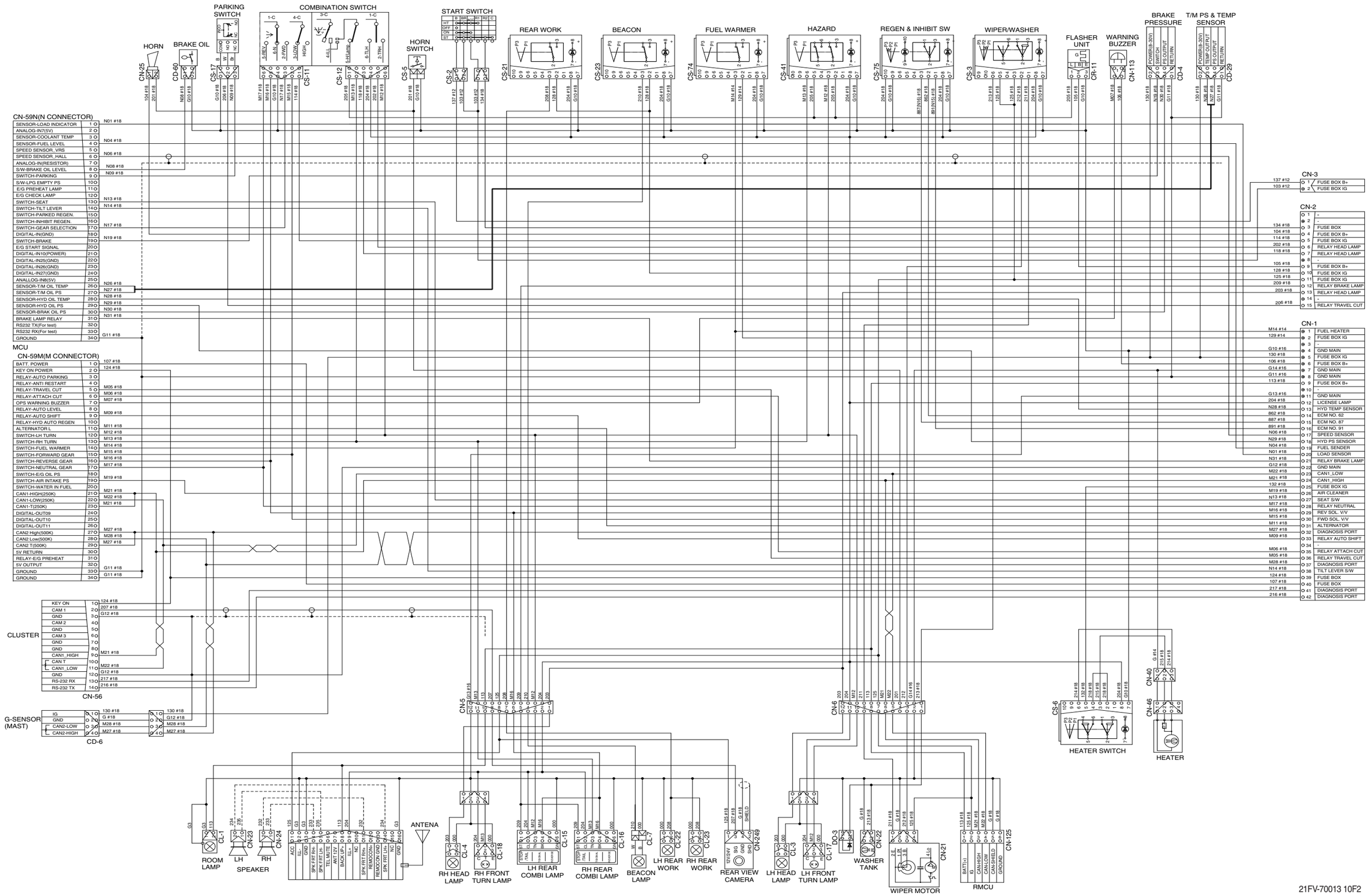


· ELECTRICAL CIRCUIT (2/26 , STD 2/2, 35D-9 : -#0043, 40D-9 : -#0010, 45D-9 : -#0134, 50DA-9 : -#0029)



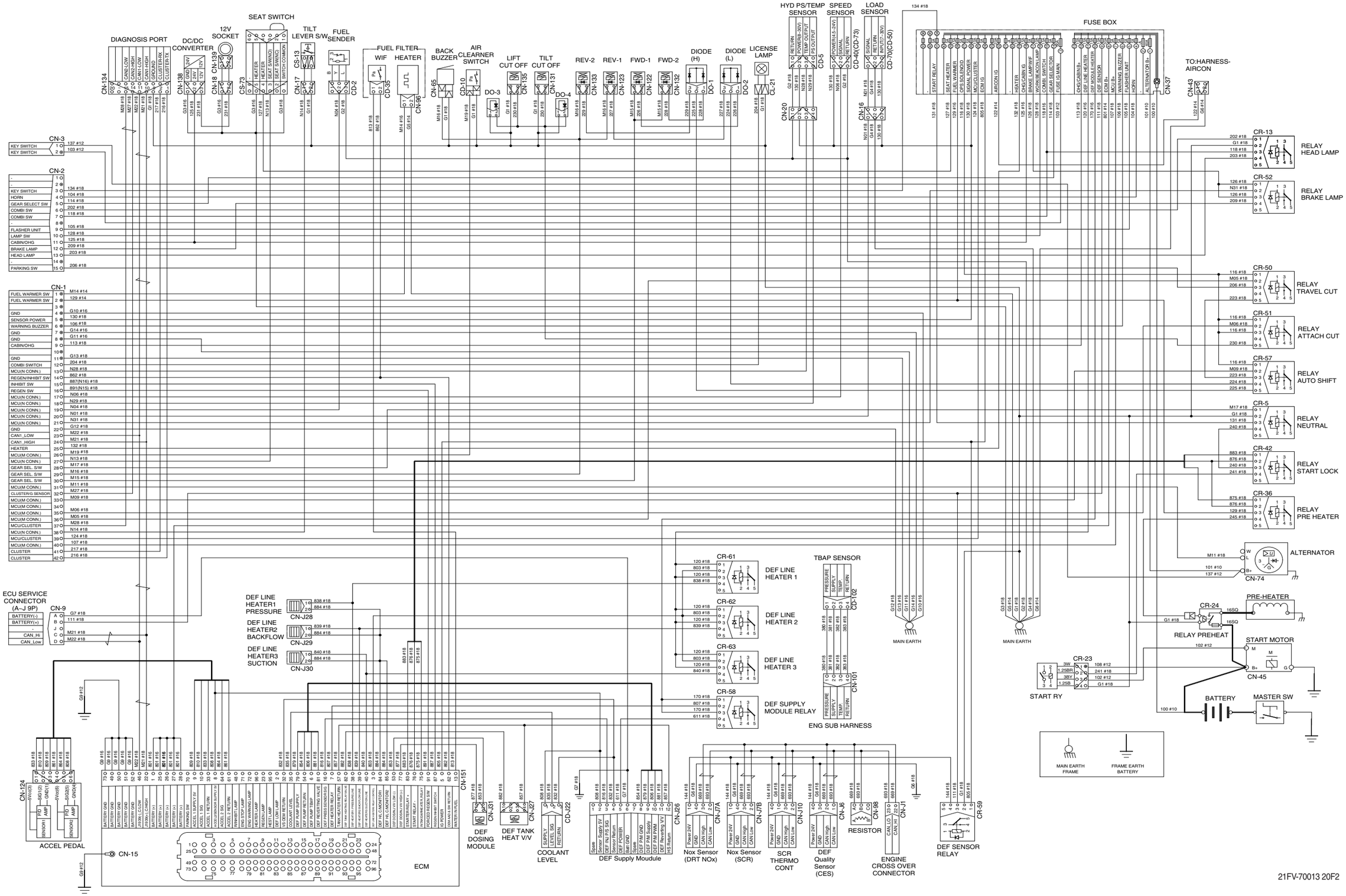
35D9EL03

· ELECTRICAL CIRCUIT (3/26 , STD 1/2, 35D-9 : #0044-#0082, 40D-9 : #0011-#0030, 45D-9 : #0135-#0269, 50DA-9 : #0030-#0073)

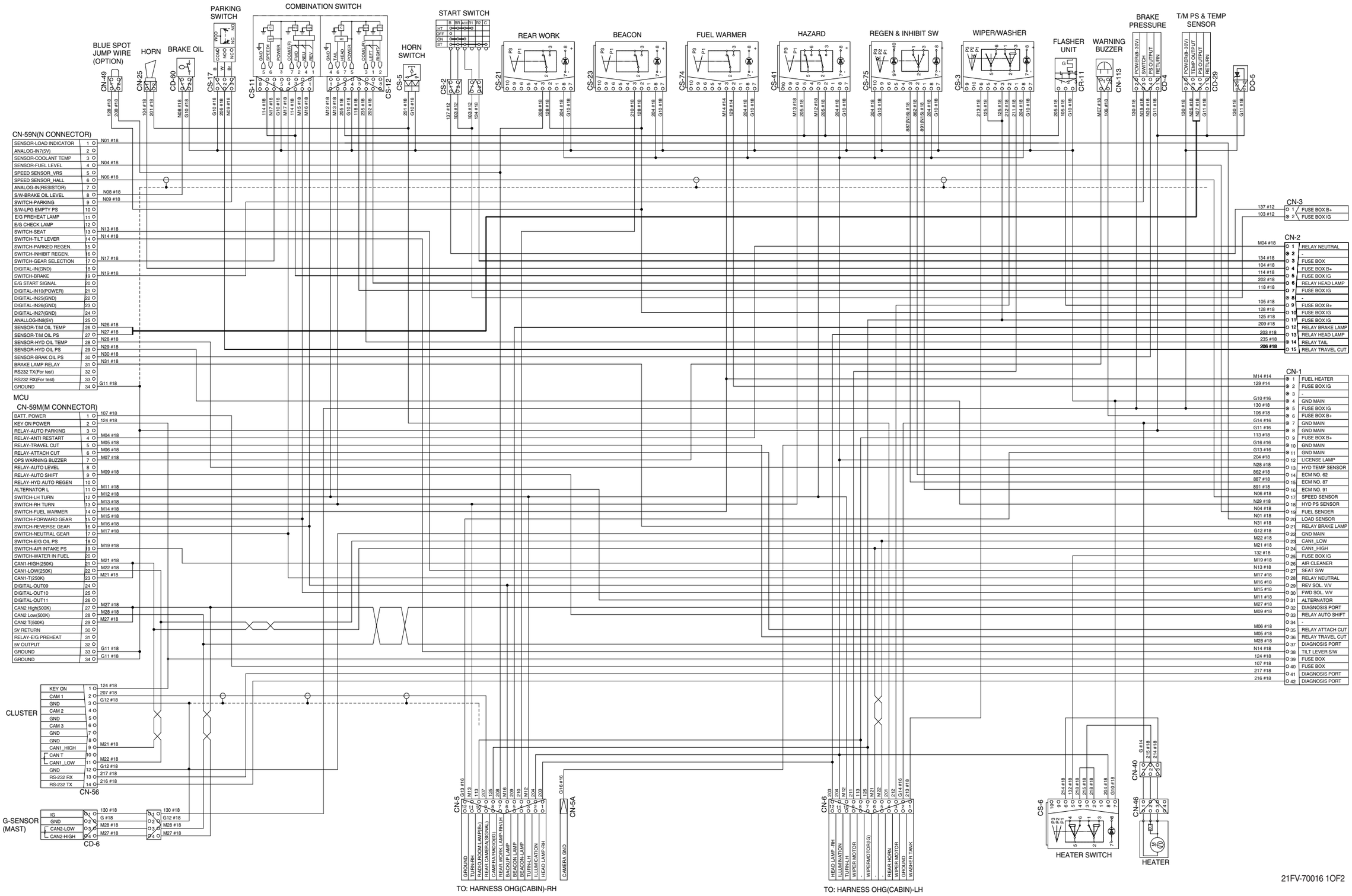


21FV-70013 10F2

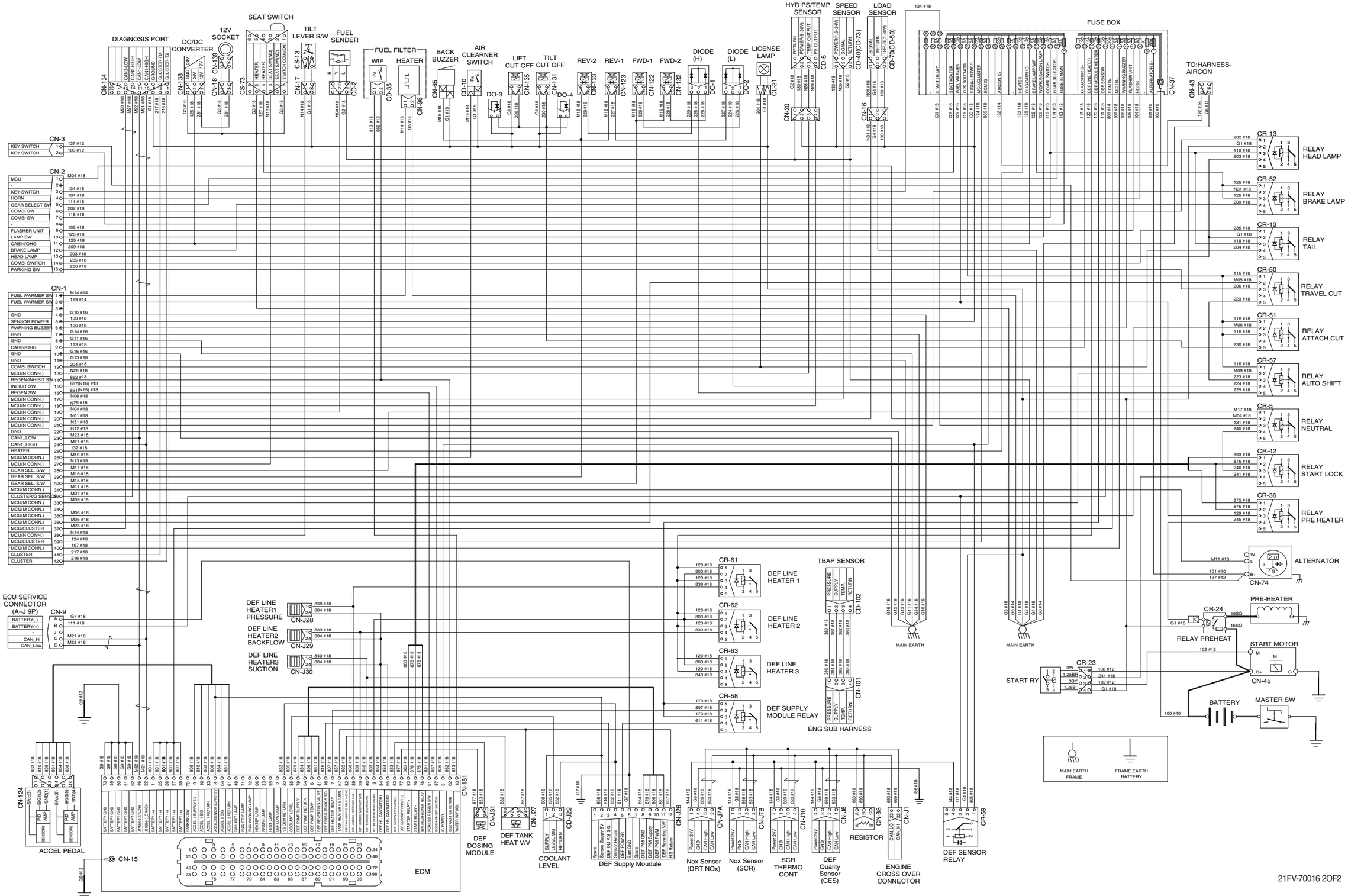
· ELECTRICAL CIRCUIT (4/26 , STD 2/2, 35D-9 : #0044-#0082, 40D-9 : #0011-#0030, 45D-9 : #0135-#0269, 50DA-9 : #0030-#0073)



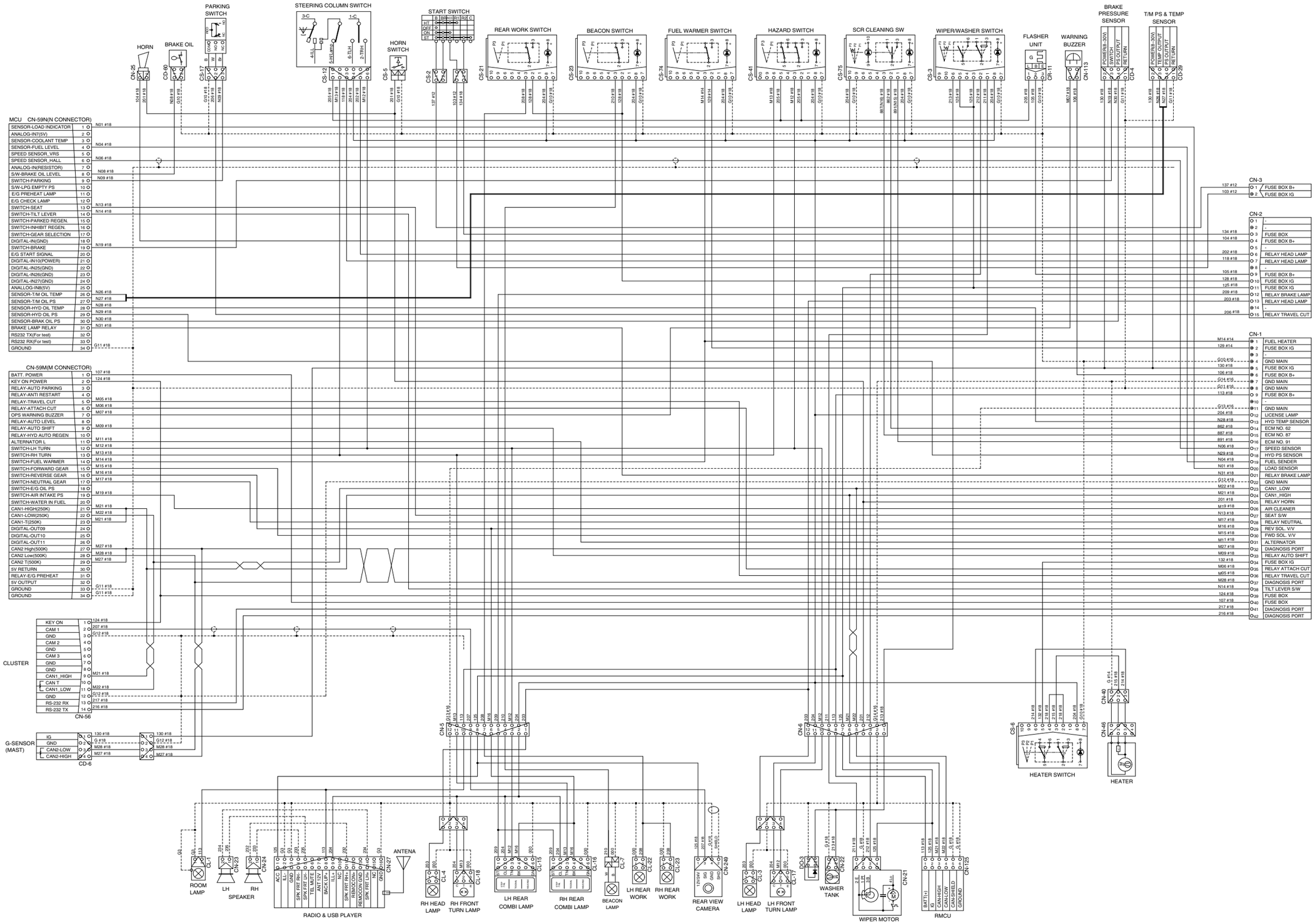
· ELECTRICAL CIRCUIT (5/26 , STD 1/2, 35D-9 : #0083-#0403, 40D-9 : #0031-#0238, 45D-9 : #0270-#1456, 50DA-9 : #0074-#1031)



· ELECTRICAL CIRCUIT (6/26 , STD 2/2, 35D-9 : #0083-#0403, 40D-9 : #0031-#0238, 45D-9 : #0270-#1456, 50DA-9 : #0074-#1031)

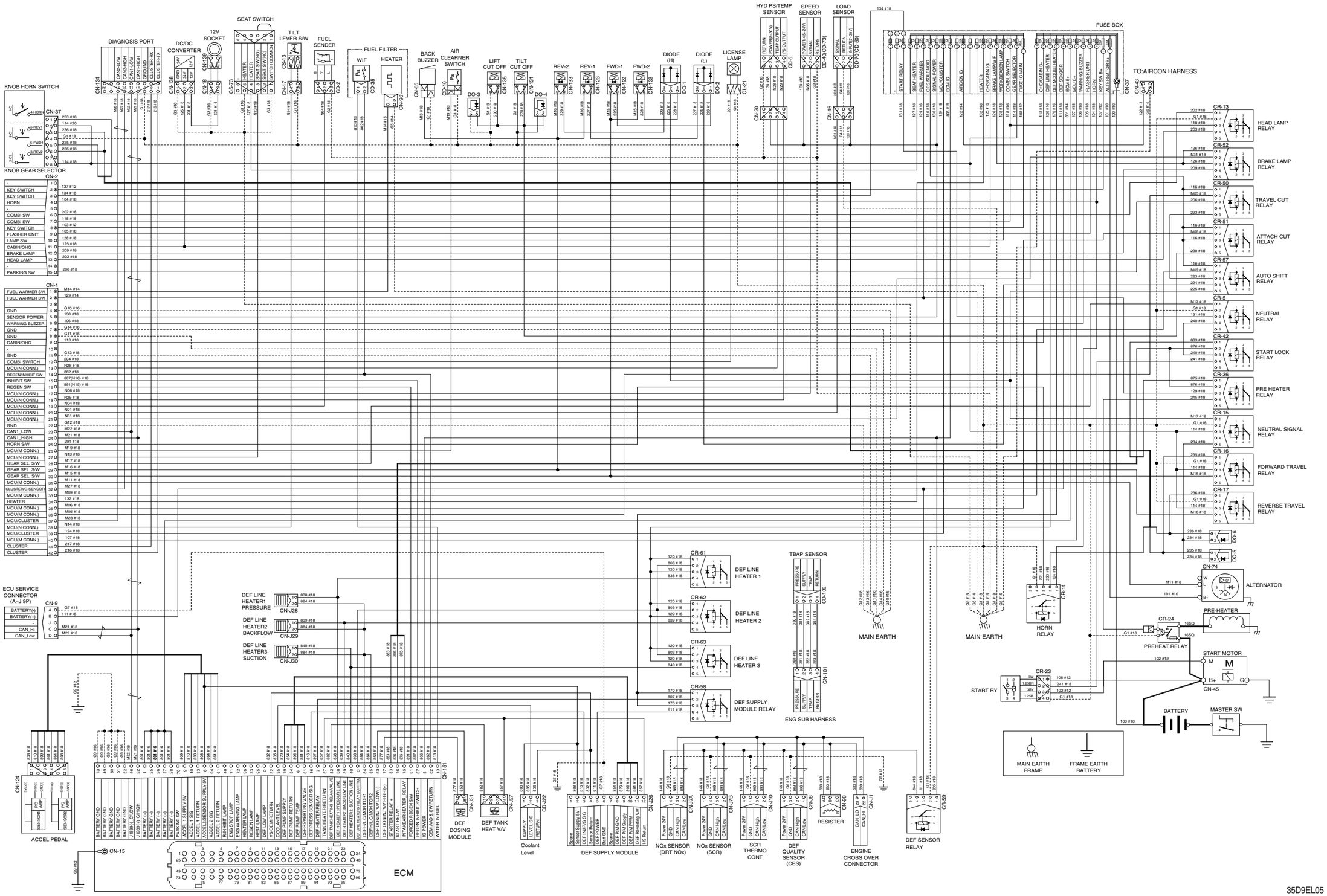


· ELECTRICAL CIRCUIT (7/26 , KNOB FNR 1/2, 35D-9 : -#0226, 40D-9 : -#0071, 45D-9 : -#0833, 50DA-9 : -#0252)



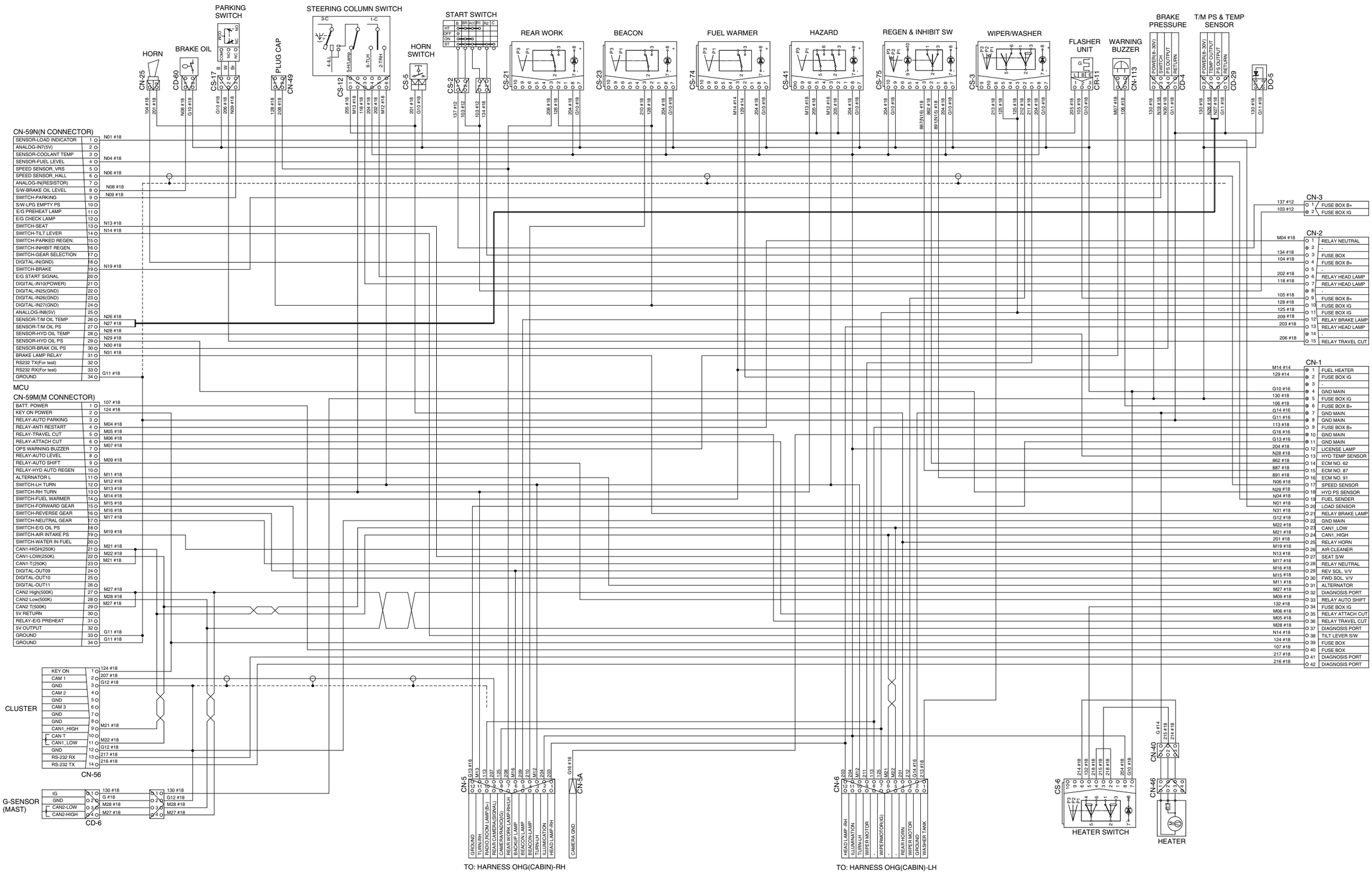
35D9EL04

· ELECTRICAL CIRCUIT (8/26 , KNOB FNR 2/2, 35D-9 : -#0226, 40D-9 : -#0071, 45D-9 : -#0833, 50DA-9 : -#0252)



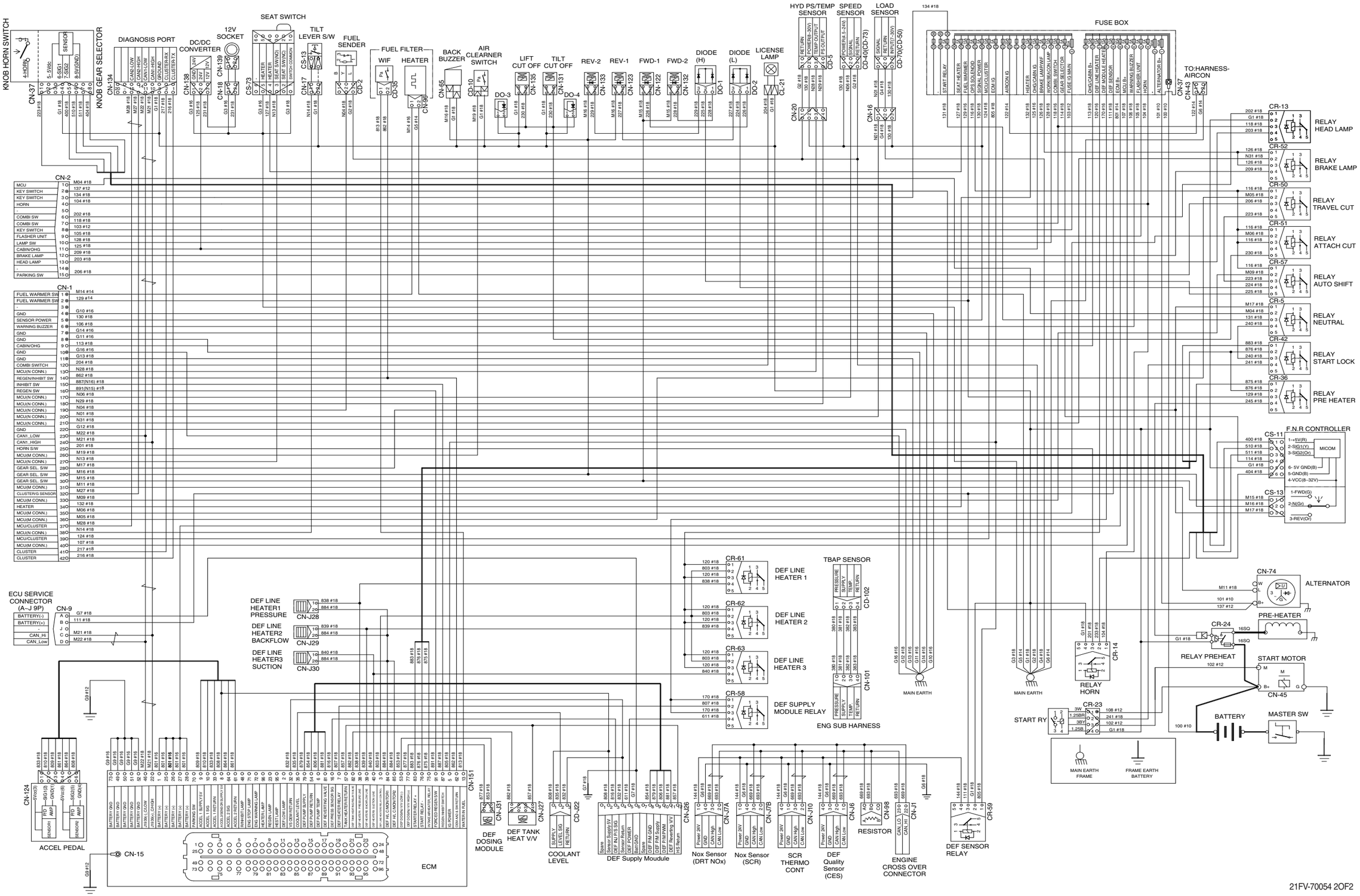
35D9EL05

· ELECTRICAL CIRCUIT (9/26 , KNOB FNR 1/2, 35D-9 : #0227-#0403, 40D-9 : #0072-#0238, 45D-9 : #0834-#1456, 50DA-9 : #0253-#1031)

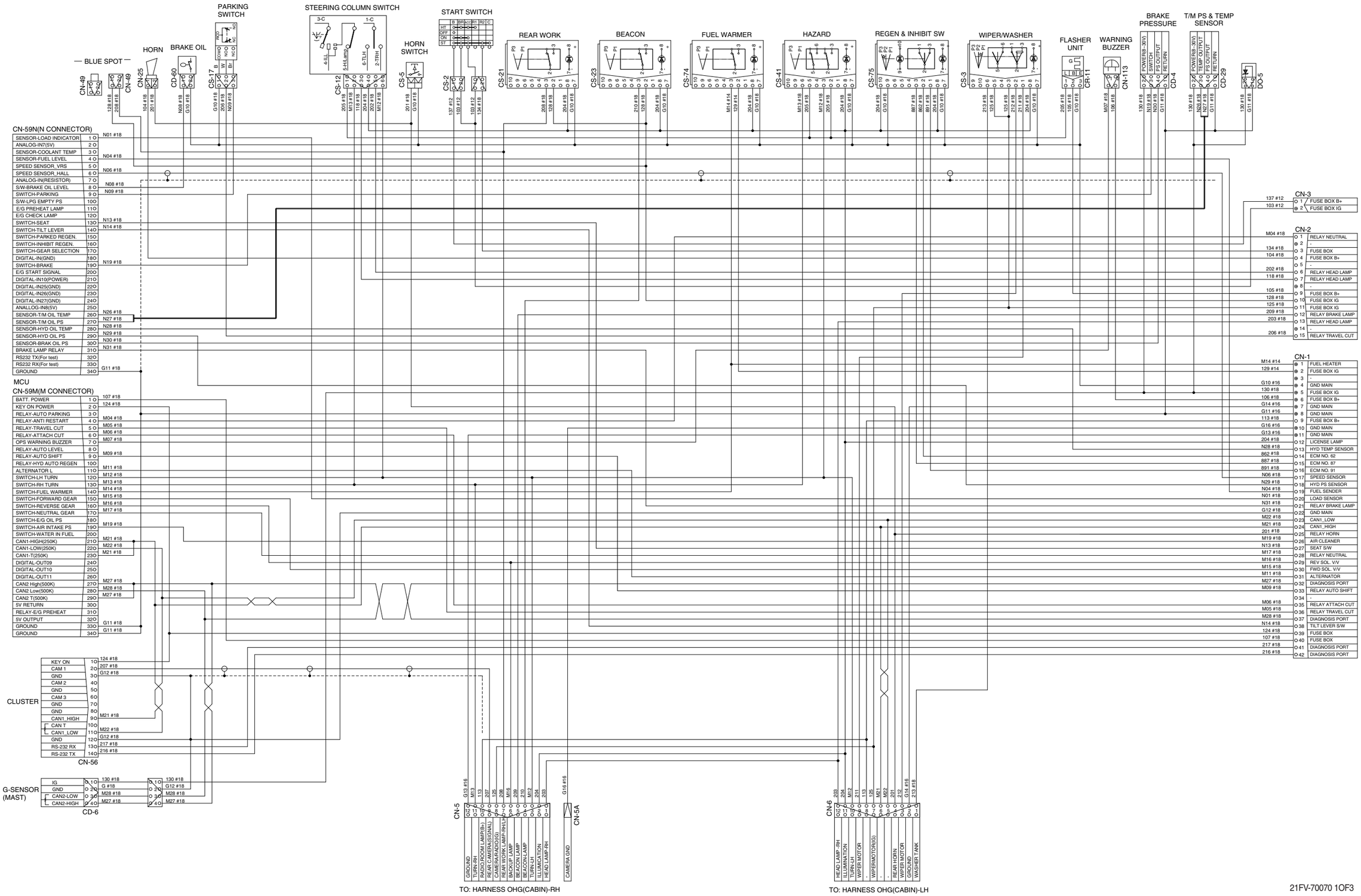


21FV-70054 1OF2

· ELECTRICAL CIRCUIT (10/26 , KNOB FNR 2/2, 35D-9 : #0227-#0403, 40D-9 : #0072-#0238, 45D-9 : #0834-#1456, 50DA-9 : #0253-#1031)

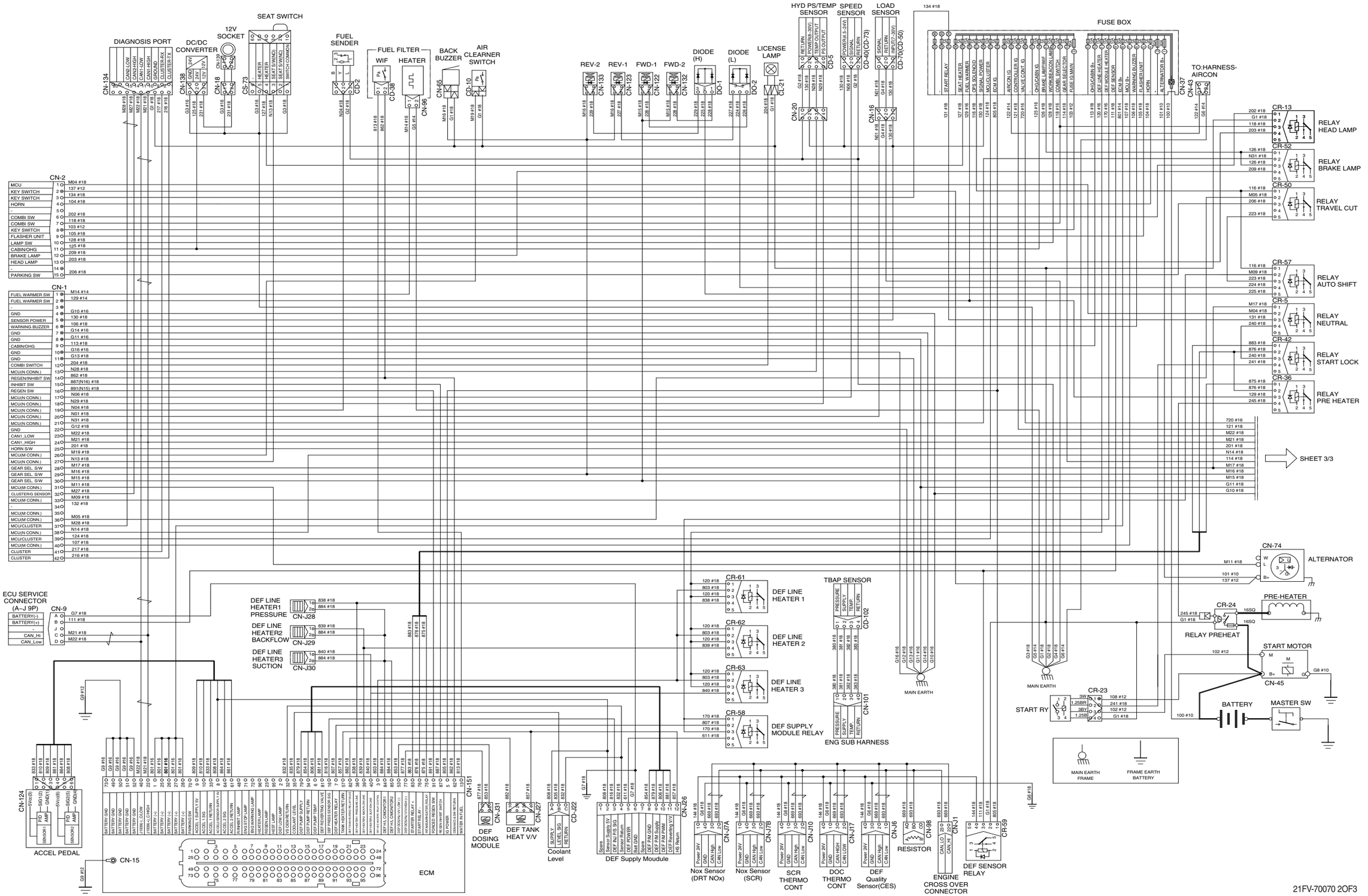


· ELECTRICAL CIRCUIT (11/26 , FINGERTIP 1/3, 35D-9 : #0187-#0403, 40D-9 : #0063-#0238, 45D-9 : #0657-#1456, 50DA-9 : #0175-#1031)

