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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

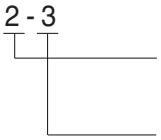
### Distribution and updating

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 |

| bar | $kgf/cm^2$ | psi | MPa |
|---|---|---|---|
| 1 | 1.02 | 14.504 | 0.1 |
| 88 | 90 | 1280 | 9 |
| 90 | 91 | 1300 | 9 |
| 92 | 94 | 1340 | 9 |
| 98 | 100 | 1420 | 10 |
| 110 | 112 | 1600 | 11 |
| 118 | 120 | 1710 | 12 |
| 120 | 122 | 1740 | 12 |
| 122 | 124 | 1770 | 12 |
| 127 | 129 | 1840 | 13 |
| 130 | 133 | 1890 | 13 |
| 132 | 135 | 1920 | 13 |
| 135 | 138 | 1960 | 14 |
| 140 | 143 | 2030 | 14 |
| 145 | 148 | 2100 | 14 |
| 147 | 150 | 2130 | 15 |
| 150 | 153 | 2180 | 15 |
| 157 | 160 | 2280 | 16 |
| 160 | 163 | 2320 | 16 |
| 162 | 165 | 2350 | 16 |
| 165 | 168 | 2390 | 16 |
| 167 | 170 | 2420 | 17 |
| 170 | 174 | 2470 | 17 |
| 172 | 176 | 2500 | 17 |
| 175 | 179 | 2540 | 18 |
| 177 | 181 | 2570 | 18 |
| 180 | 183 | 2610 | 18 |
| 185 | 188 | 2680 | 18 |
| 187 | 191 | 2710 | 19 |
| 190 | 194 | 2760 | 19 |
| 195 | 199 | 2830 | 20 |
| 197 | 200 | 2850 | 20 |
| 207 | 211 | 3000 | 21 |
| 210 | 214 | 3050 | 21 |
| 217 | 221 | 3150 | 22 |
| 220 | 224 | 3190 | 22 |
| 234 | 239 | 3400 | 23 |
| 414 | 422 | 6000 | 41 |

**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 |

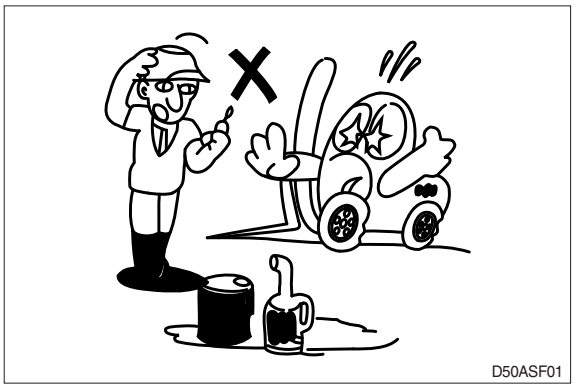
# SECTION 1 GENERAL

Group 1 Safety hints ..... 1-1
Group 2 Specifications ..... 1-5
Group 3 Periodic replacement ..... 1-18

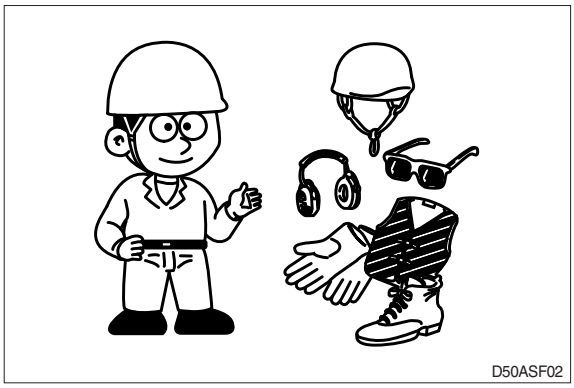
# GROUP 1 SAFETY HINTS

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

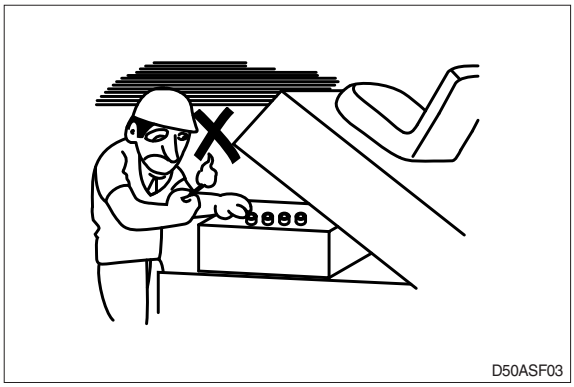
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D50ASF01

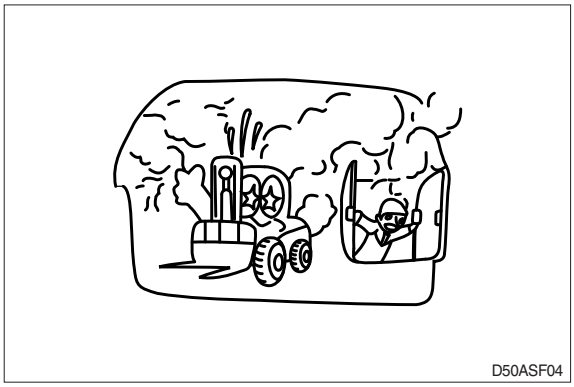
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.


D50ASF02

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

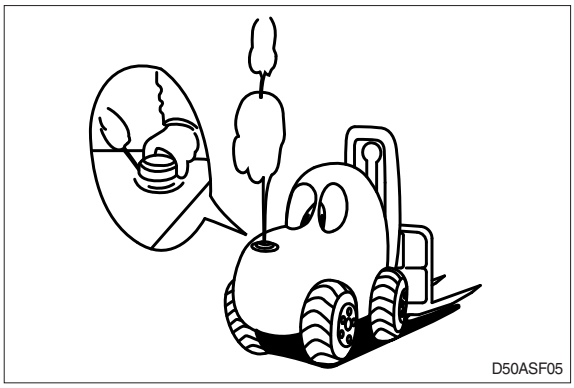

D50ASF03

- 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.

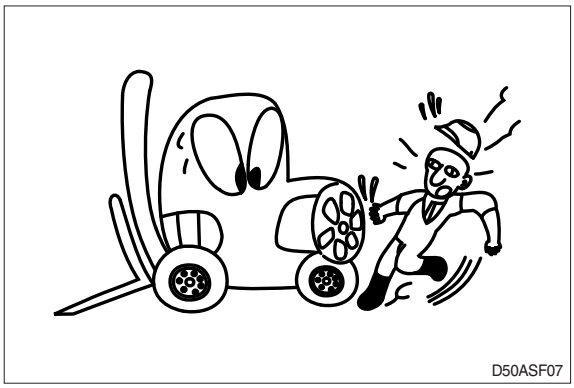

D50ASF05

· 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.

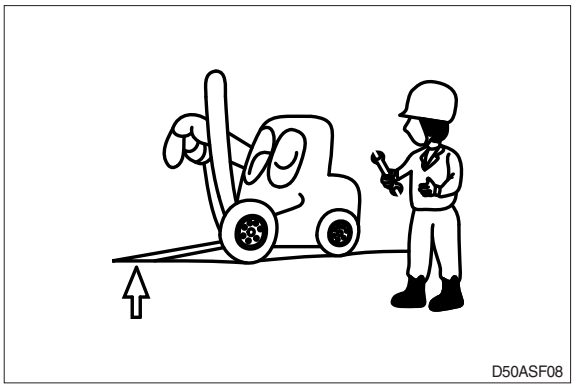
⚠ It is extremely dangerous to try to check the fan belt tension while he engine is running.


D50ASF07

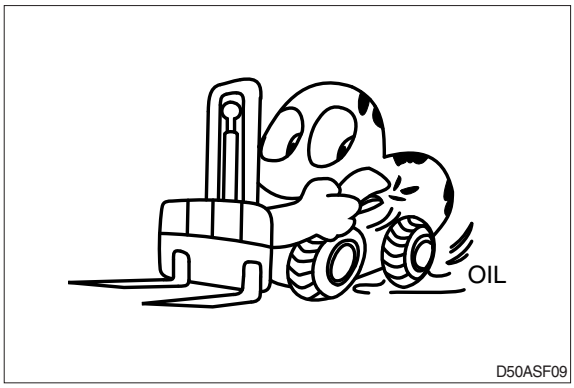
When inspecting the engine is running parts, or near such parts, always stop the engine first.

Before checking or servicing accumulator or piping, depress brake pedal repeatedLy to release pressure.

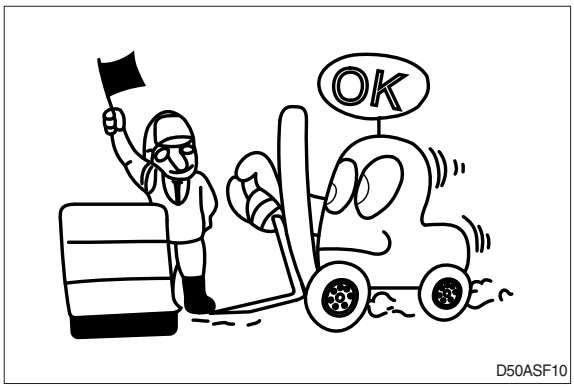
· Park the machine on firm, flat ground.
Lower the fork to the ground and stop the engine.
Return each lever to **NEUTRAL** and apply the brake lock.


D50ASF08

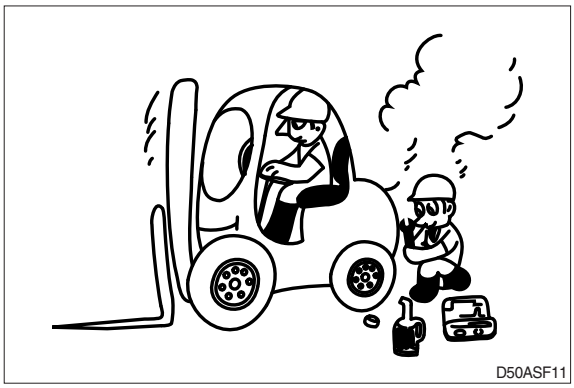
· Immediately remove any oil or grease on the floor of the operator's compartment, or on the handrail. It is very dangerous if someone slips while on the machine.




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




· 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.



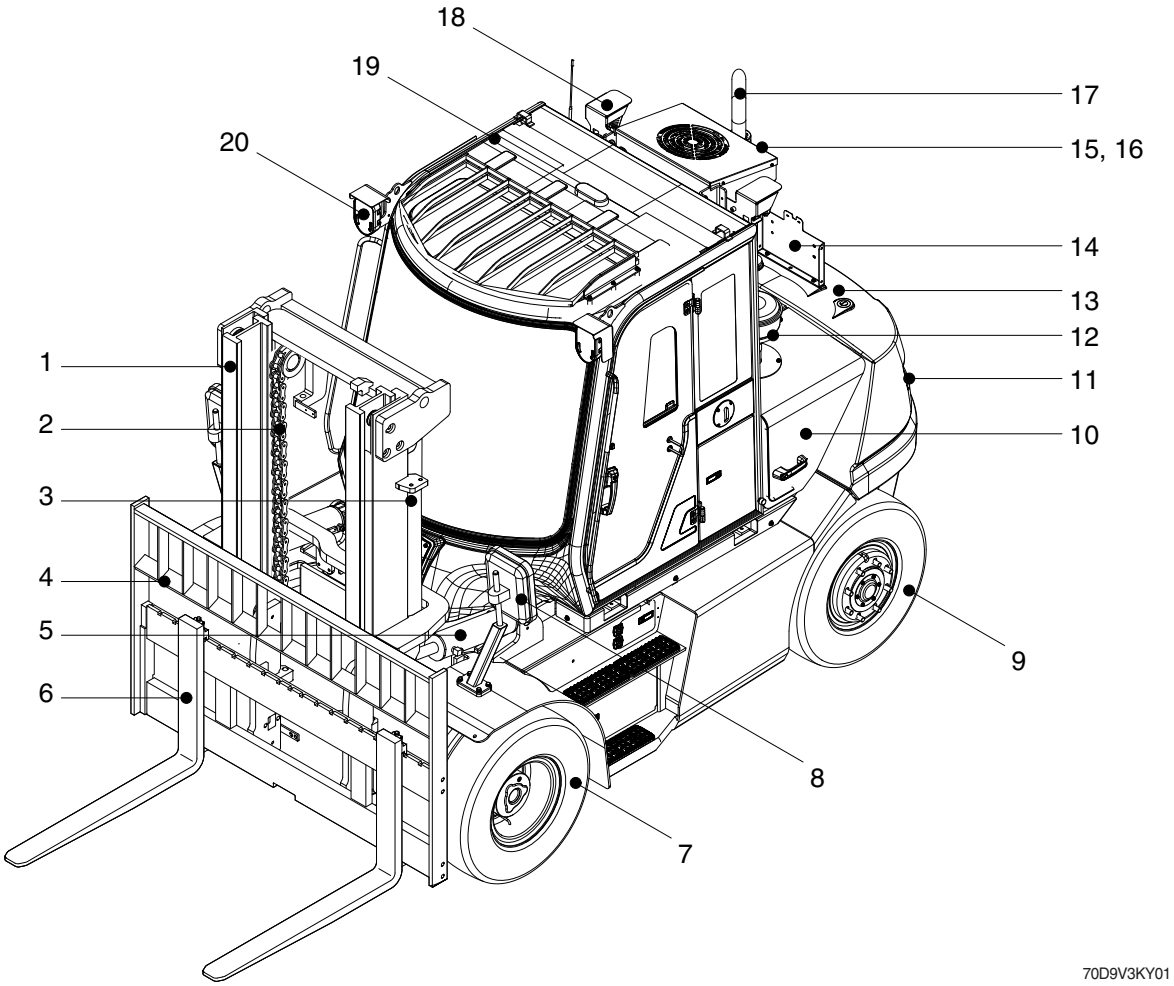

· Always remember that the hydraulic oil circuit is under pressure. When feeding or draining the oil or carrying out inspection and maintenance, release the pressure first.

- 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.

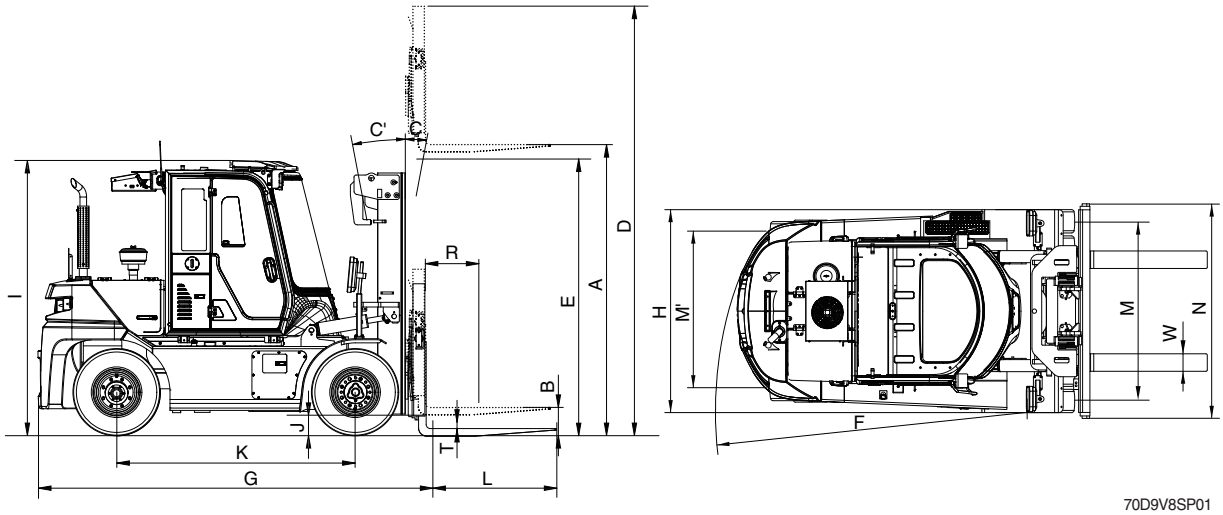
# GROUP 2 SPECIFICATIONS

## 1. MAJOR COMPONENTS




| | | | | | |
|---|---|---|---|---|---|
| 1 | Mast | 8 | Rear view mirror | 15 | Beacon lamp (option) |
| 2 | Lift chain | 9 | Rear wheel | 16 | Camera (option) |
| 3 | Lift cylinder | 10 | Bonnet | 17 | Silencer |
| 4 | Carriage and backrest | 11 | Rear combination lamp | 18 | Rear work lamp (option) |
| 5 | Tilt cylinder | 12 | Preclenaer | 19 | Cabin |
| 6 | Fork | 13 | Counterweight | 20 | Head and turn signal lamp |
| 7 | Front wheel | 14 | License lamp (option) | | |

## 2. SPECIFICATIONS




70D9V8SP01

| Model | | | Unit | 70D-9VB | |
|---|---|---|---|---|---|
| Capacity | | | kg (lb) | 7000 (15500) | |
| Load center | | R | mm (in) | 600 (24") | |
| Weight(Unloaded) | | | kg (lb) | 10040 (22229) | |
| Fork | Lifting height | A | mm (ft·in) | 3030 (9' 11") | |
| | Free lift | B | mm (in) | 140 (5.5") | |
| | Lifting speed (Unload/Load) | | mm/sec (ft/min) | 470/420 (93/83) | |
| | Lowering speed (Unload/Load) | | | 500/500 (99/99) | |
| | L×W×T | L,W,T | mm (in) | 1200×150×65 (47.2×5.9×2.6) | |
| | Carriage width | N | mm (in) | 2068 (6.9") | |
| Mast | Tilt angle (forward/backward) | C/C' | degree | 15/10 | |
| | Max. height | D | mm (ft·in) | 4320 (14' 2") | |
| | Min. height | E | mm (ft·in) | 2515 (8' 3") | |
| Body | Travel speed (Unload) | | km/h (mph) | 23.7 (14.7) | |
| | Gradeability (Load) | | % | 42.5 | |
| | Min. turning radius (Outside) | F | mm (ft·in) | 3436 (11' 3") | |
| ETC | System set pressure | | bar (psi) | 210 (3050) | ★185 (2680) |
| Overall length | | G | mm (ft·in) | 3665 (12' 0") | |
| Overall width | | H | mm (ft·in) | 2088 (6' 10") | |
| Cabin height | | I | mm (ft·in) | 2575 (8' 5") | |
| Ground clearance | | J | mm (in) | 195 (7.7") | |
| Wheel base | | K | mm (ft·in) | 2300 (7' 7") | |
| Wheel tread front/rear | | M/M' | mm (ft·in) | 1578 / 1602 (5' 2" / 5' 3") | |

★ : EU, AN corporate sales equipment

## 3. SPECIFICATION FOR MAJOR COMPONENTS

### 1) ENGINE

| Item | Unit | Specification |
|---|---|---|
| Model | – | HMC D4CC |
| Type | – | Vertical, 4 cycle DI, EU Stage V 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) | 95×102 (3.74×4.02) |
| Piston displacement | cc (cu in) | 2891 (176.4) |
| Compression ratio | – | 15.8 :1 |
| Rated gross horse power | hp/rpm | 73.2/2200 |
| Maximum torque at rpm | kgf·m/rpm | 34.5/1500 |
| Engine oil quantity | ℓ (U.S. gal) | 9.1 (2.4) |
| Dry weight | kg (lb) | 266 (586) |
| High idling speed | rpm | 2450 |
| Low idling speed | rpm | 850 |
| Rated fuel consumption | g/kWh | 207 |
| Starting motor | V-kW | 12-2.0 |
| Alternator | V-A | 13.5-130 |
| Battery | V-AH | 12-100 |
| Fan belt deflection | mm (in) | 10~12 (0.40~0.47) |
| $CO_2$ | g/kWh | 594.2 |

**※ This $CO_2$ measurement results from testing over a fixed test cycle under laboratory conditions a(n) (parent) engine representative of the engine type (engine family) and shall not imply or express any guarantee of the performance of a particular engine.**

### 2) MAIN PUMP

| Item | Unit | Specification | |
|---|---|---|---|
| Type | – | Axial piston variable pump | Gear fixed pump |
| Model | – | Casspa MVP | Casspa PLP |
| Displacement | cc/rev ($in^3$/rev) | 67 (4.1) | 9.17 (0.56) |
| Maximum operating pressure | bar (psi) | 280 (4060) | 250 (3625) |
| Rated speed (Max/Min) | rpm | 2700/600 | |
| Weight | kgf (lbf) | 30 (66.1) | |

### 3) MAIN CONTROL VALVE (MCV)

| Item | Unit | Specification |
|---|---|---|
| Type | – | Mono block (3spool), Semi-Mono block (4 / 5spool) |
| Model | – | Buchholz NG16 |
| Opearating method | - | Hydraulic pilot |
| Maximum flow rated (lift/lower, tilt) | lpm (U.S. gpm) | 170 (45), 60 (16) |
| Lift/tilt relief valve set pressure (DV1) | bar (psi) | 210 (3050) |
| Attachment oil flow rated (aux1/2/3) | lpm (U.S. gpm) | 110 / 110 / 110 (29 / 29 / 29) |
| Attachment relief valve pressure (DV2) | bar (psi) | 140 ~ 190 (2030 ~ 2760) |
| Built-in accessories valve | - | · Manual fork lowering valve (Emergency function)<br>· Adj. max. fork lowering speed, Lower breake valve<br>· Overcenter valve (tilt A2), Priority valve (steering) |
| Weight | kgf (lbf) | 3 spool : 28 (61.7), 4 spool : 36 (79.4), 5 spool : 43 (94.8) |

### 4) STEERING UNIT

| Item | Unit | Specification |
|---|---|---|
| Type | – | Load sensing, Non load reaction |
| Model | – | Sauer Danfoss VSP |
| Capacity | cc/rev ($in^3$/rev) | 160 (9.76) |
| Steering relief valve set pressure | bar (psi) | 160 ~ 165 (2320 ~ 2393) |
| Weight | kgf (lbf) | 5.5 (12) |

### 5) CYLINDER

| Index | | | Unit | Specification |
|---|---|---|---|---|
| Main lift | V300 | Tube bore diameter × Rod diameter × Stroke | mm (in) | 85×60×1483 (3.34×2.36×58.4) |
| Main lift | TF450 | | | 85×60×1483 (3.34×2.36×58.4) |
| Free lift | | | | 130×110×767 (5.12×4.33×30.2) |
| Tilt (15/10 degree) | | | | 110×50×338 (4.33×1.97×13.3) |
| Steering | | | | 80×55×150 (3.15×2.16×5.9) |
| Weight | Lift | V300 | kgf (lbf) | 66.6 (146.8) |
| | Tilt | 15/10 degree | | 32.4 (71.4) |

## 6) POWER TRAIN DEVICED

| Item | | | Specification |
|---|---|---|---|
| Torque converter | Type | | 3 Element, 1 stage, 2 phases |
| | Stall ratio | | 5.3 : 1 |
| Transmission | Type | | Full auto, power shift |
| | Gear shift (FR/RR) | | 2/1 |
| | Adjustment | | Electrical single lever type |
| | Overhaul ratio | FR | 1 : 2.456 2 : 0.946 |
| | | RR | 1 : 2.494 |
| Axle | Type | | Front-wheel drive type, fixed location |
| | Gear ratio | | 10.668 |
| | Gear | | Ring & pinion gear type |
| Wheels | Q'ty (FR/RR) | | Double : 4/2 |
| | Front (drive) | | 8.25-15-14 PR |
| | Rear (steer) | | 8.25-15-14 PR |
| Brakes | Travel | | Front wheel, wet disc brake |
| | Parking | | Wet disc (negative brake) |
| Steering | Type | | Full hydraulic, power steering |
| | Steering angle | | 75.87° to both right and left angle, respectively |

## 4. TIGHTENING TORQUE FOR MAJOR COMPONENTS

| NO | Item | | Size | kgf · m | lbf · ft |
|---|---|---|---|---|---|
| 1 | Engine | Engine mounting bolt | M10×1.25 | 7.4±1.4 | 53.7±10.7 |
| 2 | | Engine bracket mounting nut | M10×1.5 | 6.9±1.4 | 49.9±10.1 |
| 3 | | Radiator mounting bolt, nut | M10×1.5 | 6.9±1.4 | 49.9±10.1 |
| 4 | Hydraulic system | Hydraulic pump mounting bolt | M16×2.0 | 29.7±4.5 | 215±32.3 |
| 5 | | MCV mounting bolt | M 8×1.25 | 2.5±0.5 | 18.1±3.6 |
| 6 | | Steering unit mounting bolt | M10×1.5 | 4.0±0.5 | 28.9±3.6 |
| 7 | | Tilt cylinder; rod-end bolt, nut | M16×2.0 | 23±2 | 166±14.5 |
| 8 | | Tilt cylinder pin; mounting bolt | M10×1.5 | 6.9±1.4 | 50±10.1 |
| 9 | Power train system | Transmission mounting bolt, nut | M16×2.0 | 60.5±5.5 | 438±39.8 |
| 10 | | Torque converter mounting bolt | M10×1.5 | 6.9±1.4 | 50±10 |
| 11 | | Drive axle mounting bolt, nut | M27×3.0 | 150±15 | 1085±109 |
| 12 | | Propeller shaft (to axle and TM) | 3/8-24 UNF | 7.0±0.7 | 50.6±5.1 |
| 13 | | Steering axle mounting bolt, nut | M18×2.5 | 41.3±6.2 | 299±44.8 |
| 14 | | Front and rear wheel mounting nut | M22×1.5 | 62.0±9.3 | 448±67.3 |
| 15 | Others | Counterweight mounting bolt | M30×3.5 | 100±15 | 723±108 |
| 16 | | Operator's seat mounting nut | M 8×1.25 | 2.5±0.5 | 18.1±3.6 |
| 17 | | Cabin mounting bolt | M12×1.75 | 12.8±3.0 | 92.6±21.7 |
| 18 | | Mast mounting bolt | M20×2.5 | 57.9±8.7 | 419±63 |

## 5. TORQUE CHART

Use following table for unspecified torque.

### 1) BOLT AND NUT

#### (1) Coarse thread

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

#### (2) Fine thread

| Bolt size | 8.8T | | 10.9T | | 12.9T | |
|---|---|---|---|---|---|---|
| | kgf · m | lbf · ft | kgf · m | lbf · ft | kgf · m | lbf · ft |
| M 8×1.0 | 2.1 ~ 3.1 | 15.2 ~ 22.4 | 3.0 ~ 4.4 | 21.7 ~ 31.8 | 3.6 ~ 5.4 | 26.1 ~ 39.0 |
| M10×1.25 | 4.2 ~ 6.2 | 30.4 ~ 44.9 | 5.9 ~ 8.7 | 42.7 ~ 62.9 | 7.0 ~ 10.4 | 50.1 ~ 75.2 |
| M12×1.25 | 7.3 ~ 10.9 | 52.8 ~ 78.8 | 10.3 ~ 15.3 | 74.5 ~ 110 | 13.1 ~ 17.7 | 94.8 ~ 128 |
| M14×1.5 | 12.4 ~ 16.6 | 89.7 ~ 120 | 17.4 ~ 23.4 | 126 ~ 169 | 20.8 ~ 28.0 | 151 ~ 202 |
| M16×1.5 | 18.7 ~ 25.3 | 136 ~ 182 | 26.3 ~ 35.5 | 191 ~ 256 | 31.6 ~ 42.6 | 229 ~ 308 |
| M18×1.5 | 27.1 ~ 36.5 | 196 ~ 264 | 38.0 ~ 51.4 | 275 ~ 371 | 45.7 ~ 61.7 | 331 ~ 446 |
| M20×1.5 | 37.7 ~ 50.9 | 273 ~ 368 | 53.1 ~ 71.7 | 384 ~ 518 | 63.6 ~ 86.0 | 460 ~ 622 |
| M22×1.5 | 51.2 ~ 69.2 | 370 ~ 500 | 72.0 ~ 97.2 | 521 ~ 703 | 86.4 ~ 116 | 625 ~ 839 |
| M24×2.0 | 64.1 ~ 86.5 | 464 ~ 625 | 90.1 ~ 121 | 652 ~ 875 | 108 ~ 146 | 782 ~ 1056 |
| M30×2.0 | 129 ~ 174 | 933 ~ 1258 | 181 ~ 245 | 1310 ~ 1772 | 217 ~ 294 | 1570 ~ 2126 |

## 2) PIPE AND HOSE (FLARE TYPE)

| Hose size | Thread (PF) | Hex. across flat (mm) | Tightening torque | |
|---|---|---|---|---|
| | | | kgf·m | lbf·ft |
| 1/4" | 1/4 | 19 | 4 | 28.9 |
| 3/8" | 3/8 | 22 | 5 | 36.2 |
| 1/2" | 1/2 | 27 | 9.5 | 68.7 |
| 3/4" | 3/4 | 36 | 18 | 130.2 |
| 1" | 1 | 41 | 21 | 151.9 |
| 1-1/4" | 1-1/14 | 50 | 35 | 253.2 |

## 3) PIPE AND HOSE (ORFS TYPE)

| Hose size | Thread (UN/UNF/UNS) | Hex. across flat (mm) | Tightening torque | |
|---|---|---|---|---|
| | | | kgf·m | lbf·ft |
| 1/4" | 9/16-18 | 19 | 3 | 21.7 |
| 3/8" | 11/16-16 | 22 | 5 | 36.2 |
| 1/2" | 13/16-16 | 24 | 7 | 50.6 |
| 5/8" | 1-14 | 30 | 12 | 86.8 |
| 3/4" | 1-3/16-12 | 36 | 18 | 130.2 |
| 1" | 1-7/16-12 | 41 | 23 | 166.4 |
| 1-1/4" | 1-11/16-12 | 50 | 28 | 202.5 |
| 1-1/2" | 2-12 | 58 | 32 | 231.1 |

## 4) FITTING (O-RING SEAL TYPE)

| Hose size | Thread (UN/UNF) | Hex. across flat (mm) | Tightening torque | |
|---|---|---|---|---|
| | | | kgf·m | lbf·ft |
| 1/4" | 7/16-20 | 17 | 2 | 14.5 |
| 3/8" | 9/16-18 | 19 | 3 | 21.7 |
| 1/2" | 3/4-16 | 22 | 4 | 28.9 |
| | | 24 | 6 | 43.4 |
| 5/8" | 7/8-14 | 27 | 10 | 72.3 |
| | | 30 | 12 | 86.8 |
| 3/4" | 1-1/16-12 | 32 | 15 | 108.5 |
| | | 36 | 18 | 130.2 |
| 1" | 1-5/16-12 | 41 | 23 | 166.4 |
| 1-1/4" | 1-5/8-12 | 50 | 28 | 202.5 |
| 1-1/2" | 1-7/8-12 | 55 | 32 | 231.5 |

### 5) BAND CLAMP

| Tag No. | Hose size (mm) | Band width (mm) | Tightening torque | |
|---|---|---|---|---|
| | | | kgf·m | lbf·ft |
| S20-15 | 8 ~ 14 | 9 | 0.3 | 2.17 |
| S20-17 | 11 ~ 17 | | | |
| S20-22 | 13 ~ 20 | | 0.35 | 2.53 |
| S20-25 | 15 ~ 24 | | | |
| S20-28 | 19 ~ 28 | | | |
| S20-32 | 22 ~ 32 | 12 | | |
| S20-40 | 26 ~ 38 | 9 | 0.42 | 3.04 |
| S20-45 | 32 ~ 44 | | | |

### 6) BAND CLAMP (IDEAL, FLEX GEAR TYPE)

| Tag No. | Hose size (mm) | Band width (mm) | Tightening torque | |
|---|---|---|---|---|
| | | | kgf·m | lbf·ft |
| 41-212 | 32 ~ 54 | 15.9 | 1.1 | 8.0 |
| 41-262 | 45 ~ 67 | | | |
| 41-312 | 57 ~ 79 | | | |
| 41-362 | 40 ~ 92 | | | |
| 41-412 | 83 ~ 105 | | | |
| 41-462 | 95 ~ 117 | | | |
| 41-512 | 108 ~ 130 | | | |

## 6. WRENCH AND SPANEER CHART

| No. | Wrench & Spanner | | | Thread | | | PIPE AND HOSE | |
|---|---|---|---|---|---|---|---|---|
| | inch | | mm | UNF/UN | M | PF/G | ORFS (UNF/UN) | FLARE (PF) |
| 1 | - | 0.050 | 1.3 | - | - | - | - | - |
| 2 | - | 0.059 | 1.5 | - | - | - | - | - |
| 3 | 1/16 | 0.063 | 1.6 | - | - | - | - | - |
| 4 | 5/64 | 0.078 | 2 | - | - | - | - | - |
| 5 | 3/32 | 0.094 | 2.4 | - | - | - | - | - |
| 6 | - | 0.098 | 2.5 | - | - | - | - | - |
| 7 | 7/64 | 0.109 | 2.8 | - | - | - | - | - |
| 8 | - | 0.118 | 3 | - | - | - | - | - |
| 9 | 1/8 | 0.125 | 3.2 | - | - | - | - | - |
| 10 | 9/64 | 0.141 | 3.5 | - | - | - | - | - |
| 11 | 5/32 | 0.156 | 4 | - | - | - | - | - |
| 12 | - | 0.177 | 4.5 | - | - | - | - | - |
| 13 | 3/16 | 0.188 | 4.8 | - | - | - | - | - |
| 14 | - | 0.197 | 5 | - | - | - | - | - |
| 15 | 13/64 | 0.203 | 5.2 | - | - | - | - | - |
| 16 | 7/32 | 0.219 | 5.5 | - | - | - | - | - |
| 17 | 15/64 | 0.234 | 6 | - | - | - | - | - |
| 18 | 1/4 | 0.250 | 6.4 | - | - | - | - | - |
| 19 | 17/64 | 0.266 | 6.8 | - | - | - | - | - |
| 20 | 9/32 | 0.281 | 7 | - | - | - | - | - |
| 21 | 5/16 | 0.313 | 8 | - | - | - | - | - |
| 22 | 11/32 | 0.344 | 8.7 | - | - | - | - | - |
| 23 | - | 0.354 | 9 | - | - | - | - | - |
| 24 | 3/8 | 0.375 | 9.5 | - | - | - | - | - |
| 25 | - | 0.394 | 10 | - | - | - | - | - |
| 26 | - | - | 11 | - | - | - | - | - |
| 27 | 7/16 | 0.438 | 11.1 | - | - | - | - | - |
| 28 | 15/32 | 0.469 | 12 | - | - | - | - | - |
| 29 | 1/2 | 0.500 | 12.7 | - | - | - | - | - |
| 30 | - | - | 13 | - | - | - | - | - |
| 31 | 17/32 | 0.53 | 13.5 | - | - | - | - | - |
| 32 | - | 0.55 | 14 | 7/16-20 | - | - | - | - |
| 33 | 9/16 | 0.56 | 14.3 | - | - | - | - | - |
| 34 | 19/32 | 0.59 | 15 | - | - | - | - | - |
| 35 | 5/8 | 0.63 | 15.9 | - | - | - | - | - |
| 36 | - | - | 16 | - | - | - | - | - |
| 37 | 21/32 | 0.66 | 16.7 | - | - | - | - | - |

| No. | Wrench & Spanner | | | Thread | | | PIPE AND HOSE | |
|---|---|---|---|---|---|---|---|---|
| | inch | | mm | UNF/UN | M | PF/G | ORFS (UNF/UN) | FLARE (PF) |
| 38 | - | - | 17 | - | M12 | - | - | - |
| 39 | 11/16 | 0.69 | 17.5 | - | - | - | - | - |
| 40 | - | - | 18 | - | - | - | - | - |
| 41 | 3/4 | 0.75 | 19 | 9/16-18 | M14 | G1/4 | 9/16-18 | PF1/4 |
| 42 | 25/32 | 0.78 | 19.8 | - | - | - | - | - |
| 43 | - | - | 20 | - | - | - | - | - |
| 44 | 13/16 | 0.81 | 20.6 | - | - | - | - | - |
| 45 | - | - | 21 | - | - | - | - | - |
| 46 | - | - | 22 | - | M16 | G3/8 | 11/16-16 | PF3/8 |
| 47 | 7/8 | 0.88 | 22.2 | - | - | - | - | - |
| 48 | 29/32 | 0.91 | 23 | - | - | - | - | - |
| 49 | 15/16 | 0.94 | 23.8 | - | - | - | - | - |
| 50 | - | - | 24 | 3/4-16 | M18 | - | 13/16-16 | - |
| 51 | 31/32 | 0.97 | 26.4 | - | - | - | - | - |
| 52 | - | - | 25 | - | - | - | - | - |
| 53 | 1 | 1.00 | 25.4 | - | - | - | - | - |
| 54 | - | - | 26 | - | - | - | - | - |
| 55 | 1 1/16 | 1.06 | 27 | 7/8-14 | M22 | G1/2 | - | PF1/2 |
| 56 | - | - | 28 | - | - | - | - | - |
| 57 | 1 1/8 | 1.13 | 28.6 | - | - | - | - | - |
| 58 | - | - | 29 | - | - | - | - | - |
| 59 | - | - | 30 | - | - | - | 1-14 | - |
| 60 | 1 3/16 | 1.19 | 30.2 | - | - | - | - | - |
| 61 | - | - | 31 | - | - | - | - | - |
| 62 | 1 1/4 | 1.25 | 31.8 | - | - | - | - | - |
| 63 | - | - | 32 | 1-1/16-12 | M24 | G3/4 | - | - |
| 64 | - | - | 33 | - | - | - | - | - |
| 65 | 1 5/16 | 1.31 | 33.3 | - | - | - | - | - |
| 66 | - | - | 34 | - | - | - | - | - |
| 67 | 1 3/8 | 1.38 | 35 | - | - | - | - | - |
| 68 | - | - | 36 | 1-3/16-12 | M27 | G3/4 | 1-3/16-12 | PF3/4 |
| 69 | 1 7/16 | 1.44 | 37 | - | - | - | - | - |
| 70 | 1 1/2 | 1.50 | 38 | - | - | - | - | - |
| 71 | - | - | 39 | - | - | - | - | - |
| 72 | 1 9/16 | 1.56 | 39.7 | - | - | - | - | - |
| 73 | - | - | 40 | - | - | - | - | - |
| 74 | - | - | 41 | 1-5/16-12 | M33 | G1 | 1-7/16-12 | PF1 |
| 75 | 1 5/8 | 1.63 | 41.3 | - | - | - | - | - |

| No. | Wrench & Spanner | | | Thread | | | PIPE AND HOSE | |
|---|---|---|---|---|---|---|---|---|
| | inch | | mm | UNF/UN | M | PF/G | ORFS (UNF/UN) | FLARE (PF) |
| 76 | 1 11/16 | 1.69 | 43 | - | - | - | - | - |
| 77 | 1 3/4 | 1.75 | 44 | - | - | - | - | - |
| 78 | 1 13/16 | 1.81 | 46 | - | - | - | - | - |
| 79 | 1 7/8 | 1.88 | 47.6 | - | - | - | - | - |
| 80 | - | - | 48 | - | - | - | 1-11/16-12 | - |
| 81 | 1 15/16 | 1.94 | 49.2 | - | - | - | - | - |
| 82 | - | - | 50 | 1-5/8-12 | - | G1-1/4 | - | PF1-1/4 |
| 83 | 2 | 2.00 | 50.8 | - | - | - | - | - |
| 84 | - | - | 51 | - | - | - | - | - |
| 85 | 2 1/8 | 2.13 | 54 | - | - | - | - | - |
| 86 | - | - | 55 | 1-7-8-12 | - | G1-1/2 | - | PF1-1/2 |
| 87 | - | - | 57 | - | - | - | 2-12 | - |
| 88 | 2 1/4 | 2.25 | 57.2 | - | - | - | - | - |
| 89 | - | - | 60 | - | - | - | - | - |

## 7. RECOMMENDED LUBRICANTS

Use only oils listed below or equivalent.

Do not mix different brand oil.

| Service point | Kind of fluid | Capacity ℓ (U.S. gal) | Ambient temperature ˚C( ˚F)<br>-50 (-58) -30 (-22) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104) |
|---|---|---|---|
| Engine oil pan | Engine oil | 9.1 (2.4) | ★SAE 5W-40<br>SAE 10W<br>SAE 10W-30<br>SAE 5W-30<br>SAE 15W-40<br>SAE 30 |
| Torque converter transmission | Transmission oil | 20 (5.3) | Shell donax TD or<br>Huyndai oilbank xteer THF 75W-80 |
| Axle | Gear oil | 12.5 (3.3) | |
| Hydraulic oil tank | Hydraulic oil | 125 (33) | ★ISO VG 15<br>ISO VG 32<br>ISO VG 46<br>ISO VG 68 |
| Cabin tilt hand pump | | 0.7 (0.2) | |
| Fuel tank | Diesel fuel★1 | 171.5 (45.3) | ★ASTM D975 NO.1<br>ASTM D975 NO.2 |
| Fitting (Grease nipple) | Grease | - | ★NLGI NO.1<br>NLGI NO.2 |
| Radiator | Antifreeze : Water | 12.5 (3.3) | Ethylene glycol base permanent type ( 50:50)<br>★Ethylene glycol base permanent type (60 : 40) |

NOTES :

- Engine oil should be ACEA classification C2/C3.
- 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. | Periodical replacement of safety parts | Interval |
|---|---|---|
| 1 | Lift cylinder hose | Every 1 year (harsh operation)<br>Every 2 years (normal operation) |
| 2 | Tilt cylinder hose | |
| 3 | Side shift cylinder hose | |
| 4 | Brake hose | |
| 5 | Hydraulic pump hose | Every 2 years |
| 6 | Power steering hose | |
| 7 | Coolant hose and clamps | |
| 8 | Fuel hose | Every 2 years (harsh operation)<br>Every 4 years (normal operation) |
| 9 | Packing, seal, and O-ring of steering cylinder | |
| 10 | Lift chain | |
| 11 | Hydraulic pump seal kit | Every 3 years |
| 12 | Pressure sensor | Every 5 years |
| 13 | Mast accmulator (piston type) | Every 10 years |

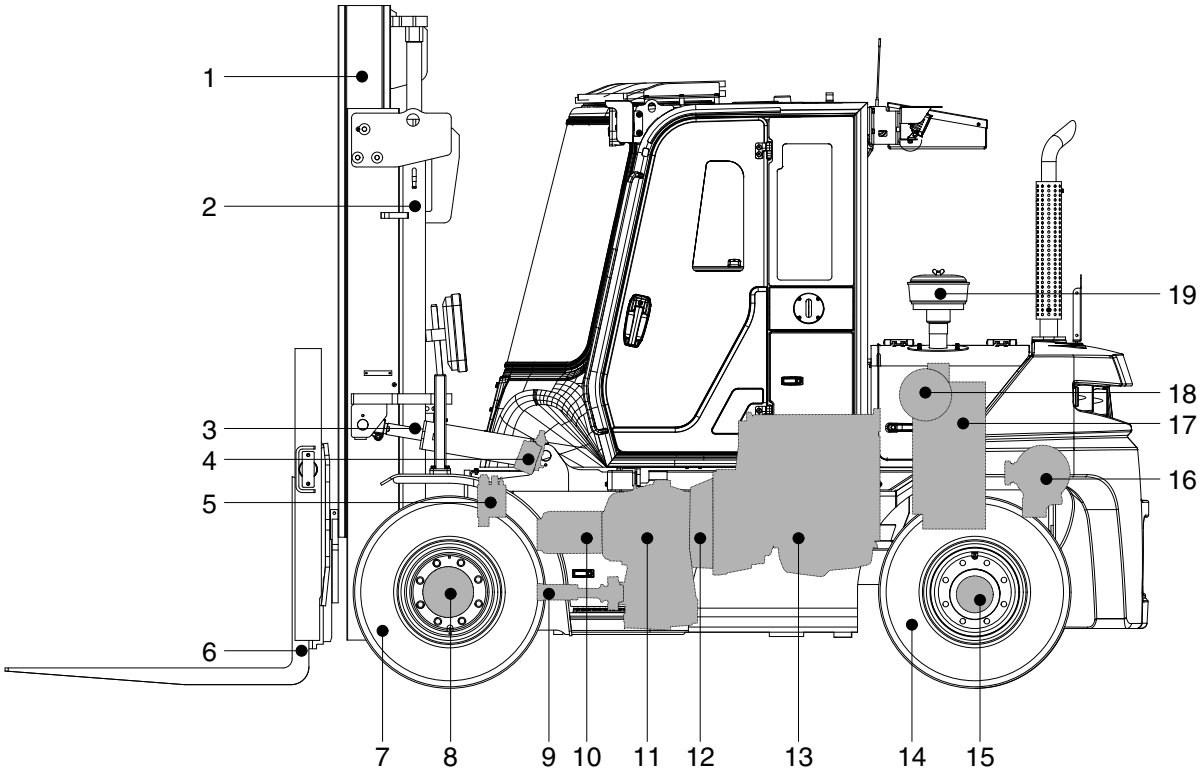
※ **Replace the O-ring and gasket at the same time when replacing the hose.**
※ **Replace clamp at the same time if the hose clamp is cracked when checking and replacing hose.**
※ **Normal operation**
- **Eight hour material handling, mostly in buildings or in clean, open air on clean paved surfaces.**

※ **Harsh operation**
- **All harsh working environment**
- **Long term heavy load operation**
- **High and low temperature working environment**
- **Sudden change in temperature**
- **Dusty or sandy working environment**
- **Highly corrosive chemical working environment**
- **Damp working environment**

# SECTION 2 REMOVAL & INSTALLATION OF UNIT


Group 1 Structure ..... 2-1
Group 2 Removal and installation of unit ..... 2-2
Group 3 Maintenance for hose ..... 2-21

# GROUP 1 STRUCTURE

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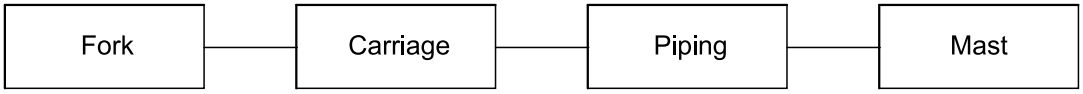
| | | | | | |
|---|---|---|---|---|---|
| 1 | Mast | 8 | Drive axle | 15 | Steering axle |
| 2 | Lift cylinder | 9 | Propeller shaft | 16 | Aftertreatment |
| 3 | Tilt cylinder | 10 | Hydraulic pump | 17 | Radiator |
| 4 | Steering unit | 11 | Transmission | 18 | Air cleaner |
| 5 | Main control valve | 12 | Torque converter | 19 | Precleaner |
| 6 | Fork | 13 | Engine | | |
| 7 | Front wheel | 14 | Rear wheel | | |

# GROUP 2 REMOVAL AND INSTALLATION OF UNIT

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

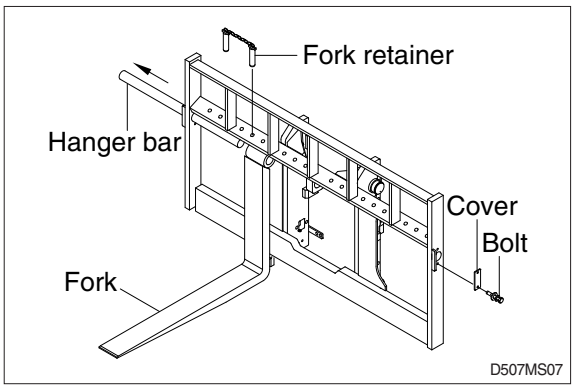
## 1. MAST

### 1) REMOVAL



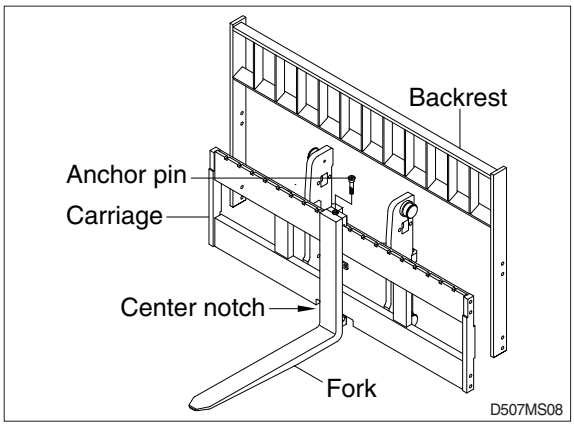

#### (1) SHAFT TYPE FORKS

① Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
② Release fork retainer and remove cover.
③ Slide one hanger bar at a time out of carriage assembly.
④ Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.



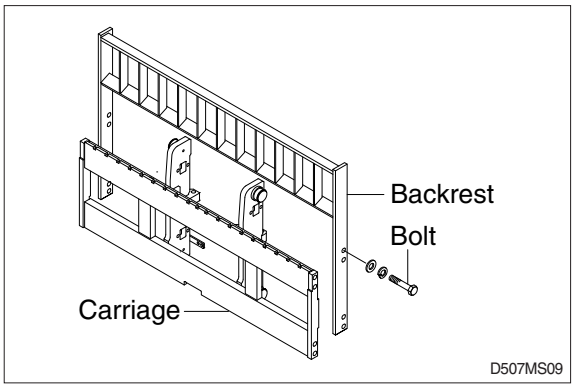

#### (2) HOOK ON TYPE FORKS (OPTION)

① Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
② Release fork anchor pins 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 fork removal.
③ Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.



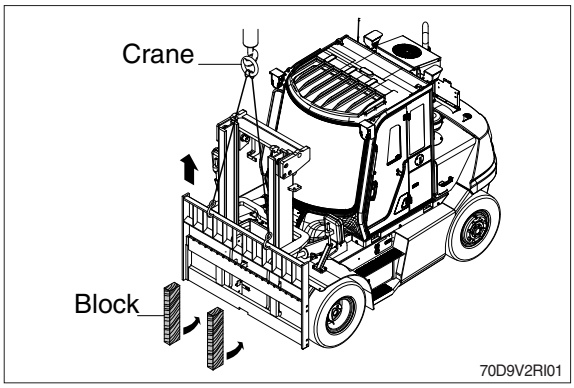

#### (3) BACKREST

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

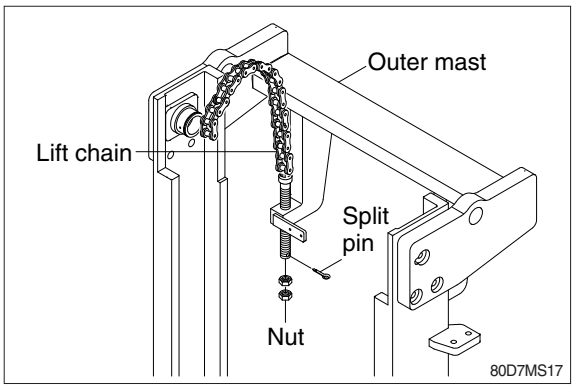


## (4) CARRIAGE

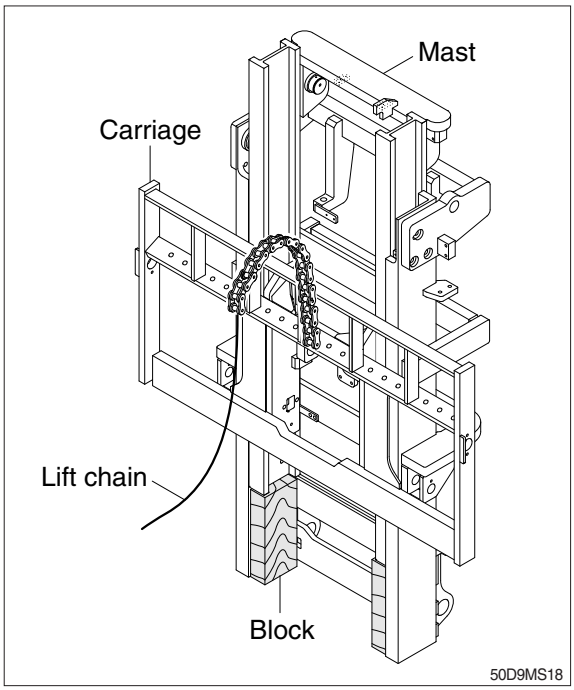
① With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is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




② While supporting lift chains, remove the split pin and nuts from the chain anchor bolts of stationary upright.



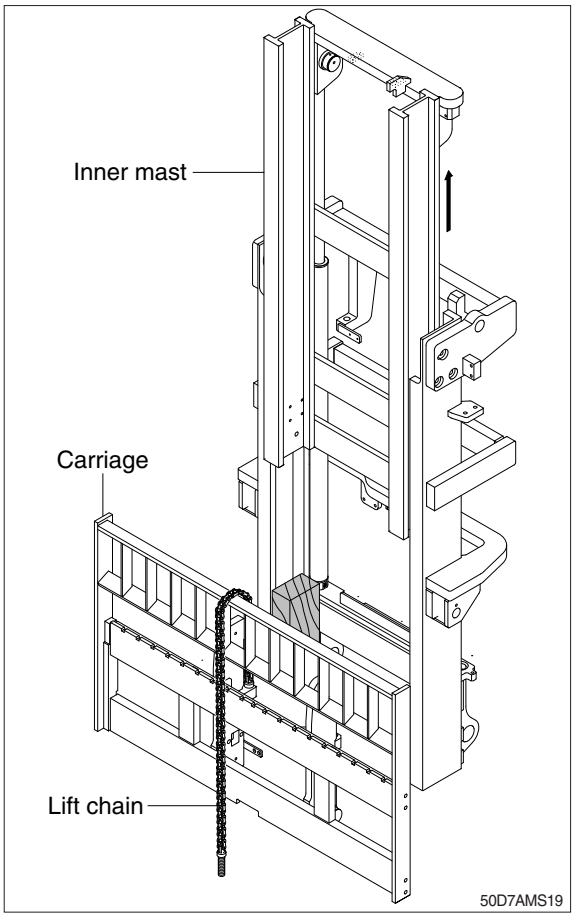

③ Pull the chains out of the sheaves and drape them over the front of the carriage.



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.

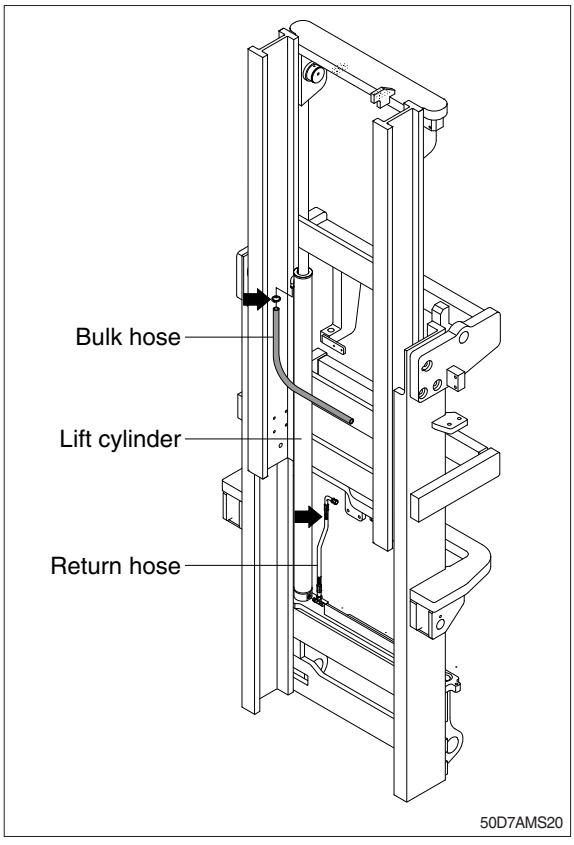



### (5) PIPING

① Remove the bulk hoses and clamps attached to the cylinder.

② Remove the return hose from the down control valve.

※ **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.**



### (6) LIFT CYLINDER

① Loosen and remove hexagon nuts and set screws securing lift cylinders to inner mast.

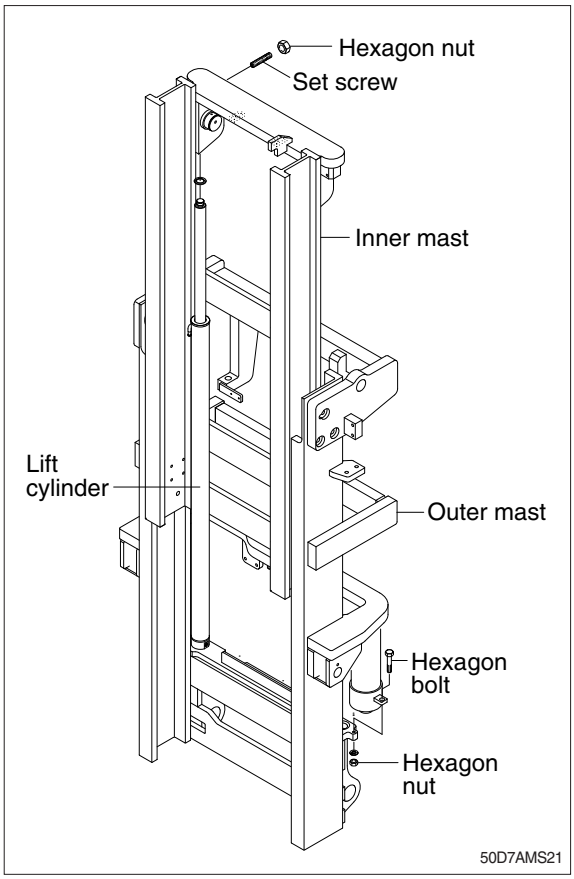
② Bind the lift cylinder with overhead hoist rope and pull up so that the rope has no slack or binding.

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

③ Loosen and remove hexagon bolts and nuts securing lift cylinders to outer mast.

④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.

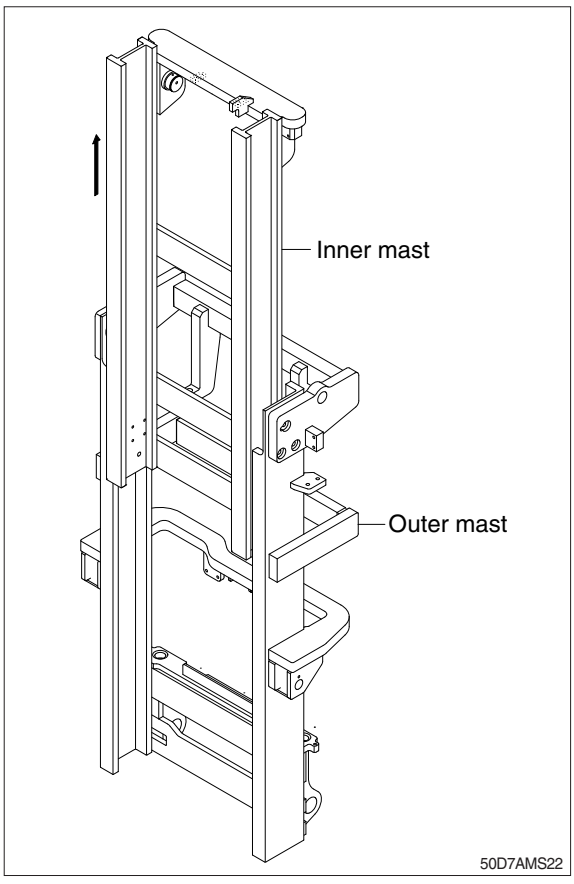
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.




### (7) 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.**



### (8) TILT CYLINDER PIN

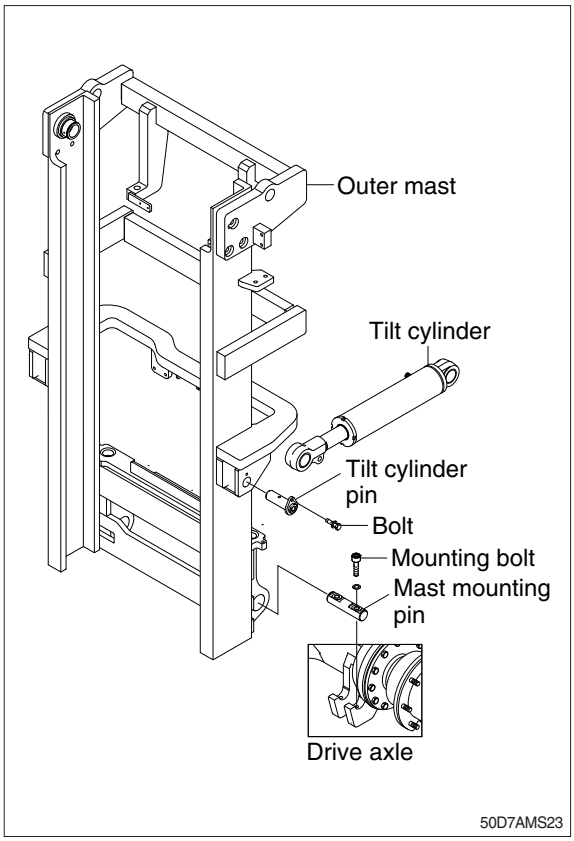
Loosen the bolt and remove the tilt cylinder pin.

### (9) MAST MOUNTING PIN

① Attach a crane to the stay at the top of the outer mast, and raise it.

② Loosen the mounting bolts and remove the mast mounting pins from drive axle, then slowly raise outer mast.

※ This operation is carried out under the truck, so use a pit, or if there is no pit, jack up the machine 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 and drive axle.

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

③ Tighten mounting socket bolts to drive axle unit.

· Tightening torque : 49.2~66.6 kgf · m (356~481 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

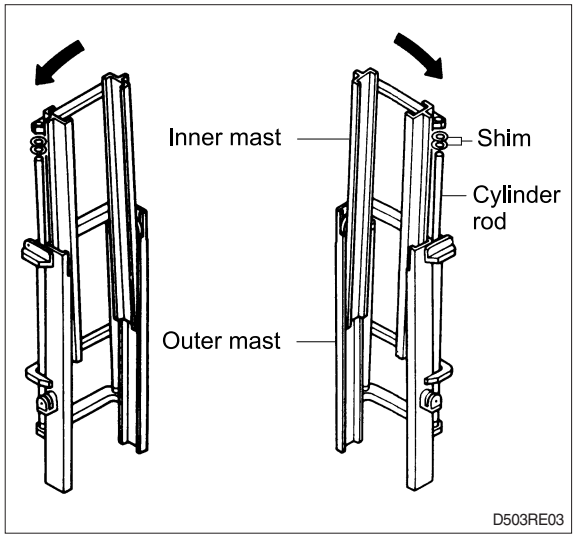
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

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.**

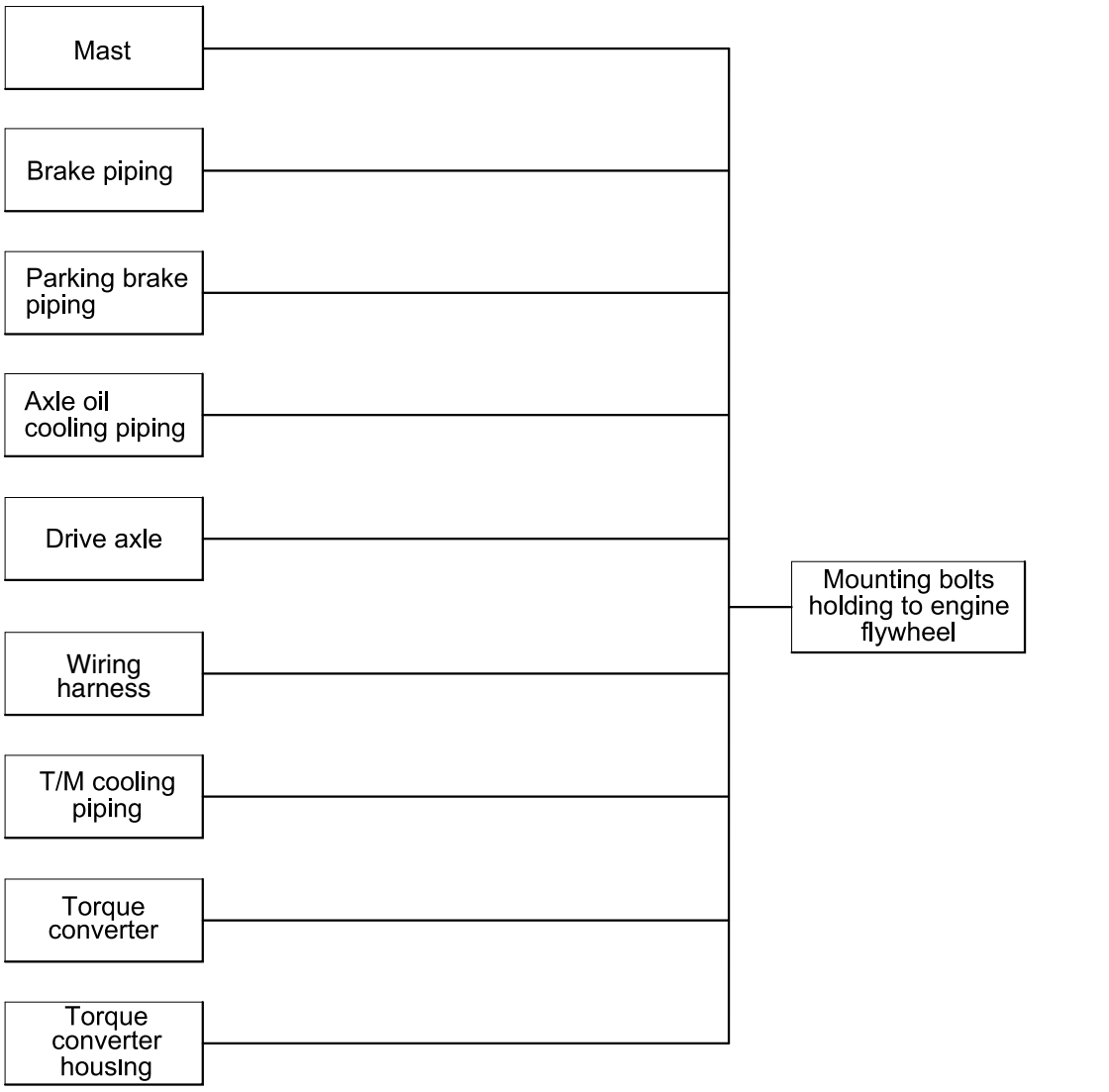
**※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.**

**· Shim thickness : 1.0 mm (0.04 in)**



## 2. POWER TRAIN ASSEMBLY

### 1) REMOVAL




#### (1) Mast

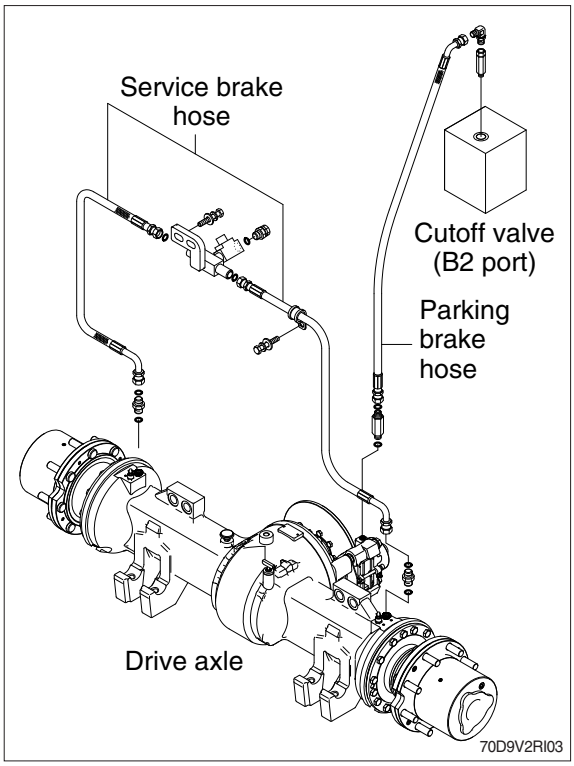
Refer to section on mast (Page 2-2)

**(2) Service brake piping**

Disconnect the brake piping from the drive axle.

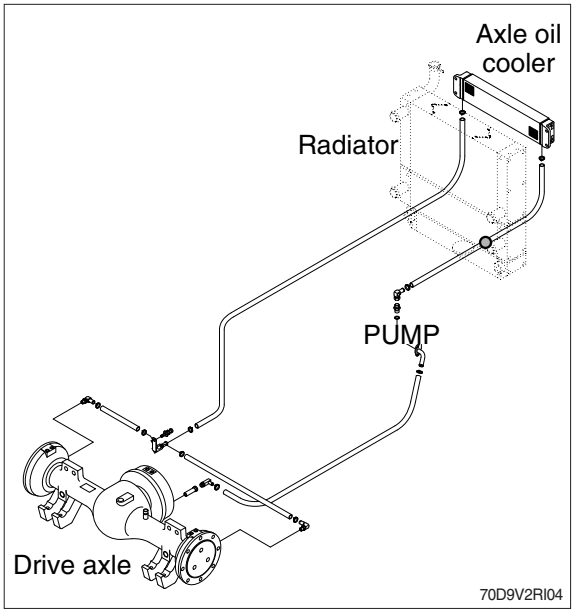
**(3) Parking brake piping**

Disconnect parking brake piping from the drive axle.




**(4) Axle oil cooling piping**

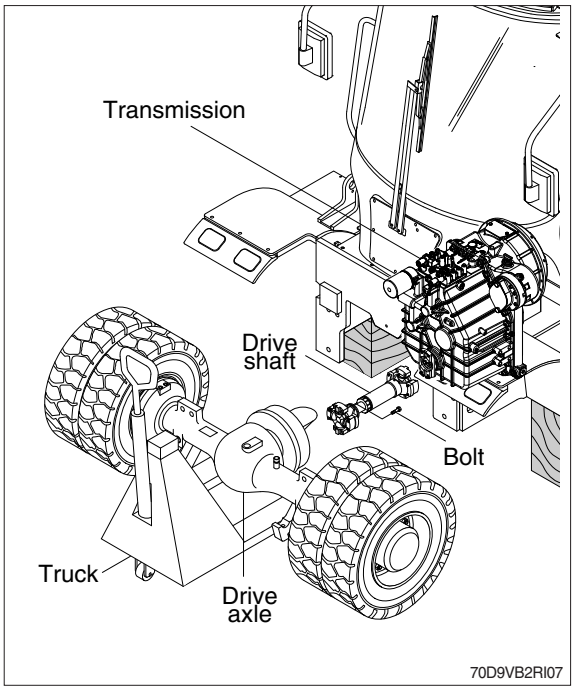
Disconnect the brake cooling piping from the drive axle.



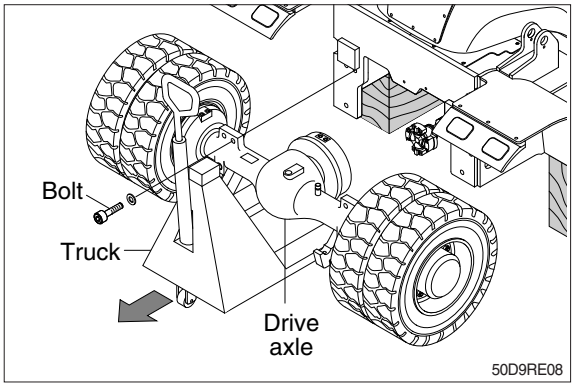
### (5) Drive axle

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

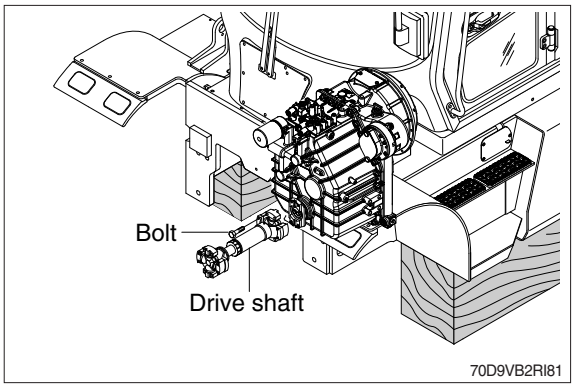
① Attach a crane to the tilt cylinder notches on the dashboard and raise the truck.
② Loosen hexagonal bolts connecting drive axle to drive shaft.
③ Put the block under the front axle and support under the drive axle with a truck.




④ Remove drive axle mounting bolts from the frame and then slowly pull out the truck with drive axle to the front.




⑤ Remove drive shaft from the transmission by loosening the mounting bolts.



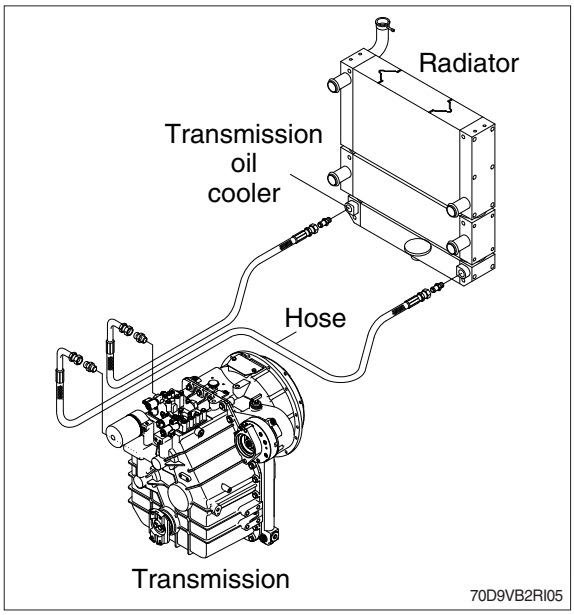
### (6) Inching linkage

Remove the inching sensor cable.

### (7) Transmission cooling piping

Disconnect cooling hose and connector from the transmission.

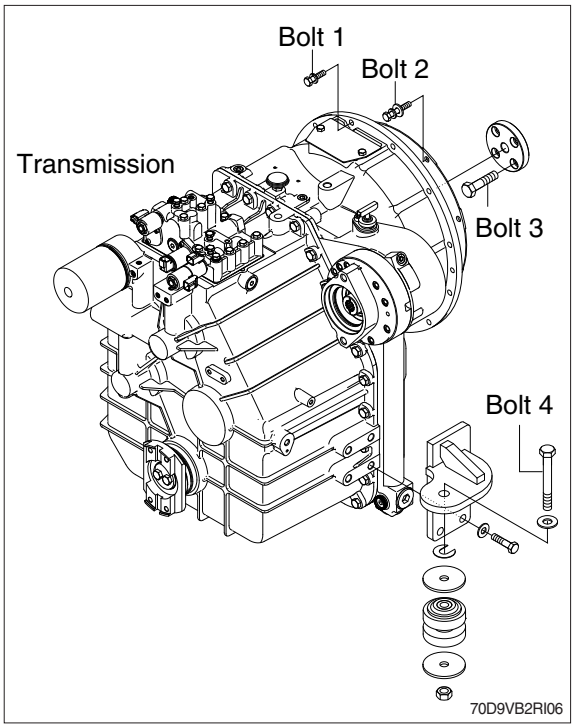
※ **Make sure that the coolant be drained from the hose.**




### (8) Transmission assembly

① Remove the transmission assembly by loosening the bolts (1,2,3) mounted on the engine flywheel housing and the bolts (4) mounted on the main frame.

② Using a moving truck slowly, pull out transmission assembly to the front.



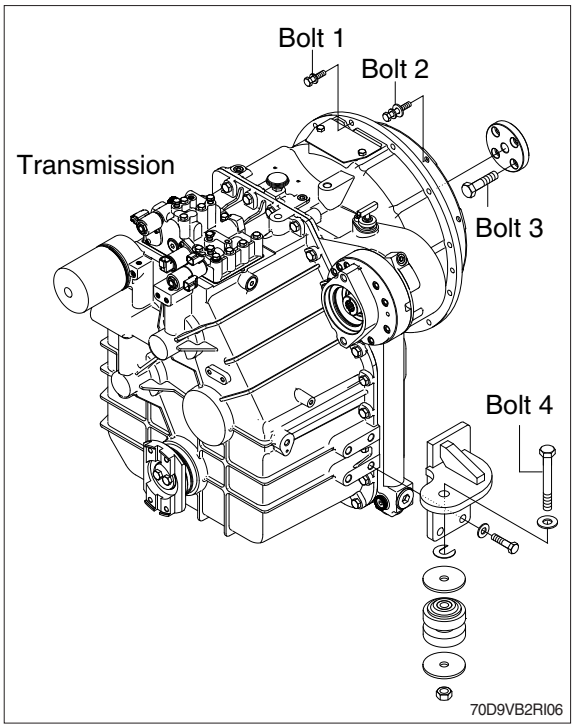
## 2) INSTALLATION

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

(1) Tightening torque of the mounting bolts for the transmission.

· 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 : 5.5~8.3 kgf · m (39.8~60.0 lbf · ft)
· Bolt 4 : 7.5 kgf · m (54.2 lbf · ft)

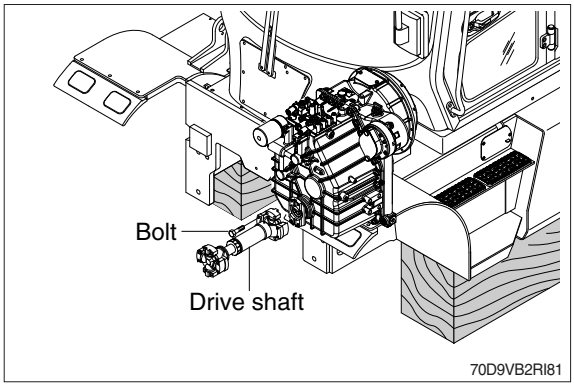
**※ Apply loctite #277 on the thread before tightening.**




(2) Tightening torque of mounting bolt for the drive shaft.

· 6.3~7.7 kgf · m (45.6~55.7 lbf · ft)

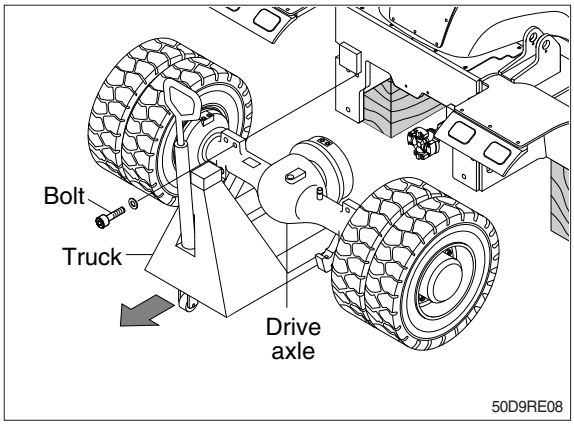
**※ Apply loctite #277 on the thread before tightening.**




(3) Tightening torque of mounting bolt for the drive axle.

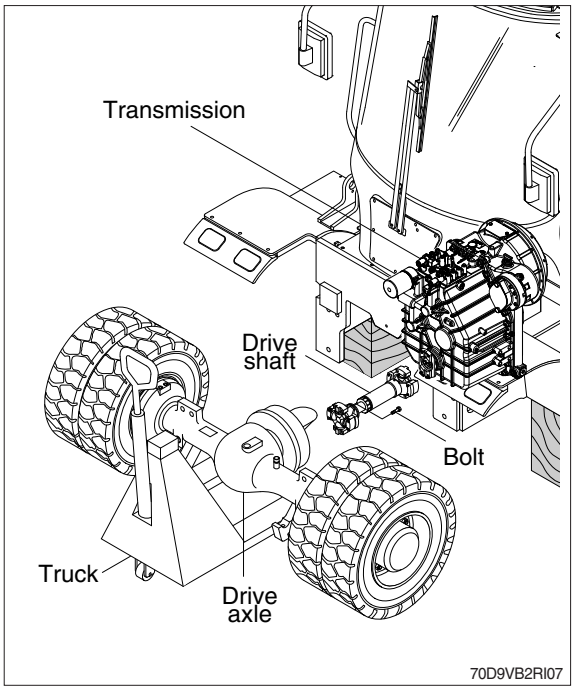
· 135~165 kgf · m (976~1194 lbf · ft)

**※ Apply loctite #277 on the thread before tightening.**



(4) Tightening torque of mounting bolt for transmission and drive shaft.
· 6.3~7.7 kgf · m (45.6~55.6 lbf · ft)

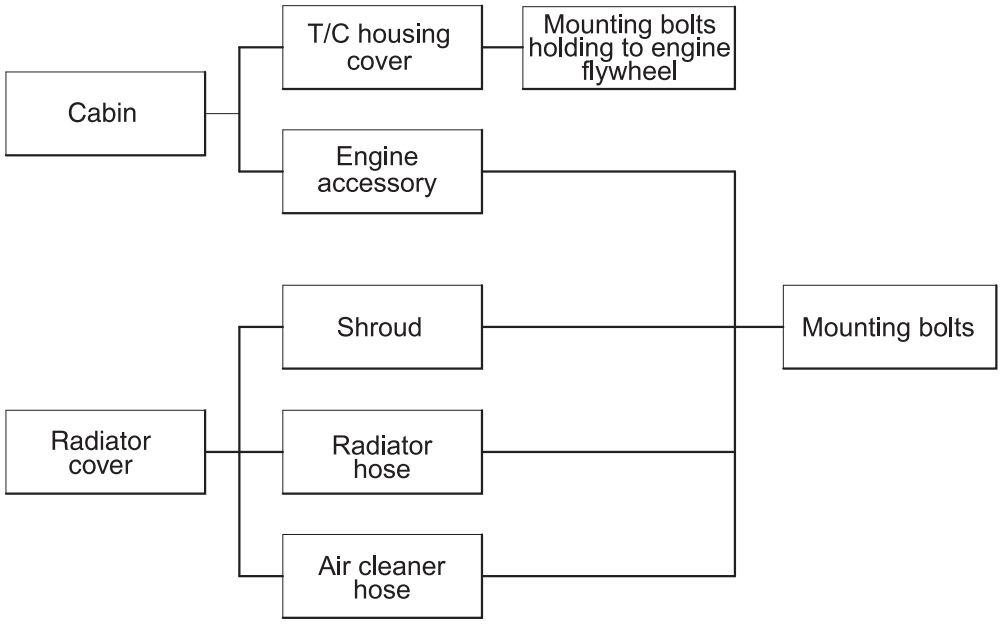
※ **Apply loctite #277 on the thread before tightening.**



## 3. ENGINE

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

### 1) REMOVAL

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#### (1) Engine hood

① Cabin

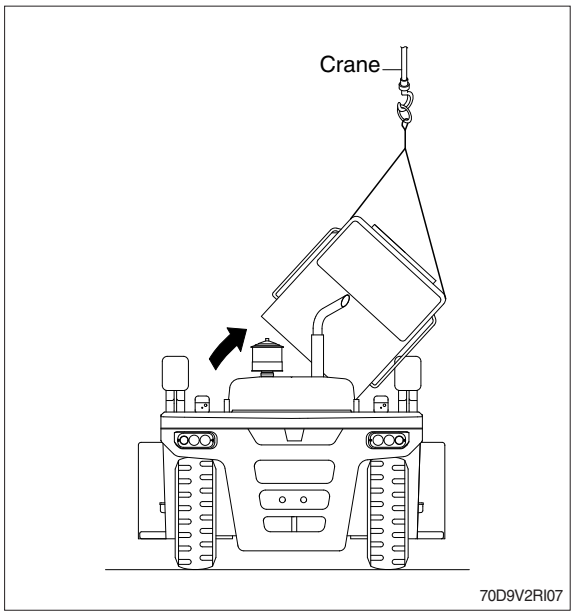
- First, tilt the cabin

※ **Refer to the operator's manual page 7-16.**

- After remove the wiring for rear combination lamp, work lamp, head lamp and flasher lamp on the stay of the cabin and then raise it with a crane
- Finally remove cabin for removal tilt option cylnder and latch assy.

② Body wing cover (LH, RH)

Remove the body wing cover by loosening the mounting bolts.

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(2) Lossen the bolts mounted on the engine flywheel housing. For details, see page 2-11.

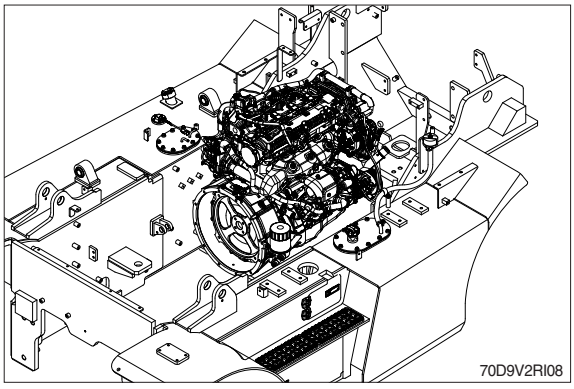
**(3) Engine accessory**

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

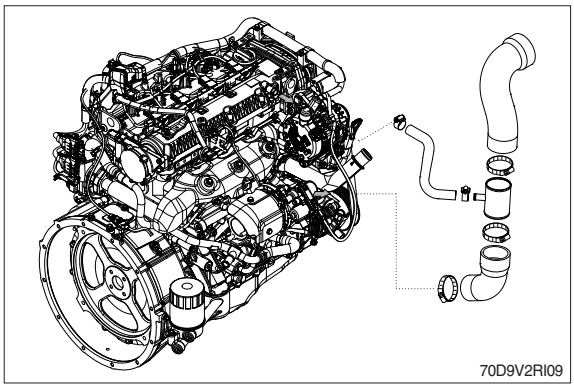
Wiring harness to alternator and starter.

① Wiring harness for oil pressure and
② engine water temperature gauges.

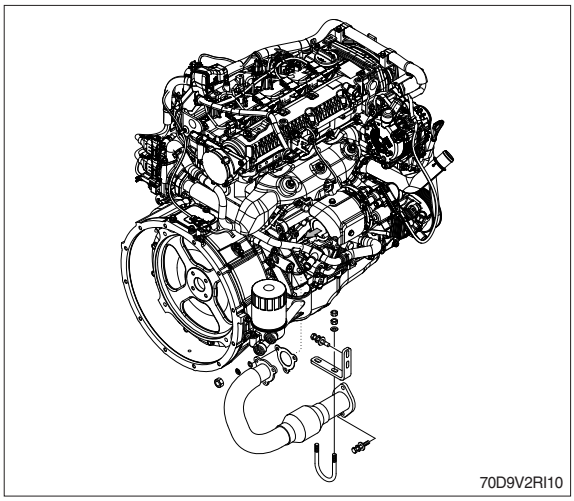
Cables for meters, buttons and accelerator
③ pedal.




④ Hoses to fuel tank and air cleaner.

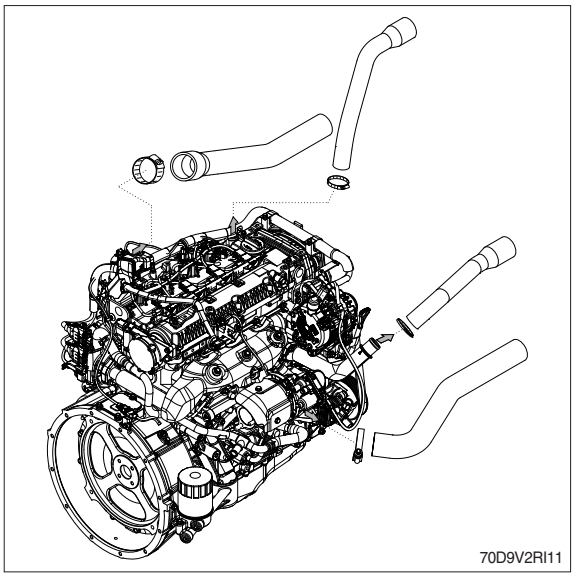



⑤ Exhaust pipe.



**(4) Radiator hose**

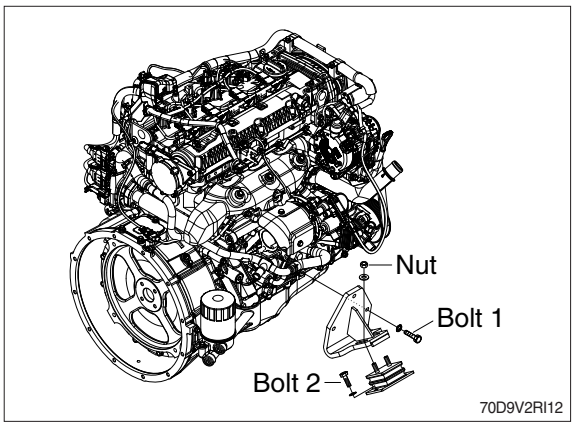
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.




**(5) Mounting bolt**

Attach a crane to the engine hook and raise, then remove mounting bolts and nuts. 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.**

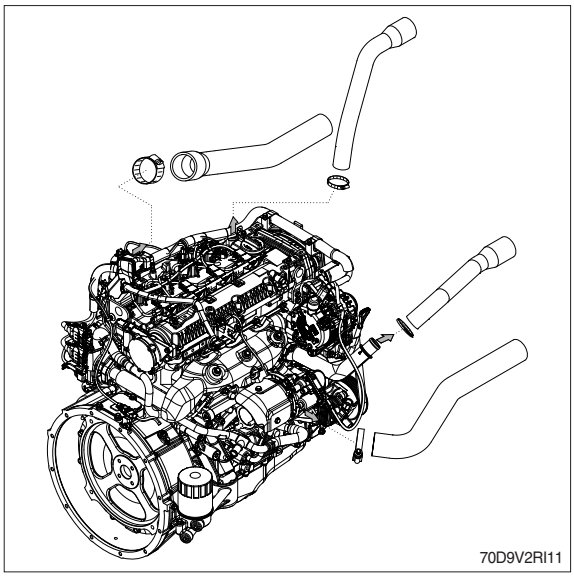
(3) Tightening torque of mounting bolt installing to torque converter housing.

- Bolt 1 : 5.9~8.9 kgf · m (42.7~64.4 lbf · ft)
- Bolt 2 : 5.5~8.3 kgf · m (39.8~60.0 lbf · ft)
- Nut : 5.5~8.3 kgf · m (39.8~60.0 lbf · ft)

※ **Apply loctite #277 on the thread before tightening.**

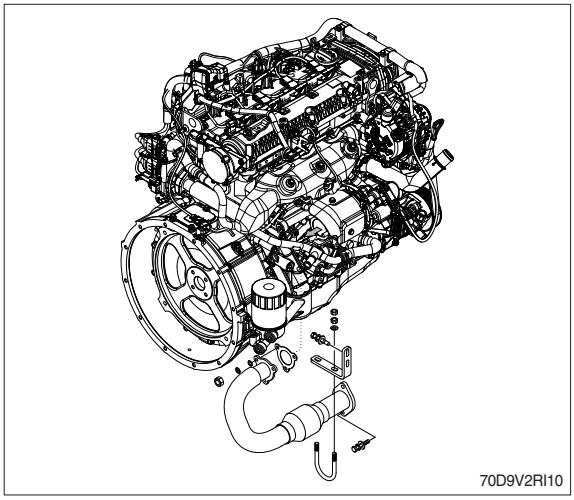
### (4) Radiator hoses

Insert the radiator hoses securely and fit the clamps.



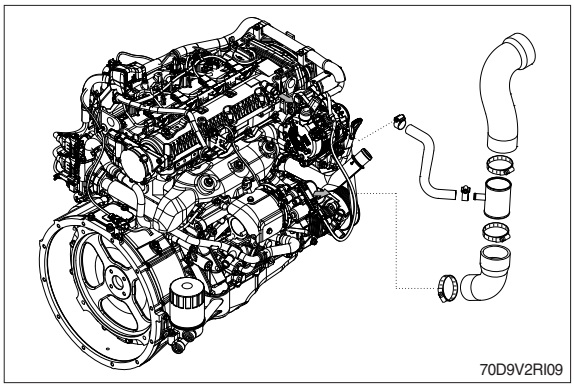

### (5) Exhaust pipe

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




### (6) Air cleaner hose

Insert the air cleaner hose securely and fit a clamp.



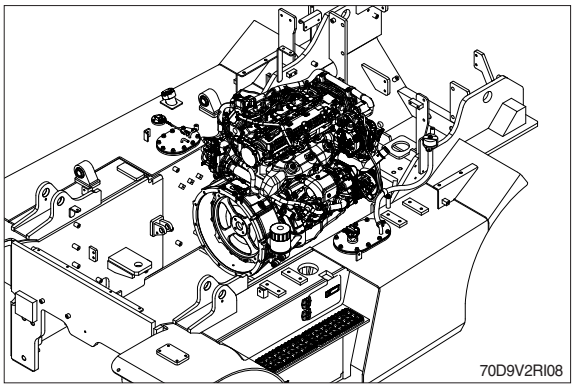
### (7) Engine accessory

Install 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. STEERING AXLE

### 1) REMOVAL

Counterweight — Rear wheel — Hose and pipe — Mounting bolt

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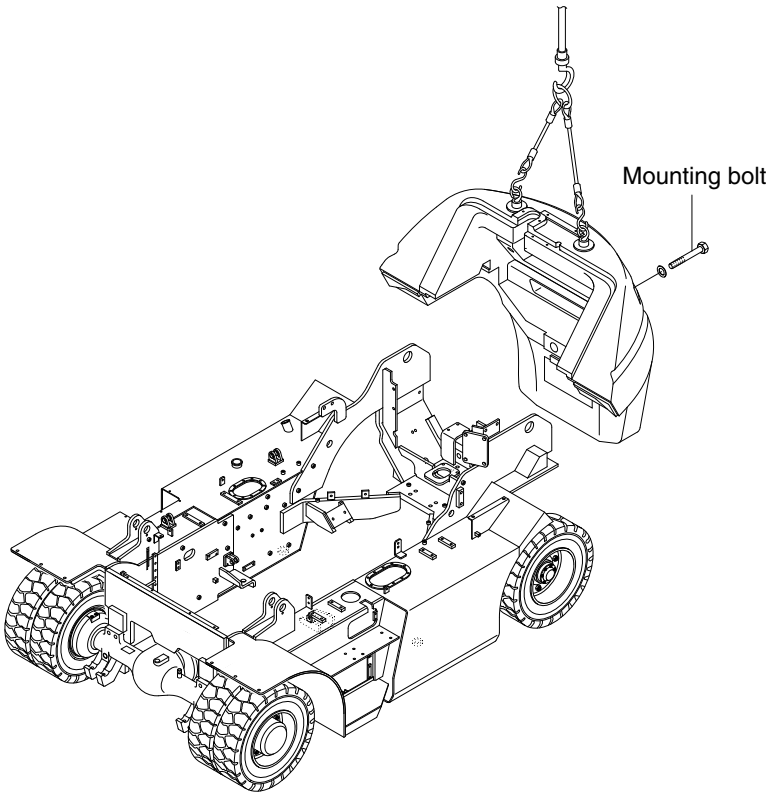


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#### (1) Counterweight

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)
  70D-9VB : 3,014 kg (6645 lb)
· Tightening torque : 100±15 kgf·m (723±108 lbf·ft)

### (2) Rear wheel

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

· Tightening torque

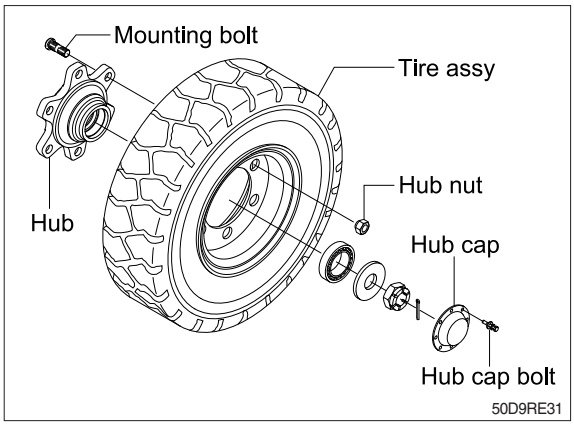
- Hub nut

  61.2±6.1 kgf·m (443±44.1 lbf·ft)

- Hub cap bolt

  2.5±0.5 kgf·m (18.0±3.6 lbf·ft)

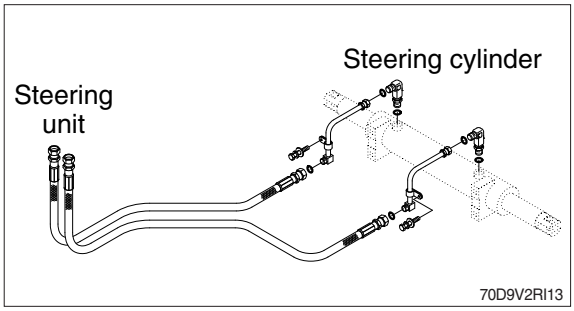
※ Keep gas tight by applying liquid gasket #1215 on the contact surface of the hub cap before assembling the hub cap.




### (3) Hose and piping

① Disconnect the hoses from the steering axle and then drain out oil.

② Disconnect the pipes from the axle support.




### (4) Mounting bolt

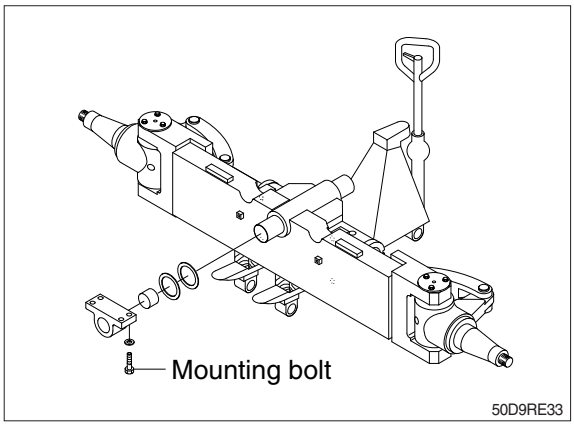
Put a block under the steering axle, support on a truck, an raise the frame with a crane. Remove the mounting bolts installing to the frame, and pull out to the rear.

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

· Mounting bolt tightening torque

  41.3±6.2 kgf·m (299±44.8 lbf·ft)

※ Apply loctite #277 on the thread before tightening.



# GROUP 3 MAINTENANCE FOR HOSE

## 1) MAINTENANCE

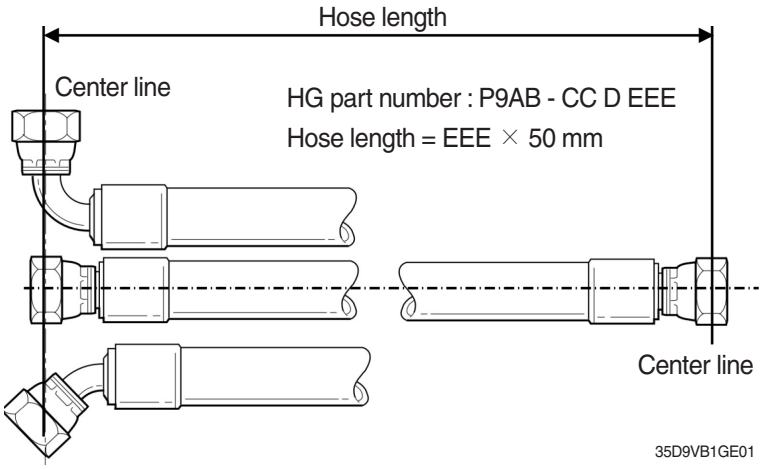
The function and service life of hydraulic components depend to a great extent on how clean the hydraulic oil is. Therefore, it is very important to prevent dirt from entering the hydraulic system. Some simple advice to keep the hydraulic system clean:

- Always clean the area around parts before starting work. If possible, it is better to wash the the truck.
- Plug hose connections immediately after disconnecting. If possible, use correct plugs for the connection type. If plugs are missing, use clean plastic bags and cable ties or tape to seal the connection.
- Never reutse oil that has been drained from the truck.
- If possible, filter the oil before pouring it into the truck, oil barrels often contain impurities.

## 2) HOSE LENGTH

Connected hoses have HG part number, but if they have no information the hoses are measured as follows:

- The hose length is measured on a laid-out hose between the sealing surfaces.
- On angled connections, measure from the sealing surface's center line according to the figure.




## 3) CAUTION FOR REPLACEMENT

When replacing hoses for maximum service life and functionality, the following must be observed:

- To avoid stress when connecting, a straight hose length must be secured after connection.
- Do not kink the hose. 7% twist reduces the service life by 90%.
- Do not use hoses that are too short. It may cause leakage or damage.
- Use the correct coupling to minimize the number of bends.
- Avoid sharp bending.
- When storing, keep the inside of the hose clean. When installing, keep the plug in place for as long as possible.

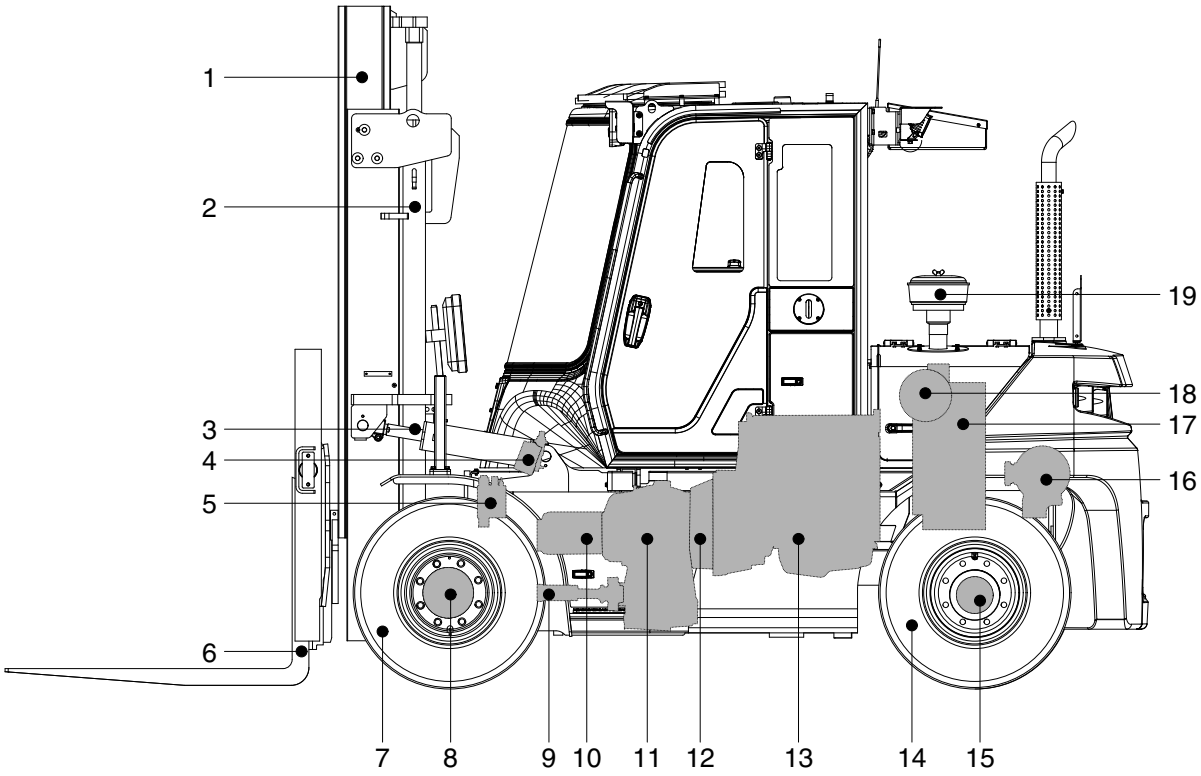
# SECTION 3 POWER TRAIN SYSTEM

Group 1 Structure and operation ····· 3-1
Group 2 Disassembly and assembly ····· 3-17
Group 3 Maintenance and troubleshooting ····· 3-69

# SECTION 3 POWER TRAIN SYSTEM

## GROUP 1 STRUCTURE AND OPERATION

### 1. STRUCTURE

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| | | | | | |
|---|---|---|---|---|---|
| 1 | Mast | 8 | Drive axle | 15 | Steering axle |
| 2 | Lift cylinder | 9 | Propeller shaft | 16 | Aftertreatment |
| 3 | Tilt cylinder | 10 | Hydraulic pump | 17 | Radiator |
| 4 | Steering unit | 11 | Transmission | 18 | Air cleaner |
| 5 | Main control valve | 12 | Torque converter | 19 | Precleaner |
| 6 | Fork | 13 | Engine | | |
| 7 | Front wheel | 14 | Rear wheel | | |

The power train consists of the following components :

- Torque converter
- Transmission
- Drive shaft
- Drive axle

Engine power is transmitted to the transmission through the torque converter.

The transmission is a hydraulically engaged 2 speed forward, 1 speed reverse power shift type transmission.

The transmission outputs through the universal joints of the drive shaft to drive axle assembly.

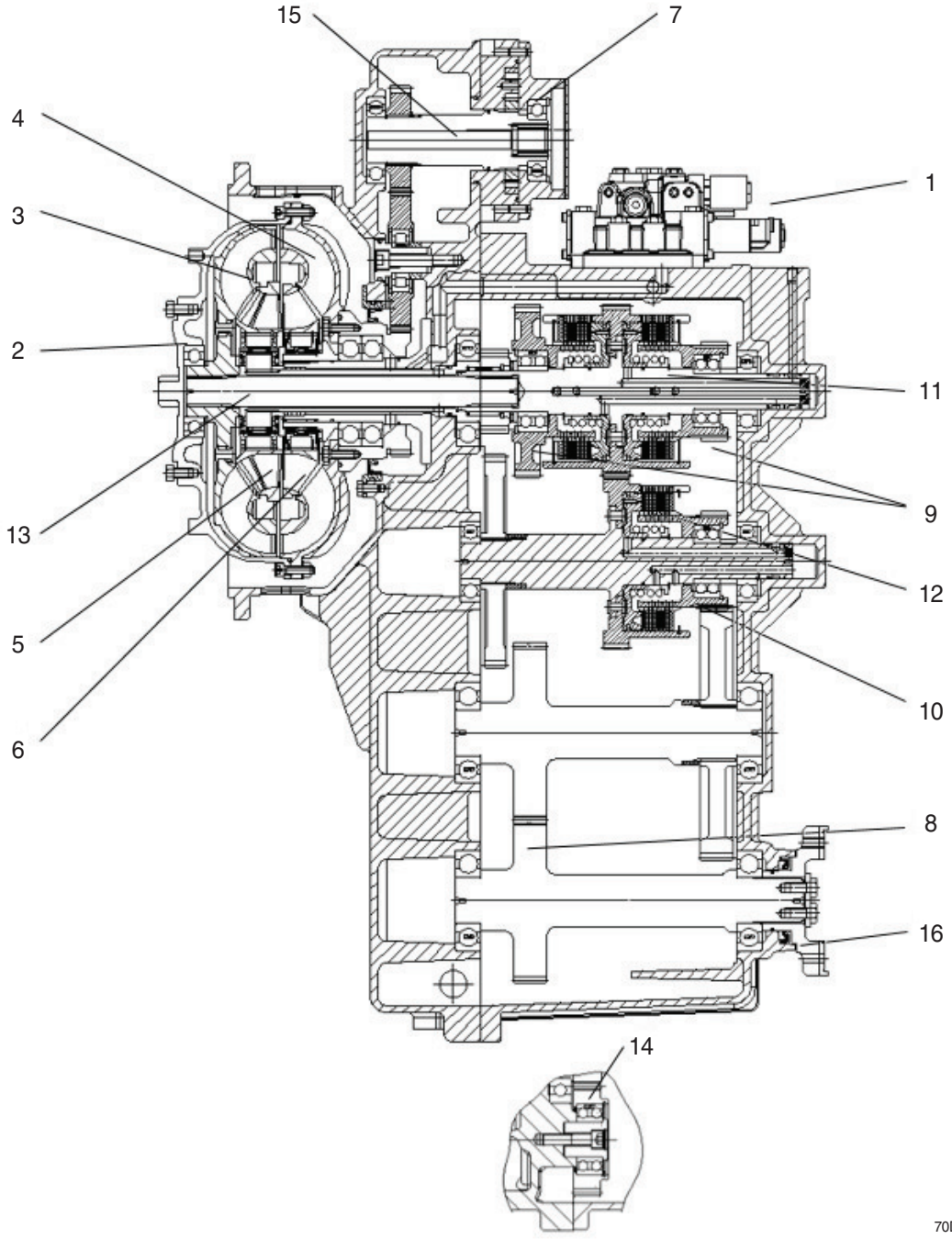
The power transmitted to front axle drives front wheels.

