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## 1. STRUCTURE

This service manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This service manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into the following sections.

#### SECTION 1 GENERAL

This section explains the safety hints and gives the specification of the machine and major components.

#### SECTION 2 STRUCTURE AND FUNCTION

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

#### SECTION 3 HYDRAULIC SYSTEM

This section explains the hydraulic circuit, single and combined operation.

#### SECTION 4 ELECTRICAL SYSTEM

This section explains the electrical circuit, monitoring system and each component. It serves not only to give an understanding electrical system, but also serves as reference material for trouble shooting.

#### SECTION 5 MECHATRONICS SYSTEM

This section explains the computer aided power optimization system and each component.

#### SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

#### SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

#### SECTION 8 DISASSEMBLY AND ASSEMBLY

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

#### SECTION 9 COMPONENT MOUNTING TORQUE

This section shows bolt specifications and standard torque values needed when mounting components to the machine.

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

- 2-3
- Item number (2. Structure and Function)

Consecutive page number for each item.

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

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## 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  |
|--------|---------|--|
|        |         | Special safety precautions are necessary when performing the work.   |
|        | Safety  | Extra special safety precautions<br>a r e n e c e s s a r y w h e n<br>performing the work because it<br>is under internal pressure. |
| *      | Caution | Special technical precautions<br>or other precautions for<br>preserving standards are<br>necessary when performing the<br>work.      |

## 3. CONVERSION TABLE

#### Method of using the Conversion Table

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

#### Example

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

Convert 55mm into inches.

- (1) Locate the number 50in 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  $\bigcirc$ . This point  $\bigcirc$  gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.
- 2. Convert 550mm 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.

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|   |    |       |       |       |       |       |       |       |       | 1 mm = | 0.03937 in |
|---|----|-------|-------|-------|-------|-------|-------|-------|-------|--------|------------|
|   |    | 0     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8      | 9          |
|   | 0  |       | 0.039 | 0.079 | 0.118 | 0.157 | 0.197 | 0.236 | 0.276 | 0.315  | 0.354      |
|   | 10 | 0.394 | 0.433 | 0.472 | 0.512 | 0.551 | 0.591 | 0.630 | 0.669 | 0.709  | 0.748      |
|   | 20 | 0.787 | 0.827 | 0.866 | 0.906 | 0.945 | 0.984 | 1.024 | 1.063 | 1.102  | 1.142      |
|   | 30 | 1.181 | 1.220 | 1.260 | 1.299 | 1.339 | 1.378 | 1.417 | 1.457 | 1.496  | 1.536      |
|   | 40 | 1.575 | 1.614 | 1.654 | 1.693 | 1.732 | 1.772 | 1.811 | 1.850 | 1.890  | 1.929      |
|   |    |       |       |       |       |       | ©     |       |       |        |            |
| a | 50 | 1.969 | 2.008 | 2.047 | 2.087 | 2.126 | 2.165 | 2.205 | 2.244 | 2.283  | 2.323      |
|   | 60 | 2.362 | 2.402 | 2.441 | 2.480 | 2.520 | 2.559 | 2.598 | 2.638 | 2.677  | 2.717      |
|   | 70 | 2.756 | 2.795 | 2.835 | 2.874 | 2.913 | 2.953 | 2.992 | 3.032 | 3.071  | 3.110      |
|   | 80 | 3.150 | 3.189 | 3.228 | 3.268 | 3.307 | 3.346 | 3.386 | 3.425 | 3.465  | 3.504      |
|   | 90 | 3.543 | 3.583 | 3.622 | 3.661 | 3.701 | 3.740 | 3.780 | 3.819 | 3.858  | 3.898      |

#### Millimeters to inches

Millimeters to inches

1 mm = 0.03937 in

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

# Kilogram to Pound

1 kg = 2.2046 lb

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

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

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

## Liter to U.K. Gallon

1 *l* = 0.21997 U.K.Gal

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

| kgf∙ | m | to | lbf | • | ft |
|------|---|----|-----|---|----|
|------|---|----|-----|---|----|

1 kgf  $\cdot$  m = 7.233 lbf  $\cdot$  ft

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

kgf/cm<sup>2</sup> to lbf/in<sup>2</sup>

1 kgf / cm<sup>2</sup> = 14.2233 lbf / in<sup>2</sup>

|     | 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    |    | ۴F    | °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 |

| Group | 1 | Safety Hints   | 1-1 |
|-------|---|----------------|-----|
| Group | 2 | Specifications | 1-9 |

# **GROUP 1 SAFETY**

#### FOLLOW SAFE PROCEDURE

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

#### WEAR PROTECTIVE CLOTHING

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



#### WARN OTHERS OF SERVICE WORK

Unexpected machine movement can cause serious injury.

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



#### USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.

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

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

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



## PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

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



#### PROTECT AGAINST FLYING DEBRIS

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



#### PROTECT AGAINST NOISE

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

Wear a suitable hearing protective device such as ear-

muffs or earplugs to protect against objectionable or uncomfortable loud noises.



## **AVOID POWER LINES**

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

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



#### **KEEP RIDERS OFF EXCAVATOR**

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

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

#### MOVE AND OPERATE MACHINE SAFELY

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

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

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

#### OPERATE ONLY FORM OPERATOR'S SEAT

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

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







#### PARK MACHINE SAFELY

Before working on the machine:

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

#### SUPPORT MACHINE PROPERLY

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

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

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

## SERVICE COOLING SYSTEM SAFELY

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

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





#### HANDLE FLUIDS SAFELY-AVOID FIRES

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

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

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

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





#### **BEWARE OF EXHAUST FUMES**

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

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

#### REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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



#### ILLUMINATE 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  $16^{\circ}C$  ( $60^{\circ}F$ ).





#### PREVENT ACID BURNS

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

Avoid the hazard by:

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

If you spill acid on yourself:

- 1. Flush your skin with water.
- 2. Apply baking soda or lime to help neutralize the acid.
- 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. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only recommended replacement parts.(See Parts 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.

# **GROUP 2 SPECIFICATIONS**

## **1. MAJOR COMPONENT**



HW602SP01A

# 2. SPECIFICATIONS

# 1) 3.0 m (9'10") MONO BOOM, 1.6 m (5' 3") ARM WITH BOOM SWING SYSTEM





HW65AH2SP02

|                                   |            | Unit        |         | Specif                  | ication        |  |
|-----------------------------------|------------|-------------|---------|-------------------------|----------------|--|
|                                   |            | m (ft in)   | Boom    | 3.0 (                   | 9' 10")        |  |
| Description                       |            | m (it-m)    | Arm     | 1.60 (                  | 5' 3")         |  |
|                                   |            | Tire        |         | Single 1200             | Double 700     |  |
|                                   |            | Axle        |         | STD                     | HD             |  |
| Operating weight                  |            | kg (lb      | )       | 6065 (13370)            | 6355 (14010)   |  |
| Overall length (travel)           | _          |             |         | 6200 (20' 4")           | 6200 (20' 4")  |  |
| Overall length (shipping)         | A          |             |         | 6055 (19' 1")           | 6055 (19' 1")  |  |
| Overall width                     | В          |             |         | 1925(6'4")              | 2100 (6' 11")  |  |
| Overall height of boom (travel)   | 6          |             |         | 2800 ( 9' 2")           | 2800 ( 9' 2")  |  |
| Overall height of boom (shipping) | C          |             |         | 2280 ( 7' 6")           | 2280 ( 7' 6")  |  |
| Upperstructure width              | D          |             |         | 1850 ( 6' 1")           | 1850 ( 6' 1")  |  |
| Overall height of cab             | E          |             |         | 2905 ( 9' 6")           | 2865 ( 9' 5")  |  |
| Ground clearance of counterweight | F          |             |         | 1000 ( 3' 3")           | 960 (3'2")     |  |
| Overall height of engine hood     | G          | mm (ft      | in)     | 2005 ( 6' 7")           | 1965 ( 6' 5")  |  |
| Minimum ground clearance          | Н          | - mm (π-in) |         | 315 (1.0")              | 275 (0.11")    |  |
| Rear-end distance                 | Ι          |             |         | 1650 ( 5' 5")           | 1653 ( 5' 5")  |  |
| Rear-end swing radius             | ľ          |             |         | 1650 ( 5' 5")           | 1650 ( 5' 5")  |  |
| Wheel base                        | J          |             |         | 2100 ( 6' 11")          | 2100 ( 6' 11") |  |
| Tread                             | К          |             |         | 1600 ( 5' 3")           | 1660 ( 5' 5")  |  |
| Dozer blade width                 | L          |             |         | 1925 ( 6' 4")           | 2100 ( 6' 11") |  |
| Height of blade                   | 0          |             |         | 350 ( 1' 2")            | 350 ( 1' 2")   |  |
| Ground clearance of blade up      | Р          |             |         | 430 ( 1' 5")            | 430 ( 1' 5")   |  |
| Depth of blade down               | Q          |             |         | 154 ( 0' 6")            | 154 ( 0' 6")   |  |
| Lc                                |            | km/br (m    | nph)    | 11 ( 6.8 )              | 13.1 (8.1)     |  |
| Travel speed High                 |            | KII/III (II | ihii)   | 32 ( 19.9)              | 30 (18.6)      |  |
| Swing speed                       |            | rpm         |         | 8.26                    | 8.26           |  |
| Gradeability                      | Degree (%) |             | 30 (58) | 30 (58)                 |                |  |
| Max traction force                |            | kg (lb)     |         | 3042 (6710) 3042 (6710) |                |  |

# 2) 3.0 m (9'10") MONO BOOM, 1.9 m (6' 3") ARM WITH BOOM SWING SYSTEM





|                                   |        | Unit       |         | Specif                  | ication         |  |
|-----------------------------------|--------|------------|---------|-------------------------|-----------------|--|
|                                   |        | (6         | Boom    | 3.0 (                   | 9' 10")         |  |
| Description                       |        | m (tt-in)  | Arm     | 1.90 (                  | 6' 3")          |  |
|                                   |        | Tire       | I       | Single 1200             | Double 700      |  |
|                                   |        | Axle       |         | STD                     | HD              |  |
| Operating weight                  |        | kg (lb)    | )       | 6195 (13660)            | 6485 (14300)    |  |
| Overall length (travel)           | _      |            |         | 6060 (19' 11")          | 6060 (19' 11")  |  |
| Overall length (shipping)         | A      |            |         | 6123 ( 20' 10")         | 6123 ( 20' 10") |  |
| Overall width                     | В      |            |         | 1925 ( 6' 4")           | 2100 ( 6' 11")  |  |
| Overall height of boom (travel)   | 6      |            |         | 3070 ( 10' 1")          | 3070 ( 10' 1")  |  |
| Overall height of boom (shipping) |        |            |         | 2590 ( 8' 6")           | 2590 ( 8' 6")   |  |
| Upperstructure width              | D      |            |         | 1850(6'1")              | 1850(6'1")      |  |
| Overall height of cab             | Е      |            |         | 2905 ( 9' 6")           | 2865 ( 9' 5")   |  |
| Ground clearance of counterweight | F      |            |         | 1000 ( 3' 3")           | 960 ( 3' 2")    |  |
| Overall height of engine hood     | G      | mm (ft i   | n)      | 2005 ( 6' 7")           | 1965(6'5")      |  |
| Minimum ground clearance          | Н      | mm (tt-in) |         | 315 ( 1.0")             | 275 ( 0.11")    |  |
| Rear-end distance                 | Ι      |            |         | 1675(5'6")              | 1675(5'6")      |  |
| Rear-end swing radius             | ľ      |            |         | 1680 ( 5' 6")           | 1680 (5'6")     |  |
| Wheel base                        | J      |            |         | 2100 ( 6' 11")          | 2100 ( 6' 11")  |  |
| Tread                             | К      |            |         | 1600 ( 5' 3")           | 1660 (5'5")     |  |
| Dozer blade width                 | L      |            |         | 1925 ( 6' 4")           | 2100 ( 6' 11")  |  |
| Height of blade                   | 0      |            |         | 350 ( 1' 2")            | 350 ( 1' 2")    |  |
| Ground clearance of blade up      | Р      |            |         | 430 (1'5")              | 430 ( 1' 5")    |  |
| Depth of blade down               | Q      |            |         | 154 (0'6")              | 154 ( 0' 6")    |  |
| Traval spood                      | Low    | km/br (m   | nh)     | 11 (6.8)                | 13.1 (8.1)      |  |
|                                   | High   |            | Pill    | 32 (19.9)               | 30 (18.6)       |  |
| Swing speed                       | rpm    |            | 8.26    | 8.26                    |                 |  |
| Gradeability                      | Degree | (%)        | 30 (58) | 30 (58)                 |                 |  |
| Max traction force                |        | kg (lb)    | )       | 3042 (6710) 3042 (6710) |                 |  |

# **3. WORKING RANGE**

# 1) 3.0 m (9'10") MONO BOOM WITH BOOM SWING SYSTEM



HW65AH2SP03

| Description                     | m (ft in)    | Boom | 3.0 n             | n (9' 10")        |
|---------------------------------|--------------|------|-------------------|-------------------|
| Description                     | rri (it-iri) | Arm  | 1.6 m (5' 3")     | 1.9 m (6' 3")     |
| Max digging reach               |              | A    | 6150 mm (20' 2")  | 6450 mm (21' 2")  |
| Max digging reach on ground     |              | A'   | 5950 mm (19' 6")  | 6250 mm (20' 6")  |
| Max digging depth               |              | В    | 3490 mm (11' 5")  | 3790 mm (12' 5")  |
| Max digging depth (8 ft level)  | mm (ft in)   | B'   | 3100 mm (10' 2")  | 3440 mm (11' 3")  |
| Max vertical wall digging depth | (11-11)      | С    | 3950 mm (13' 0")  | 3320 mm (10' 11") |
| Max digging height              |              | D    | 6045 mm (19' 1")  | 6260 mm (20' 6")  |
| Max dumping height              |              | E    | 4290 mm (14' 1")  | 4490 mm (14' 1")  |
| Min swing radius                |              | F    | 2380 mm ( 7' 10") | 2410 mm (7'11")   |
|                                 | kN           |      | 36.9 [40.2]       | 36.9 [40.2]       |
|                                 | kgf          | SAE  | 3763 [4100]       | 3763 [4100]       |
| Pueket diaging force            | lbf          |      | 8295 [9039]       | 8290 [9039]       |
| Bucket digging lorce            | kN           |      | 42.1 [45.9]       | 42.1 [45.9]       |
|                                 | kgf          | ISO  | 4292 [4680]       | 4290 [4680]       |
|                                 | lbf          |      | 9461 [10318]      | 9462 [10318]      |
|                                 | kN           |      | 27.3 [29.7]       | 24.3 [26.5]       |
|                                 | kgf          | SAE  | 2779 [3030]       | 2476 [2476]       |
| Arm around force                | lbf          |      | 6126 [6680]       | 5459 [5459]       |
|                                 | kN           |      | 28.3 [30.9]       | 25.1 [27.4]       |
|                                 | kgf          | ISO  | 2886 [3150]       | 2561 [2790]       |
|                                 | lbf          |      | 6335 [6945]       | 5646 [6151]       |

# 4. WEIGHT

| ltom   | HW6 | 65AH |
|--|-----|------|
|  | kg  | lb   |
| Upperstructure assembly                        | •   |      |
| Main frame weld assembly                       | 764 | 1684 |
| Engine assembly                                | 264 | 582  |
| Aftertreatment assy                            | 11  | 25   |
| Main pump assembly                             | 35  | 77   |
| Main control valve assembly                    | 50  | 110  |
| Swing motor assembly                           | 76  | 168  |
| Hydraulic oil tank assembly                    | 95  | 208  |
| Hydraulic oil (max)                            | 61  | 135  |
| Fuel tank assembly                             | 67  | 148  |
| Fuel oil (max)                                 | 106 | 233  |
| Counterweight (STD)                            | 210 | 463  |
| Counterweight (Heavy)                          | 330 | 728  |
| Cab assembly                                   | 350 | 772  |
| Lower chassis assembly                         | ·   |      |
| Lower frame weld assembly (single tire)        | 753 | 1660 |
| Lower frame weld assembly (double tire)        | 769 | 1695 |
| Swing bearing                                  | 102 | 225  |
| Travel motor assembly                          | 43  | 95   |
| Turning joint                                  | 60  | 132  |
| Transmission assembly                          | 100 | 220  |
| Front axle assembly                            | 280 | 617  |
| Rear axle assembly                             | 240 | 529  |
| Dozer blade assembly (single tire)             | 230 | 507  |
| Dozer blade assembly (double tire)             | 242 | 534  |
| Front attachment assembly                      |     |      |
| 3.0 m boom assembly                            | 247 | 545  |
| 1.6 m arm assembly                             | 130 | 287  |
| 1.9 m arm assembly                             | 135 | 298  |
| 0.18 m <sup>3</sup> SAE heaped bucket assembly | 162 | 357  |
| 0.07 m <sup>3</sup> SAE heaped bucket assembly | 110 | 243  |
| Boom cylinder assembly                         | 78  | 172  |
| Arm cylinder assembly                          | 65  | 143  |
| Bucket cylinder assembly                       | 37  | 82   |
| Dozer cylinder assembly                        | 31  | 68   |
| Bucket control linkage total                   | 46  | 102  |

# **5. LIFTING CAPACITIES**

| Model  | Туре      |        | Boom        | Arm         | Counterweight | Wheel      | Do    | zer  | Outr  | igger |
|--------|-----------|--------|-------------|-------------|---------------|------------|-------|------|-------|-------|
| HW65AH | MONO      | SINGLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front | Rear  |
|        | BOOM TIRE | 3000   | 1600        | 210         | -             | -          | Down  | -    | -     |       |

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



|                          |          | Lift-point radius (B) |                |                |                |                 |                |                 |             |                | max. rea       | ch             |
|--------------------------|----------|-----------------------|----------------|----------------|----------------|-----------------|----------------|-----------------|-------------|----------------|----------------|----------------|
| Lift-point<br>height (A) |          | 2.0 m (6.6 ft)        |                | 3.0 m (9.8 ft) |                | 4.0 m (13.1 ft) |                | 5.0 m (16.4 ft) |             | Capacity       |                | Reach          |
|                          |          | ŀ                     | <b>-‡</b>      | ŀ              | - <b>†</b> -)  | ŀ               | - <b>†</b> -)  | ŀ               | <b>-‡</b>   | ŀ              | <b>-</b>       | m (ft)         |
| 5.0 m<br>(16.4 ft)       | kg<br>Ib |                       |                |                |                |                 |                |                 |             | *1310<br>*2890 | *1310<br>*2890 | 3.51<br>(11.5) |
| 4.0 m<br>(13.1 ft)       | kg<br>Ib |                       |                |                |                | *1210<br>*2670  | *1210<br>*2670 |                 |             | *1270<br>*2800 | 1100<br>2430   | 4.45<br>(14.6) |
| 3.0 m<br>(9.8 ft)        | kg<br>Ib |                       |                | *1490<br>*3280 | *1490<br>*3280 | *1320<br>*2910  | 1290<br>2840   |                 |             | *1230<br>*2710 | 910<br>2010    | 4.96<br>(16.3) |
| 2.0 m<br>(6.6 ft)        | kg<br>Ib |                       |                | *2140<br>*4720 | 1900<br>4190   | *1570<br>*3460  | 1240<br>2730   | *1350<br>*2980  | 890<br>1960 | *1260<br>*2780 | 840<br>1850    | 5.19<br>(17.0) |
| 1.0 m<br>(3.3 ft)        | kg<br>Ib |                       |                | *2670<br>*5890 | 1790<br>3950   | *1810<br>*3990  | 1190<br>2620   | 1340<br>2950    | 870<br>1920 | 1270<br>2800   | 820<br>1810    | 5.19<br>(17.0) |
| 0.0 m<br>(0.0 ft)        | kg<br>Ib | *1930<br>*4250        | *1930<br>*4250 | *2820<br>*6220 | 1750<br>3860   | 1840<br>4060    | 1160<br>2560   |                 |             | 1340<br>2950   | 860<br>1900    | 4.96 (16.3)    |
| -1.0 m<br>(-3.3 ft)      | kg<br>Ib | *3740<br>*8250        | 3470<br>7650   | *2630<br>*5800 | 1750<br>3860   | *1800<br>*3970  | 1160<br>2560   |                 |             | *1500<br>*3310 | 1000<br>2200   | 4.46<br>(14.6) |
| -2.0 m<br>(-6.6 ft)      | kg<br>Ib | *3130<br>*6900        | *3130<br>*6900 | *2000<br>*4410 | 1790<br>3950   |                 |                |                 |             | *1520<br>*3350 | 1420<br>3130   | 3.53<br>(11.6) |

#### % Note

1. Lifting capacity are based on SAE J1097 and ISO 10567.

- 2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
- 3. The lift-point is bucket pivot mounting pin on the arm (without bucket mass).
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The difference between the weight of a work tool attachment must be subtracted.

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

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

| Model  | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Do    | zer  | Outr  | igger |
|--------|------|--------|-------------|-------------|---------------|------------|-------|------|-------|-------|
| HW65AH | MONO | SINGLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front | Rear  |
|        | BOOM | TIRE   | 3000        | 1600        | 210           | -          | -     | Up   | -     | -     |

- · Rating over-front
- = Rating over-side or 360 degree



|                     |          | Lift-point radius (B) |                |                |                |                |              |                |               | At             | max. rea       | ch             |
|---------------------|----------|-----------------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|----------------|----------------|----------------|
| Lift-poi            | int      | 2.0 m                 | (6.6 ft)       | 3.0 m          | (9.8 ft)       | 4.0 m (        | 13.1 ft)     | 5.0 m (        | 16.4 ft)      | Capa           | acity          | Reach          |
| height              | (A)      | ŀ                     | <b>4</b>       | ŀ              | <b>-‡</b>      | ŀ              | <b>-‡</b>    | ŀ              | - <b>£</b> *) | ŀ              | <b>-‡</b> *)   | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                       |                |                |                |                |              |                |               | *1310<br>*2890 | *1310<br>*2890 | 3.51<br>(11.5) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                       |                |                |                | *1210<br>*2670 | 1140<br>2510 |                |               | *1270<br>*2800 | 950<br>2090    | 4.45<br>(14.6) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                       |                | *1490<br>*3280 | *1490<br>*3280 | *1320<br>*2910 | 1110<br>2450 |                |               | *1230<br>*2710 | 790<br>1740    | 4.96<br>(16.3) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                       |                | *2140<br>*4720 | 1620<br>3570   | *1570<br>*3460 | 1060<br>2340 | *1350<br>*2980 | 760<br>1680   | *1260<br>*2780 | 720<br>1590    | 5.19<br>(17.0) |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                       |                | *2670<br>*5890 | 1510<br>3330   | *1810<br>*3990 | 1020<br>2250 | 1340<br>2950   | 740<br>1630   | 1270<br>2800   | 700<br>1540    | 5.19<br>(17.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib | *1930<br>*4250        | *1930<br>*4250 | *2820<br>*6220 | 1470<br>3240   | 1840<br>4060   | 990<br>2180  |                |               | 1340<br>2950   | 740<br>1630    | 4.96 (16.3)    |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *3740<br>*8250        | 2810<br>6190   | *2630<br>*5800 | 1470<br>3240   | *1800<br>*3970 | 990<br>2180  |                |               | *1500<br>*3310 | 860<br>1900    | 4.46<br>(14.6) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3130<br>*6900        | 2880<br>6350   | *2000<br>*4410 | 1510<br>3330   |                |              |                |               | *1520<br>*3350 | 1210<br>2670   | 3.53<br>(11.6) |

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- \* Lifting capacities are based upon a standard machine conditions.

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

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

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

| Model  | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Do    | zer  | Outr  | igger |
|--------|------|--------|-------------|-------------|---------------|------------|-------|------|-------|-------|
| HW65AH | MONO | SINGLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front | Rear  |
|        | BOOM | TIRE   | 3000        | 1600        | 330           | -          | -     | Down | -     | -     |

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

|                     |          |                | Lift-point radius (B) |                |                |                |                |                |               | At             | max. rea       | ch             |
|---------------------|----------|----------------|-----------------------|----------------|----------------|----------------|----------------|----------------|---------------|----------------|----------------|----------------|
| Lift-poi            | int      | 2.0 m          | (6.6 ft)              | 3.0 m          | (9.8 ft)       | 4.0 m (        | 13.1 ft)       | 5.0 m (        | 16.4 ft)      | Capa           | acity          | Reach          |
| height              | (A)      | ŀ              | <b>-‡</b>             | ŀ              | <b>*</b>       | ŀ              | ÷              | ŀ              | - <b>£</b> *) | ŀ              | <b>-‡</b> *)   | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                |                       |                |                |                |                |                |               | *1310<br>*2890 | *1310<br>*2890 | 3.51<br>(11.5) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                |                       |                |                | *1210<br>*2670 | *1210<br>*2670 |                |               | *1270<br>*2800 | 1160<br>2560   | 4.45<br>(14.6) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                |                       | *1490<br>*3280 | *1490<br>*3280 | *1320<br>*2910 | *1320<br>*2910 |                |               | *1230<br>*2710 | 970<br>2140    | 4.96<br>(16.3) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                |                       | *2140<br>*4720 | 2000<br>4410   | *1570<br>*3460 | 1310<br>2890   | *1350<br>*2980 | 940<br>2070   | *1260<br>*2780 | 880<br>1940    | 5.19 (17.0)    |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                |                       | *2670<br>*5890 | 1890<br>4170   | *1810<br>*3990 | 1260<br>2780   | 1400<br>3090   | 920<br>2030   | 1330<br>2930   | 870<br>1920    | 5.19<br>(17.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib | *1930<br>*4250 | *1930<br>*4250        | *2820<br>*6220 | 1850<br>4080   | *1920<br>*4230 | 1230<br>2710   |                |               | 1410<br>3110   | 920<br>2030    | 4.96 (16.3)    |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *3740<br>*8250 | 3660<br>8070          | *2630<br>*5800 | 1850<br>4080   | *1800<br>*3970 | 1230<br>2710   |                |               | *1500<br>*3310 | 1060<br>2340   | 4.46<br>(14.6) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3130<br>*6900 | *3130<br>*6900        | *2000<br>*4410 | 1890<br>4170   |                |                |                |               | *1520<br>*3350 | 1500<br>3310   | 3.53<br>(11.6) |

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

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| Model  | Туре |        | Boom        | Arm         | Counterweight | Wheel      | Do    | zer  | Outr  | igger |
|--------|------|--------|-------------|-------------|---------------|------------|-------|------|-------|-------|
| HW65AH | MONO | SINGLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front | Rear  |
|        | BOOM | TIRE   | 3000        | 1600        | 330           | -          | -     | Up   | -     | -     |

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

|                     |          |                |                |                | Lift-point ı   | radius (B)     |              |                |             | At             | max. rea       | ch             |
|---------------------|----------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|-------------|----------------|----------------|----------------|
| Lift-poi            | int      | 2.0 m          | (6.6 ft)       | 3.0 m          | (9.8 ft)       | 4.0 m (        | 13.1 ft)     | 5.0 m (        | 16.4 ft)    | Capa           | acity          | Reach          |
| height (            | (A)      | ŀ              | <b>-‡</b> *)   | ŀ              | <b></b>        | ŀ              | ÷            | ŀ              | <b>4</b>    | ŀ              | <b>-‡*</b> )   | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                |                |                |                |                |              |                |             | *1310<br>*2890 | *1310<br>*2890 | 3.51<br>(11.5) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                |                |                |                | *1210<br>*2670 | 1200<br>2650 |                |             | *1270<br>*2800 | 1000<br>2200   | 4.45<br>(14.6) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                |                | *1490<br>*3280 | *1490<br>*3280 | *1320<br>*2910 | 1180<br>2600 |                |             | *1230<br>*2710 | 840<br>1850    | 4.96<br>(16.3) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                |                | *2140<br>*4720 | 1710<br>3770   | *1570<br>*3460 | 1130<br>2490 | *1350<br>*2980 | 810<br>1790 | *1260<br>*2780 | 760<br>1680    | 5.19<br>(17.0) |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                |                | *2670<br>*5890 | 1610<br>3550   | *1810<br>*3990 | 1080<br>2380 | 1400<br>3090   | 790<br>1740 | 1330<br>2930   | 750<br>1650    | 5.19<br>(17.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib | *1930<br>*4250 | *1930<br>*4250 | *2820<br>*6220 | 1560<br>3440   | *1920<br>*4230 | 1050<br>2310 |                |             | 1410<br>3110   | 790<br>1740    | 4.96<br>(16.3) |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *3740<br>*8250 | 2980<br>6570   | *2630<br>*5800 | 1560<br>3440   | *1800<br>*3970 | 1050<br>2310 |                |             | *1500<br>*3310 | 910<br>2010    | 4.46<br>(14.6) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3130<br>*6900 | 3050<br>6720   | *2000<br>*4410 | 1600<br>3530   |                |              |                |             | *1520<br>*3350 | 1280<br>2820   | 3.53<br>(11.6) |

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| Model  | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Do    | zer  | Outri | gger |
|--------|------|--------|-------------|-------------|---------------|------------|-------|------|-------|------|
| HW65AH | MONO | SINGLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front | Rear |
|        | BOOM | TIRE   | 3000        | 1900        | 210           | -          | -     | Down | -     | -    |

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

|                           |                |                |                |                | Load           | radius         |                |                |                |             | At             | max. rea       | ch             |
|---------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|
| Load point                | 1.0 m          | (3 ft)         | 2.0 m          | (7 ft)         | 3.0 m          | (10 ft)        | 4.0 m          | (13 ft)        | 5.0 m          | (16 ft)     | Capa           | acity          | Reach          |
| height                    | ľ              | ⋳⋣⋑            | F              | ⋳ <b>⋕</b> ⋑   | ŀ              | ╔╋╸            | ŀ              | ⋳⋣⋑            | ŀ              | ⋐⋕₽         | ŀ              | ╔╌╋╍╸          | m (ft)         |
| 5.0 m kg<br>(16.4 ft) lb  |                |                |                |                |                |                |                |                |                |             | *1180<br>*2600 | *1180<br>*2600 | 3.97<br>(13.0) |
| 4.0 m kg<br>(13.1 ft) lb  |                |                |                |                |                |                | *1060<br>*2340 | *1060<br>*2340 |                |             | *1050<br>*2310 | 980<br>2160    | 4.80<br>(15.7) |
| 3.0 m kg<br>(9.8 ft) lb   |                |                |                |                |                |                | *1200<br>*2650 | *1200<br>*2650 | *1180<br>*2600 | 920<br>2030 | *1010<br>*2230 | 840<br>1850    | 5.27<br>(17.3) |
| 2.0 m kg<br>(6.6 ft) lb   |                |                |                |                | *1930<br>*4250 | *1930<br>*4250 | *1460<br>*3220 | 1260<br>2780   | *1270<br>*2800 | 900<br>1980 | *1030<br>*2270 | 770<br>1700    | 5.49<br>(18.0) |
| 1.0 m kg<br>(3.3 ft) lb   |                |                |                |                | *2550<br>*5620 | 1820<br>4010   | *1740<br>*3840 | 1200<br>2650   | 1340<br>2950   | 870<br>1920 | *1110<br>*2450 | 760<br>1680    | 5.49<br>(18.0) |
| 0.0 m kg<br>(0.0 ft) lb   |                |                | *1860<br>*4100 | *1860<br>*4100 | *2810<br>*6190 | 1760<br>3880   | 1840<br>4060   | 1160<br>2560   | 1320<br>2910   | 850<br>1870 | 1230<br>2710   | 790<br>1740    | 5.27<br>(17.3) |
| -1.0 m kg<br>(-3.3 ft) lb | *2260<br>*4980 | *2260<br>*4980 | *3220<br>*7100 | *3220<br>*7100 | *2720<br>*6000 | 1740<br>3840   | 1830<br>4030   | 1150<br>2540   |                |             | *1400<br>*3090 | 900<br>1980    | 4.81<br>(15.8) |
| -2.0 m kg<br>(-6.6 ft) lb | *3620<br>*7980 | *3620<br>*7980 | *3640<br>*8020 | 3500<br>7720   | *2260<br>*4980 | 1770<br>3900   |                |                |                |             | *1440<br>*3170 | 1180<br>2600   | 3.98<br>(13.1) |
| -3.0 m kg<br>(-9.8 ft) lb |                |                |                |                |                |                |                |                |                |             |                |                |                |

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| Model  | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Do    | zer  | Outri | igger |
|--------|------|--------|-------------|-------------|---------------|------------|-------|------|-------|-------|
| HW65AH | MONO | SINGLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front | Rear  |
|        | BOOM | TIRE   | 3000        | 1900        | 210           | -          | -     | Up   | -     | -     |

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

|                           |                | Load radius    |                |                |                |              |                |                       |                |             |                | max. rea     | ch             |
|---------------------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|-----------------------|----------------|-------------|----------------|--------------|----------------|
| Load poin                 | t 1.0 n        | n (3 ft)       | 2.0 m          | (7 ft)         | 3.0 m          | (10 ft)      | 4.0 m          | (13 ft)               | 5.0 m          | (16 ft)     | Capa           | acity        | Reach          |
| height                    | ŀ              |                |                | ₽₽₽            | ŀ              | ⋳⋕⋬          |                | <b>⋳⋳</b><br><b>⋳</b> | ŀ              |             | ŀ              | ╔╋╍╸         | m (ft)         |
| 5.0 m kg<br>(16.4 ft) lb  |                |                |                |                |                |              |                |                       |                |             | *1180<br>*2600 | 1160<br>2560 | 3.97<br>(13.0) |
| 4.0 m kg<br>(13.1 ft) lb  |                |                |                |                |                |              | *1060<br>*2340 | *1060<br>*2340        |                |             | *1050<br>*2310 | 850<br>1870  | 4.80<br>(15.7) |
| 3.0 m kg<br>(9.8 ft) lb   |                |                |                |                |                |              | *1200<br>*2650 | 1130<br>2490          | *1180<br>*2600 | 790<br>1740 | *1010<br>*2230 | 720<br>1590  | 5.27<br>(17.3) |
| 2.0 m kg<br>(6.6 ft) lb   |                |                |                |                | *1930<br>*4250 | 1650<br>3640 | *1460<br>*3220 | 1080<br>2380          | *1270<br>*2800 | 770<br>1700 | *1030<br>*2270 | 660<br>1460  | 5.49 (18.0)    |
| 1.0 m kg<br>(3.3 ft) lb   | I              |                |                |                | *2550<br>*5620 | 1540<br>3400 | *1740<br>*3840 | 1030<br>2270          | 1340<br>2950   | 750<br>1650 | *1110<br>*2450 | 650<br>1430  | 5.49<br>(18.0) |
| 0.0 m kg<br>(0.0 ft) lb   | I              |                | *1860<br>*4100 | *1860<br>*4100 | *2810<br>*6190 | 1480<br>3260 | 1840<br>4060   | 990<br>2180           | 1320<br>2910   | 730<br>1610 | 1230<br>2710   | 680<br>1500  | 5.27 (17.3)    |
| -1.0 m kg<br>(-3.3 ft) lb | 2260 *4980     | *2260<br>*4980 | *3220<br>*7100 | 2790<br>6150   | *2720<br>*6000 | 1470<br>3240 | 1830<br>4030   | 980<br>2160           |                |             | *1400<br>*3090 | 770<br>1700  | 4.81<br>(15.8) |
| -2.0 m kg<br>(-6.6 ft) lb | *3620<br>*7980 | *3620<br>*7980 | *3640<br>*8020 | 2850<br>6280   | *2260<br>*4980 | 1490<br>3280 |                |                       |                |             | *1440<br>*3170 | 1010<br>2230 | 3.98<br>(13.1) |
| -3.0 m kg<br>(-9.8 ft) lb | 1              |                |                |                |                |              |                |                       |                |             |                |              | ,/_            |

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| Model  | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Do    | zer  | Outri | igger |
|--------|------|--------|-------------|-------------|---------------|------------|-------|------|-------|-------|
| HW65AH | MONO | SINGLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front | Rear  |
|        | BOOM | TIRE   | 3000        | 1900        | 330           | -          | -     | Down | -     | -     |

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

|                           |                | Load radius    |                |                |                |                |                |                |                |             |                | max. rea       | ch             |
|---------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|
| Load poin                 | t 1.0 n        | n (3 ft)       | 2.0 m          | ı (7 ft)       | 3.0 m          | (10 ft)        | 4.0 m          | (13 ft)        | 5.0 m          | (16 ft)     | Capa           | acity          | Reach          |
| height                    | ľ              |                |                | ⋳⋕⋬            | ŀ              | ⋳⋕⋬            |                | ╔╋╋            | ŀ              |             | ŀ              |                | m (ft)         |
| 5.0 m kg<br>(16.4 ft) lb  |                |                |                |                |                |                |                |                |                |             | *1180<br>*2600 | *1180<br>*2600 | 3.97<br>(13.0) |
| 4.0 m kg<br>(13.1 ft) lb  |                |                |                |                |                |                | *1060<br>*2340 | *1060<br>*2340 |                |             | *1050<br>*2310 | 1040<br>2290   | 4.80<br>(15.7) |
| 3.0 m kg<br>(9.8 ft) lb   |                |                |                |                |                |                | *1200<br>*2650 | *1200<br>*2650 | *1180<br>*2600 | 970<br>2140 | *1010<br>*2230 | 890<br>1960    | 5.27<br>(17.3) |
| 2.0 m kg<br>(6.6 ft) lb   |                |                |                |                | *1930<br>*4250 | *1930<br>*4250 | *1460<br>*3220 | 1320<br>2910   | *1270<br>*2800 | 950<br>2090 | *1030<br>*2270 | 820<br>1810    | 5.49 (18.0)    |
| 1.0 m kg<br>(3.3 ft) lb   |                |                |                |                | *2550<br>*5620 | 1920<br>4230   | *1740<br>*3840 | 1270<br>2800   | *1390<br>*3060 | 920<br>2030 | *1110<br>*2450 | 800<br>1760    | 5.49<br>(18.0) |
| 0.0 m kg<br>(0.0 ft) lb   | 1              |                | *1860<br>*4100 | *1860<br>*4100 | *2810<br>*6190 | 1860<br>4100   | *1900<br>*4190 | 1230<br>2710   | 1390<br>3060   | 900<br>1980 | *1270<br>*2800 | 840<br>1850    | 5.27<br>(17.3) |
| -1.0 m kg<br>(-3.3 ft) lb | 2260 *4980     | *2260<br>*4980 | *3220<br>*7100 | *3220<br>*7100 | *2720<br>*6000 | 1840<br>4060   | *1870<br>*4120 | 1220<br>2690   |                |             | *1400<br>*3090 | 950<br>2090    | 4.81<br>(15.8) |
| -2.0 m kg<br>(-6.6 ft) lb | *3620<br>*7980 | *3620<br>*7980 | *3640<br>*8020 | *3640<br>*8020 | *2260<br>*4980 | 1870<br>4120   |                |                |                |             | *1440<br>*3170 | 1250<br>2760   | 3.98<br>(13.1) |
| -3.0 m kg<br>(-9.8 ft) lb |                |                |                |                |                |                |                |                |                |             |                |                |                |

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| Model   | Туре |        | Boom        | Arm         | Counterweight | Wheel      | Do    | zer  | Outrigger |      |
|---------|------|--------|-------------|-------------|---------------|------------|-------|------|-----------|------|
|         | MONO | SINGLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front     | Rear |
| TIVUOAN | BOOM | TIRE   | 3000        | 1900        | 330           | -          | -     | Up   | -         | -    |

- · 🕴 : Rating over-front
- 👍 : Rating over-side or 360 degree

|                     |          | Load radius    |                |                |                |                |              |                |                |                |             |                | At max. reach  |                |  |
|---------------------|----------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|--|
| Load po             | bint     | 1.0 m          | (3 ft)         | 2.0 m          | (7 ft)         | 3.0 m          | (10 ft)      | 4.0 m          | (13 ft)        | 5.0 m          | (16 ft)     | Capa           | acity          | Reach          |  |
| height              |          | ľ              | ╔╋╋            | ľ              | ₢₽₽₽           | ŀ              | ╔╋╋          | ľ              | ╔╋╋            | ŀ              | ⋳⋣⋑         | ŀ              |                | m (ft)         |  |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                |                |                |                |                |              |                |                |                |             | *1180<br>*2600 | *1180<br>*2600 | 3.97<br>(13.0) |  |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                |                |                |                |                |              | *1060<br>*2340 | *1060<br>*2340 |                |             | *1050<br>*2310 | 900<br>1980    | 4.80<br>(15.7) |  |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                |                |                |                |                |              | *1200<br>*2650 | 1190<br>2620   | *1180<br>*2600 | 840<br>1850 | *1010<br>*2230 | 770<br>1700    | 5.27<br>(17.3) |  |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                |                |                |                | *1930<br>*4250 | 1740<br>3840 | *1460<br>*3220 | 1140<br>2510   | *1270<br>*2800 | 820<br>1810 | *1030<br>*2270 | 710<br>1570    | 5.49<br>(18.0) |  |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                |                |                |                | *2550<br>*5620 | 1630<br>3590 | *1740<br>*3840 | 1090<br>2400   | *1390<br>*3060 | 790<br>1740 | *1110<br>*2450 | 690<br>1520    | 5.49<br>(18.0) |  |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib |                |                | *1860<br>*4100 | *1860<br>*4100 | *2810<br>*6190 | 1570<br>3460 | *1900<br>*4190 | 1050<br>2310   | 1390<br>3060   | 780<br>1720 | *1270<br>*2800 | 720<br>1590    | 5.27<br>(17.3) |  |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *2260<br>*4980 | *2260<br>*4980 | *3220<br>*7100 | 2960<br>6530   | *2720<br>*6000 | 1560<br>3440 | *1870<br>*4120 | 1040<br>2290   |                |             | *1400<br>*3090 | 820<br>1810    | 4.81<br>(15.8) |  |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3620<br>*7980 | *3620<br>*7980 | *3640<br>*8020 | 3010<br>6640   | *2260<br>*4980 | 1580<br>3480 |                |                |                |             | *1440<br>*3170 | 1070<br>2360   | 3.98<br>(13.1) |  |
| -3.0 m<br>(-9.8 ft) | kg<br>Ib |                |                |                |                |                |              |                |                |                |             |                |                |                |  |

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

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| Model  | Туре |         | Boom        | Arm         | Counterweight | Wheel      | Dozer |      | Outrigger |      |
|--------|------|---------|-------------|-------------|---------------|------------|-------|------|-----------|------|
| HW65AH | MONO | DOUBLE  | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front     | Rear |
|        | BOOM | OM TIRE | 3000        | 1600        | 210           | -          | -     | Down | -         | -    |

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

|                     |          | Lift-point radius (B) |                |                |                |                |                |                | At          | max. rea       | ch             |                |
|---------------------|----------|-----------------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|
| Lift-poi            | int      | 2.0 m                 | (6.6 ft)       | 3.0 m          | (9.8 ft)       | 4.0 m (        | 13.1 ft)       | 5.0 m (        | 16.4 ft)    | Capa           | acity          | Reach          |
| height              | (A)      | Ļ                     | <b>4</b>       | ŀ              | <b>#</b>       | ŀ              | <b>#</b>       | ŀ              | <b>#</b>    | ŀ              | <b>-‡</b>      | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                       |                |                |                |                |                |                |             | *1310<br>*2890 | *1310<br>*2890 | 3.48<br>(11.4) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                       |                |                |                | *1210<br>*2670 | *1210<br>*2670 |                |             | *1270<br>*2800 | 1190<br>2620   | 4.43<br>(14.5) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                       |                | *1480<br>*3260 | *1480<br>*3260 | *1320<br>*2910 | *1320<br>*2910 |                |             | *1230<br>*2710 | 990<br>2180    | 4.95<br>(16.2) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                       |                | *2130<br>*4700 | 2060<br>4540   | *1560<br>*3440 | 1340<br>2950   | *1340<br>*2950 | 960<br>2120 | *1260<br>*2780 | 910<br>2010    | 5.19<br>(17.0) |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                       |                | *2670<br>*5890 | 1950<br>4300   | *1800<br>*3970 | 1290<br>2840   | 1400<br>3090   | 940<br>2070 | 1320<br>2910   | 890<br>1960    | 5.19<br>(17.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib | *1890<br>*4170        | *1890<br>*4170 | *2820<br>*6220 | 1900<br>4190   | *1920<br>*4230 | 1260<br>2780   |                |             | 1400<br>3090   | 940<br>2070    | 4.97<br>(16.3) |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *3690<br>*8140        | *3690<br>*8140 | *2640<br>*5820 | 1900<br>4190   | *1810<br>*3990 | 1260<br>2780   |                |             | *1500<br>*3310 | 1080<br>2380   | 4.47<br>(14.7) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3170<br>*6990        | *3170<br>*6990 | *2020<br>*4450 | 1940<br>4280   |                |                |                |             | *1520<br>*3350 | 1520<br>3350   | 3.56<br>(11.7) |

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| Model  | Туре |        | Boom        | Arm         | Arm Counterweight |            | Wheel Dozer |      | Outrigger |      |
|--------|------|--------|-------------|-------------|-------------------|------------|-------------|------|-----------|------|
| HW65AH | MONO | DOUBLE | Length [mm] | Length [mm] | weight [kg]       | width [mm] | Front       | Rear | Front     | Rear |
|        | BOOM | TIRE   | 3000        | 1600        | 210               | -          | -           | Up   | -         | -    |

- · Rating over-front
- Ending over-side or 360 degree



|                     |          | Lift-point radius (B) |                |                |                |                |                |                | At          | max. rea       | ch             |                |
|---------------------|----------|-----------------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|
| Lift-poi            | int      | 2.0 m                 | (6.6 ft)       | 3.0 m          | (9.8 ft)       | 4.0 m (        | 13.1 ft)       | 5.0 m (        | 16.4 ft)    | Capa           | acity          | Reach          |
| height (A)          |          | ŀ                     | <b>-‡</b> \$   | ŀ              | <b>-†</b>      | ŀ              | <b>4</b>       | ŀ              | <b>4</b>    | ŀ              | <b>-‡</b>      | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                       |                |                |                |                |                |                |             | *1310<br>*2890 | *1310<br>*2890 | 3.48<br>(11.4) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                       |                |                |                | *1210<br>*2670 | *1210<br>*2670 |                |             | *1270<br>*2800 | 1050<br>2310   | 4.43<br>(14.5) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                       |                | *1480<br>*3260 | *1480<br>*3260 | *1320<br>*2910 | 1220<br>2690   |                |             | *1230<br>*2710 | 870<br>1920    | 4.95<br>(16.2) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                       |                | *2130<br>*4700 | 1790<br>3950   | *1560<br>*3440 | 1170<br>2580   | *1340<br>*2950 | 840<br>1850 | *1260<br>*2780 | 790<br>1740    | 5.19<br>(17.0) |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                       |                | *2670<br>*5890 | 1680<br>3700   | *1800<br>*3970 | 1130<br>2490   | 1400<br>3090   | 820<br>1810 | 1320<br>2910   | 780<br>1720    | 5.19<br>(17.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib | *1890<br>*4170        | *1890<br>*4170 | *2820<br>*6220 | 1640<br>3620   | *1920<br>*4230 | 1100<br>2430   |                |             | 1400<br>3090   | 820<br>1810    | 4.97<br>(16.3) |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *3690<br>*8140        | 3150<br>6940   | *2640<br>*5820 | 1640<br>3620   | *1810<br>*3990 | 1090<br>2400   |                |             | *1500<br>*3310 | 950<br>2090    | 4.47<br>(14.7) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3170<br>*6990        | *3170<br>*6990 | *2020<br>*4450 | 1680<br>3700   |                |                |                |             | *1520<br>*3350 | 1320<br>2910   | 3.56<br>(11.7) |

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| Model  | Туре |        | Boom        | Arm         | Counterweight | Wheel      | Dozer |      | Outrigger |      |
|--------|------|--------|-------------|-------------|---------------|------------|-------|------|-----------|------|
| HW65AH | MONO | DOUBLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front     | Rear |
|        | BOOM | M TIRE | 3000        | 1600        | 330           | -          | -     | Down | -         | -    |

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

|                     |          |                |                |                | Lift-point ı   | radius (B)     |                |                |              | ch             |                |                |
|---------------------|----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|
| Lift-poi            | int      | 2.0 m          | (6.6 ft)       | 3.0 m          | (9.8 ft)       | 4.0 m (        | 13.1 ft)       | 5.0 m (        | 16.4 ft)     | Capa           | acity          | Reach          |
| height (            | (A)      | Ļ              | <b>-‡</b> \$   | ŀ              | <b>#</b>       | ŀ              | <b>#</b> )     | ŀ              | <b>-‡</b>    | ŀ              | <b>-‡</b> ‡)   | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                |                |                |                |                |                |                |              | *1310<br>*2890 | *1310<br>*2890 | 3.48<br>(11.4) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                |                |                |                | *1210<br>*2670 | *1210<br>*2670 |                |              | *1270<br>*2800 | 1250<br>2760   | 4.43<br>(14.5) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                |                | *1480<br>*3260 | *1480<br>*3260 | *1320<br>*2910 | *1320<br>*2910 |                |              | *1230<br>*2710 | 1040<br>2290   | 4.95<br>(16.2) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                |                | *2130<br>*4700 | *2130<br>*4700 | *1560<br>*3440 | 1410<br>3110   | *1340<br>*2950 | 1010<br>2230 | *1260<br>*2780 | 960<br>2120    | 5.19<br>(17.0) |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                |                | *2670<br>*5890 | 2050<br>4520   | *1800<br>*3970 | 1360<br>3000   | *1430<br>*3150 | 990<br>2180  | *1370<br>*3020 | 940<br>2070    | 5.19<br>(17.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib | *1890<br>*4170 | *1890<br>*4170 | *2820<br>*6220 | 2000<br>4410   | *1920<br>*4230 | 1330<br>2930   |                |              | *1440<br>*3170 | 990<br>2180    | 4.97<br>(16.3) |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *3690<br>*8140 | *3690<br>*8140 | *2640<br>*5820 | 2000<br>4410   | *1810<br>*3990 | 1330<br>2930   |                |              | *1500<br>*3310 | 1140<br>2510   | 4.47<br>(14.7) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3170<br>*6990 | *3170<br>*6990 | *2020<br>*4450 | *2020<br>*4450 |                |                |                |              | *1520<br>*3350 | *1520<br>*3350 | 3.56<br>(11.7) |

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| Model  | Туре |        | Boom        | Boom Arm Counterweight Wheel |             | erweight Wheel |       | Dozer |       | Outrigger |  |
|--------|------|--------|-------------|------------------------------|-------------|----------------|-------|-------|-------|-----------|--|
| HW65AH | MONO | DOUBLE | Length [mm] | Length [mm]                  | weight [kg] | width [mm]     | Front | Rear  | Front | Rear      |  |
|        | BOOM | TIRE   | 3000        | 1600                         | 330         | -              | -     | Up    | -     | -         |  |

- · Rating over-front
- Ending over-side or 360 degree



|                     |          | Lift-point radius (B) |                |                |                |                |                |                | At          | max. rea       | ch             |                |
|---------------------|----------|-----------------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|
| Lift-poi            | int      | 2.0 m                 | (6.6 ft)       | 3.0 m          | (9.8 ft)       | 4.0 m (        | 13.1 ft)       | 5.0 m (        | 16.4 ft)    | Capa           | acity          | Reach          |
| height (A)          |          | Ļ                     | <b>-‡</b>      | ŀ              | <b>-†</b>      | ŀ              | <b>4</b>       | ŀ              | <b>4</b>    | ŀ              | <b>-‡</b>      | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                       |                |                |                |                |                |                |             | *1310<br>*2890 | *1310<br>*2890 | 3.48<br>(11.4) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                       |                |                |                | *1210<br>*2670 | *1210<br>*2670 |                |             | *1270<br>*2800 | 1110<br>2450   | 4.43<br>(14.5) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                       |                | *1480<br>*3260 | *1480<br>*3260 | *1320<br>*2910 | 1290<br>2840   |                |             | *1230<br>*2710 | 920<br>2030    | 4.95<br>(16.2) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                       |                | *2130<br>*4700 | 1880<br>4140   | *1560<br>*3440 | 1240<br>2730   | *1340<br>*2950 | 890<br>1960 | *1260<br>*2780 | 840<br>1850    | 5.19<br>(17.0) |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                       |                | *2670<br>*5890 | 1780<br>3920   | *1800<br>*3970 | 1190<br>2620   | *1430<br>*3150 | 870<br>1920 | *1370<br>*3020 | 820<br>1810    | 5.19<br>(17.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib | *1890<br>*4170        | *1890<br>*4170 | *2820<br>*6220 | 1730<br>3810   | *1920<br>*4230 | 1160<br>2560   |                |             | *1440<br>*3170 | 870<br>1920    | 4.97<br>(16.3) |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *3690<br>*8140        | 3330<br>7340   | *2640<br>*5820 | 1730<br>3810   | *1810<br>*3990 | 1160<br>2560   |                |             | *1500<br>*3310 | 1000<br>2200   | 4.47<br>(14.7) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3170<br>*6990        | *3170<br>*6990 | *2020<br>*4450 | 1770<br>3900   |                |                |                |             | *1520<br>*3350 | 1400<br>3090   | 3.56<br>(11.7) |

1. Lifting capacity are based on SAE J1097 and ISO 10567.

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

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

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

Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.
| Model   | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Dozer |      | Outrigger |      |
|---------|------|--------|-------------|-------------|---------------|------------|-------|------|-----------|------|
|         | MONO | DOUBLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front     | Rear |
| HNCOVIN | BOOM | TIRE   | 3000        | 1900        | 210           | -          | -     | Down | -         | -    |

- Rating over-front
  Rating over-side or 360 degree
- A B

|                           |                | Load radius    |                |                |                |                |                |                |                |             |                | At max. reach  |                |  |
|---------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|--|
| Load point                | 1.0 m          | n (3 ft)       | 2.0 m          | (7 ft)         | 3.0 m          | (10 ft)        | 4.0 m          | (13 ft)        | 5.0 m          | (16 ft)     | Capa           | acity          | Reach          |  |
| height                    | ŀ              | ⋳⋕⋑            |                | ╔╋╸            | ŀ              | ⋳⋣⋑            | F              | ╔╋╋            | ŀ              | ⋐⋕⋍         | ŀ              | ╔╌╋╍╸          | m (ft)         |  |
| 5.0 m kg<br>(16.4 ft) lb  |                |                |                |                |                |                |                |                |                |             | *1190<br>*2620 | *1190<br>*2620 | 3.94<br>(12.9) |  |
| 4.0 m kg<br>(13.1 ft) lb  |                |                |                |                |                |                | *1060<br>*2340 | *1060<br>*2340 |                |             | *1050<br>*2310 | *1050<br>*2310 | 4.78<br>(15.7) |  |
| 3.0 m kg<br>(9.8 ft) lb   |                |                |                |                |                |                | *1190<br>*2620 | *1190<br>*2620 | *1180<br>*2600 | 990<br>2180 | *1010<br>*2230 | 910<br>2010    | 5.26<br>(17.3) |  |
| 2.0 m kg<br>(6.6 ft) lb   |                |                |                |                | *1910<br>*4210 | *1910<br>*4210 | *1460<br>*3220 | 1360<br>3000   | *1270<br>*2800 | 970<br>2140 | *1030<br>*2270 | 840<br>1850    | 5.48<br>(18.0) |  |
| 1.0 m kg<br>(3.3 ft) lb   |                |                |                |                | *2540<br>*5600 | 1970<br>4340   | *1730<br>*3810 | 1300<br>2870   | *1380<br>*3040 | 940<br>2070 | *1110<br>*2450 | 820<br>1810    | 5.49<br>(18.0) |  |
| 0.0 m kg<br>(0.0 ft) lb   |                |                | *1830<br>*4030 | *1830<br>*4030 | *2800<br>*6170 | 1910<br>4210   | *1900<br>*4190 | 1260<br>2780   | 1390<br>3060   | 930<br>2050 | *1260<br>*2780 | 860<br>1900    | 5.28<br>(17.3) |  |
| -1.0 m kg<br>(-3.3 ft) lb | *2230<br>*4920 | *2230<br>*4920 | *3190<br>*7030 | *3190<br>*7030 | *2730<br>*6020 | 1890<br>4170   | *1870<br>*4120 | 1250<br>2760   |                |             | *1400<br>*3090 | 970<br>2140    | 4.82<br>(15.8) |  |
| -2.0 m kg<br>(-6.6 ft) lb | *3580<br>*7890 | *3580<br>*7890 | *3670<br>*8090 | *3670<br>*8090 | *2280<br>*5030 | 1920<br>4230   | *1450<br>*3200 | 1270<br>2800   |                |             | *1440<br>*3170 | 1270<br>2800   | 4.01<br>(13.1) |  |
| -3.0 m kg<br>(-9.8 ft) lb |                |                |                |                |                |                |                |                |                |             |                |                |                |  |

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

| Model | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Dozer |      | Outrigger |      |
|-------|------|--------|-------------|-------------|---------------|------------|-------|------|-----------|------|
|       | MONO | DOUBLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front     | Rear |
| ΠΑCOM | BOOM | TIRE   | 3000        | 1900        | 210           | -          | -     | Up   | -         | -    |

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

|                     |          |                |                |                |                | At max. reach  |              |                |                |                |             |                |                |                |
|---------------------|----------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|
| Load po             | oint     | 1.0 m          | (3 ft)         | 2.0 m          | (7 ft)         | 3.0 m          | (10 ft)      | 4.0 m          | (13 ft)        | 5.0 m          | (16 ft)     | Capa           | acity          | Reach          |
| height              | t        | ŀ              | ₢₽₽₽           | ŀ              | ⋐⋣⋶            |                | ╔╋╸          | ŀ              | ╔╋╋            |                | ⋐⋣⋑         | ŀ              |                | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                |                |                |                |                |              |                |                |                |             | *1190<br>*2620 | *1190<br>*2620 | 3.94<br>(12.9) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                |                |                |                |                |              | *1060<br>*2340 | *1060<br>*2340 |                |             | *1050<br>*2310 | 940<br>2070    | 4.78<br>(15.7) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                |                |                |                |                |              | *1190<br>*2620 | *1190<br>*2620 | *1180<br>*2600 | 870<br>1920 | *1010<br>*2230 | 800<br>1760    | 5.26<br>(17.3) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                |                |                |                | *1910<br>*4210 | 1820<br>4010 | *1460<br>*3220 | 1190<br>2620   | *1270<br>*2800 | 850<br>1870 | *1030<br>*2270 | 730<br>1610    | 5.48<br>(18.0) |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                |                |                |                | *2540<br>*5600 | 1700<br>3750 | *1730<br>*3810 | 1140<br>2510   | *1380<br>*3040 | 830<br>1830 | *1110<br>*2450 | 720<br>1590    | 5.49<br>(18.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib |                |                | *1830<br>*4030 | *1830<br>*4030 | *2800<br>*6170 | 1640<br>3620 | *1900<br>*4190 | 1100<br>2430   | 1390<br>3060   | 810<br>1790 | *1260<br>*2780 | 750<br>1650    | 5.28 (17.3)    |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *2230<br>*4920 | *2230<br>*4920 | *3190<br>*7030 | 3130<br>6900   | *2730<br>*6020 | 1630<br>3590 | *1870<br>*4120 | 1090<br>2400   |                |             | *1400<br>*3090 | 850<br>1870    | 4.82<br>(15.8) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3580<br>*7890 | *3580<br>*7890 | *3670<br>*8090 | 3190<br>7030   | *2280<br>*5030 | 1650<br>3640 | *1450<br>*3200 | 1110<br>2450   |                |             | *1440<br>*3170 | 1110<br>2450   | 4.01 (13.1)    |
| -3.0 m<br>(-9.8 ft) | kg<br>Ib |                |                |                |                |                |              |                |                |                |             |                |                |                |

#### % Note

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| Model   | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Dozer |      | Outrigger |      |
|---------|------|--------|-------------|-------------|---------------|------------|-------|------|-----------|------|
|         | MONO | DOUBLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front     | Rear |
| HNCOVIN | BOOM | TIRE   | 3000        | 1900        | 330           | -          | -     | Down | -         | -    |

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

|                     |          |                |                |                |                | At max. reach  |                |                |                |                |              |                |                |                |
|---------------------|----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|
| Load po             | int      | 1.0 m          | (3 ft)         | 2.0 m          | (7 ft)         | 3.0 m          | (10 ft)        | 4.0 m          | (13 ft)        | 5.0 m          | (16 ft)      | Capa           | acity          | Reach          |
| height              | t        | ŀ              | ₢₽₽₽           | ľ              | ₽₽₽            |                | ⋳⋕⋬            | ľ              | ╔╋╋            |                | ⋐⋣⋣          | ľ              | ╔╋╍╸           | m (ft)         |
| 5.0 m<br>(16.4 ft)  | kg<br>Ib |                |                |                |                |                |                |                |                |                |              | *1190<br>*2620 | *1190<br>*2620 | 3.94<br>(12.9) |
| 4.0 m<br>(13.1 ft)  | kg<br>Ib |                |                |                |                |                |                | *1060<br>*2340 | *1060<br>*2340 |                |              | *1050<br>*2310 | *1050<br>*2310 | 4.78<br>(15.7) |
| 3.0 m<br>(9.8 ft)   | kg<br>Ib |                |                |                |                |                |                | *1190<br>*2620 | *1190<br>*2620 | *1180<br>*2600 | 1040<br>2290 | *1010<br>*2230 | 960<br>2120    | 5.26<br>(17.3) |
| 2.0 m<br>(6.6 ft)   | kg<br>Ib |                |                |                |                | *1910<br>*4210 | *1910<br>*4210 | *1460<br>*3220 | 1420<br>3130   | *1270<br>*2800 | 1020<br>2250 | *1030<br>*2270 | 880<br>1940    | 5.48<br>(18.0) |
| 1.0 m<br>(3.3 ft)   | kg<br>Ib |                |                |                |                | *2540<br>*5600 | 2070<br>4560   | *1730<br>*3810 | 1370<br>3020   | *1380<br>*3040 | 1000<br>2200 | *1110<br>*2450 | 870<br>1920    | 5.49<br>(18.0) |
| 0.0 m<br>(0.0 ft)   | kg<br>Ib |                |                | *1830<br>*4030 | *1830<br>*4030 | *2800<br>*6170 | 2010<br>4430   | *1900<br>*4190 | 1330<br>2930   | *1440<br>*3170 | 980<br>2160  | *1260<br>*2780 | 910<br>2010    | 5.28<br>(17.3) |
| -1.0 m<br>(-3.3 ft) | kg<br>Ib | *2230<br>*4920 | *2230<br>*4920 | *3190<br>*7030 | *3190<br>*7030 | *2730<br>*6020 | 2000<br>4410   | *1870<br>*4120 | 1320<br>2910   |                |              | *1400<br>*3090 | 1030<br>2270   | 4.82<br>(15.8) |
| -2.0 m<br>(-6.6 ft) | kg<br>Ib | *3580<br>*7890 | *3580<br>*7890 | *3670<br>*8090 | *3670<br>*8090 | *2280<br>*5030 | 2020<br>4450   | *1450<br>*3200 | 1340<br>2950   |                |              | *1440<br>*3170 | 1340<br>2950   | 4.01<br>(13.1) |
| -3.0 m<br>(-9.8 ft) | kg<br>Ib |                |                |                |                |                |                |                |                |                |              |                |                |                |

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| Model  | Ту   | ре     | Boom        | Arm         | Counterweight | Wheel      | Dozer |      | Outrigger |      |
|--------|------|--------|-------------|-------------|---------------|------------|-------|------|-----------|------|
|        | MONO | DOUBLE | Length [mm] | Length [mm] | weight [kg]   | width [mm] | Front | Rear | Front     | Rear |
| писоип | BOOM | TIRE   | 3000        | 1900        | 330           | -          | -     | Up   | -         | -    |

Rating over-front
 Rating over-side or 360 degree

|                           |                |                |                |                | Load           | radius         |                |                |                |             | At max. reach  |                |                |
|---------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|
| Load point                | 1.0 m          | n (3 ft)       | 2.0 m          | (7 ft)         | 3.0 m (10 ft)  |                | 4.0 m          | (13 ft)        | 5.0 m          | (16 ft)     | Capa           | acity          | Reach          |
| height                    | ŀ              | ⋐⋣⋶⋬           |                | ╔╋╋            |                |                | ľ              | ╔╋╋            | ŀ              | ⋐⋣⋶         | ŀ              |                | m (ft)         |
| 5.0 m kg<br>(16.4 ft) lb  |                |                |                |                |                |                |                |                |                |             | *1190<br>*2620 | *1190<br>*2620 | 3.94<br>(12.9) |
| 4.0 m kg<br>(13.1 ft) lb  |                |                |                |                |                |                | *1060<br>*2340 | *1060<br>*2340 |                |             | *1050<br>*2310 | 990<br>2180    | 4.78<br>(15.7) |
| 3.0 m kg<br>(9.8 ft) lb   |                |                |                |                |                |                | *1190<br>*2620 | *1190<br>*2620 | *1180<br>*2600 | 920<br>2030 | *1010<br>*2230 | 840<br>1850    | 5.26<br>(17.3) |
| 2.0 m kg<br>(6.6 ft) lb   |                |                |                |                | *1910<br>*4210 | *1910<br>*4210 | *1460<br>*3220 | 1250<br>2760   | *1270<br>*2800 | 900<br>1980 | *1030<br>*2270 | 780<br>1720    | 5.48 (18.0)    |
| 1.0 m kg<br>(3.3 ft) lb   |                |                |                |                | *2540<br>*5600 | 1800<br>3970   | *1730<br>*3810 | 1200<br>2650   | *1380<br>*3040 | 880<br>1940 | *1110 *2450    | 760<br>1680    | 5.49 (18.0)    |
| 0.0 m kg<br>(0.0 ft) lb   |                |                | *1830<br>*4030 | *1830<br>*4030 | *2800<br>*6170 | 1740<br>3840   | *1900<br>*4190 | 1160<br>2560   | *1440<br>*3170 | 860<br>1900 | *1260<br>*2780 | 800<br>1760    | 5.28 (17.3)    |
| -1.0 m kg<br>(-3.3 ft) lb | *2230<br>*4920 | *2230<br>*4920 | *3190<br>*7030 | *3190<br>*7030 | *2730<br>*6020 | 1720<br>3790   | *1870<br>*4120 | 1150<br>2540   |                |             | *1400<br>*3090 | 900<br>1980    | 4.82<br>(15.8) |
| -2.0 m kg<br>(-6.6 ft) lb | *3580<br>*7890 | *3580<br>*7890 | *3670<br>*8090 | 3360<br>7410   | *2280<br>*5030 | 1750<br>3860   | *1450<br>*3200 | 1180<br>2600   |                |             | *1440<br>*3170 | 1170<br>2580   | 4.01 (13.1)    |
| -3.0 m kg<br>(-9.8 ft) lb |                |                |                |                |                |                |                |                |                |             |                |                | · /            |

#### % Note

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- \* Lifting capacities are based upon a standard machine conditions.