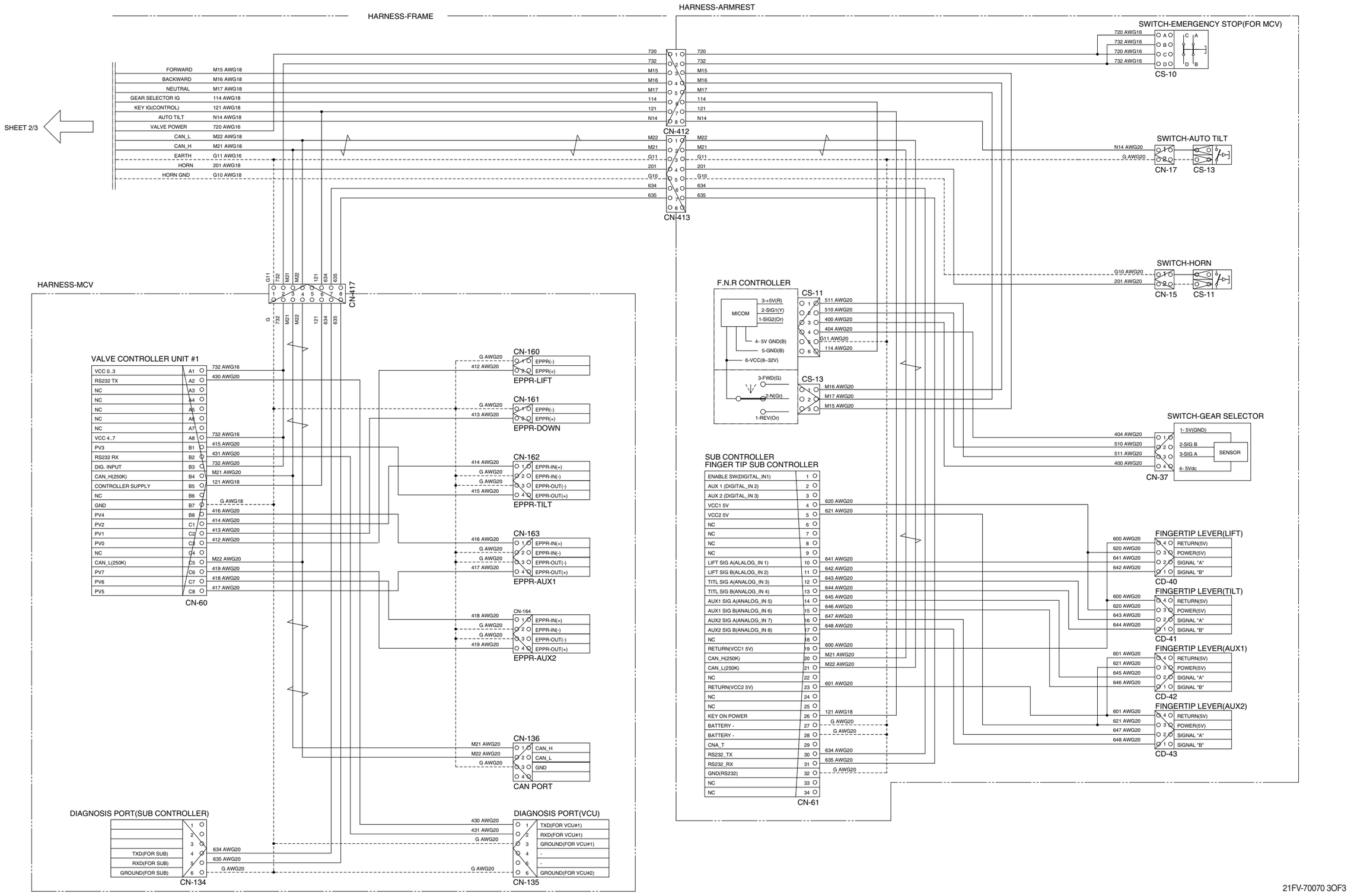


21FV-70070 1OF3

· ELECTRICAL CIRCUIT (12/26 , FINGERTIP 2/3, 35D-9 : #0187-#0403, 40D-9 : #0063-#0238, 45D-9 : #0657-#1456, 50DA-9 : #0175-#1031)

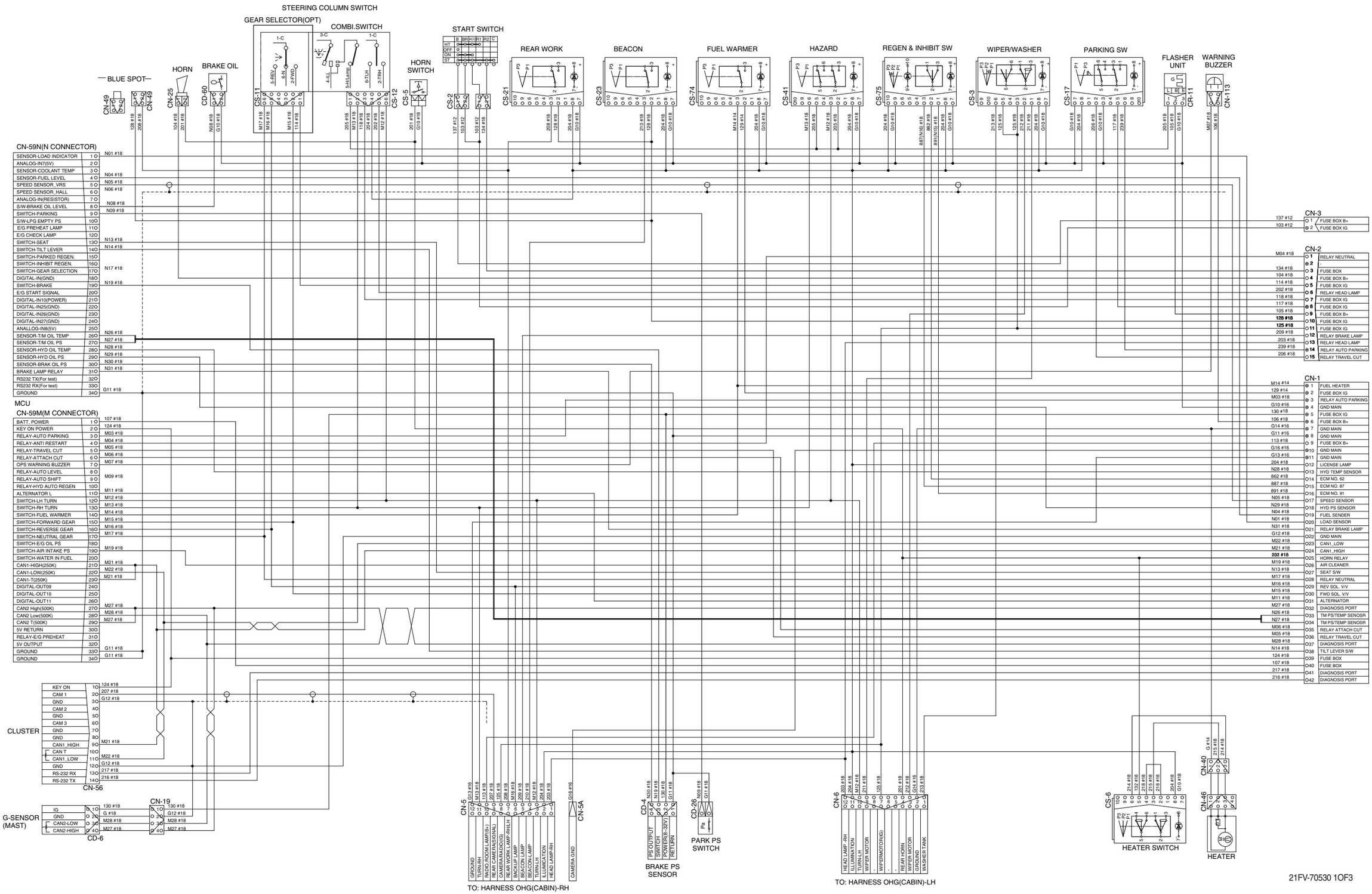


· ELECTRICAL CIRCUIT (13/26 , FINGERTIP 3/3, 35D-9 : #0187-#0403, 40D-9 : #0063-#0238, 45D-9 : #0657-#1456, 50DA-9 : #0175-#1031)

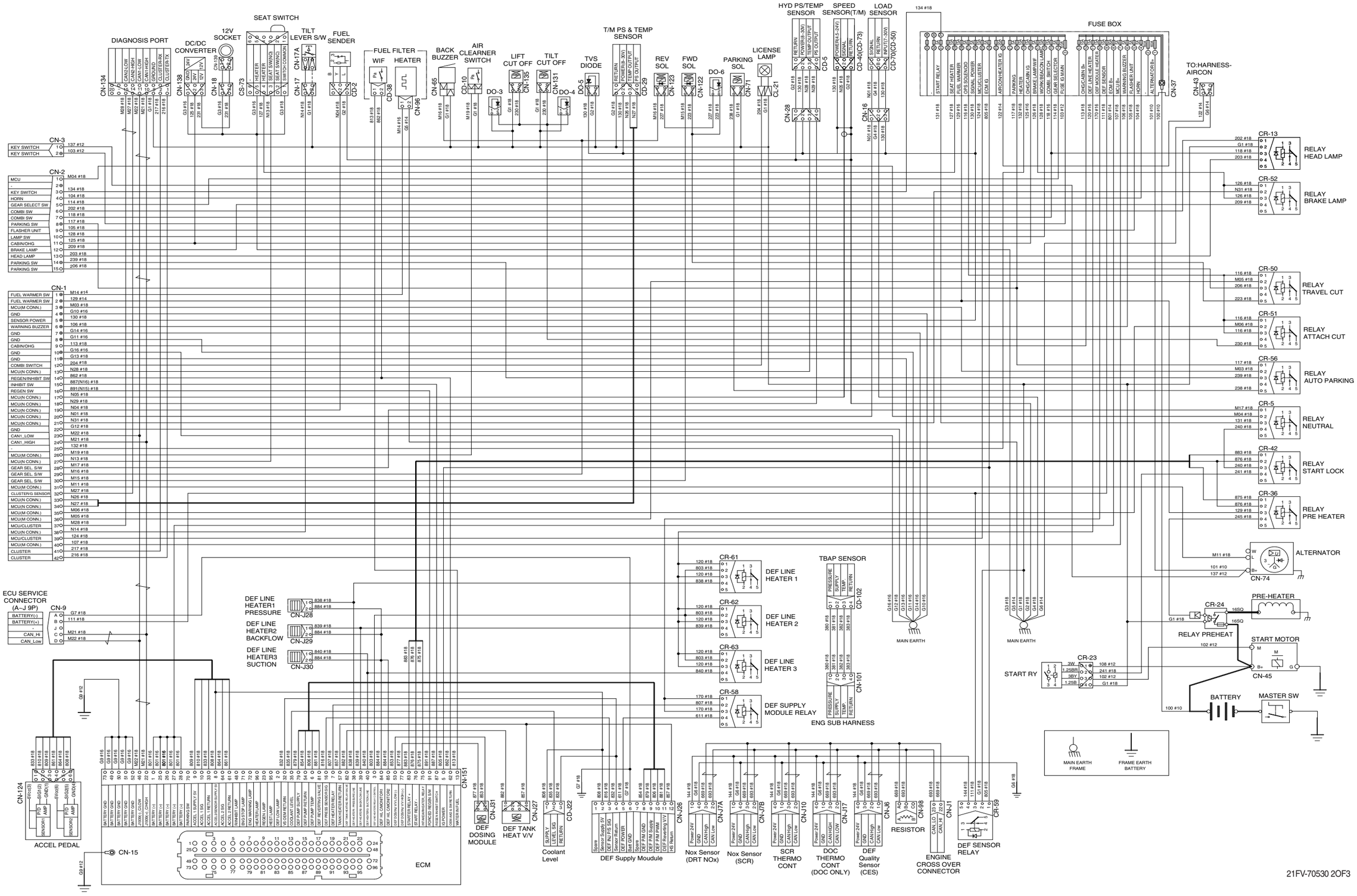


21FV-70070 3OF3

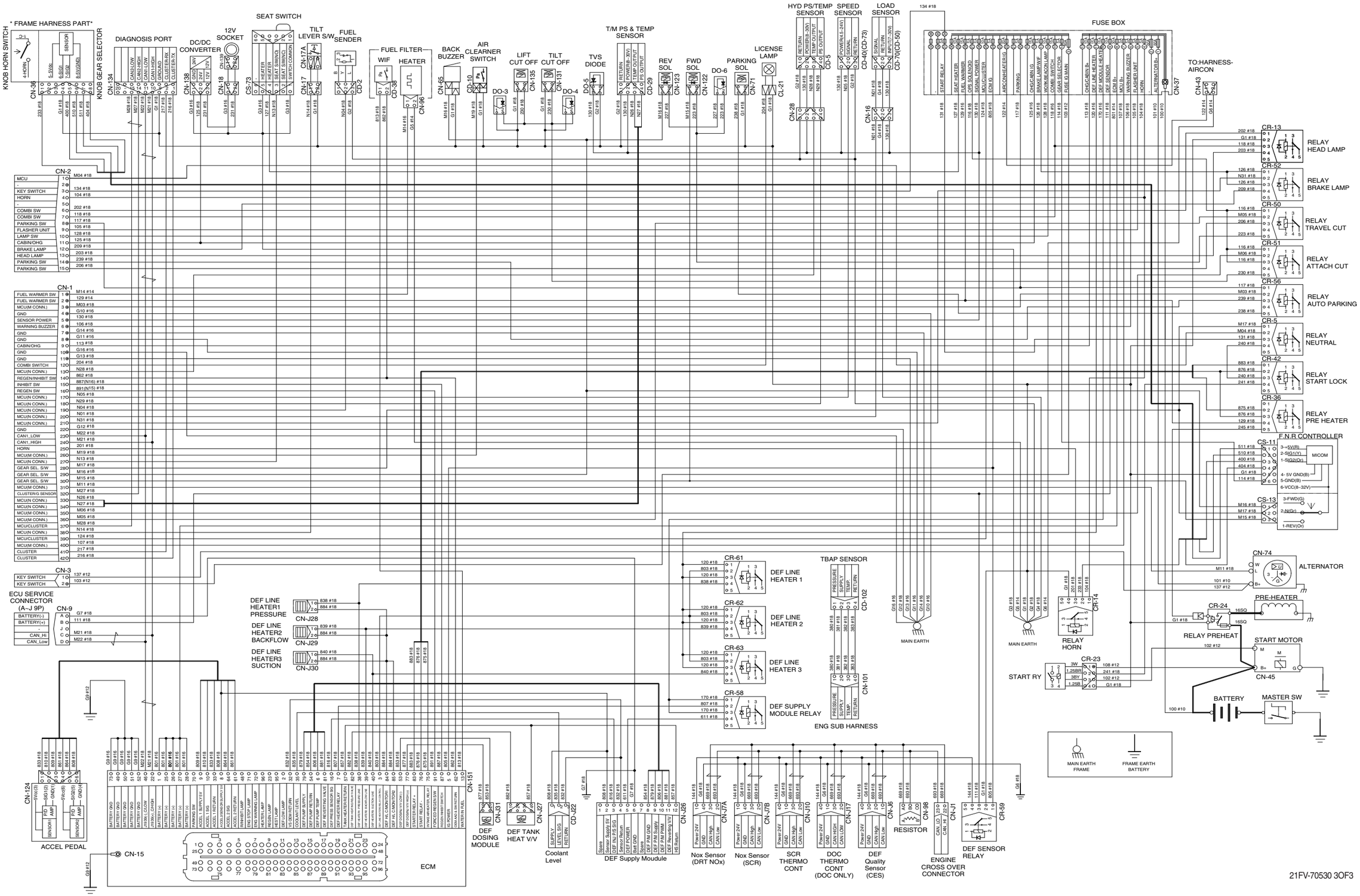
· ELECTRICAL CIRCUIT (14/26 , TNA AXLE 1/3, 35D-9 : #0227-#0403, 40D-9 : #0072-#0238, 45D-9 : #0834-#1456, 50DA-9 : #0253-#1031)



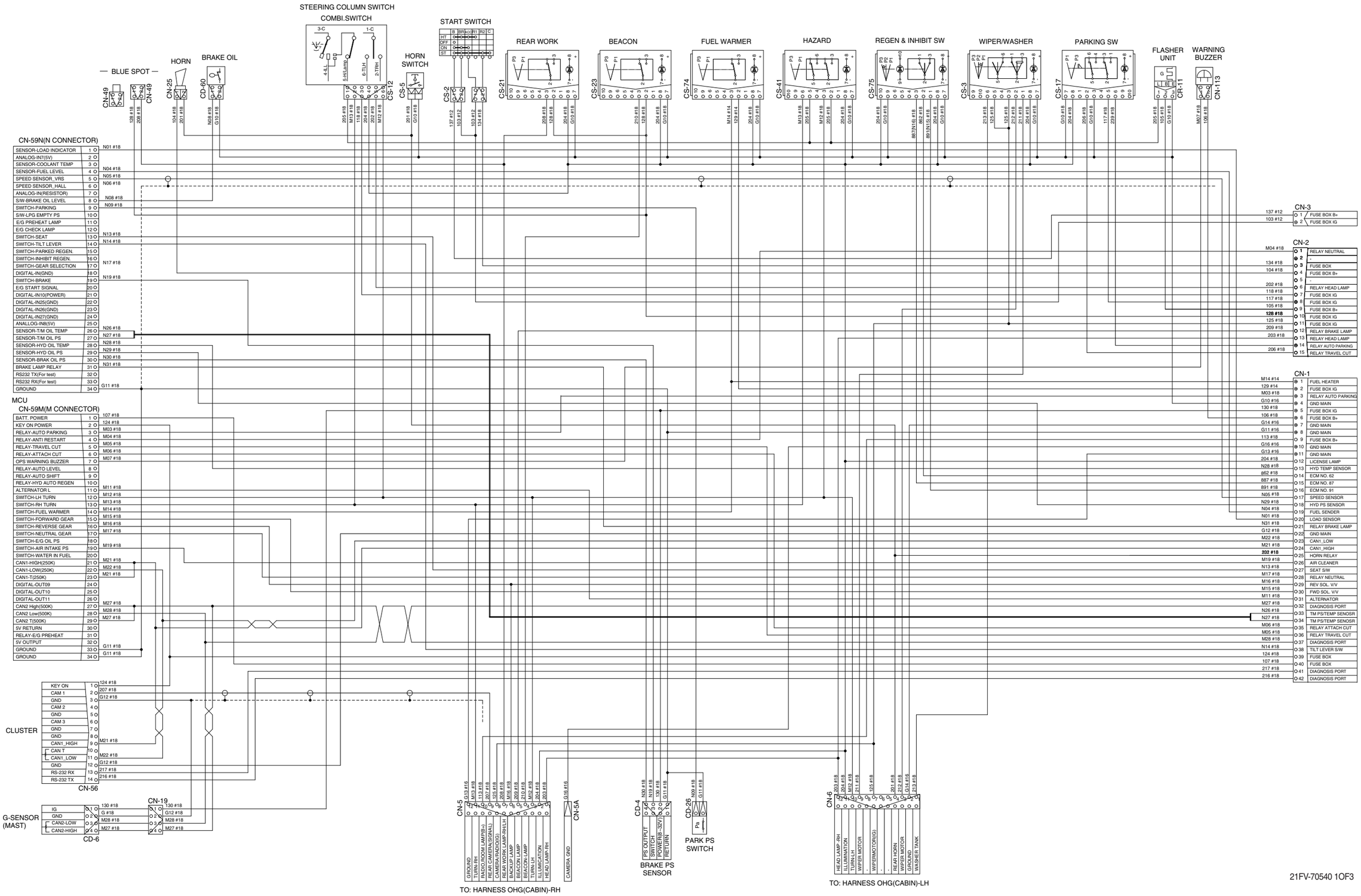
· ELECTRICAL CIRCUIT (15/26 , TNA AXLE 2/3, 35D-9 : #0227-#0403, 40D-9 : #0072-#0238, 45D-9 : #0834-#1456, 50DA-9 : #0253-#1031)



· ELECTRICAL CIRCUIT (16/26 , TNA AXLE 3/3, KNOB FNR, 35D-9 : #0227-#0403, 40D-9 : #0072-#0238, 45D-9 : #0834-#1456, 50DA-9 : #0253-#1031)

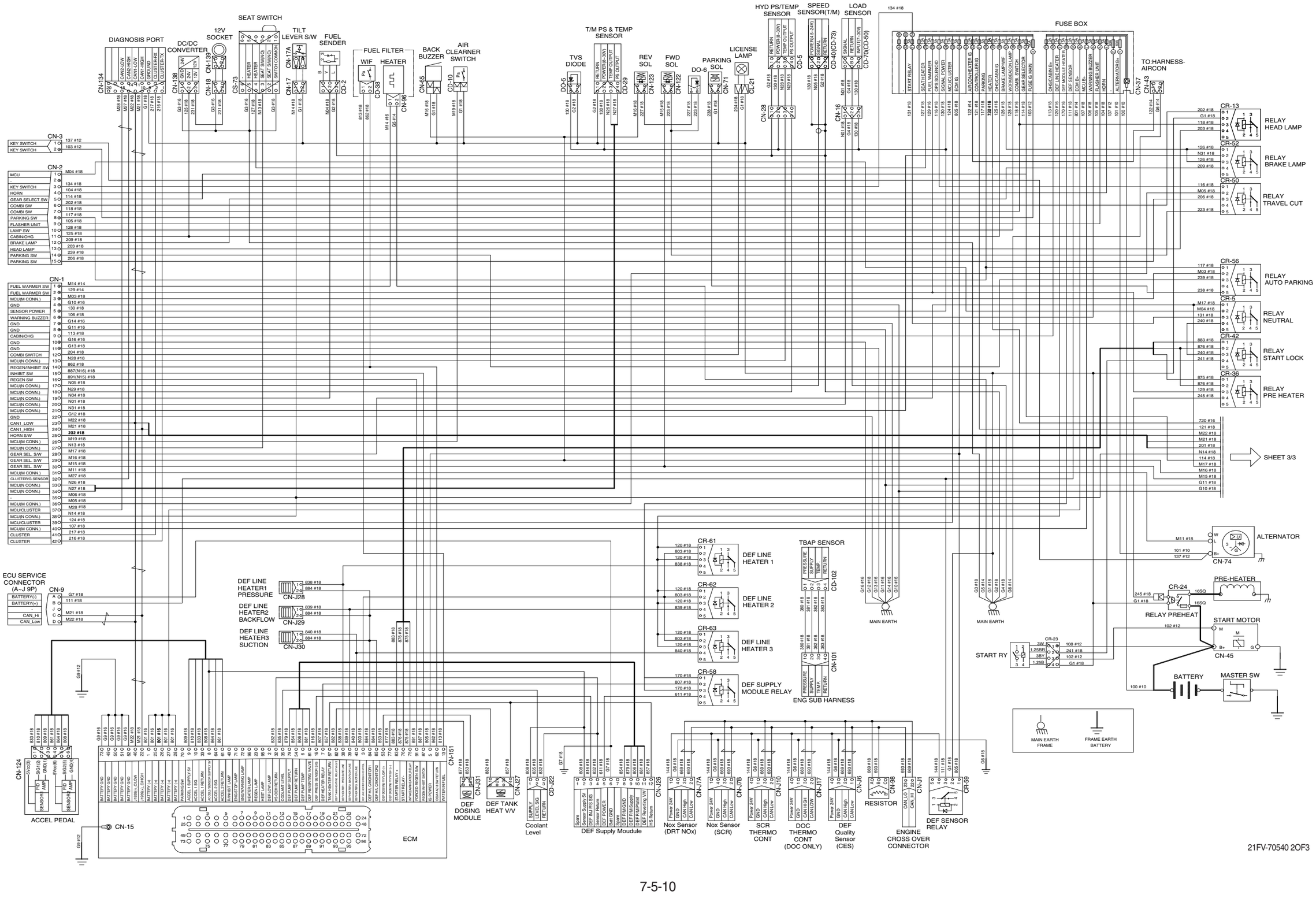


· ELECTRICAL CIRCUIT (17/26 , TNA AXLE, FINGERTIP 1/3, 35D-9 : #0251-#0403, 40D-9 : #0097-#0238, 45D-9 : #0950-#1456, 50DA-9 : #0315-#1031)



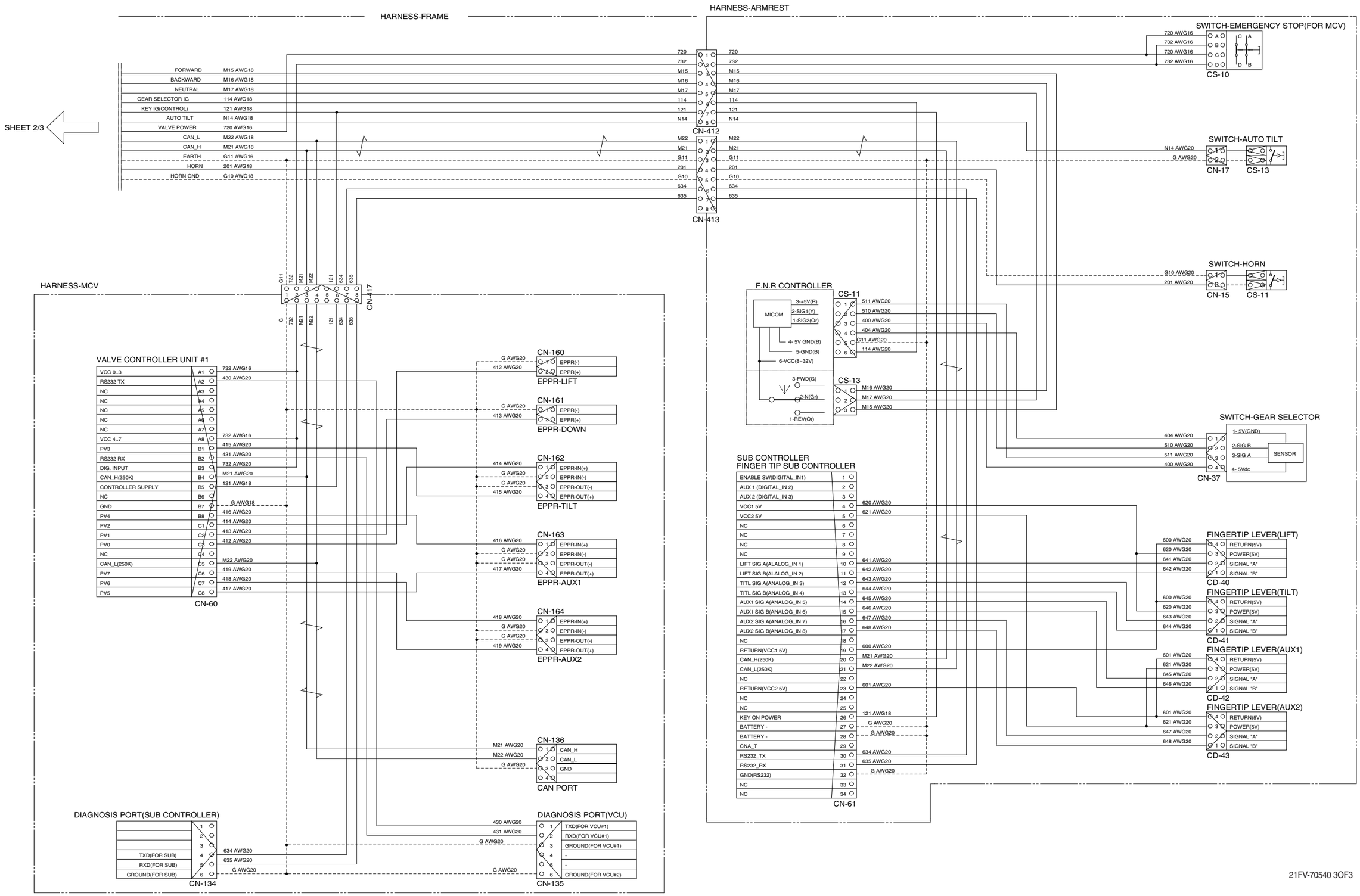
21FV-70540 1OF3

· ELECTRICAL CIRCUIT (18/26 , TNA AXLE, FINGERTIP 2/3, 35D-9 : #0251-#0403, 40D-9 : #0097-#0238, 45D-9 : #0950-#1456, 50DA-9 : #0315-#1031)

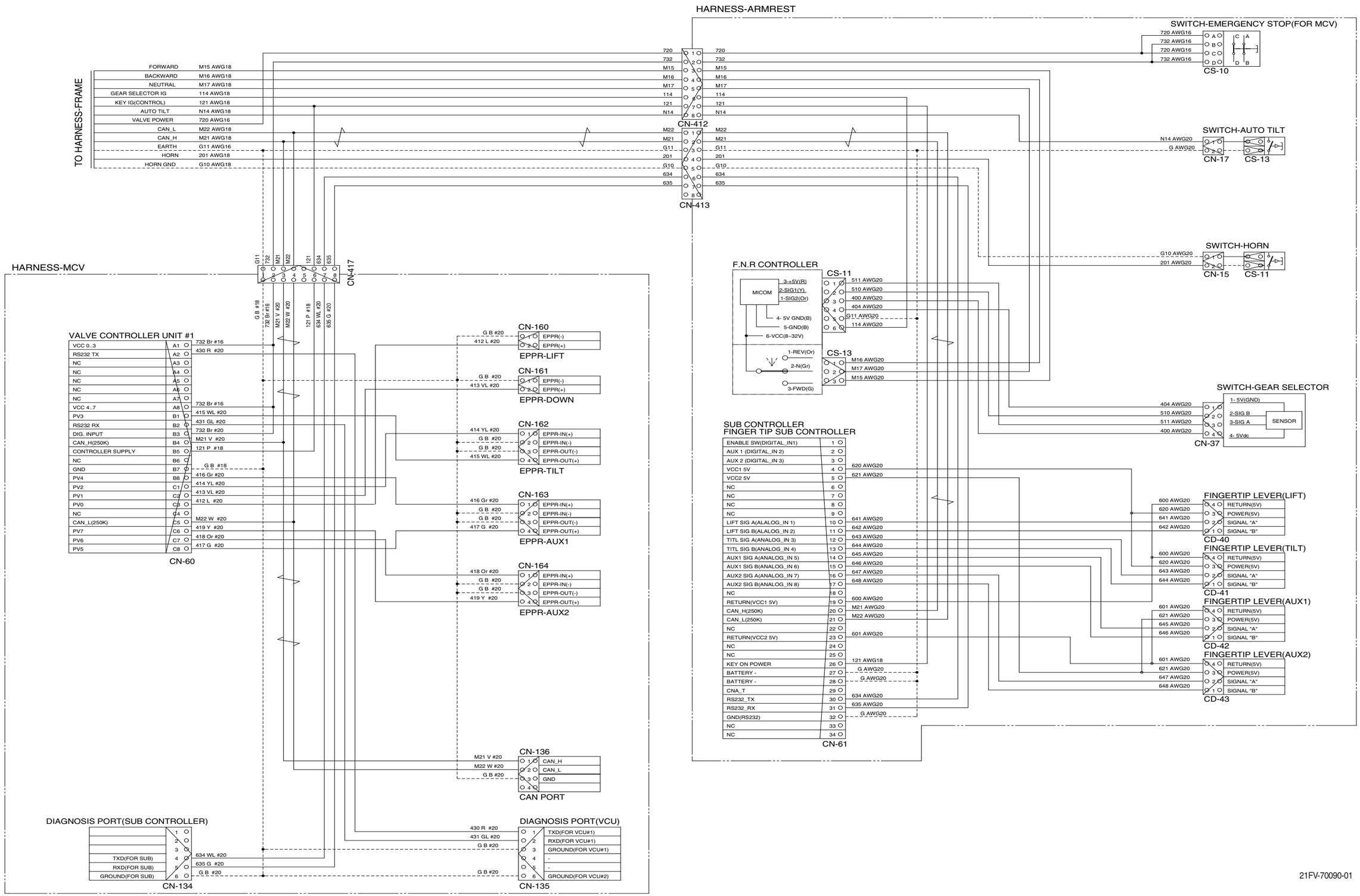


21FV-70540 2OF3

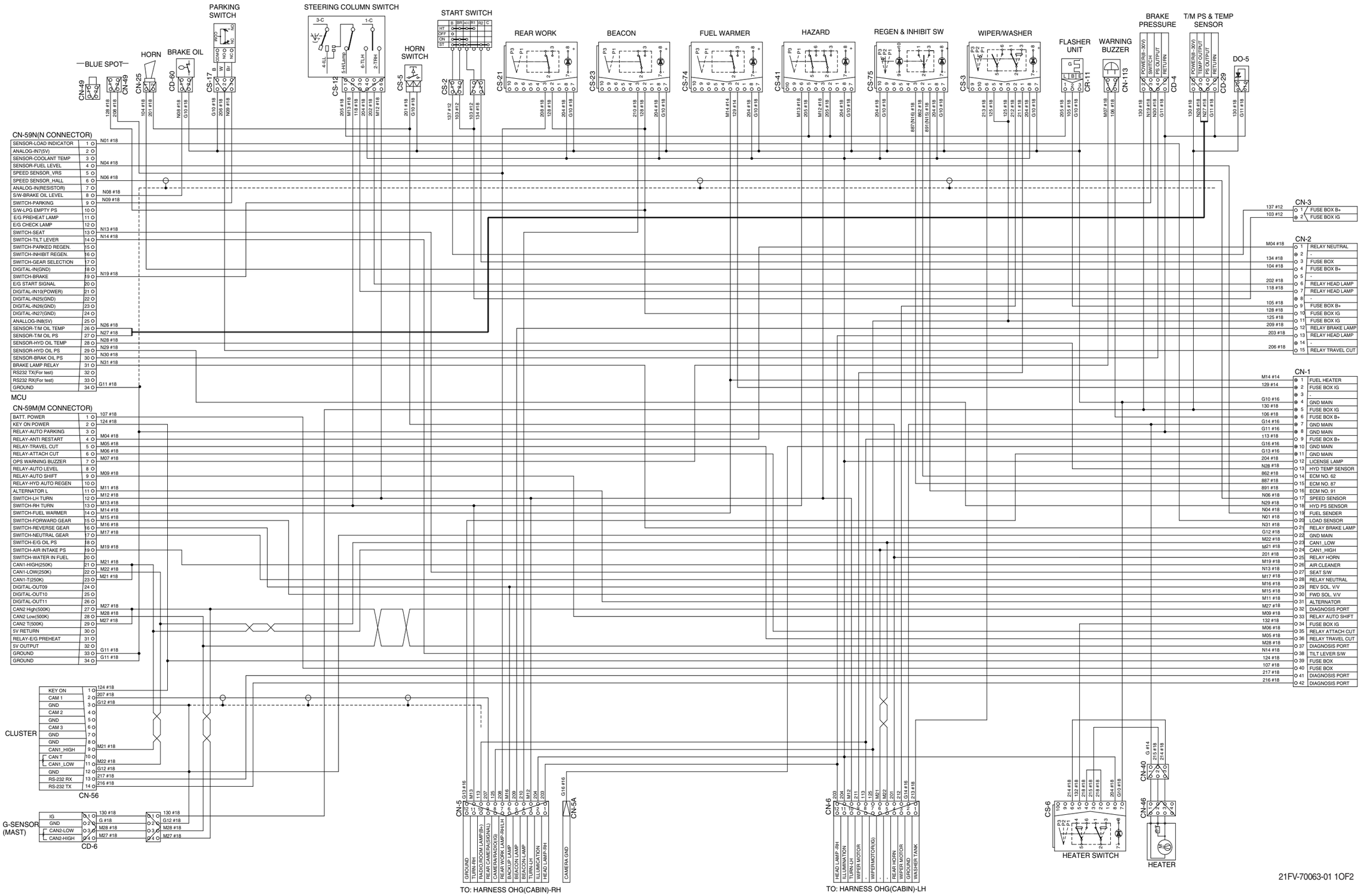
· ELECTRICAL CIRCUIT (19/26 , TNA AXLE, FINGERTIP 3/3, 35D-9 : #0251-#0403, 40D-9 : #0097-#0238, 45D-9 : #0950-#1456, 50DA-9 : #0315-#1031)



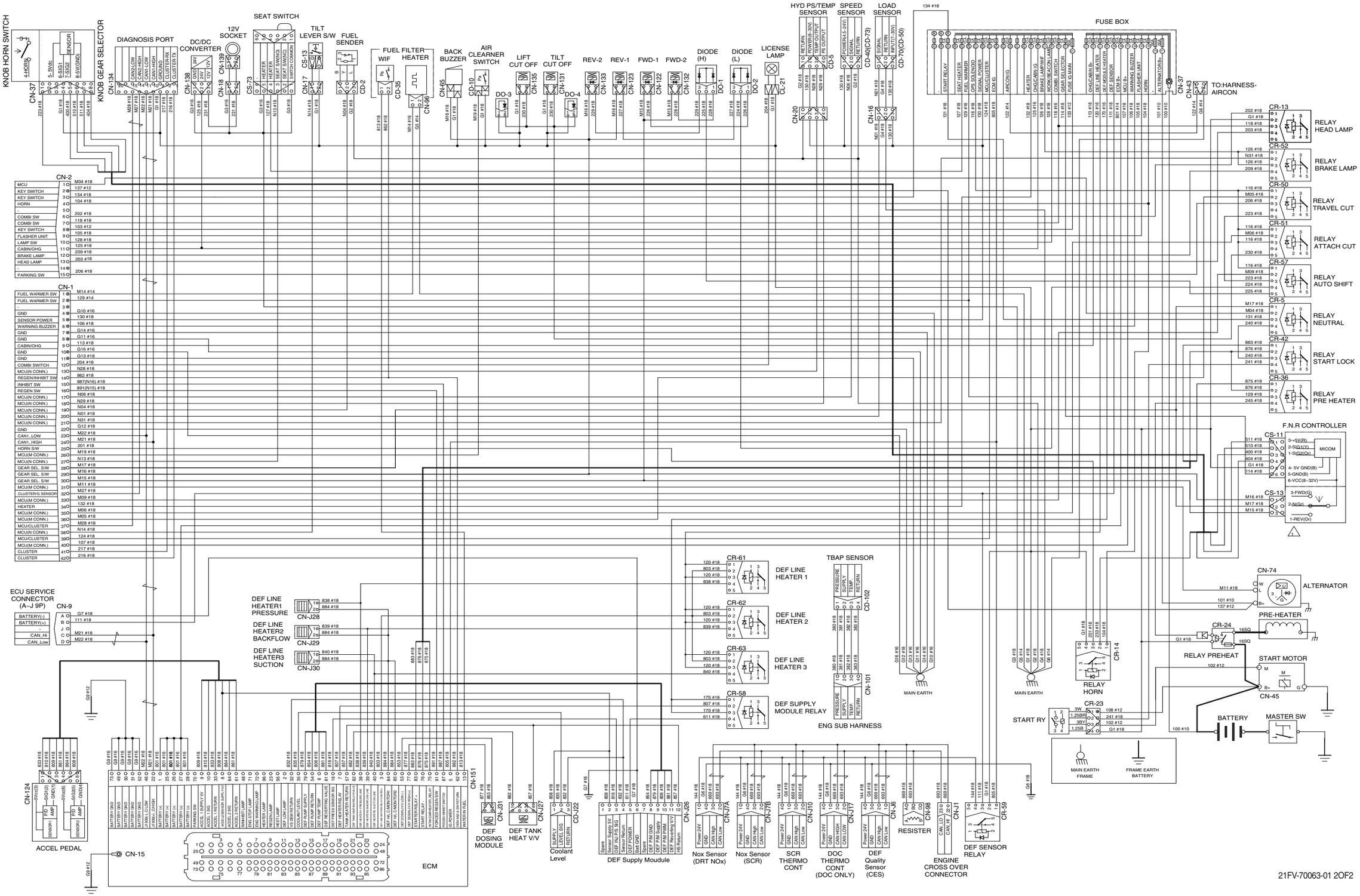
· ELECTRICAL CIRCUIT (20/26 , FINGERTIP, 35D-9 : -#0403, 40D-9 : -#0238, 45D-9 : -#1456, 50DA-9 : -#1031)



