HMC Series Dual Displacement Staffa Motor

Description

The range of dual displacement motors extends from the HMC030 in 492cc/rev. to the HMC325 in 5326cc/rev.

There are seven frame sizes as shown in the table below:

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Max. torque @ 275 bar (Nm)</th>
<th>Continuous shaft power (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC030</td>
<td>1655 **</td>
<td>60</td>
</tr>
<tr>
<td>HMC045</td>
<td>2930</td>
<td>99</td>
</tr>
<tr>
<td>HMC080</td>
<td>6560</td>
<td>138</td>
</tr>
<tr>
<td>HMC125</td>
<td>8220</td>
<td>135</td>
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<tr>
<td>HMC200</td>
<td>12820</td>
<td>174</td>
</tr>
<tr>
<td>HMC270</td>
<td>19090</td>
<td>189</td>
</tr>
<tr>
<td>HMC325</td>
<td>22110</td>
<td>189</td>
</tr>
</tbody>
</table>

**Torque calculated at 241 bar.

Key Features

- High torque at low speed
- Smooth running
- Wide range of displacements to suit specific applications
- Displacement changes with ease when the motor is running
- Electro-hydraulic or hydro-mechanical control methods available
- Various mounting options available
- Speed sensing options
- Motor mounted manifold options
<table>
<thead>
<tr>
<th>Content</th>
<th>Page</th>
</tr>
</thead>
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<td>Motor mounted manifold packages</td>
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<td>30</td>
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<tr>
<td>Installation data</td>
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</tr>
<tr>
<td>Crankcase drain connections</td>
<td>32</td>
</tr>
<tr>
<td>HMC030 shaft options</td>
<td>33</td>
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<tr>
<td>HMC045 shaft options</td>
<td>34</td>
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<tr>
<td>HMC080 shaft options</td>
<td>35</td>
</tr>
<tr>
<td>HMC125 shaft options</td>
<td>36</td>
</tr>
<tr>
<td>HMC200 shaft options</td>
<td>37</td>
</tr>
<tr>
<td>HMC270/325 shaft options</td>
<td>38</td>
</tr>
<tr>
<td>HMC030 installation</td>
<td>39</td>
</tr>
<tr>
<td>HMC045 installation</td>
<td>41</td>
</tr>
<tr>
<td>HMC080 installation</td>
<td>43</td>
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<tr>
<td>HMC125 installation</td>
<td>45</td>
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<tr>
<td>HMC200 installation</td>
<td>47</td>
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<tr>
<td>HMC270 installation</td>
<td>49</td>
</tr>
<tr>
<td>HMC325 installation</td>
<td>51</td>
</tr>
<tr>
<td>Main port connections</td>
<td>53</td>
</tr>
<tr>
<td>Speed sensing options</td>
<td>54</td>
</tr>
<tr>
<td>Ordering code</td>
<td>57</td>
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</tbody>
</table>
Kawasaki “Staffa” high torque, low speed radial piston motors use hydrostatic balancing techniques to achieve high efficiency, combined with good breakout torque and smooth running capability.

The HMC series dual displacement models have two pre-set displacements which can be chosen from a wide range to suit specific application requirements. The displacements are hydraulically selected by a directional control valve which can be remote mounted or directly on the motor. Motor displacement can be changed with ease when the motor is running.

These motors are also available in a continuously variable version using either hydro-mechanical or electro-hydraulic control methods.

Other mounting options are available on request to match many of the competitor interfaces.

Note: To order the HPC series motor refer to bulletin data sheet M-1003
Performance data is valid for the range of HMC motors when fully run-in and operating with mineral oil.

The appropriate motor displacements can be selected using performance data shown on pages 4 to 10. Refer to the table on this page for pressures and speed limits when using fire-resistant fluids.

### Limits for fire resistant fluids

<table>
<thead>
<tr>
<th>FLUID TYPE</th>
<th>CONTINUOUS PRESSURE (bar)</th>
<th>INTERMITTENT PRESSURE (bar)</th>
<th>MAX SPEED (rpm)</th>
<th>MODEL TYPE</th>
</tr>
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<tbody>
<tr>
<td>HFA 5/95 oil-in-water emulsion</td>
<td>130</td>
<td>138</td>
<td>50% of limits of petroleum oil</td>
<td>All models</td>
</tr>
<tr>
<td>HFB 60/40 water-in-oil emulsion</td>
<td>138</td>
<td>172</td>
<td>As for petroleum oil</td>
<td>All models</td>
</tr>
<tr>
<td>HFC water glycol</td>
<td>103</td>
<td>138</td>
<td>50% of limits of petroleum oil</td>
<td>All models</td>
</tr>
<tr>
<td>HFD phosphate ester</td>
<td>250</td>
<td>275</td>
<td>As for petroleum oil</td>
<td>All models</td>
</tr>
</tbody>
</table>

Specify make and type of fluid on your order if other than petroleum oil.

### Rating definitions

**Continuous rating**
The motor must be operated within each of the maximum values for speed, pressure and power.

**Intermittent pressure rating**
Intermittent max pressure: 275 bar.

This pressure is allowable on the following basis:

(a) Upto 50 rpm 15% duty for periods upto 5 minutes maximum.
(b) Over 50 rpm 2% duty for periods upto 30 seconds maximum.

Static pressure to DNV rules 380 bar.

**Intermittent power rating**
This is permitted on a 15% duty basis for periods upto 5 minutes maximum.
**Performance data**

**HMC030 Motor** *(See page 12 for power calculation limits)*

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>30</th>
<th>27</th>
<th>24</th>
<th>21</th>
<th>18</th>
<th>15</th>
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<tbody>
<tr>
<td>Displacement</td>
<td>cc/rev</td>
<td>492</td>
<td>442</td>
<td>393</td>
<td>344</td>
<td>295</td>
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<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>6.86</td>
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<td>4.59</td>
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<tr>
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<td>%</td>
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<td>86.4</td>
<td>84.7</td>
<td>83.8</td>
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<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
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<td>81.4</td>
<td>79.6</td>
<td>77.1</td>
<td>73.9</td>
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<td>500</td>
<td>525</td>
<td>550</td>
<td>575</td>
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<td>kW</td>
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<td>60</td>
<td>55</td>
<td>49</td>
<td>42</td>
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<td>Max intermittent power</td>
<td>kW</td>
<td>66</td>
<td>66</td>
<td>61</td>
<td>55</td>
<td>48</td>
</tr>
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<td>bar</td>
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<td>207</td>
<td>207</td>
<td>207</td>
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<td>bar</td>
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<table>
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<th>06</th>
<th>03</th>
<th>00</th>
<th>00</th>
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</thead>
<tbody>
<tr>
<td>Displacement</td>
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<td>147</td>
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<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>2.51</td>
<td>1.83</td>
<td>1.15</td>
<td>0.44</td>
<td>0</td>
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<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>80.1</td>
<td>78.2</td>
<td>73.7</td>
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<td>Average actual starting efficiency</td>
<td>%</td>
<td>62.6</td>
<td>51.6</td>
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<td>/</td>
<td>/</td>
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<td>Max continuous speed</td>
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<td>1000</td>
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<td>Max continuous power</td>
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<td>0</td>
<td>0</td>
</tr>
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<td>Max intermittent power</td>
<td>kW</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>bar</td>
<td>207</td>
<td>207</td>
<td>207</td>
<td>17*</td>
<td>17*</td>
</tr>
<tr>
<td>Max intermittent pressure</td>
<td>bar</td>
<td>241</td>
<td>241</td>
<td>241</td>
<td>17*</td>
<td>17*</td>
</tr>
</tbody>
</table>

Data shown is at 207 bar. Intermediate displacements can be made available to special order.

* See page 26: small displacements.

** A crankcase flushing flow of 15 lpm is required when freewheeling at 1500 rpm.
**Performance data**

**HMC045 Motor** *(See page 12 for power calculation limits)*

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>45</th>
<th>40</th>
<th>35</th>
<th>30</th>
<th>25</th>
<th>20</th>
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<tbody>
<tr>
<td>Displacement</td>
<td>cc/rev</td>
<td>737</td>
<td>655</td>
<td>573</td>
<td>492</td>
<td>410</td>
</tr>
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<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>10.63</td>
<td>9.4</td>
<td>8.04</td>
<td>6.88</td>
<td>5.68</td>
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<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>90.6</td>
<td>90.2</td>
<td>88.2</td>
<td>87.9</td>
<td>87.0</td>
</tr>
<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
<td>84.5</td>
<td>83.0</td>
<td>81.1</td>
<td>78.4</td>
<td>74.9</td>
</tr>
<tr>
<td>Max continuous speed</td>
<td>rpm</td>
<td>450</td>
<td>550</td>
<td>600</td>
<td>600</td>
<td>600</td>
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<tr>
<td>Max continuous power</td>
<td>kW</td>
<td>99</td>
<td>89</td>
<td>79</td>
<td>67</td>
<td>54</td>
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<td>Max intermittent power</td>
<td>kW</td>
<td>119</td>
<td>107</td>
<td>95</td>
<td>80</td>
<td>65</td>
</tr>
<tr>
<td>Max continuous pressure</td>
<td>bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Max intermittent pressure</td>
<td>bar</td>
<td>275</td>
<td>275</td>
<td>275</td>
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<table>
<thead>
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<th>00</th>
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<tbody>
<tr>
<td>Displacement</td>
<td>cc/rev</td>
<td>246</td>
<td>163</td>
<td>81</td>
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</tr>
<tr>
<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>3.2</td>
<td>1.55</td>
<td>0</td>
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<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>81.7</td>
<td>59.7</td>
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</tr>
<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
<td>60.6</td>
<td>43.0</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Max continuous speed</td>
<td>rpm</td>
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<td>600</td>
<td>1000</td>
<td>1000</td>
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<tr>
<td>Max continuous power</td>
<td>kW</td>
<td>30</td>
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<tr>
<td>Max intermittent power</td>
<td>kW</td>
<td>36</td>
<td>18</td>
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<tr>
<td>Max continuous pressure</td>
<td>bar</td>
<td>250</td>
<td>250</td>
<td>17*</td>
<td>17*</td>
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<tr>
<td>Max intermittent pressure</td>
<td>bar</td>
<td>275</td>
<td>275</td>
<td>17*</td>
<td>17*</td>
</tr>
</tbody>
</table>

Data shown is at 250 bar. Intermediate displacements can be made available to special order.