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## 6. BUCKET SELECTION GUIDE

| 0.07m <sup>3</sup> SAE | 0.18 m <sup>3</sup> SAE |
|------------------------|-------------------------|
| heaped bucket          | heaped bucket           |

| Capacity                                       |  | Width               |                   |                    | Recommendation   |
|--|--|---------------------|-------------------|--------------------|--|
| Cap  | acity  | rity VVidth         |                   | Weight             | 3.0 m (9' 10") boom  |
| SAE<br>heaped                                  | CECE<br>heaped                                 | Without side cutter | With side cutter  |                    | 1.6 m (5' 3") arm  |
| 0.07 m <sup>3</sup><br>(0.09 yd <sup>3</sup> ) | 0.06 m <sup>3</sup><br>(0.08 yd <sup>3</sup> ) | 270 mm<br>(10.6")   | 360 mm<br>(14.2") | 115 kg<br>(255 lb) | Applicable for materials with density of 1600 kgf/m <sup>3</sup> |
| 0.18 m <sup>3</sup><br>(0.24 yd <sup>3</sup> ) | 0.15 m <sup>3</sup><br>(0.20 yd <sup>3</sup> ) | 620 mm<br>(24.4")   | 730 mm<br>(28.7") | 170 kg<br>(375 lb) | (2700 lb/yd³) or less  |

# 7. SPECIFICATIONS FOR MAJOR COMPONENTS

# 1) ENGINE

| Item                                | Specification                                       |
|-------------------------------------|---|
| Model                               | Hyundai DM02VB                                      |
| Time                                | 4-cycle, turbocharged, intercooled, electronic con- |
| Туре                                | trolled diesel engine                               |
| Cooling method                      | Air cooled  |
| Number of cylinders and arrangement | 4 cylinders, in-line                                |
| Firing order                        | 1-3-4-2   |
| Combustion chamber type             | Direct injection type                               |
| Cylinder bore $	imes$ stroke        | 90	imes 94 mm (3.5" $	imes$ 3.7")                   |
| Piston displacement                 | 2392 cc (145 cu in)                                 |
| Compression ratio                   | 16.9 : 1  |
| Gross power                         | 65.9 Hp (48.5 kW)                                   |
| Net power                           | 63.9 Hp (47 kW)                                     |
| Max. power                          | 65.9 Hp (485 kW)                                    |
| Peak torque                         | 25 kgf·m (183 lbf·ft)                               |
| Engine oil quantity                 | 8.6 ℓ (2.3 U.S. gal)                                |
| Dry weight (wet weight)             | 253 kg (558 lb)                                     |
| Starting motor                      | 12 V - 2.5 kW                                       |
| Alternator                          | 13.5 V - 90 A                                       |

# 2) MAIN PUMP

| Item             | Specification  |
|------------------|--|
| Туре             | AP2D28   |
| Capacity         | $2 \times 25$ cc/rev                                   |
| Maximum pressure | 220 kgf/cm <sup>2</sup> (3130 psi)                     |
| Rated oil flow   | $2\times 60~\ell$ /min (15.9 U.S. gpm / 13.2 U.K. gpm) |
| Rated speed      | 2400 rpm   |

### 3) GEAR PUMP

| Item             | Specification                      |  |  |
|------------------|------------------------------------|--|--|
| Туре             | GSP2H-16                           |  |  |
| Capacity         | 16.2 cc/rev                        |  |  |
| Maximum pressure | 200 kgf/cm <sup>2</sup> (2845 psi) |  |  |
| Rated oil flow   | 38.9 ℓ /min (10.2 / 8.5 U.S. gpm)  |  |  |

# 4) MAIN CONTROL VALVE

| Item                       | Specification |                                    |  |
|----------------------------|---------------|------------------------------------|--|
| Туре                       |               | 11 spools, two- block              |  |
| Operating method           |               | Hydraulic pilot system             |  |
| Main relief valve pressure |               | 220 kgf/cm <sup>2</sup> (3130 psi) |  |
|                            | Boom          | 240 kgf/cm <sup>2</sup> (3420 psi) |  |
| Port felief valve pressure | Arm           | 240 kgf/cm <sup>2</sup> (3420 psi) |  |
|                            | Bucket        | 240 kgf/cm <sup>2</sup> (3420 psi) |  |

# 5) SWING MOTOR

| Item                      | Specification                                |
|---------------------------|--|
| Туре                      | Fixed displacement axial piston motor        |
| Capacity                  | 591.7 cc/rev                                 |
| Relief pressure           | 230 kgf/cm <sup>2</sup> (3280 psi)           |
| Braking system            | Automatic, spring applied hydraulic released |
| Swing brake               | Multi wet disc                               |
| Braking torque            | 272.5 kgf·m (1970 lbf·ft)                    |
| Brake release pressure    | 20~40 kgf/cm <sup>2</sup> (284~570 psi)      |
| Swing bearing lubrication | Grease-bathed                                |
| Reduction gear type       | 2 - stage planetary                          |

# 6) TRAVEL MOTOR

| Item            | Specification                            |
|-----------------|--|
| Туре            | Variable displacement axial piston motor |
| Capacity        | 80 / 30.2 cc/rev                         |
| Relief pressure | 235 kgf/cm <sup>2</sup> (3350 psi)       |

### 7) POWER TRAIN

| Item          | Description           |     | Specification                           |  |  |
|---------------|-----------------------|-----|---|--|--|
|               | Туре                  |     | 2 Speed Powershift transmission         |  |  |
| Transmission  | Coor rotio            | 1st | 4.06                                    |  |  |
| Transmission  | Gearrailo             | 2nd | 1.31                                    |  |  |
|               | Clutch pressure       |     | 26~32 kgf/cm² (370~455 psi)             |  |  |
| Parking brake | Туре                  |     | SAHR (Spring Applied Hydraulic Release) |  |  |
| Farking brake | Maximum braking power |     | 810 kgf · m (5856 lbf · ft)             |  |  |
|               | Туре                  |     | 4 wheel drive with differential         |  |  |
|               | Gear ratio            |     | 13.65                                   |  |  |
| Axle          | Brake                 |     | Wet Type Multiple disc                  |  |  |
|               | Brake pressure        |     | 52 kgf/cm <sup>2</sup> (740 psi)        |  |  |
|               | Steering pressure     |     | 148 kgf/cm <sup>2</sup> (2210 psi)      |  |  |

### 8) CYLINDER

|                 | Item                                    | Specification   |  |  |  |
|-----------------|---|---|--|--|--|
| Poom outindor   | Bore dia $	imes$ Rod dia $	imes$ Stroke | $\emptyset$ 110 $\times$ $\emptyset$ 60 $\times$ 715 mm |  |  |  |
| Bootti cylinder | Cushion                                 | Extend only   |  |  |  |
| Arm outindar    | Bore dia $	imes$ Rod dia $	imes$ Stroke | $\emptyset$ 90 $\times$ $\emptyset$ 55 $\times$ 850 mm  |  |  |  |
| Ann cylinder    | Cushion                                 | Extend and retract                                      |  |  |  |
| Rueket evlinder | Bore dia $	imes$ Rod dia $	imes$ Stroke | $\emptyset$ 80 $\times$ $\emptyset$ 50 $\times$ 660 mm  |  |  |  |
| Bucket cylinder | Cushion                                 | -   |  |  |  |
| Dozor ovlindor  | Bore dia $	imes$ Rod dia $	imes$ Stroke | $\emptyset$ 110 $\times$ $\emptyset$ 60 $\times$ 224 mm |  |  |  |
|                 | Cushion                                 | -   |  |  |  |

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

\* Discoloration does not cause any harmful effect on the cylinder performance.

### 9) BUCKET

| Item   |     | Capa  | Tooth                                       | Width    |                     |                  |
|--------|-----|---|---|----------|---------------------|------------------|
|        |     | SAE heaped                                  | CECE heaped                                 | quantity | Without side cutter | With side cutter |
| HW65AH | STD | 0.18 m <sup>3</sup> (0.24 yd <sup>3</sup> ) | 0.15 m <sup>3</sup> (0.20 yd <sup>3</sup> ) | 5        | 620 mm (24.4")      | 730 mm (28.7")   |
|        | OPT | 0.07 m³ (0.09 yd³)                          | 0.06 m <sup>3</sup> (0.08 yd <sup>3</sup> ) | 3        | 270 mm (10.6")      | 360 mm (14.2")   |

#### 8. RECOMMENDED LUBRICANTS

Use only oils listed below or equivalent.

Do not mix different brand oil.

|                  |                     | Canacity                        | Capacity Ambient temperature °C( °F) |             |              |            |              |            |             |
|------------------|---------------------|---------------------------------|--------------------------------------|-------------|--------------|------------|--------------|------------|-------------|
| Service point    | Kind of fluid       | ℓ (U.S. gal)                    | -20<br>(-4)                          | -10<br>(14) | 0<br>(32)    | 10<br>(50) | 20<br>(68)   | 30<br>(86) | 40<br>(104) |
|                  |                     |                                 |                                      |             |              |            | SAE          | E 30       |             |
|                  |                     |                                 |                                      | SAF         | 10W          |            |              |            |             |
| Engine           | Engine oil          | 8.6 (2.3)                       |                                      | 0,12        |              |            |              |            |             |
| 011 part         |                     |                                 |                                      |             | S            | AE 10W-3   | 80           |            |             |
|                  |                     |                                 |                                      |             |              | SAE 1      | 5W-40        |            |             |
|                  |                     |                                 |                                      |             |              |            |              |            |             |
|                  | Gear oil            | 1.5 (0.4)                       |                                      |             |              | SAE 8      | 0W-90        |            |             |
| Swing drive      |                     |                                 |                                      |             |              |            |              |            |             |
|                  | Grease              | 0.2 (0.1)                       |                                      |             |              |            |              |            |             |
|                  |                     | 4.0 (0.5)                       |                                      |             |              |            | NLGI NO.2    | <u></u>    |             |
| Gear box case    |                     | 1.8 (0.5)                       |                                      |             |              |            |              |            |             |
| Front ayle       | Gear oil            | (1.3)                           |                                      | SAE 75W-90  |              |            |              |            |             |
|                  |                     | Hub: 0.4×2<br>(0.11×2)          |                                      |             |              |            |              |            |             |
|                  |                     | Center:5                        |                                      | SAE 85W-90  |              |            |              |            |             |
| Rear axle        |                     | (1.3)<br>Hub: 0.4×2<br>(0.11×2) |                                      |             |              |            |              |            |             |
|                  |                     | Tank;                           |                                      | 19(         |              |            |              |            |             |
|                  |                     | 70 (18.5)                       |                                      |             |              |            |              |            | L I         |
| Hydraulic tank   | Hydraulic oil       | System;                         |                                      |             |              | ISO VG 4   | 6            |            |             |
|                  |                     | (31.7)                          |                                      |             |              | 1          | ISO VG 68    | 3          |             |
|                  |                     |                                 |                                      |             |              |            |              |            |             |
| Fuel tank        | Diesel fuel*1       | 125 (33)                        |                                      |             | 10.1         | AST        | M D975 N     | 10.2       |             |
| Fitting          |                     |                                 |                                      |             | NLGI NO.1    |            |              |            |             |
| (grease nipple)  | Grease              | As required                     |                                      |             |              | NLGI       | NO.2         |            |             |
|                  |                     |                                 |                                      |             |              |            |              |            |             |
| Radiator         | Mixture of          | 11 (2 0)                        |                                      | Ethyler     | ne alvcol ba | aso norma  | nent tyne (F | 50 · 50)   |             |
| (reservoir tank) | and water $\star^2$ | 11 (2.3)                        |                                      |             |              | use perma  | ioni type (t |            |             |
|                  | 1                   |                                 |                                      |             |              |            |              |            |             |

- 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

\*1 : Ultra low sulfur diesel

- sulfur content  $\leq$  15 ppm

\*2 : Soft water

City water or distilled water

- \* Using any lubricating oils other than HD Hyundai Construction Equipment genuine products may lead to a deterioration of performance and cause damage to major components.
- \* Do not mix HD Hyundai Construction Equipment genuine oil with any other lubricating oil as it may result in damage to the systems of major components.
- \* 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.

# SECTION 2 STRUCTURE AND FUNCTION

| Group | 1 Pump Device ·····   | 2-1  |
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# **GROUP 1 HYDRAULIC PUMP**

#### 1. GENERAL

This is a variable displacement double-piston pump for discharge with equal displacements from one cylinder block. This pump is so compact as to appear a single pump though this is actually a double pump.

Because this pump has one swash plate, the tilting angle is the same for two pumps. Tilting of the pump changes in response to the total pressure of P1 + P2. Namely, the output is controlled to the constant value so that the relationship between the discharge pressure and flow rate Q becomes constant, (P1 + P2) \* Q = Constant.

The third pump and pilot pump can be connected to the same shaft via a coupling.







HW60A2MP01

#### Description of the ports

| Port     | Name                | Bore                                |
|----------|---------------------|-------------------------------------|
| S1       | Suction port        | SAE 1 1/2 (standard)                |
| A1, A2   | Discharge port      | PF 1/2                              |
| A3       | Discharge port      | PF 1/2                              |
| A4       | Discharge port      | PF 1/4                              |
| A1G, A2G | Gauge port          | PF 1/4 with quick coupler           |
| Z        | Pilot pressure port | PF 1/4                              |
| R1       | Air bleeder port    | $M10 \times 1.0$ with bleeder valve |

#### 2. PRINCIPAL COMPONENTS AND FUNCTIONS



HW60A2MP02

- Drive shaft 1
- 2 Hanger
- 3 Rotary group
- 7 Gear pump

Spring sheet

Control piston

5

6

9 Body Spring 13 14 Spring

- 4 Port plate
- 8 Housing
- **SPECIFICATIONS**
- Capacity : 2 × 25+16.2+6.5 cc/rev
- Rated oil flow : 2 × 57.5+37.5+15 *l* /min
- Rated pressure : 2 × 220+220+30 kgf/cm<sup>2</sup>

This is a variable displacement double-piston pump for discharge with two equal displacements from one cylinder block. Because this is one rotary group, there is only one suction port.

The oil is divided into two equal flows by the control plate in the cover and directed to two discharge ports provided in the cover.

The discharge pressure directed to the control piston tilts the hanger by overcoming the spring force. Since the piston stroke changes according to the tilting angle of the hanger, the flow can be changed.

The simultaneous tilting angle constant-output control method is employed.

The third pump and pilot pump can be connected to the same shaft via a coupling.

#### 1) PRINCIPLE OF OPERATION

#### (1) Function of pump



HW65AH2MP03

The cylinder block is connected via spline and can rotate together with the drive shaft.

The piston assembled into the cylinder block performs reciprocal operation while following the swash plate on the hanger.

The piston moves in a direction to increase the displacement during a stroke from the lower to the upper dead points. The oil flows from the suction port via a port plate into the cylinder block (suction process).

During a stroke from the upper to the lower dead points, the piston moves in a direction to decrease the displacement. The oil is discharged to the discharge port (discharge process).

The displacement can be changed by changing the tilting of the hanger (swash plate).

The oil sucked through the port in the cylinder block is discharged from the discharge port in the port plate.

The oil sucked through the port on the outside of the cylinder block is discharged from the discharge port on the outside of the port plate.

#### 2) CONTROL FUNCTIONS



HW65AH2MP04

LV-constant power control with power shift.

The average pressure of P1 and P2 are directed to the piston which sides on the swash plate, and acts on the swash plate.

The spring is provided to act against the delivery pressure.

When the oil pressure via piston acting on the swash plate is less than the installation load of the spring, the swash plate is fixed to the maximum tilting position.

When the oil pressure via piston acting on the swash plate exceeds the installation load of the spring, the swash plate is tilted and the swash plate is kept at a position where the oil pressure is balanced with the spring force. (Region A or B in above fiture)

When the P3 oil pressure acts on the shift piston, flow line is shifted to P3 shift flow line.

When the P3 oil pressure from Z port acts on the shift piston, flow line is shifted to P3 shift flow line.<sup> $\star$ </sup>

\*When the Z port is not used, it is led to the drain.

#### 3) CONTROL / ADJUSTMENT PROCEDURE

This hydraulic pump has been set and inspected according to your specified inpput power and control. Readjustment of all the adjusting portions may lead to the loss of functions specified for each control and the pump proper may be excluded from the scope of guarantee. Never attempt operating the adjustment screw.

# **GROUP 2 MAIN CONTROL VALVE**

# 1. OUTLINE

1) **2-WAY** 



HW60A2MC01

| Mark | Port name             | Port<br>size              | Tightening<br>torque | Mark                 | Port name                  | Port<br>size          | Tightening<br>torque      |                           |   |  |
|------|-----------------------|---------------------------|----------------------|----------------------|----------------------------|-----------------------|---------------------------|---------------------------|---|--|
| P1   | P1 pump port          |                           |                      | T2                   | Tank return port           | PF3/4                 | 8~9 kgf ∙ m               |                           |   |  |
| P2   | P2 pump port          | ]                         |                      |                      | a1                         | Swing pilot port (LH) |                           |                           |   |  |
| P3   | P3 pump port          |                           |                      |                      |                            | b1                    | Swing pilot port (RH)     |                           |   |  |
| A1   | Swing port (LH)       |                           |                      | a2                   | Dozer down pilot port      |                       |                           |                           |   |  |
| B1   | Swing port (RH)       |                           |                      | b2                   | Dozer up pilot port        |                       |                           |                           |   |  |
| A2   | Dozer down port       |                           |                      | a3                   | Boom swing pilot port (LH) |                       |                           |                           |   |  |
| B2   | Dozer up port         |                           |                      | b3                   | Boom swing pilot port RH)  |                       |                           |                           |   |  |
| A3   | Boom swing port (LH)  |                           |                      | a4                   | Wood grab in port          |                       |                           |                           |   |  |
| B3   | Boom swing port (RH)  |                           |                      | b4                   | Wood grab out port         |                       |                           |                           |   |  |
| A4   | Wood grab in port     |                           | 6.0~7.0<br>kaf ⋅ m   |                      | a5                         | Boom 2 pilot port     | -                         |                           |   |  |
| B4   | Wood grab out port    |                           |                      |                      | b5                         | Breaker pilot port    |                           |                           |   |  |
| A5   | Boom 2 port           | PF                        |                      | a6                   | Arm out pilot port         | PF1/4                 | 2.5~3.0<br>kgf · m        |                           |   |  |
| B5   | Breaker port          | 1/2<br>6.0~7.0<br>kgf · m |                      | b6                   | Arm in pilot port          |                       |                           |                           |   |  |
| A6   | Arm out port          |                           |                      | a7                   | Travel pilot port (LH/FW)  |                       |                           |                           |   |  |
| B6   | Arm in port           |                           |                      | -                    | 5                          | Ngi m                 | b7                        | Travel pilot port (LH/RR) |   |  |
| A7   | Travel port (FW)      |                           |                      | a8                   | Travel pilot port (RH/FW)  |                       |                           |                           |   |  |
| B7   | Travel port (BW)      |                           |                      | -                    |                            | b8                    | Travel pilot port (RH/RR) |                           |   |  |
| A8   | Iravel port (FW)      |                           |                      |                      |                            |                       | a9                        | Boom up pilot port        | - |  |
| B8   | Iravel port (BW)      |                           | b9                   | Boom down pilot port | -                          |                       |                           |                           |   |  |
| A9   | Boom up port          |                           |                      | a10                  | Bucket out pilot port      |                       |                           |                           |   |  |
| B9   | Bucket out port       |                           |                      | b10                  | Bucket in pilot port       |                       |                           |                           |   |  |
| A10  | Bucket out port       |                           |                      | a11                  | Arm 2 pilot port           |                       |                           |                           |   |  |
| B10  | Bucket in port        |                           |                      | b11                  | Arm 2 pilot port           | -                     |                           |                           |   |  |
| BII  | Arm 2 port            |                           |                      | Ai                   | Auto idle signal port      |                       |                           |                           |   |  |
| WIRT | Main relief valve     | -                         |                      | Pn                   | Pilot supply port          | -                     |                           |                           |   |  |
| MR3  |                       |                           |                      |                      |                            |                       |                           |                           |   |  |
| OR   | Overload relief valve | _                         | 10.10                |                      |                            |                       |                           |                           |   |  |
| T1   | Tank return port      | PF1                       | 10~12<br>kgf · m     |                      |                            |                       |                           |                           |   |  |

# 2) **1-WAY**





HW60A2MC02

| Mark | Port name             | Port<br>size | Tightening<br>torque | Mark     | Port name                   | Port<br>size | Tightening<br>torque |
|------|-----------------------|--------------|----------------------|----------|-----------------------------|--------------|----------------------|
| P1   | P1 pump port          |              |                      | T2       | Tank return port            | PF3/4        | 8~9 kgf · m          |
| P2   | P2 pump port          | ]            |                      | a1       | Swing pilot port (LH)       |              |                      |
| P3   | P3 pump port          |              |                      | b1       | Swing pilot port (RH)       |              |                      |
| A1   | Swing port (LH)       |              |                      | a2       | Dozer down pilot port       |              |                      |
| B1   | Swing port (RH)       |              |                      | b2       | Dozer up pilot port         |              |                      |
| A2   | Dozer down port       |              |                      | a3       | Boom swing pilot port (LH)  |              |                      |
| B2   | Dozer up port         |              |                      | b3       | Boom swing pilot port RH)   |              |                      |
| A3   | Boom swing port (LH)  |              |                      | a4       | Wood grab in port           |              |                      |
| B3   | Boom swing port (RH)  |              |                      | b4       | Wood grab out port          |              |                      |
| A5   | Boom 2 port           | PF           |                      | a5       | Boom 2 pilot port           |              |                      |
| B5   | Breaker port          | 1/2          |                      | b5       | Breaker pilot port          |              |                      |
| A6   | Arm out port          |              | 60.70                | a6       | Arm out pilot port          |              |                      |
| B6   | Arm in port           |              | 0.0~7.0<br>kaf · m   | b6       | Arm in pilot port           |              | 25~30                |
| A7   | Travel port (FW)      |              | ingi ini             | a7       | Travel pilot port (LH/FW)   | PF1/4        | kaf · m              |
| B7   | Travel port (BW)      |              |                      | h7       | Travel pilot port (LH/RR)   |              |                      |
| A8   | Travel port (FW)      |              |                      | 28       | Travel pilot port (EH/FW)   |              |                      |
| B8   | Travel port (BW)      |              |                      | 40<br>69 | Travel pilot port (PU/PP)   |              |                      |
| A9   | Boom up port          |              |                      | 00       | Recently not point (nin/nn) |              |                      |
| B9   | Bucket out port       |              |                      | a9       |                             |              |                      |
| A10  | Bucket out port       |              |                      | 69       | Boom down pilot port        |              |                      |
| B10  | Bucket in port        | PF           |                      | a10      | Bucket out pilot port       |              |                      |
| B11  | Arm 2 port            | 1/2          |                      | b10      | Bucket in pilot port        |              |                      |
| MR1  |                       |              |                      | a11      | Arm 2 pilot port            |              |                      |
| MR3  | Main relief valve     | _            |                      | b11      | Arm 2 pilot port            |              |                      |
| OR   | Overload relief valve | _            |                      | Ai       | Auto idle signal port       |              |                      |
| T1   | Tank return port      | PF1          | 10~12<br>kaf · m     | Рр       | Pilot supply port           |              |                      |

#### 2. STRUCTURE (1/4)



- 1 Cover assy-port
- 1-1 Cover-autoidle
- 1-2 Orifice
- 1-3 Filter assy
- 1-4 Screw-set
- 1-5 O-ring
- 2 Swing block
- 2-1 Work block
- 2-2 Swing spool assy
- 2-3 Pilot cap (A)
- 2-4 Pilot cap (B1)
- 2-5 Wrench bolt
- 2-6 Plain washer
- 2-7 O-ring
- 2-8 Check proppet
- 2-9 Check spring
- 2-10 Plug assy
- 2-11 Plug assy

- 2-12 O-ring
- 2-13 O-ring
- 2-14 Screw-set
- 2-15 Gasket
  - 3 Dozer block
- 3-1 Work block
- 3-2 Dozer spool
- 3-3 O-ring
- 3-4 Pilot cap (A)
- 3-5 Wrench
- 3-6 Plain washer
- 3-7 Pilot cap (B1)
- 3-8 Check poppet
- 3-9 Check spring
- 3-10 Plug assy
- 3-11 Plug assy
- 3-12 Anti-cavitation valve
- 3-13 O-ring

- 3-14 O-ring
- 3-15 Gasket
- 4 Inlet block (P3)
- 4-1 Work block
- 4-2 Slector spool
- 4-3 O-ring
- 4-4 Pilot cap (A)
- 4-5 Wrench bolt
- 4-6 Plain washer
- 4-7 Pilot cap (B1)
- 4-8 Check poppet
- 4-9 Check spring
- 4-10 Plug assy
- 4-11 Main relief valve
- 4-12 Plug
- 4-15 Gasket
- 17 Tie bolt
- 18 Nut



HW60A2MC04

2-9



#### STRUCTURE (4/4)



13-14 Gasket

3. HYDRAULIC CIRCUIT (boom swing)



HW65A2MC07

### 4. FUNCTION

### 1) CONTROL IN NEUTRAL FUNCTION



In neutral, spring sets the spool at the neutral position, the hydraulic oil from pumps flows to the tank through the center bypass.

#### (1) P1

The oil discharged from the hydraulic pump flows into control valve P1 port, and then flows the right side travel valve through the travel straight valve. In neutral, the oil flows through the center bypass passage in the direction of right travel  $\rightarrow$  boom 1  $\rightarrow$  bucket  $\rightarrow$  arm 2 spool, and then flows from the center bypass passage to the tank port T1 and T2.

#### (2) P2

The oil discharged from the hydraulic pump flows into control valve P2 port, and then flows the left side travel valve through the travel straight valve. In neutral, the oil flows through the center bypass passage in the direction of left travel  $\rightarrow$  arm 1  $\rightarrow$  boom 2/breaker spool, and then flows from the center bypass passage to the tank port T1 and T2.

#### (3) P3

The oil discharged from the hydraulic pump flows into control valve P3.

In neutral, the oil flows through the center bypass passage in the direction of swing  $\rightarrow$  dozer spool, and then flows from the center bypass passage to the tank port T1 and T2.

#### (4) Pp

When Pp port is applied with pilot pressure, the oil flows into the swing block through TS signal passage and Ai signal passage independently via an orifice.

With the spool in neutral, the oil flows into the tank passage through the all section of the control valve(except arm 2 section). As a result, the TS valve is not shifted and the auto idle signal pressure is not raised.

#### 2) EACH SPOOL OPERATION

(1) Travel operation (forward / backward)



55W92MC03

- During travel (forward/backward) operation, the pilot pressure from RCV is supplied into the travel pilot port and shift the travel spool in the right direction.
- The hydraulic oil fluid from pump is entered center bypass passage of inlet block (P1, P2) and then flows into the port of travel motor.
- The oil from the port A of travel motor flows into the main control valve and return to the hydraulic oil tank through the tank passage.
- The TS signal passage is shut off by shifting of the travel spool, but it is connected with Ai signal passage and drain to the hydraulic oil tank. As a result, the travel straight spool is not shifted.
- The Ai signal passage is connected with travel block through swing and dozer block and it is shut off by shifting of the travel spool and then signal pressure of auto idle is raised.

#### (2) Boom operation

① Boom up operation (P1 and P2 summation)



55W92MC04

 During boom up operation, the pilot pressure from RCV is supplied into the port a9 and shift the boom 1 spool in the left direction. The hydraulic oil fluid from pump P1 is entered P1 parallel passage and then passes through the load check valve then flows into the port A9.
 Following this, it flows into the head side of the boom cylinder.

At the same time the pilot pressure through the port a5 shifts the boom 2 spool. The hydraulic oil fluid from pump P2 is entered P2 parallel passage and then passes through the load check valve then flows into the port A5. The flows combine in hydraulic hoses and are directed to the cylinder head side of boom cylinder.

The flow from rod side of the boom cylinder return to the boom 1 spool through the port B9. There after it is directed to the hydraulic oil tank through the tank passage.

- The TS signal passage oil from the Pp port is drain to the hydraulic oil tank through the left/right travel valve and the signal pressure is not raised.
- The Ai signal passage oil from the Pp port is shut off by shifting of the boom 1 spool and then signal pressure of auto idle is raised.

#### 2 Boom down operation



55W92MC05

• During the boom lowing operation, the pilot pressure from RCV is supplied to the port b9 and shift the boom 1 spool in the right direction.

The hydraulic fluid from the pump P1 enters the parallel passage and is directed to the port B9 through the load check valve. Following this, it flows into the rod side of the boom cylinder.

The return flow from the head side of the boom cylinder returns to the boom 1 spool through the port A9. Thereafter it is directed to the hydraulic oil tank through tank passage.

• The hydraulic oil flow from the Pp port is same as the boom up operation.

#### (3) Bucket operation

1 Bucket roll in operation



• During the bucket roll in operation, the pilot pressure from RCV is supplied to port b10 and shift the bucket spool in the right direction.

The hydraulic fluid from pump P1 entered P1 parallel passage and is directed to the port B10 through the load check valve.

Following this, it flows into the head side of the bucket cylinder.

The return flow from the rod side of the bucket cylinder returns to the bucket spool through the port A10. Thereafter it is directed to the hydraulic oil tank through the tank passage.

- The TS signal passage oil from the Pp port is drain to the hydraulic oil tank through the left/right travel valve and the signal pressure is not raised.
- The Ai signal passage oil from the Pp port is shut off by shifting of the bucket spool and then signal pressure of auto idle is raised.

### 2 Bucket roll out operation



55W92MC07

- In case of the bucket roll out operation, the operation is similar.
- $\cdot$  The hydraulic oil flow from the Pp port is same as the bucket in operation.

#### ③ Bucket load check valve operation



555C92MC13

- This function is used to speed up of the boom or arm by reducing the bucket speed when bucket operation with boom or arm operation simultaneously.
- When the signal pressure flows into port pp2, the plunger is shifted and orifice is made.
- The hydraulic oil from the port P1 flow into bucket cylinder via the orifice and then the speed of bucket cylinder is slow down.

Accordingly, the much fluid from the port P1 is supplied other cylinder than the bucket cylinder.

#### (4) Arm operation

① Arm roll in operation (P1 and P2 summation)



55W92MC08

- During arm roll in operation the pilot pressure from the RCV is supplied to the port b6 and shifts arm 1 spool in the right direction.
- Also, the pilot pressure is supplied to the port Sa through the external piping and shift the spool of P3 inlet block.
- The hydraulic oil from the pump P2 flows into the arm cylinder head side through P2 parallel passage, the load check valve and the port B6.
- At same time, the hydraulic fluid from the pump P3 flows into the arm summation passage in arm 1 spool through the P3 inlet spool. Then it entered the arm cylinder head side with hydraulic fluid from arm 1 spool.
- The TS signal passage oil from the Pp port is drain to the hydraulic oil tank through the left/right travel valve and the signal pressure is not raised.
- The Ai signal passage oil from the Pp port is shut off by shifting of the arm spool and then signal pressure of auto idle is raised.

#### 2 Arm roll out operation



55W92MC09

 During arm roll out operation the pilot pressure from RCV is supplied to the port a6 and shifts arm 1 spool in the left direction.

The hydraulic fluid from pump P2 flows into arm 1 spool through the parallel passage. Then it enters into the arm cylinder rod side through the load check valve and the port A6.

The return flow from the arm cylinder head side returns to the hydraulic tank through the port B6 the arm1 spool and tank passage.

• The hydraulic oil flow from the Pp port is same as the arm roll in operation.

#### (5) Swing operation



555C92MC16

 The pilot pressure from the RCV is supplied to the a1 and shift the swing spool in left direction. The hydraulic fluid from pump P3 flows into swing spool through the parallel passage. Then it is directed to swing motor through the port A1. As a result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port B1, swing spool and the tank passage.

In case of swing left operation, the operation is similar.

- The TS signal passage oil from the Pp port is drain to the hydraulic oil tank through the left/right travel valve and the signal pressure is not raised.
- The Ai signal passage oil from the Pp port is shut off by shifting of the swing spool and then signal pressure of auto idle is raised.

(6) Travel straight spool



55W92MC10

① The other actuator operation during travel operation.

When the other actuator spool(s) is selected under travel operation, the straight travel spool is moved.

Some of hydraulic fluid from pump P1 and P2 is supplied to the travel motors through parallel passage and the other hydraulic fluid is supplied to the actuator(s) through center bypass passage via orifice passage.

Thus, the machine keeps the speed and power of the actuator and travel.

② The arm in operation during straight travel operation.

The arm in pilot pressure flows into P3 pilot port Sa through the external piping and the spool is shifted. As a result, the fluid of P3 pump is combined with the arm in operation through parallel passage and then the arm in speed up.

Refer to the arm in operation for the details.
## (7) Holding valve operation

## ① Holding operation



55W72MC16

At neutral condition, the pilot piston chamber is connected to drain port through the pilot port. And the piston "B" is supported with spring "B".

Also, the pressured fluid from actuator entered to inside of the holding valve through the periphery hole of check, crevice of the check and the plug and the periphery hole of plug.

Then, this pressured oil pushed the poppet to the poppet seat and the check to the seat of body. So the hydraulic fluid from actuator is not escaped and the actuator is not moved.

2 Release holding operation



55W72MC17

The pilot pressure is supplied to the pilot port for release holding valve and shifts the piston "B" in the left direction against the spring "B", and shifts the poppet in the left direction through piston "B" and piston "A" against spring "B" and shifts the spool in the left side.

At same time, the return fluid from actuator returns to the drain port through the periphery hole of check, crevice of the check and the plug, the periphery hole of the plug, in side of holding valve,

crevice of the poppet and the poppet seat, the periphery hole of the poppet seat, crevice of socket and spool and internal passage of spool.

When the poppet is opened, pressure of inside of holding valve is decreased and the return fluid from actuator returns to the tank passage through the notch of spool.

# **GROUP 3 SWING DEVICE**

## **1. STRUCTURE**

Swing device consists swing motor, swing reduction gear.

## 1) SWING MOTOR

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



555K2SM01



| Port  | Port name                   | Port size  |
|-------|-----------------------------|------------|
| А     | Main port                   | SAE PF 1/2 |
| В     | Main port                   | SAE PF 1/2 |
| Dr    | Drain port                  | PF 3/8     |
| Mu    | Make up port                | PF 3/4     |
| PG    | Brake release stand by port | PF 1/4     |
| SH    | Brake release pilot port    | PF 1/4     |
| GA,GB | Gauge port                  | PF 1/4     |



555K2SM03

1 Body

Oil seal

Shaft

Bushing

Spring

Set plate

Ball guide

12 Rear cover

10 Piston shoe assy

Shoe plate

Cylinder block

Taper bearing

2

3

4

5

6

7

8

9

11

13

- 15 Taper bearing
- 16 Valve plate
- Relief valve assy 17
- 18 Socket bolt
  - 19 Plug
  - 20 Plug
  - O-ring 21
  - 22 Shim
  - 24 Back up ring
  - 25 O-ring
  - 26 Friction plate
  - 27 Plate
  - 28 Parking piston
  - 29 O-ring

- 30 Spring
- 31 Time delay valve
- 32 Socket bolt
- 33 Plug
- 34 O-ring
- 35 Valve
- 36 Spring
- 37 Plug
- 38 O-ring
- 39 O-ring
- 40 Back up ring
- 41 Name plate
- 42 Rivet

Pin 14 O-ring

## 2) REDUCTION GEAR



- 1 Shaft
- 2 Bearing cover
- 3 Taper roller bearing
- 4 Case
- 5 Oil seal
- 6 Taper roller bearing
- 7 Sun gear 2
- 8 Socket bolt
- 9 Sun gear 1
- 10 Carrier assy 1
- 11 Ring gear

- 12 Carrier assy 2
- 13 Dowel pin
- 14 Collar
- 15 Plug
- 16 Plug
- 17 Cover
- 18 Pipe
- 19 Level gauge
- 20 Carrier assy 1
- 21 Planet gear 1
- 22 Pin 1

- 23 Bushing 1
- 24 Thrust washer 1
- 25 Thrust washer 3
- 26 Thrust washer 2
- 27 Carrier assy 2
- 28 Planet gear 2
- 29 Pin 2
- 30 Bushing 2
- 31 Spring pin
- 32 Snap ring
- 33 Thrust washer 4

# 2. FUNCTION

## 1) ROTARY PART

When high pressurized oil enters a cylinder through port(a), which is the inlet of balance plate(16), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston(10) upon the return plate(9) which acts upon the swash plate(7) via an hydrostatic bearing. Force F1 perpendicular to swash plate(7) and force F2 perpendicular to cylinder center.

Being transferred to the cylinder block(3) through piston, force F2 causes rotational moment at surroundings of cylinder.

Since cylinder block has 9 equidistantly arrayed pistons, rotational torque is transmitted to cylinder shaft in order by several pistons connected to the inlet port of high pressurized oil. When the direction of oil flow is reversed, rotational direction of cylinder is also reversed. Output torque is given by the equation.

$$T = \frac{p \times q}{2\pi}, q = Z \cdot A \cdot PCD \cdot tan\theta , F1 = \frac{F}{COS\theta}, F_2 = F tan\theta , S = PCD \times tan\theta$$

- p : Effective difference of pressure (kgf/cm<sup>2</sup>)
- q : Displacement (cc/rev)
- T : Output torque (kgf  $\cdot$  cm)
- Z : Piston number (9EA)
- A : Piston area (cm<sup>2</sup>)
- $\theta$ : Tilting angle of swash plate (degree)
- S: Piston stroke (cm)



## 2) MAKE UP VALVE

#### (1) Outline

The safety valve portion consists of a check valve and safety valve.

#### (2) Function

When the swing is stopped, the output circuit of the motor continues to rotate because of inertia. For this reason, the pressure at the output side of the motor becomes abnormality high, and this will damage the motor. To prevent this, the oil causing the abnormal hydraulic pressure is allowed to escape from the outlet port (high-pressure side) of the motor to port Mu, thereby preventing damage to the motor.

Compared with a counterbalance valve, there is no closed-in pressure generated at the outlet port side when slowing down the swing speed. This means that there is no vibration when slowing down, so the ease of swing control is improved.

#### (3) Operation

#### ① When starting swing

When the swing control lever is operated to left swing, the pressurized oil from the pump passes through the control valves and is supplied to port B. Because of this, the pressure at port B rises, staring torque is generated in the motor, and the motor starts to rotate. The oil from the outlet port of the motor passes from port A through the control valve and returns to the tank.



- ② When stopping swing
- When the swing control lever is returned to neutral, no pressurized oil is supplied from the pump to port B.

The return circuit to the tank is closed by the control valve. So the oil from the outlet port of the motor increases in pressure at port A. Resistance to the rotation of the motor is created, and the brake starts to act.

- The pressure at port A rises to the set pressure of make up valve a, and in this way, a high brake torque acts on the motor, and the motor stops.
- When make up valve a is being actuated, the relief oil from make up valve a and the oil from port Mu pass through check valve CB and are supplied to port B. This prevents cavitation from forming at port B.



## 3) RELIEF VALVE



- 1 Body
- 2 Plug
- 3 O-ring
- 4 Plunger
- 5 Piston
- 6 Spring
- 7 Spring seat
- 8 Seat
- 9 O-ring
- 10 Nut

#### (1) Construction of relief valve

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

#### (2) Function of relief valve

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



## 4) BRAKE SYSTEM

#### (1) Control valve swing brake system

This is the brake system to stop the swing motion of the excavator during operation. In this system, the hydraulic circuit is throttled by the swing control valve, and the resistance created by this throttling works as a brake force to slow down the swing motion.



210-7 2-48(1)

## (2) Mechanical swing parking brake system

The mechanical swing parking brake system is installed to prevent the upper structure from swinging downhill because of its own weight when the excavator is parked on a slope since it completely eliminates the hydraulic drift of swing motion while the excavator is on a slop, work can be done more easily and safely.

#### ① Brake assembly

Circumferential rotation of separate plate (27) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (30) through friction plate (26), separate plate (27) and brake piston (28), friction force occurs there.

Cylinder (3) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



## ② Operating principle

a. When the swing control lever (1) is set to the swing position, the pilot oil go to the swing control valve (2) and to SH of the time delay valve (3) via the shuttle valve (4), this pressure move spool (5) to the leftward against the force of the spring (8), so pilot pump charged oil (P4) goes to the chamber G.

This pressure is applied to move the piston (28) to the upward against the force of the spring (30). Thus, it releases the brake force.



b. When the swing control lever (1) is set the neutral position, the time delay valve (3) shifts the neutral position and the pilot oil blocked chamber G.
Then, the piston (28) is moved lower by spring (30) force and the return oil from the chamber G is drain.



# **GROUP 4 TRAVEL DEVICE**

#### **1. CONSTRUCTION**

Travel motor consists motor unit, regulator and counter balance valve.









Hydraulic circuit

| Port  | Port name           | Port size     |
|-------|---------------------|---------------|
| A, B  | Main port           | SAE 6000psi 1 |
| G     | Gauge port          | M14×1.5       |
| M1    | Gauge port          | M14×1.5       |
| Х     | Pilot pressure port | M14×1.5       |
| Т     | Drain port          | PF1/2 - 15    |
| U     | Flushing port       | PF1/2 - 16    |
| S     | Make up port        | M22×1.5       |
| MA,MB | Gauge port          | M18×1.5       |
| Gext  | Brake release port  | M12×1.5       |

HW65AH2TM01

## 1) MOTOR UNIT



- 1 Drive shaft
- 5 Housing
- 8 Locking screw
- 9 Retaining ring
- 10 Shaft seal ring
- 11 Back up plate
- 12 O-ring
- 13 Locking screw

- 17 Threaded pin
- 18 Seal lock nut
- 20 Retaining ring
- 21 Back up plate
- 22 Taper roller bearing
- 23 Shim
- 24 Taper roller bearing
- 25 Retaining plate

- 26 Piston
- 27 Center pin
- 28 Pan head screw

200W34TM02

- 29 Steel sealing ring
- 30 Cylinder block
- 31 Pressure spring
- 32 Adjustment shim
- 33 Control lens

## 2) REGULATOR





- 1 Control housing
- 2 Cover
- 4 Positioning piston
- 5 Positioning trunnion
- 7 Piston
- 8 Threaded pin
- 15 Socket head screw
- 16 Socket head screw
- 19 O-ring
- 20 O-ring
- 21 O-ring
- 23 Socket head screw
- 24 Square ring
- 26 Cylinder pin

- 28 Double break off pin
- 29 Plug
- 32 Double break off pin
- 33 O-ring
- 34 Locking screw
- 50 Relief valve
- 51 Adjusting bushing
- 52 Cylinder pin
- 53 Threaded pin
- 54 Seal lock nut
- 55 Pressure spring
- 56 Spring collar
- 57 Pressure spring
- 58 O-ring

59 Retaining ring

55W72TM03

- 60 Control piston
- 61 Control bushing
- 62 Retaining disc
- 63 Locking screw
- 64 Locking screw
- 65 Double break off pin
- 66 Socket head screw
- 67 Cover
- 68 Throttle screw
- 69 Socket head screw
- 70 O-ring
- 71 Locking screw

# 2. FUNCTION



14W72TM05

#### 1) VARIABLE DISPLACEMENT MOTOR (with integrated counterbalance valve)

The variable displacement motor has a rotary group in bent axis design.

The torque is generated directly at the drive shaft.

The cylinder barrel is driven by a tapered piston arrangement.

The change of displacement is generated by the control lens via positioning piston. The control lens slides on a circular shaped surface.

In case of constant pump flow volume and high pressure

- The output speed is increased at smaller swivel angle, the torque is reduced

- The torque rises at swivel angle increase, the output speed is decreased

The max swivel angle is  $25^{\circ}$ , the min swivel angle is  $0^{\circ}$ .

The variable displacement motor with integrated counterbalance valve is designed to be operated in open loop.

Min and max displacement are limited by a stop screw. Stepless adjustment to various higher values is possible.

\* Reduction to smaller displacement may result in overspeeding the motor.

#### 2) PORT PLATE

With high pressure dependent control HA1, mounted counterbalance valve, integrated secondary pressure relief valves, plugged gauge and boosting ports, service ports to the rear.



14007

## 3) HIGH PRESSURE DEPENDENT CONTROL

The displacement is-dependent on operating pressure - automatically adjusted. Upon reaching the operating pressure set at the control valve - internally measured at A or B - the motor swivels from  $V_{gmin}$  to  $V_{gmax}$  until output torque = load torque. For values lower than the adjusted one the motor keeps min swivel angle. The necessary positioning energy is taken from the respective high pressure side via shuttle valve.

Swivelling results in a change of the displacement.

Swivel time is controlled by an orifice installed in the cover of the large positioning piston side.

#### 4) COUNTERBALANCE VALVE

Mounted at the rear of the port plate.

Incase of downhill traveling or deceleration of the machine a counterbalance valve avoids overspeeding and cavitation of hydraulic motor.

#### 5) FUNCTION AS TO CIRCUIT DIAGRAM

Check valves in the inlet line A and B for by passing of the counterbalance valve.

At traveling forward the return oil flow is controlled by a counterbalance spool. At drop in inlet pressure the counterbalance spool throttles the return oil flow. The motor is locked. The oil behind the spool is led to the low pressure side via an additional check valve. Same function for traveling forward and backward.

Braking means for the motor that

- At reduced or zero inlet flow the counterbalance spool reaches a modulating position or a neutral position caused by spring force
- The high pressure oil (at outlet side of the motor) is returned to the low pressure side(At inlet side) of the motor via crossover relief valves.

As the control pressure for regulation of the HA control via the integrated shuttle valve is no longer available, the motor with HA control and counterbalance valve will swivel to its minimum displacement during deceleration.

In addition, an external boost flow/pressure can be applied at port S for preventing cavitation.

\* Counterbalance valves do not replace the service and parking brake.



14W72TM05

#### 6) INSTALLATION

The housing must be filled entirely with oil and shall also not run empty at rotary group standstill.

## 7) FILTRATION

According to purity class 9 as to NAS 1638, 6 as to SAE, ASTM, AIA and 18/15 as to ISO/DIS 4406.

#### 8) PRESSURE

Ports A or B : Normal 400bar, peak pressure 450 bar Port A + B : Pressure summation below 700 bar Max permissible intermittent case pressure : 6 bar

#### 9) DIRECTION OF ROTATION/ DIRECTION OF FLOW

With view on the drive shaft - clockwise/ A to B; Counter-clockwise/ B to A

#### 10) LEAKAGE OIL TEMPERATURE

In the bearing area max permitted -25°C to +80°C; Short time operation -40°C to +115°C

#### 11) COMMISSIONING

Fill the housing entirely with oil through highest located T port. Also connect the leakage oil pipe at this port. After commissioning check sealing and make visual control of the complete installation.

# GROUP 5 RCV LEVER

## **1. STRUCTURE**

The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.

1) 타입 S1, S2





VIEW A





Switches

| Type   | No   | ΙH             | BH                                 |
|--------|------|----------------|------------------------------------|
| Турс   | 140. | <b>L</b> II    | 101                                |
|        | 5    | Horn           | Breaker                            |
|        | 6    | Ram lock       | Proportional type<br>ON/OFF switch |
| S1, S2 | 7    | Rotating-CCW   | Clamp                              |
|        | 8    | Rotating-CW    | Release                            |
|        | 9    | Boom swing/    | N.A                                |
|        |      | Rotating (opt) |                                    |



Pilot port

| Port | LH                    | RH                    |
|------|-----------------------|-----------------------|
| Р    | Pilot oil inlet port  | Pilot oil inlet port  |
| Т    | Pilot oil return port | Pilot oil return port |
| 1    | Left swing port       | Bucket out port       |
| 2    | Arm in port           | Boom down port        |
| 3    | Right swing port      | Bucket in port        |
| 4    | Arm out port          | Boom up port          |

HX60AMT2RL02K

## **CROSS SECTION**

The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (3), spring (5) for setting secondary pressure, return spring (7), spring seat (6) and shim (4). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5 kgf/cm<sup>2</sup> (depending on the type). The spool is pushed against the push rod (9) by the return spring.

When the push rod is pushed down by tilting the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

## **CROSS SECTION**



- 1 Case
- 2 Bushing
- 3 Spoo
- 4 Shim
- 5 Spring
- 6 Spring seat
- 7 Spring
- 8 Plug
- 9 Push rod
- 10 O-ring
- 11 Rod seal
- 12 Plate
- 13 Spacer
- 14 Boot
- 15 Joint assembly
- 16 Swash plate
- 17 Adjusting nut
- 18 Boot
- 19 Plate
- 20 Handle assembly
- 21 Handle bar
- 22 Nut
- 23 Boot
- 25 Connector
- 26 Connector
- 27 Connector

300L2RL06K

# 2. FUNCTIONS

## 1) FUNDAMENTAL FUNCTIONS

The pilot value is a value that controls the spool stroke, direction, etc of a main control value. This function is carried out by providing the spring at one end of the main control value spool and applying the output pressure (secondary pressure) of the pilot value to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

- (1) Inlet port (P) where oil is supplied from hydraulic pump.
- (2) Output ports (1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.
- (3) Tank port (T) necessary to control the above output pressure.
- (4) Spool to connect output port to inlet port or tank port.
- (5) Mechanical means to control output pressure, including springs that work on the above spools.

## 2) FUNCTIONS OF MAJOR SECTIONS

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

The spring (9) works on this spool to determine the output pressure.

The change the deflection of this spring (5), the push rod (9) is inserted and can slide in the plug (14).

For the purpose of changing the displacement of the push rod through the swash plate (16) and adjusting nut (17) are provided the handle (20) that can be tilted in any direction around the fulcrum of the universal joint (19) center.

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

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

## 3) OPERATION

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

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



2 Pilot pump

1

- 3 Main pump4 Main control valve
- 6 Hydraulic cylinder

2-70

(1) Case where handle is in neutral position



300L2RL03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (3). Therefore, the spool is pushed up by the spring (7) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

#### (2) Case where handle is tilted



300L2RL04

When the push rod (9) is stroked, the spool (3) moves downwards.

Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.

When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port (1) increases higher than the set pressure, port P is disconnected from port (1) and port T is connected with port (1). If it decreases lower than the set pressure, port P is connected with port (1) and port T is disconnected from port 1.

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

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

# **GROUP 6 RCV PEDAL**

# **1. STRUCTURE**

The casing has the oil inlet port P (primary pressure), and the oil return port T (tank). In addition the secondary pressure is taken out through port A.