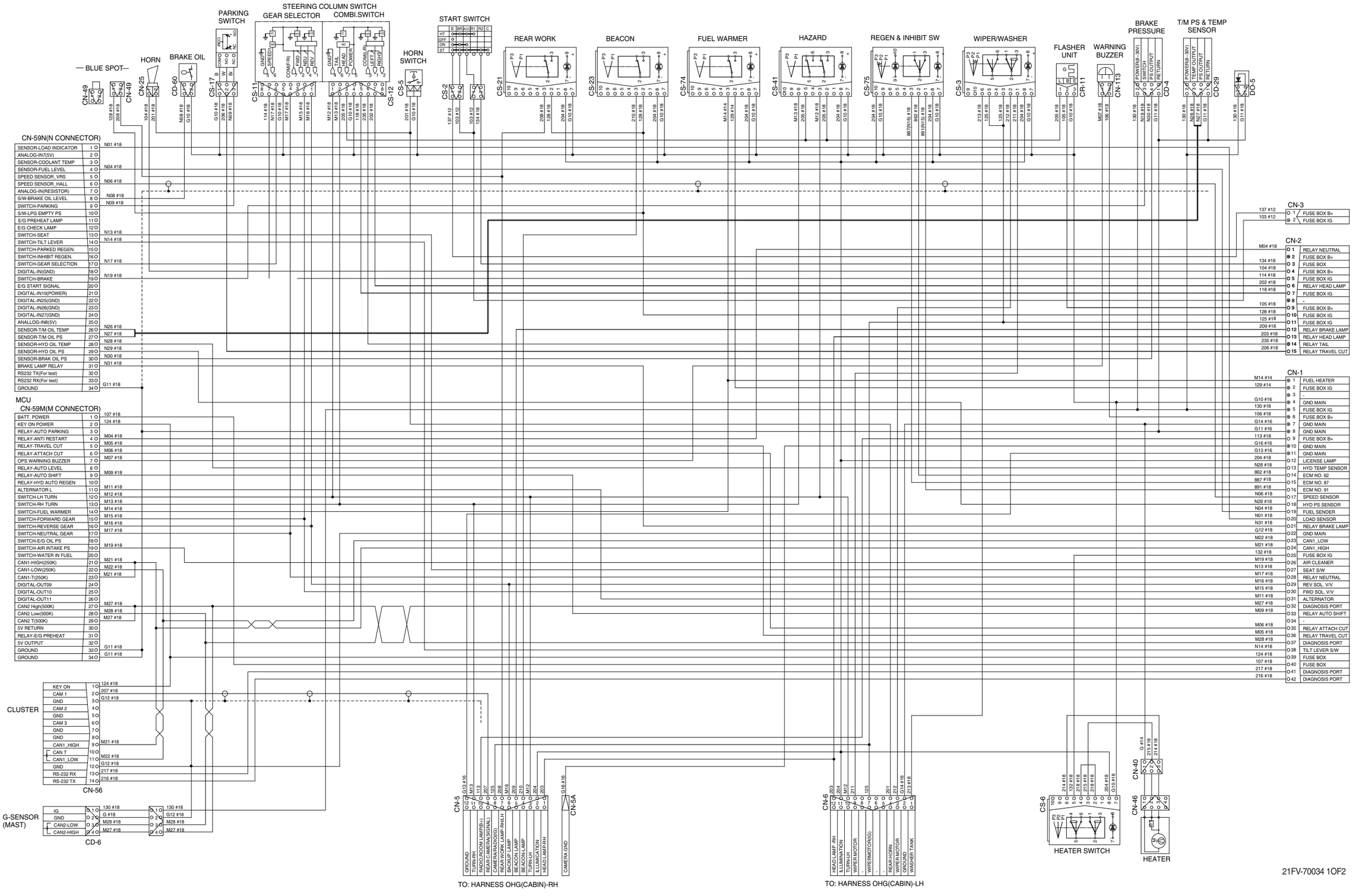
· ELECTRICAL CIRCUIT (21/26 , KNOB FNR 1/2, 35D-9 : #0083-#0403, 40D-9 : #0031-#0238, 45D-9 : #0270-#1456, 50DA-9 : #0074-#1031)



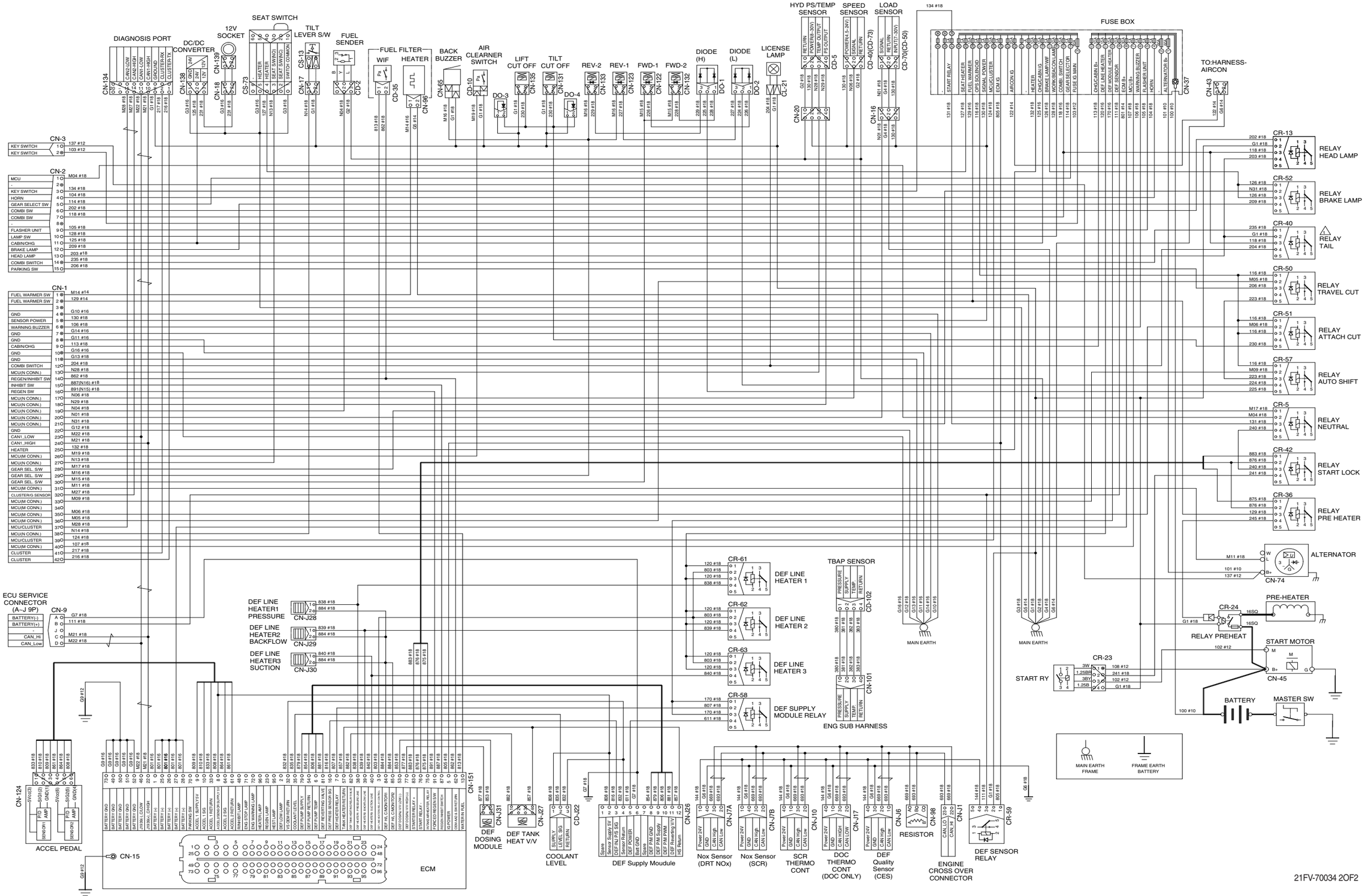
· ELECTRICAL CIRCUIT (22/26 , KNOB FNR 2/2, 35D-9 : #0083-#0403, 40D-9 : #0031-#0238, 45D-9 : #0270-#1456, 50DA-9 : #0074-#1031)



· ELECTRICAL CIRCUIT (23/26 , DOC 1/2, 35D-9 : #0107-#0403, 40D-9 : #0048-#0238, 45D-9 : #0442-#1456, 50DA-9 : #0122-#1031)



· ELECTRICAL CIRCUIT (24/26 , DOC 2/2, 35D-9 : #0107-#0403, 40D-9 : #0048-#0238, 45D-9 : #0442-#1456, 50DA-9 : #0122-#1031)



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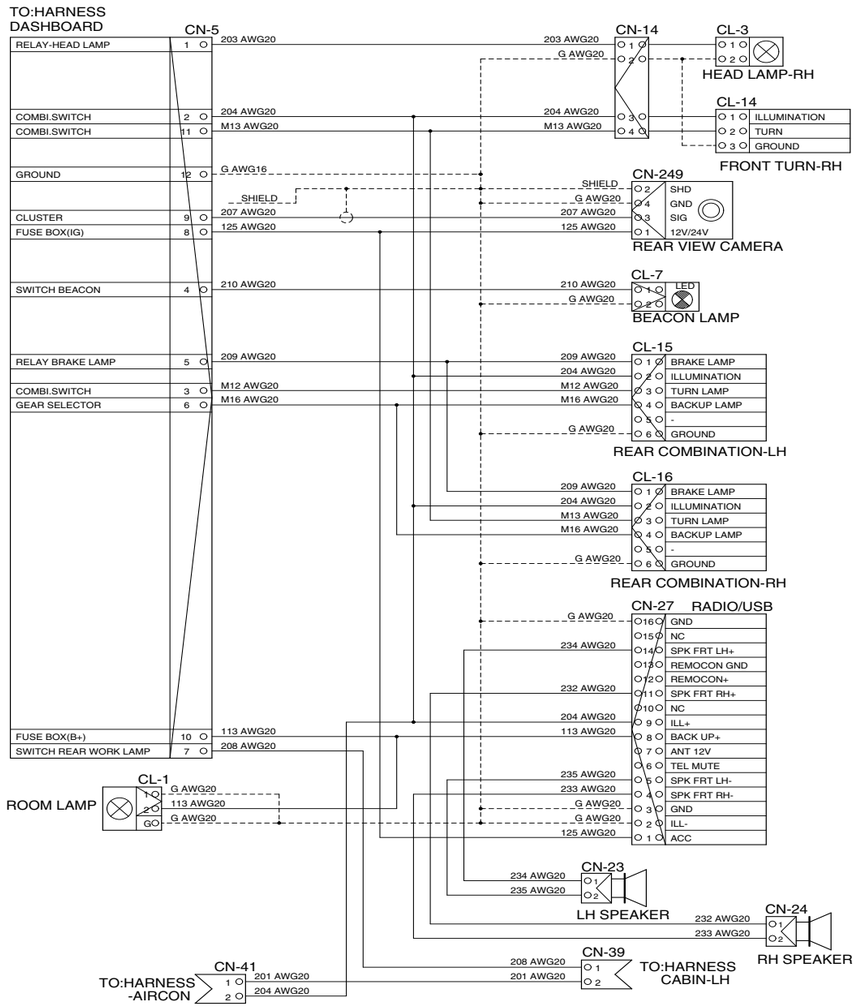
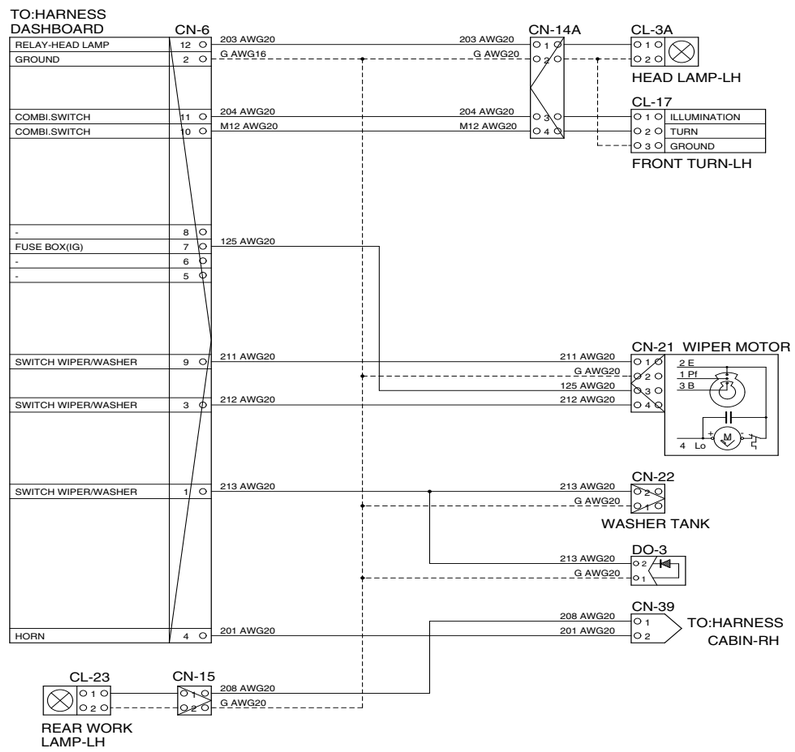
· ELECTRICAL CIRCUIT (25/26 , CABIN, W/AIR CONDITIONER, 35D-9 : -#0403, 40D-9 : -#0238, 45D-9 : -#1456, 50DA-9 : -#1031)

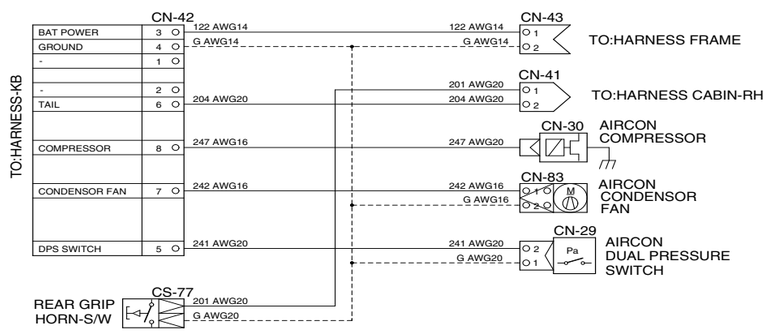
*ELEC.DIAGRAM OF HARNESS CABIN-RH



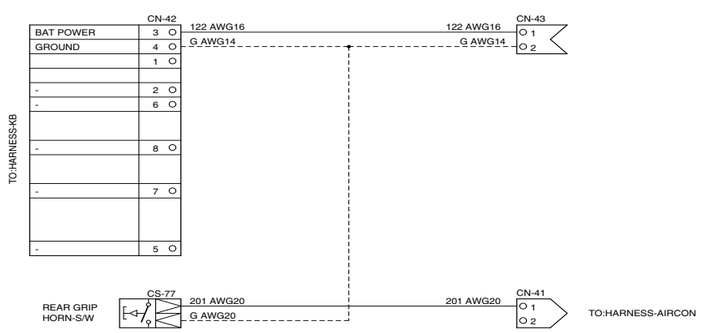
*ELEC.DIAGRAM OF HARNESS CABIN-LH



*ELEC.DIAGRAM OF HARNESS-AIRCON(AIRCON+HEATER)



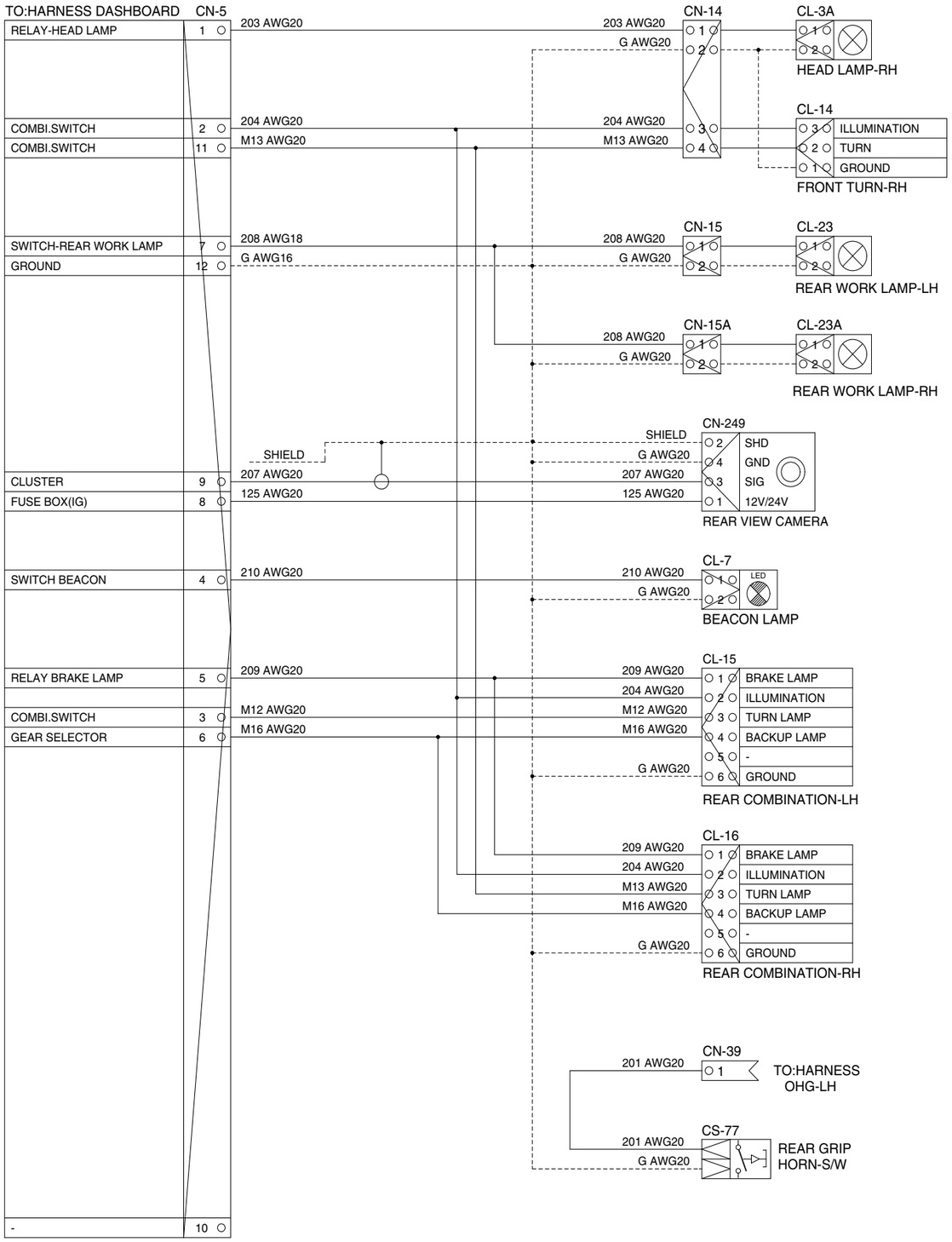
*ELEC.DIAGRAM OF HARNESS-HEATER(HEATER ONLY)



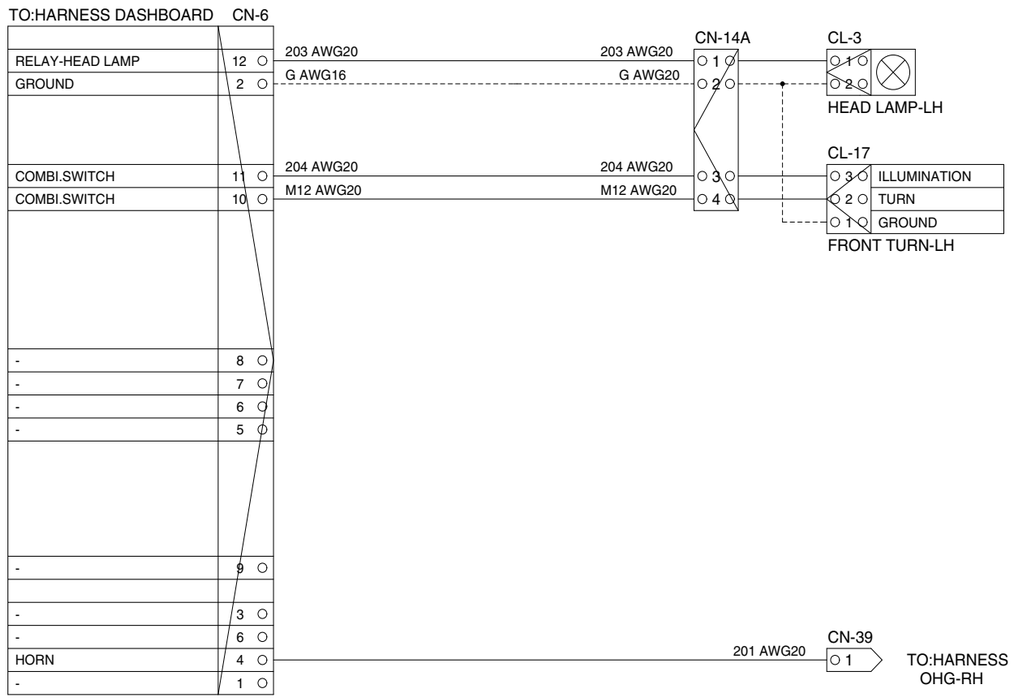
21FV-50080

· ELECTRICAL CIRCUIT (26/26 , OVERHEAD GUARD, 35D-9 : -#0403, 40D-9 : -#0238, 45D-9 : -#1456, 50DA-9 : -#1031)

*ELEC.DIAGRAM OF HARNESS CABIN-RH



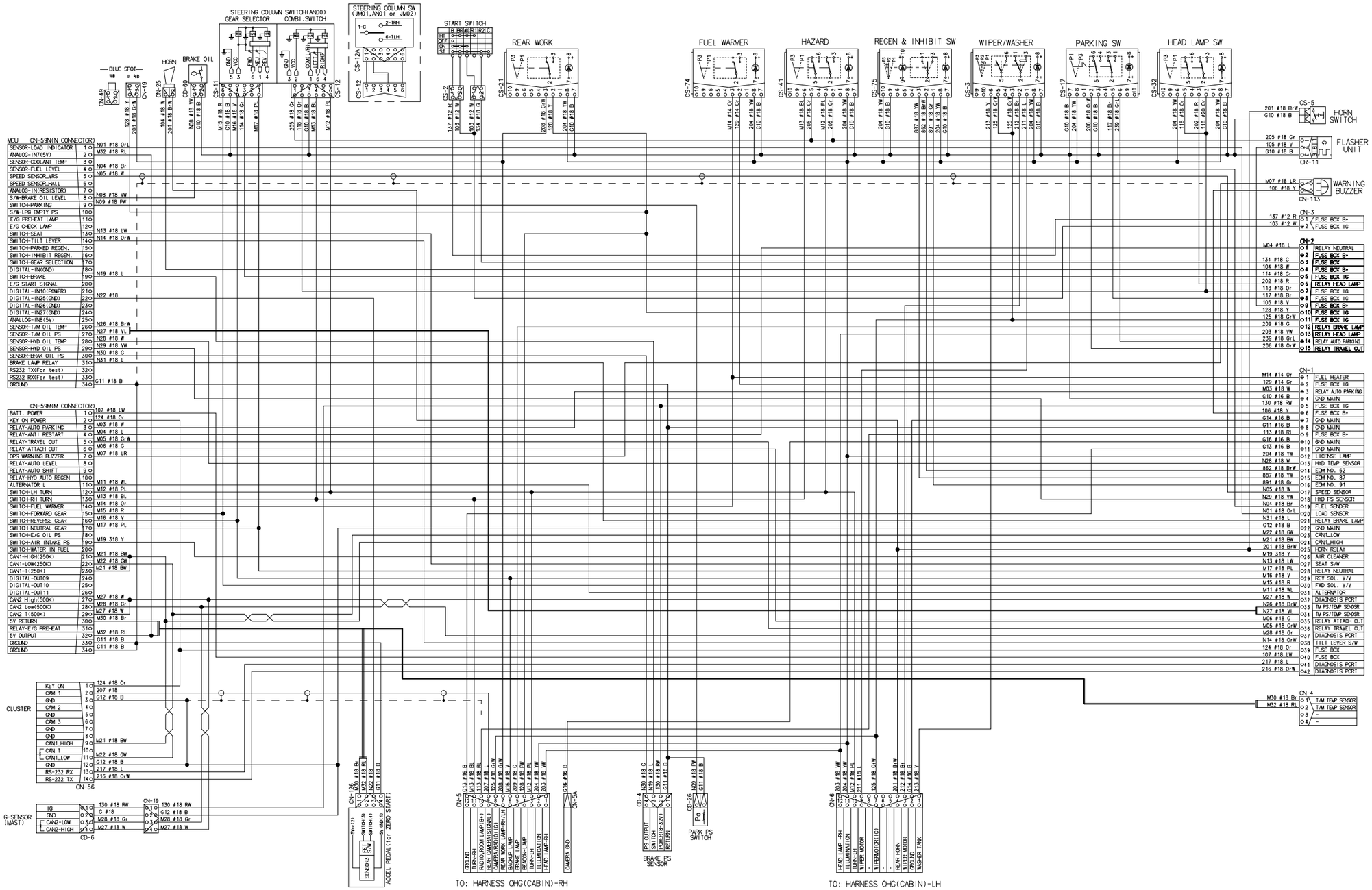
*ELEC.DIAGRAM OF HARNESS CABIN-LH



21FV-50042

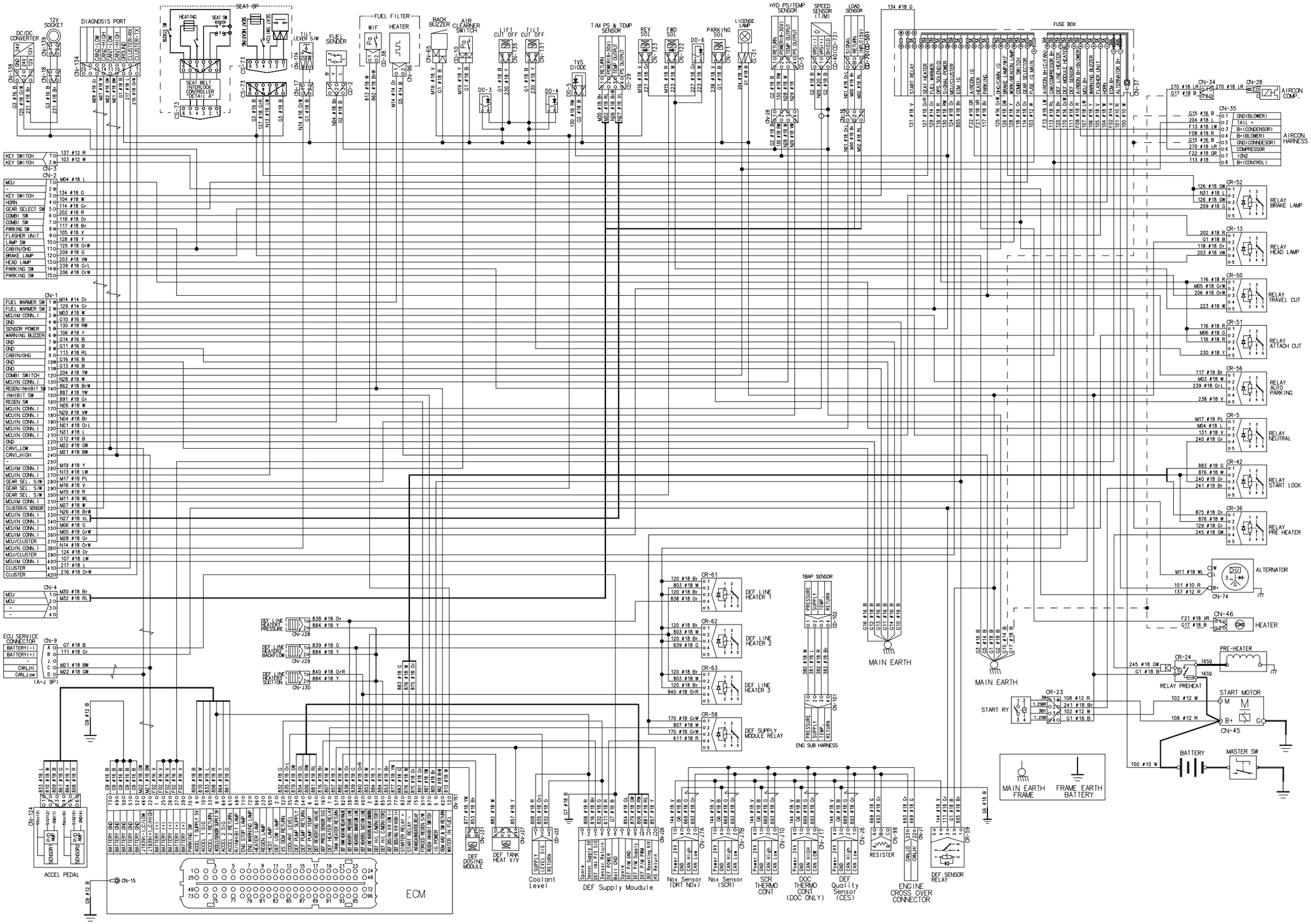
GROUP 2 ELECTRICAL CIRCUIT (TNA AXLE)

· ELECTRICAL CIRCUIT (1/6, DASHBORD)



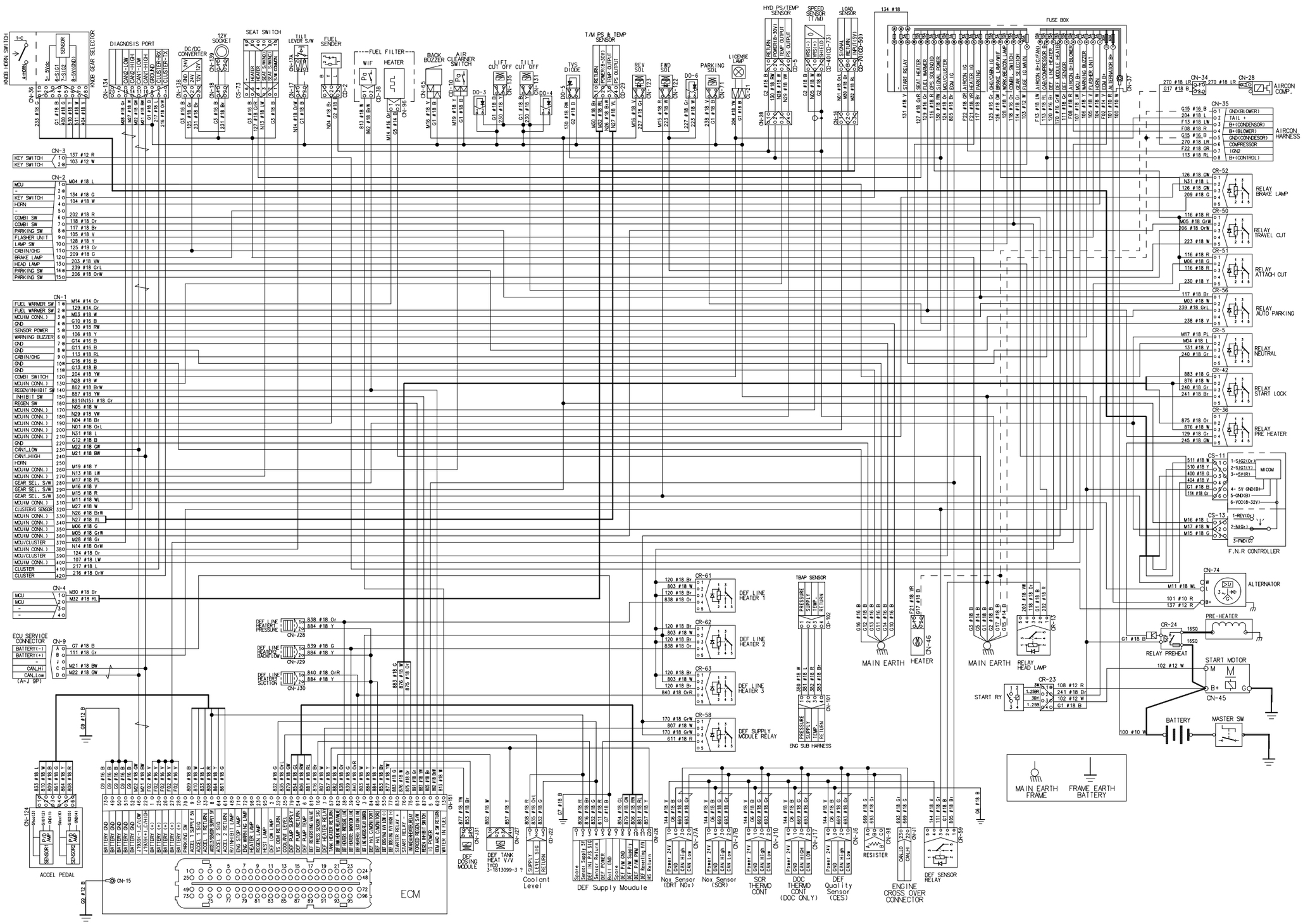
21FV-70510-00 1OF6

· ELECTRICAL CIRCUIT (2/6, FRAME)



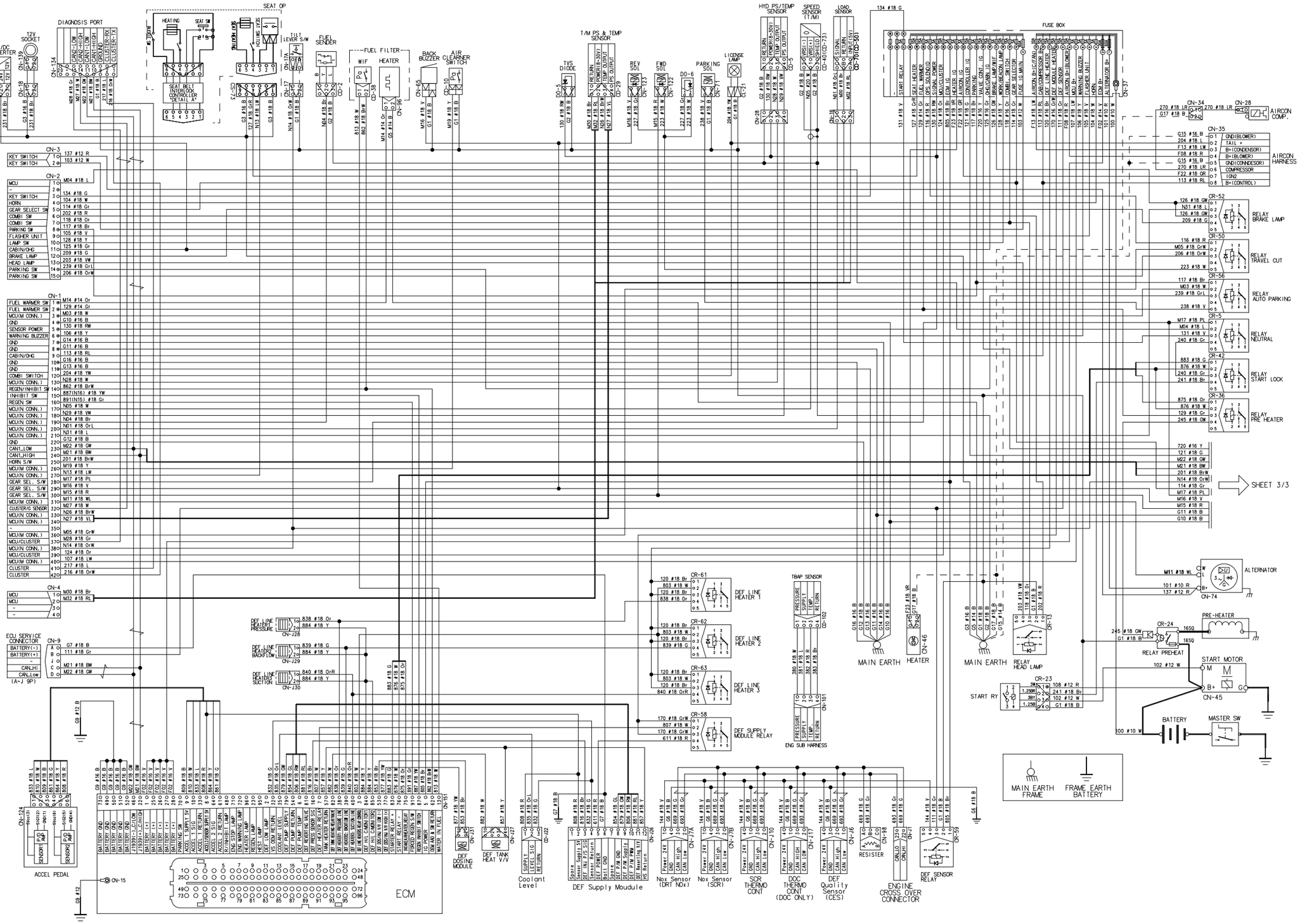
21FV-70510-00 2OF6

· ELECTRICAL CIRCUIT (3/6, FRAME-KNOB WITH FNR SWITCH)



