Fixed Displacement Radial Piston

Staffa Motor

HMB Series
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HMB Series

Fixed Displacement Radial Piston Hydraulic Motor

General Descriptions

The Kawasaki “Staffa” range of high torque low speed fixed displacement radial piston hydraulic motors consists of 13 frame sizes ranging from the HMB010 to HMB500. Capacity ranges from 188 to 8,000 cc/rev.

The rugged, well proven design incorporates high efficiency, combined with good breakout torque and smooth running capability.

Various features and options are available including, on request, mountings to match competitors’ interfaces.

The Kawasaki “Staffa” range also includes dual and triple displacement motors. To obtain details of these product ranges please refer to datasheet M-2002/03.17 and M-2005/12.17

Features

Rugged, reliable, proven design

Unique hydrostatic balancing provides minimum wear and extended life

High volumetric and mechanical efficiency

Capacities range from 50 to 8,000 cc/rev

Large variety of shaft and porting options

Output torque up to 25,250 Nm

Wide range of mounting interfaces available

Alternative displacements also available
## Specifications

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Geometric displacement (cc/rev)</th>
<th>Average actual running torque (Nm/bar)</th>
<th>Max. continuous speed (rpm)</th>
<th>Max. continuous output (kW)</th>
<th>Max. continuous pressure (bar)</th>
<th>Max. intermittent pressure (bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB010</td>
<td>188</td>
<td>2.79</td>
<td>500</td>
<td>25</td>
<td>207</td>
<td>241</td>
</tr>
<tr>
<td>HMB030</td>
<td>442</td>
<td>6.56</td>
<td>450</td>
<td>42</td>
<td>207</td>
<td>241</td>
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<tr>
<td>HMB030 (FM3)</td>
<td>492</td>
<td>7.31</td>
<td>450</td>
<td>52</td>
<td>207</td>
<td>241</td>
</tr>
<tr>
<td>HMB045</td>
<td>740</td>
<td>10.95</td>
<td>400</td>
<td>60</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMB060</td>
<td>983</td>
<td>14.5</td>
<td>300</td>
<td>80</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMB080</td>
<td>1,344</td>
<td>19.9</td>
<td>300</td>
<td>100</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMB100</td>
<td>1,639</td>
<td>24.3</td>
<td>250</td>
<td>110</td>
<td>250</td>
<td>293</td>
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<tr>
<td>HMB125</td>
<td>2,050</td>
<td>30.66</td>
<td>220</td>
<td>100</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMHDB125</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>HMB150</td>
<td>2,470</td>
<td>36.95</td>
<td>220</td>
<td>115</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMHDB150</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMB150 (FM3)</td>
<td>2,470</td>
<td>36.95</td>
<td>168</td>
<td>115</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMB200</td>
<td>3,087</td>
<td>46.07</td>
<td>175</td>
<td>130</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMHDB200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMB200 (FM3)</td>
<td>3,087</td>
<td>46.07</td>
<td>135</td>
<td>130</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMB270</td>
<td>4,310</td>
<td>63.79</td>
<td>125</td>
<td>140</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMHDB270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMB325</td>
<td>5,310</td>
<td>79.4</td>
<td>100</td>
<td>140</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMHDB325</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMHDB400</td>
<td>6,800</td>
<td>101</td>
<td>120</td>
<td>190</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>HMB500</td>
<td>8,000</td>
<td>114</td>
<td>100</td>
<td>170</td>
<td>190</td>
<td>227</td>
</tr>
</tbody>
</table>

Other non standard displacements are possible - check with KPM UK for details.
**1-1 Model Coding**

**F11/HM*B 060 / S3 V/ FM3/Tj/ */ P*******

**Fluid Type**

<table>
<thead>
<tr>
<th>Blank</th>
<th>Mineral oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Phosphate ester (HFD fluid)</td>
</tr>
<tr>
<td>F11</td>
<td>Water based fluids (HFA, HFB &amp; HFC)</td>
</tr>
</tbody>
</table>

Alternative fluids contact Kawasaki

**Model Type**

- HMB: Standard
- HMHDB: Heavy duty

* For B400 frame size, only Heavy Duty (HMHDB) is available.

**Motor Frame Size**

See options page 4

**Shaft Type**

See shaft type options in installation drawings

**Shaft Orientation**

<table>
<thead>
<tr>
<th>Blank</th>
<th>Horizontal and vertically down</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Vertically Up</td>
</tr>
</tbody>
</table>

**Main Port Connections**

See Port Connection options in installation drawings.