* See page 26: small displacements

** A crankcase flushing flow of 15 lpm is required when freewheeling at 1500 rpm.
### HMC080 Motor (See page 12 for power calculation limits)

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>97.6</th>
<th>90</th>
<th>85</th>
<th>80</th>
<th>75</th>
<th>70</th>
<th>65</th>
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<th>55</th>
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<tbody>
<tr>
<td><strong>Displacement</strong></td>
<td>cc/rev</td>
<td></td>
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<tr>
<td></td>
<td>1600</td>
<td>1475</td>
<td>1393</td>
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<td>901</td>
<td>819</td>
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<td><strong>Average actual running torque</strong></td>
<td>Nm/bar</td>
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<td></td>
<td>93.9</td>
<td>93.7</td>
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<td>93.2</td>
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<td>93.0</td>
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<td>92.1</td>
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<tr>
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<td>%</td>
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<td>86.0</td>
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<td>83.3</td>
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<td>475</td>
<td>490</td>
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<td>(SO4/F4/FM4)</td>
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<td>250</td>
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<tr>
<td><strong>Max continuous power</strong></td>
<td>kW</td>
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<td>138</td>
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<td>129</td>
<td>127</td>
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<td>118</td>
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<td>kW</td>
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<td>170</td>
<td>165</td>
<td>159</td>
<td>156</td>
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<th>10</th>
<th>5</th>
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<tbody>
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<td>cc/rev</td>
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<td>81.4</td>
<td>75.3</td>
<td>65.4</td>
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<td><strong>Average actual mechanical efficiency</strong></td>
<td>%</td>
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<td>64.4</td>
<td>58.6</td>
<td>50.3</td>
<td>38.0</td>
<td>17.5</td>
<td>/</td>
<td>/</td>
<td>/</td>
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Data shown is at 250 bar. Intermediate displacements can be made available to special order.
* See page 26: small displacements. ** A crankcase flushing flow of 15 lpm is required when freewheeling at 1500 rpm.
### HMC125 Motor
*(See page 12 for power calculation limits)*

#### Performance data

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Data shown is at 250 bar. Intermediate displacements can be made available to special order.

* See page 27: small displacements. ** A crankcase flushing flow of 15 lpm is required when freewheeling at 1500 rpm.
## Performance data

**HMC200 Motor** *(See page 12 for power calculation limits)*

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Data shown is at 250 bar. Intermediate displacements can be made available to special order.

* See page 26: small displacements. ** A crankcase flushing flow of 15 lpm is required when freewheeling at 1500 rpm.
### HMC270 Motor
(See page 12 for power calculation limits)

#### Performance data

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</table>

Data shown is at 250 bar. Intermediate displacements can be made available to special order.

* See page 26: small displacements. ** A crankcase flushing flow of 15 lpm is required when freewheeling at 1500 rpm.
### Performance data

**HMC325 Motor** *(See page 12 for power calculation limits)*

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>325</th>
<th>310</th>
<th>300</th>
<th>280</th>
<th>250</th>
<th>220</th>
<th>200</th>
<th>180</th>
<th>160</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Displacement</strong></td>
<td>cc/rev</td>
<td>5326</td>
<td>5080</td>
<td>4916</td>
<td>4588</td>
<td>4097</td>
<td>3605</td>
<td>3277</td>
<td>2950</td>
<td>2622</td>
</tr>
<tr>
<td><strong>Average actual running torque</strong></td>
<td>Nm/bar</td>
<td>80.4</td>
<td>76.6</td>
<td>74.1</td>
<td>69.1</td>
<td>61.6</td>
<td>53.9</td>
<td>49</td>
<td>43.6</td>
<td>38.3</td>
</tr>
<tr>
<td><strong>Average actual mechanical efficiency</strong></td>
<td>%</td>
<td>94.8</td>
<td>94.7</td>
<td>94.7</td>
<td>94.6</td>
<td>94.5</td>
<td>93.9</td>
<td>94.0</td>
<td>92.9</td>
<td>91.8</td>
</tr>
<tr>
<td><strong>Average actual starting efficiency</strong></td>
<td>%</td>
<td>85.7</td>
<td>85.4</td>
<td>85.2</td>
<td>84.7</td>
<td>83.8</td>
<td>82.7</td>
<td>81.8</td>
<td>80.6</td>
<td>79.2</td>
</tr>
<tr>
<td><strong>Max continuous speed</strong></td>
<td>rpm</td>
<td>130</td>
<td>135</td>
<td>140</td>
<td>150</td>
<td>160</td>
<td>170</td>
<td>190</td>
<td>215</td>
<td>230</td>
</tr>
<tr>
<td><strong>Max continuous power</strong></td>
<td>kW</td>
<td>189</td>
<td>189</td>
<td>189</td>
<td>189</td>
<td>176</td>
<td>161</td>
<td>150</td>
<td>139</td>
<td>128</td>
</tr>
<tr>
<td><strong>Max intermittent power</strong></td>
<td>kW</td>
<td>213</td>
<td>213</td>
<td>213</td>
<td>213</td>
<td>198</td>
<td>181</td>
<td>169</td>
<td>156</td>
<td>144</td>
</tr>
<tr>
<td><strong>Max continuous pressure</strong></td>
<td>bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td><strong>Max intermittent pressure</strong></td>
<td>bar</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
</tr>
</tbody>
</table>

| Displacement Code | 120 | 100 | 95 | 80 | 60 | 40 | 30 | 20 | 10 | 00 | 00 |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| **Displacement**  | cc/rev | 1966 | 1639 | 1557 | 1311 | 983 | 655 | 492 | 328 | 164 | 0 | 0 |
| **Average actual running torque** | Nm/bar | 27.9 | 22.4 | 20.9 | 17.1 | 12.2 | 7.9 | 5.15 | 2.4 | 0 | 0 | 0 |
| **Average actual mechanical efficiency** | % | 89.2 | 85.9 | 84.3 | 82.0 | 78.0 | 75.8 | 65.8 | 46.0 | 0 | 0 | 0 |
| **Average actual starting efficiency** | % | 74.9 | 71.5 | 70.4 | 66.3 | 57.8 | 40.7 | 23.5 | / | / | / | / |
| **Max continuous speed** | rpm | 330 | 370 | 405 | 440 | 460 | 495 | 515 | 545 | 1000 | 1000 | 1500** |
| **Max continuous power** | kW | 104 | 89 | 85 | 73 | 57 | 38 | 26 | 14 | 0 | 0 | 0 |
| **Max intermittent power** | kW | 120 | 107 | 101 | 95 | 80 | 55 | 38 | 20 | 0 | 0 | 0 |
| **Max continuous pressure** | bar | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 17* | 17* | 17* |
| **Max intermittent pressure** | bar | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 17* | 17* | 17* |

Data shown is at 250 bar. Intermediate displacements can be made available to special order.

* See page 26: small displacements.