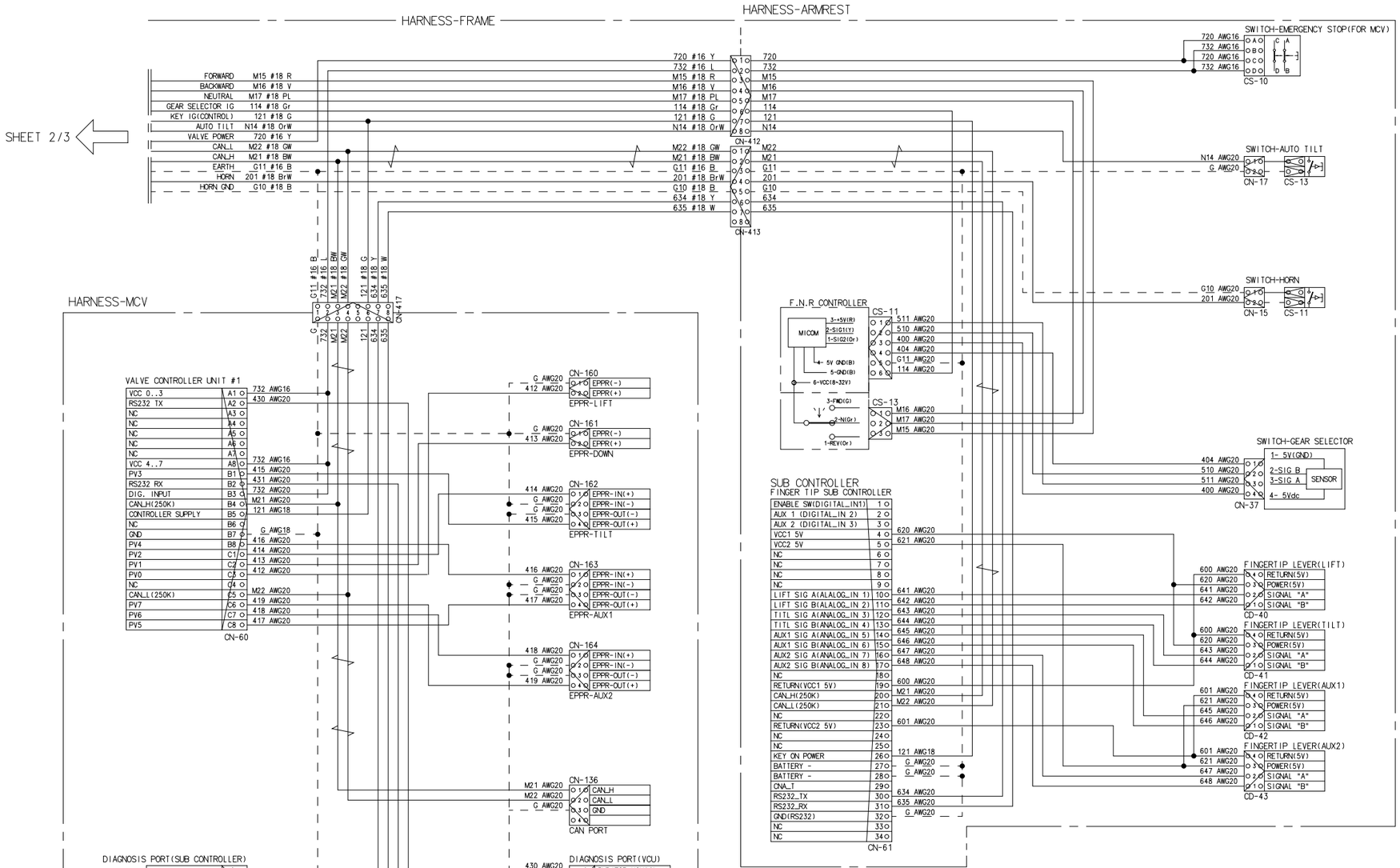
21FV-70510-00 3OF6

· ELECTRICAL CIRCUIT (4/6, FRAME-FINGERTIP 1 OF 2)



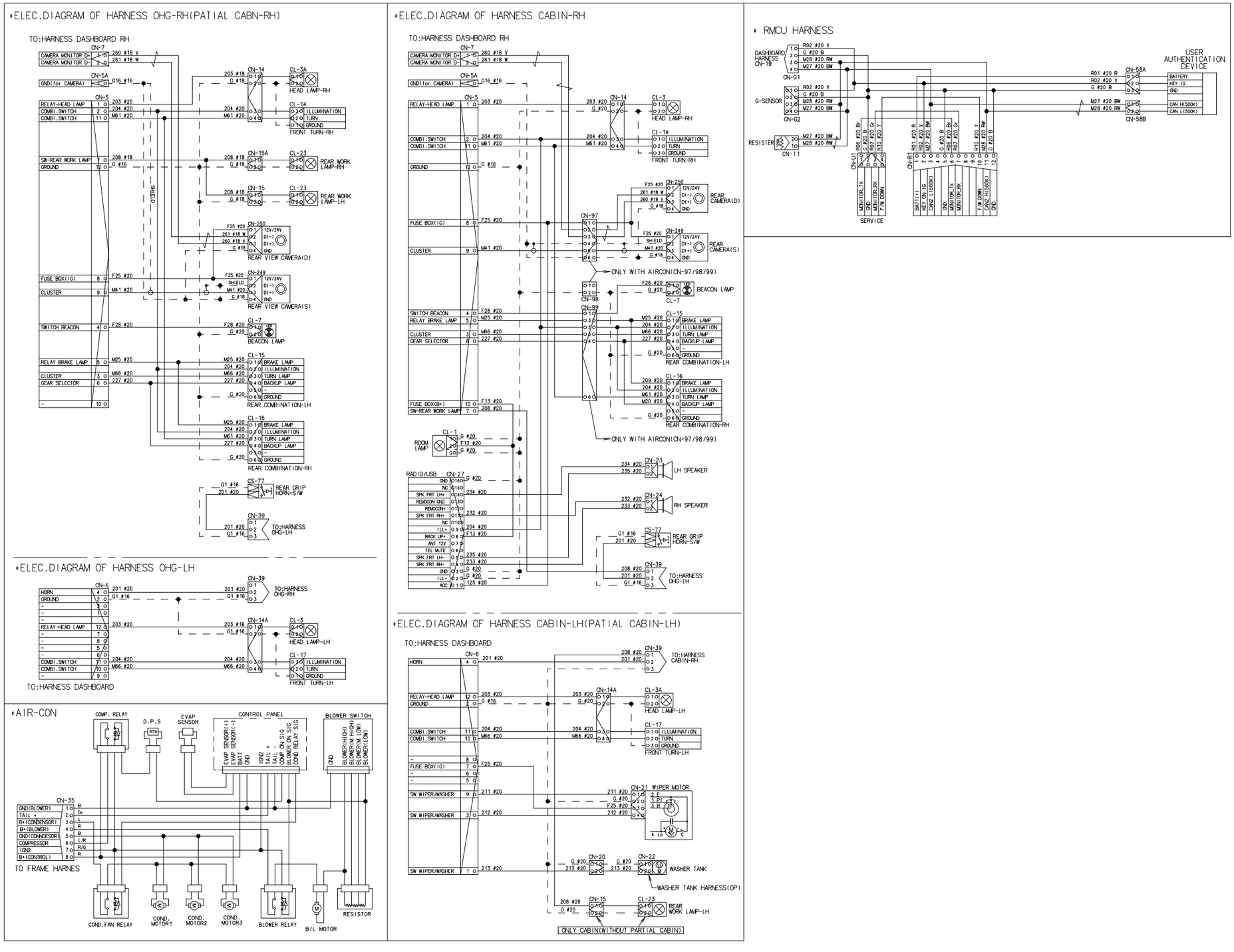
21FV-70510-00 4OF6

· ELECTRICAL CIRCUIT (5/6, FRAME-FINGERTIP 2 OF 2)



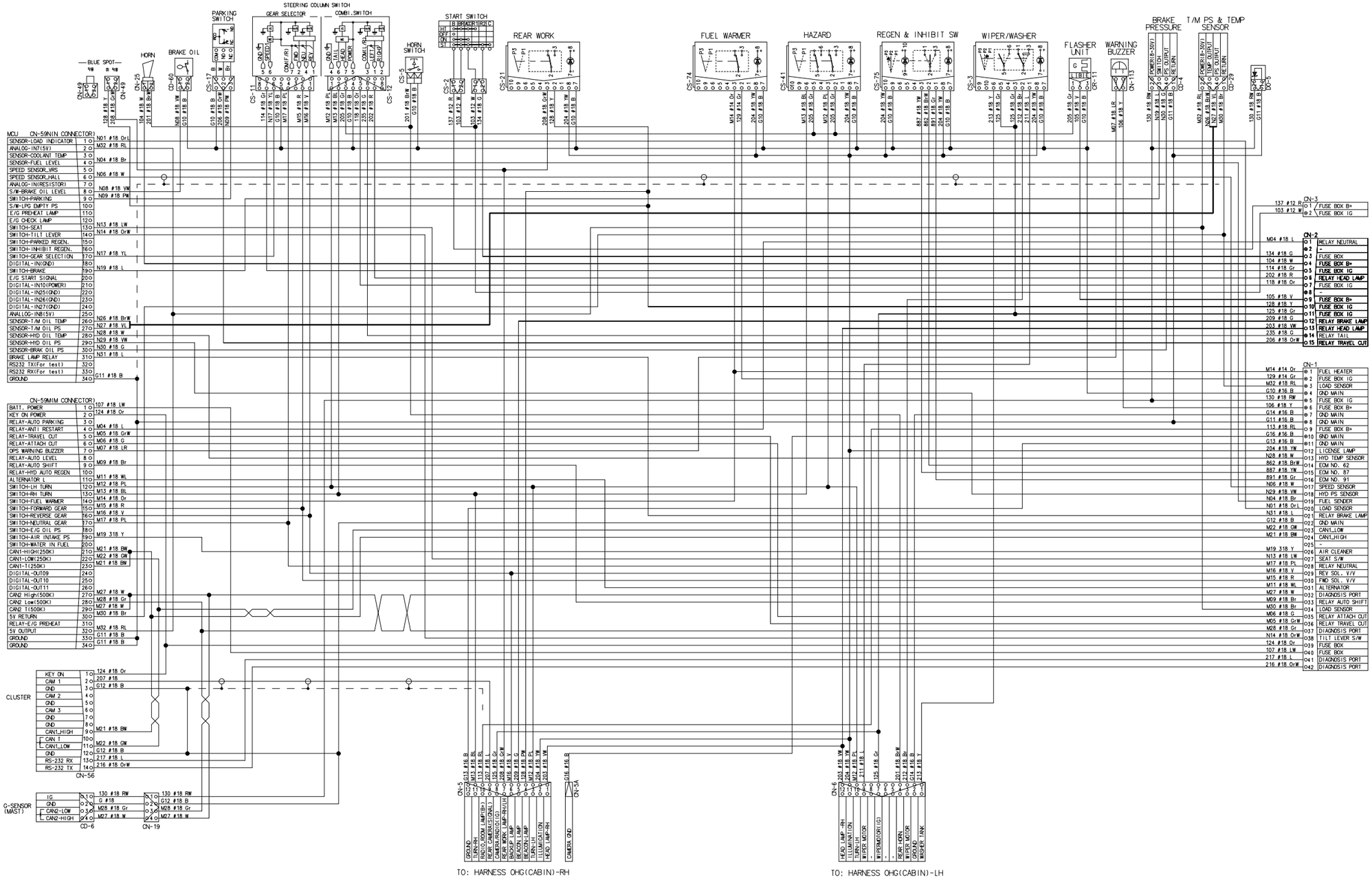
21FV-70510-00 5OF6

· ELECTRICAL CIRCUIT (6/6, CABIN, OHG, AIRCON, HEATER)



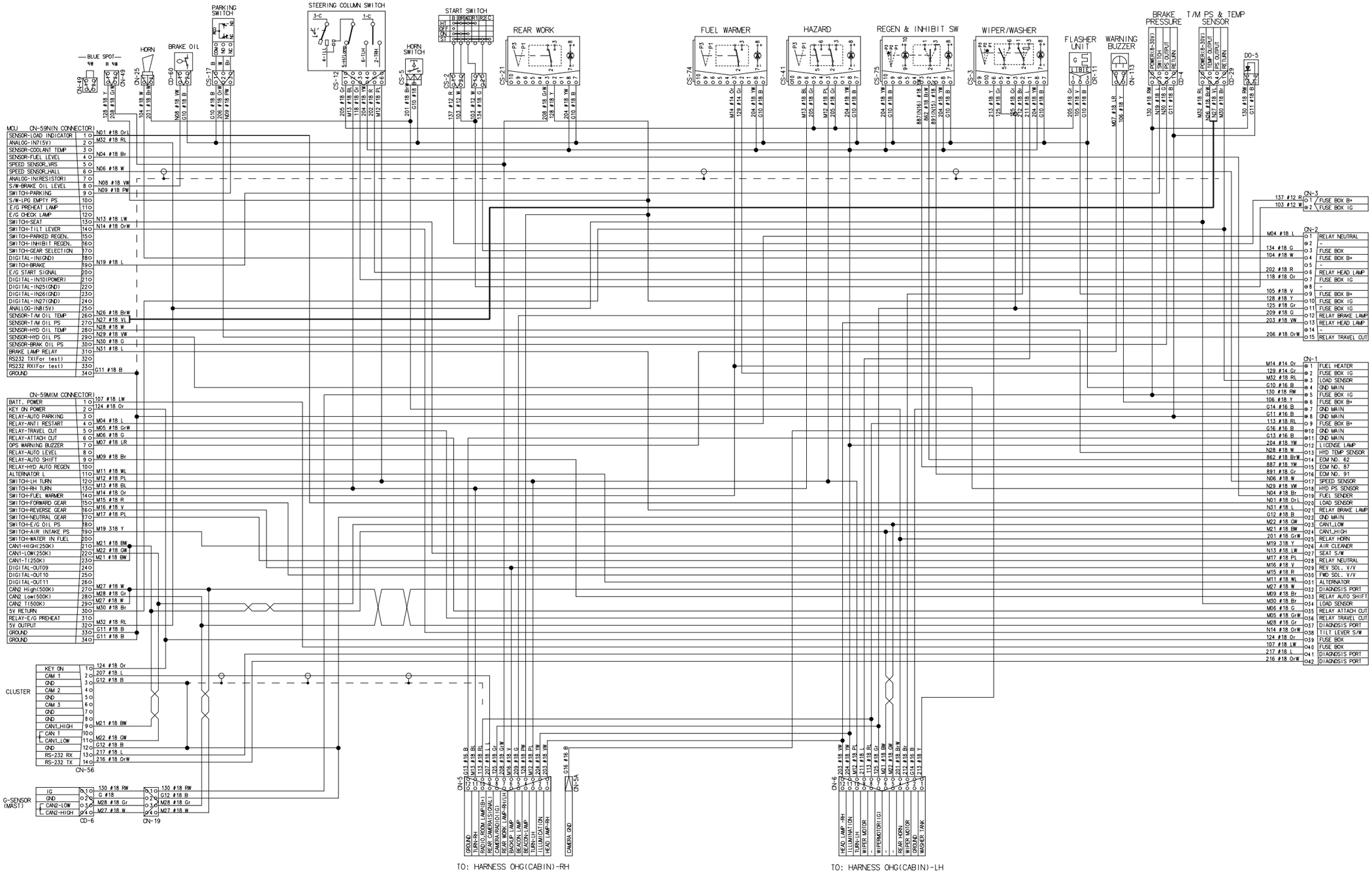
GROUP 2 ELECTRICAL CIRCUIT (DIC AXLE)

· ELECTRICAL CIRCUIT (1/7, DASHBORD)



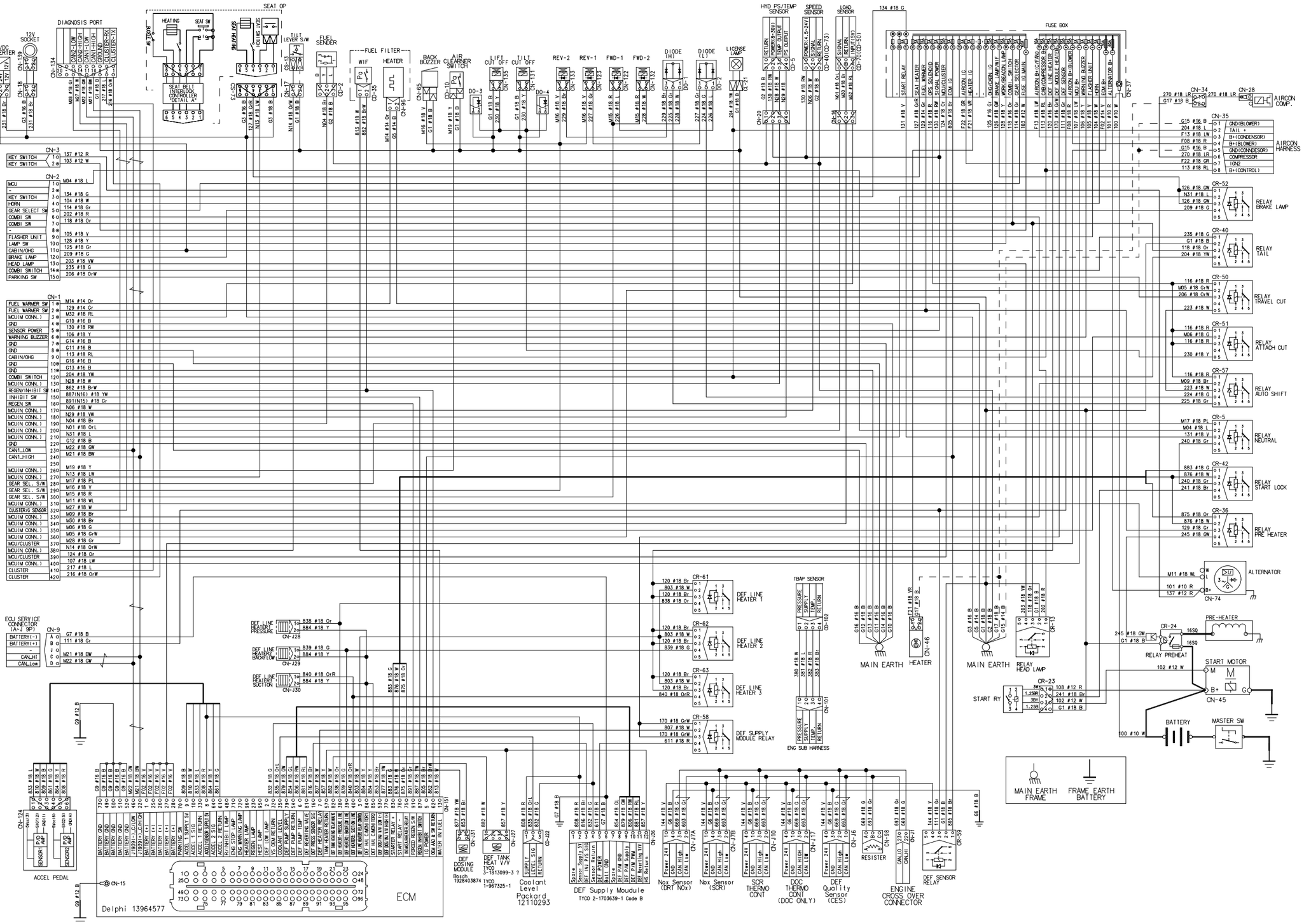
21FV-70520-00 1OF7

· ELECTRICAL CIRCUIT (2/7, DASHBOARD-FINGERTIP)



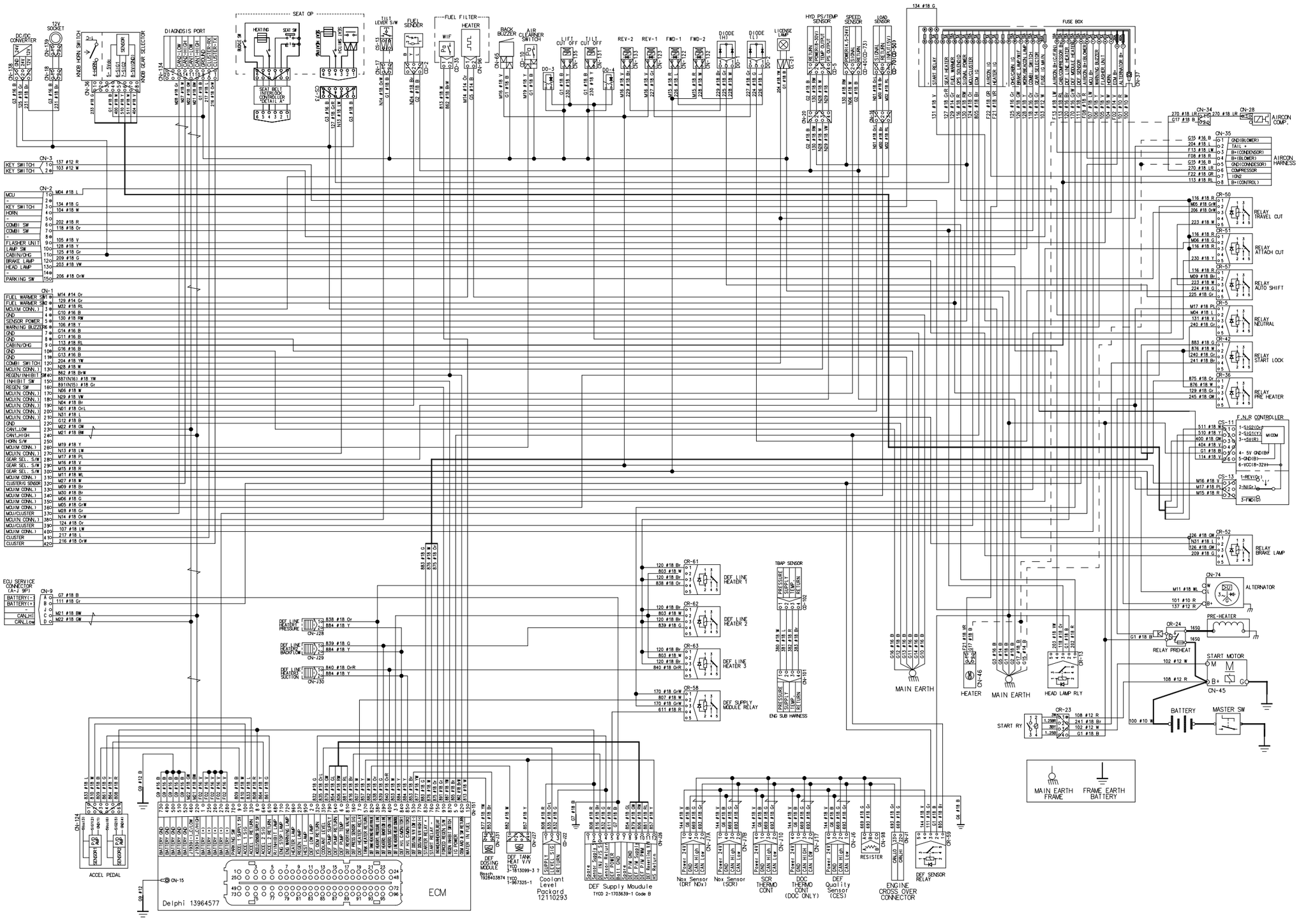
21FV-70520-00 2OF7

· ELECTRICAL CIRCUIT (3/7, FRAME)



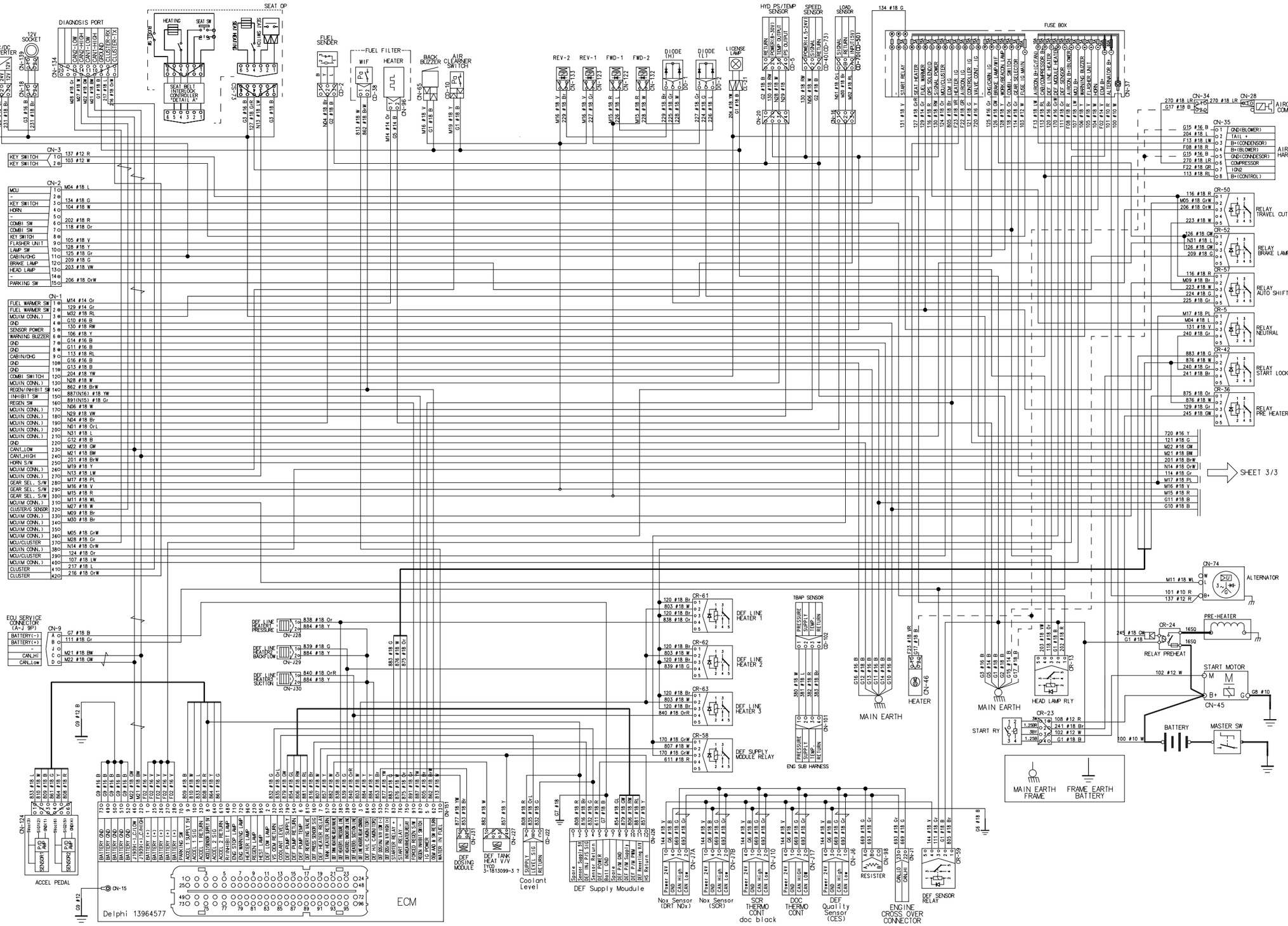
21FV-70520-00 3OF7

· ELECTRICAL CIRCUIT (4/7, FRAME-KNOB WITH FNR SWITCH)



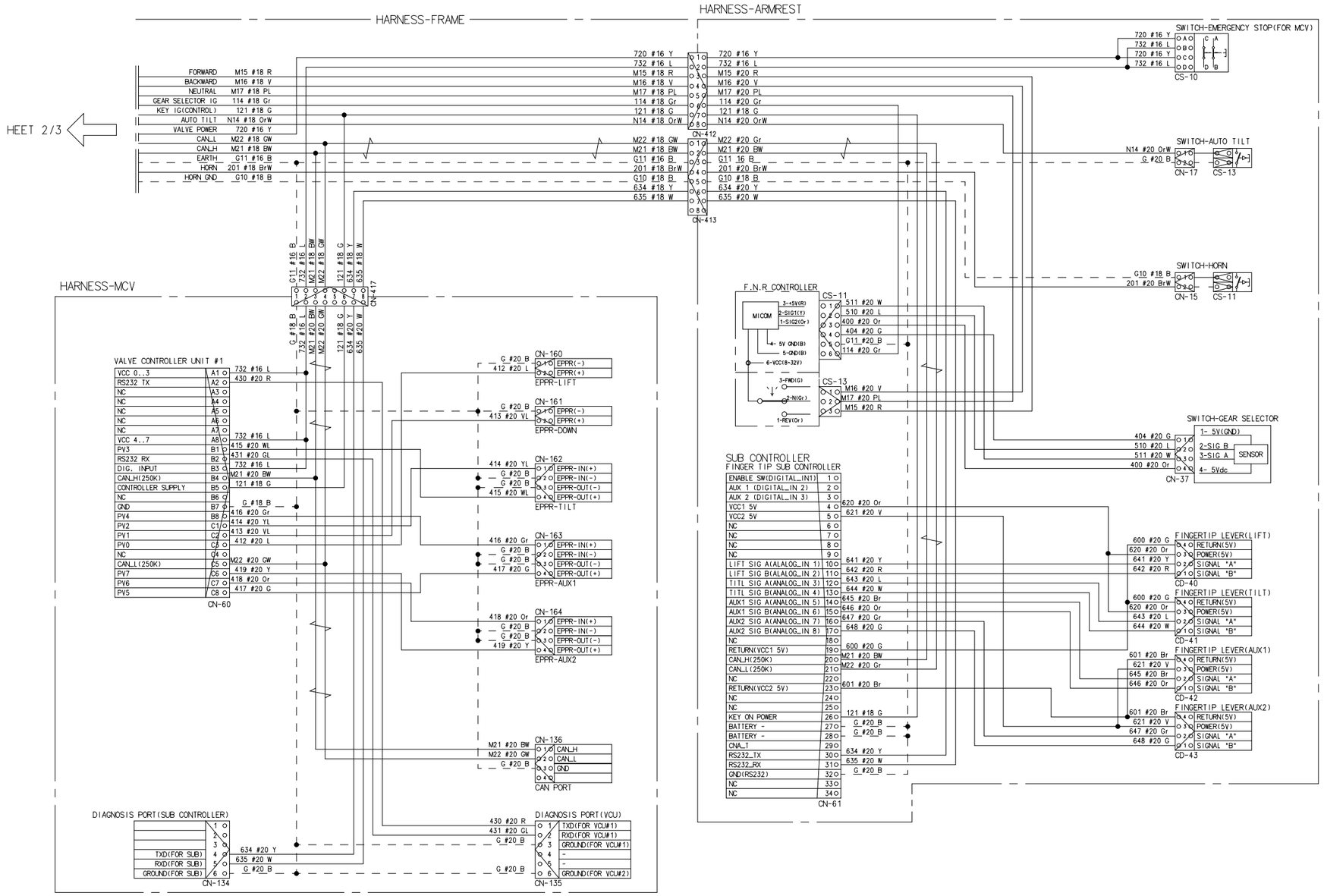
21FV-70510-00 4OF6

· ELECTRICAL CIRCUIT (5/7, FRAME-FINGERTIP 1 OF 2)



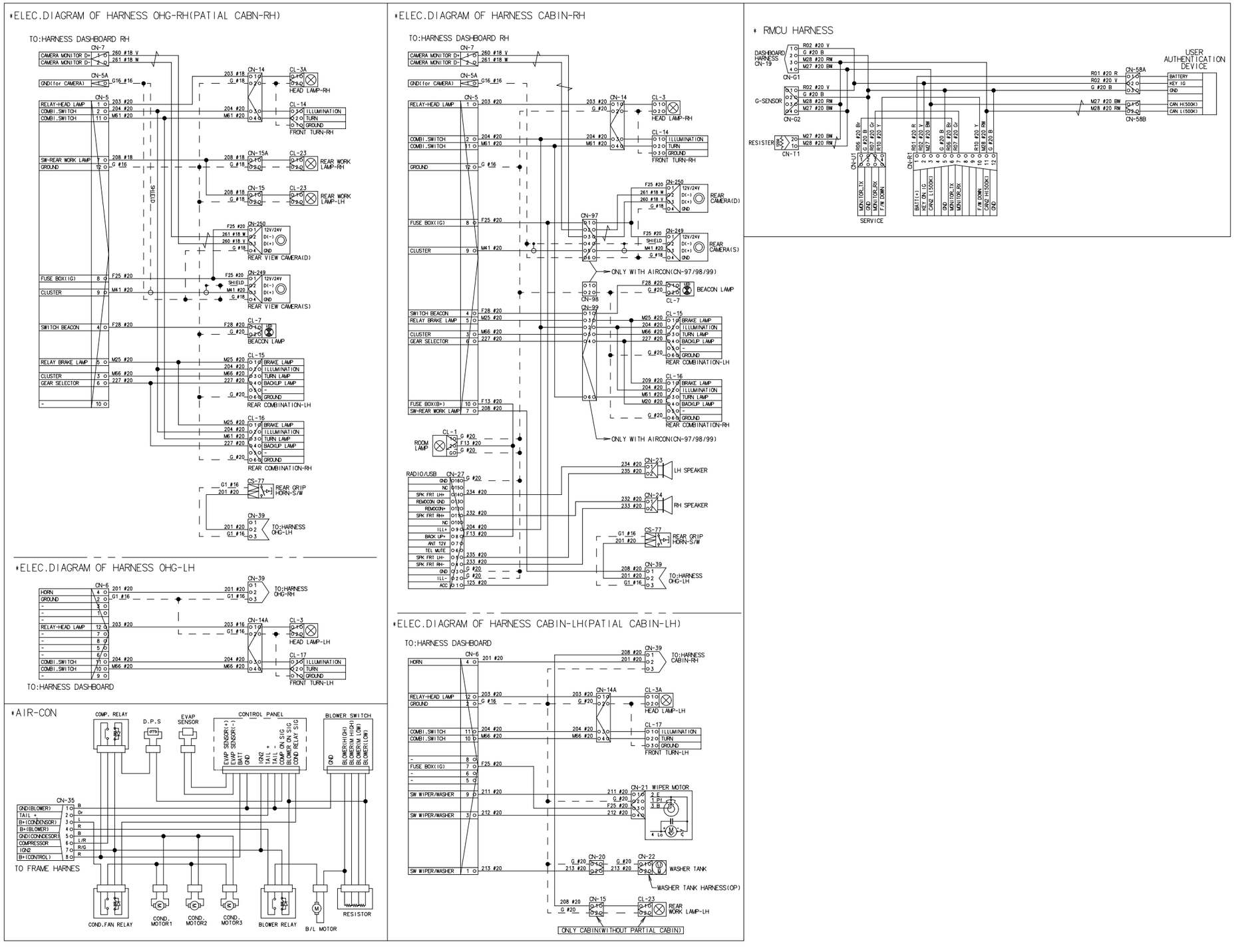
21FV-70520-00 5OF7

· ELECTRICAL CIRCUIT (6/7, FRAME-FINGERTIP 2 OF 2)

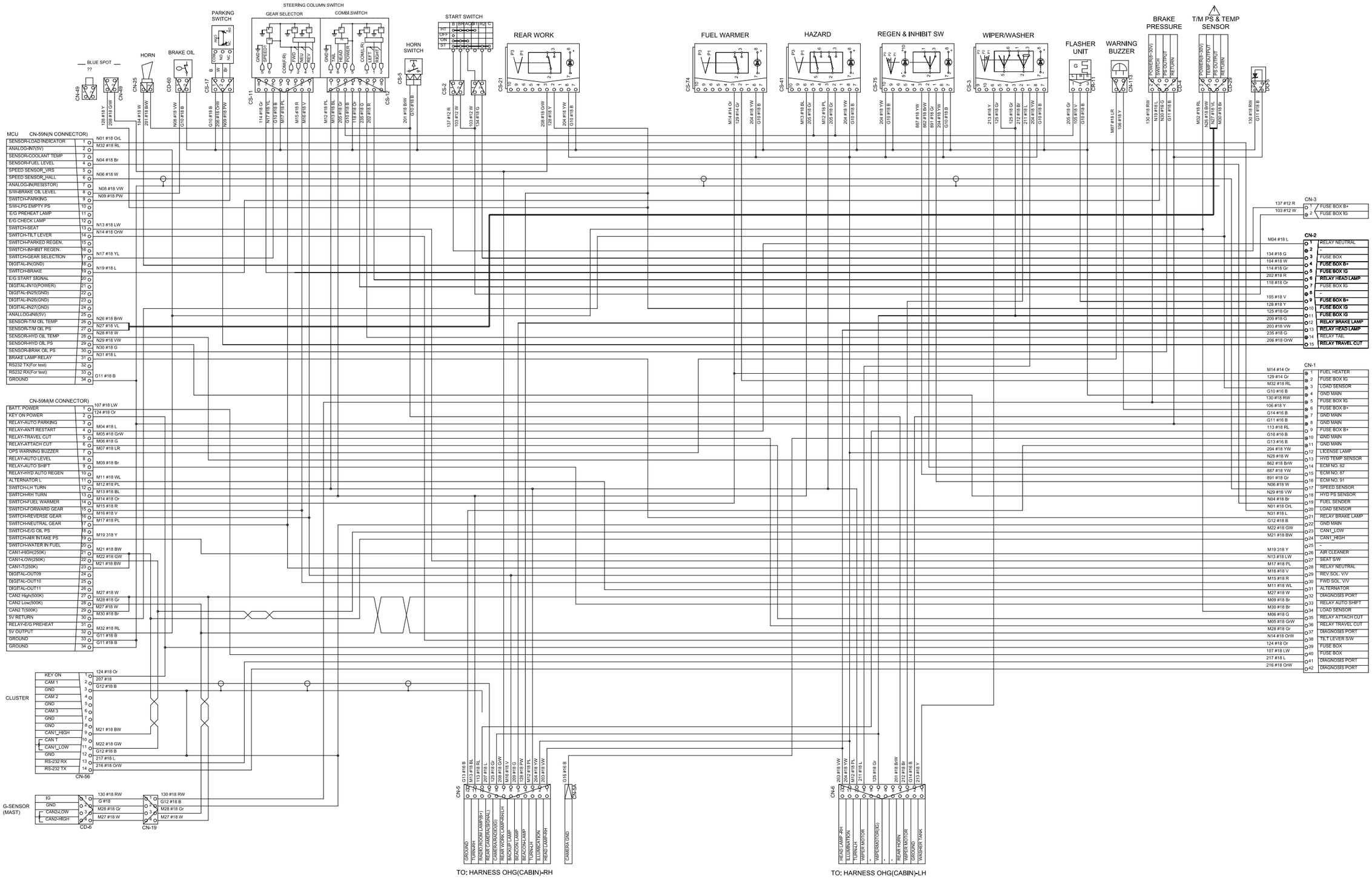


21FV-70520-00 6OF7

· ELECTRICAL CIRCUIT (7/7, CABIN, OHG, AIRCON, HEATER)