HW602AP01



| Port | Port name             | Port size |
|------|-----------------------|-----------|
| Р    | Pilot oil inlet port  |           |
| Т    | Pilot oil return port | PF 1/4    |
| А    | Pilot oil output port |           |

# **GROUP 7 BRAKE PEDAL (VALVE)**

## 1. STRUCTURE

The casing (spacer) has the oil inlet port A(Primary pressure), and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1,2,3 and 4 provided at the bottom face.





| Port | Port name           | Port size |
|------|---------------------|-----------|
| P1   | Port                | PF 3/8    |
| P2   | Port                | PF 3/8    |
| BR1  | Brake cylinder port | PF 3/8    |
| BR2  | Brake cylinder port | PF 3/8    |
| BL1  | Pluging             | PF 3/8    |
| BL2  | Pluging             | PF 3/8    |
| T1   | Drain port          | PF 3/8    |
| T2   | Drain port          | PF 3/8    |

# 2. FUNCTION

## 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 port P1/ P2 of the brake valve. A connection is established between ports BR1/BR2 and port T1/T2 so that the wheel brakes 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 (8) beneath pedal plate (16) 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 (3) is mechanically actuated via spring assembly (8), and the lower spool (3) is actuated hydraulically by spool (3). As spools (3) move downward, they will first close returns T1/T2 via the control edges, thus establishing a connection between accumulator port P1/P2 and ports BR1/BR2 for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spools (3) 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 (3) are in a partial braking position, causing ports P1/P2 and T1/T2 to close and holding the pressure in ports BR1/BR2.

# 4) FULL BRAKING POSITION

When pedal (17) is fully actuated, an 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 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) LIMITING THE BRAKING PRESSURE

Pedal restriction screw (29) on pedal plate (16) below pedal (17) is used to limit the braking pressure.

# 6) FAILURE OF A CIRCUIT

In the event of the lower circuit failing, the upper circuit will remain operational. Spring assembly (8) will mechanically actuate spool (3). In the event of the upper circuit failing, the lower circuit will remain operational since the lower spool (3) is mechanically actuated by spring assembly (8) and spool (3).

# GROUP 8 GEAR BOX

# 1. STRUCTURE



HW65AH2GB01

# 2. GEAR BOX FUNCTION

It explains mechanism, function operation principle and caution in the operation of transfer gear box applied to for this equipment.

## 1) GEAR BOX MECHANISM



HW60A2GB02

- 1 Input shaft gear 1
- Output shaft gear 2

4

Output shaft

7

- 2 Input shaft gear 1
  - Output shaft gear 1
- 5 Input shaft6 Change selector

# 2) FUNCTION

3

Transfer gear box is a hydraulic system having 1, 2 speed gear and its system is dog clutch type.

Once pushing 1 speed button for speed change, exhausted hydraulic power flow from the pump supplied to port "A" by operating 1, 2 speed solenoid valve and change selector (6) pushed by selector shift goes in gear with output shaft gear 1 (3).

The power gear box is moved to input gear shaft 1 (1), output shaft gear 1 (3), change selector (6), output shaft (7) and this procedure lead to 1 speed operation status.

Meanwhile, once pushing 2 speed button in the equipment stop condition, hydraulic power flow from the pump supplied to port "B" and change selector (6) pushed by selector shaft goes in gear with output shaft gear 2 (4).

The power gear box is moved to input shaft gear 2 (2), output shaft gear 2 (4), change selector (6), output shaft (7) and this procedure lead to 2 speed operation status.

## **3. TECHNICAL DATA**

## 1) GENERAL DATA

- (1) Max. input power : 70 kW
- (2) Max. input torque : 71.4 kgf · m
- (3) Max. input speed : 4500 rpm
- (4) Hydraulic motor : 80 cc/rev
- (5) Gear ration
  - · 1st speed : 4.06 : 1
  - · 2nd speed : 1.31 : 1
- (6) Output flange
  - $\cdot$  Bolt for propshaft connection : M10  $\times$  1.25
  - Gear box weight : 75 kg (165 lb)

## 2) GEAR BOX CONTROL

#### (1) Control pressure

- ① At connection P1 and P2 at Low/High speed : 26~32 kgf/cm<sup>2</sup>
- ② Definition of lubricants : SAE 80W-90 API GL-4

## 3) HOW TO CHANGE THE TRAVEL SPEED

If you want to change the speed, be sure to operate according to the following procedure. Otherwise, unreasonable operation may cause fatal impact and failure to the transfer box (gear box).

- In case of changing the travel speed, be sure to stop the machine completely.
- Keep the machine on the stationary state and stepping the brake pedal to full stroke. Thereafter, select the speed switch to the desired position.

When operating the travel speed switch without stepping brake pedal and stopping the machine completely, the operation of gear box can not be worked actually even though the position of speed switch is left to the desired position.

- When turning the key switch to "OFF" position to stop the machine, be sure to transfer the travel speed switch to the low speed position.

Because the position of solenoid valve for travel is automatically transferred to the low speed position when turning the key switch to "OFF"position.



# **GROUP 9 AXLE**

#### **1. OPERATION**

 $\cdot$  The power from the engine passes through main pump, travel motor and 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



HW602AX01

#### 2) REAR AXLE



HW602AX02



55W72AX03

- 11 Bevel gear set
- 12 Bolt
- 14 Taper roller bearing
- 15 Differential carrier
- 16 Friction washer
- 17 Differential side gear
- 18 Differential pinion
- 19 Friction gear
- 20 Pin
- 21 Dowel
- 22 Pin
- 23 Shaft retainer

- 24 Differential side gear
- 25 Detend ball
- 26 Circlip
- 27 Clutch disc
- 29 Circlip
- 30 Bearing
- 31 Clutch disc
- 32 Bushing
- 33 Circlip
- 34 Spacer
- 35 Bearing
- 37 Circlip

## **3. DIFFERENTIAL**



HW602AX04

The differential is installed on the front and rear axle to transfer the driving torque from the axle to the wheels. The differential transfers half of the output torque of the transmission via the universal drive shaft to the planetary gear of the wheel hubs and transfers the rpm and torque from the gear via the pinion and the ring.

In addition, the differential also servers as an equalizer when going around curves. If the mechanical connection from the transmission to the universal drive shaft, differential, shaft, and planetary gears to the wheels would be rigid, every steering movement would strain the axle construction and would result in increased tire wear.

The equalizing function comes from the special construction of the differential. The power input from the input flange to the pinion shaft, ring and differential housing to the equalizing axle in the differential housing meshes the four equalizing tapered gears with the axle gears, which are located in the equalizing axles. This changes the relative direction of rotation between the shafts meshed with the side gears. This means that one shaft turns clockwise and the other counterclockwise, and one shaft turns faster than the other.

This balancing movement has the disadvantage that when traveling off road, traction is reduced on uneven ground, on loose ground or on snow or ice only wheel per axle is engaged. This disadvantage can be corrected in part by installing a self locking differential.

# 4. FINAL DRIVE

1) FRONT AXLE



- (1) To gain a large drive force, the final drive uses a planetary gear system to reduce the speed and send drive force to the tires.
- (2) The power transmitted from the differential through universal joint (1) to pinion gear (2). The pinion gear rotates around the inside of a fixed ring gear (3) and in this way transmits rotation at a reduced speed to the planetary carrier. This power is then sent to the wheels which are installed to the planetary carriers.

## 2) REAR AXLE

1



55W72AX06

- (1) To gain a large drive force, the final drive uses a planetary gear system to reduce the speed and send drive force to the tires.
- (2) The power transmitted from the differential through axle half shaft (1) to pinion gear (2). The pinion gear rotates around the inside of a fixed ring gear (3) and in this way transmits rotation at a reduced speed to the planetary carrier.

This power is then sent to the wheels which are installed to the planetary carriers.



- 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.
# SECTION 3 HYDRAULIC SYSTEM

| Group | 1 Hydraulic Circuit ····· | 3-1  |
|-------|---------------------------|------|
| Group | 2 Main Circuit ·····      | 3-4  |
| Group | 3 Pilot Circuit ·····     | 3-7  |
| Group | 4 Single Operation        | 3-12 |
| Group | 5 Combined Operation      | 3-27 |

### **GROUP 1 HYDRAULIC CIRCUIT**



# 2. HYDRAULIC CIRCUIT (2/3)













- 1-1 Main pump
- 4-2 Travel motor
- 5-2 RCV lever-LH
- 6-2 RCV lever-RH
- 9-2 Boom cylinder with SLV
- 10-2 Arm cylinder with SLV
- 54 Solenoid valve
- 56 Accumulator

# 3. HYDRAULIC CIRCUIT (3/3)

<ROTATING,HR02>





30MN-00070-00 3OF3

# **GROUP 2 MAIN CIRCUIT**

The main hydraulic circuit consists of suction circuit, delivery circuit, return circuit and drain circuit. The hydraulic system consists of one main pump, one control valve, one swing motor, four cylinders and two travel motors.

The swash plate type variable displacement axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

# **1. SUCTION AND DELIVERY CIRCUIT**



140L3CI01

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

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

The control valve controls the hydraulic functions.

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

### 2. RETURN CIRCUIT



HW65AH3Cl02

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

The bypass check valves are provided in the return circuit.

The setting pressure of bypass check valves are 3.0 kgf/cm<sup>2</sup> (43 psi) and 4.5 kgf/cm<sup>2</sup> (64 psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.

When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. When the oil pressure exceeds 4.5 kgf/cm<sup>2</sup> (64 psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

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

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

When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm<sup>2</sup> (21 psi) differential pressure.

### **3. DRAIN CIRCUIT**



HW65AH3Cl03

Besides internal leaks from the motors and main pump, the oil for lubrication circulates.

#### 1) TRAVEL MOTOR DRAIN CIRCUIT

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

#### 2) SWING MOTOR DRAIN CIRCUIT

Oil leaked from the swing motor returns to the hydraulic tank passing through a return filter with oil drained from the travel circuit.

# **GROUP 3 PILOT CIRCUIT**



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

The pilot pump receives the oil from the hydraulic tank through the suction filter.

The pilot pressure is controlled by the relief valve in the cut off valve.

The discharged oil from the pilot pump flows to the control valves, solenoid valves and EPPR valves through the cut off valve and line filter as below.

- $\cdot\,$  RCV lever (LH & RH) and dozer lever through the safety lock solenoid value and block B.
- RCV pedal (travel), forward/reverse travel solenoid valve and 4-EPPR valve (boom swing and breaker or 2-way) through the safety lock solenoid valve.
- Auto idle supply port of MCV, parking brake standby port of swing motor and travel speed solenoid valve through the block A.
- $\cdot$  Axle parking solenoid valve, ram lock solenoid valve and pump flow control EPPR valve.

<sup>\*</sup> The circuit diagram may differ from the equipment, so please check before a repair.

# 1. SUCTION, DELIVERY AND RETURN CIRCUIT



HW65AH3HC02

The pilot pump receives oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The oil filtered by line filter flows remote control valve through safety solenoid valve.

Also, the oil flows EPPR valves, solenoid valves and auto idle port of MCV.

The pilot relief valve is provided in the cut off valve for limiting the pilot circuit pressure.

The return oil flow into the hydraulic tank.

<sup>\*</sup> The circuit diagram may differ from the equipment, so please check before a repair.

# 2. SAFETY VALVE (SAFETY LEVER)



HW65AH3HC03

When the lever of the safety solenoid valve is in the unlock position, oil flows into the remote control valve through solenoid valve and line filter.

When the lever of the safety solenoid valve is in the lock position, oil does not flow into the remote control valve, because of the blocked port.

<sup>\*</sup> The circuit diagram may differ from the equipment, so please check before a repair.

### 3. TRAVEL SPEED CONTROL SYSTEM



HW65AH3HC04

When the travel speed switch of the RH multifunction switch was placed in high or low position, the travel speed solenoid valve is changed to high or low speed position and thus the gear box is changed into high or low speed condition.

The pressure oil from pilot pump flows to the gear box through relief valve of cut off valve and the travel speed solenoid valve.

# 4. SWING PARKING BRAKE RELEASE



HW65AH3HC05

When the swing control lever is tilted, the pilot oil flow into SH port of shuttle valve, this pressure move spool so, discharged oil from pilot pump flow into PG port.

This pressure is applied to swing motor disc, thus the brake is released.

When the swing control lever is set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

# **GROUP 4 SINGLE OPERATION**

#### **1. BOOM UP OPERATION**



When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure (a5, a9) from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinder. At the same time, the oil from the small chamber of boom cylinder returns to the hydraulic oil tank through the boom 1 spool in the main control valve. When this happens, the boom goes up. The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve. When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the bottom end of the boom cylinder is closed by the boom holding valve. This prevents the hydraulic drift of boom cylinder.

# 2. BOOM DOWN OPERATION



HW65AH3HC11

When the right control lever is pushed forward, the boom spool in the main control valve are moved to the down position by the pilot oil pressure (b9) from the remote control valve.

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

The excessive pressure in the boom cylinder rod end circuit is prevented by the relief valve.

### **3. ARM ROLL IN OPERATION**



HW65AH3HC12

When the left control lever is pulled back, the arm spools in the main control valve are moved to the roll in position by the pilot oil pressure (b6, b11) from the remote control valve.

Also, the pilot pressure (sa) flows to the P3 selector valve and it moves the up position.

The oil from the A1, A2 and A3 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 1 spool in the main control valve. When this happens, the arm rolls in.

The cavitation which will happen to the bottom of the arm cylinder is also prevented by the make-up valve in the main control valve.

# 4. ARM ROLL OUT OPERATION



HW65AH3HC13

When the left control lever is pushed forward, the arm spools in the main control valve are moved to the roll out position by the pilot oil pressure (a6, a11) from the remote control valve.

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

At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm 1 spool in the main control valve. When this happens, the arm rolls out.

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

# **5. BUCKET ROLL IN OPERATION**



HW65AH3HC14

When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure (b10) from the remote control valve.

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

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

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

### 6. BUCKET ROLL OUT OPERATION



HW65AH3HC15

When the right control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure (a10) from the remote control valve.

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

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

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

# 7. SWING OPERATION



HW65AH3HC16

When the left control lever is pushed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure (a1, b1) from the remote control valve.

The oil from the A3 pump flows into the main control valve through the cut off valve and then goes to the swing motor.

At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve. When this happens, the superstructure swings to the left or right. The swing parking brake, make up valve and the overload relief valve are provided in the swing motor. The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

# SWING CIRCUIT OPERATION



HW65AH3HC17

#### 1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation.

### 2) MAKE UP VALVE

The make up valves prevent cavitation by supplying return oil to the vacuum side of the motor.

#### 3) PARKING BRAKE

In case that the parking, of the machine at slope is required during operation, there is the danger of involuntary swing caused by the self weight of the machine. The brake is connected to prevent this involuntary swing.

#### PARKING BRAKE "OFF" OPERATION

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

When the left control lever placed in the swing position, the pilot pressure (SH) at the shuttle valve is transferred to the brake release valve and the brake release valve is change over. Then the pilot pressure (PG) lift the brake piston and release the parking brake.

#### PARKING BRAKE "ON" OPERATION

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

# 8. TRAVEL FORWARD AND REVERSE OPERATION



HW65AH3HC18

When the FNR lever of the RH multifunction switch is placed in forward or reverse position, the travel spools in the main control valve is moved to the forward or reverse position by the pilot oil pressure (a7, a8 or b7, b8) from pilot pump through the axle parking solenoid valve and then goes to the travel forward/reverse solenoid valve. The oil from the both pumps (A1, A2) flows into the main control valve and then goes to the travel motor. At the same time, the oil returned from the travel motor returns to the hydraulic oil tank through the turning joint and travel spools in the main control valve. When this happens, the machine moves forward or reverse.

### TRAVEL CIRCUIT OPERATION



HW65AH3HC19

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

#### 1) COUNTER BALANCE VALVE

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

#### 2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 235 kgf/cm<sup>2</sup> (3340 psi) to prevent high pressure generated at the time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

# 9. DOZER UP OPERATION



When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure (b2) from the remote control valve.

The oil from the A3 pump flows into the main control valve and then goes to the small chamber of dozer cylinder.

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

### **10. DOZER DOWN OPERATION**



When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure (a2) from the remote control valve.

The oil from the A3 pump flows into the main control valve and then goes to the large chamber of dozer cylinder.

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

# 11. FRONT AND REAR AXLE BRAKE SYSTEM (SERVICE BRAKE)



HW65AH3HC22

When the brake pedal (valve) is pushed, the discharged oil from the pilot pump (P4) flows into the front and rear axle brake disc through the solenoid valve of cut-off valve. This pressure is applied to axle brake disc, thus the service brake is applied.

# 12. STEERING CIRCUIT OPERATION



HW65AH3HC23

When the steering wheel is turned to the left or right, the spool within the steering valve turns left or right hand direction : Because the spool is connected with steering column.

At this time, the oil discharged from the pump (A3) flows into steering cylinder through spool and gerotor within the steering valve.

Then the steering direction is applied.

### **13. RAM LOCK CIRCUIT OPERATION**



HW65AH3HC24

When the ram lock switch is selected on the switch panel, the oil discharged from the pilot pump flows into oscillating cylinder through ram lock solenoid valve and locking valve.

This pressure is applied to check valve and oscillating cylinder, thus the oscillating function is operated (ram lock released).

# **GROUP 5 COMBINED OPERATION**

# 1. OUTLINE



HW65AH3HC25

The oil from the A1, A2, A3 pump flows through the neutral oil passage, bypass oil passage and confluence oil passage in the main control valve. Then the oil goes to each actuator and operates them. Check valves and orifices are located on these oil passage in the main control valve. These control the oil from the main pumps so as to correspond to the operation of each actuator and smooth the combined operation.

#### Straight travel spool

This straight travel spool for straight travel is provided in the main control valve.

If any of boom, arm or bucket lever etc is operated when traveling, the straight travel spool is pushed to the up by the pilot oil pressure.

Consequently, the left and right travel oil supply passage are connected, and equivalent amount of oil flows into the left and right travel motors. This keeps the straight travel.

# 2. COMBINED SWING AND BOOM OPERATION



HW65AH3HC26

When the swing and boom functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure (a1, b1, a5, a9, b9) from the remote control valve.

The oil from the A1 and A2 pump flows into the boom cylinder through boom 1 and boom 2 spools. The oil from the A3 pump flows into the swing motor through the swing spool.

The superstructure swings and the boom is operated.

# 3. COMBINED SWING AND ARM OPERATION



HW65AH3HC27

When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure (a1, b1, a6, a11, b6, b11) from the remote control valve.

The oil from the A3 pump flows into the swing motor through swing spool.

The oil from the A1 and A2 pump flows into the arm cylinder through the arm 1 and arm 2 spools. The superstructure swings and the arm is operated.

# 4. COMBINED SWING AND BUCKET OPERATION



HW65AH3HC28

When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure (a1, b1, a10, b10) from the remote control valve.

The oil from the A3 pump flows into the swing motor through the swing spool.

The oil from the A2 pump flows into the bucket cylinder through the bucket spool.

The superstructure swings and the bucket is operated.

### 5. COMBINED SWING, BOOM, ARM AND BUCKET OPERATION



HW65AH3HC29

When the swing, boom, arm and bucket functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure (a1, b1, a5, a9, b9, a6, a11, b6, b11, a10, b10) from the remote control valve.

The oil from the A2 pump flows into the boom cylinder, arm cylinder and bucket cylinder through boom 1 spool, arm 2 spool, bucket spool.

The oil from the A1 pump flows into the boom cylinder and arm cylinder through the boom 2 spool and arm 1 spool.

The oil from the A3 pump flows into the swing motor through the swing spool.

The superstructure swings and the boom, arm and bucket are operated.

| Group | 1 Component Location                 | 4-1   |
|-------|--------------------------------------|-------|
| Group | 2 Monitoring system ·····            | 4-3   |
| Group | 3 Electrical Circuit                 | 4-62  |
| Group | 4 Electrical Component Specification | 4-82  |
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# **GROUP 1 COMPONENT LOCATION**

# 1. LOCATION 1



- 1 Head light switch
- 2 Work light switch
- 3 Travel alarm switch
- 4 Cab light switch
- 5 Beacon switch (opt)
- 6 Breaker selection switch (opt)
- 7 Start switch
- 8 Breaker operation switch
- 9 Accel dial switch
- 10 Cluster

- 11 Hazard switch
- 12 Select switch
- 13 Multifunction switch (RH)
- 14 Auto ram lock switch
- 15 Auto cruise switch
- 16 Overload switch (opt)
- 17 DPF switch
- 18 Quick coypler switch (opt)
- 19 12V socket
- 20 Speaker

- 21 Fuse box
- 22 Radio & USB player
- 23 Service moter
- 25 Horn switch
- 26 Master switch
- 27 Aircon and heater switch
- 28 Travel alarm switch
- 29 Multifunction switch (LH)

2. LOCATION 2



HW65AH4EL02

- 1 Horn
- 2 Head lamp
- 3 Flasher position lamp
- 4 Battery
- 5 Battery relay
- 6 Fuel filler pump
- 7 Washer pump

- 8 Filler pump toggle switch
- 9 Machine control unit (MCU)
- 10 Fuel sender
- 11 Combination lamp
- 12 Number plate lamp
- 13 12V mini relay
- 14 Travel alarm buzzer

- 15 Reverse lamp
- 16 AVCU
- 17 Alternator
- 18 RMCU
- 19 Int wiper relay
- 20 Flaher unit
- 21 Power relay

# **GROUP 2 MONITORING SYSTEM**

### 1) STRUCTURE

The cluster consists of LCD and switches as shown below. The LCD is to warn the operator in case of abnormal machine operation or conditions for the appropriate operation and inspection. Also, The LCD is to set and display for modes, monitoring and utilities with the switches. The switches or touch screen are to set the machine operation modes.

- \* 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.



HW65AH4EL100D

 $\ensuremath{\overset{\scriptstyle \times}{_{\scriptstyle }}}$  The warning lamp pops up, lights ON (on the left-top side) and the buzzer sounds when the machine has a problem.

The warning lamp lights ON until the problem is cleared. Refer to page 4-6 for details.
# 2) GAUGE

# (1) Operation screen

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



- Engine coolant temp gauge
   Hydraulic oil temp gauge

# (2) Engine coolant temperature gauge



- 1 This gauge indicates the temperature of coolant.
  - · Black range : General state
  - $\cdot$  Red range  $\phantom{\cdot}$  : Engine overheated state
- ② If the indicator is in the red range or 🔄 lamp lights ON in red, turn OFF the engine and check the engine cooling system.
- If the gauge indicates the red range or lights ON even though the machine is in the normal condition range, check the electric device as this can be caused by poor connection of sensor or connector, and poor grounding of the instrument, etc.

# (3) Hydraulic oil temperature gauge



290F3CD54

• Red range : Above 105°C (221°F)

Black range : 40-105°C (104-221°F)

① This gauge indicates the temperature of hydraulic oil.

- ② If the indicator is in the red range or ③ lamp lights ON in red, reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.
- \* If the gauge indicates the red range or in lamp lights ON in red even though the machine is in the normal condition range, check the electric device as this can be caused by poor connection of sensor.

#### (4) Fuel level gauge



- ① This gauge indicates the amount of fuel in the fuel tank.
  - Black range : 9% or more

This displays the engine speed.
 This displays the tilt of machine.

- Red range : below 9%
- O Fill the fuel when in the red range, or  $\fbox$  lamp lights ON in red.
- If the gauge indicates the red range or not light the second term of terms of the second term of terms of terms

#### (5) Engine rpm gauge and clinometer



HX60A3CD105K

#### (6) Accel dial gauge



1 This gauge indicates the level of accel dial from 0 to 10 step.

# 3) COMMUNICATION ERROR AND LOW VOLTAGE WARNING POP-UP

# (1) Communication error pop-up



- ① Cluster displays this communication error pop-up when it has communication error with MCU.
- ② Communication error pop-up displays at operation screen only. Just buzzer alarm at the other screen.
- ③ If communication with MCU become normal state, it will disappear automatically.

HX60A3CD107A

HX60A3CD108

#### (2) Low voltage warning pop-up



- ① Cluster displays this low voltage warning pop-up when the battery voltage is low.
- ② Low voltage warning pop-up displays at operation screen only. Just buzzer alarm at the other screen.
- ③ This pop-up will disappear with using touch screen or buzzer stop switch. While the battery voltage is low, buzzer sounds every minute.

④ When the battery voltage is higher than 11.5 V, the pop-up off.

#### 4) WARNING LAMPS

Emergency warning lamp Battery charging warning lamp Engine oil pressure warning lamp Engine check warning lamp Fuel level warning lamp Engine stop warning lamp Water in fuel warning lamp



Air cleaner warning lamp
Overload warning lamp (opt)
Engine coolant temperature warning lamp
Hydraulic oil temperature warning lamp
DPF warning lamp

HW65AH3CD109C

※ Each warning lamp on the left-top of the LCD pops up on the center of LCD and the buzzer sounds when the each warning is happened. The pop-up warning lamp moves to the original position and lights up when the buzzer stop switch is pushed or the pop-up is touched. And the buzzer stops. Refer to page 4-19 for the switch.

#### (1) Engine coolant temperature warning lamp



- ① The warning light is turned ON and buzzer is sounded when the engine coolant temperature is overheated.
- ② The engine speed is also decreased unless the coolant temperature is reduced again. Here, do not turn OFF the engine. When the engine is turned OFF, the coolant temperature is overheated even more to cause engine rattle due to the surge.
- \* Check the temperature gauge of the engine coolant. The coolant is overheated when the gauge in the red range. Here, the coolant temperature warning lamp is turned ON, and the engine speed is decreased automatically.

The engine performs 'low-speed idle" run until the gauge is returned to the black range. Even when the gauge returns to the black range, do not turn OFF the engine, and perform idle run additionally for 3~5 min. Ignoring this may cause surge from the heat to result in damage to the engine.

The reason for idle run of the engine is to disperse the overheated heat slowly to reduce the temperature.

After proper measures are finished check the coolant level again, and inspect whether the fan belt is loose, and whether there are any foreign substances around the radiator. When the coolant temperature returns to normal temperature, the engine speed is restored to normal speed again.

#### (2) Hydraulic oil temperature warning lamp



290F3CD62

- ① This warning lamp pops up on the center of LCD and the buzzer sounds when the hydraulic oil temperature is over 105°C.
- ② The pop-up in lamp moves to the original position and lights ON when the buzzer stop switch is pushed or pop-up is touched. Also, the buzzer stops and lamp keeps ON.
- ③ Check the hydraulic oil level and hydraulic oil cooling system.

# (3) Fuel level warning lamp



# (4) Emergency warning lamp



- ① This warning lamp lights up and the buzzer sounds when the level of fuel is below 9%.
- ② Fill the fuel immediately when the lamp is ON.
- ① This warning lamp pops up and the buzzer sounds when each of the below warnings occurs.
  - MCU input voltage abnormal
  - Accel dial circuit abnormal or open
- \* The pop-up warning lamp moves to the original position and lights ON when the buzzer stop switch is pushed or pop-up is touched. Also the buzzer will stop.
  - This is same as following warning lamps.
- ② When this warning lamp lights up, machine must be checked and serviced immediately.

# (5) Engine oil pressure warning lamp



- ① This warning lamp lights up when the engine oil pressure is low.
- ② If the lamp lights up, shut off the engine immediately. Check oil level.
- Serious damage can be caused to the engine when the engine is operated continuously while the warning lamp is turned ON.

# (6) Check engine warning lamp



Warning lamp is turned ON when the engine must be checked.
 When the warning lamp is turned ON, stop the machine and find the cause for repair.

# (7) Battery charging warning lamp



- ① This warning lamp lights up when the battery charging voltage is low.
- O Check the battery charging circuit when this lamp lights up.

# (8) Air cleaner warning lamp



This warning lamp lights up when the air cleaner is clogged.
 Check, clean or replace the filter.

# (9) Overload warning lamp (opt)



- ① When the machine is overloaded, the overload warning lamp lights up when the overload switch is ON. (if equipped)
- ② Reduce the machine load. Initiate a manual regeneration

# (10) DPF (Diesel Particulate Filter) Warning Lamp



- ① This lamp is turned ON or OFF to inform that regeneration is required.
- ② For details, please refer to the after-treatment system below.

#### \* After-treatment System

The after-treatment system uses DOG and DPF to satisfy the exhaust regulations.

The oxidation catalyst of DOG reduces the emission of hydrocarbon and carbon monoxide through the catalyst, and the particle materials (PM) discharged from the engine are collected.

DPF regeneration is composed of "forced regeneration" during driving and "manual regeneration" performed by the driver.

When the regeneration is not performed successfully according to the procedure, warning lamp relevant to the each operating condition is turned ON.

When the warning lamp is turned ON, park the machine on a safe place, and perform the regeneration process manually according to the following procedure.

The warning lamp is turned OFF when the regeneration process is performed successfully.

DPF regeneration mode is classified into the following stages according to the soot accumulation level on the DPF.

- Soot level of 80% or less : Normal operating condition
- Soot level of 80~100% : AUTO regeneration during driving
- Soot level of 100~120% : Regeneration initiated by the driver (Manual Regeneration)
- Soot level of 120% or more : Inquiry to the Service Center or agent required

(DPF warning lamp turned OFF, check engine warning lamp turned ON, engine power reduced)

▲ Engine power can be reduced when the regeneration process is not performed manually after the warning lamp is turned ON.

#### \* DPF Regeneration Procedure

| Procedure | Soot Amount   | DPF Warning<br>Lamp<br>=13 | Check engine<br>warning lamp | Decrease in<br>Torque   | Remark   |
|-----------|---------------|----------------------------|------------------------------|-------------------------|--|
| 1         | Less than 99% | -                          | -                            | -                       | No action (Manual regeneration according to the equipment)   |
| 2         | 100~105%      | -                          | -                            | -                       | Regeneration is started.<br>Performed in high temperature<br>(560~640°C)   |
| 3         | 106~110%      | Blinking slowly            | -                            | -                       | Forced regeneration induced (Alarm)  |
| 4         | 111~120%      | Blinking slowly            | Turned ON                    | Torque reduced weakly   | Forced regeneration induced (Decrease in Torque)   |
| 5         | 121% or more  | Blinking quickly           | Blinking                     | Torque reduced severely | Regeneration is inactivated.<br>Inquire to the service center or to the<br>agent to start the service<br>regeneration to solve the decrease<br>in torque |

- DPF warning lamp is turned ON when the DPF soot exceeds 100%.

- DPF warning lamp is blinked when the DPF soot level exceeds 105%.

- When the DPF soot level exceeds 111%, the DPF warning lamp blinks slowly, and the check engine warning lamp is turned ON to reduce the engine power.

- When the DPF soot level exceeds 121%, the DPF warning lamp blinks slowly, and the check engine warning lamp is turned ON to reduce the engine power.
- DPF regeneration is composed of the active regeneration occurred during driving and forced regeneration activated manually by the driver.
- When the DPF soot level is less than 105%, active regeneration is activated automatically during driving.

However, the system informs the driver to perform forced regeneration manually when the level is 105% or more.

The check engine warning lamp is turned ON when the level is 120% or more, and engine power is reduced to 50%. The driver must inquire to the service center or to the agent.

- DPF soot level of 105% or less : Active regeneration
- DPF soot level of 105~120% : Forced regeneration + Engine power reduced
- DPF soot level of 105~120% : Driver is informed that forced regeneration is required.
- DPF soot level of 120% or more : Regeneration not possible, and inquiry required to the service center or to the agent

#### \* Manual (Forced) DPF regeneration method

| 1:12:1 |     |
|--------|-----|
| 100    | 6.0 |

DPF regeneration procedure is activated manually by the driver when the driver selects to initiate the regeneration procedure.

Because the operating condition is inappropriate for the hot engine exhaust temperature (Ex.: Work near the inflammable materials), manual regeneration may be required if the driver prohibited the active regeneration procedure for long period.

① Manual regeneration condition

- Coolant (Engine oil) temperature : 40 °C or more
- Engine RPM: Low-speed idle run
- Parking brake must be applied (Only relevant to the wheel-type machine)
- When the soot concentration is accumulated to 20% or more
- 2 Manual (Forced) regeneration procedure

Park the machine on a well-ventilated area, and keep away from inflammable materials to set the machine as shown below.

- Operate the machine until the engine coolant and oil temperature becomes 40°C or more.
- Engine speed is set to low speed.
- Put the gear lever on neutral, and apply the parking brake. (Only relevant to wheel-type machine)
- Safety lever is placed on the locking position.
- When the regeneration mode is in "Prohibit", DPF switch is pressed to the manual regeneration position.
- ③ Regeneration switch is activated to initiate the regeneration procedure.
- \* DPF warning lamp is lighted on the monitor.

While the engine speed is in low speed, the speed is increased gradually to 2000 RPM, and the regeneration procedure is initiated.

Manual regeneration can be continued for maximum of 30 min. or more according to the soot accumulation amount.

HEST lamp is lighted during the regeneration, and HEST lamp is turned OFF when regeneration is stopped.

\* The driver can stop the manual regeneration by lifting the safety lever to the "Release Lock" position, or by pressing the DPF switch to the "Prohibit" position.

## (11) Stop engine warning lamp



# (12) Water in fuel warning lamp



- ① If this warning lamp lights up, stop the engine immediately and check the engine.
- 2 Check the fault codes on the monitor.
- \* Please contact your HD Hyundai Construction Equipment service center or local dealer.
- ① This warning lamp lights up when the water separator is full of water or malfunctioning.
- ② When this lamp lights up, stop the machine and drain water from the water separator.

#### (13) Brake oil pressure warning lamp



- This warning lamp lights up when the oil pressure of service brake drops below the normal range.
- ② When the lamp lights up, stop the engine and check for its cause.
- \* Do not operate until any problems are corrected.

#### (14) Seat belt reminder warning lamp



- ① When operator does not fasten the operator's seat belt, the seat belt reminder warning lamp pops up and the buzzer sounds.
- 0 Fasten the seat belt.

#### (15) Exhaust System Failure Warning Lamp



- ① This warning lamp is turned ON in 3 cases such as when the quantitative distribution is stopped, poor reagent quality and monitoring malfunction, etc.
- ② Please refer to the exhaust gas control system below.

#### ※ Exhaust Gas Control System

This machine is equipped with the engine exhaust gas emission control system that satisfies the exhaust gas emission regulations. The owner/driver has the responsibility of proper operation and maintenance on the exhaust control system provided in the guaranteed provisions related to emission.

The engine exhaust system is mounted on the DPF. DPF is a emission reduction device that reduces the diesel particulate matter or soot from the exhaust gas of the diesel engine. DPF is stored until the particulate matter is combusted. The process of combustion and elimination of the stored particulate matter is referred to as "Regeneration". After the regeneration process is completed, residue is remaining, and it must be removed from the DPF regularly.

▲ The temperature of the exhaust gas and components of the exhaust system are in very high temperature during regeneration. There are risks of fire or burn, and it can also result in death, severe injury or property loss. Inflammable materials and explosive gas must be kept far away from the exhaust system during regeneration.

| Item      | Stage               | Reducing Agent Level/Time | Notification<br>Method       | Decrease in Torque                       | Symbol |
|-----------|---------------------|---------------------------|------------------------------|--|--------|
|           | Warning Immediately |                           | Always                       | -  | $\cap$ |
| EGR Valve | Level 1             | +36 hours                 | Blinking slowly              | Torque Limit : ~25%                      |        |
| Problem   | Serious             | +64 hours<br>(100 hours)  | Blinking quickly +<br>Buzzer | Torque Limit : ~50%<br>Speed Limit : 60% |        |

# 5) PILOT LAMPS



HW65AH3CD112E

#### (1) Mode pilot lamps

| No | Mode           | Pilot lamp   | Selected mode                                     |
|----|----------------|--------------|---|
| 1  | Power mode     | P<br>S       | Heavy duty power work mode<br>Standard power mode |
| 2  | Travel mode    | <del> </del> | Low speed traveling<br>High speed traveling       |
| 3  | Auto idle mode |              | Auto idle mode<br>Auto idle status                |

#### (2) Preheat pilot lamp



- ① Turning the start key switch to the ON position starts preheating in cold weather.
- 2 Start the engine after this lamp goes OFF.

# (3) Warming up pilot lamp



# (4) Auto idle status/ mode pilot lamp



# (5) Maintenance pilot lamp



- This lamp is lights up 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 (86°F), or when 10 minutes have passed since starting the engine.
- ① The auto idle mode pilot lamp will light up when the idle mode is selected.
- ② The auto idle status pilot lamp will be ON when all levers and pedals are in the neutral position, and the auto idle mode is selected.
- ③ One of the lever or pedal is operated, the status lamp will go OFF and the engine speed returns to the previous conditions.
- ① This lamp lights up when consumable parts are in need of replacement. It means that the change or replacement interval of parts is 30 hours from the required change interval.
- ② Check the message in maintenance information of main menu. Also, this lamp lights up for 3 minutes when the start switch is switched to the ON position.
- \* Refer to page 4-24.
- 1 This lamp lights up when the boom offset switch is pressed.



(6) Boom swing pilot lamp

•

# (7) DPF regeneration inhibit warning lamp



- ① This warning lamp indicates, the DPF switch is pushed to the inhibit position, therfore automatic and manual regeneration can not occur.
- \* Refer to page 4-41 for the DPF switch.

#### (8) HEST (High exhaust system temperature) warning lamp



- ① This warning lamp indicates, when illuminated, that exhaust temperatures are high due to regeneration of the DPF.
- O The lamp will also illuminate during a manual regeneration.
- 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 600°C [1112°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 is common for the lamp to illuminate on and off during normal equipment operation as the engine completes regeneration cycles.

#### (9) Parking pilot lamp



- ① This lamp lights up when the the parking switch is set to the parking position.
- \* Refer to the page 4-41.

#### (10) Working brake pilot lamp



- ① This lamp lights up when the working brake switch is set to working position.
- ※ Refer to page 4-41

#### (11) Ram lock pilot lamp



- ① This lamp lights up when the ram lock switch is set to the LOCK position.
- ② Also, this lamp lights up when the select switch is set to the parking position or the brake pedal is applied in the traveling.

# (12) Cruise pilot lamp



- ① This lamp lights up when the auto-cruise of panel switch is pressed.
- \* Refer to the page 4-40.

# (13) High beam pilot lamp



- ① The lamp lights up when the head lamp switch is set to the high beam position or passing conditions.
- ② When passing other machines ahead, this lamp must be used for a few seconds to give other machines warning for a few seconds.

#### (14) 4-way (rotating) pilot lamp (opt)



 This lamp lights up when the boom swing selection switch is set to the rotator (not used boom swing) and the 4-way operation switch on the LH control lever is pressed.
 **Refer to the page 4-43.**

#### (15) 2-way pilot lamp



- This lamp lights up when the option flow control function is activated in the cluster.
- \* Refer to the page 4-24.

# (16) Manual safety lock pilot lamp



- ① This lamp lights up when the safety knob is set to the LOCK position.
- \* Refer to the operator's manual page 3-47 for the safety knob.

(17) Smart key pilot lamp (opt)



300A3CD36A

- $(\ensuremath{\mathbb D}$  This lamp lights up when the engine is started by the start button.
- ② This lamp is red when the a authentication fails, it will be green when it authentication is successful.
- \* Refer to the page 4-28.

# 6) SWITCHES



- When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 3-12 for details.
- (1) Power mode switch



#### (2) Select switch



HX60A3CD119

- ① This switch is to select the machine power mode and when pressed, the power mode pilot lamp will be displayed on the section of the monitor.
  - · P : Heavy duty power work.
  - · S : Standard power work.
- 0 The pilot lamp changes  $\mbox{ S} \rightarrow \mbox{ P} \rightarrow \mbox{ S}$  in this order.
- ① This switch is used to select or change the menu or input value.
- (2) Knob push
  - · Short (below 0.5 sec) : Select menu
- ③ Knob rotation
  - This knob changes menu and input value.
  - · Right turning : Down direction / Increase input value
  - · Left turning : Up direction / Decreased input value

#### (3) Auto idle switch



① This switch is used to activate or cancel the auto idle function.
 ※ Refer to the page 4-13 for details.

① The buzzer sounds when the machine has a problem.

lamp lights up until the problem is cleared.

In this case, push this switch and buzzer stops, but the warning

HX60A3CD120

#### (4) Buzzer stop switch



HX60A3CD121

#### (5) Camera switch



- In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
   December 1 25 for the camera
- \* Please refer to page 4-35 for the camera.

#### (6) Escape switch



① This switch is used to return to the previous menu or parent menu.

(7) Travel speed control switch



HX60A3CD104

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

## 7) MAIN MENU



\* Please refer to the select switch, page 4-18 for selection and change of menus and input values.

\* In the operation screen, tap MENU or press the select switch to access the sub-menu screen.

#### (1) Structure

| No | Main menu               | Sub menu   | Description  |  |  |
|----|-------------------------|--|--|--|--|
| 1  | Monitoring<br>55I3CD51A | Active fault - Machine<br>Active fault - Engine<br>Logged fault - Machine/engine<br>Delete logged fault<br>Monitoring - Machine<br>Monitoring - Switch<br>Monitoring - Output    | MCU<br>ECU<br>MCU, ECU<br>MCU, ECU<br>Engine rpm, oil temp, voltage and pressure etc.<br>Digital switch status<br>Digital output status  |  |  |
| 2  | Management              | Maintenance information<br>Option flow control<br>ESL mode setting<br>Change password<br>Machine information<br>A/S phone number<br>Cluster update<br>CAN update<br>Service menu | Elapsed time, Change interval, Replacement etc.<br>Opt attch set, Proportional flow control set,<br>Confifirmation<br>ESL mode setting<br>Password change<br>Cluster, MCU, Engine, Machine<br>A/S phone number, A/S phone number change<br>Application, System<br>Program download, Update<br>Power shift, Operating hour, Gauge type, Rpm,<br>AVCU set, Language update etc |  |  |
| 3  | Display<br>55/3CD51C    | Clock<br>Brightness<br>Unit<br>Language  | Current time set<br>Manual, Auto<br>Temperature, Pressure, Flow, Distance, Volumn<br>22 kinds  |  |  |
| 4  | Utilities               | Entertainment<br>Camera setting<br>Clinometer setting<br>Manual<br>Emergency mode<br>Quick cooling mode  | Video/music file playing<br>Setup of number of active cameras, display<br>sequences, and camera numbers<br>Initializing slope sensor<br>Display cluster manual<br>Back-up switch for failed cluster switch and accel<br>dial<br>To maximize engine cooling performance   |  |  |

#### (2) Monitoring

1 Active fault - Machine



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

#### 2 Active fault - Engine



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

#### 3 Logged fault - Machine/ Engine



- · The logged faults of the machine MCU or engine ECU can be checked by this menu.
- This menu can be used only HCE service man.

#### ④ Delete logged fault



- The logged faults of the MCU, engine ECU can be deleted by this menu. (It is possible under the engine stop conditions)
- (5) Monitoring (machine status)



• The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu.

#### 6 Monitoring (switch status)



- $\cdot\,$  The digital switch status of the machine can be checked by this menu.
- $\cdot\,$  The activated switch will display in blue color.

# ⑦ Monitoring (output status)



- $\cdot\,$  The digital output status of the machine can be checked by this menu.
- The digital output status will display in blue color.

## (3) Management

#### 1 Maintenance information



- · Elapsed time : Display the elapsed time after the maintenance.
- $\cdot$  Change interval : The change intervals can be changed in hour increments of 50.
- · Change history : Display the change history for the maintenance.
- · Replacement : The elapsed time will be reset to zero (0).
- · Change or replace interval
- \* Refer to the operator's manual page 6-16.

#### ② Option flow control

a. Option attach selection



- Three kinds of option attachment can be selected by this menu.

- ⓐ Rotary grapple (4-way)
- (b) Grapple (2-way)
- $\odot$  Auger (2-way)

\* There are two user modes (type A or B) in each option attachment.

#### b. Proportional flow control setting

The preferable value of each option attachment can be set by this menu.

a) Rotary setting



Select rotary RCV, button and flow can be set by this menu

- · Flux setting
  - Enable set from level 1 to level 5.

HW60A3CD54OA

#### b) Grapple setting





Select grapple • RCV, button and flow can be set by this menu





- **RCV** setting
- Enable set LH or RH RCV for grapple operation.
- Select LH for grapple  $\rightarrow$ RH set for rotary automatically
- · Button setting (Close) – Select RH for Close  $\rightarrow$ 
  - LH set for open automatically



- · Flow setting
  - Enable set from level 1 to
- Flow setting value can be saved by pressing change button.

- \* Setting value saved once, it memorized in each icon and the last setting value is activated.
- \* Saved setting can be used by pressing Icon button only.
- \* There are two kinds (A and B) in each option attach setting and six kinds of option attach setting can be saved totally (2 of 4-way, 4 of 2-way).

#### c) Confifirmation



- \* Symbol () is activated on the low side of main screen when option attach function is used.
- \* Previous setting value can be checked by following procedure.
  - Menu > Management > option attach
  - a) Rotary setting
    - Rotary RCV : LH
    - Rotary flow level : 3
    - CW rotation : LH
    - CCW rotation : RH
  - b) Grapple setting
    - Grapple RCV : RH
    - Grapple flow level : 3
    - Open : LH
    - Close : RH
    - ③ ESL mode setting



- ESL : Engine Starting Limit
- ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
- When you Enable the ESL mode, the password will be required when the starting switch is turned to the on position.
- Disable : ESL function is disabled and password is not required to start engine.
   Enable (always) : The password is required whenever the operator starts engine.
   Interval : The password is required when the operator starts engine first. But the operator can restart the engine within the interval time without inputting the password.
- \* The interval time can be set to a maximum 4 hours.
- % Default password : 00000

Password length : 5~10 digits

# Image: Node Setting ESL Mode Seting ESL Mode Setting <

#### Start Limit - Smart Key Setting (When smart key is installed)

#### - Smart Key Exclusive

When the Smart key option (optional) is installed, Smart key menu is shown, and performance or nonperformance of Smart key authentication can be set through the Smart key menu.

When the Smart key is not in the cabin, the approval procedure is rejected, and password must be entered.

#### Start Limit - Tag Management



- The tag management menu is activated only when the Smart key menu is set through performance. Tag can be registered or deleted.
  - When registering the tag : Locate only the tag preferred for registration inside the cabin.
  - $\cdot$  When deleting the tag : All registered tags are deleted.

| Case      | ESL Mode      | Smart Key   | Condition  |  |
|-----------|---------------|---|--|--|
| 1         | Disablo       | Disable   | - With registered tag : Engine can be started without password input.    |  |
|           | Disable       |   | - Without registered tag : Engine can be started without password input. |  |
| 0         | Dischle       | Fnabla  | If Smart Key is enabled, ESL Mode is automatically enabled.              |  |
| 2 Disable | Enable        | This Case 2 work the same as the Case 4.                              |  |  |
|           | Frable        | Disable   | - With registered tag : Engine can be started with password input.       |  |
| 3 Enable  | lable Disable | - Without registered tag : Engine can be started with password input. |  |  |
| 4         |               | Frable  | - With registered tag : Engine can be started without password input.    |  |
| 4 Enable  | Enable        | Enable  | - Without registered tag : Engine can be started with password input.    |  |

#### **Engine Starting Condition**

#### 4 Password change

- The password is 5~10 digits.



Enter the current password

|   | MENU 2020.06.13    | 2:52<br>Al       |
|---|--------------------|------------------|
|   | 🚽 ESL Mode Setting | ESL Mode Setting |
|   | ESL Mode           | ESL Mode Setting |
|   |                    | Password Change  |
|   |                    |                  |
| S |                    | <b>\$</b>        |
|   |                    | HX60A3CD153A     |

Select the password change

ł



 New Password
 ×

 Input new password,
 1

 1
 2
 3

 4
 5
 6

 7
 8
 9

 0
 ✓

HX60A3CD155A Enter the new password again



HX60A3CD149A

Enter the new password

#### (5) Machine information

Saved the new password in

the MCU



· The information of the cluster, machine MCU and engine and machine checked by this menu.

#### 6 A/S phone number



· The A/S phone number can be checked and changed.



⑦ Cluster update



Enter the user password

- Select the cluster update
- $\cdot\,$  The cluster and CAN device can be updated by this menu.

#### \* Do not turn power off while updating.



#### 8 CAN update



- $\cdot\,$  The application program can be downloaded and updated by this menu.
- \* Do not turn power off while updating.

#### a. Download



Select the OK to update another application program

#### 9 Service menu



Enter the manager password

- · Power shift : Power shift mode (default/option can be set by this menu.
- · Operating hours : Operating hours in individual modes since the machine line out can be checked by this menu.
- Main gauge type : The engine rpm or fuel level gauge can be display on the main gauge of the main screen by this menu.
- Display RPM : Display the numeric value of engine rpm on the main gauge of the main screen can be set by this menu.
- AVCU setting : Standard, 2-Way or 4-Way dependent upon the machine options can be selected by this menu.
- Adding language : The language displayed on the cluster can be update by this menu when it is required to correct language.
- \* This menu can be used only HCE service man. Do not attempt unauthorized adjustment.

# (4) Display

① Clock adjust

| MENU    | HE:01 61.80.0505<br>HEDRUYH        | •           | N | IENU           | 2020.06.13 10:3<br>HYUNDAI | 34 Ø              |
|---------|------------------------------------|-------------|---|----------------|----------------------------|-------------------|
| \$<br>2 | Display<br>Clock Adjust            | •           |   | Clock Ad لم    | just                       |                   |
|         | Brightness Setting<br>Unit Setting | ►<br>Metric |   | Year 🔺<br>2020 | Month 🔺                    | Day A             |
| )<br>D  | Language Selection                 | English     |   | Hour 🔺         | Minute                     | 12 Hour 🖌 24 Hour |
| •       | НΣ                                 | (60A3CD191A |   | 10             | 34<br>▼                    | ок                |
|         |                                    |             | Р |                |                            | HX60A3CD192A      |

- · The first row of boxes indicate Year/Month/Day.
- The second row shows the current time. (AM, PM/0:00~12:59)

#### 2 Brightness



• If "Auto" is chosen, brightness for day and night can be set accordingly. Also, users can define which day time interval. (Set day starting time and ending time)

#### ③ Unit set



- Metric units : Units change to metric units.
- US units : Units change to U.S. units
- User setting : Units change to user setting units

| Item        | Metric units | U.S. units | User setting           |
|-------------|--------------|------------|------------------------|
| Temperature | °C           | °F         | °C, °F                 |
| Distance    | km           | mile       | km, mile               |
| Pressure    | bar          | Мра        | bar, Mpa, kgf/cm², psi |
| Flow        | lpm          | gpm        | lpm, gpm               |
| Volume      | I            | gal        | l, gal                 |

# ④ Language selection



· User can select preferable language (22 languages) and all displays are changed the selected language.

#### (5) Utilities

#### ① Entertainment



- · Play MP4 or codec file of external hard disk through USB port.
- · The USB port is located left side of the cluster.
- Over 1100 engine rpm, the screen turns into the operation screen with MP4 or codec file playing for the safety. The video is played again when the engine revolution is 1100 rpm or less.
- A The video play is prohibited for the safety reason when the machine is operated.





- · Three cameras can be installed on the machine and display order can be set by this menu.
- · If the camera is not equipped, this menu is not useful.
- Turning the select switch in clockwise direction, the next ordered will be shown and in counterclockwise direction, the previously ordered will be shown. Also, the camera channel can be changed by touching the screen.
- Display change to reduction size or display is not visible by pushing the select switch or touch the screen.

CAMERA 1 CAMERA 1 Concentration Concentrat

(display reduction size  $\rightarrow$  hiding  $\rightarrow$  display)

· The camera display is terminated by pressing the ESC switch or touch the X icon on the screen.

# Rear / RH view camera UI setting (Option)

# 1) Camera control switch

- Select the CAM switch to activate Rear / RH view camera from the beginning screen.
- While in that mode, select the ESC switch to return to the home screen.



2) Cam image control (CIC) mode

- Touch (a) (Rear), (b) (RH) button on screen to set single-view camera mode.
- Touch  $\bigcirc$  (2CH-split-view) button to set split-view camera mode.



- 3) Split-view Camera order setting
- $-\operatorname{\mathsf{Touch}}\ensuremath{\mathbb{G}}$  (camera setting) button to set split-view camera order.





Rear / RH view option

- You can change spilt-view camera order on display order menu.



#### ③ Clinometer setting



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

#### (4) Manual



HX60A3CD213A

· Manual of the cluster can be read on the monitor.

#### **5** Emergency mode



- $\cdot\,$  When switches of the monitor and the accel dial fails, switches are displayed on LCD, and you are allowed to perform operation by touching the screen.
- · Such operation is allowed only on this mode screen.

#### **6** Quick Cooling Mode



While the machine is stopped and discontinued with operation, engine can be operated in maximum RPM for maximum rotation of the radiator fan. (Max. for 5 minutes)

- Setting : When the machine is stopped, the safety lever is lowered to set the quick cooling mode in the locked state

- Release : Released when the operating time exceeds 5 minutes, when the safety lever is cleared, and when the quick cooling mode release button is pressed

# 4. SWITCHES



HW65AH3CD02-2A

#### 1) START SWITCH AND BUTTON (OPTIONAL)



Start button and Smart key tag (Optional)

#### (1) There are 3 switches of OFF, ON and START.

- (OFF) : As the position possible for inserting and removing the key, engine is stopped when the key is in the OFF position while the engine is operating.
- · (ON) : The overall machine system is operated.
- $\cdot \bigcirc$  (START) : It is used to start the engine. Remove your hand after engine is started.
- When the start switch is turned ON in the winter season, the coolant temperature is detected to operate the fuel heater automatically, and the fuel is heated.

When the start switch is turned ON, the engine is started in 1~2 minutes. More time may be required according to the outdoor temperature.

\* To maintain the electrical and hydraulic functions, and to prevent machine damage, the start switch is placed on the ON position when the engine is operating.

# 2) ACCEL DIAL



- (1) There are 10 dial setting.
- (2) Setting 1 is low idle and setting 10 is high idle.
  - · By rotating the accel dial to right : Engine speed increased.
  - $\cdot$  By rotating the accel dial to left : Engine speed decreased.

# 3) HEAD LIGHT SWITCH



- (1) This switch is used to operate the head light.
  - · Press the switch once, the head light comes ON and the pilot lamp ON.
  - $\cdot$  Press the switch once more, the head light and pilot lamp turn off.

#### 4) WORK LIGHT



- (1) This switch is used to operate the work light.
  - Press the switch once, the work light comes ON and the pilot lamp ON.
  - $\cdot$  Press the switch once more, the work light and pilot lamp turn off.

# 5) FORWARD TRAVEL ALARM SELECTION SWITCH



- (1) Warning sound on forward travel of the machine can be selected. (ON/OFF)
- ※ Alarm is not sounded during forward travel when the switch is pressed forward.

#### 6) CAB LIGHT SWITCH



(1) This switch turns on the cab light on the cab.
# 7) BEACON SWITCH (opt)



- (1) This switch turns ON the rotary light on the cab.
- (2) The below indicator lamp is turned ON when operating this switch.

# 8) BREAKER SELECTION SWITCH (opt)



- (1) This switch is used to operate breaker.
- \* The breaker operates only when this switch is pressed.

# 9) QUICK COUPLER SWITCH (opt)



- (1) This switch is used to engage or disengage the moving hook on quick clamp.
- \* Refer to the operator's manual page 8-10 for details.

#### 10) AUTO-CRUISE SWITCH



- (1) When selected, this switch allows the user to drive at high speed with a constant pause at the speed selected by the uwer when selected.
- (2) This switch is released when the brake pedal is pressed.

# 11) AUTO RAM LOCK SWITCH



- (1) This switch activate front axle oscillation cylinder to locking position for increase of stability.
  - ON : Set front axle to locking position for excavation work or travels even ground. Also, the ram lock pilot lamp comes ON at the travel pilot lamp.
  - $\cdot$  AUTO : Set front axle to locking or unlocking as table.

| Select switch<br>(parking/working/<br>traveling) | Ram lock  | Conditions   |
|--|-----------|--|
| Parking (P)                                      | Locking   | · Always   |
| Traveling (T)                                    | Unlocking | · Always   |
|  | Locking   | <ul> <li>FNR lever in neutral position</li> <li>Service brake pedal is depressed.</li> </ul>   |
| Working (W)                                      | Unlocking | <ul> <li>FNR lever in forward/reverse position and<br/>service brake pedal is not depressed.</li> <li>2 way pedal is equipped and service brake<br/>pedal is not depressed.</li> </ul> |

#### 12) DPF (Diesel Particulate Filter) Switch



- (1) This switch is used to select the regeneration function on DPF.
- (2) Prohibit Switch (1)
  - ① When set to the prohibit position, the AUTO or manual DPF regeneration is not allowed.
- ② It is used to prevent DPF regeneration when operating the machine in the environment that is dangerous in high temperature.
- ③ This position is recommended for operation limited to only when it becomes dangerous in high temperature.
- ④ Even when the DPF regeneration switch is in "Prohibit" position, initialization/forced regeneration can be requested according to the condition, and the warning lamp can be turned ON or OFF.

: The DPF regeneration indicating lamp can be blinking on the cluster.

- : The DPF warning lamp may be turned ON or blinking.
- (3) AUTO Position (3)
  - In this position, DPF regeneration is performed automatically.
- (4) Manual Regeneration Position (2)
- ① In this position, the machine is not used while the engine is in lowspeed idle run, and manual DPF regeneration is performed when the DPF soot level is in the sufficient level to permit regeneration.
- ② While the DPF regeneration is performed, the HEST lamp is turned ON.
- \* For details, please refer to page 4-9.
- \* The safety button must be pulled back to move to the manual position (2).

In addition, it is returned to AUTO position when released from the manual position (s

#### 13) HORN SWITCH



#### 14) MASTER SWITCH



35Z9A3CD36

(1) This switch is at the top of left side control lever. On pressing, the horn sounds.

- (1) This switch is used to shut off the entire electrical system.
- (2) I : The battery remains connected to the electrical system. O : The battery is disconnected to the electrical system.
- \* Never turn the master switch to O (OFF) with the engine running. It could result in engine and electrical system damage.

# 15) LH RCV LEVER SWITCH

#### (1) Proportional type



The switches on the LH RCV lever is function as below.

- 1 CW rotating switch
- When this switch is pressed, the boom swing or clockwise rotating
- 2 will operate.
  - CCW rotating switch

When this switch is pressed, the boom swing or counterclockwise

- ③ rotating will operate. Horn switch
- 4 When this switch is pressed, the horn will sound.
- Ram lock switch

This switch activates only automatic mode.

When the control lever switch is pressed for 5 seconds, the front axle is locked.

 $\ensuremath{\mathbb{5}}$  The indicator lamp lights up when this switch is activated.

Boom swing/rotating switch (opt)

This switch is used to operate boom swing or rotation (if equipped rotating piping).

 $\cdot$  Switch and flow can be set on cluster.

# 16) RH RCV LEVER SWITCH

#### (1) Proportional type



The switches on the RH RCV lever is function as below.

