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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.

Structure and function

This group explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

Operational checks and troubleshooting

This group explains the system operational checks and troubleshooting charts correlating problem to remedy.

Tests and adjustments

This group explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Disassembly and assembly

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your HD Hyundai Construction Equipment distributor for the latest information.

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HD Hyundai Construction Equipment distributors.

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

Filing method

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

File the pages in correct order.

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

Example 1

3 - 3

Section number (3. Power train system)
Consecutive page number for each section.

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

10 - 4

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Added pages

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 50 in the vertical column at the left side, take this as (a), then draw a horizontal line from (a).
- (2) Locate the number 5 in the row across the top, take this as (b), then draw a perpendicular line down from (b).
- (3) Take the point where the two lines cross as (c). This point (c) 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

(b)

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon
 $1 \ell = 0.2642 \text{ U.S. Gal}$

| | 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 | 6.076 | 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
 $1 \ell = 0.21997 \text{ U.K. Gal}$

| | 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 | 7.699 | 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 | 296.6 | 303.8 | 311.0 | 318.3 | 325.5 | 332.7 | 340.0 | 347.2 | 354.4 |
| 50 | 361.7 | 368.9 | 376.1 | 383.4 | 390.6 | 397.8 | 405.1 | 412.3 | 419.5 | 426.8 |
| 60 | 434.0 | 441.2 | 448.5 | 455.7 | 462.9 | 470.2 | 477.4 | 484.6 | 491.8 | 499.1 |
| 70 | 506.3 | 513.5 | 520.8 | 528.0 | 535.2 | 542.5 | 549.7 | 556.9 | 564.2 | 571.4 |
| 80 | 578.6 | 585.9 | 593.1 | 600.3 | 607.6 | 614.8 | 622.0 | 629.3 | 636.5 | 643.7 |
| 90 | 651.0 | 658.2 | 665.4 | 672.7 | 679.9 | 687.1 | 694.4 | 701.6 | 708.8 | 716.1 |
| 100 | 723.3 | 730.5 | 737.8 | 745.0 | 752.2 | 759.5 | 766.7 | 773.9 | 781.2 | 788.4 |
| 110 | 795.6 | 802.9 | 810.1 | 817.3 | 824.6 | 831.8 | 839.0 | 846.3 | 853.5 | 860.7 |
| 120 | 868.0 | 875.2 | 882.4 | 889.7 | 896.9 | 904.1 | 911.4 | 918.6 | 925.8 | 933.1 |
| 130 | 940.3 | 947.5 | 954.8 | 962.0 | 969.2 | 976.5 | 983.7 | 990.9 | 998.2 | 10005.4 |
| 140 | 1012.6 | 1019.9 | 1027.1 | 1034.3 | 1041.5 | 1048.8 | 1056.0 | 1063.2 | 1070.5 | 1077.7 |
| 150 | 1084.9 | 1092.2 | 1099.4 | 1106.6 | 1113.9 | 1121.1 | 1128.3 | 1135.6 | 1142.8 | 1150.0 |
| 160 | 1157.3 | 1164.5 | 1171.7 | 1179.0 | 1186.2 | 1193.4 | 1200.7 | 1207.9 | 1215.1 | 1222.4 |
| 170 | 1129.6 | 1236.8 | 1244.1 | 1251.3 | 1258.5 | 1265.8 | 1273.0 | 1280.1 | 1287.5 | 1294.7 |
| 180 | 1301.9 | 1309.2 | 1316.4 | 1323.6 | 1330.9 | 1338.1 | 1345.3 | 1352.6 | 1359.8 | 1367.0 |
| 190 | 1374.3 | 1381.5 | 1388.7 | 1396.0 | 1403.2 | 1410.4 | 1417.7 | 1424.9 | 1432.1 | 1439.4 |

kgf/cm² to lbf/in²1 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 | 1-10 |
| Group 3 Operational Checkout Record Sheet | 1-24 |

SECTION 1 GENERAL

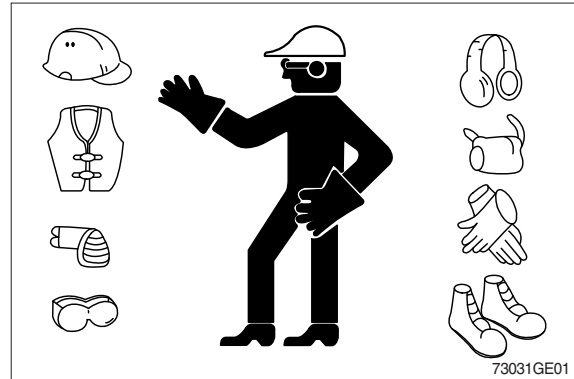
GROUP 1 SAFETY HINTS

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

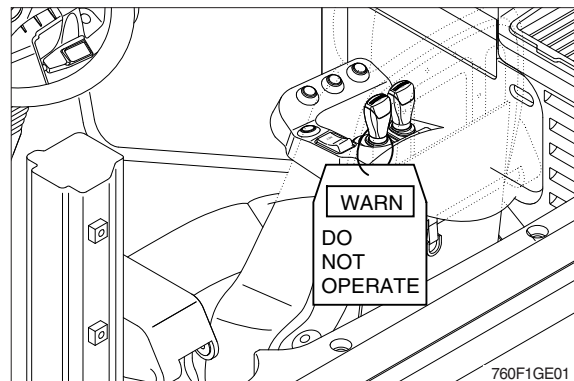
Wear close fitting clothing and safety equipment appropriate to the job.



WARN OTHERS OF SERVICE WORK

Unexpected machine movement can cause serious injury.

Before performing any work on the wheel loader, attach a 「Do Not Operate」 tag on the right side controller lever.



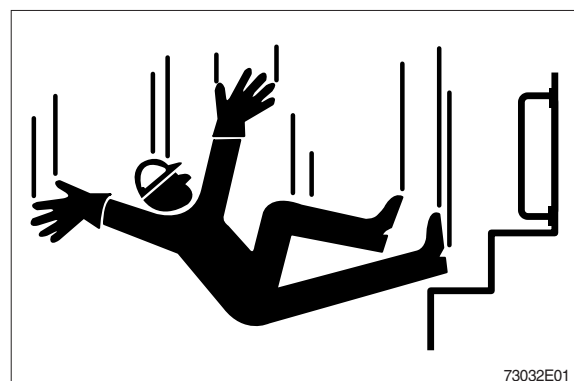
USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.

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

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

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

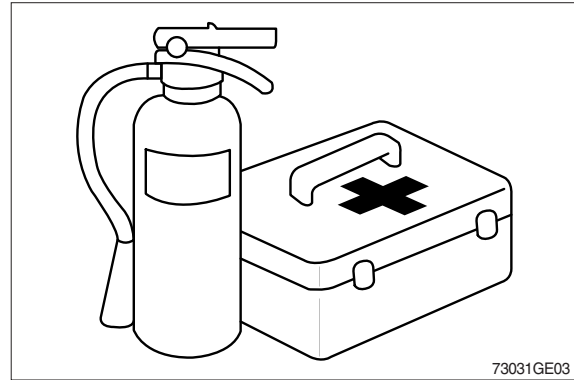


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

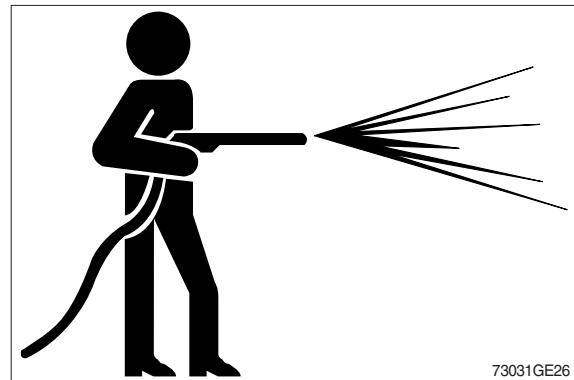
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



WORK IN CLEAN AREA

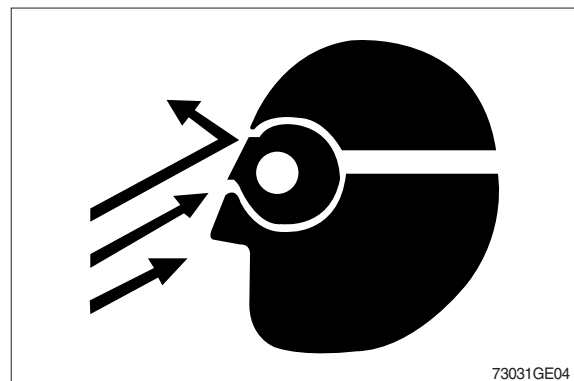
Before starting a job :

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; Do not attempt shortcuts.



PROTECT AGAINST FLYING DEBRIS

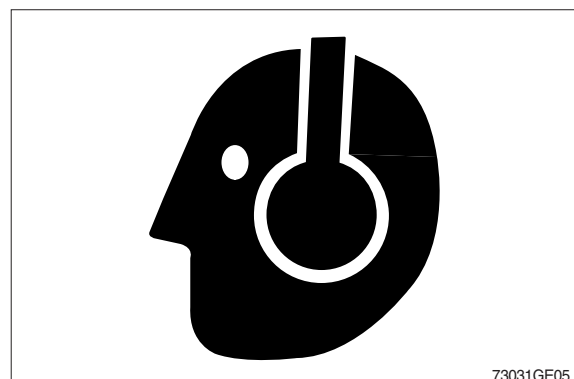
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

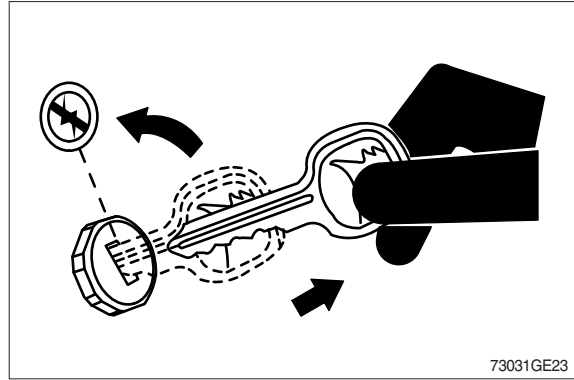
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



PARK MACHINE SAFELY

Before working on the machine:

- Park machine on a level surface.
- Lower bucket to the ground.
- Turn key switch to OFF to stop engine. Remove key from switch.
- Move pilot control shutoff lever to locked position.
- Allow engine to cool.



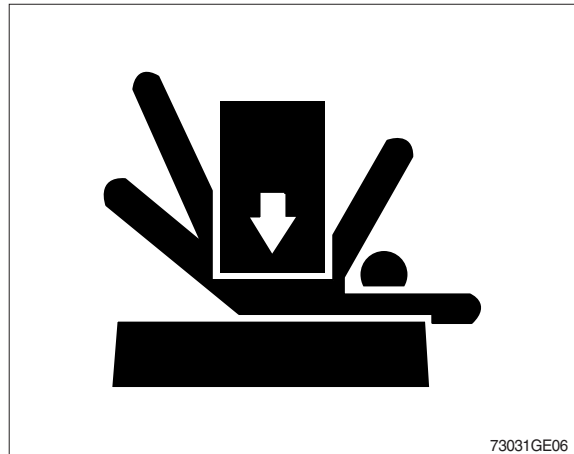
SUPPORT MACHINE PROPERLY

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

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

Do not work under a machine that is supported solely by a jack.

Follow recommended procedures in this manual.

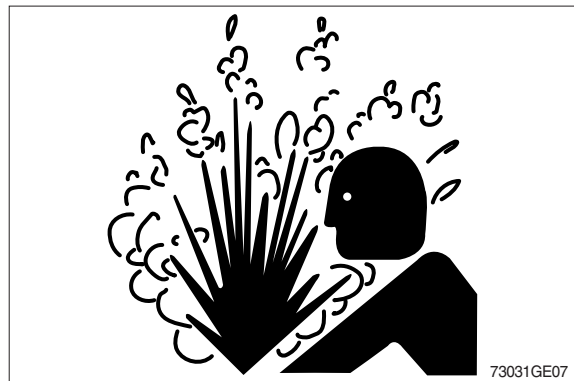


SERVICE COOLING SYSTEM SAFELY

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

Shut off engine.

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



HANDLE FLUIDS SAFELY-AVOID FIRES

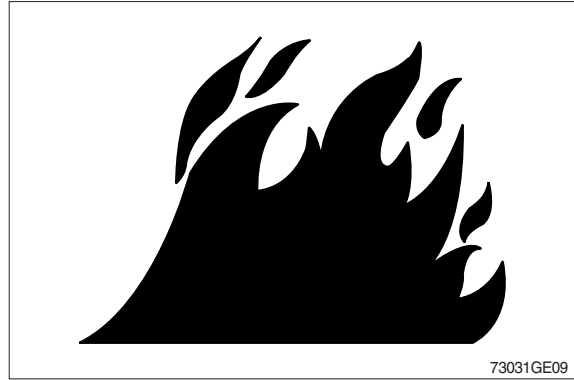
Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine. Fill fuel tank outdoors.



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

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

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



BEWARE OF EXHAUST FUMES

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

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

REMOVE PAINT BEFORE WELDING OR HEATING

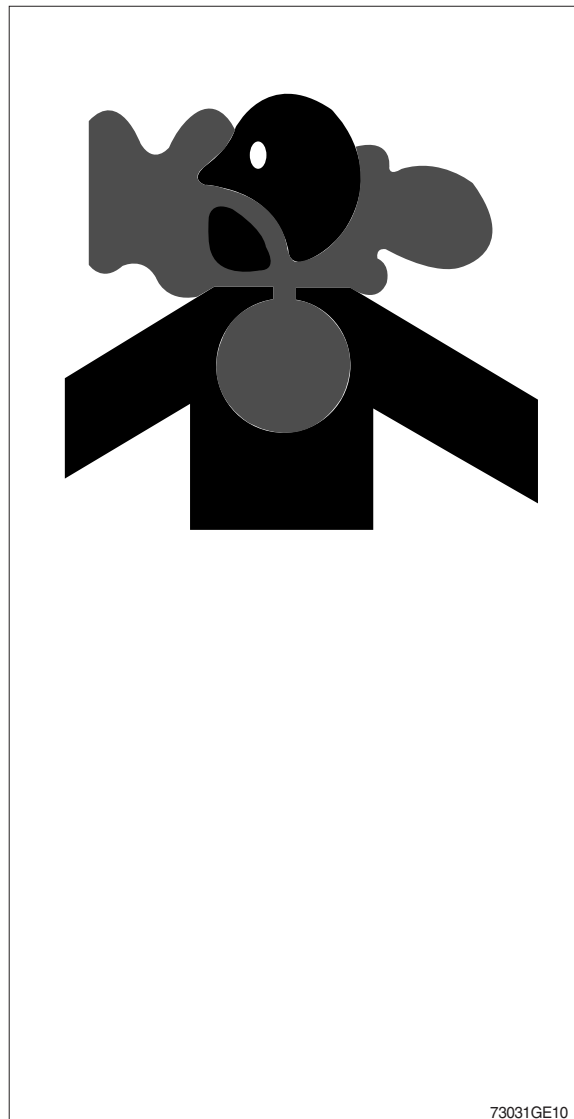
Avoid potentially toxic fumes and dust.

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

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

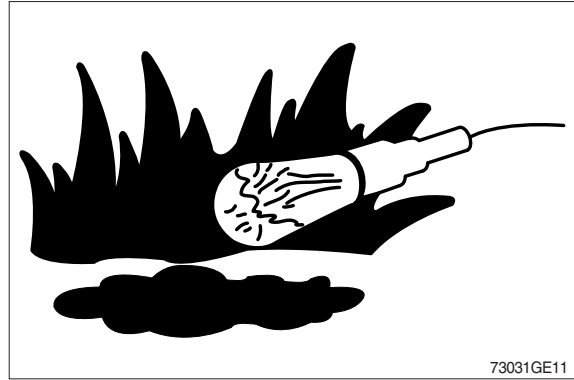
Remove paint before welding or heating:

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



ILLUMINATE WORK AREA SAFELY

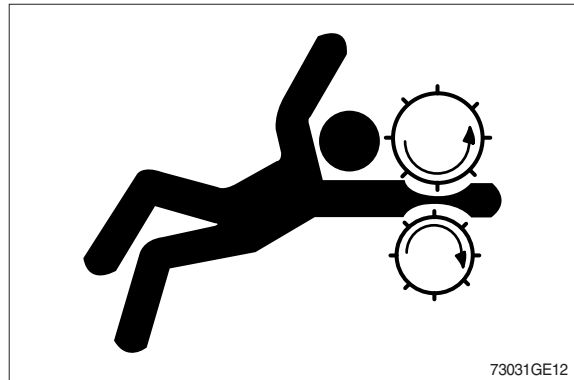
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



SERVICE MACHINE SAFELY

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

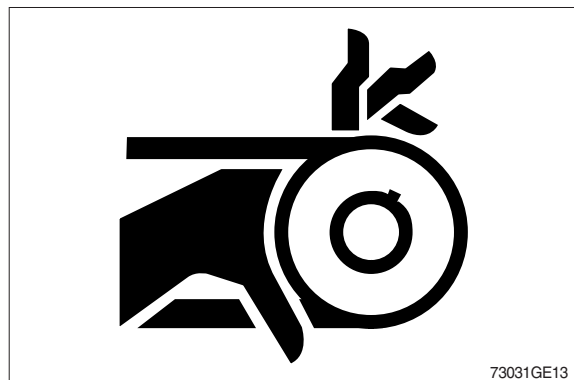
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



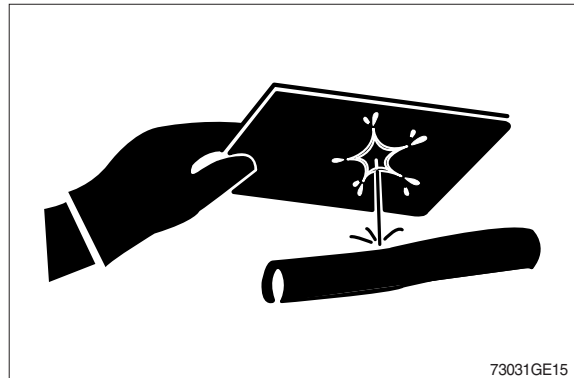
AVOID HIGH PRESSURE FLUIDS

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

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

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

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



AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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



PREVENT BATTERY EXPLOSIONS

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

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

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



PREVENT ACID BURNS

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

Avoid the hazard by:

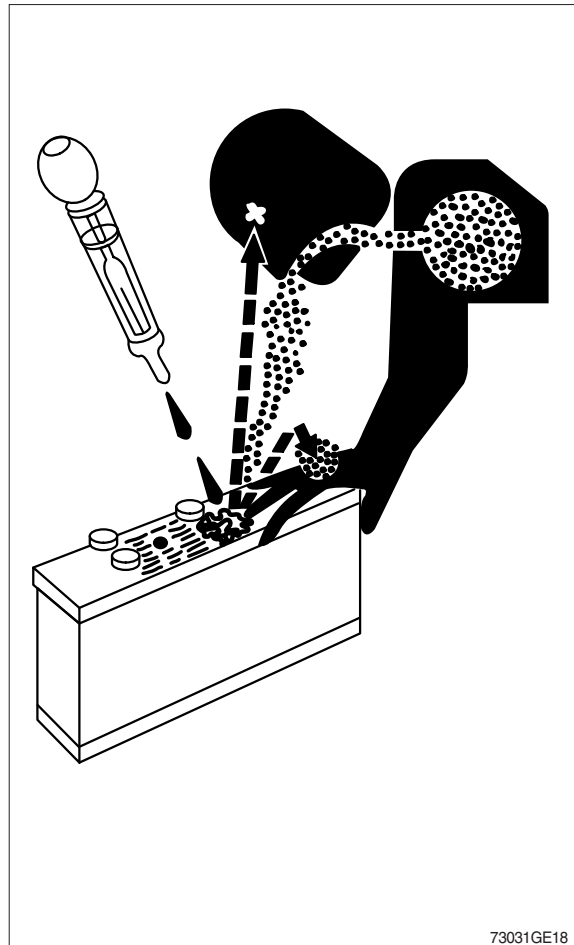
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



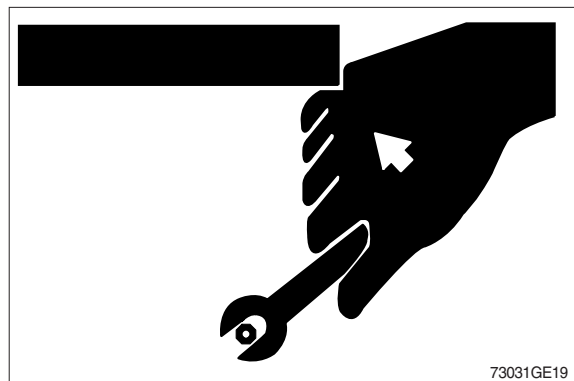
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. Avoid bodily injury caused by slipping wrenches.

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



SERVICE TIRES SAFELY

Explosive separation of a tire and rim parts can cause serious injury or death.

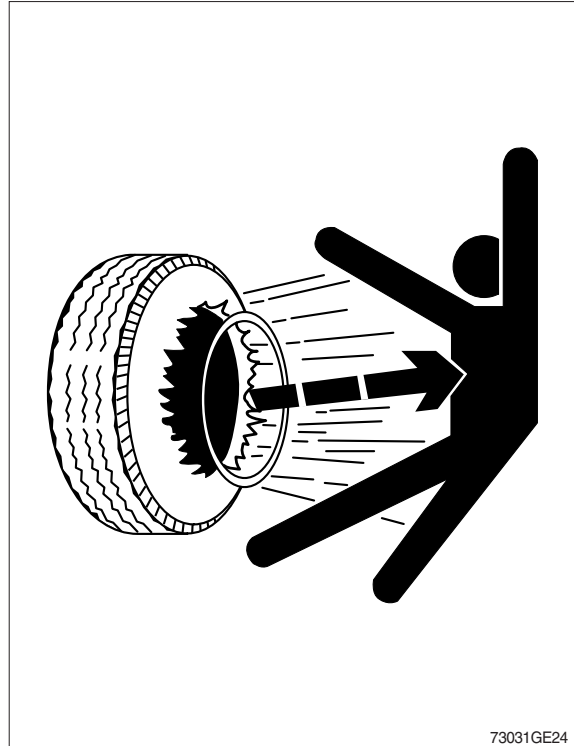
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion.

Welding can structurally weaken or deform the wheel.

When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and not in front of or over the tire assembly. Use a safety cage if available.

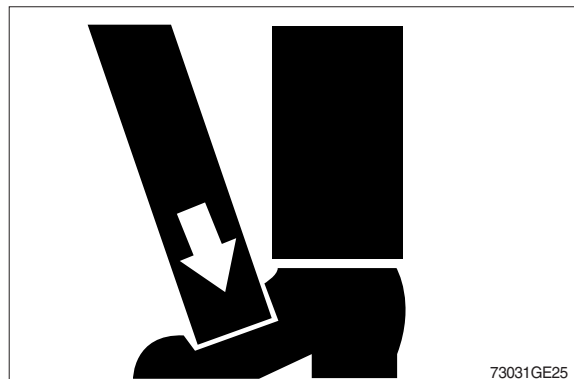
Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.



USE PROPER LIFTING EQUIPMENT

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.

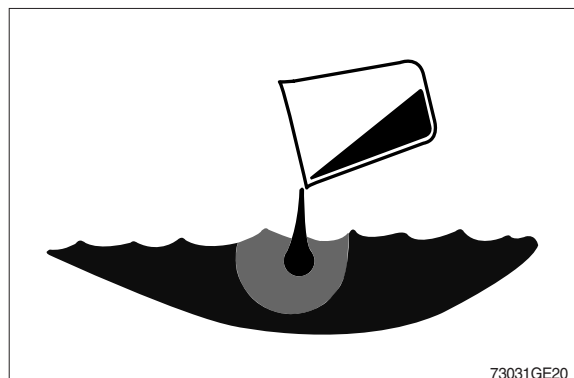


DISPOSE OF FLUIDS PROPERLY

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

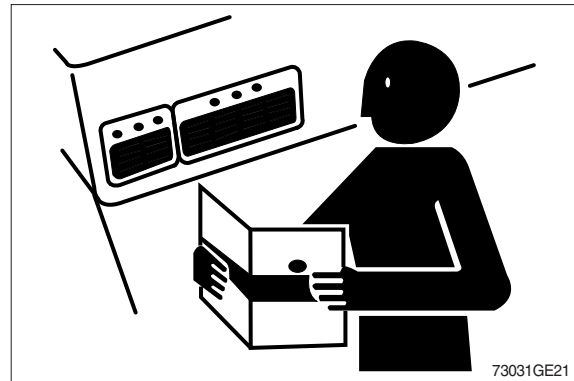
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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



REPLACE SAFETY SIGNS

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



LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems.

Install all guards and shields.

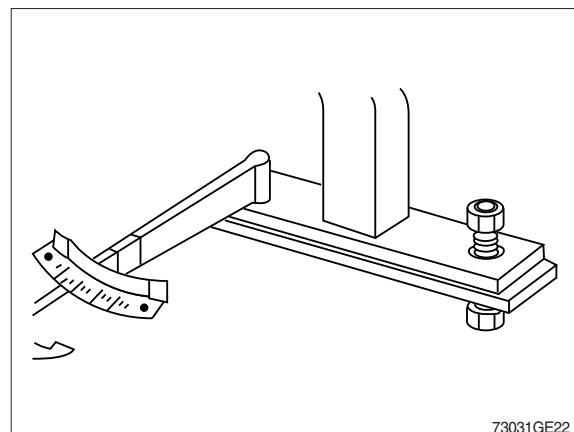
KEEP ROPS INSTALLED PROPERLY

Make certain all parts are reinstalled correctly if the roll-over protective structure (ROPS) is loosened or removed for any reason.

Tighten mounting bolts to proper torque.

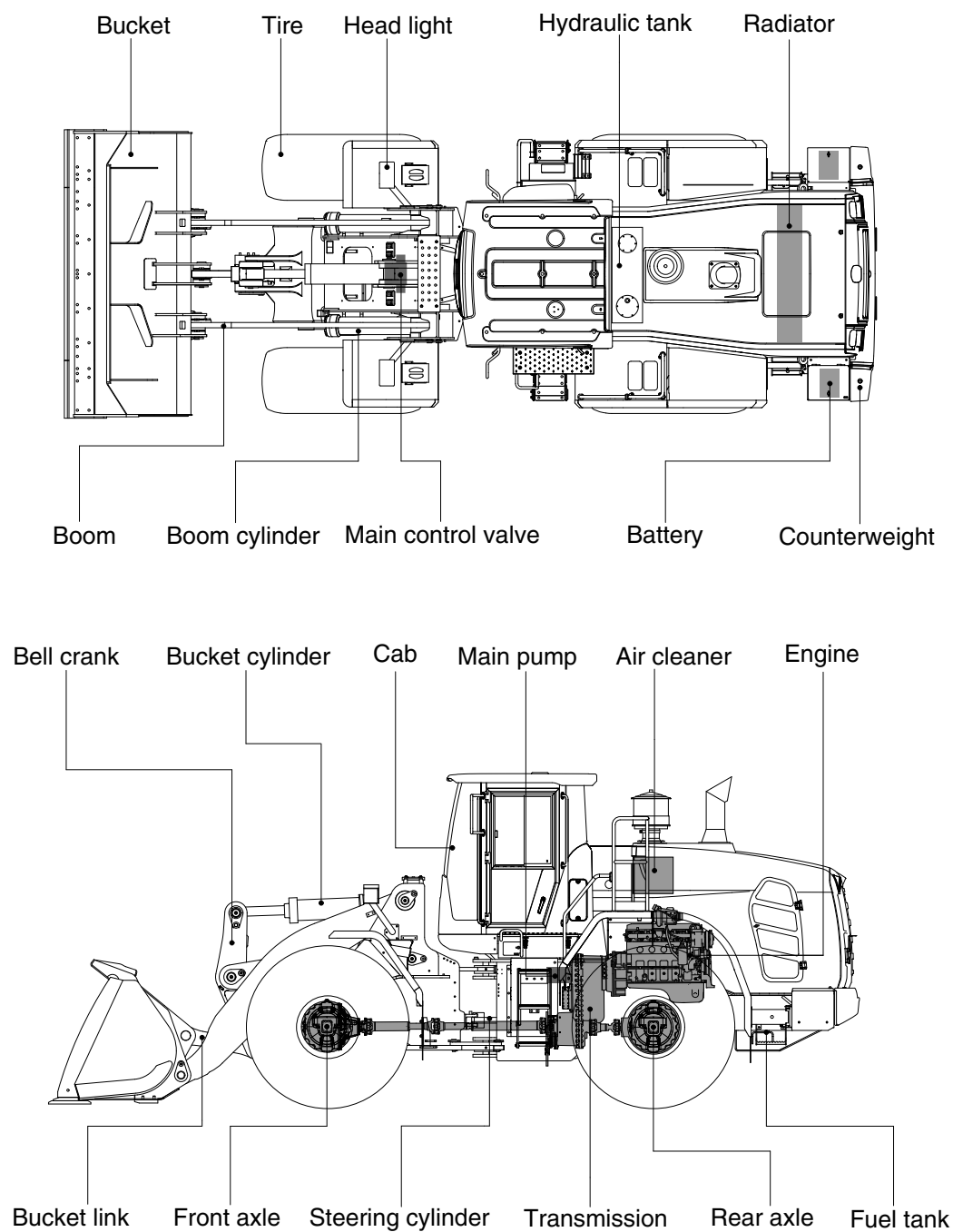
The protection offered by ROPS will be impaired if ROPS is subjected to structural damage, is involved in an overturn incident, or is in any way altered by welding, bending, drilling, or cutting.

A damaged ROPS should be replaced, not reused.



GROUP 2 SPECIFICATIONS

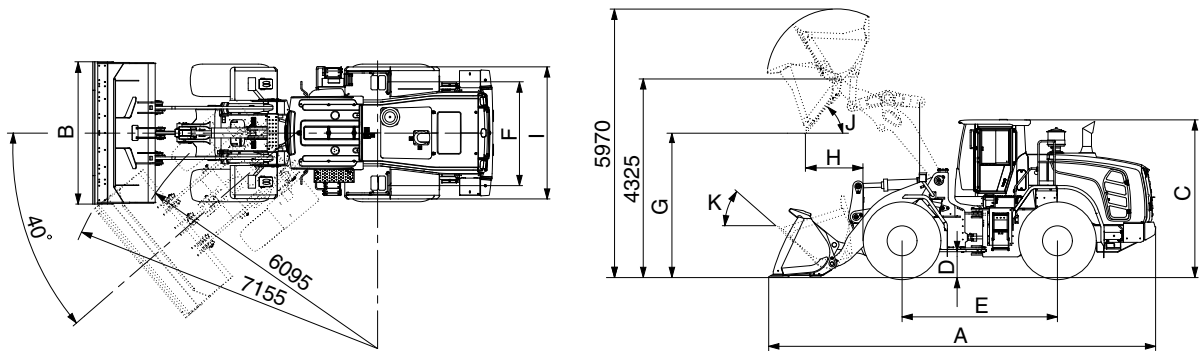
1. MAJOR COMPONENT



970A2SE01

2. SPECIFICATIONS

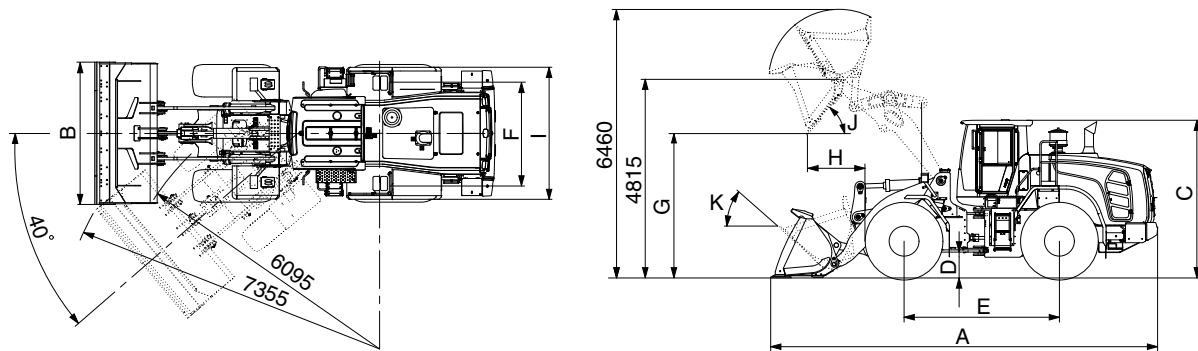
1) WITH BOLT-ON CUTTING EDGE TYPE BUCKET (HL970A)



970A2SE03

| Description | | | Unit | Specification |
|---|------------------|-------------|-------------|---------------|
| Operating weight | | | kg (lb) | 24200 (53355) |
| Bucket capacity | Struck | | m³ (yd³) | 3.6 (4.7) |
| | Heaped | | | 4.2 (5.5) |
| Overall length | A | | mm (ft-in) | 8740 (28' 8") |
| Overall width | B | | | 3100 (10' 2") |
| Overall height | C | | | 3590 (11' 9") |
| Ground clearance | D | | | 480 (1' 7") |
| Wheelbase | E | | | 3500 (11' 6") |
| Tread | F | | | 2300 (7' 7") |
| Dump clearance at 45° | G | | | 3080 (10' 1") |
| Dump reach (full lift) | H | | | 1270 (4' 2") |
| Width over tires | I | | | 2980 (9' 9") |
| Dump angle | J | | | degree (°) |
| Roll back angle (carry position) | K | | 47 | |
| Cycle time | Lift (with load) | | sec | 6.0 |
| | Dump (with load) | | | 1.5 |
| | Lower (empty) | | | 4.3 |
| Maximum travel speed | | | km/hr (mph) | 40.0 (24.9)) |
| Braking distance | | | m (ft-in) | 13.3 (43' 8") |
| Minimum turning radius (center of outside tire) | | | | 6.09 (20' 0") |
| Gradeability | | | degree (°) | 30 |
| Breakout force | | | kg (lb) | 21715 (47875) |
| Travel speed | Forward | First gear | km/hr (mph) | 7.4 (4.6) |
| | | Second gear | | 12.5 (7.8) |
| | | Third gear | | 27.8 (17.3) |
| | | Fourth gear | | 40.0 (24.9) |
| | Reverse | First gear | | 7.4 (4.6) |
| | | Second gear | | 12.5 (7.8) |
| | | Third gear | | 27.8 (17.3) |

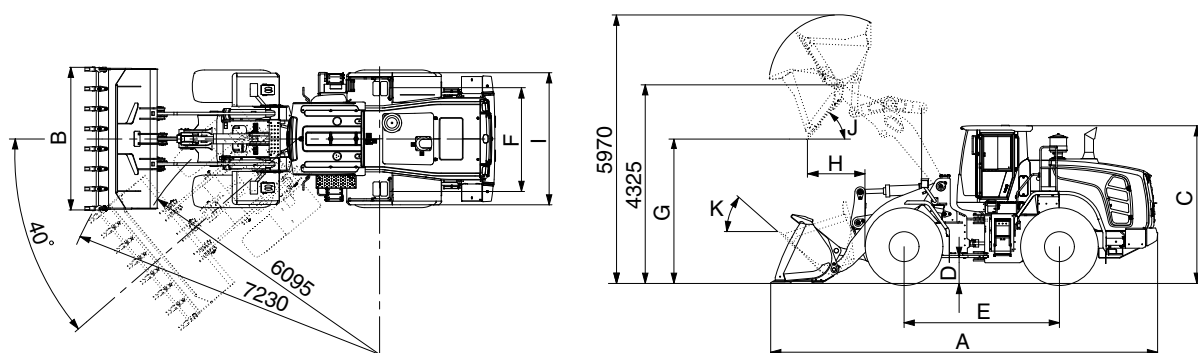
WITH BOLT-ON CUTTING EDGE TYPE BUCKET (HL970A XT)



970A2SE03-1

| Description | | | Unit | Specification |
|---|------------------|-------------|-------------|---------------|
| Operating weight | | | kg (lb) | 25000 (55120) |
| Bucket capacity | Struck | | m³ (yd³) | 3.6 (4.7) |
| | Heaped | | | 4.2 (5.5) |
| Overall length | A | | mm (ft-in) | 9280 (30' 5") |
| Overall width | B | | | 3100 (10' 2") |
| Overall height | C | | | 3590 (11' 9") |
| Ground clearance | D | | | 480 (1' 7") |
| Wheelbase | E | | | 3500 (11' 6") |
| Tread | F | | | 2300 (7' 7") |
| Dump clearance at 45° | G | | | 3570 (11' 9") |
| Dump reach (full lift) | H | | | 1255 (4' 1") |
| Width over tires | I | | | 2980 (9' 9") |
| Dump angle | J | | degree (°) | 50 |
| Roll back angle (carry position) | K | | | 49 |
| Cycle time | Lift (with load) | | sec | 6.0 |
| | Dump (with load) | | | 1.5 |
| | Lower (empty) | | | 4.3 |
| Maximum travel speed | | | km/hr (mph) | 40.0 (24.9) |
| Braking distance | | | m (ft-in) | 13.3 (43' 8") |
| Minimum turning radius (center of outside tire) | | | | 6.09 (20' 0") |
| Gradeability | | | degree (°) | 30 |
| Breakout force | | | kg (lb) | 21775 (48010) |
| Travel speed | Forward | First gear | km/hr (mph) | 7.4 (4.6) |
| | | Second gear | | 12.5 (7.8) |
| | | Third gear | | 27.8 (17.3) |
| | | Fourth gear | | 40.0 (24.9) |
| | Reverse | First gear | | 7.4 (4.6) |
| | | Second gear | | 12.5 (7.8) |
| Third gear | | 27.8 (17.3) | | |

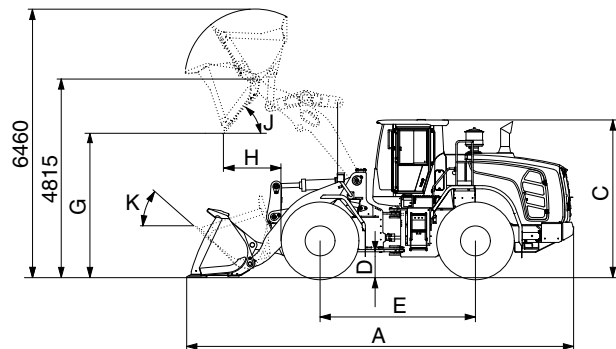
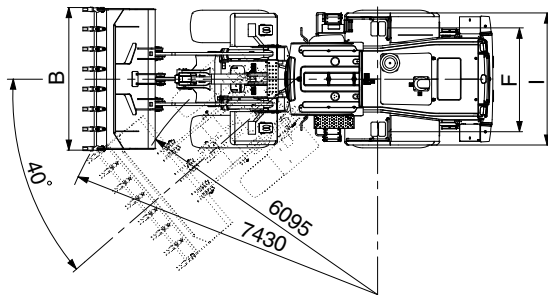
2) WITH TOOTH TYPE BUCKET (HL970A)



970A2SE04

| Description | | | Unit | Specification |
|---|------------------|-------------|-------------|---------------|
| Operating weight | | | kg (lb) | 24110 (53155) |
| Bucket capacity | Struck | | m³ (yd³) | 3.4 (4.4) |
| | Heaped | | | 4.0 (5.2) |
| Overall length | A | | mm (ft-in) | 8890 (29' 2") |
| Overall width | B | | | 3150 (10' 4") |
| Overall height | C | | | 3590 (11' 9") |
| Ground clearance | D | | | 480 (1' 7") |
| Wheelbase | E | | | 3500 (11' 6") |
| Tread | F | | | 2300 (7' 7") |
| Dump clearance at 45° | G | | | 2955 (9' 8") |
| Dump reach (full lift) | H | | | 1355 (4' 6") |
| Width over tires | I | | | 2980 (9' 9") |
| Dump angle | J | | | degree (°) |
| Roll back angle (carry position) | K | | 47 | |
| Cycle time | Lift (with load) | | sec | 6.0 |
| | Dump (with load) | | | 1.5 |
| | Lower (empty) | | | 4.3 |
| Maximum travel speed | | | km/hr (mph) | 40.0 (24.9) |
| Braking distance | | | m (ft-in) | 13.3 (43' 8") |
| Minimum turning radius (center of outside tire) | | | | 6.09 (20' 0") |
| Gradeability | | | degree (°) | 30 |
| Breakout force | | | kg (lb) | 22990 (50685) |
| Travel speed | Forward | First gear | km/hr (mph) | 7.4 (4.6) |
| | | Second gear | | 12.5 (7.8) |
| | | Third gear | | 27.8 (17.3) |
| | | Fourth gear | | 40.0 (24.9) |
| | Reverse | First gear | | 7.4 (4.6) |
| | | Second gear | | 12.5 (7.8) |
| | | Third gear | | 27.8 (17.3) |

WITH TOOTH TYPE BUCKET (HL970A XT)



970A2SE04-1

| Description | | | Unit | Specification |
|---|------------------|-------------|-------------|---------------|
| Operating weight | | | kg (lb) | 24910 (54920) |
| Bucket capacity | Struck | | m³ (yd³) | 3.4 (4.4) |
| | Heaped | | | 4.0 (5.2) |
| Overall length | A | | mm (ft-in) | 9430 (31'11") |
| Overall width | B | | | 3150 (10' 4") |
| Overall height | C | | | 3590 (11' 9") |
| Ground clearance | D | | | 480 (1' 7") |
| Wheelbase | E | | | 3500 (11' 6") |
| Tread | F | | | 2300 (7' 7") |
| Dump clearance at 45° | G | | | 3445 (11' 4") |
| Dump reach (full lift) | H | | | 1340 (4' 5") |
| Width over tires | I | | | 2980 (9' 9") |
| Dump angle | J | | | degree (°) |
| Roll back angle (carry position) | K | | 49 | |
| Cycle time | Lift (with load) | | sec | 6.0 |
| | Dump (with load) | | | 1.5 |
| | Lower (empty) | | | 4.3 |
| Maximum travel speed | | | km/hr (mph) | 40.0 (24.9) |
| Braking distance | | | m (ft-in) | 13.3 (43' 8") |
| Minimum turning radius (center of outside tire) | | | | 6.09 (20' 0") |
| Gradeability | | | degree (°) | 30 |
| Breakout force | | | kg (lb) | 23050 (50820) |
| Travel speed | Forward | First gear | km/hr (mph) | 7.4 (4.6) |
| | | Second gear | | 12.5 (7.8) |
| | | Third gear | | 27.8 (17.3) |
| | | Fourth gear | | 40.0 (24.9) |
| | Reverse | First gear | | 7.4 (4.6) |
| | | Second gear | | 12.5 (7.8) |
| | | Third gear | | 27.8 (17.3) |

3. WEIGHT

| Item | | kg | lb |
|--|-----------|---------|-----------|
| Front frame assembly | | 2153 | 4746 |
| Rear frame assembly | | 2387 | 5262 |
| Front fender (LH & RH) | | 80 | 176 |
| Counterweight (HL970A) | | 1100 | 2425 |
| Counterweight (HL970A XT) | | 1600 | 3527 |
| Cab assembly | | 1061 | 2339 |
| Engine assembly | | 777 | 1712 |
| Transmission assembly (4-speed/5-speed) | | 807/857 | 1779/1889 |
| Drive shaft (front) | | 41 | 90 |
| Drive shaft (center) | | 37 | 81 |
| Drive shaft (rear) | | 22 | 48 |
| Front axle (include differential) | | 1242 | 2738 |
| Rear axle (include differential) | | 1321 | 2912 |
| Tire (26.5 R25, ★★, L3) | | 474 | 1044 |
| Hydraulic tank assembly | | 393 | 866 |
| Fuel tank assembly | | 383 | 844 |
| Main pump assembly | | 90 | 198 |
| Fan & brake pump assembly | | 12 | 26 |
| Main control valve (2 spool/3 spool) | | 90/106 | 198/233 |
| Flow amplifier | | 29 | 63 |
| Boom assembly | HL970A | 1649 | 3635 |
| | HL970A XT | 1959 | 4318 |
| Bell crank assembly | | 483 | 1065 |
| Bucket link | | 77 | 169 |
| 4.2 m ³ bucket, with bolt on cutting edge | | 2243 | 4944 |
| 4.0 m ³ bucket, with tooth | | 2152 | 4744 |
| Boom cylinder assembly | | 201 | 443 |
| Bucket cylinder assembly | | 210 | 462 |
| Steering cylinder assembly | | 43 | 94 |
| Seat | | 89 | 196 |
| Battery | | 51 | 112 |

4. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

| Item | Specification |
|-------------------------------------|---|
| Model | Cummins L9 |
| Type | 4-cycle turbocharged, charge air cooled diesel engine |
| Control type | Electronic control |
| Cooling method | Water cooling |
| Number of cylinders and arrangement | 6 cylinders, in-line |
| Firing order | 1-5-3-6-2-4 |
| Combustion chamber type | Direct injection type |
| Cylinder bore × stroke | 114 × 145 mm (4.5" × 5.7") |
| Piston displacement | 8900 cc (543 cu in) |
| Compression ratio | 16.7 : 1 |
| Rated gross horse power | 325 hp (242 kW) at 2100 rpm |
| Peak gross torque | 167 kgf · m (1207 lbf · ft) at 1100 rpm |
| Engine oil quantity | 23 ℓ (6.1 U.S. gal) |
| Wet weight | 777 kg (1713 lb) |
| High idling speed | 2130 ± 50 rpm |
| Low idling speed | 800 ± 25 rpm |
| Rated fuel consumption | 223 g/kW · hr |
| Starting motor | 24 V - 6.4 kW) |
| Alternator | 24 V - 95 Amp) |
| Battery | 2 × 12 V × 200 Ah |

2) MAIN PUMP

| Item | Specification | |
|----------------------------------|------------------------------------|------------------------------------|
| | Steering | Loader |
| Type | Variable tandem piston pump | |
| Capacity | 110 cc/rev | 61 cc/rev |
| Maximum operating pressure | 210 kgf/cm ² (2990 psi) | 280 kgf/cm ² (3980 psi) |
| Rated oil quantity (at 2200 rpm) | 242 ℓ /min (63.9 U.S.gpm) | 134 ℓ /min (35.4 U.S.gpm) |
| Maximum speed | 2100 rpm | |

3) FAN + BRAKE PUMP

| Item | Specification |
|----------------------------------|------------------------------------|
| Type | Variable piston pump |
| Capacity | 28 cc/rev |
| Maximum operating pressure | 250 kgf/cm ² (3560 psi) |
| Rated oil quantity (at 2200 rpm) | 62 ℓ /min (16.3 U.S.gpm) |
| Maximum speed | 2100 rpm |

4) MAIN CONTROL VALVE

| Item | Specification |
|--------------------------------|------------------------------------|
| Type | 2 spool / 3 spool |
| Operating method | Hydraulic pilot assist |
| Main relief valve pressure | 280 kgf/cm ² (3980 psi) |
| Overload relief valve pressure | 340 kgf/cm ² (4840 psi) |

5) REMOTE CONTROL VALVE (EH TYPE)

| Item | Specification |
|-------------------|---|
| Type | Fingertip |
| Axle | Single axle for boom, bucket, auxiliary |
| Operating voltage | 4.5~5.5 V |
| Output signal | 0.5~4.5 V (neutral 2.5 V) |

6) REMOTE CONTROL VALVE (FNR TYPE)

| Item | Specification |
|----------------|---|
| Type | Joystick |
| Axle | Two axle for boom, bucket, roller for auxiliary |
| Operating type | CAN J1939 |
| Baud rate | 500 kbps |

7) CYLINDER

| Item | | Specification |
|-----------------------------|-----------------------------|-----------------------|
| Boom cylinder | Bore dia × Rod dia × Stroke | Ø 165 × Ø 95 × 780 mm |
| Bucket cylinder (HL970A) | Bore dia × Rod dia × Stroke | Ø 180 × Ø 95 × 565 mm |
| Bucket cylinder (HL970A XT) | Bore dia × Rod dia × Stroke | Ø 180 × Ø 95 × 570 mm |
| Steering cylinder | Bore dia × Rod dia × Stroke | Ø 95 × Ø 50 × 468 mm |

8) DYNAMIC POWER TRANSMISSION DEVICES

| Item | | | Specification |
|----------------------------|-----------------|-------------------|---|
| 4-speed transmission (std) | Model | | ZF 4WG 260 |
| | Type | Converter | Single-stage, single-phase |
| | | Transmission | Full-automatic power shift |
| | Gear shift | | Forward fourth gear, reverse third gear |
| | Control | | Electrical single lever type, kick-down system Automatic kick down from 2nd to 1st gear FNR switch on joystick lever (option) |
| | Pump rated flow | | 115 ℓ /min (30.4 U.S.gpm) at 2000 rpm |
| | Travel speed | | See the page 2-2. |
| 5-speed transmission (opt) | Model | | ZF 5WG 260 |
| | Type | Converter | Single-stage, double-phase (with lock up clutch) |
| | | Transmission | Full-automatic power shift |
| | Gear shift | | Forward fifth gear, reverse third gear |
| | Control | | Electrical single lever type, kick-down system Automatic kick down from 2nd to 1st gear FNR switch on joystick lever (option) |
| | Pump rated flow | | 135 ℓ /min (35.7 U.S.gpm) at 2000 rpm |
| | Travel speed | Forward 1/2/3/4/5 | 7.4/12.6/20.1/28.7/40.0 km/hr |
| | | Reverse 1/2/3 | 7.4/12.6/28.7 km/hr |
| Axle | Drive devices | | 4-wheel drive |
| | Front | | Front fixed location |
| | Rear | | Oscillation ± 11° of center pin-loaded |
| Wheels | Tires | | 26.5 R25, ★★, L3 |
| Brakes | Travel | | Four-wheel, wet-disc type, full hydraulic |
| | Parking | | Spring applied, hydraulic released brake on T/M |
| Steering | Type | | Full hydraulic, articulated |
| | Steering angle | | 40° to both right and left angle, respectively |

5. TIGHTENING TORQUE

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)

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

3) PIPE AND HOSE (ORFS type)

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

4) FITTING

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

5) TIGHTENING TORQUE OF MAJOR COMPONENT

| No. | Descriptions | | Bolt size | Torque | |
|-----|--------------------|---|-----------|------------|-------------|
| | | | | kgf · m | lbf · ft |
| 1 | Engine | Engine mounting bolt, nut (rubber, 2EA) | M24×3.0 | 76.5 ± 7.7 | 553 ± 55.7 |
| 2 | | Engine mounting bolt (bracket, 8EA) | M12×1.75 | 11.7 | 84.6 |
| 3 | | Engine mounting bolt (T/C housing, 11EA) | M10×1.5 | 6.63 ± 1.0 | 48 ± 7.2 |
| 4 | | Engine mounting socket bolt (flywheel, 8EA) | M10×1.5 | 6.9 | 49.9 |
| 5 | | Fan motor mounting bolt | M12×1.75 | 12.8 ± 3.0 | 92.6 ± 21.7 |
| 6 | | Radiator mounting bolt | M16×2.0 | 29.7 ± 5.9 | 215 ± 42.7 |
| 7 | | Fuel tank mounting bolt, nut | M16×2.0 | 29.7 ± 4.5 | 215 ± 32.5 |
| 8 | Hydraulic system | Main pump housing mounting bolt | M14×2.0 | 19.6 ± 2.9 | 142 ± 21.0 |
| 9 | | Fan & Brake pump housing mounting bolt | M12×1.75 | 12.8 ± 3.0 | 92.6 ± 21.7 |
| 10 | | Main control valve mounting bolt | M12×1.75 | 12.8 ± 3.0 | 92.6 ± 21.7 |
| 11 | | Steering unit mounting bolt | M10×1.5 | 6.9 ± 1.4 | 50 ± 10.1 |
| 12 | | Steering valve mounting bolt | M10×1.5 | 6.9 ± 1.4 | 50 ± 10.1 |
| 13 | | Brake valve mounting bolt | M8×1.25 | 2.5 ± 0.5 | 18.1 ± 3.6 |
| 14 | | Cut-off valve mounting bolt | M8×1.25 | 2.5 ± 0.5 | 18.1 ± 3.6 |
| 15 | | EH control block mounting bolt | M8×1.25 | 2.5 ± 0.5 | 18.1 ± 3.6 |
| 16 | | Safety valve mounting bolt | M10×1.5 | 6.9 ± 1.4 | 50 ± 10.1 |
| 17 | | Hydraulic oil tank mounting bolt | M16×2.0 | 29.7 ± 4.5 | 215 ± 32.5 |
| 18 | Power train system | Transmission mounting bolt, nut (rubber, 4EA) | M24×3.0 | 76.5 ± 7.7 | 553 ± 55.7 |
| 19 | | Transmission mounting bolt (bracket, 8EA) | M20×2.5 | 56.1 ± 8.4 | 406 ± 60.8 |
| 20 | | Front axle mounting bolt, nut | M33×2.0 | 225 ± 20 | 1627 ± 145 |
| 21 | | Rear axle support mounting bolt, nut | M36×3.0 | 280 ± 30 | 2025 ± 217 |
| 22 | | Tire mounting nut | M22×1.5 | 79 ± 2.5 | 571 ± 18.1 |
| 23 | | Drive shaft joint mounting bolt | 1/2-20UNF | 15 ± 2.0 | 108 ± 14.5 |
| 24 | Others | Counterweight mounting bolt | M30×3.5 | 199 ± 30 | 1439 ± 216 |
| | | Counterweight mounting bolt | M24×3.0 | 100 ± 15 | 723 ± 108 |
| 25 | | Operator's seat mounting bolt | M8×1.25 | 3.4 ± 0.8 | 24.6 ± 5.0 |
| 26 | | ROPS Cab mounting bolt (4EA) | M30×3.5 | 199 ± 29.9 | 1440 ± 216 |
| | | ROPS Cab mounting nut (4EA) | M16×2.0 | 20.5 ± 4.7 | 148± 34 |

6. SPECIFICATION OF FUEL, COOLANT AND LUBRICANTS

1) NEW MACHINE

New machine used and filled with following lubricants.

| Description | Specification |
|-----------------------|--|
| Engine oil (API CK-4) | SAE 15W-40, ^{★2} SAE 5W-40 |
| DEF/AdBlue® | ISO 22241 (32.5% high-purity urea and 67.5 deionized water) |
| Hydraulic oil | HD Hyundai Construction Equipment genuine long life (ISO VG 46, VG 68 only) Conventional (ISO VG15 ^{★2}) HD Hyundai Construction Equipment Bio Hydraulic Oil (HBHO, ISO VG 46) |
| Transmission oil | SAE 15W-40 (Oils of the API CI-4+, CJ-4, CK-4, SM, or ACEA specification, Category E9 are not permitted to use for the transmission) |
| Axle oil | [★] Refer to below list |
| Grease | Lithium base grease NLGI No. 2 |
| Fuel | ASTM D975-No. 2, ^{★1} Ultra low sulfur diesel |
| Coolant | ASTM D6210 Mixture of 50% ethylene glycol base antifreeze and 50% water Mixture of 60% ethylene glycol base antifreeze and 40% water ^{★2} |

SAE : Society of Automotive Engineers

API : American Petroleum Institute

ISO : International Organization for Standardization

NLGI : National Lubricating Grease Institute

ASTM : American Society of Testing and Material

DEF : Diesel Exhaust Fluid

DEF compatible with AdBlue®

[★] Recommended oil list

- Gear oil with limited-slip additive

- Viscosity grades: SAE 75W-90/75W-110/
75W-140 /80W-90/85W-90

- Universal axle and transmission oil

- Premium universal axle and transmission oil

^{★1} Ultra low sulfur diesel

- sulfur content ≤ 15 ppm

^{★2} Cold region

Russia, CIS, Mongolia

2) RECOMMENDED OILS

HD Hyundai Construction Equipment genuine lubricating oils have been developed to offer the best performance and service life for your equipment. These oils have been tested according to the specifications of HD Hyundai Construction Equipment and, therefore, will meet the highest safety and quality requirements.

We recommend that you use only HD Hyundai Construction Equipment genuine lubricating oils and grease officially approved by HD Hyundai Construction Equipment.

※ Using any lubricating oils other than HD Hyundai Construction Equipment genuine products may lead to a deterioration of performance and cause damage to major components.

※ Do not mix HD Hyundai Construction Equipment genuine oil with any other lubricating oil as it may result in damage to the systems of major components.

※ Do not use any engine oil other than that specified above, as it may clog the diesel particulate filter(DPF).

※ For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

| Service point | Kind of fluid | Capacity ℓ (U.S. gal) | Ambient temperature °C(°F) | | | | | | | | | |
|------------------------------|---|--|--|---|-------------|-------------|-----------|----------------|------------|------------|-------------|--|
| | | | -50 (-58) | -30 (-22) | -20 (-4) | -10 (14) | 0 (32) | 10 (50) | 20 (68) | 30 (86) | 40 (104) | |
| Engine oil pan | Engine oil | 23 (6.1) | | | | | | | | | | |
| | | | | | SAE 15W-40 | | | | | | | |
| | | | | | *2SAE 5W-40 | | | | | | | |
| | | | | SAE 0W-40 | | | | | | | | |
| DEF/ AdBlue® tank | Mixture of urea and deionized water | 44.5 (11.8) | | | | | | | | | | |
| | | | ISO 22241, High-purity urea + deionized water (32.5 : 67.5) | | | | | | | | | |
| | | | | | | | | | | | | |
| Transmission | Engine oil | 53 (14) | | SAE 10W-30 | | | | | | | | |
| | | | | SAE 15W-40 | | | | | | | | |
| | | | | | | | | | | | | |
| Axle ★ ⁴ | UTTO | FR : 42 (11.1) RR : 42 (11.1) | ★Refer to below list | | | | | | | | | |
| Hydraulic tank | Hydraulic oil | Tank: 152 (40.2) System: 276 (72.9) | | ★ ² ISO VG 15 | | | | | | | | |
| | | | | ISO VG 46, HBHO VG 46★ ⁵ | | | | | | | | |
| | | | | ISO VG 68 | | | | | | | | |
| | | | | | | | | | | | | |
| Fuel tank | Diesel fuel★ ¹ | 365 (96.4) | ★ ² ASTM D975 NO.1 | | | | | | | | | |
| | | | | | | | | ASTM D975 NO.2 | | | | |
| Fitting (grease nipple) | Grease | As required | ★ ² NLGI NO.1 | | | | | | | | | |
| | | | | | | | | | NLGI NO.2 | | | |
| Radiator (reservoir tank) | Mixture of antifreeze and soft water★ ³ | 47 (12.4) | | Ethylene glycol base permanent type (50 : 50) | | | | | | | | |
| | | | ★ ² Ethylene glycol base permanent type (60 : 40) | | | | | | | | | |
| | | | | | | | | | | | | |

SAE : Society of Automotive Engineers

API : American Petroleum Institute

ISO : International Organization for Standardization

NLGI : National Lubricating Grease Institute

ASTM : American Society of Testing and Material

UTTO : Universal Tractor Transmission Oil

DEF : Diesel Exhaust Fluid

DEF compatible with AdBlue®

★¹ Ultra low sulfur diesel

- sulfur content ≤ 15 ppm

★ Recommended oil list

- Gear oil with limited-slip additive

- Viscosity grades: SAE 75W-90/75W-110/
75W-140 /80W-90/85W-90

- Universal axle and transmission oil

- Premium universal axle and transmission oil

★² Cold region : Russia, CIS, Mongolia

★³ Soft water : City water or distilled water

★⁴ If the machine is equipped with axle oil cooler,
refer to the operator's manual.

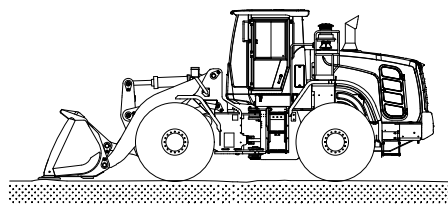
★⁵ HD Hyundai Construction Equipment Bio Hydraulic Oil

GROUP 3 OPERATIONAL CHECKOUT RECORD SHEET

- Owner :
- Date :
- Hours :
- Serial No. :
- Technician :

※ Use this sheet to record operational checkout results.

Perform the operational check before installing any test equipment.



760F1GE02

| Item | OK | NOT OK | Comments |
|------|----|-----------|----------|
|------|----|-----------|----------|

1. Monitor indicator and gauge checks (engine OFF)

- Hourmeter and gauge check ☐ ☐ _____
- Battery check ☐ ☐ _____
- Monitor indicator circuit check ☐ ☐ _____
- Cluster turn signals and warning indicator check ☐ ☐ _____

2. Transmission, axle and engine, neutral start switch and reverse warning alarm switch checks

- Transmission control lever and neutral ☐ ☐ _____
- Neutral start and reverse warning ☐ ☐ _____
- Alarm circuit checks ☐ ☐ _____

3. Monitor indicator and gauge checks (engine running)

- Monitor display and alternator output checks ☐ ☐ _____
- Monitor bypass circuit and seat belt indicator check ☐ ☐ _____
- Monitor primary and secondary level check ☐ ☐ _____
- Transmission oil warm up procedure ☐ ☐ _____
- Transmission temperature gauge check ☐ ☐ _____

4. Brake system and clutch cut off checks

| | | | |
|--|--------------------------|--------------------------|-------|
| · Park brake capacity check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Park brake transmission lockout check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Service brake pump flow check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Service brake capacity check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Brake accumulator precharge check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Brake system leakage check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Service brake pedal check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Service and park brake system drag check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Clutch cut off check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |

5. Driving checks

| | | | |
|--|--------------------------|--------------------------|-------|
| · Transmission oil warm up procedure | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Transmission noise check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Speedometer check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Transmission kick down system check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · 1st, 2nd, 3rd and 4th speed clutch pack drag check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Transmission pressure, pump flow and leakage check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Transmission shift modulation check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Torque converter check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Engine power check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |

6. Hydraulic system checks

| | | | |
|--|--------------------------|--------------------------|-------|
| · Hydraulic system warm up procedure | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Hydraulic pump performance check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Pilot control valve boom float check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Boom down solenoid valve check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Control valve lift check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Bucket rollback circuit relief valve check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Bucket dump circuit relief | | | |
| Low pressure check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| High pressure check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Boom and bucket cylinder drift check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Boom down solenoid valve leakage check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Pilot controller check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Return to dig check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Boom height kickout check-if equipped | <input type="checkbox"/> | <input type="checkbox"/> | _____ |

7. Steering system checks

- | | | | |
|---------------------------------|--------------------------|--------------------------|-------|
| · Steering unit check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Steering system leakage check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Steering valve (EHPS) | | | |
| Low check pressure | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| High check pressure | <input type="checkbox"/> | <input type="checkbox"/> | _____ |

8. Accessory checks

- | | | | |
|---------------------------------------|--------------------------|--------------------------|-------|
| · Operating lights check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Work light check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Brake light check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Cab light check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Horn circuit check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Windshield washer and wiper check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Defroster blower check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Heater/Air conditioner blower check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Heater functional check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Air conditioner functional check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Start aid system check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |

9. Cab components and vandal protection checks

- | | | | |
|------------------------------------|--------------------------|--------------------------|-------|
| · Cab door latch check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Cab door hold open latch check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Cab door release button check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Cab door lock check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Cab door window check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Cab window latch check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Steering column adjustment check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Seat and seat belt check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Air intake filter door check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Engine side panels check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Radiator cap access door check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Frame locking bar check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Boom lock check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |
| · Service decal check | <input type="checkbox"/> | <input type="checkbox"/> | _____ |

SECTION 2 ENGINE

| | | |
|---------|----------------------------------|-----|
| Group 1 | Structure and Function | 2-1 |
| Group 2 | Engine speed and Stall rpm | 2-7 |
| Group 3 | Fuel warmer system | 2-8 |

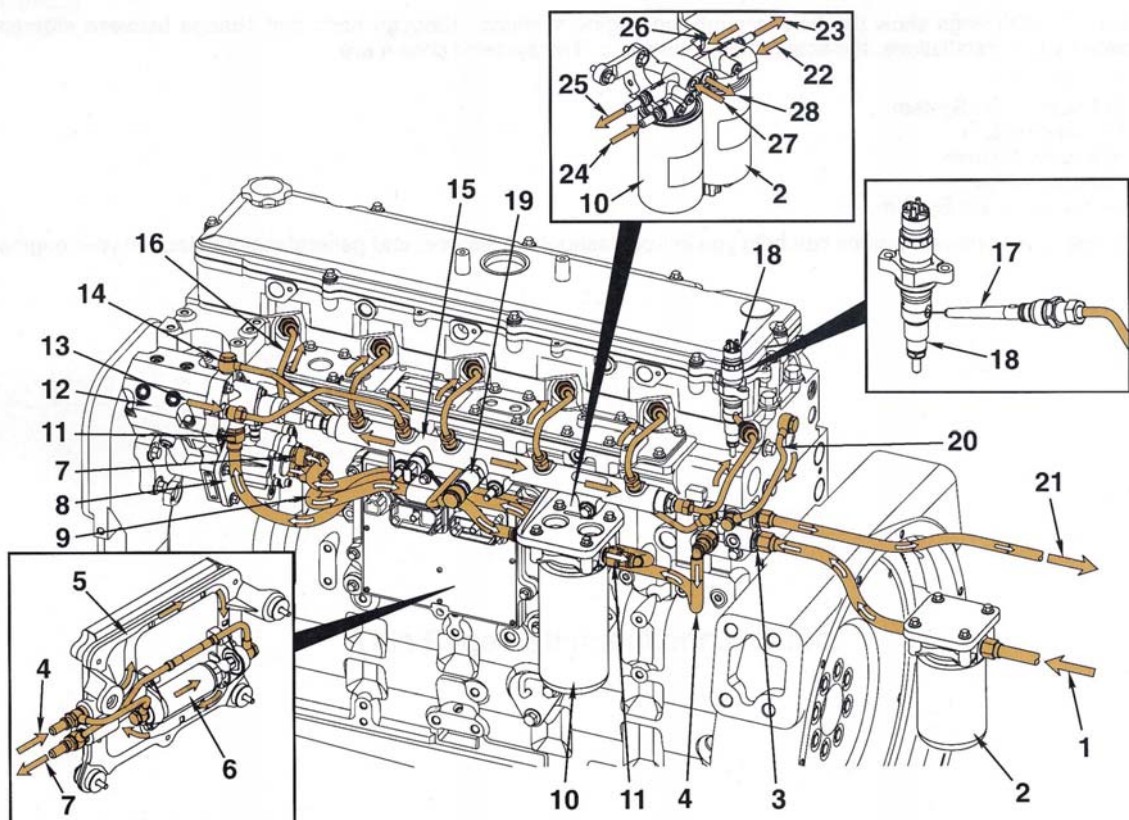
SECTION 2 ENGINE

GROUP 1 STRUCTURE AND FUNCTION

1. SYSTEM DIAGRAMS

The following drawings show the flow through the engine systems.

1) FUEL SYSTEM

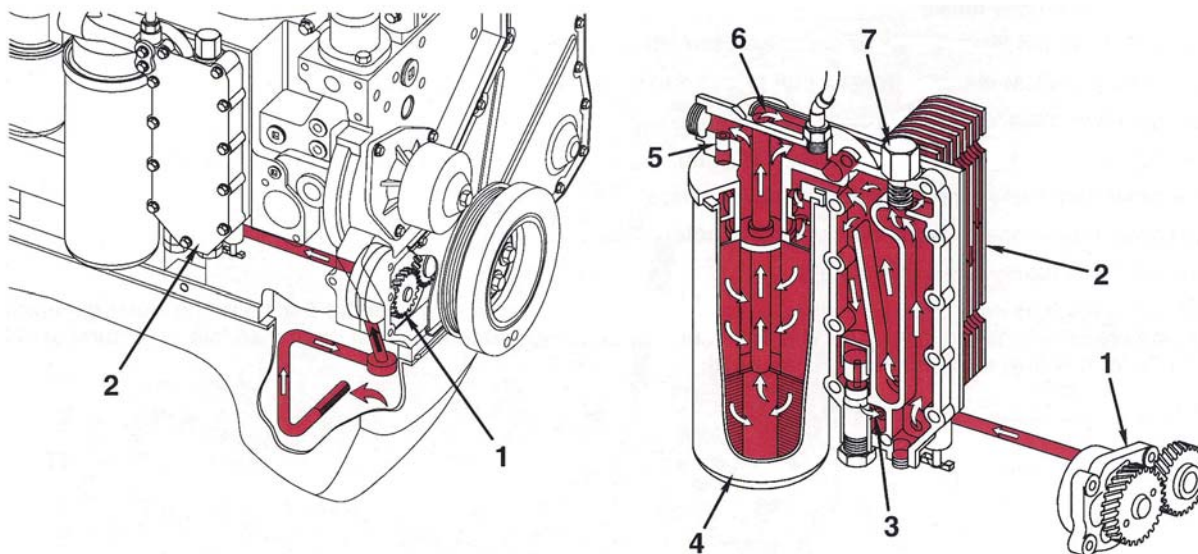


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- | | |
|---|---|
| 1 Fuel from supply tank | 15 Fuel rail |
| 2 Fuel filter and water separator | 16 High-pressure injector supply lines |
| 3 Fuel supply connection | 17 High-pressure fuel connector |
| 4 Fuel supply to ECM mounted fuel lift pump | 18 Fuel injector |
| 5 ECM cooling plate | 19 Fuel pressure relief valve |
| 6 ECM mounted fuel lift pump | 20 Fuel injector drain flow line |
| 7 Fuel outlet from ECM mounted fuel lift pump/fuel to gear pump | 21 Fuel return to supply tanks |
| 8 Fuel gear pump | 22 Fuel supply to fuel filter and water separator |
| 9 Fuel from gear pump to fuel filter | 23 Fuel supply to ECM mounted fuel lift pump |
| 10 Pressure-side fuel filter | 24 Fuel supply to pressure-side fuel filter |
| 11 Fuel to fuel pump actuator | 25 Fuel supply to high-pressure fuel pump |
| 12 High-pressure fuel pump | 26 Fuel drain from fuel rail and injector drains |
| 13 Fuel outlet from high-pressure pump | 27 Fuel drain from high-pressure fuel pump |
| 14 High-pressure pump drain flow connection | 28 Fuel return to supply tanks |

2) LUBRICATING OIL SYSTEM

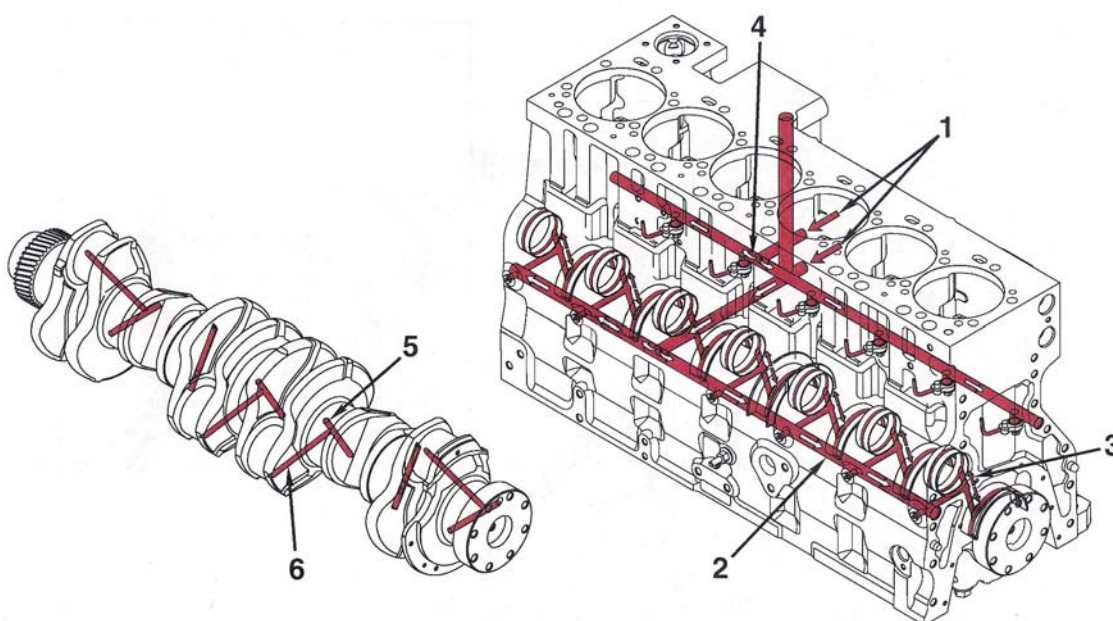
(1) Lubricating oil cooler flow



7709A2EG03

- | | |
|-------------------------------------|---|
| 1 Gerotor lubricating oil pump | 5 Filter bypass valve |
| 2 Lubricating oil cooler | 6 From lubricating oil filter to main oil rifle |
| 3 Bypass oil to lubricating oil pan | 7 Oil thermostat |
| 4 Full flow lubricating oil filter | |

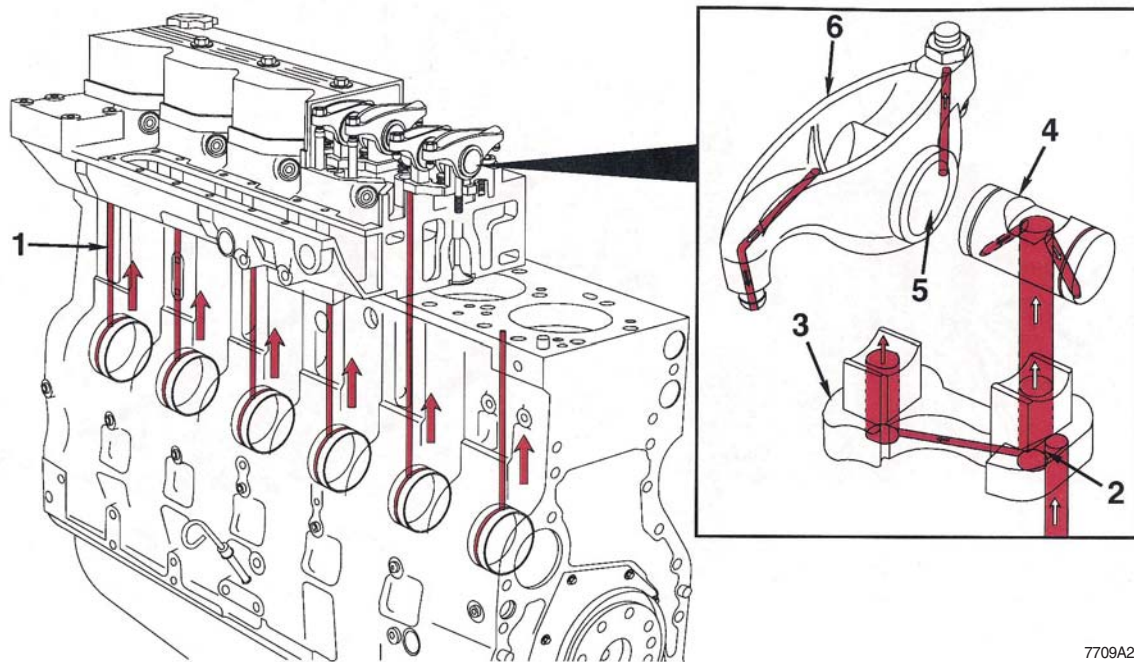
(2) Lubrication for power components



7709A2EG04

- | | |
|-------------------------------|-----------------------------------|
| 1 From lubricating oil filter | 4 To piston cooling nozzle |
| 2 Main lubricating oil rifle | 5 From main lubricating oil rifle |
| 3 To camshaft | 6 To connecting rod bearing |

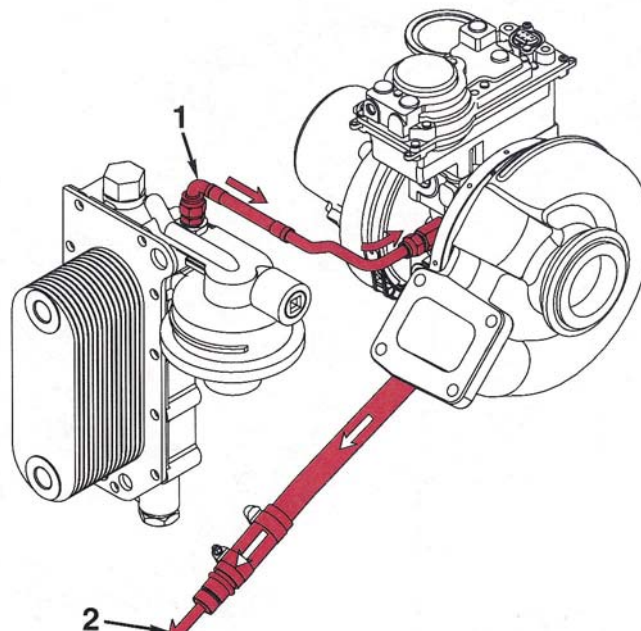
(3) Lubrication for the overhead



7709A2EG05

- | | | | |
|---|----------------------|---|--------------------|
| 1 | From cam bushings | 4 | Rocker lever shaft |
| 2 | Transfer slot | 5 | Rocker lever bore |
| 3 | Rocker lever support | 6 | Rocker lever |

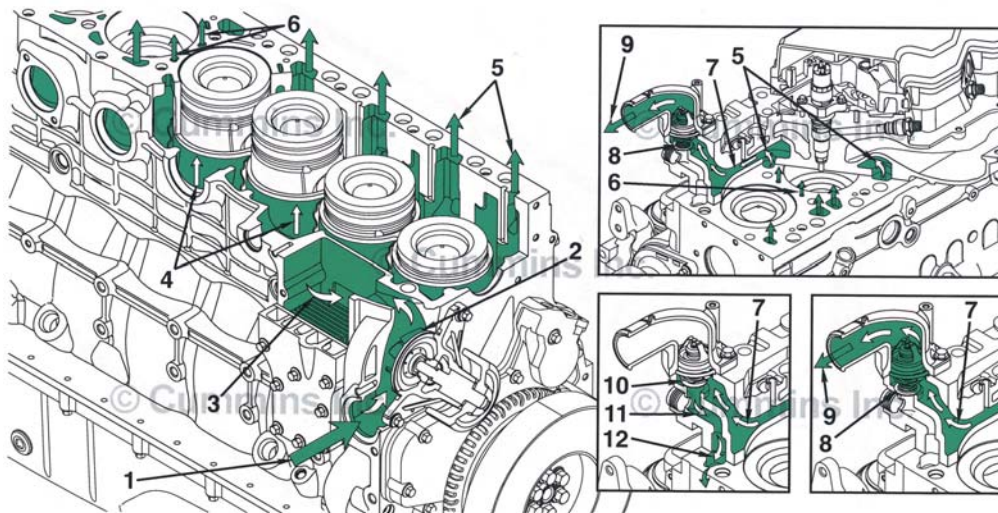
(4) Turbocharger oil flow



7709A2EG06

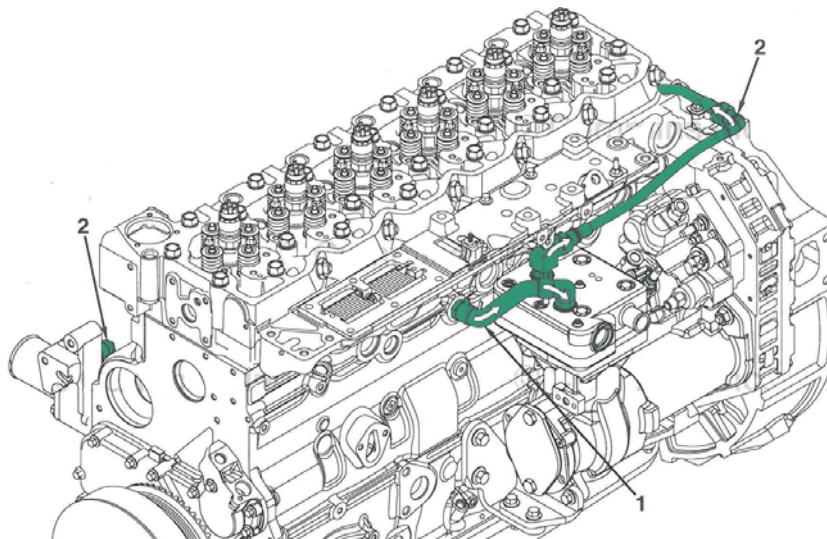
- | | | | |
|---|--|---|--|
| 1 | Turbocharger oil supply from oil filter head | 2 | Turbocharger oil drain to cylinder block |
|---|--|---|--|

3) COOLING SYSTEM



7609A2EG16

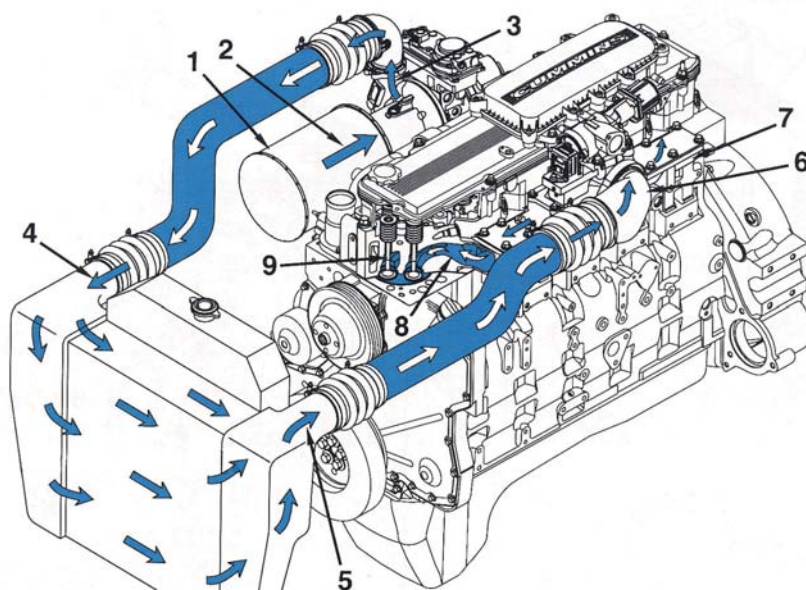
- | | | | |
|---|---|----|---|
| 1 | Coolant inlet from radiator and aftertreatment diesel exhaust fluid (DEF) dosing valve and DEF tank | 7 | Coolant flow to thermostat housing |
| 2 | Water pump Impeller | 8 | Thermostat open - bypass passage closed |
| 3 | Coolant flow past lubricating oil cooler | 9 | Coolant flow back to radiator |
| 4 | Coolant flow past cylinders | 10 | Thermostat closed - bypass passage open |
| 5 | Coolant flow from cylinder block to cylinder head | 11 | Coolant bypass passage in cylinder head |
| 6 | Coolant flow between cylinders | 12 | Coolant flow to water pump inlet |



760F2EG17

- | | |
|---|---|
| 1 | Air compressor coolant supply line |
| 2 | Air compressor coolant return to coolant inlet connection |

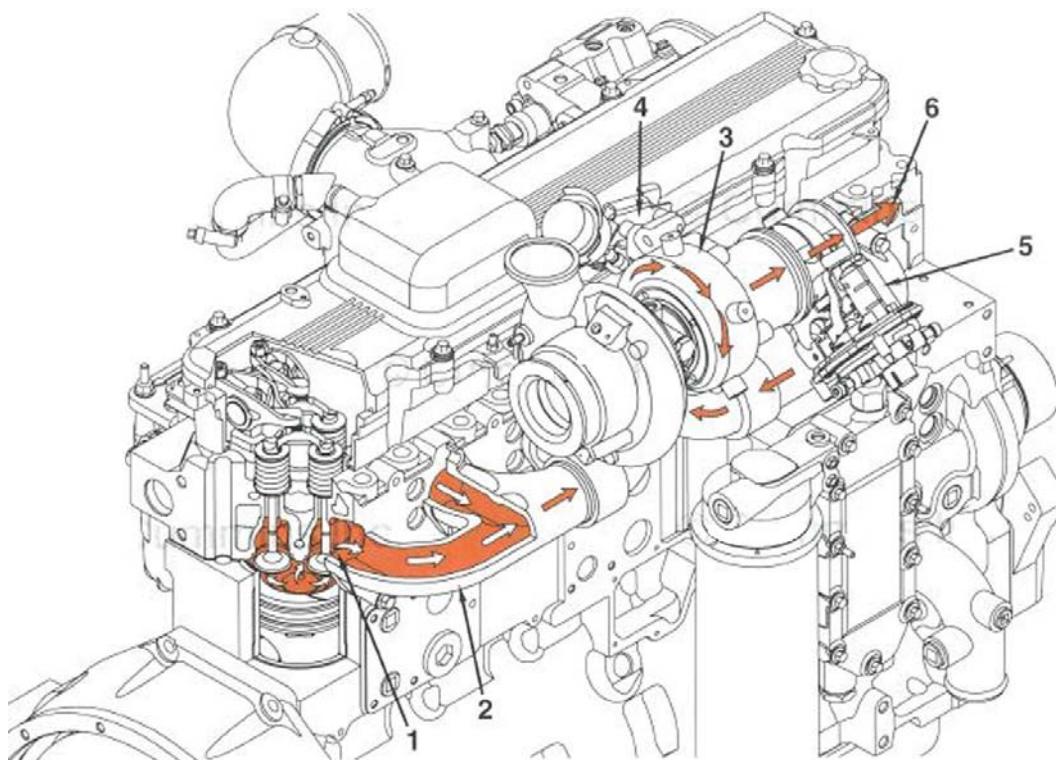
4) AIR INTAKE SYSTEM



7709A2EG11

- | | | | |
|---|--------------------------------|---|---|
| 1 | Air cleaner | 6 | Air intake connection |
| 2 | Turbocharger compressor inlet | 7 | Intake manifold (Integral part of the cylinder head) |
| 3 | Turbocharger compressor outlet | 8 | Intake port |
| 4 | Charge air cooler inlet | 9 | Intake valve |
| 5 | Charge air cooler outlet | | |

5) EXHAUST SYSTEM



970A2EG08

- | | |
|------------------------|---|
| 1 Exhaust valve port | 4 Wastegate valve assembly |
| 2 Exhaust manifold | 5 Exhaust pressure regulator |
| 3 Turbocharger turbine | 6 Exhaust gas flow to aftertreatment system |

GROUP 2 ENGINE SPEED & STALL RPM

1. TEST CONDITION

1) Normal temperature of the whole system

- Coolant : Approx 80°C (176°F) - Hydraulic oil : 45 ± 5°C (113 ± 10°F)
- Transmission oil : 75 ± 5°C (167 ± 10°F)

2) Normal operating pressure : See page 6-57.

2. SPECIFICATION

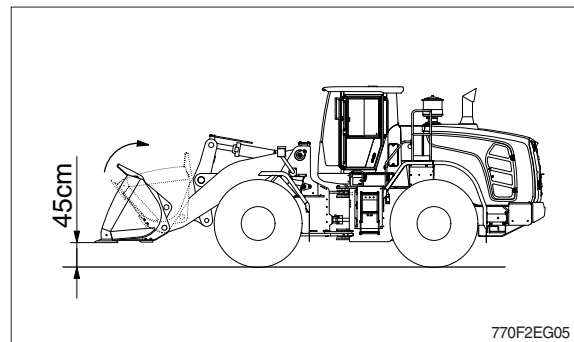
| Engine speed, rpm (P mode) | | | | | | Remark |
|----------------------------|-----------|------------|--|--|-----------|--------|
| Low idle | High idle | Pump stall | Converter stall | Full stall | Fan motor | |
| 800 ± 25 | 2130 ± 50 | 2140 ± 70 | 1850 ± 70 (4-speed) 1830 ± 70 (5-speed) | 1810 ± 70 (4-speed) 1790 ± 70 (5-speed) | 950 ± 50 | |

3. ENGINE RPM CHECK

Remark : If the checked data is not normal, it indicates that the related system is not working properly.
Therefore, it is required to check the related system pressure : See page 6-57.

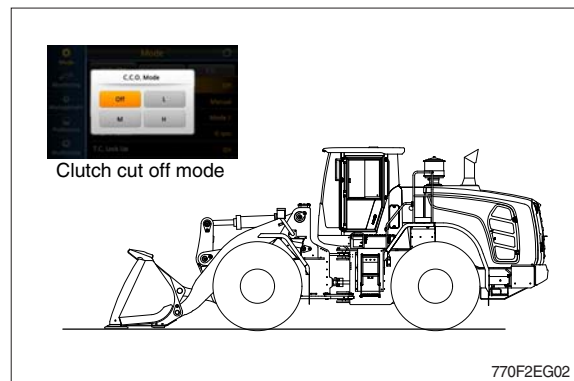
1) Pump stall rpm

- Start the engine and raise the bucket approx 45 cm (1.5 ft) as the figure.
- Press the accelerator pedal fully and operate the bucket control lever to the retract position fully.
- Check the engine rpm at the above condition.



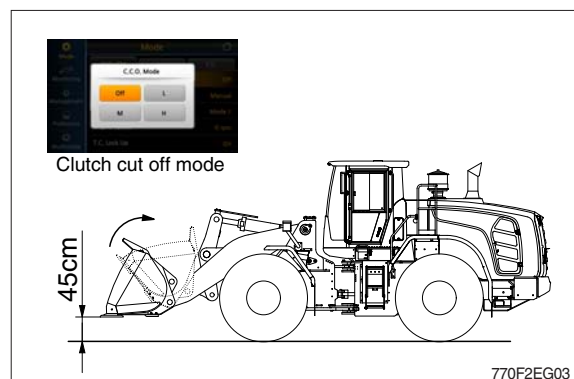
2) Converter stall rpm

- Start the engine and lower the bucket on the ground as the figure.
- Set the clutch cut off mode at the OFF position.
- Press the brake pedal and accelerator pedal fully.
- Shift the transmission lever to the 4th forward position.
- Check the engine rpm at the above condition.



3) Full stall rpm

- Start the engine and raise the bucket approx 45 cm (1.5 ft) as the figure.
- Set the clutch cut off mode at the OFF position.
- Press the brake pedal and accelerator pedal fully.
- Shift the transmission lever to the 4th forward position and operate the bucket lever to the retract position fully.
- Check the engine rpm at the above condition.



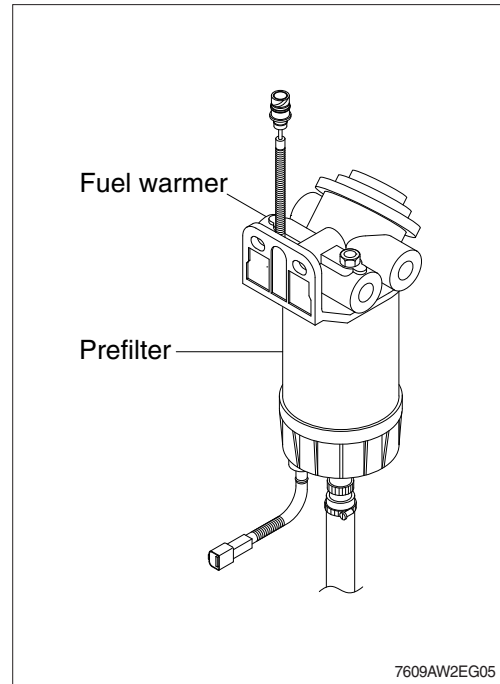
GROUP 3 FUEL WARMER SYSTEM

1. SPECIFICATION

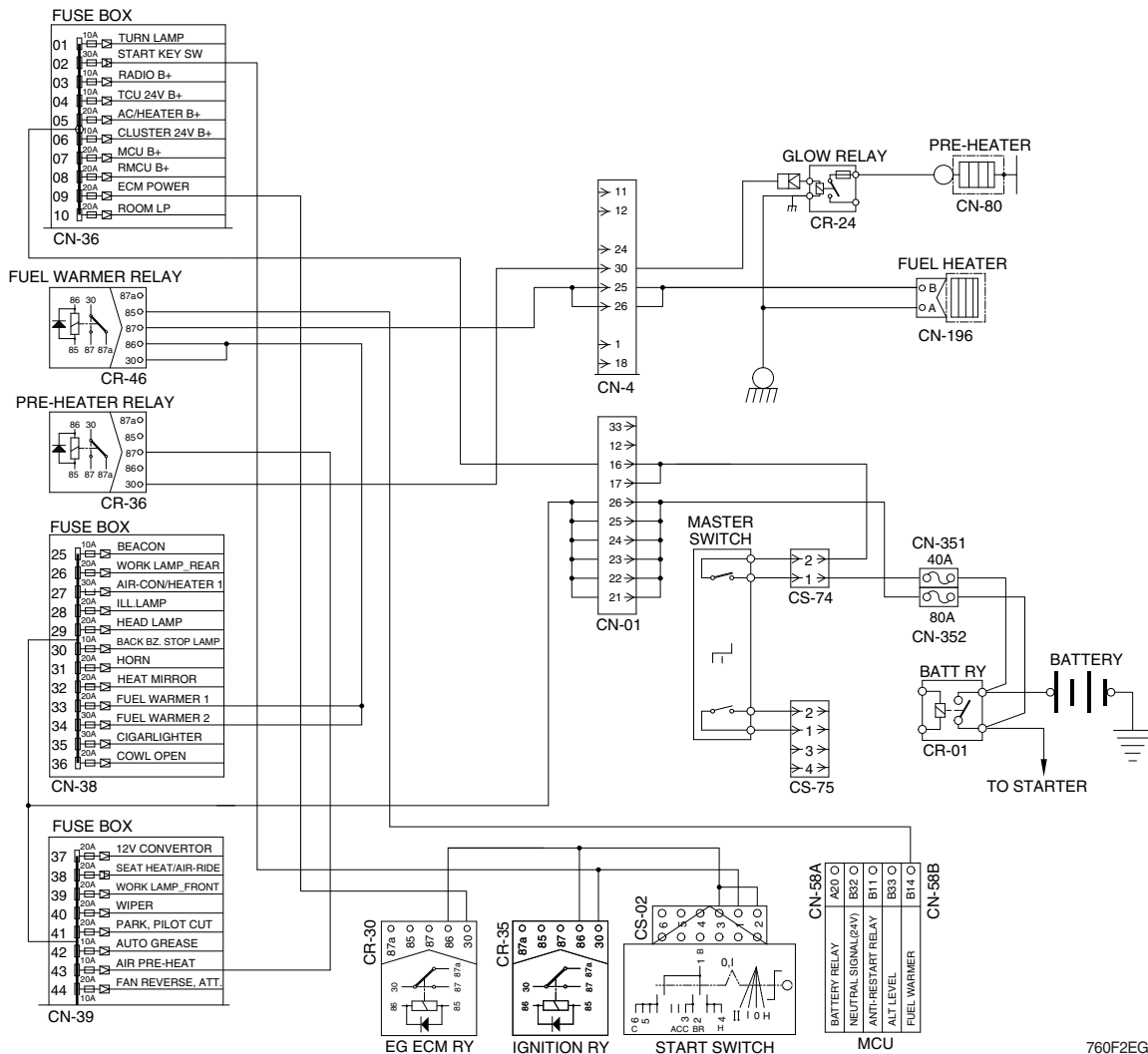
- 1) Operating voltage : $24 \pm 4V$
- 2) Power : $350 \pm 50W$
- 3) Current : 15A

2. OPERATION

- 1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
 - 2) At the first state, the 15A current flows to the fuel warmer and engine may be started in 1~2 minutes.
 - 3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5A.
- So, fuel is protected from overheating by this mechanism.



3. ELECTRIC CIRCUIT



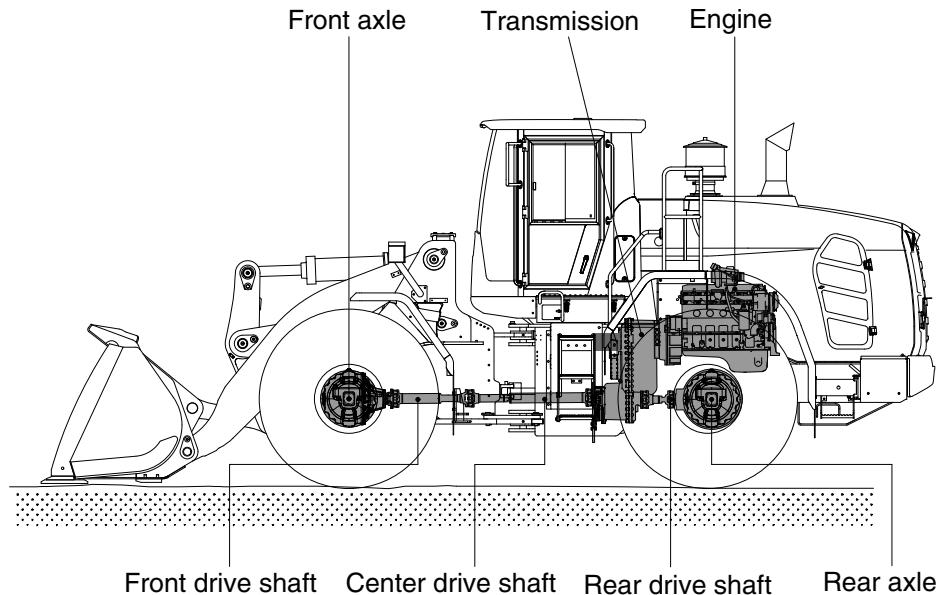
SECTION 3 POWER TRAIN SYSTEM

| | | |
|---------|--|------|
| Group 1 | Structure and Function | 3-1 |
| Group 2 | Operational Checks and Troubleshooting | 3-78 |
| Group 3 | Tests and Adjustments | 3-90 |
| Group 4 | Disassembly and Assembly | 3-92 |

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. POWER TRAIN COMPONENT OVERVIEW



970A3PT01

The power train consists of the following components:

- Transmission
- Front, center and rear drive shafts
- Front and rear axles

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

The transmission is a hydraulically engaged four speed forward, three speed reverse countershaft type power shift transmission. A calliper-disc type parking brake is located on the transmission.

The transmission outputs through universal joints to three drive shaft assemblies. The front drive shaft is a telescoping shaft which drives the front axle. The front axle is mounted directly to the loader frame. The front axle is equipped with conventional differential as standard (option : Limited slip, Hyd lock differential).

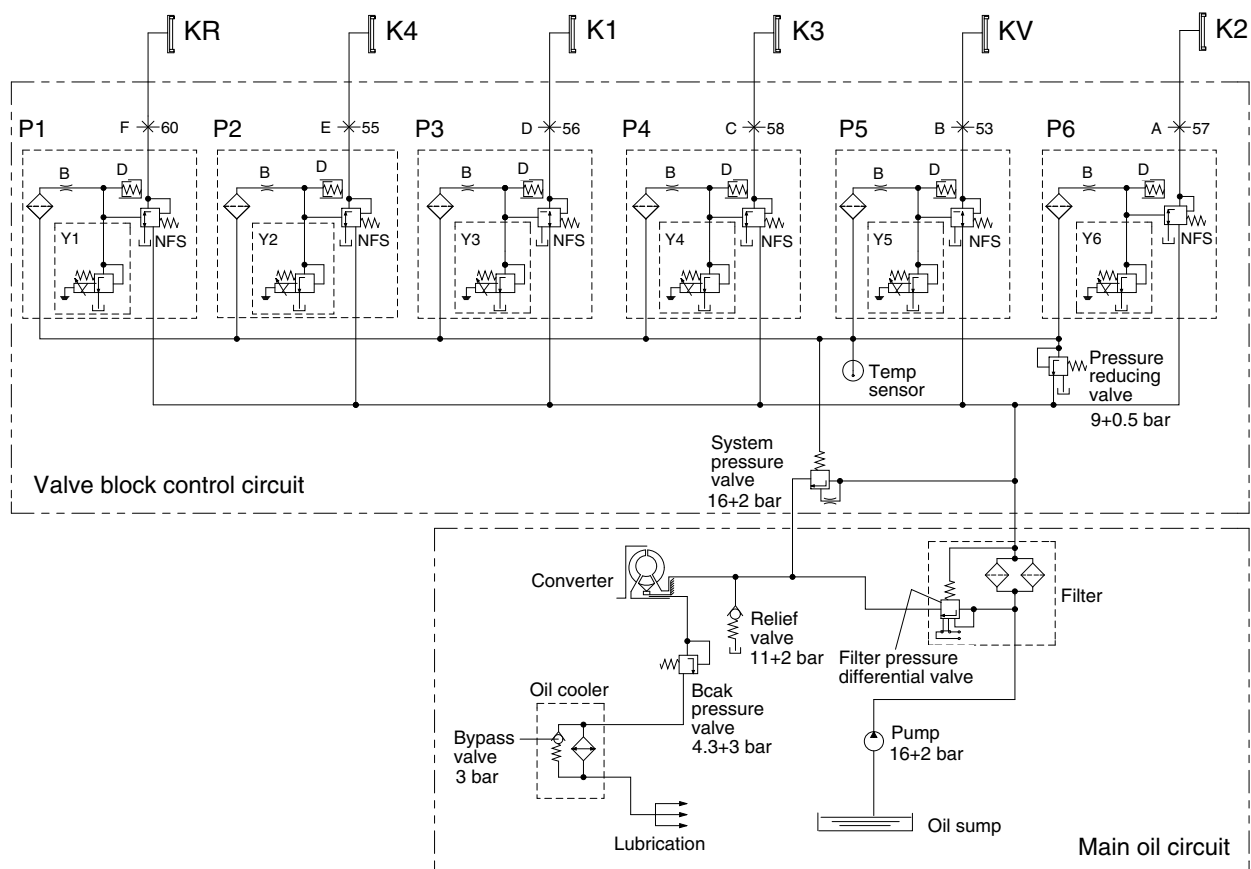
The rear axle is equipped with conventional differential as standard (option : Limited slip differential).

The rear axle is mounted on an oscillating pivot.

The power transmitted to front axle and rear axle is reduced by the pinion gear and ring gear of differential. It then passes from the differential to the sun gear shaft (axle shaft) of final drive.

The power of the sun gear is reduced by a planetary mechanism and is transmitted through the planetary hub to the wheel.

HYDRAULIC CIRCUIT (4-speed transmission)



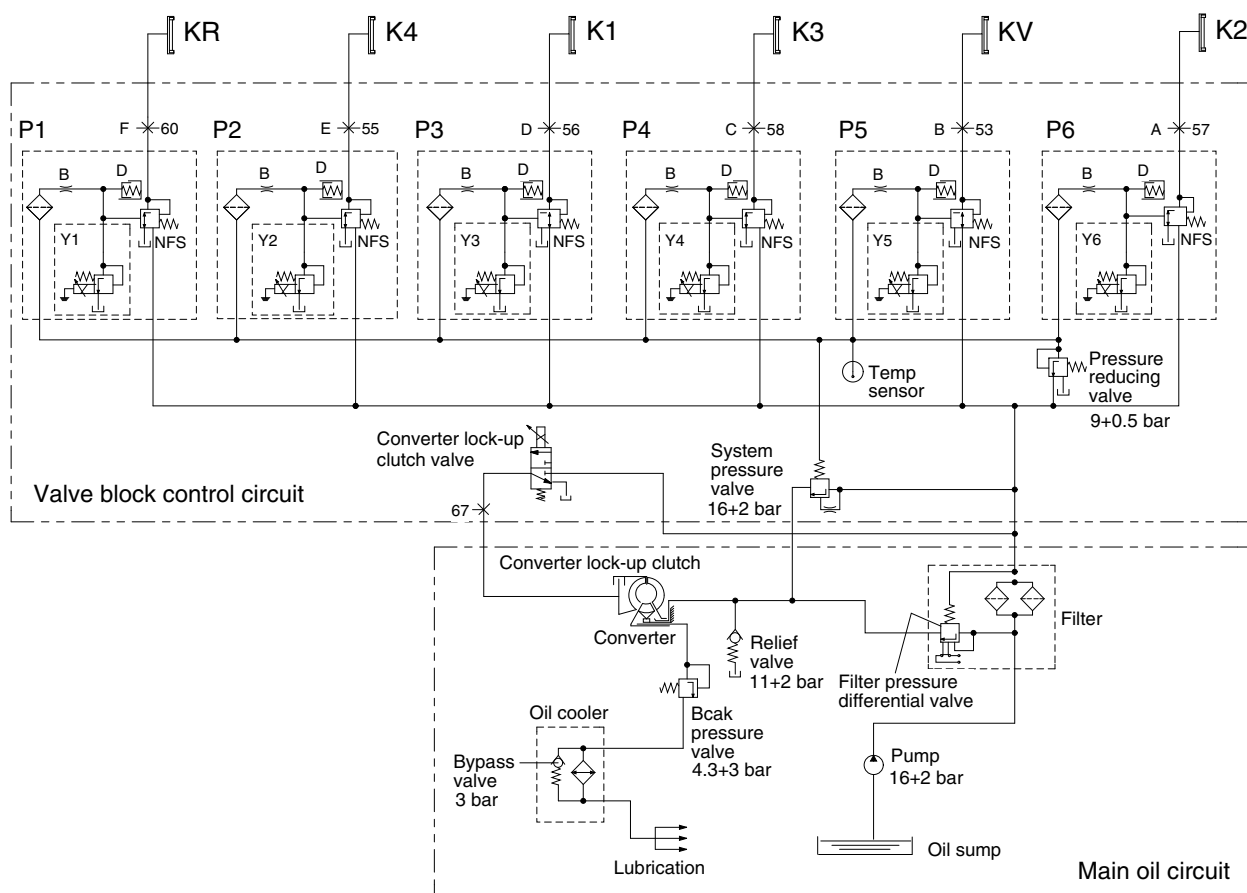
7707APT09

- | | | | |
|-----|------------------------------|-------|--------------------------------------|
| NFS | Follow-on slide | P3 | Proportional valve clutch K1 |
| D | Oscillation damper | P4 | Proportional valve clutch K3 |
| B | Orifice | P5 | Proportional valve clutch KV |
| P1 | Proportional valve clutch KR | P6 | Proportional valve clutch K2 |
| P2 | Proportional valve clutch K4 | Y1~Y6 | Pressure regulator valve with filter |

| Speed | Forward | | | | Reverse | | | Neutral | Engaged clutch | Positions on the valve block | Current No. of the measuring points |
|----------------|---------|-------|-------|-------|---------|-------|--------|---------|----------------|------------------------------|-------------------------------------|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | | | | |
| Y1 | | | | | X | X | X | | KR | F | 55 |
| Y2 | | | | X | | | | | K4 | E | 60 |
| Y3 | X | | | | X | | | | K1 | D | 56 |
| Y4 | | | X | X | | | X | | K3 | C | 58 |
| Y5 | X | X | X | | | | | | KV | B | 53 |
| Y6 | | X | | | | X | | | K2 | A | 57 |
| Engaged clutch | K1,KV | KV,K2 | KV,K3 | K4,K3 | KR,K1 | KR,K2 | KR, K3 | | - | - | - |

X : Pressure regulator under voltage

HYDRAULIC CIRCUIT (5-speed transmission)



7709A3PT09

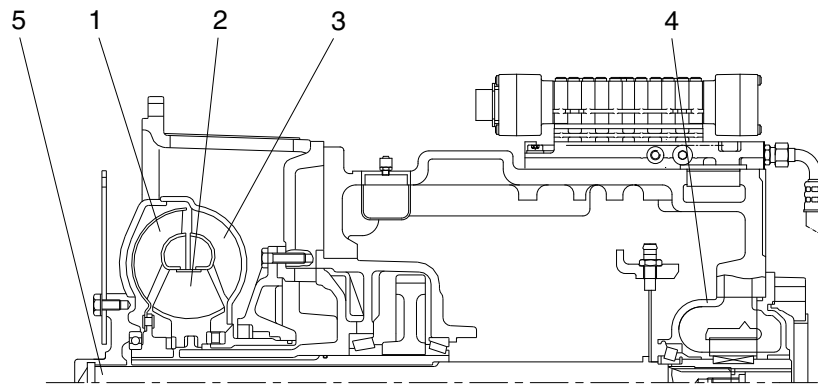
- | | | | |
|-----|------------------------------|-------|--------------------------------|
| NFS | Follow-on slide | P3 | Proportional valve clutch K1 |
| D | Oscillation damper | P4 | Proportional valve clutch K3 |
| B | Orifice | P5 | Proportional valve clutch KV |
| P1 | Proportional valve clutch KR | P6 | Proportional valve clutch K2 |
| P2 | Proportional valve clutch K4 | Y1~Y6 | Pressure regulator with filter |

| Speed | Forward | | | | | Reverse | | | Neutral | Engaged clutch | Positions on the valve block | Current No. of the measuring points |
|----------------|---------|-------|-------|-------|-------|---------|-------|-------|---------|----------------|------------------------------|-------------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | | | | |
| Y1 | | | | | | X | X | X | | KR | F | 55 |
| Y2 | | | X | | X | | | | | K4 | E | 60 |
| Y3 | X | | | | | X | | | | K1 | D | 56 |
| Y4 | | | | X | X | | | X | | K3 | C | 58 |
| Y5 | X | X | | X | | | | | | KV | B | 53 |
| Y6 | | X | X | | | | X | | | K2 | A | 57 |
| Engaged clutch | K1,KV | KV,K2 | K2,K4 | KV,K3 | K3,K4 | KR,K1 | KR,K2 | KR,K3 | | - | - | - |

X : Pressure regulator under voltage

2. TORQUE CONVERTER

1) FUNCTION



7704PT03

- | | | | | | |
|---|---------|---|-------------------|---|-------------|
| 1 | Turbine | 3 | Pump | 5 | Input shaft |
| 2 | Stator | 4 | Transmission pump | | |

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

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

The Torque converter is composed of 3 main components :
Pump wheel - turbine wheel - stator (reaction member)

These 3 impeller wheels are arranged in such a ring-shape system that the fluid is streaming through the circuit components in the indicated order.

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

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

According to the rate of inversion, the turbine wheel and with it also the output shaft, receive a more or less high reaction moment. The stator (reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge direction to the pump wheel.

Due to the inversion, the stator receives a reaction moment.

The relation turbine moment/pump moment is called torque conversion. This is the higher the greater the speed difference of pump wheel and turbine wheel will be.

Therefore, the maximum conversion is created at standing turbine wheel.

With increasing output speed, the torque conversion is decreasing. The adoption of the output speed to a certain required output moment is infinitely variable and automatically achieved by the torque converter.

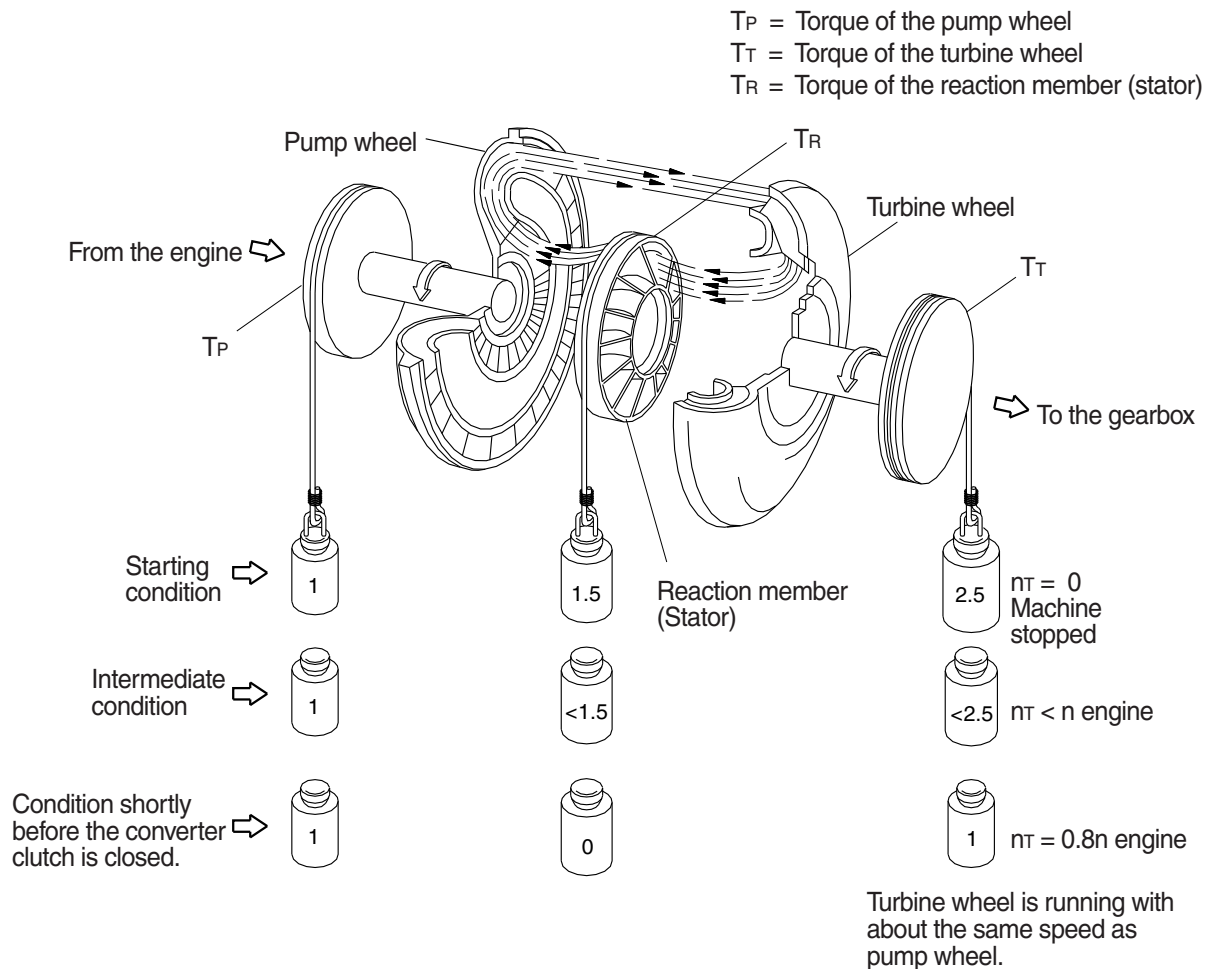
If the turbine speed is reaching about 80% of the pump speed, the conversion becomes 1.0 i.e. the turbine moment becomes equal to that of the pump moment.

From this point on, the converter is working similar to a fluid clutch.

A stator freewheel serves to improve the efficiency in the upper driving range, it is backing up in the conversion range the moment upon the housing, and is released in the coupling range.

In this way, the stator can rotate freely.

Function of a hydrodynamic torque converter (schematic view)



3-4(770-3)

2) CONVERTER LOCK-UP CLUTCH (5-speed transmission)

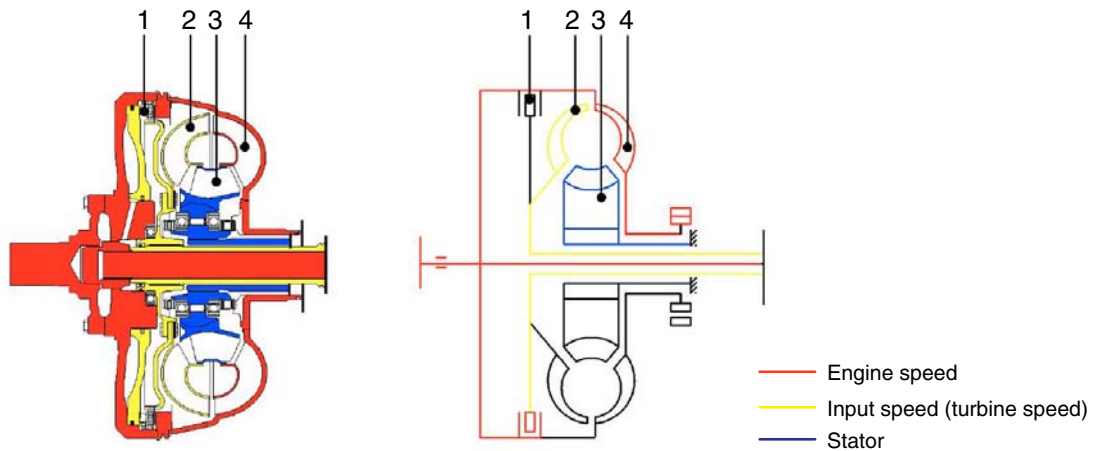


Figure A

7609A3PT22

- 1 Converter lock-up clutch
- 2 Turbine wheel
- 3 Stator
- 4 Circuit cover/pump wheel
- 5 Proportional valve
- 6 Measuring point "Lock-up clutch"
- 7 Cover
- 8 System pressure to lock-up clutch valve
- 9 System pressure from lock-up clutch valve to lock-up clutch

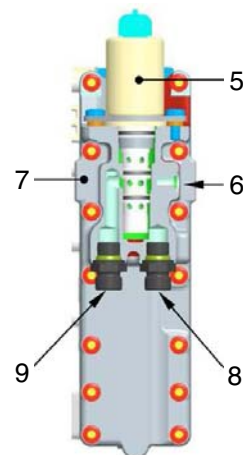


Figure B

7609A3PT23

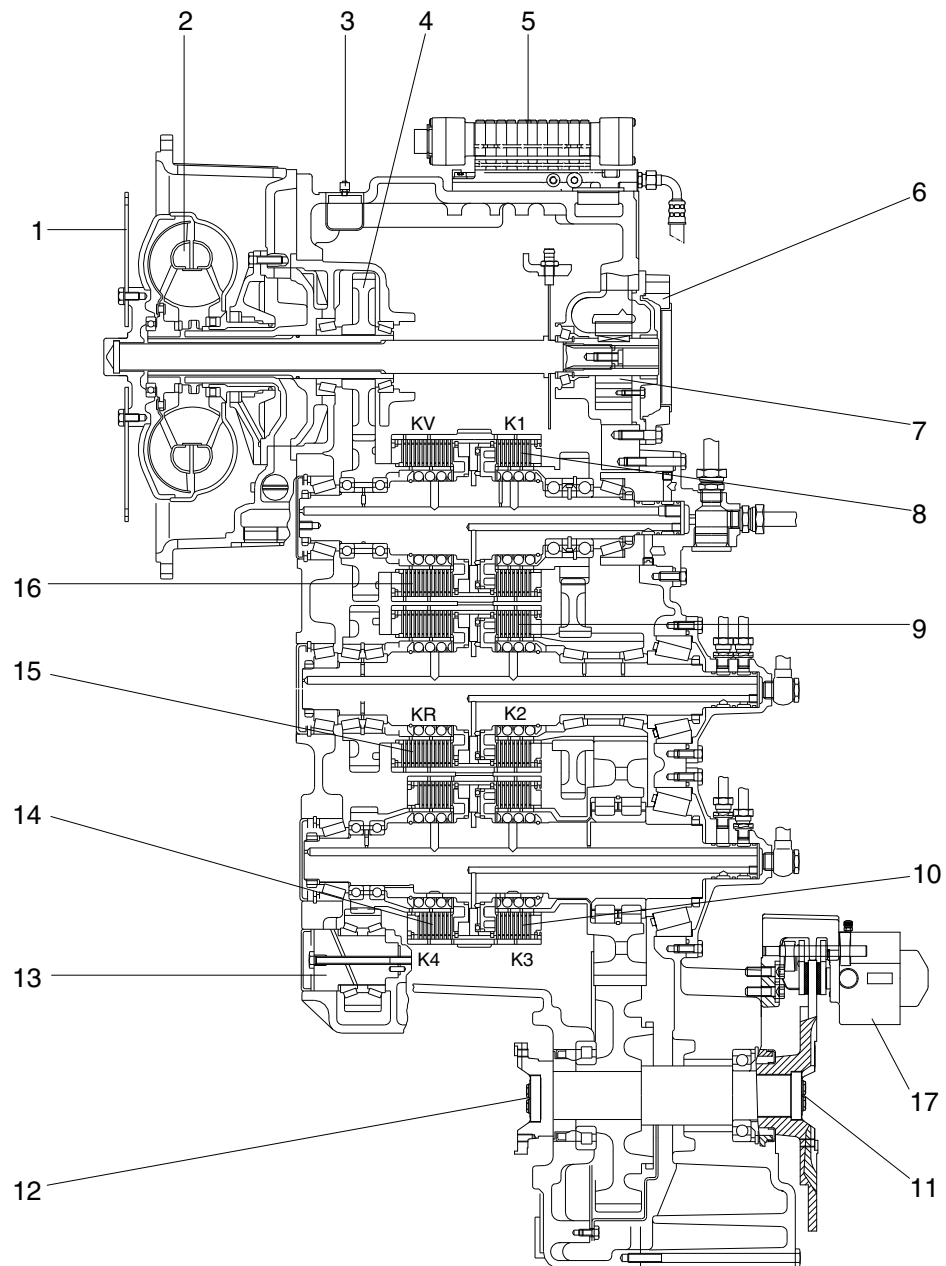
With closed converter lock-up clutch the slip between pump and turbine wheel and consequently the hydraulic loss in the converter is equal to "zero" (see figure A).

According to the turbine speed the converter lock-up clutch is shifted automatically.

Via a proportional valve the pilot pressure is applied to the actuating piston, which compresses the disc set (see figure B, lock-up clutch valve).

3. TRANSMISSION

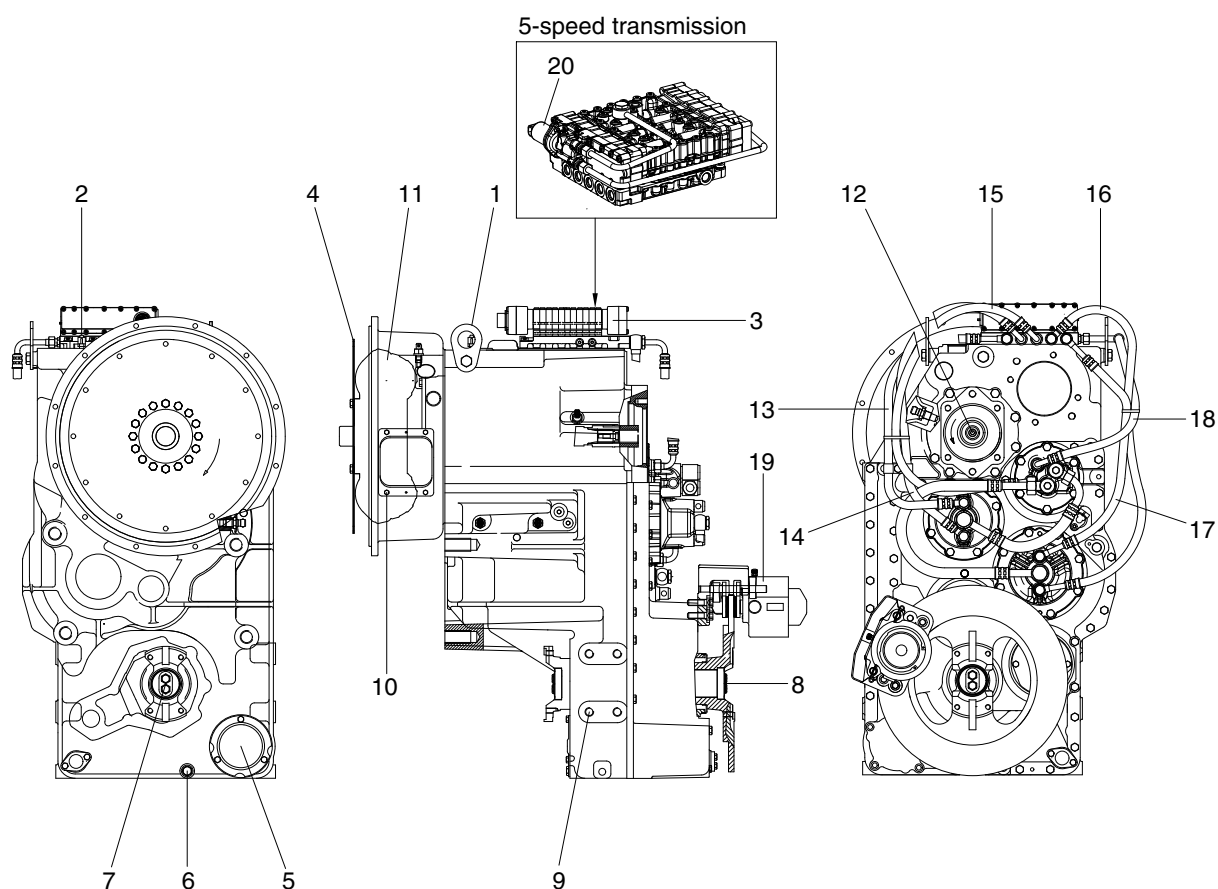
1) LAYOUT



77093PT03

- | | | | | | |
|---|---------------------------------|----|--|----|---------------------|
| 1 | Engine connection | 7 | Converter change and control pressure pump | 12 | Output shaft |
| 2 | Torque converter | 8 | 1st clutch (K1) | 13 | Lay shaft |
| 3 | Breather | 9 | 2nd clutch (K2) | 14 | 4th clutch (K4) |
| 4 | Drive | 10 | 3rd clutch (K3) | 15 | Reverse clutch (KR) |
| 5 | Electro-hydraulic shift control | 11 | Output shaft | 16 | Forward clutch (KV) |
| 6 | 1st power take off | | | 17 | Parking brake |

2) INSTALLATION VIEW



7709A3PT02

- | | | | |
|----|-----------------------------------|----|--|
| 1 | Lifting lugs | 11 | Converter |
| 2 | Breather | 12 | Engine driver |
| 3 | Electro-hydraulic shift control | 13 | Pressure line clutch K2 |
| 4 | Engine connection | 14 | Pressure line clutch KR |
| 5 | Coarse filter | 15 | Pressure line clutch KV |
| 6 | Oil drain plug M22 × 1.5 | 16 | Pressure line clutch K4 |
| 7 | Output-rear axle | 17 | Pressure line clutch K3 |
| 8 | Output-front axle | 18 | Pressure line clutch K1 |
| 9 | Transmission suspension holes M20 | 19 | Parking brake |
| 10 | Mounting holes | 20 | Solenoid valve for converter lock-up clutch (5-speed transmission only) |

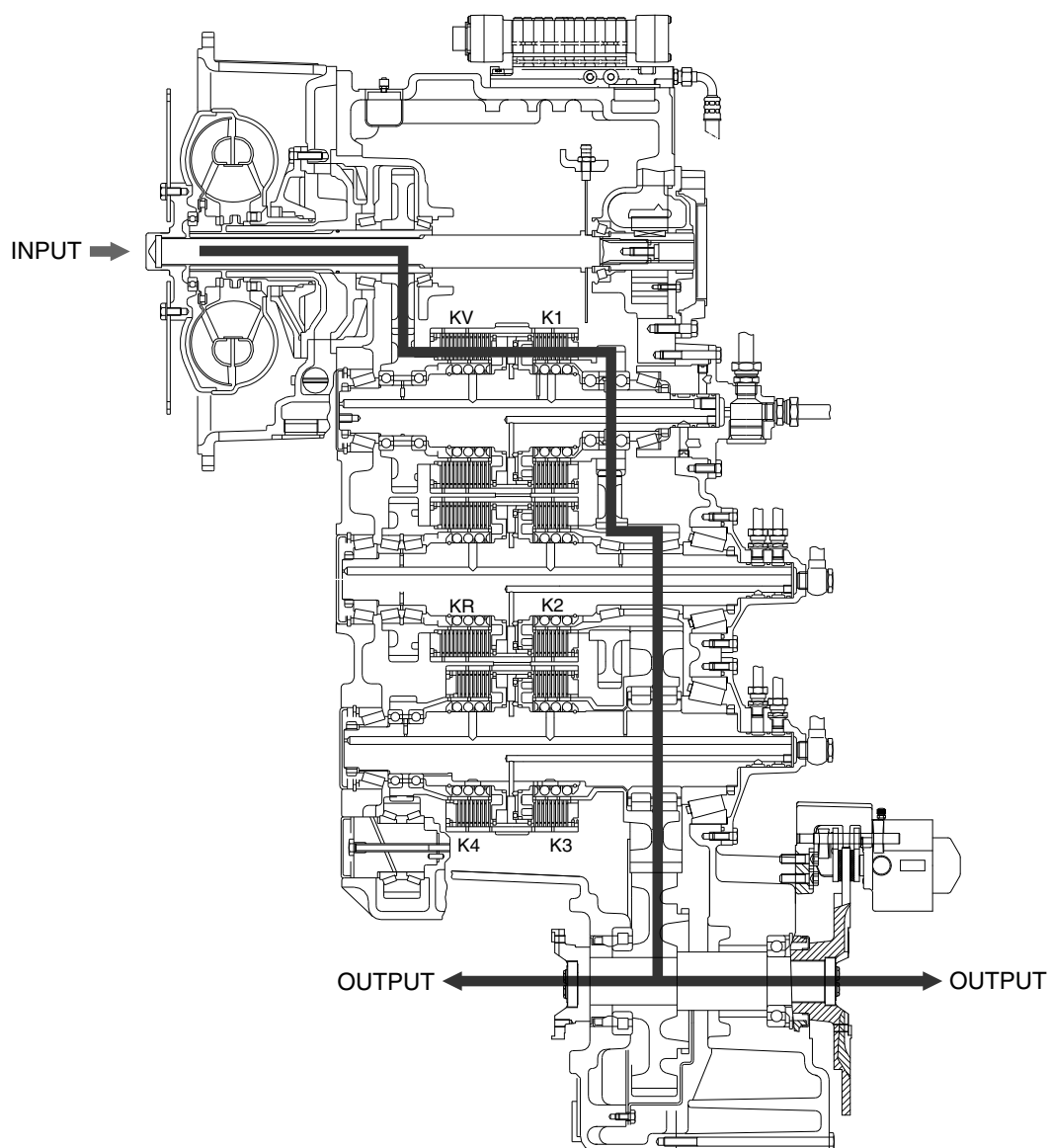
3) OPERATION OF TRANSMISSION (4-speed transmission)

(1) Forward

① Forward 1st

In 1st forward, forward clutch (KV) and 1st clutch (K1) are engaged.

Forward clutch and 1st clutch are actuated by the hydraulic pressure applied to the clutch piston.

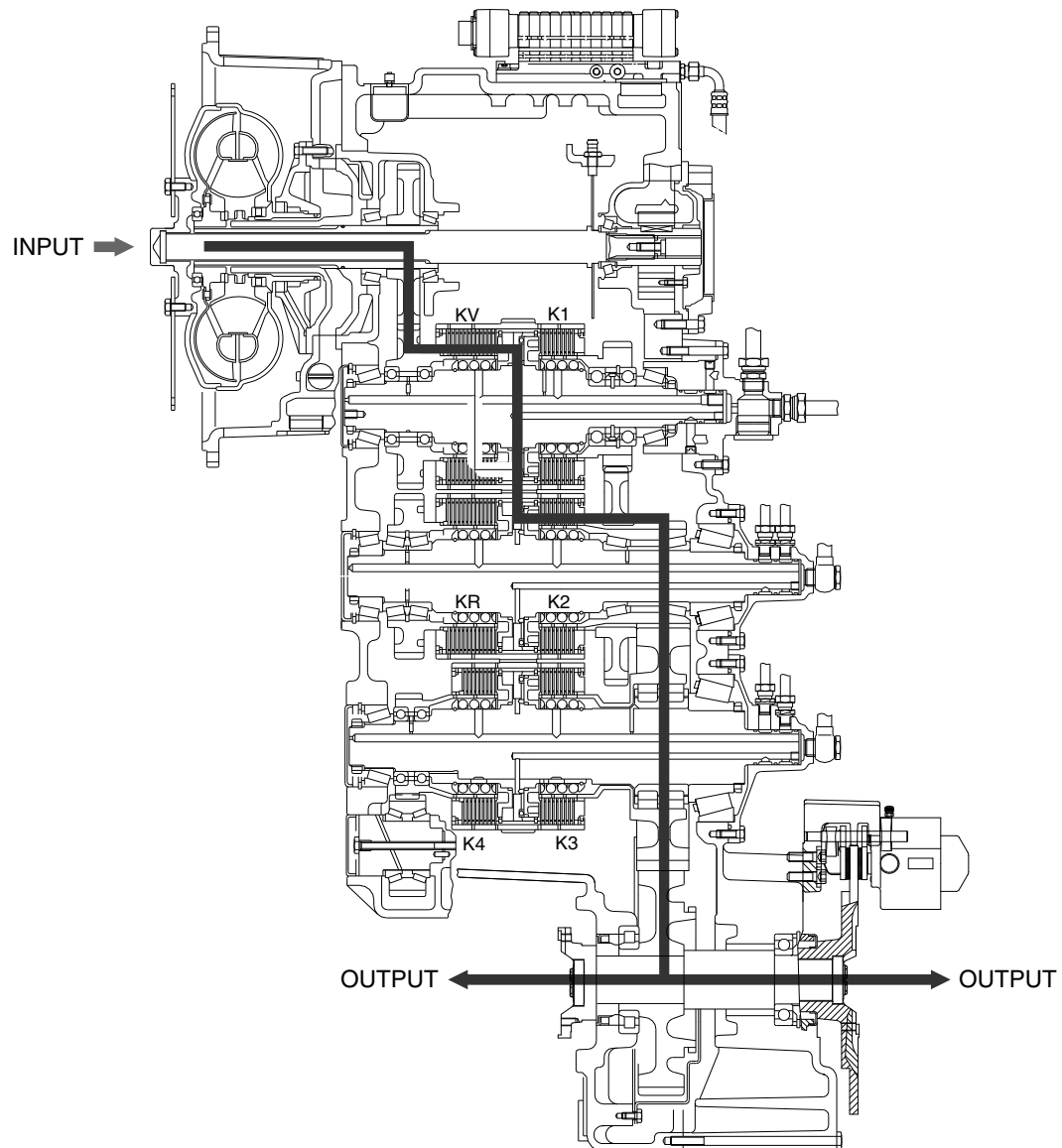


77093PT07

② Forward 2nd

In 2nd forward, forward clutch (KV) and 2nd clutch (K2) are engaged.

Forward clutch and 2nd clutch are actuated by the hydraulic pressure applied to the clutch piston.

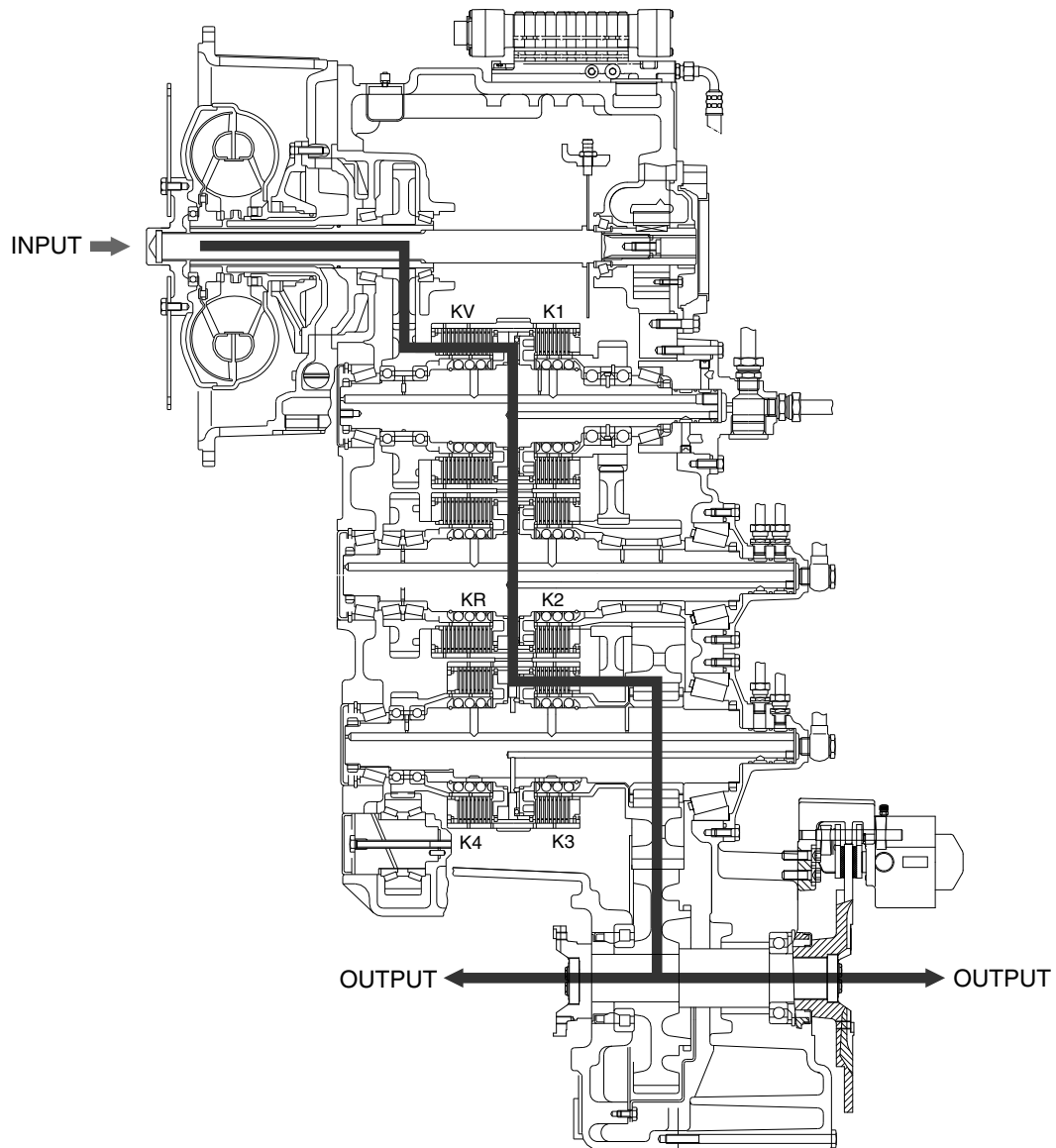


77093PT08

③ Forward 3rd

In 3rd forward, forward clutch (KV) and 3rd clutch (K3) are engage.

Forward clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.

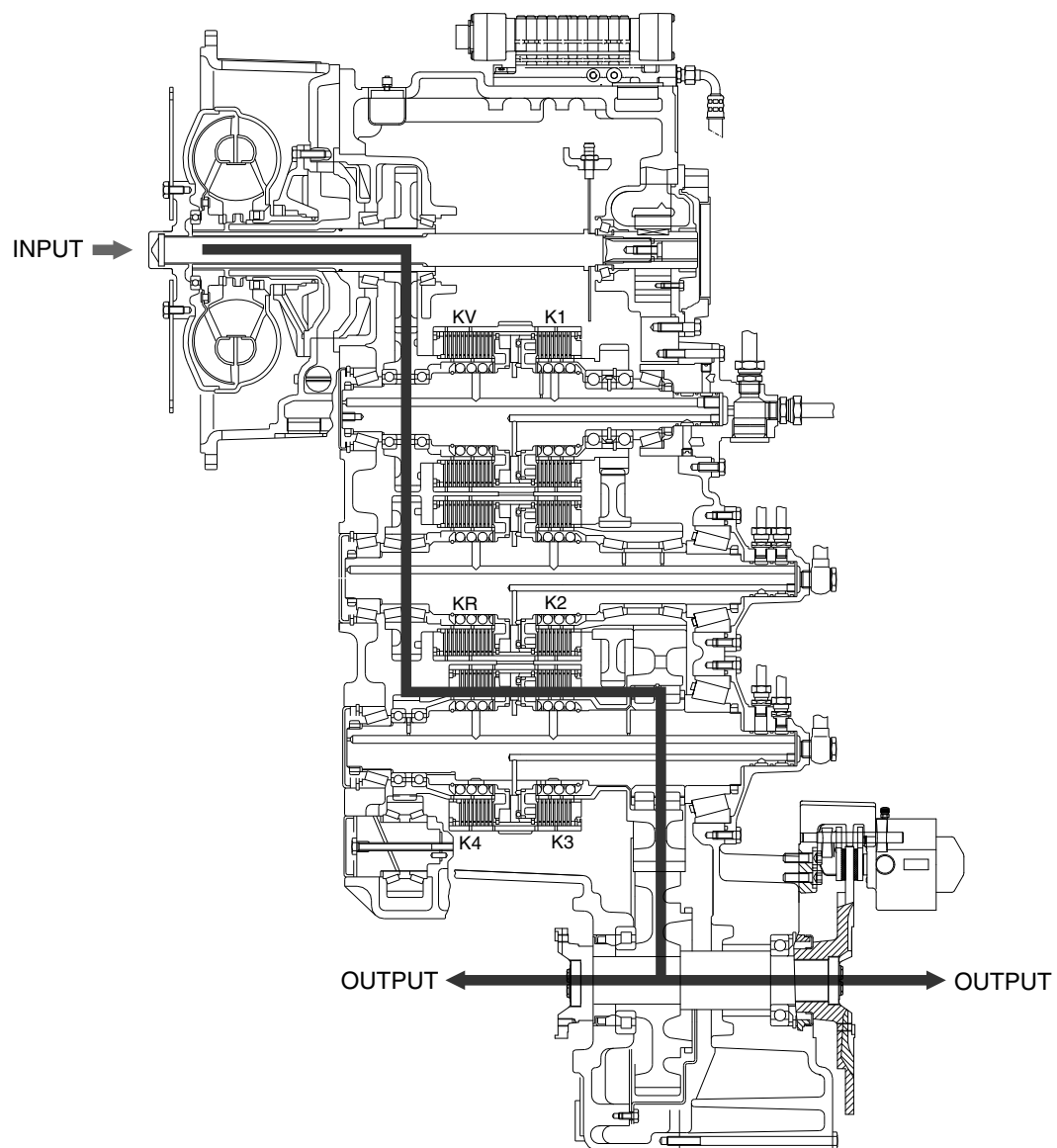


77093PT09

④ Forward 4th

In 4th forward, 4th clutch (K4) and 3rd clutch (K3) are engaged.

4th clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



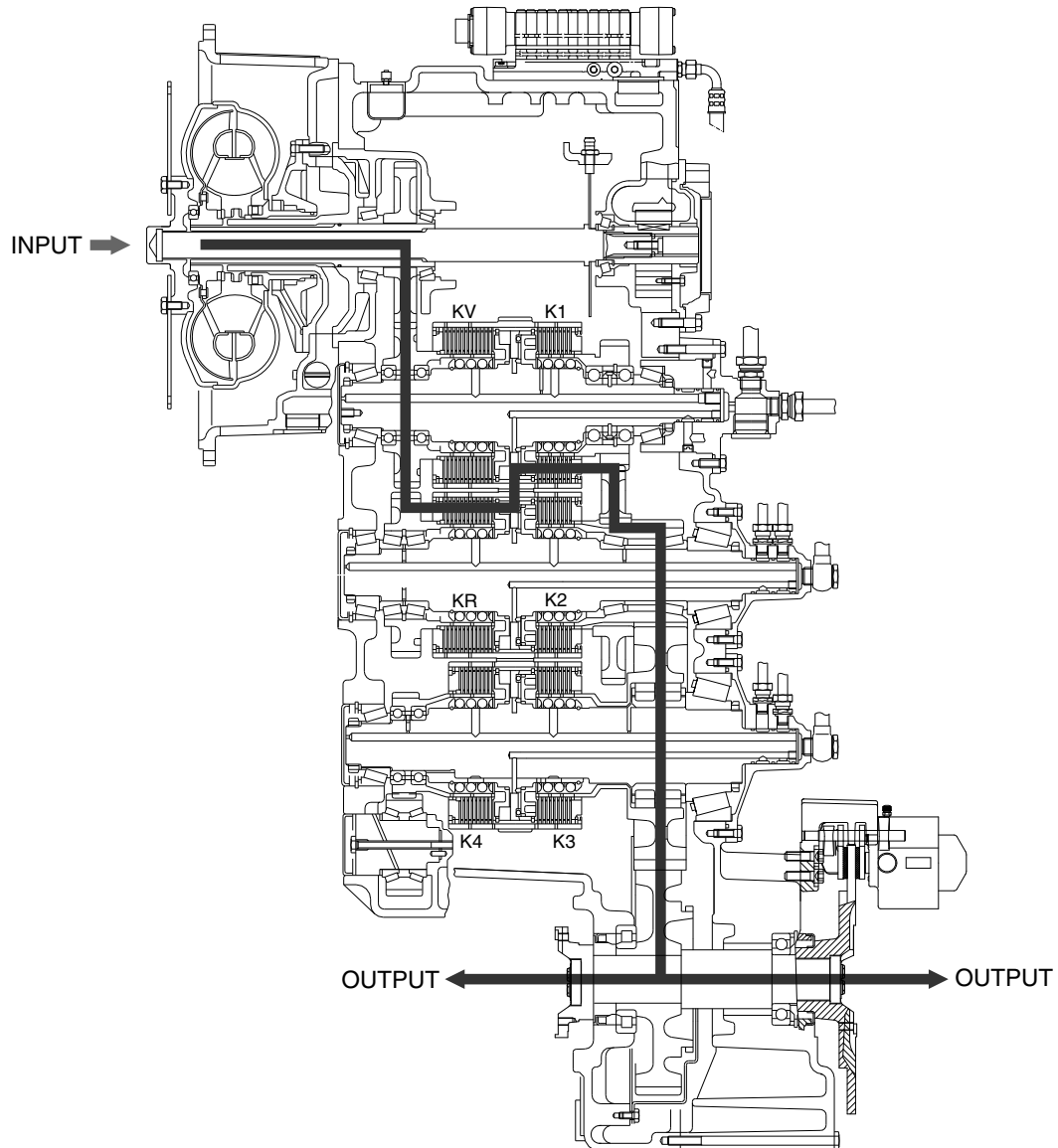
77093PT10

(2) Reverse

① Reverse 1st

In 1st reverse, reverse clutch (KR) and 1st clutch (K1) are engaged.

Reverse clutch and 1st clutch are actuated by the hydraulic pressure applied to the clutch piston.

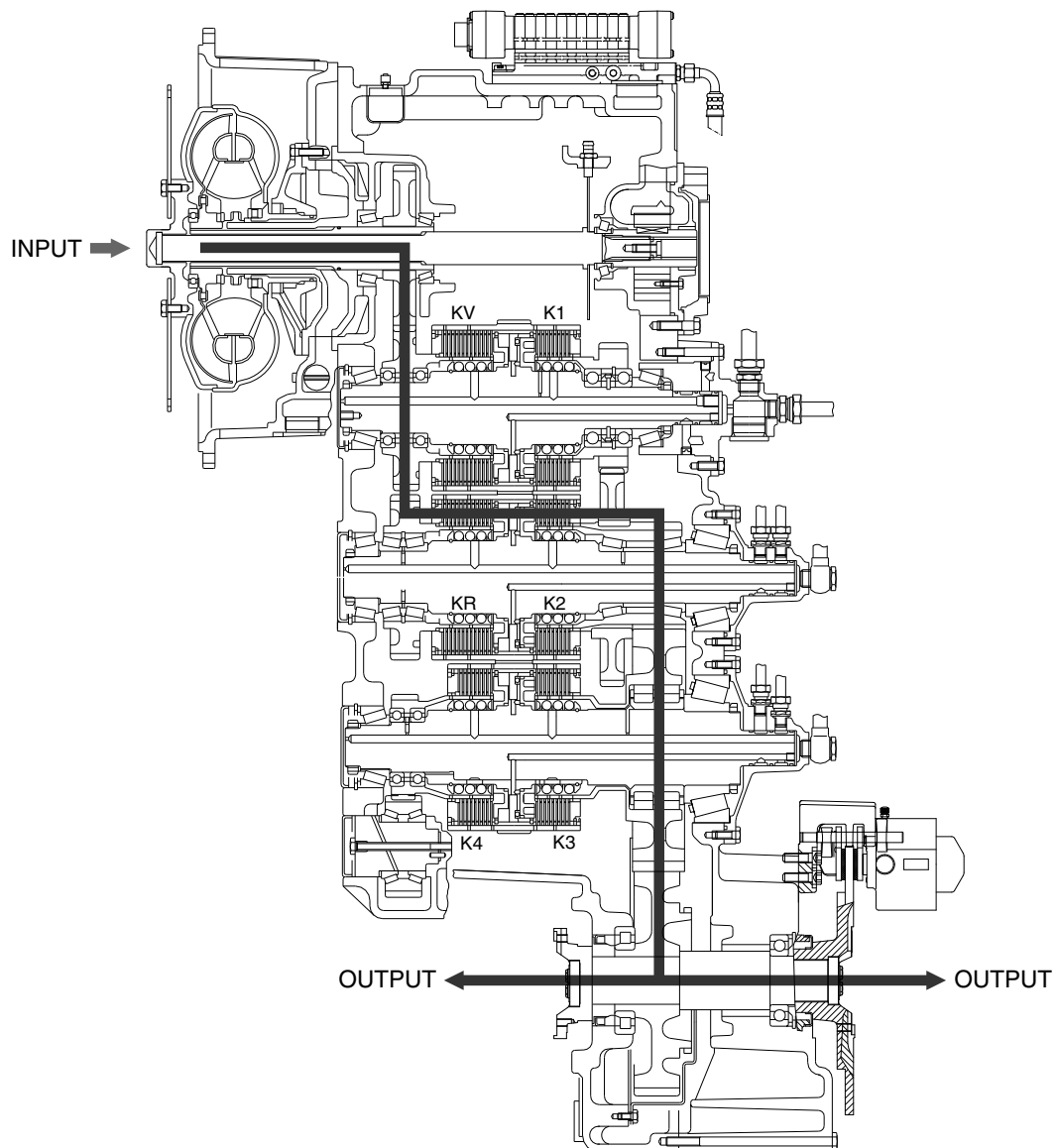


77093PT11

② Reverse 2nd

In 2nd reverse, reverse clutch (KR) and 2nd clutch (K2) are engaged.

Reverse clutch and 2nd clutch are actuated by the hydraulic pressure applied to the clutch piston.

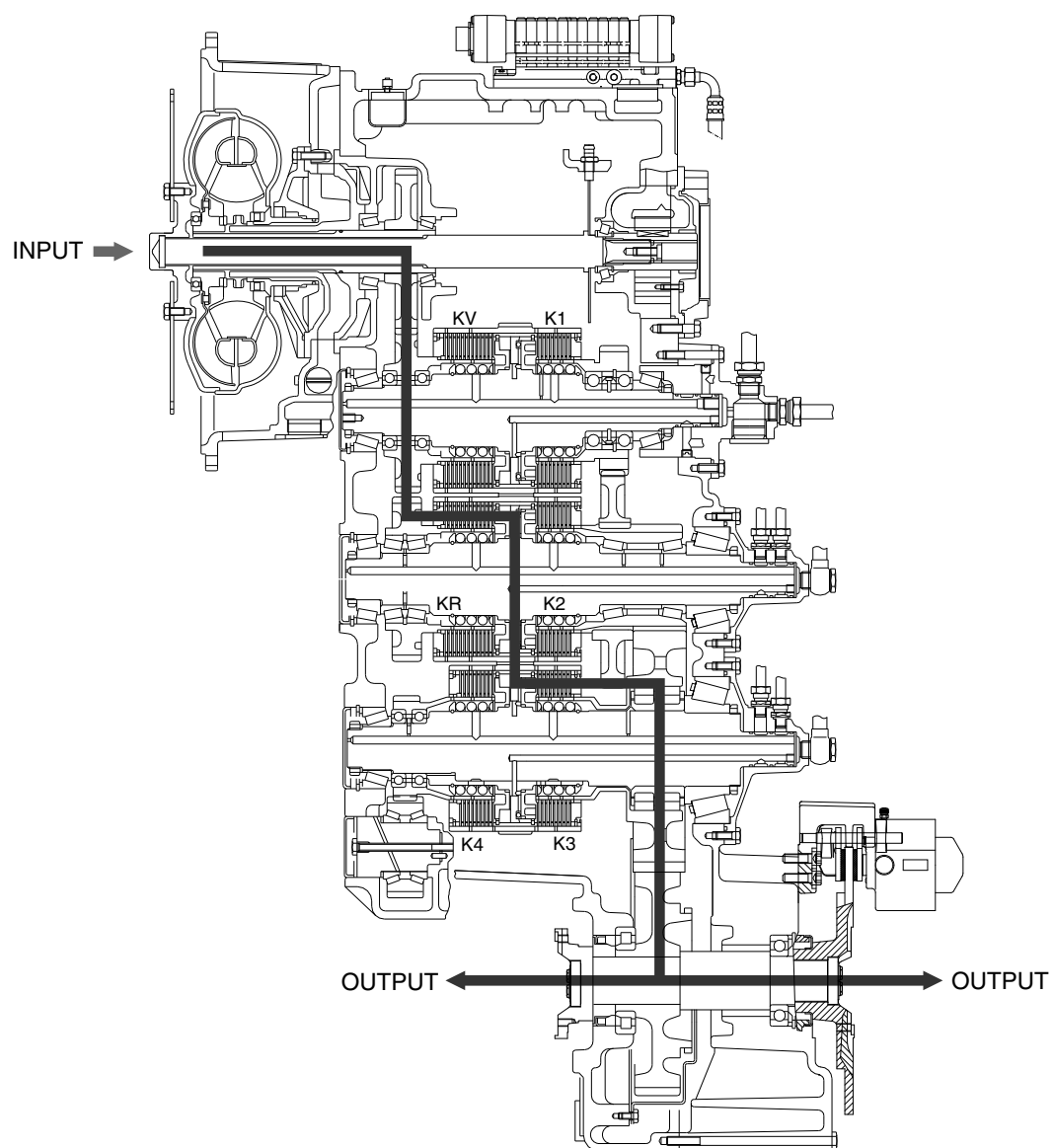


77093PT12

③ Reverse 3rd

In 3rd reverse, reverse clutch (KR) and 3rd clutch (K3) are engaged.

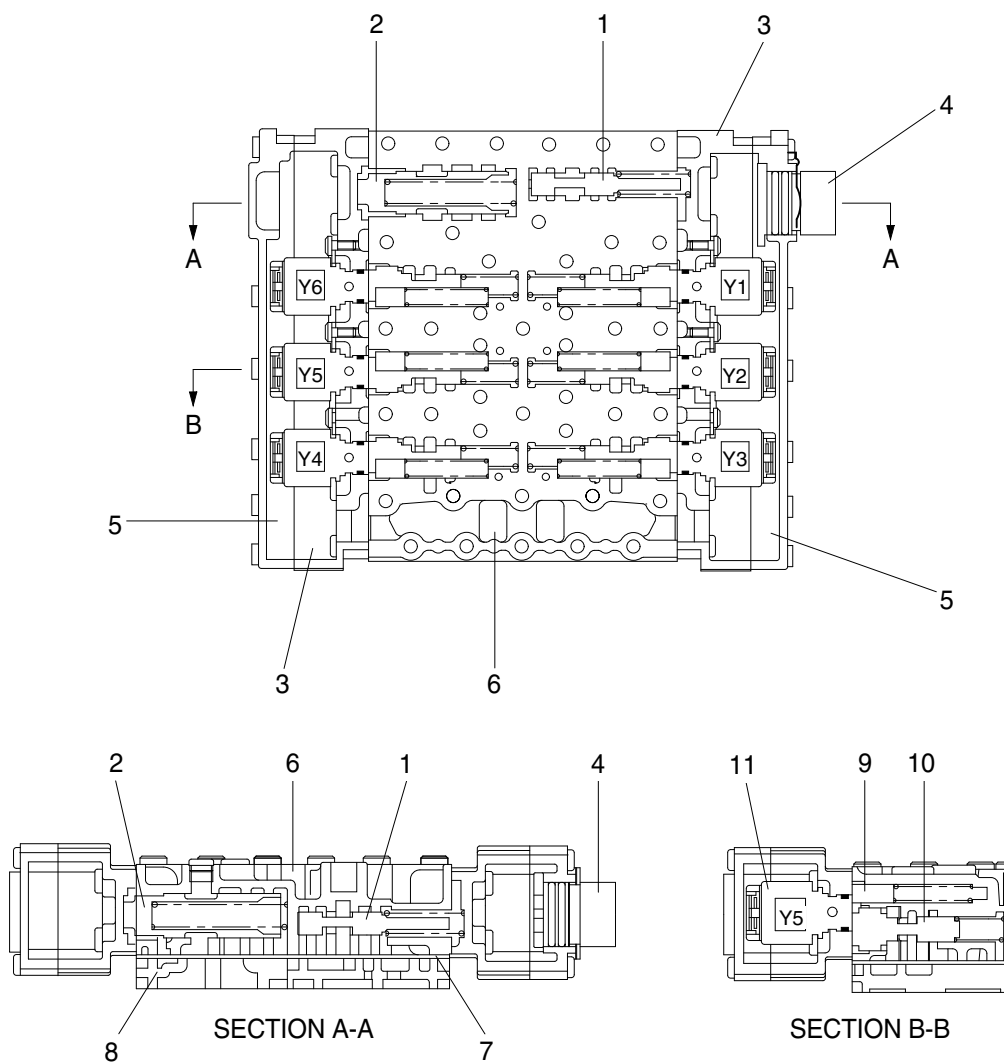
Reverse clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



77093PT13

4) ELECTRO-HYDRAULIC SHIFT CONTROL WITH PROPORTIONAL VALVE

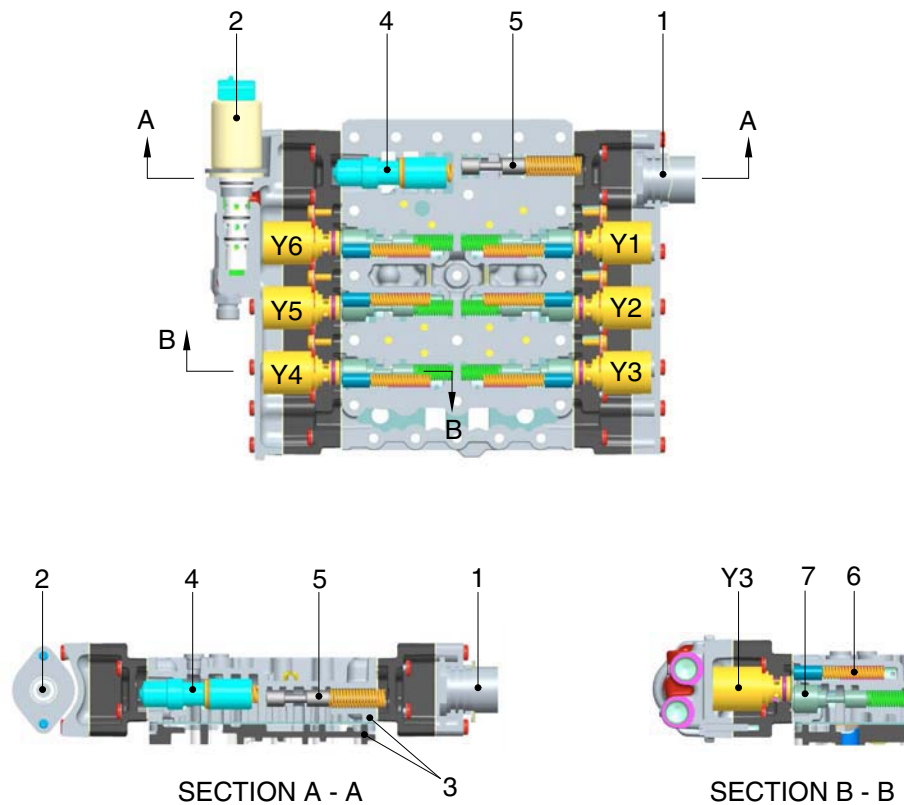
(1) 4-speed transmission



73033CV01

- | | | | |
|---|-------------------------------------|----|--------------------|
| 1 | Pressure reducing valve (9+0.5 bar) | 7 | Intermediate sheet |
| 2 | System pressure valve (16+2 bar) | 8 | Duct plate |
| 3 | Housing | 9 | Oscillation damper |
| 4 | Cable harness | 10 | Follow-on slide |
| 5 | Cover | 11 | Pressure regulator |
| 6 | Valve block | | |

(2) 5-speed transmission



7609AW3PT30

- | | | | |
|---|----------------------------------|-------|-------------------------------------|
| 1 | Cable harness | 5 | Pressure reducing valve (9+0.5 bar) |
| 2 | Proportional valve | 6 | Vibration damper |
| 3 | Intermediate plate/duct plate | 7 | Follow-on slide |
| 4 | System pressure valve (16+2 bar) | Y1~Y6 | Proportional valve |

Transmission control, see schedule of hydraulic circuit, electro-hydraulic control unit and measuring points at page 3-2, 3-16, 3-17 and 3-97.

The six clutches of the transmission are selected via the 6 proportional valves P1 to P6. The proportional valve (pressure regulator unit) is composed of pressure regulator (e.g. Y1), follow-on slide and vibration damper.

The control pressure of 9 bar for the actuation of the follow-on slides is created by the pressure reducing valve. The pressure oil (16+2 bar) is directed via the follow-on slide to the respective clutch.

Due to the direct proportional selection with separated pressure modulation for each clutch, the pressures to the clutches, which are engaged in the gear change, will be controlled. In this way, a hydraulic intersection of the clutches to be engaged and disengaged becomes possible.

This is creating spontaneous shiftings without traction force interruption.

At the shifting, the following criteria are considered:

- Speed of engine, turbine, central gear train and output.
- Transmission temperature.
- Shifting mode (Up-, down-, reverse shifting and speed engagement out of neutral).
- Load condition (full and part load, traction, overrun inclusive consideration of load cycles during the shifting).

The main pressure valve is limiting the maximum control pressure to 16+2 bar and releases the main stream to the converter and lubricating circuit.

In the inlet to the converter, a converter safety valve is installed which protects the converter from high internal pressures (opening pressure 11+2 bar).

Within the converter, the oil serves to transmit the power according to the well-known hydrodynamic principle (see torque converter, page 3-3).

To avoid cavitation, the converter must be always completely filled with oil.

This is achieved by a converter back pressure back-up valve, rear-mounted to the converter, with an opening pressure of at least 4.3bar.

The oil, escaping out of the converter, is directed to a oil cooler.

The oil is directed from the oil cooler to the transmission and from there to the lubricating oil circuit, so that all lubricating points are supplied with cooled oil.

In the electro-hydraulic control unit are 6 pressure regulators installed.

5) GEAR SELECTOR (DW-3)

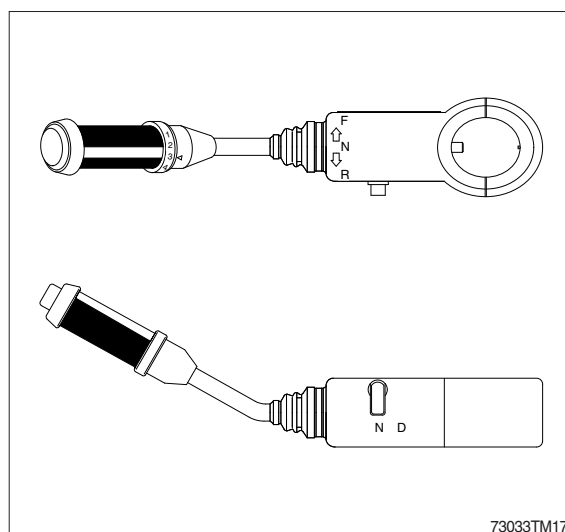
The gear selector is designed for the mounting on the left side of the steering column. The positions (speeds) 1 to 4 are selected by a rotary motion, the driving direction Forward (F)-Neutral (N)-Reverse (R) by tilting the gear selector lever.

The gear selector is also available with integrated kickdown push button.

For the protection from unintended start off, a neutral interlock is installed.

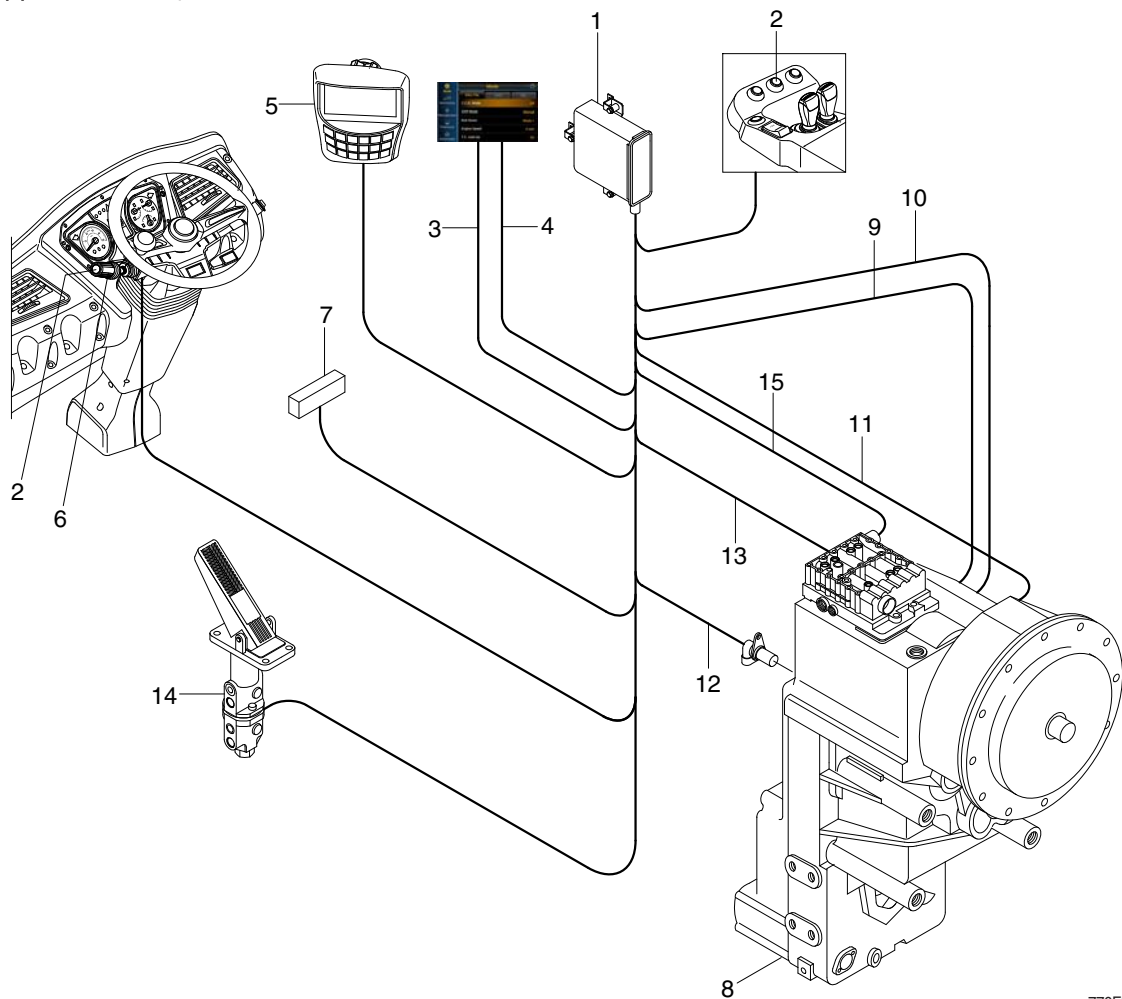
Position N - Gear selector lever blocked in this position.

Position D - Driving.



6) ELECTRIC CONTROL UNIT

(1) Complete system



770F3PT37

- 1 Control unit (EST-37A)
- 2 Kickdown switch
- 3 Clutch cut off mode
- 4 Transmission shift mode
- 5 Monitor
- 6 Gear selector (DW-3) with integrated kickdown switch
- 7 Supply-system connection
- 8 Transmission
- 9 Cable to inductive transmitter - speed central gear train
- 10 Cable to inductive transmitter - speed turbine
- 11 Cable to inductive transmitter - speed engine
- 12 Cable to speed sensor output and speedometer
- 13 Cable to plug connection on the electro - hydraulic control unit
- 14 Brake pressure sensor/load sensor
- 15 Cable to lock-up clutch valve (5-speed transmission)

(2) Description of the basic functions

The powershift-reversing transmissions will be equipped with the electronic transmission control unit (EST-37A), developed for them.

The system is processing the wishes of the driver according to the following criteria.

- Speed definition as a function of gear selector position, driving speed and load level.

- Protection against operating errors, as far as possible and practical.
- Protection against overspeeds (on the basis of engine and turbine speed).
- Reversing-automatic system (driving speed-dependent).
- Pressure cut off (disconnecting of the drive train for maximum power on the power take-off).
- Switch for manual or automatic operation.
- Reversing function button, respectively kickdown function.

(3) Gearshifts

The control unit (EST-37A) shifts the required speeds fully-automatically under consideration of the following criteria.

- Gear selector position
- Driving speed
- Load level

At the same time, the following speeds are picked up by the control unit (EST-37A).

- n Engine
- n Turbine
- n Central gear train
- n Output

- Neutral position

Neutral position is selected through the gear selector.

After the ignition is turned on, the electronics remains in the waiting state; By the position neutral of the gear selector, respectively by pressing on the key neutral, the control unit (EST-37A) becomes ready for operation.

Now, a speed can be engaged.

- Speed engagement

In principle, the speed, adapted to the driving speed (at standing, or rolling machine), will be engaged. The engagement is realized in dependence on load and rotational speed.

- Upshifting under load

Upshifting under load will be then realized if the machine can still accelerate by it.

- Downshifting under load

Downshifting under load will be realized if more traction force is needed.

- Upshifting in coasting condition

In the coasting condition, the upshifting will be suppressed if the speed of the machine on a slope shall not be further increased.

- Downshifting in coasting condition

Downshifts in the coasting condition will be realized if the machine shall be retarded.

- Reversing

At speeds below the reversing limit, direct reversing can be carried out at any time in the speeds 1F 1R and 2F 2R (as a rule, this is the maximum driving speed of the 2nd speed).

Reversings in the speeds 3 and 4 are realized dependent on the driving speed.

- Above the programmed reversing limit, the machine is braked down by downshifts of the electronic control unit (EST-37A) to the permitted driving speed, and only then, the reversing into the correspondingly preselected speed will be carried out.
- Below the permitted driving speed, the reversing is carried out immediately.

(4) Specific kickdown function

By means of the kickdown-button, integrated in the gear selector, it is at any time possible to select in the speeds 2F and 2R (i.e. position 2 of the gear selector, at automatic mode also in the 2nd speed of the automatic range) the 1st speed by a short touch. This kickdown state can be cancelled by :

1. Pressing the kickdown-button again
2. Realization of a reversal operation
3. Change of the gear selector position by the following modification
Gear selector (DW-3) - (rotation) of the driving position 1...4.

The kickdown function will be always terminated by shifting to neutral.

(5) Clutch cut off

Especially at wheel loaders, the clutch cut off can be activated through a switch signal. It is interrupting the power flow in the transmission as long as this signal is active. Besides, this function can be used for the transmission-neutral shifting at applied hand brake or as emergency-stop (in this case, a restarting is only possible through the gear selector-neutral position).