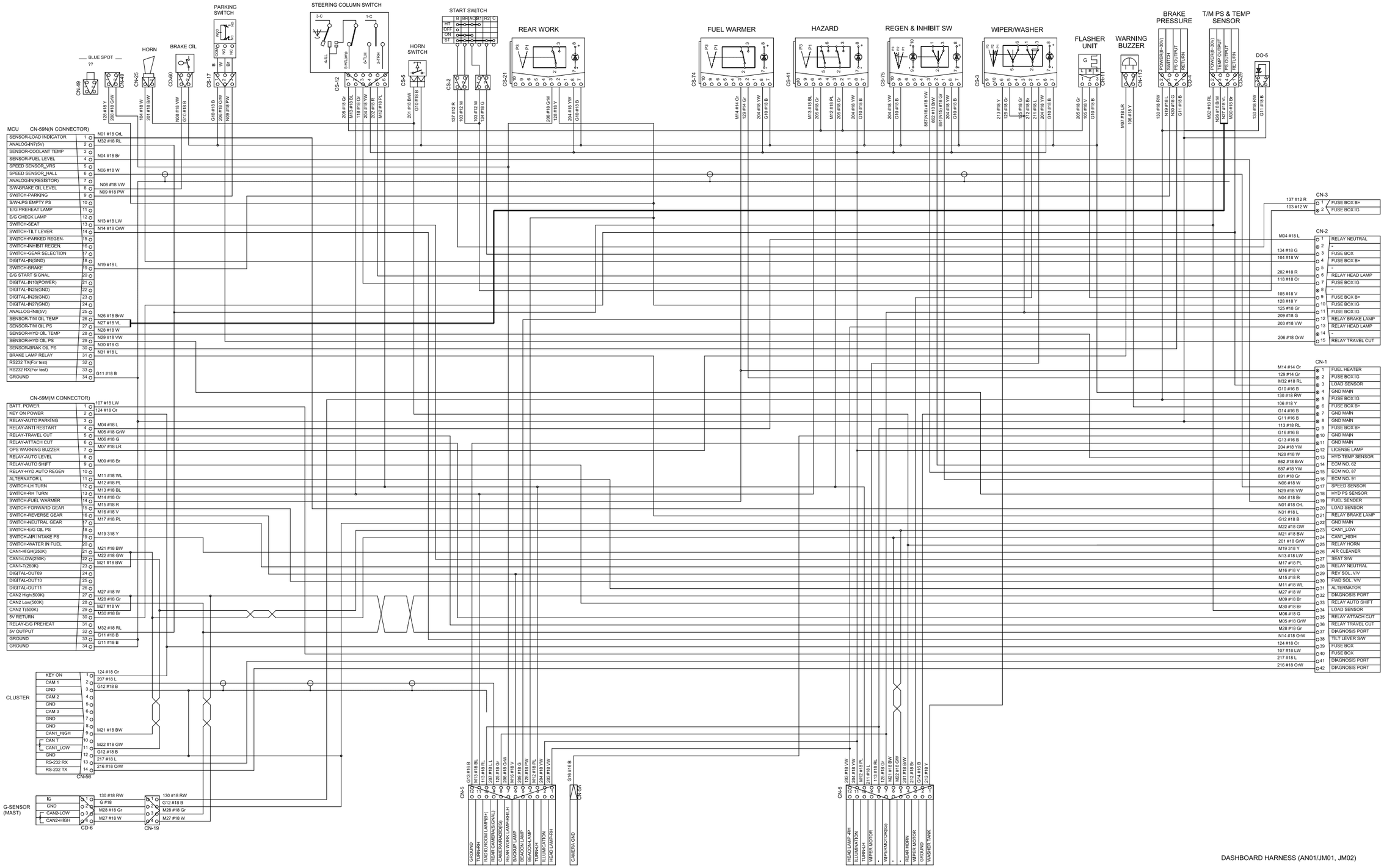


· ELECTRICAL CIRCUIT (DASHBOARD HARNESS 35D-9 : #0403-, 40D-9 : #0242-, 45D-9 : #1455-, 50DA-9 : #1034-)



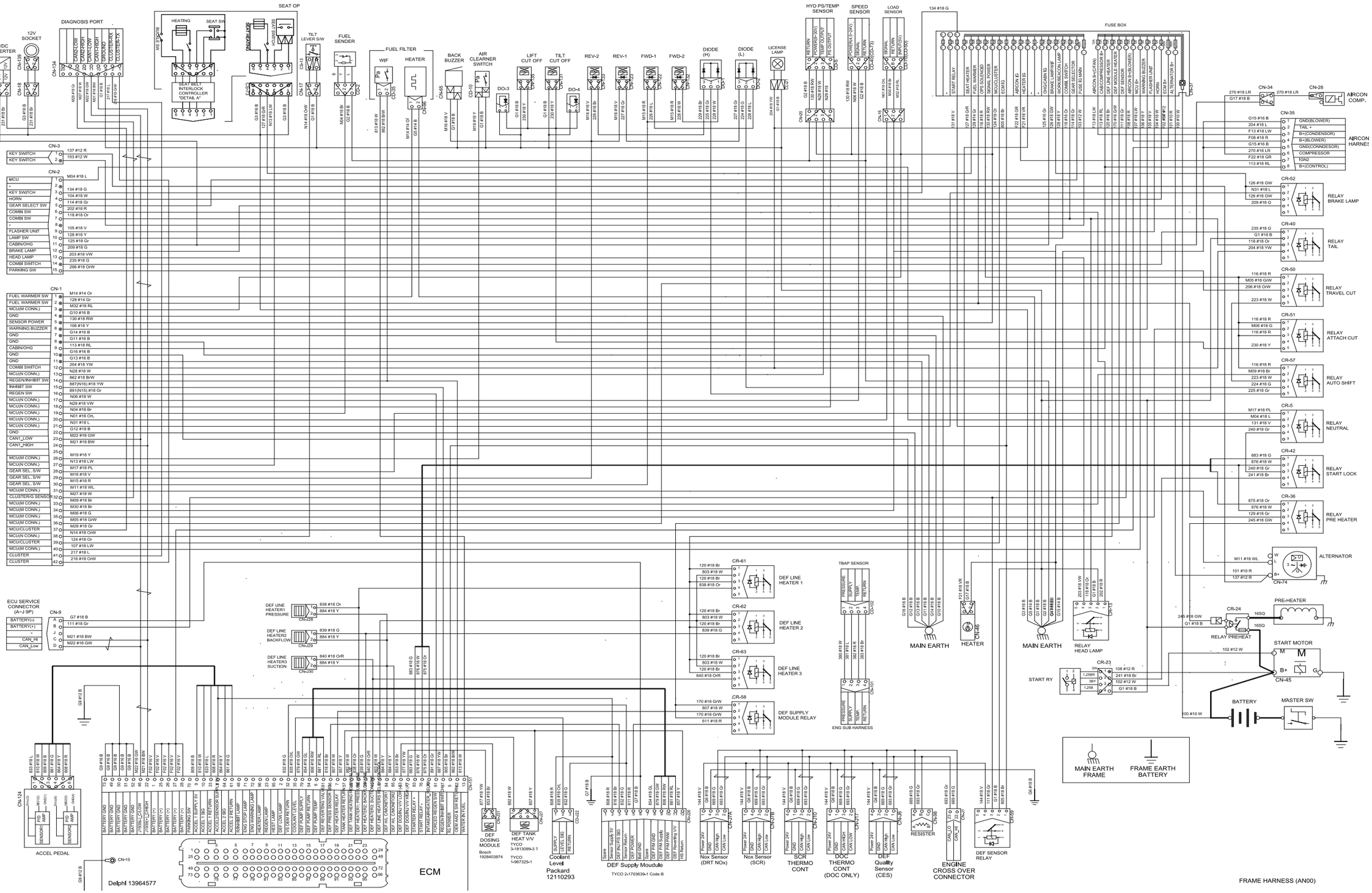
21FV-70521-1

· ELECTRICAL CIRCUIT (DASHBOARD HARNESS 35D-9 : #0403-, 40D-9 : #0242-, 45D-9 : #1455-, 50DA-9 : #1034-)



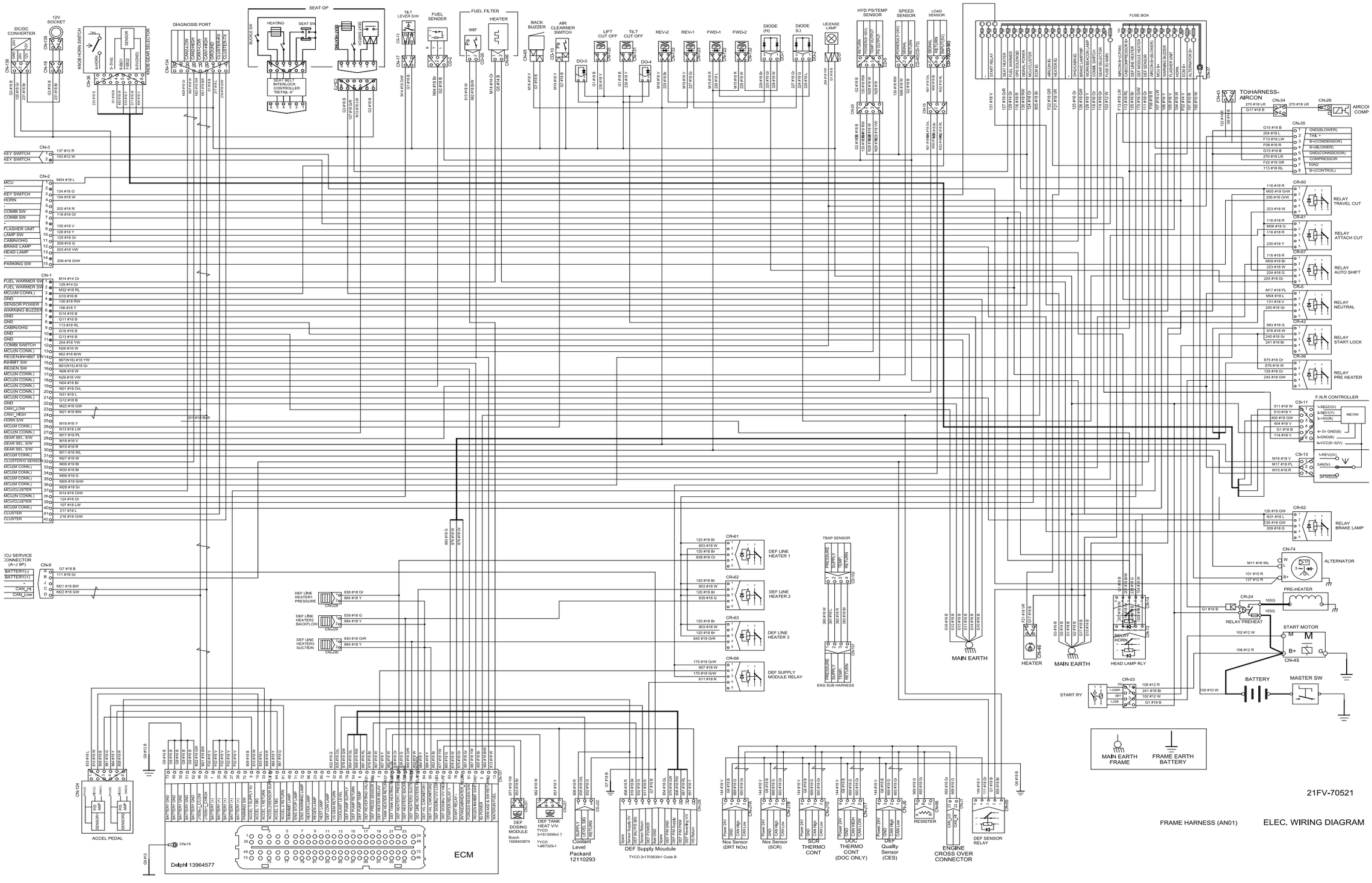
21FV-70521-2

· ELECTRICAL CIRCUIT (FRAME HARNESS 35D-9 : #0403-, 40D-9 : #0242-, 45D-9 : #1455-, 50DA-9 : #1034-)

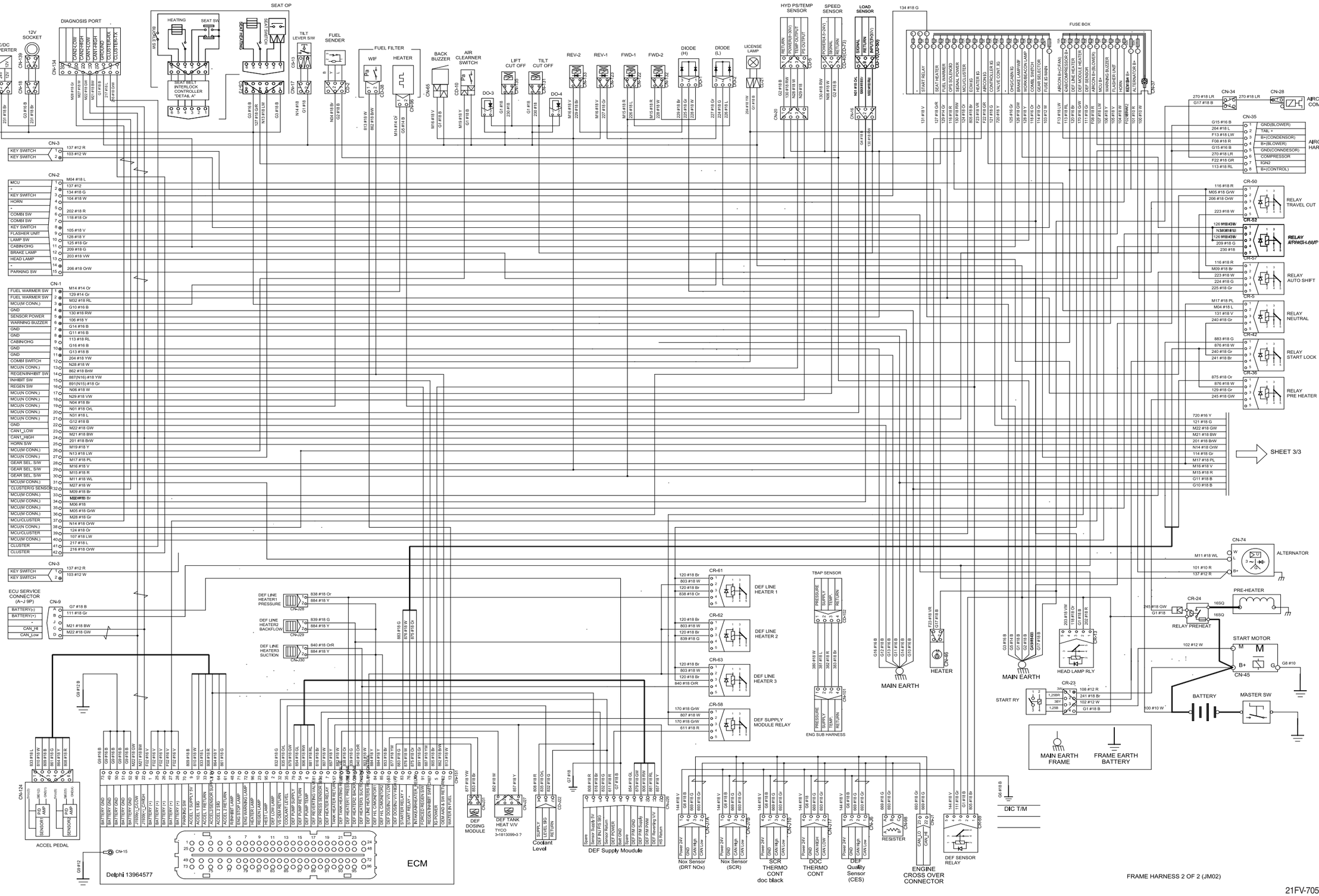


21FV-70521-3

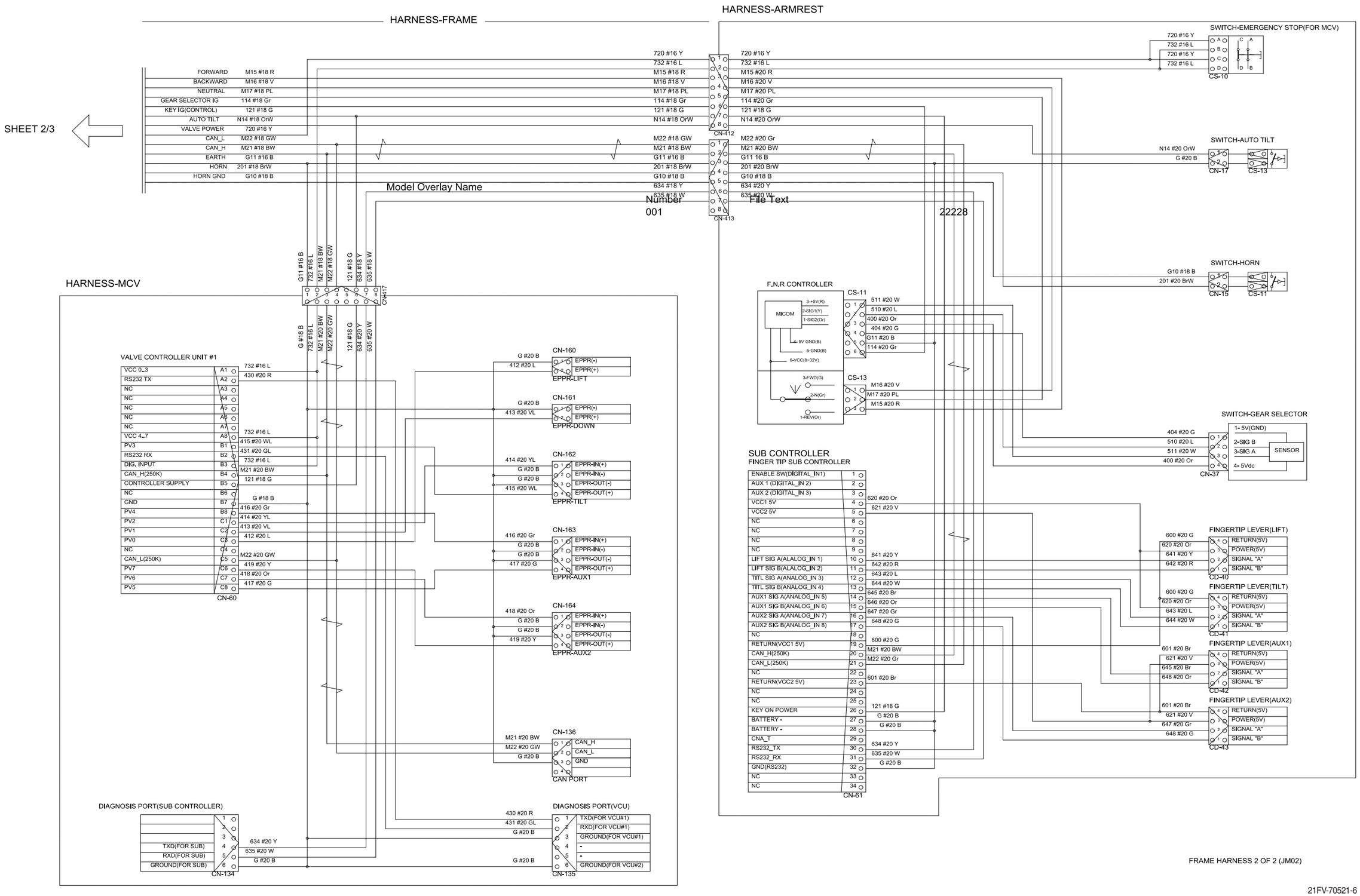
· ELECTRICAL CIRCUIT (DASH BOARD HARNESS 35D-9 : #0403-, 40D-9 : #0242-, 45D-9 : #1455-, 50DA-9 : #1034-)



· ELECTRICAL CIRCUIT (FRAME HARNESS 35D-9 : #0403-, 40D-9 : #0242-, 45D-9 : #1455-, 50DA-9 : #1034-)



· ELECTRICAL CIRCUIT (FRAME HARNESS 35D-9 : #0403-, 40D-9 : #0242-, 45D-9 : #1455-, 50DA-9 : #1034-)

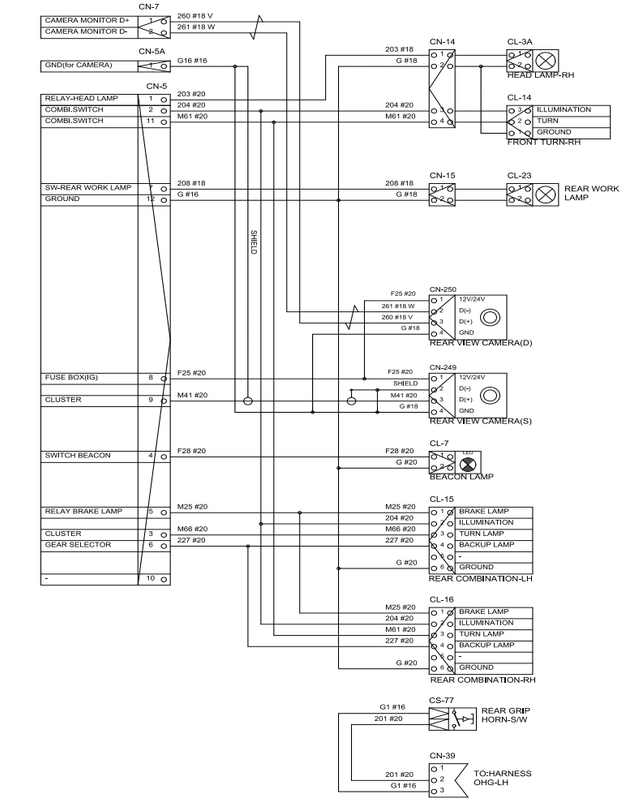


FRAME HARNESS 2 OF 2 (JM02)

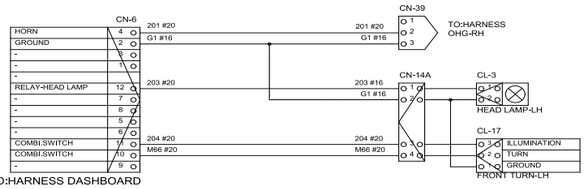
21FV-70521-6

· ELECTRICAL CIRCUIT (CABIN HARNESS 35D-9 : #0403-, 40D-9 : #0242-, 45D-9 : #1455-, 50DA-9 : #1034-)

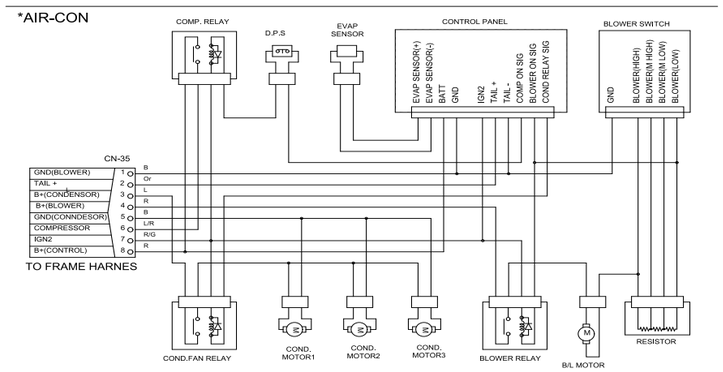
*ELEC.DIAGRAM OF HARNESS OHG-RH(PATIAL CABN-RH)



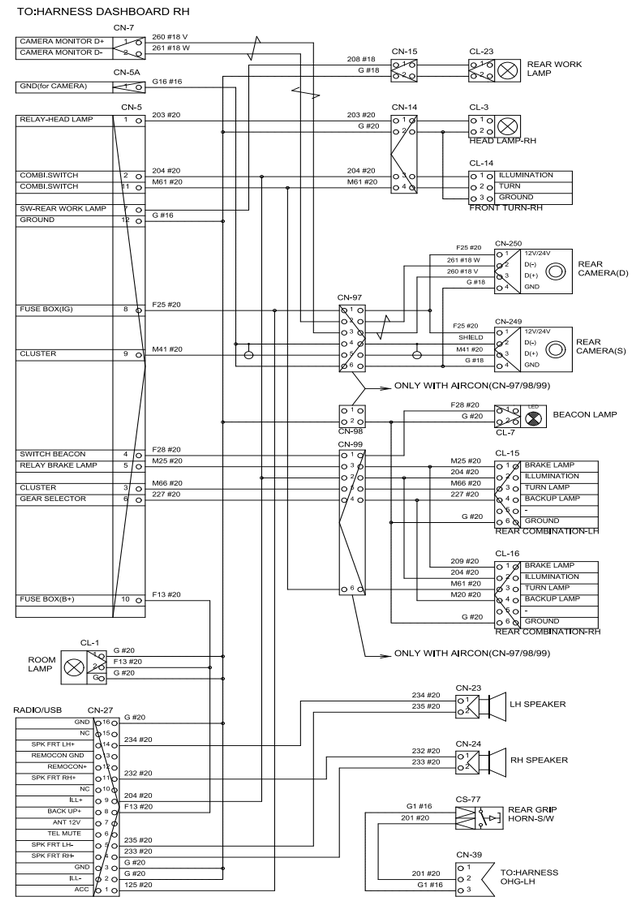
*ELEC.DIAGRAM OF HARNESS OHG-LH



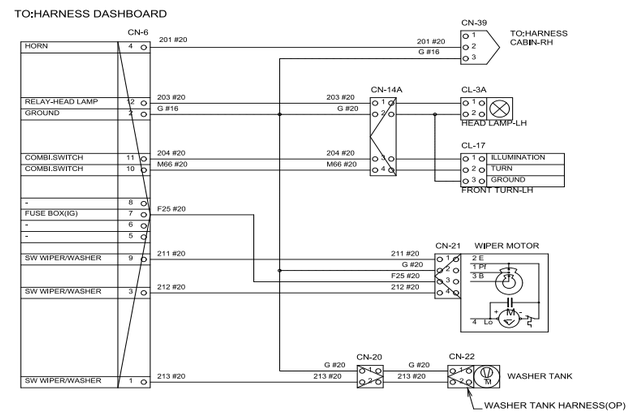
*AIR-CON



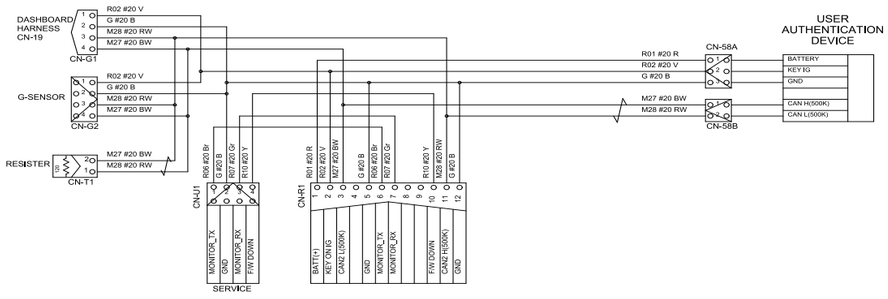
*ELEC.DIAGRAM OF HARNESS CABIN-RH



*ELEC.DIAGRAM OF HARNESS CABIN-LH(PATIAL CABIN-LH)



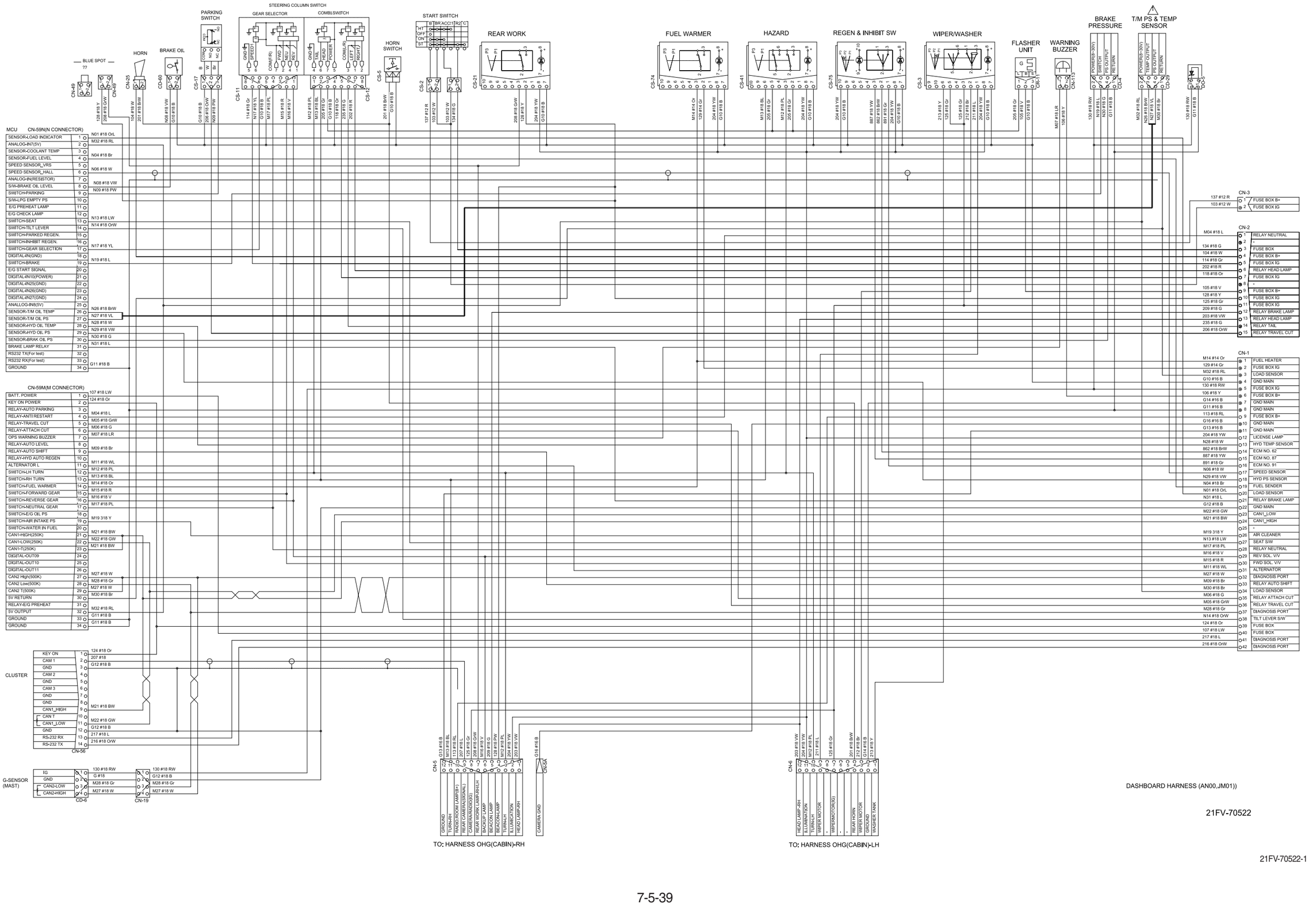
* RMCU HARNESS



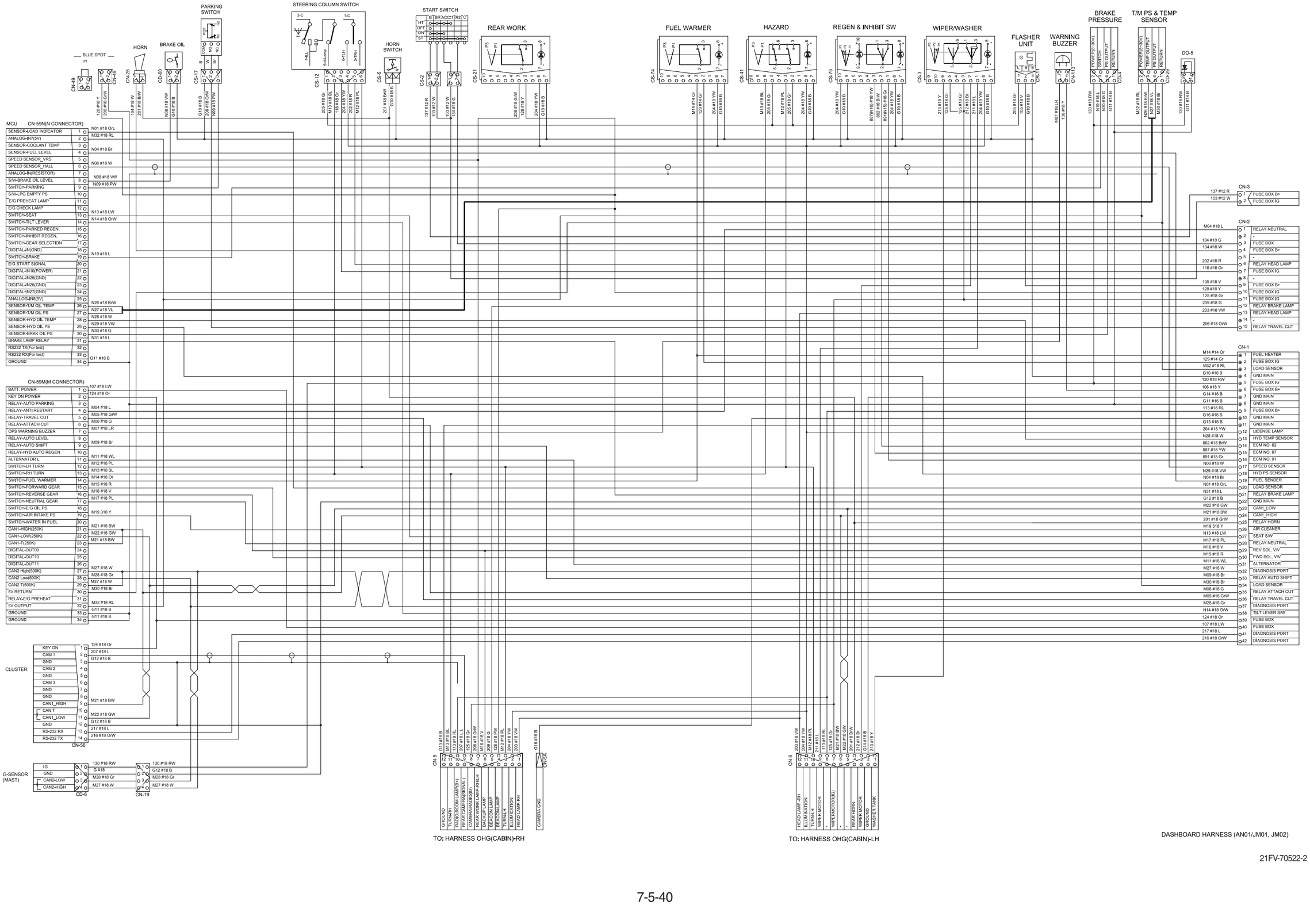
HARNESS(CABIN, OHG, AIRCON, HEATER))

21FV-70521-7

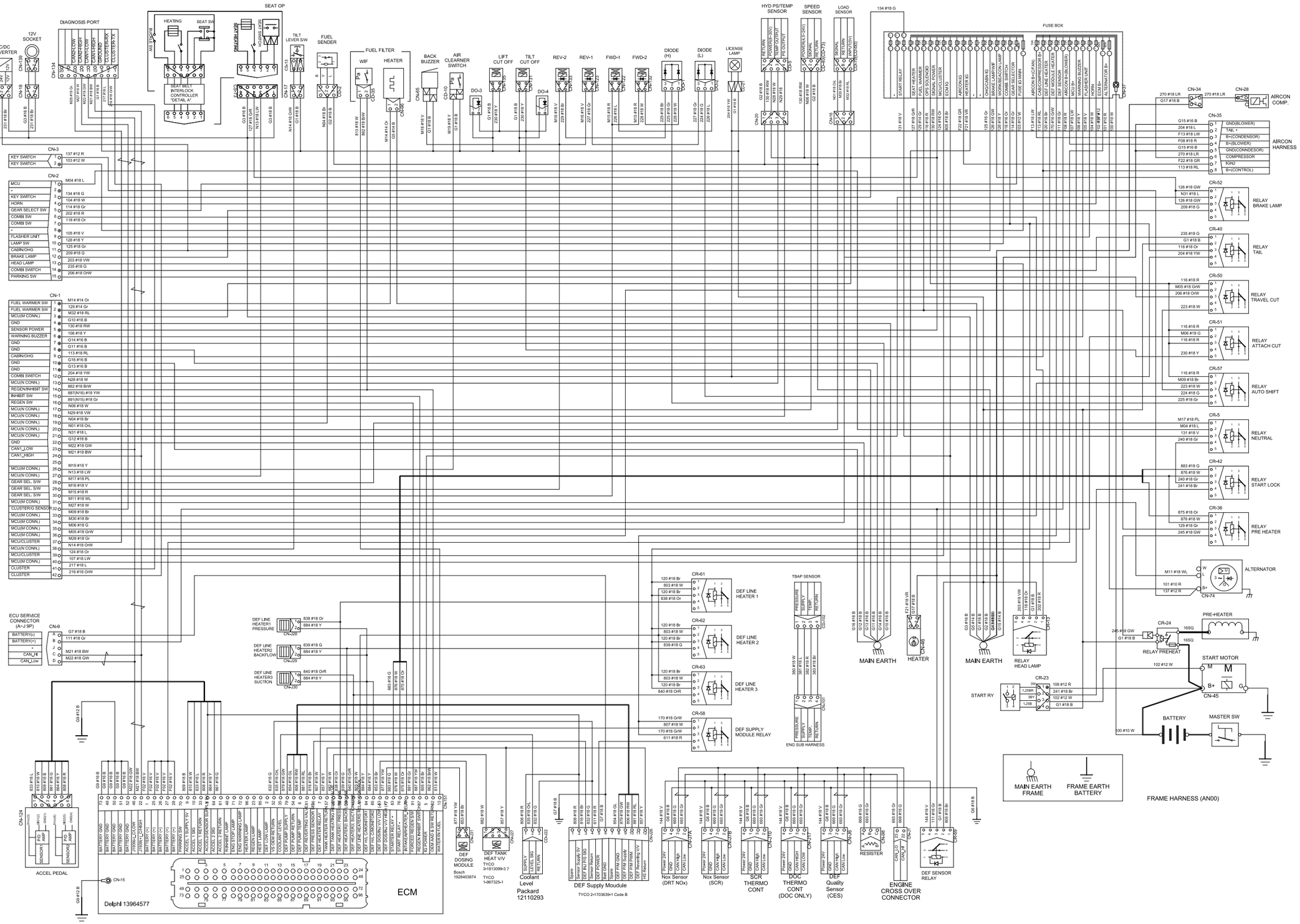
· ELECTRICAL CIRCUIT (DASHBOARD HARNESS 35D-9 : #0417-, 40D-9 : #0272-, 45D-9 : #1486-, 50DA-9 : #1106-)