## 2. SPECIFICATION

| Item | | | Specification |
|---|---|---|---|
| Torque converter | Type | | 3 Element, 1 stage, 2 phases |
| | Stall ratio | | 5.3 : 1 |
| Transmission | Type | | Full auto, power shift |
| | Gear shift (FR/RR) | | 2/1 |
| | Adjustment | | Electrical single lever type |
| | Overhaul ratio | FR | 1 : 2.456 2 : 0.946 |
| | | RR | 1 : 2.494 |
| Axle | Type | | Front-wheel drive type, fixed location |
| | Gear ratio | | 10.668 |
| | Gear | | Ring & pinion gear type |
| Wheels | Q'ty (FR/RR) | | Double : 4/2 |
| | Front (drive) | | 8.25-15-14 PR |
| | Rear (steer) | | 8.25-15-14 PR |
| Brakes | Travel | | Front wheel, wet disc brake |
| | Parking | | Wet disc (negative brake) |
| Steering | Type | | Full hydraulic, power steering |
| | Steering angle | | 75.87° to both right and left angle, respectively |

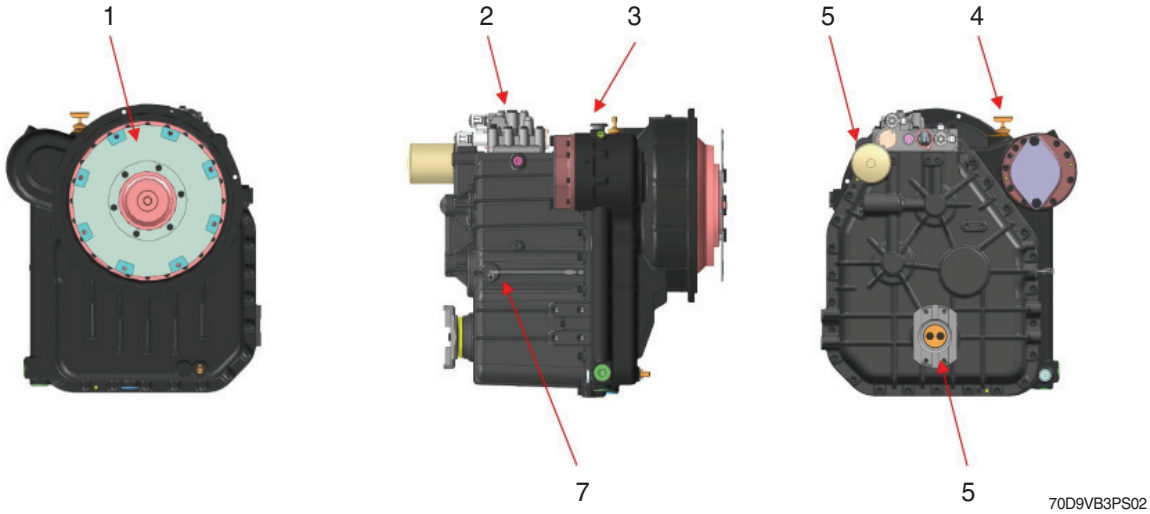
## 3. TRANSMISSION

### 1) STRUCTURE




| | | | | | |
|---|---|---|---|---|---|
| 1 | Control valve | 7 | Charging pump | 13 | PTO shaft |
| 2 | Torque converter | 8 | Output gear | 14 | Intermdiate gear |
| 3 | Turbine | 9 | Forward clutch gear | 15 | PTO pump shaft |
| 4 | Impeller | 10 | Reverse clutch gear | 16 | Flange yoke |
| 5 | 1st stator | 11 | Forward clutch pack | | |
| 6 | 2nd stator | 12 | Reverse clutch pack | | |

## 2) INSTALLATION VIEW




| | | | | | |
|---|---|---|---|---|---|
| 1 | Torque converter | 4 | Oil level gauge and tube | 7 | Speed sensor |
| 2 | Control valve | 5 | Oil filter | | |
| 3 | Air breather | 6 | Output (Universal joint link part) | | |

## 3) OPERATION

### (1) Torque converter

#### ① Converter equipment

a. The outside of Impeller is connected with flywheel of engine through cover wheel, front cover and Input plate. The inside of it is supported by Inner race of free wheel through angular contact bearing.

b. The engine power is transmitted to Impeller wheel, and that is transmitted to turbine wheel assembly through fluid.

c. Turbine wheel assembly is connected with turbine shaft by spline, A gear is fixed in other side of turbine shaft. This gear is working with a gear on output shaft. They are a reduction gear and transmit power to output shaft with flange.

d. Stator wheel 2 is fixed in transmission housing through free wheel cam, one way clutch bearing and 2nd stator shaft. When the fluid returns to Impeller wheel from turbine wheel assembly, the reaction torque occurs in Stator wheel. This reaction torque is added to the turbine torque. Therefore, the turbine torque becomes larger than the input torque. In addition when turbine wheel speed is high. Stator wheel does not occur the reaction torque by idling itself.

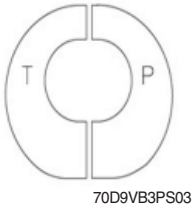
#### ② Power transmission principle of torque converter

a. The mechanism that transmits power through fluid id called "Hydraulic Clutch". This is divided into about two types.

b. One is called "Fluid coupling", another is called "Torque Converter". Those main part structures are such as below figures.

Fluid Coupling


Torque Converter

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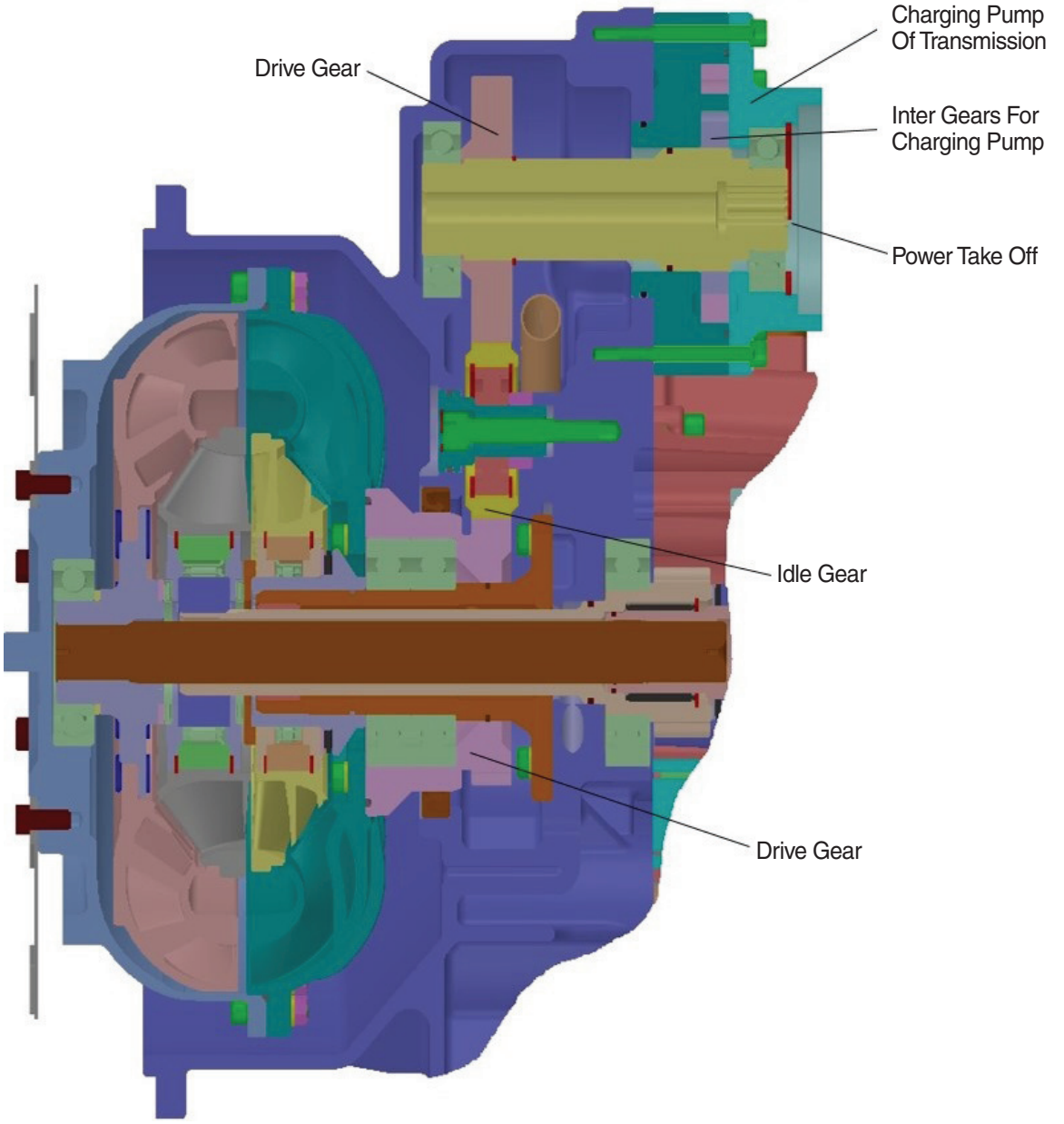
P : Pump Wheel (Impeller Wheel)
T : Turbine Wheel
S1 : Stator Wheel 1
S2 : Stator Wheel 2

c. Fluid coupling consists of impeller and turbine. This is the same principle that the electric fan transmits revolution (power) to the windmill when they are laid face to face.
d. When the Impeller rotates by engine, the fluid (oil) starts rotating around the axis of rotation and moves outside by centrifugal force.
e. The fluid flows from the outside of Impeller blades, and flows into the outside of turbine blades faced to Impeller blades.
f. While the fluid is flowing to the inside along turbine blades, that gives turbine wheel rotation (power). And that returns to the inside of Impeller blades.
g. Therefore as for the flow of the fluid, at first according as impeller rotates, the rotary flow that the rotary center is the axis of impeller occurs. As a result the eddy flow that circulates between impeller and turbine occurs by centrifugal force.
h. Fluid coupling must be used the oil as continuous power transmitting medium in the space closed up.
i. When the difference between impeller speed and turbine speed is large, namely when the load is large for example in case of starting, or in case of going up slope, and so on, the efficiency is low. And it is necessary for turning turbine to input large impeller torque.
j In other to exclude this loss. Stator wheel is set between the outlet of turbine and the inlet of impeller. In this way Torque converter is what the transmission efficiency when the load is large is improved.
k. In fluid coupling, the flow of oil which returns to impeller from turbine makes the power which disturbs impeller rotation.
l In torque converter, the flow direction of oil from turbine is changed to the direction which turns impeller by stator wheel. Therefore the efficiency is high when the load is large. Besides, the torque increased than the input torque is transmitted to turbine.
m. Stator improves the ability of torque converter by idling itself or stopping according to the flow direction of oil in the outlet of turbine.
n. For example like the vehicle which is running fast, when the load of turbine is small, the difference between impeller speed and turbine speed becomes small.
o. According as those speeds become this condition, the oil flowing in the outlet of turbine changes the flow angle to the direction of stator rotation. Finally that becomes hitting against the back of stator blade.
p. And stator becomes large resistance which disturbs the flow, and the efficiency goes down. Then stator of torque converter has a one-way clutch (free wheel) which is pushed by the flow of oil and idles when the fluid (oil) becomes hitting against the back of blade.
q. In other words, stator is fixed in one direction and increases the torque. If the rotation of stator is reverse direction, stator idles. And stator becomes functioning as fluid coupling when the load is small.

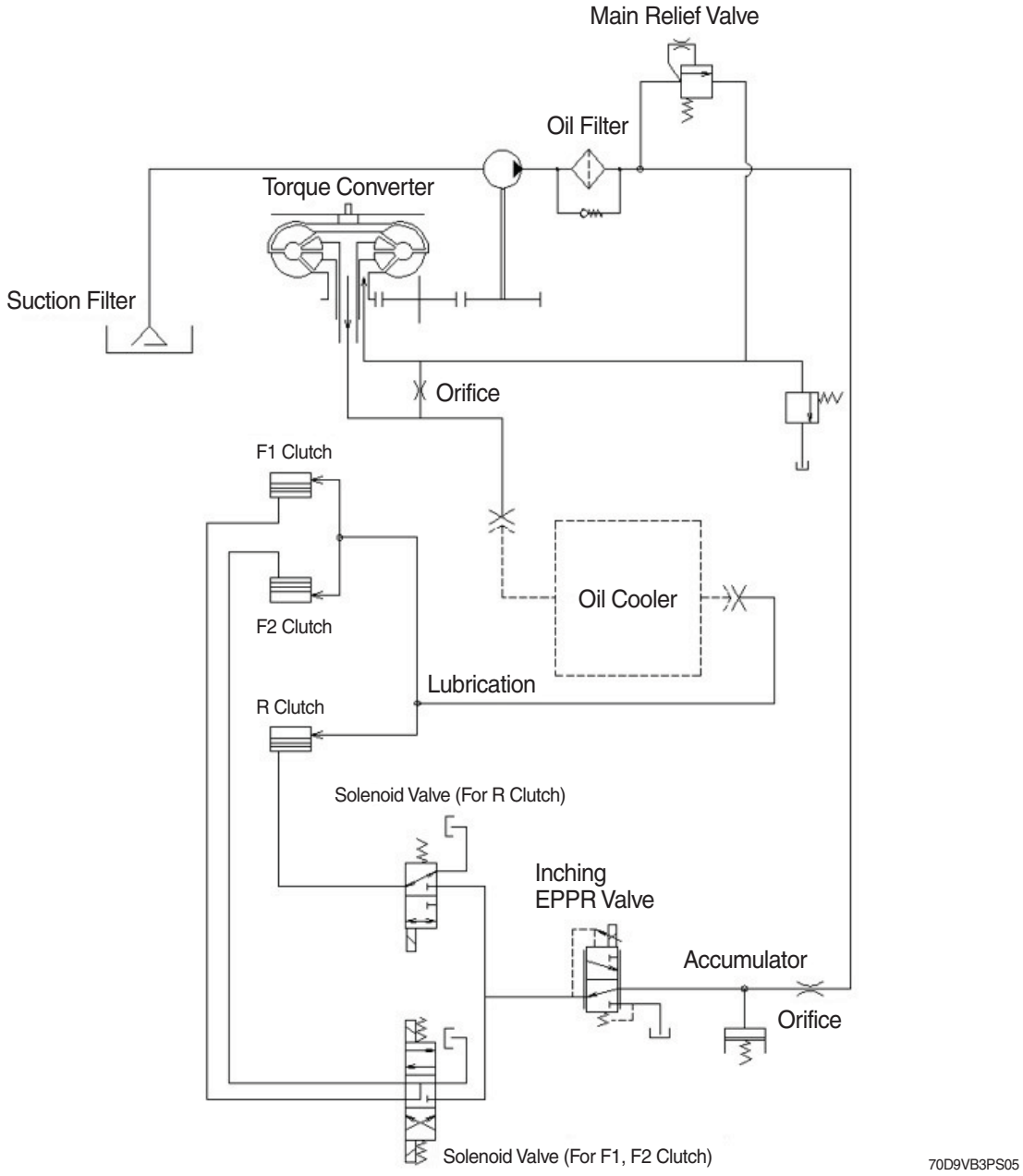
### ③ Pump drive device

There is pump device beside torque converter as below picture which is for charging pump of transmission and power take off (PTO).




70D9VB3PS04

## 4) HYDRAULIC CIRCUIT



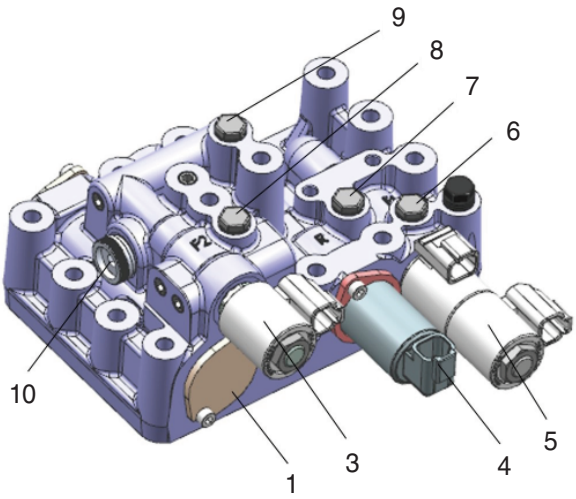

(1) The oil that is pumped up through the strainer from the oil pump of transmission by charging pump of transmission. And this oil is sent to torque converter through the relief valve for the main pressure of hydraulic clutches.

(2) The oil that is sent to torque converter flows between the turbine shaft and Inner race of free wheel, and flows into the circuit of converter through the space between stator wheel and Turbine wheel.

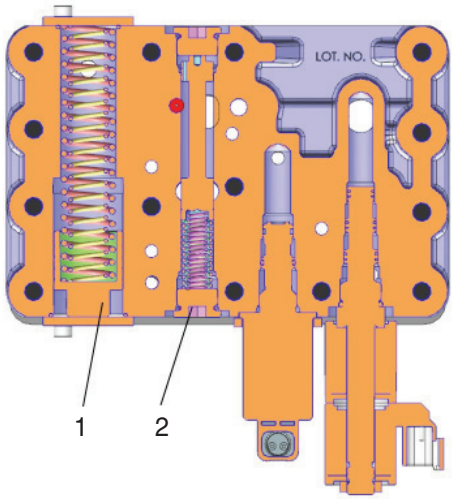
(3) The oil which is drained from torque converter is cooled by the external cooler of the vehicle. And this cooled oil lubricates and cools each parts of transmission like bearings, clutches and so on.

## 5) CONTROL VALVE

(1) Structure




70D9VB3PS06




70D9VB3PS07

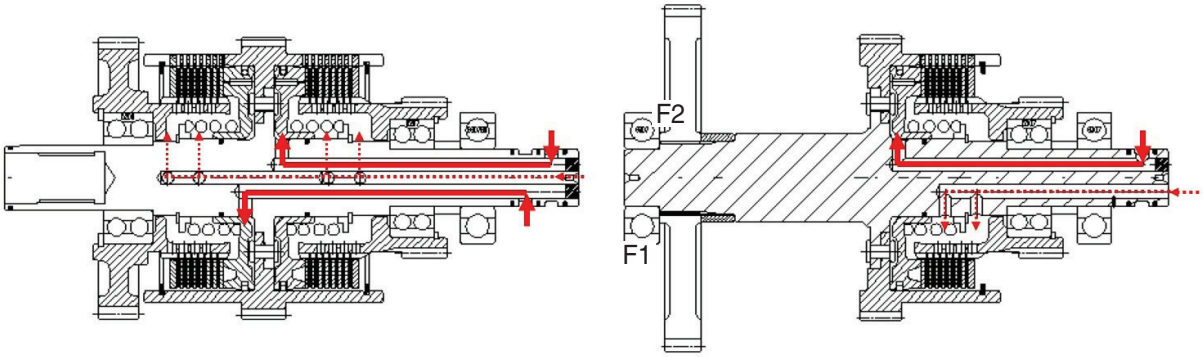
| | | | |
|---|---|---|---|
| 1 | Modulation | 6 | Check port for F1 clutch |
| 2 | Main relief | 7 | Check port for R clutch |
| 3 | Solenoid valve for F2 clutch | 8 | Check port for F2 clutch |
| 4 | EPPR valve for inching | 9 | Check port main pressure |
| 5 | Solenoid valve for F1 & R clutch | 10 | Pressure sensor port |

(2) Assembly

Control valve assembly contains main relief valve for regulating pressure of hydraulic clutch assembly, inching valve for adjusting clutch pressure, accumulator valve for rising up clutch pressure smoothly, solenoid valves for selecting direction (F1, F2, R) and controlling parking brake.

| Structure | Operation |
|---|---|
| Main Relief Valve | This valve regulates the clutch pressure stably. |
| Inching Valve | This valve adjusts the pressure of clutch through the controlling Inching pedal. |
| Accumlator Valve | This valve adjusts the pressure of clutch for smooth start when the operator wants to move and change the direction. |
| Solenoid Valve For Dierction (F1, F2, R) | These valve control the oil flow for moving forward 1, 2 & reverse through voltage signal which is given by direction selector. |
| Solenoid Valve For Parking | This valve control the oil flow for applying and releasing parking brake. |

## 6) CLUTCH




Forward 1, 2 clutch

Reverse clutch

: Pressure line

: Lubrication line

70D9VB3PS08

### (1) Summary

① This transmission consists of the forward and reverse shift equipments which is the wet multipic disc type of hydraulic clutch.

② There are 7 discs per each clutch which is made by carbon paper.

### (2) Clutch shifting

① The explain of shift is represented in case of the shift "N (neutral) → F or R" in the vehicle.

② F & R solenoid valve become "ON" by voltage signal which is given by gear selector on the vehicle.

③ The hydraulic oil that is charged in accumulator valve discharges to the clutch port, and the port is filled.

④ After the filling of the port concludes, the oil that comes through the orifice "A" presses the piston of the accumulator slowly. And the clutch is engaged by the prescribed characteristic of pressure up, and the shock in clutch engagement is relieved.

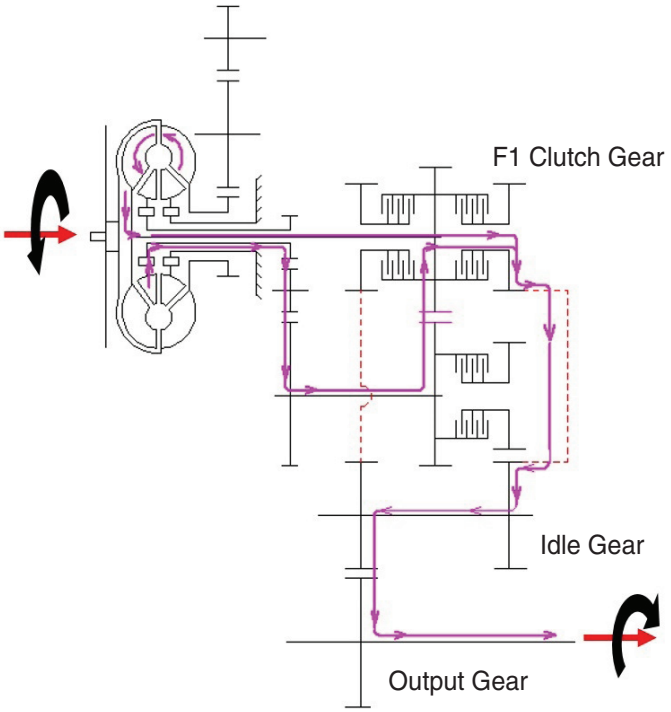
⑤ When the clutch engagement concludes and the hydraulic oil becomes regular pressure.

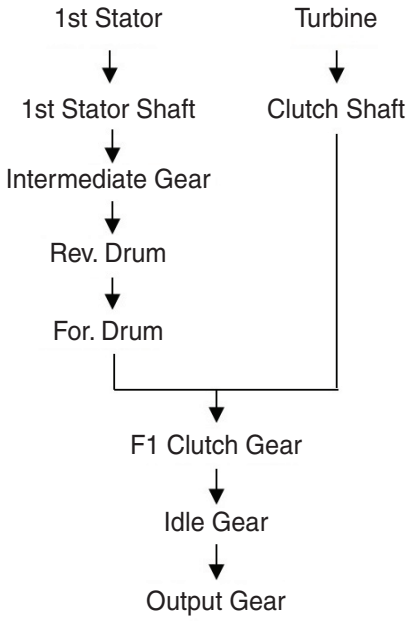
⑥ The hydraulic oil in the piston room presses the piston, and make the steel plates and the friction plates stick strongly against the force of the return spring.

⑦ Therefore the torque that is transmitted to the clutch shaft assembly transmits to the reduction gears.

## 7) POWER FLOW

### (1) Forward 1

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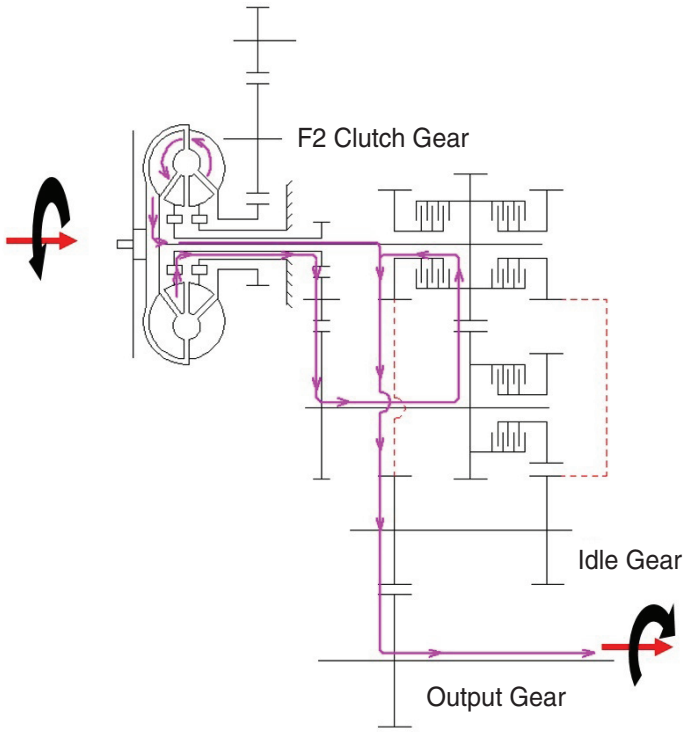
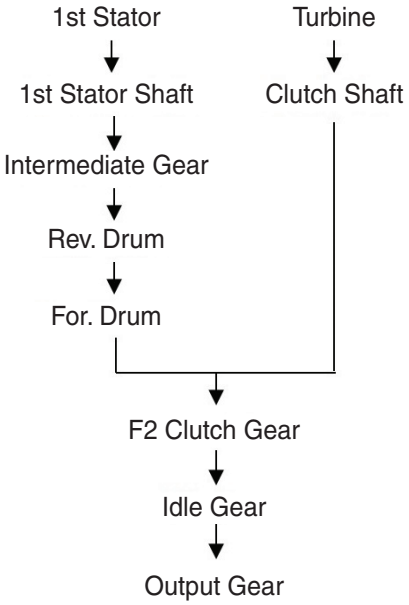
### (2) Forward 2

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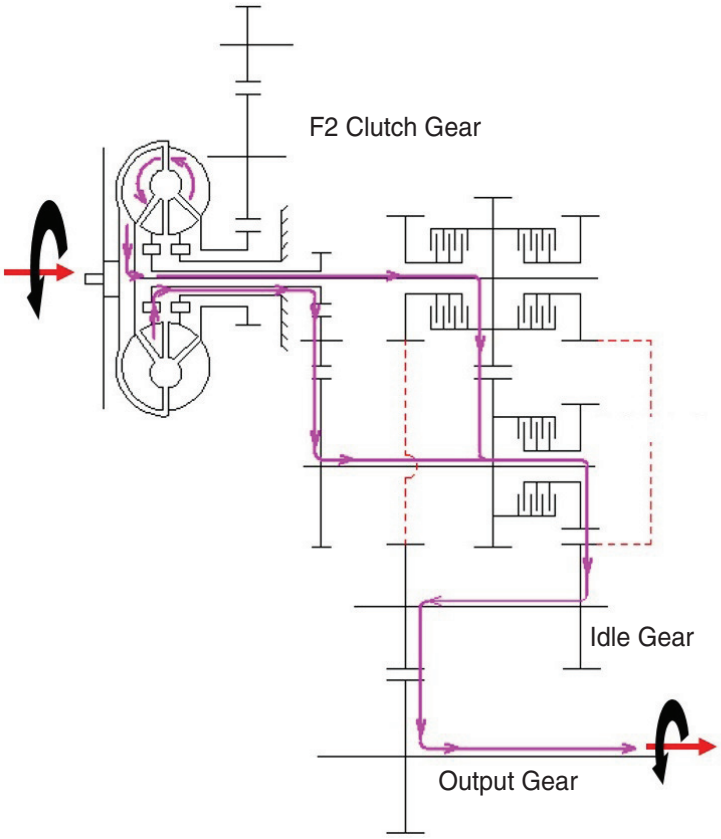
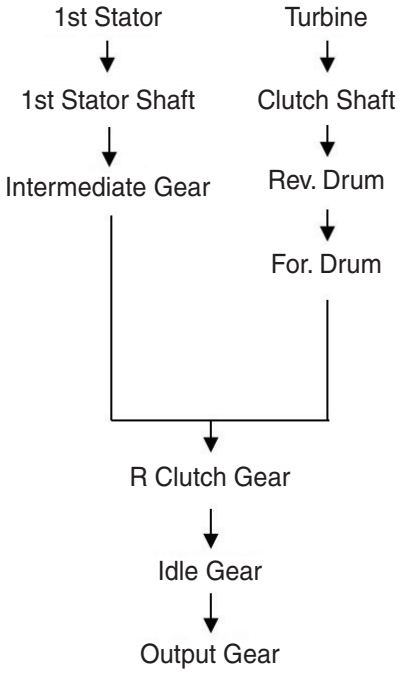
(3) Reverse

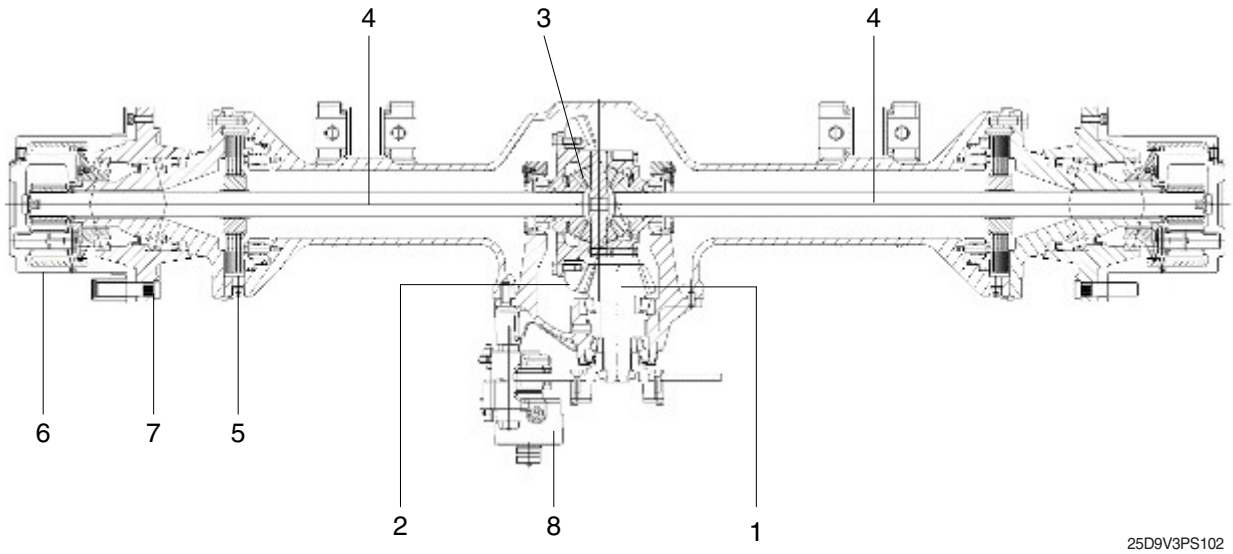



70D9VB3PS11

## 4. DRIVE AXLE

### 1) STRUCTURE

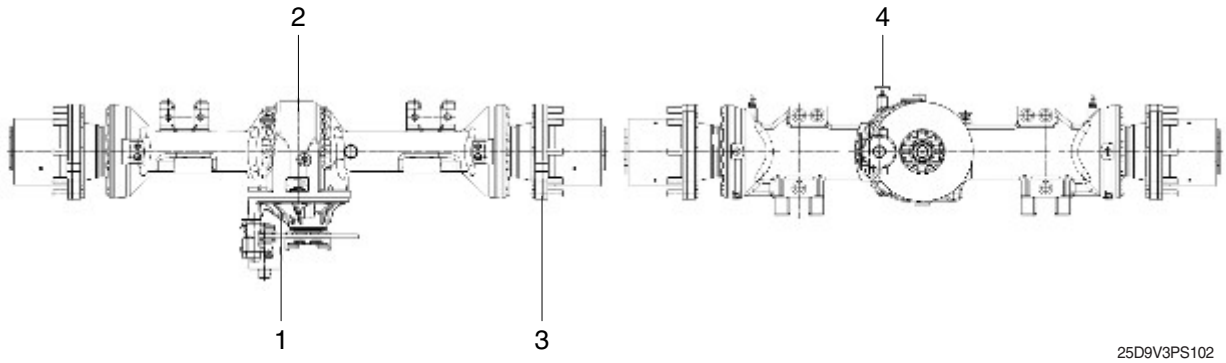



| | | | | | |
|---|---|---|---|---|---|
| 1 | Pinion shaft | 4 | Axle shaft | 7 | Hub |
| 2 | Ring gear | 5 | Service brake | 8 | Parking brake |
| 3 | Differential device | 6 | Hub reduction | | |

### 2) SPECIFICATION

| Item | | Specification |
|---|---|---|
| | | 70D-9VB |
| Axle | Type | Front-wheel drive type, fixed location |
| | Gear ratio | 10.668 |
| | Gear | Ring & pinion gear type |
| Brakes | Travel | Front wheel, wet disc brake |
| | Parking | Wet disc, SHAR (Spring Actuate Hydraulic Release) type |

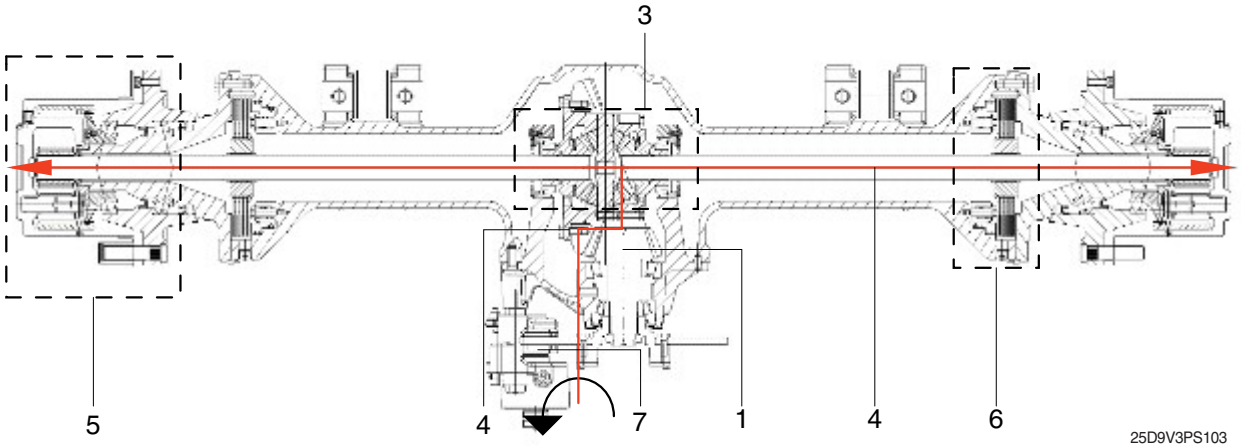
### 3) LAYOUT




| | | | | | |
|---|---|---|---|---|---|
| 1 | Carrier sub assembly | 3 | Hub | 4 | Oil level gauge |
| 2 | Axle housing | | | | |

## 2) OPERATION

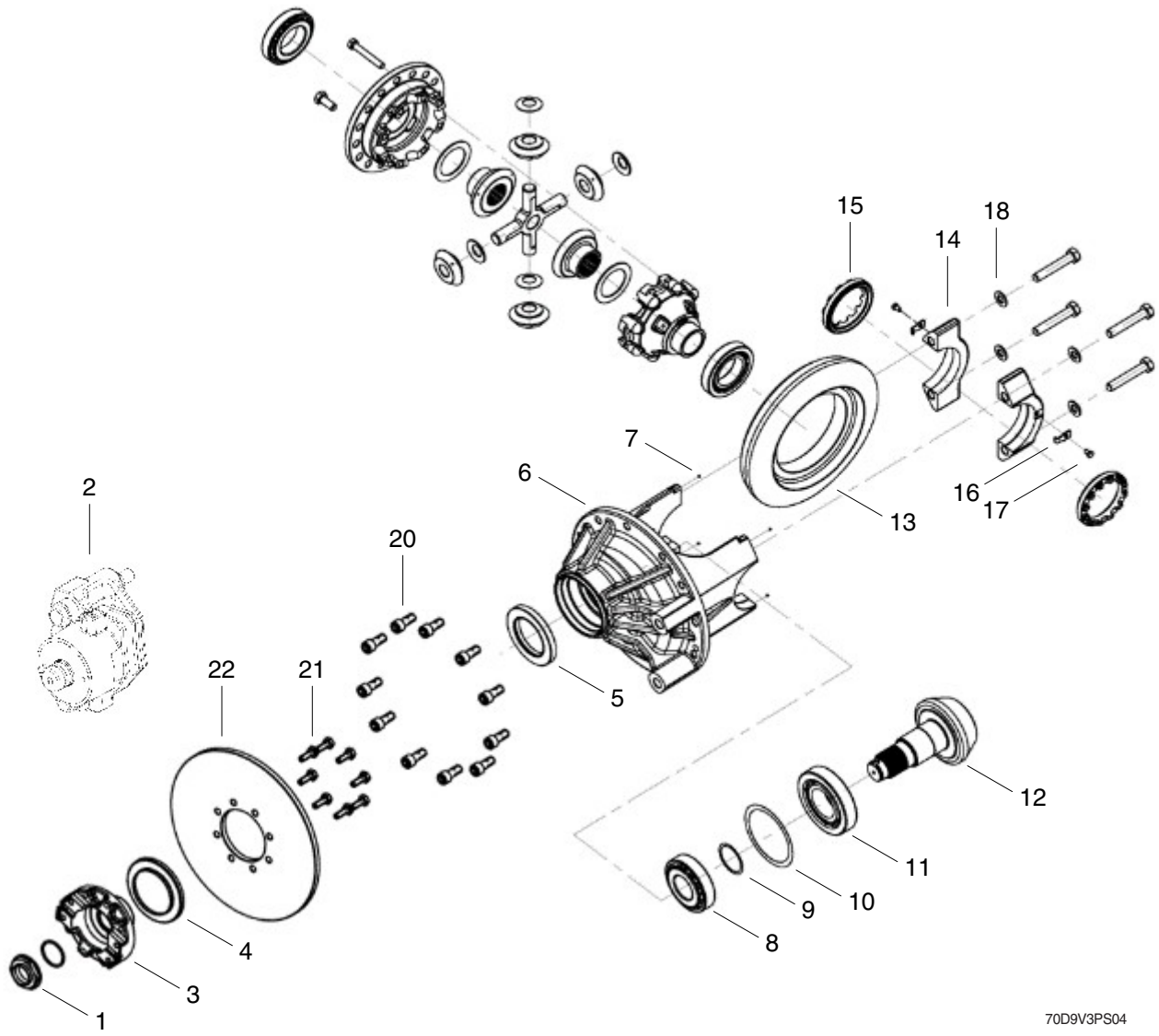
The drive axle is connected with the transmission output gear by drive shaft assembly. The power transferred by the drive shaft assembly is connected to the pinion shaft of drive axle, the pinion shaft delivers the power to the differential device through the ring gear. The differential device deliver the power to hub reduction through axle shaft.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Pinion shaft | 4 | Axle shaft | 7 | Parking brake |
| 2 | Ring gear | 5 | Hub reduction | | |
| 3 | Differential device | 6 | Service brake | | |

### 3) Carrier sub assembly

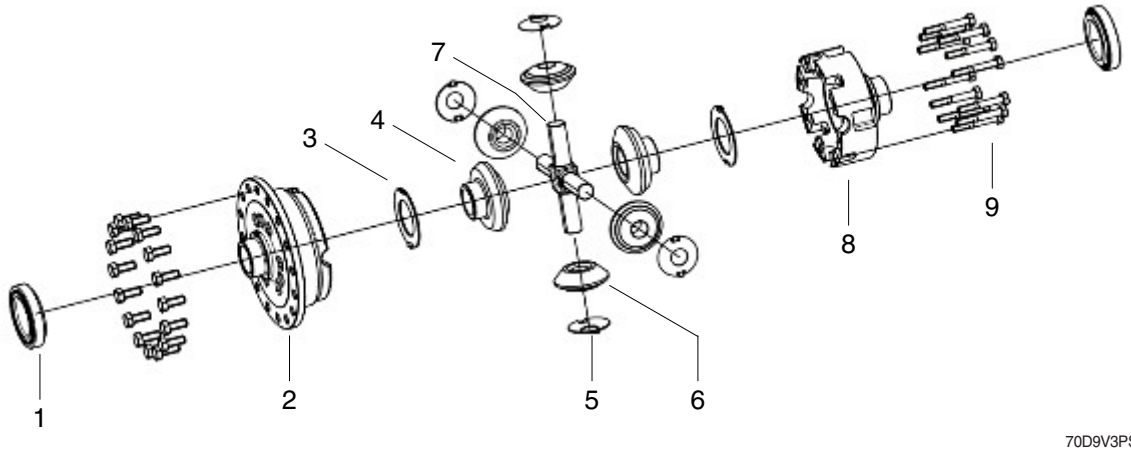
#### (1) Structure




| | | | | | |
|---|---|---|---|---|---|
| 1 | Lock nut | 12 | Pinion shaft | 17 | Hex bolt |
| 2 | Parking brake | 13 | Ring gear | 18 | Plain washer |
| 3 | Flange yoke | 14 | Carrier cap | 19 | Hex bolt |
| 4 | Output cover | 15 | Adjust screw | 20 | Socket bolt |
| 5 | Oil seal | 16 | Lock plate | 21 | Hex bolt |
| 6 | Carrier case | 9 | Shim | 22 | Parking disk |
| 7 | Steel ball | 10 | Shim | | |
| 8 | Taper roller bearing | 11 | Taper roller bearing | | |

### 4) Differential deivce

#### (1) Structure




70D9V3PS05

| | | | | | |
|---|---|---|---|---|---|
| 1 | Taper roller bearing | 4 | Diff side gear | 7 | Spider |
| 2 | Diff case (RH) | 5 | Thrust washer | 8 | Diff case (LH) |
| 3 | Thrust washer | 6 | Diff pinion gear | 9 | Hex bolt |

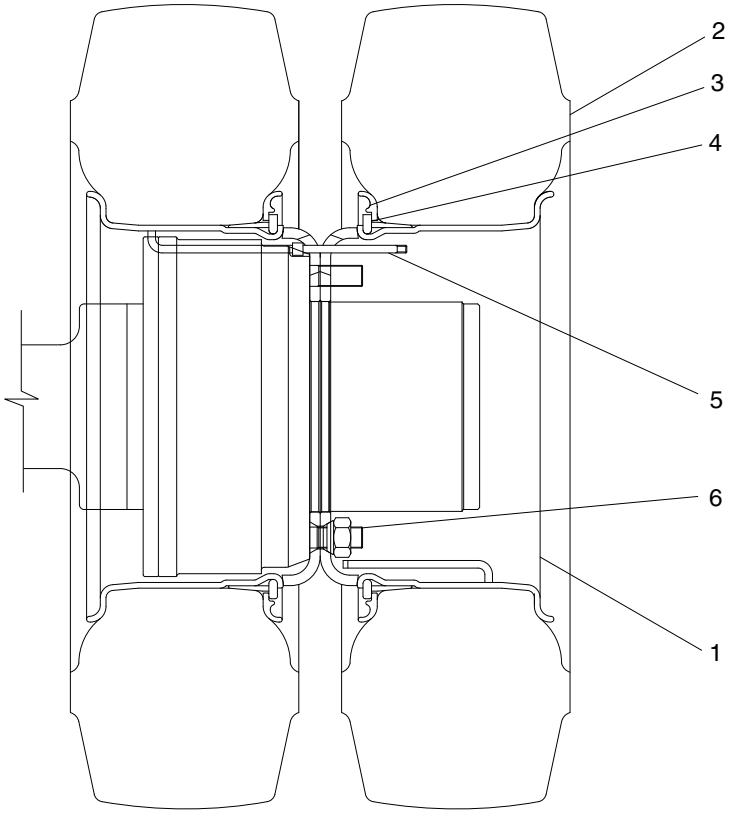
(2) Performance property

Since the ring gear is linked with the right of the differential case and the bolt, the power transferred to the ring gear makes the differential device revolve.

And also, the differential case are connected with the left and right of the axle shaft and the spline respectively, it delivers the power to the final drive.

If the load concerning in the left and right of the final drive is different, the shock is transferred to the drive axle, the differential gear in the differential device runs, the power transferred to the differential device adjusts the delivering rate to the left and right axle shaft. Consequently, it guarantees for safety of drivers.

## 5. TIRE AND WHEEL

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| | | | | | |
|---|---|---|---|---|---|
| 1 | Wheel rim | 3 | Lock ring | 5 | Valve assembly |
| 2 | Tire | 4 | Side ring | 6 | Wheel nut |

1) The tire acts to absorb the shock from the ground surface to the machine, and at the same time they must rotate in contact with the ground to gain the power which drives the machine.

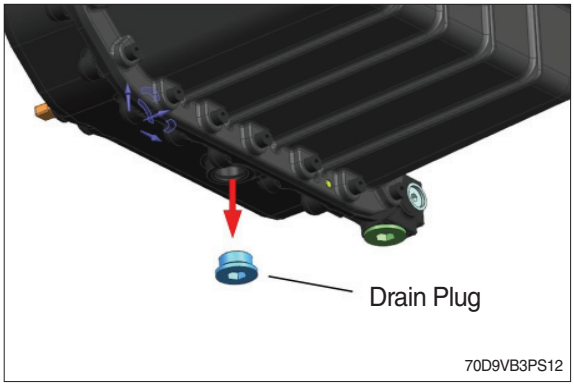
2) Various types of tires are available to suit the purpose. Therefore it is very important to select the correct tires for the type of work.

# GROUP 2 DISASSEMBLY AND ASSEMBLY

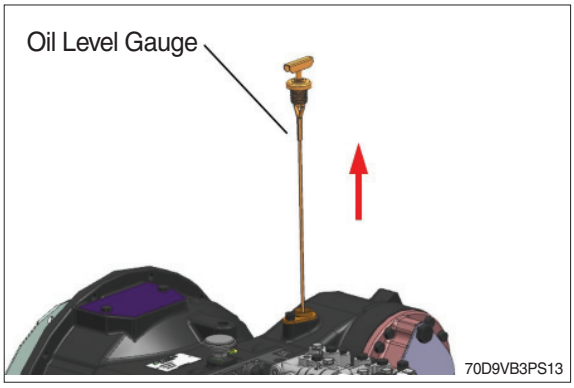
## 1. DISASSEMBLY OF TRANSMISSION

### 1) DISASSEMBLY OF TRANSMISSION

(1) Remove the drain plug. Discharge the transmission oil.

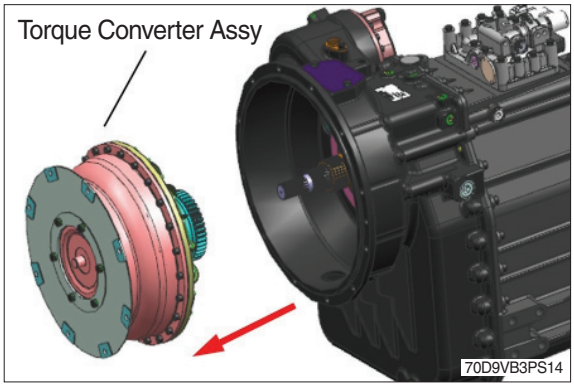



(2) Remove the oil level gauge.

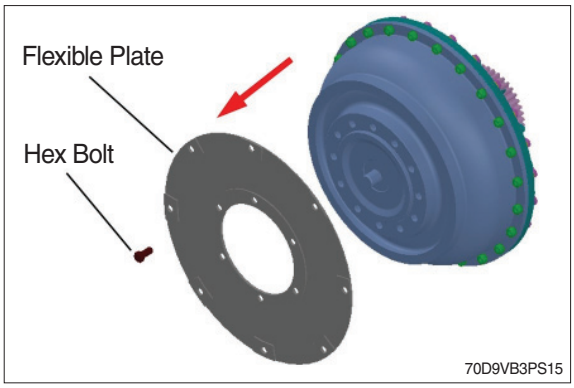



**(3) Disassemble the torque converter assy.**

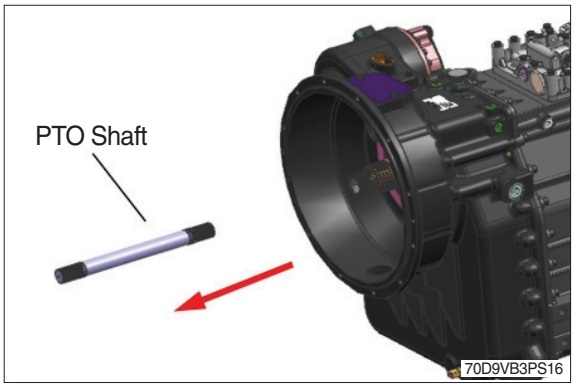
① Disassemble the torque converter assy.



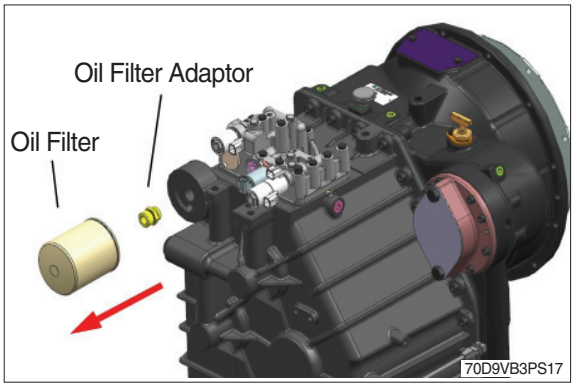
② Loosen the hex bolts and separate the flexible plate



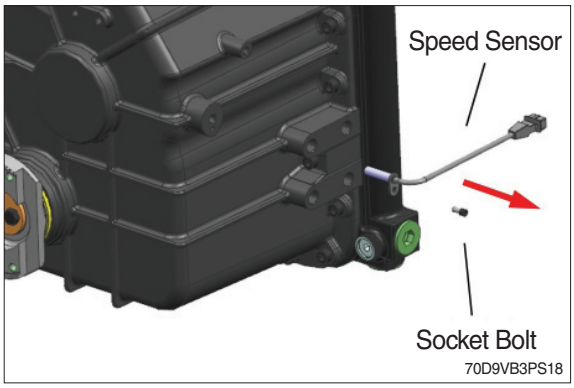

(4) Disassemble PTO shaft.



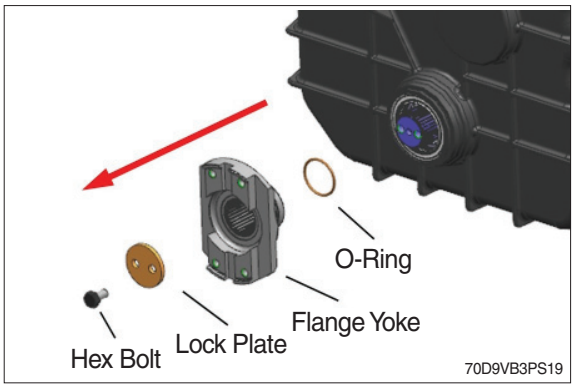

(5) Remove the oil filter and oil filter adaptor.



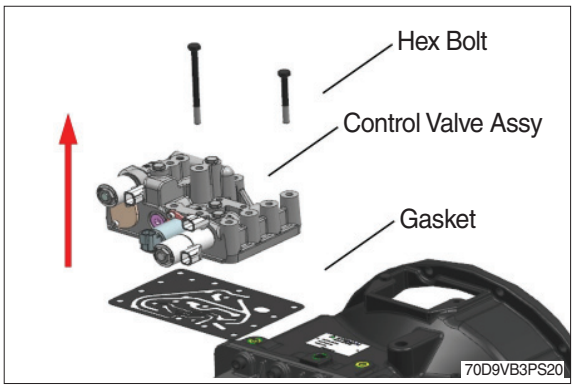

(6) Disassemble the socket bolt and speed sensor.



(7) Disassemble the hex bolt. And disassemble the lock plate, flange yoke and O-ring.

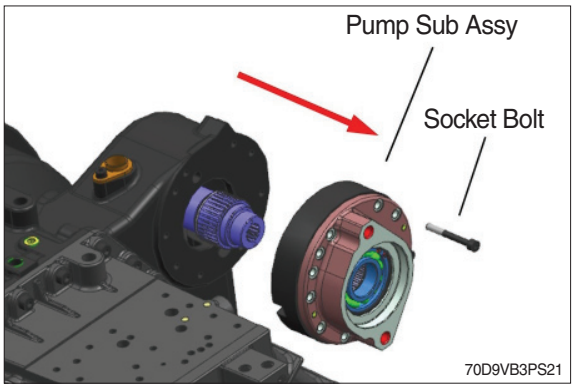



(8) Disassemble the control valve assy. Loosen the hex bolts (M8×60L 2EA, M8×75L 1EA, M8×110L 2EA, M8×70L 9EA). Separate the control valve ass'y and gasket.

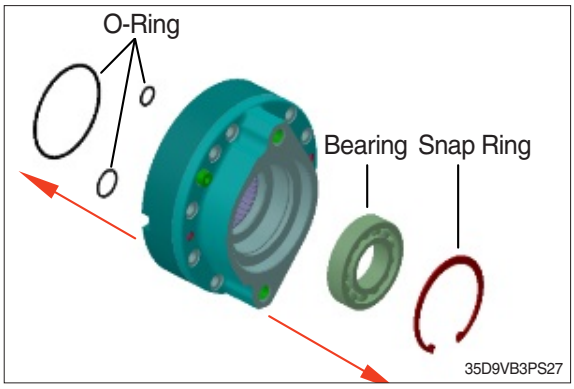



**(9) Disassemble the pump sub assy.**

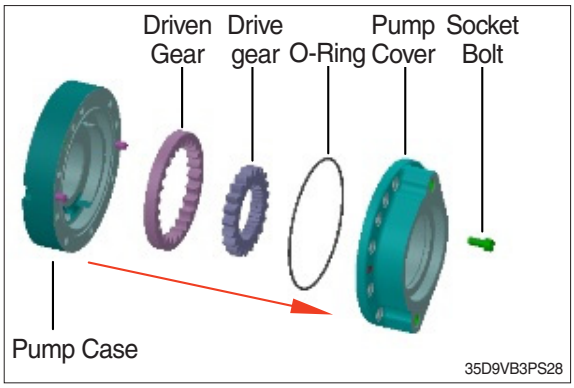
① Disassemble the socket bolts and pump assy.



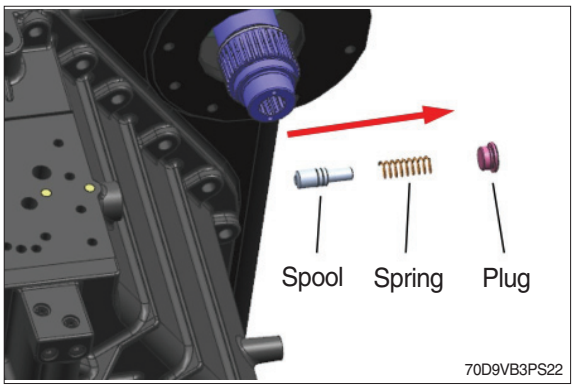

② Disassemble the snap ring, bearing and O-rings (3 EA).



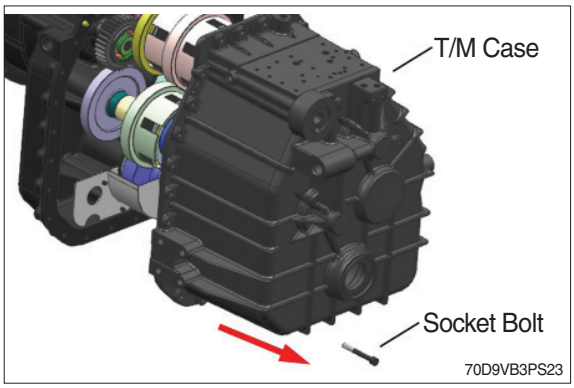
② Disassemble the socket bolts. And separate the O-ring, drive gear and driven gear from the pump case.



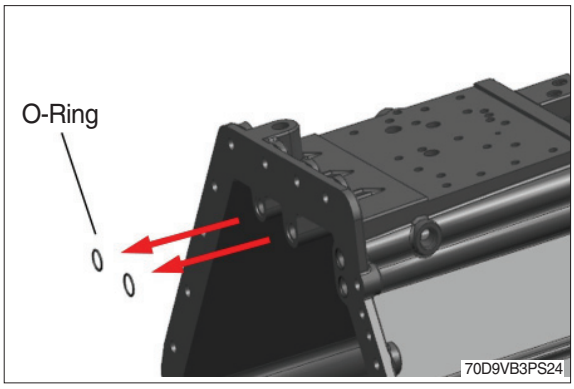

(10) Remove the plug, spring, spool.



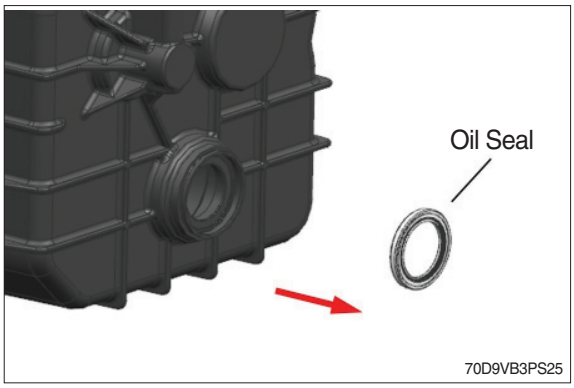

(11) Loosen the socket bolts. Then separate the T/M case.



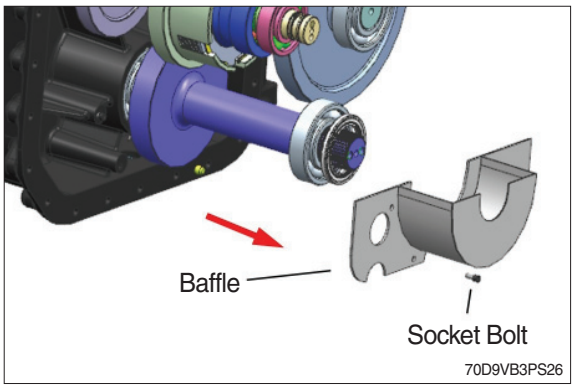

(12) Remove the O-rings.



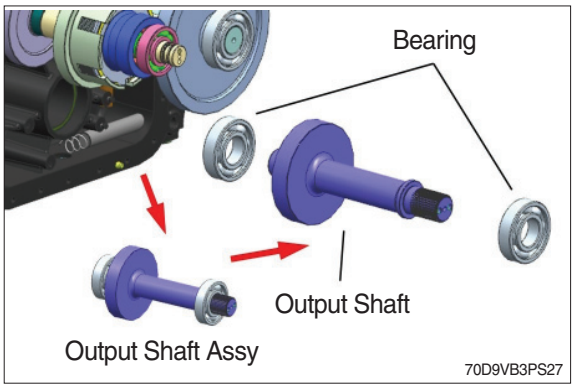
(13) Remove the oil seal.



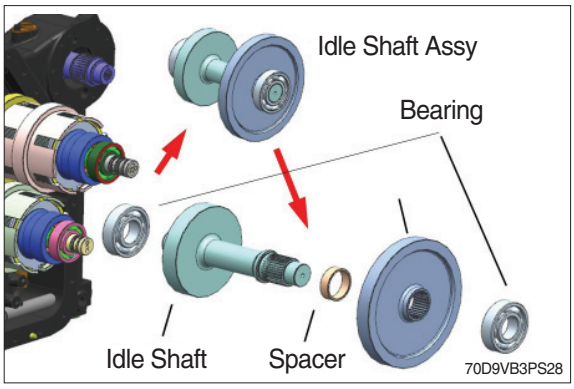

(14) Loosen the socket bolts and remove the baffle.



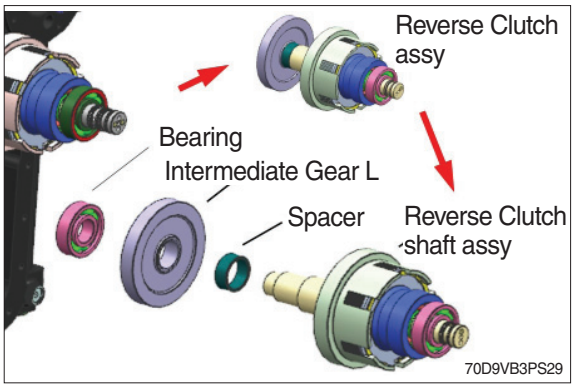

(15) Remove the output shaft assy and disassemble the bearings.



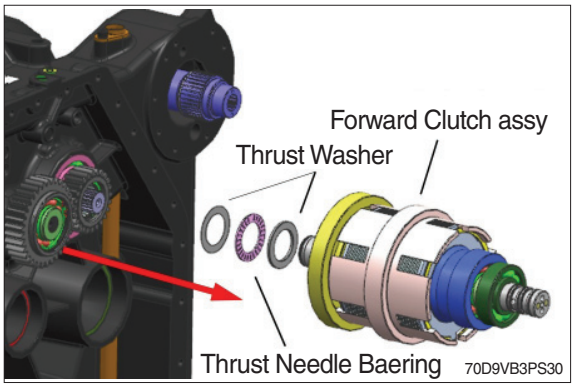

(16) Remove the Idle shaft assy and dissassemble the bearings and spacer.



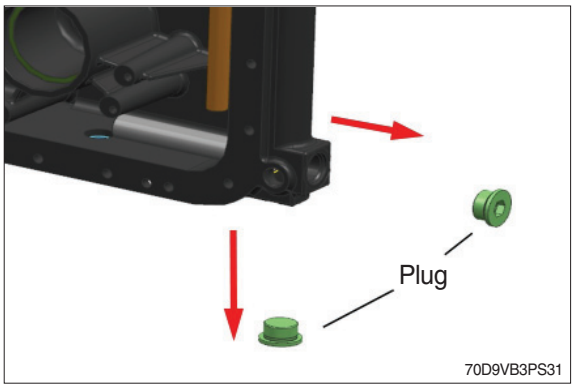
(17) Remove the reverse clutch assy and dis-sassemblethe reverse clutch shaft assy, baering and spacer.



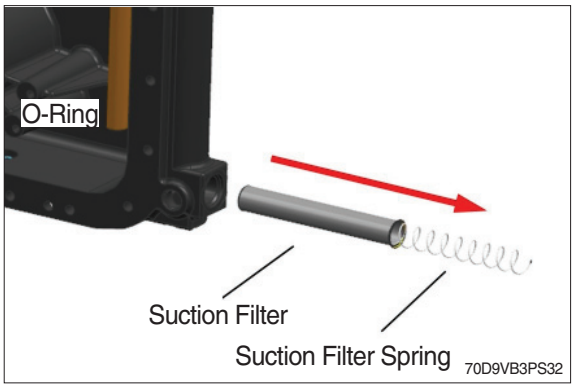

(18) Remove the Forward clutch assy and dis-sassemble the thrust bearing and wash-ers.



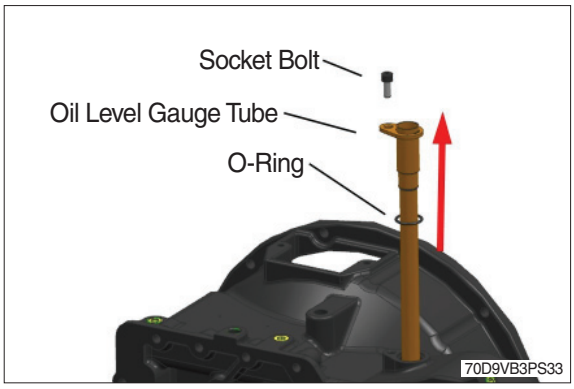

(19) Remove the plugs.




(20) Remove the suction filter spring and suc-tion filter.

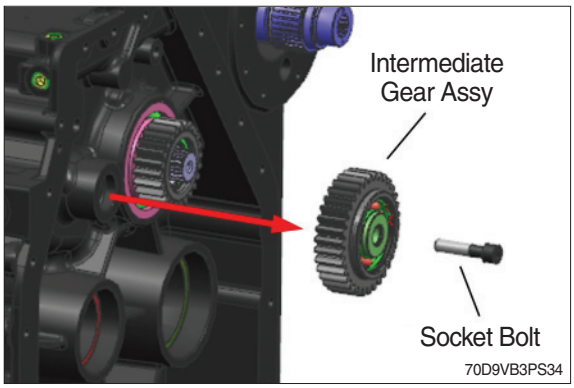


(21) Loosen the socket bolt. And remove the oil level gauge and O-ring.



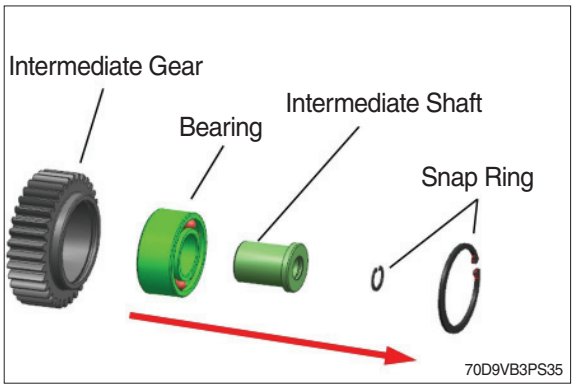

**(22) Disassemble intermediate gear sub part.**

① Loosen the socket bolt and remove the intermediate gear assy.



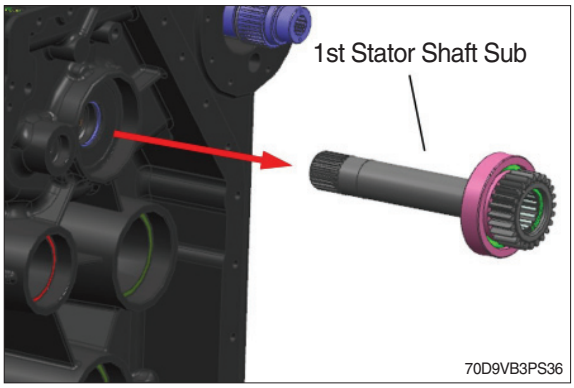

② Remove the snap ring (large) from the intermediate gear. And remove the intermediate shaft and bearing.

③ Remove the snap ring (small) from the intermediate shaft.

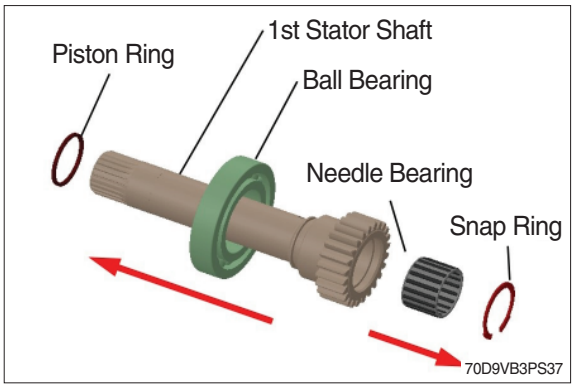



**(23) Disassemble the 1st stator sub part.**

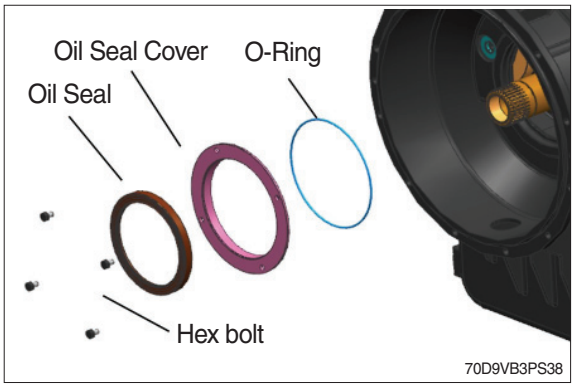
① Remove the 1st stator shaft sub.



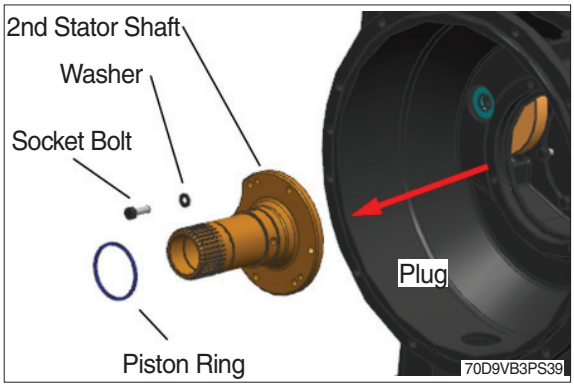
② Remove the snap ring and needle bearing. And disassemble the needle bearing.
③ Pull off the bearing and remove the thrust piston ring.



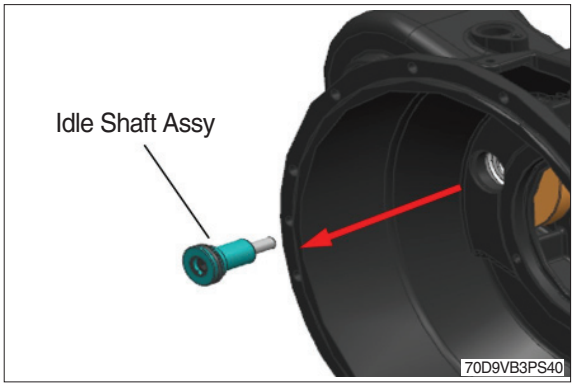

(24) Loosen the hex bolts and remove the oil seal cover, oil seal, and O-ring.



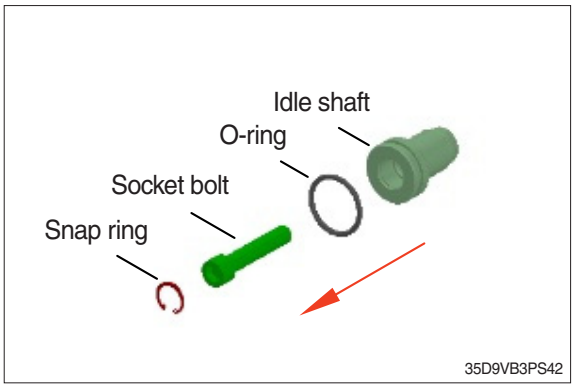

(25) Loosen the socket bolts and Remove washers, 2nd stator shaft, piston ring.



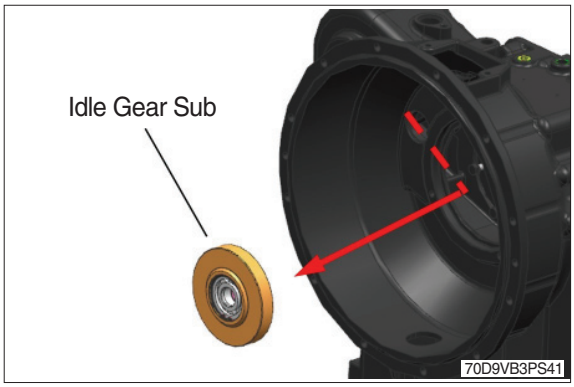

**(26) Disassemble the PTO idle gear part.**
① Loosen socket bolt and remove idle shaft assy.
※ Do not remove the snap ring.



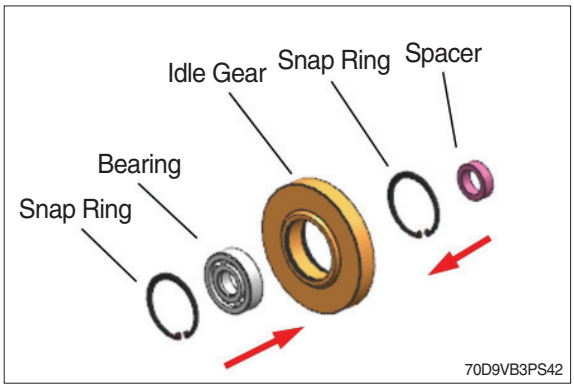
② Remove the sanp ring, socket bolt, and O-ring from the idle shaft.



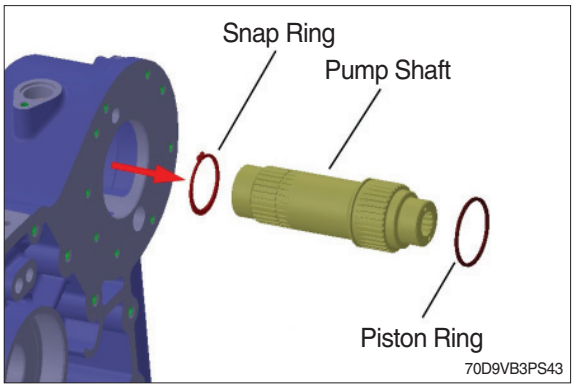

③ Remove the idle gear sub through the hole in the T/C housing.



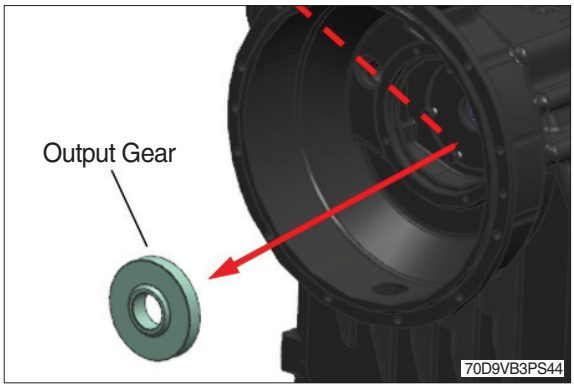

④ After disassembling the snap rings, remove the spacer & spacer.



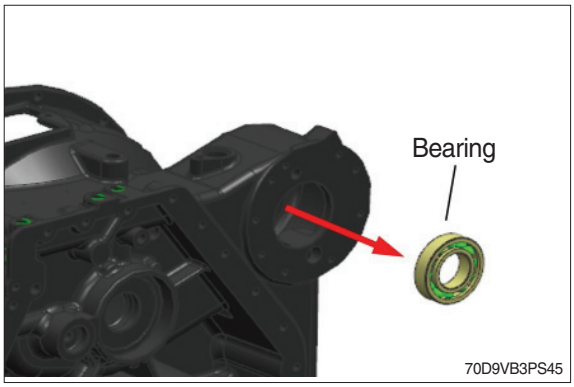

(27) After remove the pump shaft sub, then disassemble the piston ring and the snap ring.



(28) Remove the output gear through the hole in the T/C housing.

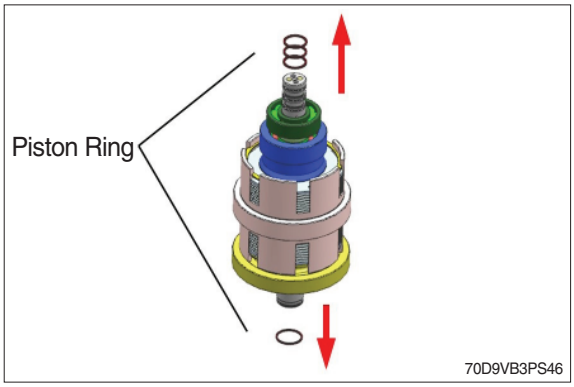



(29) Remove the bearing.

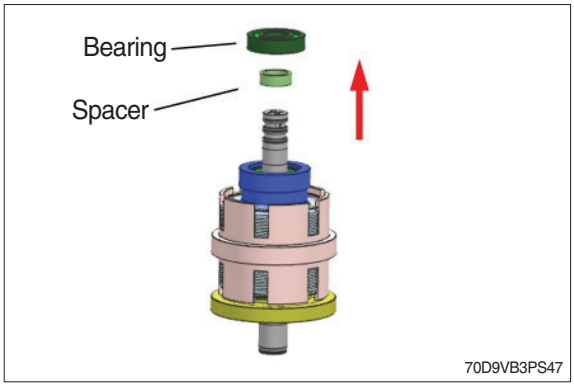



## 2) DISASSEMBLY OF CLUTCH SUB ASSEMBLY

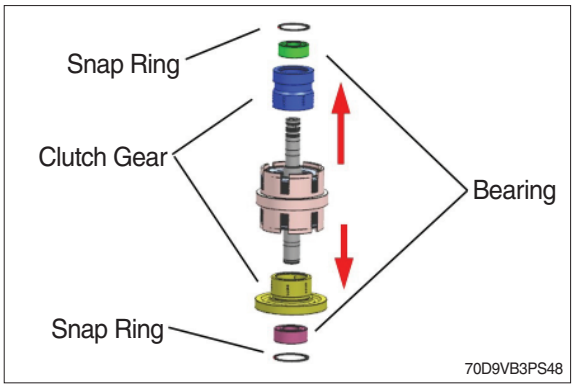
(1) Disengage the piston rings.



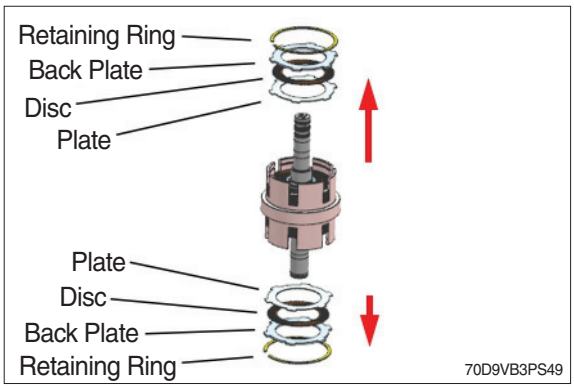

(2) Pull off the bearings and remove the spacer.



(3) Disassemble the snap rings, pull off the bearings, and disassemble the clutch gears.

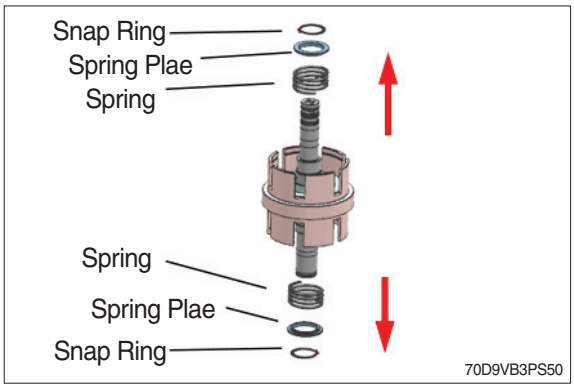



(4) Disengage the retaining ring. Then remove the back plate, opp. plates and friction plates.

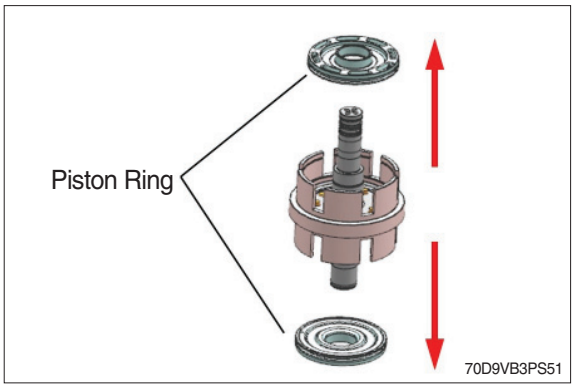



(5) Remove the snap rings, spring plates and springs.

⚠ **When removing the snap ring, it may bounce off by spring force, so fix the spring firmly before removing it. Pay attention to safety when removing snap ring.**




(6) By means of compresed air, press the piston sub off and remove them.



## 2. ASSEMBLY OF TRANSMISSION

### 1) SUB ASSEMBLY OF CLUTCH

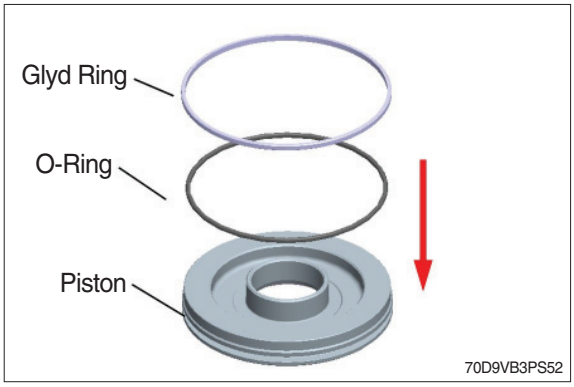
(1) Assemble the piston groove in the O-ring and glyd ring.

※ **Apply T/M oil when assembling the O-ring.**

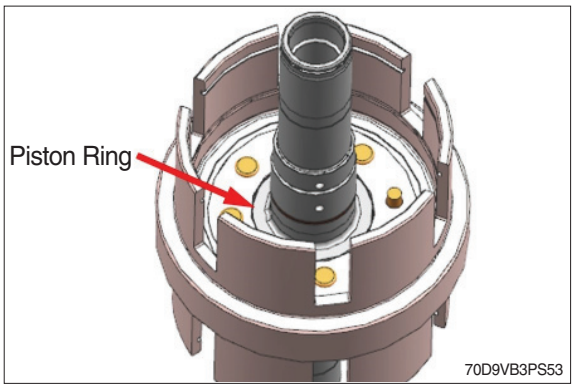
※ **How to assemble the glide ring.**

① Heat the glide ring.

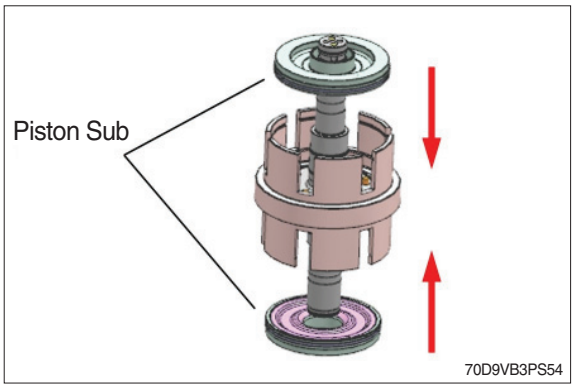
② Assemble the gliding when it becomes loose.




(2) Insert the piston ring into the shaft groove and oil it.

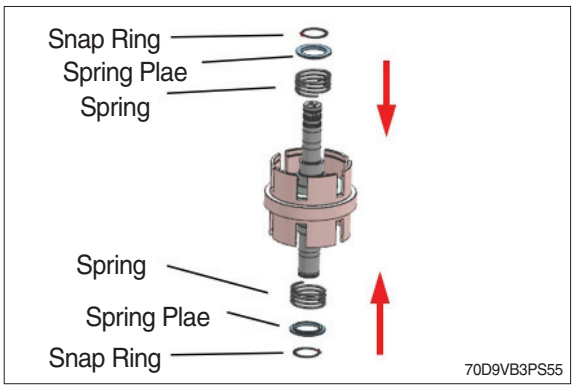



(3) Insert the piston sub into the drum gear.

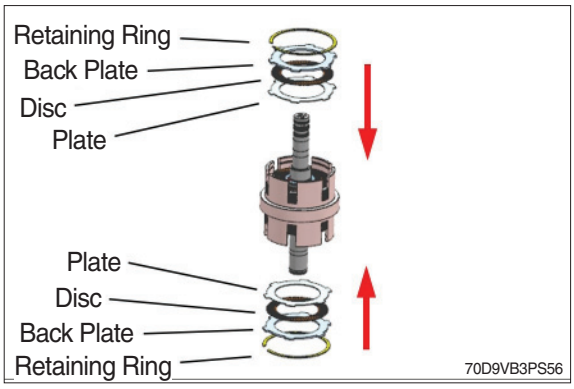



(4) Assemble the spring, spring plate & snap ring.

⚠ **When removing the snap ring, it may bounce off by spring force, so fix the spring firmly before removing it. Pay attention to safety when removing snap ring.**

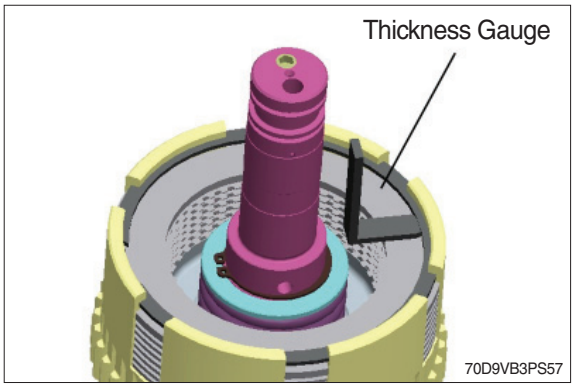


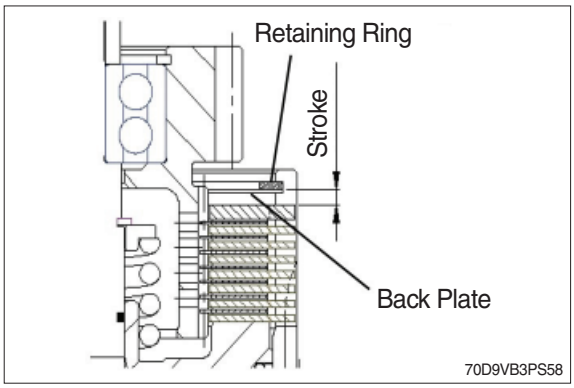
(5) Install the opp. plates and friction plates alternately into the drum gear. Then install the back plate and retaining ring.



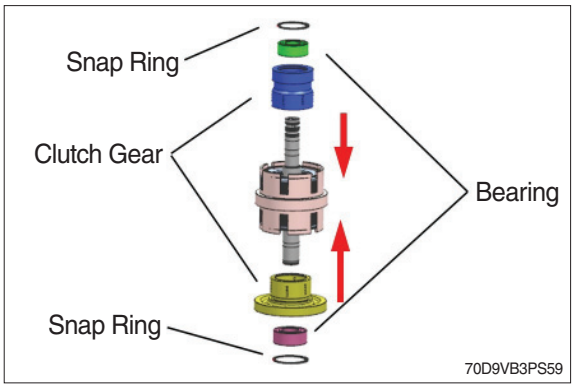

(6) Measure clearance between the back plate and retaining ring using thickness gauge.

※ **Stroke specification : 3.6 ~ 4.0 mm**
**If the measureed value id out of the specified range, replace with a suitable retaining ring.**
**Retaining ring thickness : 2, 2.2, 2.5, 3.1 mm**

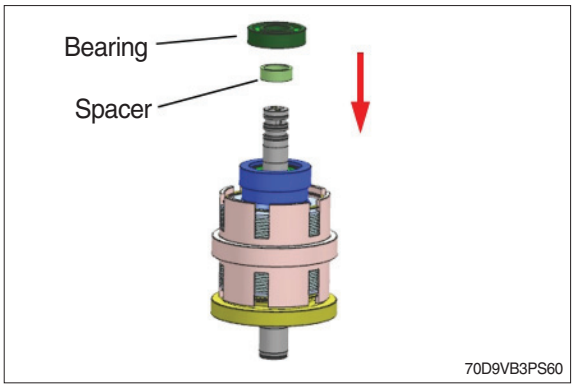



(7) After assembling the clutch gear and bearing, fasten the snap ring.

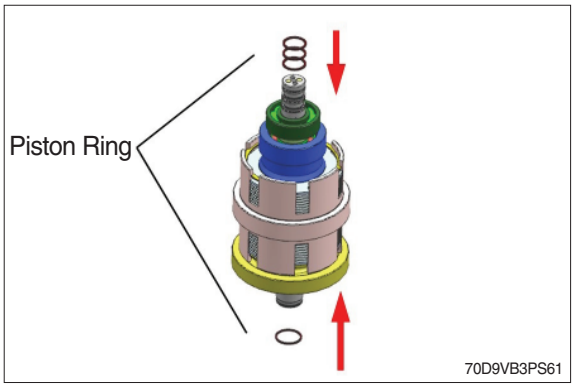


(8) Assemble the spacer and bearing.

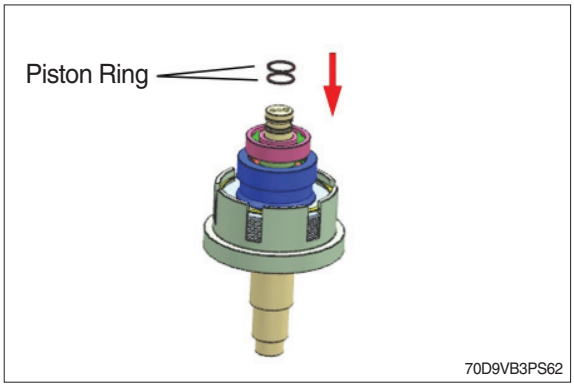



**(9) Assemble piston ring.**

① Forward clutch : fit the piston rings (4 EA) at groove of clutch shaft and oil them.

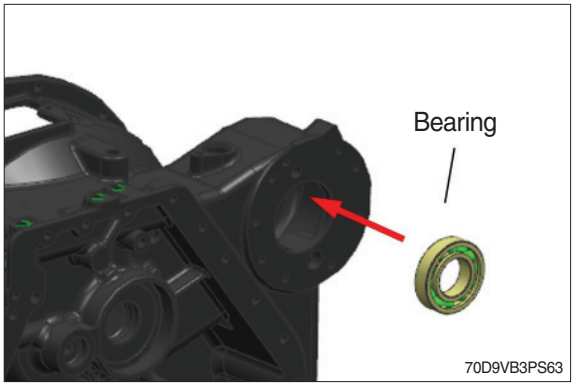



② Reverse clutch : fit the piston rings (2 EA) at groove of clutch shaft and oil them.

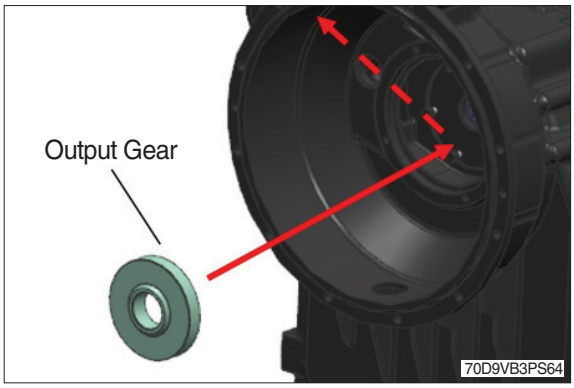



## 2) ASSEMBLY OF TRANSMISSION

(1) Insert the bearing into the T/C housing.



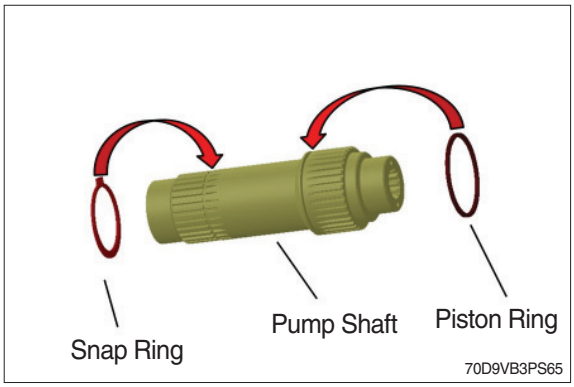
(2) Insert the output gear through the central hole of the T/C housing.



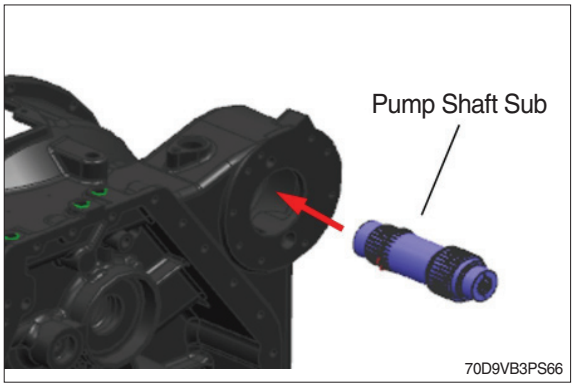

**(3) Assemble pump shaft sub part.**

① Assemble the snap ring & piston ring on pump shaft.

※ **Cover grease on piston ring.**



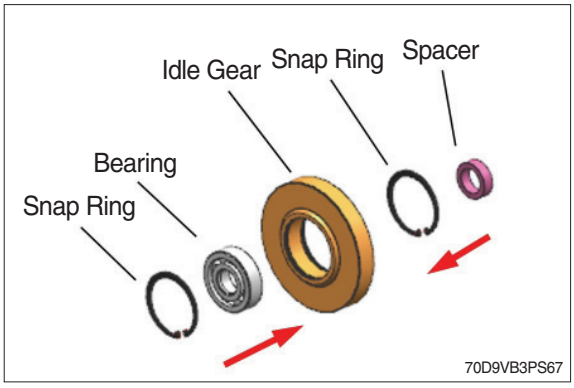

② Assemble the pump shaft sub.



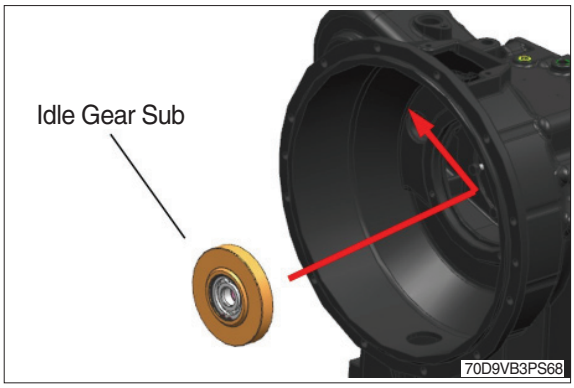

**(4) Assemble the idle gear sub.**

① Insert bearing into idle gear and assemble snap rings on both sides.

※ **Assemble the spacer on one side of the idle gear.**

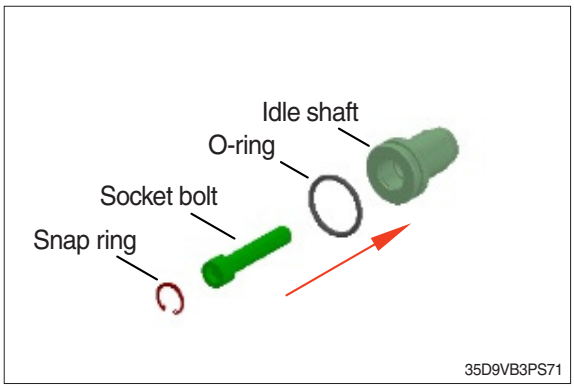


② Insert the idle gear sub through the central hole of the T/C housing.




③ Assemble socket bolt and snap ring on idle shaft. And assemble o-ring.

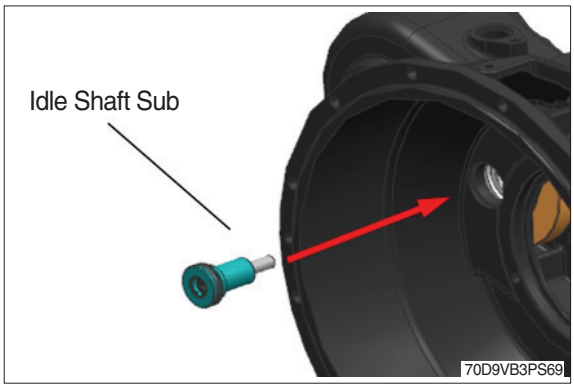
※ **Cover grease on o-ring.**




④ Assemble idle shaft sub.

· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.8 ~ 81.0 lbf·ft)

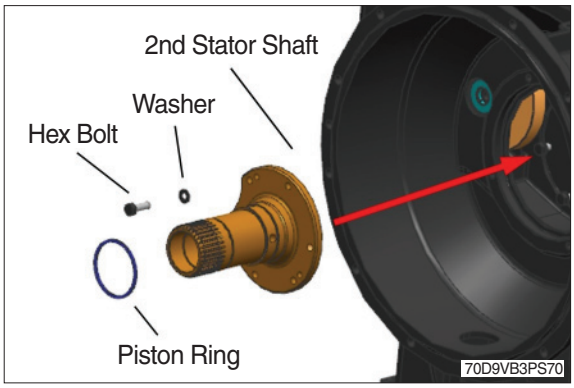
※ Cover Loctite #277 on the screw side of bolt.




(5) Assemble piston ring on 2nd stator shaft. And assemble 2nd stator shaft, hex bolts and washers on T/C housing.

· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt and grease on piston ring.**

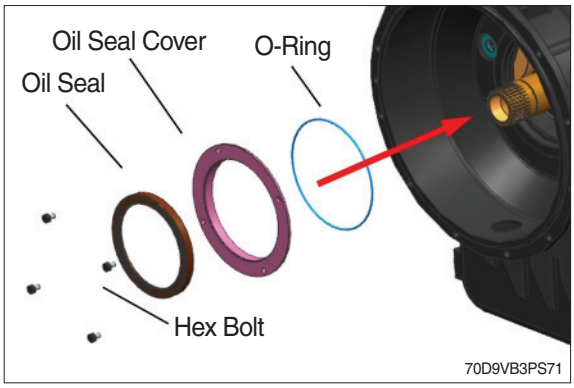


(6) Assemble the oil seal onto the oil seal cover in advance. After that, assemble the oil seal on the oil seal cover and tighten the bolts.

· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

※ **Spread grease on the seal lip of oil seal.**

※ **Cover loctite #277 on the screw side of bolt and grease the O-ring when assembling.**

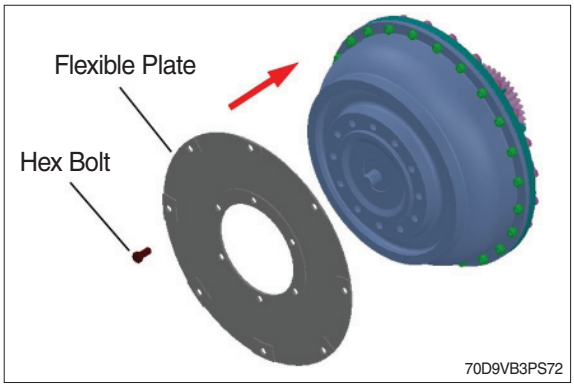



**(7) Assemble torque converter part.**

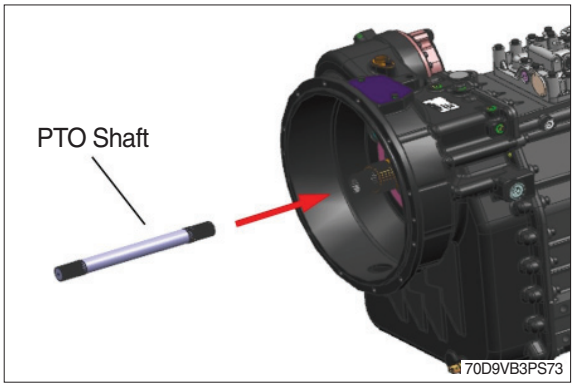
① Assemble the flexible plate and hex bolt on torque converter.

· Tightening torque : 4.1 ~ 4.9 kgf·m
(29.7 ~ 35.5 lbf·ft)

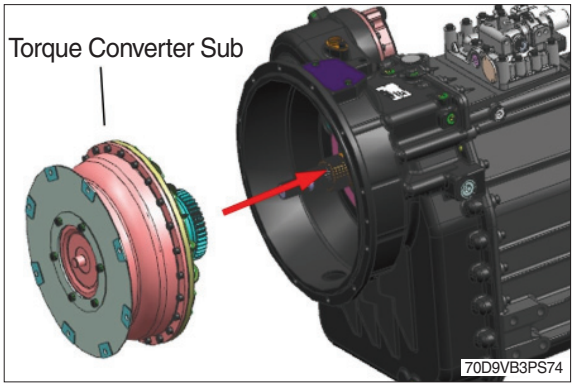
※ **Cover loctite #277 on the screw side of bolt.**




② Assemble PTO shaft.

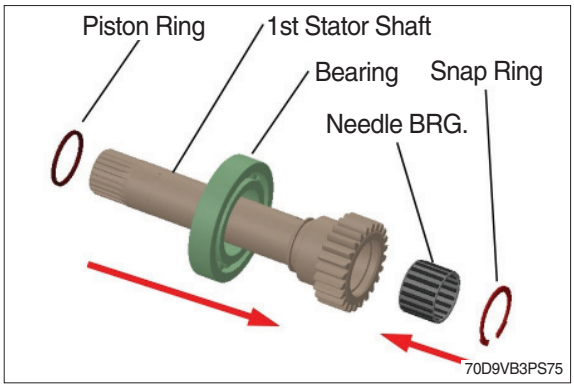



③ Assemble the torque converter sub.

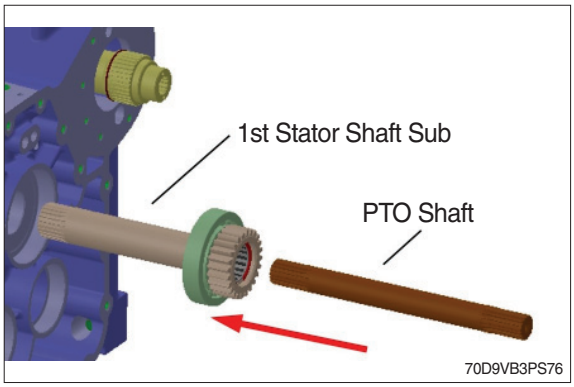


(8) Assemble the needle BRG. & snap ring on 1st stator shaft. And assemble the bearing and piston ring.

※ **Cover grease on piston ring.**

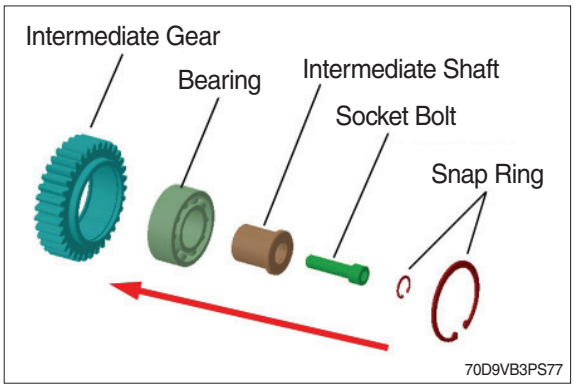



(9) Assemble 1st stator shaft sub and PTO shaft.




**(10) Assemble the intermediate shaft sub part.**

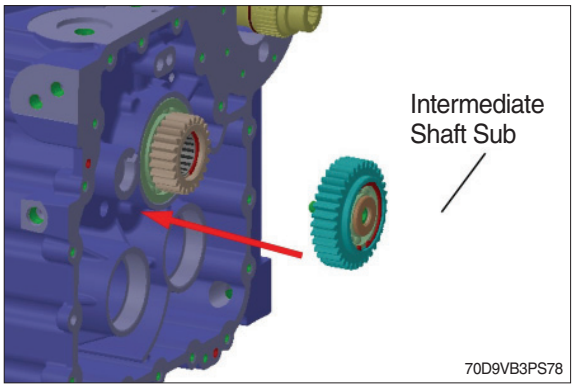
① Assemble the socket bolt and snap ring (small) on intermediate shaft. And assemble the bearing, intermediate shaft and snap ring (large) on intermediate gear.




② Assemble the flexible plate and hex bolt on torque converter.

· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.8 ~ 81.0 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt.**



**(11) Assemble oil level gague and tube part.**

① Assemble the O-ring on oil level gauge tube.

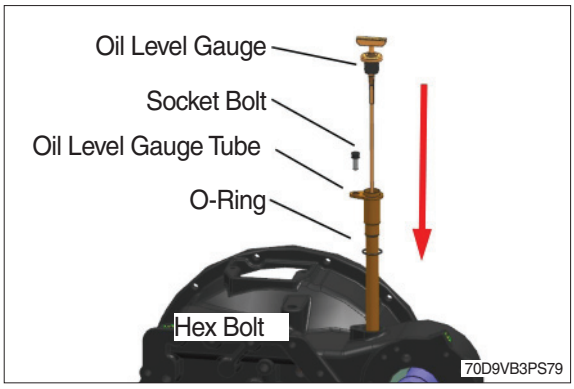
※ **Cover grease on O-ring.**

② Assemble the oil level gauge tube and bolt on the T/C housing.

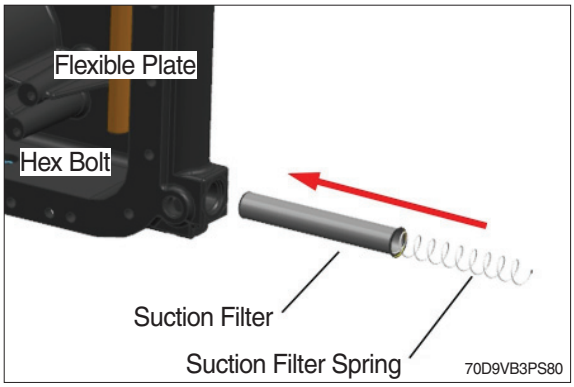
· Tightening torque : 3.1 ~ 3.5 kgf·m (22.4 ~ 25.3 lbf·ft)

※ **Cover Loctite #277 on the screw side of bolt.**

③ Assemble the oil level gauge.



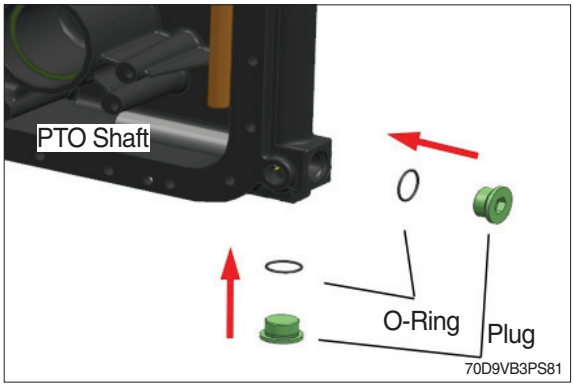

(12) Assemble the suction filter and spring.




(13) Assemble O-ring and plug. Assemble the plugs, o-rings.

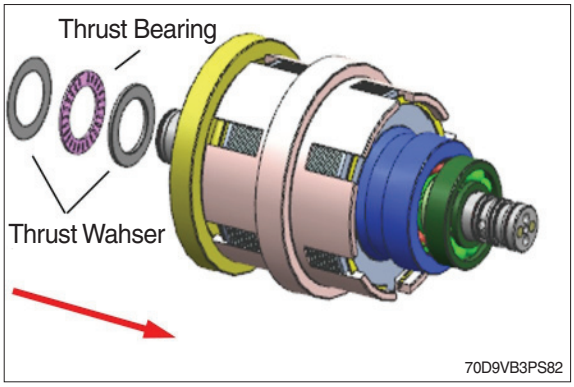
· Tightening torque : 4.1 ~ 4.9 kgf·m (29.7 ~ 35.5 lbf·ft)

※ **Cover grease on O-ring.**

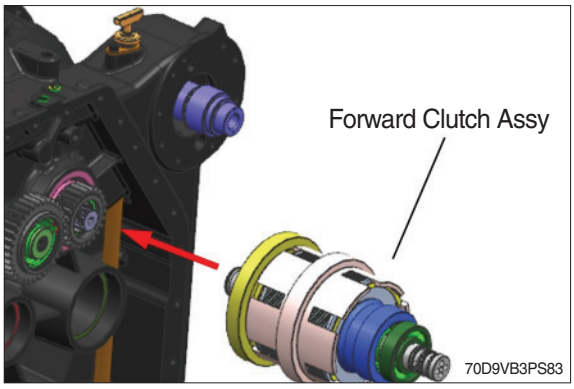



(14) Assemble the thrust washers and bearing on forward clutch sub.

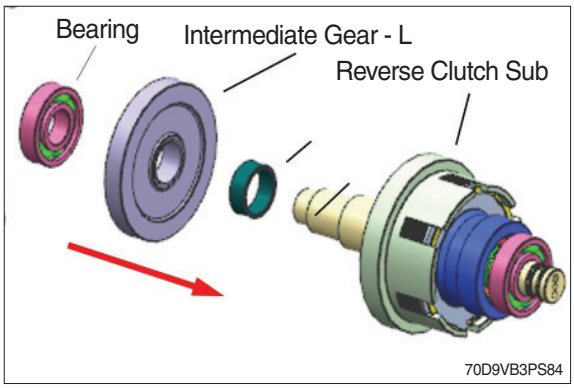
※ **Cover grease on the washers and bearing.**



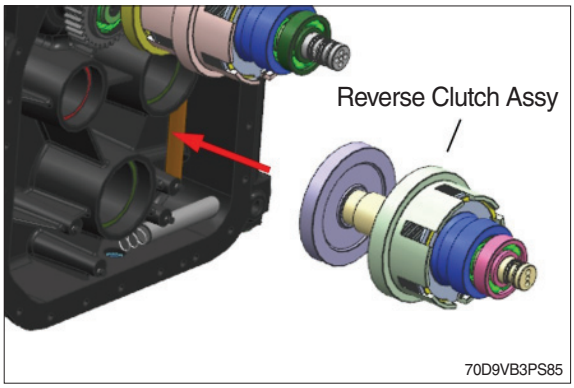
(15) Assemble the forward clutch assy.



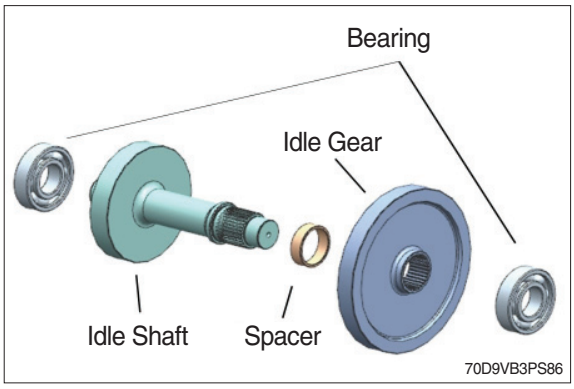

(16) Assemble the spacer, intermediate gear-L, and bearing.



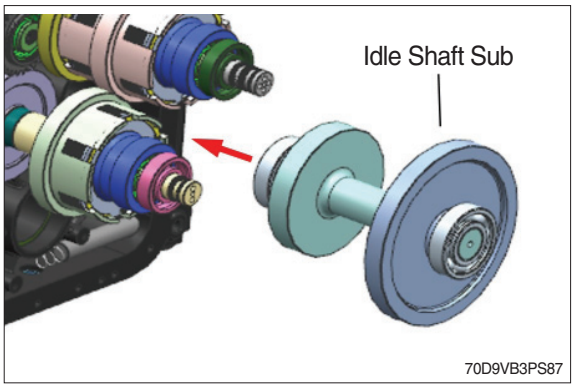

(17) Assemble the forward clutch assy.



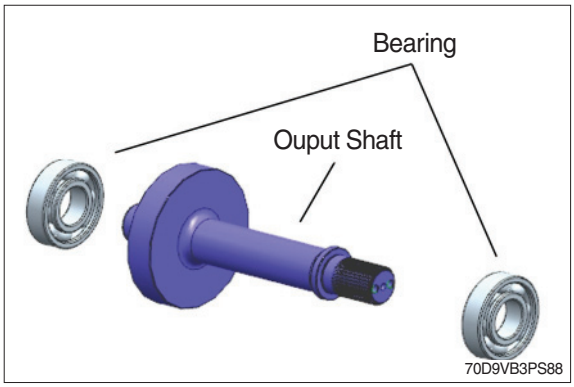

(18) Assemble the spacer, idle gear, and bearings on idle shaft.



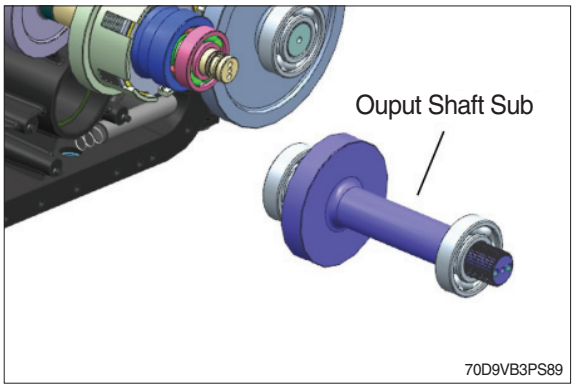
(19) Assemble the idle shaft sub.




(20) Assemble the bearings on output shaft.



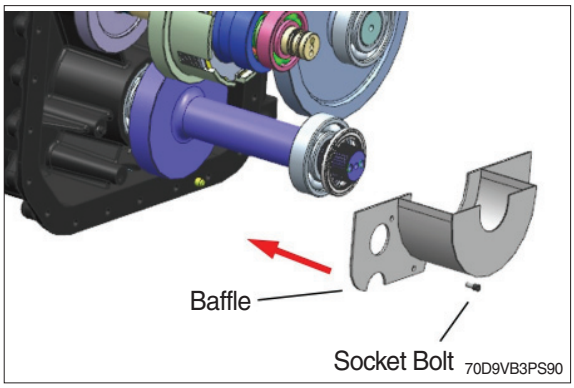

(21) Assemble the ouput shaft sub.