** A crankcase flushing flow of 15 lpm is required when freewheeling at 1500 rpm.
### Volumetric efficiency data

<table>
<thead>
<tr>
<th>MOTOR TYPE</th>
<th>GEOMETRIC DISPLACEMENT</th>
<th>ZERO SPEED CONSTANT</th>
<th>SPEED CONSTANT</th>
<th>CREEP SPEED CONSTANT</th>
<th>CRANKCASE LEAKAGE CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC</td>
<td>cc/rev</td>
<td>$K_1$</td>
<td>$K_2$</td>
<td>$K_3$</td>
<td>$K_4$</td>
</tr>
<tr>
<td>HMC030</td>
<td>492</td>
<td>4.9</td>
<td>*</td>
<td>10</td>
<td>3.5</td>
</tr>
<tr>
<td>HMC045</td>
<td>737</td>
<td>6.6</td>
<td>47.8</td>
<td>8.5</td>
<td>4</td>
</tr>
<tr>
<td>HMC080</td>
<td>1639</td>
<td>9.5</td>
<td>45.7</td>
<td>5.8</td>
<td>7.9</td>
</tr>
<tr>
<td>HMC125</td>
<td>2048</td>
<td>6.1</td>
<td>38.5</td>
<td>3</td>
<td>4.25</td>
</tr>
<tr>
<td>HMC200</td>
<td>3087</td>
<td>6.1</td>
<td>38.5</td>
<td>2</td>
<td>4.25</td>
</tr>
<tr>
<td>HMC270</td>
<td>4310</td>
<td>6.5</td>
<td>37.3</td>
<td>1.5</td>
<td>6</td>
</tr>
<tr>
<td>HMC325</td>
<td>5210</td>
<td>6.8</td>
<td>40</td>
<td>1.3</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FLUID VISCOSITY</th>
<th>VISCOSITY FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>cSt</td>
<td>Kv</td>
</tr>
<tr>
<td>20</td>
<td>1.58</td>
</tr>
<tr>
<td>25</td>
<td>1.44</td>
</tr>
<tr>
<td>30</td>
<td>1.3</td>
</tr>
<tr>
<td>40</td>
<td>1.1</td>
</tr>
<tr>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>60</td>
<td>0.88</td>
</tr>
</tbody>
</table>

\[
Q_t \quad (\text{total leakage}) = (K_1 + n/K_2) \times \Delta P \times K_v \times 0.005 \quad \text{(lpm)}
\]

\[
*Q_t \quad (C030) = K_1 \times \Delta P \times K_v \times 0.005 \quad \text{(lpm)}
\]

Creep speed \[= K_3 \times \Delta P \times K_v \times 0.005 \quad \text{(rpm)}\]

Crankcase leakage \[= K_4 \times \Delta P \times K_v \times 0.005 \quad \text{(lpm)}\]

\[
\Delta P = \text{differential pressure} \quad \text{(bar)}
\]

\[
n = \text{speed} \quad \text{(rpm)}
\]

The motor volumetric efficiency can be calculated as follows:

\[
\text{Volumetric efficiency (\%) } = \left[ \frac{(\text{speed} \times \text{disp.})}{(\text{speed} \times \text{disp.}) + Q_t} \right] \times 100
\]

**Example:**

HMC200 motor with displacement of 3.087 l/rev.

- Speed: 60 rpm
- Differential pressure: 200 bar
- Fluid viscosity: 50 cSt

Total leakage \[= (K_1+n/K_2) \times \Delta P \times K_v \times 0.005 \quad \text{(lpm)}\]

\[
= (6.1+60/38.5) \times 200 \times 1 \times 0.005
\]

\[
= 7.7 \quad \text{(lpm)}
\]

Volume efficiency \[= \left[ \frac{(60 \times 3.087)}{(60 \times 3.087) + 7.7} \right] \times 100
\]

\[
= 96\%
\]
Example (see page 9):
HMC270 motor with a displacement code of 280:

Firstly, to find the maximum differential pressure $\Delta P$ at rated speed:

Rated shaft power (W): 189000
Average actual running torque (Nm/bar): 69.4
Rated shaft speed (rpm): 150

\[
189000 = 69.4 \times \Delta P \times 150 \times 2 \times \frac{\pi}{60}
\]
\[
\Delta P = 174 \text{ bar (max.)}
\]

Secondly, to find the maximum speed at rated pressure:

Rated shaft power (W): 189000
Average actual running torque (Nm/bar): 69.4
Rated pressure (bar): 250

\[
189000 = 69.4 \times 250 \times n \times 2 \times \frac{\pi}{60}
\]
\[
n = 104 \text{ rpm (max.)}
\]

In summary, operating the motor within its shaft power limit, at rated speed, would give a maximum pressure of 174 bar, and operating the motor at rated pressure, would give a maximum speed of 104 rpm.

Notes:

1. The maximum calculated speed is based on a rated inlet pressure of 250 bar.
2. The maximum shaft power is only allowable if the motor drain temperature remains below 80°C.
3. The maximum calculated differential pressure assumes that the low pressure motor port is less than 30 bar.
There is a single port (PC) in the ‘C’ spacer.

Pressure ports in FM3 & FM4 valve housings can be called up as special features when required.
Displacement control options

Example model code - HMC200/S/180/FM4/X/71

Types: C, CS & C1

MOUNTING INTERFACE FOR DIRECTIONAL CONTROL VALVE* TO: ISO 4401 SIZE 03/ANSI B93.7M SIZE D03.
*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED WITH MOTOR; SPECIFY & ORDER SEPARATELY

Connection to P port
G1/4" (BSPF) X 15
FULL THREAD DEPTH,
SUPPLIED PLUGGED

\( \varnothing 4.0 \times 6 \) DEEP HOLE FOR ORIENTATION PIN

DISPLACEMENT SELECTION:
HIGH DISPLACEMENT: P TO B; A TO T
LOW DISPLACEMENT: P TO A; B TO T

Types: C, CS & C1

Frame Size | Dim 'A' | Dim 'B'
--- | --- | ---
HMC030 | 159.0 | /
HMC045 | 188.5 | /
HMC080 | 173.5 | 477.0
HMC125 | 203.8 | 507.0
HMC200 | 216.4 | 520.0
HMC270 | 232.4 | 538.0
HMC325 | 232.4 | 538.0

Example model code - HMC200/S/180/FM4/X/71

Type: X

HMC030/HMC045/HMC080/HMC200  HMC270/HMC325

DISPLACEMENT SELECTION (VIA REMOTELY LOCATED VALVE*)
HIGH DISPLACEMENT: P TO Y; X TO T
LOW DISPLACEMENT: P TO X; Y TO T
*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED WITH MOTOR; SPECIFY & ORDER SEPARATELY

Frame Size | Dim 'A' | Dim 'B'
--- | --- | ---
HMC030 | 159.0 | /
HMC045 | 188.5 | /
HMC080 | 173.5 | 477.0
HMC125 | 203.8 | 507.0
HMC200 | 216.4 | 520.0
HMC270 | 232.4 | 538.0
HMC325 | 232.4 | 538.0

Type: C, CS & C1

MOUNTING FACE

Connection to P port
G1/4" (BSPF) X 15
FULL THREAD DEPTH,
SUPPLIED PLUGGED

\( \varnothing 4.0 \times 6 \) DEEP HOLE FOR ORIENTATION PIN

DISPLACEMENT SELECTION:
HIGH DISPLACEMENT: P TO B; A TO T
LOW DISPLACEMENT: P TO A; B TO T

Types: C, CS & C1

MOUNTING INTERFACE FOR DIRECTIONAL CONTROL VALVE* TO: ISO 4401 SIZE 03/ANSI B93.7M SIZE D03.
*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED WITH MOTOR; SPECIFY & ORDER SEPARATELY

Connection to P port
G1/4" (BSPF) X 15
FULL THREAD DEPTH,
SUPPLIED PLUGGED

\( \varnothing 4.0 \times 6 \) DEEP HOLE FOR ORIENTATION PIN

DISPLACEMENT SELECTION:
HIGH DISPLACEMENT: P TO B; A TO T
LOW DISPLACEMENT: P TO A; B TO T
Example model code - HMC200/S/180/60/FM4/CS/71

Refer to circuit diagram on page 13 for 'CS' C-Spacers.

CS Type shuttle endcap on F4 & FM4 assemblies only

CS Type shuttle on F3 & FM3 assemblies only

See valve housing page.

'B' See table on page 14.
Description

The constant power control uses the HMC series dual displacement motor with an improved crankshaft assembly and a motor mounted pressure sensing proportional valve. The advantage of such a system attempts to utilise all of the installed power and transfer it to the load. This results in either high torque low speed or low torque high speed operation of the load.

The motor displacement is dependent on load pressure and valve pressure setting. If the load pressure is below the valve pressure setting, then the displacement will change towards its minimum and if the load pressure is above the valve pressure setting, then the displacement will change towards its maximum.

The motor displacement will be set between its maximum and minimum limits when the valve setting pressure equals the load pressure. If the load pressure cannot achieve the valve setting pressure, then the motor will remain in its minimum displacement. If the load pressure continues to exceed the valve pressure setting, then the motor will remain in its maximum displacement and the load pressure will continue to increase to the system pressure limit.

The control system will seek to maintain the valve pressure setting when the motor is either motoring or pumping.

Constant motor input power is achieved when the motor operates at the valve pressure setting and the motor flow remains constant.

Operation of constant pressure valve

The higher motor port pressure is shuttled to the H port on the CP valve and if the pressure level is below 7 bar, then the spool will move to the left, due to the bias spring, and port pressure from H to Y. This will select the motor maximum displacement or low speed operation.

As the motor pressure increases above 7 bar, pressure at port C will act on the nut adjusting piston and move the spool to the right until the nut contacts the CP valve body. The nut position sets the primary spring force and hence valve pressure setting. This will now select the motor to minimum displacement or low speed.