4. FAULT CODE

1-1) MACHINE FAULT CODE

| DTC | | Diagnostic Criteria | Application | | |
|--------|---|--|-------------|---|---|
| HCESPN | FMI | | G | C | S |
| 101 | 3 | 10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.95 V | ● | | |
| | 4 | 10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3 V | ● | | |
| | (Results / Symptoms) 1. Monitor – Hydraulic Oil temperature display failure 2. Control Function – No warming up operation, No fuel warmer function operation, High hydraulic oil temperature warning failure (Checking list) 1. CN-58B (#23) – CD-01 (#2) Checking Open/Short 2. CN-58B (#25) – CD-01 (#1) Checking Open/Short | | | | |
| 202 | 0 | 10 seconds continuous, Steering main pump pressure Measurement Voltage > 5.3 V | ● | | |
| | 4 | 10 seconds continuous, Steering main pump pressure Measurement Voltage < 0.3 V | ● | | |
| | (Results / Symptoms) 1. Monitor – Steering main pump press. Display failure 2. Control Function – No automatic Emergency steering operation, ECO gauge display failure 3. RMS – Working hours accumulation failure (Checking list) 1. CN-58B (#35) – CD-39 (B) Checking Open/Short 2. CN-58A (#11) – CD-39 (A) Checking Open/Short 3. CN-58B (#25) – CD-39 (C) Checking Open/Short | | | | |
| 204 | 0 | 10 seconds continuous, Boom cylinder 'head' pressure Measurement Voltage > 5.3 V | ● | | |
| | 4 | 10 seconds continuous, Boom cylinder 'head' pressure Measurement Voltage < 0.3 V | ● | | |
| | (Results / Symptoms) 1. Monitor – Boom cylinder 'head' press. display failure 2. Control Function – No Boom pressure calibration function operation, workload measurement sys. operation failure (Checking list) 1. CN-58B (#29) – CD-80 (B) Checking Open/Short 2. CN-58A (#11) – CD-80 (A) Checking Open/Short 3. CN-58B (#25) – CD-80 (C) Checking Open/Short | | | | |

G : General C : Cummins Engine application equipment S : Scania Engine application equipment

| DTC | | Diagnostic Criteria | Application | | |
|--------|---|--|-------------|---|---|
| HCESPN | FMI | | G | C | S |
| 205 | 0 | 10 seconds continuous, Boom cylinder 'rod' pressure Measurement Voltage > 5.3V | ● | | |
| | 4 | 10 seconds continuous, Boom cylinder 'rod' pressure Measurement Voltage < 0.3V | ● | | |
| | (Results / Symptoms) 1. Monitor – Boom cylinder 'rod' press. display failure 2. Control Function – No Boom pressure calibration function operation, workload measurement sys. operation failure (Checking list) 1. CN-58B(#36) – CD-81(B) Checking Open/Short 2. CN-58A(#11) – CD-81(A) Checking Open/Short 3. CN-58B(#25) – CD-81(C) Checking Open/Short | | | | |
| | | | | | |
| 301 | 3 | 10 seconds continuous, Fuel level Measurement Voltage > 3.8V | ● | | |
| | 4 | 10 seconds continuous, Fuel level Measurement Voltage < 0.3V | ● | | |
| | (Results / Symptoms) 1. Monitor – Fuel level display failure 2. Control Function – Fuel level low warning operation failure (Checking list) 1. CN-58B (#22) – CD-02 (#2) Checking Open/Short 2. CN-58B (#25) – CD-02 (#1) Checking Open/Short | | | | |
| | | | | | |
| 318 | 8 | (In the startup conditions) 30 seconds continuous, Fan speed < 10 rpm in the Remote cooling fan EPPR current reference value is in X Ma(differ by model) | ● | | |
| | (Results / Symptoms) 1. Monitor – Cooling Fan revolutions display failure (Checking list) 1. CN-58A (#15) – CD-73 (#1) Checking Open/Short 2. CN-58A (#18) – CD-73 (#2) Checking Open/Short | | | | |
| | | | | | |
| | | | | | |
| 339 | 3 | 10 seconds continuous, Accel pedal position 1 voltage Measurement Voltage > 5.0 V | | | ● |
| | 4 | 10 seconds continuous, Accel pedal position 1 voltage Measurement Voltage < 0.2 V | | | ● |
| | (Results / Symptoms) 1. Monitor – Accel pedal position 1 voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-58B(#39) – CN-162(#2) Checking Open/Short 2. CN-58A(#6) – CN-162(#3) Checking Open/Short 3. CN-58A(#8) – CN-162(#1) Checking Open/Short | | | | |
| | | | | | |

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| DTC | | Diagnostic Criteria | Application | | |
|--------|---|---|-------------|---|---|
| HCESPN | FMI | | G | C | S |
| 343 | 3 | 10 seconds continuous, Accel pedal position 2 voltage Measurement Voltage > 5.0 V | | | ● |
| | 4 | 10 seconds continuous, Accel pedal position 2 voltage Measurement Voltage < 0.2 V | | | ● |
| | (Results / Symptoms) 1. Monitor – Accel pedal position 2 voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-58B (#40) – CN-162 (#5) Checking Open/Short 2. CN-58A (#7) – CN-162 (#6) Checking Open/Short 3. CN-58A (#9) – CN-162 (#4) Checking Open/Short | | | | |
| 503 | 0 | 10 seconds continuous, Brake oil pressure Measurement Voltage > 5.3V | ● | | |
| | 4 | 10 seconds continuous, Brake oil pressure Measurement Voltage < 0.3V | ● | | |
| | (Results / Symptoms) 1. Monitor – Brake oil press. display failure 2. Control Function – Brake oil pressure low warning display failure (Checking list) 1. CN-58B (#27) – CD-03 (B) Checking Open/Short 2. CN-58A (#11) – CD-03 (A) Checking Open/Short 3. CN-58B (#25) – CD-03 (C) Checking Open/Short | | | | |
| 507 | 0 | 10 seconds continuous, Parking oil pressure Measurement Voltage > 5.3V | ● | | |
| | 4 | 10 seconds continuous, Parking oil pressure Measurement Voltage < 0.3V | ● | | |
| | (Results / Symptoms) 1. Monitor – Parking oil Press. display failure 2. Control Function – No judgment Parking status (Checking list) 1. CN-58B (#34) – CD-26 (B) Checking Open/Short 2. CN-58A (#11) – CD-26 (A) Checking Open/Short 3. CN-58B (#25) – CD-26 (C) Checking Open/Short | | | | |
| 557 | 0 | 10 seconds continuous, Brake oil charging priority pressure Measurement Voltage > 5.3V | ● | | |
| | 4 | 10 seconds continuous, Brake oil charging priority pressure Measurement Voltage < 0.3V | ● | | |
| | (Results / Symptoms) 1. Monitor – Brake oil charging priority press. display failure 2. Control Function – Cooling fan revolutions control failure, Brake oil(Accumulator) charging failure (Checking list) 1. CN-58B (#38) – CD-31 (B) Checking Open/Short 2. CN-58A (#11) – CD-31 (A) Checking Open/Short 3. CN-58B (#25) – CD-31 (C) Checking Open/Short | | | | |

G : General C : Cummins Engine application equipment S : Scania Engine application equipment

| DTC | | Diagnostic Criteria | Application | | |
|--------|---|--|-------------|---|---|
| HCESPN | FMI | | G | C | S |
| 705 | 0 | 10 seconds continuous, Battery input Voltage > 35V | ● | | |
| | 1 | 10 seconds continuous, Battery input Voltage < 18V | ● | | |
| | (Results / Symptoms) 1. Control Function – Disabled startup (Checking list) 1. Checking battery voltage 2. CN-58A (#1) – CN-36 (07 fuse) Checking Open/Short 3. CN-58A (#2) – CN-36 (07 fuse) Checking Open/Short | | | | |
| 707 | 1 | (In the 500rpm or more) 10 seconds continuous, Alternator Node I Measurement Voltage < 18V | ● | | |
| | (Results / Symptoms) 1. Control Function – Battery charging circuit failure (Checking list) 1. CN-58B (#33) – CN-04 (#18) Checking Open/Short 2. CN-04 (#18) – CN-74 (#2) Checking Open/Short | | | | |
| 728 | 3 | 10 seconds continuous, Boom position sensor signal voltage Measurement Voltage > 5.0V | ● | | |
| | 4 | 10 seconds continuous, Boom position sensor signal voltage Measurement Voltage < 0.3V | ● | | |
| | (Results / Symptoms) 1. Monitor – Boom position sensor signal voltage display failure 2. Control Function – No calibration angle sensor, No calibration boom pressure , Boom Detent operation failure, Soft end stop(Boom) operation failure, Lock-up clutch operation failure (Checking list) 1. CN-58B (#37) – CN-100 (B) Checking Open/Short 2. CN-58A (#5) – CN-100 (C) Checking Open/Short 3. CN-58B (#25) – CN-100 (A) Checking Open/Short | | | | |
| 729 | 3 | 10 seconds continuous, Bucket position sensor signal voltage Measurement Voltage > 5.0V | ● | | |
| | 4 | 10 seconds continuous, Bucket position sensor signal voltage Measurement Voltage < 0.3V | ● | | |
| | (Results /Symptoms) 1. Monitor – Bucket position sensor signal voltage display failure 2. Control Function – No calibration angle sensor, Bucket Detent operation failure, Soft end stop(Bucket) operation failure (Checking list) 1. CN-58B(#30) – CN-101(B) Checking Open/Short 2. CN-58A(#5) – CN-101(C) Checking Open/Short 3. CN-58B(#25) – CN-101(A) Checking Open/Short | | | | |

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| DTC | | Diagnostic Criteria | Application | | |
|--------|--|--|-------------|---|---|
| HCESPN | FMI | | G | C | S |
| 831 | 2 | (When mounting the A/C Controller) 10 seconds continuous, A/C controller Communication Data Error | ● | | |
| | (Results / Symptoms) 1. Control Function – A/C Controller malfunction | | | | |
| 841 | 2 | 10 seconds continuous, ECM Communication Data Error | ● | | |
| | (Results / Symptoms) 1. Control Function – ECM operation failure | | | | |
| 842 | 2 | 10 seconds continuous, TCU Communication Data Error | ● | | |
| | (Results / Symptoms) 1. Control Function – TCU operation failure | | | | |
| 844 | 2 | 10 seconds continuous, Monitor Communication Data Error | ● | | |
| | (Results / Symptoms) 1. Control Function – Monitor operation failure | | | | |
| 850 | 2 | (When mounting the RMCU) 90 seconds continuous, RMCU Communication Data Error | ● | | |
| | (Results / Symptoms) 1. Control Function – RMCU operation failure | | | | |
| 861 | 2 | (When mounting the EHCU) 10 seconds continuous, EHCU Communication Data Error | ● | | |
| | (Results / Symptoms) 1. Control Function – EHCU operation failure | | | | |
| 869 | 2 | (When mounting the BKCU) 10 seconds continuous, BKCU Communication Data Error | ● | | |
| | (Results / Symptoms) 1. Control Function – BKCU operation failure | | | | |

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1-2) EHCU FAULT CODE

| HCESPN | FMI | Description |
|--------|-----|---|
| 2333 | 9 | Communication timeout between EHCU and TCU |
| 2331 | 9 | Communication timeout between EHCU and MCU |
| 2332 | 9 | Communication timeout between EHCU and working joystick |
| 2317 | 9 | Communication timeout between EHCU and steering joystick |
| 2319 | 2 | Steering joystick position signal error |
| 2320 | 2 | Steering joystick - FNR enable switch error |
| 2321 | 2 | Steering joystick - forward switch error |
| 2322 | 2 | Steering joystick - neutral switch error |
| 2323 | 2 | Steering joystick - reverse switch error |
| 2324 | 2 | Steering joystick - kick down switch error |
| 2325 | 2 | Steering joystick - steering on switch error |
| 2326 | 5 | PVE coil power current below normal or open circuit |
| 2326 | 6 | PVE coil power current above normal or grounded circuit |
| 2327 | 0 | PVE coil PWM duty cycle input value above normal operation range |
| 2327 | 1 | PVE coil PWM duty cycle input value below normal operation range |
| 2327 | 5 | PVE coil PWM duty cycle current below normal or open circuit |
| 2327 | 6 | PVE coil PWM duty cycle current above normal or grounded circuit |
| 2327 | 14 | PVE coil PWM duty cycle control block parameter invalid |
| 2311 | 2 | Boom joystick position signal error |
| 2311 | 0 | Boom joystick position input value above normal operation range |
| 2311 | 1 | Boom joystick position input value below normal operation range |
| 2311 | 3 | Boom joystick position input voltage above normal or shorted to high source |
| 2311 | 4 | Boom joystick position input voltage below normal or shorted to low source |
| 2311 | 13 | Boom joystick position control block out of calibration |
| 2311 | 14 | Boom joystick position control block parameter invalid |
| 2311 | 31 | Boom joystick position signal redundancy lost |
| 2313 | 2 | Bucket joystick position signal error |
| 2313 | 0 | Bucket joystick position input value above normal operation range |
| 2313 | 1 | Bucket joystick position input value below normal operation range |
| 2313 | 3 | Bucket joystick position input voltage above normal or shorted to high source |
| 2313 | 4 | Bucket joystick position input voltage below normal or shorted to low source |
| 2313 | 13 | Bucket joystick position control block out of calibration |
| 2313 | 14 | Bucket joystick position control block parameter invalid |
| 2313 | 31 | Bucket joystick position signal redundancy lost |
| 2315 | 2 | Aux joystick position signal error |
| 2315 | 0 | Aux joystick position input value above normal operation range |
| 2315 | 1 | Aux joystick position input value below normal operation range |

| HCESPN | FMI | Description |
|--------|-----|--|
| 2315 | 3 | Aux joystick position input voltage above normal or shorted to high source |
| 2315 | 4 | Aux joystick position input voltage below normal or shorted to low source |
| 2315 | 13 | Aux joystick position control block out of calibration |
| 2315 | 14 | Aux joystick position control block parameter invalid |
| 2315 | 31 | Aux joystick position signal redundancy lost |
| 2304 | 0 | Boom up EPPR valve input value above normal operation range |
| 2304 | 1 | Boom up EPPR valve input value below normal operation range |
| 2304 | 5 | Boom up EPPR valve input current below normal or open circuit |
| 2304 | 6 | Boom up EPPR valve input current above normal or grounded circuit |
| 2304 | 14 | Boom up EPPR valve block parameter invalid |
| 2305 | 0 | Boom down EPPR valve input value above normal operation range |
| 2305 | 1 | Boom down EPPR valve input value below normal operation range |
| 2305 | 5 | Boom down EPPR valve input current below normal or open circuit |
| 2305 | 6 | Boom down EPPR valve input current above normal or grounded circuit |
| 2305 | 14 | Boom down EPPR valve block parameter invalid |
| 2306 | 0 | Bucket in EPPR valve input value above normal operation range |
| 2306 | 1 | Bucket in EPPR valve input value below normal operation range |
| 2306 | 5 | Bucket in EPPR valve input current below normal or open circuit |
| 2306 | 6 | Bucket in EPPR valve input current above normal or grounded circuit |
| 2306 | 14 | Bucket in EPPR valve block parameter invalid |
| 2307 | 0 | Bucket dump EPPR valve input value above normal operation range |
| 2307 | 1 | Bucket dump EPPR valve input value below normal operation range |
| 2307 | 5 | Bucket dump EPPR valve input current below normal or open circuit |
| 2307 | 6 | Bucket dump EPPR valve input current above normal or grounded circuit |
| 2307 | 14 | Bucket dump EPPR valve block parameter invalid |
| 2308 | 0 | Aux. Up EPPR valve input value above normal operation range |
| 2308 | 1 | Aux. Up EPPR valve input value below normal operation range |
| 2308 | 5 | Aux. Up EPPR valve input current below normal or open circuit |
| 2308 | 6 | Aux. Up EPPR valve input current above normal or grounded circuit |
| 2308 | 14 | Aux. Up EPPR valve block parameter invalid |
| 2309 | 0 | Aux. Down EPPR valve input data above normal operation range |
| 2309 | 1 | Aux. Down EPPR valve input data below normal operation range |
| 2309 | 5 | Aux. Down EPPR valve input current below normal or open circuit |
| 2309 | 6 | Aux. Down EPPR valve input current above normal or grounded circuit |
| 2309 | 14 | Aux. Down EPPR valve block parameter invalid |
| 2328 | 0 | EHCUSensor power voltage high |
| 2328 | 1 | EHCUSensor power voltage low |
| 2328 | 3 | EHCUSensor power voltage above normal or shorted to high source |

| HCESPN | FMI | Description |
|--------|-----|--|
| 2328 | 4 | EHCUC sensor power voltage below normal or shorted to low source |
| 2329 | 0 | EHCUC power voltage high |
| 2329 | 1 | EHCUC power voltage low |
| 2329 | 11 | EHCUC safety cpu error |
| 739 | 2 | Armrest switch signal error |
| 2334 | 0 | Steering pilot pressure sensor data above normal range |
| 2334 | 1 | Steering pilot pressure sensor data below normal range |
| 2335 | 2 | Steering proportional valve moving position error |
| 2335 | 14 | Steering proportional valve start position error |

1-3) AAVM FAULT CODE

| Fault Code | Description |
|------------|--|
| A01 | AAVM Communication Error -AAVM |
| A02 | AAVM Communication Error -Front Camera |
| A03 | AAVM Communication Error -Rear Camera |
| A04 | AAVM Communication Error -Left Camera |
| A05 | AAVM Communication Error -Right Camera |
| A06 | Manual Setting Fail |
| A07 | No MCU CID |
| A08 | MCU CID Format Error |
| A09 | AAVM Hardware Error -AAVM |
| A10 | AAVM Hardware Error -Front Camera |
| A11 | AAVM Hardware Error -Rear Camera |
| A12 | AAVM Hardware Error -Left Camera |
| A13 | AAVM Hardware Error -Right Camera |
| A14 | MCU CID Model is not registered |
| A15 | MCU CID Model can't be applied |

2) ENGINE FAULT CODE

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 111 629 12 | Engine control module critical internal failure - Bad intelligent device or component. Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits. | Possible no noticeable performance effects, engine dying, or hard starting. |
| 115 612 2 | Engine magnetic crankshaft speed/position lost both of two signals - Data erratic, intermittent, or incorrect. The ECM has detected the primary and backup speed sensor signals are connected backwards. | The engine will shut down or will not start. |
| 122 102 3 | Intake manifold 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the intake manifold pressure circuit. | Engine power derate. |
| 123 102 4 | Intake manifold 1 pressure sensor circuit - Voltage below normal, or shorted to low Source. Low signal voltage or open circuit detected at the intake manifold pressure circuit. | Engine power derate. |
| 124 102 16 | Intake manifold 1 pressure - Data valid but above normal operational range - Moderately severe level. Intake manifold pressure is above the maximum operating limit. | Engine power derate. |
| 125 102 18 | Intake Manifold 1 Pressure - Data valid but below normal operating range - Moderately severe level. Intake manifold pressure is below the minimum operating limit. | Engine power derate. |
| 131 91 3 | Accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at accelerator pedal position number 1 circuit. | The engine will operate in limp home mode. |
| 132 91 4 | Accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at accelerator pedal position number 1 signal circuit. | The engine will operate in limp home mode. |
| 133 974 3 | Remote accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at remote accelerator pedal position signal circuit. | Remote accelerator will not operate. |
| 134 974 4 | Remote accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at remote accelerator pedal position signal circuit. | Remote accelerator will not operate. |
| 143 100 18 | Engine oil rifle pressure - Data valid but below normal operational range - Moderately severe level. Engine oil pressure signal indicates engine oil pressure is below the engine protection warning limit. | Engine power derate. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 144 110 3 | Engine coolant temperature 1 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at engine coolant temperature circuit. | Fan will stay ON if controlled by ECM. |
| 145 110 4 | Engine coolant temperature 1 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine coolant temperature circuit. | Fan will stay ON if controlled by ECM. |
| 146 110 16 | Engine coolant temperature - Data valid but above normal operational range - Moderately severe level. Engine coolant temperature is above engine protection warning limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing. |
| 151 110 0 | Engine coolant temperature - Data valid but above normal operational range - Most severe level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing. |
| 153 105 3 | Intake manifold 1 temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at intake manifold air temperature circuit. | Fan will stay ON if controlled by ECM. |
| 154 105 4 | Intake manifold 1 temperature sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at intake manifold air temperature circuit. | Fan will stay ON if controlled by ECM. |
| 155 105 0 | Intake manifold 1 temperature - Data valid but above normal operational range - Most severe level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection critical limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing. |
| 175 3464 3 | Electronic throttle control actuator driver circuit - Voltage above normal, or shorted to high source. A short circuit to battery or open circuit has been detected in the engine intake air throttle actuator signal circuit. | Possible reduced engine performance. |
| 176 3464 4 | Electronic throttle control actuator driver circuit - Voltage below normal, or shorted to low source. A short circuit to ground has been detected in the engine intake air throttle actuator signal circuit. | Possible reduced engine performance. |
| 177 3464 7 | Electronic throttle control actuator - Mechanical system not responding or out of adjustment. The engine intake air throttle actuator has failed the auto zero span check. | Possible reduced engine performance. |
| 187 3510 4 | Sensor supply 2 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the sensor supply number 2 circuit. | Engine power derate. |
| 195 111 3 | Coolant level sensor 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at engine coolant level circuit. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 196 111 4 | Coolant level sensor 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine coolant level circuit. | None on performance. |
| 197 111 18 | Coolant level - Data valid but below normal operational range - Moderately severe level. Low coolant level has been detected. | Engine power derate. |
| 221 108 3 | Barometric pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at barometric pressure circuit. | Engine power derate. |
| 222 108 4 | Barometric pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at barometric pressure circuit. | Engine power derate. |
| 227 3510 3 | Sensor supply 2 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 2 circuit. | Engine power derate. |
| 234 190 0 | Engine crankshaft speed/position - Data valid but above normal operational range - Most severe level. Engine speed signal indicates engine speed above engine protection limit. | Engine power derate. |
| 238 3511 4 | Sensor supply 3 circuit - Voltage below normal, or shorted to low source. Low voltage detected on the +5 volt sensor supply circuit to the engine speed sensor. | Engine may run rough, may stop running, may not start, or may be difficult to start. |
| 239 3511 3 | Sensor supply 3 circuit - Voltage above normal or shorted to high source. High voltage detected on the 5 volt sensor supply circuit to the engine speed sensor. | Engine may run rough, may stop running, may not start, or may be difficult to start. |
| 241 84 2 | Wheel-based vehicle speed - Data erratic, intermittent, or incorrect. The ECM lost the vehicle speed signal or is reading an erratic value. | Engine speed limited to ,maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work. |
| 245 647 4 | Fan control circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fan control circuit when commanded on. | The fan may stay on continuously or not run at all. |
| 249 171 3 | Ambient air temperature sensor 1 circuit - Voltage above normal or shorted to high source. High signal voltage detected at ambient air temperature circuit. | Possible reduced engine performance. |
| 256 171 4 | Ambient air temperature sensor 1 circuit - Voltage below normal or shorted to low source. Low voltage detected at ambient air temperature circuit. | Possible reduced engine performance. |
| 271 1347 4 | Fuel pump pressurizing assembly 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fuel pump actuator circuit. | Engine power derate. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|--|
| 272 1347 3 | Fuel pump pressurizing assembly 1 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the fuel pump actuator circuit. | Engine may run rough, may stop running, may not start, or may be difficult to start. |
| 285 639 9 | SAE J1939 multiplexing PGN timeout error - Abnormal update rate. The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all. | At least one multiplexed device will not operate properly. |
| 286 639 13 | SAE J1939 multiplexing configuration error - Out of calibration. The ECM expected information from a multiplexed device but only received a portion of the necessary information. | At least one multiplexed device will not operate properly. |
| 288 974 19 | Sae J1939 multiplexing remote accelerator pedal or lever position sensor circuit - Received network data in error. The oem vehicle electronic control unit (VECM) detected a fault with the remote accelerator. | Remote accelerator will not operate. |
| 295 108 2 | Barometric pressure - Data erratic, intermittent, or incorrect. An error in the barometric pressure sensor signal was detected by the ECM. | Engine power derate. |
| 322 651 5 | Injector solenoid driver cylinder 1 circuit - Current below normal, or open circuit. Current detected at injector 1 when voltage is turned OFF. | Engine power derate. |
| 323 655 5 | Injector solenoid driver cylinder 5 circuit - Current below normal, or open circuit. Current detected at injector 5 when voltage is turned OFF. | The current to the injector is shut OFF. Engine power derate. |
| 324 653 5 | Injector solenoid driver cylinder 3 circuit - Current below normal, or open circuit. Current detected at injector 3 when voltage is turned OFF. | The current to the injector is shut OFF. Engine power derate. |
| 325 656 5 | Injector solenoid driver cylinder 6 circuit - Current below normal, or open circuit. Current detected at injector 6 when voltage is turned OFF. | The current to the injector is shut OFF. Engine power derate. |
| 331 652 5 | Injector solenoid driver cylinder 2 circuit - Current below normal, or open circuit. Current detected at injector 2 when voltage is turned OFF. | The current to the injector is shut OFF. Engine power derate. |
| 332 654 5 | Injector solenoid driver cylinder 4 circuit - Current below normal, or open circuit. Current detected at injector 4 when voltage is turned OFF. | The current to the injector is shut OFF. Engine power derate. |
| 334 110 2 | Engine coolant temperature - Data erratic, intermittent, or incorrect. The engine coolant temperature sensor is reading an erratic value at initial key ON. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|--|
| 338 1267 3 | Idle shutdown vehicle accessories relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or short to voltage source detected at the idle shutdown vehicle accessory/ignition bus relay circuit. | Vehicle accessories or ignition bus loads controlled by the idle shutdown relay will not power up. |
| 339 1267 4 | Idle shutdown vehicle accessories relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at the idle shutdown vehicle accessory or ignition bus relay circuit when commanded ON. | Vehicle accessories or ignition bus loads controlled by the idle shutdown relay will not power up. |
| 343 629 12 | Engine control module warning internal hardware failure - Bad intelligent device or component. ECM power supply errors have been detected. | Engine power derate. |
| 346 630 12 | Engine control module calibration memory software - Bad intelligent device or component. Invalid switch configuration adjustable parameter setting have been detected by the engine control module (ECM). | Various optional switch inputs to the ECM may not operate correctly. |
| 351 627 12 | Injector power supply - Bad intelligent device or component. The ECM measured injector boost voltage is low. | Engine power derate. |
| 352 3509 4 | Sensor supply 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at sensor supply number 1 circuit. | Engine power derate. |
| 383 729 5 | Engine intake air heater 1 circuit - Current below normal or open circuit. A malfunctioning engine intake air heater circuit has been detected. | Engine may not start or may be difficult to start. |
| 386 3509 3 | Sensor supply 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 1 circuit. | Engine power derate. |
| 415 100 1 | Engine oil rifle pressure - Data valid but below normal operational range - Most severe level. Oil pressure signal indicates oil pressure below the engine protection critical limit. | Progressive power and/or speed derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing. |
| 418 97 15 | Water in fuel indicator - Data valid but above normal operational range - Least severe level. water has been detected in the fuel filter. | None on performance. |
| 427 639 9 | J1939 data link - Abnormal update rate. Communication between the engine control module (ECM) and another device on the SAE J1939 data link has been lost. | Engine will only idle. |
| 428 97 3 | Water in fuel indicator sensor circuit - Voltage above normal, or shorted to high source. High voltage detected at the water in fuel circuit. | None on performance. No water in fuel warning available. |
| 435 100 2 | Engine oil rifle pressure - Data erratic, intermittent, or incorrect. The engine oil pressure sensor is reading an erratic value. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 436 105 2 | Intake manifold 1 temperature - Data erratic, intermittent, or incorrect. The intake manifold temperature sensor is reading an erratic value at initial key on or while the engine is running. | Possible reduced engine performance. |
| 441 168 18 | Battery 1 voltage - Data valid but below normal operational range - Moderately severe level. ECM supply voltage is below the minimum system voltage level. | Engine may run rough, may stop running, may not start, or may be difficult to start. |
| 442 168 16 | Battery 1 Voltage - Data valid but above normal operational range - Moderately severe level. ECM supply voltage is above the maximum system voltage level. | None on performance. |
| 451 157 3 | Injector metering rail 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the rail fuel pressure sensor circuit. | Power and/or speed derate. |
| 452 157 4 | Injector metering rail 1 pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the rail fuel pressure sensor circuit. | Power and/or speed derate. |
| 483 1349 3 | Injector metering rail 2 pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the fuel rail 2 pressure sensor circuit. | Possible reduced engine performance. |
| 484 1349 4 | Injector metering rail 2 pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the fuel rail 2 pressure sensor circuit. | Possible reduced engine performance. |
| 515 3514 3 | Sensor supply 6 circuit - Voltage above normal or shorted to high source. High voltage detected on the +5 volt sensor supply circuit to the fuel rail pressure sensor. | Engine power derate. |
| 516 3514 4 | Sensor supply 6 circuit - Voltage below normal or shorted to low source. Low voltage detected on the +5 volt sensor supply circuit to the fuel rail pressure sensor. | Engine power derate. |
| 553 157 16 | Injector metering rail 1 pressure - Data valid but above normal operational range - Moderately severe level. The ECM has detected that fuel pressure is higher than commanded pressure. | Possible reduced engine performance. |
| 555 101 16 | Crankcase pressure - Data valid but above normal operational range - Moderately severe level. The crankcase breather filter requires maintenance. | None on performance. |
| 556 101 0 | Crankcase pressure - Data valid but above normal operational range - Most severe level. The crankcase breather filter requires maintenance. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|--|
| 559 157 18 | Injector metering rail 1 pressure - Data valid but below normal operational range - Moderately severe level. The ecm has detected that fuel pressure is lower than commanded pressure. | Possibly hard to start or low power. Engine could possibly not start. |
| 584 677 3 | Starter relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at starter lockout circuit. | Either the engine will not start or the engine will not have starter lockout protection. |
| 585 677 4 | Starter relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at starter lockout circuit. | Either the engine will not start or the engine will not have starter lockout protection. |
| 595 103 16 | Turbocharger 1 speed - Data valid but above normal operating range - Moderately severe level. High turbocharger speed has been detected by the ecm. | Engine power derate. |
| 596 167 16 | Electrical charging system voltage - Data valid but above normal operational range - Moderately severe level. High battery voltage detected by the battery voltage monitor feature. | None on performance. |
| 597 167 18 | Electrical charging system voltage - Data valid but below normal operational range - Moderately severe level. Low battery voltage detected by the battery voltage monitor feature. | None on performance. |
| 649 1378 31 | Engine oil change interval - Condition exists. Change engine oil and filter. | None on performance. |
| 687 103 18 | Turbocharger 1 speed - Data valid but below normal operational range - Moderately severe level. Low turbocharger speed detected by the ECM. | Engine power derate. The ECM uses an estimated turbocharger speed. |
| 689 190 2 | Engine crankshaft speed/position - Data erratic, intermittent, or incorrect. The ECM has detected an error in the engine speed signal. | Possible reduced engine performance. |
| 691 1172 3 | Turbocharger 1 compressor inlet temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at turbocharger compressor inlet air temperature circuit. | Engine power derate. |
| 692 1172 4 | Turbocharger 1 compressor inlet temperature circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at turbocharger compressor inlet air temperature circuit. | Engine power derate. |
| 693 1172 2 | Turbocharger 1 compressor intake temperature - Data erratic, intermittent, or incorrect. A temperature too high or low for the operating conditions has been detected by the turbocharger compressor intake temperature sensor. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 731 723 7 | Engine speed / position camshaft and crankshaft misalignment - Mechanical system not responding properly or out of adjustment. Engine position signal from the crankshaft position sensor and camshaft position sensor do not match. | Engine power derate. |
| 755 157 7 | Injector metering rail 1 pressure - Mechanical system not responding or out of adjustment. The ecm has detected a difference in the 2 fuel rail pressure signals. | Possible reduced engine performance. |
| 778 723 2 | Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. The ECM has detected an error in the camshaft position sensor signal. | Possible reduced engine performance. |
| 784 1590 2 | Adaptive cruise control mode - Data erratic, intermittent, or incorrect. Loss of communication with adaptive cruise control. | Adaptive cruise control will not operate. Standard cruise control may not operate. |
| 1117 627 2 | Power supply lost with ignition on - Data erratic, intermittent, or incorrect. Supply voltage to the ECM fell below 6.2 volts momentarily, or the ECM was not allowed to power down correctly (retain battery voltage for 30 seconds after key OFF). | Possible no noticeable performance. |
| 1139 651 7 | Injector solenoid driver cylinder 1 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity. | Possible reduced engine performance. |
| 1141 652 7 | Injector solenoid driver cylinder 2 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity. | Possible reduced engine performance. |
| 1142 653 7 | Injector solenoid driver cylinder 3 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity. | Possible reduced engine performance. |
| 1143 654 7 | Injector solenoid driver cylinder 4 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity. | Possible reduced engine performance. |
| 1144 655 7 | Injector solenoid driver cylinder 5 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity. | Possible reduced engine performance. |
| 1145 656 7 | Injector solenoid driver cylinder 6 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity. | Possible reduced engine performance. |
| 1228 27 2 | Egr valve position - Data erratic, intermittent, or Incorrect. The EGR valve is unable to meet commanded position. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 1239 2623 3 | Accelerator pedal or lever position sensor 2 circuit - Voltage above normal or shorted to high source. High voltage detected at accelerator pedal position number 2 signal circuit. | The engine will operate in limp home mode. |
| 1241 2623 4 | Accelerator pedal or lever position sensor 2 circuit - Voltage below normal or shorted to low source. Low voltage detected at accelerator pedal position number 2 signal circuit. | The engine will operate in limp home mode. |
| 1242 91 2 | Accelerator pedal or lever position sensor 1 and 2 - Data erratic, intermittent, or incorrect. Accelerator position sensor number 1 and number 2 are reading different values. | The engine will only idle. |
| 1515 91 19 | Sae J1939 multiplexed accelerator pedal or lever sensor system - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the multiplexed accelerator pedal. | The engine will only idle. |
| 1654 1323 31 | Engine misfire cylinder 1- Condition exists. Engine misfire has been detected in cylinder number 1. | Possible reduced engine performance. |
| 1655 1324 31 | Engine misfire cylinder 2 - Condition exists. Engine misfire has been detected in cylinder number 2. | Possible reduced engine performance. |
| 1656 1325 31 | Engine misfire cylinder 3 - Condition exists. Engine misfire has been detected in cylinder number 3. | Possible reduced engine performance. |
| 1657 1326 31 | Engine misfire cylinder 4 - Condition exists. Engine misfire has been detected in cylinder number 4. | Possible reduced engine performance. |
| 1658 1327 31 | Engine misfire cylinder 5 - Condition exists. Engine misfire has been detected in cylinder number 5. | Possible reduced engine performance. |
| 1659 1328 31 | Engine misfire cylinder 6 - Condition exists. Engine misfire has been detected in cylinder number 6. | Possible reduced engine performance. |
| 1668 1761 4 | Aftertreatment diesel exhaust fluid tank level sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid tank level sensor circuit. | Possible reduced engine performance. |
| 1669 1761 3 | Aftertreatment diesel exhaust fluid tank level sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the catalyst tank level sensor circuit. | Possible reduced engine performance. |
| 1673 1761 1 | Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Most severe level. The aftertreatment diesel exhaust fluid tank level has fallen below the critical warning level. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|---|
| 1677 3031 4 | Aftertreatment diesel exhaust fluid tank temperature sensor - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid tank temperature sensor circuit. | Possible reduced engine performance. |
| 1678 3031 3 | Aftertreatment diesel exhaust fluid tank temperature sensor - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the diesel exhaust fluid tank temperature sensor circuit. | Possible reduced engine performance. |
| 1679 3031 2 | Aftertreatment diesel exhaust fluid tank temperature - Data erratic, intermittent, or incorrect. The diesel exhaust fluid tank temperature sensor has indicated a tank temperature too high or too low for the ambient conditions. | Possible reduced engine performance. |
| 1682 3362 31 | Aftertreatment diesel exhaust fluid dosing unit input lines - Condition exists. The aftertreatment diesel exhaust fluid dosing unit is unable to prime. | Possible reduced engine performance. |
| 1683 3363 3 | Aftertreatment diesel exhaust fluid tank heater - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid tank heater circuit. | Possible reduced engine performance. |
| 1684 3363 4 | Aftertreatment diesel exhaust fluid tank heater - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid tank heater circuit. | Possible reduced engine performance. |
| 1691 100 18 | Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Moderately severe level. The temperature increase across the aftertreatment catalyst is lower than expected. | Possible frequent need for aftertreatment regeneration. |
| 1695 3513 3 | Sensor supply 5 - Voltage above normal or shorted to high source. High voltage detected at sensor supply 5 circuit in the oem harness. | the engine will operate in limp home mode. |
| 1696 3513 4 | Sensor supply 5 - Voltage below normal or shorted to low source. Low voltage detected at sensor supply number 5 circuit in the oem harness. | the engine will operate in limp home mode. |
| 1712 3363 18 | Aftertreatment diesel exhaust fluid tank heater - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid tank heater is unable to thaw the frozen diesel exhaust fluid. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 1713 3363 16 | Aftertreatment diesel exhaust fluid tank heater - Data valid but above normal operating range - Moderately severe level. The diesel exhaust fluid tank heater is continuously in the on position. | None on performance. |
| 1718 1322 31 | Engine misfire for multiple cylinders - Condition exists. Engine misfire has been detected in multiple cylinder numbers. | Possible reduced engine performance. |
| 1776 2634 3 | Power relay driver circuit - Voltage above normal or shorted to high source. High voltage detected at power relay driver circuit. | Possible reduced engine performance. |
| 1777 2634 4 | Power relay driver circuit - Voltage below normal or shorted to low source. An open circuit or low voltage has been detected at the power relay circuit. | Possible reduced engine performance. |
| 1843 101 3 | Crankcase pressure circuit - Voltage above normal or shorted to high source. High signal voltage detected at the crankcase pressure circuit. | None on performance. |
| 1844 101 4 | Crankcase pressure circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the crankcase pressure circuit. | None on performance. |
| 1866 411 2 | Exhaust gas recirculation valve delta pressure - Data erratic, intermittent, or incorrect. An error in the egr delta pressure signal was detected at initial key on or the sensor failed the autozero test. | possible reduced engine performance. |
| 1867 412 2 | Engine gas recirculation temperature - Data erratic, intermittent, or incorrect. Engine misfire has been detected in multiple cylinder numbers. | Possible reduced engine performance. |
| 1879 3251 3 | Aftertreatment diesel particulate filter differential pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment differential pressure sensor circuit. | possible reduced engine performance. |
| 1881 3251 4 | Aftertreatment diesel particulate filter differential pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage or open circuit detected at the aftertreatment differential pressure sensor circuit. | possible reduced engine performance. |
| 1883 3251 2 | Aftertreatment diesel particulate filter differential pressure sensor - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter differential pressure sensor is reading an erratic value at initial key on or during engine operation. | possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 1885 3216 4 | Aftertreatment intake NOx sensor circuit - Voltage below normal or shorted to low source. An internal circuit error has been detected by the aftertreatment intake NOx sensor. | Possible reduced engine performance. |
| 1887 3226 4 | Aftertreatment outlet NOx sensor circuit - Voltage below normal or shorted to low source. An internal circuit error has been detected by the aftertreatment outlet NOx sensor. | Possible reduced engine performance. |
| 1896 2791 13 | EGR valve controller - Out of calibration. The EGR valve has failed the automatic calibration procedure at initial key ON. | Possible reduced engine performance. |
| 1921 3251 0 | Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Moderately severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits. | Possible reduced engine performance. |
| 1922 3251 0 | Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Most severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits. Engine protection derate is enabled. | Possible reduced engine performance. |
| 1938 3597 1 | Ecu power output supply voltage 1 - Data valid but below normal operational range - Moderately severe level. Low battery voltage detected by the VGT actuator. | Possible reduced engine performance. |
| 1942 101 2 | Crankcase pressure - Data erratic, intermittent, or incorrect. The ECM has detected that the crankcase pressure signal is reading an erratic value at initial key ON or during engine operation. | None on performance. |
| 1961 2791 0 | EGR valve control circuit calculated over temperature - Data valid but above normal operational range - Least severe level. High EGR valve driver temperature has been detected. | Possible reduced engine performance. |
| 1962 641 0 | VGT Actuator driver over temperature (calculated) - Data valid but above normal operating range - Least severe level. High internal VGT actuator temperature has been detected. | None on performance. |
| 1974 101 16 | Crankcase pressure - Data valid but above normal operating range - Moderately severe level. The crankcase breather filter requires maintenance. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|--|
| 1993 4795 31 | Aftertreatment diesel particulate filter missing - Condition exists. The aftertreatment diesel particulate filter in the exhaust system is not present. | Active aftertreatment diesel particulate filter regeneration will be disabled. |
| 2185 3512 3 | Sensor supply 4 circuit - Voltage above normal, or shorted to high source. High voltage detected at 5 VDC sensor supply circuit to the accelerator pedal position sensor. | Engine will only idle. |
| 2186 3512 4 | Sensor supply 4 circuit - Voltage below normal, or shorted to low source. Low voltage detected at 5 VDC sensor supply circuit to the accelerator pedal position sensor. | Engine will only idle. |
| 2198 641 11 | VGT Actuator driver circuit - Root cause not known. Intermittent communication between the smart VGT controller and the ECM has been detected. The VGT controller is not interpreting the J1939 message from the ECM correctly. | Possible reduced engine performance. |
| 2272 27 4 | EGR Valve position circuit - Voltage below normal or shorted to low source. Low signal voltage has been detected at the EGR valve position sensor circuit | Possible reduced engine performance. |
| 2273 411 3 | Exhaust gas recirculation valve delta pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the EGR differential pressure sensor circuit. | Possible reduced engine performance. |
| 2274 411 4 | Exhaust gas recirculation valve delta pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the EGR differential pressure sensor circuit. | Possible reduced engine performance. |
| 2288 103 15 | Turbocharger 1 speed - Data valid but above normal operating range - Least severe level. High turbocharger speed has been detected by the ECM. | Possible reduced engine performance. |
| 2311 633 31 | Electronic fuel injection control valve circuit - Condition exists. Fuel pump actuator circuit resistance too high or too low, or an intermittent connection has been detected. | Possible reduced engine performance. |
| 2322 723 2 | Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. Camshaft engine speed sensor intermittent synchronization. | None on performance. |
| 2349 2791 5 | EGR Valve control circuit - Current below normal or open circuit. Motor terminal or motor coil open circuit has been detected by the ECM. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 2353 2791 6 | EGR Valve control circuit - Current above normal or grounded circuit. A short circuit to ground has been detected in the EGR valve motor circuit. | Possible reduced engine performance. |
| 2372 95 16 | Fuel filter differential pressure - Data valid but above normal operational range - Moderately severe level. Excessive fuel flow restriction to the high pressure fuel pump has been detected. | Possible reduced engine performance. |
| 2373 1209 3 | Exhaust gas pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the exhaust gas pressure circuit. | Possible reduced engine performance. |
| 2374 1209 4 | Exhaust gas pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the exhaust gas pressure circuit. | Possible reduced engine performance. |
| 2375 412 3 | Exhaust gas recirculation temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at EGR temperature circuit. | Possible reduced engine performance. |
| 2376 412 4 | Exhaust gas recirculation temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at EGR temperature circuit. | Possible reduced engine performance. |
| 2377 647 3 | Fan control circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at the fan control circuit. | The fan can stay on continuously or not run at all. |
| 2387 641 7 | VGT Actuator driver circuit (motor) - Mechanical system not responding or out of adjustment. The smart VGT controller has detected incorrect stop limits, or the VGT is unable to move to the closed position. | Possible reduced engine performance. |
| 2398 171 2 | Ambient air temperature - Data erratic, intermittent, or incorrect. The ambient air temperature sensor is reading an erratic value. | Possible reduced engine performance. |
| 2448 111 17 | Coolant level - Data valid but below normal operational range - Least severe level. Low engine coolant level detected. | none on performance. |
| 2449 641 13 | Vgt actuator controller - Out of calibration. The VGT actuator has been installed incorrectly. | Possible reduced engine performance. |
| 2468 102 3 | Engine crankshaft speed/position - Data valid but above normal operating range - Moderately severe level. The engine speed has exceeded a critical limit. | Engine will be shut down. |
| 2554 1209 2 | Exhaust gas pressure - Data erratic, intermittent or incorrect. The exhaust gas pressure sensor is reading an erratic value. | possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 2555 729 3 | Intake air heater 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at the intake air heater signal circuit. | The intake air heaters may be ON or OFF all the time. |
| 2556 729 4 | Intake air heater 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the intake air heater signal circuit. | The intake air heaters may be ON or OFF all the time. |
| 2634 641 12 | VGT Actuator controller - Bad intelligent device or component. An internal error has been detected by the smart VGT controller. | Possible reduced engine performance. |
| 2636 641 9 | VGT Actuator driver circuit - abnormal update rate. No communications on the J1939 data link between the engine ECM and the smart VGT controller. | Possible reduced engine performance. |
| 2638 5298 17 | Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Least severe level. The temperature increase across the aftertreatment diesel oxidation catalyst is lower than expected. | Possible frequent need for aftertreatment regeneration. |
| 2639 3251 15 | Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Least severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits. | Possible reduced engine performance. |
| 2646 110 32 | Engine coolant temperature - Condition exists. The EGR valve was closed to reduce engine coolant temperature. | Possible reduced engine performance. |
| 2718 520325 31 | Brake switch and accelerator pedal position incompatible - Condition exists. The ECM has detected the brake pedal and accelerator pedal were depressed simultaneously. | The engine will operate in limp home mode. |
| 2771 3226 9 | Aftertreatment outlet NOx sensor - Abnormal update rate. No communications or an invalid data transfer rate detected on the J1939 data link between the ECM and the aftertreatment outlet NOx sensor. | Possible reduced engine performance. |
| 2777 3703 31 | Particulate trap active regeneration inhibited due to inhibit switch - Condition exists. Regeneration of the diesel particulate filter has been prevented due to the permit switch being disabled. | Possible frequent need for aftertreatment regeneration. |
| 2961 412 15 | Exhaust gas recirculation temperature - Data valid but above normal operational range - Least severe level. EGR temperature has exceeded the engine protection limit. | Possible reduced engine performance. |
| 2962 412 16 | Exhaust gas recirculation temperature - Data valid but above normal operational range - Moderately severe level. EGR temperature has exceeded the engine protection limit. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 2963 110 15 | Engine coolant temperature - Data valid but above normal operational range - Least severe level. Engine coolant temperature is above the engine protection warning limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 2964 105 15 | Intake manifold 1 temperature - Data valid but above normal operational range - Least severe level. Intake manifold air temperature signal indicates intake manifold air temperature is above engine protection warning limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 2973 102 2 | Intake manifold 1 pressure - Data erratic, intermittent, or incorrect. The intake manifold pressure sensor is reading an erratic value. | Possible reduced engine performance. |
| 2976 3361 2 | Aftertreatment diesel exhaust fluid dosing unit temperature - Data erratic, intermittent, or incorrect. An internal error has been detected in the aftertreatment diesel exhaust fluid dosing unit. | Possible reduced engine performance. |
| 3133 3610 3 | Aftertreatment diesel particulate filter outlet pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment diesel particulate filter outlet pressure sensor circuit. | Possible reduced engine performance. |
| 3134 3610 4 | Aftertreatment diesel particulate filter outlet pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter outlet pressure sensor circuit. | Possible reduced engine performance. |
| 3135 3610 2 | Aftertreatment diesel particulate filter outlet pressure - Data erratic, intermittent or incorrect. The aftertreatment diesel particulate filter outlet pressure sensor is reading an erratic value at initial key ON or during engine operation. | Possible reduced engine performance. |
| 3146 4363 3 | Aftertreatment SCR outlet temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the SCR outlet temperature sensor circuit. | Possible reduced engine performance. |
| 3147 4363 4 | Aftertreatment SCR outlet temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the SCR outlet temperature sensor circuit. | Possible reduced engine performance. |
| 3148 4363 2 | Aftertreatment SCR outlet temperature sensor - Data erratic, intermittent, or incorrect. The SCR outlet temperature sensor is not changing with engine operating conditions. | Possible reduced engine performance. |
| 3151 4794 31 | Aftertreatment SCR catalyst system missing - Condition exists. The aftertreatment SCR catalyst in the exhaust system is not present. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 3165 4363 0 | Aftertreatment SCR outlet temperature - Data valid but above normal operational range - Most severe level. The SCR outlet temperature sensor reading has exceeded the maximum engine protection temperature limit. | Possible reduced engine performance. |
| 3168 3936 16 | Aftertreatment diesel particulate filter system - Data valid but above normal operating range - Moderately severe level. The system has detected a malfunction in the filtering capability of the aftertreatment diesel particulate filter. | None on performance. |
| 3186 1623 9 | Tachograph output shaft speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the tachograph output shaft speed sensor. | None on performance. |
| 3213 1623 19 | Tachograph output shaft speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the tachograph output shaft speed sensor. | None on performance. |
| 3228 3216 2 | Aftertreatment Intake NOx sensor - Data erratic, intermittent, or incorrect. An incorrect NOx sensor reading has been detected by the aftertreatment intake NOx sensor. | Possible reduced engine performance. |
| 3232 3216 9 | Aftertreatment Intake NOx sensor - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the aftertreatment intake NOx sensor. | Possible reduced engine performance. |
| 3235 4363 16 | Aftertreatment SCR outlet temperature - Data valid but above normal operating range - Moderately severe level. The SCR outlet temperature sensor reading has exceeded the maximum temperature limit. | Possible reduced engine performance. |
| 3237 4340 3 | Aftertreatment diesel exhaust fluid line heater 1 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 1 circuit. | Possible reduced engine performance. |
| 3238 4340 4 | Aftertreatment diesel exhaust fluid line heater 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 1 circuit. | Possible reduced engine performance. |
| 3239 4342 3 | Aftertreatment diesel exhaust fluid line heater 2 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 2 circuit. | Possible reduced engine performance. |
| 3241 4342 4 | Aftertreatment diesel exhaust fluid line heater 2 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 2 circuit. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 3242 3363 7 | Aftertreatment diesel exhaust fluid tank heater - Mechanical system not responding or out of adjustment. The aftertreatment diesel exhaust fluid temperature did not increase when the aftertreatment diesel exhaust fluid tank heater was commanded ON. | Possible reduced engine performance. |
| 3243 3060 18 | Engine cooling system monitor - Data valid but below normal operating range - Moderately severe level. The engine is not warming up as expected. | None on performance. |
| 3251 4765 16 | Aftertreatment diesel oxidation catalyst intake temperature - Data valid but above normal operating range - Moderately severe level. The diesel oxidation catalyst intake temperature sensor reading has exceeded the maximum temperature limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 3253 3242 16 | Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Moderately severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 3254 3242 15 | Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Least severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit. | Possible reduced engine performance. |
| 3255 3246 16 | Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Moderately severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 3256 3246 15 | Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Least severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit. | Possible reduced engine performance. |
| 3258 4340 5 | Aftertreatment diesel exhaust fluid line heater 1 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 1. | Possible reduced engine performance. |
| 3261 4342 5 | Aftertreatment diesel exhaust fluid line heater 2 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 2. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|---|
| 3311 3242 0 | Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Most severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 3312 3246 0 | Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Most severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 3313 4765 4 | Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the catalyst intake sensor circuit. | Possible reduced engine performance. |
| 3314 4765 3 | Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the catalyst intake temperature sensor circuit. | Possible reduced engine performance. |
| 3315 4765 2 | Aftertreatment diesel oxidation catalyst intake temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel oxidation catalyst intake temperature sensor is not changing with engine operating conditions. | Possible reduced engine performance. |
| 3316 3242 4 | Aftertreatment diesel particulate filter intake temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter intake temperature sensor circuit. | Possible reduced engine performance. |
| 3317 3242 3 | Aftertreatment diesel particulate filter intake temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the aftertreatment diesel particulate filter intake temperature sensor circuit. | Possible reduced engine performance. |
| 3318 3242 2 | Aftertreatment diesel particulate filter intake temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter intake temperature is not changing with engine operating conditions. | Possible reduced engine performance. |
| 3319 3246 3 | Aftertreatment diesel particulate filter outlet temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the aftertreatment diesel particulate filter outlet temperature sensor circuit. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|---|
| 3321 3246 4 | Aftertreatment diesel particulate filter outlet temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter outlet temperature sensor circuit. | Possible reduced engine performance. |
| 3322 3246 2 | Aftertreatment diesel particulate filter outlet temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter outlet temperature is not changing with engine operating conditions. | Possible reduced engine performance. |
| 3326 91 9 | SAE J1939 Multiplexed accelerator pedal or lever sensor system - Abnormal update rate. The ECM expected information from a multiplexed accelerator pedal or lever sensor but did not receive it soon enough or did not receive it at all. | Engine will only idle. |
| 3328 191 9 | Transmission output shaft speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the transmission output shaft speed sensor. | None on performance. |
| 3342 4752 18 | Engine exhaust gas recirculation cooler efficiency - Data valid but below normal operating range - Moderately severe level. The EGR cooler is not cooling the recirculated exhaust gas sufficiently. | None on performance. |
| 3343 5285 18 | Engine charge-air cooler efficiency - Data valid but below normal operating range - Moderately severe level. The engine charge air cooler is not cooling the intake air flow sufficiently. | None on performance. |
| 3361 102 10 | Intake manifold 1 pressure - Abnormal rate of change. The VGT position reading is stuck. | Possible reduced engine performance. |
| 3366 111 18 | Coolant level - Data valid but below normal operating range - Moderately severe level. Very low engine coolant level detected. | None on performance. |
| 3374 1818 31 | Roll over protection brake control active - Condition exists. The ECM received a message from the anti-lock braking (ABS) controller, inhibiting cruise control operation. | Cruise control could possibly not operate. |
| 3375 5397 31 | Aftertreatment diesel particulate filter regeneration too frequent - Condition exists. The system has detected the need for an active regeneration has occurred too soon following the last active regeneration. | None on performance. |
| 3376 5319 31 | Aftertreatment diesel particulate filter incomplete regeneration - Condition exists. The system has detected that the aftertreatment diesel particulate filter differential pressure is too high following an active regeneration. | Possible frequent need for aftertreatment regeneration. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|---|
| 3382 3058 18 | Engine exhaust gas recirculation (EGR) system - Data valid but below normal operating range - Moderately severe level. Measured egr flow is lower than commanded. | Possible reduced engine performance. |
| 3383 3058 16 | Engine exhaust gas recirculation (EGR) system - Data valid but above normal operating range - Moderately severe Level. Measured EGR flow is higher than commanded. | Possible reduced engine performance. |
| 3394 4766 18 | Aftertreatment 1 diesel oxidation catalyst outlet gas temperature - Data valid but below normal operating range - Moderately severe level. The diesel oxidation catalyst outlet Temperature is below the operating limit | Possible frequent need for aftertreatment regeneration. |
| 3396 3750 31 | Diesel particulate filter 1 conditions not met for active regeneration - Condition exists. The aftertreatment temperatures are not warm enough for aftertreatment injection. | Possible frequent need for aftertreatment regeneration. |
| 3418 191 19 | Transmission output shaft speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the transmission output shaft speed sensor. | None on performance. |
| 3422 4344 3 | Aftertreatment diesel exhaust fluid line heater 3 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 3 circuit. | Possible reduced engine performance. |
| 3423 4344 4 | Aftertreatment diesel exhaust fluid line heater 3 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 3 circuit. | Possible reduced engine performance. |
| 3425 4344 5 | Aftertreatment diesel exhaust fluid line heater 3 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 3. | Possible reduced engine performance. |
| 3488 563 9 | Anti-lock braking (ABS) controller - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the anti-lock braking (ABS) controller. | None on performance. |
| 3492 251 10 | Real time clock - Abnormal rate of change. The real time clock indicates a stuck engine off timer. | None on performance. |
| 3494 1081 7 | Engine wait to start lamp - Mechanical system not responding or out of adjustment. Wait to Start lamp has malfunction. | None on performance. |
| 3497 1761 17 | Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Least severe level. The aftertreatment diesel exhaust fluid tank level is low. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|---|
| 3498 1761 18 | Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid tank level is very low. | None on performance. |
| 3525 84 19 | Wheel-based vehicle speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the wheel-based vehicle speed sensor. | Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work. |
| 3526 84 9 | Wheel-Based vehicle speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the wheel-based vehicle speed sensor. | Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work. |
| 3527 558 19 | Accelerator pedal or lever idle validation switch - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the accelerator pedal or lever idle validation switch. | The engine will only idle. |
| 3528 558 9 | Accelerator pedal or lever idle validation switch - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the accelerator pedal or lever idle validation switch. | Engine will only idle. |
| 3531 171 9 | Ambient air temperature - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the ambient air temperature sensor. | Possible reduced engine performance. |
| 3532 171 19 | Ambient air temperature - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the ambient air temperature sensor. | Possible reduced engine performance. |
| 3539 51 3 | Engine intake throttle actuator position sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine intake air throttle position sensor circuit. | Possible reduced engine performance. |
| 3541 51 4 | Engine intake throttle actuator position sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the engine intake air throttle position sensor circuit. | Possible reduced engine performance. |
| 3542 51 2 | Engine intake throttle actuator position sensor - Data erratic, intermittent or incorrect. The engine intake air throttle position feedback is erratic or incorrect. | Possible reduced engine performance. |
| 3545 3226 10 | Aftertreatment outlet NOx sensor circuit - Abnormal rate of change. The aftertreatment outlet NOx sensor reading is not valid. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|---|
| 3547 4096 31 | Aftertreatment diesel exhaust fluid tank empty - Condition exists. The diesel exhaust fluid tank is empty. | Possible reduced engine performance. |
| 3555 1081 9 | Engine wait to start lamp - Abnormal update rate. A loss of communication has been detected. | None on performance. |
| 3556 1081 19 | Engine wait to start lamp - Received network data in error. The ECM received an invalid signal on the SAE J1939 datalink. | None on performance. |
| 3558 3361 3 | Aftertreatment diesel exhaust fluid dosing unit - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit. | Possible reduced engine performance. |
| 3559 3361 4 | Aftertreatment diesel exhaust fluid dosing unit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit. | Possible reduced engine performance. |
| 3562 5491 3 | Aftertreatment diesel exhaust fluid line heater relay - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater relay. | Possible reduced engine performance. |
| 3563 5491 4 | Aftertreatment diesel exhaust fluid line heater relay - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater relay. | Possible reduced engine performance. |
| 3567 5394 5 | Aftertreatment diesel exhaust fluid dosing valve - Current below normal or open circuit. A circuit error has been detected in the aftertreatment diesel exhaust fluid dosing valve circuit. | Possible reduced engine performance. |
| 3568 5394 7 | Aftertreatment diesel exhaust fluid (DEF) Dosing valve - Mechanical system not responding or out of adjustment. A mechanical malfunction has been detected in the DEF dosing valve. | Possible reduced engine performance. |
| 3571 4334 3 | Aftertreatment diesel exhaust fluid pressure sensor - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid pressure sensor circuit. | Possible reduced engine performance. |
| 3572 4334 4 | Aftertreatment diesel exhaust fluid pressure sensor - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid pressure sensor circuit. | Possible reduced engine performance. |
| 3574 4334 18 | Aftertreatment diesel exhaust fluid pressure sensor - Data valid but below normal operating range - Moderately severe level. Low diesel exhaust fluid pressure has been detected in the dosing unit. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|---|
| 3575 4334 16 | Aftertreatment diesel exhaust fluid pressure sensor - Data valid but above normal operating range - Moderately severe level. The diesel exhaust fluid dosing unit has detected a blockage in the diesel exhaust fluid return flow. | Possible reduced engine performance. |
| 3577 4376 3 | Aftertreatment diesel exhaust fluid return valve - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid return valve. | Possible reduced engine performance. |
| 3578 4376 4 | Aftertreatment diesel exhaust fluid return valve - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid return valve. | Possible reduced engine performance. |
| 3582 4364 18 | Aftertreatment SCR catalyst conversion efficiency - Data valid but below normal operating range - Moderately severe level. NOx conversion across the SCR catalyst is too low. | Possible reduced engine performance. |
| 3583 5031 10 | Aftertreatment outlet NOx sensor heater - Abnormal rate of change. The aftertreatment outlet NOx sensor heater is unable to maintain its normal operating temperature. | None on performance. |
| 3596 4334 2 | Aftertreatment diesel exhaust fluid pressure sensor - Data erratic, intermittent, or incorrect. The diesel exhaust fluid pressure sensor has reported a reading too high or low for the operating conditions. | Possible reduced engine performance. |
| 3649 5024 10 | Aftertreatment Intake NOx sensor heater - Abnormal rate of change. The aftertreatment intake NOx sensor heater is unable to maintain its normal operating temperature. | None on performance. |
| 3681 3228 2 | Aftertreatment outlet NOx sensor power supply - Data erratic, intermittent, or incorrect. The aftertreatment outlet NOx sensor indicates that the power supply to the sensor is incorrect. | None on performance. |
| 3682 3218 2 | Aftertreatment Intake NOx sensor power supply - Data erratic, intermittent or incorrect. The aftertreatment intake NOx sensor indicates that the power supply to the sensor is incorrect. | None on performance. |
| 3697 630 12 | Engine control module calibration memory - Bad intelligent device or component. Error internal to the ECM related to engine software failures. | Engine may not start or may be difficult to start. |
| 3712 5246 0 | Aftertreatment SCR operator inducement - Data valid but above normal operational range - Most severe level. Critical SCR related fault codes have been active for an extended period of time and require immediate attention. | Vehicle speed will be limited to 8 km [5 miles] per hour. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 3714 1569 31 | Engine protection torque derate - Condition exists. Critical fault codes related to engine operation are active. | Possible reduced engine performance. |
| 3715 188 16 | Engine speed at idle - Data valid but below normal operating range - Moderately severe level. The engine speed at idle has exceeded the governed idle speed. | Possible reduced engine performance. |
| 3716 188 18 | Engine speed at idle - Data valid but below normal operational range - Moderately severe level. Engine is not maintaining the governed idle speed. | None on performance. |
| 3717 3226 13 | Aftertreatment outlet NOx sensor - Out of calibration. A calibration mismatch between the aftertreatment outlet NOx sensor and the ECM has been detected. | None on performance. |
| 3718 3216 13 | Aftertreatment intake NOx - Out of calibration. A calibration mismatch between the aftertreatment intake NOx sensor and the ECM has been detected. | None on performance. |
| 3724 168 17 | Battery 1 voltage - Data valid but below normal operating range - Least severe level. Low voltage to the EGR valve device driver has been detected. | Possible reduced engine performance. |
| 3725 3216 10 | Aftertreatment Intake NOx sensor - Abnormal rate of change. The aftertreatment intake NOx sensor reading is not valid. | None on performance. |
| 3727 5571 7 | High pressure common rail fuel pressure relief valve - Mechanical system not responding or out of adjustment. The fuel rail high-pressure relief valve has opened at a lower than expected pressure. | Possible reduced engine performance. |
| 3737 1675 31 | Engine starter mode overcrank protection - Condition exists. The starter motor has been temporarily disabled in order to prevent starter damage. | Starter operation is prohibited until the starter motor has adequately cooled. |
| 3741 5571 0 | High pressure common rail fuel pressure relief valve - Data valid but above normal operational range - Most severe level. The fuel rail pressure relief valve has opened due to high fuel rail pressure. | Engine may run rough, may stop running, may not start, or may be difficult to start. |
| 3749 3226 20 | Aftertreatment outlet NOx sensor - Data not rational - Drifted high. An offset in the outlet NOx sensor reading has been detected. | None on performance. |
| 3838 2978 9 | Estimated engine parasitic losses - Percent torque - Abnormal update rate. A loss of communication has been detected. | None on performance. |
| 3843 5603 9 | Cruise control disable command - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the cruise control. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 3844 5605 31 | Cruise control pause command - Condition exists. The adaptive cruise control has dropped out and must be manually engaged. | Cruise control could possibly not operate. |
| 3845 5603 31 | Cruise control disable command - Condition exists. The adaptive cruise control has dropped out and must be manually engaged. | Cruise control could possibly not operate. |
| 3899 5848 4 | Aftertreatment 1 SCR Intermediate NH3 sensor - Voltage below normal, or shorted to low source. A circuit error has been detected in the NH3 sensor. | None on performance. |
| 3911 5848 9 | Aftertreatment SCR Intermediate NH3 sensor - Abnormal update rate. Loss of communication with the aftertreatment SCR intermediate NH3 sensor. | Possible reduced engine performance. |
| 3912 5853 10 | Aftertreatment SCR Intermediate NH3 sensor heater - Abnormal rate of change. A malfunction of the aftertreatment SCR intermediate NH3 sensor heater has been detected. | Possible reduced engine performance. |
| 3932 5851 16 | Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data valid but above normal operating range - Moderately severe level. High battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor. | Possible reduced engine performance. |
| 3933 5851 18 | Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data valid but below normal operating range - Moderately severe level. Low battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor. | Possible reduced engine performance. |
| 3934 5851 2 | Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data erratic, intermittent or incorrect. Intermittent battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor. | Possible reduced engine performance. |
| 3935 5848 13 | Aftertreatment SCR Intermediate NH3 sensor - Out of calibration. Incorrect trim resistance has been detected in the aftertreatment SCR intermediate NH3 sensor. | Possible reduced engine performance. |
| 3936 5848 12 | Aftertreatment SCR Intermediate NH3 sensor - Bad intelligent device or component. An internal error of the aftertreatment SCR intermediate NH3 sensor has been detected. | Possible reduced engine performance. |
| 3937 5848 10 | Aftertreatment 1 SCR Intermediate NH3 sensor - Abnormal rate of change. The aftertreatment SCR intermediate NH3 sensor reading is NOT valid. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|--|
| 4149 2623 8 | Accelerator pedal or lever position sensor 2 circuit frequency - Abnormal frequency or pulse width or period. The accelerator pedal position sensor reading is out of range. | The engine will operate in Limp Home mode. |
| 4151 5742 9 | Aftertreatment diesel particulate filter temperature sensor module - Abnormal update rate. No communications on the J1939 data link between the ECM and the aftertreatment diesel particulate filter temperature sensor module. | Possible reduced engine performance. |
| 4152 5743 9 | Aftertreatment selective catalytic reduction temperature sensor module - Abnormal update rate. No communications on the J1939 data link between the ECM and the aftertreatment SCR temperature sensor module. | Possible reduced engine performance. |
| 4155 5746 3 | Aftertreatment 1 diesel exhaust fluid dosing unit heater relay - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit heater relay circuit. | Possible reduced engine performance. |
| 4156 5746 4 | Aftertreatment 1 diesel exhaust fluid dosing unit heater relay - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit heater relay circuit. | Possible reduced engine performance. |
| 4157 4376 7 | Aftertreatment diesel exhaust fluid return valve - Mechanical system not responding or out of adjustment. A stuck aftertreatment diesel exhaust fluid return valve has been detected. | None on performance. |
| 4158 5742 12 | Aftertreatment diesel particulate filter temperature sensor module - Bad intelligent device or component. An internal error has been detected in the aftertreatment diesel particulate filter temperature sensor module. | Possible reduced engine performance. |
| 4159 5743 12 | Aftertreatment selective catalytic reduction temperature sensor module - Bad intelligent device or component. An internal error has been detected in the aftertreatment SCR temperature sensor module. | Possible reduced engine performance. |
| 4161 5742 3 | Aftertreatment diesel particulate filter temperature sensor module - Voltage above normal, or shorted to high source. High battery supply voltage detected at the aftertreatment diesel particulate filter temperature sensor module. | Possible reduced engine performance. |
| 4162 5742 4 | Aftertreatment diesel particulate filter temperature sensor module - Voltage below normal, or shorted to low source. Low battery supply voltage detected at the aftertreatment diesel particulate filter temperature sensor module. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 4163 5742 16 | Aftertreatment diesel particulate filter temperature sensor module- Data valid but above normal operating range - Moderately severe level. High internal temperature detected in the aftertreatment diesel particulate filter temperature sensor module. | Possible reduced engine performance. |
| 4164 5743 3 | Aftertreatment selective catalytic reduction temperature sensor module - Voltage above normal, or shorted to high source. High battery supply voltage detected at the aftertreatment SCR temperature sensor module. | Possible reduced engine performance. |
| 4165 5743 4 | Aftertreatment selective catalytic reduction temperature sensor module - Voltage below normal, or shorted to low source. Low battery supply voltage detected at the aftertreatment SCR temperature sensor module. | Possible reduced engine performance. |
| 4166 5743 16 | Aftertreatment selective catalytic reduction temperature sensor module - Data valid but above normal operating range - Moderately severe level. High internal temperature detected in the aftertreatment SCR temperature sensor module. | Possible reduced engine performance. |
| 4168 5745 3 | Aftertreatment diesel exhaust fluid dosing unit heater - Voltage above normal, or shorted to high source. The aftertreatment diesel exhaust fluid dosing unit heater is detected to be stuck on. | None on performance. |
| 4169 5745 5 | Aftertreatment diesel exhaust fluid dosing unit heater - Voltage below normal, or shorted to low source. The aftertreatment diesel exhaust fluid dosing unit heater is detected to be stuck off. | Possible reduced engine performance. |
| 4171 5745 18 | Aftertreatment diesel exhaust fluid dosing unit heater - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid dosing unit failed to thaw. | Possible reduced engine performance. |
| 4213 3695 2 | Aftertreatment diesel particulate filter regeneration inhibit switch - Data erratic, intermittent or incorrect. The diesel particulate filter regeneration permit switch is stuck in the OFF or INHIBIT position. | Possible frequent need for aftertreatment regeneration. |
| 4215 563 31 | Anti-lock braking (ABS) Active - Condition exists. Cruise control was paused due to an anti-wheel slip message from the ABS controller. | Adaptive cruise control will not operate. Standard cruise control may not operate. |
| 4244 4337 2 | Aftertreatment diesel exhaust fluid dosing temperature - Data erratic, intermittent or incorrect. The aftertreatment diesel exhaust fluid dosing temperature is irrational. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|--|--|
| 4245 5798 2 | Aftertreatment diesel exhaust fluid dosing unit heater temperature - Data erratic, intermittent or incorrect. The aftertreatment diesel exhaust fluid dosing unit heater temperature is irrational. | None on performance. |
| 4249 4337 10 | Aftertreatment diesel exhaust fluid dosing temperature - Abnormal rate of change. The aftertreatment diesel exhaust fluid dosing unit temperature is stuck. | None on performance. |
| 4251 5798 10 | Aftertreatment 1 diesel exhaust fluid dosing unit heater temperature - Abnormal rate of change. The aftertreatment diesel exhaust fluid dosing unit heater temperature sensor reading is stuck. | None on performance. |
| 4252 1081 31 | Engine wait to start lamp - Condition exists. The received signal does not match the commanded signal. | None on performance. |
| 4259 5742 11 | Aftertreatment diesel particulate filter temperature sensor module - Root cause not known. Intermittent battery voltage supply detected at the aftertreatment diesel particulate filter temperature sensor module. | Possible reduced engine performance. |
| 4261 5743 11 | Aftertreatment selective catalytic reduction temperature sensor module - Root cause not known. Intermittent battery voltage supply detected at the aftertreatment SCR temperature sensor module. | Possible reduced engine performance. |
| 4279 5848 21 | Aftertreatment 1 SCR Intermediate NH3 - Data not rational - Drifted low. An in range low failure has been detected. | Possible reduced engine performance. |
| 4281 5848 2 | Aftertreatment SCR Intermediate NH3 - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate NH3 sensor reading is stuck. | None on performance. |
| 4284 5793 9 | Desired engine fueling state - Abnormal update rate. A valid message from the transmission ECU has NOT been received. | Engine may not start or may be difficult to start. |
| 4289 91 8 | Accelerator pedal or lever position sensor 1 circuit frequency - Abnormal frequency or pulse width or period. The accelerator pedal position sensor reading is out of range. | The engine will operate in limp home mode. |
| 4452 520668 31 | Aftertreatment outlet NOx sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached. | Possible reduced engine performance. |
| 4453 520669 31 | Aftertreatment intermediate NH3 sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached. | None on performance. |
| 4517 237 13 | Vehicle Identification number - Out of calibration. The vehicle identification number has not been programmed into the ECM. | None on performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 4518 5862 3 | Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment SCR intermediate temperature sensor circuit. | Possible reduced engine performance. |
| 4519 5862 4 | Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment SCR intermediate temperature sensor circuit. | Possible reduced engine performance. |
| 4521 5862 2 | Aftertreatment SCR Intermediate gas temperature sensor - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate temperature sensor reading is irrational. | Possible reduced engine performance. |
| 4524 5862 0 | Aftertreatment SCR intermediate gas temperature - Data valid but above normal operational range - Most severe level. The aftertreatment SCR intermediate temperature sensor reading is above the engine protection limit. | Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 4525 5862 16 | Aftertreatment 1 SCR intermediate gas temperature - Data valid but above normal operating range - Moderately severe level. High SCR Intermediate temperature detected. | Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing. |
| 4526 521 2 | Brake pedal position - Data erratic, intermittent or incorrect. The values of the 2 brake switch signals do not match. | None on performance. |
| 4572 3031 9 | Aftertreatment diesel exhaust fluid tank temperature - Abnormal update rate. The ECM lost communication with the aftertreatment diesel exhaust fluid tank temperature sensor. | Possible reduced engine performance. |
| 4584 3936 14 | Aftertreatment diesel particulate filter system - Special instructions. The incorrect aftertreatment diesel particulate filter system has been installed with the engine. | Engine will be shut down. |
| 4585 4792 14 | Aftertreatment 1 SCR catalyst system - Special instructions. The incorrect SCR system has been Installed. | Engine will be shut down. |
| 4612 520701 31 | Engine intake manifold pressure system monitor - Condition exists. The engine is unable to meet the air handling system commands. | Possible reduced engine performance. |
| 4658 4331 18 | Aftertreatment SCR actual dosing reagent quantity - Data valid but below normal operating range - Moderately severe level. Low aftertreatment diesel exhaust fluid flow detected. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|--|
| 4691 5585 18 | Engine injector metering rail 1 cranking pressure - Data valid but below normal operating range - Moderately severe level. The fuel rail pressure during cranking is too low for the engine to start. | Engine may not start or may be difficult to start. |
| 4713 5357 31 | Engine fuel injection quantity error for multiple cylinders - Condition exists. A malfunction of all fuel injectors has been detected. | Engine may run rough, may stop running, may not start, or may be difficult to start. |
| 4726 1239 16 | Engine fuel leakage - Data valid but above normal operating range - Moderately severe level. Fuel rail pressure decay has been detected. | Engine may run rough, may stop running, may not start, or may be difficult to start. |
| 4727 157 15 | Injector metering rail 1 pressure - Data valid but above normal operating range - Least severe level. A self pumping condition has been detected in the fuel system. | Possible reduced engine performance. |
| 4731 3031 13 | Aftertreatment diesel exhaust fluid tank temperature sensor - Out of calibration. The received datalink message was not valid. | Possible reduced engine performance. |
| 4732 1761 13 | Aftertreatment diesel exhaust fluid tank level sensor - Out of calibration. The received datalink message was not valid. | None on performance. |
| 4739 1761 11 | Aftertreatment 1 diesel exhaust fluid tank level sensor - Root cause not known. An unknown error has been detected with the aftertreatment diesel exhaust fluid tank level sensor. | Possible reduced engine performance. |
| 4769 1761 10 | Aftertreatment 1 diesel exhaust fluid tank level sensor - Abnormal rate of change. A valid diesel exhaust fluid tank level reading has NOT been received. | Possible reduced engine performance. |
| 4865 6303 3 | Engine coolant level 2 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine coolant level 2 circuit. | None on performance. |
| 4866 6303 4 | Engine coolant level 2 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the engine coolant level 2 circuit. | None on performance. |
| 4956 520750 13 | Engine variable geometry turbo (VGT) software - Out of calibration. VGT software does not match application. | Possible reduced engine performance. |
| 4957 520750 31 | Engine variable geometry turbo (VGT) software - Condition exists. The VGT actuator and ECM software is not compatible. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

3) DEFINITION OF OPERATING MODES

(1) Normal

There's no failure detected in the transmission system or the failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations. (See following table)

(2) Substitute clutch control

TCU can't change the gears or the direction under the control of the normal clutch modulation.

TCU uses the substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST 25)

(3) Limp-home

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible.

TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position.

If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear.

If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction.

If output speed is greater than the threshold, TCU will shift the transmission into neutral.

The operator has to slow down the vehicle and must shift the gear selector into neutral position.

(4) Transmission-shutdown

TCU has detected a severe failure that disables control of the transmission.

TCU will shut off the solenoid valves for the clutches and also the common power supply (VPS1).

Transmission shifts to neutral.

The park brake will operate normally, also the other functions which use ADM1 to ADM8.

The operator has to slow down the vehicle. The transmission will stay in neutral.

(5) TCU-shutdown

TCU has detected a severe failure that disables control of system.

TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2).

The park brake will engage, also functions are disabled which use ADM 1 to ADM 8.

The transmission will stay in neutral.

※ Abbreviations

OC : Open circuit

SC : Short circuit

OP mode : Operating mode

TCU : Transmission control unit

EEC : Electronic engine controller

PTO : Power take off

4) TRANSMISSION FAULT CODES

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|--|---|--|
| 10 | Logical error at direction select signal 3rd shift lever TCU detected a wrong signal combination for the direction · Cable from shift lever 3 to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective | TCU shifts transmission to neutral if selector active OP mode : Transmission shutdown if selector active | <ul style="list-style-type: none"> · Check the cables from TCU to shift lever 3 · Check signal combinations of shift lever positions F-N-R · If shift lever is a CAN shift lever check CAN cable/shifter/device ※ Fault is cleared if TCU detects a valid neutral signal for the direction at the shift lever |
| 11 | Logical error at gear range signal TCU detected a wrong signal combination for the gear range · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective | TCU shifts transmission to neutral OP mode : Transmission shutdown | <ul style="list-style-type: none"> · Check the cables from TCU to shift lever · Check signal combinations of shift lever positions for gear range ※ Failure cannot be detected in systems with DW2/DW3 shift lever. Fault is taken back if TCU detects a valid signal for the position |
| 12 | Logical error at direction select signal TCU detected a wrong signal combination for the direction · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective | TCU shifts transmission to neutral OP mode : Transmission shutdown | <ul style="list-style-type: none"> · Check the cables from TCU to shift lever · Check signal combinations of shift lever positions F-N-R ※ Fault is taken back if TCU detects a valid signal for the direction at the shift lever |
| 13 | Logical error at engine derating device TCU detected no reaction of engine while derating device active | After selecting neutral, TCU change to OP mode limp home | <ul style="list-style-type: none"> · Check engine derating device ※ This fault is reset after power up of TCU |
| 15 | Logical error at direction select signal 2 shift lever TCU detected a wrong signal combination for the direction · Cable from shift lever 2 to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective | TCU shifts transmission to neutral if selector active OP mode : Transmission shutdown if selector active | <ul style="list-style-type: none"> · Check the cables from TCU to shift lever 2 · Check signal combinations of shift lever positions F-N-R ※ Fault is taken back if TCU detects a valid neutral signal for the direction at the shift lever |
| 17 | S.C. to ground at customer specific function No. 1 (ride control) TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Customer specific function No. 1 device has an internal defect · Connector pin is contacted to vehicle ground | Customer specific | <ul style="list-style-type: none"> · Check the cable from TCU to customer specific function No. 1 device · Check the connectors from customer specific function No. 1 to TCU · Check the resistance of customer specific function No. 1 device |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|---------------------|---|--|--|
| 18 | S.C. to battery voltage at customer specific function No. 1 (ride control) TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul style="list-style-type: none"> · Cable is defective and is contacted to battery voltage · Customer specific function No. 1 device has an internal defect · Connector pin is contacted to battery voltage | Customer specific | <ul style="list-style-type: none"> · Check the cable from TCU to customer specific function No. 1 device · Check the connectors from customer specific function No. 1 to TCU · Check the resistance of customer specific function No. 1 device |
| 19 | O.C. at customer specific function No. 1 (ride control) TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin <ul style="list-style-type: none"> · Cable is defective and has no connection to TCU · Customer specific function No. 1 device has an internal defect · Connector has no connection to TCU | Customer specific | <ul style="list-style-type: none"> · Check the cable from TCU to customer specific function No. 1 device · Check the connectors from customer specific function No. 1 device to TCU · Check the resistance of customer specific function No. 1 device |
| 21 | S.C. to battery voltage at clutch cut off input The measured voltage is too high: <ul style="list-style-type: none"> · Cable is defective and is contacted to battery voltage · Clutch cut off sensor has an internal defect · Connector pin is contacted to battery voltage | Clutch cut off function is disabled OP mode : Normal | <ul style="list-style-type: none"> · Check the cable from TCU to the sensor · Check the connectors · Check the clutch cut off sensor |
| 22 | S.C. to ground or O.C. at clutch cut off input The measured voltage is too low: <ul style="list-style-type: none"> · Cable is defective and is contacted to vehicle ground · Cable has no connection to TCU · Clutch cut off sensor has an internal defect · Connector pin is contacted to vehicle ground or is broken | Clutch cut off function is disabled OP mode : Normal | <ul style="list-style-type: none"> · Check the cable from TCU to the sensor · Check the connectors · Check the clutch cut off sensor |
| 25 | S.C. to battery voltage or O.C. at transmission sump temperature sensor input The measured voltage is too high: <ul style="list-style-type: none"> · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Temperature sensor has an internal defect · Connector pin is contacted to battery voltage or is broken | No reaction, TCU use default temperature OP mode : Normal | <ul style="list-style-type: none"> · Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|---------------------|--|---|---|
| 26 | S.C. to battery voltage or O.C. at transmission sump temperature sensor input The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground | No reaction, TCU uses default temperature OP mode : Normal | · Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor |
| 27 | S.C. to battery voltage or O.C. at retarder temperature sensor input The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Temperature sensor has an internal defect · Connector pin is contacted to battery voltage or is broken | No reaction, TCU uses default temperature OP mode : Normal | · Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor |
| 28 | S.C. to ground at retarder temperature sensor input The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground | No reaction, TCU uses default temperature OP mode : Normal | · Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor |
| 31 | S.C. to battery voltage or O.C. at engine speed input TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact | OP mode : Substitute clutch control | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor |
| 32 | S.C. to ground at engine speed input TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect | OP mode : Substitute clutch control | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor |
| 33 | Logical error at engine speed input TCU measures a engine speed over a threshold and the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size | OP mode : Substitute clutch control | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|--|---|---|
| 34 | S.C. to battery voltage or O.C. at turbine speed input TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to vehicle battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact | OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor |
| 35 | S.C. to ground at turbine speed input TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect | OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor ※ This fault is reset after power up of TCU |
| 36 | Logical error at turbine speed input TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size | OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap |
| 37 | S.C. to battery voltage or O.C. at internal speed input TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to vehicle battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact | OP mode : Substitute clutch control | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor |
| 38 | S.C. to ground at turbine speed input TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect | OP mode : Substitute clutch control | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor |
| 39 | Logical error at internal speed input TCU measures a internal speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size | OP mode : Substitute clutch control | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU |
| 3A | S.C. to battery voltage or O.C. at output speed input TCU measures a voltage higher than 12.5V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact | Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : Limp home | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|---|---|--|
| 3B | S.C. to ground at output speed input TCU measures a voltage less than 1.00V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect | Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : Limp home | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor |
| 3C | Logical error at output speed input TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size | Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : Limp home | · Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU |
| 3D | Turbine speed zero doesn't fit to other speed signals | - | · Not used |
| 3E | Output speed zero doesn't fit to other speed signals If transmission is not neutral and the shifting has finished, TCU measures output speed zero and turbine speed or internal speed not equal to zero. · Speed sensor has an internal defect · Sensor gap has the wrong size | Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : Limp home | · Check the sensor signal of output speed sensor · Check the sensor gap of output speed sensor · Check the cable from TCU to the sensor ※ This fault is reset after power up of TCU |
| 54 | DCT1 timeout Timeout of CAN-message DCT1 from display computer · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage | OP mode : Normal | · Check display computer · Check wire of CAN-Bus · Check cable to display computer |
| 55 | JSS timeout Timeout of CAN-message JSS from joystick steering controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage | TCU shifts to neutral while joystick steering is active OP mode : Normal | · Check joystick steering controller · Check wire of CAN-Bus · Check cable to joystick steering controller |
| 56 | Engine CONF timeout Timeout of CAN-message engine CONF from engine controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage | OP mode : Substitute clutch control | · Check engine controller · Check wire of CAN-Bus · Check cable to engine controller |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|---------------------|--|--|--|
| 57 | EEC1 timeout Timeout of CAN-message EEC1 from EEC controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage | OP mode : Substitute clutch control | · Check EEC controller · Check wire of CAN-Bus · Check cable to EEC controller |
| 58 | EEC3 timeout Timeout of CAN-message EEC3 from EEC controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective an has contact to vehicle ground or battery voltage | OP mode : Substitute clutch control | · Check EEC controller · Check wire of CAN-Bus · Check cable to EEC controller |
| 5C | Auto downshift signal CAN signal for automatic downshift is defective · Cluster controller is defective · Interference on CAN-Bus | No reaction | · Check cluster controller · Check wire of CAN-Bus · Check cable to cluster controller |
| 5D | Manual downshift signal CAN signal for manual downshift is defective · Cluster controller is defective · Interference on CAN-Bus | No reaction | · Check cluster controller · Check wire of CAN-Bus · Check cable to controller |
| 5E | CCO request signal CAN signal for CCO request is defective · Cluster controller is defective · Interference on CAN-Bus | No reaction | · Check cluster controller · Check wire of CAN-Bus · Check cable to controller |
| 61 | AEB request signal CAN signal for AEB request is defective · I/O controller is defective · Interference on CAN-Bus | No reaction OP mode : Normal | · Check I/O controller, Omron master · Check wire of CAN-Bus · Check cable to I/O controller, Omron master |
| 64 | Sarting gear signal CAN signal for starting gear is defective · I/O controller is defective (illegal starting gear) · Interference on CAN-Bus | No reaction. TCU uses default starting gear OP mode : Normal | · Check I/O controller · Check wire of CAN-Bus · Check cable to I/O controller |
| 65 | Engine torque signal CAN signal for engine torque is defective · Engine controller is defective · Interference on CAN-Bus | OP mode : Substitute clutch control | · Check engine controller · Check wire of CAN-Bus · Check cable to engine controller |
| 69 | Reference engine torque signal CAN signal for reference of engine torque is defective · Engine controller is defective · Interference on CAN-Bus | OP mode : Substitute clutch control | · Check engine controller · Check wire of CAN-Bus · Check cable to engine controller |
| 6A | Actual engine torque signal CAN signal for actual engine torque is defective · Engine controller is defective · Interference on CAN-Bus | OP mode : Substitute clutch control | · Check engine controller · Check wire of CAN-Bus · Check cable to engine controller |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|---|--|---|
| 6E | EEC2 timeout Timeout of CAN-message EEC2 from EEC controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage | No reaction, TCU uses default signal accelerator pedal in idle position OP mode : Normal | · Check EEC controller · Check wire of CAN-Bus · Check cable to EEC controller |
| 71 | S.C. to battery voltage at clutch K1 The measured resistance value of the valve is out of limit, the voltage at K1 valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from TCU to the gearbox · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 72 | S.C. to ground at clutch K1 The measured resistance value of the valve is out of limit, the voltage at K1 valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 73 | O.C. at clutch K1 The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 74 | S.C. to battery voltage at clutch K2 The measured resistance value of the valve is out of limit, the voltage at K2 valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 75 | S.C. to ground at clutch K2 The measured resistance value of the valve is out of limit, the voltage at K2 valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|---|--|---|
| 76 | O.C. at clutch K2 The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 77 | S.C. to battery voltage at clutch K3 The measured resistance value of the valve is out of limit, the voltage at K3 valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 78 | S.C. to ground at clutch K3 The measured resistance value of the valve is out of limit, the voltage at K3 valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 79 | O.C. at clutch K3 The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 7D | S.C. ground at engine derating device · Cable is defective and is contacted to vehicle ground · Engine derating device has an internal defect · Connector pin is contacted to vehicle ground | Engine derating will be on until TCU power down even if fault vanishes (Loose connection) OP mode : Normal | · Check the cable from TCU to the engine derating device · Check the connectors from engine derating device to TCU · Check the resistance* of engine derating device ※ Not used * See page 3-74 |
| 7E | S.C. battery voltage at engine derating device · Cable/connector is defective and is contacted to battery voltage · Engine derating device has an internal defect | No reaction OP mode : Normal | · Check the cable from TCU to the engine derating device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-74 |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|---------------------|---|--|--|
| 7F | O.C. at engine derating device TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Engine derating device has an internal defect · Connector has no connection to TCU | No reaction OP mode : Normal | · Check the cable from TCU to the engine derating device · Check the connectors from engine derating device to TCU · Check the resistance* of engine derating device * See page 3-74 |
| 81 | S.C. to battery voltage at clutch K4 The measured resistance value of the valve is out of limit, the voltage at K4 valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 82 | S.C. to ground at clutch K4 The measured resistance value of the valve is out of limit, the voltage at K4 valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the engine derating device · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 83 | O.C. at clutch K4 The measured resistance value of the valve is out of limit · Cable/connector is defective and has contact to TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 84 | S.C. to battery voltage at clutch KV The measured resistance value of the valve is out of limit, the voltage at KV valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 85 | S.C. to ground at clutch KV The measured resistance value of the valve is out of limit, the voltage at KV valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|---------------------|---|--|---|
| 86 | O.C. at clutch KV The measured resistance value of the valve is out of limit · Cable/connector is defective and has contact to TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 87 | S.C. to battery voltage at clutch KR The measured resistance value of the valve is out of limit, the voltage at KR valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 88 | S.C. to ground at clutch KR The measured resistance value of the valve is out of limit, the voltage at KR valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 89 | O.C. at clutch KR The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74 |
| 91 | S.C. to ground at relay reverse warning alarm TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contact to vehicle ground · Backup alarm device has an internal defect · Connector pin is contacted to vehicle ground | Backup alarm will be on until TCU power down even if fault vanishes (Loose connection) OP mode : Normal | · Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-74 |
| 92 | S.C. to battery voltage at relay reverse warning alarm TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and is contacted to battery voltage · Backup alarm device has an internal defect · Connector pin is contacted to battery voltage | No reaction OP mode : Normal | · Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-74 |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|---|---------------------------------|--|
| 93 | O.C. at relay reverse warning alarm TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Backup alarm device has an internal defect · Connector has no connection to TCU | No reaction OP mode : Normal | · Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-74 |
| 94 | S.C. to ground at relay starter interlock TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is connection to vehicle ground · Starter interlock relay has an internal defect · Connector pin is contacted to vehicle ground | No reaction OP mode : Normal | · Check the cable from TCU to the stater interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-74 |
| 95 | S.C. to battery voltage at relay starter interlock TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Starter interlock relay has an internal defect · Connector pin is contacted to battery voltage | No reaction OP mode : Normal | · Check the cable from TCU to the starter interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-74 |
| 96 | O.C. at relay starter interlock TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Starter interlock relay has an internal defect · Connector has no connection to TCU | No reaction OP mode : Normal | · Check the cable from TCU to the starter interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-74 |
| 9A | S.C. to ground at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Converter clutch solenoid has an internal defect · Connector pin is contacted to vehicle ground | No reaction OP mode : Normal | · Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of converter clutch solenoid * See page 3-74 |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|--|--|--|
| 9B | O.C. at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Converter clutch solenoid has an internal defect · Connector has no connection to TCU | Converter clutch always open, retarder not available OP mode : Normal | · Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of converter clutch solenoid * See page 3-74 |
| 9C | S.C. to battery voltage at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no contacted to battery voltage · Converter clutch solenoid has an internal defect · Connector pin is contacted to battery voltage | No reaction OP mode : Normal | · Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of converter clutch solenoid * See page 3-74 |
| A1 | S.C. to ground at difflock or axle connection solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Difflock solenoid has an internal defect · Connector pin is contacted to vehicle ground | No reaction OP mode : Normal | · Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-74 |
| A2 | S.C. to battery voltage at difflock or axle connection solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Difflock solenoid has an internal defect · Connector pin is contacted to battery voltage | No reaction OP mode : Normal | · Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-74 |
| A3 | O.C. at difflock or axle connection solenoid TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Difflock solenoid has an internal defect · Connector has no connection to TCU | No reaction OP mode : Normal | · Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-74 |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|---|--|--|
| A4 | S.C. to ground at warning signal output TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Warning device has an internal defect · Connector pin is contacted to vehicle ground | No reaction OP mode : Normal | · Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-74 |
| A5 | O.C. voltage at warning signal output TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Warning device has an internal defect · Connector has no connection to TCU | No reaction OP mode : Normal | · Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-74 |
| A6 | S.C. to battery voltage at warning signal output TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has is contacted to battery voltage · Warning device has an internal defect · Connector pin is contacted to battery voltage | No reaction OP mode : Normal | · Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-74 |
| B1 | Slippage at clutch K1 TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K1 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check pressure at clutch K1 · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor · Replace clutch |
| B2 | Slippage at clutch K2 TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K2 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | · Check pressure at clutch K2 · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor · Replace clutch |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|---------------------|--|--|---|
| B3 | Slippage at clutch K3 TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> · Low pressure at clutch K3 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | <ul style="list-style-type: none"> · Check pressure at clutch K3 · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor Replace clutch |
| B4 | Slippage at clutch K4 TCU calculates a differential speed at closed clutch K4. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> · Low pressure at clutch K4 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | <ul style="list-style-type: none"> · Check pressure at clutch K4 · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor Replace clutch |
| B5 | Slippage at clutch KV TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> · Low pressure at clutch KV · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | <ul style="list-style-type: none"> · Check pressure at clutch KV · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor Replace clutch |
| B6 | Slippage at clutch KR TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> · Low pressure at clutch KR · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective | TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown | <ul style="list-style-type: none"> · Check pressure at clutch KR · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor Replace clutch |
| B7 | Overtemp sump TCU measured a temperature in the oil sump that is over the allowed threshold. | No reaction OP mode : Normal | <ul style="list-style-type: none"> · Cool down machine · Check oil level · Check temperature sensor |
| B9 | Overspend engine | Retarder applies OP mode : Normal | - |
| BA | Differential pressure oil filter TCU measured a voltage at differential pressure switch out of the allowed range <ul style="list-style-type: none"> · Oil filter is polluted · Cable/connector is broken or cable/connector is contacted to battery voltage or vehicle ground · Differential pressure switch is defective | No reaction OP mode : Normal | <ul style="list-style-type: none"> · Check oil filter · Check wiring from TCU to differential pressure switch · Check differential pressure switch(Measure resistance) |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|---|---|--|
| BB | Slippage at converter lockup clutch TCU calculates a differential speed at closed converter lockup clutch. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> · Low pressure at converter lockup clutch · Low main pressure · Wrong signal at engine speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective | No reaction OP mode : Normal | <ul style="list-style-type: none"> · Check pressure at converter lockup clutch · Check main pressure in the system · Check sensor gap at engine speed sensor · Check sensor gap at turbine speed sensor · Check signal at engine speed sensor · Check signal at turbine speed sensor · Replace clutch |
| C0 | Engine torque or engine power overload TCU calculates an engine torque or engine power above the defined thresholds | OP mode : Normal | |
| C1 | Transmission output torque overload TCU calculates an transmission output torque above the defined threshold | OP mode : Normal | |
| C2 | Transmission input torque overload TCU calculates an transmission input torque above the defined threshold | programmable : No reaction or shift to neutral OP mode : Normal | |
| C3 | Overtemp converter output TCU measured a oil temperature at the converter output that is the allowed threshold | No reaction OP mode : Normal | <ul style="list-style-type: none"> · Cool down machine · Check oil level · Check temperature sensor |
| C4 | S.C. to ground at joystick status indicator TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground <ul style="list-style-type: none"> · Cable is defective and is contacted to vehicle ground · Joystick status indicator has an internal defect · Connector pin is contacted to vehicle ground | No reaction OP mode : Normal | <ul style="list-style-type: none"> · Check the cable from TCU to joystick status indicator · Check the connectors from joystick status indicator to TCU · Check the resistance* of joystick status indicator <p>* See page 3-74</p> |
| C5 | S.C. to battery voltage at joystick status indicator TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul style="list-style-type: none"> · Cable is defective and is contacted to battery voltage · Joystick status indicator has an internal defect · Connector pin is contacted to battery voltage | No reaction OP mode : Normal | <ul style="list-style-type: none"> · Check the cable from TCU to joystick status indicator · Check the connectors from joystick status indicator to TCU · Check the resistance* of joystick status indicator <p>* See page 3-74</p> |

※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|---------------------|--|--|--|
| C6 | O.C. at joystick status indicator TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Joystick status indicator has an internal defect · Connector pin has no connection to TCU | No reaction OP mode : Normal | · Check the cable from TCU to joystick status indicator · Check the connectors from joystick status indicator to TCU · Check the resistance* of joystick status indicator * See page 3-74 |
| D1 | S.C. to battery voltage at power supply for sensors TCU measures more than 6V at the pin AU1 (5V sensor supply) | See fault codes No.21 to 2C | · Check cables and connectors to sensors, which are supplied from AU1 · Check the power supply at the pin AU1(Should be appx. 5V) · Fault codes No.21 to No.2C may be reaction of this fault |
| D2 | S.C. to ground at power supply for sensors TCU measures less than 4V at the pin AU1 (5V sensor supply) | See fault codes No.21 to 2C | · Check cables and connectors to sensors, which are supplied from AU1 · Check the power supply at the pin AU1(Should be appx. 5V) · Fault codes No.21 to No.2C may be reaction of this fault |
| D3 | Low voltage at battery Measured voltage at power supply is lower than 18V(24V device) | Shift to neutral OP mode : TCU shutdown | · Check power supply battery · Check cables from batteries to TCU · Check connectors from batteries to TCU |
| D4 | High voltage at battery Measured voltage at power supply is higher than 32.5V(24V device) | Shift to neutral OP mode : TCU shutdown | · Check power supply battery · Check cables from batteries to TCU · Check connectors from batteries to TCU |
| D5 | Error at valve power supply VPS1 TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect | Shift to neutral OP mode : TCU shutdown | · Check fuse · Check cables from gearbox to TCU · Check connectors from gearbox to TCU · Replace TCU |
| D6 | Error at valve power supply VPS2 TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect | Shift to neutral OP mode : TCU shutdown | · Check fuse · Check cables from gearbox to TCU · Check connectors from gearbox to TCU · Replace TCU |

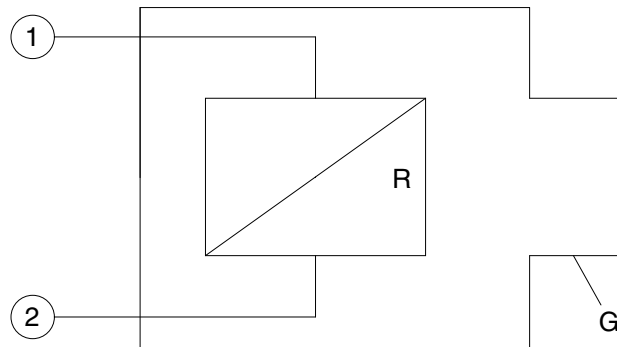
※ Some fault codes are not applied to this machine.

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection | Reaction of the TCU | Possible steps to repair |
|------------------|--|--|---|
| E3 | S.C. to battery voltage at display output TCU sends data to the display and measures always a high voltage level on the connector · Cable or connectors are defective and are contacted to battery voltage · Display has an internal defect | No reaction OP mode : Normal | · Check the cable from TCU to the display · Check the connectors at the display · Change display |
| E4 | S.C. to ground at display output TCU sends data to the display and measures always a high voltage level on the connector · Cable or connectors are defective and are contacted to battery voltage · Display has an internal defect | No reaction OP mode : Normal | · Check the cable from TCU to the display · Check the connectors at the display · Change display |
| E5 | Communication failure on DeviceNet | Shift to neutral OP mode : TCU shutdown | · Check Omron master · Check wire of DeviceNet-Bus · Check cable to Omron master |
| F1 | General EEPROM fault TCU can't read non volatile memory · TCU is defective | No reaction OP mode : Normal | · Replace TCU ※ Often shown together with fault code F2 |
| F2 | Configuration lost TCU has lost the correct configuration and can't control the transmission · Interference during saving data on non volatile memory · TCU is brand new or from another vehicle | Transmission stay neutral OP mode : TCU shutdown | · Reprogram the correct configuration for the vehicle (e.g. with cluster controller,...) |
| F3 | Application error Something of this application is wrong | Transmission stay neutral OP mode : TCU shutdown | · Replace TCU ※ This fault occurs only if an test engineer did something wrong in the application of the vehicle |
| F5 | Clutch failure AEB was not able to adjust clutch filling parameters · One of the AEB-Values is out of limit | Transmission stay neutral OP mode : TCU shutdown | · Check clutch ※ TCU shows also the affected clutch on the display |
| F6 | Clutch adjustment data lost TCU was not able to read correct clutch adjustment parameters · Interference during saving data on non volatile memory · TCU is brand new | No reaction, Default values : 0 for AEB Offsets used OP mode : Normal | · Execute AEB and brake sensor calibration |
| F7 | Substitute clutch control · Transmission input torque wrong · Engine retarder torque wrong · Speed signal (s) defective | OP mode : Substitute clutch control | · Check engine retarder torque · Check speed sensors |

※ Some fault codes are not applied to this machine.

5) MEASURING OF RESISTANCE AT ACTUATOR/SENSOR AND CABLE

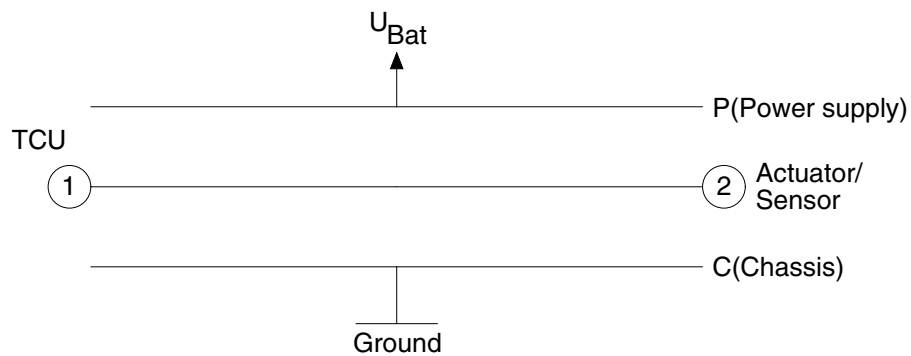
(1) Actuator



76043PT19

Open circuit $R_{12} = R_{1G} = R_{2G} = \infty$
 Short cut to ground $R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$
 (For S.C. to ground, G is connected to vehicle ground)
 Short cut to battery $R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$
 (For S.C. to battery, G is connected to battery voltage)

(2) Cable



76043PT20

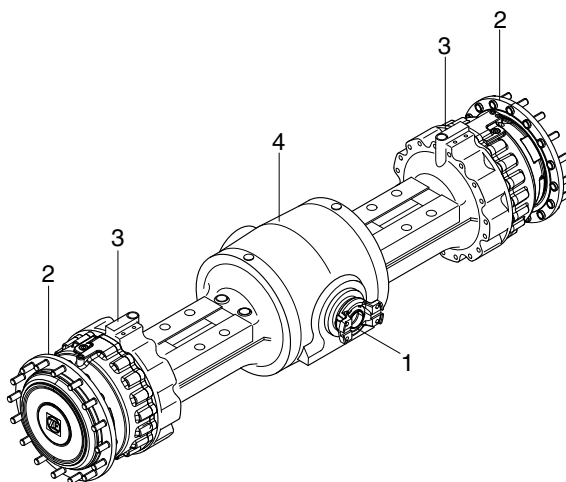
Open circuit $R_{12} = R_{1P} = R_{1C} = R_{2P} = R_{2C} = \infty$
 Short cut to ground $R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = \infty$
 Short cut to battery $R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = 0$

5. AXLE

1) OPERATION

- The power from the engine passes through torque converter, transmission and drive shafts, and is then sent to the front and rear axles.
- Inside the axles, the power passes from the bevel pinion to the bevel gear and is sent at right angles. At the same time, the speed is reduced and passes through the both differentials to the axle shafts. The power of the axle shafts is further reduced by planetary-gear-type final drives and is sent to the wheels.

(1) Front axle



7709A3PT10

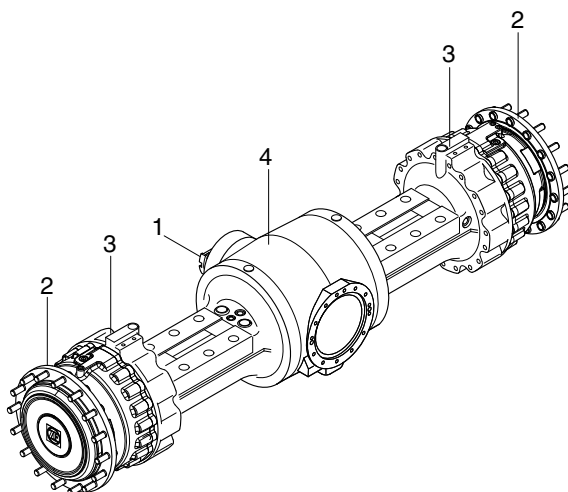
1 Input

2 Output

3 Brake

4 Axle housing

(2) Rear axle



7709A3PT11

1 Input

2 Output

3 Brake

4 Axle housing

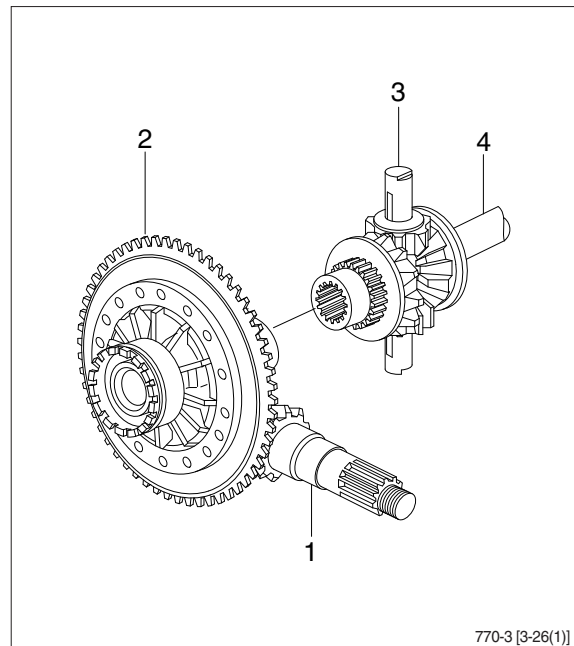
2) DIFFERENTIAL

(1) Description

When the machine makes a turn, the outside wheel must rotate faster than the inside wheel. A differential is a device which continuously transmits power to the right and left wheels while allowing them to turn at different speeds, during a turn.

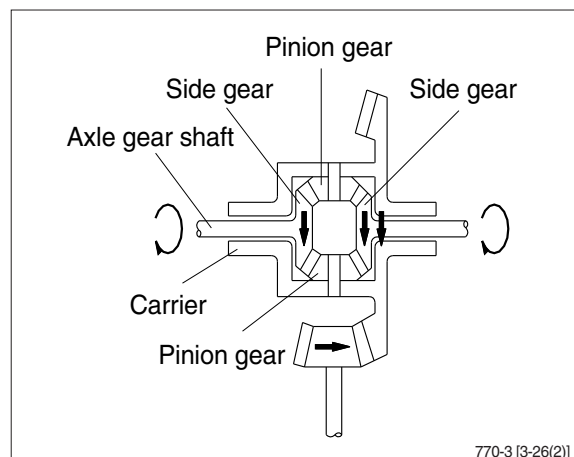
The power from the drive shaft passes through bevel pinion (1) and is transmitted to the bevel gear (2). The bevel gear changes the direction of the motive force by 90 degree, and at the same time reduces the speed.

It then transmits the motive force through the differential (3) to the axle gear shaft (4).



(2) When driving straight forward

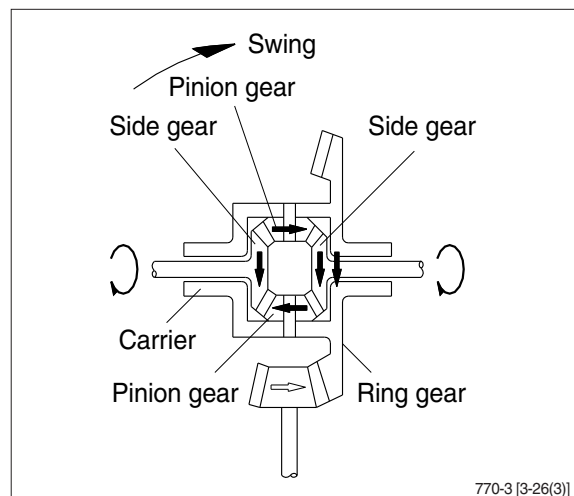
When the machine is being driven straight forward and the right and left wheels are rotating at the same speed, so the pinion gear inside the differential assembly do not rotate. The motive force of the carrier is sent through the pinion gear and the side gear, therefore the power is equally transmitted to the left and right axle gear shaft.



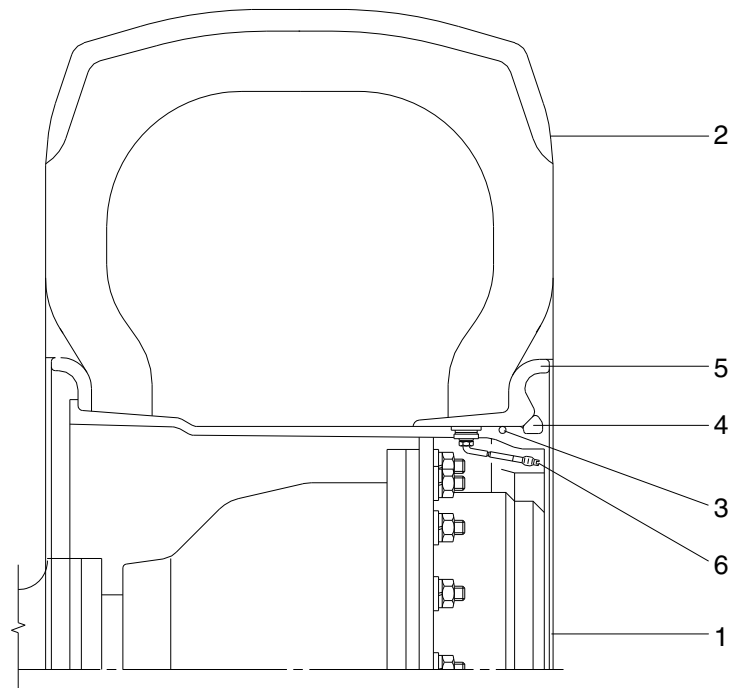
(3) When turning

When turning, the rotating speed of the left and right wheels is different, so the pinion gear and side gear inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels.

The power of the carrier is then transmitted to the axle gear shafts.



6. TIRE AND WHEEL



7407APT10

1 Wheel rim
2 Tire

3 O-ring
4 Lock ring

5 Side ring
6 Valve assembly

- 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 and bucket capacity.

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. POWER TRAIN OPERATIONAL CHECKS

This procedure is designed so that the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read Structure and function, Group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.





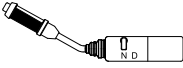



At the end of each check, if no problem is found(OK), that check is complete or an additional check is needed. If problem is indicated(NOT OK), you will be given repair required and group location.

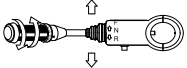
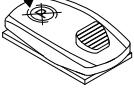


If verification is needed, you will be given next best source of information :



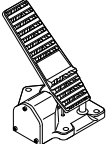
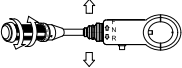
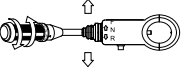
Chapter 2 : Troubleshooting

Group 3 : Tests and adjustments

※ Transmission oil must be at operating temperature for these checks.

| Item | Description | Service action |
|--|---|---|
| Transmission oil warm-up procedure |   <p>MANUAL mode</p>  <p>Start engine. Apply service brakes and release parking brake.</p> <p>Select T/M shift mode to MANUAL mode.</p> <p>Move gear selector lever to 3rd speed.</p> <p>Move gear selector lever to forward "F" position.</p> <p>Increase engine speed to high idle for 30 seconds.</p> <p>Move gear selector lever to neutral "N" position and run for 15 seconds.</p> <p>Repeat procedure until transmission temperature gauge arrow points to bar above dial.</p> | <p>OK Check completed.</p> |
| Gear selector lever and neutral lock latch checks Engine OFF. |   <p>Move gear selector lever to each position.</p> <p>NOTE : Gear selector lever position changes slightly as steering column is tilted.</p> <p>FEEL : Lever must move freely through all positions.</p> <p>Engage neutral lock.</p> <p>Apply slight effort to move lever into forward (F) and reverse (R).</p> <p>LOOK : Neutral lock must stay engaged.</p> | <p>OK Check completed.</p> <p>NOT OK Repair lock or replace switch.</p> |
| Automatic shifting check |   <p>AL mode</p>  <p>Automatic mode</p> <p>Start engine.</p> <p>Move gear selector lever to 4th speed.</p> <p>Select T/M shift mode to AL (auto light) mode.</p> <p>LOOK : Automatic sign on cluster.</p> <p>Move gear selector lever to forward or reverse position.</p> <p>Increase engine rpm.</p> <p>LOOK : Speed on cluster must vary with machine speed.</p> | <p>OK Check completed.</p> <p>NOT OK Go to transmission fault code group at page 3-57~3-73. Repair or replace the monitor or harness.</p> |

| Item | Description | Service action |
|--|--|--|
| Transmission noise check Engine running. |  <p>Run engine at approximately 1600 rpm.</p> <p>Drive unit with transmission in each forward and reverse speed.</p> <p>LISTEN : Transmission must not make excessive noise in any range.</p> <p>Engine rpm must not "lug down" as unit is shifted between gears.</p> | <p>OK Check completed.</p> <p>NOT OK Go to transmission makes excessive noise, chapter 2 in this group.</p> |
| Transmission "quick shift" check Engine running. | <p>Release</p>  <p>MANUAL mode</p>  <p>LOOK/FEEL : Transmission must shift to and remain in 1st gear.</p> <p>Press gear selector lever kick down switch once.</p> <p>LOOK/FEEL : Transmission must shift back to 2nd gear.</p> <p>Shift to (3rd or 4th) gear and press gear selector lever kick down switch once.</p> <p>LOOK/FEEL : Transmission must not shift down.</p> <p>AL mode</p>  <p>Select T/M shift mode to AL (auto light) mode.</p> <p>Drive machine at approximately 90% speed of max speed in each gear (2nd or 3rd or 4th).</p> <p>Shift to (2nd or 3rd or 4th) gear in each forward and reverse speed and press gear selector kick down lever switch or RCV lever switch once.</p> <p>LOOK/FEEL :</p> <p>If shift down quickly from current gear to one step lower speed and recover to original speed quickly when push the switch one more time. (mode 1)</p> <p>If shifts down from current gear to one step lower speed when push the switch everytime and recover when push the switch in 1st gear. (mode 2)</p> | <p>OK Check completed.</p> <p>NOT OK Check connector at base of control valve.</p> <p>IF OK Go to transmission controller circuit in group 1.</p> |

| Item | Description | Service action |
|---|---|--|
| Forward, reverse and 4th speed clutch pack drag check ※ Transmission must be warmed up for this check. Engine running. |    <p>Park unit on level surface.</p> <p>Apply service brakes.</p> <p>Move gear selector lever to neutral.</p> <p>Move gear selector lever to 1st.</p> <p>Release parking brake and service brakes.</p> <p>Run engine at low idle.</p> <p>LOOK : Unit must not move in either direction.</p> <p>NOTE : If unit moves forward, either the forward pack or the 4th speed pack is dragging.</p> | <p>OK Check completed.</p> <p>NOT OK If unit moves, repair transmission.</p> |
| Transmission shift modulation check Engine running. |  <p>Run engine at approximately 1300 rpm.</p> <p>Put transmission in 1st forward, shift several times from forward to reverse and reverse to forward. Repeat check in 2nd gear.</p> <p>LOOK : Unit must slow down and change direction smoothly.</p> | <p>OK Check completed.</p> <p>NOT OK Go to unit shifts too fast, chapter 2 in this group.</p> |
| Torque converter check |  <p>Start engine. Apply service brakes and release parking brake.</p> <p>Move gear selector lever to 3rd speed.</p> <p>Move gear selector control lever to forward "F" position.</p> <p>Increase engine speed to high idle.</p> <p>LOOK : Torque converter stall rpm must be within the following range. Stall rpm : 1850 ± 70 rpm (4-speed) 1830 ± 70 rpm (5-speed)</p> <p>Move gear selector control lever to neutral "N" position and run for 15 seconds.</p> | <p>OK Check completed.</p> <p>NOT OK If stall rpm are too low or too high, problem may be engine power or torque converter.</p> <p>IF OK Replace transmission torque converter.</p> |

2. TROUBLESHOOTING

1) TRANSMISSION

※ Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (See group 3 in section 1.)

Step 2. Operational checks (In this group.)

Step 3. Troubleshooting

Step 4. Tests and/or adjustments (See group 3.)

| Problem | Cause | Remedy |
|-----------------------|--|--|
| Transmission slippage | Low oil level. | Add oil. |
| | Wrong oil grade. | Change oil. |
| | Restricted transmission pump suction screen. | Remove and clean screen. |
| | Leak in transmission control valve or gasket. | Remove valve and inspect gaskets. |
| | Low transmission pump flow due to worn pump. | Do transmission pump flow test. |
| | Weak or broken pressure regulating valve spring. | Do transmission system pressure test. |
| Error code on display | Something wrong in transmission. | Go to transmission fault code group at page 3-57~3-73. |

| Problem | Cause | Remedy |
|-------------------------------------|---|---|
| Machine will not move | Low oil level. | Add oil. |
| | Applied park brake. | Check parking brake fuse. Check continuity to parking brake switch. |
| | No power to transmission controller. | Check transmission controller fuse. |
| | Malfunctioning parking brake solenoid valve. | Remove and inspect parking brake solenoid valve. Check for power to solenoid valve. |
| | Restricted orifice of PPC valve. | Remove orifice and check for contamination and/or plugging. (Do not remove valve housing for this purpose.) |
| | Excessive leakage in transmission element. | Do transmission element leakage test using system pressure. |
| | Worn clutch disks. | Repair transmission. |
| | Low or no transmission pressure. | See transmission pressure is low in this group. |
| | Service brake will not release. | Do brake pedal operational check. Do service and park system drag checks. |
| | Failed torque converter. | Do torque converter stall test. If engine pulldown in normal, torque converter is good. |
| | Broken shafts or gears. | Drain transmission to determine if large pieces of metal contamination are present. |
| | Broken drive shafts. | Inspect drive shafts and universal joints for external damage. Repair. |
| | Broken ring or pinion gear. | If drive shaft rotate with transmission in gear but machine does not move, a differential failure is indicated. Repair. |
| Machine does not engage in low gear | Malfunctioning transmission control solenoid valve. | Check solenoid valve. |
| | Stuck spool in transmission control valve. | Remove and inspect transmission control valve spools. |
| | Stuck PPC valve. | Remove end cover to inspect PPC valve. Replace if necessary. |
| | Malfunctioning transmission speed sensor. | Check speed sensor. |

| Problem | Cause | Remedy |
|--|--|--|
| Transmission pressure is low (all gears) | Low oil level. | Check transmission oil level and refill if necessary. |
| | Failed transmission pressure switch. | Verify transmission system pressure. Do transmission system pressure test. |
| | Plugged suction strainer. | Transmission pump may be noisy if transmission suction screen is clogged. Drain transmission. Remove and clean suction screen. Also, check condition of transmission filter. |
| | Stuck transmission pressure regulating valve or broken spring. | Remove transmission pressure regulating valve. Inspect for damage (See transmission control valve). |
| | Failed control valve gasket. | Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket. |
| | Stuck PPC valve. | Remove end cover to inspect modulation spool and check torque on cap screws retaining control valve to transmission. |
| Transmission system pressure is low (one or two gears) | Failed transmission pump. | Do pump flow test. |
| | Failed transmission control valve gasket. | Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket. |
| | Leakage in clutch piston or seal ring. | Disassemble and repair. |
| Transmission shifts too low | Low oil level (aeration of oil). | Add oil. |
| | Low transmission pressure. | Do transmission system pressure test. |
| | Restricted transmission pump suction screen. | Remove and clean screen. |
| | Low transmission pump flow. | Do transmission pump flow test. |
| | Excessive transmission element leakage. | Do transmission element leakage test using system pressure. |
| | Stuck PPC valve. | Remove end cover to inspect modulation spool. Replace if necessary. |
| | Restricted PPC valve orifice. | Remove orifice and inspect for contamination and /or plugging. |
| | Restricted oil passages between control valve and transmission elements. | Remove control valve and inspect oil passage. |
| | Incorrect transmission oil. | Change oil (SAE 10W-30/15W-40) |

| Problem | Cause | Remedy |
|---|--|--|
| Transmission shifts too fast | <p>Wrong transmission controller.</p> <p>System pressure too high.</p> <p>Stuck PPC valve.</p> <p>Stuck or missing check valves.</p> <p>Missing O-ring from end of modulation orifice.</p> <p>Broken piston return spring.</p> <p>Incorrect transmission oil.</p> | <p>Check if transmission controller has been changed</p> <p>Do transmission system pressure test.</p> <p>Remove and inspect PPC valve. Replace if necessary. Also remove end cover to inspect PPC valve and control valve housing. Replace if necessary.</p> <p>Inspect transmission control valve.</p> <p>Remove orifice and inspect port for O-ring.</p> <p>Disassemble and inspect clutch.</p> <p>Change oil (SAE 10W-30/15W-40).</p> |
| Machine "creeps" in neutral | Warped disks and plates in transmission. | Check transmission. |
| Transmission hydraulic system overheats | <p>High oil level.</p> <p>Low oil level.</p> <p>Wrong oil grade.</p> <p>Park brake dragging.</p> <p>Pinched, restricted or leaking lube lines.</p> <p>Machine operated in too high gear range.</p> <p>Malfunction in temperature gauge or sensor.</p> <p>Restricted air flow through oil cooler or radiator.</p> <p>Failed oil cooler bypass valve (In thermal bypass valve).</p> <p>Failed thermal bypass valve.</p> <p>Internally restricted oil cooler.</p> <p>Leakage in transmission hydraulic system.</p> <p>Malfunction in converter relief valve.</p> <p>Low transmission pump output.</p> | <p>Transmission overfilled or hydraulic pump seal leaking.</p> <p>Add oil.</p> <p>Change oil.</p> <p>Check for heat in park brake area.</p> <p>Check cooler lines.</p> <p>Operate machine in correct gear range.</p> <p>Install temperature sensor the verify temperature. Do tachometer/temperature reader installation procedure.</p> <p>Do radiator air flow test.</p> <p>Disassemble and inspect.</p> <p>Remove thermal bypass valve and check to see if machine still overheats. Do transmission oil cooler thermal bypass valve test.</p> <p>Do oil cooler restriction test.</p> <p>Do transmission system pressure, element leakage test.</p> <p>Do converter out pressure test.</p> <p>Do transmission pump flow test.</p> |

| Problem | Cause | Remedy |
|--|--|---|
| Excessive transmission noise (Under load or no load) | Too low engine low idle. Worn parts or damaged in transmission. Warped drive line between engine and torque converter. Low or no lube. | Check engine low idle speed. Remove transmission suction screen. Inspect for metal particles. Repair as necessary. Inspect drive line. Do converter-out and lube pressure test. Do transmission pump flow test. |
| Foaming oil | Incorrect type of oil. High oil level. Low oil level. Air leak on suction side of pump. | Change oil. Transmission overfilled or hydraulic pump seal leaking. Add oil. Check oil pickup tube on side of transmission. |
| Oil ejected from dipstick | Plugged breather. | Inspect breather on top of transmission. Replace. |
| Machine vibrates | Aerated oil. Low engine speed. Failed universal joints on transmission drive shaft or differential drive shafts. | Add oil. Check engine speed. Check universal joints. |
| Machine lacks power and acceleration | Engine high idle speed set too low. Incorrect transmission oil. Aerated oil. Low transmission pressure. Warped transmission clutch. Torn transmission control valve gasket. Brake drag. Failed torque converter. Low engine power. | Check high idle adjustment. Change oil. Add oil. Do transmission system pressure test. Do transmission clutch drag checks. Inspect gasket. Do brake drag check. Do torque converter stall speed test. Do engine power test. |
| Torque converter stall RPM too high | Aerated oil. Stuck open converter relief valve. Leakage in torque converter seal. Torque converter not transferring power (Bent fins, broken starter). | Put clear hose on thermal bypass outlet port. Run machine to check for bubbles in oil. Do converter-out pressure test. Do converter-out pressure test. Replace torque converter. |

| Problem | Cause | Remedy |
|---|---|---|
| Torque converter stall RPM too low | Low engine power. Mechanical malfunction. | Do engine power test. Remove and inspect torque converter. |
| Transmission pressure light comes ON when shifting from forward to reverse (all other gears OK) | Low oil level. Cold oil. Leak in reverse pack. | Add oil. Warm oil to specification. Do transmission pressure, pump flow, and leakage check. |
| Transmission pressure light comes ON for each shift | Cold oil. No time delay in monitor. Restriction in modulation orifice. Stuck PPC valve. Low transmission pressure circuit. Leak in transmission pressure circuit. Failed transmission pump. Clogged filter. | Warm oil to specification. Do monitor check. Remove orifice and inspect for restriction and/or plugging. Remove and inspect. Do transmission system pressure test. Do converter out pressure test. Do transmission pump flow test. Inspect filter. Replace. |

2) DIFFERENTIAL / AXLE

| Problem | Cause | Remedy |
|--|---|---|
| Differential low on oil | External leakage. | Inspect axle and differential for leaks. |
| Excessive differential and/or axle noise | Low oil level in differential. | Check oil. Remove drain plug and inspect for metal particles in differential case. Disassemble and determine cause. |
| | Incorrect type of oil. | Change oil |
| | Dragging brakes. | Do brake check. |
| | Failed pinion bearing. | Remove and inspect pinion. Check to ensure pinion housing was indexed. |
| | Incorrect gear mesh pattern between ring and pinion gear. | Remove pinion gear housing and inspect ring and pinion gear. |
| | Failed differential pinion gears and/or cross shafts. | Remove differential housing drain plug and inspect for metal particles. Disassemble and inspect. |
| | Failed axle bearing. | Do axle bearing adjustment check. |
| Oil seeping from outer axle seal | Mechanical failure in axle planetary. | Remove differential. Inspect, repair. |
| | Excessive end play in axle. | Do axle bearing adjustment check. |
| | Worn outer bearing and/or cup. | Disassemble and inspect outer axle bearing, cup, spacer, and seal. Replace, if necessary. |
| Axle overheats | Overfilled differential. | Check differential oil return system for excessive internal restriction. |
| | Low differential oil. | Add oil. |
| | Overfilled differential. | See differential overfills with oil in this group. |
| | Brake drag. | See brakes drag in this group. |

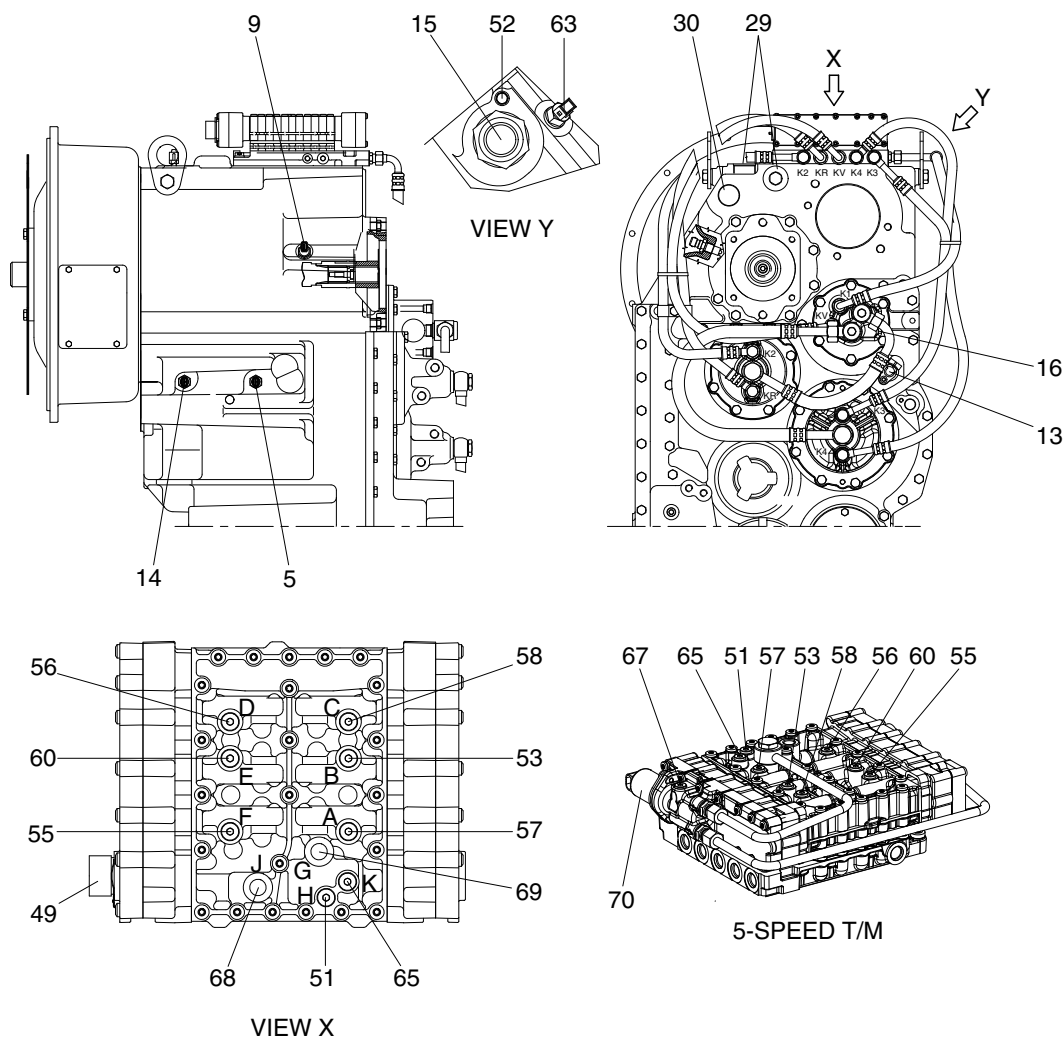
3) DRIVE LINE

| Problem | Cause | Remedy |
|---|--|--|
| Excessive drive line vibration or noise | Yokes not in line on drive shafts. | Inspect. Align drive shaft yokes. |
| | Worn front drive line support bearing. | Inspect, repair. |
| | Bent drive shaft. | Inspect all drive shafts. Replace. |
| | Loose yoke retaining nuts (drive shafts wobble at high speed). | Inspect. Replace. |
| | Rear axle oscillating support. | Inspect, repair. |
| | Lack of lubrication. | Lubricate with proper grade of grease. |

GROUP 3 TESTS AND ADJUSTMENTS

1. TRANSMISSION MEASURING POINTS AND CONNECTIONS

The measurements have to be carried out at hot transmission (about 80~95°C).



7709A3PT17

1) OIL PRESSURE AND TEMPERATURE

| Port | Description | Size |
|------|--|---------|
| 51 | In front of the converter-opening pressure (11bar) H | M10×1.0 |
| 52 | Behind the converter-opening pressure (5bar) | M14×1.5 |
| 53 | Forward clutch (16+2bar) KV B | M10×1.0 |
| 55 | Reverse clutch (16+2bar) KR F | M10×1.0 |
| 56 | 1st clutch (16+2bar) K1 D | M10×1.0 |
| 57 | 2nd clutch (16+2bar) K2 A | M10×1.0 |
| 58 | 3rd clutch (16+2bar) K3 C | M10×1.0 |
| 60 | 4th clutch (16+2bar) K4 E | M10×1.0 |
| 63 | Behind the converter temperature 100°C, short-time 120°C | M14×1.5 |
| 65 | System pressure (16+2bar) K | M10×1.0 |
| *67 | Lock-up clutch pressure (12+2bar) | M10×1.0 |

* : 5-speed transmission

2) CONNECTIONS

| Port | Description | Size |
|------|---|---------|
| 15 | Connection to the oil cooler | M42×2.0 |
| 16 | Connection from the oil cooler | M42×2.0 |
| 29 | Connection from filter | M42×2.0 |
| 30 | Connection to filter | M42×2.0 |
| 49 | Plug connection on the hydraulic control unit | - |
| 68 | Pilot pressure (option) J | M16×1.5 |
| 69 | System pressure (option) G | M16×1.5 |

3) INDUCTIVE TRANSMITTER AND SPEED SENSOR

| Port | Description | Size |
|------|--|---------|
| 5 | Inductive transmitter n Central gear chain | M18×1.5 |
| 9 | Inductive transmitter n Engine | M18×1.5 |
| 13 | Speed sensor n Output and speedometer | - |
| 14 | Inductive transmitter n Turbine | M18×1.5 |

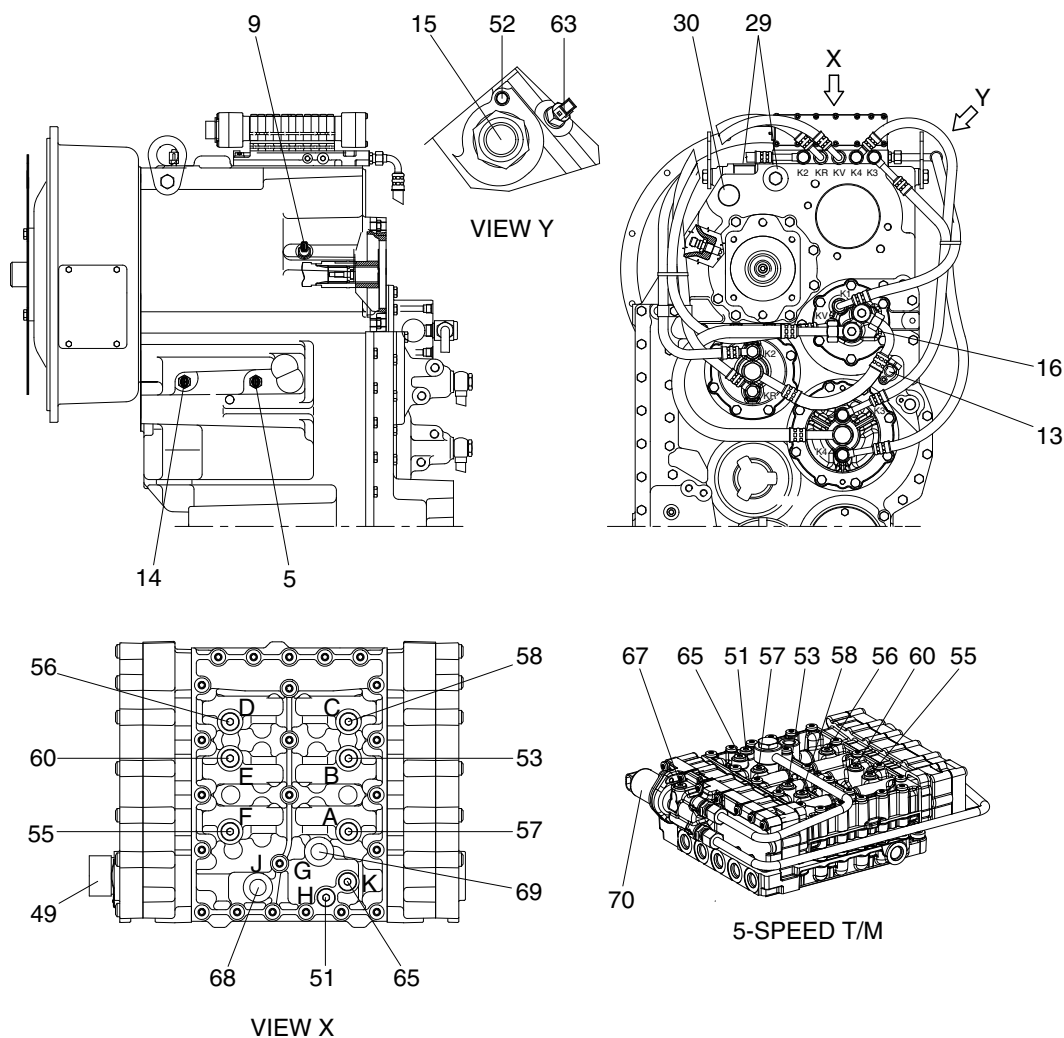
4) SOLENOID VALVE (5-speed transmission)

| Item | Description | Size |
|------|--------------------------|----------------|
| 70 | Converter lock-up clutch | AMP 282080 - I |

GROUP 3 TESTS AND ADJUSTMENTS

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|------|--|---------|
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| 9 | Inductive transmitter n Engine | M18×1.5 |
| 13 | Speed sensor n Output and speedometer | - |
| 14 | Inductive transmitter n Turbine | M18×1.5 |

4) SOLENOID VALVE (5-speed transmission)

| Item | Description | Size |
|------|--------------------------|----------------|
| 70 | Converter lock-up clutch | AMP 282080 - I |

GROUP 4 DISASSEMBLY AND ASSEMBLY

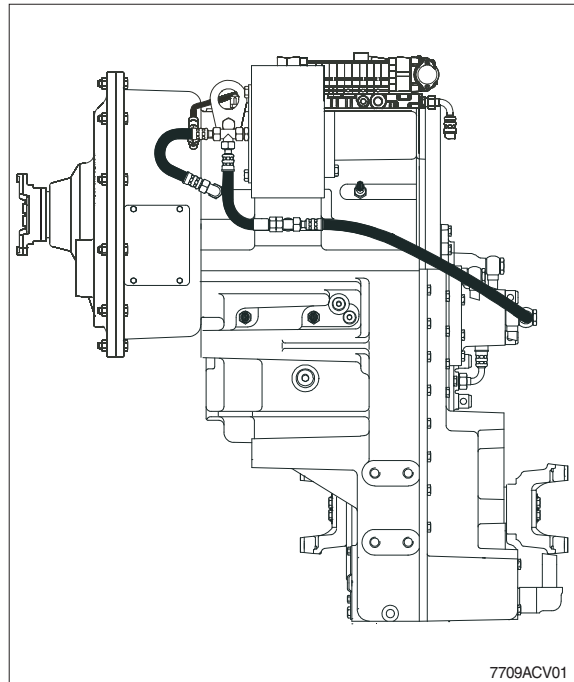
1. CONTROL VALVE

1) DISASSEMBLY

- (1) Attach transmission to assembly truck.

| | |
|-----------------|--------------|
| Assembly truck | 5870 350 000 |
| Holding fixture | 5870 350 071 |

- ※ Drain oil prior to starting disassembly.
- ※ Disposal of oil according to legal requirements.

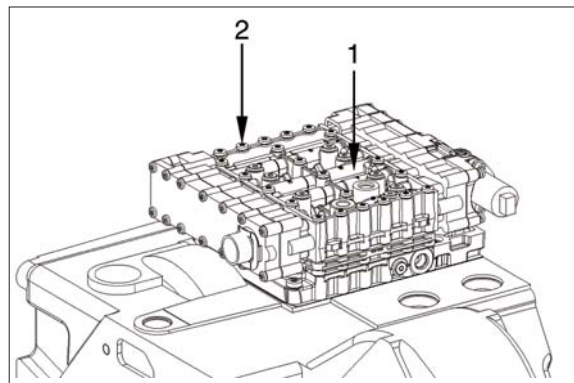


7709ACV01

Removal of electric gear-shift control

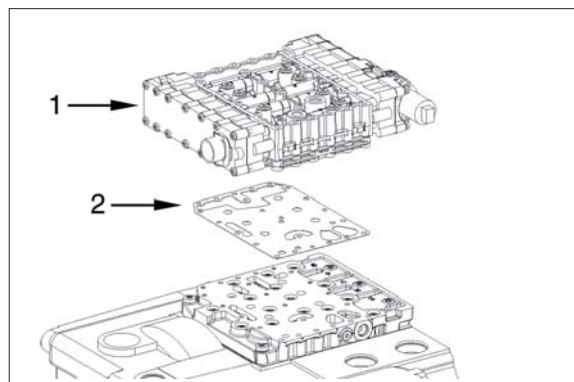
- (2) Remove all oil pipes.
Remove gear-shift control (1).
Loosen torx screws (2).

| | |
|---------------------|--------------|
| Socket wrench TX-27 | 5873 042 002 |
| Adjusting screws M6 | 5870 204 063 |



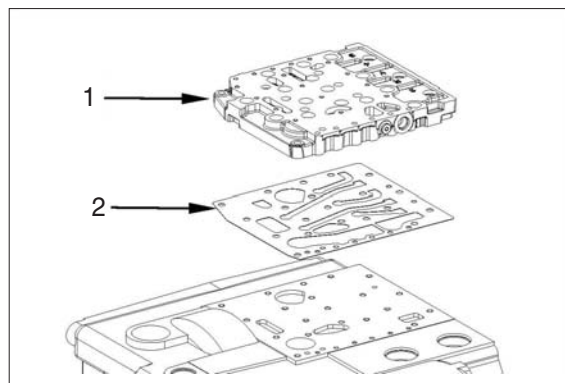
7709ACV02

- (3) Remove gear-shift control assy (1) and gasket (2).



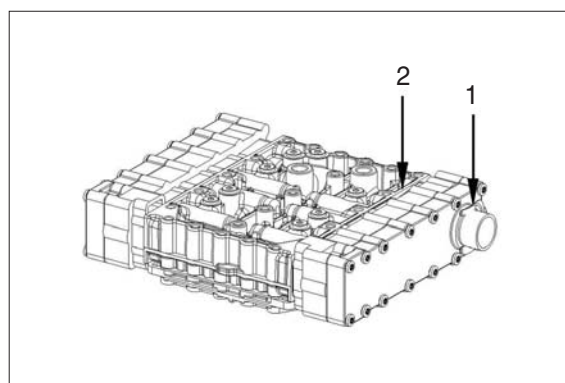
7709ACV03

- (4) Loosen torx screws and separate duct plate (1) and gasket (2) from gearbox housing.



7709ACV04

- (5) Mark installation position of wiring harness (1) towards valve block (2).

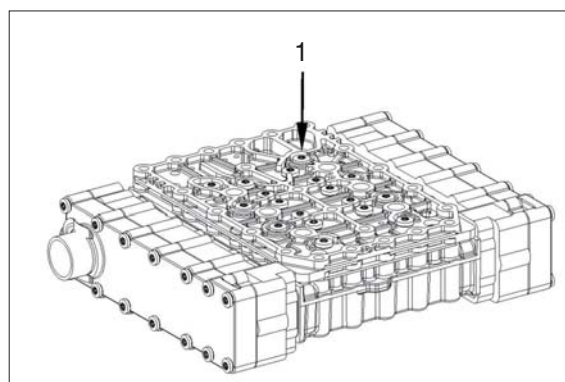


7709ACV05

- (6) Loosen torx screws (1).

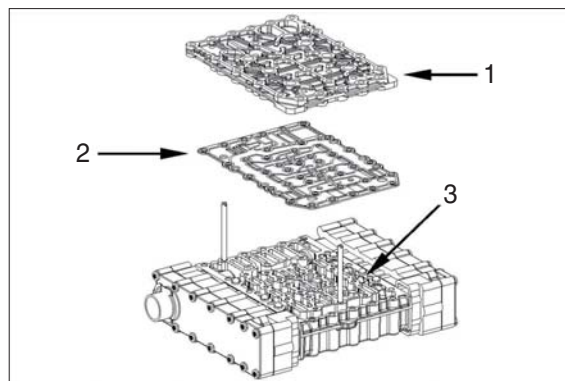
Socket wrench TX-27

5873 042 002



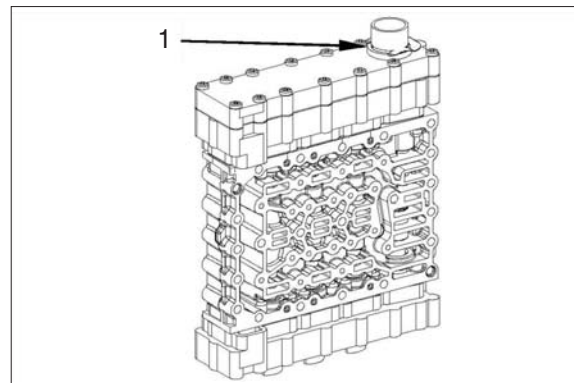
7709ACV06

- (7) Separate duct plate (1) and sealing plate (2) from valve block (3).



7709ACV07

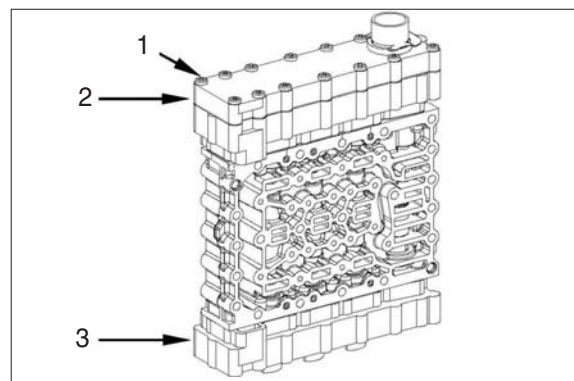
(8) Remove retaining clamp (1).



7709ACV08

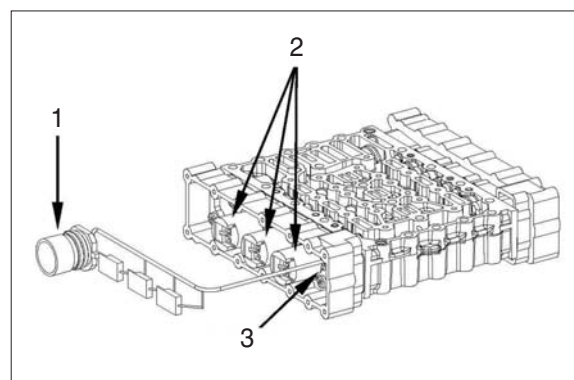
(9) Loosen torx screws (2) and remove cover (2). Remove opposite cover (3) in the same way.

Socket wrench TX-27 5873 042 002



7709ACV09

(10) Remove wiring harness (1).
Loosen cylindrical screws (3), remove fixing plates and remove pressure controllers (2).



7709ACV10

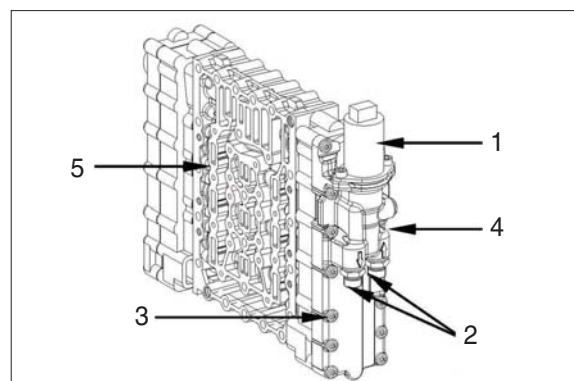
(11) **Lock-up clutch solenoid valve (5-speed transmission)**

Mark installation position of connecting housing (4) towards valve block (5).

Loosen cylindrical screws (1) and remove lock-up clutch valve.

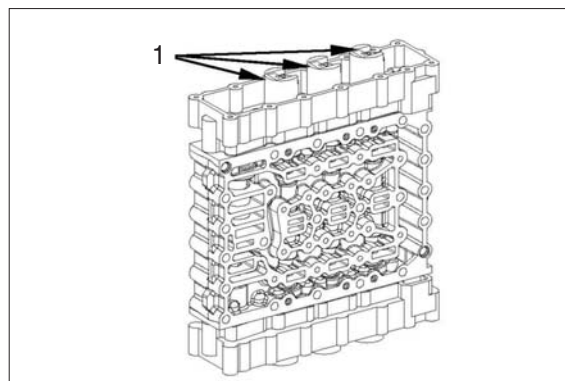
Loosen screws neck (2) and remove O-rings.

Loosen torx screws (3) and remove connecting housing.



7709ACV11

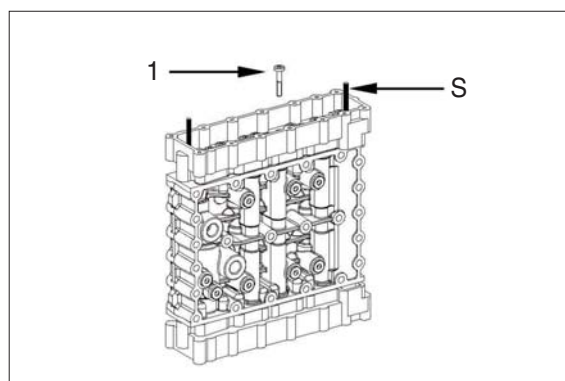
- (12) Loosen cylindrical screws, remove fixing plates and remove pressure controllers (1) on opposite side.



7709ACV12

- (13) Loosen torx screws (1) and preliminarily fix housing by means adjusting screws (S). (Housing is spring-loaded.) Then loosen remaining torx screws.

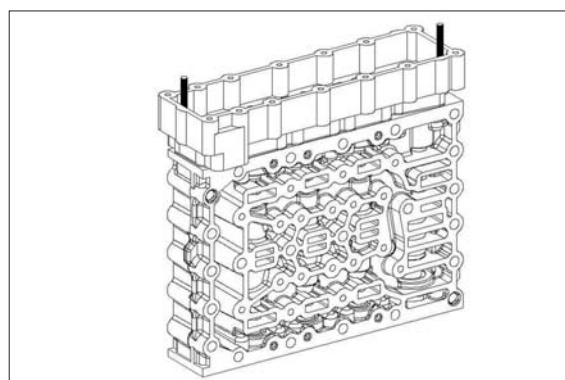
Adjusting screws 5870 204 036



7709ACV13

- (14) Separate housing from valve housing by loosening the adjusting screws equally.

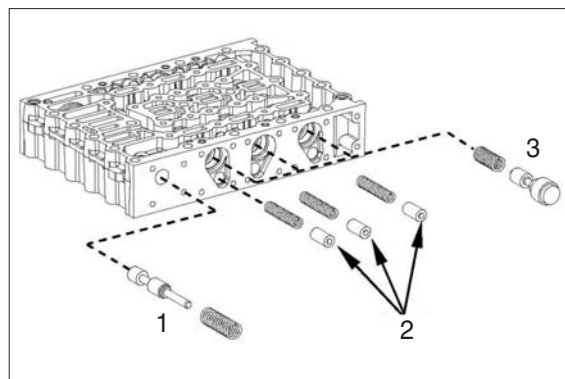
Adjusting screws 5870 204 036



7709ACV14

- (15) Remove individual parts :

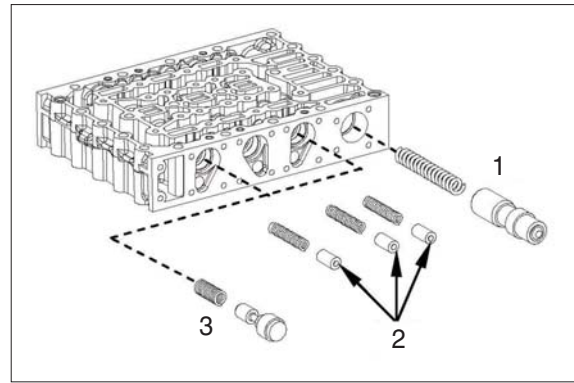
- 1 Pressure reducing valve
- 2 Vibration dampers
- 3 Follow-on silde



7709ACV15

(16) Remove individual parts of opposite side analogously :

- 1 Main pressure valve
- 2 Vibration dampers
- 3 Follow-on silde

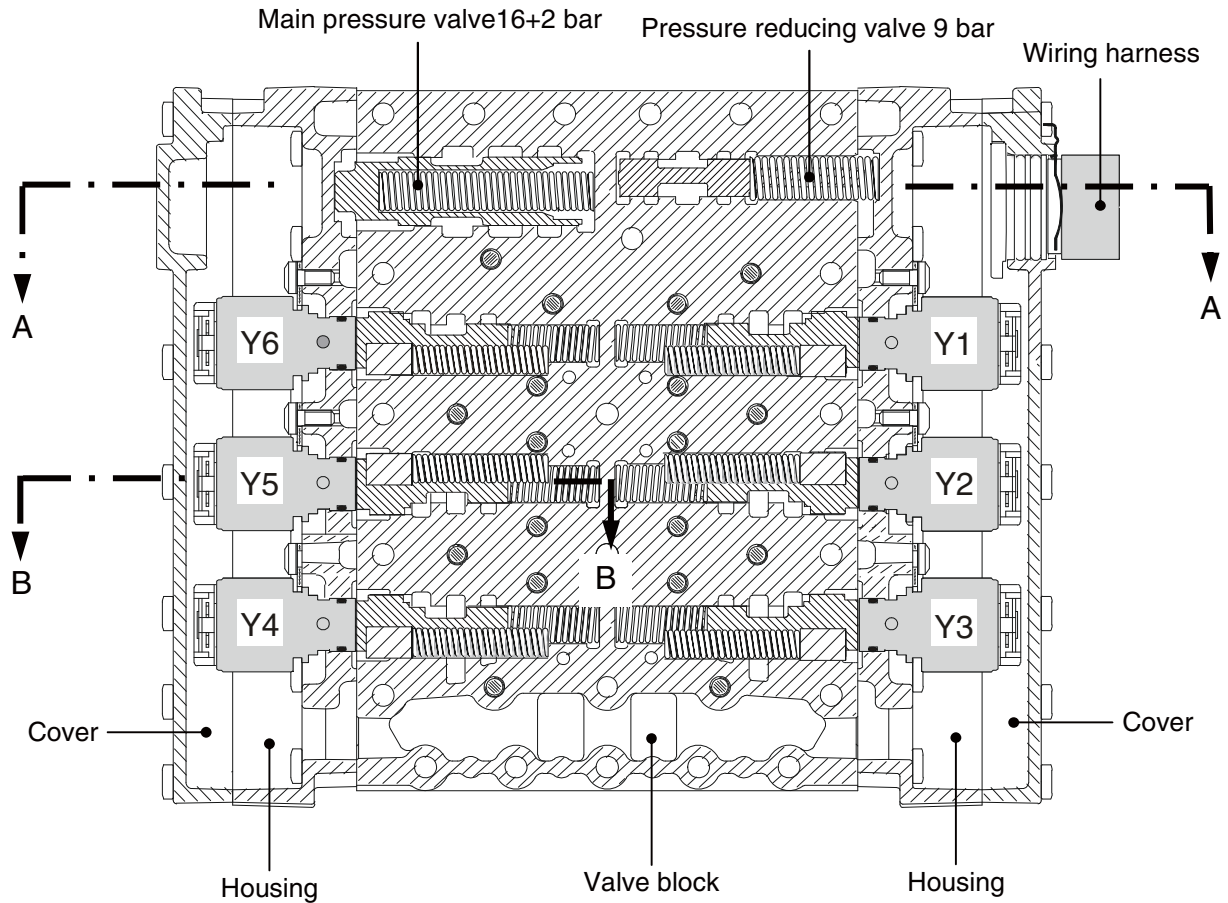


7709ACV16

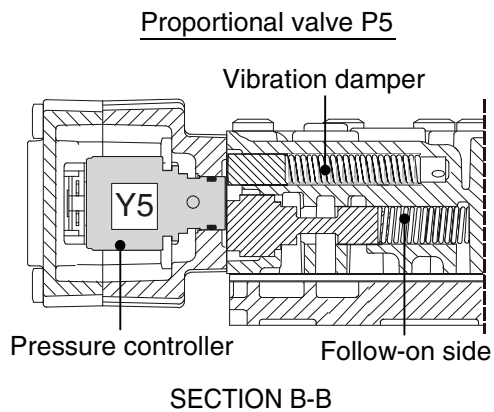
2) REASSEMBLY

Electro-hydraulic control with proportional valves :

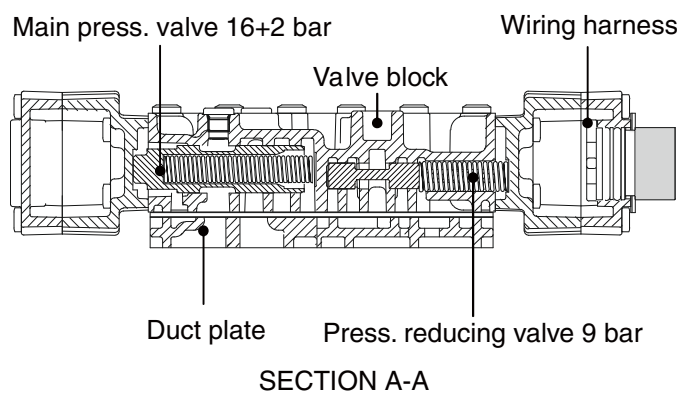
※ The following sketches show the sectional views of the electro-hydraulic control.



7709ACV17



7709ACV18



7709ACV19

(1) Fitting of electric control

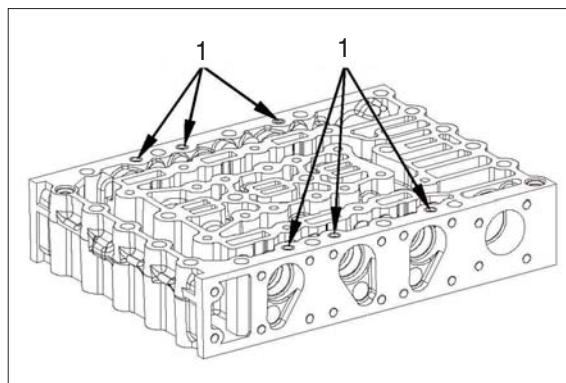
※ All single parts are to be checked for damage and replaced, if required.

Ensure free travel of the moving parts in the valve block prior to installation. Pistons can be exchanged individually.

Prior to the installation, oil single part.

- ① With the concave side showing upwards, insert orifice (1) until contact is obtained.

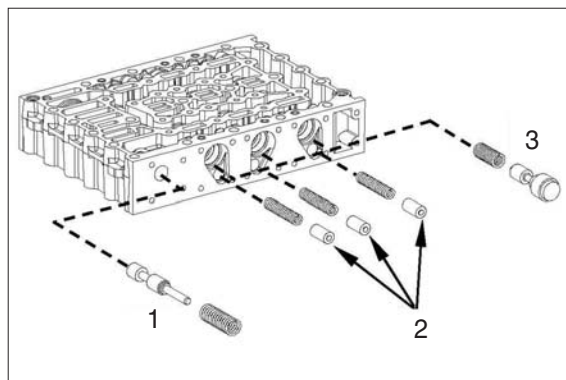
※ See arrows for installation position.



7709ACV20

- ② The opposite figure shows the following single parts :

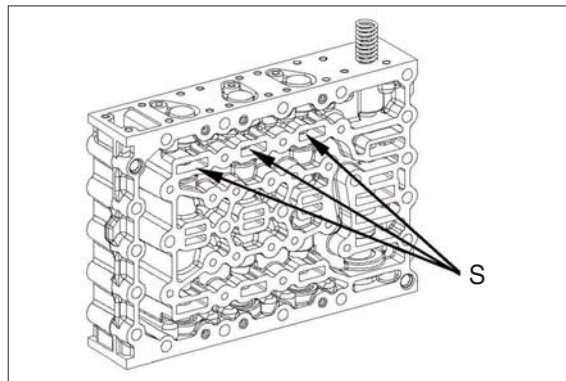
- 1 Pressure reducing valve
(1EA, piston and compression spring)
- 2 Vibration damper
(3EA, piston and compression spring)
- 3 Follow-on slide
(3EA, piston and compression spring)



7709ACV21

- ③ Install the single parts according to figure CV21.

※ Preload compression springs of the follow-on slides and preliminarily fix pistons by means of cylindrical pins $\varnothing 5.0$ mm (assembly aid), see arrows (S).



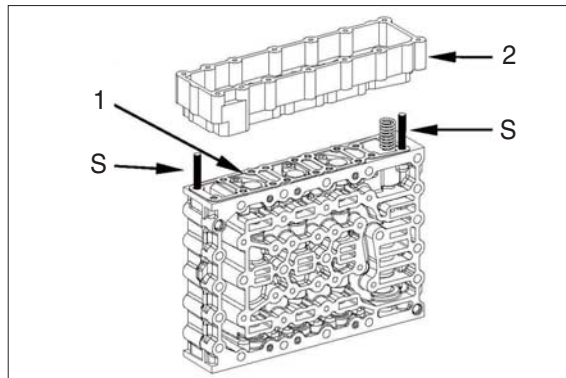
7709ACV22

- ④ Fit two adjusting screws.

Mount seal (1) and housing (2).

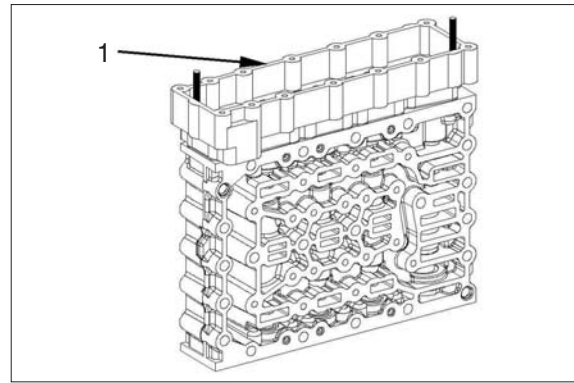
Then position housing equally by means of adjusting screws until contact is obtained.

Adjusting screws (S) 5870 204 036



7709ACV23

- ⑤ Bring housing (1) into contact position by means of the torx screws. This will preload the pistons, and you can remove the cylindrical pins (assembly aid).

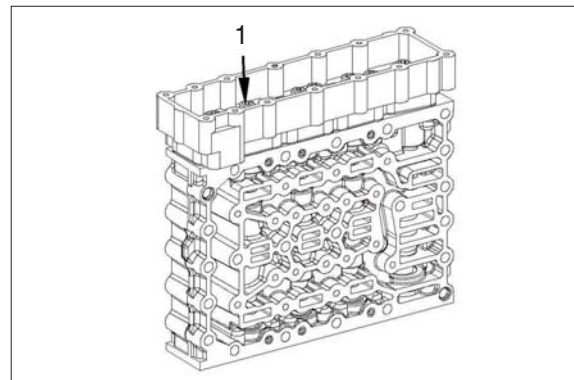


7709ACV24

- ⑥ Fix housing by means of the torx screws (1).

· Tightening torque (M5/10.9×30) :
0.56 kgf · m (4.06 lbf · ft)

Reducing adapter 5870 656 056
Socket wrench TX-27 5873 042 002



7709ACV25

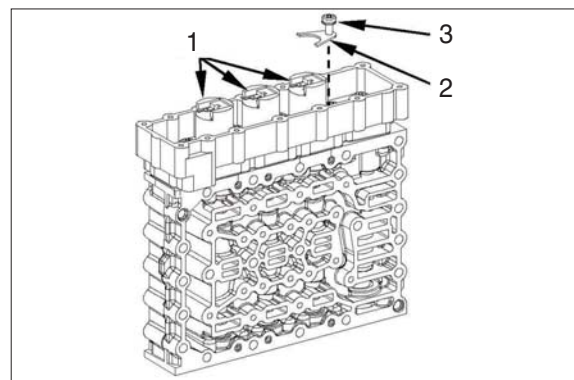
- ⑦ Monut pressure controllers with O-ring 13.5×2 (1) and fasten them by means of fixing plates (2) and torx screws (3).

※ Install the fixing plate, with the claw showing downwards.

Pay attention to the radial installation position of pressure controllers, see figure.

· Tightening torque (M5/8.8×12) :
0.56 kgf · m (4.06 lbf · ft)

Reducing adapter 5870 656 056
Socket wrench TX-27 5873 042 002

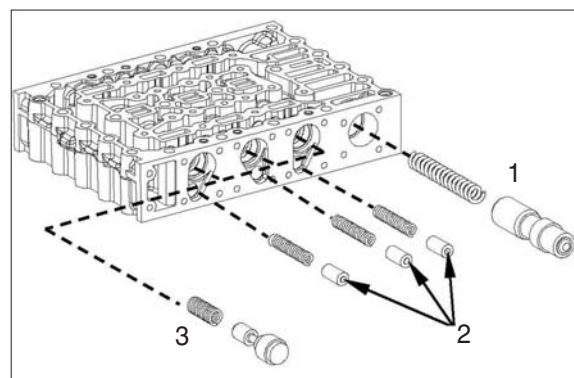


7709ACV26

Preassemble the opposite side

- ⑧ The figure on the right shows the following single parts :

- 1 Main pressure valve
(1EA, piston and compression spring)
- 2 Vibration damper
(3EA, piston and compression spring)
- 3 Follow-on slide
(3EA, piston and compression spring)



7709ACV27

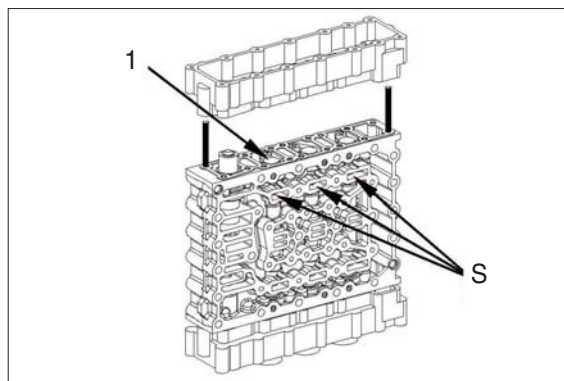
- ⑨ Install the single parts according to figure CV27.

- ※ Preload the compression springs of the follow-on slides and fasten the pistons preliminarily by means of cylindrical pins (S) $\varnothing 5.0$ mm (assembly aid), see arrows (S).

Install two adjusting screws.

Adjusting screws M5 5870 204 036

Assemble flat gasket (1) and housing cover. Then place the housing cover by means of adjusting screws equally until contact.



7709ACV28

- ⑩ Preload the position with torx screws and remove the cylindrical pins (assembly aid) again.

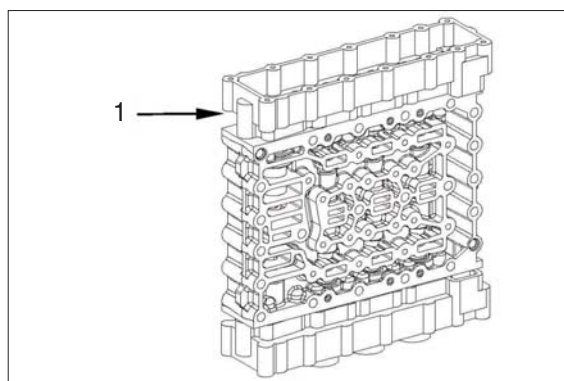
Then fasten the housing cover by means of torx screws (1).

- Tightening torque (M5/10.9 \times 30) :
0.56 kgf · m (4.06 lbf · ft)

Adjusting screws 5870 204 036

Reducer 5870 656 056

Socket spanner TX-27 5873 042 002



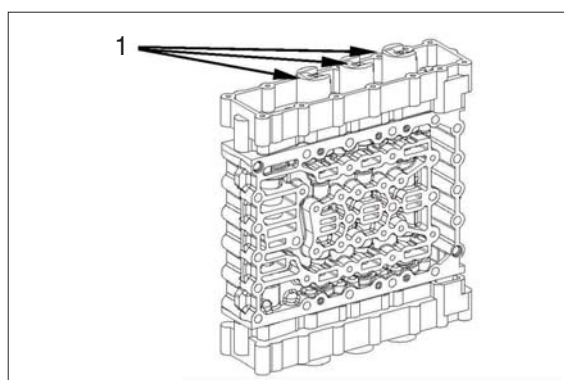
7709ACV29

- ⑪ Mount the pressure regulators with O-ring 13.5 \times 2 (1) and fasten them by means of fixing plates and cap screws.

- ※ Install the fixing plate with the neck showing downwards.

Observe radial installation position of the pressure regulators, see figure.

- Tightening torque (M5/8.8 \times 12) :
0.56 kgf · m (4.06 lbf · ft)

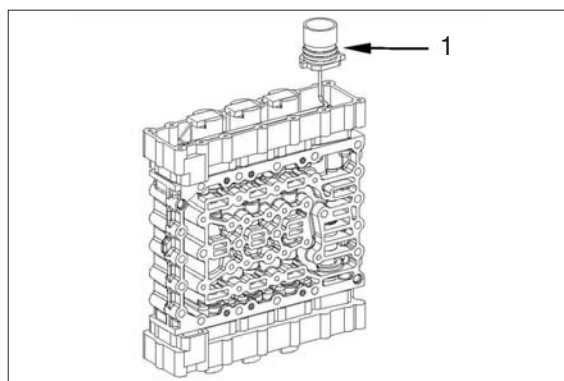


7709ACV30

- ⑫ Assemble the wiring harness (1) and connect the pressure regulators (6EA).

- ※ See figure CV01 for installation position of pressure regulators.

- ※ Pay attention to the installation position of the wiring harness, also see markings (figure CV05).



7709ACV31

⑬ Put on the flat gasket (1).

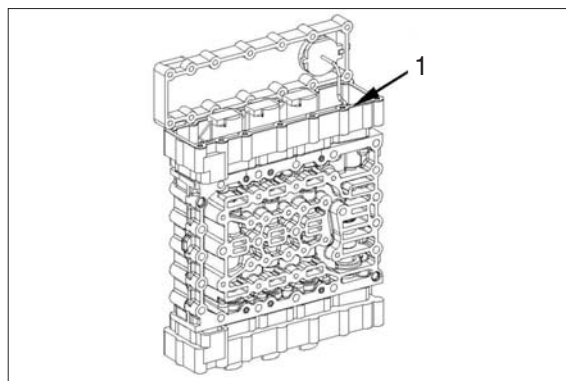
Assemble the plug socket with the slot showing to the lug of the cover until contact.

Fasten the cover by means of cap screws.

- Tightening torque (M5/10.9×30) :
0.56 kgf · m (4.06 lbf · ft)

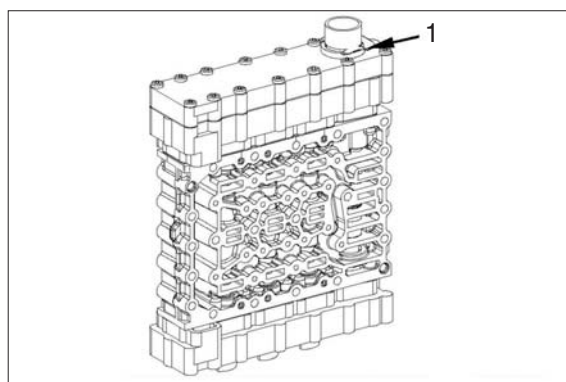
Reducer 5870 656 056

Socket spanner TX-27 5873 042 002



7709ACV32

⑭ Fix the wiring harness by means of retaining clamp (1).



7709ACV33

⑮ Lock-up clutch solenoid valve (5-speed transmission)

a. Place gasket (1).

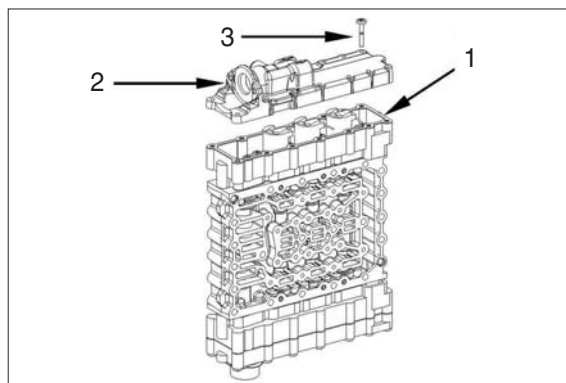
Fix connecting housing (2) by means of torx screws (3).

- Tightening torque (M5/10.9×30) :
0.56 kgf · m (4.06 lbf · ft)

Torque wrench 5870 203 031

Socket wrench TX-27 5873 042 002

Reducing adapter 5870 656 056



7709ACV34

※ Pay attention to installation position of connection housing, see the markings applied during disassembly.

- b. Fix pressure controller (1) by means of cylindrical screws (2).

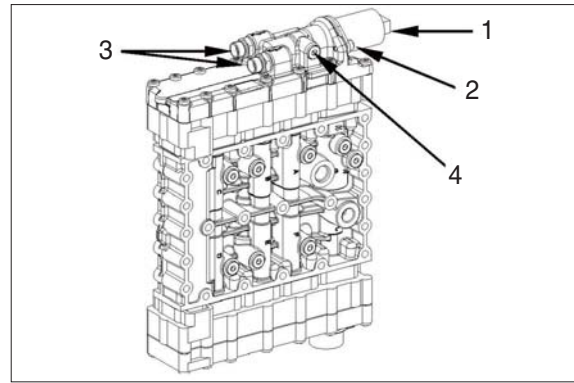
· Tightening torque (M6/8.8×12) :
1.02 kgf · m (7.38 lbf · ft)

Fit screw necks with O-ring 11.3×2.4 (3).

· Tightening torque :
2.55 kgf · m (18.4 lbf · ft)

Fit screw plug with O-ring 8×1.5 (4).

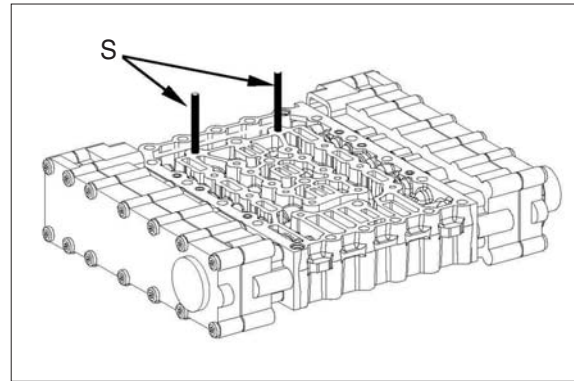
· Tightening torque (M10×1) :
1.02 kgf · m (7.38 lbf · ft)



7709ACV35

- ⑩ Install two adjusting screws (S).

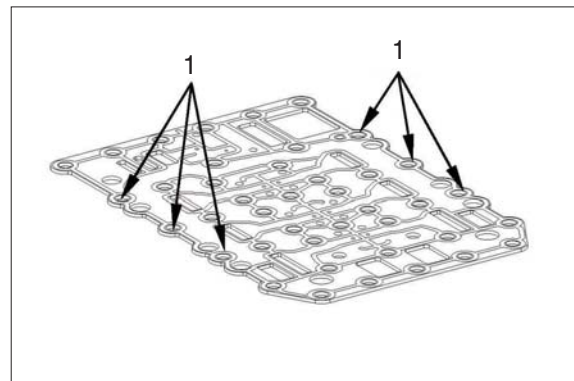
Adjusting screws 5870 204 063



7709ACV36

- ⑪ Flush-mount screens (1) into the holes of the sealing plate, see arrows.

※ Pay attention to the installation position
- screens to show upwards (towards the duct plate).



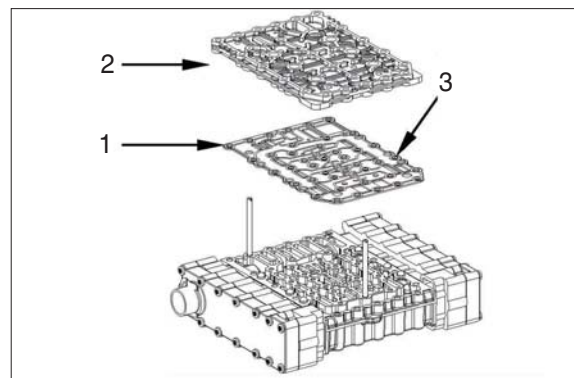
7709ACV37

- ⑫ Put on sealing plate (1) and duct plate (2).

※ Screens (3) to show upwards.

※ It is not permitted to reassemble the seal plate after opening the threaded joint shift unit/duct plate.

In case of repair it is always necessary to mount a new seal plate.

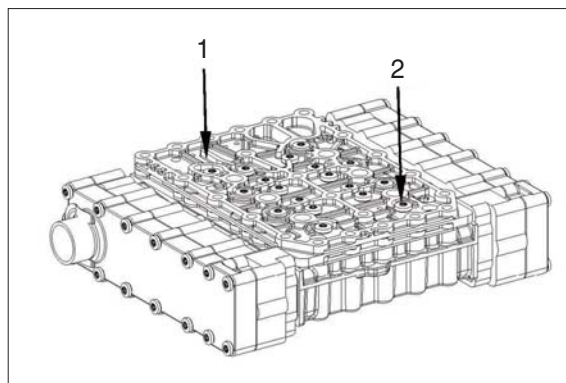


7709ACV38

- ⑲ Place duct plate (1) and fix it equally by means of torx screws (2).

· Tightening torque (M6/10.9×23) :
1.07 kgf · m (7.74 lbf · ft)

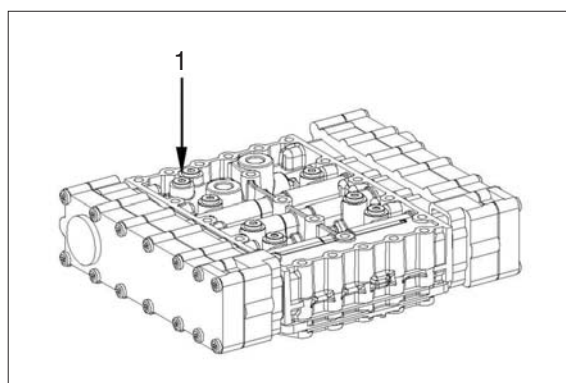
Socket wrench TX-27 5873 042 002



7709ACV39

- ⑳ Provide the screw plugs M10×1 with O-rings 8×1.5 (1) and install them.

· Tightening torque :
0.61 kgf · m (4.43 lbf · ft)

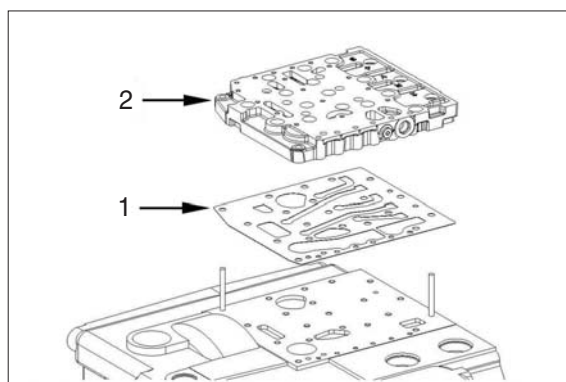


7709ACV40

- ㉑ Fit two adjusting screws.

Adjusting screws 5870 204 011

Place gasket (1) and duct plate (2) at the gearbox housing part until contact is obtained.



7709ACV41

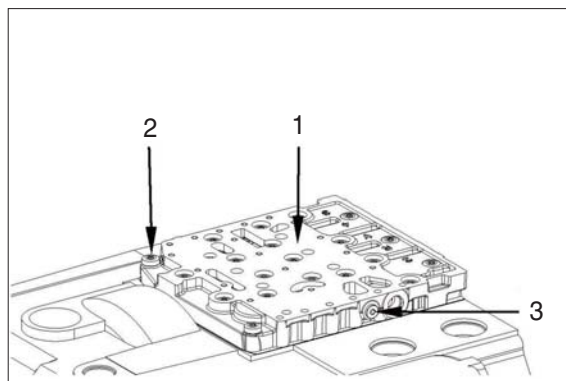
- ㉒ Fix duct plate (1) by means of torx screws (2).

· Tightening torque (M8/10.9×35) :
2.35 kgf · m (17.0 lbf · ft)

Mount screw plug with O-ring 8×1.5 (3).

· Tightening torque (M10×1) :
0.61 kgf · m (4.43 lbf · ft)

Socket wrench TX-40 5873 042 004



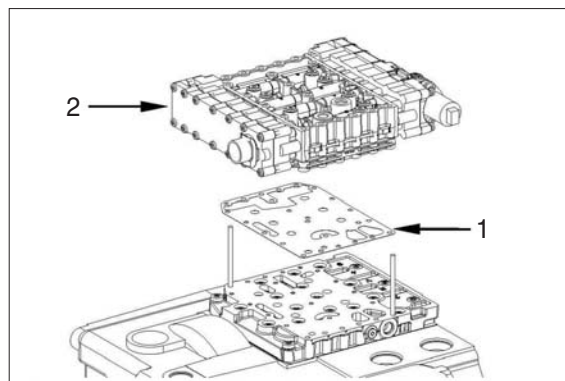
7709ACV42

②③ Fit two adjusting screws.

Adjusting screws 5870 204 063

Mount sealing plate (1) and electro-hydraulic control unit (2).

- ※ It is not permitted to reassemble the seal plate after opening the threaded joint shift unit/gearbox housing.
In case of repair it is always necessary to mount a new seal plate.



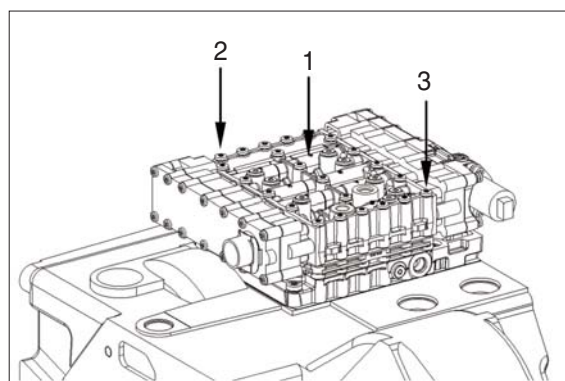
7709ACV43

②④ Fix electro-hydraulic control unit (1) equally by means of torx screws (2 and 3)

- Tightening torque (M6/10.9×76) :
0.97 kgf · m (7.01 lbf · ft)
- Tightening torque (M6/10.9×100) :
0.97 kgf · m (7.01 lbf · ft)

Socket wrench TX-27 5873 042 002

Reducing adapter 5870 656 056



7709ACV44

Pipe - System pressure to lock-up clutch valve (5-speed transmission)

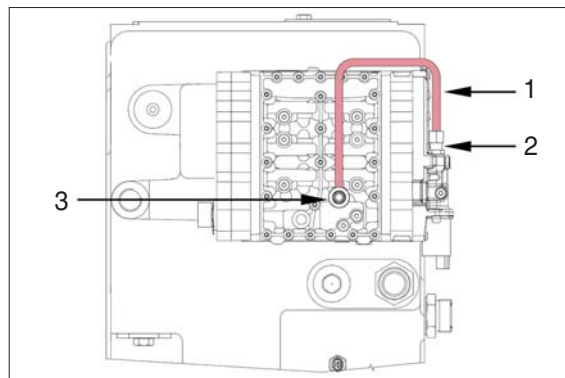
②⑤ Fix pipes (1) with hollow screws (3) and O-rings and screw nut (2).

Fit O-ring 13×2 on hollow screw (3), insert into eye of pipes, mount O-ring 18×2.5.

- Tightening torque :
4.59 kgf · m (33.2 lbf · ft)

Fixing of screw nut (2).

- Tightening torque :
3.57 kgf · m (25.8 lbf · ft)



7709ACV45

Pipes - System pressure from lock-up clutch valve to lock-up clutch (5-speed transmission)

②⑥ Fix pipe union (1).

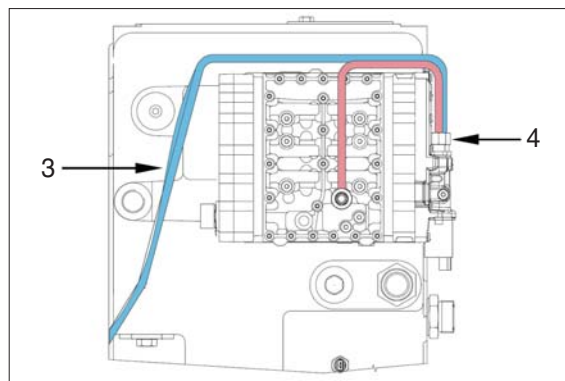
- Tightening torque :
4.08 kgf · m (29.5 lbf · ft)

Fix connection socket (2).

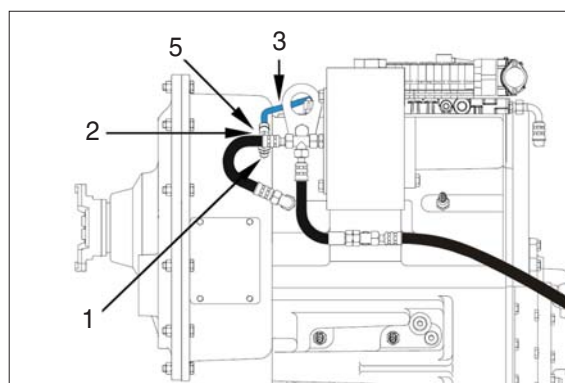
- Tightening torque :
3.57 kgf · m (25.8 lbf · ft)

Fix pipes (3) with screw nut (4 and 5).

- Tightening torque :
3.57 kgf · m (25.8 lbf · ft)

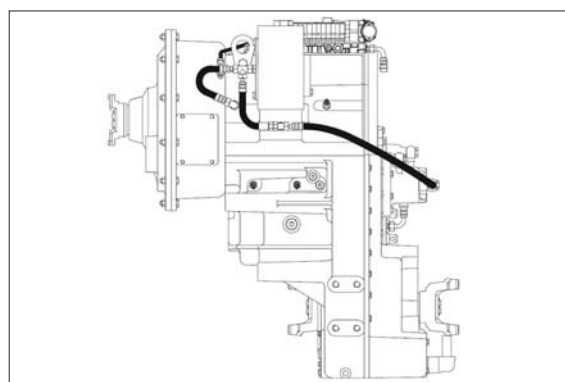


7709ACV46



7709ACV47

※ Before putting the transmission into operation, fill it with oil according to operation manual.



7709ACV48

2. TRANSMISSION

1) DISASSEMBLY

- (1) Fasten the complete transmission to the assembly truck.

※ Special tool

Assembly truck 5870 350 000

Holding fixture 5870 350 071



Figure 1

- (2) Remove the plug (arrow) and drain the oil. Then remove the oil cylinder.

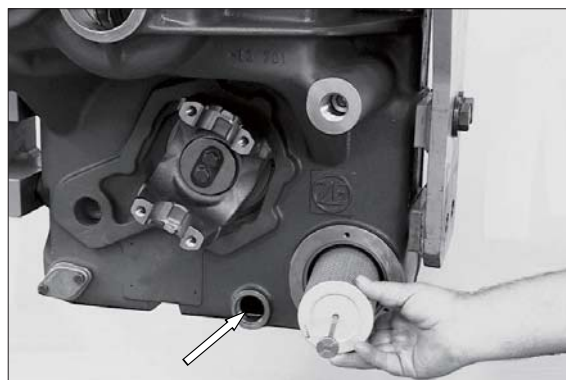


Figure 2

- (3) Remove all oil pipes, the complete gear shift system and the duct plate.

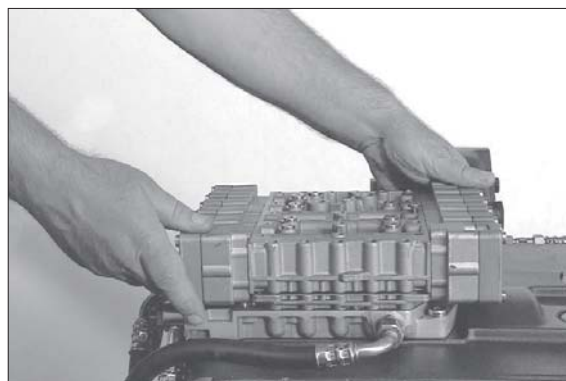


Figure 3

Converter/drive

- (1) By means of the lifting tackle separate the torque converter from the transmission.

※ Special tool

Eybolts assortment 5870 204 002

Lifting chain 5870 281 047



Figure 4

- (2) Loosen the bolt connection and by means of the forcing screws (3EA) separate the cover from the converter bell.

※ Special tool

Forcing screws 5870 204 005



Figure 5

- (3) By means of the extractor pull the oil supply flange out of the converter bell.

※ Special tool

Extractor 5870 000 089



Figure 6

- (4) Remove the converter safety valve (arrow 1), if required.

※ Converter safety valve is fixed by means of slotted pin (arrow 2).



Figure 7

- (5) Loosen the bolt connection (M8 and M12) and by means of lifting tackle and pry bar set separate the coverter bell from the transmission housing.

※ Special tool

Eyebolts assortment 5870 204 002

Pry bar set 5870 345 036

Lifting chain 5870 281 047



Figure 8

(6) Remove the rectangular ring (arrow).



Figure 9

(7) Press the input shaft out of the spur gear bearing. Remove the released bearing inner ring and the spur gear.



Figure10

(8) Press off the bearing inner ring from the spur gear.

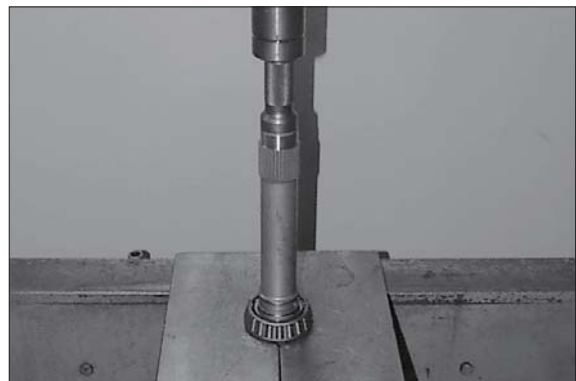


Figure11

(9) Remove the converter pressure back-up valve.



Figure 12

- (10) Remove the inductive transmitter.
9 = n - Engine

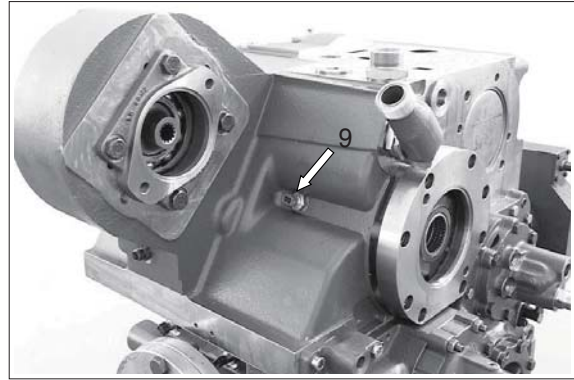


Figure 13

Input shaft - pump/power take-off

- (1) Loosen the cap screw.

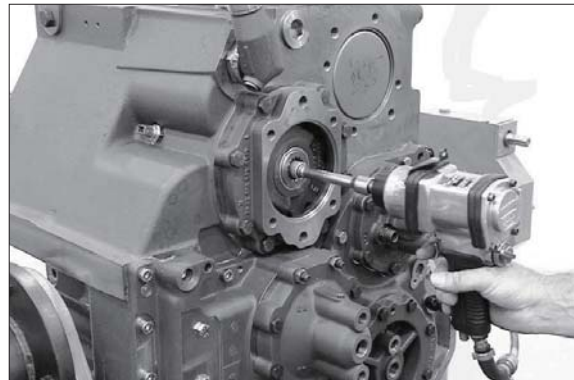


Figure 21

- (2) Remove the cap screw and clamping plate.

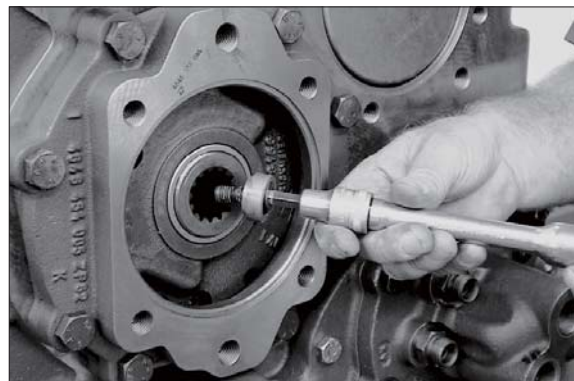


Figure 22

- (3) Press the input shaft out of the bearing.

※ Pay attention to released input shaft as well as shims.

※ Special tool
Extractor

5870 000 065



Figure 23

- (4) Snap out the rectangular ring (arrow 1) and remove both shims (arrow 2).

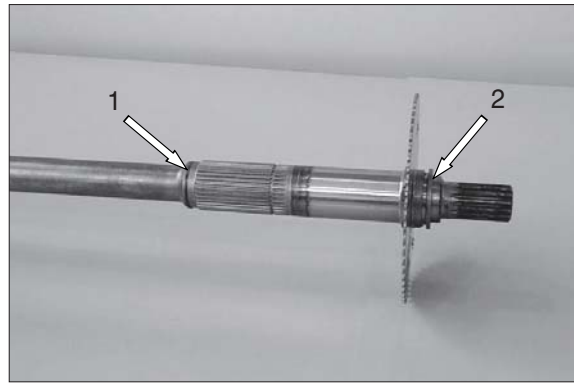


Figure 24

Transmission pump

- (1) Loosen the cap and hexagon screws (depending on the version) respectively and separate the pump flange from the housing.

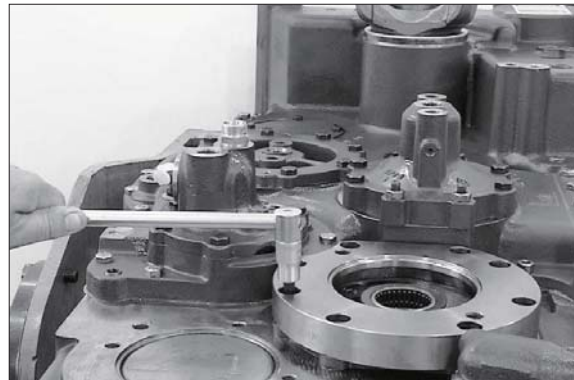


Figure 25

- (2) Loosen the cap screws (4EA / M8).
Position the extractor on the transmission pump and fasten it by means of screws (M8 \times 65) to the transmission pump. Then pull out the pump from the housing bore.

※ Extracting is supported by slightly tapping onto the transmission housing.

※ Special tool

Extractor

5870 000 089

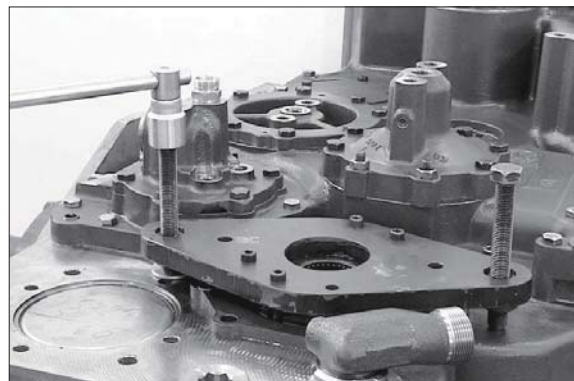


Figure 26

Remove the ball bearing and the driver (figure 28~29)

- (3) Snap out the retaining ring.



Figure 28

- (4) Press out the driver with ball bearing from the bearing bore.
Then separate the ball bearing from the driver.

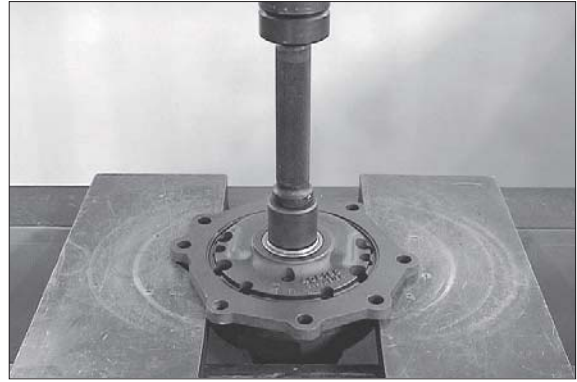


Figure 29

- (5) Loosen the cap screws, take off the pump cover and remove the rotor set.

▲ If marks due to running-in are found on the pump housing or housing cover, the complete pump is to be replaced.

Then assemble the rotor set with the chamfer on the tooth tip showing downwards and install the housing cover again.



Figure 30

- Torque limit (M8/8.8) :
2.35 kgf · m (17.0 lbf · ft)
- Torque limit (M6/8.8) :
0.97 kgf · m (7.01 lbf · ft)

Layshaft

- (1) Remove the sealing cover and loosen the hexagon screw.



Figure 38

- (2) Expel the idler shaft by means of the striker from the housing bore and layshaft bearing respectively.

※ Special tool

Striker

5870 650 014

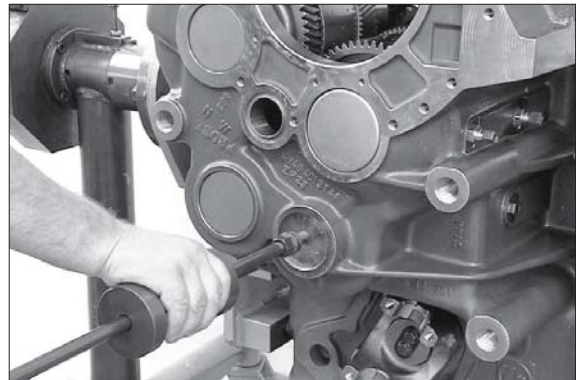


Figure 39

Removal of inductive and speed transmitter (figure 40~41)

14 = n - Turbine

5 = n - Internal speed input

13 = n - Output (speed transmitter)

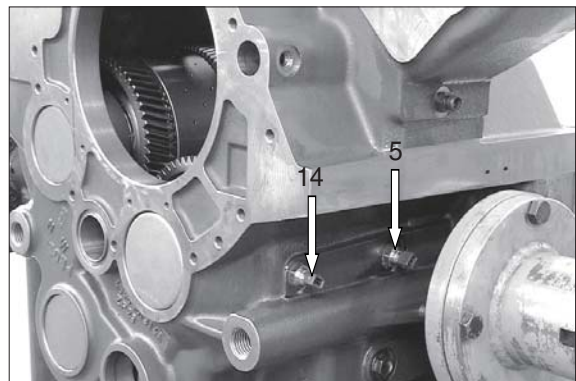


Figure 40

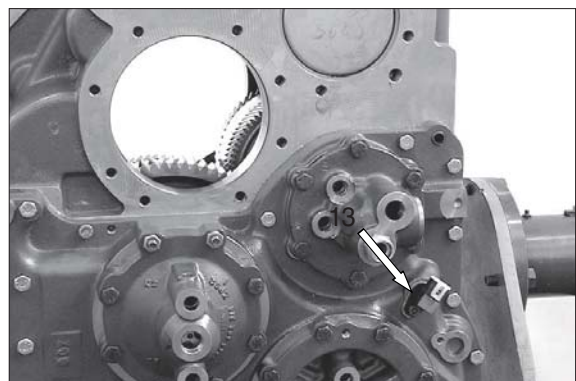


Figure 41

Output

Converter side :

Remove the lock plate. Loosen hexagon screws and take off the output flange. Rotate the housing by 180° and remove the output flange on the housing rearside.



Figure 42

Removal of the clutches and layshaft

- (1) Loosen the hexagon screws and expel the bearing cover KV/K1 by means of the striker from the housing bore. Remove the bearing cover KR/K2 (arrow) analogously.

※ Mark the installation location of the bearing cover.

※ Special tool

Threaded insert 5870 204 069

Striker 5870 650 014

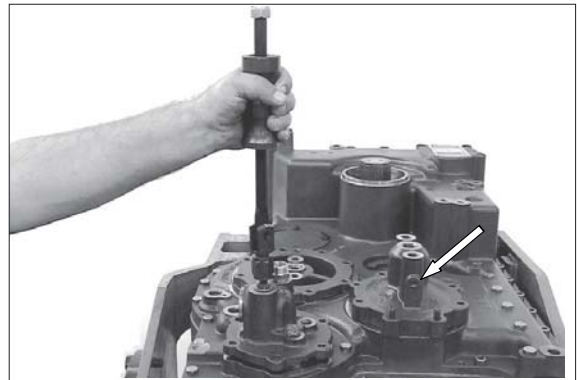


Figure 46

- (2) Pull out the bearing cover K4/K3 by means of the forcing screws from the housing bore.

※ Special tool

Forcing screws 5870 204 005

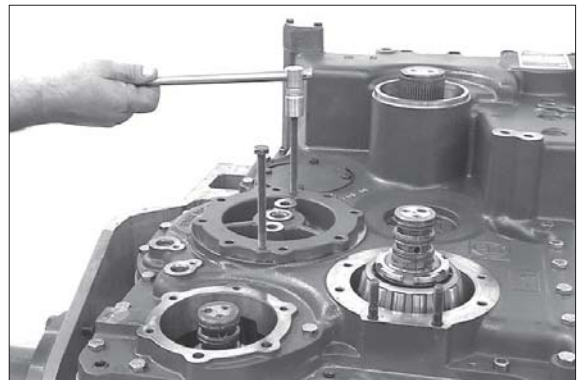


Figure 47

- (3) Separate the bearing inner ring from bearing cover K4/K3.

※ Special tool

Three-armed puller 5870 971 003



Figure 48

- (4) Loosen the bolt connection.

Separate the housing cover from the housing by equally tightening both forcing screws (arrow 1 and 2) as well as the threaded spindle (arrow 3).

※ Special tool

Internal hex spanner, size 8 5870 290 003

Forcing screws 5870 204 005

Lifting tackle 5870 281 061

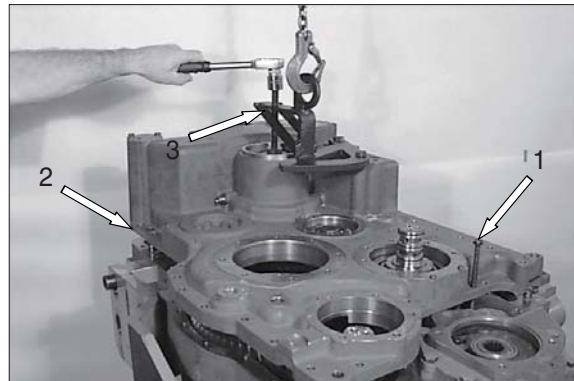


Figure 49

- (5) Expel the output shaft from the output gear.

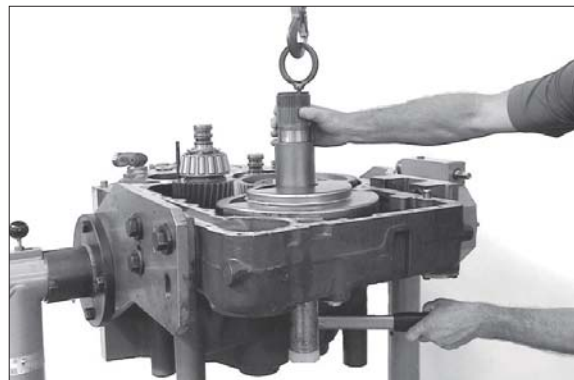


Figure 50

- (6) Loosen the hexagon screws and remove the oil baffle.

Lift the output gear out of the transmission housing (figure).

※ Special tool

Stop washer 5870 100 054

Eyebolts assortment 5870 204 002



Figure 51

- (7) Remove the bearing inner ring from the output gear.

※ Special tool

Three-armed puller 5870 971 003



Figure 52

- (8) Take the roller bearing out of the housing bore and remove the oil baffle (arrow).

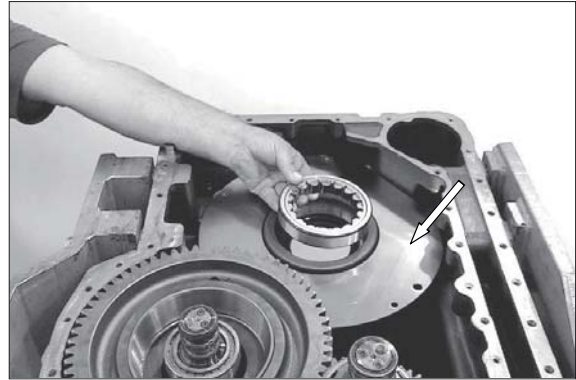


Figure 53

Remove the multi-disc clutches

- ※ For removal of the single clutches observe the following sequence :
K4/K3 → KR/K2 → KV/K1.
For removal of clutch K4/K3, lift the clutch KR/K2 slightly and move it in direction of the arrow, see figure.
- ※ Special tool
Eyebolts assortment 5870 204 002

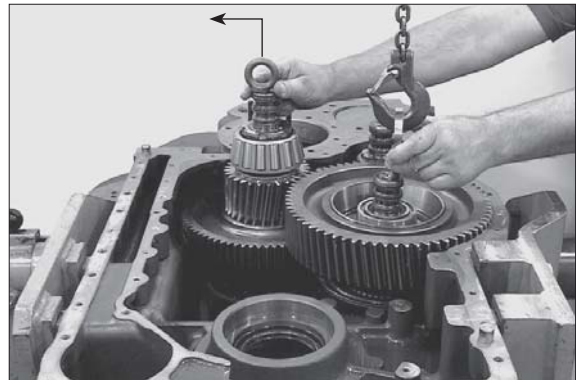


Figure 54

- (9) Opposite figure shows the clutches when removed.

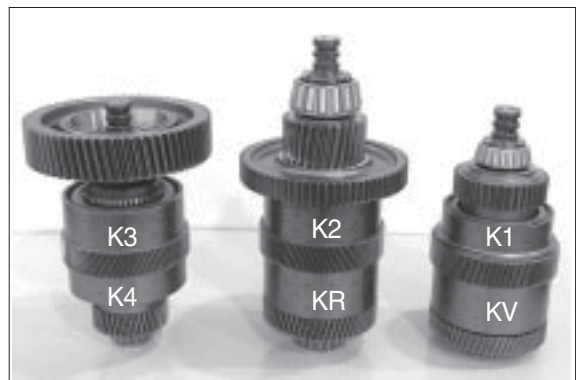


Figure 55

- (10) Remove the layshaft gear.



Figure 56

Dismantling of the Multi-Disc Clutch K3/K4

- (1) By means of clamping ring fasten the clutch to the assembly truck.

※ Special tool
Clamping ring 5870 654 033



Figure 62

- (2) Pull off the roller bearing from the disc carrier.

※ Special tool
Three-armed puller 5870 971 002



Figure 63

- (3) Separate spur gear K3 from the disc carrier.



Figure 64

- (4) Pull off the bearing inner ring from the disc carrier.

※ Special tool
Rapid grip 5873 012 012
Basic tool 5873 002 001



Figure 65

- (5) Squeeze out the snap ring.
Remove the end shim and disc set K3.



Figure 66

- (6) Rotate disc carrier by 90°.
Loosen the slotted nut.

- ※ Special tool
Slotted nut wrench 5870 401 118
Slotted nut wrench 5870 401 115



Figure 67

- (7) Rotate disc carrier by 90°.
Pull off the taper roller bearing.

- ※ Special tool
Gripping insert 5873 011 012
Basic tool 5873 001 000



Figure 68

- (8) Pull off the spur gear K4 from the disc carrier.

- ※ Special tool
Three-armed puller 5870 971 003



Figure 69

(9) Remove the ring.



Figure 70

(10) Pull off the taper roller bearing.

※ Special tool
Three-armed puller 5870 971 002

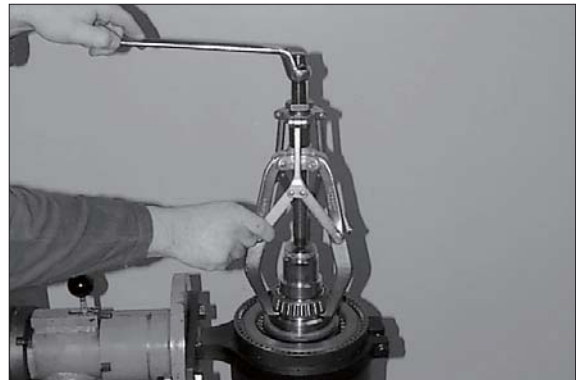


Figure 71

(11) Squeeze out the snap ring.
Remove the end shim and the disc set K4.



Figure 72

(12) Preload the compression spring by means of fixture.
Squeeze out the snap ring and the released single components.
Remove the opposite single components (K3 side) analogously.

※ Special tool
Pressure piece 5870 345 072



Figure 73

- (13) Separate both pistons by means of compressed air from the disc carrier.

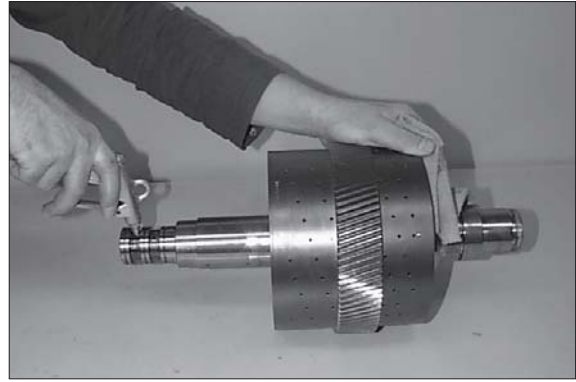


Figure 74

Dismantling of the multi-disc clutch KR/K2

- (1) Fasten the clutch by means of clamping ring (arrow) on the assembly truck.

※ Special tool
Clamping ring 5870 654 033



Figure 75

- (2) Rotate disc carrier by 90°.
Loosen the slotted nut.

※ Special tool
Slotted nut wrench 5870 401 099

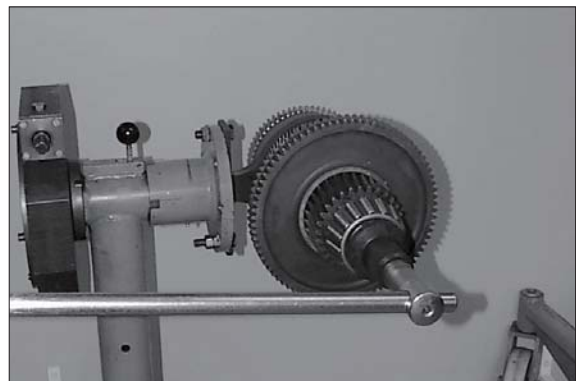


Figure 76

- (3) Pull off the taper roller bearing from the disc carrier.

※ Special tool
Gripping insert 5873 012 018
Basic tool 5873 002 001



Figure 77

- (4) Press off the spur gear K2 from the disc carrier.

⚠ Pay attention to released disc carrier.

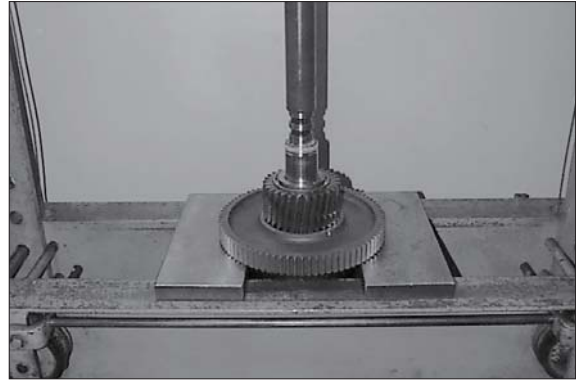


Figure 78

- (5) Fasten the disc carrier by means of clamping ring.
Pull off the taper roller bearing from the disc carrier.