**Special Features**

- P*****: Special features (see page 6)
- PL***: Non-catalogued features. [****] = number assigned by Kawasaki as required

**Design Series Number**

Current series for HMB motors

**Tacho Encoder Drive**

<table>
<thead>
<tr>
<th>Blank</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tj*</td>
<td>Square wave output with directional signal*</td>
</tr>
<tr>
<td>Tk</td>
<td>Combines Tj with the T401 instrument to give a 4 to 20 mA output proportional to speed. Directional signal and speed relay output.</td>
</tr>
</tbody>
</table>

See page 39

* Not available for B010 frame size.
## 1-1 Model Coding

### Special Features Suffix

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>O</th>
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<tbody>
<tr>
<td></td>
<td>High pressure shaft seal</td>
<td>Improved shaft seal life</td>
<td>High pressure shaft seal &amp; improved shaft seal life</td>
<td>None</td>
</tr>
</tbody>
</table>

See pages 25 & 26 for details

### Shaft Seal Enhancements

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anti-pooling bolt heads</td>
<td>Marine-specification primer paint</td>
<td>Anti-pooling bolt heads &amp; Marine-specification primer paint</td>
<td>None</td>
</tr>
</tbody>
</table>

See pages 28 & 36 for details

### External Protection

<table>
<thead>
<tr>
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<th>B</th>
<th>C</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drain port adaptor x 1</td>
<td>Drain port adaptor x 2</td>
<td>21 mm mounting holes</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>22 mm mounting holes</td>
<td>21 mm mounting holes &amp; Drain port adaptor x 1</td>
<td>21 mm mounting holes &amp; Drain port adaptor x 2</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>22 mm mounting holes &amp; Drain port adaptor x 1</td>
<td>22 mm mounting holes &amp; Drain port adaptor x 2</td>
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<td>None</td>
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</table>

See pages 34 & 35 for details

### Performance Enhancements

<table>
<thead>
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<th>B</th>
<th>C</th>
<th>O</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Increased starting torque</td>
<td>Increased power rating</td>
<td>Increased starting torque &amp; increased power rating</td>
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</table>

See pages 30 & 37-8 for details

### Valve Enhancements

<table>
<thead>
<tr>
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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Improved cavitation resistance</td>
<td>Anti-clockwise</td>
<td>Thermal shock resistance</td>
<td>Improved cavitation resistance &amp; anti-clockwise</td>
<td>Improved cavitation resistance &amp; thermal shock resistance</td>
<td>Anti-clockwise &amp; thermal shock resistance</td>
<td>Improved cavitation resistance &amp; anti-clockwise &amp; thermal shock resistance</td>
<td>None</td>
</tr>
</tbody>
</table>

See pages 27, 31 & 32 for details
## 2-1 Performance Data

### Rating definitions

#### Continuous rating

For continuous duty the motor must be operating within each of the maximum values for speed, pressure and power.

#### Intermittent rating

Operation within the intermittent power rating (up to the maximum continuous speed) is permitted on a 15% duty basis, for periods up to 5 minutes maximum.

#### Intermittent max pressure

This pressure is allowable on the following basis:

- a) Up to 50rpm 15% duty for periods up to 5 minutes maximum.
- b) Over 50 rpm 2% duty for periods up to 30 seconds maximum.

Static pressure to DNV rules 405 bar (except HMB010 and HMB030 motors).

### 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>
</thead>
<tbody>
<tr>
<td>HFA 5/95 oil-in-water emulsion</td>
<td>130</td>
<td>138</td>
<td>50% of limits of mineral 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 mineral oil</td>
<td>All models</td>
</tr>
<tr>
<td>HFC water glycol</td>
<td>103</td>
<td>138</td>
<td>50% of limits of mineral oil</td>
<td>All models</td>
</tr>
<tr>
<td>HFD phosphate ester</td>
<td>207</td>
<td>241</td>
<td>As for mineral oil</td>
<td>HMB010</td>
</tr>
<tr>
<td></td>
<td>207</td>
<td>293</td>
<td>As for mineral oil</td>
<td>HMB030</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>293</td>
<td>As for mineral oil</td>
<td>HMB045 to HMHDBB400 inc.</td>
</tr>
<tr>
<td></td>
<td>190</td>
<td>227</td>
<td>As for mineral oil</td>
<td>HMB500</td>
</tr>
</tbody>
</table>
2-1 Performance Data (cont)

Output Torque Curves

These torque curves indicate the maximum output torque and power of a fully run-in motor for a range of pressures and speeds when operating with zero outlet pressure on Mineral Oil of 50 cSt (232 SUS) viscosity. High return line pressures will reduce torque for a given pressure differential. - x - x - x - Upper limit of continuous rating envelope.
2-1 Performance Data (cont)