As the load pressure on the sensing pin area approaches the primary spring preload force, as determined by the adjuster nut position, the spool will now move proportionally to the left. This will connect port H to port Y and the motor displacement will increase until the pressure at port H reduces back to the CP valve pressure setting.

The spool position will continue to adjust the pressure at ports X and Y in a proportional manner to maintain a constant motor pressure.
Valve pressure setting

The constant pressure valve is factory set to give a motor inlet pressure of between 100 to 220 bar as specified by the customer. The actual valve pressure setting will depend on the following considerations: load speed characteristic, motor displacement range, speed range, motor mechanical efficiency in low displacement and load holding requirements. The effect of valve pressure setting can be seen in fig.3 whereby for a fixed motor inlet flow, the motor input power can be seen to increase with valve pressure setting.

Fig. 3 shows the corner power limit in a displacement of 40 cu.in. This assumes that the motor low pressure port is at 10 bar, giving a motor differential pressure of 190 bar. CP operation at the corner power is assumed to be an intermittent condition and therefore the intermittent power is allowed, see page 9. This sets the maximum shaft power at the valve pressure setting of 200 bar. If the motor inlet flow is maintained for an increase in load, then the motor shaft power will remain at a low level just above the corner power limit. To utilise the installed power, the motor inlet flow and load must now be increased in order to increase the motor shaft power and hence run on a higher power curve.

Valve adjustment

A variable load pressure is used to factory set the valve pressure setting. The valve pressure adjustment without a variable load pressure can be difficult to set due to the very stiff adjustment spring. A 360 degree rotation of the adjusting nut will produce a pressure setting change of 200 bar. However, it is possible to adjust the valve pressure setting without load providing that before adjustment, the adjusting nut is marked with reference to the valve body, see fig.4.
Override valve selection

The constant pressure valve can be fitted with a CETOP3 override valve, which when activated moves the constant pressure valve spool in a direction to select maximum displacement. The override option is available with a lever operated or a solenoid activated valve, see fig.5 and fig.6. Fig.6 includes the Tj speed sensor option, which when combined with the T401 module can be used to automatically select maximum displacement at a pre-set low speed (see page 56).

Motor operation at constant inlet pressure

Fig. 7 shows the relationship between motor displacement and motor inlet pressure. If the inlet pressure is below 7 bar, then the motor will be in its maximum displacement (minimum speed). As the inlet pressure level increases above 7 bar the valve spindle and spool will move directing flow to the large displacement diameter piston (within the shaft assembly), which will force the motor to its minimum displacement (maximum speed).

A further increase in load will increase the motor inlet pressure until the valve pressure setting is reached. At this point, the motor displacement will move away from minimum towards maximum displacement until the motor torque, at valve pressure setting, equals the load torque.

The motor displacement will now automatically adjust itself to maintain the inlet pressure constant at the valve pressure setting. Any further change in load will cause a proportional action from the pressure sensing valve to maintain the motor inlet pressure constant.

Fig. 7
M0

The valve package is fitted to a FM3 valve housing and includes a CETOP3 interface with two direct acting relief valves of type model RDFA-L**.

M1

The valve package is fitted to a FM3 valve housing and includes two direct acting relief valves of type model RDHA with a rated flow of 380 lpm, and two make-up checks of type model CXFA-XAN.
M2

The valve package is fitted to a FM3 valve housing and includes a single counterbalance valve of type model CBIA with a rated flow of 480 lpm, and two make-up checks of type model CXFA-XAN.

M3

The valve package is fitted to a FM3 valve housing and includes a dual counterbalance valve of type model CBIA with a rated flow of 480 lpm, and two make-up checks of type model CXFA-XAN.
M4

The valve package is fitted to a FM3 valve housing and includes a single pilot operated load control valve of type model MWGM with a rated flow of 480 lpm, pilot relief of type model RBAC and two make-up checks of type model CXFA-XAN.

M5

The valve package is fitted to a FM4 valve housing and includes two direct acting relief valves of type model RDJA with a rated flow of 760 lpm, and two make-up checks of type model CXFA-XAN.
M6

The valve package is fitted to a FM4 valve housing and includes a single counterbalance valve of type model CBIA with a rated flow of 480 lpm, and two make-up checks of type model CXFA-XAN.

M7

The valve package is fitted to a FM4 valve housing and includes a dual counterbalance valve of type model CBIA with a rated flow of 480 lpm, and two make-up checks of type model CXFA-XAN.
M8

The valve package is fitted to a FM4 valve housing and includes a dual counterbalance valve of type model CBIA with a rated flow of 960 lpm, and two make-up checks of type model CXFA-XAN.

M9

The valve package is fitted to a FM4 valve housing and includes a single pilot operated load control valve of type model MWGM with a rated flow of 480 lpm, pilot relief of type model RBAC and two make-up checks of type model CXFA-XAN.
When applying large external radial loads, consideration should also be given to motor bearing lives, (see page 25).

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Maximum external radial bending moment (kNmm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC030</td>
<td>2600</td>
</tr>
<tr>
<td>HMC045</td>
<td>3330</td>
</tr>
<tr>
<td>HMC080</td>
<td>4500</td>
</tr>
<tr>
<td>HMC125</td>
<td>6500</td>
</tr>
<tr>
<td>HMC200</td>
<td>6750</td>
</tr>
<tr>
<td>HPHDC200</td>
<td>12200</td>
</tr>
<tr>
<td>HMC270</td>
<td>8250</td>
</tr>
<tr>
<td>HPHDC270</td>
<td>16000</td>
</tr>
<tr>
<td>HMC325</td>
<td>8250</td>
</tr>
</tbody>
</table>

**Example:**
Determine the maximum radial shaft load of a HMC080 motor:

Radial load offset, $A = 100\text{mm}$

Maximum radial load, $W = \frac{4500}{100} = 45\text{kN (4587 kg)}$

$W = \text{Side load}$

$A = \text{Distance from mounting face to load centre}$

**NOTE:** The offset distance $A$ is assumed to be greater than 50mm. Contact KPM UK LTD if this is not the case.
Consideration should be given to the required motor bearing life in terms of bearing service life. The factors that will determine bear life include:

1. Duty cycle - time spent on and off load
2. Speed
3. Differential pressure
4. Fluid viscosity, type, cleanliness and temperature
5. External radial shaft load
6. External axial shaft load

A heavy duty HM(HD)C motor can be ordered to further improve bearing life. Consult KPM if you need a detailed bearing life calculation.
Limits for fire resistant fluids

To select either displacement, a pressure at least equal to 2/3 of the motor inlet/outlet pressure (whichever is higher) is required. In most applications the motor inlet pressure will be used. If the inlet/outlet pressure is below 3.5 bar, a minimum control pressure of 3.5 bar is required. In the event of loss of control pressure the motor will shift to its highest displacement.

Starting torque

Refer to performance data, (see pages 4 to 10).

Low speed operation

The minimum operating speed is determined by load inertia, drive elasticity, motor displacement and system internal leakage. If the application speed is below 3 rpm, then consult KPM.

If possible, always start the motor in high displacement.

Small displacements

The pressures given in the table on pages 4 to 10 for displacement code “00” are based on 1000 rpm output shaft speed. This pressure can be increased for shaft speeds less than 1000 rpm; consult Kawasaki for details. Speeds greater than 1000 rpm may be applied but only after the machine duty cycle has been considered in conjunction with KPM.

A zero swept volume displacement (for freewheeling requirements) is available on request, consult KPM.

High back pressure

When both inlet and outlet ports are pressurised continuously, the lower pressure port must not exceed 70 bar at any time. Note that high back pressure reduces the effective torque output of the motor.

Boost pressure

When operating as a motor the outlet pressure should equal or exceed the crankcase pressure. If pumping occurs (i.e. overrunning loads) then a positive pressure, “P”, is required at the motor ports. Calculate “P” (bar) from the boost formula:

\[ P = 1 + \frac{N^2 \times V^2}{K} + C \]

Where P is in bar, \( N = \) motor speed (rpm), \( V = \) motor displacement (cc/rev.), \( C = \) Crankcase pressure (bar).