# ① 2-way clamp switch

When this switch is pressed, the clamp will only operate when the crusher operation mode is selected.

#### 2 2-way release switch

When this switch is pressed, the release or breaker will operate when the crusher operation mode or breaker operation mode is selected.

③ Proportional type ON/OFF switch The 4-way operation is activated only by turning on the proportional control ON/OFF switch located on the left control level.

#### ④ Breaker

When this switch is pressed, the breaker will only operate when the breaker operation mode is selected.

(5) None

# 17) RH MULTI FUNCTION SWITCH

# (1) FNR lever



- $(\ensuremath{\mathbbm l})$  This lever changes travel direction of machine.
  - · F : Machine moves forward
  - $\cdot$  **N** : Neutral position
  - · R : Machine moves backward
- A Travel direction will be reversed if lower structure is positioned with dozer in front.
- O The warning buzzer sounds when the lever is in the reverse position.
- A If this lever is not in the neutral position, engine does not started.
- A Be sure to stop the machine when changing the direction forward or backward while traveling.

# (2) Travel speed switch



- 1 This switch is for selecting travelling speed between high and low.
  - $\cdot$  Low speed (–) : 11.3 km/hr (7.0 mph), turtle mark
  - $\cdot$  High speed (=) : 30 km/hr (19.0 mph), rabbit mark
- ▲ In case of changing the travel speed, be sure to stop the machine completely.

# 18) LH MULTI FUNCTION SWITCH

#### (1) Direction indication lamp switch



- ① This switch is used to warn or signal the turning direction of the machine to other machines or equipment.
- ② Push the lever to forward for turning right ( ), pull the lever to backward for turning loft ( ).
- ③ The turning pilot lamp comes ON at the travel pilot lamp on the steering column.

#### (2) Dimmer switch



- ${\ensuremath{\textcircled{}}}$  This switch is used to turn the head lights direction.
- ② Switch positions.
  - · Up (∽O≣) : To flash for passing
  - · Middle ( O ≥ ) : Head lights low beam ON
  - · Down ( OS ) : Head lights high beam ON
- ③ If you release the switch when it's in up position, the switch will return to middle.

#### (3) WIPER SWITCH



- 1 When the switch is in J position, the wiper moves intermittently.
- 2 When placed in I or II position, the wiper moves continuously.

#### (4) WASHER SWITCH



#### (5) HORN SWITCH



- 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 tank is 1.5 liter.
- 1 This switch is at the end of left side multifunction switch. On pressing, the horn sounds.

# 19) SELECT SWITCH (parking / working / traveling)



- (1) This switch is used to select the operation mode as below.
  - $\cdot$  Parking ((P)) : The parking brake is applied.
  - $\cdot$  Working (W) : The machine needs to be working.
  - $\cdot$  Traveling (T) : The machine needs to be traveling.

# 20) HAZARD SWITCH



- (1) Use for parking, or roading machine.
- (2) LH and RH turn signal lamps come ON at the same time by this switch.
- \* If the switch is left ON for a long time, the battery may be discharged.

# 21) TURNING PILOT LAMP

#### (1) Left turning pilot lamp



(1) This lamp flashes with sound when the LH multifunction switch is move to backward position.

#### (2) Right turning pilot lamp



 $(\hfill)$  This lamp flashes with sound when the LH multifunction switch is  $(\hfill)$  move to forward position.

# **GROUP 3 ELECTRICAL CIRCUIT**

# · ELECTRICAL CIRCUIT (1/3)



20MN-99200-00



20MN-99100-00

#### **ELECTRICAL CIRCUIT (3/3)**

RH MIRROR VIEW SYTEM(EI06)

RH-SIDE VIEW CAMERA CONTROLLER DIFF\_H(OL DIFF\_L(OU NC GND GND NC CAN2HI CAN2HI CAN2LO CAN2LO GND GND DIFF 012 012 013 013 014 015 013 013 015 015 012 M406-12 0.75R M406-20 0.75B/W 0.05B/W 0.05B/W 0.05B/W 0.05B/W 0.05B/W 0.05B/W 0.05B/W 0.075B/W 0 N406-26 0.75FW N406-27 0.75L N406-03 0.75BW N406-03 0.75BW 0.75Br N406-01 N406-01 N406-06 N406-06 N406-01 N406-06 N406-07 N406-26 N406-27 V406-12 N406-21 V406-13 N406-16 N406-25 N406-17 0.75R 0.75Br 0.75RW 0.75L 
 CN-3
 EESTM/TOWN

 1
 DBFFM/TOWN

 2
 DRF\_HOUT)

 3
 DRF\_LOUT)

 4
 ON LA

 5
 CM LA

 7
 OM S

 8
 NC

 9
 NC

 10
 CM LA
 ADJUST SIGNAL NC POWER 6.5V LVDS NE G GND LVDS POS ADJ LVDS GND

REAR VIEW CAMERA



RIGHT VIEW CAMERA

AAVM CAMERA SYSTEM(EI02)



|                   |         | CN-4 | 05 DT04-6P    |
|-------------------|---------|------|---------------|
| 267               | 0.75Y   | 01   | LVDS POS      |
| 269               | 0.75B   |      | CNID          |
| 268               | 0.75BrW | 1.2  | GND           |
| 0.07              | 0.75P   | 03   | LVDS NEG      |
| 200               | 0.7011  | 04   | POWER 12V     |
|                   | 0.75.0- | 05   | NC            |
| 266               | 0.7501  | 06   | ADJUST SIGNAL |
| RIGHT VIEW CAMERA |         |      |               |

|     |         | CN-4 | 03            |
|-----|---------|------|---------------|
| 215 | 0.75YR  | 01   | LVDS POS      |
| 217 | 0.75BH  | 02   | GND           |
| 216 | 0.75B/G | 03   | LVDS NEG      |
| 213 | 0.70110 | 04   | POWER 12V     |
|     | 0.7FO-D | 05   | NC            |
| 214 | 0.75G/h | 06   | ADJUST SIGNAL |
|     |         | REAF | R VIEW CAMERA |

20MN-97300-00

# MEMORANDUM

# **1. POWER CIRCUIT**

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

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

# 1) OPERATING FLOW

Battery [B+] — Battery relay [CR-1] — Maxi fuse (CN-60) — I/conn [CN-13 (2)] — Master switch [CS-74A]

Fuse box [No.1] - ECU main power [CR-45 (30, 86)]
 Fuse box [No.2] - I/conn [CN-6 (7)] - Room lamp [CL-1 (2)]
 Fuse box [No.3] - Start switch [CS-2 (1)]
 Fuse box [No.4] - I/conn [CN-1 (16)] - MCU [CN-51 (22)]
 Fuse box [No.5] - Cluster [CN-56 (1)]
 Hour meter [CN-48 (1)]
 RMS [CN-125A (1)]
 Smart key reader [CN-427 (12)]
 Fuse box [No.6] - New MP3 radio [CN-27 (8)]
 Fuse box [No.7] - I/conn [CN-11 (5)] - Aircon & heater controller [3]
 Blow relay [2]
 Fuse box [No.8] - Flasher unit [CR-11 (2)]

% I/conn : Intermediate connector

# 2) CHECK POINT

| Engine | Start switch | Check point         | Voltage  |
|--------|--------------|---------------------|----------|
|        |              | ① - GND (battery)   |          |
| STOP   | OFF          | ② - GND (relay)     | 10~12.5V |
|        |              | ③ - GND (maxi fuse) |          |

\* GND : Ground

# **POWER CIRCUIT**



HW65AH4EL05

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

4-52

# 2. STARTING CIRCUIT

#### 1) OPERATING FLOW

Battery (+) terminal --- Battery relay [CR-1] --- Maxi fuse [CN-60]

--- I/conn [CN-13 (2)] --- Master switch [CS-74A] --- Fuse box No.3 --- Start sw [CS-2 (1)]

#### (1) Start switch : ON

--- Start switch ON [CS-2 (2)] --- I/conn [CN-4 (22)]

ECU [CN-94 (1-75)]

- Battery relay [CR-1] : Battery relay operating (all power is supplied with the electric component)
- └─► Start switch ON [CS-2 (3)] ─► Fuse box No.11 ─► I/conn [CN-1 (7)] ─► MCU [CN-51 (23)]

#### (2) Start switch : START

Start switch START [CS-2 (6)]  $\rightarrow$  Start limit relay [CR-385 (30 $\rightarrow$ 87)]  $\rightarrow$  Neutral relay [CR-38 (30 $\rightarrow$ 87)]

- → ECU [CN-94 (1-84)→(1-72)] → I/conn [CN-18 (1)]
- --- Anti-restart relay [CR-5 (86)  $\rightarrow$  (87)] --- I/conn [CN-18 (9)]
- → Start relay [CR-23 (85)→(87)] → Start motor operating

#### 2) CHECK POINT

| Engine      | Start switch | Check point                       | Voltage  |
|-------------|--------------|-----------------------------------|----------|
|             |              | ① - GND (battery B <sup>+</sup> ) |          |
| Operating S |              | ② - GND (start switch)            |          |
|             |              | ③ - GND (battery relay M4)        |          |
|             | Start        | ④ - GND (starter B)               | 10~12.5V |
|             |              | ⑤ - GND (starter S)               |          |
|             |              | ⑥ - GND (start relay)             |          |
|             |              | ⑦ - GND (battery relay M8)        |          |

\* GND : Ground

# STARTING CIRCUIT



# **3. CHARGING CIRCUIT**

When the starter is activated and the engine is started, the operator releases the start switch to the ON position.

Charging current generated by operating the alternator flows into the battery through the battery relay (CR-1).

The current also flows from the alternator to each electrical component and controller through the fuse box.

#### 1) OPERATING FLOW

#### (1) Warning flow

Alternator [CN-74 (L)] → MCU alternator level [CN-51 (20)]

--- Cluster charging warning lamp (via CAN interface)

# (2) Charging flow

Alternator [CN-74 (B)] - Starter [CN-45 (B)] - Battery relay [CR-1] Battery (+) terminal Maxi fuse [CN-60] - I/conn [CN-13 (2)] - Master switch [CS-74A]

---- Fuse box [CN-36 No.1~8]

→ Maxi fuse [CN-95] → I/conn [CN-13 (1)] → Fuse box [CN-36 No. 12~27]

# 2) CHECK POINT

| Engine       | Start switch | Check point                       | Voltage  |
|--------------|--------------|-----------------------------------|----------|
|              |              | ① - GND (battery B <sup>+</sup> ) |          |
| Operating ON |              | ② - GND (battery relay)           |          |
|              | ON           | ③ - GND (alternator B terminal)   | 10~12.5V |
|              |              | ④ - GND (alternator L terminal)   |          |
|              |              | ⑤ - GND (MCU)                     |          |

\* GND : Ground

# **CHARGING CIRCUIT**



HW65AH4EL07

# 4. HEAD LAMP AND WORK LAMP CIRCUIT

# 1) OPERATING FLOW

Fuse box (No.14) Head lamp Hi relay [CR-14 (30)]

- Head lamp Low relay [CR-13 (30)]
- Head lamp power relay [CR-78 (30)]
- └─► I/conn [CN-8 (4)] ─► I/conn [CN-97 (8)] ─► Multifunction sw left lever [(12)]

Fuse box (No.15) -- Work lamp relay [CR-3 (30, 86)]

Fuse box (No.10) -- Switch panel [CN-116 (10)]

# (1) Head lamp switch ON : Mult function sw [LH, dimmer sw (Middle)]

- Head lamp switch ON [CN-116 (3)] → Head lamp power relay [CR-78 (85)→(87)]
- → I/conn [CN-8 (11)] → I/conn [CN-97 (11)] → Multifunction sw left lever [(4)→(5)]
- → I/conn [CN-97 (10)] → I/conn [CN-8 (3)] → Head light low relay [CR-13 (86)→(87)]
- → I/conn [CN-8 (2)] → Head light ON [CL-3 (1), CL-4 (1)] : Head light ON

# (2) Head lamp switch ON : Mult function sw [LH, dimmer sw (Down)]

Head lamp switch [CN-116 (3)] → Head lamp power relay [CR-78 (85)→(87)]

- → I/conn [CN-8 (11)] → I/conn [CN-97 (11)] → Multifunction sw left lever [(4)→(3)]
- --- I/conn [CN-97 (9)] --- I/conn [CN-8 (1)]
- ---- Head light high relay [CR-14 (86) $\rightarrow$  (87)] ---- I/conn [CN-8 (7)]
  - Head light ON [CL-3 (2), CL-4 (2)] : Head light high beam ON
- → MCU [CN-51 (37)] → Cluster high bean pilot lamp ON [Via CAN interface]

# (3) Work lamp switch ON :

Work lamp switch ON [CS-116 (2)] → Work lamp relay [CR-3 (85) → (87)] → I/conn [CN-8 (11)] → I/conn [CN-12 (2)] → Work lamp ON [CL-5 (2)] : Work lamp ON

# 2) CHECK POINT

| Engine  | Start switch | Check point                                       | Voltage  |
|---------|--------------|---|----------|
|         |              | ① - GND (fuse box)                                |          |
|         |              | ② - GND (switch power input)                      |          |
| STOP ON |              | ③ - GND (switch power output)                     |          |
|         |              | ④ - GND (head light)                              |          |
|         | ON           | ⑤ - GND (fuse box)                                | 10~12.5V |
|         |              | 6 - GND (head lamp power relay input)             |          |
|         |              | $\bigcirc -$ GND (work lamp relay input)          |          |
|         |              | $\circledast$ - GND (head lamp Lo/Hi relay input) |          |
|         |              | 9 - GND (work light)                              |          |

\* GND : Ground

# HEAD LAMP AND WORK LAMP CIRCUIT



# 5. BEACON LAMP AND CAB LAMP CIRCUIT

#### 1) OPERATING FLOW

Fuse box (No.17) — Beacon lamp relay [CR-85 (30, 86)] Fuse box (No.18) — Cab lamp relay [CR-9 (30, 86)] Fuse box (No.10) — Switch panel [CR-116 (10)]

#### (1) Beacon lamp switch ON

Switch panel [CN-116 (6)]  $\rightarrow$  Beacon lamp relay [CR-85 (85) $\rightarrow$  (87)]  $\rightarrow$  l/conn [CN-6 (5)]  $\rightarrow$  Beacon lamp [CL-7]

#### (2) Cab lamp switch ON

Switch panel [CN-116 (7)] → Cab lamp relay [CR-9 (85)→(87)] → I/conn [CN-6 (8)] → Cab light [CL-9 (2)]

# 2) CHECK POINT

| Engine | Start switch | Check point                                   | Voltage    |
|--------|--------------|---|------------|
| STOP   |              | ① - GND (fuse box)                            |            |
|        |              | 2 - GND (switch power input)                  |            |
|        | ON           | ③ - GND (switch power output)                 | 10, 12.51/ |
|        |              | 4 - GND (beacon & cab lamp relay power input) | 10~12.50   |
|        |              | ⑤ - GND (beacon lamp)                         |            |
|        |              | ⑥ - GND (cab lamp)                            |            |

※ GND : Ground

# BEACON AND CAB LAMP CIRCUIT



HW65AH4EL09

# 6. WIPER AND WASHER CIRCUIT

# 1) OPERATING FLOW

# (1) Key switch ON

Fuse box (No.8) - Wiper motor [CN-21 (3)]

- Int wiper relay [CR-6 (3)]
- --- Wiper relay [CR-4 (86)]
- Wiper relay [CR-4 (87)]
- L- I/conn [CN-4 (34)] -- Washer pump [CN-22 (2)]

Fuse box (No.4) → I/conn [CN-8 (4)] → I/conn [CN-97 (8)] → Multifunction sw [LH lewer (21)]

# (2) Wiper switch ON : 1st step (intermittent)

Multifunction switch left lever (2) → I/conn [CN-98 (5)] → I/conn [CN-4 (13)]

- → Int wiper relay [CR-6 (4)  $\rightarrow$  (2)]
- $\rightarrow$  I/conn [CN-4 (12)]  $\rightarrow$  I/conn [CN-98 (4)]  $\rightarrow$  Multifunction switch left lever (6)  $\rightarrow$  (2)
- --- I/conn [CN98 (2)] --- I/conn [CN-4 (10)]
- $\rightarrow$  Wiper relay [CR-4 (87)  $\rightarrow$  (30)]  $\rightarrow$  Wiper motor [CN-21 (4)] : Wiper motor operating

# (3) Wiper switch ON : 2nd or 3rd step

Multifunction switch left lever (2) --- I/conn [CN-98 (2)] --- I/conn [CN-4 (10)]

- → Wiper relay [CR-4 (85)] : Wiper relay operating → Wiper relay [CR-4 (87)  $\rightarrow$  (30)]
- --- Wiper motor operating [CN-21 (1)] : Wiper motor operating

#### (4) Auto parking (when switch OFF)

Wiper switch OFF Wiper relay OFF

- → Wiper motor [CN-21 (3)  $\rightarrow$  (1)] → Wiper relay [CR4 (87a)  $\rightarrow$  (30)]
- Wiper motor [CN-21 (4)]: Wiper motor parking position

#### (5) Washer switch ON

Multifunction sw left lever (7) — I/conn [CN-98 (8)] → Washer pump [CN-22 (1)] : Washer pump operating Multifunction switch left lever (2) - I/conn [CN-98 (2)] - I/conn [CN-4 (10)]

- → Wiper relay [CR-4 (85)] : Wiper relay operating → Wiper relay [CR-4 (87)  $\rightarrow$  (30)]
- --- Wiper motor operating [CN-21 (1)]: Wiper motor operating

# 2) CHECK POINT

| Engine | Start switch | Check point                   | Voltage   |  |
|--------|--------------|-------------------------------|-----------|--|
| STOP   |              | ① - GND (fuse box)            |           |  |
|        |              | ② - GND (wiper motor)         | 10 10 51/ |  |
|        | ON           | ③ - GND (switch power input)  |           |  |
|        |              | 4 - GND (switch power output) |           |  |

% GND : Ground

#### WIPER AND WASHER CIRCUIT



HW65AH4EL10

# MONITORING CIRCUIT

CN-36 

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 12.1.2.

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 12.2.

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 < FUSE BOX 0.8Br 1.25Gr CAMERA CONTROLLER(RH) CN-9 L.0Gr 0.75F 0.75F 01 IGN 12V 1.0W 0.75Br 2 IGN 12V 0.75Y 0.75Y DIFF\_H(OUT) DIFF\_L(OUT) ha 0.75Or 0.75RW 40 7 0.75L 0.75L 28 GND 5 C D9 NC 0/60 1.0B 0.75BW 0.75RW 0 70 O 26 CAN 2 Hi O 27 CAN 2 Lo 0.75L CN-1 O 28 GND 0.75BW 010 O3 GND 0.8G 0.8R 0.8G 0.8R 20 0.8B 0.8B 100 CN-406 0.8W 0.8W hic 0.8Y 0.8Y 0.8R 0180 0140 015þ 016¢ 0.8G 0.8G 01<u>7</u>d 0210 0220 0230 0.8Or 0.5R 024 0.8L 0.5B 025/C 0.8R 0.8B 0260 ozho 0280 0290 9340 6350 1.0B 0.8B 0360  $\widehat{\mathbb{A}}$ CD-2 0.8B 0.8B FUEL SENDER 0.8YW CD-1 0.8W .8B HYD OIL TEMP CN-249A 0 0 5 O 6 O CD-10 0.8B 0.8B 0.8LW CN-27A AUX L AUX R AUX GND AIR CLEANER SW 0.8LW 0.75Gr 0.75Or 0.75L 0.75B 0.75Gr 0.75Gr 0.75G 0.75Br 0.8W 0.8YW 0.8W P.C. 0.8Gr 0.5B 0.5R 0.8B 0.8Br 0.8B 0.8G 5 0 6 0 8 0 REAR CAMERA 52 0 57 0 57 0 66 0 67 0 CN-56 0 CN-48 2 O 0 0 0 17 O 18 O 19 O 23 O 25 O 40 O 41 O 42 0 55 0 51 0 51 0 4 0 0 0 0 9 **CN-56A** CN-249 ∾ TRAVEL SPEED SOL(DO) Q/COUPLER SOL(DO) NC : SIG POTENTIOMETER SIG(AI) 10. TEMP SENSOR(AI) POWER OUTPUT || || BOOM SWING PS(DI) AIR CLEANER SW(DI ACCEL DIAL SIG(AI) METER OUTPUT PPOGRAM DUMP(D) = = = RS232\_TX(1) J1939 CAN\_Lo(2)C J1938 CAN\_Lo(2)C GND\_SENSOR = = O CRUISE SELECT S / 1 FUEL SENDER(AI) // ;;; || т CRUISE SOL(DO) BATTERY 12V POWER\_IG NTSC+ GND NTSC-6.5V POWER IG CAN LO MAIN GND AUX GND AUX\_R AUX\_L 6.5V GND HOUR METER CAN H CAM1 CAM1 CAM2 CAM3 GND NTSC NTSC CAM 6 ΏΗ CLUSTER MCU

HW65AH4EL11

# **ILLUMINATION CIRCUIT**



HW65AH4EL12

# COMBINATION LAMP CIRCUIT

CN-36



HW65AH4EL13

# ELECTRIC CIRCUIT FOR HYDRAULIC



# GROUP 4 ELECTRICAL COMPONENT SPECIFICATION

| Part name                           | Symbol        | Specification  | Check   |
|-------------------------------------|---------------|--|---|
| Battery                             |               | 12V $	imes$ 100Ah  | <ul> <li>Check specific gravity</li> <li>1.280 over : Over charged</li> <li>1.280 ~ 1.250 : Normal</li> <li>1.250 below : Recharging</li> </ul> |
| Battery relay                       | CR-1          | Rated load : 12V<br>100A (continuity)<br>1000A (30 second) | <ul> <li>* Check coil resistance<br/>Normal : about 12Ω</li> <li>* Check contact<br/>Normal : ∞ Ω</li> </ul>                                    |
| Start switch                        | CS-2          | 12V  | * Check contact<br>OFF : ∞ Ω (for each terminal)<br>ON : 0 Ω (for terminal 1-3 and 1-2)<br>START : 0 Ω (for terminal 1-6)                       |
| Pressure switch<br>(for engine oil) | V 0<br>0<br>P | 0.5 kgf/cm <sup>2</sup><br>(N.C TYPE)                      | _   |
| Hydraulic<br>temperature<br>sensor  | CD-1          | -  | <ul> <li>* Check resistance</li> <li>50°C : 804 Ω</li> <li>80°C : 310 Ω</li> <li>100°C : 180 Ω</li> </ul>                                       |
| Coolant<br>temperature<br>sensor    | t°C<br>V      |  | <ul> <li>* Check resistance</li> <li>50°C : 804 Ω</li> <li>80°C : 310 Ω</li> <li>100°C : 180 Ω</li> </ul>                                       |

| Part name                       | Symbol  | Specification                       | Check  |
|---------------------------------|---|-------------------------------------|--|
| Air cleaner<br>pressure switch  | Pa<br>  | Pressure:<br>635mmH2O<br>(N.O TYPE) | <b>※ Check contact</b><br>Normal : ∞ Ω   |
| Fuel sender                     | 020<br>000<br>CD-2  | -                                   | <ul> <li>Check resistance</li> <li>Full : 100 Ω</li> <li>Low : 500 Ω</li> <li>Empty warning :700 Ω</li> </ul>  |
| Relay                           | 86       30       87a         86       30       85         87       86         86       87         86       87         86       87         86       87         86       87         86       87         86       87         86       87         86       87         86       87         86       87         86       87         86       87         86       87         86       87         87       87         86       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87         87       87 <t< td=""><td>12V 20A</td><td><ul> <li>Check resistance</li> <li>Normal : About 200 Ω</li> <li>(for terminal 85-86)</li> <li: (for="" 0="" 30-87a)<="" li="" terminal="" ω=""> </li:></ul></td></t<> | 12V 20A                             | <ul> <li>Check resistance</li> <li>Normal : About 200 Ω</li> <li>(for terminal 85-86)</li> <li: (for="" 0="" 30-87a)<="" li="" terminal="" ω=""> </li:></ul> |
| Relay<br>(start,<br>air heater) | ○ 87<br>○ 30<br>○ 86<br>○ 86<br>○ 85<br>87<br>85<br>CR-23<br>CR-24<br>30<br>86<br>○<br>86<br>○<br>87<br>85<br>87<br>85<br>85  | 12V 70A                             | ※ Rated coil current 1.2±0.3A  |
| Solenoid valve                  | CN-66 CN-66P CN-68<br>CN-69 CN-70 CN-71<br>CN-122 CN-123 CN-140<br>CN-246   | 12V 1A                              | * Check resistance<br>Normal : 15~25 Ω<br>(for terminal 1-2)   |
| Speaker                         | 20<br>10<br>CN-23(LH)<br>CN-24(RH)  | 4Ω 20W                              | <b>*</b> Check resistance<br>Normal : 4 $\Omega$   |

| Part name                  | Symbol  | Specification         | Check  |
|----------------------------|---|-----------------------|--|
| Travel alarm select switch | 8 3 1 6 4<br>7 2 5<br>1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 12V 16A               | <ul> <li>* Check contact<br/>Normal</li> <li>OFF - ∞ Ω (for terminal 2-1, 5-4)</li> <li>- 0 Ω (for terminal 2-3, 5-6)</li> </ul> |
| Work lamp                  | CL-5 CL-9   | 12V LED<br>(ABL type) | * Check disconnection<br>Normal : A few Ω  |
| Room lamp                  | CL-1  | 12V 10W               | * Check disconnection<br>Normal : A few Ω  |
| Fuel filler pump           | M<br>CN-61  | 12V<br>35 ℓ /min      | * Check operation<br>Supply power(for terminal 1) : 12V  |
| Fuel feed pump             | M<br>2 O<br>CN-145  | 12V                   | -  |
| Horn                       | CN-20 CN-25   | 12V                   | 100±5dB  |

| Part name       | Symbol   | Specification                   | Check  |
|-----------------|--|---------------------------------|--|
| Safety switch   | $\begin{array}{c c} 1 \\ 0 \\ 2 \\ 0 \\ 3 \\ 4 \\ 0 \\ - 1 \\$ | Micro                           | ※ Check contact<br>Normal : ∞ Ω (for terminal 1-2, 3-4)  |
| Reverse lamp    | CL-15A CL-16A  | 12V                             | ※ Check disconnection.<br>Normal : A few Ω   |
| Pressure sensor | CD-3 CD-4 CD-7<br>CD-31 CD-32 CD-38<br>CD-42 CD-73   | 8-30V                           | * Check contact<br>Normal : 0.1 Ω  |
| Beacon lamp     | ○ 2<br>○ 1 ○ M<br>○ 1<br>CL-7  | 12V LED (17W)<br>(Double flash) | ※ Check disconnection<br>Normal : A few Ω  |
| Cruise switch   | CS-23 CS-67  | 12V 16A                         | * Check contact<br>Normal<br>OFF - $\infty \Omega$ (for terminal 2-3, 5-6)<br>- $0 \Omega$ (for terminal 2-1, 5-4) |
| Ram lock switch | CS-104   | 12V 16A                         | <ul> <li>* Check contact</li> <li>Normal</li> <li>OFF - ∞ Ω (for terminal</li> <li>2-1, 2-3, 5-4, 5-6)</li> </ul>  |

| Part name             | Symbol   | Specification | Check   |
|-----------------------|--|---------------|---|
| Washer pump           | M<br>20<br>10<br>CN-22   | 12V 3.8A      | Check contact<br>Normal : 3Ω (for terminal 1-2)   |
| USB charger           | ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ←  | 12V 3.1A      | <ul> <li>Check coil resistance<br/>Normal : About 1MΩ</li> <li>Check contact<br/>Normal : ∞ Ω<br/>Operating time : 5~15sec</li> </ul> |
| Wiper motor           | $ \begin{array}{c}                                     $   | 12V 3A        | * Check contact<br>Normal : 6 Ω (for terminal 2-6)  |
| Int wiper relay       | CR-6   | 12V 12A       | _   |
| Radio & USB<br>player | USB_5V       0       1         USB_D-       2       0         USB_D+       3       0         USB_GND       4       0         N.C       5       0         AUX_L       6       0         AUX_R       7       0         AUX_GND       8       0 | 12V 3A        | <ul> <li>Check voltage</li> <li>10 ~ 12.5V</li> <li>(for terminal 10-14,11-14)</li> </ul>   |
| Receiver dryer        | ○ 2 Pa<br>○ 1  | 12V           | % Check contact<br>Normal :<br>- OFF : $\infty \Omega$ (for terminal 1-2)   |

| Part name         | Symbol                     | Specification  | Check   |
|-------------------|----------------------------|--|---|
| Starter           |                            | 12V 2.5kW  | ※ Check contact<br>Normal : 0.1 Ω   |
| Alternator        | CN-74                      | 12V 100A   | ※ Check contact<br>Normal : 0 Ω (for terminal B-L)<br>Normal : 10 ~ 12.5V |
| Travel buzzer     |                            | 12V  | -   |
| MAP sensor        | CD-158A                    | 5V   | -   |
| Air con<br>blower |                            | 12V 8.5A   | -   |
| Maxi fuse         | CN-60 CN-62<br>CN-95 CN-96 | 12V, 50A (CN-96)<br>12V, 60A (CN-60, 62)<br>12V, 80A (CN-95) | -   |

| Part name                           | Symbol  | Specification          | Check   |
|-------------------------------------|---|------------------------|---|
| Rear<br>combination<br>lamp-LH, RH  | O 4 Ø TU ⊗<br>3 O TA<br>2 O BK<br>0 1 €H €<br>CL-15 CL-16   | 12V 21W×2<br>12V 21/5W | * Normal : 4.8 $\Omega$<br>(for terminal 1-4)<br>Normal : 2.1 $\Omega$<br>(for terminal 2-4, 4-5, 4-6)  |
| Front<br>combination<br>lamp-LH, RH | E 1 0<br>C 2 T<br>T 3 0<br>CL-24 CL-25  | 12V 21W<br>12V 5W      | * Normal : 4.8 $\Omega$<br>(for terminal 1-2)<br>Normal : 2.1 $\Omega$<br>(for terminal 2-3)  |
| Head lamp<br>-LH, RH                | $ \begin{array}{c c}     0, 1 & Lo \\     0, 2 & Hi \\     0, 3 & E \\     \hline     CL-3 & CL-4 \end{array} $ | 12V 60/55W             | * Normal : 1.0Ω<br>(for terminal 1-3, 2-3)<br>Normal : 1.5Ω<br>(for terminal 1-2)   |
| Master switch                       | CS-74A  | 12V 1000A              | -   |
| Glow plug                           |   | -                      | -   |
| Accel dial                          | O A O +<br>B O S<br>O C Q -<br>CN-142   | -                      | <ul> <li>※ Check resistance<br/>Normal : about 5k Ω<br/>(for terminal A-C)</li> <li>※ Check voltage<br/>Normal : about 5V<br/>(for terminal A-C)<br/>: 2-4.5V<br/>(for terminal C-B)</li> </ul> |

| Part name                 | Symbol   | Specification | Check   |
|---------------------------|--|---------------|---|
| EPPR vlave                | 2<br>1<br>A1, A2, A3, A4                               | -             | -   |
| 12V socket                | 02<br>01<br>CN-139                                     | 12V 120W      | -   |
| Fuel pump<br>switch       | CS-16  | -             | -   |
| Resistor                  | 0 1<br>0 2<br>RS-1                                     | 1W 47Ω        | * Check resistance<br>A-B: 47 Ω   |
| Relay<br>(air con blower) | $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 12V 20A       | ※ Check resistance<br>Normal : About 200 Ω<br>(for terminal 1-3)<br>0 Ω<br>(for terminal 2-4) |
| New MP3<br>radio          | CN-52  | 12V 2A        | % Check voltage<br>10~16V<br>(for terminal 1-3, 3-8)  |

| Part name             | Symbol  | Specification        | Check  |
|-----------------------|---|----------------------|--|
| Quick clamp<br>buzzer | 010<br>20<br>CN-113   | 12V 60mA<br>65dB Min | -  |
| DPF switch            | <sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup><br><sup>10</sup> | 12V 16A              | <ul> <li>※ Check resistance<br/>Normal<br/>OFF -∞ Ω (for terminal<br/>2-1, 2-3, 5-4, 5-6)</li> </ul> |
# **GROUP 5 CONNECTORS**

# **1. CONNECTOR DESTINATION**

| Connector | Туро    | No. of           | Destination                              | Connecto     | or part No.  |
|-----------|---------|------------------|--|--------------|--------------|
| number    | туре    | pin              | Destination                              | Female       | Male         |
| CN-1      | AMP     | 36               | I/conn (Main harness-Cab room harness)   | 1743059-2    | 1743062-2    |
| CN-4      | AMP     | 36               | I/conn (Cab room harness-Main harness)   | 1743059-2    | 1743062-2    |
| CN-6      | AMP     | 16               | I/conn (Frame harness-Cabin harness)     | 368047-1     | 368050       |
| CN-7      | AMP     | 16               | I/conn (Main harness-Console harness)    | 368047-1     | 368050       |
| CN-7A     | AMP     | 12               | I/conn (Main harness-Console harness)    | 174661-2     | -            |
| CN-8      | AMP     | 12               | I/conn (Cab room harness-Cab harness)    | 174661-2     | S816-112002  |
| CN-9      | AMP     | 12               | I/conn (Cab room harness-AAVM harness)   | 174655-2     | 174657-2     |
| CN-11     | DEUTSCH | 8                | I/conn (Cab room harness-Aircon harness) | DT06-8S-EP06 | -            |
| CN-12     | AMP     | 2                | I/conn (Main harness-Boom harness)       | S816-002002  | S816-102002  |
| CN-13     | KET     | 2                | Master switch                            | S813-030201  | MG620558-5   |
| CN-14     | KET     | 2                | Earth                                    | MG610557     | MG620558     |
| CN-16     | AMP     | 6                | Emergency engine start                   | S816-006002  | S816-106002  |
| CN-16A    | AMP     | 6                | Emergency engine start                   | S816-006002  | -            |
| CN-18     | AMP     | 16               | I/conn (Main harness-Cab room harness)   | 368047-1     | 368050-1     |
| CN-19     | AMP     | 10               | Cabin lamp                               | 174655-2     | 174657-2     |
| CN-20     | DEUTSCH | 2                | Horn                                     | DT06-2S-EP06 | -            |
| CN-21     | -       | 4                | Wiper motor                              | 180900-0     | -            |
| CN-22     | KET     | 2                | Washer tank                              | MG640605     | -            |
| CN-23     | KET     | 2                | Speaker LH                               | MG610070     | -            |
| CN-24     | KET     | 2                | Speaker RH                               | MG610070     | -            |
| CN-25     | DEUTSCH | 2                | Horn                                     | DT06-2S-EP06 | -            |
| CN-27     | -       | 16               | Radio/USB player                         | PK145-16017  | -            |
| CN-27A    | -       | 8                | Radio/USB player                         | -            | S816-108002  |
| CN-29     | KET     | 2                | Receiver dryer                           | MG640795     | -            |
| CN-36     | -       | -                | Fuse box                                 | 21MN-55010   | -            |
| CN-41A    | DELPHI  | 2                | Fuse heater                              | 15300027     | -            |
| CN-41B    | DELPHI  | 2                | Fuse heater                              | 15300027     | -            |
| CN-45     | MOLEX   | <b>RING TERM</b> | Starter                                  | MK238-10     | -            |
| CN-48     | -       | 3                | Hour meter                               | -            | -            |
| CN-51     | AMP     | 70               | MCU                                      | 1-968879-1   | -            |
| CN-56     | AMP     | 8                | Cluster                                  | -            | S816-106002  |
| CN-56A    | AMP     | 8                | Cluster                                  | 174982-2     | -            |
| CN-60     | MTA     | 2                | Maxi fuse assy                           | 21K6-03270   | 03.01060     |
| CN-61     | DEUTSCH | 2                | Fuel filler pump                         | DT06-2S-EP06 | DT04-2P-E005 |
| CN-62     | MTA     | 2                | Maxi fuse assy                           | 21K6-03270   | 03.01060     |
| CN-66     | DEUTSCH | 2                | Breaker solenoid                         | DT06-2S-EP06 | DT04-2P-E005 |
| CN-66P    | DEUTSCH | 2                | 2-way/breaker select solenoid            | DT06-2S-EP06 | DT04-2P-E005 |
| CN-68     | DEUTSCH | 2                | Safety solenoid                          | DT06-2S-EP06 | -            |

| Connector | Туре    | No. of           | Destination                              | Connector part No. |                |
|-----------|---------|------------------|--|--------------------|----------------|
| number    | туре    | pin              | Destination                              | Female             | Male           |
| CN-69     | DEUTSCH | 2                | Ram lock solenoid                        | DT06-2S-EP06       | -              |
| CN-70     | DEUTSCH | 2                | Travel solenoid                          | DT06-2S-EP06       | -              |
| CN-71     | DEUTSCH | 2                | Parking solenoid                         | DT06-2S-EP06       | -              |
| CN-74     | DONGA   | <b>RING TERM</b> | Alternator                               | S820-408000        | -              |
| CN-75     | DEUTSCH | 2                | Main pump EPPR                           | DT06-2S-EP06       | DT04-2P-E005   |
| CN-80     | YAZAKI  | 1                | Air heater                               | 7323-3010          | -              |
| CN-81     | DEUTSCH | 2                | Travel buzzer                            | DT06-2S-EP06       | DT04-2P-E005   |
| CN-94     | BOSCH   | 91               | ECU                                      | 1 928 405 452      | -              |
| CN-95     | KET     | 2                | Fusible link                             | 21K6-03270         | 03.01050       |
| CN-96     | MTA     | 2                | Maxi fuse assy                           | 21K6-03270         | 03.01050       |
| CN-97     | AMP     | 12               | Multifunction switch                     | S816-012002        | S816-112002    |
| CN-98     | AMP     | 10               | Multifunction switch                     | S816-010002        | S816-110002    |
| CN-99     | AMP     | 8                | Multifunction switch                     | S816-008002        | S816-108002    |
| CN-100    | KET     | 1                | ECU ground                               | MG640944-5         | -              |
| CN-113    | -       | 2                | Buzzer                                   | S810-002202        | -              |
| CN-116    | AMP     | 12               | Switch panel                             | 368542-1           | -              |
| CN-122    | DEUTSCH | 2                | Forward solenoid                         | DT06-2S-EP06       | -              |
| CN-123    | DEUTSCH | 2                | Reverse solenoid                         | DT06-2S-EP06       | -              |
| CN-125A   | DEUTSCH | 12               | RMCU                                     | DT06-126-P021      | DT04-12PA-P021 |
| CN-126    | DEUTSCH | 4                | RS232                                    | DT06-4S-EP06       | DT06-4P        |
| CN-139    | AMP     | 2                | 12V socket                               | 172434-2           | -              |
| CN-140    | DEUTSCH | 2                | Quick clamp solenoid                     | DT06-2S-EP06       | DT04-2P-E005   |
| CN-142    | DEUTSCH | 3                | Accel dial                               | DT06-3S-EP06       | -              |
| CN-142A   | DEUTSCH | 2                | Accel dial indicator                     | 174352-2           | -              |
| CN-145    | DEUTSCH | 2                | Fuel feed pump                           | DT06-2S-EP06       | -              |
| CN-148    | DEUTSCH | 6                | Service tool                             | DT06-6S-EP06       | DT04-6P-E005   |
| CN-157    | -       | 1                | Antena power                             | S822-014000        | -              |
| CN-170    | PACKARD | 2                | Seat heat switch                         | 12052641           | -              |
| CN-240    | DEUTSCH | 3                | 4-way/boom swing switch                  | DT06-3S-E006       | -              |
| CN-240A   | DEUTSCH | 2                | Horn switch                              | -                  | DT04-2P-E005   |
| CN-240B   | DEUTSCH | 2                | Swing/rotating select switch             | DT06-2S-E006       | -              |
| CN-240C   | DEUTSCH | 1                | Ram lock switch                          | -                  | ST750036-3     |
| CN-241    | DEUTSCH | 3                | 2-way/clamp switch                       | DT06-3S-EP06       | -              |
| CN-241A   | DEUTSCH | 2                | 2-way/clamp switch                       | -                  | DT04-2P-E005   |
| CN-241B   | DEUTSCH | 2                | 2-way/clamp switch                       | DT06-2S-EP06       | -              |
| CN-241C   | -       | 1                | 2-way/clamp switch                       | DT06-3S-EP06       | -              |
| CN-246    | DEUTSCH | 2                | Cruise solenoid                          | -                  | ST750036-3     |
| CN-247    | AMP     | 1                | USB charger                              | 171809             | -              |
| CN-249A   | AMP     | 6                | Rear camera                              | DT06-6S-EP06       | DT04-6P-E005   |
| CN-264    | DEUTSCH | 8                | l/conn (RH console harness-Main harness) | DT06-8S            | DT04-8P-E004   |

| Connector  | Type    | No. of    | Destination                   | Connector part No. |               |
|------------|---------|-----------|-------------------------------|--------------------|---------------|
| number     |         | pin       | Destination                   | Female             | Male          |
| CN-305     | DEUTSCH | 12        | AVCU                          | DTM-06-12SA        | -             |
| CN-306     | DEUTSCH | 12        | AVCU                          | DTM-06-12SB        | -             |
| CN-307     | DEUTSCH | 3         | Service tool                  | DT06-3S-EP06       | DT04-2P-E005  |
| CN-403     | DEUTSCH | 6         | Front camera                  | DT06-6S-EP06       | DT04-6P-E005  |
| CN-404     | DEUTSCH | 6         | LH camera                     | DT06-6S-EP06       | DT04-6P-E005  |
| CN-427     | -       | 12        | Smart key reader              | 5559-12R           | 5559-12P      |
| CN-542     | DEUTSCH | 6         | Service tool (ECU)            | DT06-6S-EP06       | DT04-6P-E005  |
| CN-641     | KET     | 3         | Button key                    | MG641035           | -             |
| CN-641B    | KET     | 3         | Button key-input              | MG651032           | -             |
| CN-A1      | DEUTSCH | 2         | EPPR- Rotate or boom swing RH | DT06-2S-EP06       | -             |
| CN-A2      | DEUTSCH | 2         | EPPR- Rotate or boom swing LH | DT06-2S-EP06       | -             |
| CN-A3      | DEUTSCH | 2         | EPPR- Release or breaker      | DT06-2S-EP06       | -             |
| CN-A4      | DEUTSCH | 2         | EPPR- Clamp                   | DT06-2S-EP06       | -             |
| CN-INTER 1 | KET     | 1         | Inter connection 1            | -                  | MG643800      |
| CN-INTER 2 | KET     | 6         | Inter connection 2            | -                  | MG610513      |
| CN-INTER 3 | DEUTSCH | 12        | Inter connection 3            | -                  | DT04-12P-E005 |
| · LAMP     |         |           |                               |                    |               |
| CL-1       | KET     | 2         | Room lamp                     | MG610392           | -             |
| CL-2       | AMP     | 3         | Cigar lighter                 | S810-003201        | -             |
| CL-3       | KET     | 3         | Head lamp                     | S810-003702        | -             |
| CL-4       | KET     | 3         | Head lamp                     | S810-003702        | -             |
| CL-5       | DEUTSCH | 2         | Work lamp                     | DT06-2S-EP06       | -             |
| CL-7       | DEUTSCH | 2         | Beacon lamp                   | DT06-2S-EP06       | DT04-2P-E005  |
| CL-9       | DEUTSCH | 2         | Cabin lamp                    | DT06-2S-EP06       | DT04-2P-E005  |
| CL-10      | DEUTSCH | 2         | Cabin lamp                    | DT06-2S-EP06       | DT04-2P-E005  |
| CL-15      | AMP     | 4         | Rear combination lamp-LH      | 282088-1           | -             |
| CL-15A     | AMP     | 2         | Reverse lamp                  | 282080-1           | -             |
| CL-16      | AMP     | 4         | Rear combination lamp-RH      | 282088-1           | -             |
| CL-16A     | AMP     | 2         | Reverse lamp                  | 282080-1           | -             |
| CL-21      | AMP     | 2         | Number plate lamp             | 174463-1           | 174460-1      |
| CL-21A     | KET     | 1         | Licence lamp                  | ST30057-2          | -             |
| CL-21B     | KET     | 1         | Licence lamp                  | ST30057-2          | -             |
| CL-24      | KET     | 3         | Front combination lamp-LH     | S814-003001        | -             |
| CL-25      | KET     | 3         | Front combination lamp-RH     | S814-003001        | -             |
| · RELAY    |         | 1         |                               | I                  |               |
| CR-1       | DONGA   | RING TERM | Battery relay (IG)            | S820-408000        | -             |
| CR-1       | AMP     | 2         | Battery relay                 | S816-002002        | S816-102002   |
| CR-1       | DONGA   | RING TERM | Battery relay (B+)            | S820-408000        | -             |
| CR-2       | HELLA   | 5         | Horn relay                    | SJA003526-001      | -             |
| CR-3       | HELLA   | 5         | Work lamp relay               | SJA003526-001      | -             |

| Connector | Type    | No. of | Destination                   | Connector part No. |              |
|-----------|---------|--------|-------------------------------|--------------------|--------------|
| number    | number  |        | Destination                   | Female             | Male         |
| CR-4      | HELLA   | 5      | Wiper relay                   | SJA003526-001      | -            |
| CR-5      | HELLA   | 5      | Anti-restart relay            | SJA003526-001      | -            |
| CR-6      | KET     | 4      | Int wiper relay               | MG652999           | -            |
| CR-7      | HELLA   | 5      | Aircon comp relay             | SJA003526-001      | -            |
| CR-9      | HELLA   | 5      | Cabin lamp relay              | SJA003526-001      | -            |
| CR-11     | AMP     | 3      | Flasher unit relay            | 180913             | -            |
| CR-13     | HELLA   | 5      | Head lamp low relay           | SJA003526-001      | -            |
| CR-14     | HELLA   | 5      | Head lamp high relay          | SJA003526-001      | -            |
| CR-23     | KET     | 4      | Start relay                   | MG612017-5         | -            |
| CR-24     | KET     | 4      | Air heater relay              | MG612017-5         | -            |
| CR-29     | HELLA   | 5      | Forward relay                 | SJA003526-001      | -            |
| CR-30     | HELLA   | 5      | Reverse relay                 | SJA003526-001      | -            |
| CR-36A    | HELLA   | 4      | Pre-heater relay              | SJA003526-001      | -            |
| CR-38     | HELLA   | 5      | Neutral relay                 | SJA003526-001      | -            |
| CR-45     | HELLA   | 5      | ECU power relay               | SJA003526-001      | -            |
| CR-63     | HELLA   | 5      | Stop lamp relay               | SJA003526-001      | -            |
| CR-66     | HELLA   | 5      | Parking relay                 | SJA003526-001      | -            |
| CR-67     | CARLING | 10     | Quick coupler relay           | VC2-01             | -            |
| CR-68     | AMP     | 5      | Safety solenoid relay         | S816-002002        | -            |
| CR-75     | HELLA   | 5      | Illumination relay            | SJA003526-001      | -            |
| CR-78     | HELLA   | 5      | Head lamp relay               | SJA003526-001      | -            |
| CR-85     | HELLA   | 5      | Beacon lamp relay             | SJA003526-001      | -            |
| CR-93     | HELLA   | 5      | Travel relay                  | SJA003526-001      | -            |
| CR-385    | HELLA   | 5      | Start limit relay             | SJA003526-001      | -            |
| · SENDEF  | 1       |        |                               |                    |              |
| CD-1      | AMP     | 2      | Hydraulic temp sender         | 85202-1            | -            |
| CD-2      | AMP     | 2      | Fuel sender                   | -                  | S816-102002  |
| CD-3      | DEUTSCH | 3      | Brake oil pressure switch     | DT06-3S-EP06       | -            |
| CD-4      | DEUTSCH | 3      | Stop lamp pressure switch     | DT06-3S-EP06       | -            |
| CD-7      | DEUTSCH | 3      | Working pressure switch       | DT06-3S-EP06       | -            |
| CD-10     | AMP     | 2      | Air cleaner switch            | 85202-1            | -            |
| CD-31     | DEUTSCH | 3      | Overload pressure switch      | DT06-3S-EP06       | DT04-3P-E005 |
| CD-32     | DEUTSCH | 3      | Boom up pressure switch       | DT06-3S-EP06       | -            |
| CD-38     | DEUTSCH | 3      | Working brake pressure switch | DT06-3S-EP06       | -            |
| CD-42     | DEUTSCH | 3      | P1 pump pressure switch       | DT06-3S-EP06       | -            |
| CD-45     | DEUTSCH | 2      | WIF switch                    | DT06-2S-EP06       | -            |
| CD-73     | DEUTSCH | 3      | Forward pressure switch       | DT06-3S-EP06       | -            |
| CD-158A   | AMP     | 4      | MAF sensor                    | 1-1718645-1        | 1-1564559-1  |

| Connector | Tupo      | No. of | o. of Destination          | Connector part No. |              |  |  |
|-----------|-----------|--------|----------------------------|--------------------|--------------|--|--|
| number    | nber Type |        | Destination                | Female             | Male         |  |  |
| · SWITCH  | · SWITCH  |        |                            |                    |              |  |  |
| CS-2      | KET       | 6      | Start key switch           | S814-006000        | -            |  |  |
| CS-2B     | DEUTSCH   | 3      | BKCU (CAN)                 | DT06-3S-EP06       | DT04-3P-E005 |  |  |
| CS-4      | AMP       | 3      | Safety switch              | 174257-2           | -            |  |  |
| CS-4A     | -         | 4      | Safety switch              | -                  | 174259-2     |  |  |
| CS-16     | KET       | 2      | Fuel pump switch           | 174352-2           | 174354-2     |  |  |
| CS-23     | CALING    | 10     | Auto cruise switch         | VC2-01             | -            |  |  |
| CS-26A    | AMP       | 2      | Foot pedal                 | 174352-2           | S816-103002  |  |  |
| CS-50     | CARLING   | 10     | Overload switch            | VC2-01             | -            |  |  |
| CS-52     | CARLING   | 10     | Travel alarm select switch | VC2-01             | -            |  |  |
| CS-67     | CARLING   | 10     | Quick clamp switch         | VC2-01             | -            |  |  |
| CS-74     | -         | 2      | Master switch              | MG620557           | -            |  |  |
| CS-100    | CARLING   | 10     | DPF switch                 | VC2-01             | -            |  |  |
| CS-104    | CARLING   | 10     | Ram lock switch            | VC2-01             | -            |  |  |
| CS-250    | DEUTSCH   | 2      | Seat belt alarm            | DT06-2S-EP06       | DT04-2P-E005 |  |  |
| · DIODE   |           |        |                            |                    |              |  |  |
| DO-1      | AMP       | 2      | Diode (alternator)         | S816-002002        | 21EA-50550   |  |  |
| DO-2      | AMP       | 2      | Diode (fuel feed pump)     | S816-002002        | 21EA-50550   |  |  |
| DO-3      | AMP       | 2      | Diode (neutral)            | S816-002002        | 21EA-50550   |  |  |
| DO-3      | AMP       | 2      | Diode (MCU)                | S816-002002        | 21EA-50550   |  |  |
| DO-3A     | AMP       | 2      | Diode (MCU)                | S816-002002        | 21EA-50550   |  |  |
| DO-4      | AMP       | 2      | Diode (battery relay)      | S816-002002        | 21EA-50550   |  |  |
| DO-17     | AMP       | 2      | Diode (travel)             | 174352-2           | 21EA-50570   |  |  |
| DO-18     | AMP       | 2      | Diode (travel)             | 174352-2           | 21EA-50570   |  |  |
| DO-19     | AMP       | 2      | Diode (travel)             | 174352-2           | 21EA-50570   |  |  |
| DO-20     | AMP       | 2      | Diode (2way/breaker)       | S816-002002        | 21EA-50550   |  |  |

# 2. CONNECTION TABLE FOR CONNECTORS

# 1) PA TYPE CONNECTOR





# 2) J TYPE CONNECTOR



# 3) SWP TYPE CONNECTOR





# 4) CN TYPE CONNECTOR





#### 5) 375 FASTEN TYPE CONNECTOR



#### 6) AMP ECONOSEAL CONNECTOR



#### 7) AMP TIMER CONNECTOR



#### 8) AMP 040 MULTILOCK CONNECTOR



#### 9) AMP 070 MULTILOCK CONNECTOR



#### 10) AMP FASTIN - FASTON CONNECTOR



# 11) KET 090 CONNECTOR

| No. of<br>pin | Connector (female) | Connector (male) |
|---------------|--------------------|------------------|
| 2             |                    |                  |
|               | MG610070           |                  |

# 12) KET 090 WP CONNECTORS

| No. of<br>pin | Connector (female) | Connector (male) |
|---------------|--------------------|------------------|
| 2             | 1<br>2<br>MG640605 |                  |
| 2             | 1<br>2<br>MG640795 |                  |

# 13) KET SDL CONNECTOR

| No. of<br>pin | Connector (female) | Connector (male) |
|---------------|--------------------|------------------|
| 14            | исе10406           |                  |
|               | MG610406           |                  |

#### 14) DEUTSCH DT CONNECTORS



- Modification
  - E003 : Standard end cap gray
  - E004 : Color of connector to be black
  - E005 : Combination E004 & E003
  - EP04 : End cap
  - EP06 : Combination P012 & EP04

P012 : Front seal enhancement - connectors color to black for 2, 3, 4 & 6pin





# 15) MOLEX 2CKTS CONNECTOR

| No. of<br>pin | Connector (female) | Connector (male) |
|---------------|--------------------|------------------|
| 2             |                    |                  |
|               | 35215-0200         |                  |

# 16) ITT SWF CONNECTOR



# 17) MWP NMWP CONNECTOR

| No. of<br>pin | Connector (female) | Connector (male) |
|---------------|--------------------|------------------|
| 1             | 1                  |                  |
|               | NMWP01F-B          |                  |

# GROUP 6 FAULT CODES

# 1. MACHINE FAULT CODE

| Fault code |     | Description   |  |  |
|------------|-----|---|--|--|
| HCESPN     | FMI | Description   |  |  |
| 101        | 3   | Hydraulic oil temperature sensor circuit - voltage above normal or shorted to high source (or open circuit) |  |  |
|            | 4   | Hydraulic oil temperature sensor circuit - voltage below normal or shorted to low source                    |  |  |
|            | 0   | Working pressure sensor data above normal range (or open circuit)   |  |  |
| 105        | 1   | Working pressure sensor data below normal range   |  |  |
| 105        | 2   | Working pressure sensor data error  |  |  |
|            | 4   | Working pressure sensor circuit - voltage below normal, or shorted to low source                            |  |  |
|            | 0   | Travel oil pressure sensor data above normal range (or open circuit)  |  |  |
| 100        | 1   | Travel oil pressure sensor data below normal range  |  |  |
| 100        | 2   | Travel oil pressure sensor data error   |  |  |
|            | 4   | Travel oil pressure sensor circuit - voltage below normal or shorted to low source                          |  |  |
|            | 0   | Overload pressure sensor data above normal range (or open circuit)  |  |  |
| 100        | 1   | Overload pressure sensor data below normal range  |  |  |
| 122        | 2   | Overload pressure sensor data error   |  |  |
|            | 3   | Overload pressure sensor circuit - voltage below normal or shorted to low source                            |  |  |
| 201        | 3   | Fuel level sensor circuit - voltage above normal or shorted to high source (or open circuit)                |  |  |
| 301        | 4   | Fuel level sensor circuit - voltage below normal or shorted to low source                                   |  |  |
|            | 0   | Brake pressure sensor data above normal range (or open circuit)   |  |  |
| 502        | 1   | Brake pressure sensor data below normal range   |  |  |
| 503        | 2   | Brake pressure sensor data error  |  |  |
|            | 4   | Brake pressure sensor data - voltage below normal or shorted to low source                                  |  |  |
|            | 0   | Working brake pressure sensor data above normal range (or open circuit)                                     |  |  |
| 505        | 1   | Working brake pressure sensor data below normal range   |  |  |
| 505        | 2   | Working brake pressure sensor data error  |  |  |
|            | 4   | Working brake pressure sensor circuit - voltage below normal, or shorted to low source                      |  |  |
|            | 0   | Travel fwd pilot pressure sensor data above normal range (or open circuit)                                  |  |  |
|            | 1   | Travel fwd pilot pressure sensor data below normal range  |  |  |
| 530        | 2   | Travel fwd pilot pressure sensor data error   |  |  |
| 500        | 4   | Travel fwd pilot pressure sensor circuit - voltage below normal, or shorted to low source                   |  |  |
|            | 14  | Travel fwd pilot pressure sensor circuit - special instructions   |  |  |
|            | 16  | Travel fwd pilot pressure sensor circuit - voltage valid but above normal operational range                 |  |  |
| 701        | 4   | Hour meter circuit - voltage below normal, or shorted to low source   |  |  |
| 705        | 0   | MCU input voltage high  |  |  |
| /00        | 1   | MCU input voltage low   |  |  |
| 707        | 1   | Alternator node I voltage low (or open circuit)   |  |  |
| 714        | 3   | Acc. dial circuit - voltage above normal, or shorted to high source (or open circuit)                       |  |  |
|            | 4   | Acc. dial circuit - voltage below normal, or shorted to low source  |  |  |
| 840        | 2   | Cluster communication data error  |  |  |
| 841        | 2   | ECM communication data error  |  |  |
| IDSP       |     | Water in fuel warning   |  |  |
| Lo bat     |     | Low battery warning   |  |  |