※ Special tool
Clamping ring 5870 654 033
Gripping insert 5873 012 019
Basic tool 5873 002 001



Figure 79

- (6) Squeeze out the snap ring.
Remove the end shim and disc set K2.



Figure 80

- (7) Rotate disc carrier by 90°.
Loosen the slotted nut.

※ Special tool
Slotted nut wrench 5870 401 099

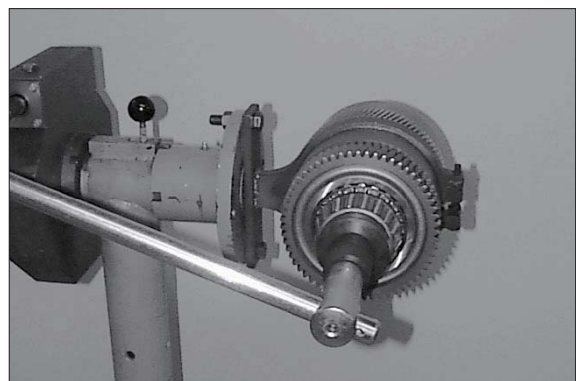


Figure 81

(8) Pull off the taper roller bearing from the disc carrier.

※ Special tool

Gripping insert 5873 002 044

Basic tool 5873 002 001



Figure 82

(9) Fasten spur gear KR by means of clamping ring (arrow) and pull it from the disc carrier.

※ Collar of the clamping ring must show upwards (to the spur gear).

※ Special tool

Three-armed puller 5870 971 003

Clamping ring 5870 654 045

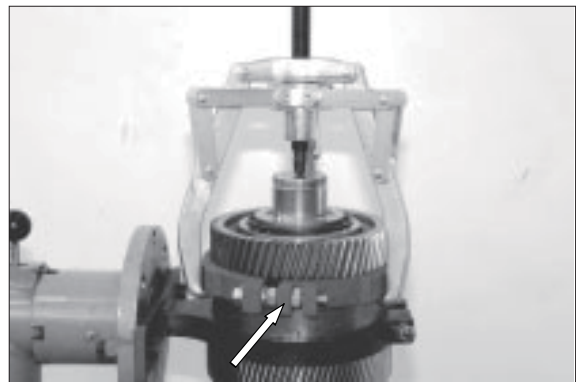


Figure 83

(10) Remove the ring.

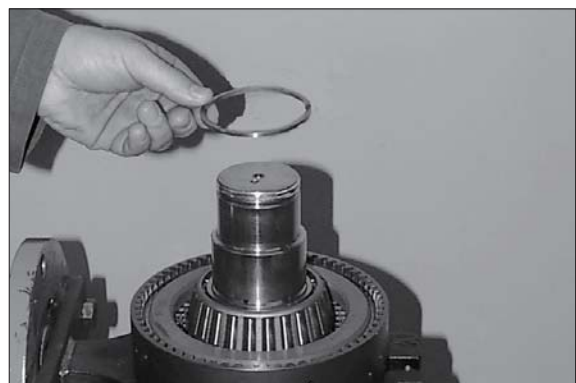


Figure 84

(11) Squeeze out the snap ring.
Remove end shim and disc set KR.



Figure 85

(12) Pull off the taper roller bearing from the disc carrier.

※ Special tool

Gripping insert 5873 012 013

Basic tool 5873 002 001

Remove both piston (like described in figure 73 and 74)



Figure 86

Dismantling of the multi-disc clutch KV/K1

(1) Fasten clutch by means of clamping ring to the assembly truck.

Loosen the slotted nut (figure 87).

※ Special tool

Clamping ring 5870 654 033

Slotted nut wrench 5870 401 118

Slotted nut wrench 5870 401 099

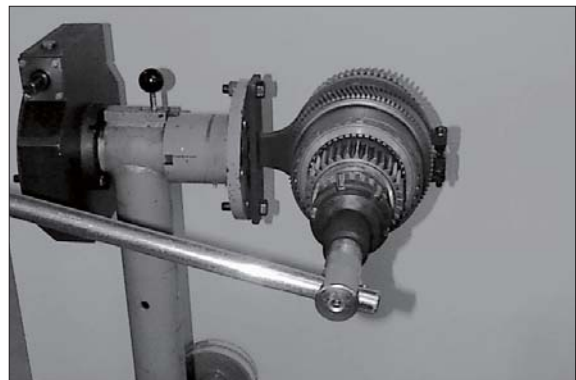


Figure 87

(2) Pull off the taper roller bearing from the disc carrier.

※ Special tool

Gripping insert 5873 001 023

Basic tool 5873 001 000



Figure 88

(3) Remove the shim.



Figure 89

(4) Pull off spur gear K1 from the disc carrier.

※ Special tool

Three-armed puller 5870 971 003



Figure 90

(5) Opposite figure shows the spur gear bearing K1.

Bearing (1) can only be obtained as complete part.

▲ If it is necessary to remove the clutch-pack-sided ball bearing (arrow or Figure 93 and 94), the complete bearing (1) has to be removed.

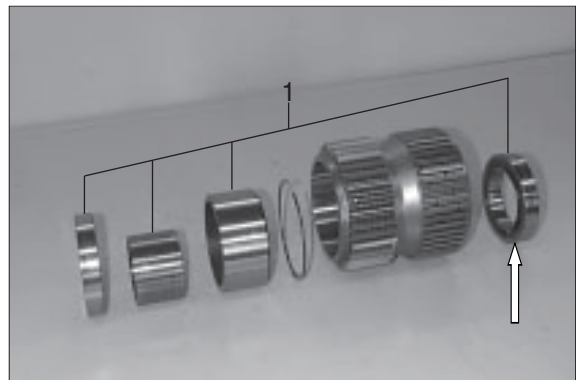


Figure 91

(6) Take off the bush.



Figure 92

(7) Pull off the ball bearing from the disc carrier (figure 93 and 94).

※ Pay attention to released balls.



Figure 93



Figure 94

- (8) Squeeze out the snap ring.
Remove end shim and disc set K1.



Figure 95

- (9) Rotate disc carrier by 90°.
Loosen the slotted nut.

- ※ Special tool
Slotted nut wrench 5870 401 118
Slotted nut wrench 5870 401 115



Figure 96

- (10) Pull off the taper roller bearing from the disc carrier.

- ※ Special tool
Gripping insert 5873 001 034
Basic tool 5873 001 000



Figure 97

(11) Pull off spur gear KV from the disc carrier.

※ Special tool

Three-armed puller 5870 971 003



Figure 98

(12) Remove the ring.

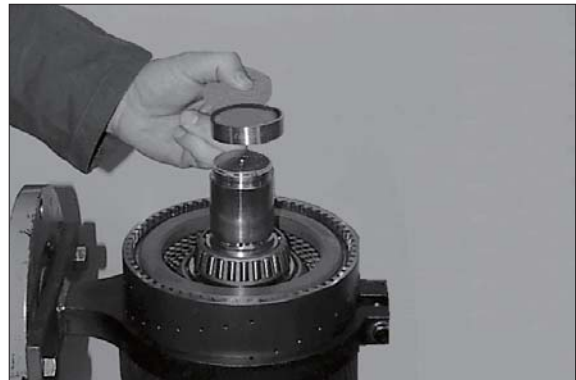


Figure 99

(13) Pull off the taper roller bearing from the disc carrier (figure 100).

Squeeze out the snap ring.

Remove end shim and disc set KV.

Remove both pistons (like described in Figure 73 and 74).

※ Special tool

Gripping insert 5873 001 034

Basic tool 5873 001 000



Figure 100

2) ASSEMBLY

Assembly of the multi-disc clutch K4/K3

The following sketch shows the clutch sectioning

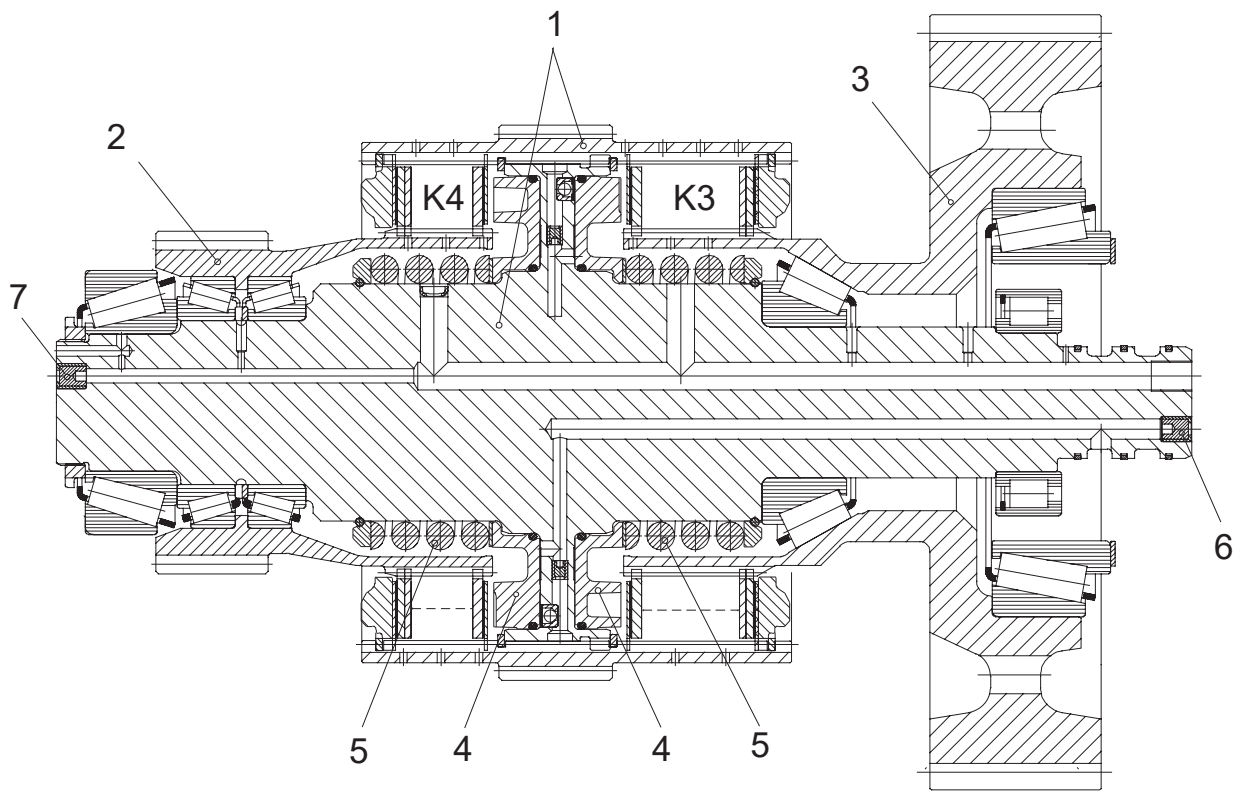


Figure 127

- | | | | | | |
|---|--------------------|----|----------------------|---|--------------------|
| 1 | Disc carrier(assy) | K4 | Multi-disc clutch K4 | 5 | Compression spring |
| 2 | Spur gear K4 | K3 | Multi-disc clutch K3 | 6 | Plug 2EA |
| 3 | Spur gear K3 | 4 | Piston | 7 | Plug 1EA |

※ Observe the installation position of the single components for the following assembly.

- (1) Lift the disc carrier with the K4-side showing downwards into the clamping ring (S) and fasten it.
Rotate disc carrier by 180°.

※ Special tool
Clamping ring 5870 654 033

▲ To install new disc carriers the finished bores have to be sealed with plugs.
Installation position, see arrow, figure 128 and 129.

※ Special tool
Hand inserting tool 5870 320 014
Ratchet spanner 5870 320 018



Figure 128



Figure 129

- (2) Flush-mount the drain valve (arrow) with the chamfer showing downwards.

※ Special tool
Inserting tool 5870 320 019

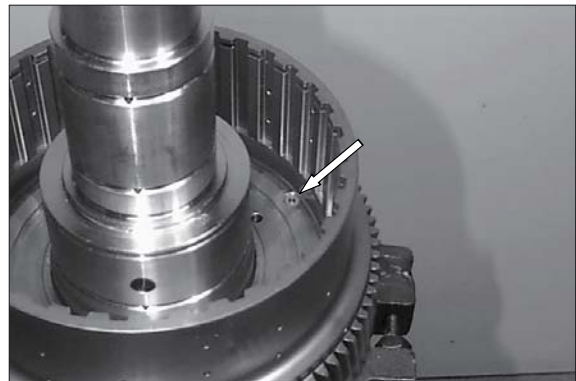


Figure 130

- (3) Put both O-rings scroll-free into the annular grooves of the piston, see arrows.

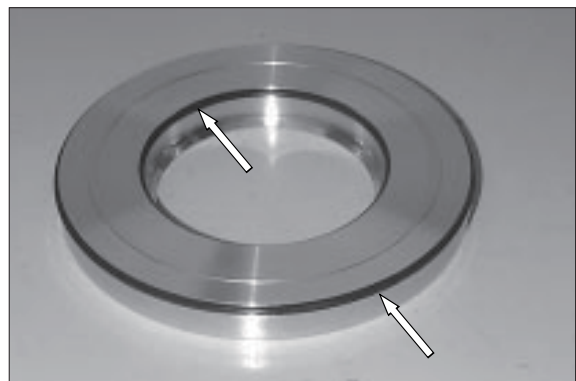


Figure 131

- (4) Oil the O-rings and the piston contact surface.
Install K3 piston equally until contact.
- ※ Observe the installation position of the piston, see figure.



Figure 132

- (5) Install spacer and compression spring.

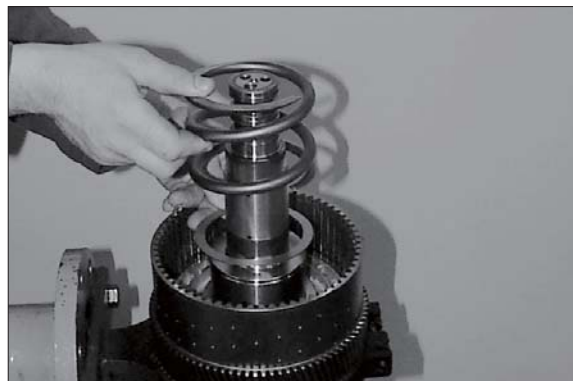


Figure 133

- (6) Place guide ring, with the chamfer (arrow) showing upwards, over the compression spring and install the snap ring.

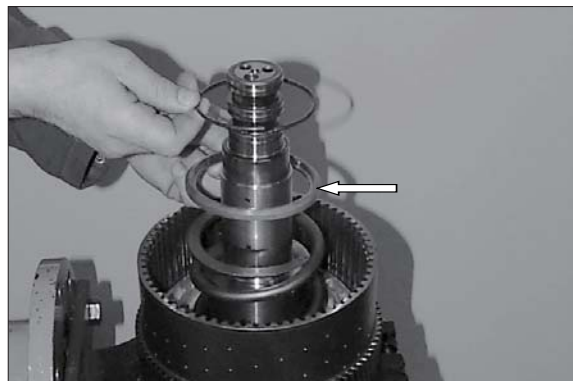


Figure 134

- (7) Lift the disc carrier out of the clamping ring. Preload the compression spring by means of fixture and engage the snap ring into the annular groove of the disc carrier (arrow), see figure 135.

※ Special tool

Fixture 5870 345 072

Clamping fixture 5870 654 036

Install the drain valve, piston and compression spring on the opposite side (clutch K4) analogously (figure 130~135).

Then lift the disc carrier with the K4-side showing downwards into the clamping ring and fasten it. Rotate disc carrier by 180°.



Figure 135

Disc Components K4

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

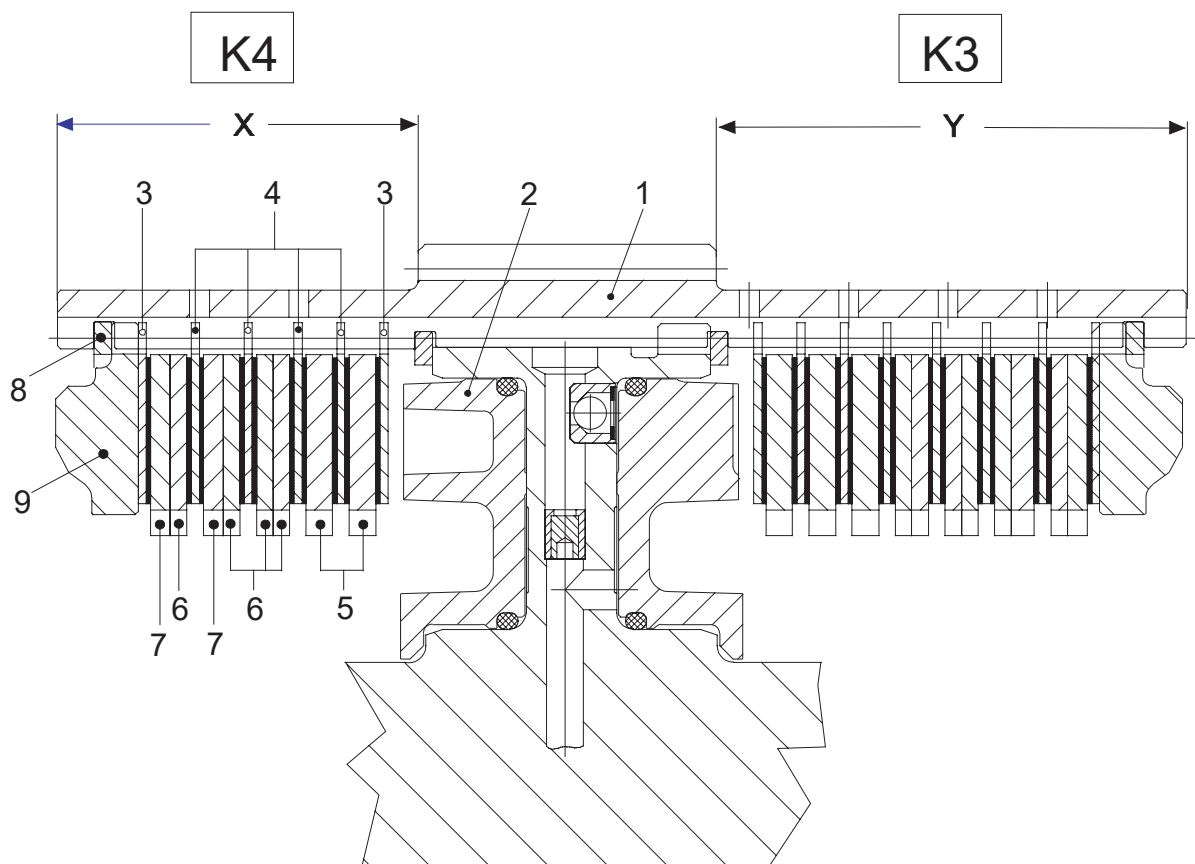


Figure 136

| Position | Description | Quantity | s (mm) | Remarks |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1 | Disc carrier | 1 | | |
| 2 | Piston | 1 | | |
| 3 | Outer clutch disc | 2 | 1.85 | Coated on one side |
| 4 | Outer clutch disc | 4 | 2.5 | Coated on both sides |
| 5 | Inner clutch disc | 2 | 4.0 | |
| 6 | Inner clutch disc | 4 | 2.5 | |
| 7 | Inner clutch disc | 2 | 2.5~4.0 | Optional |
| 8 | Snap ring | 1 | 2.10~3.10 | Optional |
| 9 | End shim | 1 | | |
| Number of friction surfaces : 10 | | | | |
| Disc clearance : 2.2 ~ 2.4 mm | | | | |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length of the disc carrier, see sketch.

K4 Dimension X (short disc carrier side)

K3 Dimension Y (long disc carrier side)

Check disc clearance $K4=2.2\sim2.4$ mm
(figure 137~139)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-129).



Figure137

(2) Install the end shim and fasten it by means of the snap ring.

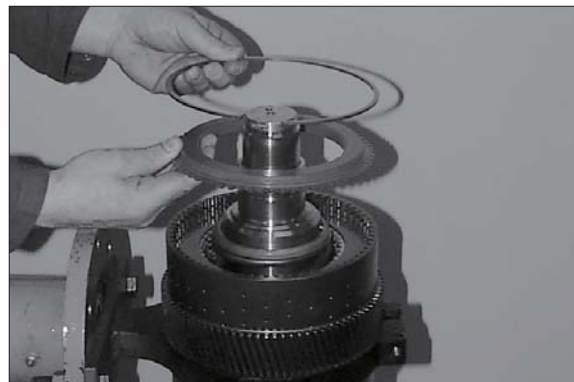


Figure138

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

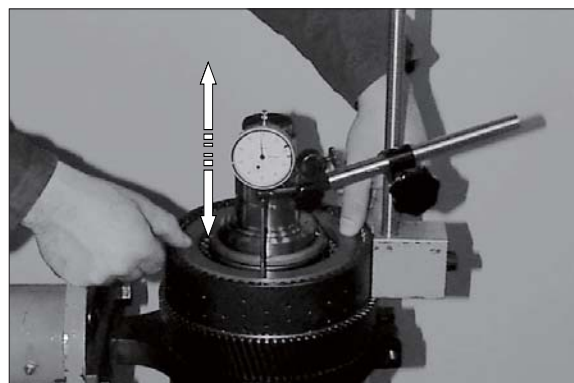


Figure139

Preamble and install spur gear K4
(figure 140~144) :

(1) Opposite figure shows the single components of spur gear K4.

- 1 Bearing inner ring
- 2 Bearing outer ring
- 3 Ring
- 4 Spur gear

Locate both bearing outer rings (2) until contact.

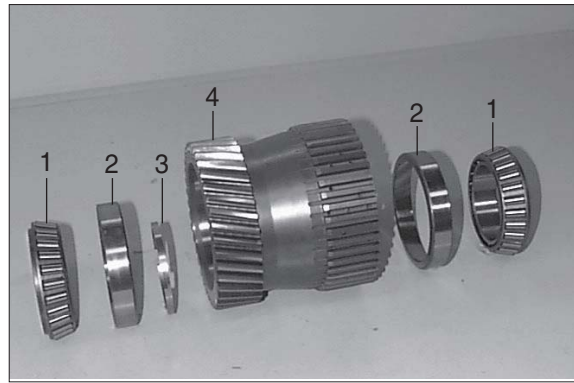


Figure140

(2) Heat the bearing inner ring and install it until contact.



Figure141

(3) Install the ring (3).



Figure142

(4) Assemble the spur gear until all inner clutch discs are located.



Figure143

(5) Heat the bearing inner ring (spur gear bearing) and locate it until contact.

⚠ Use safety gloves.



Figure144

(6) Heat the bearing inner ring (clutch bearing) and install it until contact.

⚠ Use safety gloves.



Figure145

Clutch Components K3

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

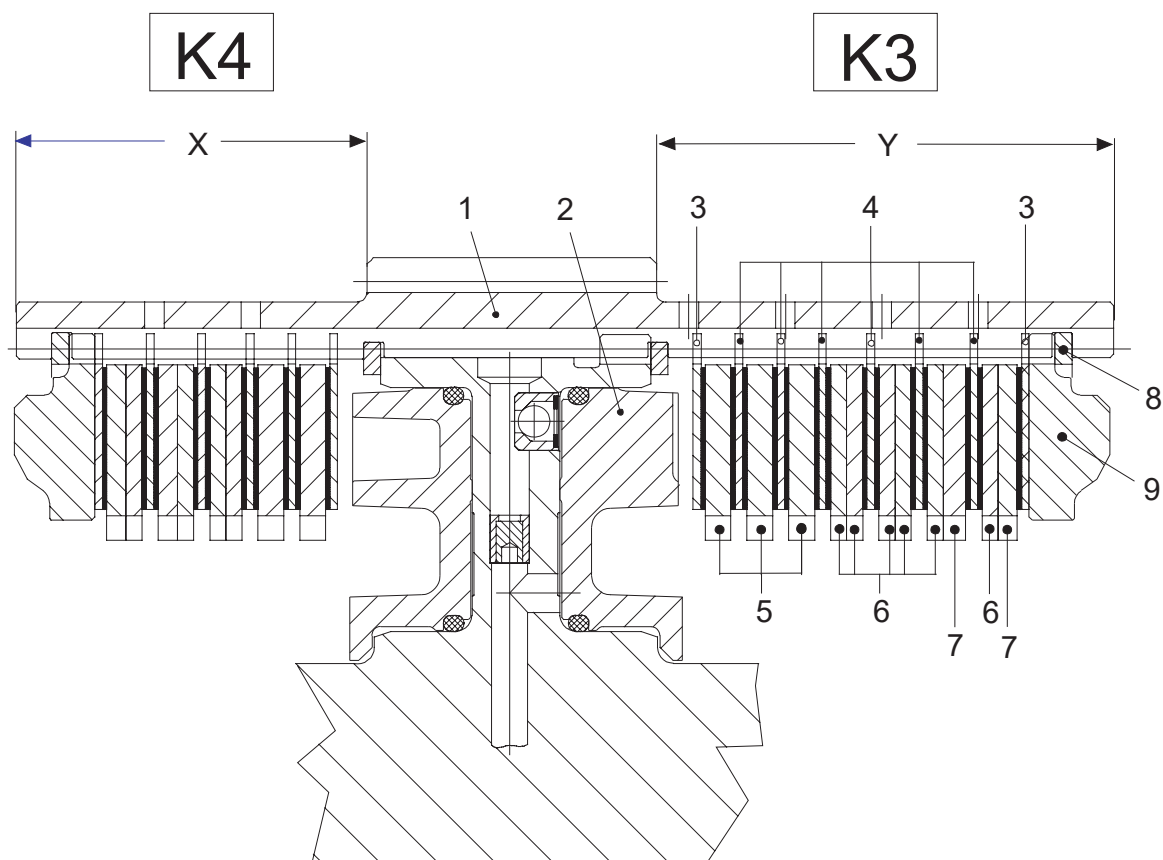


Figure146

| Position | Description | Quantity | s(mm) | Remarks |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1 | Disc carrier | 1 | | |
| 2 | Piston | 1 | | |
| 3 | Outer clutch disc | 2 | 1.85 | Coated on one side |
| 4 | Outer clutch disc | 6 | 2.5 | Coated on both sides |
| 5 | Inner clutch disc | 3 | 4.0 | |
| 6 | Inner clutch disc | 6 | 2.5 | |
| 7 | Inner clutch disc | 2 | 2.5~4.0 | Optional |
| 8 | Snap ring | 1 | 2.10~3.10 | Optional |
| 9 | End shim | 1 | | |
| Number of friction surfaces : 14 | | | | |
| Disc clearance : 2.2 ~ 2.4mm | | | | |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length of the disc carrier, see sketch.

K3 Dimension Y (long disc carrier side)

K4 Dimension X (short disc carrier side)

Check disc clearance $K3=2.2\sim2.4$ mm
(figure 147~149)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-133).



Figure 147

(2) Install the end shim and fasten it by means of the snap ring.



Figure 148

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

※ Magnetic stand 5870 200 055

Dial indicator 5870 200 057

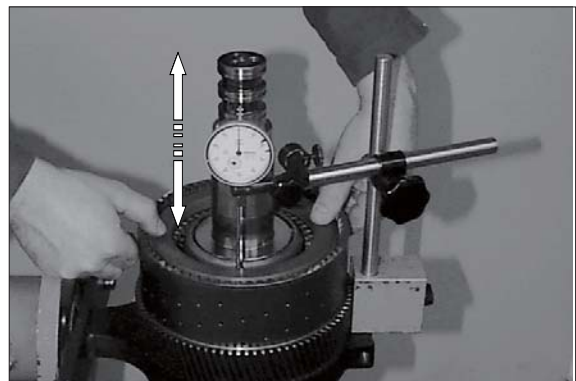


Figure 149

- (4) Heat the bearing inner ring and install it until contact.

⚠ Use safety gloves.



Figure 150

- (5) Lift the disc carrier out of the clamping ring.

To ensure the exact locating of the single components, preload the bearing with 100KN (10 t) (figure 151)

⚠ Support on the lower as well as upper bearing inner ring.
Use pressure pieces.

※ Special tool

Pressure piece 5870 506 096



Figure 151

- (6) Lift the disc carrier with the K4-side showing downwards into the clamping ring (S) and fasten it.
Rotate disc carrier by 90°.
Install the slotted nut.

※ Observe installation position of the slotted nut. Collar (Ø60 mm) must show to the bearing inner ring, also see sketch/page 3-133. Oil the thread.

· Tightening torque : 56.1 kgf · m (406 lbf · ft)

※ Special tool

Clamping ring 5870 654 033

Slotted nut wrench 5870 401 118

Slotted nut wrench 5870 401 115



Figure 152

- (7) Install the bearing outer ring into spur gear K3 until contact.



Figure 153

- (8) Assemble the spur gear until all inner clutch discs are located.

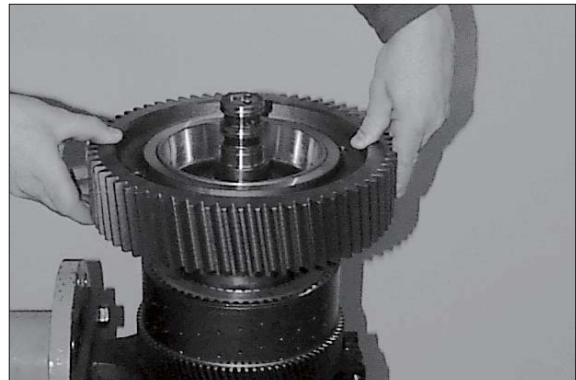


Figure 154

- (9) Heat the roller bearing and locate it until contact.

▲ Use safety gloves.



Figure 155

- (10) Install the bearing inner ring.



Figure 156

(11) Check function of the clutches K3 and K4 by means of compressed air.

※ Closing or opening of the clutches is clearly audible when the single parts have been installed adequately.

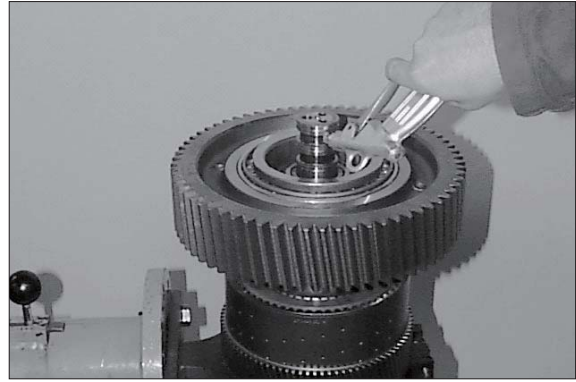


Figure 157

(12) Snap-in and lock the rectangular rings (3EA, see arrows).



Figure 158

Assembly of the multi-disc clutch KR/K2

The following sketch shows the clutch sectioning.

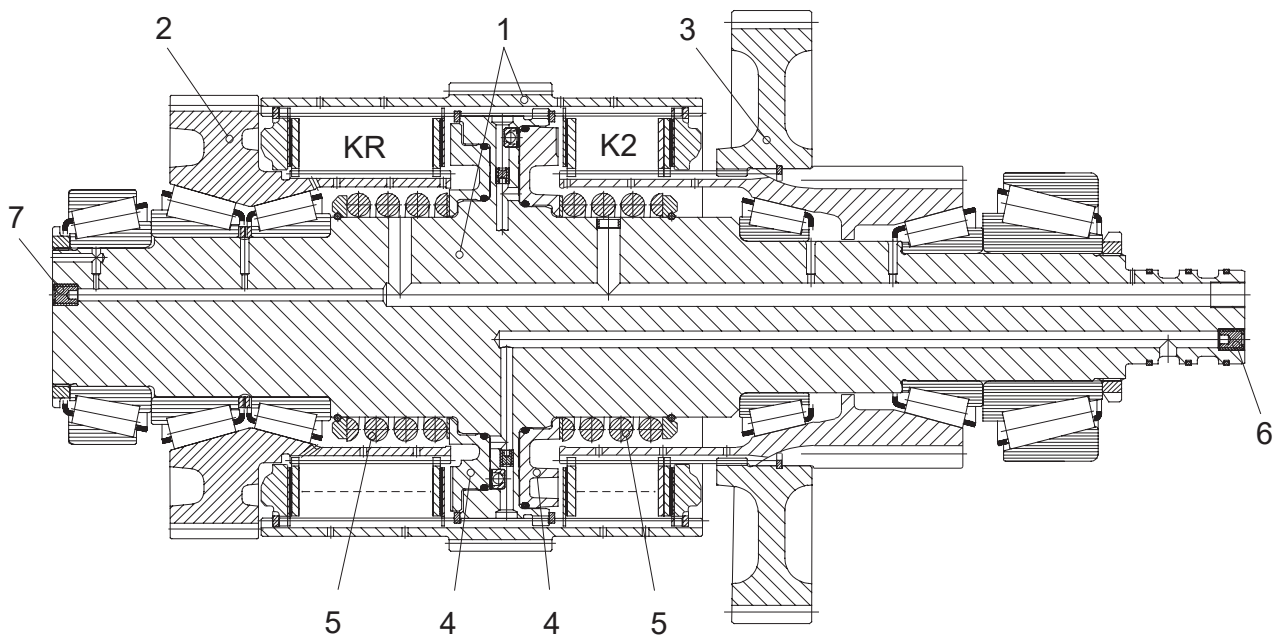


Figure159

- | | | | | | |
|---|--------------|----|----------------------|---|--------------------|
| 1 | Disc carrier | K4 | Multi-disc clutch KR | 5 | Compression spring |
| 2 | Spur gear KR | K3 | Multi-disc clutch K2 | 6 | Plug 2EA |
| 3 | Spur gear K2 | 4 | Piston | 7 | Plug 1EA |

※ Observe the installation position of the single components for the following assembly.

- (1) Lift the disc carrier with the KR-side showing downwards into the clamping ring and fasten it.
Then rotate disc carrier by 180°.

**▲ To install new disc carriers the finished bores have to be sealed with plugs.
Installation position, see arrow, figure 160~161.**

※ Special tool

Clamping ring 5870 654 033

Hand mounting tool 5870 320 014

Ratchet 5870 320 018

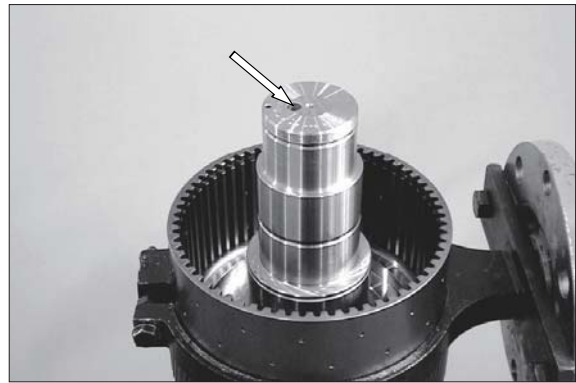


Figure 160



Figure 161

- (2) Flush-mount the drain valve (arrow) with the chamfer showing downwards.

※ Special tool

Inserting tool 5870 320 019

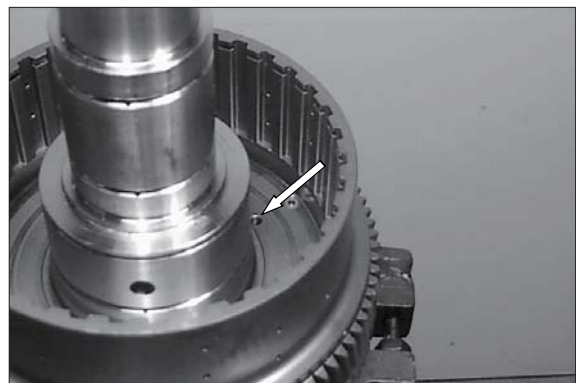


Figure 162

- (3) Put both O-rings scroll-free into the annular grooves of the piston, see arrows.

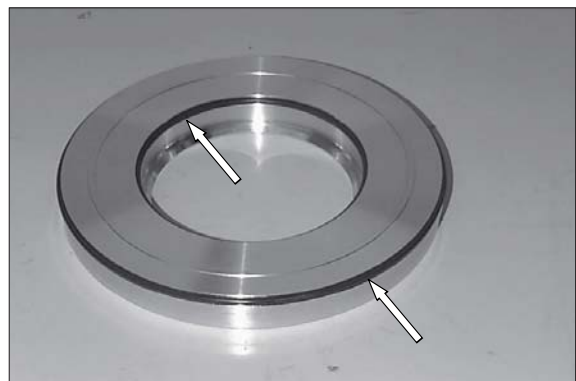


Figure 163

- (4) Oil the O-rings and the piston contact surface.
Install K2 piston equally until contact.
- ※ Observe the installation position of the piston, see figure.



Figure 164

- (5) Install spacer and compression spring.

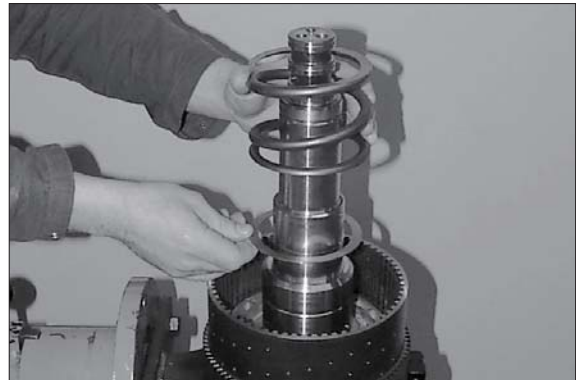


Figure 165

- (6) Place guide ring, with the chamfer (arrow) showing upwards, over the compression spring and install the snap ring.



Figure 166

- (7) Lift the disc carrier out of the clamping ring. Preload the compression spring by means of fixture and engage the snap ring into the annular groove of the disc carrier (arrow), see figure 167.
Install the drain valve, piston and compression spring on the opposite side (clutch K4) analogously (like figure 162~167).
Then lift the disc carrier with the KR-side showing downwards into the clamping ring and fasten it. Rotate disc carrier by 180°.



Figure 167

- ※ Special tool
- | | |
|------------------|--------------|
| Pressure piece | 5870 345 072 |
| Clamping fixture | 5870 654 036 |

Disc Components KR

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

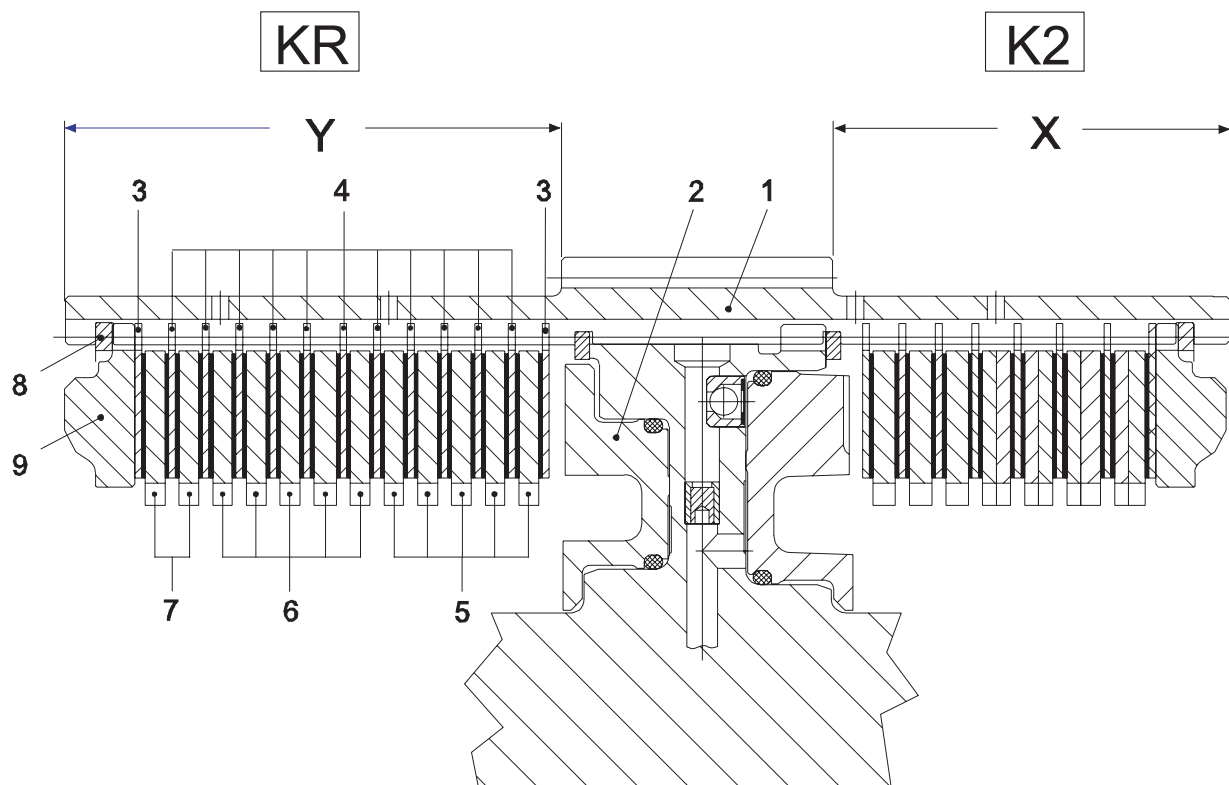


Figure 168

| Position | Description | Quantity | s (mm) | Remarks |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1 | Disc carrier | 1 | | |
| 2 | Piston | 1 | | |
| 3 | Outer clutch disc | 2 | 1.85 | Coated on one side |
| 4 | Outer clutch disc | 11 | 3.35 | Coated on both sides |
| 5 | Inner clutch disc | 5 | 2.5 | |
| 6 | Inner clutch disc | 5 | 3.0 | |
| 7 | Inner clutch disc | 2 | 2.5~4.0 | Optional |
| 8 | Snap ring | 1 | 2.10~3.10 | Optional |
| 9 | End shim | 1 | | |
| Number of friction surfaces : 24 | | | | |
| Disc clearance : 2.8 ~ 3.0 mm | | | | |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length of the disc carrier, see sketch.

KR Dimension X (long disc carrier side)

K2 Dimension Y (short disc carrier side)

Check disc clearance $KR=2.8\sim3.0$ mm
(figure 169~171)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-141).



Figure 169

(2) Install the end shim and fasten it by means of the snap ring.



Figure 170

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and Position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

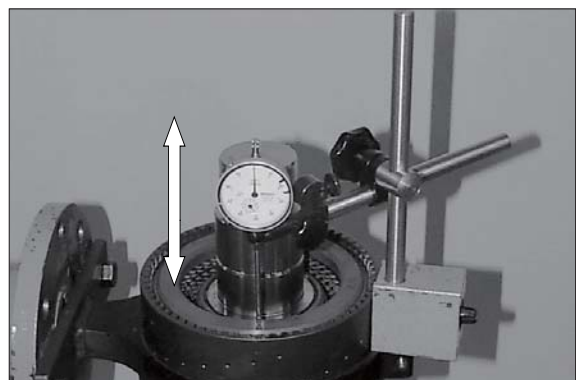


Figure 171

Preassemble and install spur gear KR
(figure 172~176) :

(1) Opposite figure shows the single components of spur gear KR.

- 1 Bearing inner ring (75×37 mm)
- 2 Ring
- 3 Spur gear
- 4 Bearing inner ring (75×41 mm)

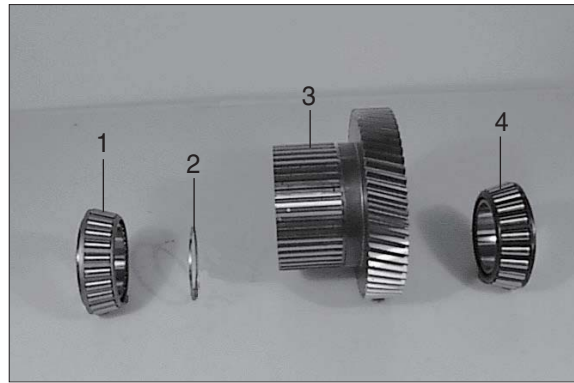


Figure 172

(2) Heat the bearing inner ring (75×37 mm)
and install it until contact.

▲ Use safety gloves.



Figure 173

(3) Assemble the spur gear until all inner
clutch discs are located.



Figure 174

(4) Install the ring.

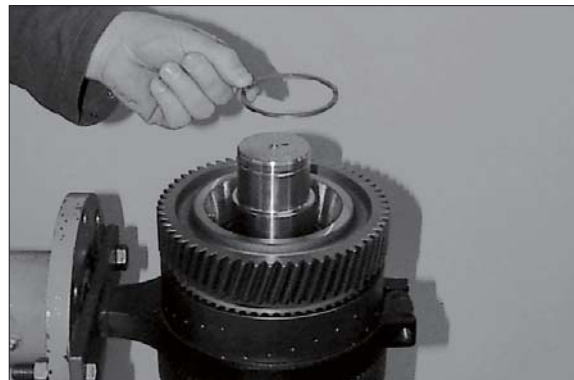


Figure 175

(5) Heat the bearing inner ring (75×41 mm) and locate it until contact.

⚠ Use safety gloves.



Figure 176

(6) Heat the bearing inner ring (clutch bearing) and locate it until contact.

⚠ Use safety gloves.



Figure 177

Disc Components K2

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

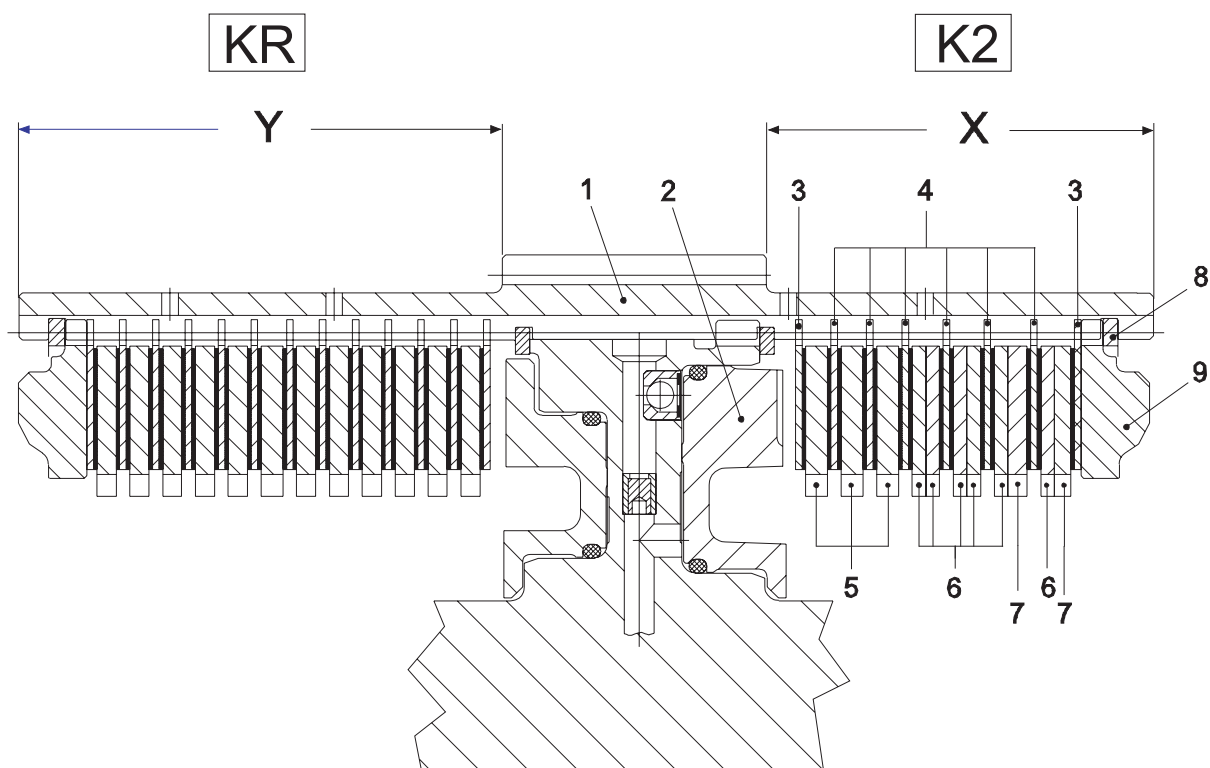


Figure 178

| Position | Description | Quantity | s (mm) | Remarks |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1 | Disc carrier | 1 | | |
| 2 | Piston | 1 | | |
| 3 | Outer clutch disc | 2 | 1.85 | Coated on one side |
| 4 | Outer clutch disc | 6 | 2.5 | Coated on both sides |
| 5 | Inner clutch disc | 3 | 4.0 | |
| 6 | Inner clutch disc | 6 | 2.5 | |
| 7 | Inner clutch disc | 2 | 2.5~4.0 | Optional |
| 8 | Snap ring | 1 | 2.10~3.10 | Optional |
| 9 | End shim | 1 | | |
| Number of friction surfaces : 14 | | | | |
| Disc clearance : 2.2 ~ 2.4 mm | | | | |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length of the disc carrier, see sketch.

K2 Dimension X (short disc carrier side)

KR Dimension Y (long disc carrier side)

Check disc clearance $K_2=2.2\sim 2.4$ mm
(figure 179~181)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-145).



Figure 179

(2) Install the end shim and fasten it by means of the snap ring.

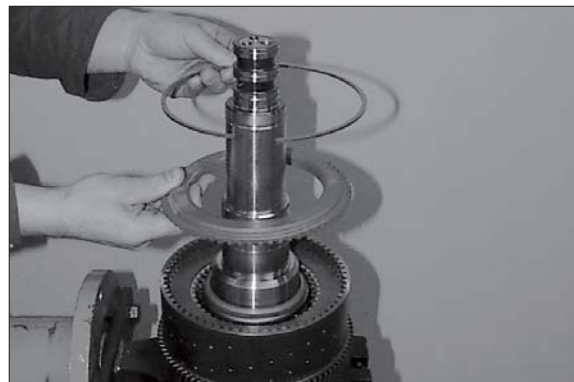


Figure 180

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

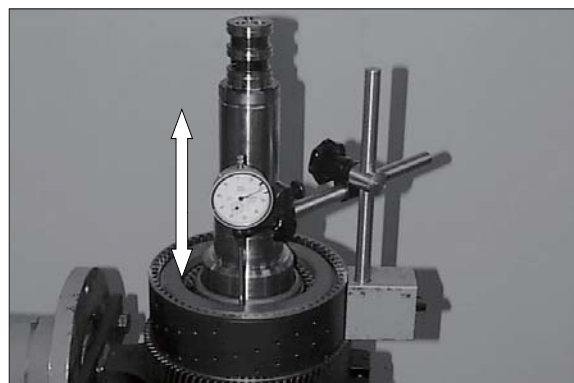


Figure 181

Preamble and install spur gear K2 (figure182~186) :

- (1) Undercool gear 1 (approx -80°C) and heat gear 2 (approx 120°C). Engage the snap ring (arrow), preload it and join both components by means of hydraulic press until the snap ring engages into the annular groove of gear 2.

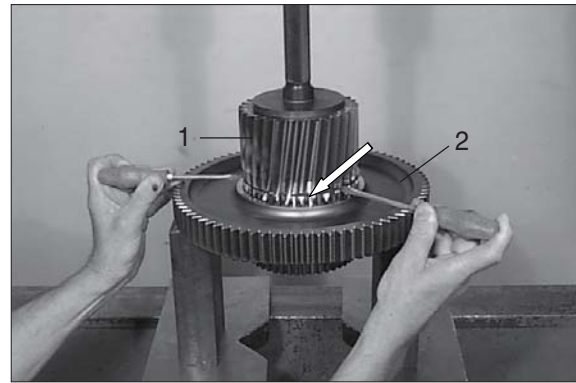


Figure 182

- (2) Opposite figure shows the single components of the spur gear bearing.

- 1 Bearing inner ring
- 2 Spur gear assy
- 3 Bearing inner ring

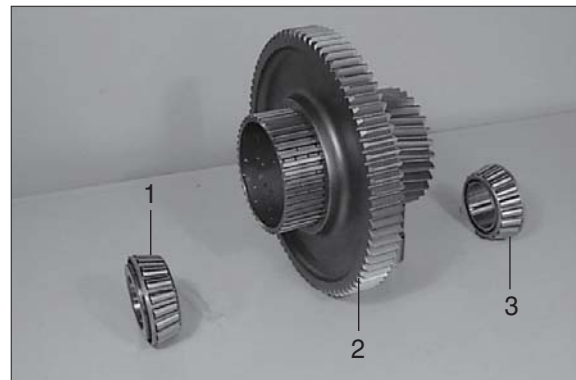


Figure 183

- (3) Heat the bearing inner ring and install it until contact.

▲ Use safety gloves.



Figure 184

- (4) Assemble the spur gear until all inner clutch discs are located.



Figure 185

- (5) Heat the bearing inner ring (spur gear bearing) and install it until contact.

▲ Use safety gloves.



Figure 186

- (6) Heat the bearing inner ring (clutch bearing) and locate it until contact.

▲ Use safety gloves.



Figure 187

- (7) Lift the disc carrier out of the clamping ring.

To ensure the exact locating of the single components, preload the bearing with 100 KN (10t) (figure 188)

**▲ Support on the lower as well as upper bearing inner ring.
Use pressure pieces.**

※ Special tool
Pressure piece

5870 506 096



Figure 188

- (8) Lift the disc carrier into the clamping ring and fasten it.

Rotate disc carrier by 90°.

K2-side :

Install the slotted nut.

- ※ Observe installation position of the slotted nut. Chamfer must show to the bearing inner ring, also see sketch/page 3-123. Oil the thread.

· Torque limit : 81.6 kgf · m (590 lbf · ft)

- ※ Special tool

Clamping ring 5870 654 033

Slotted nut wrench 5870 401 099

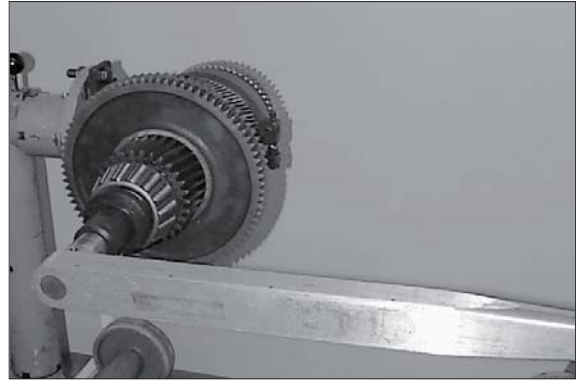


Figure 189

KR-side :

Install the slotted nut.

- ※ Observe installation position of the slotted nut. Collar (Ø76 mm) must show to the bearing inner ring, also see sketch/page 3-123. Oil the thread.

· Torque limit : 81.6 kgf · m (590 lbf · ft)

- ※ Special tool

Slotted nut wrench 5870 401 099



Figure 190

- (9) Check function of the clutches K3 and K4 by means of compressed air (figure 191).

- ※ Closing or opening of the clutches is clearly audible when the single parts have been installed adequately.

Snap-in and lock the rectangular rings (3EA, see arrows).

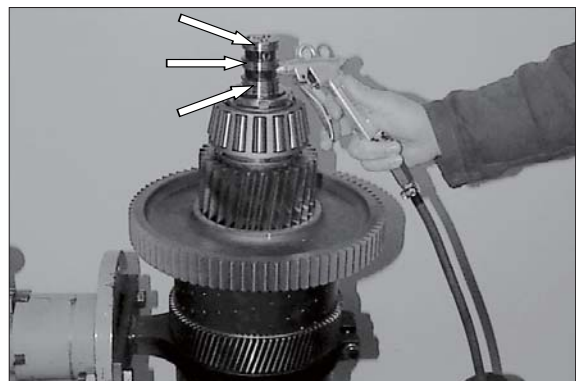


Figure 191

Assembly of the multi-disc clutch KV/K1

The following sketch shows the clutch sectioning

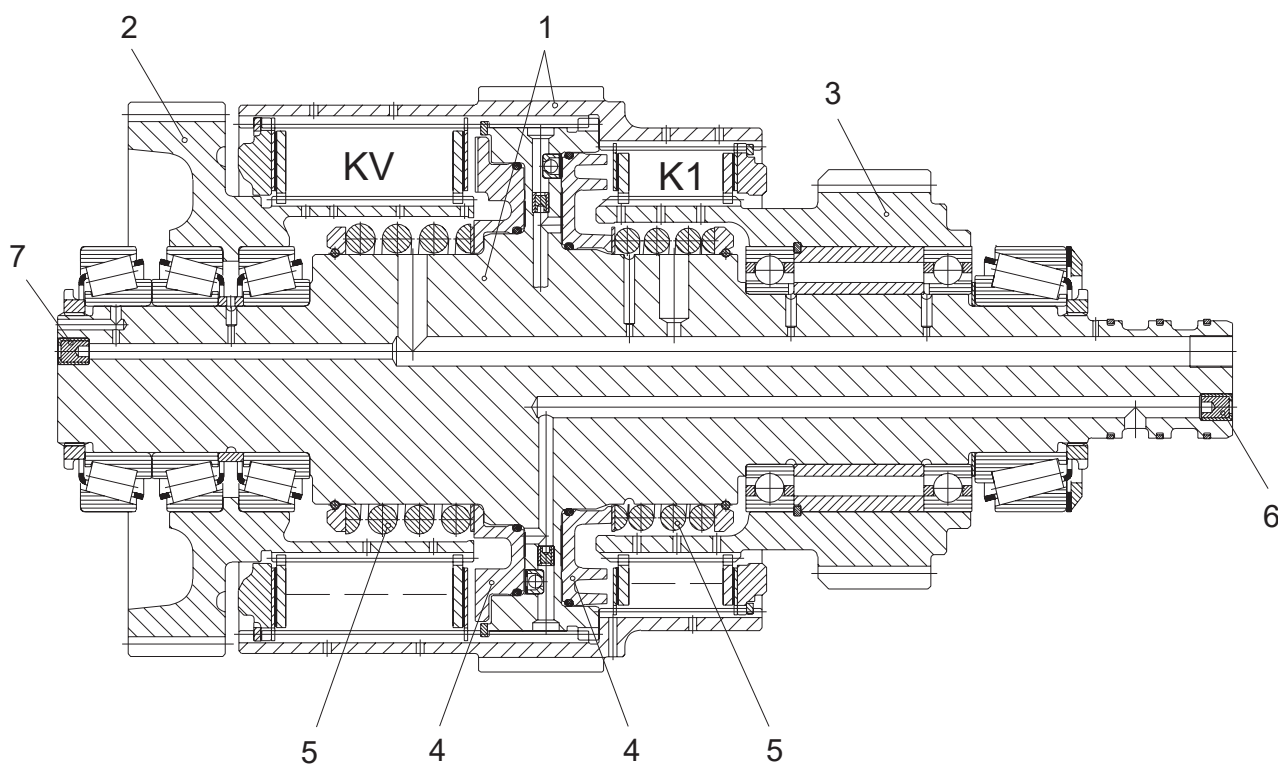


Figure 192

| | | | | | |
|---|--------------|----|----------------------|---|--------------------|
| 1 | Disc carrier | KV | Multi-disc clutch KV | 5 | Compression spring |
| 2 | Spur gear KV | K1 | Multi-disc clutch K1 | 6 | Plug 2EA |
| 3 | Spur gear K1 | 4 | Piston | 7 | Plug 1EA |

※ Observe the installation position of the single components for the following assembly.

- (1) Lift the disc carrier with the KV-side showing downwards into the clamping ring(S) and fasten it.
Then rotate disc carrier by 180°.

**▲ To install new disc carriers the finished bores have to be sealed with plugs.
Installation position, see arrow, figure193~194.**

※ Special tool

Hand mounting tool 5870 320 014

Ratchet spanner 5870 320 018



Figure 193



Figure 194

- (2) Flush-mount the drain valve (arrow) with the chamfer showing downwards.

※ Special tool

Inserting tool 5870 320 019

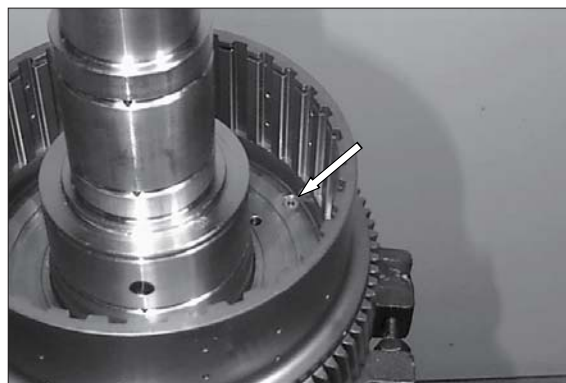


Figure 195

- (3) Put both O-rings scroll-free into the annular grooves of the piston, see arrows.

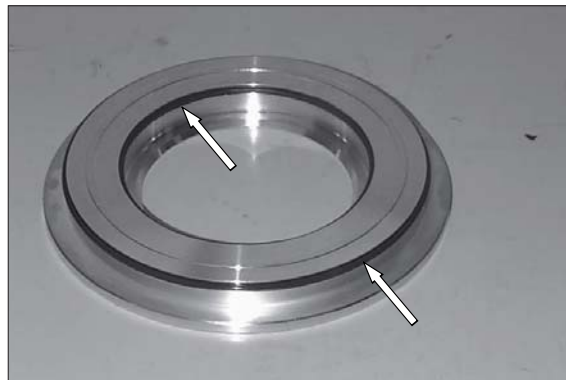


Figure 196

- (4) Oil the O-rings and the piston contact surface.

Install K1 piston **equally** until contact.

- ※ Observe the installation position of the piston, see figure.



Figure 197

- (5) Install spacer and compression spring.



Figure 198

- (6) Place guide ring, with the chamfer (arrow) showing upwards, over the compression spring and install the snap ring.

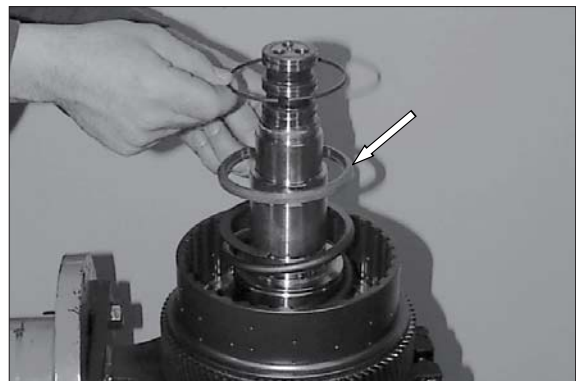


Figure 199

- (7) Lift the disc carrier out of the clamping ring. Preload the compression spring by means of fixture and engage the snap ring into the annular groove of the disc carrier (arrow), see figure 200.

Install the drain valve, piston and compression spring on the opposite side (clutch KV) analogously.

Then lift the disc carrier with the KV-side showing downwards into the clamping ring and fasten it.

Rotate disc carrier by 180°.



Figure 200

- ※ Special tool

Pressure piece 5870 345 072

Clamping fixture 5870 654 036

Disc Components KV

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

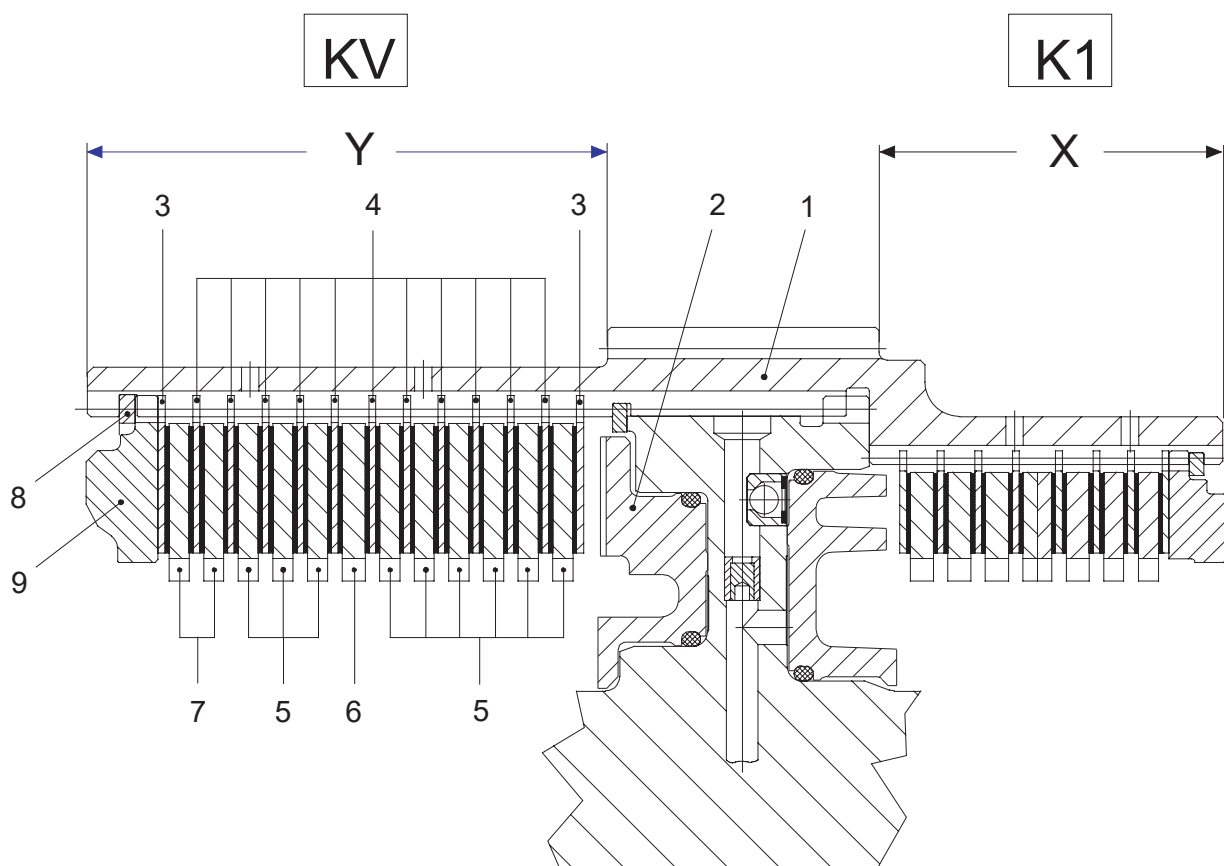


Figure 201

| Position | Description | Quantity | s (mm) | Remarks |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1 | Disc carrier | 1 | | |
| 2 | Piston | 1 | | |
| 3 | Outer clutch disc | 2 | 1.85 | Coated on one side |
| 4 | Outer clutch disc | 11 | 2.5 | Coated on both sides |
| 5 | Inner clutch disc | 9 | 3.5 | |
| 6 | Inner clutch disc | 1 | 4.0 | |
| 7 | Inner clutch disc | 2 | 2.5~4.0 | Optional |
| 8 | Snap ring | 1 | 2.10~3.10 | Optional |
| 9 | End shim | 1 | | |
| Number of friction surfaces : 24 | | | | |
| Disc clearance : 2.8 ~ 3.0 mm | | | | |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length and \varnothing of the disc carrier respectively, see sketch.

KV Dimension Y (long disc carrier side and large \varnothing respectively)

K1 Dimension X (short disc carrier side and small \varnothing respectively)

Check disc clearance KV=2.8~3.0 mm
(figure 202~204)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-153).

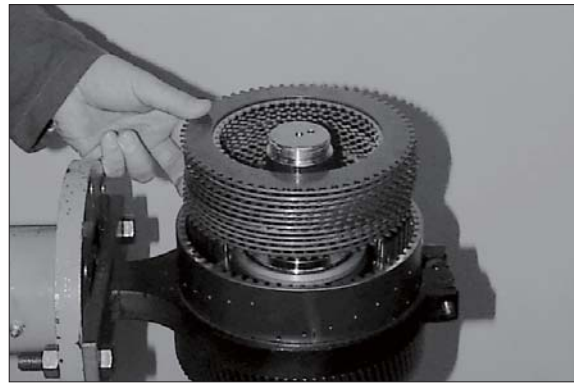


Figure 202

(2) Install the end shim and fasten it by means of the snap ring.

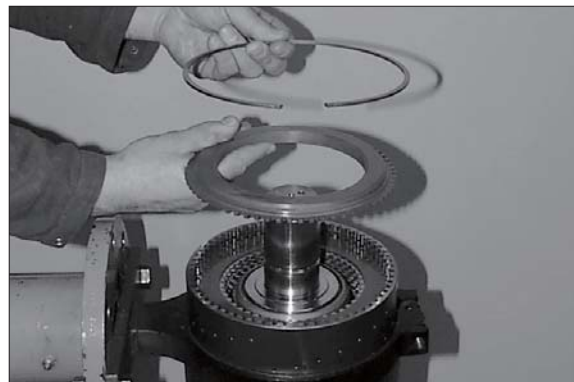


Figure 203

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

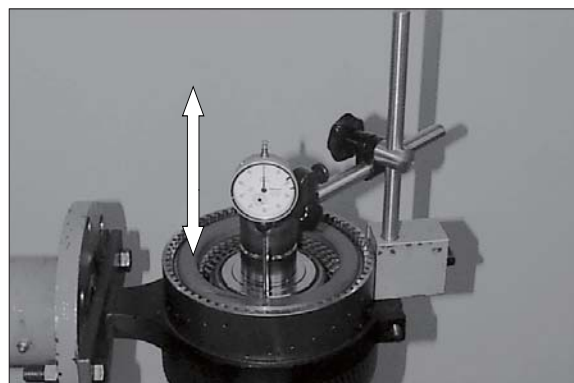


Figure 204

Preamble and install spur gear KV
(figure 205~209) :

(1) Opposite figure shows the single components of spur gear KV.

- 1 Bearing inner ring
- 2 Bearing outer ring
- 3 Ring
- 4 Spur gear

Install both bearing outer rings (2) until contact.

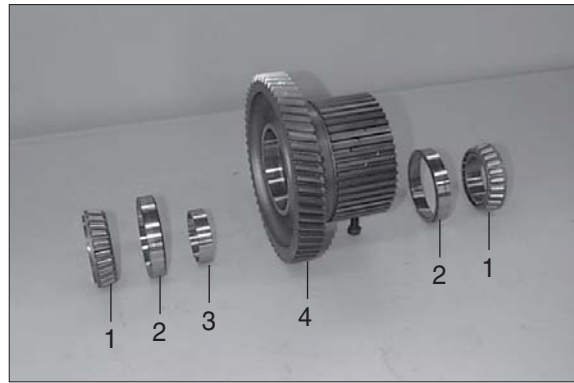


Figure 205

(2) Heat the bearing inner ring and install it until contact.

▲ Use safety gloves.

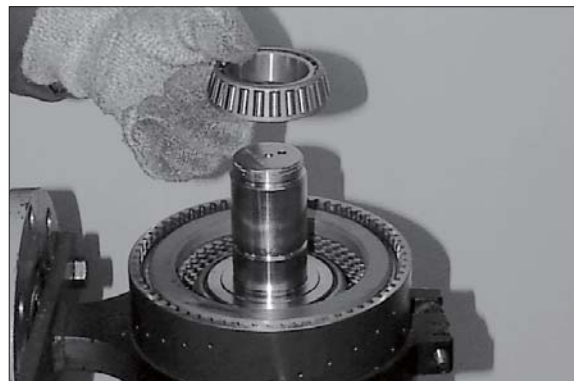


Figure 206

(3) Install the ring.

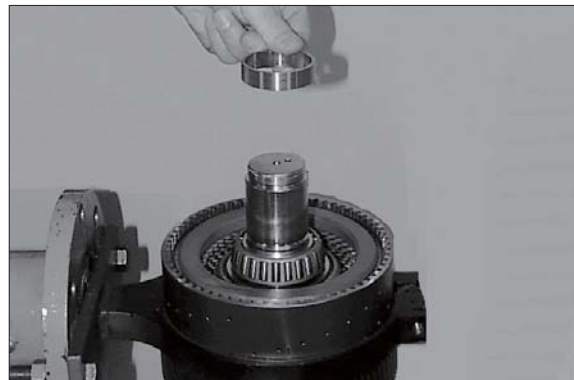


Figure 207

(4) Assemble the spur gear until all inner clutch discs are located.

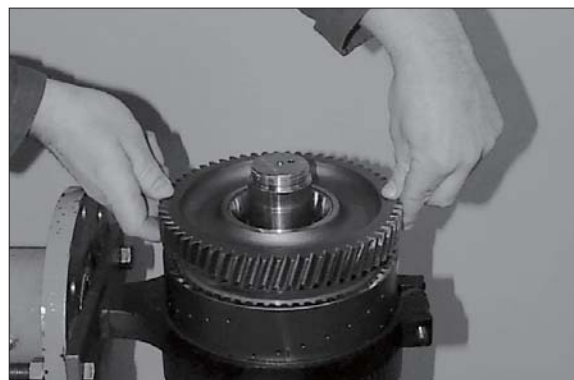


Figure 208

- (5) Heat the bearing inner ring (spur gear bearing) and locate it until contact.

⚠ Use safety gloves.



Figure 209

- (6) Heat the bearing inner ring (clutch bearing) and locate it until contact.

⚠ Use safety gloves.

Rotate disc carrier by 180°.



Figure 210

Disc Components K1

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

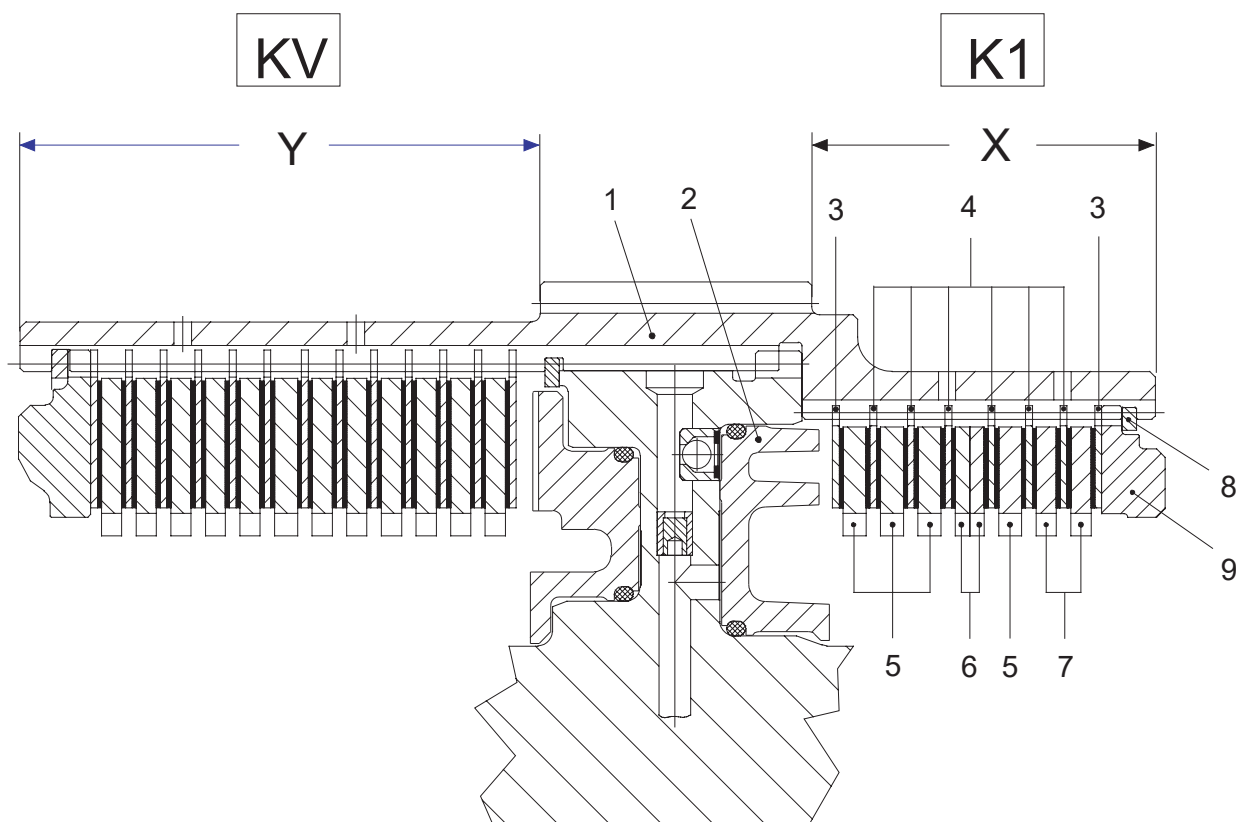


Figure 211

| Position | Description | Quantity | s (mm) | Remarks |
|----------------------------------|-------------------|----------|---------|----------------------|
| 1 | Disc carrier | 1 | | |
| 2 | Piston | 1 | | |
| 3 | Outer clutch disc | 2 | 1.85 | Coated on one side |
| 4 | Outer clutch disc | 6 | 2.5 | Coated on both sides |
| 5 | Inner clutch disc | 4 | 4.0 | |
| 6 | Inner clutch disc | 2 | 2.5 | |
| 7 | Inner clutch disc | 2 | 2.5~4.0 | Optional |
| 8 | Snap ring | 1 | 2.1~2.5 | Optional |
| 9 | End shim | 1 | | |
| Number of friction surfaces : 14 | | | | |
| Disc clearance : 2.2 ~ 2.4 mm | | | | |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length and \varnothing of the disc carrier respectively, see sketch.

K1 Dimension X (short disc carrier side and small \varnothing respectively)

KV Dimension Y (long disc carrier side and large \varnothing respectively)

Check disc clearance $K1=2.2\sim2.4$ mm
(figure 212~214)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-157).



Figure 212

(2) Install the end shim and fasten it by means of the snap ring.

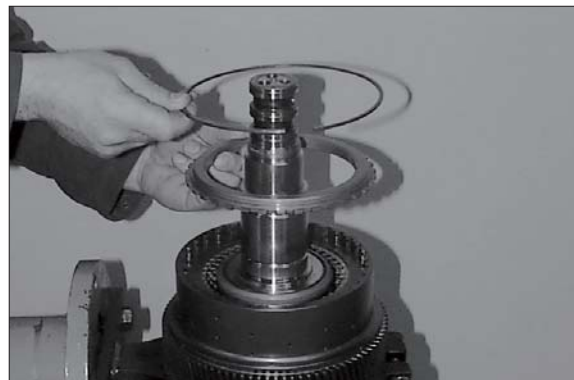


Figure 213

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

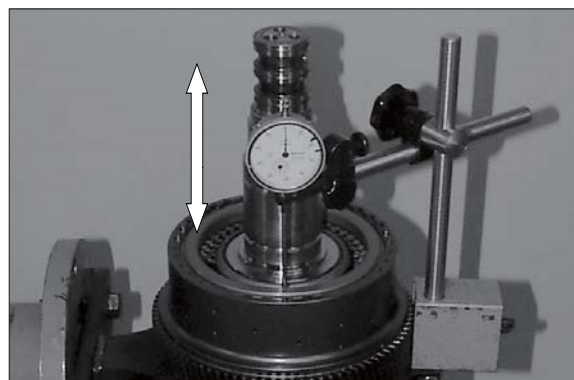


Figure 214

Preambly and install spur gear K1
(figure 215~222) :

(1) Opposite figure shows the single components of spur gear K1.

- 1 Ball bearing (assy)
- 2 Snap ring
- 3 Spur gear

※ Prior to installation of the single components, align the disc set by means of the spur gear radially and center it, see figure 216.

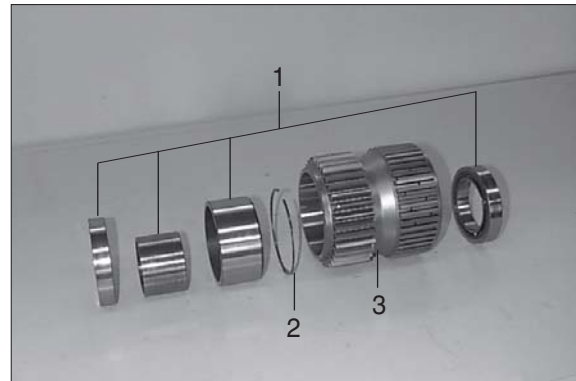


Figure 215



Figure 216

(2) Install the ring.



Figure 217

(3) Install the bush with collar (arrow) on face end showing to the snap ring.



Figure 218

(4) Press in the ball bearing until contact.

- ※ Install the ball bearing with the lubricating groove (arrow) showing downwards. Put the press-in tool only to the bearing outer ring.

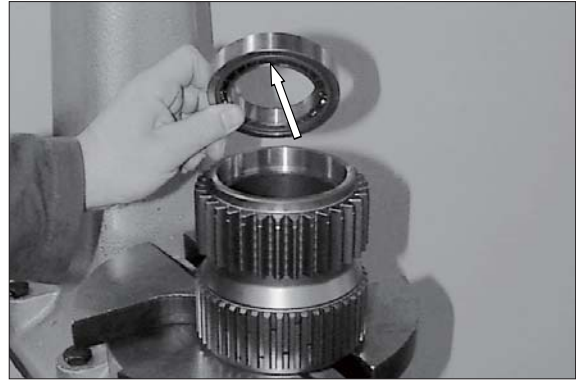


Figure 219

(5) Heat the second ball bearing and install it until contact.

- ※ Lubricating groove (arrow), must show upwards.

▲ Use safety gloves.



Figure 220

(6) Assemble the bush.



Figure 221

(7) Heat the spur gear to approximately 120°C and assemble it until all inner clutch discs are located.

▲ Use safety gloves.



Figure 222

(8) Install shim $s = 1.20 \text{ mm}$



Figure 223

(9) Heat the bearing inner ring and install it until contact.

▲ Use safety gloves.



Figure 224

(10) Lift the disc carrier out of the clamping ring (S). To ensure the exact locating of the single components, preload the bearing with 100KN (10 t) (figure 225).

**▲ Support on the lower as well as upper bearing inner ring.
Use pressure pieces (S).**

※ Special tool

Pressure pieces

5870 506 096



Figure 225

(11) Lift the disc carrier into the clamping ring.
 Rotate disc carrier by 90°.
 Install the slotted nut.

※ Observe installation position of the slotted nut. Collar (Ø60 mm) must show to the taper roller bearing also see sketch/page 3-146. Oil the thread.

· Torque limit : 56.1 kgf · m (406 lbf · ft)

※ Special tool

Slotted nut wrench 5870 401 118

Slotted nut wrench 5870 401 099

Install the opposite slotted nut (KV-side) analogously.

※ Special tool

Slotted nut wrench 5870 401 118

Slotted nut wrench 5870 401 115

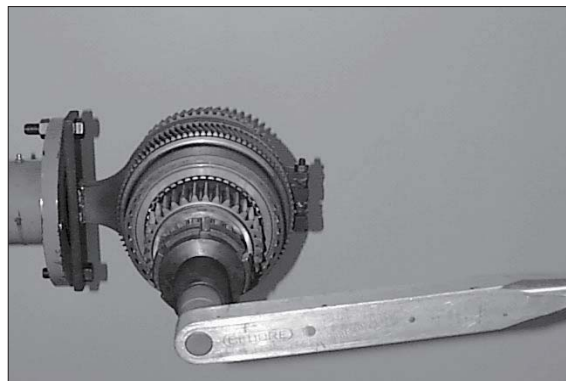


Figure 226

(12) Check function of the clutches KV and K1 by means of compressed air.

※ Closing or opening of the clutches is clearly audible when the single parts have been installed adequately.



Figure 227

(13) Snap-in and lock the rectangular rings (3EA, see arrows).

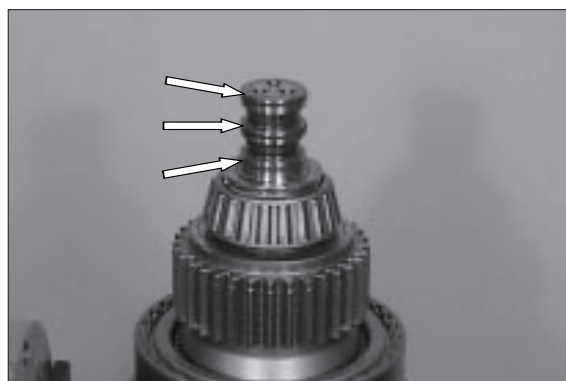


Figure 228

Installation of layshaft gear, multi-disc clutches and output gear

(1) Opposite figure shows the single components of the layshaft gear bearing.

- 1 Bearing inner ring (2EA)
- 2 Ring
- 3 Layshaft gear

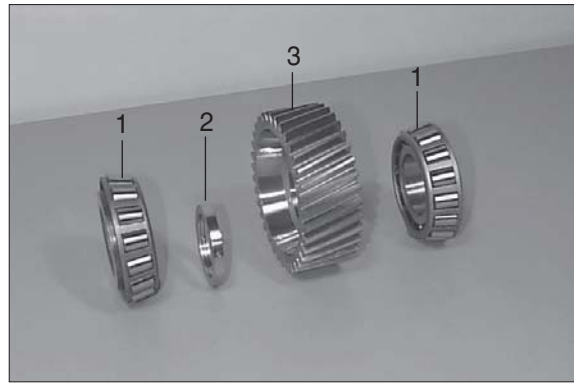


Figure 229

(2) Position layshaft gear (assy) in the housing.

※ Only when the clutches are installed, the idler shaft can be mounted.

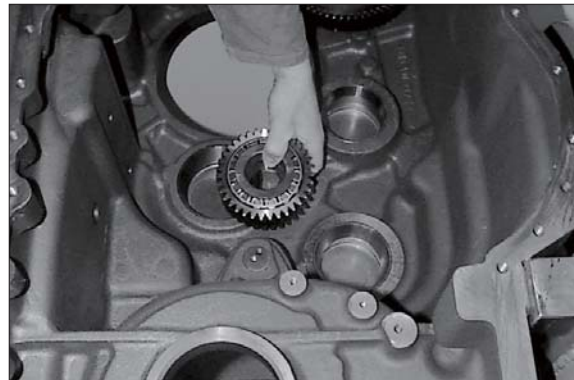


Figure 230

(3) Insert the bearing outer rings KV/K1, KR/K2 and K3/K4 into the housing bores until contact, see arrows.

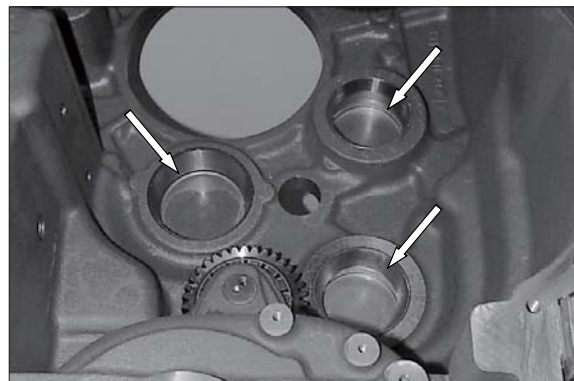


Figure 231

(4) Position clutch KV/K1 by means of lifting tackle.

※ Special tool
Eyebolts assortment 5870 204 002



Figure 232

(5) Position clutch KR/K2.

※ Special tool

Eyebolts assortment 5870 204 002



Figure 233

(6) Check the installation position of the layshaft gear (arrow) once again and correct it, if required.



Figure 234

(7) Fasten the spur gear K3 by means of fixture and eyebolt (arrow) axially.

※ Spur gear fixing prevents the clutch discs from dislocating when the clutch is lifted in.

※ Special tool

Assembly fixture 5870 345 033

Eyebolt 5870 204 066



Figure 235

(8) Lift the clutch KR/K2 slightly, move it in direction of the arrow and position clutch K3/K4.

Then remove the fixture (figure 235) again.



Figure 236

- (9) Insert the bearing outer ring into the housing bore until contact.

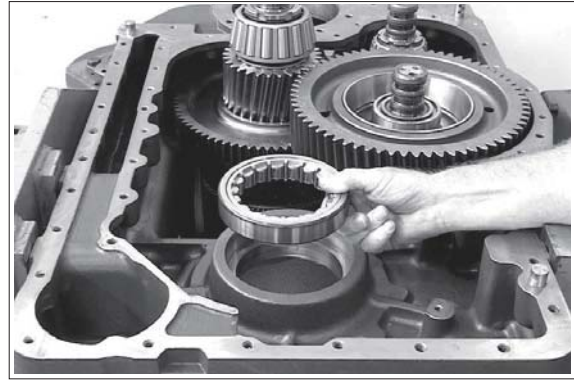


Figure 237

- (10) Heat the bearing inner ring and install it until contact.

▲ Use safety gloves.

- ※ Observe installation position-collar (arrow) shows to the spur gear. Install the bearing inner ring after cooling down subsequently (press).



Figure 238

- (11) Position the oil baffle.



Figure 239

- (12) Install the output gear by means of lifting tackle.

- ※ Special tool
Stop washer 5870 100 054
Eyebolts assortment 5870 204 002



Figure 240

- (13) Position upper oil baffle and fasten both plates by means of hexagon screws (4EA).

※ Install washers.

Secure hexagon screws with loctite (type No.243).

· Torque limit : 2.35 kgf · m (16.7 lbf · ft)



Figure 241

Preassembly and mounting of the housing cover

Note to figure 242 and 243 :

Depending on the transmission version, differences as regards the single components and their installation position are possible.

Obligatory is the respective parts list.

- (1) Install the sealing cover (arrow).

※ Wet the sealing surface with loctite (type No.262).

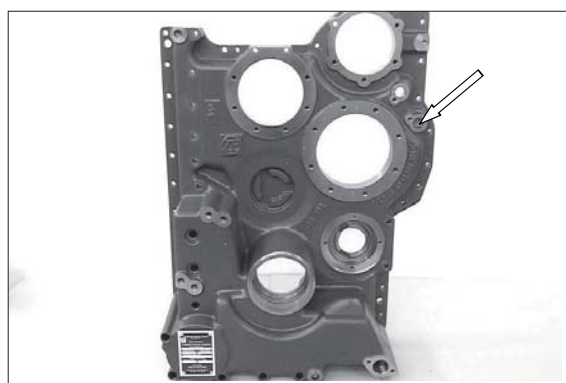


Figure 242

- (2) Insert the O-ring into the annular groove of the cover and fasten the cover by means of hexagon screws.

※ Wet the thread of the hexagon screws with loctite (type No.574). Observe the installation position of the cover, see figure.

· Torque limit : 2.35 kgf · m (16.7 lbf · ft)



Figure 243

- (3) Wet the mounting face with sealing compound (loctite, type No.574).

By means of the lifting tackle place the housing cover on the transmission housing until contact.

※ Special tool

Lifting tackle

5870 281 055



Figure 244

- (4) Install both cylindrical pins (arrow 1 and 2) and the slotted pin (arrow 3).

Then fasten the housing cover by means of hexagon and cap screws.

· Torque limit M10/8.8 :

4.69 kgf · m (33.9 lbf · ft)

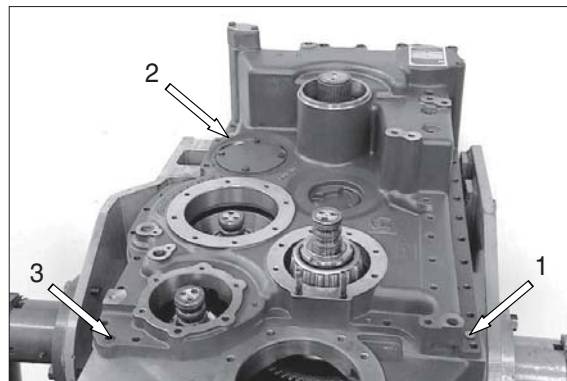


Figure 245

Adjust the bearing preload of clutch K4/K3 = 0.0~0.05 mm (figure 248~250)

- ※ For installation of a new bearing cover, both finished bores have to be sealed by means of a plug.

Finished bores are located opposite (180°) to each other, also see arrow/figure 246 and 247.

1 Bearing cover-K4/K3

2 Plug (konig)

(S) Special tool

- ※ Special tool

Hand mounting tool 5870 320 014

Ratchet spanner 5870 320 018

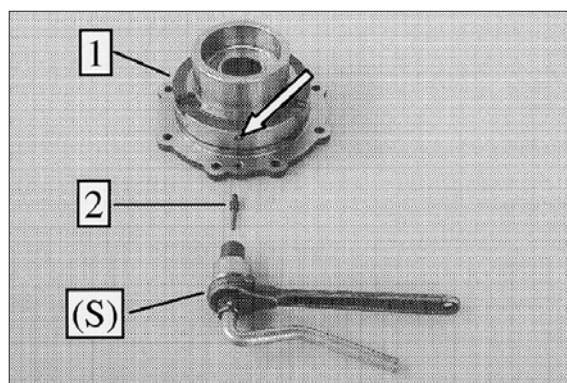


Figure 246

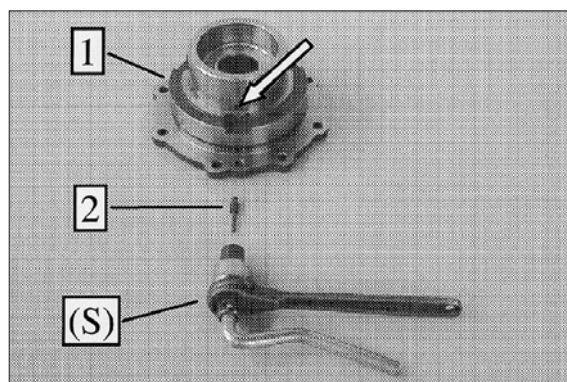


Figure 247

Housing dimension :

- (1) Press on equally the bearing inner ring and determine Dimension I, from the mounting face to the bearing inner ring.

Dimension I e.g 43.65 mm

- ※ Take several measuring points and determine the mean value.

Then remove the bearing inner ring again.

- ※ Special tool

Measuring shaft 5870 200 022

Digital depth gauge 5870 200 072

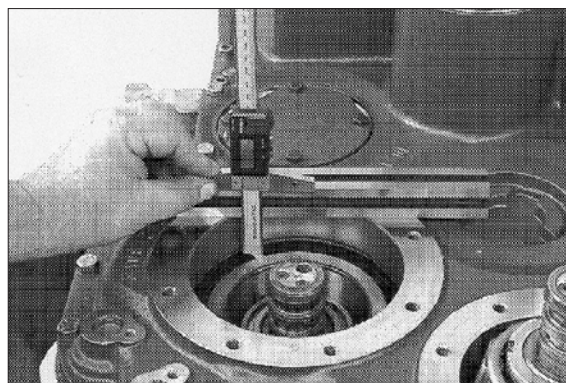


Figure 248

Cover dimension :

- (2) Determine Dimension II, from the mounting face until contact/bearing inner ring.

Dimension II e.g 42.12 mm

- ※ Special tool

Straightedge 5870 200 022

Gauge blocks 5870 200 067

Digital depth gauge 5870 200 072

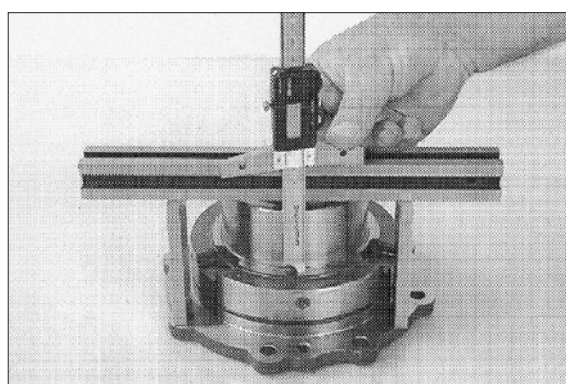


Figure 249

Example :

Dimension I 43.65 mm

Dimension II - 42.12 mm

Difference = 1.53 mm

Bearing preload e.g. + 0.02 mm

Resulting shim(s) s = 1.55 mm

- (3) Put on the shim.



Figure 250

- (4) Heat the bearing inner ring and place it until contact.

▲ Use safety gloves.

- ※ Install the bearing inner ring after cooling down subsequently (press).



Figure 251

- (5) Grease the rectangular rings (3EA, arrows) and centrally align them.



Figure 252

- (6) Install the O-ring (arrow) and grease it.
Heat the inner diameter of the bearing cover (bearing seat).

※ Special tool

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501



Figure 253

- (7) Install two adjusting screws.
Assemble the bearing cover and tighten it equally until contact by means of hexagon screws.

· Torque limit (M10/8.8) :

4.69 kgf · m (33.9 lbf · ft)

- ※ Observe the radial installation position.

※ Special tool

Adjusting screws 5870 204 007



Figure 254

- (8) Check the function of **both** clutches by means of compressed air.

- ※ In case of a decisive pressure loss, the possible cause might be the breakage of one or several rectangular rings (see arrow , figure 252).

Replace the rectangular rings, if required.



Figure 255

**Adjust the bearing preload of clutch KR/K2
= 0.0~0.05 mm (figure 258~262)**

- ※ For installation of a new bearing cover, both finished bores have to be sealed by means of a plug.

Finished bores are located opposite (18°) to each other, also see arrow/Figure 256 and 257.

1 Bearing cover-KR/K2

2 Plug

(S) Special tool

- ※ Special tool

Hand mounting tool 5870 320 014

Ratchet spanner 5870 320 018

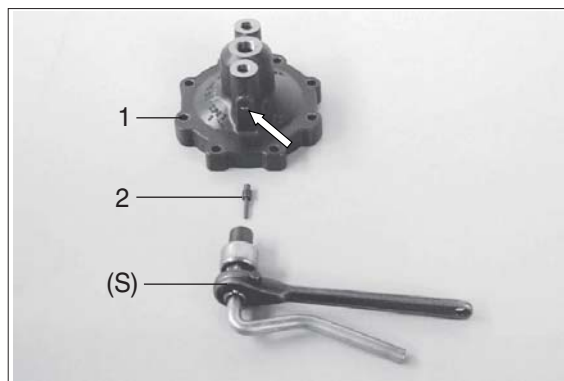


Figure 256

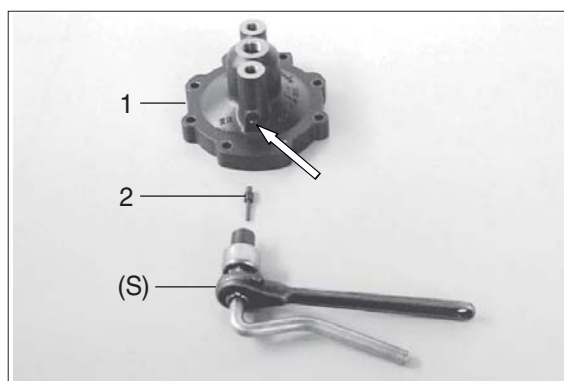


Figure 257

(1) Install both studs (arrows).

- ※ Wet the thread with loctite (type No. 243).

· Torque limit (M10) :
1.33 kgf · m (9.59 lbf · ft)



Figure 258

(2) Install the bearing outer ring until contact.

- ※ Pay attention to exact contact.

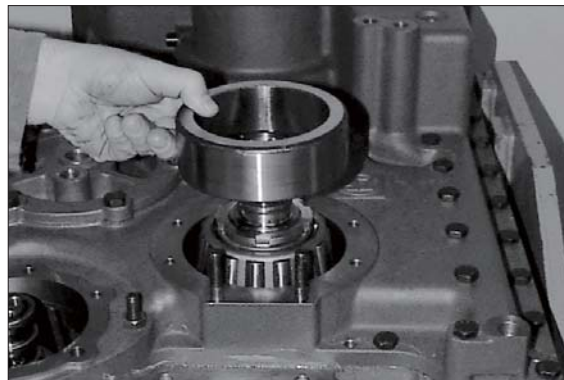


Figure 259

Housing dimension :

- (3) Determine Dimension I, from the bearing outer ring to the mounting face.

Dimension I e.g 16.13 mm

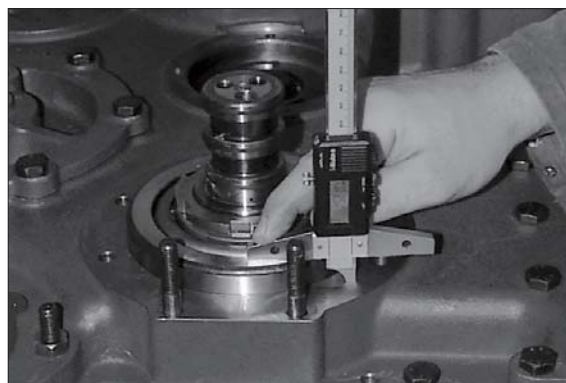


Figure 260

Cover dimension :

- (4) Determine Dimension II, from the contact/ bearing outer ring to the mounting face.

Dimension II e.g 17.75 mm

※ Special tool

Digital depth gauge 5870 200 072



Figure 261

Example :

Dimension II 17.75 mm

Dimension I - 16.13 mm

Difference = 1.62 mm

Bearing preload e.g. + 0.03 mm

Resulting shim (s) s = 1.65 mm

- (5) Fix the shim with assembly grease into the cover. Install the O-ring (arrow).



Figure 262

- (6) Grease the rectangular rings (arrows) and centrally align them.



Figure 263

(7) Pull the bearing cover equally until contact.

· Torque limit (M10/8.8) :

4.69 kgf · m (33.9 lbf · ft)

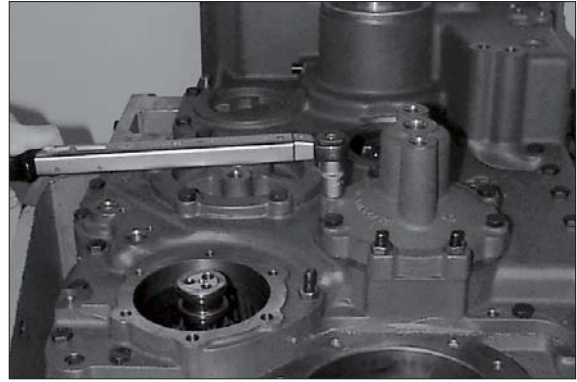


Figure 264

(8) Check the function of both clutches by means of compressed air.

※ In case of a decisive pressure loss, the possible cause might be the breakage of one or several rectangular rings (see figure 263).

Replace the rectangular rings, if required.



Figure 265

**Adjust the bearing preload of clutch KV/K1
= 0.0~0.05 mm (figure 267~270)**

※ For installation of a new bearing cover, both finished bores have to be sealed by means of a plug.

Installation position, see arrows/Figure 266.

1 Bearing cover-KV/K1

2 Plug

(S) Special tool

※ Special tool

Hand mounting tool 5870 320 014

Ratchet spanner 5870 320 018



Figure 266

- (1) Put the bearing outer ring over the bearing inner ring.

Housing dimension :

Press on equally the bearing outer ring and determine Dimension I, from the mounting face to the bearing outer ring.

Dimension I e.g 52.67 mm

※ Take several measuring points and determine the mean value.

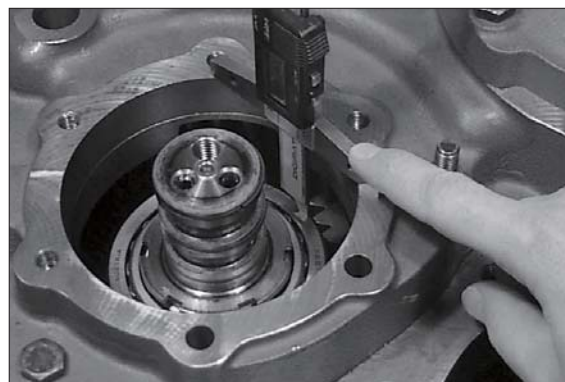


Figure 267

- (2) Put the ring with the chamfer showing downwards into the bearing cover.



Figure 268

Cover dimension :

- (3) Determine Dimension II, from the mounting face to the ring.

Dimension II e.g 50.75 mm

※ Special tool

Digital depth gauge 5870 200 072

Gauge blocks 5870 200 067



Figure 269

Example :

Dimension I 52.67 mm

Dimension II - 50.75 mm

Difference e.g. 1.92 mm

Bearing preload + 0.03 mm

Resulting shim (s) s = 1.95 mm

- (4) Put in the shim.



Figure 270

- (5) Install the bearing outer ring until contact.
Assemble the O-ring (arrow).



Figure 271

- (6) Grease the rectangular rings (arrows) and centrally align them.



Figure 272

(7) Heat the bearing bore.

※ Special tool

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501



Figure 273

(8) Install two adjusting screws.

Place the bearing cover until contact and
fasten it by means of hexagon screws.

※ Observe the radial installation position,
see figure.

※ Special tool

Adjusting screws 5870 204 007

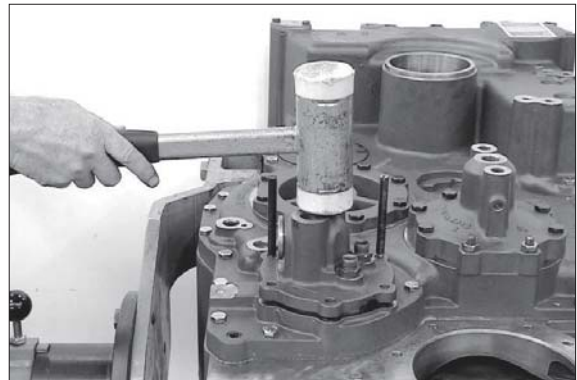


Figure 274

(9) Check the function of **both** clutches by
means of compressed air.

※ In case of a decisive pressure loss, the
possible cause might be the breakage of
one or several rectangular rings (see
arrow, figure 272).
Replace the rectangular ring (s), if
required.

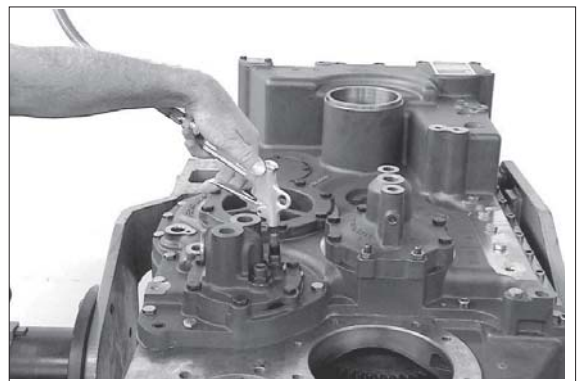


Figure 275

Output

Installation of the output shaft

(1) Heat the inner diameter of the output gear.

※ Special tool

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501



Figure 276

(2) Assemble the output shaft with the long gearing showing downwards until contact.



Figure 277

(3) Rotate the transmission housing into the vertical position (90°).

By means of the mounting tool the output shaft has preliminarily to be fixed axially (figure 278 and 279) at the convert-er side.

※ Special tool

Mounting tool 5870 048 265

Then rotate the transmission housing back again (90°).



Figure 278

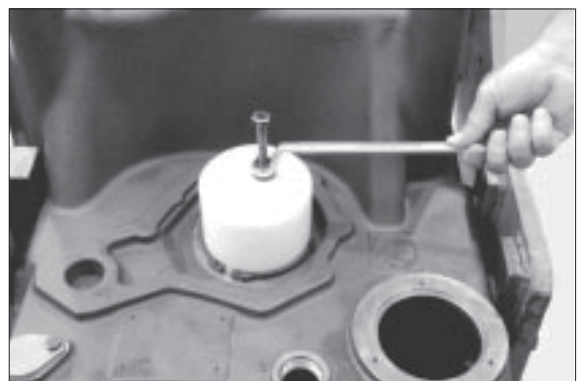


Figure 279

**Adjust the axial play of the output bearing
= 0.3~0.5 mm (figure 280~282)**

- (4) Determine Dimension I, from plane face/
housing to end face/output shaft.

Dimension I e.g 66.90 mm

※ Special tool

Digital depth gauge 5870 200 072



Figure 280

- (5) Measure Dimension II, from plane face/
housing to contact face/ball bearing.

Dimension II e.g 64.20 mm

Example :

Dimension I 66.90 mm

Dimension II - 64.20 mm

Difference = 2.70mm

Required axial play e.g. - 0.40 mm
(0.3~0.5 mm)

Resulting shim s = 2.30 mm



Figure 281

- (6) Install the shim.



Figure 282

- (7) Install the ball bearing (figure 283) and
pull it until contact by means of the output
flange (figure 284).

Then remove the output flange again.



Figure 283



Figure 284

(8) Fasten the ball bearing by means of retaining ring.

※ Clamping pliers 5870 900 021

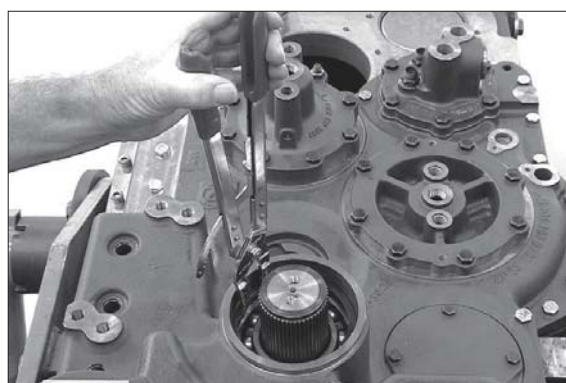


Figure 285

(9) Remove the converter-side mounting tool again.

Install the shaft seal, (arrow) with the sealing lip showing to the oil sump.

※ Using of the specified mounting tool, results in the exact installation position (without retaining ring = 20 mm).
Grease the sealing lip.

※ Special tool
Mounting tool 5870 048 265

※ Depending on the version different shaft seals can be used :
Outer diameter rubber-coated-wet it with spirit. Outer diameter metallic-wet it with sealing compound (loctite, type No. 574).



Figure 286

Output Flange

(1) Press on the screen sheet (arrow) until contact.

※ Observe the installation position, see figure 288.

※ Special tool

Pressing bush

5870 506 138

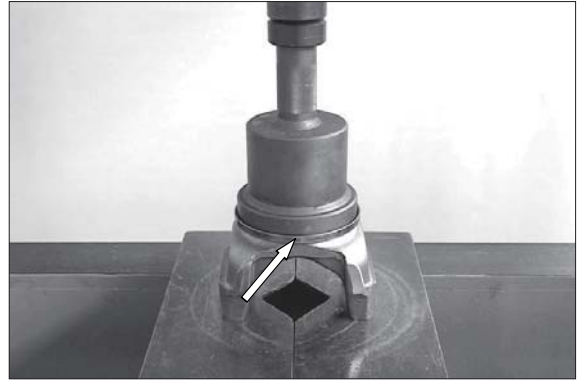


Figure 287

1 Screen sheet

2 Output flange

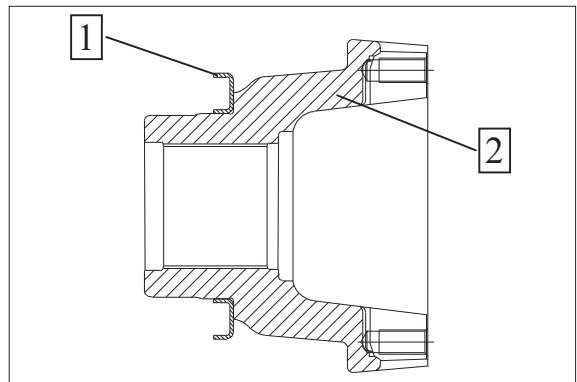


Figure 288

Adjust gap size $X = 0.3 \sim 0.8$ mm
(figure 289~292) :

- X Gap size
- 1 Shim
- 2 O-ring.

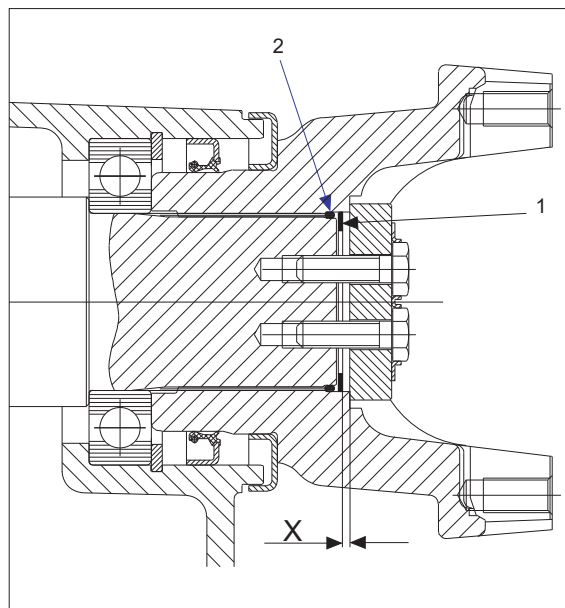


Figure 289

- (1) Install the output flange until contact.

Measure Dimension I, from the plane face of the output flange to the end face of the output shaft.

Dimension I e.g.37.00 mm

※ Special tool

Digital depth gauge 5870 200 072

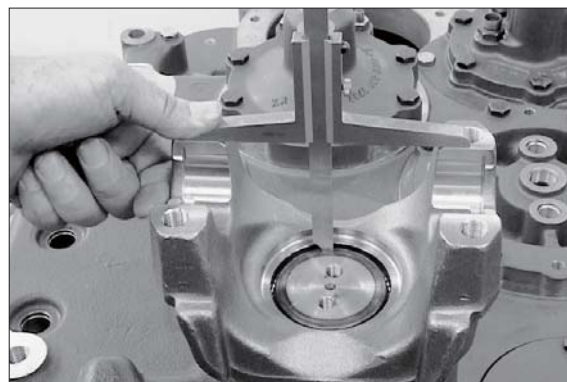


Figure 290

- (2) Measure Dimension II, from the plane face to the collar of the output flange.

Dimension II e.g. 36.00 mm

Example :

Dimension I 37.00 mm

Dimension II - 36.00 mm

Difference = 1.00 mm

Gap size X e.g. - 0.50 mm
(0.3~0.8 mm)

Resulting shim s = 0.50 mm

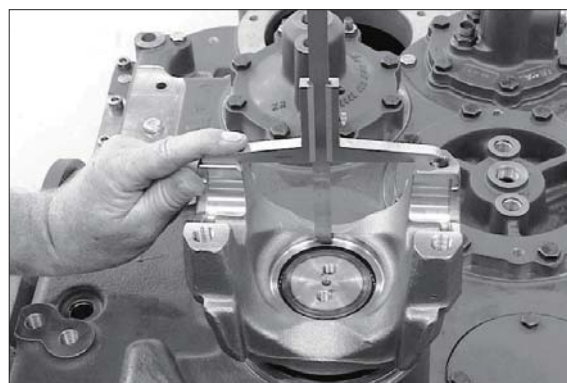


Figure 291

- (3) Place the O-ring (arrow) into the space between output flange and shaft (see also figure 289) and put on the shim.

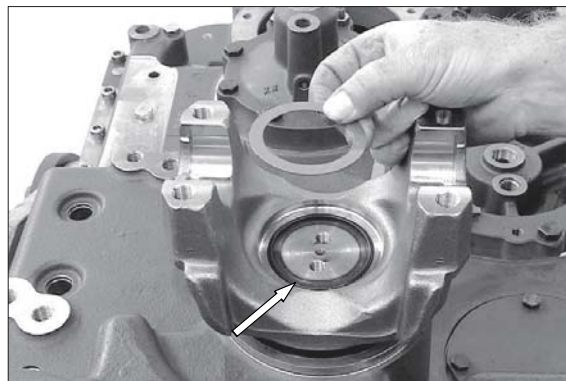


Figure 292

- (4) Put on the washer and fasten the output flange by means of hexagon screws.

· Torque limit (M10/8.8) :
4.69 kgf · m (33.9 lbf · ft)



Figure 293

- (5) Fasten the hexagon screws by means of the lock plate.

※ Specail tool
Mounting tool 5870 057 009
Handle 5870 260 002



Figure 294

Output Flange (converter side)

(1) Install the shaft seal (arrow) with the sealing lip showing to the oil sump.

- ※ Using of the specified mounting tool, results in the exact installation position (with retaining ring = 7.0 mm). Grease the sealing lip.

※ Special tool
Mounting tool 5870 048 265

- ※ Depending on the version different shaft seals can be used :
Outer diameter rubber-coated-wet it with spirit. Outer diameter metallic-wet it with sealing compound (loctite, Type No. 574).

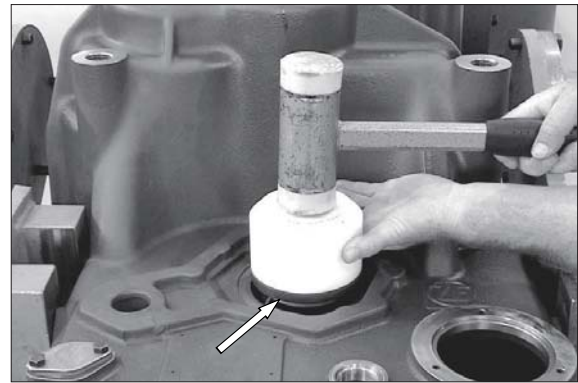


Figure 302

(1) Press the screen sheet (arrow) over the collar of the output flange until contact.

- ※ Observe the installation position, see figure 304.

※ Special tool
Pressing bush 5870 506 138

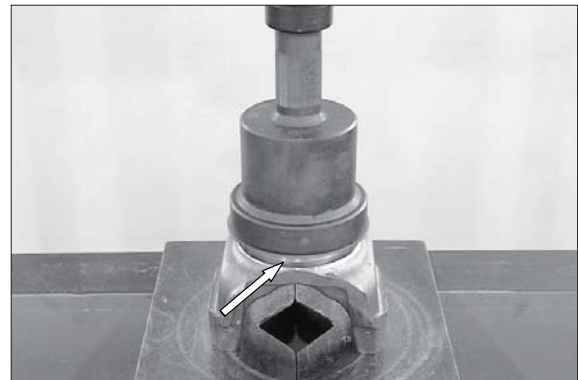


Figure 303

- 1 Screen sheet
- 2 Output flange

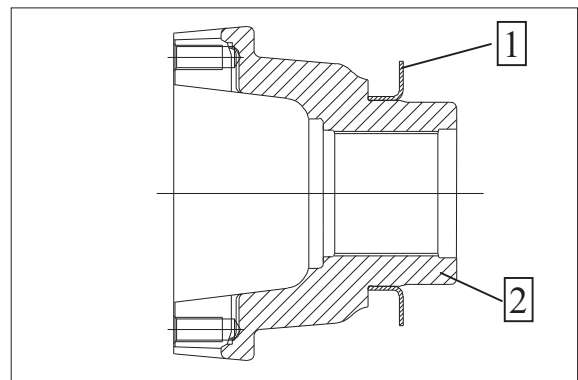


Figure 304

(2) Install the output flange until contact.

- ※ Setting of the gap size as well as fixing of the output flange is identical with the installation of the output flange at the transmission rearside, see page 3-180 and 3-181.



Figure 305

Installation of the idler shaft

(1) Align the layshaft gear and the single components centrally.
Heat the layshaft gearing (figure 306).

- ※ Special tool

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501



Figure 306

(2) Install the adjusting screw.

- ※ Special tool

Adjusting screws 5870 204 007



Figure 307

(3) Install the idler shaft until contact.



Figure 308

(4) Remove the adjusting screw and fasten the axle by means of hexagon screw.

※ Wet the thread of the hexagon screw with Loctite (type No. 243).

· Torque limit (M10/8.8) :
4.69 kgf · m (33.9 lbf · ft)



Figure 309

(5) Insert the sealing covers (arrow), with the concave side showing downwards, flush to the housing surface.

※ Wet contact face with Loctite (type No. 262).



Figure 310

Transmission pump

- (1) Press the needle sleeve (arrow), with the reinforced coating towards the press-in tool until contact.

※ Special tool

Mounting tool 5870 058 041

Handle 5870 260 002



Figure 329

- (2) Snap the V-Rings (3EA) into the recess of the driver (internal gearing). Install the key (arrow).



Figure 330

- (3) Press the ball bearing over the collar of the driver until contact.



Figure 331

- (4) Install the ball bearing and driver respectively and press it until contact.

※ Pay attention to align the key to the keyway.



Figure 332

(5) Fasten the ball bearing by means of retaining ring.

※ Special tool

Set of internal pliers 5870 900 013



Figure 333

(6) Install the O-ring (arrow) and grease it.



Figure 334

(7) Heat the housing bore.

※ Special tool

Preheating bush 5870 801 006

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501

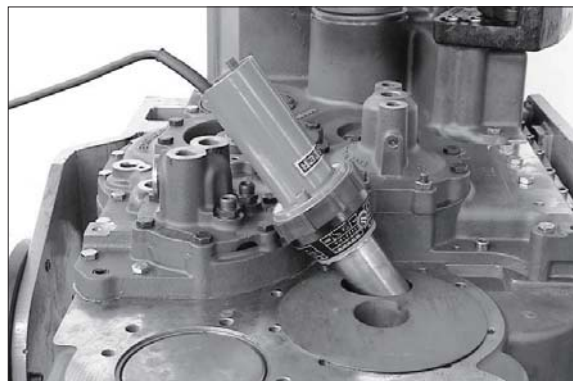


Figure 335

(8) Install two adjusting screws and assemble the pump until contact.

※ Observe the radial installation position.

※ Special tool

Adjusting screws 5870 204 021



Figure 336

(9) Put the O-ring (arrow) into the annular groove of the pump flange.

※ Depending on the transmission version, differences as regards the version and fastening of the pump flange are possible. Obligatory is the respective parts list.



Figure 337

(10) Fasten the pump flange and the pump respectively by means of hexagon screws.

※ Wet thread of both hexagon screws (position, see arrows) with loctite, Type No. 574 (through holes).

· Torque limit (M12/8.8) :

8.06 kgf · m (58.3 lbf · ft)

Then rotate the transmission housing by 90°.

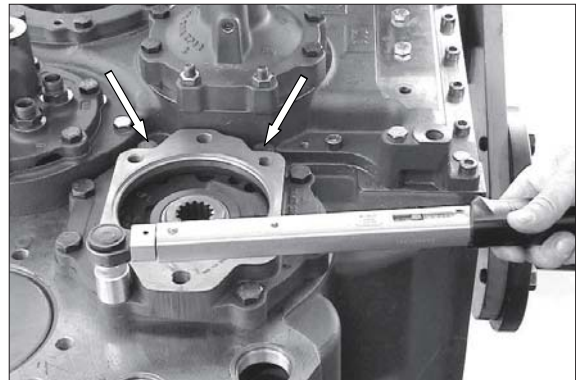


Figure 338

(11) Snap-in and lock the rectangular ring (arrow).



Figure 339

(12) Install both shims (each 2.0 mm thick)

※ Use assembly grease.



Figure 340

(13) Heat the bevel bearing inner ring.

※ Special tool

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501

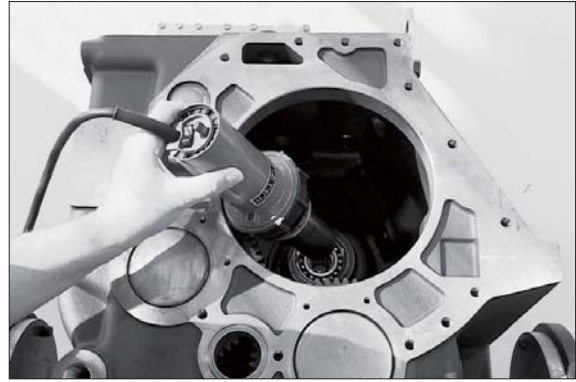


Figure 341

(14) Install the input shaft until contact.

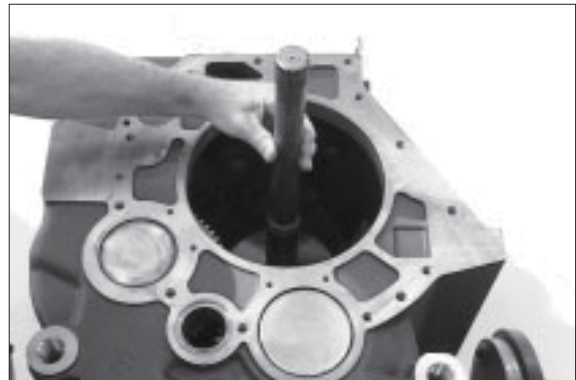


Figure 342

(15) Fasten the input shaft by means of clamping plate and cap screw (arrow).

· Torque limit (M10/8.8) :

3.26 kgf · m (23.6 lbf · ft)

※ Wet thread of the cap screw with loctite (type No. 243).



Figure 343

Input-Converter Bell

※ To install a new converter bell the finished bores (3EA) have to be sealed with plugs. Installation position, see arrow, figure 344.

※ Special tool

Lever riveting tongs 5870 320 016



Figure 344

(1) Locate the bearing outer ring into the housing bore until contact and install the bearing inner ring, see arrow.



Figure 345

(2) Install the spur gear (arrow) with the long collar showing upwards and position it.



Figure 346

(3) Heat the spur gear bore (arrow).

※ Special tool

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501



Figure 347

- (4) Install the input shaft until contact.



Figure 348

- (5) Heat the bearing inner ring and install it until contact.

▲ Use safety gloves.



Figure 349

- (6) Install the bearing outer ring until contact.



Figure 350

- (7) Snap in the rectangular ring (arrow) into the annular groove of the input shaft and lock it.
Then grease the rectangular ring and centrally align it.



Figure 351

- (8) Install the converter safety valve (arrow 1) and fasten it by means of slotted pin (arrow 2).

※ Flush-mount slotted pin to recess.

Put the O-ring (arrow 3) into the annular groove.



Figure 352

- (9) Press the needle bearing (arrow), with the reinforced coating towards the press-in tool into the bore of the bearing cover until contact.

※ Special tool

Mounting tool 5870 058 051

Handle 5870 260 002



Figure 353

- (10) Flush-mount the shaft seal (arrow) with the sealing lip showing (downwards) to the oil sump.

※ Wet the outer diameter with spirit.
Grease the sealing lip.

※ Special tool

Mounting tool 5870 048 030



Figure 354

※ Make the following steps (figure 355~358) in direct time sequence to secure the precise contact of the oil supply flange.

- (11) Heat the housing bore.

※ Special tool

Preheating bush 5870 801 006

Hot-air blower 5870 221 500

Hot-air blower 5870 221 501



Figure 355

(12) Install two adjusting screws and put in the oil supply flange until contact.

※ Observe the radial installation position.

※ Special tool

Adjusting screws 5870 204 007



Figure 356

(13) Place the O-ring (arrow) with assembly grease into the annular groove of the bearing cover.



Figure 357

(14) Put on the bearing cover and fasten it by means of hexagon screws.

· Torque limit (M10/8.8) :

4.69 kgf · m (33.9 lbf · ft)



Figure 358

(15) Install the single components according to the opposite figure.

1 Screw plug : 15.3 kgf · m (110 lbf · ft)

2 Screw plug : 2.55 kgf · m (18.4 lbf · ft)

3 Temperature sensor :

2.55 kgf · m (18.4 lbf · ft)

and screw plug respectively (depending on the version) : 3.57 kgf · m (25.8 lbf · ft)

※ Always install new O-ring.



Figure 359

Converter pressure back-up valve
(figure 360~361)

- (1) Install the slotted pin (6×50 mm) until contact.



Figure 360

- (2) Assemble piston and compression spring. Provide screw plug with a new O-ring and install it.

- Torque limit (M36×1.5) :
13.3 kgf · m (95.9 lbf · ft)



Figure 361

- (3) Fasten the gasket and cover plate by means of hexagon screws (install the washers).

- Torque limit (M6/8.8) :
0.97 kgf · m (7.0 lbf · ft)



Figure 362

- (4) Install two adjusting screws and put on the gasket (arrow 1). Put the O-ring (arrow 2) into the annular groove.

- ※ Special tool
- Adjusting screws 5870 204 021

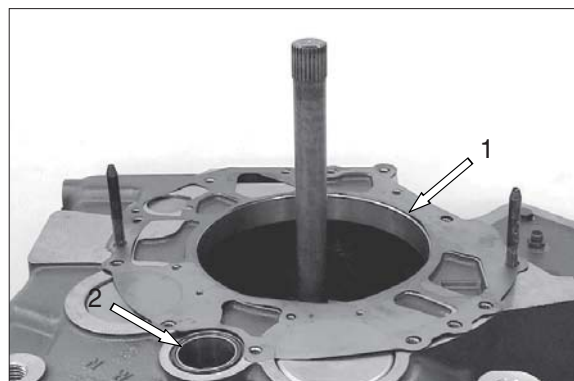


Figure 363

(5) Install the converter bell by means of lifting tackle until contact.

※ Slight rotary motions of the input shaft facilitate the installation (protect teeth from damage). Observe the radial installation position.

※ Special tool

Lifting tackle 5870 281 047

Eyebolts assortment 5870 204 002



Figure 364

(6) Fasten the converter bell by means of hexagon screws.

· Torque limit (M8/10.9) :

3.47 kgf · m (25.1 lbf · ft)

· Torque limit (M12/10.9) :

11.7 kgf · m (84.8 lbf · ft)



Figure 365

(7) Fasten flexible plate (3EA) by means of hexagon screws (install the washers).

※ Wet thread of the hexagon screws with Loctite (type No. 243).

· Torque limit (M10/8.8) :

4.69 kgf · m (33.9 lbf · ft)

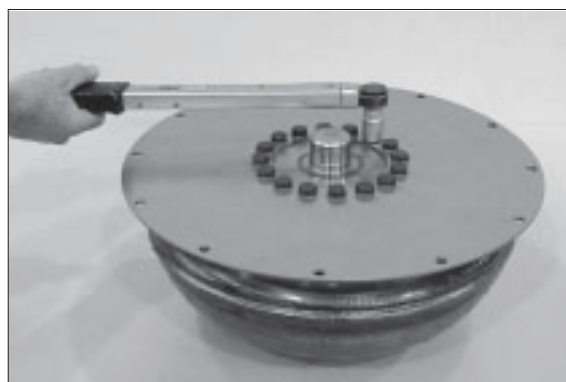


Figure 366

(8) Install the rectangular ring (arrow) into the annular groove and lock it.

Then grease the rectangular ring and centrally align it.



Figure 367

(9) Assemble converter by means of lifting tackle until contact (figure 368).

※ At a control dimension < 43 mm, the exact installation position of the converter is ensured, see Figure 369.

※ Special tool

Eyebolts assortment 5870 204 002

Lifting chain 5870 281 047



Figure 368



Figure 369

⚠ Until installation of the transmission, fix the converter axially, see figure 370.



Figure 370

Coarse Filter

(1) Install filter (assy) into the housing bore.

※ Oil the sealing (arrow).

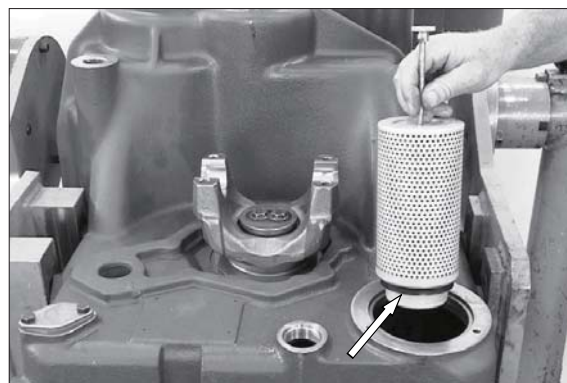


Figure 371

(2) Fasten the cover by means of hexagon screws (install the washers).

※ Install the new O-ring (arrow).

· Torque limit (M8/8.8) :

2.35 kgf · m (17.0 lbf · ft)



Figure 372

Inductive and speed transmitters

(1) Following sketches show the installation position of the single inductive and speed transmitters.

| | | |
|----|-----------------------|------------------------|
| 14 | Inductive transmitter | n-Turbine |
| 9 | Inductive transmitter | n-Engine |
| 5 | Inductive transmitter | n-Internal speed input |
| 13 | Speed transmitter | n-Output |

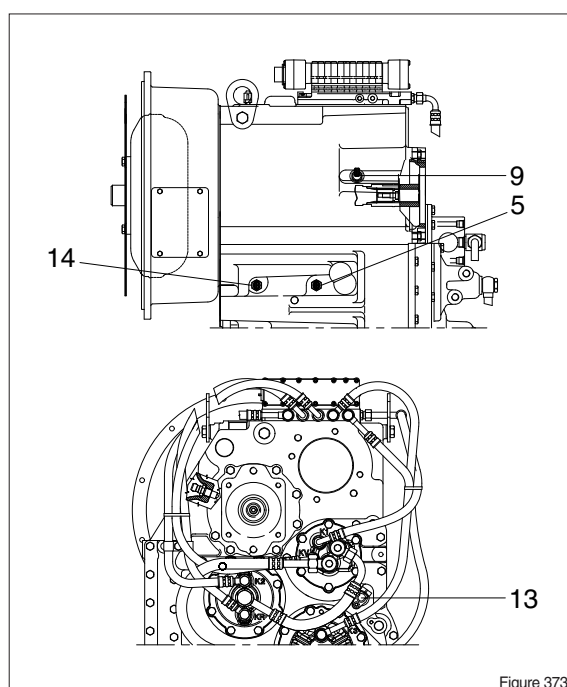


Figure 373

※ The following figures describe the installation and setting respectively of the inductive transmitter n-Engine (9).

Installation of the inductive transmitter n-Turbine (14) and n-internal speed input (5) is to be made analogously.

Observe the different setting dimensions "X" :

▲ Inductive transmitter n-Engine (9)

$X = 0.5^{+0.3}_{-0}$ mm

Inductive transmitter n-Turbine (14)

$X = 0.5^{+0.3}_{-0}$ mm

Induct. transmitter n-int. speed input (5)

$X = 0.3 \pm 0.1$ mm

Adjust Dimension "X" by means of shim ring (s) (figure 376~381)

(1) Measure Dimension I on the inductive transmitter, from contact face to screw-in face.

※ Dimension I e.g. 30.00 mm

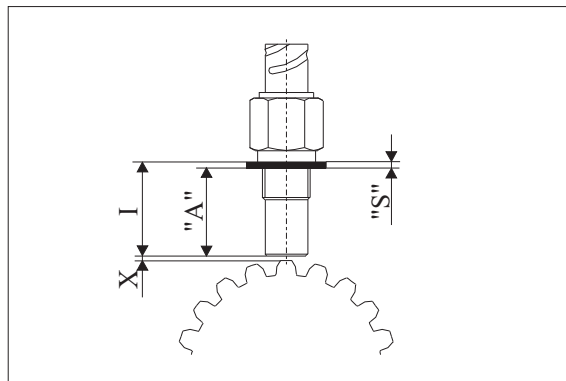


Figure 375



Figure 376

(2) Turn in the counting disc radially until one tooth tip is centrally to the inductive transmitter bore.

Turn the plug gauge until contact.

Locate anvil at the tooth tip and lock it by means of threaded pin (figure 377 and 378).

※ Special tool
Plug gauge 5870 200 104

※ Special tool
Plug gauge 5870 200 104

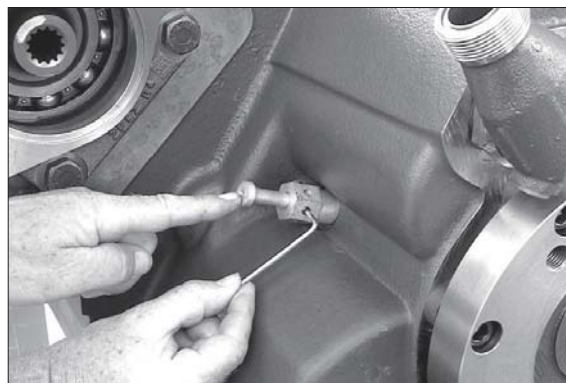


Figure 377

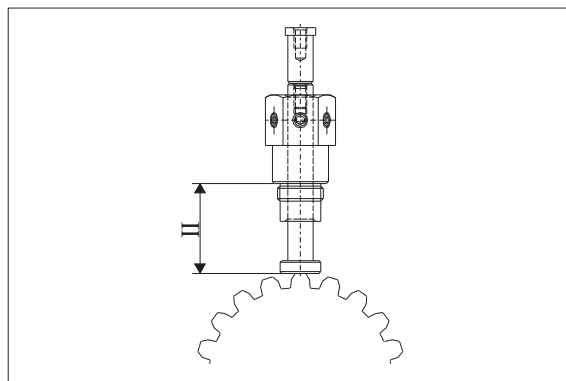


Figure 378

- (3) Turn out the plug gauge and determine Dimension II (also see figure 378).

Dimension II e.g 30.10 mm



Figure 379

Example "A₁" :

| | |
|--------------------------------------|------------------|
| Dimension II | <u>30.10 mm</u> |
| Dimension X (0.5 ^{+0.3} mm) | - <u>0.60 mm</u> |
| Results in installation dimension A | = 29.50 mm |

Example "A₂" :

| | |
|--------------------------|-------------------|
| Dimension I | <u>30.00 mm</u> |
| Installation dimension A | - <u>29.50 mm</u> |
| Results in shim ring (s) | s = 0.50 mm |

- (4) Install the adequate shim ring (s) and wet the thread (arrow) with loctite (type No. 574).

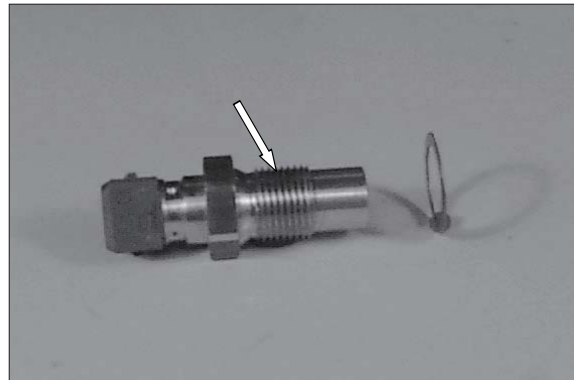


Figure 380

- (5) Install the inductive transmitter n-Engine (9), see arrow.

· Torque limit : 3.06 kgf · m (22.1 lbf · ft)

Set and install the inductive transmitter n-Turbine (14) and n-internal speed input (5) analogously.

- ※ Observe the different setting dimensions.
Installation position of the single inductive transmitters, also see page 3-197.



Figure 381

Install speed transmitter n-Output/Speedo
(13) (figure 382~387)

- 1 Housing
- 2 Spur gear K3
- 3 Disc carrier
- 13 Speed transmitter (hall sensor)
- X** Setting dimension "X" = 1.0 ± 0.5 mm

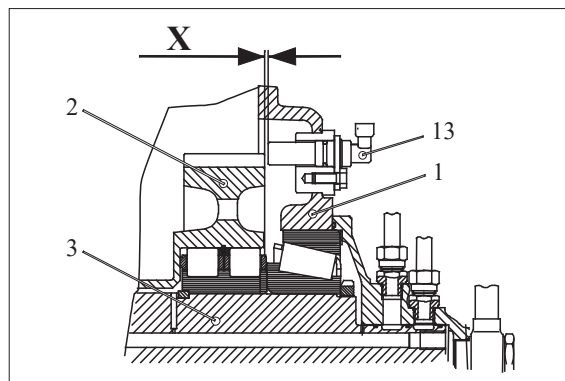


Figure 382

(1) Opposite figure shows the speed transmitter (hall sensor).



Figure 383

(2) Determine Dimension I, from the housing face to spur gear K3.

Dimension I e.g 39.70 mm

※ Special tool

Digital depth gauge 5870 200 072

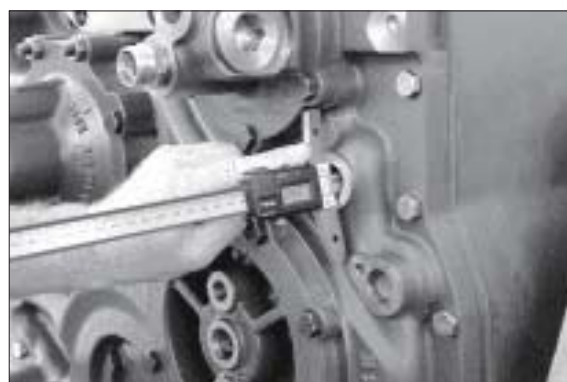


Figure 384

(3) Measure Dimension II, from the contact face to the mounting face.

Dimension II e.g 40.00 mm

※ Special tool

Digital depth gauge 5870 200 072



Figure 385

Example "B₁" :

| | |
|-------------------------------------|-------------------|
| Dimension I | <u>39.70 mm</u> |
| Dimension X(1.0 ^{+0.5} mm) | - <u>1.20 mm</u> |
| Results in installation dimension | <u>= 38.50 mm</u> |

Example "B₂" :

| | |
|--------------------------|--------------------|
| Dimension II | <u>40.00 mm</u> |
| Installation dimension A | - <u>38.50 mm</u> |
| Results in shim(s) | s = <u>1.50 mm</u> |

- (4) Install shims (3EA, s = 0.50 mm) and grease the O-ring (arrow).

- (5) Fasten the speed transmitter by means of cap screw.

· Torque limit (M8/8.8) :
2.35 kgf · m (17.0 lbf · ft)

※ Installation position of the speed transmitter, also see page 3-197.

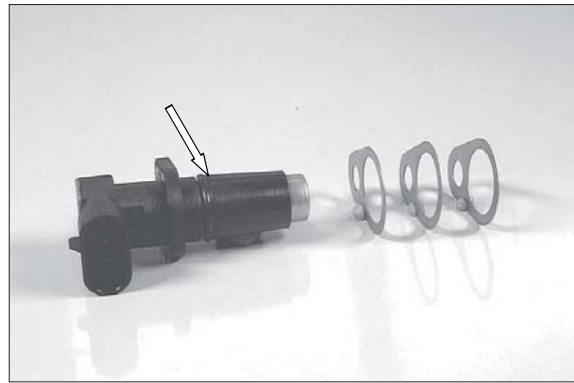


Figure 386

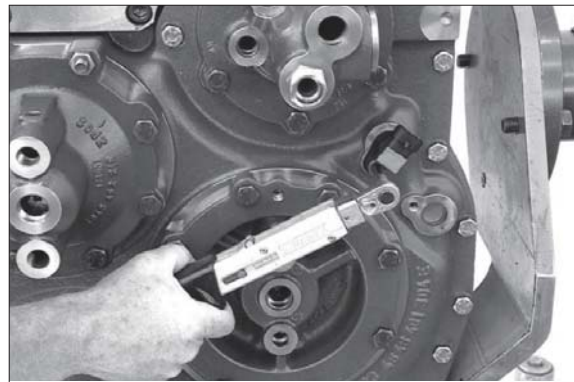


Figure 387

3. AXLE

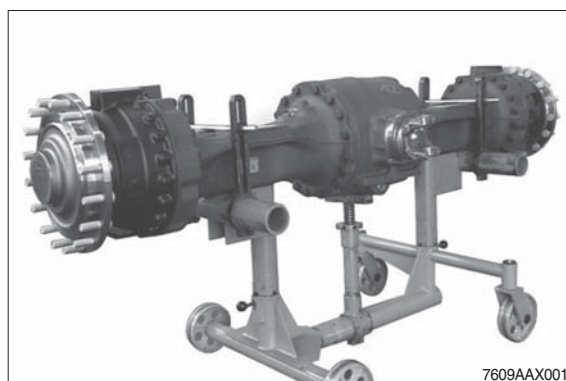
1) DISASSEMBLY

(1) Disassembly output and brake

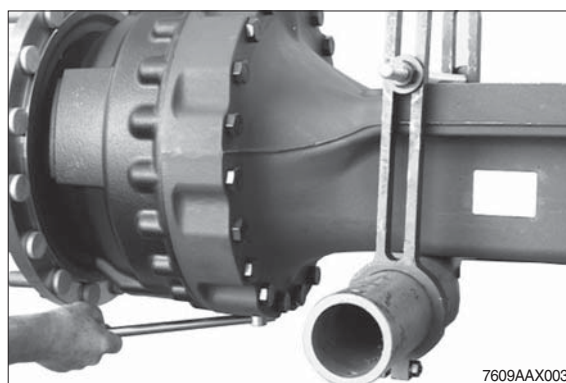
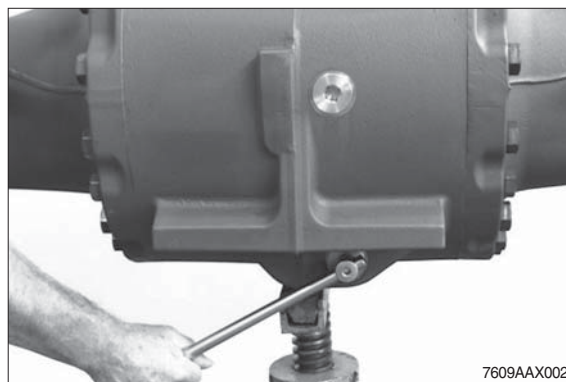
- ① Fix axle to assembly truck.

| | |
|-------------------|--------------|
| Assembly truck | 5870 350 000 |
| Fixtures | 5870 350 077 |
| Clamping brackets | 5870 350 075 |
| Support | 5870 350 125 |

- ※ Before clamping the axle fully turn in the support. Position axle first onto the two fixtures, secure with clamping brackets and then unbolt the support until contact with the axle is obtained.

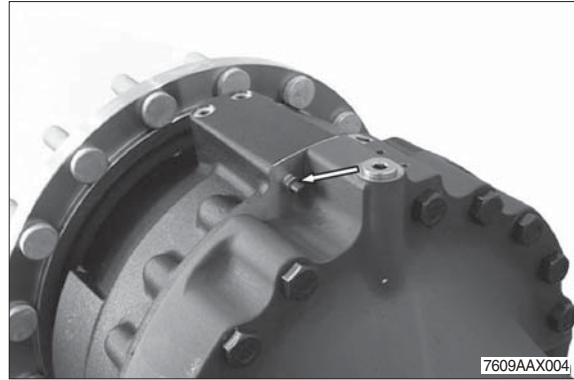


- ② Loosen screw plugs (3EA, see AX002 and AX003) and drain oil from the axle.



③ Remove the breather valve (see arrow).

※ To avoid any damage, the breather valve must be removed when separating the output.

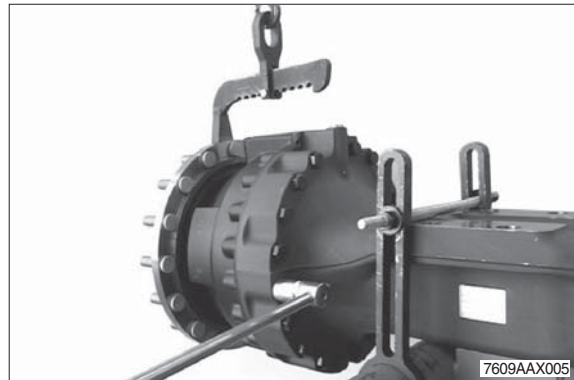


④ Secure the output with the lifting device and loosen hexagon screws.

Then separate the output assy from the axle housing.

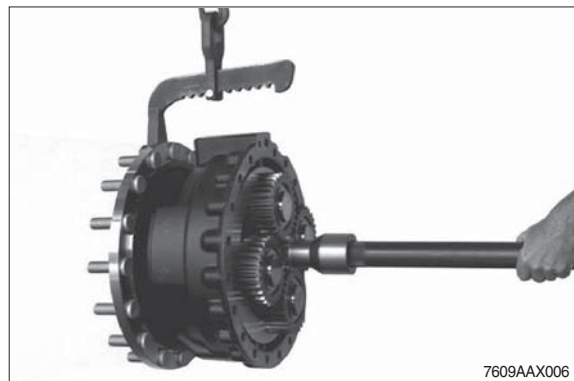
Load carrying device 5870 281 043

※ Fix the load carrying device with a wheel nut.



⑤ Pull stub shaft and sun gear shaft.

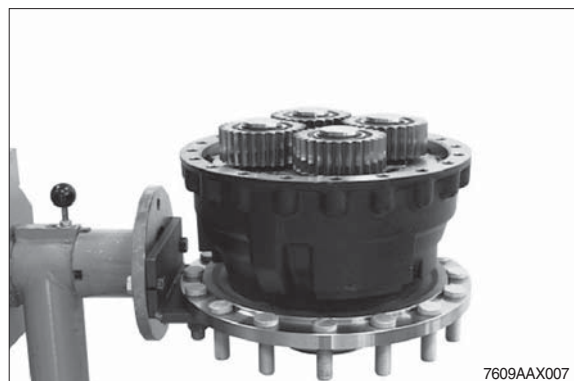
※ Pay attention to potentially releasing shim.



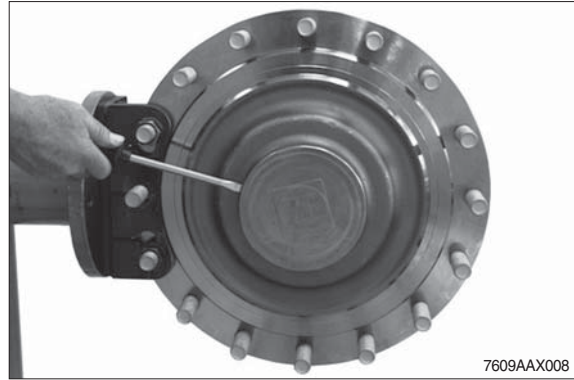
⑥ Fix output to assembly truck.

Assembly truck 5870 350 000

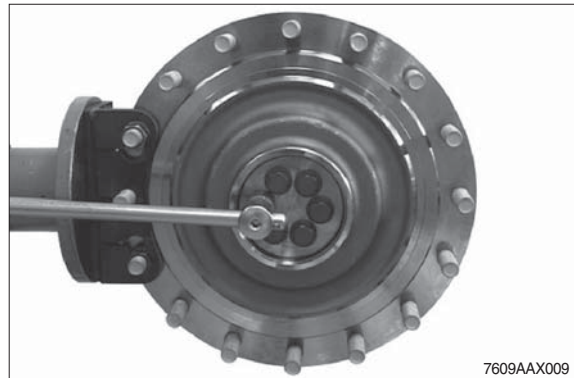
Fixture 5870 350 113



- ⑦ Use a lever to remove the cover from the output shaft.



- ⑧ Loosen locking screws and remove the releasing cover.



- ⑨ Press planetary carrier with a two-armed puller out of the profile of the output shaft.



- ⑩ Lift the planetary carrier out of the brake housing by means of the lifting device.

Inner extractor 5870 300 017
Eye nut 5870 204 076



- ⑪ Pull the tapered roller bearing from the planetary carrier.

| | |
|------------|--------------|
| Rapid grip | 5873 014 016 |
| Basic tool | 5873 004 001 |



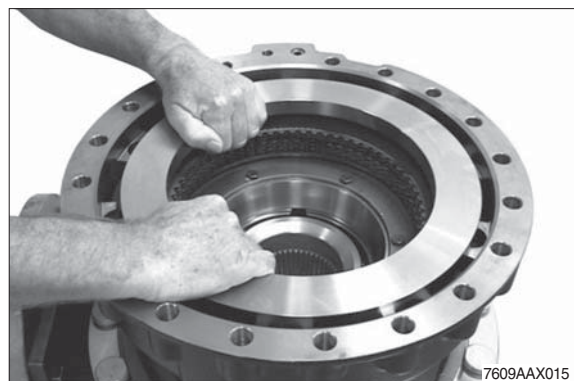
- ⑫ Disengage retaining ring.



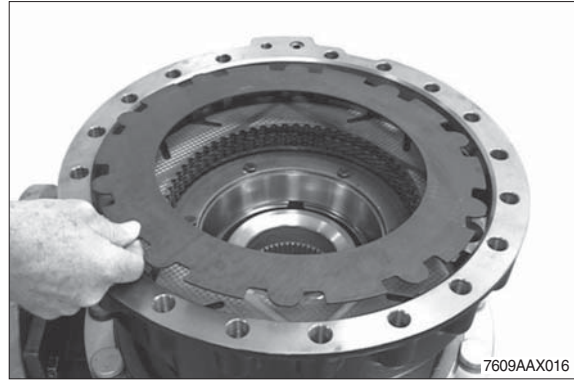
- ⑬ Pull off planetary gear.



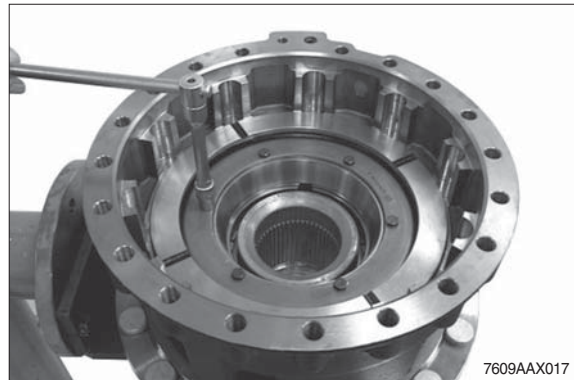
- ⑭ Lift the end plate out of the brake housing.



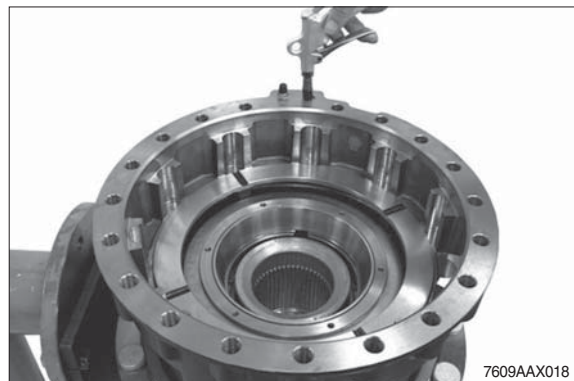
- ⑮ Lift the disk package out of the brake housing.



- ⑯ Loosen hexagon screws, remove releasing cover and cup spring.

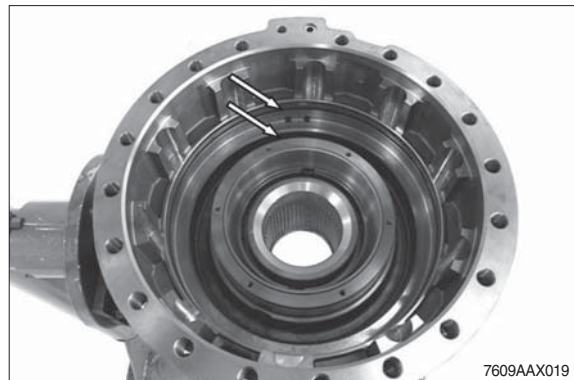


- ⑰ Mount breather valve and press piston out of the brake housing by means of compressed air.

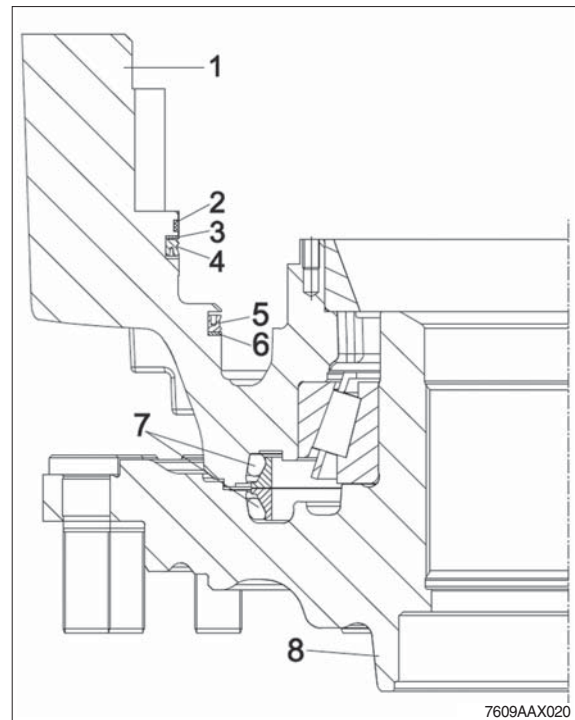


- ⑱ If necessary, remove guide ring, back-up rings and grooved rings out of the annular grooves of the brake housing (see arrows).

※ For the installation position of the single parts please also refer to the following sketch.



- 1 Brake housing
- 2 Guide ring
- 3 Back-up ring
- 4 Grooved ring
- 5 Grooved ring
- 6 Back-up ring
- 7 Slide ring seal
- 8 Output shaft



- ①⑨ Lift the brake housing from the output shaft by means of the lifting device.



- ② Use a lever to remove the slide ring seal from the brake housing.

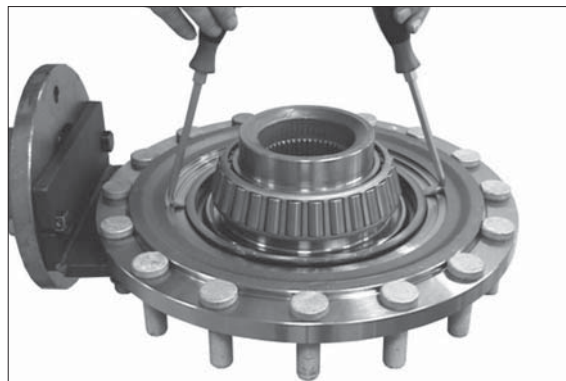
If necessary, force out both bearing outer rings.

Resetting device 5870 400 001



- ② Use a lever to remove the slide ring seal from the output shaft.

Resetting device 5870 400 001



7609AAX023

- ② Pull the tapered roller bearing from the output shaft.

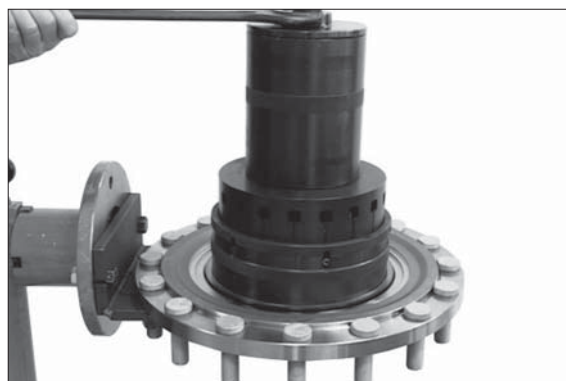
Rapid grip

Front axle AA00 693 459

Rear axle 5873 014 013

Basic tool 5873 004 001

Pressure piece AA00 334 968



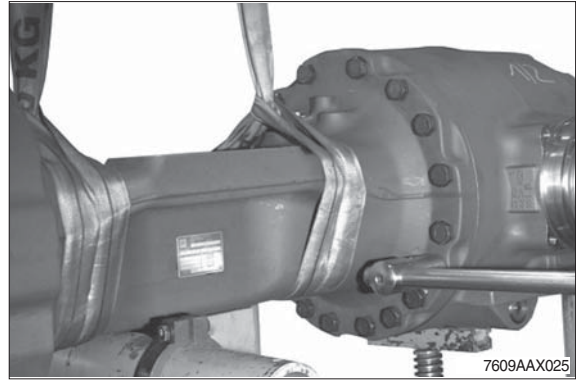
7609AAX024

(2) Disassembly axle housing

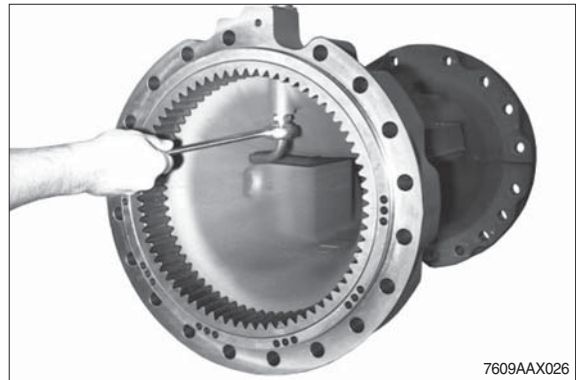
- ① Secure axle housing with the lifting device and loosen the hexagon screws.

Then separate the axle housing from the axle drive housing.

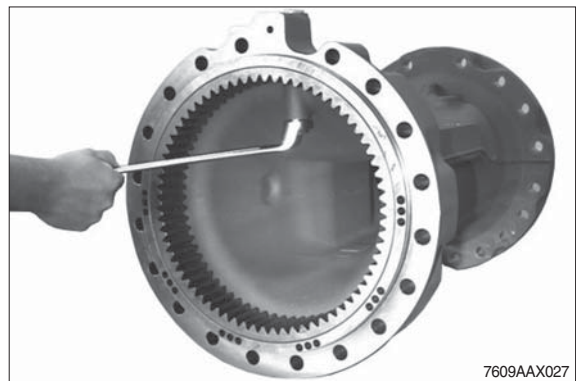
※ Pay attention to releasing differential.



- ② Loosen the threaded connections and remove the releasing brake tube.

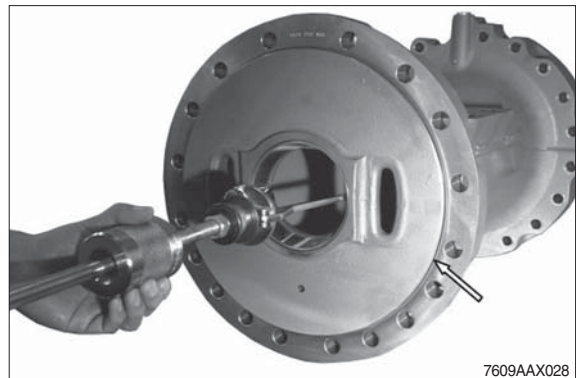


- ③ Loosen screw neck.



- ④ Pull the bearing outer ring out of the bearing hole and remove the shim behind.

Then remove the O-ring (see arrow).

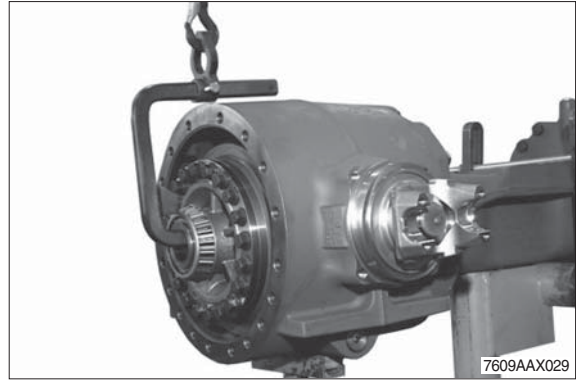


(3) Disassembly input

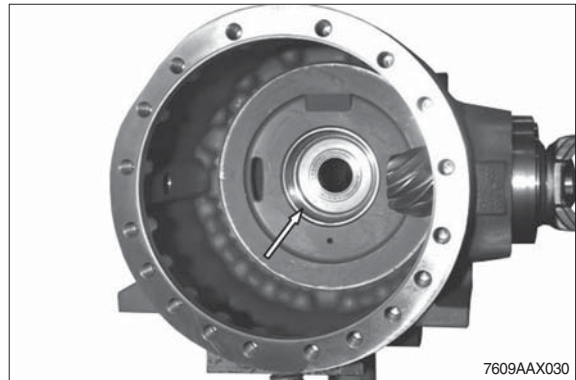
- ① Use the lifting device to lift the differential out of the axle drive housing.

Load carrying fixture 5870 281 083

- ※ Disassembly of the differential is described as of page 3-212.

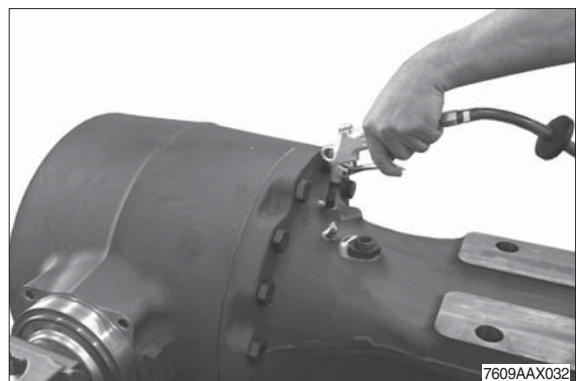
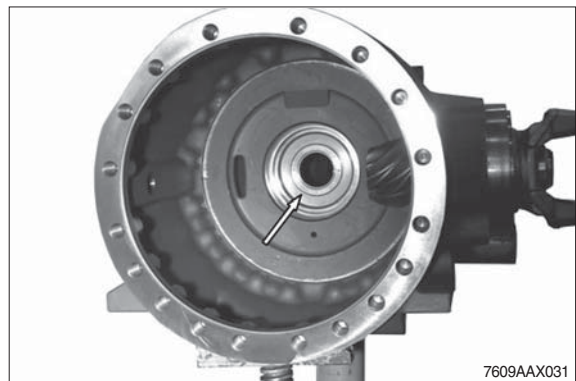


- ② Pull the bearing outer ring (see arrow) out of the housing hole and remove the shim behind.



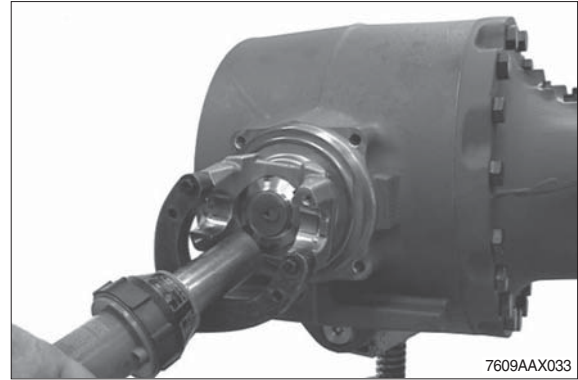
- ③ Press piston (see arrow) out of the axle housing (see subsequent figure) by means of compressed air.

- ※ This operation is only necessary for the hydraulic lock differential (option).



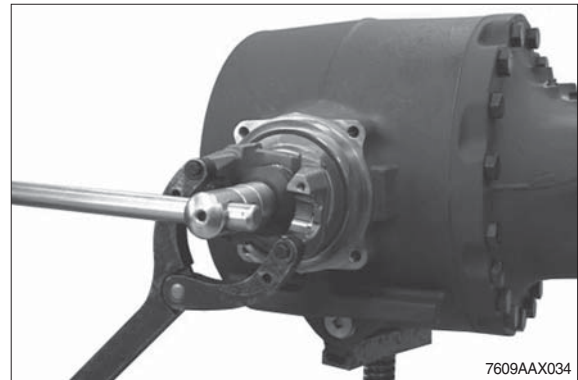
- ④ Heat slotted nut by means of hot air blower.

※ Slotted nut is secured with loctite (type No. : 262).

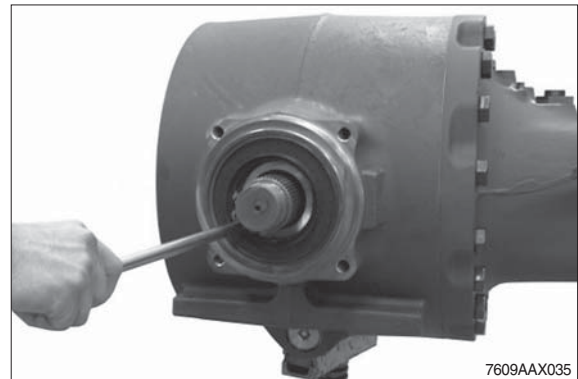


- ⑤ Loosen slotted nut and remove the shim behind.

| | |
|--------------------|--------------|
| Slotted nut wrench | 5870 401 139 |
| Clamping device | 5870 240 002 |



- ⑥ Pull the input flange from the input pinion and use a lever to remove the shaft seal behind from the axle drive housing.



- ⑦ Press input pinion from the axle drive housing and remove the releasing tapered roller bearing.

| | |
|---------------------|--------------|
| Front axle | |
| Clamp (2EA) | AA00 338 279 |
| Rear axle | |
| Extractor | 5870 000 065 |
| Hexagon screw (2EA) | AA00 331 360 |



- ⑧ Remove spacer ring and pull the tapered roller bearing from the input pinion.

Gripping device

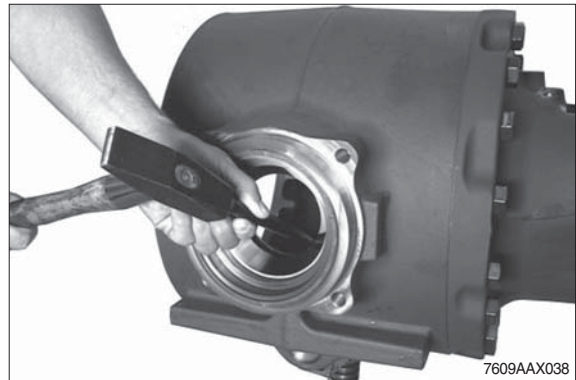
Front axle 5873 002 030

Rear axle AA00 684 425

Basic tool 5873 002 000



- ⑨ If necessary, force both bearing outer rings out of the axle drive housing.



(4) Disassembly differentials

Disassembly hydraulic lock differential (option)

- ① Remove axial roller cage (arrow).



- ② Pull both tapered roller bearings from the differential.

Crown wheel side

Grab sleeve 5873 012 016

Basic tool 5873 002 001

Opposite side

Grab sleeve 5873 003 029

Basic tool 5873 002 001

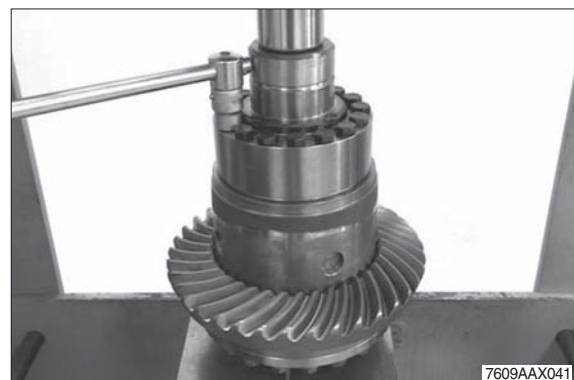
Reduction 5873 003 011

Pressure piece 5870 100 075



- ③ Preload the differential by means of the press, loosen the hexagon screws and remove the releasing housing cover.

Pressure piece 5870 100 075



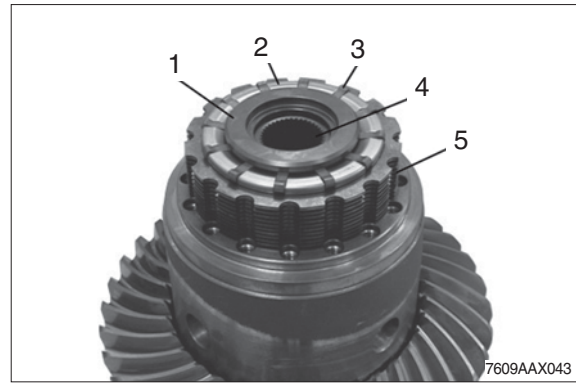
- ④ Preload the housing cover/compression spring by means of the press and disengage the retaining ring.

Then remove sliding sleeve and compression spring from the housing cover.

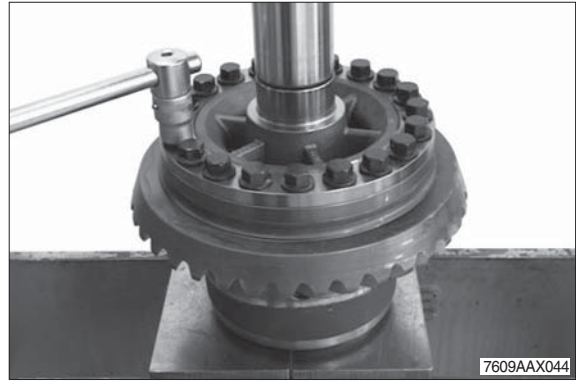


⑤ Remove single parts.

- 1 Pressure piece
- 2 Cage
- 3 Lever (12EA)
- 4 Disk carrier
- 5 Disk package



⑥ Preload differential by means of the press, loosen locking screws and housing cover.



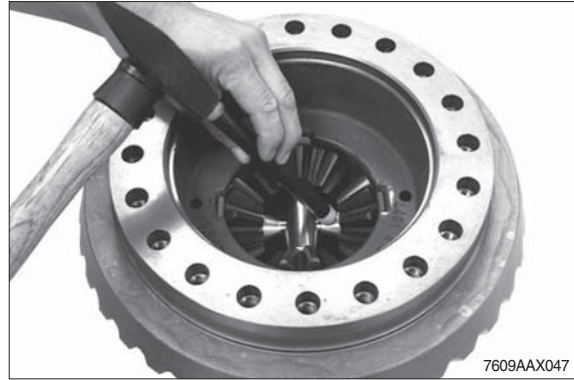
⑦ Remove axle bevel gear with thrust washers from the differential housing.



⑧ Force out both slotted pins.



- ⑨ Force out both differential axles (short) and remove the releasing spider gears with thrust washers from the differential housing.



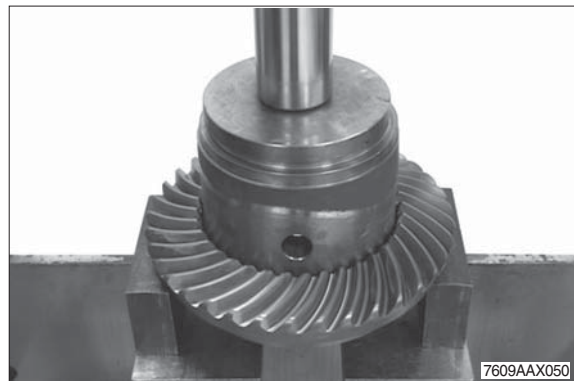
- ⑩ Pull the differential axle (long) and remove the releasing spider gears with thrust washers from the differential housing.



- ⑪ Remove the axle bevel gear and the shim behind.



- ⑫ Press crown wheel from the differential carrier.



Disassembly conventional differential (standard)

- ① Pull both tapered roller bearings from the differential.

Grab sleeve 5873 012 016

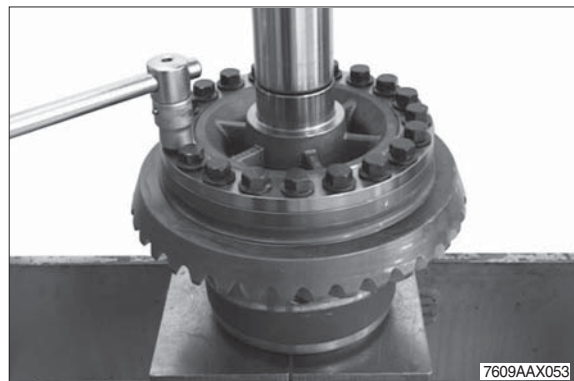
Basic tool 5873 002 001



- ② Preload the differential by means of the press, loosen the hexagon screws and remove the releasing housing cover.



- ③ Preload the differential by means of the press, loosen locking screws and housing cover.



- ④ Remove axle bevel gear with thrust washers from the differential housing.



- ⑤ Force out both slotted pins.



- ⑥ Force out both differential axles (short) and remove the releasing spider gears with thrust washers from the differential housing.



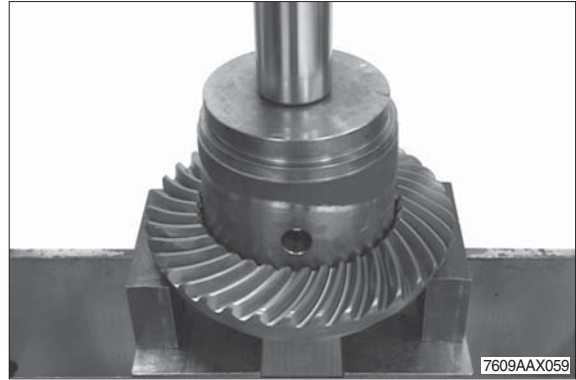
- ⑦ Pull the differential axle (long) and remove the releasing spider gears with thrust washers from the differential housing.



- ⑧ Remove the axle bevel gear and the shim behind.



- ⑨ Press crown wheel from the differential carrier.



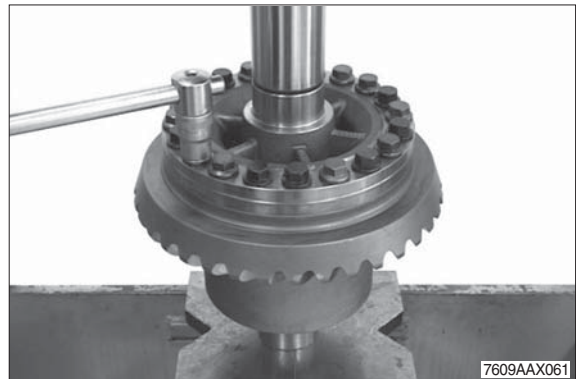
Disassembly limited slip differential (option)

- ① Pull both tapered roller bearings from the differential.

| | |
|-------------|--------------|
| Grab sleeve | 5873 012 016 |
| Basic tool | 5873 002 001 |



- ② Preload the differential by means of the press, loosen locking screws and housing cover.



- ③ Lift the axle bevel gear with pressure ring, disk package and thrust washers out of the differential housing.



- ④ Remove spider shafts and axle bevel gears (see figure) out of the differential housing.



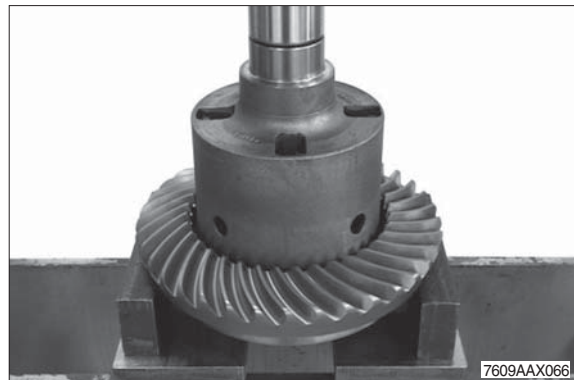
- ⑤ Remove the second axle bevel gear.



- ⑥ Lift the pressure ring out of the differential housing and remove the disk package and thrust washers behind.



- ⑦ Press crown wheel from the differential carrier.

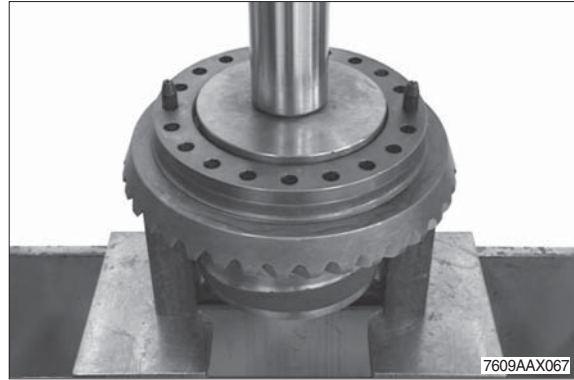


(5) Reassembly differentials

Reassembly hydraulic lock differential (option)

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins 5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Insert axle bevel gear.



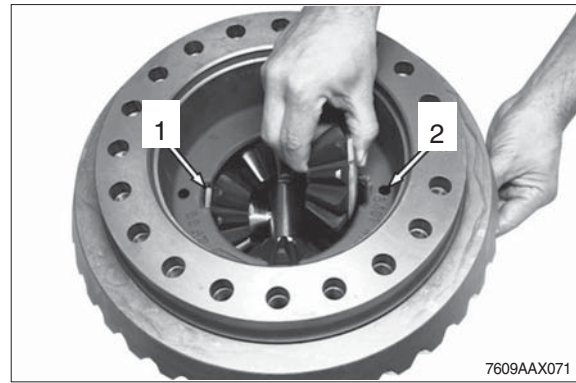
- ④ Insert spider gears with thrust washers into the differential housing and fix them with the spider shaft (long).

※ Thrust washers must be positioned with the tabs (see arrow) being located in the recesses of the differential housing.



- ⑤ Insert spider gears with thrust washers into the differential housing and fix them with the two spider shafts (short).

- ※ Thrust washers must be positioned with the tabs (see arrow 1) being located in the recesses of the differential housing.
- ※ Pay attention to radial installation position of the spider shafts (fixing holes, arrow 2).



- ⑥ Fix spider shafts (short) with slotted pins.

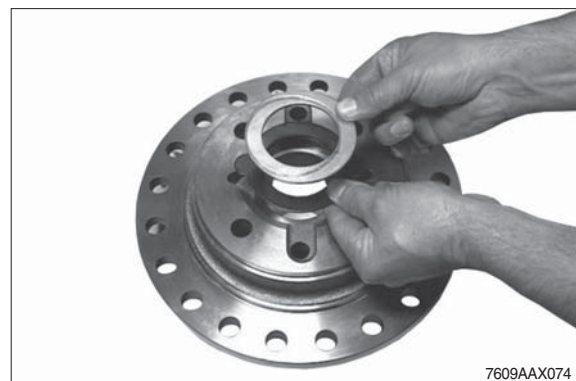
- ※ Flush mount slotted pins.



- ⑦ Mount second axle bevel gear.



- ⑧ Fix the thrust washers into the housing cover by means of grease.

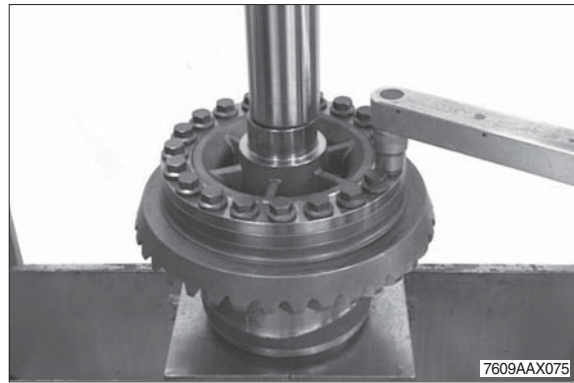


- ⑨ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

- Tightening torque (M16/12.9) :
40.8 kgf · m (295 lbf · ft)



- ⑩ Install compression spring onto the sliding sleeve.



- ⑪ Insert the premounted sliding sleeve into the housing cover.

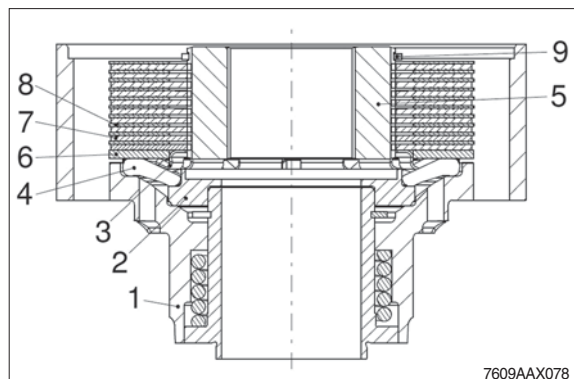
Preload the compression spring by means of the press and engage the retaining ring into the annular groove of the sliding sleeve.



Setting of disk package

- ⑫ Premount single parts according to the adjacent sketch.

- 1 Housing cover
- 2 Pressure piece
- 3 Cage
- 4 Lever (12EA)
- 5 Disk carrier
- 6 Pressure ring
- 7 Inner disks
- 8 Outer disks (optional)
- 9 Snap ring



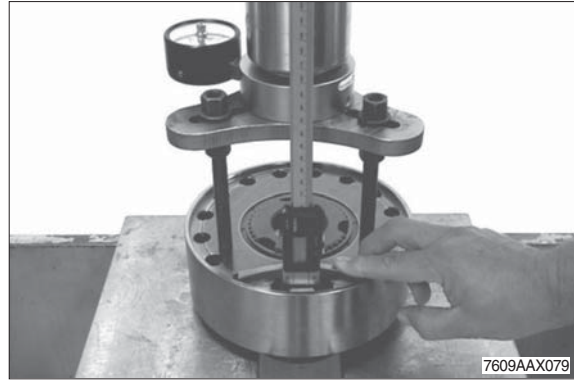
- ※ For the number of disks and the disk arrangement please refer to the relating parts manual.

- ⑬ Preload disk package with an axial force of $F = 50^{+30}$ kN.

Then check the setting dimension "A" = 1.05 ± 0.1 mm from the collar of the differential cover to the plane face of the outer disk (see also below sketch).

Pressure piece 5870 100 069
Load cell 5870 700 004

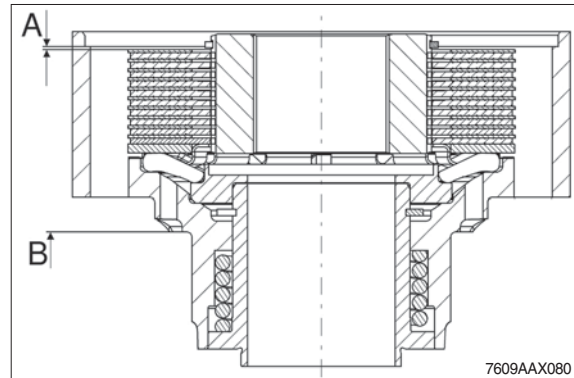
- ※ Any deviation from the specified setting dimension must be corrected with a corresponding outer disk.



A = Setting dimension = 1.05 ± 0.1 mm

B = Contact face

- ⑭ To obtain a correct measuring result :
The housing cover may only be supported on the contact face (B).
Ensure that the assembly fixture is only supported on the disk package and not on the disk carrier (5).



- ⑮ Position housing cover onto pressure piece (see arrow).
Insert two hexagon screws into the housing cover to radially fix the disk package.

Pressure piece 5870 100 075



- ⑯ Position the premounted differential with the lifting device onto the housing cover and preliminarily fix with hexagon screws.

Lifting device AA00 331 446

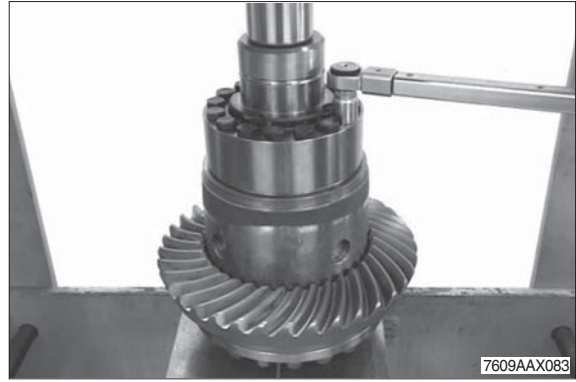


- ⑰ Preload the differential by means of the press and the pressure piece.

Then finally tighten the housing cover with hexagon screws.

· Tightening torque (M14/10.9) :
18.9 kgf · m (136 lbf · ft)

Pressure piece 5870 100 075



- ⑱ Heat both tapered roller bearings and insert until contact is obtained.

※ Adjust tapered roller bearing after cooling down.



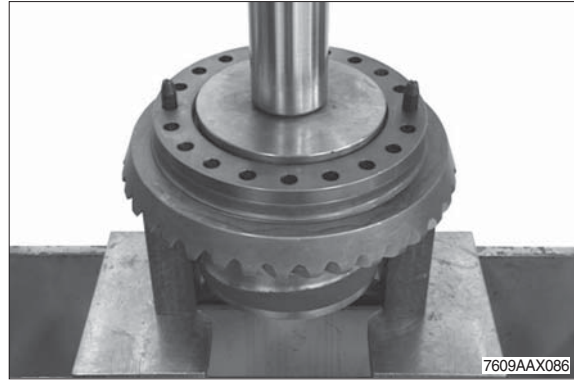
- ⑲ Fix axial roller cage (see arrow) to the sliding sleeve by means of grease.



Reassembly conventional differential (standard)

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins 5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Insert axle bevel gear.



- ④ Insert spider gears with thrust washers into the differential housing and fix them with the spider shaft (long).

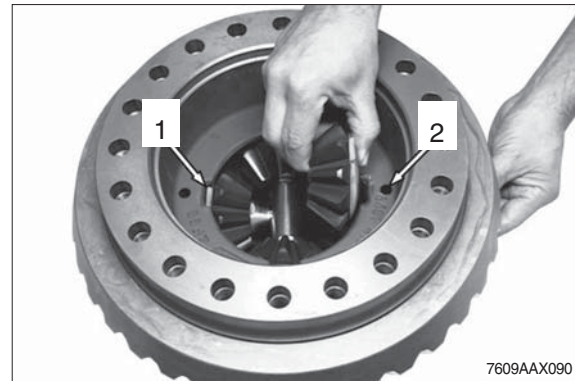
※ Thrust washers must be positioned with the tabs (see arrow) being located in the recesses of the differential housing.



- ⑤ Insert spider gears with thrust washers into the differential housing and fix them with the two spider shafts (short).

※ Thrust washers must be positioned with the tabs (see arrow 1) being located in the recesses of the differential housing.

※ Pay attention to radial installation position of the spider shafts (fixing holes, arrow 2).

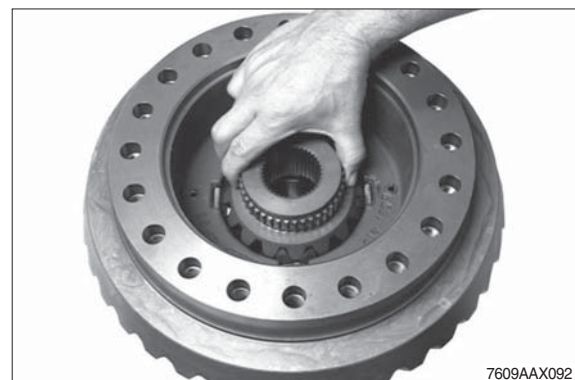


- ⑥ Fix spider shafts (short) with slotted pins.

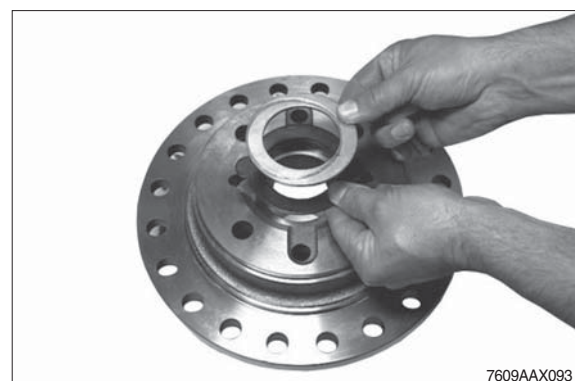
※ Flush mount slotted pins.



- ⑦ Mount second axle bevel gear.



- ⑧ Fix the thrust washers into the housing cover by means of grease.

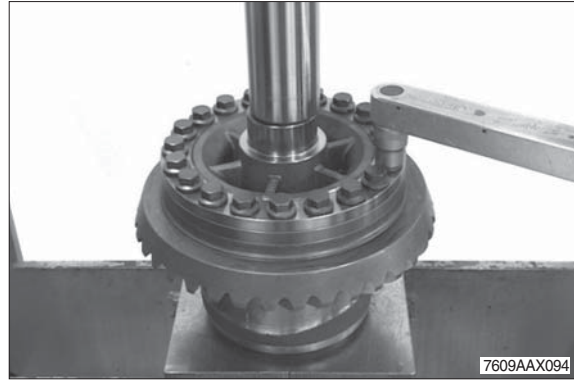


- ⑨ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

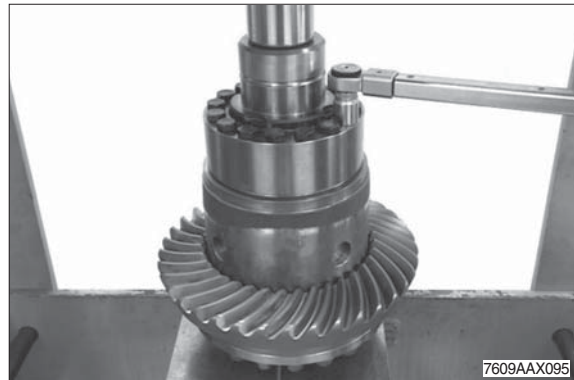
- Tightening torque (M16/12.9) :
40.8 kgf · m (295 lbf · ft)



- ⑩ Attach the housing cover and preload the differential with the press.