<table>
<thead>
<tr>
<th>Motor</th>
<th>Porting</th>
<th>Constant (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC030</td>
<td>F2, FM2</td>
<td>(3.7 \times 10^9)</td>
</tr>
<tr>
<td></td>
<td>S03, F3, FM3</td>
<td>(7.5 \times 10^9)</td>
</tr>
<tr>
<td>HMC045</td>
<td>F2, FM2</td>
<td>(3.7 \times 10^9)</td>
</tr>
<tr>
<td></td>
<td>S03, F3, FM3</td>
<td>(1.6 \times 10^{10})</td>
</tr>
<tr>
<td>HMC080</td>
<td>S03, F3, FM3</td>
<td>(1.6 \times 10^{10})</td>
</tr>
<tr>
<td>HMC125</td>
<td>S03, F3, FM3</td>
<td>(1.6 \times 10^{10})</td>
</tr>
<tr>
<td>HMC200</td>
<td>S03, F3, FM3</td>
<td>(1.6 \times 10^{10})</td>
</tr>
<tr>
<td></td>
<td>S04, F4, FM4</td>
<td>(3.3 \times 10^{10})</td>
</tr>
<tr>
<td>HMC270</td>
<td>S04, F4, FM4</td>
<td>(4 \times 10^{10})</td>
</tr>
<tr>
<td>HMC325</td>
<td>S04, F4, FM4</td>
<td>(4 \times 10^{10})</td>
</tr>
</tbody>
</table>
The flow rate of oil for the make-up system can be estimated from the crankcase leakage data (see page 11) plus an allowance for changing displacement:

- **HMC030** To change high to low in 0.2 seconds requires 11 lpm
- **HMC045** To change high to low in 0.25 seconds requires 15 lpm
- **HMC080** To change high to low in 0.25 seconds requires 32 lpm
- **HMC125** To change high to low in 0.5 sec requires 15 lpm
- **HMC200** To change high to low in 0.5 sec requires 15 lpm
- **HMC270** To change high to low in 1 sec requires 24 lpm
- **HMC325** To change high to low in 1 sec requires 20 lpm

Allowances should be made for other systems losses and also for “fair wear and tear” during the life of the motor, pump and system components.

**Motorcase pressure**

The motorcase pressure should not continuously exceed 3.5 bar with a standard shaft seal fitted. On installations with long drain lines a relief valve is recommended to prevent over-pressurising the seal.

**Notes:**
1. The motorcase pressure at all times must not exceed either the motor inlet or outlet pressure.
2. High pressure shaft seals are available to special order for casing pressures of: 10 bar continuous and 15 bar intermittent.
3. Check installation dimensions (pages 39 to 52) for maximum crankcase drain fitting depth.

**Hydraulic fluids**

Dependent on motor (see model code fluid type - page 57) suitable fluids include:

- (a) Antiwear hydraulic oils
- (b) Phosphate ester (HFD fluids)
- (c) Water glycols (HFC fluids)
- (d) 60/40% water-in-oil emulsions (HFB fluids)
- (e) 5/95% oil-in-water emulsions (HFA fluids)

Reduce pressure and speed limits, as per table on page 3. Viscosity limits when using any fluid except oil-in-water (5/95) emulsions are:

- Max. off load: 2000 cSt (9270 SUS)
- Max. on load: 150 cSt (695 SUS)
- Optimum: 50 cSt (232 SUS)
- Minimum: 25 cSt (119 SUS)

**Mineral oil recommendations**

The fluid should be a good hydraulic grade, non-detergent petroleum oil. It should contain anti-oxidant, antifoam and demulsifying additives. It must contain antiwear or EP additives. Automatic transmission fluids and motor oils are not recommended.
Temperature limits

Ambient min. -30°C
Ambient max. +70°C
Max. operating temperature range.

<table>
<thead>
<tr>
<th>Fluid Type</th>
<th>Min Temperature</th>
<th>Max Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum oil</td>
<td>-20°C</td>
<td>+80°C</td>
</tr>
<tr>
<td>Water-containing</td>
<td>+10°C</td>
<td>+54°C</td>
</tr>
</tbody>
</table>

* To obtain optimum service life from both fluid and hydraulic systems components, 65°C normally is the maximum temperature expected for water-containing fluids.

Filtration

Full flow filtration (open circuit), or full boost flow filtration (close circuit) to ensure system cleanliness to ISO4406/1986 code 18/14 or cleaner. Note: If a CP valve is used, then 17/13 or cleaner is recommended.

Noise levels

The airborne noise level is less than 66.7 dBA (DIN) through the “continuous” operating envelope. Where noise is a critical factor, installation resonances can be reduced by isolating the motor by elastomeric means from the structure and the return line installation. Potential return line resonance originating from liquid borne noise can be further attenuated by providing a return line back pressure of 2 to 5 bar.

Polar moment of Inertia

Typical data:

<table>
<thead>
<tr>
<th>Motor</th>
<th>Displacement code</th>
<th>Kgm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC030</td>
<td>30</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>0.0094</td>
</tr>
<tr>
<td>HMC045</td>
<td>45</td>
<td>0.044</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0.041</td>
</tr>
<tr>
<td>HMC080</td>
<td>90</td>
<td>0.052</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>0.044</td>
</tr>
<tr>
<td>HMC125</td>
<td>125</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>0.14</td>
</tr>
<tr>
<td>HMC200</td>
<td>188</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>0.18</td>
</tr>
<tr>
<td>HMC270</td>
<td>280</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>0.61</td>
</tr>
<tr>
<td>HMC325</td>
<td>325</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Mass

HMC030 Approx. all models 100kg.
HMC045 Approx. all models 150kg.
HMC080 Approx. all models 172kg.
HMC125 Approx. all models 235kg.
HMC200 Approx. all models 282kg.
HMC270 Approx. all models 450kg.
HMC325 Approx. all models 460kg.
When operating the motor at low temperature consideration should be given to the fluid viscosity. The maximum fluid viscosity before the shaft should be turned is 2000 cSt. The maximum fluid viscosity before load is applied to the motor shaft is 150 cSt.

If low ambient temperature conditions exist, then a crankcase flushing flow of 5 lpm should be applied to the motor during periods when the motor is not in use.

The shaft seal temperature limits for both medium and high pressure applications are shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Non-operating temperature limits</th>
<th>Minimum operating temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium pressure shaft seal</td>
<td>below minus 40 and above 100 degrees C</td>
<td>minus 30 degrees C</td>
</tr>
<tr>
<td>High pressure shaft seal</td>
<td>below minus 30 and above 120 degrees C</td>
<td>minus 15 degrees C</td>
</tr>
</tbody>
</table>

All seals are very brittle at minus 40° C and are likely to break very easily and due to their sluggish response may not provide a 100% leak free condition.

It should be noted that the maximum continuous operating temperature within the motor crankcase is plus 80° C.

It is recommended that the motor is operated by observing the rule for viscosity and the minimum operating temperature.
All Staffa motors can be used in freewheeling applications. In all circumstances it is essential that the motor is unloaded (A and B ports connected together) and that the circuit is boosted.

The required boost pressure will be dependent on speed and displacement.

It should be noted that for ‘B’ series motors large flows will re-circulate around the motor. This will require a large re-circulating valve and consideration of circuit cooling as the motor will generate a braking torque. It is for these reasons that ‘C’ series motors are the preferred option for freewheeling applications. It is normal to select displacement codes 10, 05 or 00.

Selecting the lowest available displacement of zero (00) will allow the motor shaft to be rotated at high speed without pumping fluid and with a minimum boost requirement. This will result in a minimum drive torque requirement for the freewheeling motor. Examples of the freewheeling feature on a winch are: dropping the load quickly in the case of an emergency and paying out cable. Consideration should be given when freewheeling such that the load does not drive the motor above its rated freewheeling speed.

**Displacement selection**

If the motor inlet/outlet pressure is below 3.5 bar, then a minimum 3.5 bar control pressure is required in order to ensure that the motor remains in minimum displacement. It should be noted that in the event of loss of control pressure, the motor will shift to its highest displacement, which could result in damage to the motor. When freewheeling with displacement codes: 00, 05 or 10, it can be difficult to generate a 3.5 bar pressure. In these circumstances it is necessary to feed the displacement change control circuit from a separate source thus ensuring a minimum control pressure of 3.5 bar. Under all operating conditions the control pressure port should be at least 2/3 of the motor inlet/outlet pressure ports.

**Boost requirement**

The required boost pressure is detailed on page 26. The actual required level will be determined by the expected maximum speed in maximum displacement during the overrunning condition. A maximum motor and control pressure of 17 bar at 1000 rpm is stated in the bulletins, although for purposes of freewheeling it is better to maintain a minimum boost level that satisfies all motor operating conditions. The Staffa motor bulletin boost formula does not apply to freewheeling displacements. High boost levels will increase motor losses at the conrod slipper interface and valve assembly, which will increase the motor operating temperature.

The boost flow required should be sufficient to make-up circuit leakage loss and provide cooling for recirculating flow pressure drop.

**Crankcase cooling**

A crankcase flushing flow of up to 15 lpm can be used to control and reduce the temperature rise of the motor during the freewheeling operation. This should not be necessary for motor speeds up to 1000 rpm but for freewheel speeds up to 1500 rpm then crankcase flushing flow must be used.
General

Spigot
The motor should be located by the mounting spigot on a flat, robust surface using correctly sized bolts. The diametrical clearance between the motor spigot and the mounting must not exceed 0.15mm. If the application incurs shock loading, frequent reversing or high speed running, then high tensile bolts should be used, including one fitted bolt.

Bolt torque
The recommended torque wrench setting for bolts is as follows:

- **M18**: 312 +/- 7 Nm
- **5/8" UNF**: 265 +/- 14 Nm
- **M20**: 407 +/- 14 Nm
- **3/4" UNF**: 393 +/- 14 Nm

Shaft coupling
Where the motor is solidly coupled to a shaft having independent bearings the shaft must be aligned to within 0.13mm TIR.

Motor axis - horizontal
The crankcase drain must be taken from a position above the horizontal centre line of the motor, (see page 32).