# 2. ENGINE FAULT CODE

| Fault code |     |  |  |
|------------|-----|--|--|
| SPN        | FMI | Description  |  |
| 0          | 19  | Timeout Error of CAN-Receive-Frame TSC1VE (Engine speed & Torque demand)                   |  |
| 27         | 0   | EGR Position Open jammed fault   |  |
| 27         | 1   | EGR Position Closed jammed fault   |  |
| 27         | 3   | EGR Position Sensor High Fault   |  |
| 27         | 4   | EGR Position Sensor Low Fault  |  |
| 27         | 20  | EGR Close Position Learning Range Over Fault   |  |
| 27         | 22  | EGR Close Position Learning Drift Fault for long time                                      |  |
| 27         | 23  | EGR Close Position Learning Drift Fault for short time                                     |  |
| 29         | 3   | Accel pedal position track2 sensor High fault  |  |
| 29         | 4   | Accel pedal position track2 sensor Low fault   |  |
| 29         | 15  | Hand pedal position track2 sensor High fault   |  |
| 29         | 17  | Hand pedal position track2 sensor Low fault  |  |
| 51         | 0   | Throttle valve Position Open jammed fault  |  |
| 51         | 1   | Throttle valve Position Closed jammed fault  |  |
| 51         | 3   | Throttle valve Position Sensor High Fault  |  |
| 51         | 4   | Throttle valve Position Sensor Low Fault   |  |
| 51         | 22  | Throttle valve Close Position Learning Drift Fault for long time                           |  |
| 51         | 23  | Throttle valve Close Position Learning Drift Fault for short time                          |  |
| 51         | 30  | Throttle valve Close Position Learning Range Over Fault                                    |  |
| 91         | 3   | Accel pedal position track1 sensor High fault  |  |
| 91         | 4   | Accel pedal position track1 sensor Low fault   |  |
| 91         | 11  | Accel pedal position sensor plausibility fault (Not synchronism between track1 and track2) |  |
| 91         | 12  | Hand pedal position sensor plausibility fault (Not synchronism between track1 and track2)  |  |
| 91         | 15  | Hand pedal position track1 sensor High fault   |  |
| 91         | 17  | Hand pedal position track1 sensor Low fault  |  |
| 91         | 19  | Timeout Error of CAN-Receive-Frame EEC2 (Pedal)  |  |
| 97         | 3   | Water In Fuel Sensor signal range high fault   |  |
| 97         | 4   | Water In Fuel Sensor signal range low fault  |  |
| 97         | 14  | Water in fuel detected – Warning step  |  |
| 97         | 23  | Water in fuel detected – Torque de-rate step (After 20min)                                 |  |
| 98         | 3   | Oil combination (Level and temperature) signal output short circuit to battery error       |  |
| 98         | 4   | Oil combination (Level and temperature) signal output short circuit to ground error        |  |
| 98         | 5   | Oil combination (Level and temperature) sensor itself open or short circuit error          |  |
| 98         | 18  | Engine oil level is too low (Low step3)  |  |
| 98         | 22  | Oil combination (Level and temperature) sensor timeout fault                               |  |
| 98         | 23  | Oil combination (Level and temperature) sensor itself Voltage out of range error           |  |
| 98         | 24  | Engine oil level is low (Low step2)  |  |

| Fault co | de  | Description   Engine Oil Pressure Too Low Fault   Engine Oil Pressure Sensor High Fault   Engine Oil Pressure Sensor Low Fault   Intake Manifold temperature sensor High fault   Intake manifold temperature sensor Low fault   Intake manifold temperature Sensor Low fault   Intake manifold temperature High fault   Atmospheric Pressure Sensor Low Fault   Coolant high temperature Fault   Coolant Temperature Sensor Low Fault   Intake manifold pressure low plausibility fault (Compressor out pressure too low)   Signal range check high error for Air mass flow sensor   Signal range check low error for Air mass flow sensor   Signal error of Air mass flow sensor   Signal error of Air mass flow |
|----------|-----|--|
| SPN      | FMI |  |
| 100      | 1   | Engine Oil Pressure Too Low Fault  |
| 100      | 3   | Engine Oil Pressure Sensor High Fault  |
| 100      | 4   | Engine Oil Pressure Sensor Low Fault   |
| 102      | 3   | Intake Manifold Pressure Sensor High Fault   |
| 102      | 4   | Intake Manifold Pressure Sensor Low Fault  |
| 105      | 3   | Intake manifold temperature sensor High fault  |
| 105      | 4   | Intake manifold temperature sensor Low fault   |
| 105      | 16  | Intake manifold temperature High fault   |
| 108      | 3   | Atmospheric Pressure Sensor High Fault   |
| 108      | 4   | Atmospheric Pressure Sensor Low Fault  |
| 110      | 0   | Coolant high temperature Fault   |
| 110      | 3   | Coolant Temperature Sensor High Fault  |
| 110      | 4   | Coolant Temperature Sensor Low Fault   |
| 110      | 10  | Coolant Temperature Plausibility Fault   |
| 132      | 1   | Intake manifold pressure low plausibility fault (Compressor out pressure too low)  |
| 132      | 3   | Signal range check high error for Air mass flow sensor   |
| 132      | 4   | Signal range check low error for Air mass flow sensor  |
| 132      | 5   | Battery voltage error of Air mass flow sensor  |
| 132      | 19  | Signal error of Air mass flow sensor   |
| 132      | 21  | Sensitivity drift error low for Air mass flow sensor   |
| 157      | 10  | Fuel Leakage is detected based on fuel quantity balance  |
| 157      | 11  | Maximum positive deviation of rail pressure exceeded   |
| 157      | 26  | Rail pressure too low fault  |
| 157      | 27  | Maximum rail pressure exceeded   |
| 157      | 28  | Pressure relief valve(PRV) failure   |
| 171      | 0   | Environment Temperature Too High   |
| 171      | 3   | Environment Temperature Sensor Signal High   |
| 171      | 4   | Environment Temperature Sensor Signal Low  |
| 172      | 0   | Inlet air temperature High fault   |
| 172      | 3   | Inlet air temperature sensor High fault  |
| 172      | 4   | Inlet air temperature sensor Low fault   |
| 173      | 1   | DOC Exothermal Efficiency Fault  |
| 174      | 0   | Fuel temperature high fault  |
| 174      | 3   | Fuel Temperature Sensor High Fault   |
| 174      | 4   | Fuel Temperature Sensor Low Fault  |
| 175      | 11  | Oil combination (Level and temperature) sensor itself Oil temperature out of range error   |
| 177      | 15  | Transmission oil temperature high fault (CAN)  |
| 177      | 16  | Transmission oil temperature high fault (H/W Switch)   |
| 190      | 0   | Engine over speed detection fault  |

| Fault code   SPN FM   444 0   444 1   444 2   444 2   444 3   444 4   444 12   626 12   636 2   636 8   637 2   637 8   637 30   639 2   639 19   651 2 |     | Description   |
|---|-----|---|
| SPN   | FMI | Description   |
| 444   | 0   | Battery Voltage High fault (Warning)                              |
| 444   | 1   | Battery Voltage Low fault (Warning)                               |
| 444   | 2   | Powerstage diagnosis could be disabled due to low Battery voltage |
| 444   | 3   | Battery Voltage Signal Range Max fault                            |
| 444   | 4   | Battery Voltage Signal Range Min fault                            |
| 444   | 12  | Powerstage diagnosis disabled due to high Battery voltage         |
| 626   | 12  | Starter switch stuck fault (Cranking request is too long.)        |
| 636   | 2   | Crank Signal disturbed fault                                      |
| 636   | 8   | Cranks No signal error  |
| 637   | 2   | Cam Signal disturbed fault  |
| 637   | 8   | Cam Signal Lost fault   |
| 637   | 30  | Cam Signal Drift Fault  |
| 639   | 2   | CAN communication error   |
| 639   | 19  | CAN bus off error   |
| 651   | 2   | Injector Code(IQA) Program Missing Fault (Cylinder#1)             |
| 651   | 4   | Injector Short circuit Fault (Cylinder #1)                        |
| 651   | 5   | Injector Open circuit Fault (Cylinder #1)                         |
| 651   | 22  | Injector High Low side Short circuit Fault (Cylinder #1)          |
| 652   | 2   | Injector Code(IQA) Program Missing Fault (Cylinder#2)             |
| 652   | 4   | Injector Short circuit Fault (Cylinder #2)                        |
| 652   | 5   | Injector Open circuit Fault (Cylinder #2)                         |
| 652   | 22  | Injector High Low side Short circuit Fault (Cylinder #2)          |
| 653   | 2   | Injector Code(IQA) Program Missing Fault (Cylinder#3)             |
| 653   | 4   | Injector Short circuit Fault (Cylinder #3)                        |
| 653   | 5   | Injector Open circuit Fault (Cylinder #3)                         |
| 653   | 22  | Injector High Low side Short circuit Fault (Cylinder #3)          |
| 654   | 2   | Injector Code(IQA) Program Missing Fault (Cylinder#4)             |
| 654   | 4   | Injector Short circuit Fault (Cylinder #4)                        |
| 654   | 5   | Injector Open circuit Fault (Cylinder #4)                         |
| 654   | 22  | Injector High Low side Short circuit Fault (Cylinder #4)          |
| 676   | 3   | Glow plug Relay driver Short circuit to Battery Fault             |
| 676   | 4   | Glow plug Relay driver Short circuit to Ground Fault              |
| 676   | 5   | Glow plug Relay driver Open circuit Fault                         |
| 970   | 12  | Engine shut off request through CAN (EBC1)                        |
| 970   | 22  | Engine shut off request through hardwire                          |
| 975   | 3   | PWM FAN Output short to battery circuit fault                     |
| 975   | 4   | PWM FAN Output short to ground circuit fault                      |
| 975   | 5   | PWM FAN Output open circuit fault                                 |
| 987   | 3   | CE(Check engine) Lamp Short to Battery                            |

| Fault co | de  | Description  |
|----------|-----|--|
| SPN      | FMI | Description  |
| 987      | 4   | CE(Check engine) Lamp Short to Ground  |
| 987      | 5   | CE(Check engine) Lamp Open circuit   |
| 1076     | 3   | Fuel Metering unit plausibility error in overrun mode                                  |
| 1076     | 4   | Fuel Metering unit plausibility error in idle mode                                     |
| 1076     | 16  | Maximum negative rail pressure deviation with metering unit on lower limit is exceeded |
| 1076     | 20  | Rail pressure too low for injection  |
| 1081     | 3   | Glow plug Lamp Short to Battery  |
| 1081     | 4   | Glow plug Lamp Short to Ground   |
| 1081     | 5   | Glow plug Lamp Open circuit  |
| 1207     | 0   | ECU temperature High fault   |
| 1207     | 3   | ECU temperature sensor High fault (Short circuit to battery)                           |
| 1207     | 4   | ECU temperature sensor Low fault (Short circuit to ground)                             |
| 1382     | 0   | Fuel filter pressure high fault  |
| 1382     | 1   | Fuel filter pressure low fault   |
| 1382     | 3   | Fuel filter pressure sensor signal high fault  |
| 1382     | 4   | Fuel filter pressure sensor signal low fault   |
| 1382     | 7   | Fuel Filter Pressure low detection 1 - Warning   |
| 1382     | 13  | Fuel Filter Pressure low detection 2 - Torque reduction                                |
| 1485     | 7   | ECU Main relay Stuck fault   |
| 1485     | 11  | ECU Main relay Early opening fault   |
| 1568     | 3   | Multi-torque switch signal too high fault  |
| 1568     | 4   | Multi-torque switch signal too low fault   |
| 1612     | 3   | Injector bank 1st Short circuit fault  |
| 1612     | 12  | Injector bank 2nd Short circuit fault  |
| 1639     | 3   | Fan speed too high fault   |
| 1639     | 4   | Fan speed too low fault  |
| 1639     | 11  | Fan speed signal long period fault path  |
| 1761     | 19  | DEF Tank Level Signal error  |
| 1867     | 1   | ECU over temperature for SCR Monitoring  |
| 1867     | 3   | "ABE active" report due to overvoltage detection                                       |
| 1867     | 4   | "ABE active" report due to undervoltage detection                                      |
| 1867     | 11  | "WDA/ABE active" report due to unknown reason  |
| 1867     | 19  | "WDA active" report due to errors in query-response communication                      |
| 1867     | 22  | ECU Software Reset 0 fault   |
| 2789     | 0   | Turbine inlet temperature High fault   |
| 2789     | 3   | Turbine inlet temperature sensor High fault  |
| 2789     | 4   | Turbine inlet temperature sensor Low fault   |
| 2789     | 11  | Turbine inlet temperature Plausibility Fault   |
| 2791     | 3   | EGR H-Bridge Driver Short circuit to battery   |

| Fault co | de  | Departmen  |
|----------|-----|--|
| SPN      | FMI | Description  |
| 2791     | 4   | EGR H-Bridge Driver Short circuit to ground                            |
| 2791     | 5   | EGR H-Bridge Driver Open Circuit Fault                                 |
| 3031     | 14  | DEF Tank temperature overheated  |
| 3031     | 16  | DEF Tank Temperature sensor High plausibility fault                    |
| 3031     | 18  | DEF Tank Temperature sensor Low plausibility fault                     |
| 3216     | 4   | NOx sensor signal low fault (Upstream NOx sensor)                      |
| 3216     | 18  | NOx sensor 1 (Upstream) concentration Low plausibility fault           |
| 3219     | 7   | NOx sensor heating error (Upstream NOx sensor)                         |
| 3224     | 5   | NOx sensor Open circuit fault (Upstream NOx sensor)                    |
| 3224     | 6   | NOx sensor Short circuit fault (Upstream NOx sensor)                   |
| 3226     | 4   | NOx sensor signal low fault (Downstream NOx sensor)                    |
| 3229     | 7   | NOx sensor heating error (Downstream NOx sensor)                       |
| 3234     | 5   | NOx sensor Open circuit fault (Downstream NOx sensor)                  |
| 3234     | 6   | NOx sensor Short circuit fault (Downstream NOx sensor)                 |
| 3236     | 0   | EGR rate slow response positive error                                  |
| 3236     | 16  | Maximum EGR rate governor deviation                                    |
| 3242     | 0   | DPF(SCRF) inlet temperature High fault                                 |
| 3242     | 3   | DPF(SCRF) inlet temperature sensor High fault                          |
| 3242     | 4   | DPF(SCRF) inlet temperature sensor Low fault                           |
| 3242     | 11  | DPF(SCRF) inlet temperature Plausibility Fault                         |
| 3242     | 20  | DPF(SCRF) inlet temperature Drift fault                                |
| 3251     | 3   | DPF differential pressure sensor High fault                            |
| 3251     | 4   | DPF differential pressure sensor Low fault                             |
| 3251     | 13  | DPF differential pressure drift fault                                  |
| 3251     | 18  | DPF differential pressure too low fault                                |
| 3360     | 14  | DEF pressure line heater error (Perform afterrun)                      |
| 3361     | 3   | DEF dosing valve actuator Short circuit to battery Fault               |
| 3361     | 4   | DEF dosing valve actuator Short circuit to ground Fault                |
| 3361     | 5   | DEF dosing valve actuator Open Circuit Fault                           |
| 3361     | 13  | DEF dosing valve actuator Over temperature Fault                       |
| 3361     | 14  | Urea dosing valve plausibility fault                                   |
| 3361     | 22  | DEF dosing valve actuator HS(High side) Short circuit to battery Fault |
| 3361     | 23  | DEF dosing valve actuator HS(High side) Short circuit to ground Fault  |
| 3361     | 27  | DEF Dosing valve is blocked  |
| 3363     | 3   | DEF Tank heating coolant valve output Short circuit to battery Fault   |
| 3363     | 4   | DEF Tank heating coolant valve output Short circuit to ground Fault    |
| 3363     | 5   | DEF Tank heating coolant valve output Open circuit Fault               |
| 3363     | 7   | DEF Tank heating coolant valve output Over temperature Fault           |
| 3509     | 3   | ECU Sensor supply1 Over voltage fault                                  |

| Fault co | de  | Description  |
|----------|-----|--|
| SPN      | FMI | Description  |
| 3509     | 4   | ECU Sensor supply1 Under voltage fault   |
| 3509     | 5   | ECU Sensor supply1 voltage fault   |
| 3509     | 6   | ECU Sensor supply1 Short circuit to ground   |
| 3509     | 11  | ECU Sensor supply Overvoltage monitoring error   |
| 3510     | 3   | ECU Sensor supply2 Over voltage fault  |
| 3510     | 4   | ECU Sensor supply2 Under voltage fault   |
| 3510     | 5   | ECU Sensor supply2 voltage fault   |
| 3510     | 6   | ECU Sensor supply2 Short circuit to ground   |
| 3510     | 11  | ECU Sensor supply Undervoltage monitoring error  |
| 3511     | 3   | ECU Sensor supply3 Over voltage fault  |
| 3511     | 4   | ECU Sensor supply3 Under voltage fault   |
| 3511     | 5   | ECU Sensor supply3 voltage fault   |
| 3511     | 6   | ECU Sensor supply3 Short circuit to ground   |
| 3516     | 0   | DEF Quality Too High fault   |
| 3516     | 1   | DEF Quality Too Low fault  |
| 3517     | 18  | DEF Tank level is empty  |
| 3520     | 3   | DEF Quality Sensor Open circuit  |
| 3520     | 4   | DEF Quality Sensor Short circuit   |
| 3532     | 3   | DEF Level Sensor Open circuit  |
| 3532     | 4   | DEF Level Sensor Short circuit   |
| 3695     | 3   | DPF regeneration inhibit switch Stuck (Short to Battery) fault (Hardwire)                          |
| 3696     | 3   | DPF regeneration enable switch Stuck (Short to Battery) fault (Hardwire)                           |
| 3696     | 11  | DPF regeneration inhibit & enable switch plausibility fault (Hardwire)                             |
| 3697     | 3   | DPF lamp 1 (DPF regeneration switch enable lamp) Short to Battery                                  |
| 3697     | 4   | DPF lamp 1 (DPF regeneration switch enable lamp) Short to Ground                                   |
| 3697     | 5   | DPF lamp 1 (DPF regeneration switch enable lamp) Open circuit                                      |
| 3715     | 14  | DPF regeneration failure<br>(DPF regeneration is not performed well during machine operation mode) |
| 3720     | 16  | DPF Ash loading High fault (Ash cleaning is needed)  |
| 4082     | 3   | Fuel metering unit Short circuit to Battery fault  |
| 4082     | 4   | Fuel metering unit Short circuit to Ground fault   |
| 4082     | 5   | Fuel metering unit Open circuit fault  |
| 4082     | 7   | Fuel metering unit Over temperature fault  |
| 4335     | 0   | DEF Overpressure error at METERINGCONTROL (DEF pump pressure is too high)                          |
| 4335     | 1   | DEF Underpressure error at METERINGCONTROL (DEF pump pressure is too low)                          |
| 4335     | 2   | DEF pressure build up error at PRESSUREBUILDUP<br>(DEF pump pressure is too low)                   |
| 4335     | 7   | DEF Leakage detection at METERINGCONTROL   |
| 4335     | 12  | DEF Overpressure error regardless of the state (DEF pump pressure is too high)                     |

| Fault code |     | Description   |
|------------|-----|---|
| SPN        | FMI | Description   |
| 4335       | 15  | DEF Pressure reduction error at PRESSUREREDUCTION<br>(Detected an insufficient pressure drop) |
| 4335       | 16  | DEF underpressure error at AFTERRUN_PRESSURECOMPENSATION                                      |
| 4344       | 2   | DEF backflow Line plausibility error at DETECTIONMODE<br>(Does not detect a pressure drop)    |
| 4354       | 5   | DEF Pressure line heater circuit Open circuit Fault   |
| 4354       | 6   | DEF Pressure line heater circuit Open circuit or Short circuit to ground Fault                |
| 4355       | 5   | DEF Backflow line heater circuit Open circuit Fault   |
| 4355       | 6   | DEF Backflow line heater circuit Open circuit or Short circuit to ground Fault                |
| 4356       | 5   | DEF Suction line heater circuit Open circuit Fault  |
| 4356       | 6   | DEF Suction line heater circuit Open circuit or Short circuit to ground Fault                 |
| 4364       | 14  | SCR Efficiency Too low fault  |
| 4365       | 3   | DEF Temperature Sensor Open circuit   |
| 4365       | 4   | DEF Temperature Sensor Short circuit  |
| 4365       | 14  | DEF Tank temperature plausibility fault<br>(Insufficient temperature increment)               |
| 4374       | 3   | DEF Supply Pump Motor Signal output Short circuit to battery Fault                            |
| 4374       | 4   | DEF Supply Pump Motor Signal output Short circuit to ground Fault                             |
| 4374       | 5   | DEF Supply Pump Motor Signal output Open circuit Fault  |
| 4374       | 7   | DEF Supply Pump Motor Signal output Over temperature Fault                                    |
| 4374       | 8   | DEF Supply Pump Motor Speed Deviation Fault   |
| 4374       | 9   | DEF Supply Pump Motor Speed Deviation Permanent Fault   |
| 4374       | 12  | DEF Supply Pump Motor No activation Fault   |
| 4781       | 15  | DPF Soot mass too high status (> 120%)  |
| 4781       | 16  | DPF Soot mass high status (> 110%)  |
| 5067       | 3   | PTO (Idle up) Lamp Short to Battery   |
| 5067       | 4   | PTO (Idle up) Lamp Short to Ground  |
| 5067       | 5   | PTO (Idle up) Lamp Open circuit   |
| 5099       | 3   | Oil Pressure Warning Lamp Short to Battery  |
| 5099       | 4   | Short circuit to ground error of oil pressure lamp  |
| 5099       | 5   | Oil Pressure Warning Lamp Open circuit  |
| 5313       | 3   | Rail pressure sensor High fault   |
| 5313       | 4   | Rail pressure sensor Low fault  |
| 5419       | 3   | Throttle valve H-Bridge Driver Short circuit to battery                                       |
| 5419       | 4   | Throttle valve H-Bridge Driver Short circuit to ground  |
| 5419       | 5   | Throttle valve H-Bridge Driver Open Circuit Fault   |
| 5435       | 10  | DEF pressure stabilization error at DETECTIONMODE (DEF pump pressure is not stable)           |
| 5435       | 12  | DEF pressure check error at DETECTIONMODE (Detected an insufficient pressure drop)            |
| 5436       | 3   | DEF Reverting valve output Short circuit to battery Fault                                     |
| 5436       | 4   | DEF Reverting valve output Short circuit to ground Fault                                      |

| Fault co | de  | Description  |
|----------|-----|--|
| SPN      | FMI | Description  |
| 5436     | 5   | DEF Reverting valve output Open circuit Fault  |
| 5436     | 7   | DEF Reverting valve output Over temperature Fault  |
| 5436     | 11  | DEF Reverting valve Pressure drop plausibility fault   |
| 5436     | 14  | DEF Reverting valve is blocked<br>(Detected an insufficient pressure drop)                                 |
| 5491     | 3   | DEF Pressure line heater relay output Short circuit to battery Fault                                       |
| 5491     | 4   | DEF Pressure line heater relay output Short circuit to ground Fault  |
| 5491     | 5   | DEF Pressure line heater relay output Open circuit Fault   |
| 5491     | 7   | DEF Pressure line heater relay output Over temperature Fault   |
| 5491     | 12  | DEF Pressure line heater feedback plausibility Fault   |
| 5571     | 22  | Common rail pressure relief valve reached maximum allowed opening count                                    |
| 5571     | 23  | Common rail pressure relief valve Forced to open status (Pressure increase)                                |
| 5571     | 24  | Common rail pressure relief valve Forced to open status (Pressure shock)                                   |
| 5571     | 25  | Common rail pressure relief valve is open  |
| 5571     | 27  | Averaged rail pressure is outside the expected tolerance range   |
| 5571     | 28  | Common rail pressure relief valve reached maximum allowed open time  |
| 5629     | 14  | DPF differential pressure too high fault   |
| 5629     | 15  | DPF differential pressure high fault (Warning)   |
| 5706     | 5   | DEF Supply module heater circuit Open circuit Fault  |
| 5706     | 6   | DEF Supply module heater circuit Open circuit or Short circuit to ground Fault                             |
| 5706     | 12  | DEF Supply module heater temperature plausibility fault<br>(Insufficient temperature increment)            |
| 5706     | 14  | DEF Supply module heater temperature plausibility fault at cold start (Insufficient temperature increment) |
| 5706     | 22  | DEF Supply module heater plausibility fault (Insufficient temperature increment)                           |
| 5746     | 3   | DEF Main heater relay output Short circuit to battery Fault  |
| 5746     | 4   | DEF Main heater relay output Short circuit to ground Fault   |
| 5746     | 5   | DEF Main heater relay output Open circuit Fault  |
| 5746     | 6   | DEF heater line circuit Short circuit to battery Fault   |
| 5746     | 7   | DEF Main heater relay output Over temperature Fault  |
| 5965     | 3   | SCR system Main relay short circuit to battery   |
| 5965     | 4   | SCR system Main relay short circuit to ground  |
| 5965     | 5   | SCR system Main relay open circuit   |
| 6323     | 3   | Electric fuel feed pump Output short to battery circuit fault  |
| 6323     | 4   | Electric fuel feed pump Output short to ground circuit fault   |
| 6323     | 5   | Electric fuel feed pump Output open circuit fault  |
| 6323     | 13  | Electric fuel feed pump performance fault  |
| 6385     | 19  | Timeout Error of CAN-Receive-Frame EOI (Engine Starter Motor Relay Control)                                |
| 6875     | 3   | DEF Supply Pump pressure sensor High fault   |
| 6875     | 4   | DEF Supply Pump pressure sensor Low fault  |

| Fault code   SPN FMI   6875 16   6875 18   6915 3   6915 4   6915 5   6916 3   6916 4   6916 5 |     | Description   |
|--|-----|---|
| SPN  | FMI | Description   |
| 6875   | 16  | DEF Supply Pump pressure sensor High plausibility fault   |
| 6875   | 18  | DEF Supply Pump pressure sensor Low plausibility fault  |
| 6915   | 3   | DPF lamp 2 (DPF Regeneration Active Lamp) Short to Battery  |
| 6915   | 4   | DPF lamp 2 (DPF Regeneration Active Lamp) Short to Ground   |
| 6915   | 5   | DPF lamp 2 (DPF Regeneration Active Lamp) Open circuit  |
| 6916   | 3   | DPF lamp 3 (DPF regeneration switch inhibit lamp) Short to Battery                                  |
| 6916   | 4   | DPF lamp 3 (DPF regeneration switch inhibit lamp) Short to Ground                                   |
| 6916   | 5   | DPF lamp 3 (DPF regeneration switch inhibit lamp) Open circuit                                      |
| 7069   | 3   | DEF Backflow line heater relay output Short circuit to battery Fault                                |
| 7069   | 4   | DEF Backflow line heater relay output Short circuit to ground Fault                                 |
| 7069   | 5   | DEF Backflow line heater relay output Open circuit Fault  |
| 7069   | 7   | DEF Backflow line heater relay output Over temperature Fault  |
| 7069   | 12  | DEF Backflow line heater feedback plausibility Fault  |
| 7107   | 12  | DEF Supply module temperature plausibility fault (Insufficient temperature increment)               |
| 7107   | 14  | DEF Supply module temperature plausibility fault at cold start (Insufficient temperature increment) |
| 7416   | 3   | DEF Supply module heater relay output Short circuit to battery Fault                                |
| 7416   | 4   | DEF Supply module heater relay output Short circuit to ground Fault                                 |
| 7416   | 5   | DEF Supply module heater relay output Open circuit Fault  |
| 7416   | 7   | DEF Supply module heater relay output Over temperature Fault  |
| 7416   | 12  | DEF Supply module heater feedback plausibility Fault  |
| 7538   | 12  | DEF Supply module temperature duty cycle in failure range   |
| 7538   | 13  | Diagnostic Fault Check for Urea supply module duty cycle in the invalid range                       |
| 7538   | 22  | DEF Supply module heater temperature duty cycle in failure range                                    |
| 7538   | 23  | DEF Supply module heater temperature duty cycle in invalid range                                    |
| 7538   | 24  | DEF Supply module temperature measurement non-availability fault                                    |
| 7538   | 25  | DEF Supply module time period outside specified range   |
| 7538   | 26  | DEF Supply module PWM signal fault  |
| 7540   | 3   | DEF Suction line heater relay output Short circuit to battery Fault                                 |
| 7540   | 4   | DEF Suction line heater relay output Short circuit to ground Fault                                  |
| 7540   | 5   | DEF Suction line heater relay output Open circuit Fault   |
| 7540   | 7   | DEF Suction line heater relay output Over temperature Fault   |
| 7540   | 12  | DEF Suction line heater feedback plausibility Fault   |
| 7748   | 3   | Starter relay power stage output short circuit to battery   |
| 7748   | 4   | Starter relay HS power stage output short circuit to ground   |
| 7748   | 5   | Starter relay power stage output open circuit   |
| 8614   | 12  | Injection cut off demand (ICO) for shut off coordinator   |
| 55296  | 12  | ECU EEPROM Read Error   |
| 55552  | 12  | ECU EEPROM Write Error  |

| Fault co | de  | Description  |
|----------|-----|--|
| SPN      | FMI | Description  |
| 57344    | 19  | Timeout Error of CAN-Receive-Frame CM1<br>(Status of regeneration initiate and inhibit switches) |
| 61441    | 19  | Timeout Error of CAN-Receive-Frame EBC1 (Engine shut off request)                                |
| 61454    | 19  | Timeout Error of CAN-Receive-Frame AT1IG1 (NOx Upstream Concentration)                           |
| 61455    | 19  | Timeout Error of CAN-Receive-Frame AT1O1 (NOx Downstream Concentration)                          |
| 64923    | 19  | Timeout Error of CAN-Receive-Frame A1DEFI (DEF Tank)   |
| 65110    | 19  | Timeout Error of CAN-Receive-Frame AT1T1I (Urea Level, Temperature over CAN)                     |
| 65164    | 19  | Timeout Error of CAN-Receive-Frame AAI (Hydraulic Oil Temperature)                               |
| 65241    | 19  | Timeout Error of CAN-Receive-Frame AUXIO1 (status of vehicle cut off [Safety bar])               |
| 65265    | 19  | Timeout Error of CAN-Receive-Frame RxCCVS (PTO / Idle up)  |
| 65272    | 19  | Timeout Error of CAN-Receive-Frame TRF1 (Transmission oil temperature)                           |
| 65320    | 19  | Timeout Error of CAN-Receive-Frame FanCtl (FAN Control)  |
| 65400    | 19  | Timeout Error of CAN-Receive-Frame RxSMVCU<br>(Pedal & Engine speed demand from VCU)             |
| 65400    | 22  | Message Check Sum Error of CAN Receive Frame SMVCU<br>(Pedal & Engine speed demand from VCU)     |
| 65400    | 23  | Message Counter Error of CAN Receive Frame SMVCU<br>(Pedal & Engine speed demand from VCU)       |
| 65401    | 19  | Timeout Error of CAN-Receive-Frame DPM1 (Air Conditioning Switch Status / Oil life reset)        |
| 65402    | 19  | Timeout Error of CAN-Receive-Frame DPM9 (Multiple torque Map select switch)                      |
| 104332   | 9   | NOx sensor Mounting Error (Upstream NOx sensor)  |
| 104385   | 9   | NOx sensor Mounting Error (Downstream NOx sensor)  |
| 520601   | 12  | CY327(Power control chipset) SPI Communication Error   |
| 520618   | 12  | ECU ADC(Analog to Digital Convertor) NTP(Null Load Test Pulse) Monitoring fault                  |
| 520641   | 12  | ECU ROM Memory multiple error  |
| 520642   | 12  | ECU MM(Monitoring Module) Synchronization Loss fault during Shut-off path test                   |
| 520643   | 12  | MoF(Monitoring of Function) Over Run error   |
| 520696   | 12  | ECU ADC(Analog to Digital Convertor) Test error  |
| 520697   | 12  | ECU ADC(Analog to Digital Convertor) Voltage ratio error   |
| 520698   | 12  | ECU query response-communication error   |
| 520699   | 12  | ECU SPI-communication error  |
| 520700   | 12  | ECU Shut–off path test error   |
| 520701   | 12  | ECU Wrong set response time error during shut off path test                                      |
| 520702   | 12  | ECU Too many SPI errors during shut off path test  |
| 520703   | 12  | ECU WDA working error during Shut-off path test  |
| 520704   | 12  | ECU OS Timeout error during Shut-off path test   |
| 520705   | 12  | ECU Positive test failure error during Shut-off path test  |
| 520706   | 12  | ECU Shut-off path test timeout fault   |
| 520707   | 3   | ECU Overvoltage error during Shut-off path test  |
| 520707   | 4   | ECU Undervoltage error during Shut-off path test   |

| Fault co | de  | Deve della   |
|----------|-----|--|
| SPN      | FMI | Description  |
| 520723   | 12  | NCD Inducement Fault Level1 (Group1 - EGR Block)                         |
| 520724   | 12  | NCD Inducement Fault Level2 (Group1 - EGR Block)                         |
| 520725   | 12  | NCD Inducement Fault Level3 Final inducement (Group1 - EGR Block)        |
| 520726   | 12  | NCD Inducement Fault Warning (Group1 - EGR Block)                        |
| 520727   | 12  | NCD Inducement Fault Level1 (Group2 – Dosing Interrupt)                  |
| 520728   | 12  | NCD Inducement Fault Level2 (Group2 – Dosing Interrupt)                  |
| 520729   | 12  | NCD Inducement Fault Level3 Final inducement (Group2 – Dosing Interrupt) |
| 520730   | 12  | NCD Inducement Fault Warning (Group2 – Dosing Interrupt)                 |
| 520736   | 12  | NCD inducement Fault Level1 (Group4 – DEF Quality)                       |
| 520737   | 12  | NCD inducement Fault Level2 (Group4 – DEF Quality)                       |
| 520738   | 12  | NCD inducement Fault Level3 Final inducement (Group4 – DEF Quality)      |
| 520739   | 12  | NCD inducement Fault Warning (Group4 – DEF Quality)                      |
| 520740   | 12  | NCD inducement Fault Level1 (Group5 – Tampering)                         |
| 520741   | 12  | NCD inducement Fault Level2 (Group5 – Tampering)                         |
| 520742   | 12  | NCD inducement Fault Level3 Final inducement (Group5 – Tampering)        |
| 520743   | 12  | NCD inducement Fault Warning (Group5 – Tampering)                        |
| 520790   | 12  | NCD inducement Repeat offense Level1                                     |
| 520791   | 12  | NCD inducement Repeat offense Level2                                     |
| 520792   | 12  | NCD inducement Repeat offense Level3 Final inducement                    |
| 520797   | 12  | MoF(Monitoring of Function) Engine speed error                           |

| Group | 1 | Before Troubleshooting            | 5-1  |
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# **GROUP 1 BEFORE TROUBLESHOOTING**

#### **1. INTRODUCTION**

When a trouble is occurred in the machine, this section will help an operator to maintain the machine with easy.

The trouble of machine is parted Hydraulic & Mechanical system, Electrical system and Air conditioner and heater system.

At each system part, an operator can check the machine according to the troubleshooting process diagram.



#### 2. DIAGNOSING PROCEDURE

To carry out troubleshooting efficiently, the following steps must be observed.

#### STEP 1. Study the machine system

Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.

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



#### STEP 2. Ask the operator

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

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

#### STEP 3. Inspect the machine

Before starting troubleshooting, check the machine for the daily maintenance points as shown in the operator's manual.

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





# STEP 4. Inspect the trouble actually on the machine

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

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



#### STEP 5. Perform troubleshooting

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



#### STEP 6. Trace a cause

Before reaching a conclusion, check the most suspectible causes again. Try to trace what the real cause of the trouble is.

Make a plan of the appropriate repairing procedure to avoid consequential malfunctions.



# **GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM**

#### **1. INTRODUCTION**

#### 1) MACHINE IN GENERAL

(1) If even a minor fault is left intact and operation is continued, a fatal failure may be caused, entailing a large sum of expenses and long hours of restoration.

Therefore when even a small trouble occurs, do not rely on your intuition and experience, but look for the cause based on the troubleshooting principle and perform maintenance and adjustment to prevent major failure from occurring. Keep in mind that a fault results from a combination of different causes.

- (2) The following lists up commonly occurring faults and possible causes with this machine. For the troubleshooting of the engine, refer to the coming troubleshooting and repair.
- (3) When carrying out troubleshooting, do not hurry to disassemble the components. It will become impossible to find the cause of the problem.
- (4) Ask user or operator the following.
- ① Was there any strange thing about machine before failure occurred?
- O Under what conditions did the failure occur?
- ③ Have any repairs been carried out before the failure?
- (5) Check before troubleshooting.
- 1 Check oil and fuel level.
- 2 Check for any external leakage of oil from components.
- ③ Check for loose or damage of wiring and connections.
# 2. DRIVE SYSTEM

# 1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



#### 2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL



# 3. HYDRAULIC SYSTEM

### 1) HYDRAULIC OIL IS CLOUDY



#### 2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



# 3) CAVITATION OCCURS WITH PUMP



# 4) HYDRAULIC OIL IS CONTAMINATED



# 4. SWING SYSTEM

### 1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



#### 2) SWING SPEED IS LOW



#### 3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



#### 4) MACHINE SWINGS BUT DOES NOT STOP



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



# 5. TRAVEL SYSTEM

#### 1) TRAVEL DOES NOT FUNCTION



#### 2) TRAVEL ACTION IS POWERLESS (travel only)



# 3) THE HYDRAULIC MOTOR DOSE NOT GET STARTED

|  | Cause   | Remedy   |
|--|---|--|
| The hydraulic<br>motor does not<br>get started | The spool does<br>work property.<br>(the spool keeps<br>fully open)                                 | Screw the fitting<br>bolts one more<br>time with correct<br>tightening torque.<br>If the spool turns<br>out to be damaged,<br>it should be<br>repaired or the new<br>one should be<br>used |
| l  | The anti-cavitation<br>check valve does<br>not work properly.<br>(the check valve<br>is kept open.) | Ditto  |

# 4) IT TAKES TIME TO ACCELERATE THE MOTOR

|                                       | Cause   | Remedy   |
|---------------------------------------|---|--|
| It takes time to accelerate the motor | The spool does not work properly.                               | Screw the fitting<br>bolts one more<br>time with correct<br>tightening torque.<br>If the spool turns<br>out to be<br>damaged, it should<br>be repaired, or the<br>new one should be<br>used. |
|                                       | The orifice for<br>closing the<br>counterbalance is<br>clogged. | Remove the foreign matter by disassembling and cleaning.   |
| ļ                                     | Wrong setting of pressure of the relief valve.                  | Adjust at the<br>correct value.<br>If the relief valve<br>turns out to be<br>out of order, the<br>new one should<br>be used.   |

# 5) IT IS NOT POSSIBLE TO REDUCE THE MOTOR SMOOTHLY

|   | Cause  | Remedy  |
|---|--|---|
| It is not possible<br>to reduce the<br>motor smoothly | The orifice for<br>closing the<br>counterbalance is<br>clogged. The<br>opening of the<br>neutral position of<br>the spool is<br>clogged.<br>Wrong setting of<br>pressure of the<br>relief valve. | Remove the<br>foreign matter by<br>disassembling<br>and cleaning.<br>Adjust at the<br>correct value.<br>If the relief valve<br>turns out to be<br>out of order, the<br>new one should |
|   |  |   |

# 6) EXTRAORDINARY NOISE IS HEARD WHEN SUDDENLY REDUCING THE SPEED FROM THE HIGH-SPEED MODE

| It takes time to     | Cause   | Remedy   |
|----------------------|---|--|
| accelerate the motor | The anti-cavitation<br>valve does not not<br>work properly. | Screw the fitting<br>bolts one more<br>time with correct<br>tightening torque.<br>If the valve turns<br>out to be<br>damaged, is<br>should be<br>repaired. |

# 6. ATTACHMENT SYSTEM

# 1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



#### 2) BOOM, ARM OR BUCKET SPEED IS LOW



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



#### 4) BOOM, ARM OR BUCKET POWER IS WEAK



# 5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



# 6) BOOM MAKES A SQUARING NOISE WHEN BOOM IS OPERATED

| Cause Remedy  |
|---|
| YES Frictional noise occurs betwee the sliding faces of boom cylinder's oil seal and boom proper.   sufficiently? Boom foot pin disappear if they are kep used.   NO Boom foot pin disappear if they are kep used.   NO Supply grease to it.   if seizure is in an initial stage supply sufficien grease. #   If seizure is in a grown state, correct it by paper lapping or with an oil stone. # |

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

- 1. Lower the bucket teeth to the ground with bucket cylinder fully retracted and arm cylinder rod retracted almost in full.
- 55W75TS01
- Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinder and hose. (put cups on piping and hose ends)



3. Raise bucket OFF the ground by retracting the arm cylinder rod.

If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.

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



# **GROUP 3 ELECTRICAL SYSTEM**

Check voltage

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

- · Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.5 and No.12.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



| -       |            |
|---------|------------|
| YES     | 10 ~ 12.5V |
| NO      | ov         |
| NO      | 00         |
|         |            |
|         |            |
| CLUSTER | F          |
| BATTER  | RY 12V / 1 |
| POWER   | IG / 2     |
|         |            |
|         |            |
|         |            |
|         | CN-56      |

# 2. - + BATTERY CHARGING WARNING LAMP LIGHTS UP (starting switch : ON)

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





65A5TS11

# 3. OWNEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

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





65A5TS12

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

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



Check resistance

| YES | <b>ΜΑΧ 1</b> Ω |
|-----|----------------|
| NO  | MIN 1M Ω       |



# 5. → (→) ← WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

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



#### Check resistance

| YES | <b>ΜΑΧ 1</b> Ω  |
|-----|-----------------|
| NO  | <b>ΜΙΝ 1Μ</b> Ω |



65A5TS14

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

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





# 7. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

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





| Check Table                 |       |          |                      |  |
|-----------------------------|-------|----------|----------------------|--|
| Temperature<br>Item         | 40°C  | 85~110°C | 115°C<br>(red range) |  |
| Unit Resistance( $\Omega$ ) | 1170~ | 270~130  | ~124                 |  |
| Tolerance(%)                | ±5    | -8~0     | ±5                   |  |





# 8. WHEN FUEL GAUGE DOES NOT OPERATE (check warning lamp ON/OFF)

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





| Check Table |       |     |
|-------------|-------|-----|
| Level       | Empty | 1/2 |
|             |       |     |

700

 $\pm 5$ 

300

 $\pm$ 8

| Empty |  |
|-------|--|



Unit Resistance ( $\Omega$ )

Tolerance (%)

65AH5TS17

Full

~100

 $\pm 5$ 

# 9. WHEN SAFETY SOLENOID DOES NOT OPERATE

- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.20.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



# 10. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

- · Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.10, 18.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.



65AH5TS23

CL-5

FUSE 3<del>-0</del>-[ No.18

CR-3

30.86

87a 87 85

087a

085

087 086

**30** 

NC

NC

CN-116

WORK LIGHT OUT

HEAD LIGHT OUT

40

30

20

10

# 11. WHEN ENGINE DOES NOT START

- $\cdot$  Check supply of the power at engine stop solenoid while starting switch is ON.
- $\cdot$  Before disconnecting the connector, always turn the starting switch OFF.
- · Before carrying out below procedure, check all the related connectors are properly inserted.
- · After checking, insert the disconnected connectors again immediately unless otherwise specified.





65AH5TS20

# 12. WHEN STARTING SWITCH ON DOES NOT OPERATE

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





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

· Before disconnecting the connector, always turn the starting switch OFF.

• Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.14, 18 is not blown out.

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





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

· Before disconnecting the connector, always turn the starting switch OFF.

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.10, 14.

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





# GROUP 4 AXLE

# **1. TROUBLE SHOOTING**

| Problem                  | Cause  | Correction   |
|--------------------------|--|--|
| Loss of brakes           | 1. Incorrect adjustment  | Inspect disc thickness (see page 7-149) and if discs are usable readjust brakes to the specifications in the manual.   |
|                          | 2. Brake discs worn out  | Inspect disc thickness (see page 7-149) and replace if needed  |
|                          | 3. Incorrect brake fluid   | Replace all seals in axle and master cylinder that<br>have made contact with the incorrect fluid and all<br>brake hoses.<br>If incorrect fluid leaked into axle oil, seals and O-rings<br>in axle must be replaced.  |
|                          | 4. Loss of brake fluid   | Inspect for and repair any leaks in outside circuit or<br>master cylinder.<br>If caused by incorrect brake fluid see correction No.3.<br>If leak is to the outside replace the O-rings between<br>the center and intermediate sections.<br>If leak is to the inside replace above O-rings and<br>brake piston O-rings. |
|                          | 5. Overheated axle causing<br>brake fluid to vaporize (brake<br>return when axle cools). | See "Overhearing" problem.   |
| Soft brake pedal         | 6. Air in brake fluid  | Bleed brakes.  |
| Ineffective safety brake | 7. One or both overrides are engaged   | Check override bolts and adjust if needed (see page 7-155).  |
|                          | 8. Incorrect adjustment  | See correction No.1.   |
|                          | 9. Brake disc worn out   | See correction No.2.   |
| Overheating              | 10. Oil level wrong  | Drain, flush and refill oil to proper level.   |
|                          | 11. Too small of a brake gap.  | Readjust brakes to the specifications (see page 7-155)   |
|                          | 12. Park brake dragging.   | Unlock the brake and adjust the correct gap.   |
|                          | 13. Incorrect brake fluid in system.   | See correction No.3.   |
|                          | 14. No free-pedal at master cylin-<br>der.   | Readjust brake pedal.  |
|                          | 15. Restriction in brake lines.  | Inspect for and replace damage lines.  |
|                          | 16. Restriction in return line of brake servo system.                                    | Inspect for and replace damaged return line.<br>Inspect for and remove any filter, tee'd in line or any<br>other source of back pressure from the return line.   |
|                          | 17. Incorrect oil  | Drain, flush and refill to the proper level with oil rec-<br>ommended.   |

| Problem  | Cause  | Correction   |  |
|--|--|--|--|
| Diff-lock inoperative                              | 18. If manual, loss or misadjusted linkage.  | Inspect and correct linkage and readjust.  |  |
|  | 19. If hydraulic, problems in the hydraulic or electrical circuits of the vehicle. | Refer to the Group 2 and 3 of this section.  |  |
|  | 20. If hydraulic, problems in the hydraulic or electrical circuits of the vehicle. | Rebuilt cylinder as described on page 7-192.   |  |
|  | 21. If with self locking differential, weared discs.                               | Replace discs as described on page 7-189.  |  |
| Oil coming out of breather                         | 22. Hydraulic leak in brake system.  | See corrections No.2 & 3.  |  |
|  | 23. Hydraulic leak in diff-lock acti-<br>vating cylinder.                          | See corrections No.20.   |  |
| No spin indexing<br>noise when driven<br>straight. | 24. Unequal tire pressure from one side to the other.                              | Inflate tires to the recommended pressure or until the rolling radius is equal.  |  |
|  | 25. Different style, size or brand of tires from one side to the other.            | Change tires to make the rolling radius equal.<br>Vary the tire pressure within the specifications until<br>the rolling radius is equal. |  |
| Noise during coast<br>and under power<br>the same  | 26. Wheel bearings   | Replace and adjust as described on page 7-157.   |  |
| Noise under power<br>greater than during<br>coast. | 27. Low oil level  | Refill oil to proper level   |  |
|  | 28. Incorrect oil  | See correction No.17.  |  |
|  | 29. Ring and pinion worn   | Inspect through rear cover. Replace and adjust as described on page 7-173.   |  |
|  | 30. Worn ring and pinion bearings  | Replace and adjust as described on page 7-173.   |  |
|  | 31. Worn planetary gears or bear-<br>ings  | Replace as described on page 7-157.  |  |
| Noise during coast<br>greater than under<br>power  | 32. Loose pinion nut   | Inspect ring, pinion and pinion bearings. If undamaged, retighten nut as described on page 7-173.  |  |
|  | 33. Only one pinion bearing dam-<br>ages.  | See correction No.30.  |  |
| Noise during turn<br>(without no spin)             | 34. Worn spider and / or side gears  | Replace as described on page 7-185.  |  |

| Problem  | Cause   | Correction   |
|--|---|--|
| A "Stick slip" noise<br>when going from<br>forward to reverse. | 35. Worn or damaged U-joint on<br>drive shaft               | Inspect and replace the u-joint.   |
|  | 36. Loose wheel   | Inspection for wheel and wheel stud damage.<br>Replace if needs and retorque nuts. |
|  | 37. Worn or damaged U-joint at<br>steering knuckle          | Inspect and replace as described on page 7-166.                                    |
|  | 38. Spider pins loose in carrier.                           | Inspect through rear cover. Replace as described on page 7-185.                    |
|  | 39. Damaged or missing spider<br>and / or side gear washers | See correction No.34.  |

# **GROUP 5 AIR CONDITIONER AND HEATER SYSTEM**

# **1. AIR CONDITIONER DOES NOT OPERATE**



#### 1) FAN DOES NOT OPERATE

| Cause                                     | Check   | Remedy          |
|---|---|-----------------|
| Fuse is blown or abnormal relay operation | * Fuse<br>* Does relay normally operate?                        | Replace         |
| Harness short or<br>poor contact          | Check any harness short or<br>abnormal contact of connnector    | Repair shortage |
| Fan motor failure                         | Supply 24V to 2 lead wire from motor<br>and check the operation | Replace         |
| Resistor is broken                        | Check current flow of resistor with tester                      | Replace         |
| Fan switch failure                        | Push fan switch by turn and check the operation                 | Replace         |
## 2) WEAK AIR FLOW FROM FAN MOTOR

| Cause  | Check                               | Remedy  |
|--|-------------------------------------|---------|
| Clogged evaporator or obstacles around air inlet | Check if evaporator is contaminated | Clean   |
| Leakage of air flow                              | Check HVAC case assembly            | Adjust  |
| Duct sensor failure                              | Check if evaporator is frozen       | Replace |

## 3) ABNORMAL OPERATION OF FAN MOTOR

| Cause                                      | Check                        | Remedy           |
|--|------------------------------|------------------|
| Abnormal operation of each step of control | 4 step only operate          | Replace resistor |
|  | 1 or 2 step does not operate | Replace control  |
|  | 3 or 4 step does not operate | Replace relay    |

## 4) COMPRESSOR DOES NOT ROTATE OR HARDLY ROTATE

| Cause                                | Check   | Remedy                                   |
|--------------------------------------|---|--|
| Loose belt                           | Belt shaking is severe                                | Adjust tension                           |
| Failure of compressor itself         | Belt slip   | Repair or Replace                        |
| Low voltage of battery               | Slip when rotate                                      | Charge battery                           |
| Fieldcoil short                      | Slip when rotate                                      | Replace magnetic clutch                  |
| Oily clutch face                     | Contamination around clutch                           | Replace magnetic<br>clutch, clean        |
| Fieldcoil is broken                  | Magnetic clutch does not operate or<br>"∞" resistance | Replace compressor                       |
| Leakage of refrigerant or oil inside | Check if wet with oil                                 | Replace compressor<br>Charge refrigerant |

| Cause   | Check  | Remedy                                       |
|---|--|--|
| Shortage of refrigerant   | When air con operate during 5~10 min small temperature difference between high and low pressure pipes. | Repair leakage joint<br>Charge refrigerant   |
| Overcharge of refrigerant         *Magnetic clutch on/off rapidly           *High pressure over specification           *Lukewarm air from nozzle |  | Recharge refrigerant following specification |
|   | Shortage of refrigerant  | Make up refrigerant                          |
|   | Clogged receive dryer  | Replace<br>receive dryer                     |
| Lower pressure than<br>normal condition at<br>low side  | Clogged expansion valve  | Replace<br>expansion valve                   |
|   | Clogged or crushed pipe  | Replace pipe or clean                        |
|   | Failure of duct sensor   | Replace duct sensor                          |

## 5) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

## 6) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

| Cause   | Check   | Remedy                                    |
|---|---|---|
| Lower pressure than<br>normal condition at<br>low side  | Failure of duct sensor<br>Magnetic clutch off before air<br>temperature sufficiently down       | Replace duct sensor<br>or adjust location |
|   | Defective compressor gasket<br>When compressor off, high and low<br>pressure balance immediatly | Repair compressor<br>or Replace           |
| Higher pressure than                                    | Failure of condensing<br>Contamination on condenser or<br>insufficient air flow from fan        | Clean the condenser<br>Repair fan         |
| normal condition at high side                           | Overcharge of refrigerant   | Adjust refrigerant                        |
|   | Entrained air   | Vacuum and recharge                       |
| Lower pressure than<br>normal condition at<br>high side | Shortage of refrigerant   | Make up refrigerant                       |

| Group | 1 | Operational Performance Test | 6-1  |
|-------|---|------------------------------|------|
| Group | 2 | Major Components             | 6-19 |

# SECTION 6 MAINTENANCE STANDARD

# **GROUP 1 OPERATIONAL PERFORMANCE TEST**

#### 1. PURPOSE

Performance tests are used to check:

### 1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

Whenever a new machine is delivered in parts and reassembled at a customer's site, it must be tested to confirm that the operational performance of the machine meets HD Hyundai Construction Equipment spec.

#### 2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

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

#### 3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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



55W76MS01

## 2. TERMINOLOGY

#### 1) STANDARD

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



55W76MS02

#### 2) SERVICE LIMIT

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



## 3. OPERATION FOR PERFORMANCE TESTS

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

#### (1) The machine

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

#### (2) Test area

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

#### (3) Precautions

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

#### (4) Make precise measurements

- ① Accurately calibrate test instruments in advance to obtain correct data.
- ② Carry out tests under the exact test conditions prescribed for each test item.
- ③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.

7-3 (140-7)

## 2) ENGINE SPEED

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

#### (2) Preparation

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

#### (3) Measurement

- ① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.
- ② Measure and record the engine speed at each mode (P, S).
- ③ Select the P-mode.
- ④ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.
- <sup>(5)</sup> Measure and record the auto deceleration speed.



#### (4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

| Model  | Engine speed | Standard | Remark |
|--------|--------------|----------|--------|
| HW65AH | Start idle   | 1000±50  |        |
|        | P mode       | 2300±50  |        |
|        | S mode       | 1950±50  |        |
|        | Auto decel   | 1100±50  |        |

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

#### 3) TRAVEL SPEED

 Measure the time required for the excavator to travel a 50m at high speed and a 20m at low speed test run.

#### (2) Preparation

- ① Adjust the pressure of both tires to be equal.
- <sup>(2)</sup> Prepare a flat and solid test track 50m in length, with extra length of 150m for machine acceleration.
- ③ Set the traveling position as figure.
- (4) Keep the hydraulic oil temperature at  $50\pm5^{\circ}$ C.

#### (3) Measurement

- ① Measure both the low and high speed of the machine.
- ② Before starting either the low or high speed tests, adjust the RH multifunction switch to the speed to be tested.
- ③ Start traveling the machine in the extra length with the two speed switch at high or low speed.
- ④ Measure the time required to travel 50m at high speed or 20m at low speed.
- ⑤ After measuring the forward travel speed, turn the upperstructure 180° and measure the reverse travel speed.
- 6 Repeat steps ④ and ⑤ three times in each direction and calculate the average values.

#### (4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

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| Model  | Travel speed | Standard | Maximum allowable | Remarks     |
|--------|--------------|----------|-------------------|-------------|
| HW65AH | Low speed    | 5.5±0.5  | 7.9               | Seconds/20m |
|        | High speed   | 6.0±0.5  | 8.4               | Seconds/50m |





#### 4) SWING SPEED

 Measure the time required to swing three complete turns.

#### (2) Preparation

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

#### (3) Measurement

- 1 Operate swing control lever fully.
- ② Swing 1 turn and measure time taken to swing next 2 revolutions.
- ③ Repeat steps ① and ② three time and calculate the average values.

#### (4) Evaluation

The time required for 2 swings should meet the following specifications.

Unit : Seconds / 2 revolutions

| Model  | Standard | Maximum allowable | Remark |
|--------|----------|-------------------|--------|
| HW65AH | 13.9±1.0 | 17.4              | -      |



#### 5) SWING FUNCTION DRIFT CHECK

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

#### (2) Preparation

- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- 3 Lower the dozer blade at ground.
- ④ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
- 5 Make two chalk marks: one on the swing
- 6 bearing and one directly below it on the track frame.

Swing the upperstructure 360°.

 $( \widehat{ } )$  Keep the hydraulic oil temperature at 50±5°C.

#### (3) Measurement

- Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360°.
- ② Measure the distance between the two marks.
- ③ Align the marks again, swing 360°, then test the opposite direction.
- ④ Repeat steps ② and ③ three times each and calculate the average values.

#### (4) Evaluation

The measured drift angle should be within the following specifications.

Unit : Degree

| Model  | Standard | Maximum allowable | Remark |
|--------|----------|-------------------|--------|
| HW65AH | 45 below | 60                | -      |





#### 6) SWING BEARING PLAY

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

#### (2) Preparation

- ① Check swing bearing mounting cap screws for loosening.
- ② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.
- ③ Install a dial gauge on the track frame as shown, using a magnetic base.
- ④ Position the upperstructure so that the boom aligns with the tracks facing towards the front axle.
- ⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.
- 6 Bucket should be empty.

#### (3) Measurement

- With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin. Record the dial gauge reading (h1).
- ② Lower the bucket to the ground and use it to raise the front axle 50 cm.
  - Record the dial gauge reading (h2).
- Galculate bearing play (H) from this data (h1 and h2) as follows.
   H=h2-h1

#### (4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

| Model  | Standard  | Maximum allowable | Remark |
|--------|-----------|-------------------|--------|
| HW65AH | 0.5 ~ 1.2 | 2.4               |        |



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#### 7) HYDRAULIC CYLINDER CYCLE TIME

(1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

#### (2) Preparation

① To measure the cycle time of the boom cylinder.

With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

② To measure the cycle time of the arm cylinder.

With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5m above the ground.

③ To measure the cycle time of the bucket cylinder.

The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

④ Keep the hydraulic oil temperature at 50±5°C.

#### (3) Measurement

1 To measure cylinder cycle times.

#### -Boom cylinder.

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

#### -Arm cylinder.

Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.



#### Arm cylinder



#### Bucket cylinder



#### -Bucket cylinders

Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

- Repeat each measurement 3 times and calculate the average values.

## (4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds Model Maximum allowable Remarks Function Standard Boom raise  $2.2 \pm 0.4$ 2.8 Boom lower  $2.6 \pm 0.4$ 3.3 Arm in 2.3±0.4 2.9 2.8 Arm out  $2.2 \pm 0.3$ Bucket load  $3.5 \pm 0.3$ 4.4 HW65AH 2.9 Bucket dump  $2.3\pm0.4$ Boom swing (LH)  $4.6 \pm 0.7$ 5.75 Boom swing (RH)  $5.5\pm0.7$ 6.9 Dozer up (raise) 2.9  $2.3\pm0.3$ Dozer down (lower)  $2.8 \pm 0.3$ 3.5

#### 8) DIG FUNCTION DRIFT CHECK

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

#### (2) Preparation

- Load bucket fully. Instead of loading the bucket, weight (W) of the following specification can be used.
  - W=M<sup>3</sup>×1.5

Where :

 $M^3$  = Bucket heaped capacity (m<sup>3</sup>) 1.5 = Soil specific gravity

- ② Position the arm cylinder with the rod 20 to 30 mm extended from the fully retracted position.
- ③ Position the bucket cylinder with the rod 20 to 30 mm retracted from the fully extended position.
- ④ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin.
- (5) Keep the hydraulic oil temperature at  $50\pm5^{\circ}$ C.

#### (3) Measurement

- 1 Stop the engine.
- ② Five minutes after the engine has been stopped, measure the changes in the positions of the boom, arm and bucket cylinders.
- ③ Repeat step ② three times and calculate the average values.
- (4) The measured drift should be within the following specifications.



| Unit | ; | mm / | 5min |
|------|---|------|------|
|------|---|------|------|

| Model  | Drift to be measured | Standard | Maximum allowable | Remarks |
|--------|----------------------|----------|-------------------|---------|
|        | Boom cylinder        | 10 below | 5                 |         |
|        | Arm cylinder         | 20 below | 5                 |         |
| ПАСОЛЛ | Bucket cylinder      | 20 below | 5                 |         |
|        | Dozer cylinder       | 10 below | 15                |         |

## 9) CONTROL LEVER OPERATING FORCE

(1) Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

#### (2) Preparation

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

#### (3) Measurement

- 1 Start the engine.
- ② Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.
- ③ Repeat steps ② three times and calculate the average values.