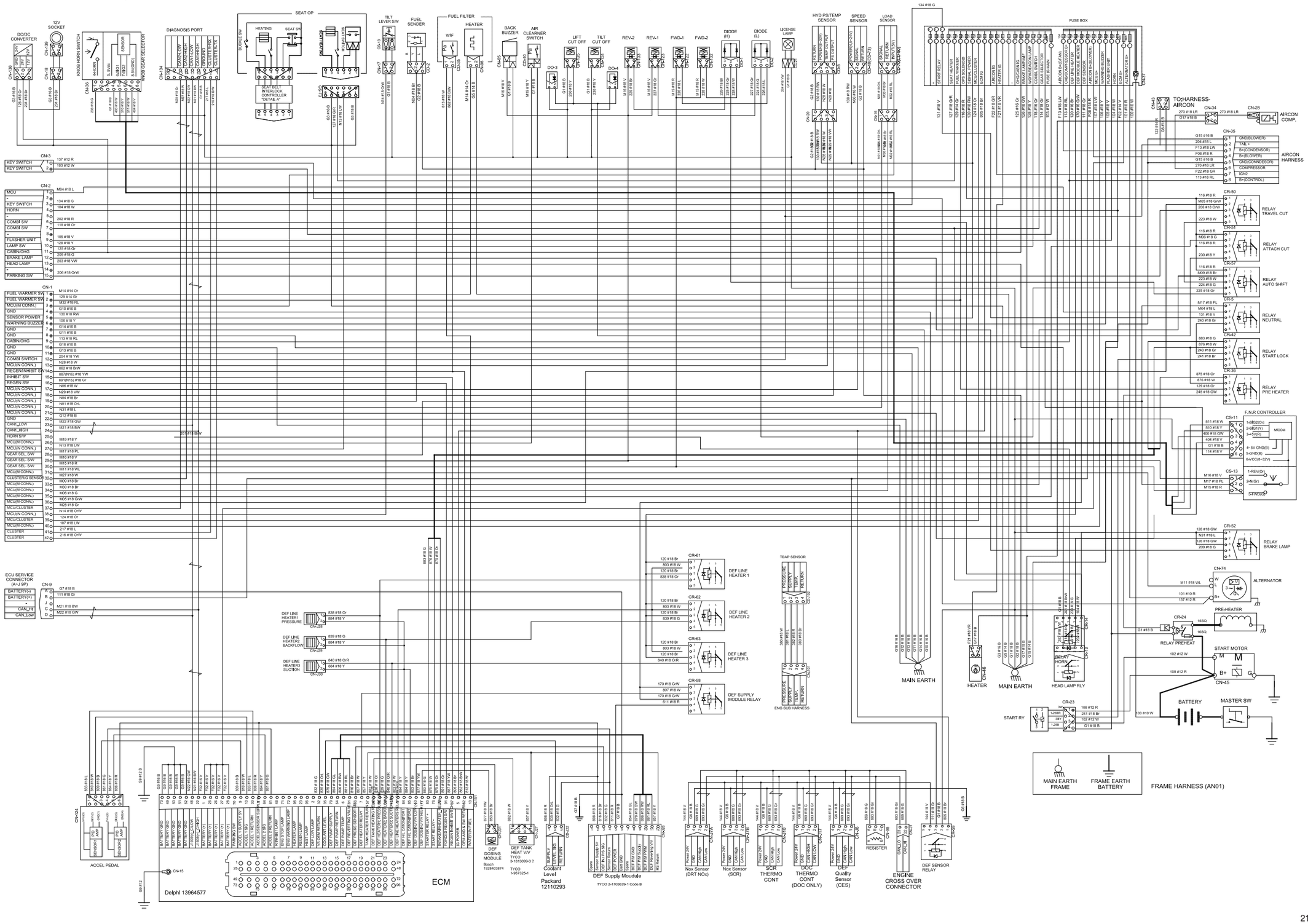
· ELECTRICAL CIRCUIT (DASH BOARD HARNESS 35D-9 : #0417-, 40D-9 : #0272-, 45D-9 : #1486-, 50DA-9 : #1106-)



· ELECTRICAL CIRCUIT (FRAME HARNESS 35D-9 : #0417-, 40D-9 : #0272-, 45D-9 : #1486-, 50DA-9 : #1106-)

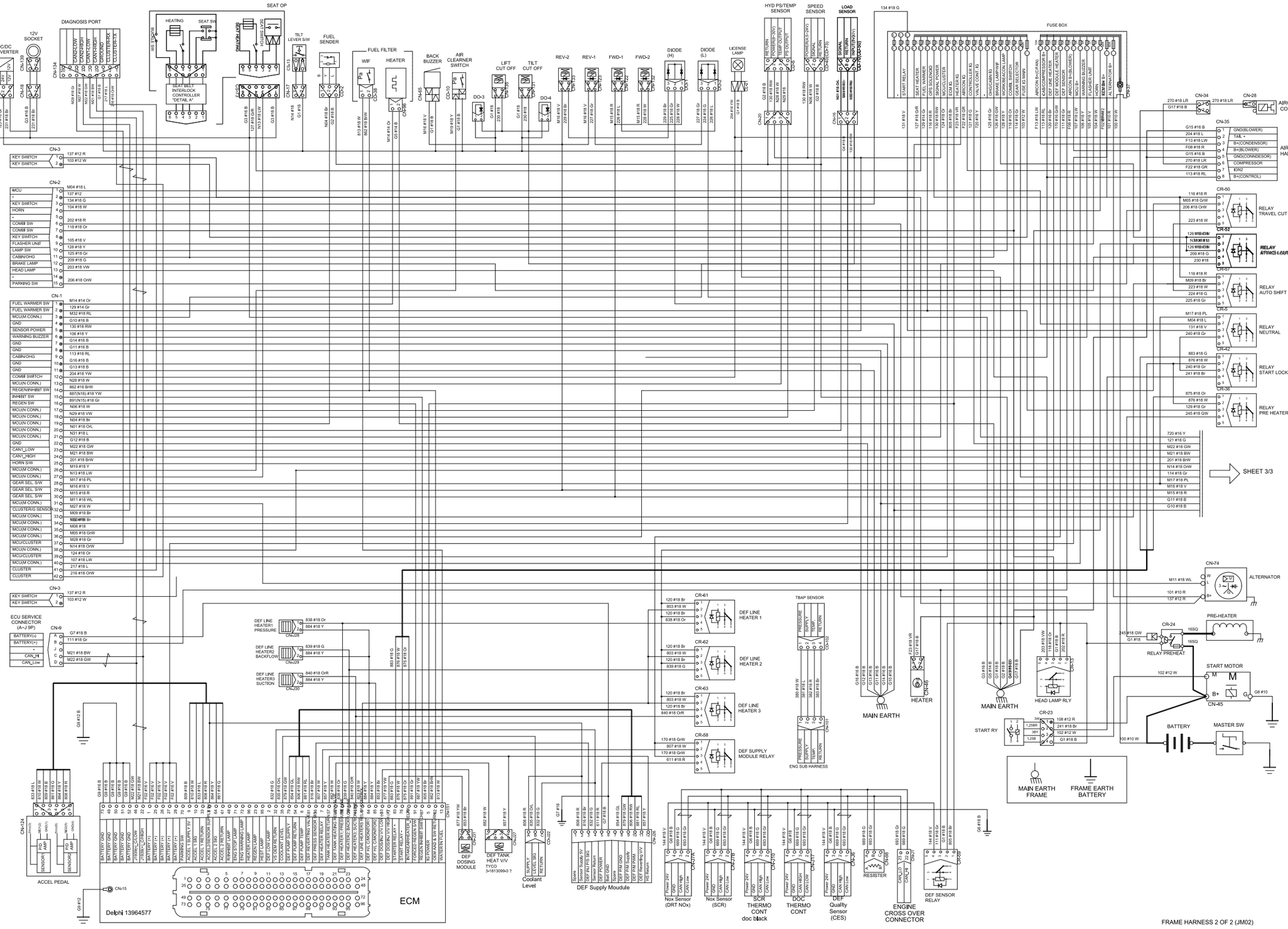


· ELECTRICAL CIRCUIT (FRAME HARNESS 35D-9 : #0417-, 40D-9 : #0272-, 45D-9 : #1486-, 50DA-9 : #1106-)



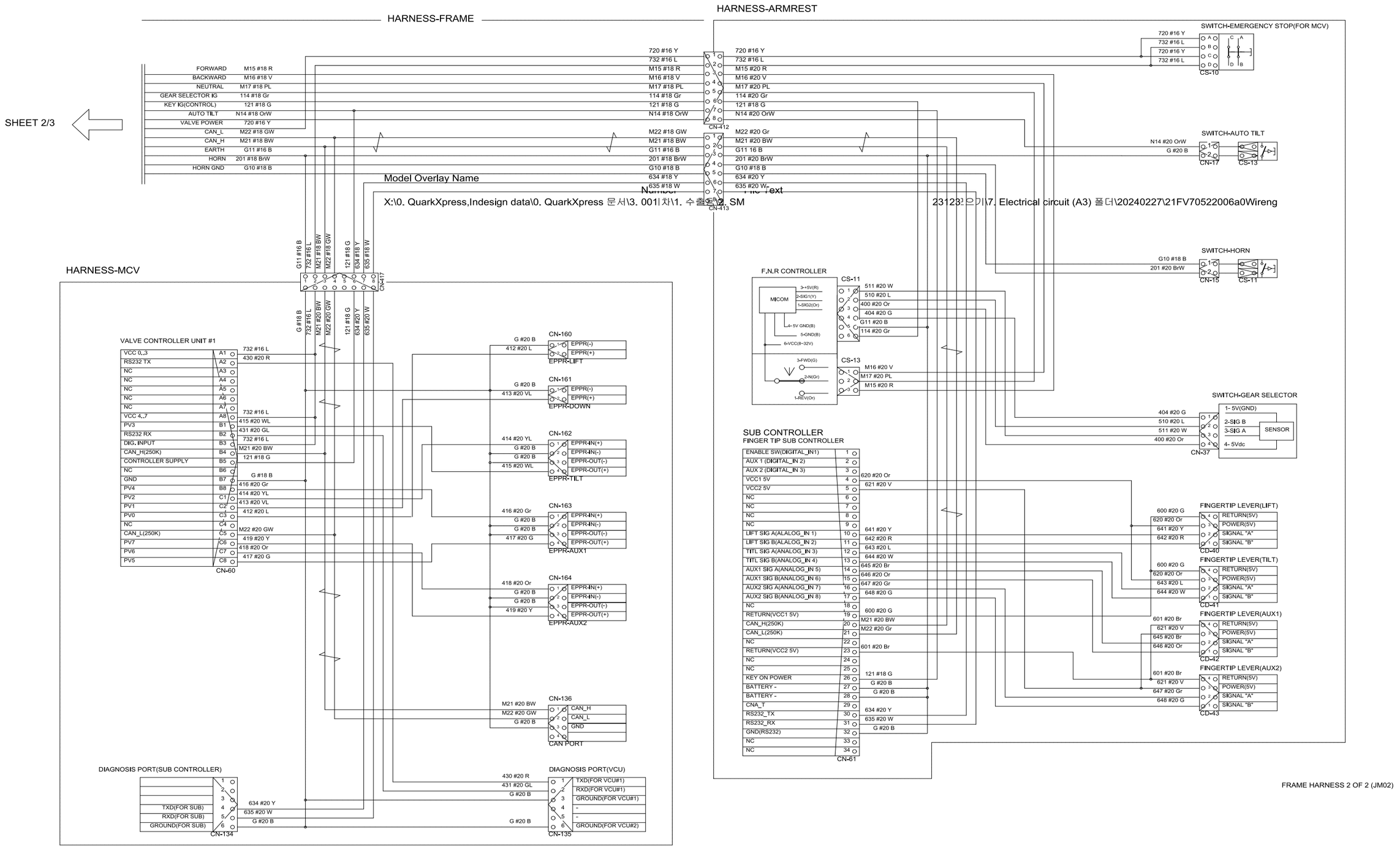
21FV-70522-4

· ELECTRICAL CIRCUIT (FRAME HARNESS 35D-9 : #0417-, 40D-9 : #0272-, 45D-9 : #1486-, 50DA-9 : #1106-)



21FV-70522-5

· ELECTRICAL CIRCUIT (FRAME HARNESS 35D-9 : #0417-, 40D-9 : #0272-, 45D-9 : #1486-, 50DA-9 : #1106-)

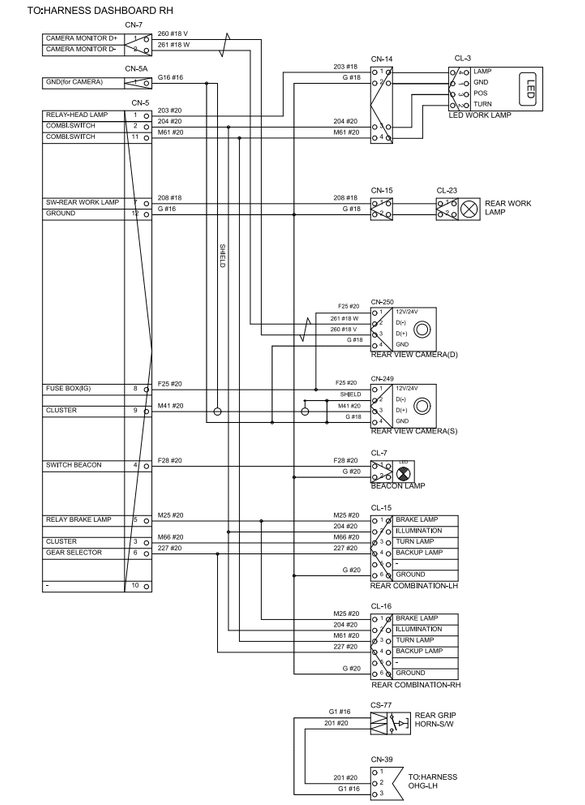


FRAME HARNESS 2 OF 2 (JM02)

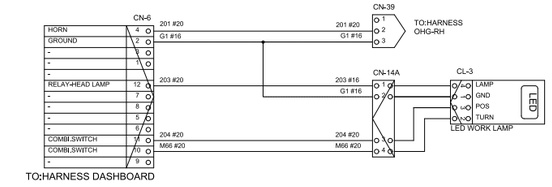
21FV-70522-6

· ELECTRICAL CIRCUIT (CABIN HARNESS 35D-9 : #0417-, 40D-9 : #0272-, 45D-9 : #1486-, 50DA-9 : #1106-)

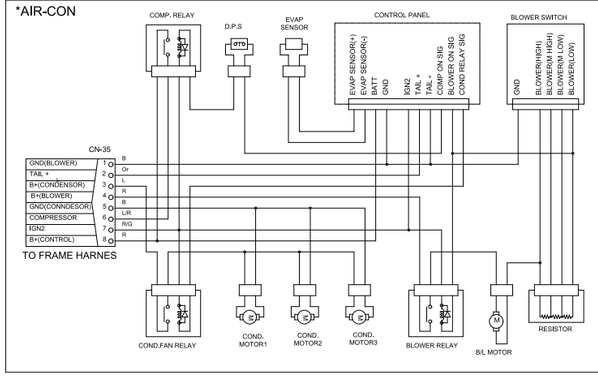
*ELEC.DIAGRAM OF HARNESS OHG-RH(PATIAL CABN-RH)



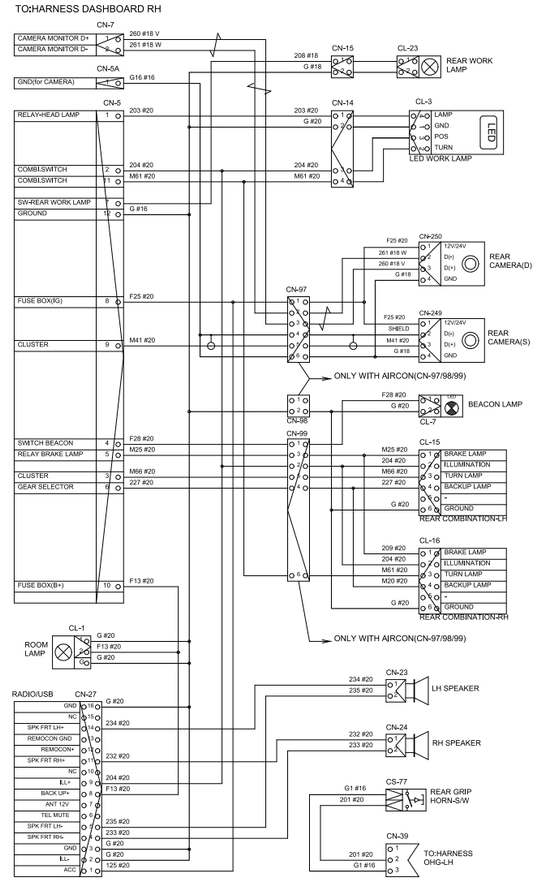
*ELEC.DIAGRAM OF HARNESS OHG-LH



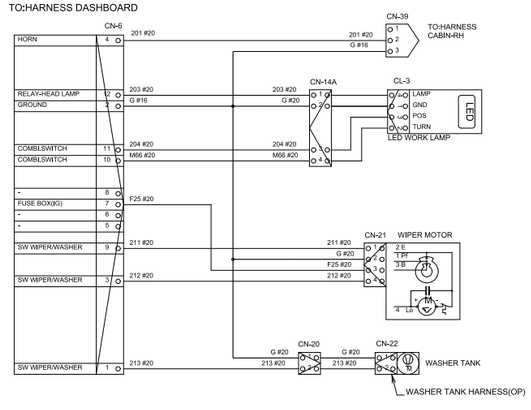
*AIR-CON



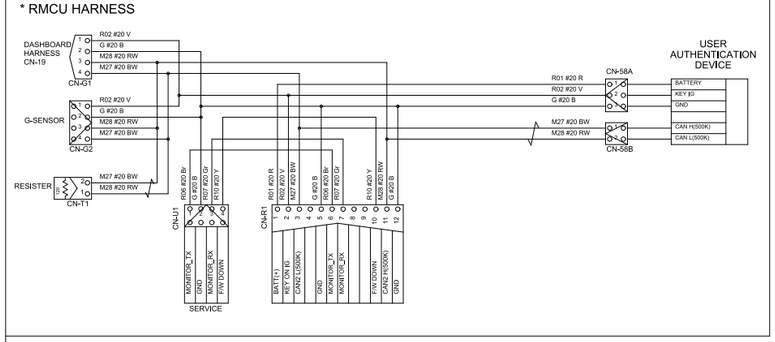
*ELEC.DIAGRAM OF HARNESS CABIN-RH



*ELEC.DIAGRAM OF HARNESS CABIN-LH(PATIAL CABIN-LH)



* RMCU HARNESS



HARNESS(CABIN, OHG, AIRCON, HEATER))

21FV-70522-7

1. POWER CIRCUIT

The negative terminal of the battery is grounded to the machine chassis.
When the start switch is in the off position, the current flows from the positive battery terminal.

1) OPERATING FLOW

Battery(+)
- Start motor [CN-45 (B+)]
  - Preheater relay [CR-24]
  - Start relay [CR-23 (1)]
- Fuse box [CN-37]
  - Fuse box [No.1] → Alternator [CN-74 (B+)]
  - Fuse box [No.2] → I/conn [CN-3 (1)] → Start switch [CS-2 (1)]
  - Fuse box [No.4] → I/conn [CN-2 (4)] → Horn [CN-25 (1)]
  - Fuse box [No.5] → I/conn [CN-2 (9)] → Flasher unit [CR-11 (2)]
  - Fuse box [No.6] → I/conn [CN-1 (6)] → Warning buzzer [CN-113 (1)]
  - Fuse box [No.7] → I/conn [CN-1 (40)] → MCU [CN-59 (M)]
  - Fuse box [No.8] → ECM [CN-151 (1, 25, 26, 27, 28)]
  - Fuse box [No.9]
    - DEF sensor relay [CR-59 (3)]
    - ECU service connector [CN-9 (B)]
  - Fuse box [No.10] → DEF supply module relay [CR-58 (1, 3)]
  - Fuse box [No.11]
    - DEF line heater relay 1 [CR-61 (1, 3)]
    - DEF line heater relay 2 [CR-62 (1, 3)]
    - DEF line heater relay 3 [CR-63 (1, 3)]
  - Fuse box [No.12] → I/conn [CN-1 (1)]
    - I/conn [CN-6 (8)] → RMCU [CN-125 (1)]
    - I/conn [CN-5 (10)]
      - Room lamp [CL-1 (2)]
      - Radio and USB player [CN-27 (8)]

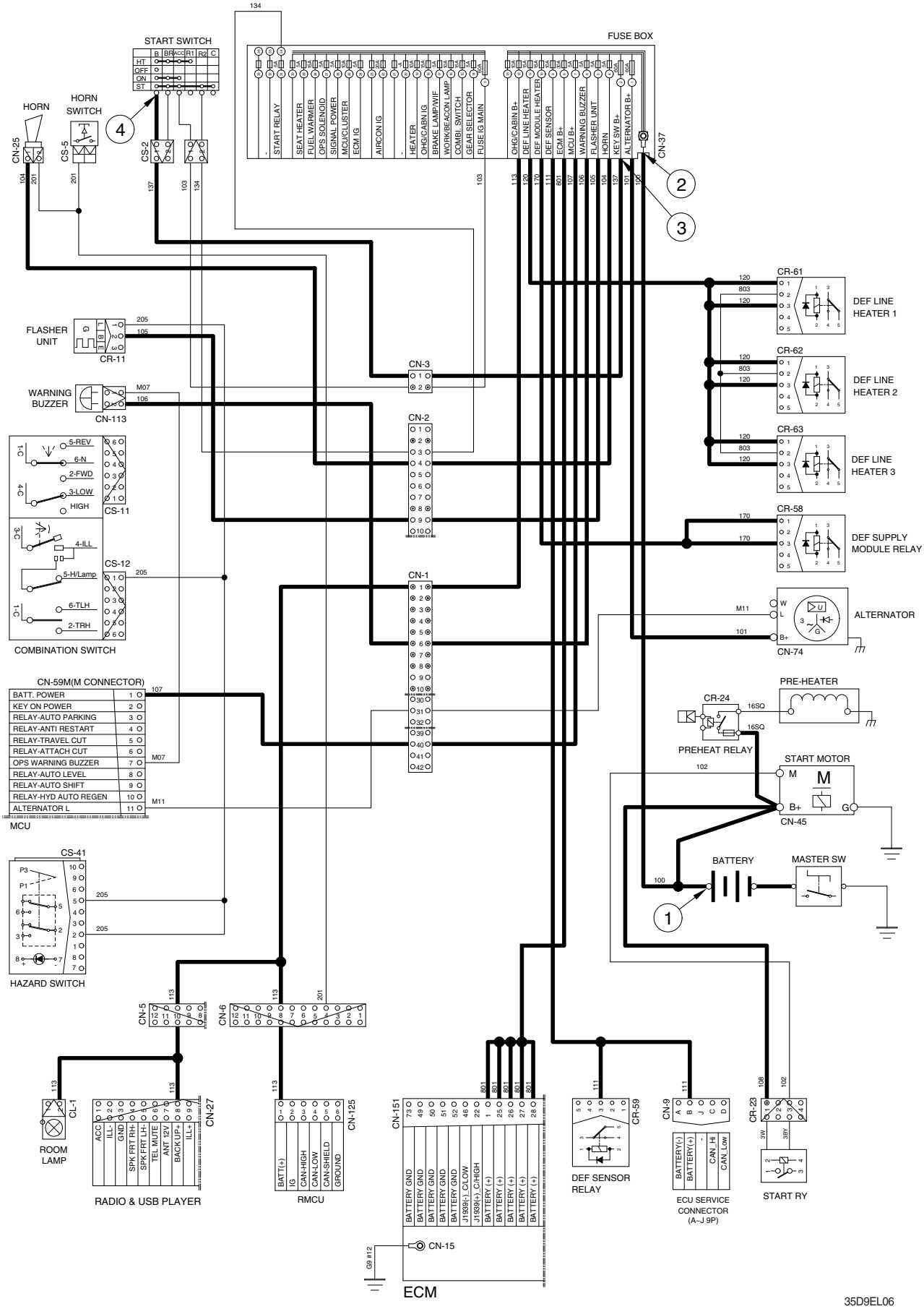
2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	OFF	① - GND (Battery (+)) ② - GND (Fuse B+) ③ - GND (Fuse No.2) ④ - GND (Start key)	24V

※ GND : Ground

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

POWER CIRCUIT



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

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Start motor [CN-45 (B+)] → Start relay [CR-23 (1)]
Battery (+) terminal → Fuse box [CN-37] → Fuse box [CN-36 (No.2)] → I/conn [CN-3 (1)] → Start switch [CS-2 (1)]

※ **The engine can be started only when the gearshift is in neutral position.**

(1) When start key switch is in ON position

Start switch ON [CS-2 (1)] → I/conn [CN-3 (1)] → Fuse box [CN-37 (No.3 →33)] → Power is supply with the electric components.

(2) When start key switch is START position

Start switch START [CS-2 (2)] → I/conn [CN-2 (3)] → Fuse box [CN-37 (No. 34 →31)] → Neutral relay [CR-5 (3 →4)] → Start lock relay [CR-42 (3 →4)] → Start relay [CR-23 (2 →3)] → Start motor [CN-45 (M)] → Start motor operating

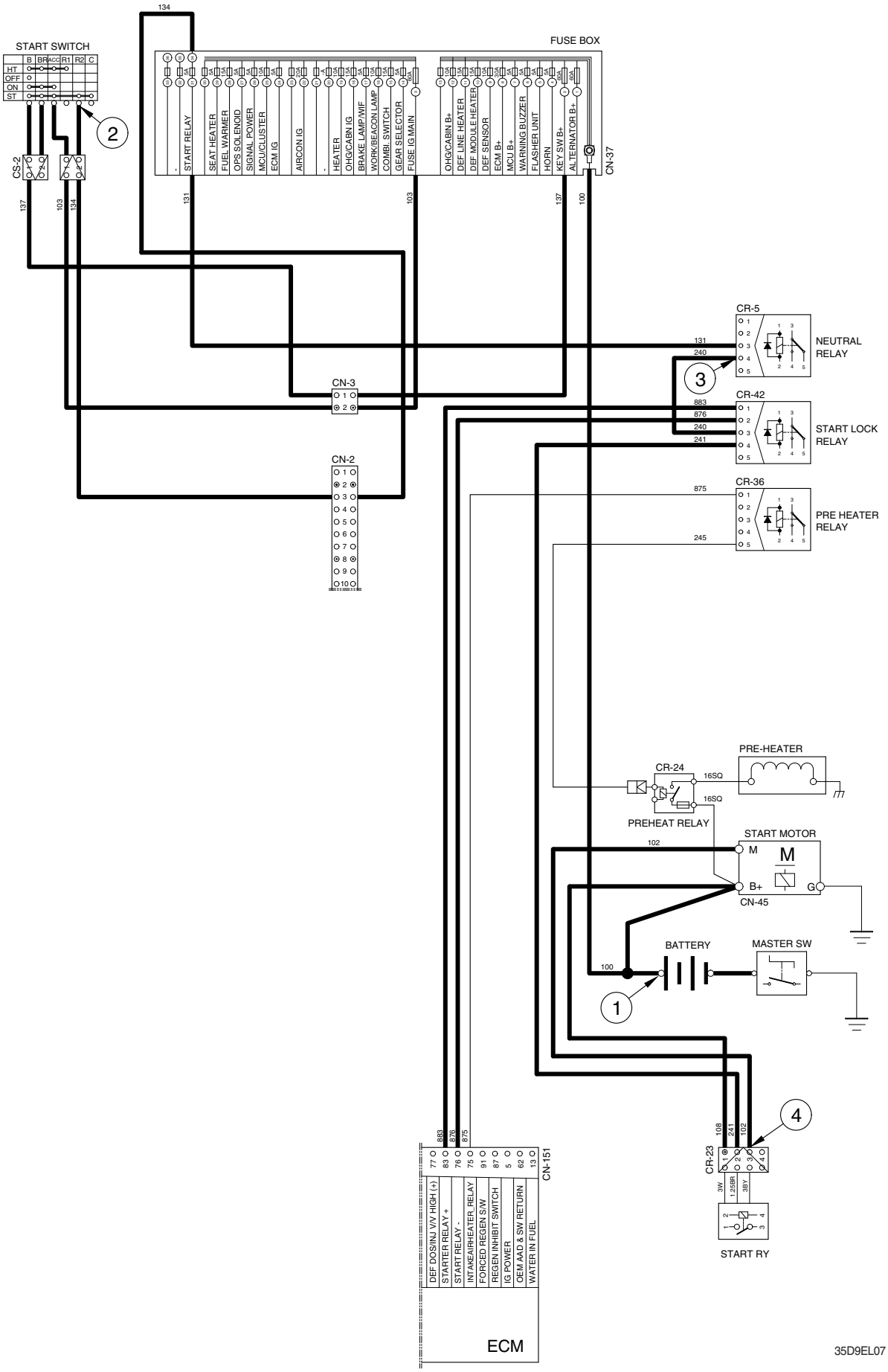
2) CHECK POINT

Engine	Key switch	Check point	Voltage
Running	ON	① - GND (Battery B+) ② - GND (Start key) ③ - GND (Neutral relay) ④ - GND (Start relay)	24V

※ GND : Ground

※ 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 release the start switch to the ON position. Charging current generated by operating alternator flows into the battery.
The current also flows from alternator to each electrical component through the fuse box.

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (L)] → I/conn [CN-1 (31)] → MCU alternator level [CN-59M (11)] → Cluster charging warning lamp (via CAN interface)

(2) Charging flow

Alternator [CN-74 (B+)] → Fuse box [CN-37 (No.1 →B+)] → Battery (+) terminal → Charging

2) CHECK POINT

Engine	Key switch	Check point	Voltage
ON	ON	① - GND (Battery voltage) ② - GND (Alternator B+) ③ - GND (Start switch) ④ - GND (MCU alternator level)	24V

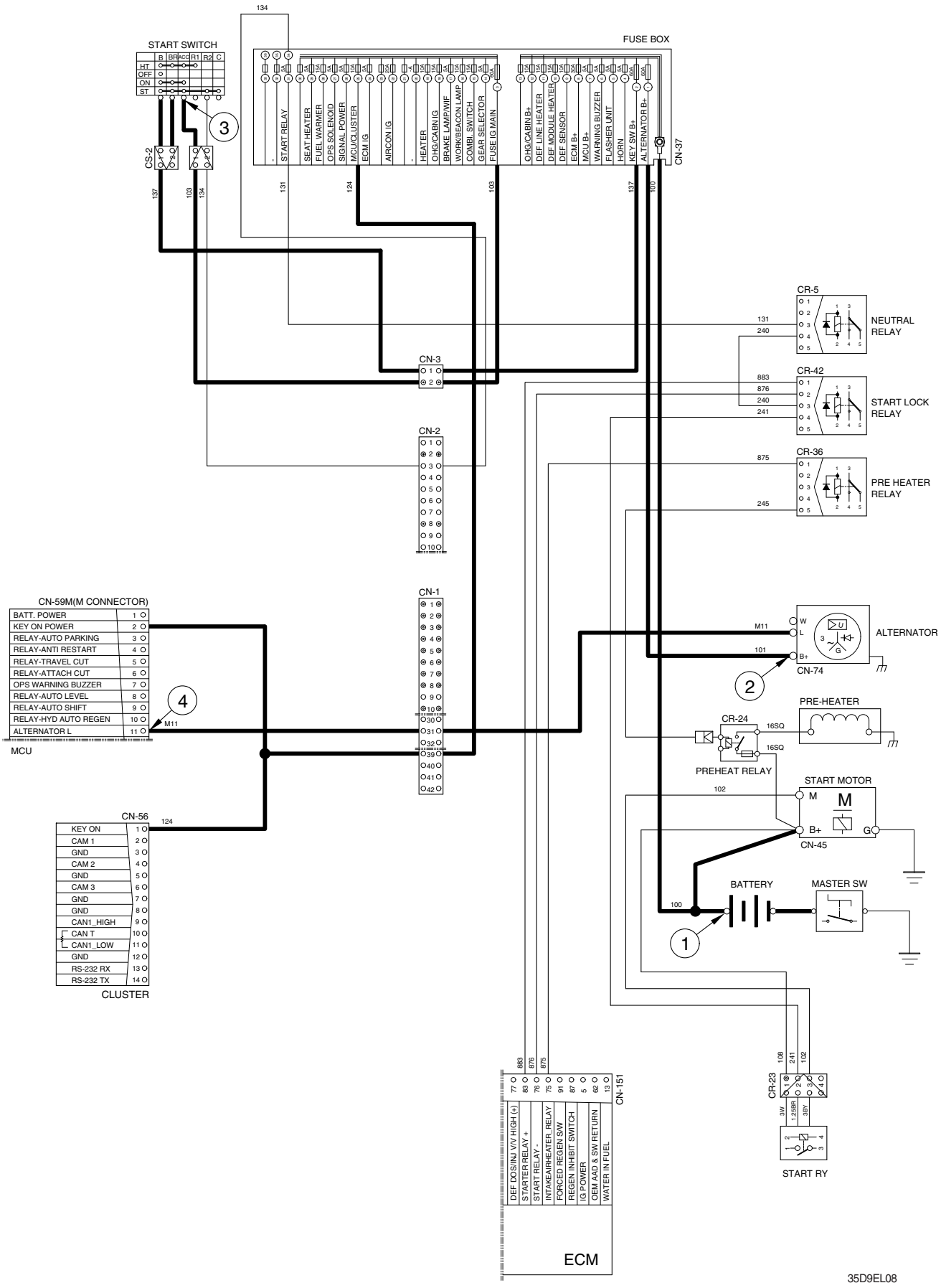
※ GND : Ground

※ Cautions

1. When using an arc welder, always disconnect the ground lead from the battery to prevent alternator or battery damage.
2. Attach the welding ground clamp as close to the weld area as possible to prevent welding current from damaging the bearings of the alternator.
3. Do not disconnect the battery when the engine is running. The voltage surge can damage the diode and resistors in the electrical system.
4. Do not disconnect an electric wire before the engine is stopped and the switches are OFF.

※ 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. PREHEATING CIRCUIT

Combustion chamber air heater are used in order to give satisfactory starting of low ambient temperatures.

1) OPERATING FLOW

Battery (+) terminal → Start motor [CN-45 (B+)] → Preheater relay [CR-23]

※ When you turn the start switch to the ON position, the air heater relay makes the air heater operated and the air heater of the cluster turned ON.

Start switch ON [CS-2 (1)]

- ECM [CN-151 (75)] → Preheater relay [CR-36 (1→4)] → Preheater relay [CR-24] → Preheater operating
- I/conn [CN-3 (2)] → Fuse box [CN-37 (No.3 →28)] → I/conn [CN-1 (2)] → Fuel warmer switch [CS-74 (2→3)] → I/conn [CN-1 (1)] → Fuel heater [CN-96 (1)] → Fuel heater operating

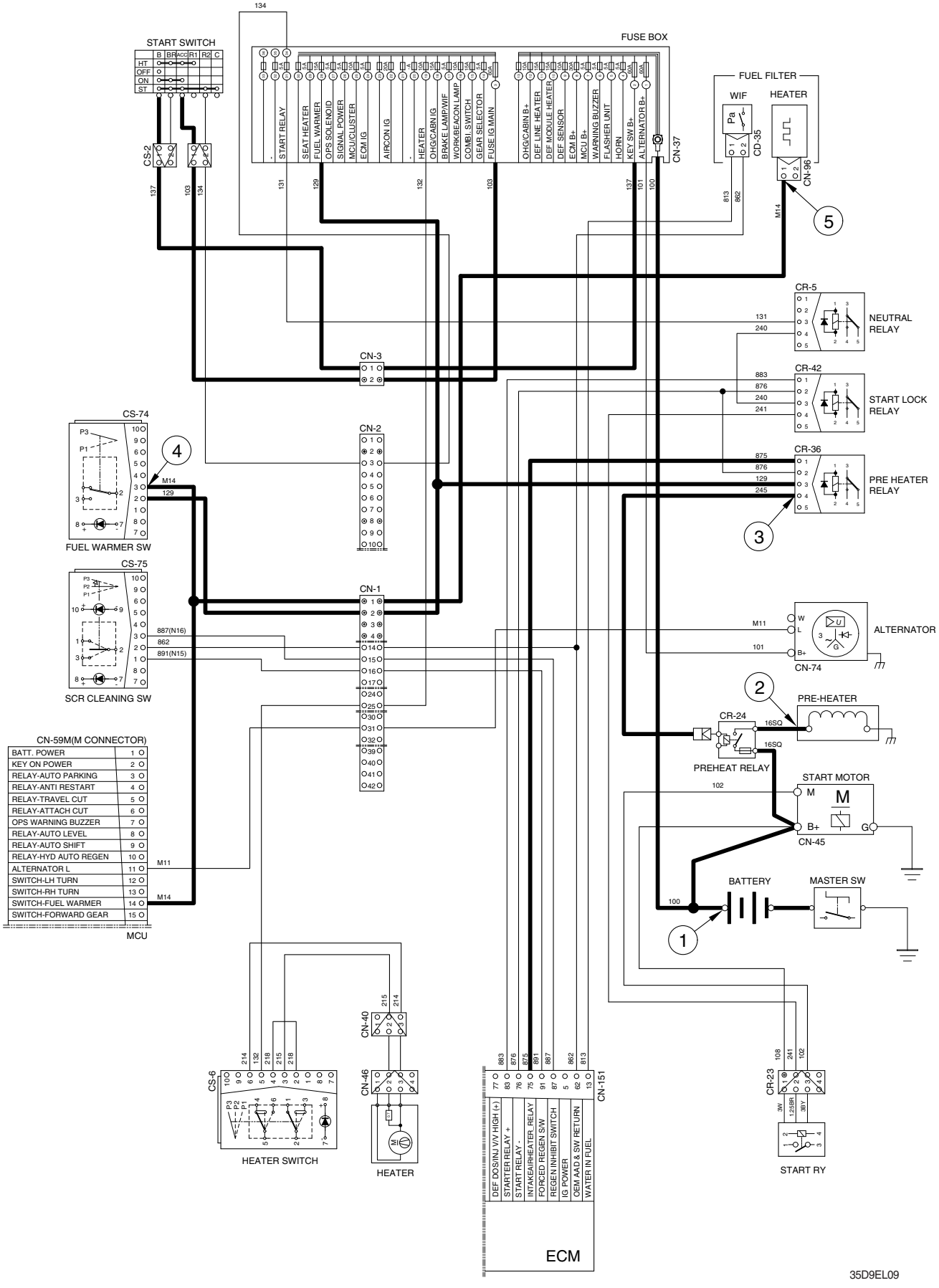
2) CHECK POINT

Engine	Key switch	Check point	Voltage
Stop	HEAT	① - GND (Battery B+) ② - GND (Preheater) ③ - GND (Preheater relay) ④ - GND (Fuel warmer switch) ⑤ - GND (Fuel heater)	24V

※ GND : Ground

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

PREHEATING CIRCUIT



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

5. HEAD LIGHT AND REAR WORK LIGHT CIRCUIT

1) OPERATING FLOW

(1) Head light

Fuse box (No.15) → Multi function switch [CS-12 (3)]

→ Multi function switch ON [CS-12 (5)] → I/conn [CN-2 (6)] → Head lamp relay [CR-13 (1→4)]

→ I/conn [CN-2 (13)] → I/conn [CN-6 (12)] → LH Head lamp ON [CL-3 (1)]

→ I/conn [CN-5 (1)] → RH Head lamp ON [CL-4 (1)]

→ Multi function switch ON [CS-12 (4)] → Switch pilot lamp ON

(2) Rear work light

Fuse box (No.16) → Rear work light switch [CS-21 (2)] → Switch ON [CS-21 (3)]

→ I/conn [CN-5 (7)] → LH rear work light ON [CL-22 (2)]

→ RH rear work light ON [CL-23 (2)]