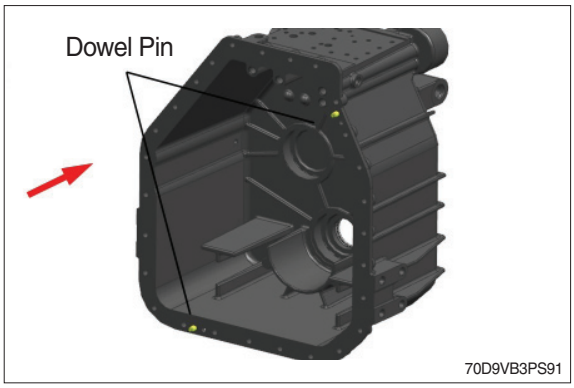

(22) Assemble the baffle and socket bolts.

· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

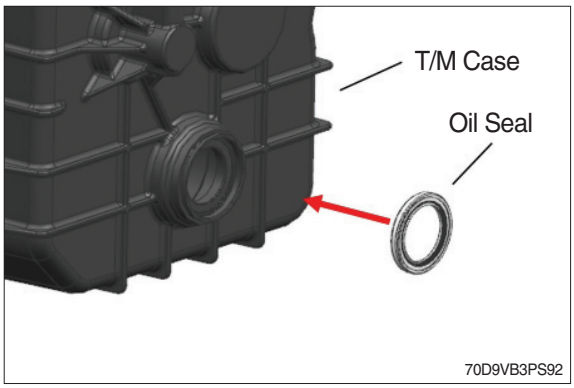
※ **Cover Loctite #277 on the screw side of bolt.**



(23) Press in the dowel pins (2 EA).




(24) Insert the oil seal into the T/M case. Spread grease on the seal lip of oil seal.

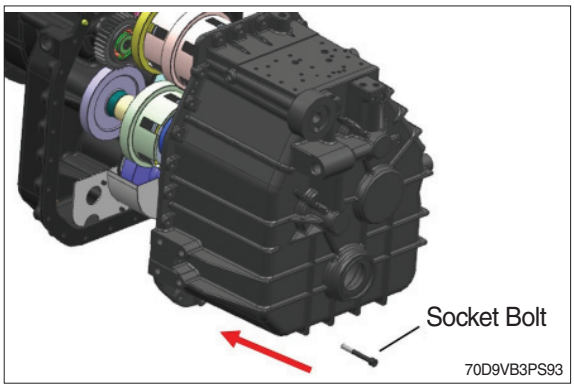



(25) Assemble the T/M case. Tighten the socket bolts.

· Tightening torque : 7.1 ~ 7.7 kgf·m
(51.4 ~ 55.7 lbf·ft)

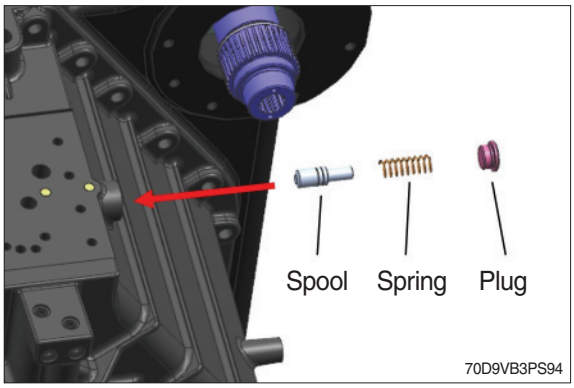
※ **Cover Loctite #5127 on the joint surface of T/M case. Do not apply to the bolt holes.**

※ **Cover Loctite #277 on socket bolt.**




(26) Assemble the spool, spring and tighten the plug.

· Tightening torque : 4.1 ~ 5.1 kgf·m
(29.7 ~ 36.9 lbf·ft)



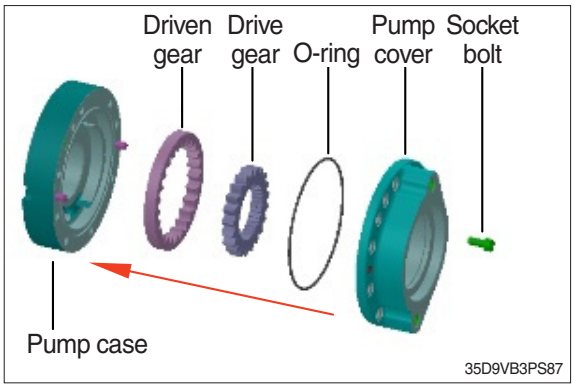
**(27) Assemble oil pump sub part.**

① Assemble the driven gear, drive gear and O-ring on pump case. And assemble the pump cover and socket bolt.

· Tightening torque : 3.1 ~ 3.5 kgf·m (22.4 ~ 25.3 lbf·ft)

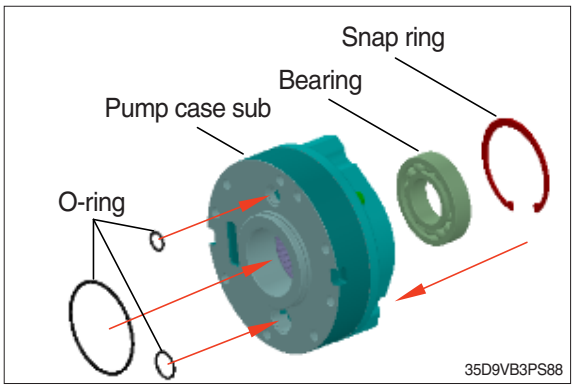
**※ Cover grease on the o-ring.**

**※ Cover Loctite #277 on the screw side of bolt.**




② Assemble the O-rings (3 EA) on pump case sub. Overturn assemble bearing and snap ring.

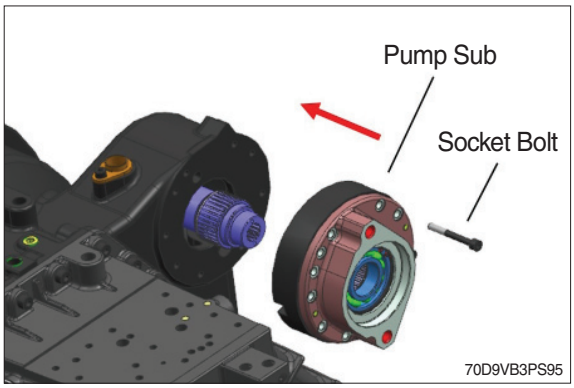
**※ Cover grease on O-ring.**




③ Assemble the pump case sub and socket bolt.

· Tightening torque : 3.1 ~ 3.5 kgf·m (22.4 ~ 25.3 lbf·ft)

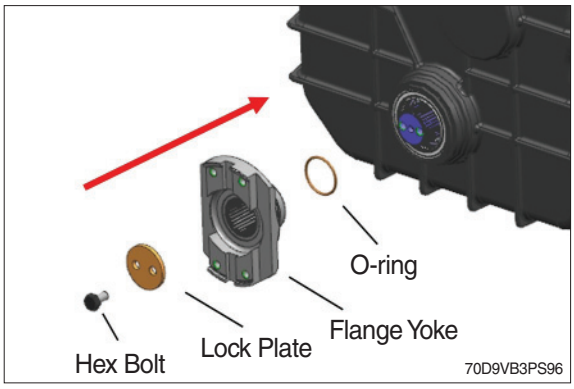
**※ Cover Loctite #277 on the screw side of bolt.**




(28) Assemble the o-ring, flange yoke, lock plate and hex bolts.

· Tightening torque : 6.1 ~ 6.6 kgf·m (44.1 ~ 47.7 lbf·ft)

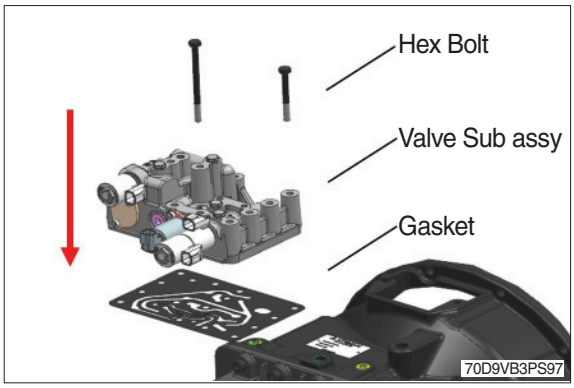
**※ Cover Loctite #277 on the screw side of bolt.**



(29) Assemble the gasket, valve sub and hex bolt.

· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

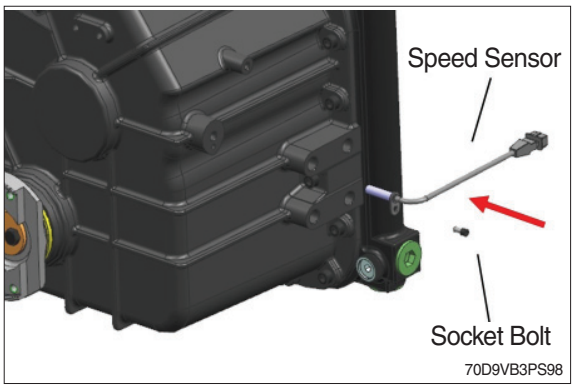
※ **Cover Loctite #277 on the screw side of bolt.**




(30) Assemble the speed sensor and socket bolt.

· Tightening torque : 0.9 ~ 1.1 kgf·m
(6.5 ~ 8.0 lbf·ft)

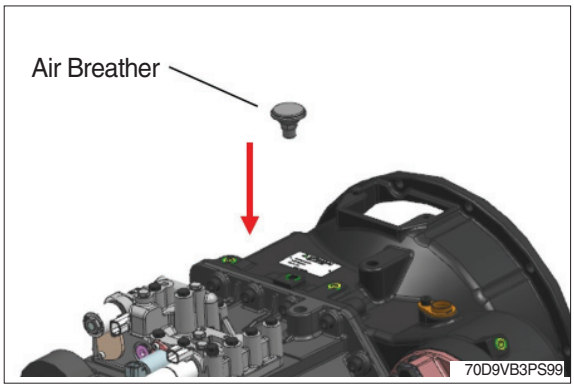
※ **Cover Loctite #277 on the screw side of bolt.**




(31) Assemble the air breather.

· Tightening torque : 1.0 ~ 1.4 kgf·m
(7.2 ~ 10.1 lbf·ft)

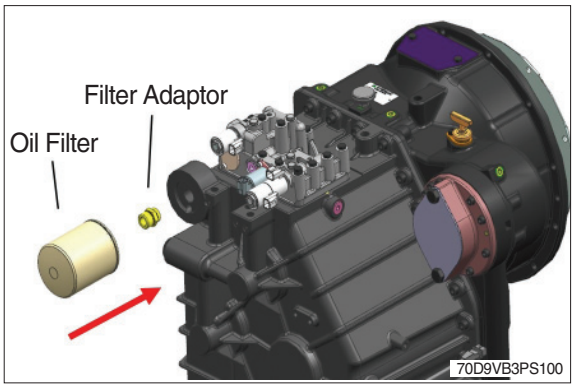
※ **Cover Loctite #577 on the screw side.**




(32) Tighten the oil filter adaptor and assemble the oil filter.

Slightly oil the seal on the oil filter. Turn in the oil filter until contact with the sealing surface is obtained, and then tighten it by band with approx. 1/3 to 1/2 rotation.

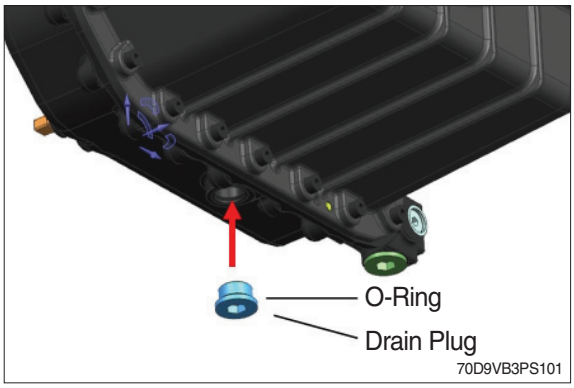
· Tightening torque : 13.3 ~ 14.7 kgf·m
(96.2 ~ 106.3 lbf·ft)



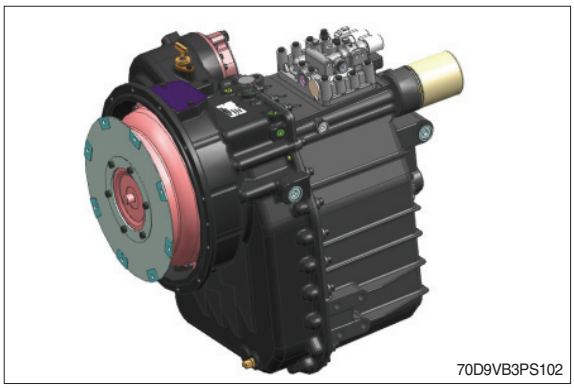
(33) After assembling the O-ring to the plug, assemble it to the T/M case.

· Tightening torque : 4.1 ~ 5.1 kgf·m
(29.7 ~ 36.9 lbf·ft)

※ **Grease the O-ring when assembling it.**



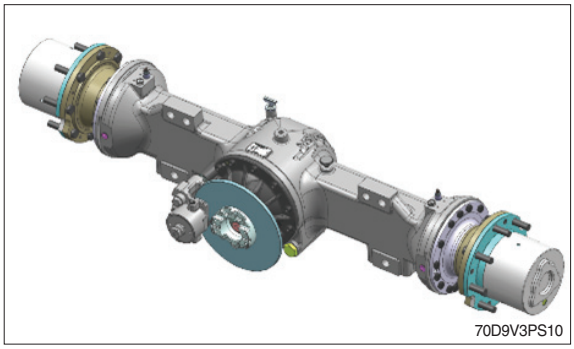

(34) Complete the transmission assembly.



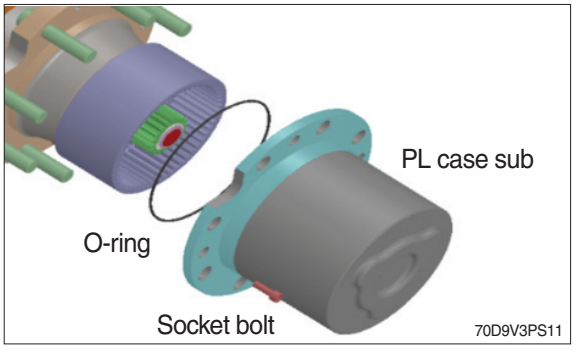
## 3. DISASSEMBLY OF DRIVE AXLE

### 1) DISASSEMBLY OF HUB

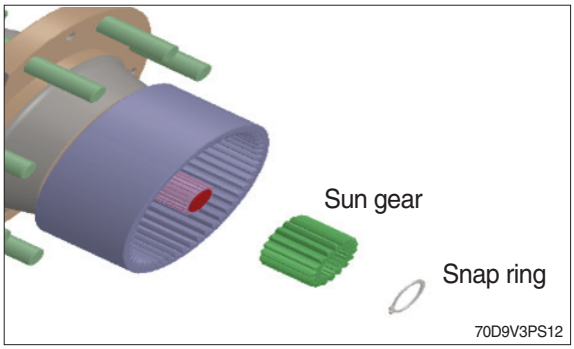
(1) Disaasemble drive axle assy.



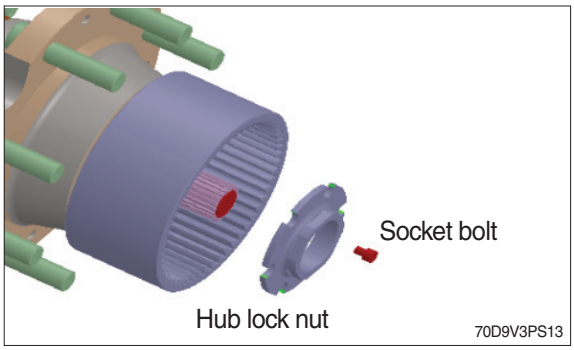

(2) Disassemble PL case sub assy, the socket bolt, and O-ring.



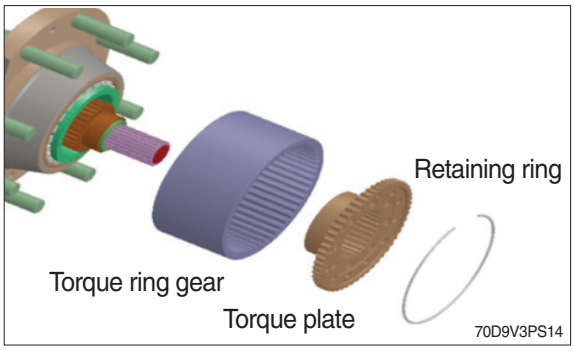

(3) Disassemble snap ring and sun gear at the end of axle shaft.




(4) Disassemble socket bolt and hub lock nut.

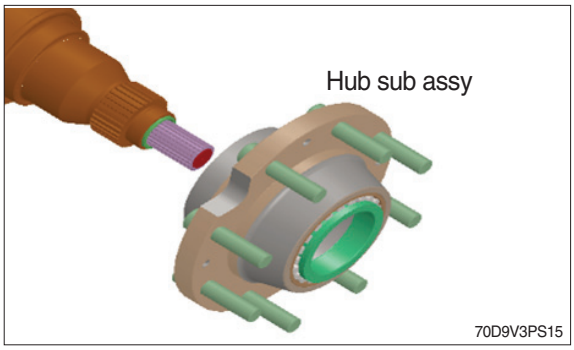


(5) Disassemble retaining ring, torque plate, and torque ring gear.

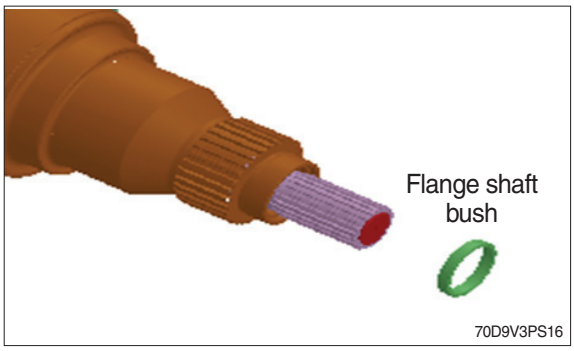



(6) Disassemble hub sub assy.

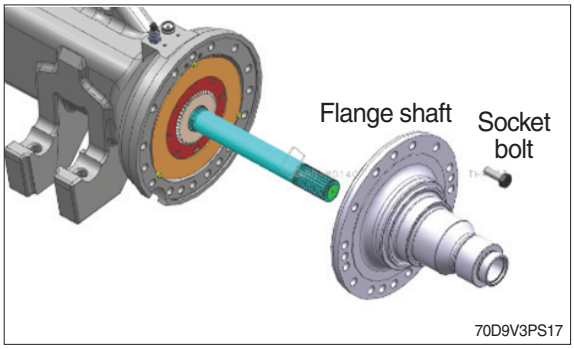
△ **When you disassemble hub sub assembly, the hub sub assembly will be prevention of falling from lift system. Falling of hub sub assembly will make engineers harm and product damage. You must be careful.**



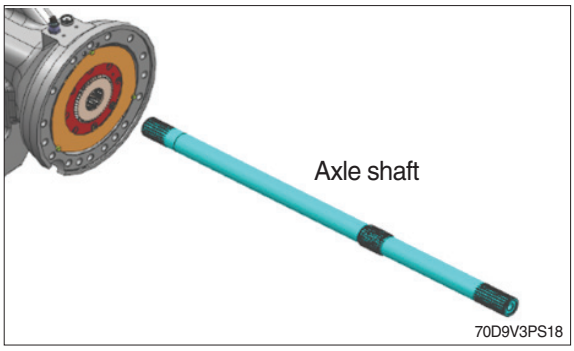

(7) Disassemble flange shaft bush.



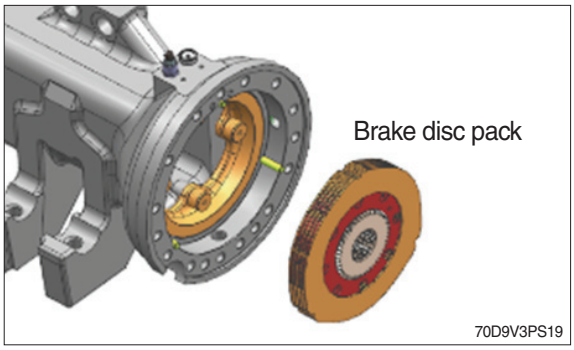

(8) Disassemble flange shaft and socket bolt.



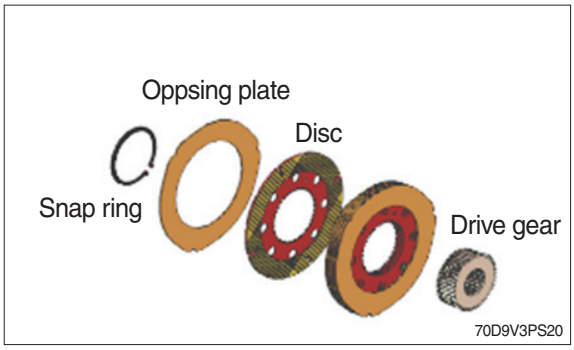
(9) Disassemble axle shaft.



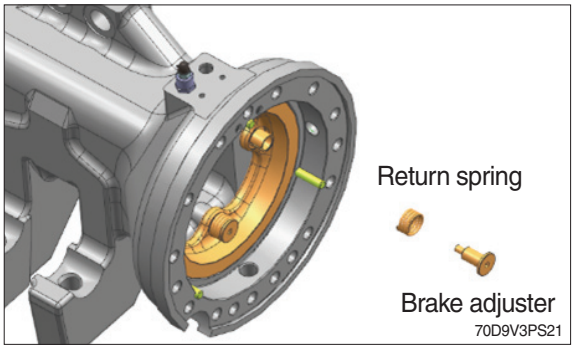

(10) Disassemble brake disc pack.



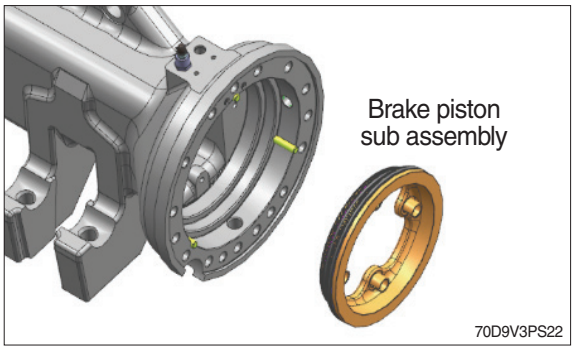

(11) Disassemble snap ring, opposing plate, disc, and drive gear.



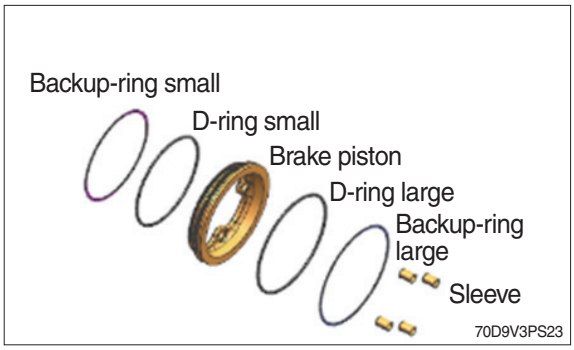

(12) Disassemble return spring, brake adjuster.



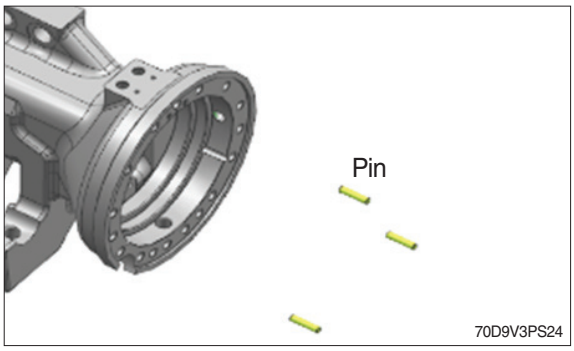
(13) Disassemble brake piston sub assembly.




(14) Disassemble sleeve, backup ring, D-ring.

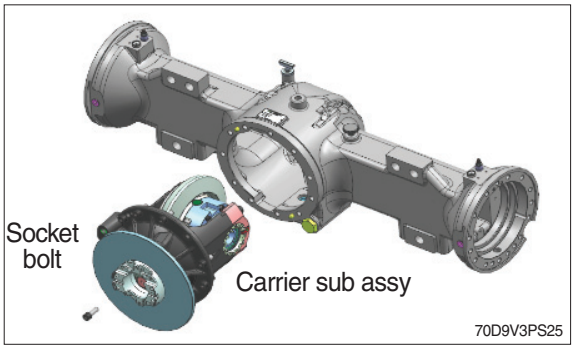



(15) Disassemble pin.

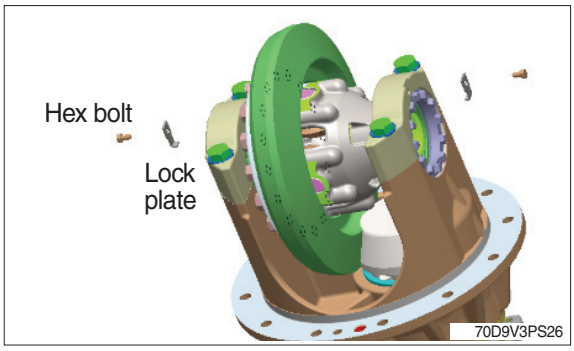



## 2) DISASSEMBLY OF CARRIER SUB ASSEMBLY

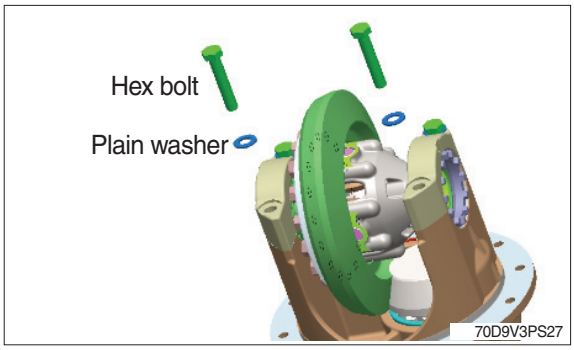
(1) Disassemble hex bolt and carrier sub assembly.



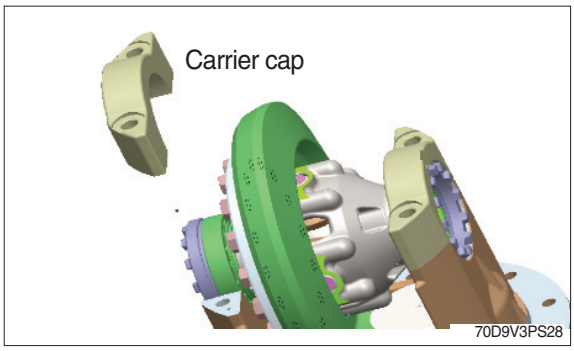
(2) Disassemble hex bolt and lock plate.



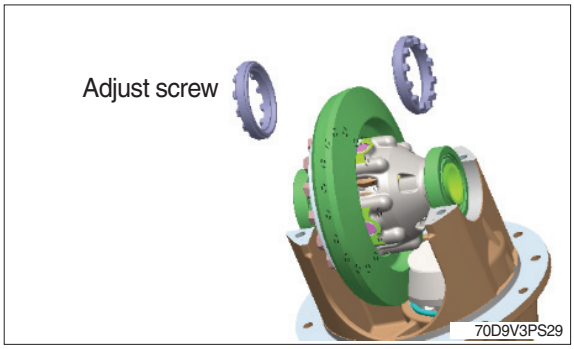

(3) Disassemble hex bolt and plain washer.



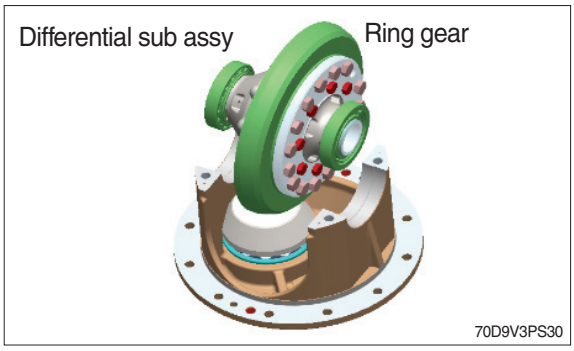

(4) Disassemble carrier cap.



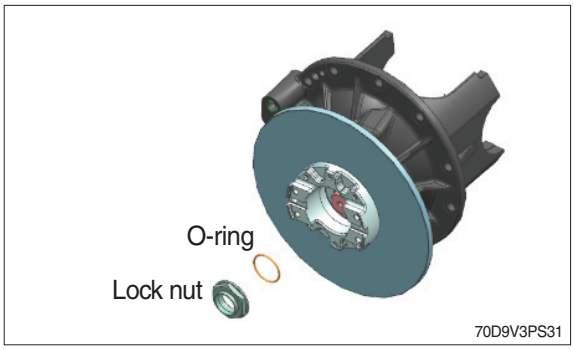

(5) Disassemble adjust screw.



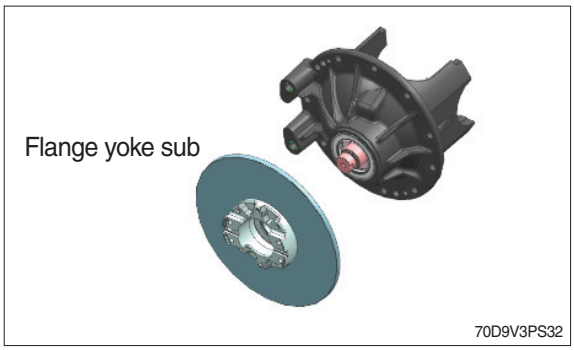
(6) Disassemble differential sub assembly and ring gear.



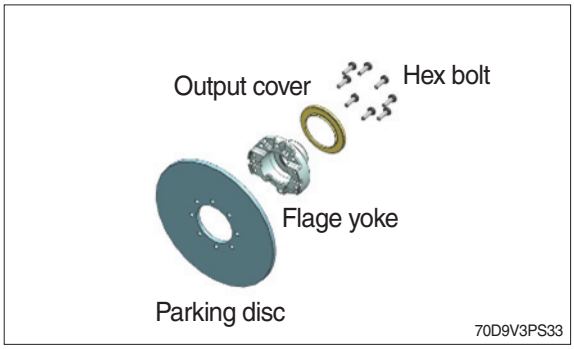

(7) Disassemble lock nut and O-ring.




(8) Disassemble flange yoke sub.

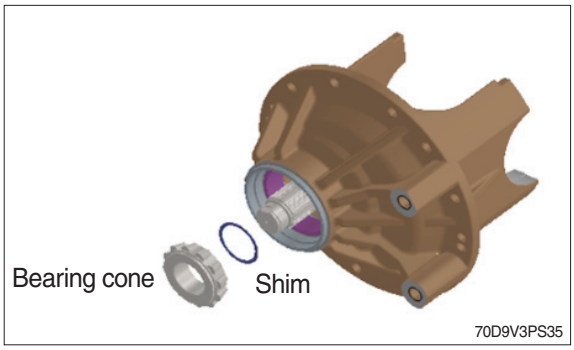



※ **Flage yoke sub**

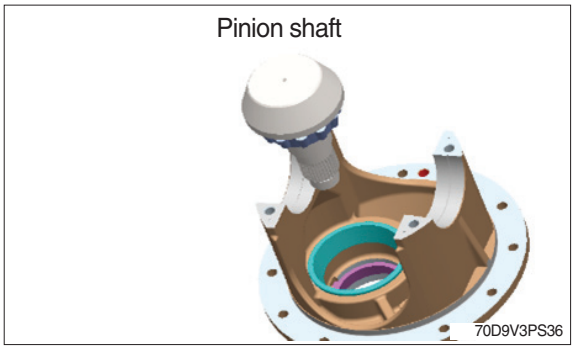


(9) Disassemble oil seal.

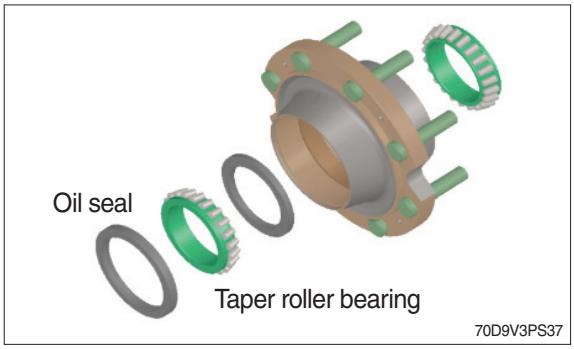

(10) Disassemble bearing cone and shim.




(11) Disassemble pinion shaft.

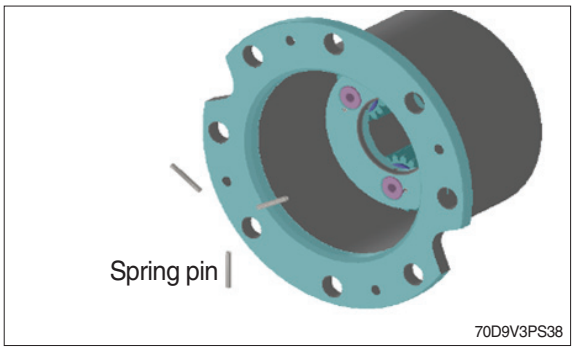



(12) Disassemble oil seal and taper rooler bearing.

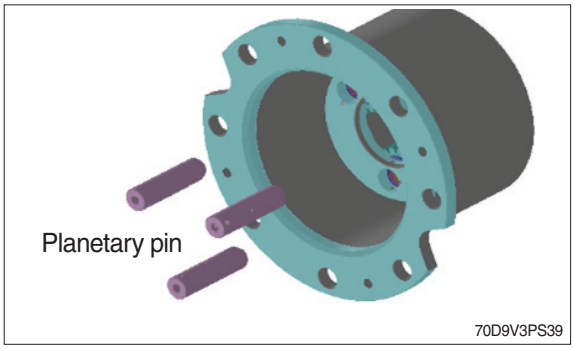


### 3) DISASSEMBLY OF PLANETARY CASE

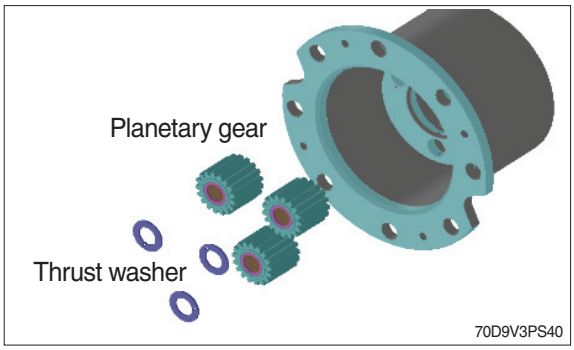
(1) Disassemble spring pin.




(2) Disassemble planetary pin.




(3) Disassemble planetart gear and thrust washer.

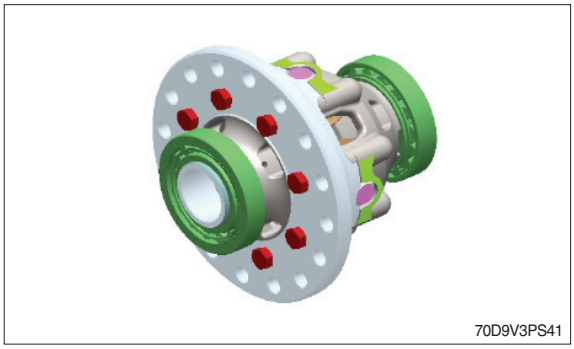


## 4. ASSEMBLY OF DRIVE AXLE

### 1) ASSEMBLY OF CARRIER SUB ASSEMBLY

**(1) Assembly of differential device**

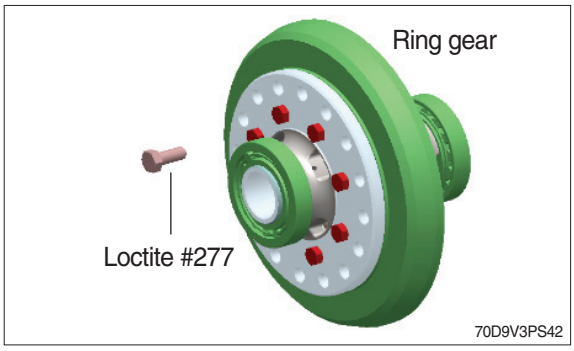
① Make preparation for diffdrential assy.




② Assemble ring gear by bolt.

· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.8 ~ 81.0 lbf·ft)

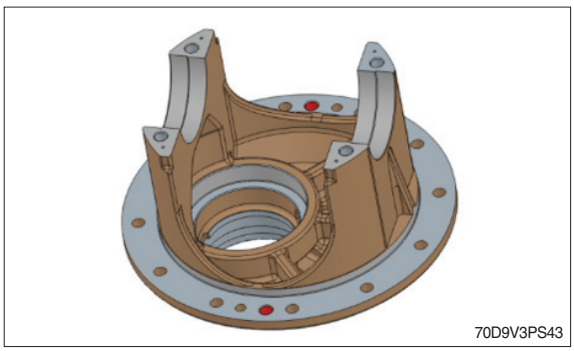
**※ Cover loctite #277 on the screw side of bolt.**




**(2) Control of shim and pinion shaft assy**

**① Fix carrier case to jig.**

**※ Before install gearset to carrier, you must recognize information. You always have tested the mark at gear set which each pair of gear suits it. The mark of gearset supposed to look like the illustration.**

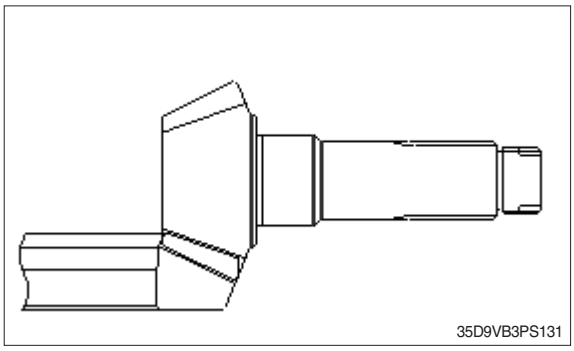



**a. Part number**

a) Example of gearset part number
· Ring gear, HA80-20100
· Conventional pinion gear, HA80-20110

b) The place of pinion shaft : At the end of Shaft

c) The place of Ring gear : Front face or outer diameter



**b. Tooth combination number**

a) Example of tooth combination number : - (12-32 gearset is maning of 12-tooth drive pinion and 32-tooth ring gear.)

b) The place of pinion shaft : at the end of shaft

c) The place of ring gear : front face or outer diameter

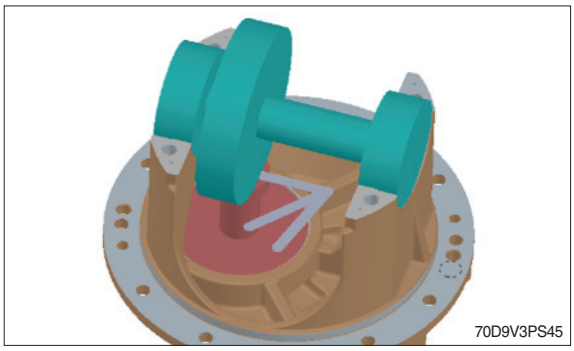
c. Pinion cone variation number

(The pinion cone variation number is disused in match checking the gearset. The number is using in carrier for adjusting the depth of pinion.)

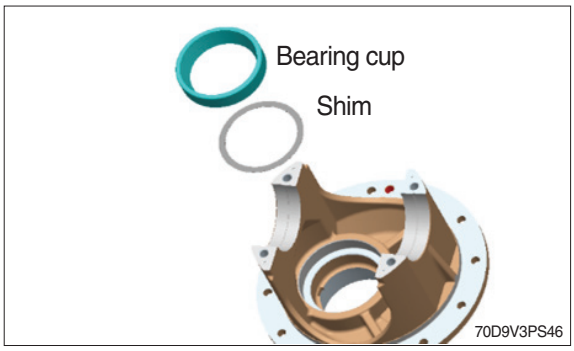
a) For example - pinion cone variation nubmers : +2 (+0.01 mm), -1 (0.02 mm)

b) The place of gearset : end of pinion shaft head or outer diameter of ring gear

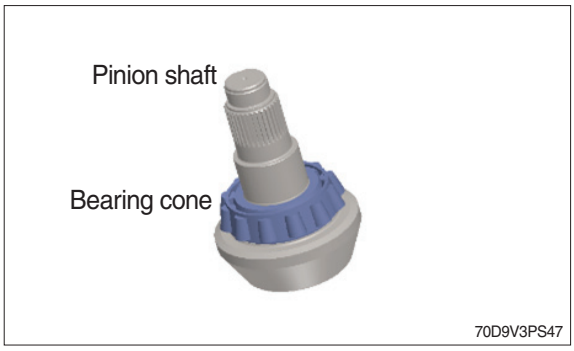
② The THK of the shim will be decided of measured value of gauge and machine.
(basic gap step between bearing and carrier case : A)
(Mounting distance of pinion shaft : B)
· THK of shim
X = A - B + Carrier case bearing step depth
ex) A= 0.5, B= -0.1, Bearing setp depth = +0.1
→ X= 0.5 + 0.1 + 0.1 =0.7 mm
ex) A= 0.5, B= +0.1, Bearing setp depth = -0.1
→ X= 0.5 - 0.1 - 0.1 =0.3 mm



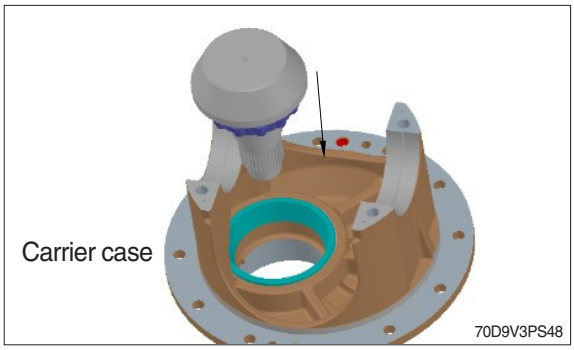

③ Assemble shim and press the bearing cup.
· Sort of shim : 0.1, 0.15, 0.3 mm



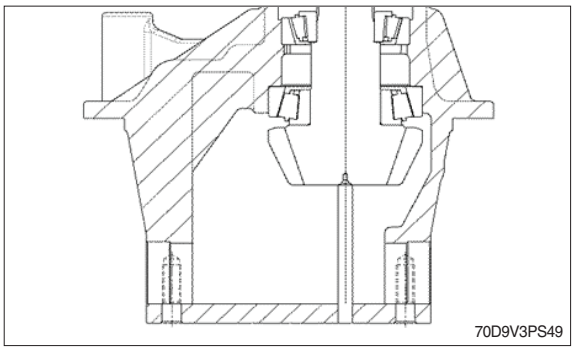
④ Press bearing cone on pinion shaft.




⑤ Assemble carrier case on pinion shaft.




⑥ Turn carrier case a one-eighty (180˚) and fix it on jig.

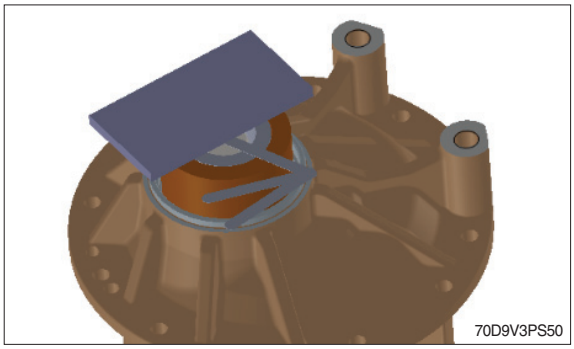



⑦ The THK of shim will be decided of measured value of gauge and machine. (THK: B)

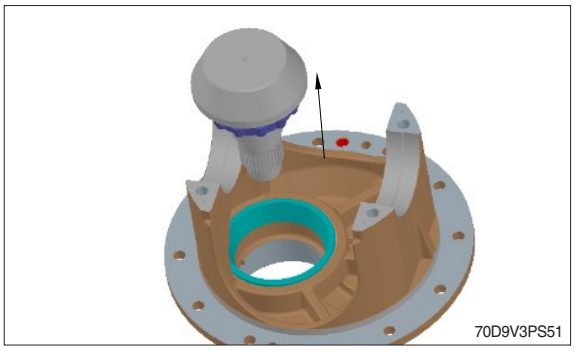
**※ THK of shim : X = B - end play (0.03~0.06)**

**ex) B = 0.4**

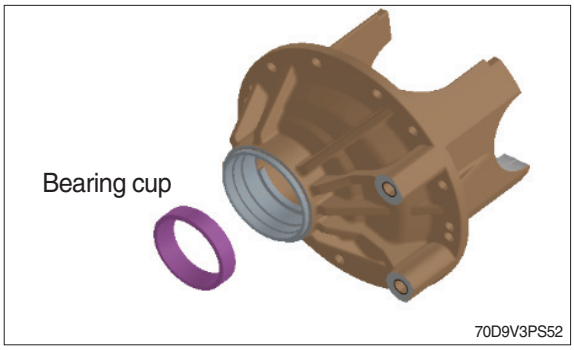
**X = 0.4 - (0.03~0.06) = 0.34~0.37 mm**



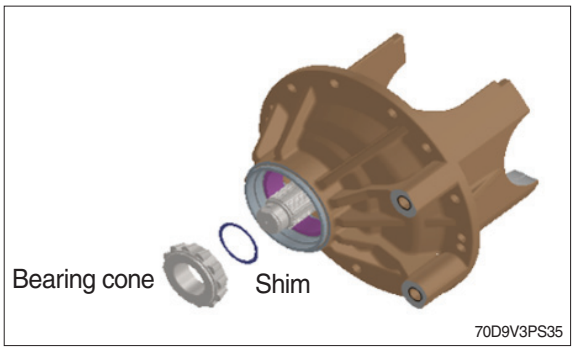
⑧ Disassemble pinion shaft from carrier case.



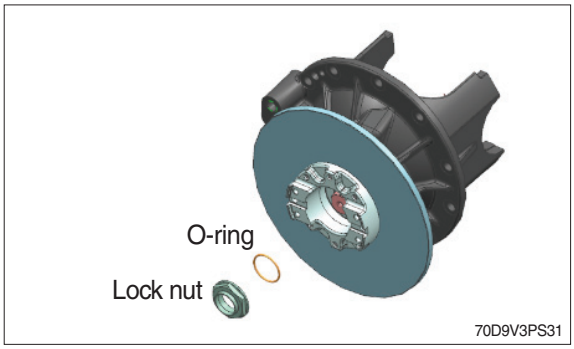

⑨ Assemble bearing cup.



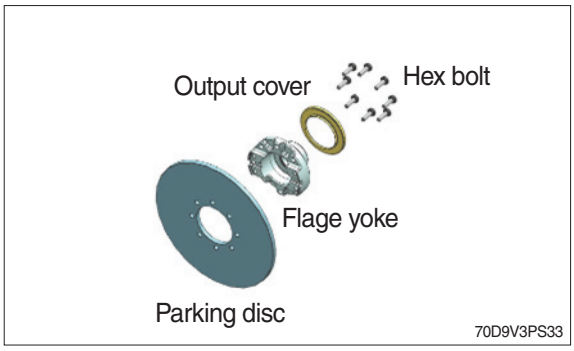

⑩ Reassemble pinion shaft and assemble shim and master bearing.
· Sort of shim : 0.1 , 0.15 , 0.3 mm



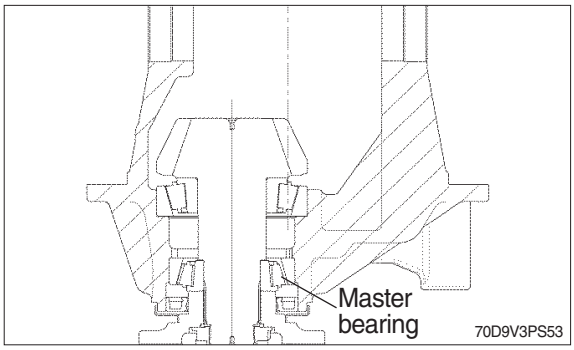

⑪ Assemble flange yoke sub, o-ring, and lock nut.



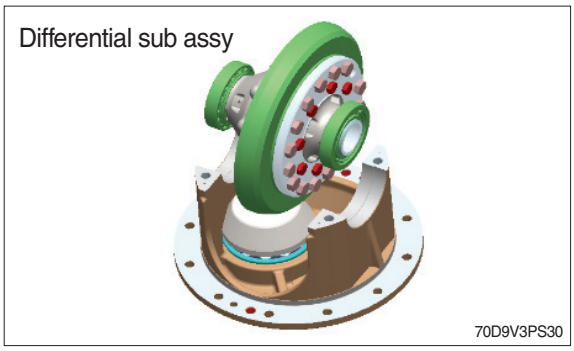
※ **Flage yoke sub**




⑫ Over turn (180˚) carrier case assembly.



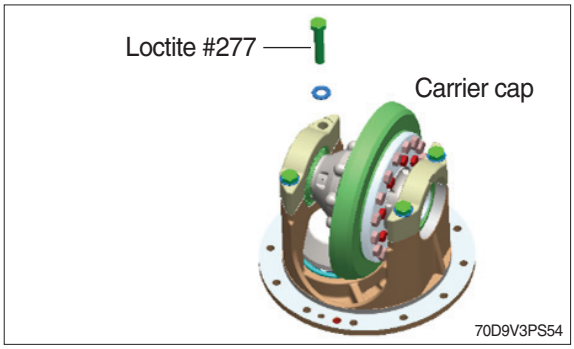

⑬ Assemble differencial assembly on carrier case.




⑭ Assemble hex bolt on carrier cap.

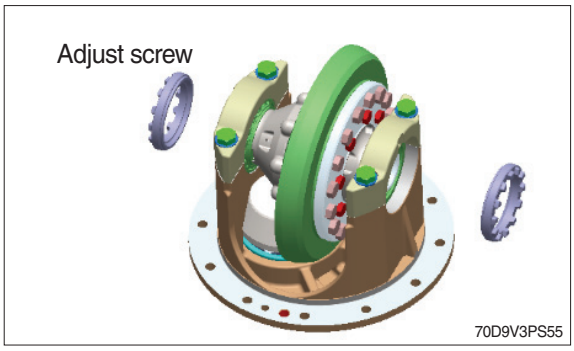
· Tightening torque : 15.8 ~ 18.4 kgf·m
(114 ~ 133 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt.**

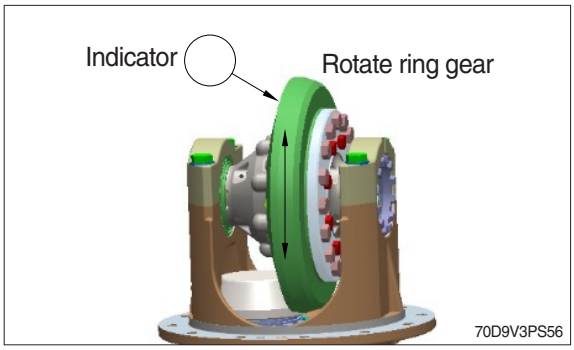


### (3) Control of gearset backlash

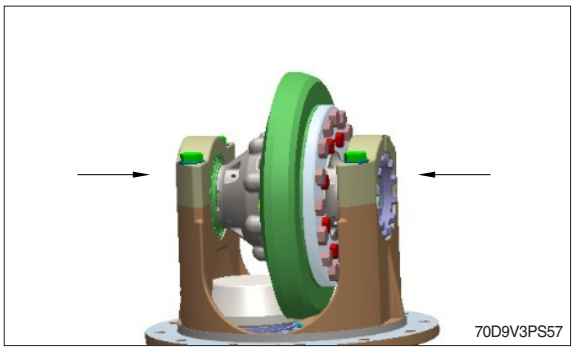
① Assemble differencial assembly on carrier case.




② Measure backlash as turn ring gear slowly.



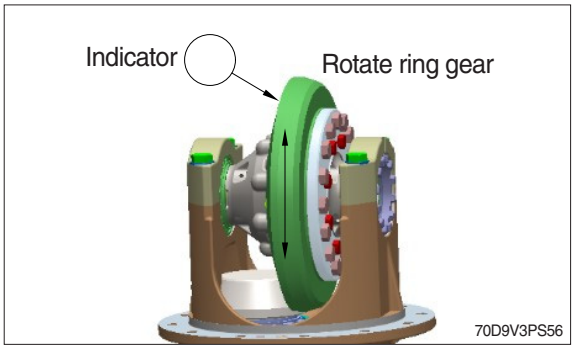

③ Lock adjust screw.



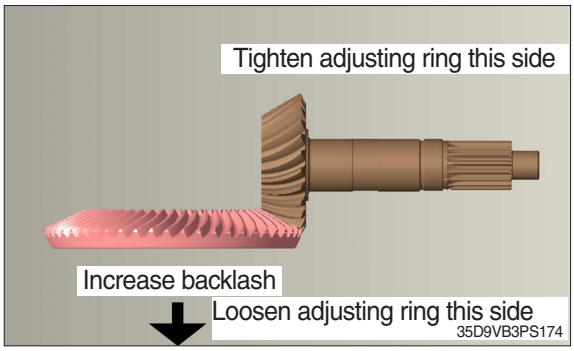

④ Remeasure Backlash.

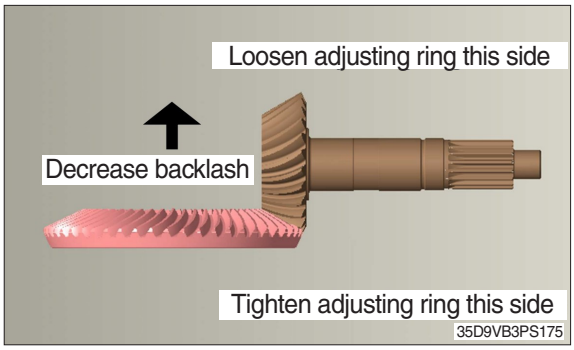
· Backlash of pinion and ring gear : 0.18 ~ 0.23 mm

**※ If it is wrong backlash, you can adjust value as moving each step.**



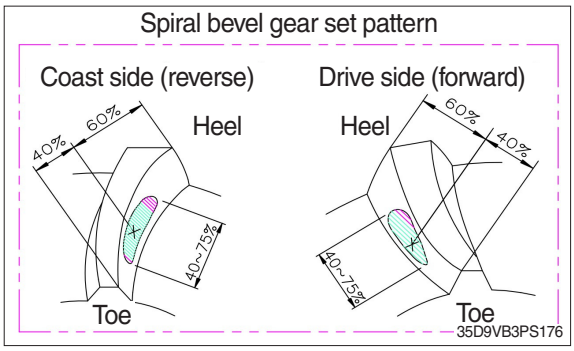
※ If ring loosen same with one bolt screw side, you should ring tighten it. And if ring tighten it, you should loosen the adjusting ring.



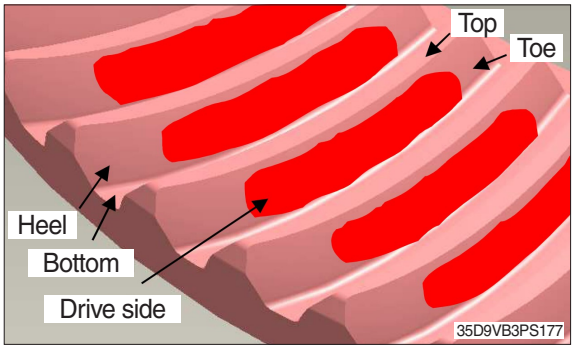




(4) Measurement of tooth contact pattern

※ After assemble, adjust pattern of the gear and pinion shaft figure. If pattern is not adjusted, take a measure as measuring backlash again and then reassemble.

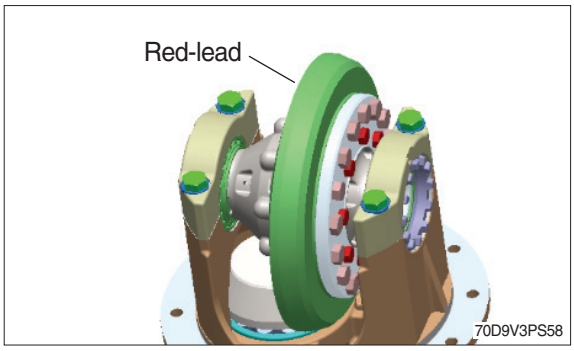



※ Always check tooth contact pattern on the driving side of gear teeth.



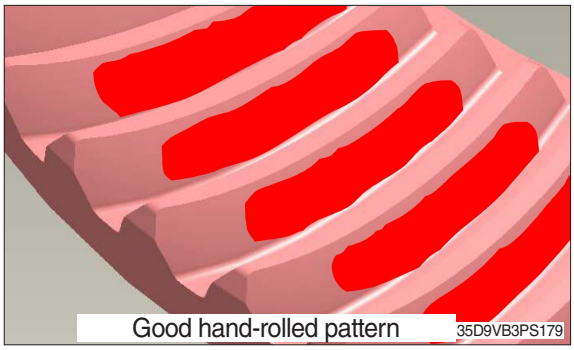
① Marking red-lead on 6 tooth surface of ring gear.

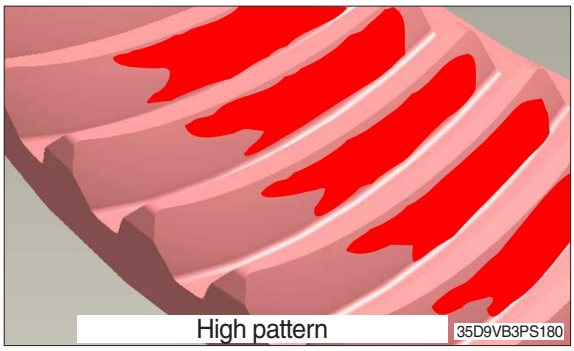
② Rotate ring gear forward and backward so that the 6 marked teeth go past the drive pinion six time to get a good contact pattern.

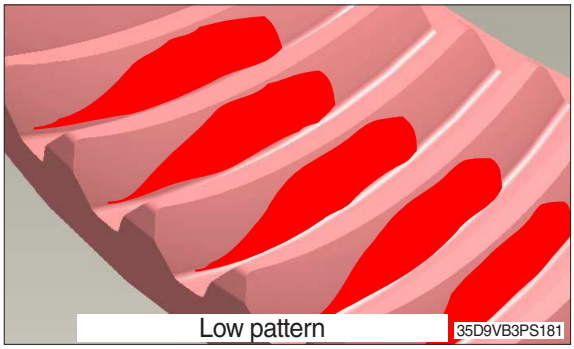



③ Compare the contact pattern with illustrations.

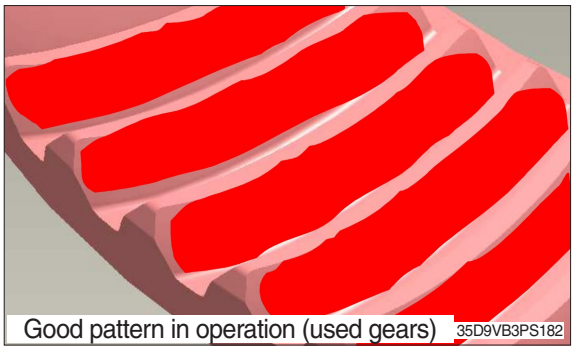
※ **The good contact pattern of gearset is appeared what the length of tooth has had.**



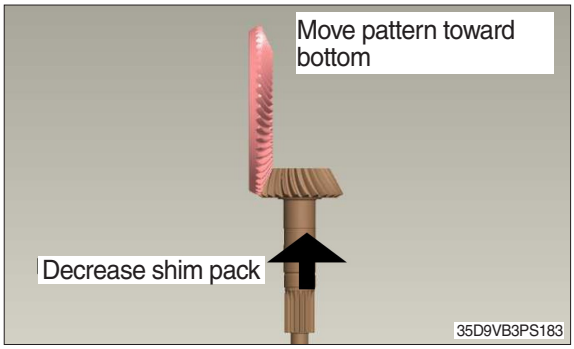



※ **The good contact pattern of used gearset is appeared what the length of tooth has had as wear pattern.**

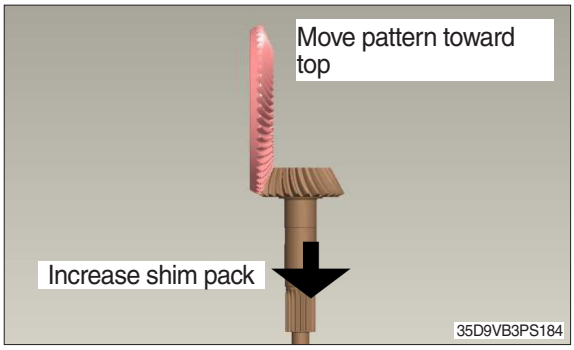



④ If you need control contact pattern to adjust THK of tooth (top/bottom), you should obey steps a-b.
If you need control contact pattern to adjust THK of tooth (toe/heel), you should obey steps c-d.

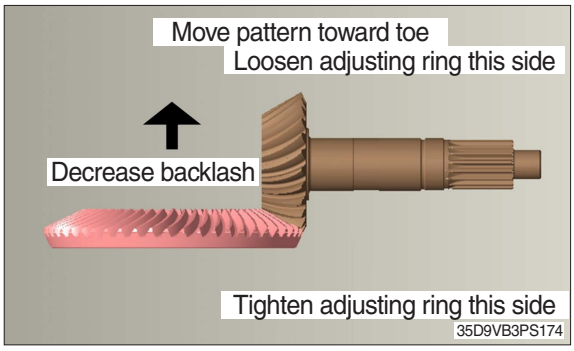
a. High pattern
If A high contact pattern appear it which pinion was installed shallowly in carrier.
To modify, move the pinion toward the ring gear by decreasing the shim pack between pinion spigot and inner bearing cone.




b. Lower pattern
If A low contact pattern appear it which pinion was installed deeply in carrier.
To modify, move the pinion away from the ring gear by increasing the shim pack between pinion spigot and inner bearing cone.

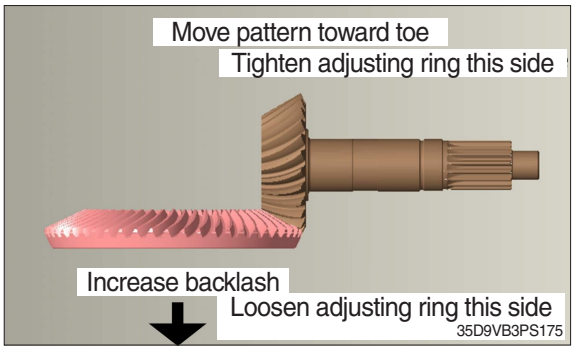



c. Heel pattern
Decrease the gearset backlash (within specified range) to move contact pattern toward toe and away from heel. Refer to "Adjusting the gearset backlash".



d. Toe pattern

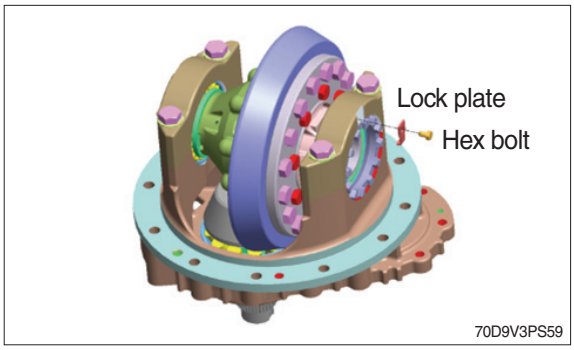
Increase the gearset backlash (within specified range) to move contact pattern toward heel and away from toe. Refer to "Adjusting the gearset back lash".



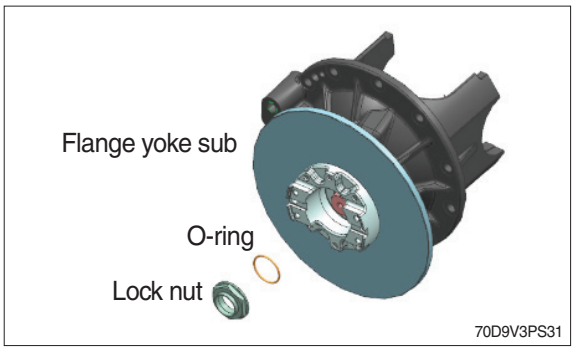

⑤ Assemble lock plate and hex bolt.

· Tightening torque : 0.92 ~ 1.2 kgf·m
(6.7 ~ 8.7 lbf·ft)

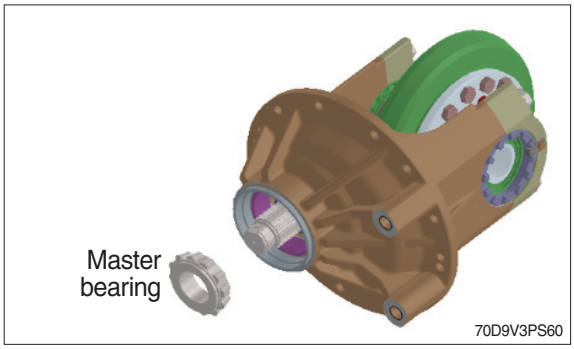
**※ Cover loctite #277 on the screw side of bolt.**



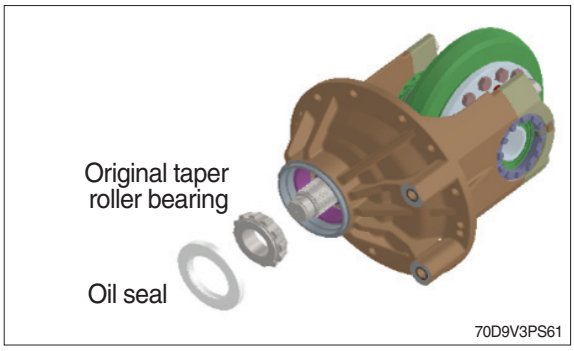

⑥ Disassemble lock nut, O-ring, and flange yoke.




⑦ Disassemble master bearing.



⑧ Assemble original taper roller bearing and oil seal.

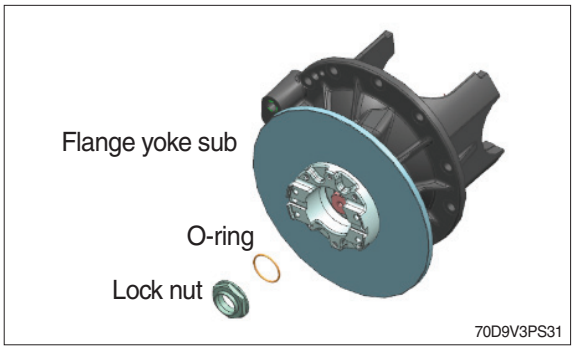



⑨ Assemble o-ring and lock nut.

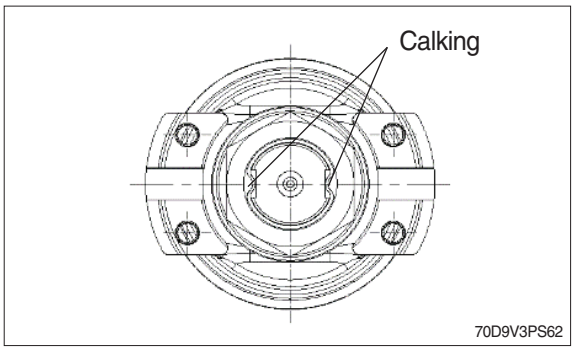
· Tightening torque : 0.92 ~ 1.2 kgf·m
(6.7 ~ 8.7 lbf·ft)

· Preload : 0.2 ~ 0.4 kgf·m
(1.4 ~ 2.9 lbf·ft)

**※ Cover grease on O-ring and loctite #277 on lock nut.**

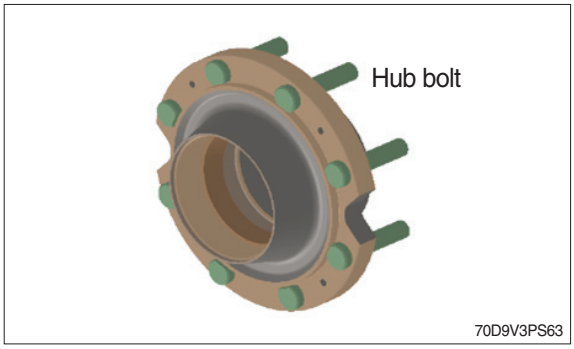



⑩ Calking (2 EA).

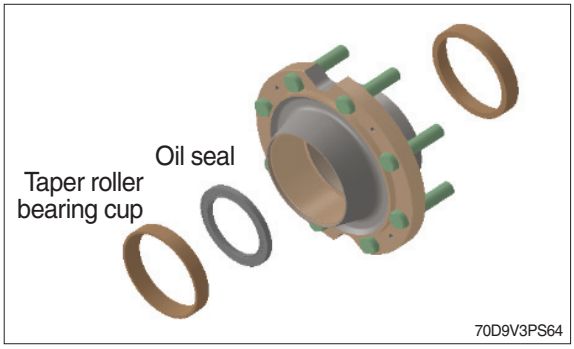


## 2) ASSEMBLY OF HUB SUB

(1) Press hub bolt into hub.

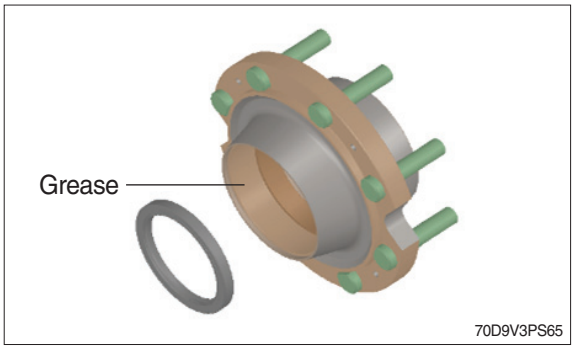



(2) Press hub oil seal. Assemble bearing cup (2 EA) on each left and right hub.



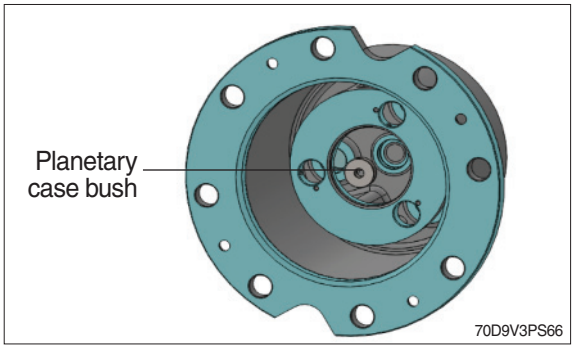

(3) Press hub bolt into hub.

**※ Cover grease at inside hub. (grease : Shell Retinax 0434 - 45 ~ 80cc spread )**

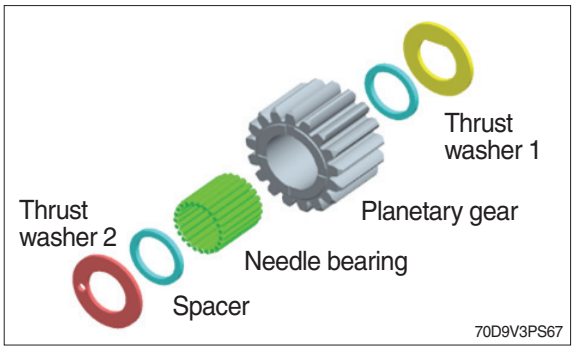



## 3) ASSEMBLY OF PLANETARY CASE

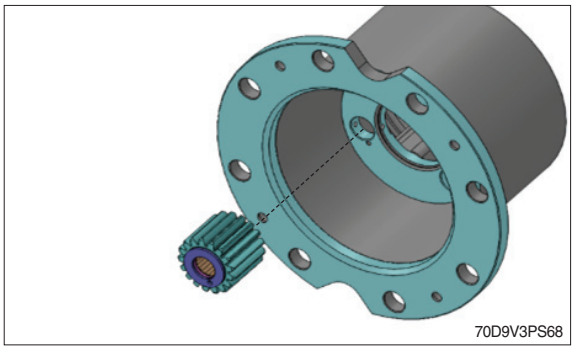
(1) Assemble planetary case bush at the middle of planetary case.



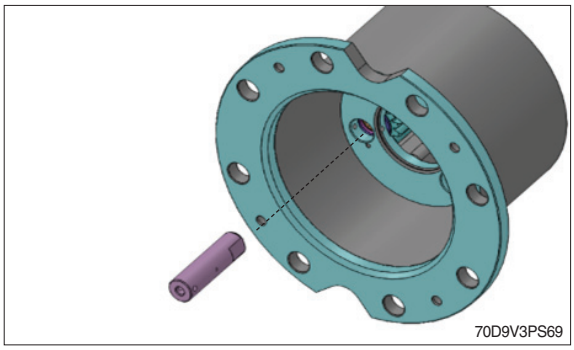
(2) Thrust washer 1 → Spacer → Needle bearing → Planetary gear → Washer → Thrust washer 2
Assemble planetary gear (3 EA) as above in order.



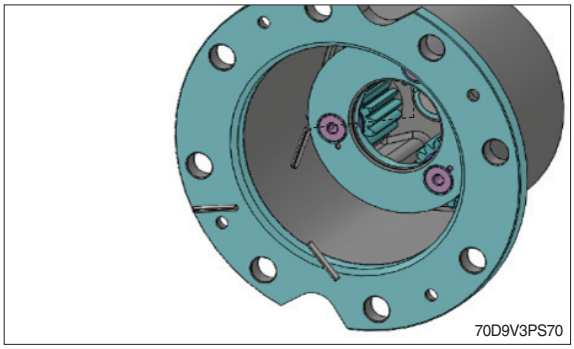

(3) Assemble planetary gear (3 EA)



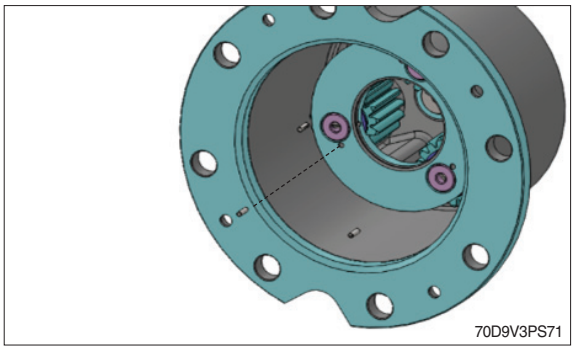

(4) Assemble planetary pin (3 EA).




(5) Assemble spring pin (3 EA).

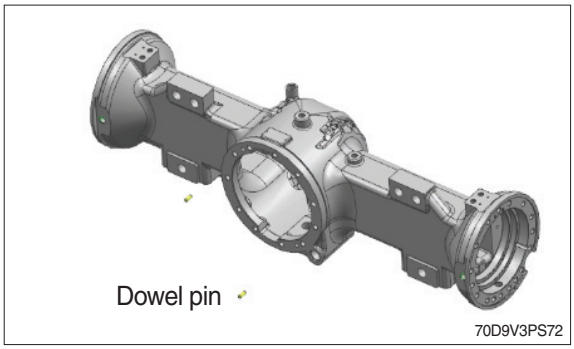


(6) Assemble spring pin (3 EA).



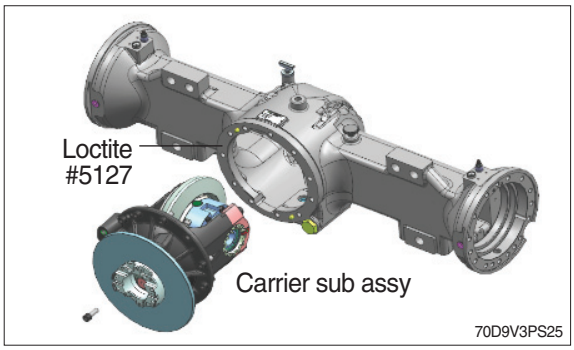

## 5) ASSEMBLY OF DRIVE AXLE

(1) Assemble dowel pin on axle housing.




(2) Assemble carrier assy.

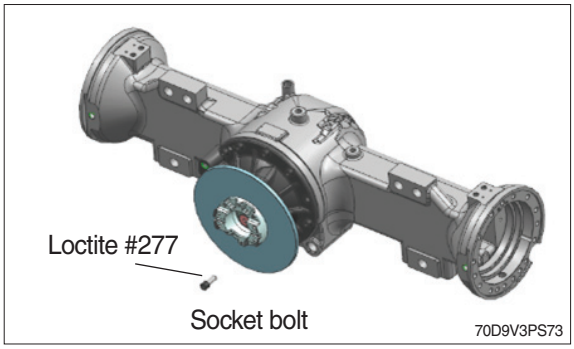
※ **Cover loctite #5127 on axle housing.**



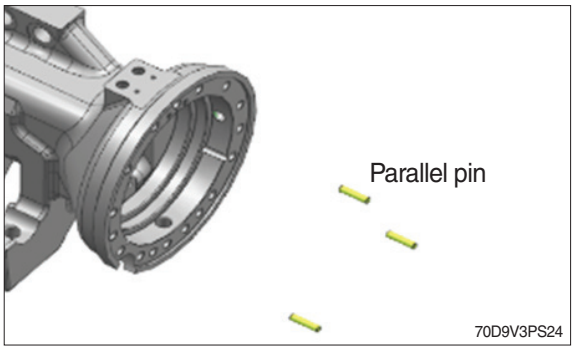

(3) Assemble socket bolt.

· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.3 ~ 80.6 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt.**

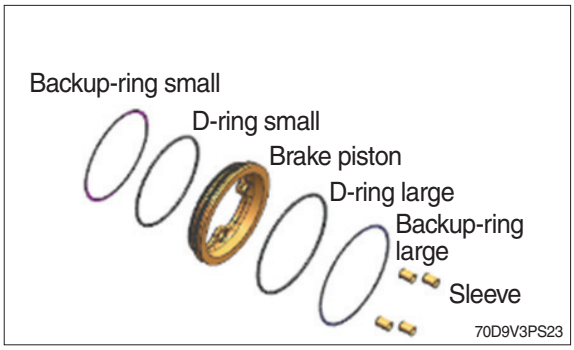


(4) **Assemble parallel pin.**

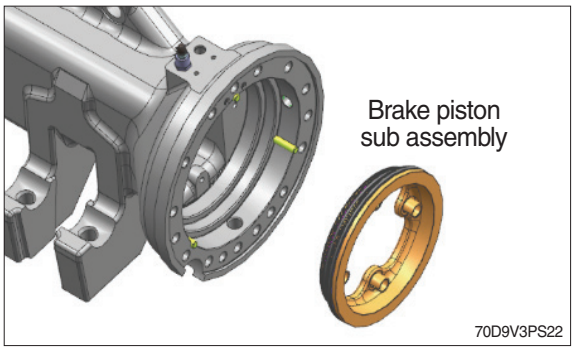



(5) Assemble sleeve, backup ring, and D-ring

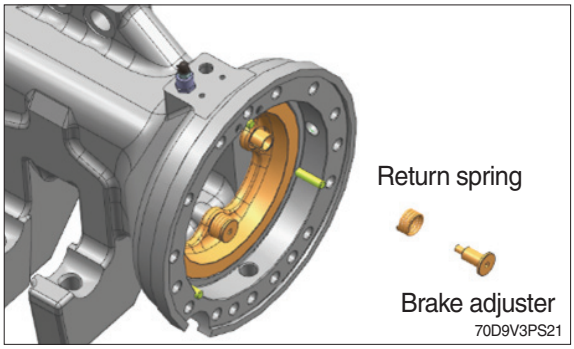
※ **Spread grease on D-ring.**



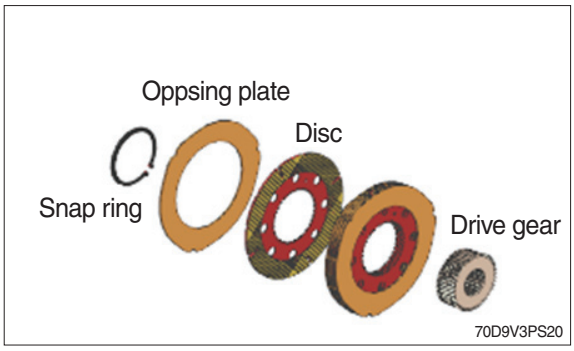

(6) **Assemble piston sub assy.**



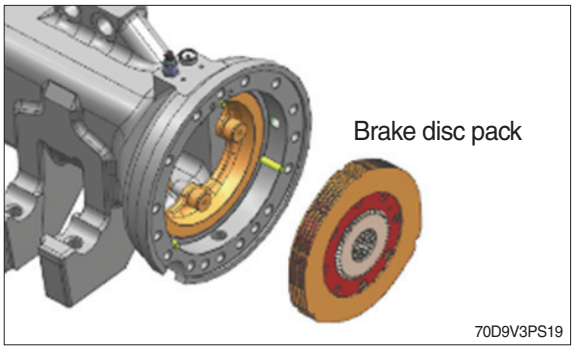

(7) **Assemble return spring and brake adjuster.**



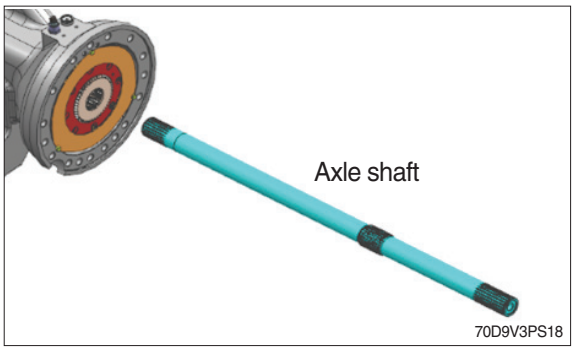
(8) Assemble disc, opposing plate, drive gear, and snap ring.




(9) Assemble brake disc pack sub assy.

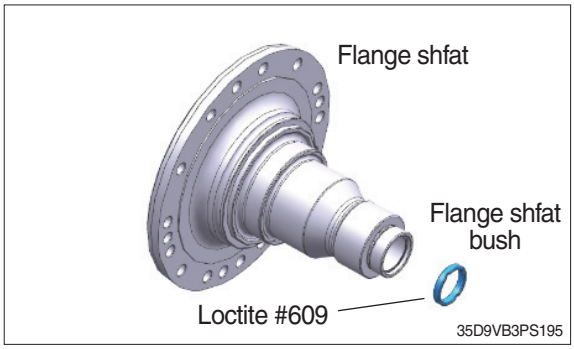



(10) Assemble axle shaft.



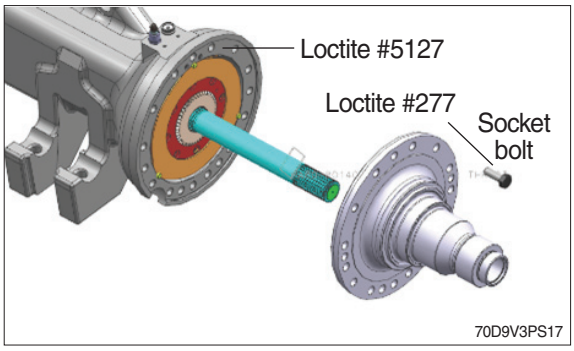

(11) Assemble parallel pin on beam.

※ **Cover loctite #609 on the bush side.**

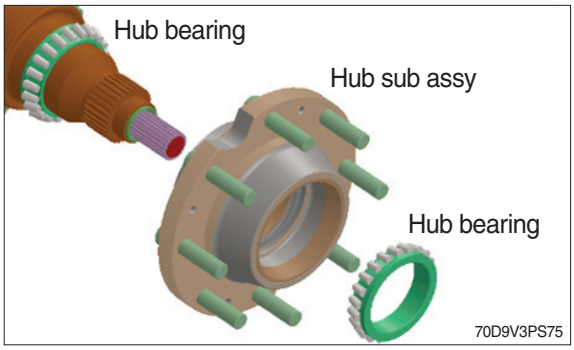


(12) Assemble flange shfat and socket bolt.
· Tightening torque : 18.4 ~ 21.4 kgf·m
(133 ~ 155 lbf·ft)

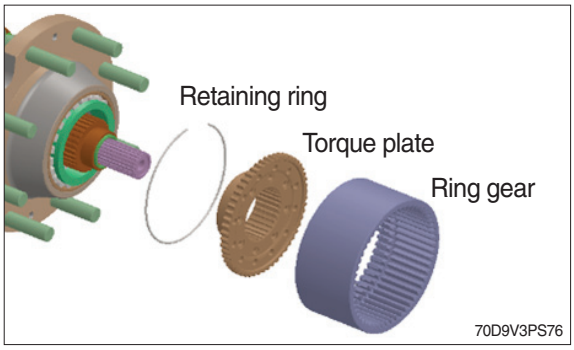
※ **Cover loctite #277 on the screw side of bolt and loctite #5127 on axle housing**




(13) Hub bearing → Hub sub assy → Hub bearing
Assemble in as above in order.




(14) Retaining ring → Torque plate → Ring gear
Assemble in as above in order.

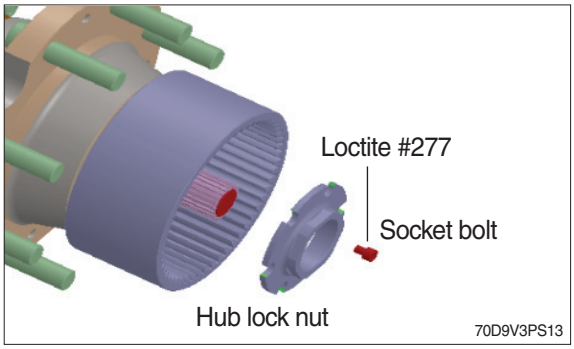



(15) Assemble hub lock nut and tighten socket bolt on hub lock nut.
· Tightening torque : 6.1 ~ 6.6 kgf·m
(44.0 ~ 47.6 lbf·ft)

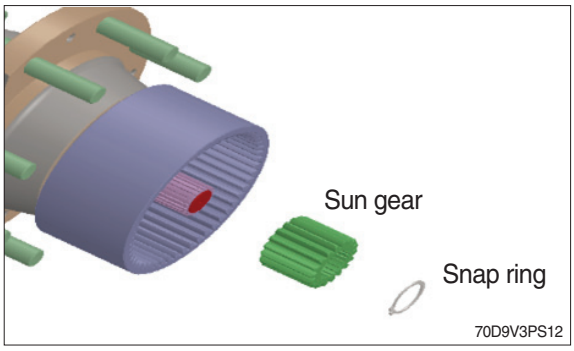
※ **Cover loctite #277 on the screw side of bolt.**

※ **Measure preload : settle down hub lock nut, hub move around each left and right 5 times and measure it.**

※ **Measured value : 1.5 ~ 3.0 kgf·m**
**(10.8 ~ 21.7 lbf·ft)**



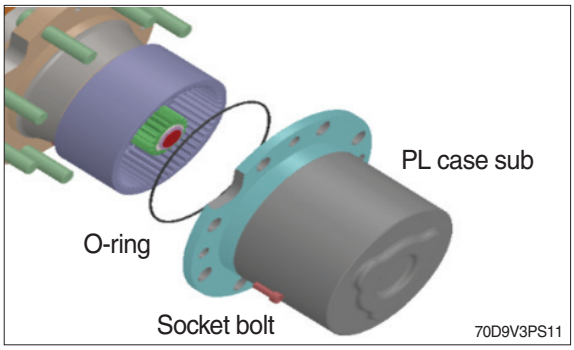
(16) Assemble sun gear and snap ring.




(17) Assemble O-ring, PL case sub, and socket bolt.

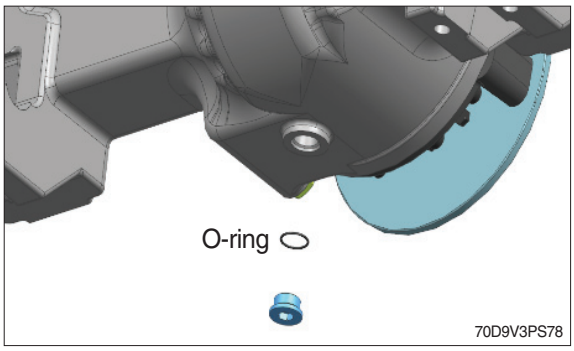
· Tightening torque : 6.1 ~ 6.5 kgf·m
(44.1 ~ 47.0 lbf·ft)

※ **Spread grease on O-ring.**



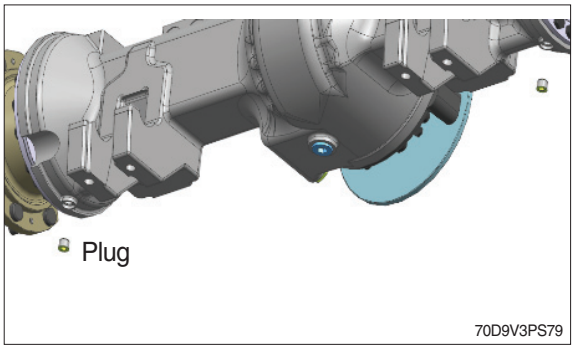

(18) Assemble O-ring and drain plug.

· Tightening torque : 4.0 ~ 5.0 kgf·m
(28.9 ~ 36.2 lbf·ft)

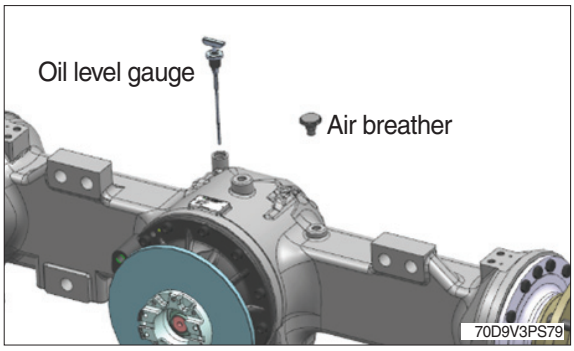



(19) Assemble plug.

· Tightening torque : 4.0 ~ 5.0 kgf·m
(28.9 ~ 36.2 lbf·ft)

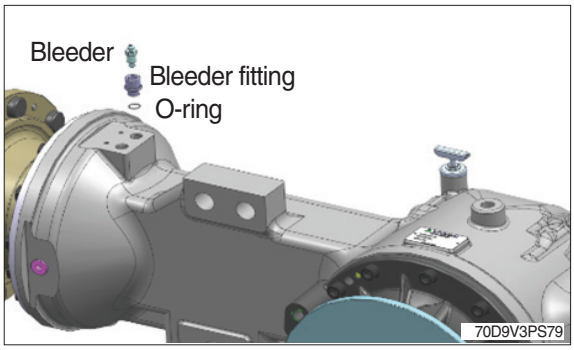


(21) Assemble oil level gauge and air breather on axle housing.

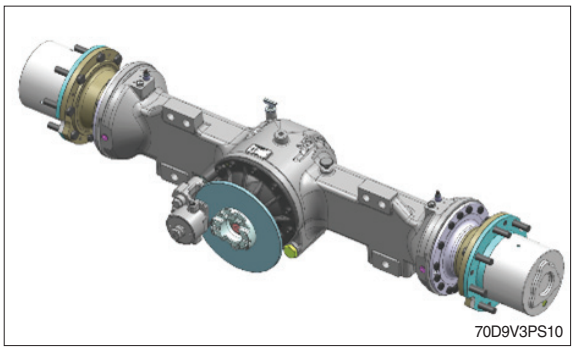



(21) Assemble O-ring, bleeder, and bleeder fitting.

· Tightening torque
- Bleeder : .4.0 kgf·m (28.9 lbf·ft)
- Bleeder fitting : 1.8 kgf·m (13.1 lbf·ft)




(22) Complete Drive axle assembly



# GROUP 3 MAINTENANCE AND TROUBLESHOOTING

## 1. MAINTENANCE

### 1) TRANSMISSION

#### (1) Recommend oils

The property that needs for auto transmission oil.

- · It has suitable viscosity at the height temperature.
- · It has suitable fluidity at the low temperature.
- · It has excellent oxidation stability.
- · It has property which remove bubble, and property of lubricant.
- · Therefore please be sure to use following the oil when you supply or change oil. In addition, please use the same oil that you supplied already.

① Oil volume is approximately 8 liters (without torque converter).

② Suggested oil : ATF (Auto Transmission oil, Dexron type)

#### (2) Point of exchange oil

**① Pulling out oil**

a. Please take off the drain plug where under of the transmission, and then discharge the old oil.

b. Please take off the hose join part, and then discharge the old oil that remained in the oil cooler and in the hose.

**※ Period of exchange oil filter : initial time 100 hr, and then every 1000 hr**

**② Oil supply**

a. Please stop the engine (ok), then refuel the oil into transmission until「HOT」level of oil level gauge.

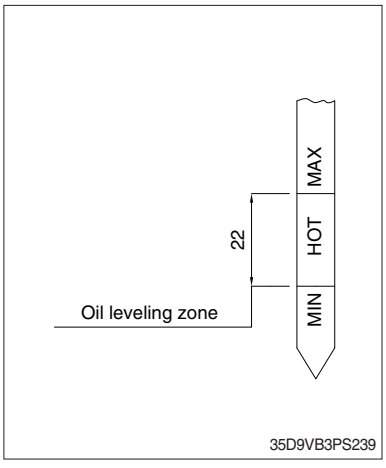
b. Please change lever "neutrality" position. Then please turn on the engine and keep low idle speed.

c. The oil reaches the hydraulic torque converter, cooler and pipe and so on, after start up the engine. Then oil level sink down.

d. Please drive the engine about 5 minutes at low idle speed, then refuel the oil gradually the oil level settle in regular position (between「MAX」and「MIN」position).

**※ Please refuel the oil carefully, without get rubbish or water and so on in the oil.**
**Lack of oil or excess of oil becomes cause of breakdown. So please be careful.**

**※ Check the oil level, when the oil temperature is 50℃ ~ 60℃.**
**Amount of all oil : about 20 liters.**



### (3) Period of overaul

① As for the overhaul, we recommend either every 5 years or 7000 hours coming early to be done as a limit.

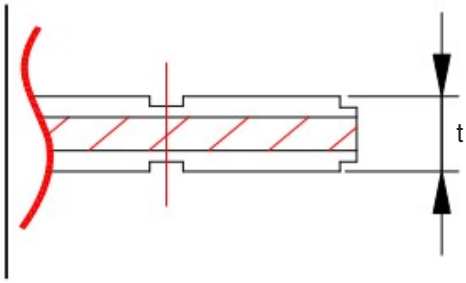
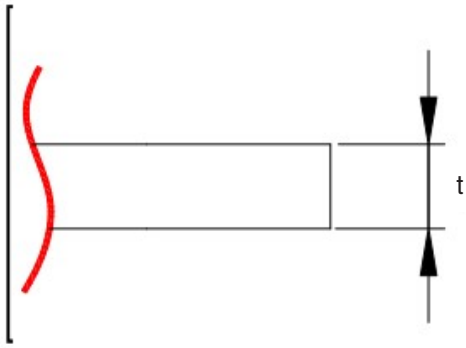
② Please change the oil seal, rubber such as o-ring, and gasket, copper gasket, if it has damaged.

③ Please check the part by your eyes which you disassembled whether they have the crack, the scar, abnormal wear and corrosion etc. If the parts have such abnormal condition, please change or repair.

④ Seal ring, snap ring, friction disc, plate → Change the part that exceeds the wear limits.

⑤ Bearing, bush → Check the bearing to see if it rotates freely. If in doubt about the wear or lack of lubrication, replace this bearing.

⑥ Gear, shaft → if it is abnormal you have to change.

| | Item in the F&R clutch | Standard | Limit |
|---|---|---|---|
| Friction disk |  | 2.06 | 1.56 |
| Plate |  | 2 | 1.85 |
| Back plate | | 4 | 3.85 |

### (4) Period of exchanging parts

| time / Item name | Item in the F&R clutch | Standard |
|---|---|---|
| Oil seal | Please change all parts. | Please change all parts at every overhaul. |
| O-ring | | |
| Gasket | | |
| Copper gasket | | |
| Oil seal ring | Please check the each part. | Please change all parts at 2nd and 4th time. |
| Seal ring race plane | | Please change the part that exceeds the wear limit. |
| Sinter plate | | |
| Stator free wheel part | | Please change the part that exceeds the wear limit.<br>Please change the abnormal leaf spring. |
| Sliding surfaces of oil seal | | Please change the part that exceeds the wear limit. |
| Sliding seciton of clutch piston | | |
| Inside diameter or bush | | |
| Each bearing | | |
| Spring | | |

### (5) Standard of exchanging parts

| Classfication | Contents | Object parts | Item name |
|---|---|---|---|
| A | The part that you should change the part to new one whenever overhauling and for check cleaning. | Gasket, Rubber | Gasket, O-ring, Copper gasket, Oil seal |
| B | The part that wear of the part is extreme comparatively, so the change time is high frequency. | Seal ring, Clutch plate | Oil seal ring, Snap ring, Friction plate&steel plate in clutch |
| C | The part that you do not have to change every overhauling but it is abnormally when overhauling you have to change the part. | Bearings, Race side of seal ring | Bearing, Bush, Part of free wheel, Seal race |
| D | The part that you usually do not have to change to new part but when if it its abnormally you have to chage. | Gear, Shaft | Each gear, Clutch shaft, Turbine shaft, Flange |

(6) Test

① **Operation check**

· Please change the change lever to 「N」 position and hold this position, then please change the engine speed from low idle to high idle, and check the below condition.

· The abnormal sound dose not occur.

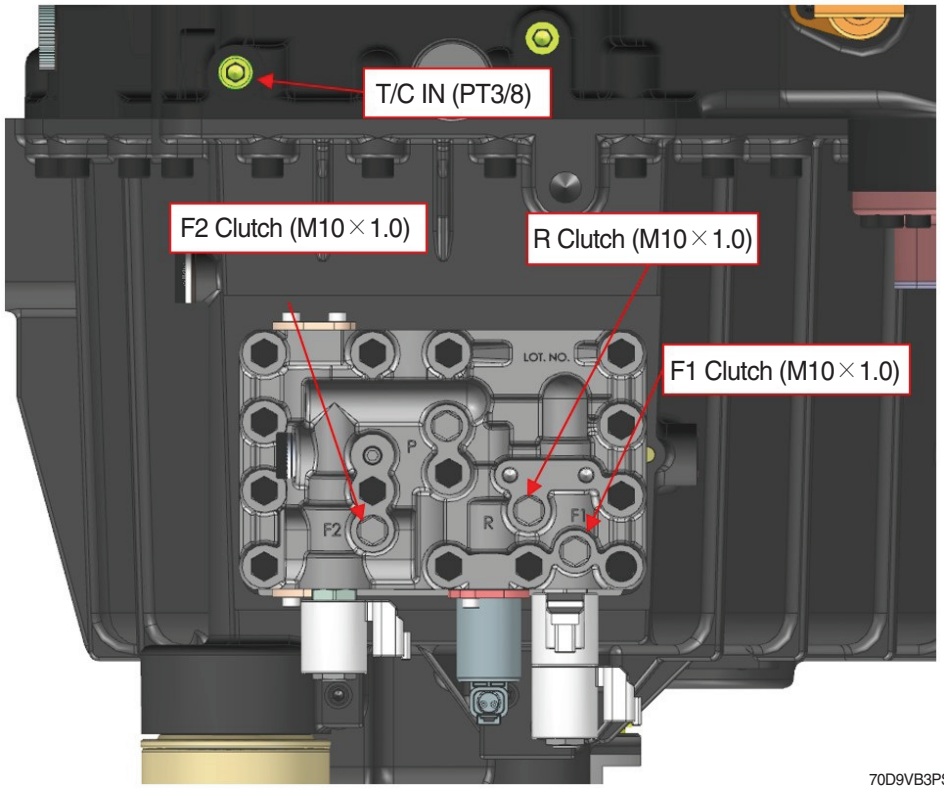
· The abnormal oscillation dose not occur.

· The oil is not leaking.

· Overheating, a strong odor of overheated oil is a major trouble sign.

② **Oil pressure measurement**

· If you measure each part pressure, remove the plug and then install the pressure gauge. (PT 3/8, M10×1.0)




a. Please warming up the engine until the torque converter oil temperature becomes about 50~60˚C.

b. Please measure the oil pressure of every required part as below under the low & high idle speed of engine.

c. When if you measure the individual pressure of clutch and pressure of lubricating. Please install the pressure gauge on the hole which take out the pressure then check the pressure while up the crane.

· Measure the oil pressure of clutch and T/C inlet at the 800 ~ 2400 rpm.

| Description | Standard (MPa) | |
|---|---|---|
| | 800 rpm | 2400 rpm |
| Main relief | 1.7±0.2 | 1.7±0.2 |
| Forward 1st | 1.7±0.2 | 1.7±0.2 |
| Forward 2nd | | |
| Reverse | | |
| T/C inlet | 0.3 ~ 0.7 | 0.3 ~ 0.7 |

③ **Stall torque output test**

· Please pay attention to the truck starts suddenly, because the torque converter generates largest torque.

※ **When the torque converter is stall condition, heat generate suddenly inside of the torque converter. So do not drive the engine when you drive over 30 seconds and the torque converter oil temperature is over 90℃.**

a. Please use the parking brake and service brake securely.

b. Please set the lever to F1 or R.

c. Please step on the accelerator pedal until limit position, then check the engine speed when the engine speed become constant.

d. Standard of engine maximum speed in stall condition is around 1,800~2,000 rpm. (depends on the standard performance of engine and torque converter)

## 2) DRIVE AXLE

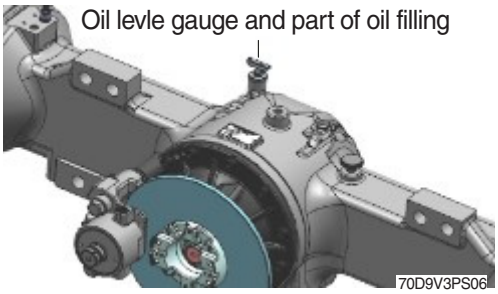
### (1) General information

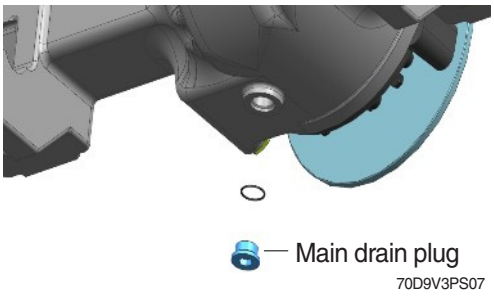
Drive axles generate small metal wear particles during operating, especially hard particles are allowed to circulate in the lubricant, along with external moisture. In these case the internal components can be more faster damaged.

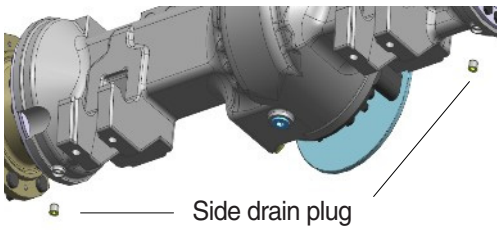
### (2) Oil level

#### ① Check and adjust oil

The part for oil filling and drain plugs are located in the axle housing.

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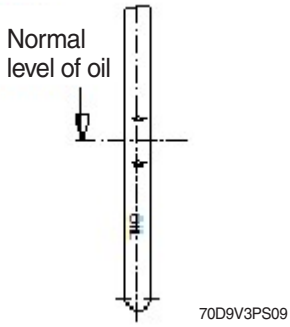
a. Park the truck on flat ground.

b. Pull out oil level gauge from axle, then check the height of oil.




70D9V3PS09

c. If the height of oil of level gauge is higher than the upper limit, drain the oil outby after loosening main drain plug, if the height of oil is lower than the lowest limit, replenish up to normal level.

② **Oil change**

⚠ **Park the truck on flat ground. Block the wheels to prevent the truck moving during maintenance. Do not work under the truck supported only jacks for safe. Because Jacks can slip and fall over.**

a. Make sure the vehicle is on level surface.

b. Raise lift of vehicle and drain oil by loosening main drain plug and 2 places of side plug.

c. After drain all oil, clean the magnetic plug.

d. Fill oil with checking the height of level with level gauge.

③ **Oil volume and available of list**

a. Oil volume is approximately 12 liters.

b. **Available oil list**

| Manufacture name | Brand name |
|---|---|
| Mobil corporation | Mobil fluid 424 |
| Sheel oil corporation | Shell spriax S4 TXM |

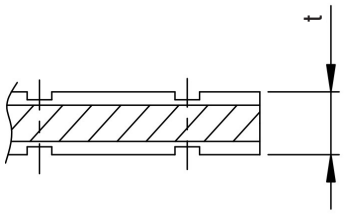
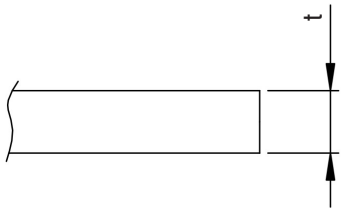
**(3) Maintenance**

① The Axle oil needs to be replaced per every 1,000 hours.

② O-ring, oil seal, rubber, gasket : Change all parts at every overhaul.

③ Check internal leakage of brake system (Brake seal) : Every 2,000 hours, replace as necessary.

④ **Disc, opposing plate : Change the part that exceeds the wear limits.**

| Item | | Part no. | Standard | Limit |
|---|---|---|---|---|
| Disc |  | HA50-60220 | t=4 | t=3.36 |
| Opposing plate |  | HA50-60200 | t=2.5 | t=2.35 |

⑤ Bearing : Check the release bearing the see if it rotates freely. If it has doubt for the wear or lack of lubrication, replace this bearing.

⑥ Gear, shaft : If the gear or shaft is damaged or in an abnormal condition, replace it.

⑦ Spring : If the springs are deformed by more than ±10% of the free length, replace the parts.