#### (4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

| Model  | Kind of lever | Standard     | Maximum allowable | Remarks |
|--------|---------------|--------------|-------------------|---------|
|        | Boom lever    | 1.4 or below | 1.9               |         |
| HW65AH | Arm lever     | 1.4 or below | 1.9               |         |
|        | Bucket lever  | 1.4 or below | 1.9               |         |
|        | Swing lever   | 1.4 or below | 1.9               |         |

#### 10) CONTROL LEVER STROKE

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

#### (2) Preparation

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

#### (3) Measurement

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

#### (4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

| Model  | Kind of lever | Standard | Maximum allowable | Remarks |
|--------|---------------|----------|-------------------|---------|
|        | Boom lever    | 82±10    | 103               |         |
|        | Arm lever     | 82±10    | 103               |         |
| ПАСОЛЛ | Bucket lever  | 82±10    | 103               |         |
|        | Swing lever   | 82±10    | 103               |         |

#### **11) PILOT PRIMARY PRESSURE**

#### (1) Preparation

- ① Stop the engine.
- ② Push the pressure release button to bleed air.
- ③ Loosen and remove plug on the pilot pump delivery port (A4) and connect pressure gauge.
- ④ Start the engine and check for oil leakage from the port.
- (5) Keep the hydraulic oil temperature at  $50\pm5^{\circ}$ C.

#### (2) Measurement

① Measure the primary pilot pressure at rated rpm.

#### (3) Evaluation

The average measured pressure should meet the following specifications:

Unit: kgf/cm<sup>2</sup>

HW60A6MA14

| Model  | Standard | Remark |
|--------|----------|--------|
| HW65AH | 30±5     |        |



#### 12) FOR TRAVEL SPEED SELECTING PRESSURE:

#### (1) Preparation

- ① Stop the engine.
- <sup>(2)</sup> Push the pressure release button to bleed air.
- <sup>(3)</sup> To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint D, E port as shown.
- ④ Start the engine and check for on leakage from the adapter.
- (5) Keep the hydraulic oil temperature at  $50\pm5^{\circ}$ C.

#### (2) Measurement

- ① Lower the bucket and dozer blade to the ground to raise the tires off the ground.
- ② Select the following switch positions. Parking switch : OFF
- ③ Measure the travel speed selecting pressure in the Hi or Lo position.
- ④ Operate the travel speed switch turns to the high or low position and measure the port D (high) or E (low) pressure.
- ⑤ Repeat steps ③ three times and calculate the average values.

#### (3) Evaluation

The average measured pressure should be within the following specifications.

| Turning |         |
|---------|---------|
|         | E gauge |
| 000     |         |
|         |         |

55W76MS15

| Madal  | Travel speed mode | Stan   | idard Maximum allowable |   | Pomarka |
|--------|-------------------|--------|-------------------------|---|---------|
| Model  | Traver speed mode | D port | E port                  |   | nemains |
|        | Low speed         | -      | 30±5                    | - |         |
| ПАСОЛЛ | High speed        | 30±5   | -                       | - |         |

Unit : kgf / cm<sup>2</sup>

#### 13) SWING PARKING BRAKE RELEASING PRESSURE

#### (1) Preparation

- 1 Stop the engine.
- <sup>(2)</sup> Push the pressure release button to bleed air.
- ③ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
- ④ Start the engine and check for oil leakage from the adapter.
- (5) Keep the hydraulic oil temperature at  $50\pm5^{\circ}$ C.

#### (2) Measurement

 Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.



55W76MS16

② Repeat three times and calculate the average values.

#### (3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm<sup>2</sup>

| Model   | Description      | Standard | Remarks |
|---------|------------------|----------|---------|
|         | Brake disengaged | 30±5     |         |
| ПАСОЛИЦ | Brake applied    | 0        |         |

#### 14) MAIN PUMP DELIVERY PRESSURE

#### (1) Preparation

- 1 Stop the engine.
- <sup>(2)</sup> Push the pressure release button to bleed air.
- ③ To measure the main pump pressure.
   Install a connector and pressure gauge assembly main pump gauge port (1G, 2G) as shown.
- ④ Start the engine and check for oil leakage from the port.
- (5) Keep the hydraulic oil temperature at  $50\pm5^{\circ}$ C.

#### (2) Measurement

① Measure the main pump delivery pressure at high idle.

#### (3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm<sup>2</sup>

HW60A6MA17

| Model  | Engine speed | Standard | Allowable limits | Remarks |
|--------|--------------|----------|------------------|---------|
| HW65AH | High ilde    | 20±5     | -                |         |



#### 15) SYSTEM PRESSURE REGULATOR RELIEF SETTING

#### (1) Preparation

- ① Stop the engine.
- <sup>(2)</sup> Push the pressure release button to bleed air.
- ③ To measure the system relief pressure. Install a connector and pressure gauge assembly main pump gauge port, as shown.
- ④ Start the engine and check for oil leakage from the port.
- (5) Keep the hydraulic oil temperature at  $50\pm5^{\circ}$ C.

### (2) Measurement

- Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.
- ② In the swing function, place bucket against an immovable object and measure the relief pressure.
- ③ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.

#### (3) Evaluation

The average measured pressure should be within the following specifications.

| 커플링   |
|-------|
|       |
|       |
|       |
| A2    |
|       |
|       |
| 메인 펌프 |

HW60A6MA17

|        |                       | Unit : kgf / cm <sup>2</sup> |
|--------|-----------------------|------------------------------|
| Model  | Function to be tested | Standard                     |
| HW65AH | Boom, Arm, Bucket     | 220±10                       |
|        | Travel                | 220±10                       |
|        | Swing                 | 220±10                       |

# **GROUP 2 MAJOR COMPONENT**

#### 1. MAIN PUMP

Before inspection, wash the parts well and dry them completely.

Inspect the principal parts with care and replace them with new parts when any abnormal wear exceeding the allowable limit or damage considered harmful is found.

Replace the seal also when any remarkable deformation and damage are found.

## 1) PISTON ASSEMBLY AND CYLINDER BLOCK

- Check the appearance visually. No damage, scouring, abnormal wear (particularly, in the slide portion) should be found.
- (2) Check the clearance between the piston outside dia and cylinder block inside dia. D-d  $\leq$  0.050 mm

#### 2) PISTON SHOE AND PISTON

- (1) Check the axial play of the piston and piston shoe.
  - $\epsilon \leq 0.2$ mm



#### 3) SHAFT

(1) Check the wear amount of the oil seal mounting section. Wear mount  $\leq 0.025$  mm



## 4) CONTROL PLATE

 Check the slide surface for any damage. When the damage is large, replace the plate with new one.



#### 5) GUIDE AND RETAINER

- Check for scouring or stepped wear.
   If this can not be corrected, replace the guide and retainer with new full-set.
- (2) Fine scouring or damage can be corrected with lapping.Carry out thorough washing after lapping.



# 2. MAIN CONTROL VALVE

| Part name           | Inspection item  | Criteria & measure   |
|---------------------|--|--|
| Block               | Existence of scratch, rusting or corrosion.  | <ul> <li>In case of damage in following section, replace<br/>part.</li> </ul>  |
|                     |  | <ul> <li>Sliding sections of casing fore and spool, especially land sections applied with holded pressure.</li> <li>Seal pocket section where spool is inserted.</li> <li>Seal section of port where O-ring contacts.</li> <li>Seal section of each relief valve for main, travel, and port.</li> <li>Other damages that may damage normal functions.</li> </ul> |
| Spool               | <ul> <li>Existence of scratch, gnawing, rusting or<br/>corrosion.</li> </ul>       | <ul> <li>Replacement when its outside sliding section<br/>has scratch(Especially on seals-contacting<br/>section).</li> </ul>  |
|                     | <ul> <li>O-ring seal sections at both ends.</li> </ul>                             | <ul> <li>Replacement when its sliding section has<br/>scratch.</li> </ul>  |
|                     | <ul> <li>Insert spool in casing hole, rotate and<br/>reciprocate it.</li> </ul>    | <ul> <li>Correction or replacement when O-ring is<br/>damaged or when spool does not move<br/>smoothly.</li> </ul>   |
| Poppet              | Damage of poppet or spring   | Correction or replacement when sealing is incomplete.  |
|                     | Insert poppet into casing and function it.   | <ul> <li>Normal when it can function lightly without<br/>being caught.</li> </ul>  |
| Around spring       | Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover. | Replacement for significant damage.  |
| Around seal         | · External oil leakage.  | · Correction or replacement.   |
| for spool           | <ul> <li>Rusting, corrosion or deformation of seal<br/>plate.</li> </ul>           | Correction or replacement.   |
| Main relief valve   | External rusting or damage.  | · Replacement.   |
| & port relief valve | · Contacting face of valve seat.   | Replacement when damaged.  |
|                     | Contacting face of poppet.   | Replacement when damaged.  |
|                     | Abnormal spring.   | · Replacement.   |
|                     | $\cdot$ O-rings, back up rings and seals.  | · 100% replacement in general.   |

# 3. SWING DEVICE

# 1) WEARING PARTS

| Inspection item  | Standard dimension | Recommended<br>replacement<br>value | Counter measures                    |
|--|--------------------|-------------------------------------|-------------------------------------|
| Clearance between piston and cylinder block bore           | 0.020              | 0.045                               | Replace piston or cylinder block    |
| Play between piston and shoe caulking section ( $\delta$ ) | 0                  | 0.3                                 | Replace assembly of piston and shoe |
| Thickness of shoe (t)                                      | 4                  | 3.8                                 | Replace assembly of piston and shoe |
| Combined height of set plate and guide (H)                 | 17.4               | 17                                  | Replace set of set plate and guide  |
| Thickness of friction plate                                | 3.6                | 3.2                                 | Replace                             |
|  |                    |                                     | <br>H                               |

## 2) SLIDING PARTS

| Part name   | Standard roughness | Remark |
|-------------|--------------------|--------|
| Shoe        | 0.8S               |        |
| Shoe plate  | 0.8S               |        |
| Cylinder    | 0.8S               |        |
| Valve plate | 0.8S               |        |

## 4. TRAVEL MOTOR

1) Free of corrosion, erosion or fretting; no damage to splines or keyways.



#### 2) Pistons

No scoring and no pittings.



## 3) Center pin

No scoring and no pittings.



## 4) Retaining plate

No scoring and no evidence of wear.



## 5) Cylinder block/control lens

- ① Bores free of scoring, no evidence of wear.
- <sup>(2)</sup> Faces smooth and even, free of cracks and scoring.



#### 6) Control housing

Sliding surface and side guides free of scoring and no wear.



## 7) Visual check

Bearing areas free of scoring and no evidence of wear.



# 5. RCV LEVER

| Maintenance<br>check item | Criteria   | Remark  |
|---------------------------|--|---|
| Leakage                   | The valve is to be replaced when the leakage becomes<br>more than 1000 cc/m at neutral handle position, or more<br>than 2000 cc/m during operation.  | Conditions :<br>Primary pressure : 30 kgf/cm <sup>2</sup><br>Oil viscosity : 23 cSt     |
| Spool                     | This is to be replaced when the sliding surface has worn more than 10 $\mu$ m, compared with the non-sliding surface.  | The leakage at the left condition is estimated to be nearly equal to the above leakage. |
| Push rod                  | This is to be replaced when the top end has worn more than 1mm.  |   |
| Play at operating section | The pin, shaft, and joint of the operating section are to<br>be replaced when their plays become more than 2 mm<br>due to wears or so on.  | When a play is due to looseness of a tightened section, adjust it.                      |
| Operation stability       | When abnormal noises, hunting, primary pressure drop,<br>etc. are generated during operation, and these cannot<br>be remedied, referring to section 6 troubleshooting,<br>replace the related parts. |   |

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

# 6. ACCELERATOR PEDAL

| Maintenance<br>check item | Criteria   | Remark  |
|---------------------------|--|---|
| Leakage                   | The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.   | Conditions :<br>Primary pressure : 30 kgf/cm <sup>2</sup><br>Oil viscosity : 23 cSt     |
| Spool                     | This is to be replaced when the sliding surface has worn more than $10\mu$ m, compared with the non-sliding surface.   | The leakage at the left condition is estimated to be nearly equal to the above leakage. |
| Push rod                  | $\underbrace{1 \text{ mm}}_{\text{m}} \underbrace{\varphi_{7}}_{\text{m}} \bigotimes$ This is to be replaced when th top end has worn more than 1mm.   |   |
| Play at operating section | The pin, shaft, and joint of the operating section are to<br>be replaced when their plays become more than 2mm<br>due to wears or so on.   | When a play is due to looseness of a tightened section, adjust it.                      |
| Operation stability       | When abnormal noises, hunting, primary pressure drop,<br>etc. are generated during operation, and these cannot<br>be remedied, referring to section 6 troubleshooting,<br>replace the related parts. |   |

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

# 7. TURNING JOINT

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

# 8. CYLINDER

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

# 9. WORK EQUIPMENT



HW606MS30

Unit : mm

|      |                                      |                 | Pin                         |                 | Bushing                     |                 | Domodu  |  |
|------|--------------------------------------|-----------------|-----------------------------|-----------------|-----------------------------|-----------------|---------|--|
| Mark | Measuring point<br>(pin and bushing) | Normal<br>value | Recomm.<br>service<br>limit | Limit<br>of use | Recomm.<br>service<br>limit | Limit<br>of use | Remark  |  |
| А    | Boom Rear                            | 55              | 54                          | 53.5            | 55.5                        | 56              | Replace |  |
| В    | Boom Cylinder Head                   | 60              | 59                          | 58.5            | 60.5                        | 61              | "       |  |
| С    | Boom Cylinder Rod                    | 60              | 59                          | 58.5            | 60.5                        | 61              | "       |  |
| D    | Arm Cylinder Head                    | 50              | 49                          | 48.5            | 50.5                        | 51              | "       |  |
| E    | Boom Front                           | 50              | 49                          | 48.5            | 50.5                        | 51              | "       |  |
| F    | Arm Cylinder Rod                     | 50              | 49                          | 48.5            | 50.5                        | 51              | "       |  |
| G    | Bucket Cylinder Head                 | 45              | 44                          | 43.5            | 45.5                        | 46              | "       |  |
| Н    | Arm Link                             | 45              | 44                          | 43.5            | 45.5                        | 46              | "       |  |
| I    | Bucket and Arm Link                  | 45              | 44                          | 43.5            | 45.5                        | 46              | "       |  |
| J    | Bucket Cylinder Rod                  | 45              | 44                          | 43.5            | 45.5                        | 46              | "       |  |
| К    | Bucket Link                          | 45              | 44                          | 43.5            | 45.5                        | 46              | "       |  |
| L    | Boom swing post                      | 110             | 109                         | 108.5           | 110.5                       | 111             | "       |  |
| М    | Boom swing cylinder                  | 50              | 49                          | 48.5            | 50.5                        | 51              | "       |  |
| Ν    | Blade cylinder                       | 55              | 54                          | 53.5            | 55.5                        | 56              | "       |  |
| 0    | Blade and frame link                 | 35              | 34                          | 33.5            | 35.5                        | 36              | "       |  |

# SECTION 7 DISASSEMBLY AND ASSEMBLY

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# SECTION 7 DISASSEMBLY AND ASSEMBLY

# **GROUP 1 PRECAUTIONS**

#### **1. REMOVAL WORK**

- 1) Lower the work equipment completely to the ground. If the coolant contains antifreeze, dispose of it correctly.
- 2) After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
- 3) When draining oil, prepare a container of adequate size to catch the oil.
- 4) Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.
- 6) Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
- 7) Check the number and thickness of the shims, and keep in a safe place.
- 8) When raising components, be sure to use lifting equipment of ample strength.
- 9) When using forcing screws to remove any components, tighten the forcing screws alternately.
- Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.
- 11) When removing hydraulic equipment, first release the remaining pressure inside the hydraulic tank and the hydraulic piping.

| Nominal | Dimensions |      |    |  |
|---------|------------|------|----|--|
| number  | D          | d    | L  |  |
| 06      | 6          | 5    | 8  |  |
| 08      | 8          | 6.5  | 11 |  |
| 10      | 10         | 8.5  | 12 |  |
| 12      | 12         | 10   | 15 |  |
| 14      | 14         | 11.5 | 18 |  |
| 16      | 16         | 13.5 | 20 |  |
| 18      | 18         | 15   | 22 |  |
| 20      | 20         | 17   | 25 |  |
| 22      | 22         | 18.5 | 28 |  |
| 24      | 24         | 20   | 30 |  |
| 27      | 27         | 22.5 | 34 |  |





#### 2. INSTALL WORK

- 1) Tighten all bolts and nuts (sleeve nuts) to the specified torque.
- 2) Install the hoses without twisting or interference.
- 3) Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- 4) Bend the cotter pin or lock plate securely.
- 5) When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.
- 6) When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- 7) Clean all parts, and correct any damage, dents, burrs, or rust.
- 8) Coat rotating parts and sliding parts with engine oil.
- 9) When press fitting parts, coat the surface with antifriction compound (LM-P).
- 10) After installing snap rings, check that the snap ring is fitted securely in the ring groove (check that the snap ring moves in the direction of rotation).
- 11) When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- 12) When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.
- 13) When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.
- 14) When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:
- (1) Start the engine and run at low idling.
- (2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100 mm before the end of the stroke.
- (3) Next, operate the piston rod to the end of its stroke to relieve the circuit. (The air bleed valve is actuated to bleed the air.)
- (4) After completing this operation, raise the engine speed to the normal operating condition.
- If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to the work equipment.
- \* Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

## **3. COMPLETING WORK**

- 1) If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- 2) If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- 3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.
- 4) Add the specified amount of grease (molybdenum disulphied grease) to the work equipment related parts.
# **GROUP 2 TIGHTENING TORQUE**

### **1. MAJOR COMPONENTS**

| No   | Io. Descriptions |                                       | Polt oizo        | Torque   |           |
|------|------------------|---------------------------------------|------------------|----------|-----------|
| INO. |                  |                                       | DUILSIZE         | kgf ∙ m  | lbf ∙ ft  |
| 1    |                  | Engine mounting bolt (engine-Bracket) | $M10 \times 1.5$ | 6.9±1.0  | 50±7.2    |
| 2    |                  | Engine mounting bolt (bracket-Frame)  | M16 	imes 2.0    | 25±2.5   | 181±18.1  |
| 3    | Engine           | Radiator mounting bolt, nut           | M10 $	imes$ 1.5  | 6.9±1.4  | 50±10.0   |
| 4    |                  | Coupling mounting socket bolt         | M 8 × 1.25       | 1.8±0.2  | 13±1.4    |
| 4    |                  | Coupling mounting clamp socket bolt   | M10 × 1.5        | 6.0±1.0  | 43.4±7.2  |
| 5    |                  | Main pump mounting bolt               | M12 × 1.75       | 12.3±3.0 | 92±22.0   |
| 6    |                  | Main pump housing mounting bolt       | M 8 × 1.25       | 2.5±0.5  | 18±3.6    |
| 7    |                  | Main control valve mounting bolt      | M12 × 1.75       | 14.7±2.2 | 106±15.9  |
| 8    | Hydraulic        | Travel motor mounting bolt            | M16 × 2.0        | 29.7±4.5 | 215±33    |
| 9    | - Oyotom         | Fuel tank mounting bolt               | M16 × 2.0        | 29.7±4.5 | 215±33    |
| 10   |                  | Hydraulic oil tank mounting bolt      | M12 × 1.75       | 14.7±2.2 | 106±16.0  |
| 11   |                  | Turning joint mounting bolt, nut      |                  |          |           |
| 12   |                  | Swing motor mounting bolt             | M16 × 2.0        | 29.7±4.5 | 215±33.0  |
| 13   | _                | Swing bearing upper mounting bolt     | M16 × 2.0        | 29.7±4.5 | 215±33.0  |
| 15   |                  | Swing bearing lower mounting bolt     | M16 × 2.0        | 29.7±4.5 | 215±33.0  |
| 16   |                  | Front axle mounting bolt, nut         | M16 × 2.0        | 29.7±4.5 | 215±33.0  |
| 17   | Power            | Rear axle mounting bolt, nut          | M16 × 2.0        | 29.7±4.5 | 215±33.0  |
| 18   | train            | Gear box mounting bolt                | M14 × 2.0        | 19.6±2.9 | 142±21.0  |
| 19   | system           | Oscillating cylinder mounting bolt    | M16 × 2.0        | 29.7±4.5 | 215±33.0  |
| 20   |                  | Oscillating cylinder support bolt     | M12 × 1.75       | 12.8±3.0 | 92.6±22.0 |
| 21   |                  | Wheel nut                             | M18 × 1.5        | 46.0±3.0 | 333±22.0  |
| 22   |                  | Front drive shaft mounting bolt, nut  | M10 × 1.25       | 7.4±1.5  | 53.5±11.0 |
| 23   | 3                | Rear drive shaft mounting bolt, nut   | M10 × 1.25       | 7.4±1.5  | 53.5±11.0 |
| 24   |                  | Counterweight mounting bolt           | $M20 \times 2.5$ | 57.8±6.4 | 418±46.3  |
| 25   | Others           | Cab mounting bolt, nut                | M12 × 1.75       | 12.8±3.0 | 92±22.0   |
| 26   | ]                | Operator's seat mounting bolt         | M 8 × 1.25       | 1.17±0.1 | 8.5±0.7   |

## 2. TORQUE CHART

Use following table for unspecified torque.

## 1) BOLT AND NUT

## (1) Coarse thread

| Bolt size      | 8T          |             | 10T         |             |
|----------------|-------------|-------------|-------------|-------------|
| DOIL SIZE      | kg∙m        | lb ∙ ft     | kg∙m        | lb∙ft       |
| M 6×1.0        | 0.85 ~ 1.25 | 6.15 ~ 9.04 | 1.14 ~ 1.74 | 8.2 ~ 12.6  |
| M 8×1.25       | 2.0 ~ 3.0   | 14.5 ~ 21.7 | 2.7 ~ 4.1   | 19.5 ~ 29.7 |
| M10 × 1.5      | 4.0 ~ 6.0   | 28.9 ~ 43.4 | 5.5 ~ 8.3   | 39.8 ~ 60   |
| M12 	imes 1.75 | 7.4 ~ 11.2  | 53.5 ~ 81.0 | 9.8 ~ 15.8  | 70.9 ~ 114  |
| M14 × 2.0      | 12.2 ~ 16.6 | 88.2 ~ 120  | 16.7 ~ 22.5 | 121 ~ 163   |
| M16 × 2.0      | 18.6 ~ 25.2 | 135 ~ 182   | 25.2 ~ 34.2 | 182 ~ 247   |
| M18 × 2.5      | 25.8 ~ 35.0 | 187 ~ 253   | 35.1 ~ 47.5 | 254 ~ 344   |
| M20 × 2.5      | 36.2 ~ 49.0 | 262 ~ 354   | 49.2 ~ 66.6 | 356 ~ 482   |
| M22 	imes 2.5  | 48.3 ~ 63.3 | 349 ~ 458   | 65.8 ~ 98.0 | 476 ~ 709   |
| M24 	imes 3.0  | 62.5 ~ 84.5 | 452 ~ 611   | 85.0 ~ 115  | 615 ~ 832   |
| M30 × 3.0      | 124 ~ 168   | 898 ~ 1214  | 169 ~ 229   | 1223 ~ 1656 |
| M36 × 4.0      | 174 ~ 236   | 1261 ~ 1704 | 250 ~ 310   | 1808 ~ 2242 |

## (2) Fine thread

|            | 8T          |             | 10T         |             |
|------------|-------------|-------------|-------------|-------------|
| DOIL SIZE  | kg∙m        | lb∙ft       | kg∙m        | lb ∙ ft     |
| M 8×1.0    | 2.2 ~ 3.4   | 15.9 ~ 24.6 | 3.0 ~ 4.4   | 21.7 ~ 31.8 |
| M10 × 1.2  | 4.5 ~ 6.7   | 32.5 ~ 48.5 | 5.9 ~ 8.9   | 42.7 ~ 64.4 |
| M12 × 1.25 | 7.8 ~ 11.6  | 56.4 ~ 83.9 | 10.6 ~ 16.0 | 76.7 ~ 116  |
| M14 × 1.5  | 13.3 ~ 18.1 | 96.2 ~ 131  | 17.9 ~ 24.1 | 130 ~ 174   |
| M16 × 1.5  | 19.9 ~ 26.9 | 144 ~ 195   | 26.6 ~ 36.0 | 192 ~ 260   |
| M18 × 1.5  | 28.6 ~ 43.6 | 207 ~ 315   | 38.4 ~ 52.0 | 278 ~ 376   |
| M20 × 1.5  | 40.0 ~ 54.0 | 289 ~ 391   | 53.4 ~ 72.2 | 386 ~ 522   |
| M22 × 1.5  | 52.7 ~ 71.3 | 381 ~ 516   | 70.7 ~ 95.7 | 511 ~ 692   |
| M24 × 2.0  | 67.9 ~ 91.9 | 491 ~ 665   | 90.9 ~ 123  | 658 ~ 890   |
| M30 × 2.0  | 137 ~ 185   | 990 ~ 1339  | 182 ~ 248   | 1314 ~ 1796 |
| M36 × 3.0  | 192 ~ 260   | 1390 ~ 1880 | 262 ~ 354   | 1894 ~ 2562 |

## 2) PIPE AND HOSE (FLARE type)

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

## 3) PIPE AND HOSE (ORFS type)

| Thread size (UNF) | Width across flat (mm) | kgf ∙ m | lbf ⋅ ft |
|-------------------|------------------------|---------|----------|
| 9/16-18           | 19                     | 4       | 28.9     |
| 11/16-16          | 22                     | 5       | 36.2     |
| 13/16-16          | 27                     | 9.5     | 68.7     |
| 1-3/16-12         | 36                     | 18      | 130      |
| 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      |

## **GROUP 3 PUMP DEVICE**

#### **1. REMOVAL AND INSTALL**

#### 1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- (4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.
  - Hydraulic tank quantity : 70 l

(18.5 U.S.gal)

- (5) Disconnect hydraulic hoses (22, 64, 65).
- (6) Remove socket bolts (83) and disconnect pump suction pipe (10).
- When pump suction pipe is disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (7) Sling the pump assembly and remove the pump mounting bolts.

• Weight : 30 kg (70 lb)

\* Pull out the pump assembly from housing.

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





#### 2) INSTALL

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

## 2. STRUCTURE (1/9)



- 4 Port plate
- 5 Spring seat
- 6 Control piston
- 11 Air vent valve

### 13 Spring

14 Spring

- 23 Screw-Hex Socket
- 25 O-ring
- 26 O-ring



7-9

STRUCTURE (3/9)



## STRUCTURE (5/9)



HW60A7MP105

- 1 Port plate
- 2 Control plate
- 3 Dowel pin
- 4 Screw-Hex Socket
- 5 O-ring

- 6 O-ring
- 7 Double breakoff pin
- 10 Bearing
- 12 O-ring
- 13 Screw-Hex Socket
- 14 Filter
- 15 Retaining ring (C type)
- 16 Double breakoff pin
- 17 Plug

## STRUCTURE (6/9)



- 1 Spring seat
- 2 Spring seat
- 3 Cover
- 4 Adjusted screw
- 7 O-ring
- 8 Screw-Hex Socket
- 9 Screw-Hex
- 34 Shim

- 44 Shim
- 54 Shim
- 64 Shim

## STRUCTURE (7/9)



Cylinder 1

Piston

Dowel pin

2

3

- Dowel pin 4
- 5 Spring seat
- 6 Hex socket cap screw
- Disc spring 7
- O-ring 8
- 9 O-ring

STRUCTURE (8/9)



Guide 11

- 17 Square ring
- 18 Hex socket cap screw
- 28 Filter
- 32 O-ring

# STRUCTURE (9/9)





- 1 Frame
- 2 Housing
- 3 Gear
- 4 Gear
- 5 Thrust plate

- 6 Metal
- 7 Backup ring
- 8 Dowel pin
- 9 Square ring
- Coupling Assy 10
- Hex socket cap screw
- 13 O-ring

## **3. NECESSARY TOOLS AND JIGS**

### 1) Tools

The followings tools and jigs are necessary to disassemble and reassemble the pump.

| Name                      | Quantity     | Size (nominal)                                   |
|---------------------------|--------------|--|
| Hexagon socket screw key  | One each     | 5,6,8,10   |
| Spanner                   | One each     | 14,19,21,24                                      |
| Plastic hammer            | 1            | Medium size                                      |
| Pliers for retaining ring | 1            | For hole (retaining ring for 72)                 |
| Pliers for retaining ring | 1            | For shaft (retaining ring for 30)                |
| Standard screwdriver      | 2            | Medium size                                      |
| Torque wrench             | -            | Wrench which can tighten at the specified torque |
| Grease                    | Small amount |  |
| Adhesives                 | Small amount | LOCTITE # 245 or # 243                           |

### 2) Jigs

(1) Disassemble table



R55NM7HP01

This is a plate to stand the pump facing downward.

A square block may be used instead of the shaft and does not contact.

### (2) Bearing assembling jig



R55NM7HP02

## (3) Tightening torque

| Port name                | Polt oizo | Torque    |           | Wrench size |    |
|--------------------------|-----------|-----------|-----------|-------------|----|
| Faithaine                |           | kgf ∙ m   | lbf ⋅ ft  | in          | mm |
|                          | M 6       | 1.3~1.5   | 9.4~10.0  | 0.20        | 5  |
|                          | M 8       | 3.0~3.6   | 21.7~25   | 0.24        | 6  |
| Hexagon socket head bolt | M12       | 5.6~7.0   | 40~50     | 0.31        | 8  |
|                          | M16       | 10.0~12.4 | 72.3~90.2 | 0.39        | 10 |
|                          | M18       | 34.0      | 246       | 0.55        | 14 |

### 4. DISASSEMBLY PROCEDURE

## 1) DISASSEMBLING THE GEARED PUMP

- ① Remove the hexagon socket head cap screws. (M8 × 40, 2 pieces) Hexagon socket screw key. (Hex. side distance : 6)
- Be careful because the O-rings (at 4pieces) are provided to the body.

## 2) DISASSEMBLING THE GEAR PUMP

- ① Remove the cover. Remove the hexagon socket heas cap screws. (M10  $\times$  25.2 pieces) Hexagon socket screw key. (Hex. side distance : 8)
- Be careful because the O-rings (at 3pieces) and filter are provided to the port plate.
- $\ensuremath{\textcircled{}}$  Remove the coupling and bush.



HW60A7MP01



HW60A7MP02



HW60A7MP03

#### 3) DISASSEMBLING THE GEAR PUMP

(2) Removing the port plate in a horisontal condition.

Remove the hexagon socket heas cap screws. (M12  $\times$  30.3 pieces) (M12  $\times$  55.1 piece) Hexagon socket screw key. (Hex. side distance : 10)

- \* Be careful because the control plate is provided to the back site.
- When the plate is difficult to remove, knock lightly with a plastic hammer. Removing the port plate.



HW60A7MP04

(2) Remove the port plate.



HW60A7MP05

(3) The removal of the control spring. Remove two springs (inner and outer).



HW60A7MP06





HW60A7MP07

(5) Lay the pump on the side and take out the rotary group from the shaft.



(6) Remove the plate.



HW60A7MP09

(7) The removal of the shaft. Remove the retaining ring (for hole: 72)



HW60A7MP10

(8) Use two standard screw-drivers to remove the oil seal case.







(10) Remove it while knocking the shaft rear end lifhrly with a plastic hammer.



HW60A7MP13

HW60A7MP14

(11) Remove the swash plate. Remove the hexagon socket head cap screw (M6x16, 4pieces) and plate. hexagon socket screw key. (Hex. side distance : 5)

(12) Remove the distance piece.



HW60A7MP15



HW60A7MP16

(13) Remove the bearing.

(14) Remove the bearing.



HW60A7MP17

(15) Remove the swash plate.



HW60A7MP18

(16) Remove the port plate. Remove the control plate.

(17) Remove the retaining ring (for hole: 25).

HW60A7MP19



HW60A7MP20

#### (18) The removal of the control piston

Remove the hexagonal socket head cap screws (M8  $\times$  25, 2pieces). Hexagon socket screw key. (Hex. side distance : 6)

\* The threaded portion of the bolt is coated with LOCTITE #245 or #243. This disassembly must therefore be made only when necessary.

- (19) Remove the cylinder and the three pistons.
- \* Be careful because 3 O-rings are provided to the cylinder.



R55NM7HP23



HW60A7MP22



HW65AH7MP23



(20) Remove the piston.

(21) Take out four caned disk springs and spring seats.



HW60A7MP25



HW65AH7MP26

## (22) The removal of the control piston Remove the hexagonal socket head cap screws. (M8 $\times$ 30, 2pieces). Hexagon socket screw key. (Hex. side distance : 6)





HW60A7MP28

(23) Remove the spring seat.

## (24) Disassembly of the shaft

Remove the bearing. Remove the retaining ring. (for shaft 30, 2pieces)



HW60A7MP29

(25) Remove it while knocking the shaft end lightly with a plastic hammer.



HW60A7MP30

## 4) DISASSEMBLING THE GEAR PUMP (G1)

(1) Remove the hexagon socket head cap screws. (M8 x 45, 4pieces) Hexagonal socket screw key (Hex. side distance : 6)



- (2) The removal of the parts
- Side plate.
- Backup ring.
- \_ Squre ring.
- \_ Drive gear and idle gear.



#### 5) DISASSEMBLING THE GEAR PUMP (G1)

- (2) Remove the filter
- ① Remove the hexagon socket head cap screws.
- · Hexagon socket screw key. (Hex. side distance : 8)
- ② Remove the O-ring.
- (3) Remove the intermediate frame.
- (2) Remove the plate, the guides, and the O-rings.



HW60A7MP33



HW60A7MP34

(3) Remove the drive gear, the idle gear, and the side plate.



HW60A7MP35

6) DISASSEMBLING THE BODY. Remove the O-rings.



### 5. MAINTENANCE AND SERVICE STANDARD

Before inspection, wash the parts well and dry them completely. Inspect the principal parts with care and replace them with new parts when any abnormal wear exceeding the allowable limit or damage considered harmful is found.

Replace the seal also when any remarkable deformation and damage are found.

### 1) PISTON ASSEMBLY AND CYLINGDER BLOCK

-Check the appearance visually.

No damage, souring, abnormal wear (particularly, in the side portion) should be found.

Check the clearance between the piston outside dia, and cylinder block inside dia.

 $D-d \le 0.05 \text{ mm}$ 



-Check the axial piston shoe.

 $\epsilon~\leq 0.2~mm$ 





#### 3) SHAFT

-Check the wear amount of the seal mounting section.

Wear amount  $\leq$  0.025 mm



## 4) CONTROL PLATE

Check the side surface for any damage.
 When the damage is large, replace the plate with new one.



HW60A7MP40

### 5) GUIDE AND RETAINER

- -Check for scouring or stepped wear.
- If this can not be corrected, replace the guide and retainer as a set.
- -Fine scouring or damage can be corrected with lapping.

Catty out through washing after lapping.



#### 6.ASSEMBLING PROCEDURE 1) ASSEMBLING THE MAIN PUMP

(2) Assemble the bearing.

(1) Assmbling the main pump. Assemble the hanger into the housing.



HW60A7MP50



HW60A7MP51



HW60A7MP52

- (4) Fix the plate with the hexagon socket head cap screws.
  - (M6imes16, 4pieces)
- . Hexagon socket screws key.

(3) Assemble the distance piece.

Confirm that the pre-load is 0.1±0.02

. (Hex. side distance : 5) Tightening torque : 1.3~1.5 kgf·m



(5) Assembling the shaft.

Fit the shaft into the bearing (with the bearing in the bottom) by using the press and jig.

If the press is not available, use the jig in the similar manner and drive the shaft into the bearing by knocking with a plastic hammer.

(6) Assemble the retaining ring. (for shaft : 30, 2pieces)



HW60A7MP54



HW60A7MP29

(7) Assembling the shaft.Assemble the shaft into the housing.Fix the bearing outer ring firmly into the housing hole.







- (9) Assemble the case with oil seal vertically without tilting.
- \* Apply grease to the oil seal lip beforehand.



HW60A7MP58

(10) Assemble the retaining ring to fix the shaft. (for hole : 72)



HW60A7MP59

(11) Assemble the rotary group.Assemble the pistons (10 pistons) into the retainer.



HW60A7MP60

(12) Apply grease to 3 parallel pins and assemble them to the cylinder block.



(13) Apply grease to the spherical portion of the guide.



HW60A7MP62

- (14) Assemble the guide between the retainer and the cylinder block and assemble the piston into the hole of the cylinder block.
- \* Apply grease to the end part of the shoes.



HW60A7MP63

 (15) Assemble the rotary group.
 To prevent dislodgment, apply grease to the back side of the plate and assemble it to the swash plate.



HW60A7MP64



(16) Assemble the rotary group. Assemble the rotary group along the shaft spline.



HW60A7MP66

(17) Apply grease to the spherical portion of the spring seat before assembling.

(18) Assemly two springs. (inner and outer)



HW60A7MP67



(19) Assempling the port plate.Assemble the spring seats and coned disk springs. (4 pieces)



HW60A7MP25



HW65AH7MP69

(20) Assembling the control piston.



HW60A7MP24



HW65AH7MP70

(21) Apply grease to the O-ring and assemble them to the cylinder.



HW60A7MP71

(22) Apply grease to 3 pistons and assemble 3 pistons into the cylinder.



HW60A7MP72



HW65AH7MP23

- (23) Fix the cylinder with the hexagon socket head cap screws.
  - . (M8×25, 2pieces)
  - Hexagon socket screws key.
- (Hex. side distance : 6)
- Tightening torque : 3.0~3.6 kgf·m Apply LOCTITE #245 (or #243) to the threaded portion of bolt.



(24) Assemble the filter to the port plate.



HW60A7MP20

(25) Assemble the retaining ring. (for hole: 25)



HW60A7MP19

(26) Assemble the spring seat into the port plate.



HW60A7MP19

- (27) Assemble the cover of the control spring and fix it with hexagonal socket headed
- $\cdot$  bolts. (M8  $\times$  30, 2pieces)
- Hexagonal bar spanner (Hex. side distance : 6) Tightening torque : 2.9 ~ 3.5kgf · m



(28) Apply grease to the back side of the control plate, (to prevent dislodgement), and assemble it to the port plate while matching knock holes.



HW60A7MP75

(29) Assemble the O-ring.



HW60A7MP76



HW60A7MP77

(31) Fix the port plate with the hexagon socket head cap screws.

(30) Assemble the port plate parallel to the

housing mounting surface.

(M12×30, 3pieces)

- . (M12×55, 1piece)
- Hexagon bar spanner.
  (Hex. side distance : 10)
  Tightening torque : 10~12.4 kgf·m



#### (32) Assemble the O-ring and bush.



HW60A7MP78

#### 2) ATTACH THE GEAR PUMP

(1) Assemble the coupling to the shaft end on the main pump.



HW60A7MP79

- (2) Connect the main pump and the gear pump and fix the gear pump with the hexagon socket head cap screws.
- . (M10  $\times$  25, 2pieces)
- Hexagon socket screw ke
  (Hex. side distance : 8)
  Tightening torque : 5.6 ~ 7.0kgf · m



HW60A7MP80

#### 3) ATTACH THE VALVE ASSEMBLY

- Fix the body with the hexagon socket head cap screws. (M8  $\times$  40, 2pieces) Hexagon socket screw key.
- . (Hex. side distance : 6)
- . Tightening torque : 3.0 ~ 3.6kgf ⋅ m



#### 4) ASSEMBLING THE GEAR PUMP

 $\scriptstyle (1)$  Assmbling the idle and drive gear into the housing.

Assemble the side plate assy.

Apply grease to the square ring and backup ring to prevent dislodgment and assemble the min this order.



HW60A7MP82



HW65AH7MP83

(2) Assmbling the two parallel pins into the intermediate frame.



HW60A7MP84

- (3) Assemble the intermediate frame.
  - 1.2 Assemble the two parallel pins and O-ring.
  - (3.4) Fix the hexagon socket head cap
  - screws. (M8×45, 4pieces) Hexagon socket screw key. (Hex. side distance : 6)
  - Tightening torque : 3.0 kgf·m



### (4) ASSEMBLE THE GEAR PUMP

Assemble the square ring into the side plate.

※ Pay attention to the suction and delivery directions.



HW60A7MP86



(5) Insert the O-ring into the guides, then insert them into the plate.





- (6) Assemble the plate, guides and O-rings.
- \* Pay attention to the suction and ddlivery directions.



HW60A7MP90



(7) Assamble the square ring.



(8) Assamble the coupling to the drive shaft.


(9) Front gear pump (GSP2) and rear gear pump (G1) are connected.



HW60A7MP94

## (10) ASSEMBLE THE GEAR PUMP

- ① Assemble the O-ring.
- O Fix the hexagon socket head cap screws (M10 $\times$ 90, 4pieces)
- . Hexagon socket screw key.
- . (Hex. side distance : 8) Tightening torque : 5.6 ~ 7.0kgf  $\cdot$  m
- 5) Assemble the body. Assemble the O-ring.



HW60A7MP95



HW60A7MP36

# **GROUP 4 MAIN CONTROL VALVE**

#### **1. REMOVAL AND INSTALL OF MOTOR**

#### 1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Disconnect hydraulic hose.
- (5) Disconnect pilot line hoses.
- (6) Remove link.
- (7) Sling the control valve assembly and remove the control valve mounting bolt.
   Weight : 40 kg (90 lb)
- (8) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

### 2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- (2) Bleed the air from below items.
- ① Cylinder (boom, arm, bucket)
- ② Swing motor
- ③ Travel motor
- \* See each item removal and install.
- (3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.









# 2. STRUCTURE (1/4)



- 1 Cover
- 1-1 Cover
- 1-2 Orifice
- 1-3 Filter
- 1-4 Screw
- 1-5 **O-ring**
- 2 Swing block assy
- 2–1 Work block
- 2-2 Spool assy-Swing
- 2-3 Pilot cap (A)
- 2-4 Pilot cap (B1)
- 2-5 Wrench bolt
- 2-6 Plain washer
- 2-7 **O-ring**
- 2-8 Check poppet
- 2-9 Check spring
- 2-10 Plug
- 2-11 Plug

- 2-12 **O-ring**
- 2-13 O-ring
- 2-14 Screw
- 2-15 Gasket
  - 3 Dozer block
- 3-1 Work block
- 3-2 Dozer spool assy
- 3-3 **O-ring**
- 3-4 Pilot cap (A))
- 3-5 Wrench bolt
- 3-6 Plain washer
- 3-7 Pilot cap (B1)
- 3-8 Check poppet
- 3-9 Check spring
- 3-10 **Plug**
- 3-11 Plug
- 3-12 Anti-cavitation valve
- 3-13 **O-ring**

- 3-14 O-ring
- 3-15 Gasket
- 4 Inlet block assy (P3)

HW60A2MC03

- 4-1 Work block
- 4-2 Select spool
- 4-3 **O-ring**
- 4-4 Pilot cap (A)
- 4-5 Wrench bolt
- 4-6 Plain washer
- 4-7 Pilot cap (B1)
- 4-8 Check poppe
- 4-9 Check spring
- 4-10 **Plug**
- 4-11 Main relief valve
- 4-12 Plug
- 4-15 Gasket
- 17 Tie bolt
- 18 Nut

# STRUCTURE (2/4)



- 5-9 Check spring
- 5-10 Plug assy

5

- 5-11 Overload relief valve
- 5-12 Plug assy
- 5-13 **O-ring**
- 5-14 **O-ring**
- 5-15 Gasket
- Arm 1 block assy 6
- 6-1 Work block
- 6-2 Arm 1 spool assy
- 6-3 **O-ring**
- 6-4 Pilot cap (A1)

- 6-15 Gasket
  - 7 Boom swing spool
- 7-1 Work block
- 7-2 Boom swing spool
- 7-3 **O-ring**
- 7-4 Pilot cap (A)
- 7-5 Wrench bolt
- 7-6 Plain washer
- 7-7 Pilot cap (B1)
- 7-8 Check poppet
- 7-9 Check spring
- 7-10 Plug assy
  - 7-43

HW60A2MC04

- 8-2 Rotator spool assy
- 8-6 Plain washer
- 8-7 Pilot cap (B1)
- 8-8 Check poppet
- 8-9 Check spring
- 8-10 Plug assy
- 8-11 Overload relief valve
- 8-12 **O-ring**
- 8-13 **O-ring**
- 8-15 Gasket
- 8-16 Overload relief valve



## STRUCTURE



## 3. DISASSEMBLY AND ASSEMBLY

## 1) GENERAL PRECAUTIONS

- (1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.
- (2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.
- (3) When a control value is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the value, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the value on it.
- (4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.
- (5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

## 2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

| Name of tool                      | Quantity     | Size (mm)                 |
|-----------------------------------|--------------|---------------------------|
| Vice mounted on bench (soft jaws) | 1 unit       |                           |
| Hexagon wrench                    | Each 1 piece | 5, 6, 10, 12 and 14       |
| Socket wrench                     | Each 1 piece | 5 and 6                   |
| Spanner                           | Each 1 piece | 13, 21 and 30             |
| Rod                               | 1 piece      | Less than $10 \times 250$ |

## 3) DISASSEMBLY

### (1) Disassembly of spools

- Loosen hexagon socket head bolts (5) with washer (6). (Hexagon wrench : 5 mm)
- ② Remove the pilot cover (3).
- \* Pay attention not to lose the O-ring (7) under the pilot cover.
- ③ Remove the spool assembly (2) from the body by hand slightly.
- When extracting each spool from its body, pay attention not to damage the body.
- \* When extracting each spool assembly, it must be extracted from spring side only.
- When any abnormal parts are found, replace it with completely new spool assembly.
- When disassembled, tag the components for identification so that they can be reassembled correctly.





#### (2) Disassembly of holding valve (boom 1)

- Loosen hexagon socket head bolts (7). (hexagon wrench : 5 mm)
- 2 Remove the holding valve.
- \* Pay attention not to lose the O-ring and the poppet under the pilot cover.
- \* Pay attention not to damage the "piston A" under pilot cover.
- When any abnormal parts are found, replace it with completely new holding valve assembly.
- When disassembled, tag the components for identification so that they can be reassembled correctly.





- (3) Disassembly of the load check valve and the negative relief valve
- ① The load check valve
  - a. Fix the body to suitable work bench.
  - \* Pay attention not to damage the body.
  - b. Loosen the plug (10) (hexagon wrench : 10 mm).
  - c. Remove the spring (9) and the load check valve (8) with pincers or magnet.





- (4) Disassembly of the main and overload relief valve
- T is the body to suitable work bench.
- ② Remove the main relief valve (5). (spanner : 30 mm)
- ③ Remove the overload relief valve (12). (spanner : 22 mm)
- When disassembled, tag the relief valve for identification so that they can be reassembled correctly.
- \* Pay attention not to damage seat face.
- When any abnormal parts are found, replace it with completely new relief valve assembly.





# (5) Disassembly of the block assembly

- Tix the body to suitable work bench.
- ② Remove the nut (20).(spanner : 13 mm)
- \* The work block is assembled by two sets of tie-bolts.
- ③ Remove the end cover (1) and the work blocks.
- \* Do not removed the tie bolt.
- \* Pay attention not to lose the O-ring (16).





## (6) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

## ① Control valve

- a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
- b. Confirm that seal groove faces of body and block are smooth and free of dust, dent, rust etc.
- c. Correct dents and damages and check seat faces within the body, if any, by lapping.
- \* Pay careful attention not to leave any lapping agent within the body.
- d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and path's are free foreign matter.
- e. If any spring is broken or deformed, replace it with new one.
- f. When a relief valve does not function properly, repair it, following it's the prescribed disassembly and assembly procedures.
- g. Replace all seals and O-rings with new ones.

## 2 Relief valve

- a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
- b. Confirm manually that main poppet and seat can slide lightly and smoothly.
- c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
- d. Confirm that springs are free from breakage, deformation, and wear.
- e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
- f. Replace all O-rings with new ones.
- g. When any light damage is found in above inspections, correct it by lapping.
- h. When any abnormal part is found, replace it with a completely new relief valve assembly.

## 4) ASSEMBLY

## (1) General precaution

 In this assembly section, explanation only is shown.

For further understanding, please refer to the figures shown in the previous structure & disassembly section.

- <sup>(2)</sup> Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.
- <sup>(3)</sup> Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly.
- ④ Do not stretch seals so much as to deform them permanently.
- ⑤ In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.
- <sup>(6)</sup> Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque.
- ⑦ Do not reuse removed O-rings and seals.

## (2) Load check valve

- ① Assemble the load check valve (8) and spring (9).
- ② Put O-rings on to plug (10).
- $\ensuremath{\textcircled{}}$  3 Tighten plug to the specified torque.
  - · Hexagon wrench : 8 mm
  - $\cdot$  Tightening torque : 3.7 kgf  $\cdot$  m

(26.7 lbf · ft)





- (3) Main relief, port relief valves
- Install the main relief value (5).
  - $\cdot$  Spanner : 30 mm
  - $\cdot$  Tightening torque : 6 kgf  $\cdot$  m (43.4 lbf  $\cdot$  ft)
- 2 Install the over load relief valve (12).
  - · Spanner : 22 mm
  - $\cdot$  Tightening torque : 4 kgf  $\cdot$  m (28.9 lbf  $\cdot$  ft)





# (4) Main spools

- Carefully insert the previously assembled spool assemblies into their respective bores within of body.
- \* Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.



## (5) Covers

- Fit spool covers (3) tighten the hexagonal socket head bolts (5) to the specified torque.
  - · Hexagon wrench : 5 mm
  - $\cdot$  Tightening torque : 1~1.1 kgf  $\cdot$  m (7.2~7.9 lbf  $\cdot$  ft)
- \* Confirm that O-rings (7) have been fitted.



# (6) Holding valve

- Fit the holding valve to the body and tighten hexagon socket head bolt (7) to specified torque.
  - Hexagon wrench : 5 mm
  - Tightening torque : 1.1 kgf m (7.9 lbf ft)





# **GROUP 5 SWING DEVICE**

#### 1. REMOVAL AND INSTALL OF MOTOR

#### 1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Disconnect hose assembly (2, 3).
- (5) Disconnect pilot line hoses (4, 5, 6, 7, 8).
- (6) Sling the swing motor assembly (1) and remove the swing motor mounting bolts (9).
  - Motor device weight : 23 kg (51 lb)
- (7) Remove the swing motor assembly.
- When removing the swing motor assembly, check that all the piping have been disconnected.

#### 2) INSTALL

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







# 2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

# 1) STRUCTURE



HX60A2SM03

- 1 Body
- 2 Oil seal
- 3 Cylinder block
- 4 Shaft
- 5 Taper bearing
- 6 Bushing
- 7 Swash plate
- 8 Spring
- 9 Set plate
- 10 Piston shoe assy
- 11 Ball guide
- 12 Rear cover
- 13 Pin
- 14 O-ring

- 15 Taper bearing
- 16 Valve plate
- 17 Relief valve assy
- 18 Socket bolt
- 19 Plug
- 20 Plug
- 21 O-ring
- 22 Back up ring
- 23 O-ring
- 24 Friction plate
- 25 Plate
- 26 Parking piston
- 27 O-ring
- 28 Spring

- 29 Time delay valve
- 30 Socket bolt
- 31 Plug
- 32 O-ring
- 33 Valve
- 34 Spring
- 35 Plug
- 36 O-ring
- 37 O-ring
- 38 Back up ring
- 39 Name plate
- 40 Rivet

# 2) DISASSEMBLY

- (1) Removal of relief valve assembly
  Remove cap of relief valve assembly (17)
  with 14 mm hexagonal wrench.
- Assemble removed relief valve assembly (17) to original state when reassembling.



 (2) Removal of make up valve and bypass valve assembly
 Loosen plug (35) with 14mm hexagonal wrench, and remove check valve (33) and spring (34).



(3) Marking at swing motor Before disassembling motor, make a matching mark between cover (12) and housing (1) for easy reassembling.





25038SM02(4)

(5) Removal of cover assemblyPlace shaft of motor assembly to downward and take cover (12) out.



(6) Remove inner race of needle bearing (15) by bearing puller.



(7) Remove O-ring (27) from cover.



# (8) Remove balance plate

Valve plate (16) is adhered on end surface of cylinder (3) by oil viscosity. Take off balance plate (16) with hands. Assembling method of balance plate (16) depends on cover (12). (band groove and round groove of high • low pressure transmission area) Before removing, check and record location of balance plate (16) to prevent misassembling.



 (9) Removal of spring (28, brake area)
 Remove spring (28) from piston (26).
 Check and record original position of each spring (28) for correct assembling.



## (10) Removal of brake piston

When removing piston (26) from housing (1), there is a sliding resistance against tightening of O-rings (14,27). Use tap hole on piston (26) as shown in the picture.



(11) Remove O-rings (14,27) from piston (26) and housing (1).



(12) Remove friction plate (24) and lining plate (25) from housing (1).



## (13) Removal of cylinder assembly

Holding end of cylinder assembly (3) with hand, draw out cylinder assembly from housing.

- \* Oil seal (2) and outer race of taper roller bearing (15) are left inside of housing.
- End surface of cylinder (3) is sliding face.
  So, protect the surface with a scrap of cloth against damage.
- Make a matching mark on piston hole of cylinder (3) and piston assembly (10) to fit piston into the same hole when reassembling.
- (14) Separate outer race of taper roller bearing(5) from housing.





#### (15) Removal of oil seal

Remove oil seal (2) from housing (1) with driver and hammer.

\* Do not reuse oil seal after removal.



## (16) Disassembly of cylinder assembly

 Removal of inner race of taper roller bearing (5).

Lift out cylinder block (3) with 2 inner race of roller bearing (5) by applying gear puller at the end of spline in the cylinder.



② Separate shoe plate (7), piston assembly (10), set plate (9) from cylinder block (3).



- ③ Get shoe plate (7) slide on sliding face of piston assembly (10) and remove it.
- \* Be cautious not to damage on sliding face of cam plate.



④ Remove ball guide (11) from cylinder block (3).



This completes disassembly.

# 3) ASSEMBLY

## (1) Preparation

Before reassembling, perform below procedure.

- ① Check each part for damage caused by using or disassembling. If damaged, eliminate damage by grinding with proper sandpaper, wash them with cleaning oil and dry with compressed air.
- <sup>②</sup> Replace seal with new one.
- ③ Grind sliding face of piston assembly (10), balance plate (16) and shoe plate (7) with sandpaper #2000.







- ④ When assembling, lubricate with specified clean hydraulic oil.
- ⑤ When assembling piston assembly (10) to piston hole of cylinder block (3), check matching mark between them.

# (2) Cylinder assembly

- Lubricate grease on round area (contacting area withball guide (11)) of cylinder block (3) and assemble spring (4).
- SM23

SM24

SM25

② Insert piston assembly (10) in hole of set plate (9).

- ③ Assemble piston assembly (10) and set plate (9) to cylinder block (3). When assembling, check matching mark between them. Before assembling, lubricate specified hydraulic oil in piston hole of cylinder block (3).
- and set n assembetween ubricate n hole of
- ④ Lubricate specified hydraulic oil on shoe sliding face of piston assembly (10) and assemble shoe plate (7).



(5) Assemble inner race of taper roller bearing (5) to cylinder block (3).



⑥ Apply loctite to bearing mounting area of inner race of cylinder block (3) lightly.



 $\ensuremath{\textcircled{}}$  Assemble bushing (6) to cylinder block (3).



(3) Oil seal

Apply three bond of white color on outer surface of oil seal (2) and assemble and insert it.

\* Before assembling, lubricate lip of oil seal with grease.



(4) Assemble outer race of taper roller bearing (5) to motor housing (1).



## (5) Cylinder assembly

Hold end of cylinder assembly (3) with hands and assemble cylinder assembly to housing (1). Be careful to prevent damage of seal by spline of shaft.

- When assemble cylinder assembly, spline shaft of cylinder is protruded from end of housing, therefore put pads with length 30~50 mm under bottom of housing.
- (6) Assemble friction plate (24) and lining plate (25).
- \* Lubricate specified hydraulic oil on each side.





- (7) Insert O-rings (14,27) into housing (1) and piston (26).
- \* Lubricate O-ring with grease.



## (8) Brake piston

Lubricate specified hydraulic oil on outer sliding face of piston (26) and assemble brake piston to housing (1).

It is too tight to assemble piston (10) because O-rings (14,29) are fitted, therefore it is recommended to push piston (26) horizontally by hands at once.



- (9) Spring (28, brake unit) Assemble spring (28) to piston (26) of brake unit.
- \* Insert spring (28) into original position.



(10) Lubricate locating pin for antirotation of valve plate (16) of cover (12) with grease sufficiently and install locating pin to housing.



## (11) Balance plate

Assemble valve plate (16) to cover (12).

\* Be cautious of assembling direction.



(12) Assemble inner race of needle bearing (15) to cover (12).



- (13) Assemble O-ring (27) to cover (12).
- $\ast~$  Lubricate O-ring with grease.







# (15) Cover

Assemble cover (12) and valve plate (16) to housing (1) lightly, holding them up with hands.

- When assembling, be careful not to detach valve plate (16) from cover (12).
- \* Fit matching marks on housing (1) and cover (12) made before disassembling.



- (16) Tighten cover (12) and housing (1) with 12 mm hexagonal socket bolt (18).
  - $\cdot$  Tightening torque : 16 kgf  $\cdot$  m (116 lbf  $\cdot$  ft)



## (17) Make up valve

Assemble check (33) and spring (34) to cover (12) and tighten plug (35) with 14 mm hexagonal socket bolt.

• Tightening torque : 14 kgf • m (101 lbf • ft)



## (18) Relief assembly

Assemble relief valve assembly (17) to cover (12) with 14 mm hexagonal socket bolt.

 $\cdot$  Tightening torque : 8 kgf  $\cdot$  m (58 lbf  $\cdot$  ft)

\* Be cautious of assembling method.



## (19) Check of assembly

Load pilot pressure of 20 kgf/cm<sup>2</sup> to brake release port after opening inlet and outlet port.

Check if output shaft is rotated smoothly around torque of 0.5~1 kgf  $\cdot$  m.

If not rotated, disassemble and check.

This completes assembly.