Motor axis - vertical shaft up
The recommended minimum pipe size for drain line lengths up to approx. 5m is 12.0mm as an internal diameter. If using longer drain lines, then increase the pipe internal bore diameter to keep the motorcase pressure within specified limits.

Specify “V” in the model code for extra drain port, G¼" (BSPF). Connect this port into main drain line downstream of a 0.35 bar check valve.

Motor axis - vertical shaft down
Piping (from any drain port) must be taken above level of motorcase.

Bearing lubrication - piping
The installation arrangement must not allow syphoning from the motorcase. Where this arrangement is not practical, please consult KPM.

Any of the drain port positions can be used, but the drain line should be run above the level of the uppermost bearing and if there is risk of syphoning then a syphon breaker should be fitted.

Start - up
Fill the crankcase with system fluid. Where practical, a short period (30 minutes) of “running in” should be carried out with the motor set to its high displacement.
Motor axis - horizontal

The recommended minimum pipe size for drain line lengths up to approx. 5m is 12.0mm ½" bore. Longer drain lines should have their bore size increased to keep the crankcase pressure within limits.

Motor axis - vertical shaft up

Specify “V” within the model code for extra drain port, G¼" (BSPF). Connect this port into the main drain line downstream of a 0.35 bar check valve to ensure good bearing lubrication. The piping arrangement must not allow syphoning from the motorcase.

Motor axis - vertical shaft down

The piping, from any drain port, must be taken above the level of the motorcase to ensure good bearing lubrication. The arrangement must not allow syphoning from the motorcase.
**SPLINE DATA**

### 'S'
- TO BS 3550 (ANSI B92.1 CLASS 5)
- FLAT ROOT SIDE FIT, CLASS 1
- PRESSURE ANGLE: 30°
- NUMBER OF TEETH: 17
- PITCH: 8/16
- MAJOR DIAMETER: 56.41/56.29
- FORM DIAMETER: 50.70
- MINOR DIAMETER: 50.06/49.60
- PIN DIAMETER: 6.096
- DIAMETER OVER PINS: 62.984/62.931

### 'Z'
- DIN 5480 W55 x 3 x 17 x 7h

### 'Z2'
- DIN 5480 W60 x 3 x 18 x 7h

---

**KEY SUPPLIED -**
- 14.046/14.028 WIDE
- 9.04/8.96 THICK

**SHAFT options**

- **HMC030**
  - Example model code - HMC030/P/30/15/FM3/X/70

---

**MOUNTING FACE**

- 1/2"-20 UNF-2B X 32 FULL THREAD DEPTH

**'P'**

**'S', 'Z' & 'Z2'**

---

**EXAMPLE FOR MODEL CODE -**

HMC030/P/30/15/FM3/X/70

---

**Kawasaki Precision Machinery**
**SPLINE DATA**

**'P'**
- TO BS 3550 (ANSI B92.1 CLASS 5)
- FLAT ROOT SIDE FIT, CLASS 1
- PRESSURE ANGLE: 30°
- NUMBER OF TEETH: 17
- PITCH: 8/16
- MAJOR DIAMETER: 56.41/56.29
- FORM DIAMETER: 50.70
- MINOR DIAMETER: 50.06/49.60
- PIN DIAMETER: 6.096
- DIAMETER OVER PINS: 62.984/62.931

**'S'**
- DIN 5480 W55 x 3 x 17 x 7h

**'Z'**
- DIN 5480 W60 x 3 x 18 x 7h

**'Z2'**
- DIN 5480 W60 x 3 x 18 x 7h
**Shaft options**

**HMC080** - Example model code - HMC080/P/90/20/FM3/X/70

### SPLINE DATA

**S**
- TO BS 3550 (ANSI B92.1 CLASS 5)
- FLAT ROOT SIDE FIT, CLASS 1
- PRESSURE ANGLE: 30°
- NUMBER OF TEETH: 14
- PITCH: 6/12
- MAJOR DIAMETER: 62.553/62.425
- FORM DIAMETER: 55.052
- MINOR DIAMETER: 54.084/53.525
- PIN DIAMETER: 8.128
- DIAMETER OVER PINS: 71.593/71.544

**Z**
- DIN 5480 W70 x 3 x 30 x 22 x 7h

---

**MOUNTING FACE**

**T**
- KEY SUPPLIED: 19.10/19.05 SQ.
- M20 x 1.0P x 50 LONG
- BASIC TAPER, ON DIA 0.1001/0.0999 : 1
- MINOR DIAMETER: Ø59.992
- DIAMETER OVER PINS: 71.593/71.544

**X**
- KEY SUPPLIED: 19.10/19.05 SQ.
- M12 x 1.75P x 30 LONG - QTY 3
- EQUI-SPACED ON 30.0 PCD
- BASIC TAPER, ON DIA 0.1001/0.0999 : 1
- MINOR DIAMETER: Ø53.95
- DIAMETER OVER PINS: 71.593/71.544

**P**
- KEY SUPPLIED: 18.037/18.019 SQ.
- 1/2" 20 UNF-2B X 32 FULL THREAD DEPTH

---

**KEY SUPPLIED**

- 19.10/19.05 SQ.
- 11.99/11.94 THICK
- 1/2" 20 UNF-2B X 32 FULL THREAD DEPTH
**Shaft options**

**HMC125** - Example model code - HMC125/P/125/100/FM3/X/70

---

**'T'**

- Key supplied: 22.27/22.22 wide 15.92/15.87 thick
- M30 x 60 LQ hex head screw
- Basic taper, on diameter 0.1001/0.0999 per mm

---

**'P1'**

- Key supplied: 24.066/24.000 wide 16.05/16.00 thick
- 3/4"-16 UNF-2B x 32 full thread depth

---

**'S3' & 'Z3'**

- 76 min straight
- 3/4"-16 UNF-2B x 32 full thread depth

---

**'Q'**

- HMHDC125 only
- Spline data
  - Spline to BS 3550 flat root side fit
  - Class 1
  - Number of teeth: 34
  - Pitch: 12/24
  - Pressure angle: 30°

---

**Spline data**

- 'S3'
  - To BS 3550/SAE J498c (ANSI B92.1, CLASS 5)
  - Flat root side fit, Class 1
  - Pressure angle: 30°
  - Number of teeth: 20
  - Pitch: 6/12
  - Major diameter: 87.953/87.825
  - Form diameter: 80.264
  - Minor diameter: 79.485/78.925
  - Pin diameter: 8.128
  - Diameter over pins: 97.084/97.030

- 'Z3'
  - DIN 5480 W85 x 3 x 27 x 7h
HMC200 - Example model code - HMC200/P/180/60/FM3/X/70

**Shaft options**

**HMHDC200 ONLY**

**SPLINE DATA**
- TO BS 3550
- FLAT ROOT SIDE FIT
- CLASS 1
- NUMBER OF TEETH: 34
- PITCH: 12/24
- PRESSURE ANGLE: 30°

**SPLINE DATA**
- TO BS 3550/SAE J498c (ANSI B92.1, CLASS 5)
- FLAT ROOT SIDE FIT, CLASS 1
- PRESSURE ANGLE: 30°
- NUMBER OF TEETH: 20
- PITCH: 6/12
- MAJOR DIAMETER: 87.953/87.825
- FORM DIAMETER: 80.264
- MINOR DIAMETER: 79.485/78.925
- PIN DIAMETER: 8.128
- DIAMETER OVER PINS: 97.084/97.030

**SPLINE DATA**
- DIN 5480 W85 x 3 x 27 x 7h

**MOUNTING FACE**

- 'T'
- 'Q'
- 'P1'
- 'S3' & 'Z3'

**KEY SUPPLIED**
- 22.27/22.22 WIDE
- 15.02/15.07 THICK

**MAJOR DIAMETER**
- Ø95

**DIMENSIONS**
- 97
- 76 MIN STRAIGHT
- 3/4"-16 UNF-2B X 32 FULL THREAD DEPTH
- 3/4"-16 UNF-2B X 32 FULL THREAD DEPTH
HMC270/HMC325 - Example model code - HMC270/S/280/60/FM4/X/70
- Example model code - HMC325/S/300/60/FM4/X/70

**Shaft options**

- **MOUNTING FACE**
  - 133.4
  - 10.54
  - 10.49
  - Ø99.446 (DATUM)
  - M30 x 60 LG HEX HEAD SCREW

- **'T'**
  - KEY SUPPLIED - 25.45/25.40 WIDE
  - 17.539/17.463 THICK
  - Ø99.446 (DATUM)

- **'P1'**
  - KEY SUPPLIED - 24.066/24.000 WIDE
  - 16.05/16.00 THICK

- **'S3' & 'Z4'**

**SPLINE DATA**

- **'S3'**
  - TO BS 3550 (ANSL B92.1, CLASS 5)
  - FLAT ROOT SIDE FIT, CLASS 1
  - PRESSURE ANGLE 30°
  - NUMBER OF TEETH 20
  - PITCH 6/12
  - MAJOR DIAMETER 87.953/87.825
  - FORM DIAMETER 80.264
  - MINOR DIAMETER 79.485/78.925
  - PIN DIAMETER 8.128
  - DIAMETER OVER PINS 97.084/97.030