⑧ **Oil exchange and level check cycle**

| First time | 100 hours after deliver |
|---|---|
| Check oil level | Every 250 hours |
| Regular exchange | Every 1000 hours (at least once a year) |

## 2. TROUBLESHOOTING

### 1) TRANSMISSION

#### (1) Output does not go up

| Locating fault and cause | | | Measures |
|---|---|---|---|
| Engine | The engine speed is abnormal. | | When the gear is neutral position and torque converter is stall state, please measure the engine speed. Then if the engine speed does not become proper speed, please adjust the engine or repair it. (Please refer to page of stall test.) |
| Torque converter | Torque converter oil | The oil is in short supply. | Please replenish oil. |
| | | The oil that is not regulated is used. | Please change the oil to regular oil. |
| | | The air has mixed into oil. | Please tighten each joint coupling and the pipe further. |
| | | The air bubble occurs because the torque converter pressure decrease. | Please check and adjust the torque converter pressure. |
| | | The water has mixed into oil. | Please check the cooler, and change all oil. |
| | | The oil filter is clogging. | Please wash the oil filter of change it. |
| | Main body of torque converter | The stator free wheel is broken. | Please change the stall revolution then if the revolution is extremely low, please change the free wheel inner race, free wheel cam and roller. |
| | | The stator free wheel is sticking. | Please check the rise of the temperature of oil at no load. And please change the free wheel inner race, free wheel cam and roller when the temperature of oil rises abnormally. |
| | | The wheel with blades is broken or it is touching other components. | Please check whether the aluminum powder and the like has mixed into torque converter oil. Please change the wheel with baldes if the aluminum powder and the like has mixed in. |
| | Charging pump | The pump dose not operates normally. | Please change the pump. |
| Transmission | Control valve assy | The clutch oil pressure has decreased because the spring is settling or break. | Please change the spring. |
| | | The valve does not move with the valve opens. | Please repair or change the valve. |

### (2) Power is not transmitted

| Locating fault and cause | | | Measures |
|---|---|---|---|
| Torque converter | The input plate wheel is broken. | | Please change the input plate. |
| | The oil is in short supply. | | Please replenish oil. |
| | The shaft and spline are worn. | | Please change the shaft and the spline. |
| | The gear is broken. | | Please change the gear. |
| | The charging pump does not operate normally. | | Please change the charging pump. |
| Transmission | Torque converter oil | The oil is in short supply. | Please replenish oil. |
| | Clutch assembly | The clutch plate is worn and broken. | Please change the clutch plate. |
| | | The clutch plate is sticking. | Please change the clutch plate. |
| | | The clutch shaft spline is worn. | Please change the clutch shaft spline. |
| | | The clutch pressure has decreased because the shaft end of the clutch and the oil seal ring of the clutch piston do not operate normally. | Please change the clutch assembly. |
| | Output shaft | The shaft spline is worn. | Please change the part which has worned spline. |
| | | The gear is broken. | Please change the gear. |
| | Solenoid valve | The solenoid valve is broken. | Please change the solenoid. |
| | | Spool does not operate normally. | Please change the solenoid valve. |

### (3) Oil temperature rises abnormally

| Locating fault and cause | | | Measures |
|---|---|---|---|
| Torque converter | Main body of torque converter | The device of stator free wheel is broken. | Please check the stall speed, and then if the speed is out of regular valve, please change the stator assembly to new part. |
| | | The wheel with blades are touching each other. | If the foreign material (the aluminum powder and the like) has entered in torque converter oil, please change the wheel with blades to new one. |
| | | The bearings are worn or sticking. | Please repair the bearings or change them. |
| | Torque converter oil | Amount of oil is not appropriate. | Please check the oil level. |
| | | The oil that is not regulated is used. | Please change the oil to regular oil. |
| | | The air has mixed into oil. | Please tighten each joint coupling and the pipe further. |
| | | The water has mixed into oil. | Please check the cooler and change the all oil. |
| | The piping resistance is large | The hose is bending, or it is broken. | Please repair the hose or change it. |
| | | The oil cooler is sticking. | Please wash the oil cooler or change them. |

| Locating fault and cause | | | Measures |
|---|---|---|---|
| Transmission | The clutch is dragging | The clutch plate is sticking. | Please change the clutch plate. |
| | | The clutch piston does not operate normally. | Please repair the clutch piston or change it. |
| | | The pressure of clutch has decreased. | Please check the clutch pressure. |
| | The bearings are worn or sticking. | | Please change the bearings. |

### (4) Clutch or converter oil pressure is too high

| Locating fault and cause | | | Measures |
|---|---|---|---|
| Torque converter | Hose of outlet side is bending, and the hose is broken and the oil cooler is clogging. | | Please repair or change the hose and oil filter, cooler |
| | Viscosity of oil is too high. (At cold time) | | Please warm up the torque converter if the temperature of torque converter oil is below outside air temperature. |
| | The oil that is not regulated is used. | | Please change the oil to regular oil. |
| Transmission | Control valve assembly | The valve does not operate normally because spring is broken or spools are sticked in the valve. | Please repair the valve assembly or change to new one. |

### (5) Clutch or converter oil pressure is too low

| Locating fault and cause | | | Measures |
|---|---|---|---|
| Transmission | The oil is in short supply. | | Please replenish oil. |
| | The oil that is not regulated is used. | | Please change the oil to regular oil. |
| | The charging pump is worn and broken. | | Please change the charging pump. |
| | The oil seal ring or o-ring is worn or damaged. | | Please change the oil seal ring or the o-ring. |
| | The filter is clogging. | | Please wash the oil filter or change it. |
| | control valve assembly | The spring is settling, and broken. | Please change the spring. |
| | | The valve does not move with the valve opens. | Please repair the valves or change it. |
| | | The restriction is clogging. | Please wash the restriction. |
| | Clutch part | The end of the shaft and the seal ring of the clutch piston are damaged. | Please change the clutch piston. |

### (6) Noise occurs

| Locating fault and cause | | Measures |
|---|---|---|
| Torque converter | The input plate is broken. | Please change the input plate. |
| | The bearing is broken or bearings are worn. | Please change the bearing. |
| | The gear is broken. | Please change the gear. |
| | The wheel with blades are touching each other. | Please change the wheel with blades. |
| | The bolt and rivet are loosen or broken. | Please repair the bolt and rivet or change it. |
| | The spline is worn. | Please change the part which has worned spline. |
| | The pump does not operate normally. | Please change the pump. |
| Transmission | The clutch is sticking and dragging. | Please change the clutch. |
| | The bearings are sticking and worn. | Please change the bearing. |
| | The gear is broken. | Please change the gear. |
| | The spline is worn. | Please change the spline. |
| | The bolt is loosen or broken. | Please repair the bolt or change it. |

### (7) Shinfting is impossible

| Locating fault and cause | | Measures |
|---|---|---|
| Transmission | The clutch plate is sticking. | Please change the clutch plate. |
| | The solenoid valve does not operate normally. | Please repair the solenoid valve or change it. |
| | The gear is broken. | Please change the gear. |

## 2) DRIVE AXLE

### (1) Noise and vibration

| Locating fault and cause | | Measures |
|---|---|---|
| Drive axle | Shortage of oil | Check oil level or refill lubricating oil. |
| | Inappropriate oil | Replace the oil. |
| | Damaged wheel bearing | Replace the wheel bearing. |
| | Damaged ring gear and pinion shaft | Replace the ring gear and pinion shaft. |
| | Loosened or worn bearing of pinion shaft | Disassemble, check or replace the bearing. |
| Differencial | Loosened bolt for assembling ring gear | Disassemble, check and reassemble the ring gear. |
| | Damaged ring gear | Replace the ring gear. |
| | Loosened or worn differencial bearing | Disassemble, check, reassemble or replace the differencial bearing. |
| | Damaged bevel gear bearing | Replace the bevel gear bearing. |
| | Worn or damaged diff pinion and side gear. | Replace the diff pinion and side gear. |
| | Worn or damaged thrust washer. | Replace the thrust washer. |
| | Excessive backlash of diff pinion and side gear. | Replace the diff pinion and side gear. |
| Brake | Incorrect axle fluid and/or friction material used | Use only meritor specified or approved materials. |
| | | Drain and flush fluid from axle. Replace with approved fluid. |
| | | Replace all friction discs. Throughly clean or replace stationary discs. |

### (2) Oil leakage

| Locating fault and cause | | | Measures |
|---|---|---|---|
| External leakage | Excess supply of oil | | Check oil level. set of oil amount. |
| | Inappropriate oil | | Replace the oil. |
| | Blocking air breather | | Cleaning, replace the air breather |
| | Damaged hub oil seal | | Replace the hub oil seal. |
| | Worn or damaged bevel pinion shaft oil seal | | Replace the oil seal. |
| | Loosened bleeder screw | | Tighten bleeder screw. |
| | Losened brake inlet fitting and plugs | | Tighten brake inlet fitting. |
| | Damaged brake inlet fitting, plug and o-ring | | Replace the brake inlet fitting, plug and o-ring. |
| Brake | Internal leak : Fluid bypasses seals into axle and fills axle with fluid and blows out breather or empties brake fluid reservoir. | Worn or damaged piston seal | Replace the piston seals. |
| | | Melted or extruded piston seals | Correct cause of overheating and replace seals. |
| | | Corrosion, pitting, wear or other damage, marks scratches to piston and/or brake housing bore in area of seal/sealing lips | Clean, smooth, rework or replace affected parts. |
| | External leak | Loosened bleeder screw | Tighten bleeder screw to 2 ~ 2.7 kgf·m (14.5 ~ 19.6 lbf·ft). |
| | | Loosened inlet fitting or plugs | Tighten inlet fitting to 3.4 ~ 4.8 kgf·m (24.7 ~ 34.8 lbf·ft). |
| | | Damaged inlet fitting or plugs or damaged seats | Replace inlet fitting or plug and o-ring if used. |

### (3) Service brake

#### ① Brake overheats.

| Locating fault and cause | | Measures |
|---|---|---|
| Overheating due to excessive duty cycle | Inadequate coolant flow or heat exchange | Install brake cooling system if not already installed on truck. |
| | | Re-analyze and re-size brake cooling system if necessary. |
| Inadequate coolant flow | Low pump output, blocked filter or coolant lines | Check pump output at different operating modes. Replace filter and check lines. |
| Low or no coolant | Improper fill or leaks | Check for proper fill level. |
| | leaking face seal | Replace or reinstall face seal assembly. |
| | Loosened or damaged plugs. | Tighten drain, fill or forced cooling plug. Replace if damaged. |
| | Deteriorated or inadequate sealant used at joint. | Disassemble, clean, re-seal and re-assemble bake housing joint. |
| Brake drags | More than 0.14 MPa pressure applies when brakes released. | Repair hydraulic system so pressure is less than 0.14 MPa when brakes released and while machine is operating in any mode. |
| | Damaged piston return spring assy | Repair or replace for piston return spring assy. |
| | Piston not returning | Check piston seals and seal separator. |
| | Wrong cooling and/or actuation fluid used. | Check piston seals and seal separator for swelling or damaged. Replace as necessary. Purge system and use correct fluid. |
| | Tighten or damaged splines (ex. friction disc-to-hub driver) | Repair or replace parts. |

#### ② Brake does not apply.

| Locating fault and cause | | Measures |
|---|---|---|
| Low or no pressure to brake | Empty fluid reservoir | Fill reservoir to correct level with specified fluid. |
| | Damaged hydraulic system | Repair hydraulic system. |
| | Leaked of brake actuation fluid | Refer to "brake leaks actuation fluid" in this manual. |
| | Parking brake not adjust properly | Adjust parking brake swtich as described in assy of this manual. |

### ③ Brake does not release.

| Locating fault and cause | | Measures |
|---|---|---|
| Truck does not move. | Damaged hydraulic system | Repair hydraulic system. |
| Brakes dragging | More than 0.14 MPa pressure applied when brakes released. | Repair hydraulic system so pressure is less than 0.14 MPa when brakes released and while machine is operating in any mode. |
| | Damaged piston return spring assy | Repair or replace piston return spring assy. |
| | Piston not returning. | Check piston seals for swelling or damage. Replace as necesary. |
| | Wrong cooling and/or actuation fluid used | Check piston seals for swelling or damage. Purge system and use specified fluid. |
| | Parking brake not adjusted prorerly | Adjust parking brakeing lever as described in assy of this manual. |

### ④ Braking performance

| Locating fault and cause | | Measures |
|---|---|---|
| Noticeable change or decrease in stopping performance. | Inadequate actuation fluid supply to brakes | Replenish fluid in brake system. Check for leakge and correct cause. |
| | Inadequate pressure to apply brakes | Check brkaes apply system. Check for leakage in brake system or brakes, and correct cause. |
| | Worn or damaged discs | Inspect and replace discs if necssary. |
| | | ※ **As disc wear occurs, make sure brake system can supply adequate fluid to fully apply brakes.** |
| | Overheated seals and/or discs | Inspect and replace discs and seals if necessary. |
| Brake does not fully apply. | Dirty or contaminated cooling fluid. | Drain and flush cooling fluid from brakes and entire brake system. Replace with approved fluid. In some case, it may necessary to replace discs. Clean or replace filter. |
| Brake does not fully apply. | Empty fluid reservoir. | Fill reservoir to correct level with specified fluid. |
| | Damaged hydraulic system | Repair hydraulic system |
| | Leakage of brake actuation fluid. | Refer to "brake leaks actuation fluid" in this manual. |
| Brake fell spongy/soft | Brakes or brake system not proerly bled. | Bleed brakes and brake system. |

# SECTION 4 BRAKE SYSTEM

Group 1 Structure and Function ····· 4-1
Group 2 Operational Checks and Troubleshooting ····· 4-18
Group 3 Tests and Adjustments ····· 4-20
Group 4 Disassembly and reassembly ····· 4-23

# SECTION 4 BRAKE SYSTEM

## GROUP 1 STRUCTURE AND FUNCTION

### 1. OUTLINE

※ The brakes are operated by a pressure compensated, closed center hydraulic system.
Flow is supplied by a fixed displacement, gear type brake pump.

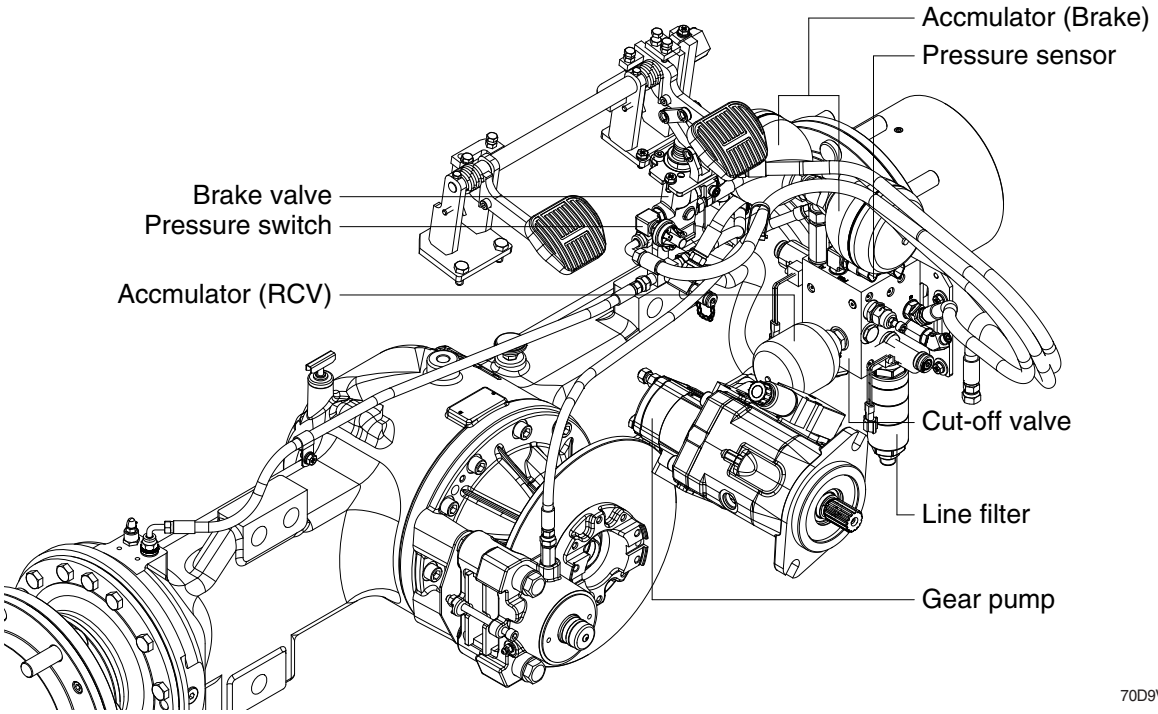
#### 1) SERVICE BRAKE SYSTEM

The fixed displacement brake pump supplies flow to the cut-off valve for service brake circuit. It flows to two accumulator. The accumulator has a gas precharge and an inlet check valve to maintain a pressurized volume of oil for reserve brake applications. Oil through the accumulator flows to the brake valves. The brake valve is a closed center design, single circuit operated by a pedal. The brake system contains the following components:

- Gear pump
- Cut-off valve, Line filter, Accumlators, Prssure sensor
- Brake valve, Prssure switch

#### 2) PARKING BRAKE SYSTEM

In the parking brake system, turn parking brake switch ON, the parking brake solenoid valve in the cut off solenoid valve is de-energized and the valve open the drain port.
At the same time, the hydraulic oil in the parking brake return to the tank through the solenoid valve. When the piston is returned by the force of the spring, the parking brake is applied.

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### 3) FULL POWER HYDRAULIC BRAKE SYSTEM

ADVANTAGES - The full power hydraulic brake system has several advantages over traditional brake actuation systems. These systems are capable of supplying fluid to a range of very small and large volume service brakes with actuation that is faster than air brake systems. Figure represents a time comparison between a typical air/ hydraulic and full power hydraulic brake actuation system.

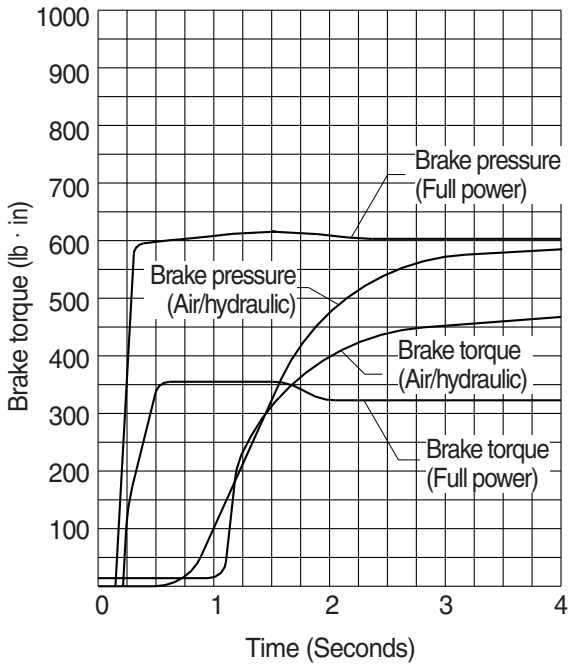
Full power systems can supply significantly higher brake pressures with relatively low reactive pedal forces. The reactive pedal force felt by the operator will be proportional to the brake line pressure being generated. This is referred to as brake pressure modulation.

Another key design feature of full power systems is the ability to control maximum brake line pressure. In addition, because these systems operate with hydraulic oil, filtration can be utilized to provide long component life and low maintenance operation.

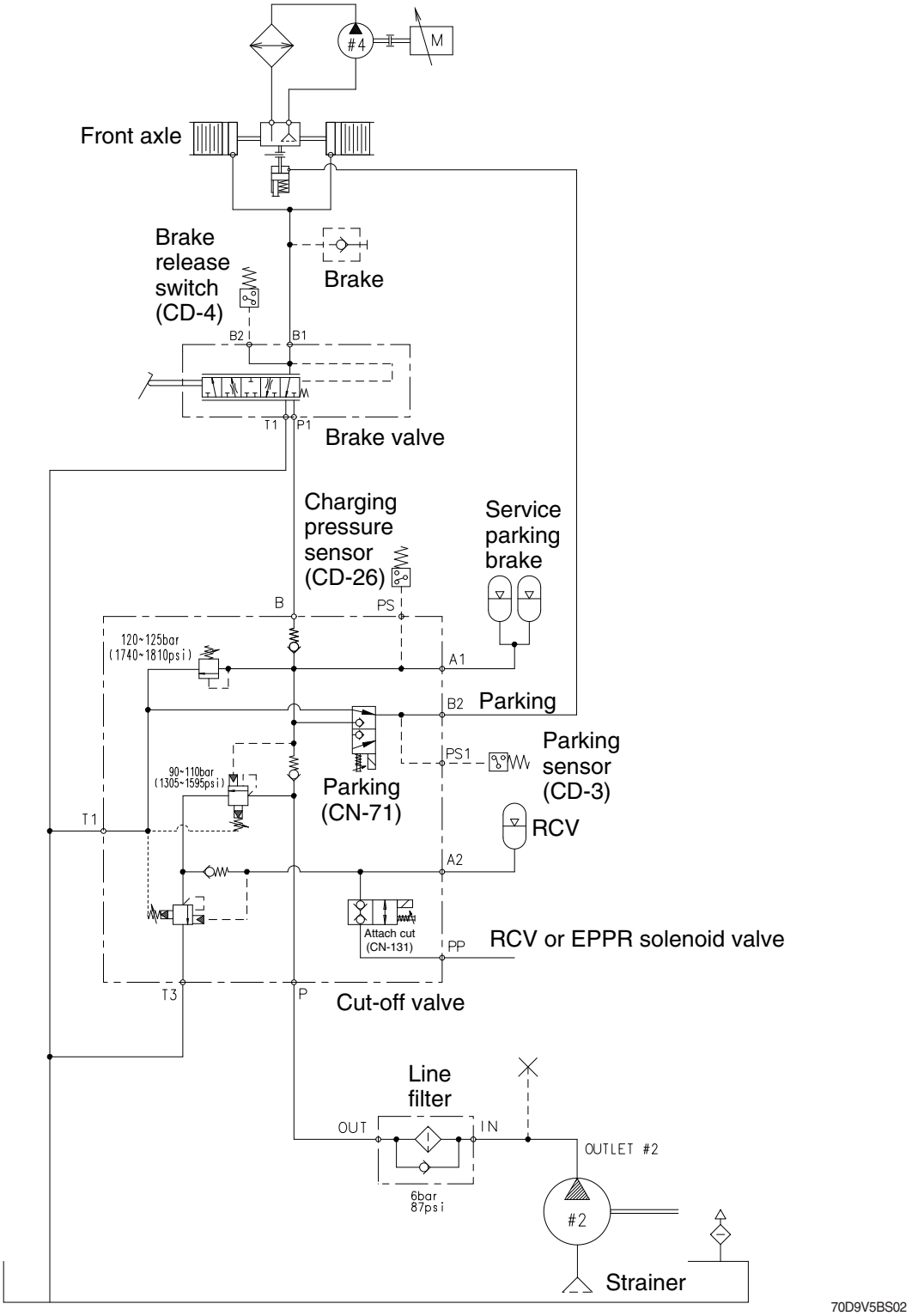
Because these systems are closed center, by using a properly sized accumulator, emergency power-off braking that is identical to power-on braking can be achieved. These systems can be either dedicated, where the brake system pump supplies only the demands of the brake system or non-dedicated, where the pump supplies the demands of the brake system as well as some secondary down stream hydraulic devise.

Another important note is that all seals within these system must be compatible with the fluid medium being used.

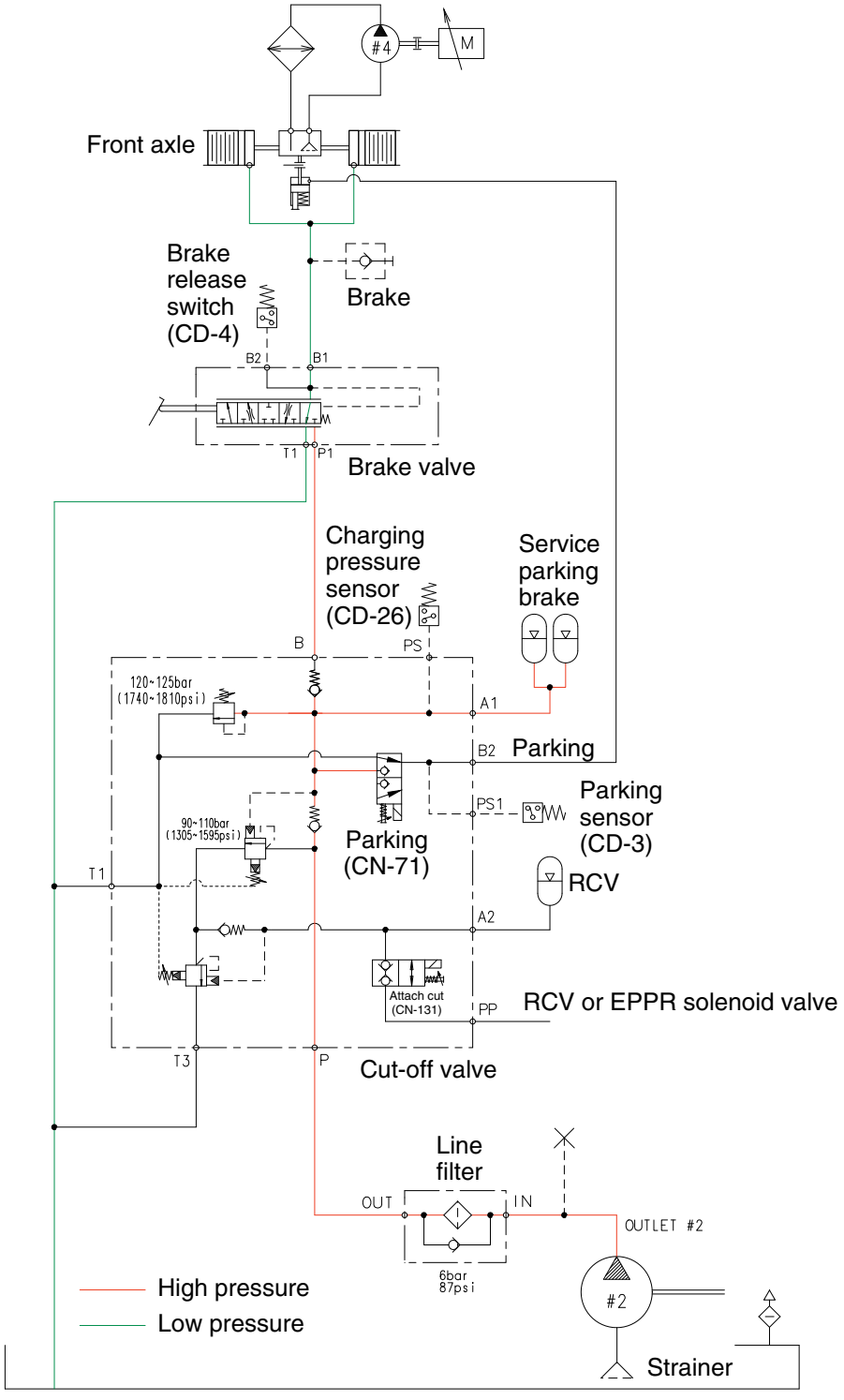
**Response time**
**Full power brake actuation VS**
**Air/Hydraulic brake actuation**



## 2. HYDRAULIC CIRCUIT



## 1) SERVICE BRAKE RELEASED

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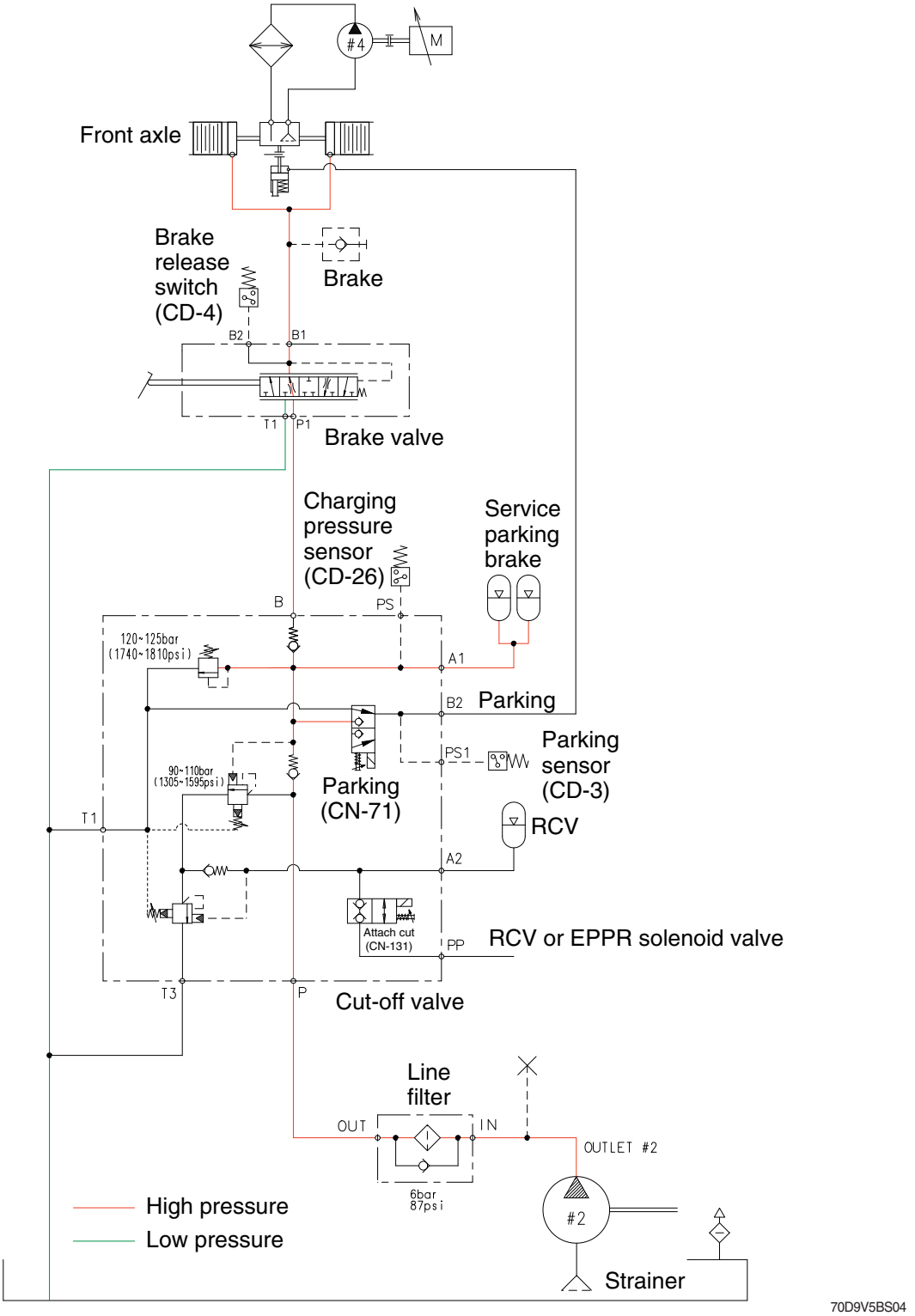
When the pedal of brake valve is released, the operating force is eliminated by the force of the spring, and the spool is returned.

When the spool removes up, the drain port is opened and the hydraulic oil in the piston of axles return to the tank.

Therefore, the service brake is kept released.

## 2) SERVICE BRAKE OPERATED

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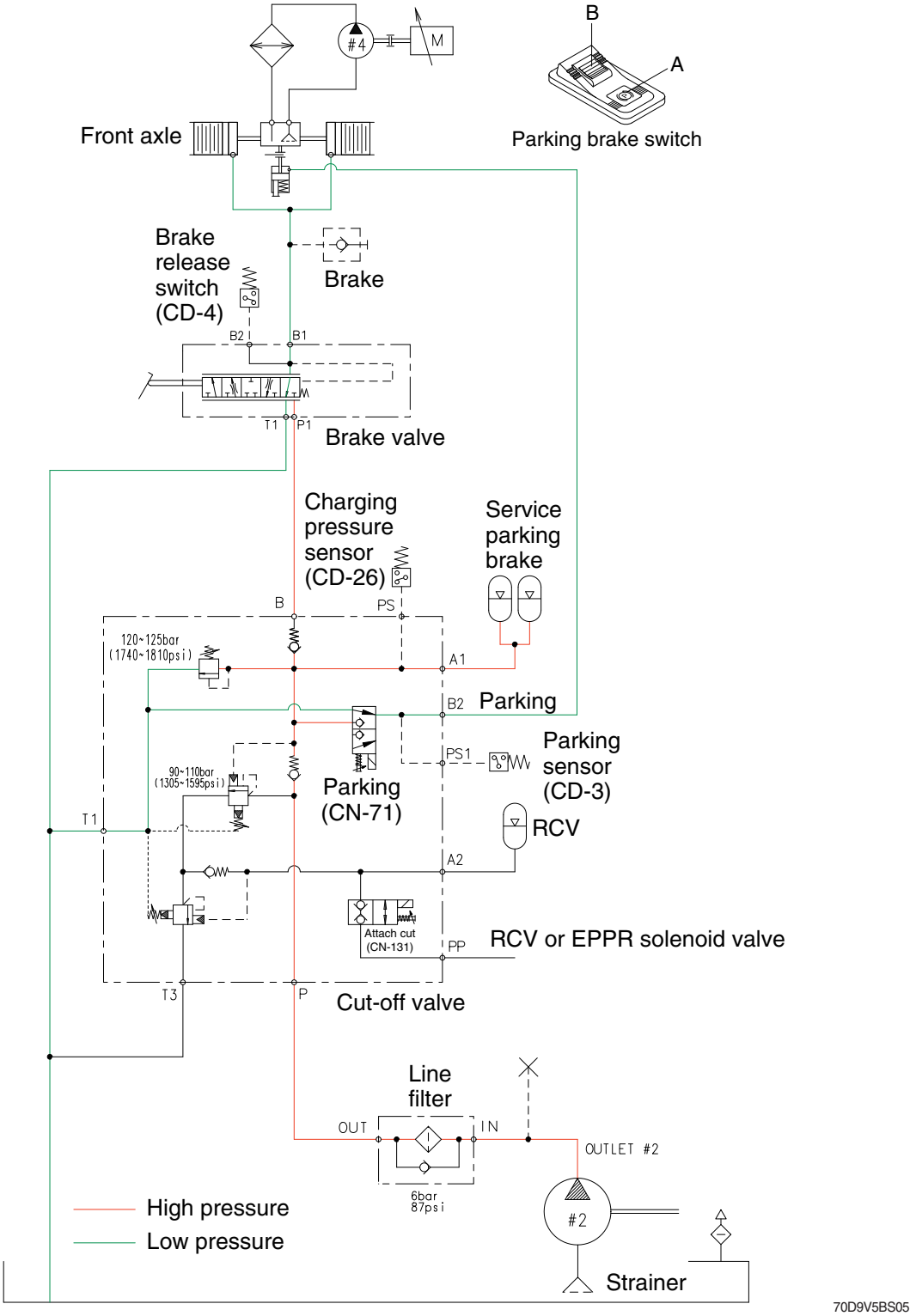
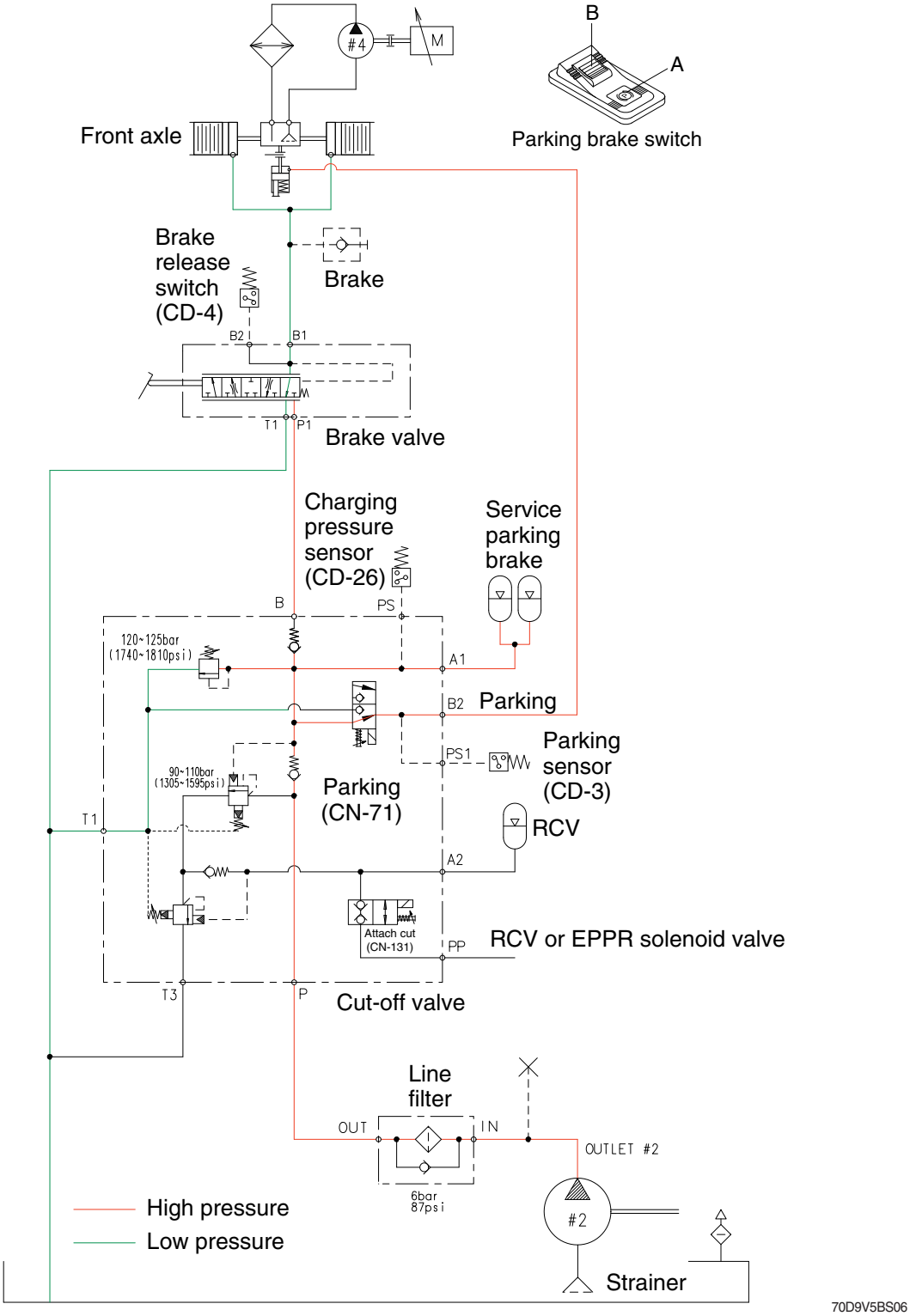
When the pedal of brake valve is depressed, the operating force overcomes the force of the spring, and is transmitted to the spool. When the spool moves down, the inlet port is opened, and at the same time the hydraulic oil controlled the pressure level by the cut-off valve enters the piston in the front and rear axles. Therefore, the service brake is applied.

### 3) PARKING BRAKE RELEASED




When the parking brake switch is pressed B position, the solenoid valve is energized and the hydraulic oil controlled the pressure level by the cut-off valve enters the parking brake. It overcomes the force of the spring and pushes the parking brake piston. This releases the parking brake.
Therefore, the hydraulic oil pressure is applied to the parking brake piston through the solenoid valve and the parking brake is kept released.

## 4) PARKING BRAKE OPERATED

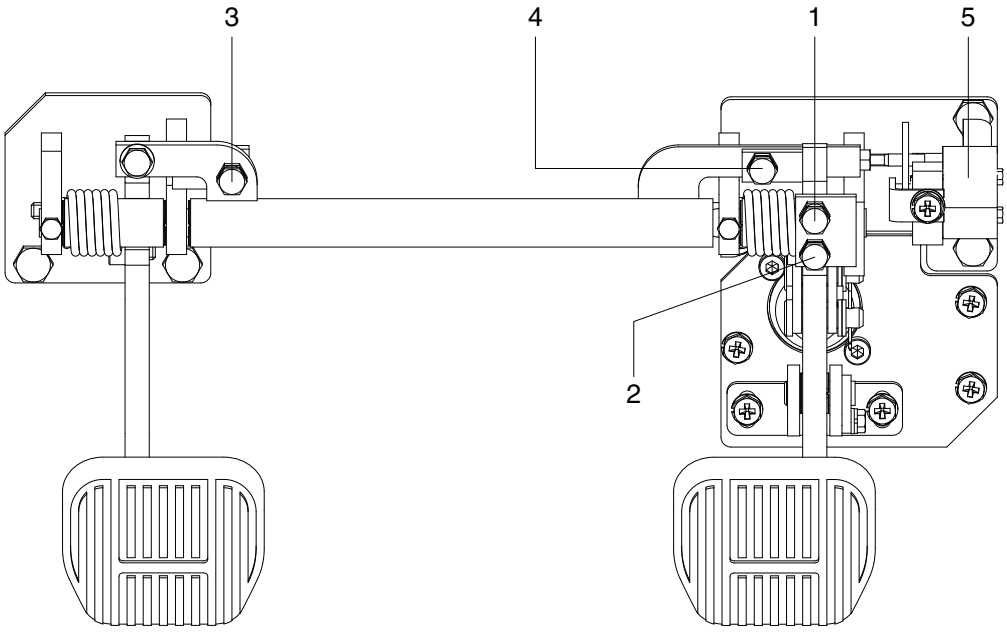



When the parking brake switch is pressed A position, the solenoid valve is de-energized and the valve open the drain port.

At the same time, the hydraulic oil in the parking brake return to the tank through the solenoid valve. When the piston is returned by the force of the spring, the parking brake is applied.

## 3. 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.



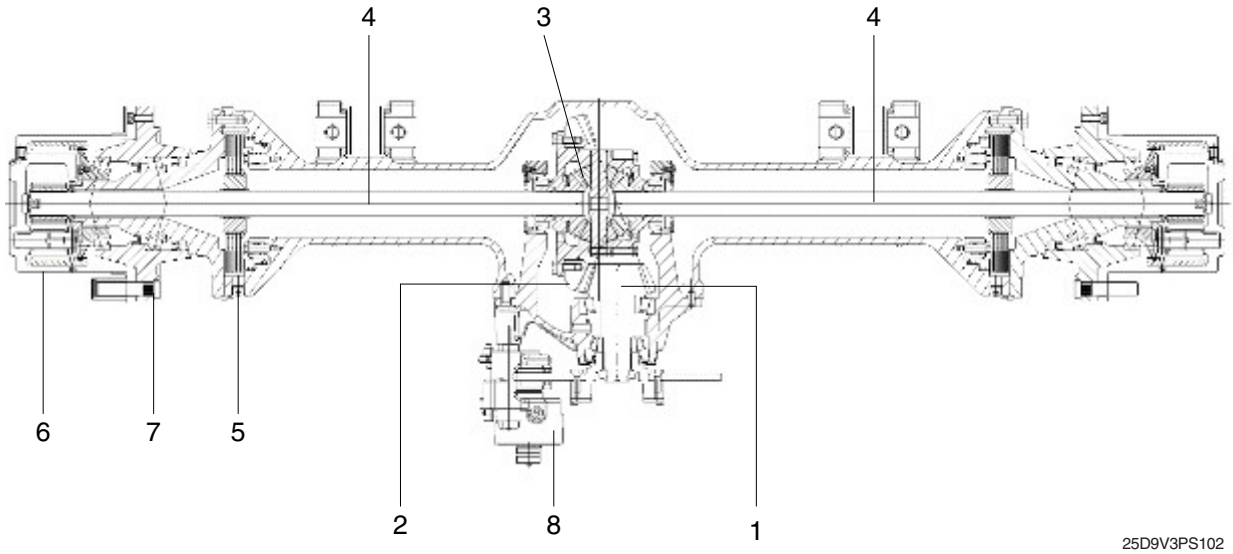

| | | | | | |
|---|---|---|---|---|---|
| 1 | Brake stopper bolt | 3 | Inching stopper bolt | 5 | Inching sensor |
| 2 | Brake storke limit bolt | 4 | Brake&inching pedal interlock bolt | | |

### 1) INITIALIZING THE INCHING SENSOR

Refer to the page of the cluster setting.

## 4. DISK BRAKE

### 1) STRUCTURE

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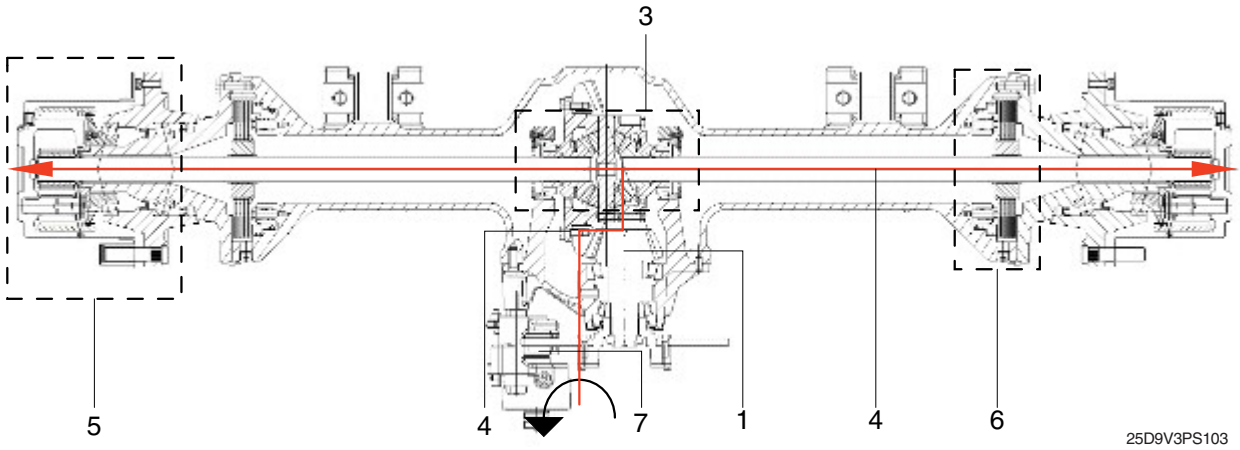
| | | | | | |
|---|---|---|---|---|---|
| 1 | Pinion shaft | 4 | Axle shaft | 7 | Hub |
| 2 | Ring gear | 5 | Service brake | 8 | Parking brake |
| 3 | Differential device | 6 | Hub reduction | | |

### 2) OPERATION

The drive axle is connected with the transmission output gear by drive shaft assembly. The power transferred by the drive shaft assembly is connected to the pinion shaft of drive axle, the pinion shaft delivers the power to the differential device through the ring gear. The differential device deliver the power to hub reduction through axle shaft.

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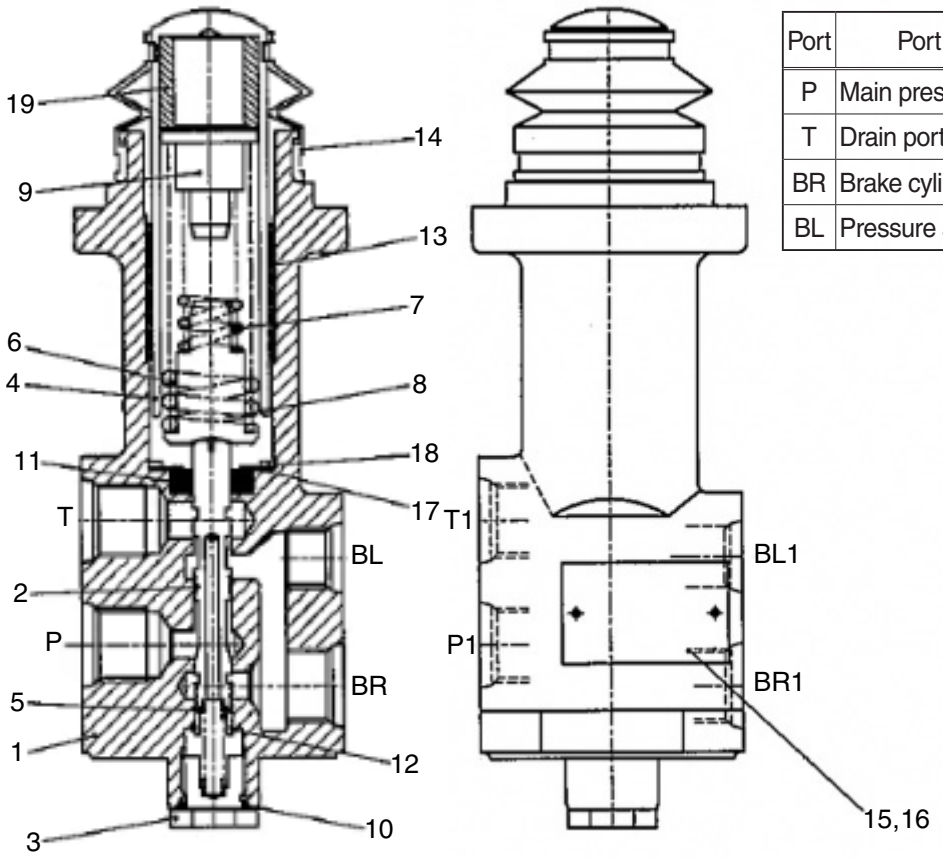
| | | | | | |
|---|---|---|---|---|---|
| 1 | Pinion shaft | 4 | Axle shaft | 7 | Parking brake |
| 2 | Ring gear | 5 | Hub reduction | | |
| 3 | Differential device | 6 | Service brake | | |

## 5. BRAKE VALVE

### 1) STRUCTURE




| Port | Port name | Port size |
|---|---|---|
| P | Main pressure port | PF 3/8 |
| T | Drain port | PF 3/8 |
| BR | Brake cylinder port | PF 3/8 |
| BL | Pressure switch port | PF 1/4 |

70D9V5BS07

| | | | | | |
|---|---|---|---|---|---|
| 1 | Body | 8 | Retainer spring | 15 | Name plate |
| 2 | Spool | 9 | Retainer spring | 16 | Drive screw |
| 3 | Plug | 10 | O-ring | 17 | Plate washer |
| 4 | Brake holder | 11 | Oil seal | 18 | Snap ring |
| 5 | Lower spring | 12 | Snap ring | 19 | Spacer |
| 6 | Main spring | 13 | Du bushing | | |
| 7 | Reatiner spring | 14 | Rubber cover | | |

**(1) Purpose**

The purpose of the brake valve is to sensitively increase and decrease the braking pressure when the brake pedal is actuated.

**(2) Ready position**

A connection is established between ports (BR) and ports (T) so that the wheel brakes ports (BR) are pressureless via the returns ports (T).

**(3) Partial braking**

When the brake valve is actuated, an amount of hydraulic pressure is output as a ratio of the foot force applied.

The main spring (6) beneath pedal plate (12) is designed in such a way that the braking pressure changes depending on the angle. In the lower braking pressure range, the machine can be slowed sensitively.

When the braking process is commenced, the spool (2) is mechanically actuated via main spring (6). As spool (2) move downward, they will first close returns (T) via the control edges, thus establishing a connection between accumulator ports (P) and ports (BR) for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spool (2) is held in the control position by the force applied (Spring assembly above the spool).
After output of the braking pressure, spool (2) is in a partial braking position, causing ports (P) and ports (T) to close and holding the pressure in ports (BR).

**(4) Full braking position**

When pedal is fully actuated, end position of the brakes is reached and a connection established between accumulator ports (P) and brake cylinder ports (BR). Returns (T) are closed at this point.

When the braking process is ended, a connection is once again established between brake cylinder ports (BR) and return ports (T), closing accumulator ports (P).

**(5) Installation requirements**

Return lines (T) must be connected directly to the tank.
The connecting lines must be installed is such a way as to permit proper bleeding.

**(6) Maintenance of the brake valve**

No special maintenance beyond the legal requirements is necessary.

When using high-pressure cleaners on the machine, please make sure that the water jet is not aimed directly at the brake valve (To prevent damaging the bellows).

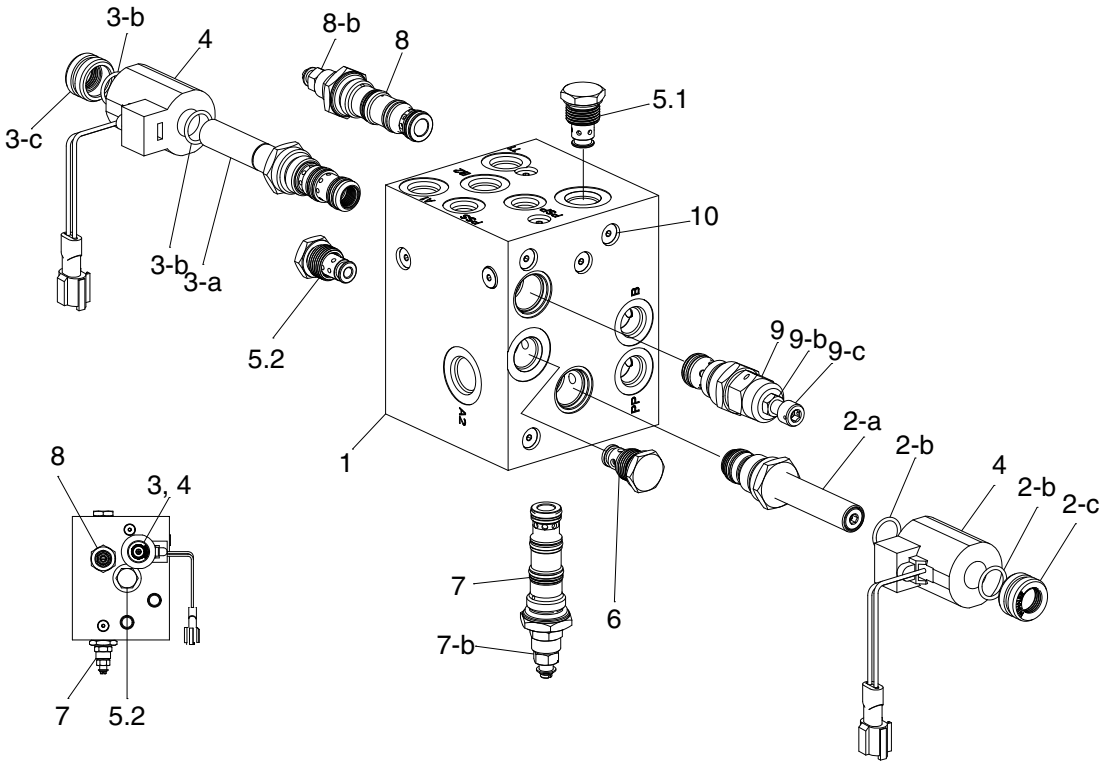
△ **For safety reasons the whole of the brake valve must be replaced if parts other than those listed above are damaged.**

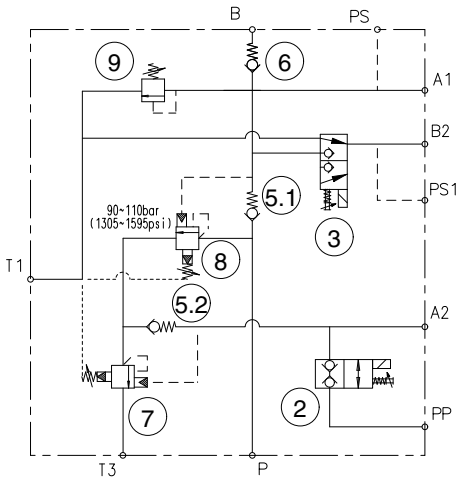
**(7) Repair work**

△ **When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine is switched off there will be some residual pressure in the system.**
**When doing repair work, make sure your environment is very clean.**
**Immediately close all open ports on the components and on pipes using plugs.**

## 6. CUT-OFF VALVE

### 1) STRUCTURE




Hydraulic circuit

| Port | Thread | Tightening torque | |
|---|---|---|---|
| | | kgf·m | lbf·ft |
| A2 | PF 1/2 | 6.1 | 44.1 |
| P, A1, B, B2, T1, T3 | PF 3/8 | 5 | 36.2 |
| PS, PS1 | 9/16-18 UNF | 3 | 21.7 |

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| No. | | Part name | Hex. (mm) | Tightening torque | | Remark (bar) |
|---|---|---|---|---|---|---|
| | | | | kgf·m | lbf·ft | |
| 1 | | Manifold | - | - | | - |
| 2 | a | Solenoid valve (RCV) | 27 | 5.0 ± 0.6 | 36.9 ± 4.4 | Attach (RCV) |
| | b | O-Ring (2 EA) | - | - | | |
| | c | Cap | | 0.6 ± 0.1 | 4.4 ± 0.7 | |
| 3 | a | Solenoid valve (parking) | 27 | 5.0 ± 0.6 | 36.9 ± 4.4 | Parking |
| | b | O-Ring (2 EA) | - | - | | |
| | c | Cap | - | 0.6 ± 0.1 | 4.4 ± 0.7 | |
| 4 | | 12V Coil (2 EA) | - | - | | 12V |
| 5 | | Check valve (2 EA) | 22 | 3.8 ± 0.25 | 28 ± 1.8 | - |
| 6 | | Check valve | 22 | 3.8 ± 0.25 | 28 ± 1.8 | - |
| 7 | a | Cut-off valve (RCV) | 27 | 4.8 ± 0.25 | 35.4 ± 1.8 | Set pressure (OFF : 40 ~ 45, ON : 25 ~ 30) |
| | b | Lock nut | 13 | 1.0 ± 0.1 | 7.4 ± 0.7 | |
| 8 | a | Cut-off valve (brake) | 27 | 4.8 ± 0.25 | 35.4 ± 1.8 | Set pressure (OFF : 105 ~ 110, ON : 90 ~ 95) |
| | b | Lock nut | 13 | 1.0 ± 0.1 | 7.4 ± 0.7 | |
| 9 | a | Relief valve | 27 | 4.8 ± 0.25 | 35.4 ± 1.8 | System (120 ~ 125) |
| | b | Lock nut | 13 | 1.0 ± 0.1 | 7.4 ± 0.7 | |
| | c | Screw | SW 6 | - | | - |
| 10 | | Plug (M7, 18 EA) | 3 | 0.6 ± 0.1 | 4.4 ± 0.7 | - |

### 2) OPERATION

When the pump works, the oil under the pressure flows into P port.

The oil in P port is stored in the accumulator on A1 port.

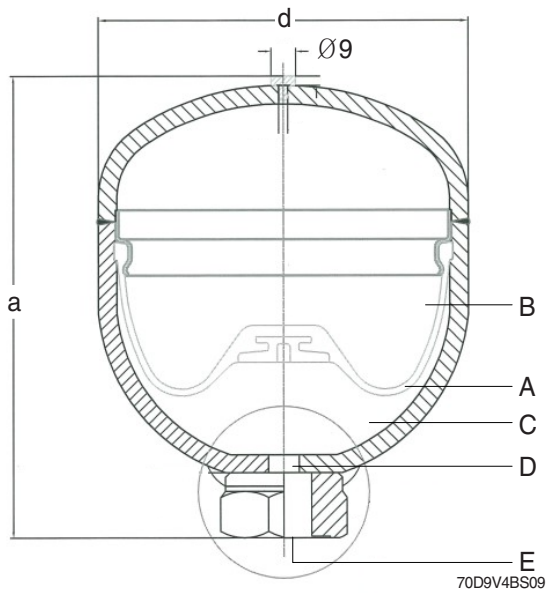
As the pressure on P line rises to 95 bar, the cut off valve (7) starts cut-offing and the oil in the P port is unloaded. The pressure on P line goes down 80 bar by the minute leakage from valve and other factors.

At this pressure, the cut-off valve starts cutting.

This process is repeated in the regular period of 30~40 seconds.

## 7. BRAKE ACCUMULATOR

### 1) STRUCTURE




| Item | Brake (2 EA) | RCV (1 EA) |
|---|---|---|
| Diameter (d) | 122 mm | 90 mm |
| Mounting height (a) | 145 mm | 120 mm |
| Nominal volume | 0.75 ℓ | 0.35 ℓ |
| Priming pressure | 50 bar | 15 bar |
| Operating medium | Oil | Oil |
| Operating pressure | Max. 210 bar | Max. 170 bar |
| Thread | M18×1.5 | PF 1/2 |
| Priming gas | Nitrogen | Nitrogen |

A Fluid portion C Diaphragm E Flat port
B Gas portion D Valve disk

### 2) OPERATION

#### (1) Purpose

Fluids are practically incompressible and are thus incapable of accumulating pressure energy. In hydropneumatic accumulators, the compressibility of a gas is utilized to accumulate fluid. The compressible medium used in the accumulators is nitrogen.

In braking systems, the purpose of the accumulators is to store the energy supplied by the hydraulic pump. They are also used as an energy reserve when the pump is not working, as a compensator for any losses through leakage, and as oscillation dampers.

#### (2) Operation

The accumulator consists of a fluid portion (A) and a gas portion (B) with a diaphragm (C) as a gas-tight dividing element. The fluid portion (A) is connected to the hydraulic circuit, causing the diaphragm accumulator to be filled and the gas volume to be compressed as the pressure rises.

When the pressure falls, the compressed gas volume will expand, thus displacing the accumulated pressure fluid into the circuit.

The diaphragm bottom contains a valve disk (D) which, if the diaphragm accumulator is completely empty, closes the hydraulic outlet, thus preventing damage to the diaphragm.

#### (3) Installation requirements

The accumulators can be fitted in the hydraulic circuit, directly on a component or in blocks on suitable consoles.

They should be fitted in as cool a location as possible.

Installation can be in any position.

#### (4) Maintenance of the accumulator

No special maintenance beyond the legal requirements is necessary.

The accumulator should be checked annually. It should be replaced if the initial gas pressure has fallen by more than 30% (Please refer to **Performance testing and checking of the accumulator**).

**(5) Disposal of the accumulator**

Before the accumulator is scrapped, its gas filling pressure must be reduced. For this purpose, drill a hole through gas chamber (B) using a drill approx. 3 mm in diameter. The gas chamber is located on the side opposite the threaded port above the welding seam around the center of the accumulator.

※ **Wear safety goggles when doing this job.**

**(6) Performance testing and checking of the accumulator**

The accumulator is gradually pressurized via the test pump; until the initial gas pressure is reached, the hydraulic pressure in the accumulator will rise abruptly. This is apparent from gauge **M.** If the initial gas pressure is more than 30% below the prescribed value, the accumulator needs to be replaced. If the measuring process needs to be repeated, wait for intervals of 3 minutes between the individual tests. Any accumulator whose initial gas pressure is insufficient must be scrapped following the instructions under **Disposal of the accumulator.**

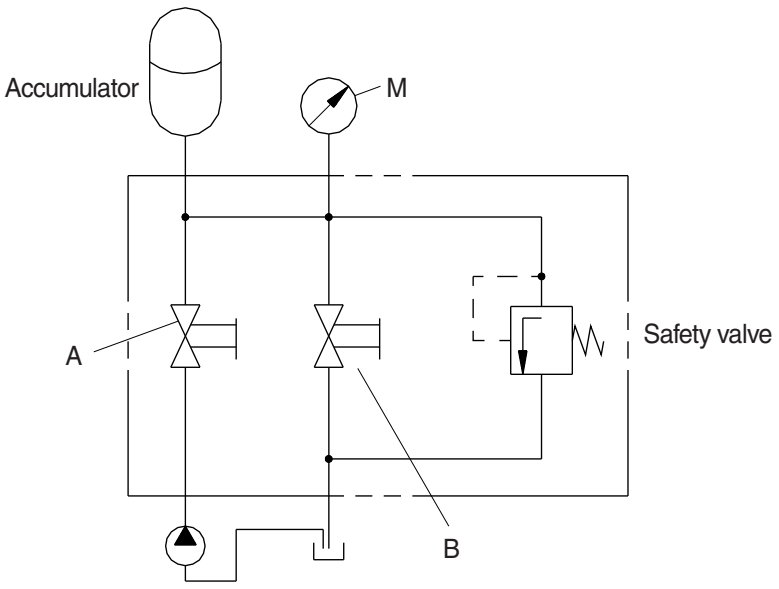
The amount of initial gas pressure can also be checked from the vehicle. Start the vehicle's engine. The pump will now supply oil to the accumulators. Until the initial gas pressure is reached, the hydraulic pressure in the accumulator will rise abruptly. This is apparent from the gauge in the cab. If the initial gas pressure is more than 30% below the prescribed value, that initial pressure lies outside the permissible range for **at least one** of the accumulators fitted in the vehicle. This accumulator can be traced only by using the method described above, i.e. all accumulators have to be individually tested. The accumulator whose initial gas pressure is insufficient must be replaced and scrapped following the instruction under **Disposal of the accumulator.**

**(7) Repair work**

△ **When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine in switched off there will be some residual pressure in the system.**

※ **When doing repair work, make sure your environment is very clean.**
**Immediately close all open ports on the components and on pipes using plugs.**

△ **For safety reasons the accumulators need to be replaced as a whole if damaged.**

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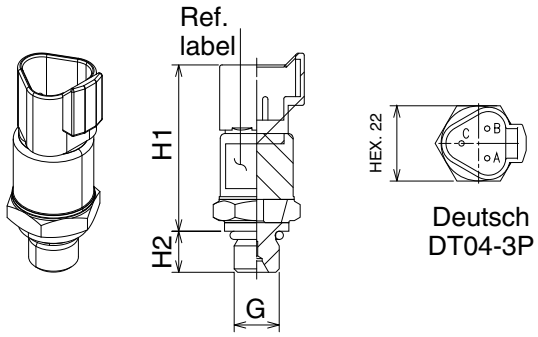
## 8. PRESSURE SENSOR AND SWITCH

### 1) PRESSURE SENSOR

(1) Structure




· Tightening torque : 2.5 ~ 3.0 kgf·m
(18 ~ 21.7 lbf·ft)

| Pin map | Function |
|---|---|
| A | + Supply |
| B | - Supply |
| C | Output |

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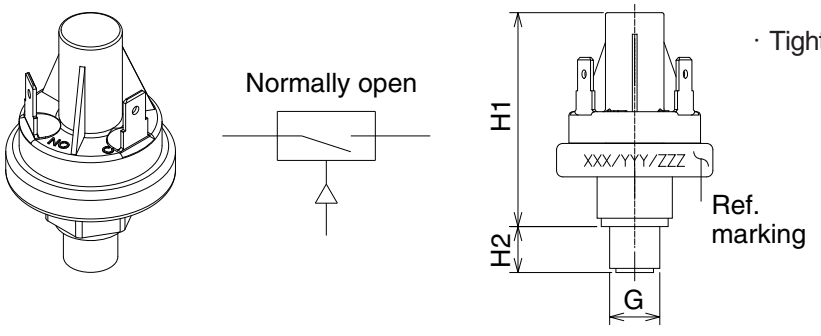
| Item | Medium | Thread (G) | H1 (mm) | H2 (mm) | Measuring range (bar) | Cut-off actuating pressure | Voltage (V) | Electircal connections |
|---|---|---|---|---|---|---|---|---|
| Charging pressure sensor (PS or PSS) | Oil | 9/16-18 UNF | 49 | 12 | 0 ~ 350 | 90 ~ 95 bar (1.52 ~ 1.58 V) | Max. 30 | CD-3 |
| Parking pressure sensor (PS1 or PSP) | Oil | 9/16-18 UNF | 49 | 12 | 0 ~ 350 | 90 ~ 95 bar (1.52 ~ 1.58 V) | Max. 30 | CD-26 |

※ O-ring (S611-012001) : 11.89×1.98 (AS568-906, NBR Hs90)

### 2) PRESSURE SWITCH

(1) Structure




· Tightening torque : 2.5 ~ 3.0 kgf·m
(18 ~ 21.7 lbf·ft)

70D9V4BS11

| Item | Type | Medium | Thread (G) | H1 (mm) | H2 (mm) | Measuring range (bar) | Actuating pressure | Supply voltage | Electrical connections |
|---|---|---|---|---|---|---|---|---|---|
| Brake lamp pressure switch (B2 or BL) | Normally open | Oil | 1/2-20 UNF | 49 | 11 | 1 ~ 10 | 5 ± 1 bar (0.56 V) | Max. 45 V | Slip on CD-4 |

※ O-ring (S611-011001) : 10.52×1.82 (AS568-905, NBR Hs90)

## 2) OPERATION

### (1) Purpose

The pressure switches are used to visually or audibly warn the driver of the pressure within the system.

### (2) Make contact / circuit closer

The pressure switch can be fitted in the braking system or directly on one of its components.
The system pressure acts on an absorption area within the switch, making an electrical contact as the pressure on that area is increased. The resulting current is used to activate a warning facility, for instance.

### (3) Break contact / circuit breaker

The pressure switch can be fitted in the braking system or directly on one of its components.
The system pressure acts on a absorption area within the switch, breaking an electrical contact as the pressure on that area is increased. The current is now broken, e.g. to deactivate a warning facility.

### (4) Installation requirements

No special measures need to be taken.

### (5) Maintenance of the pressure switch

No special maintenance beyond the legal requirements is necessary.
When using high-pressure cleaners on the vehicle, please make sure that the water jet is not directed at the pressure switch(Corrosion of contacts).

### (6) Repair work

△ **When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine is switched off there will be some residual pressure in the system.**

※ When doing repair work, make sure your environment is very clean.
Immediately close all open ports on the components and on pipes using plugs.

※ For safety reasons the pressure switch needs to be replaced as a whole if damaged.

# GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

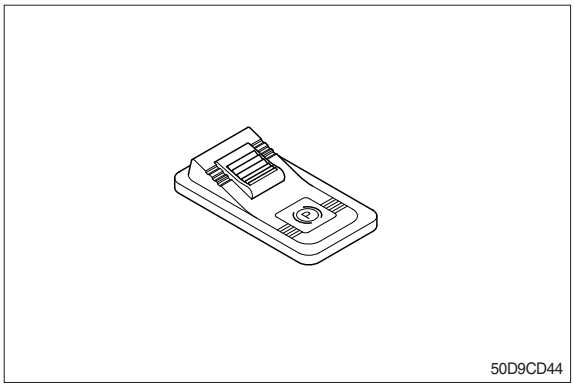
## 1. OPERATIONAL CHECKS

### 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) 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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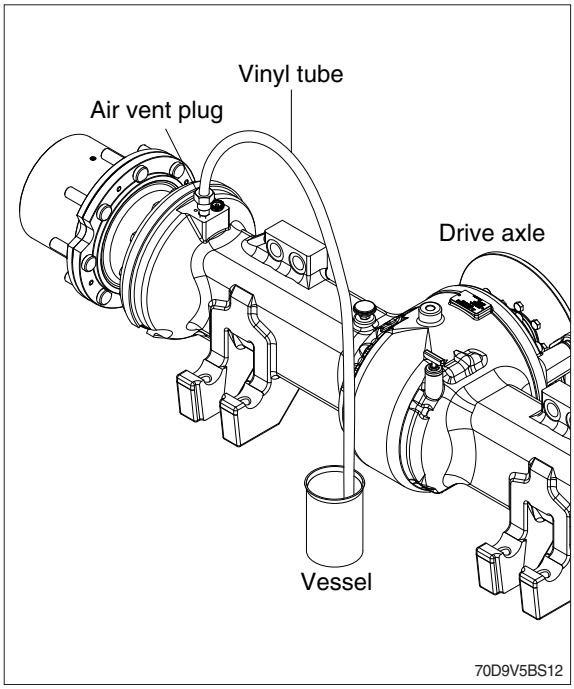
## 2. TROUBLESHOOTING

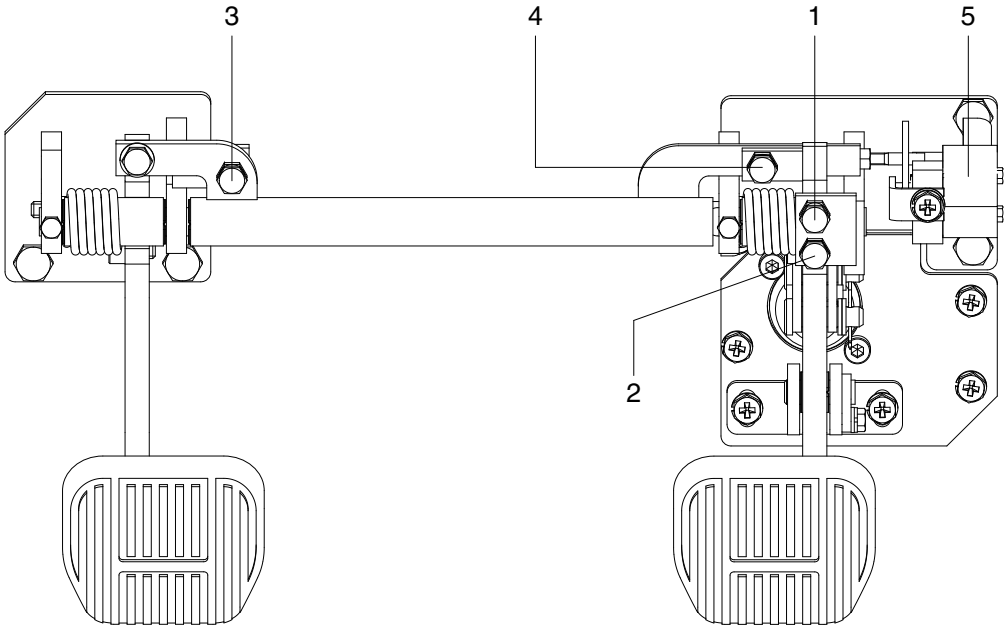
| Problem | Cause | Remedy |
|---|---|---|
| Insufficient braking force | · Hydraulic system leaks oil.<br>· Hydraulic system leaks air.<br>· Disk worn.<br>· Brake valve malfunctioning.<br>· Hydraulic system clogged. | · Repair and add oil.<br>· Bleed air.<br>· Replace.<br>· Repair or replace.<br>· Clean.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



## 2. ADJUSTMENT OF PEDALS



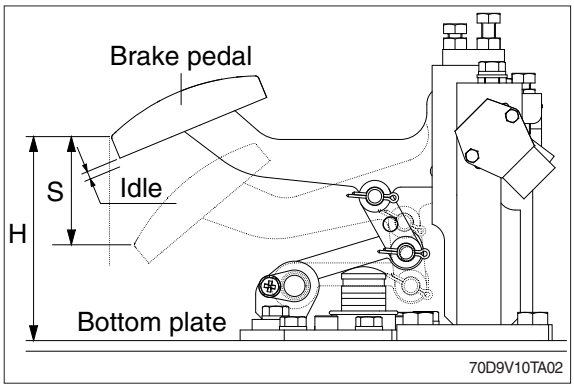

| | | | | | |
|---|---|---|---|---|---|
| 1 | Brake stopper bolt | 3 | Inching stopper bolt | 5 | Inching sensor |
| 2 | Brake storke limit bolt | 4 | Brake&inching pedal interlock bolt | | |

### 1) Brake pedal

- Adjust the brake stopper bolt (1) so that pedal height is "H".
- Adjust the brake storke limit bolt (2) so that pedal stroke is "S"

Unit : mm

| H | S | IDLE |
|---|---|---|
| 116±5 | 62±5 | 0 |

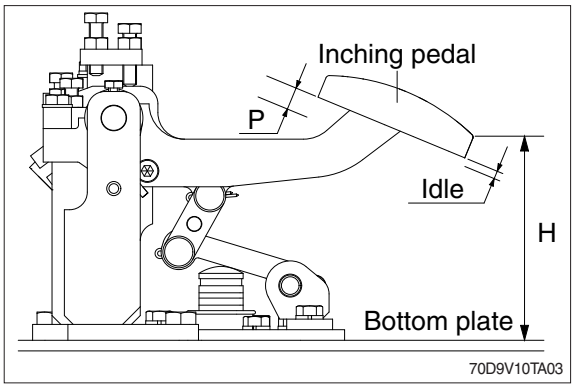



### 2) Inching pedal

- Adjust inching stopper bolt (3) so that pedal height is "H".
- Adjust rod of inching cable so that inching pedal play is idle stroke when pedal height is "H".
- Adjust the brake and inching pedal interlock bolt (4) so that brake pedal interconnects with inching pedal at inching pedal stroke "P".

Unit : mm

| H | P | IDLE |
|---|---|---|
| 116±5 | 10 | 3 |

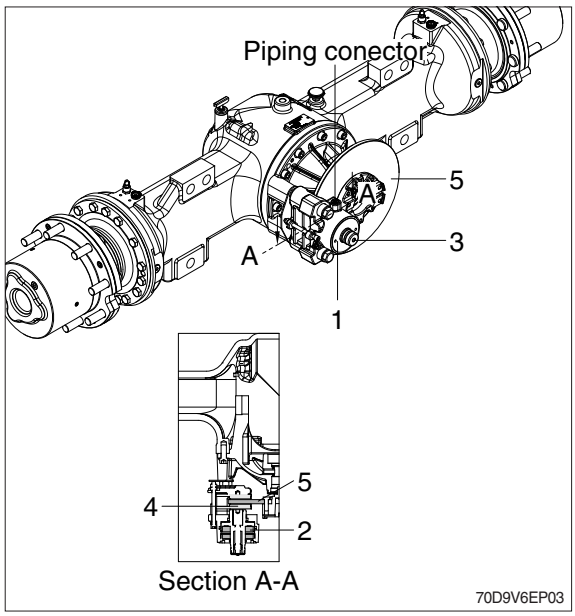


## 3. PARKING BRAKE RELEASE

In case of malfunction of transmission, it is hard to supply pressure at parking brake.
Using function of parking force release at carrier sub assembly of drive axle, it is possible to tow the truck.

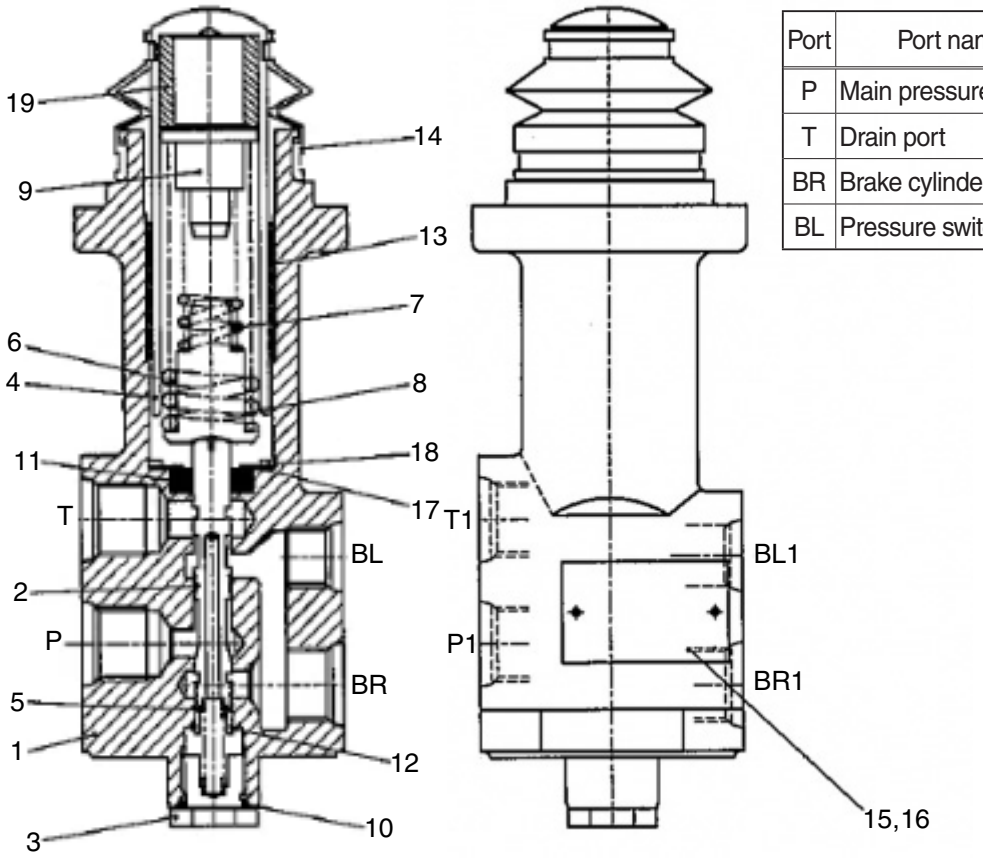
**※ After the start switch OFF, perform this procedure.**

1) Loosen the cover (1) by using a spanner wrench ( ).
2) Remove the disc spring (2).
3) Pull the piston (3) until the lining (4) is unforced.
   Check the parking disc (5) is driven.
4) The assembly is the reverse of the release
5) procedure. After the assembly, conect the parking brake piping and check the parking disc (5) is not driven.



## 1. BRAKE VALVE

### 1) STRUCTURE




| Port | Port name | Port size |
|---|---|---|
| P | Main pressure port | PF 3/8 |
| T | Drain port | PF 3/8 |
| BR | Brake cylinder port | PF 3/8 |
| BL | Pressure switch port | PF 1/4 |

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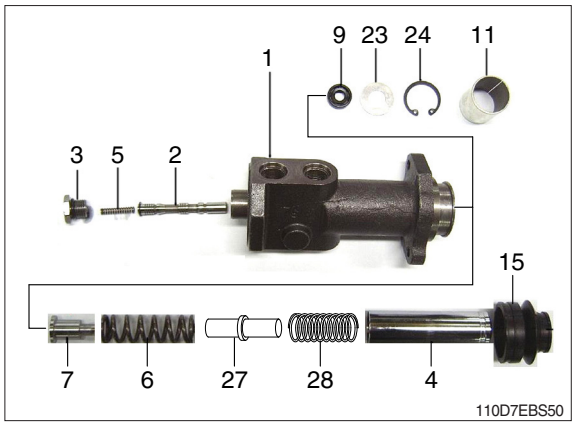
| | | | | | |
|---|---|---|---|---|---|
| 1 | Body | 8 | Retainer spring | 15 | Name plate |
| 2 | Spool | 9 | Retainer spring | 16 | Drive screw |
| 3 | Plug | 10 | O-ring | 17 | Plate washer |
| 4 | Brake holder | 11 | Oil seal | 18 | Snap ring |
| 5 | Lower spring | 12 | Snap ring | 19 | Spacer |
| 6 | Main spring | 13 | Du bushing | | |
| 7 | Reatiner spring | 14 | Rubber cover | | |

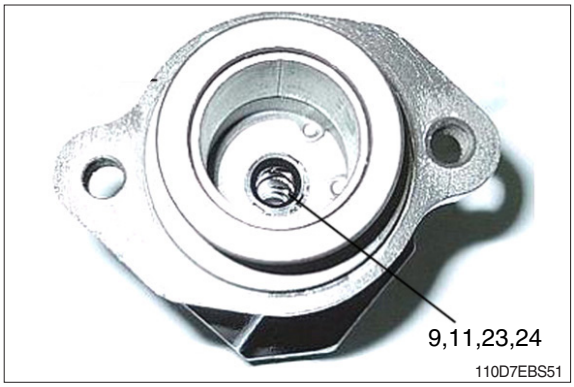
## 2) REASSEMBLY

### (1) Body assembly

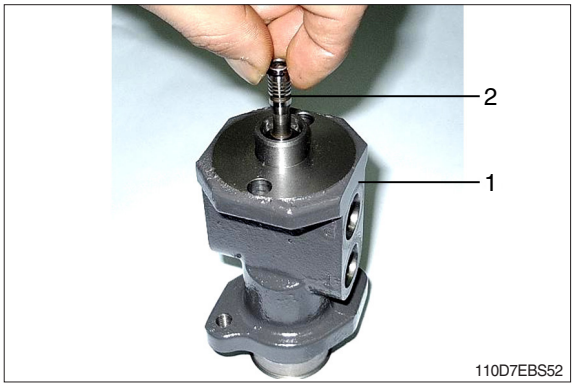



1 Body
2 Spool
3 Plug
4 Holder
5 Spring
6 Main spring 1
7 Spring retainer 1
9 Oil seal
11 DU bushing
15 Rubber cover
23 Plain washer
24 Stop ring
27 Spring retainer 2
28 Main spring 2

① Install oil seal (9), plain washer (23), stop ring (24), DU bushing (11).
- Tool : Jig for dry bearing, snap ring plier.



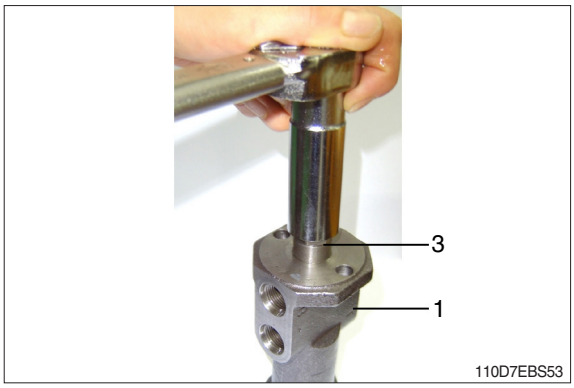

② Install spool (2) into body (1).



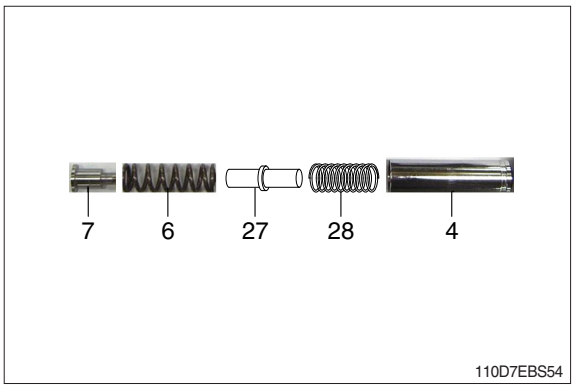
③ Tighten plug (3)
- Tool : 19 mm spanner
- Tightening torque : 14.0~16.5 kgf · m

⚠ **Press-in the DU bushing (11) with a exclusive jig.**

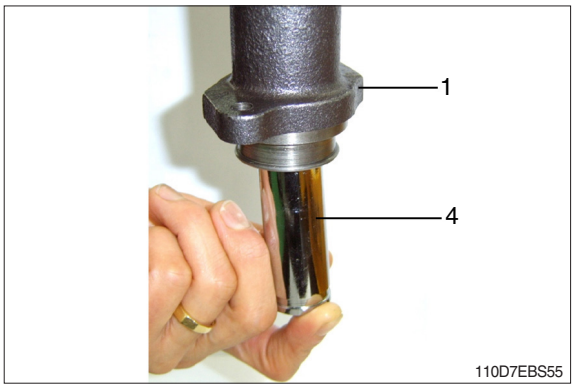
⚠ **Be careful of dust and scrap after washing the parts.**



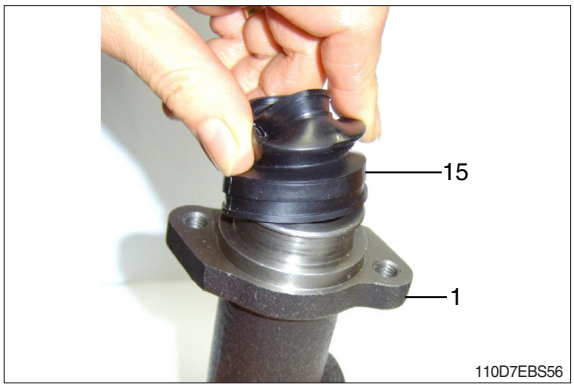

④ Spring retainer (7, 27), main spring (6, 28) and holder (4).




⑤ Holder (4) → Body (1)




⑥ Rubber cover (15)

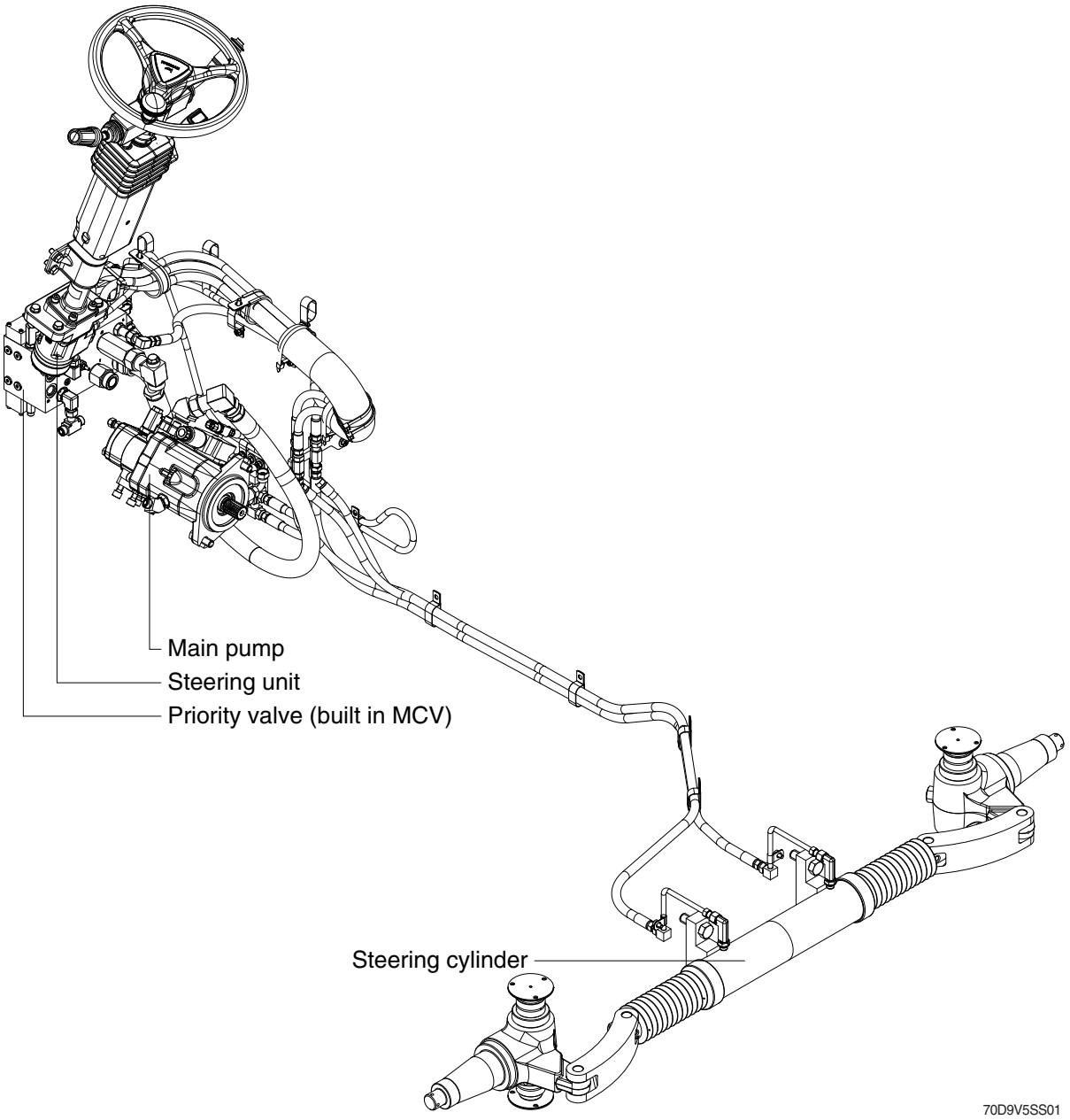


# SECTION 5 STEERING SYSTEM

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

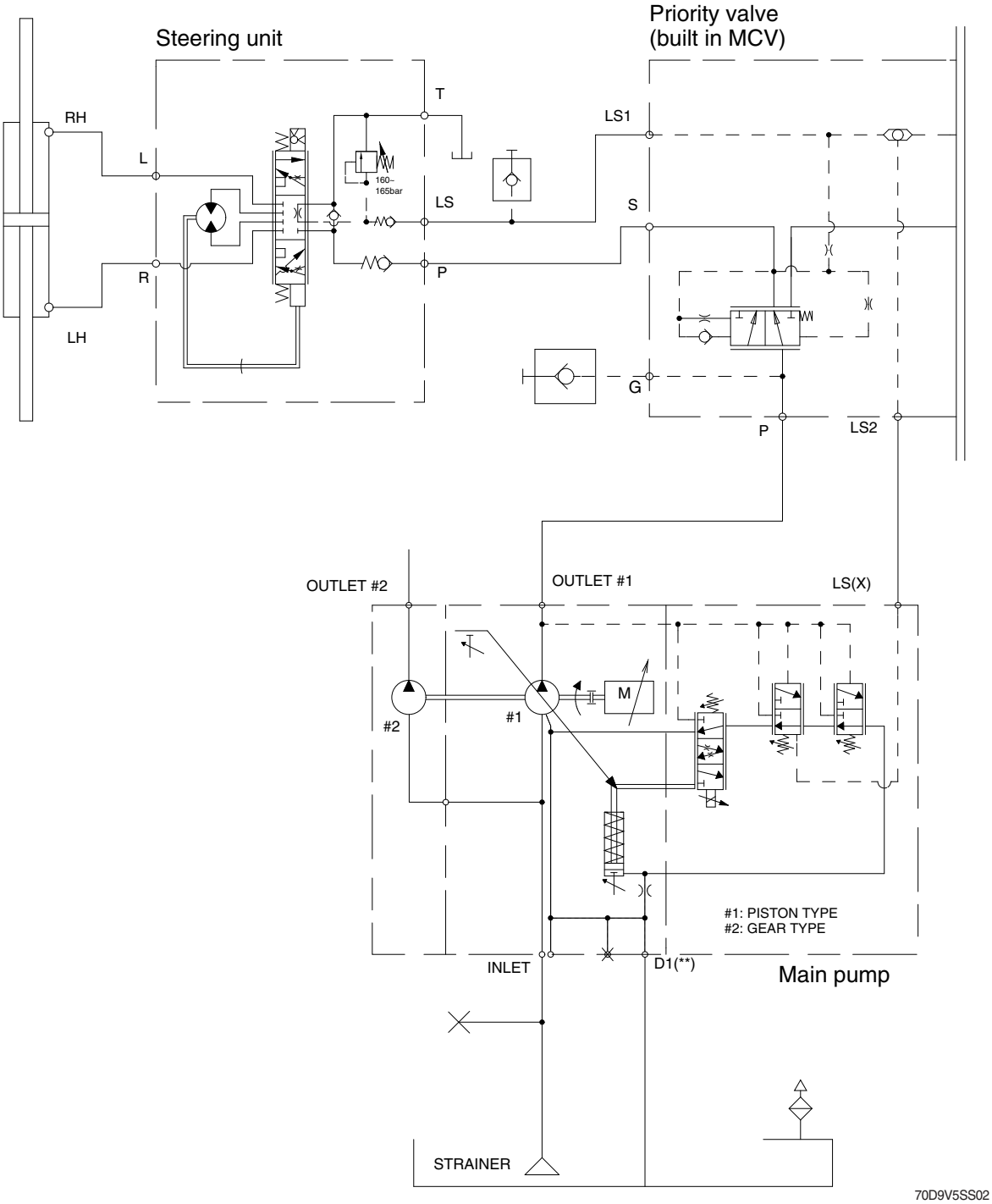
## GROUP 1 STRUCTURE AND FUNCTION

### 1. OUTLINE



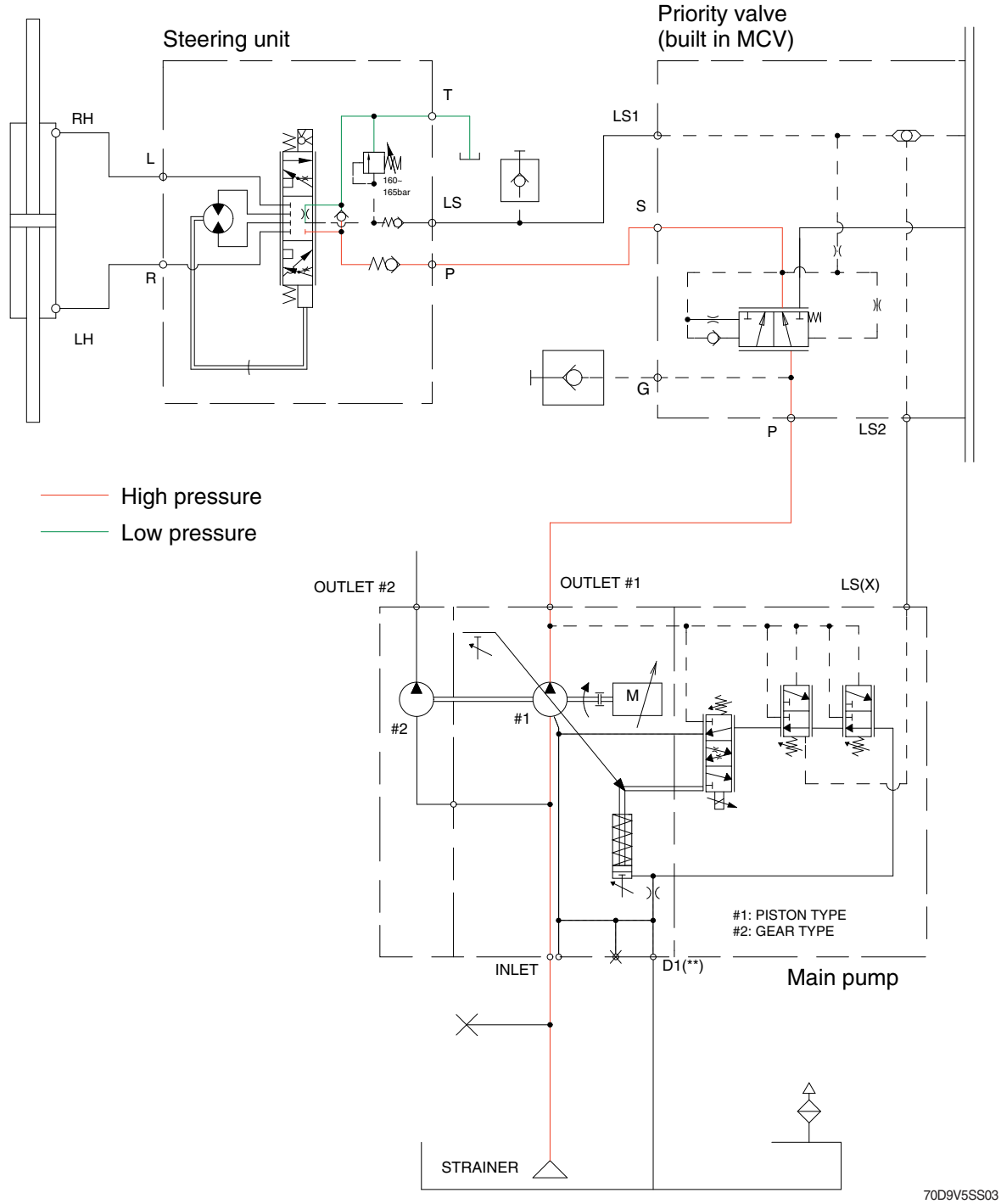

The steering system for this truck is composed of main pump, steering wheel assembly, steering unit, priority valve (built in MCV), steering cylinders, steering axle and piping. The steering axle supports the forklift weight with the rear axle, contains a cylinder and controls the position of the rear tires. The steering axle body is unit structure having steering knuckles installed to its both ends by means of king pins. Hub and wheel are mounted through bearing to spindle of knuckle. When the steering wheel is turned, the rotation torque is transmitted to the steering unit, and the hydraulic oil in the steering unit is transmitted to the steering axle hydraulic cylinder through the hose, so that the forklift moves left and right. The force produced by the steering cylinders moves the knuckle of rear tires through the intermediate link. Refer to the illustration for the location of the steering system components.

## 2. HYDRAULIC CIRCUIT



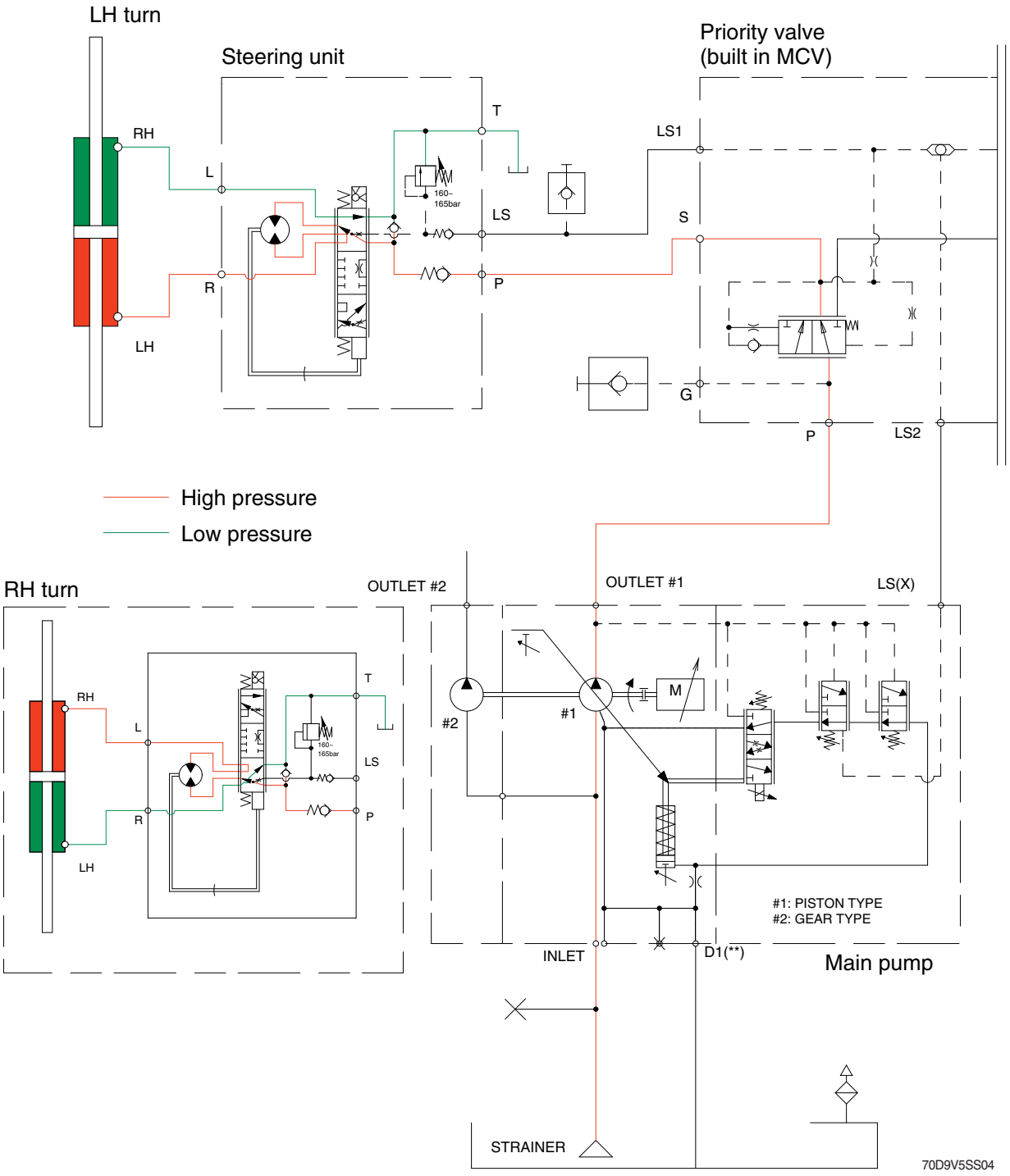

The hydraulic oil discharged from the pump flows to the priority valve. When the driver operates the steering wheel, the steering unit is supplied with pressure oil preferentially by the priority valve operation circuit. The oil passages in the steering unit are changed over to direct the hydraulic pressure from the priority valve to the steering cylinder, which extends or contracts depending on the hydraulic pressure, thereby steering the truck. The excess flow of the pump generated at this time flows to the priority valve and the tank through the priority valve EF flow path.

## 1) NEUTRAL




When the engine is running and the steering wheel is not being turned, the steering unit spool and sleeve set are aligned (neutral position). Oil flow through the valve is blocked from entering the left or right steering ports.The pressure on the pilot side of the priority valve spool controls the spool to move in the opposite direction (spring direction). This movement causes the pump discharge flow to flow to the priority valve. In this neutral position, a small amount of oil is constantly bled through the dynamic orifice. The oil then flows into the LS hose piping and returns to the tank through the steering unit spool and sleeve set. This dynamic flow prevents initial hard spot when steering is turned rapidly or abruptly.

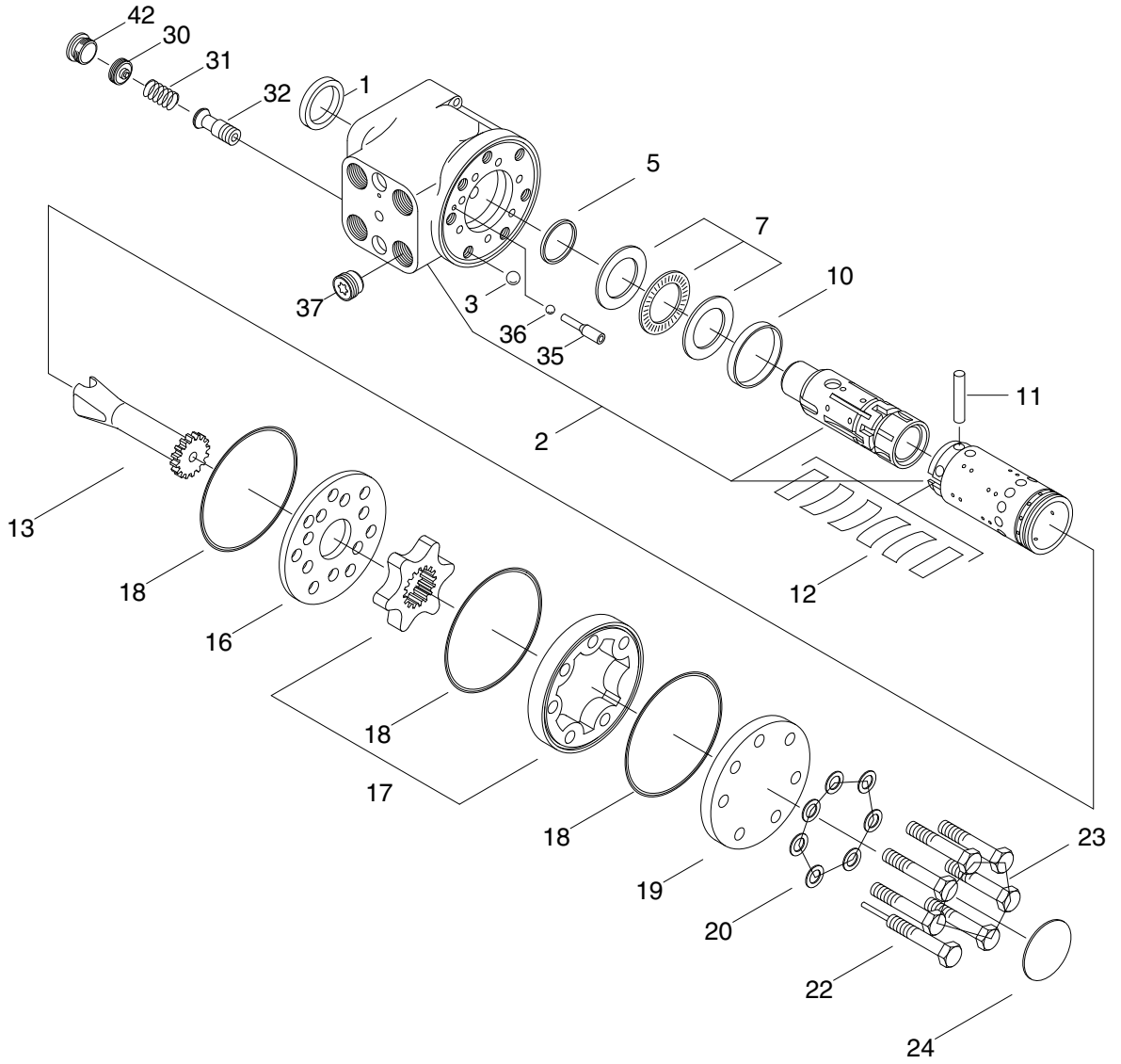
## 2) LEFT OR RIGHT TURN




When the engine is running and the steering wheel is being turned, the steering unit spool and sleeve set rotates. The passage opens to allow oil to flow into the internal gerotor gear of the steering unit. The oil flow causes the gerotor pump to rotate. Oil flows back into the steering valve spool and sleeve set and out to the left or right steering ports depending on the direction of steering wheel rotation. At the same time, the LS circuit blocks the return to the hydraulic tank and is connected to the S port to sense the pressure required to turn the steering wheel. As the required pressure increases or decreases in the LS circuit, the priority valve spool moves to meet the flow and pressure required to rotate the tire. When the steering cylinder reaches the end of the stroke, a relief valve in the steering circuit releases LS pressure into the hydraulic tank.

## 3. STEERING UNIT

### 1) STRUCTURE

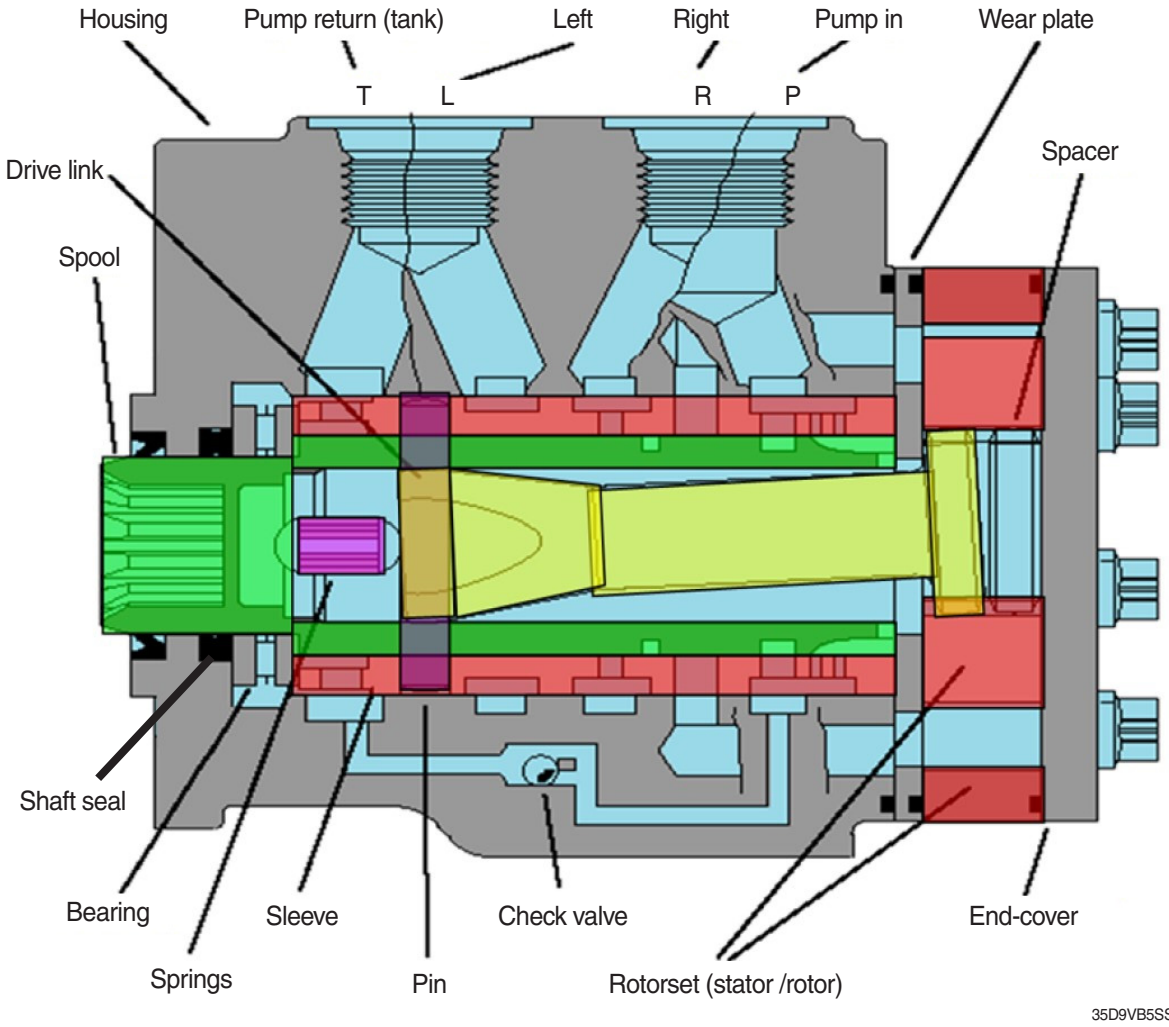



70D9V5SS06

| | | | | | |
|---|---|---|---|---|---|
| 1 | Dust seal ring | 13 | Cardan shaft | 24 | Model / Code label |
| 2 | Housing and spool/sleeve | 16 | Distributor plate | 30 | Adjusting screw |
| 3 | Ball | 17 | Gearwheel set | 31 | Spring |
| 5 | Shaft seal | 18 | O-ring | 32 | Piston |
| 7 | Bearing assembly | 19 | End over | 35 | Ball |
| 10 | Ring | 20 | Washer | 36 | Ball |
| 11 | Cross pin | 22 | Pin bolt screw | 37 | Check valve |
| 12 | Set of springs | 23 | Screw | 42 | Plug |

※ Seal kit (EA) : 1 (1), 5 (1), 18 (3), 20 (7)

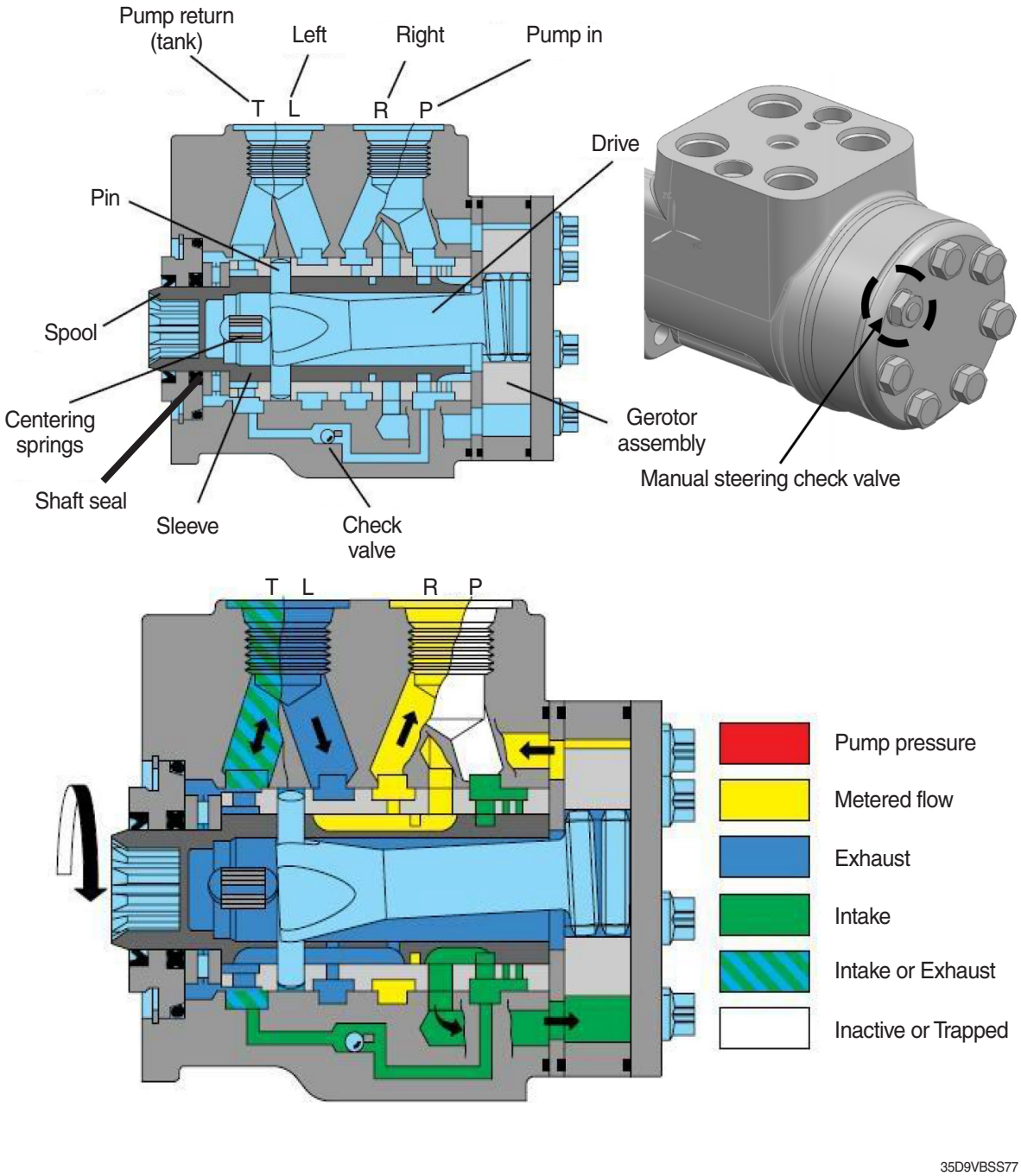
## 2) OPERATION




The steering unit is a closed center circuit and consists of a rotary valve (spool + sleeve set) and a metering gear set. With a LS (load sensing) dynamic circuit, even when the viscosity of the oil is low in winter, it operates smoothly without jamming the steering wheel and reduces the impact of the steering wheel due to rapid rotation or kickback of the tire. The LS circuit in the valve is used to control the operation of the priority valve spool. Steering relief valve oil flows through an internal flow path to the tank return line. The relief valve is set lower than the AUX relief valve set pressure in the MCV.