Then fix the housing cover with hexagon screws.

- Tightening torque (M14/10.9) :
18.9 kgf · m (136 lbf · ft)



- ⑪ Heat both tapered roller bearings and insert until contact is obtained.

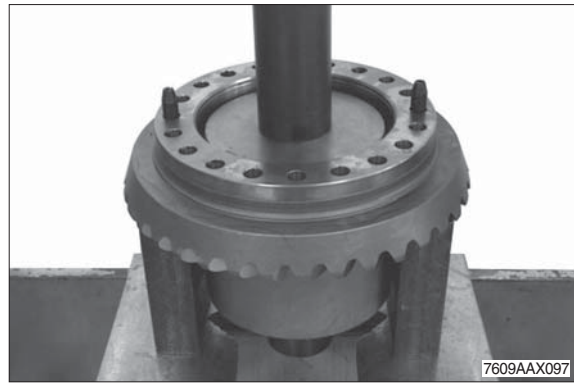
- ※ Adjust tapered roller bearing after cooling down.



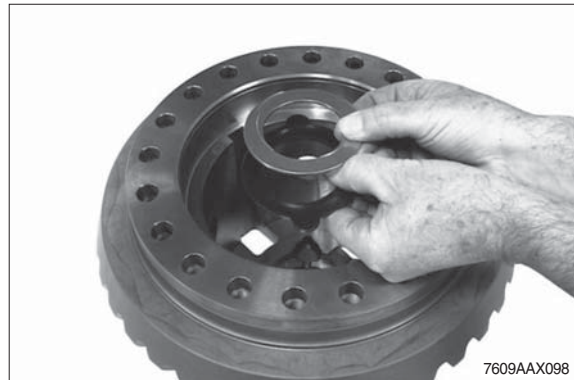
Reassembly limited slip differential (option)

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins 5870 204 040



- ② Insert thrust washer into the differential housing.



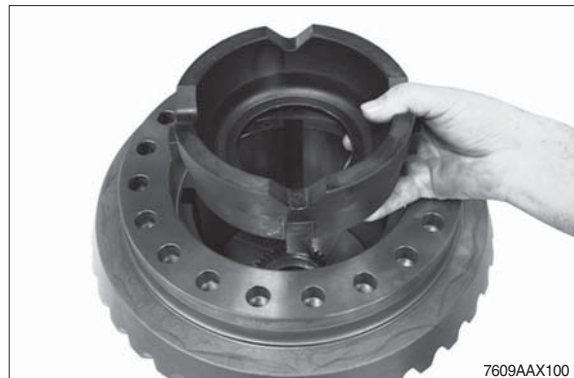
- ③ Mount outer and inner disks in alternating order, starting with an outer disk.

※ The installation clearance of the internal parts is corrected by mounting outer disks with different thicknesses.

▲ The difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.



- ④ Place the pressure ring.



- ⑤ Insert the axle bevel gear until contact is obtained and install the inner disks with the teeth.



- ⑥ Preassemble the differential spider and insert it into the differential housing/into the pressure ring.



- ⑦ Mount second axle bevel gear.



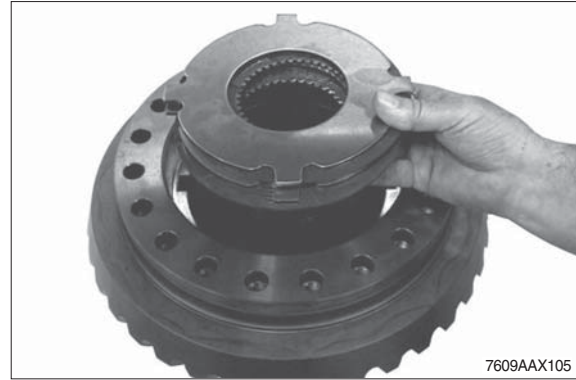
- ⑧ Insert the second pressure ring into the differential housing.



- ⑨ Mount outer and inner disks in alternating order, starting with an inner disk.

The installation clearance of the internal parts is corrected by mounting outer disks with different thicknesses.

- ▲ The difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.



Determine the installation clearance 0.2~0.7 mm

- ⑩ Measure dimension I, from the mounting face of the differential housing to the plane face of the outer disk.

Dimension I e.g. 44.30 mm



- ⑪ Measure dimension II, from the contact face of the outer disk to the mounting face on the housing cover.

Dimension II e.g. 43.95 mm

CALCULATION EXAMPLE :

Dimension I 44.30 mm

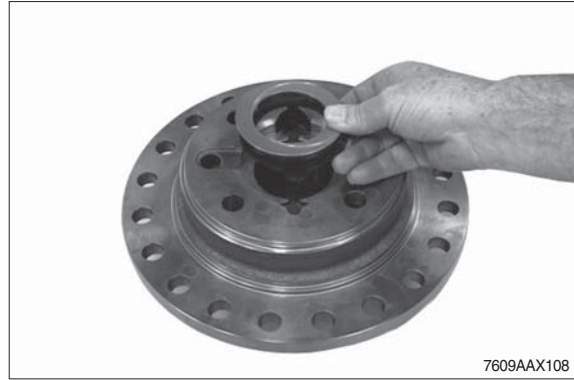
Dimension II - 43.95 mm

Difference = disk clearance = 0.35 mm



- ※ Any deviation from the required installation clearance is to be corrected with corresponding outer disks (s = 2.7, s = 2.9, s = 3.0, s = 3.1, s = 3.2, s = 3.3 or s = 3.5 mm), taking care that the difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.

- ⑫ Fix the thrust washers into the housing cover by means of grease.

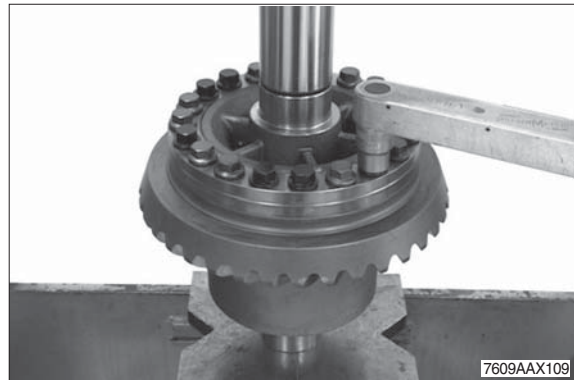


- ⑬ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

- Tightening torque (M16/12.9) :
40.8 kgf · m (295 lbf · ft)



- ⑭ Heat both tapered roller bearings and insert until contact is obtained.

- ※ Adjust tapered roller bearing after cooling down.



(6) Reassembly input

- ※ If crown wheel or input pinion are damaged, both parts must be jointly replaced.

In case of a new installation of a complete bevel gear set pay attention to an identical mating number of input pinion and crown wheel.

Determination of shim thickness to obtain a correct contact pattern

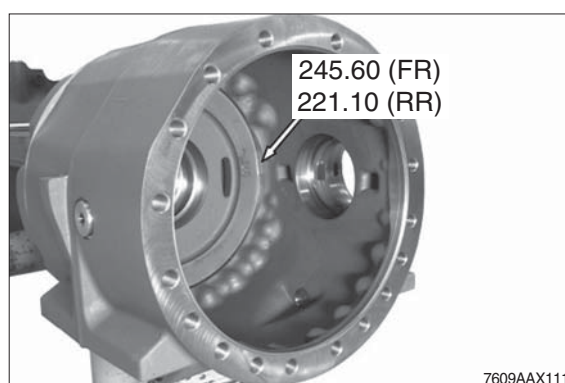
- ※ The following measuring procedures must be carried out with utmost accuracy.

Inaccurate measurements lead to an incorrect contact pattern requiring an additional disassembly and reassembly of input pinion and differential.

- ① Read dimension I from the axle drive housing.

Dimension I e.g.

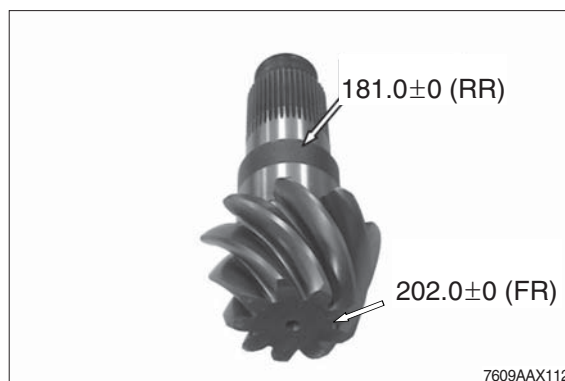
| | | |
|------------|-------|-----------|
| Front axle | | 245.60 mm |
| Rear axle | | 221.10 mm |



- ② Read dimension II (pinion dimension).

Dimension II e.g.

| | | |
|------------|-------|-----------|
| Front axle | | 202.00 mm |
| Rear axle | | 181.00 mm |



③ Determine dimension III (bearing width).

Dimension III e.g.

Front axle 42.50 mm

Rear axle 39.10 mm

CALCULATION EXAMPLE "A₁":

Front axle

Dimension I 245.60 mm

Dimension II - 202.00 mm

Dimension III - 42.60 mm

Difference = shim s = 1.00 mm

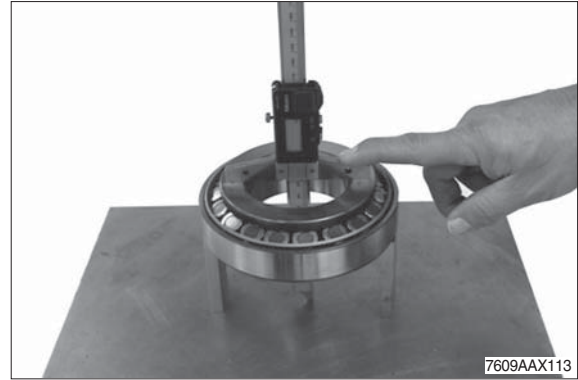
Rear axle

Dimension I 221.10 mm

Dimension II - 181.00 mm

Dimension III - 39.10 mm

Difference = shim s = 1.00 mm

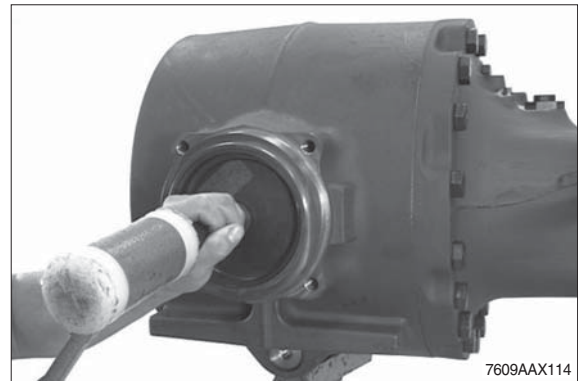


Reassembly of input pinion

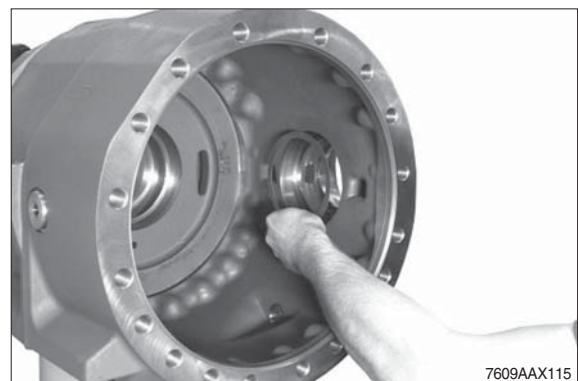
- ④ Undercool the external bearing outer ring and insert it into the axle drive housing until contact is obtained.

Driver tool 5870 058 079

Handle 5870 260 004



- ⑤ Insert the determined shim e.g. s = 1.00 mm into the housing hole.



- ⑥ Undercool the internal bearing outer ring and bring it into contact position in the housing hole by using the assembly fixture.

Assembly fixture

Front axle AA00 338 352

Rear axle 5870 345 080



- ⑦ Heat the tapered roller bearing and insert it into the input pinion until contact is obtained.



Setting of rolling torque of input pinion bearing 0.15~0.41 kgf · m (1.11~2.95 lbf · ft) (without shaft seal)

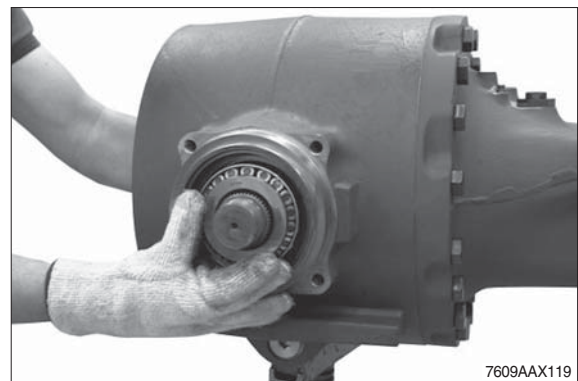
- ⑧ Insert spacer (e.g. $s = 8.18 \text{ mm}$).

※ According to our experience the necessary rolling torque is obtained when reusing the spacer which has been removed during disassembly (e.g. $s = 8.18 \text{ mm}$).

A later check of the rolling torque, however, is absolutely necessary.

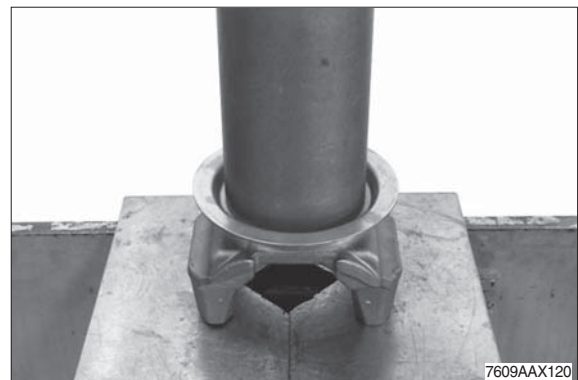


- ⑨ Insert the preassembled input pinion into the axle drive housing and insert the heated tapered roller bearing until contact is obtained.



- ⑩ Press the protection plate onto the input flange (see arrow) until contact is obtained.

※ Do not fit the shaft seal until the contact pattern has been checked.



- ⑪ Insert input flange and fix it by means of disk and slotted nut.

· Tightening torque :

122 kgf · m (885 lbf · ft)

Slotted nut wrench 5870 401 139

Clamping device 5870 240 002

- ※ Preliminarily mount slotted nut without loctite.

▲ While tightening rotate the input pinion several times in both directions.

- ⑫ Check rolling torque (0.15~0.41 kgf · m without shaft seal).

- ※ When installing new bearings try to achieve the upper value of the rolling torque.

▲ In case of deviations from the necessary rolling torque correct with a corresponding spacer (AX118, page 3-233) as specified below.

Insufficient rolling torque

install thinner spacer ring

Excessive rolling torque

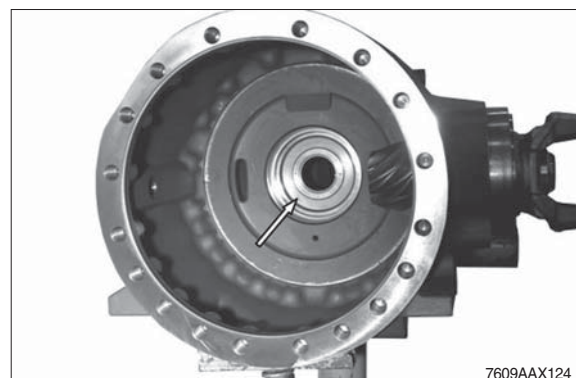
install thicker spacer ring

- ⑬ Grease O-rings (2EA, see arrows) and insert them into the annular grooves of the piston.

- ※ Operation figure AX123 and AX124 is only necessary for hydraulic lock differential (option).



- ⑭ Insert piston (see arrow) into the bearing housing until contact is obtained.



Determination of shims for setting of bearing rolling torque (differential housing) and backlash (bevel gear set)

- ※ Determine the required shims on the basis of the read value (deviation/test dimension) and the corresponding specifications of the table below :

(KRS – SET – RIGHT)

(KRS = bevel gear set)



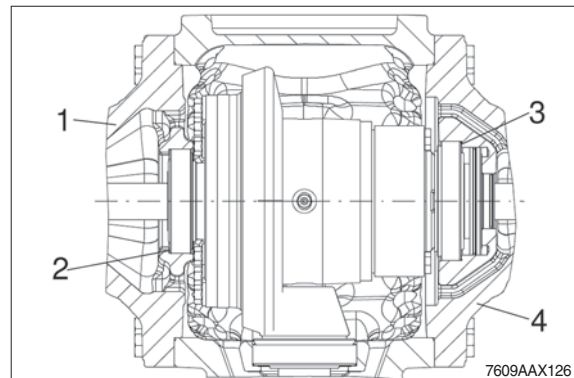
⑮ Deviation see crown wheel rear side.

- ※ The test dimension “101,, is stamped into the crown wheel rear side. If no + or – deviation is indicated, this value corresponds to the actual value “0” in the table below.

According to this value, the required shims are allocated in the table below.

Any + or – deviation of the test dimension caused by production is also marked on the crown wheel rear side (e.g. - 20 or - 10 or 10 or 20).

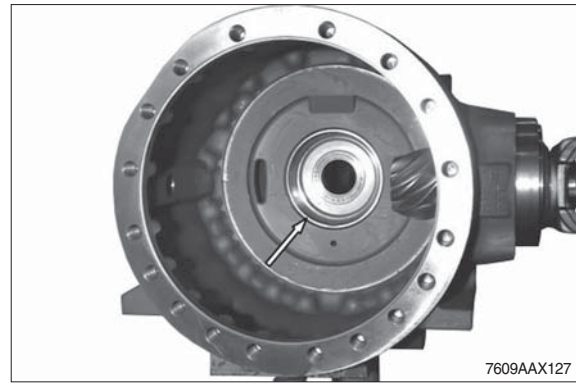
In accordance with this deviation, the required shims are allocated in the table below. (see parts manual for details)



- 1 Axle housing
- 2 Shim (crown wheel side)
- 3 Shim (differential carrier side)
- 4 Axle housing

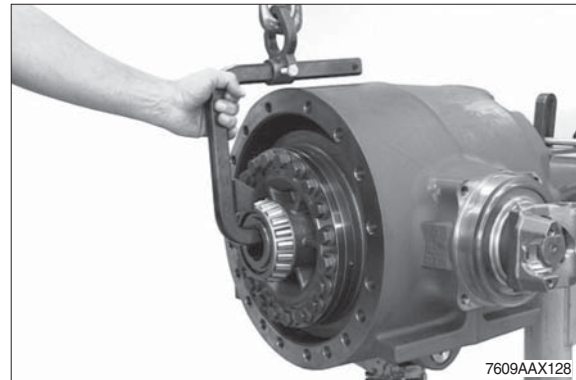
| Shims for differential | | | | | |
|--|------------|------------|------------|------------|------------|
| Crown wheel marking | | - 20 | - 10 | - | 10 |
| Deviation | | - 0.2 | - 0.1 | 0 | 0.1 |
| Shim Differential cage side Shim thickness | Front axle | 0.8 | 0.9 | 1.0 | 1.1 |
| | Rear axle | 0.7 | 0.8 | 0.9 | 1.0 |
| Shim | Front axle | ZGAQ-04167 | ZGAQ-04168 | ZGAQ-04169 | ZGAQ-04170 |
| Shim Hydraulic lock differential | Rear axle | ZGAQ-04367 | ZGAQ-04167 | ZGAQ-04168 | ZGAQ-04169 |
| Shim Conventional, L/slip differential | Rear axle | ZGAQ-04368 | ZGAQ-03896 | ZGAQ-03897 | ZGAQ-03898 |
| Shim Crown wheel side Shim thickness | Front axle | 1.2 | 1.1 | 1.0 | 0.9 |
| | Rear axle | 1.3 | 1.2 | 1.1 | 1.0 |
| Shim | Front axle | ZGAQ-04171 | ZGAQ-04170 | ZGAQ-04169 | ZGAQ-04168 |
| | Rear axle | ZGAQ-04368 | ZGAQ-03900 | ZGAQ-03899 | ZGAQ-03898 |

- ⑩ Insert the determined shim (e.g. $s = 0.9 \text{ mm}$) into the hole of the axle housing and adjust the bearing outer ring (see arrow) until contact is obtained.

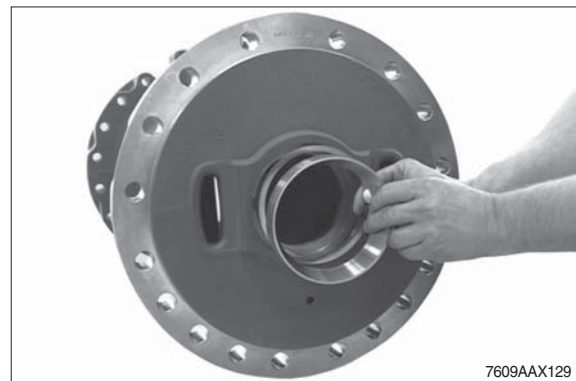


- ⑪ Cover some drive and coast flanks of the crown wheel with marking ink.
- Then insert the premounted differential into the axle drive housing.

Load carrying device 5870 281 083



- ⑫ Insert the determined shim (e.g. $s = 1.1 \text{ mm}$) into the hole of the axle housing and adjust the bearing outer ring (see arrow) until contact is obtained.

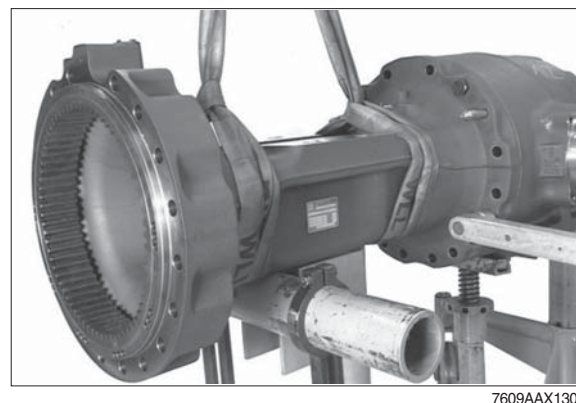


- ⑬ Mount two locating pins and bring the axle housing into contact position with the axle drive housing by means of the lifting device.

Locating pins 5870 204 024

Then preliminarily fix the axle housing with 4 hexagon screws.

- Tightening torque (M20/10.9) :
 $57.1 \text{ kgf} \cdot \text{m}$ ($413 \text{ lbf} \cdot \text{ft}$)



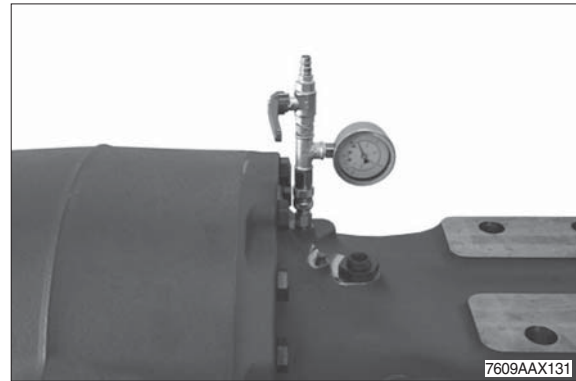
- ※ Preliminarily mount the axle housing without O-ring.

Leakage test of lock

- ② Pressurize the lock ($p = 1 \text{ bar}$), close shut-off valve and remove air line.

▲ No noticeable pressure loss is allowed to occur within 10 sec.

※ This operation is only necessary for hydraulic lock differential (option).

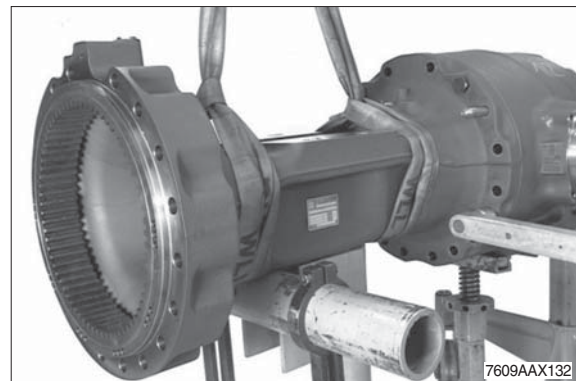


- ② By rotating the input flange, roll crown wheel over the input pinion in both directions several times.

Then remove the axle housing again and lift the differential out of the axle drive housing.

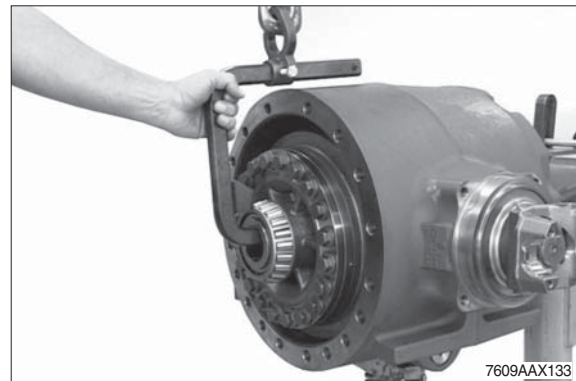
Compare the obtained contact pattern.

▲ In case of any contact pattern deviation, a measuring error was made when determining the shim (AX115), which must be corrected by all means.



- ② After the contact pattern check insert the differential again into the axle drive housing.

Load carrying device 5870 281 083

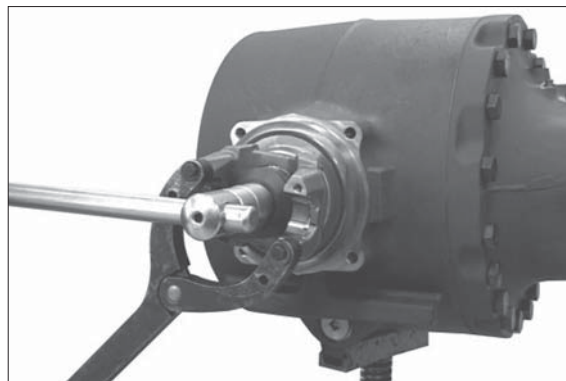


Reassembly of shaft seal (figure AX134~136)

- ㉓ Loosen the slotted nut and pull the input flange from the input pinion.

Slotted nut wrench 5870 401 139

Clamping device 5870 240 002



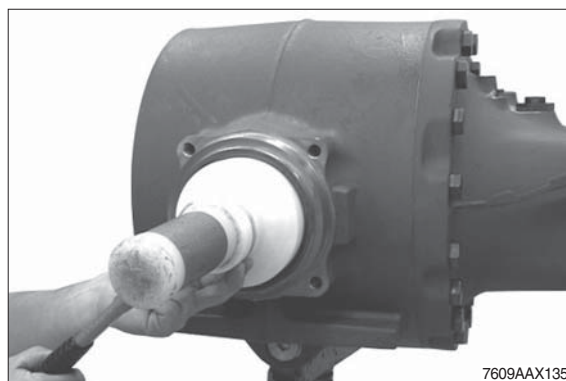
7609AAX134

- ㉔ Mount the shaft seal with the seal lip showing to the oil chamber.

Driver tool 5870 048 233

- ※ The exact installation position of the shaft seal is obtained when using the specified driver tool.

- ※ Wet the outer diameter of the shaft seal with spirit directly before installation and fill the space between seal and dust lip with grease.



7609AAX135

- ㉕ Insert input flange and finally tighten by means of disk and slotted nut.

- Tightening torque :

122 kgf · m (885 lbf · ft)

Slotted nut wrench 5870 401 139

Clamping device 5870 240 002

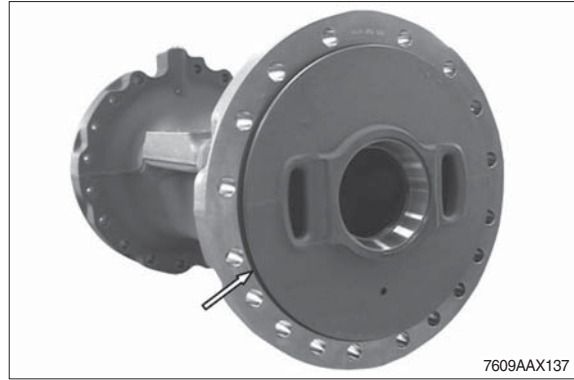
- ※ Cover the thread of the slotted nut with loctite (type no. : 262).



7609AAX136

(7) Reassembly axle housing

- ① Grease O-ring (see arrow) and insert it into the axle housing.

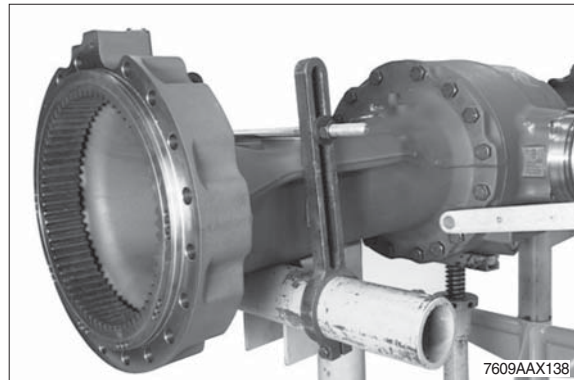


- ② Mount two locating pins and bring the axle housing into contact position with the axle drive housing by using the lifting device.

Then fix the axle housing by means of hexagon screws.

- Tightening torque (M20/10.9) :
57.1 kgf · m (413 lbf · ft)

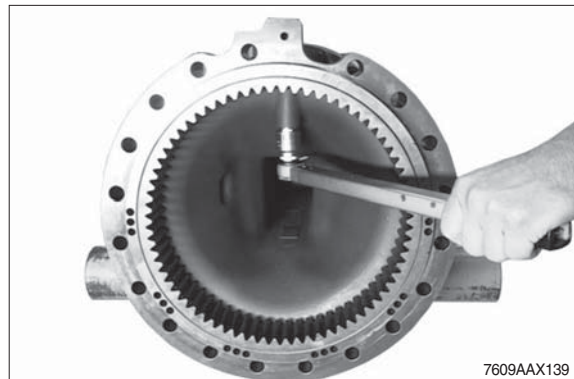
Locating pins 5870 204 024



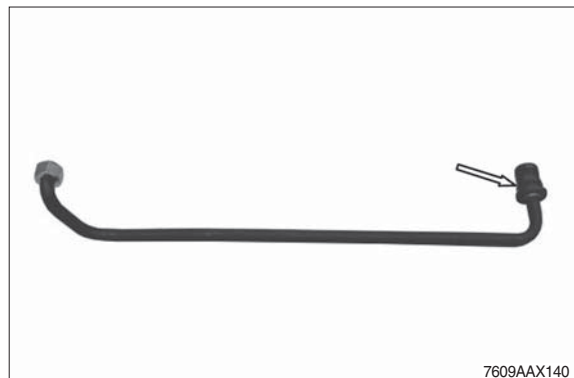
- ※ After assembling the axle housing secure the axle with clamping brackets.

- ③ Mount fitting.

- Tightening torque :
3.67 kgf · m (26.6 lbf · ft)

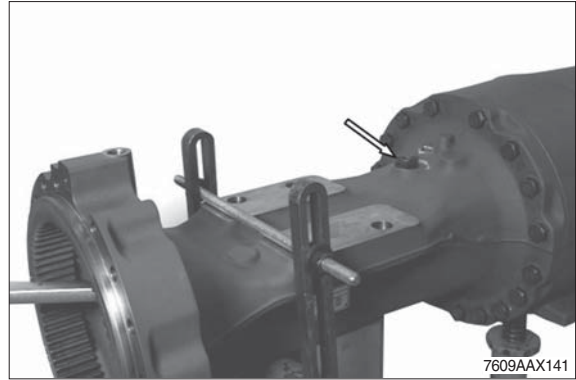


- ④ Grease O-ring and insert it into the annular groove of the brake tube (see arrow).



- ⑤ Mount brake tube with threaded connection and hexagon nut (see arrow).

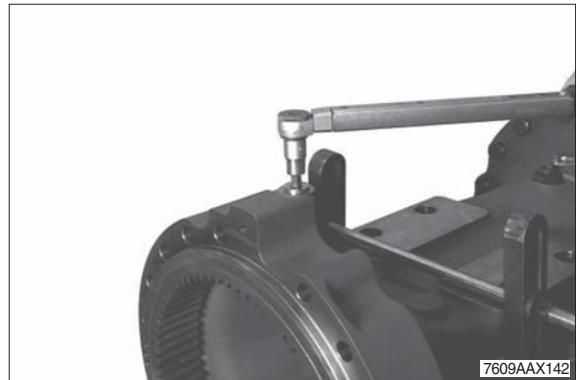
· Tightening torque :
10.2 kgf · m (73.8 lbf · ft)



- ⑥ Provide screw plug with a new O-ring and fit it.

Flush mount slotted pins.

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



(8) Reassembly output and brake

- ① Pull in wheel stud into the output shaft until contact is obtained.

Wheel stud puller-basic tool

5870 610 001

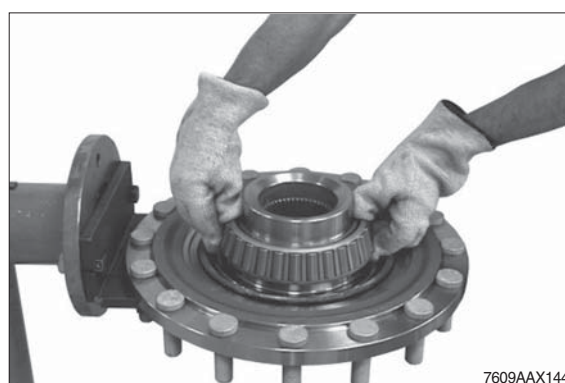
Insert (M22 × 1.5)

5870 610 002

Special tool may only be used for repair solution when exchanging individual wheel studs with mounted output shaft. When using a new output shaft, mount the wheel studs with the press.



- ② Heat tapered roller bearing and insert it into the output shaft until contact is obtained.

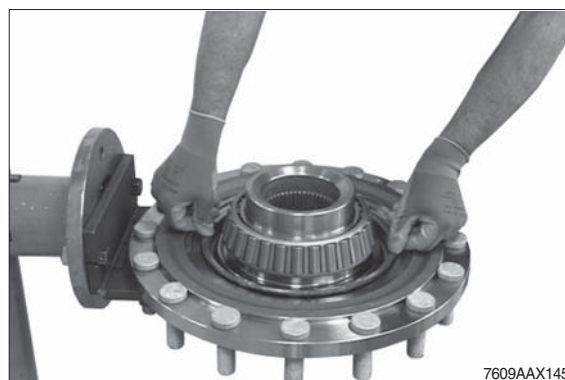


- ③ Wet O-ring of slide ring seal and locating hole with spirit.

Snap **new** slide ring seal (part 1) into the output shaft.

Then mount **new** slide ring seal (part 2) accordingly into the brake housing.

※ For the installation position of the seal please also refer to sketch, page 3-243.



※ The surface of the slide ring seal may not have any grooves, scratches or other types of damage. Take care that the sealing surface is parallel to the housing face. The O-rings must be mounted evenly into the locating hole and must not bulge out of the hole.

▲ **Risk of injury-Metal rings have extremely sharp edges.**
Wear protective gloves.



- ④ Insert both bearing outer rings (see arrows) into the brake housing until contact is obtained.



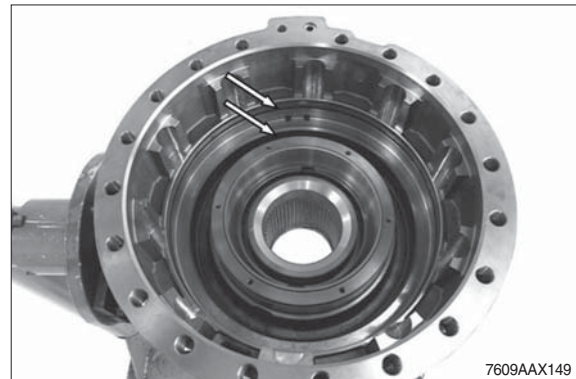
- ⑤ Insert the premounted brake housing by means of the lifting device over the output shaft until contact is obtained.

- ※ Before clamping the seal rings (slide ring seal) to installation dimension, clean the sliding surfaces and apply an oil film. We recommend to use a leather cloth soaked with oil.



- ⑥ Insert back-up rings and grooved rings into the annular grooves of the brake housing (see arrows).

- ※ Pay attention to the installation position; please also refer to sketch, page 3-243.



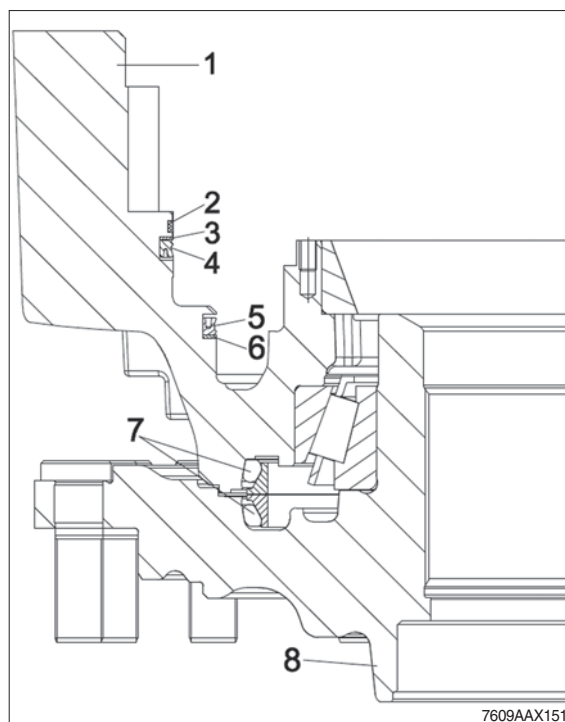
- ⑦ Clean the annular groove of the brake housing with spirit.

Then insert the guide ring into the annular groove (see also the following sketch) and fix it with loctite (type No. : 415) at its extremities (see arrows).

- ※ The full circumference of the guide ring must be in an exact contact position.
- ※ Upon installation the orifice of the guide ring must show upwards (12 o'clock).



- 1 Brake housing
- 2 Guide ring
- 3 Back-up ring
- 4 Grooved ring
- 5 Grooved ring
- 6 Back-up ring
- 7 Slide ring seal
- 8 Output shaft



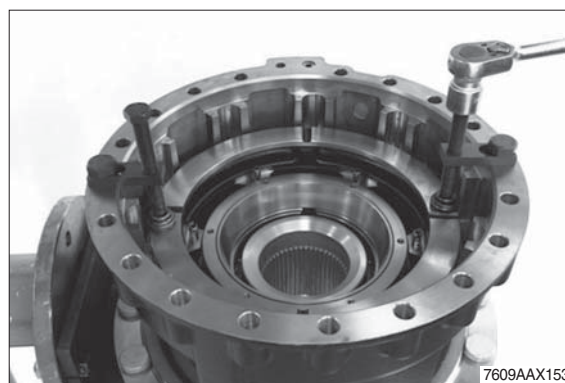
- ⑧ Flush-mount the slotted pins (6EA) into the holes of the piston.



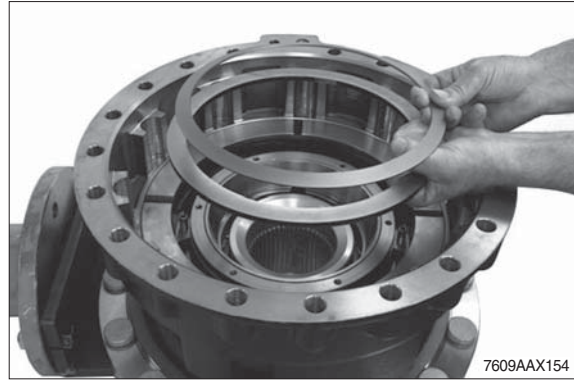
- ⑨ Insert the piston into the brake housing and carefully install with the fixing device until contact is obtained.

Fixing device AA00 680 530

- ※ Sufficiently oil seal surface of piston/back-up rings, grooved rings and guide ring.

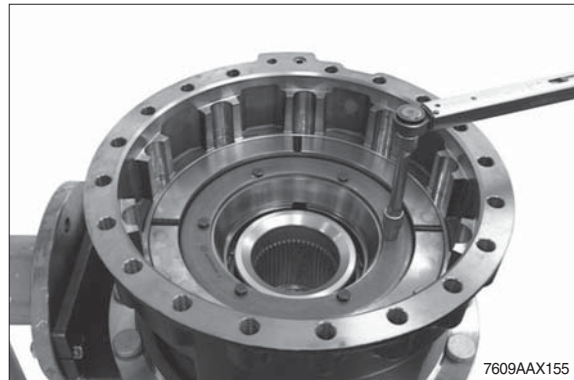


- ⑩ Insert disk and cup spring with the convex side showing upwards into the piston.



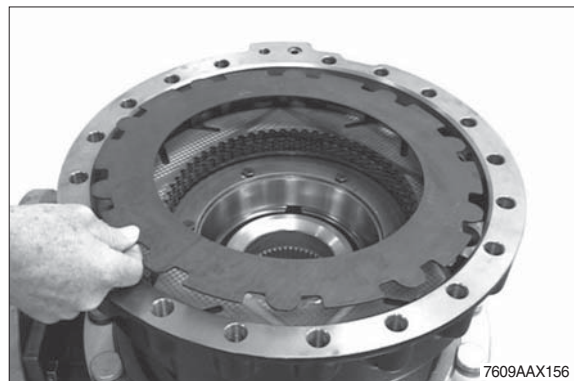
- ⑪ Insert cover and fix it by means of hexagon screws.

· Tightening torque (M8/10.9) :
3.47 kgf · m (25.1 lbf · ft)

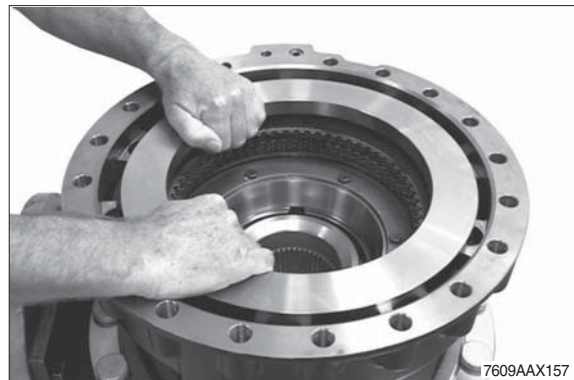


- ⑫ Mount outer and inner disks.

※ For the number of disks and the disk arrangement please refer to the relating parts manual.

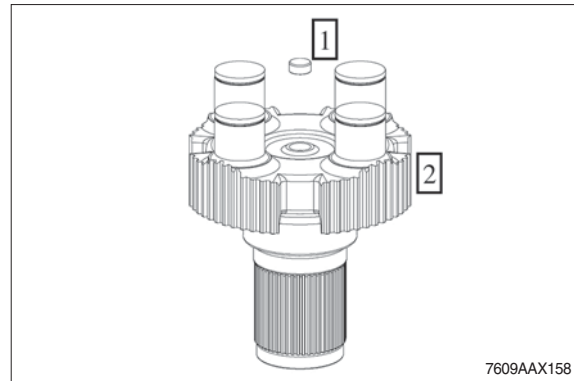


- ⑬ Insert end plate.



- ⑭ Press stop bolt into the planetary carrier until contact is obtained.

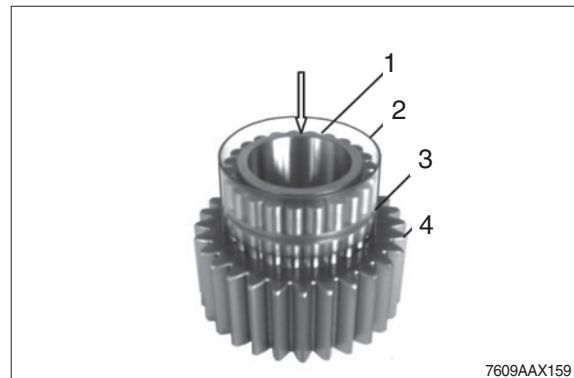
- 1 Stop bolt
- 2 Planetary carrier



- ⑮ Insert the cylindrical roller bearing into the planetary gear – for this purpose press the cylindrical roller bearing through the packaging sleeve until the snap ring engages into the annular groove of the planetary gear.

※ Use packaging sleeve to facilitate assembly.

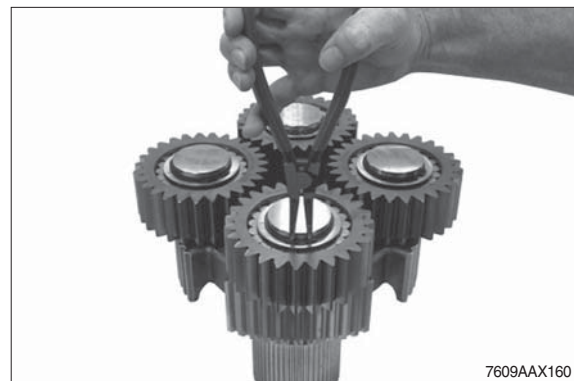
- 1 Cylindrical roller bearing
- 2 Packaging sleeve
- 3 Snap ring
- 4 Planetary gear



- ⑯ Heat bearing inner rings and insert the premounted planetary gears with large radius facing the planetary carrier (downwards) until contact is obtained.

※ Adjust bearing inner rings after cooling down.

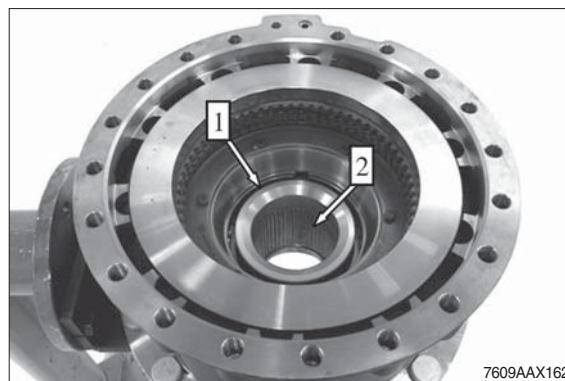
Then fix planetary gears by means of retaining rings.



- ⑰ Heat tapered roller bearing and install it to the planetary carrier until contact is obtained.

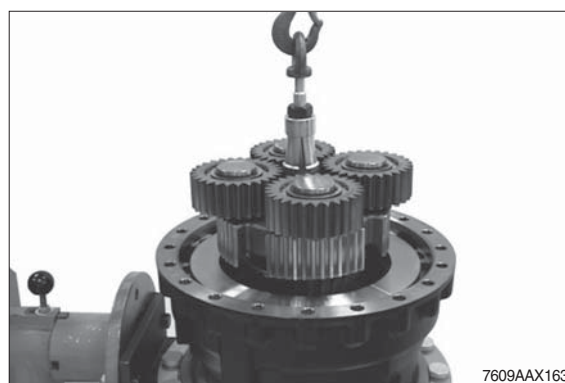


- ⑮ Wet front face (contact face bearing inner ring, arrow 1) and profile (teeth, arrow 2) in the output shaft with anti-corrosive agent.



- ⑰ Align disk package centrally and radially.
Then insert the planetary carrier by means of the lifting device into the teeth of the output shaft.

Inner extractor 5870 300 017
Eye nut 5870 204 076

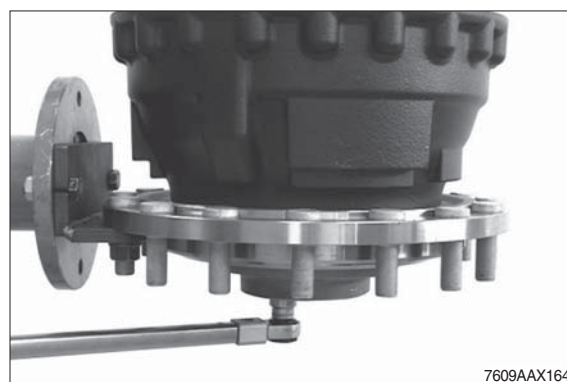


Setting of gap width output shaft / planetary carrier

- ⑱ Bring planetary carrier with measuring disk and three old locking screws, which were removed during disassembly, into contact position.

· Tightening torque :
20.4 kgf · m (148 lbf · ft)

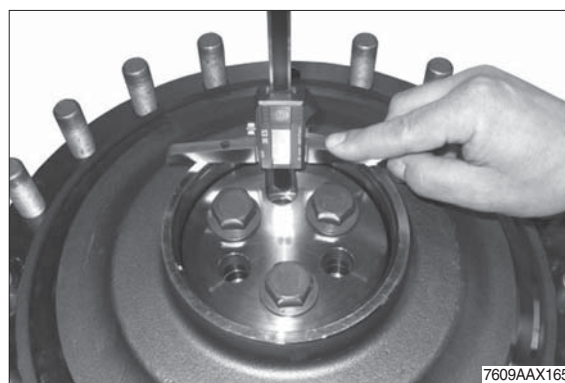
Measuring disk AA00 360 730



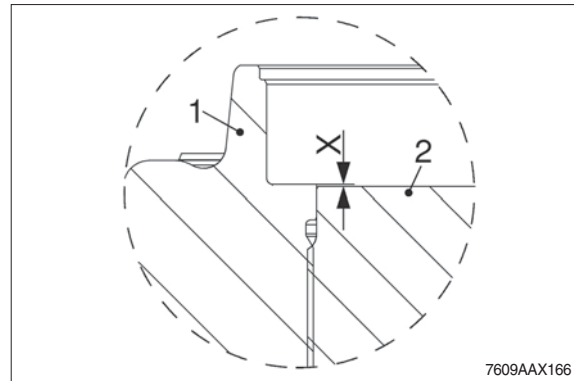
- ⑲ Pivot output 180° and measure gap width from the output shaft to the planetary carrier (see also subsequent sketch).

Gap width e.g. 0.21 mm

Then remove the locking screws and the measuring disk again.



- 1 Planetary carrier
- 2 Output shaft
- X Gap width

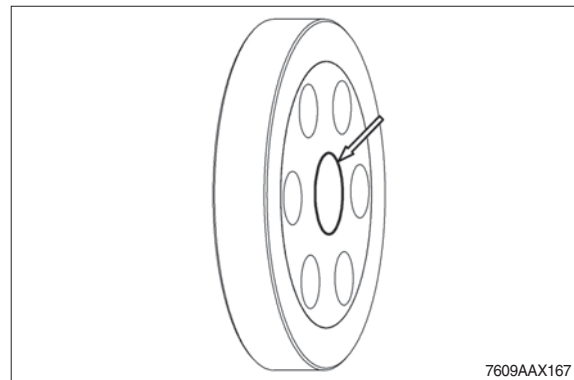


② Select the cover (optional) on the basis of the following table.

| Determined gap width (Delta) | Offset to be used on the cover | P/No. |
|------------------------------|--------------------------------|------------|
| 0.30~0.24 mm | 0.13 ± 0.01 mm | ZGAQ-04137 |
| 0.239~0.18 mm | 0.07 ± 0.01 mm | ZGAQ-04370 |
| 0.179~0.10 mm | 0.0 mm | ZGAQ-03909 |

※ Cover (ZGAQ-04370) has an offset of 0.07 mm on one side and an offset of 0.13 mm on the other side.

※ Offset 0.13 mm is visually marked with an annular groove (see arrow).

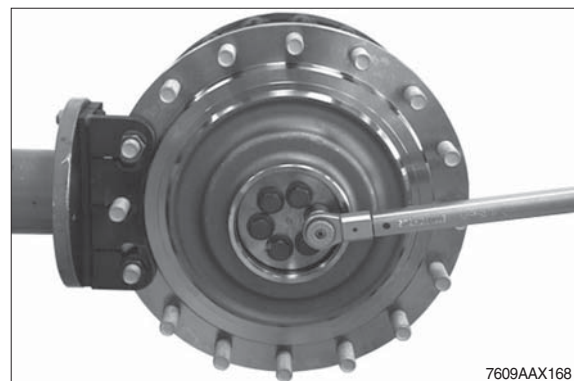


③ Insert the cover with the offset e.g. 0.07 mm showing to the planetary carrier and tighten with **new** locking screws.

※ When using the cover with offset 0.07 mm, the groove (figure AX167) must be visible when the cover is installed.

※ Tighten locking screws successively with a tightening torque of 20.4 kgf · m (148 lbf · ft).

Then retighten the locking screws successively with a tightening torque of 51 kgf · m (369 lbf · ft).



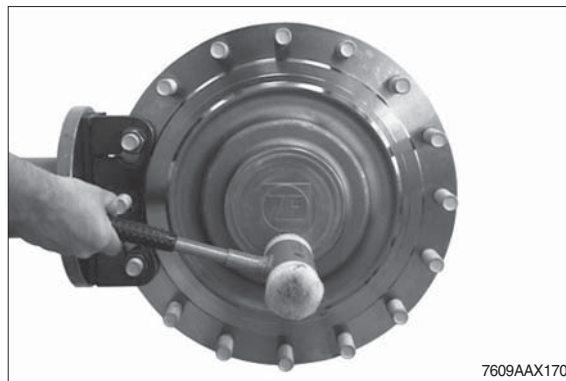
④ Install O-ring (see arrow 1) to the cover.

Then wet contact face (arrow 2).

※ Use new cover and O-ring.



- ②⑤ Insert the cover into the output shaft until contact is obtained.



Set the axial play of the sun gear shaft 0.5~2.0 mm

- ②⑥ Determine dimension I, from the mounting face of the brake housing to the front face of the stop bolt.

Dimension I e.g.

Front axle 40.80 mm

Rear axle 19.75 mm

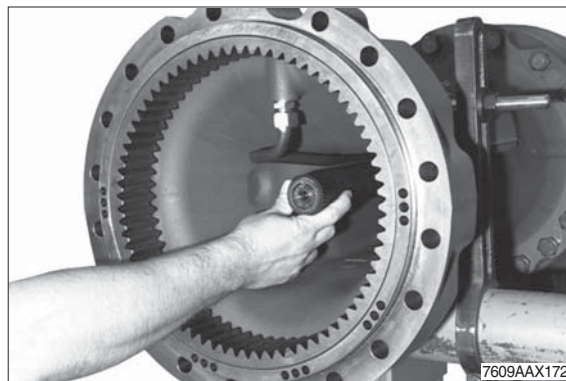
Gauge blocks 5870 200 066

Straightedge 5870 200 022

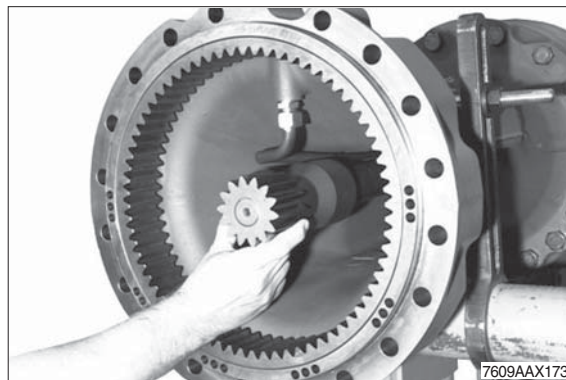


- ②⑦ Insert stub shaft into the teeth of the axle bevel gear until contact is obtained.

※ Pay attention to the installation position ;
mount the stub shaft with the long teeth
showing to the differential.



- ②⑧ Insert the sun gear shaft until contact is obtained.



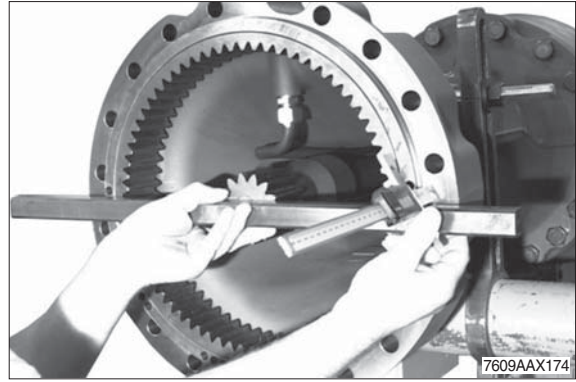
- ② Measure dimension II, from the front face of the sun gear shaft to the mounting surface of the axle housing.

Dimension II e.g.

Front axle 38.20 mm

Rear axle 17.15 mm

Straightedge 5870 200 022



CALCULATION EXAMPLE :

Front axle

Dimension I 40.80 mm

Dimension II - 38.20 mm

Difference 2.60 mm

Required axial play e.g. ... - 1.00 mm

Difference = shim e.g. s = 1.60 mm

Rear axle

Dimension I 19.75 mm

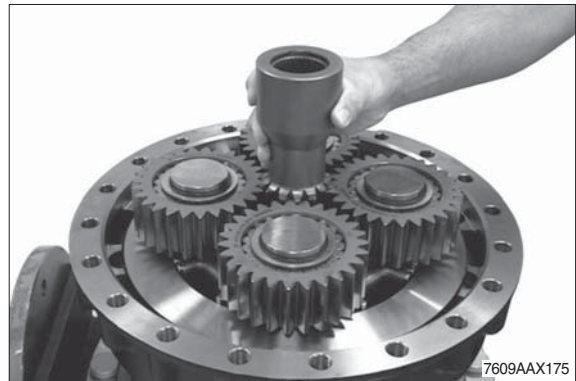
Dimension II - 17.15 mm

Difference 2.60 mm

Required axial play e.g. ... - 1.00 mm

Difference = shim e.g. s = 1.60 mm

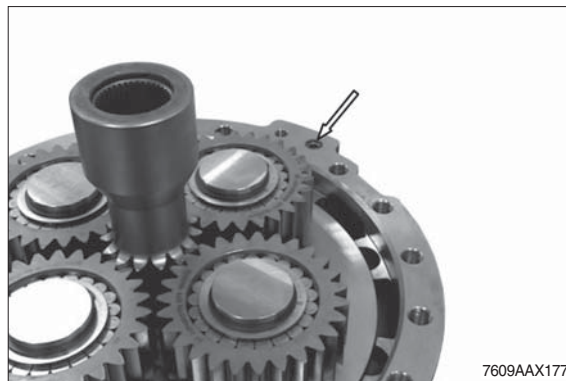
- ③ Insert sun gear shaft into the planetary carrier.



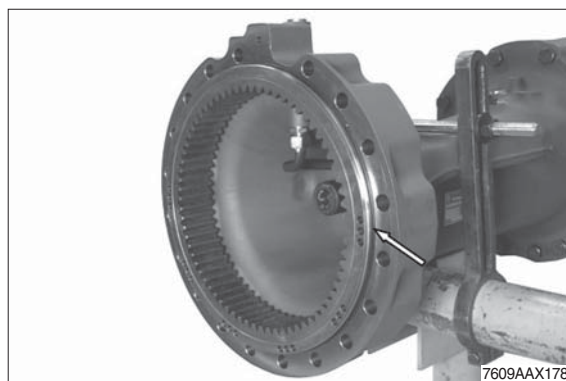
- ③ Fix determined shim (s) e.g. s = 1.60 mm with grease into the sun gear shaft.



- ③ Fix O-ring (see arrow) with grease into the countersink of the brake housing.



- ③ Grease O-ring (see arrow) and install it to the axle housing.



- ③ Mount two adjusting screws and use the lifting device to bring the output into contact position with the axle housing.

Then fix the output by means of hexagon screws.

· Tightening torque :

Front axle (M20/10.9)

57.1 kgf · m (413 lbf · ft)

Rear axle (M18/10.9)

39.8 kgf · m (288 lbf · ft)

Adjusting screws

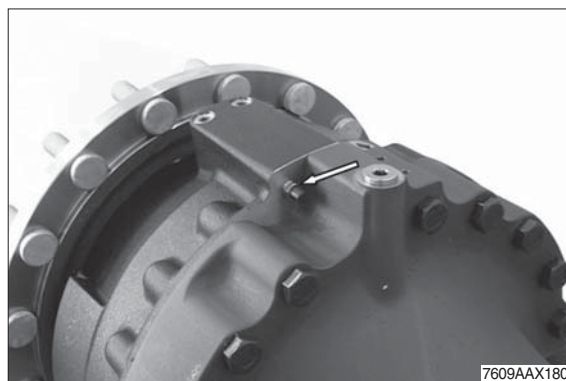
Front axle (M20) 5870 204 024

Rear axle (M18×15) 5870 204 029

Load carrying device 5870 281 043

※ Fix load carrying device with wheel stud.

- ③ Mount breather (see arrow).



Check brake hydraulics for leakages

- ※ Before starting the test, completely breathe the brake hydraulics.

Then pressurize the brake temporarily (5EA) with $p = 100$ bar max.

High-pressure test :

Build up test pressure $p = 100$ - 10 bar max and close connection to HP pump via shut-off valve.

A pressure drop of max 2 % (2 bar) is permissible during a 5-minute testing time.

Low-pressure test :

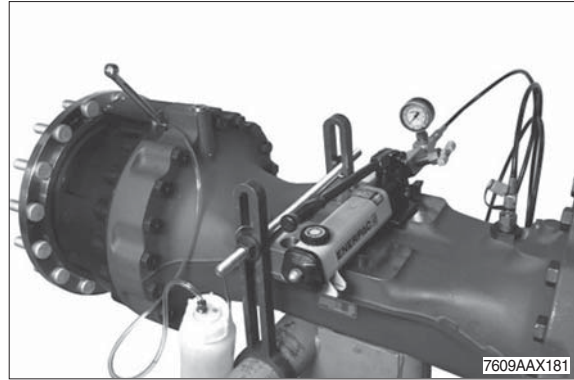
Reduce test pressure $p = 5$ bar and close shut-off valve.

No pressure drop is allowed during a 5-minute testing time.

Test media :

Engine oil SAE 10W

| | |
|-----------------------|--------------|
| HP pump | 5870 287 007 |
| Clutch | 0501 207 939 |
| Reduction (M18 × 1.5) | 5870 950 161 |
| Oil collector bottle | 5870 286 072 |



Check operability of hydraulic lock differential (opt)

Build up pressure $p = 20$ bar max and close connection to HP pump via shut-off valve.

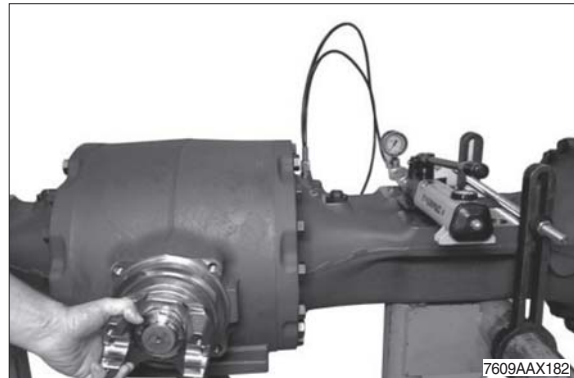
Lock on :

When rotating the input flange, both outputs must have the same direction of rotation.

Lock off :

When rotating the input flange, one side has no movement or has the opposite direction of rotation.

Prior to putting the axle into operation, fill it with oil according to the related lubrication and maintenance instructions.



SECTION 4 BRAKE AND FAN SYSTEM

| | | |
|---------|--|------|
| Group 1 | Structure and Function | 4-1 |
| Group 2 | Operational Checks and Troubleshooting | 4-29 |
| Group 3 | Tests and Adjustments | 4-36 |
| Group 4 | Disassembly and Assembly | 4-38 |

SECTION 4 BRAKE AND FAN SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

The variable displacement piston pump supplies the hydraulic oil that is required in order to operate the brake and the hydraulic fan system. Oil flows from pump to the cut-off valve.

The cut-off valve controls the flow of oil from the pump to the brake accumulators and also controls the flow of oil to the hydraulic fan motor.

The cut-off valve contains a priority valve. The brake system has priority. The oil flows to the brake accumulators while the accumulators are charged. After the accumulators are fully charged, the oil then flows to the hydraulic fan system.

The accumulator has pre-charged gas and an inlet check valve to maintain a pressurized volume of oil for reserving brake system.

The oil through the accumulator flows to the brake valves. The brake valve is a closed center design, dual circuit operated by a pedal.

The front and rear brakes will operate simultaneously with only one brake pedal depressed.

The hydraulic fan system is used to meet the cooling requirements. The hydraulic fan system controls the fan speed through the pump output pressure. The desired pressure level can be set by varying the solenoid current.

The hydraulic fan system contains directional valve that reverses the direction of fan.

The brake and hydraulic fan system contains the following components :

- Fan & brake pump
- Cut-off valve
- Brake valve
- Accumulators
- Pressure sensors and switch
- Fan motor
- Directional valve

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.

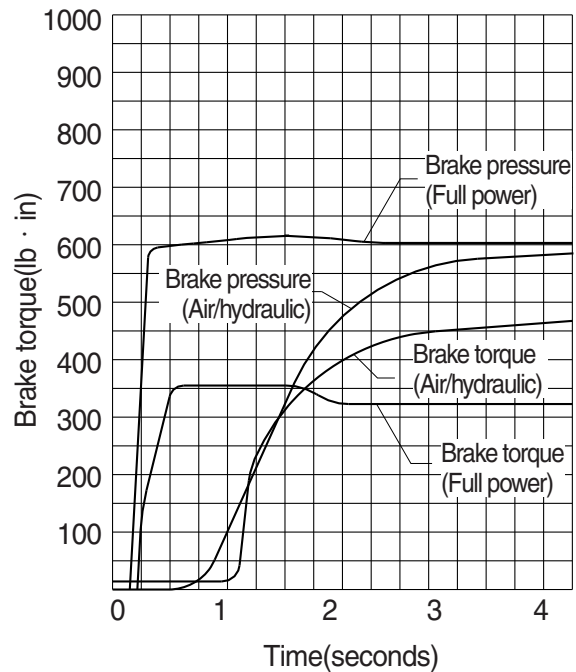
This is referred to as brake pressure modulation.

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.

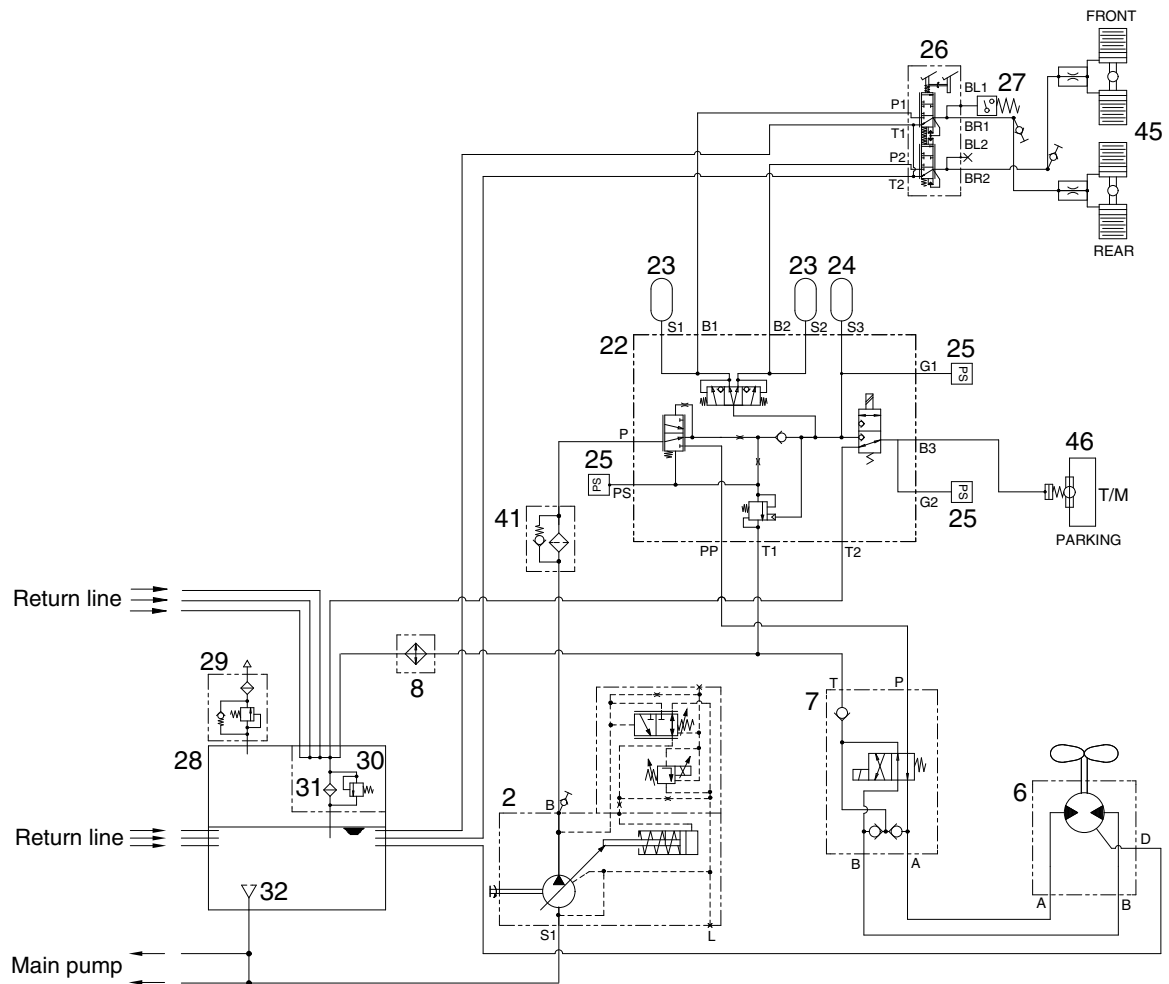
Because these systems are closed center, by using a properly sized accumulator, emergency power-off braking that is identical to power-on braking can be achieved. These systems can be either dedicated, where the brake system pump supplies only the demands of the brake system or non-dedicated, where the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

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



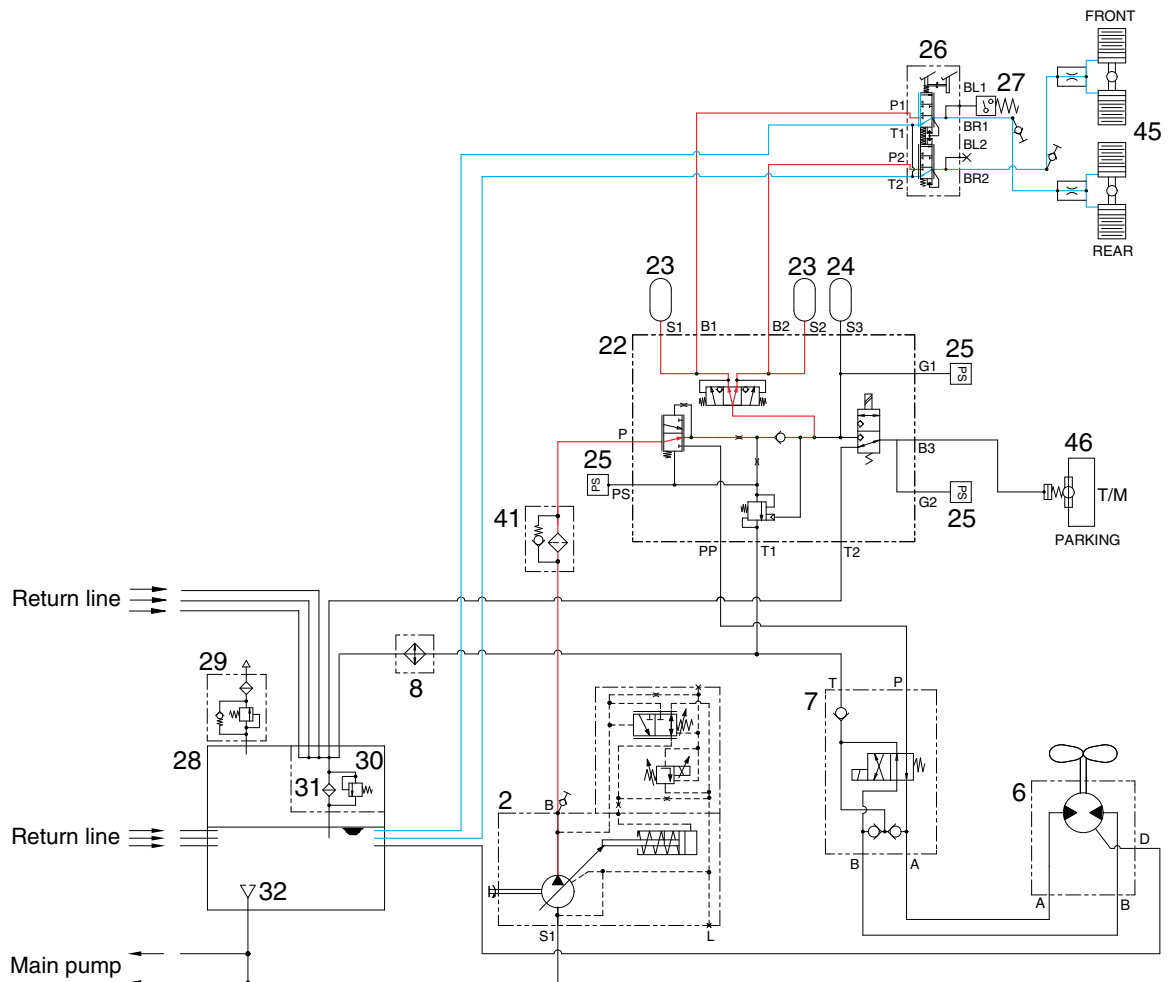
2. HYDRAULIC CIRCUIT



970A4BS01

- | | | | | | |
|----|-------------------|----|-----------------|----|----------------------|
| 2 | Fan & brake pump | 24 | Accumulator | 30 | Return filter |
| 6 | Fan motor | 25 | Pressure sensor | 31 | Bypass valve |
| 7 | Directional valve | 26 | Brake valve | 32 | Strainer |
| 8 | Oil cooler | 27 | Pressure switch | 41 | Filter |
| 22 | Cut-off valve | 28 | Hydraulic tank | 45 | Axle |
| 23 | Accumulator | 29 | Air breather | 46 | Parking brake at T/M |

1) SERVICE BRAKE RELEASED



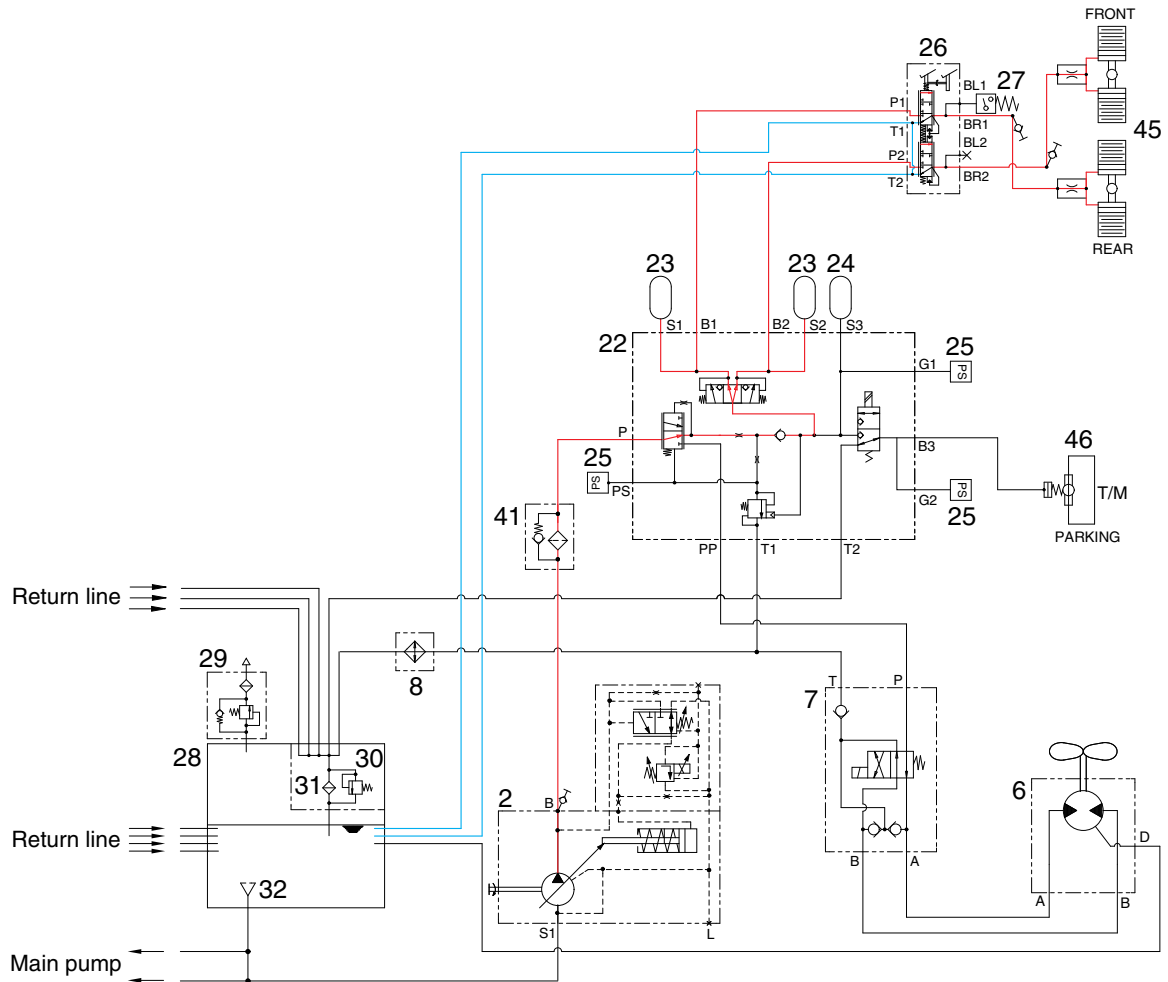
970A4BS02

When the pedal of brake valve (26) is released, the operating force is eliminated by the force of the spring, and the spool is returned.

When the spool moves up, the drain port is opened and the hydraulic oil in the piston of axles returns to the tank (28).

Therefore, the service brake is kept released.

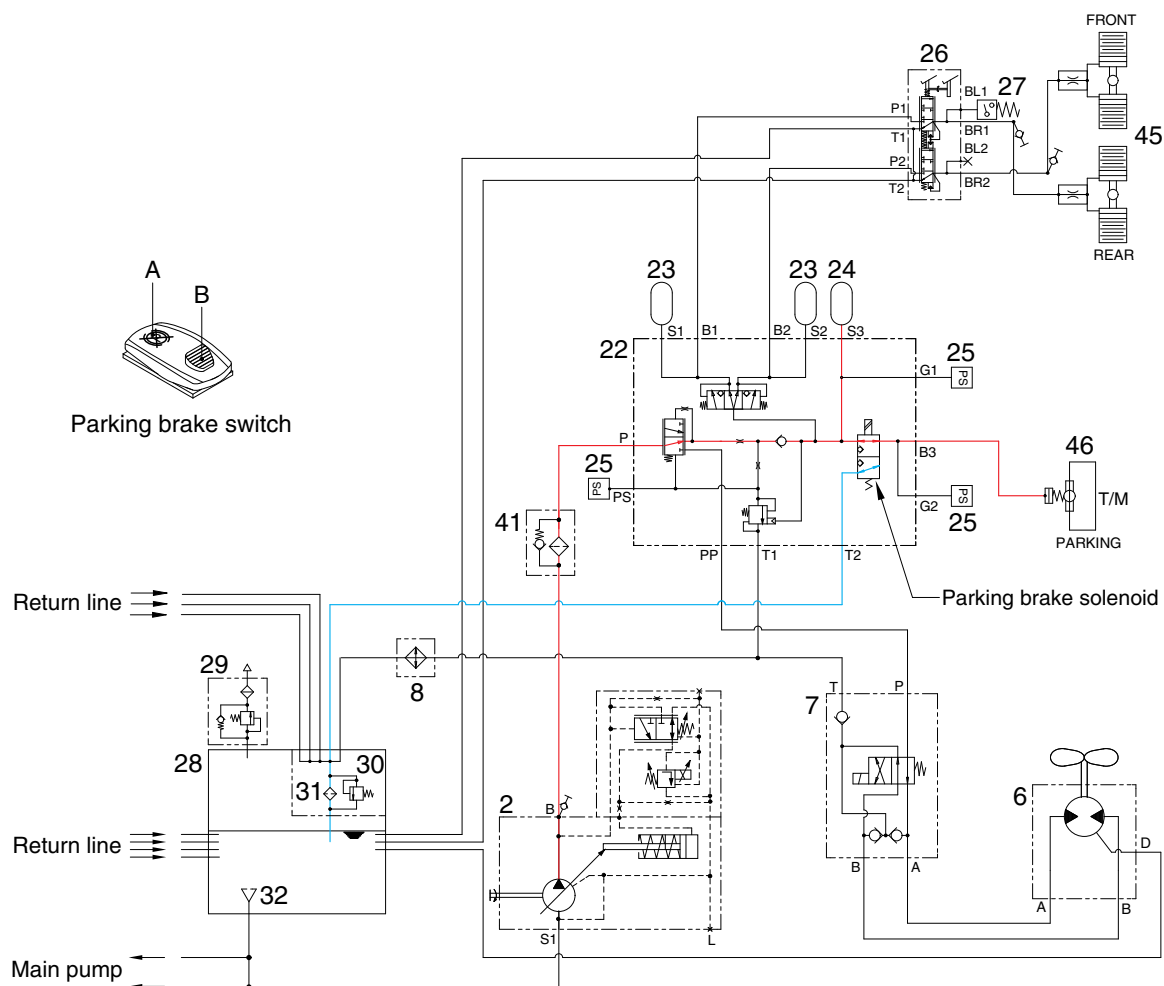
2) SERVICE BRAKE OPERATED



970A4BS03

When the pedal of brake valve (26) 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 (22) enters the piston in the front and rear axles. Therefore, the service brake is applied.

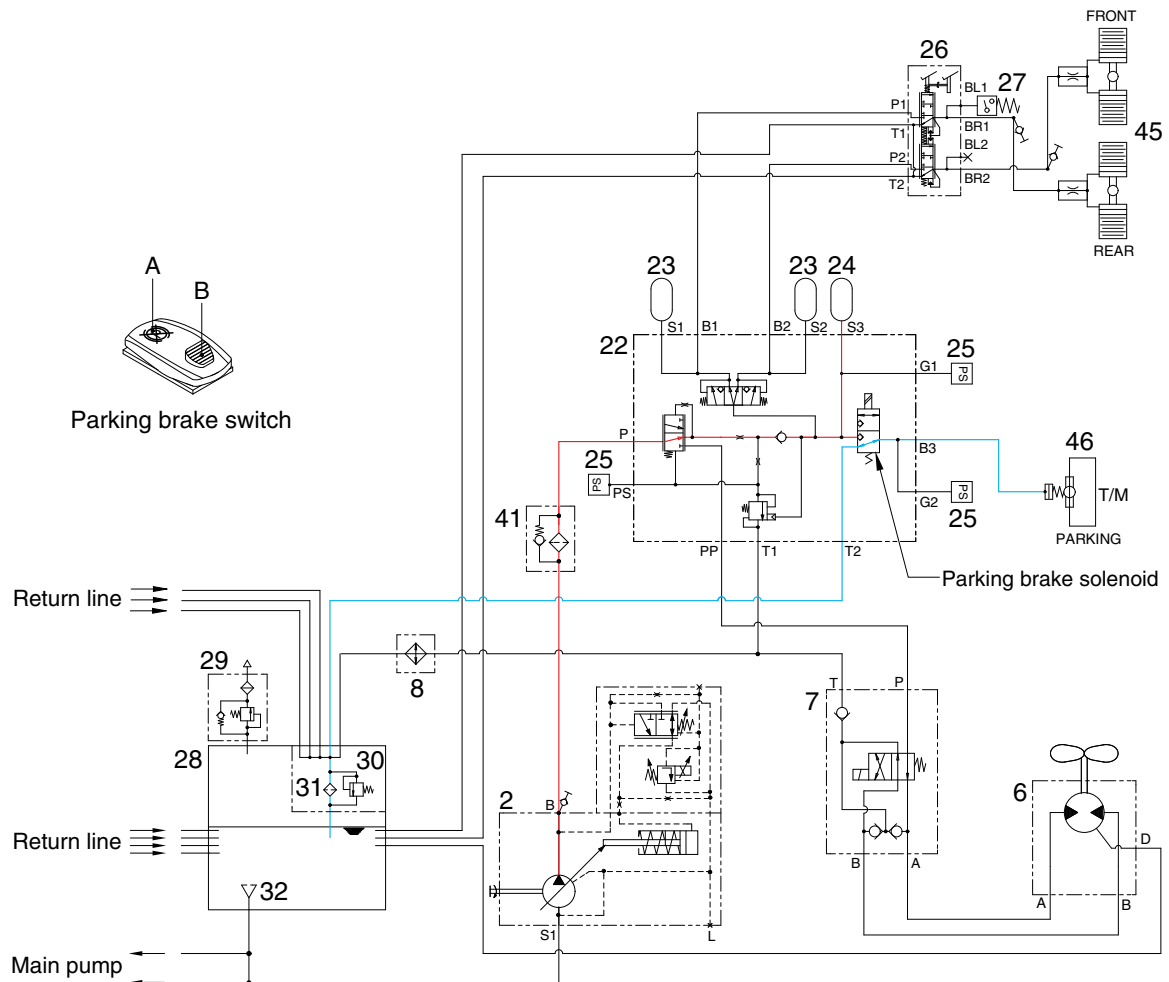
3) PARKING BRAKE RELEASED



970A4BS04

When the parking brake switch is pressed A 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 piston rod. This releases the 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

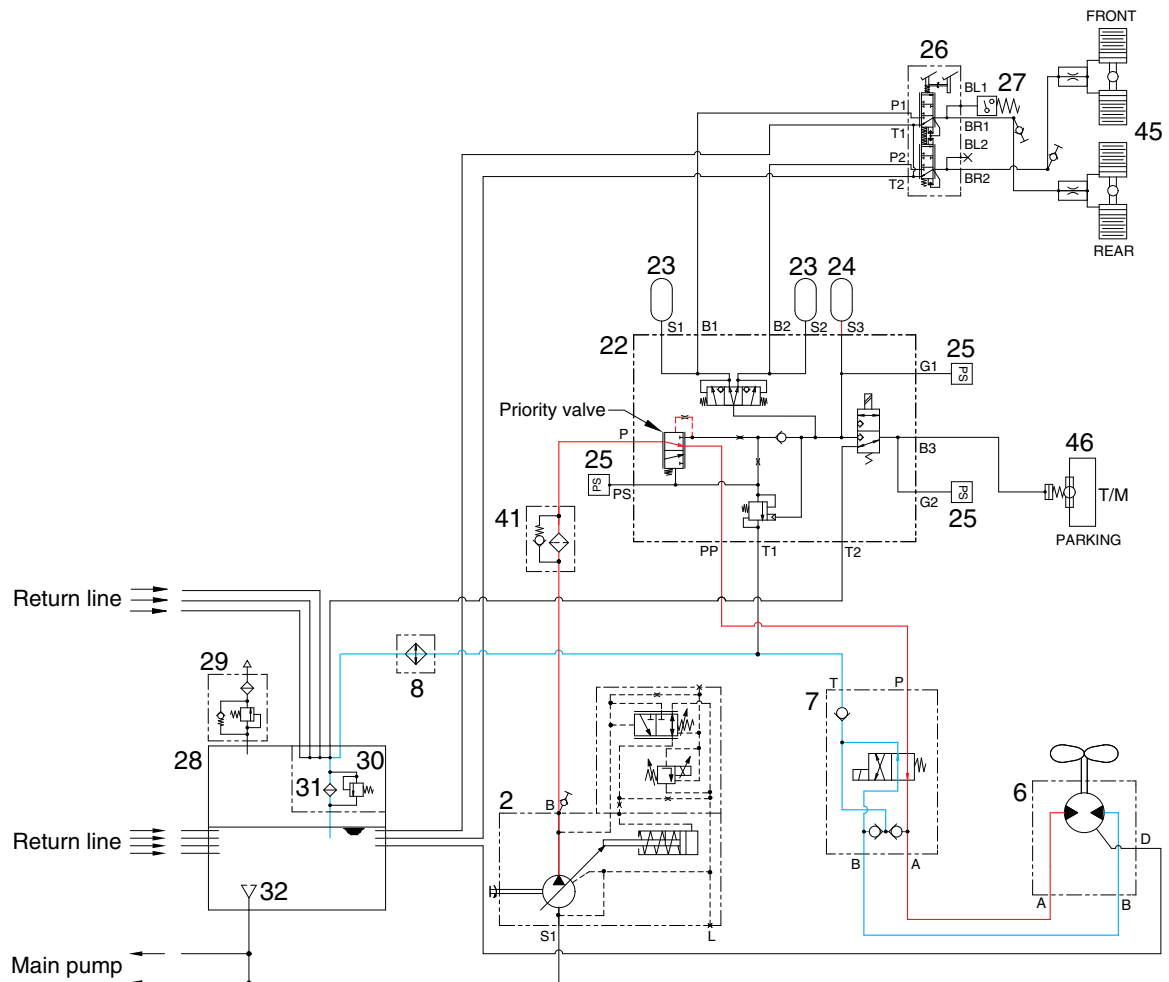


970A4BS05

When the parking brake switch is pressed B position, the solenoid valve is deenergized 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 rod is returned by the force of the spring, the parking brake is applied.

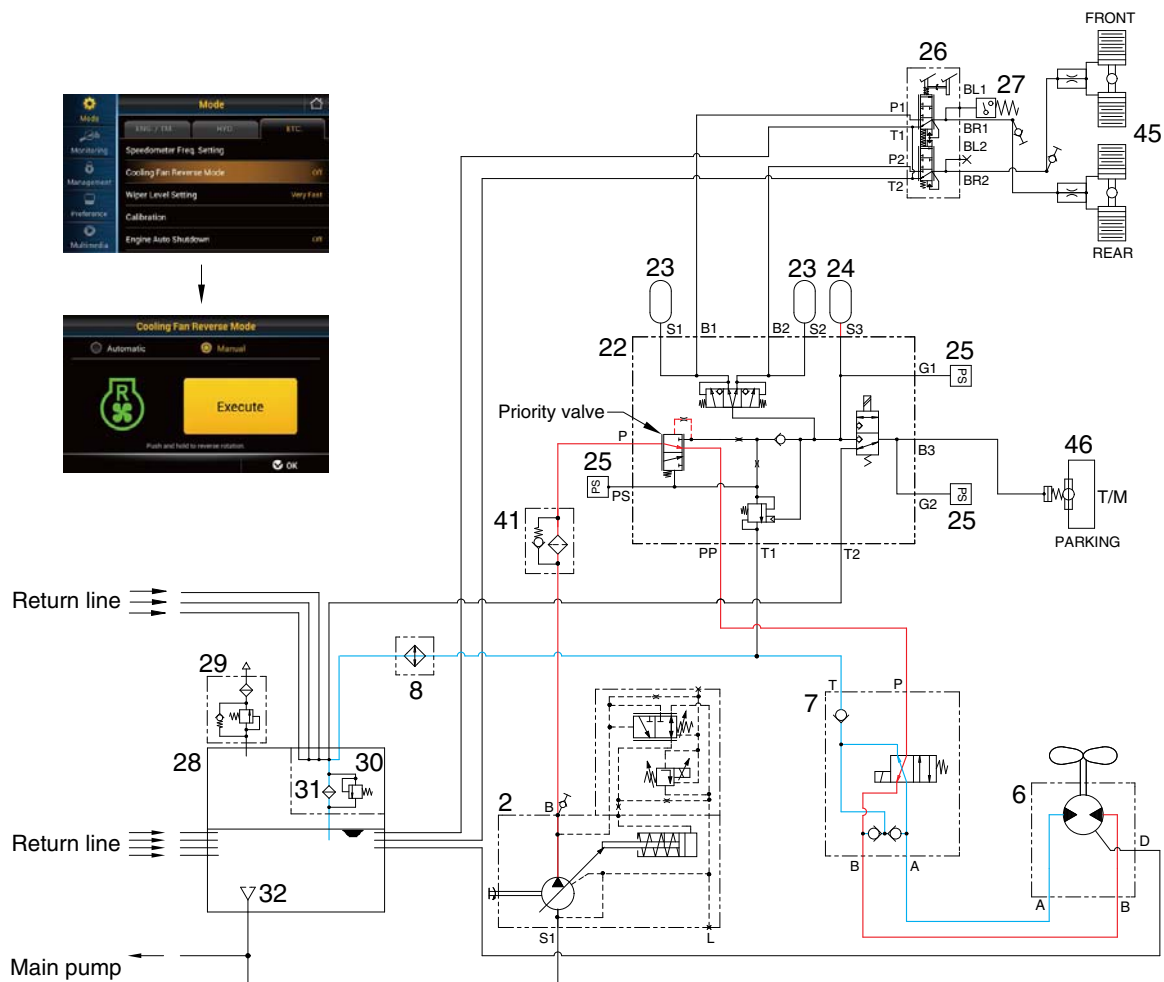
5) FAN MOTOR OPERATED



970A4BS06

When the brake accumulators are fully charged, the priority valve switches position and the oil is directed to hydraulic fan motor through directional valve (7). The flow of the oil causes fan motor (6) to rotate the fan blade. The rotation of the fan forces cool air to flow through the cooler.

6) DIRECTIONAL VALVE OPERATED

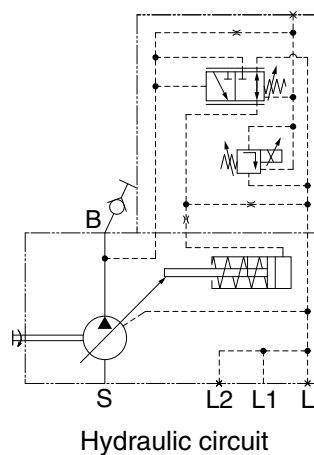
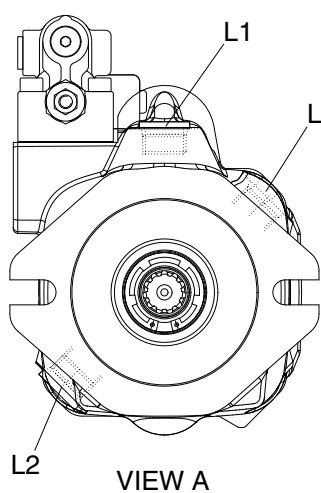
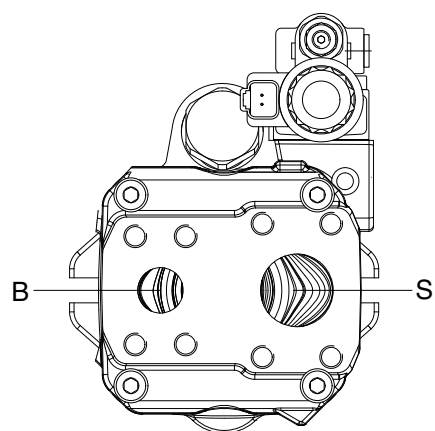
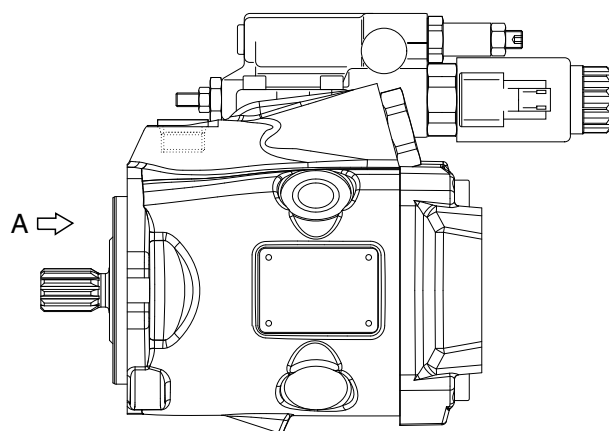


970A4BS07

When the cooling fan reverse mode is selected manual or automatic mode, the solenoid valve in the directional valve (7) is energized and the flow of the oil is changed. The rotation of the fan is reversed to clear the radiators.

3. FAN AND BRAKE PUMP

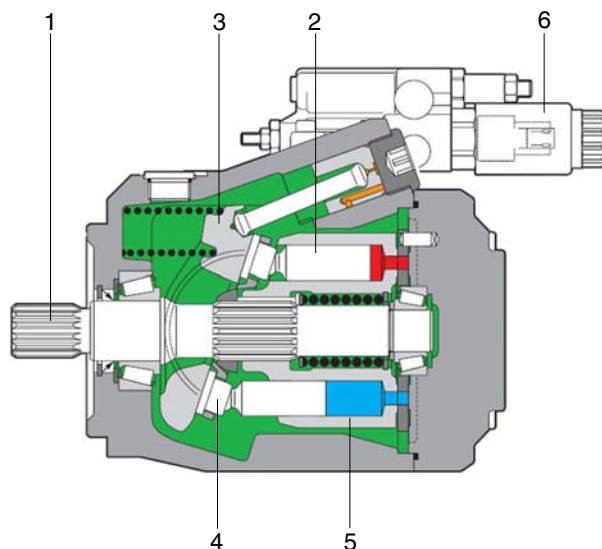
1) STRUCTURE



| Port | Port name | Port size |
|-----------|---------------|--------------|
| B | Delivery port | SAE 3/4" |
| S | Suction port | SAE 1 1/4" |
| L, L1, L2 | Drain port | 3/4-16UNF-2B |

7609A4BS30

2) OPERATION



7609A4BS31

The pump is a variable displacement piston pump. This pump has a maximum delivery pressure of 250 kgf/cm². The axial piston type pump is used to supply oil flow to the cut off valve. The oil is pressurized by the movement of rotary group in the pump.

When the engine is in operation, the drive shaft (1) is driven by the gears in the engine with rotary group. There are nine piston assemblies (2) in rotary group.

Each piston inside cylinder (5) is held against swashplate (3) by piston shoe (4). Swashplate can be any angle between the maximum angle and the neutral angle. The angle of swashplate determines the amount of oil that is pushed out of each cylinder.

The neutral angle is perpendicular with drive shaft (1). When swashplate(3) is at the neutral angle, pistons (2) do not move in and out of rotating cylinder. Therefore, no oil is drawn into the pump and no oil is pushed out of the pump. The pump has zero displacement and zero flow.

When swashplate (3) is at the maximum angle, pistons (2) move in and out of cylinder. The movement of the pistons allows the maximum amount of oil to be drawn into the cylinder. The pump will produce the maximum displacement.

The swashplate (3) angle is controlled by command current signal to control valve solenoid (6). The pump output pressure level can be set by the solenoid current. When the solenoid current signal drops toward a zero value, the pump output pressure level is the maximum.

※ FAN SYSTEM OPERATION

When the brake system pressure is below minimum pressure (125 ± 5 bar), it has the high priority than the fan system. Pump flow to the fan motor is blocked while brake system is charged.

However, The fan system has controlled pump when the brake system pressure is charged.

The fan speed solenoid valve (6) controls the pressure (fan speed) of pump when the brake system is fully charged.

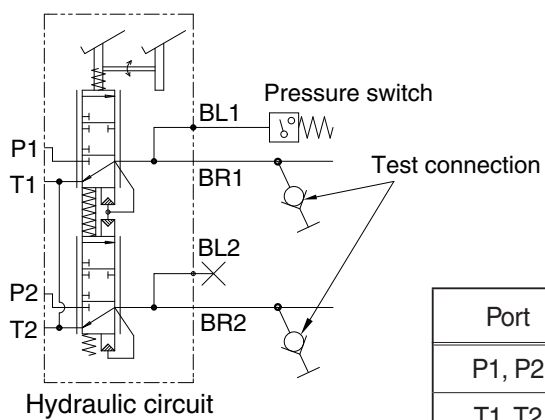
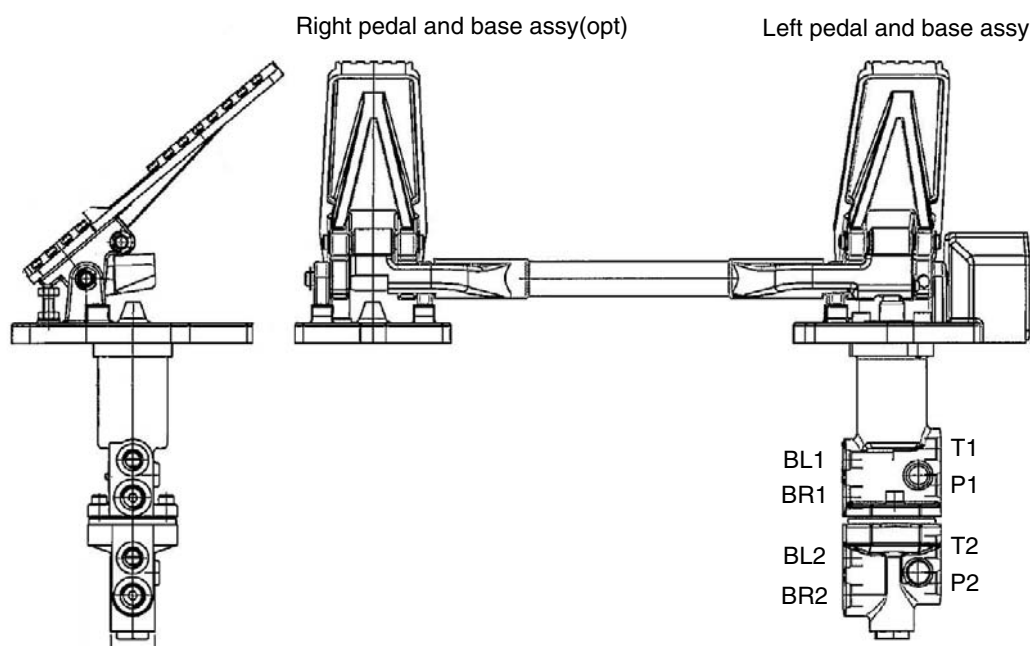
The fan speed solenoid valve (6) is a proportional solenoid. As current to the fan speed solenoid increases, pump output pressure decreased, therefore, the fan motor rotates slower.

When the current of the fan speed solenoid valve (6) is reduced, the output pressure is increased.

The pump will be stroked and the pump will send maximum flow to the fan motor, thus, the fan motor is turning faster.

4. BRAKE VALVE

1) STRUCTURE



970A4BS08

| Port | Port name | Port size |
|----------|----------------------|-----------|
| P1, P2 | Pressure port | PF 3/8 |
| T1, T2 | Return port | PF 3/8 |
| BR1, BR2 | Brake cylinder port | PF 3/8 |
| BL1, BL2 | Pressure switch port | PF 1/4 |

- Brake pressure specification : 80 ± 5 bar (1160 ± 70 psi)

2) OPERATION

(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

When the braking system is ready for operation, its accumulator pressure acts directly on ports (P1, P2) of the brake valve. A connection is established between ports (BR1, BR2) and ports (T1, T2) so that the wheel brake ports (BR1, BR2) are pressureless via the returns ports (T1, T2).

(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 spring assembly beneath base 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 upper spool is mechanically actuated via spring assembly, and the lower spool is actuated hydraulically by spool. As spools move downward, they will first close returns (T1, T2) via the control edges, thus establishing a connection between accumulator ports (P1, P2) and ports (BR1, BR2) for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spools are held in the control position by the force applied (Spring assembly above the spools and the hydraulic pressure below the spool (Balance of forces).

After output of the braking pressure, spools are in a partial braking position, causing ports (P1, P2) and ports (T1, T2) to close and holding the pressure in ports (BR1, BR2).

(4) Full braking position

When pedal is fully actuated, end position of the brakes is reached and a connection established between accumulator ports (P1, P2) and brake cylinder ports (BR1, BR2). Returns (T1, T2) are closed at this point.

When the braking process is ended, a connection is once again established between brake cylinder ports (BR1, BR2) and return ports (T1, T2), closing accumulator ports (P1, P2).

The arrangement of spools in the valve ensures that even if one braking circuit fails the other remains fully operational. This is achieved by means of the mechanical actuation of both spools and requires slightly more pedal travel.

(5) Failure of a circuit

In the event of the lower circuit failing, the upper circuit will remain operational. Spring assembly will mechanically actuate spool.

In the event of the upper circuit failing, the lower circuit will remain operational since the lower spool is mechanically actuated by spring assembly and spool.

(6) Installation requirements

Return lines (T1, T2) must be connected directly to the tank.

The connecting lines must be installed in such a way as to permit proper bleeding.

(7) 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.**

(8) Repair work

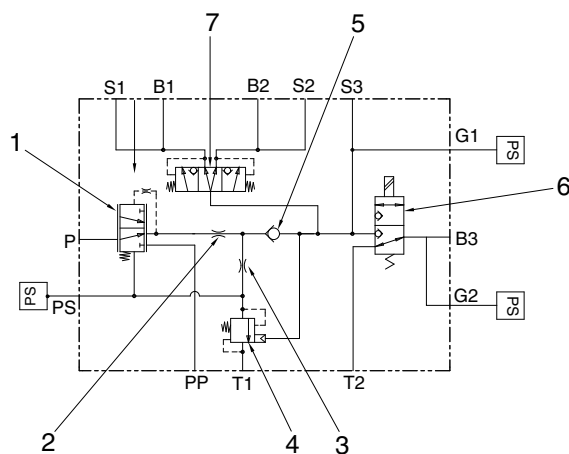
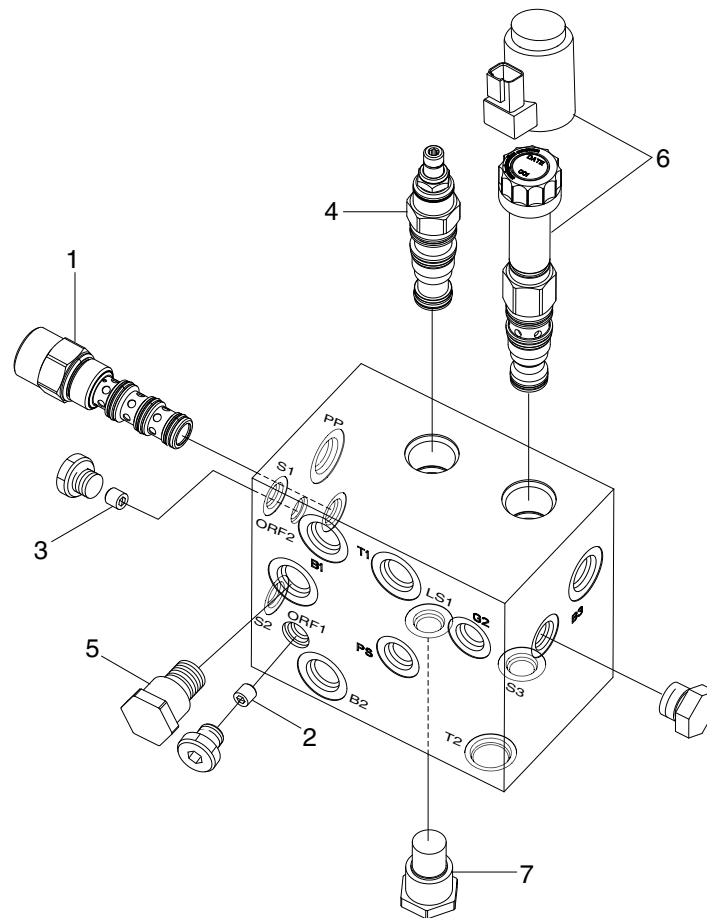
- △ When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine is switched off there will be some residual pressure in the system.
- ※ When doing repair work, make sure your environment is very clean.
Immediately close all open ports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

(9) Replacing the complete actuating mechanism

Carefully clamp the unit vertically in a fixture. The actuating mechanism can be removed by taking out the three bolts. Make sure that spring assembly does not fall out. When installing the new actuating mechanism, make sure that spring assembly is fitted in the right order.

Tighten the three bolts.

1) STRUCTURE



Hydraulic circuit

- 1 Priority valve
- 2 Orifice
- 3 Orifice
- 4 Pressure control valve
- 5 Check valve
- 6 Coil, Solenoid valve
- 7 Directional valve

970A4BS32

2) OPERATION

The pressure control valve (4) controls the minimum and maximum pressure of the braking system. When the service brake pressure is below the maximum pressure (125 ± 5 bar), the pressure control valve (4) is blocked and PS pilot pressure (brake priority pressure) increases.

As soon as PS pilot pressure raises up above 15 bar, pump controller current is reduced by MCU (pressure sensor detects brake priority pressure, and pump supply flow and pressure in order to meet the brake system).

The pressure sensor at PS port detect whether brake system needs to be charged.

Priority valve spring and pilot pressure (brake priority pressure) pushed priority spool to the upward.

Therefore, full pump flow directly goes to the brake system in order to satisfy the demand of the brake system.

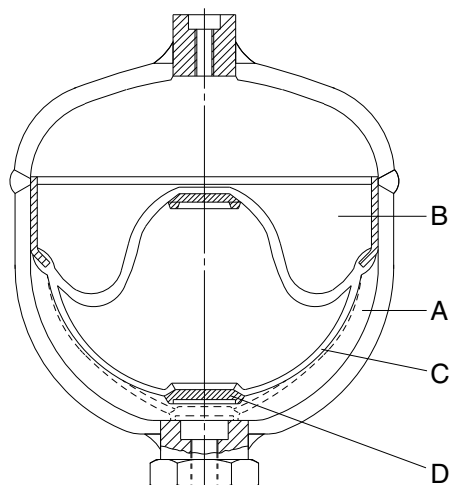
Pump flow goes through the following components : orifice (2), check valve (5), directional valve (7). Brake failure pressure sensor at G1 port detects pressure in the brake accumulators.

When the pressure is lower than 100 bar, the sensor activates warning lamp on the cluster in order to check brake system.

When brake system pressure reaches the maximum brake system pressure ($150 \text{ bar} \pm 5 \text{ bar}$), pressure control valve (4) opens, pilot pressure (brake priority pressure) of priority valve is low by draining the spring side of priority valve (1) to hydraulic tank through valve (4).

6. BRAKE ACCUMULATOR

1) STRUCTURE



75794BS09

| Item | 31LL-40020 (item24) | 31AC-10030 31LC-80030★ (item23) |
|--------------------|-----------------------------|---------------------------------------|
| Diameter | 167 mm | 136 mm |
| Mounting height | 219 mm | 159 mm |
| Norminal volume | 2.0 ℓ | 1.0 ℓ |
| Priming pressure | 50 kgf/cm ² | 50 kgf/cm ² |
| Operating medium | Oil | Oil |
| Operating pressure | Max 210 kgf/cm ² | Max 200 kgf/cm ² |
| Thread | M22×1.5 | M22×1.5 |
| Priming gas | Nitrogen | Nitrogen |

A Fluid portion

B Gas portion

C Diaphragm

D Valve disk

★ : Cold region

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

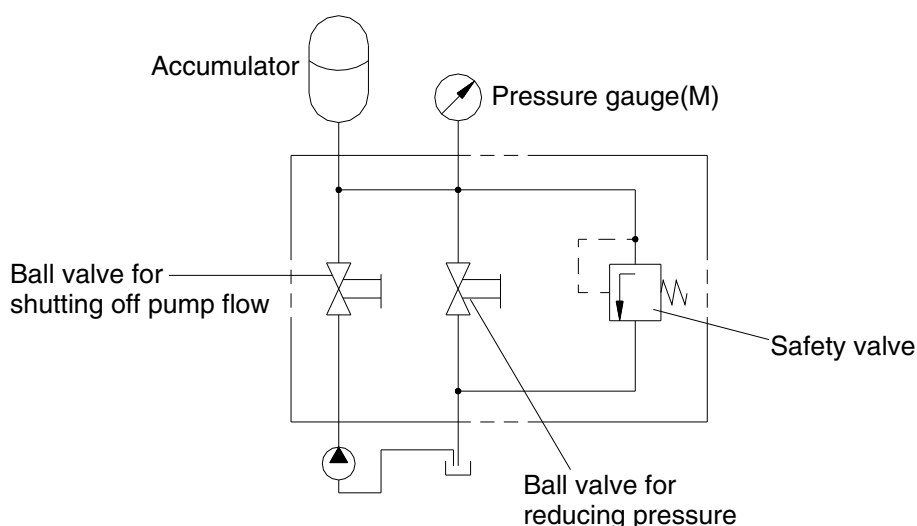
Before the accumulator is scrapped, its gas filling pressure must be reduced. For this purpose, drill a hole through gas chamber (B) using a drill approx. 3mm in diameter. The gas chamber is located on the side opposite the threaded port above the welding seam around the center of the accumulator.

※ 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**.



75794BS10

(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.

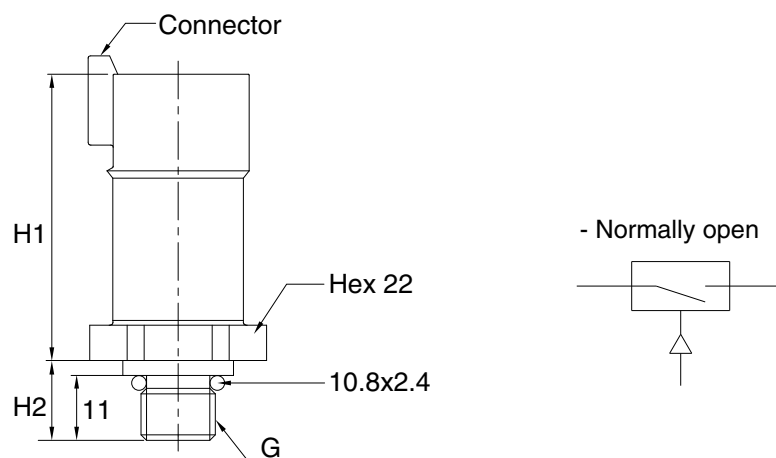
※ When doing repair work, make sure your environment is very clean.

Immediately close all open ports on the components and on pipes using plugs.

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

7. PRESSURE SENSOR AND SWITCH

1) STRUCTURE



7609A4BS12

2) TECHNICAL DATA

| Item | Type | Medium | G | H1 mm | H2 mm | Adjusting range kgf/cm ² | Actuating pressure kgf/cm ² | Voltage V |
|--------------------------------|------|--------|---------|----------|----------|--|---|--------------|
| Parking pressure sensor | - | Oil | PF 1/4" | 45 | 12.5 | 0 ~ 200 | 100 ± 5 | Max 30 |
| Charging pressure sensor | - | Oil | PF 1/4" | 45 | 12.5 | 0 ~ 200 | 100 ± 5 | Max 30 |
| Brake priority pressure sensor | - | Oil | PF 1/4" | 45 | 12.5 | 0 ~ 200 | 100 ± 5 | Max 30 |
| Brake stop pressure switch | NO | Oil | PF 1/4" | 45 | 12.5 | 1 ~ 10 | 5 ± 1 | Max 32 |

NO : Normally open

3) Tightening torque : 3.5 kgf · m (25.3 lbf · ft)

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.

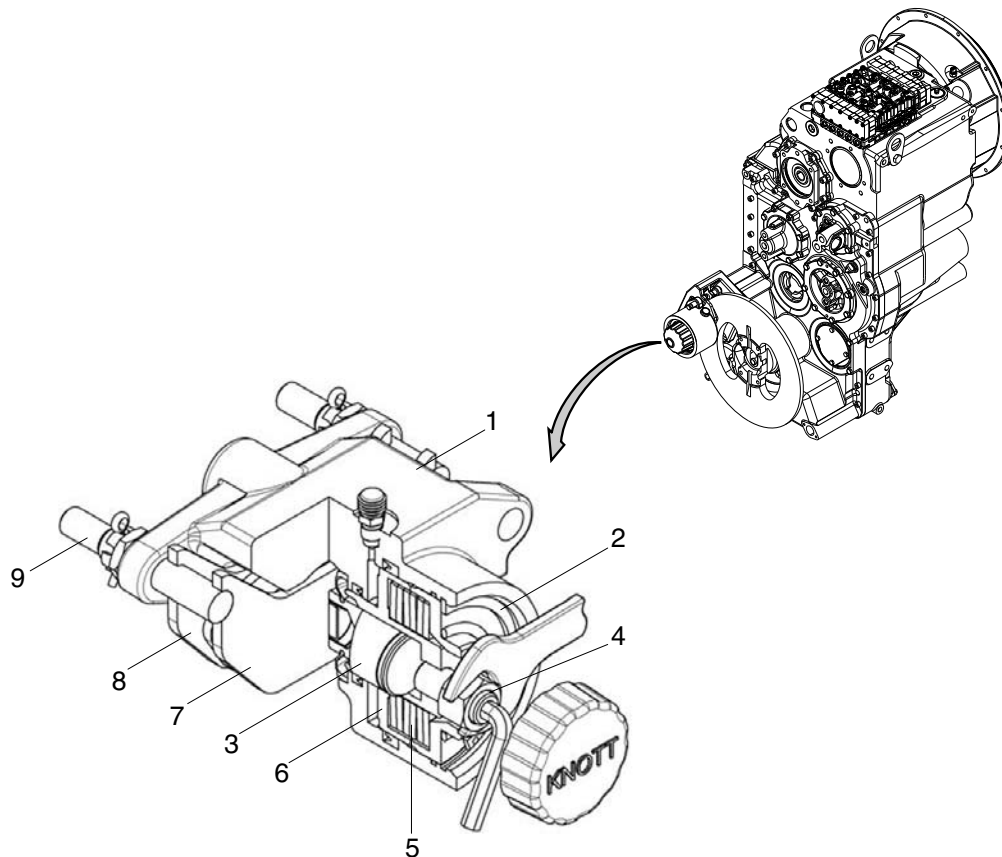
※ When doing repair work, make sure your environment is very clean.

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.

8. PARKING BRAKE SYSTEM

1) STRUCTURE



77094BS21

| | | | | | |
|---|---------------|---|---------------------|---|--------------|
| 1 | Housing | 4 | Adjust screw | 7 | Lining pad |
| 2 | Pressure ring | 5 | Bank of cup springs | 8 | Lining pad |
| 3 | Thrust bolt | 6 | Piston | 9 | Gliding bolt |

2) OPERATION

The two identical brake pads and slide freely on the guide bolt, which is fastened in the housing. The guide bolts are guided in an additional brake anchor plate which in turn is screwed onto the vehicle, i.e. its axle.

On actuation, the brake generates a clamping force at the brake lining pads, which cause a tangential force/braking moment to be generated at the brake disk, the extent of which depends on the coefficients of friction generated by the linings.

The clamping force is generated by the bank of cup springs, during which the piston is moved together with the adjusting screw, the thrust bolt and the brake pad towards the brake disk.

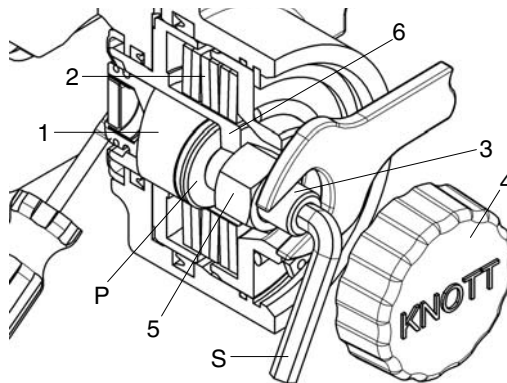
When the brake pad comes into contact with the brake disk, the reaction force shifts the housing onto the guide bolts until the brake pad is also pressed against the brake disk.

The brake is released by complete pre-tensioning of the bank of cup springs. During this process, through application of the necessary release pressure after overcoming the cup spring force, the piston must move back until it comes to rest against the pressure ring.

The clamping force diminishes with wear of the brake lining and brake disk. The brake must be adjusted at the latest at the times indicated by the adjusting specification followings.

3) MOUNTING AND BASIC SETTING REGULATIONS

Basic brake setting is required after mounting new brake lining plates or brake disks, as well as during all repair stages and in the event of insufficient braking performance.



100D7BS112

- | | | | | | |
|---|---------------------|---|-----------|---|---------------|
| 1 | Thrust bolt | 4 | Screw cap | P | Even surface |
| 2 | Bank of cup springs | 5 | Lock nut | S | Socket wrench |
| 3 | Adjusting screw | 6 | Piston | | |

※ All mounting and basic setting work must be carried out on the brake when cold.

(1) Mounting the brake

- ① Stand the vehicle on an even surface and secure against rolling away.
- ② Release the screw cap.
- ③ Release the lock nut (size 24 or 30) and turn the adjusting screw anticlockwise using a size 8 or 10 socket wrench until the pressure bolt comes to rest against the even surface of the piston. In this status, the brake can be mounted onto the brake disk and fastened.
- ④ Mount the pressure connection again.
Apply the necessary release pressure to the brake until the bank of cup springs is completely pre-tensioned. Following carry out the following page basic setting regulation.

(2) Basic setting regulation

- ① Turn the adjusting screw manually clockwise until both brake pads make contact with the brake disk. Then it is not longer possible to turn the adjusting screw without exerting a major amount of force.
- ② Turn the adjusting screw anticlockwise in order to set the following rated clearances.

| Adjusting screw | Clearance (mm) | | Turns |
|-----------------|----------------|-----|-------|
| M20 (SW 10) | Min. | 1.0 | 2/5 |
| | Clearance | 2.0 | 4/5 |
| | Max. | 3.0 | 1 1/5 |

- ③ Hold the adjusting screw in position with a hexagonal socket wrench and lock with lock nut.
- ④ Mount the screw cap and tighten as far as possible manually.
- ⑤ Mount the pressure connection in accordance with the instructions of the axle.

※ For bleeding the piston chamber use the socket spanner size 13 for the bleeding valve.

(3) Adjusting regulations

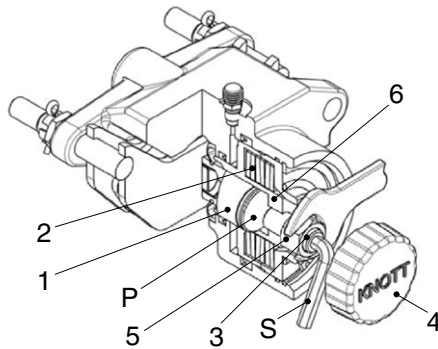
During this adjusting process, the parking brake must be released, i.e. the bank of cup springs must be completely pre-tensioned.

- ① Stand the vehicle on an even surface and secure against rolling away.
- ② Release the parking brake by using the required release pressure.
- ③ Release the screw cap and unscrew.
- ④ Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually clockwise until the two brake pads make contact with the brake disk.
- ⑤ Turn the adjusting screw anti-clockwise and set the clearance specified in the above table.
- ⑥ Hold the adjusting screw in position with the hexagonal socket wrench and lock with the lock nut.
- ⑦ Mount the screw cap and tighten as far as possible manually.

※ Actuate the brake valve several times and check the braking efficiency of the parking brake on a slope.

4) EMERGENCY RELEASE OF THE PARKING BRAKE

After the failure of the pressure release the parking brake by using following manual procedure.



100D7BS117

- | | | | | | |
|---|---------------------|---|-----------|---|---------------|
| 1 | Thrust bolt | 4 | Screw cap | P | Even surface |
| 2 | Bank of cup springs | 5 | Lock nut | S | Socket wrench |
| 3 | Adjusting screw | 6 | Piston | | |

- (1) The vehicle has to be secured against rolling away.
- (2) Release the screw cap and unscrew
- (3) Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually counter-clockwise until the brake disc is free.

⚠ For the emergency release is an actuation torque of 40Nm respectively 70Nm required.

- (4) Mount the lock nut and the screw cap and tighten both as far as possible manually. (protection against dirt)

⚠ Now, the vehicle do not have any brake function. The vehicle must be secured against moving away with proper means. Before putting the vehicle into operation again, the brake has to be adjusted again. Refer to previous page. "Assembly and basic setting regulations".

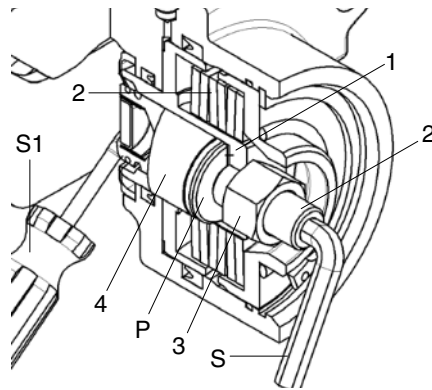
5) MAINTENANCE AND REPAIR WORK

(1) Maintenance and exchange of brake pads

The brake pads themselves are maintenance free. All that is required here is a check for damaged parts, as well as inspection to ensure that the brake disk remains easy running.

The thickness of the brake lining must be subjected to a visual inspection at regular intervals, which depend on vehicle usage, but every six months at the latest. In the event of a minimal residual lining thickness, these intervals must be reduced accordingly in order to avoid major damage to the brake or disk.

Min. residual thickness 2.0 mm per lining pad (8 mm carrier plate thickness).

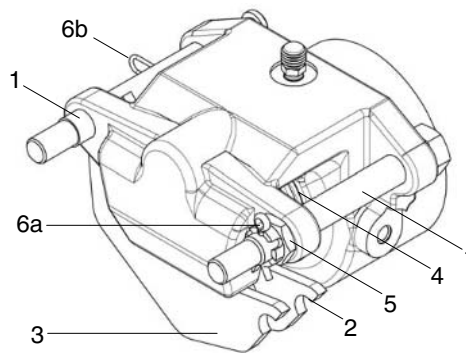


100D7BS113

- | | | | |
|---|-----------------|----|----------------------|
| 1 | Piston | S | Socket wrench |
| 2 | Adjusting screw | S1 | Screwdriver |
| 3 | Lock nut | P | Inside of the piston |
| 4 | Thrust bolt | | |

※ Only original spare lining plates may be used. If any other spare parts are used, no warranty claims will be accepted either for the brakes or their functional characteristics.

- ① Stand the vehicle on an even surface and secure against rolling away.
- ② Release the parking brake by applying the required release pressure.
- ③ Release the screw cap and unscrew.
- ④ Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually clockwise until it lies flush with the inside of the piston.
- ⑤ Press back the thrust bolt using a suitable screwdriver until it has contact with the piston.



100D7BS114

- | | | | |
|---|------------------|----|-----------------|
| 1 | Guide bolt | 5 | Castellated nut |
| 2 | Lining pad | 6a | Safety splint |
| 3 | Lining pad | 6b | Safety clip |
| 4 | Permanent magnet | | |

⑥ Depending on the free space available, release one of the two guide bolts, removing the safety splint, unscrewing the castellated nut and pulling the guide bolt out of the brake anchor plate. Now, the brake lining pads can be removed tangentially to the brake disk.

※ In the event of minimal clearance, i.e. it is not possible for space reasons to exchange the brake lining plate in accordance with these instructions, the brake must be removed completely. To do this, pull both guide bolts out of the brake anchor plate.

⚠ Check the pressure hose. If the pressure hose is too short, it must be unscrewed to remove the brake. Before the pressure hose can be released the brake must be emergency released.

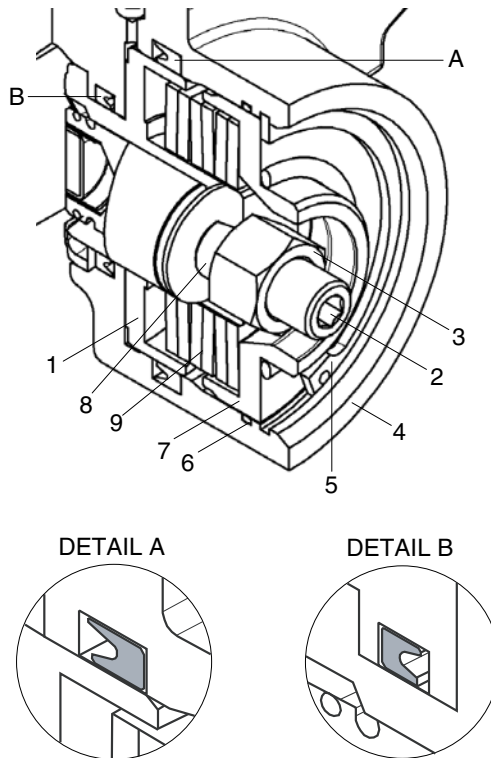
⑦ Exchange the brake pads and insert the guide bolts into the brake anchor plate. If you have removed the complete brake you have to mount the brake on both guide bolt again, now.

⑧ Check both permanent magnets if they still have sufficient magnetic force to hold the brake lining plates. Should this not be the case, the permanent magnets must also be changed by using a suitable screw driver.

⑨ Secure the guide bolt with the castellated nut and the safety splint respective safety clip.

⚠ After mounting new brake lining plates or their repair, the brake must be correctly set in accordance with the instructions "Adjusting regulations".

(2) Changing the seal



100D7BS115

| | | | | | |
|---|-----------------|---|-------------|---|--------------------|
| 1 | Piston | 5 | Circlip | 9 | Bank of cup spring |
| 2 | Adjusting screw | 6 | Seal | A | Detail of the seal |
| 3 | Lock nut | 7 | Guide bolt | B | Detail of the seal |
| 4 | Housing | 8 | Thrust bolt | | |

※ Faulty seals must be exchanged in accordance with the instructions below.

- ① Stand the vehicle on an even surface and secure against rolling away.
- ② Release the parking brake by applying the necessary release pressure.
- ③ Release the screw cap and unscrew.
- ④ Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually counter clockwise until the adjuster screw is flush with the inner side of the piston.
- ⑤ Push back the thrust bolt until it has contact with the piston. Following actuate the hand brake valve (no pressure must be in the piston chamber). The bank of cup springs is now completely depressurized.
- ⑥ Unscrew the pressure hose and remove the brake.
- ⑦ Release the circlip and remove the pressure ring of the housing.
- ⑧ Release the bank of cup springs and the piston.

▲ Pay attention to the mounting direction of the seal rings, otherwise leaks can occur.

▲ Use for mounting the new seal rings a suitable mounting needle with rounded edge.
Be careful.

- ⑨ Change all seals and mount the parts of the brake in other way round order. By mounting the piston, the sliding and sealing surfaces must be greased lightly using lubricating grease to DIN 51825. The dust protection cap is fitted with a vulcanized-in steel ring which is used to press it through the locating hole. For exchanging, "lever out" the ring using a suitable tool. The new dust protection cap must be pressed in with the aid of a suitable mounting ring and screw clamps or a lever press.

(2) General

Any discovered defects or damage to parts not listed here must naturally be repaired or replaced using original parts.

For any other information not contained in these instructions or for more detailed instructions, please contact HD Hyundai Construction Equipment dealer.

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

This procedure is designed so the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read **structure and function**, Group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

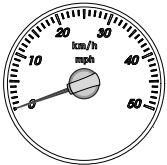
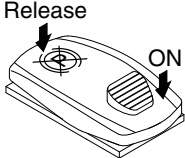
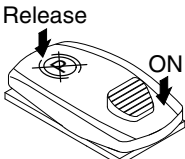
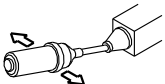
At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be given repair required and group location.

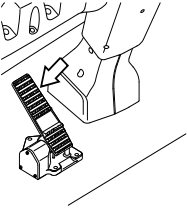


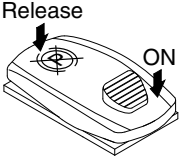
If verification is needed, you will be given next best source of information:




Chapter 2 : Troubleshooting

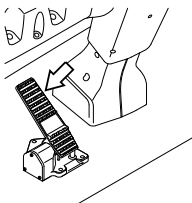

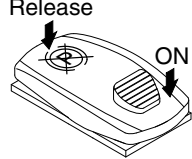

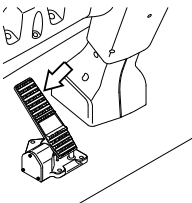
Group 3 : Tests and adjustments

※Hydraulic oil must be at operating temperature for these checks (refer to page 6-49).

| Item | Description | Service action |
|--|--|--|
| Parking brake capacity check Seat belt must be worn while doing this check to prevent possible injury when machine stops suddenly. |   Start engine. Fasten seat belt. Release parking brake and put transmission in 2nd gear forward. Drive machine at 8 km/hr and switch parking brake ON. LOOK/FEEL : Machine must come to a stop within 2 meters (6 feet) when parking brake is engaged at 8 km/hr. Transmission must shift to neutral. | OK Check completed. NOT OK Inspect parking brake. Go to group 3. |
| Parking brake transmission lockout check Engine running. |   Turn parking brake to ON. Place transmission in 1st forward. Slowly increase engine speed to high idle. LOOK : Machine must not move. | OK Check completed. NOT OK Go to transmission control circuit in section 3. |

| Item | Description | Service action |
|--|---|--|
| Service brake pump flow check ※ Hydraulic oil must be at operating temperature for the check. Engine OFF. |  <p>Stop engine.</p> <p>Operate brake pedal approximately 20 times.</p> <p>Start engine and run at low idle.</p> <p>Record number of seconds required for low brake pressure indicator lamp to go out.</p> <p>LOOK : Indicator lamp must go out in less than 4 seconds from time engine starts.</p> <p>NOTE : Indicator will not come on approximately 1 second after starting engine.</p>  | <p>OK Check completed.</p> <p>NOT OK Check for brake circuit leakage. Go to next page.</p> <p>IF OK Install a cap on line connected to inlet of brake valve and repeat pump flow check. If time does not decrease, check for worn brake pump.</p> |
| Service brake capacity check Engine running. | <p>OFF</p>  <p>Release</p>  <p>ON</p> <p>Select clutch cut-off mode to OFF.</p> <p>Apply service brakes, release park brake and put transmission in 2nd forward.</p> <p>Increase engine speed to high idle.</p> <p>LOOK : Machine may not move or move at a very slow speed.</p> <p>Repeat check three times to ensure accurate results.</p> | <p>OK Check completed.</p> <p>NOT OK Check brake pressure.</p> <p>IF OK Inspect brake disk.</p> |

| Item | Description | Service action |
|--|--|---|
| Brake accumulator precharge check ※ The axles and hydraulic oil must be at operating temperature for this check. |   <p>Start and run engine for 30 seconds.</p> <p>Stop engine and turn start switch to ON and wait 5 seconds.</p> <p>NOTE : Engine oil pressure lamp will be on due to no engine oil pressure.</p> <p>Count the number of times the brake pedal can be fully depressed before the low brake pressure warning lamp comes ON.</p> <p>LOOK : Warning lamp should not come ON in 1~5 applications.</p> <p>Start engine and operate at low idle.</p> <p>Observe cluster while applying brake pedal with maximum force.</p> <p>LOOK/LISTEN : Brake pressure indicator must not come ON.</p> | <p>OK Check completed.</p> <p>NOT OK Make sure brake pedal is not binding and keeping brakes partially engaged.</p> <p>Bleed brakes in group 3.</p> <p>Check brake system pressure.</p> <p>NOT OK If light comes ON with engine running, accumulator has lost it's charge. Inspect and recharge accumulator.</p> |
| Brake system leakage check |  <p>Start engine and wait 30 seconds.</p> <p>Stop engine.</p> <p>Wait 2 minutes.</p> <p>Turn start switch to ON and wait 5 seconds.</p> <p>LOOK : Brake oil pressure warning lamp must not come ON within 2 minutes after stopping engine.</p> | <p>OK Check completed.</p> <p>NOT OK If brake leakage is indicated with brakes released, check leakage at accumulator inlet check valve and brake valve. If brake leakage is indicated with brakes applied, check for leakage at brake valve and brake pistons.</p> <p>Check individual component leakage.</p> |

| Item | Description | Service action |
|---|--|---|
| Service brake pedal check |  <p>Slowly depress brake pedal.</p> <p>Listen for a hissing noise that indicates oil is flowing to brake pistons.</p> <p>LISTEN/FEEL : A hissing noise must be heard when pedal is depressed.</p> | <p>OK Check completed.</p> <p>NOT OK Inspect for debris under brake pedal.</p> |
| Service and parking brake system drag checks Engine running |  <p>Position machine on gradual slope.</p> <p>Lower bucket approximately 50 mm (2 in) from ground.</p> <p>Release parking and service brakes.</p>  <p>LOOK : Machine must move or coast.</p> <p>NOTE : If machine does not move, check brake pedals to be sure they fully release when feet are removed from pedals.</p> <p>Drive machine at high speed for about 5 minutes.</p> <p>Brake drag is indicated if brake areas in differential case are hot.</p> <p>NOTE : Observe parking brake.</p> <p>If disk is hot, parking brake drag is indicated.</p> | <p>OK Check completed.</p> <p>NOT OK Adjust park brake.</p> <p>NOT OK Check floor mat interference to pedal or debris build-up.</p> <p>IF OK Check for brake pressure when brake is released.</p> <p>Go to brake pressure test.</p> |
| Clutch cut-off check |  <p>Select clutch cut-off mode to L mode.</p> <p>Release parking brake.</p> <p>Run engine at half speed in 1st forward.</p>  <p>Firmly depress brake pedal.</p> <p>FEEL : Transmission must disengage when brake pedal is depressed at 30% of pedal stroke.</p> <p>NOTE : Clutch cut-off mode can be selected to operator preference to match your loading needs.</p> | <p>OK Check completed.</p> <p>NOT OK Adjust clutch cut-off mode.</p> |

2. TROUBLESHOOTING

1) SERVICE BRAKE

Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (see section 1)

Step 2. Operational checks (in this group)

Step 3. Troubleshooting

Step 4. Tests and adjustments (see group 3)

| Problem | Cause | Remedy |
|--------------------------|--|--|
| Poor or no brakes | Brake accumulator charge low. Brake pump standby pressure low. Brake pressure low. Air in system. Worn brake surface material. Leakage in brake valve. Leakage in brake piston seal. | Do brake accumulator check. Do brake pump standby pressure test. Do brake valve pressure test. Bleed brakes. Inspect brake surface material. Do brake valve leakage test. Check for an over filled differential. Apply brakes and check for leakage from check plug. ※ It is normal for the oil level to be slightly above the check plug. |
| Aggressive brakes | Internal restriction in circuit. Brake valve malfunction. Low oil level. | Remove lines and components. Disassemble and inspect. Check oil level. |
| Brakes drag | Brake pedal not returning properly. Debris holding valve partially open in brake valve. Warped brake disk. Stuck brake piston. | Inspect floor mat and pedal. Do brake valve pressure test. Inspect brake disk. Repair. |
| Brakes lock up | Brake valve malfunction. | Clean or replace brake valve. |

| Problem | Cause | Remedy |
|---|--|---|
| Brakes chatter | Air in brake system. Worn brake surface material. Wrong oil in differential. | Do brake bleed procedure. Inspect brake surface material. Drain. Refill. |
| Hissing noise when brake pedal is held with engine stopped | Leakage in brake valve, or brake piston. | Do brake system leakage test. |
| Brake pressure warning light will not go out or stays on excessively long after start-up | Malfunction in brake low pressure warning switch. Brake accumulator pressure too low. Low brake pump standby pressure setting. Leakage in pressure reducing manifold block. Leakage in brake system. Worn brake pump. Leakage in parking brake solenoid. | Replace switch. Recharge accumulator. Do brake pump standby pressure test. Do pressure reducing valve manifold leakage test. Do brake system components leakage tests. Do brake pump flow test. Do parking brake pressure test. |

2) PARKING BRAKE MALFUNCTIONS

| Problem | Cause | Remedy |
|---|--|---|
| Brake will not hold | Pads not adjusted correctly. Malfunctioning parking brake solenoid. Worn brake disk and / or brake pads. Brake piston hangs up in bore. | Adjust parking brake. Inspect and replace. Disassemble, inspect, repair. Remove and inspect. Repair. |
| Brake disk overheats | Pads out of adjustment. Brake not released. | Adjust parking brake. Release parking brake. Disassemble, inspect brake. Repair if necessary. Inspect for loosen or broken lines between brake pressure switch and indicator on dash. |
| Parking brake indicator in monitor does not come on when brake applied | Faulty wiring or switch. | Inspect for loose or broken lines between brake pressure switch and indicator on dash. Inspect for a faulty indicator on dash. Replace if necessary. |
| Brake will not apply | Pads out of adjustment. Malfunctioning wiring, switch, or solenoid. Restriction between brake valve and brake. | Adjust parking brake. Check electric circuit. Remove hose and inspect. Replace. |

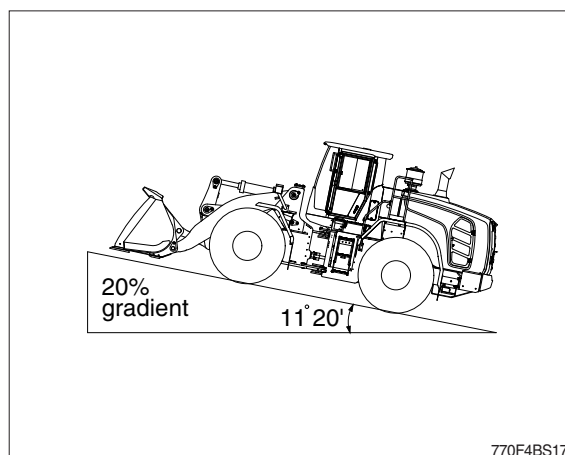
GROUP 3 TESTS AND ADJUSTMENTS

1. PARKING BRAKE PERFORMANCE

1) MEASUREMENT CONDITION

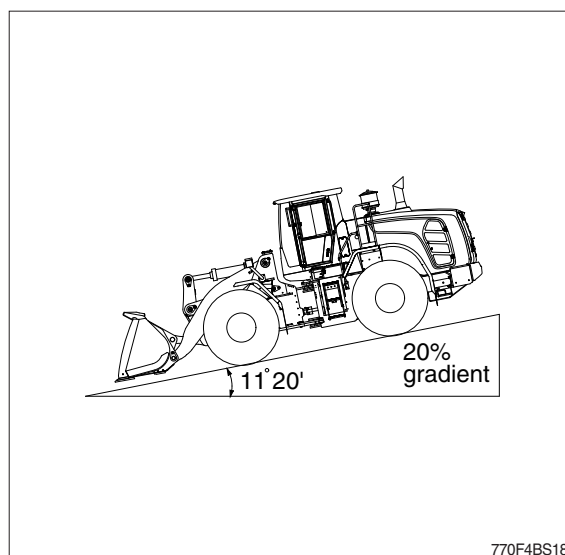
- (1) Tire inflation pressure : Specified pressure
- (2) Road surface : Flat, dry, paved surface with 1/5 (11°20') gradient.
- (3) Machine : In operating condition

| Item | Standard value |
|---------------------------|---------------------------------------|
| Parking brake performance | Keep machine on 20% (11°20') gradient |



2) MEASURING PROCEDURE

- (1) Start the engine and drive the machine straight up a 1/5 gradient with the bucket unloaded.
 - (2) Depress the service brake, place the gear selector lever in neutral, then stop the engine.
 - (3) Turn the parking brake switch ON, then slowly release the service brake pedal and the machine must be kept stopped.
- ※ The measurement must be made with the machine facing either up or down the slope.



2. ADJUSTMENT OF PARKING BRAKE

- (1) External brake inspection
 - Inspect for wear of brake pad
- (2) Refer to the PARKING BRAKE SYSTEM on the page 4-21.

3. HYDRAULIC BRAKE BLEEDING PROCEDURE

⚠ Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

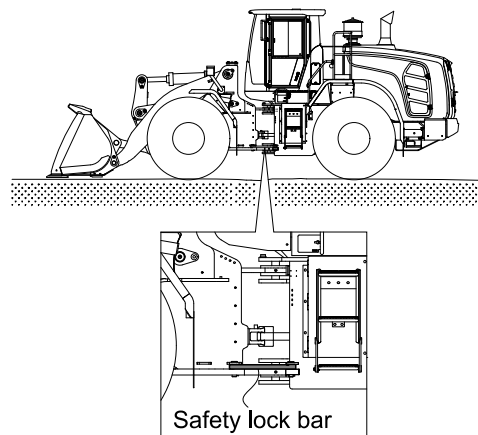
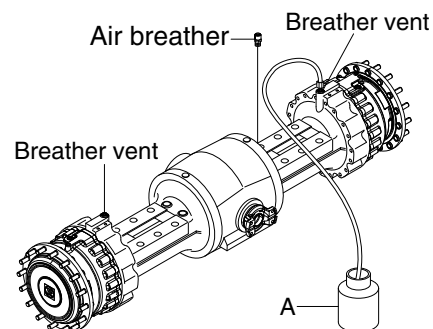
Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

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

Doctors unfamiliar with this type of injury should reference a knowledgeable medical source.

Two people are required to bleed brake system oil, one to operate brake valve and other to open and close bleed screws.

- 1) Install frame locking bar. Engage parking brake.
- 2) Put a clear plastic tube on bleed screw to route low to hydraulic oil tank filler tube or container (A).
- 3) Start engine and run at low idle.
- 4) Push and hold brake pedal down until brake bleeding procedure is complete.
 - ※ If bubbles continue for more than 2 minutes, stop bleeding procedure. Check for and correct problem, then continue.
- 5) Open on bleed screw on differential and axle assembly until hydraulic oil starts to flow. Close bleed screw when oil is free of air. Release brake pedal.
- 6) Repeat steps 1)~5) for each bleed screw.
- 7) Push either brake pedal and hold down.
- 8) Check hydraulic oil level.

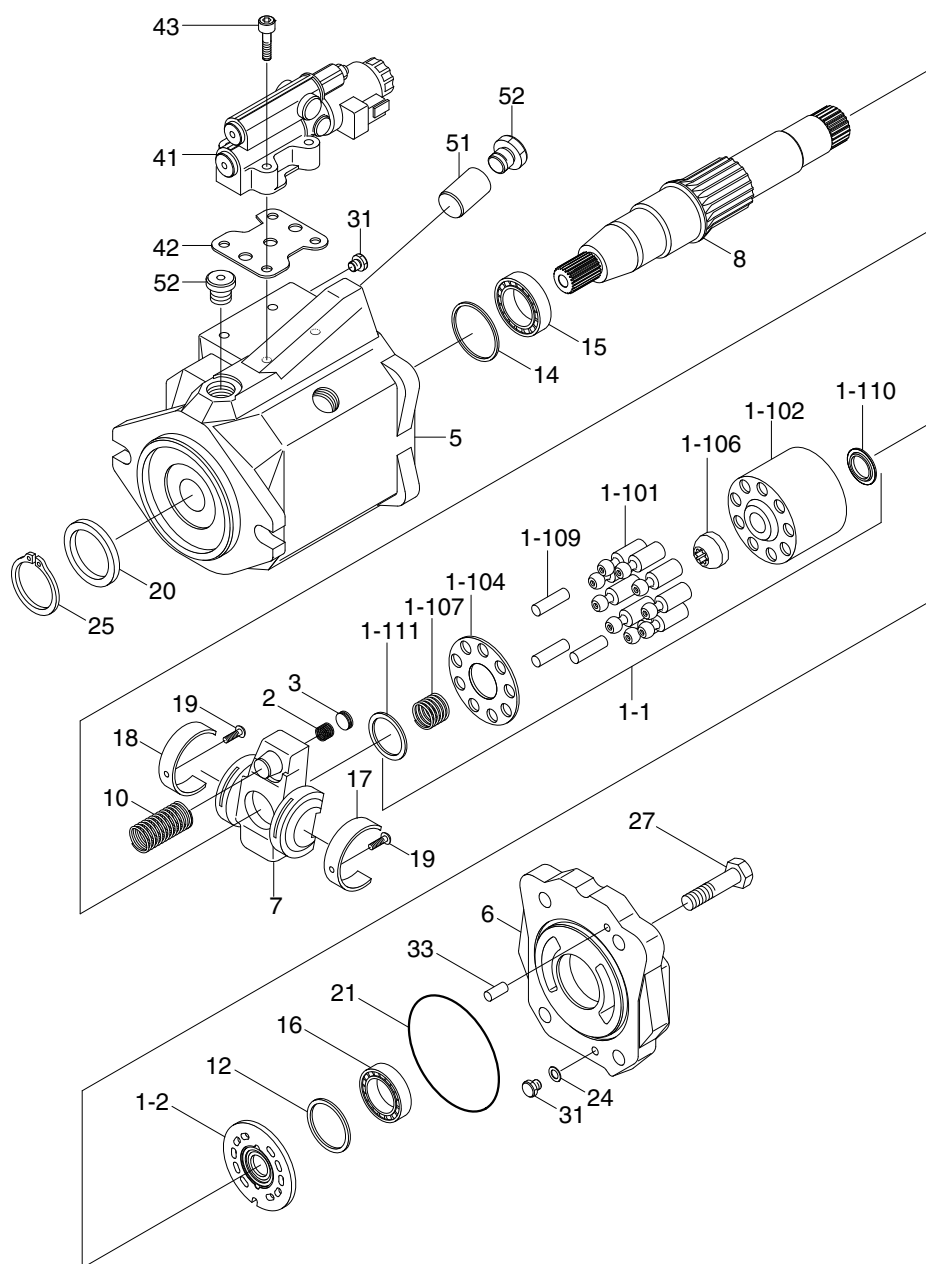


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GROUP 4 DISASSEMBLY AND ASSEMBLY

1. FAN AND BRAKE PUMP

1) STRUCTURE



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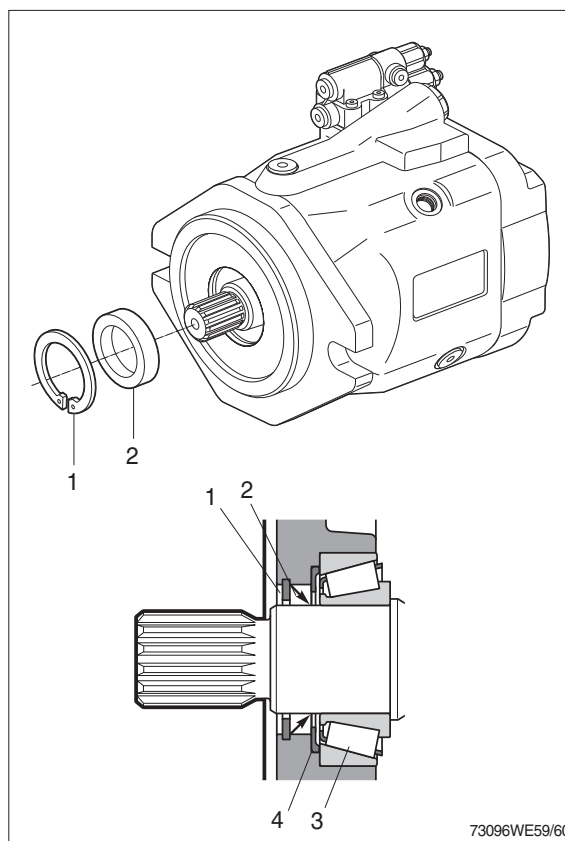
| | | | | | |
|-------|-----------------|----|------------------------|----|-----------------|
| 1-1 | Rotary group | 5 | Pump housing | 20 | Shaft seal ring |
| 1-101 | Piston | 6 | Port plate | 21 | O-ring |
| 1-102 | Cylinder | 7 | Swash plate | 24 | Kantseal ring |
| 1-104 | Retaining plate | 8 | Drive shaft | 25 | Retaining ring |
| 1-106 | Retaining ball | 10 | Spring | 27 | Socket screw |
| 1-107 | Spring | 12 | Adjustment shim | 31 | Plug |
| 1-109 | Pressure pin | 14 | Stop ring | 33 | Cylinder pin |
| 1-110 | V-ring | 15 | Tapered roller bearing | 41 | Control valve |
| 1-111 | Back-up plate | 16 | Tapered roller bearing | 42 | Gasket |
| 1-2 | Control plate | 17 | Liner bearing | 43 | Socket screw |
| 2 | Pressure spring | 18 | Liner bearing | 51 | Control piston |
| 3 | Stop | 19 | Flat screw | 52 | Locking screw |

2) GENERAL REPAIR GUIDELINES

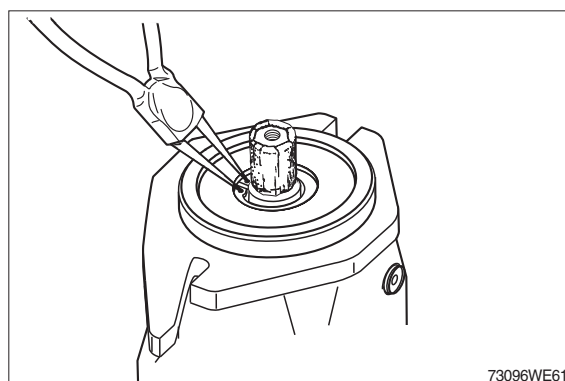
- ※ Observe the following guidelines when carrying out repairs on hydraulic pumps.
- (1) Close off all openings of the hydraulic unit.
- (2) Replace all of the seals.
Use only original spare parts.
- (3) Check all sealing and sliding surfaces for wear.
- ※ Re-work of the sliding surfaces by using, for example abrasive paper, can damage the surface.
- (4) Fill the hydraulic pump with hydraulic oil before commissioning.

3) SEALING THE DRIVE SHAFT

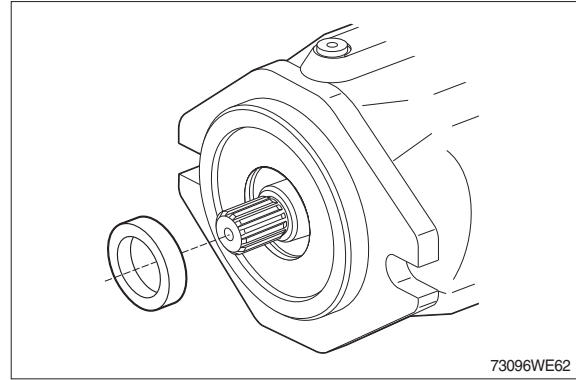
- | | | | |
|---|----------------|---|------------|
| 1 | Retaining ring | 2 | Shaft seal |
| 3 | Bearing | 4 | Stop ring |



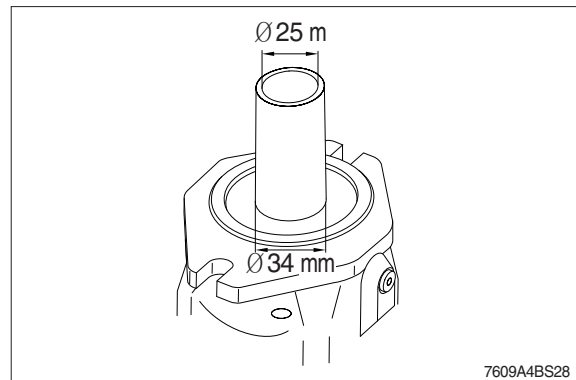
- (1) Protect the drive shaft.
Wrap the drive shaft with tape.
Remove the retaining ring.
Remove shaft seal to front.



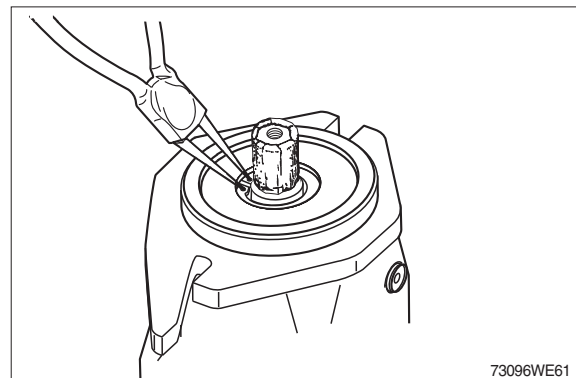
- ※ Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.
Visual check shaft seal and housing.



- (2) Assembling of the sealing ring carefully down to the stop ring.

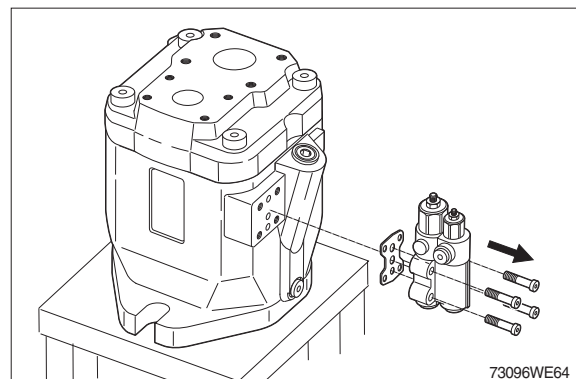


- (3) Assemble the retaining ring (circlip).
- ※ Visual check to ensure that the circlip is correctly located in the groove.

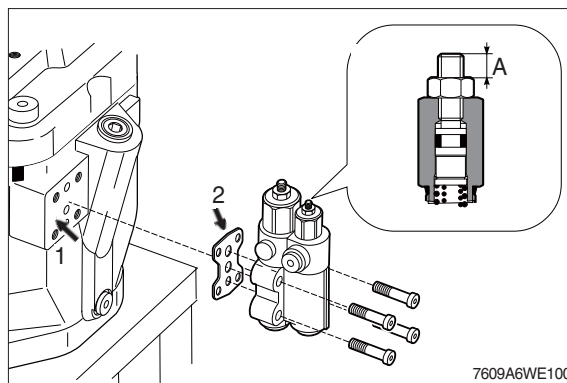


4) SEALING THE CONTROL VALVE

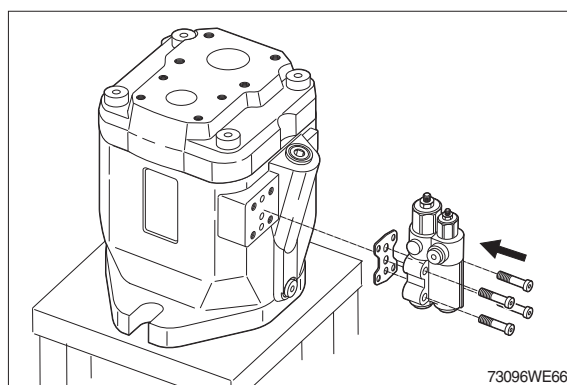
- (1) Remove the control valve.



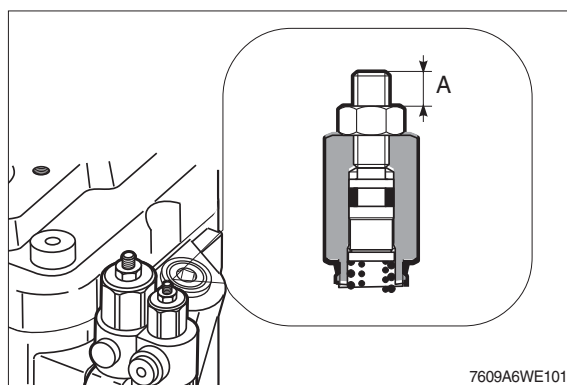
- (2) Measure dimension A and note down.
Check sealing surface (1).
Replace gasket (2).



- (3) Assemble control valve.
Tighten the bolts.
· Tightening torque : 1.58 kgf · m
(11.4 lbf · ft)

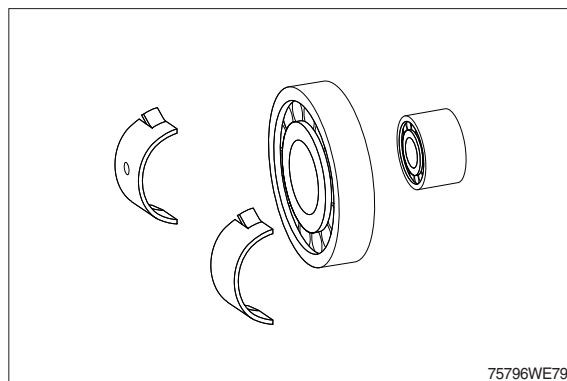


- (4) Check dimension A.



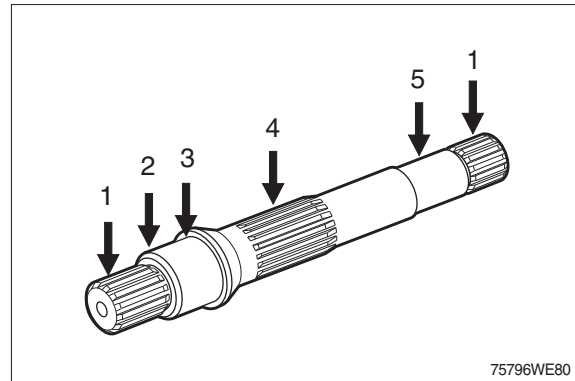
5) INSPECT HINTS

- (1) Renew all bearings.



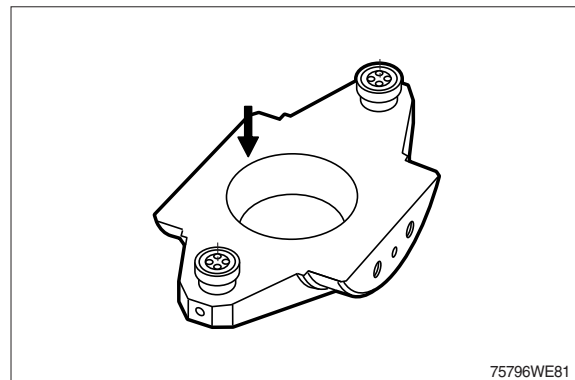
(2) Check :

- 1 Wear on splines, rust
- 2 Drive shaft seal wear grooves
- 3 Bearing seat
- 4 Splines for cylinder drive
- 5 Bearing seat



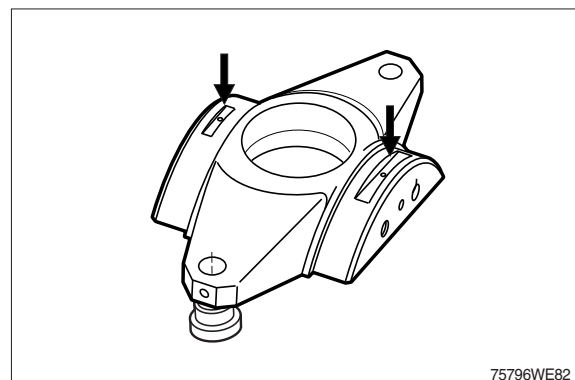
(3) Check :

Sliding surface free of grooves.



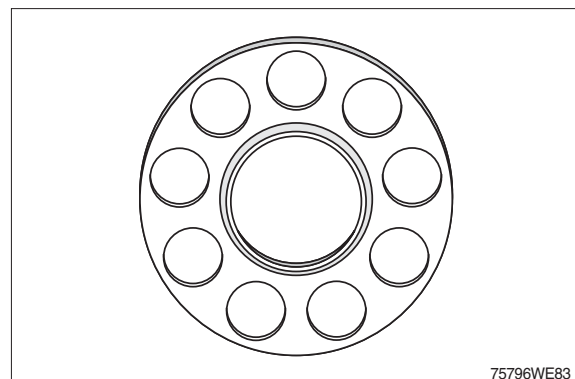
(4) Check :

Bearing surfaces.



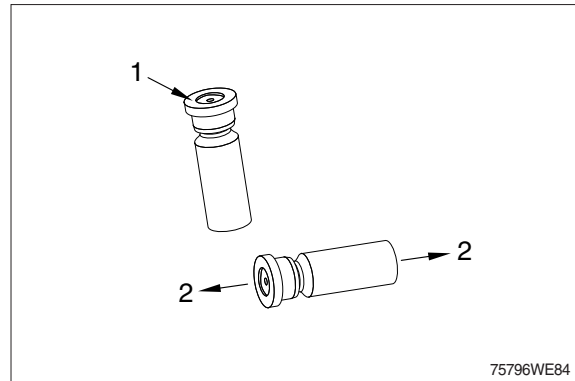
(5) Check :

That the retaining plate is free of grooves and that there is no wear in the slipper pad area.



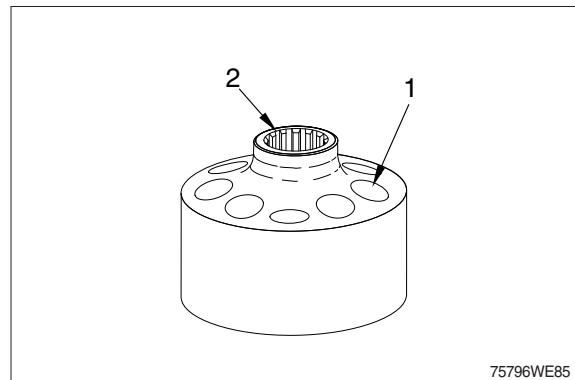
(6) Check :

Check to see that there are no scratches or metal deposits on the sliding surface (1) and that there is no axial play (2) (Pistons must only be replaced as a set).

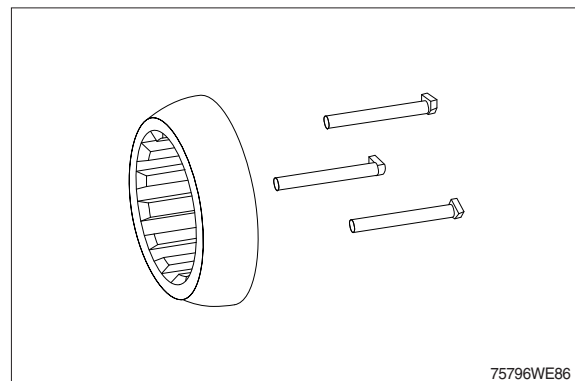


(7) Check :

- 1 Cylinder bores
- 2 Splines

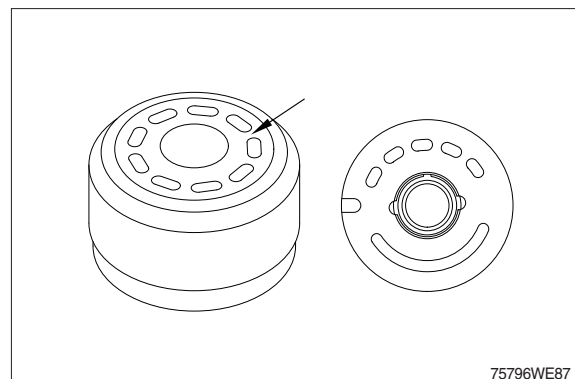


(8) Free of grooves, no signs of wear.



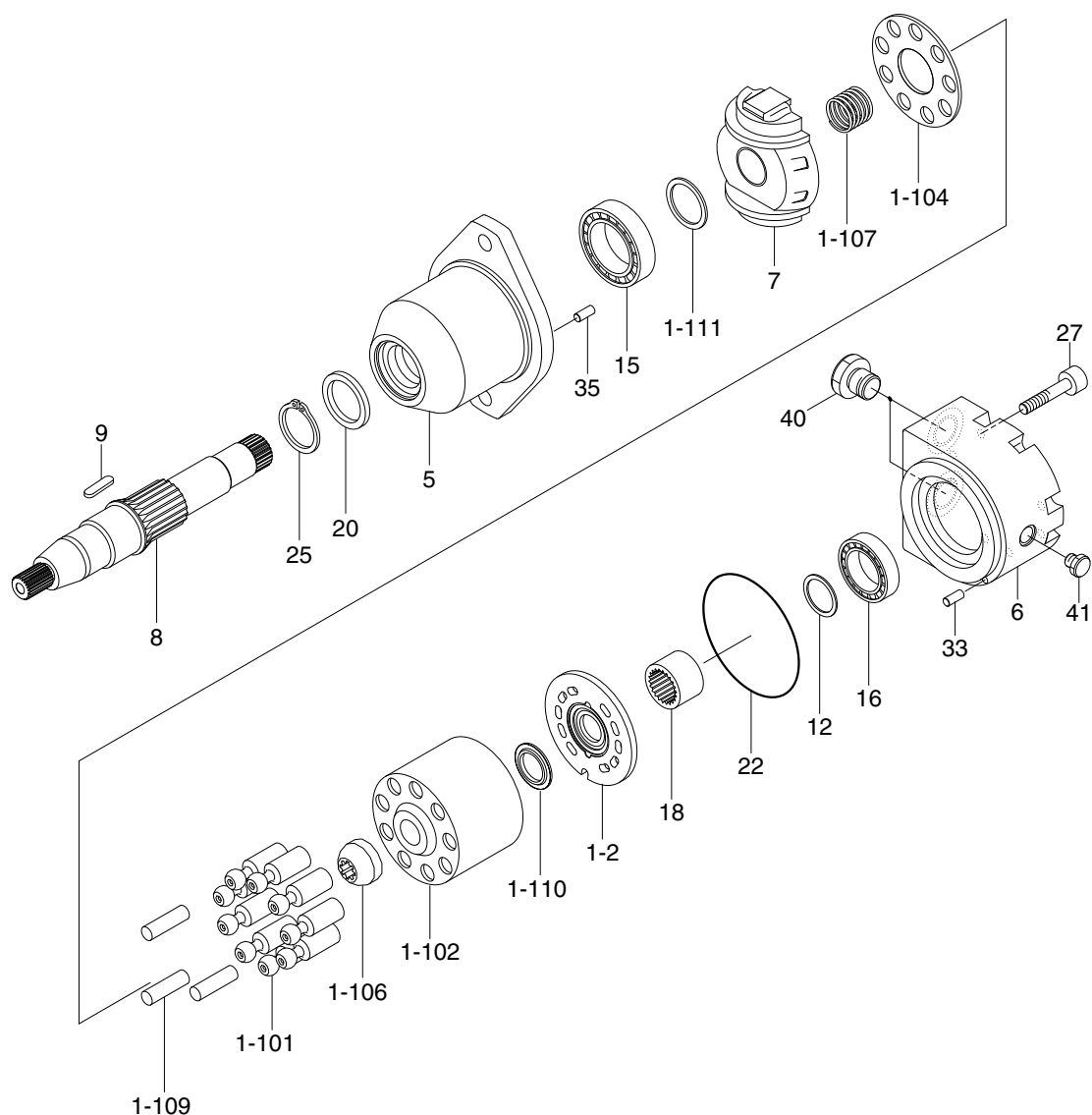
(9) Check :

Cylinder sliding surface free of grooves, no wear, no embedded foreign particles. That there are no scratches on the control plate. (Only replace them as a set).



2. FAN MOTOR

1) STRUCTURE

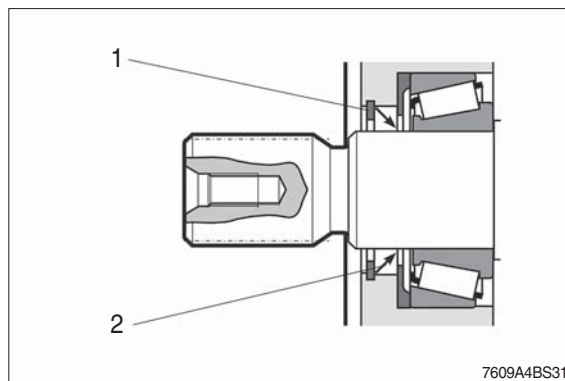


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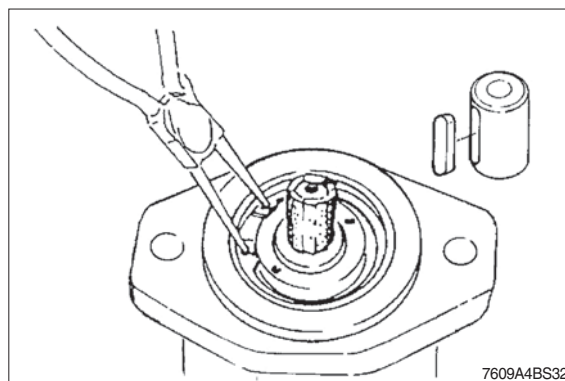
| | | |
|-----------------------|---------------------------|-----------------------------|
| 1-1 Rotary group | 1-2 Control plate | 18 Bearing bushing |
| 1-101 Piston | 5 Motor housing | 20 Shaft seal |
| 1-102 Cylinder | 6 Port plate | 22 O-ring |
| 1-104 Retaining plate | 7 Cam plate (swash plate) | 25 Retaining ring (circlip) |
| 1-106 Retaining ball | 8 Drive shaft | 27 Socket bolt |
| 1-107 Spring | 9 Shaft key | 33 Cylinder pin |
| 1-109 Pressure pin | 12 Adjustment shim | 35 Cylinder pin |
| 1-110 V-ring | 15 Tapered roller bearing | 40 Screw |
| 1-111 Back-up plate | 16 Tapered roller bearing | 41 Screw |

2) SEALING THE DRIVE SHAFT

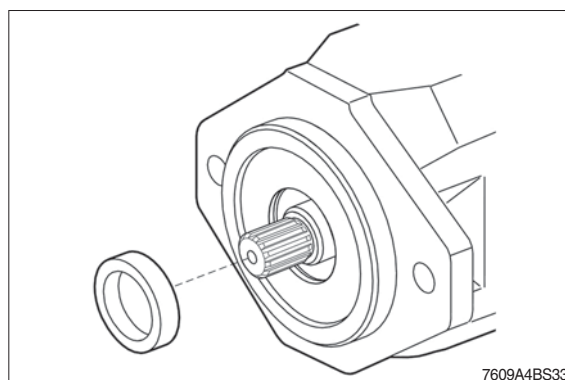
- (1) 1 Circlip
- 2 Shaft seal



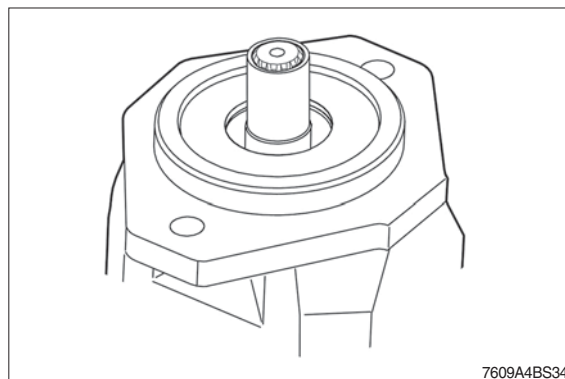
- (2) Remove key.
Protect the drive shaft.
Remove the circlip.



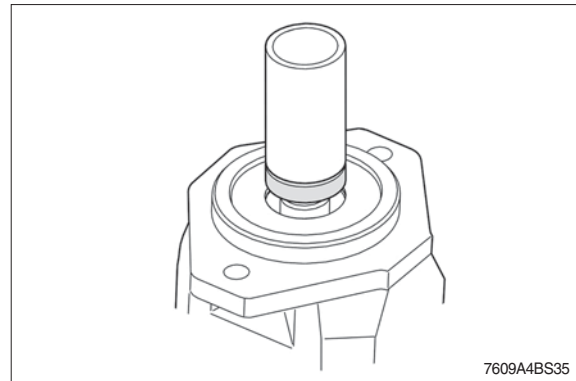
- (3) Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.



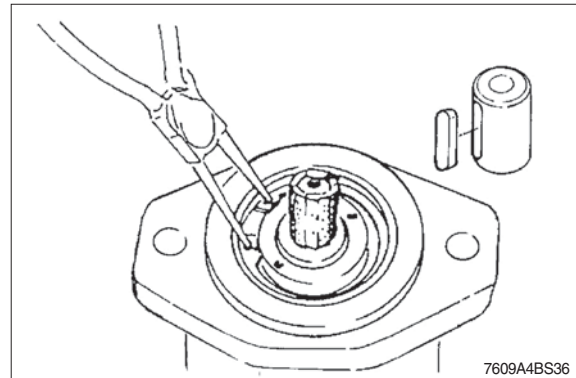
- (4) Use installation tool or plastic strip for assembling seal.



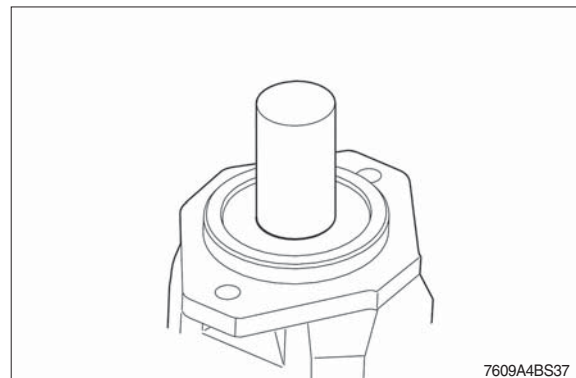
- (5) Use a suitable pipe to mount the shaft seal, but don't push it too deep. If the shaft ring touches the bearing ring you will damage the seal ring.



- (6) Assemble the circlip.



- (7) Assemble the circlip in the correct position.

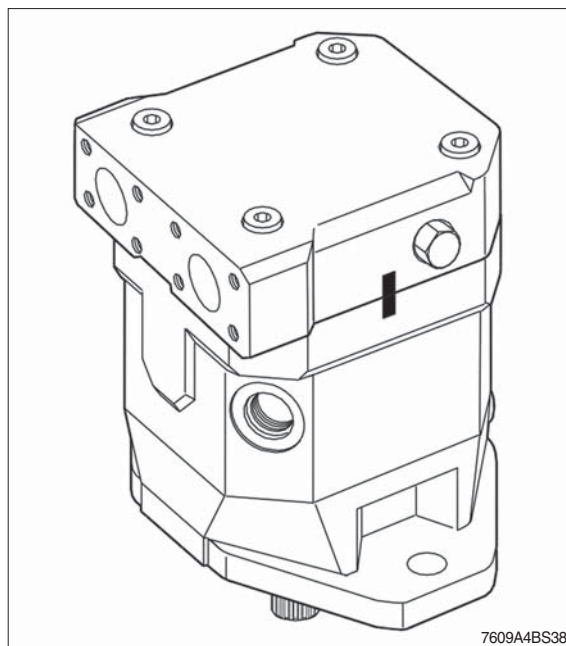


※ This discription shows how th change the drive shaft seal but it isn't the way of serial assembly.

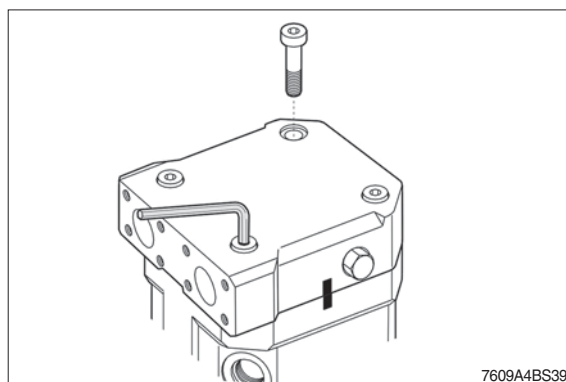
The seal is assembled together with the taper roller bearing from inside the motor housing normally to get a secure sealing condition. If you decide to repair the motor in the shown way be very careful while handling so that the drive shaft wouldn't be damaged during disassembly of the shaft seal.

3) DISASSEMBLE THE MOTOR

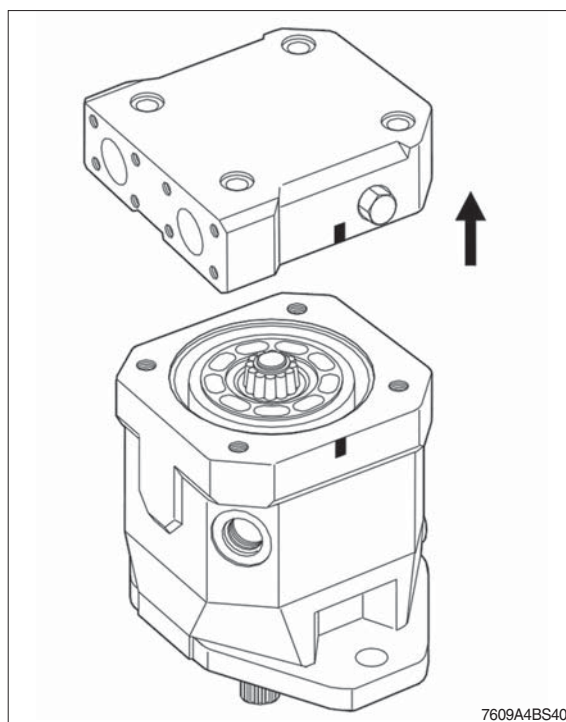
- (1) Disassembly position.
Mark the location of the port plate on the housing.



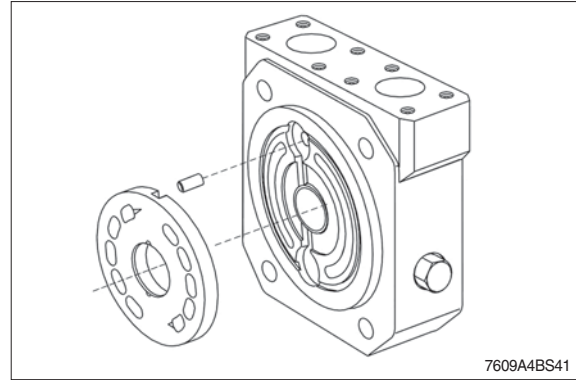
- (2) Remove the port plate fixing bolts crosswise.



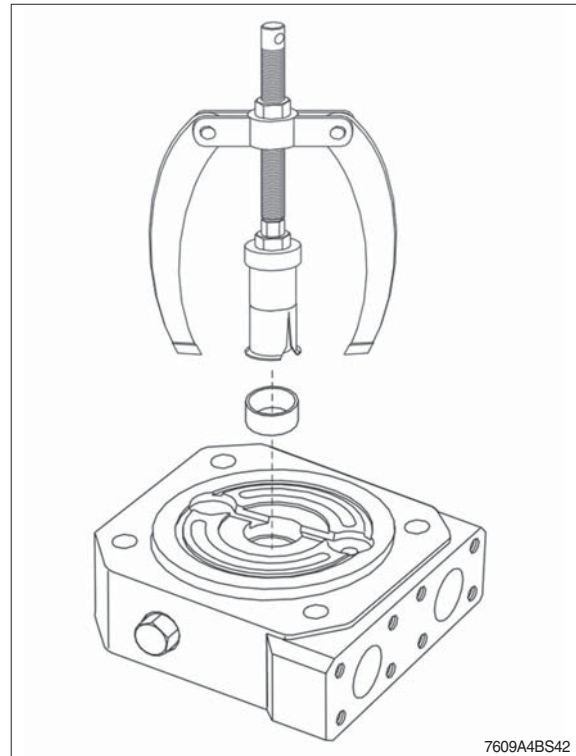
- (3) Remove the port plate.
※ Control plate can drop down-hold tight.



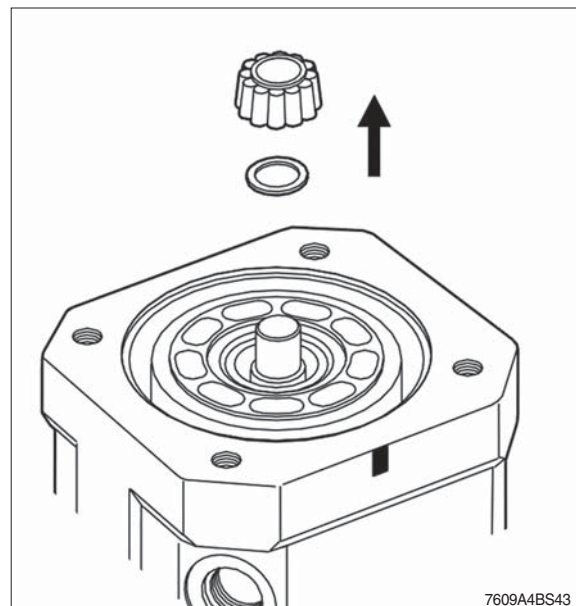
(4) Remove control plate.



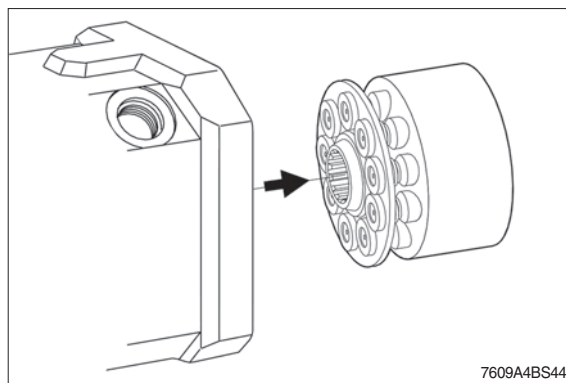
(5) Remove bearing outer ring with withdrawal tool.
Do not damage the sealing surface.



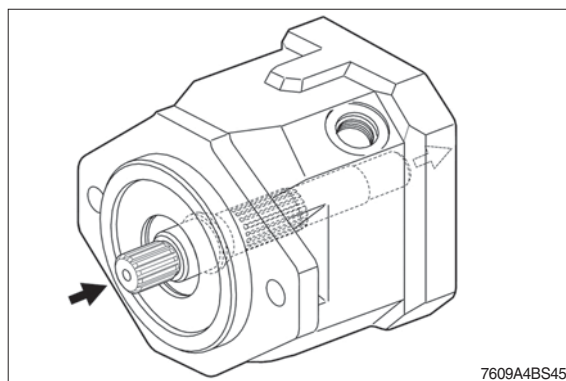
(6) Disassemble the taper roller bearing (near by port plate).
Remove the adjustment shim.



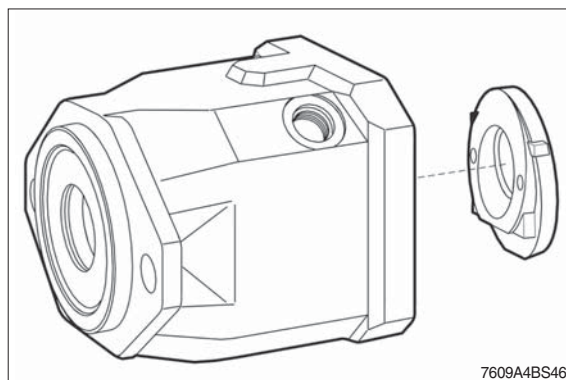
- (7) Remove the rotary group in a horizontal position.



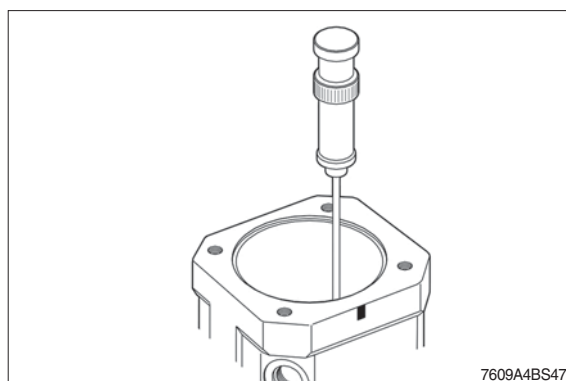
- (8) Remove the drive shaft to rear side.



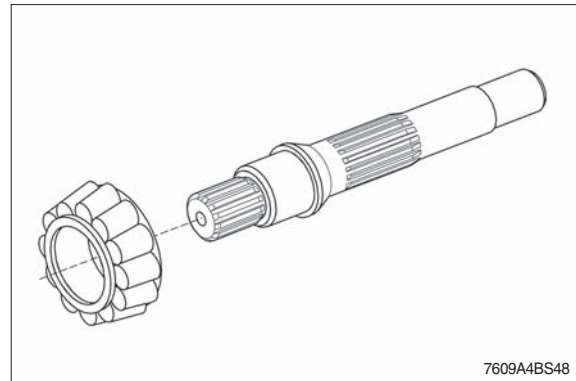
- (9) Remove swash plate with special tool (see the next figure).



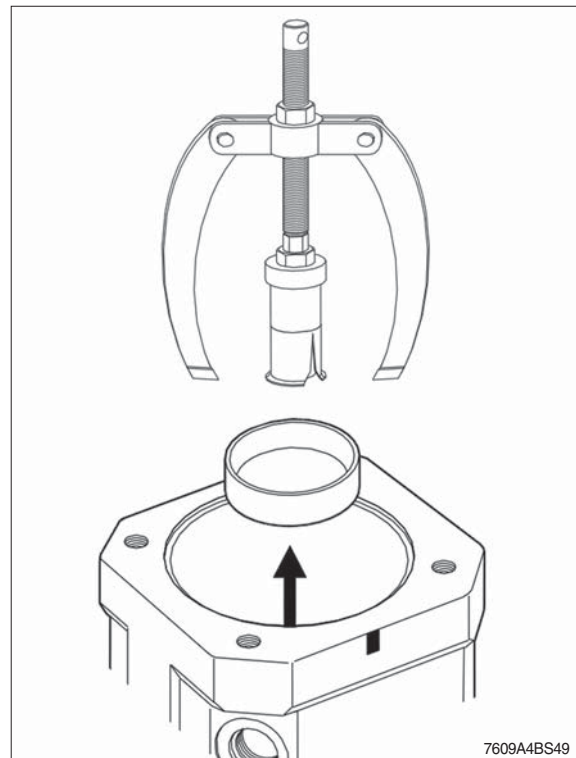
- (10) Loosen the swash plate with a slide hammer (a small hook - diameter 6 mm - catches the end of the swash plate at the bottom).



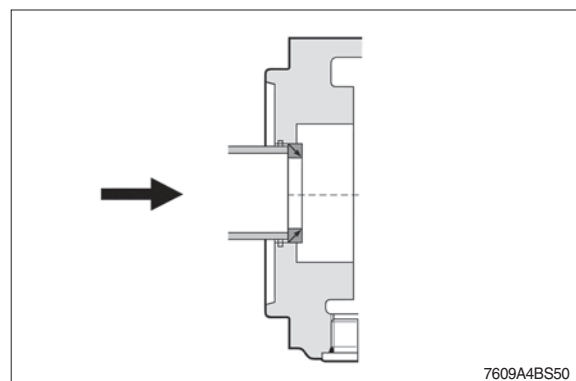
(11) Press down bearing.



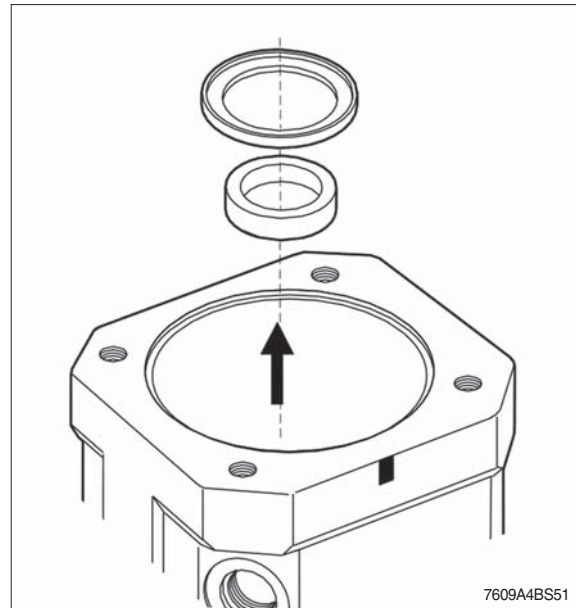
(12) The external front bearing ring is pulled out of the pump housing.



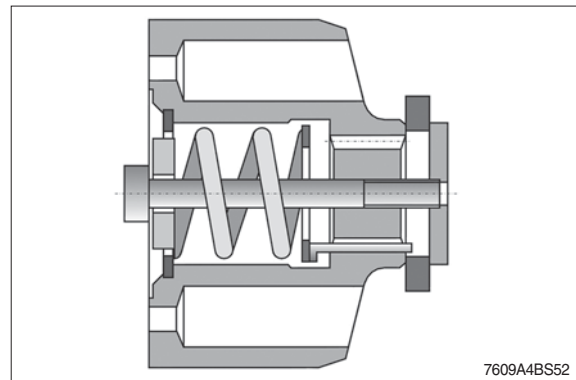
(13) Disassemble circlip and shaft seal.