- **'Z4'**
  - DIN 5480 W90 x 4 x 21 x 7h
HMC030 installation

SUPPLIED WITH 2 '0' RING SEALS

8 HOLES, SEE TABLE FOR THREAD SIZES

PORT FLANGE BOLT TAPPING SIZE -
F3: 7/16"-14 UNC-2B X 27 FULL THREAD DEPTH
FM3: M12 X P1.75 X 27 FULL THREAD DEPTH

SO3 - 3" VALVE HOUSING WITH 6-BOLT FLANGE

2x4 HOLES, SEE TABLE FOR THREAD SIZES

PORT FLANGE BOLT TAPPING SIZE -
F2: 3/8"-16 UNC-2B X 22 FULL THREAD DEPTH
FM2: M10 X P1.5 X 22 FULL THREAD DEPTH

SO3 - 3" VALVE HOUSING WITH 6-BOLT FLANGE

F3/FM3 - 3" VALVE HOUSING WITH 1 1/4" SAE 4-BOLT FLANGES

PORT FLANGE BOLT TAPPING SIZE -
F3: 7/16"-14 UNC-2B X 27 FULL THREAD DEPTH
FM3: M12 X P1.75 X 27 FULL THREAD DEPTH

FLOW DIRECTIONS FOR SHAFT ROTATION SHOWN.
REVERSE FLOW DIRECTIONS FOR OPPOSITE ROTATION.

Example model code - HMC030/S/30/20/FM3/X/70
**Reverse Port Connections for Opposite Direction of Shaft Rotation**

See separate sheets for C-spacer and shaft variants.

**Flow Direction for All VLV HSG Variants except F2/FM2**

- Centre line of drains
- Clockwise direction of rotation

**Inlet 3/8” BSP x 17 Full Thread**

- Choice of 3 positions (2 normally plugged)
- Note: ensure on installation that drain is taken from above motor centreline.
- Do not exceed 1/2 depth of coupling into drain port.

**5 Holes Ø18 Equi-Spaced as Shown on a 260.1 P.C.D. Spotface to Give an Effective Ø35.159**

**Dimensions**

- Ø254
- 598
- 328
- Ø374
- 98
- 119
- 159
- 28 MAX.
- 281
- 179.96
- 179.91
- Ø305 MAX.
- Ø260

---

**Drawing Notes**

- sized in a red circle.
- sized in a red square.
- sized in a red triangle.
Supplied with 2 'O' ring seals

Thread sizes:
- **Port flange tapping size -**
  - F2: 7/16"-14 UNC-2B X 27 Full thread depth
  - FM2: M10 X P1.5 X 22 Full thread depth
- **Port flange bolt tapping size -**
  - F3: 3/8"-16 UNC-2B X 22 Full thread depth
  - FM3: M12 X P1.75 X 27 Full thread depth

Views on arrow A:

Port 1:
- 6 holes: see table for thread sizes
- Port flange bolt tapping size:
  - F2 / FM2: M10 X P1.5 X 22 Full thread depth
- Port flange bolt tapping size:
  - F3 / FM3: M12 X P1.75 X 27 Full thread depth

Port 2:
- 4 holes: see table for thread sizes
- Port flange bolt tapping size:
  - F2 / FM2: M10 X P1.5 X 22 Full thread depth
- Port flange bolt tapping size:
  - F3 / FM3: M12 X P1.75 X 27 Full thread depth

SO3 - 3" Valve Housing with 6-Bolt Flange

F2 / FM2 - 2 1/4" Valve Housing with 1 SAE 4-Bolt Flanges

F3 / FM3 - 3" Valve Housing with 1 1/4" SAE 4-Bolt Flanges

SO3 - 3" Valve Housing with 6-Bolt Flange

F2 / FM2 - 2 1/4" Valve Housing with 1 SAE 4-Bolt Flanges

F3 / FM3 - 3" Valve Housing with 1 1/4" SAE 4-Bolt Flanges

Flow directions for shaft rotation shown.

Reverse flow directions for opposite rotation.
3/4"-UNF-2B DRAIN (CHOICE OF 3 POSITIONS)

Note: Ensure on installation that drain is taken from above motor centreline.

Do not exceed 12mm depth of coupling into drain port.

Reverse port connections for opposite direction of shaft rotation.

Flow direction for all VLV and variants except F2/FM2.

See separate sheets for C-spacer and shaft variants.

Clockwise direction of rotation.

41 max

115 max

Ø225.40

Ø225.32

Ø350 max

188.5

115

32

Ø254

Ø434

159

5 holes Ø18 equi-spaced as shown on a 304.8 PCD spotfaced to give an effective Ø38.0.15

Ø260
MOUNTING FACE

SO4 - 4" VALVE HOUSING WITH 6-BOLT FLANGE

SO3 - 3" VALVE HOUSING WITH 6-BOLT FLANGE

F3/FM3 - 3" VALVE HOUSING WITH 1 1/4" SAE 4-BOLT FLANGES

F2/FM2 - 2 1/4" VALVE HOUSING WITH 1 1/4" SAE 4-BOLT FLANGES

FLOW DIRECTIONS FOR SHAFT ROTATION SHOWN.

REVERSE FLOW DIRECTIONS FOR OPPOSITE ROTATION.

HMC080 installation

Example model code - HMC080/S/90/20/FM3/X/70
3/4"-16UNF-2B DRAIN (CHOICE OF 3 POSITIONS) (2 NORMALLY PLUGGED)
NOTE:- ENSURE ON INSTALLATION THAT DRAIN IS TAKEN FROM ABOVE MOTOR CENTRELINE
DO NOT EXCEED 12mm DEPTH OF COUPLING IN TO DRAIN PORT

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION
FLOW DIRECTION FOR ALL VLV HSG VARIANTS

PORT FLANGE BOLT TAPPING SIZE:
F4: 5/8"-11 UNC-2B X 35 FULL THREAD DEPTH
FM4: M16 X P2 X 35 FULL THREAD DEPTH

SEE SEPARATE SHEETS FOR C-SPACER AND SHAFT VARIANTS
Example model code - HMC125/S/125/100/FM3/X/70

SUPPLIED WITH 2 'O' RING SEALS

8 HOLES, SEE TABLE FOR THREAD SIZES

PORT FLANGE BOLT TAPPING SIZE -
F3: 7/16"-14 UNC-2B X 27 FULL THREAD DEPTH
FM3: M12 X P1.75 X 27 FULL THREAD DEPTH

2x4 HOLES, SEE TABLE FOR THREAD SIZES

PORT FLANGE BOLT TAPPING SIZE -
F2: 3/8"-16 UNC-2B X 22 FULL THREAD DEPTH
FM2: M10 X P1.5 X 22 FULL THREAD DEPTH

SO4 - 3 VALVE HOUSING WITH 6 BOLT FLANGE

SO3 - 3" VALVE HOUSING WITH 6 BOLT FLANGE

F2/FM2 - 2 1/4 VALVE HOUSING WITH 1 1/4 SAE 4 BOLT FLANKES

F3/FM3 - 3" VALVE HOUSING WITH 1 1/4 SAE 4 BOLT FLANKES

PORT FLANGE BOLT TAPPING SIZE -
F3/FM3: M12 X P1.75 X 27 FULL THREAD DEPTH

MOUNTING FACE

FLOW DIRECTIONS FOR SHAFT ROTATION SHOWN.
REVERSE FLOW DIRECTIONS FOR OPPOSITE ROTATION.

1" CODE 61 S.A.E. PORTS (2 POSITIONS)

84 84
6 HOLES 3/8"-24 UNF-2B X 16 DEEP
SO3 -
3" VALVE HOUSING WITH 6-BOLT FLANGE

SO4 -
4" VALVE HOUSING WITH 6-BOLT FLANGE

F2/FM2 -
2 1/4" VALVE HOUSING WITH 1" SAE 4-BOLT FLANGES

F3/FM3 -
3" VALVE HOUSING WITH 1 1/4" SAE 4-BOLT FLANGES

Example model code - HMC200/S/180/60/FM3/X/70

HMC200 installation
F4/FM4 - 4" VALVE HOUSING WITH 1 1/2" SAE 4 BOLT FLANGES
PORT FLANGE BOLT TAPPING SIZE -
F4: 5/8"-11 UNC-2B X 35 FULL THREAD DEPTH
FM4: M16 X P2 X 35 FULL THREAD DEPTH

8 HOLES, SEE TABLE FOR THREAD SIZE 5

8 HOLES, SEE TABLE FOR THREAD SIZE 5

3/4"-16UNF-2B DRAIN (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)
NOTE: ENSURE ON INSTALLATION THAT DRAIN IS TAKEN FROM ABOVE MOTOR CENTRELINE.
DO NOT EXCEED 12mm DEPTH OF COUPLING IN TO DRAIN PORT