- Manual steering check valve : converts unit to hand operated pump for limited manual steering.
- Inlet check valve (P port) : Prevents oil from returning through the steering unit when pressure on the cylinder side is greater than pressure on the inlet side to prevent steering wheel kick.
- LS relief valve : Limits maximum pressure in the steering circuit.

### 3) MANUAL STEERING (EMERGENCY)




35D9VBSS77

When the engine is not running and the steering wheel is being turned, the priority divider valve spool is pushed against the end stop by spring force. In this position, oil flow opens to the spool and sleeve set. As the steering wheel turns, a vacuum is created in the supply line between the priority valve and the steering unit spool and sleeve set. As the spool and sleeve set rotates, a passage opens to allow oil to flow to the inner gerotor gear set of the steering unit. Oil trapped in the steering port passes through the manual steering check valve and feeds through the gerotor gear to the opposite side of the steering cylinder, enabling manual steering.

## 4) RELIEF VALVE PRESSURE TEST AND ADJUSTMENT

**(1)** Test specification

- Enine speed : low idle rpm
- Oil temperature : 50 ± 5 ℃ (122 ± 9 ℉)
- Steering relief set pressure : 135 ~ 140 bar (1958 ~ 2031 psi)

**(2) Pressure test and adjustment**

① Operate hydraulic system until the oil temperature is within test specification. See hydraulic warmup procedure.

② Lower the fork to the ground, stop the engine, and apply the parking brake switch.

③ Connect pressure gauge to "LS" pressure check port of the steering unit as shown the illustration.

④ Operate engine at test specifications.

⑤ Turn the steering wheel all the way to a stop and hold it there.

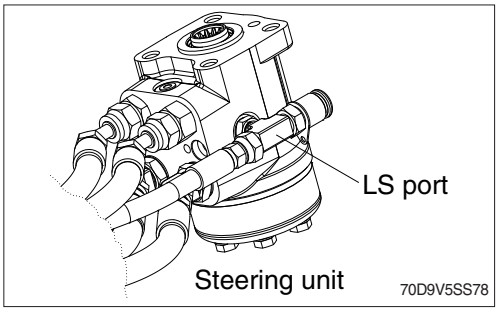
⑥ Check pressure gauge reading. Compare the readings and specifications.

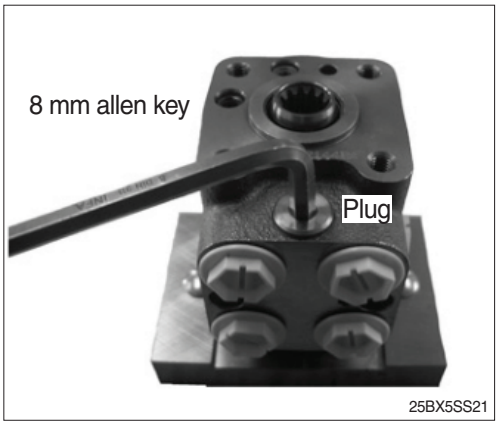
⑦ Loosen the relief valve plug. Turn the adjusting screw to adjust the pressure.

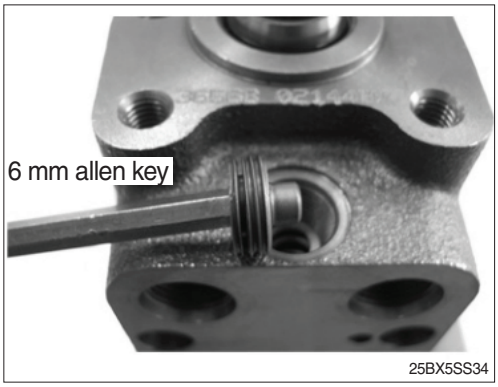
- Tightening torque : 6.6 ± 0.5 kgf·m (47.9 ± 3.7 lbf·ft)
- If pressure is lower than specification, turn relief valve adjusting screw clockwise.
- If the pressure is higher than the specification, turn the adjusting screw counterclockwise.

⑧ Repeat Step ⑥, ⑦. If pressure is to specifications, remove test equipment.

△ **Do not permit dirt or other contaminants to enter the hydraulic system. Disconnected hoses, tubes, open valves, cylinder fittings, and ports should be protected with clean caps or plugs.**

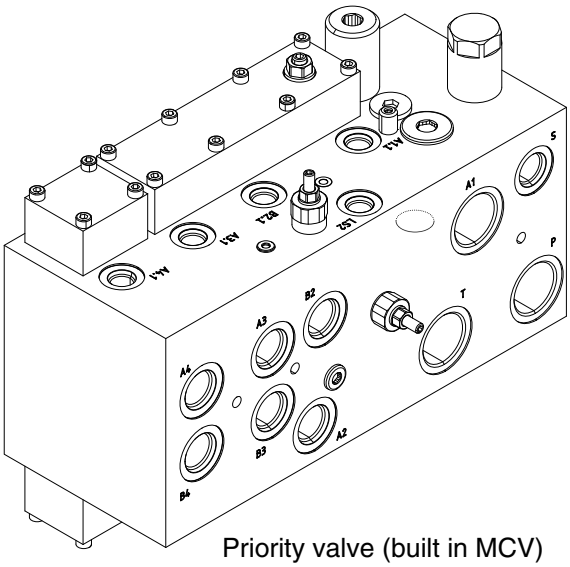


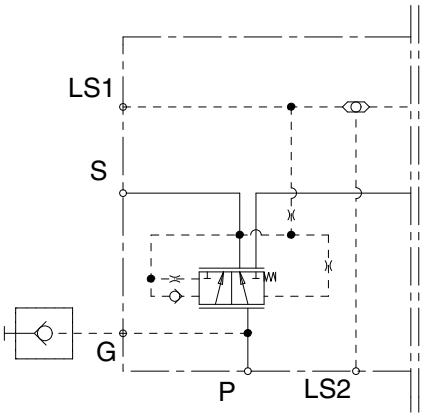



## 4. PRIORITY VAVLVE

### 1) STRUCTURE




Priority valve (built in MCV)




Hydraulic circuit

70D9V5SS07

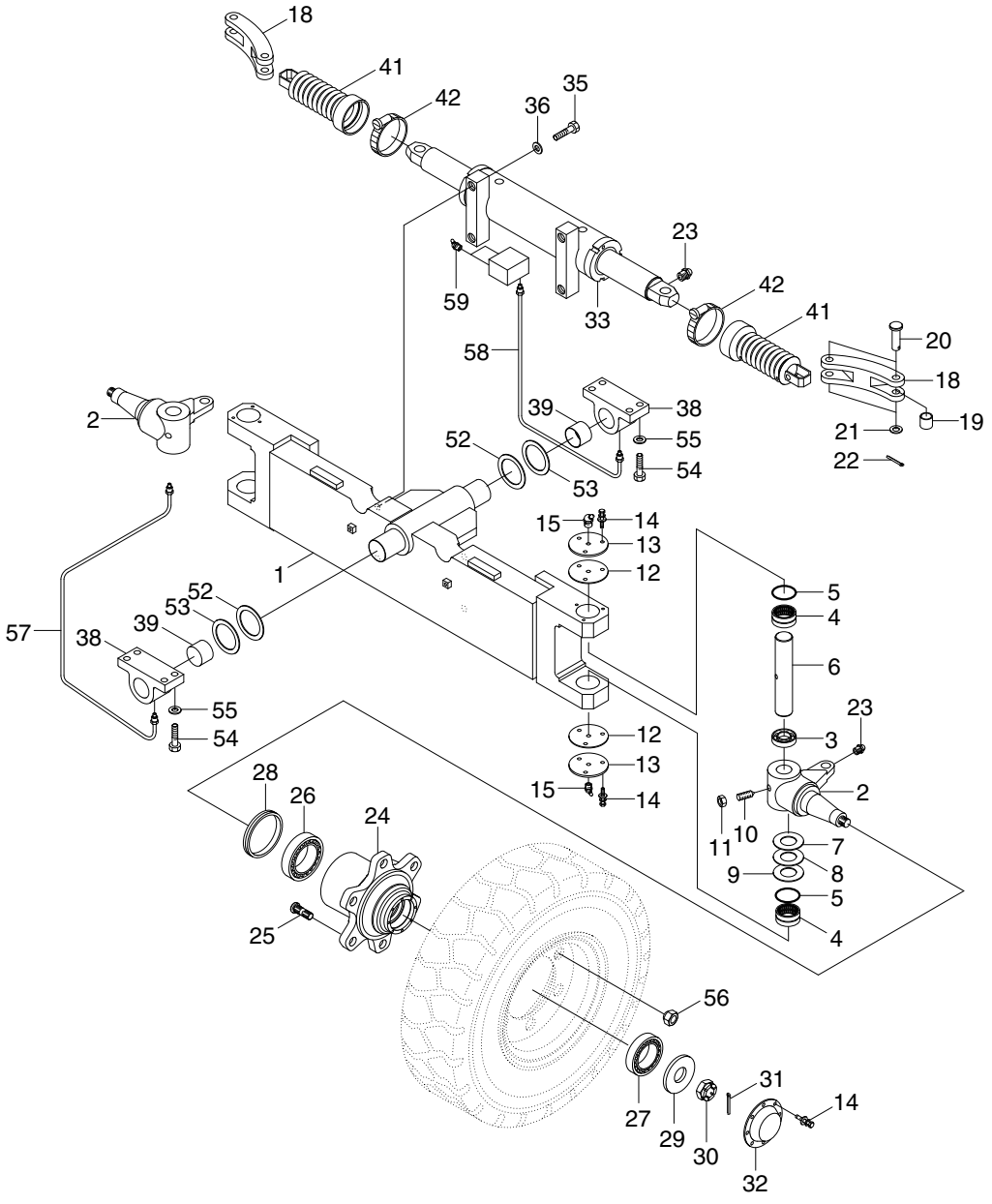
### 2) STRUCTURE

The oil from the hydraulic pump flows to the priority valve.
The priority valve supplies a flow of oil to the steering system and lift, tilt system.
The steering flow is controlled by the steering unit to operate the steering cylinder.
The remainder of the oil flow from the pump flows to the main control valve.

## 5. STEERING AXLE

### 1) STRUCTURE

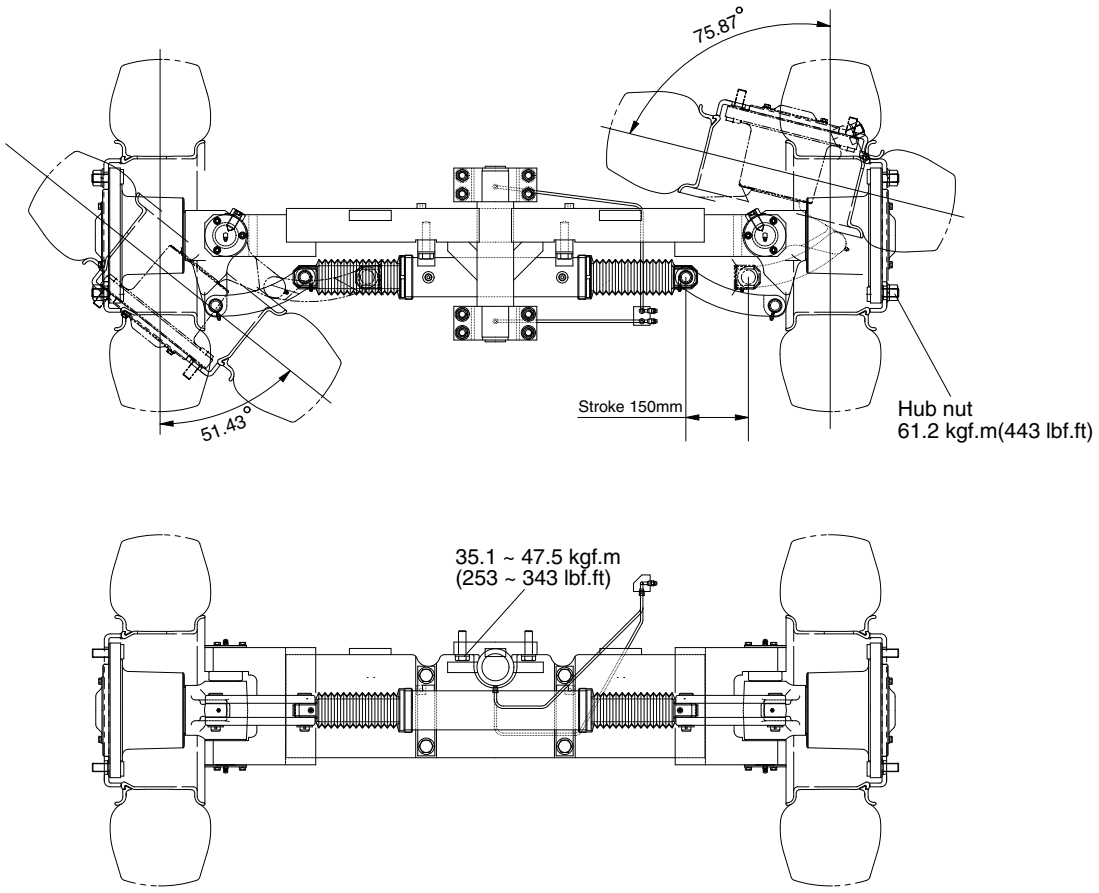
※ Do not remove the stopper bolt unless necessary.




50D9SE24

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Steering axle | 13 | Cover | 25 | Hub bolt | 39 | Bushing |
| 2 | Knuckle | 14 | Bolt w/washer | 26 | Taper roller bearing | 41 | Steering cylinder boot |
| 3 | Thrust bearing | 15 | Grease nipple | 27 | Taper roller bearing | 42 | Clamp |
| 4 | Needle bearing | 16 | Hexagon bolt | 28 | Oil seal | 52 | Shim (1.0 t) |
| 5 | Oil seal | 17 | Hexagon nut | 29 | Special washer | 53 | Shim (0.5 t) |
| 6 | King pin | 18 | Link | 30 | Slotted nut | 54 | Hexagon bolt |
| 7 | Thrust washer | 19 | Bushing | 31 | Split pin | 55 | Hardened washer |
| 8 | Shim washer (0.1 t) | 20 | Link pin | 32 | Hub cap | 56 | Hub nut |
| 9 | Shim washer (0.2 t) | 21 | Special washer | 33 | Steering cylinder | 57 | Front pipe assy |
| 10 | Set screw | 22 | Split pin | 35 | Hexagon bolt | 58 | Rear pipe assy |
| 11 | Hexagon nut | 23 | Grease nipple | 36 | Hardened washer | 59 | Grease nipple |
| 12 | Gasket | 24 | Hub | 38 | Support | | |

## 2) TIGHTENING TORQUE AND SPECIFICATION

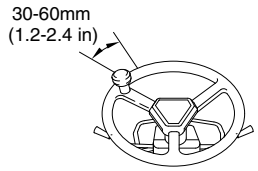



50D9SE07

| 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 | 75.87/ 51.43 |
| Tread | mm (in) | 1604 (63.1) |

# GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

## 1. OPERATIONAL CHECKS

| Check item | Checking procedure |
|---|---|
| Steering wheel<br>  | · 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.<br>Test steering wheel play with engine at idling. |
| Knuckle | · Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear. |
| Steering axle | · Put camber gauge in contact with hub and measure camber.<br>If camber is not within 0±0.5° ; rear axle is bent.<br>· Ask assistant to drive machine at minimum turning radius.<br>· Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius.<br>· If minimum turning radius is not within±100 mm (±4 in)of specified value, adjust turning angle stopper bolt.<br>Min turning radius (Outside)<br>70D-9VB \| 3436 mm (11' 3") |
| Hydraulic pressure of power steering | Remove plug from the LS port of the steering unit and install oil pressure gauge. Turn steering wheel fully and check oil pressure.<br>※ Oil pressure : 160 ~ 165 bar (2320 ~ 2390 psi) |

## 2. TROUBLESHOOTING

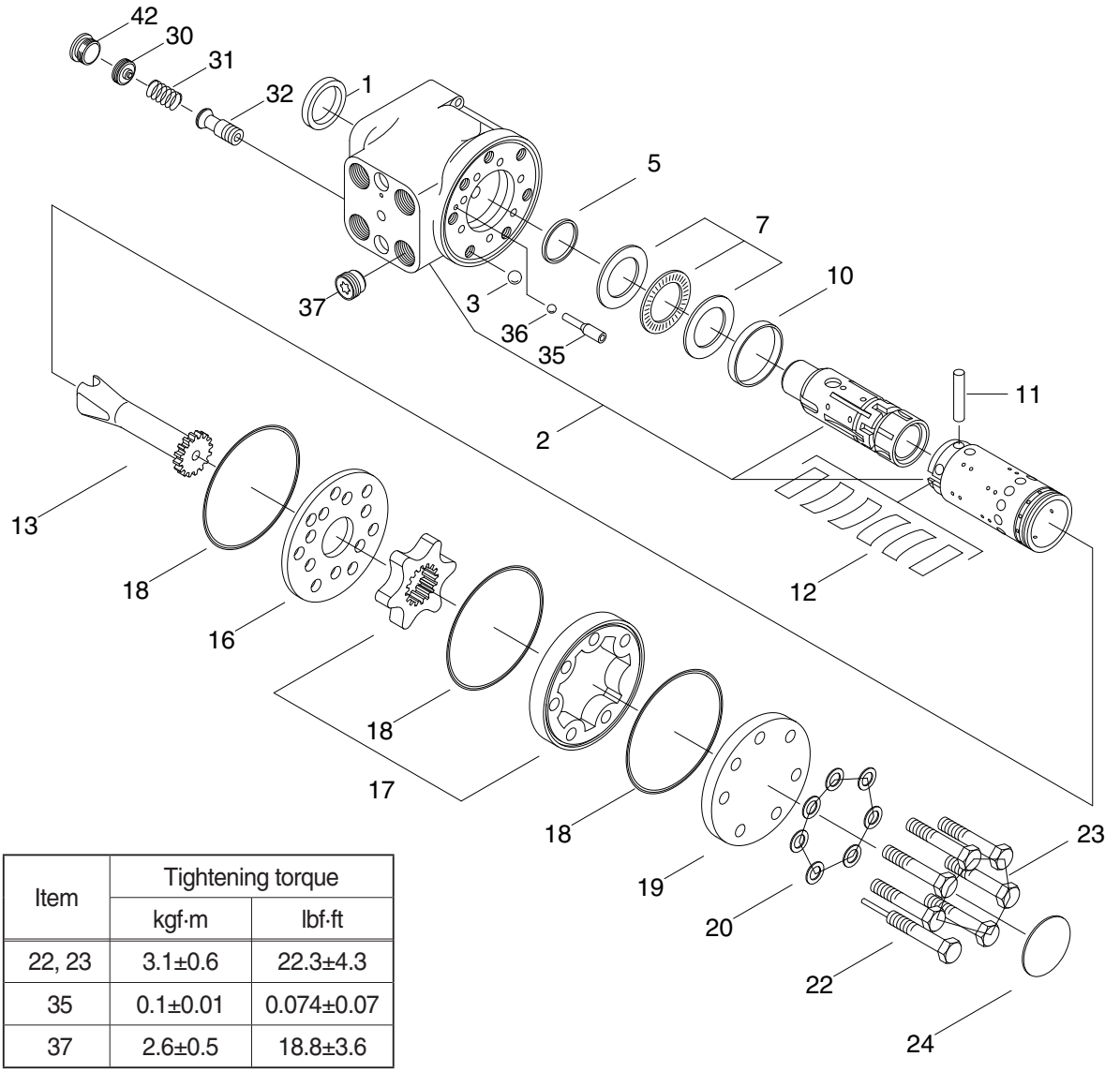
### 1) STEERING UNIT

| Problem | Cause | Remedy |
|---|---|---|
| The steering wheel cannot be rotated. | · The steering unit column shaft is installed incorrectly or damaged. | · Inspect and correct or replace. |
| | · The oil pressure does not rise. | · Inspect and adjust the relief set pressure. |
| | · The relief valve is faulty or not closed. | · Inspect and correct. |
| | · LS line (Hose) incorrectly connected. | · Inspect and correct. |
| | · The piping is damaged. | · Replace. |
| The steering wheel is heavy. | · The tire inflating pressure is low. | · Adjust the inflating pressure. |
| | · The oil pressure does not rise. | · Inspect and adjust the relief set pressure. |
| | · The high and low pressure hoses are connected reversely. | · Inspect and correct. |
| | · The power steering cylinder rod is bent or the piston is sticking. | · Inspect and correct or replace. |

| Problem | Cause | Remedy |
|---|---|---|
| The oil pressure does not rise. | · The high and low pressure hoses are connected reversely.<br>· The relief valve is faulty or not closed.<br>· The oil pump function is degraded or the oil volume is insufficient.<br>· The power steering cylinder piston packing is damaged. | · Inspect and correct.<br>· Inspect and correct.<br>· Inspect and correct or replace.<br>· Replace. |
| The steering wheel does not return properly. | · The tire inflating pressure is low.<br>· The steering unit spool does not move smoothly.<br>· The steering knuckle sliding motion is improper. | · Adjust the inflating pressure.<br>· Correct or replace the steering unit<br>· Add the lubricant or correct. |
| The steering wheel does not return (lateness) to the neutral position when released. | · The steering unit spool does not move smoothly.<br>· The steering unit column shaft is damaged.<br>· The centering spring is damaged.<br>· The piping is blocked (crushed or clogged). | · Correct or replace the steering unit.<br>· Replace the steering unit<br>· Replace.<br>· Inspect and correct or replace. |
| The play is excessive and the vehicle wobbles. | · Oil moves in the steering unit.<br>· The steering unit spool is not moving correctly.<br>· Air is sucked from the piping.<br>· The steering unit column shaft is defective. | · Replace the steering unit.<br>· Correct or replace the steering unit.<br>· Inspect and correct or replace.<br>· Inspect and correct or replace. |
| The tires are steered opposite to the steering wheel operated direction. | · The cylinder piping is connected reversely. | · Inspect and correct. |
| The steering wheel in the idling state is heavy. | · Oil moves in the steering unit.<br>· The relief valve is not functioning correctly.<br>· Air is sucked from the piping.<br>· The piping is blocked (crushed or clogged).<br>· The end cap set screw is tightened to an excessive torque. | · Replace the steering unit.<br>· Inspect and correct.<br>· Inspect and correct or replace.<br>· Inspect and correct or replace.<br>· Tighten uniformly to the specified torque. |
| Abnormal noise is generated. | · The relief valve is defective.<br>· Air is sucked from the piping.<br>· The piping is blocked (crushed or clogged). | · Correct, inspect the pressure, and adjust.<br>· Inspect and correct or replace.<br>· Inspect and correct or replace. |

## 1. STEERING UNIT

### 1) STRUCTURE




| Item | Tightening torque | |
|---|---|---|
| | kgf·m | lbf·ft |
| 22, 23 | 3.1±0.6 | 22.3±4.3 |
| 35 | 0.1±0.01 | 0.074±0.07 |
| 37 | 2.6±0.5 | 18.8±3.6 |

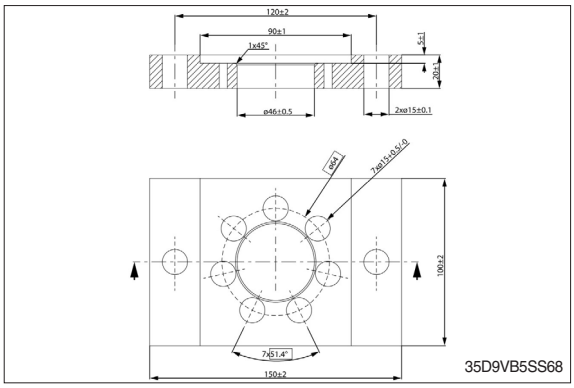
70D9V5SS06

| | | | | | |
|---|---|---|---|---|---|
| 1 | Dust seal ring | 13 | Cardan shaft | 24 | Model / Code label |
| 2 | Housing and spool/sleeve | 16 | Distributor plate | 30 | Adjusting screw |
| 3 | Ball | 17 | Gearwheel set | 31 | Spring |
| 5 | Shaft seal | 18 | O-ring | 32 | Piston |
| 7 | Bearing assembly | 19 | End over | 35 | Ball stop |
| 10 | Ring | 20 | Washer | 36 | Ball |
| 11 | Cross pin | 22 | Pin bolt screw | 37 | Check valve |
| 12 | Set of springs | 23 | Screw | 42 | Plug |

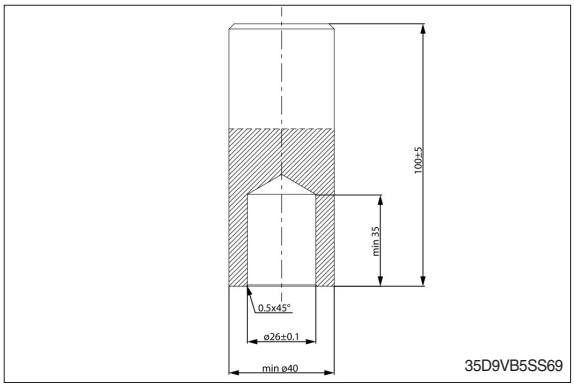
※ Seal kit (EA) : 1 (1), 5 (1), 18 (3), 20 (7)

## 2) TOOLS

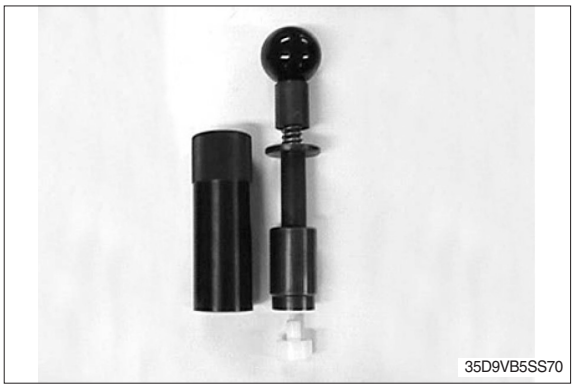
(1) Holding tool for the entire steering unit.
Material: Appropriate metal or hard plastic.



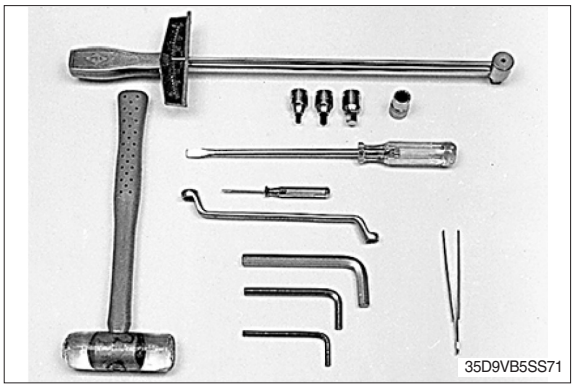

(2) Assembly tool for dust seal.
Material: Free cutting steel.




(3) Assembly tool for shaft seal, O-ring/Roto Glyd type:
Code number: 11092408.

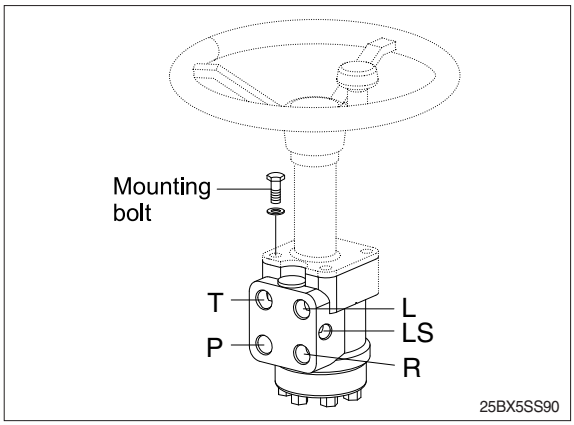



(4) Torque wrench
- 13 mm socket spanner
- 2 mm, 7/64 inch (2.75 mm) allen key
- Torx Bit size T50
- 12 mm screwdriver
- 2 mm screwdriver
- 13 mm ring spanner
- Plastic hammer
- Tweezers



### 3) TIGHTENING TORQUE

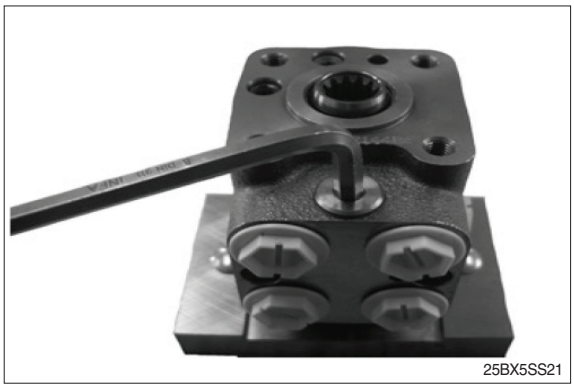
L : Left port
R : Right port
T : Tank port
P : Pump port
LS : Load sensing port



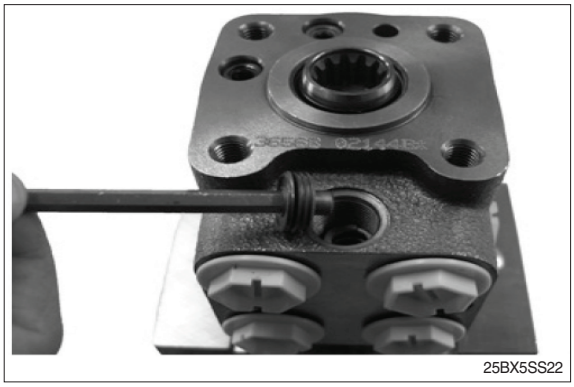

| Port | Port size | Tightening torque | |
|---|---|---|---|
| | | kgf·m | lbf·ft |
| L, P, R, T | 3/4-16 UNF | 6 | 43.4 |
| LS | 7/16-20 UNF | 2 | 14.5 |
| Mounting bolt | M10×1.5×85 mm | 4 | 28.9 |

## 4) DISASSEMBLY

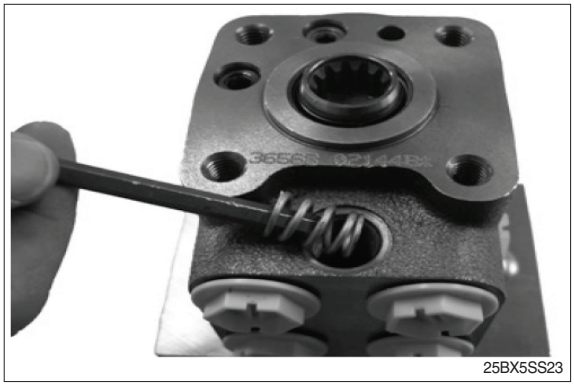
(1) Screw out the plug (42) for relief valve using an 8 mm allen key. Sealing washer is crimped on the plug.


25BX5SS21

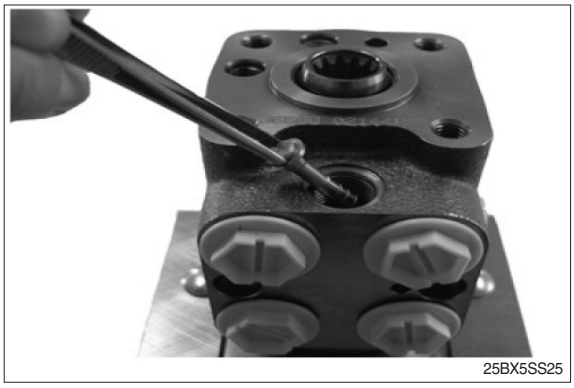
(2) Screw out the adjusting screw (30) using a 6 mm allen key.


25BX5SS22

(3) Remove the spring for relief valve (31).


25BX5SS23

(4) Remove the piston for relief valve (32).

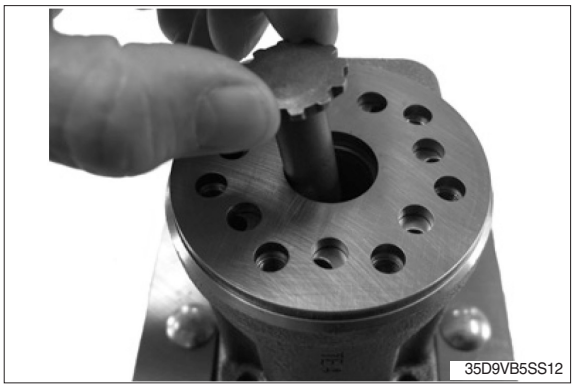

25BX5SS25

(5) Replace the unit in the holding tool on steering column end.
Remove the screws (22 and 23) with washers (20) using a 13 mm ring spanner or top wrench.

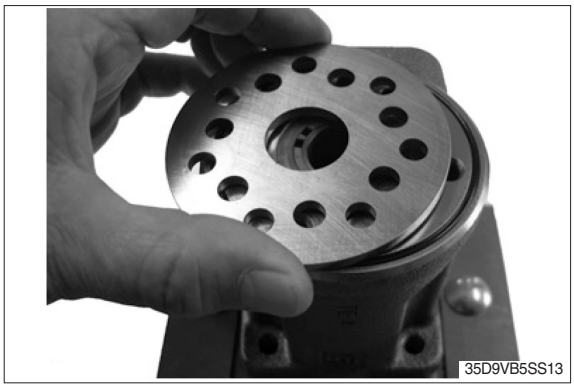

(6) Remove the end cover (19), sideways.


(7) Lift the gearwheel set (17) off the unit. Remove the two o-rings (18).

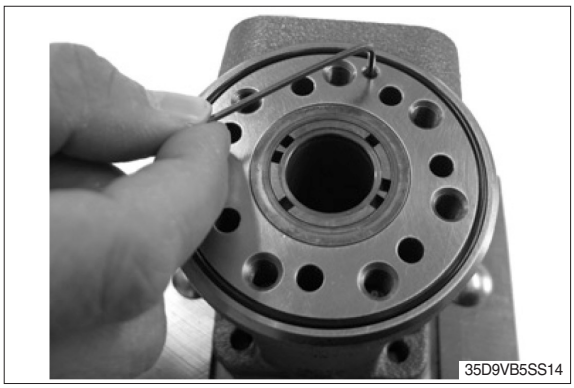

(8) Remove the cardan shaft (13).



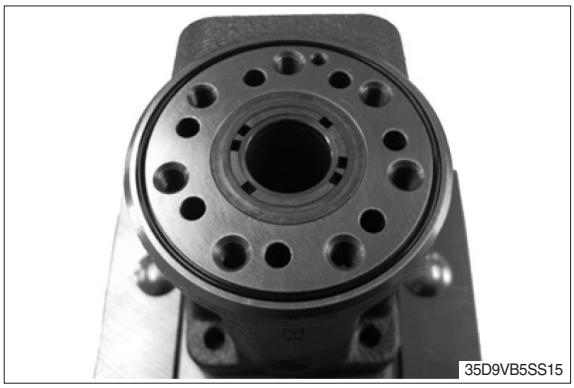
(9) Remove the distributor plate (16).




(10) Screw out the ball stop (35) using a 2 mm allen key.

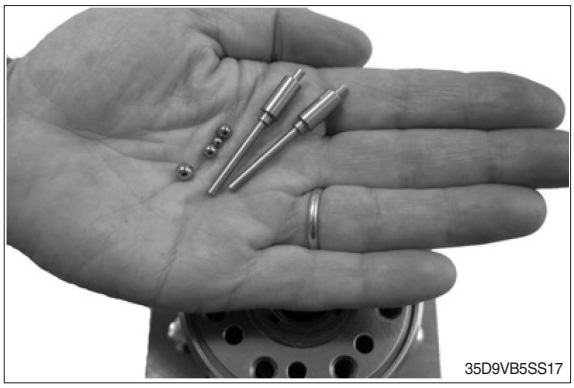



(11) Remove the o-ring (18) from housing.

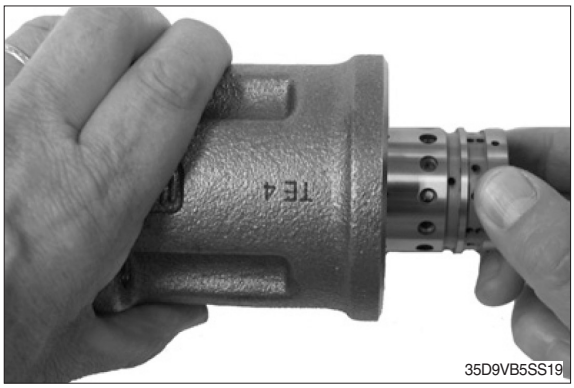



(12) Remove the check valve (37) using a torx bit size T50.

(13 Shake out the check valve ball (3), suction valve pins (34), balls (33 and 36).




(14) Place the housing with the ports facing down on the work bench. Ensure that the cross pin (11) in the spool and sleeve set (2) is in the horizontal position. The pin (11) can be observed through the open end of the spool. Press the spool (2) inwards (from the housing mounting face end) and the sleeve (2), ring (7) and bearing assembly (6) will be pushed out of the housing together.

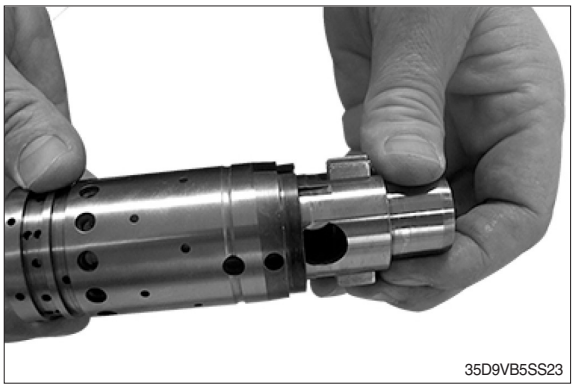




(15) Take the bearing races and needle bearing (7) from the spool and sleeve set (2). The outer bearing (7) race can sometimes “stick” in the housing, therefore check that it has come out.

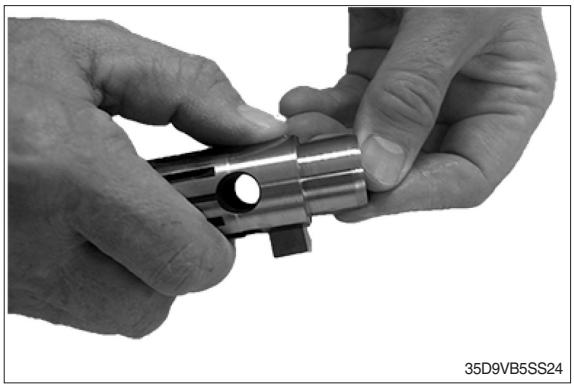
(16) Press out the cross pin (11).


(17) Remove the ring (10).

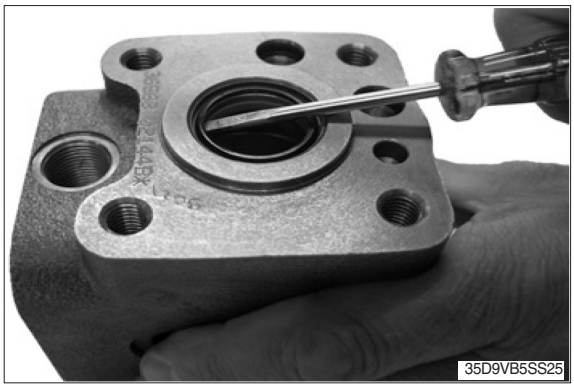

(18) Carefully press the spool out of the sleeve.




(19) Press the neutral position springs (12) out of the slot of the spool.



(20) Remove dust seal (1) and shaft seal (Roto Glyd) (5) carefully with a screw driver or similar tool.




(21) The steering unit is now completely dismantled.

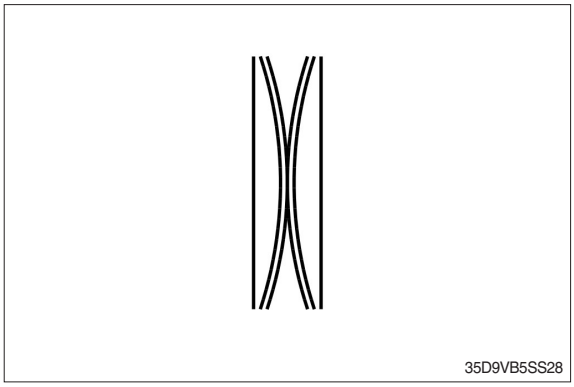
※ **Clean all parts carefully in shellsol K or similar cleaner fluid.**

※ **Inspection and replacement Replace all seals and washers. Check all parts carefully and make any replacements as is necessary.**

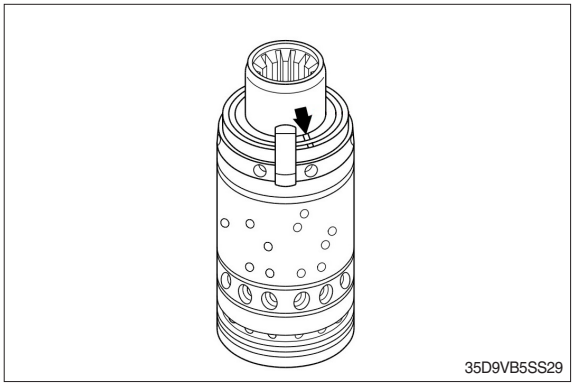
## 5) ASSEMBLY

(1) Place the two flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into place.

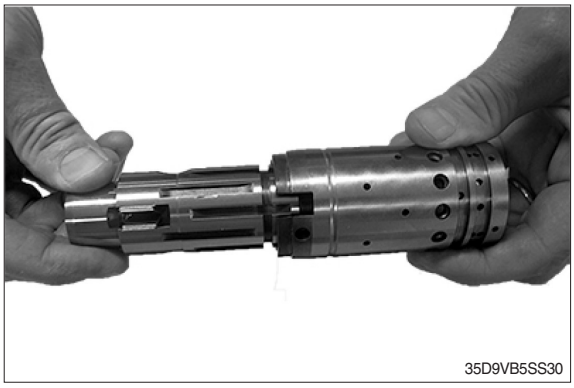

(2) Configuration of spring set (12). There can be different numbers of curved springs depending on configuration of spring set. There can be 2, 4 or 6 curved springs.



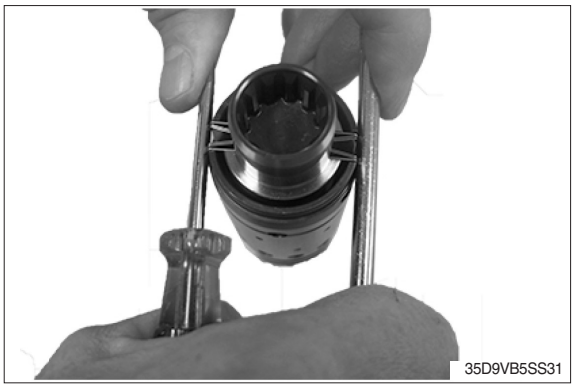

(3) Some spool and sleeve sets for steering unit must be positioned correctly relatively to each other. Small marks are present on both spool and sleeve close to one of the slots for the spring set. Most spool and sleeve sets for steering unit have no marks, so those can be positioned relatively to each other in any of the 2 positions possible.




(4) Guide the spool into the sleeve (2). Make sure the centering springs (12) are placed into the slot.



(5) Line up the spring set (12).

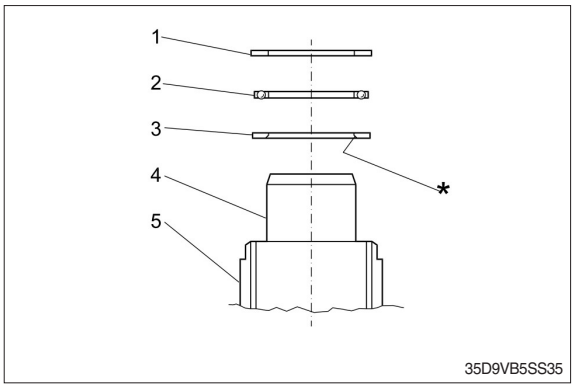



(6) Guide the ring (10) down over the sleeve. The ring should be able to move free of the springs.

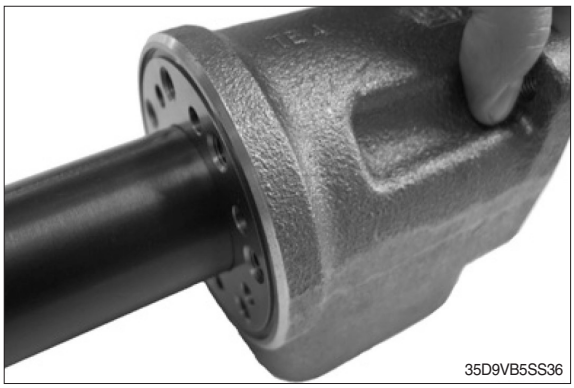

(7) Fit the cross pin (11) into the spool/sleeve.


(8) Fit bearing races and needle bearing (7) as shown on the drawing below.

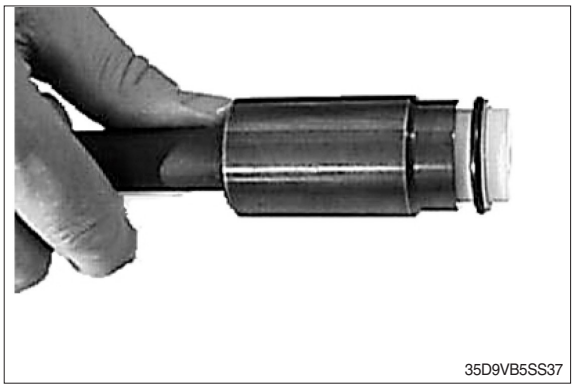
(9) Assembly pattern for standard bearing 1 Outer bearing race → 2 Needlebearing → 3 Inner bearing race → 4 Spool → 5 Sleeve.
The inside chamfer on the inner bearing race must face the chest of the inner spool.




(11) Place the steering unit housing with the port face down on the work bench. Guide the outer part of the assembly tool for shaft seal into the bore for the spool/ sleeve set (2).

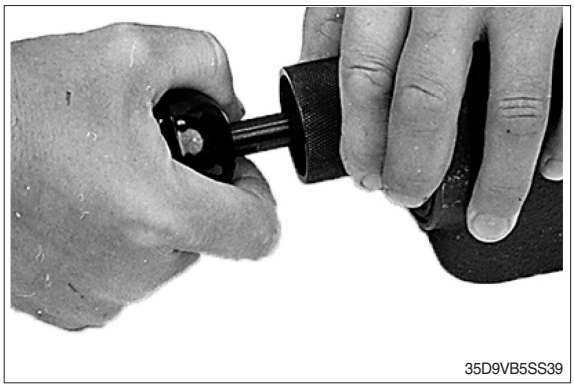



(10) Grease the shaft seal (Roto Glyd, 5) with hydraulic oil and place them on the tool. Ensure that the Roto Glyd seal is placed on the insertion tool as per the photograph.

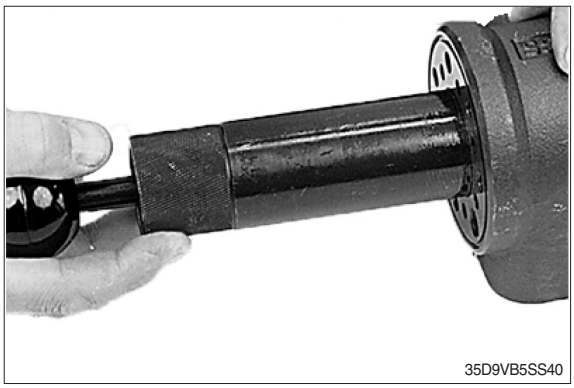



(13) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.

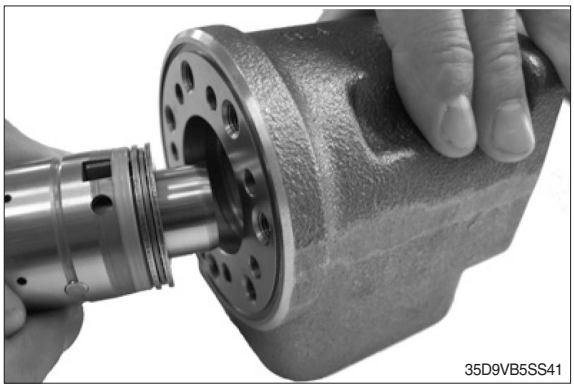
(14) Press and turn the shaft seal (5) into position in the housing.



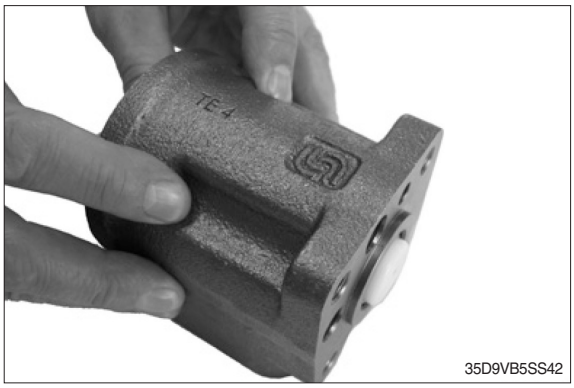

(15) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



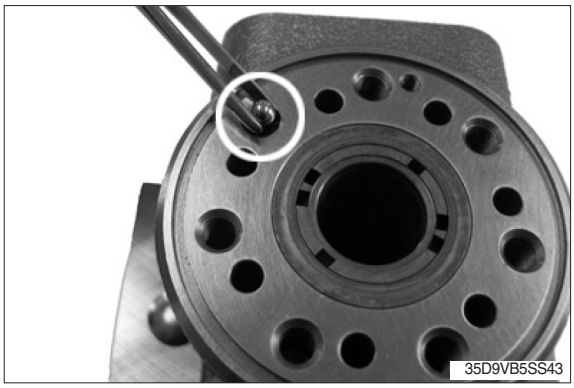

(16) With a light turning movement, guide the spool and sleeve into the bore.
Fit the spool set holding the cross pin (11) horizontal.



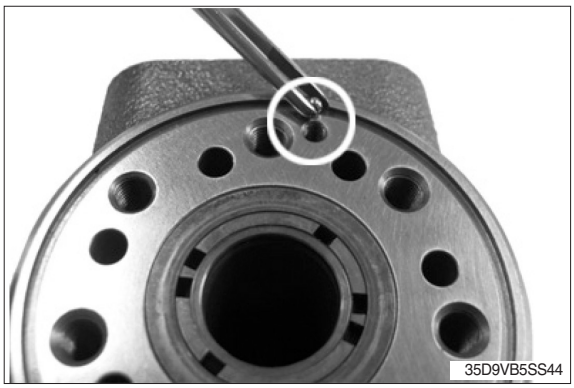

(17) The spool set will push out the assembly tool guide. The shaft seal (5) are now installed.



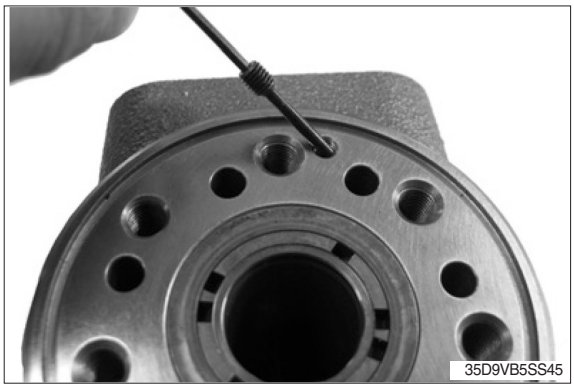
(18) Place the steering unit housing on the holding tool on the steering column end. Put the check valve ball (3) into the hole indicated by the circle.



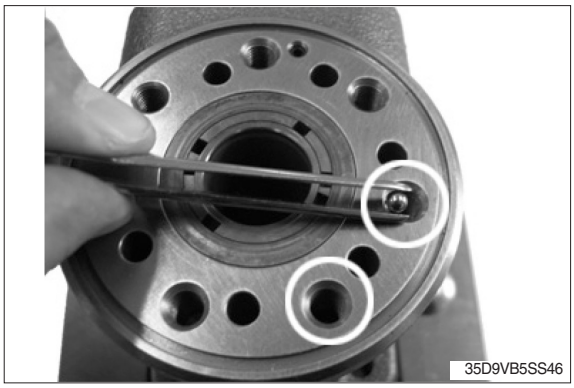

(19) Place the ball for LS check valve (36) into the hole indicated by the circle.



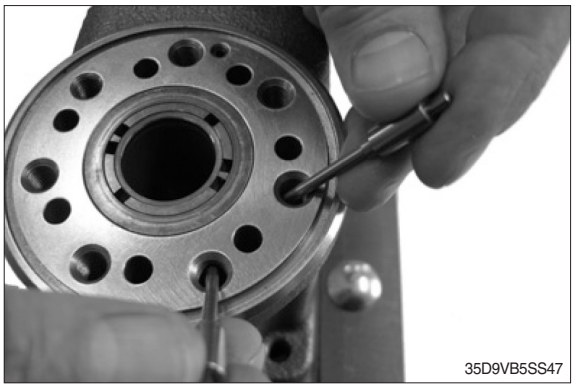

(20) Screw the ball stop (35) into the LS check valve bore using a 2 mm allen key.
· Tightening torque : 0.1±0.01 kgf·m
(0.72±0.072 lbf·ft)



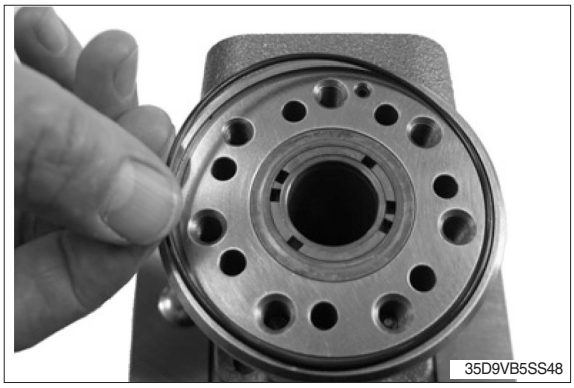

(21) Place a ball (33) in the two bolt holes indicated by the circles.



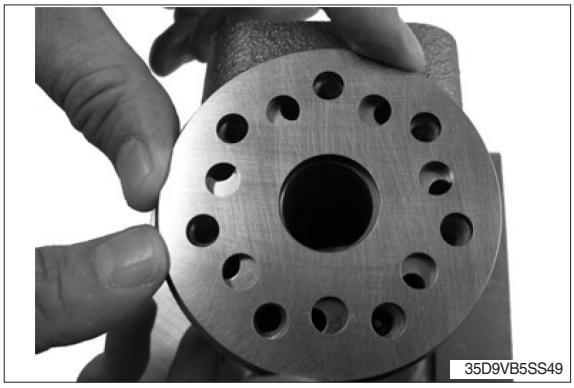
(22) Place the pins (34) in the same two bolt holes.



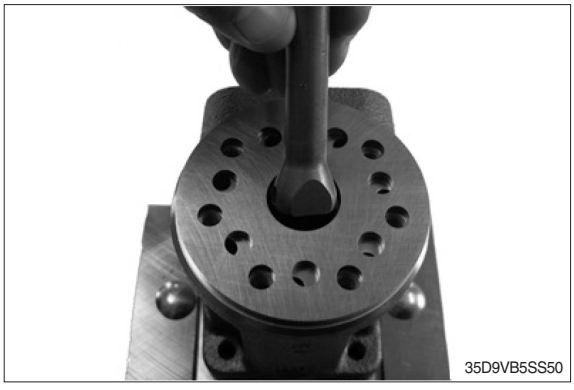

(23) Insert the O-ring (18) in the grove on the housing.



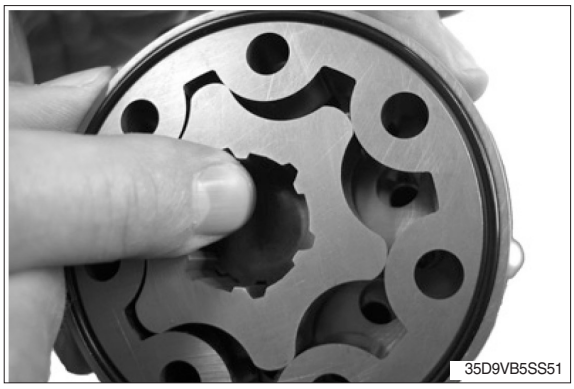

(24) Place the distributor plate (16) so that the channel holes match the thread holes in the housing.




(25) Guide the cardan shaft (13) down into the bore so that the slot is parallel with the connection flange ports and lines up with the cross pin (11).



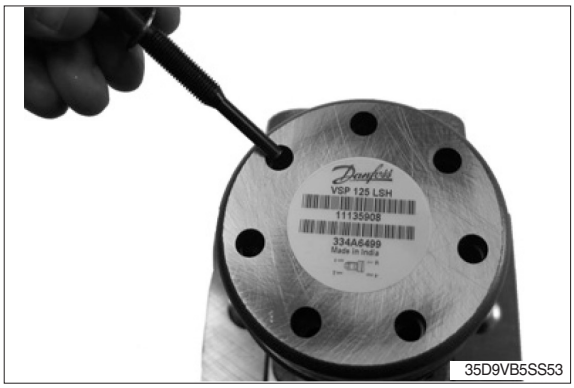
(26) Place the 2 o-rings (18) in the two groves in the gear rim. Fit the gearwheel and rim (17) on the cardan shaft (13).
Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in steering unit have timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing. Line up the gear rim holes to match the thread holes of the housing.


35D9VB5SS51

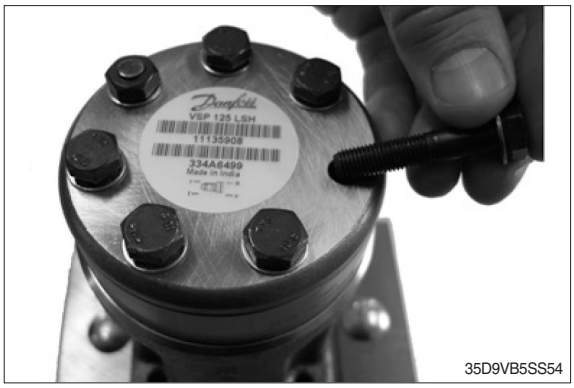
(27) Place the end cover (19) in position. Ensure that the bar codes and writing are parallel with port face.

35D9VB5SS52

(28) Fit the pin bolt screw (22) with washer (20) and place it in the hole shown.


35D9VB5SS53

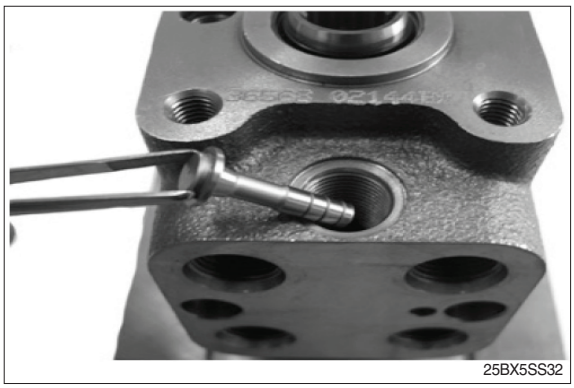
(29) Fit the six screws (23) with new washers (20) and insert them. Use a 13 mm top wrench. Cross-tighten all the screws (22 and 23) with a torque
· Tightening torque : 3.1±0.6 kgf·m
(22.4±4.3 lbf·ft)


35D9VB5SS54

(30) Screw in the check valve (37) into the P-port using a Torx Bit size T50.
· Tightening torque : 2.6±0.5 kgf·m
(18.8±3.6 lbf·ft)


35D9VB5SS55

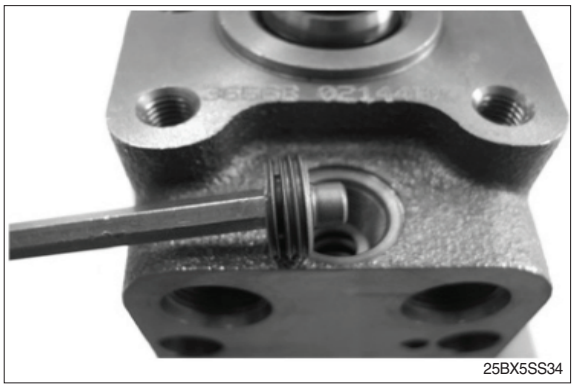
(31) Replace the unit in the holding tool on gear set end. Install the piston (32) to housing.


25BX5SS32

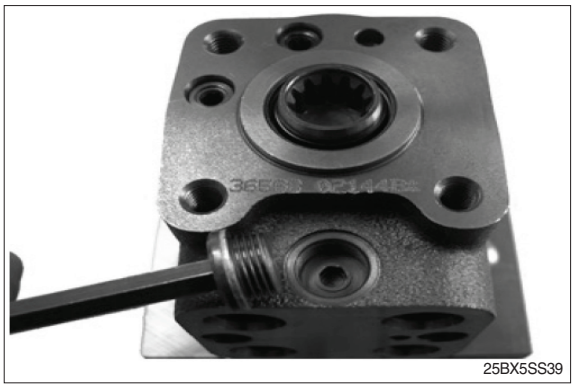
(32) Install the spring (31) on top of the piston (32).


25BX5SS33

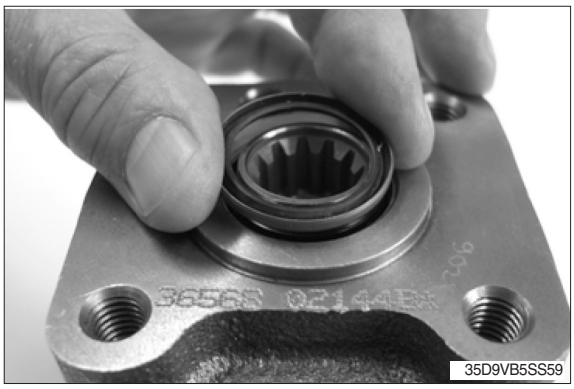
(33) Screw in the adjustment screw (30) using a 6 mm allen key. Make the pressure setting on a test panel according to valve setting specification.


25BX5SS34

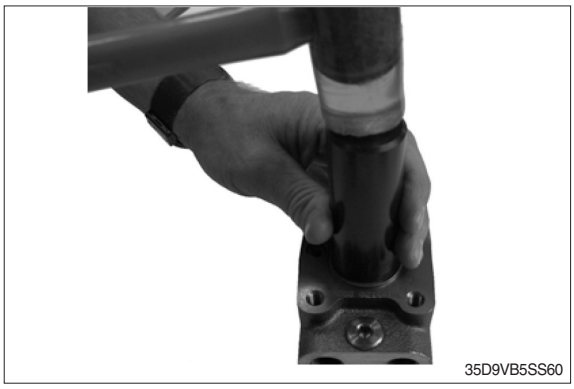
(34) Screw in the plug (42) using a 8 mm allen key.
· Tightening torque : 6.6±0.5 kgf·m
(47.7±3.6 lbf·ft)


25BX5SS39

(35) Place the dust seal ring (1) in the housing.


35D9VB5SS59

(36) Fit the dust seal ring in the housing using special tool for dust seal assembly and a plastic hammer.

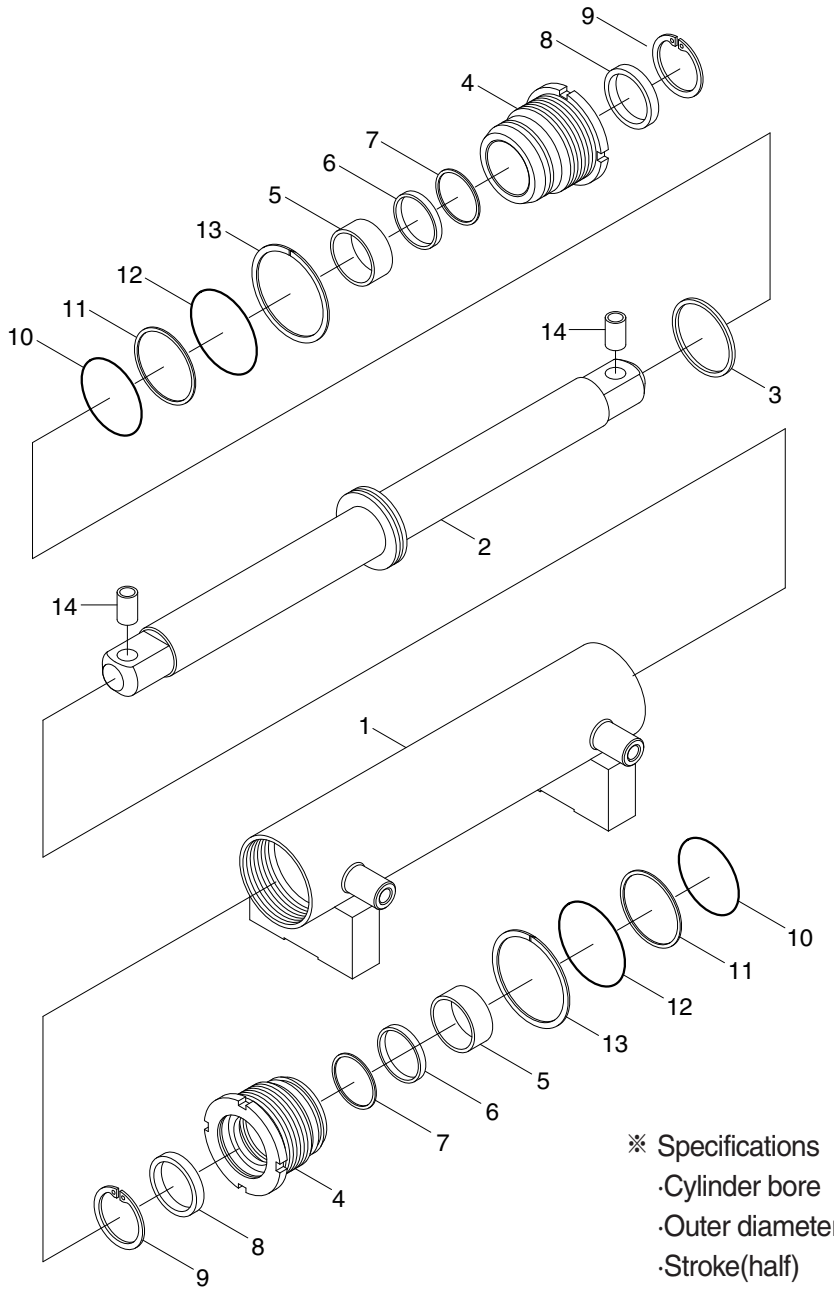

35D9VB5SS60

(37) Screw in the plastic plugs into the connection ports to keep the ports clean during storage and transportation.


25BX5SS40

## 2. STEERING CYLINDER

### 1) STRUCTURE




※ Specifications
- ·Cylinder bore : 80 mm (3.1 in)
- ·Outer diameter : 94 mm (3.7 in)
- ·Stroke(half) : 150 mm (2.9 in)
- ·Rod diameter : 55 mm (2.2 in)

50D9SE21

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

※ Seal kit : 3, 6, 7, 8, 10, 11, 12

## 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

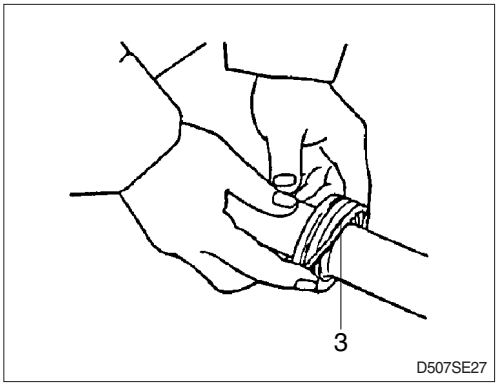
mm (in)

| 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 |

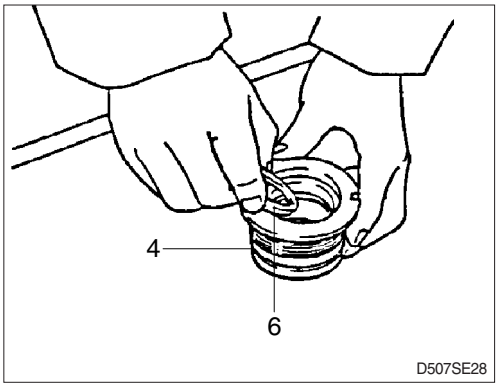
## 4) ASSEMBLY

(1) Install a new piston seal (3) around the groove on the piston.

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

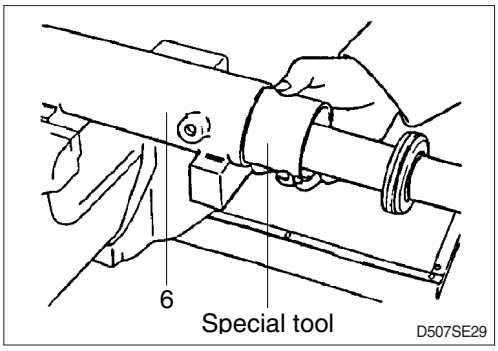



(2) Install the rod seal (6) to the position in the gland(4) applying a slight coat with grease prior to install.

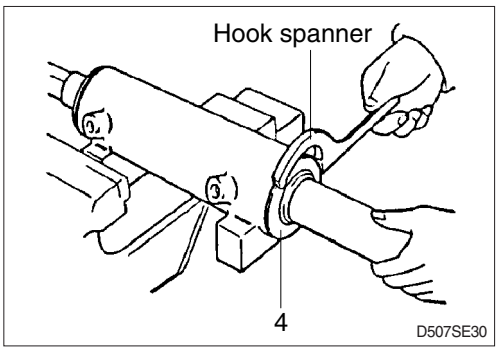


(3) Install the dust wiper (8) to the gland (4) using a special installing tool. Coat the dust wiper with grease slightly before installing.

(4) Using a special tool, install gland assembly into the cylinder tube (1).

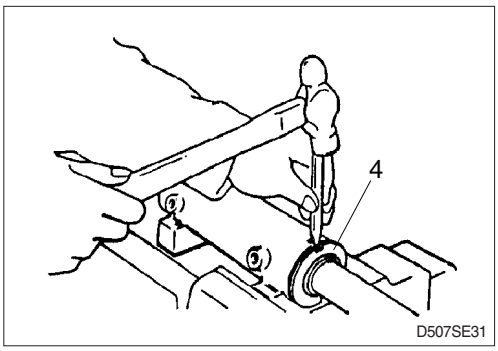



(5) Using a hook spanner, install the gland (4) assembly, and tighten it with torque 60±6 kgf·m (434±43 lbf·ft).




(6) After the gland (4) assembly was installed to the cylinder tube (1), 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.

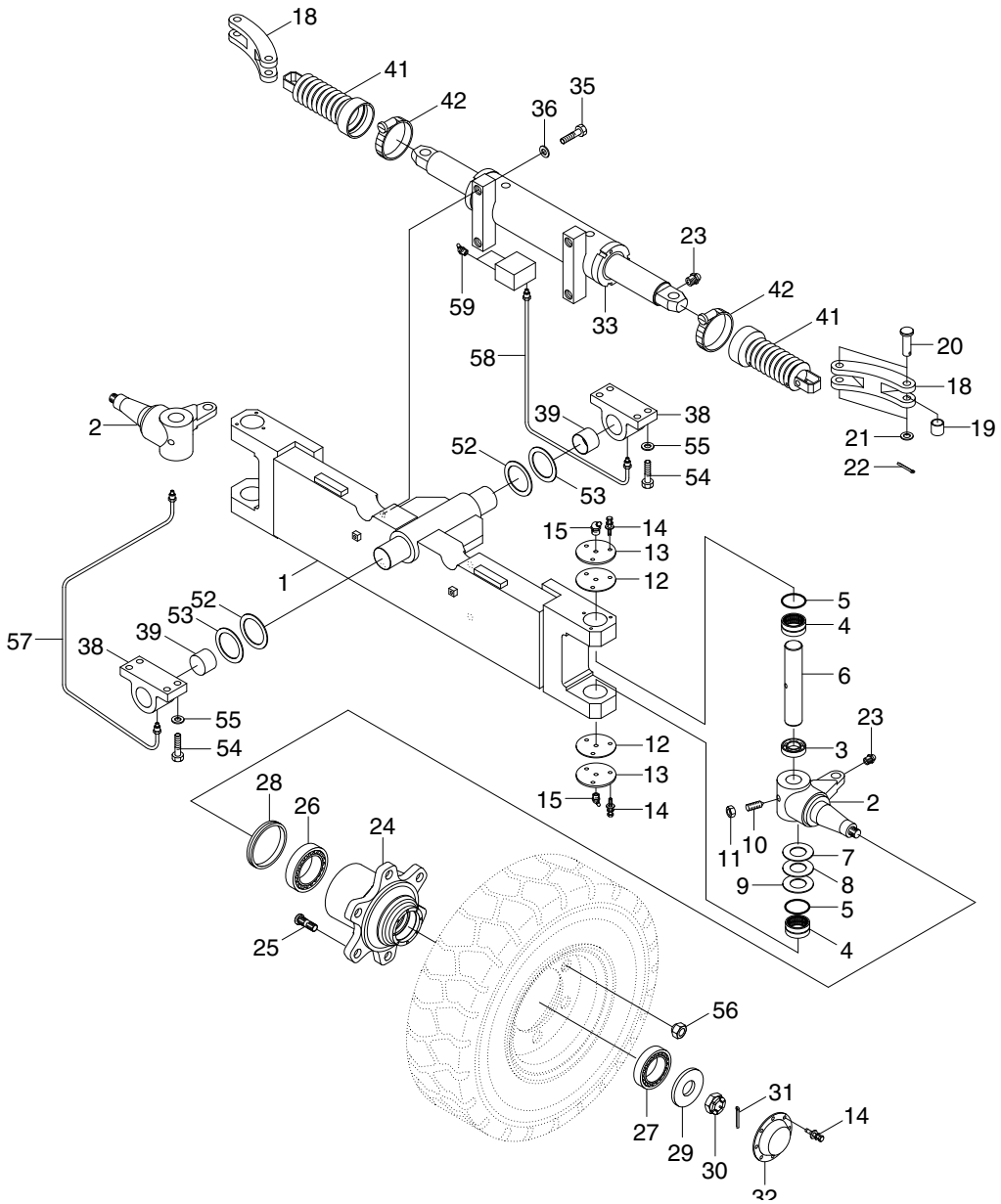
※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

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

## 4. STEERING AXLE

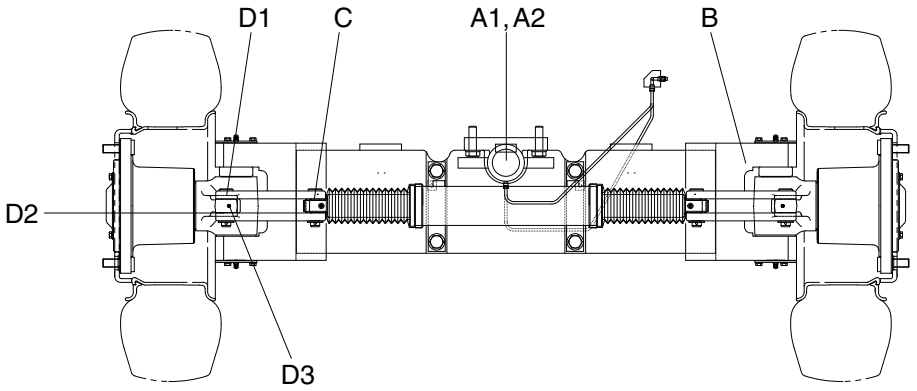
### 1) STRUCTURE

※ Do not remove the stopper bolt unless necessary.




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Steering axle | 13 | Cover | 25 | Hub bolt | 39 | Bushing |
| 2 | Knuckle | 14 | Bolt w/washer | 26 | Taper roller bearing | 41 | Steering cylinder boot |
| 3 | Thrust bearing | 15 | Grease nipple | 27 | Taper roller bearing | 42 | Clamp |
| 4 | Needle bearing | 16 | Hexagon bolt | 28 | Oil seal | 52 | Shim (1.0 t) |
| 5 | Oil seal | 17 | Hexagon nut | 29 | Special washer | 53 | Shim (0.5 t) |
| 6 | King pin | 18 | Link | 30 | Slotted nut | 54 | Hexagon bolt |
| 7 | Thrust washer | 19 | Bushing | 31 | Split pin | 55 | Hardened washer |
| 8 | Shim washer (0.1 t) | 20 | Link pin | 32 | Hub cap | 56 | Hub nut |
| 9 | Shim washer (0.2 t) | 21 | Special washer | 33 | Steering cylinder | 57 | Front pipe assy |
| 10 | Set screw | 22 | Split pin | 35 | Hexagon bolt | 58 | Rear pipe assy |
| 11 | Hexagon nut | 23 | Grease nipple | 36 | Hardened washer | 59 | Grease nipple |
| 12 | Gasket | 24 | Hub | 38 | Support | | |

## 2) CHECK AND INSPECTION




50D9SE25

unit : mm (in)

| No. | Check item | | | Criteria | | Remedy |
|---|---|---|---|---|---|---|
| | | | | Standard size | Repair limit | |
| A | Shaft | A1 | OD of shaft | 60(2.4) | 59.5(2.3) | Replace |
| | | A2 | ID of bushing | 60(2.4) | 59.5(2.3) | |
| B | OD of king pin | | | 50(2.0) | 49.8(2.0) | |
| C | OD of steering cylinder pin | | | 22(0.9) | 21.9(0.9) | |
| D | Knuckle | D1 | OD of pin | 22(0.9) | 21.9(0.9) | |
| | | D2 | Vertical play | - | 0.2(0.008) | Adjust shim |
| | | D3 | ID of bushing | 22(0.9) | 22.5(0.9) | Replace |

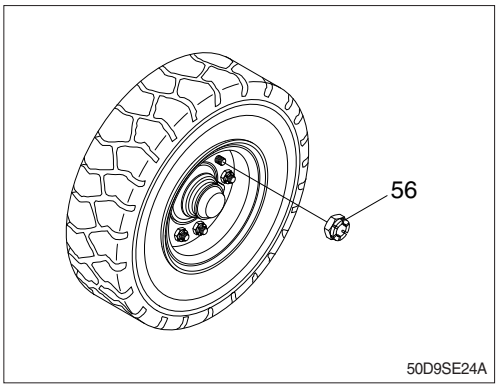
·OD : Outer diameter

·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 balance weight part of the truck.

(1) Loosen the hub nut (56) and take off the steering wheel tire.




(2) Remove Hub cap (32).

(3) Pull out split pin (31) and remove slotted nut (30), washer (29).

(4) Using the puller, take off the hub (24) together with the taper roller bearing (26, 27).

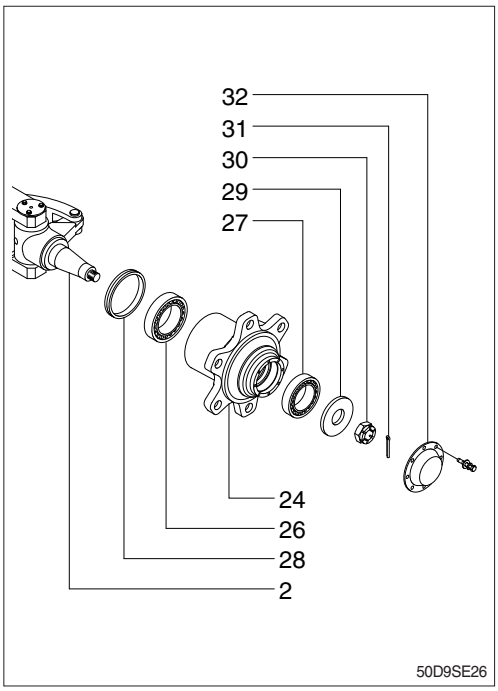
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.

(5) After hub (24) is removed take off the inner race of taper roller bearing (26, 27).

(6) Pull out oil seal (28).

※ 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 set screw (10) and nut (11).

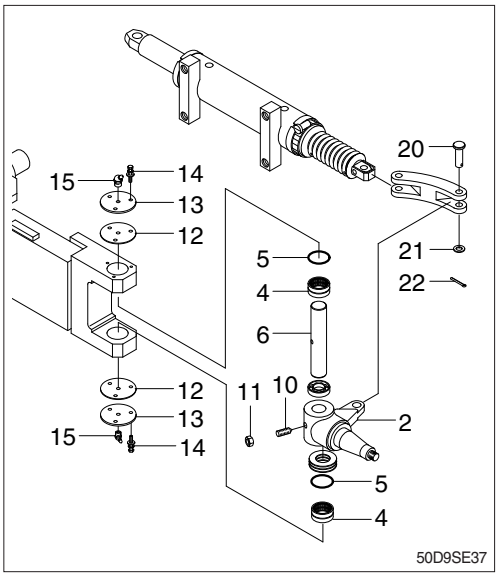
(9) Loosen with washer bolt (14) and remove cover (13), gasket (12). Remove grease nipple (15).

(10) Push out the king pin (6) without damaging the knuckle arm (2).

(11) At the same time the king pin is removed, pull out the oil seal (5).

(12) If defect is observed in needle bearing (4), pull it out by using extractor.

(13) Remove spilt pin (22), special washer (21) and link pin (20).



### 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 set screw (10) of king pin (6).

(2) There is a notch in the middle of the king pin (6), make sure that this notch is on the set screw side.

(3) Do not hammer to drive in needle bearing(4) because it will break.
Always use drive-in tool. In assembling the thrust bearing (3), be sure that the fixed ring of the bearing is placed in position facing the knuckle (2).

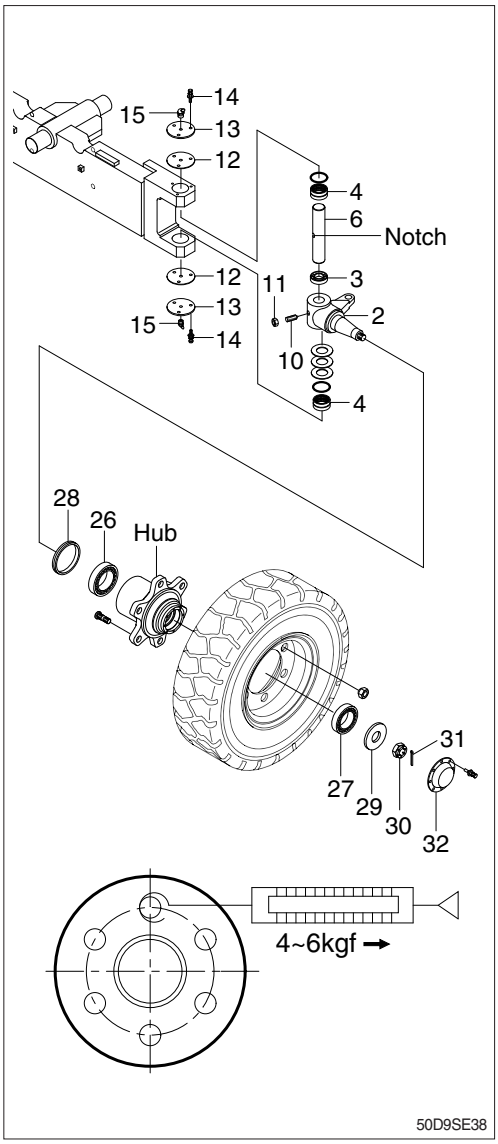
(4) Hub

※ Mount oil seal (28) and inner race of taper roller bearing (26) on the knuckle. The bearing should be well greased before assembling.

※ Install the outer race of the bearing (27) in the wheel center and assemble to the knuckle.

※ Put washer (29) in place, tighten with nut (30) and locked with split pin (31). 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.

※ Mount the hub cap (32).
Bearing should be well greased before assembling.



# SECTION 6 HYDRAULIC SYSTEM

Group 1 Structure and function ..... 6-1
Group 2 Operational checks and troubleshooting ..... 6-27
Group 3 Disassembly and assembly ..... 6-32

# SECTION 6 HYDRAULIC SYSTEM

## GROUP 1 STRUCTURE AND FUNCTION

### 1. HYDRAULIC SYSTEM OUTLINE

The hydraulic system consists of a variable displacement pump, a control valve (MCV), lift cylinders and tilt cylinders. Refer to below followings. The oil is supplied from the tank at the left side of the frame. The hydraulic return filter is installed inside in the hydraulic tank. For the high-pressure piping, the o-ring fitting method (ORFS) that provides high sealing performance is employed to improve hydraulic system serviceability.

#### 1) VARIABLE DISPLACEMENT PUMP

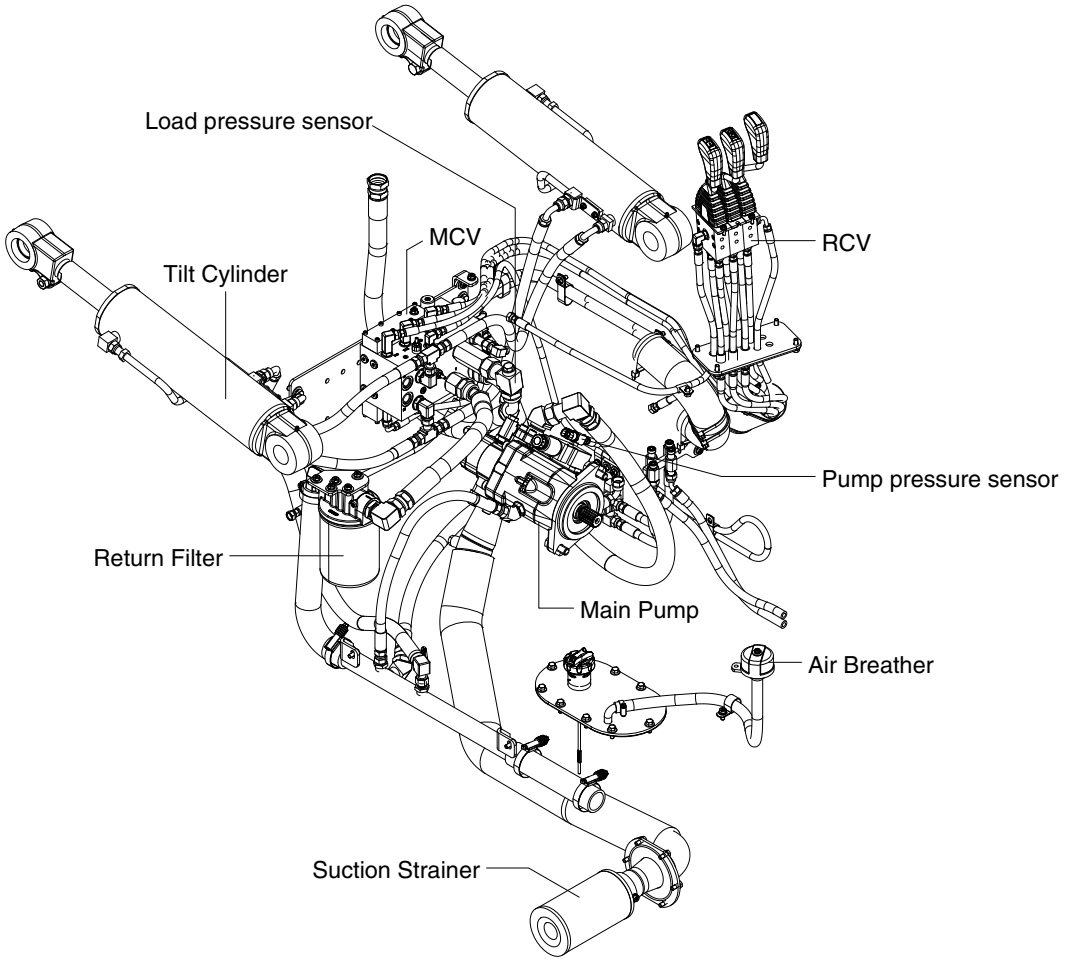
· Lift cylinder ,Tilt cylinder, Steering cylinder, Auxiliary function cylinder

#### 2) MCV

· Built in priority valve and shuttle valve, Lift function, Tilt function, Auxiliary function (Sideshift etc.), RCV

#### 3) HYDRAULIC OIL TANK

· Return filter, Suction strainer, Air breather, Drain plug-magnetic

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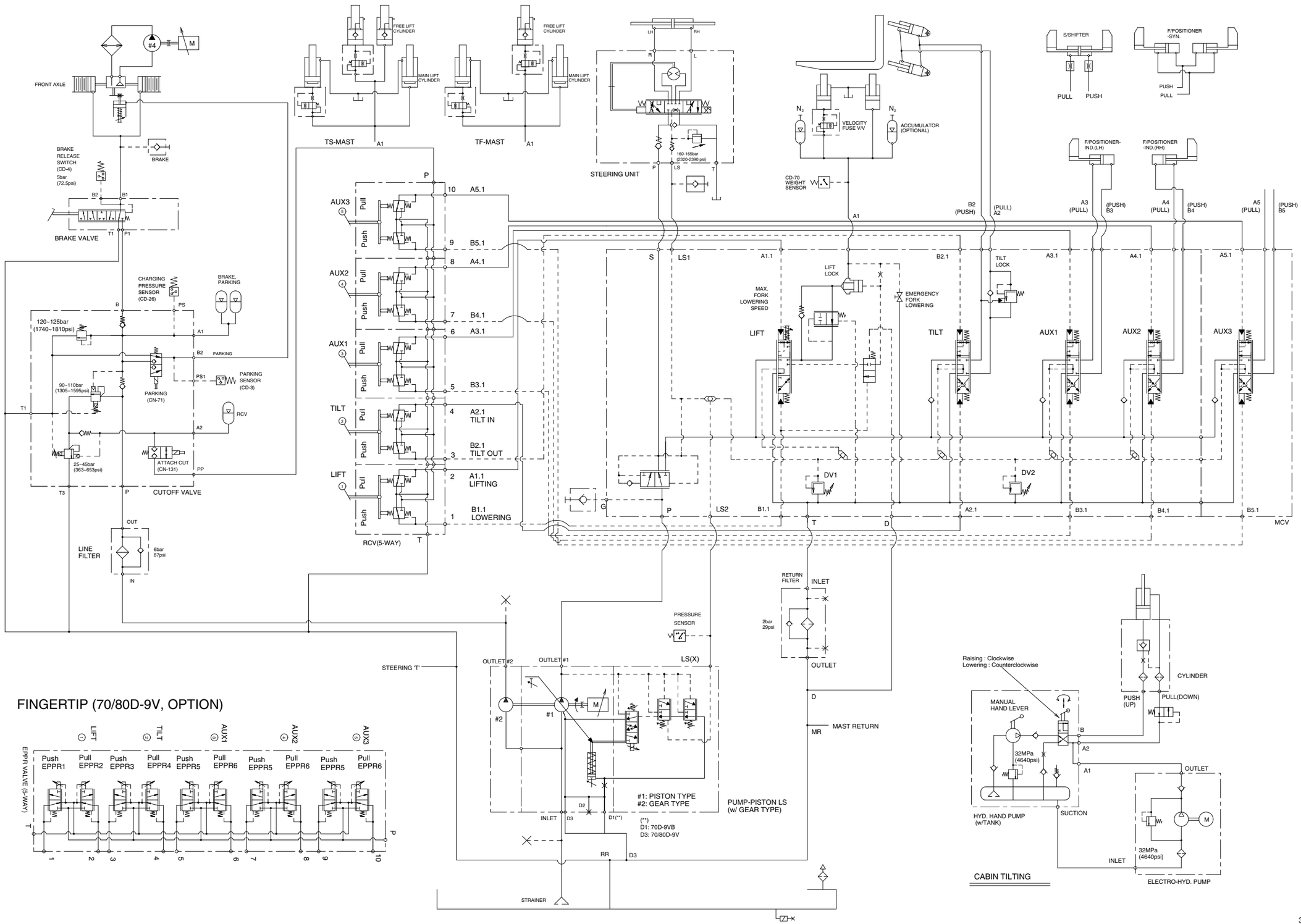
## 2. HYDRAULIC CIRCUIT



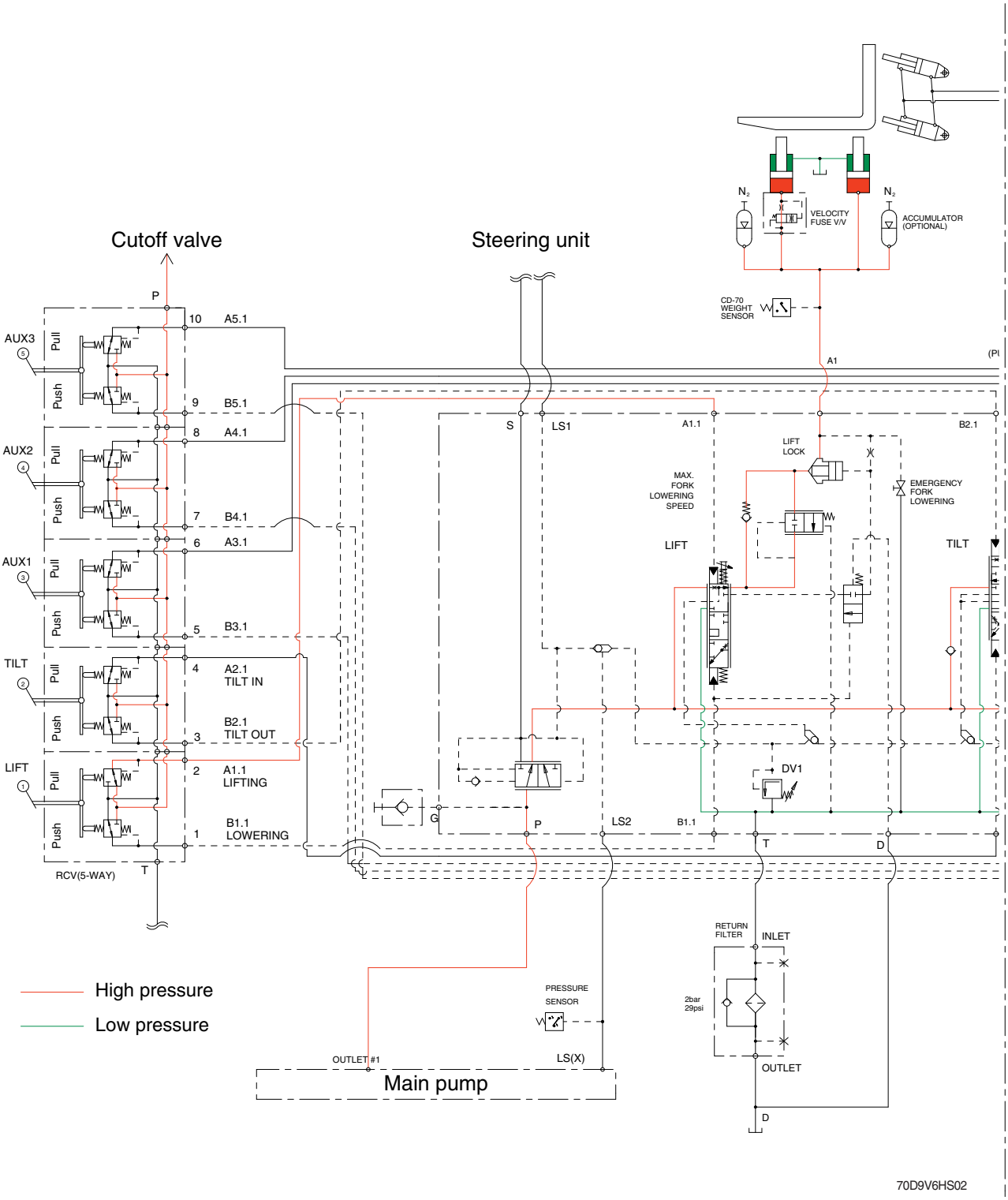

### FINGERTIP (70/80D-9V, OPTION)




3YFJ-00100-05

## 3. WORK EQUIPMENT HYDRAULIC CIRCUIT

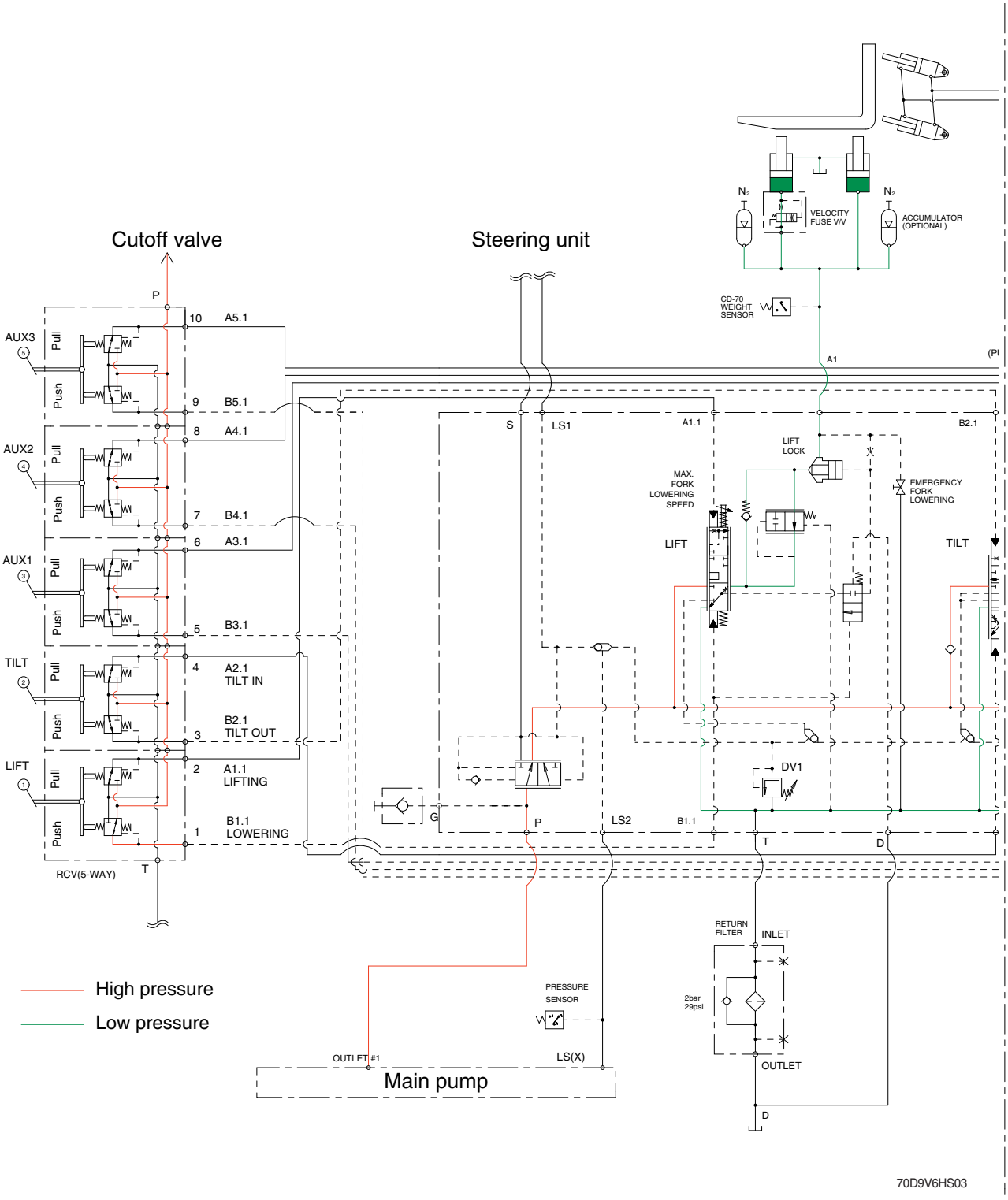
### 1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION




When the lift control lever is pulled back, the spool in the first block is moves to lift position. The oil from the main pump flows into main control valve through the priority valve. Then goes to the large chamber of lift cylinder by pushing the load check valve of the spool and lift lock valve.

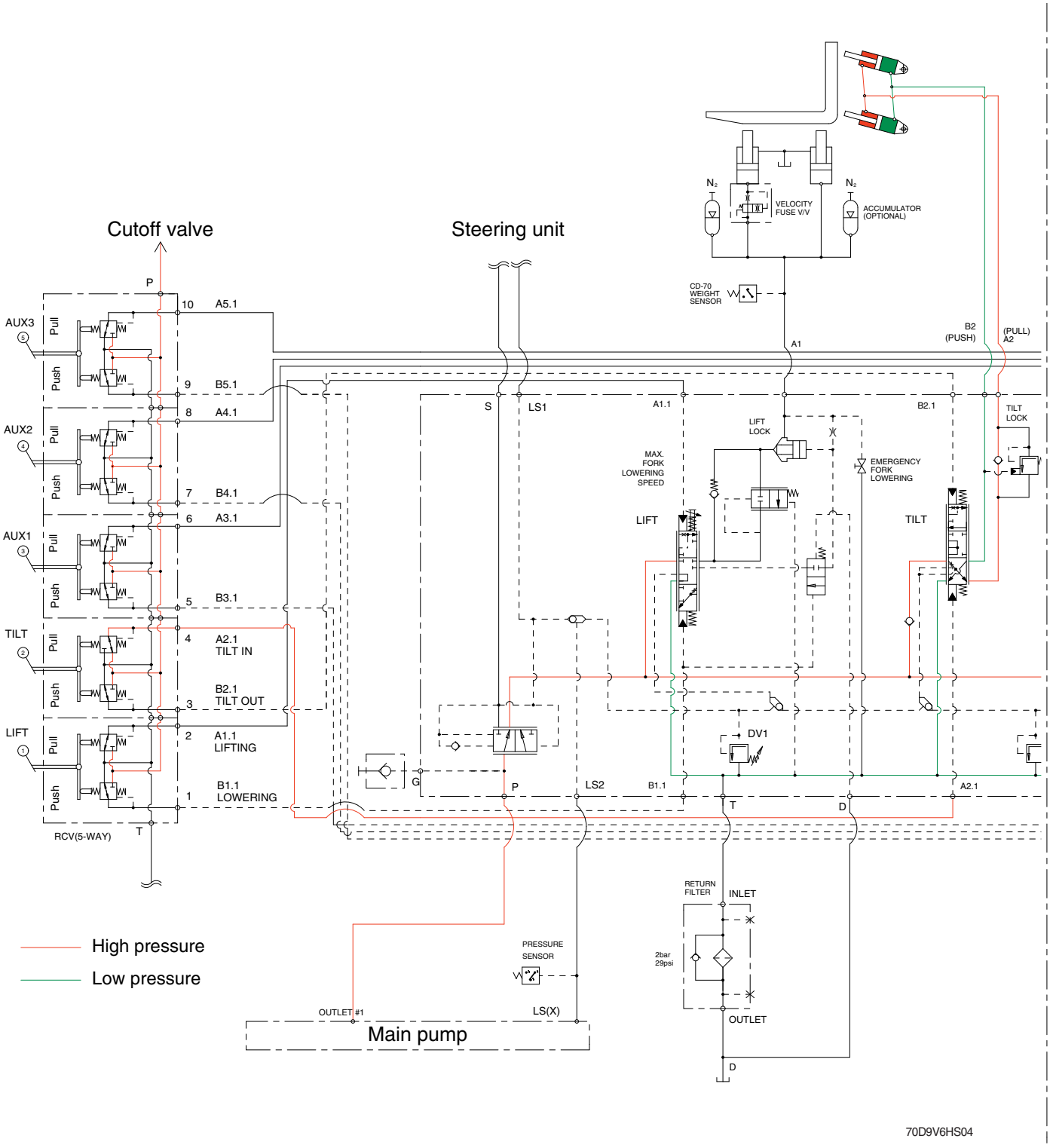
The oil from the small chamber of lift cylinder returns to hydraulic oil tank at the same time. When this happens, the forks go up.

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




When the lift control is pushed forward, the spool in the first block is moved to lower position.
The work port 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.

## 3) WHEN THE TILT CONTROL LEVER IS IN THE BACKWARD POSITION



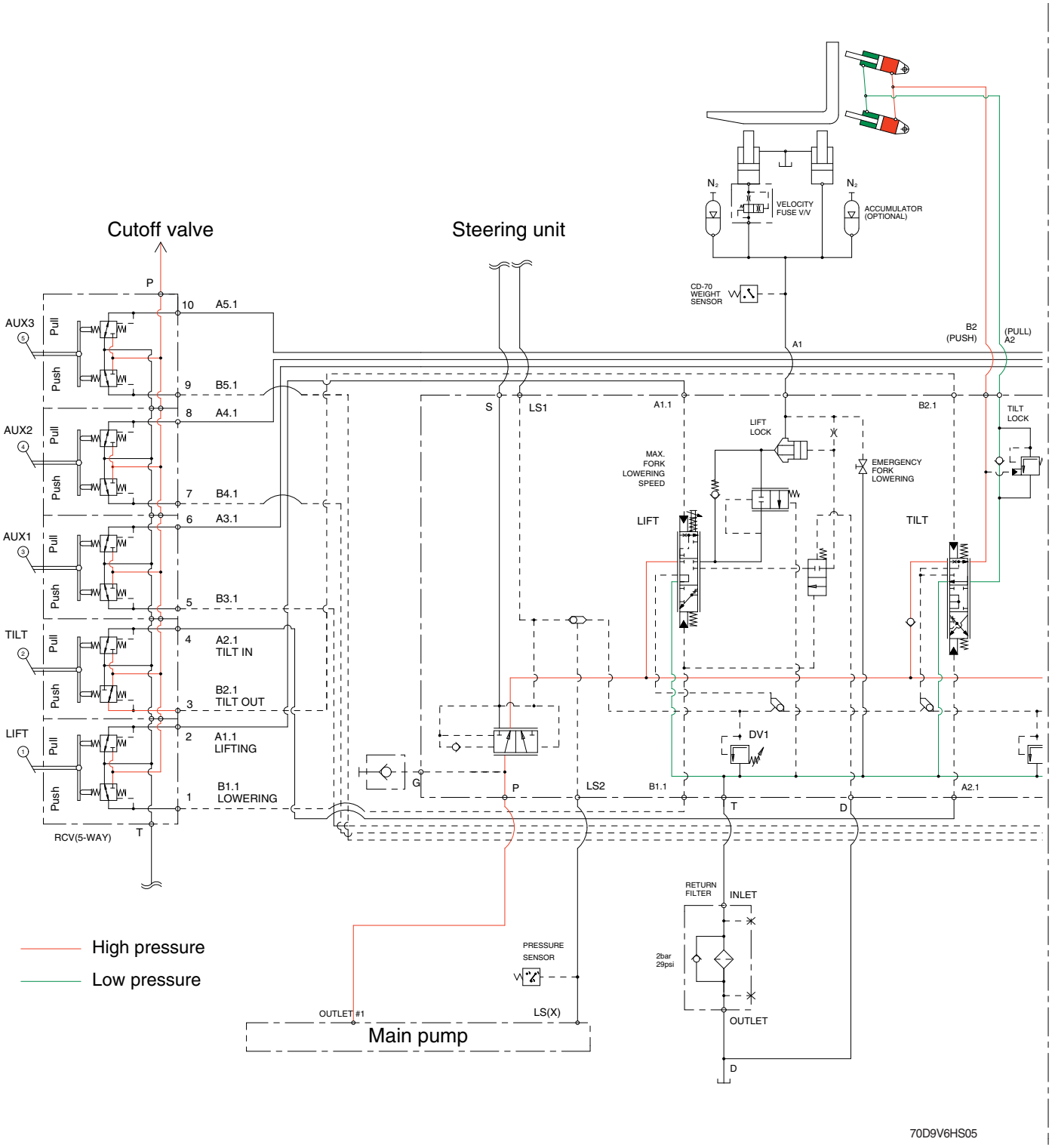

When the tilt control lever is pulled back, the spool in the second block is moved to tilt backward position.

The oil from the main pump flows into main control valve through the priority valve. Then goes to the small chamber of tilt cylinder by pushing the load check valve of the spool and tilt lock valve.

The oil at the large chamber of tilt cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

When this happens, the mast tilt backward.