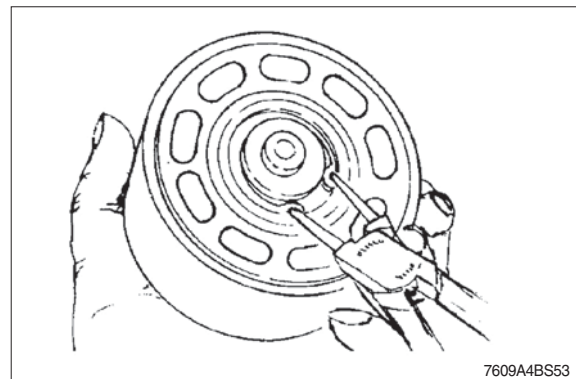
(14) Remove shaft seal and shim.



(15) Pre-tension the spring using a suitable device.

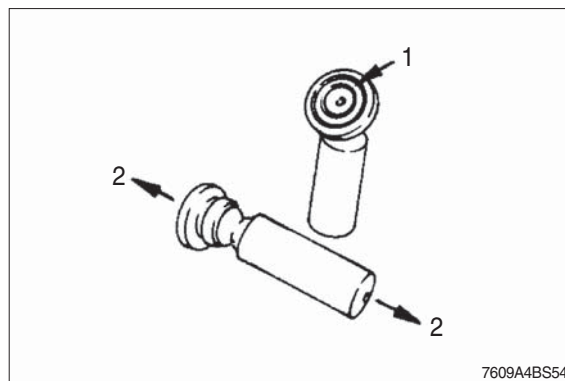


(16) Remove circlip.
Remove spring and pressure pins.

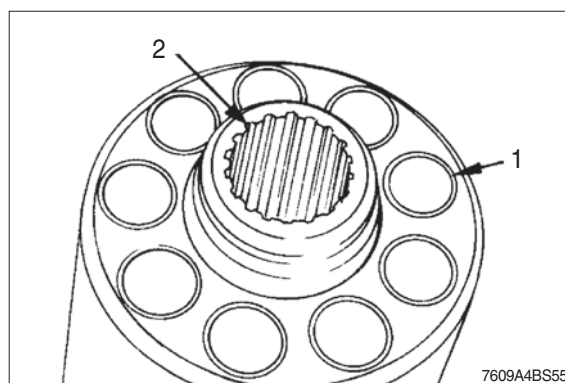


4) INSPECTION HINTS

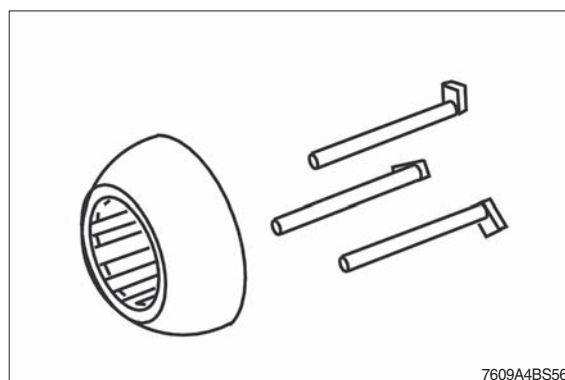
- (1) Check to see that there are no scratches or metal deposits on the sliding surface (1), and that there is no axial play (2), (pistons must only be replaced as a set).



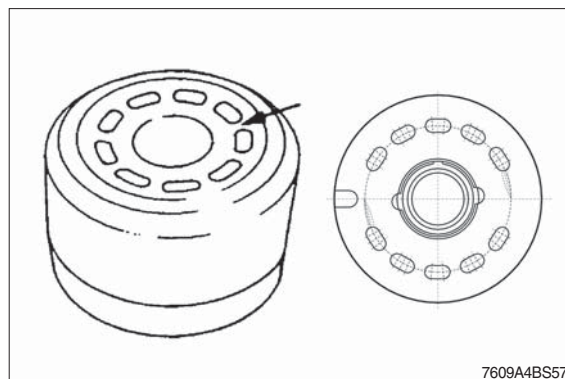
- (2) Check cylinder bores (1) and splines (2).



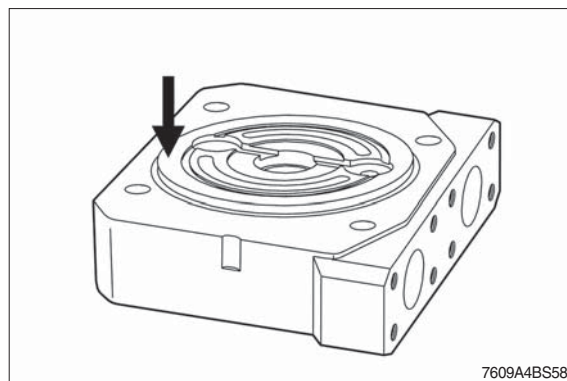
- (3) Free of grooves, no signs of wear.



- (4) Cylinder sliding surface free of grooves, no wear, no embedded foreign particles. That there are no scratches on the control plate. (Only replace them as a set).

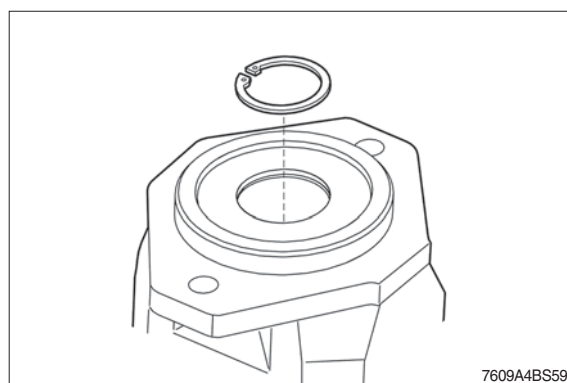


- (5) Mounting surface - control plate undamaged.

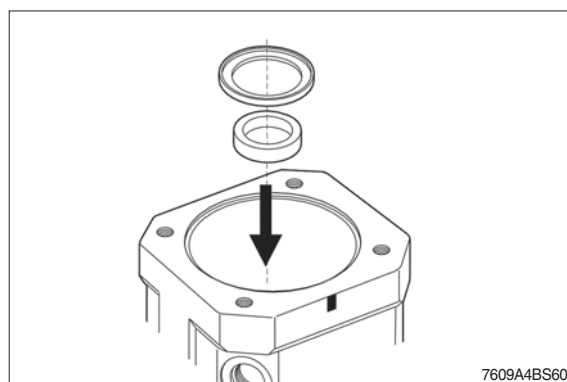


5) MOTOR ASSEMBLY

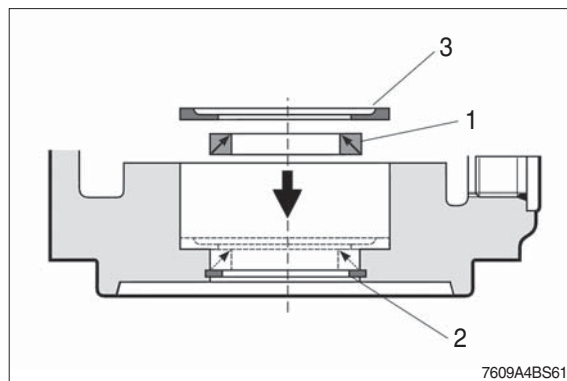
- (1) Fit the circlip into the housing.



- (2) Assemble shaft seal and shim against circlip.

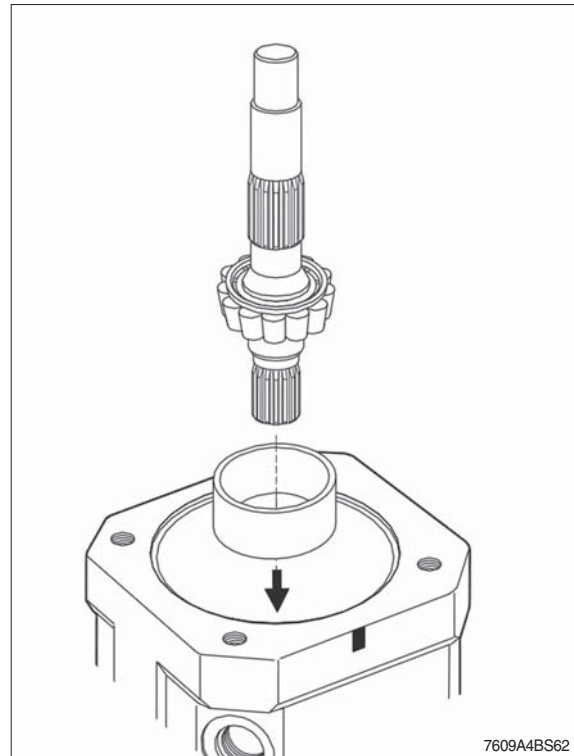


- (3) Assembly of the shaft seal (1) against the safety ring (2) back up the shim (3) down to the seal ring.

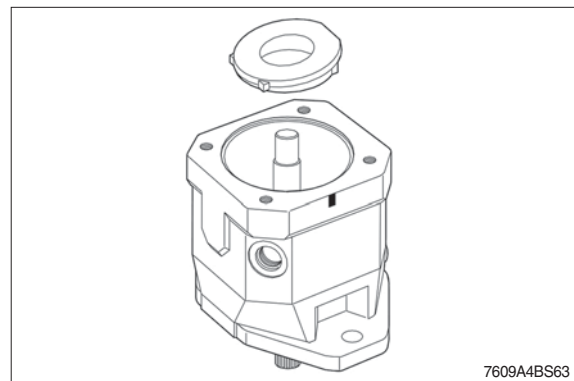


(4) Press outer bearing ring into housing.
Shaft seal with pre-assembled bearing into housing.

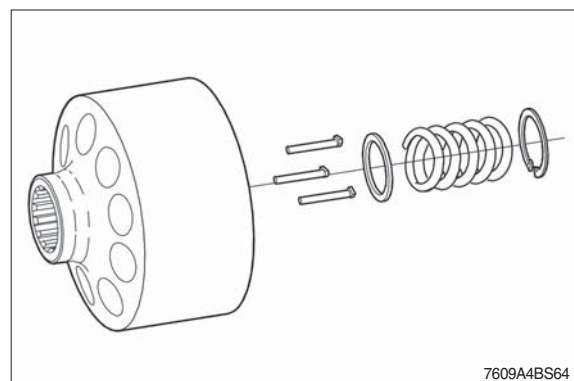
※ Protect splines of the shaft with plastic strip against damage of the seal lip.



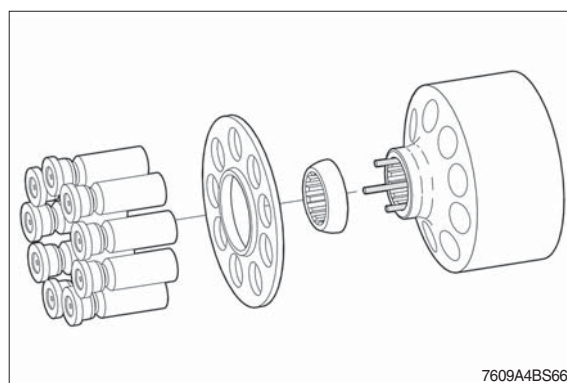
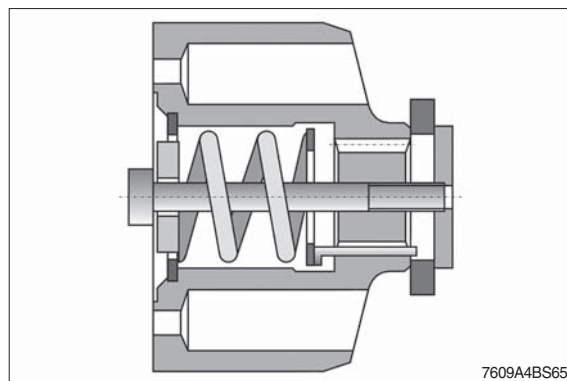
(5) Assemble swash plate.



(6) Fit pressure pins using an assembly aid.

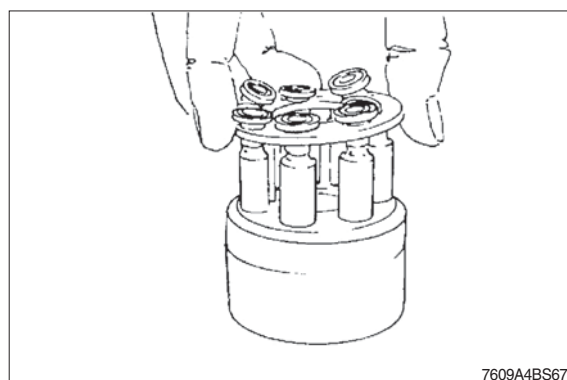


- (7) Pre-tension the spring using a suitable device.



- (8) Assemble piston with retaining plate.

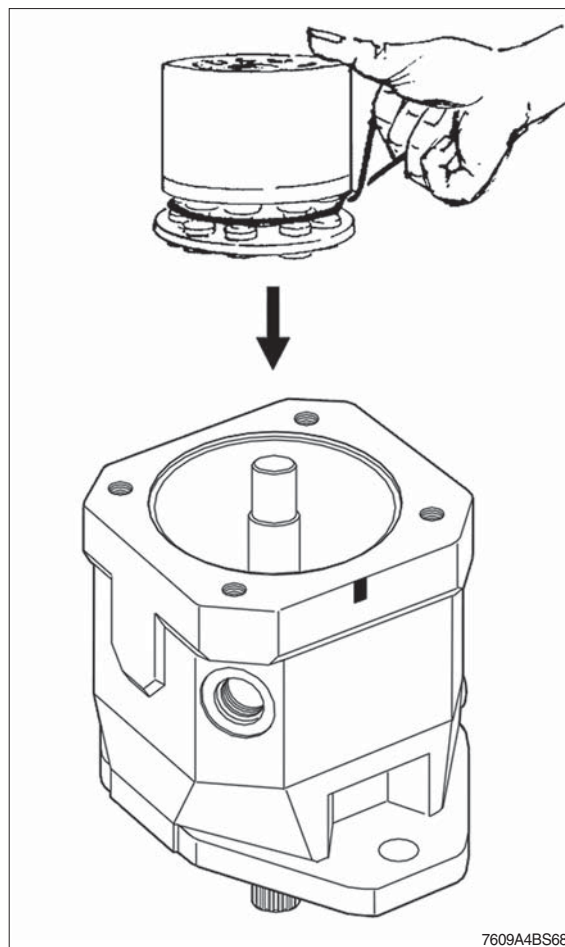
※ Oil piston and slipper pad.



(9) Fit rotary group.

※ Assembly aid :

Hold the pistons by using an O-ring.



(10) Fit bearing (1) in port plate.

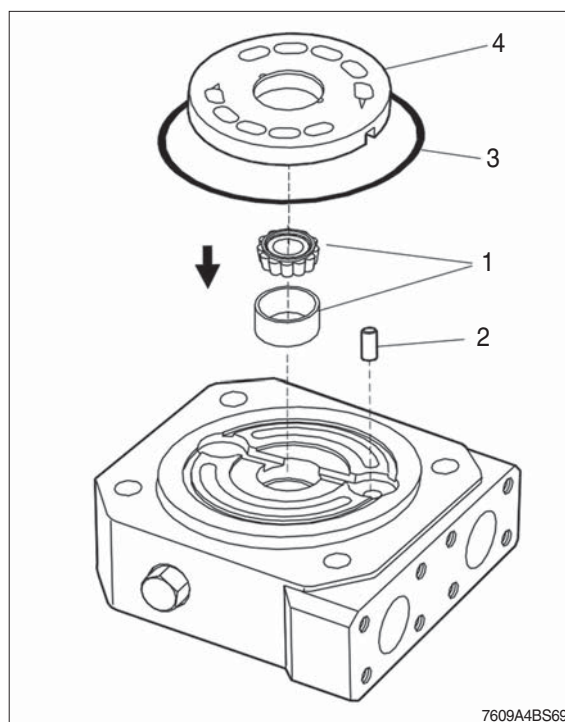
Fit cylindrical pin (2).

Fit O-ring (3).

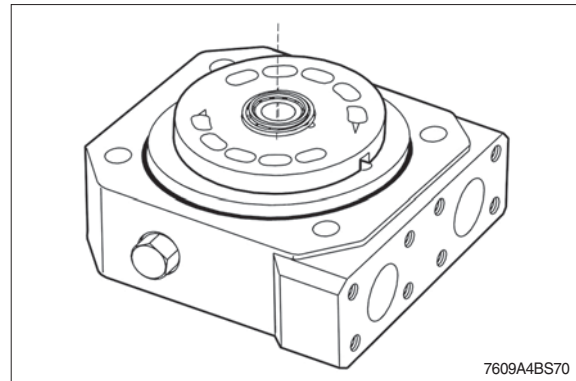
Fit control plate (4).

※ Assembly :

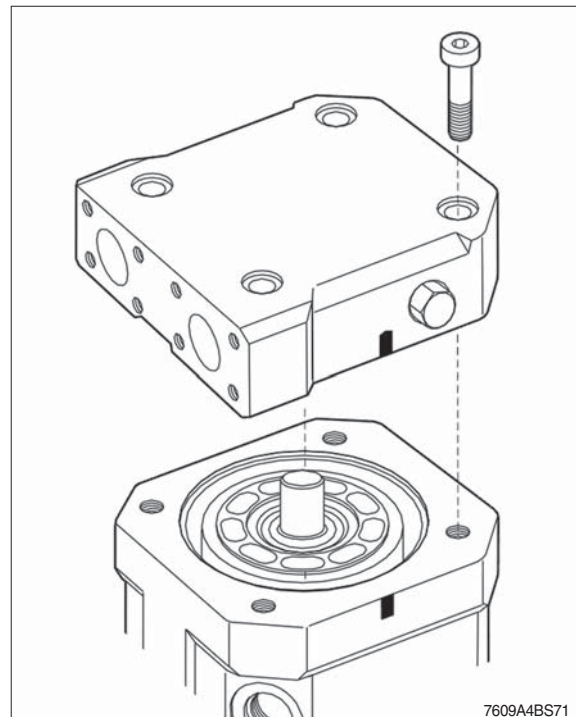
Hold the components in place with grease.



- (11) Fit control plate.
Assembly aid : Grease



- (12) Fit the port plate and fix it with the bolts crosswise.



SECTION 5 STEERING SYSTEM

| | | |
|---------|--|------|
| Group 1 | Structure and Function | 5-1 |
| Group 2 | Operational Checks and Troubleshooting | 5-16 |
| Group 3 | Tests and Adjustments | 5-24 |
| Group 4 | Disassembly and Assembly | 5-31 |

SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

The steering system of this machine consists of a variable displacement piston pump supplying a load sensing steering system and a closed center loader system.

This system offers faster response from the priority valve of flow amplifier and the pump. Also it offers advantages in connection with cold start up and improvements in system stability.

The components of the steering system are :

- Steering pump
- Flow amplifier
- Steering unit
- Steering cylinders

The flow amplifier contains a directional valve, an amplification stage, a priority valve, a pilot pressure relief valve and shock and suction valve.

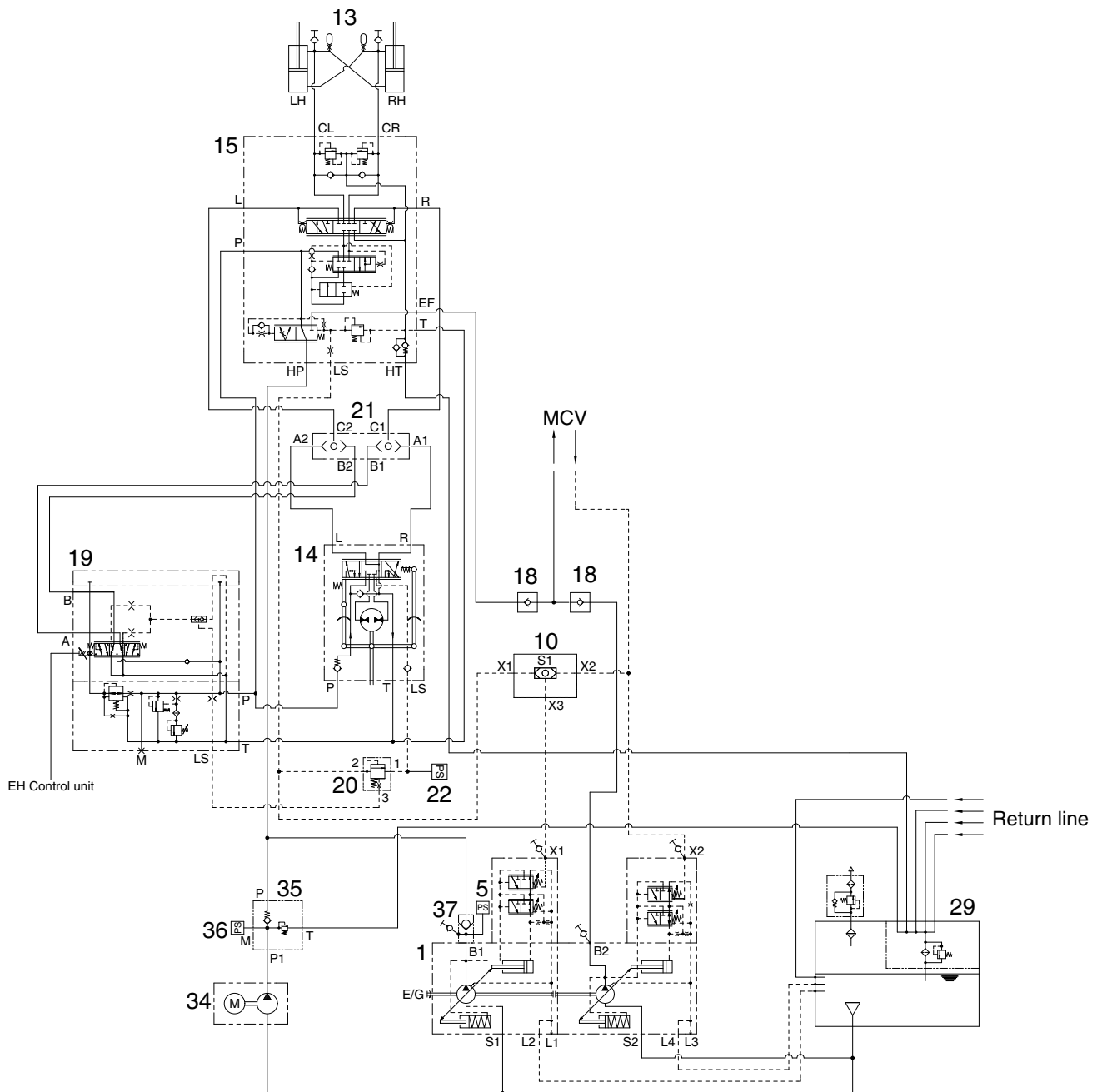
The steering pump, the first pump of hydraulic pump, draws hydraulic oil from the hydraulic tank.

Outlet flow from the pump flows to the priority valve of flow amplifier. The priority valve of flow amplifier preferentially supplies flow, on demand, to the steering unit. When the machine is steered, the steering unit routes flow to the steering cylinders to articulate the machine.

When the machine is not being steered, or if pump flow is greater than steering flow, the priority valve supplies flow to the loader system.

That is, output flow from the steering pump enters into the main control valve for the operation of the attachment.

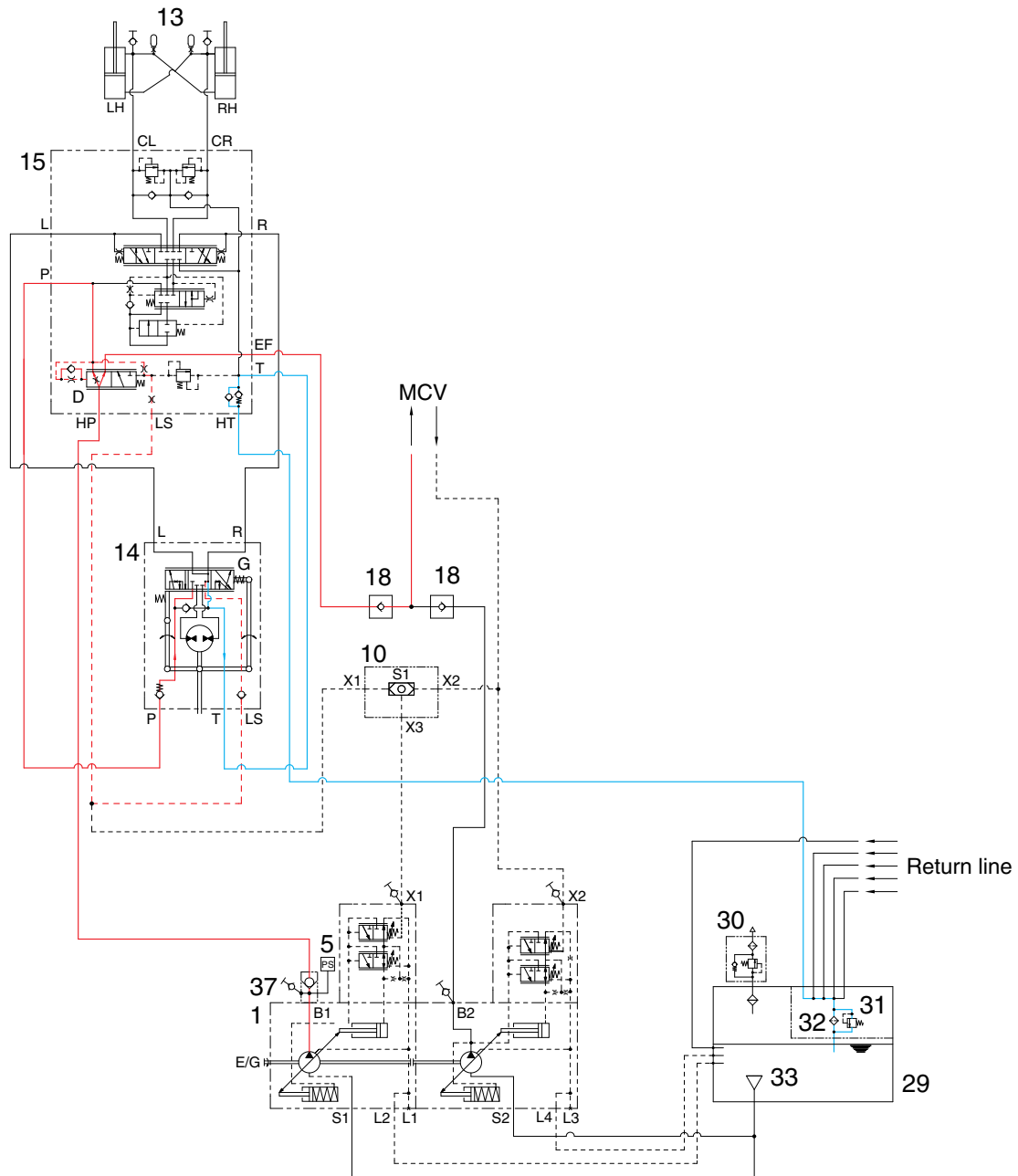
2. HYDRAULIC CIRCUIT



970A5SE01

- | | | |
|------------------------|-----------------------------------|-----------------------------|
| 1 Main pump (steering) | 18 Check valve | 34 Motor pump (option) |
| 5 Pressure sensor | 19 Proportional valve (option) | 35 Check block (option) |
| 13 Steering cylinder | 20 LS compensating valve (option) | 36 Pressure sensor (option) |
| 14 Steering unit | 21 Shuttle valve (option) | 37 Check valve (option) |
| 15 Flow amplifier | 22 Pressure sensor | |
| 16 Accumulator | 29 Hydraulic tank | |

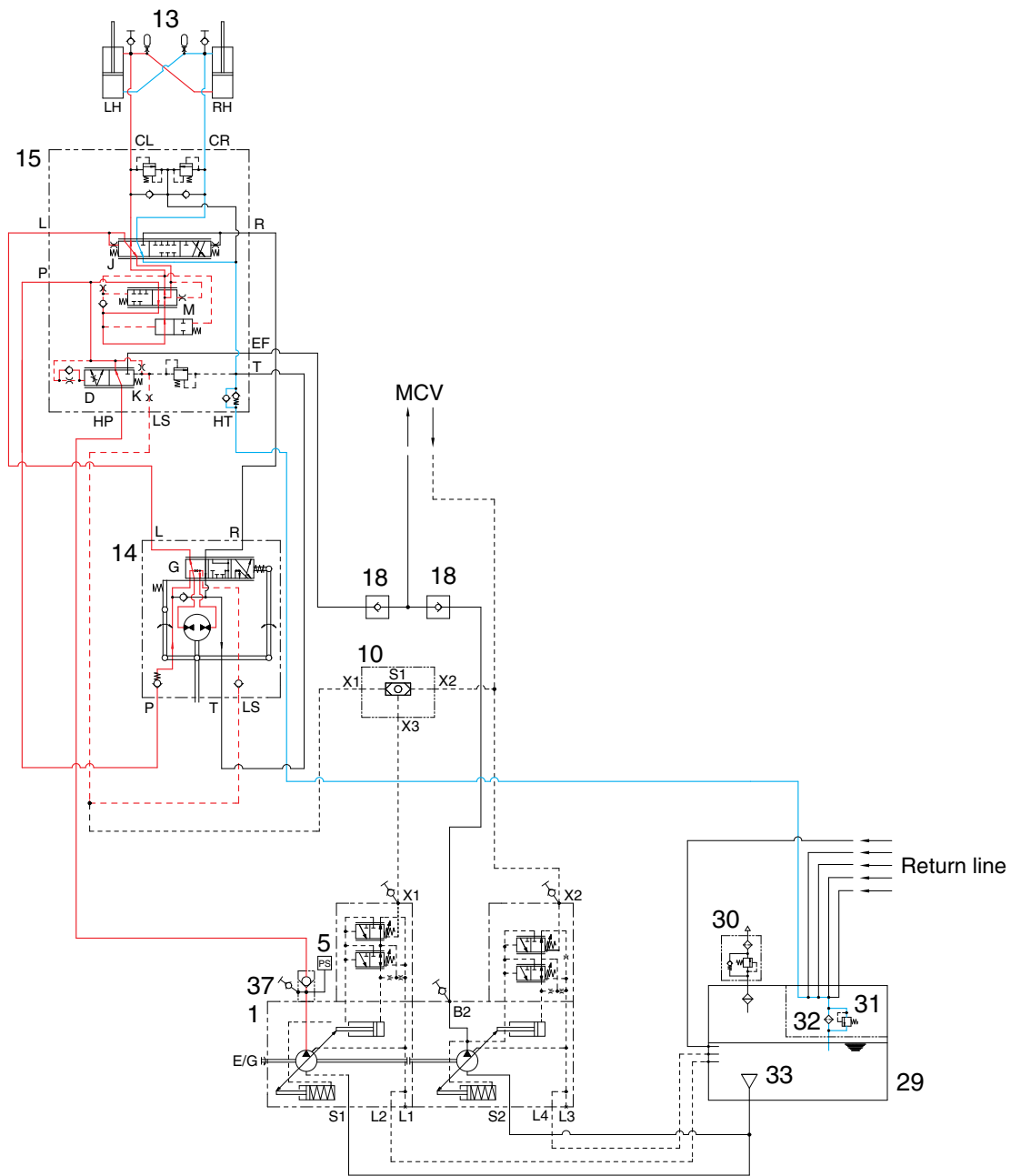
1) NEUTRAL



970A5SE02

- The steering wheel is not being operated so control spool (G) does not move.
- The oil from the steering pump enters port HP of the priority valve of flow amplifier and the inlet pressure oil moves the spool (D) to the right.
- Almost all of pump flow goes to the loader system (main control valve) through the EF port and partly flows into the hydraulic tank (29) through the control spool (G).
This small flow is useful to prevent the thermal shock problem of the steering unit(14).

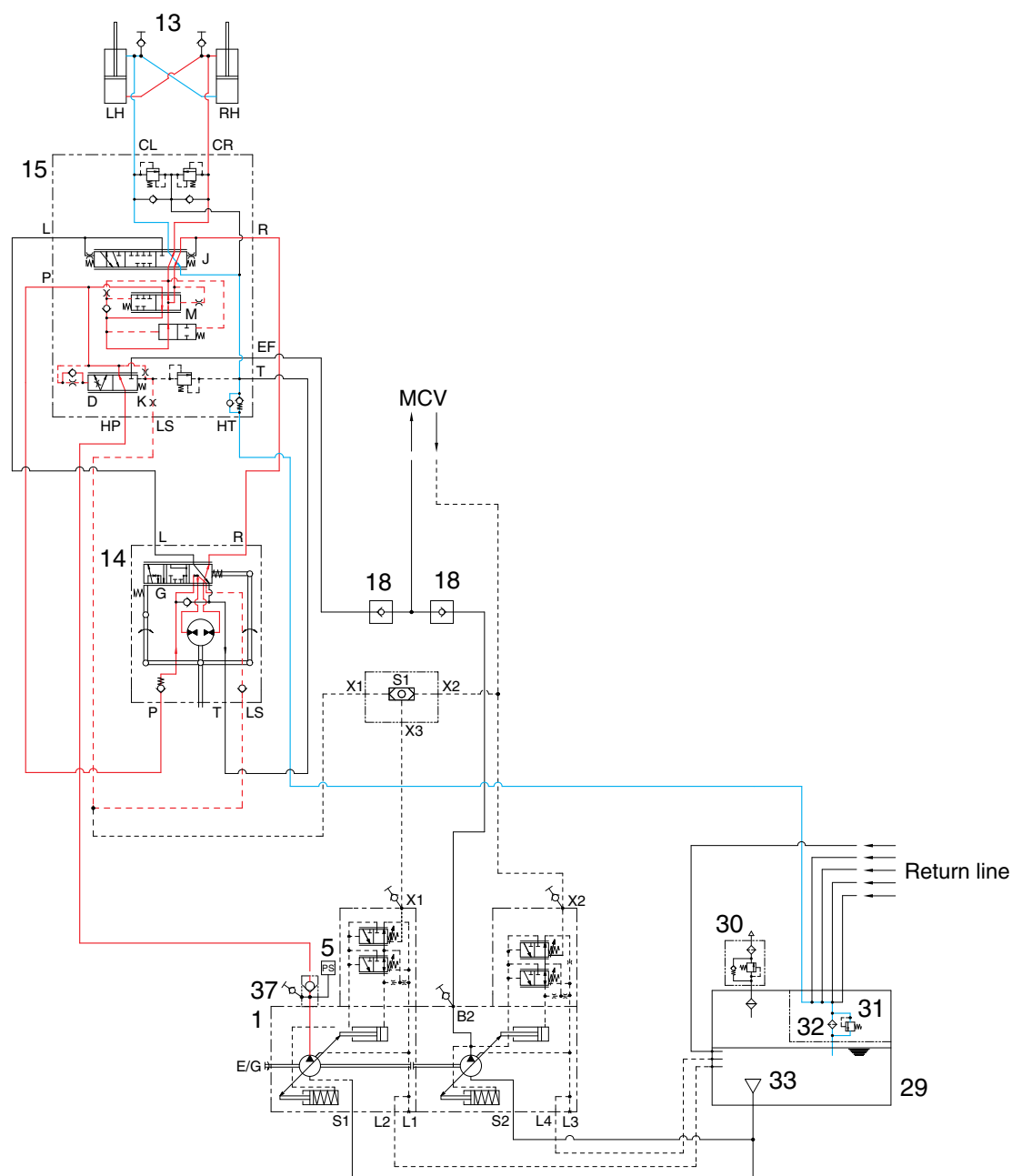
2) LEFT TURN



970A5SE03

- When the steering wheel is turned to the left, the spool (G) within steering unit (14) connected with steering column shaft is pushed to the right direction.
- The oil discharged from the pump flows into HP port of flow amplifier (15).
- The delivered oil passes through the main orifice of steering unit (5), through the priority valve spool (D) of flow amplifier (15). The position of priority spool (D) is determined when the pressure difference between front and rear of main orifice is balanced with control spring (K) force.
- The oil supplied through the directional spool (J) from the steering unit (14) is combined with the direct oil from the priority valve spool (D) in the amplifier spool (M).
The amplified oil flows into the small chamber of the left steering cylinder and large chamber of the right steering cylinder respectively. Oil returned from left and right cylinder returns to hydraulic tank through directional spool (J) of flow amplifier (15).
- When the above operation is completed, the machine turns to the left.

3) RIGHT TURN

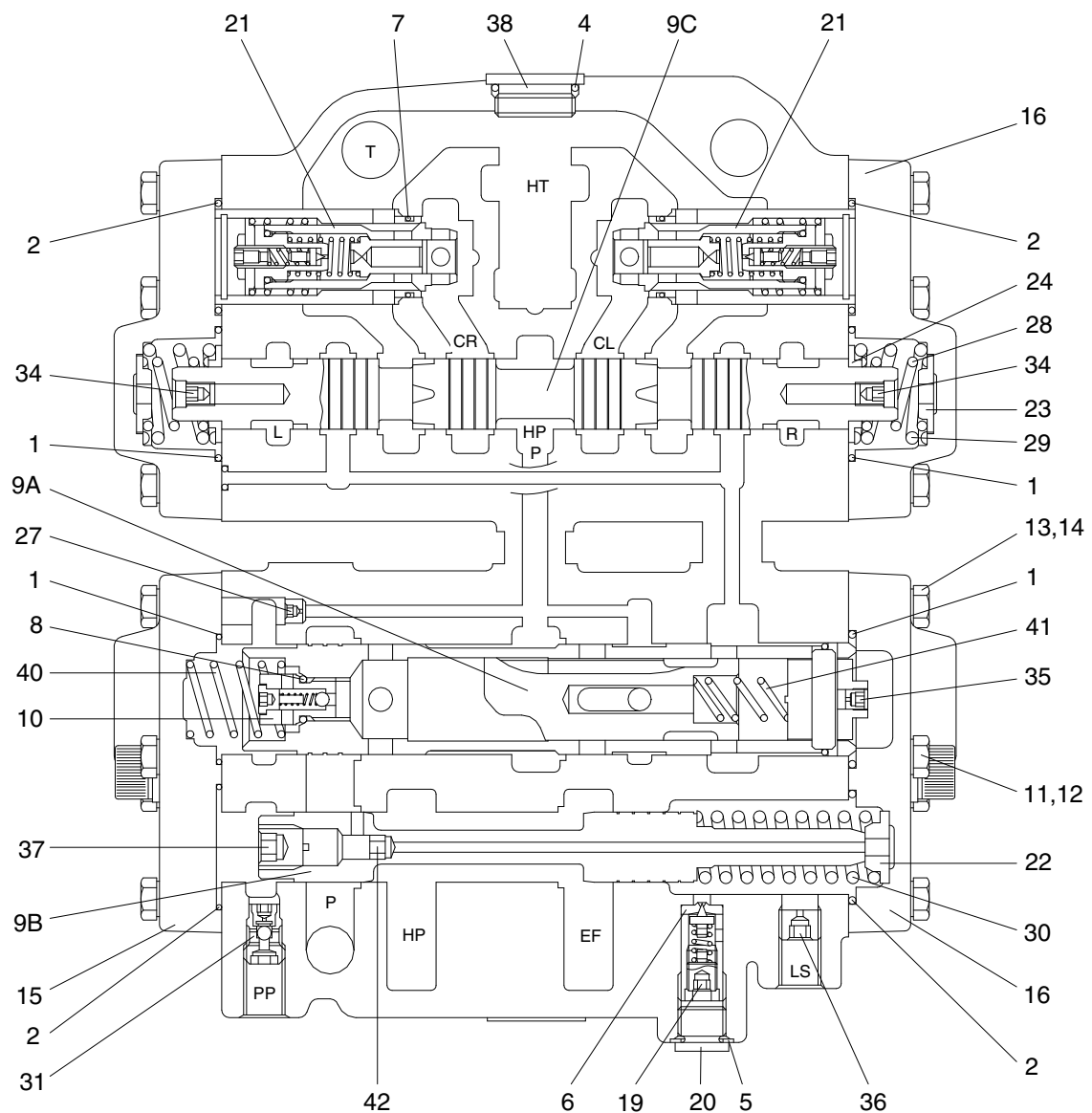


970A5SE04

- When the steering wheel is turned to the right, the spool (G) within steering unit (14) connected with steering column shaft is pushed to the right direction.
- The oil discharged from the pump flows into HP port of flow amplifier (15).
- The delivered oil passes through the main orifice of steering unit (14), through the priority valve spool (D) of flow amplifier (15). The position of priority spool (D) is determined when the pressure difference between front and rear of main orifice is balanced with control spring (K) force.
- The oil supplied through the directional spool (J) from the steering unit (14) is combined with the direct oil from the priority valve spool (D) in the amplifier spool (M). The amplified oil flows into the small chamber of the right steering cylinder and large chamber of the left steering cylinder respectively.
- Oil returned from left and right cylinder returns to hydraulic tank through directional spool (J) of flow amplifier (15).
- When the above operation is completed, the machine turns to the right.

3. FLOW AMPLIFIER

1) STRUCTURE



(770-7) 5-6

| | | |
|----------------------|-------------------------|-------------------------|
| 1 O-ring | 12 Spring washer | 28 Spring |
| 2 O-ring | 13 Screw | 29 Spring |
| 4 O-ring | 14 Spring washer | 30 Spring |
| 5 Washer | 15 End cover | 31 Throttle check valve |
| 6 Washer | 16 End cover | 34 Orifice |
| 7 O-ring | 19 Relief valve | 35 Orifice |
| 8 O-ring | 20 Plug | 36 Orifice |
| 9A Amplifier valve | 21 Shock, suction valve | 37 Plug |
| 9B Priority valve | 22 Spring seat | 38 Plug |
| 9C Directional valve | 23 Spring seat | 40 Spring |
| 10 Check valve | 24 Spring guide | 41 Spring |
| 11 Screw | 27 Orifice | 42 Orifice |

2) OPERATION

(1) Introduction

The flow amplifier contains a directional valve, an amplification stage, a priority valve, a pilot pressure relief valve and shock and suction valves.

The flow amplifier amplifies the oil flow from the steering unit cylinder ports L or R by an amplification factor of 8. The amplified oil flow is directed from the flow amplifier ports CL or CR to the steering cylinder. The amplified flow is proportional to the rate of the steering wheel rotation. If the oil flow from the pump fails, the flow amplifier cuts off the amplification.

(2) Priority valve

The priority valve is used in load sensing systems where the same pump supplies oil to both steering system and working hydraulics.

The steering system always has first priority.

The pressure on the LS connection is almost zero during measuring (Steering unit in neutral position).

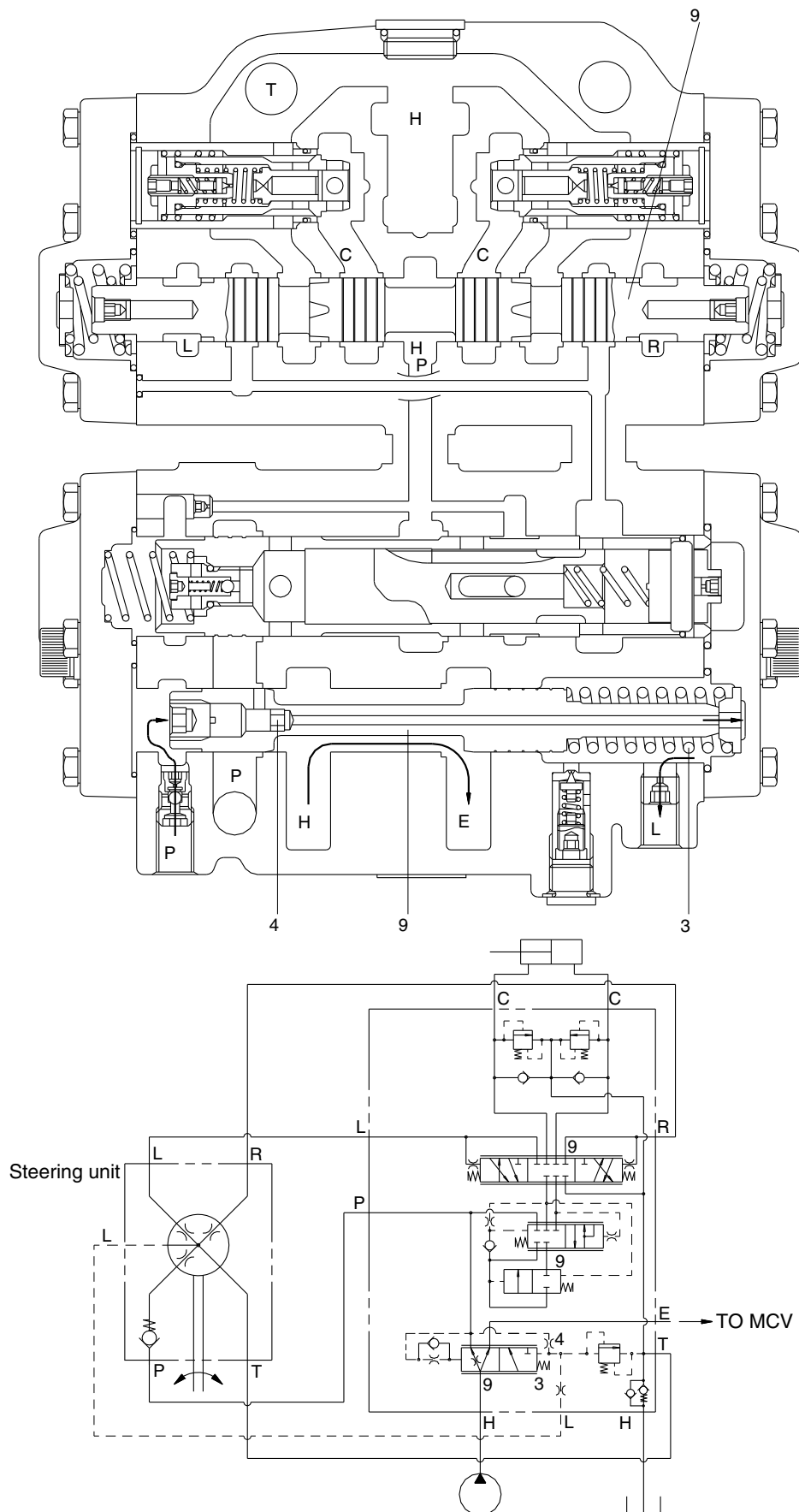
(3) Shock valves

The shock valves protect the flow amplifier against shock from external forces on the steering cylinders. The shock valves in flow amplifier limit the maximum pressure drop from CL to HT and from CR to HT.

(4) HP-HT ports characteristic

The pilot pressure relief valve protects the steering unit against excess pressure. The pilot pressure relief valve together with the priority valve limit the maximum steering pressure HP-HT.

(5) Neutral



980A5SE100

In neutral position, the oil passes from the pump across the integrated priority valve (9B) in the flow amplifier for discharge through the EF port. With the steering unit in neutral, flow through it is blocked and all flow through the priority valve (9B) in flow amplifier is directed out the EF port to the loader control valve.

With the engine off, the priority valve spool (9B) is pushed to the left by the spring (30). The passage to the EF port is blocked while the passage to the P port is open.

When the machine is first started, all pump flow is routed to the steering unit which blocks the flow. With the flow blocked, the pressure increases.

Steering inlet pressure is supplied through the dynamic orifice (42) in the spool. This causes the priority valve spool (9B) to shift to the right against the spring (30) and open the EF port.

As long as the steering unit is in neutral, just enough pressure is maintained at the steering unit to keep the priority valve spool (9B) shifted to the right.

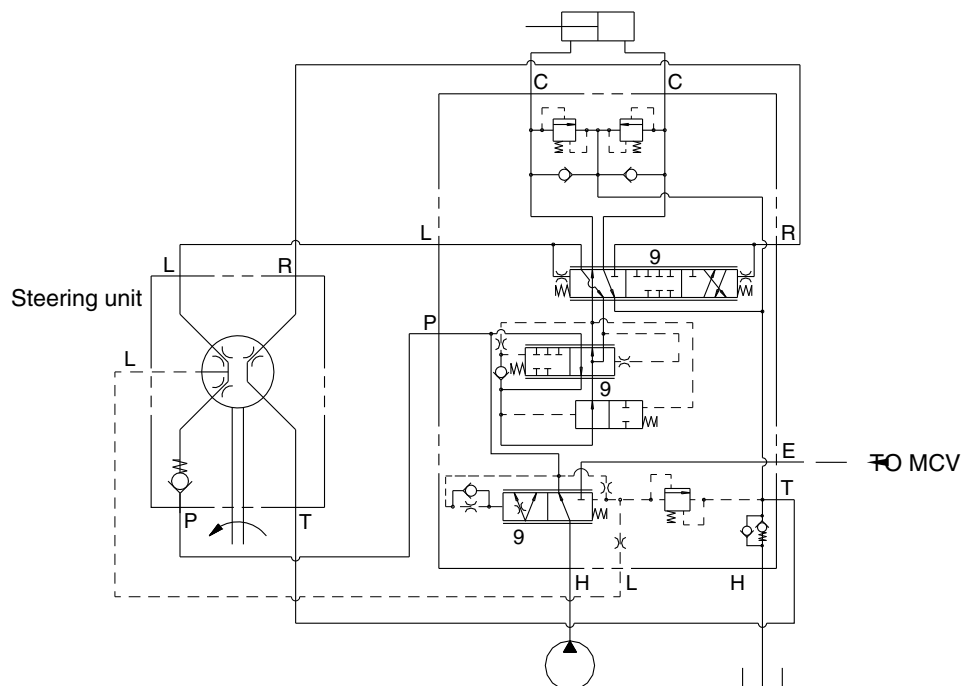
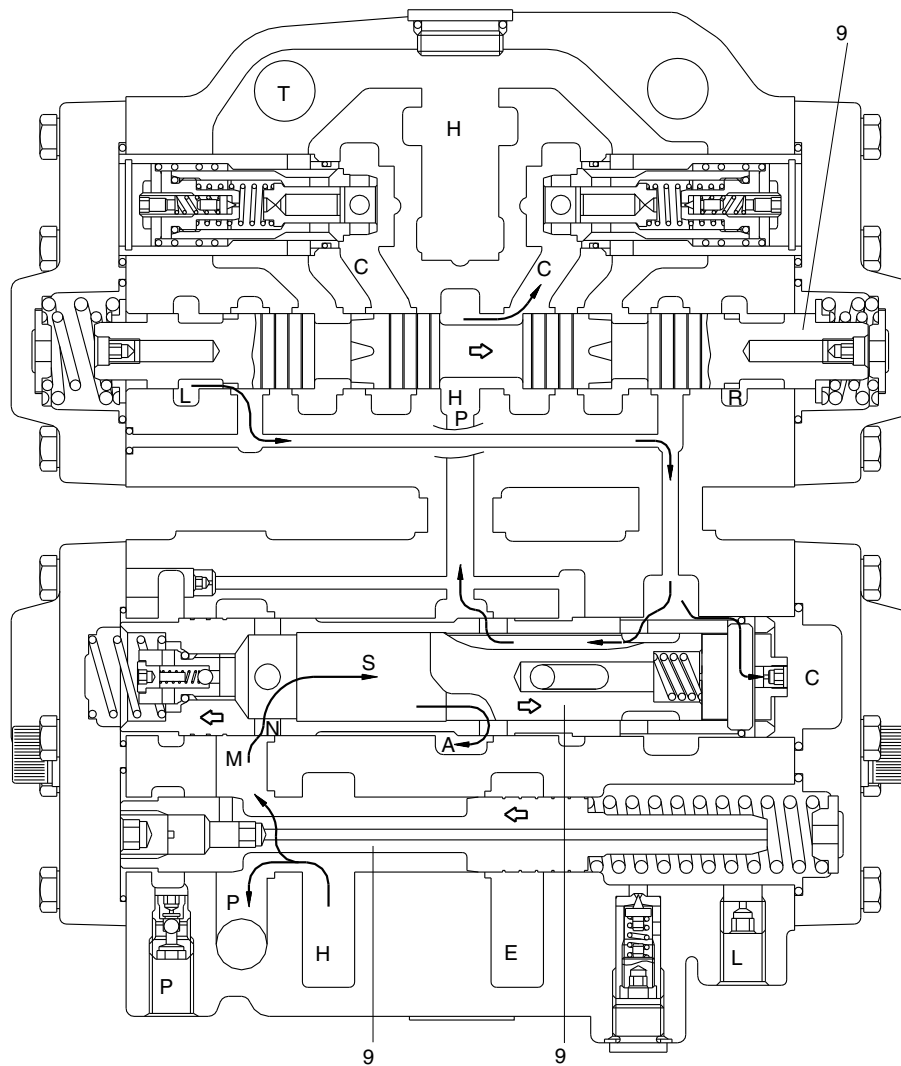
The operating pressure in the loader system has no effect on the operation of the priority valve (9B) of flow amplifier. With the loader actuated in relief, the priority valve (9B) will not shift until the machine is steered.

Flow through the priority valve spool (9B) passes from the P port through the orifice (42) and into the LS port. It flows through the steering unit LS passage which is routed to return when the steering unit is in neutral. This provides a warm-up circuit for the steering unit to prevent binding of the steering unit due to oil temperature extremes.

In neutral position, also the directional valve (9C) is in its center position.

This means that knock and impacts from the cylinder are not transmitted to the steering unit. The flow amplifier is thus of the non-reaction type.

(6) Mid-turn



980A5SE101

If the steering wheel is turned to the left, a LS signal is passed to the priority valve (9B).

The priority valve (9B) is reversed so that more oil is passed across the P port to the steering unit for discharge through the L port of the flow amplifier.

The directional valve (9C) is reversed through the pressure being transmitted across the boring in the spool whereby the spool is moved the right.

The opening shall allow connection between the pilot flow and the pressure control/amplifier valve (9A).

The pilot pressure from the orifice in chamber C moves the valve to the left and passage for the pilot flow therefore is possible out of hole F.

The main flow passes from the priority valve (9B) to the circular channel M. As the amplifier spool is moved to the left, the passage will now be open across the holes N to the chamber S.

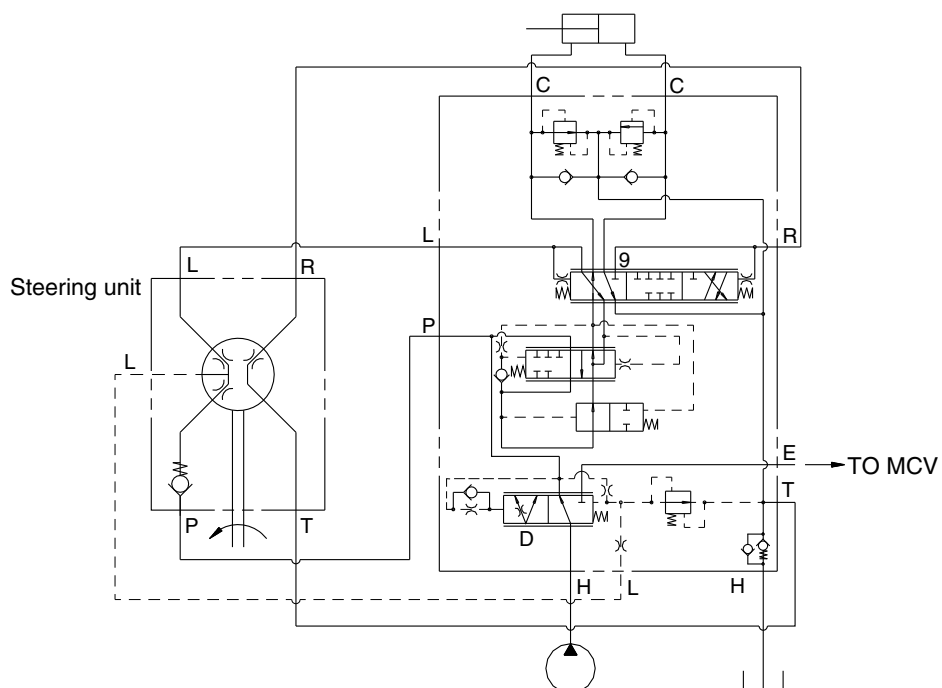
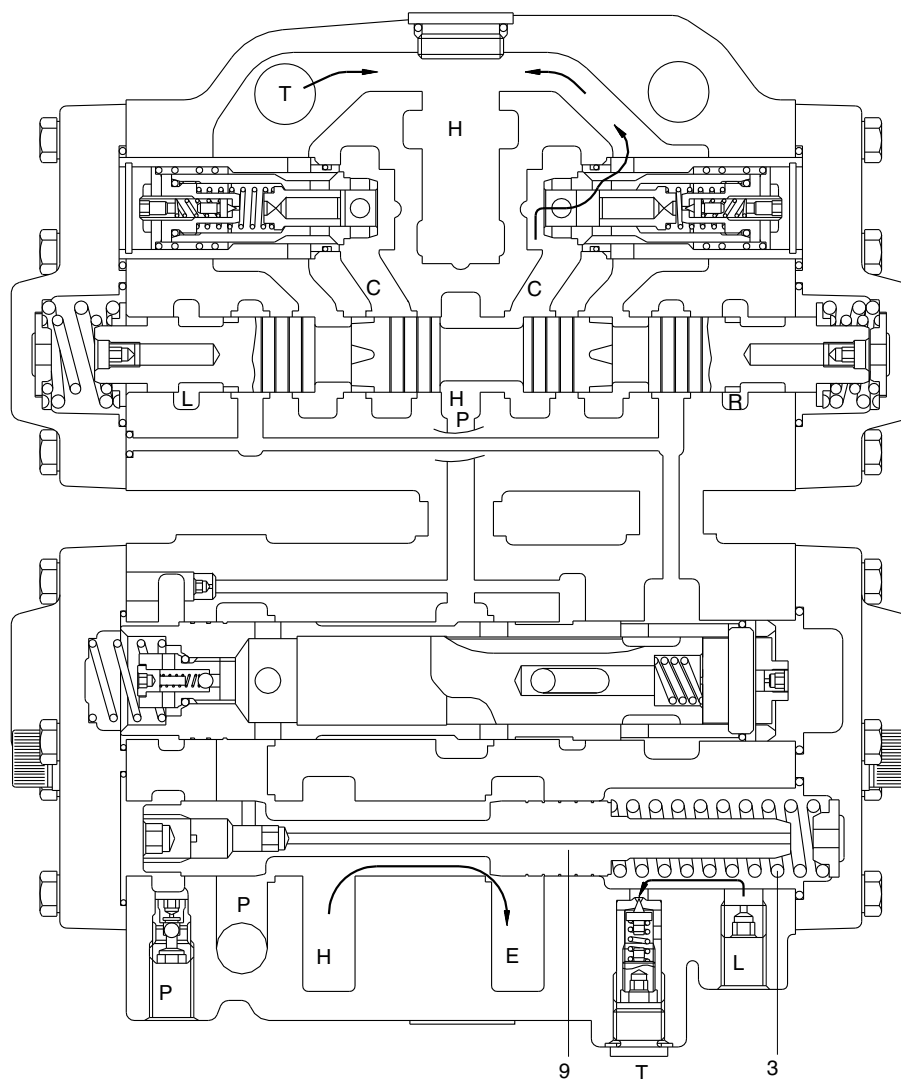
The spool goes to a position so that the pressure in chamber S equals the pressure in chamber C.

The passage is now open for the main flow through the priority valve (9B) across the holes A.

The main flow and pilot flow merge and is passed across the directional valve (9C) to the steering cylinder through CL port.

The return oil passes across the directional valve (9C) to the hydraulic tank.

(7) Full turn



980A5SE102

When the machine is steered to a full turn, the frames bottom against the steering stops. To limit steering system pressure, a relief system is built into the priority valve assembly (9B).

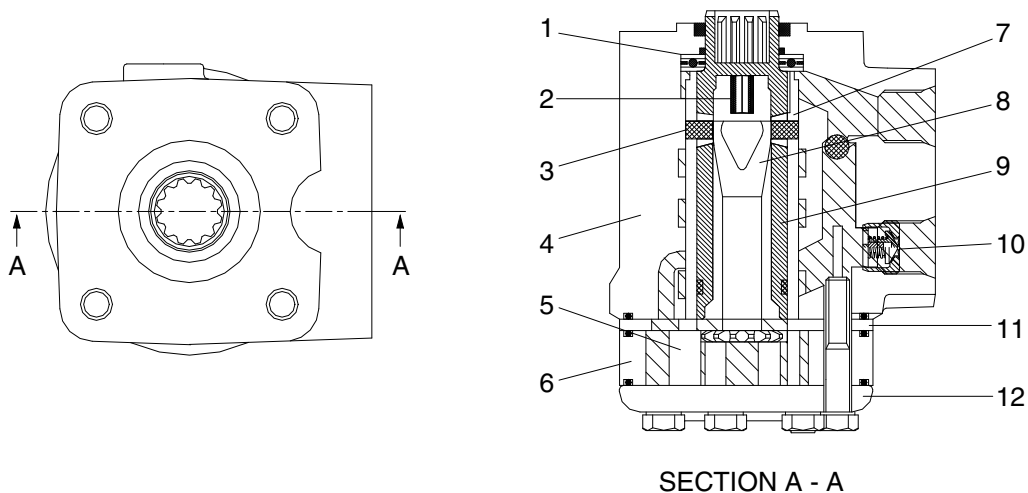
When the frames bottom is stopped, the pressure in the steering cylinders increases. This pressure is sensed at the LS port. When the pressure in the LS port increases enough to push priority valve spool (9B) off its seat, oil in the load sensing circuit flows to return through the T port. Load sensing pressure is limited to the pressure setting of the relief valve.

Pressure to the steering unit (pilot pressure), which is sensed at the left end of the priority valve spool (9B) in flow amplifier, continues to increase until it can move the spool to the right against the load sensing pressure plus spring (30) force. At this time, all oil flows out of the EF port to the loader control valve.

If the loader attachment is being operated while steering, the loader function will slow until the machine reaches the steering stops. At that time, the loader cycle speed will increase until the machine is steered again.

4. STEERING UNIT

1) STRUCTURE



7607SE17

| | | | | | |
|---|-------------------------|---|--------------|----|-------------------|
| 1 | Bearing | 5 | Gear wheel | 9 | Spool |
| 2 | Neutral position spring | 6 | Gear rim | 10 | Check valve |
| 3 | Cross pin | 7 | Sleeve | 11 | Distributor plate |
| 4 | Housing | 8 | Cardan shaft | 12 | End cover |

2) OPERATION

The steering unit consists of a rotary valve and a rotary meter.

Via a steering column the steering unit is connected to the steering wheel of the machine.

When the steering wheel is turned, oil is directed from the steering system pump via the rotary valve (spool and sleeve) and rotary meter (gear wheel set) to the cylinder ports L or R, depending on the direction of turn. The rotary meter meters the oil flow to the steering cylinder in proportion to the angular rotation of the steering wheel.

Spool (9) is connected directly to the drive shaft of steering wheel. It is connected to sleeve (7) by cross pin (3) (not in contact with the spool when the steering wheel is at neutral) and neutral position spring (2).

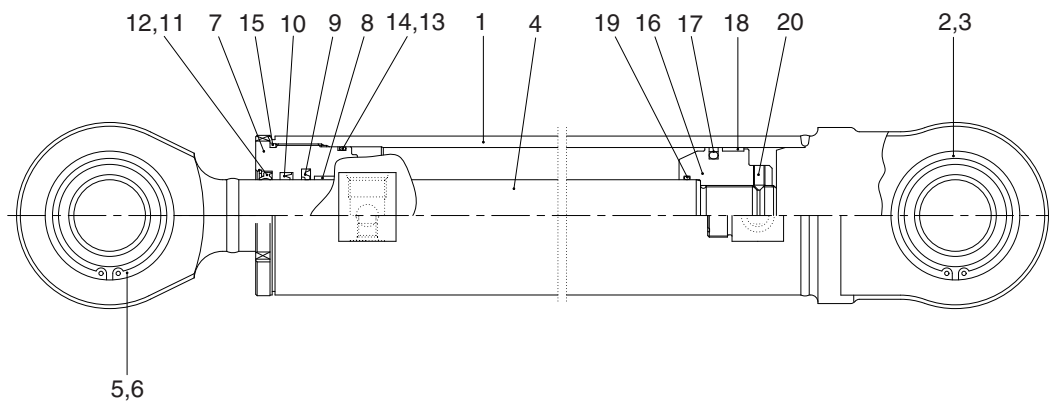
Cardan shaft(8) is meshed at the top with cross pin (3) and forms one unit with sleeve (7).

At the same time, it is meshed with gear rim (5) of the gerotor set by spline.

There are four ports in valve body. They are connected to the pump circuit, tank circuit, and the head, and left and right steering cylinder. In addition, the pump port and tank port are connected inside the body by the check valve. Therefore, if there is any failure in the pump of engine, oil can be sucked in directly from the tank through the check valve.

5. STEERING CYLINDER

1) STRUCTURE



77095SE17

| | | | | | |
|---|-------------------|----|----------------|----|-------------|
| 1 | Tube assembly | 8 | Rod bushing | 15 | O-ring |
| 2 | Spherical bearing | 9 | Buffer seal | 16 | Piston |
| 3 | Retaining ring | 10 | U-packing | 17 | Piston seal |
| 4 | Rod assy | 11 | Dust wiper | 18 | Wear ring |
| 5 | Spherical bearing | 12 | Retaining ring | 19 | O-ring |
| 6 | Retaining ring | 13 | O-ring | 20 | Set screw |
| 7 | Gland | 14 | Back up ring | | |

2) OPERATION

This machine use to cross connected cylinder for steering operation.

The steering cylinder use a gland (7) to remove piston and sealed seals. Dust wiper (11) located on the in side of the glands (7) protects cylinder inner parts from dust. The piston (16) is fastened to the rod (4).

The piston uses a single wear ring (18) with a piston seal (17) to seal between the piston and tube. The gland seals against the tube with two O-rings. The rod is sealed against the gland with a U-packing (10).

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

This procedure is designed so the service man can make a quick check of the steering system using a minimum amount of diagnostic equipment. If you need additional information, refer to structure and function in group 1.

A location will be required which is level and has adequate space to complete the checks.

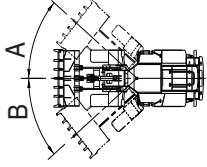
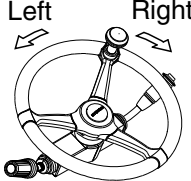
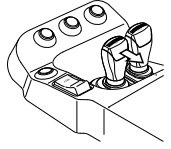
The engine and all other major components must be at operating temperature for some checks.

Locate system check in the left column and read completely, following this sequence from left to right. Read each check completely before performing.

At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be give repair required and group location. If verification is needed, you will be give next best source of information :

- Chapter 2 : Troubleshooting
- Group 3 : Tests and adjustments

※Hydraulic oil must be at operating temperature for these checks (refer to page 6-55).

| Item | Description | Service action |
|---|--|---|
| Steering unit check  | <p>Run engine at low idle.</p> <p>Turn steering wheel until frames are at maximum right (A) and then left (B) positions.</p> <p>LOOK : Frames must move smoothly in both directions.</p> <p>When steering wheel is stopped, frames must stop.</p> <p>FEEL : Excessive effort must not be required to turn steering wheel.</p> <p>NOTE : It is normal for steering to drift from stops when steering wheel is released.</p> | <p>OK Check completed.</p> <p>NOT OK Go to next check.</p> |
| Steering system leakage check Heat hydraulic oil to operating temperature. Run engine at high idle. |  <p>Turn steering wheel rapidly until frames are against stop.</p> <p>Hold approximately 2 kg on steering wheel.</p> <p>Count steering wheel revolutions for 1 minute.</p> <p>Repeat test in opposite direction.</p> <p>LOOK : Steering wheel should rotate less than 7 rpm.</p> <p>NOTE : Use good judgment;</p> <p>Excessive steering wheel rpm does not mean steering will be affected.</p> | <p>OK Check completed.</p> <p>NOT OK Do steering system leakage test in group 3 to isolate the leakage.</p> |
| Priority valve (in flow amplifier) low pressure check | <p>Park machine on a hard surface.</p> <p>Hold brake pedal down.</p> <p>Run engine at high idle.</p> <p>Steer machine to the right and left as far as possible.</p> <p>LOOK : Machine must turn at least half way to the right and left stops.</p> | <p>OK Check completed.</p> <p>NOT OK Do flow amplifier pressure test in group 3.</p> |
| Priority valve (in flow amplifier) high pressure check Run engine at high idle. |  <p>Steer to steering stop and release steering wheel.</p> <p>Roll bucket back and hold over relief and observe engine rpm.</p> <p>Turn steering wheel to steering stop and hold, observe engine rpm.</p> <p>LOOK : Steering stall engine rpm must be higher than hydraulic stall rpm.</p> | <p>OK Check completed.</p> <p>NOT OK Priority pressure is set too high. Do flow amplifier pressure test in group 3.</p> |

2. TROUBLESHOOTING

※ Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (see group 3 in section 1)

Step 2. Operational checks (in this group)

Step 3. Troubleshooting

Step 4. Tests and adjustments (see group 3)

| Problem | Cause | Remedy |
|---|--|---|
| No steering | Low oil level. Failed steering pump. Failed main pump drive. Stuck priority valve spool. Broken priority valve spring. Relief valve in flow amplifier stuck open. | Add recommended oil. Remove and inspect return filter for metal pump particles. Do main pump flow test. Remove and inspect priority valve spool. Remove and inspect spring. Do relief cartridge leakage test in group 3. |
| No hydraulic functions steering normal | Stuck open system relief valve. Locked safety valve. Plugged pilot line filter. Failed hydraulic pump. Low secondary pressure of RCV. | Replace relief valve. Unlock safety valve. Inspect and replace. Remove and inspect the pump. Check the pressure and replace if necessary. |

| Problem | Cause | Remedy |
|---|--|--|
| Slow or hard steering | Too much friction in the mechanical parts of the machine. Cold oil. Low priority valve pressure setting. Worn hydraulic pump. Sticking priority valve spool. Broken priority valve spring. | Lubricate bearings and joints of steering column or repair if necessary. Check steering column installation. Warm the hydraulic oil. Do priority valve pressure test. Clean or replace cartridge in flow amplifier. Do hydraulic pump performance check . Remove and inspect. Remove and inspect. |
| Constant steering to maintain straight travel | Air in system. Leakage in steering system. Worn steering unit. Leaf spring without spring force or broken. Spring in double shock valve broken. Gear wheel set worn. Cylinder seized or piston seals worn. | Check for foamy oil. Do steering system leakage check. Do steering system leakage check. Do steering unit neutral leakage test in group 3. Replace leaf springs. Replace shock valve. Replace gear wheel set. Replace defects parts. |
| Slow steering wheel movement will not cause any frame movement | Leakage in steering unit gerotor. Worn steering unit gerotor. | Do steering system leakage check. Do steering leakage check. |
| Steering wheel can be turned with frames against steering stop | Leakage in steering system. | Do steering system leakage check. |
| Steering wheel turns with no resistance and causes no frame movement | Broken steering column or splined coupling. Lack of oil in steering unit. Leakage in steering system. | Remove and inspect. Start engine and check steering operation. Do steering system leakage test in group 3. |

| Problem | Cause | Remedy |
|---|--|---|
| Erratic steering | Air in oil. Low oil level. Sticking priority valve spool. Loose cylinder piston. Damaged steering unit. | Check for foamy oil. Add recommended oil. Remove and inspect spool. Remove rod to inspect piston. Remove and inspect. |
| Spongy or soft steering | Air in oil. Low oil level. | Check for foamy oil. Add recommended oil. |
| Free play at steering wheel | Loose steering wheel nut. Worn or damaged splines on steering column or unit. | Tighten. Inspect. |
| Steering unit binding or steering wheel does not immediately return to neutral when released | Binding in steering column or misalignment of column. High return pressure. Contamination in steering unit. Large particles of contamination in steering unit. | Inspect. Check for a pinched or damaged return line. Inspect hydraulic filter for contamination. Repair cause of contamination. Flush hydraulic system. Inspect hydraulic filter for contamination. Repair cause of contamination. Flush hydraulic system. |
| Steering unit locks up | ★ Thermal shock Worn or damaged steering unit. | Do priority valve LS port flow test in group 5. This oil flow provides a warm -up flow to steering unit when not using the steering. Repair or replace steering unit. |
| Abrupt steering wheel oscillation | Improperly timed gerotor gear in steering unit. | Time gerotor gear. |
| Steering wheel turns by itself | Lines connected to wrong port. | Reconnect lines. |
| Vibration in steering system or hoses jump | High priority valve setting. | Do priority valve pressure test. |
| Neutral position of steering wheel cannot be obtained, i.e. there is a tendency towards "motoring" | Steering column and steering unit out of line. Too little or no play between steering column and steering unit input shaft. Pinching between inner and outer spools. | Align the steering column with steering unit. Adjust the play and, if necessary, shorten the splines journal. Contact the nearest service shop. |

★ Thermal shock is caused by a large temperature differential(Approx. 30°C, 50°F) between the steering valve and hydraulic oil. If the steering is not operated for a long period of time and the orifice in the bottom of the priority valve spool is plugged, the steering valve may bind up when the steering is operated if the hydraulic oil is hot enough.

| Problem | Cause | Remedy |
|---|---|--|
| "Motoring" effect. The steering wheel can turn on its own. | Leaf springs are stuck or broken and have therefore reduced spring force. | Replace leaf springs. |
| | Inner and outer spools pinch, possibly due to dirt. | Clean steering unit or contact the nearest service shop. |
| | Return pressure in connection with the reaction between differential cylinder and steering unit too high. | Reduce return pressure. |
| | Oil is needed in the tank. | Fill with clean oil and bleed the system. |
| | Steering cylinder worn. | Replace or repair cylinder. |
| | Gear wheel set worn. | Replace gear wheel set. |
| | Spacer across cardan shaft forgotten. | Install spacer. |

| Problem | Cause | Remedy |
|--|--|--|
| Backlash | Cardan shaft fork worn or broken. Leaf springs without spring force or broken. Worn splines on the steering column. | Replace cardan shaft. Replace leaf springs. Replace steering column. |
| "Shimmy" effect. The steered wheels vibrate. (Rough tread on tires gives vibrations) | Air in the steering cylinder. Mechanical connections or wheel bearings worn. High priority valve setting pressure. | Bleed cylinder. Find and remove the reason for air collection. Replace worn parts. Set pressure as regular value. |
| Steering wheel can be turned slowly in one or both directions without the steered wheels turning. | One or both shock valves are leaky or are missing in steering valve. | Clean or replace defective or missing valves. |
| Steering is too slow and heavy when trying to turn quickly. | Insufficient oil supply to steering unit, pump defective or number of revolutions too low. Relief valve setting too low. Relief valve sticking owing to dirt. Spool in priority valve sticking owing to dirt. Too weak spring in priority valve. | Replace pump or increase number of revolutions. Adjust valve to correct setting. Clean the valve. Clean the valve, check that spool moves easily without spring. Replace spring by a stronger. |
| "Kick back" in steering wheel from system. Kicks from wheels. | Fault in the system. | Contact authorized man or shop. |

| Problem | Cause | Remedy |
|---|--|---|
| Heavy kick-back in steering wheel in both directions. | Wrong setting of cardan shaft and gear-wheel set. | Correct setting as shown in this manual. |
| Turning the steering wheel activates the steered wheels opposite. | Hydraulic hoses for the steering cylinders have been switched around. | Connect lines to correct ports. |
| Hard point when starting to turn the steering wheel | Spring force in priority valve too weak. Oil is too thick (cold). | Replace spring by a stronger. Let motor run until oil is warm. |
| Too little steering force (possibly to one side only). | Pump pressure too low. Too little steering cylinder. Piston rod area of the differential cylinder too large compared with piston diameter. | Correct pump pressure. Fit a larger cylinder. Fit cylinder with thinner piston rod or 2 differential cylinders. |
| Leakage at either input shaft, end cover, gear-wheel set, housing or top part. | Shaft defective. Screws loose. Washers or O-rings defective. | Replace shaft seal. Tighten screws. Replace. |

GROUP 3 TESTS AND ADJUSTMENTS

1. HYDRAULIC OIL CLEAN UP PROCEDURE USING PORTABLE FILTER CADDY

- ※ Service equipment and tool.
 - Portable filter caddy
 - Two 3658 mm (12 ft) × 1" I.D. 100R1 hoses with 3/4 M NPT ends
 - Quick disconnect fittings
 - Discharge wand
 - Various size fittings and hoses
- ※ Brake system uses oil from hydraulic oil tank. Flush all lines in the steering system.
Disassemble and clean major components for steering system.
Steering components may fail if steering system is not cleaned after hydraulic oil tank contamination.
- 1) If hydraulic system is contaminated due to a major component failure, remove and disassemble steering cylinders to clean debris from cylinders.
- 2) Install a new return filter element. Clean filter housing before installing new element.
- ※ For a failure that creates a lot of debris, remove access cover from hydraulic oil tank. Drain and clean hydraulic oil tank of fill the specified oil to hydraulic oil tank through upper cover.
- 3) To minimize oil loss, pull a vacuum in hydraulic oil tank using a vacuum pump. Connect filter caddy suction line to drain port at bottom of hydraulic oil tank using connector. Check to be sure debris has not closed drain port.
- 4) Put filter caddy discharge line into hydraulic oil tank filter hole so end is as far away from drain port as possible to obtain a thorough cleaning of oil.

- 5) Start the filter caddy. Check to be sure oil is flowing through the filters.
Operate filter caddy approximately 10 minutes so oil in hydraulic oil tank is circulated through filter a minimum of four times.
※ Hydraulic oil tank capacity 152 ℓ (40.2 U.S. gal).
Leave filter caddy operating for the next steps.
- 6) Start the engine and run it at high idle.
※ For the most effective results, cleaning procedure must start with the smallest capacity circuit then proceed to the next largest capacity circuit.
- 7) Operate all functions, one at a time, through a complete cycle in the following order: clam, steering, bucket, and boom. Also include all auxiliary hydraulic functions.

Repeat procedure until the total system capacity has circulated through filter caddy seven times, approximately 30 minutes.
Each function must go through a minimum of three complete cycles for a thorough cleaning for oil.

※ Filtering time for machines with auxiliary hydraulic functions must be increased because system capacity is larger.
- 8) Stop the engine. Remove the filter caddy.
- 9) Install a new return filter element.
- 10) Check oil level in hydraulic oil tank ; Add oil if necessary.

2. TEST TOOLS

1) CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

- Service equipment and tools

Tachometer

A : Clamp on tachometer.

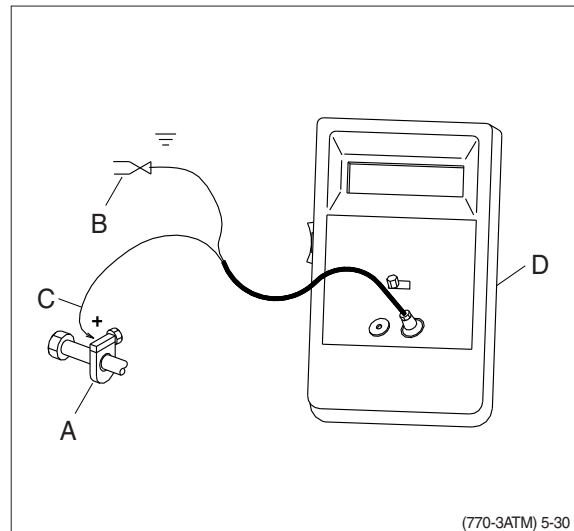
Remove paint using emery cloth and connect to a straight section of injection line within 100 mm (4in) of pump.

Finger tighten only-do not over tighten.

B : Black clip (-). Connect to main frame.

C : Red clip (+). Connect to transducer.

D : Tachometer readout. Install cable.



2) DIGITAL THERMOMETER INSTALLATION

- Service equipment and tools

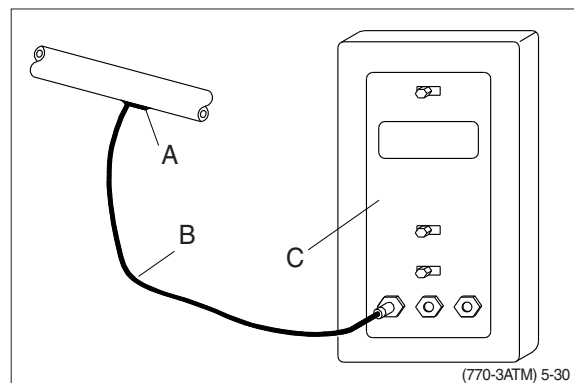
Digital thermometer

A : Temperature probe.

Fasten to a bare metal line using a tie band. Wrap with shop towel.

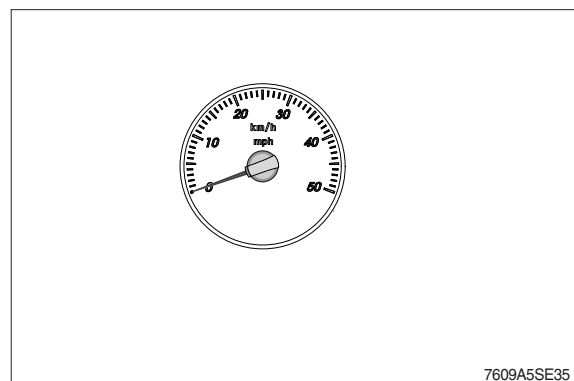
B : Cable.

C : Digital thermometer.



3) DISPLAY MONITOR TACHOMETER

The display monitor tachometer is accurate enough for test work.



3. STEERING UNIT LEAKAGE TEST

· SPECIFICATION

Oil temperature $45 \pm 5^{\circ}\text{C}$ ($113 \pm 9^{\circ}\text{F}$)

Engine speed High idle

Maximum leakage 7.5 l/min (2 gpm)

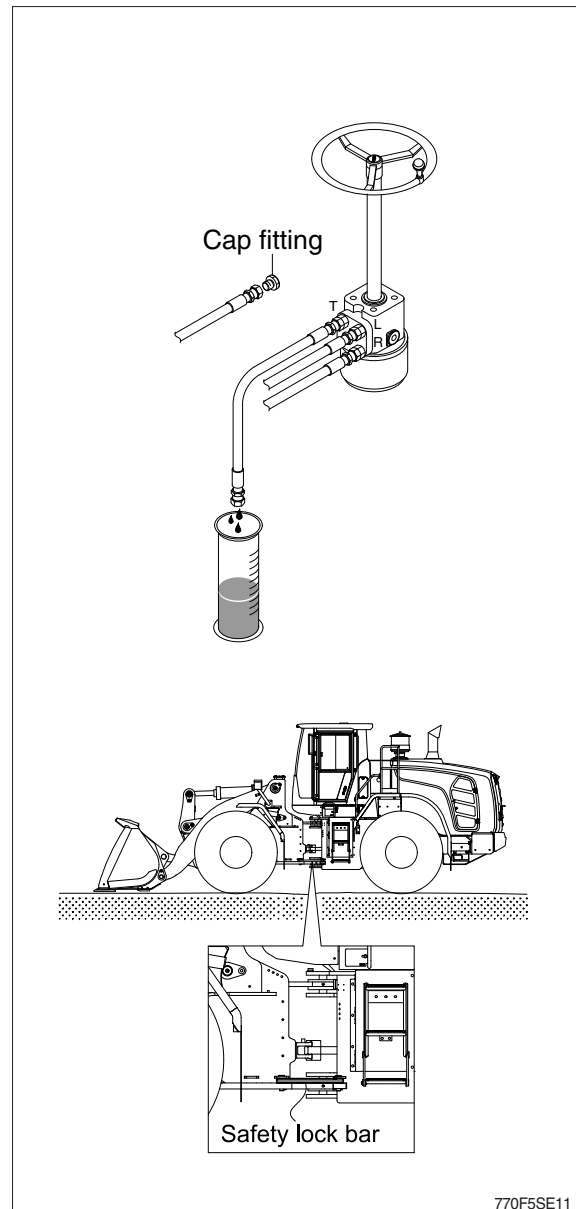
· GAUGE AND TOOL

Temperature reader

Measuring container (approx. 20 l)

Stop watch

- 1) Install frame locking bar to prevent machine from turning.
- 2) Install temperature reader.
(see temperature reader installation procedure in this group).
- 3) Heat hydraulic oil to specifications.
(see hydraulic oil warm up procedure at page 6-55).
- 4) Disconnect return hose from fitting.
Install cap fitting.
- 5) Run engine at specifications. Rotate steering wheel against locking bar using approximately $1.2 \text{ kgf} \cdot \text{m}$ of force.
Measure oil flow from return hose for 1 minute.
- 6) Leakage is greater than specifications,
repair or replace steering unit.



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4. FLOW AMPLIFIER PRESSURE TEST

· SPECIFICATION

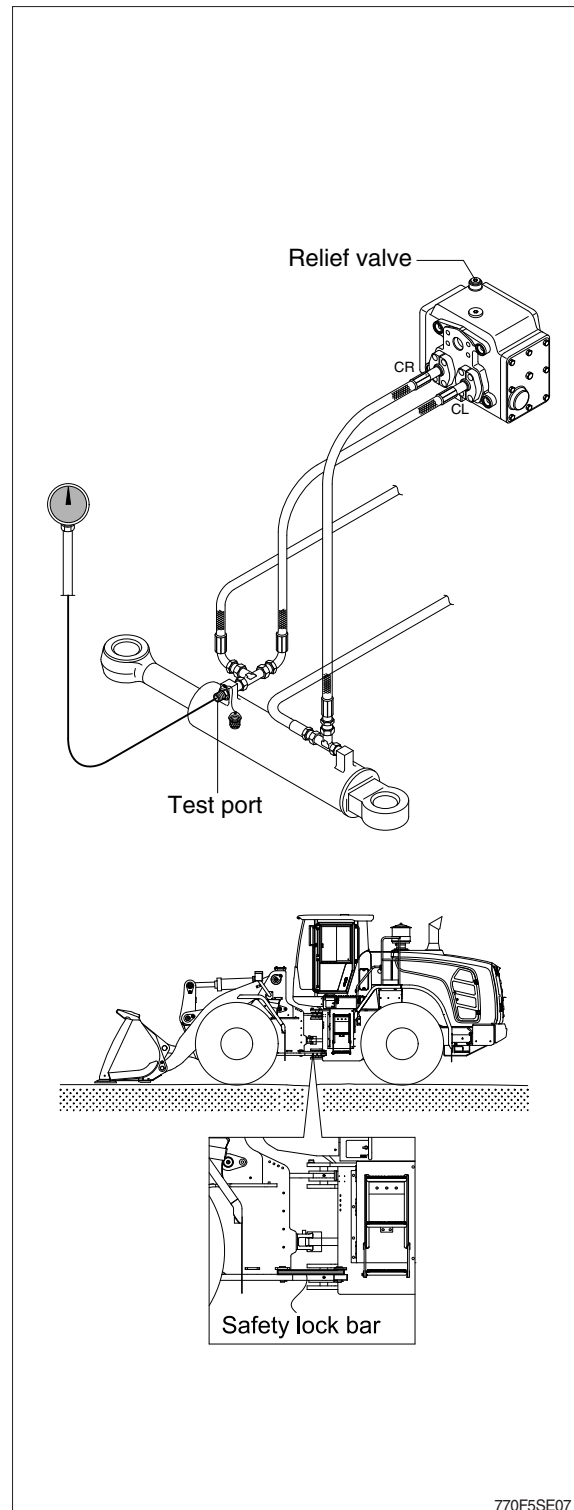
| | |
|-----------------|--|
| Oil temperature | $45 \pm 5^{\circ}\text{C}$ ($113 \pm 9^{\circ}\text{F}$) |
| Engine speed | High idle |
| Oil pressure | 20.1~21.1 MPa (205~215 bar, 2900~3100 psi) |

· GAUGE AND TOOL

Gauge 0~35 MPa (0~350 bar, 0~5000 psi)
Temperature reader

- 1) Connect gauge to test port.
- 2) Install temperature reader (see installation procedure in this group).
- 3) Install frame locking bar.
- 4) Heat hydraulic oil to specifications (see hydraulic oil warm up procedure at page 6-55).
- 5) Run engine at specifications and turn steering wheel rapidly hold approximately 22N (5lb force) pressure on wheel with frames locked.
 - ※ If steering wheel is turned slowly, it will continue to with the frames locked. This will give an incorrect pressure reading.
If steering wheel continues to turn rapidly with the frames locked, steering system leakage is indicated.
- 6) Read pressure gauge. This is the flow amplifier relief pressure.
- 7) If pressure is not to specification, turn adjusting screw in relief cartridge using a hex head wrench to adjust pressure.

If pressure cannot be adjusted to specification, disassemble and inspect flow amplifier.



5. FLOW AMPLIFIER LS PORT FLOW TEST

· SPECIFICATION

Oil temperature $45 \pm 5^{\circ}\text{C}$ ($113 \pm 9^{\circ}\text{F}$)
Engine speed Low idle
LS port flow (approx.) 1 mℓ/min

· GAUGE AND TOOL

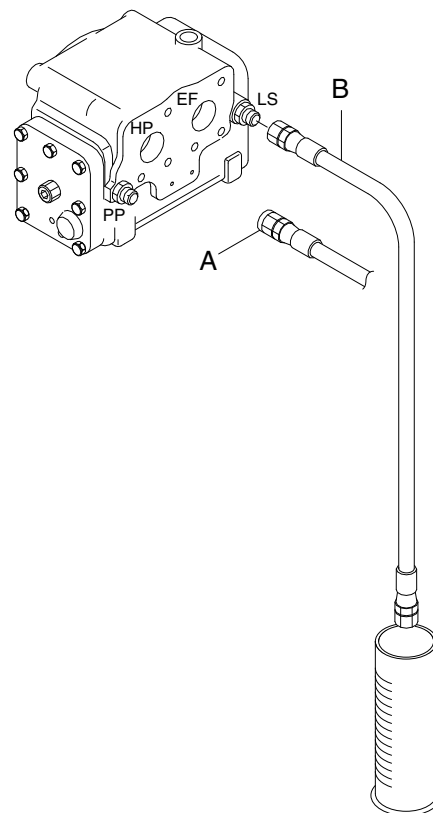
Temperature reader
Measuring container
Stop watch

Flow amplifier LS port flow test will check for a plugged or missing orifice in the bottom of the priority valve spool. A plugged orifice will block warm up flow to the steering unit which can cause thermal shock (see for an explanation of thermal shock page 5-20).

A missing orifice can cause the pump to be loaded to high pressure at all times causing overheating.

- 1) Install temperature reader (see temperature reader installation procedure in this group.)
- 2) Heat hydraulic oil to specifications (see hydraulic oil warm up procedure at page 6-55).
- 3) Disconnect line from LS port and install plug (A).
- 4) Connect line (B) to flow amplifier.
- 5) Start engine and run at specification.
- 6) Measure flow from LS port for 1 minute.
- 7) If flow is low, low steering system neutral pressure or a plugged orifice in bottom priority valve spool is indicated.

If flow is high, remove priority valve spool and inspect for a missing orifice.



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6. FLOW AMPLIFIER RELIEF CARTRIDGE LEAKAGE TEST

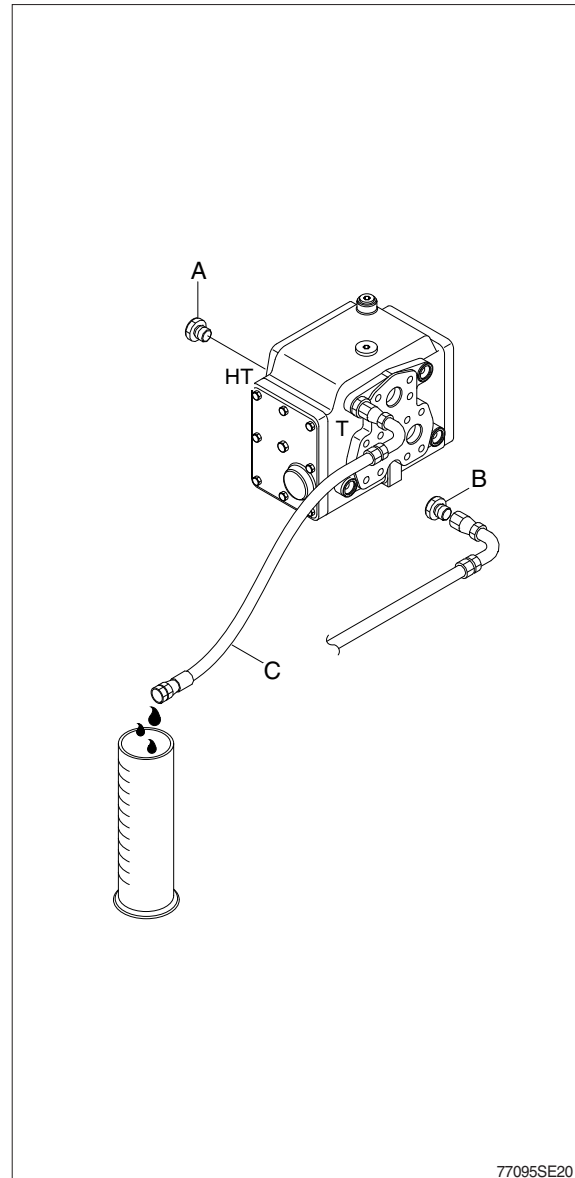
· SPECIFICATION

Oil temperature $45 \pm 5^{\circ}\text{C}$ ($113 \pm 9^{\circ}\text{F}$)
Engine speed High idle
Maximum leakage 1 mℓ/min (16 drops per min)

· GAUGE AND TOOL

Temperature reader
Measuring container
Stop watch

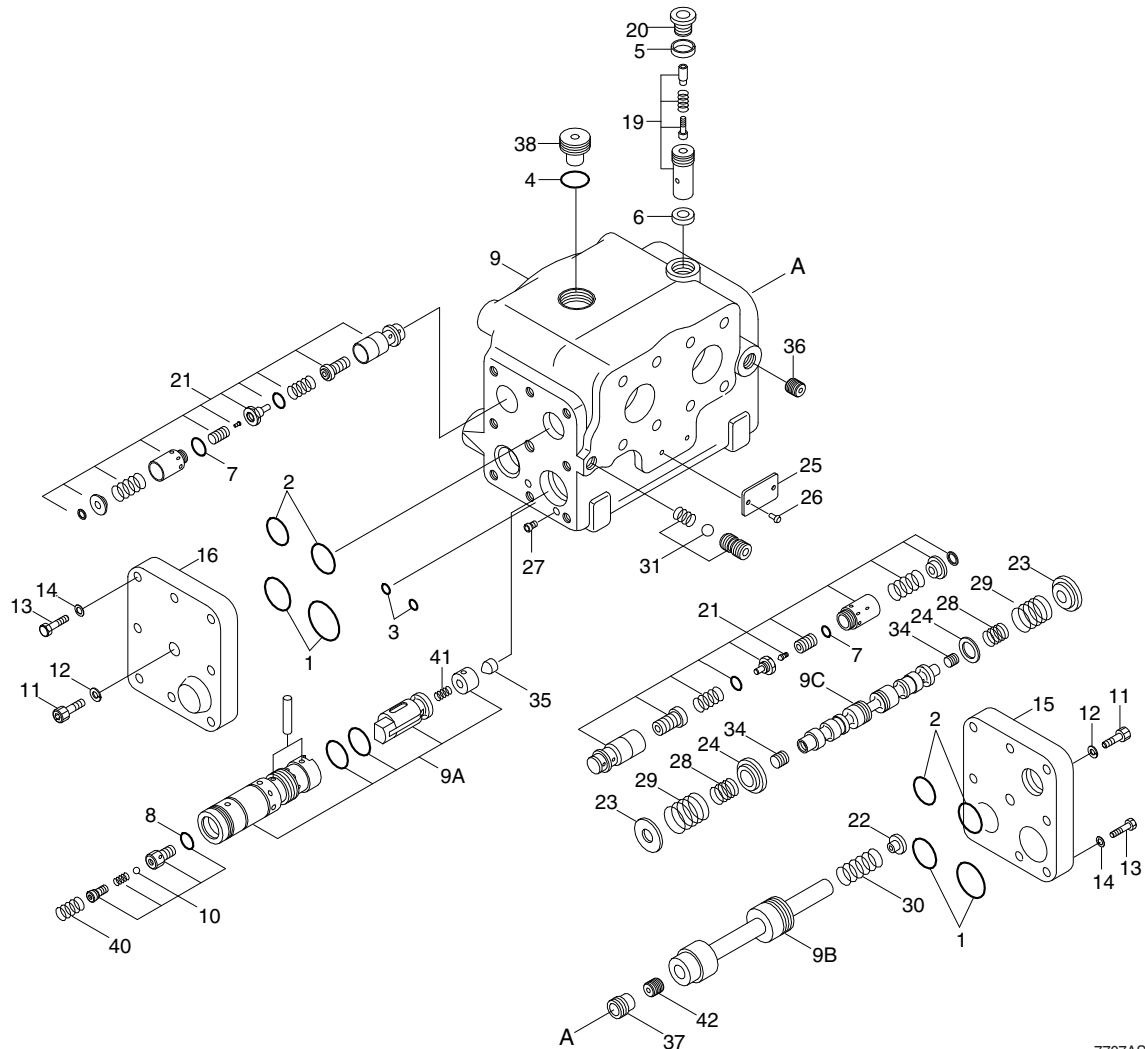
- 1) Install temperature reader.
(see temperature reader installation procedure in this group).
- 2) Heat hydraulic oil to specifications.
(see hydraulic oil warm up procedure at page 6-55).
- 3) Install plug (A) in HT port.
Disconnect line from T port on flow amplifier.
Install plug (B) in line.
- 4) Connect line (C) to flow amplifier.
- 5) Start engine and run at specification.
- 6) Measure oil leakage from T port.
- 7) If leakage is more than specification, disassemble and inspect cartridge for damage or debris.



GROUP 4 DISASSEMBLY AND ASSEMBLY

1. FLOW AMPLIFIER

1) STRUCTURE

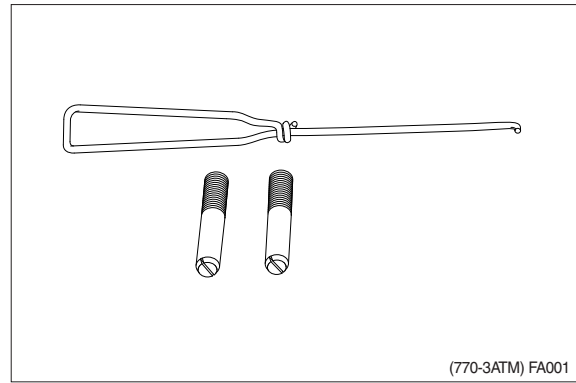


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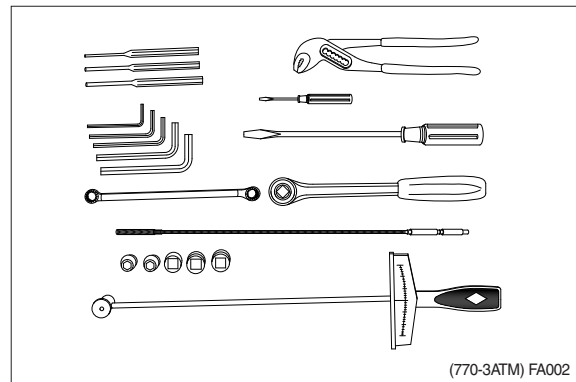
| | | | | | |
|----|-------------------|----|----------------------|----|----------------------|
| 1 | O-ring | 12 | Spring washer | 28 | Spring |
| 2 | O-ring | 13 | Screw | 29 | Spring |
| 3 | O-ring | 14 | Spring washer | 30 | Spring |
| 4 | O-ring | 15 | End cover | 31 | Throttle check valve |
| 5 | Washer | 16 | End cover | 34 | Orifice |
| 6 | Washer | 19 | Relief valve | 35 | Orifice |
| 7 | O-ring | 20 | Plug | 36 | Orifice |
| 8 | O-ring | 21 | Shock, suction valve | 37 | Plug |
| 9 | Housing | 22 | Spring seat | 38 | Plug |
| 9A | Amplifier valve | 23 | Spring seat | 40 | Spring |
| 9B | Priority valve | 24 | Spring guide | 41 | Spring |
| 9C | Directional valve | 26 | Name plate | 42 | Orifice |
| 10 | Check valve | 27 | Orifice | | |
| 11 | Screw | | | | |

2) TOOLS

- Guide screws : M8×1.0
- Hook : Wire



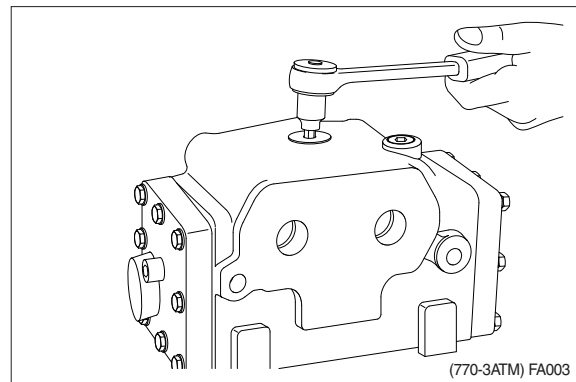
- Hexagon keys : 4, 5, 6, 8 and 10 mm
- Ratchet for socket spanners
- Hex socket for external : 13, 17 & 19 mm
- Hex socket for internal : 8 & 10 mm
- Multigrip pliers
- Ring spanner: 13 mm
- Screwdrivers : 3 and 10 mm
- Steel Mandrels : 3, 5 and 8 mm
- Torque wrench : 12.2 kgf · m (88 lbf · ft)
- Magnetic rod



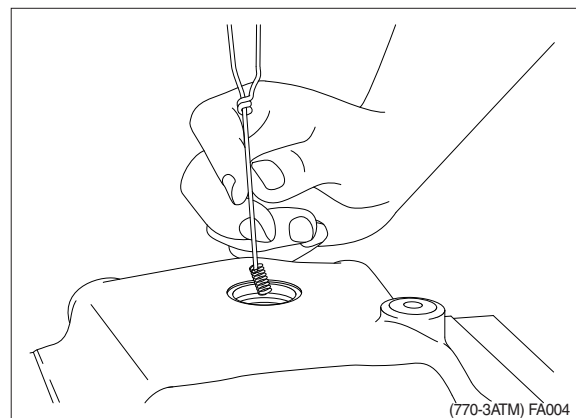
3) DISASSEMBLY

(1) Disassembly counter pressure valve

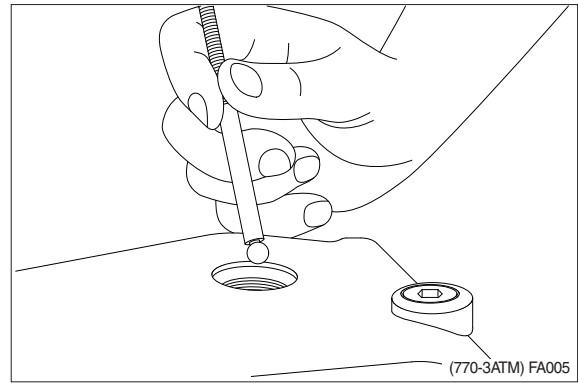
- ① Unscrew plug with O-ring (hexagon socket for 8 mm internal hexagon).



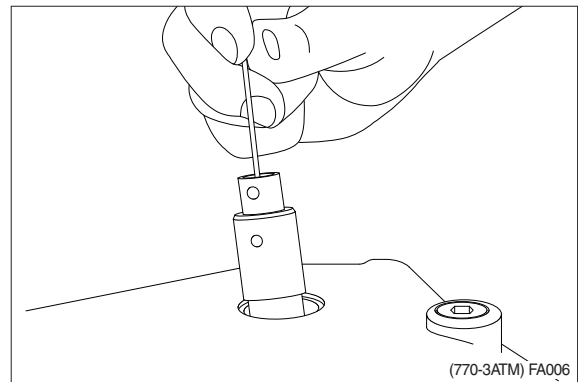
- ② Take out small spring (hook).



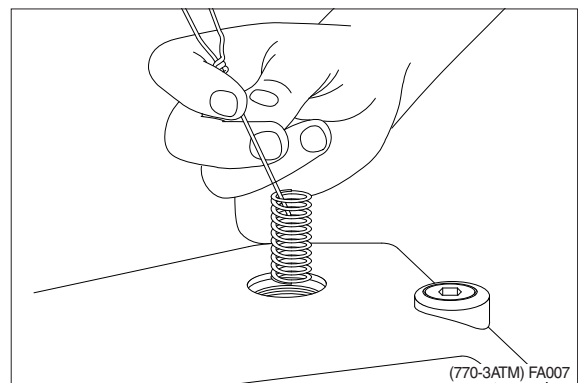
- ③ Take out ball (magnetic rod).



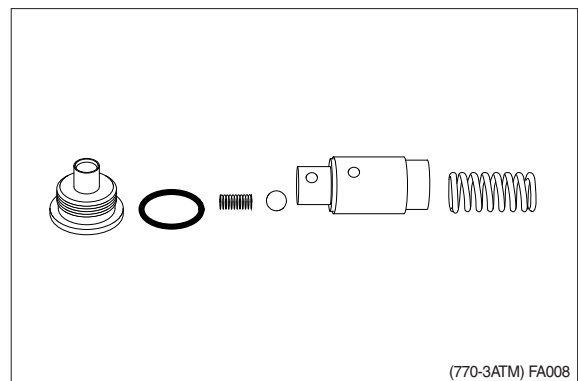
- ④ Take out piston.



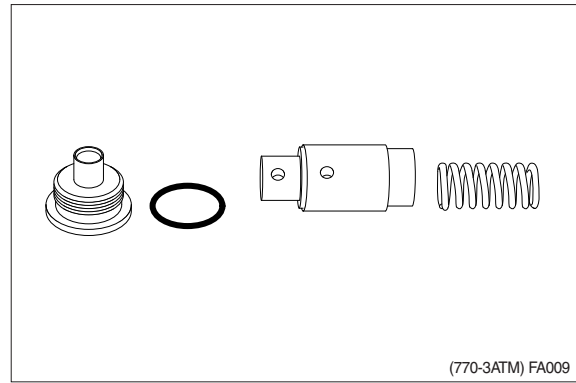
- ⑤ Take out spring.



- ⑥ Counter pressure valve shown disassembled.

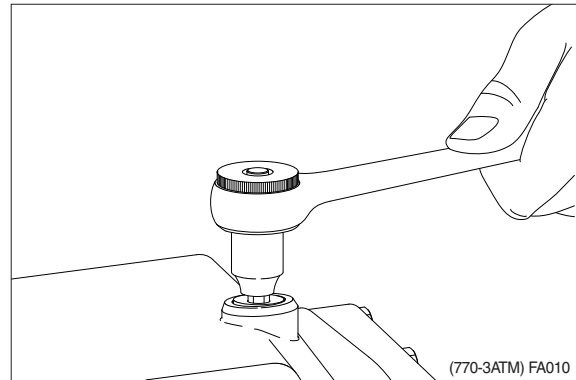


- ⑦ Counter pressure valve with orifice shown disassembled.

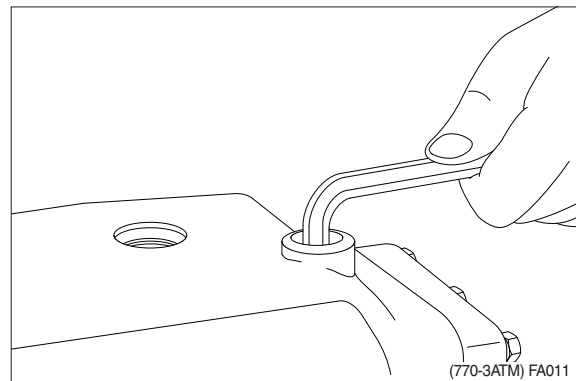


(2) Removing pressure relief valve

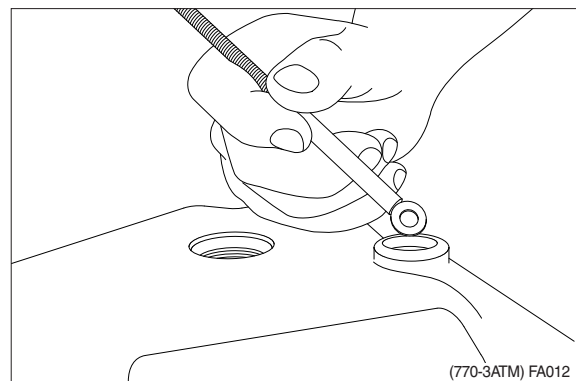
- ① Unscrew plug with washer (hexagon socket for 8 mm internal hexagon).



- ② Screw pressure relief valve out (10 mm hexagon key).

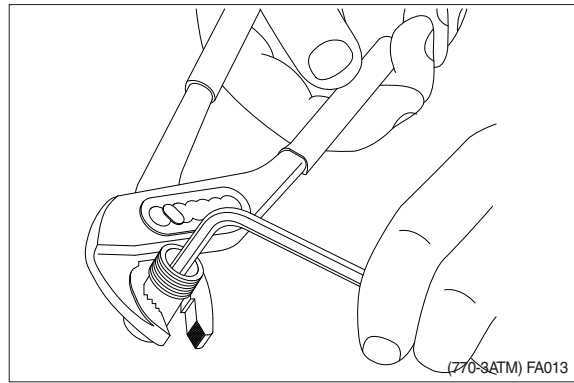


- ③ Take out washer(Magnetic rod).

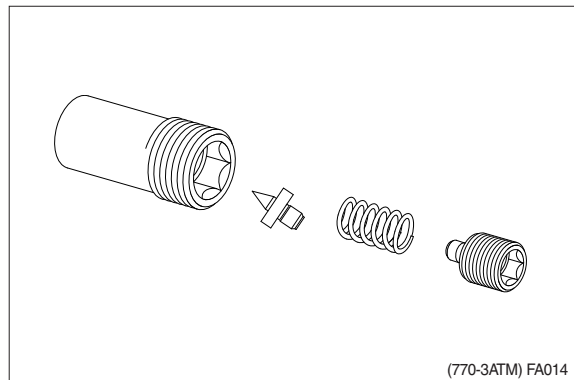


(3) Disassembly pressure relief valve

- ① Hold cartridge (multigrip pliers) and screw the adjustment screw out (5 mm hexagon key).

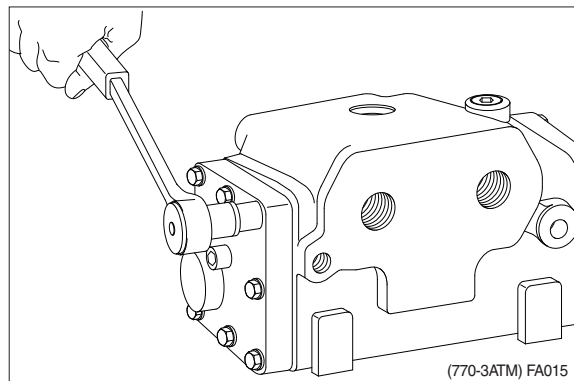


- ② Pressure relief valve shown disassembled.

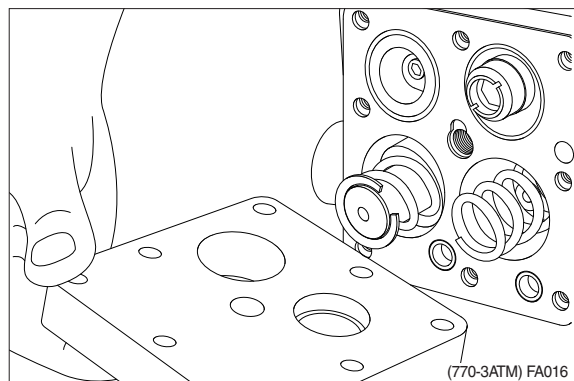


(4) Removing end cover at PP-connection

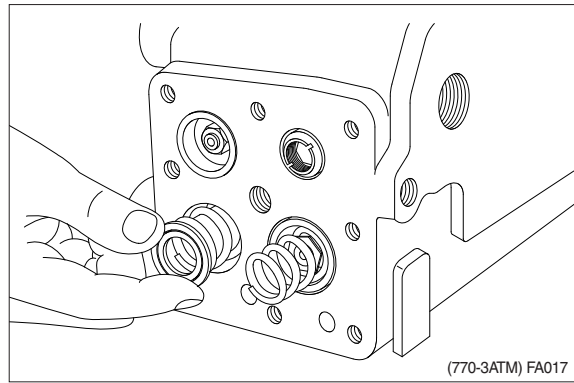
- ① Unscrew screws with spring washer using hexagon socket for 13 mm external hexagon and 10 mm internal hexagon.



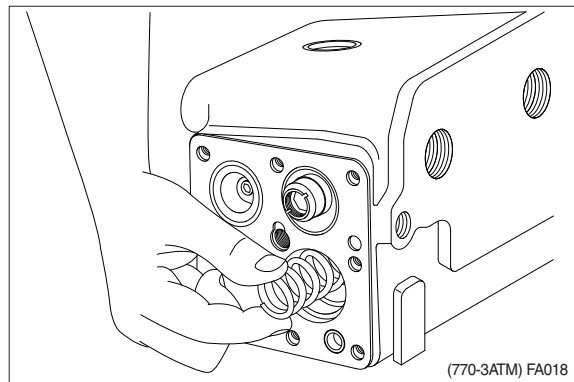
- ② Remove end cover.



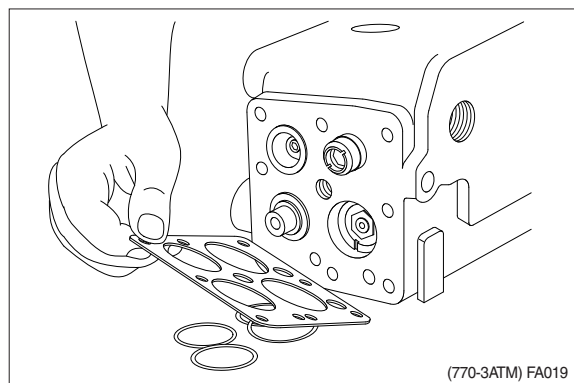
- ③ Remove stop and 2 springs.



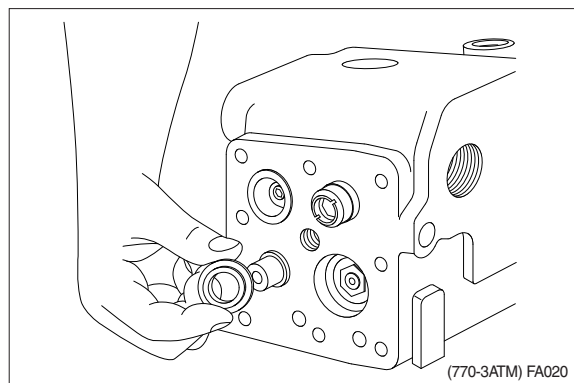
- ④ Remove spring.



- ③ Remove plate and 6 O-rings.

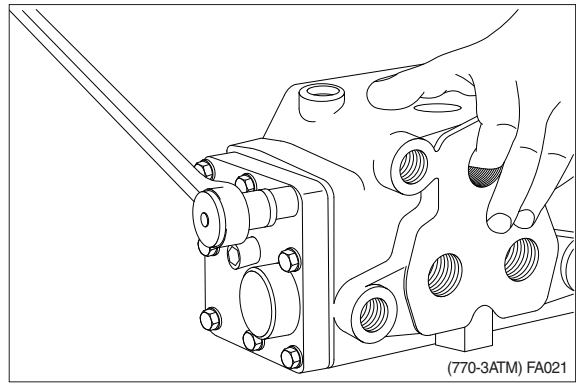


- ④ Remove spring guide.

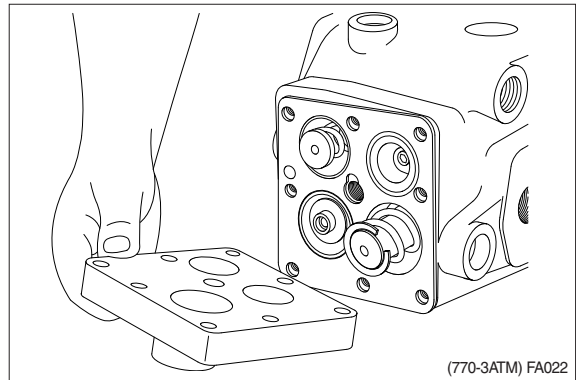


(5) Removing end cover at LS-connection

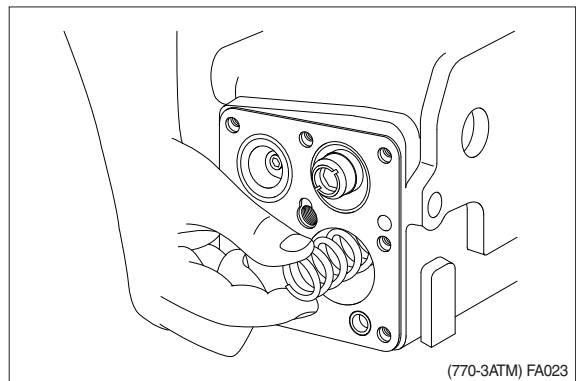
- ① Unscrew screws with spring washer using hexagon socket for 13 mm external hexagon and 10 mm internal hexagon.



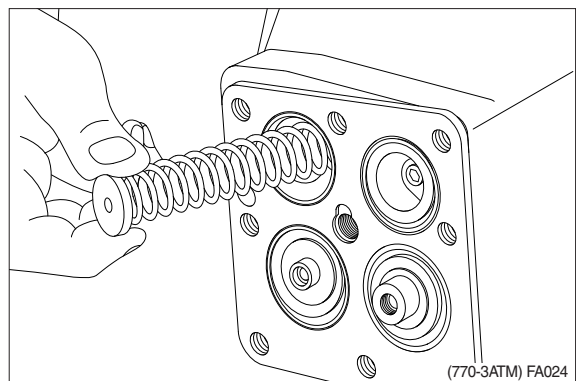
- ② Remove end cover.



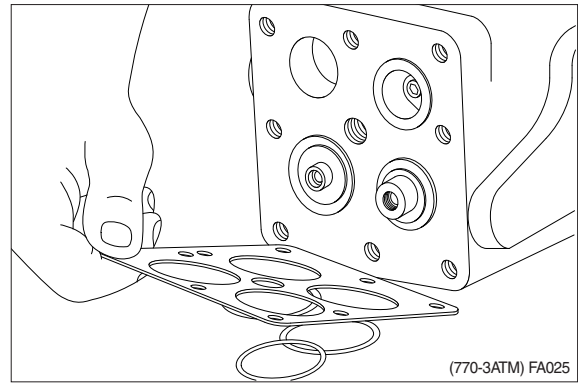
- ③ Remove stop and 2 springs.



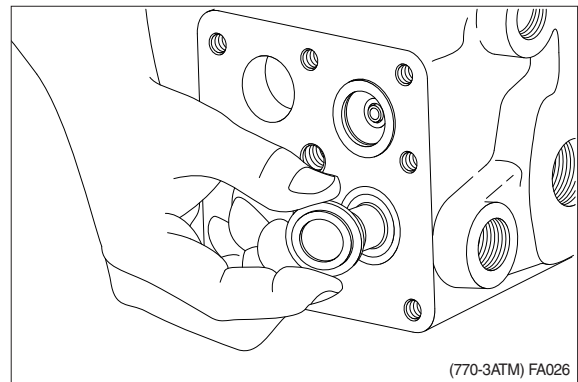
- ④ Remove stop and spring.



- ⑤ Remove plate and 4 O-rings.

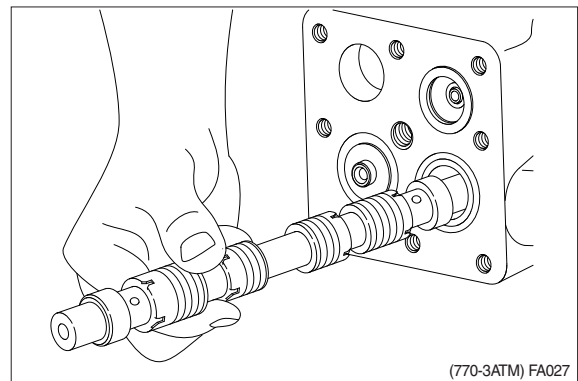


- ⑥ Remove spring guide.

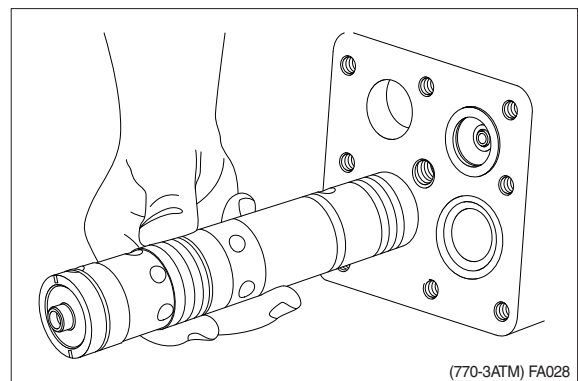


(6) Removing spools

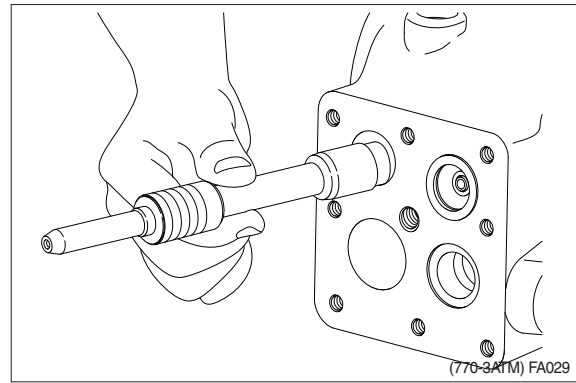
- ① Remove directional spool.



- ② Remove amplifier spool.

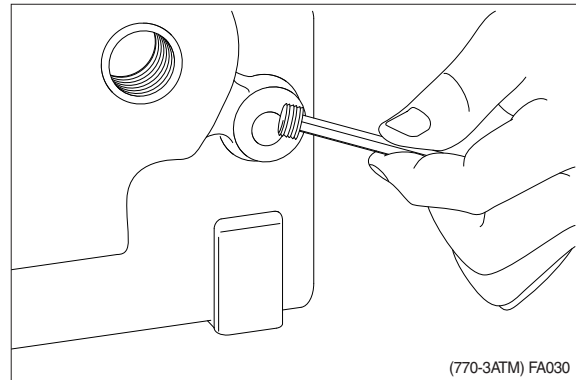


- ③ Remove priority valve spool.

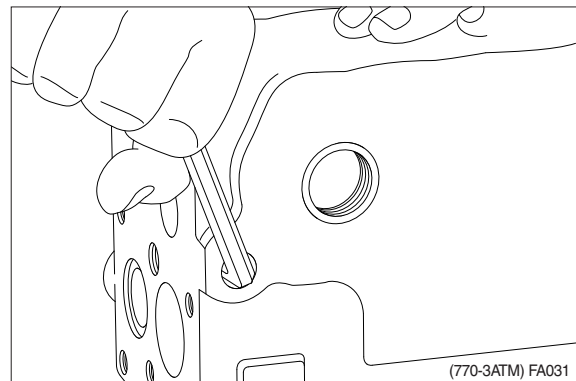


(7) Removing orifices and throttle check valve

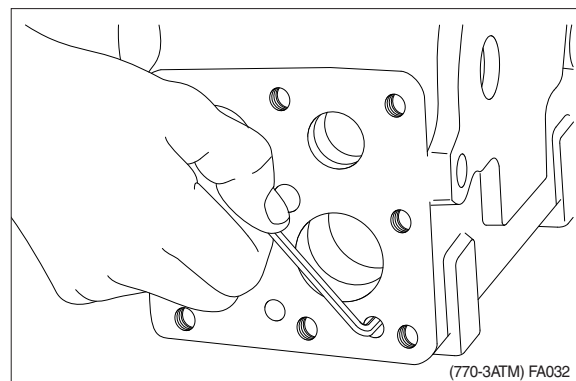
- ① Unscrew orifice in LS-connection with 6 mm hexagon key.



- ② Unscrew throttle check valve in PP-connection with 6mm hexagon key.

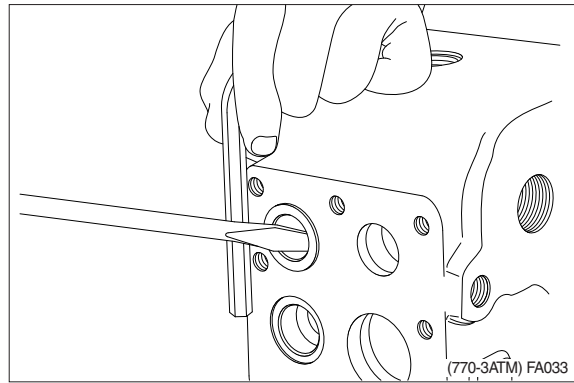


- ③ Unscrew orifice in housing with 4 mm hexagon key.



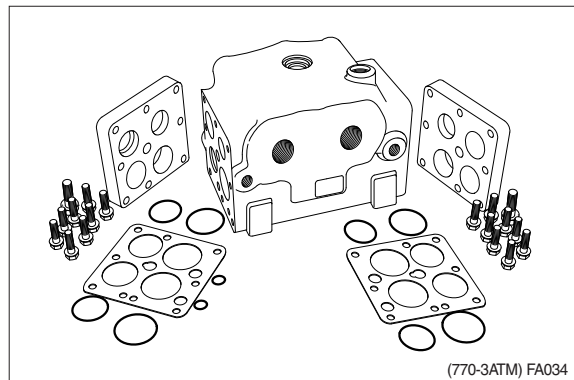
(8) Removing shock valves

- ① Remove shock valve with screwdriver and hexagon key.

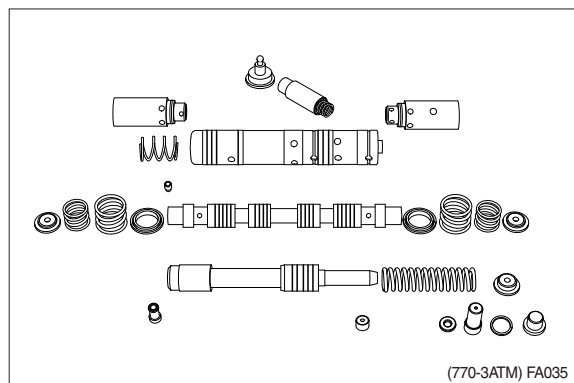


(9) Overview of disassembled parts

- ① Housing and end cover with accessories.

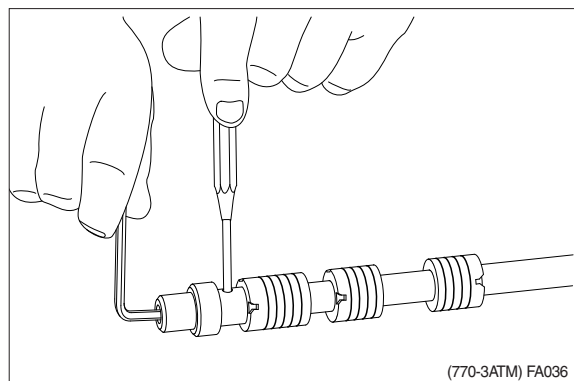


- ② Spool with accessories.

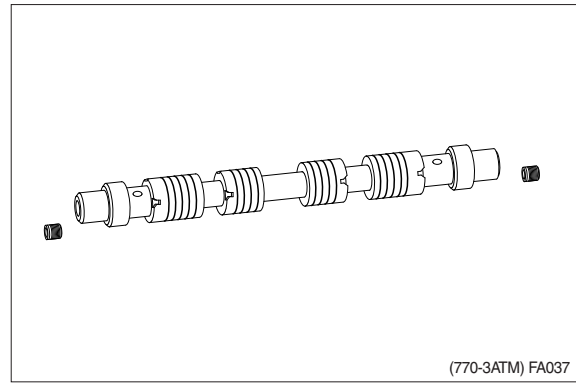


(10) Disassembly of directional spool

- ① Unscrew orifice with 4 mm hexagon key. Use a mandrel.

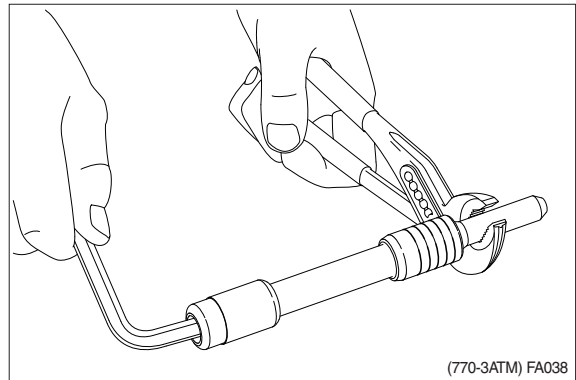


- ② Directional spool shown disassembled.

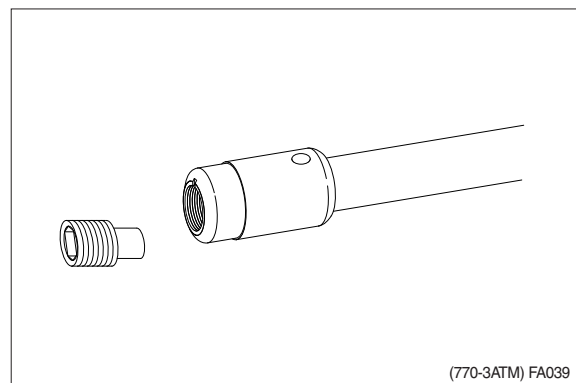


(11) Disassembly of priority valve spool

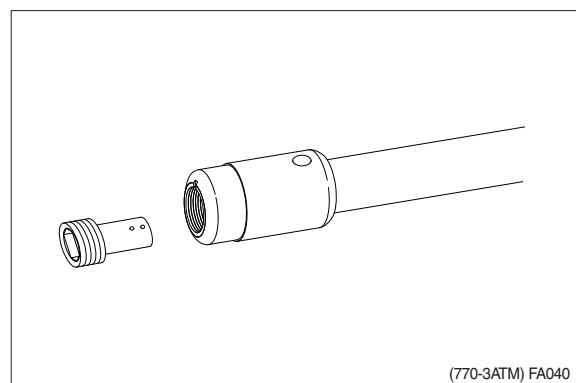
- ① Unscrew plug or throttle check valve with 8 mm hexagon key.



- ② Priority valve spool with plug for external PP shown disassembled.

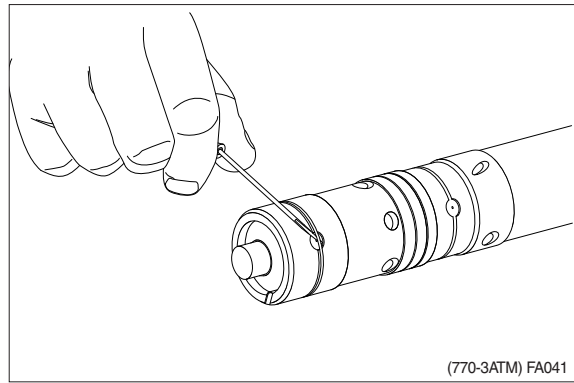


- ③ Priority valve spool with throttle check valve for internal PP shown disassembled.

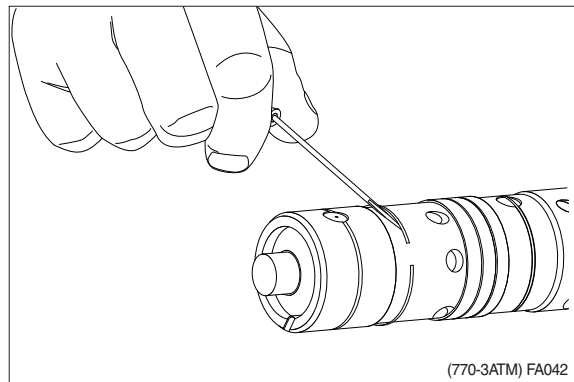


(12) Disassembly of amplifier spool

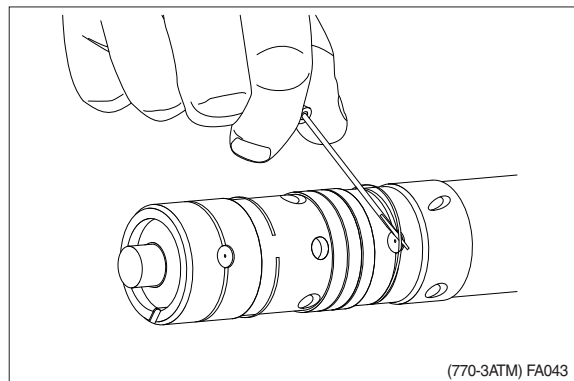
- ① Carefully remove the spring ring from the recess with 3mm screwdriver.
- ※ Avoid damage to the spring ring.



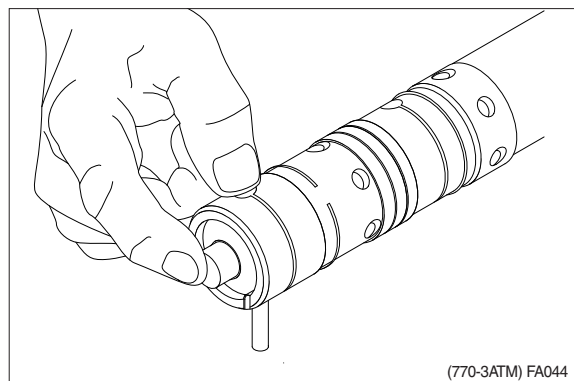
- ② Carefully guide the spring ring back.



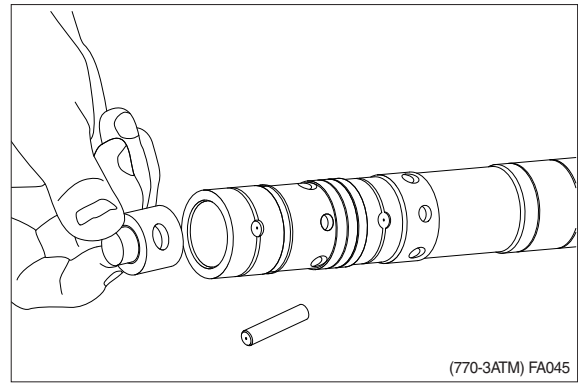
- ③ Carefully take the spring ring from the recess and guide it back with 3mm screwdriver.
- ※ Avoid damage to the spring ring.



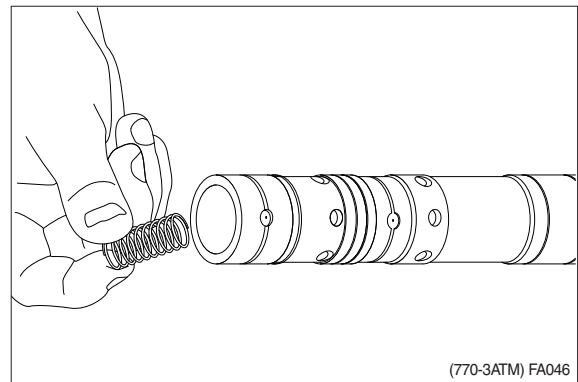
- ④ Press pin out gently with finger.



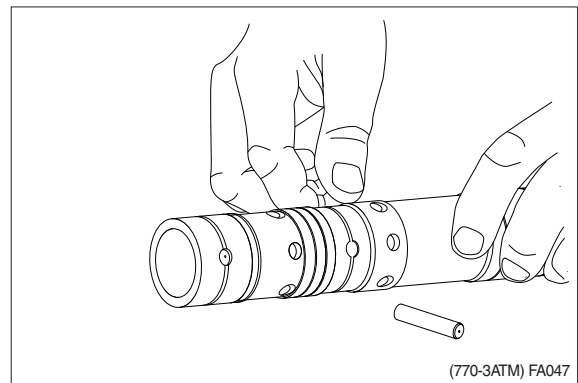
- ⑤ Take out plug.



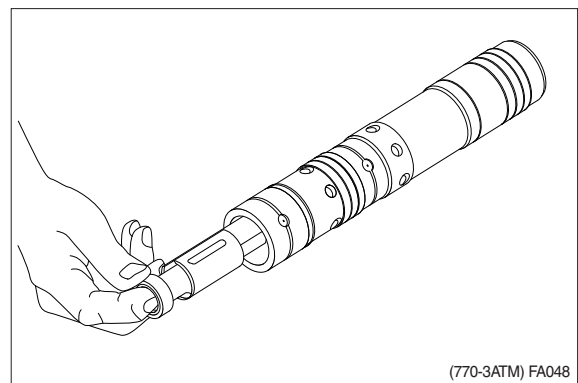
- ⑥ Take out spring.



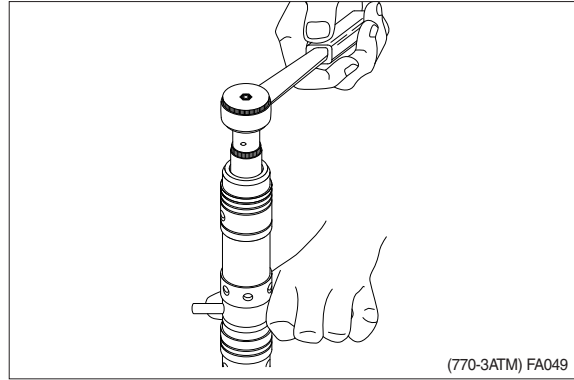
- ⑦ Take out pin 3mm screwdriver.



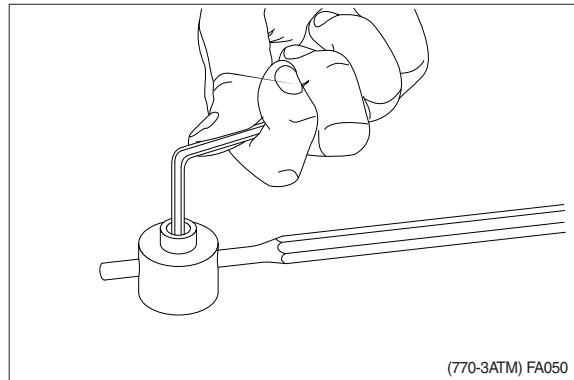
- ⑧ Take out inner spool.



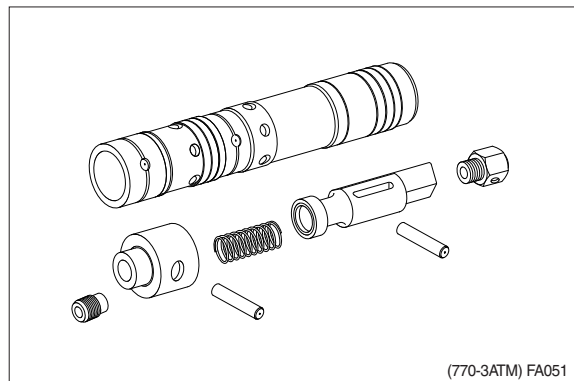
- ⑨ Unscrew check valve with hexagon socket for 17 mm external hexagon and mandrel in the pin hole.
 ※ Avoid damaging the spool surface.



- ⑩ Unscrew orifice out of plug with 4 mm hexagon key. Use a mandrel.

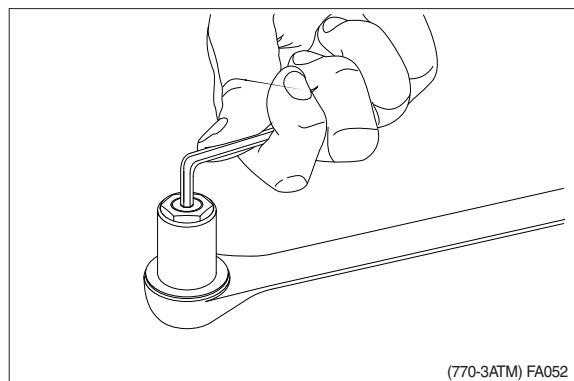


- ⑪ Amplifier spool shown disassembled.

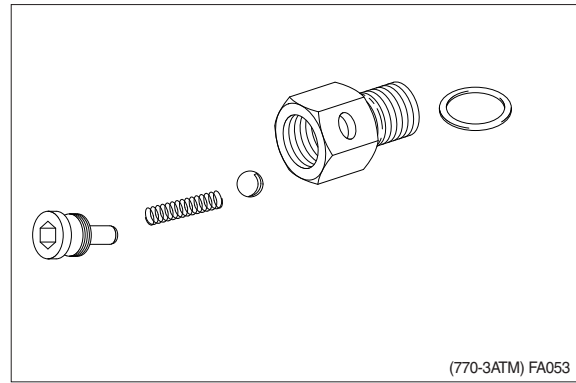


(13) Disassembly of check valve

- ① Unscrew plug with 4 mm hexagon key and hexagon socket for 17 mm external hexagon.

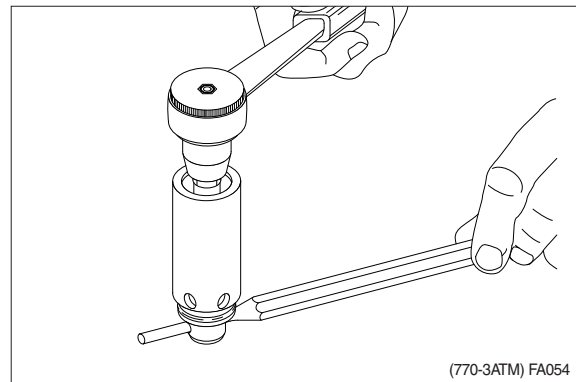


- ② Check valve shown disassembled.

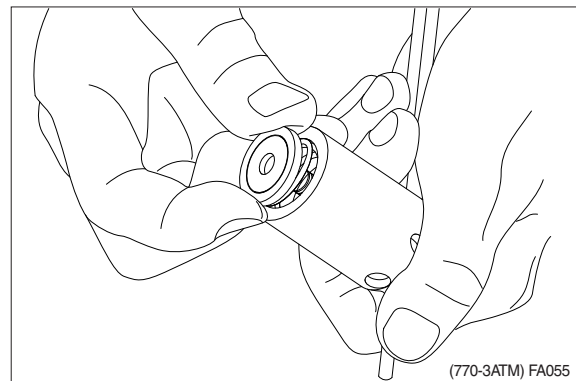


(14) Disassembly of shock valve / suction valve

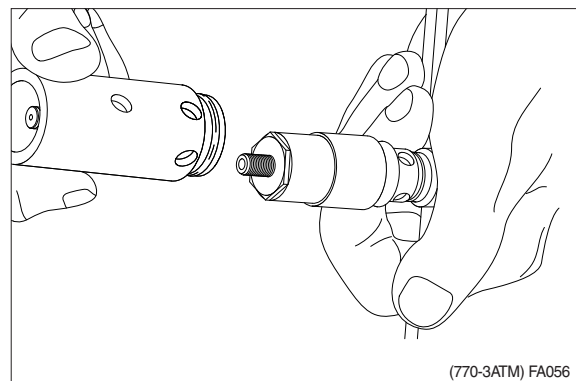
- ① Unscrew locknut with hexagon socket for 13 mm external hexagon. Use a mandrel.
- ※ When readjusting shock valve hold locknut with 13 mm ring spanner.



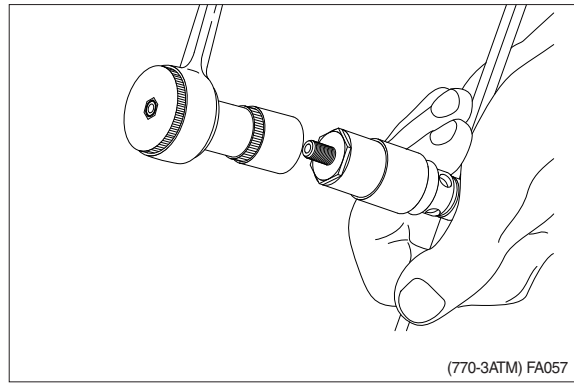
- ② Take out disc and spring.



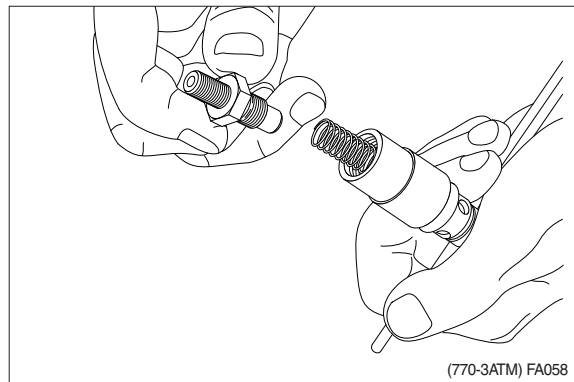
- ③ Take off housing.



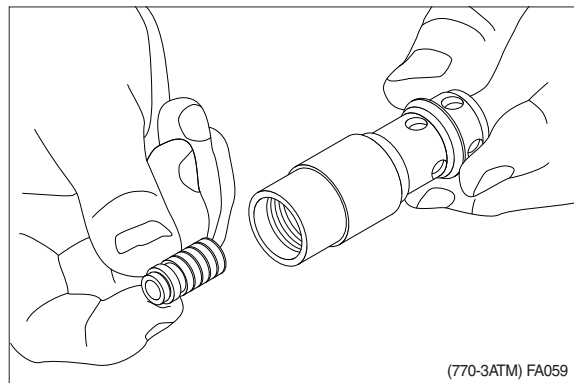
- ④ Unscrew pilot valve with hexagon socket for 19 mm external hexagon. Use a mandrel.



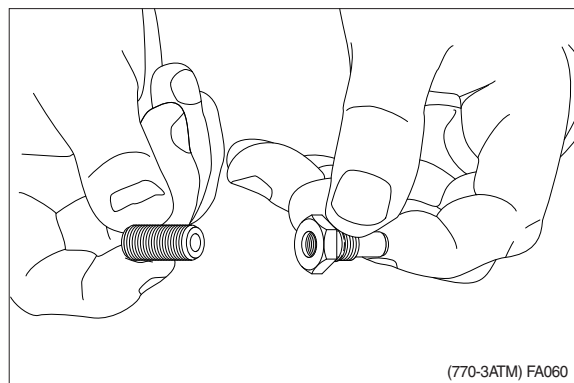
- ⑤ Take out pilot valve and spring.



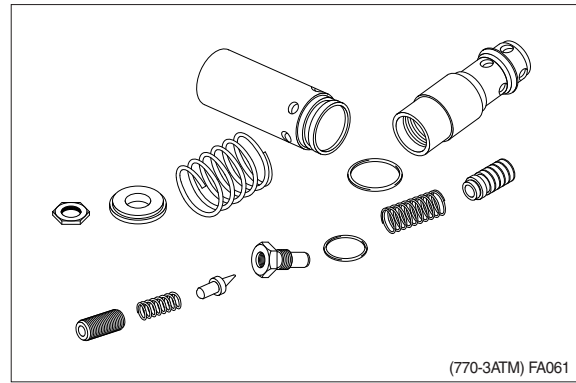
- ⑥ Take out spool.



- ⑦ Unscrew adjustment screw and take out spring and ball.



- ⑧ Shock valve / suction valve shown disassembled.



※ **Cleaning**

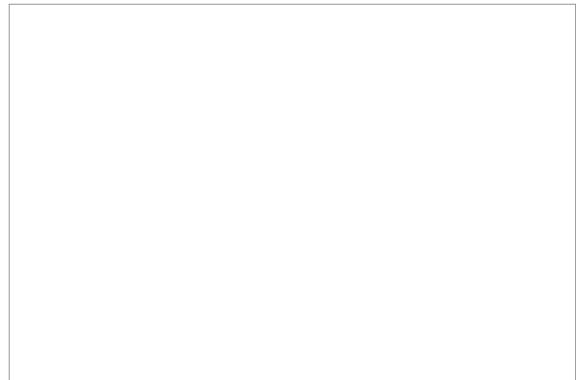
Clean all parts carefully with low aromatic kerosene.

※ **Inspection and replacement**

Replace all gaskets and sealing washers. Check all other parts carefully and replace if necessary.

※ **Lubrication**

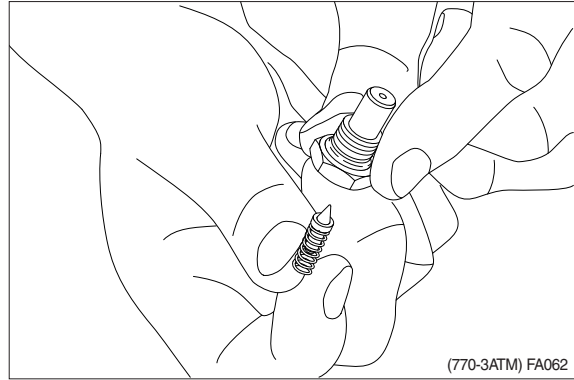
Before assembly, lubricate all parts with hydraulic oil.



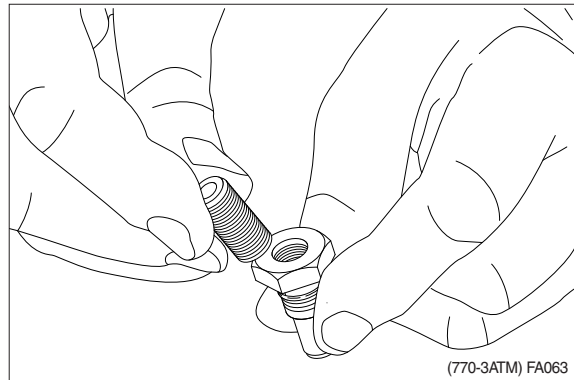
4) ASSEMBLY

(1) Assembly of shock valve / suction valve

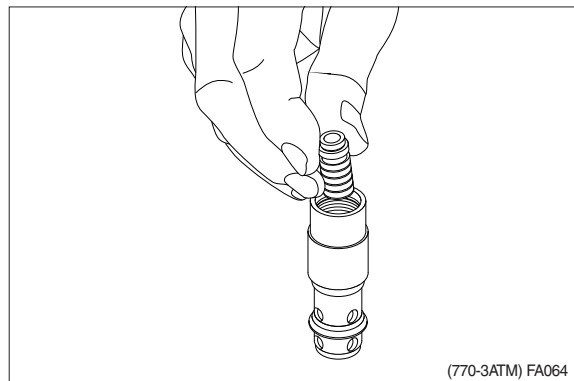
- ① Guide spring with cone into housing.



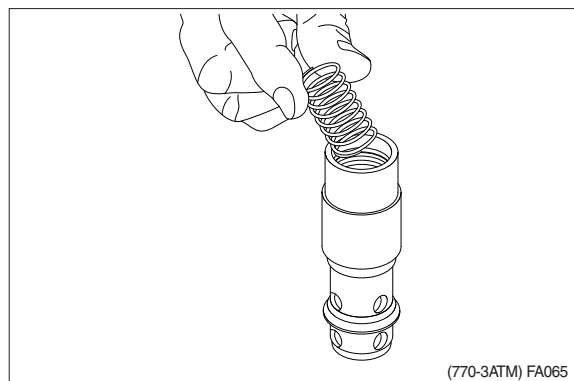
- ② Fit adjustment screw.



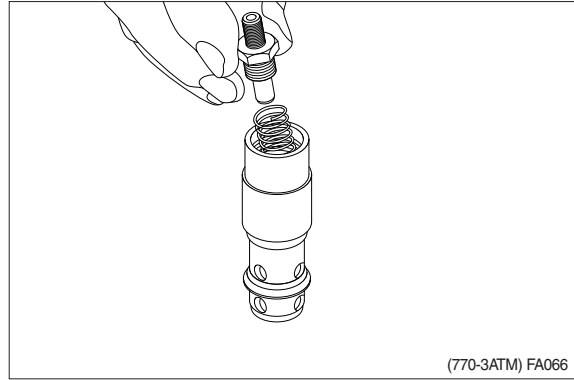
- ③ Fit spool.



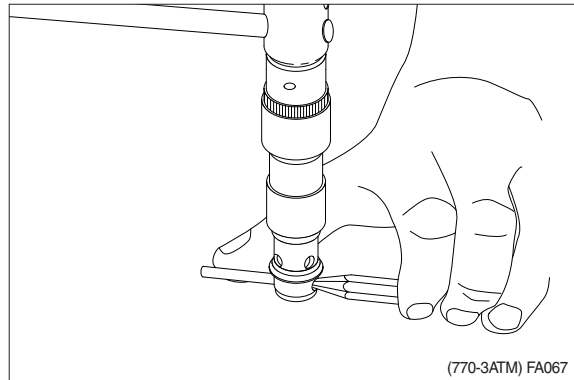
- ④ Fit spring.



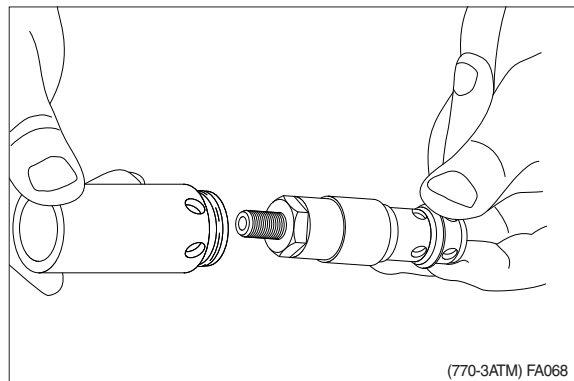
- ⑤ Fit pilot valve.
Remember O-ring.



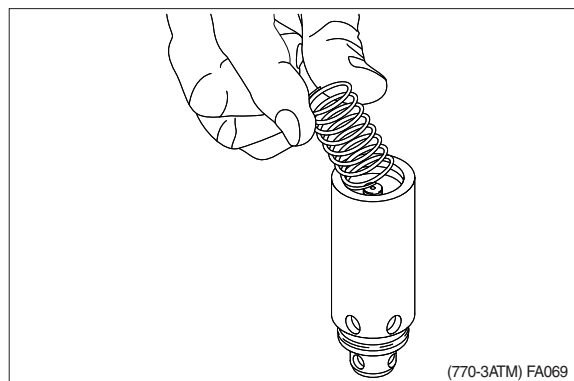
- ⑥ Tighten with torque wrench for 19 mm external hexagon. Use a mandrel.
· Tightening torque : $2 \pm 0.5 \text{ kgf} \cdot \text{m}$
($14.5 \pm 3.6 \text{ lbf} \cdot \text{ft}$)



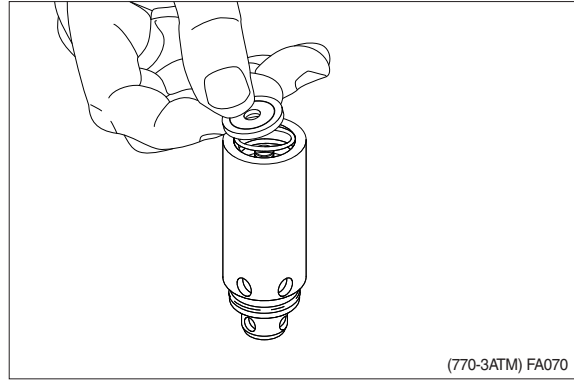
- ⑦ Fit housing.



- ⑧ Fit spring.

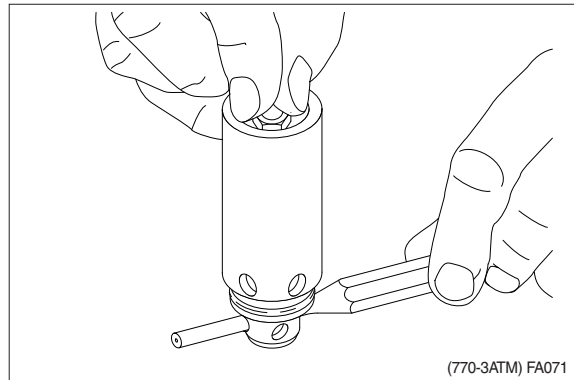


- ⑨ Fit disc.



- ⑩ Fit locknut.

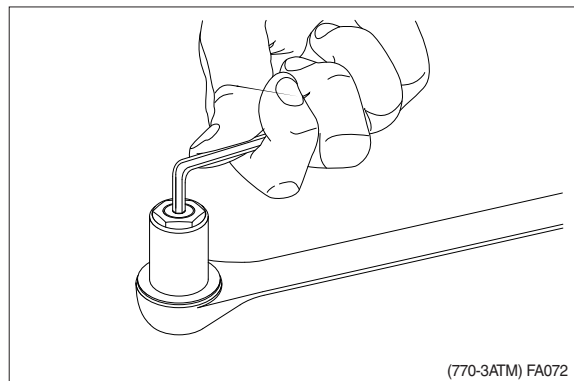
· Tightening torque : $1.5 \pm 0.2 \text{ kgf} \cdot \text{m}$
($10.8 \pm 1.4 \text{ lbf} \cdot \text{ft}$)



(2) Assembly of check valve

- ① Fit ball, spring and plug.

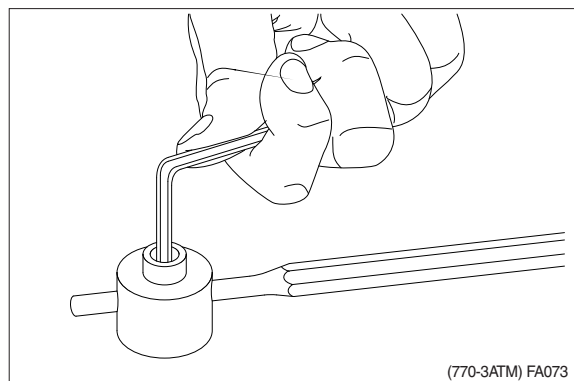
· Tightening torque : $0.5 \pm 0.1 \text{ kgf} \cdot \text{m}$
($3.6 \pm 0.7 \text{ lbf} \cdot \text{ft}$)



(3) Assembly of amplifier spool

- ① Fit orifice in plug.

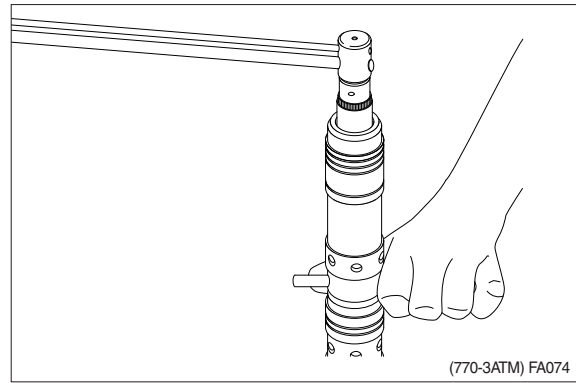
· Tightening torque : $0.5 \pm 0.1 \text{ kgf} \cdot \text{m}$
($3.6 \pm 0.7 \text{ lbf} \cdot \text{ft}$)



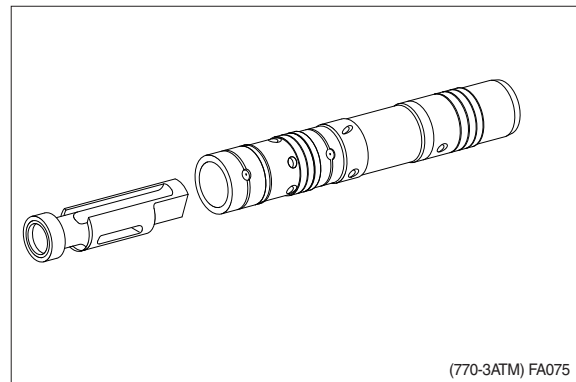
② Fit check valve.

- Tightening torque : $2 \pm 0.3 \text{ kgf} \cdot \text{m}$
($14.5 \pm 2.2 \text{ lbf} \cdot \text{ft}$)

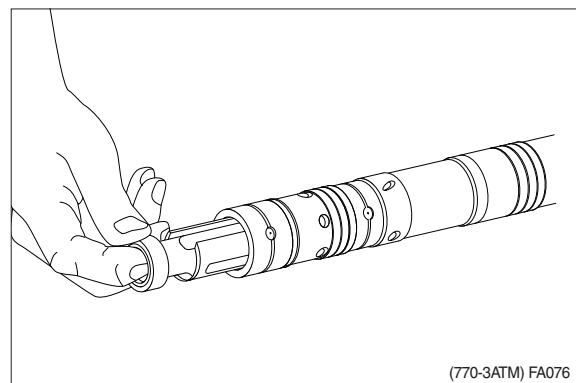
- ※ Avoid damaging spool surface.
Remember O-ring.



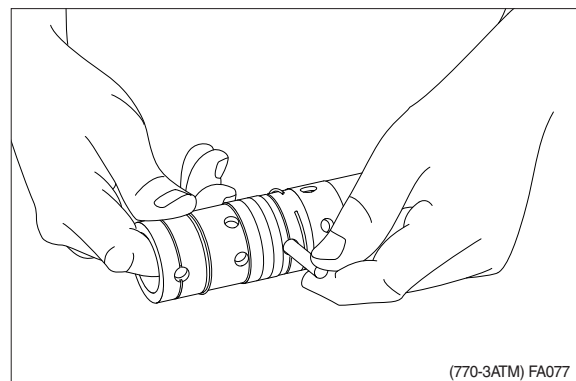
③ Place inner spool in the correct position.



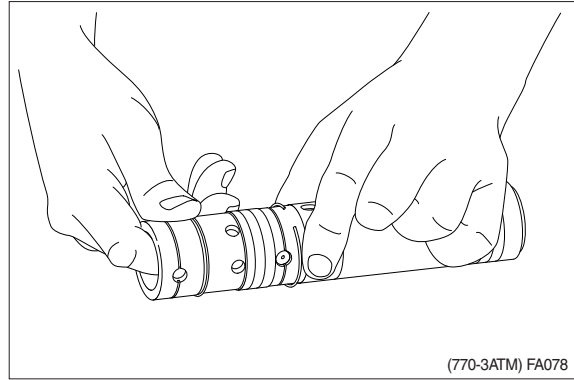
④ Guide inner spool in.



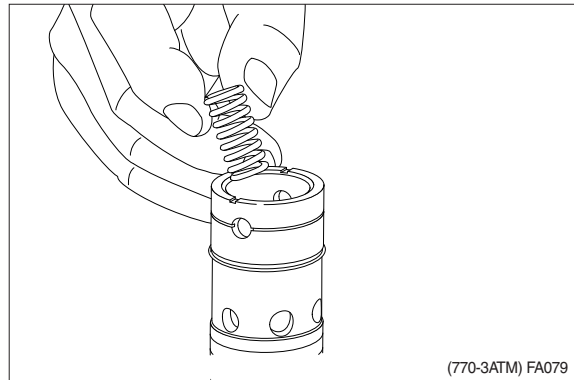
⑤ Fit pin.



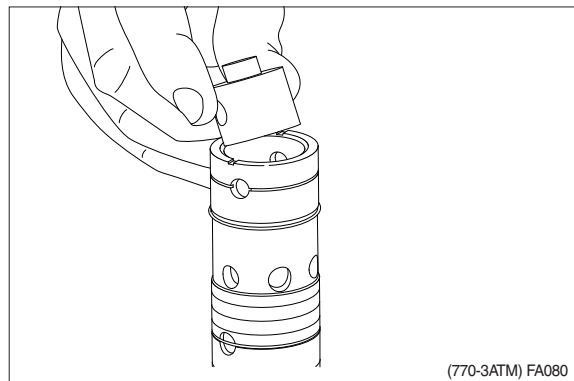
- ⑥ Push spring ring into position. Place spring ring into the recess with ends facing away from pin holes.



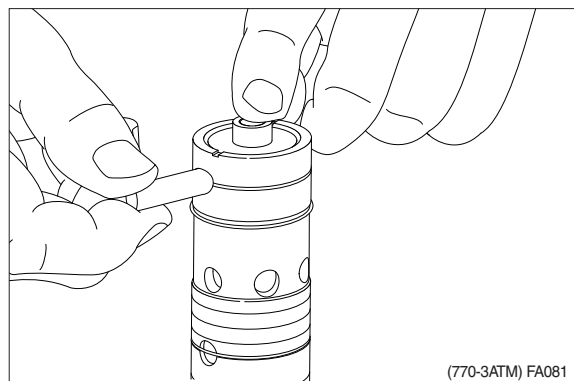
- ⑦ Fit spring.



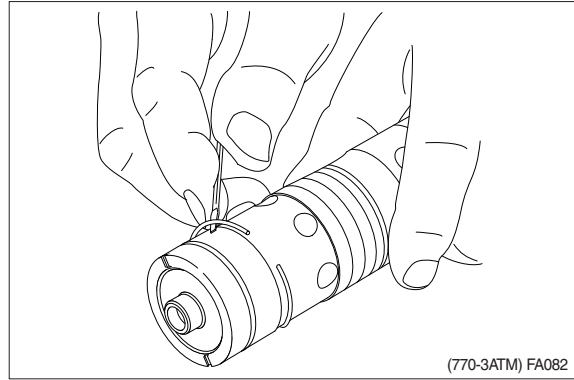
- ⑧ Fit plug.



- ⑨ Fit pin.

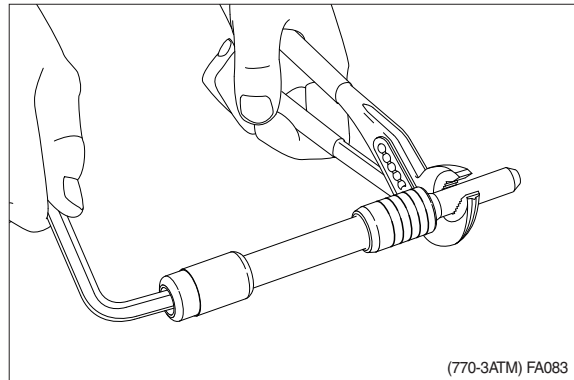


- ⑩ Push spring ring into position. Place spring ring into the recess with ends facing away from pin holes.



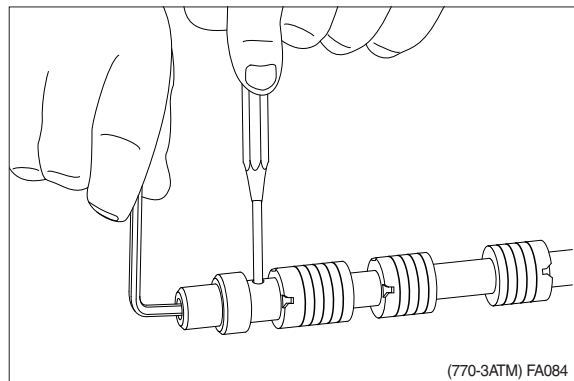
(4) Assembly of priority valve spool

- ① Fit plug or throttle check valve.
External PP : Plug.
Internal PP : Throttle check valve.
· Tightening torque : $1 \pm 0.3 \text{ kgf} \cdot \text{m}$
($7.2 \pm 2.2 \text{ lbf} \cdot \text{ft}$)



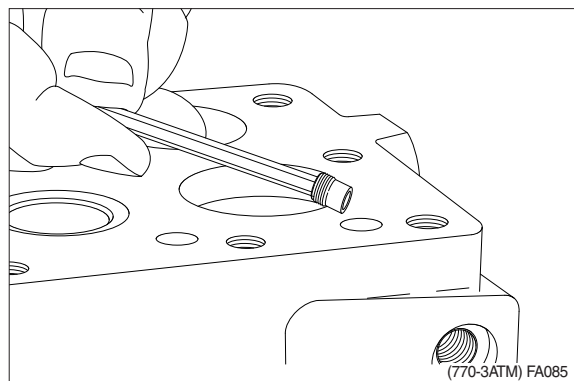
(5) Assembly of directional spool

- ① Screw in orifice.
· Tightening torque : $0.5 \pm 0.1 \text{ kgf} \cdot \text{m}$
($3.6 \pm 0.7 \text{ lbf} \cdot \text{ft}$)



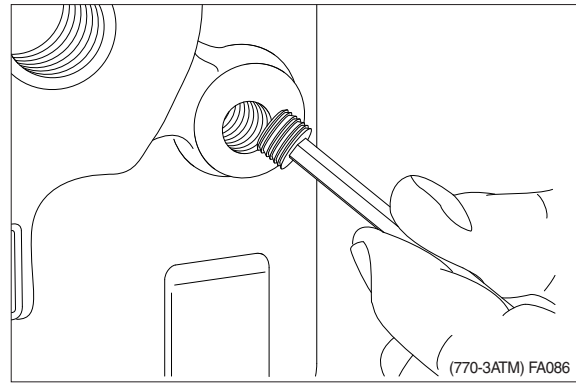
(6) Installation of orifice and throttle check valve

- ① Fit orifice in housing.
· Tightening torque : $0.5 \pm 0.1 \text{ kgf} \cdot \text{m}$
($3.6 \pm 0.7 \text{ lbf} \cdot \text{ft}$)



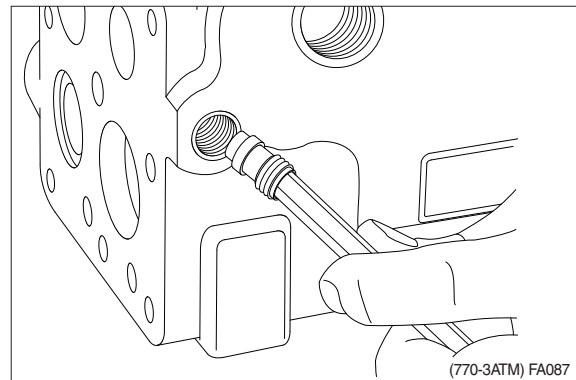
② Fit orifice in LS - connection.

- Tightening torque : $1 \pm 0.3 \text{ kgf} \cdot \text{m}$
($7.2 \pm 2.2 \text{ lbf} \cdot \text{ft}$)



③ Fit throttle check valve in PP - connection.

- Tightening torque : $1 \pm 0.3 \text{ kgf} \cdot \text{m}$
($7.2 \pm 2.2 \text{ lbf} \cdot \text{ft}$)



※ Comments on flow amplifiers with internal PP :

1. 1/4 BSP. F in PP - connection.

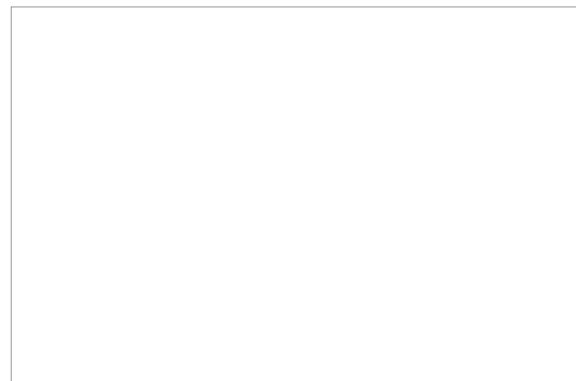
Fit washer and plug.

- Tightening torque : $4.1 \pm 0.3 \text{ kgf} \cdot \text{m}$
($29.7 \pm 2.2 \text{ lbf} \cdot \text{ft}$)

2. 7/16 - 20 UNF in PP - connection.

Fit O-ring and plug.

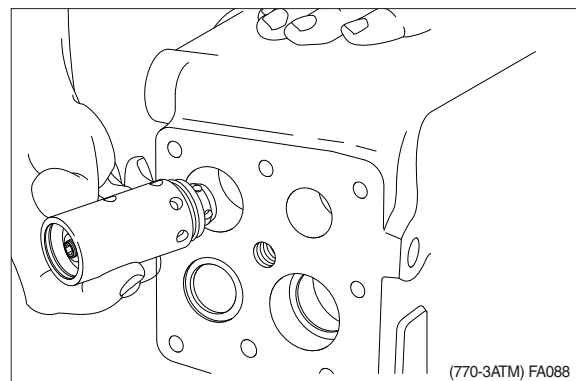
- Tightening torque : $1.5 \pm 0.5 \text{ kgf} \cdot \text{m}$
($10.8 \pm 3.6 \text{ lbf} \cdot \text{ft}$)



(7) Installation of shock valves

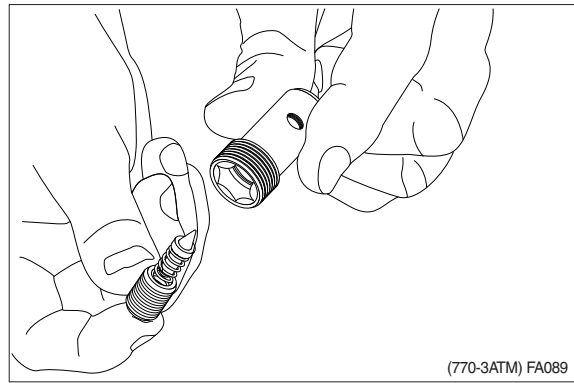
① Guide shock valve in and secure it by hand.

Remember O-ring.

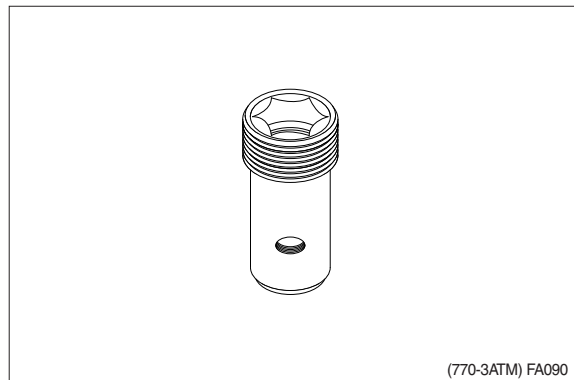


(8) Assembly of pressure relief valve

- ① Guide adjustment screw, spring and cone up into the cartridge.

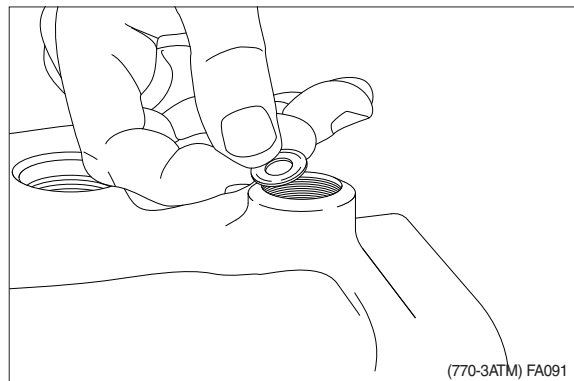


- ② Screw the adjustment screw so far in that the 10 mm hexagon key fully engages.

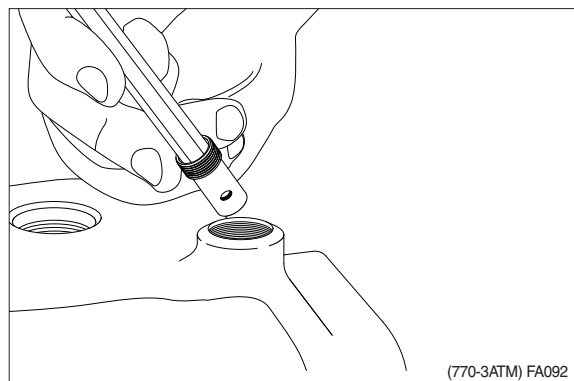


(9) Installation of pressure relief valve

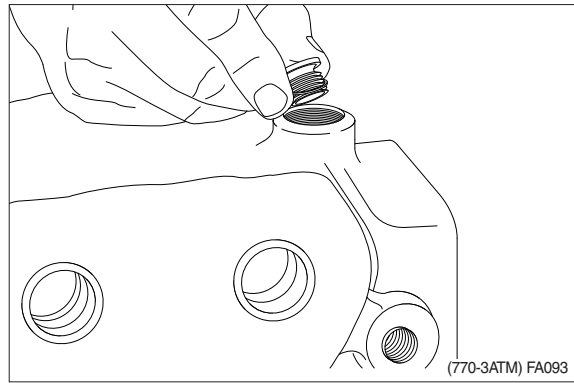
- ① Let the washer drop into the hole.



- ② Fit pressure relief valve.
 - Tightening torque : $3.1 \pm 0.3 \text{ kgf} \cdot \text{m}$
($22.4 \pm 2.2 \text{ lbf} \cdot \text{ft}$)

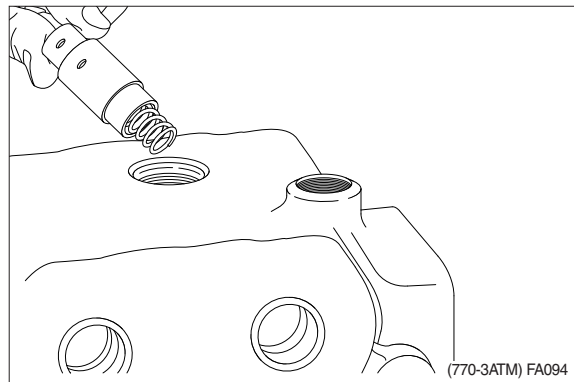


- ③ Fit plug with washer.
 · Tightening torque : $6 \pm 0.5 \text{ kgf} \cdot \text{m}$
 ($44.1 \pm 3.6 \text{ lbf} \cdot \text{ft}$)

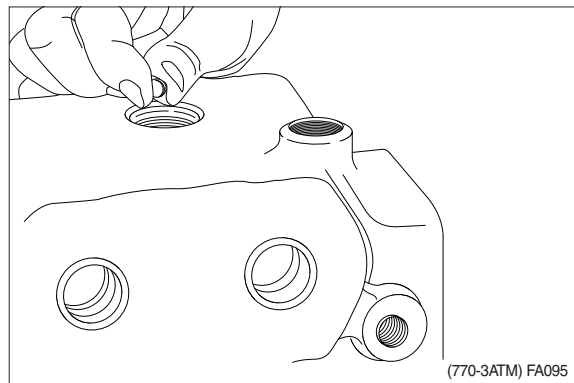


(10) Installation of back pressure valve

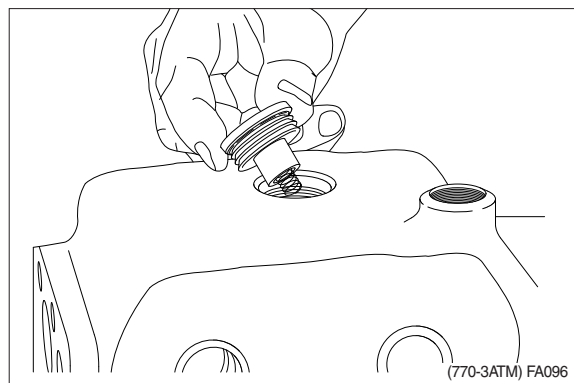
- ① First fit spring in piston with vaseline.
 Fit assembled piston and spring.



- ② Let the ball drop down.

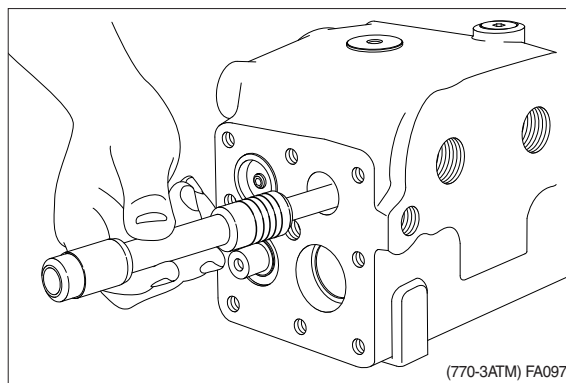


- ③ Fit spring in plug with vaseline.
 Fit assembled plug and spring.
 Remember O-ring.
 · Tightening torque : $2.6 \pm 0.3 \text{ kgf} \cdot \text{m}$
 ($18.8 \pm 2.2 \text{ lbf} \cdot \text{ft}$)

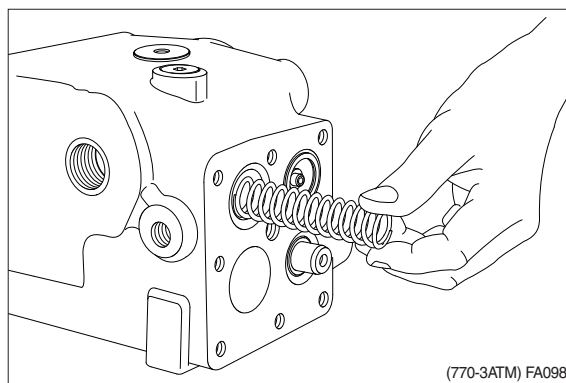


(11) Installation of spools

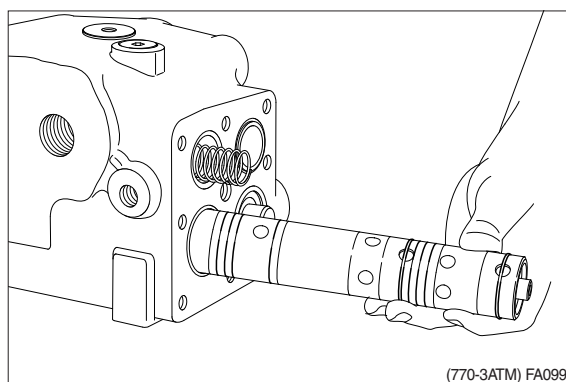
- ① Fit directional spool.
Fit priority valve spool.
- ※ Spring control must be placed in correct position against LS - connection.



- ② Fit spring.
- ※ Spring must be by the LS - connection.

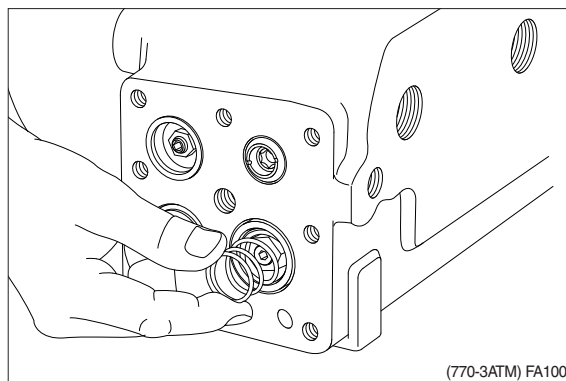


- ③ Fit amplifier spool.
- ※ The orifice must be placed in correct position against LS - connection.

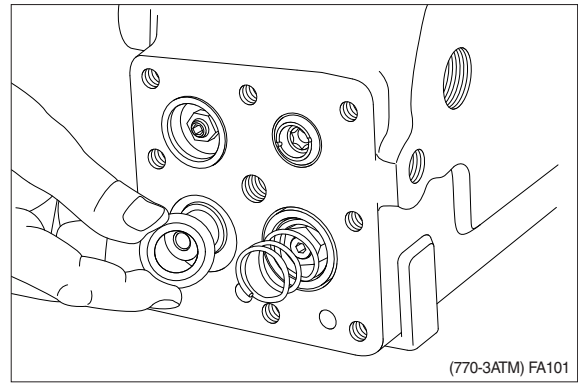


(12) Installation of end cover at PP - connection

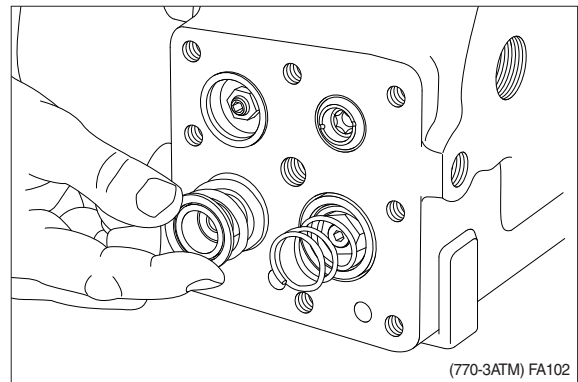
- ① Fit spring with vaseline on amplifier
- ※ spool.
- The spring must be fitted at the PP - connection.



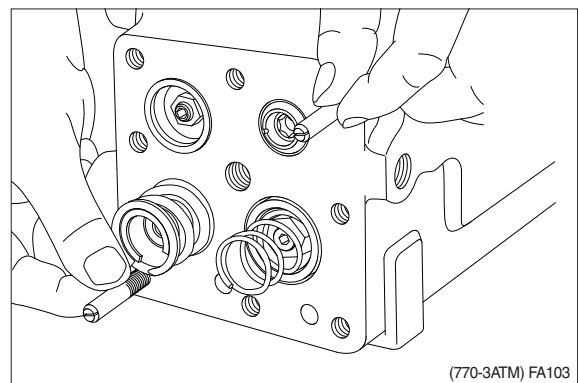
- ② Fit spring guide with vaseline.



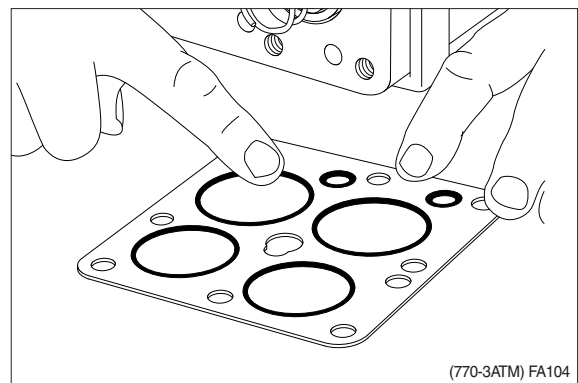
- ③ Fit large and small springs with vaseline.



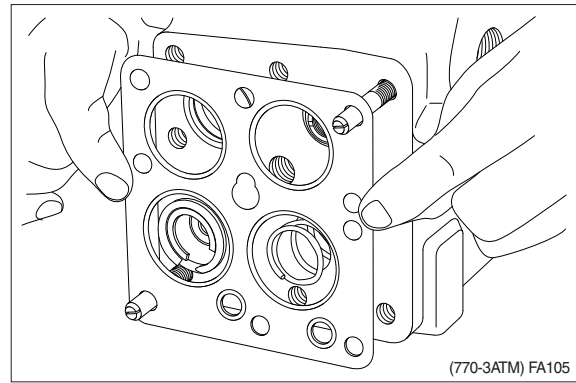
- ④ Fit guide screws.



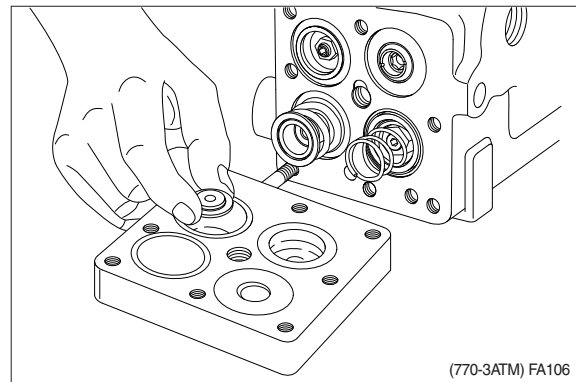
- ⑤ Fit 4 large and 2 small O-rings.



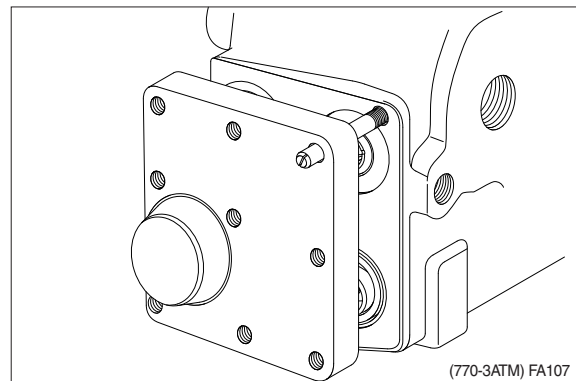
- ⑥ Guide plate in.



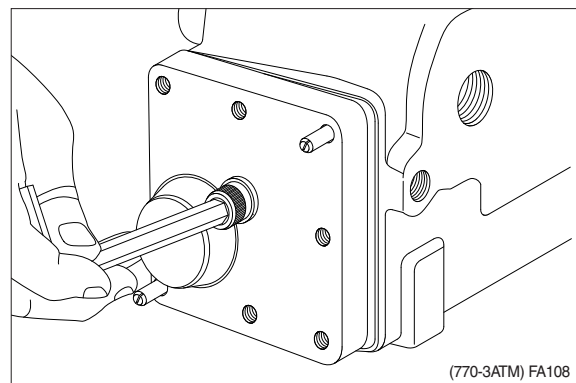
- ⑦ Fit stop (thickness : 5 mm) in end cover with vaseline.



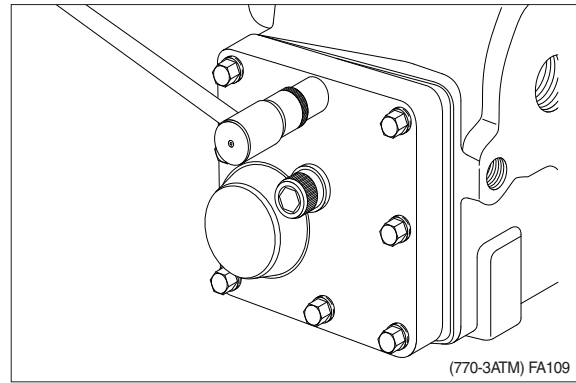
- ⑧ Guide end cover in.



- ⑨ Fit screw with spring washer.

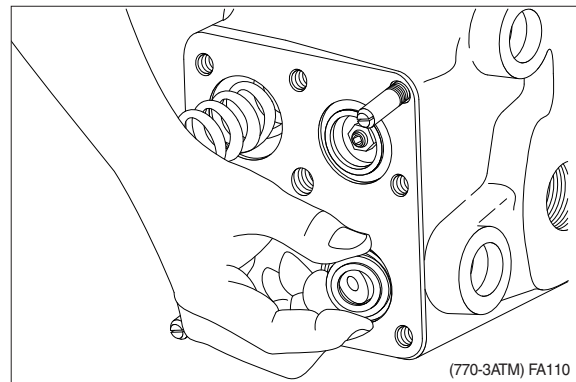


- ⑩ Fit screws with spring washer.
- Tightening torque : $2.6 \pm 0.5 \text{ kgf} \cdot \text{m}$
($18.8 \pm 3.6 \text{ lbf} \cdot \text{ft}$)
 - Tightening torque : $8.2 \pm 1 \text{ kgf} \cdot \text{m}$
for large screw ($59.3 \pm 7.2 \text{ lbf} \cdot \text{ft}$)

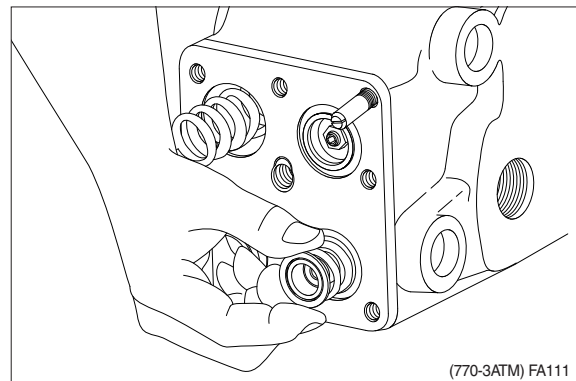


(13) Installation of end cover at LS - connection

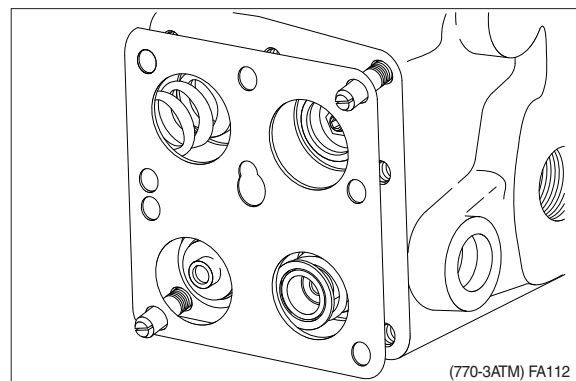
- ① Fit guide screws.
Fit remote control with vaseline.