# 3. REMOVAL AND INSTALL OF REDUCTION GEAR

## 1) REMOVAL

- (1) Remove the swing motor assembly.For details, see removal of swing motor assembly.
- (2) Sling reduction gear assembly (1) and remove mounting bolts (2).
- (3) Remove the reduction gear assembly.
   Reduction gear device weight : 45 kg (99 lb)



## 2) INSTALL

- (1) Carry out installation in the reverse order to removal.
  - $\cdot$  Tightening torque : 29.7  $\pm$  4.5 kgf  $\cdot$  m (215  $\pm$  32.5 lbf  $\cdot$  ft)



# 4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



- \_
- 41 Case42 Pinion gear
- 43 Bearing cover
- 44 Taper roller bearing
- 45 Oil seal
- 46 Taper roller bearing
- 47 Lock collar
- 48 Knock pin
- 49 Ring gear
- 50 Carrier assy No.2
- 51 Planetary gear No.2

- 52 Pin 2
- 53 Needle roller bearing
- 54 Thrust washer
- 55 Spring pin
- 56 Sun gear No.2
- 57 Carrier assy No.1
- 58 Planetary gear No.1
- 59 Needle roller bearing
- 60 Collar
- 61 Thrust washer No.1
- 62 Thrust washer No.2

- 63 Snap ring
- 64 Side plate
- 65 Sun gear No.1
- 66 Wrench bolt
- 67 Plug
- 68 Plug
- 69 Level bar
- 70 Lever pipe
- 71 Air breather
- 72 Cover

# 2) DISASSEMBLY

(1) Remove the plug (67) and drain out gear oil.



(2) Remove the No.1 sun gear (65).



(3) Remove the No.1 carrier sub-assembly(57) using the jig.



- (4) Remove the No.2 sun gear (56).
- \* Pay attention to ensure the gear is not damaged during disassembling.



(5) Remove the No.2 carrier sub assembly (50).



(6) Remove the ring gear by the removal groove between the ring gear (49) and casing (41) by using jig.Full out the knock pin (48).

Do not need to remove the knock pin (48) if it is not worn or damaged.



(7) Put it on the working table with the drive shaft up.



(8) Disassemble the drive shaft (42) with bearing (44) by using jig.



- 3) ASSEMBLING SWING REDUCTION GEAR
- (1) Place the case (41) on the reversing machine having the flange side of the case up.



- (2) Install shaft assembly (42) into case (41).
- Be sure to clean the case before install, using washing machine with the temperature of 80°C
- \* Do not install shaft assembly by force.



(3) Reverse case and press to insert oil seal (45) by using pressing jig after spreading grease oil around the outside ring of the seal and bearing.

Coat grease oil slightly on the lip surface to prevent any scratch when installing.

- Be sure to check by eye that the oil seal is seated completely after being installed.
- (4) Clean the assembling surface of case and spread packing liquid (TH1105) as shown in figure.





- (5) Place ring gear on the case by matching it with knock pin hole.
- (6) Insert 2 knock pins by using jig.
- \* Be sure to check the hole location of oil gage before inserting.

(7) Screw drain plug into drain plug (67) after winding sealing tape.

- (8) Mount No.2 carrier assembly (50) in the case sub assembly and install bolts into 2 TAP holes (M6) as shown in figure.
- \* Turn the carrier slowly by hand to adjust the matching holes when assembling.

\* Be sure to check the direction of sun gear

(9) Install No.2 sun gear (56).

(56) when assembling.








- (10) Mount No.1 carrier assembly (57) in the case sub assembly and install bolts into 2 TAP holes (M6) as shown in figure.
- \* Turn the carrier slowly by hand to adjust the matching holes when assembling.



(11) Assemble No.1 sun gear (65).



# **GROUP 6 TRAVEL MOTOR**

#### 1. REMOVAL AND INSTALL

#### 1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- (4) Loosen the socket stud (1) and remove the pipe assy (2).
- (5) Disconnect hoses (3,4,5).
- (6) Loosen the hex bolt (6) and remove travel motor (7).
  - · Weight : 80 kg (180 lb)
- When removing the travel motor assembly, check that all the hoses have been disconnected.

#### 2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- (2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.





## 2. STRUCTURE 1) MOTOR UNIT



- 1 Drive shaft
- 5 Housing
- 8 Locking screw
- 9 Retaining ring
- 10 Shaft seal ring
- 11 Back up plate
- 12 O-ring
- 13 Locking screw

- 17 Threaded pin
- 18 Seal lock nut
- 20 Retaining ring
- 21 Back up plate
- 22 Taper roller bearing
- 23 Shim
- 24 Taper roller bearing
- 25 Retaining plate

- 26 Piston
- 27 Center pin
- 28 Pan head screw
- 29 Steel sealing ring
- 30 Cylinder block
- 31 Pressure spring
- 32 Adjustment shim
- 33 Control lens

### 2) CONTROL UNIT





- 1 Control housing
- 2 Cover
- 4 Positioning piston
- 5 Positioning trunnion
- 7 Piston
- 8 Threaded pin
- 15 Socket head screw
- 16 Socket head screw
- 19 O-ring
- 20 O-ring
- 21 O-ring
- 23 Socket head screw
- 24 Square ring
- 26 Cylinder pin

- 28 Double break off pin
- 29 Plug
- 32 Double break off pin
- 33 O-ring
- 34 Locking screw
- 50 Relief valve
- 51 Adjusting bushing
- 52 Cylinder pin
- 53 Threaded pin
- 54 Seal lock nut
- 55 Pressure spring
- 56 Spring collar
- 57 Pressure spring
- 58 O-ring

59 Retaining ring

55W72TM03

- 60 Control piston
- 61 Control bushing
- 62 Retaining disc
- 63 Locking screw
- 64 Locking screw
- 65 Double break off pin
- 66 Socket head screw
- 67 Cover
- 68 Throttle screw
- 69 Socket head screw
- 70 O-ring
- 71 Locking screw

### 3) COUNTER-BALANCE VALVE



- 1 Valve poppet
- 2 Pressure spring
- 3 Poppet seat
- 4 Valve poppet
- 5 Pressure spring
- 6 Locking screw
- 7 O-ring
- 9 Valve screw
- 10 Ball
- 11 Bushing

- 12 Brake piston
- 13 Valve bushing
- 14 Throttle pin
- 15 Valve screw
- 16 Bolt
- 17 Spring collar
- 18 Pressure spring
- 19 Housing
- 20 Locking screw

- 21 Locking screw
- 22 Locking screw
- 23 Socket screw
- 24 Plug
- 25 O-ring
- 26 O-ring
- 27 O-ring
- 28 Locking screw
- 29 D/Break OFF pin

# 3. TIGHTENING TORQUE

The torques given are standard figures. Any figures specifically described in the procedure has priority.

| Page | Item | Size            | kgf ⋅ m | lbf ⋅ ft |
|------|------|-----------------|---------|----------|
| 8-75 | 8    | M22 × 1.5       | 6.1     | 44       |
|      | 13   | M26 × 1.5       | 7.1     | 51       |
|      | 18   | M12             | 7.0     | 50.9     |
|      | 28   | M 6 × 20        | 1.4     | 10.3     |
| 8-76 | 15   | M16 × 45        | 21.4    | 155      |
|      | 23   | M14 × 25        | 13.8    | 99.5     |
|      | 34   | M18 × 1.5       | 4.0     | 29       |
|      | 53   | M 6 × 30        | 1.4     | 10.3     |
|      | 54   | M6              | 1.0     | 7.4      |
|      | 63   | M14 × 1.5       | 3.0     | 22       |
|      | 66   | M 8 $\times$ 40 | 2.5     | 18.4     |
|      | 69   | M12 × 35        | 12.2    | 88.4     |
|      | 71   | M14 × 1.5       | 3.0     | 22       |

-

## 4. DISASSEMBLY AND ASSEMBLY

### 1) GENERAL PRECAUTIONS

### (1) Disassembly

- ① Before disassembling the motor, check the items to be inspected and, for remedy against trouble, closely examine the nature of the trouble, so that the motor can be disassembled effectively.
- ② To disassemble the motor, use the disassembling procedures described in section 2) and select a clean place.
- ③ Place a rubber or vinyl sheet or other such protective materials on your working bench to protect the surface of the motor to be serviced.
- ④ During disassembly, give a match mark to the mating surfaces of each part.
- <sup>⑤</sup> Arrange removed parts in order so that they will not become damaged or missing during disassembly.
- ⑥ Once seals have been disassembled, they should be replaced even if damage is not observed.
   Have replacement seals ready on hand before starting your disassembling job.

#### (2) Assembly

- ① Reassemble in a work area that is clean and free from dust and grit.
- 2 Handle parts with bare hands to keep them free of linty contaminants.
- ③ Repair or replace the damaged parts.Each parts must be free of burrs its corners.
- ④ Do not reuse O-ring oil seal and floating seal that were removed in disassembly. Provide the new parts.
- Wash all parts thoroughly in a suitable solvent.Dry thoroughly with compressed air.Do not use the cloths.
- <sup>(6)</sup> When reassembling oil motor components of motor, be sure to coat the sliding parts of the motor and valve with fresh hydraulic oil. (NAS class 9 or above)
- $\bigcirc$  Use a torque wrench to tighten bolts and plugs, to the torque specified as follows.

2) SEAL KITS AND COMPONENT GROUPS Observe the following notices when carrying out repair work at hydraulic aggregates.



- (1) Close all ports of the hydraulic aggregates.
- (2) Replace all seals. Use only original hydromatik spare parts.



- (3) Check all seal and sliding surfaces for wear.
- \* Rework of sealing area f.ex. with abrasive paper can damage surface.



(4) Fill up hydraulic aggregates with hydraulic oil before start up.



(5) Seal kit for drive shaft



(6) External seal kit.







(8) Complete rotary group.



(9) Port plate with control piston.



(10) Counter balance valve.



(11) Relief valve / Make up check valve.



# 3) SEAL NUT

(1) Replace seal nut.First measure and record setting height.



(2) When tightening, counterhold setting screw, then check setting height.



## 4) SEALING THE DRIVE SHAFT



Protecting the drive shaft.
 Remove retaining ring and shim.



(2) Screw in sheet metal screw into the holes fitted with rubber.Pull out seal with pliers.



- (3) Press in shaft seal and shim with bush to stop.
- Pay attention to pressing depth.
   \* Mark for pressing depth.
   Assemble retaining ring.



## 5) SEALING OF THE CONTROL PARTS



(1) Disassembly position Remove cover 1.



- 1 O-ring
- 2 Input flow of oil control
- 3 Throttle pin
- Installation position differs according to the control components.



- 1 Input flow of oil control
- 2 High pressure / Low pressure
- 3 High pressure / Low pressure
- 4 Leakage oil
- 5 Control piston



- (2) Disassembly position : Remove cover 2.
- \* Attention spring load.



\* Dimension X : Note dimension (begin of regulation)



1 Check of O-ring



- 1 O-ring / High pressure-small control position side
- 2 O-ring / Control pressure
- 3 O-ring / High pressure-check valve
- 4 O-ring / High pressure-check valve



# 6) SEALING OF THE RELIEF VALVE / COUNTER BALANCE VALVE

- $\cdot$  Remove counter balance valve
- · Inspect
- $\cdot \text{ O-ring}$

(2) Inspect O-ring



(1) Remove relief valve





(3) Remove counter-balance valve.InspectO-ring



## 7) DISASSEMBLY OF THE PORT PLATE

- $\cdot$  Note dimension X
- Remove Qmin screw
- · Swivel rotary group to zero P



(1) Port plate.Mark position. Loosen screws.Removal.



- (2) Check O-ring.
- Stick new O-ring with some grease.
   Do not swivel rotary group.
   Piston rings to hang out from the cylinder boring.



## 8) REMOVE OF THE POSITIONING PISTON



(1) Loosen fixing screw. Use only socket wrench.



(2) Remove piston with piston ring.



- (3) Warm up fixation screw \*for positioning plug via boring (screw glued-to turn out).
- Use new screw.
   Precode coating.
   Note tightening torque.



- Stick control lens in sliding surface with grease. Assembly in reversal order. Mount port plate.
- \* Rotary group vertical.



### 9) REMOVE ROTARY GROUP

- (1) Screw in threaded pin into center pin. Fix the cylinder with disc and locknut. M8  $\times$  105  $\it l$



- (2) Press out rotary group.
- \* If the bearings are used again do not hit on the drive shaft.



## 10) EXCHANGING OF THE ROTARY GROUP

Complete rotary group

\* Setting of hydraulic part necessary.



#### Rotary group

- 1 Mechanical part: Adjust drive shaft with bearing
- 2 Hydraulic part : Adjustment necessary



(1) Remove fixing screw (cylinder). Remove cylinder.



- (2) Disassemble retaining plate.
- Screws are glued.Use Torx tools.



### **11) INSPECTION INSTRUCTIONS**

 Free of corrosion, erosion or fretting; No damage to splines or keyways.



### (2) Pistons

No scoring and no pittings.



#### (3) Center pin

No scoring and no pittings.



## (4) Retaining plate

No scoring and no evidence of wear.



### (5) Cylinder block / Control lens

- 1 Bores free of scoring, no evidence of wear
- 2 Faces smooth and even, free of cracks and scoring



#### (6) Control housing

Sliding surface and side guides free of scoring and no wear.



## (7) Visual check

Bearing areas free of scoring and no evidence of wear.



## 12) ROTARY GROUP ASSEMBLY

(1) Rotary group completely assembled ready for assembly.



(2) Place assembly sleeve.



(3) Warm up housing to  $80^{\circ}$ C.



(4) Insert rotary group into housing to seat position.



(5) Insert rotary group into housing to seat position.



- (6) Fix zero position of cylinder with Q<sub>max</sub> screw.
  - 1 Disassemble cylinder fixing screw
  - 2 Insert O-ring



# 13) ROTARY GROUP ADJUSTMENT

(1) Determine cylinder swivel range to max angle with screw.



14W7TM065

(2) \* Disc

(3) Place centering disc.



(4) Mount measuring device.



(5) Check dimension X.



# 14) ASSEMBLY OF THE PORT PLATE

- (1) Assemble port plate.
- Take care of assembly design.Tighten fixing screws with torque.
- (2) Set  $Q_{min}$  screw to dimension (\*).
- (3) Assemble plug.
- (4) Remove assembly sleeve.



(5) Assemble control components.



(6) Assemble cover.



- (7) Assemble shaft seal, disc and safety ring. Press in with assembly sleeve.
- $\ast~$  Take care of press in depth.



(8) Assemble counter balance valve.



# GROUP 7 GEAR BOX

### 1. REMOVAL AND INSTALL

### 1) REMOVAL

- Swing the work equipment 90° and lower it completely to the ground.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Remove the propeller shaft mounting nuts(3).

 $\cdot$  Tightening torque : 7.4  $\pm$  1.5 kgf  $\cdot$  m (53.5  $\pm$  10.8 lbf  $\cdot$  ft)

- (5) Remove the travel motor mounting bolts (2).

   • Tightening torque : 14.7±2.2 kgf m (53.5±10.8 lbf • ft)
- (6) Remove the hoses (4).
- \* Fit blind plugs to the disconnected hoses.
- (7) Remove the mounting bolts (2), then remove the gear box (1) device assembly.
  - Weight : 63 kg (140 lb)
  - $\cdot$  Tightening torque : 19.6±2.9 kgf  $\cdot$  m (142±21 lbf  $\cdot$  ft)

#### 2) INSTALL

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





## 2. INSTRUCTIONS

The efficiency and continued operation of mechanical units depend on constant and correct maintenance and also on efficient repair work, should there be a break-down or malfunction. The instructions in this manual have been based on a complete overhaul of the unit. However, the mechanic must decide whether or not it is necessary to dismantle the individual components when only partial repair work is needed. The manual provides a quick and sure guide which, with the use of photographs and diagrams illustrating the various phases of the operations, allows to perform accurate work to take place.

Therefore all the information needed for correct disassembly, the relative check and assembly of each individual component, has been written down.

In order to remove the different unit from the vehicle, the manuals provided by the vehicle manufacturer should be consulted. In describing the following operations it is presumed that the unit has already been removed from the vehicle.

#### 1) IMPORTANT

Throughout the phases of repair or maintenance work it is advisable to use proper equipment such as : Trestles or supporting benches, plastic or copper hammers, appropriate levers, extractor and specific spanners or wrenches. So that the work is facilitated and the working surfaces and the operators themselves are protected. Before going on to disassemble the parts it is beat to thoroughly clean the unit, removing any encrusted or accumulated greases and then drain the oil through the oil-draining plug.

#### 2) INTRODUCTORY REMARKS

All the disassembled mechanical units should be thoroughly cleaned with appropriate products and then restored or replaced if damage, wear, cracking or seizing have occurred.

In particular, thoroughly check the state of all moving parts (bearings, gear, crown wheel and pinion, shaft) and sealing parts (O-ring, oil shield) which are subject to major stress and wear. In any case it is a disable to replace the seals every time a component is overhauled or repaired. During assembly the sealing rings must be lubricated on the sealing edge. In the case of the crown wheel and pinion, replacement of one component requires the replacement of the other one. During assembly the prescribed pre-loading and backlash of the parts must be maintained.

#### 3) MAINTENANCE AND REPAIR

We have compiled these instructions for maintenance and repair in order to facilitate any such work on the DANA components differential units and change units. The drawings of any special tools required for maintenance and repair work can be bought directly from us. Spare parts can be ordered either through the vehicle manufacturer or to us directly.

4) LUBRICANT SPECIFICATIONS SAE 85W-90 (API GL-5)

## 3. COUNTER - REVOLUTION SENSOR

## 1) REPLACING

(1) Undo the sensor adjuster screw lock nut and the counter-revolution sensor.





55W9NGB002

- (2) Replace the counter-revolution sensor if damaged.
- \* Clean the sensor reading zone "A" every oil change and every malfunctioning.



55W9NGB003

 (3) Screw the counter-revolution sensor untill to the contact with the phonic end disk, then unloose the sensor 1/2 ~ 3/4 turn. Tighten the lock nuts completely.



55W9NGB004

## 4. HYDRAULIC GEAR CONTROL

1) DISASSEMBLY



55W9NGB005

(1) Remove gear-in position switch (4),O-ring (5) and (7) and washer (7).



(2) Remove the cap (1) from the gear selector.



55W9NGB007

(3) Use a magnet to remove the spring (2) from the gear selector.



55W9NGB008

(4) Remove the gear selector balls (3).



55W9NGB009

(5) Remove screws (8) on the gear control cylinder (9).



55W9NGB010

- (6) Remove the gear control cylinder (9).
- \* Carefully remove all residue of loctite from the surfaces.



55W9NGB011

(7) Remove the snap ring (12) securing the piston (13).



55W9NGB012

(8) Remove the piston (13), complete with seals.



55W9NGB013

(9) Remove the snap ring (12) securing the piston (13).

(10) Remove the O-ring (15).



55W9NGB014



55W9NGB015

(11)Use two levers to remove the bushing (16).



55W9NGB016

- (12) Remove the dust scraper ring (10) and the rod's O-ring (11) from the gearshift cylinder (9).
- \* The O-rings and the dust scraper ring must be replaced every time the unit is disassembled.



55W9NGB017

## 2) ASSEMBLY



(1) Fit the rod's O-ring (11) and the dust scraper ring (10) into the cylinder.



55W9NGB019

- (2) Fit the new O-ring (11) on the gear selector rod (19).
- \* Lubricate before installing.



(3) Fit the O-rings (15), (17), (18) on the guide bush (16) and lubricate rings.Fit the bush (16) onto the gear selector rod (19).



55W9NGB021

(4) Insert the snap ring (12).



55W9NGB022



55W9NGB023

(6) Secure the piston (13) in position with the snap ring (12).

(5) Fit the O-rings (11), (14) onto the piston

Fit the complete piston (15) onto the gear selector rod (20) and engage it by means

(13) and lubricate rings.

of the snap ring (12).



- (7) Coat the coupling surface of the gearshift cylinder (9) with loctite 510; fit the cylinder on the gear selector rod (19).
- \* Make sure that the sealant forms a continuous film around the locking holes.

(8) Assembly the screws (8), spreading

(9) Tighten screws (8) using a torque wrench

setting of 4.89~5.4 kgf · m (35.4~

loctite 242 on screws.



55W9NGB025



55W9NGB026



55W9NGB027



\* Lubricate before installing.

39.1 lbf · ft).



55W9NGB028

- (11) Fit the gear selector springs.
- \* Replace the springs (14) if they are weakened or bent.



55W9NGB029



55W9NGB030



55W9NGB031

NEUTRAL POSITION 21mm

(12) Coat the dowel (1) with loctite 510 and screw it until it is level with the cylinder.

(13) Fix the gear-in position switch (4) with washer (7) and O-ring (5), (6).
Tighten with torque wrench setting of 3.57~5.09 kgf · m (25.8~36.9 lbf · ft).

(14) Engage the 1st speed and verify with a control device (tester) that the switch 1st speed gives signal and that the switch 2nd speed is disabled.

Repeat the operation on the switch 2nd speed.
# 5. INTEGRATED REDUCTION GEAR

## 1) DISASSEMBLY



55W9NGB048

(1) Remove the gear control cylinder. For more details, see : REMOVAL OF HYDRAULIC GEAR CONTROL

(2) Unloose the nut (1) from the flange (3).



55W9NGB048-1

55W9NGB049

### 7-111

(3) Remove the nut (1) and O-ring (2) and pull out the flange (3).



55W9NGB050

(4) Remove the phonic end disk (5).



55W9NGB051



55W9NGB052

55W9NGB053

(6) Unloose the nut (10) from the flange (12).

(5) Remove screws (15) of the cover (40).

(7) Remove the nut (1) and O-ring (2) and pull out the flange (3).



55W9NGB054

- (8) Loosen and remove the check screws(42) of the cover (41).

55W9NGB055

- (9) Disjoin and remove the cover (41).
- \* Carefully remove all residue of loctite from the surfaces.



55W9NGB056

- (10) Remove seal ring (31).
- \* Note down direction of installation.



- (11) Disjoin and remove the cover (40).
- \* Carefully remove all residue of loctite from the surfaces.



55W9NGB058

(12) Using an internal extractor, remove the bearing (29).



55W9NGB059

- (13) Remove gear (41).
- \* Note the correct mounting direction.



55W9NGB060

(14) Remove the bearing (27) from the gear (41).



(15) Remove the snap ring (42).



55W9NGB062

(16) Remove the baffle plate (32) and retainer screws (54).

(17) Remove the lower shaft (24).



55W9NGB063



55W9NGB064

(18) Secure the lower shaft assembly to a hoist.

Remove the lower shaft assembly, complete with yoke and gearbox control rod.



(19) Remove the internal baffle plate (32).



55W9NGB066

- (20) Remove yoke and gearbox control rod. Check the yoke pads for wear.
- \* Replace if worn.



55W9NGB067

- (21) Remove the snap ring (26) securing the synchroniser (25).
- \* Take care not to bend the snap ring (26).



55W9NGB068

- (22) Remove the complete synchroniser (25).
- \* Note the correct mounting direction.



- (23) Repeat the operation on both sides. Remove the snap ring (23) securing the gear (42).
- \* Take care not to bend the snap ring (23).



55W9NGB070

- (24) Remove gear (42).
- \* Note the correct mounting direction.



55W9NGB071

(25) Remove the bearings (21) from the gear (42).



(26) Remove the snap ring (22).



#### (27) Remove the upper shaft (35).



55W9NGB074

#### (28) Input shaft

Mark the position between the motion entrace cover (10) and reduction gear cover (14); remove screws (9) from the motion entrace cover (10).



\* Carefully remove all residue of loctite from the surfaces.



55W9NGB075



55W9NGB076

- (30) Remove seal ring (11).
- \* Note down direction of installation.



(31) Remove the bearing (13) from the cover (14).



55W9NGB078

(32) Loosen and remove the check screws (4) of the cover (6).



55W9NGB079

- (33) Disjoin and remove the cover (6).
- \* Carefully remove all residue of loctite from the surfaces.





(34) Remove the bearing (8) from the cover (14).



- (35) Remove seal ring (7).
- \* Note down direction of installation.



55W9NGB082

# 2) ASSEMBLY



55W9NGB083

- (1) Re-insert the new sealing ring (7) in the output cover (6).
- \* Pay particular attention to the direction of assembly of the rings (7).

Lubricate the lip of the sealing ring with grease.



(2) Using a normal tool insert the bearing (8).



55W9NGB085

(3) Assembly the cover (16) spreading loctite510 on planes.



55W9NGB086

(4) Assembly the screws (4) spreading loctite 242.

Tighten screws (4) using a torque wrench setting of  $4.89 \sim 5.4 \text{ kgf} \cdot \text{m}$  (35.4~ 39.1 lbf  $\cdot$  ft).



55W9NGB087

(5) Using a normal tool insert the bearing (13).



- (6) Re-insert the new sealing ring (11) in the motion input cover (10).
- \* Pay particular attention to the direction of assembly of the rings (11).

Lubricate the lip of the sealing ring with grease.

(7) Zero the depth gauge between the cover surface and bearing contact surface.



55W9NGB089



55W9NGB090

- (8) Measure distance "A" between the surface and thrust block.
  - $\cdot$  Example : A = 0.50



55W9NGB091

(9) Calculate thickness "S" of the shims by using this formula :

S = A - Y = S, where Y is the predefined axial backlash.

 $\label{eq:Y} \begin{array}{l} Y = backlash = 0.15 \ \pm \ 0.35 \ \text{mm} \\ \text{Example}: S = A \cdot Y = 0.50 \cdot 0.25 = 0.25 \ \text{mm} = S \end{array}$ 

Make up the appropriate pack of shims.



55W9NGB092

(10) Apply loctite 510 to the machined surfaces.

Assembly the cover (10) and shims (12).



55W9NGB093

(11) Assembly the screws (9) spreading loctite 242.
Tighten screws (9) using a torque wrench setting of 4.89~5.4 kgf · m (35.4~ 39.1 lbf · ft).



55W9NGB094

(12) Install the drive side shaft (35) with a plastic hammer.



55W9NGB095



55W9NGB096

(13) Fit the snap ring (22) in the gear (42).

- (14) Using a pusher of suitable diameter, fit the bearings (21).
- \* Ensure that the bearing is seated securely.



55W9NGB097

(15) Fit gear (42) onto the shaft (24).

\* Fit as originally mounted, using the markings made previously as reference.



55W9NGB098

(16) Repeat the operation on both sides.Secure the gear (42) in position with the snap ring (20), (23).



55W9NGB099

(17) Fit the complete synchroniser (25).

\* Fit as originally mounted, using the markings made previously as reference.



- (18) Secure the synchroniser (25) in position with the snap ring (26).
- \* Check that the snap ring is seated correctly.



55W9NGB101

(19) Fit the gear selector yoke in the synchroniser (25).



55W9NGB102

(20) Fit the internal baffle plate (32) in position.



55W9NGB103

(21) Secure the lower shaft assembly (24) to a hoist.

Install the lower shaft assembly (24), complete with yoke and gearbox control rod.



(22) Using a plastic hammer, install the lower shaft (24).



55W9NGB105

55W9NGB106

(23) Spread loctite 270 on the screws and tighten to a torque of 0.97~1.07 kgf · m (7.02~7.74 lbf · ft).

- (24) Using a pusher of suitable diameter, fit gear (41) onto the shaft (24).
- \* Fit as originally mounted, using the markings made previously as reference.



9,5 - 10,5 Nm Loctite 270

55W9NGB107

(25) By hand install the bearing on the input shaft.

Reset a digital depth gauge between cover surface and bearing.



55W9NGB108

(26) Remove the bearing (75) from the input shaft (73).



55W9NGB109

- (27) Measure distance "B" between the cover surface and bearing contact surface.
  - Example : B = 0.45



55W9NGB110

- (28) Calculate thickness "S2" of the shims by using this formula : S2 = B - Y = S2, where Y is the predefined axial backlash.  $Y = backlash = 0.15 \pm 0.35$  mm Example : S2 = B-Y = 0.45 - 0.25 = 0.20 mm = S2 Make up the appropriate pack of shims.
- (29) Using a normal tool, push the bearing(36) and shims into its seat in the cover(40).



55W9NGB111



(30) Insert guide bushings (38), (39).Apply loctite 510 to the machined surfaces, Fit the cover (14) onto the casing (40) and align the pins (38), (39).



55W9NGB113

(31) Tap the cover (14) gently with a mallet to seat correctly.



55W9NGB114

(32) Spread loctite 242 on the screws (15).
Secure in position with the screws (15), tightening to a torque of 4.89~5.4 kgf · m (35.4~39.1 lbf · ft).



(33) Reset a centesimal digital depth gauge between calibrated blocks (whose known thickness is 30 mm) and output shaft.



55W9NGB116



55W9NGB117

- (34) Measure distance "C" between the output shaft and bearing thrust block.
  - Example : C = 0.45



55W9NGB118

(35) Calculate thickness "S3" of the shims by using this formula : S3 = C - X = S3, where X is the predefined axial backlash.  $X = backlash = 0.15 \pm 0.35$  mm Example : S3 = C-X = 0.45 - 0.25 = 0.20 mm = S3

Make up the appropriate pack of shims.



- (36) Using a pusher of suitable diameter, fit the bearing (29) into output shaft (24).
- \* Ensure that the bearing is seated securely.



55W9NGB120

- (37) Re-insert the new sealing ring (31) in the motion output cover (41).
- \* Pay particular attention to the direction of assembly of the rings (31).

Lubricate the lip of the sealing ring with grease.



55W9NGB121

(38) Measure distance "D" between cover surface and bearing.



55W9NGB122

(39) Zero the depth gauge between calibrated blocks (whose known thickness is 30 mm) and bearing seat.



#### (40) Measure dimension "E" on the cover.



55W9NGB124

(41) Calculate thickness "S4" of the shims by using this formula :

S4 = (Dimension E - Dimension D) - X = S4, where X is the predefined axial backlash.

X = backlash =  $0.15 \pm 0.25$  mm Example : S4 = (E-D)-X = (3.85-3.40)-

$$0.20 = 0.25 \text{ mm} = S4$$

Make up the appropriate pack of shims.

(42) Assembly the cover (41) spreading loctite 510 on planes.



55W9NGB125



55W9NGB126

(43) Assembly the screws (42) spreading loctite 242.
Tighten screws (42) using a torque wrench setting of 4.89~5.4 kgf · m (35.4~39.1 lbf · ft).



(44) Fit the flange (3) on the shaft (24), seating completely.

(45) Lubricate the O-ring (2) with grease and

(46) Tighten the lock nut (1) to a torque of

28.6~31.6 kgf · m (207~229 lbf · ft).

Spread with loctite 242 the lock nut (1)

fit in the flange (3) seating.

and fit.



55W9NGB128

Loctite 242 O-ring 2 3

55W9NGB129







(48) Fit the flange (3) on the shaft (24), seating completely.



55W9NGB132

- (49) Lubricate the O-ring (2) with grease and fit in the flange (3) seating.Spread with loctite 242 the lock nut (1) and fit.
- Loctite 242 O-ring 0-ring 3

55W9NGB133



55W9NGB134

(51) Coat the coupling surface of the gearshift cylinder with loctite 510 ; fit the cylinder on the gear selector rod.

(50) Tighten the lock nut (1) to a torque of

28.6~31.6 kgf · m (207~229 lbf · ft).

 Make sure that the sealant forms a continuous film around the locking holes.
 For more details, see : INSTALLATION OF HYDRAULIC GEAR CONTROL



# **GROUP 8 STEERING VALVE**

#### 1. REMOVAL AND INSTALL

#### 1) REMOVAL

- Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- (4) Disconnect steering line hoses (3).
- (5) Loosen the hexagon bolt (2) and remove the steering valve assembly (1).
  - $\cdot$  Tightening torque : 4.8  $\pm$  0.3 kgf  $\cdot$  m (34.7  $\pm$  2.2 lbf  $\cdot$  ft)

## 2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- (2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.
- When removing the steering valve assembly, check that all the hoses have been disconnected.





# 2. STEERING VALVE

# 1) STRUCTURE



- 1 Dust seal ring
- 2 Housing
- 3 Sleeve
- 4 Spool
- 5 O-ring
- 6 Kin ring
- 7 Bearing assy
- 8 Ring
- 9 Cross pin

- 11 Shaft
- 12 Spring set
- 13 O-ring
- 14 Distributor plate
- 15 Gear wheel set
- 16 O-ring
- 17 End cover
- 18 Washer

- 20 Pin screw
- 21 Screw
- 22 Name plate
- 23 Drive screw
- 25 Plug
- 26 Shock valve
- 27 Ball
- 29 Suction valve pin

# 2) TOOLS

(1) Holding tool.



(2) Assembly tool for O-ring (5,13,16) and kin-ring (6).



(3) Assembly tool for cardan shaft (11).



(4) Assembly tool for dust seal (1).



(5) 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 mm and 12 mm hexagon socket spanners.
Plastic hammer.
Tweezers.



## 3) DISASSEMBLY

 Dissemble steering column from steering valve and place the steering valve 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) Shake out the check valve ball and suction valve pins and balls.



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



(10) 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.

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



6-3 (200W-3)

\* 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 spring as figure.

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.



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



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



(14) Remove dust seal and O-ring/kin ring.



### (15) Disassemble the dual shock valve

 Remove plugs from shock valves using a 6mm hexagon socket spanner.



2 Remove seal washers (2-off).



③ Unscrew the setting screws using a 6 mm hexagon socket spanner.



④ Shake out the two springs and two valve balls into your hand. The valve seats are bonded into the housing and cannot be removed.



5 The dual shock valves are now disassembled.



### 4) 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.



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





\* Assembly pattern.Part no. : 150N4035



(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.



(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 patted for standard bearings
  - 1 Outer bearing race
  - 2 Needle bearing
  - 3 Inner bearing race
  - 4 Spool
  - 5 Sleeve



## Installation instruction for O-ring/Kin-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 and kin-ring with hydraulic oil and place them on the tool.





(12) Hole 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 / kin-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.
- 18-5 (2003)
- (15) With a light turning movement, guide the spool and sleeve into the bore.
- \* Fit the spool set holding the cross pin horizontal.

- (16) The spool set will push out the assembly tool guide. The O-ring and kin-ring are now in position.
- 20-2 (2000-3)
- (17) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.





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



#### Assembly of the two suction valve

(19) Place a ball in the two holes indicated by the arrows.



(20) Place a pin in the same two holes.



(21) In some cases a spring has to be fitted on the pin before it is placed in the housing.



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



000

0 0 000

0

22-2 (200W-3)

(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) 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.







(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.
  - $\cdot$  Tightening torque : 2.3  $\pm$  0.6 kgf  $\cdot$  m (16.6  $\pm$  4.3 lbf  $\cdot$  ft)



(32) Place the dust seal ring in the housing. The dust seal ring must be placed only after the pressure relief valve and shock valves have been fitted.



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



- (34) Press the plastic plugs into the connection ports.
- \* Do not use a hammer!



Assembly of the pressure relief valve (35) Fit the piston.







(37) Screw in the setting screw with an 8mm hexagon socket spanner. Make the pressure setting on a panel or the machine.



(38) Screw plug with seal ring into the two shock valves using a 6mm hexagon socket spanner.

• Tightening torque : 3.1 kgf • m (22.4 lbf • ft)



Steering valve is now assembled.

## **GROUP 9 AXLE**

### **1. GENERAL INTRODUCTIONS**

#### 1) Introduction

The efficiency and continued operation of mechanical units depends on constant and correct maintenance and also on efficient repair work should there be a break-down or malfunction.

The instructions in this manual have been made based on a complete overhaul of the unit. However the mechanic must decide whether or not it is necessary to dismantle the individual components when only partial repair work is needed.

The manual provided a quick and sure guide which, with the use of photographs and diagrams illustrating the various phases of the operations, allows accurate work to take place. Therefore all the information needed for correct disassembly, the relative checks and assembly of each individual component, has been written down.

In order to remove the differential unit from the vehicle, the manuals provided by the vehicle manufacturer should be consulted. In describing the following operations it is presumed that the unit has already been removed from the vehicle.

\* Throughout the phases of repair or maintenance work it is advisable to use proper equipment such as : trestles, or supporting benches, plastic or copper hammers, appropriate levers, extractors and specific spanners or wrenches. So that the work is facilitated and the working surfaces and the operators themselves are protected.

Before going on to disassemble the parts it is best to thoroughly clean the unit, removing any encrusted or accumulated greases and then drain the oil through the oil-draining plugs.

#### 2) Introductory statement

All the disassembled mechanical units should be thoroughly cleaned with appropriate products and then restored or replaced if damage, wear, cracking or seizing have occurred. In particular, thoroughly check the state of all moving parts (bearing, gears, crown wheel and pinion, shafts) and sealing parts (O-ring, oil shield) which are subject to major stress and wear. In any case it is advisable to replace the seals every time a component is overhauled or repaired. During assembly the sealing rings must be lubricated on the sealing edge. In the case of the crown wheel and pinion, replacement of one requires the replacement of the other. During assembly the prescribed pre-loading and backlash of the parts must be maintained.

#### 3) Maintenance and repair

We have compiled these instructions for maintenance and repair in order to facilitate any such work on the CLARK-HURTH Components differential units and gear change unit.

## 2. FRONT AXLE

# 1) THE PLANETARY REDUCTION AND THE COMPLETE STEERING CASE

(1) Disassembly



 Remove the securing screws (23) from the planetary carrier cover (25).
Disconnect the steering bars from the steering case (14).



55W9NAX002

② Disjoint the planetary carrier cover (25) from the steering case by alternatively forcing a screwdriver into the appropriate slots.



③ Remove the complete planetary carrier cover (25).



55W9NAX004

④ Remove the safety spring rings (28) of the planetary gears (27).



55W9NAX005

(5) Remove the planetary gears (27).



\* Note down direction of assembly of planetary gears.



6 Remove the snap ring (30).



55W9NAX008

⑦ Unloose and remove the tightening nuts(32) from the crown flange (35).



55W9NAX009

⑧ Remove the shim washer (31).



55W9NAX010



55W9NAX011

9 Remove the safety flange (33).

1 Using a puller, remove the complete crown flange (35) by acting on the stud bolts.



55W9NAX012



55W9NAX013

- ① Partially extract the hub (41) using a plastic hammer.
- \* Alternately hammer on several equidistant points.



55W9NAX014

<sup>(1)</sup> Remove the external bearing (38).



③ By hand remove the complete hub (41).



55W9NAX016

55W9NAX017

- (A) Remove the external thrust blocks of bearings, using a pindriver.
- Hammer in an alternate sequence to prevent crawling and deformation of the thrust blocks.



\* Pay due attention not to damage the seat of bearing.



(b) Note the measure of the screw of lock steering case.





17 Loose the lockscrew and insert it to allow the passage of tool.

18 Remove the nuts that lock the

articulation pins.



55W9NAX020



55W9NAX021

1 Disconnect the tapered pins of the articulation from the steering case (14) by means of a puller.



- ② Unloose and remove the fitting screws (19) from the bottom articulation pin (20).
- \* Screws cannot be reused.



② Remove the bottom articulation pin (18) complete with front sealing ring (20).



55W9NAX024

Unloose and remove the fitting screws(13) from the top articulation pin (10).



55W9NAX025

② Using two levers, remove the top articulation pin (10) complete with front seal (8).

Pay attention not to damage the surfaces.



A Remove the complete steering case (14).



- Use a puller to remove the sealing ring from the steering case (14).
- \* Note down the orientation of sealing ring (5).



55W9NAX028

- 26 Remove the bushing (6) from the steering case (14).
- \* Note down the orientation of bushing.



55W9NAX029



- ⑦ Remove the u-joint (4).
- \* To remove the u-joint use, if necessary, a plastic hammer or a lever.



Using a puller for inner parts, remove the top bush (7) and the bottom ball-bush (17).



55W9NAX032

- Remove the articulation pins (10) (20) and the front sealing rings (8) (18).
- \* Note down the side for assembly.



55W9NAX033

 If the ball cover (17) needs replacing, remove it from the bottom articulation pin (20).



③ Remove seal ring (3) and the bushing (2) from the arm (1).



55W9NAX035





55W9NAX037

 $\cdot$  Continuos rolling torque without planetary gear cover 0.71~2.04 kgf  $\cdot$  m (5.14~14.8 lbf  $\cdot$  ft)

• **Preload steering case** 4.08~8.16 kgf · m (29.5~59.0 lbf · ft)

 Lubricate the bushing (6) and the seat of the steering case (14).
Install the bushing (6), using tool T1.



55W9NAX038



② Lubricate the outer surface of the sealing ring (5); fit them into their seat using tool T2.





- ③ Using special tool T3 apply a repositionable jointing compound for seals to the outer surface of the sealing ring (44). Position the sealing ring (44) in the steering case (14).
- \* Check that the ring (44) is correctly oriented.
- ④ If the bottom articulation pin (17) has been extracted, position the pin under a press and fit the ball cover (20).



55W9NAX042



55W9NAX043

- ⑤ Fit the front sealing rings (18) (8) onto the articulation pins (4) and (6).
- \* Carefully check that the rings are properly oriented (18) (8).



6 Lubricate the top bush (7) or the bottom ball bush (17) and fit them into the fulcrum holes of the arm.



 ⑦ Lubricate the bushing (2) and the seat of the steering case (1).
Install the bushing (2), using tool T1.



55W9NAX046

55W9NAX047

- ⑧ Lubricate and fit the sealing ring (3) onto tool T4 ; install the rings into the arm.
- \* Pay particular attention to the direction of assembly of the rings.

(9) Insert the u-joint (4).



Τ4

3

In Lubricate the terminal of the u-joint (4) and install the steering case (14).
Pay due attention not to damage the dust cover rings and the sealing rings.



I) Prepare a series of shims (9) of 0.4 up to 0.7 mm.

To be assembled under the upper pin (10).



55W9NAX050

<sup>(2)</sup> Lubricate and install the unit in the steering case.

(13) Lubricate the steering case.



55W9NAX051



Fit the unit (20) in the steering case (14).
Position the screws (19) and tightly tighten.



- (5) Tighten the new fitting screws (13) of top articulation pins in sequence using the cross tightening method.
  - Torque wrench setting : 13.1~14.5 kgf · m (94.8~105 lbf · ft)

(b) Tighten the new fitting screws (19) of bottom articulation pins in sequence using the cross tightening method.

17) Check by means of a lever that there is

In case there is any gap, determine the width and reduce it by removing shims.

· Torque wrench setting :

no vertical gap.

13.1~14.5 kgf · m (94.8~105 lbf · ft)



55W9NAX054



55W9NAX055

55W9NAX056

40 - 80 Nm

55W9NAX057

 (B) Check the torque of the pins, which has to be between 4.08 and 8.16 kgf · m.
If the preliminary measured value is too high, the shims have to be increased. (19) Look for the position of the notch regarding the safety cotter pin hole when the nut is finaly locked max 30.6 kgf  $\cdot$  m (221 lbf · ft).

2 Bring the lockscrew to the quote at the

measure previously survey.



55W9NAX058



55W9NAX059

2 Position the lower part of tool T5 and the thrust block of the external bearing (38).



- 2 Lubricate the seats of the bearings and position the hub (41) on tool T5 ; position the thrust block of the internal bearing (43).
- \* Check that the thrust block is correctly oriented.



- (38).
- \* Move the bearing to the limit stop by hammering lightly all around the edge.



55W9NAX062

2 Install the wheel hub (41).

(25) Install the crown wheel (36).



55W9NAX063



55W9NAX064

- <sup>26</sup> Fit the complete crown flange (36).
- \* In order to fasten the flange (36), use a plastic hammer and alternately hammer on several equidistant points.



Install the security flange (33).
Grease the surface of the safety flange (33) that touches the crown wheel.



55W9NAX066

Scoat the nuts (23) with loctite 242 and screw them.



90 - 100 Nm

55W9NAX067

- ② Tighten nuts (32) in two stages, using the criss-cross method.
  - · Initial torque wrench setting :

9.18 kgf  $\cdot$  m (66.4 lbf  $\cdot$  ft)

 $\cdot$  Final torque wrench setting : 10.2 kgf  $\cdot$  m (73.8 lbf  $\cdot$  ft)

30 Install the distance piece (31).



③ Install the snap ring (31).



55W9NAX070

- ③ Check the continuous rolling torque on the hub.
  - Torque : 0.71~2.04 kgf · m (5.14~14.8 lbf · ft)

 Check the condition and position of the O-ring (37).



55W9NAX071



55W9NAX072

- (3) Fit the planetary gear (27) onto the planetary gear cover (25).
- \* The jointed portion of the internal ring of the bearings must face the bottom of the pin.



Lock into position the planetary gears(16) with the snap rings (15).



55W9NAX074



55W9NAX075



55W9NAX076

③ Fit the planetary gear cover (18) onto the wheel hub (4).

③ Torque wrench : 4.08~5.1 kgf · m (29.5~36.9 lbf · ft)

## 2) STEERING CYLINDER

# (1) Disassembly



55W9NAX077

① Remove the centring sensor (21) of the steering piston.



② Remove the nuts (18) that lock the articulation pins (14).



3 Disconnect the tapered pins of the articulation (14) from the steering case by means of a puller.



55W9NAX080

④ If the connection of the steering bars includes a safety collar, raise the border.



55W9NAX081

⑤ Disconnect left and right steering bars from the piston.



6 Remove the securing screws (19) from the steering cylinder (16).



⑦ Extract the cylinder (16) using a plastic hammer.



55W9NAX084



\* Before attempting to disassemble the unit, drain the oil in the cylinder chambers completely.

Using a screwdriver, remove the snap ring (1) of the cylinder head.



- 8 Lightly tap the cylinder head (2) with a plastic hammer so as to push it inside the cylinder (3).
- \* Insert the cylinder head so it is flush with the cylinder.

③ Using a punch, force the stop ring (4) located inside the cylinder (3) and extract ring using a screwdriver.

1 Take the cylinder unit a part by extracting the head first, followed by the piston.

\* Note down direction of installation of piston whose seal ring is oriented towards cylinder head.



55W9NAX087



55W9NAX088





- I Remove all seals, anti-extrusion rings and scraper rings from head (2), cylinder (3) and piston (5).
- \* All seals must be replaced every time the unit is disassembled.
- Particular attention must be paid not to damage the seats of both seals and piston slide.



55W9NAX091

## (2) Assembly

 Grease and install the piston rod seal ring (6), rod wiper (8) and back up washer (7) into cylinder (3).



 ② Grease and install the piston rod seal ring (6), rod wiper (8) and anti-extrusion ring (7) into the head (2).



- 3 Fit seal (9) on the outside of the head (2).
- \* To ease installation, grease the outer surface of the piston
- \* Do not roll the seal (9).


- ④ Prepare piston (5) by fitting it with magnetic ring (11), anti-extrusion ring (10) and piston seal (13).
- \* To ease installation, lubricate with grease.



55W9NAX095

- ⑤ Center the shaft on the cylinder (3) so that it fits into the piston (5).
- \* Apply a little grease to seals and cylinder.





55W9NAX096



- ⑦ Apply grease to head (5) seals, fit the head onto the piston and push it into the cylinder (3) using a plastic hammer.
- Insert the head as to line it up with the edge of the cylinder.



⑧ Introduce the stop ring (4) and ensure that it sets in the seat of cylinder (3).



55W9NAX099

\* To insert the heading not to go beyond with the ring of gasket the hole of feeding because it could be cut.



(9) Using two screwdrivers or levers, force the head until it is seated against the stop ring (4).

Fit the snap ring (1) on the head (2).

- \* Make sure that the snap ring (1) is securely fastened in its seat. If necessary, force it into its seat using a drift and a hammer.
- ① Renew at each reassembly.







 Check that the O-rings (17) (15) of the axle unit are in good condition ; lubricate the seats of the seals and fit the steering cylinder (3).



55W9NAX103

- ② Lock the cylinder by cross- tightening the screws (3).
  - $\cdot$  Torque wrench setting :

11.8~13.1 kgf · m (85.3~94.8 lbf · ft)



55W9NAX104

- ③ Apply loctite 242 to the thread and connect the steering bars by screwing the terminals onto the piston stem.
  - Torque wrench setting : 24.5~27.5 kgf · m (177~199 lbf · ft)
- \* Versions with coupling require that the rim of the articulation is riveted onto the surfaces of the piston stem.
- Insert the pins (18) in the steering case and lock into position using a torque wrench setting of 27.5~30.6 kgf · m (199~221 lbf · ft).





- Install the proximity (21) for checking piston centring - if applicable - and tighten the screws (20).
  - · Torque wrench setting :
    - 0.51~0.82 kgf · m (3.7~5.9 lbf · ft)



\* Eliminate the action of the negative brake, if fitted.

Apply tools T6 to the hubs and lock them.

Using a level "B", check that tools are perfectly flat and parallel to each other.

(6) Connect the sensor (21) to the inspection device according to either diagram.



55W9NAX108





⑦ Center the piston by slowly moving it first in one direction then in the other and position it half way on the stroke, which is determined by the switching on and off of the signal lamp of the inspection device in the reversal stage.



55W9NAX112

- (B) Inspect jut "C" on one side of the piston and note down the size for checking later adjustments.
- If cylinders come without a sensor, the centering of the piston must be carried out on the basis of the maximum stroke.



- Without moving the piston, check front and rear size at the edge of tools T6. Max. difference : 0.6-0.7 mm
- In order to check the rear size, rotate the bevel pinion and check that tools T6 are flat.



55W9NAX114

- If necessary, adjust convergency without moving the centering of the piston and adjust the length of the steering bars (14).
- With a half turn of screw, the front size is reduced by about 3 mm, whereas the rear one is increased by about 3 mm.



55W9NAX115

② Unloose the nuts and screw them onto the ball-and-socket joints.

2 Hold the articulations still and rotate the

· Torque wrench setting for nuts :

Once the convergency has been

24.5~27.5 kgf · m (177~199 lbf · ft)

ball-and-socket joints.

adjusted, lock the nuts.



55W9NAX116

240 - 270 Nm Loctite 242

55W9NAX117

#### ADJUSTING THE STEERING ANGLE

\* Perform the same operations on both sides (see diagram).

Loosen the nut of one of the adjusting screws on cylinder side.

Pos. 2 Pos. 4 Po

55W9NAX118

Adjust the jutting portion of the screw according to data shown in the table (see the next page).

Lock into the position with nut tightened to max 15.1 kgf  $\cdot$  m (109 lbf  $\cdot$  ft).



Perform one full steering operation until the adjusted screw leans against the arm stop.



55W9NAX120

- As you hold the adjusted screw in position against the arm stop, adjust the screw opposite, on non-cylinder side, until it leans against the arm stop.
- \* The screws must lean against the respective arm stops all at the same time.



55W9NAX121

| Requested steering angle : value $\alpha$            | 25°  | 27°  | 30°  | 32°  | 35°  | 36°  | 40°  | 42°  | 45°  |
|--|--|------|------|------|------|------|------|------|------|
| Steering cases versions based on max. steering angle | Value W = Adjustment of the steering stop screw, steering cylinder side [mm] |      |      |      |      |      |      |      |      |
| 35° max angle  | 55.1   | 51.2 | 45.4 | 41.4 | 35.0 |      |      |      |      |
| 45° max angle  |  |      | 57.4 |      | 47.0 | 44.7 | 35.8 | 31.2 | 24.6 |

\* The screws must lean against the respective arm stops all at the same time.



#### 3) BRAKE : SERVICE BRAKE, NEGATIVE BRAKE

(1) Disassembly



55W9NAX122

- 1 Connect an external pump to the union piece "P1" of the negative brake and introduce a pressure of  $15\pm30$  bar to eliminate the pressure of the belleville washers.
- \* Perform all operations on both arms.
- ② Loosen the unlocking screws (30) and remove both stop washers (32).







③ Insert block screws to end stroke and release pression.



55W9NAX125

④ Sling the arm to be removed and connect it to a hoist, remove screws.

5 Take off the arm and lay it down vertically.



55W9NAX126



- ⑥ Remove the brake discs one after the other (2).
- \* If they are not to be substituted, do not mix up the sequence.



⑦ Remove the flange (3) complete with the discs.

⑧ In order to keep the disc springs of the

③ Remove the negative brake locking

Always exchange the O-ring (31).

screws (30).

negative brake preloaded, screw down the screws with washers to the end stop.



55W9NAX129

M12x45 with washer

55W9NAX130



55W9NAX131

① Loosen the before installed provisional screws in the same sequence and same measure.



ID Remove the negative brake locking screws (30).Always exchange the O-ring (31).

12 Pull out brake piston assembly module

(22).



55W9NAX133



55W9NAX134

\* Check locking screw (33) of the brake piston module.



③ Turn upside down the brake module and with a pin driver remove the locking pin of the slotted nut.



4 Sign the position of the slotted nut.



55W9NAX137

Is Bring the piston group below a press, compress the cup springs and loosen the metal ring.



55W9NAX138



55W9NAX139



16 Remove nut (29).



(B) Applying air pressure, remove the piston(27) of the negative brake.



55W9NAX141

(19) Using a new screw remove the pressure seal caps.



55W9NAX142

② Remove the reversal springs (11).



55W9NAX143

55W9NAX144

0 Remove the adjusting screws (5).

2 Remove the service brake piston (4).



55W9NAX145

② Remove the three bolts (24).



Remove the O-rings and the anti-extrusions rings from the service brake, the negative brake piston and from the piston.



55W9NAX147



## (2) Assembly



55W9NAX149



① Zero the centesimal calibre between the support plane and the centering arm.

② Then measure the distance between the

stop.

arm support plane and the piston pack



55W9NAX151

A = 141,0 mm

55W9NAX152

③ Measure the distance between the disk support plane and the arm support plane.

Subtract the value B from the value A to obtain the effective dimension of the arm containing the brake disks and the piston pack.

B = 19,0 mm

55W9NAX153

④ Bring the disk pack beneath a press, load with 1000 kg, then measure the dimension D.

Add the play G and the fixed value F (equal to 0.2 mm) to the value D.

\* Do not take into account the thickness between the press piston and the disks.



55W9NAX154

⑤ To determine the value of the piston pack, subtract value C from value D1.

C = A - B 141,0 - 19,0 = 122 mm C= arm quote D1 = D + G + F 26,0 + 0,75 + 0,2 = 26,95 mm D= tickness of discs pack G= brake discs gap F= fix quote E = C - D1 122 - 26,95 = 95,05 mm E = piston pack quote

55W9NAX155

⑥ Insert the service brake piston (4) hammering alternately with a plastic hammer.



55W9NAX156

⑦ Insert the bolts (24).



⑧ Turn upside down and insert the negative brake piston (27).



\* To determin the level "E" the slotted nut has to be operated without spring mounted.

\* To define the level "E" adjust the slotted

to the closer notch.

nut always to the smaller value by driving



55W9NAX159

E = 95,05 mm



- (9) Before removing the slotted nut in order to insert the springs, note down the distance "H" from the plane to the tooth near the pin.
- \* Sign.

① Remove the service brake piston (4).





 Insert the stroke automatic regulation springs (6); place them in line with the piston (4).



55W9NAX163

- ② Complete the O-rings and anti-extrusion rings on all pistons.
- \* The O-rings always have to be assembled from the pressure facing side.



55W9NAX164



55W9NAX165



③ Insert the service brake piston (4) hammering alternately with a plastic hammer.



55W9NAX167

- If the adjusting screws (5).
  Apply loctite 242 to the thread.
  Torque wrench setting :
  - 0.51~0.71 kgf · m (3.69~5.16 lbf · ft)



55W9NAX168

10 - 15 Nm Loctite 242

55W9NAX169



55W9NAX170

(5) Fit the reversal springs (11) on the piston (4).

Apply loctite 242 to the thread of the adjustment screw.

Tighten with torque wrench setting of  $1.02 \sim 1.53 \text{ kgf} \cdot \text{m}$  (7.38 $\sim 11.1 \text{ lbf} \cdot \text{ft}$ ).

(16) Insert the stroke end seal caps.

1 Insert the negative brake piston (27).



55W9NAX171

(28)

55W9NAX172

1 Insert at the bottom the piston of the negative brake (27) and screw up the slotted nut (29).

(B) Insert the disc springs in the right posi-

tion (28).



55W9NAX173

② Screw down the slotted nut to the earlier determined position.



2 Check the earlier measured distance "H" from the plane to the tooth next to the pin.



55W9NAX175

② Alternately tighten with a torque wrench setting of maximum 4.59 kgf  $\cdot$  m (33.2 lbf · ft).



55W9NAX176

② Put the pin in locking (21) position.



\* Check locking screw (33) of the brake piston module.



(2) Insert the brake module facing the input holes to the top.



55W9NAX179

(25) Insert the piston to the end stop by alternating light strokes and remove the screws.



55W9NAX180

(26) Insert the negative brake unlocking screw (30) up to the end stop.



⑦ Remove the two auxiliary screws.



- Insert the brake discs (1) (2) in the right sequence.
- \* The first brake disc to be inserted must be of friction material.



55W9NAX183



(2) Install the flange (3) on the arm.



55W9NAX185

- Insert the brake discs (1) (2) in the right sequence.
- \* The last brake disc to be inserted must be of metal material.



(3) Insert the screws and tighten them alternately.



55W9NAX187

Remove the negative brake locking screws (30).
 Fit the special tool T7 into the seat of the manual release of the screws insert a

manual release of the screws, insert a comparator and pre-load it with 1 mm.

③ Introduce a pressure of maximum 25 bar.



55W9NAX188



55W9NAX189



Once the pressure is inserted into the circuit the comparator must give a measurement equal to play X (0.75 mm).

7-208

- Insert the two "U"-shaped shims and tighten the screws with a torque wrench setting of 9.69~11.7 kgf · m (70.1~84.8 lbf · ft).
- \* The position of the negative brake is unlocked.



55W9NAX191

Check the flatness of the arms and finally lock the arms with the screws (4) and the washer (5) using the crosstightening method.



55W9NAX192

## 4) BEVEL PINION

(1) Disassembly



55W9NAX223

 Position tool T10, so as to avoid pinion rotation.
 Unloose and remove the nut (1); also remove the O-ring (6).



55W9NAX224

② Remove the pinion (11), shims and distance piece.



③ Refer and keep to the positions marked during disassembly.



55W9NAX226



55W9NAX227

5 Remove the thrust block of the external

bearing (14).

④ Using a puller and a press, remove the inner bearing (4) from the pinion (11).



55W9NAX228

6 Insert a drift in the appropriate holes.



Remove the thrust block of the internal bearing (4) as well as the shim washers (10) (S).



(8) Remove the snap ring (15).



55W9NAX231

③ Remove the cap (14).



#### (2) Assembly



#### Calculating pinion center distance

 Using a faceplate, reset a centesimal comparator "DG" on a calibrated block (whose known thickness is 30 mm).
 Preload the comparator by about 3 mm.



55W9NAX234

- ② Bring inner bearing (4), complete with thrust block, under comparator "DG".
- Press the thrust block centrally and carry out several measurements by rotating the thrust block.

Example : 30 - 0.55 = 29.45 = "D".



③ Check nominal dimension "I" as marked on the pinion. Add up to or subtract from "I" the variation indicated as "Y" to obtain the actual centre distance "I".