## 4) WHEN THE TILT CONTROL LEVER IS IN THE FORWARD POSITION




When the tilt control lever is pushed forward, the spool in the second block is moved to tilt forward position.

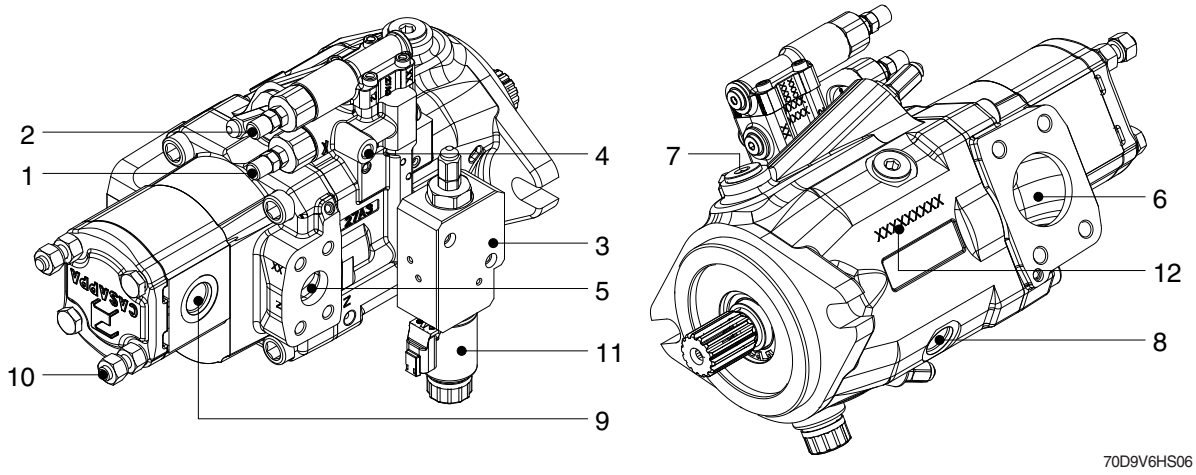
The oil from the main pump flows into main control valve through the priority valve. Then goes to the large chamber of tilt cylinder by pushing the load check valve of the spool and tilt lock valve.

The oil at the small chamber of tilt cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

When this happens, the mast tilt forward.

## 4. MAIN PUMP

### 1) STRUCTURE



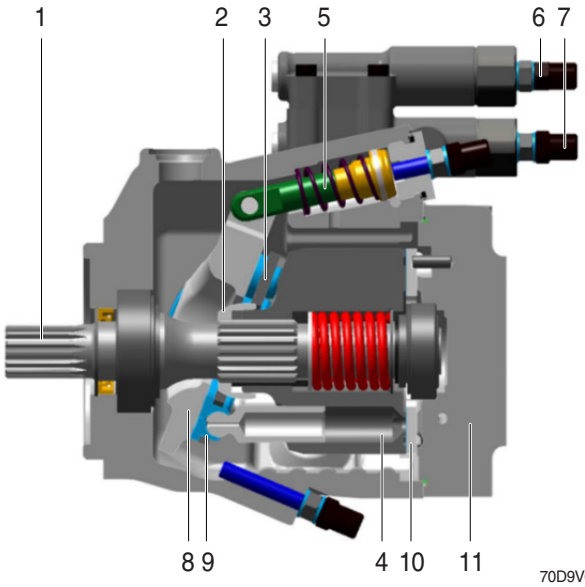

| | | | | | |
|---|---|---|---|---|---|
| 1 | Flow compensator | 5 | Pressure port (out) B | 9 | Pressure port (Outlet) |
| 2 | Pressure compensator | 6 | Suction port (in) S | 10 | Stud bolt and nut |
| 3 | DEC valve | 7 | Drain port D1 | 11 | 12V coil (CN-155) |
| 4 | Load sense (LS) port X | 8 | Drain port D3 | 12 | Label |

| Index | Function | Port | Thread (quantity) | Tightening torque | |
|---|---|---|---|---|---|
| | | | | kgf·m | lbf·ft |
| Piston pump | Suction | IN (S) | M12 (4 EA) | 3.1 | 22.4 |
| | Dischrage | OUT (B) | M10 (4 EA) | 3.1 | 22.4 |
| | LS | X | BSPP PF 1/8 | 1.5 | 10.9 |
| | Drain | D1, D3 | 7/8-14UNF | 3.1 | 22.4 |
| | Plug and nut (M8) | Limiter (Displacement, pressure) | | 1.5 | 10.9 |
| | | Flow regulator | | 1.5 | 10.9 |
| | | DEC Valve | | 1.5 | 10.9 |
| | Mount bolt | DEC Valve | M6 (2 EA) | 1.5 | 10.9 |
| | | Flow regulator, pressure limiter | M6×60 (4 EA) | 1.5 | 10.9 |
| | | Cover | M14×45 (4 EA) | 13.2 | 95.5 |
| | Coil valve DEC | - | - | 0.6 | 4.4 |
| Gear pump | Dischrage | Outlet | 7/8-14UNF | 7.2 | 52 |
| | Mount bolt | Stud bolt | M10×120 (2 EA) | 4.6 | 33.3 |
| | | Rear cover | M10×85 (2 EA) | 4.6 | 33.3 |

**※ Drain port : D1 - 70D-9VB, D3 - 70/80D-9V**

## 2) OPERATION

### (1) General

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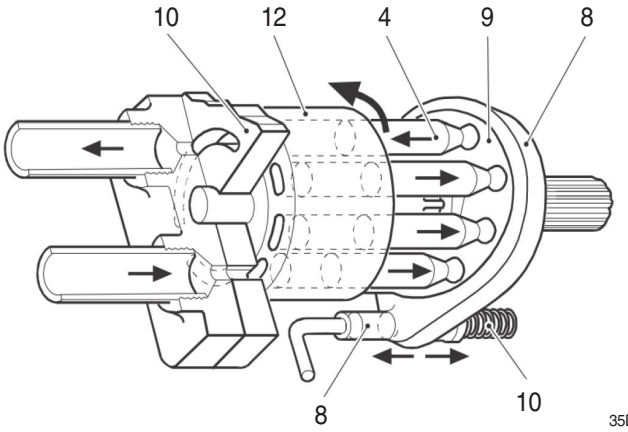



35D9VB6HS62

1 Drive shaft
2 Sleeve (retaining ball)
3 Slider
4 Piston
5 Regualting piston
6 Pressure compensator
(adusting screw, max. Pressure)
7 Flow compensator
(adjusting screw, stand-by pressure)
8 Swash plate
9 Regualting plate
10 Valve palte (distributor plate)
11 Connection plate
12 Cyclinder rotor
13 Return spring

These pumps are the variable axial piston pump type and are controlled with load signals from the flow demand for each respective function. They pump oil with 9 pistons (4) that are located in a cylindrical cylinder block (cylinder rotor). The pistons (4) are tubular sleeves with a ball-shaped top. There are T-shaped sliders (3) on the piston top. The sliders are fixed in the swash plate (8).

The swash plate secures the piston tops so that the pistons run straight in the cylinder bores. The swash plate is forced against the regulating plate by a ball-shaped sleeve (2) on the pump shaft. The cylinder rotor (12), pistons (4), sliders (3) and swash plate (8) rotate with the pump shaft.

The sliders (3) slide against the regulating plate (9). On the other side of the cylinder rotor, there is a valve plate (10) which controls oil to and from the cylinder rotor. The regulating plate (9) angles in relation to the pump's shaft with a regulating piston (5) to change the pump's capacity. A return spring (13) acts against the regulating piston (5). The pressure regulator (7) limits max. pressure and min. pressure (stand-by pressure).

The pressure regulator (7) limits max. pressure and min. pressure (stand-by pressure).

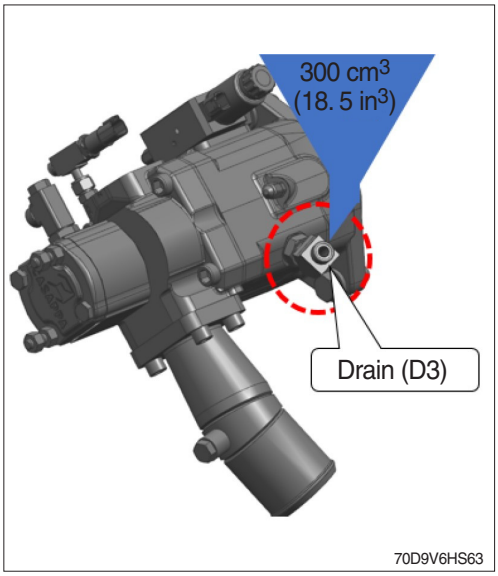
When the shaft turns, the cylinder rotor (12) will rotate. The angle of the regulating plate (9) results in the pistons being pulled in and out of the cylinder rotor by the sliders. The pistons' (4) stroke is changed by changing the angle of the yoke.

When the pistons are pulled out of the cylinder rotor (12), the cylinder and the space in the piston are filled with oil (suction phase). The oil is sucked through the outlets in the valve plate (1).

When the pistons are pressed in, the oil is forced out at the bottom, through the valve plate (10). A small amount of oil is forced through the piston head and lubricates the slider and yoke. The yoke does not rotate, which means that the pistons always suck and respectively force oil in a certain part of the revolution. This makes it possible to simplify the design of the valve plate, and valves can be avoided.

The regulating piston, which controls the angle of the yoke and thus the pump performance, is affected by load signals from the hydraulic system's valves. The pump also has its own supply which means that the pump always pumps a small amount, a so-called "stand-by pressure".

※ **Axial piston variable pumps may not be started until they are filled with oil. A pump of this construction relies on the oil it is pumping to provide lubrication for its moving parts. Never lubricate the sliding parts in the pump casing and do not operate the pump in a dry state. It will be damaged immediately. Fill the pump case to the highest case drain or vent port. Use clean filtered fluid.**



### 3) CHECKS AND ADJUSTMENTS

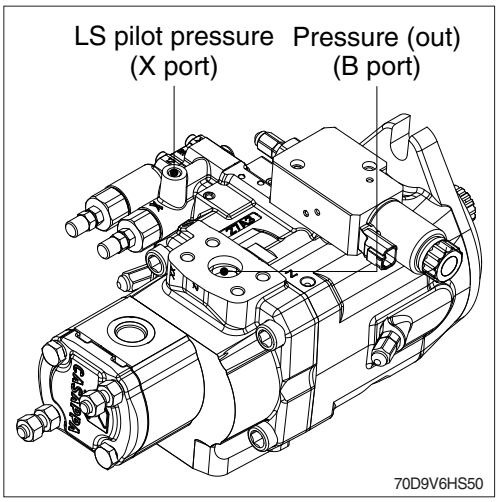
#### (1) Margin pressure check

The margin pressure is the difference between the pressure at the B-Port and X-Port. If the margin pressure is not within the range shown in the below table, the flow of hydraulic oil out of the variable displacement pump will be either too low or too high.

**⚠ Do not operate the hydraulic functions while checking the margin pressure. Serious injury to personnel and damage to the lift truck can result if hydraulic functions are operated.**

① Install pressure gauges on port B and port X respectively. See the illustration for location.
② Start the engine and keep the forklift at idle for 5 minutes.
③ Check the pressure on the gauge compared to that listed in the under table.
④ If the margin pressure is not within the range specified in the below table, go to "The flow compensator adjustment section".

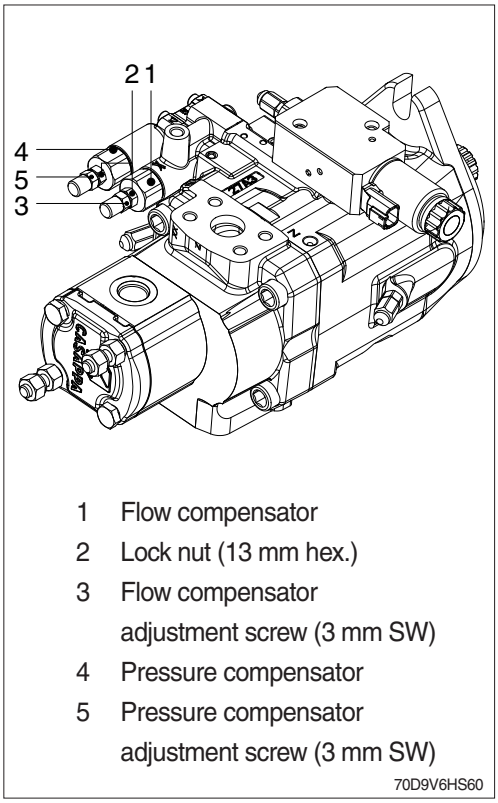
| Gague B-X | bar | psi |
|---|---|---|
| | 25 ± 1 | 363 ± 14.5 |




#### (2) Flow compensator adjustment

① Insert an hexagonal wrench (3 mm) into flow compensator adjustment screw. Hold hexagonal wrench in flow compensator screw and turn locknut (13 mm) counterclockwise all the way.
② Turn the flow compensator adjustment screw to adjust the B port pressure.
- Clockwise to increase the B port pressure by 16 bar (232 psi) per turn.
- Counterclockwise to decrease the B Port pressure by 16 bar (232 psi) per turn.

③ Check the margin pressure as described in the margin pressure checks. If margin pressure is not correct, perform Step 1 and Step 2 until correct margin pressure is reached.
④ Tighten the locknut to 1.5 kgf·m (10.9 lbf·ft).




1 Flow compensator
2 Lock nut (13 mm hex.)
3 Flow compensator adjustment screw (3 mm SW)
4 Pressure compensator
5 Pressure compensator adjustment screw (3 mm SW)

### (3) Pressure compensator adjustment

① Mark or measure the screw locations of the flow and pressure compensators.

※ **Be sure to count and note the number of turns on the lock nut.**

| Pressure compensator | bar | psi |
|---|---|---|
| | 250 | 3625 |

② Using an hexagonal wrench (3 mm), hold the flow compensator adjustment screw and turn the lock nut (13 mm) counterclockwise all the way.

③ Turn the flow compensator adjustment screw clockwise until it stops.

- Clockwise to increase the B port pressure by 52 bar (754 psi) per turn.
- Counterclockwise to decrease the B Port pressure by 52 bar (75 psi) per turn.

④ Start forklift truck engine and let it idle. Do not operate the hydraulic functions. Measure the pressure at the B port of the pump. If pressure does not match what is shown in the above table, adjust the pressure compensator as follows.

a. Turn pressure compensator adjustment screw clockwise to increase pressure by 52 bar (754 psi) per turn.

b. Turn pressure compensator adjustment screw counter clockwise to decrease pressure by 52 bar (754 psi) per turn.

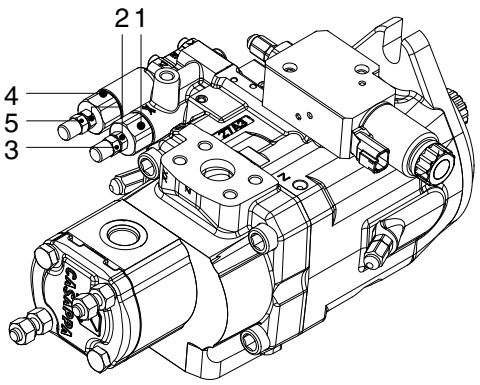
c. Put the pressure compensator adjustment screw back to its original position by turning the adjustment screw counter clockwise by the number of turns noted earlier.

d. Tighten locknut on pressure compensator adjustment screw to 1.5 kgf·m (10.9 lbf·ft).

e. Put the flow compensator adjustment screw back to its original position by turning the adjustment screw counter clockwise by the number of turns noted earlier.

f. Check the margin pressures as described in the margin pressure checks.

g. If margin pressure is correct, tighten the flow compensator lock nut to 1.5 kgf·m (10.9 lbf·ft). If margin pressure is not correct, adjust margin pressure as outlined in the margin pressure checks.

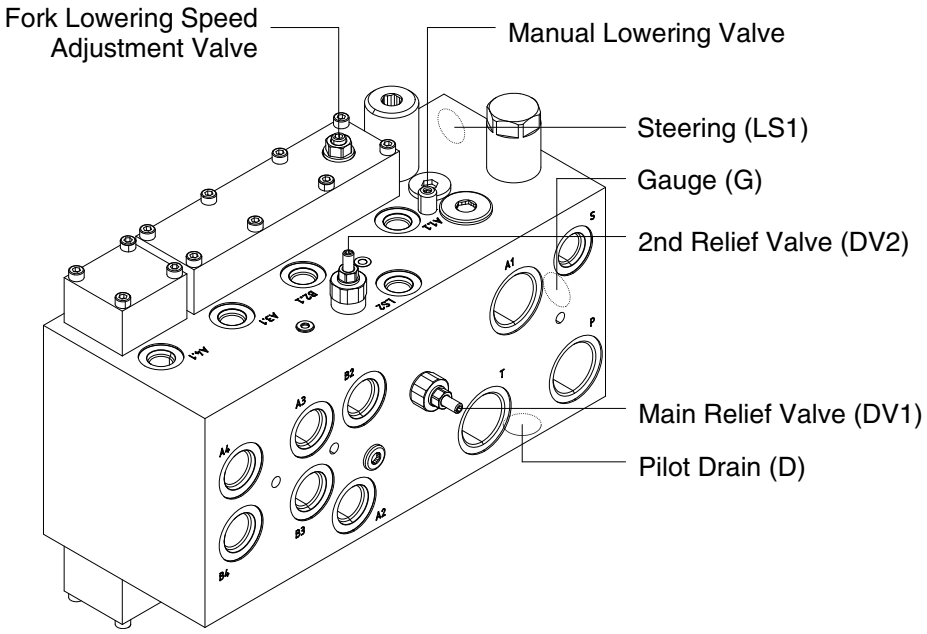



1 Flow compensator
2 Locknut (13 mm hex.)
3 Flow compensator adjustment screw (3 mm SW)
4 Pressure compensator
5 Pressure compensator adjustment screw (3 mm SW)

70D9V6HS60

## 5. MAIN CONTROL VALVE

### 1) STRUCTURE (4 SPOOL)



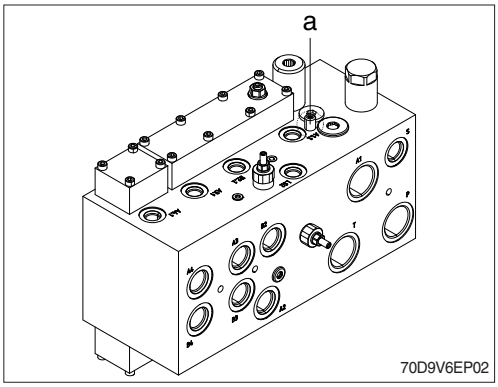

70D9V6HS07A

| Port | Port name | Port size | Tightening torque | |
|---|---|---|---|---|
| | | | kgf·m | lbf·ft |
| A1 | Lift / Lower | BSPP PF 1 | 19.0 | 177 |
| A2, B2 | Tilt rod / head | 7/8-14 UNF | 9.5 | 51.6 |
| A-, B- | Aux 1, Aux 2 | | | |
| P | Inlet | BSPP PF 1 | 19.0 | 177 |
| T | Outlet | | | |
| a-.-, b-.- | RCV Lever | 9/16-18 UNF | 3.0 | 22.4 |
| G / LS2 / D / LS1, S | Gauge / Pilot / Drain / Steering | | | |
| - | Main relief valve (DV1) | - | 0.27 | 1.95 |
| | 2nd relief valve (DV2) | | | |
| | Manual lowering valve | | | |
| | Fork lowering speed ajdustment valve | M8 | | |

## 2) FUNCTION

### (1) Emergency fork lowering

In case that the mast can not be lowered due to a problem in the controller, activate the emergency lowering valve on the MCV assembly by rotating the valve (a).




**⚠ Manual override features are intended for emergency use, not for continuous-duty operation.**

① Rasing the cabin.

② Use the L-wrench (3 mm) to slowly undo the screw for the emergency lowering feature in an anti-clockwise direction until lowering begins.

※ **Do not undo the screw more than 1.5 turns.**

※ **If lowering still does not begin, there is a mechanical block. Do not under any circumstances continue to unscrew the emergency lowering feature.**

③ After lowering is complete, the screw must be screwed back in again

※ **Screw locking is essential to prevent fork lifting (or lowering) slow (or malfunction) due to valve opening.**

※ **Do not exceed a tightening torque of maximum 0.25 ~ 0.3 kgf·m (1.8 ~ 2.2 lbf·ft).**

**⚠ When operating the emergency lowering valve in order to lower the mast inevitably, always make certain that any person should not stand or pass under the mast, the fork and platform so as to avoid from unexpected accident such as severe personal injury or death.**

(2) **Cutoff solenoid for hydraulic blocking**

This device is a mast interlock that prevents the hydraulic functions of the RCV from being activated unless the driver is seated. In addition, it is a key lowering interlock device that prevents the fork from descending even when the ignition key is turned off. This safety function is defined in ISO 3691-1 and should not be arbitrarily disabled in the RCV.

**(3) Relief valve**

① Main relief valve (DV1)

The main relief valve limits the maximum pressure for the lift and tilt functions. If the lift or tilt function is operated simultaneously with the auxiliary function, the maximum pressure of the lift or tilt function is limited by the 2nd relief valve pressure setting. Typically the main relief valve would not require any field adjustment. If adjustment is necessary, refer to next page for main relief valve test and adjustment.

② 2nd relief valve (DV2)

The secondary relief valve limits the maximum pressure of the auxiliary function and is set lower than the main relief valve. Secondary relief valves may require pressure adjustment depending on the type of attachment.

**※ If pressure adjustment is required, it is recommended to adjust within 90% of the main relief valve set pressure (e.g. 210 × 0.9=190 bar). If the main relief valve is too close to the set pressure, a problem of inter-circuit interference may occur. Refer next page for relief valve test and adjustment for adjustment instructions. As for the auxiliary function, up to 2 fingertip control methods and up to 3 manual control methods are provided as options.**

## 3) RELIEF VALVE PRESSURE TEST AND ADJUSTMENT

(1) Test specification

- Engine speed : high idle rpm
- Oil temperature : 50 ± 5 ℃ (122 ± 9 ℉)
- MCV relief set pressure
  - Main : 210 ± 3 bar (3045 ± 43 psi)
    ★185 ± 3 bar (2680 ± 43 psi) / ★ : EU, AN corporate sales equipment
  - 2nd : 140 ± 3 bar (2030 ± 43 psi)
- Tools : spanner 10 mm, hex. wrench 3 mm

**⚠ In general, the main relief valve (DV1) should not be adjusted for boosting applications in the field. Increasing the main relief valve pressure above the specified set pressure can damage the equipment.**

**⚠ Inspect the relief valve in a safe and clean environment.**

**⚠ Make sure that there is no other person around the equipment during operation and testing.**

**⚠ Even after turning off the engine, hydraulic oil may remain in the hydraulic system. To prevent personal injury, lower the fork completely down to the ground. (The mast chain has to be released loosely so that the fork is completely lowered.)**

**⚠ Before disassembling, tightening, removing, or adjusting piping components (hoses, fittings, plugs, etc.), be sure to turn off the engine. Completely remove the pressure inside the circuit by moving the MCV control lever two or three times in the forward and backward direction. Also opening the hydraulic tank cap and remove the pressure. (If the hydraulic tank breather filter is clogged, the pressure in the tank may remain.)**

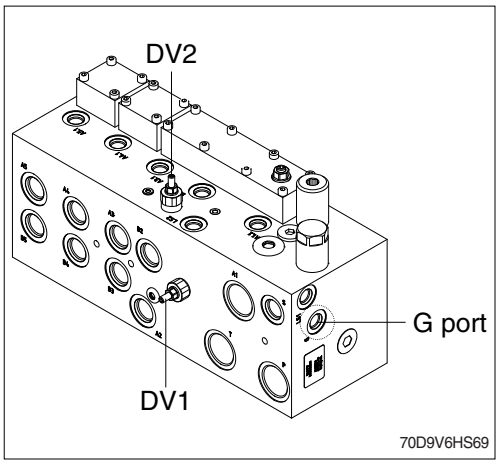
⚠ **Hot hydraulic oil can cause serious burns to skin. Do not touch hydraulic components or oil during test. Make sure hydraulic oil has cooled to safe temperature before installing or removing test equipment.**

⚠ **Hydraulic oil under pressure can be injected into skin. Lower forks to ground and relieve all circuit pressure before removing test plugs from valve.**

① Operate hydraulic system until the oil temperature is within test specification. See Hydraulic WarmUp Procedure.
② Lower the fork to the ground, stop the engine, and apply the parking brake switch.
③ Rasing the cabin.
④ Connect a pressure gauge to the “G” pressure check port on the MCV.
⑤ Operate engine at test specifications.
⑥ Pull the lift lever to raise the fork all the way and hold it.
⑦ Check pressure gauge reading. Compare the readings and specifications.
⑧ Loosen the MCV relief valve locknut (10 mm) and turn the adjusting (3 mm) screw to adjust the pressure.
- Tightening torque : 0.25 kgf·m (1.81 lbf·ft)
- If pressure is lower than specification, turn relief valve adjusting screw clockwise.
- If the pressure is higher than the specification, turn the adjusting screw counterclockwise.

⚠ **The MCV relief valve adjustment screw is very sensitive. Operate in 1/4 turn increments to avoid system overpressure.**

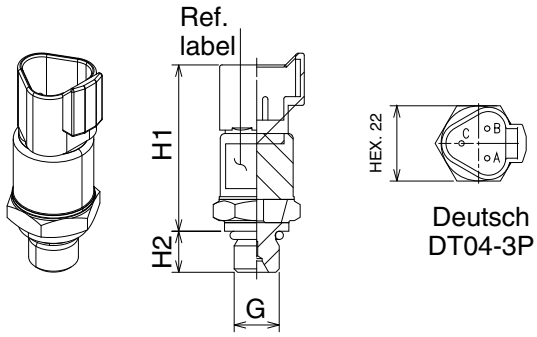
⑨ Repeat step ⑦, ⑧. If pressure is to specifications, remove test equipment.



## 6. PRESSURE SENSORS

### 1) LOAD PRESSURE SENSOR

(1) Structure




· Tightening torque : 2.5 ~ 3.0 kgf·m
(18 ~ 21.7 lbf·ft)

| Pin map | Function |
|---|---|
| A | + Supply |
| B | - Supply |
| C | Output |

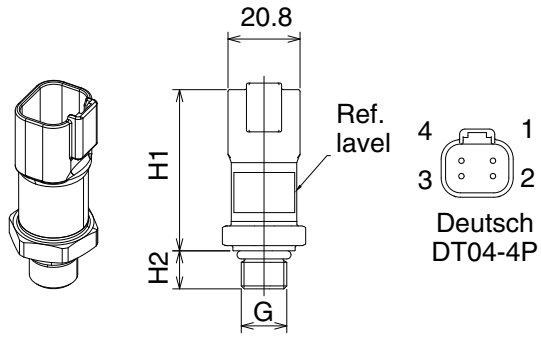
70D9V4BS10

| Item | Medium | Thread (G) | H1 (mm) | H2 (mm) | Measuring range (bar) | Voltage (V) | Electircal connections |
|---|---|---|---|---|---|---|---|
| Fork load pressure sensor | Oil | 9/16-18 UNF | 49 | 12 | 0 ~ 350 | 5 ± 0.5 | CD-70 (CN-17) |

※ O-ring (S611-012001) : 11.89×1.98 (AS568-906, NBR Hs90)

### 2) PUMP PRESSURE SENSOR

(1) Structure




· Tightening torque : 2.5 ~ 3.0 kgf·m
(18 ~ 21.7 lbf·ft)

| Pin map | Function |
|---|---|
| 1 | + Supply |
| 2 | - Supply |
| 3 | - |
| 4 | Output |

70D9V6HS15

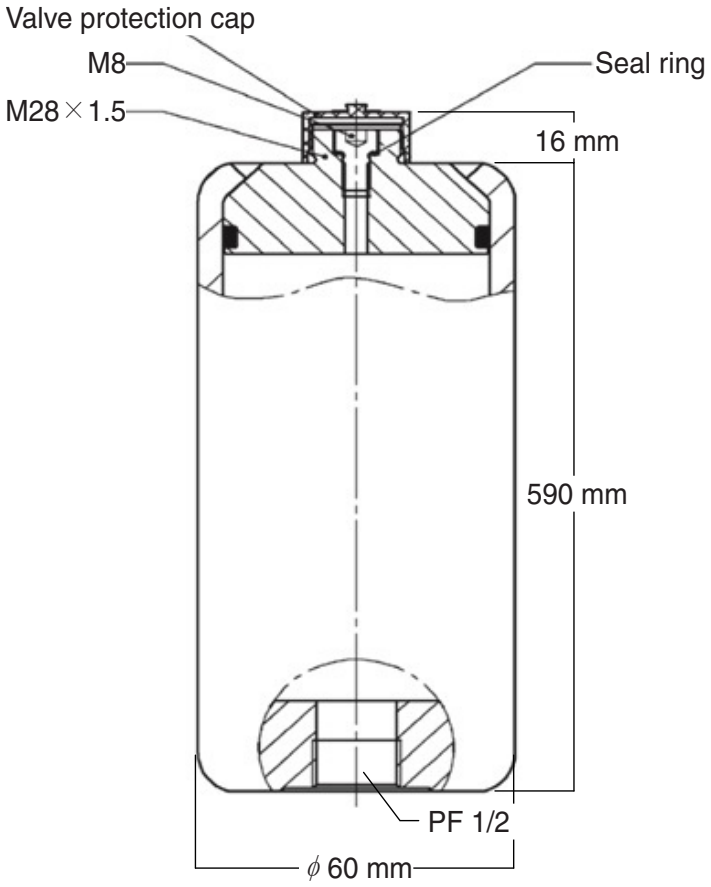
| Item | Medium | Thread (G) | H1 (mm) | H2 (mm) | Measuring range (bar) | Pressure output signal (V) | Voltage (V) | Electircal connections |
|---|---|---|---|---|---|---|---|---|
| Pump pressure sensor (LS) | Oil | 9/16-18 UNF | 49 | 12 | 0 ~ 250 | 1 ~ 5 | Max. 30 | CD-5 |

※ O-ring (S611-012001) : 11.89×1.98 (AS568-906, NBR Hs90)

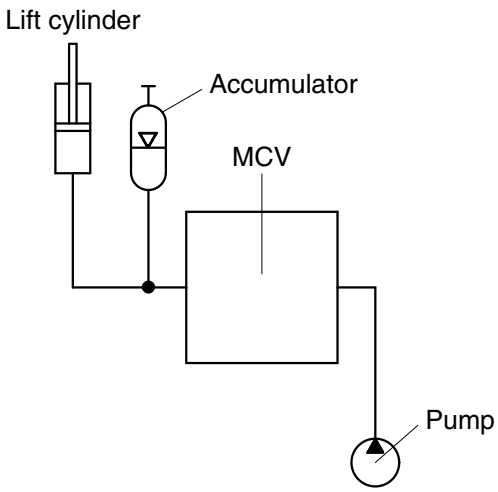
## 7. MAST ACCUMULATOR

### 1) STRUCTURE

· Tightening torque : 2 kgf·m (14.7 lbf·ft)




35D9VB6HS52




35D9VB6HS59

| Parts No. | Normal volume | Pre-charging pressure at 20 ℃ (68 ℉) | Gas | Weight |
|---|---|---|---|---|
| 35FV-05000 | 0.5 ℓ (0.13 U.S. gal) | 25 bar (363 psi) | Nitrogen gas $N_2$ | 4. 8 kg (10.6 lb) |

**※ Max. working pressure : 280 bar (4000 psi), shell, rod material : carbon steel**

**※ Permitted operating temperature : -20 ~ +80 ℃ (-4 ~ +176 ℉), seal material : NBR/PUR**

The mast accumulator is installed in the hydraulic line of the lift cylinder to absorb fork vibration and reduce hydraulic pulsation, which acts as a shock absorber to reduce vibration that may occur when climbing slopes or driving on rough road surfaces. This helps to prevent damage to fragile items such as glass or ceramics (porcelain) by ensuring the stability of the truck. In addition, when applied to hydraulic attachments (e.g. paper roll clamps, carton clamps, etc.), it can be configured and utilized to help reduce damage to the load through "prevent slipping of loads".

**※ The accumulator works effectively under light and heavy loads. The higher the load, the smaller the absorption effect.**

**※ Compared with the case without the accumulator, this device can repeat overrun and underrun for a certain period of time when the fork stops. The phenomenon is slightly different depending on the load conditions, so please understand its characteristics before operation.**

## 2) PRE-CHARGE PRESSURE

The accumulator is supplied pre-charged with nitrogen gas. The pre-fill pressure provided is indicated on the label of the accumulator shell or engraved on the surface of the top shell of the accumulator. A gas valve connection terminal is provided on the top of the accumulator to adjust the filling pressure (depending on the load or workplace conditions) as needed.

- First, it can be adjusted in the range of 6 ~ 50 bar (87 ~ 725 psi), and more can be adjusted.
- Based on temperature of 20 ℃ (68 ℉), charging is prohibited under high temperature conditions.

## 3) MAINTENANCE

**⚠ Under no circumstances should the piston accumulator be welded, soldered or mechanically repaired.**

**(1)** Normal checks

The basic maintenance instructions for the piston type mast accumulator are as follows. To maintain trouble-free operation, it is recommended to perform the following maintenance procedures regularly.

- Check that the connection is tihgt and there are no oil or gas leaks.
- Check the fastening parts.
- Accumulator pre-charge pressure test

**(2)** Checking for oil leakage into the gas side

Hydraulic oil in the accumulator may leak to the gas side through the piston seal. Check this in the following way. In this case, there is oil leakage on the gas side, so replace the accumulator.

- If a higher filling pressure than the previous test is found.
- When oil or oil mist comes out when loosening the M8 screw with a 6 mm hex. wrench.

**※ If there is oil leakage inside the accumulator, it is recommended not to repair it and replace the parts.**

- The supplied HYDAC SK280 piston accumulator is a non-repairable sealed product.
- It is an economical product with excellent durability and non-repairable structure, optimizing size and weight to reduce costs.

**(3)** Pre-charge pressure testing and frequency

**※ Check the charging pressure of the accumulator after completely draining the hydraulic oil from the lift cylinder line. If the cylinder line is not fully evacuated, the gas filling pressure may look different. Also, when disconnecting the accumulator connection piping, the pressure oil in the cylinder line must be discharged first.**

It t is recommended to check the filling pressure as follows.

- Initial 250 hour or 6 weeks
- Once 2000 hours or every year.

If there is no significant gas loss during the initial inspection, check 2000 hours.

**※ if the truck continues to run in harsh workplace (or high operating temperature) conditions, it should be tested more often.**

### 4) GAS RELEASE AND CHARGING

**(1)** Release

① Loosen the plastic cap and loosen the M8 screw tightly locked to the gas valve connection on the top of the accumulator with a 6 mm hex. wrench and lock it again.

② Connect FPU to the accumulator gas vlave.

※ **Release valve (D) be sure to connect while locked.**

③ Open the accumulator valve (counterclockwise) with the spindle of the FPU and check the gas.

④ Open the release valve of FPU slowly (counter-clockwise) and blow out nitrogen gas until the set pressure is confirmed. Pressure is measured at room temperature around 20 ℃ (68 ℉ ).

⑤ When the set pressure is reached, close the release valve (clockwise) and close the accumulator valve with the spindle.

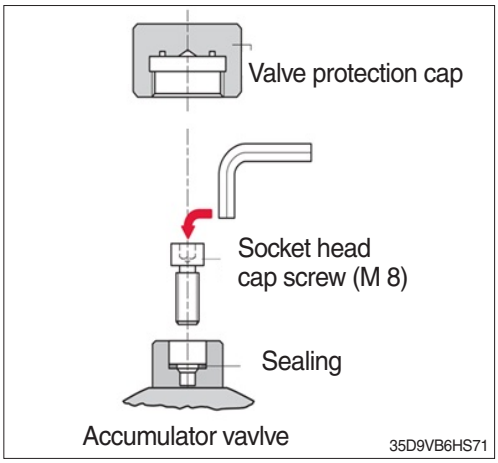
⑥ Wait 5-10 minutes for the filled nitrogen gas pressure to stabilize, then recheck the set pressure and adjust if necessary.

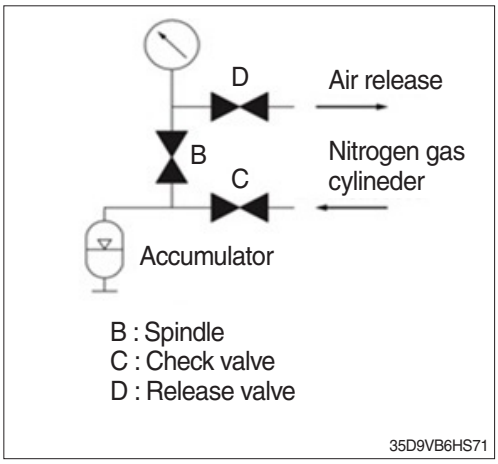
⑦ Open the release valve and blow out gas in the FPU.

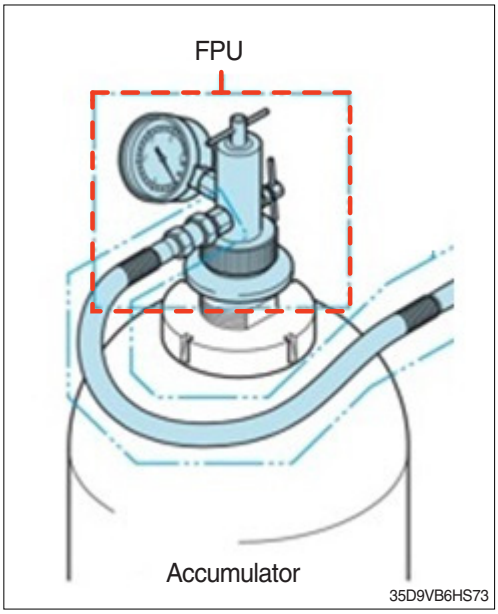
※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

⑧ Separate the FPU from the accumulator.

⑨ Tighten the M8 screw on the top of the accumulator to 2.0 kgf·m (15 lbf·ft) and tighten the plastic cap by hand.



(2) Charging

※ **The filling kit operation method was prepared based on HYDAC product standards.**

※ **Accumulator gas pressure adjustment and charging kit must be purchased separately.**

※ **To recharge nitrogen gas, it is convenient to use the HYDAC FPU-1 unit.**

⚠ **Must be filled with clean nitrogen gas only. Never use oxygen or air. Explosion hazard. Basically, nitrogen must use a minimum class 4.0. (99,99 %, filtering < 3 µm)**


① Connect the charging hose to the nitrogen gas cylinder and FPU. Be sure to connect the release valve while it is closed. The release valve has a structure that lengthens when locked and decreases when released.

② Loosen the plastic cap and loosen the M8 screw tightly locked to the gas valve connection on the top of the accumulator with a 6 mm hex. wrench and lightly lock it again.

③ Connect FPU to the accumulator.

④ Using the spindle of FPU, open the M8 screw on the top of the accumulator. (counterclockwise)

⑤ Slowly open the valve of the nitrogen gas cylinder and check the pressure of the gas injected into the accumulator.

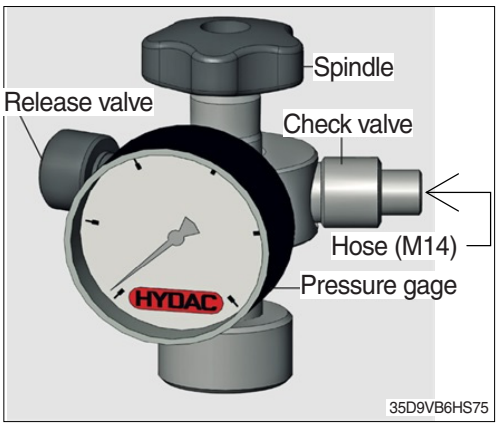
⑥ When filling is complete, close the gas valve of the accumulator using the valve of the nitrogen gas cylinder and the spindle of the FPU.

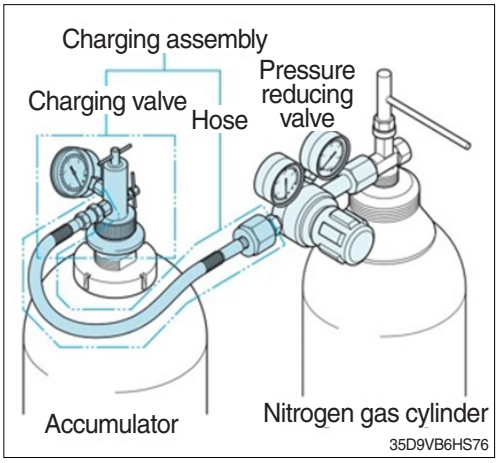
※ **When adding nitrogen to the accumulator filled with nitrogen gas, wait 5-10 minutes for the temperature and pressure of the gas mixture to stabilize, then check the pressure again and adjust if necessary.**

⑦ Open the release valve of FPU to remove nitrogen from the charging hose and FPU.

⑧ Using the spindle of FPU, open the accumulator valve, check the gauge, and adjust the release valve to blow out the accumulator nitrogen to the desired pressure.

⑨ When the desired pressure is reached, close the release valve of the FPU and close the gas valve of the accumulator using the spindle.



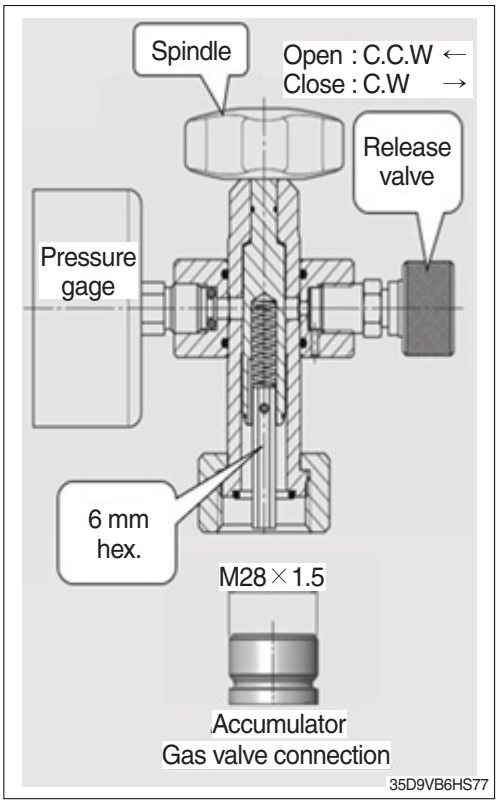



⑩ Open the release valve and blow out nitrogen gas in the FPU.

※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

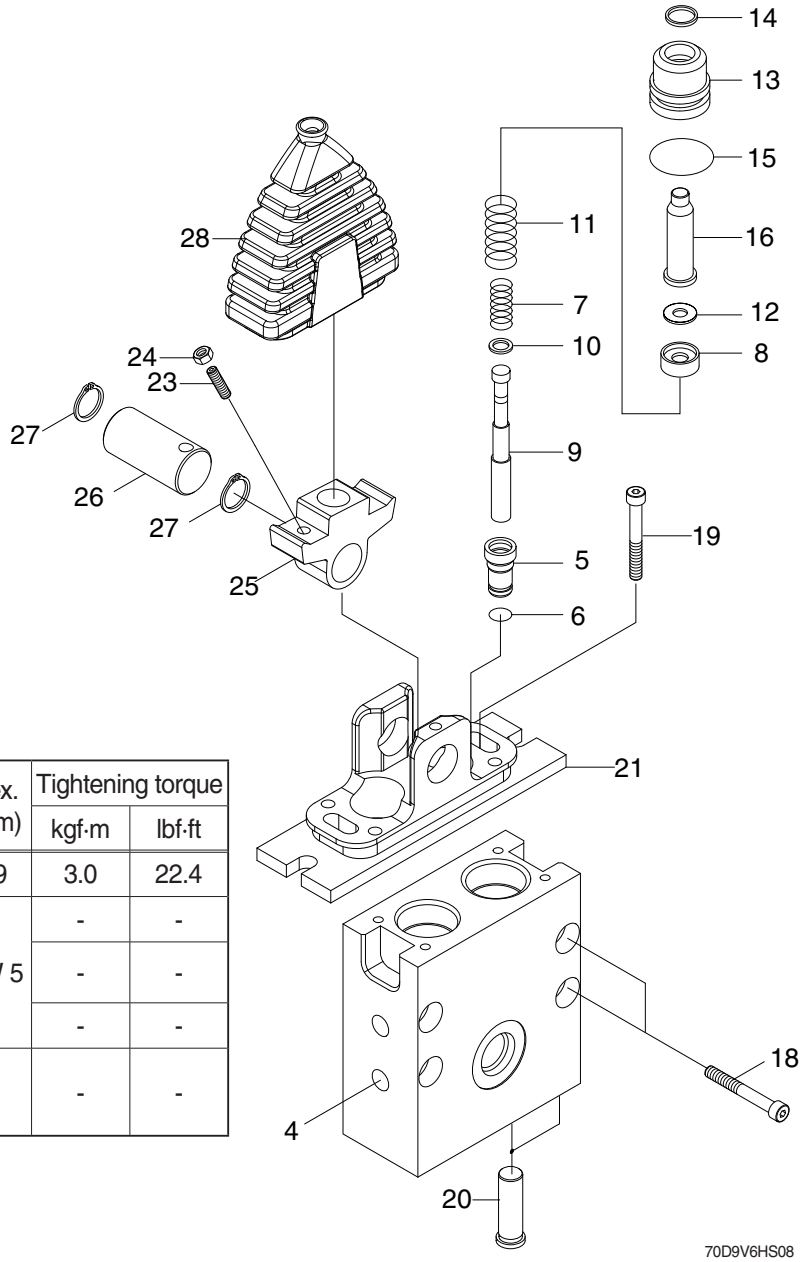
⑪ Remove the FPU from the accumulator.

⑫ Tighten the M8 screw on the top of the accumulator to 2.0 kgf·m (15 lbf·ft) and tighten the plastic cap by hand.



## 8. REMOTE CONTROL VALVE

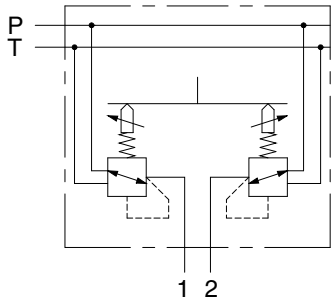
### 1) STRUCTURE



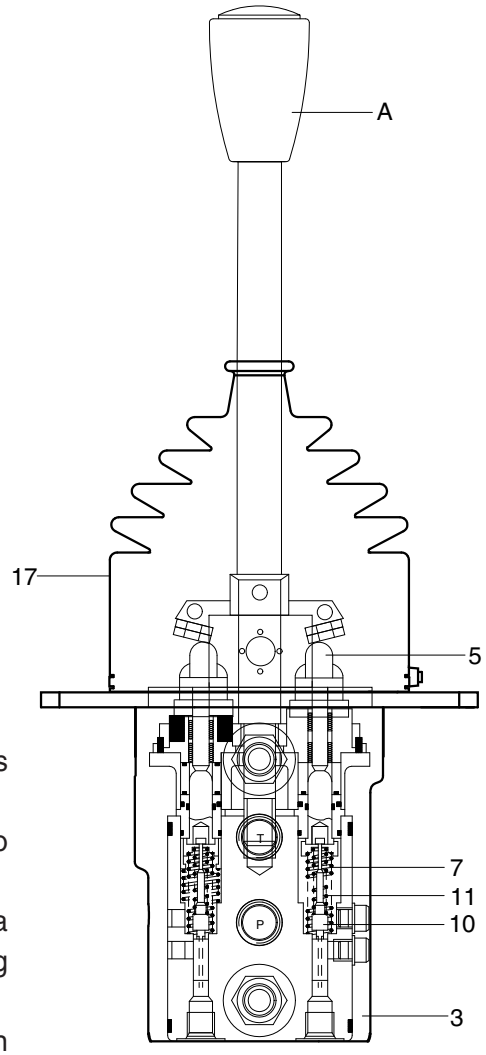

| Port name | Port thread | Hex. (mm) | Tightening torque | |
|---|---|---|---|---|
| | | | kgf·m | lbf·ft |
| All port | 9/16-18UNF | 19 | 3.0 | 22.4 |
| Bolt - tie 3SP | M6 × 40L (8 EA) | SW 5 | - | - |
| Bolt - tie 4SP | M6 × 40L (4 EA)<br>M6 × 75L (4 EA) | | - | - |
| Bolt - tie 5SP | M6 × 75L (8 EA) | | - | - |
| Bolt cover | M4 × 20L (12 EA)<br>M4 × 20L (16 EA)<br>M4 × 20L (20 EA) | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| 1 | Body | 12 | Stopper | 21 | Cover |
| 4 | Plug | 13 | Plug | 23 | Bolt |
| 5 | Plug | 14 | Oil seal | 24 | Nut |
| 6 | O-ring | 15 | O-ring | 25 | Guide |
| 7 | Spring | 16 | Push rod | 26 | Pin |
| 8 | Spring seat | 17 | O-ring | 27 | Spring pin |
| 9 | Spool | 18 | Bolt | 28 | Boot |
| 10 | Spool | 19 | Bolt | | |
| 11 | Shim | 20 | Cap | | |

## 2) OPERATION




HYDRAULIC CIRCUIT




100D7RCV01

### (1) Hydraulic functional principle

Pilot devices with end position locks operate as direct operated pressure reducing valves.

They basically comprise of control lever (A), two pressure reducing valves, body (3) and locks.

Each pressure reducing valve comprises of a plunger kit (5), a metering spring (7) and a spring (11).

At rest, control lever(A) is held in its neutral position by return springs (11). Ports (1, 2) are connected to tank port T.

When control lever (A) is deflected, plunger kit (5) is pressed against return spring (11) and metering spring (7).

Metering spring (7) initially moves docking rod (10) downwards and closes the connection between the relevant port and tank port T. At the same time the relevant port is connected to port P. The control phase starts as soon as docking rod (10) finds its balance between the force from metering spring (7) and the force, which results from the hydraulic pressure in the relevant port (ports 1, 2).

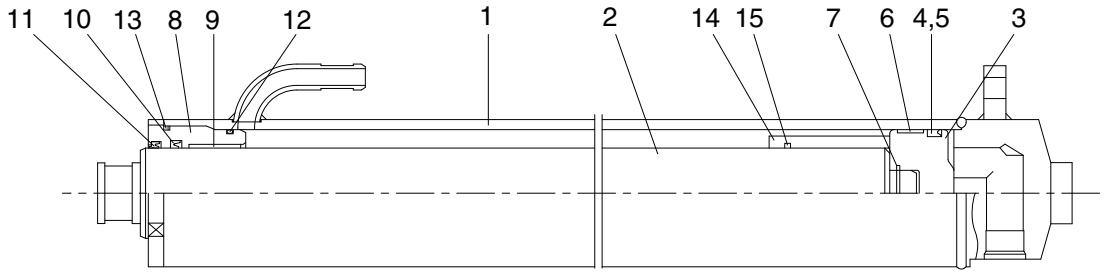
Due to the interaction between docking rod (10) and metering spring (7) the pressure in the relevant port is proportional to the stroke of plunger (5) and hence to the position of control lever (A).

This pressure control which is dependent on the position of the control lever and the characteristics of the control spring permits the proportional hydraulic control of the main directional valves and high response valves for hydraulic pumps.

A rubber bellows (17) protects the mechanical components in the housing from contamination.

## 9. LIFT CYLINDER

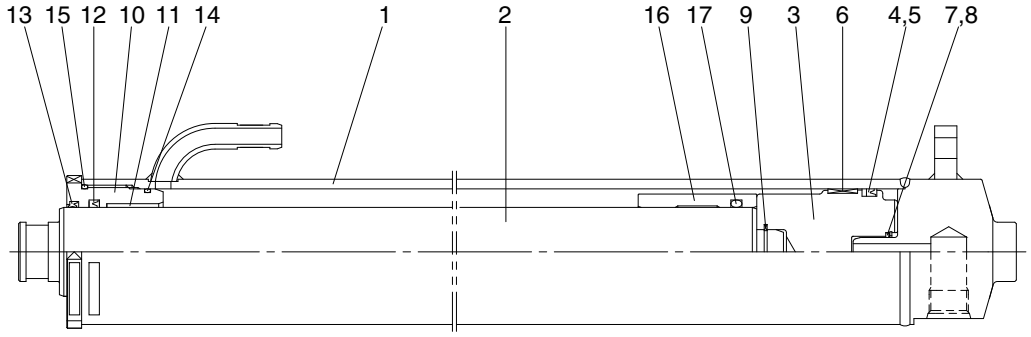
### 1) V-MAST




50D9HS12A

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 6 | Wear ring | 11 | Dust wiper |
| 2 | Rod | 7 | Cushion seal | 12 | O-ring |
| 3 | Piston | 8 | Gland | 13 | O-ring |
| 4 | Piston seal | 9 | Du bushing | 14 | Spacer |
| 5 | Back up ring | 10 | Rod seal | 15 | O-ring |

### 2) TF/TS MAST

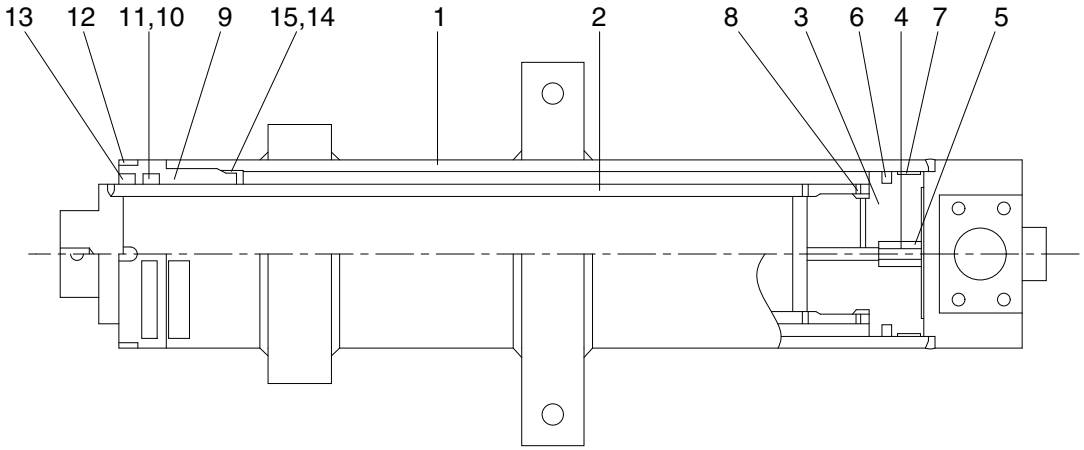



D507HS12

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 7 | Cushion seal | 13 | Dust wiper |
| 2 | Rod | 8 | Retaining ring | 14 | O-ring |
| 3 | Piston | 9 | Retaining ring | 15 | O-ring |
| 4 | Piston seal | 10 | Gland | 16 | Spacer |
| 5 | Back up ring | 11 | Du bushing | 17 | O-ring |
| 6 | Wear ring | 12 | Rod seal | | |

## 10. FREE LIFT CYLINDER

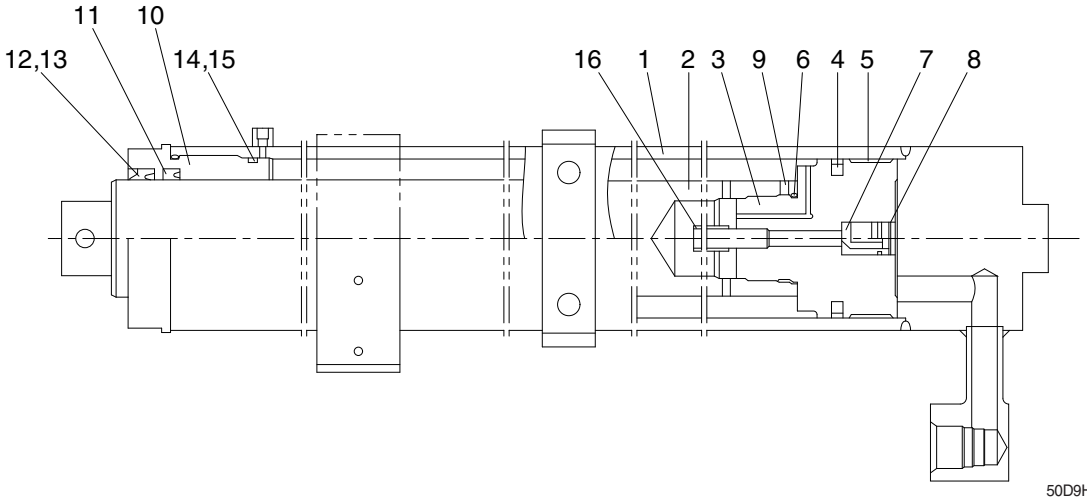
### 1) TF-MAST




50D9HS12B

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 6 | GLYD ring | 11 | Back up ring |
| 2 | Rod assy | 7 | Wear ring | 12 | Dust wiper |
| 3 | Piston | 8 | Set screw | 13 | Snap ring |
| 4 | Check valve | 9 | Gland | 14 | O-ring |
| 5 | Retaining ring | 10 | Rod seal | 15 | Back up ring |

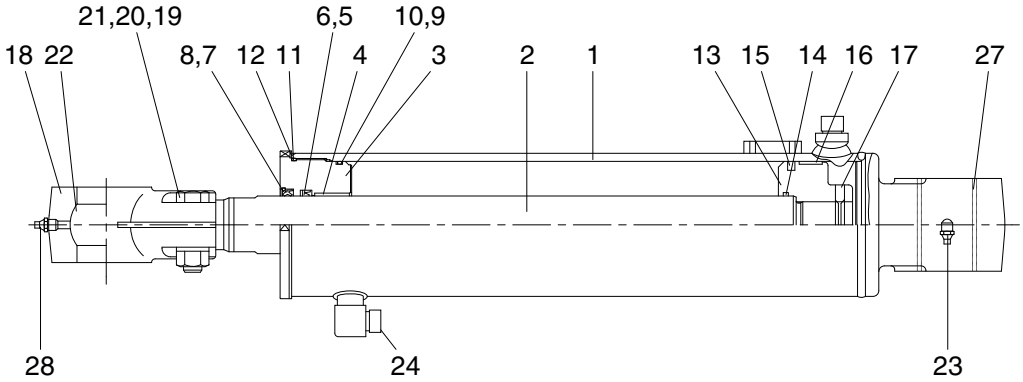
### 2) TS MAST




50D9HHS12C

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 7 | Check valve | 13 | Retaining ring |
| 2 | Rod | 8 | Retaining ring | 14 | O-ring |
| 3 | Piston | 9 | Set screw | 15 | Backup ring |
| 4 | Piston seal | 10 | Rod cover | 16 | Pipe |
| 5 | Wear ring | 11 | U-packing | | |
| 6 | O-ring | 12 | Dust wiper | | |

## 11. TILT CYLINDER




50D9HS12C

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 10 | Back up ring | 19 | Hex bolt |
| 2 | Rod | 11 | O-ring | 20 | Hex nut |
| 3 | Rod cover | 12 | Washer | 21 | Spring washer |
| 4 | Rod bushing | 13 | Piston | 22 | Spherical bearing |
| 5 | U-packing | 14 | O-ring | 23 | Grease nipple |
| 6 | Back up ring | 15 | Piston seal | 24 | O-ring |
| 7 | Dust wiper | 16 | Wear ring | 27 | Rod bushing |
| 8 | Stop ring | 17 | Set screw | 28 | Grease nipple |
| 9 | O-ring | 18 | Eye | | |

# GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

## 1. OPERATIONAL CHECKS

### 1) CHECK ITEM

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

(2) Set mast vertical and raise 1 m (39 inch) from ground. Wait for 10 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

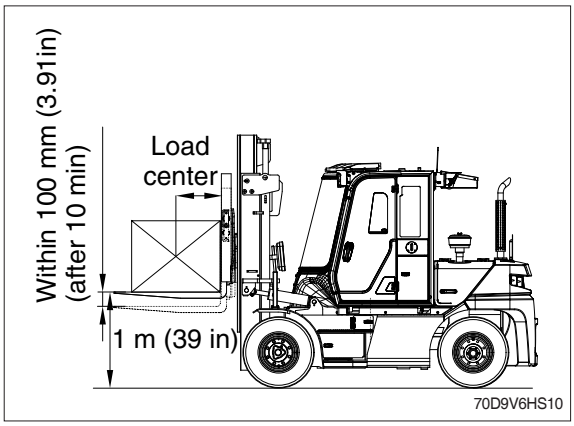
· **Check condition**

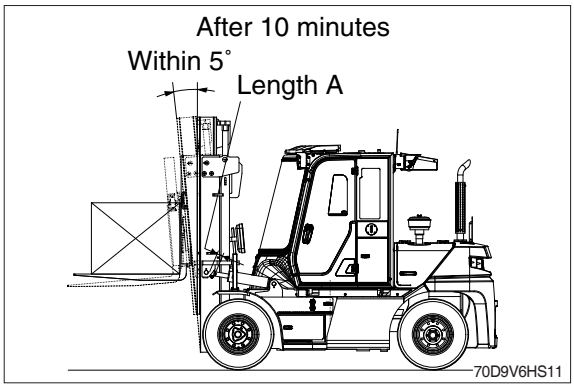
- Hydraulic oil : 45±5 ℃ (113±41 ℉)
- Rated capacity load
- Mast substantially vertical
- Key OFF, operator non-existence

· **Hydraulic drift**

- Down (Downward movement of forks)
  : Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
  : Within 5° or length (A) 67.5 mm (2. 7in)

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



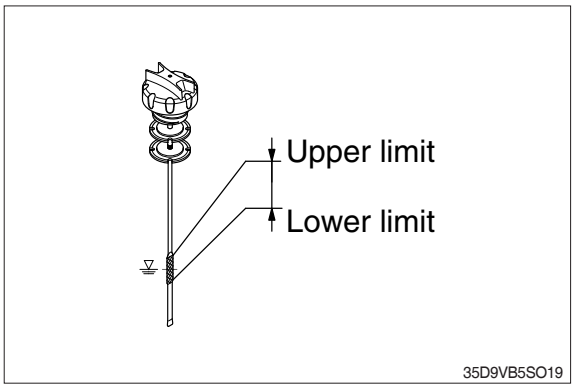




### 2) HYDRAULIC OIL

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

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

· Dipstick length = 260 mm (7.9 in)




### 3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure. Check the oil pressure.

| Model | Unit | Pressure |
|---|---|---|
| 70D-9VB | bar (psi) | 210 ± 3 (3050 ± 43) |
| | | ★185 ± 3 (2680 ± 43) |

★ : EU, AN coporate sales equipment

## 2. TROUBLESHOOTING

### 1) SYSTEM

| Problem | Cause | Remedy |
|---|---|---|
| Large fork lowering speed | · Seal inside control valve defective.<br>· Oil leaks from joint or hose.<br>· Seal inside cylinder defective. | · Replace spool or valve body.<br>· Replace.<br>· Replace packing. |
| Large spontaneous tilt of mast | · Tilting backward : Check valve defective.<br>· Tilting forward : tilt lock valve defective.<br>· Oil leaks from joint or hose.<br>· Seal inside cylinder defective. | · Clean or replace.<br>· Clean or replace.<br>· Replace.<br>· Replace seal. |
| Slow fork lifting or slow mast tilting | · Lack of hydraulic oil.<br>· Hydraulic oil mixed with air.<br>· Oil leaks from joint or hose.<br>· Excessive restriction of oil flow on pump suction side.<br>· Relief valve fails to keep specified pressure.<br>· Poor sealing inside cylinder.<br>· High hydraulic oil viscosity.<br>· Mast fails to move smoothly.<br>· Oil leaks from lift control valve spool.<br>· Oil leaks from tilt control valve spool. | · Add oil.<br>· Bleed air.<br>· Replace.<br>· Clean filter.<br>· Adjust relief valve.<br>· Replace packing.<br>· Change to SAE10W, class CD engine oil.<br>· Adjust roll to rail clearance.<br>· Replace spool or valve body.<br>· Replace spool or valve body. |
| Hydraulic system makes abnormal sounds | · Excessive restriction of oil flow pump suction side.<br>· Gear or bearing in hydraulic pump defective. | · Clean filter.<br>· Replace gear or bearing. |
| Control valve lever is locked | · Foreign matter jammed between spool and valve body.<br>· Valve body defective. | · Clean.<br>· Tighten body mounting bolts uniformly. |
| High oil temperature | · Lack of hydraulic oil.<br>· High oil viscosity.<br>· Oil filter clogged. | · Add oil.<br>· Change to SAE10W, class CD engine oil.<br>· Clean filter. |
| Actuator (cylinder or motor) works slowly or does not operate. | · Shortage of oil in oil tank.<br>· Decrease of relief valve pressure.<br>· Spool got stuck.<br>· Shortage of oil flow to the valve. | · Check the oil level in the oil tank.<br>· Install pressure gauge on the circuit, and check the pressure with it by handling the lever.<br>· Check that manual lever moves smoothly. Check that lever stroke is enough.<br>· Check that oil flow of the pump is within specified rate. |

| Problem | Cause | Remedy |
|---|---|---|
| High oil temperature | · Lack of hydraulic oil.<br>· High oil viscosity.<br>· Oil filter clogged. | · Add oil.<br>· Change to SAE10W, class CD engine oil.<br>· Clean filter. |
| Cylinder lowers considerably under normal circumstance. | · Internal leakage of cylinder happens frequently.<br>· Excessive leakage from spool of the valve.<br>· Spool got stuck.<br>· Leakage in a part of the circuit. | · Fit the stop valve on the pipe between valve and cylinder, observe the internal leakage of cylinder.<br>· Check the oil viscosity is not too low.<br>· Check that manual lever moves smoothly.<br>· Check the circuit. Observe leakage from pipes. |
| Pressure does not increase sufficiently. | · Defect of relief valve.<br>· Leakage in a part of the circuit. | · Check the relief valve.<br>· Check the circuit. Observe leakage from pipes. |
| Temperature rising of the hydraulic oil. | · Working with higher pressure than rated pressure.<br>· Low viscosity of oil.<br>· Leakage from a part of the circuit.<br>· Oil leakage in the pump.<br>· Insufficient suction of the pump. | · Check the flow pressure.<br>· Check the sort of oil and viscosity.<br>· Check if the circuit is relieved at all times.<br>· Check if the temperature of pump surface higher 30˚C than oil temperature.<br>· 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) MAIN PUMP

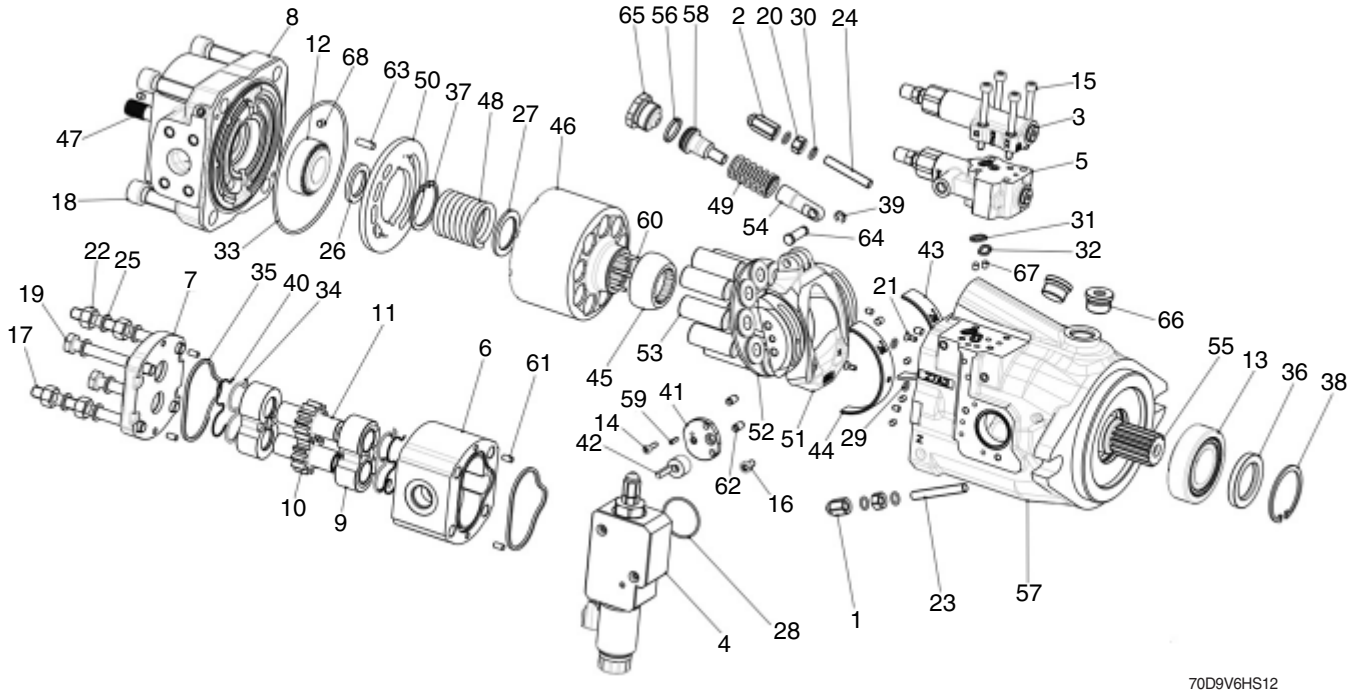
| Problem | Cause | Remedy |
|---|---|---|
| Unusual noises<br>No or insufficient flow | · Insufficient air bleeding of the hydraulic system. | · Fill the axial piston pump, suction line for the hydraulic pump and the oil tank.<br>· Completely air bleed the pump and hydraulic system.<br>· Inspect and correct or replace.<br>- Installation position |
| | · Insufficient suction conditions<br>- Viscosity of the hydraulic fluid too high<br>- Suction pressure too low<br>- Impermissible filter in the suction line<br>- Foreign particles in the suction line | · Optimize inlet conditions.<br>- Use suitable hydraulic fluid.<br>- Fill the suction line with hydraulic fluid.<br>- Remove foreign particles from the suction line. |
| | · Improper mounting of the axial piston pump | · Inspect and correct the mounting of the pump.<br>- Observe tightening torques. |
| | · Improper mounting of assembled parts (hydraulic lines) | · Mount assembled parts according to the information provided. |
| | · Pump control valve vibration | · Optimize the adjustment of the axial piston pump and the pressure limitation in the hydraulic system. |
| | · Mechanical damage to the main pump (e.g. bearing damage) | · Inspect and correct or replace. |
| No or insufficient flow | · Faulty mechanical drive (e.g. defective coupling & spline)<br>· Hydraulic fluid not in optimal viscosity range | · Inspect and correct or replace.<br>· Check temperature range and use suitable hydraulic fluid. |
| No or insufficient pressure | · Insufficient pilot pressure or control pressure<br>· Output actuator defective (e.g. hydraulic cylinder) | · Check pilot pressure or control pressure. Inspect and correct.<br>· Inspect and correct. |
| Pressure<br>Flow fluctuations<br>Instabilities | · Malfunction of the control device of the axial piston pump<br>· Wear or mechanical damage to the axial piston pump<br>· Unstable control signal | · Inspect and correct.<br>· Inspect and correct or replace.<br>· Inspect and correct. |
| Increased, unusual vibration | · Bearings worn | · Inspect and correct or replace. |
| Excessively high temperature of hydraulic fluid and housing | · Wrong setting or malfunction in the pressure relief and pressure control valves<br>e.g.)<br>- high pressure relief valve<br>- pressure cut-off<br>- pressure controller<br>· Axial piston pump worn | · Optimize the adjustment of the pressure limitation and pressure control valves of the axial piston pump and the pressure safeguarding in the hydraulic system.<br>· Inspect and correct.<br>· Inspect and correct or replace. |

### 3) CYLINDER

| Problem | Cause | Remedy |
|---|---|---|
| Oil leaks out from rod cover through rod | · Foreign matters on packing.<br>· Unallowable score on rod.<br>· Unusual distortion of dust seal.<br>· Chrome plating is striped. | · Replace packing.<br>· Smooth rod surface with an oil stone.<br>· Replace dust seal.<br>· 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.<br>· Unallowable score on the inner suface of tube.<br>· Foreign matters in piston seal. | · Smooth rod surface with an oil stone.<br>· Replace cylinder tube.<br>· 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.<br>· Bent tilt cylinder rod. | · Lubricate or replace.<br>· Replace. |

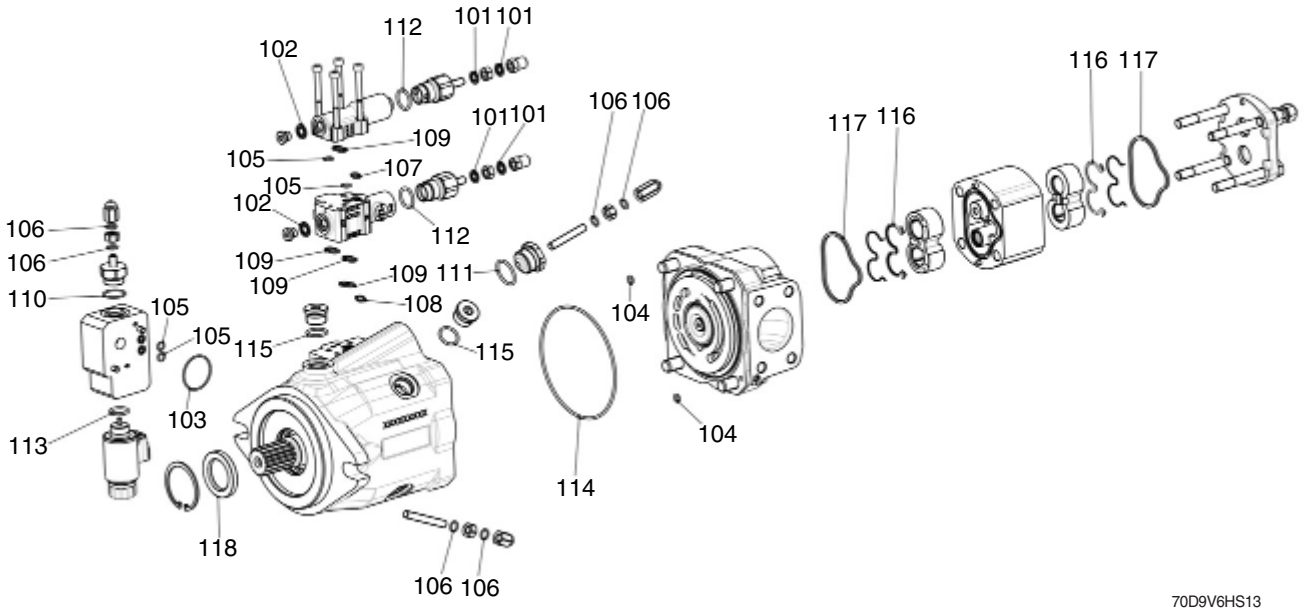
## 1. MAIN PUMP

### 1) STRUCTURE




| | | | | | |
|---|---|---|---|---|---|
| 1 | Lock nut | 24 | Screw (M8×50) | 47 | Hub |
| 2 | Lock nut | 25 | Washer | 48 | Piston spring |
| 3 | Flow compensator | 26 | Washer | 49 | Spring |
| 4 | Displacement regulator | 27 | Washer | 50 | Valve plate |
| 5 | Flow compensator | 28 | O-Ring | 51 | Swash plate |
| 6 | Housing | 29 | O-Ring | 52 | Piston guide plate |
| 7 | Rear Cover | 30 | Seal | 53 | Piston |
| 8 | Cover | 31 | Seal | 54 | Connection shaft |
| 9 | Thrust plate | 32 | Seal | 55 | Version shaft |
| 10 | Drive gear | 33 | O-Ring | 56 | Segment |
| 11 | Drive gear | 34 | Seal | 57 | Pump body |
| 12 | Roller bearing | 35 | Seal | 58 | Piston |
| 13 | Roller bearing | 36 | Shaft seal | 59 | Dowel pin |
| 14 | Screw (M4×14) | 37 | Ring | 60 | Dowel pin |
| 15 | Screw (M6×60) | 38 | Snap ring | 61 | Dowel pin |
| 16 | Screw (M6×10) | 39 | Ring | 62 | Dowel pin |
| 17 | Stud bolt (M10×120) | 40 | Seal plate | 63 | Dowel pin |
| 18 | Screw (M14×45) | 41 | Drive Support | 64 | Dowel pin |
| 19 | Screw | 42 | Drive regulator | 65 | Plug |
| 20 | Nut (M8) | 43 | Swash plate | 66 | Plug |
| 21 | Screw (M4×10) | 44 | Swash plate | 67 | Plug |
| 22 | Nut | 45 | Ring spline | 68 | Plug |
| 23 | Screw (M8×60) | 46 | Cylinder block | | |

· Seal kit (101~118)




| | | | | | |
|---|---|---|---|---|---|
| 101 | Washer | 107 | O-Ring | 113 | O-Ring |
| 102 | Washer | 108 | Seal | 114 | O-Ring |
| 103 | O-Ring | 109 | Seal | 115 | O-Ring |
| 104 | O-Ring | 110 | O-Ring | 116 | Seal |
| 105 | O-Ring | 111 | O-Ring | 117 | Seal |
| 106 | Seal | 112 | O-Ring | 118 | Shaft seal |

## 2) GENERAL INSTRUCTION

### (1) Purpose

The following document shows all replacement steps for all seals, belonging to the pump. When you see a leakage, you must follow the replacement instruction only for the components involved in the leak. This explain the most common replacements, that concern shaft seal, compensators seals and internal pump seals (piston and gear).

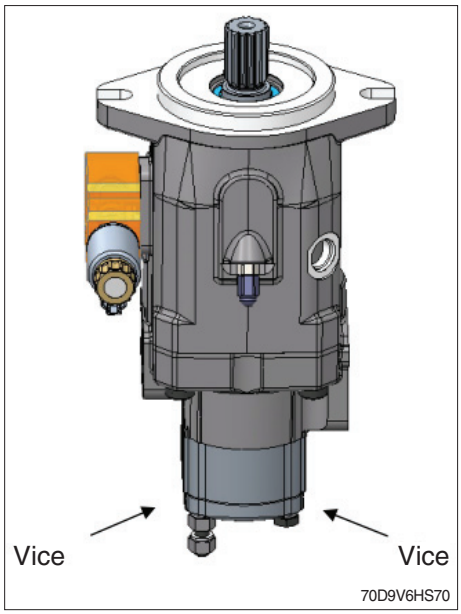
### (2) Suggestion

① Check the parts have not been damaged during the shipment.
② Work in a clean area.
③ Clean with solvent (except the seals) and dry air all components before assembling.
④ Pay attention not to damage the machined surfaces.
⑤ The components need to be fitted in place without forcing them. If too much force is required, it is due to a bad clearances issues.
⑥ When hand pressure is not enough, use only mallet and never hammer.
⑦ Respect the tightening torque for bolts.
⑧ Pay attention when you see a warning sign.

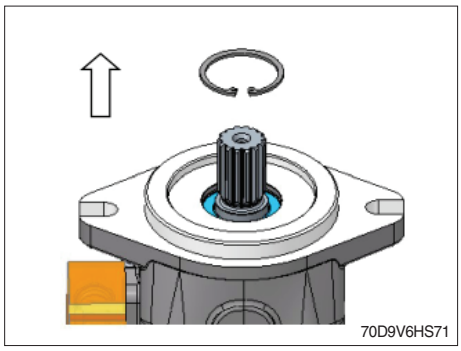
### 3) SHAFT SEAL REPLACEMENT

(1) Put the pump in vertical, with the shaft facing up.

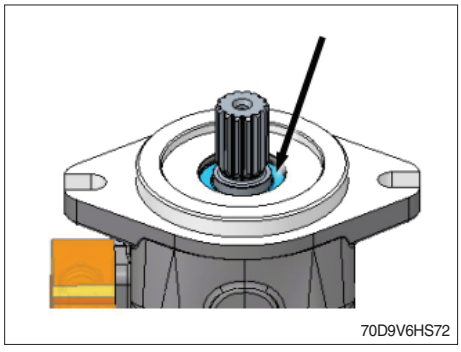
⚠ **You need to find something suitable for the cover geometry, in order to put the pump in vertical position.**



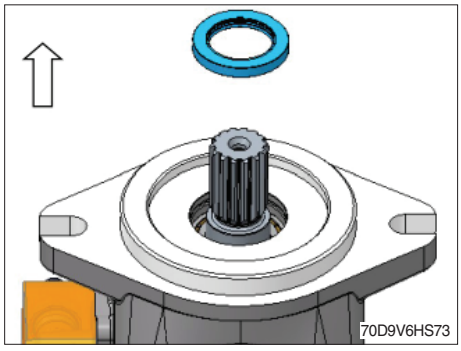

(2) Remove the snap ring.



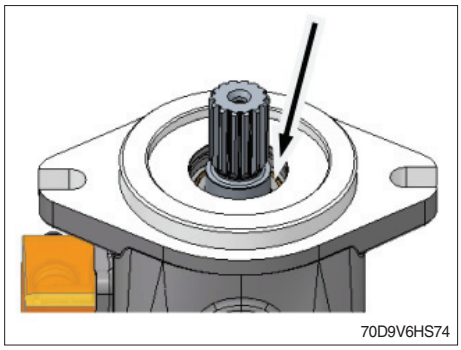

(3) Realize a small hole (or more small holes) in the shaft seal.



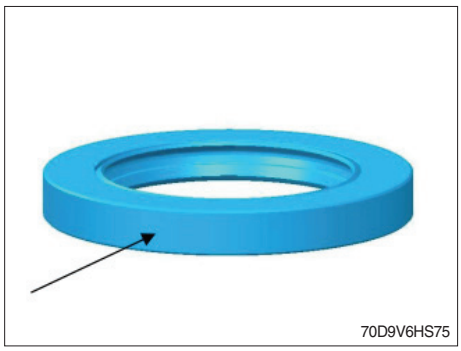

(4) Use an artisanal tool or a screwdriver, in order to deform the shaft seal and remove it. Holes made before can help to enter between shaft seal lip and the shaft, with the tool or the screwdriver.



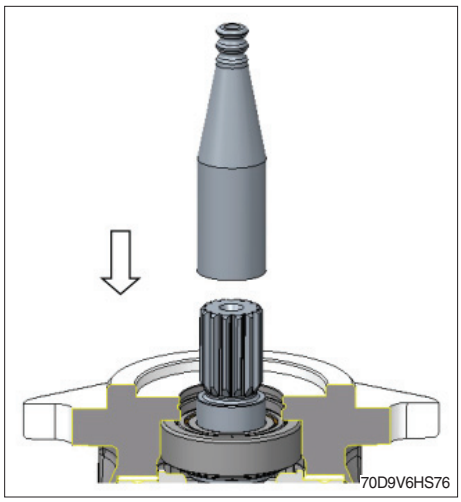
(5) Clean the surface with compressed air.



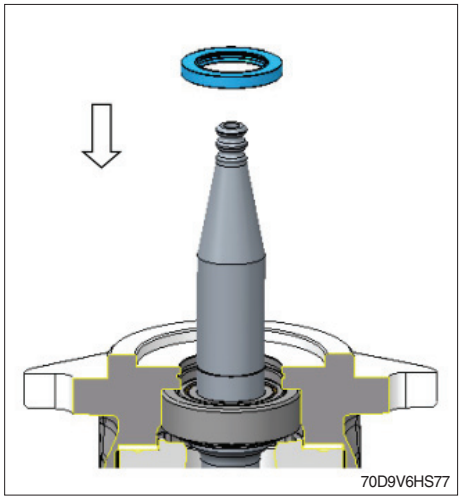

(6) Put a thin layer of clean grease on the contact surface.



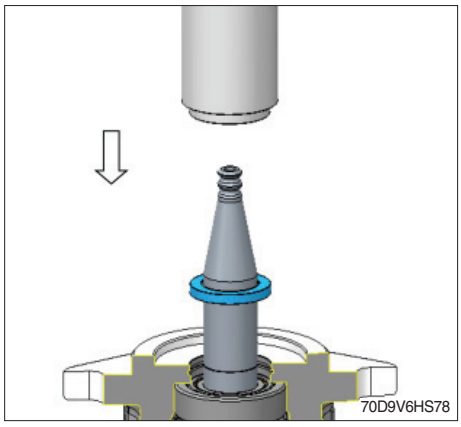

(7) Protect the shaft seal using a proper protection for the shaft end.



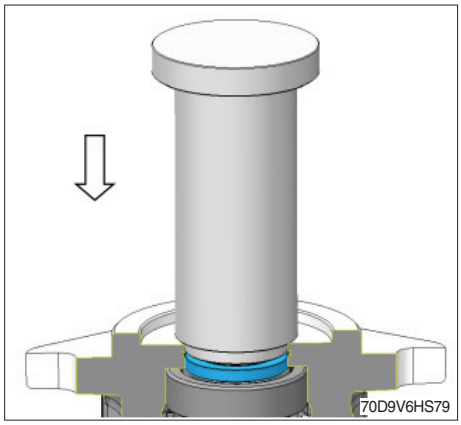

(8) Do not damage the shaft seal lip while assembling the seal on the shaft. Pay attention both to the shaft end and to the little gap in the diameter between the shaft end and the seat of the shaft seal.



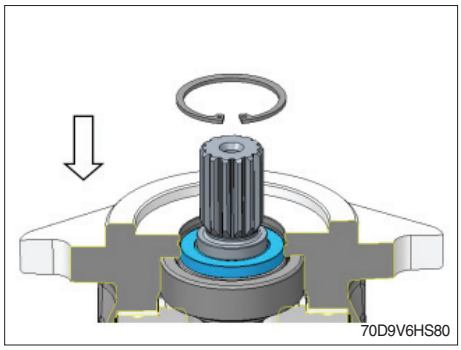
(7) Use a proper tool to push the shaft seal close to its seat. The shaft seal must be kept always perpendicular to the shat to not damage the seal lip.



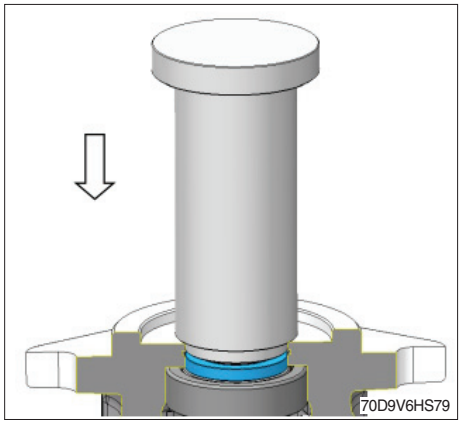

(8) Be careful not to push the shaft seal inside the case. It is sufficient to push it in order to have enough space for the snap ring to be placed near its seat.




(9) Insert the snap ring.

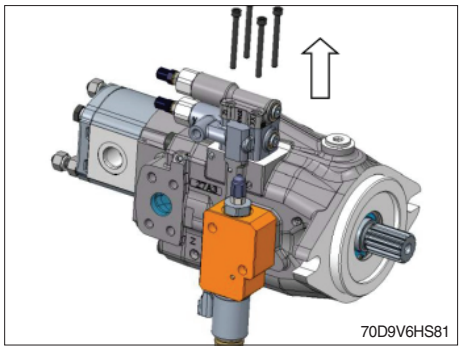



(10) Use a proper tool to push the snap ring in its seat. The shaft seal is going to be pushed by the snap ring in the correct position.

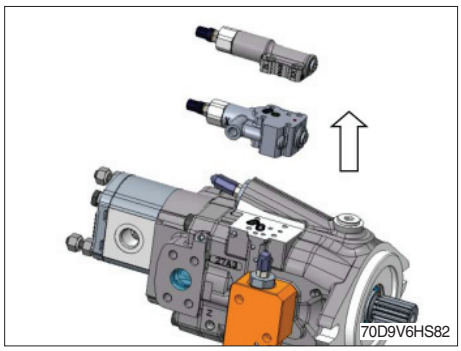


## 4) COMPENSATOR SEALS REPLACEMENT

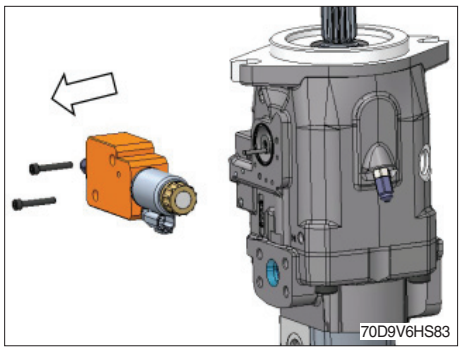
(1) Remove the screws of the compensators.



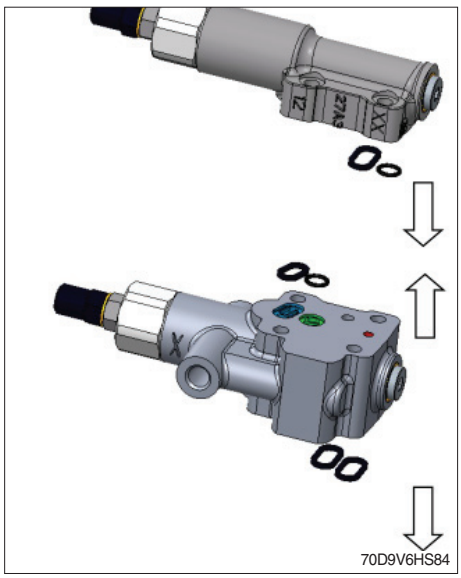

(2) Remove the pressure and the flow compensators.



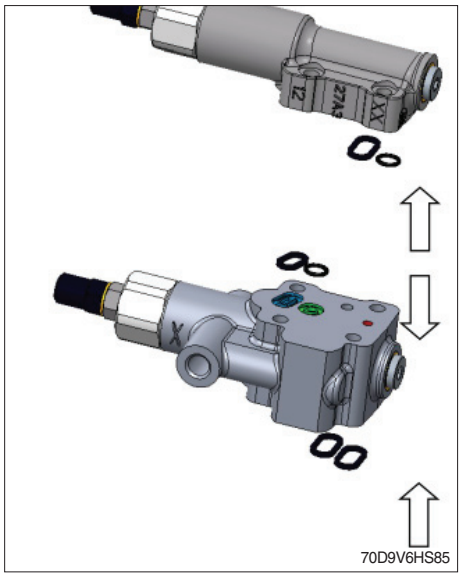

(3) Remove the DEC (Displacement Electronic Control).



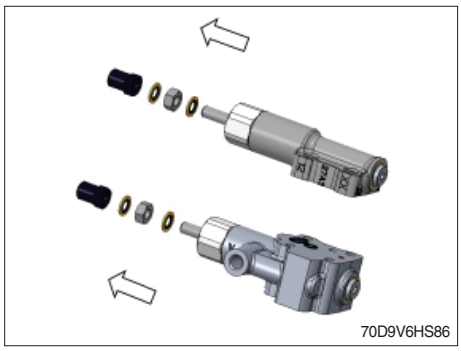

(4) Remove the O-ring seals.



(5) Insert the new O-ring seals.



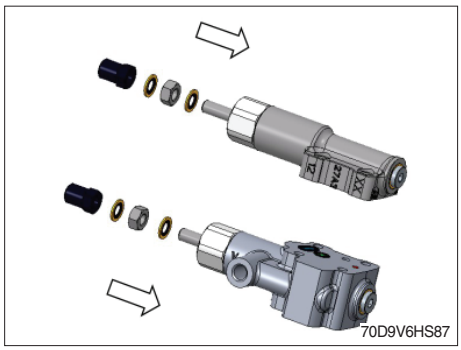

(6) Remove nut and washer.



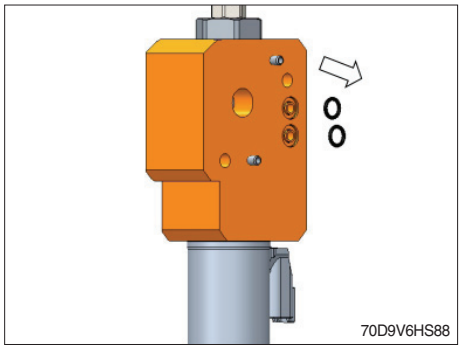

(7) Insert new washers. Tightening torque of nut and plug.

· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

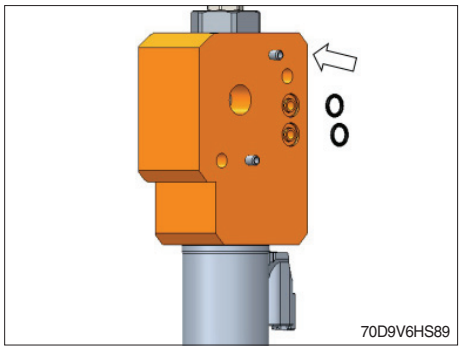
⚠ **Keep attention to do not touch the limiter screws or you will change the calibration of pressure and flow compensators.**



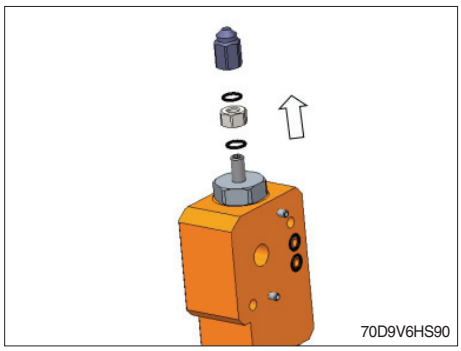

(8) Remove the O-ring seals.



(9) Insert the new O-ring seals.



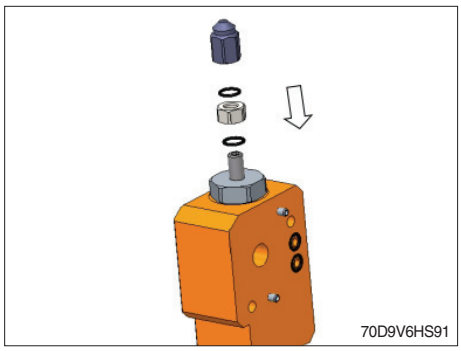

(10) Remove plug, nut and the O-ring seals.



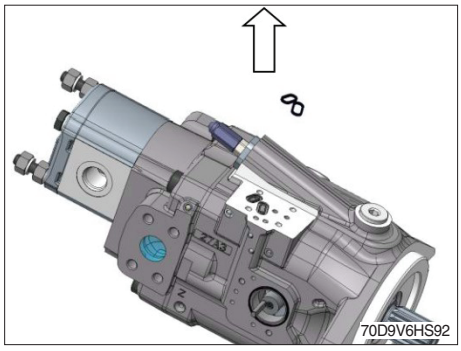

(11) Insert the new O-ring seals. Tightening torque of nut and plug.

· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

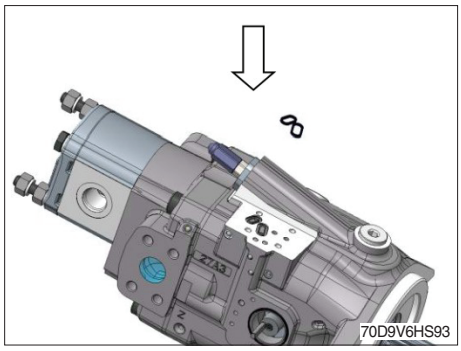
⚠ **Keep attention to do not touch the limiter screws or you will change the calibration.**



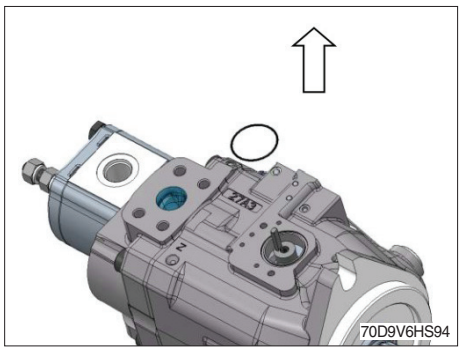

(12) Remove the O-ring seals on the compensator plane.



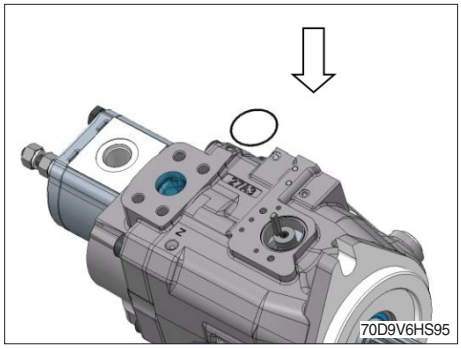
(13) Insert the new O-ring seals on the compensator plane.



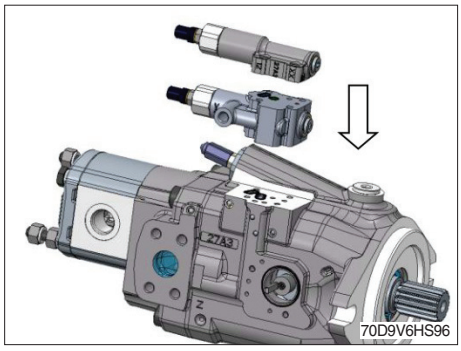

(14) Remove the O.ring seals on DEC (Displacement Electronic Control) plane.



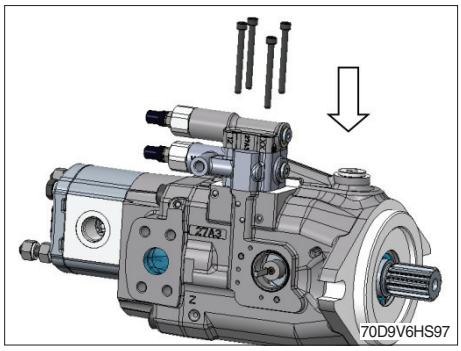

(15) Insert the new O-ring seals on DEC (Displacement Electronic Control) plane.




(16) Reassemble the flow and the pressure regulators.

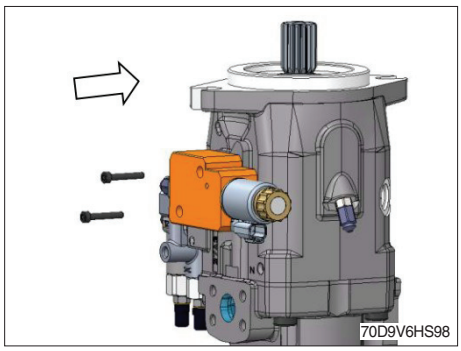


(17) Tighten the bolts with a torque wrench.
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



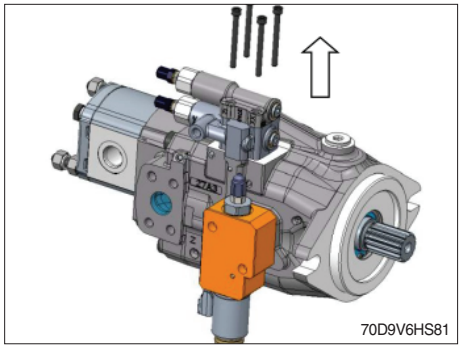

(18) Reassemble the DEC (Displacement Electronic Control). Tighten the bolts with a torque wrench.
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

⚠ **Keep attention, in order to reassemble the torque limit in the right way, you need to spin the limiter, using the eccentric as reference, pushing it against the body pump.**

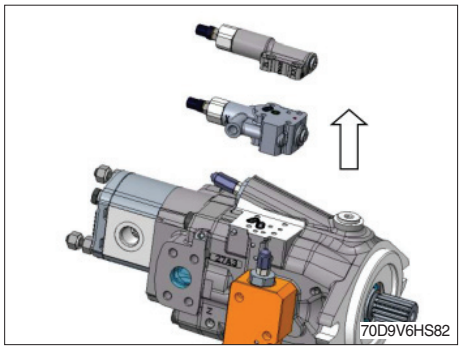



## 5) PISTON PUMP SEALS REPLACEMENT

(1) Remove the screws of the compensators.

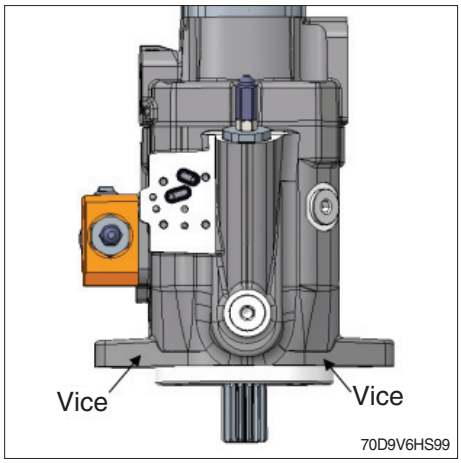



(2) Remove the pressure and the flow compensators.

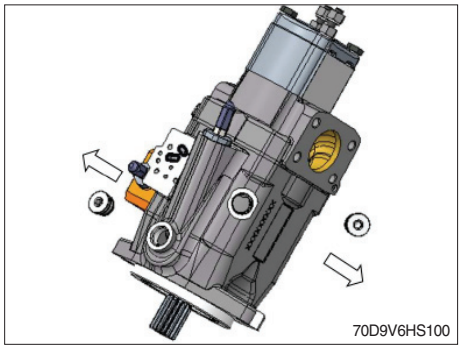


⚠ **Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.**

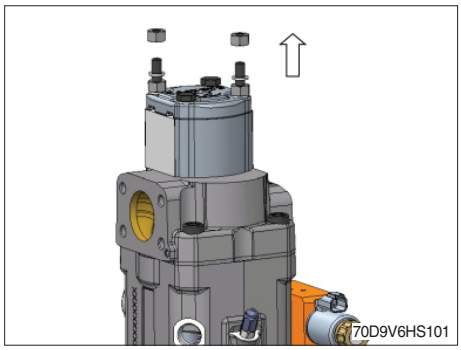
(3) Loosen the screws.



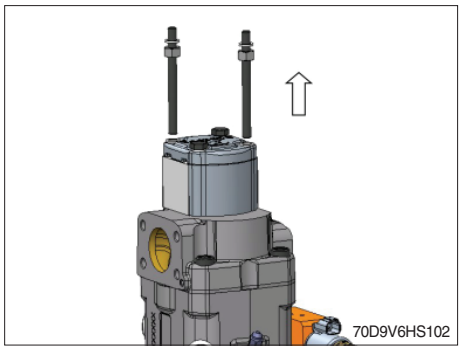

(4) Remove the drain plugs.



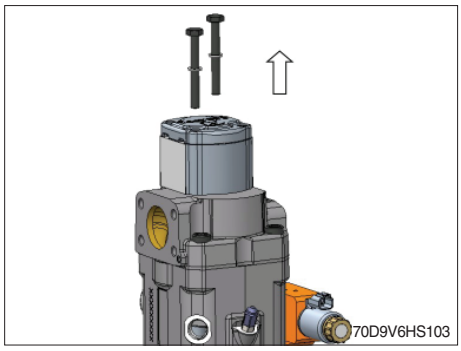

(5) Remove the nut from stud bolt from gear pump section.



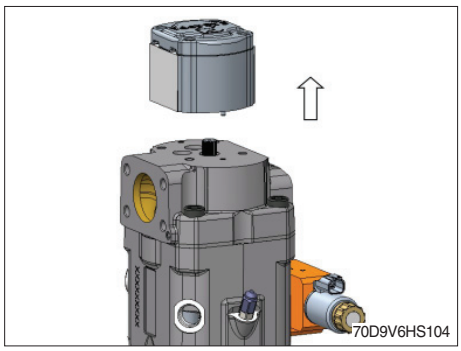

(6) Remove the nut, washers and stud bolt from gear pump section.



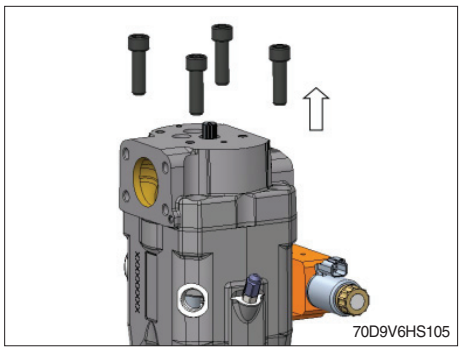
(7) Remove the screws and washers from gear pump section.



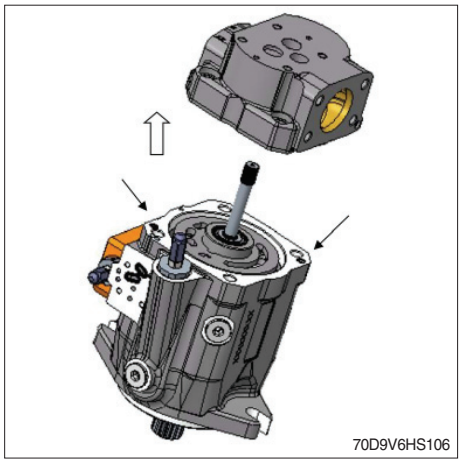

(8) Remove the gear pump section.



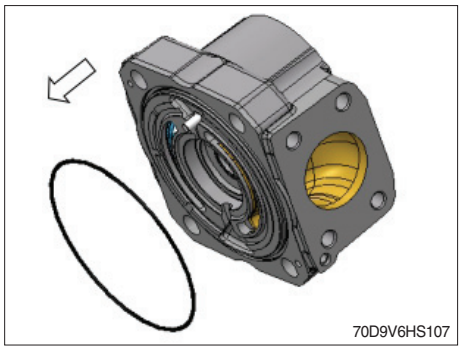

(9) Remove the screws from the cover.



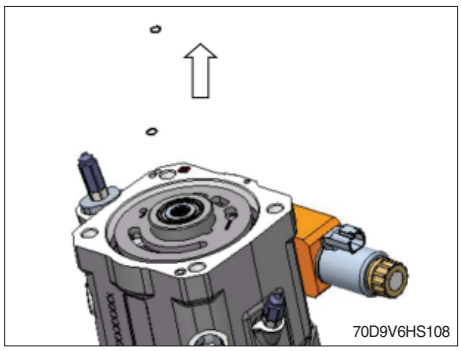

(10) Remove gently the cover slipping the fingers between it and the case in order to keep the valve plate that could be attached to the cover.
In this view and following ones, the bearing is represented as a single piece, but actually the outer ring will remain fixed to the cover because of the interference between parts. The mobile part of the bearing is the only one that will remain on shaft.
Attention to the little O-ring near the screws holes indicated with the black arrows.
Remove also the hub.



(11) Remove the seals from the cover.

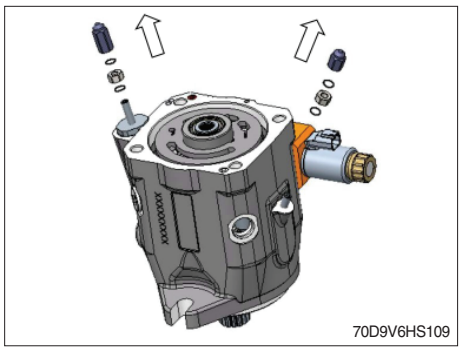



(12) Remove the O-rings from the body.

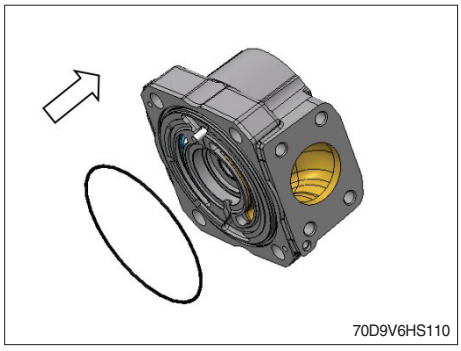



(13) Remove plugs from the max and min displacement limiter and their seals.

⚠ **Keep attention to don't touch the limiter screws or you will change the max or min displacement of your pump.**

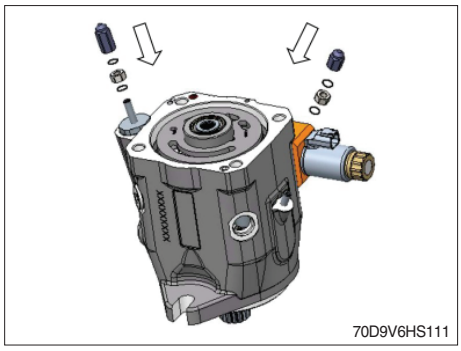



(14) Insert the new static seals.

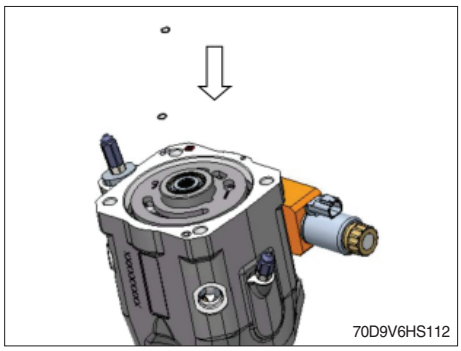


(15) Insert the new O-rings and reassemble the max and min displacement limiters. Tighten the plug M8 and the nut M8.

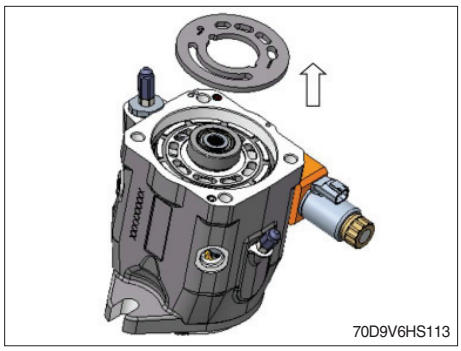
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



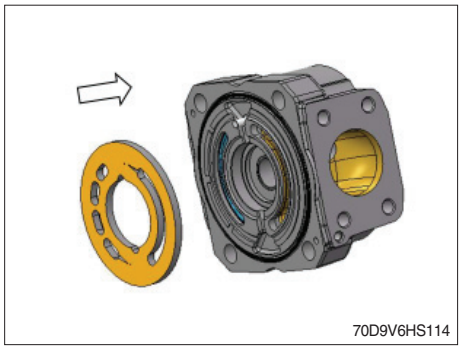

(16) Insert the new O-rings.



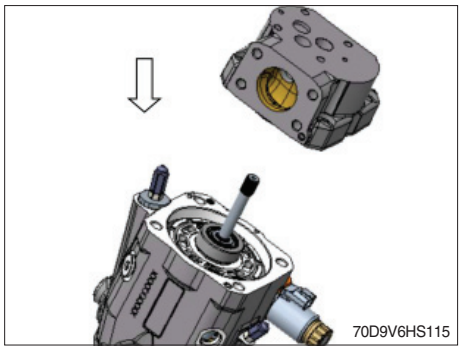

(17) Remove the valve plate.