Output Torque Curves (cont)

HMB060

Output power kW
Nm 22.4 44.7 70.8

HMB080

Output power kW
Nm 18.6 37.5 56 74.6 93.2

HMB100

Output power kW
Nm 18.6 37.3 60.0 74.6 93.2

HM(HD)B125

Output power kW
Nm 18.6 37.3 55.9 74.6
2-1 Performance Data (cont)

Output Torque Curves (cont)

HM(HD)B150

Output power kW
37.3  74.6  112
Nm  186  559  932

Torque vs Shaft speed (r/min)

HM(HD)B200

Output power kW
37.3  74.6  112
Nm  276  250  207  172  138  103  69

Torque vs Shaft speed (r/min)

HM(HD)B270

Output power kW
37.3  74.6  112
Nm  18000  16000  14000  12000  10000  8000  6000  4000  2000  0

Torque vs Shaft speed (r/min)

HM(HD)B325

Output power kW
37.3  74.6  112
Nm  24000  22000  20000  18000  16000  14000  12000  10000  8000  6000  4000  2000  0

Torque vs Shaft speed (r/min)
2-1 Performance Data (cont)

Output Torque Curves (cont)

HMB MOTORS

HMHDB400

Output Torque Curves

Shaft speed (r/min)

30,000
25,000
20,000
15,000
10,000
5,000
0

Nm 37.3 74.6 112 150

276 bar
250 bar
207 bar
172 bar
138 bar
103 bar
69 bar

HMB500

Output power kW

Shaft speed (r/min)

30,000
25,000
20,000
15,000
10,000
5,000
0

Nm 37.3 74.6 112 150 170

227 bar
190 bar
172 bar
138 bar
103 bar
69 bar
2-2 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>HMB010</td>
<td>188 cc/rev</td>
<td>1.34</td>
<td>534.05</td>
<td>7.31</td>
<td>0.51</td>
</tr>
<tr>
<td>HMB030</td>
<td>442 cc/rev</td>
<td>1.04</td>
<td>57.67</td>
<td>2.47</td>
<td>0.59</td>
</tr>
<tr>
<td>2-piece HMB030</td>
<td>492 cc/rev</td>
<td>1.04</td>
<td>57.67</td>
<td>2.47</td>
<td>0.59</td>
</tr>
<tr>
<td>HMB045</td>
<td>740 cc/rev</td>
<td>1.92</td>
<td>43.36</td>
<td>2.71</td>
<td>1.76</td>
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<tr>
<td>HMB060</td>
<td>983 cc/rev</td>
<td>1.72</td>
<td>29.91</td>
<td>2.35</td>
<td>1.88</td>
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<tr>
<td>HMB080</td>
<td>1,344 cc/rev</td>
<td>1.71</td>
<td>21.62</td>
<td>1.84</td>
<td>1.84</td>
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<tr>
<td>HMB100</td>
<td>1,639 cc/rev</td>
<td>1.83</td>
<td>17.74</td>
<td>1.41</td>
<td>1.88</td>
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<tr>
<td>HM(HD)B125</td>
<td>2,050 cc/rev</td>
<td>2.06</td>
<td>11.45</td>
<td>1.24</td>
<td>1.35</td>
</tr>
<tr>
<td>HM(HD)B150</td>
<td>2,470 cc/rev</td>
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<td>9.98</td>
<td>1.00</td>
<td>1.39</td>
</tr>
<tr>
<td>HM(HD)B200</td>
<td>3,080 cc/rev</td>
<td>2.53</td>
<td>14.99</td>
<td>0.78</td>
<td>1.39</td>
</tr>
<tr>
<td>HM(HD)B270</td>
<td>4,310 cc/rev</td>
<td>3.17</td>
<td>21.16</td>
<td>0.68</td>
<td>1.80</td>
</tr>
<tr>
<td>HM(HD)B325</td>
<td>5,310 cc/rev</td>
<td>3.14</td>
<td>18.21</td>
<td>0.55</td>
<td>1.80</td>
</tr>
<tr>
<td>HM(HD)B400</td>
<td>6,800 cc/rev</td>
<td>4.06</td>
<td>10.18</td>
<td>0.53</td>
<td>2.35</td>
</tr>
<tr>
<td>HMB500</td>
<td>8,000 cc/rev</td>
<td>9.247</td>
<td>78.247</td>
<td>1.739</td>
<td>5.797</td>
</tr>
</tbody>
</table>