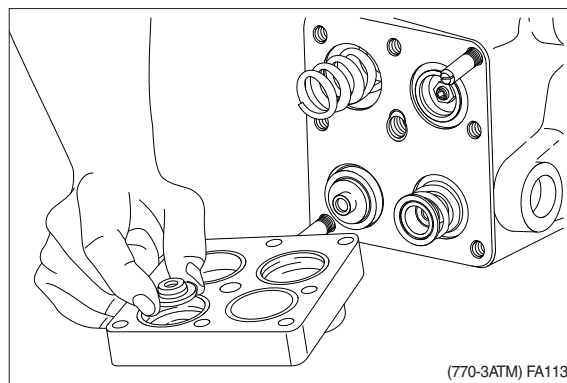
- ② Fit large and small springs with vaseline.



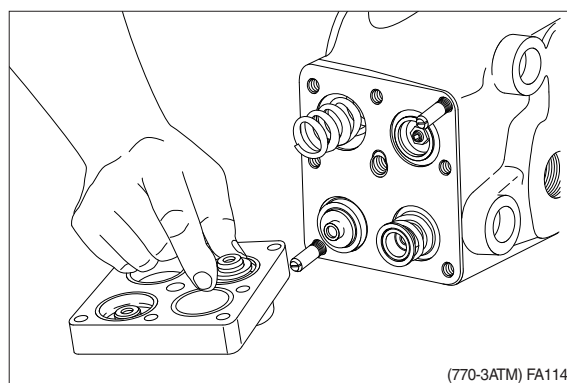
- ③ Guide in plate with 4 O-rings.



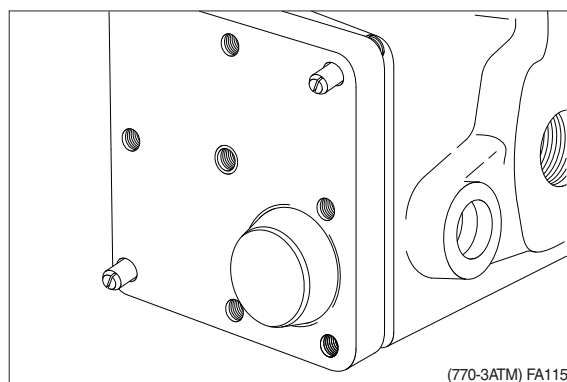
- ④ Fit stop for priority valve spool (thickness : 8 mm) with vaseline.



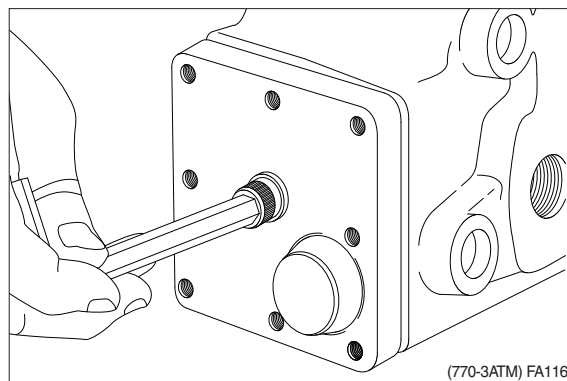
- ⑤ Fit stop for directional spool (thickness : 5 mm) with vaseline.



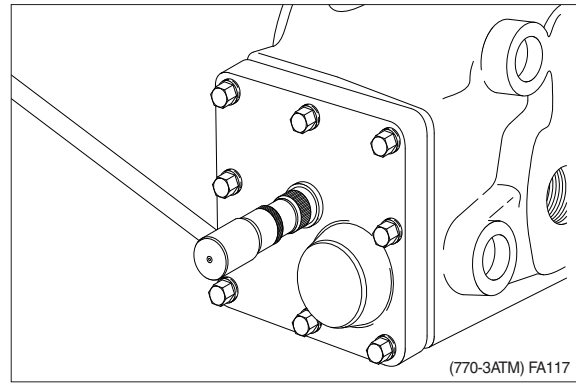
- ⑥ Guide in end cover.



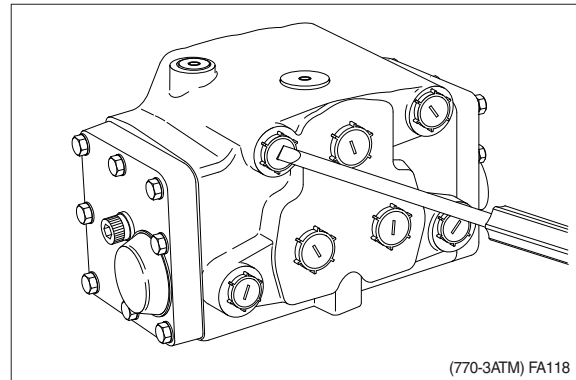
- ⑦ Fit large screw with spring washer.



- ⑧ Fit screws with spring washers.
- Tightening torque : $2.6 \pm 0.5 \text{ kgf} \cdot \text{m}$
($18.8 \pm 3.6 \text{ lbf} \cdot \text{ft}$)
 - Tightening torque : $8.2 \pm 1 \text{ kgf} \cdot \text{m}$
for large screw ($59.3 \pm 7.2 \text{ lbf} \cdot \text{ft}$)



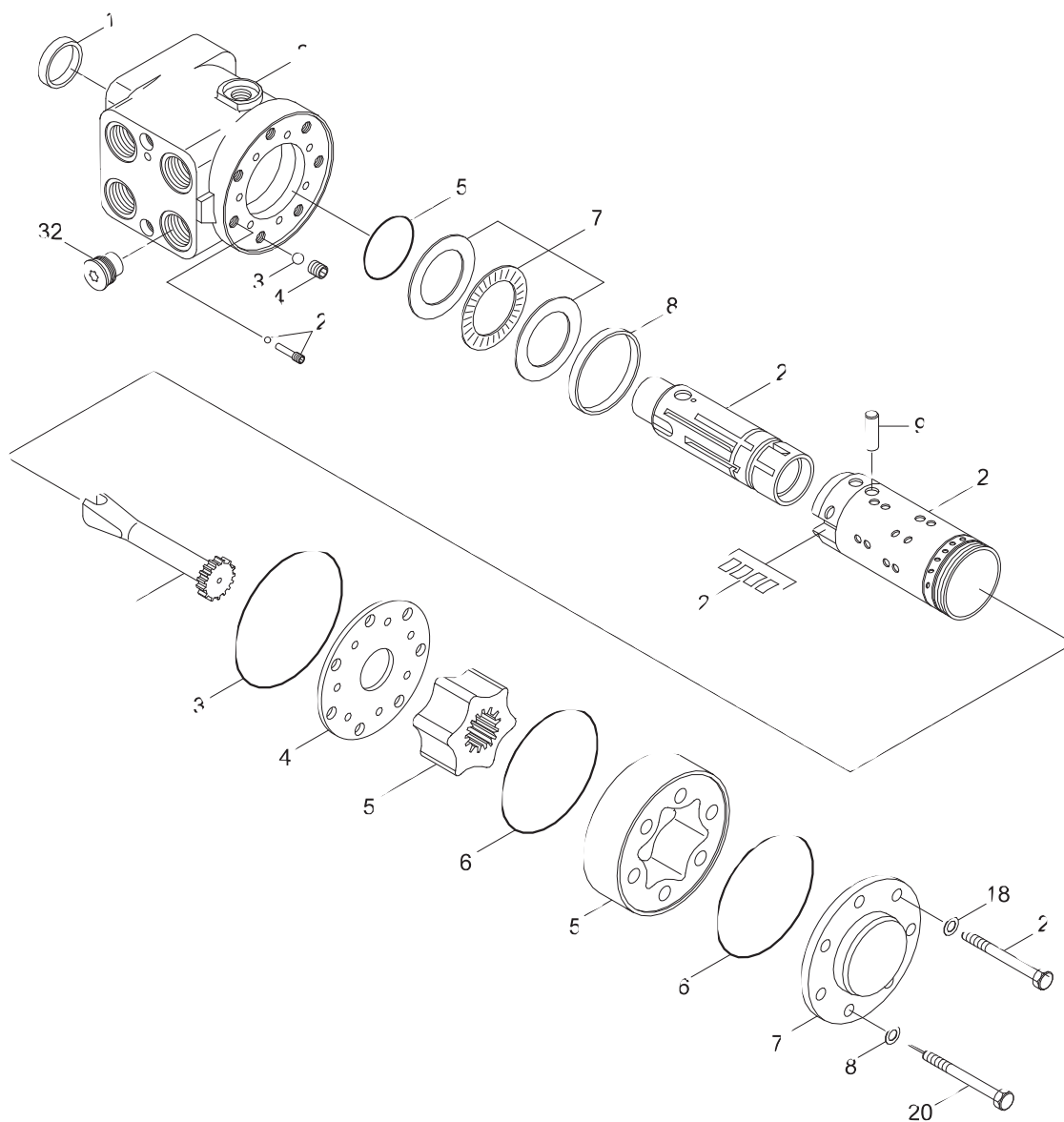
- ⑨ Fit plastic plugs.



This completes assembly.

2. STEERING UNIT

1) STRUCTURE

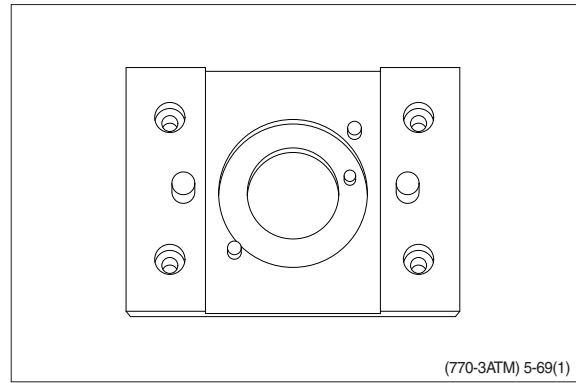


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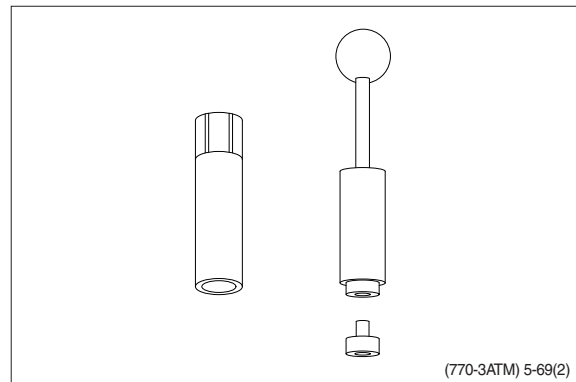
- | | | | | | |
|---|------------------------|----|-------------------|----|-------------|
| 1 | Dust seal ring | 9 | Cross pin | 17 | End cover |
| 2 | Housing, Spool, sleeve | 11 | Shaft | 18 | Washer |
| 3 | Ball | 12 | Spring set | 20 | Pin screw |
| 4 | Bushing | 13 | O-ring | 21 | Screw |
| 5 | Lip seal | 14 | Distributor plate | 32 | Check valve |
| 7 | Bearing assy | 15 | Gearwheel set | | |
| 8 | Ring | 16 | O-ring | | |

2) TOOLS

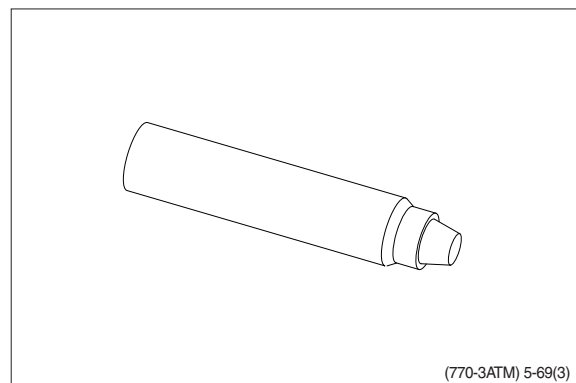
(1) Holding tool.



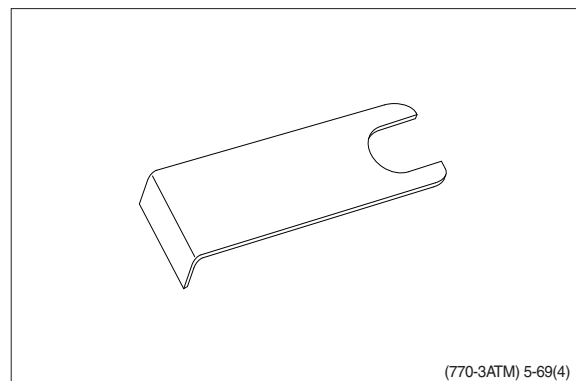
(2) Assembly tool for O-ring and kin-ring.



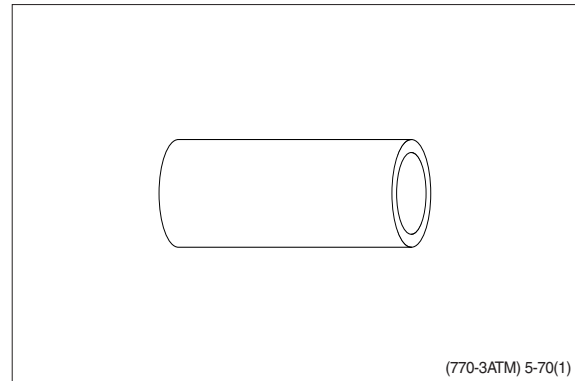
(3) Assembly tool for lip seal.



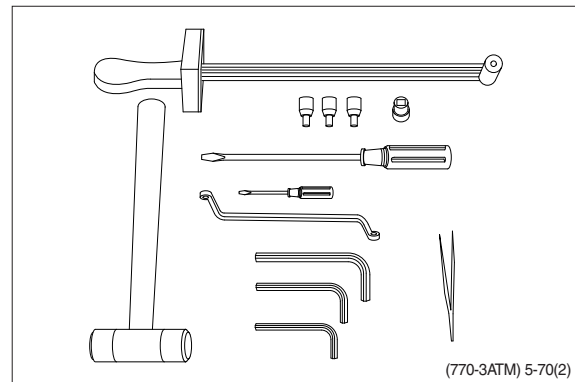
(4) Assembly tool for cardan shaft.



(5) Assembly tool for dust seal.

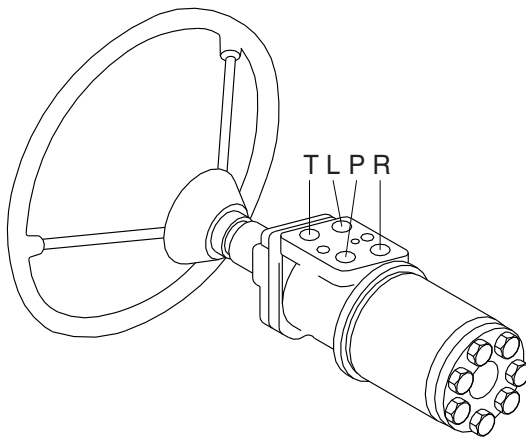


(6) Torque wrench 0~7.1 kgf · m
(0~54.4 lbf · ft)
13 mm socket spanner
6, 8 mm and 12 mm hexagon sockets
12 mm screwdriver
2 mm screwdriver
13 mm ring spanner
6, 8 and 12 mm hexagon socket spanners
Plastic hammer
Tweezers



3) TIGHTENING TORQUE AND HYDRAULIC CONNECTIONS

(1) Hydraulic connections



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

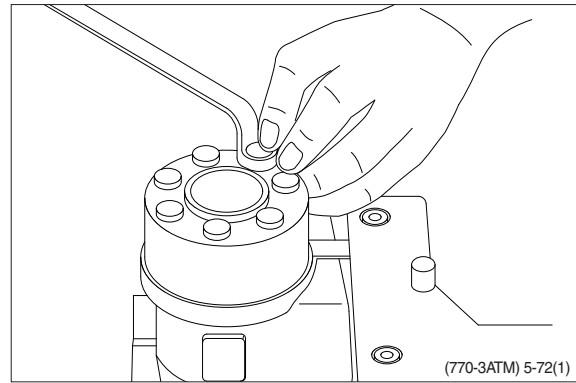
(770-3ATM) 5-71

(2) Tightening torque

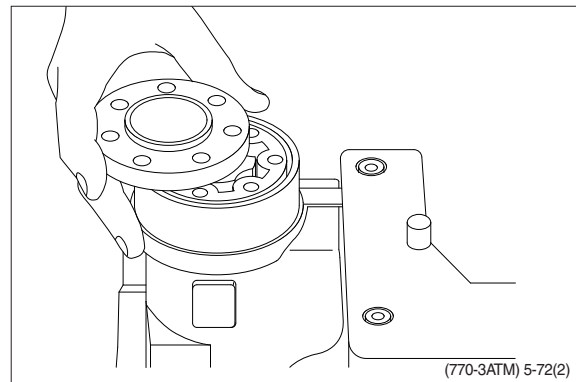
| Screwed connection | Max. tightening torque [kgf · m (lbf · ft)] | | | |
|--------------------|---|--------------------|----------------------|---------------|
| | With cutting edge | With copper washer | With aluminum washer | With O - ring |
| 1/4 BSP.F | 4.1 (29.7) | 2.0 (14.5) | 3.1 (22.4) | - |
| 3/8 BSP.F | 6.1 (44.1) | 2.0 (14.5) | 5.1 (36.9) | - |
| 1/2 BSP.F | 10.2 (73.8) | 3.1 (22.4) | 8.2 (59.3) | - |
| 7/16-20 UNF | - | - | - | 2.0 (14.5) |
| 3/4-16 UNF | - | - | - | 6.1 (44.1) |
| M 12×1.5 | 4.1 (29.7) | 2.0 (14.5) | 3.1 (22.4) | 2.0 (14.5) |
| M 18×1.5 | 7.1 (51.4) | 2.0 (14.5) | 5.1 (36.9) | 5.1 (36.9) |
| M 22×1.5 | 10.2 (73.8) | 3.1 (22.4) | 8.2 (59.3) | 7.1 (51.4) |

4) DISASSEMBLY

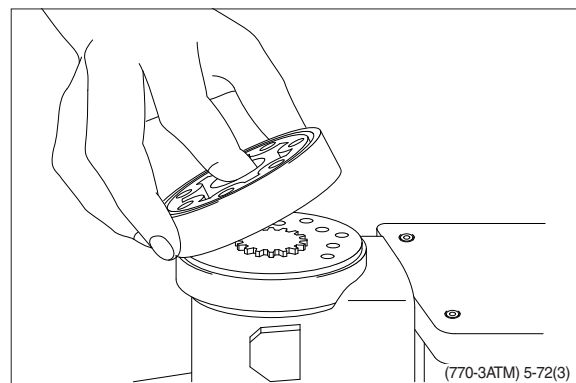
- (1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover(6-off plus one special screw).



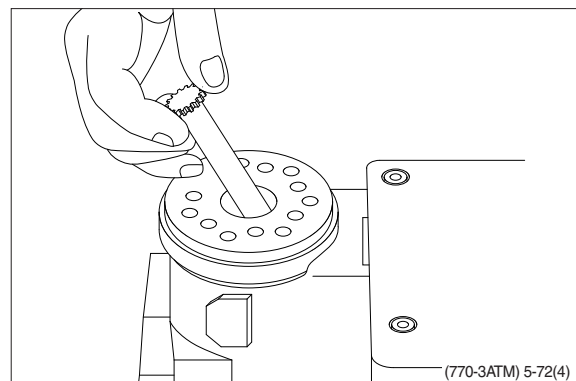
- (2) Remove the end cover, sideways.



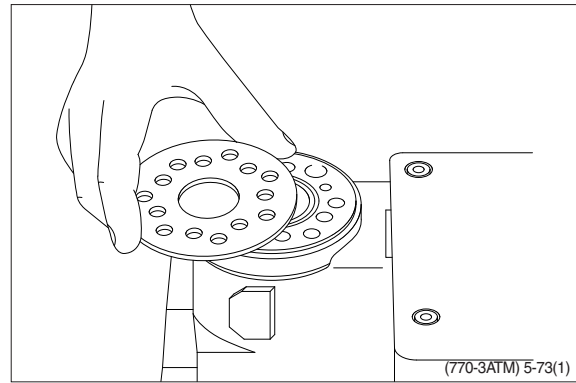
- (3) Lift the gearwheel set (with spacer if fitted) off the unit.
Take out the two O-rings.



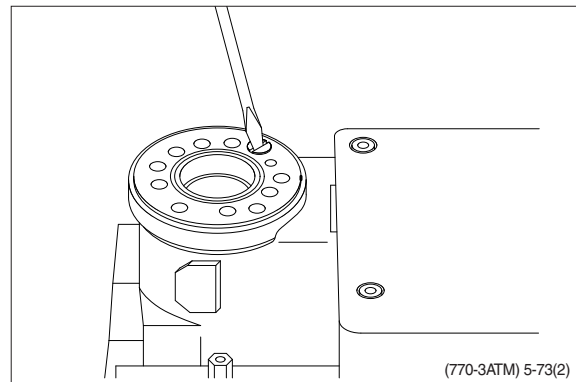
- (4) Remove cardan shaft.



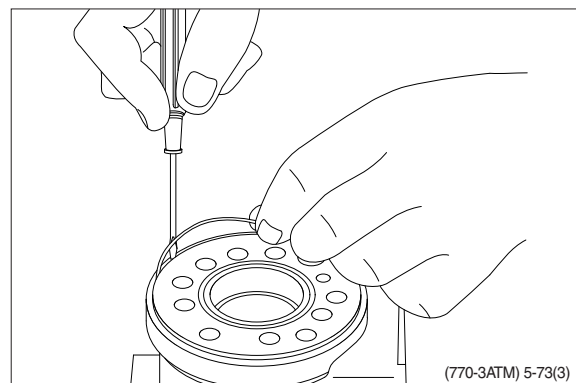
(5) Remove distributor plate.



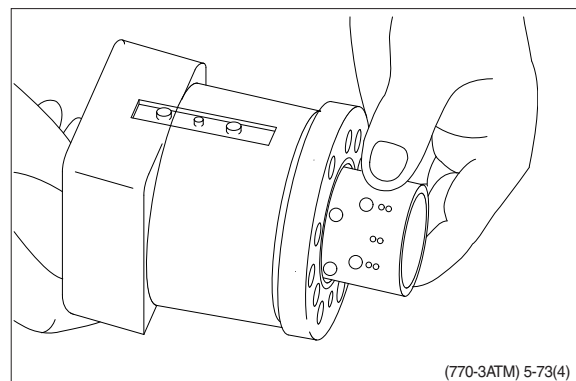
(6) Screw out the threaded bush over the check valve.



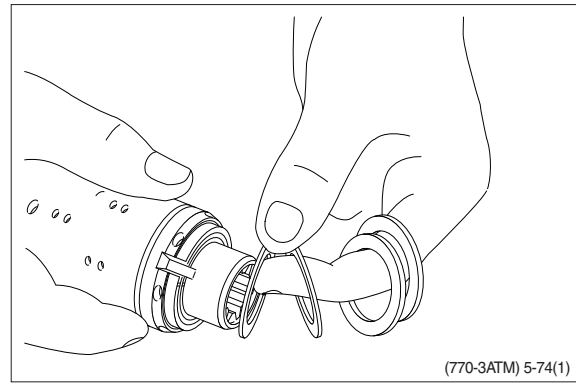
(7) Remove O-ring.



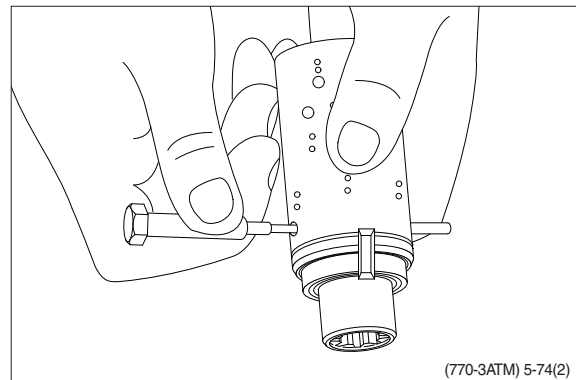
(8) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and needle bearing will be pushed out of the housing together.



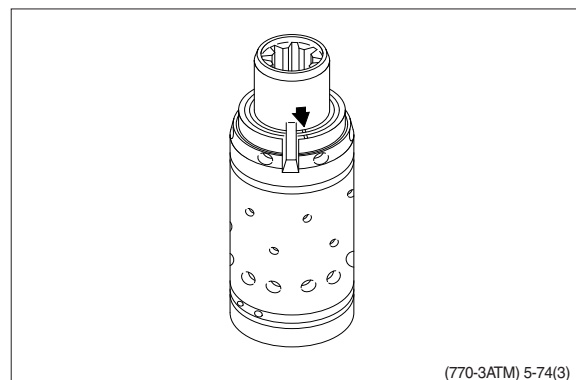
- (9) Take ring, bearing races and needle bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.



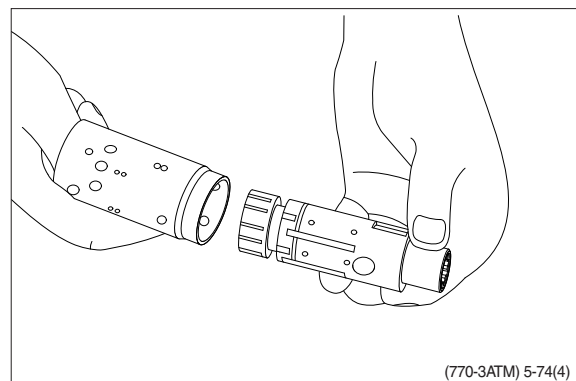
- (10) Press out the cross pin. Use the special screw from the end cover.



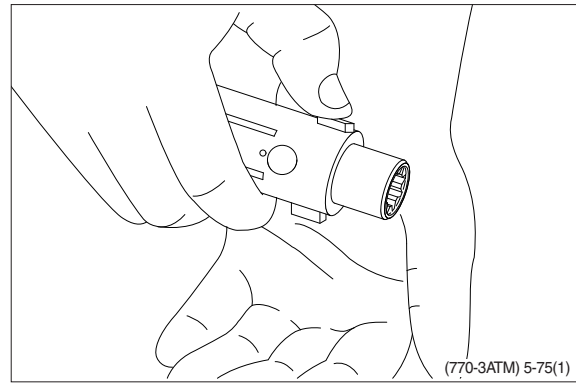
- ※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs (see drawing). If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.



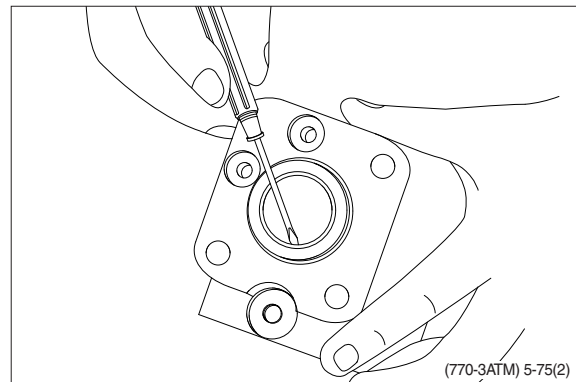
- (11) Carefully press the spool out of the sleeve.



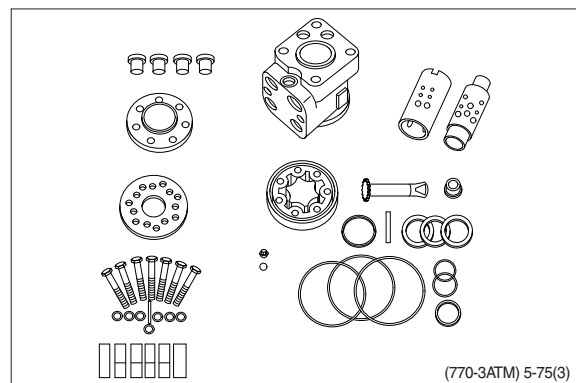
- (12) Press the neutral position springs out of their slots in the spool.



- (13) Remove dust seal and O-ring.



- (14) The steering unit is now completely disassembled.



※ **Cleaning**

Clean all parts carefully in Shellsol K or the like.

※ **Inspection and replacement**

Replace all seals and washers. Check all parts carefully and make any replacements necessary.

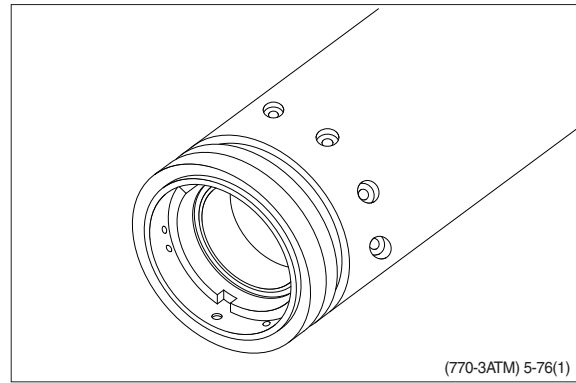
※ **Lubrication**

Before assembly, lubricate all parts with hydraulic oil.

5) ASSEMBLY

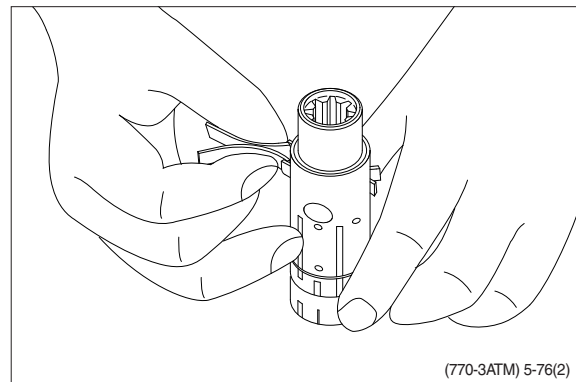
(1) Assemble spool and sleeve.

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



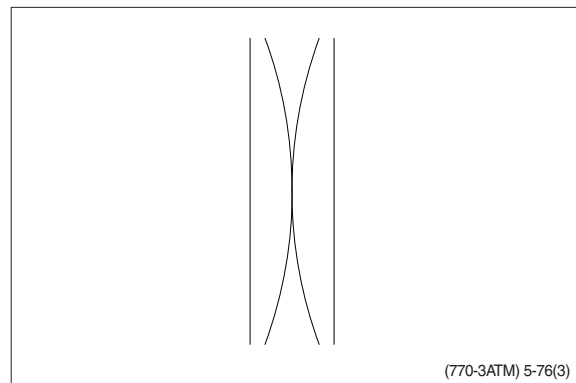
(2) Place the two flat neutral position springs in the slot.

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

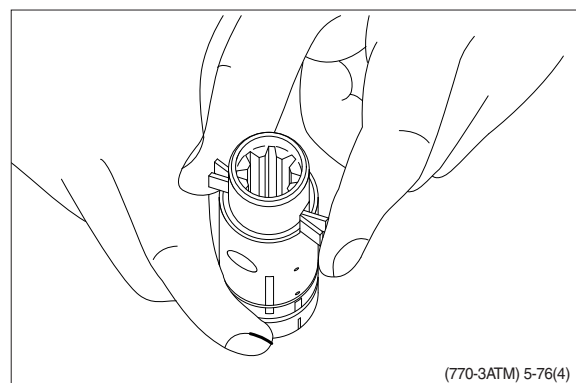


※ Assembly pattern.

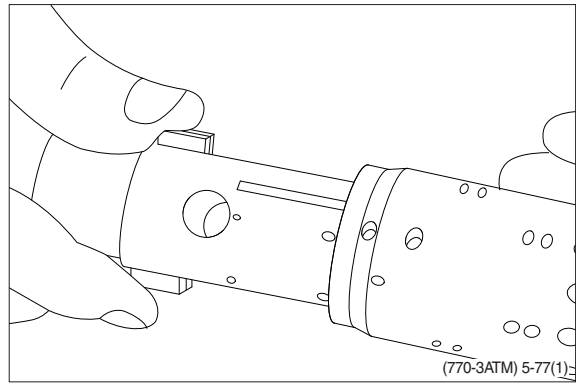
- Weak springs (blue)
 - 2 - off flat, blue : Part no. 150-0748
 - 2 - off curved, blue : Part no. 150-0749
- Blue set
 - Spare set : Part no. 150-4265



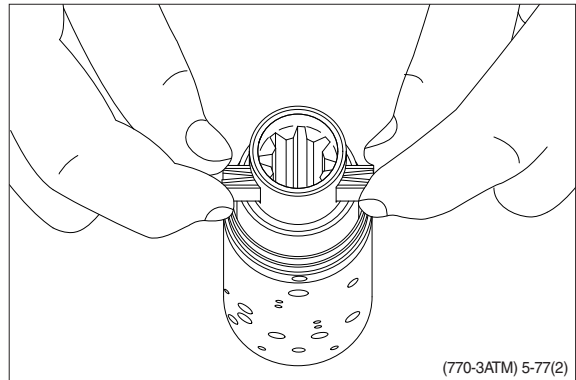
(3) Line up the spring set.



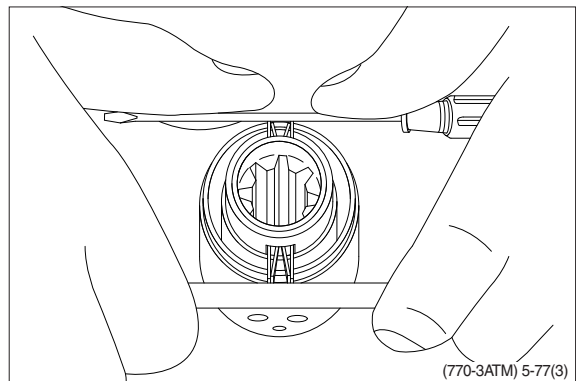
- (4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other(See page 3-76, No.(1)).



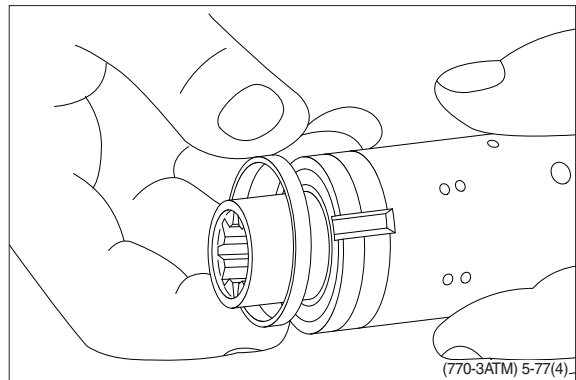
- (5) Press the springs together and push the neutral position springs into place in the sleeve.



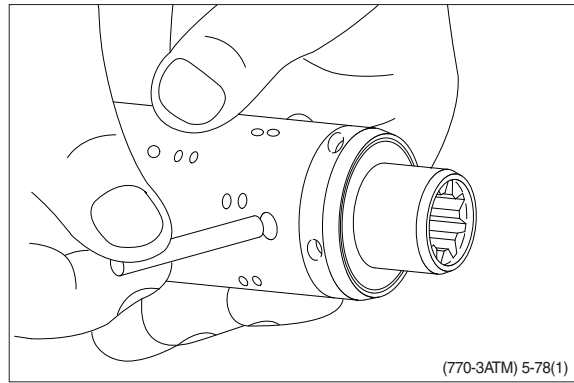
- (6) Line up the springs and center them.



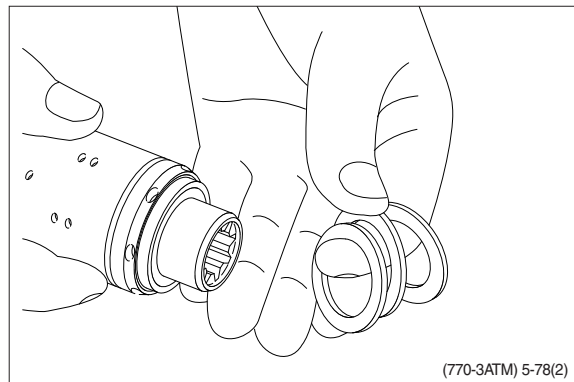
- (7) Guide the ring down over the sleeve.
※ The ring should be able to rotate free of the springs.



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

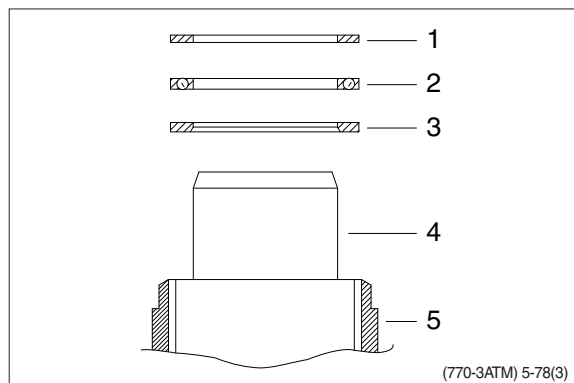


(9) Fit bearing races and needle bearing as shown on below drawing.



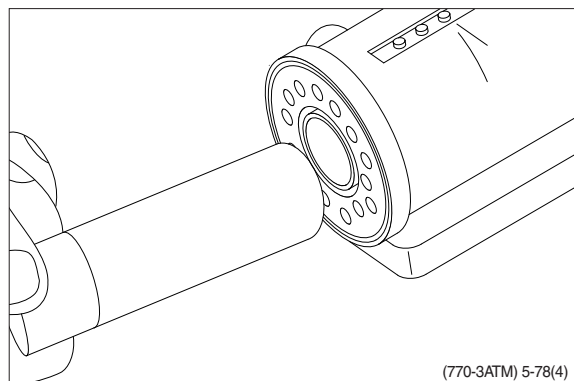
※ Assembly pattern for standard bearings

- 1 Outer bearing race
- 2 Needle bearing
- 3 Inner bearing race
- 4 Spool
- 5 Sleeve

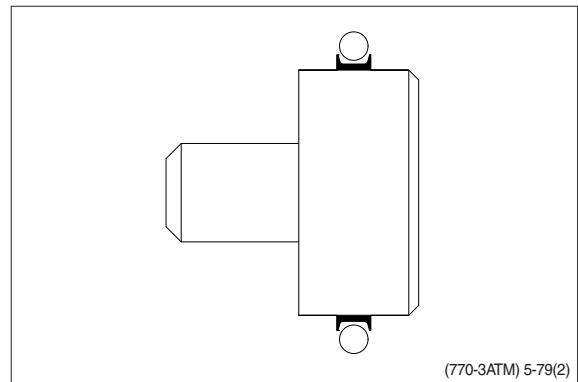
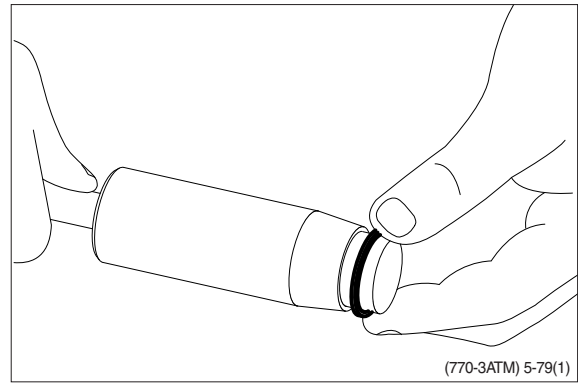


Installation instruction for O-ring

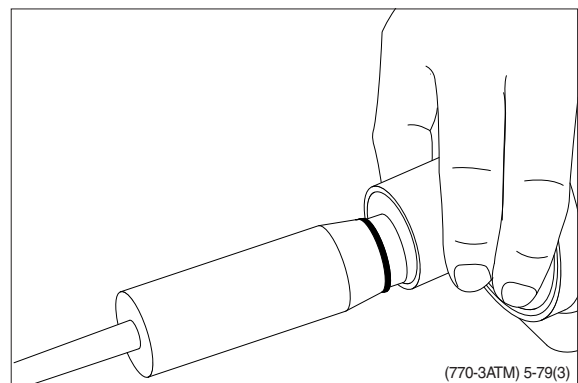
(10) Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool / sleeve.



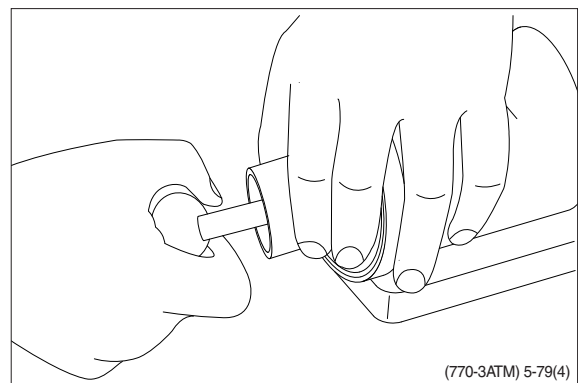
- (11) Grease O-ring with hydraulic oil and place them on the tool.



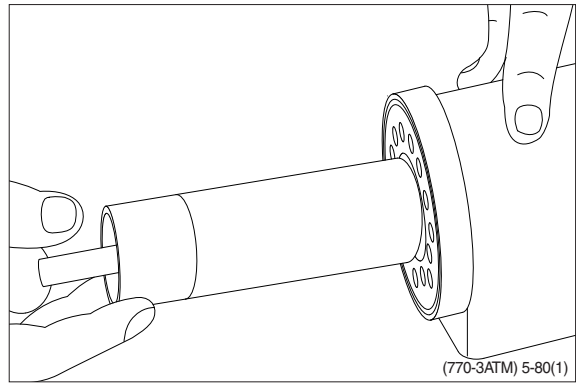
- (12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



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

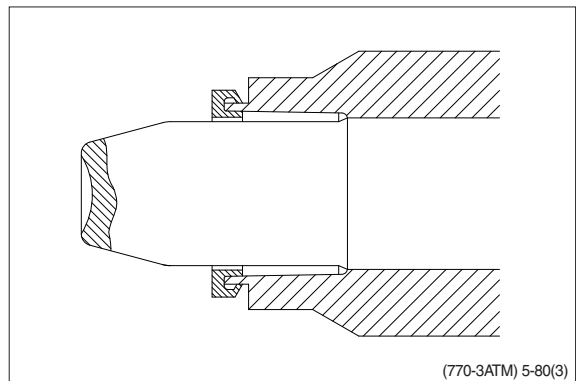
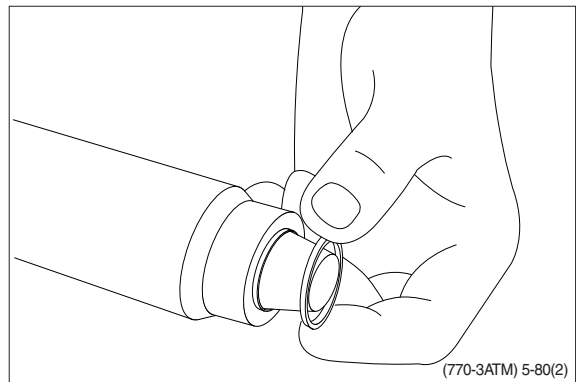


- (14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.

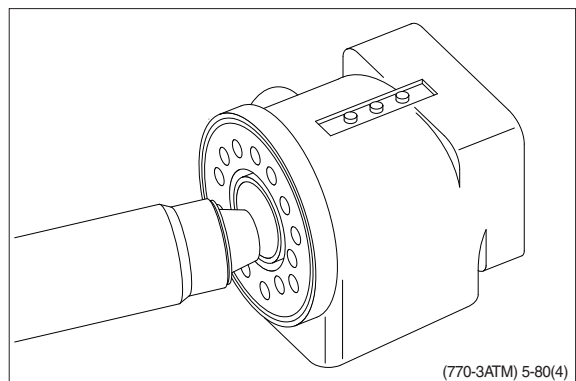


Installation instructions for lip seal

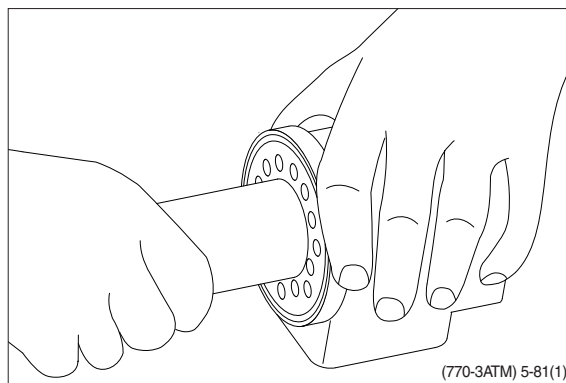
- (15) Lubricate the lip seal with hydraulic oil and place it on the assembly tool.



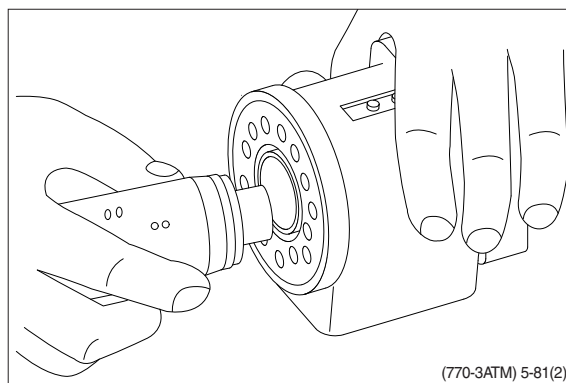
- (16) Guide the assembly tool right to the bottom.



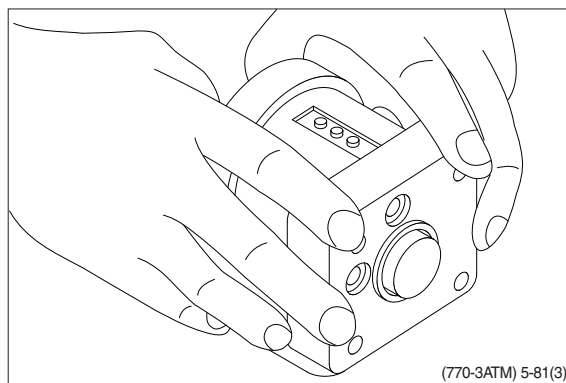
- (17) Press and turn the lip seal into place in the housing.



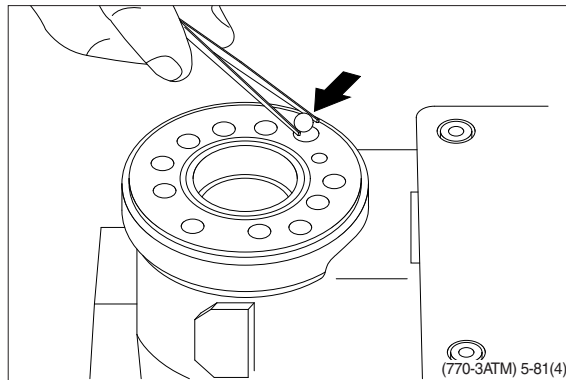
- (18) With a light turning movement, guide the spool and sleeve into the bore.
※ Fit the spool set holding the cross pin horizontal.



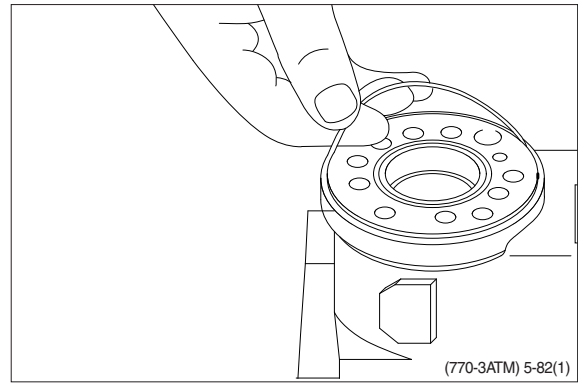
- (19) The spool set will push out the assembly tool guide. The O-ring are now in position.



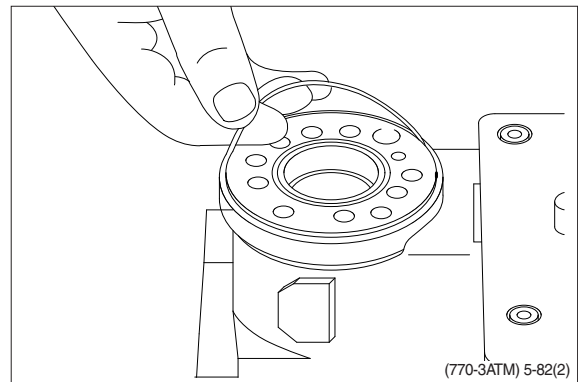
- (20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



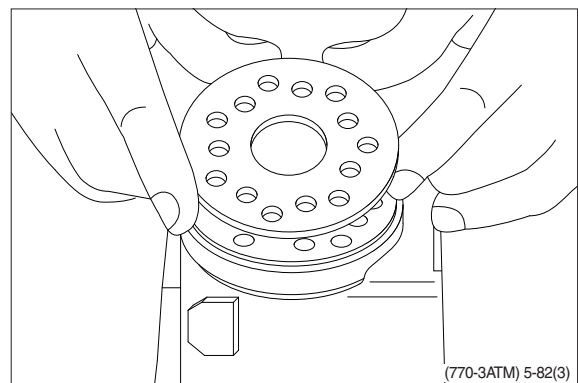
- (21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



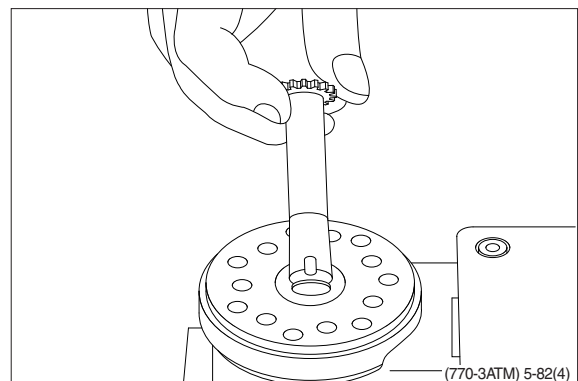
- (22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20. C .



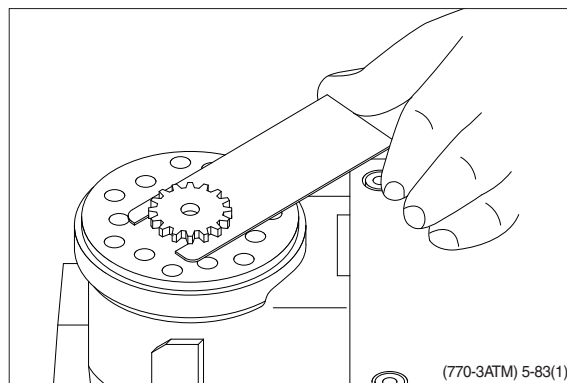
- (23) Place the distributor plate so that the channel holes match the holes in the housing.



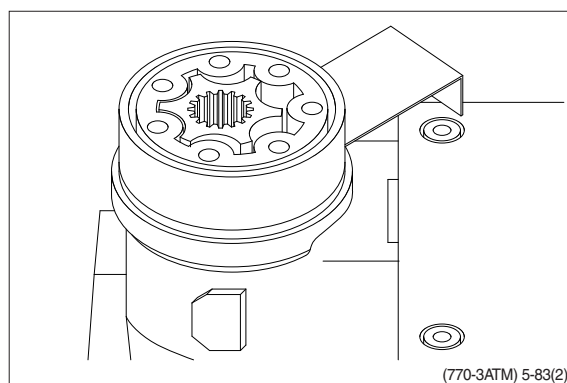
- (24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



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



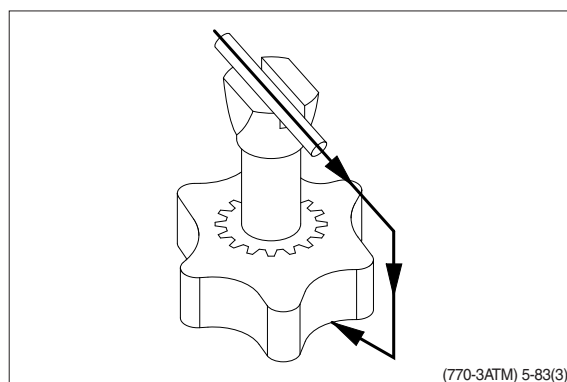
- (26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20° C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



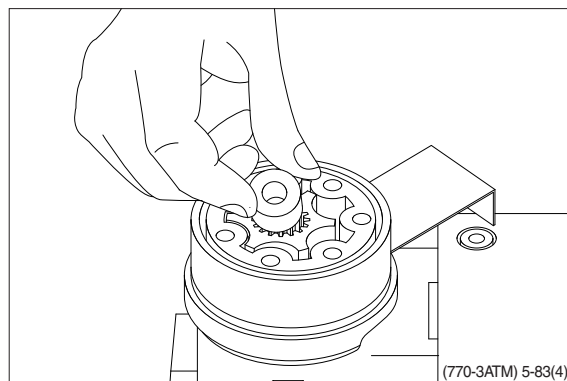
- (27) Important

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

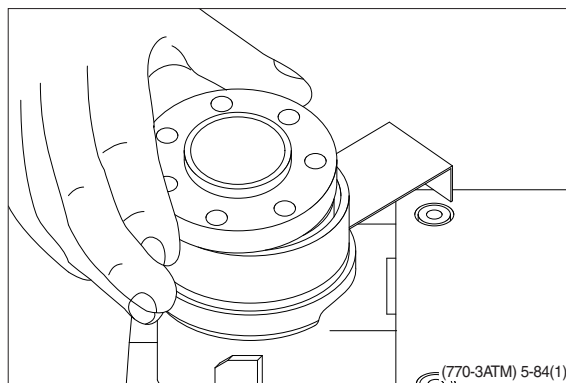
Turn the gear rim so that the seven through holes match the holes in the housing.



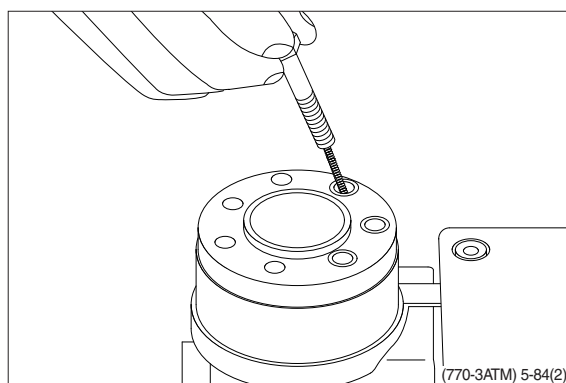
- (28) Fit the spacer, if any.



(29) Place the end cover in position.

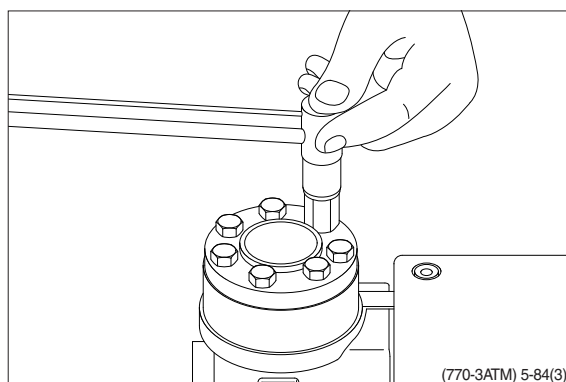


(30) Fit the special screw with washer and place it in the hole shown.

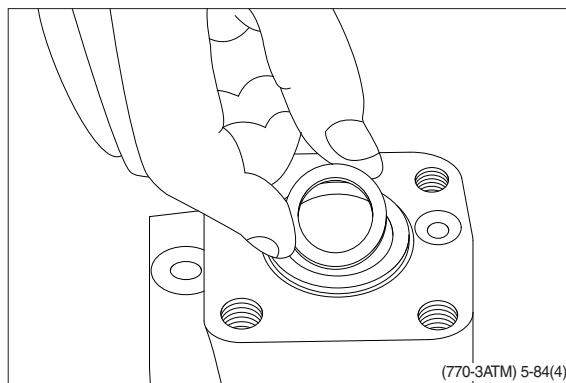


(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

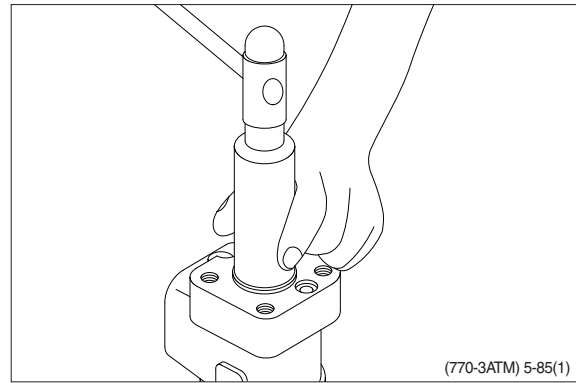
- Tightening torque : $3.1 \pm 0.6 \text{ kgf} \cdot \text{m}$
($22.4 \pm 4.3 \text{ lbf} \cdot \text{ft}$)



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

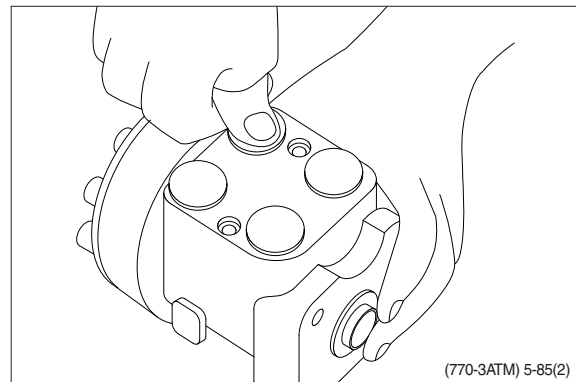


(33) Fit the dust seal ring in the housing.



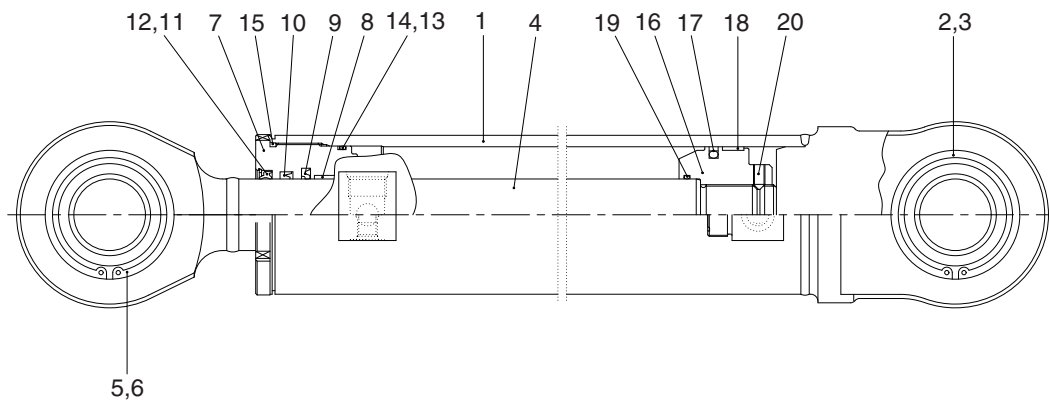
(34) Press the plastic plugs into the connection ports.

※ Do not use a hammer!



3. STEERING CYLINDER

1) STRUCTURE

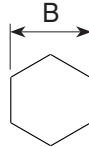


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- | | | | | | |
|---|-------------------|----|----------------|----|-------------|
| 1 | Tube assembly | 8 | Rod bushing | 15 | O-ring |
| 2 | Spherical bearing | 9 | Buffer seal | 16 | Piston |
| 3 | Retaining ring | 10 | U-packing | 17 | Piston seal |
| 4 | Rod assy | 11 | Dust wiper | 18 | Wear ring |
| 5 | Spherical bearing | 12 | Retaining ring | 19 | O-ring |
| 6 | Retaining ring | 13 | O-ring | 20 | Set screw |
| 7 | Gland | 14 | Back up ring | | |

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

| Tool name | B | Remark |
|---------------|--|---|
| L-wrench | 6 |  |
| Spanner | 13 | |
| | 65 | |
| Wrench | For gland | |
| (-) Driver | Small and large sizes | |
| Torque wrench | Capable of tightening with the specified torques | |

(2) Tightening torque

| Part name | Item | Size | Torque | |
|-----------|------|----------|---------|----------|
| | | | kgf · m | lbf · ft |
| Gland | 7 | M100×2 | 50±5 | 362±36 |
| Piston | 16 | M 42×2 | 50±5 | 362±36 |
| Set screw | 20 | M 8×1.25 | 1.5 | 10.8 |

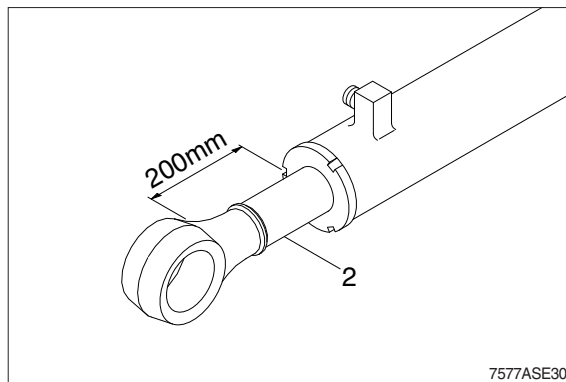
3) DISASSEMBLY

(1) Remove cylinder head and piston rod

① Hold the clevis section of the tube in a vise.

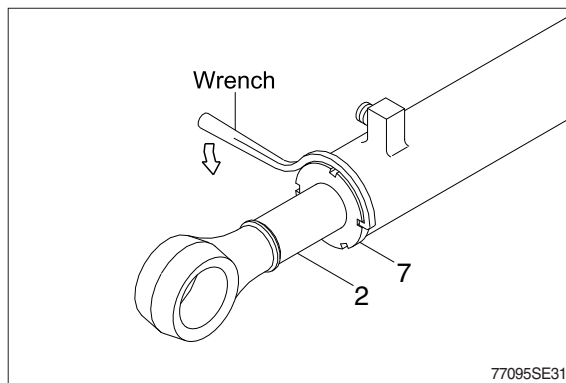
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out piston rod (2) about 200 mm (7.8 in). Because the piston rod is rather heavy, finish extending it with air pressure after the oil draining operation.



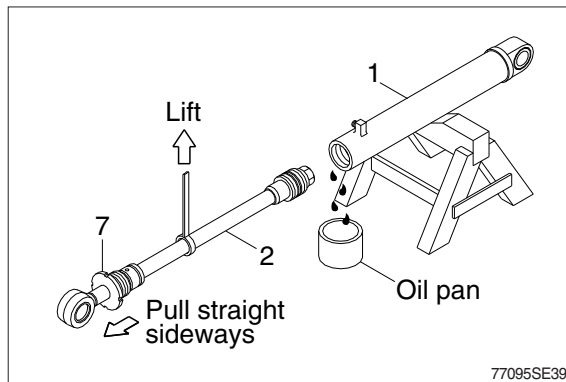
③ Loosen and remove the gland (7).

※ Cover the extracted piston rod (2) with rag to prevent it from being accidentally damaged during operation.



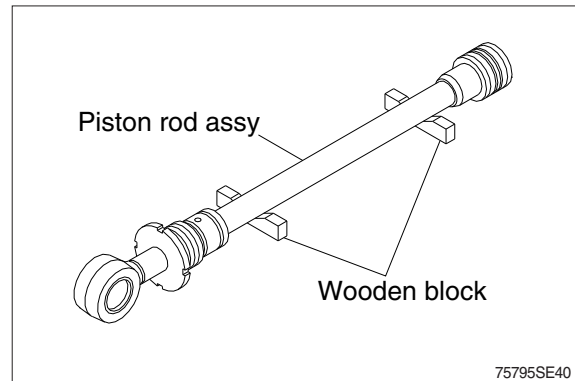
④ Draw out gland (7) and piston rod (2) assembly together from cylinder tube (1).

※ Since the piston rod assembly is heavy in this case, lift the tip of the piston rod (2) with a crane or some means and draw it out. However, when piston rod (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



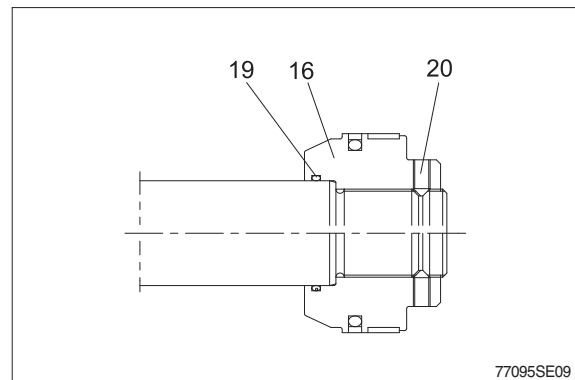
- ※ Note that the plated surface of piston rod (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

- ⑤ Place the removed piston rod assembly on a wooden V-block that is set level.
- ※ Cover a V-block with soft rag.

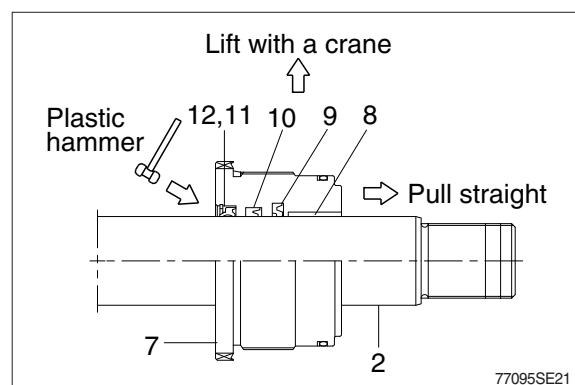


(2) Remove piston and gland assembly

- ① Remove the set screw (20).
- ② Remove piston assembly (16) and O-ring (19).



- ③ Remove the gland (7) assembly from piston rod (2).
 - ※ If it is too heavy to move, move it by striking the flanged part of gland (7) with a plastic hammer.
 - ※ Pull it straight with gland assembly lifted with a crane.
- Exercise care so as not to damage the lip of rod bushing (8) and packing (9, 10, 11, 12) by the threads of piston rod (2).

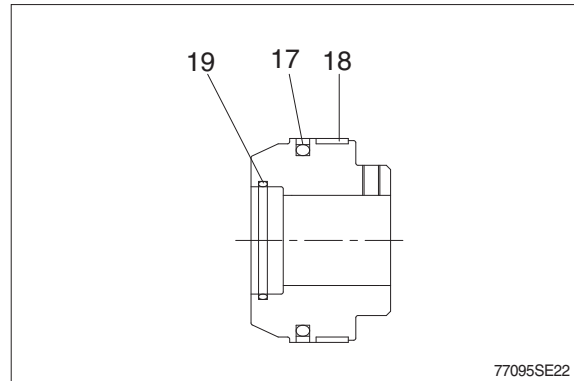


(3) Disassemble the piston assembly

- ① Remove wear ring (18) and piston seal (17).

Remove O-ring (19).

- ※ Exercise care in this operation not to damage the grooves.

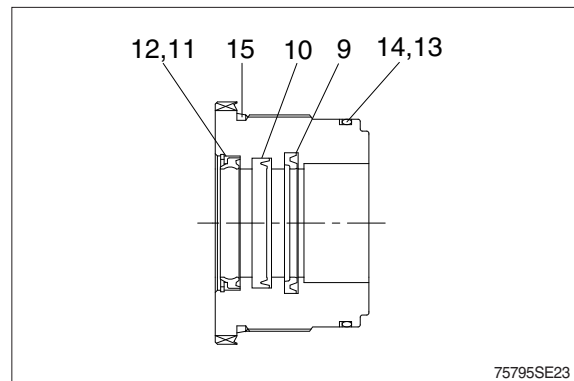


(4) Disassemble gland assembly

- ① Remove back up ring (14), and O-ring (13).
- ② Remove O-ring (15).
- ③ Remove retaining ring (12) and dust wiper (11).
- ④ Remove U-packing (10) and buffer seal (9).

- ※ Exercise care in this operation not to damage the grooves.

- ※ Do not remove seal and ring, if does not damaged.

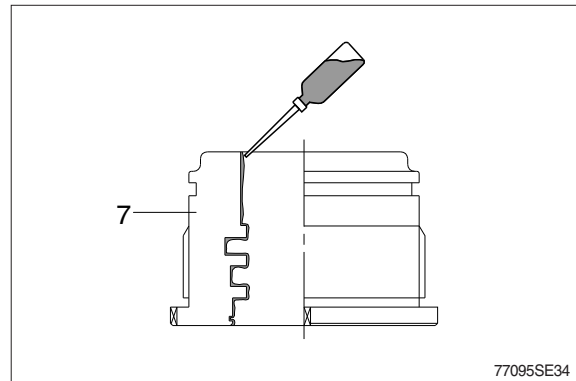


4) ASSEMBLY

(1) Assemble gland assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

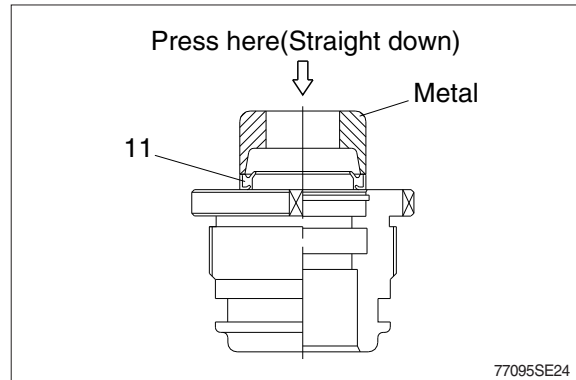
- ① Coat the inner face of gland (7) with hydraulic oil.



- ② Coat dust wiper (11) with grease and fit dust wiper (11) to the bottom of the hole of dust wiper.

At this time, press a pad metal to the metal ring of dust seal.

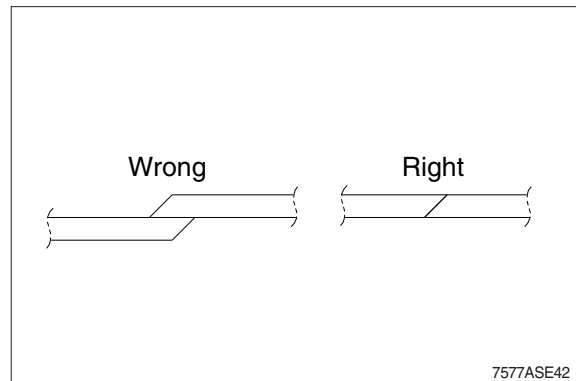
- ③ Fit retaining ring (12) to the stop face.



- ④ Fit U-packing (10) and buffer seal (9) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

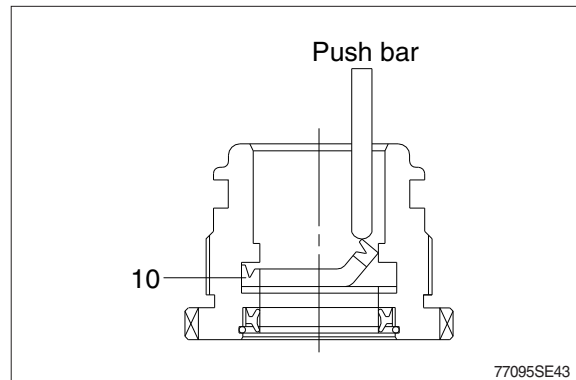
※ Insert the backup ring until outside of it is inserted into groove.



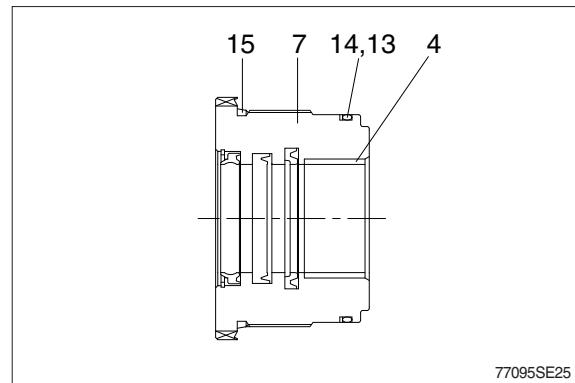
※ U-packing (10) has its own fitting direction.

Therefore, confirm it before fitting them.

※ Fitting U-packing (10) up side down may damage its lip. Therefore check the correct direction that is shown in figure.

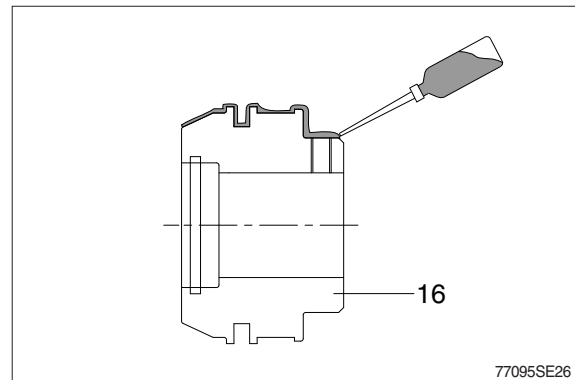


- ⑤ Fit back up ring (14) to gland (7).
- ※ Put the back up ring in the warm water of 30~50°C.
- ⑥ Fit O-ring (13, 15) to gland (7).
- ⑦ Fit bushing (8) to gland (7).

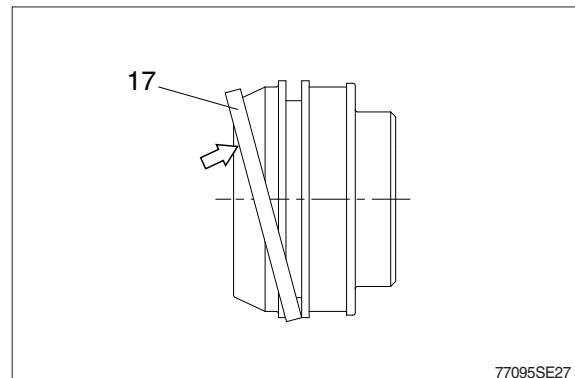


(2) Assemble piston assembly

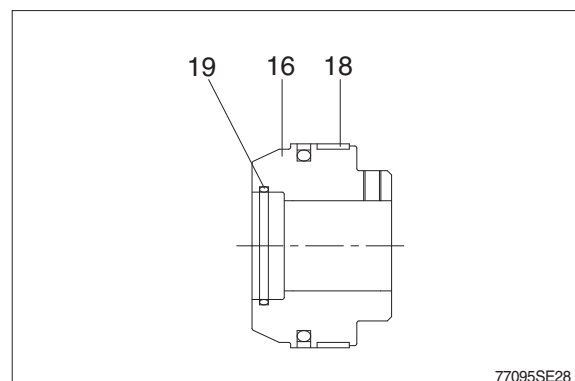
- ※ Check for scratches or rough surfaces.
- ① If found smooth with an oil stone.
Coat the outer face of piston (16) with hydraulic oil.



- ② Fit piston seal (17) to piston.
- ※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.
- ※ After assembling the piston seal, press its outer diameter to fit in.

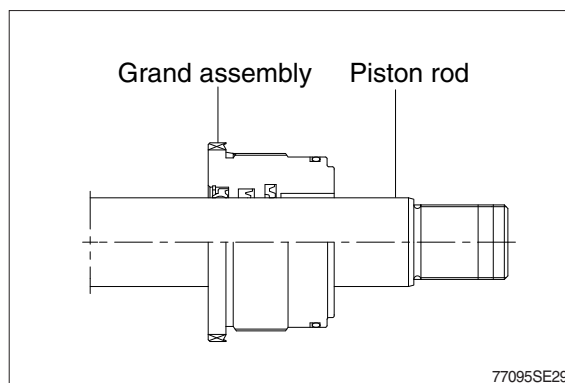


- ③ Fit wear ring (18) to piston (16).
- ④ Fit O-ring (19) to piston (16).

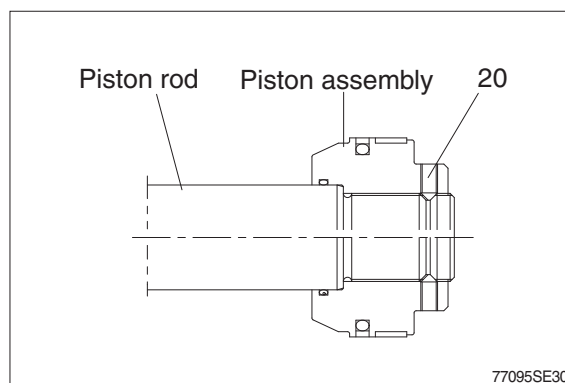


(3) Install piston and gland assembly

- ① Fix the piston rod assembly to the work bench.
- ② Apply hydraulic oil to the outer surface of piston rod (2), the inner surface of piston and gland (7).
- ③ Insert gland assembly to piston rod (2).

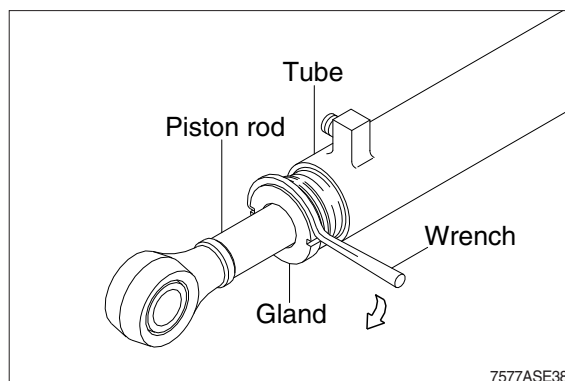
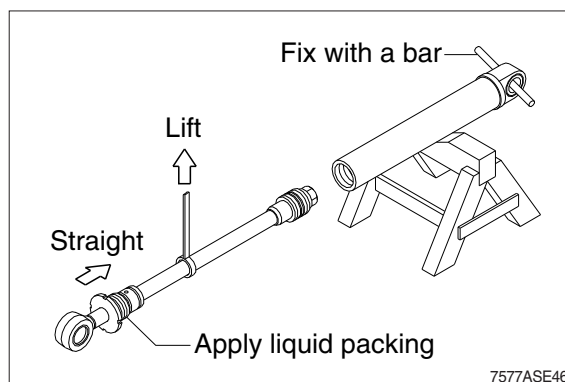


- ④ Fit piston assembly to piston rod.
 - Tightening torque : 50 ± 5 kgf · m
(362 ± 36 lbf · ft)
- ⑤ Insert the set screw (20).



(4) Overall assembly

- ① Place a V-block on a rigid work bench.
Mount the cylinder tube assembly on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.
- ② Insert the piston rod assembly in to the cylinder tube assembly, while lifting and moving the piston rod assembly with a crane.
- ※ Be careful not to damage piston seal by thread of cylinder tube.
- ③ Fit gland to the tube.
 - Tightening torque : 50 ± 5 kgf · m
(362 ± 36 lbf · ft)



1) CONSTRUCTION

A technical drawing of a mechanical assembly, likely a valve or a pump component, shown in a cross-sectional view. The drawing includes various parts labeled with numbers 1 through 29. The central part is a large, cylindrical body (1) with a wavy internal surface. It is surrounded by a housing (2) with a flange (28) on the right. The assembly is secured by bolts (25, 24, 6,20, 22) and washers (27) on top. A central shaft (11) passes through the body, with a seal (13) and a nut (22) at the top. A side port (3) is located on the right, with a plug (4,5) and a seal (2) at the entrance. A bottom flange (16) is attached to the base, with a bolt (29) and a nut (23,20) at the bottom. A small component (19,20) is visible on the left side of the housing.

Technical drawing of a mechanical assembly, likely a valve or actuator, showing a cross-sectional view. The drawing includes various components labeled with numbers 7 through 29. The central part is a vertical cylinder (7) with a flange at the top. It is mounted on a base (10) which has four vertical support legs (14, 15, 26). The assembly is secured by four large bolts (17, 18, 19, 20) and four smaller bolts (8, 9, 12, 13). A central actuator or piston rod (6, 20) is visible at the bottom. A curved line (29) indicates a seal or gasket. A rectangular component (28) is attached to the side of the central cylinder. A small component (4, 5) is also visible on the side.

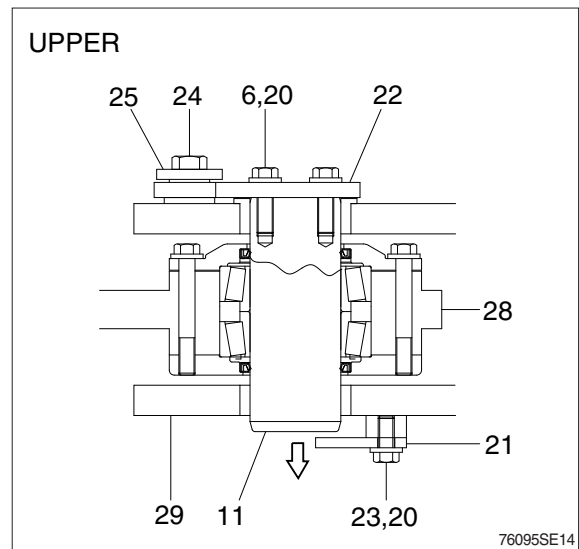
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5-89

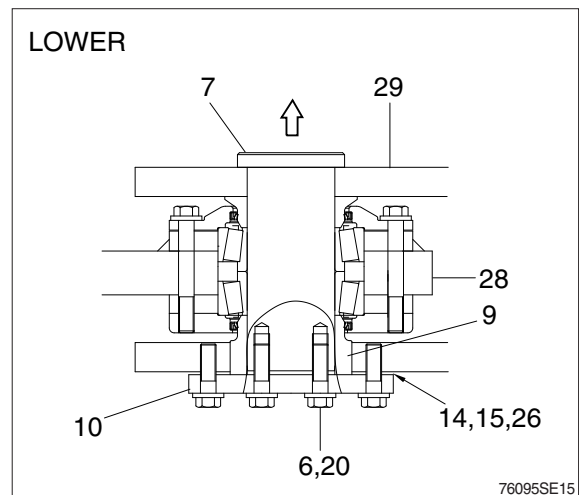
2) DISASSEMBLY

After supporting the front frame and the rear frame as horizontally as possible using wood blocks and jacks, disassemble as follows: In order to facilitate the disassembly/assembly of the center pivot pins, remove the drive shaft, hydraulic line and steering cylinder first.

- (1) Maintain the horizontal level of front frame (28) and rear frame (29), and then remove hexagon bolt (6, 23, 24), washer (20, 25) and plate (21, 22).
- (2) Take out upper pin (11) to the downside using a metal punch.



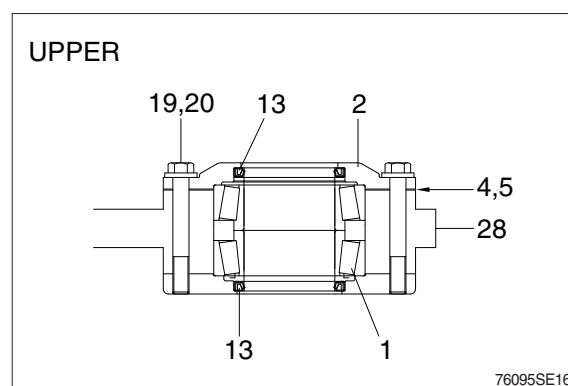
- (3) Maintain the front frame horizontal level, remove hexagon bolts (6) and then remove the plate (10) and shims (14, 15, 26).
- (4) Take out lower pin (7) to the upside using a metal punch carefully.
- (5) Jack up or lifting the front frame (28) slightly, the collar (9) protrudes over the rear frame. Remove the collar (9).
- (6) Lift the frame by passing the slinging wire rope at four positions of front frame, in order to separate it from the rear frame.
- (7) Support the front frame safely.



(8) Remove bolt (19), washer (20) and then take out cover (2) and shims (4, 5).

(9) Take out dust seal (13) from the cover (2).

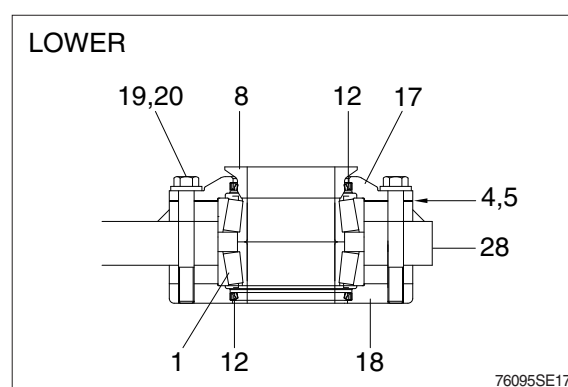
(10) Remove the bearing (1), and dust seal (13).



(11) Remove bolt (19), washer (20) and then take out cover (17, 18) and shims (4, 5).

(12) Take out the dust seal (12) from the cover (17, 18).

(13) Remove the bearing (1) and collar (8).



3) INSPECTION

(1) Check the bearing sliding surface for excessive wear, scorching or scratches; replace if necessary.

(2) Replace all dust seals (12,13) with new ones.

(3) Grind any pins (7, 11) dented with an oilstone or replace any pins abrasive excessively.

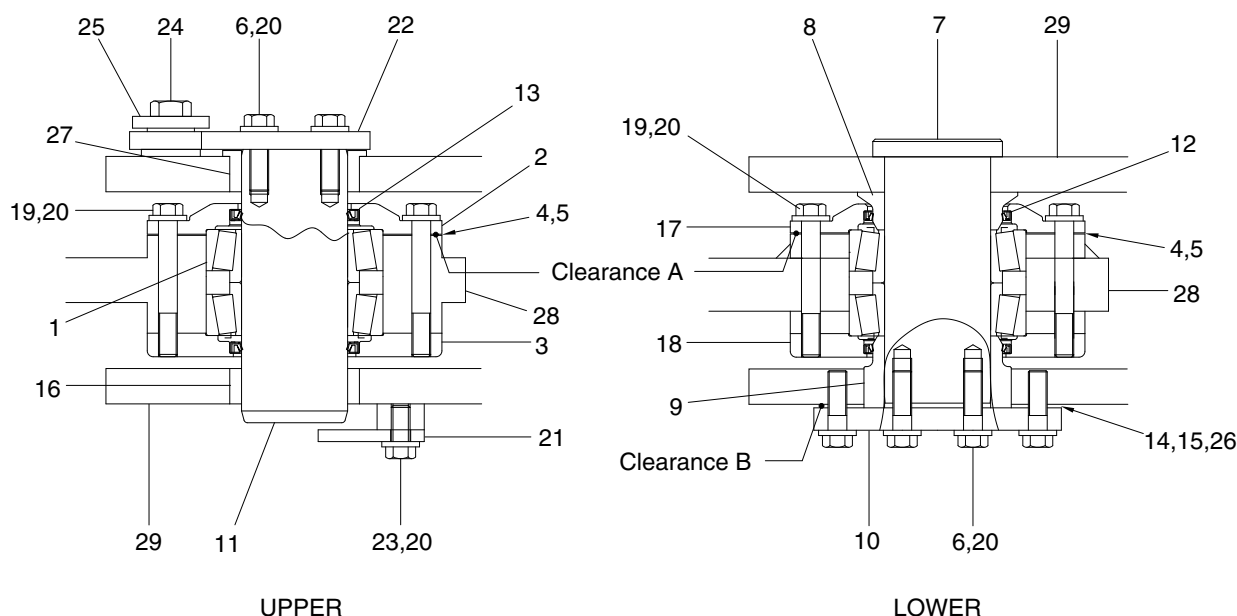
(4) Check inside cover (2, 3, 17, 18) and collar (8, 9) for dents or scratches; if any damage is found, correct with a grinder or replace.

(5) The serviceable limit of pins and bushings is shown in the table below.

Unit : mm

| Item No. | Name | Std dimension | Serviceable limit | | | Remedy |
|----------|------------------------|---------------|-------------------|-----------|-----------|---------|
| | | | Outer dia | Inner dia | Clearance | |
| 7, 11 | Pin | 90 | 89.5 | | 0.8 | Replace |
| 1 | Tapered roller bearing | | | 90.5 | | |
| 8, 9 | Collar | | | 90.5 | | |
| 12, 13 | Dust seal | When removed | | | | Replace |

4) ASSEMBLY



76095SE18

Assemble the center pivot group by reversing the order of disassembly while paying close attention to the following.

- (1) Put the dust seal (12,13) into cover (2, 3, 17, 18).
 - ※ Apply grease to the lip of the dust seal. Insert the dust seal so that the dust seal lip faces out and punch four places on the outer circumference of the seal to lock it.
- (2) Lower the temperature of the lower bearing cup to $-75 \pm 5^{\circ}\text{C}$ ($-103 \pm 9^{\circ}\text{F}$) and install it to front frame until it contacts the bottom of the frame.
- (3) Place the cover (3, 18).
- (4) Coat lightly with oil and install lower bearing in bore in front frame. Coat lightly with oil and install upper bearing in bore in upper front frame.
- (5) Place the cover (2, 17) and hold in place with bolt (19). At this time, adjust shims (4, 5) to press the shoulder of bearing (1) against retainer.
 - **Adjustment method of clearance A**
 - ① Install bearing (1) and cover (2, 17) without shim (4, 5)
Install four of bolt (19) so that each bolt is separated by 90 degrees.
 - Tightening torque : $1.5 \sim 1.7 \text{ kgf} \cdot \text{m}$ ($10.8 \sim 12.3 \text{ lbf} \cdot \text{ft}$)
 - ② Adjust shims (4, 5) in order to control the clearance A.
 - Clearance A : Below 0.1 mm
 - Shim thickness : 0.1 mm, 0.5 mm
 - ③ Measure bearing preload and confirm the value.
 - Bearing preload : $0.7 \sim 1.2 \text{ kgf} \cdot \text{m}$ ($5.1 \sim 8.7 \text{ lbf} \cdot \text{ft}$)

- (5) Apply grease to lower collar (8) and insert it to the lower of roller bearing.
- (6) After setting the bearing so that its upper surface is horizontal, tighten the all the bolt (19).
After tightening, confirm that tapered roller bearing moves lightly ; if does not move smoothly, add shims (4, 5).
- Tightening Torque : 25.4~34.2 kgf · m (184~247 lbf · ft)
 - Apply loctite #243.
- (7) Move the front frame and join it to the rear frame so that match the pin hole at the center.
- (8) Apply grease to pin (11), bushing (27) and insert it into tapered roller bearing (1).
- (9) Apply grease to lower collar (9) and insert it to the lower of roller bearing through rear frame (29).
- (10) Apply grease to pin (7) and insert it into tapered roller bearing (1).
- (11) Before tightening bolt (6), adjust shims (14, 15) in order to control the clearance between the plate (21) and rear frame (29).
- **Adjustment method of clearance B**
- ① Install pin (7) and plate (21) without shim (14,15, 27).
Install four of bolt (6) so that each bolt is separated by 90 degrees.
 - Tighting torque : 1.5~1.7 kgf · m (10.8~12.3 lbf · ft)
 - ② Adjust shims in order to control the clearance B.
 - Clearance B : 0.1~0.2 mm
 - Shim thickness : 0.1 mm, 0.5 mm, 2.0 mm
- (12) Tighten the all the bolts (6).
- Tightening Torque : 25.4~34.2 kgf · m (184~247 lbf · ft)
 - Apply loctite #243.

5) TROUBLESHOOTING

| Trouble | Probable cause | Remedy |
|---|---|-------------------------|
| Shock is felt when steering | Capscrew for fixing steering valve is loose | Retighten |
| | Faulty center pivot pin mounting bolts | Retighten |
| | Center pivot pins have worn out | Readjust or replace |
| | Faulty hydraulic system | See hydraulic system |
| Shock is felt when moving backward or forward | Fault fixing of connecting capscrews | Retighten |
| | Center pins have worn out | Readjust or replace |
| | Bearings of support unit have worn out | Retighten |
| | Drive shaft damaged | See drive system |
| | Faulty transmission | See transmission system |

SECTION 6 WORK EQUIPMENT

| | | |
|---------|--|------|
| Group 1 | Structure and Function | 6-1 |
| Group 2 | Operational Checks and Troubleshooting | 6-34 |
| Group 3 | Tests and Adjustments | 6-45 |
| Group 4 | Disassembly and Assembly | 6-56 |

SECTION 6 WORK EQUIPMENT

GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC SYSTEM OUTLINE

The loader hydraulic system is a pilot operated, closed center system which is supplied with flow from the variable displacement piston main hydraulic pump.

The loader system components are :

- Main pump
- Main control valve
- Bucket cylinder
- Boom cylinders
- Remote control valve
- Safety valve

Flow from the main hydraulic pump not used by the steering system leaves the priority valve EF port. It flows to the inlet port plate of two section or three section block type main control valve.

The main control valve is load pressure independent flow distribution system which routes flow to the boom, bucket or auxiliary cylinders (not shown) when the respective spools are shifted.

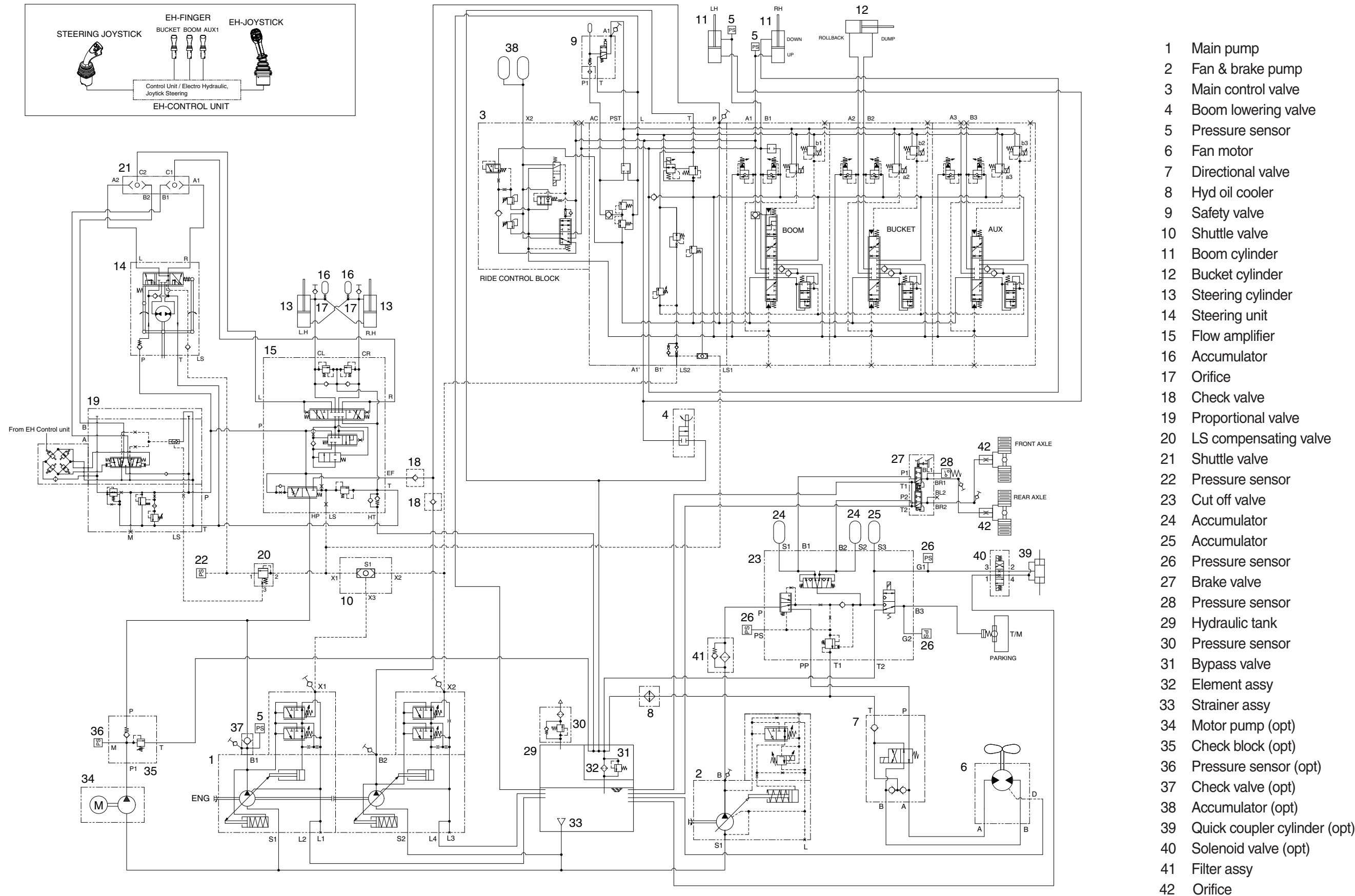
Flow from the main pump is routed to the main control valve where pump outlet pressure is reduced to pilot circuit pressure. The main control valve flow to the remote control valve.

The remote control valve routed flow to either end of each spool valve section in the main control valve to control spool stroke.

A accumulator mounted on safety valve supplies a secondary pressure source to operated remote control valve so the boom can be lowered if the engine is off.

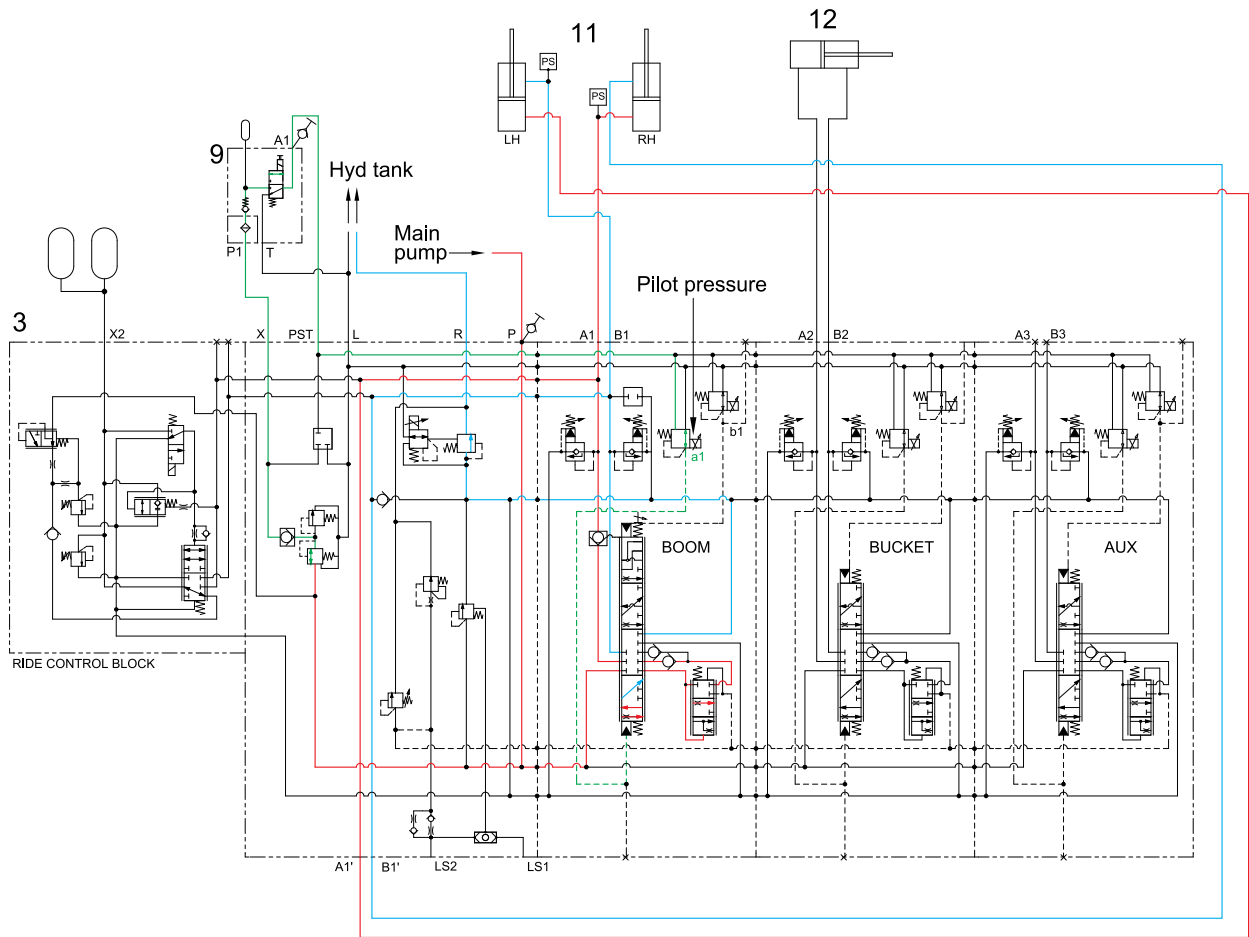
The return circuit for the main hydraulic system have return filter inside the hydraulic tank. The return filter uses a filter element and a bypass valve. The bypass valve is located in the upside of filter.

2. HYDRAULIC CIRCUIT



3. WORK EQUIPMENT HYDRAULIC CIRCUIT

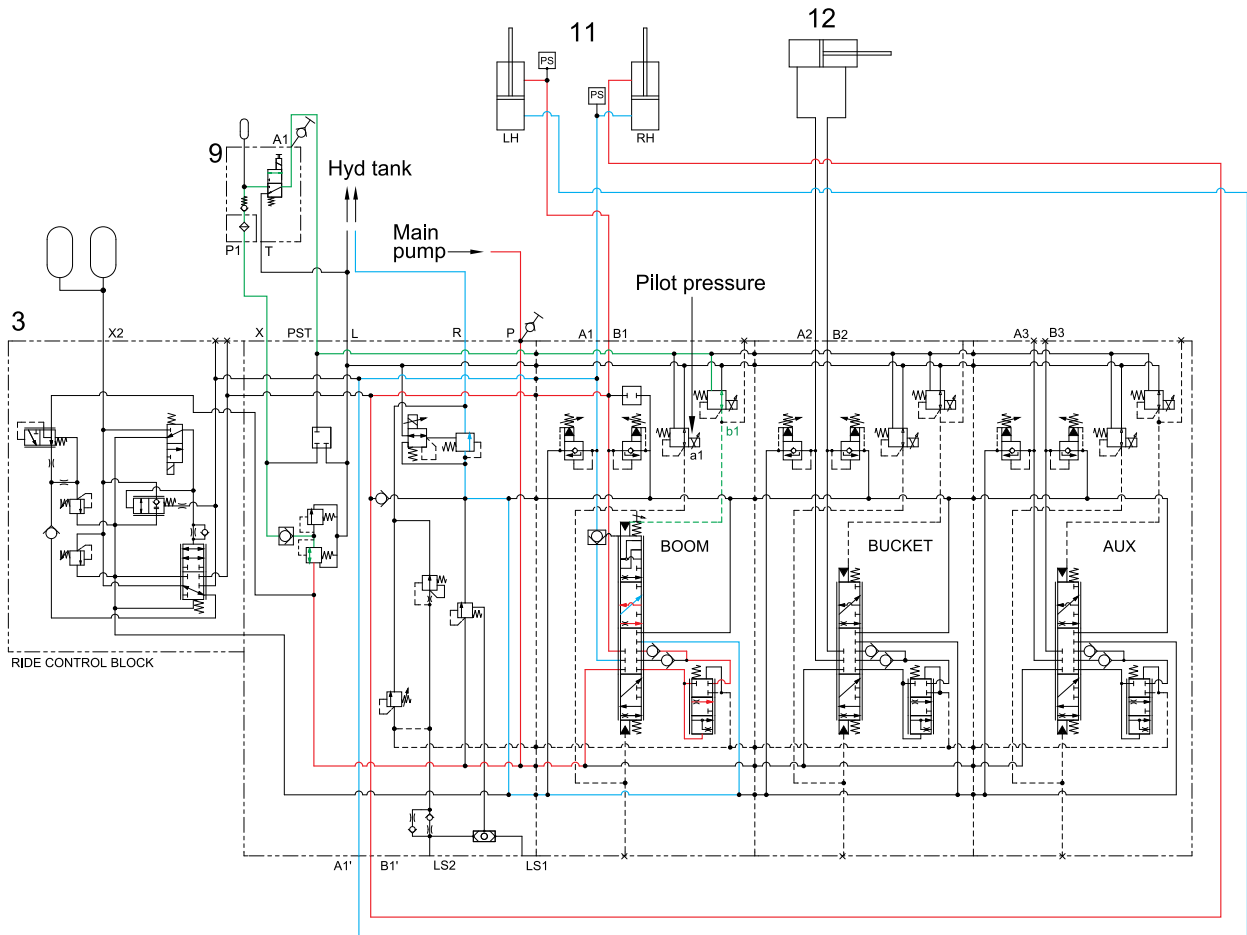
1) WHEN THE RCV LEVER IS IN THE BOOM RAISE POSITION



970A6WE02

- When the RCV lever is pulled back, the boom spool is moved to raise position by pilot pressure from EPPR valve.
- The oil from main pump flows into main control valve (3) and then goes to the large chamber of boom cylinder (11).
- The oil from the small chamber of boom cylinder (11) returns to hydraulic oil tank through the boom spool at the same time.
- When this happens, the boom goes up.

2) WHEN THE RCV LEVER IS IN THE BOOM LOWER POSITION

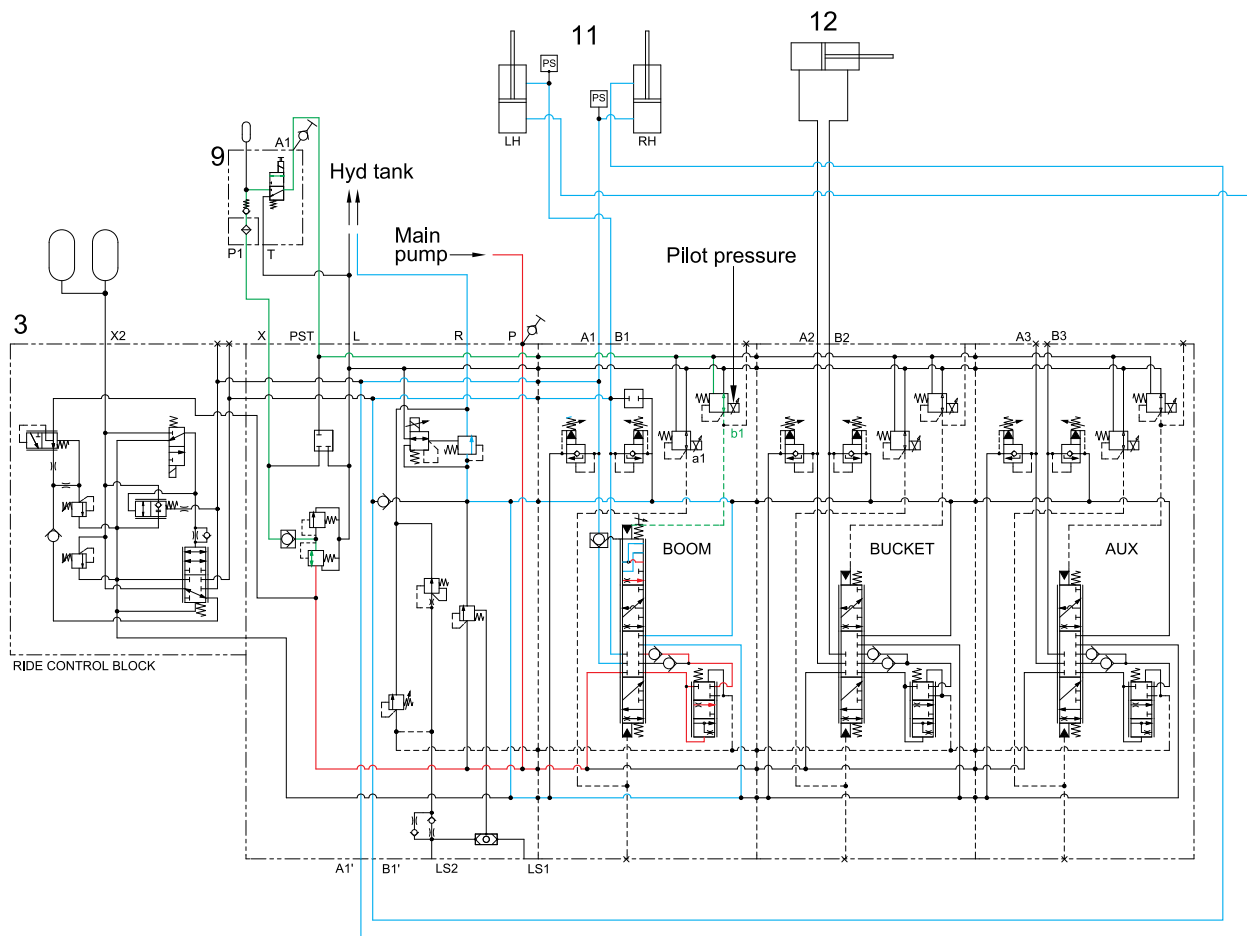


970A6WE03

- When the RCV lever is pushed forward, the boom spool is moved to lower position by pilot pressure from EPPR valve.
- The oil from main pump flows into main control valve (3) and then goes to small chamber of boom cylinder (11).
- The oil returned from large chamber of boom cylinder (11) returns to hydraulic tank through the boom spool at the same time.
- When the lowering speed of boom is faster, the return oil from the large chamber of boom cylinder combines with the oil from the pump through the regeneration check valve, and flows into the small chamber of the cylinder.

This prevents cylinder cavitation by the negative pressure when the pump flow cannot match the boom down speed.

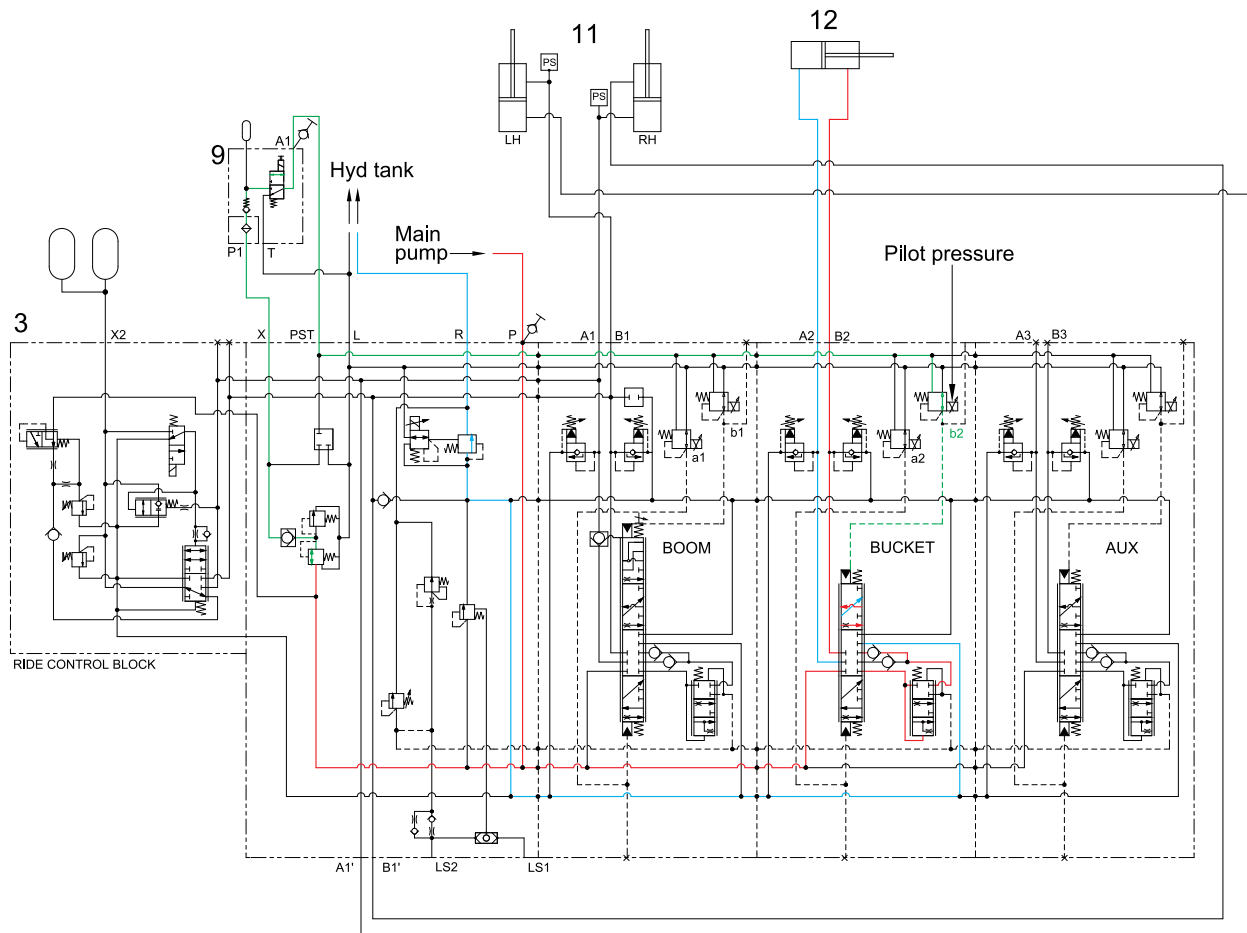
3) WHEN THE RCV LEVER IS IN THE BOOM FLOAT POSITION



970A6WE04

- When the RCV lever is pushed further forward from the lower position, the pilot pressure reaches to 13~15 bar, then the boom spool is moved to floating position.
- The work ports (A1), (B1) and the small chamber and the large chamber are connected to the return passage, so the boom will be lowered due to it's own weight.
- In this condition, when the bucket is in contact with the ground, it can be move up and down in accordance with the shape of the ground.

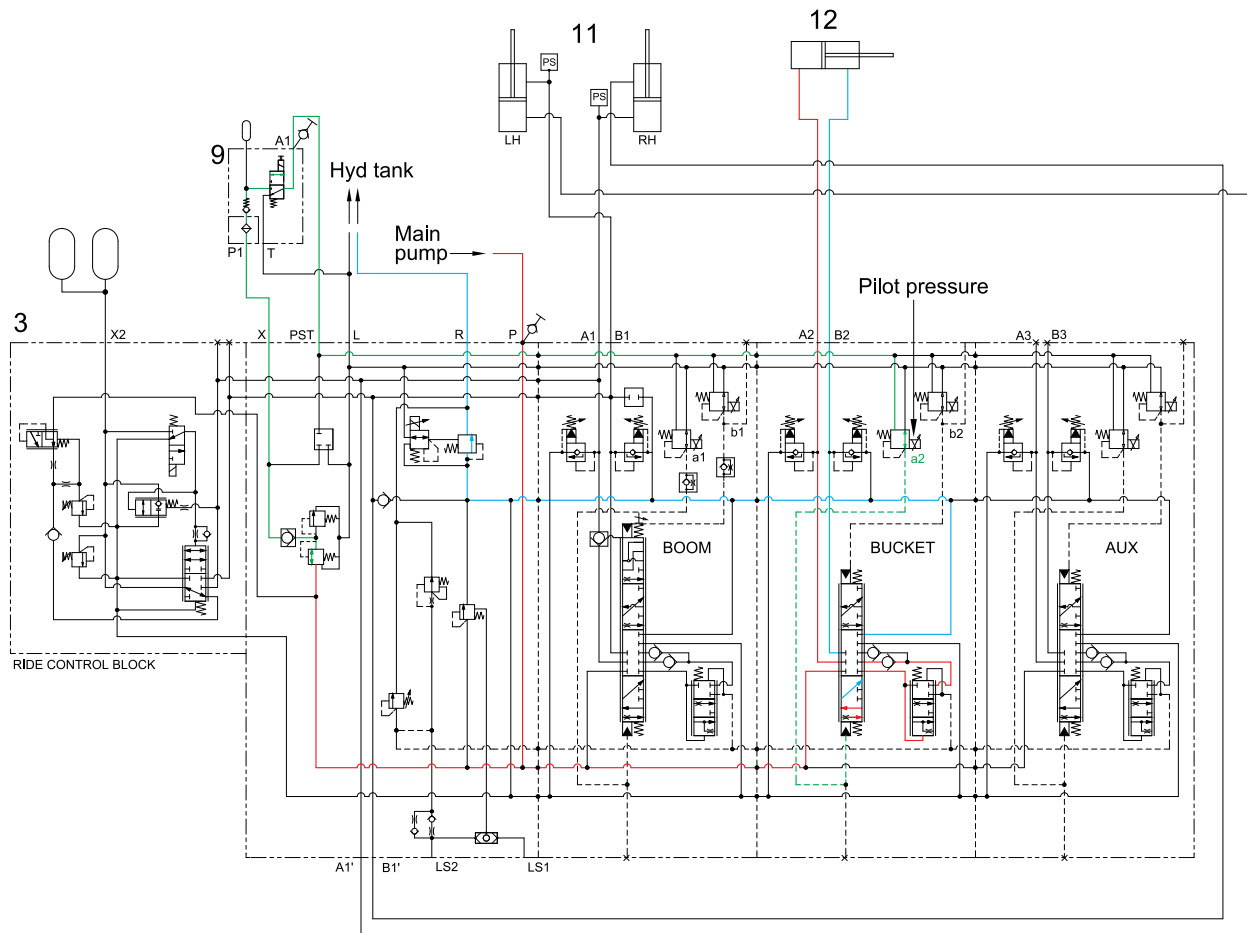
4) WHEN THE RCV LEVER IS IN THE BUCKET DUMP POSITION



970A6WE05

- If the RCV lever is pushed right, the bucket spool is moved to dump position by pilot pressure from EPPR valve.
- The oil from main pump flows into main control valve (3) and then goes to the small chamber of bucket cylinder (12).
- The oil at the large chamber of bucket cylinder (12) returns to hydraulic tank.
- When this happens, the bucket is dumped.
- When the dumping speed of bucket is faster, the oil returned from the large chamber of bucket cylinder combines with the oil from the pump, and flows into the small chamber of the cylinder. This prevents cylinder cavitation by the negative pressure when the pump flow cannot match the bucket dump speed.

5) WHEN THE RCV LEVER IS IN THE BUCKET ROLL BACK (retract) POSITION



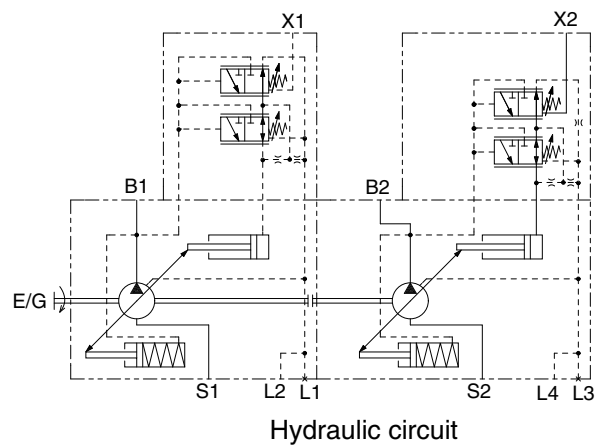
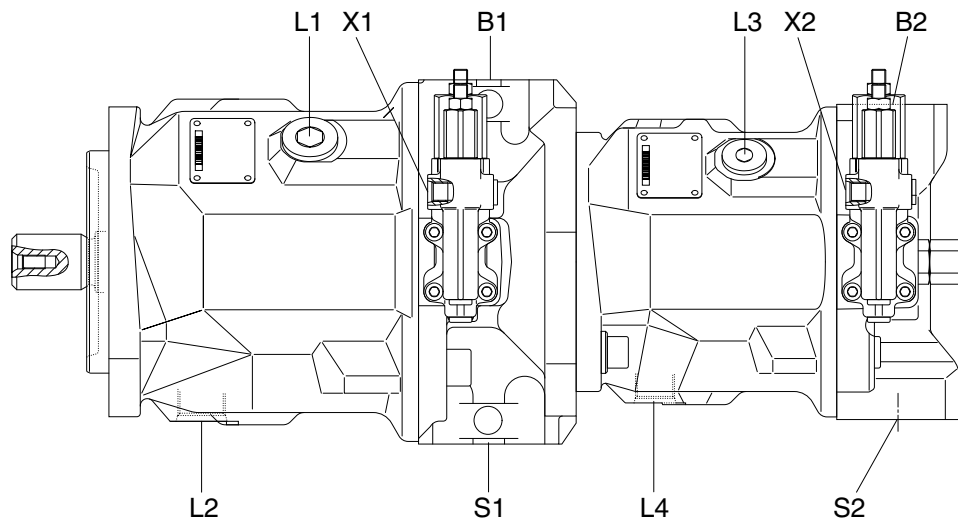
970A6WE06

- If the RCV lever is pulled left, the bucket spool is moved to roll back position by pilot oil pressure from EPPR valve.
- The oil from main pump flows into main control valve (3) and then goes to the large chamber of bucket cylinder.
- The oil at the chamber of bucket cylinder (12) returns to hydraulic tank.
- When this happens, the bucket roll back.

4. MAIN PUMP

1) STRUCTURE (1/2)

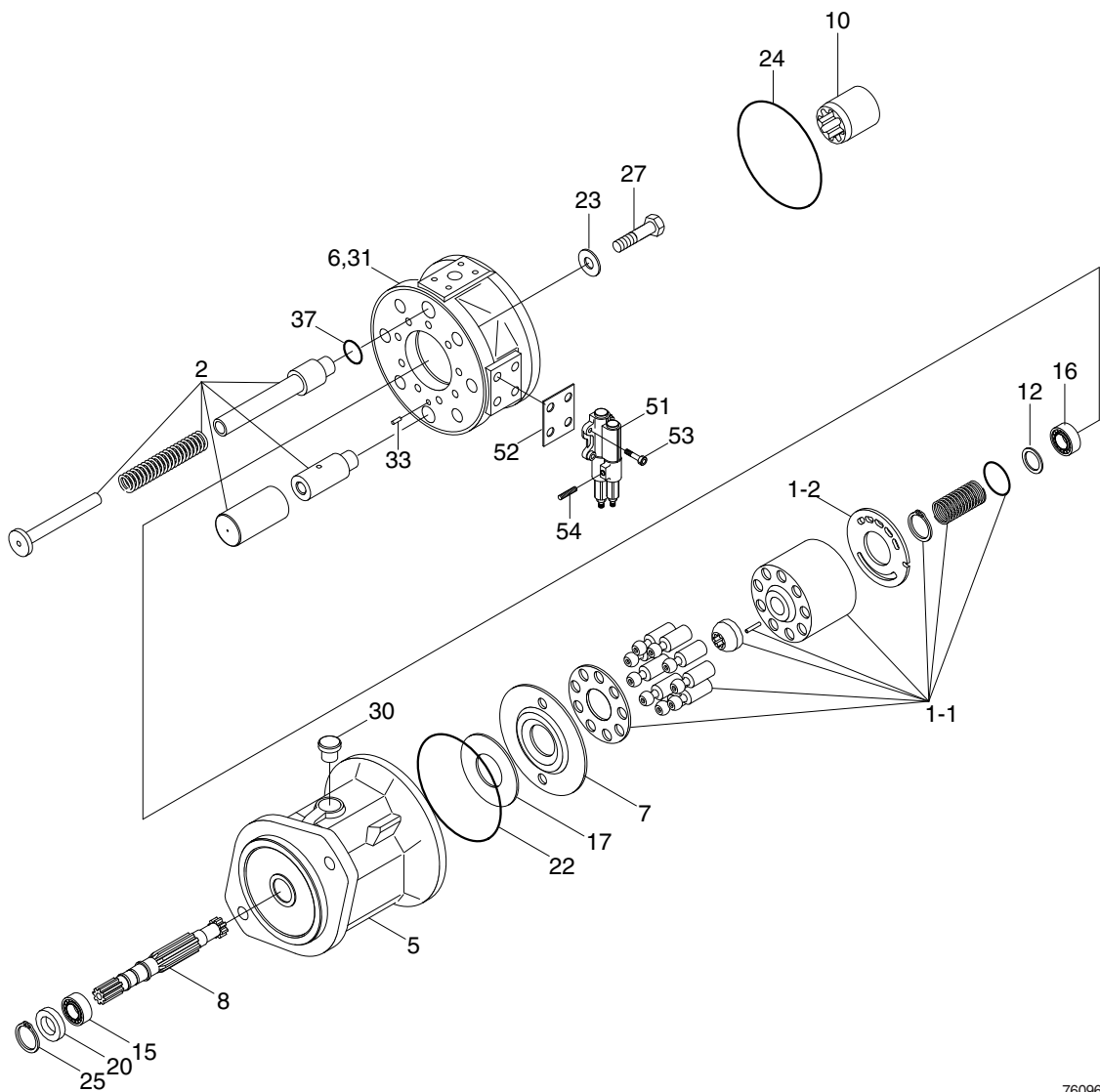
This variable displacement piston pump consists of steering pump and loader pump.



76096WE88

| Port | Port name | Port size |
|--------|---------------------|----------------|
| B1 | Pressure port | SAE 1" |
| B2 | Pressure port | SAE 1" |
| S1 | Suction port | SAE 2" |
| S2 | Suction port | SAE 2" |
| L1, L2 | Case drain port | 1 1/16-12UN-2B |
| L3, L4 | Case drain port | 1 1/16-12UN-2B |
| X1, X2 | Pilot pressure port | 7/16-20UNF-2B |

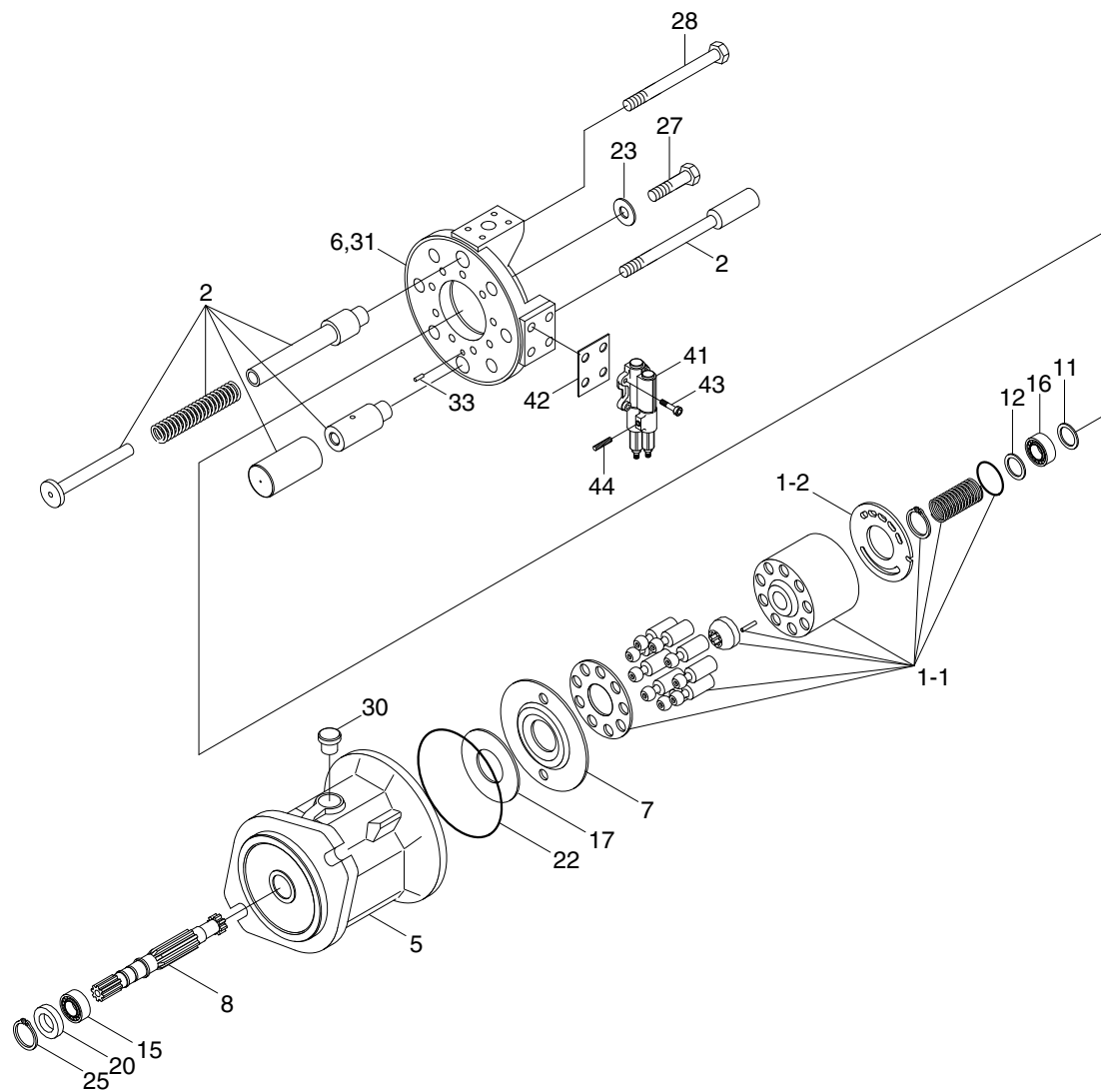
· MAIN PUMP (1/2, STEERING)



76096WE11

- | | | | | | |
|-----|-------------------------|----|----------------------|----|----------------------|
| 1 | Rotary group | 12 | Adjustment shim | 27 | Socket screw |
| 1-1 | High speed rotary group | 15 | Taper roller bearing | 30 | Locking screw |
| 1-2 | Control plate | 16 | Taper roller bearing | 31 | Double break-off pin |
| 2 | Adjusting piece | 17 | Bearing liner | 33 | Cylinder pin |
| 5 | Pump housing | 20 | Shaft seal ring | 37 | Side mark ring |
| 6 | Port plate | 22 | O-ring | 51 | Control valve |
| 7 | Swash plate | 23 | O-ring | 52 | Gasket |
| 8 | Drive shaft | 24 | O-ring | 53 | Socket head screw |
| 10 | Splined hub | 25 | Retaining ring | 54 | Locking screw |

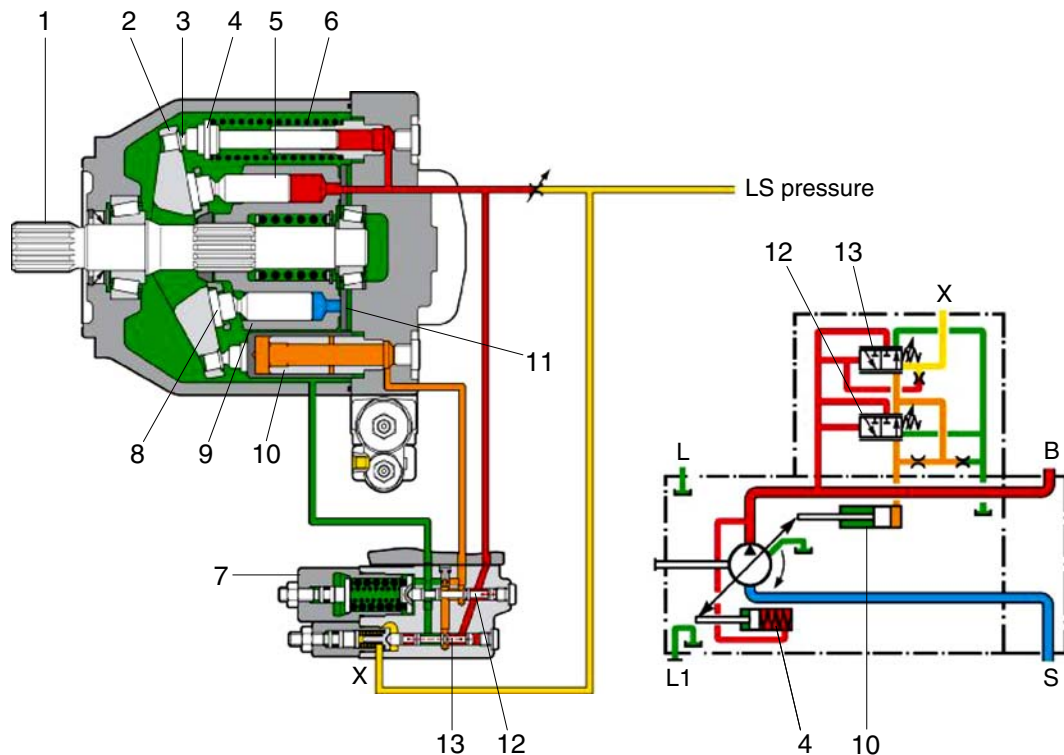
· MAIN PUMP (2/2, LOADER)



76096WE12

- | | | | | | |
|-----|-------------------------|----|----------------------|----|----------------------|
| 1 | Rotary group | 12 | Adjustment shim | 28 | Locking screw |
| 1-1 | High speed rotary group | 15 | Taper roller bearing | 30 | Locking screw |
| 1-2 | Control plate | 16 | Taper roller bearing | 31 | Double break-off pin |
| 2 | Adjusting piece | 17 | Bearing liner | 33 | Cylinder pin |
| 5 | Pump housing | 20 | Shaft seal ring | 41 | Control valve |
| 6 | Port plate | 22 | O-ring | 42 | Gasket |
| 7 | Swash plate | 23 | O-ring | 43 | Socket screw |
| 8 | Drive shaft | 25 | Retaining ring | 44 | Locking screw |
| 11 | Adjustment shim | 27 | Socket screw | | |

2) FUNCTION



75796WE33

| | | | | | |
|---|----------------|----|-----------------------------------|----|----------------------------|
| 1 | Drive shaft | 6 | Counter spring | 11 | Control plate |
| 2 | Swash plate | 7 | Pressure & flow compensator valve | 12 | Pressure compensator spool |
| 3 | Shoe plate | 8 | Piston shoe | 13 | Flow compensator spool |
| 4 | Counter piston | 9 | Cylinder | | |
| 5 | Piston | 10 | Control piston | | |

The steering pump and loader pump are variable displacement piston pump. The steering pump and loader pump are flow controlled by LS signal. When the steering and loader are not being used, the pumps are at low pressure standby.

The load sensing pressure that is sensed from steering and loader hydraulic systems flows to flow compensator spool (13). This spool keeps the pump output at a level that is necessary to fulfill the requirements for the system flow and for the pressure.

The pressure compensator spool (12) also limits maximum system pressure. The pressure compensator spool (12) prevents damage to the steering and loader hydraulic components from excessive pressure.

The swivel angle of the pumps is controlled by counter piston (4) and control piston (10). Counter spring (6) cause swash plate (2) to move at maximum displacement or causes swash plate (2) to upstroke.

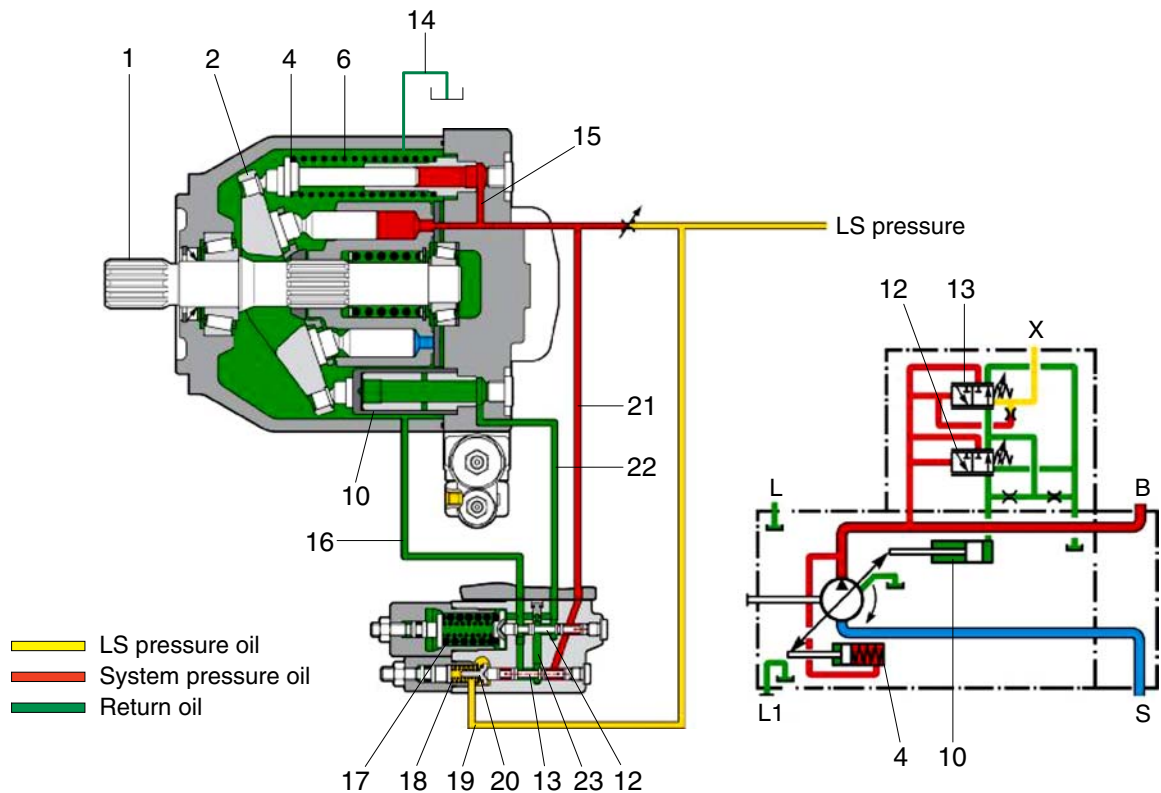
Control piston (10) has a larger area (diameter) than counter piston (4). Control piston (10) causes swash plate (2) to destroke the pump.

Flow compensator spool (13) and/or pressure compensator spool (12) changes pump output by regulating the pump discharge pressure that is acting on control piston (10).

Control piston (10) diameter is larger than counter piston (4) diameter, the oil pressure that is acting against control piston (10) overcomes the force of counter spring (6). The oil pressure then causes the pump to destroke.

Pressure and flow compensator valve (7) also controls the maximum output of pump pressure. When steering and loader pressure rises above pressure compensator setting, pressure compensator spool (12) overrides flow compensator spool (13). This causes the pump to destroke.

(1) Upstroking



75796WE35

| | | |
|-------------------------------|---------------------------|-----------------------------------|
| 1 Drive shaft | 13 Flow compensator spool | 19 LS line from the metering pump |
| 2 Swash plate | 14 Case drain | 20 Cavity |
| 4 Counter piston | 15 Passage | 21 Passage |
| 6 Counter spring | 16 Passage | 22 Passage |
| 10 Control piston | 17 Spring | 23 Cavity |
| 12 Pressure compensator spool | 18 Spring | |

Upstroking of the pump occurs as flow demand from loader and steering system.

The increased flow demand causes a LS pressure in LS line (19). The LS pressure in LS line (19) combines with the force of spring (18) in cavity (20).

The force of spring (18) causes pump pressure to be higher than the LS pressure (19).

If the combination of LS pressure and of spring force is greater than the pump discharge pressure, this difference pressure causes spool (13) to move right. As spool (13) moves right, the spool (13) blocks the flow of supply oil to control piston (10). Pump swash plate (2) is controlled by pressure and flow as much as hydraulic system requests.

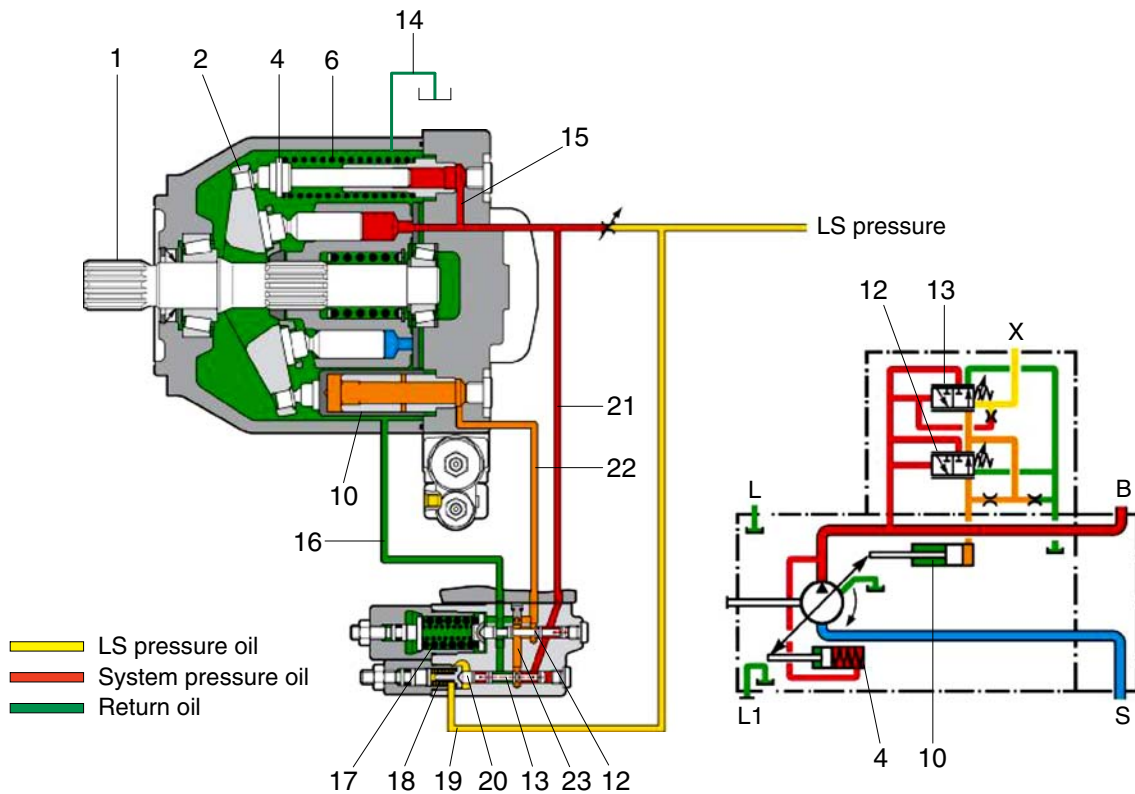
When the oil flow to control piston (10) is blocked, the pilot oil in passage (22) drains to passage (23). The oil then flows past pressure compensator spool (12) and through passage (16) into the housing and via the drain line (14) to tank.

Supply oil flows through passage (15) to counter piston (4). The oil acts against counter piston (4). The oil combines with the force of counter spring (6). This causes swash plate (2) to upstroke.

This also causes the pump flow to increase. As flow requirements are satisfied, the pump output pressure increase. The pressure increases until the pressure in passage (15) moves flow compensator spool (13) up to be satisfied with system requirement for pressure and flow.

· Pump discharge pressure = force of spring (18) + LS pressure (19)

(2) Destroking



75796WE34

| | | | | | |
|----|----------------------------|----|------------------------|----|--------------------------------|
| 1 | Drive shaft | 13 | Flow compensator spool | 19 | LS line from the metering pump |
| 2 | Swash plate | 14 | Case drain | 20 | Cavity |
| 4 | Counter piston | 15 | Passage | 21 | Passage |
| 6 | Counter spring | 16 | Passage | 22 | Passage |
| 10 | Control piston | 17 | Spring | 23 | Cavity |
| 12 | Pressure compensator spool | 18 | Spring | | |

The decreased flow demand causes a LS pressure in line (19). The LS pressure in line (19) combines with the force of spring (18) in cavity (20).

This combination of LS pressure and of spring force is less than the pump pressure in passage (21). This causes flow compensator spool (13) to move left.

Pump oil now flows through passage (15). The oil then flows past flow compensator spool (13), through passage (22), and then to control piston (10).

The pump pressure behind control piston (10) is now greater than the combined force of counter piston (4) and of counter spring (6). The angle of swash plate (2) decreases.

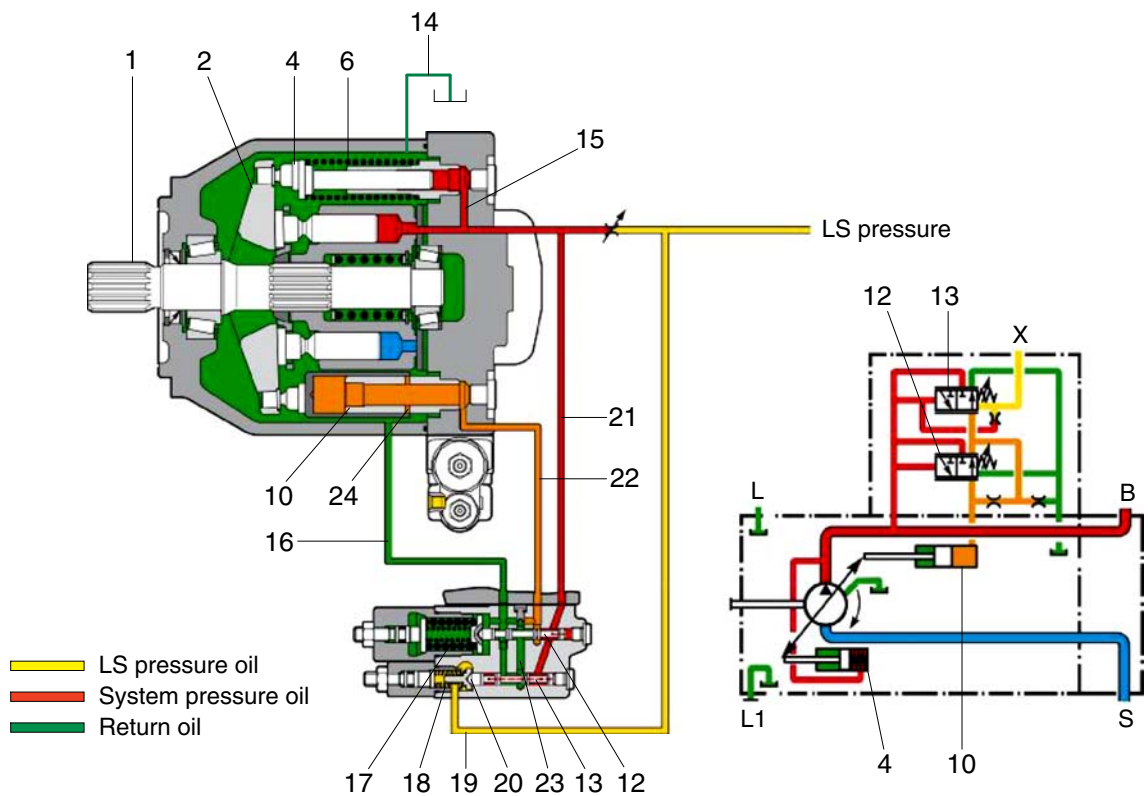
This decreases the pump output and the system pressure.

When the lower flow requirements are met, flow compensator spool (13) moves right up to the balanced position. Swash plate (2) maintains an angle that is sufficient to provide the lower required pressure. If the operator does not turn the steering wheel and does not move RCV, then the pump will return to low pressure standby.

※ Control piston → Changes pump displacement ; influenced by controller.

Counter piston → Helps to change pump displacement but no possible to control this piston.

(3) Low pressure standby



75796WE36

| | | | | | |
|----|----------------------------|----|------------------------|----|--------------------------------|
| 1 | Drive shaft | 13 | Flow compensator spool | 19 | LS line from the metering pump |
| 2 | Swash plate | 14 | Case drain | 20 | Cavity |
| 4 | Counter piston | 15 | Passage | 21 | Passage |
| 6 | Counter spring | 16 | Passage | 22 | Passage |
| 10 | Control piston | 17 | Spring | 23 | Cavity |
| 12 | Pressure compensator spool | 18 | Spring | 24 | Cross-drilled hole |

Low pressure standby constitutes the following condition: a running engine and inactive steering and loader. There are no flow demands on the pump or pressure demands on the pump. Therefore, there is no LS pressure in line (19).

Before you start the engine, counter spring (6) holds swash plate (2) at the maximum angle. As the pump begins to turn, oil begins to flow and pressure increases in the system.

Because of close centered steering control valve and close centered loader hydraulic system.

As this pressure increase, the pressure pushes flow compensator spool (13) against spring (18). This causes flow compensator spool (13) to move left. This opens passage (23) in order to allow pressure oil to flow to control piston (10).

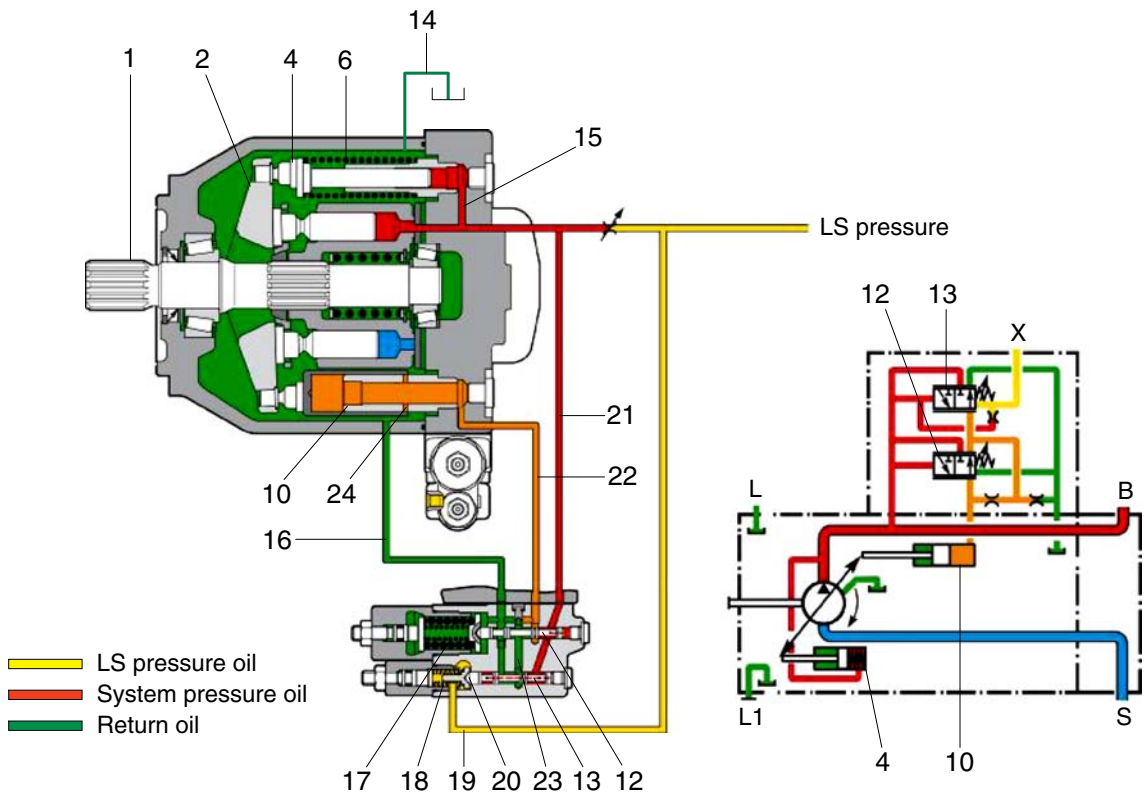
The oil acts against control piston (10) in order to overcome the force of counter spring (6). The oil causes control piston (10) to move to the left.

When control piston (10) moves to the left, the piston moves swash plate (2) toward the minimum angle. Control piston (10) continues to move to the left until cross-drilled hole (24) allows the oil to drain to the case.

Cross-drilled hole (24) limits the maximum travel of control piston (10) to the left. The pump supplies a sufficient amount of flow that compensates for system leakage. The pump also supplies a sufficient amount of flow that compensates for leakage to the pump case. The leakage to the pump case is a result of the cross-drilled hole. The pump maintains low pressure standby. Low pressure standby pressure should not exceed 40 bar (580 psi).

- ※ Low pressure standby will vary in the same pump as the system leakage or the pump leakage increases. The pump will upstroke slightly in order to compensate for the increasing leakage. Control piston (10) will cover more of the cross-drilled hole.

(4) High pressure stall



75796WE36

- | | | |
|-------------------------------|---------------------------|-----------------------------------|
| 1 Drive shaft | 13 Flow compensator spool | 19 LS line from the metering pump |
| 2 Swash plate | 14 Case drain | 20 Cavity |
| 4 Counter piston | 15 Passage | 21 Passage |
| 6 Counter spring | 16 Passage | 22 Passage |
| 10 Control piston | 17 Spring | 23 Cavity |
| 12 Pressure compensator spool | 18 Spring | |

When the hydraulic system stalls under load or when the cylinders reach the end of the stroke, the main system pressure increases. But LS pressure (19) is regulated by LS relief valve on steering system and loader system. The pressure difference between discharged pump and LS pressure equal to spring (18). It means no flow is necessary. Therefore, discharged pressure push flow compensator spool (13) left. Supply oil now flows past flow compensator spool (13) and through passage (23). The oil flows past flow compensator spool (13) and into passage (22). The oil then flows to control piston (10).

Pump swash plate (2) will be minimum displacement if the operator does not turn the steering wheel and RCV, then the pump will return to low pressure standby.

(5) Adjustment of flow control

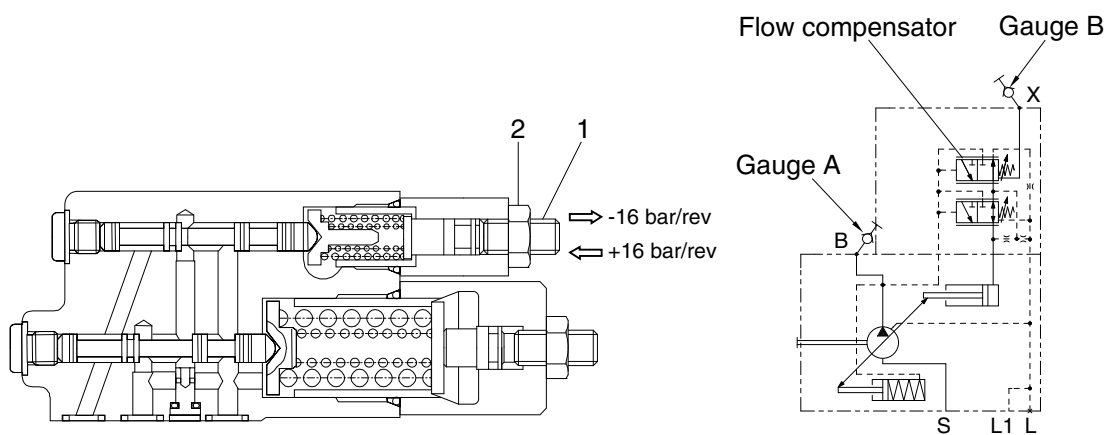
Flow compensator setting must be carried out following procedures and conditions.

① Conditions

- Engine is running (at high or low idle).
- RCV is operated slowly (example : Boom up).
- Pressure gauges are installed.
- ※ Discharge pump flow should be less than max pump flow.

② Procedures

- Loosening the hexagon nut (2).
- Adjusting screw (1) of flow controller by tightening or loosening the screw (1).
 - Flow setting : $\Delta P = \text{Gauge A} - \text{Gauge B}$
 - Specification : Steering pump (23 bar)/Loader pump (19 bar)



75796WE37

(6) Adjustment of pressure control

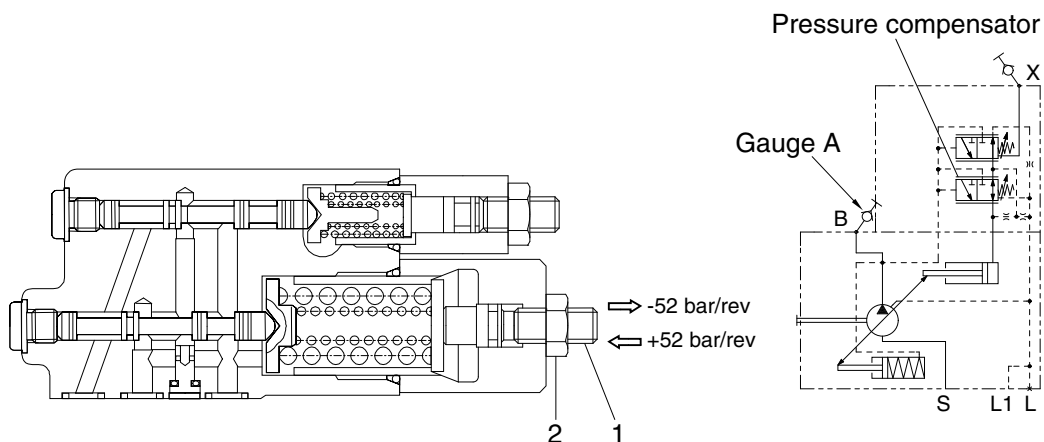
Pressure compensator setting must be carried out following procedures and conditions.

① Conditions

- Engine is running.
- System is at relief condition.

② Procedures

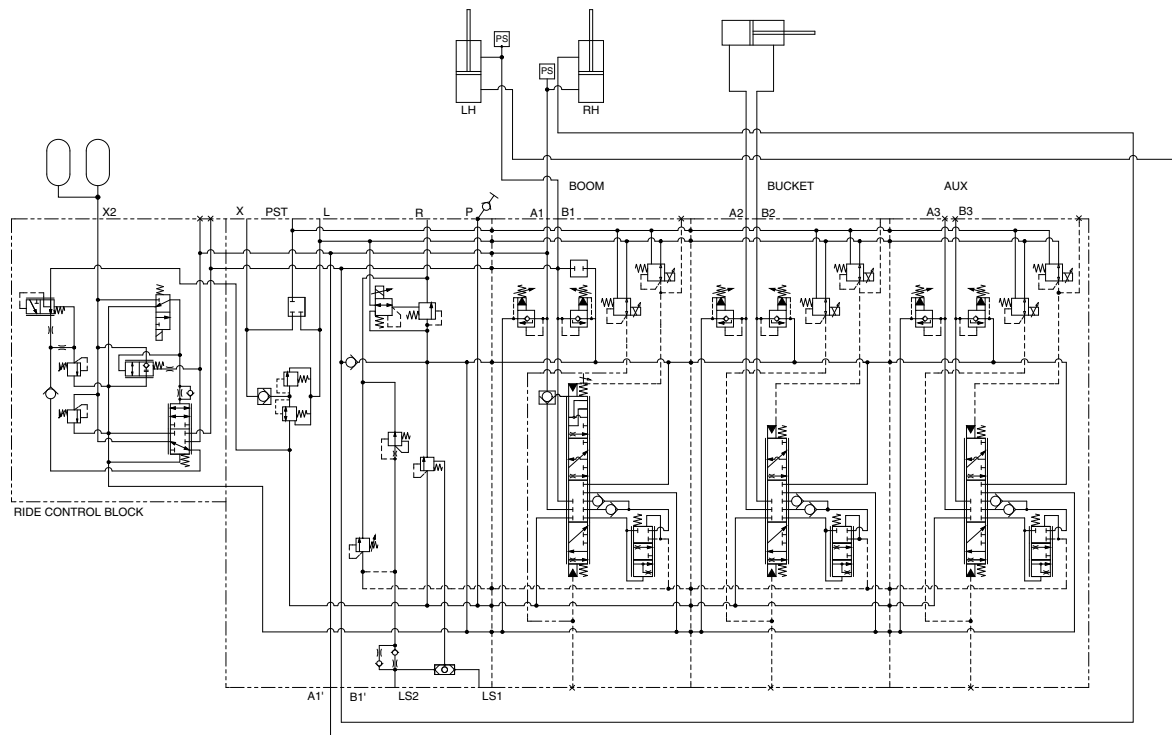
- Loosening the hexagon nut (2).
- Adjusting screw (1) of pressure controller by tightening or loosening the screw (1).
 - Maximum pressure setting = Gauge A
 - Specification : Steering pump (250 bar)/Loader pump (300 bar)



75796WE38

5. MAIN CONTROL VALVE

1) HYDRAULIC CIRCUIT

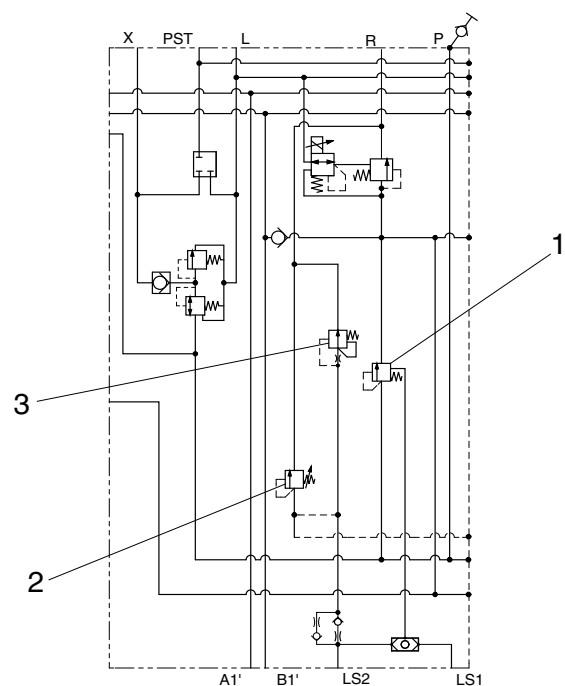


960A6WE10

2) INLET ELEMENT DESCRIPTION

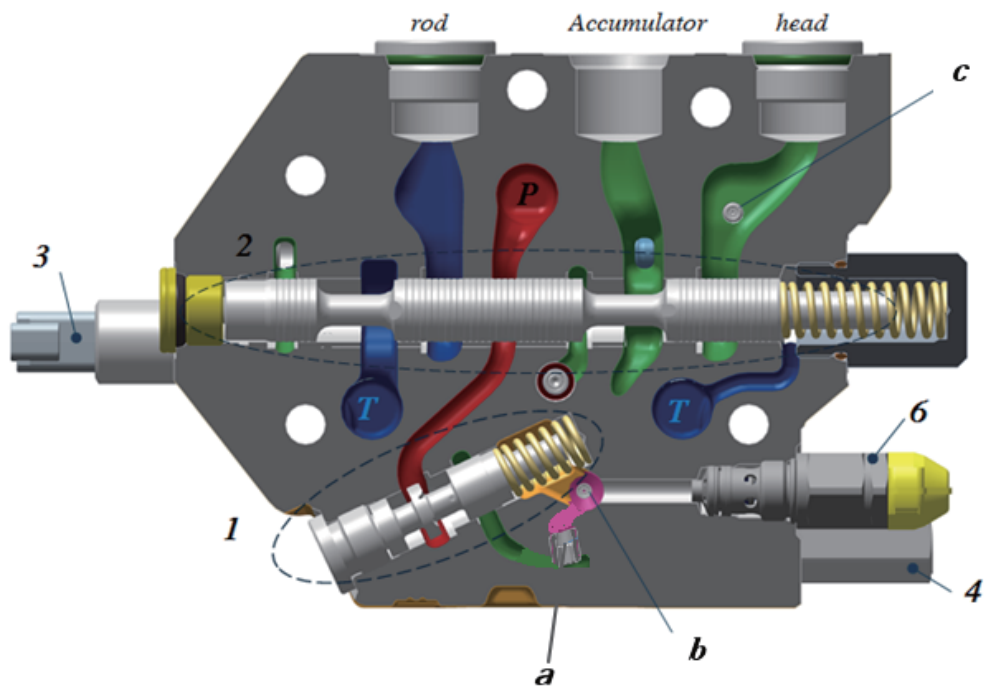
(1) The inlet element moreover comprises all components necessary for the system function : One flow control valve (1) for the controlled unloading of the LS line and one LS pressure relief valve (2) to limit the maximum system pressure.

(2) Protection of the system by means of LS pressure relief valve (2) combined with flushing valve (3).



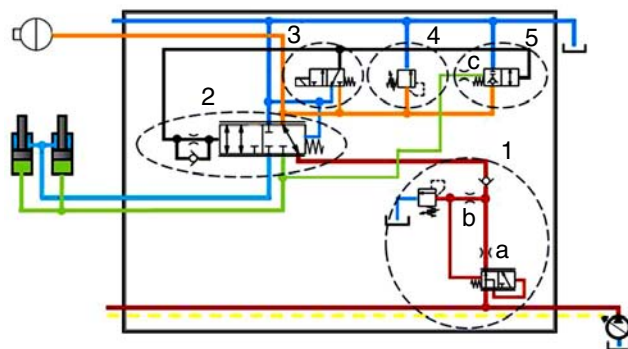
960A6WE11

3) RIDE CONTROL VALVE STRUCTURE



960A6WE12

- 1 Accumulator loading
- 2 Main spool
- 3 Activation of RSM
- 4 Accumulator relief valve
- 5 Accumulator balancing
- 6 Accumulator loading pressure relief valve
- a Loading flow limitation orifice
- b LS orifice
- c Balancing damping orifice



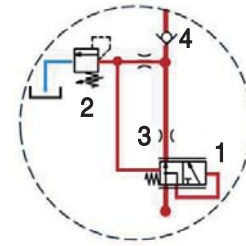
960A6WE14

4) RIDE CONTROL VALVE FUNCTION

- (1) The LS compensator in the loading function is limiting the loading flow in combination with the loading orifice (3). In under saturation, the loading flow is reduced.

As soon as the pressure setting of the pressure relief valve (2) is reached (120 bar), the pressure compensator will close as the pump pressure is higher.

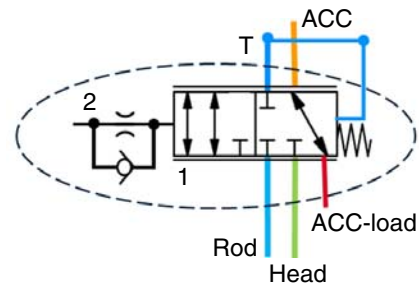
The charging stops automatically.



960A6WE15

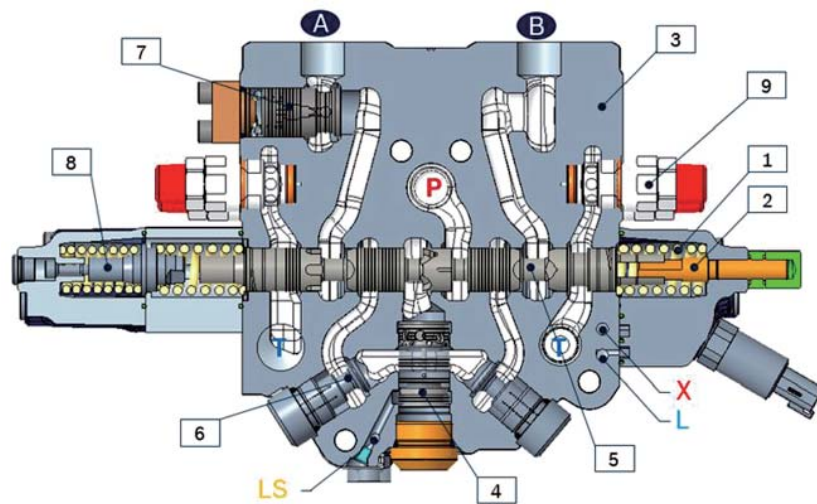
- (2) When switching on the ride control valve, the rod side of the boom cylinder is connected with the tank and the head side is connected to the accumulator. The loading of the accumulator is disconnected when ride control is activated.

The shuttle valve (2) guarantees that balancing of the accumulator pressure with the current cylinder pressure is finished before head side and accumulator are connected.



960A6WE16

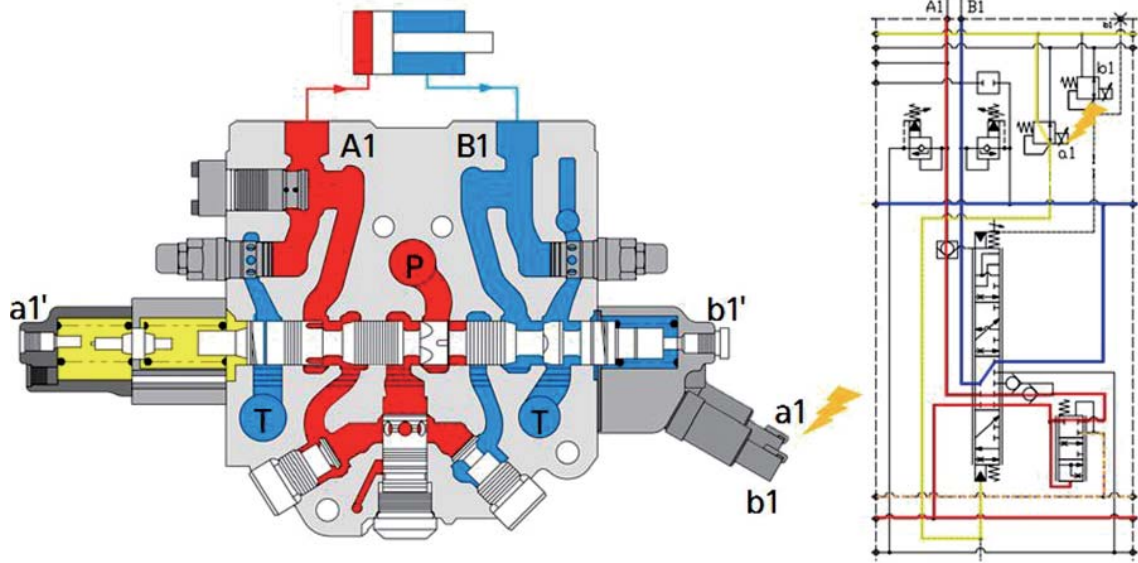
5) BOOM SECTION DESCRIPTION



960A6WE17

- | | | | |
|---|----------------------|---|--------------------------|
| 1 | Spring | 6 | Load holding check valve |
| 2 | Anti rotation device | 7 | Anti drift poppet |
| 3 | Housing | 8 | 4th position device |
| 4 | Pressure compensator | 9 | Port relief valve |
| 5 | Spool | | |

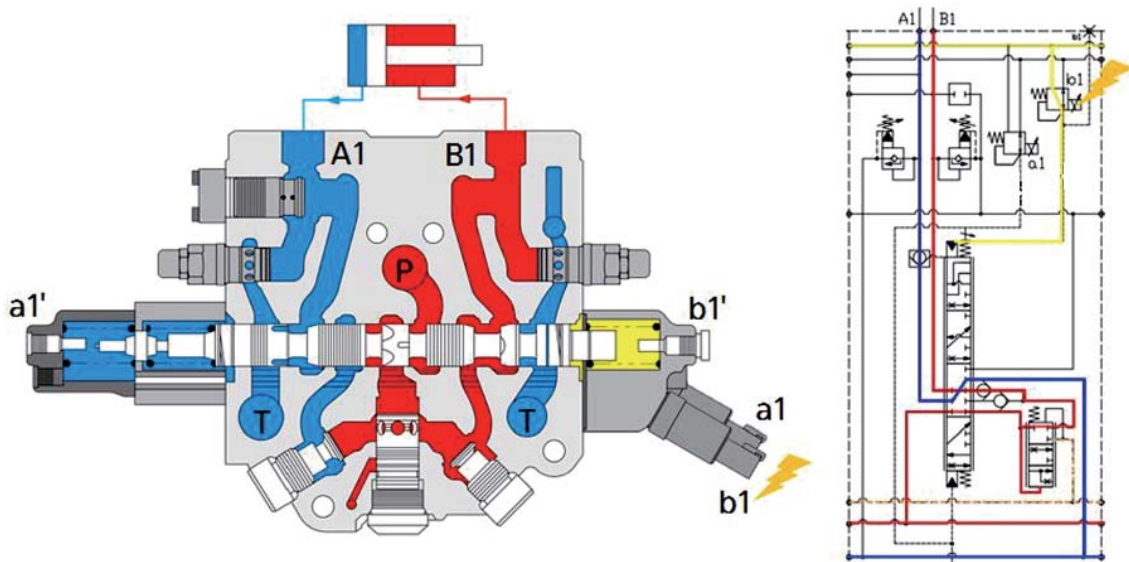
6) BOOM UP DESCRIPTION



960A6WE18

When the pilot pressure from EPPR valve (a1) is led to the port a1', the oil from the pump flows to the boom cylinder (LC) port A1 and oil from the boom cylinder (SC) flows into the tank through the boom cylinder (SC) port B1.

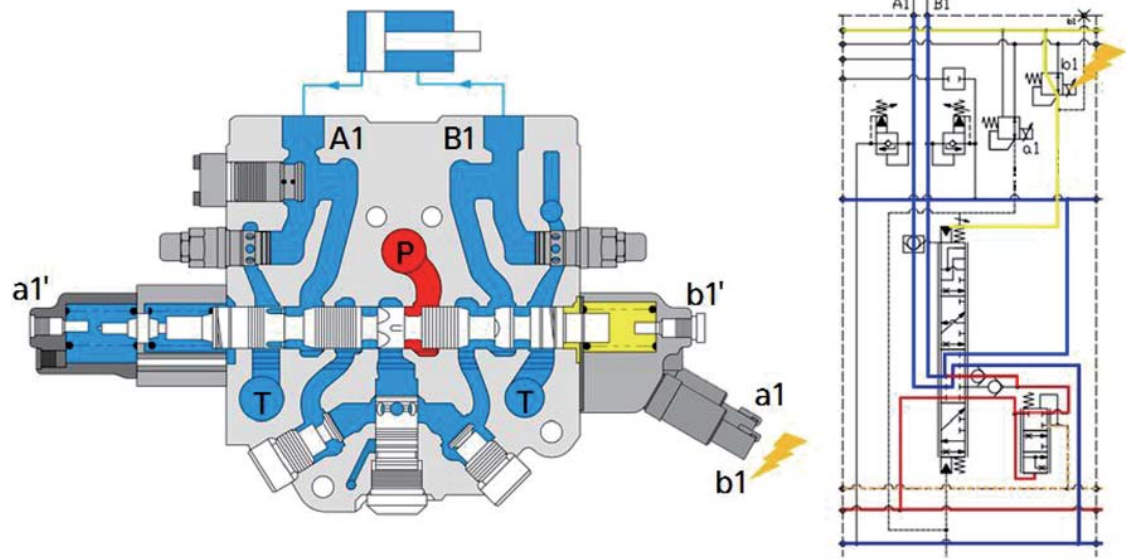
7) BOOM DOWN DESCRIPTION



960A6WE19

When the pilot pressure from EPPR valve (b1) is led to the port b1', the oil from the pump flows to the boom cylinder (SC) port B1 and oil from the boom cylinder (LC) flows into the tank through the boom cylinder (LC) port A1.

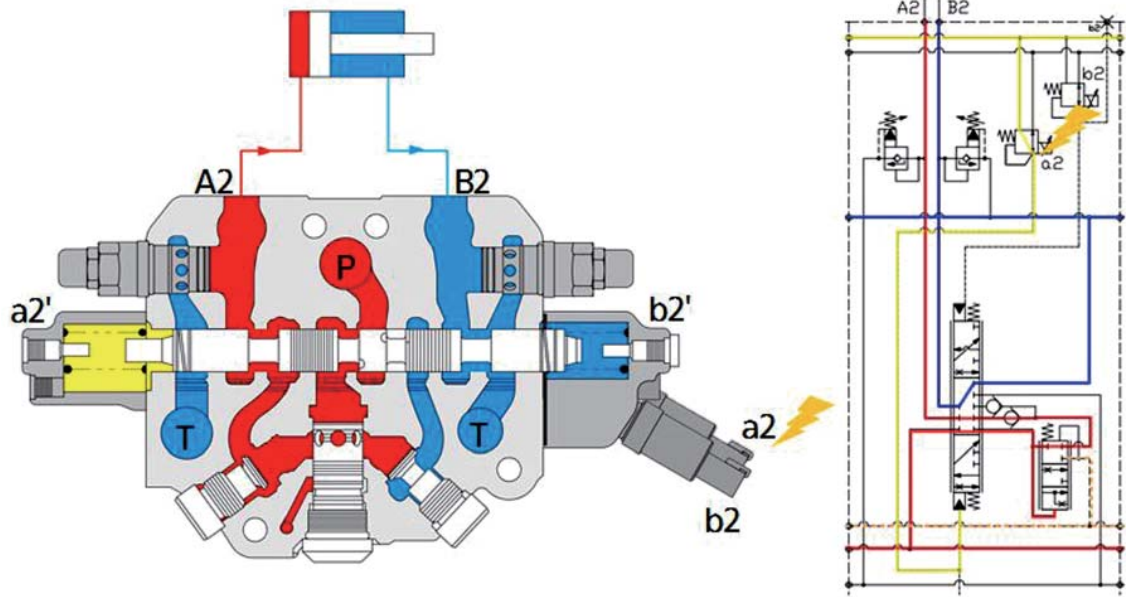
8) BOOM FLOATING DESCRIPTION



960A6WE20

When the pilot pressure from EPPR valve (b1) is led to the port b1' to maximal pressure, the spool is in the forth position. The pump is in low pressure stand-by while port A1 and B1 are connected to tank.

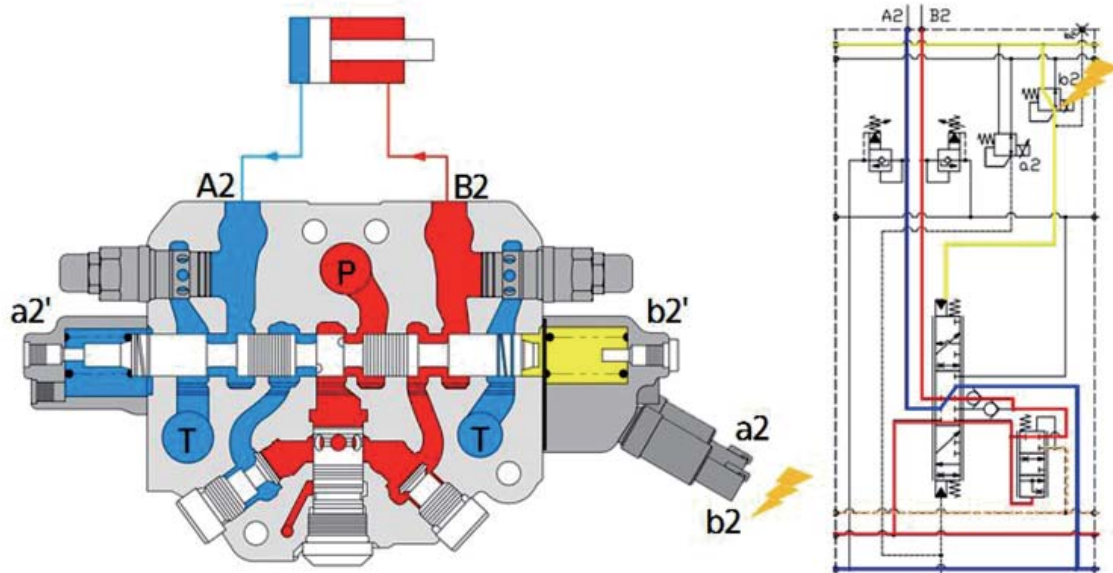
9) BUCKET ROLL BACK DESCRIPTION



960A6WE21

When the pilot pressure from EPPR valve (a2) is led to the port a2', the oil from the pump flows to the bucket cylinder (LC) port A2 and oil from the bucket cylinder (SC) flows into the tank through the bucket cylinder (sc) port B2.

10) BUCKET DUMP DESCRIPTION

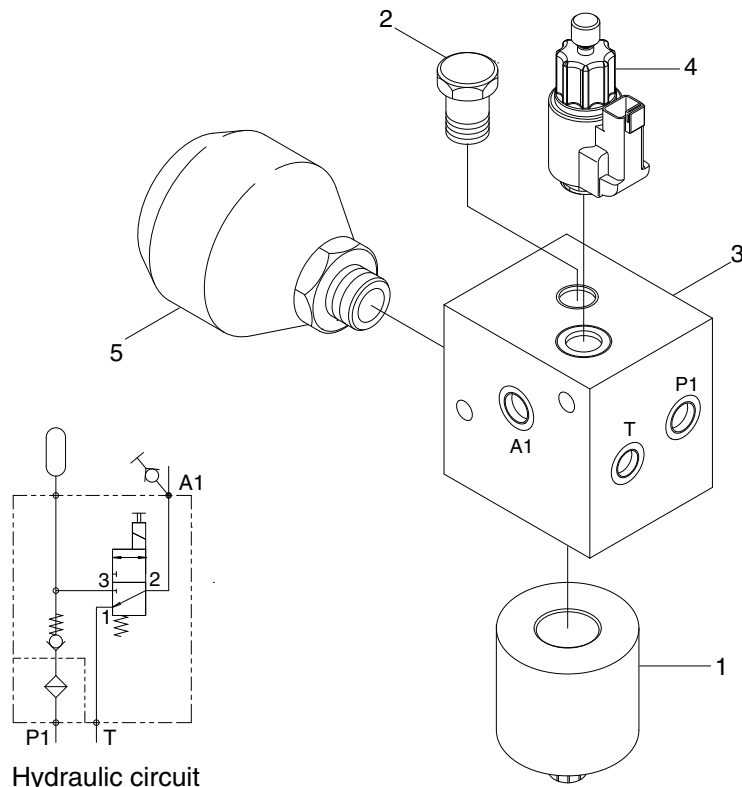


960A6WE22

When the pilot pressure from EPPR valve (b2) is led to the port b2', the oil from the pump flows to the bucket cylinder (SC) port B2 and oil from the bucket cylinder (LC) flows into the tank through the bucket cylinder (LC) port A2.

6. SAFETY VALVE

1) STRUCTURE



| Port | Port name | Port size |
|------|---------------------|-----------|
| P1 | From MCV | PF 3/8" |
| A1 | Supply to RCV lever | PF 1/4" |
| T | To hydraulic tank | PF 1/4" |

75796WE16

- 1 Bowl and element assy
- 2 Check valve
- 3 Cartridge

- 4 Solenoid valve
- 5 Accumulator

2) OPERATION

This valve is used to cut off the pilot circuit.

When the pilot cut off switch in the cab is pressed to ON position, the solenoid valve is activated and then the pilot oil flow into the pilot circuit.

The accumulator satisfied short term peak power demands and is a source of emergency power in case of main circuit pressure failures.

7. BOOM AND BUCKET CYLINDER

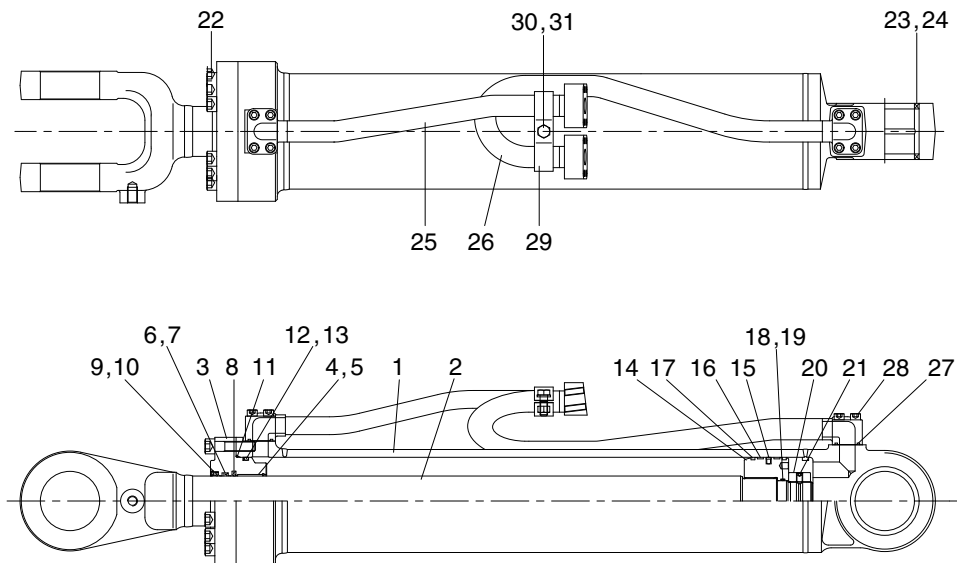
The boom cylinders are two unit and the bucket cylinder is one unit. They use a bolt on rod guide.

The piston (14) threads on to the rod (2) and is retained by a nut (20) and set screw (21).

The piston seals against the tube (1) with piston seal (15). Two wear rings (16) are located on each side of the piston seal.

The gland (3, the rod guide) seals against the tube with an O-ring (12). The cylinder thread seals against the rod with a lip type buffer ring (8) and a rod seal (5). A dust wiper (9) cleans the rod when it is retracted.

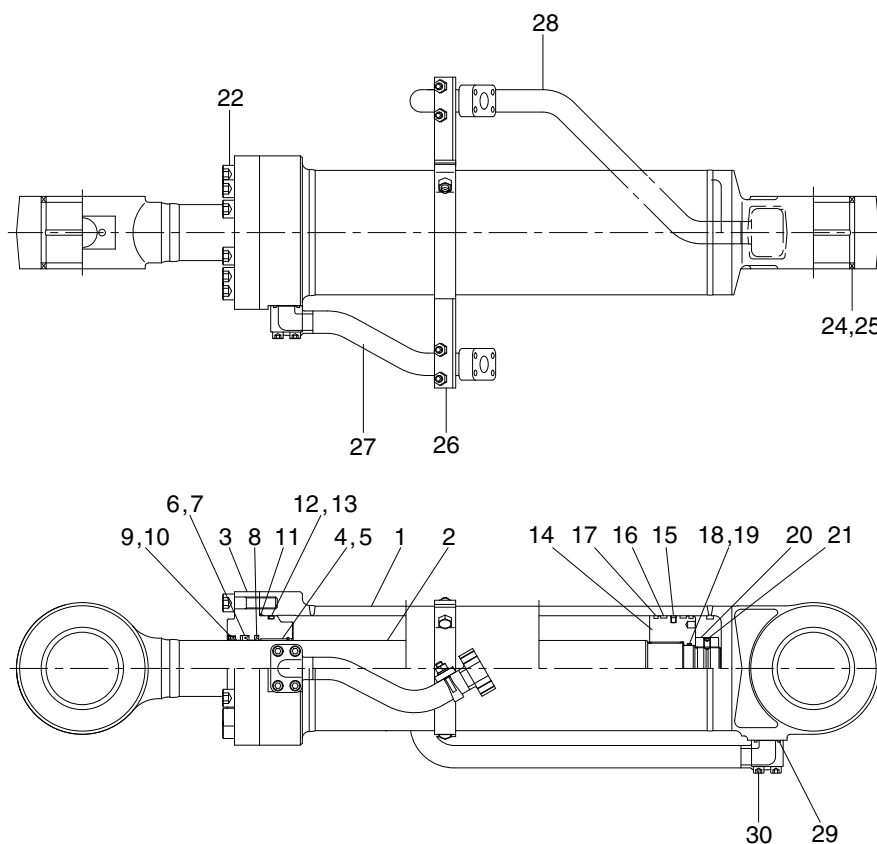
1) BOOM CYLINDER



770F6WE17

| | | | | | |
|----|---------------|----|--------------|----|---------------|
| 1 | Tube assembly | 12 | O-ring | 23 | Bushing |
| 2 | Rod assembly | 13 | Back up ring | 24 | Dust seal |
| 3 | Gland | 14 | Piston | 25 | Pipe assembly |
| 4 | Bushing | 15 | Piston seal | 26 | Pipe assembly |
| 5 | Snap ring | 16 | Wear ring | 27 | O-ring |
| 6 | Rod seal | 17 | Dust ring | 28 | Bolt |
| 7 | Back up ring | 18 | O-ring | 29 | Band assembly |
| 8 | Buffer ring | 19 | Back up ring | 30 | Bolt |
| 9 | Dust wiper | 20 | Lock nut | 31 | Spring washer |
| 10 | Snap ring | 21 | Set screw | | |
| 11 | O-ring | 22 | Bolt | | |

2) BUCKET CYLINDER



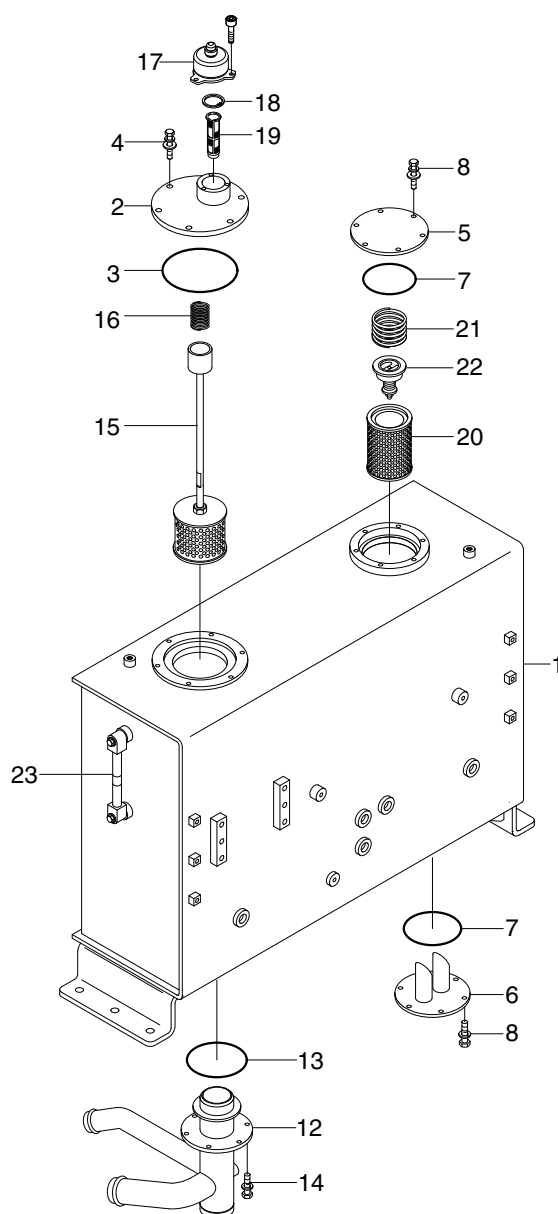
970A6WE18

| | | | | | |
|----|---------------|----|--------------|----|---------------|
| 1 | Tube assembly | 11 | O-ring | 21 | Set screw |
| 2 | Rod assembly | 12 | O-ring | 22 | Socket bolt |
| 3 | Gland | 13 | Back up ring | 23 | Pin bushing |
| 4 | Bushing | 14 | Piston | 24 | Dust seal |
| 5 | Snap ring | 15 | Piston seal | 25 | Band assembly |
| 6 | Rod seal | 16 | Wear ring | 26 | Pipe assembly |
| 7 | Back up ring | 17 | Dust ring | 27 | Pipe assembly |
| 8 | Buffer ring | 18 | O-ring | 28 | O-ring |
| 9 | Dust wiper | 19 | Back up ring | 29 | Socket bolt |
| 10 | Snap ring | 20 | Lock nut | | |

9. HYDRAULIC OIL TANK

1) STRUCTURE

- The oil from the hydraulic tank is sent from the pump through main control valve to the cylinders. In the return circuit, the oil from various parts merges.
- A part of oil is cooled in the oil cooler, passes through the hydraulic filter and returns to the hydraulic tank (1).
- If the hydraulic return oil filter becomes clogged, return filter bypass valve (22) acts to allow the oil to return directly to the hydraulic tank (1). This prevents damage to the hydraulic filter (20). The bypass valve (22) is also actuated when negative pressure is generated in the circuit.