(18) Use grease in order to attach valve plate to the cover, following the pin.



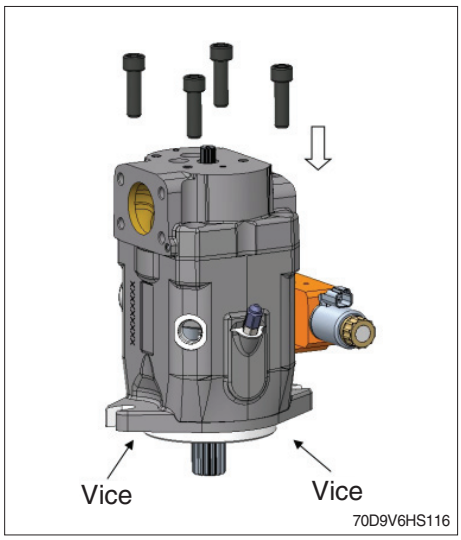
(19) Reassemble the hub and the cover.



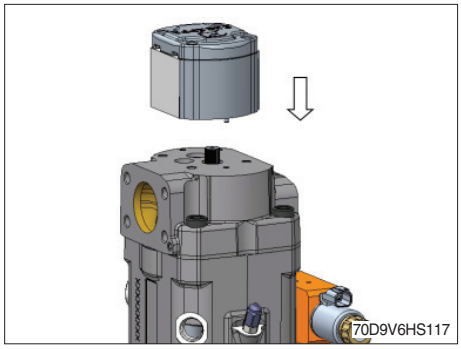

⚠ **Put the pump in the vice. Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.**

(20) Tighten the bolts with a torque wrench.

· Tightening torque : 13.2 kgf·m (95.5 lbf·ft)

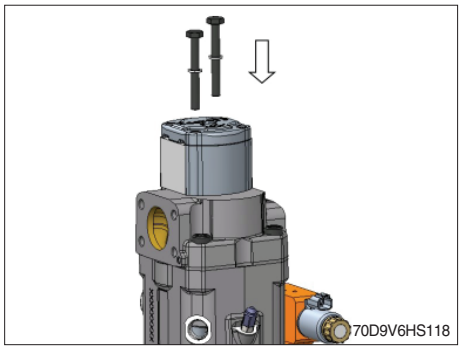



(21) Reassemble the gear pump section.

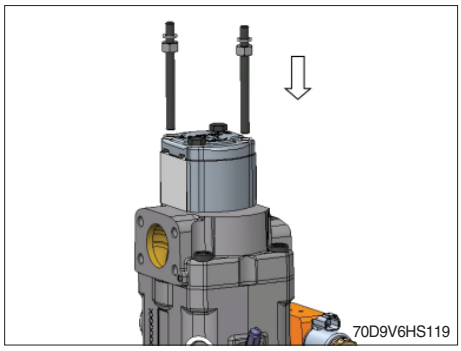



(22) Tighten the screws with a torque wrench.

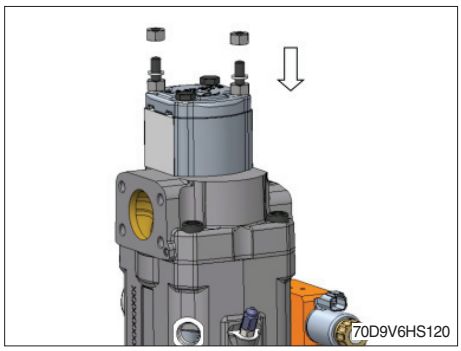
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



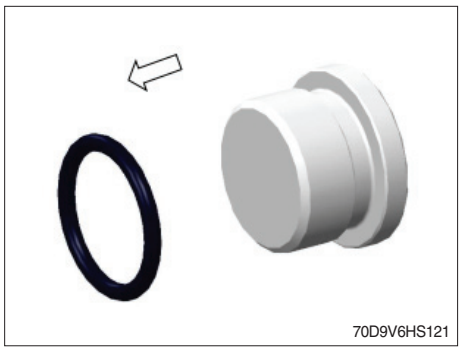
(23) Reassemble the nut, washers and stud bolt.
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



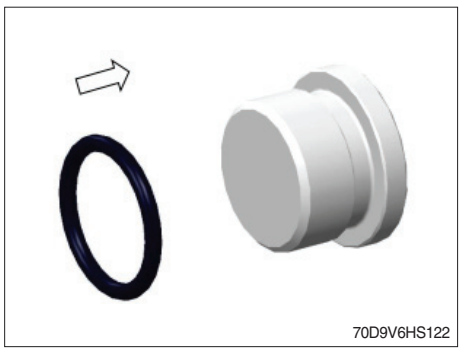

(24) Reassemble the nut from stud bolt.




(25) Remove the O-ring from the drain plugs.

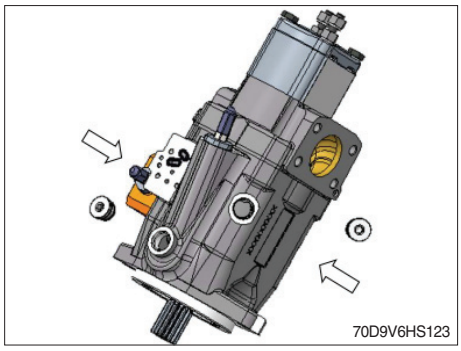



(26) Insert the new O-ring.

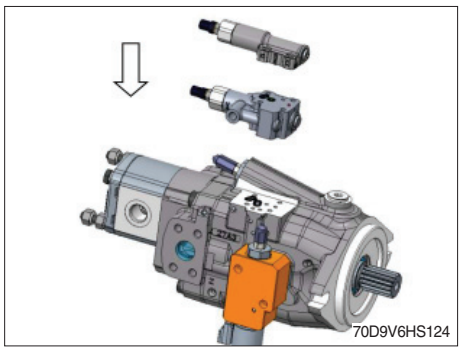


(27) Insert the plug in the body.

· Tightening torque : 3.1 kgf·m (22.4 lbf·ft)

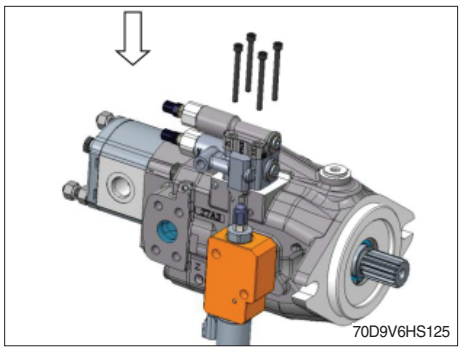



(28) Reassemble the flow and the pressure regulators.




(29) Tighten the bolts with a torque wrench.

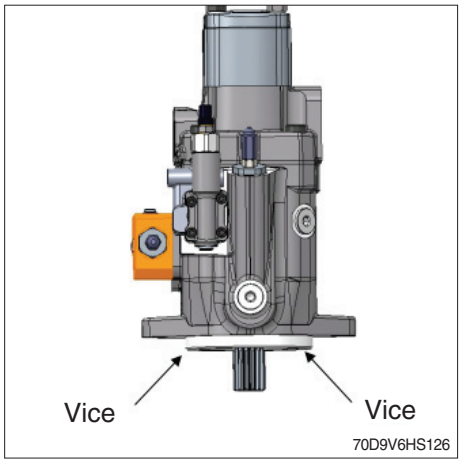
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



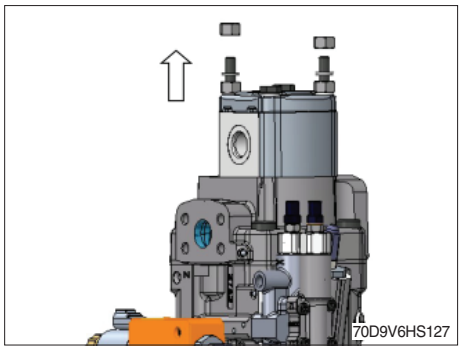

### 6) GEAR PUMP SEALS REPLACEMENT

**⚠ Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.**

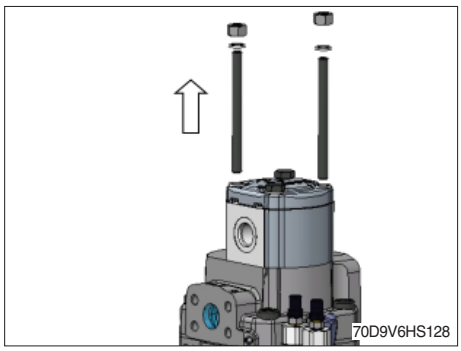
1) Loosen the screws.



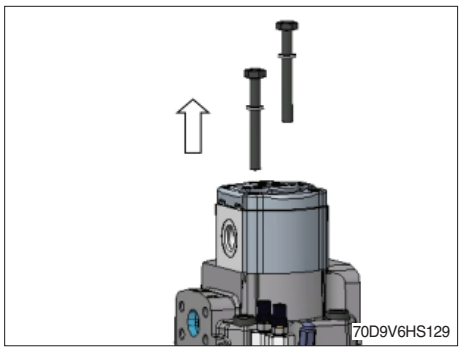
(6) Remove the nut from stud bolt from gear pump section.



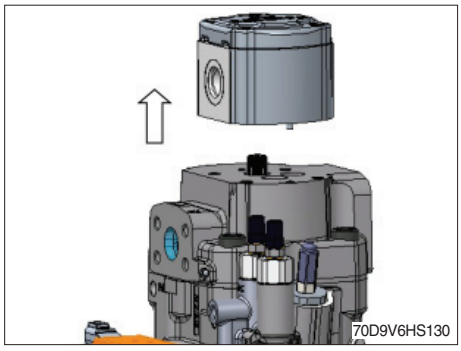

(7) Remove the nut, washers and stud bolt from gear pump section.



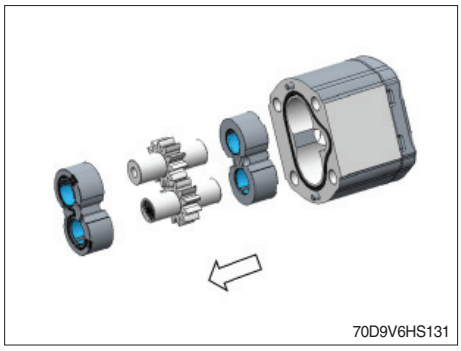

(8) Remove the screws and washers from gear pump section.



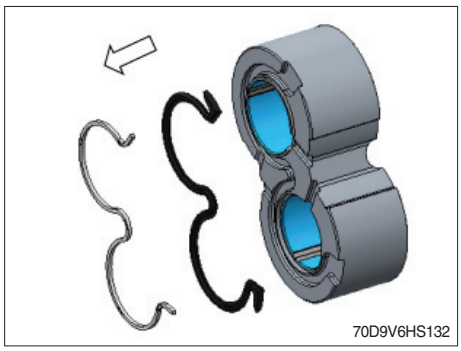

(8) Remove the gear pump section.



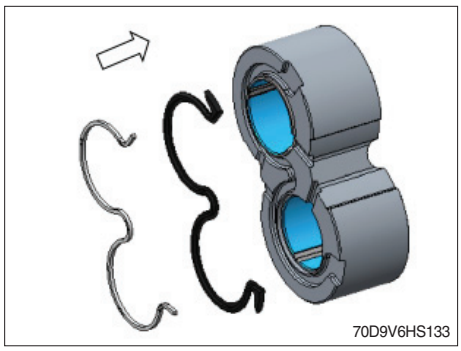
(9) Remove thrust plates and gears from the housing.



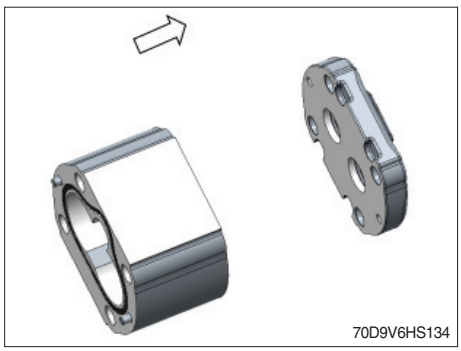

(10) Remove seal and anti-extrusion seal.



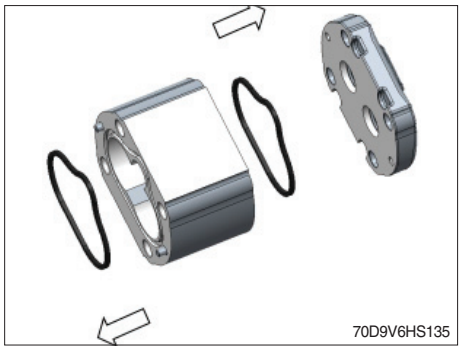

(11) Insert new seal and anti-extrusion seal.



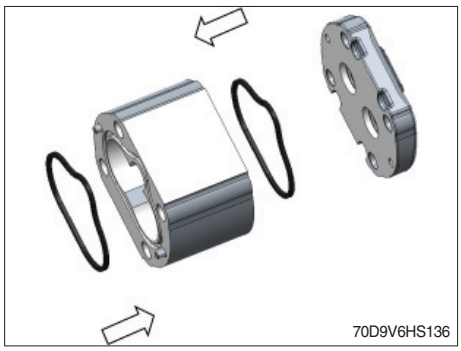

(12) Remove rear cover.



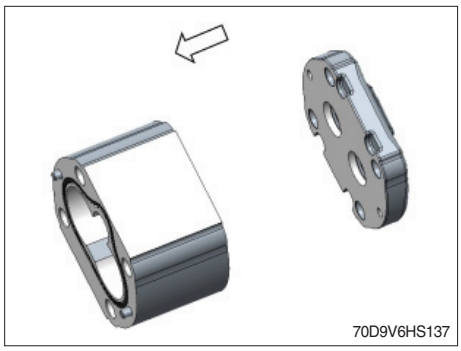
(13) Remove seal of the housing.



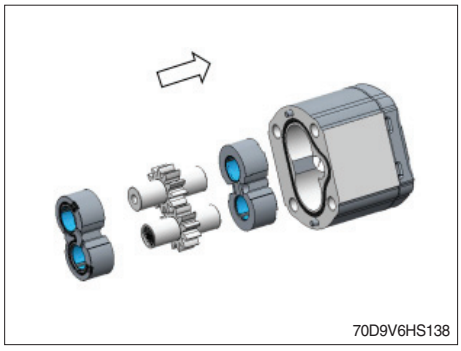

(14) Insert new seal of the housing.



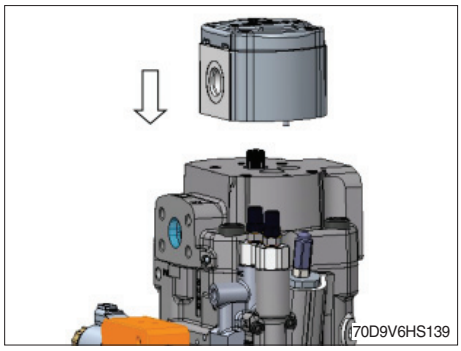

(15) Reassemble rear cover.



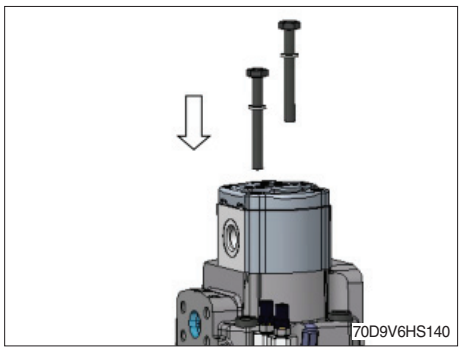

(16) Reassemble thrust plates and gears.



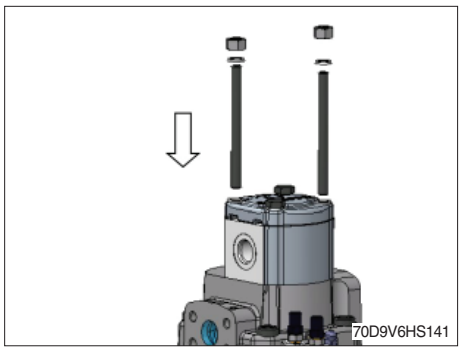
(17) Reassemble the gear pump section.



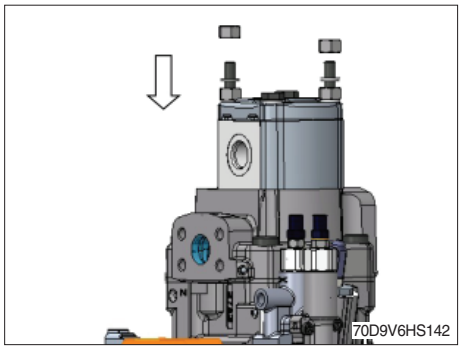

(18) Reassemble the screws and washers from gear pump section. Tighten the screws with a torque wrench.
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)




(19) Reassemble the nut, washers and stud bolt from gear pump section.
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



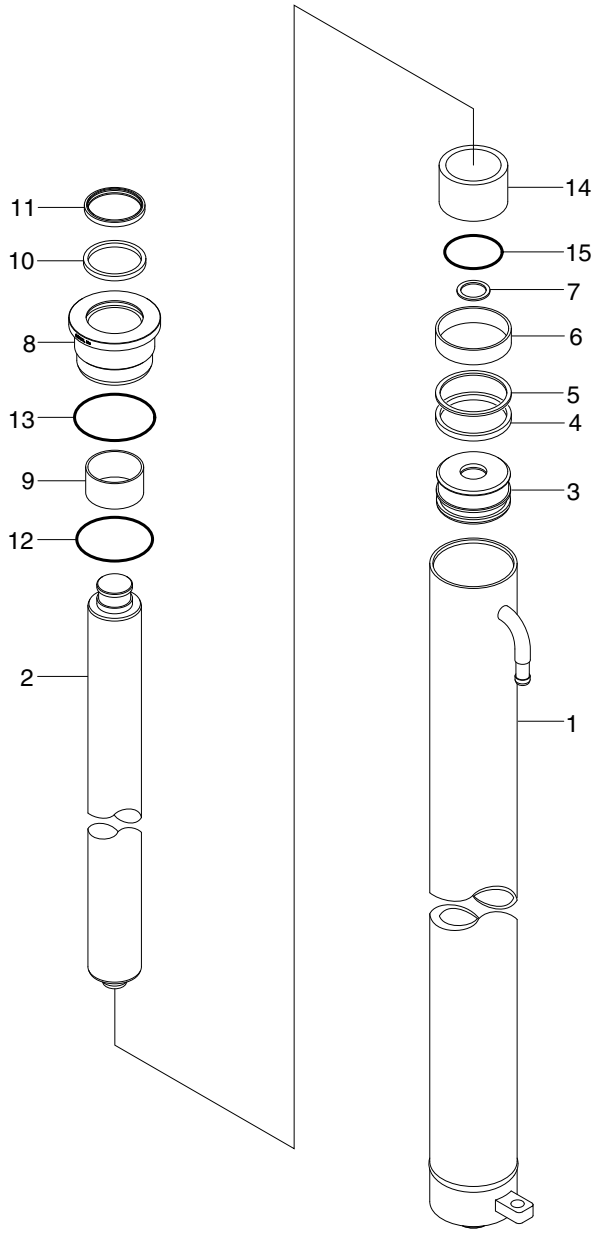

(20) Reassemble the nut from stud bolt from gear pump section.



## 3. LIFT CYLINDER

### 1) STRUCTURE

#### (1) V-mast

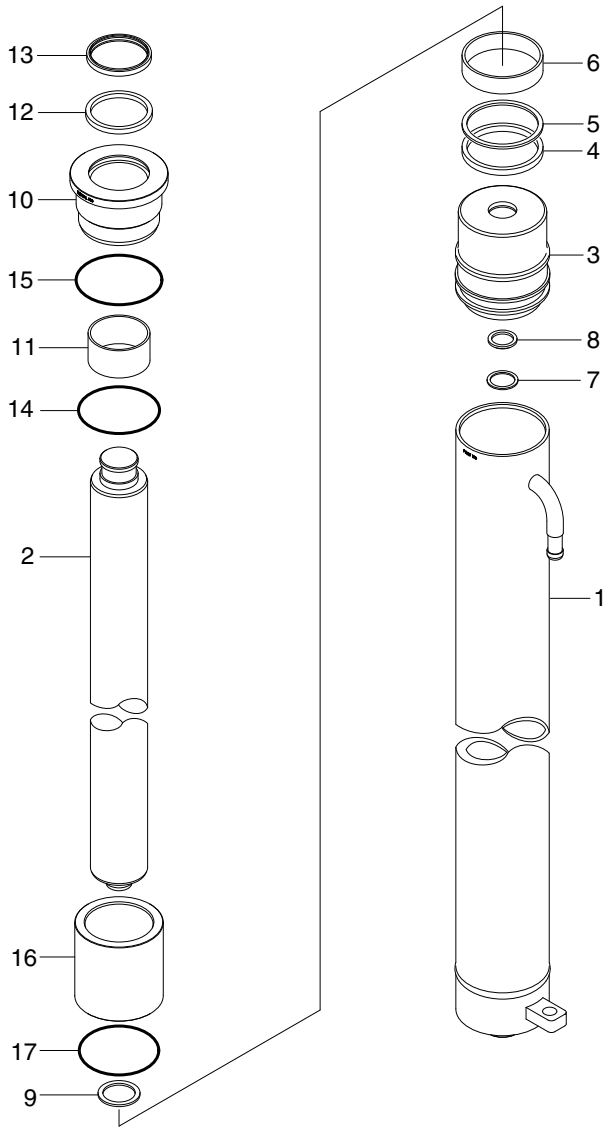



· I.D × O.D × stroke (standard)
85 × 98 × 1335 mm
(3.3 × 3.9 × 52.6 in)
· Rod O.D : 60 mm (2.4 in)

50D9HS19

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 6 | Wear ring | 11 | Dust wiper |
| 2 | Rod | 7 | Cushion seal | 12 | O-ring |
| 3 | Piston | 8 | Gland | 13 | O-ring |
| 4 | Piston seal | 9 | Du bushing | 14 | Spacer |
| 5 | Back up ring | 10 | Rod seal | 15 | O-ring |

## (2) TF/TS-mast

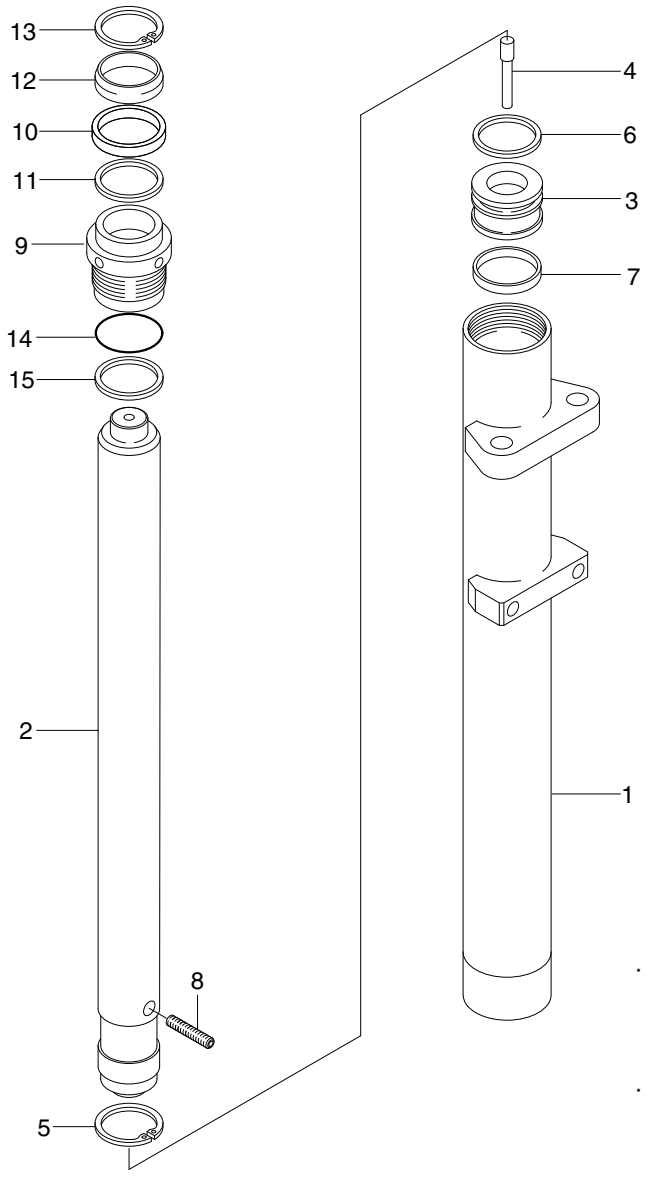



· I.D × O.D × stroke (standard)
85 × 98 × 1335 mm
(3.3 × 3.9 × 52.6 in)
· Rod O.D : 60 mm (2.4 in)

50D9HS20

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 7 | Cushion seal | 13 | Dust wiper |
| 2 | Rod | 8 | Retaining ring | 14 | O-ring |
| 3 | Piston | 9 | Retaining ring | 15 | O-ring |
| 4 | Piston seal | 9 | Gland | 16 | Spacer |
| 5 | Back up ring | 10 | Du bushing | 17 | O-ring |
| 6 | Wear ring | 11 | Rod seal | | |

### (3) Free lift (TF-mast)

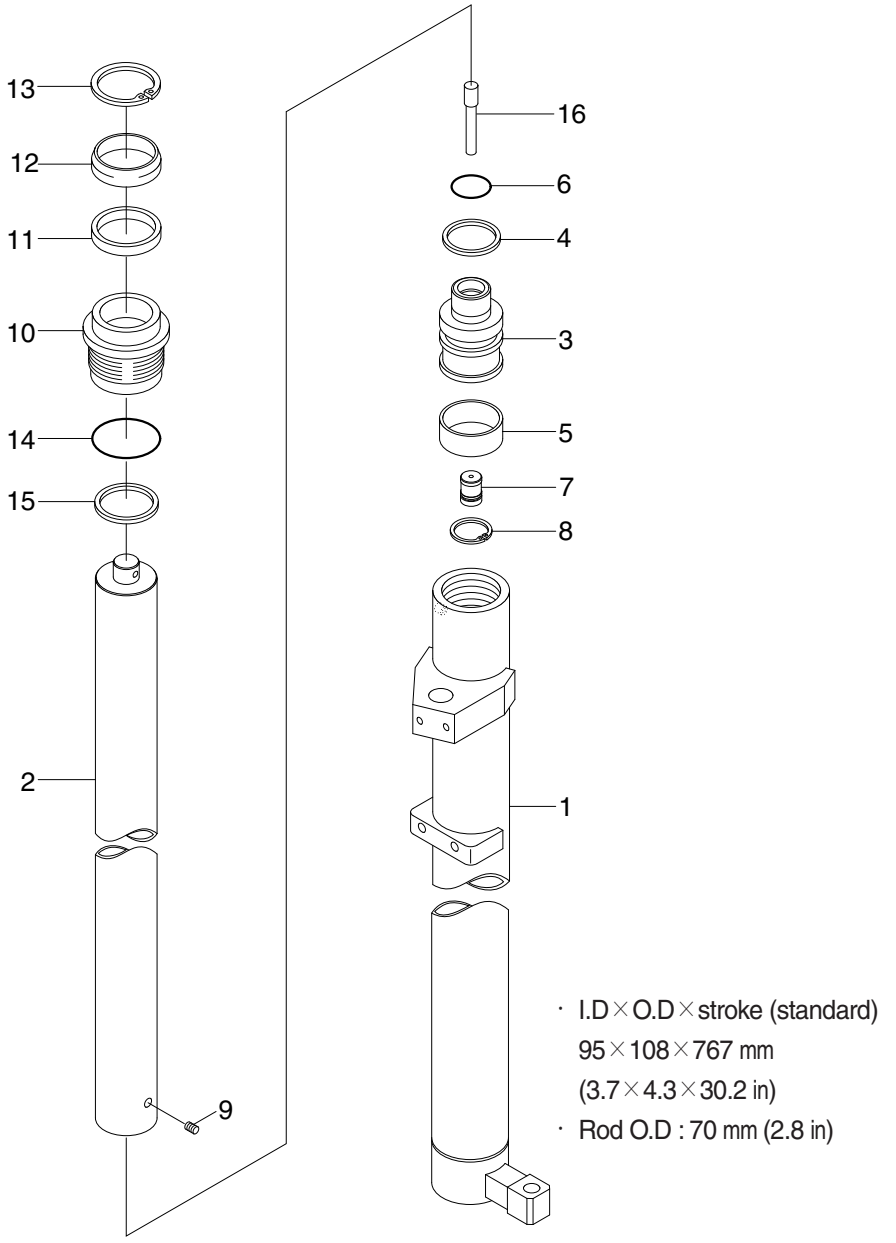



· I.D × O.D × stroke (standard)
85 × 98 × 1335 mm
(3.3 × 3.9 × 52.6 in)
· Rod O.D : 60 mm (2.4 in)

50D9HS21

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 6 | GLYD ring | 11 | Back up ring |
| 2 | Rod assy | 7 | Wear ring | 12 | Dust wiper |
| 3 | Piston | 8 | Set screw | 13 | Snap ring |
| 4 | Check valve | 9 | Gland | 14 | O-ring |
| 5 | Retaining ring | 10 | Rod seal | 15 | Back up ring |

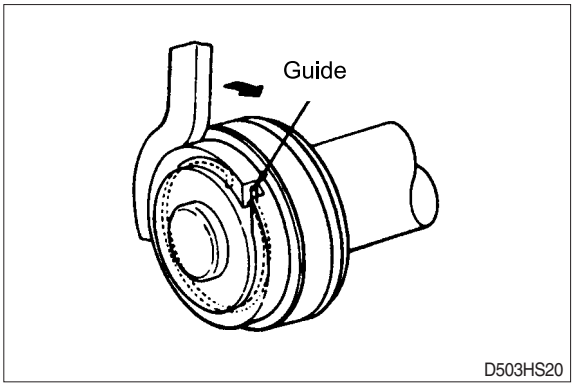
**(4) Free lift** (TS-mast)




| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 7 | Check valve | 13 | Retaining ring |
| 2 | Rod | 8 | Retaining ring | 14 | O-ring |
| 3 | Piston | 9 | Set screw | 15 | Backup ring |
| 4 | Piston seal | 10 | Rod cover | 16 | Pipe |
| 5 | Wear ring | 11 | U-packing | | |
| 6 | O-ring | 12 | Dust wiper | | |

## 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.



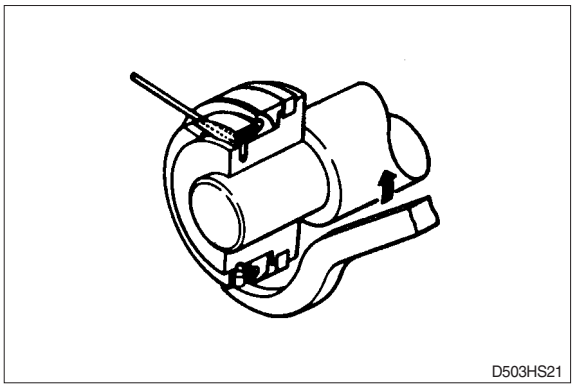

## 3) CHECK AND INSPECTION

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 |

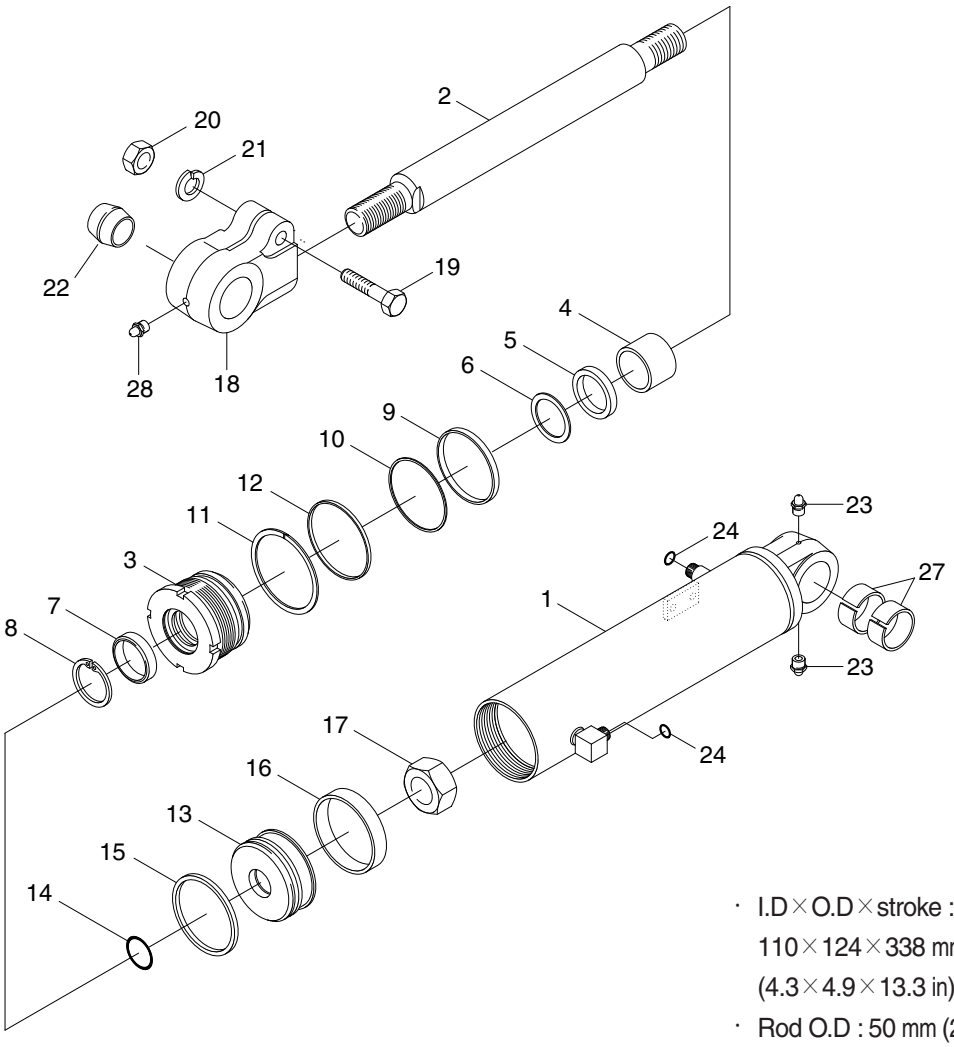
## 4) ASSEMBLY

(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.



## 4. TILT CYLINDER

### 1) STRUCTURE




· I.D × O.D × stroke :
110 × 124 × 338 mm
(4.3 × 4.9 × 13.3 in)

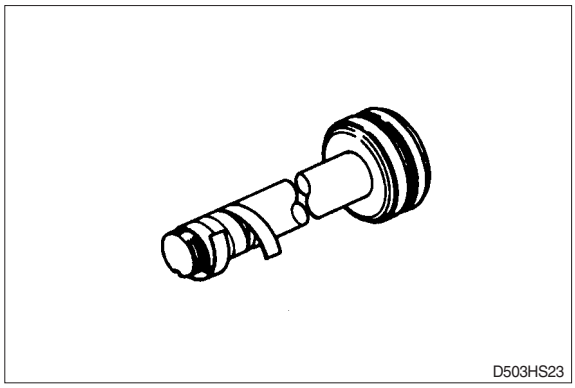
· Rod O.D : 50 mm (2.0 in)

70D9V6HS17

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 10 | Back up ring | 19 | Hex bolt |
| 2 | Rod | 11 | O-ring | 20 | Hex nut |
| 3 | Rod cover | 12 | Washer | 21 | Spring washer |
| 4 | Rod bushing | 13 | Piston | 22 | Spherical bearing |
| 5 | U-packing | 14 | O-ring | 23 | Grease nipple |
| 6 | Back up ring | 15 | Piston seal | 24 | O-ring |
| 7 | Dust wiper | 16 | Wear ring | 27 | Rod bushing |
| 8 | Stop ring | 17 | Set screw | 28 | Grease nipple |
| 9 | O-ring | 18 | Eye | | |

## 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.


D503HS23

## 3) CHECK AND INSPECTION

mm (in)

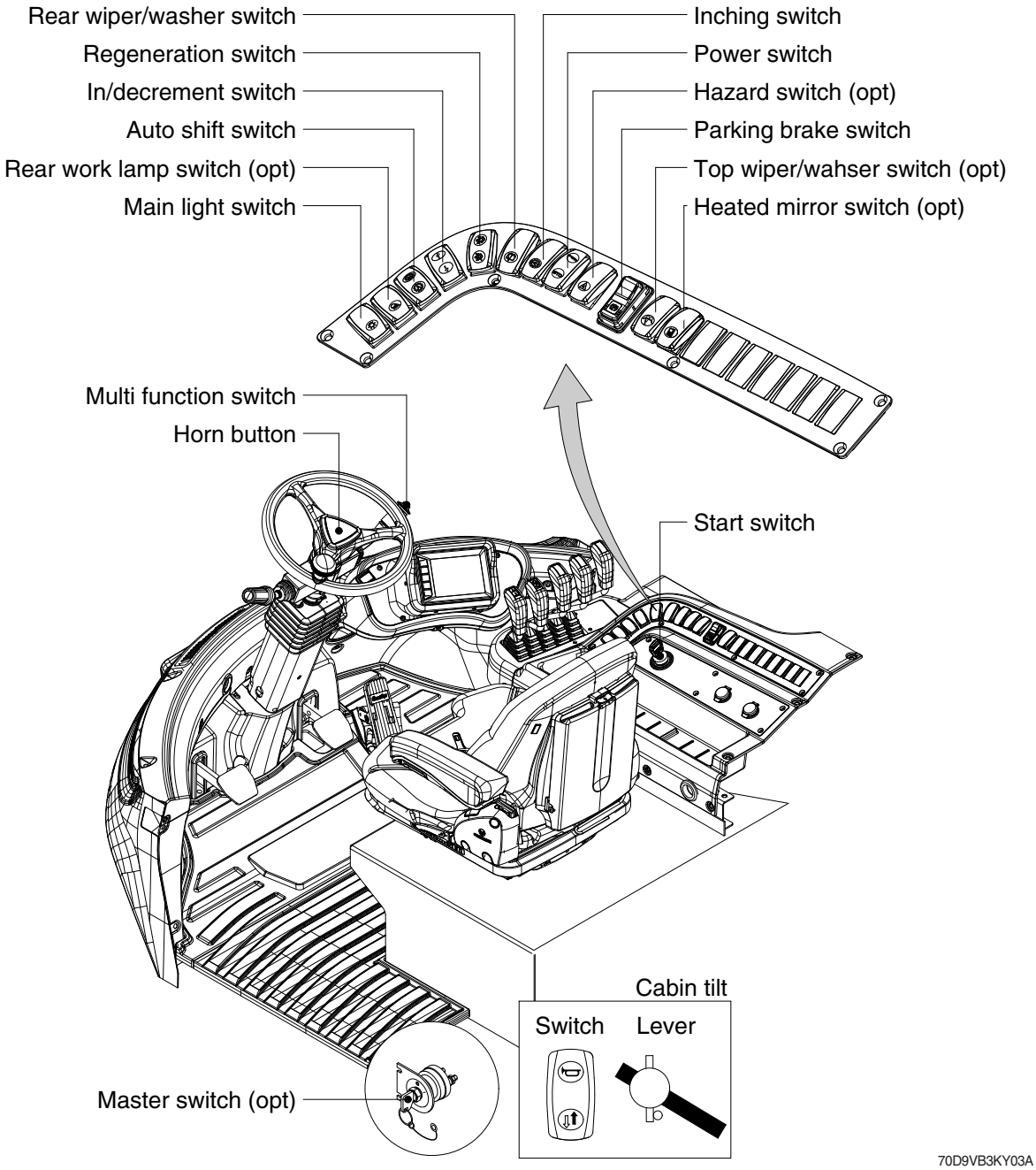
| Check item | Standard size | Repair limit | Remedy |
|---|---|---|---|
| Clearance between cylinder rod & bushing | 0.072~0.288 (0.003~0.011) | 0.5 (0.020) | Replace bushing |
| Clearance between rod head bushing & pin | 0.10~0.35 (0.004~0.014) | 0.6 (0.024) | Replace bushing |

# SECTION 7 ELECTRICAL SYSTEM

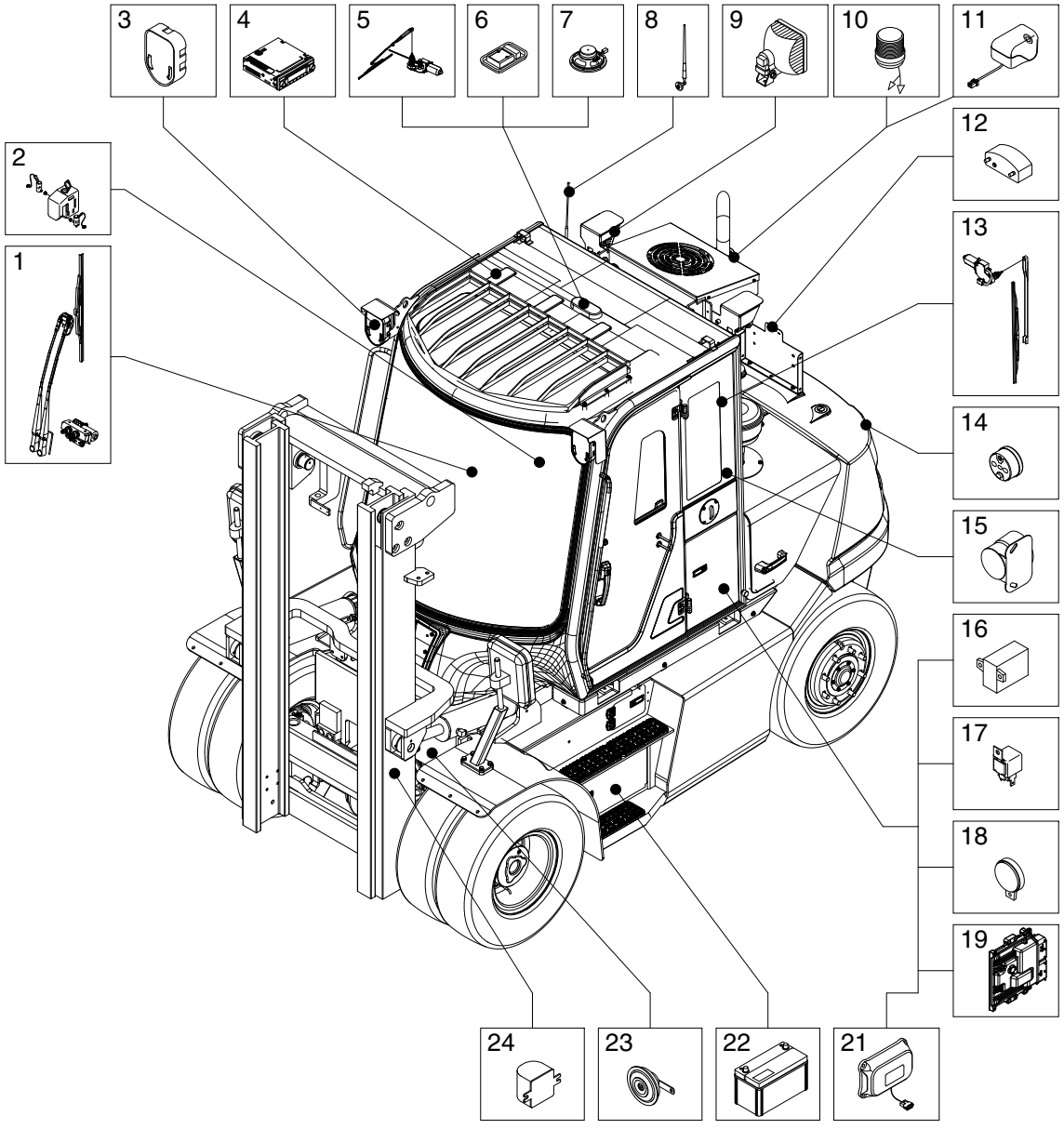

Group 1 Component location ..... 7-1
Group 2 Electrical circuit ..... 7-3
Group 3 Cluster ..... 7-18
Group 4 Component specification ..... 7-56
Group 5 Connector destination ..... 7-57
Group 6 Troubleshooting ..... 7-60

## GROUP 1 COMPONENT LOCATION

### 1. LOCATION 1



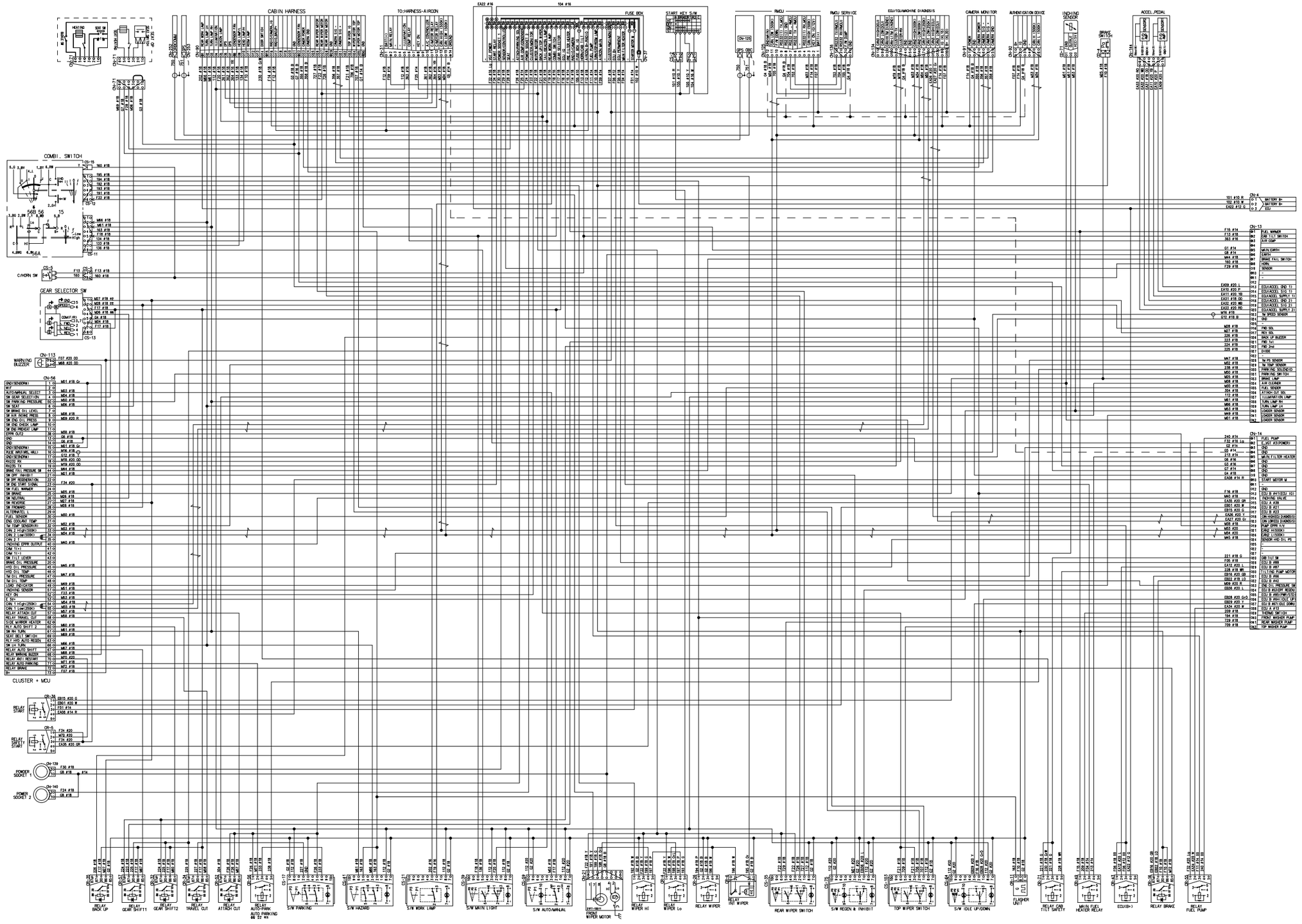
## 2. LOCATION 2




70D9VB7ES01

| | | | | | |
|---|---|---|---|---|---|
| 1 | Wiper assembly | 9 | Work lamp | 17 | Flasher unit |
| 2 | Washer reservoir tank | 10 | Beacon lamp | 18 | Warning buzzer |
| 3 | Head and turn signal lamp | 11 | Camera (opt) | 19 | ECU |
| 4 | Radio and USB player | 12 | License lamp (opt) | 21 | RMCU (opt) |
| 5 | Top wiper assembly (opt) | 13 | Rear wiper assembly | 22 | Battery |
| 6 | Room lamp switch | 14 | Rear combination lamp | 23 | Horn |
| 7 | Speaker | 15 | Back buzzer | 24 | Angle sensor (opt) |
| 8 | Mobile antenna | 16 | Int wiper relay | | |

## · ELECTRICAL CIRCUIT (1/3, DASHBOARD)

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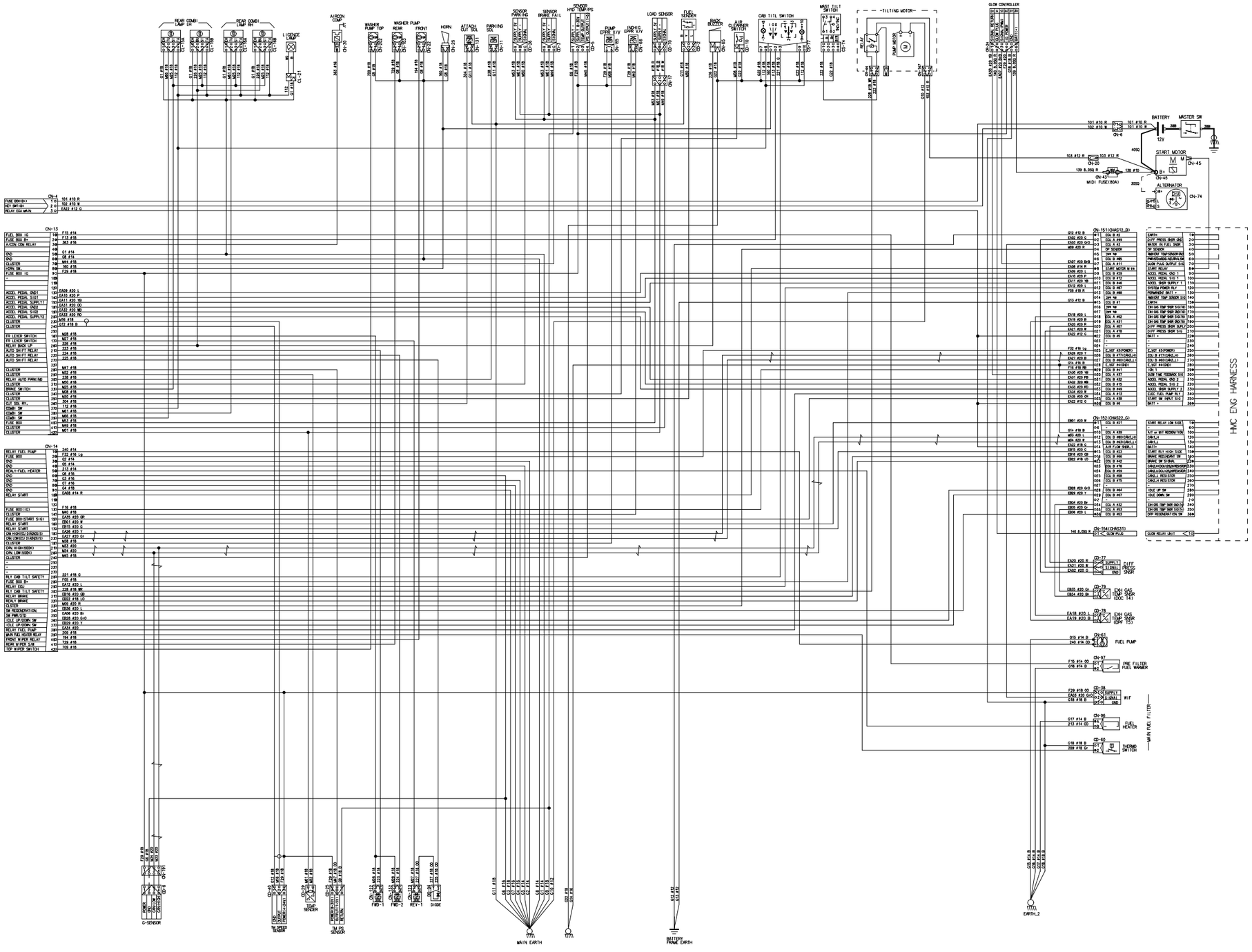
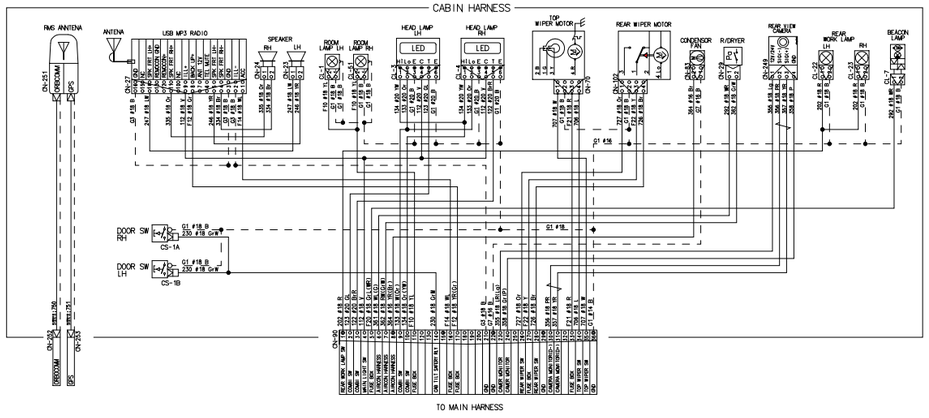
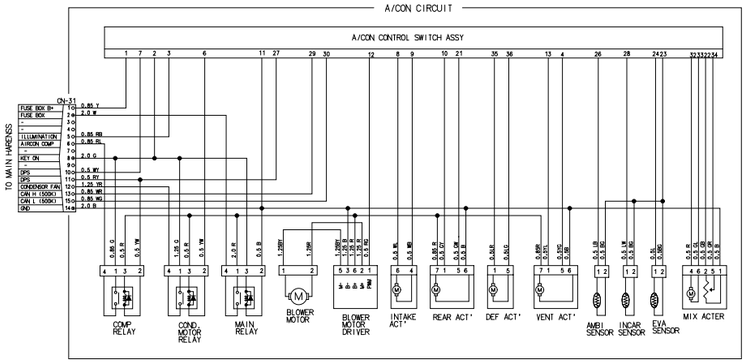
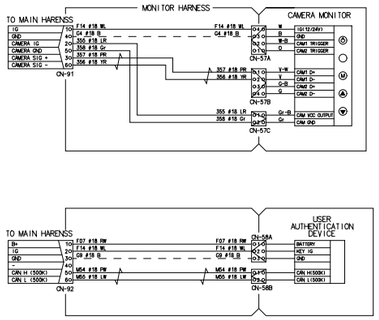
## · ELECTRICAL CIRCUIT (2/3, FRAME)



## · ELECTRICAL CIRCUIT (3/3, CABIN WITH AIRCON)



## 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+)] → Tiliting motor (B+) [CN-20] → Tilting motor [CN-147]
→ Midi fuse [CN-43] → Glow controller [CR-24 (6)]
→ Alternator [CN-74 (B+)]
Battery(+) → I/conn [CN-6 (1)] → I/conn [CN-4 (1)] → Start key switch [CS-2 (1)]
→ I/conn [CN-6 (2)] → I/conn [CN-4 (2)] → Fuse box [CN-37]
→ [No. 1] → Start relay [CR-36 (3)]
→ [No. 4] → Main fuel heater relay [CR-49 (3)]
→ [No. 5] → I/conn [CN-14 (28)] → I/conn [CN-151 (13)] → Engine harness
→ [No. 6] → ECU (B+) [CR-43 (1, 3)]
→ [No. 7] → RMCU [CN-125 (1)]
→ Dianosis [CN-134 (16)]
→ User device [CN-92 (1)]
→ Warning buzzer [CN-113 (2)]
→ Cluster [CN-56 (73)]
→ [No. 9] → Aircon harness [CN-31 (2)]
→ [No. 10] → I/conn [CN-90 (11)] → Room lamp RH/H [CL-51 (2), CL-1 (2)]
→ Flasher unit [CR-11 (B)]
→ Brake switch [CD-4]
→ Brake relay [CR-16 (30, 86)]
→ [No. 11] → Fuel pump relay [CR-55 (3)]
→ [No. 12] → I/conn [CN-90 (17)] → Radio and USB player [CN-27 (8)]
→ Aircon harness [CN-31 (1)]
→ [No. 13] → Aircon harness [CN-31 (2)]

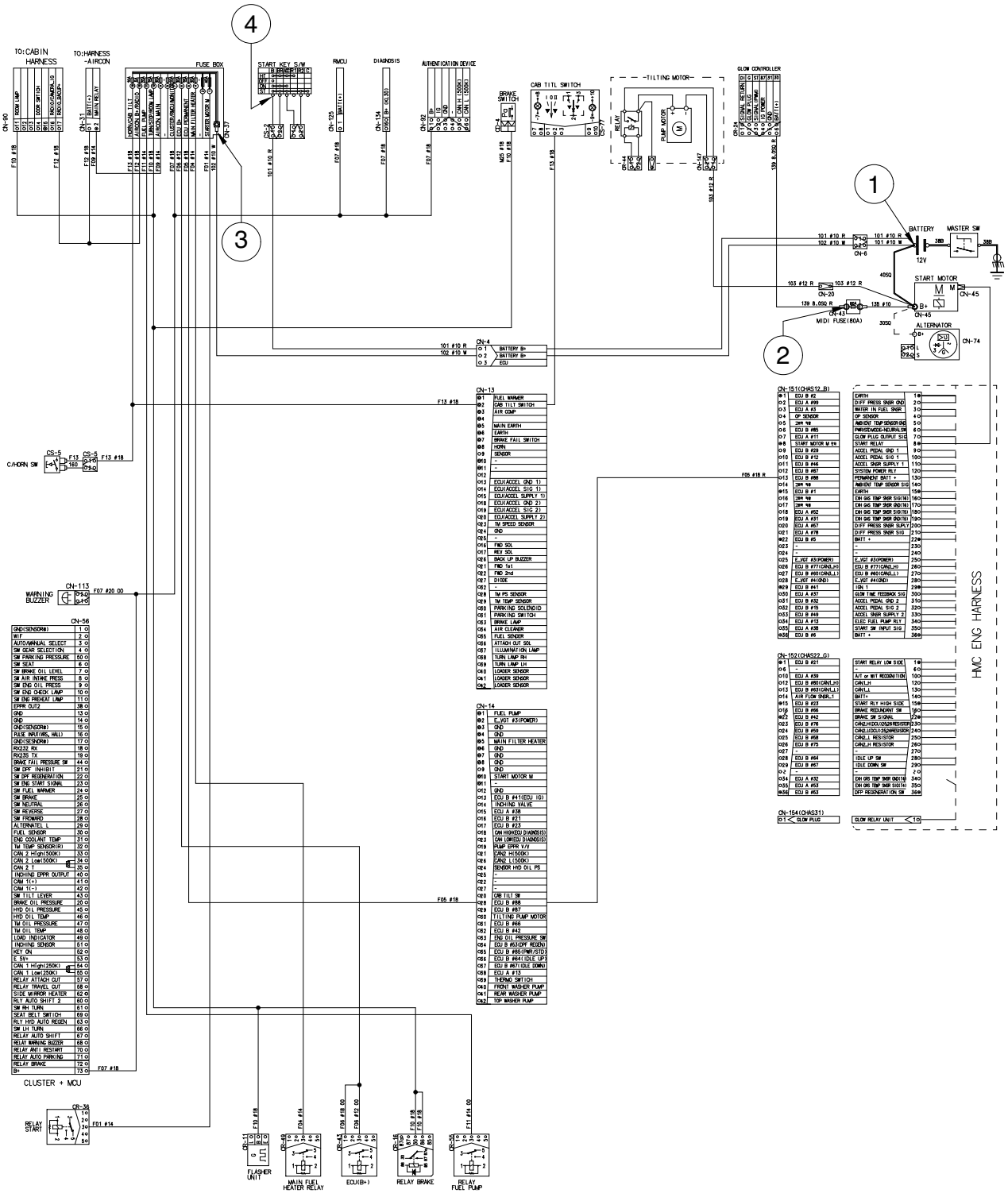
### 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| OFF | OFF | ① - GND (Battery (+))<br>② - GND (Midi fuse)<br>③ - GND (Fuse box ring terminal)<br>④ - GND (Start key) | 14V |

※ GND : Ground

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

# POWER CIRCUIT




70D9VB7ES02

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

## 2. STARTING CIRCUIT

### 1) OPERATING FLOW

Battery(+) → I/conn [CN-6 (1)] → I/conn [CN-4 (1)] → Start key switch [CS-2 (1)] → Start motor [CN-45 (B+ → M)] → I/conn [CN-151 (8)] → I/conn [CN-14 (10)] → Start relay [CR-36(4)]

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

**(1) When start key switch is in ON position**

Start switch ON [CS-2 (2)] → Fuse box [CN-37 (3)] → Power is supplied with the electric component

**(2) When start key switch is START position**

Start switch START [CS-2 (2)] → Fuse box [No. 34 → 31] → Safety start relay [CR-5 (3) → (4)] → I/conn [CN-14 (15)] → ECU harness [CN-151 (35)], ECU start signal → ECU Harness [CN-152 (1,15)] → I/conn[CN-14 (16,17)] → Start relay [CR-36 (1 → 2)]

Then, Fuse box [No. 1] → Start realy [CR-36 (3 → 4)] →I/conn [CN-14 (10)] → ECU Harness [CN-151 (8)] → Start motor [CN-45 (M)]

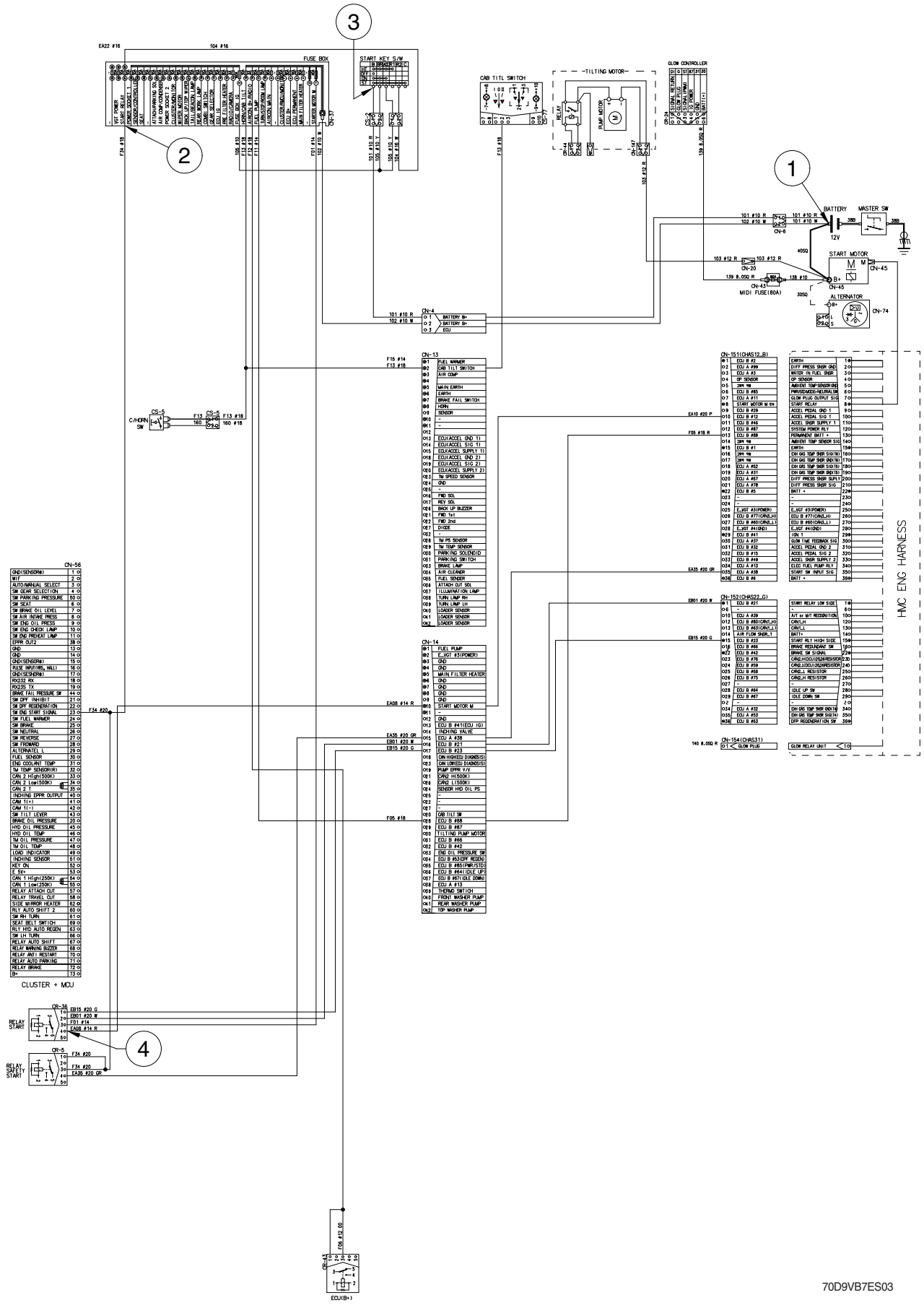
### 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| Running | ON | ① - GND (Battery B+)<br>② - GND (Fuse box No.31)<br>③ - GND (Start key)<br>④ - GND (Safety start relay) | 12V |

※ 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 fusible link (CN-95) and the fuse box.

### 1) OPERATING FLOW

(1) Warning flow
Cluster charging warning lamp (Via CAN interface)

(2) Charging flow
Alternator [CN-74 (B+)] → Start motor [CN-45 (B+)] → Battery (+) charging

### 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| ON | ON | ① - GND (Battery voltage)<br>② - GND (Alternator B+ terminal)<br>③ - GND (Start motor B+ terminal) | 12V |

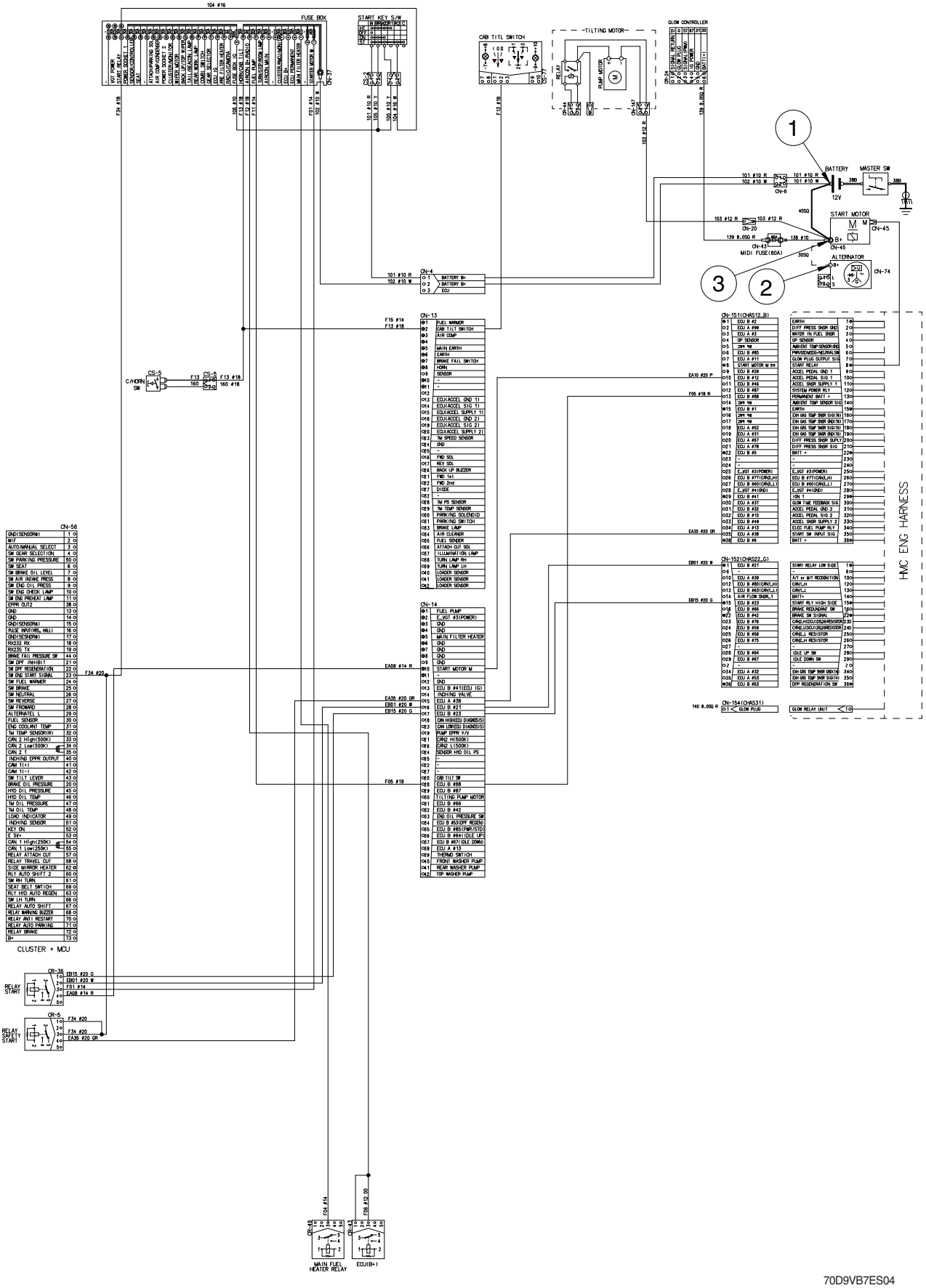
※ GND : Ground

### ※ 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




70D9VB7ES04

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

## 4. PREHEATING CIRCUIT

Combustion chamber glow plugs are used in order to give satisfactory starting of low ambient temperatures.

### 1) OPERATING FLOW

Battery (+) → Start motor [CN-45 (B+)] → Midi fuse [CN-43] → Glow controller [CR-24 (6)]
→ Fuse box [No. 4] → Main fuel heater relay [CR-49 (3) → (4)] → I/conn [CN-14 (5)] →
Fuel heater [CN-96 (B)]

※ When you turn the start switch to the ON position, the glow relay makes the glow plugs operated and the glow lamp of the cluster turned ON.

Start switch ON [CS-2 (2)] → Fuse box [No. 3 → 15]
→ I/conn [CN-13 (1)] → Prefilter fuel warmer [CN-97 (1)]
→ Main fuel heater relay [CR-49 (1) → (2)] → I/conn [CN-14 (39)] →
Thermo switch [CD-60 (2)]

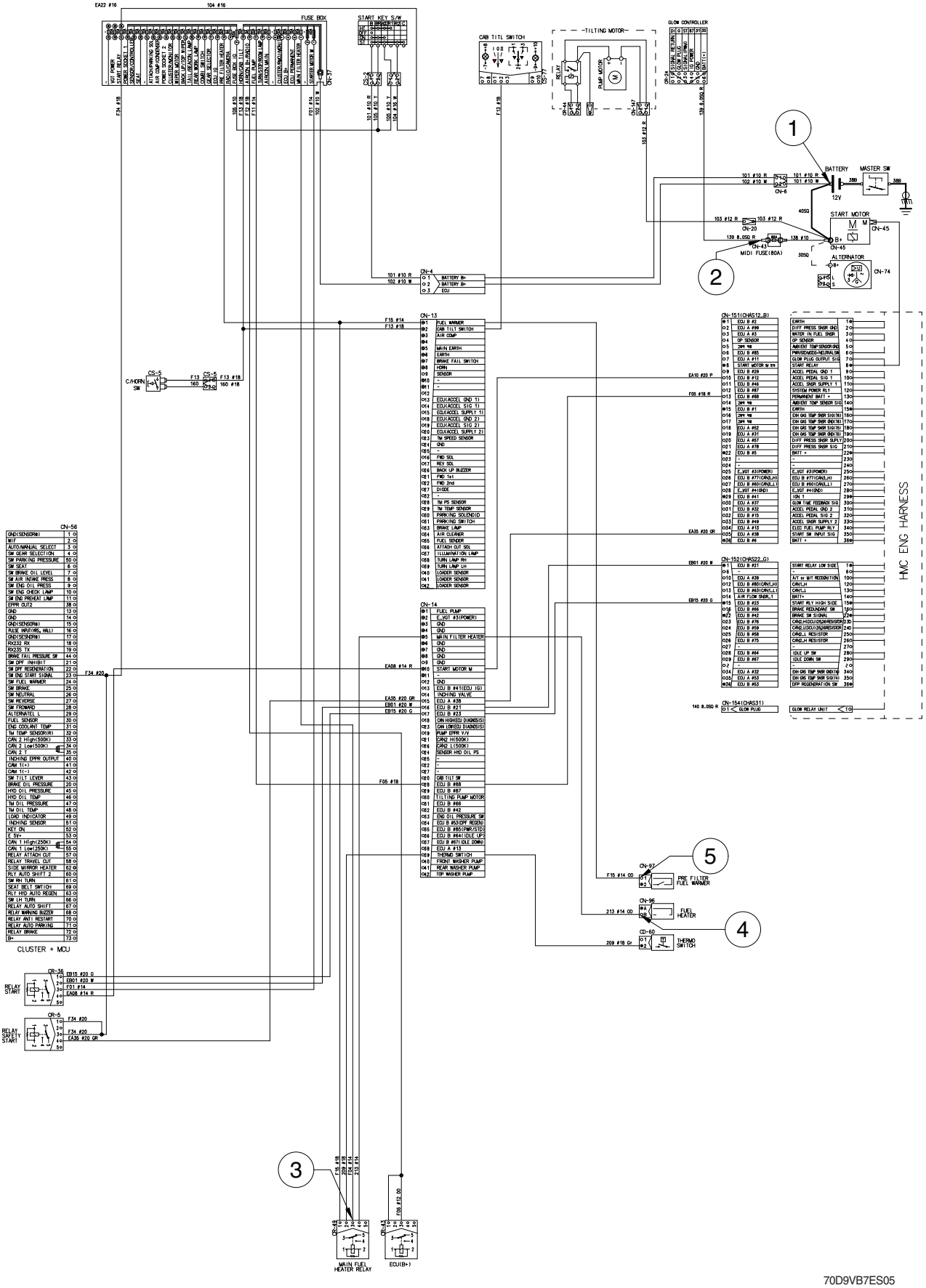
### 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| Stop | HEAT | ① - GND (Battery B+)<br>② - GND (Midi fuse)<br>③ - GND (Main fuel heater relay)<br>④ - GND (Fuel heater)<br>⑤ - GND (Prefilter fuel warmer) | 12V |

※ 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. 18) → Main light switch [CS-39 (6)] → Switch ON, 2nd step [CS-39 (5)] → Multi function switch [CS-11 (8)] → Multi function switch MIDDLE [CS-11(7)] → I/conn [CN-90 (9)]
→ LH Head light low beam ON [CL-3 (2)]
→ RH Head light low beam ON [CL-4 (2)]
→ Multi function switch DOWN [CS-11 (6)] → I/conn [CN-90 (13)]
→ LH Head light high beam ON [CL-3 (1)]
→ RH Head light high beam ON [CL-4 (1)]

#### (2) Rear work light

Fuse box (No. 19) → Rear work lamp switch [CS-21 (2)] → Switch ON [CS-21 (3)] → I/conn [CN-90 (1)] → LH, RH rear work lamp [CL-22 (2), CL-23 (2)]

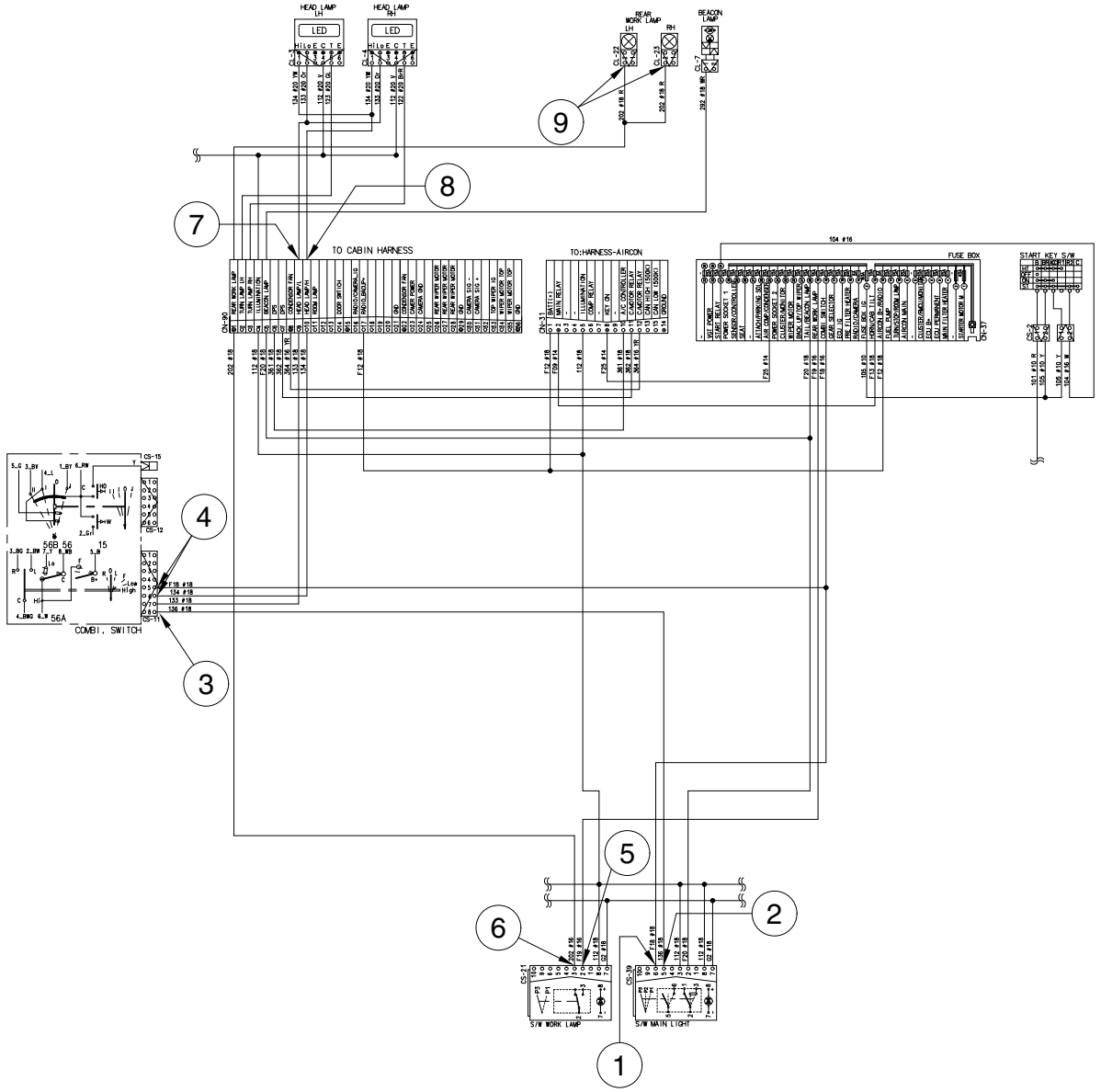
### 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| OFF | ON | ① - GND (Main light switch input)<br>② - GND (Main light switch output)<br>③ - GND (Multifunction switch input)<br>④ - GND (Multifunction switch output)<br>⑤ - GND (Rear work light switch input)<br>⑥ - GND (Rear work light switch output)<br>⑦ - GND (Low beam)<br>⑧ - GND (High beam)<br>⑨ - 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




70D9V7ES06

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

## 6. WIPER AND WASHER CIRCUIT

### 1) OPERATING FLOW

Fuse box [No. 22] → Front wiper motor [CN-21 (8)]
→ Wiper relay Hi [CR-39 (3)]
→ Wiper relay Lo [CR-4 (1)]
→ Multi function switch [CS-12 (6)]
→ Rear wiper and washer switch [CS-3 (3, 6)]
→ I/conn [CN-90 (27)] → Rear wiper motor [CN-102 (3)]

Fuse box [No. 21] → Top wiper and washer switch [CS-103 (3, 6)]
→ I/conn [CN-90 (3)] → Top wiper motor [CN-70 (3)]

#### (1) Front washer switch ON

① Washer switch ON [CS-12 (6) → (2)] → I/conn [CN-14 (40)] → Front washer pump [CN-22 (2)] → Wiper relay [CR-26 (1) → (4)] → Wiper relay Lo [CR-4 (2) → (3)] → Front wiper motor [CN-21 (2)]

#### (2) Front wiper switch ON

① **INT position**

Wiper switch ON [CS-12 (6) → (1)] → Int wiper relay [CR-6 (3) → (2)] → Wiper relay Lo [CR-4 (2) → (3)] → Front wiper motor [CN-21 (2)] → Front wiper motor intermittently operating

② **Lo position**

Wiper switch ON [CS-12 (6) → (4)] → Wiper relay Lo [CR-4 (5) → (3)] → Front wiper motor [CN-21 (2)] → Front wiper motor operating (low)

③ **Hi position**

Wiper switch ON [CS-12 (6) → (3)] → Wiper relay Hi [CR-39 (1) → (4)] → Front wiper motor [CN-21 (4)] → Front wiper motor operating (high)

#### (3) Auto-parking (when switch OFF)

Switch OFF [CS-12 (3)] → Wiper relay Lo [CR-4 (5)→(3)] → Front wiper motor [CN-21 (2)] → Wiper motor stop

#### (4) Rear wiper and washer switch

① **Wiper switch ON** (1st step)

Wiper switch ON [CS-3 (3) → (2)] → I/conn [CN-90 (28)] → Rear wiper motor [CN-102 (4)] → Rear wiper motor operating

② **Washer switch ON** (2nd step)

Washer switch ON [CS-3 (6) → (5)] → I/conn [CN-14 (41)] → Rear washer pump [CN-103 (2)] → Washer operating

Wiper switch ON [CS-3 (3) → (2)] → I/conn [CN-90 (28)] → Rear wiper motor [CN-102 (4)] → Rear wiper motor operating

#### (5) Top wiper and washer switch

① **Wiper switch ON** (1st step)

Wiper switch ON [CS-103 (3) → (2)] → I/conn [CN-90 (34)] → Top wiper motor [CN-70 (4)] → Top wiper motor operating

② **Washer switch ON** (2nd step)

Washer switch ON [CS-103 (6)→(5)] → I/conn [CN-14 (42)] → Top washer pump [CN-202 (2)] → Washer operating

Wiper switch ON [CS-103 (3)→(2)] → I/conn [CN-90 (34)] → Top wiper motor [CN-70 (4)] → Top wiper motor operating

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

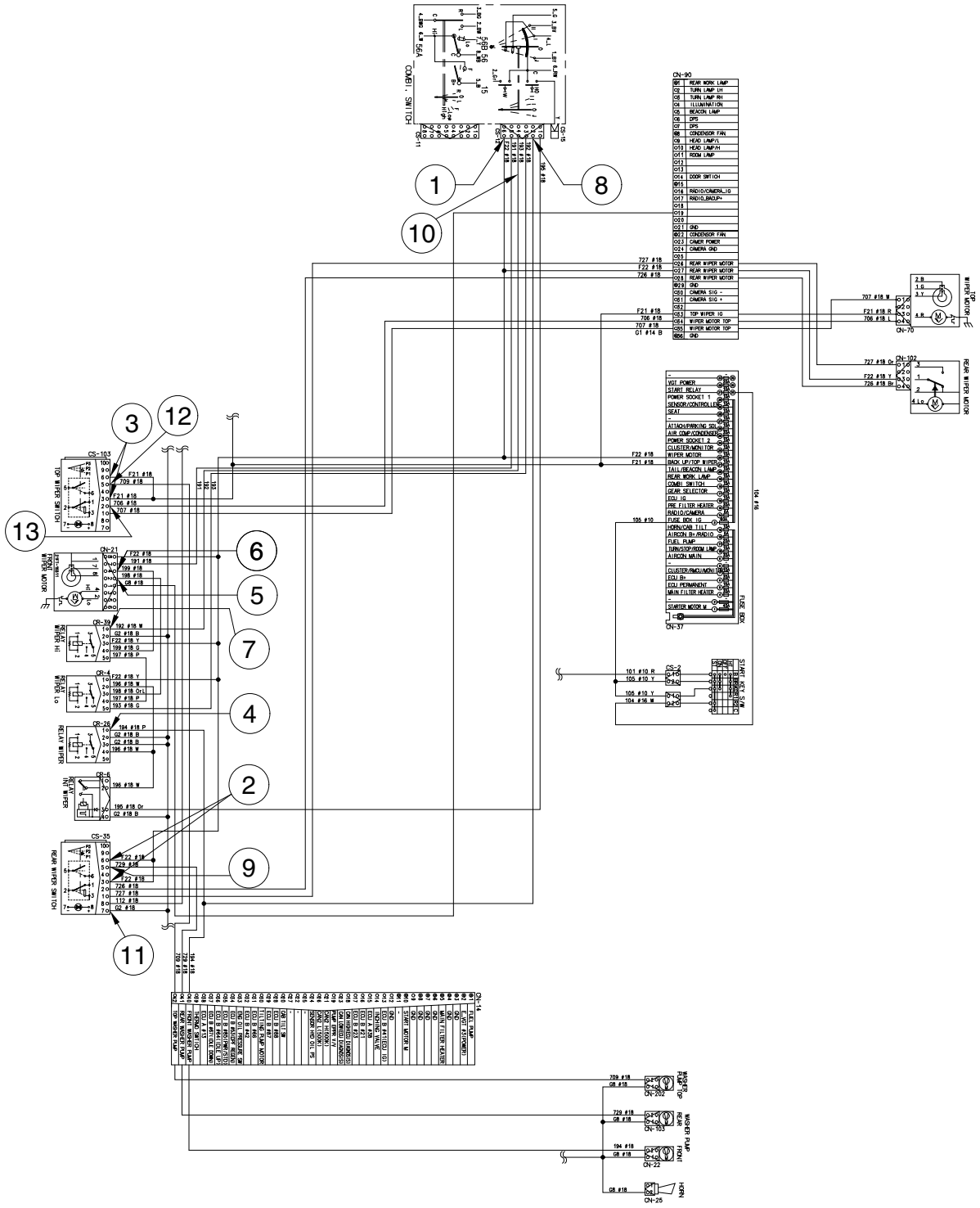
## 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| Stop | ON | ① - GND (Front wiper switch power input)<br>② - GND (Rear wiper switch power input)<br>③ - GND (Top wiper switch power input)<br>④ - GND (Wiper relay power input)<br>⑤ - GND (Front wiper motor Lo power input)<br>⑥ - GND (Front wiper motor High power input)<br>⑦ - GND (Wiper relay power input)<br>⑧ - GND (Front washer power output)<br>⑨ - GND (Rear washer power output)<br>⑩ - GND (Front wiper motor power output)<br>⑪ - GND (Rear wiper motor power output)<br>⑫ - GND (Top washer power output)<br>⑬ - GND (Top wiper motor power output) | 12 V |

※ GND : Ground

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

## WIPER AND WASHER CIRCUIT




70D9VB7ES07

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

## GROUP 3 CLUSTER

1) STRUCTURE

Like following figure, cluster is consisted of LCD and buttons. LCD will indicate the operation and abnormal status of truck to the driver in order to use and maintenance. Also, LCD allows to set and indicate the various modes, monitoring, and gadgets.

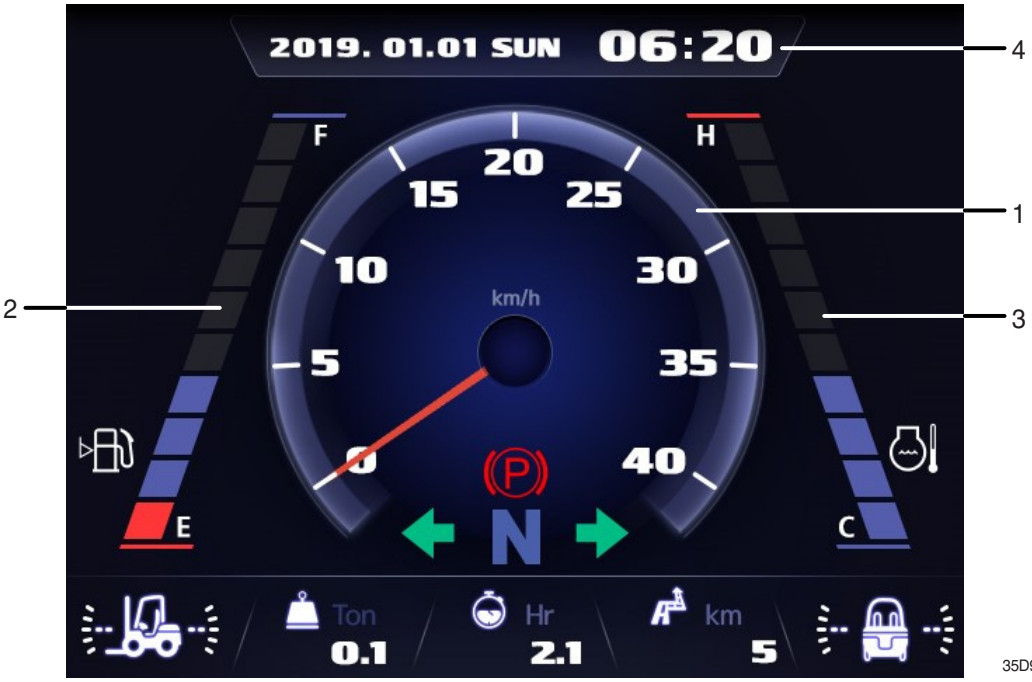
※ **The cluster installed on this truck does not entirely guarantee the condition of the truck. Daily inspection should be performed according to chapter 7. PLANNED MAINTERNACNE AND LUBRICATION.**

※ **When the cluster provides a warning immediately check the problem, and perform the required action.**

## 2) GAUGE

### (1) Operation screen

Operating screen will be displayed if turn on the start switch.




35D9VB3KY04

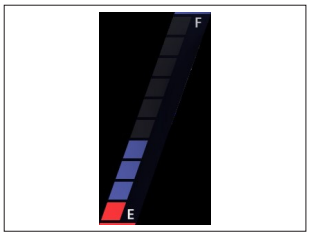
| | | | |
|---|---|---|---|
| 1 | Speed meter | 3 | Coolant temperature gauge |
| 2 | Fuel gauge | 4 | Clock |

### (2) Speed meter

It indicates the speed of truck and calibrated in miles per hour (mph) or kilometer per hour (km/h).

※ **Speed unit can be set in the speed unit menu of display set up at page 7-52.**

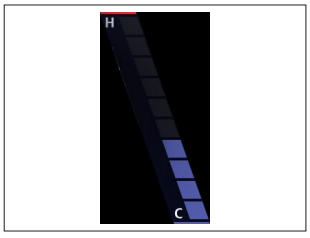
### (3) Fuel gauge




35D9VB3KY05

- Fuel gauge displays the approximate amount of fuel remaining in the fuel tank.
- It shall be obtained fuel as soon as warning lamp lights on.

### (4) Coolant temperature gauge




35D9VB3KY06

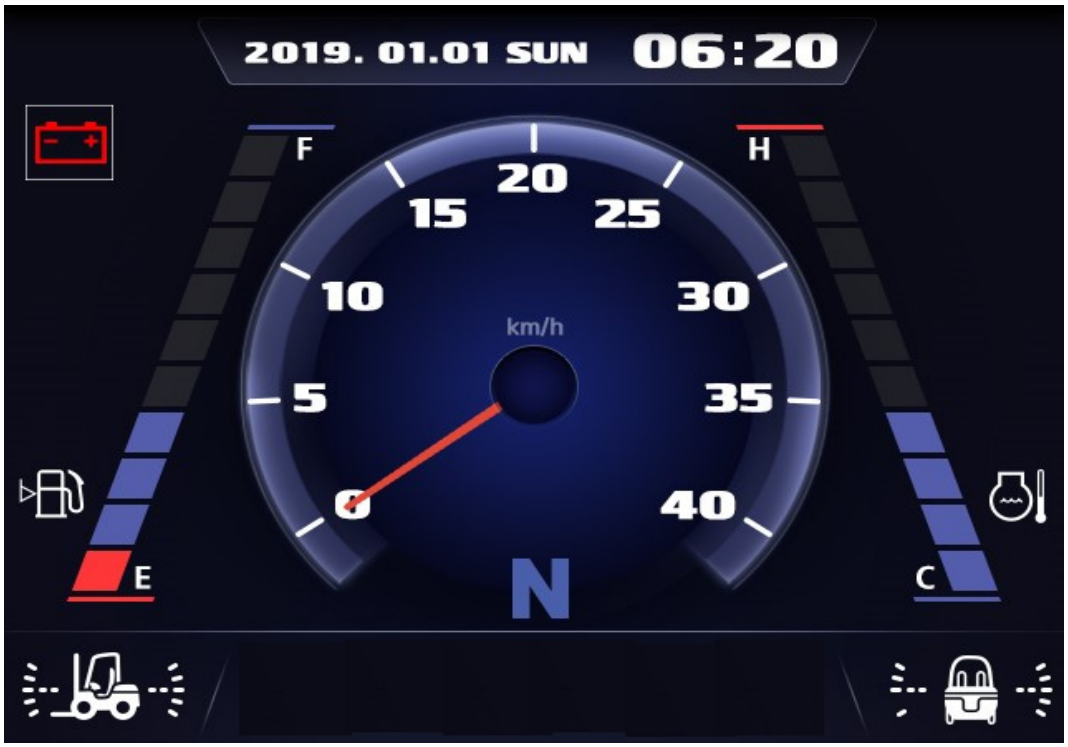
- It indicates the temperature of the engine coolant.
  - White zone : 40 ~ 120 ℃ (104 ~ 248 °F)
  - Red zone : Over 120 ℃ (248 °F)
  - Warning lamp on : Over 115 ℃ (239 °F)
- If the gauge display in the red zone, or warning lamp comes on, please stop the engine and inspect the coolant system.

### (5) Clock


35D9VB3KY07

- It displays current time.
- The time can be adjusted at display Set Up > Time Set Up menu.

### 3) WARNING LAMPS

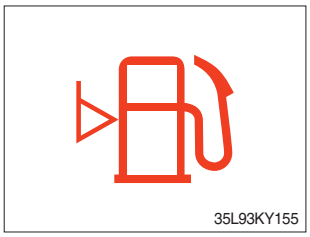



35D9VB3KY08

※ Warning and indicator lamp will display only items that were set as ON, and all warning and indicator except fuel level warning and coolant temperature warning will be displayed in order from the left of screen. And directional indicator lamp will display at the center.

| No. | Warning lamp | | No. | Warning lamp | |
|---|---|---|---|---|---|
| 1 | | Fuel Level warning lamp | 9 | | Transmission oil temperature warning lamp |
| 2 | | Coolant temperature warning lamp | 10 | | DPF regeneration warning lamp |
| 3 | | Engine oil pressure warning lamp | 11 | | DPF inhibit warning lamp |
| 4 | | Air cleaner warning lamp | 12 | | DPF high temperature warning lamp |
| 5 | | Water in fuel warning lamp | 13 | | Clutch protection warning lamp |
| 6 | CHECK | Engine check warning lamp | 14 | COMM ERROR COMM ERROR | Communication error warning lamp |
| 7 | | Engine stop warning lamp | 15 | | Brake fail warning lamp |
| 8 | | Battery charge warning lamp | - | - | - |

### (1) Fuel level warning lamp

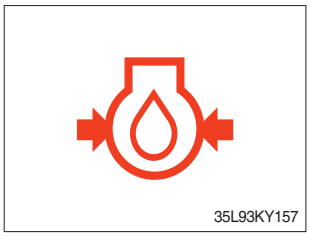



- Warning lamp will be displayed if fuel level is low.
- Please refuel immediately if the lamp is ON.

### (2) Coolant temperature warning lamp

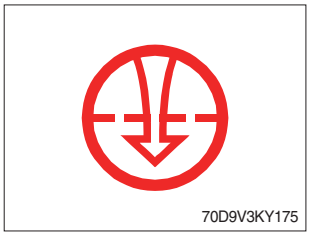

- Coolant temperature warning will be lit up when temperature is over 115 ℃ (239 °F).
- If the warning lamp is on continuously, please inspect the coolant system.

### (3) Engine oil pressure warning lamp



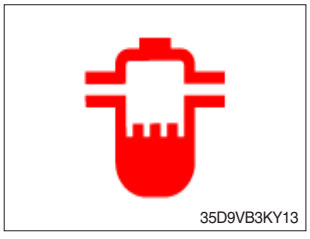

- This warning lamp will be lit up when engine oil pressure is low.
- Stop the engine immediately if the warning lamp is lit up. Please check the engine oil.

### (4) Air cleaner warning lamp



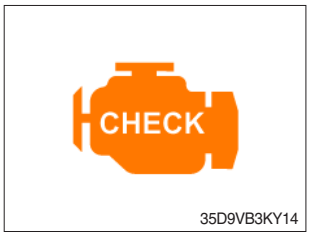

- This warning lamp is lit when air cleaner filter is clogged up.
- Please clean up or replace the filter.

### (5) Water in fuel warning lamp




- Light up when water in fuel.
- Stop the engine and please drain the water of the fuel filter.

### (6) Engine check warning lamp

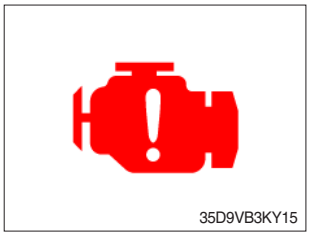



- When the engine is ON, it blinks for about 3 seconds. If the warning light remains on after 3 seconds, there is something wrong with the engine control, fuel supply and so on.
- Check the failure code of cluster.

※ **Some engine controls may not start if there is a problem.**

※ **Continued operation with the engine warning lamp ON or flashing can damage the exhaust control system, which affects operating performance and fuel consumption. You may also be subject to sanctions related to emission regulations, so be sure to check.**

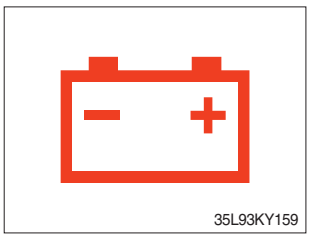
### (7) Engine stop warning lamp




- If the lamp lights on, stop the engine immediately and check the engine.

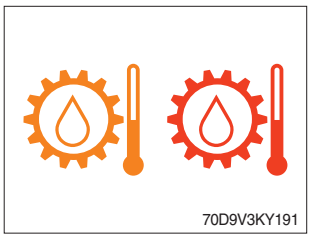
※ **Please contact your Hyundai service center or local dealer.**

### (8) Battery charge warning lamp



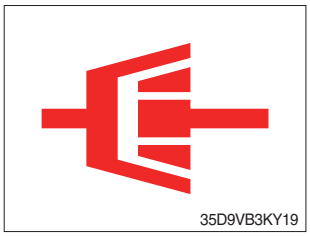

- This warning lamp is lit when battery charging voltage is low.
- Please inspect the battery charging circuit if the warning lamp is lit.

### (9) Transmission oil temperature warning lamp




- Transmission oil temperature warning is consisted of two indications.
  - 110 ℃ (230 °F) or higher : Amber is light up
  - 120 ℃ (248 °F) or higher : Red is flashing
- When this lamp light up during operation, stop the engine and check the truck.

### (10) Clutch protection warning lamp




- Warning lamp will be displayed if transmission oil pressure is not enough or while inching operation.
- Please check the transmission when the lamp is displayed without inching operation. If not, the brake performance can be decreased until the problem is resolved.

### (11) Communication error warning lamp


· This warning lamp will be lit up if the communication between cluster-CI and ECU is fail.
· Please check the communication line if the warning lamp is lit up.

### (12) Communication error warning lamp


· This warning lamp will be lit up if the communication between cluster-CI and TCU is fail.
· Please check the communication line if the warning lamp is lit up.

### (13) DPF

※ During auto regeneration, it is possible to operate the truck (driving and handling the load).
※ Sufficient automatic regeneration could reduce the frequency of parked regeneration.

① Inhibit regeneration switch : OFF

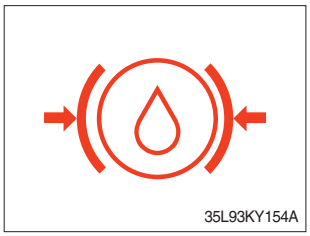
| Level | Warning lamp | | | | Stage of regeneration |
|---|---|---|---|---|---|
| | DPF inhibit | DPF regeneration | DPF high temp | Engine check | |
| |  |  |  |   | |
| Level 0 (No need regeneration) | | | ★On | | Regeneration is not required. |
| Level 1 (Auto regeneration) | | | ★On | | Regeneration starts automatically when the PM (particulate matter) level reaches to this level. |
| Level 2 (Request parked regeneration) | | On | ★On | | ECU requests parked regeneration.<br>Operator needs to follow parked regeneration method.<br>Automatic regeneration does not stop in this level. |
| Level 3 (Parked regeneration) | | On | ★On | On | Automatic regeneration stops.<br>Operator had better park the machine and start parked regeneration as soon as possible.<br>During parked regeneration, machine operation is restricted.<br>Engine output will be limited from Level 3. |
| Level 4 (Regeneration with service tools) | | Blink | Blink | Blink | Parked regeneration is impossible.<br>Regeneration is possible with service tools only. |

★ : When regenerating

② Inhibit regeneration switch : ON

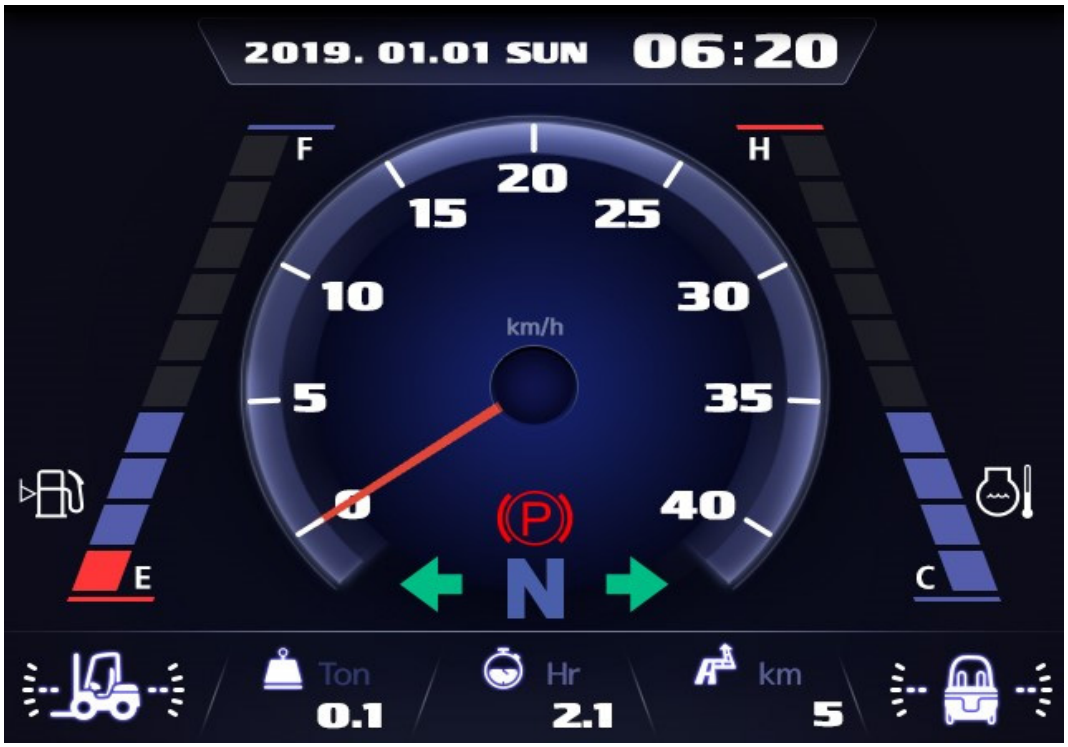
| Level | Warning lamp | | | | Stage of regeneration |
|---|---|---|---|---|---|
| | DPF inhibit | DPF regeneration | DPF high temp | Engine check | |
| |  |  |  |   | |
| Level 0 (No need regeneration) | On | | | | Regeneration is not required. |
| Level 1 (Auto regeneration) | On | | | | Automatic regeneration inhibit. |
| Level 2 (Request parked regeneration) | On | Blink | | | ECU requests parked regeneration.<br>Operator needs to follow parked regeneration method.<br>(Automatic regeneration inhibit) |
| Level 3 (Parked regeneration) | On | Blink | | On | Operator had better park the machine and start parked regeneration as soon as possible.<br>During parked regeneration, machine operation is restricted.<br>Engine output will be limited from Level 3. |
| Level 4 (Regeneration with service tools) | On | Blink | | Blink | Parked regeneration is impossible.<br>Regeneration is possible with service tools only. |

(14) Brake fail warning lamp




· The lamp lights ON when the oil pressure of service brake drops below the nomal range.
· When the lamp is ON, stop the engine and check for its cause.
※ **Do not operate untill andy problems are corrected.**

## 4) INDICATOR LAMPS

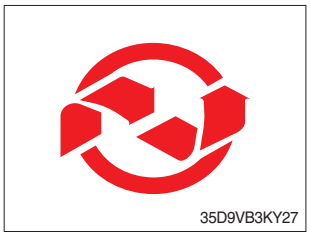



35D9VB3KY24

※ Warning and indicator lamps will display only items that were set as ON, and all warning and indicator except turning indicator lamp and driving indicator lamp will be displayed in order from the left of screen.

| No. | Indicator lamp | | No. | Indicator lamp | |
|---|---|---|---|---|---|
| 1 | | Consumables management indicator lamp | 8 | N | Driving indicator lamp |
| 2 | | Engine warning up indicator lamp | 9 | F F1 F2 F3 | |
| 3 | | Fuel warmer indicator lamp | 10 | R R1 R2 R3 | |
| 4 | | Parking brake indicator lamp | 11 | SIDE | Side mirror heated action indicator lamp |
| 5 | TILT LOCK | Tilt lock indicator lamp | 12 | | High beam indicator lamp |
| 6 | OP SS | OPSS indicator lamp | 13 | | Inching switch ON indicator lamp |
| 7 | | Driving turn lamp | - | - | - |

### (1) Consumables management indicator lamp




- Light up if consumables which must be replaced are exist.
- The indicator lamp will light up only 3 minutes since start switch ON, and then light OFF.
- Please check the consumables management list in maintenance menu.

### (2) Engine warm-up indicator lamp


- The truck senses the engine coolant temperature and warms-up engine when needed.
- When it is happening, the indicator lamp is ON.

### (3) Fuel warmer indicator lamp


- Light up when fuel warmer is operating. (Controlled by ECU)

### (4) Parking brake indicator lamp


- Light up when parking brake is ON.

### (5) Tilt lock indicator lamp


- The Indicator lamp will be lit up if the tilt lock switch (option) is entered.
- Tilt action will be limited if this Indicator lamp is lit up and the mast is located at 90 degrees.

### (6) OPSS indicator lamp


- Light up if driver leave seat during operation.
- Truck driving and/or mast control will be blocked if lamp is lit up.

※ **Please refer to page 0-12 for details.**

### (7) Driving indicator lamp

#### ①Neutral


- This indicator lamp will be lit up when direction lever is located in neutral.

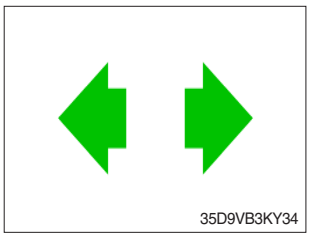
#### ②Forward


- This indicator lamp will be lit up if the forward gear is selected.

#### ③Reverse

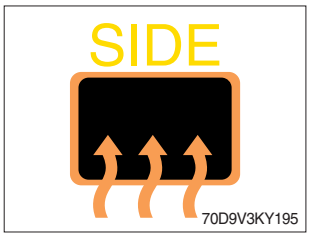

- This indicator lamp will be lit up if the reverse gear is selected.

### (8) Driving turn lamp



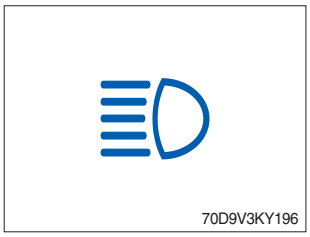

- This indicator lamp will flash if turns on the right or left turn signal.

### (9) Side mirror heated action indicator lamp



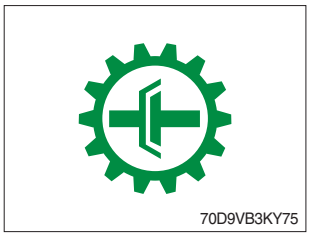

- This indicator is displayed when the heating switch is pressed.
- The heating operation is maintained for 10 minutes and canceled the operation when the switch is pressed again.

### (10) High beam indicator lamp




- This indicator is displayed when the vehicle's high beam is on.

### (11) Inching indicator lamp




- This indicator is displayed when the vehicle's Inching switch is on.

## 5) INFORMATION DISPLAY


35D9VB3KY35

### (1) Mast front/rear tilt

70D9V3KY41

· Display the real time tilt of mast.

### (2) Truck front/rear tilt

35D9VB3KY36

· Display the front and rear tilt of truck in real time.
· The red warning symbol turned on condition.
  - Stop : Tilt angle is higher than 2.3˚
  - Driving : Tilt angle is higher than 10.2˚

### (3) Truck left/right tilt

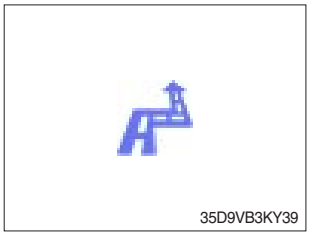
35D9VB3KY37

· Display the left and right tilt of truck in real time.
· The red warning symbol turned on condition.
  - Stop : Tilt angle is higher than 3.4˚
  - Driving : Tilt angle is higher than 28.0˚

### (4) Load weight (option)

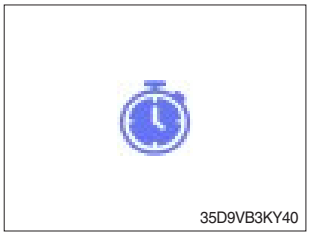

- Display the load weight.
- Screen will display blurry if the weight sensor has not been mounted.