5 HOLES Ø30 EQUISPACED AS SHOWN ON CROSS SECTION SPOTACED TO GIVE AN EFFECTIVE Ø40

FLOW DIRECTION FOR ALL VALVE HOUSING VARIANTS
REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION

* SEE SEPARATE SHEETS FOR C-SPACER AND SHAFT VARIANTS

CLOCKWISE DIRECTION OF ROTATION

8 HOLES, SEE TABLE FOR THREAD SIZE 5

8 HOLES, SEE TABLE FOR THREAD SIZE 5

8 HOLES, SEE TABLE FOR THREAD SIZE 5
Example model code - HMC270/S/280/60/FM4/X/70

HMC270 installation
3/4"-16UNF-2B DRAIN (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)
NOTE: ENSURE ON INSTALLATION THAT DRAIN IS TAKEN FROM ABOVE MOTOR CENTRELNE
DO NOT EXCEED 12mm DEPTH OF COUPLING IN TO DRAIN PORT

7 HOLES Ø20, EQUISPOILED AS SHOWN ON 480.7 PCD. SPOTFACE TO GIVE EFFECTIVE Ø40

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION
FLOW DIRECTION FOR ALL VLV HSG VARIANTS

CLOCKWISE DIRECTION OF ROTATION

* SEE SEPARATE SHEETS FOR C-SPACER AND SHAFT VARIANTS

NOTE:- ENSURE ON INSTALLATION THAT DRAIN IS TAKEN FROM ABOVE MOTOR CENTRELINE
DO NOT EXCEED 12mm DEPTH OF COUPLING IN TO DRAIN PORT
3/4" - 16UNF-2B drain (choice of 3 positions)
(2 normally plugged)

Note: Ensure on installation that drain is taken from above motor centreline. Do not exceed 12mm depth of coupling into drain port.

7 holes Ø20, equi spaced as shown on A457.07 PCD. Spot face to give effective Ø40.

Reverse port connections for opposite direction of shaft rotation.

Flow direction for all VLV HSG variants.

See separate sheets for C-spacer and shaft variants.

Clockwise direction of rotation.
## Product type

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC030</td>
<td>As per HMC045</td>
</tr>
<tr>
<td>HMC045</td>
<td>F2  =  1&quot; SAE 4-bolt UNC flange</td>
</tr>
<tr>
<td></td>
<td>FM2 = 1&quot; SAE 4-bolt metric flange</td>
</tr>
<tr>
<td></td>
<td>SO3 = Staffa 3&quot; 6-bolt flange</td>
</tr>
<tr>
<td></td>
<td>F3 = 1¼&quot; SAE 4-bolt flange</td>
</tr>
<tr>
<td></td>
<td>FM3 = 1¼&quot; SAE 4-bolt flange</td>
</tr>
<tr>
<td>HMC080</td>
<td>SO3 = Staffa 3&quot; 6-bolt flange</td>
</tr>
<tr>
<td></td>
<td>SO4 = 6-bolt UNF flange Staffa original valve housing</td>
</tr>
<tr>
<td></td>
<td>F3 = 1¼&quot; SAE 4-bolt flange</td>
</tr>
<tr>
<td></td>
<td>FM3 = 1¼&quot; SAE 4-bolt flange</td>
</tr>
<tr>
<td></td>
<td>F4 = SAE 1½&quot; 4-bolt UNC flanges</td>
</tr>
<tr>
<td></td>
<td>FM4 = SAE 1½&quot; 4-bolt metric flanges</td>
</tr>
<tr>
<td>HMC125</td>
<td>SO3 = Staffa 3&quot; 6-bolt flange</td>
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<tr>
<td></td>
<td>SO4 = 6-bolt UNF flange Staffa original valve housing</td>
</tr>
<tr>
<td></td>
<td>F3 = 1¼&quot; 3000 series SAE 4-bolt flange</td>
</tr>
<tr>
<td></td>
<td>FM3 = 1¼&quot; 3000 series SAE 4-bolt flange</td>
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<tr>
<td></td>
<td>F4 = SAE 1½&quot; 4-bolt UNC flanges</td>
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<tr>
<td></td>
<td>FM4 = SAE 1½&quot; 4-bolt metric flanges</td>
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<tr>
<td>HMC200</td>
<td>SO3 = Staffa 3&quot; 6-bolt flange</td>
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<tr>
<td></td>
<td>SO4 = 6-bolt UNF flange Staffa original valve housing</td>
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<tr>
<td></td>
<td>F3 = 1¼&quot; SAE code 61 4-bolt flange</td>
</tr>
<tr>
<td></td>
<td>FM3 = 1¼&quot; SAE code 61 4-bolt flange</td>
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<tr>
<td></td>
<td>F4 = SAE 1½&quot; 4-bolt UNC flanges</td>
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<td>FM4 = SAE 1½&quot; 4-bolt metric flanges</td>
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<td>HMC270</td>
<td>SO4 = Staffa 4&quot; 6-bolt flange</td>
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<tr>
<td></td>
<td>F4 = 1½&quot; SAE code 62 4-bolt flange</td>
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<td></td>
<td>FM4 = 1½&quot; SAE code 62 4-bolt flange</td>
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<tr>
<td>HMC325</td>
<td>SO4 = Staffa 4&quot; 6-bolt flange</td>
</tr>
<tr>
<td></td>
<td>F4 = 1½&quot; SAE code 62 4-bolt flange</td>
</tr>
<tr>
<td></td>
<td>FM4 = 1½&quot; SAE code 62 4-bolt flange</td>
</tr>
</tbody>
</table>
HOG 71 - encoder

**Model code:**
HOG71 DN 1024 TTL  
IP66  
Power supply: 5V @ 100 mA  
Output signal: Two TTL signals displaced by 90 deg. plus maker and inverted signals

**Model code:**
HOG71 DN 1024 HTL  
IP66  
Power supply: 9 TO 26V @ 100 mA  
Output signal: As per TTL but with HTL signals

---

Note: Speed sensors should be ordered as a separate item from Hubner.
**GTB 9 - tacho**

**TO SUIT: F3/FM3/SO3**

- **'Tg'**
- **TO SUIT: F4/FM4/SO4**

*Model code:*

GTB9.06 L 420  
IP68  
Output signal: 20V/1000 rpm

---

**Note:** Speed sensors should be ordered as a separate item from Hubner.
### Tj speed sensor with Tk option

TO SUIT: F3/FM3/SO3

<table>
<thead>
<tr>
<th>'Tj'</th>
<th>TO SUIT: F4/FM4/SO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEED SENSOR</td>
<td>SPEED SENSOR</td>
</tr>
<tr>
<td>Ø115</td>
<td>Ø146.0</td>
</tr>
<tr>
<td>17.00</td>
<td>17.00</td>
</tr>
<tr>
<td>M8 x 16 CAP SCREW</td>
<td>M8 x 16 CAP SCREW</td>
</tr>
</tbody>
</table>

#### Technical specification:
- **Description:** Hall effect dual channel speed probe
- **Signal outputs:** Square wave plus direction signal
- **Power supply:** 8 to 32V @ 40 mA
- **Protection class:** IP68
- **Output frequency:** 16 pulses/revolution

Tj speed probe and Tk optional T401 module. See model code detail on page 57. The T401 is software configured for both speed calibration and relay speed trip setting.

#### Tj cable assembly

- +V, BROWN
- SIGNAL 2, BLACK
- SIGNAL 1/D, WHITE
- GND, BLUE

Kawasaki Precision Machinery
Fluid type
(refer to page 3 for performance data)
Blank: Mineral oil.
F3: Phosphate ester (HFD fluid).
F11: Water-based fluids (HFA, HFB & HFC).
Alternative fluids contact Kawasaki Precision Machinery UK Ltd.
Nominate fluid type and make on order.

Model type
HM: Standard
HMHD: Heavy Duty

Motor frame size
C030 C125 C325
C045 C200
C080 C270

Shaft type
Vertically up

High displacement code
See displacement code details on pages 4 to 10

Main port connections
See port connection details on pages 4 to 10

Displacement control ports (pages 14 to 15)
Threaded ports/bi-directional shaft rotation:
X: X and Y ports G¼" (BSPF to ISO 228/1).
ISO 4401 size 03 mounting face/bi-directional shaft rotation:
C: No shuttle.
CS: With shuttle valve (see options by product type).
ISO 4401 size 03 mounting face/uni-directional shaft rotation (viewed on shaft end):
C1: Control pressure from main port 1 (shaft rotation clockwise with flow into port 1).
CP18: CP valve set to 180 bar
CHP18: CP valve set to 180 bar with override valve attached (see page 18).
Please state CP valve setting when placing an order and note that the maximum setting is 220 bar, i.e. CP22.

Special features PL****:
Non-catalogued features, (****)= number assigned as required.

Design number
Tacho/Encoder drive - Leave blank if not required
Tj: Square wave output with directional signal.
Tk: Combines Tj with the T401 instrument to give a 4 to 20 mA output proportional to speed, directional signal and speed relay output.
Th: Encoder system with a pulsed frequency output proportional to speed.
Tg: Tachogenerator with a D.C. output signal proportional to speed.
The specified data is for product description purposes only and may not be deemed to be guaranteed unless expressly confirmed in the contract.

Data sheet: M-1004/07.07