- 1 Hydraulic tank
- 2 Cover
- 3 O-ring
- 4 Bolt
- 5 Cover
- 6 Cover
- 7 O-ring
- 8 Bolt
- 12 Suction pipe
- 13 O-ring
- 14 Bolt
- 15 Strainer
- 16 Spring
- 17 Air breather
- 18 Retaining ring
- 19 Strainer
- 20 Return filter
- 21 Spring
- 22 Bypass valve
- 23 Sight gauge

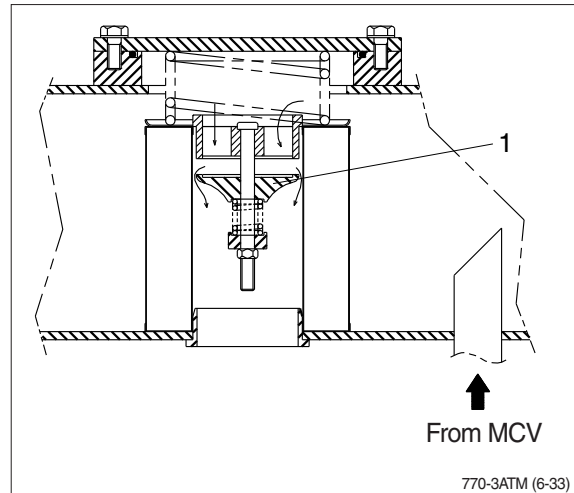
970A6WE21

2) RETURN OIL FILTER BYPASS VALVE

(1) When the filter is clogged

Bypass valve (1) is opened and the oil returns directly to the tank without passing through the filter.

- Bypass valve set pressure : 1.36 kg/cm²
(19.3 psi)



3) AIR BREATHER

The air breather is equipped with the capacity to perform three functions simultaneously-as an air filter, breathing valve, and as a lubrication opening.

(1) Preventing negative pressure inside the tank

The tank is a pressurized sealed type, so negative pressure is formed inside the hydraulic tank when the oil level drops during operations. When this happens, the difference in pressure between the tank and the outside atmospheric pressure opens the poppet in the breather, and air from the outside is let into the tank or prevent negative pressure.

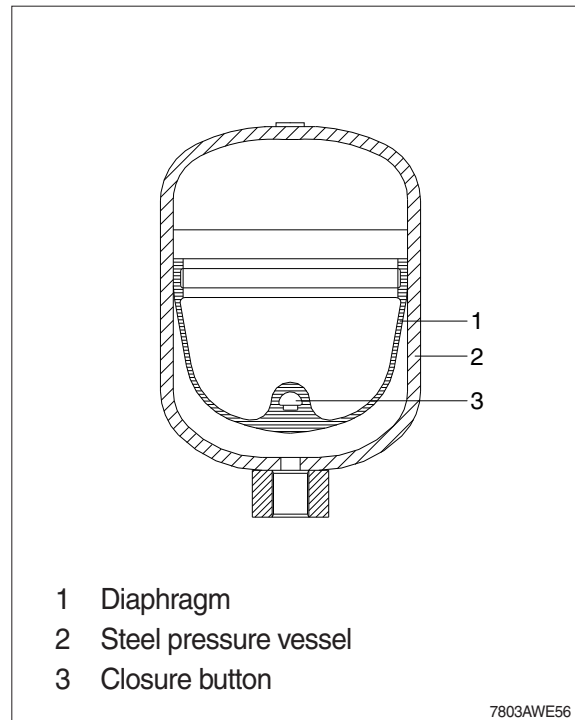
(2) Preventing excessive pressure inside the tank

When the hydraulic cylinder is being used, the oil level in the hydraulic system increases and as temperature rises. If the hydraulic pressure rises above the set pressure, breather is actuated to release the hydraulic pressure inside the tank.

9. ACCUMULATOR

The accumulator is installed at the safety valve. When the boom is left the raised position, and the control levers are operated with the engine stopped the pressure of the compressed nitrogen gas inside the accumulator sends pilot pressure to the control valve to actuate it and allow the boom and bucket to come down under their own weight.

| | |
|--------------------------|----------------------------------|
| Type of gas | Nitrogen gas (N ₂) |
| Volume of gas | 0.75 ℓ (0.2 U.S.gal) |
| Charging pressure of gas | 16 kg/cm ² (228 psi) |
| Max actuating pressure | 128 kg/m ² (1820 psi) |



10. RIDE CONTROL SYSTEM (option)

1) ACCUMULATORS

(1) Pre-charging

Use an inert gas such as nitrogen for pre-charging accumulator.

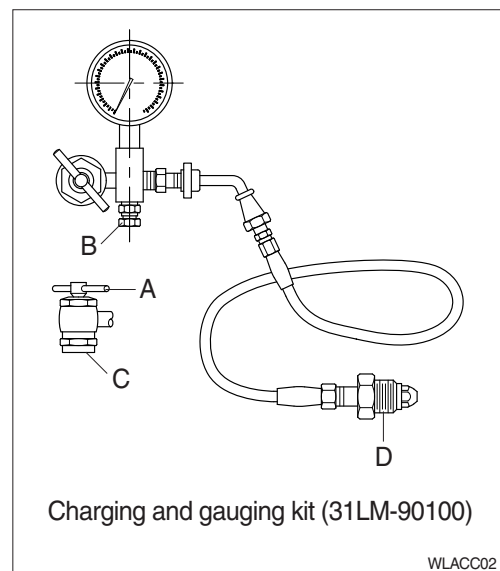
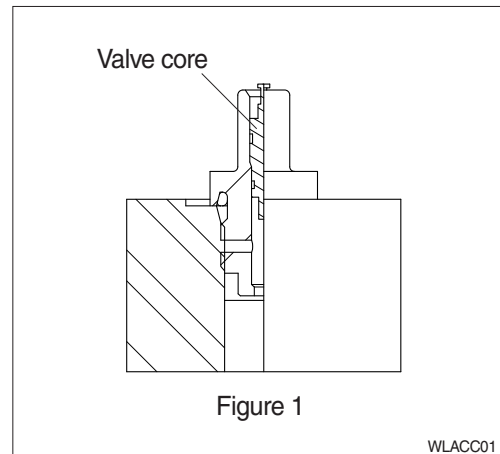
- ※ Do not use oxygen or shop air.
- ※ Nitrogen source and all components must be rated for a pressure at least as high as the nitrogen source.

Accumulator having gas valve as per figure 1.

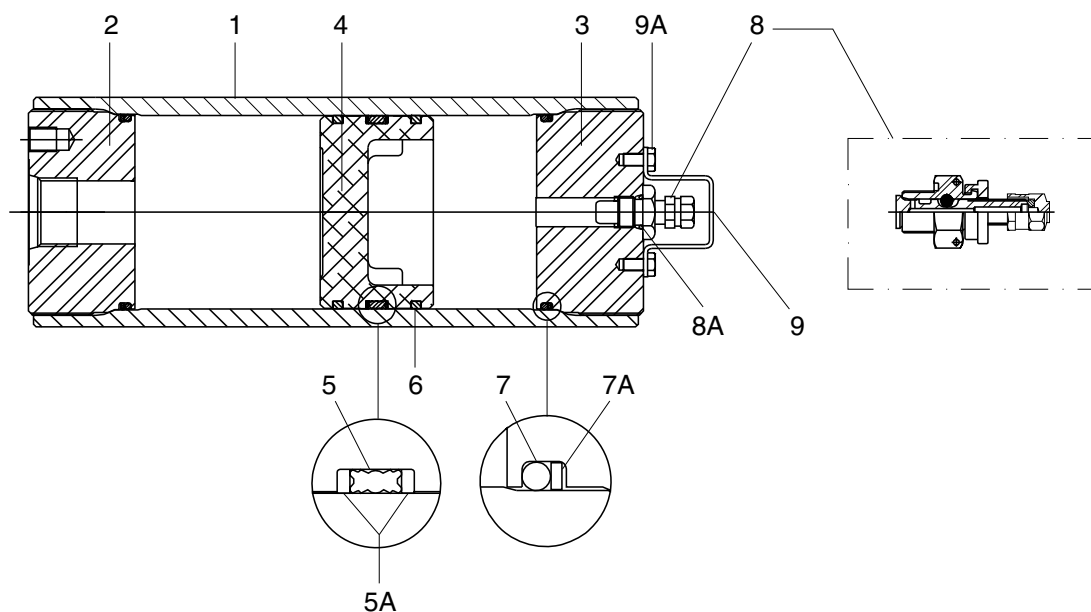
- ① Remove gas valve guard and gas valve cap.
- ② Back gas chuck "T" handle (A) all the way out (counter clockwise) before attaching charging & gauging kit to accumulator gas valve.
- ③ Close bleed valve (B).
- ④ Making sure not to loop or twist the hose, attach swivel nut (C) to gas valve and tighten 11.5~17 kgf·cm (10~15 lbf·ft).
- ⑤ Turn gas chuck "T" handle (A) until the gauge starts showing the pressure in the accumulator. Do not turn the "T" handle all the way down, as it will damage the valve core.
- ⑥ Crack open nitrogen bottle valve (D) and **slowly** fill accumulator. Shut off when gauge indicates desired pre-charge.
- ⑦ Let the pre-charge set for 10 to 15 minutes. This will allow the gas temperature to stabilize. If the desired pre-charge is exceeded, close nitrogen bottle valve (D), then slowly open bleed valve (B). Do not reduce pre-charge by depressing valve core with a foreign object. High pressure may rupture rubber valve seat.
- ⑧ When finished pre-charging accumulator, turn "T" handle (A) all the way out on gas chuck, then open bleed valve (B).
- ⑨ Hold gas valve to keep from turning, loosen swivel nut (C), remove assembly. Check for pre-charge leak using a common leak reactant.
- ⑩ Replace gas valve cap 11.5~17 kgf·cm (10~15 lbf·ft) and valve guard. (Gas valve cap serves as a secondary seal.)

(2) Pre-charge checking procedure

Using appropriate valve in the hydraulic system, discharge all oil from accumulator and allow piston to bottom against hydraulic end cap.



(3) Structure



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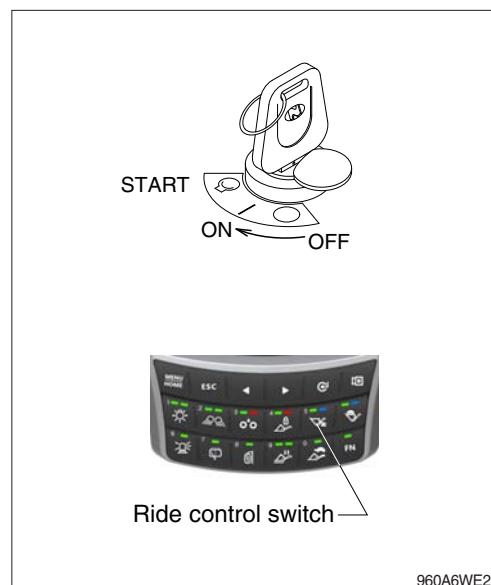
| | | | | | |
|---|---------------|----|--------------------------|----|------------------|
| 1 | Body | 5A | V-O-ring back-up washers | 8A | Gas valve O-ring |
| 2 | Hydraulic cap | 6 | Piston ring (piston) | 9 | Gas valve guard |
| 3 | Gas cap | 7 | O-ring | 9A | Screw |
| 4 | Piston | 7A | O-ring back-up washer | | |
| 5 | V-O-ring | 8 | Gas valve | | |

2) REMOVE FROM HYDRAULIC SYSTEM

⚠ Attention

※ Before carrying out any maintenance work the accumulators must be unloaded (zero pressure).

- 1) Bucket should be lade on the ground.
- 2) Turn the starting switch to ON position and press the ride control switch on monitor to operate ride control function.
- 3) Lower the boom to the position of down or floating to release the charged oil in accumulators.



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GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

This procedure is designed so the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read structure and function, Group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

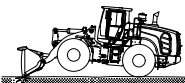
Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

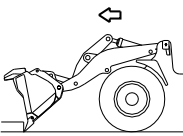
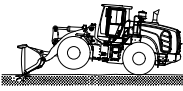
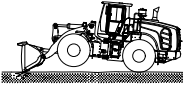
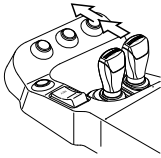
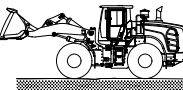
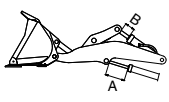
At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be given repair required and group location.

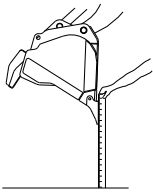
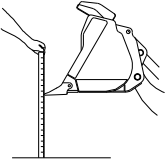
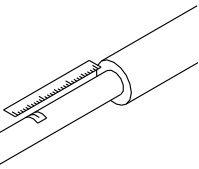
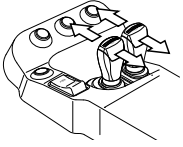
If verification is needed, you will be given next best source of information:

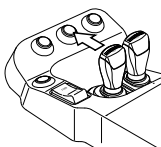
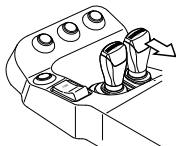
- Chapter 2 : Troubleshooting
- Group 3 : Tests and adjustments

※Hydraulic oil must be at operating temperature for these checks (refer to page 6-49).

| Item | Description | Service action |
|---|---|--|
| Hydraulic system warm-up procedure Run engine at high idle. Refer to page 6-57. | Hold a hydraulic function over relief to heat oil. (don't keep relief condition over 5 seconds at a time) Periodically cycle all hydraulic functions to distribute warm oil. Repeat procedure until oil is at operating temperature. FEEL : Hydraulic reservoir must be uncomfortable to hold your hand against. (approximately 40 ~50°C) | OK Check completed. |
| Hydraulic pump performance check Heat hydraulic oil to operating temperature. Run engine at high idle. | With bucket flat on ground, actuate boom raise. Time how long it takes to raise boom to full height. LOOK : Boom must raise to full height in less than 7 seconds. | OK Check completed. NOT OK Go to priority valve (in flow amplifier) high pressure check at page 5-28. IF OK Do steering system leakage check at page 5-29. IF OK Do main hydraulic pump flow test at page 6-50. |
| Control valve lift check Run machine at low idle. |  With bucket partially dumped, lower boom to raise front of machine. Slowly move boom control lever (RCV lever) to boom lower position. Slowly move bucket control lever to bucket dump position. LOOK : Boom must not raise before moving down. Bucket must not rollback before dumping. | OK Check complete. NOT OK Repair lift checks in loader control valve. |

| Item | Description | Service action |
|--|--|--|
| Bucket rollback circuit relief valve check |  <p>Position bucket at a 45° angle against an immovable object.</p> <p>Engage transmission in 3rd speed forward.</p> <p>LOOK : Bucket angle must not change.</p> | <p>OK Check complete.</p> <p>NOT OK Replace boom lower check valve.</p> |
| Bucket dump circuit relief valve low pressure check |  <p>Raise front of machine which bucket at 45° angle.</p> <p>Backdrag with bucket while observing bucket angle.</p> <p>LOOK : Bucket must not rollback</p> | <p>OK Go to next check.</p> <p>NOT OK Do loader system and circuit relief valve test at page 6-51.</p> |
| Pilot control valve float check Run engine at low idle. |  <p>With the bucket partially dumped, lower boom to raise front of machine.</p> <p>Push control lever to the float detent position and release lever.</p>  <p>LOOK : Front of machine lower to the ground and valve must remain in float position when lever is released.</p> | <p>OK Check complete.</p> <p>NOT OK Do pilot control valve pressure test in group 3.</p> |
| Boom cylinder and bucket cylinder drift check Heat hydraulic oil to operating temperature. |  <p>Set the boom and bucket horizontal, then stop the engine.</p> <p>Stop the engine, wait for 5 minutes, then start measuring.</p> <p>Measure the amount the lift and dump cylinder rods retract during 15 minutes. (unloaded bucket)</p>  <p>A : Retraction of boom cylinder rod</p> <p>B : Retraction of bucket cylinder rod</p> <p>Boom cylinder must drift less than 5.5 mm</p> <p>Bucket cylinder must drift less than 17.7 mm</p> | <p>OK Check complete.</p> <p>NOT OK Go to next check.</p> |

| Item | Description | Service action |
|--|--|--|
| Boom cylinder leakage check Heat hydraulic oil to operating temperature. |  <p>Dump bucket until teeth or cutting edge is perpendicular to the ground.</p> <p>Raise boom until cutting edge is about 1 m (3 ft) above ground.</p> <p>Stop engine. Measure drift from tooth or cutting edge to ground for 1 minute.</p> <p>Wait 10 minutes.</p> <p>Measure drift from tooth or cutting edge to ground for 1 minute.</p> <p>LOOK : Compare the drift rate between the first measurement and the second measurement.</p> | <p>OK Drift is approximately the same between first and second measurement.</p> <p>Repair loader control valve or circuit relief valve.</p> <p>NOT OK If drift is considerably less on second measurement, repair cylinder.</p> |
| Bucket cylinder leakage check Heat hydraulic oil to operating temperature. |  <p>Raise bucket about 1 m (3 ft) off ground with bucket level.</p> <p>Stop engine. Place a support under boom.</p> <p>Measure drift from tooth or cutting edge to ground for 1 minute.</p> <p>Wait 10 minutes.</p> <p>Measure drift from tooth or cutting edge to ground for 1 minute.</p> <p>LOOK : Compare the drift rates between the first measurement and the second measurement.</p> | <p>OK Drift is approximately the same between first and second measurement.</p> <p>Repair loader control valve or circuit relief valve at page 6-59.</p> <p>NOT OK Drift is considerably less on second measurement.</p> <p>Repair cylinder.</p> |
| Check valve of safety valve leakage check Heat hydraulic oil to operating temperature. |  <p>Put bucket level and position about 1.2 m (4 ft) above ground.</p> <p>Place a piece of tape on cylinder rod at least 51 mm (2 in) from rod guide.</p> <p>Run engine at low idle in safety-release position.</p> <p>LOOK : Bucket must not drift up.</p> | <p>OK Check complete.</p> <p>NOT OK Check or replace safety valve.</p> |
| Pilot control valve (RCV lever) check |  <p>Stop engine. Turn key switch to OFF position.</p> <p>Move control lever to all positions and then release.</p> <p>LOOK : Lever must return to neutral when released from all positions.</p> | <p>OK Check completed.</p> <p>NOT OK Repair pilot control valve.</p> |

| Item | Description | | Service action |
|---|---|--|---|
| Bucket leveler (positioner) check Run engine at low idle. |  | Position bucket fully dumped just above ground level. Move control lever to bucket leveler detent position and release. LOOK : Bucket must rollback to the level position and control lever must return to neutral. If bucket is in a rolled back position when key is turned ON, control lever must be returned to neutral manually if placed in the bucket leveler detent position. After bucket is dumped once, bucket leveler will work normally. | OK Check complete. NOT OK Do bucket leveler checks. |
| Boom height kickout check Run engine at low idle. |  | Position bucket flat on ground. Move control lever to boom raise detent position and release. LOOK : Boom must raise to the set height and stop. Control lever must return to neutral. | OK Check complete. NOT OK Do boom height kickout check. |
| Cycle time check Heat hydraulic oil to operating temperature. Run engine at high idle. | Function Boom raise Boom lower Bucket dump Steering [No. of turns] | Operating condition. Bucket flat on ground to full height. Full height to level ground. Boom at full height. Frame stop to frame stop. | Maximum cycle time 6.0 sec 4.3 sec 1.5 sec 4.2 turns OK Check complete. NOT OK Go to slow hydraulic functions in group 2. |

※ MEASURING BOOM AND BUCKET CYCLE TIME

1) MEASUREMENT CONDITION

- Coolant temperature : Inside operating range
- Steering position : Neutral
- Hydraulic temperature : 40~50°C
- Bucket : Unloaded
- Engine speed : High idling

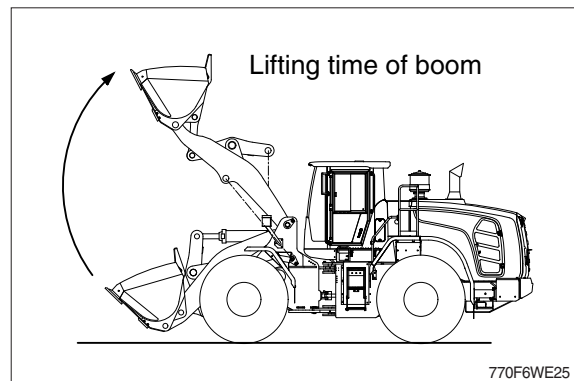
2) MEASURING TOOL

- Stop watch (1EA)

3) MEASURING PROCEDURE

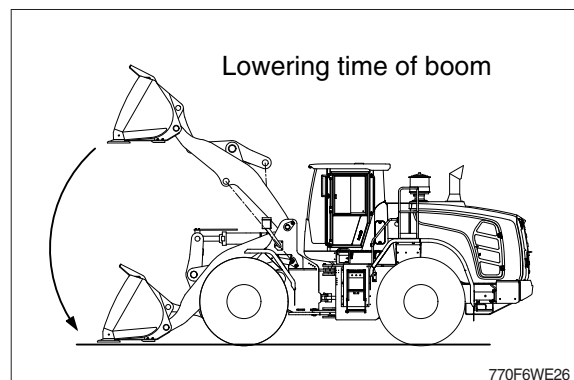
(1) LIFTING TIME OF BOOM

Set the bucket near the maximum tilt back position and at the lowest position on the ground. Raise the bucket and measure the time taken for bucket to reach the maximum height of the boom.



(2) LOWERING TIME OF BOOM

Set the bucket horizontal with the boom at the maximum height, lower the bucket and measure the time taken for the bucket to reach the lowest position on the ground.

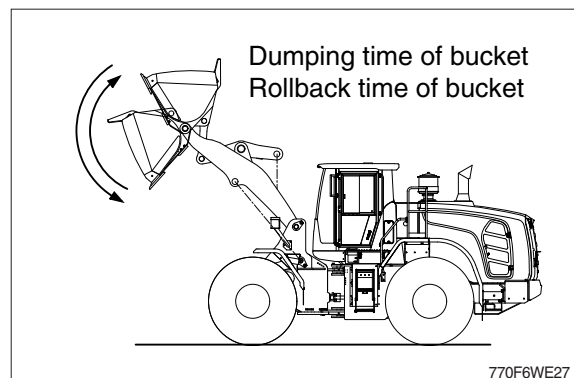


(3) DUMPING TIME OF BUCKET

Raise the boom to the maximum height and measure the time taken for the bucket to move from the maximum tilt back position to the maximum dump position.

(4) ROLL BACK TIME OF BUCKET

Raise the boom to the maximum height and measure the time taken for the bucket to reach the maximum tilt back position.



2. TROUBLESHOOTING

※ Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (see section 1)

Step 2. Operational checks (see group 2)

Step 3. Troubleshooting

Step 4. Tests and adjustments (see group 3)

| Problem | Cause | Remedy |
|---------------------------------------|--|---|
| Noisy hydraulic pump | Low oil supply or wrong viscosity. Plugged or pinched suction line. Air in oil. Plugged suction strainer. Loose or missing hydraulic line clamps. Hydraulic lines in contact with frame. Worn or damaged pump. | Fill reservoir with recommended oil. Clean or replace line. Check for foamy oil. Tighten connections. Replace O-rings and or lines. Inspect and clean strainer in reservoir. Tighten or replace clamps. Inspect and repair. Do hydraulic pump performance check in group 2. Do hydraulic pump flow test in group 3. |
| No or Slow hydraulic functions | Failed or worn hydraulic pump. Cold oil. Slow engine speed. Suction line air leak. Low oil supply. Wrong oil viscosity. Oil leaking past cylinders or control valve. Blocked or damaged line. Faulty pilot control valve (RCV). Binding loader control valve (MCV) spool. Faulty flow amplifier. | Do performance check. Warm oil up. Adjust engine speed. Check high idle speed. Check for foamy oil. Add recommended oil. Use recommended oil. Check cylinder drift in group 2. Inspect lines. Do pilot control valve (RCV) pressure test in group 3. Inspect valve. Check priority valve, orifice of flow amplifier specification. |

| Problem | Cause | Remedy |
|---|---|---|
| No steering or hydraulic function | Low oil level. Failed hydraulic pump. | Add recommended oil. Remove and inspect return filter for metal pump particles. |
| No hydraulic functions steering normal | Failed hydraulic pump. Failed line filter. Faulty safety valve. Stuck open port relief valve. | Remove and inspect return filter for metal pump particles, or replace the pump. Remove and inspect line filter for RCV. Safety valve leakage test or ON, OFF function test. Replace relief valve. |
| Boom float function does not work | Low pilot control pressure. Faulty pilot control valve (RCV). Loader control valve (MCV) spool binding in bore. | Do pressure reducing valve pressure test in group 3. Replace relief valve. Do pressure reducing valve pressure test in group 3. |
| One hydraulic function does not work. | Faulty pilot control valve (RCV). Stuck open port relief valve. Oil leaking past cylinder packings. Blockage in oil lines or valve. Loader control valve (MCV) spool stuck in bore. | Do pilot control valve pressure test. Inspect and repair valve. Replace relief valve. Do boom and bucket cylinder leakage test in group 3. Inspect lines for damage. Disconnect and inspect lines for internal blockage. Inspect and repair valve. |
| Low hydraulic power | Leakage within work circuit. Low system relief valve (main relief valve) setting. Low port relief valve setting. Leaking system relief valve. Worn hydraulic pump. Faulty pilot control valve (RCV). | Do cylinder drift check in group 2. Do loader system and port relief valve pressure test in group 3. Do loader system and port relief valve pressure test in group 3. Remove and inspect valve. Do hydraulic pump performance check in group 2. Do pilot control valve pressure test in group 3. |

| Problem | Cause | Remedy |
|--|--|--|
| Function drifts down | Leaking cylinders. Leaking seals in circuit relief valve (port relief valve) or valve stuck open. Leaking loader control valve (MCV). | Do cylinder leakage checks in group 3. Inspect seals. Replace relief valve. Repair or replace valve section. |
| Boom drifts up | Leakage in boom down spool. | Remove and inspect boom down spool. |
| Boom down does not work (engine off) | Safety valve not operated. Stuck pilot control valve. Faulty line filter. Accumulation not operated. MCV spool stuck. | Operate valve. Inspect. Remove and inspect filter. Inspect. Inspect and repair valve. |
| Oil overheats | Low oil viscosity in hot weather. Excessive load. Holding hydraulic system over relief. Leakage in work circuit. Plugged fins in oil cooler. Internally plugged oil cooler. Incorrect system or circuit relief valve setting. Restriction in oil lines or loader control valve (MCV). Malfunctioning steering valve. Leaking system main relief valve. Worn hydraulic pump (internal leakage). | Use recommended oil. Reduce load. Reduce load. Do boom and bucket cylinder leakage test in group 3. Inspect and clean oil cooler. Do hydraulic oil cooler restriction test. Do loader system and circuit relief valve pressure test in group 3. Inspect for dented or kinked lines. Do hydraulic system restriction test in group 3. Do hydraulic system restriction test in group 3. Remove and inspect valve and seals. Do hydraulic pump performance check in group 2. |
| Function drops before raising when valve is activated | Stuck open lift check valve. | Do control valve lift check in group 2. |

| Problem | Cause | Remedy |
|---|--|--|
| Hydraulic oil foams | Low oil level. Wrong oil. Water in oil. Loose or faulty suction lines (air leak in system). | Add recommended oil. Change to recommended oil. Change oil. Tighten or install new lines. |
| Remote control valve (RCV) leaking | Leaking plunger seals. | Remove, inspect and replace plunger seals. |

※ Followings are general precautions for the hydraulic system and equipment.

- 1) Every structure has its limit of strength and durability. The relief valve is installed to limit the pressure on the hydraulic equipment and protect various parts of the wheel loader from possible damage. Therefore, never change the preset pressure of the relief valve unless absolutely necessary.
- 2) Since the hydraulic equipment is built with precision, the presence of only the slightest amount of dust and / or other particles in the hydraulic circuit might cause wear and/or damage, resulting in unstable functions and/or damage, resulting in unstable functions and/or unexpected accidents. Therefore, always keep hydraulic oil clean. Periodically, check the filter in the return circuit and replace the element as necessary.
- 3) Extract about 200cc of hydraulic oil from the tank as a sample every 6 months. If possible, have it analyzed by a specialist to confirm that the oil can still be used. Never extract the oil for sampling until the oil temperature has become the normal operating temperature. Since the replacement period varies depending on operating conditions, refer to **Operator's Manual** and change oil.
- 4) Should the equipment get damaged due to the presence of metal particles and/or foreign matter in the circuit drain out the hydraulic oil and carry out flushing. Also, replace the filter element and clean the hydraulic tank. Change the hydraulic oil entirely.
- 5) When checking the filter, if found metal particles in the element, drain out the hydraulic oil entirely, flush the whole circuit, and then fill with new oil. The presence of metal particles may indicate internal damage to the equipment. In such a case, check carefully before flushing, and repair or replace as required.
- 6) To add and/or change the hydraulic oil, always use recommended oil. (Refer to the list of recommended oils and lubricants at page 1-22, **Recommended lubricants**.) Never mix oil of different makes of kinds.
- 7) To change the hydraulic oil, use a clean vessel and funnel for pouring it into the tank. Never use cloth because it might cause the presence of lint in the circuit.
- 8) When removing the hydraulic equipment, be sure to put plugs or caps on hoses, tube lines and ports. Also, enter mating marks for later identification.

- 9) Disassemble and/or assemble the hydraulic equipment only in a clean place free of dust. When disassembling, be careful about the interchangeability of parts, and clean the disassembled parts with pure and clean mineral cleansing oil. Clean the internal passages as well. After the parts have dried, wipe them off with a clean lint-free cloth.
- 10) When overhauling the hydraulic equipment replace all O-rings, backup rings, etc. with new ones. Assemble O-rings with grease or vaseline applied.
- 11) After installing the equipment, add more hydraulic oil to make up for that lost during disassembly.
- 12) Tighten joints correctly. Loose joints will cause the hydraulic oil to leak. If the oil leaks, the tank oil level drops and air gets sucked in, so the pump will break down. Also loose joints in suction lines will take air in and might cause abnormal noise, malfunction or damage to pumps.

GROUP 3 TESTS AND ADJUSTMENTS

1. HYDRAULIC OIL CLEAN UP PROCEDURE USING PORTABLE FILTER CADDY

- ※ Service equipment and tool
 - Portable filter caddy
 - Two 4000 mm × 1in 100R1 Hoses
 - Quick disconnect fittings.
 - Discharge wand
 - Various size fittings.
- ※ Brake system uses oil from hydraulic oil tank. Flush all lines in the brake, pilot, steering system and cut off system. Disassemble and clean major components for brake and steering system. Remove and clean pilot caps from main control valve.
Brake and steering components may fail if brake and steering system is not cleaned after hydraulic oil tank contamination.
- 1) If hydraulic system is contaminated due to a major component failure, remove and disassemble steering cylinders to clean debris from cylinders.
- 2) Install a new return filter element. Inspect filter housing before installing new element.
- ※ For a failure that creates a lot of debris, remove access cover from hydraulic oil tank. Drain and clean hydraulic oil tank of fill the specified oil to hydraulic oil tank through upper cover.
- 3) To minimize oil loss, pull a vacuum in hydraulic oil tank using a vacuum pump. Connect filter caddy suction line to drain port at bottom of hydraulic oil tank using connector. Check to be sure debris has not closed drain port.
- 4) Put filter caddy discharge line into hydraulic oil tank filler hole so end is as far away from drain port as possible to obtain a thorough cleaning of oil.

- 5) Start the filter caddy. Check to be sure oil is flowing through the filters.
Operate filter caddy approximately 10 minutes so oil in hydraulic oil tank is circulated through filter a minimum of four times.
※ Hydraulic oil tank capacity : 152 ℓ (40.2 U.S. gal)
Leave filter caddy operation for the next steps.
- 6) Start the engine and run it at high idle.
※ For the most effective results, cleaning procedure must start with the smallest capacity circuit then proceed to the next largest capacity circuit.
- 7) Operate all functions, one at a time, through a complete cycle in the following order: Clam, steering, bucket, and boom. Also include all auxiliary hydraulic functions.
Repeat procedure until the total system capacity has circulated through filter caddy seven times, approximately 30 minutes.
Each function must go through a minimum of three complete cycles for a thorough
※ cleaning for oil.
Filtering time for machines with auxiliary hydraulic functions must be increased because system capacity is larger.
- 8)
- 9) Stop the engine. Remove the filter caddy.
- 10) Install a new return filter element.
Check oil level in reservoir; Add oil if necessary.


2. BOOM HEIGHT KICKOUT ADJUSTMENT

The bucket can be adjusted to a height desired by using the boom kick-out device.


- ▲ Park the machine on level ground and block the tires to prevent sudden movement of the machine.
- ▲ Press the parking brake switch.
- ▲ Fix the front and rear frames by using the safety lock bar.
- ▲ Do not work underneath the work equipment.

1) ADJUSTMENT OF THE BOOM KICKOUT AND BUCKET LEVELER


(1) Lift kickout position

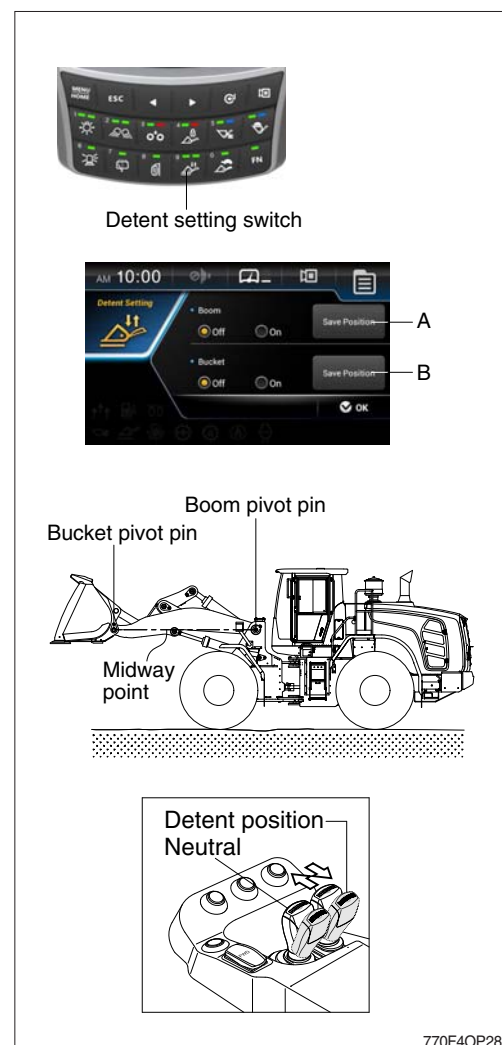
To set the lift kickout, raise the bucket to the desired position above the midway point. Then push icon ( , A) for 2~3 seconds. The boom will return to the programmed position when the raise detent is activated and the boom is below the kickout position.

(2) Lower kickout position

To set the lower kickout, lower the bucket to the desired position below the midway point. Then push icon ( , A) for 2~3 seconds. The boom will return to the programmed position when the float detent is activated and the boom is at least a foot above the kickout position.

(3) Bucket leveler position

To set the bucket leveler, roll back the bucket to the desired position. Then push icon ( , B) for 2~3 seconds. The bucket will return to the programmed position when the roll back detent is activated and the bucket is below the leveler position.



3. TEST TOOLS

1) CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

· Service equipment and tools

Tachometer

A : Clamp on tachometer.

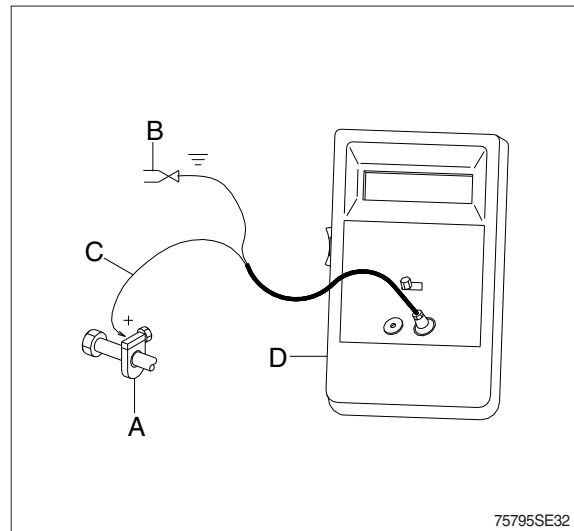
Remove paint using emery cloth and connect to a straight section of injection line within 100 mm (4 in) of pump.

Finger Tighten only-do not over tighten.

B : Black clip (-). Connect to main frame.

C : Red clip (+). Connect to transducer.

D : Tachometer readout. Install cable.



2) DIGITAL THERMOMETER INSTALLATION

· Service equipment and tools

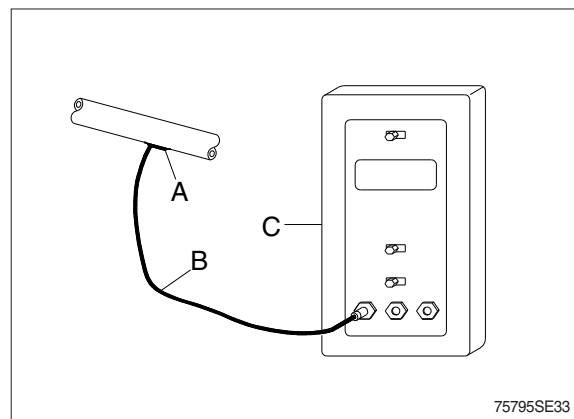
Digital thermometer

A : Temperature probe.

Fasten to a bare metal line using a tie band. Wrap with shop towel.

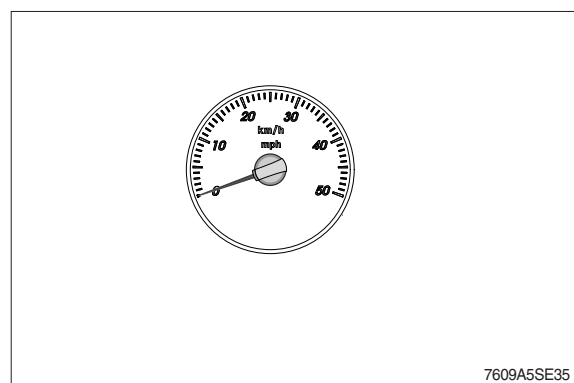
B : Cable.

C : Digital thermometer.



3) DISPLAY MONITOR TACHOMETER

The display monitor tachometer is accurate enough for test work.



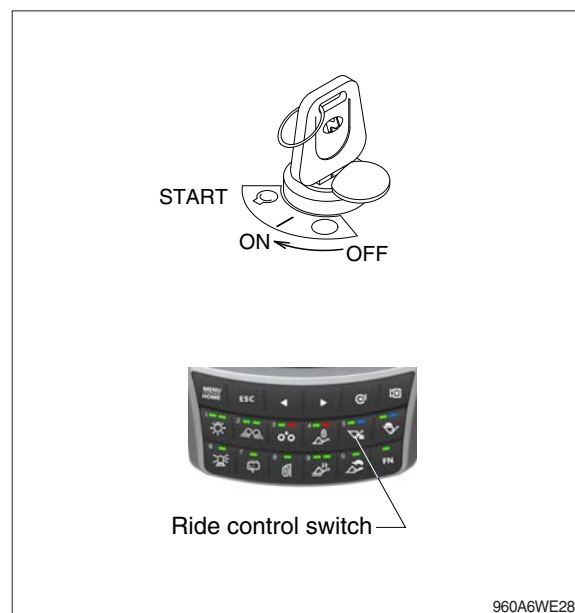
4. HYDRAULIC OIL WARM UP PROCEDURE

- 1) Install temperature reader (see temperature reader installation procedure in this group).
- 2) Run engine at high idle.
- 3) Hold a hydraulic function over relief to heat the oil.
- 4) Periodically cycle all hydraulic functions to distribute warm oil.
- 5) Heat oil to test specification (approx. 45°C).

※ Ride control system (option)

▲ Attention

- 1) Before carrying out any maintenance work the accumulators must be unloaded (zero pressure).
- 2) Bucket should be lade on the ground.
- 3) Turn the starting switch to ON position and press the ride control switch on monitor to operate ride control function.
- 4) Lower the boom to the position of down or floating to release the charged oil in accumulators.



5. MAIN HYDRAULIC PUMP FLOW TEST

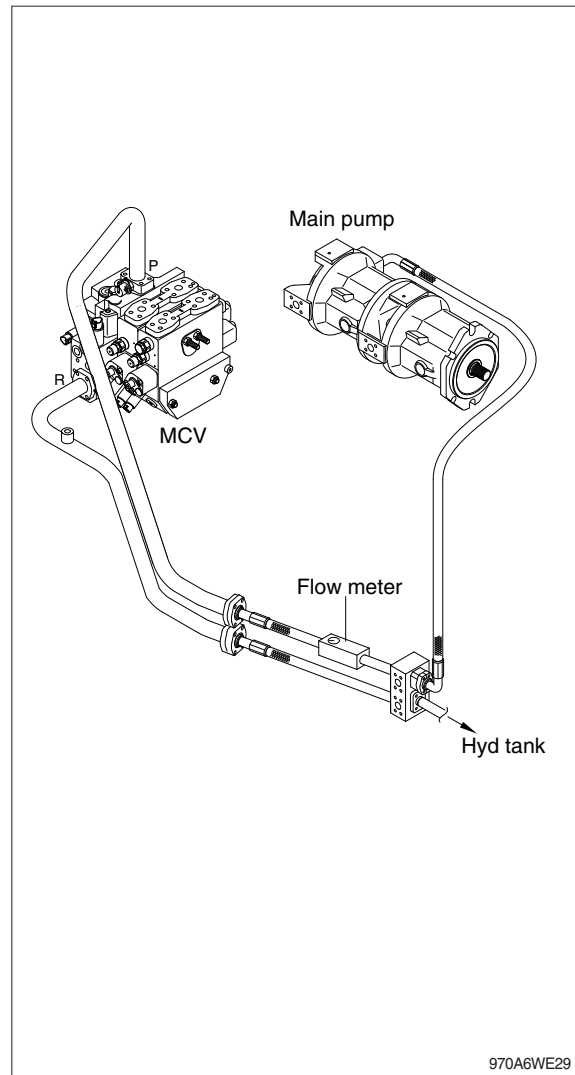
· SPECIFICATION

| | |
|-------------------|--|
| Oil temperature | $45 \pm 5^{\circ}\text{C}$ ($113 \pm 9^{\circ}\text{F}$) |
| Engine speed | 2100 ± 25 rpm |
| Test pressure | 200 ± 5 bar (2900 psi) |
| Maximum pump flow | 359 l/min (94.8 gpm) |

· FLOW METER GAUGE AND TOOL

Gauge 0~35 MPa (0~350 bar, 0~5000 psi)
Temperature reader

- 1) Make test connections.
- 2) Install temperature reader.
(see temperature reader installation procedure in this group)
- 3) Heat hydraulic oil to specifications.
(see hydraulic oil warm up procedure in this group)
- 4) Run engine at test specifications.
- 5) Close flow meter loading valve to increase pressure to test specifications.
- 6) Read flow meter.
- 7) If flow is below specifications, check suction line and suction pressure for abnormality before removing pump.



6. LOADER SYSTEM AND PORT RELIEF VALVE PRESSURE TEST

· SPECIFICATION

Oil temperature (40~50°C)

| Relief valve | Engine speed | Relief pressure |
|---------------------|--------------|---|
| System (M) | Low | 280 ± 5 kg/cm ² (3980 ± 70 psi) |
| Boom raise (U) | Low | 340 ± 10 kg/cm ² (4840 ± 140 psi) |
| Boom down (W) | Low | 340 ± 10 kg/cm ² (4840 ± 140 psi) |
| Bucket rollback (R) | Low | 340 ± 10 kg/cm ² (4840 ± 140 psi) |
| Bucket dump (D) | Low | 340 ± 10 kg/cm ² (4840 ± 140 psi) |

· Gauge and tool

Gauge 0~35 MPa (0~350 bar, 0~5000 psi)

M : System (main) relief valve

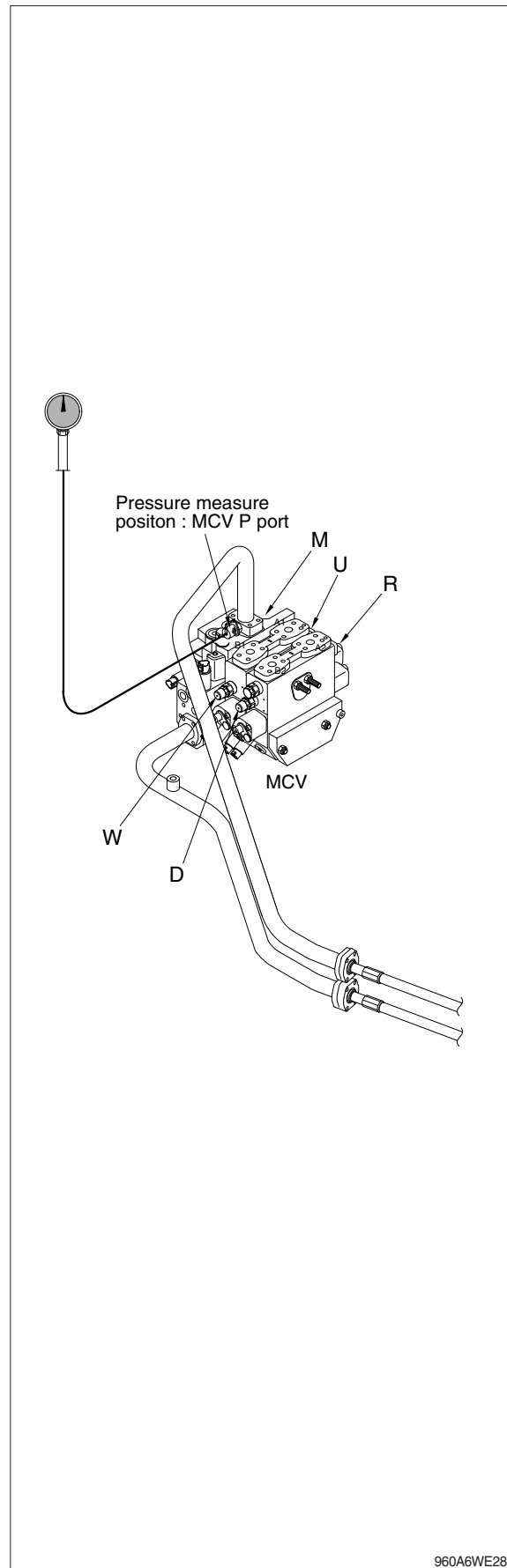
R : Bucket rollback relief

D : Bucket dump relief

U : Boom raise relief

W : Boom down relief

- 1) Install fitting and pressure gauge to test port in pump delivery line.
 - 2) Install temperature reader.
(see temperature reader installation procedure in this group)
 - 3) Heat hydraulic oil to specifications.
(see hydraulic oil warm up procedure in this group)
 - 4) To check the system relief (M), run engine at low idle. Lower boom to bottomed position.
Slowly activate boom down function while watching pressure gauge. If pressure is not to specification, loosen lock nut on system relief valve (M) and adjust to specification.
- ※ Do not adjust the system relief valve above 280 kg/cm² (3980 psi). Damage to the pump will result from excessive pressure settings.



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7. LOADER CYLINDER DRIFT TEST

· SPECIFICATION

Oil temperature $45 \pm 5^{\circ}\text{C}$ ($113 \pm 9^{\circ}\text{F}$)

Boom horizontal

Bucket horizontal

Bucket unloaded

| Item | Standard value |
|-----------------------------------|----------------|
| Retraction of boom cylinder rod | 5.5 mm |
| Retraction of bucket cylinder rod | 17.7 mm |

· GAUGE AND TOOL

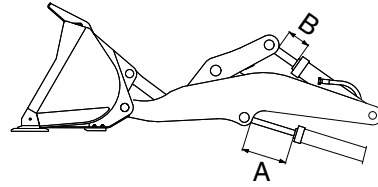
Stop watch

Temperature reader

⚠ Put the safety lock lever in the lock position.

⚠ Do not go under the work equipment.

- 1) Set the boom and bucket horizontal, then stop the engine.
- 2) Stop the engine, wait for 5 minutes, then start measuring.
- 3) Measure the amount the boom and bucket cylinder rods retract during 15 minutes.



A : Retraction of boom cylinder rod

B : Retraction of bucket cylinder rod

7577AWE31

8. BOOM AND BUCKET CYLINDER LEAKAGE TEST

· SPECIFICATION

Oil temperature $45 \pm 5^{\circ}\text{C}$ ($113 \pm 9^{\circ}\text{F}$)
Engine speed Low idle
Maximum leakage 15 mℓ/min (1/2 oz/min)

· GAUGE AND TOOL

Temperature reader
Stop watch
Measuring container

1) Fasten temperature sensor to head end port of cylinder to be tested. Cover sensor with a shop towel.

2) Heat hydraulic oil to specifications (see hydraulic oil warm up procedure in this group).

⚠ Never work under raised equipment unless it is supported with a hoist or support stands.

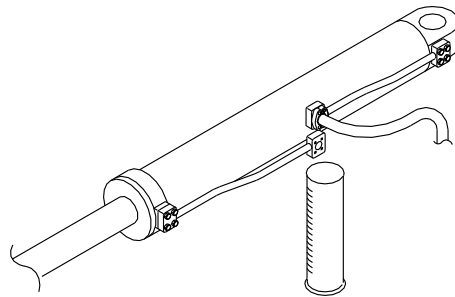
3) Full extend the cylinder to be tested. If testing the boom cylinders, restrain boom in the fully raised position using a hoist or a stand.

※ Check cylinders for leakage in the fully extended position only. In the retracted position contacts the end of the cylinder and seals off piston seal leakage.

4) Remove and plug cylinder rod end hose or line.

5) Run engine at slow idle. Activate control lever to extend cylinder for 1 minute over relief while measuring leakage for open port.

If leakage is within specification, excessive cylinder drift is caused by leakage in the loader control valve or circuit relief valve.



(770-3ATM) 6-56

9. CYCLE TIME TEST

· SPECIFICATION

Oil temperature — $45 \pm 5^{\circ}\text{C}$ ($113 \pm 9^{\circ}\text{F}$)

Engine speed — High idle

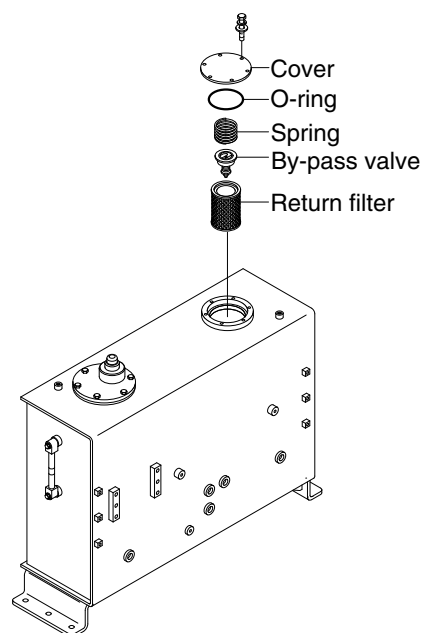
| Function | Operating conditions | Maximum cycle time (seconds) |
|----------------------------|--------------------------------------|------------------------------|
| Boom raise | Bucket flat on ground to full height | 6.0 |
| Boom lower (float) | Full height to ground level | 4.3 |
| Bucket dump | Boom at full height | 1.5 |
| Steering (number of turns) | Frame stop to stop | 4.2 turns |

10. HYDRAULIC OIL FILTER INSPECTION PROCEDURE

- 1) Lower the bucket to the ground, stop the engine, move the control lever back and forth several times, and clean all over the upper surface of the hydraulic oil tank.
- 2) Remove the bolts and take out the filter case cover and O-ring.
- 3) Remove the spring and bypass valve.
- 4) Remove the filter element from the tank.
- 5) Check the element and the filter case bottom for debris. Excessive amounts of brass and steel particles can indicate a failed hydraulic pump or a pump failure in process. A rubber type of material can indicate cylinder packing or other packing failure.

※ The hydraulic oil filter in the filter case of the hydraulic oil tank should be replaced every 1000 operating hours or more often. When the filter element is replaced, please keep as follows.

- (1) Clean the inside of the filter case.
- (2) Place new element in the proper positions inside the filter case.
- (3) Install the bypass valve and spring. Make sure the element stand upright, and check for complete contact of the element bottom with the filter case bottom.
- (4) Install the O-ring and filter case covers. Tighten them with bolt. Replace the O-ring with new one if damaged.

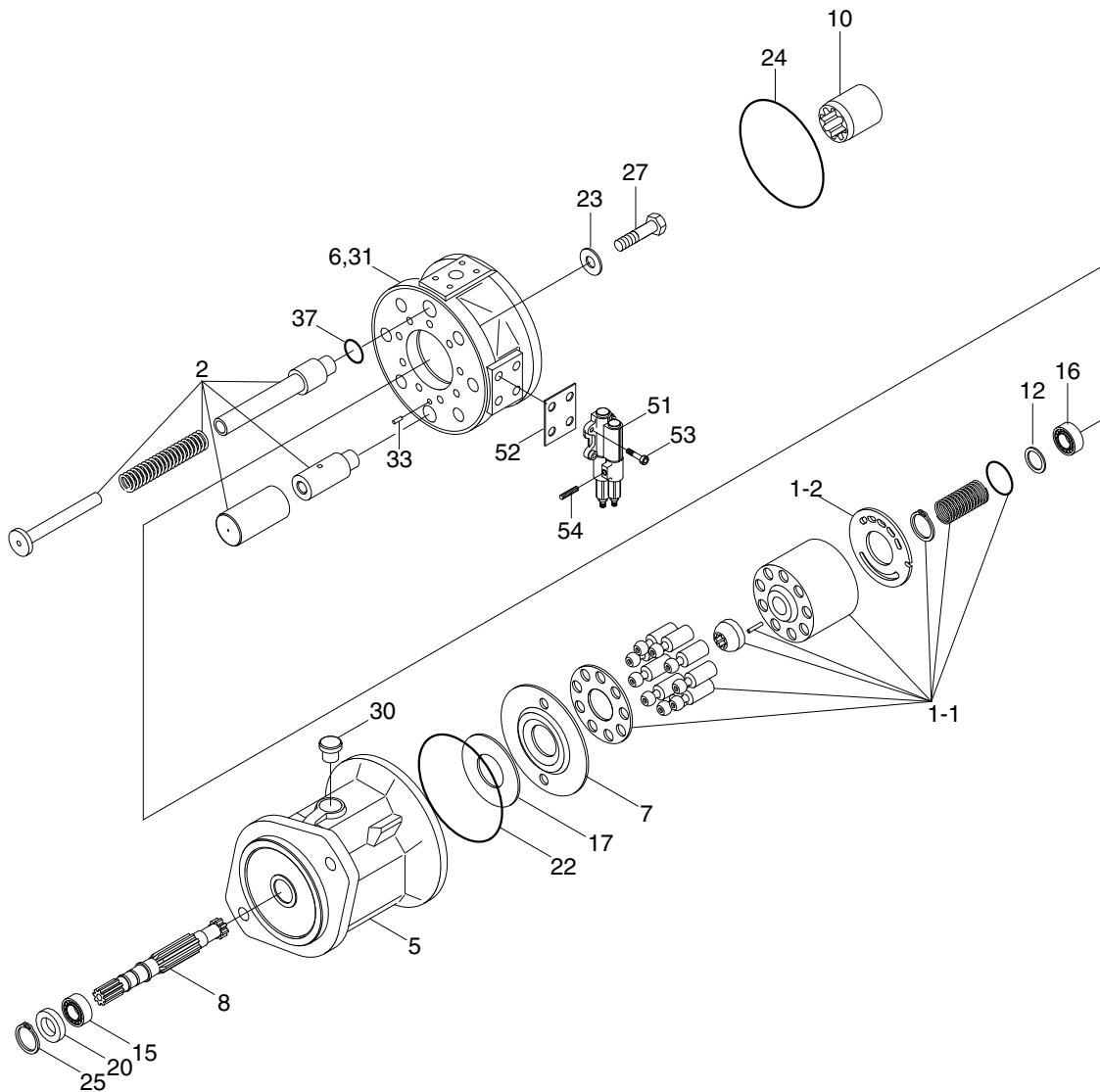


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GROUP 4 DISASSEMBLY AND ASSEMBLY

1. MAIN PUMP

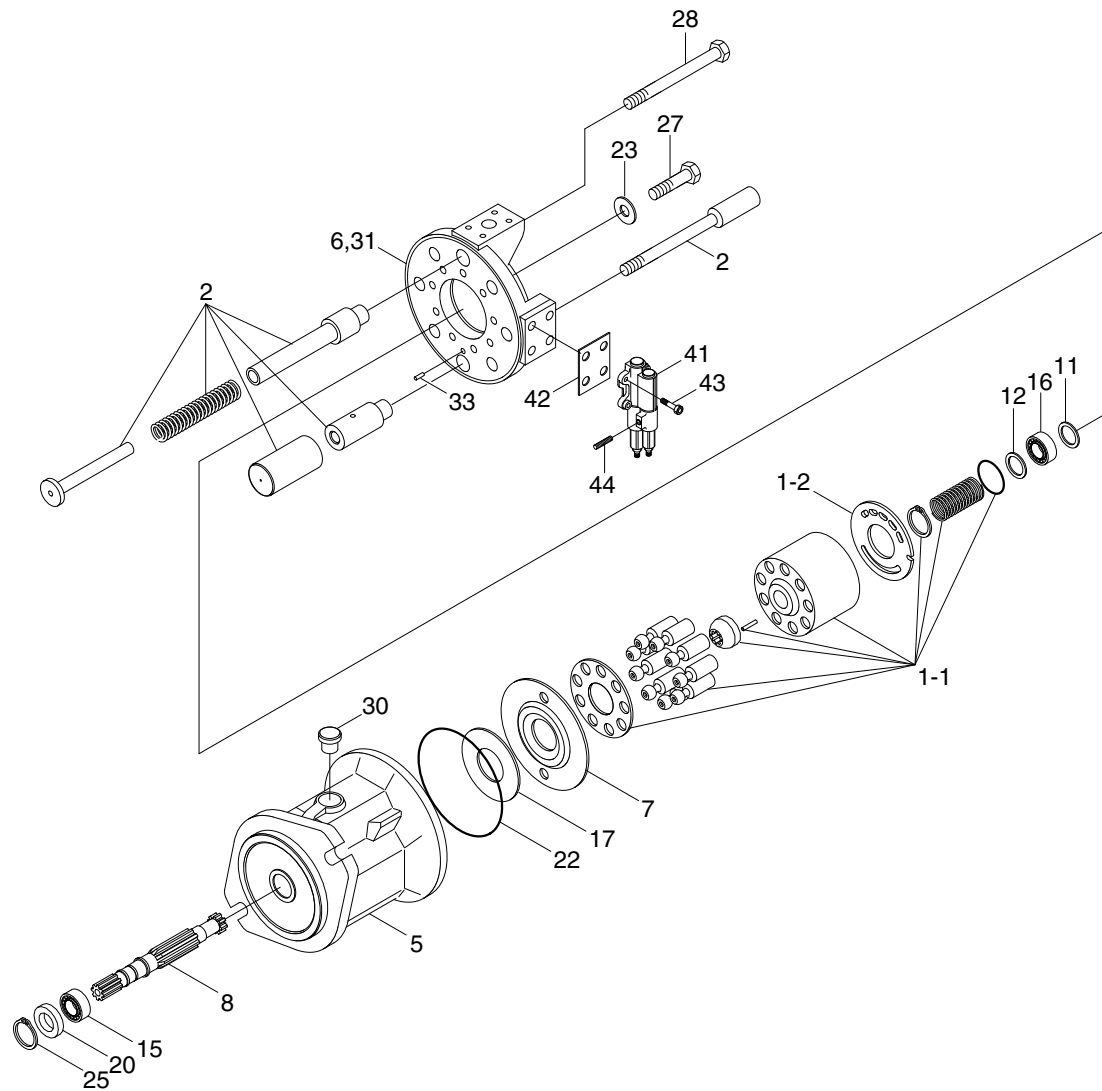
1) STEERING (1/2)



76096WE11

| | | | | | |
|-----|-------------------------|----|----------------------|----|----------------------|
| 1 | Rotary group | 12 | Adjustment shim | 27 | Socket screw |
| 1-1 | High speed rotary group | 15 | Taper roller bearing | 30 | Locking screw |
| 1-2 | Control plate | 16 | Taper roller bearing | 31 | Double break-off pin |
| 2 | Adjusting piece | 17 | Bearing liner | 33 | Cylinder pin |
| 5 | Pump housing | 20 | Shaft seal ring | 37 | Side mark ring |
| 6 | Port plate | 22 | O-ring | 51 | Control valve |
| 7 | Swash plate | 23 | O-ring | 52 | Gasket |
| 8 | Drive shaft | 24 | O-ring | 53 | Socket head screw |
| 10 | Splined hub | 25 | Retaining ring | 54 | Locking screw |

LOADER (2/2)



76096WE12

- | | | | | | |
|-----|-------------------------|----|----------------------|----|----------------------|
| 1 | Rotary group | 12 | Adjustment shim | 28 | Locking screw |
| 1-1 | High speed rotary group | 15 | Taper roller bearing | 30 | Locking screw |
| 1-2 | Control plate | 16 | Taper roller bearing | 31 | Double break-off pin |
| 2 | Adjusting piece | 17 | Bearing liner | 33 | Cylinder pin |
| 5 | Pump housing | 18 | Shaft seal ring | 41 | Control valve |
| 6 | Port plate | 22 | O-ring | 42 | Gasket |
| 7 | Swash plate | 23 | O-ring | 43 | Socket screw |
| 8 | Drive shaft | 25 | Retaining ring | 44 | Locking screw |
| 11 | Adjustment shim | 27 | Socket screw | | |

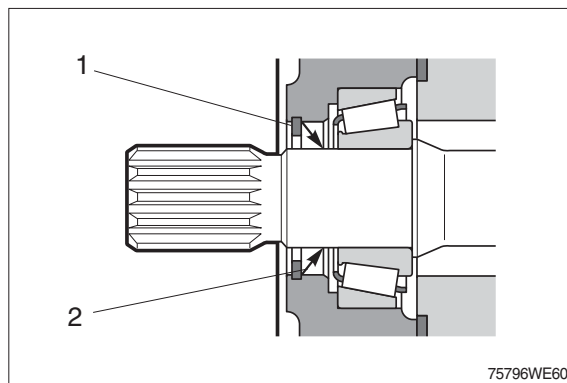
2) GENERAL REPAIR GUIDELINES

- ※ Observe the following guidelines when carrying out repairs on hydraulic pumps.
- (1) Close off all openings of the hydraulic unit.
- (2) Replace all of the seals.
Use only original spare parts.
- (3) Check all sealing and sliding surfaces for wear.
- ※ Re-work of the sliding surfaces by using, for example abrasive paper, can damage the surface.
- (4) Fill the hydraulic pump with hydraulic oil before commissioning.

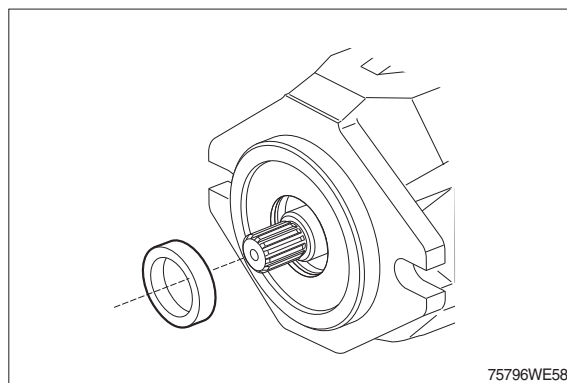
3) SEALING THE DRIVE SHAFT

- (1) Protect the drive shaft.
Remove the circlip.
Remove the shaft seal.

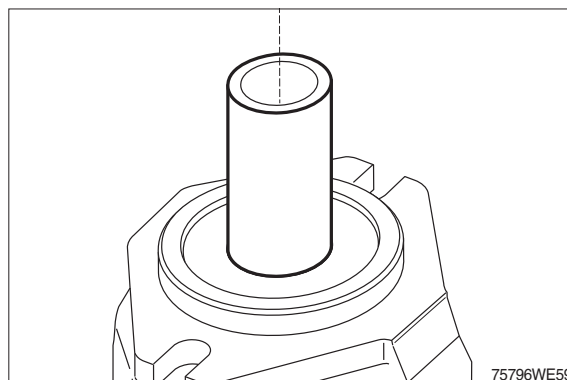
1 Circlip 2 Shaft seal



- (2) Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.

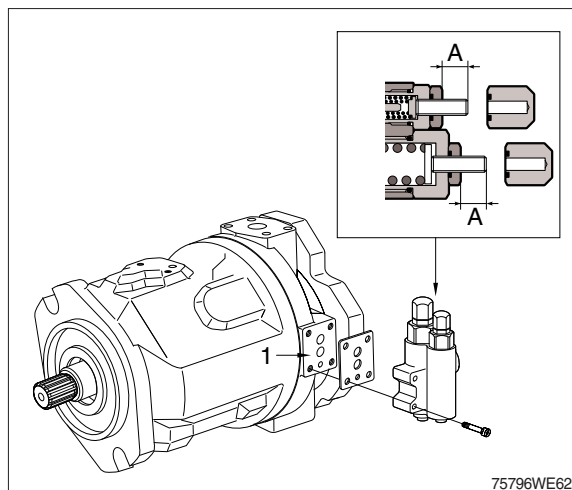


- (3) Assemble the sealing ring, fitting tool holds the correct position of the sealing ring in the pump housing.
Assemble the circlip in the correct position.



4) SEALING / CLEANING THE CONTROL VALVE

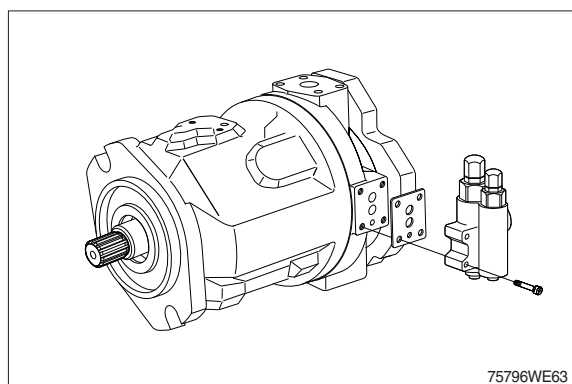
- (1) Disassemble the control valve.
- ※ Measure dimension A and note down.
Check sealing surface (1).



75796WE62

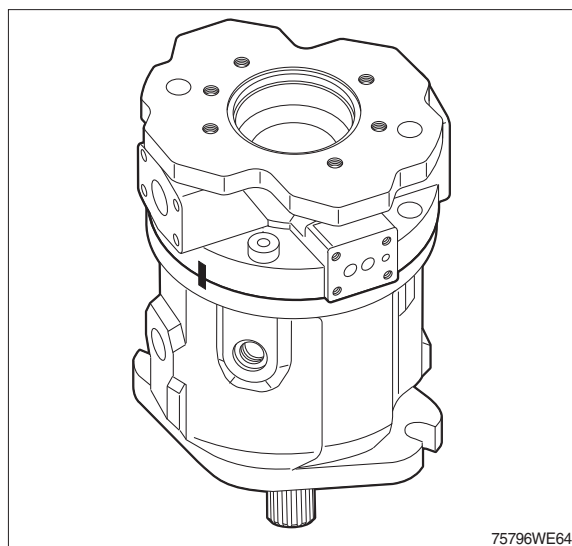
5) DISASSEMBLE THE PUMP

- (1) Remove the control valve.



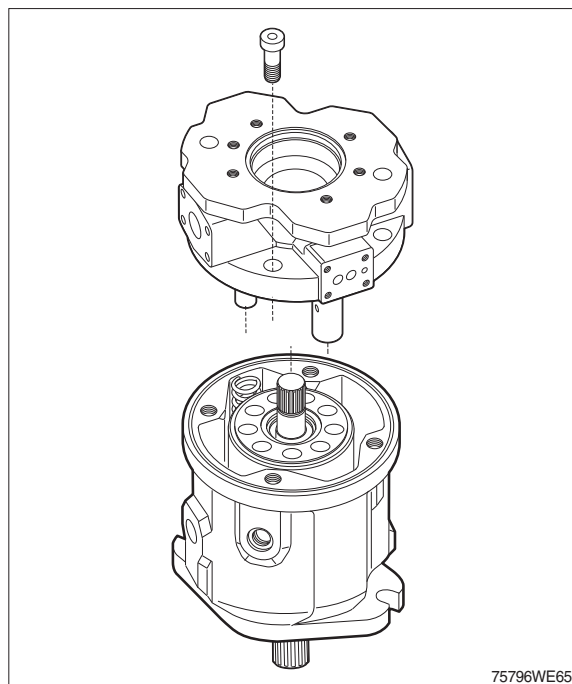
75796WE63

- (2) Mark the location of the connection plate on the housing.

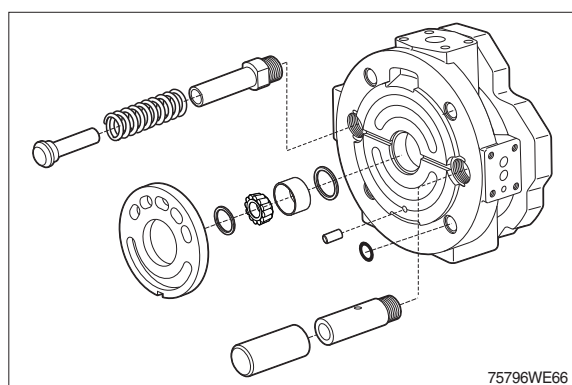


75796WE64

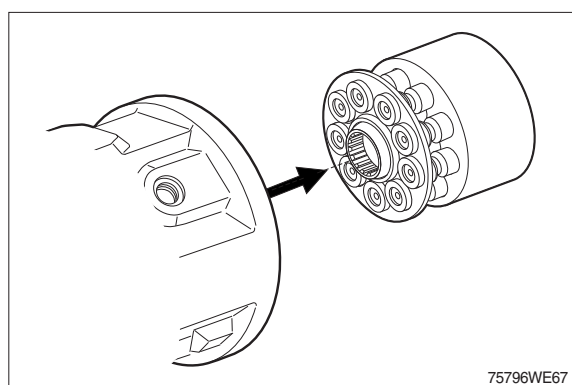
- (3) Remove the connection plate fixing bolts and the connection plate.
※ Distributor plate and adjustment piston can drop down.



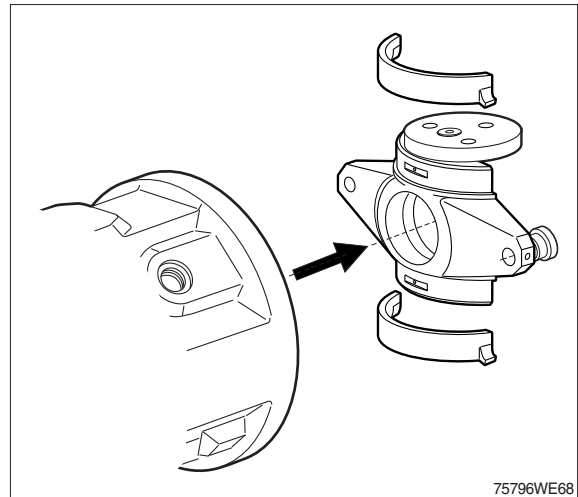
- (4) Remove distributor plate.
Take note of the orientation.
※ Remove bearing with withdrawal tool.
Do not damage the sealing surface.



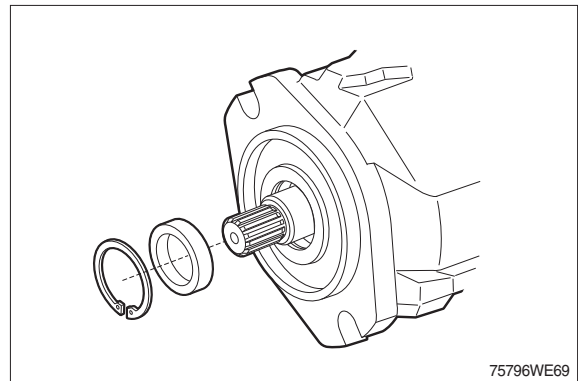
- (5) Remove the rotary group in a horizontal position.



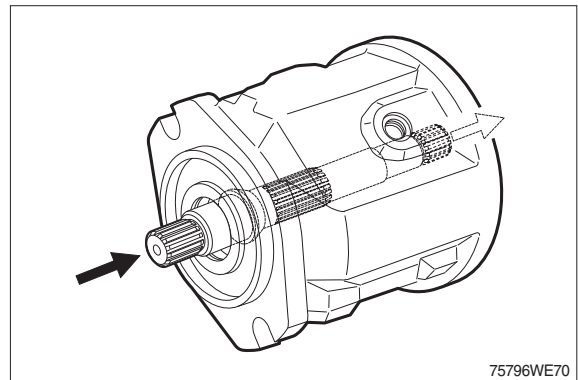
(6) Remove swash plate and bearing shells.



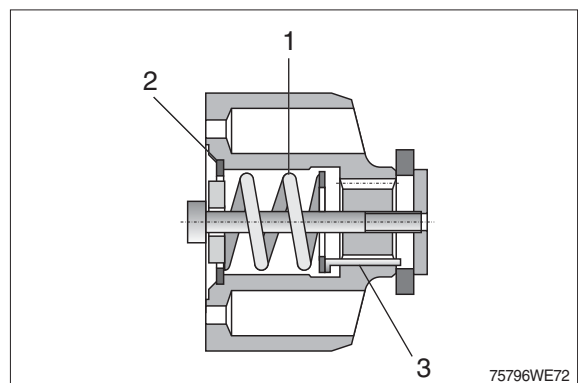
(7) Remove the circlip and the shaft seal.



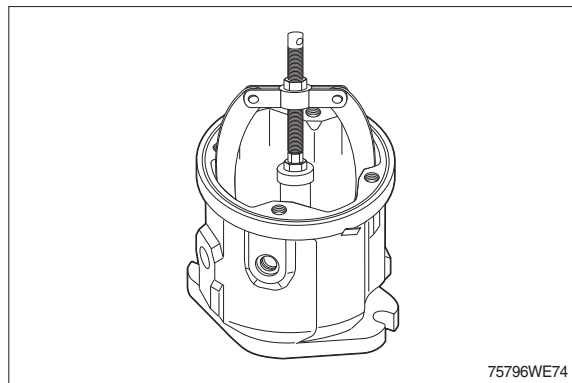
(8) Remove the drive shaft through rear side.



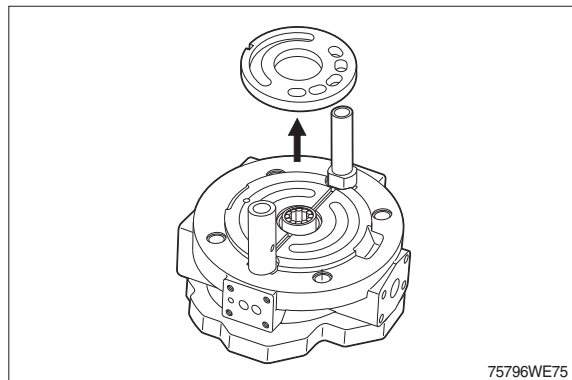
(9) Pre-tension the spring (1) using a suitable device.
Remove circlip (2).
Remove spring (1) and pressure pins (3).



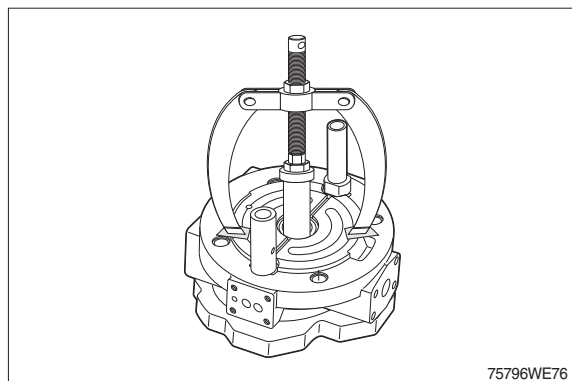
- (10) Use bearing puller to remove outer bearing race of front bearing out of housing press seat.



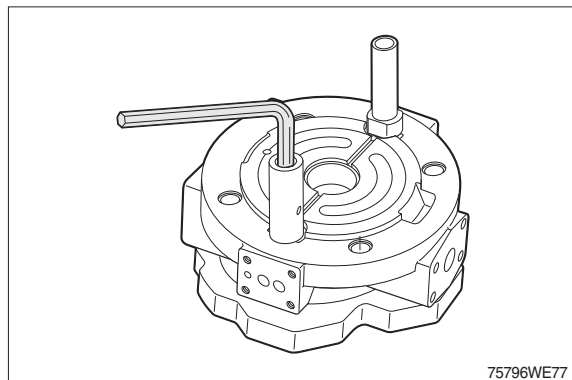
- (11) Remove the control plate.



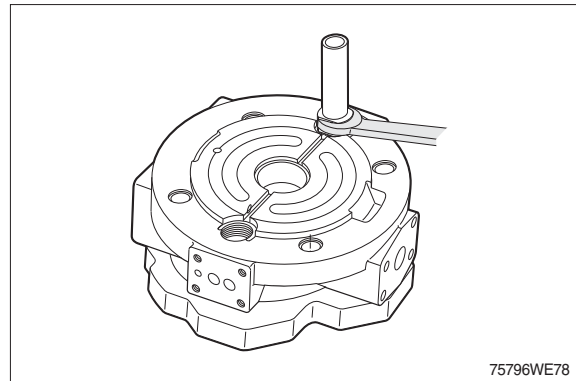
- (12) Use bearing puller to remove outer bearing race of rear bearing - press seat.



- (13) Disassemble the guide of control piston (Mounting position: pilot valve side).

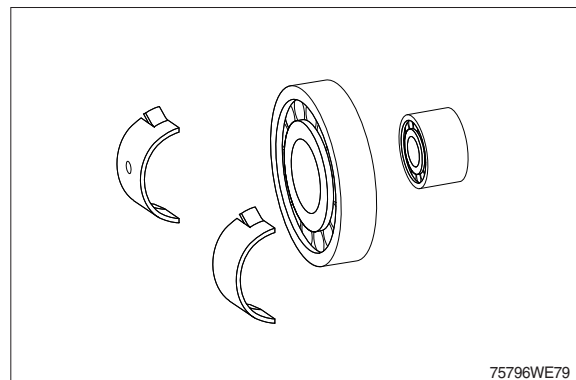


- (14) Disassemble the guide of the opposite piston.



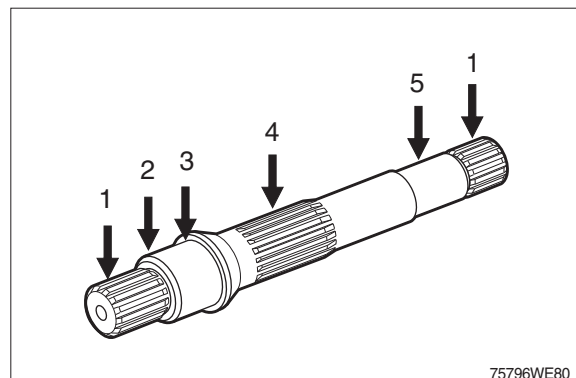
6) INSPECT HINTS

- (1) Renew all bearings.



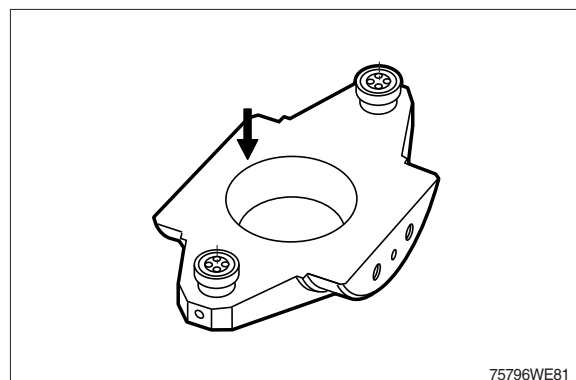
- (2) Check :

- 1 Wear on splines, rust
- 2 Drive shaft seal wear grooves
- 3 Bearing seat
- 4 Splines for cylinder drive
- 5 Bearing seat

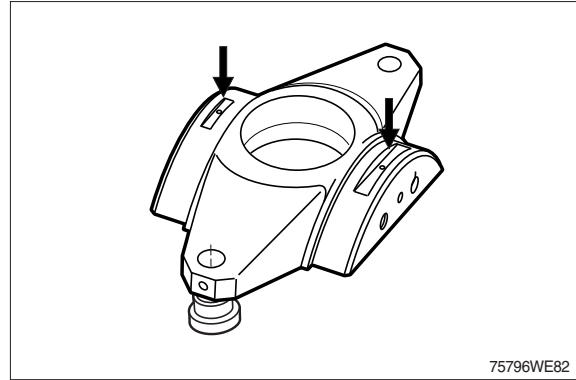


- (3) Check :

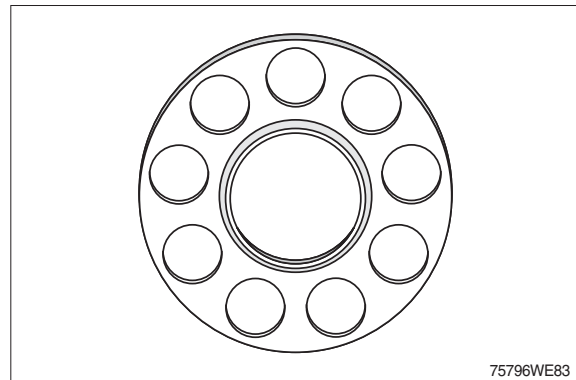
Sliding surface free of grooves.



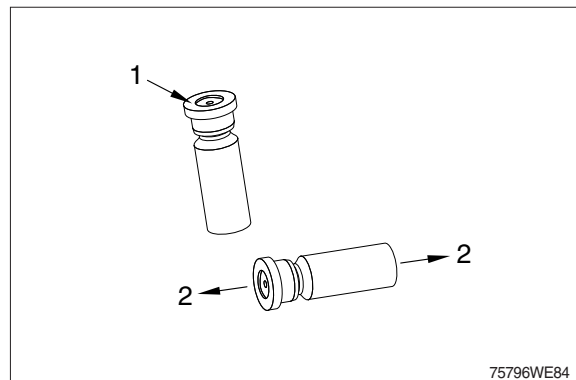
- (4) Check :
Bearing surfaces.



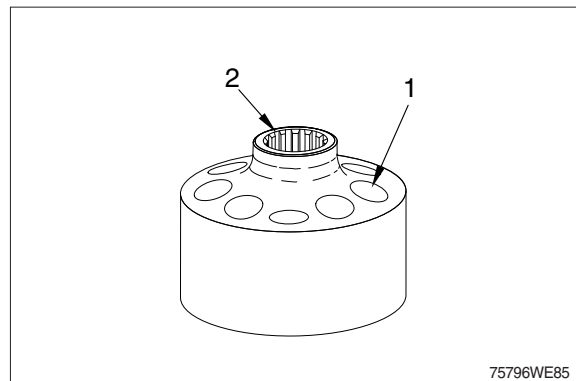
- (5) Check :
That the retaining plate is free of grooves
and that there is no wear in the slipper
pad area.



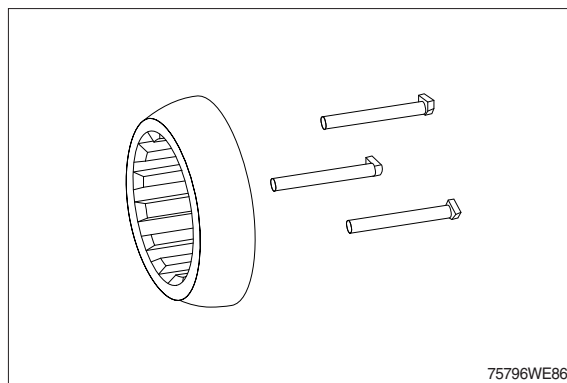
- (6) Check :
Check to see that there are no scratches
or metal deposits on the sliding surface
(1) and that there is no axial play (2)
(Pistons must only be replaced as a set).



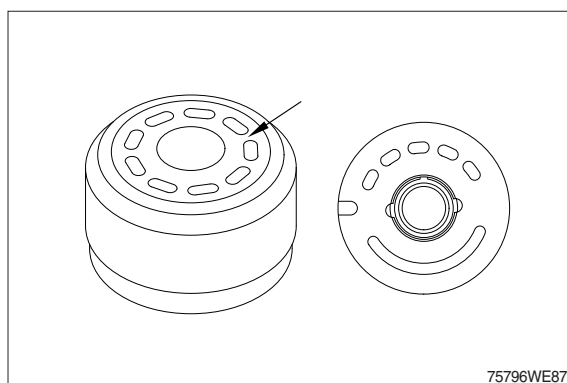
- (7) Check :
1 Cylinder bores
2 Splines



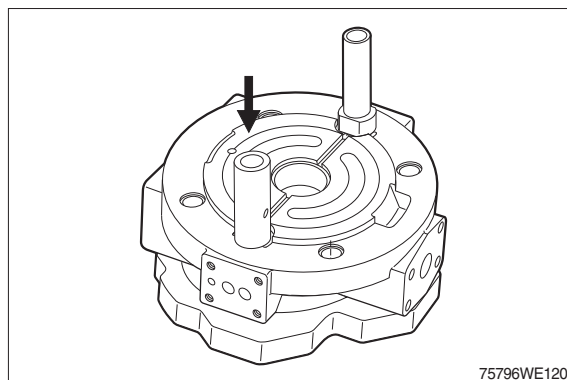
(8) Free of grooves, no signs of wear.



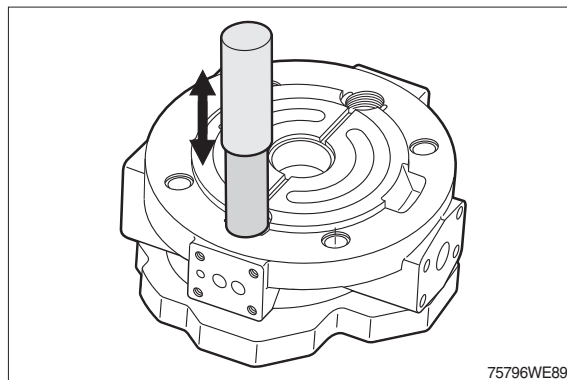
(9) Check :
Cylinder sliding surface free of grooves,
no wear, no embedded foreign particles.
That there are no scratches on the control
plate. (Only replace them as a set).



(10) Check :
Mounting surface - control plate
undamaged.

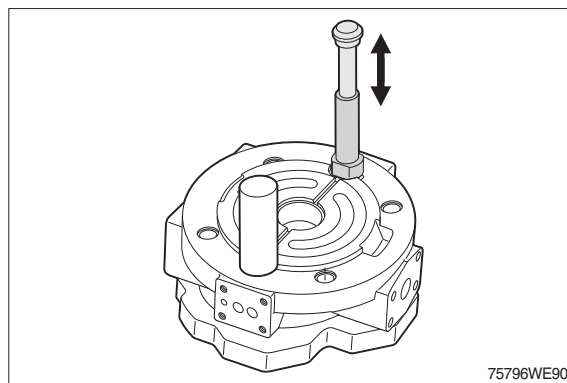


(11) Check :
Check running conditions of the control
piston.



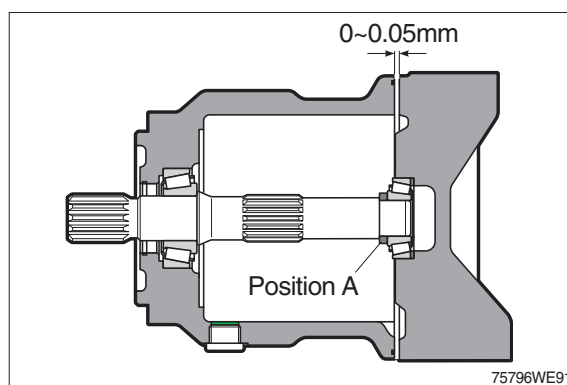
(12) Check :

Check running conditions of the opposite piston.



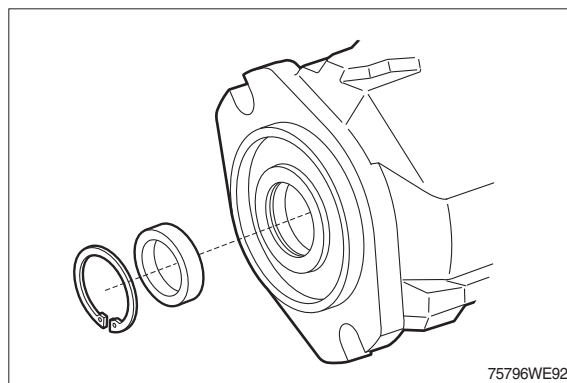
7) ADJUSTMENT OF TAPER ROLLER BEARING SET

- (1) Cast iron housing must have initial tension of the bearings: 0~0,05 mm, grind position A if necessary.

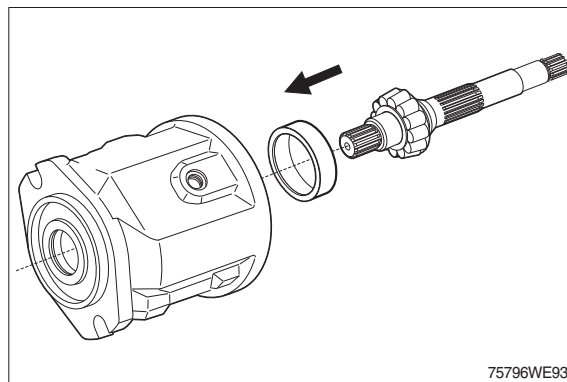


8) PUMP ASSEMBLY

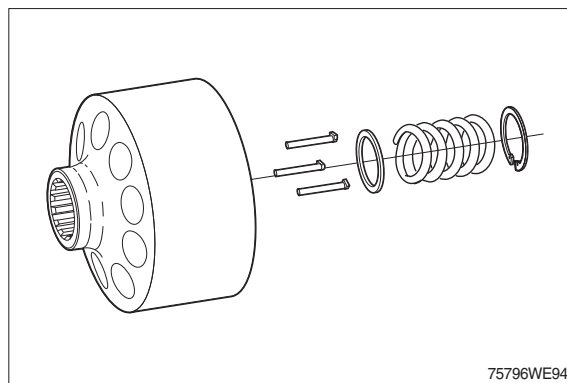
- (1) Fit the seal into the housing.
Fit the circlip.



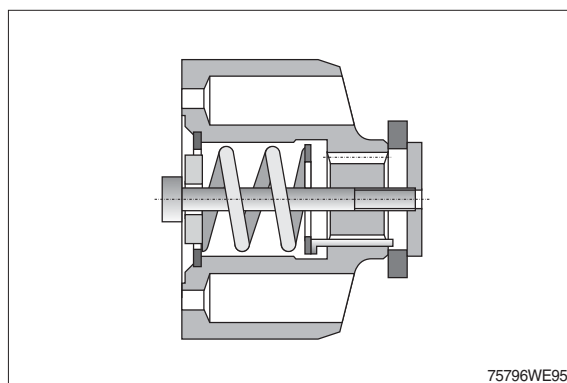
- (2) Fit the drive with bearing from rear end.
※ Do not touch seal lip with edge of keyway or spline.



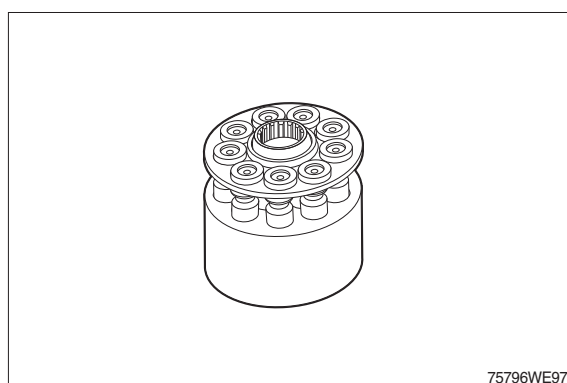
(3) Fit pressure pins using an assembly aid.



(4) Pre-tension the spring using a suitable device.

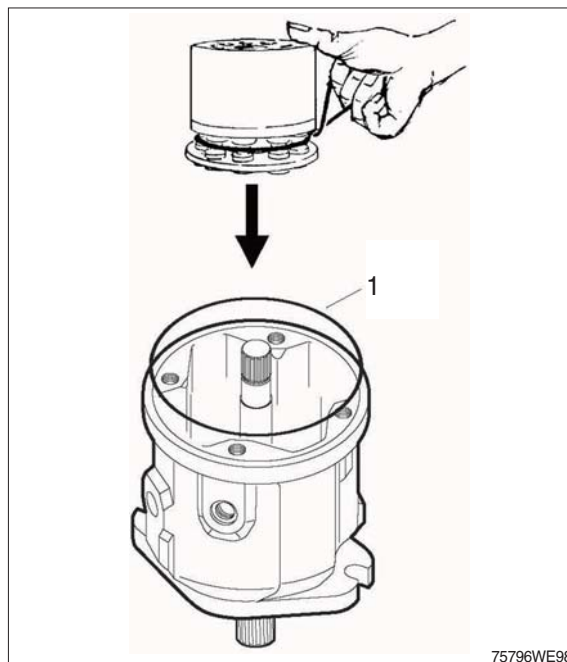


(5) Assemble piston with retaining plate.
※ Oil piston and slipper pad.



(6) Fit rotary group.

- ※ Hold the piston by using an O-ring.
Fit O-ring (1).



(7) Fit bearing (1) in connection plate.

Fit cylindrical pin (2).

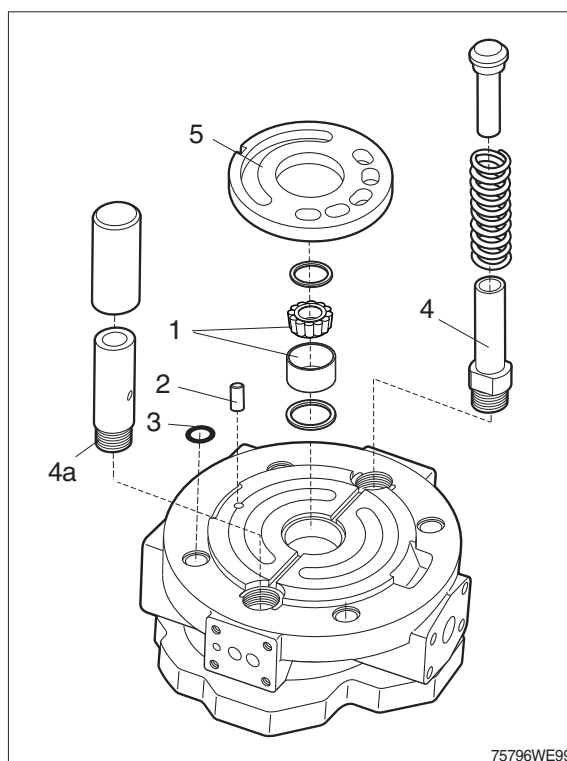
Fit O-rings (3) 4 pieces.

Fit adjustment spool (4) and guide piston (4a).

Fit distributor plate (5) (direction of rotation dependent)

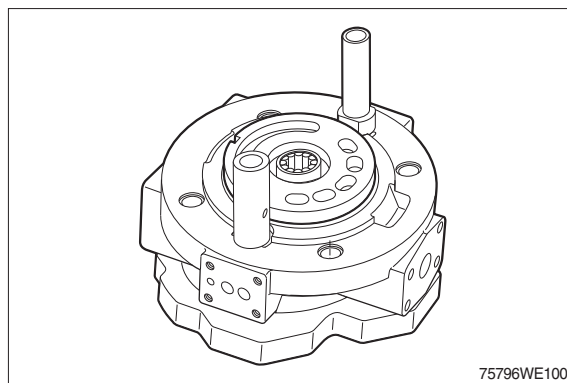
※ Assembly.

Hold the components in place with grease.



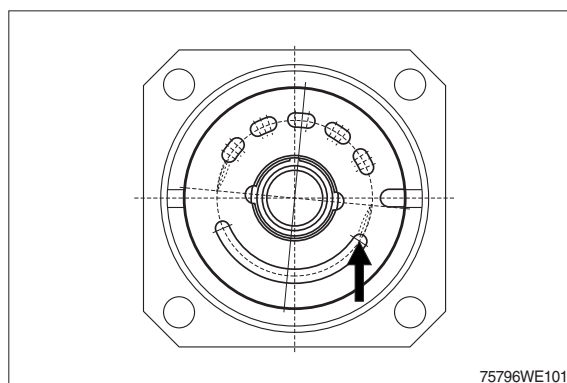
(8) Fit distributor plate.

※ Assembly aid : Grease

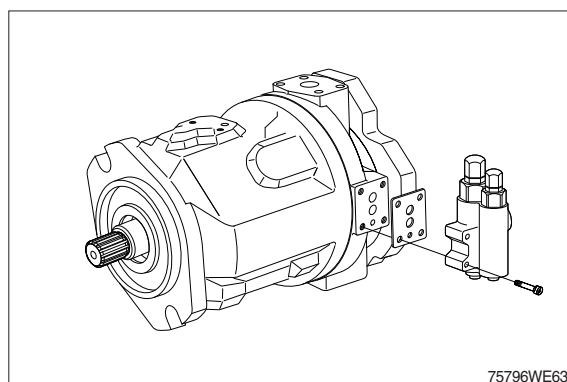


(9) For clockwise rotation pumps the distributor plate is off-set by 4° to the right from the centre position.

(Clockwise and anti-clockwise rotation distributor plates are not identical).



(10) Fit connection plate and control valve.



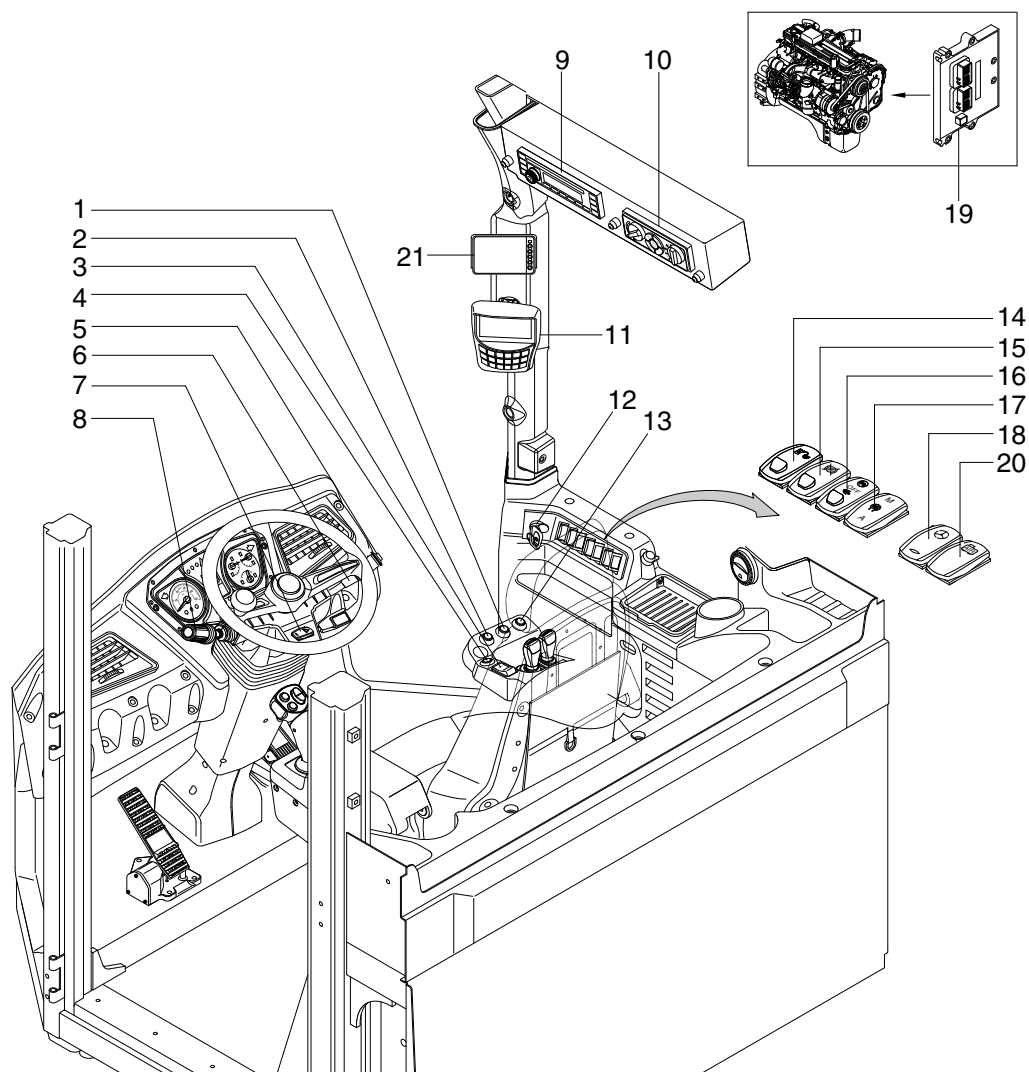
SECTION 7 ELECTRICAL SYSTEM

| | |
|--|-------|
| Group 1 Component Location | 7-1 |
| Group 2 Electrical Circuit | 7-3 |
| Group 3 Monitoring System | 7-22 |
| Group 4 Electrical Component Specification | 7-72 |
| Group 5 Connectors | 7-79 |
| Group 6 Troubleshooting | 7-100 |

SECTION 7 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

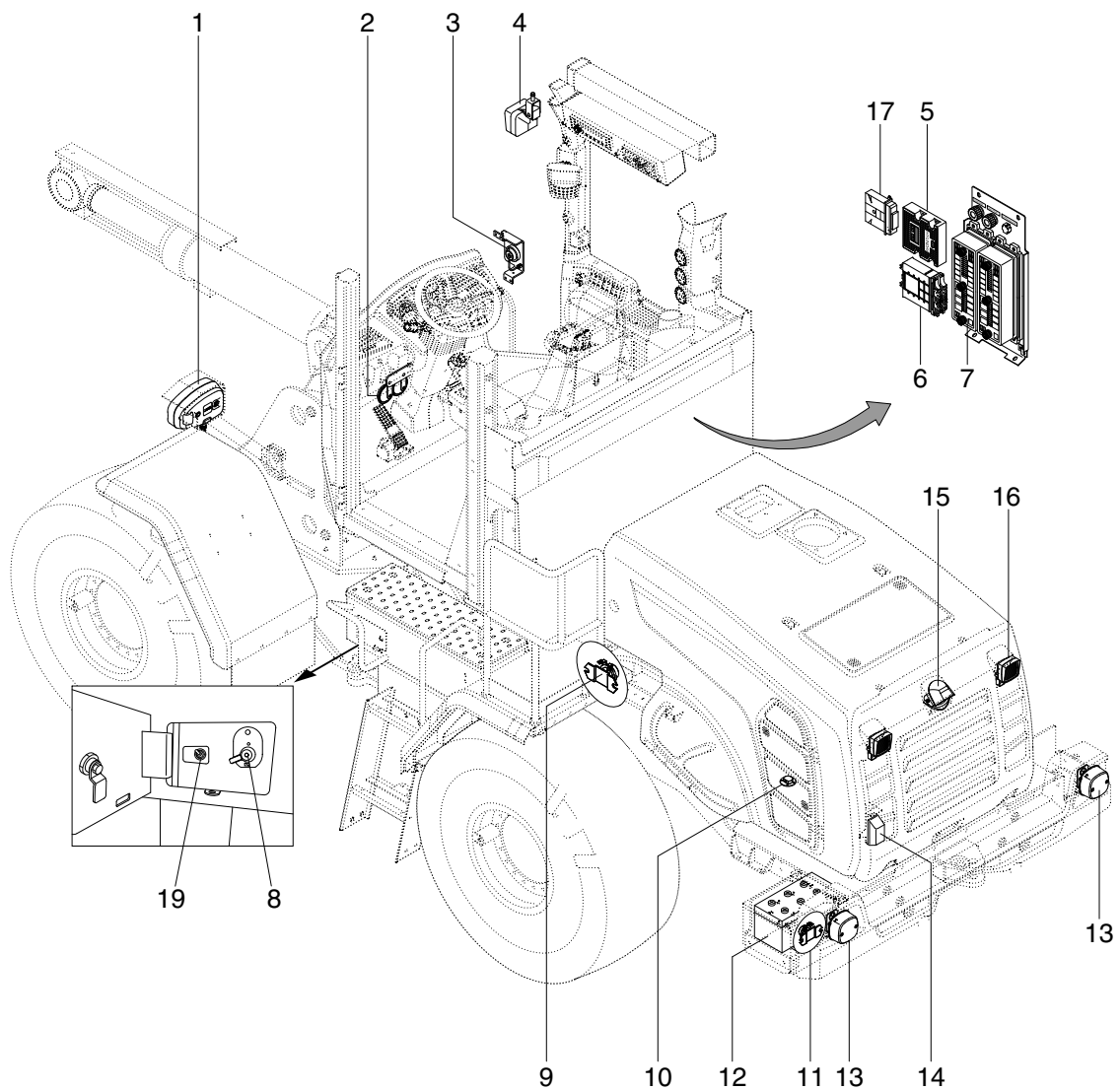
1. LOCATION 1



960A7EL20

- | | | |
|-------------------------|---------------------------|-----------------------------------|
| 1 Kick down button | 8 Gear select lever | 14 Pilot cut off switch |
| 2 Horn button | 9 Radio & USB player | 15 Parking brake switch |
| 3 FNR switch | 10 Aircon & heater switch | 16 SCR switch |
| 4 FNR select button | 11 Monitor | 17 Differential lock switch (opt) |
| 5 Hone button | 12 Starting switch | 18 Emergency test switch |
| 6 Multi function switch | Starting button (opt) | 19 Engine control unit (ECU) |
| 7 Hazard switch | 13 Work load button | 20 Air compressor switch (opt) |
| | | 21 Camera monitor |

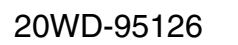
2. LOCATION 2



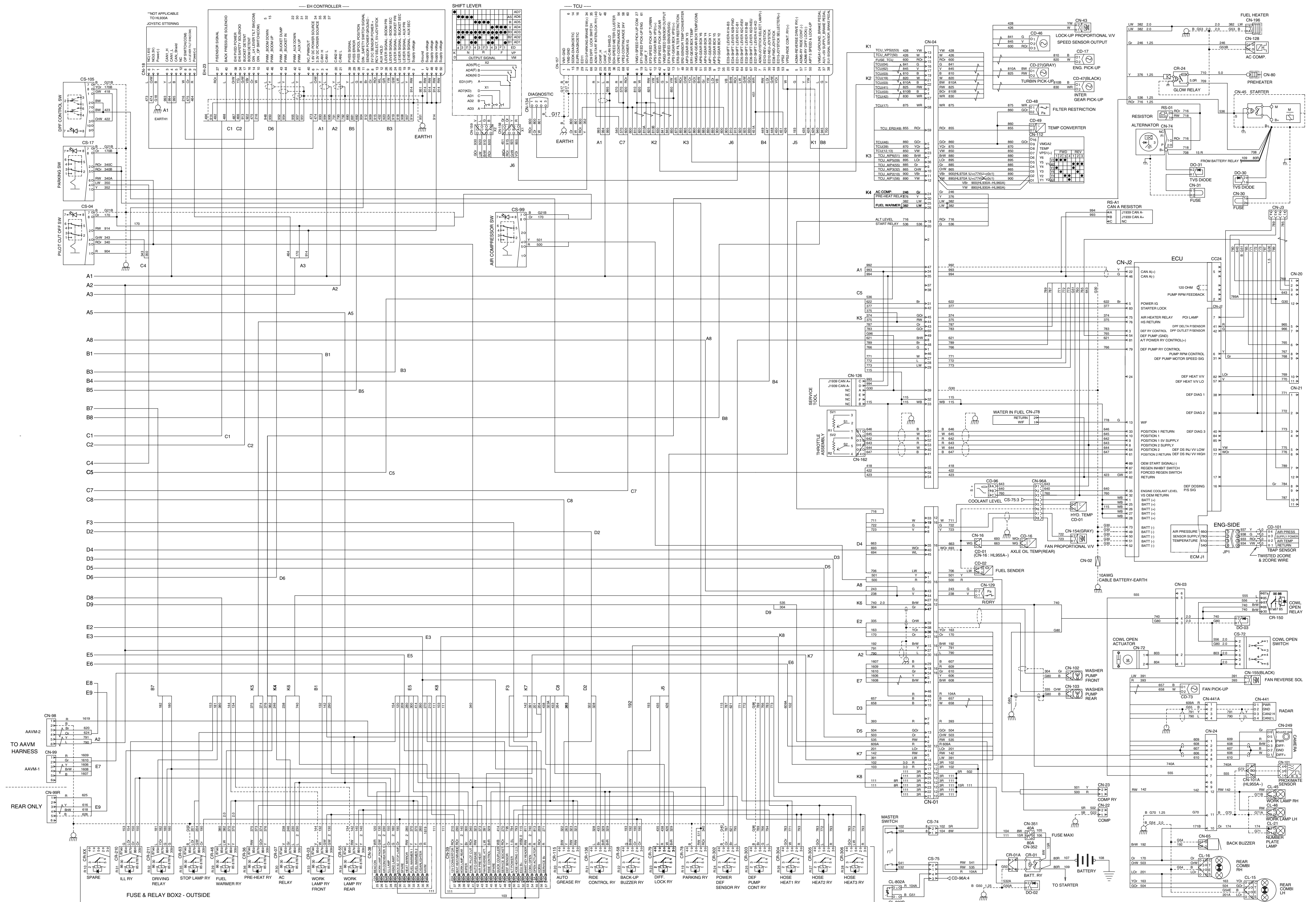
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- | | | |
|-----------------------------------|----------------------|---|
| 1 Head lamp | 8 Master switch | 15 Camera (opt) |
| 2 Horn | 9 Start relay | 16 Work lamp |
| 3 Angle sensor | 10 Fuel sender | 17 Control unit (electro hydraulic & joystick steering) |
| 4 Work lamp | 11 Battery relay | 19 Engine hood open switch |
| 5 Machine control unit (MCU) | 12 Battery | |
| 6 Transmission control unit (TCU) | 13 Rear combi lamp | |
| 7 Fuse and relay box | 14 Number plate lamp | |

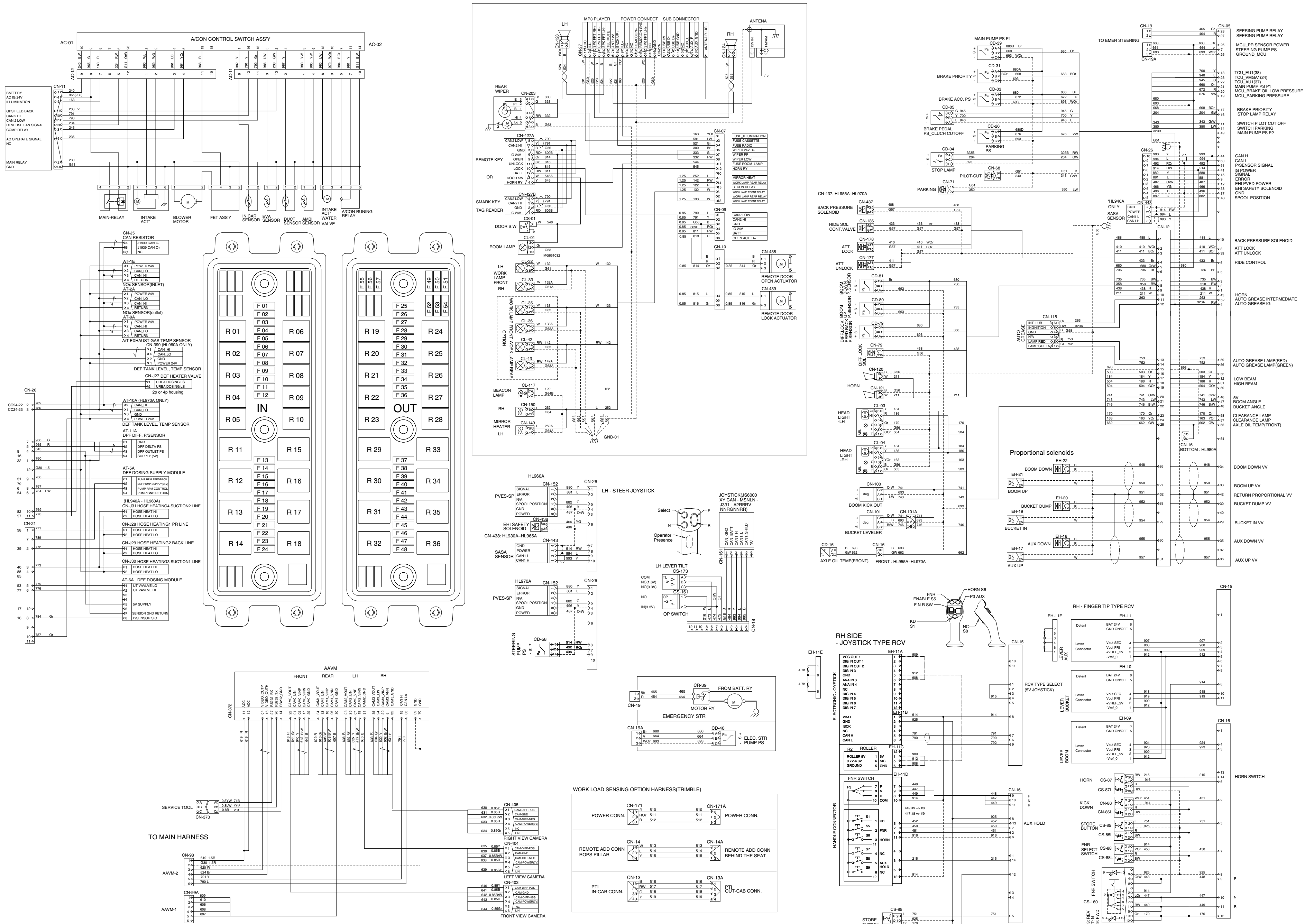
• ELECTRICAL CIRCUIT (1/3)



ELECTRICAL CIRCUIT (2/3)



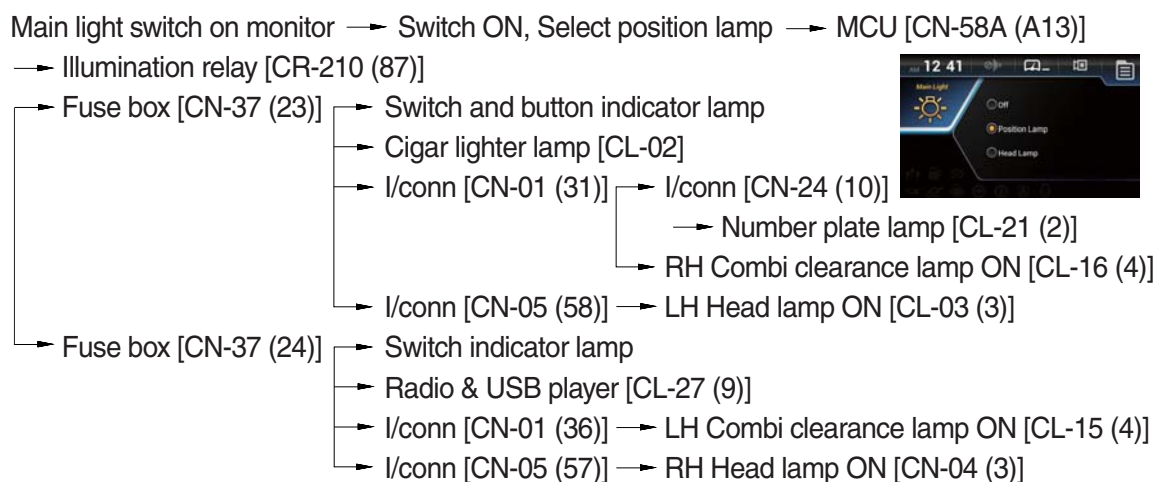
ELECTRICAL CIRCUIT (3/3)





1. ILLUMINATION CIRCUIT

1) OPERATING FLOW



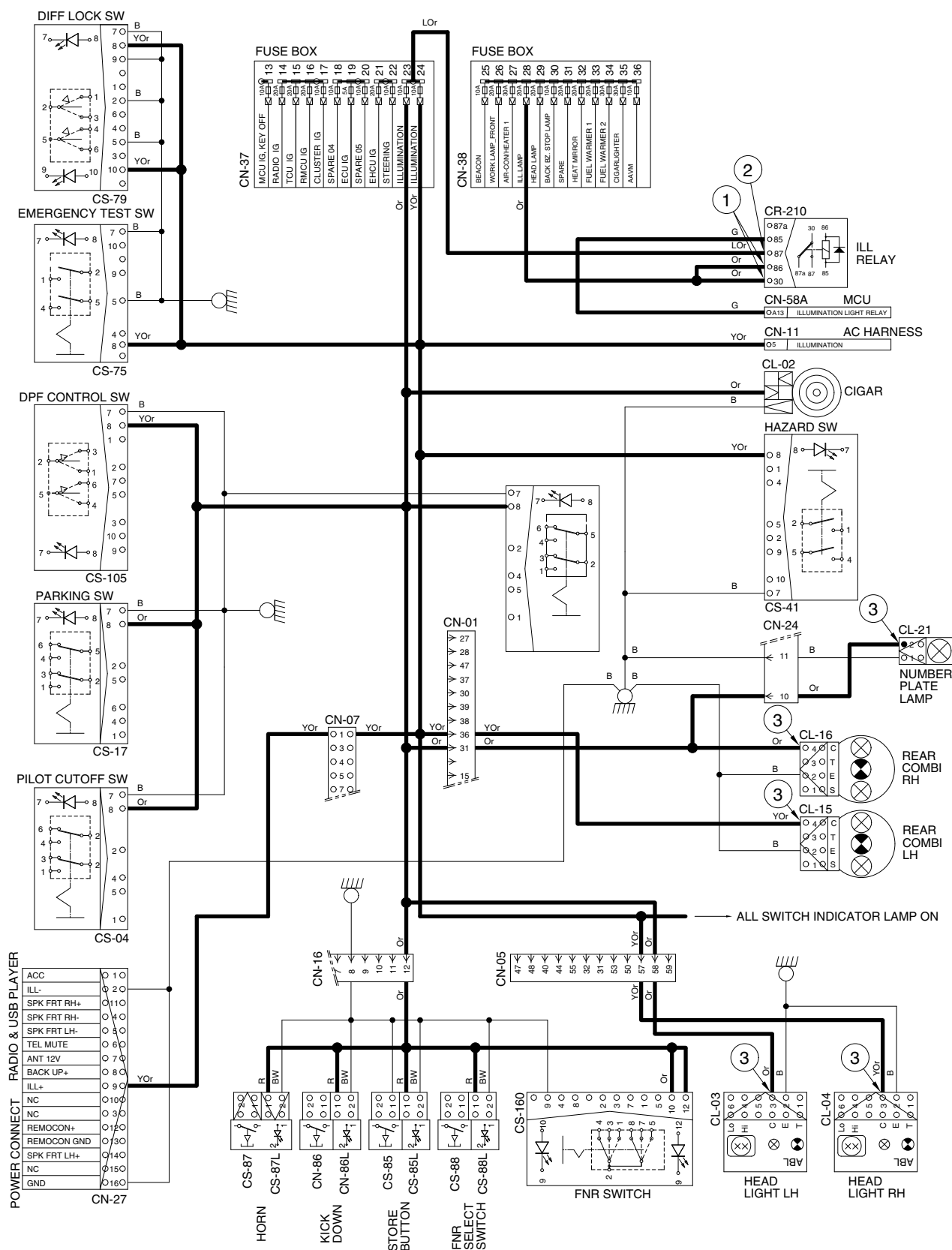
2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|--------|------------|---|---------|
| OFF | ON | ① - GND (relay input) ② - GND (relay output) ③ - GND (to light) | 20~25V |

※ GND : Ground

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

ILLUMINATION CIRCUIT

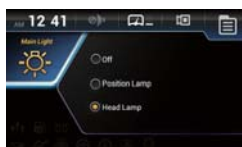
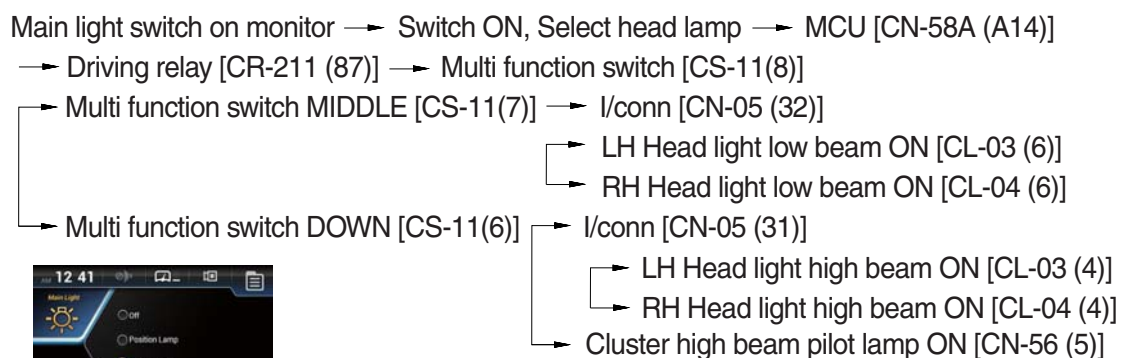


960A7EL04

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

2. HEAD LIGHT CIRCUIT

1) OPERATING FLOW



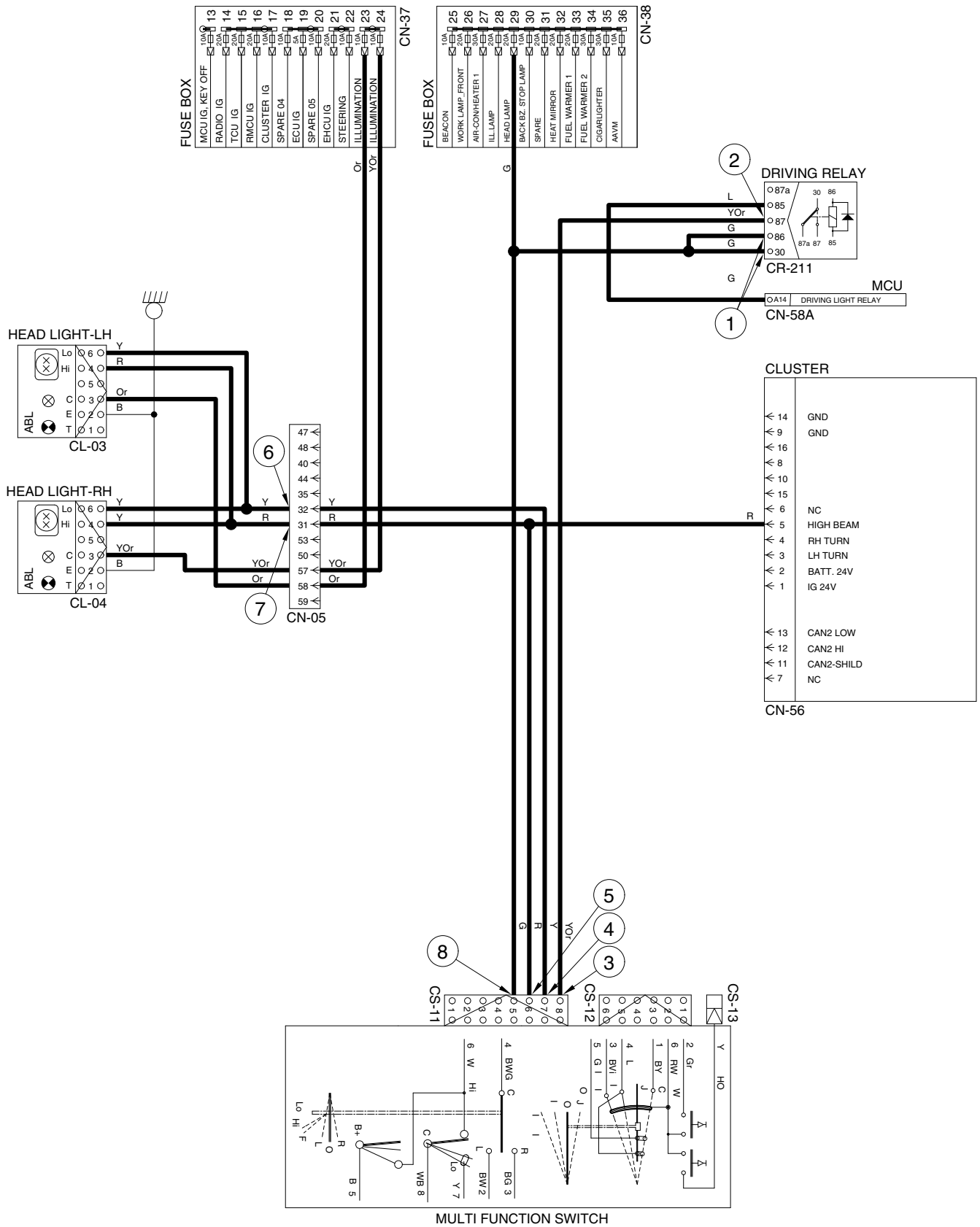
2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|--------|------------|---|---------|
| OFF | ON | ① - GND (relay input) ② - GND (relay output) ③ - GND (multi function input) ④ - GND (multi function output) ⑤ - GND (multi function output) ⑥ - GND (low beam) ⑦ - GND (high beam) ⑧ - GND (passing B ⁺) | 20~25V |

※ GND : Ground

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

HEAD LIGHT CIRCUIT



960A7EL05

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

3. WORK LIGHT SWITCH

1) OPERATING FLOW

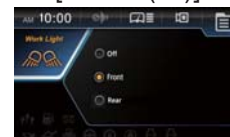
※ Main light switch on monitor : Select position lamp.

(1) Work lamp switch (select Front)

MCU [CN-58B (B09)] → Front work lamp relay [CR-03 (87)] → I/conn [CN-07 (06)]

→ LH Front work lamp ON [CL-32 (1)]

→ RH Front work lamp ON [CL-33 (1)]

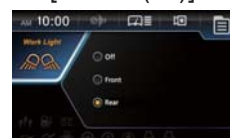


(2) Work lamp switch (select Rear)

MCU [CN-58B (B03)] → Rear work lamp relay [CR-55 (87)] → I/conn [CN-01 (05)]

→ I/conn [CN-24 (12)] → LH Rear work lamp ON [CL-46 (1)]

→ RH Rear work lamp ON [CL-45 (1)]



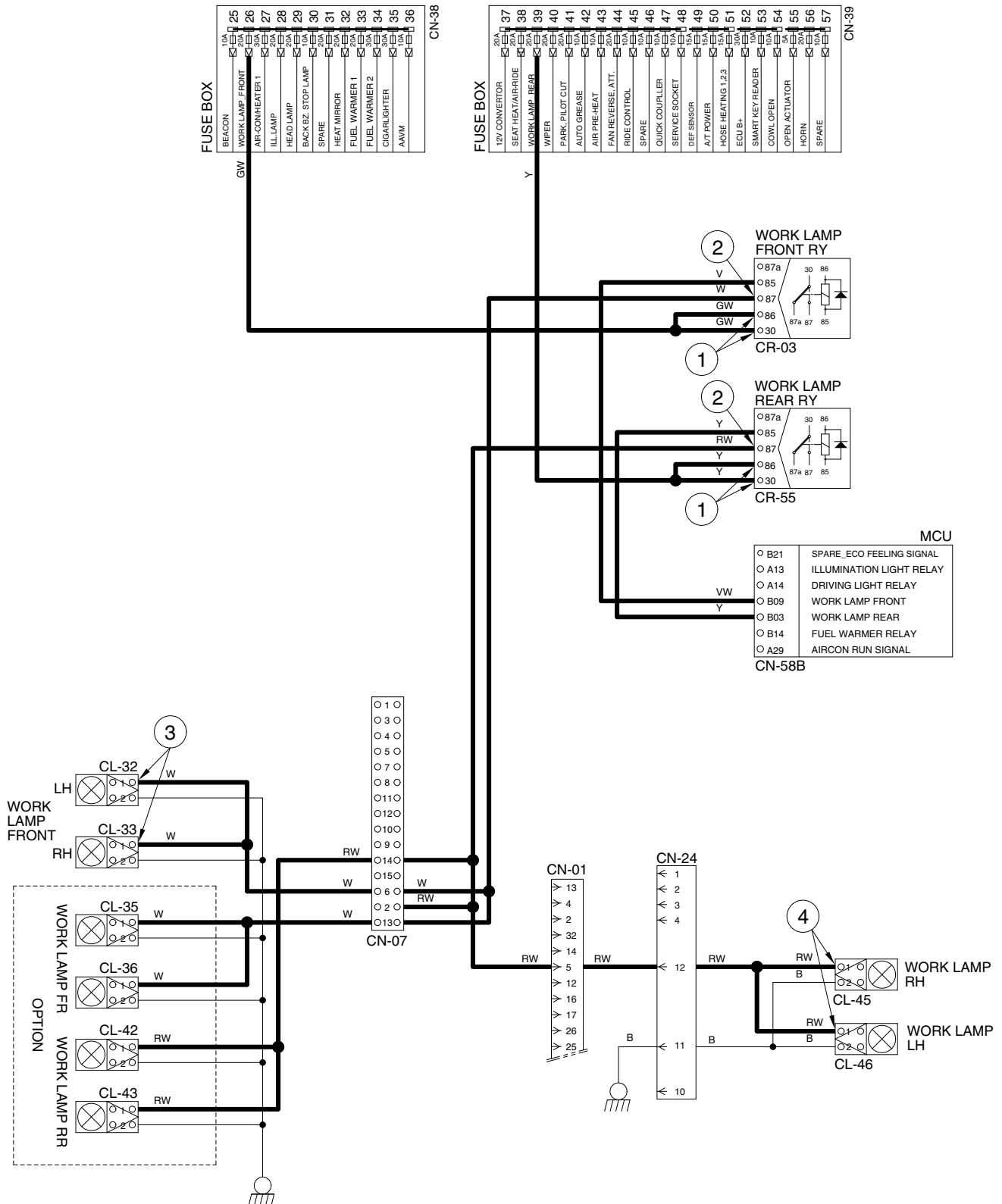
2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|--------|------------|--|---------|
| OFF | ON | ① - GND (work lamp power input) ② - GND (work lamp power output) ③ - GND (front work lamp) ④ - GND (rear work lamp) | 20~25V |

※ GND : Ground

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

WORK LIGHT SWITCH



960A7EL06

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

4. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Fusible link [CN-351 (40A)] → Master switch [CS-74 (1) → (2)]
 → I/conn [CN-01 (16, 17)] → Fuse box [CN-36] → Start switch [CS-02 (1)]
 → ECM power relay [CR-30 (30)]
 → Power relay [CR-35 (30)]

※ The gear selector lever is neutral position. It is necessary condition before the starting.

The gear selector has an output signal which is activated whenever the shift lever is in the neutral position. This signal can be used to control a relay and prevent engine from starting whenever the shift lever is not in the neutral position.

(1) When start key switch is in ON position

Start switch ON [CS-02 (2, 3)] → I/conn [CN-01(2)] → Master switch [CS-75 (1) → (2)]
 → Battery relay [CR-1]
 → Battery relay operating (All power is supplied with the electric component)
 → ECM power relay [CR-30 (30) → (87)] → Fuse box [CN-37 (19)]
 → I/conn [CN-04 (31)] → ECM [CN-J2 (5)]
 → Fuse box [CN-37 (13)] → MCU [CN-58A (A03)]
 → Power relay [CR-35 (30) → (87)] → Fuse box [CN-37 (15)]
 → TCU [CN-157 (45)]

(2) When start key switch is in START position

Start switch START [CS-2 (6)] → Start safety relay [CR-05 (30) → (87)] → I/conn [CN-04 (20)] →
 I/conn [CN-13(7)] → Start relay [CR-23] → Starter (terminal B⁺ and M connector of start motor)

2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---------|------------|--|---------|
| Running | ON | ① - GND (battery B ⁺) ② - GND (fusible link) ③ - GND (start key B terminal) ④ - GND (start key BR terminal) ⑤ - GND (i/conn CN-01 (16)) ⑥ - GND (start key C terminal) ⑦ - GND (start safety relay output) ⑧ - GND (start key ACC terminal) | 20~25 V |

※ GND : Ground

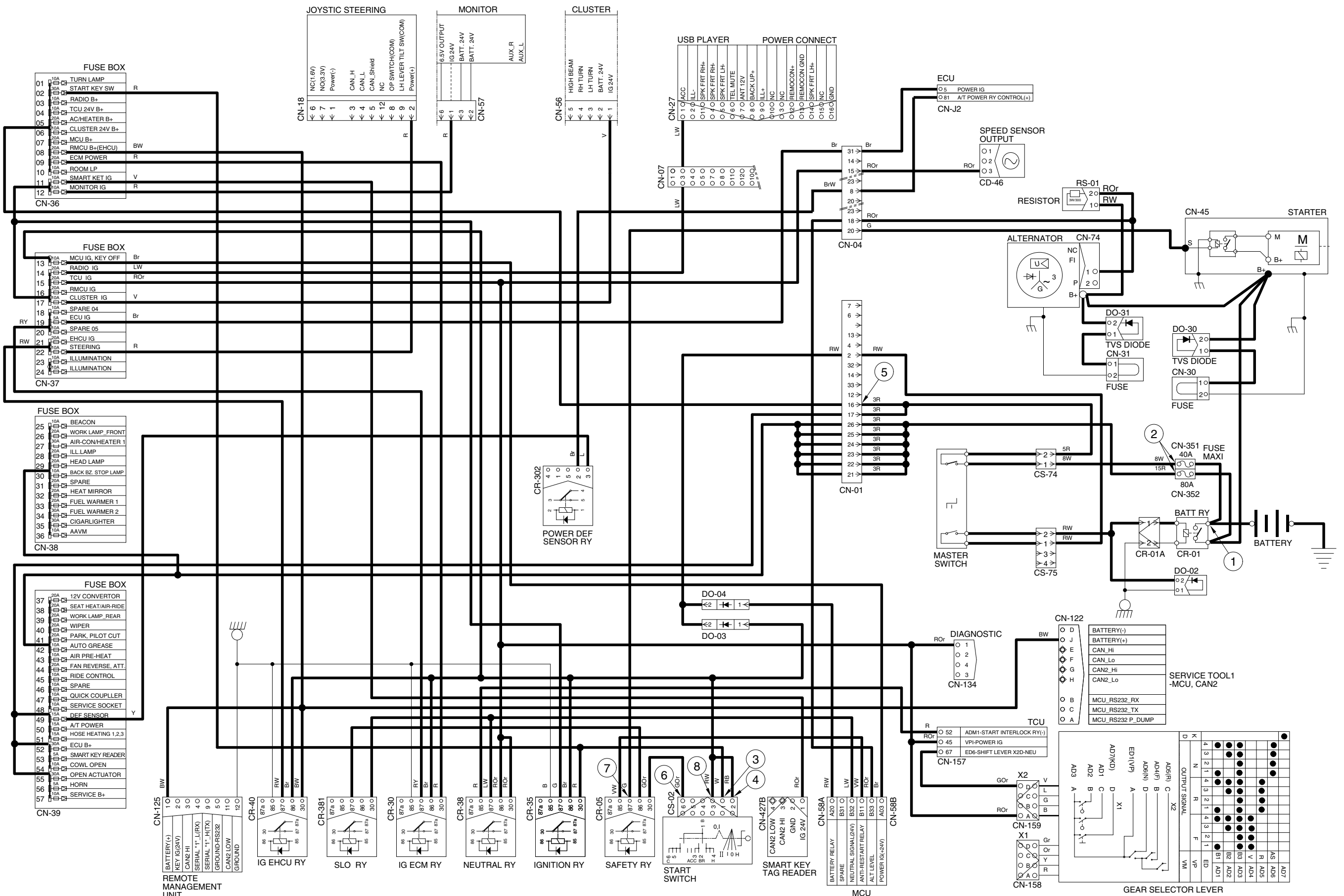
※ ECM : Electronic control module

※ MCU : Machine control unit

※ TCU : Transmission control unit

※ 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.

5. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator releases the key switch to the ON position.

Charging current generated by operating alternator flows into the battery through the battery relay (CR-01).

The current also flows from alternator to each electrical component and controller through the fuse box.

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (1)] → I/conn [CN-04 (18)] → MCU [CN-58B (B33)]

→ Cluster charge warning lamp ON

(2) Charging flow

Alternator → Starter [CN-45 (B⁺)] → Battery relay [CR-01]

→ Battery (+) terminal → Charging

→ Fusible link [CN-351 (40A)] → Master switch [CS-74 (1)→(2)] → I/conn [CN-01 (16, 17)]
→ Fuse box [CN-36, 39]

→ Fusible link [CN-352 (80A)] → I/conn [CN-01 (21~26)] → Fuse box [CN-38, 39]

2) CHECK POINT

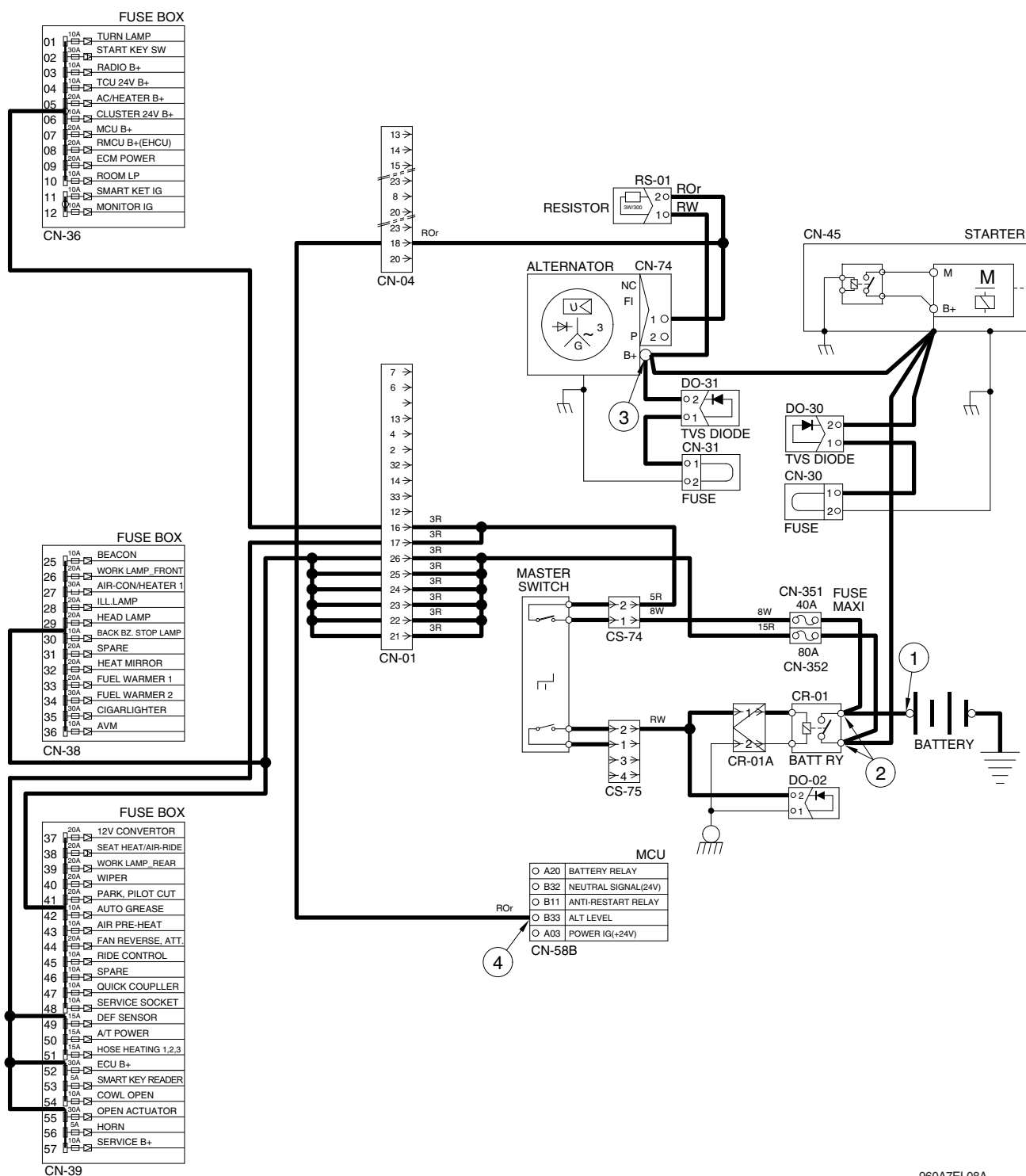
| Engine | Key switch | Check point | Voltage |
|--------|------------|---|---------|
| OFF | ON | ① - GND (battery) ② - GND (battery relay) ③ - GND (alternator B ⁺) ④ - GND (MCU) | 20~28V |

※ GND : Ground

※ MCU : Machine control unit

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

CHARGING CIRCUIT



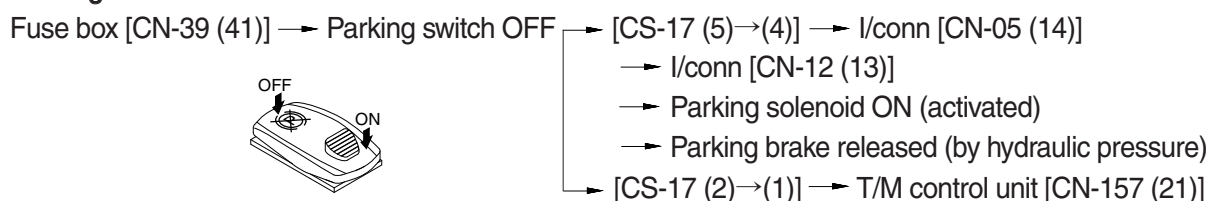
960A7EL08A

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

6. ELECTRIC PARKING, PILOT CUT OFF CIRCUIT

1) OPERATING FLOW

(1) Parking OFF



(2) Parking ON

Fuse box [CN-39 (41)] → Parking switch ON → Parking solenoid [CN-71] OFF
 → Parking brake applied [By spring force]

(3) Pilot cut off ON

Fuse box [CN-39 (41)] → Pilot cut off switch ON → Pilot cut off switch [CS-4 (5) → (4)]
 → I/conn [CN-05 (11)] → I/conn [CN-12 (12)] → Pilot cut off solenoid ON [CN-68] (activate)
 → Pilot cut off released

(4) Pilot cut off OFF

Fuse box [CN-39 (41)] → Pilot cut off switch OFF → Pilot cut off solenoid [CN-68] OFF
 → Pilot cut off applied

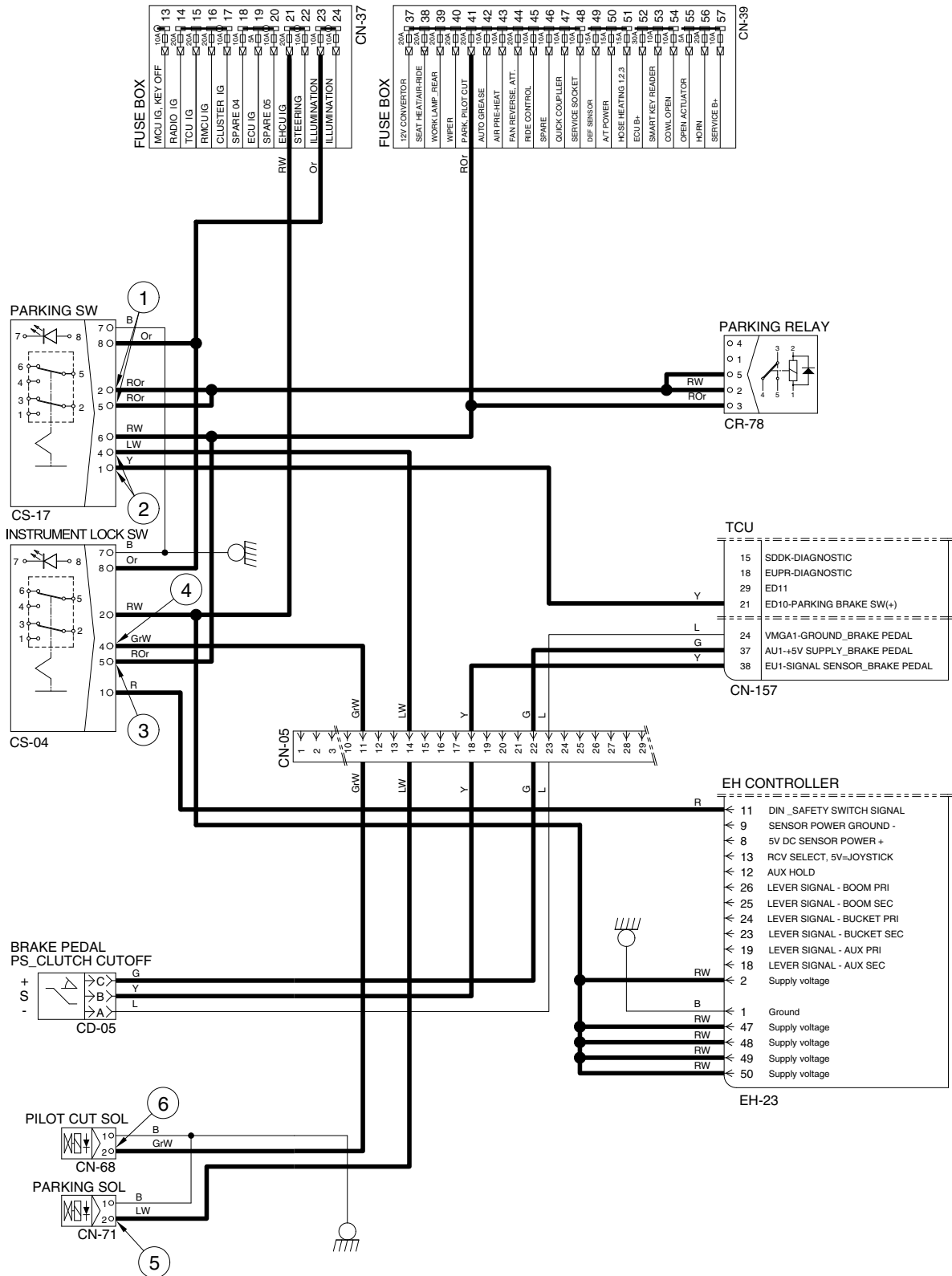
2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---------|------------|--|---------|
| Running | ON | ① - GND (parking switch input) ② - GND (parking switch output) ③ - GND (pilot cut off switch input) ④ - GND (pilot cut off switch output) ⑤ - GND (parking solenoid) ⑥ - GND (pilot cut off solenoid) | 20~25V |

※ GND : Ground

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

ELECTRIC PARKING, PILOT CUT OFF CIRCUIT

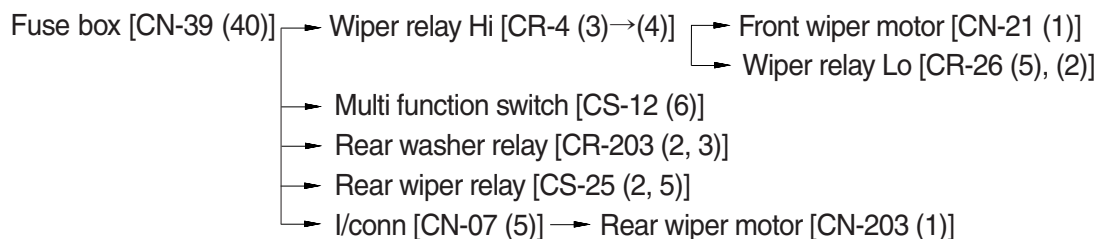


960A7EL09A

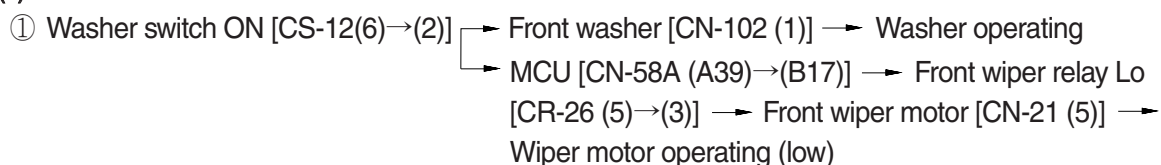
※ The circuit diagram may differ from the equipment, so please check before a repair.

7. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

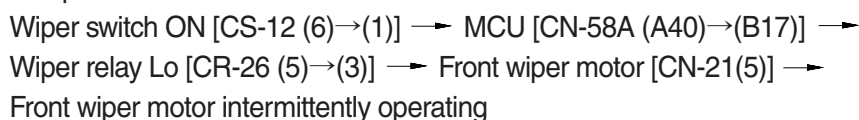


(1) Front washer switch ON

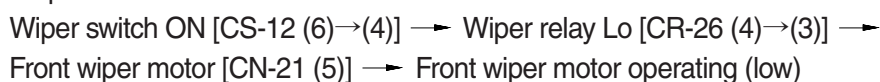


(2) Front wiper switch ON

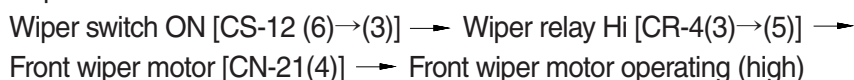
① INT position



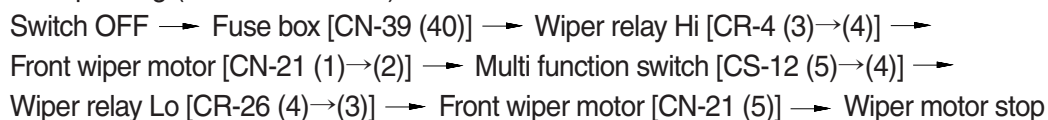
② Lo position



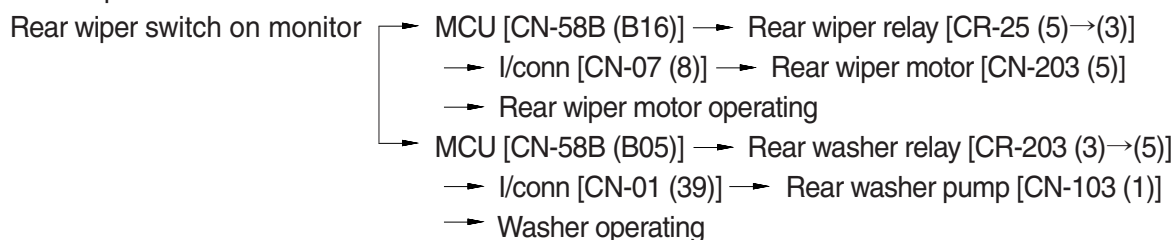
③ Hi position



(3) Auto-parking (when switch OFF)



(4) Rear wiper and washer switch



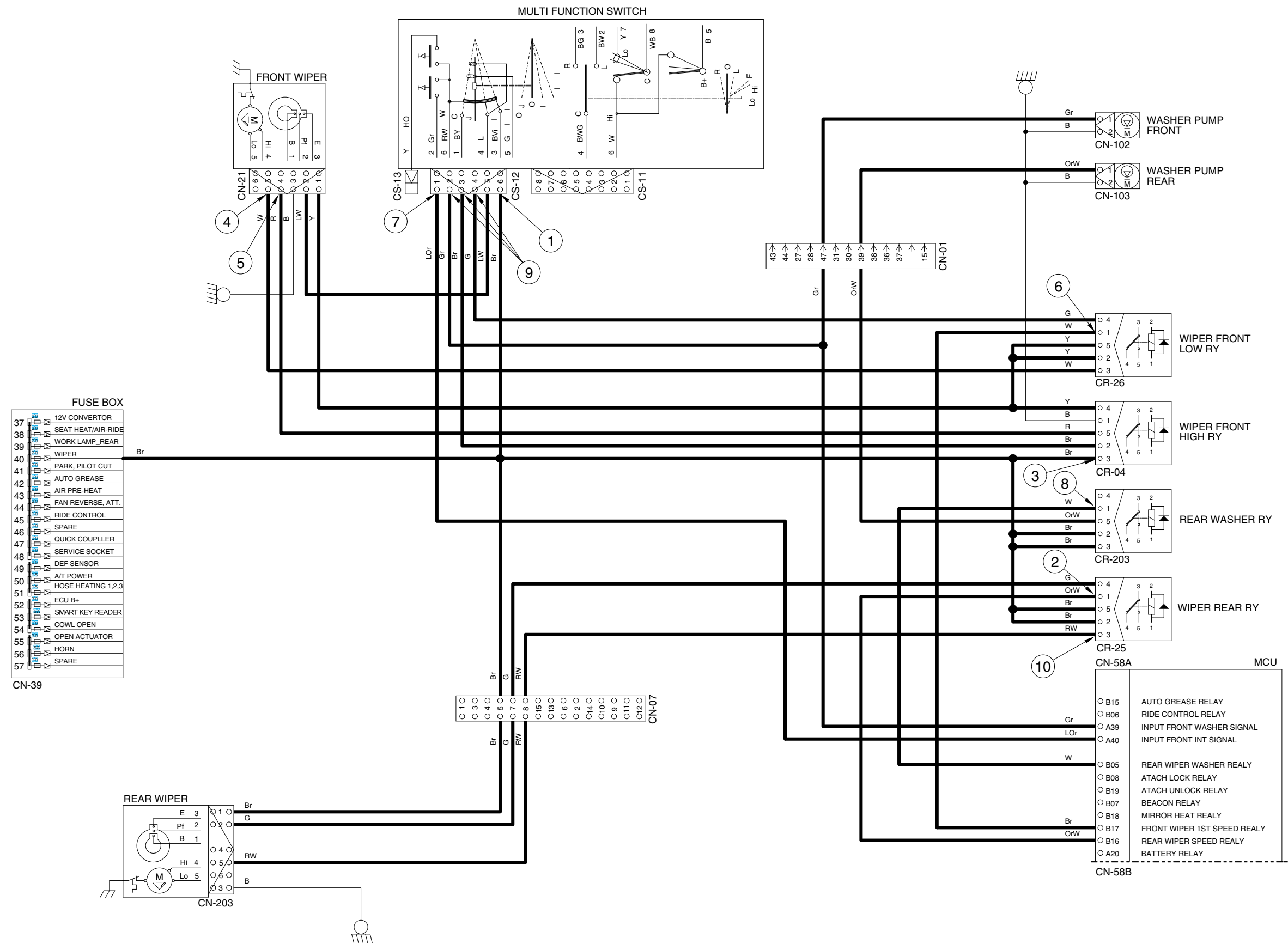
2) CHECK POINT

| Condition | Check point | |
|--|--|--|
| Engine : Stop Key switch : ON Voltage : 20~25V | ① - GND (front wiper switch power input) | ⑥ - GND (wiper relay power input) |
| | ② - GND (rear wiper relay power input) | ⑦ - GND (front washer power output) |
| | ③ - GND (wiper relay power input) | ⑧ - GND (rear washer power output) |
| | ④ - GND (front wiper motor Lo power input) | ⑨ - GND (front wiper motor power output) |
| | ⑤ - GND (front wiper motor High power input) | ⑩ - GND (rear wiper motor power output) |

※ GND : Ground

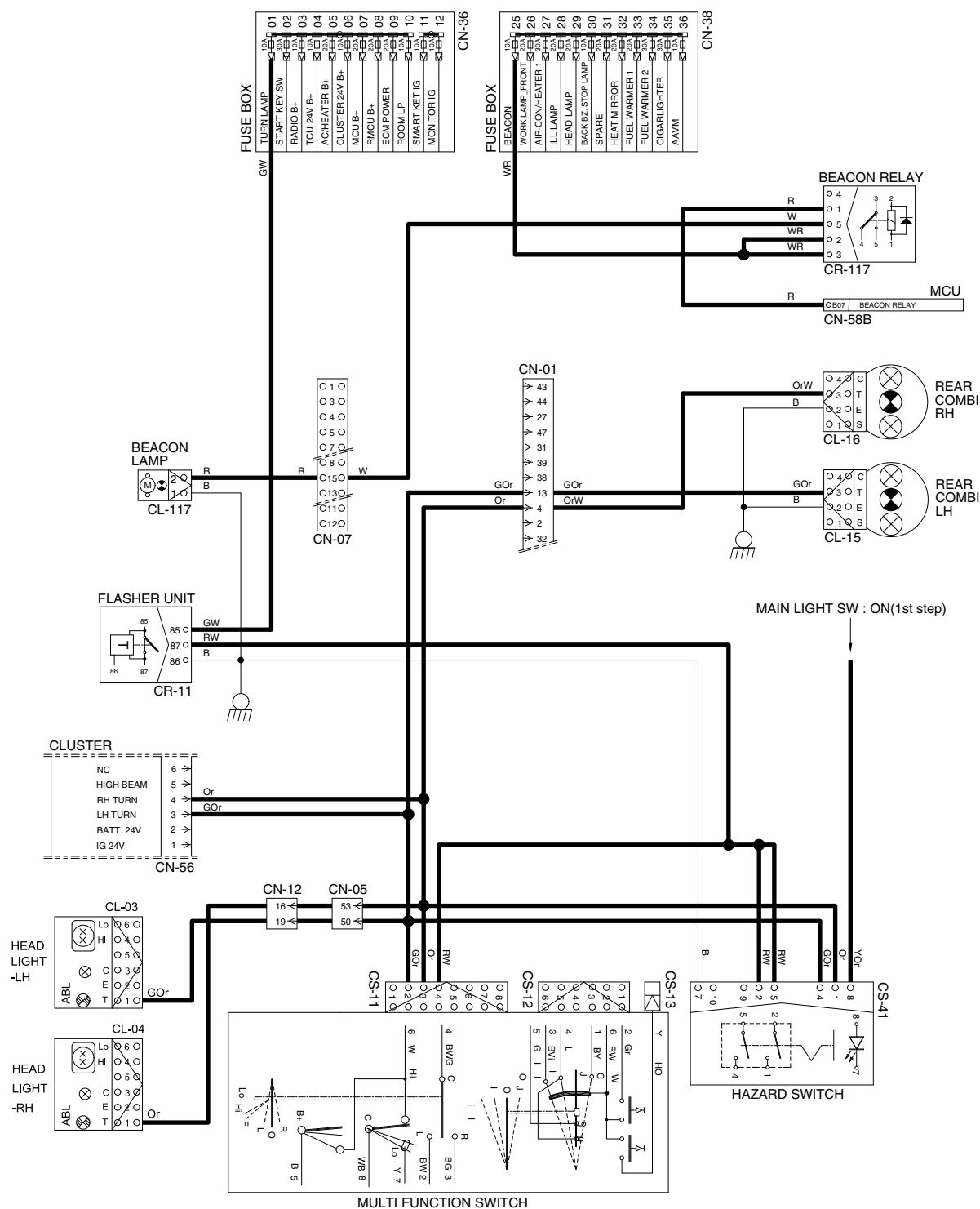
※ The circuit diagram may differ from the equipment, so please check before a repair.

WIPER AND WASHER CIRCUIT



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

HAZARD, TURN AND ROTARY CIRCUIT



960A7EL11

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

GROUP 3 MONITORING SYSTEM

1. CLUSTER

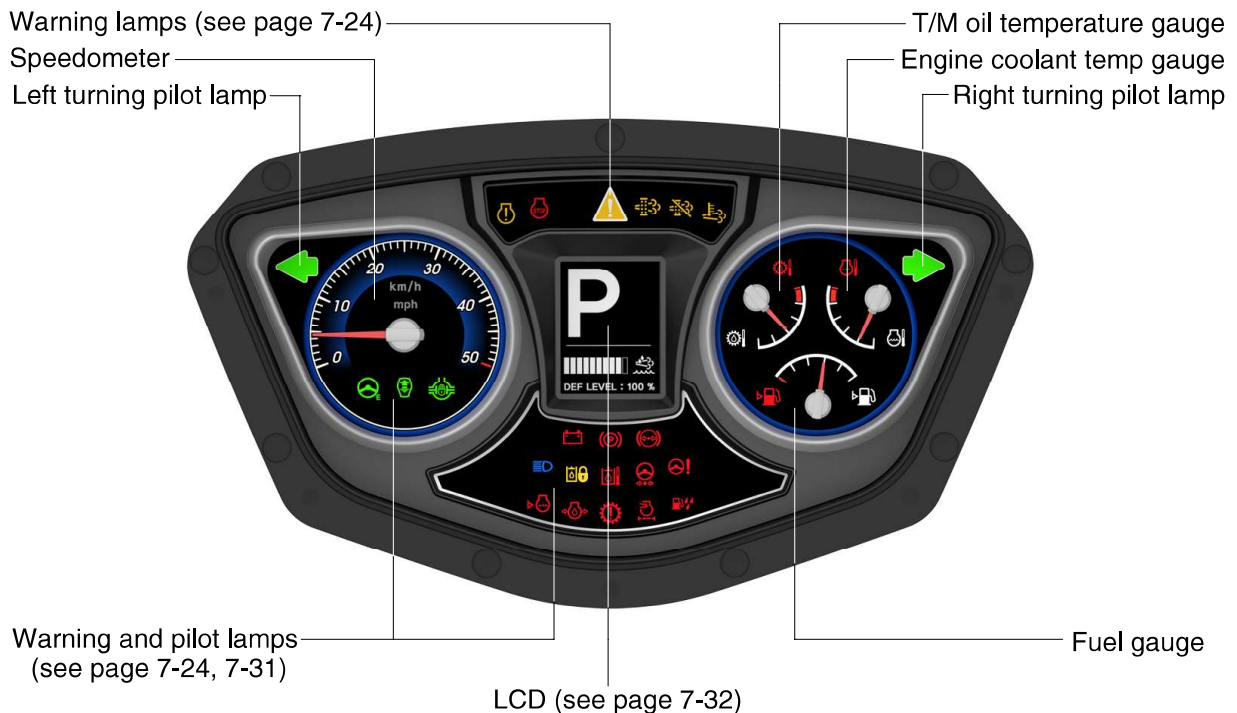
1) STRUCTURE

The cluster consists of gauges, lamps and LCD as shown below, to warn the operator in case of abnormal machine operation or conditions for the appropriate operation and inspection.

- Gauges : Indicate operating status of the machine.
- Warning lamps : Indicate abnormality of the machine.
- Pilot lamps : Indicate operating status of the machine.
- LCD : Indicates selected the driving speed and direction.

※ The cluster installed on this machine does not entirely guarantee the condition of the machine. Daily inspection should be performed according to chapter 6, MAINTENANCE.

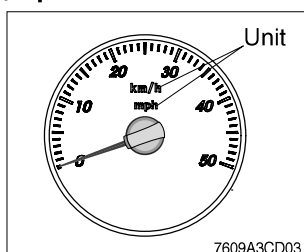
※ When the cluster provides a warning immediately check the problem, and perform the required action.



960A7EL50

2) GAUGE

(1) Speedometer

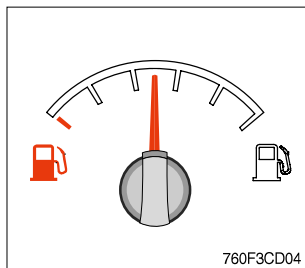



① The speedometer displays the speed of machine in mph and km/h.

※ The unit (km/h or mph) can be set by the display set up menu of the monitor and selected unit is displayed.

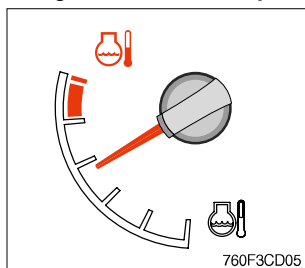
Refer to page 7-55.


(2) Fuel gauge



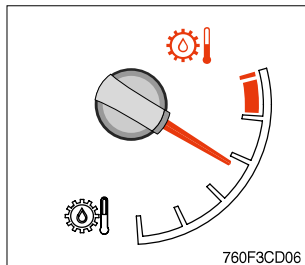
- ① This gauge indicates the amount of fuel in the fuel tank.
- ② Fill the fuel when the indicator moves red range or  lamp blinks in red, refuel as soon as possible to avoid running out of fuel.
- ※ If the gauge indicates red range even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.


(3) Engine coolant temperature gauge



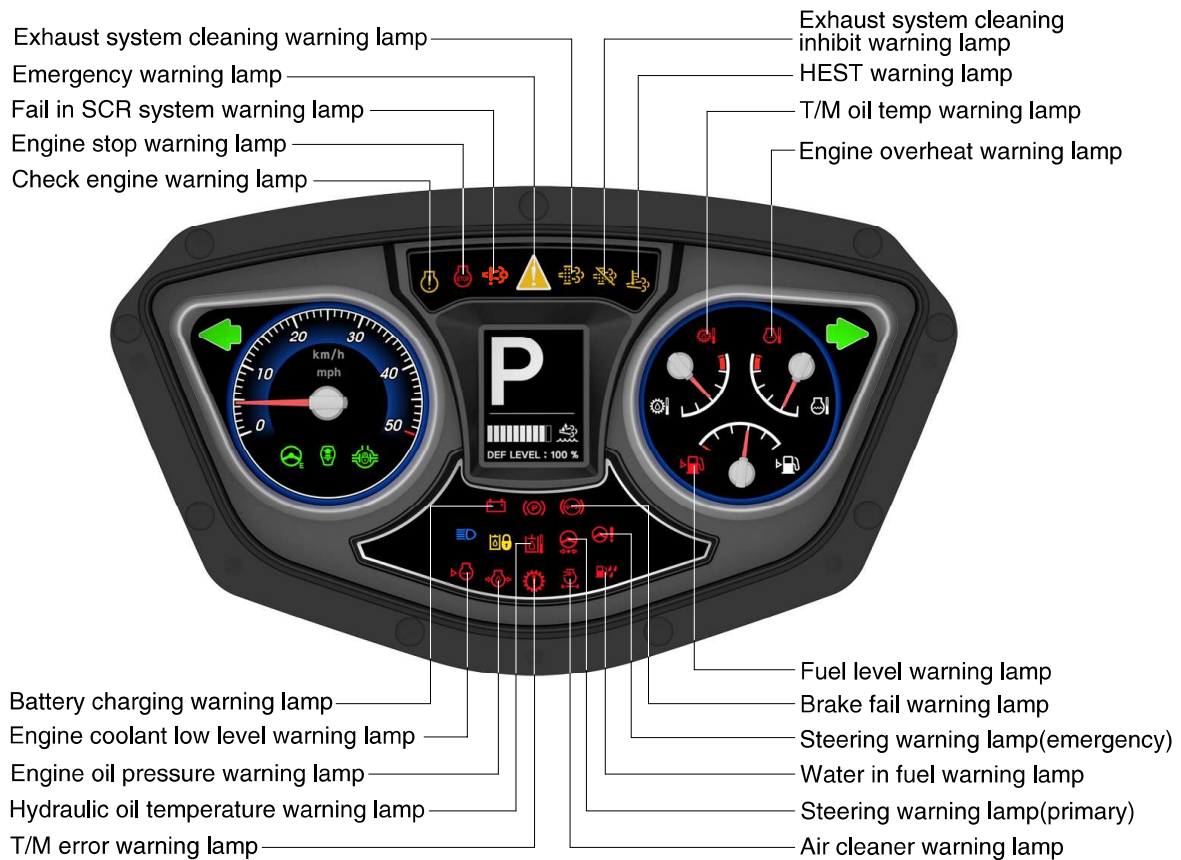
- ① This gauge indicates the temperature of coolant.
 - White range : 40~105°C (104~221°F)
 - Red range : Above 105°C (221°F)
- ② If the indicator is in the red range or  lamp blinks in red, turn OFF the engine and check the radiator and engine.
- ※ If the gauge indicates red range even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.

(4) Transmission oil temperature gauge



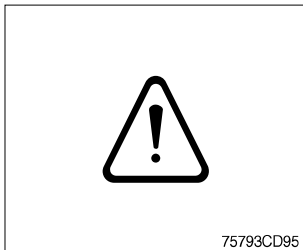
- ① This gauge indicates the temperature of transmission oil.
 - White range : 40~107°C (104~225°F)
 - Red range : Above 107°C (225°F)
- ② If the indicator is in the red range or  lamp blinks in red, it means the transmission is overheated. Be careful that the indicator does not move into the red range.
- ※ If the gauge indicates red range even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.

3) WARNING LAMPS



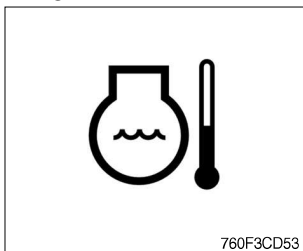
960A3CD09A

(1) Emergency warning lamp



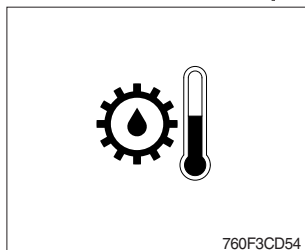
- ① This lamp blinks when each of the below warnings is happened.
 - Warning lamps light ON
 - MCU input voltage abnormal
 - Monitor communication data error
 - Engine ECM and TCU communication data error
- ② When this warning lamp blinks, machine must be checked and service immediately.

(2) Engine overheating warning lamp



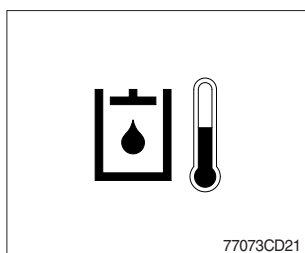
- ① This lamp is turned ON when the temperature of coolant is over the normal temperature (105°C, 221°F).
- ② Check the cooling system when the lamp is ON.


(3) Transmission oil temperature warning lamp



- ① This lamp is turned ON when the temperature of transmission oil is over the normal temperature (107°C, 225°F).
- ② When this lamp lights up during operation, stop the engine and check the machine.

(4) Hydraulic oil temperature warning lamp



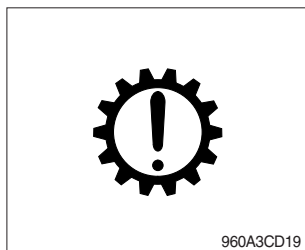
- ① This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 106°C (223°F).
 - ② Check the hydraulic oil level when the lamp is turned ON and the buzzer sounds.
 - ③ Check for debris between oil cooler and radiator.
- ※ If you want to stop buzzer sound, just touch the  icon.

(5) Fuel level warning lamp



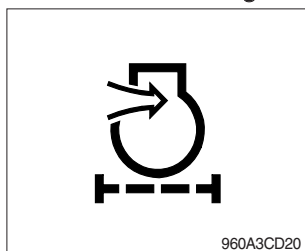
- ① This warning lamp lights ON when the fuel level is low. Refuel the machine as soon as possible.


(6) Transmission error warning lamp



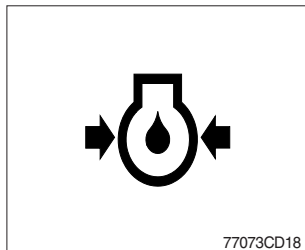
- ① This lamp lights ON and the LCD display show the error codes when an error occurs in the transmission.
 - ② Immediately pull the machine to a convenient stop. Stop the engine. Investigate the cause.
- ※ Consult a HD Hyundai Construction Equipment dealer to investigate the cause.
- ※ Do not operate until the cause has been corrected.


(7) Air cleaner warning lamp



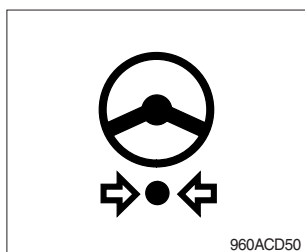
- ① This lamp lights ON and the buzzer sounds when the filter of air cleaner is clogged.
 - ② When the air cleaner warning lamp is ON and the buzzer sounds, check and clean the primary element.
- ※ If you want to stop buzzer sound, just touch the  icon.
- ※ The primary element should be replaced if the warning lamp is ON after installation of a clean primary element.
- ※ Replace the primary element after 4 times cleanings.

(8) Engine oil pressure warning lamp




- ① This lamp is comes ON and the buzzer sounds after starting the engine because of the low engine oil pressure.
- ② If the lamp comes ON and the buzzer sounds during engine operation, shut OFF engine immediately. Check engine oil level.
- ※ If you want to stop buzzer sound, just touch the  icon.

(9) Steering warning lamp



① Primary

This lamp indicates that the primary steering has failed. When the indicator comes ON and the action alarm sounds, steer the machine immediately to a convenient location and stop the machine. Stop the engine and investigate the cause.

- ※ If you want to stop buzzer sound, just touch the  icon.
- ※ Do not operate the machine until the cause has been corrected.

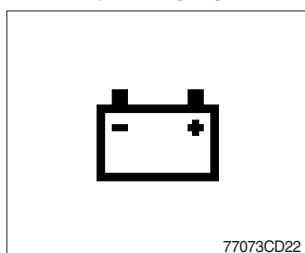



② Emergency

This lamp indicates the emergency steering system is active.

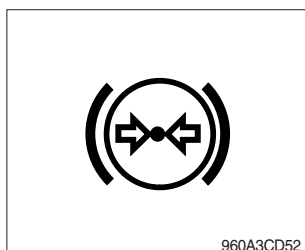
- ※ Immediately pull the machine to a convenient stop and stop the engine.
- ※ The emergency steering system can be manually tested. Refer to page 7-68.


(10) Battery charging warning lamp



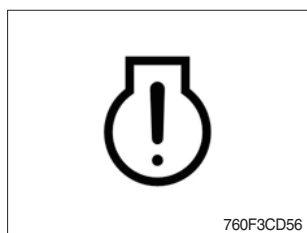
- ① This lamp is ON and the buzzer sounds when key ON, it is turned OFF after starting the engine.
- ② Check the battery charging circuit when this lamp comes ON and the buzzer sounds, during engine operation.
- ※ If you want to stop buzzer sound, just touch the  icon.

(11) Brake fail warning lamp



- ① The lamp lights ON and the buzzer sounds when the oil pressure of service brake drops below the normal range.
- ② When the lamp is ON and the buzzer sounds, stop the engine and check for its cause.
- ※ If you want to stop buzzer sound, just touch the  icon.
- ※ Do not operate until any problems are corrected.

(12) Check engine warning lamp



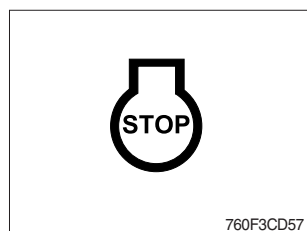
① This lamp lights ON and the buzzer sounds when the communication between MCU and engine ECM on the engine is abnormal, or if the cluster received specific fault code from engine ECM.

② Check the communication line between them.

If the communication line is OK, then check the fault codes on the monitor.

※ If you want to stop buzzer sound, just touch the  icon.

(13) Engine stop warning lamp



① This warning lamp pops up and the buzzer sounds when 30 minutes elapsed with empty condition of the DEF/AdBlue® tank, stop the engine immediately and check the DEF/AdBlue® tank.

② Fill the DEF/AdBlue® immediately in the DEF/AdBlue® tank.

※ Refer to page 7-30.

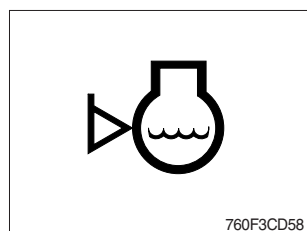
③ This lamp lights ON when the stationary exhaust system cleaning is not performed.

※ Refer to page 7-28.

※ Please contact your HD Hyundai Construction Equipment service center or local dealer.

※ "Engine shutdown" cluster message up when the exhaust gas temperature reaches above 800°C.

(14) Engine coolant low level warning lamp



① This warning lamp lights ON when the level of coolant is low.

② Fill the coolant immediately when the lamp is ON.

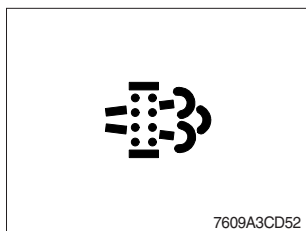
(15) Water in fuel warning lamp






① This warning lamp lights ON when the water separator is full of water or malfunctioning.

※ When this lamp lights ON, stop the machine and spill water out of the separator.

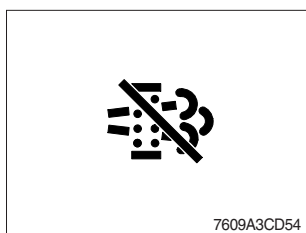
(16) Exhaust system cleaning warning lamp



- ① This warning lamp lights ON or blinks when the exhaust system cleaning is needed as table below.

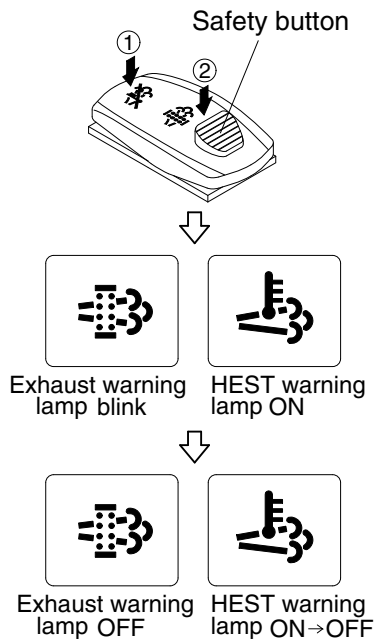
| Warning lamp | | | Description |
|---|---|---|--|
| Exhaust | Check engine | Stop engine | |
|  |  |  | |
| Off | Off | Off | · Automatic exhaust system cleaning |
| Blink | Off | Off | · The status of a manual (stationary) exhaust system cleaning when the exhaust system cleaning switch has been activated. ※ Refer to page 7-29. |
| On | On | Off | · The aftertreatment exhaust system needs to be cleaned immediately. · Engine power will be reduced automatically if action is not taken. ※ The exhaust system cleaning can be accomplished by : - Changing to more challenging duty cycle. - Performing a manual exhaust system cleaning. |
| On | On | On | · These lamps will be ON when a stationary (manual) exhaust system cleaning is not performed. · Stop the engine immediately. · Please contact your HD Hyundai Construction Equipment service center or local dealer. |

(17) Exhaust system cleaning inhibit warning lamp



- ① This warning lamp indicates, when illuminated, the exhaust system cleaning switch is pushed inhibit position, therefore automatic and manual exhaust system cleaning can not occur.
※ Refer to the page 7-69 for the exhaust system cleaning switch.

※ Manual exhaust system cleaning



9753CD129A

※ Manual exhaust system cleaning applies if the machine is in a fireproof area.

※ To stop a manual exhaust system cleaning before it has completed, set the exhaust system cleaning switch to the inhibit position or turn OFF the engine.

① Stop and park the machine.

② Pull the safety button and push the switch to position ② to initiate the manual exhaust system cleaning.

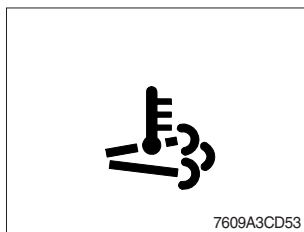
※ Refer to the page 7-69 for the exhaust system cleaning switch operation.

※ The engine speed may increase to 950~1050 rpm and exhaust system cleaning begins and it will take approximately 20~30 minutes.

③ The exhaust system cleaning warning lamp will blink and HEST warning lamp will light ON during the exhaust system cleaning is operating.

④ The exhaust system cleaning and/or HEST warning lamp will light OFF when the exhaust system cleaning is completed.

(18) HEST (High exhaust system temperature) warning lamp



① This warning lamp indicates, when illuminated, that exhaust temperatures are high due to exhaust system cleaning.

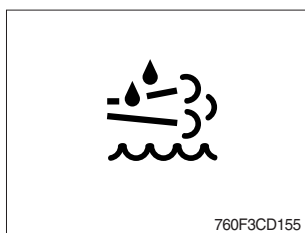
② The lamp will also illuminate during a manual exhaust system cleaning.

③ When this lamp is illuminated, be sure the exhaust pipe outlet is not directed at any surface or material that can melt, burn, or explode.

⚠ When this lamp is illuminated, the exhaust gas temperature could reach 800°C [1500°F], which is hot enough to ignite or melt common materials, and to burn people.

※ The lamp does not signify the need for any kind of equipment or engine service; It merely alerts the equipment operator to high exhaust temperatures. It will be common for the lamp to illuminate on and off during normal equipment operation as the engine completes exhaust system cleaning.

(19) DEF/AdBlue® level warning lamp

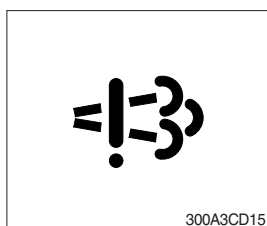


① This warning lamp indicates when ON or blinking, that the DEF/AdBlue® level is low as table below.

※ It is recommended that the DEF/AdBlue® tank be filled completely full of the DEF/AdBlue® in order to correct any fault conditions.

| Warning lamp | | | | Description |
|--------------------|-------------------|--------------|-------------|--|
| Fail in SCR system | DEF/AdBlue® level | Check engine | Stop engine | |
| | | | | |
| On | On | Off | Off | <ul style="list-style-type: none"> The DEF/AdBlue® level has fallen below the initial warning level (10%). |
| On | On | On | Off | <ul style="list-style-type: none"> The DEF/AdBlue® level has fallen below the initial derate level (2.5%). The engine power will be limited automatically. |
| On | Blink | On | On | <ul style="list-style-type: none"> This is happened when 30 minutes elapsed with empty conditions (0%) of the DEF/AdBlue® tank. The engine will enter the final derate level which may include low idle lock or engine shutdown with restart limitations. In order to remove the final derate, the DEF/AdBlue® tank must be filled to above 10 percent gauge reading. |

(20) Fail in SCR system warning lamp



① This warning lamp indicates there are faults related to SCR system.

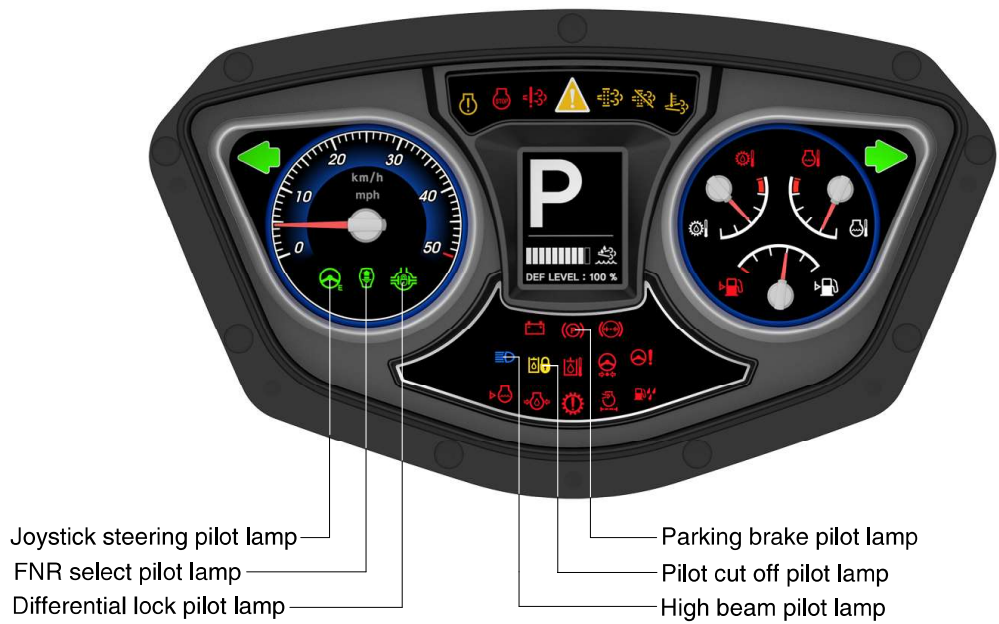
② The lamp lights ON when each of the below warnings is happened.

- Low DEF/AdBlue® level
- Poor quality of DEF/AdBlue®
- Tempering or malfunction in the aftertreatment system

③ Once the lamp lights ON, the engine will derate shortly.

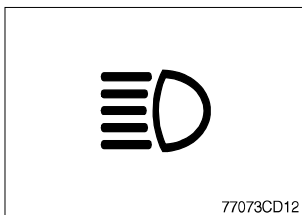
※ Please contact your HD Hyundai Construction Equipment service center or local dealer.

4) PILOT LAMPS



960A3CD10

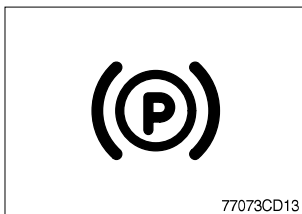
(1) High beam pilot lamp



77073CD12

- ① This lamp works when the illuminating direction is upward.
- ② This lamp comes ON when the dimmer switch is operated, e.g., when passing another vehicle.

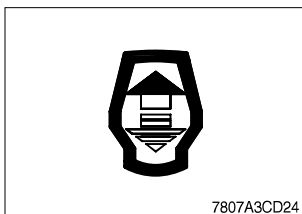
(2) Parking brake pilot lamp



77073CD13

- ① When the parking brake is actuated, the lamp lights ON.
- ※ Check the lamp is OFF before driving.

(3) FNR select pilot lamp (option)



7807A3CD24

- ① The lamp comes ON when FNR select button on the optional FNR remote control lever is pressed.
- ※ Refer to page 7-70.

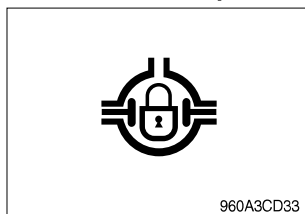
(4) Joystick steering pilot lamp (option)



960A3CD54

- ① This lamp lights ON when joystick steering is activated. It is then possible to steer the machine and select gears from the armrest to the left of the operator's seat.

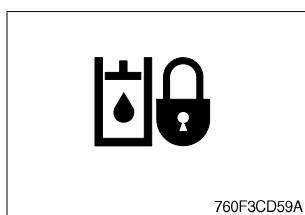
(5) Differential lock pilot lamp (option)



① This lamp lights ON when the differential lock function is operating.

※ Refer to page 7-68.

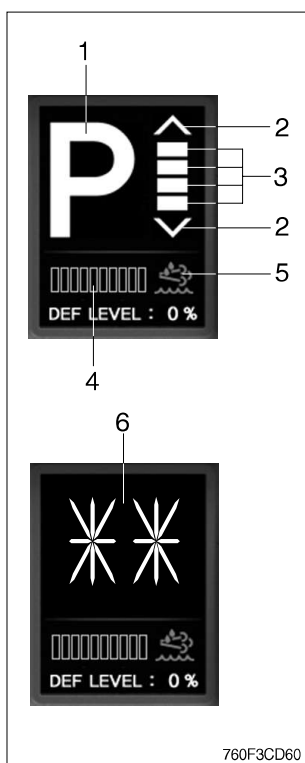
(6) Pilot cut off pilot lamp



① This lamp lights ON when the pilot cut off switch is pressed.

※ Refer to page 7-68.

5) LCD



(1) The LCD can be used with the gear selector.

It indicates speed, driving direction, DEF/AdBlue® level and transmission warning.

| No | Symbol | Meaning | Remark |
|----|---------------|--|---|
| 1 | △, ▽, N | Actual gear display | Forward, reverse, neutral |
| | 1, 2, 3, 4, 5 | | Actual gear |
| | P | | Parking brake mode active |
| 2 | ^, v | Forward, reverse | <div> <div>^</div> <div>FWD 1</div> </div> <div> <div>▽</div> <div>REV 1</div> </div> |
| 3 | ≡ | Gear range display | <div> <div>≡</div> <div>FWD 5</div> </div> <div> <div>≡</div> <div>REV 5</div> </div> |
| 4 | | DEF/AdBlue® level | Display the amount of liquid in the DEF/AdBlue® tank |
| 5 | | DEF/AdBlue® level warning lamp | Fill the DEF/AdBlue® when the lamp ON or blinks in red. - ON : DEF/AdBlue® level 5~10% - Blink : DEF/AdBlue® level below 5% ※ If the lamp ON or blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor. |
| 6 | LF, LR | Limp home gear | - |
| | ** | Oil temperature too low, no gear available | Warm up engine/transmission |
| | WS | Warning sump temperature | Alternate between WS and actual gear / direction while driving, in neutral only displayed WS if no fault is detected ※ Cool down transmission |
| | WT | Warning torque converter temperature | Alternate between WS and actual gear / direction while driving, in neutral only displayed WS if no fault is detected ※ Cool down transmission |

2. MONITOR (7 inch touch screen)

- The monitor is adjustable.
- Vertical : 30°
- Horizontal : 15°



760F3CD20-1

1) MAIN DISPLAY

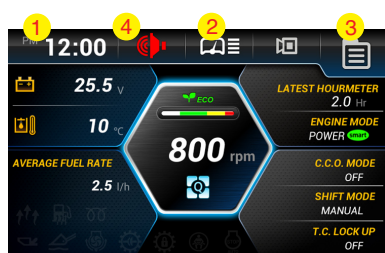
- ※ You can select or set the menu by the switches or touch screen.
- ※ Please refer to switch, page 7-62 for selection and change of menu and input value.
- ※ Display type can be changed by operator. See page 7-56 for details.



760F3CD11-1

- | | | |
|-----------------|---------------------------------|---------------|
| 1 Clock | 6 Machine monitoring | 11 Engine rpm |
| 2 Buzzer | 7 Fuel rate | 12 Quick menu |
| 3 Wiper speed | 8 Engine mode/Operation history | 13 10 lamps |
| 4 Camera screen | 9 Transmission mode | |
| 5 Menu | 10 ECO gauge | |

(1) Menu bar



760F3CD07-1

※ In main display, you can move to right side menu by touching each icon.

① Clock setting

Set the time (hour, minute and AM or PM)

② Wiper speed

Set the wiper speed (slow, normal, fast and very fast)

③ Menu

Move to main menu.

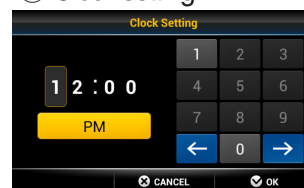
④ Buzzer stop

If you want to stop buzzer sound, just touch the



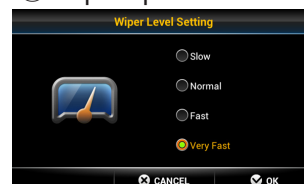
icon.

① Clock setting



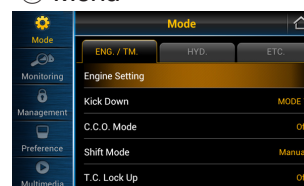
760F3CD07A-1

② Wiper speed



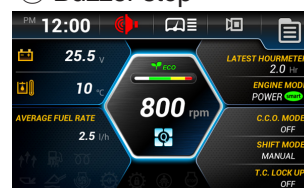
760F3CD07B-1

③ Menu



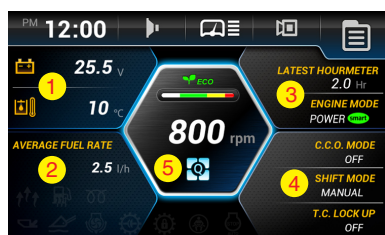
760F3CD07C-1

④ Buzzer stop



760F3CD07E-1

(2) Change display information



760F3CD08-1

※ In main display, you can check the data and setup what you want by touching each window area or icon.