### (5) Total trip distance




- Display total trip distance of the truck.
- Unit of distance is kilometer.

### (6) Operation time



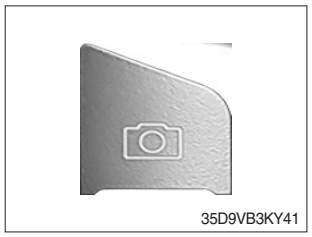

- Display the used time of the truck.

### (7) Explanation of warning lamp and indicator lamp

- When warning lamp or indicator lamp comes on, please press the enter button to check detailed explanation.
- During pressing the enter button, it keeps the screen to be shown explanation for warning lamp or indicator.

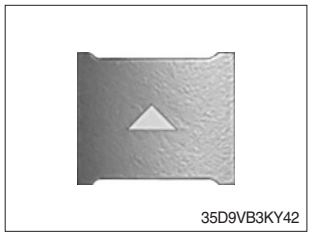
## 6) BUTTONS

### (1) Camera



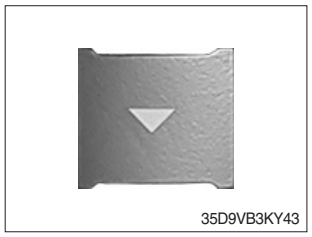

· This switch displays rear camera images. (if the camera is mounted)

### (2) UP/Left



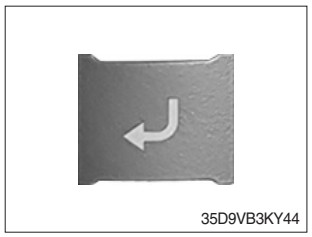

· This switch is used to move upward or leftward in menu or increase the value.

### (3) Down/Right



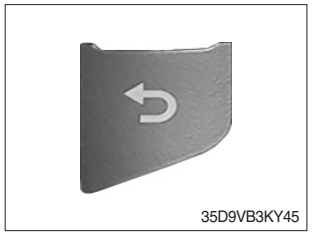

· This switch is used to move downward or rightward in menu or decrease the value.

### (4) Select




· This switch is used to enter into the menu or to select.

### (5) Cancel (ESC)




· This switch is used to cancel or move to upper menu.

## 7) MAIN MENU

### (1) Structure

Menus consist of main menu and sub-menu.

Operation Screen


Main Menu Screen


Sub-Menu Screen


70D9VB3KY42

| No. | Main menu screen | Sub menu | Explanation |
|---|---|---|---|
| 1 |  35D9VB3KY47 | · Model select<br>· Tilt setting<br>· ESL setting<br>· Weight sensor setting (option)<br>· Camera setting (if installed)<br>· Fingertips setting (null)<br>· CSC setting (if installed)<br>· Auto shift setting<br>· DCSR setting<br>· HAC setting (if installed)<br>· Vehicle Max speed limit<br>· Zero start setting (if installed)<br>· Clutch protection beep (if installed)<br>· TCU calibration<br>· Inching pedal initialization<br>· Seat belt interlock (option)<br>· Cluster-CI info | · Diesel, LPG<br>· Truck tilt initialize<br>· ESL setting, Engine start limit, Delay time<br>· Enter the cylinder cross section area, Adjust load weight, Weight display setup<br>· Reverse gear interworking<br>· DCSR on, Cut-off driving speed, Restore driving speed<br>· Maximum speed limitation<br>· Cluster-CI information |
| 2 |  35D9VB3KY48 | · Failure history<br>· Consumables management<br>· I/O inforamation | · Engine, Transmission failure history<br>· Change oil and filter replacement cycle<br>· Analog, Digital signal |
| 3 |  35D9VB3KY49 | · LCD brightness adjustment<br>· User setting<br>· A/S phone No.<br>· Password change<br>· Consumables management | · Automatic, Manual<br>· Time, Unit, Language<br>· Change A/S contact<br>· Engine starting password connect<br>· Maintenance parts management |

## (2) Equipment menu

### ① Model Select (a required setting)

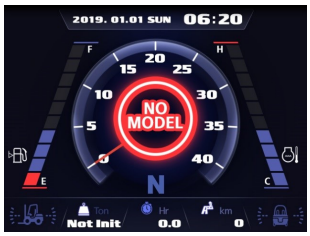
Check under the start switch ON status. Selection will be canceled if press the cancel button.

※ **This is a required setting. Some functions may not be worked properly if you do not select the model.**

※ **If you want to move back to previous page, please enter ESC button in any stage.**

※ **It shall be selected right model to prevent malfunction of truck.**

1. NO MODEL




35D9VB3KY50

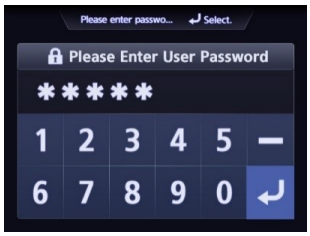
Select the your model.

2. Equipment


35D9VB3KY47

Enter to Equipment.

3. Password




35D9VB3KY51

Enter the password.
Default password is “00000”.
Password length must be 5~10 digits.

4. Model select


70D9V3KY54

Choose Model Select and enter.

5. Diesel or LPG


35D9VB3KY53

Please select the fuel type.

6. Truck weight


70D9V3KY44

Please select the truck weight level.

7. Truck model


70D9VB3KY45

Please select the exact model name.

8. Confirm


70D9VB3KY46

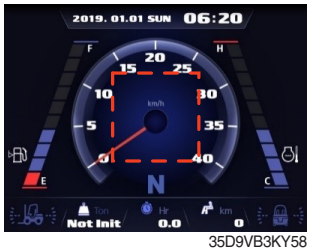
Confirm the model which you select.

9. Completion


70D9VB3KY47

Model selection is completed.

10. Check




35D9VB3KY58

Check the status which is not shown 'NO MODEL' in main display.

## ② Tilt Setting

a. **Setting (Check under the start switch ON status.)**

※ **The tilt sensor has already been initialized when deliver the truck from factory.**

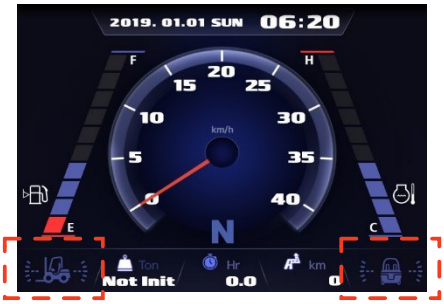
※ **Tilt reset if the tilt sensor figure or truck tilt is not horizontal in the flatland.**

⚠ **You must set tilt in the flatland since this is a horizontal set up.**

※ **If tilt sensor for mast is mounted (option), locates the mast vertically.**

※ **Mast maximum angle depends on the truck.**

· Truck that has not applied the mast angle sensor




· Truck that has applied the mast angle sensor (option)

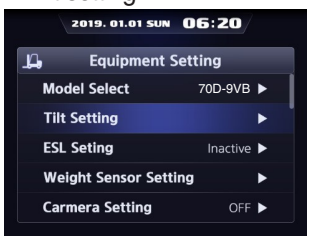

70D9VB3KY59

1. Equipment


35D9VB3KY47

Enter to Equipment.

2. Tilt setting




70D9VB3KY50

Choose Tilt Setting and enter.

3. Instruction


70D9V3KY51

Follow the instruction showing in the screen.

4. Completion


70D9V3KY52

Setting has been completed.

b. **Check functions**

a) Check the real time operation by changing angles of truck tilt and mast tilt.

**b) Auto-leveling (if installed)**

(a) Tilt mast forward or backward.

(b) Start tilting mast toward its vertical position, pushing the auto tilt leveling switch.

(c) Check if the mast stops traveling when it becomes vertical to ground.

**c) Forward or backward truck tilt warning (red)**

· Stop : ±2.3° (1.5 tons ~ 5.0 tons)

· Driving : ±10.2° (1.5 tons ~ 5.0 tons)

### d) Left or right truck tilt warning (red)

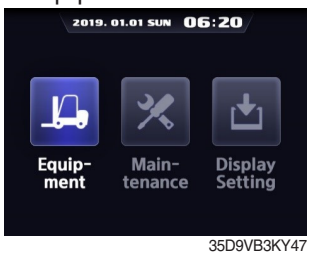
- Stop : ±3.4° (1.5 tons ~ 5.0 tons)
- Driving

| Truck weight | Warning angles (red) |
|---|---|
| 1.5 tons ~ 2.0 tons | ±20.3° |
| 2.2 tons ~ 3.3 tons | ±20.8° |
| 3.5 tons ~ 4.5 tons | ±24.2° |
| 5.0 tons | ±28.0° |

## ③ ESL (Engine Start Limit) Setting : Default is 'Inactive'

### a. Setting

1. Equipment




35D9VB3KY47

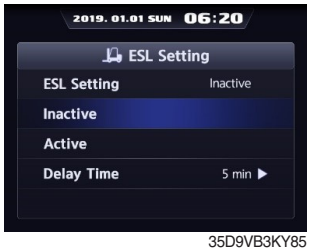
Enter to Equipment.

2. ELS Setting


70D9VB3KY55

Choose ESL setting and enter.

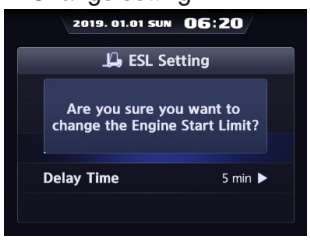
3-1. Inactive




35D9VB3KY85

Choose Inactive.

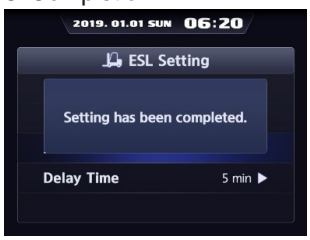
4. Change setting




35D9VB3KY86

If you want to change setting, press enter button.

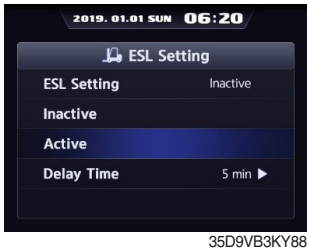
5. Completion




35D9VB3KY87

Setting has been completed.

3-2. Active




35D9VB3KY88

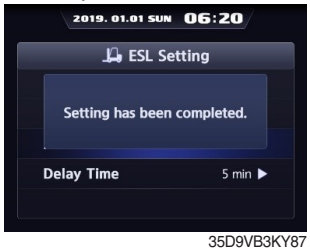
Choose Active.

4. Change setting


35D9VB3KY89

If you want to change setting, press enter button.

5. Completion




35D9VB3KY87

Setting has been completed.

### b. Check functions

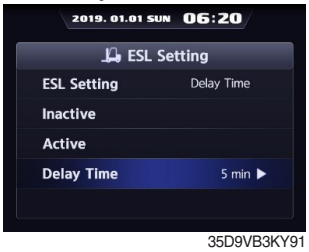
a) The active mode can be set when engine is starting. (cf. inactive mode can change any time.)
b) Upon start switch ON, the password screen pops up and starting is prohibited until the right password has been offered. (But, driver still can start the truck if starts within 10 seconds from start switch OFF)
c) Set the mode as 5 minutes of delay time and start switch OFF.
d) Check if truck can start within 5 minutes and start switch OFF.
e) Check if truck requests password after 5 minutes.

※ **Start switch ON screen (When startup control mode is ON)**

35D9VB3KY90

### c. Delay Time

3-3. Delay time



35D9VB3KY91

Choose Delay Time.

4. Select value

35D9VB3KY92

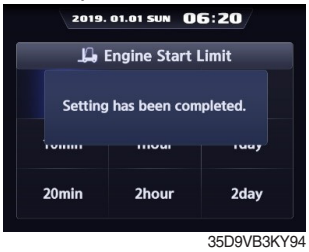
Select value you want to apply.

5. Change setting

35D9VB3KY93

If you are sure to change ESL, press enter.

6. Completion



35D9VB3KY94

Setting has been completed.

## ④ Weight Sensor Setting (option)

Check under the start switch ON status. There are three settings (unload, load, reset) for weight sensor.

※ **The weight sensor has already been set when deliver the truck from factory.**

### a. Setting Cylinder Cross-Section

※ **Cylinder cross-section value**

unit : $cm^2$

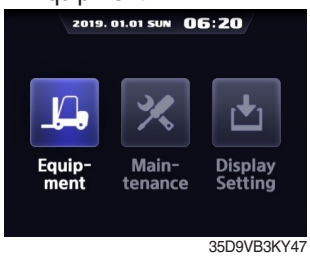
| Model | V-mast | TF-mast | TS-mast |
|---|---|---|---|
| 70D-9VB | 113.49 | 132.73 | 141.76 |

· Truck that has not applied the weight sensor


· Truck that has applied the weight sensor (option)


70D9VB3KY63

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. Weight Sensor Setting


70D9VB3KY56

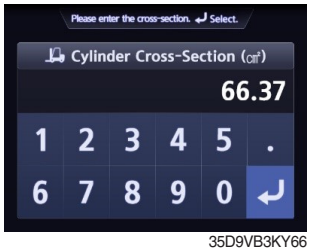
Choose Weight Sensor Setting and enter.

3-1. Cylinder Cross-Section


70D9V3KY57

Choose Cylinder Cross-Section. If cylinder cross-section is already set up, setting value is shown in initial screen.

4. Value




35D9VB3KY66

Enter cylinder cross-section value using up or down buttons.

5. Completion


35D9VB3KY67

Setting has been completed.

6. Check


70D9V3KY58

Check the value whether it is right.

### b. Unloaded status adjustment

3-2. Load Weight Adjustment


70D9V3KY59

Choose Load Weight Adjustment and enter.

4-1. Unloaded Status Adjustment


70D9V3KY60

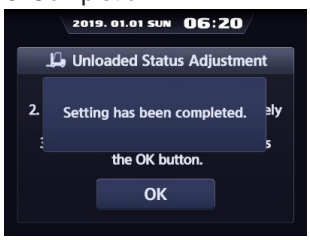
Choose Unloaded Status Adjustment and enter.

5. Instruction


35D9VB3KY71

Follow the instruction showing in the screen. After finish setting and press enter button

6. Completion




35D9VB3KY72

Setting has been completed.

### c. Loaded status adjustment

※ Must be prepared to lift up by locating the load on the fork before enter the weight.

※ MCU (Main Control Unit) recognizes the weight automatically by detecting the pressure change.

※ Must be performed within 30 seconds of lift task. If it is not completed within 30 seconds, this process will be canceled automatically.

※ Accurate weight value is not recognized if other pressure changes that are occurred besides salvage work.

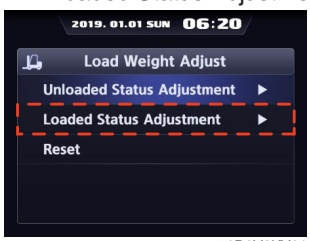
※ Perform again, if the measurement malfunction is occurred.

3-2. Load Weight Adjustment


70D9V3KY59

Choose Load Weight Adjustment and enter.

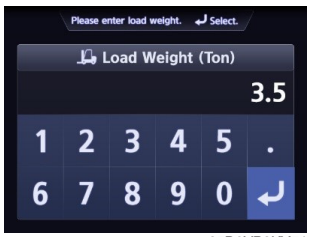
4-2. Loaded Status Adjustment




70D9V3KY61

Choose Load Weight Adjustment and enter.

5. Value




35D9VB3KY74

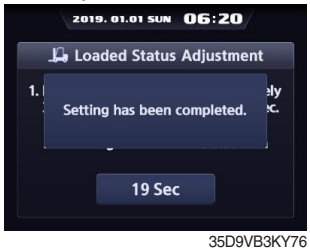
Enter load weight using up or down buttons.

5. Instruction


35D9VB3KY75

Follow the instruction showing in the screen. After finish setting and press enter button. Please proceed the operation within 30 seconds.

6. Completion




35D9VB3KY76

Setting has been completed.

## d. Reset

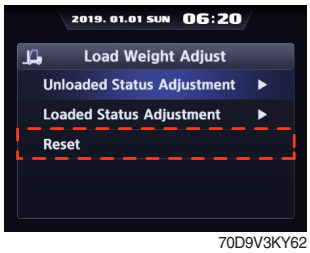
Initialize the all values of 'Unloaded and Loaded Status Adjustment' that were entered previously. (Cylinder cross-sectional area is not initialized.)

3-2. Load Weight Adjustment


70D9V3KY59

Choose Load Weight Adjustment and enter.

4-3. Reset




70D9V3KY62

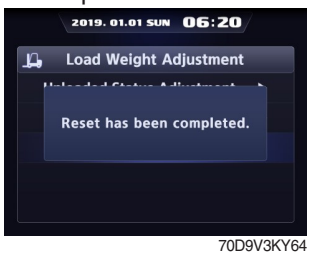
Enter to Reset.

5. Check


70D9V3KY63

Press the enter button.

6. Completion




70D9V3KY64

Reset has been completed.

## e. Weight Display Setting

Enable to adjust the digit-number fo weight of main screen.

3-3. Weight Display Setting


70D9V3KY65

Choose weight sensor setting and enter.

4. Unit


35D9VB3KY81

Choose unit what you want to use.

5. Completion


35D9VB3KY80

Setting has been completed.

· 100 kg unit


· 10 kg unit


35D9vB3KY83

### f. Overload Alarm

3-4. Overload alarm


70D9V3KY68

Enter to Overload alarm.

4. Select


35D9VB3KY81

Select ON or OFF.

5. Completion

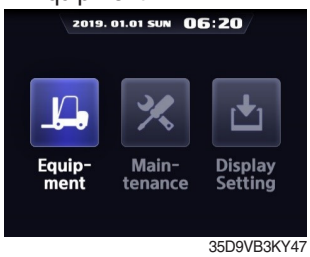

35D9VB3KY80

Setting has been completed.

### ⑤ Camera Setting (if installed)

- Device setup → Camera setup
- After set the reverse gear interoperation as ON, the screen will be changed from main screen to camera mode if put gear into reverse, and if the gear is changed, screen will be back to the main screen.

1. Equipment




35D9VB3KY47

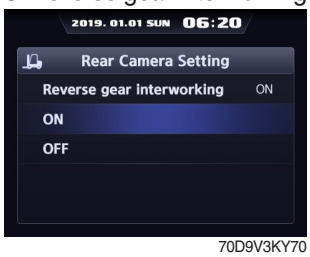
Enter to Equipment.

2. Camera Setting


70D9VB3KY69

Choose Camera Setting and enter.

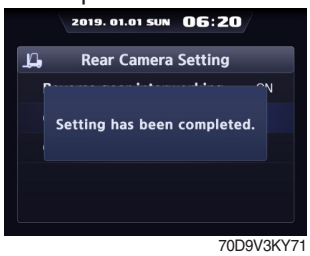
3. Reverse gear interworking




70D9V3KY70

Select ON or OFF.

4. Completion




70D9V3KY71

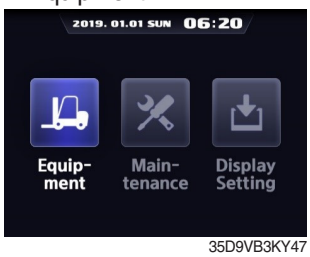
Setting has been completed.

35D9VB3KY98

## ⑥ FingerTips Setting (null)

### a. Lever Position Setting

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. FingerTips Setting


70D9V3KY72

Choose FingerTips Setting and enter.

3-1. Lever Position Setting


70D9V3KY73

Choose Lever Position Setting and Enter

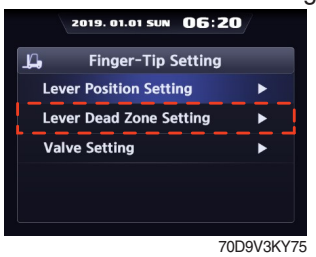
5. Setting


70D9V3KY74

Set minimum and maximum value.

### b. Lever Dead Zone Setting

3-2. Lever Dead Zone Setting




70D9V3KY75

Choose Lever Dead Zone Setting and enter.

4. Setting


70D9V3KY76

Set lever dead zone range.

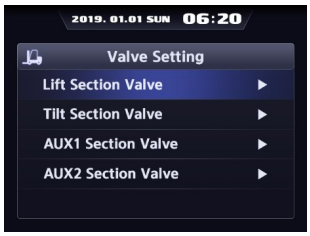
### c. Valve setting

3-3. Valve Setting


70D9V3KY77

Choose Valve Setting and enter.

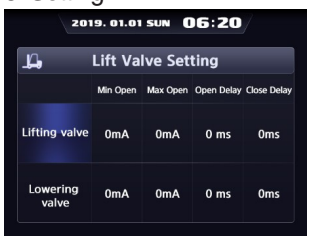
4. Lift Section Valve




70D9V3KY78

In the Valve Setting, you can set the lift, tilt, AUX1, or AUX2 section valves

5. Setting.

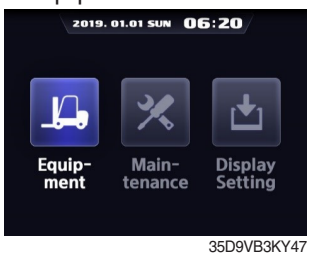



70D9V3KY79

For each valve value, you can adjust the current value and time on the above screen

## ⑦ CSC (Curve Speed Control) Setting (if installed)

1. Equipment




35D9VB3KY47

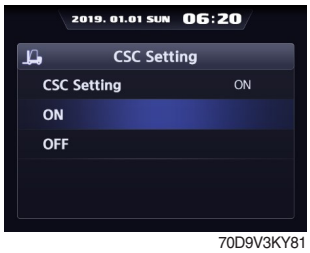
Enter to Equipment.

2. CSC Setting


70D9V3KY80

Choose CSC setting and enter.

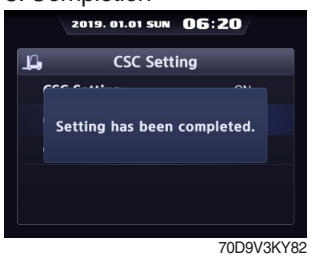
3. Select




70D9V3KY81

Select ON or OFF.

5. Completion




70D9V3KY82

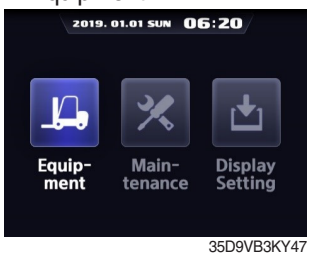
Setting has been completed.

## ⑧ Auto Shift Setting

Enable to turn the function ON or OFF or change the shift speed.

### a. Mode Select

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. Auto Shift Setting


70D9V3KY83

Choose Auto Shift setting and enter.

3-1. Mode Select


70D9V3KY84

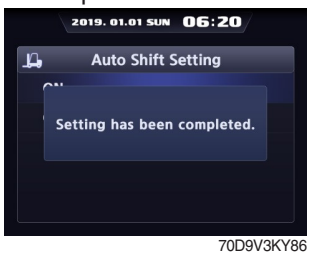
Choose Mode Select.

4. Select


70D9V3KY85

Select ON or OFF.

5. Completion




70D9V3KY86

Setting has been completed.

### b. Speed Setting

· In case of 1st gear → 2nd gear, it is possible to set up to 7 ~ 10 km/h.

· In case of 2nd gear → 1st gear, it is possible to set up to 4 ~ 5 km/h.

3-2. Speed Setting


35D9VB3KY47

Choose Speed Setting and enter.

4. Adjustment


70D9V3KY83

Change the speed value after selecting the shift point that needs to be changed

### ⑨ DCSR (Direction Change Shock Relief) setting (if installed)

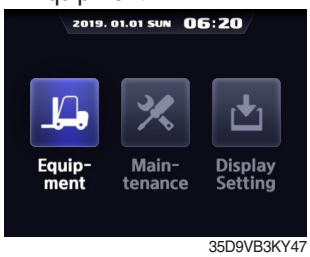
· Set the mode ON. Below is how this feature functions.

· If you are driving at over the block drive speed and then change gear from forward to reverse (or reverse to forward), the gear stays as neutral until the truck reaches the restore drive speed.

· The truck changes direction and starts to travel.

**※ Restore drive speed can not be set over the block drive speed.**

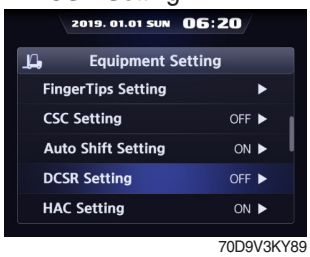
1. Equipment




35D9VB3KY47

Enter to Equipment.

2. DCSR Setting




70D9V3KY89

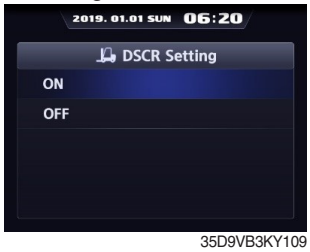
Choose DCSR setting and enter.

3. Mode Select


35D9VB3KY108

Select Mode Select.

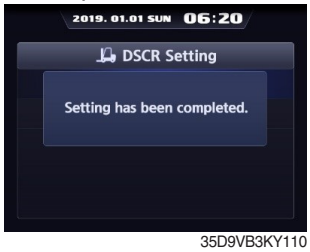
4. Setting




35D9VB3KY109

Select ON or OFF.

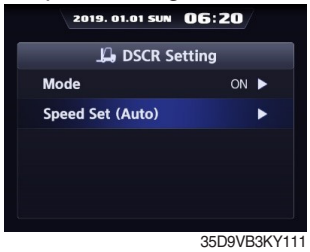
5. Completion




35D9VB3KY110

Setting has been completed.

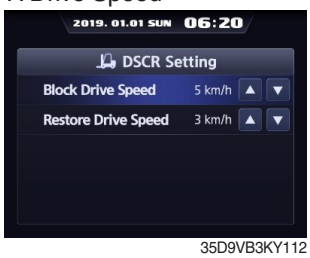
6. Speed Setting




35D9VB3KY111

If you want to change speed setting, enter Speed Setting.

7. Drive Speed



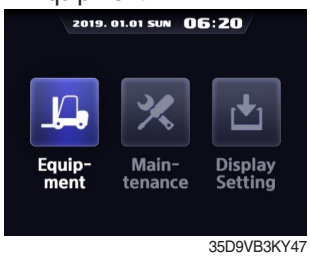

35D9VB3KY112

Change speed.

## ⑩ HAC (Hill Assist Control) Setting (if installed)

If you are trying to drive in stop status on the hill, the truck does not move backward when the HAC setting is ON.

1. Equipment




35D9VB3KY47

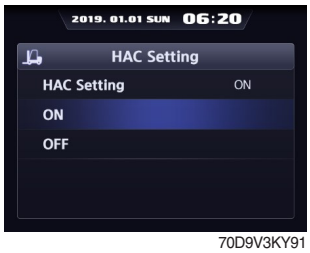
Enter to Equipment.

2. HAC Setting


70D9V3KY90

Choose DCSR setting and enter.

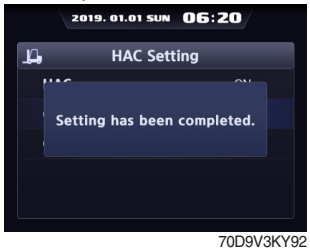
3. Select




70D9V3KY91

Select ON or OFF.

5. Completion

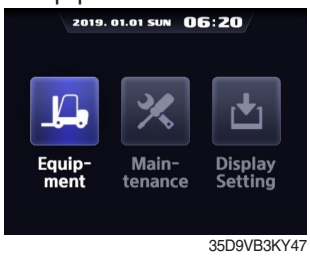



70D9V3KY92

Setting has been completed.

## ⑪ Vehicle Max Speed Limit

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. Vehicle Max Speed Limit


70D9V3KY93

Choose Vehicle Max Speed Limit and enter.

3. Mode


70D9V3KY94

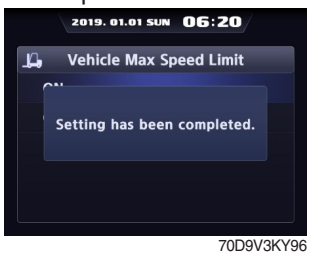
Enter to Mode.

4. Select


70D9V3KY95

Select ON or OFF.

5. Completion




70D9V3KY96

Setting has been completed.

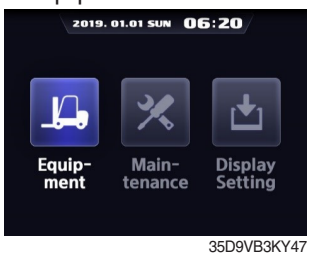
· Limit speed : 10 km/h


70D9VB3KY119

The truck does not exceed the limit speed.

## ⑫ Zero Start Setting (if installed)

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. Zero Start Setting


70D9V3KY98

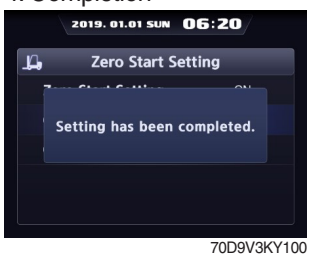
Choose Zero Start Setting and enter.

3. Select


70D9V3KY99

Select ON or OFF.

4. Completion

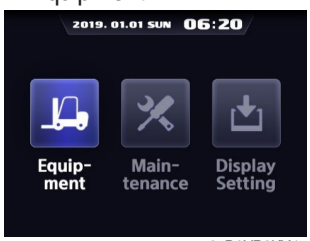



70D9V3KY100

Setting has been completed.

## ⑬ Clutch Protection Beep (if installed)

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. Clutch Protection Beep


70D9V3KY101

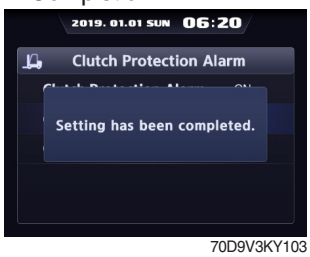
Choose Clutch Protection Beep and enter.

3. Select


70D9V3KY102

Select ON or OFF.

4. Completion




70D9V3KY103

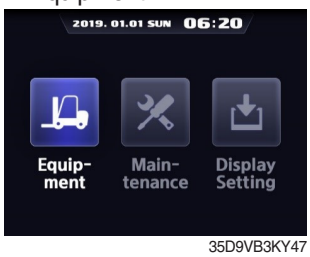
Setting has been completed.

## ⑭ TCU Calibration

Enable to set the TCU control value.

### a. Inching Sensor Calibration

1. Equipment




35D9VB3KY47

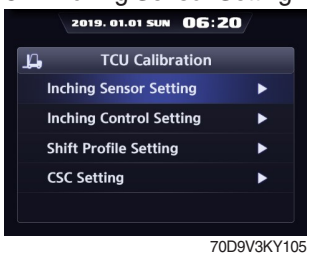
Enter to Equipment.

2. TCU Calibration


70D9V3KY104

Choose TCU Calibration and enter.

3-1. Inching Sensor Setting




70D9V3KY105

Choose Inching Sensor Setting and enter.

4. Inching Sensor Setting 1


70D9V3KY106

Before starting calibration, press the START button when the parking switch is turned on and the gear is in the neutral state.

5. Inching Sensor Setting 2


70D9V3KY107

Fully press the inching pedal.

6. Inching Sensor Setting 3

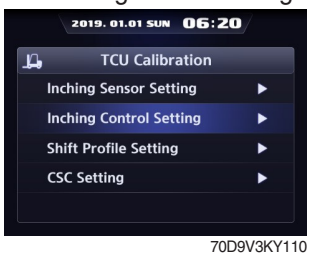

70D9V3KY108

7. Inching Sensor Setting 4


70D9V3KY109

## b. Inching Control Setting

3-2. Inching Control Setting




70D9V3KY110

Choose Inching Control Setting and enter.

4. Mode Select


70D9V3KY111

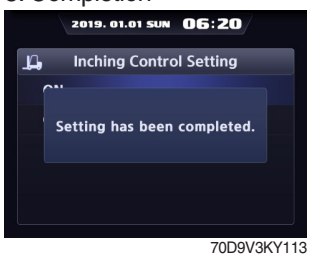
Choose Mode Select.

5. Select


70D9V3KY112

Select ON or OFF.

5. Completion




70D9V3KY113

Setting has been completed.

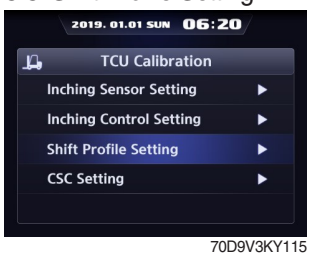
6. Control Setting


70D9V3KY114

Choose Control value.

## c. Shift Profile Setting

3-3. Shift Profile Setting




70D9V3KY115

Choose Shift Profile Setting and enter.

4. Mode Select


70D9V3KY116

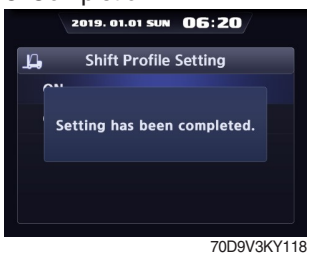
Choose Mode select.

5. Select


70D9V3KY117

Select ON or OFF.

5. Completion




70D9V3KY118

Setting has been completed.

6. Shift Lever Setting 1


70D9V3KY119

Choose Shift Lever Setting and enter.

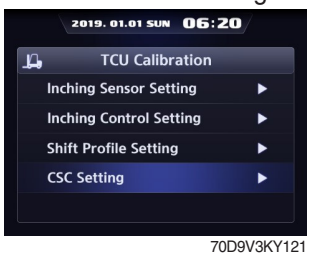
7. Shift Lever Setting 2


70D9V3KY120

Choose what needs to be change and change value.

### d. CSC Control Setting

3-4. CSC Control Setting




70D9V3KY121

Choose CSC Control Setting and enter.

4. Mode Select


70D9V3KY122

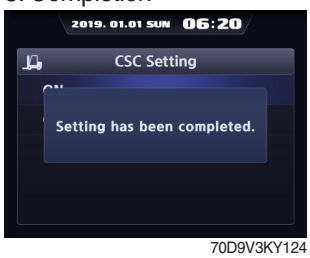
Choose Mode select.

5. Select


70D9V3KY123

Select ON or OFF.

5. Completion




70D9V3KY124

Setting has been completed.

6. Control Setting 1


70D9V3KY125

Choose Shift Lever Setting and enter.

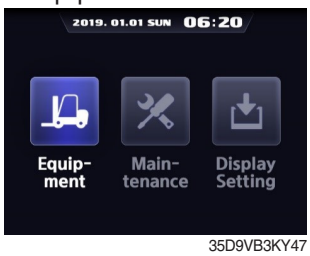
7. Control Setting 2


70D9V3KY126

Choose what needs to be change and change value.

### ⑮ Seat Belt Interlock (option)

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. Seat Belt Interlock


70D9V3KY132

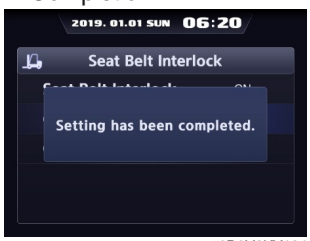
Choose Seat Belt Interlock and enter.

3. Select


70D9V3KY133

Select ON or OFF.

4. Completion

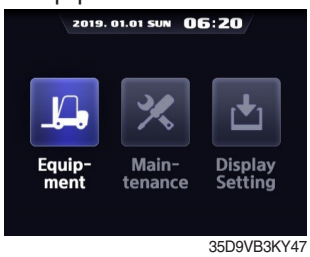



70D9V3KY134

Setting has been completed.

## ⑯ Inching Pedal Initialization

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. Inching Pedal Initailization


70D9VB3KY70

Choose Inching Pedal Initialization.

3. Inching Pedal Initailization 2


70D9VB3KY71

Before starting calibration, turn on the parking switch, the gear neutral.

4. Inching Pedal Initailization 3


70D9VB3KY72

Fully press the inching pedal.

5. Inching Pedal Initailization 4


70D9VB3KY73

Take your foot off the inching pedal.

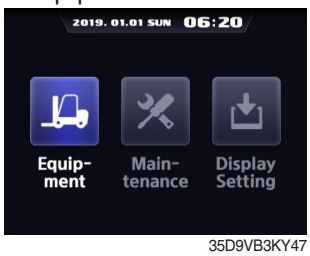
6. Completion


70D9VB3KY74

Confirm the completion of calibration and press the ESC button or OK button to exit to the menu

## ⑰ Cluster-CI

1. Equipment




35D9VB3KY47

Enter to Equipment.

2. Version


70D9V3KY136

Choose Version and enter.

3. Cluster-CI


70D9V3KY137

Choose Cluster-CI and enter.

4. Check Version


70D9V3KY138

## (2) Maintenance

### ① Failure History

1. Maintenance


35D9VB3KY48

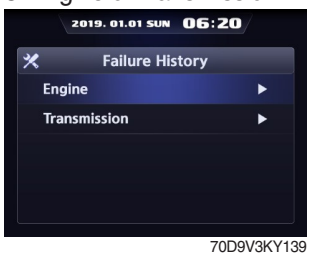
Enter to Maintenance.

2. Failure History


70D9V3KY138

Choose Failure History and enter.

3. Engine or Transmission




70D9V3KY139

Choose what needs to check.

4. History


70D9V3KY140

5. Failure List

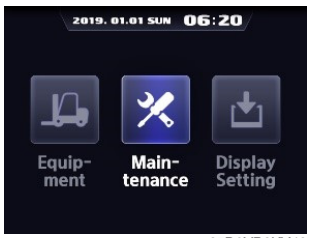

70D9V3KY141

### ② Consumables Management

- If the consumables replacement cycle has been passed, alarm will be displayed as ON.
- Press the 'Consumables replacement' if replaced the consumables.
- Information about recent replacement (maximum 9) will be displayed.
- If you want to change the cycle, please press the 'Change' button.

※ Refer to page 7-12 about periodic replacement parts.

1. Maintenance




35D9VB3KY48

Enter to Maintenance.

2. Consumables Mangement


70D9V3KY142

Choose Consumables Mangement and enter.

3. Select Replacement Item


70D9V3KY143

Select the replaced item.

4-1. Replacement History


70D9V3KY144

Select Replacement History.

5. Check.


70D9V3KY145

Check history.

4-2. Replacement


70D9V3KY146

Select Replacement.

5. Confirm


70D9V3KY147

Press enter button.

4-3. Change


70D9V3KY148

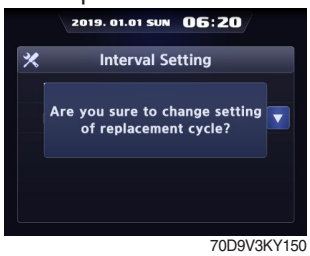
Select Change.

5. Setting Cycle


70D9V3KY149

Change properly the interval.

6. Completion




70D9V3KY150

Setting has been completed.

## ③ I/O Information

1. Maintenance


35D9VB3KY48

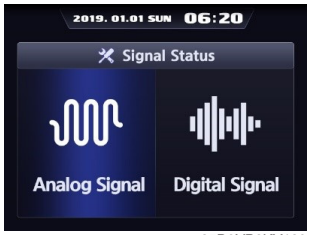
Enter to Maintenance.

2. I/O Information


70D9V3KY151

Choose I/O Information and enter.

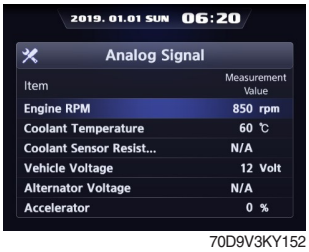
3-1. Analog signal




35D9VB3KY139

Enter to Analog Signal.

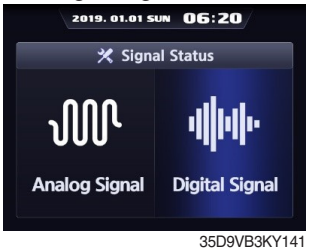
4. Analog signal list




70D9V3KY152

Check the analog signal list.

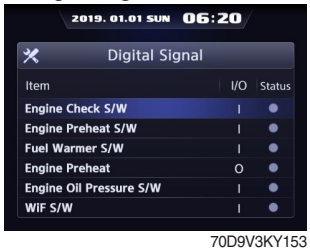
3-2. Digital signal




35D9VB3KY141

Enter to Digital Signal

4. Digital signal list




70D9V3KY153

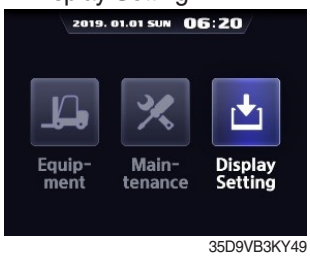
Check the digital signal list.

## (3) Display setting

### ① LCD Brightness Adjustment

- LCD brightness has two options. (Automatic and Manual modes)
- Manual mode always keeps the selected brightness.
- Brightness : Daytime 100%, Nighttime 50%
- Daytime/Nighttime time zone : 06 ~ 18

1. Display Setting




35D9VB3KY49

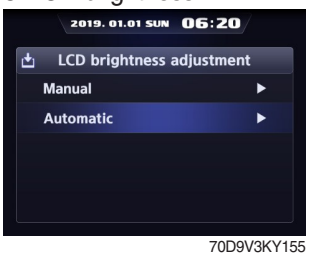
Enter to Display Setting.

2. LCD Brightness Adjustment


70D9V3KY154

Choose LCD Brightness Adjustment and enter.

3. LCD brightness




70D9V3KY155

Select Manual or Automatic.

4. LCD Brightness (Day/Night)


70D9V3KY156

Set day and night brightness in the manual mode.

5. LCD Brightness


35D9VB3KY148

Set LCD brightness in the manual mode.

### ② User Setting

Enable to set time, unit, and language.

#### a. Time Setting

1. Display Setting


35D9VB3KY49

Enter to Display Setting.

2. User Setting


35D9VB3KY149

Choose User Setting and enter.

3-1. Time Setting


35D9VB3KY150

Select Time Setting.

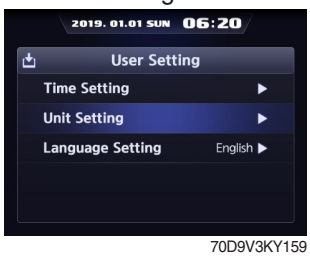
4. Setting


35D9VB3KY49

Set time.

## b. Unit Setting

3-2. Unit Setting




70D9V3KY159

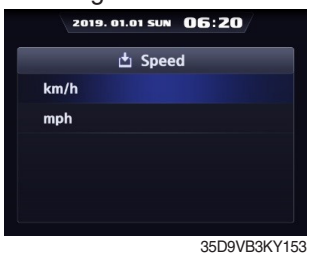
Select Unit Setting.

4. Unit Setting Litst


35D9VB3KY152

Enable to set the unit of speed, weight, temperature and pressure.

5. Setting




35D9VB3KY153

Set unit.

3-3. Language Setting


70D9V3KY160

Select Language Setting.

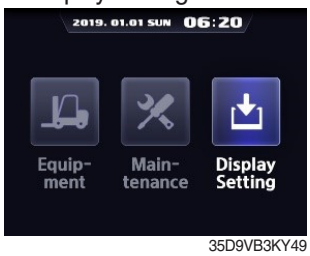
4. Setting


70D9V3KY161

Choose a language.

## ③ A/S Phone No.

1. Display Setting




35D9VB3KY49

Enter to Display Setting.

2. A/S Phone No.


70D9V3KY162

Choose A/S Phone No. and enter.

3. Change


70D9V3KY163

Select phone number if you want to change.

4. New A/S Phone No.


70D9V3KY164

Enter new phone number using up or down buttons and press the enter button.

5. Finish


70D9V3KY165

Contact will be displayed as the modified number.

## ④ Password Change.

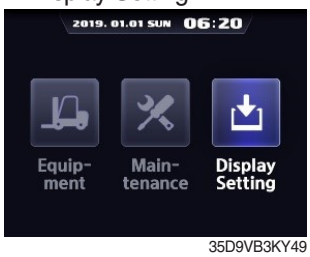
· This function is to allow to change password from default password to user defined password.

· Password length must be 5~10 digits.

※ Since, if you forget the password, you must request the A/S, do not forget the password.

### a. User Password Change

1. Display Setting




35D9VB3KY49

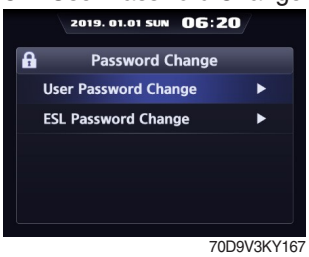
Enter to Display Setting.

2. Password Change


70D9V3KY166

Choose Password Change and enter.

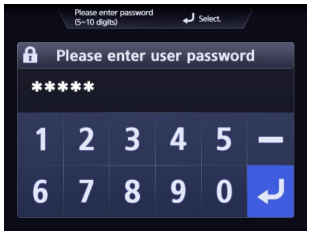
3-1. User Password Change




70D9V3KY167

Select User Password Change.

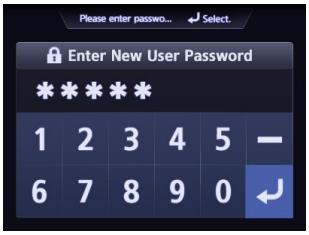
4. Current User Password




70D9V3KY168

Enter the current user passwrd.

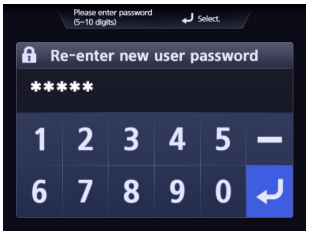
5. New User Password




35D9VB3KY144

Enter a new user password.

6. Re-enter




70D9V3KY169

Enter a new user password again.

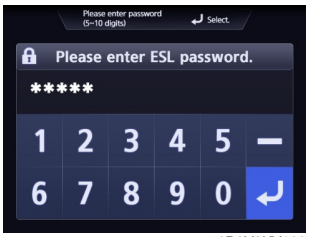
### b. ESL Password Change

3-2. ESL Password Change


35D9VB3KY49

Select ESL Password Change.

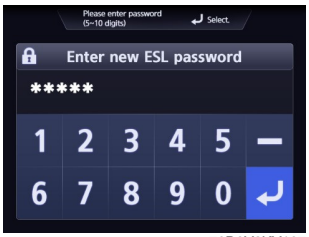
4. Current User Password




70D9V3KY166

Enter the current user password.

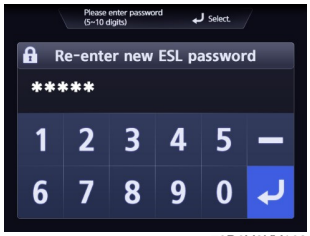
5. New User Password




70D9V3KY167

Enter a new user password.

6. Re-enter

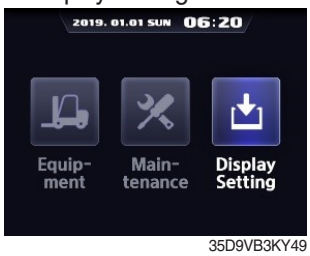



70D9V3KY168

Enter a new user password again.

### ⑤ Consumables Management

1. Display Setting




35D9VB3KY49

Enter to Display Setting.

2. Conusmables Management


70D9V3KY174

Choose Consumables Management and enter.

3. List


70D9V3KY143

## 8) CAUSES AND CORRECTION OF CLUSTER WARNING LAMP

| No. | Warning lamp types | Symbol | Warning and indicator lamp | Causes and correction |
|---|---|---|---|---|
| 1 | Engine oil pressure warning | | Engine oil pressure warning lamp | Engine oil pressure is low.<br>Please fill the engine oil |
| 2 | Engine warm-up indicator | | Engine warm-up indicator lamp | Warm-up will be started. |
| 3 | Air cleaner warning | | Air cleaner warning lamp | Replace the air cleaner filter. |
| 4 | Water in fuel warning | | Water in fuel warning lamp | Please drain the water of the fuel filter. |
| 5 | Engine check warning | CHECK | Engine check warning lamp | Check the failure code of cluster. |
| 6 | Engine stop warning | | Engine stop warning lamp | Check the failure code of cluster. |
| 7 | DPF regeneration warning | | DPF regeneration warning lamp | DPF regeneration is required. |
| 8 | DPF inhibit warning | | DPF inhibit warning lamp | DPF regeneration is inhibited. |
| 9 | DPF High temp warning | | DPF high temp warning lamp | High exhaust system temperature will be started. |
| 10 | Fuel warmer indicator | | Fuel warmer indicator lamp | Warming up the fuel. |
| 11 | Transmission oil temperature warning | | Transmission oil temperature warning lamp | T/M oil is over temperature condition.<br>110 ℃ (230 °F) or higher : Amber<br>120 ℃ (248 °F) or higher : Red |
| 12 | Parking brake indicator | P | Parking brake indicator lamp | Parking brake is the operational status. |

| No. | Warning lamp types | Symbol | Warning and indicator lamp | Causes and correction |
|---|---|---|---|---|
| 13 | Battery charging warning |  | Battery charging warning lamp | Battery is not being charged.<br>Please check alternator and wiring. |
| 14 | Tilt lock indicator (if installed) |  | Tilt lock indicator lamp | Auto-leveling is the operational status. |
| 15 | OPSS indicator |  | OPSS indicator lamp | OPSS is working :<br>Driving, lifting, and tilting is locked or the truck is parked status. |
| 16 | Fuel level warning |  | Fuel level warning lamp | Fuel level is low.<br>Please fill the fuel. |
| 17 | Coolant temperature warning |  | Engine coolant temperature warning lamp | Engine coolant is over temperature condition. |
| 18 | Clutch protection warming |  | Clutch protection warming lamp | Clutch protection warning operation |
| 19 | Consumables replacement indicator |  | Consumables replacement indicator lamp | Consumables replacement cycle has been passed. |
| 20 | LH Turn indicator |  | LH Turning indicator lamp | - |
| 21 | RH Turn indicator |  | RH Turning indicator lamp | - |
| 22 | Forward gear |  | Forward gear, 1 gear, 2 gear, and 3 gear indicator lamp | - |
| 23 | Reverse gear |  | Reverse gear, 1 gear, 2 gear, and 3 gear indicator lamp | - |
| 24 | Communication error warning (ECU) |  | Communication error warning lamp | Communication between cluster-CI and ECU has been failed.<br>Check communication line. |
| 25 | Communication error warning (TCU) |  | Communication error warning lamp | Communication between cluster-CI and TCU has been failed.<br>Check communication line. |
| 26 | Brake fail warning |  | Brake fail warning lamp | Stop the engine and check for its cause. |
| 27 | Side mirror heated action idicator |  | Side mirror heated action idicator lamp | The heated mirror switch is ON. |
| 28 | High beam indicator |  | High beam indicator lamp | The position of the dimmer switch is DOWN. |
| 29 | Inching switch ON indicator |  | Inching switch ON indicator lamp | The inching switch is ON. |

# GROUP 4 COMPONENT SPECIFICATION

| No | Part name | Qty | Specification |
|---|---|---|---|
| 1 | Battery | 2 | 12 V×100 AH<br>RC : 190 min<br>CCA : 850 A |
| 2 | LED work lamp | 2 | 12~24 V, 20~27 W |
| 3 | License lamp (opt) | 1 | 12 V, 5 W |
| 4 | LED rear combination lamp | 2 | 12 V, LED (turn signal, tail, stop) |
| 5 | LED head and turn lamp | 2 | 12 V, 26 W (high and low), 18 W (low)<br>12 V, 2.4 W (turn) |
| 6 | Room lamp | 1 | 24 V, 10 W |
| 7 | LED beacon lamp (opt) | 1 | 12~24 V, Max. 0.96 A |
| 8 | Radio and USB player | 1 | 12~32 V, 20 W×2 |
| 9 | Cluster | 1 | 12 V / 24 V |
| 10 | Rear view camera | 1 | 6~32 V, 1.4 W |
| 11 | 12V socket | 1 | 12 V, 10 A |
| 12 | Relay (5P) | 7 | 12 V, 20 A |
| 13 | Flasher unit | 1 | 12 V, 85±10 C/M, (23 W+23 W)×2+3 W×2 |
| 14 | Back buzzer | 1 | 12 V, 90±5 dB, 60±10 C/M, 300 mA |
| 15 | Warning buzzer | 1 | 12 V, 85±5 dB, 120±20 C/M, 50 mA |
| 16 | Horn | 1 | 12 V, 100~115 dB, 3.5A |
| 17 | Intermittent wiper relay | 1 | 9~16 V, 2.5 A (rated), operating time : 4.5±1 sec |
| 18 | Fuel level sender | 1 | Float indicator: Empty / 7/14 / Full<br>Resistance (Ω): EC / 350 / 50<br>Tolerance (Ω): ±(R×1.5 %+1 Ω) |
| 19 | Start switch | 1 | 24 V, 60 A |
| 20 | Parking brake switch | 1 | 12 V, 20 A |
| 21 | Main light switch | 1 | 24 V, 15 A |
| 22 | Auto shift switch | 1 | 12 V, 20 A |
| 23 | Power switch | 1 | 12 V, 20 A |
| 24 | Inhching switch | 1 | 12 V, 20 A |
| 25 | In/decrement switch | 1 | 12 V, 20 A |
| 26 | Rear wiper and washer switch | 1 | 12 V, 20 A |
| 27 | Regeneration switch | 1 | 12 V, 20 A |
| 28 | Rear work lamp switch (opt) | 1 | 12 V, 20 A |
| 29 | Hazard switch (opt) | 1 | 12 V, 20 A |
| 30 | Top wiper/washer switch (opt) | 1 | 12 V, 20 A |
| 31 | Multi function switch | 1 | 12 V, 2 A |
| 32 | Gear selector switch | 1 | 12 V, 3.5 A |
| 33 | Master switch (opt) | 1 | 6~36 V, 180 A |
| 34 | Cabin tilt switch | 1 | 12 V, 20 A |

## GROUP 5 CONNECTOR DESTINATION

| Connector number | Type | No. of pin | Destination | Connector part No. | |
|---|---|---|---|---|---|
| | | | | Female | Male |
| CN-6 | KET | 2 | Key switch (B+) | - | MG652934-5 |
| CN-4 | AMP/KET | 3 | I/conn (frame-main harness) | MG642292 | MG652290 |
| CN-13 | AMP | 42 | I/conn (main-frame harness) | 936421 | 936429 |
| CN-14 | AMP | 42 | I/conn (frame-main harness) | 936421 | 936429 |
| CN-17 | AMP | 3 | Load sensor | 174357-2 | 174359-2 |
| CN-20 | KET | 1 | Tiliting motor (B+) | - | MG650943-5 |
| CN-21 | DEUTSCH | 8 | Front wiper | DT06-8S | - |
| CN-22 | KET | 2 | Washer pump front | MG642292 | - |
| CN-23 | - | 2 | Speaker (LH) | MG610070 | - |
| CN-24 | - | 2 | Speaker (RH) | MG610070 | - |
| CN-25 | MOLEX | 2 | Horn | 35825-0211 | - |
| CN-27 | - | 16 | Radio and USB player | PK145-16017 | - |
| CN-30 | KUM | 1 | Aircon compressor | PB625-01027 | - |
| CN-31 | AMP | 15 | I/conn (main-aircon harness) | 2-85262-1 | - |
| CN-43 | HCE | 1 | MIDI fuse | S820-308000 | - |
| CN-45 | HCE | 1 | Start motor (B+) | S820-308000 | - |
| CN-56 | MOLEX | 73 | Cluster CI | 34566-0103 | - |
| CN-61 | HCE | 1 | Fuel pump | S820-104000 | - |
| CN-61 | HCE | 1 | Fuel pump | S820-105000 | - |
| CN-65 | KET | 1 | Backup buzzer | ST730018-3 | ST750036-2 |
| CN-66 | DEUTSCH | 2 | Inching valve | DT06-2S | - |
| CN-70 | - | 4 | Top wiper motor | 180900 | - |
| CN-71 | KET | 2 | Pakring solenoide | MG610320 | - |
| CN-71 | DEUTSCH | 6 | Seat switch | DT06-6S | 21HN-52080 |
| CN-83 | - | 2 | Condenser fan | PB625-02027 | - |
| CN-90 | AMP | 36 | I/conn (main-cabin harness) | 1743059-2 | 1743062-2 |
| CN-91 | AMP | 6 | I/conn (main-monitor harness) | 174262-2 | 174264-2 |
| CN-92 | AMP | 6 | I/conn (monitor-main harness) | 174262-2 | 174264-2 |
| CN-96 | DELPHI | 2 | Fuel heater | 10737780 | - |
| CN-97 | DELPHI | 2 | Prefilter fuel heater | 1530027 | - |
| CN-102 | - | 4 | Rear wiper motor | 180900 | - |
| CN-103 | KET | 2 | Washer pump rear | MG642292 | - |
| CN-113 | KET | 2 | Warning buzzer | MG610320 | - |
| CN-122 | DEUTSCH | 2 | FWD 1 | DT06-2S | - |
| CN-123 | DEUTSCH | 2 | REV | DT06-2S | - |
| CN-125 | DEUTSCH | 12 | RMCU | DT06-12S | DT04-12P |
| CN-125 | - | 1 | GPS | - | SMA-C-316R/V |
| CN-131 | KET | 2 | Attach cut solenoide | MG610320 | - |

| Connector number | Type | No. of pin | Destination | Connector part No. | |
|---|---|---|---|---|---|
| | | | | Female | Male |
| CN-132 | DEUTSCH | 2 | FWD 2 | DT06-2S | - |
| CN-134 | MOLEX | 16 | Diagnosis | 51115-1601 | - |
| CN-136 | AMP | 4 | RMCU service | 174257-2 | - |
| CN-139 | KET | 2 | Socket (12 V) | MG610043 | - |
| CN-139 | KET | 2 | Socket (12 V) | MG610043 | - |
| CN-144 | AMP | 6 | Accel pedal | 174262-2 | - |
| CN-147 | KET | 2 | Cabin tilt relay switch | MG640188-4 | - |
| CN-151 | AMP | 36 | Engine | - | 1743062-2 |
| CN-152 | AMP | 36 | Engine | - | 1743062-3 |
| CN-154 | KET | 1 | Engine | MG613801-5 | - |
| CN-155 | DEUTSCH | 2 | Pump EPPR valve | DT06-2S | - |
| CN-191 | AMP | 4 | G sensor | 174257-2 | 174259-2 |
| CN-202 | KET | 2 | Washer pump top | MG640605 | - |
| CN-249 | - | 4 | Rear view camera | 174257-2 | 174259-2 |
| CN-251 | - | 1 | RMS antenna (ORBCOMM) | FME J1505-58 | - |
| CN-251 | - | 1 | RMS antenna (GPS) | - | FME P1505-316 |
| CN-252 | - | 1 | RMS antenna (ORBCOMM) | TNJ-C-58 | TNC-C-58 |
| CN-253 | - | 1 | RMS antenna (GPS) | SMJ-C-316R/V | SMA-C-316R/V |
| · Switch | | | | | |
| CS-2 | KET | 2 | Start key switch | MG610281 | MG620282 |
| CS-5 | KET | 2 | Center horn | - | MG640322 |
| CS-11 | KET | 8 | Multi function switch | MG610339 | - |
| CS-12 | KET | 6 | Multi function switch | MG610335 | - |
| CS-13 | AMP | 8 | Gear selector | 174982-2 | - |
| CS-17 | CARLING | 10 | Parking brake switch | 21HN-56300 | - |
| CS-21 | CARLING | 10 | Work lamp switch | 21HN-56300 | - |
| CS-35 | CARLING | 10 | Rear wiper switch | 21HN-56300 | - |
| CS-39 | CARLING | 10 | Main light switch | 21HN-56300 | - |
| CS-41 | CARLING | 10 | Hazard switch | 21HN-56300 | - |
| CS-42 | CARLING | 10 | Inching switch | 21HN-56300 | - |
| CS-59 | CARLING | 10 | Auto shift switch | 21HN-56300 | - |
| CS-64 | CARLING | 10 | In/decrement switch | 21HN-56300 | - |
| CS-74 | DEUTSCH | 4 | Tilt switch | - | DT04-4P |
| CS-75 | CARLING | 10 | Regeneration switch | 21HN-56300 | - |
| CS-77 | CARLING | 10 | Cabin tilt switch | 21HN-56300 | - |
| CS-79 | CARLING | 10 | Power switch | 21HN-56300 | - |
| CS-103 | CARLING | 10 | Top wiper/washer switch | 21HN-56300 | - |
| · Lamp | | | | | |
| CL-1 | - | 2 | Room lamp (LH) | MG610392 | - |
| CL-3 | - | 6 | Head lamp (LH) | HP285-06021 | - |

| Connector number | Type | No. of pin | Destination | Connector part No. | |
|---|---|---|---|---|---|
| | | | | Female | Male |
| CL-4 | - | 6 | Head lamp (RH) | HP285-06021 | - |
| CL-7 | - | 2 | Beacon lamp | DT06-2S | DT04-2P |
| CL-15A | AMP | 4 | Turn/Stop/Tail lamp (black) | 184050-1 | - |
| Cl-15B | AMP | 4 | Backup/Stop/Tail lamp (gray) | 184050-2 | - |
| CL-16A | AMP | 4 | Turn/Stop/Tail lamp (black) | 184050-1 | - |
| Cl-16B | AMP | 4 | Backup/Stop/Tail lamp (gray) | 184050-2 | - |
| CL-21 | KET | 1 | License lamp | ST730018-3 | ST750036-2 |
| CL-22 | - | 2 | Rear work lamp (LH) | DT06-2S | - |
| CL-23 | - | 2 | Rear work lamp (RH) | DT06-2S | - |
| CL-51 | - | 2 | Room lamp (RH) | MG610392 | - |
| **· Relay** | | | | | |
| CR-6 | KET | 4 | Relay INT wiper | MG652999 | - |
| CR-11 | DAEDONG | 3 | Flsher unit | 312 GIHUNG 3P | - |
| CR-16 | HELLA | - | Brake | 8JA003526-001 | - |
| CR-24 | FCI | 6 | Glow controller | F162210 | - |
| CR-32 | HELLA | - | Gear shift 2 | 8JA003526-001 | - |
| CR-34 | HELLA | - | Travel cut | 8JA003526-001 | - |
| CR-35 | HELLA | - | Back up | 8JA003526-001 | - |
| CR-44 | AMP | 2 | Cabin tilt relay coil | 174352-2 | - |
| CR-52 | HELLA | - | Attach cut | 8JA003526-001 | - |
| CR-57 | HELLA | - | Gear shift 1 | 8JA003526-001 | - |
| **· Sensor and pressure switch** | | | | | |
| CD-2 | DEUTSCH | 3 | Fuel sender | DT06-3S | - |
| CD-3 | DEUTSCH | 3 | Brake fail switch (PS) | DT06-3S | - |
| CD-4 | AMP | 1 | Brake switch | 171809-2 | - |
| CD-5 | DEUTSCH | 4 | Hydraulic pressure and temperature sensor | DT06-4S | - |
| CD-10 | KET | 1 | Air cleaner switch | ST730057-2 | - |
| CD-17 | AMP | 2 | Speed pickup engine | 1-1418483-1 | - |
| CD-25 | DEUTSCH | 3 | T/M pressure and temperature sensor | DT06-3S | - |
| CD-26 | DEUTSCH | 3 | Parking switch (PS1) | DT06-3S | - |
| CD-29 | AMP | 2 | Sump temperature sensor | 963040-3 | - |
| CD-38 | AMP | 3 | Water in fuel | - | 936292-2 |
| CD-40 | KET | 2 | T/M Speed output | MG610327-5 | - |
| CD-60 | AMP | 2 | Thermo switch | 282080-1 | - |
| CD-71 | DEPLHI | 3 | Inching sensor | 12110293 | - |
| CD-77 | KET | 3 | Differential sensor | MG644453-5 | - |
| CD-78 | DELPHI | 2 | Exhuast gas temperature sensor (DPF T5) | 33401218 | - |
| CD-79 | DELPHI | 2 | Exhaust gas temperautre sensor (DOC T4) | 33401219 | - |
| DO-4 | AMP/QPL | 2 | DIODE 4 | 174352-2 | 21EA-50550 |

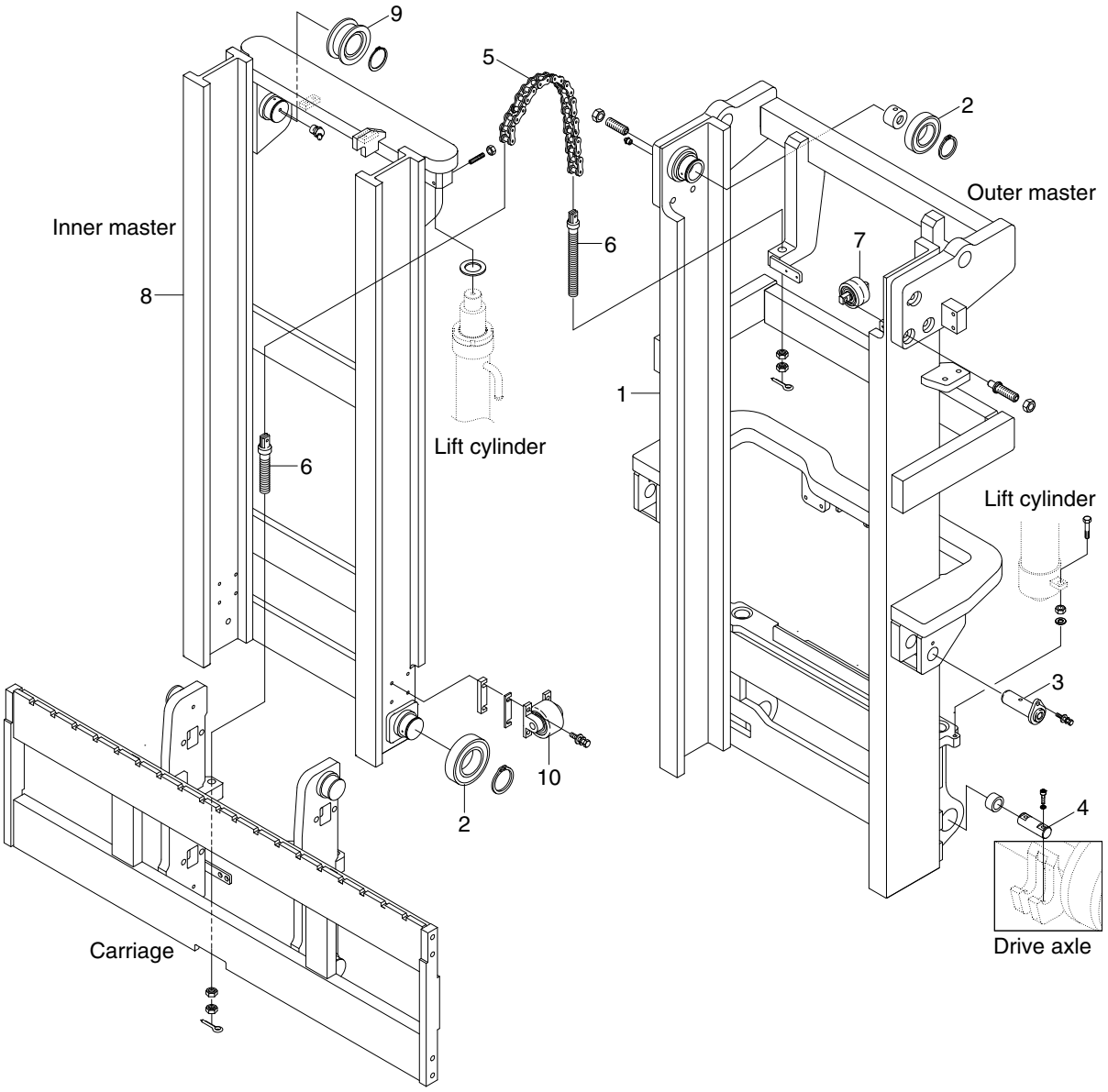
| Trouble symptom | Probable cause | Remedy |
|---|---|---|
| Lamps dimming even at maximum engine speed. | · Faulty wiring. | · Check for loose terminal and disconnected wire. |
| Lamps flicker during engine operation. | · Improper belt tension. | · Adjust belt tension. |
| Charge lamp does not light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

# SECTION 8 MAST


Group 1 Structure ..... 8-1
Group 2 Operational Checks and Troubleshooting ..... 8-6
Group 3 Adjustment ..... 8-9
Group 4 Removal and Installation ..... 8-11

## GROUP 1 STRUCTURE

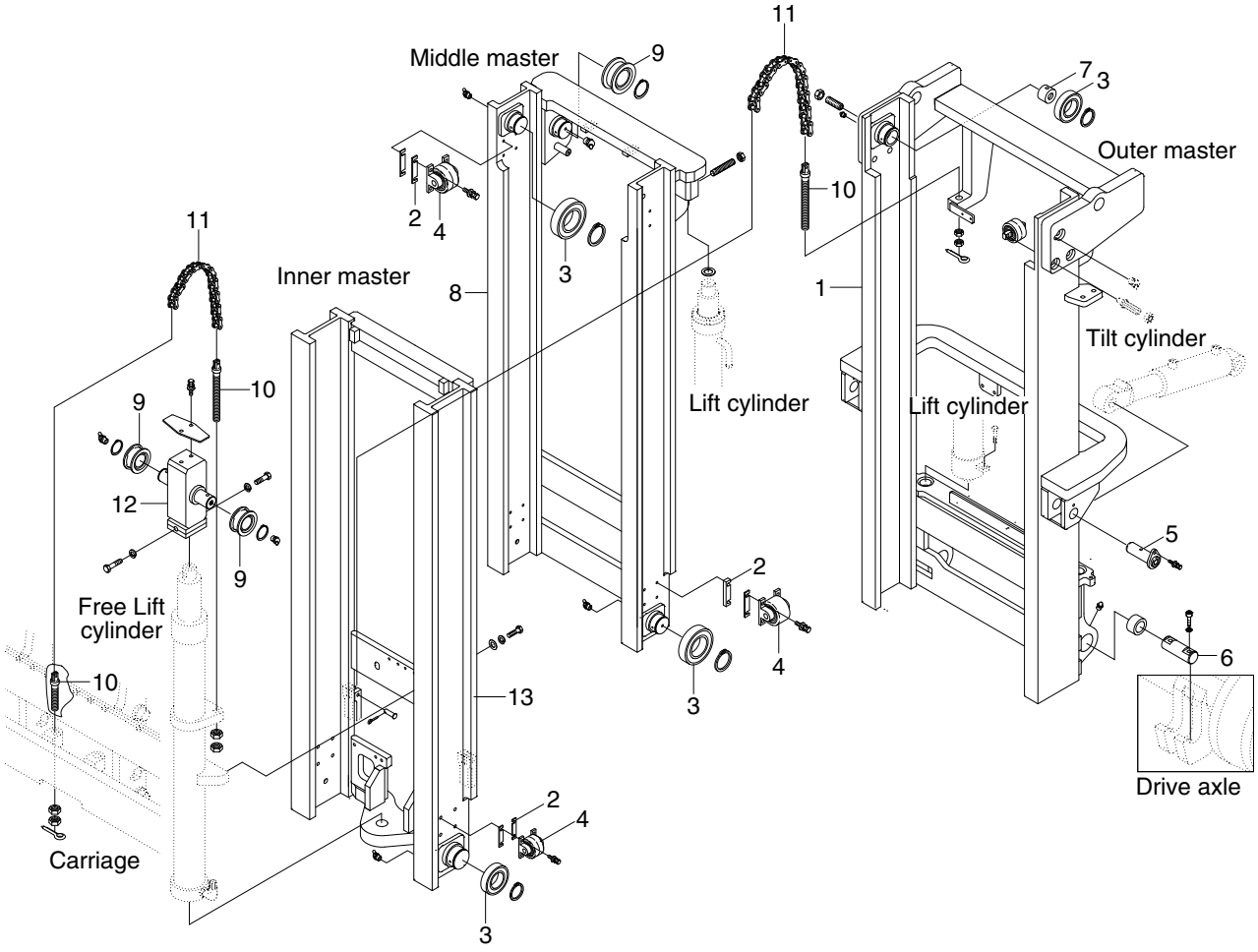
### 1. 2 STAGE MAST (V MAST)




50D7AMS01

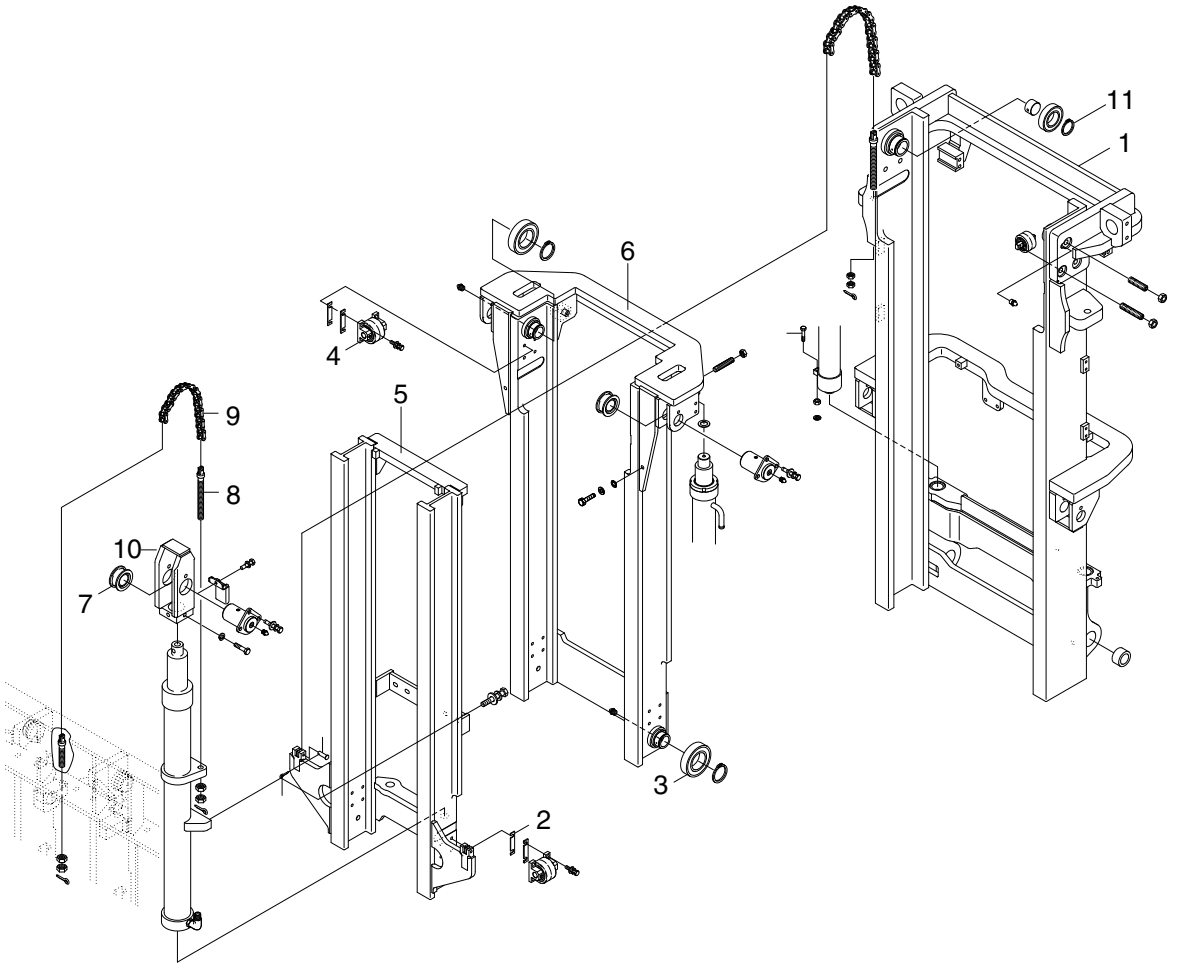
| | | | | | |
|---|---|---|---|---|---|
| 1 | Outer mast | 5 | Lift chain | 9 | Chain sheave bearing |
| 2 | Roller bearing | 6 | Anchor bolt | 10 | Side roller bearing |
| 3 | Tilt cylinder pin | 7 | Side roller bearing | | |
| 4 | Mast mounting pin | 8 | Inner mast | | |

## 2. 3 STAGE MAST(TF MAST)




| | | | | | |
|---|---|---|---|---|---|
| 1 | Outer mast | 6 | Mast mounting pin | 11 | Chain |
| 2 | Shim | 7 | Wear plug | 12 | Sheave bracket |
| 3 | Roller bearing | 8 | Middle mast | 13 | Inner mast |
| 4 | Side roller bearing | 9 | Sheave | | |
| 5 | Tilt cylinder pin | 10 | Anchor bolt | | |

## 3. 3 STAGE MAST (TS MAST)

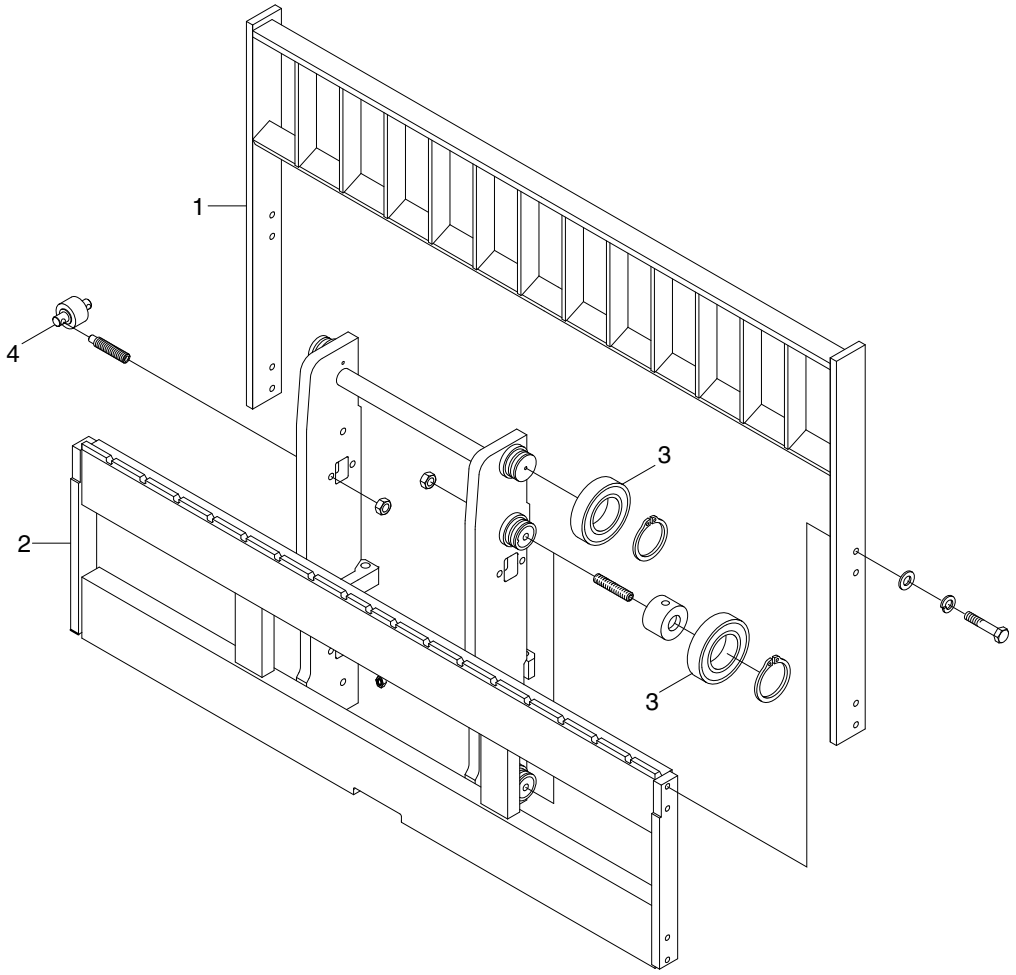



70D9V8MS01

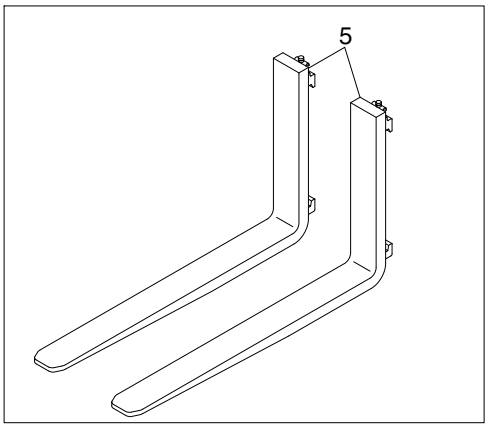
| | | | | | |
|---|---|---|---|---|---|
| 1 | Outer mast | 5 | Inner mast | 9 | Chain |
| 2 | Shim | 6 | Middle mast | 10 | Sheave bracket |
| 3 | Load roller bearing | 7 | Sheave | 11 | Retainer ring |
| 4 | Side roller bearing | 8 | Anchor bolt | | |

## 3. CARRIAGE, BACKREST AND FORK

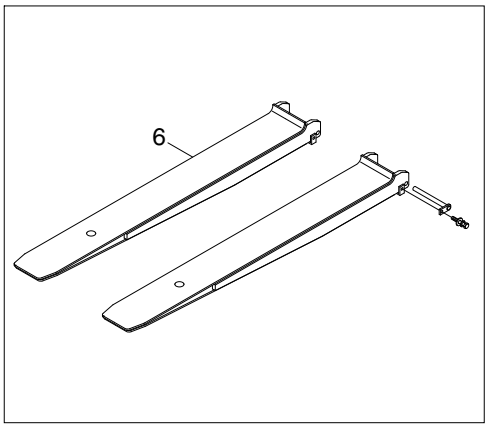
### 1) HOOK ON TYPE (STD)




Hook on type fork



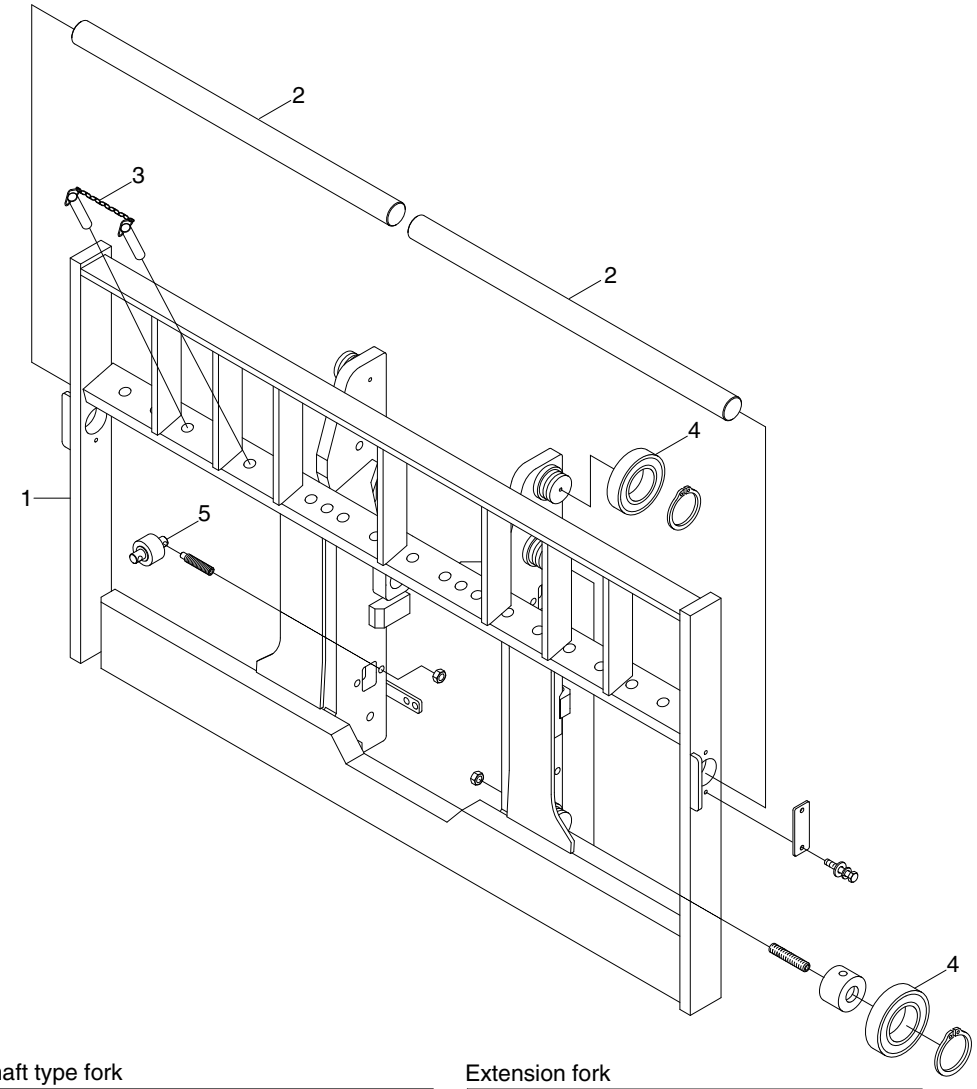

Extension fork



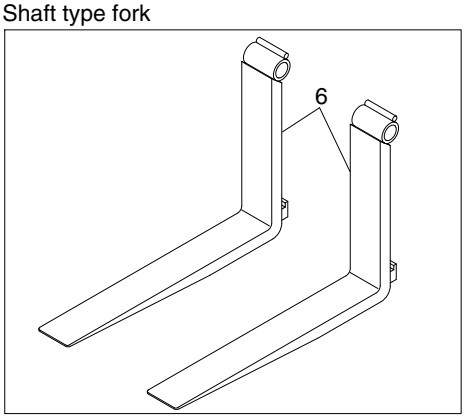

50DS7EMS03

| | | | |
|---|---|---|---|
| 1 | Backrest | 4 | Side roller |
| 2 | Carriage | 5 | Fork |
| 3 | Roller | 6 | Extension fork |

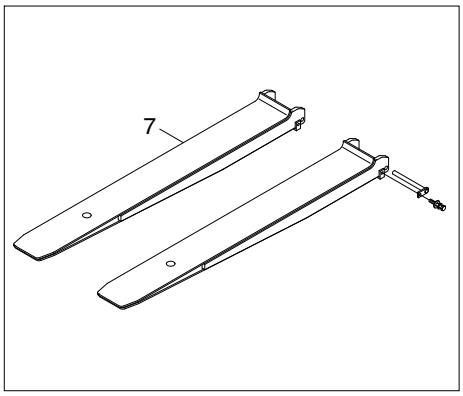
## 2) SHAFT TYPE (OPTION)




Shaft type fork




Extension fork




80D7MS02

1 Carriage & backrest
2 Hanger bar
3 Fork retaining
4 Roller
5 Side roller
6 Fork
7 Extension fork

# GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

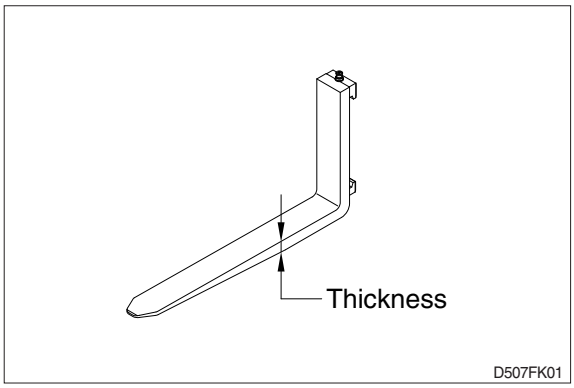
## 1. OPERATIONAL CHECKS

### 1) FORKS

(1) Measure thickness of root of forks and check that it is more than specified value.
EX : ℓ =1200 mm (47 in)

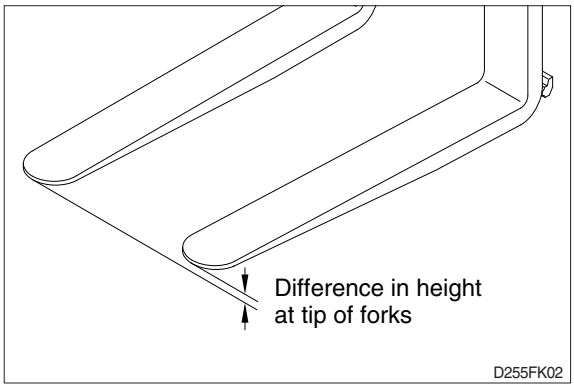
mm (in)

| STD Fork assy | Applicable model | Standard | Limit |
|---|---|---|---|
| F14710111 | 70D-9VB | 65 (2.6) | 59 (2.3) |




2) Set forks in middle and measure out of parallel and difference in height at the top of forks.

| Model | Fork length | Height difference |
|---|---|---|
| 70D-9VB | 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.<br>· Deformed mast assembly. | · See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system.<br>· Disassemble mast and replace damaged parts or replace complete mast assembly. |
| Slow lifting speed and insufficient handling capacity. | · Faulty hydraulic equipment.<br>· Deformed mast assembly. | · See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system.<br>· Disassemble mast and replace damaged parts or replace complete mast assembly. |
| Mast fails to lift smoothly. | · Deformed masts or carriage.<br>· Faulty hydraulic equipment.<br>· Damaged load and side rollers.<br>· Unequal chain tension between LH & RH sides.<br>· LH & RH mast inclination angles are unequal. (Mast assembly is twisted when tilted) | · Disassembly, repair or replace.<br>· See Troubleshooting Hydraulic Cylinders, pump and control valve in section 6, hydraulic system.<br>· Replace.<br>· Adjust chains.<br>· Adjust tilt cylinder rods. |
| Abnormal noise is produced when mast is lifted and lowered. | · Broken load roller bearings.<br>· Broken side roller bearings.<br>· Deformed masts.<br>· Bent lift cylinder rod.<br>· Deformed carriage.<br>· Broken sheave bearing. | · Replace.<br>· Replace.<br>· Disassemble, repair or replace.<br>· Replace.<br>· Replace.<br>· Replace. |
| Abnormal noise is produced during tilting operation. | · Insufficient lubrication of anchor pin, or worn bushing and pin.<br>· Bent tilt cylinder rod. | · Lubricate or replace.<br>· 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.<br>Inspection for thickness is needed.<br>· 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.<br>· Difference in fork tip height<br><table><tr><th>Fork length (mm)</th><th>Height difference (mm)</th></tr><tr><td>equal or below 1500</td><td>3</td></tr><tr><td>above 1500</td><td>4</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.<br>· Crack on the fork heel.<br>· Crack on the fork weldments.</td><td>Repair fork by expert.<br>In case of excessive distortion, replace fork.</td></tr>
</table>

## 1. MAST LOAD ROLLER

### 1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

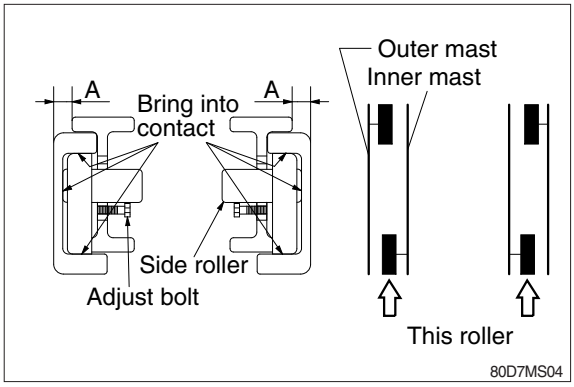
(1) Measure the clearance with the mast overlap at near 480 mm (19 in).

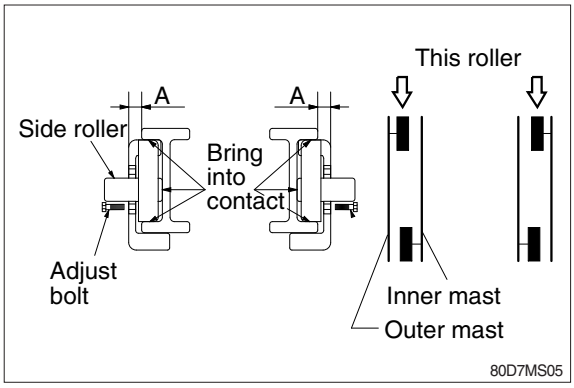
(2) Shift the inner mast to one side to bring the side roller into contact with the outer mast, and adjust the clearance between the end of inner beam and the outside of outer mast position on the opposite side to the following value by adjust bolt.

· Reference clearance A = 43.1 mm

**(3) Distribute the clearance A equally to the left and right.**

(4) After the adjustment, check that the inner mast moves smoothly in the outer mast.



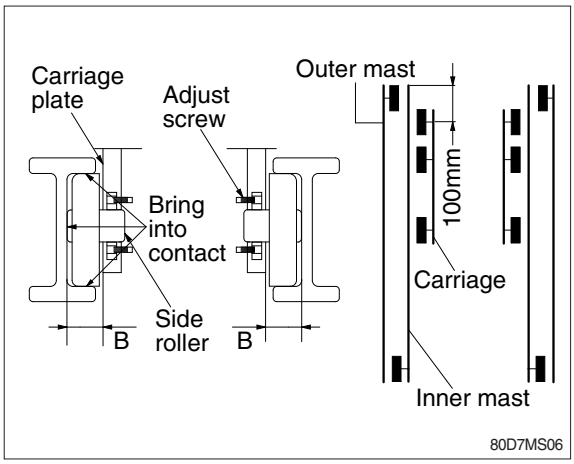
## 2) CARRIAGE LOAD ROLLER

(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 side roller into contact with the inner mast, and measure the clearance between inner face of the inner mast and carriage plate at the closest position on the opposite side to the following value by adjust screw.
· Reference clearance B = 56.9 mm

**(3) Distribute the clearance B equally to the left and right.**

(4) After the adjustment, the carriage should move smoothly along the overall mast length.

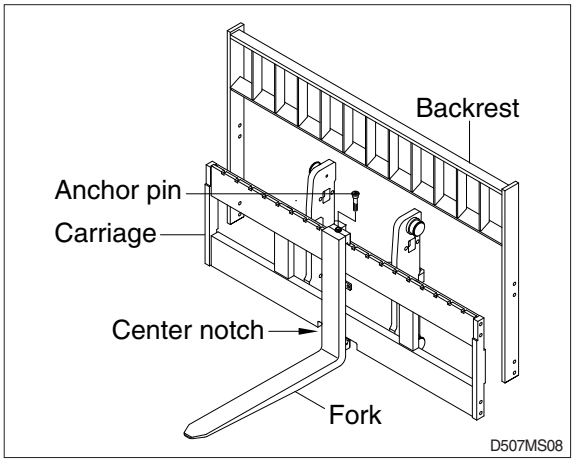


# GROUP 4 REMOVAL AND INSTALLATION

## 1. FORKS

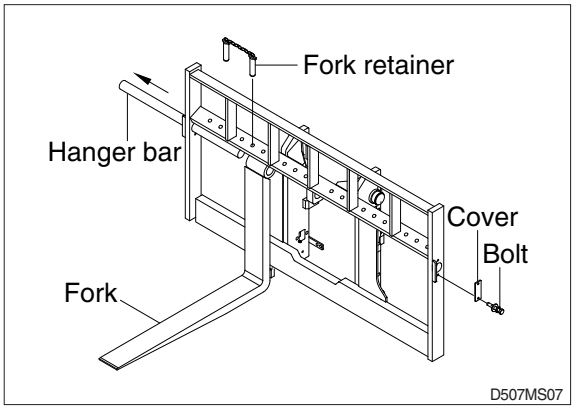
### 1) HOOK ON TYPE

(1) Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
(2) Release fork anchor pins 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 fork removal.
(3) Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.
(4) Reverse the above procedure to install load forks.



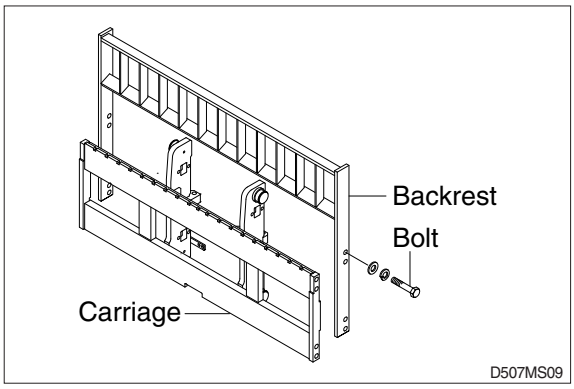

### 2) SHAFT TYPE (Option)

(1) Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
(2) Release fork retainer and remove cover.
(3) Slide one hanger bar at a time out of carriage assembly.
(4) Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.
(5) Reverse the above procedure to install load forks.




## 2. BACKREST (Hook on type)

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 inner mast 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 parts.

(6) Reverse the above steps to reinstall.

※ Replace the split pin of chain anchor with new one.

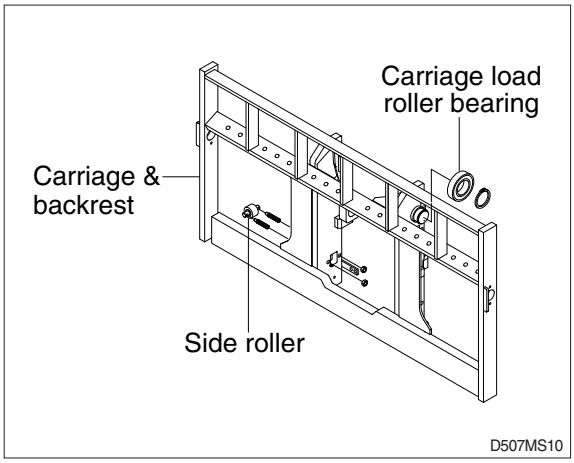
### 2) SIDE ROLLER

(1) Remove carriage as outlined in the carriage removal paragraph.

(2) Loosen and remove nuts, adjust screws and side rollers from carriage side plate.

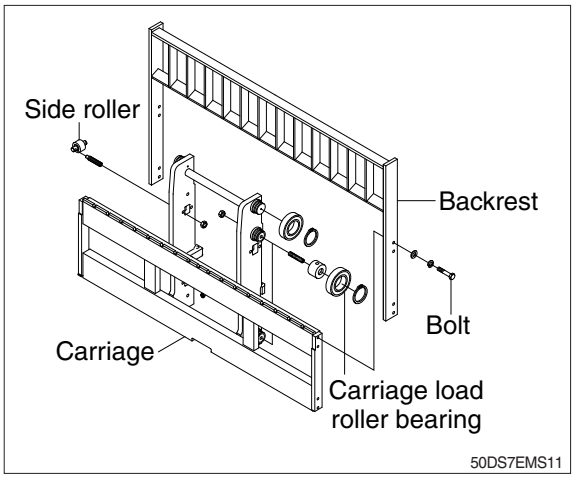
(3) Thoroughly clean, inspect and replace all worn or damaged parts.

(4) Reverse the above procedure to assembly.



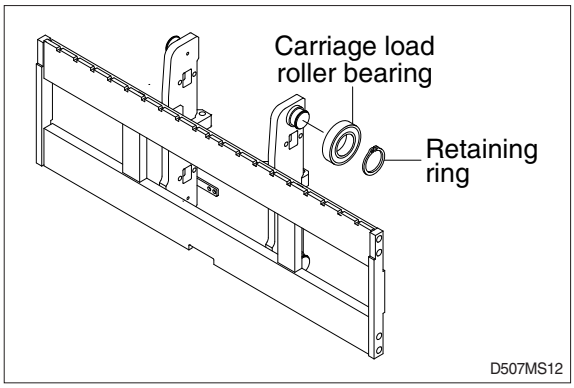

※ **Adjustment**

- 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 along 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 BEARING

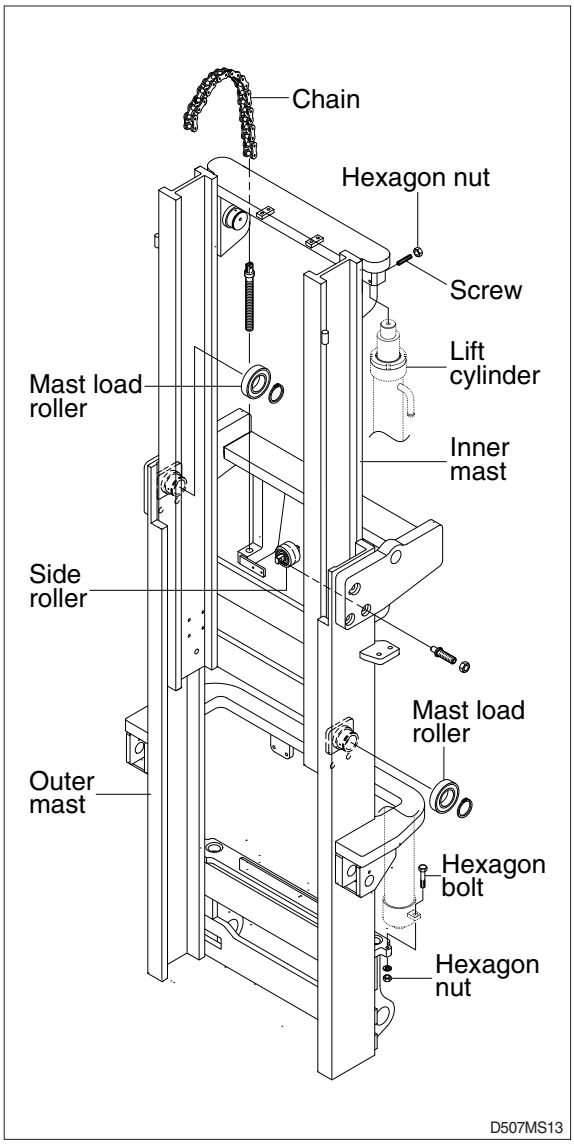
(1) Remove carriage as outlined in the carriage removal paragraph.
(2) Using the plier, remove retaining rings from load roller bearing bracket.
(3) Using a plier, remove load roller bearings from load roller bearing bracket.
(4) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.




## 4. MAST LOAD ROLLER

### 1) 2 STAGE MAST (V MAST)

(1) Remove the carriage assembly and move them to one side.
(2) Loosen and remove hexagon nuts and screws securing lift cylinders to inner mast.
(3) Loosen and remove hexagon bolts and nuts securing lift cylinders to outer 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) with ropes to the outer mast.
(6) Using the overhead hoist, lower inner mast until top and bottom rollers are exposed.
(7) Using a plier, remove load rollers from load roller bracket. Remove side rollers.
(8) Thoroughly clean, inspect and replace all worn or damaged parts.
(9) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.
(10) After completing all necessary steps for load rollers removal, use an overhead hoist to remove sling or chain around upper crossmember of the inner mast section.
Lift inner mast upright straight up and out of outer mast section.
(11) Replace and reverse above procedure to install.
(12) Make all necessary measurements and adjustments.



### 3) 3 STAGE MAST(TF, TS MAST)

(1) Remove the carriage assembly and move it to one side.

(2) Loosen and remove hexagon bolt securing bottom cylinder from outer mast.

(3) Loosen and remove set screws and nuts 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 4inch 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 supporting chains, remove chain sheaves and let chains hang free.
The upper outer and lower middle mast rollers and back up liners are now exposed.

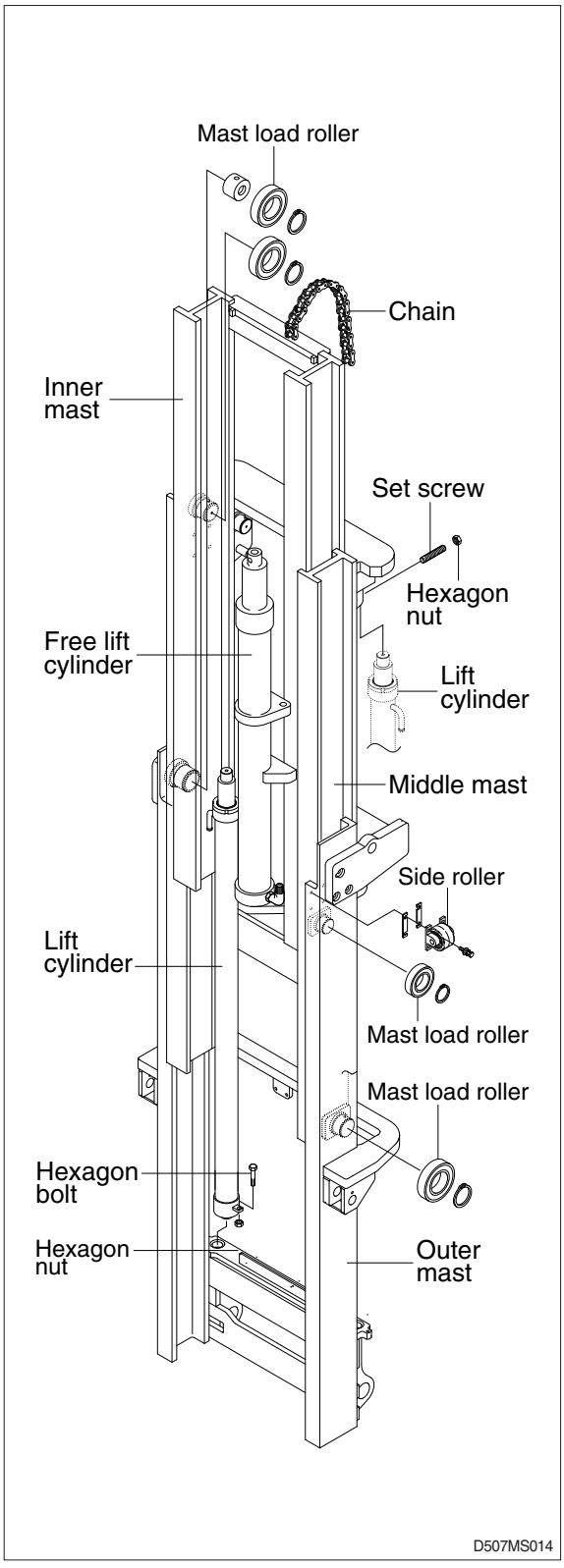
(8) Using a plier, remove load rollers from load bracket. Remove side rollers from mast.

(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 plier, remove load rollers from 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. CHAIN

### 1) CHAIN SHEAVE

(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.

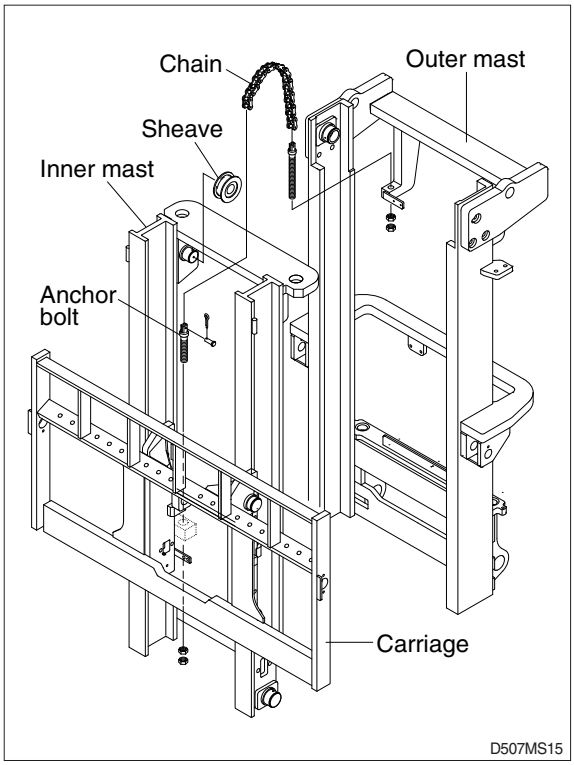
(2) Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins and drape the chain over the carriage.

(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, TS mast)

(1) Raise and securely block carriage and inner mast section.

(2) Remove the split pin securing the chain anchor pins and discard.

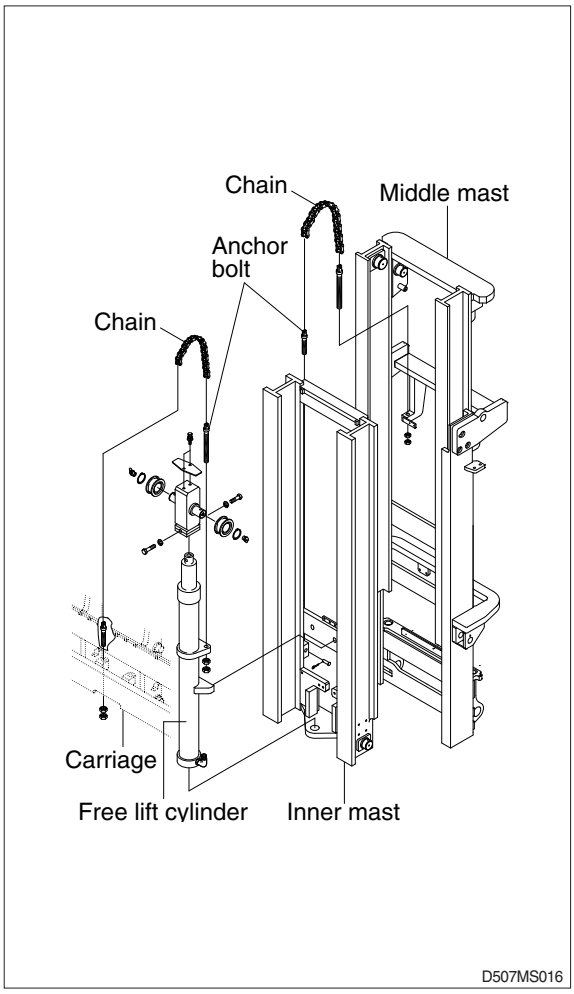
(3) Remove chains.

(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) Sheave support (TF, TS mast)

(1) Remove the carriage assembly and move to one side.
(2) After removing bolt to securing sheave support assembly to free lift cylinder.
Attach a sling to the sheave 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 sheave to sheave support.
(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 procedure to install.

### 4) Rear chain (TF, TS 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 sheaves, the joints very gradually wear. The stretch a chain develops 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 out 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 phenomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will eventually 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 sheaves

An inspection of the chain system includes a close examination of chain anchors and sheaves. 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. Sheaves 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 sheaves. 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.