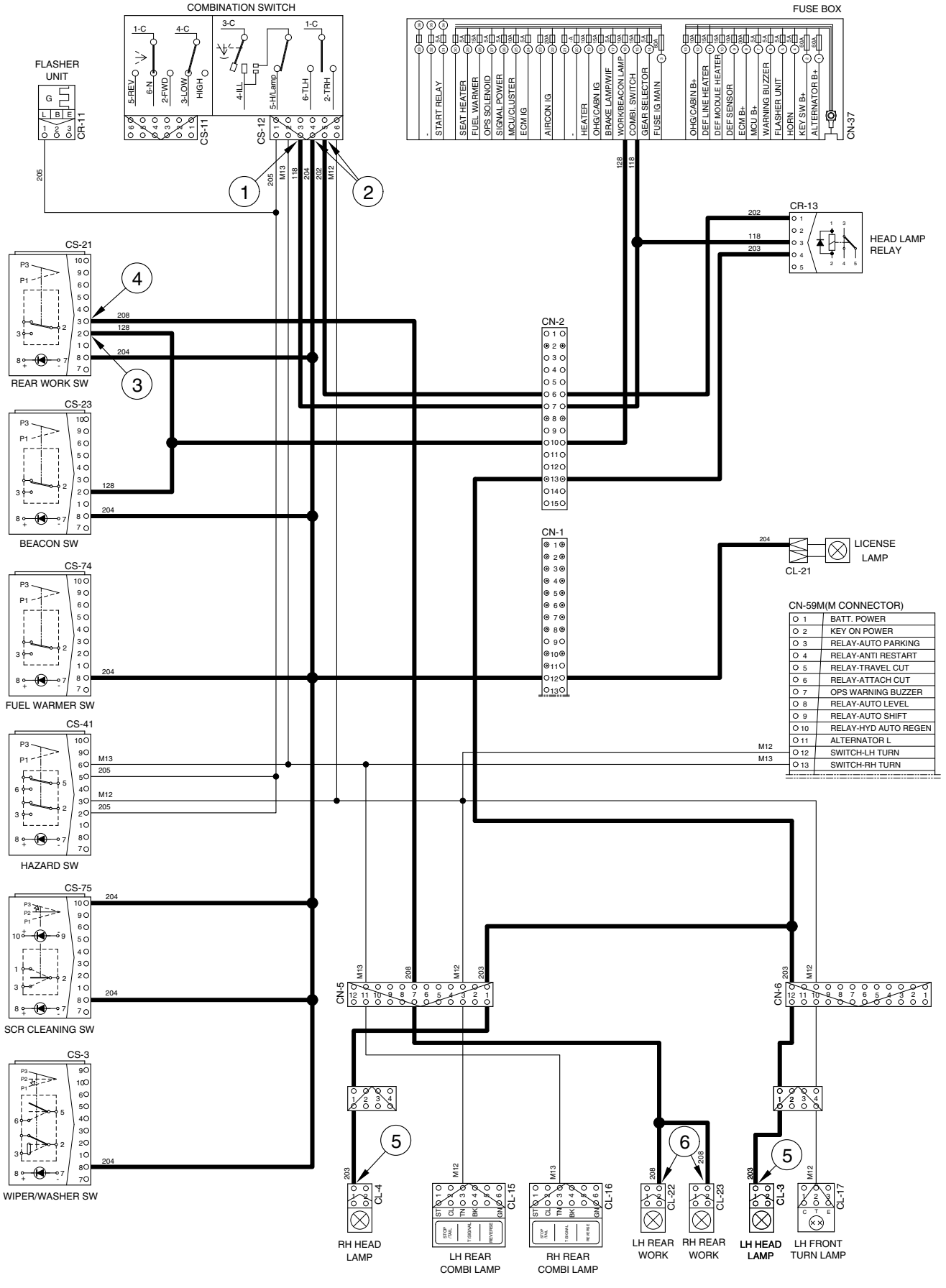
2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	ON	① - GND (Multifunction switch input) ② - GND (Multifunction switch output) ③ - GND (Rear work light switch input) ④ - GND (Rear work light switch output) ⑤ - GND (High light) ⑥ - GND (Rear work light)	20~25V

※ GND : Ground

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

HEAD LIGHT AND REAR WORK LIGHT CIRCUIT



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

6. FRONT WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

Fuse box [CN-37 (No.18)] → Front wiper & washer switch [CS-3 (2, 5)]

(1) Front wiper & washer switch ON (1st step)

Front wiper & washer switch [CS-3 (2)] → I/conn [CN-6 (3)] → Front wiper motor [CN-21 (3)] → Front wiper motor operating

(2) Front wiper & washer switch ON (2nd step)

- Front wiper & washer switch ON [CS-3 (2)] → I/conn [CN-6 (3)] → Front wiper motor [CN-21 (3)] → Front wiper motor operating
- Front wiper & washer switch [CS-3 (6)] → I/conn [CN-6 (1)] → Front washer tank [CN-22 (2)] → Front washer pump operating

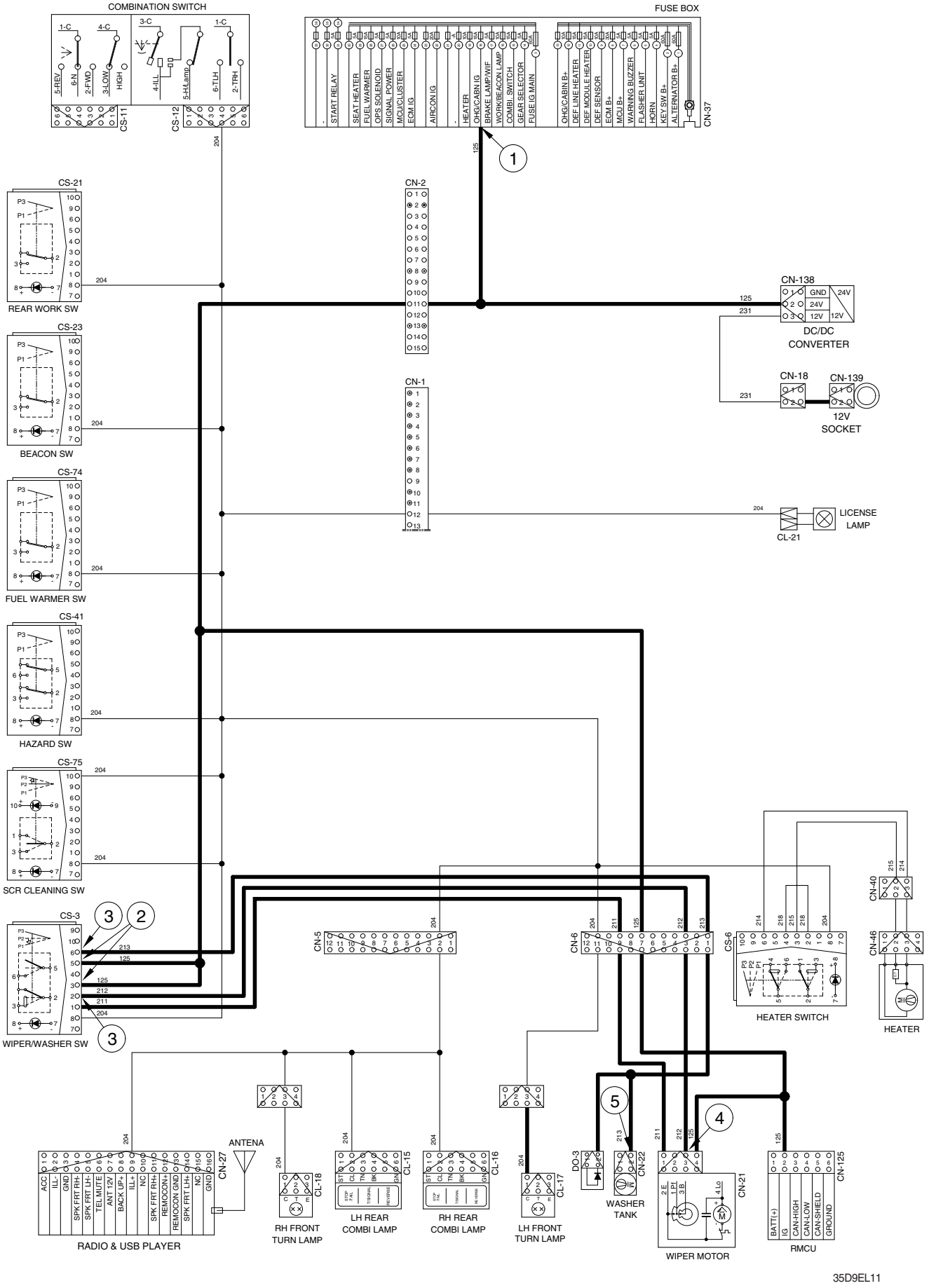
2) CHECK POINT

Engine	Key switch	Check point	Voltage
Stop	ON	① - GND (Fuse box No. 18) ② - GND (Front wiper & washer switch power input) ③ - GND (Front wiper & washer switch output) ④ - GND (Front wiper motor power input) ⑤ - GND (Front washer pump power input)	20~25V

※ GND : Ground

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

FRONT WIPER AND WASHER CIRCUIT



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

GROUP 3 COMPONENT SPECIFICATION

<table>
<tr><th>No</th><th>Part name</th><th>Qty</th><th>Specification</th></tr>
<tr><td>1</td><td>Battery</td><td>2</td><td>12V×80 AH×2 EA
RC : 130 min
CCA : 640A</td></tr>
<tr><td>2</td><td>Working lamp</td><td>1</td><td>24V, 75W</td></tr>
<tr><td>3</td><td>License lamp</td><td>1</td><td>24V, 3W×2</td></tr>
<tr><td>4</td><td>Rear Combination lamp (LED)</td><td>2</td><td>24V, 1.2/0.7W (Stop/Tail)
24V, 2.4W (Turn)
24V, 1.2W (Back Up)</td></tr>
<tr><td>5</td><td>Head lamp</td><td>2</td><td>24V, 75W</td></tr>
<tr><td>6</td><td>Flasher lamp</td><td>2</td><td>24V, 0.7/3.4W (posi/turn signal)</td></tr>
<tr><td>7</td><td>Beacon lamp (opt)</td><td>1</td><td>24V, max. 0.560A</td></tr>
<tr><td>8</td><td>Beacon lamp (LED)</td><td>1</td><td>12~30V, max. 0.800A</td></tr>
<tr><td>9</td><td>Camera (opt)</td><td>1</td><td>24V, 2.5W</td></tr>
<tr><td>10</td><td>Start relay</td><td>1</td><td>24V, 300A</td></tr>
<tr><td>11</td><td>Glow relay</td><td>1</td><td>24V, 300A</td></tr>
<tr><td>12</td><td>Relay (4P)</td><td>3</td><td>24V, 20A</td></tr>
<tr><td>13</td><td>Relay (5P)</td><td>3</td><td>24V, 6A</td></tr>
<tr><td>14</td><td>Flasher Unit</td><td>1</td><td>24V, 85±10 CM, (21W + 21W) × 2 + 3W ×2</td></tr>
<tr><td>15</td><td>Back buzzer</td><td>1</td><td>24V, 90±5 dB, 60±10 C/M</td></tr>
<tr><td>16</td><td>Horn</td><td>1</td><td>24V, MAX 1.5A, 100 ~ 115 dB</td></tr>
<tr><td>17</td><td>Cluster</td><td>1</td><td>24V, 15W</td></tr>
<tr><td>18</td><td>G-sensor (Mast angle) (opt)</td><td>1</td><td>24V, 5W</td></tr>
<tr><td>19</td><td>Fuel level sender</td><td>1</td><td>
<table>
<tr><td>Float indicator</td><td>E</td><td>4/8</td><td>F</td></tr>
<tr><td>Resistance (Ω)</td><td>700</td><td>350</td><td>50</td></tr>
<tr><td rowspan="2">Tolerance (Ω)</td><td>+0%</td><td rowspan="2">+5%</td><td>-0%</td></tr>
<tr><td>+5%</td><td>-5%</td></tr>
</table>
</td></tr>
<tr><td>20</td><td>Master switch</td><td>1</td><td>24V, 180A</td></tr>
<tr><td>21</td><td>Gear selector switch</td><td>1</td><td>24V, 3.5A</td></tr>
<tr><td>22</td><td>Combination switch</td><td>1</td><td>Direction : 24V, 3.5A
Multi-function switch : 24V, 2A</td></tr>
<tr><td>23</td><td>Working lamp switch</td><td>1</td><td>24V, 15A</td></tr>
<tr><td>24</td><td>Hazard switch</td><td>1</td><td>24V, 15A</td></tr>
<tr><td>25</td><td>Start switch</td><td>1</td><td>24V, 60A</td></tr>
<tr><td>26</td><td>SCR cleaning switch</td><td>1</td><td>24V, 15A</td></tr>
<tr><td>27</td><td>Fuel warmer switch</td><td>1</td><td>24V, 15A</td></tr>
<tr><td>28</td><td>Beacon lamp switch (opt)</td><td>1</td><td>24V, 15A</td></tr>
<tr><td>29</td><td>Wiper/washer switch (opt)</td><td>1</td><td>24V, 15A</td></tr>
<tr><td>30</td><td>Heater switch</td><td>1</td><td>24V, 15A</td></tr>
</table>

GROUP 4 CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	42	I/conn (Dashboard harness-frame harness)	936421	936429
CN-2	AMP	15	I/conn (Dashboard harness-frame harness)	2-85262-1	368301-1
CN-3	KET	2	I/conn (Dashboard harness-frame harness)	MG642928-5	MG652934-5
CN-5	KET	12	I/conn (Cabin harness-dashboard harness, RH)	MG610346	MG640348
CN-6	KET	12	I/conn (Cabin harness-dashboard harness, LH)	MG610346	MG640348
CN-9	DEUTSCH	9	ECU service connector	-	HD10-9-1939P
CN-12	AMP	42	Engine harness	936421	-
CN-13	MOLEX	12	Injection harness	33472-1206	-
CN-14	DAEDONG	4	Head/Turn lamp harness	110-4PR	110-4PT
CN-15	DAEDONG	2	Work lamp harness	-	110-2PT
CN-16	AMP	3	I/conn (Frame harness-load sensor harness)	174357-2	174359-2
CN-17	KET	2	I/conn (Frame harness-tilt lever switch)	MG610320	MG642552
CN-18	AMP	2	Socket harness	174352-2	174354-2
CN-19	AMP	4	I/conn (G-sensor-dashboard harness)	174257-2	174259-2
CN-20	KET	4	Hydraulic PS/temp sensor	MG610331	MG640333
CN-23	KET	2	Speaker - LH	MG610070	-
CN-24	KET	2	Speaker - RH	MG610070	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-27	KUM	16	Radio/USB player	PK145-16017	-
CN-29	KET	2	A/C dual pressure switch	MG640795	-
CN-30	KET	2	A/C compressor	MG610043	-
CN-30A/B	KET	2	I/conn (A/C harness-A/C compressor)	MG610320	MG640322
CN-36	KET	2	Knob gear selector (opt)	-	MG640341
CN-37	QPL	-	Fuse box	21HN-55010	-
CN-39	KET	2	To LH cab harness	MG610320	-
CN-41	KET	2	I/conn (Cab harness-A/C harness)	MG610320	MG640322
CN-42	KET	8	To A/C harness	MG610271	-
CN-43	KET	2	I/conn (Frame harness-A/C harness)	MG642928-5	MG652934-5
CN-45	KET	1	Start motor (B+)	S820-310000	-
		1	Start motor (M)	S820-205000	-
CN-56	AMP	14	Cluster	776273-2	-
CN-59N	AMP	34	MCU (Machine control unit)	4-1437290-1	-
CN-59M	AMP	34	MCU (Machine control unit)	4-1437290-0	-
CN-65	KET	1	Back buzzer	ST730018-3	ST750036-3
CN-66	DEUTSCH	2	Pressure auto regen valve	DT06-2S	-
CN-74	KET	1	Alternator (L)	S820-105000	-
		1	Alternator (B+)	S820-308000	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-83	KUM	2	A/C condensor fan	PB625-02027	-
CN-90E	MOLEX	80	Engine control unit	34566-1903	-
CN-91V	MOLEX	80	Engine control unit	34566-0803	-
CN-96	AMP	2	Fuel heater	2-967325-3	-
CN-97	KET	2	Fuel feed pump	MG610043	-
CN-98	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-101	DELPHI	4	Engine sub harness	-	54200415
CN-113	KET	2	OPSS buzzer	MG610320	-
CN-122	DEUTSCH	2	Forward solenoid 1	DT06-2S	-
CN-123	DEUTSCH	2	Reverse solenoid 1	DT06-2S	-
CN-124	AMP	6	Accelerator pedal	174262-2	-
CN-131	AMP	2	Cut-off solenoid 1 (Tilt)	174352-2	174354-2
CN-132	DEUTSCH	2	Forward solenoid 2	DT06-2S	-
CN-133	DEUTSCH	2	Reverse solenoid 2	DT06-2S	-
CN-134	KET	20	Diagnosis port	MG632867	-
CN-135	AMP	2	Cut-off solenoid 2 (Lift)	174352-2	174354-2
CN-138	KET	3	DC/DC converter	MG610045	MG620044
CN-139	DEUTSCH	3	Load sensor harness	DTM06-3S	-
	KET	2	12V socket	MG610043	-
CN-140	KET	3	MCU update	MG610327	-
CN-151	DELPHI	96	ECU	13964577	-
CN-157	AMP	4	CAN (service port)	174257-2	174259-2
CN-249	AMP	4	Rear view camera	174257-2	174259-2
CN-J1	DELPHI	24	Engine cross over connector	F934000	-
CN-J6	DEUTSCH	4	DEF quality sensor	DT06-4S	-
CN-J7A	AMP	4	NOx sensor	2-1418390-1	-
CN-J7B	AMP	4	NOx sensor	1-1418390-1	-
CN-J10	AMP	4	SCR thermo control	3-1418390-1	-
CN-J26	AMP	12	DEF supply module	2-1703639-1	-
CN-J27	AMP	4	DEF tank heat valve	1-967325-1	-
CN-J28	DEUTSCH	2	DEF pressure line heater 1	DT06-2S-W2SB	-
CN-J29	DEUTSCH	2	DEF backflow line heater 2	DT06-2S-W2SB	-
CN-J30	DEUTSCH	2	DEF suction line heater 3	DT06-2S-W2SB	-
CN-J31	AMP	2	DEF dosing unit	936059-1	-
Switch					
CS-2	KET	2	Start switch	MG610281	MG620282
CS-3	CARLING	10	Wiper/Washer switch	21HN-56300	-
CS-5	RING TERM	-	Horn switch	S810-105000	-
CS-6	CARLING	10	Heater switch	21HN-56300	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-11	DEUTSCH	6	Gear selector switch	DT06-6S	-
CS-12	DEUTSCH	6	Combination switch	DT06-6S-P012	-
CS-13	KET	2	Tilt lever switch	MG610320	MG642552
CS-17	KET	3	Parking switch	MG610045	-
CS-21	CARLING	10	Rear work lamp switch	21HN-56300	-
CS-23	CARLING	10	Beacon lamp switch	21HN-56300	-
CS-41	CARLING	10	Hazard switch	21HN-56300	-
CS-73	DEUTSCH	6	Seat switch	DT06-6S	-
CS-74	CARLING	10	Fuel warmer switch	21HN-56300	-
CS-75	CARLING	10	Parked regeneration switch	21HN-56300	-
	CARLING	10	Inhibit regeneration switch	21HN-56300	-
CS-77	KET	1	Rear grip horn switch	ST730018-3	ST750036-3
Lamp					
CL-1	KET	2	Room lamp	MG610392	-
CL-3	DEUTSCH	2	Head lamp	DT06-2S	-
CL-7	DEUTSCH	2	Beacon lamp	DT06-2S	DT04-2P
CL-14	AMP	3	Front turn lamp	936187-3	-
CL-15	DAEDONG	6	R/Combination lamp-LH	110-6PR	-
CL-16	DAEDONG	6	R/Combination lamp-RH	110-6PR	-
CL-21	KET	1	License lamp	ST730018-3	ST750036-3
CL-23	KET	2	Work lamp	MG652520	-
Relay					
CR-5	OMRON	5	Neutral relay	21FV-55510	-
CR-11	KET	3	Flasher unit relay	312_GIHUNG_3P	-
CR-12	OMRON	5	Auto level relay	21FV-55510	-
CR-13	OMRON	5	Head lamp relay	21FV-55510	-
CR-23	KET	4	Start relay	MG610047	-
CR-24	KET	1	Heater relay	ST730018-3	-
CR-43	OMRON	5	ECU (B+) relay	21FV-55510	-
CR-45	OMRON	5	ECU (IG) relay	21FV-55510	-
CR-50	OMRON	5	Travel cut relay	21FV-55510	-
CR-51	OMRON	5	Attach cut relay	21FV-55510	-
CR-52	OMRON	5	Brake lamp relay	21FV-55510	-
CR-57	OMRON	5	Auto shift relay	21FV-55510	-
Sensor and pressure switch					
CD-2	DEUTSCH	4	Fuel sendor	DT06-4S	-
CD-4	DEUTSCH	4	Brake oil pressure sensor	DT06-4S	-
CD-5	DEUTSCH	4	Hyd pressure temperature sensor	DT06-4S	-
CD-6	DEUTSCH	4	G sensor	DT06-4S	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-10	KET	1	Air cleaner switch	ST730057-2	-
CD-29	DEUTSCH	4	T/M pressure temperature sensor	DT06-4S	-
CD-38	DEUTSCH	2	Water in fuel switch	DT06-2S	-
CD-40	KET	3	Speed sensor	MG610327	-
CD-50	DEUTSCH	3	Load sensor (hall)	DTM06-3S	-
CD-60	KET	2	Brake oil level	MG610320	-
CD-60	YAZAKI	2	DOC inlet temp sensor	7283-7026-30	-
CD-61	YAZAKI	2	DOC outlet temp sensor	7283-7028-10(-30)	-
CD-62	YAZAKI	2	DOC outlet temp sensor	7283-7023(-10)	-
CD-64	SUMITOMO	5	Air-flow sensor	6189-1046	-
CD-73	KET	3	Speed sensor	MG610327	-
CD-102	SUMITOMO	4	TBAP sensor	6098-0144	-
CD-J22	DELPHI	3	Coolant level sensor	12110293	-
DO-01	-	-	Diode	F15890030	-
DO-01(H)	-	-	Diode	F15890030	-
DO-02	-	-	Diode	F15890030	-
DO-02(L)	-	-	Diode	F15890030	-
DO-03	-	-	Diode	21EA-50550	-
DO-04	-	-	Diode	21EA-50550	-

GROUP 5 TROUBLESHOOTING

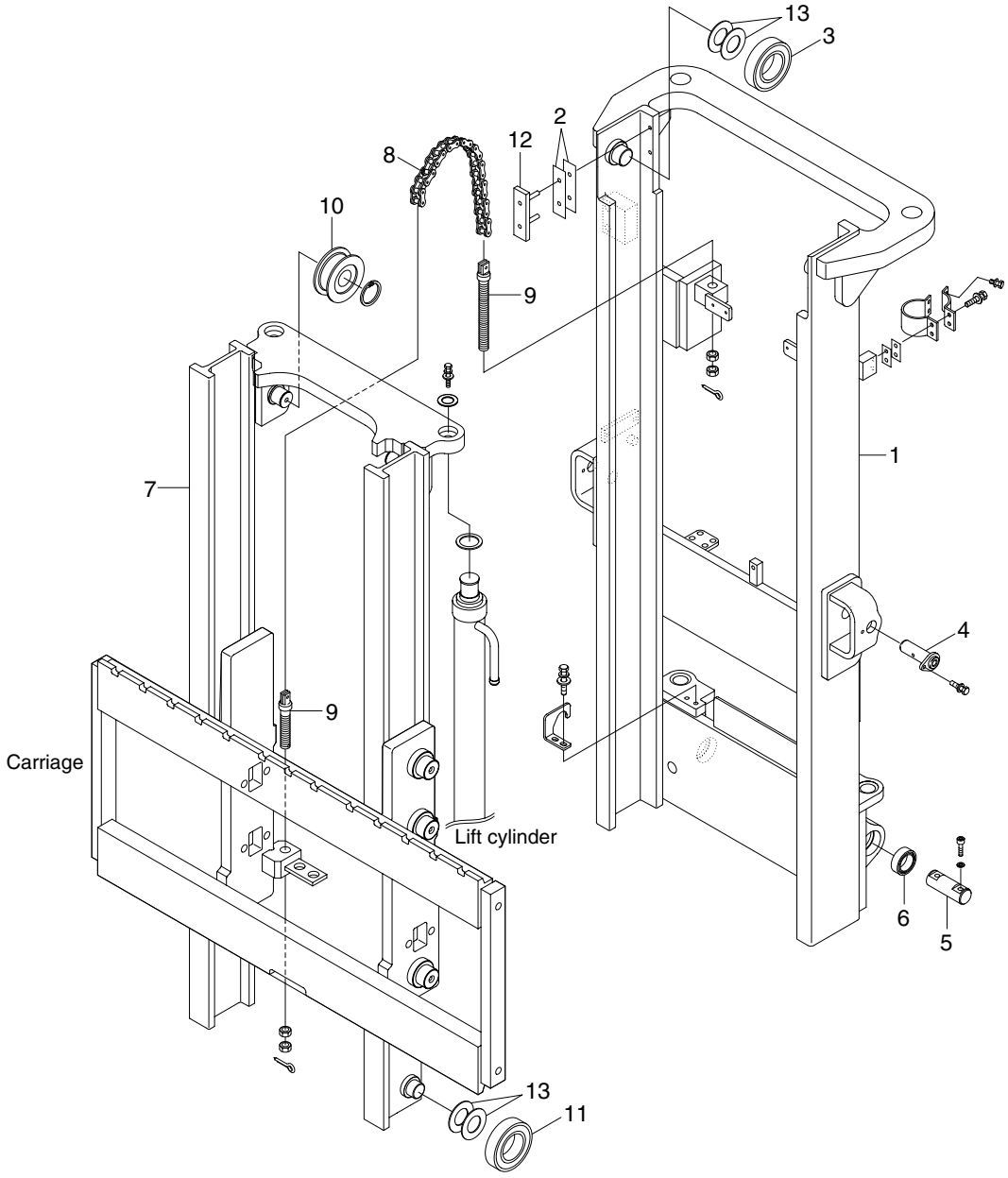
Trouble symptom	Probable cause	Remedy
Lamps dimming even at maximum engine speed.	· Faulty wiring.	· Check for loose terminal and disconnected wire.
Lamps flicker during engine operation.	· Improper belt tension.	· Adjust belt tension.
Charge lamp does not light during normal engine operation.	· Charge lamp defective. · Faulty wiring.	· Replace. · Check and repair.
Alternator makes abnormal sounds.	· Alternator defective.	· Replace.
Starting motor fails to run.	· Faulty wiring. · Insufficient battery voltage.	· Check and repair. · Recharge battery.
Starting motor pinion repeats going in and out.	· Insufficient battery voltage.	· Recharge battery.
Excessively low starting motor speed.	· Insufficient battery voltage. · Starting motor defective.	· Recharge battery. · Replace
Starting motor comes to a stop before engine starts up.	· Faulty wiring. · Insufficient battery voltage.	· Recharge battery. · Replace
Heater signal does not become red.	· Faulty wiring. · Glow plug damaged.	· Check and repair. · Replace
Engine oil pressure caution lamp does not light when enigne is stopped (with starting switch left in "ON" position).	· Caution lamp defective. · Caution lamp switch defective.	· Replace · Replace

SECTION 8 MAST

Group 1 Structure 8-1
Group 2 Operational Checks and troubleshooting 8-5
Group 3 Adjustment 8-8
Group 4 Removal and Installation 8-11

GROUP 1 STRUCTURE

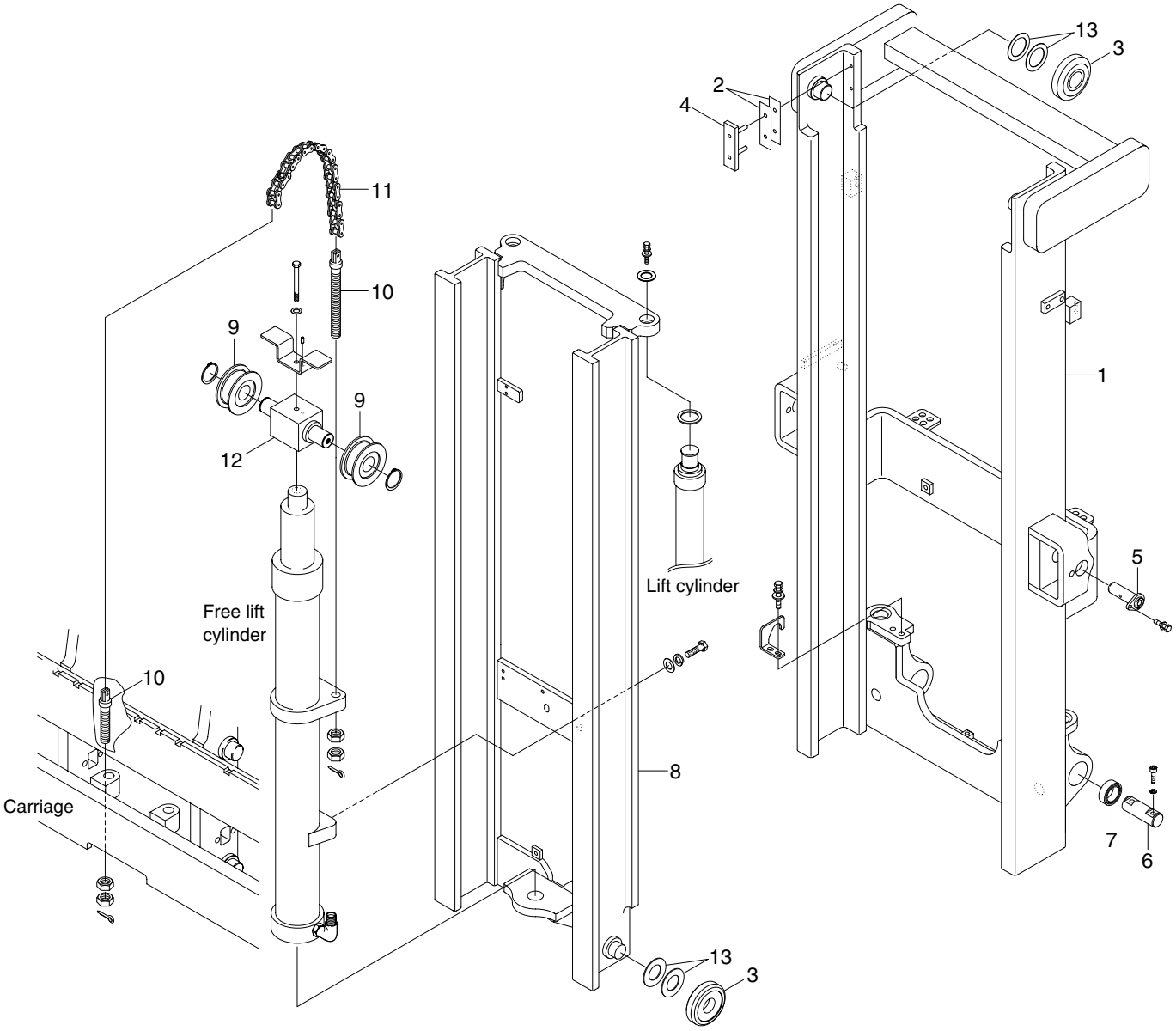
1. 2 STAGE MAST (V MAST)



35D9MS01

1	Outer mast	6	Bearing	11	Roller bearing
2	Shim (0.5, 1.0t)	7	Inner mast	12	Back up liner
3	Roller bearing	8	Lift chain	13	Shim (0.5, 1.0t)
4	Tilt cylinder pin	9	Anchor bolt		
5	Mast mounting pin	10	Chain sheave bearing		

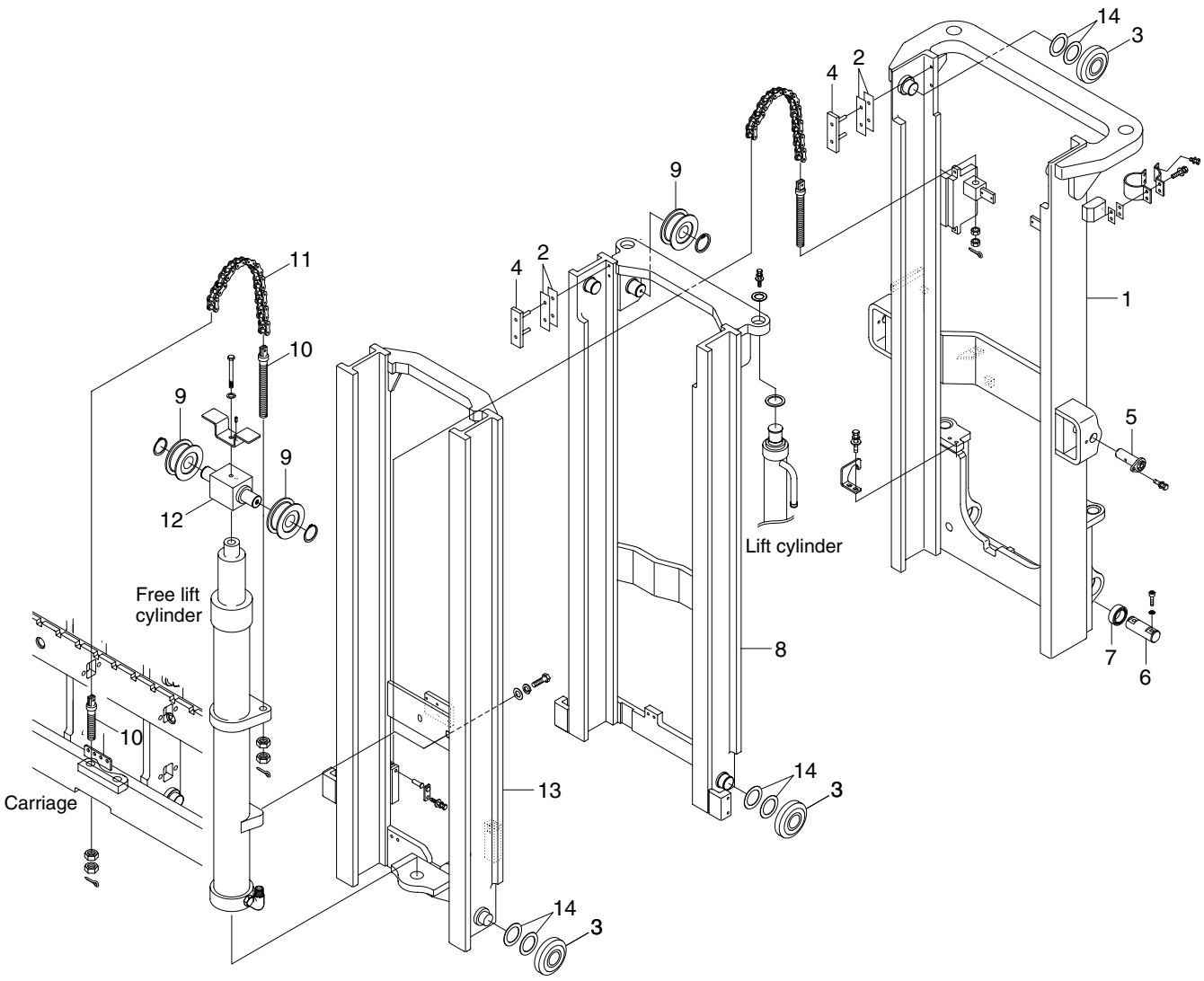
2. 2 STAGE MAST(VF MAST)



35D9MS02

1	Outer mast	6	Mast mounting pin	11	Chain
2	Shim (0.5, 1.0t)	7	Bearing	12	Sheave bracket
3	Roller bearing	8	Inner mast	13	Shim (0.5, 1.0t)
4	Backup liner	9	Chain sheave bearing		
5	Tilt cylinder pin	10	Anchor bolt		

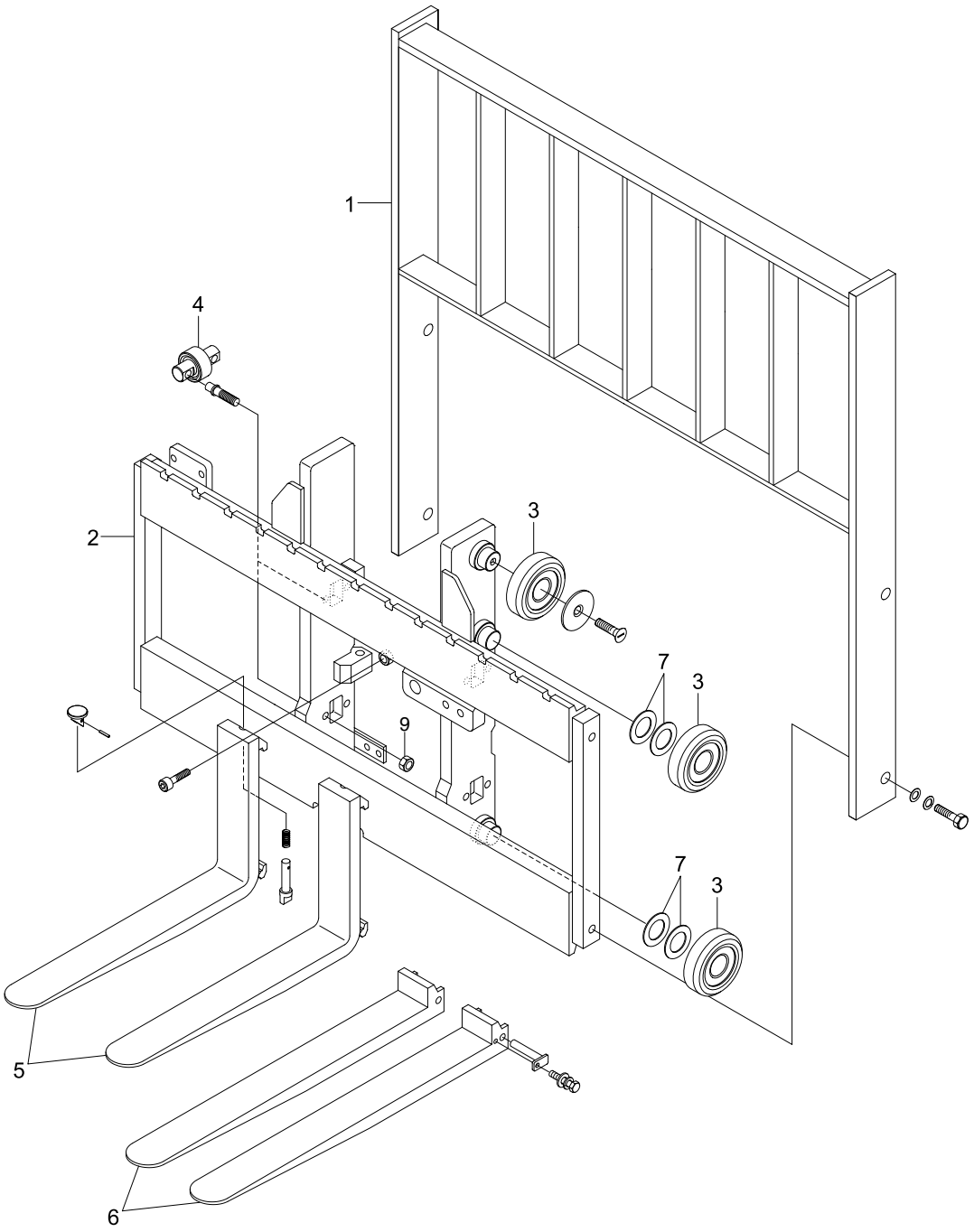
3. 3 STAGE MAST(TF MAST)



35D9MS03

1	Outer mast	6	Mast mounting pin	11	Chain
2	Shim (0.5, 1.0t)	7	Bearing	12	Sheave bracket
3	Roller bearing	8	Middle mast	13	Inner mast
4	Backup liner	9	Chain sheave bearing	14	Shim (0.5, 1.0t)
5	Tilt cylinder pin	10	Anchor bolt		

3. CARRIAGE, BACKREST AND FORK



35D9MS04

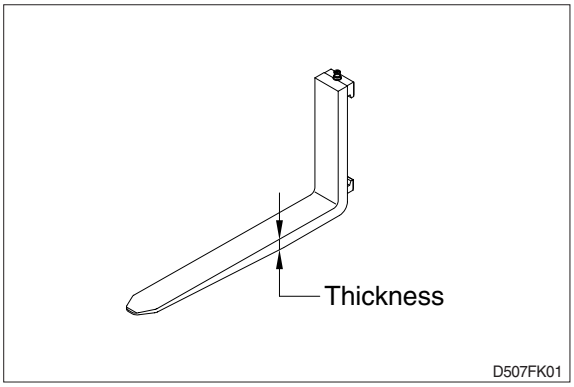
1	Backrest	5	Fork
2	Carriage	6	Extension fork
3	Roller	7	Shim (0.5, 1.0t)
4	Side roller		

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) FORKS

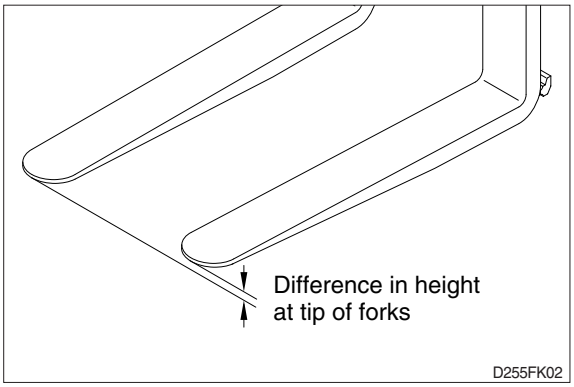
(1) Measure thickness of root of forks and check that it is more than specified value.
EX : ℓ =1200 mm (47 in)



mm (in)

STD Fork assy	Applicable model	Standard	Limit
S173896-02	35D-9	50 (2.0)	45 (1.7)
F13710020	40D-9	50 (2.0)	45 (1.7)
F13710020	45D-9	50 (2.0)	45 (1.7)
F14710011	50DA-9	60 (2.4)	54 (2.1)

2) Set forks in middle and measure out of parallel and difference in height at the top of forks.