Example : I=INT ± Y=98 - 0.1=97.9 mm

- \* C61 = Match part number
- ④ C61=bevel gear set matching number (-0.1)=Y variation from the theorical I =98



55W9NAX236



55W9NAX237

 Galculate shims "S" for insertion under the thrust block of the inner bearing using the following formula :

S = X-(I+D) where : X = fixed dimension

I = actual pinion center distance

D = Total bearing thickness ;

Example :

- S = 128 (97.9 + 29.45) = 0.65 mm
- ⑥ Using special tool T11.Insert the thrust block of the bearings (4) and shims (10).



55W9NAX238



\* Before starting the next stage, make sure that the thrust block has been completely inserted into its seat.



55W9NAX240

⑦ Using special tool T11.
 Insert the thrust block of the bearings (4) and shims (10).



55W9NAX241

# Calculating pinion bearings rolling torque

⑧ Introduce tool T12 complete with bearings (4) and (14) into the main body (12); tighten by hand until a rolling torque is definitely obtained.



Reset the comparator with a preload of about 3 mm.



55W9NAX242





55W9NAX244

 Remove the comparator and take out tool T12 and bearing kits from the main body.
 Reinstall every part, also introducing a

distance piece between bearings (4) and (14). Tighten the entire pack by hand.

 Assemble on top of the tool T12 and between the two bearings the shim (5) and the largest calibrated shim (9).



55W9NAX245



55W9NAX246

- DG
  T12

  Image: Strategy of the strate
- Measure the difference H using a dial gauge DDG.
  - $\cdot$  Example : H = A B = 2.93 mm



55W9NAX248



55W9NAX249



- (b) Heat the external bearing (14) to a temperature of about 100°C and fit it on to the pinion (11) so as to complete the pack as shown in the figure.
- \* Lightly lubricate bearing with SAE85W90 oil.



55W9NAX251

④ Heat the bearing to 100°C and assemble it to the pinion shaft.

(3) Calculate the shim S2 to be inserted.
 Example : S2 = H + X1 = 3.01 mm
 where X1 = fixed value to obtain =

0.07~0.08 mm

- (5) Fit the pinion (11), shim "S2" (10) and distance piece (5) (9) in the main body (12).
- \* The finer shims must be placed inbetween the thicker ones.

⑦ Apply loctite 270 to the thread of the ring nut (8) and screw the nut onto the pinion.



55W9NAX252



55W9NAX253

(B) Apply onto the pinion (11) the bar-hold and with the help of a torque meter, check the torque of the pinion (11).

Torque : 50.9~71.4 kgf · m

(368~516 lbf · ft)

- If torque exceeds the maximum value, then the size of shim "S1" (4) between the bearing (9) and the distance piece (3) needs to be increased. If torque does not reach the set value, increase the torque setting of the ring nut (10) in different stages to obtain a maximum value of 50.9 kgf · m (368 lbf · ft).
- If torque does not reach the minimum value, then the size of shim "S1" (4) needs to be reduced.

### 5) DIFFERENTIAL UNIT

## (1) Disassembly



55W9NAX254

 Connect an external pump to the union piece "P1" of the negative brake and introduce a pressure of 15±30 bar to eliminate the pressure of the belleville washers.



② Loosen the unlocking screws (30) and remove both stop washers (32).


③ Insert block screws to end stroke and release pression.



55W9NAX257

④ Remove the brake side arm and the brake discs pack.

Sling the arm to be removed and connect it to a hoist, remove screws of the crown wheel side arm.

Remove the arm together with the pack of the braking disks.

Place the arm on a bench.

⑤ Remove the fitting screws from the middle cover.



55W9NAX258



55W9NAX259

⑥ Insert a screw-driver in the opposing slots then force and remove the middle cover.



- $\bigcirc$  If the bearings need replacing (13), extract the external thrust blocks of the bearings (13) from middle cover and central body.
- \* Accurately check the O-ring.

⑧ Pull out the differental (14).

(9) If the bearing need replacing, extract the bearing (13) from the differential carrier.

1 Remove fixing screws (24) of the crown wheel (11); exchange each time when removed.





55W9NAX262



55W9NAX263



① Extract the crown wheel (11).



55W9NAX265

② Remove the shim washer (15).



<sup>(3)</sup> Remove the planetary gear (16).



55W9NAX267

() Remove the three spider blocking pins (20) by using a pin driver.



 Move the two opposite mounted short bolts (19) to the outside of the box using the same pin driver.



55W9NAX269

- 16 Drive out the long bolt (21) and pull out the spider (22) from the center.

55W9NAX270

(7) Remove the two half bolts (19), spherical washers and satellite wheels.



55W9NAX271

(18) Remove long bolt, spherical washers (18) and satellite wheels (17).



19 Pull out the spider (22) from the center.



55W9NAX273

② Remove the planetary gear (16).



② Remove the shim washer (15).



# (2) Assembly



55W9NAX276

 Lubricate and insert washer (15) and plantary wheel (16).





② Partially insert the long bolt (21), satellite wheels (17) and spherical washers (21).

③ Insert the two half bolts (19), spherical

washers (18) and satellite wheels (17).



55W9NAX279



55W9NAX280

- (1) Insert spider (22) and completely insert the long bolt (21).



(5) Insert completely the bolts (19).



- 6 Center the pin holes and insert the 3V pins (20).
- \* Check the free rotation of the satellite wheels on the bolts.



55W9NAX283

⑦ Lubricate wheel (16).



55W9NAX284



55W9NAX285

 Position the shim washer (15) on the
 crown (11).

⑧ Insert planetary gear wheel (16).

\* In order to hold the shim washer (15) in position, apply grease to it.



<sup>55</sup>W9NAX286

- Position the crown (11) on the differential carrier and lock it with screws (24) applied with loctite 270.
- \* Secure the screws using the cross-tightening method.

- ① Tighten screws with a torque wrench : see table.
- \* Always use new screws to fix the crown wheel. In case the screws are not thread locking pretreated, use loctite 270.



55W9NAX287



55W9NAX288

- 1 Assemble the bearing (13).
- \* Heat the bearing to 100°C before assembling.



55W9NAX289

If the bearings are replaced, insert the external thrust blocks in the middle cover and in the central body.



- ④ Position the differential unit in the central body with the help of a bar and fit the middle cover.
- Thoroughly check the state of the O-ring and make sure that the cover is fitted with the oil discharge in the lower position.



 $\cdot$  Torque wrench setting for screw : 2.43~2.67 kgf  $\cdot$  m (17.6~19.3 lbf  $\cdot$  ft)

(b) Check that the positioning of the sealing ring on the arm is intact; install the complete arm. Lock it into position using two

facing screws and washers.



55W9NAX291



55W9NAX292

### 6) RING AND PINION ADJUSTING



55W9NAX294

#### Setting of the crown wheel and pinion

(1) Insert the thrust block of the bearing (6) opposit side of the crown wheel shims
 (Sb) (7) of an initial thickness of about 0.8 mm.



- (2) Insert the thrust block (6) and the shims (Sb) (7) into the arm.
- \* Check to be at end of stroke.



- (3) Insert thrust block (4) of the bearing shims (Sc) (3) of an initial thickness of about 0.75 mm. Insert the thrust block and the shims into the arm.
- \* Check to be at end of stroke.
- (4) Insert complete differential (5).
- \* Do not damage the seat of the O-ring with the gearwheel.

- (5) Check the O-ring (2) and grease.
- (5

(6) Lock the middle cover (5) with screws (4). Torque wrench setting for screw : 2.43~2.67 kgf · m (17.6~19.3 lbf · ft)



55W9NAX297



Install 4 screws M12x30 temporary

lubricate

55W9NAX300

(7) Apply torque meter TM to pinion nut and check that torque will increase by 0.04~0.06 kgf · m (0.29~0.43 lbf · ft) as a result of differential bearing preload.

Example : pinion torque :

- 0.08~0.12 kgf · m (0.59~0.87 lbf · ft) Pinion + differential torque : 0.12~0.18 kgf · m (0.87~1.3 lbf · ft)
- (8) Position comparator on the center of one of the crown teeth, preset it to 1 mm and reset it to zero.

Manually move the crown in both directions to check the existing clearance between pinion and crown.

Gap = 0.13~0.20 mm

(9) + Sc (3) - Sb (7) = reduction gap ring and pinion



55W9NAX301



55W9NAX302





(10) - Sc (3) + Sb (7) = increase gap ring and pinion

- (11) Install the crown wheel side arm (1) without half-axle.
- \* To check the torque of the differential, neither of both half-axles must be installed.

(12) Temporarily insert all screws of the arm

(13) Check the flatness of the arms; then lock the arms into their final position, using screws adequately coated with loctite

(18).

242.



55W9NAX305





55W9NAX308

(14) Torque wrench setting :

13.1 kgf · m (94.4 lbf · ft)

\* Tighten using the criss-cross method.



(15) Using a driver, fit the cap and position it in its seat with the snap ring.



55W9NAX310

# 7) SPECIAL TOOLS







55W9NAX311-3



55W9NAX312-1









55W9NAX313-2



55W9NAX313-3







55W9NAX314-2





55W9NAX316-1



## 4. REAR AXLE

# 1) PLANETARY REDUCTION GEAR

(1) Assembly diagram



55W9NAX441

## (2) Disassembly

- \* Perform all operations on both arms.
- 1 Remove the oil level plug (4).



55W9NAX442

② Remove the securing screws (20) from the spider cover (21).



③ Disjoin the spider cover (21) from the hub
 (26) by alternatively forcing a screwdriver into the appropriate slots.



55W9NAX444

④ Remove the complete planetary carrier cover (21).



55W9NAX445

(5) Remove the complete axle-shaft (27).



55W9NAX446



⑥ Unloose and remove the tightening nuts(23) from the crown flange (13).



 $\bigcirc$  Remove the safety flange (14).



55W9NAX448

⑧ Remove the crown (12).



55W9NAX449

- ③ Partially extract the hub (26) using a plastic hammer.
- \* Alternately hammer on several equidistant points.



55W9NAX450

1 Remove the external bearing (31).



(1) By hand remove complete hub (26).



55W9NAX452

- ② Using an extractor, remove the seal ring (6).
- \* Note down the direction of assembly of snap ring.



55W9NAX453

③ Remove snap ring (15).



55W9NAX454

(1) Using a screw M6 remove all bolts (16).



(5) Positioning the planet wheel gear (17) in center of the spider cover and remove.



55W9NAX456

(6) Remove the sealing ring (7) from the hub (26).

1 Remove the internal bearing (10).



55W9NAX457

- (B) Remove the thrust blocks (10) (31) from the bearings and forcing a pin-driver into the appropriate slots on the hub.
- \* Hammer in an alternate way so as to avoid crawling or deformation of the thrust blocks.



(1) Remove the snap ring (12) from the crown (13).



55W9NAX460

2 Remove the crown flange (13).



## (3) ASSEMBLY

 Lubricate and fit the sealing ring (6) onto tool T3; install the rings into the arm.



55W9NAX462

\* Pay particular attention to the direction of assembly of the rings.

② Position the lower part of tool T1 and the thrust block of the external bearing (31).



55W9NAX463



55W9NAX464

③ Lubricate the seats of the bearings and position the hub on tool T1; position the thrust block of the internal bearing (10).

Check that the thrust block is correctly oriented.



④ Fit the bearing (10) into the internal thrust block.



55W9NAX466

T2

- Using special tool T2 apply a repositionable jointing compound for seals to the outer surface of the sealing ring (7).
   Position the sealing ring (7) in the hub (26).
- \* Check that the ring (7) is correctly oriented.
- ⑥ Install the wheel hub (26).



55W9NAX468

- ⑦ Install the external bearing (31).
- \* Move the bearing to the limit stop by hammering lightly all around the edge.



- Install the crown wheel (12).
  Insert the snap ring (11) in order to fix the flange (13) in the crown (12).
- \* Carefully check that ring (11) is properly inserted in the slot of the crown (12).



55W9NAX470

- ③ Fit the complete crown flange.
- In order to fasten the flange, use a plastic hammer and alternately hammer on several equidistant points.





55W9NAX471



55W9NAX472

① Coat the nuts (23) with loctite 242 and screw them.



- ⑦ Tighten nuts (23) in two stages, using the criss-cross method.
  - Initial torque wrench setting :

9.18 kgf · m (66.4 lbf · ft)

 $\cdot$  Final torque wrench setting : 10.2 kgf  $\cdot$  m (73.8 lbf  $\cdot$  ft)



55W9NAX474

- ③ Check the continuous rolling torque on the hub.
  - Torque : 0.71~2.04 kgf · m (5.14~14.8 lbf · ft)

Install the axle shaft (27), making sure that it is properly inserted into braking disks and differential unit.





55W9NAX476

 Check the condition and position of the O-ring (25).



(15) Install the spherical washer (19).



55W9NAX478

(16) Install planetary gears complete with roller bearing (17).



55W9NAX479

Install the others friction washers.Two friction washers for every planetary

gear.



55W9NAX480

(B) Check the concentricity of the planetary gear, the seat and friction washers. Using a screw M6 install the pin (16).



(19) Carefully check that pin is completely inserted and install the snap rings (15).



55W9NAX482

- ② Fit the planetary gear cover (21) onto the wheel hub (26).
  - $\cdot$  Torque wrench : 2.04~2.55 kgf  $\cdot$  m (14.8~18.4 lbf  $\cdot$  ft)



55W9NAX483

### 2) SERVICE AND NEGATIVE BRAKE

(1) Assembly diagram



55W9NAX484

#### (2) Disassembly

- D Connect an external pump to the union piece "P1" of the negative brake and introduce a pressure of 15~30 bar to eliminate the pressure of the belleville washers.
- \* Perform all operations on both arms.
- 2 Loosen the unlocking screws (30) and remove both stop washers (32).







③ Insert block screws to end stroke and release pression.



55W9NAX487

④ Sling the arm to be removed and connect it to a hoist, remove screws.

⑤ Take off the arm and lay it down vertically.



55W9NAX488

55W9NAX489

- ⑥ Remove the brake discs one after the other (2).
- \* If they are not to be substituted, do not mix up the sequence.



⑦ Remove the flange (3) complete with the discs.



55W9NAX491

⑧ In order to keep the disc springs of the negative brake preloaded, screw down the screws with washers to the end stop.

(9) Remove the negative brake locking

Always exchange the O-ring (31).

screws (30).

M12x45 with washer

55W9NAX492



55W9NAX493

① Loosen the before installed provisional screws in the same sequence and same measure.


ID Remove the negative brake locking screws (30). Always exchange the O-ring (31).



55W9NAX495

Pull out brake piston assembly module (22).



55W9NAX496

\* Check locking screw (33) of the brake piston module.



55W9NAX497

③ Turn upside down the brake module and with a pin driver remove the locking pin of the slotted nut.



1 Sign the position of the slotted nut.



55W9NAX499

 Bring the piston group below a press, compress the cup springs and loosen the metal ring.



55W9NAX500

16 Remove nut (29).



55W9NAX501

17 Remove the disc springs (28).



(B) Applying air pressure, remove the piston(27) of the negative brake.



55W9NAX503

(19) Using a new screw remove the pressure seal caps.



00110100000



55W9NAX505



② Remove the reversal springs (11).



2 Remove the service brake piston (4).



<sup>(2)</sup> Remove the three bolts (24).



② Remove the O-rings and the anti-extrusions rings from the service brake, the negative brake piston and from the piston.



# (3) Assembly



55W9NAX149

C = A - B 141.0 - 19.0 = 122 mm C = arm quote D1 = D + G + F 26.0 + 0.75 + 0.2 = 26.95 mm D = tickness of discs pack G = brake discs gap F = fix quote E = C - D1 122 - 26.95 = 95.05 mm E = piston pack quote



① Zero the centesimal calibre between the support plane and the centring arm.

② Then measure the distance between the

stop.

arm support plane and the piston pack



55W9NAX512



55W9NAX513

③ Measure the distance between the disk support plane and the arm support plane.

Subtract the value "B" from the value "A" to obtain the effective dimension "C" of the arm containing the brake disks and the piston pack.

B = 19,0 mm

55W9NAX514

④ Bring the disk pack beneath a press, load with 1000 kg, then measure the dimension "D".

Add the play "G" and the fixed value "F" (equal to 0.2 mm) to the value "D".

\* Do not take into account the thickness between the press piston and the disks.



⑤ To determine the value "E" of the piston pack, subtract value "C" from value "D1".

C = A - B 141,0 - 19,0 = 122 mm C= arm quote D1 = D + G + F 26,0 + 0,75 + 0,2 = 26,95 mm D= tickness of discs pack G= brake discs gap F= fix quote E = C - D1 122 - 26,95 = 95,05 mm E = piston pack quote

55W9NAX516

6 Insert the service brake piston (4) hammering alternately with a plastic hammer.



55W9NAX517

⑦ Insert the bolts (24).



8 Turn upside down and insert the negative brake piston (27).



\* To determin the level "E" the slotted nut has to be operated without spring mounted.

\* To define the level "E" adjust the slotted

to the closer notch.

nut always to the smaller value by driving



55W9NAX520

E = 95.05 mm



- (9) Before removing the slotted nut in order to insert the springs, note down the distance "H" from the plane to the tooth near the pin.
- \* Sign.

① Remove the service brake piston (4).





Insert the stroke automatic regulation springs (6); place them in line with the piston (4).

- ② Complete the O-rings and anti-extrusion rings on all pistons.
- \* The O-rings always have to be assembled from the pressure facing side.

- ③ Insert the service brake piston (4) hammering alternately with a plastic hammer.

55W9NAX525

55W9NAX524

6)



- If the adjusting screws (5).Apply loctite 242 to the thread.
  - Torque wrench setting : 0.51~0.71 kgf · m (3.69~5.16 lbf · ft)



(5) Fit the reversal springs (11) on the piston (4).

Apply loctite 242 to the thread of the adjustment screw.

Tighten with torque wrench setting of  $1.02 \sim 1.53 \text{ kgf} \cdot \text{m} (7.38 \sim 11.1 \text{ lbf} \cdot \text{ft})$ 



(16) Insert the stroke end seal caps.

1 Insert the negative brake piston (27).

Threated hole on external side

55W9NAX531



55W9NAX532

(B) Insert the disc springs in the right position (28).



(I) Insert at the bottom the piston of the negative brake (27) and screw up the slotted nut (29).

② Screw down the slotted nut to the earlier

determined position.



55W9NAX534

55W9NAX535

② Check the earlier measured distance "H" from the plane to the tooth next to the pin.



55W9NAX536

2 Alternately tighten with a torque wrench setting of maximum 4.59 kgf  $\cdot$  m (33.2 lbf  $\cdot$  ft).



<sup>(2)</sup> Put the pin in locking (21) position.



55W9NAX538

\* Check locking screw (33) of the brake piston module.



55W9NAX539

0 Insert the brake module facing the input holes to the top.



55W9NAX540

(25) Insert the piston to the end stop by alternating light strokes and remove the screws.



Insert the negative brake unlocking screw (30) up to the end stop.



55W9NAX542

⑦ Remove the two auxiliary screws.



55W9NAX543

- Insert the brake discs (1) (2) in the right sequence.
- \* The first brake disc to be inserted must be of friction material.

(2) Install the flange (3) on the arm.



55W9NAX544



- ③ Insert the brake discs (1) (2) in the right sequence.
- \* The last brake disc to be inserted must be of metal material.

③ Insert the screws and tighten them alter-

nately.



55W9NAX546

128 Nm Loctite 242

55W9NAX547

② Remove the negative brake locking screws (30).

Fit the special tool T4 into the seat of the manual release of the screws, insert a comparator and pre-load it with 1 mm.



55W9NAX548

③ Introduce a pressure of maximum 25 bar.



Once the pressure is inserted into the circuit the comparator must give a measurement equal to play X (0.75 mm).

- Insert the two "U"-shaped shims and tighten the screws with a torque wrench setting of 9.69~11.7 kgf · m (70.1~ 84.6 lbf · ft).
- \* The position of the negative brake is unlocked.
- ③ Check the flatness of the arms and finally lock the arms with the screws (4) and the washer (5) using the crosstightening method.



55W9NAX550



55W9NAX551



## 4) NORMAL DIFFERENTIAL

# (1) Assembly diagram



55W9NAX553

# (2) DISASSEMBLY

 Connect an external pump to the union piece "P1" of the negative brake and introduce a pressure of 15~30 bar to eliminate the pressure of the belleville washers.



② Loosen the unlocking screws (30) and remove both stop washers (32).



③ Insert block screws to end stroke and release pression.



55W9NAX556

④ Remove the brake side arm and the brake discs pack.

Sling the arm to be removed and connect it to a hoist, remove screws of the crown wheel side arm.

Remove the arm together with the pack of the braking disks.

Place the arm on a bench.

⑤ Remove the fitting screws from the middle cover.



55W9NAX557



55W9NAX558

⑥ Insert a screw-driver in the opposing slots then force and remove the middle cover.



- ⑦ If the bearings need replacing (13), extract the external thrust blocks of the bearings (13) from middle cover and central body.
- \* Accurately check the O-ring.

8 Pull out the differental (14).

If the bearing need replacing, extract the bearing (13) from the differential carrier.

① Remove fixing screws (24) of the crown wheel (11); exchange each time when removed.





55W9NAX561



55W9NAX562



① Extract the crown wheel (11).



55W9NAX564

② Remove the shim washer (15).



55W9NAX565

<sup>(3)</sup> Remove the planetary gear (16).



55W9NAX566

()) Remove the three spider blocking pins (20) by using a pin driver.



 Move the two opposite mounted short bolts (19) to the outside of the box using the same pin driver.



55W9NAX568

- 16 Drive out the long bolt (21) and pull out the spider (22) from the center.

55W9NAX569

(7) Remove the two half bolts (19), spherical washers and satellite wheels.



55W9NAX570

(18) Remove long bolt, spherical washers (18) and satellite wheels (17).



19 Pull out the spider (22) from the center.



55W9NAX572

② Remove the planetary gear (16).



② Remove the shim washer (15).



## (3) ASSEMBLY

① Lubricate and insert washer (15) and plantary wheel (16).



55W9NAX575

② Partially insert the long bolt (21), satellite wheels (17) and spherical washers (21).

③ Insert the two half bolts (19), spherical

washers (18) and satellite wheels (17).



55W9NAX576



④ Insert spider (22) and completely insert the long bolt (21).



(5) Insert completely the bolts (19).



55W9NAX581

20

55W9NAX582

- <sup>(6)</sup> Center the pin holes and insert the 3V pins (20).
- \* Check the free rotation of the satellite wheels on the bolts.

⑦ Lubricate wheel (16).

⑧ Insert planetary gear wheel (16).



55W9NAX583



- Position the shim washer (15) on the crown (11).
- In order to hold the shim washer (15) in position, apply grease to it.

1 Position the crown (11) on the differential

\* Secure the screws using the cross-tight-

applied with loctite 270.

ening method.

carrier and lock it with screws (24)

55W9NAX585



55W9NAX586

- Tighten screws with a torque wrench: see table.
- \* Always use new screws to fix the crown wheel. In case the screws are not thread locking pretreated, use loctite 270.



55W9NAX587

- D Assemble the bearing (13).
- Heat the bearing to 100°C before assembling.



- If the bearings are replaced, insert the external thrust blocks in the middle cover and in the central body.
- Street.

55W9NAX589

- ④ Position the differential unit in the central body with the help of a bar and fit the middle cover.
- \* Thoroughly check the state of the O-ring and make sure that the cover is fitted with the oil discharge in the lower position.



55W9NAX590

- (5) Lock the middle cover with screws.
  - $\cdot$  Torque wrench setting for screw : 2.47~2.67 kgf  $\cdot$  m (17.9~19.3 lbf  $\cdot$  ft)



55W9NAX5

(b) Check that the positioning of the sealing ring on the arm is intact; install the complete arm. Lock it into position using two facing screws and washers.



### 4) RING AND PINION ADJUSTING

# (1) Assembly diagram



55W9NAX593

# (2) Adjusting

 Setting of the crown wheel and pinion Insert the thrust block of the bearing (6) opposit side of the crown wheel shims (Sb) (7) of an initial thickness of about 0.8 mm.



- ② Insert the thrust block (6) and the shims(Sb) (7) into the arm.
- \* Check to be at end of stroke.



③ Setting of the crown wheel and pinion

Insert thrust block (4) of the bearing shims (Sc) (3) of an initial thickness of about 0.75 mm. Insert the thrust block and the shims into

the arm.

- \* Check to be at end of stroke.
- ④ Insert complete differential (5).
- \* Do not damage the seat of the O-ring with the gearwheel.

(5) Check the O-ring (2) and grease.



55W9NAX597



55W9NAX598



55W9NAX599



55W9NAX600

6 Lock the middle cover (5) with screws (4).

 $\cdot$  Torque wrench setting for screw : 2.47~2.67 kgf  $\cdot$  m (17.9~19.3 lbf  $\cdot$  ft)

- ⑦ Apply torque meter TM to pinion nut and check that torque will increase by 0.04~0.06 kgf · m as a result of differential bearing preload.
  - Example : pinion torque : 0.08~0.12 kgf · m (0.58~0.87 lbf · ft)
     Pinion + differential torque :
    - 0.12~0.18 kgf · m (0.87~1.3 lbf · ft)
- ⑧ Position comparator on the center of one of the crown teeth, preset it to 1 mm and reset it to zero.

Manually move the crown in both directions to check the existing clearance between pinion and crown.

· Gap = 0.13~0.20 mm

- Install the crown wheel side arm (1) without half-axle.
- \* To check the torque of the differential, neither of both halfaxles must be installed.

 Temporarily insert all screws of the arm (18).



55W9NAX601



55W9NAX602



55W9NAX603



 Check the flatness of the arms; then lock the arms into their final position, using screws adequately coated with loctite 242.



55W9NAX605

2 Torque wrench setting : 13.1 kgf  $\cdot$  m (94.4 lbf  $\cdot$  ft) Tighten using the criss-cross method.



55W9NAX606

③ Using a driver, fit the cap and position it in its seat with the snap ring.



### 5) BEVEL PINION

(1) Assembly diagram



55W9NAX637

#### (2) Disassembly

- Make positional marks across nut (1) and pinion (11) tang; If disassembly is awkward, heat the check nut (1) of the flange (2) at 80°C.
- Heating is meant to unloose the setting of loctite on the nut (1).



② Position tool T6, so as to avoid pinion rotation.

Unloose and remove the nut (1); also remove the O-ring (6).



③ Remove the flange (2) complete with guard (7) by means of a puller.



55W9NAX640

4 Remove the sealing ring (3).



55W9NAX641

- ⑤ Remove the sealing ring (3) and spacer (8A).
- \* Sealing rings (3) must be replaced each time the unit is disassembled.



55W9NAX642

⑥ Remove the pinion (11), shims and distance piece.



⑦ Refer and keep to the positions marked during disassembly.



55W9NAX644

③ Using a puller and a press, remove the inner bearing (4) from the pinion (11).



55W9NAX645

③ Remove the thrust block of the external bearing (14).



55W9NAX646

1 Insert a drift in the appropriate holes.



 Remove the thrust block of the internal bearing (4) as well as the shim washers (10) (S).



55W9NAX648

② Remove the snap ring (15). Remove the cap (14).



55W9NAX649

## (3) Assembly

Calculating pinion center distance
 Using a faceplate, reset a centesimal comparator "DG" on a calibrated block (whose known thickness is 30 mm).

 Preload the comparator by about 3 mm.



55W9NAX650

- <sup>(2)</sup> Bring inner bearing (4), complete with thrust block, under comparator "DG".
- Press the thrust block centrally and carry out several measurements by rotating the thrust block.
  - Example : 30 0.55 = 29.45 = "D"



 $\cdot$  Example : I=INT  $\pm$  Y=98-0.1=97.9 mm



55W9NAX651



55W9NAX652

- ④ Calculate shims "S" for insertion under the thrust block of the inner bearing using the following formula :
  - S = X (I + D) where :
  - X = Fixed dimension I = actual pinion center distance
  - D = Total bearing thickness ;

Example :

S = 128 - (97.9 + 29.45) = 0.65 mm



 Using special tool T7.
 Partially insert the thrust block of the bearings (4) and shims (10).



55W9NAX654

⑥ Connect the tension rod to the press and move the thrust block of bearings (4) (14) into the seats.

Disconnect the press and remove the tension rod.

\* Before starting the next stage, make sure that the thrust block has been completely inserted into its seat.



55W9NAX655

# ⑦ Calculating pinion bearings rolling torque

Introduce tool T8 complete with bearings (4) and (14) into the main body (12); tighten by hand until a rolling torque is definitely obtained.

⑧ Introduce the tracer of a depth comparator "DDG" into either side hole of tool T8. Reset the comparator with a preload of about 3 mm.



55W9NAX656



55W9NAX657

 Remove the comparator and take out tool and bearing kits from the main body.
 Reinstall every part, also introducing a distance piece between bearings (4) and (14). Tighten the entire pack by hand.



55W9NAX658

 Assemble on top of the tool T8 and between the two bearings the shim (5) and the largest calibrated shim (9).



55W9NAX659

Measur the difference H using a dial gauge DDG.



55W9NAX660

(2) Calculate the shim S2 to be inserted. E.g. S2 = H + X = 3.01 mm where X = fixed value to obtain =  $0.07 \sim 0.08$  mm


- If the pinion (11), shim "S1" (10) and distance piece (5), (9) in the main body (12).
- \* The finer shims must be placed inbetween the thicker ones.



55W9NAX662

- Heat the external bearing (14) to a temperature of about 100°C and fit it on to the pinion (11) so as to complete the pack as shown in the figure.
- \* Lightly lubricate bearing with SAE85W90 oil.



55W9NAX663

- (5) Insert the spacer (8A).
- \* Check the using of the friction washers.



55W9NAX664

(b) Install the flange (2) onto the pinion (11) without sealing ring.



55W9NAX665

1 Install the nut (1) without loctite 270.



55W9NAX666

- (B) Lock the wrench T6, rotate the pinion using a dynamometric wrench, up to a minimum required torque setting of 26.5~30.6 kgf · m (192~221 lbf · ft).
- 260 300 Nm

55W9NAX667



55W9NAX668

(9) Apply onto the pinion (1) the bar-hold and with the help of a torque meter, check the torque of the pinion (1).

 Torque : 0.08~0.12 kgf · m (0.58~0.87 lbf · ft)

- If torque exceeds the maximum value, then the size of shim "S1" (4) between the bearing (9) and the distance piece (3) needs to be increased. If torque does not reach the set value, increase the torque setting of the ring nut (10) in different stages to obtain a maximum value of 51 kgf · m (369 lbf · ft).
- If torque does not reach the minimum value, then the size of shim "S1" (4) needs to be reduced. When calculating the increase or decrease in size of shim "S1", bear in mind that a variation of shim of 0.01 mm corresponds to a variation of 0.06 kgf · m (0.44 lbf · ft) in the torque of the pinion (1).

② Make positional marks across nut (1) and pinion (11) tang; then remove nut and flange (2).



55W9NAX669

② Apply Arexons rubber cement to the outer surface of the new seal ring (3) and fit ring in the main body (12) using driver T9.



55W9NAX670

② Oil seal ring lips and install flange (2).
Mount O-ring (6) and apply loctite 270 to pinion tang; tighten nut (1).



55W9NAX671

③ Tighten the nut until the match marks made at stage "a" line up.



## 6) SPECIAL TOOLS





55W9NAX674-1











55W9NAX676



55W9NAX677



# **GROUP 10 RCV LEVER**

#### **1. REMOVAL AND INSTALL**

#### 1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.
- (4) Loosen the socket bolt (1).
- (5) Remove the cover of the console box.
- (6) Disconnect pilot line hoses (3).
- (7) Remove the pilot valve assembly (2).
- When removing the pilot valve assembly, check that all the hoses have been disconnected.

#### 2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- (2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.





# 2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



| 1  | Case              |  |  |  |  |
|----|-------------------|--|--|--|--|
| 2  | Bushing           |  |  |  |  |
| 3  | Spool             |  |  |  |  |
| 4  | Shim              |  |  |  |  |
| 5  | Spring            |  |  |  |  |
| 6  | Spring seat       |  |  |  |  |
| 7  | Spring            |  |  |  |  |
| 8  | Plug              |  |  |  |  |
| 9  | Push rod          |  |  |  |  |
| 10 | O-ring            |  |  |  |  |
| 11 | Rod seal          |  |  |  |  |
| 12 | Plate             |  |  |  |  |
| 13 | Spacer            |  |  |  |  |
| 14 | Boot              |  |  |  |  |
| 15 | Joint             |  |  |  |  |
| 16 | Swash plate       |  |  |  |  |
| 17 | Adjusting nut     |  |  |  |  |
| 18 | Bushing           |  |  |  |  |
| 19 | Plug              |  |  |  |  |
| 20 | Handle            |  |  |  |  |
| 21 | Handle bar        |  |  |  |  |
| 22 | Nut               |  |  |  |  |
| 23 | Boot              |  |  |  |  |
| 24 | Last guard filter |  |  |  |  |
| 25 | Connector         |  |  |  |  |
| 26 | Connector         |  |  |  |  |
| 27 | Connector         |  |  |  |  |
| 28 | Connector         |  |  |  |  |
| 29 | Connector         |  |  |  |  |
| 30 | Connector         |  |  |  |  |
| 32 | Connector         |  |  |  |  |
| 34 | Connector         |  |  |  |  |

210S2RL06AK

# 2) TOOLS AND TIGHTENING TORQUE

# (1) Tools

| Tool name     | Remark   |  |  |
|---------------|--|--|--|
| Allen wrench  | 6 <u>B</u>                                       |  |  |
| Spannar       | 22   |  |  |
| Spanner       | 27   |  |  |
| (+) Driver    | Length 150                                       |  |  |
| (-) Driver    | Width 4~5  |  |  |
| Torque wrench | Capable of tightening with the specified torques |  |  |

## (2) Tightening torque

| Part name     | ltem | Size | Torque         |          |
|---------------|------|------|----------------|----------|
|               |      |      | kgf ∙ m        | lbf ⋅ ft |
| Joint         | 15   | M14  | 3.5            | 25.3     |
| Swash plate   | 16   | M14  | 7.0±0.40       | 51.8±2.9 |
| Adjusting nut | 17   | M14  | 7.0±0.40       | 51.8±2.9 |
| Lock nut      | 22   | M14  | $5.0 \pm 0.35$ | 36.2±2.5 |

## 3) DISASSEMBLY

- (1) Clean pilot valve with kerosene.
- \* Put blind plugs into all ports
- (2) Fix pilot valve in a vise with copper (or lead) sheets.
- (3) Remove end of boot (23) from case (1) and take it out upwards.



\* For valve with switch, remove cord also through hole of casing.



(4) Loosen lock nut (22) and adjusting nut(17) with spanners on them respectively, and take out handle section as one body.



(5) Remove the boot (14).



(6) Loosen adjusting nut (17) and plate (16) with spanners on them respectively, and remove them.





- (7) Turn joint anticlockwise to loosen it, utilizing jig (special tool).
- When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
  Pay attention to this.





(8) Remove plate (12).



- (9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.
- \* Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.
- During taking out, plug may jump up due to return spring (7) force.
  Pay attention to this.
- (10) Remove reducing valve subassembly and return spring (7) out of casing.
- Record relative position of reducing valve subassembly and return springs (7).





- (11) Separate spool (3), spring seat (6), spring(5) and shim (4) individually.
- \* Until being assembled, they should be handled as one subassembly group.



(12) Take push rod (8) out of plug (9).



(13) Remove O-ring (10) and seal (11) from plug (8).Use small minus screwdriver or so on to remove this seal.





 $(14)\,Remove$  lock nut (22) and then boot (23).





## (15) Cleaning of parts

- Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).
- If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.
- If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.

Therefore, control cleanliness of kerosene fully.

- ② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).
- Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

#### (16) Rust prevention of parts.

Apply rust-preventives to all parts.

If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

## 4) ASSEMBLY

(1) Put shim (4), springs (5) and spring seat(6) onto spool (3) in this order.



- (2) Assemble spring (7) into casing (1).Assemble reducing valve subassembly into casing.
- \* Assemble them to their original positions.



(3) Assemble O-ring (8) onto plug (10).



- (4) Assemble seal (11) to plug (8).
- \* Assemble seal in such lip direction as shown below.



- (5) Assemble push rod (9) to plug (8).
- \* Apply working oil on push-rod surface.



- (6) Assemble plug subassembly to casing.
- When return spring is weak in force, subassembly stops due to resistance of O-ring.

(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.





- (8) Fit plate (12).
- (9) Tighten joint (15) with the specified torque to casing, utilizing jig.



(10) Assemble plate (16) to joint (15).

- \* Screw it to position that it contacts with 4 push rods evenly.
- \* Do not screw it over.



- (11) Assemble adjusting nut (17), apply spanner to width across flat of swash plate (16) to fix it, and tighten adjusting nut to the specified torque.
- \* During tightening, do not change position of disk.



(12) Fit boot (14) to plate.



(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.





(14) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



- (15) Assemble bushing (18) to plate and pass cord and tube through it.
- \* Provide margin necessary to operation.



(16) Determine handle direction, tighten locknut (22) to specified torque to fix handle.



(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



- (18) Assemble lower end of bellows to casing.
- (19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



# **GROUP 11 TURNING JOINT**

#### **1. REMOVAL AND INSTALL**

#### 1) REMOVAL

- (1) Lower the work equipment to the ground and stop the engine.
- (2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- (3) Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrate the skin causing serious injury.
- When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.
- (4) Disconnect all hoses.
- (5) Sling the turning joint assembly (1) and remove the mounting bolt (2).
  - Weight : 30 kg (70 lb)
  - $\cdot$  Tightening torque : 14.7  $\pm$  2.2 kgf  $\cdot$  m
    - $(106 \pm 15.9 \text{ lbf} \cdot \text{ft})$
- (6) Remove the turning joint assembly.
- When removing the turning joint, check that all the hoses have been disconnected.

#### 2) INSTALL

- (1) Carry out installation in the reverse order to removal.
- \* Take care of turning joint direction.
- \* Assemble hoses to their original positions.
- \* Confirm the hydraulic oil level and check the hydraulic oil leak or not.







## 2. DISASSEMBLY AND ASSEMBLY

## 1) STRUCTURE



4 Spacer

Shaft

Hub

Cover

1

2

3

- 5 Shim
- 6 Shim

- 10 O-ring Wear ring 11
- Retainer ring 12
- Plug
- 16 Hexagon bolt
- Spring washer 17

HW60A7TJ03

#### 2) DISASSEMBLY

- \* Before the disassembly, clean the turning joint.
- (1) Loosen the bolts (16), washer (17) and remove cover (3).



- (2) Remove shim (6) and O-ring (7).
- (3) Remove retainer ring (12), spacer (4) and shim (5).



- (4) Place hub (2) on a V-block and by using a wood buffer at the shaft end, hit out shaft(2) to about 1/2 from the body with a hammer.
- \* Take care not to damage the shaft (1) when remove hub (2) or rest it sideway.
- \* Put a fitting mark on hub (2) and shaft (1).
- (5) Remove wear rings (11), thirteen slipper seals (7) and O-rings (8, 9) from hub (2).





# 3) ASSEMBLY

- \* Clean all parts.
- \* As a general rule, replace oil seals and O-ring.
- \* Coat the sliding surfaces of all parts with engine oil or grease before installing.
- (1) Fix wear rings (11), thirteen slipper seals(7) and O-rings (8, 9) to hub (2).



(2) Set shaft (1) on block, tap hub (2) with a plastic hammer to install.



- (3) Fit shim (5), spacer (4) and retainer ring (12) to shaft (11).
- (4) Fit O-ring (7) to hub (2).



(5) Install cover (3) to hub (2) and tighten bolts (16) with washer (13).



# GROUP 12 BOOM, ARM AND BUCKET CYLINDERS

## **1. REMOVAL AND INSTALL**

- 1) BUCKET CYLINDER
- (1) Removal
- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- \* Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- ▲ Loosen the breather slowly to release the pressure inside the hydraulic tank. Escaping fluid under pressure can penetrate the skin causing serious injury.
- Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Set block between bucket cylinder and arm.





- 2 Remove bolt (2), nut (3) and pull out pin (1).
- \* Tie the rod with wire to prevent it from coming out.



③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



- ④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).
- (5) Remove bucket cylinder assembly (8).
  - Weight : 34 kg (75 lb)



## (2) Install

- ① Carry out installation in the reverse order to removal.
- A When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- \* Bleed the air from the bucket cylinder.
- \* Confirm the hydraulic oil level and check the hydraulic oil leak or not.

## 2) ARM CYLINDER

#### (1) Removal

- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- \* Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- ▲ Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Set block between arm cylinder and boom.





- $\bigcirc$  Remove bolt (2) and pull out pin (1).
- \* Tie the rod with wire to prevent it from coming out.



- ③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.
- 4 Disconnect greasing pipings (5).



- (5) Sling arm assembly (8) and remove bolt(7) then pull out pin (6).
- 6 Remove arm cylinder assembly (8).
  - Weight : 56 kg (153 lb)



## (2) Install

- ① Carry out installation in the reverse order to removal.
- A When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- \* Bleed the air from the arm cylinder.
- \* Confirm the hydraulic oil level and check the hydraulic oil leak or not.

## 3) BOOM CYLINDER

#### (1) Removal

- Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
- \* Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
- ▲ Loosen the breather slowly to release the pressure inside the hydraulic tank.
- A Escaping fluid under pressure can penetrate the skin causing serious injury.
- Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.
- ① Disconnet greasing hoses.
- ② Sling boom cylinder assembly.
- ③ Remove bolt (2) and pull out pin (1).
- \* Tie the rod with wire to prevent it from coming out.







④ Lower the boom cylinder assembly (3) on a stand.



⑤ Disconnect boom cylinder hoses (4) and put plugs on cylinder pipe.



- $^{\textcircled{6}}$  Remove bolt (6) and pull out pin (5).
- $\bigcirc$  Remove boom cylinder assembly (3).
  - · Weight : 64 kg (141 lb)



## (2) Install

- ① Carry out installation in the reverse order to removal.
- A When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- $^{*}$  Bleed the air from the boom cylinder.
- \* Conformed the hydraulic oil level and check the hydraulic oil leak or not.

## 2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

10

Back-up ring

(1) Bucket cylinder (DY POWER)



7-326

20

O-ring

#### Bucket cylinder (SH PAC)



- Piston rod 2
- 3 Gland

1

- 4 Dust seal
- 5 Retaining ring
- 6 Rod seal
- 7 Back-up ring
- 8 Buffer ring
- 9 Dry bearing

- 12 O-ring
- 13 Piston
- 14 Dust ring
- 15 Piston seal
- 16 Wear ring
- 17 O-ring

- 19
- 20 Set screw
- Dimple bushing 21

HX60A7CY23

- 23 Dust seal
- 24 Grease nipple
- 25 Grease nipple
- 26 O-ring
#### Bucket cylinder (CHANGZHOU)



- 1 Tube assembly
- 2 Rod assembly
- 3 Gland
- 4 DU bushing
- 5 Rod seal
- 6 Back-up ring
- 7 Buffer ring
- 8 Dust wiper
- 9 Snap ring
- 10 O-ring

- 11 O-ring
- 12 Back-up ring
- 13 Piston
- 14 O-ring
- 15 Back-up ring
- 16 Piston seal
- 17 Wear ring
- 18 Dust ring
- 19 Lock nut
- 20 Socket screw

- HX60A7CY24
- 21 Dimple bushing
- 22 Dust seal
- 23 Pipe assl (R)
- 24 Pipe assl (B)
- 25 Pipe clamp
- 26 Hexagon head bolt
- 27 Spring washer
- 28 Grease nipple
- 29 O-ring



- 12 O-ring
- 13 Back-up ring
  - ing

25

Pause ring

7-329

37

Grease nipple



- Spring washer 31
- Pin bushing 30
- Dust 31
- 32 Grease nipple
- 33
- 34

- 1

- 5 Retaining ring
- Rod seal 6
- 7 Back-up ring
- 8 Buffer ring
- 9 Bushing
- 10 O-ring
- Back-up ring 11
- 12 O-ring

- O-ring 17
- Back-up ring 18
- Steel ball 19
- Set screw 20
- Cushion ring 21
- Valve 22
- Coiled spring 23

- Nut 30

- O-ring
- O-ring



- 3 Gland
- 4 DU bushing
- 5 Rod seal
- 6 Back-up ring
- 7 Buffer ring
- 8 Dust wiper
- 9 Snap ring
- 10 O-ring
- 11 O-ring
- 12 Back-up ring

- O-ring 15
- Back-up ring 16
- 17 Piston seal
- 18 Wear ring
- 19 Dust ring
- 20 Lock nut
- 21 Socket screw
- 22 Valve
- 23 Coiled sprin
- 24 O-ring
  - 7-331

- 27 Dust seal
- Pipe (R) 28
- 29 Hexagon head bolt
- 30 Hexagon head nut
- 31 Spring washer
- 32 Grease nipple
- 33 O-ring
- 34 O-ring



- 1 Tube assembly
- 2 Bushing
- 3 Rod assembly
- 4 Bushing
- 5 Rod cover
- 6 Rod bushing
- 7 Buffer seal
- 8 U-packing
- 9 Back-up ring
- 10 Dust wiper

- 11 Retaining ring
- 12 O-ring
- 13 Back-up ring
- 14 O-ring
- 15 Back-up ring
- 16 O-ring
- 17 Cushion ring
- 18 Piston
- 19 Piston seal

- 20 Wear ring
- 21 Dust ring
- 22 O-ring
- 23 Back-up ring
- 24 Piston nut
- 25 Set screw
- 26 Dust wiper
- 27 Grease nipple
- 28 O-ring



- 1 Tube assembly
- 2 Piston rod
- 3 Gland
- 4 Dust seal
- 5 Retaining ring
- 6 Rod seal
- 7 Back-up ring
- 8 Buffer ring
- 9 Bushing
- 10 O-ring

- 11 Back-up ring
- 12 O-ring
- 13 Wear ring
- 14 O-ring
- 15 Piston
- 16 Dust rung
- 17 Piston seal
- 18 Back-up ring
- 19 O-ring

- 20 Back-up ring
- 21 Steel ball
- 22 Hexagon head bolt
- 23 Pin bushing
- 24 Pin bushing
- 25 Dust seal
- 26 Grease nipple
- 27 O-ring
- 28 Cushion ring



- 1 Tube assembly
- 2 Rod
- 3 Gland
- 4 DU bushing
- 5 Rod seal
- 6 Back-up ring
- 7 Buffer ring
- 8 Dust wiper
- 9 Snap ring
- 10 O-ring
- 11 O-ring
- 12 Back-up ring

- 13 O-ring
- 14 Back-up ring
- 15 Cushion ring
- 16 Piston
- 17 O-ring
- 18 Back-up ring
- 19 Piston seal
- 20 Wear ring
- 21 Dust ring
- 22 Lock nut
- 23 Socket screw
- 24 Dimpling

- 26 Dust seal
- 27 Pipe (R)
- 28 Pipe (B)
- 29 U bolt
- 30 Spring washer
- 31 Hexagon head nut
- 34 Pipe clamp
- 35 Hexagon head bolt
- 36 Spring washer
- 37 Grease nipple
- 38 O-ring

#### (4) Dozer cylinder



- 1 Tube assembly
- 2 Rod assembly
- 3 Gland
- 5 Retaining ring
- 6 Rod seal
- 7 Buck-up ring
- 4 Dust wiper
- 8 Buffer ring
- 9 DU bushing
- 10 O-ring

- 11 Buck-up ring
- 12 O-ring
- 13 Piston
- 14 Piston seal
- 15 Wear ring
- 16 Dust ring
- 17 O-ring
- 18 Steel ball
- 19 Set screw
- 20 Pipe assembly (R)

- 21 Check valve
- 22 O-ring
- 23 O-ring
- 24 Socket head bolt
- 25 Socket head bolt
- 26 Pin bushing
- 27 Dust seal
- 28 Grease nipple

#### (5) Boom swing cylinder



- 1 Tube assembly
- 2 Rod assembly
- 3 Gland
- 4 Dust wiper
- 5 Retaining ring
- 6 DU bushing
- 7 Rod seal
- 8 Buck-up ring

- 9 O-ring
- 10 Buck-up ring
- 11 O-ring
- 12 Piston
- 13 Piston seal
- 14 Wear ring
- 15 Dust ring
- 16 O-ring

- 17 Back-up ring
- 18 Steel ball
- 19 Set screw
- 20 Pin bushing
- 21 Dust seal
- 22 Grease nipple
  - 23 O-ring

## 2) TOOLS AND TIGHTENING TORQUE

## (1) Tools

| Name          | Specification                                    |  |  |  |
|---------------|--|--|--|--|
| Allen wrench  | 8 B  |  |  |  |
|               | 10   |  |  |  |
| Spanner       | M22  |  |  |  |
| Hook spanner  | Suitable size                                    |  |  |  |
| (-) 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        |
| Rod cover (Gland) | Boom cylinder*1            | 5    | M115 | 70±7.0         | 506±51          |
|                   | Boom cylinder*2            | 3    | M115 | 95±9.5         | $686\pm70$      |
|                   | Boom cylinder*3            | 3    | M115 | 70±7.0         | $506\pm51$      |
|                   | Arm cylinder*1             | 5    | M95  | 70±7.0         | 506±51          |
|                   | Arm cylinder* <sup>2</sup> | 3    | M95  | $76\pm7.6$     | $550\pm56$      |
|                   | Arm cylinder*3             | 3    | M95  | 70±7.0         | $506\pm51$      |
|                   | Bucket cylinder*1          | 5    | M85  | 75±7.5         | $540 \pm 5.4$   |
|                   | Bucket cylinder*2          | 3    | M85  | $70\pm7.0$     | $506\pm51$      |
|                   | Bucket cylinder*3          | 3    | M85  | 70±7.0         | $506\pm51$      |
|                   | Dozer cylinder             | 3    | M115 | 95±9.5         | $686\pm70$      |
| Piston nut        | Boom cylinder*1            | 24   | M42  | 75±7.5         | 540±5.4         |
|                   | Boom cylinder*3            | 22   | -    | 75±7.5         | $540\pm5.4$     |
|                   | Arm cylinder*1             | 22   | M39  | 75±7.5         | $540 \pm 5.4$   |
|                   | Arm cylinder*3             | 20   | -    | 75±7.5         | $540\!\pm\!5.4$ |
|                   | Bucket cylinder*1          | 22   | M36  | 75±7.5         | $540 \pm 5.4$   |
|                   | Bucket cylinder*3          | 19   | M36  | 75±7.5         | 540±5.4         |
| Piston            | Boom cylinder*1            | 18   | M52  | $50\pm5.0$     | $361\pm36$      |
|                   | Boom cylinder*2            | 15   | M45  | $113 \pm 11.3$ | 817±83          |
|                   | Boom cylinder*3            | 16   | -    | $50\pm5.0$     | $361\pm36$      |
|                   | Arm cylinder*1             | 16   | M39  | $50\pm5.0$     | $361 \pm 36$    |
|                   | Arm cylinder*2             | 13   | M39  | 97.5±9.8       | 705±71          |
|                   | Arm cylinder*3             | 14   | -    | $50\pm5.0$     | $361\pm36$      |
|                   | Bucket cylinder*1          | 16   | M48  | 50±5.0         | $361\pm36$      |
|                   | Bucket cylinder*2          | 13   | M36  | 90±9.0         | $650\pm66$      |
|                   | Bucket cylinder*3          | 13   | M48  | $50\pm5.0$     | $361\pm36$      |
|                   | Dozer cylinder             | 13   | M45  | 113±11.3       | 817±83          |

★1: DY POWER

★2: SHPAC

★3: CHANGZHOU

| Part name |                            | Item | Size | Torque  |                |
|-----------|----------------------------|------|------|---------|----------------|
|           |                            |      |      | kgf ∙ m | lbf ∙ ft       |
| Set screw | Boom cylinder*1*4          | 25   | M8   | 1.5     | 10.8           |
|           | Boom cylinder*2            | 22   | M8   | 1.7±0.2 | $12.3 \pm 1.4$ |
|           | Boom cylinder*3            | 23   | M8   | 2.7±0.3 | 19.5±2.2       |
|           | Arm cylinder*1*4           | 23   | M8   | 1.5     | 10.8           |
|           | Arm cylinder* <sup>2</sup> | 20   | M8   | 1.7±0.2 | $12.3 \pm 1.4$ |
|           | Arm cylinder*3             | 21   | M8   | 2.7±0.3 | 19.5±2.2       |
|           | Bucket cylinder*1*4        | 23   | M8   | 1.5     | 10.8           |
|           | Bucket cylinder*2*5        | 20   | M8   | 1.7±0.2 | $12.3 \pm 1.4$ |
|           | Bucket cylinder*3 *5       | 20   | M8   | 2.7±0.3 | 19.5±2.2       |

★1: DY POWER

★2: SHPAC

★3: CHANGZHOU

 $\star$ 4 : Apply loctite #242 on the thread of bolt.

 $\star$ 5 : on the thread of bolt.

#### 3) DISASSEMBLY

- (1) Remove cylinder head and piston rod
- Procedures are based on the bucket cylinder (DY POWER type).
- 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 rod assembly (3) about 200 mm (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



- ③ Remove rod cover (5) by hook spanner.
- \* Cover the extracted rod assembly (3) with rag to prevent it from being accidentally damaged during operation.



- ④ Draw out cylinder head and rod assembly(3) together from tube assembly (1).
- Since the rod assembly is heavy in this case, lift the tip of the rod assembly (3) with a crane or some means and draw it out. However, when rod assembly (3) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



Note that the plated surface of rod assembly (3) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

- ⑤ Place the removed rod assembly on a wooden V-block that is set level.
- \* Cover a V-block with soft rag.



#### (2) Remove piston and rod cover

- ① Loosen set screw (23) and remove piston nut (22).
- Since piston nut (22) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the piston nut (22).
- ② Remove piston assembly (16), back up ring (21), and O-ring (20).
- ③ Remove the rod cover from rod assembly (3).
- If it is too heavy to move, move it by striking the flanged part of gland with a plastic hammer.
- Pull it straight with cylinder head assembly lifted with a crane.
  Exercise care so as not to damage the lip of Du bushing (6) and packing (8, 9, 10, 11, 12, 13, 14) by the threads of rod assembly (3).





#### (3) Disassemble the piston assembly

- ① Remove wear ring (18).
- ② Remove dust ring (19) and piston seal (17).
- \* Exercise care in this operation not to damage the grooves.



#### (4) Disassemble gland assembly

- Remove back up ring (14) and O-ring (13).
- 2 Remove retaining ring (12), dust seal3 (11).

Remove U-packing (9) and buffer seal \* (8).

Exercise care in this operation not to \* damage the grooves.

Do not remove seal and ring, if does not damaged.



#### 4) ASSEMBLY

## (1) Assemble cylinder head assembly

- \* Check for scratches or rough surfaces if found smooth with an oil stone.
- ① Coat the inner face of rod cover (5) with hydraulic oil.



② Coat dust seal (11) with grease and fit dust seal (11) to the bottom of the hole of dust seal.

At this time, press a pad metal to the metal ring of dust seal.

 $\bigcirc$  Fit snap ring (12) to the stop face.



- ④ Fit U-packing (9) and buffer seal (8) to corresponding grooves, in that order.
- \* Coat each packing with hydraulic oil before fitting it.
- Insert the backup ring until one side of it is inserted into groove.



- U-packing (9) has its own fitting direction.
   Therefore, confirm it before fitting them.
- Fitting U-packing (9) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



- 5 Fit back up ring (14) to rod cover (5).
- \* Put the backup ring in the warm water of  $30{\sim}50^{\circ}C$ .
- 6 Fit O-ring (13) to rod cover (5).



#### (2) Assemble piston assembly

- \* Check for scratches or rough surfaces. If found smooth with an oil stone.
- ① 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) and dust ring (19) to piston (15).



#### (3) Install piston and cylinder head

- Tix the rod assembly to the work bench.
- ② Apply hydraulic oil to the outer surface of rod assembly (3), the inner surface of piston and cylinder head.
- ③ Insert cylinder head assembly to rod assembly.



- 4 Fit piston assembly to rod assembly.
  - $\cdot$  Tightening torque : 50±5 kgf·m



- ⑤ Fit piston nut (22) and tighten the set screw (23).
  - · Tightening torque :
  - ·Piston nut (21):75±7.5 kgf·m
  - ·Set screw (22) : 1.5 kgf·m



#### (4) Overall assemble

- Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.
- ② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.
- \* Be careful not to damage piston seal by thread of tube assembly.
- ③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.
- \* Refer to the table of tightening torque.





# **GROUP 13 WORK EQUIPMENT**

## 1. STRUCTURE



R5577AT01

## 2. REMOVAL AND INSTALL

## 1) BUCKET ASSEMBLY

## (1) Removal

- ① Lower the work equipment completely to ground with back of bucket facing down.
- HW607WE01
- <sup>(2)</sup> Remove nut (1), bolt (2) and draw out the pin (4).



③ Remove nut (1), bolt (2) and draw out the pin (3) then remove the bucket assembly.
 · Weight : 170 kg (370 lb)



## (2) Install

- ① Carry out installation in the reverse order to removal.
- A When aligning the mounting position of the pin, do not insert your fingers in the pin hole.
- Adjust the bucket clearance.
   For detail, see operation manual.



#### 2) ARM ASSEMBLY

#### (1) Removal

- \* Loosen the breather slowly to release the pressure inside the hydraulic tank.
- ▲ Escaping fluid under pressure can penetrated the skin causing serious injury.
- Remove bucket assembly.
   For details, see removal of bucket assembly.
- ② Disconnect bucket cylinder hose (4).
- ▲ Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.
- ③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.
- \* Tie the rod with wire to prevent it from coming out.
- ④ For details, see removal of arm cylinder assembly.

Place a wooden block under the cylinder and bring the cylinder down to it.

- ⑤ Remove bolt (1) and pull out the pin (2) then remove the arm assembly.
  · Weight : 205 kg (455 lb)
- When lifting the arm assembly, always lift the center of gravity.







## (2) Install

- ① Carry out installation in the reverse order to removal.
- When lifting the arm assembly, always lift the center of gravity.
- \* Bleed the air from the cylinder.

## 3) BOOM CYLINDER

#### (1) Removal

- 1 Remove arm and bucket assembly.
- $_{\bigodot}$  For details, see removal of arm and bucket assembly.

Remove boom cylinder assembly from boom.

For details, see removal of arm cylinder assembly.

- ③ Disconnect head lamp wiring.
- ④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).
- A When the hose are disconnected, oil may spurt out.
- (5) Sling boom assembly (3).





- 6 Remove bolt (3), nut (4) and pull out the pin (5) then remove boom assembly.
  Weight : 310 kg (695 lb)
- When lifting the boom assembly always lift the center of gravity.



## (2) Install

- Carry out installation in the reverse order to removal.
- When lifting the arm assembly, always lift the center of gravity.
- \* Bleed the air from the cylinder.