① Machine monitoring

To display the item in main display, select two items of them.

※ Priority in the machine monitoring display

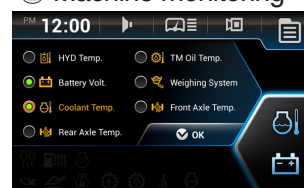
The priority of the weighing system is the highest.

If the weighing system is selected, the other items are not available.

To display the other items, the weighing system should not be selected.

※ **Weighing system** : see page 7-42.

① Machine monitoring

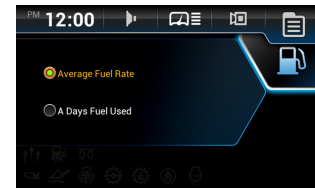


960A3CD08A

② Fuel rate

- Set average fuel rate or a days fuel used on main display screen.
- Refer to page 7-49.

② Fuel rate



760F3CD08B-1

③ Engine mode and operation history

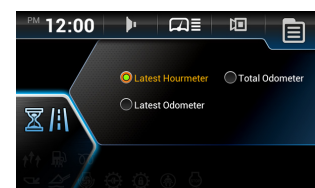
- Set the engine mode (A).
- Refer to page 7-39.
- Set Hour meter / ODO meter (B).
- Refer to page 7-48.

③ Engine mode



A

960A3CD08D



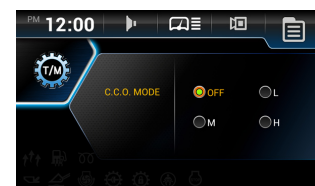
B

760F3CD08K-1

④ Transmission mode

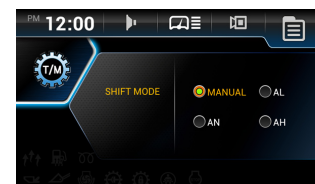
- Set the clutch cut off (A), shift (B) and torque converter lock up mode (C).
- Refer to page 7-40.

④ Transmission mode



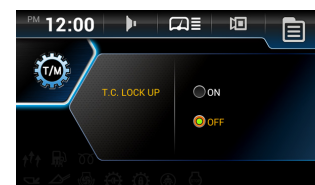
A

760F3CD08C-1



B

760F3CD08L-1




C

760F3CD08M-1

⑤ Quick menu



※ Move the quick menu screen by touching .

① User switching

- When multiple users share a machine, it allows users to switch user settings of machine.
- User can apply or save the setting of monitor easily.

② Active fault

- Display the fault code of MCU/ECU/TCU/EHCU.
- Refer to page 7-48.

③ Maintenance

- Elapsed time, change or replace cycle can be changed.
- Refer to page 7-52.

④ Help

- Read the monitor manual as a PDF file on the monitor.

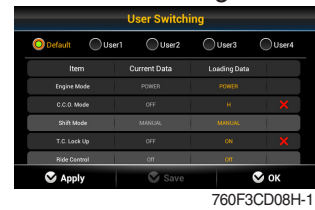
※ Smart terminal

- The menu features a smartphone and operates the miracast.

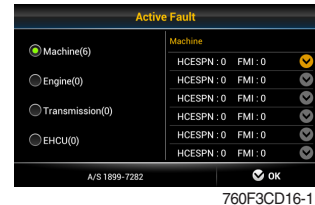
▲ Operation of screen mirroring can be dangerous while driving.

Driver is responsible for accident or other damages.
Operate the screen mirroring while stopping for safety.

① User switching



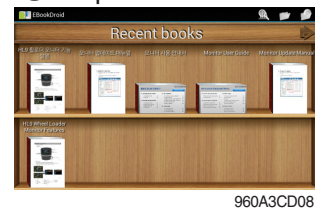
② Active fault




③ Maintenance

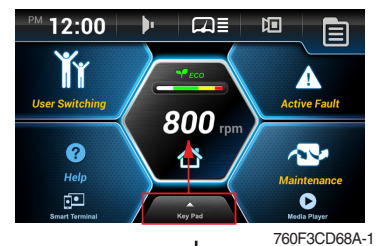


④ Help

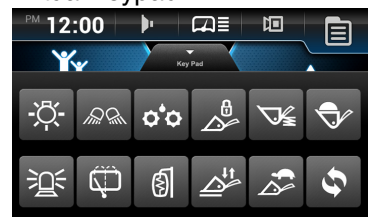


⑤ Virtual keypad

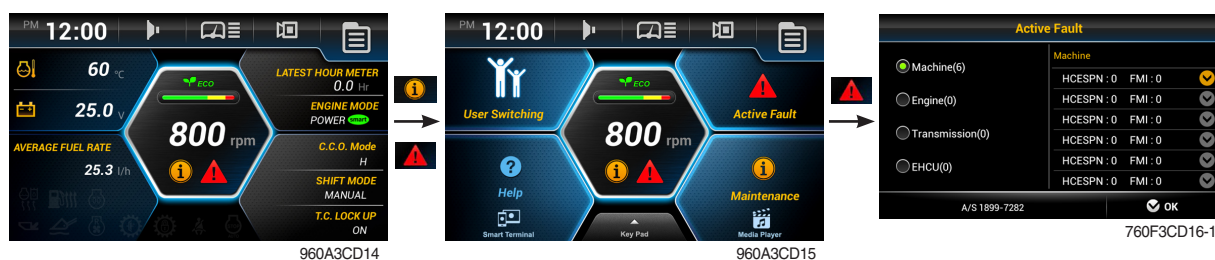
To display the virtual keypad, drag the button () to top of the screen.



Virtual keypad



(3) Fault and maintenance warning



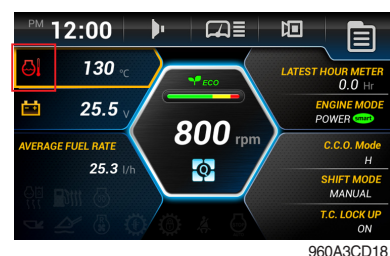
- ① If you touch the warning sign (red icon), move to the quick menu.
- ② You can check the fault message and move the maintenance screen by touching relevant area.



(4) Machine monitoring warning

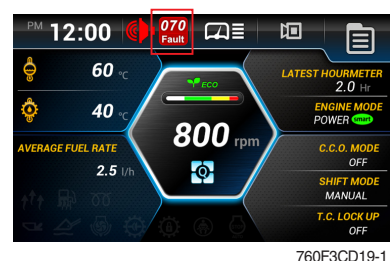
- ① Warning sign (red icon) will be shown when the temperature of hydraulic oil, cooling water, transmission oil or battery voltage is not normal state.
- ② Case of warning sign

| Icon | Description |
|------|---|
| | Above 106°C of hydraulic oil temperature |
| | Above 105°C of cooling water temperature |
| | Above 107°C of transmission oil temperature |
| | Below 24.5 voltage of battery (for 3 minutes) |
| | Above 100°C of axle oil temperature (option) |



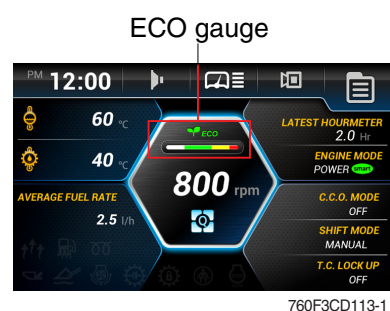
(5) Communication error

- ① MCU could not communicate with monitor over 10 seconds, error message will be show on the screen.



(6) Eco gauge

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



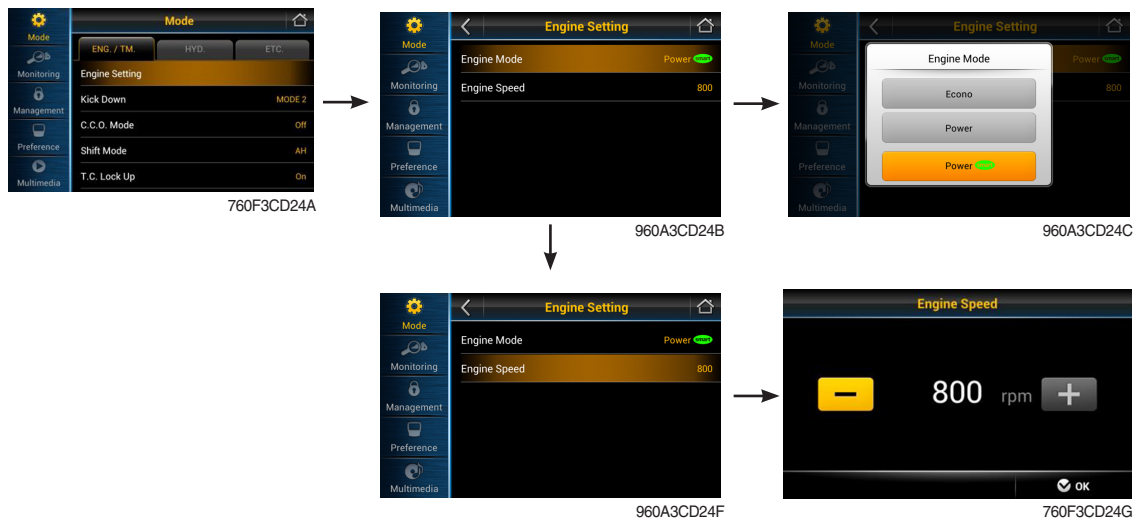
2) MAIN AND SUB MENU

(1) Structure

| No | Main menu | Sub menu | Description |
|----|--|---|---|
| 1 | Mode  760F3CD25A | Engine setting Kick down C.C.O mode Shift mode T.C. lock up Work load Boom/bucket detent mode Bucket priority Auxiliary attach max flow level Soft end stop Speedometer frequency setting Cooling fan reverse mode Wiper level setting Calibration Engine auto shutdown | Engine mode, Engine speed Mode 1 (down/up), Mode 2 (down only) Clutch cut off mode (Off, L, M, H) Transmission shift mode (manual, AL, AN, AH) Torque converter lock up ON/OFF Weighing system, Weighing display, Error detection Boom pressure calibration, Weighing system compensation Boom/bucket detent ON/OFF, Save position Bucket priority ON/OFF Max oil flow level setting Boom up/down, Bucket in/dump ON/OFF Speedometer setting Off, Manual, Automatic Slow, Normal, Fast, Very fast Boom/bucket angle, Boom pressure, Brake pedal sensor, AEB Once, On/Always, Disable, ESL system setting |
| 2 | Monitoring  760F3CD25B | Machine monitoring Operation history Fault history Fuel consumption history Machine information | Hyd, Coolant, axle and TM oil temp, Battery voltage Hour meter, ODO meter Active/Logged fault (MCU, ECU, TCU, EHC, AAVM) General record, Hourly record, Daily record, Mode record, Operation efficiency record TCU, ECM, MCU, RMCU, EHC, Monitor, Cluster |
| 3 | Management  760F3CD25C | Machine security Maintenance Service menu Change A/S phone number Software update Owner menu editing | ESL system setting, Change password Elapsed time, Cycle, Maintenance history Sensor monitoring, Speed limit setting, Weighing system compensation, EHC I/O information Check and change of contact information Update file in USB memory Owner menu editing, Menu list, Password change |
| 4 | Preference  760F3CD25D | Brightness setting Clock setting Unit setting Display style/Language Camera setting AAVM setting | Manual, Automatic Clock setting Temp (°F/°C), Distance (km, mile), Weight (ton, lb), Pressure (bar, Mpa, kgf/m², psi), Volume (l, gal) Type A, Type B, 14 multiple language Active camera, Display order, Reverse mode AAVM camera reverse mode |
| 5 | Multimedia  760F3CD25E | Media player Smart terminal | Play video and audio files in USB. Operation of screen mirroring |

(2) Mode

① Engine setting mode



- **Engine mode**

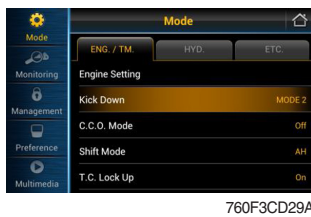
The operator can adjust the machine's performance.

- Econo : Maximum fuel efficiency for general loading.
- Power : Maximum power output for hard digging operation or hill climb.
- Smart power : Fuel efficient operation with same performance as power mode.

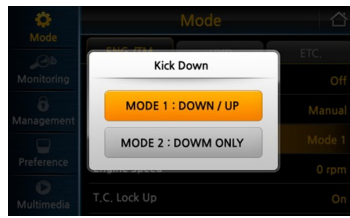
- **Engine speed**

Setting engine low idle rpm.

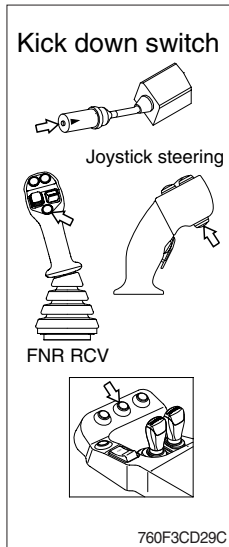
② Kick down mode



760F3CD29A



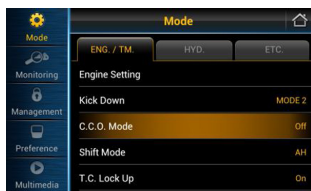
760F3CD29B



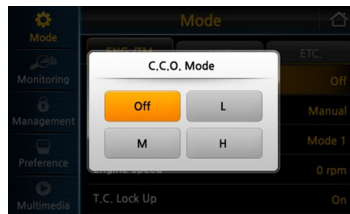
760F3CD29C

- **Manual mode** (shift mode : manual)
It is effective 2nd speed to 1st speed only and recover to 2nd speed quickly when push the switch one more time.
- **Automatic mode** (shift mode : AL, AN, AH)
 - **Mode 1** (down/up)
It shifts down quickly from current gear to one step lower speed by pushing the switch and recover to current speed quickly when push the switch one more time.
 - **Mode 2** (down only)
It shifts down from current gear to one step lower speed when push the switch every time.
The kick down function is released in only 1st speed.
- ※ **The normal autoshift function continues after the kick down switch is released.**

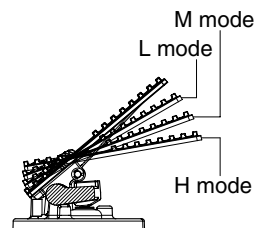
③ Clutch cut off (C.C.O) mode



760F3CD26A



760F3CD26B



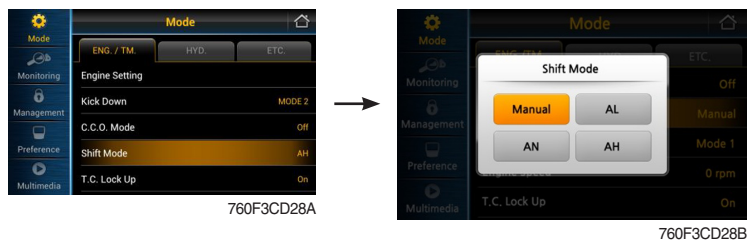
Left brake pedal

760F3CD27

- Four modes are available for operator's preference and job condition.
 - OFF : The clutch cut off function is disable.
 - L (Low) : The clutch is disengaged early for short-distance and rapid loading.
 - M (Medium) : The clutch is disengaged normally for general digging and loading operation.
 - H (High) : The clutch cut off function is automatically adjusted depending on slope angle or machine load, And inching fuction becomes possible by using the brake pedal.
- The clutch cut off functions of the left brake pedal depend on the position of the left brake pedal and the setting of the clutch cut off mode.

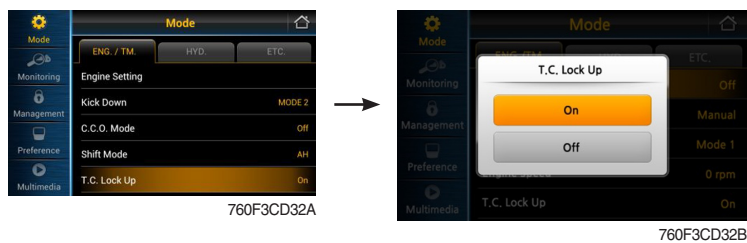
| Positions for clutch cut off function | | | |
|---------------------------------------|------|---|---|
| Clutch cut off mode | L | M | H |
| Left brake pedal | L, M | M | H |

④ Shift mode



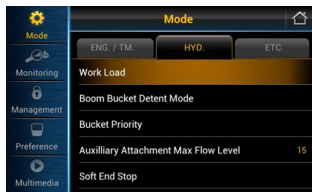
- Four modes are available for operator's preference and job condition.
 - Manual : Machine is operated by selected gear on lever.
 - AL (Auto Light) : Automatic shifting point is fast for long-distance transportation and fuel efficiency.
 - AN (Auto Normal) : Automatic shifting point is normal without automatic kick-down to 1st gear for general digging and loading operation.
 - AH (Auto Heavy) : Automatic shifting point is normal with automatic kick-down to 1st gear for more powerful operation.

⑤ Torque converter (T.C.) lock up mode (5-speed transmission)

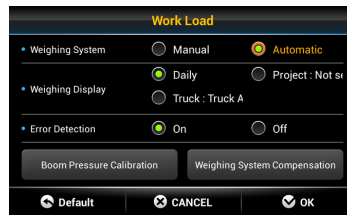


- If you select ON, the lock-up clutch on the torque converter will automatically activate according to load.
- Lock-up clutch function (option)**
To prevent power loss in the torque converter, the pump rotor and turbine rotor on the torque converter lock together through a direct lock-up clutch.

⑥ Work load

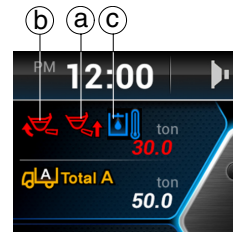


760F3CD33A



960A3CD33

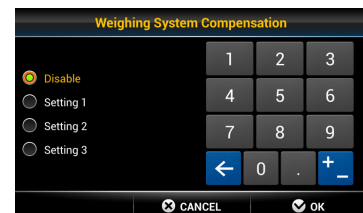
- Weighing system : Set the workload measurements.
- Weighing display : Set the display on main display screen.
- Error detection : Set error detection ON/OFF.
 - OFF : Errors are not displayed.
 - ON : ①, ② and ③ are displayed on main display screen.
 - ① The boom lift was performed too fast.
 - ② The bucket was not in the fully tilted back position while bucket was in the weigh range.
 - ③ The hydraulic temperature is low (below 40 °C).



760F3CD33CK

| | |
|--|--|
| | Work weight (today) |
| | Work weight (previous day) |
| | Total weight accumulated in memory A, B, C individually regardless of date |
| | Current weight |

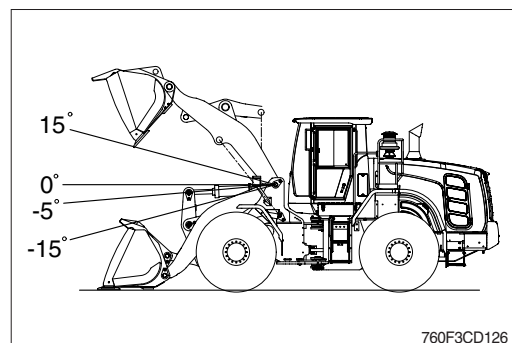
- Boom pressure calibration : See the page 7-45 for details.
- Weighing system compensation
 - Calibration workload depending on work tool.
 - ※ **Only for the service person. Do not adjust arbitrary.**
 - ※ **Refer to page 7-65 for details.**



9603CD75G

※ Weighing system

- The weight indication in bucket is calculated by measuring boom position and boom pressure.
- ① The weight is '0.0 ton' when the boom is placed at below -15°.
- ② The weight is indicated when the boom is placed at the range (-5°→15°).
- ③ The weight is calculated when the boom is placed at above -5° and boom is lowered below -15° after dumping operation.



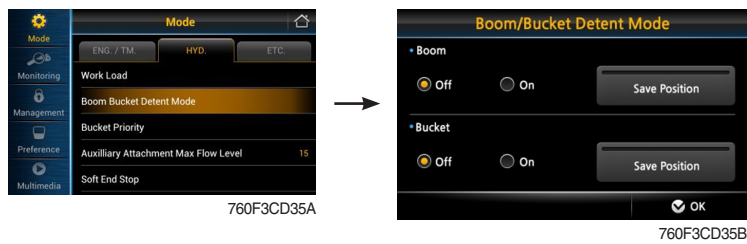
760F3CD126

In order to recheck weight, go to the ② after changing boom position (below -15°).

- Dump operation : It is checked by bucket cylinder's stroke change (below 250 mm).

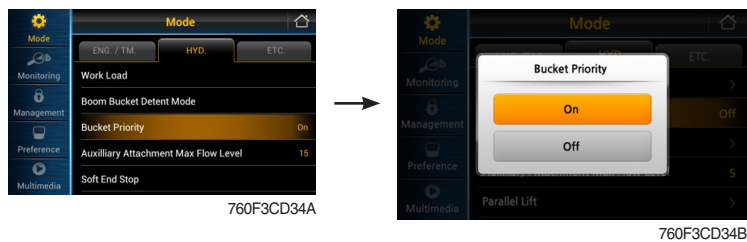
※ The temperature for the hydraulic oil must be raised to at least 40 °C (104 °F) before operation.

⑦ Boom/bucket detent mode



- OFF : Detent functions are not operated.
- ON : Boom or bucket detent functions are operated.
- Save position

⑧ Bucket priority mode (option)



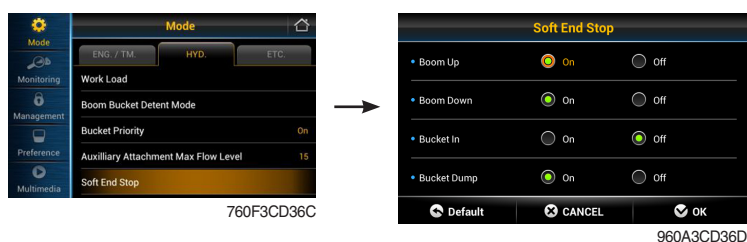
- Bucket priority function is to be more convenient for operator to load materials. Bucket-in (roll back) operation takes priority over the boom-up (raise) operation in case of using both operations at the same time and therefore boom (raise) operation is stopped and only bucket (roll back) is operated.
- Set the bucket priority function ON/OFF.

⑨ Auxiliary attachment max flow level mode (option)



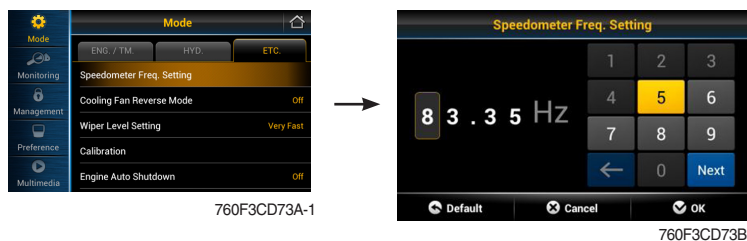
- If the machine is equipped with auxiliary attachment, auxiliary attachment flow can be easily adjusted and controlled.
- Set the oil flow level from 0 to 15 level by using +/- button.



⑩ Soft end stop mode (option)



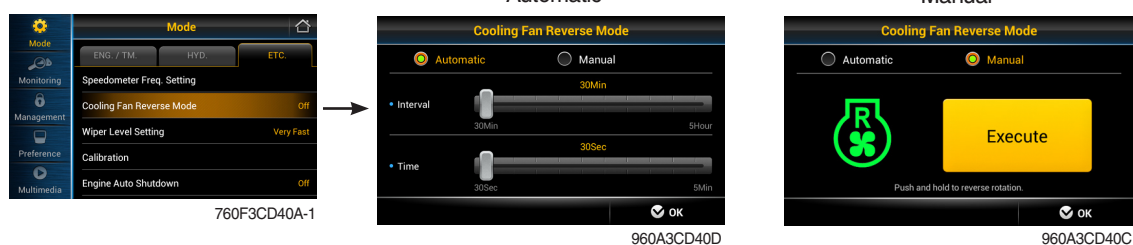
- This function gives shock free operation by reducing the speed of attachment near the end stroke.
- Set the soft end stop function ON/OFF.

⑪ Speedometer frequency setting mode



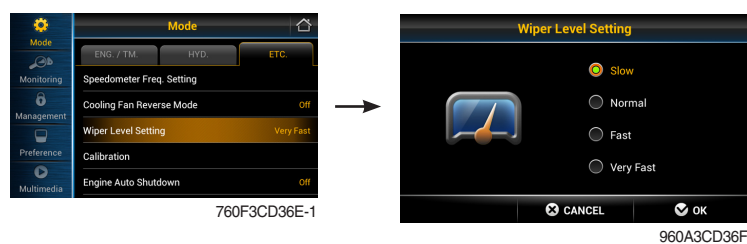
- Press speedometer setting bar (or ) for 3 seconds.
- ※ **Only for the service person. Do not adjust arbitrary.**
- ※ **Using button**
 - To change the pulse value, press ◀ or ▶.
 - To change the position, press .

⑫ Cooling fan reverse mode



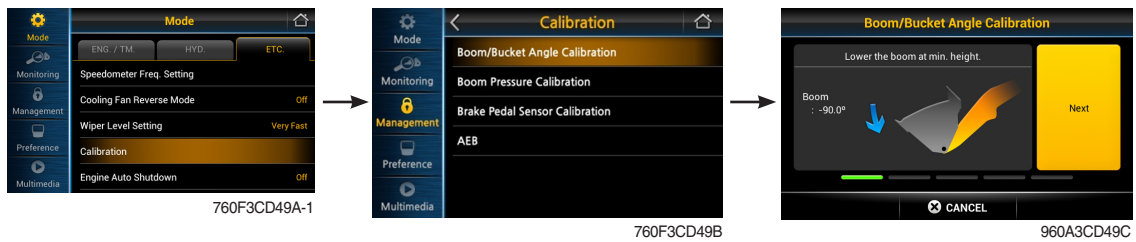
- **Manual** : Rotate the fan with reverse direction while pressing the button "Execute".
- **Automatic** : Rotate the fan with reverse direction by preset cycle.
 - Interval : 30 min ~ 5 hrs
 - Time : 30 sec ~ 5 min
- ※ **Default : Interval (60 min), time (120 sec)**

⑬ Wiper level setting (Intermittent mode)



- Setting wiper speed in J position of multi function switch (slow, normal, fast and very fast)
- ※ Refer to the page 7-71.

⑭ Calibration



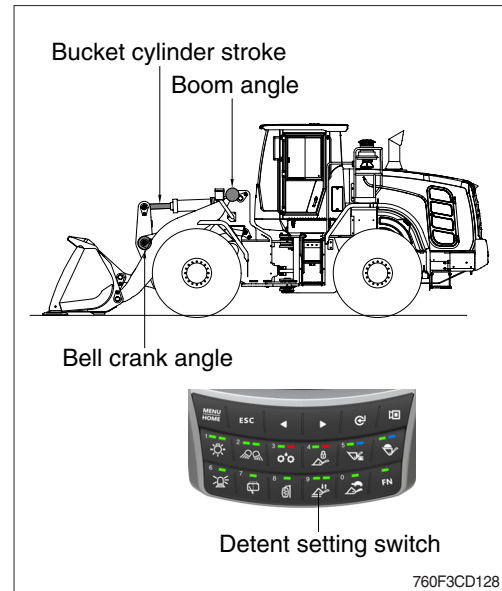
- You should turn OFF " Soft end stop " before start calibration.
- Press NEXT button after following the instruction at each step.
- If correction is right, NEXT button will be activated, then go to next stage.
- After following each step correctly, the message "Calibration completed" will be shown. Press OK button, then process be ended.






※ Using switch

- Using  instead of NEXT, complete button.

· Boom / Bucket angle calibration

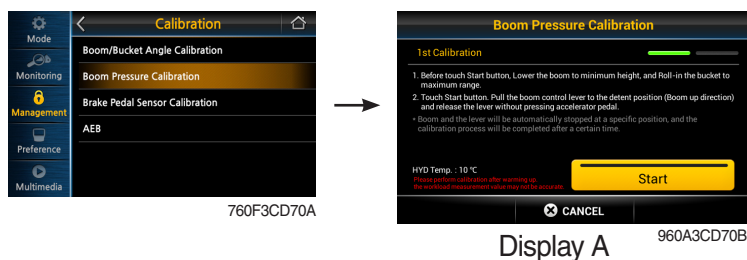
- MCU get sensing signal from boom angle and bell crank angle and calculate bucket cylinder stroke and boom link position angle from ground real time basis.
- Boom angle position and bucket cylinder stroke is set by detent setting switch on monitor.
- Individual setting position is done by lever (detent, release operation).
- Angle sensor calibration is basically carried out before delivery of the machine.
When angle sensor is replaced or actual value is different compared to setting value, this function can be done.



- The calibration must be carried out as follows :
 - ① Lower the boom at maximum low position and press NEXT button or  (bucket must be max tilting position).
 - ② Raise boom at maximum high position and press NEXT button (or ).
 - ③ Position boom at -5° and press NEXT button (or ).
 - ④ Retract bucket cylinder length (to minimum position) at -5° boom position and press NEXT button (or ).
 - ⑤ Extend bucket cylinder length (to maximum position) at -5° boom position and press NEXT button (or ).
 - ⑥ In case above steps are carried normally, "Calibration is done" message is shown. Then angle sensor calibration is finished.

※ **Boom down / boom up / bucket position setting : Refer to page 4-22 in operator's manual.**

· Boom pressure calibration




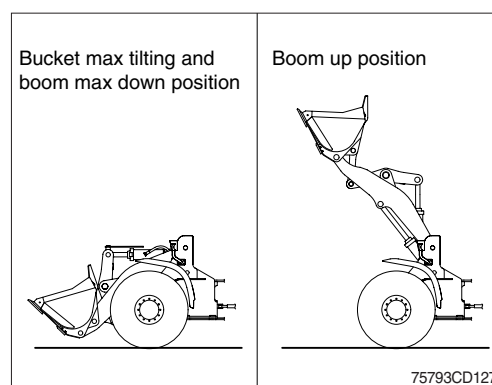
- Press START button after following the instruction.
- After a few minutes, "Calibration failed" or "Calibration completed" message will be shown. Press OK button then process be ended.

※ Using button

- Using  instead of NEXT, complete button.

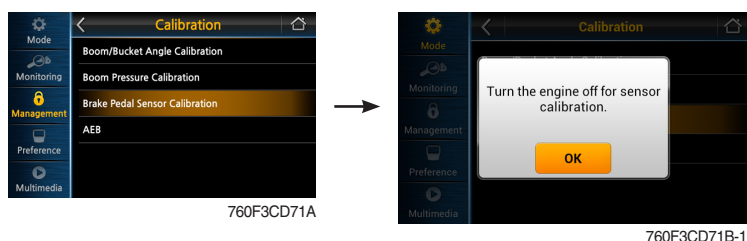
· Boom pressure calibration



- It is used when bucket weight is changed or measured weight is inaccurate.
- The calibration must be carried out as follows :
 - ① Increase hydraulic temperature (about 40~60°C).
 - ② Select "Boom-pressure".
 - ③ Roll-in the bucket at maximum range and lower the boom at minimum height.
 - ④ Press START button.
 - ⑤ Raise boom to maximum position. Boom up must be finished before stepping advance in "display A".
 - ⑥ If it show "Calibration success" message in a moment, press complete button (or ).



- ※ **Raise hydraulic temperature enough when checking work load / boom pressure sensor calibration (recommendation : about 40 ~ 60°C).**
- ※ **Check if pressure sensor or angle sensor is in normal condition for accurate work load algorism or pressure sensor calibration [pressure sensors at boom cylinder head area and rod area, boom angle sensor (CD-80), bell crank angle sensor (CD-81)].**
- ※ **Sensor error message during pressure sensor calibration : sensor need to be checked.**

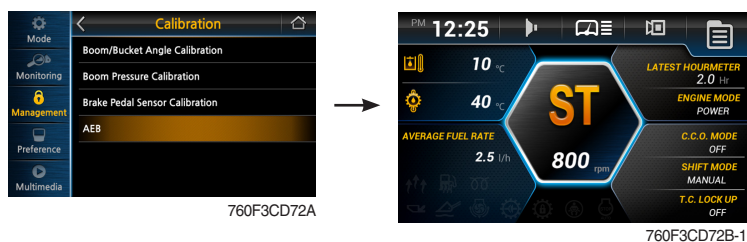
· Brake pedal sensor calibration






- Turn the engine OFF and turn the starting switch ON position.
- Press OK button, then calibration will be started.
- When display "IP  " on main display, press slowly the brake pedal completely.
- Release the brake pedal when display "IP  " on main display.
- For cancel, press MENU/HOME switch.

- ※ When the brake pedal or sensor is replaced, **brake pedal sensor calibration must be performed.**

· AEB

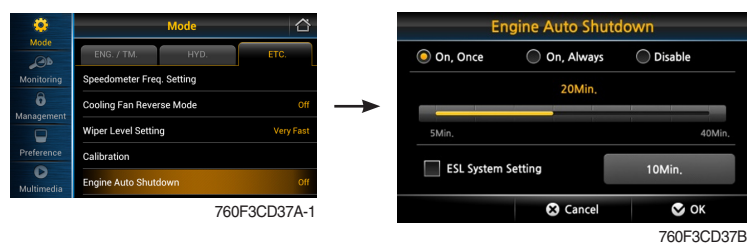


- AEB mode controls the disk clearance of the transmission, automatically.
- To start AEB setting, press AEB bar (or ) for 3 seconds.
- If you press  or ESC, AEB setting will be canceled. Machine need to restart.
- If "OK" in actual gear window, press  to complete AEB setting.
- **Display during AEB mode**

| Symbol | Meaning |
|-----------------|---|
| ST | Start AEB |
| K1~K4, KV, KR | Calibrating clutch K1~K4, KV or KR respectively |
| OK* | Calibration for all clutches finished |
| Spanner and Kx* | Kx couldn't be calibrated, AEB finished |
| △E | Engine speed too low - Raise engine speed |
| ▽E | Engine speed too high - Lower engine speed |
| △T | Transmission oil temperature too low - Heat up transmission |
| ▽T | Transmission oil temperature too high - Cool down transmission |
| FO* | Output speed not zero |
| FN* | Shift lever not in neutral position |
| FP* | Parking brake not applied |

* : Transmission stays in neutral, you have to restart the TCU (starting switch off/on).

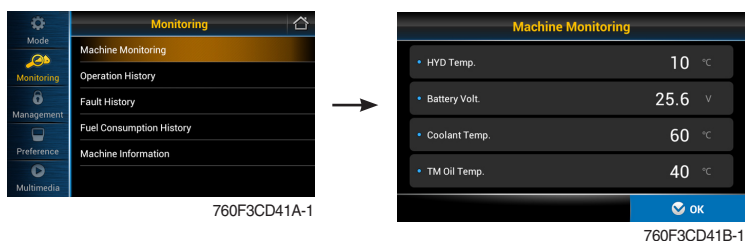
⑮ Engine auto shutdown mode



- The engine auto shutdown function can be activated or cancelled.
- If machine is idling for the setting time (2~40 minutes), then engine will be shutdown automatically.

(3) Monitoring

① Machine monitoring



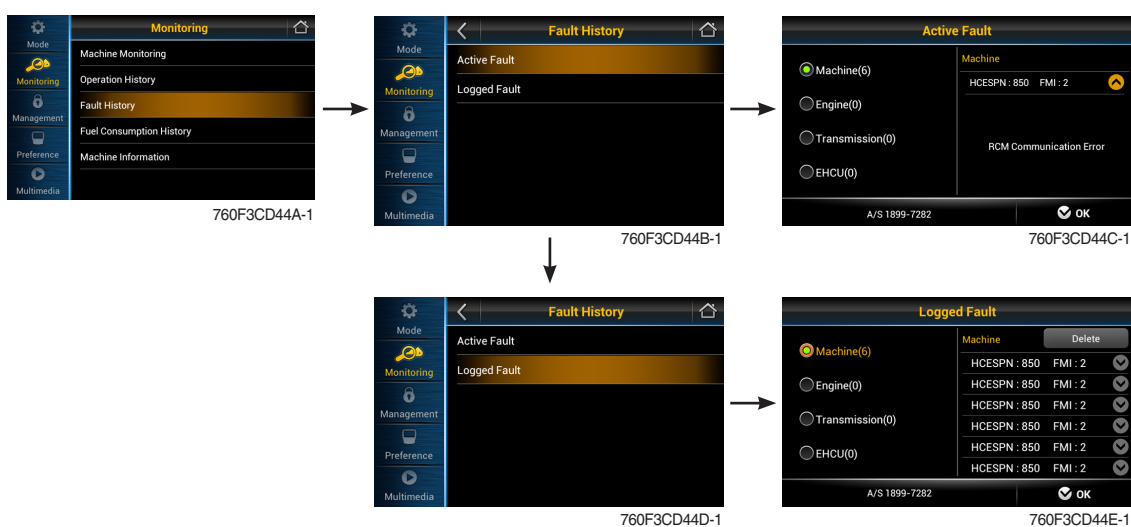
- Monitor the status of the machine.

② Operation history



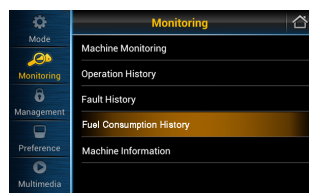
- **Hour meter / ODO meter**
- **Total**
 - Total distance (this item cannot be initialized).
 - Total working hour can check on service meter.
- **Latest**
 - Working hour/distance after reset.
 - If you select **Initialization**, working hour/distance start zero.
- To display the item in main display, select the item in main display.

③ Fault history

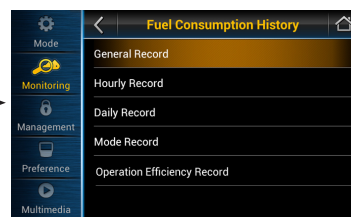


- Display the fault code of MCU/ECU/TCU/EHCU and delete logged fault.
- ※ Refer to service manual for HCESPN/FMI of engine and transmission.
- ※ EHCU : Electro Hydraulic Control Unit AAVM : All Around View Monitoring

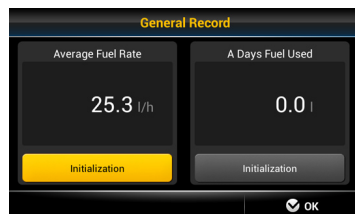
④ Fuel consumption history



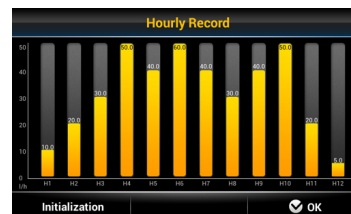
760F3CD141



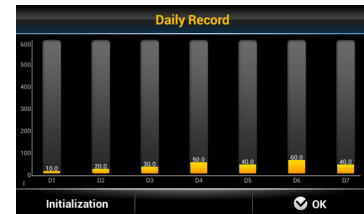
760F3CD141A



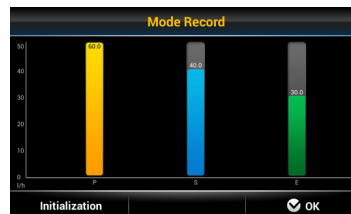
960A3CD141B



960A3CD141C



960A3CD141G



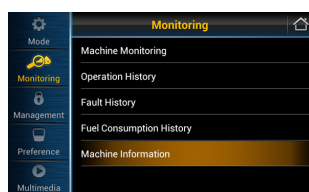
960A3CD141E



960A3CD141F

- Display the fuel consumption history.
 - General record (average fuel rate and a days fuel used)
 - Hourly record - Daily record - Mode record : P, P(smart), E mode
 - Operation efficiency record (Shuttle shift, Idle, Relief)

⑤ Machine information



760F3CD46A-1

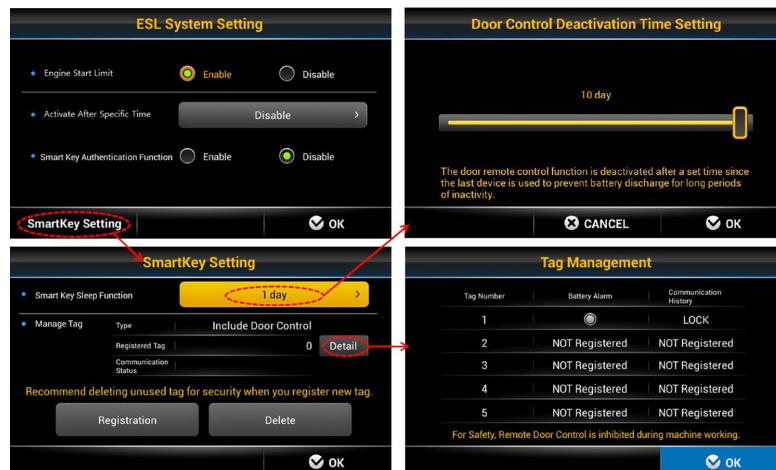
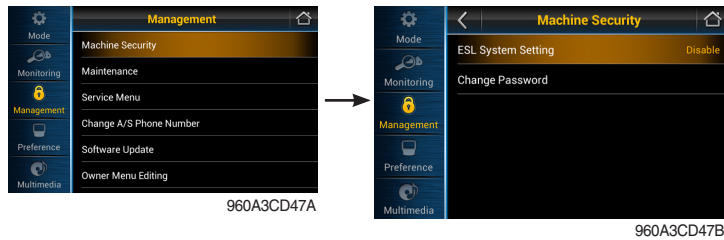


960A3CD46B

- Software versions of MCU, ECM, TCU, EHCU, RMCU, Cluster and monitor can be checked.

(4) Management

① Machine security



• ESL system setting

- ESL : Engine Starting Limit
- ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
- If the ESL mode was selected ON, the password will be required when the start switch is turned ON.
- **Engine start limit**
 - . **Disable** : Not used ESL function
 - . **Enable** : The password is required whenever the operator start engine.
- **Activate after specific time**

The password is required when the operator start engine first. But the operator can restart the engine within the specific time without inputting the password.

The specific time can be set maximum 2 days.
- **Smart key authentication function (option)**
 - . **Enable** : Set the using or not of smart key. If you using smart key, ESL function always be activated.
 - . **Disable** : Register or delete user tag and display registered user tag. When delete user tag, all user tag will be deleted.

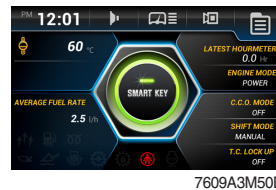
※ Using smart key

- Verification success

Green smart key icon is displayed on the main display screen.

- Verification failure

Red smart key icon and password input screen is displayed.



7609A3M50D

Verification success



7609A3M50E

Verification failure

※ Remote door control system (option)

- The machine operator can lock, unlock and open the cab door by means of the remote key tag, as long as he is within a range of 15 meters from the machine.
- Please note that the door cannot be closed using the Remote Key Tag.

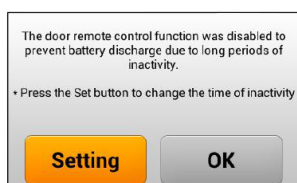


- 1 Door lock
- 2 Door unlock
- 3 Door open (press and hold for 2 seconds)

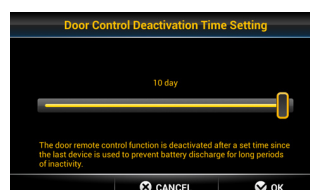
⚠ Do not activate this function if there is person nearby the door and when machine work or travel.

· Door control deactivation time setting

- There is a limited period of a maximum of 10 days that can be set during which the ' Remote Door Functionality ' can be used if the machine has been parked or at a standstill.
- If the machine is parked or at a standstill for a period that exceeds the period in days set by the operator without any activity, then to prevent the machine batteries from draining, the ' Remote Door Functionality ' will be disabled.
- When this happens, the operator will be able to only use the machine Key to open the cab door, after which the ' Remote Door functionality ' can be enabled again during first start-up.
- During the first start-up after the machine was inactive for a period that exceeds the period in days set by the operator, the operator will be able to see the below pop-up on the monitor, by which the operator can then enable the ' Remote Door functionality ' again by clicking the ' Setting ' tab and confirming the settings thereafter.



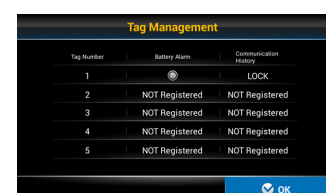
960A3CD47H



960A3CD47G

· Tag management

- Tag number
 - . Max 5 tags can be registered.
- Battery alarm
 - . Check tag's battery status. (normal or low)
- Communication history (check, lock, unlock, open)



960A3CD47K

· Engine Starting Condition

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

② Maintenance



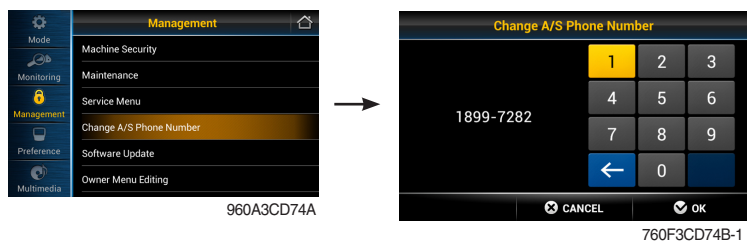
- **Replacement** : The elapsed time will be reset to zero (0).
- **Change cycle** : The change or replace cycle can be changed in the unit of 50 hours.
- **Show the maintenance history below 10.**
When history have more than 10, delete the old item.
- **Change or replace interval** : Refer to page 6-10 on operator's manual.

③ Service menu



- **Sensor monitoring** : Display information of each sensors.
- **Speed limit setting** : 20~40 km/h (5 km/h intervals)
- **EHCUI/O information**
 - Real time monitoring (joystick stroke, EPPR current).

④ Change A/S phone number



- Check and change of contact information for customer service.

Software update



- Update file in USB memory.

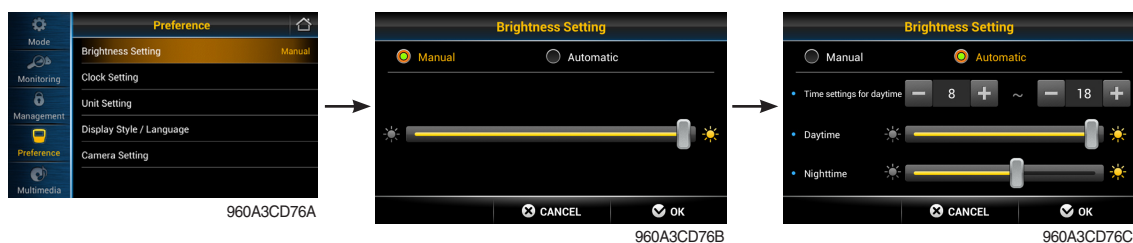
⑤ Owner menu editing



- **Owner menu editing** : Owner can set the status of the function. (Enable / Disable)
- **Menu list** : In the menu, owner can set the list of the function to lock or unlock it.
- **Owner password change** (Default password : 11111)
 - Owner can manage and change the password.
 - Necessary to input the password to access the set of function.

(5) Preference

① Brightness setting



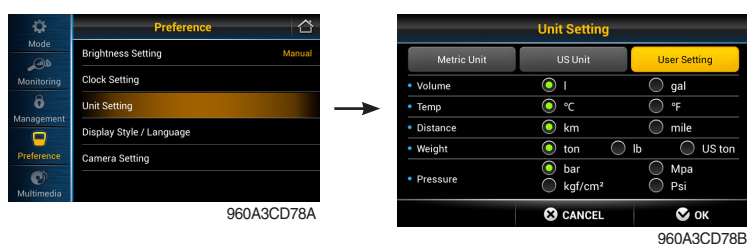
- **Manual**
 - Manual setting for LCD brightness.
- **Automatic**
 - Automatic control of LCD brightness as set level of day/night.
- **Setting day time**
 - Set the time for daylight.
 - If you set the time for daylight, the rest time will be night.

② Clock setting



- Set the time (hour, minute and AM or PM)

③ Unit setting

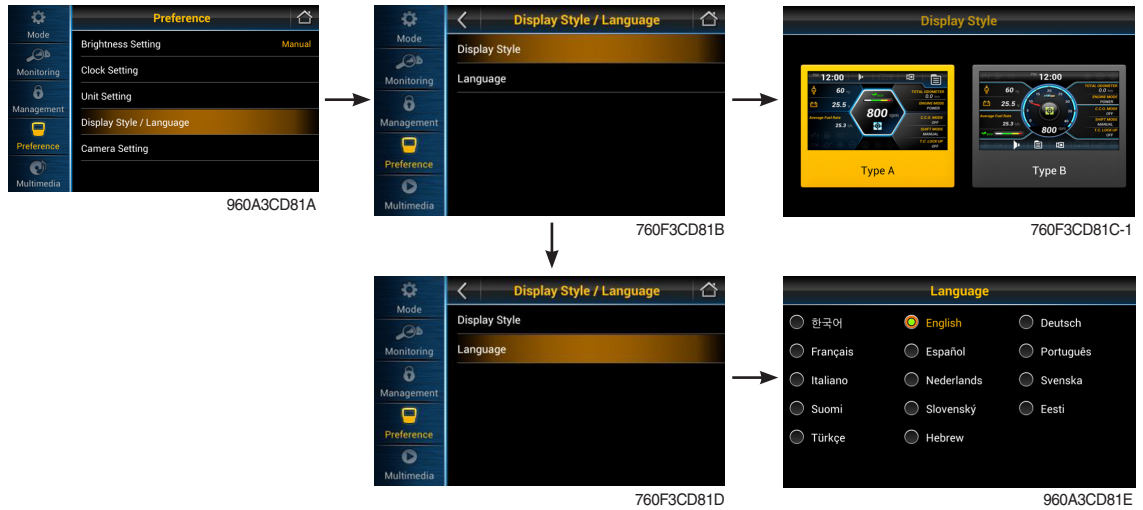


- Volume : ℓ ↔ gal
- Temperature : °C ↔ °F
- Distance : km ↔ mile
- Weight : ton ↔ lb
- Pressure : bar ↔ Mpa ↔ kgf/m² ↔ psi

※ Using button

- Move to other item by .

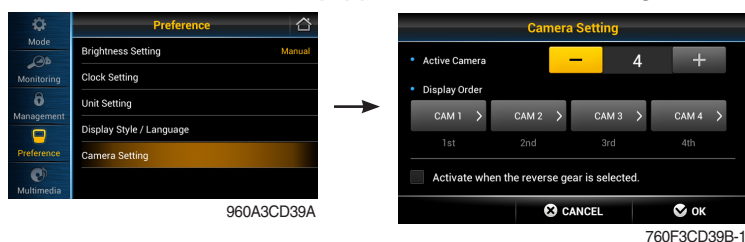
④ Display style/ Language



- Set the display type A or B.
- User can select preferable language and all display are changed the selected language.
- 14 multiple language available.

⑤ Camera setting

※ If the camera monitor is equipped, camera will showing on camera monitor only.



- **Active camera**
 - Four cameras can be installed on the machine.
 - **Display order**
 - Set the channel sequence of each camera.
 - **Active when the reverse gear is selected**
 - If transmission engages the reverse gear (R1~R3), the camera mode is displayed automatically in main display.
 - If the camera was not equipped, this menu is not useful.
 - If the camera monitor is equipped, camera will showing on camera monitor only. This menu is not useful.
 - In main display, if the is touched (or switch is pushed), the first ordered display camera will be viewed.
- ※ If AAVM is equipped, this menu will be changed to AAVM setting.

⑥ AAVM (Advance Around View Monitoring, option)

- ※ If the camera monitor is equipped, AAVM will showing on camera monitor only.
- The AAVM switches of the cluster consist of Camera, ESC and Buzzer stop.



- **Camera switch**
 - It will enter into the AAVM mode from the main display if the AAVM is installed.
 - If the camera monitor is equipped, AAVM will showing on camera monitor only. This menu is not useful.
- While in the AAVM mode, select the ESC switch to return to the main display.



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



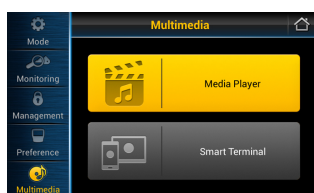
290F3CD246



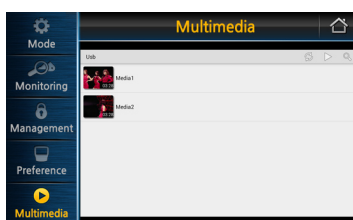
290F3CD247

- When the worker or pedestrian go near the danger area line (green, radius 3 m), an external danger area of equipping on the main display, the warning buzzer sounds and it displays the green rectangular box for the recognition of the worker and pedestrian. At this time, the operator should stop work immediately, and stop the buzzer by pressing the buzzer stop switch. And then, please work after you check whether the danger factors are solved.
- When the worker or pedestrian go inside of the danger area line (red, radius 3 m), an internal danger area of equipping on the main display, the warning buzzer sounds and it displays the red rectangular box for the recognition of the worker and pedestrian. At this time, the operator should stop work immediately, and stop the buzzer by pressing the buzzer stop switch. And then, please work after you check whether the danger factors are solved.

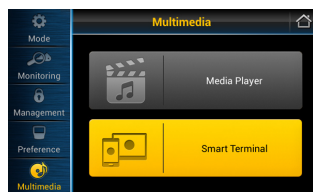
(6) Multimedia



960A3CD83A



760F3CD83A



960A3CD83C

- Media player

- Play video files in USB (mp4, mkv, avi, 3gp, divx, f4v, flv, mpeg, mov, vob, wmv, webm, xvid).
- Play audio files in USB (mp3, mp4, ogg, wma, wav, flac, aac).

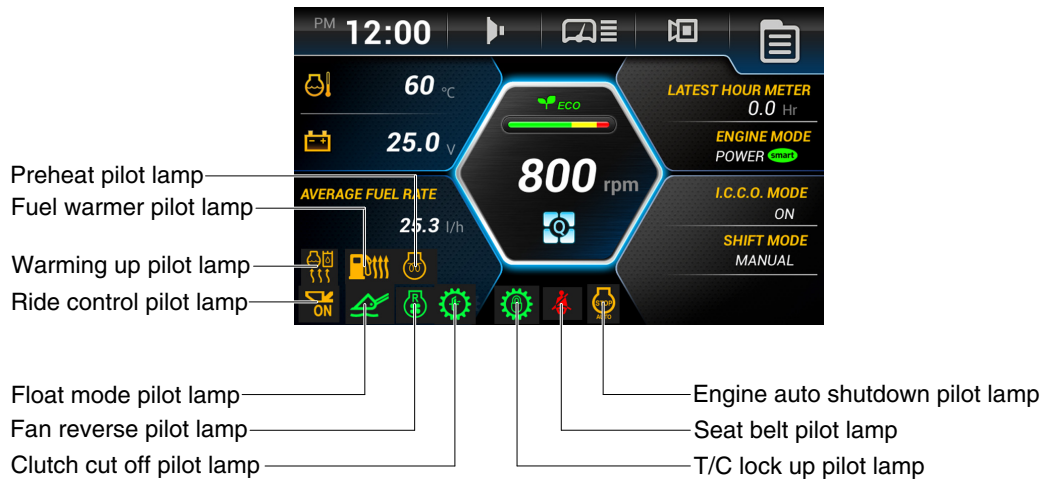
- Smart terminal

- The menu features a smartphone and operates the miracast.

⚠ Operation of screen mirroring can be dangerous while driving.

Driver is responsible for accident or other damages. Operate the screen mirroring while stopping for safety.

3) PILOT LAMPS



960A3CD90

(1) Warming up pilot lamp



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

(2) Seat belt pilot lamp



- ① This lamp lights ON for the first five seconds after starting the engine.

(3) Preheat pilot lamp



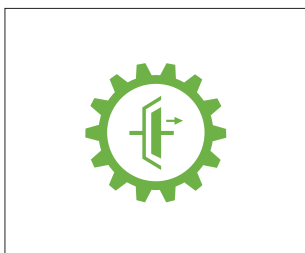
- ① This lamp lights ON when start switch is turned clockwise to the ON position. Light will turn off after approximately 5~45 seconds, depending on engine temperature, indicating that preheating is completed.
- ② When the lamp goes out the operator should start cranking the engine.

(4) Engine auto shutdown pilot lamp



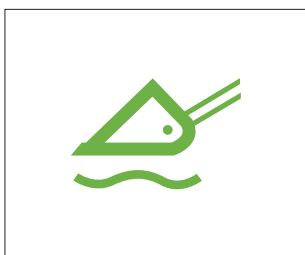
- ① This lamp lights ON when the engine auto shutdown function is activated.

(5) Clutch cut off pilot lamp



- ① This lamp lights ON when clutch cut off mode is set L, M, H.

(6) Float mode pilot lamp



- ① This lamp lights ON when the boom float is activated.

(7) Ride control pilot lamp (option)



① **Auto ride control**

This lamp lights ON when the automatic ride control function is activated (**ON**, **Conditional speed** setting).



② **Manual ride control**

This lamp lights ON when the manual ride control function is activated (**ON**, **Always** setting).

(8) Fan reverse pilot lamp



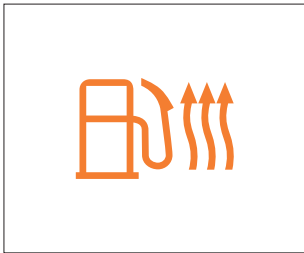
- ① This lamp lights ON when the cooling fan reverse mode is activate

(9) Torque converter lock up pilot lamp (option)



- ① This lamp lights ON when the torque converter lock up function is operating.

(10) Fuel warmer pilot lamp



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

3) SWITCHES



760F3CD95-1

- ※ If you push left or right switch (◀ ▶) on main display, show the select box on current time.
Move to next item in order by using left / right button.
(① Time → ② Buzzer → ③ Wiper → ④ Camera → ⑤ Menu → ⑥ Machine monitoring →
⑦ Fuel rate → ⑧ Engine mode/Operation history → ⑨ Transmission mode → ⑩ Quick menu)
- ※ Move to selected setting screen by using enter switch (⏎).
- ※ When keypad is not pressed for 3 seconds, convert screen to main display.
- ※ If you push left and right switch (◀ ▶) at the same time, move language settings.

(1) Menu / Home switch



- ① Main display to main menu, main menu to main display.

(2) ESC switch



- ① For other menu, this is used for cancellation (move to previous menu).
- ② AEB cancel or finish button in AEB.

(3) Left / Right move switch



- ① Move in menu (left, up / right, down).
- ② Decrease / Increase input value.
- ③ Stop buzzer sound when sound is on.

(4) Enter switch



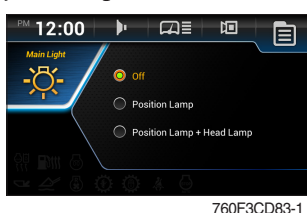
- ① Select menu (enter).

(5) Camera switch



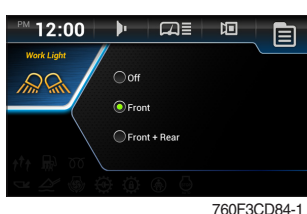
- ① Enter camera or AAVM mode in main display.
- ② If the camera monitor is equipped, camera or AAVM will showing on camera monitor only. This switch is not useful.

(6) Main light switch



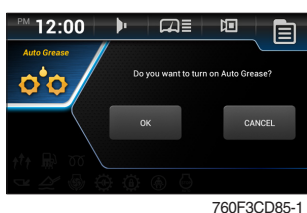
- ① This switch use to operates the clearance lamp and head light.
 - **Position lamp** : Clearance lamp and cluster illumination lamp come ON. The green pilot lamp is turned ON.
 - **Head lamp + Position lamp** : Clearance lamp, cluster illumination lamp and head light come ON. The green pilot lamp is turned ON.

(7) Work lamp switch



- ① This switch use to operates the front and rear work lamps.
 - **Front** : Front work lamp located on the cab comes ON. The green pilot lamp is turned ON.
 - **Front + Rear** : Front work lamp located on the cab and rear work lamp located on the cowl come ON. The green pilot lamp is turned ON.

(8) Central grease lubrication switch (option)



- ① This switch is used to operate the central grease lubrication system.
- ② The central grease lubrication system is operated for set period. The green pilot lamp is turned ON.
- ※ **When malfunction occur in grease lubrication system, the red pilot lamp is turned ON.**

(9) Quick coupler switch (option)



① Disengage quick coupler

- The quick coupler pins move in the disengaged position and buzzer sounds.
- The red pilot lamp is turned ON.

⚠ **Always check that the attachment is properly secured to the attachment quick coupler by pressing the front part of the attachment against the ground.**

⚠ **Never use an attachment before you have checked its mounting.**

② Engage quick coupler

- The quick coupler pins move in the engaged position and buzzer sounds.
- The green pilot lamp is turned ON.

※ Check for engagement as followings.

- Put down pressure on the attachment.
- Back up the machine and make sure that there is no movement between the quick coupler and attachment.

(10) Ride control switch (option)



① Forward / Backward 1~15 km/h

- The ride control automatically turns on when the travel speed exceeds a preset speed. (forward / backward 1~15 km/h)
- The blue pilot lamp is turned ON.

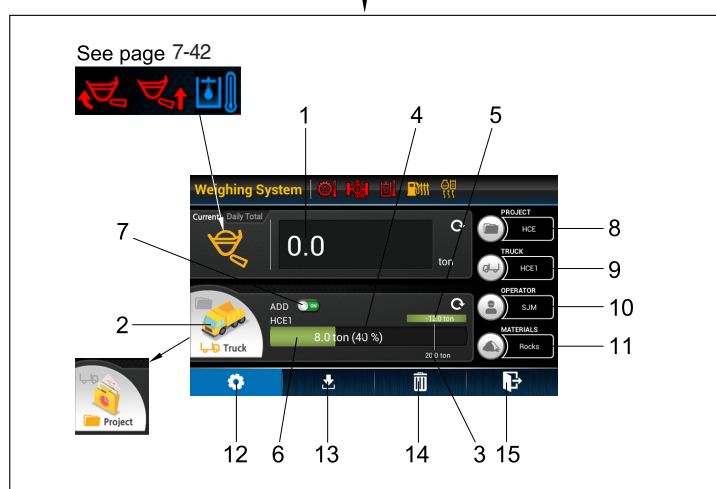
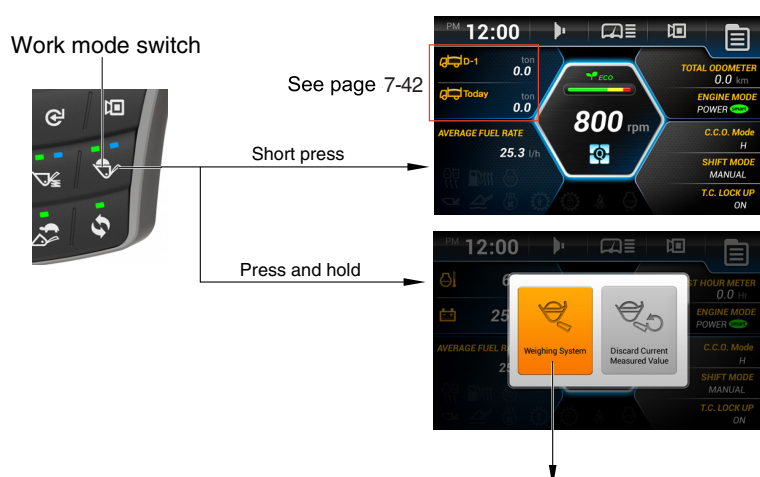
② ON, Always

- Select **ON, Always** in order to turn on the system for ride control regardless speed. The ride control will smooth the ride of the machine during travel.
- The green pilot lamp is turned ON.

③ ON/OFF

Select **ON/OFF** in order to turn on/off the system for the ride control.

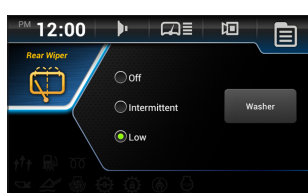
(11) Work mode switch



960A3CD115

- | | | | |
|---|---|----|---|
| 1 | Current weight in the bucket / Daily total weight | 7 | Select button for mode (Standby mode / Weigh mode) |
| 2 | Select button (Click gray icon) for status (Project status / Truck status) | 8 | Project name |
| 3 | Target weight | 9 | Truck name |
| 4 | Loaded weight | 10 | Operator |
| 5 | Remaining weight to complete job / Over weight to complete job | 11 | Materials |
| 6 | Progress bar / Total weight | 12 | Go to Work load setting menu |
| | | 13 | Save Work log to USB |
| | | 14 | Delete Work log |
| | | 15 | Go to Main menu |

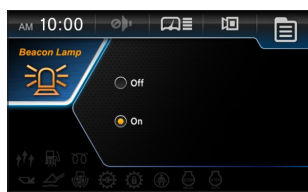
(12) Rear wiper and washer switch



760F3CD89-1

- ① This switch use to operates the rear wiper and washer.
When pressing the switch, the mode is changed sequence base.
(OFF → intermittent → Low → OFF)
 - **Intermittent** : The rear wiper operates intermittently.
 - **Low** : The rear wiper is operated lower speed.
 - **Washer** : The washer liquid is sprayed while long pressing the button.
- ② The green pilot lamp is turned ON.

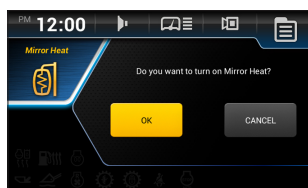
(13) Beacon lamp switch (option)



760F3CD88

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

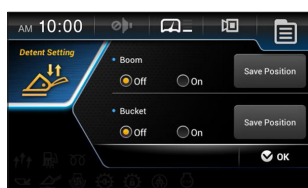
(14) Mirror defrost switch (option)



960A3CD65A

- ① **ON**
 - In condition of ON, it operates for 15 minutes. After 15 minutes, the defrost function stops automatically.
 - The green pilot lamp is turned ON.
- ② **OFF**
 - Stops defrost function.

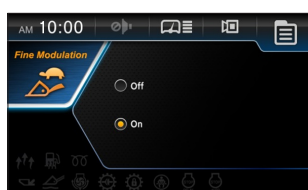
(15) Detent setting switch



760F3CD66

- ① **Boom and bucket**
 - Set the boom and bucket detent function ON/OFF.
 - ② **Save position**
 - Set the boom kickout and bucket leveler.
 - Refer to page 4-22 in operator's manual.
- ※ **The green pilot lamps are turned ON.**

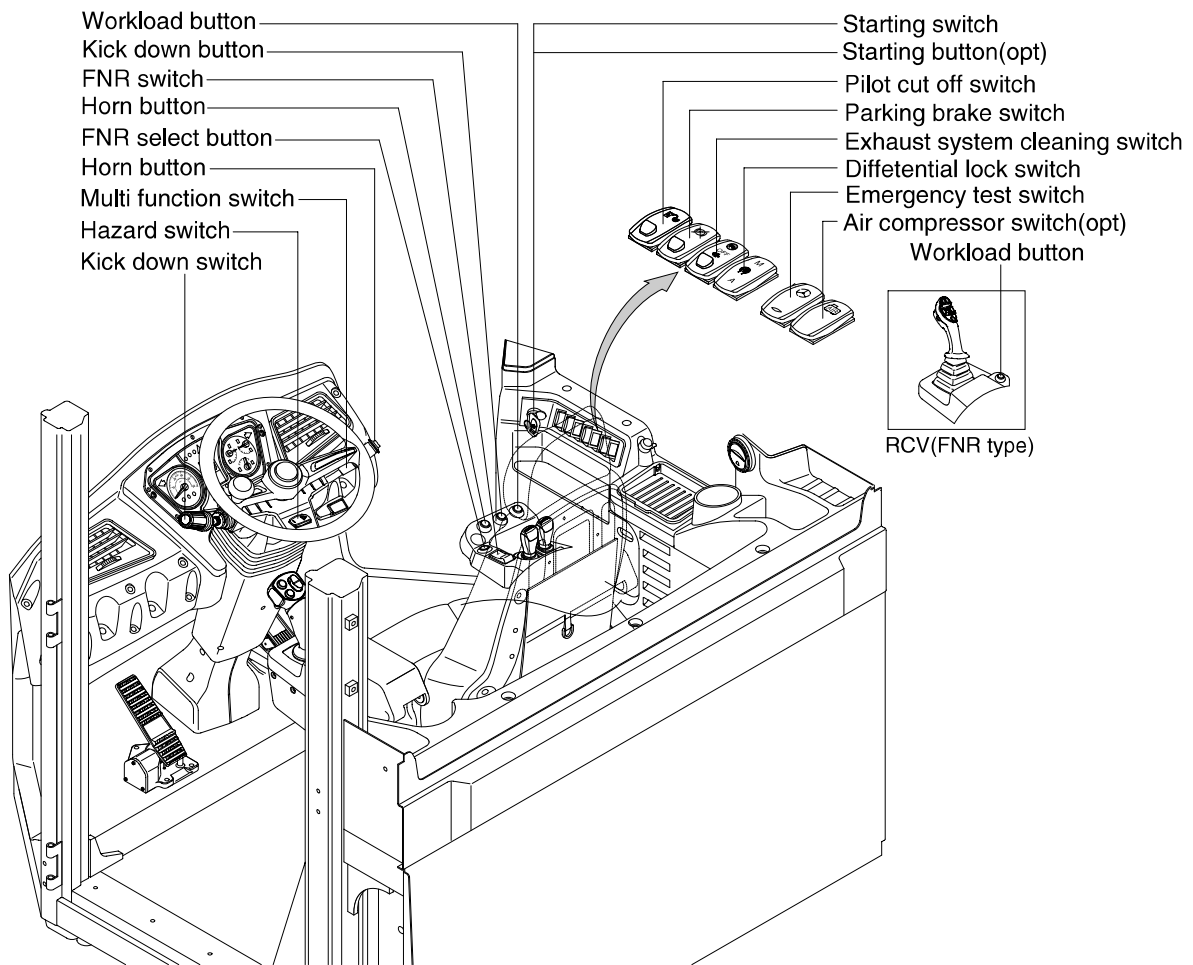
(16) Fine modulation switch



760F3CD67

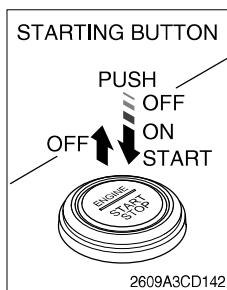
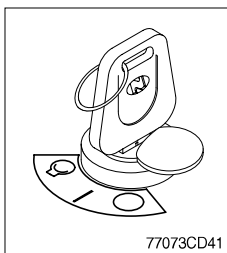
- ① **ON**
 - Remote control lever provide the operator with precise control of the work equipment (bucket and boom cylinders can be controlled precisely).
 - The green pilot lamp is turned ON.
- ② **OFF**
 - Turn off the function.

4. SWITCHES



960A3CD29A

1) STARTING SWITCH & STARTING BUTTON (OPT)



Starting button with smart key tag (opt)

(1) There are three positions, OFF, ON and START.

- ○ (OFF) : None of electrical circuits activate.
- | (ON) : All the systems of machine operate.
- ⦿ (START) : Use when starting the engine.

Release key immediately after starting.

※ If you turn ON the starting switch in cold weather, the fuel warmer is automatically operated to heat the fuel by sensing the coolant temperature. Start the engine in 1~2 minutes after turning ON the starting switch. More time may take according to ambient temperature.

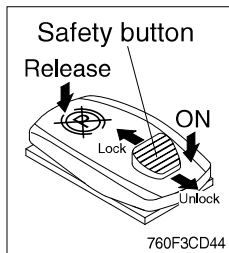
※ Key must be in the ON position with engine running maintain electrical and hydraulic function and prevent serious machine damage.

2) PILOT CUT OFF SWITCH



- (1) When the switch is pressed to OFF position, the hydraulic pilot line will be cut off, so the work equipment will not operate.
 - (2) Press the ON position in order to unlock the hydraulic pilot line.
- ※ **This switch can be set to ON or OFF position only when the safety button is pulled to the unlock position.**

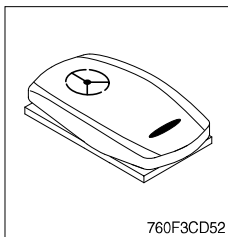
3) PARKING BRAKE SWITCH



- (1) When the switch is pressed to ON position, the parking brake will start to operate and the cluster warning lamp will come ON.
 - (2) Press the release position in order to disengage the parking brake.
- ※ **When operating the gear selector lever, be sure to release the parking brake. If the machine is operated with the parking brake engaged, the brake will overheat and may cause the brake system to go out of order.**
- ※ **This switch can be set to ON or Release position only when the safety button is pulled to the unlock position.**

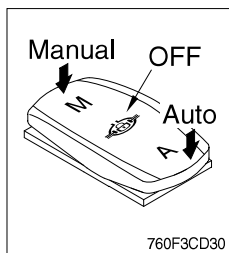
- ※ **If you turn ON the starting switch with the parking brake disengaged (release position), the parking brake will be engaged.**
- To release the parking brake, press the parking brake switch to ON and Release position.**

4) EMERGENCY TEST SWITCH (option)



- (1) The emergency steering system can be manually tested. Push the switch in order to determine if the emergency steering and the emergency steering lamp are functional.
- (2) When the switch is pressed, the emergency steering pump motor will run. The emergency steering lamp will light. If the emergency steering lamp does not light, do not operate the machine.

5) DIFFERENTIAL LOCK SWITCH (option)



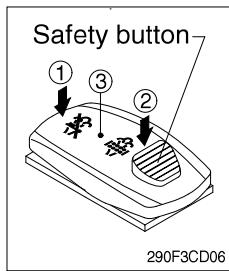
- (1) This switch is used to apply differential lock.
The differential lock gives equal power to both front wheels and is used in conditions when traction is poor.
- (2) **Manual mode**
Press the **M** of the switch for the manual mode of the differential lock function. You press the switch, the differential lock will engage immediately and differential lock pilot lamp lights ON (buzzer sounds). Manual mode is temporarily engaged as long as the operator pushes the switch. When the switch is released, differential lock function is disengaged and the switch returns to OFF position.

(3) Auto mode

Press the **A** of the switch for auto mode of the differential lock function. If you press the switch, the axle differential lock will automatically engage when the differential function is used.

- ※ **While the axle differential lock function is operating, the differential lock pilot lamp lights ON.**

6) EXHAUST SYSTEM CLEANING SWITCH



(1) This switch is used to select the exhaust system cleaning.

(2) Inhibit position (①)

- ① The inhibit position disallows any automatic or manual exhaust system cleaning.
- ② This may be used by operator to prevent exhaust system cleaning when the machine is operating in a hazardous environment is concerned about high temperature.
- ③ It is strongly recommended that this position is only activated when high temperatures may cause a hazardous condition.

(3) Auto position (③)

This position will initiate a automatic exhaust system cleaning.

(4) Manual position (②)

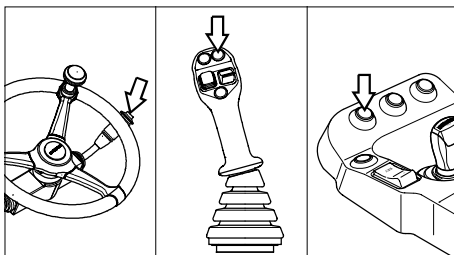
- ① This position will only initiate a manual exhaust system cleaning when the machine is in non-mission condition, engine must run at low idle speed and exhaust system levels are high enough to allow cleaning.
- ② HEST lamp will be illuminated during the entire exhaust system cleaning.

※ Refer to the page 7-29 for details.

※ This switch can be move to the manual position (②) only when the safety button is pulled to backward.

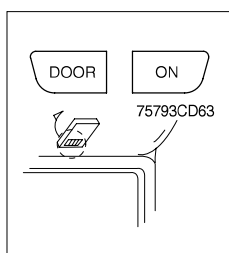
※ Also, this switch return to the auto position when released the manual position (②).

7) HORN BUTTON



(1) If you press the button, the horn will sound.

8) CAB LAMP SWITCH



(1) This switch turns ON the cab room lamp.

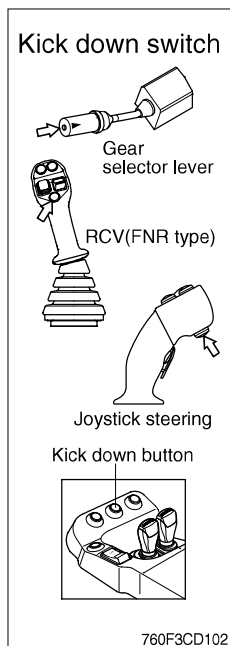
① DOOR

The lamp comes ON when the door is opened.
When the door is closed the lamp is OFF.

② ON

This switch is used to turn the lamp ON or OFF.

9) KICK DOWN SWITCH



(1) Manual mode

It is effective 2nd speed to 1st speed only and recover to 2nd speed quickly when push the switch one more time.

(2) Automatic mode

① Mode 1 (down/up)

It shifts down quickly from current gear to one step lower speed by pushing the switch and recover to current speed quickly when push the switch one more time.

② Mode 2 (down)

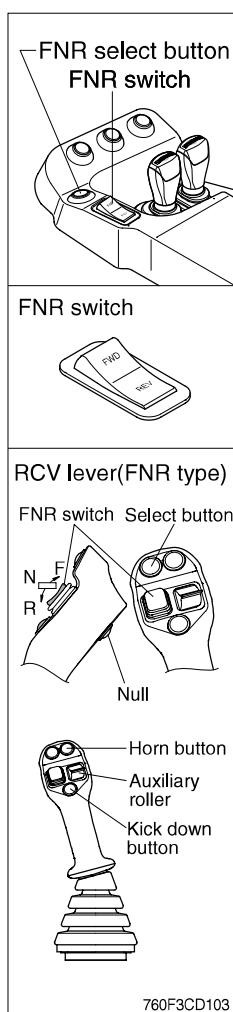
It shifts down from current gear to one step lower speed when push the switch every time.

The kick down function is released in only 1st speed.

※ Refer to page 7-40 for the kick down mode.

※ The normal autoshift function continues after the kick down switch is released.

10) FNR SELECT BUTTON AND SWITCH



(1) These button and switch are used for forward and backward drive.

※ Gear range can be selected by gear selector lever.

(2) FNR select button

① If the select button is pressed, the indication lamp on the cluster will be ON and this FNR switch will start to operate.

※ When the engine is running, the machine is on standstill (0 speed), parking brake is released, gear selector lever is in the neutral position, you can use this function after pressing the select button.

(3) FNR switch

- F : Forward drive
- N : Neutral
- R : Reverse drive

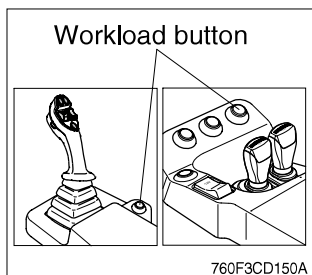
① If the upper side (F, FWD) of this switch is pushed, the machine moves forward.

② If the down side (R, REV) of this switch is pushed, the machine moves backward.

③ This function is automatically released when the engine is stopped, parking brake is ON or gear selector lever is out of neutral.

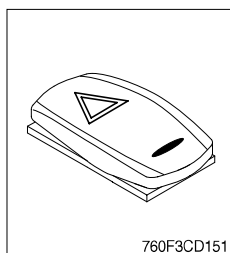
(4) **Auxiliary roller** : If the machine is equipped with auxiliary hydraulics, this roller is used for the attachments.

11) WORKLOAD BUTTON



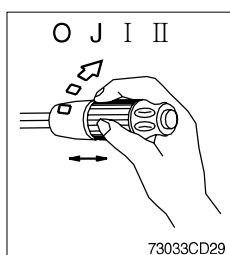
- (1) This button is used to calculate the weight manually.
If the button is not pushed, the weight of the weighing system is not calculated.
 - (2) This button is pushed for one second more, calculated weight will be accumulated.
- ※ **Refer to the page 7-42, weighing system.**

12) HAZARD SWITCH



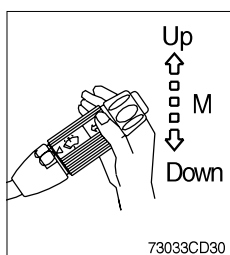
- (1) Use for parking or loading the machine.
 - (2) Both turn signal lights will flash simultaneously.
- ※ **If the switch is left ON for a long time, the battery may be discharged.**

13) MULTI FUNCTION SWITCH



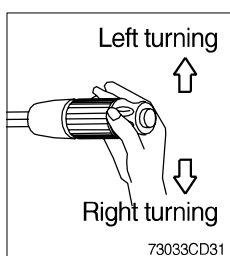
(1) Front wiper and washer switch

- ① When the switch is in J position, the wiper moves intermittently.
※ **Refer to the page 7-44 (Wiper level setting).**
 - ② When placed in I or II position, the wiper moves continuously.
 - ③ If you push the grip of the lever, washer liquid will be sprayed and the wiper will be activated 2-3 times.
- ※ **Check the quantity of washer liquid in the tank. If the level of the washer liquid is LOW, add the washer liquid (in cold, winter days) or water. The capacity of the tank is 1 liter.**
- ※ **If the wiper does not operate with the switch in ON (J, I, II) position, turn the switch OFF (O) immediately and check the cause. If the switch remains ON, motor failure can result.**



(2) Dimmer switch

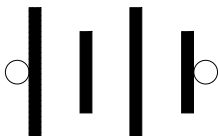
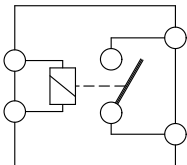
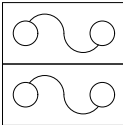
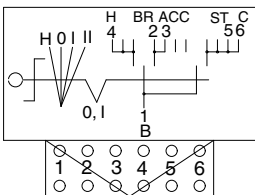
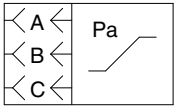
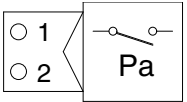
- ① This switch is used to turn the head lights direction.
- ② Switch positions
 - Up : To flash for passing
 - Middle : Head lights low beam ON
 - Down : Head lights high beam ON
- ③ If you release the switch when it's in up position, the switch will return to middle.

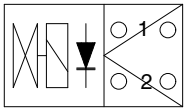
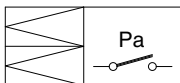
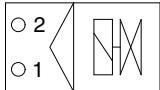
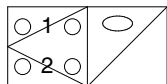
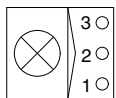
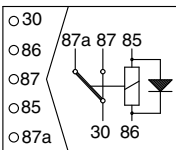


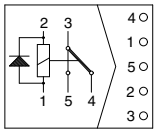
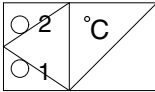
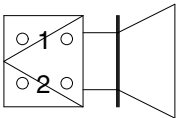
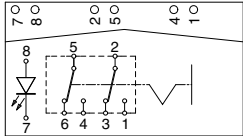
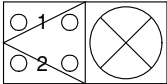
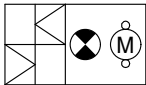
(3) Turning switch

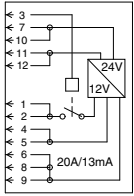
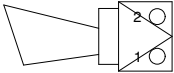
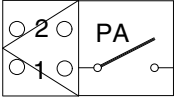
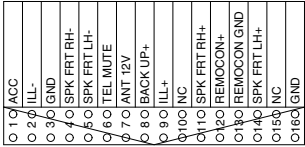
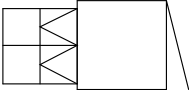
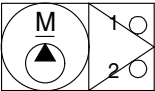
- ① This switch is used to warn or signal the turning direction of the machine to other vehicles or equipment.
- ② Push the lever up for turning left, pull the lever down for turning right.

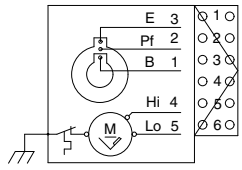
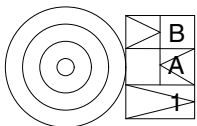
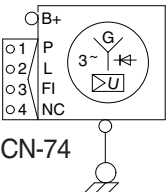
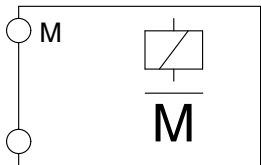
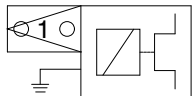
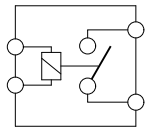
GROUP 4 ELECTRICAL COMPONENT SPECIFICATION

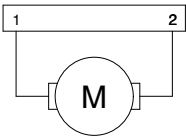
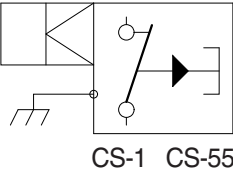
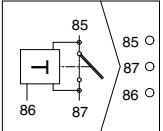
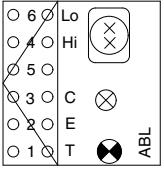
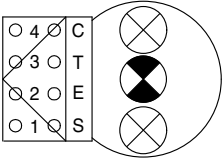
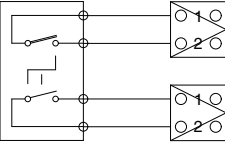
| Part name | Symbol | Specifications | Check item |
|-----------------|---|--|--|
| Battery |  | 12V × 160Ah (2EA) | Gravity 1.280 over : over charged 1.280 ~ 1.250 : normal 1.250 below : discharged |
| Battery relay |  CR-1 | Rated load : 24V 100A (continuity) 1000A (30seconds) | Coil resistance broken : approx 50 Ω connected : ∞ Ω |
| Fusible link |  CN-351 (40A), CN-352 (80A) | 24V | Resistance between ring terminal and each connector pin 0 Ω : normal |
| Start key |  CS-2 | B-BR : 24V 1A B-ACC : 24V 10A B-ST : 20V 40A | Resistance between each pin Key off : ∞ Ω (for each pin) Key on : 0 Ω (for pin 1-2 & 1-3) Start : 0 Ω (for pin 1-5) |
| Pressure switch |  CD-3 CD-26 CD-31 CD-39 CD-40 CD-58 CD-79 CD-80 CD-81 | N.C Type | Resistance 0 Ω : normal (close) |
| Pressure switch |  CD-48 CD-129 | N.O Type | Resistance ∞ Ω : normal (open) |

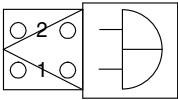
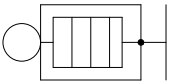
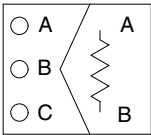
| Part name | Symbol | Specifications | Check item |
|---|--|---------------------------|--|
| Pilot cut off, parking brake, diff lock, attach lock, unlock solenoid |  CN-68 CN-177 CN-71 CN-178 CN-79 | 24V 1A | Resistance normal : 15~25 Ω |
| Air cleaner pressure switch |  CD-10 | Max load : 6W N.O Type | Resistance ∞ Ω : normal (open) |
| Lock-up, Ride control valve / Fan sole- noid |  CN-43 CN-136 CN-154 CN-155 | 24V 1.2A | ※ Check LED lamp ※ Check resistance about 24 Ω |
| Fuel sender |  CD-2 | - | Resistance at fuel levels full level : 200 Ω 9/12 level : 500 Ω 6/12 level : 800 Ω 3/12 level : 1100 Ω empty : 1300 Ω |
| Room lamp |  CL-1 | 24V 10W | Resistance normal : 1.2 Ω |
| Relay (5pin) |  CR-3 CR-5 CR-7 CR-30 CR-35 CR-36 CR-38 CR-40 CR-46 CR-55 CR-56 CR-63 CR-210 CR-211 CR-381 | 24V 20A | Resistance normal : about 160 Ω (for pin 85~86) 0 Ω (for pin 30~87) ∞ Ω (for pin 30~87) |

| Part name | Symbol | Specifications | Check item |
|---|---|--|---|
| Relay (5 pin) |  CR-2 CR-4 CR-25 CR-26 CR-37 CR-58 CR-79 CR-115 CR-117 CR-136 CR-302 CR-303 | 24V 20A | Resistance normal : about 160 Ω (for pin 1~2) 0 Ω (for pin 3~4) ∞ Ω (for pin 3~5) |
| Hydraulic, transmission temperature |  CD-1 CD-49 | - | Resistance normal : ∞ Ω 105° C over : 0 Ω |
| Speaker |  CN-123 (LH) CN-124 (RH) | 4 Ω 20W | Resistance normal : 4 Ω |
| Switch (Locking type) |  CS-4 CS-17 CS-75 | 24V 8A | Resistance at switch off position ∞ Ω between pin 1-5 and 2-6 0 Ω between pin 5-7 and 6-8 |
| Work lamp, Number plate lamp |  CL-21 CL-32 CL-33 CL-35 CL-36 CL-42 CL-43 CL-45 CL-46 | Work lamp 24V 70W Number plate lamp 24V 10W | Resistance normal : 1.2 Ω |
| Beacon lamp |  CL-117 | 24V 70W (H1 TYPE) | Resistance normal : 1.1 Ω |

| Part name | Symbol | Specifications | Check item |
|--------------------|--|-------------------|--|
| DC/DC Converter |  CN-138 | 12V 3A | Resistance 8.8 Ω (for pin A-B) 7.7 Ω (for pin B-C) |
| Horn |  CN-120 CN-121 | 24V 2A | Operation by external power source - connect 24V power to (+) terminal - ground the (-) terminal |
| Receiver dryer |  CN-29 | 24V 2.5A | Resistance 0 Ω : $2.1 \pm 0.3 \sim 27 \pm 2 \text{ kgf/cm}^2$ ∞ Ω : $\sim 2.1 \pm 0.3, 27 \pm 2 \sim \text{kgf/cm}^2$ |
| Radio & USB player |  CN-27 | 24V 20W+20W | Resistance Power ON : 4 Ω + 4 Ω (for pin 1-6, 4-8) |
| Back up buzzer |  CN-65 | 24V 0.5A 110dB | Resistance normal : 5.2 Ω |
| Washer pump |  CN-102 (FR) CN-103 (RR) | 24V 2.5A | Resistance normal : 26.4 Ω (for pin1-2) |

| Part name | Symbol | Specifications | Check item |
|-------------------|---|-------------------------------------|---|
| Wiper motor |  <p>CN-21 (FR) CN-102 (RR)</p> | 24V 1.5A 2-speed Auto parking | - |
| Cigar lighter |  <p>CL-2</p> | 24V 5A 1.4W | Coil resistance normal : about 1M Ω |
| Alternator |  <p>CN-74</p> | Denso 24V 95A | Voltage normal : 24~28V |
| Starter |  <p>CN-45</p> | Denso PA90L (24V-5.5kW) | Operating or not |
| Aircon compressor |  <p>CN-28</p> | 24V 79W | Resistance normal : 13.4 Ω |
| Start relay |  <p>CR-23</p> | 24V 300A | Coil resistance normal : 1-2 Ω Switch connection ∞ Ω at normal open position 0 Ω when engaged |

| Part name | Symbol | Specifications | Check item |
|-------------------|--|--|--|
| Blower motor |  | 24V 9.5A | Resistance at each switch position normal : 0.5-2 Ω |
| Door switch |  CS-1 CS-55 | 24V 2W | Resistance normal : about 5M Ω |
| Flasher unit |  CR-11 | 24V 85 ~ 190 C/M 50dB | - |
| Head lamp |  CL-3 CL-4 | 24V 75W/70W (H4 TYPE) 24V 4W (T4W) | Resistance normal : a few Ω |
| Combi lamp (rear) |  CL-15 CL-16 | 24V 5W (R5W) 2 × 24V 21W (P21W) | - |
| Master switch |  CS-74 CS-75 | Continuous capacity : 180Amp Push in capacity : 1000Amp | - |

| Part name | Symbol | Specifications | Check item |
|----------------|---|---|------------------------------------|
| Warning buzzer |  CN-26 | 24V 200mA $90 \pm 5\text{dB}$ (l m) | - |
| Preheater |  CN-80 | 24V 200A | Resistance 0.25~0.12 Ω |
| Resistor |  CN-99 | 4W | Resistance A - B : 120 Ω |

GROUP 5 CONNECTORS

1. CONNECTOR DESTINATION

| Connector number | Type | No. of pin | Destination | Connector part No. | |
|------------------|-----------|------------|--|--------------------|------------------|
| | | | | Female | Male |
| CN-1 | DEUTSCH | 48 | I/conn (Frame harness-Main harness) | DRB16-48SAE-L018 | DRB12-48PAE-L018 |
| CN-2 | DEUTSCH | 60 | I/conn (Front harness-Main harness) | DRB12-60SBE-L018 | DRB12-60PBE-L018 |
| CN-4 | DEUTSCH | 60 | I/conn (Engine harness-Main harness) | DRB16-60SAE-L018 | DRB12-60PAE-L018 |
| CN-5 | DEUTSCH | 60 | I/conn (Front harness-Main harness) | DRB16-60SBE-L018 | DRB12-60PBE-L018 |
| CN-7 | AMP | 15 | I/conn (Main harness-Cab harness) | 2-85262-1 | 368301-1 |
| CN-9 | DEUTSCH | 6 | I/conn (Main harness-Cab harness) | 174264-2 | 174262-2 |
| CN-11 | AMP | 15 | I/conn (Main harness-Aircon harness) | HDP26-24-35SN | HDP24-24-35PN |
| CN-12 | DEUTSCH | 35 | I/conn (Front harness-Bottom harness) | 2-85262-1 | 368301-1 |
| CN-14 | DEUTSCH | 12 | I/conn (Frame harness-Grill harness) | DT06-12S | DT04-12P |
| CN-15 | KET | 11 | I/conn (RH console harness-Main harness) | MG651350 | MG641353 |
| CN-16 | KET | 14 | I/conn (RH console harness-Main harness) | MG651110 | MG641113 |
| CN-18 | DEUTSCH | 12 | LH seat console | DT06-12S | DT04-12P |
| CN-19 | DEUTSCH | 2 | I/conn (Emer steer harness-Bottom harness) | DT04-2S | DT04-2P |
| CN-21 | AMP | 6 | Front wiper motor | 936257-1 | - |
| CN-22 | DEUTSCH | 2 | Compressor | DTP06-2S | |
| CN-24 | DEUTSCH | 12 | Grill harness | DT06-12S | - |
| CN-26 | TYCO | 10 | EHI unit | 174655-2 | 174657-2 |
| CN-26A | AMP | 10 | Joystick steering | - | 174657-2 |
| CN-27 | MK II | 16 | Radio and USB player | PK145-16017 | - |
| CN-27A | MK II | 8 | USB connector | 174984-2 | - |
| CN-31 | DEUTSCH | 3 | Brake priority | DT06-3S | - |
| CN-36~39 | - | - | Fuse box | 21WD-15021 | - |
| CN-43 | AMP | 2 | Lock-up | 282028 | - |
| CN-45 | Ring term | - | Starter | R14-12 | ST 710246-2 |
| CN-48 | AMP | 1 | Hour meter | 2-520193-2 | - |
| CN-51 | AMP | 34 | MCU | 4-1437290-1 | - |
| CN-52 | AMP | 34 | MCU | 2-1437285-3 | - |
| CN-53 | AMP | 26 | MCU | 1473416-1 | |
| CN-54 | AMP | 34 | MCU | 4-1437290-1 | |
| CN-56 | KUM | 16 | Cluster | KPK145-16017 | - |
| CN-57 | AMP | 20 | Monitor | 174047-2 | - |
| CN-64 | MOLEX | 4 | Smart key | 39012040 | - |
| CN-65 | DEUTSCH | 2 | Back up buzzer | DT06-2S | - |
| CN-68 | DEUTSCH | 2 | Pilot cut off | DT06-2S | - |
| CN-71 | DEUTSCH | 2 | Parking solenoid | DT06-2S | - |
| CN-72 | DEUTSCH | 2 | Cowl open activator | DT06-2S | - |

| Connector number | Type | No. of pin | Destination | Connector part No. | |
|------------------|-------------|------------|---|--------------------|--------------|
| | | | | Female | Male |
| CN-74 | PACKARD | 4 | Alternator | 1218-6568 | - |
| CN-79 | DEUTSCH | 2 | Differential lock solenoid | DT06-2S | - |
| CN-79A | DEUTSCH | 2 | Differential lock solenoid | DT06-2S | DT04-2D-E005 |
| CN-83 | NMWP | 2 | Aircon fan | PB625-02027 | - |
| CN-100 | DEUTSCH | 3 | Boom kick out | DT06-3S | - |
| CN-101 | DEUTSCH | 3 | Bucket leveler | DT06-3S | - |
| CN-102 | KET | 2 | Front washer tank | MG640605 | - |
| CN-103 | KET | 2 | Rear washer tank | MG640605 | - |
| CN-112 | - | 16 | Gear box | 21L7-60290 | - |
| CN-115 | DEUTSCH | 6 | Auto grease | DT06-6S | DT04-6P |
| CN-120 | MOLEX | 2 | Horn | 26825-0211 | - |
| CN-121 | MOLEX | 2 | Horn | 26825-0211 | - |
| CN-123 | KET | 2 | Speaker (LH) | 7123-1520 | - |
| CN-124 | KET | 2 | Speaker (RH) | 7123-1520 | - |
| CN-125 | DEUTSCH | 12 | RMCU(remote management control unit) | DT06-12S | DT04-12P |
| CN-126 | DEUTSCH | 9 | Data link | HD10-9-96P | - |
| CN-128 | NMWP | 1 | Aircon compressor | PB625-01027 | - |
| CN-129 | KET | 2 | Receiver drier | MG640795 | - |
| CN-134 | AMP | 6 | Diagnostic (TCU) | 1-480705-0 | - |
| CN-136 | DEUTSCH | 2 | Ride control solenoid | DT06-2 | - |
| CN-136A | Econoseal J | 2 | I/conn (Ride control harness-Front harness) | S816-002002 | S816-102002 |
| CN-137 | AMP | 1 | 12V socket | 172434-2 | - |
| CN-138 | AMP | 12 | DC/DC Converter | 1-967622-1 | - |
| CN-139 | AMP | 2 | 12V socket | 172434-2 | - |
| CN-149 | DEUTSCH | 2 | Mirror heat (LH) | DT06-2S | DT04-2P |
| CN-150 | DEUTSCH | 2 | Mirror heat (RH) | DT06-2S | DT04-2P |
| CN-152 | AMP | 4 | Proportional valve | 2-967059-1 | - |
| CN-154 | DEUTSCH | 2 | Fan speed solenoid | DT06-2S | - |
| CN-155 | DEUTSCH | 2 | Fan reverse solenoid | DT06-2S | - |
| CN-156 | DEUTSCH | 2 | Seat heat (with switch) | - | DT04-2P-E005 |
| CN-157 | AMP | 68 | T/M control unit | 963598-1 | - |
| CN-158 | PACKARD | 4 | Gear shift lever | 1201-0974 | - |
| CN-159 | PACKARD | 4 | Gear shift lever | 1201-5797 | - |
| CN-160 | CARLING | 12 | FNR joystick lever | LC3-01 | - |
| CN-162 | AMP | 6 | Pedal | 174262-2 | - |
| CN-163 | AMP | 2 | ECO feeling switch | 174352-2 | - |
| CN-171 | AMP | 1 | Service socket | 172434-2 | - |
| CN-177 | DEUTSCH | 2 | Quick coupler unlock solenoid | DT06-2S | - |

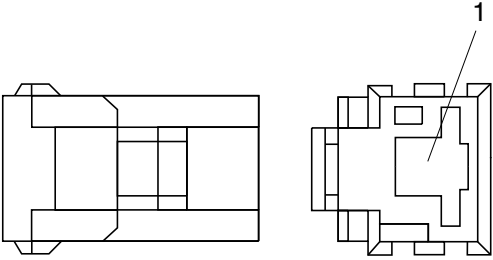
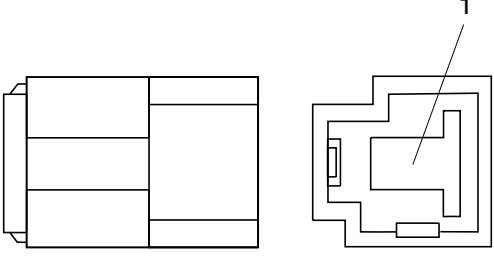
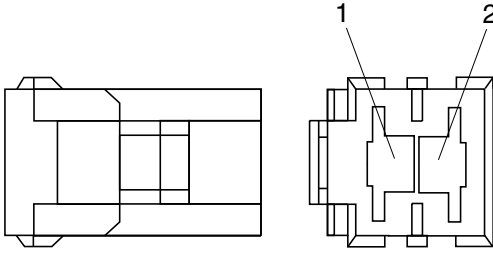
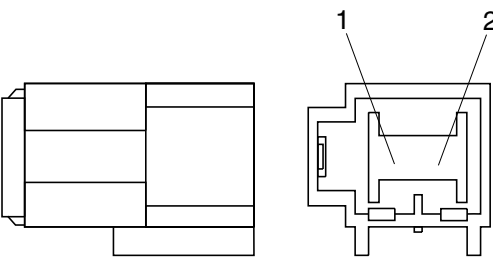
| Connector number | Type | No. of pin | Destination | Connector part No. | |
|------------------|-------------|------------|--|--------------------|--------------|
| | | | | Female | Male |
| CN-177A | Econoseal J | 3 | I/conn (Front harness-Quick coupler harness) | S816-003002 | S816-103002 |
| CN-178 | DEUTSCH | 2 | Quick coupler lock solenoid | DT06-2S | - |
| CN-196 | PACKARD | 4 | Fuel heater | 2-967325-3 | - |
| CN-203 | AMP | 6 | Rear wiper motor | 936257-1 | - |
| CN-246 | KET | 1 | PTC power | - | MG620659-5 |
| CN-249 | DEUTSCH | 6 | Camera | DT06-4S | DT04-6P |
| CN-250 | DEUTSCH | 2 | Seat belt alarm | DT06-2S-EP06 | - |
| CN-252 | TYCO | 6 | Differential lock | S816-006602 | S816-106602 |
| CN-313 | DEUTSCH | 6 | AAVM monitor service tool | DT06-4S-EP06 | DT06-4S-EP06 |
| CN-399 | AMP | 4 | DEF sensor | 1-967325-1 | - |
| CN-431 | KET | 20 | AAVM monitor | MG635026 | - |
| CN-J2 | DELPHI | 96 | ECM | 13964572 | - |
| CN-J7A | AMP | 4 | Nox sensor engine inlet | 2-1418390-1 | - |
| CN-J7B | AMP | 4 | Nox sensor turbo pipe | 1-1418390-1 | - |
| CN-J10 | AMP | 4 | SCR temp sensor | 3-1418390-1 | - |
| CN-J17 | AMP | 4 | DOC temp sensor | 4-1418390-1 | - |
| CN-J26 | BOSCH | 12 | DEF supply module | 2-1703639-1 | - |
| CN-J27 | AMP | 2 | DEF heater valve | 174352-2 | - |
| CN-J28 | DEUTSCH | 2 | Hose heating PR line | DT06-2S | - |
| CN-J29 | DEUTSCH | 2 | Hose heating back line | DT06-2S | - |
| CN-J30 | DEUTSCH | 2 | Hose heating suction line | DT06-2S | - |
| CN-J31 | DEUTSCH | 2 | DEF dosing inlet valve | DT06-2S | - |
| Relay | | | | | |
| CR-1 | Ring term | - | Battery relay | S820-104002 | - |
| CR-2 | AMP | 5 | Horn relay | VCFM-1002 | - |
| CR-3 | AMP | 5 | Front work lamp relay | VCFM-1002 | - |
| CR-4 | AMP | 5 | Wiper relay (Hi) | VCFM-1002 | - |
| CR-5 | HELLA | 5 | Safety relay | 8JA003526-001 | - |
| CR-7 | AMP | 5 | Aircon relay | VCFM-1002 | - |
| CR-11 | 250 | - | Flasher unit | S810-003702 | - |
| CR-23 | Ring term | - | Start relay | ST 710289-2 | ST 710384-2 |
| CR-24 | Shur | 1 | Preheater relay | S822-014000 | - |
| CR-25 | AMP | 5 | Rear wiper relay | VCFM-1002 | - |
| CR-26 | AMP | 5 | Wiper relay (low) | VCFM-1002 | - |
| CR-30 | HELLA | 5 | ECM power relay | 8JA003526-001 | - |
| CR-36 | AMP | 5 | Preheater relay | VCFM-1002 | - |
| CR-39 | - | 2 | Emergency steering pump relay | S820-104000 | - |
| CR-40 | KET | 5 | EHCUC power relay | MG610047-1 | - |

| Connector number | Type | No. of pin | Destination | Connector part No. | |
|------------------|---------|------------|--------------------------------|--------------------|----------|
| | | | | Female | Male |
| CR-46 | HELLA | 5 | Fuel warmer relay | 8JA003526-001 | - |
| CR-55 | AMP | 5 | Rear work lamp relay | VCFM-1002 | - |
| CR-56 | KET | 5 | Mirror heat relay | MG610047-1 | - |
| CR-58 | AMP | 5 | Back up relay | VCFM-1002 | - |
| CR-63 | AMP | 5 | Stop lamp relay | VCFM-1002 | - |
| Switch | | | | | |
| CS-1 | AMP | 1 | Door switch | ST730018-3 | - |
| CS-2 | KET | 6 | Start key switch | MG610335-5 | - |
| CS-4 | CARLING | 10 | Pilot cut off switch | VC2-01 | - |
| CS-11 | KET | 8 | Multi function switch | MG610339-5 | - |
| CS-12 | KET | 6 | Multi function switch | MG610339-5 | - |
| CS-13 | KET | 1 | Multi function switch | ST730018-3 | - |
| CS-17 | CARLING | 10 | Parking switch | VC2-01 | - |
| CS-33 | AMP | 6 | Engine stop switch | 174262-2 | - |
| CS-41 | CARLING | 10 | Hazard switch | VC2-01 | - |
| CS-74 | DEUTSCH | 2 | Master switch | DT06-2S | - |
| CS-75 | CARLING | 10 | Emergency steering test switch | VC2-01 | - |
| CS-79 | CARLING | 10 | Differential lock switch | VC2-01 | - |
| CS-85, 85L | KET | 2 | Workload switch | MG610070 | MG620074 |
| CS-86, 86L | KET | 2 | Kick down switch | MG610070 | MG620074 |
| CS-87, 87L | KET | 2 | Horn switch | MG610070 | MG620074 |
| CS-88, 88L | KET | 2 | FNR select switch | MG610070 | MG620074 |
| CS-105 | CARLING | 10 | SCR switch | VC2-01 | - |
| Light | | | | | |
| CL-1 | KET | 3 | Room lamp | MG651032 | - |
| CL-3 | DEUTSCH | 6 | Head light (LH) | DT06-6S-EP06 | - |
| CL-4 | DEUTSCH | 6 | Head light (RH) | DT06-6S-EP06 | - |
| CL-15 | YAZAKI | 4 | Combi lamp (RR, LH) | 7232-7444 | - |
| CL-16 | YAZAKI | 4 | Combi lamp (RR, RH) | 7232-7444 | - |
| CL-21 | SWP | 2 | Number plate lamp | S814-002000 | - |
| CL-22 | DEUTSCH | 2 | Work light (LH) | DT06-2S | - |
| CL-23 | DEUTSCH | 2 | Work light (RH) | DT06-2S | - |
| CL-32 | DEUTSCH | 2 | Rear work light (RH) | DT06-2S | DT04-2P |
| CL-33 | DEUTSCH | 2 | Rear work light (LH) | DT06-2S | DT04-2P |
| CL-42 | DEUTSCH | 2 | Rear work light (opt) | DT06-2S | DT04-2P |
| CL-45 | DEUTSCH | 2 | Work light (RH) | DT06-2S-EP06 | - |
| CL-46 | DEUTSCH | 2 | Work light (LH) | DT06-2S-EP06 | - |
| CL-117 | AMP | 2 | Beacon lamp | 174198-2 | - |

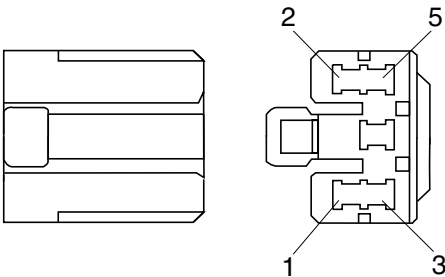
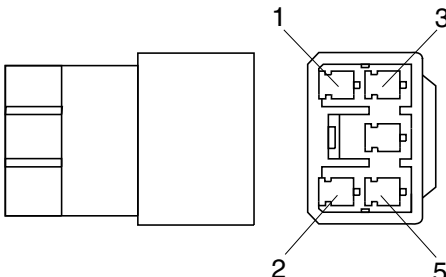
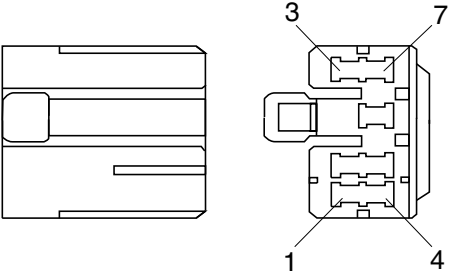
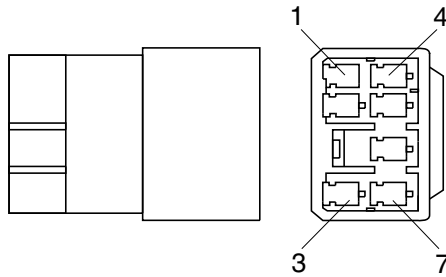
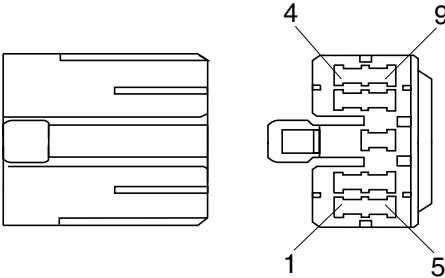
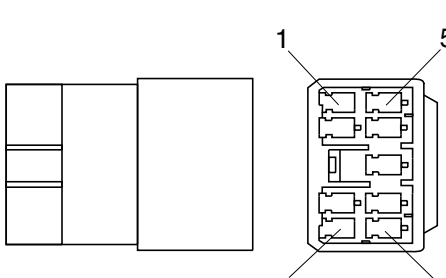
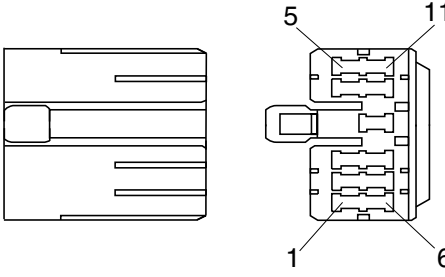
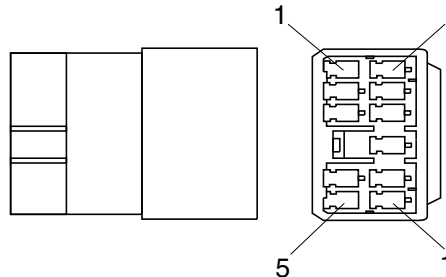
| Connector number | Type | No. of pin | Destination | Connector part No. | |
|------------------|----------|------------|--------------------------------|--------------------|---------|
| | | | | Female | Male |
| Sensor, sender | | | | | |
| CD-1 | AMP | 2 | Hyduaualic oil temp sendor | 85202-1 | - |
| CD-2 | YAZAKI | 2 | Fuel sendor | 7123-7424 | - |
| CD-3 | DEUTSCH | 3 | Brake fail pressure switch | DT06-3S | - |
| CD-4 | DEUTSCH | 3 | Stop lamp pressure switch | DT06-3S | - |
| CD-5 | PACKARD | 3 | Clutch cut off pressure switch | - | 1215793 |
| CD-10 | AMP | 2 | Air cleaner switch | 85202-1 | - |
| CD-17 | AMP | 2 | Engine pick-up sensor | 85202-1 | - |
| CD-26 | DEUTSCH | 3 | Parking pressure switch | DT06-3S | - |
| CD-27 | AMP | 2 | Turbin pick up sensor | 85202-1 | - |
| CD-31 | DEUTSCH | 3 | Brake priority pressure switch | DT06-3S | - |
| CD-39 | DEUTSCH | 3 | Main pump pressure switch | DT06-3S | - |
| CD-40 | DEUTSCH | 3 | Steering pump pressure switch | DT06-3S | - |
| CD-43 | AMP | 2 | Lock up proportional valve | 282027 | - |
| CD-45 | DEUTSCH | 2 | WIF sensor | DT06-2S-EP06 | - |
| CD-46 | AMP | 3 | Output speed sensor | 282087 | - |
| CD-47 | AMP | 2 | Gear chain sensor | 85202-5 | - |
| CD-48 | AMP | 2 | Oil filter restriction sensor | 282080 | - |
| CD-49 | AMP | 2 | Converter temp sensor | 85202-1 | - |
| CD-73 | AMP | 2 | Speed sendor | 174352-2 | - |
| CD-79 | DEUTSCH | 3 | Diff lock feed back sensor | DT06-3S | - |
| CD-80 | DEUTSCH | 3 | Boom positioner sensor | DT06-3S | - |
| CD-81 | DEUTSCH | 3 | Bucket positioner sensor | DT06-3S | - |
| CD-96 | PACKARD | 3 | Coolant level sensor | 12110293 | - |
| CD-101 | SUMITOMO | 4 | TBAP sensor | 6098-0144 | - |

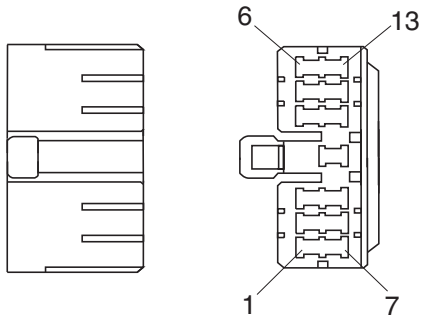
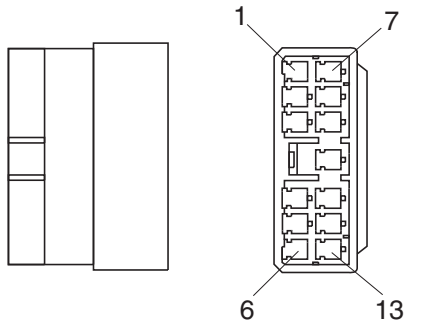
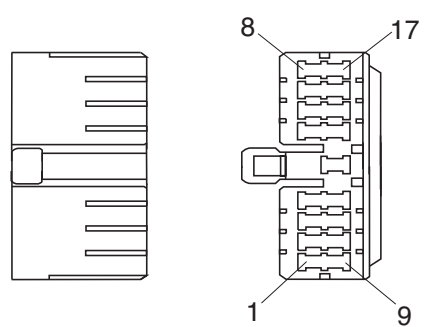
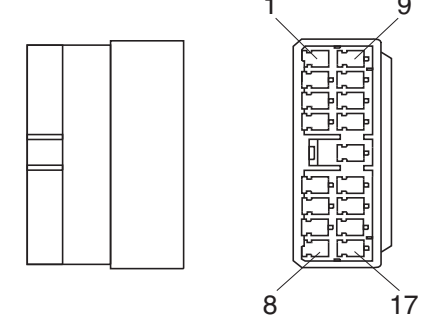
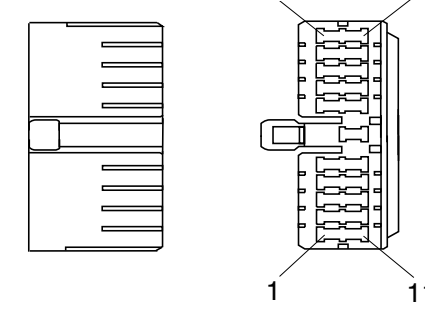
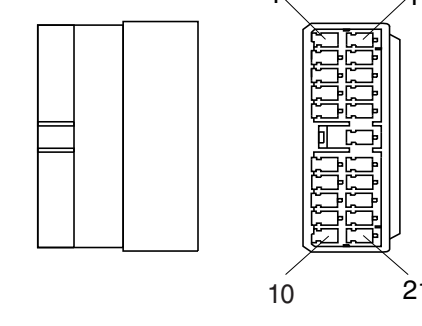
2. CONNECTION TABLE FOR CONNECTORS

1) 58-L TYPE CONNECTOR

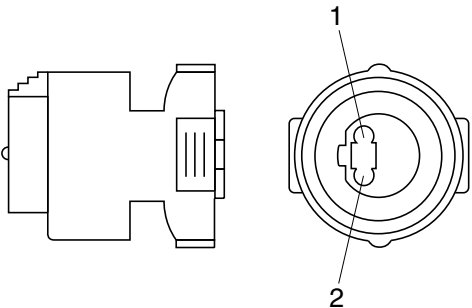
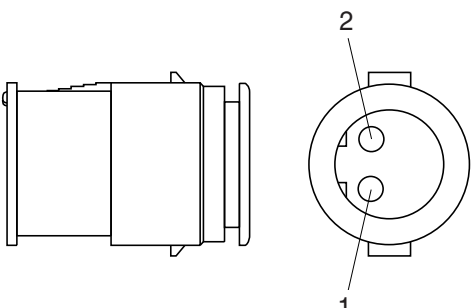
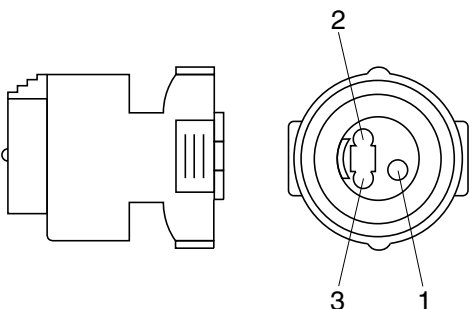
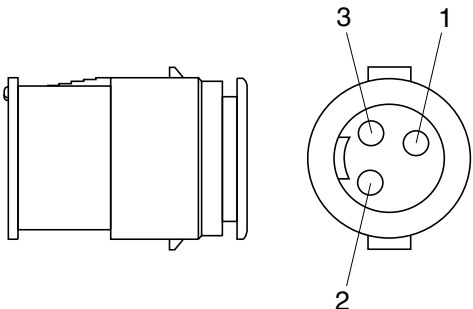
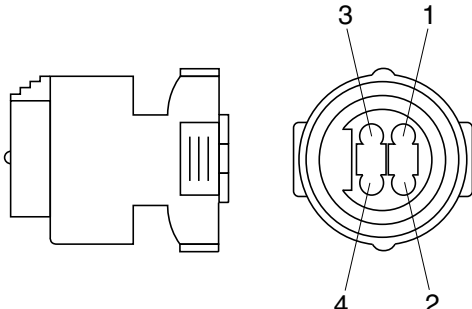
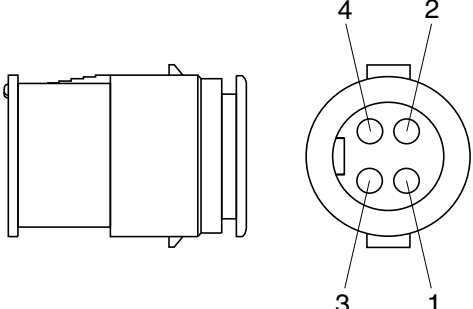
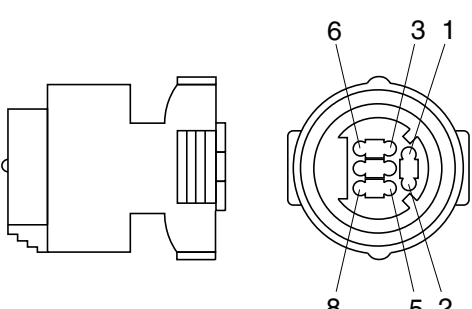
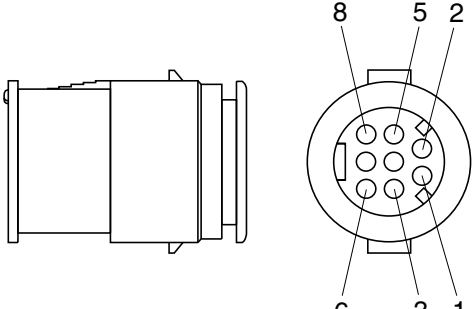
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|--|
| 1 |  S813-030100 |  S813-130100 |
| 2 |  S813-030200 |  S813-130200 |

2) PA TYPE CONNECTOR

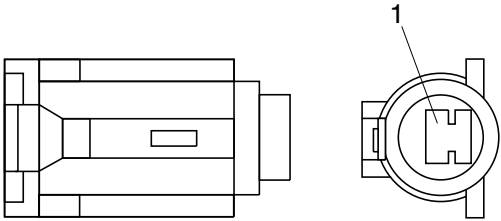
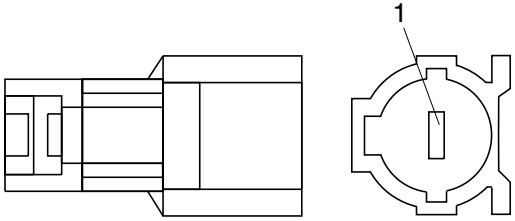
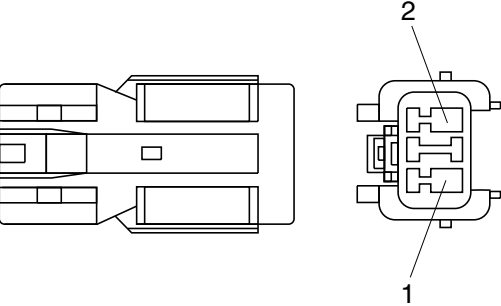
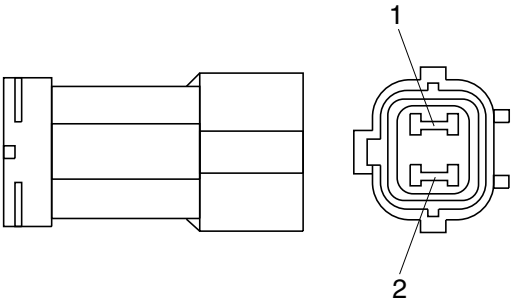
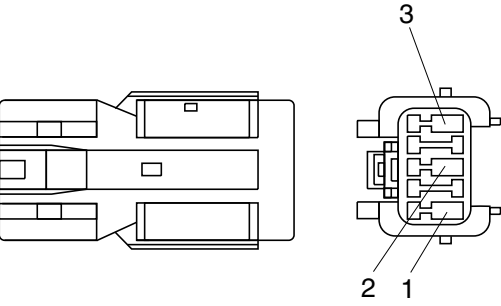
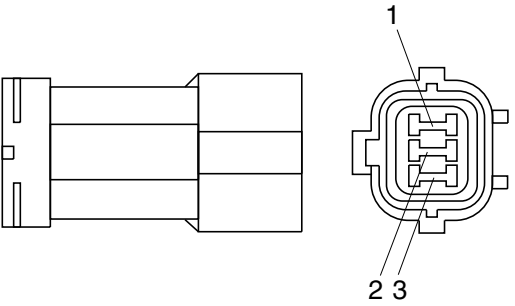
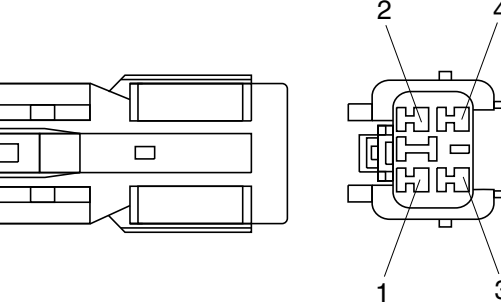
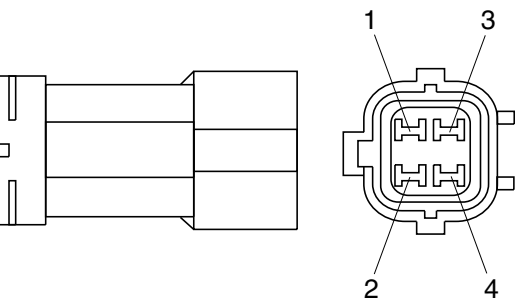
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|---|
| 5 |  <p>S811-005002</p> |  <p>S811-105002</p> |
| 7 |  <p>S811-007002</p> |  <p>S811-107002</p> |
| 9 |  <p>S811-009002</p> |  <p>S811-109002</p> |
| 11 |  <p>S811-011002</p> |  <p>S811-111002</p> |

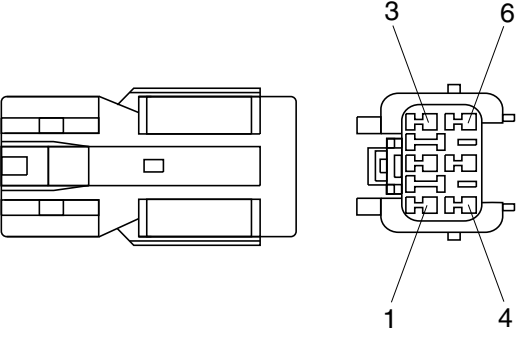
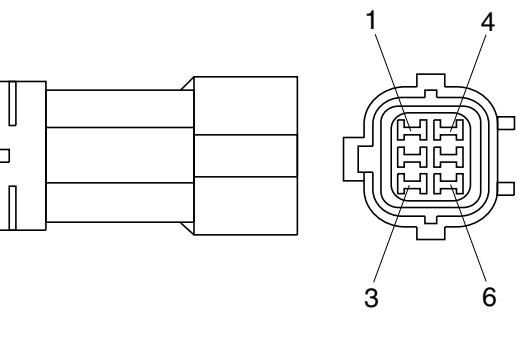
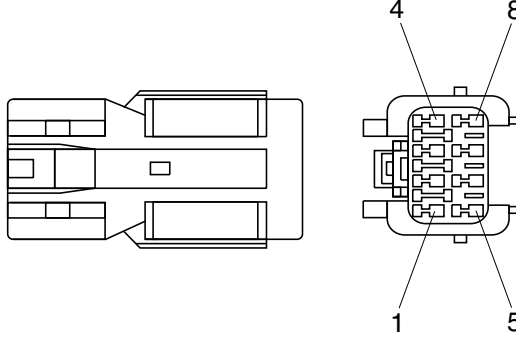
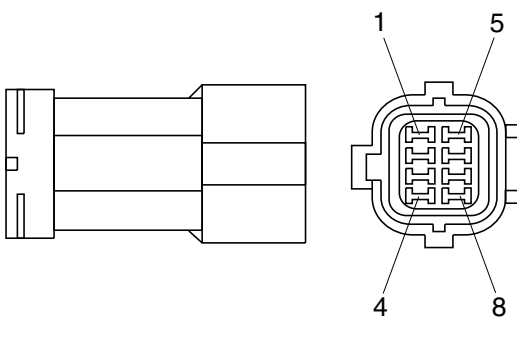
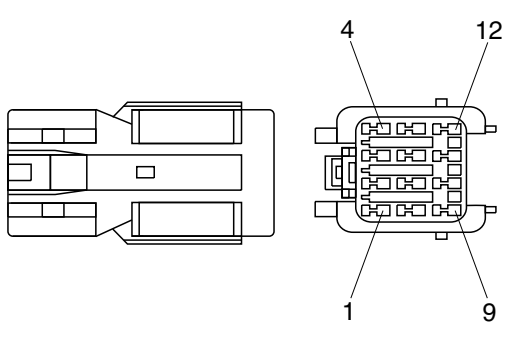
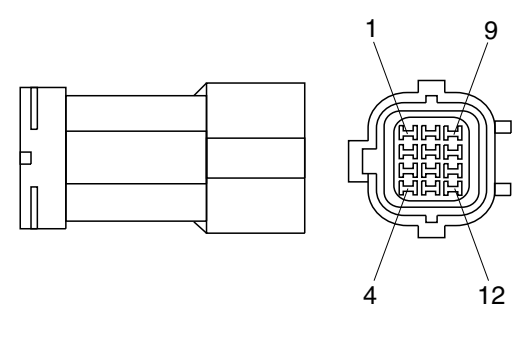
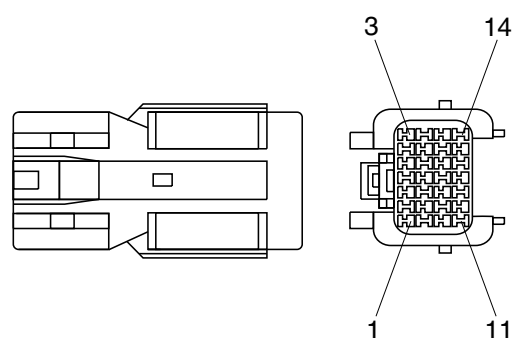
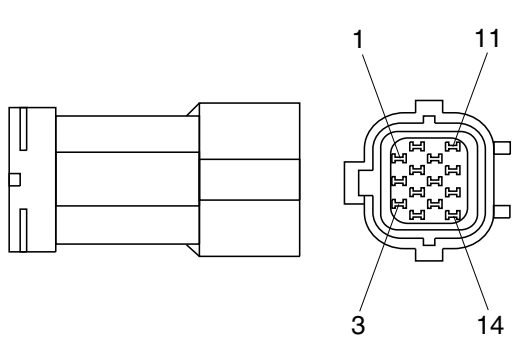
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|---|
| 13 |  <p>S811-013002</p> |  <p>S811-113002</p> |
| 17 |  <p>S811-017002</p> |  <p>S811-117002</p> |
| 21 |  <p>S811-021002</p> |  <p>S811-121002</p> |

3) J TYPE CONNECTOR

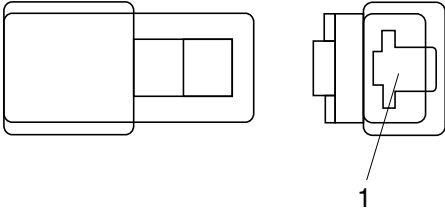
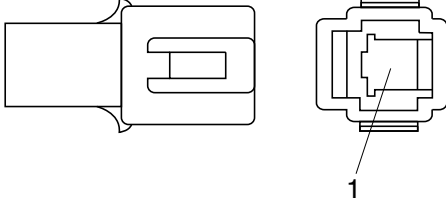
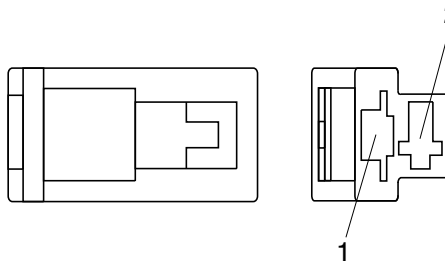
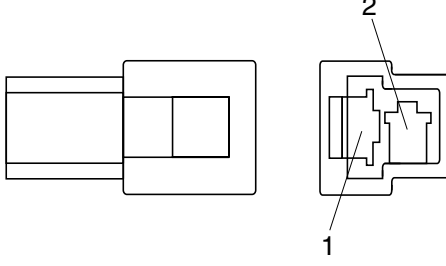
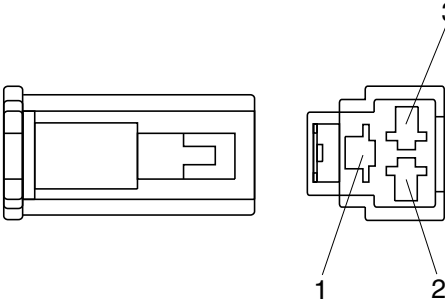
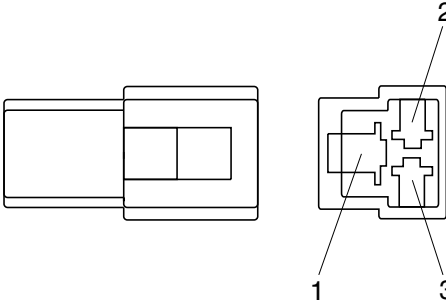
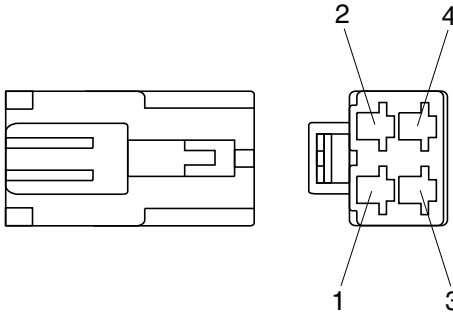
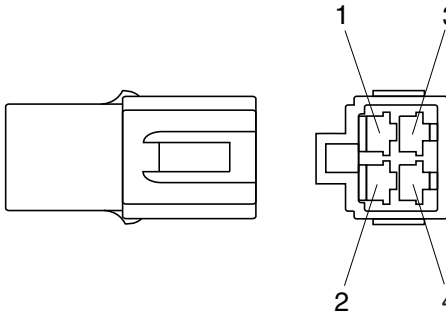
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|---|
| 2 |  <p>S816-002001</p> |  <p>S816-102001</p> |
| 3 |  <p>S816-003001</p> |  <p>S816-103001</p> |
| 4 |  <p>S816-004001</p> |  <p>S816-104001</p> |
| 8 |  <p>S816-008001</p> |  <p>S816-108001</p> |

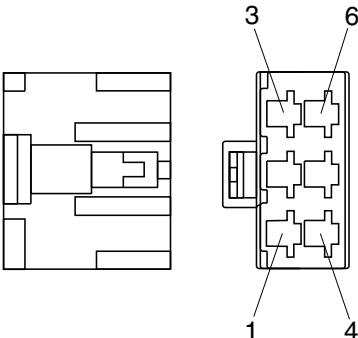
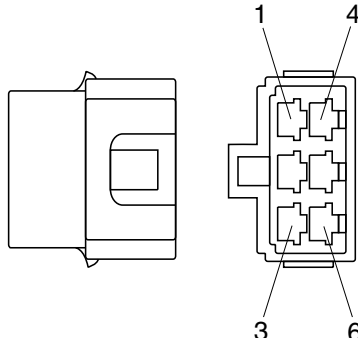
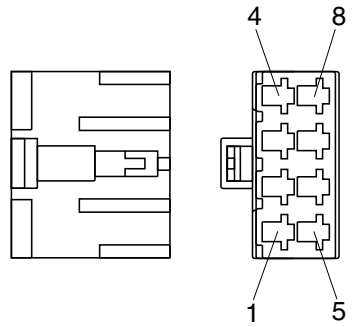
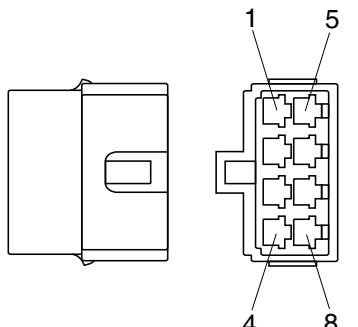
4) SWP TYPE CONNECTOR

| No. of pin | Receptacle connector (Female) | Plug connector (male) |
|------------|--|---|
| 1 |  S814-001000 |  S814-101000 |
| 2 |  S814-002000 |  S814-102000 |
| 3 |  S814-003000 |  S814-103000 |
| 4 |  S814-004000 |  S814-104000 |

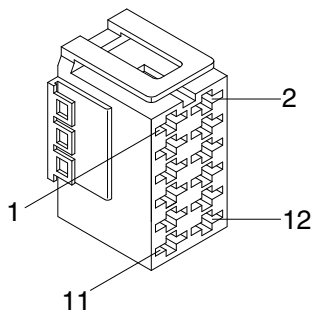
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|---|
| 6 |  <p data-bbox="686 627 837 660">S814-006000</p> |  <p data-bbox="1260 627 1412 660">S814-106000</p> |
| 8 |  <p data-bbox="686 1030 837 1064">S814-008000</p> |  <p data-bbox="1260 1030 1412 1064">S814-108000</p> |
| 12 |  <p data-bbox="686 1433 837 1467">S814-012000</p> |  <p data-bbox="1260 1433 1412 1467">S814-112000</p> |
| 14 |  <p data-bbox="686 1836 837 1870">S814-014000</p> |  <p data-bbox="1260 1836 1412 1870">S814-114000</p> |

5) CN TYPE CONNECTOR

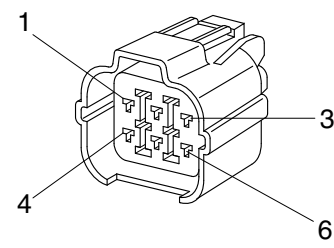
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|---|
| 1 |  <p>S810-001202</p> |  <p>S810-101202</p> |
| 2 |  <p>S810-002202</p> |  <p>S810-102202</p> |
| 3 |  <p>S810-003202</p> |  <p>S810-103202</p> |
| 4 |  <p>S810-004202</p> |  <p>S810-104202</p> |

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|--|
| 6 |  <p>S810-006202</p> |  <p>S810-106202</p> |
| 8 |  <p>S810-008202</p> |  <p>S810-108202</p> |

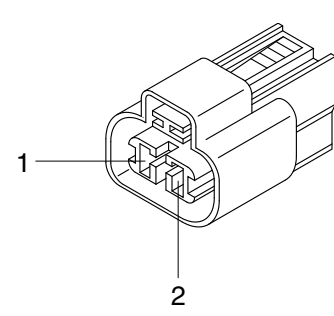
6) ITT SWF CONNECTOR

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|-----------------------|
| 10 |  <p>SWF589790</p> | |

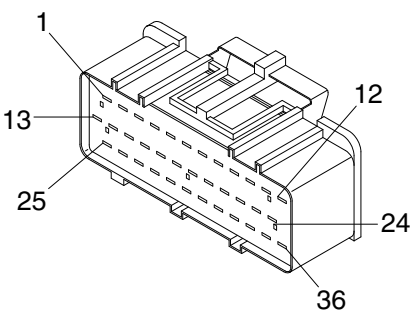
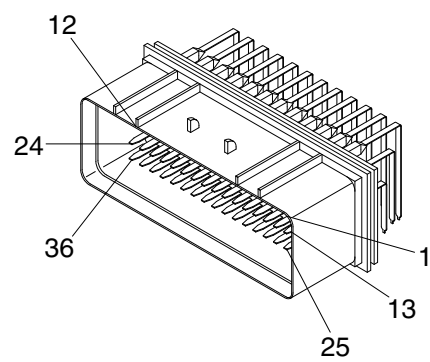
7) HW090 SEALED CONNECTOR

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|-----------------------|
| 6 |  <p>6189-0133</p> | |

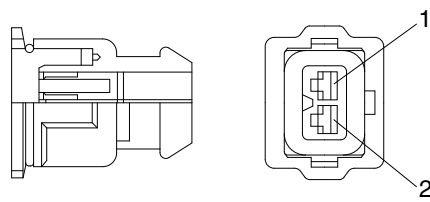
8) MWP02F-B CONNECTOR

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|-----------------------|
| 2 |  <p>PH805-02028</p> | |

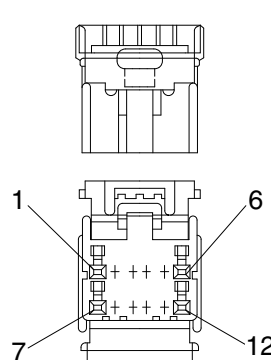
9) AMP ECONOSEAL CONNECTOR

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|--|
| 36 |  <p>344111-1</p> |  <p>344108-1</p> |

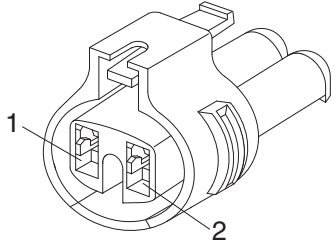
10) AMP TIMER CONNECTOR

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|-----------------------|
| 2 |  <p>85202-1</p> | |

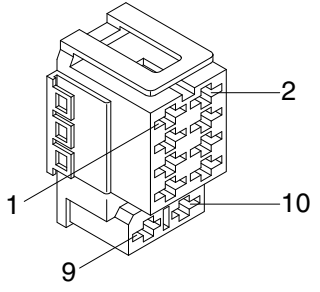
11) AMP 040 MULTILOCK CONNECTOR

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|-----------------------|
| 12 |  <p>174045-2</p> | |

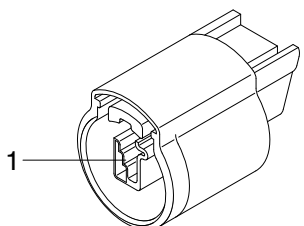
12) KET 090 WP CONNECTORS

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|-----------------------|
| 2 |  <p>MG640795</p> | |

13) ITT SWF CONNECTOR

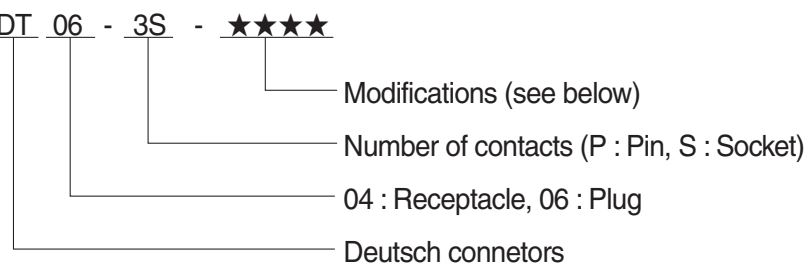
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|-----------------------|
| 10 |  <p>SWF593757</p> | |

14) MWP NMWP CONNECTOR

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|-----------------------|
| 1 |  <p>NMWP01F-B</p> | |

15) DEUTSCH DT CONNECTORS

DT 06 - 3S - ★★★★★



※ Modification

E003 : Standard end cap - gray

E004 : Color of connector to be black

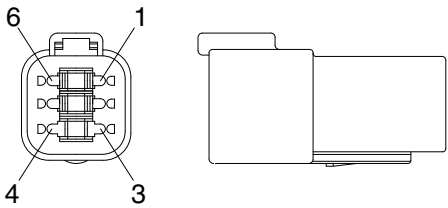
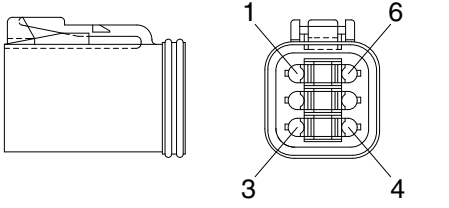
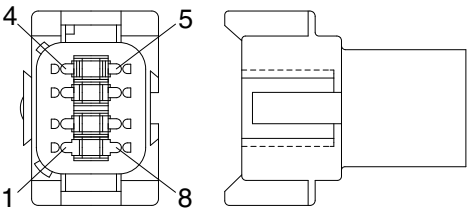
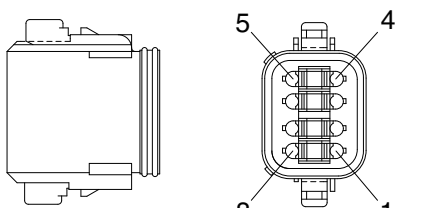
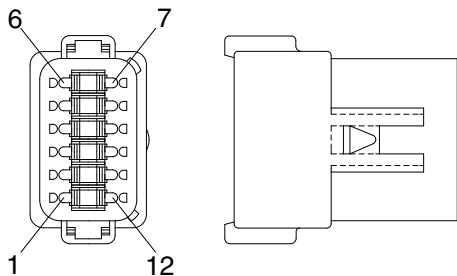
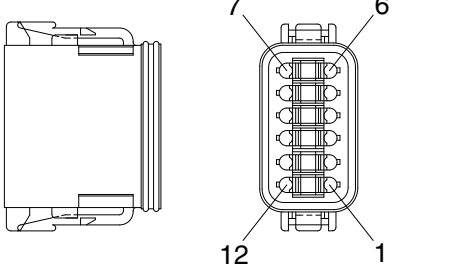
E005 : Combination - E004 & E003

EP04 : End cap

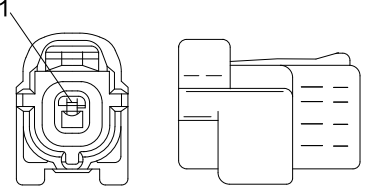
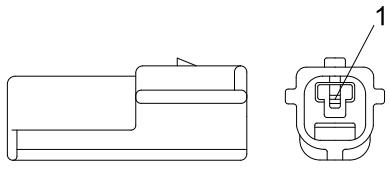
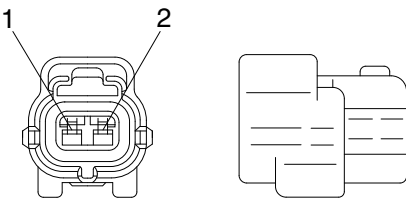
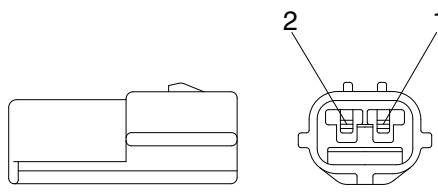
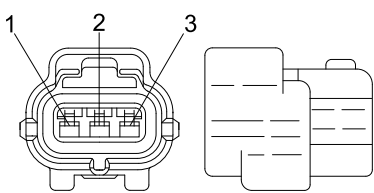
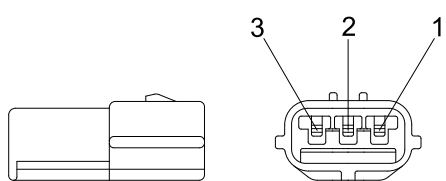
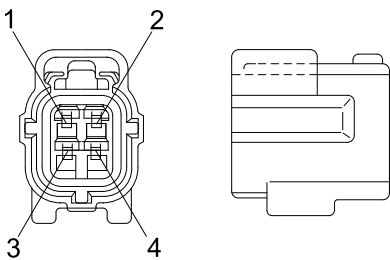
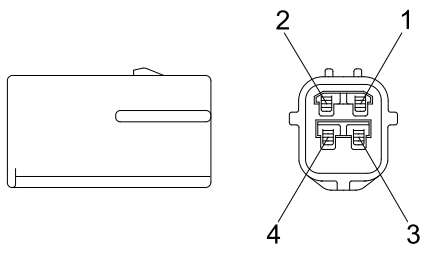
EP06 : Combination P012 & EP04

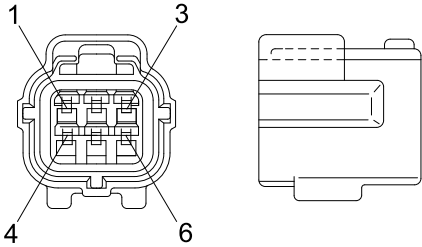
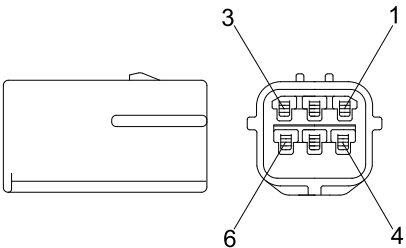
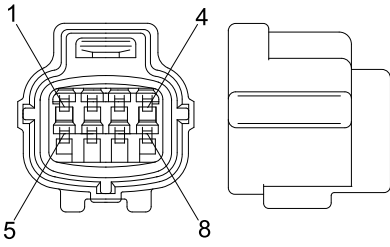
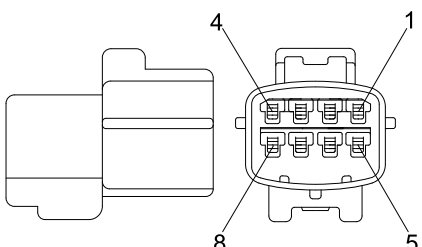
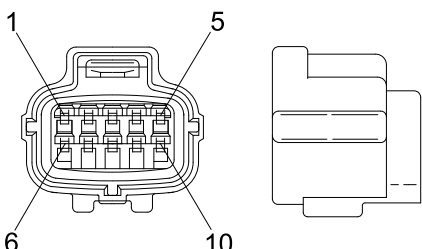
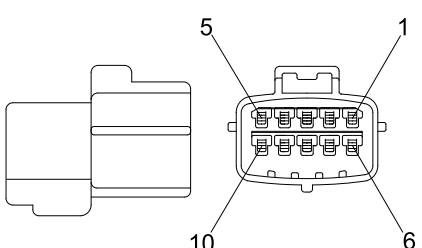
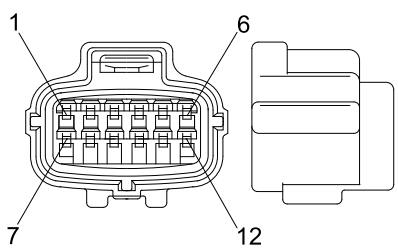
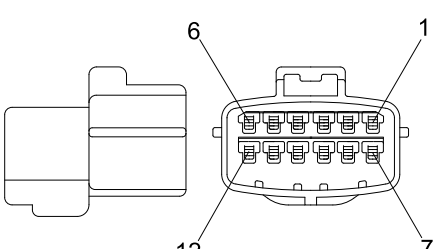
P012 : Front seal enhancement - connectors color to black for 2, 3, 4 & 6pin

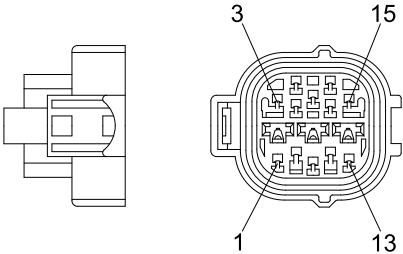
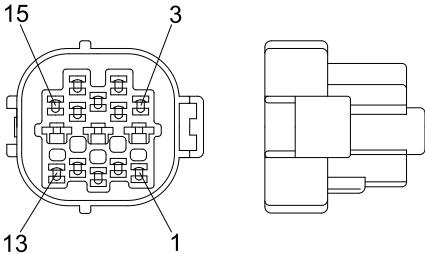
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|-------------------------------|-----------------------|
| 2 | | |
| 3 | | |
| 4 | | |

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|--|
| 6 |  <p>DT06-6S</p> |  <p>DT04-6P</p> |
| 8 |  <p>DT06-8S</p> |  <p>DT04-8P</p> |
| 12 |  <p>DT06-12S</p> |  <p>DT04-12P</p> |

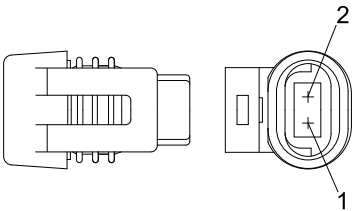
16) ECONOSEAL J TYPE CONNECTORS

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|---|
| 1 |  <p>S816-001002</p> |  <p>S816-101002</p> |
| 2 |  <p>S816-002002</p> |  <p>S816-102002</p> |
| 3 |  <p>S816-003002</p> |  <p>S816-103002</p> |
| 4 |  <p>S816-004002</p> |  <p>S816-104002</p> |

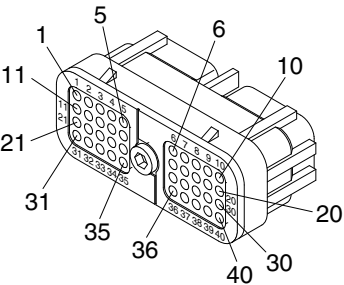
| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|---|
| 6 |  <p>S816-006002</p> |  <p>S816-106002</p> |
| 8 |  <p>S816-008002</p> |  <p>S816-108002</p> |
| 10 |  <p>S816-010002</p> |  <p>S816-110002</p> |
| 12 |  <p>S816-012002</p> |  <p>S816-112002</p> |

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|---|---|
| 15 |  <p>368301-1</p> |  <p>2-85262-1</p> |

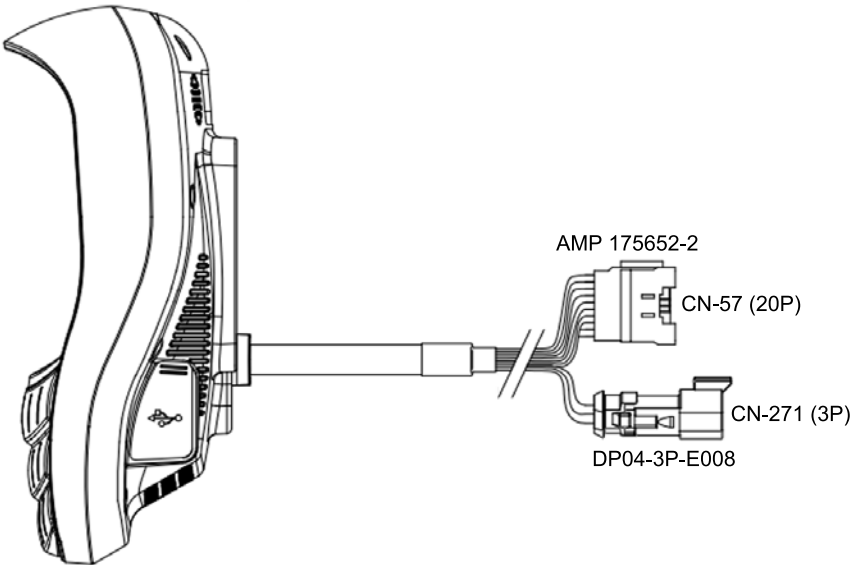
17) METRI-PACK TYPE CONNECTOR

| No. of pin | Receptacle connector (female) | Plug connector (male) |
|------------|--|-----------------------|
| 2 |  <p>12040753</p> | |

18) DEUTSCH MCU CONNECTOR

| No. of pin | Receptacle connector (Female) | Plug connector (Male) |
|------------|---|-----------------------|
| 40 |  <p>DRC23-40PA/B</p> | |

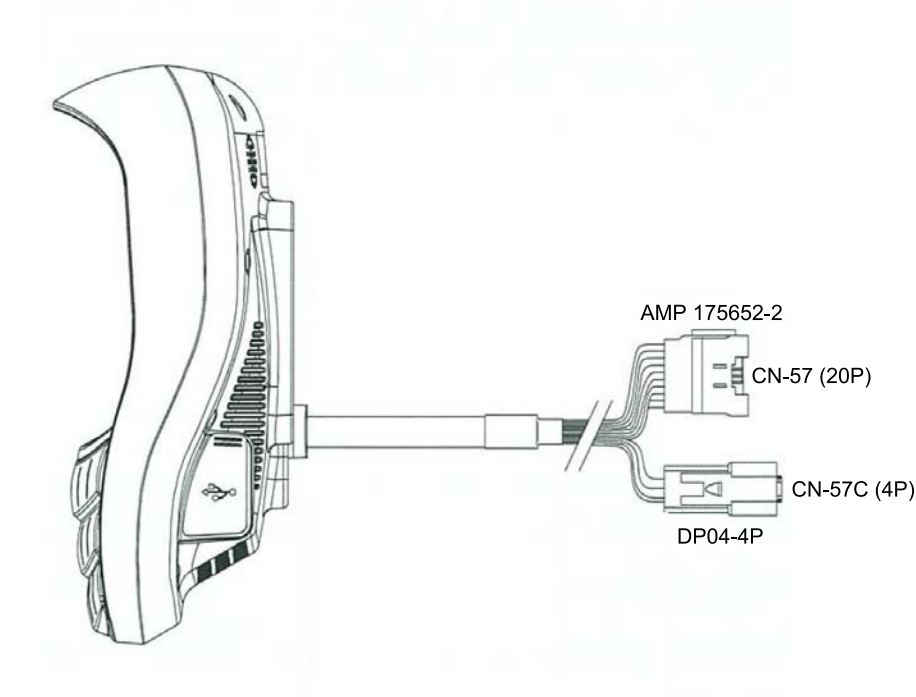
19) MONITOR CONNECTOR (21WD-11100, 21WD-11101, 21WD-11102)



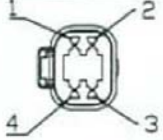
| <div><div><div>10</div><div>1</div><div>20</div><div>11</div></div><div><div>10</div><div>1</div><div>20</div><div>11</div></div></div> <div>PART NO. : AMP 175652-2</div> | | | |
|--|-----------------|----|---------------|
| NO | PIN NAME | NO | PIN NAME |
| 1 | IG 24V | 11 | GND |
| 2 | BATTERY 24V | 12 | GND |
| 3 | BATTERY 24V | 13 | CAN1 H |
| 4 | CAMERA CH0 | 14 | CAN2 L |
| 5 | CAMERA CH0 SIDE | 15 | CAN2 H |
| 6 | 6.5V OUTPUT | 16 | CAN2 SHIELD |
| 7 | AVX LEFT | 17 | CAMERA SHIELD |
| 8 | AVX RIGHT | 18 | CAN1 LOW |
| 9 | CAMERA CH1 | 19 | GND |
| 10 | CAMERA CH2 | 20 | CAMERA CH3 |

| <div><div><div>A</div><div>B</div><div>C</div></div></div> <div>PART NO. : DP04-3P-E008</div> | | | |
|---|----------|----|-----------|
| NO | PIN NAME | NO | PIN NAME |
| A | AUX GND | C | AUX RIGHT |
| B | AUX LEFT | | |

MONITOR CONNECTOR (21WD-11103, 21WD-11104)



|  PART NO. : AMP 175652-2 | | | |
|---|------------------|----|------------------|
| NO | PIN NAME | NO | PIN NAME |
| 1 | IG 24V | 11 | GND |
| 2 | BATTERY 24V | 12 | GND |
| 3 | BATTERY 24V | 13 | CAN1 H |
| 4 | CAMERA CH0 | 14 | CAN2 L |
| 5 | CAMERA CH3 DIFF- | 15 | CAN2 H |
| 6 | 6.5V OUTPUT | 16 | CAN2 SHIELD |
| 7 | N.C | 17 | CAMERA SHIELD |
| 8 | N.C | 18 | CAN1 L |
| 9 | CAMERA CH1 | 19 | N.C |
| 10 | CAMERA CH2 | 20 | CAMERA CH3 DIFF+ |

|  PART NO. : DT04-4P | | | |
|--|----------|----|-----------|
| NO | PIN NAME | NO | PIN NAME |
| 1 | CAM VCC | 3 | CAM CH3 + |
| 2 | CAM GND | 4 | CAM CH3 - |

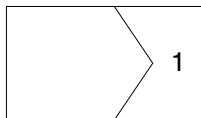
GROUP 6 TROUBLESHOOTING

1. WHEN STARTING SWITCH IS TURNED ON, CLUSTER AND MONITOR LAMP DOES NOT LIGHT UP

- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.12, 17 are not blown out and ON/OFF of bulb.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.

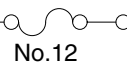
| | | Cause | Remedy |
|---|-----|--|---------------------------------|
| Check voltage between CN-56 (1), CN-57(1) and chassis | YES | Defective cluster | Replace |
| | | Defective monitor | Replace |
| | NO | Disconnection in wiring harness or poor contact between CN-56 (1), CN-57 (1) and fuse No. 12, 17 | Repair or replace (after clean) |

MONITOR

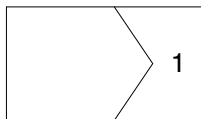


CN-57

FUSE[CN-36]

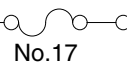


CLUSTER



CN-56

FUSE[CN-37]



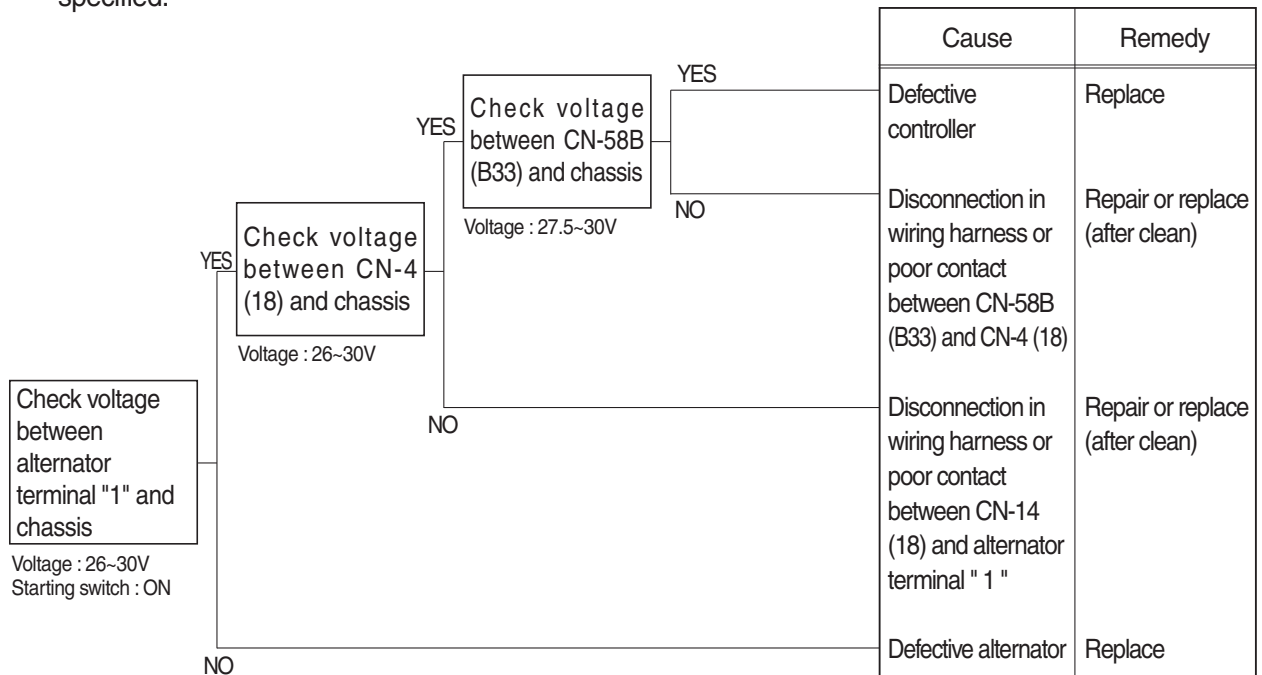
960A7EL24

Check voltage

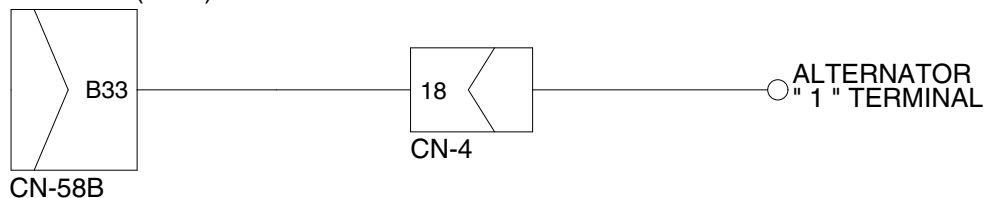
| | |
|-----|-----------|
| YES | 20 ~ 30 V |
| NO | 0 V |

2. WHEN BATTERY LAMP LIGHTS UP (engine is started)

- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



CONTROLLER(MCU)



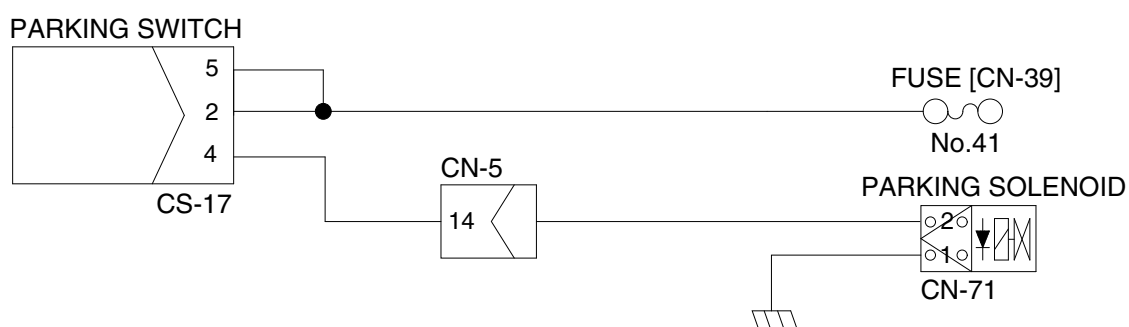
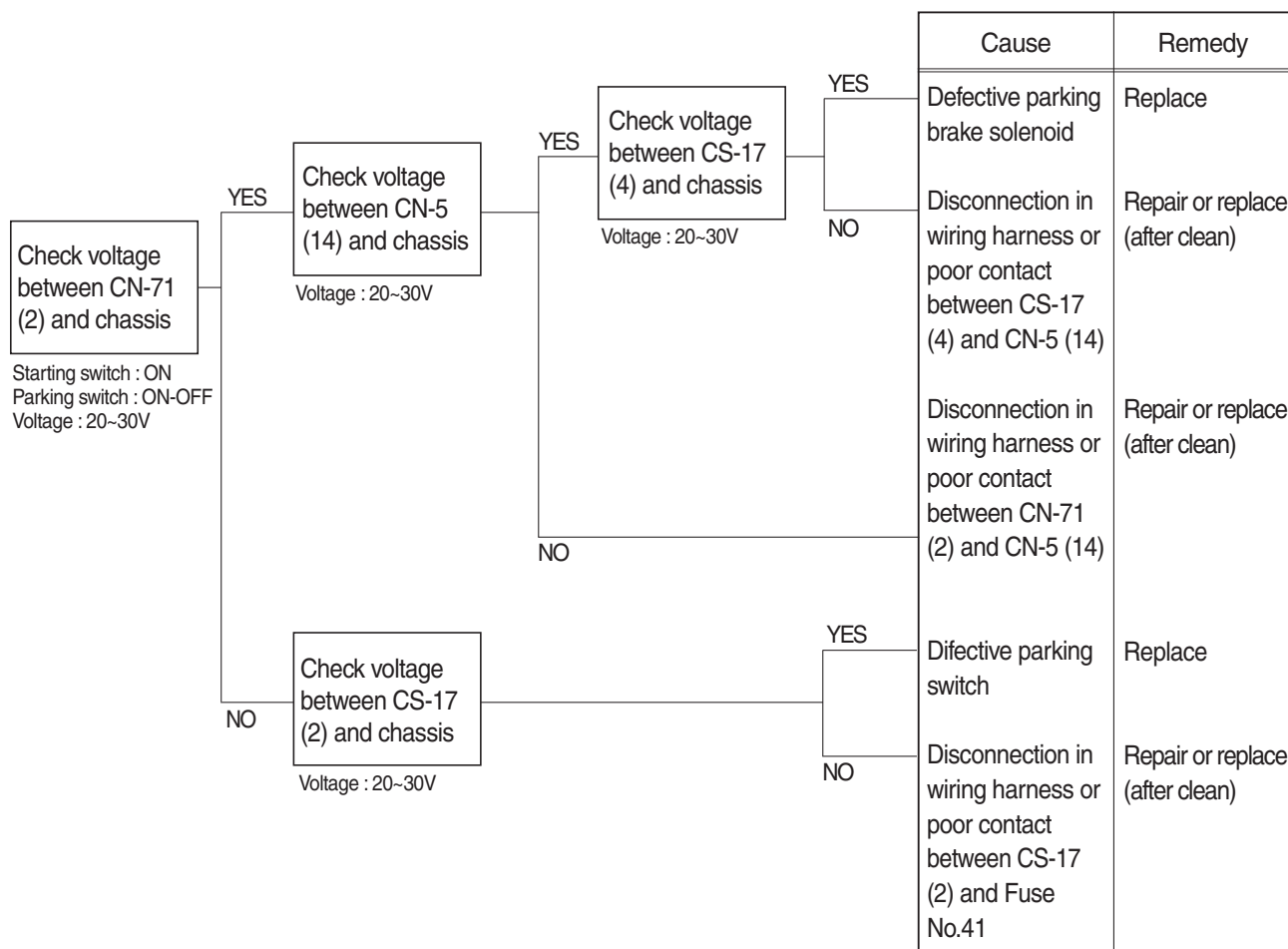
960A7EL38

Check valtage

| | |
|-----|-----------|
| YES | 20 ~ 30 V |
| NO | 0 V |

3. WHEN PARKING SOLENOID DOES NOT WORK

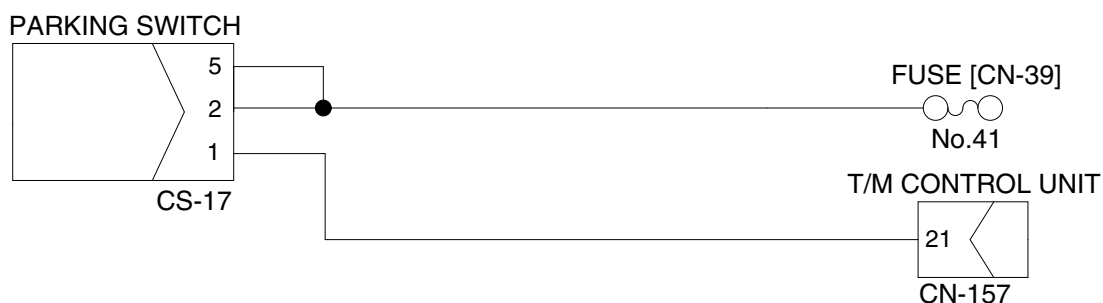
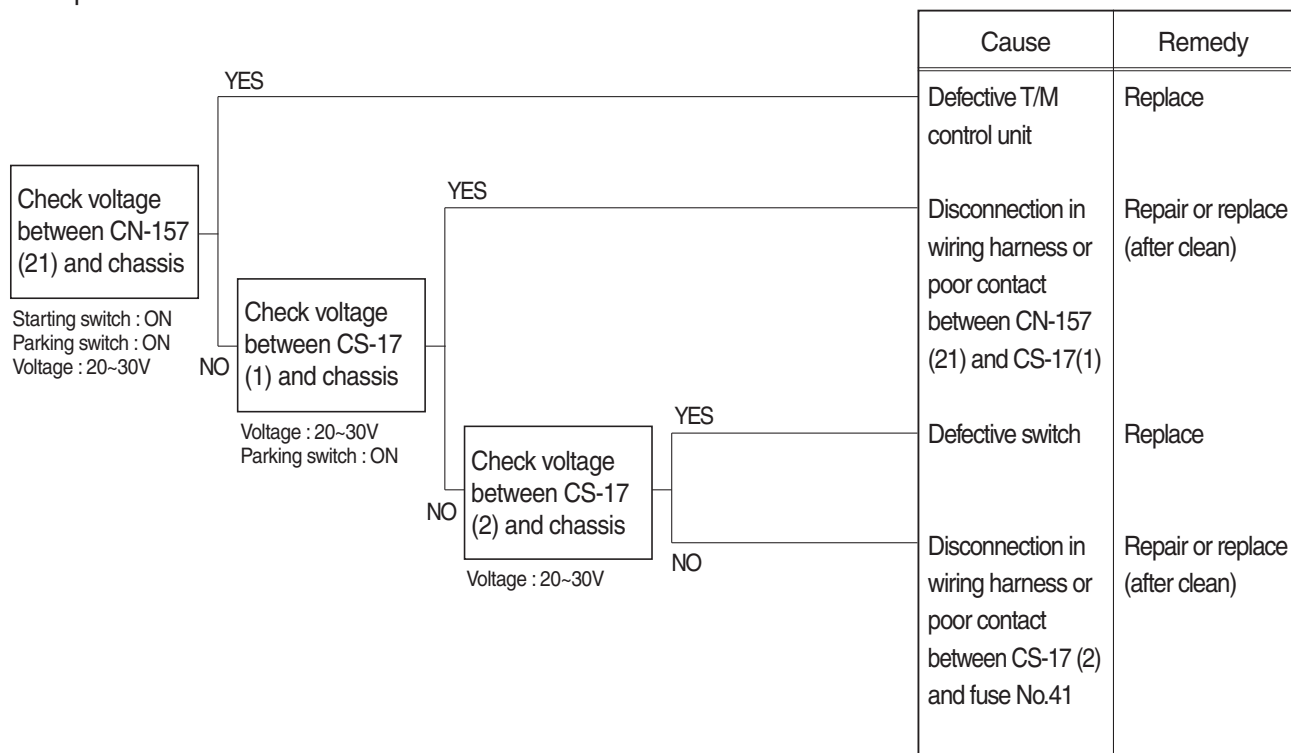
- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.41 is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



960A7EL39

4. TRANSMISSION IS NOT RETURNED TO NEUTRAL WHEN PARKING BRAKE IS APPLIED

- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.15 (transmission control unit) and No.41 are not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



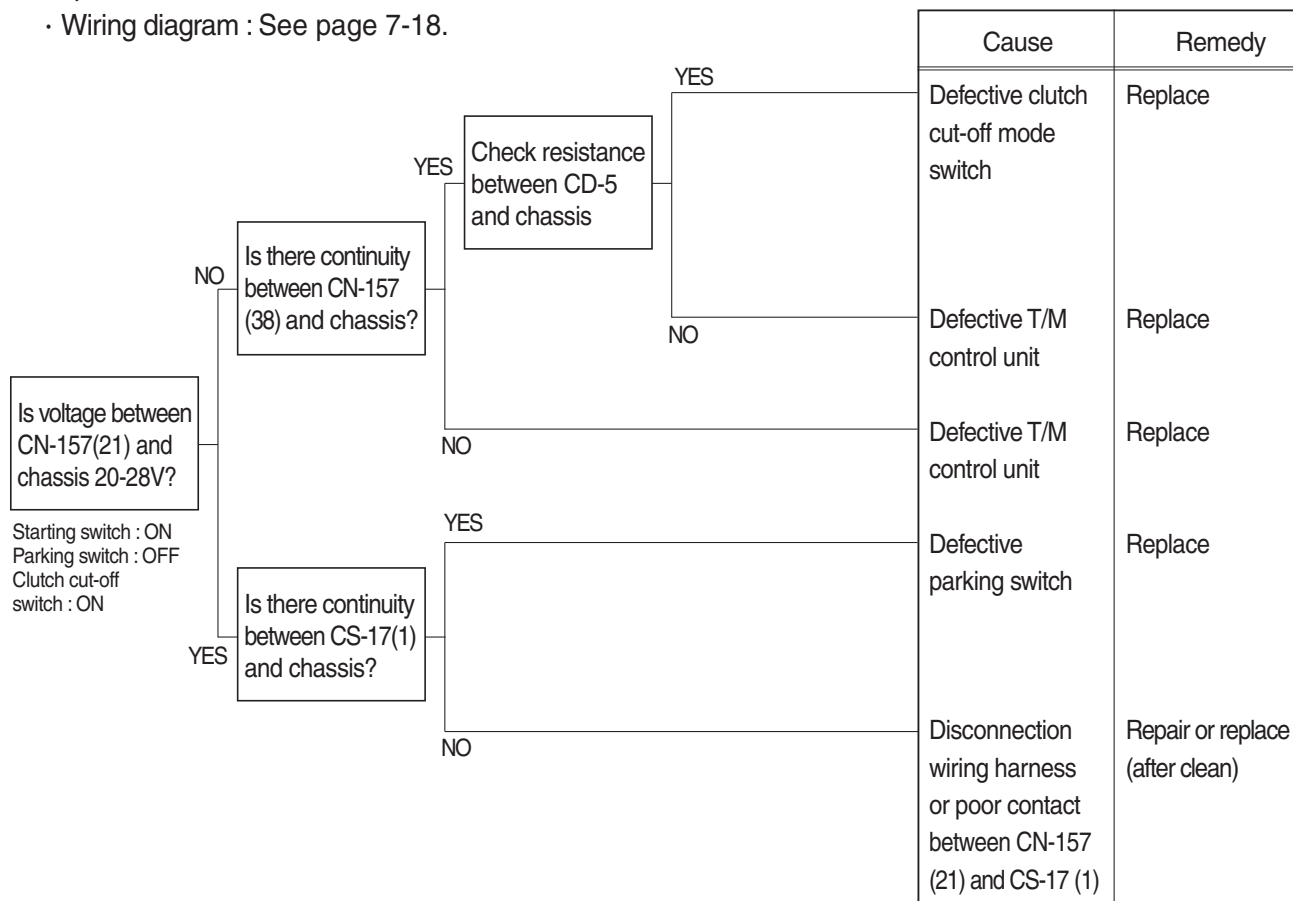
Check resistance

| | |
|-----|----------|
| YES | MAX 1 Ω |
| NO | MIN 1M Ω |

760F7EL40

5. MACHINE DOES NOT TRAVEL

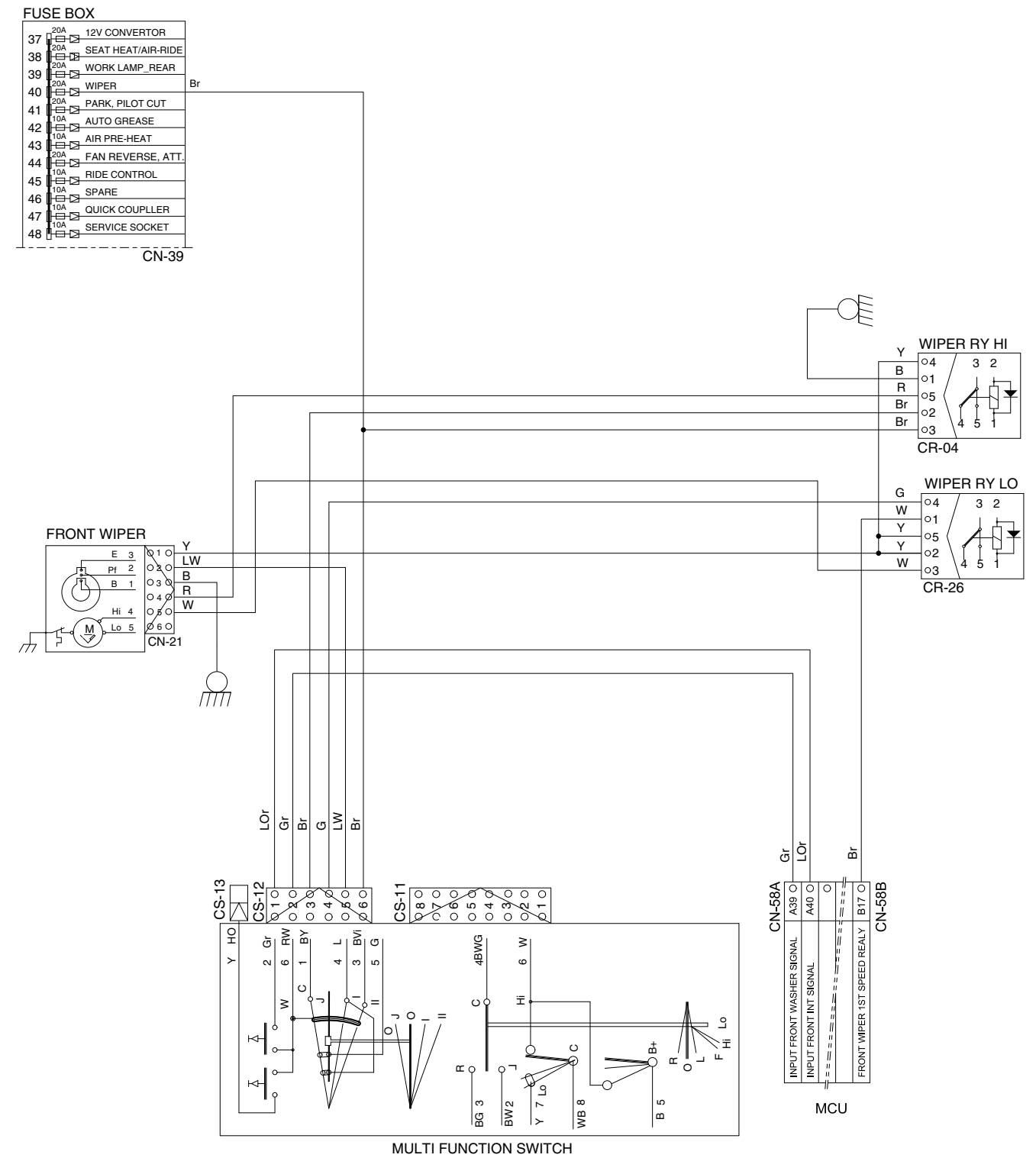
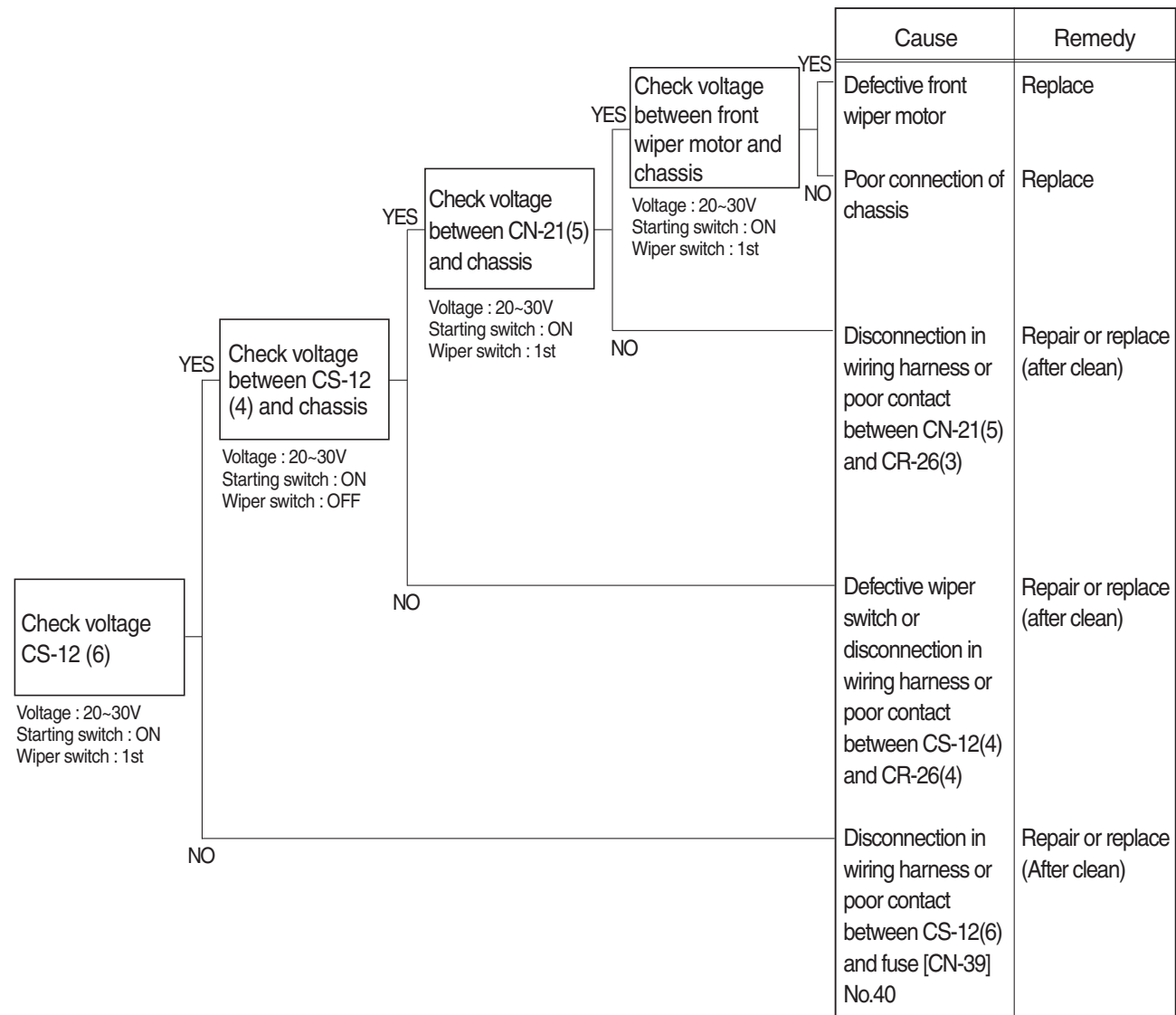
- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.15 (transmission control unit) is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.
- Wiring diagram : See page 7-18.



Check resistance

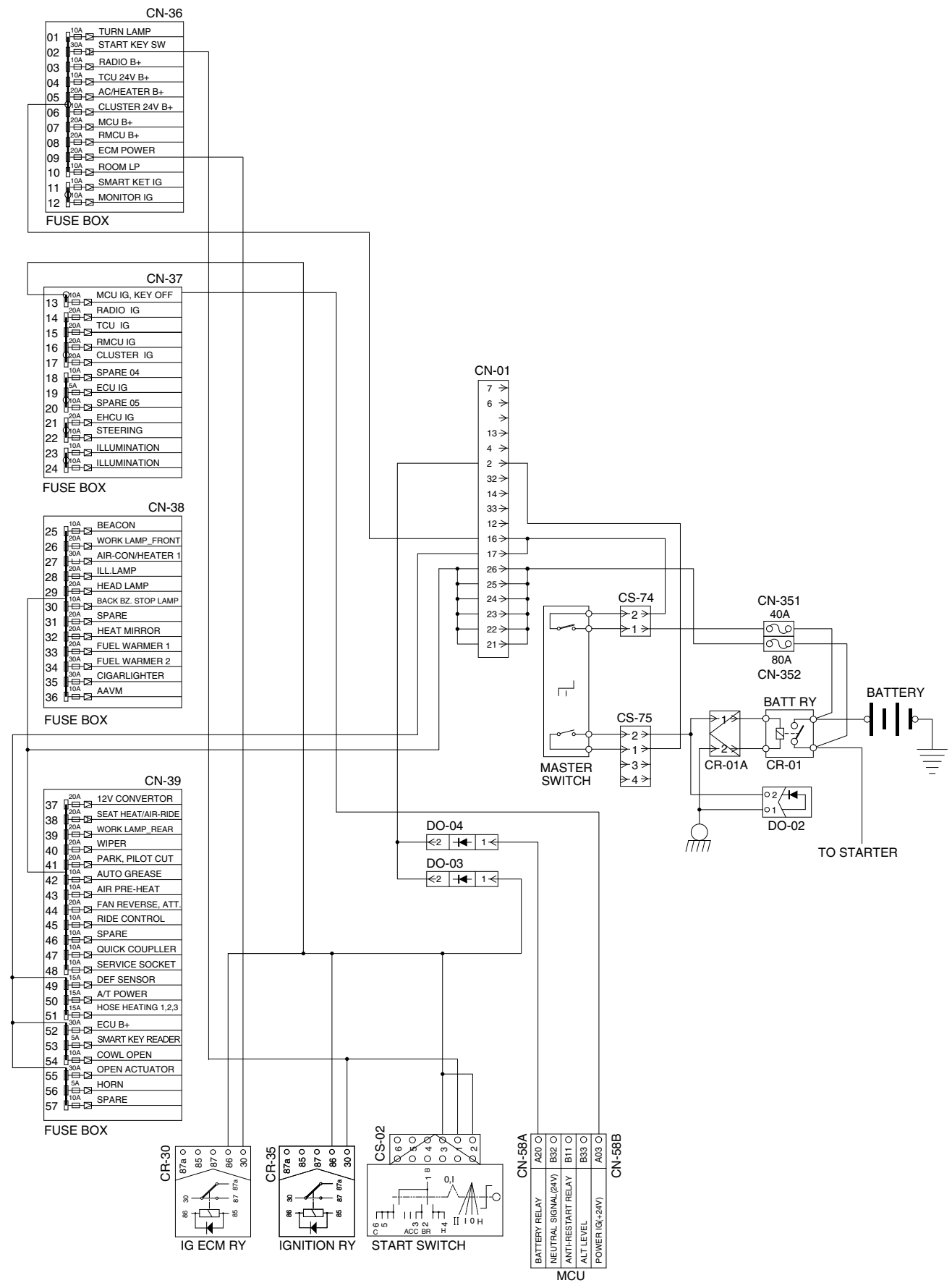
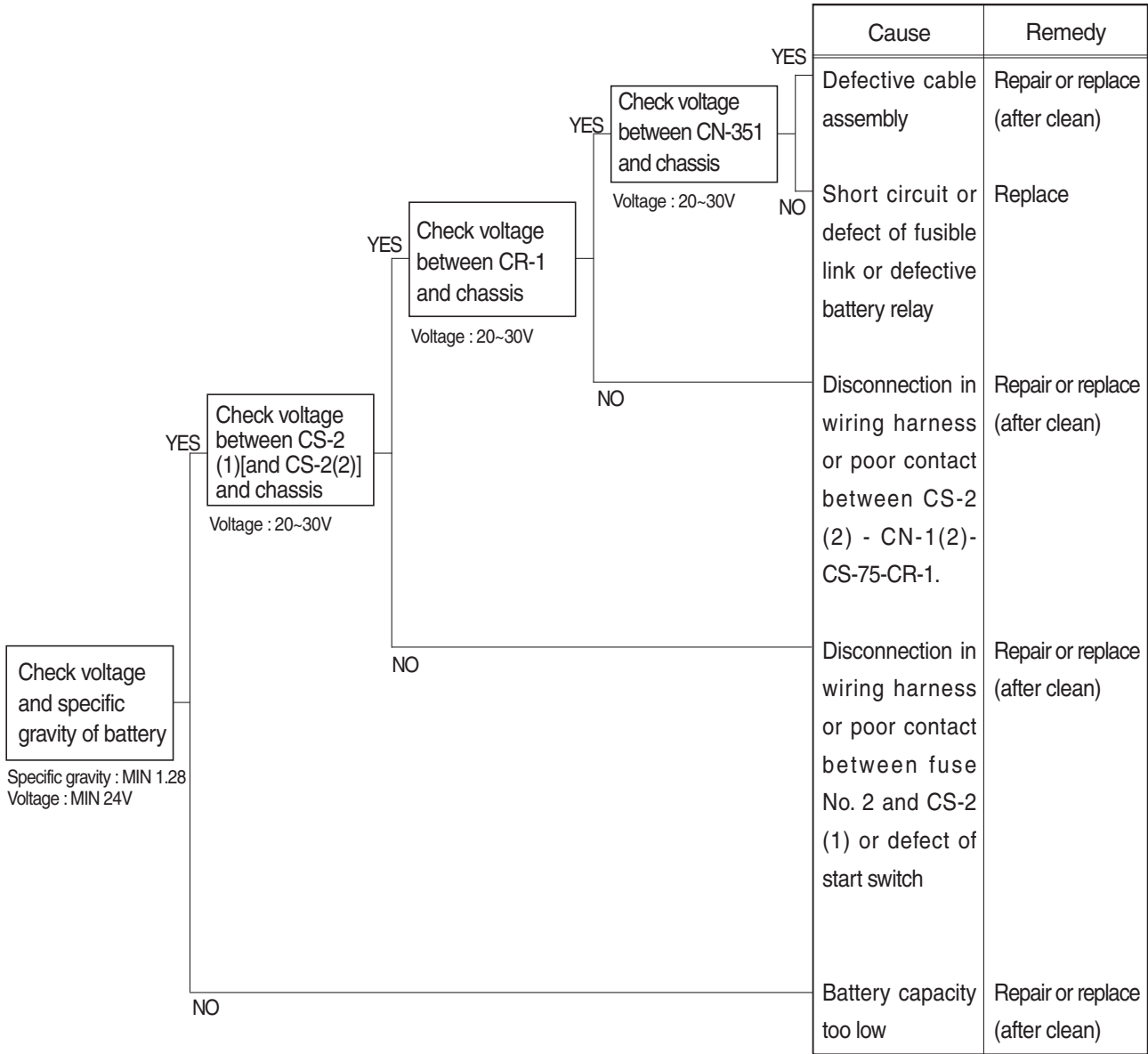
| | |
|-----|----------|
| YES | MAX 1 Ω |
| NO | MIN 1M Ω |

- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.40 is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



7. WHEN STARTING SWITCH "ON" DOES NOT OPERATE

- Before carrying out below procedure, check all the related connectors are properly inserted the fuse No.2 is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



8. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

- Before carrying out below procedure, check all the related connectors are properly inserted, and the fuse No.26, 39 is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.