Model	Fork length	Height difference
35D/40D/45D-9 50DA-9	equal or below 1500	3 mm
	above 1500	4 mm

3) Most force is concentrated at root of fork and at hook, so use crack detection method to check cracks.

2. MAST

1) Check for cracks at mast stay, tilt cylinder bracket, guide bar, fork carriage and roller shaft weld. Check visually or use crack detection method. Repair any abnormality.
2) Set mast vertical, raise forks about 10cm from ground and check front-to-rear clearance and left-to-right clearance between inner mast and fork carriage, and between outer mast and inner mast. Use these figures to judge if there is any play at roller or rail.
   - Front-to-rear clearance : Within 2.0 mm (0.08 in)
   - Left-to-right clearance : Within 2.5 mm (0.10 in)
3) Check that there is an oil groove in bushing at mast support.
4) Set mast vertical, raise forks about 10 cm from ground, and push center of lift chain with finger to check for difference in tension.
   If there is any difference in tension, adjust chain stopper bolt.
5) Check visually for abnormalities at thread of chain anchor bolt, and at contact surface between chain wheel and chain.
   Rotate chain wheel by hand and check for any play of bearing.

2. TROUBLESHOOTING

1) MAST

Problem	Cause	Remedy
Forks fail to lower.	· Deformed mast or carriage.	· Disassemble, repair or replace.
Fork fails to elevate	· Faulty hydraulic equipment. · Deformed mast assembly.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system. · Disassemble mast and replace damaged parts or replace complete mast assembly.
Slow lifting speed and insufficient handling capacity.	· Faulty hydraulic equipment. · Deformed mast assembly.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system. · Disassemble mast and replace damaged parts or replace complete mast assembly.
Mast fails to lift smoothly.	· Deformed masts or carriage. · Faulty hydraulic equipment. · Damaged load and side rollers. · Unequal chain tension between LH & RH sides. · LH & RH mast inclination angles are unequal. (Mast assembly is twisted when tilted)	· Disassembly, repair or replace. · See Troubleshooting Hydraulic Cylinders, pump and control valve in section 6, hydraulic system. · Replace. · Adjust chains. · Adjust tilt cylinder rods.
Abnormal noise is produced when mast is lifted and lowered.	· Broken load roller bearings. · Broken side roller bearings. · Deformed masts. · Bent lift cylinder rod. · Deformed carriage. · Broken sheave bearing.	· Replace. · Replace. · Disassemble, repair or replace. · Replace. · Replace. · Replace.
Abnormal noise is produced during tilting operation.	· Insufficient lubrication of anchor pin, or worn bushing and pin. · Bent tilt cylinder rod.	· Lubricate or replace. · Replace.

2) FORKS

<table>
<tr><th>Problem</th><th>Cause</th><th>Remedy</th></tr>
<tr><td>Abrasion</td><td>Long-time operations causes the fork to wear and reduces the thickness of the fork.
Inspection for thickness is needed.
· Wear limit : Must be 90% of fork thickness</td><td>If the measured value is below the wear limit, replace fork.</td></tr>
<tr><td>Distortion</td><td>Forks are bent out of shape by a number of reasons such as overloading, glancing blows against walls and objects, and picking up load unevenly.
· Difference in fork tip height
<table>
<tr><th>Model</th><th>Fork length</th><th>Height difference</th></tr>
<tr><td rowspan="2">35D/40D/45D-9
50DA-9</td><td>equal or below 1500</td><td>3 mm</td></tr>
<tr><td>above 1500</td><td>4 mm</td></tr>
</table></td><td>If the measured value exceeds the allowance, replace fork.</td></tr>
<tr><td>Fatigue</td><td>Fatigue failure may result from the fatigue crack even though the stress to fork is below the static strength of the fork. Therefore, a daily inspection should be done.
· Crack on the fork heel.
· Crack on the fork weldments.</td><td>Repair fork by expert.
In case of excessive distortion, replace fork.</td></tr>
</table>

GROUP 3 ADJUSTMENT

1. MAST LOAD ROLLER (V, VF MAST)

1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

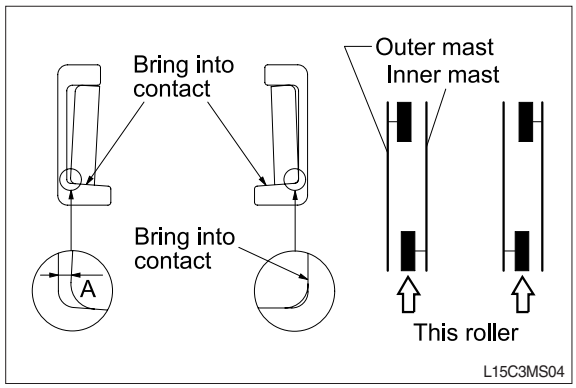
(1) Measure the clearance with the mast overlap at near 480 mm.

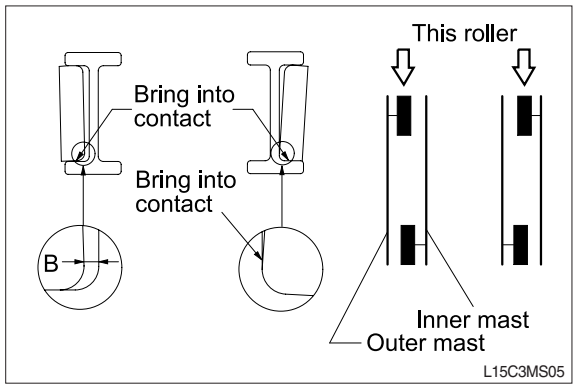
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner/outer mast roller shim.

- Standard clearance A, B = 0~0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

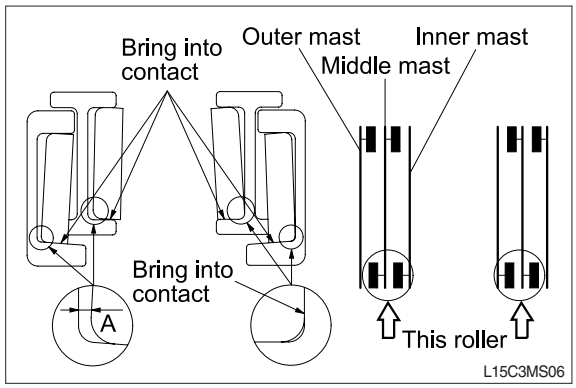
(4) After the adjustment, check that the inner mast moves smoothly in the outer mast.





2. MAST LOAD ROLLER (TF MAST)

1) INNER AND MIDDLE MAST ROLLER CLEARANCE ADJUSTMENT



(1) Measure the clearance with the mast overlap at near 480 mm.

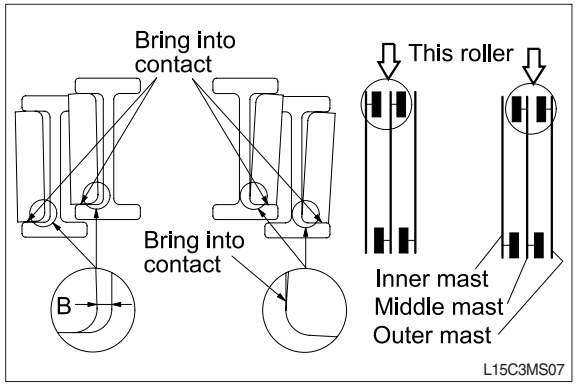
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner and middle mast roller shim, respectively.

- Standard clearance A = 0~0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

(4) After the adjustment, check that the inner mast moves smoothly in the middle mast, and the middle mast moves smoothly in the outer mast.

2) OUTER AND MIDDLE MAST UPPER ROLLER CLEARANCE ADJUSTMENT.



(1) Measure the clearance with the mast overlap at near 480 mm.

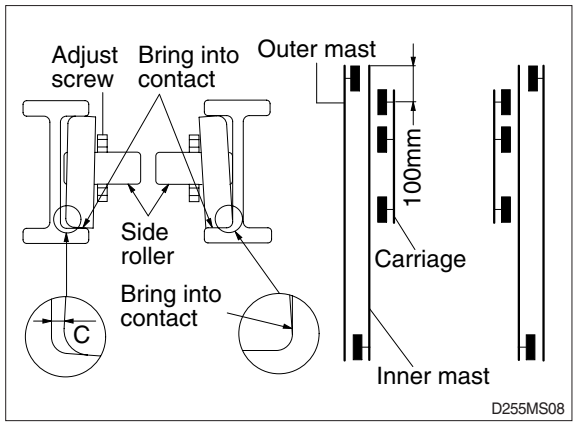
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the outer and middle mast roller shim, respectively.

- Standard clearance B = 0~0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

(4) After the adjustment, check that the inner mast moves smoothly in the middle mast, and the middle mast moves smoothly in the outer mast.

3) CARRIAGE LOAD ROLLER



(1) Measure the clearance when the center of the carriage upper roller is 100 mm from the top of the inner mast.

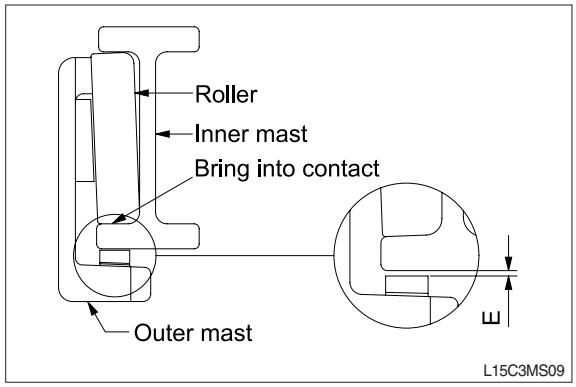
(2) Measure the clearance at upper, middle and lower rollers after loosen the adjust screws from the side rollers. Shift the carriage to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the carriage roller shim.

- Standard clearance C = 0~0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Carriage assembly.

(4) After the adjustment, the carriage should move smoothly along the overall mast length.

4) MAST BACK UP LINER



(1) Measure the clearance with the middle mast at the bottom position.

(2) With the middle mast in contact with the outer mast roller, adjust the clearance between the mast back up liner and middle mast to the following value by inserting the back up liner shim.

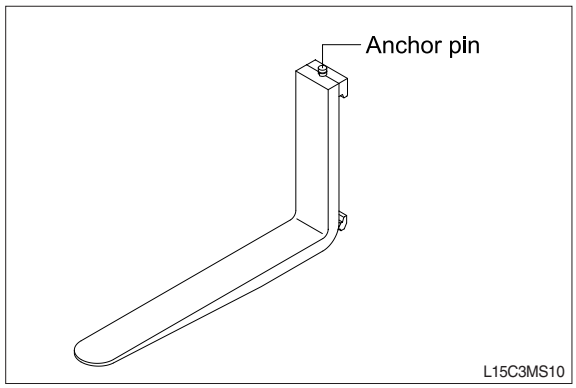
- Standard clearance E = 0.2 ~ 0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) After the adjustment, the mast should move smoothly.

GROUP 4 REMOVAL AND INSTALLATION

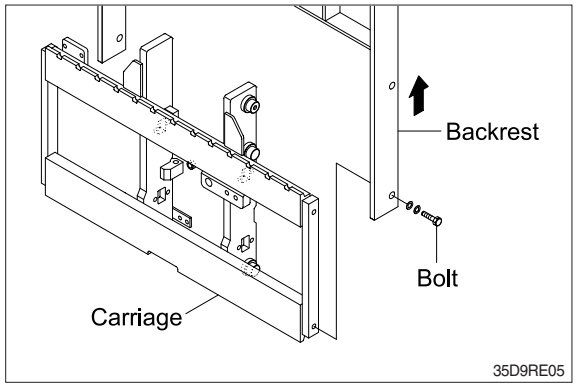
1. FORKS

1) Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
2) Release fork anchor pins and slide forks, one by one, toward the center of the carriage where a notch has been cut in the bottom plate for easy fork removal.
3) Remove the fork one by one. On larger forks it may be necessary to use a block of wood.
4) Reverse the above procedure to install load forks.



2. BACKREST

1) Remove bolts securing backrest to fork carriage. Lift backrest straight up and remove from carriage.
2) Position backrest on carriage and lower in place. Install and tighten bolts.



3. CARRIAGE ASSEMBLY

1) CARRIAGE

(1) With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is raised.
(2) While supporting lift chains, remove the split pin and slide out chain anchor pins from the chain anchors of stationary upright.
(3) Pull the chains out of the sheaves and drape them over the front of the carriage.
(4) Slowly raise elevating upright until mast clears top of fork carriage. Move carriage to work area and lower mast.

⚠ Make sure carriage remains on floor and does not bind while mast is being raised.

(5) Inspect all parts for wear or damage. Replace all worn or damaged pars.
(6) Reverse the above steps to reinstall.

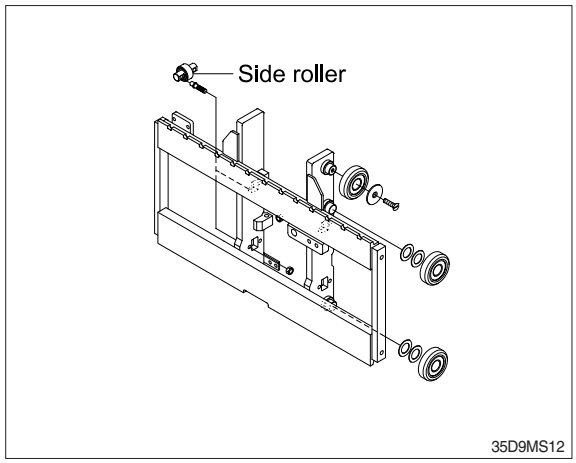
⚠ Replace the split pin of chain anchor with new one.

2) SIDE ROLLER

(1) Remove carriage as outlined in the carriage assembly and removal paragraph.
(2) Loosen and remove nuts, adjust screws and side rollers from carriage side pate.
(3) Thoroughly clean, inspect and replace all worn or damaged parts.
(4) Reverse the above procedure to assembly.

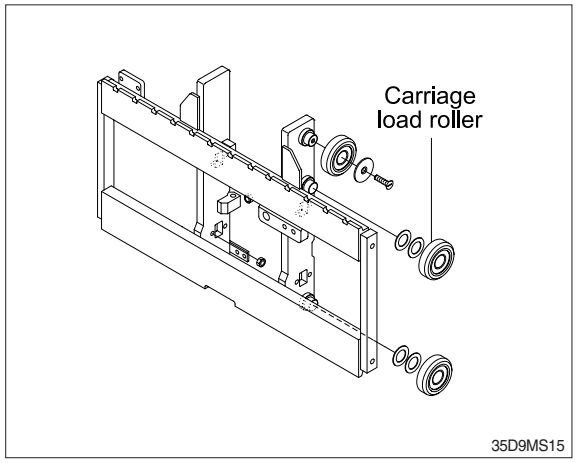
※ **Adjustment**

- Once carriage is properly installed, loosen nuts and adjust screws, (if not already done) allowing carriage to be centered in the inner mast.
- Adjust side roller by tightening screw until side roller just makes contact with mast. Back off approximately 1/10 turn on screw and tighten nut to lock screw in place.
- Run carriage up and down for the inner mast to be sure the carriage has free movement and does not stick. Also, make sure chains are properly adjusted. Refer to chain adjustment paragraph. Make adjustment when necessary and recheck operation of carriage.



3) CARRIAGE LOAD ROLLER

(1) Remove carriage as outlined in the carriage assembly removal paragraph.
(2) Loosen and remove flat head bolts and plain washers from top load roller bracket.
(3) Using a pryer, remove load rollers from load roller bracket.
(4) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.



4) MAST LOAD ROLLER AND BACK UP LINER

(1) 2 stage mast (V mast)

① Remove the carriage assembly and move them to one side.

② Loosen and remove hexagon bolts and clamps securing lift cylinders to outer mast.

③ Loosen and remove hexagon bolts and washers securing lift cylinders to inner mast.

④ Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.

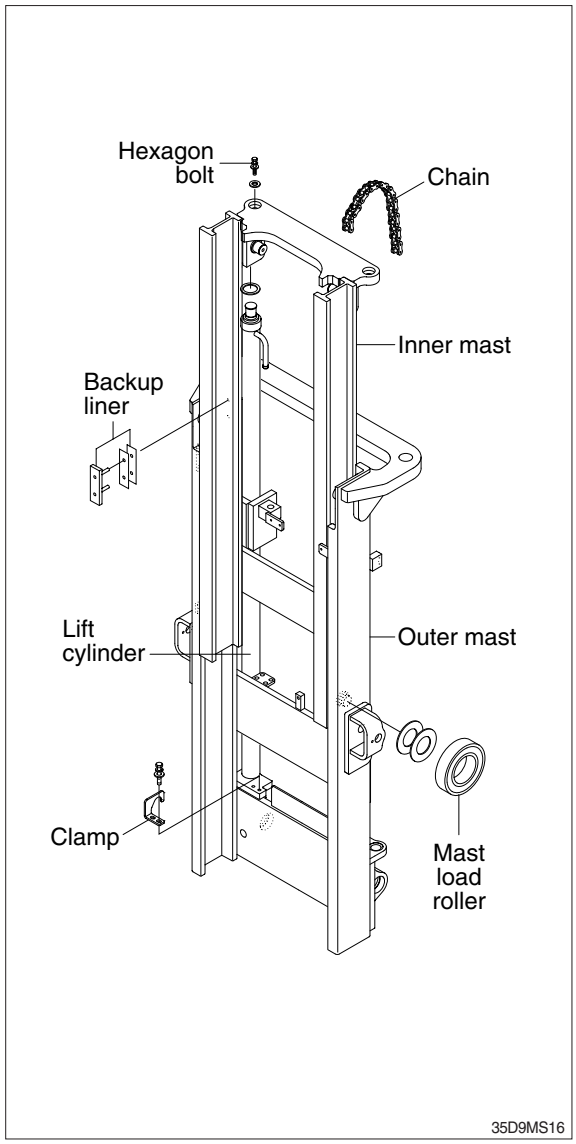
⑤ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and them with ropes to the outer mast.

⑥ Using the overhead hoist, lower inner mast until top and bottom rollers and back up liners are exposed.

⑦ Using a pryer, remove load rollers from load roller bracket. Remove back up liners and shims.

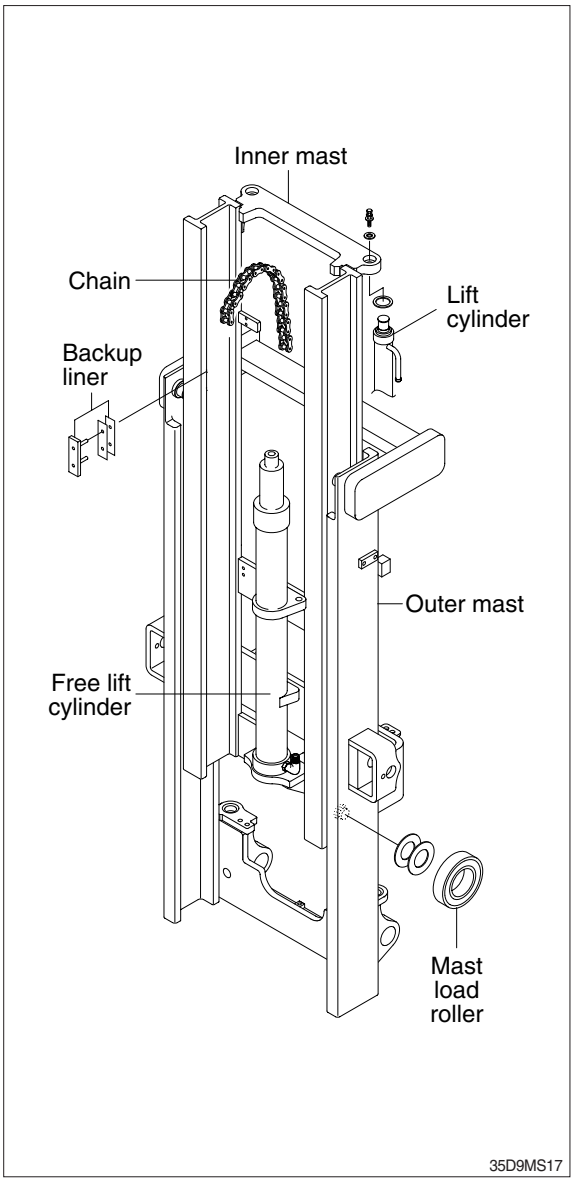
⑧ Thoroughly clean, inspect and replace all worn or damaged parts.

⑨ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



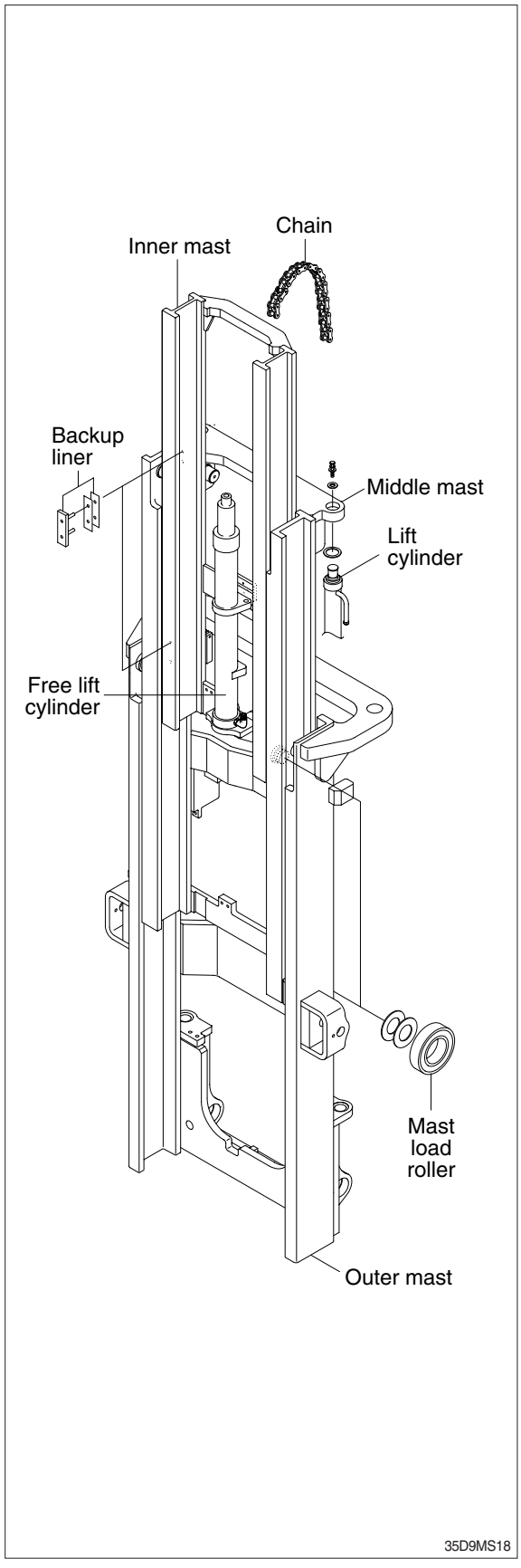
(2) 2 stage mast (VF mast)

① Remove free lift chain connected between carriage and free lift cylinder.
② Remove the carriage assembly and move them to one side.
③ Loosen and remove hexagon bolts and washers securing lift cylinders to inner mast.
④ Loosen and remove hexagon bolts and nuts securing lift cylinders to inner mast.
⑤ Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑥ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and them with ropes to the outer mast.
⑦ Using the overhead hoist, lower inner mast until top and bottom rollers and back up liners are exposed.
⑧ Using a pryer, remove load rollers from load roller bracket. Remove back up liners and shims.
⑨ Thoroughly clean, inspect and replace all worn or damaged parts.
⑩ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



(3) 3 stage mast (TF mast)

① Remove the carriage assembly and move to one side.
② Loosen and remove hexagon bolt securing bottom cylinder from outer mast.
③ Loosen and remove bolts and special washers securing lift cylinders to middle mast.
④ Attach chains or sling to the inner and middle mast section at top crossmember. Using an overhead hoist, slowly raise the uprights high enough to clear lift cylinder.
⑤ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and tie them with ropes to the outer mast.
⑥ Using the overhead hoist raise inner and middle masts. Place 4 inch block of wood under the free lift cylinder bracket of the inner mast then lower mast sections (this will create slack in the chains).
⑦ Remove retaining rings securing chain sheaves to sheave support brackets. While support chains, remove chain sheaves and let chains hang free. The upper outer and lower middle mast rollers and back up liners are now exposed.
⑧ Using a pryer, remove load rollers from load bracket. Remove back up liners and shims.
⑨ Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist, slowly raise the middle mast until top and bottom rollers are exposed.
⑩ Using a player, remove load rollers from load roller bracket.
⑪ Thoroughly clean, inspect and replace all worn or damaged parts.
⑫ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



5) ELEVATING MAST

(1) Inner mast (V, VF mast)

① After completing all necessary steps for load rollers and back up liner removal use an overhead hoist and sling or chain around upper crossmember of the inner mast section.

② Lift inner mast upright straight up and out of outer mast section.

③ Replace and reverse above procedure to install. Make all necessary measurements and adjustments.

(2) Inner and middle mast (TF mast)

① After completing all necessary steps for load rollers and back up liner removal. Remove rear chains and sheave support if not already done.

② Disconnect free lift cylinder hose. Drain hose into a suitable pan or container and cap hose.

③ While supporting free lift cylinder assembly, remove bolts and washers securing cylinder to mast crossmember.

④ Place a sling around free lift cylinder and attach to an overhead hoist. Slowly raise and move cylinder to one side.

⑤ Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist slowly raise the upright straight up and out of middle mast section.

⑥ Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist slowly raise the upright straight up and out of outer mast section.

⑦ Replace upright and reverse above procedure to install. Make all necessary measurements and adjustments.

6) CHAIN

(1) Chain sheave (V, VF mast)

① Place a sling around carriage and attach to an overhead hoist. Lift carriage high enough so that the tension on the chain over sheaves is relieved after the carriage is blocked. Position wooden blocks under the carriage and lower it.

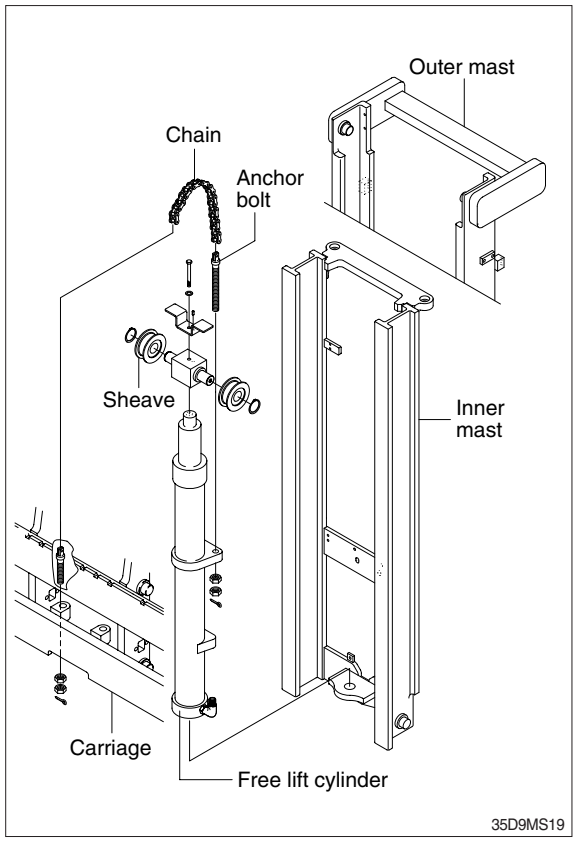
② Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins and drape the chains over the carriage.

③ Remove retaining ring securing sheaves to sheave support. Remove sheaves with bearings.

④ Remove bearing retaining ring from sheave and press bearings from sheaves.

⑤ Thoroughly clean, inspect and replace all worn or damaged parts.

⑥ Reverse the above to assemble and install. Use new split pins in chain anchor pins.



(2) Rear chain sheave (TF mast)

① Raise and securely block carriage and inner mast section.

② Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins from outer mast section.

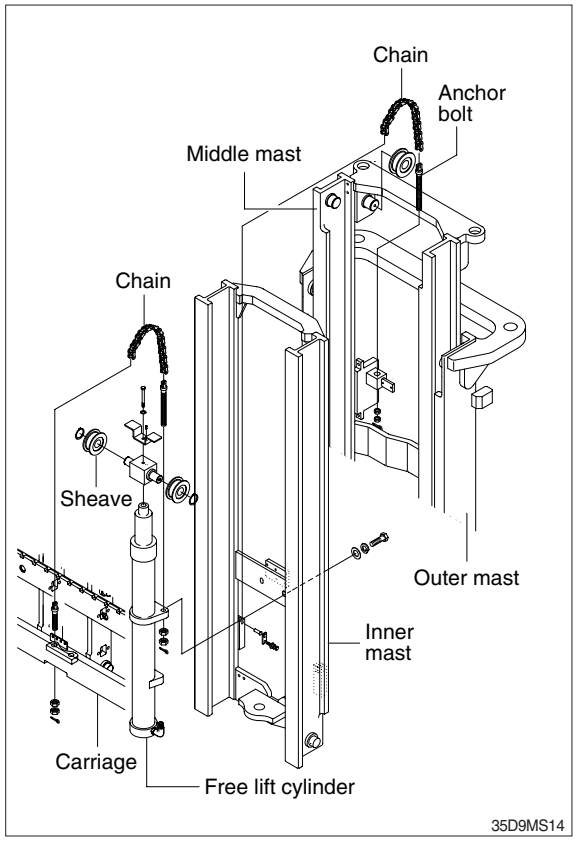
③ Remove chains.

④ Remove retaining ring securing chain sheaves to sheave support. Pry off sheaves with bearings.

⑤ Remove bearing retaining ring from sheave and press bearings from sheaves.

⑥ Thoroughly clean, inspect and replace all worn or damaged parts.

⑦ Reverse the above procedure to assemble and install. Use new split pins in chain anchor pins.



(3) Chain wheel bearing support (TF mast)

① Remove the carriage assembly and move to one side.
② After removing bolt to securing chain wheel bearing support assembly to free lift cylinder.
After a sling to the chain wheel bearing support assembly. Using an overhead hoist, lift support assembly straight up and off of free lift cylinder. Move assembly to work area.
③ Remove retaining ring securing chain wheel bearing to chain wheel bearing support.
④ Remove bearing retaining ring from chain wheel bearing and press bearings from chain wheel bearings.
⑤ Thoroughly clean, inspect and replace all worn or damaged parts.
⑥ Reverse the above procedure to install.

(4) Rear chain (TF mast)

① Remove the carriage assembly and move to one side. Refer to carriage removal and installation.
② Raise and securely block truck approximately 6 inches from the floor.
③ Using a sling or chain around inner mast section attached to an overhead hoist, slowly raise inner mast until there is enough slack in the chains to remove them. Block inner mast section.
④ Remove split pins and chain anchor pins securing chains to chain anchor(part of inner mast).
⑤ While supporting the chains, remove split and chain anchor pins securing chains to chain anchors attached to outer mast section.
⑥ Remove chains.
⑦ Reverse the above to assemble and install. Use new split pins in chain anchor pins. Refer to this section for Load chain lubrication and adjustment.

(5) Carriage chain

① Place a sling around carriage front plate and attach to an overhead hoist. Lift and secure carriage high enough so that split and chain anchor pins on carriage can be easily be removed. Remove chain anchor pins from carriage and drape chains out over carriage.
② Place a wooden block under the carriage and lower the carriage on the block.
③ While supporting the chains, remove split pins and chain anchor pins from chain anchors.
④ Remove chains and wash them with solvent. Refer to this section for Load chain inspection and maintenance.
⑤ Reverse the above procedure to assemble and install. Use new split pins in chain anchor pins. Refer to this section for Load chain lubrication and adjustment.

(6) Load chain inspection and maintenance

After every 200 hours of truck operation, lift chains should be inspected and lubricated inspect for the following chain conditions :

① Wear

As the chain flexes on and off the chain wheel bearings, the joints very gradually wear. The stretch a chain developes in service is due to material being worn off pin outer diameter and pitch hole inner diameter on the inside plate.
Chain wear can be measured using a wear scale or steel tape. When chains have elongated 2%, they should be discarded. When checking chain wear, be sure to measure a segment of chain that operates over a sheave. Do not repair chains by cutting our the worn section and splicing in a new piece. If part of the chain is worn, replace all the chains on the truck.

② Rust and corrosion

Chains used on lift trucks are highly stressed precision components. It is very important that the "as-manufactured" ultimate strength and fatigue strength be maintained throughout the chain service life. Corrosion will cause a major reduction in the load-carrying capacity of lift chain or roller chain because corrosion causes side plate cracking.

③ Cracked plate

The most common cause of plate cracking is fatigue failure. Fatigue is a penomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will evenually break. Fatigue cracks are almost always found through the pitch holes perpendicular to the pitch line. Contrast this failure mode to the random failures caused by stress-corrosion cracking. If cracks are present, replace all the chain on the truck. Noise in the chain indicates that the plate is on the verge of cracking and will be failed before long.

④ Tight joints

All joints in lift chain should flex freely. Tight joints resist flexure, increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.

Tight joints in lift chains can be caused by :

- Bent pins or plates.
- Rusty joints.
- Peened plate edges.

Oil rusty chains and replace chains with bent or peened components.

⑤ Protruding or turned pins

Heavily loaded chains operating with lube generate tremendous friction between pins and plates. In extreme cases, the frictional torque in the joint can actually turn pins in the press-fit outside plates. If chain is allowed to operate in this condition, the pins slowly work out of the chain causing chain failure. Turned pins can be quickly spotted because the flats on the V heads are no longer in line. Chains with turned or protruding pins should be replaced immediately. Do not attempt to repair the chain by driving pins back into the chain.

⑥ Chain side wear

A wear pattern on pin heads and outside plates indicates misalignment. This condition damages chain and sheaves as well as increasing internal friction in the chain system.

⑦ Chain anchors and chain wheel bearings

An inspection of the chain system includes a close examination of chain anchors and chain wheel bearings. Check chain anchors for wear, breakage and misalignment.

Anchors with worn or broken fingers should be replaced. Anchors should be adjusted to eliminate twisting or other misalignment in the chain. When chain is misaligned, load is not distributed uniformly between the plates. Prolonged operation will result in premature fatigue failure. Chain wheel bearings with badly worn flanges and outside diameter should be replaced. Heavy flange wear indicates chain misalignment.

⑧ Chain wear scale

The chain can be checked for wear or stretching with the use of a chain wear scale. Stretching of a chain is due to the elongation of the pitch holes and wearing of the pin O.D. The greatest amount of stretching occurs at the areas of the chain that flex over the sheaves most frequently. Check the chain at this point with a scale. The wear scale has instructions printed on the sides for use in determining chain stretch and are as follows :

- Determine pitch length of chain using 6 inch scale on one side of wear scale.
- If pitch is 1/2 (12.7 ㎜), 3/4 (19.05 ㎜), 1 (25.4 ㎜), 1-1/2 (38.1 ㎜), 2 (50.8 ㎜), use side A of scale.
- If pitch is 5/8 (15.875 ㎜), 1-1/4 (31.75 ㎜) or 2 (50.8 ㎜), use side B.
- Align point A or B to center of a pin and note position of the opposite A or B point.
- If other point also lines up with a pin, the chain is worn and should be replaced.

If any of the above conditions exists (cracked plates, turned pins, stretching etc), the chains should be replaced in pairs as a complete assembly. Order chains by part number to insure the correct chain length, pitch and material specifications.

(7) Load chain lubrication and adjustment

① Lubrication

The most important consideration in field maintenance of lift chains is lubrication. Hard working, heavily loaded chains cannot be expected to give satisfactory wear life without scheduled periodic re-lubrication. Like all bearing surfaces, the precision manufactured, hardened steel, joint-wearing surfaces require a film of oil between mating parts to prevent rapid wear. Oil must penetrate the chain joint to prevent wear. Applying oil to external surfaces will prevent rust, but oil must flow into the live bearing surfaces for maximum wear life. Frequency of re-lube will vary with operating conditions and environment, the best estimate of lube period is 200 hours. Trucks parked outdoors or trucks in extremely severe service, may require more frequent re-lube to maintain an oil film on all chain surface.

- Wipe off the old oil with a clean cloth and blow out the remaining dirt with compressed air.

⚠ Wear eye protection.

- With a clean brush, apply EP-140 extreme pressure lubricant or heavy motor oil (40W).

② Replacement

Replace chains as a pair. It will be virtually impossible to maintain uniform loading between the strands if a new chain is put into service opposite an old chain. The joints in the old chain will be greater than that on the new chain, greatly complicating the problem of maintaining equal chain tension. The new chain will wear more slowly causing it to bear the major portion of the load resulting in premature wear and fatigue failure. Don't steam clean or decrease new chains.

The manufacturer's grease is effective in reducing wear and corrosion. If the original factory lube is dried out or wiped off, soak the new chain in heavy engine oil for at 1/2 hour prior to installing on truck. After the old chains have been stripped from the mast, very carefully inspect chain anchors and chain wheel bearing. Broken, cracked or worn anchor must be replaced using the new anchor pin and split pin. Do not paint newly replaced chain after it has been installed.

③ Adjustment

Chain adjustments are important for the following reasons :

- Equal loading of chain.
- Proper sequencing of mast.
- Prevent over-stretching of chains.
- Prevent chains from jumping off sheaves if they are too loose.

④ Adjustment procedure

- With mast in its fully collapsed and vertical position, lower the fork to the floor.
- Adjust the chain length by loosening or tightening nut on the chain anchor.
  After making adjustment on the mast, be sure to tighten the nut.