Qt (total leakage) = \([K_1 + n/K_2] \times ΔP \times Kv \times 0.005 \) l/min
Creep speed = \(K_3 \times ΔP \times Kv \times 0.005 \) rpm
Crankcase leakage = \(K_4 \times ΔP \times Kv \times 0.005 \) l/min

\(ΔP\) = differential pressure bar
\(n\) = speed rpm

\(K_1\), \(K_2\), \(K_3\), \(K_4\), cSt, Kv

The motor volumetric efficiency can be calculated as follows:

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

Example:
HMB200 motor with displacement of 3.080 l/rev.
Speed 60 rpm
Differential pressure 200 bar
Fluid viscosity 50 cSt
Total leakage = \((K_1 + n/K_2) \times ΔP \times Kv \times 0.005\) l/min
= \((2.53 + 60/14.99) \times 200 \times 1 \times 0.005\)
= 6.53 l/min

Volumetric efficiency = \(\left( \frac{60 \times 3.080}{60 \times 3.080 + 6.53} \right) \times 100\)
= 96.5%
2-3 Shaft Power Calculation

Example (see page 4)

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

Select the rated shaft power ($W$) for the motor from the performance data table (page 4). This is presented in kilowatts so must be converted to watts ($\times 1000$).

Then also take the Actual Average running torque in N.m/bar ($T_o$) and the rated shaft speed in rpm ($n$).

\[
W = \frac{T_o \cdot \Delta P \cdot 2\pi \cdot n}{60}
\]

Or to find maximum $\Delta P$ then use:

\[
\Delta P = \frac{60 \cdot W}{2\pi \cdot T_o \cdot n}
\]

HMB270 Example:

Rated shaft power, $W$ (W): 140,000
Average actual running torque, $T_o$ (Nm/bar): 63.79
Rated shaft speed, $n$ (rpm): 125

\[
\Delta P = \frac{60 \times 140,000}{2\pi \times 63.79 \times 125}
\]

\[
\Delta P = 167 \text{ bar (max.)}
\]

Secondly, to find the maximum speed at rated pressure (using the same information as before):

\[
n = \frac{60 \cdot W}{2\pi \cdot T_o \cdot \Delta P}
\]

Rated pressure (bar): 250

\[
n = \frac{60 \times 140,000}{2\pi \times 63.79 \times 250}
\]

\[
n = 83 \text{ rpm (max.)}
\]

In summary, operating the motor within its shaft power limit, at rated speed, would give a maximum pressure of 167 bar, and operating the motor at rated pressure, would give a maximum speed of 83 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.
2-4 Functional Symbols

HMB010- HMB030 (Monobloc)

HMB045---** (Monobloc)

HMB045---**D-(Monobloc)

HMHDB400---**-HMB500
Removable plug

SM3
HMB030*/045*(TPB)
HMB060/080
HMB100/125
HMB150/200

*F(M)3 ONLY

-F(M)3-; F(M)4-; SM3

HMB045---**(TPB)
HMB060/080
HMB100/125
HMB150/200

HMHDB400---**-HMB500
SO45
Dual ports
2-5 Stress Limits

When applying large external radial loads, consideration should also be given to motor bearing lives (see page 16).

<table>
<thead>
<tr>
<th>Motor Frame Size</th>
<th>Shaft Types</th>
<th>Maximum External Radial Bending Moment [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB010</td>
<td>P, S</td>
<td>1,550</td>
</tr>
<tr>
<td>HMB030</td>
<td>P, S &amp; Z</td>
<td>2,400</td>
</tr>
<tr>
<td>HMB045</td>
<td>P, S &amp; Z</td>
<td>3,240</td>
</tr>
<tr>
<td>HM060, 080 &amp; 100</td>
<td>P, S, Z &amp; T</td>
<td>5,500</td>
</tr>
<tr>
<td>HMB125, 150 &amp; 200</td>
<td>P1, S3, S4, Z3, &amp; T</td>
<td>6,600</td>
</tr>
<tr>
<td>HMHDB125, 150, 200</td>
<td>S5, Z5 &amp; P2</td>
<td>12,750</td>
</tr>
<tr>
<td>HMB270 &amp; 325</td>
<td>P1, S3, Z3 &amp; T</td>
<td>7,500</td>
</tr>
<tr>
<td>HMHDB270 &amp; 325</td>
<td>P2, S5 &amp; Z5</td>
<td>15,900</td>
</tr>
<tr>
<td>HMHDB400</td>
<td>P, S &amp; Z</td>
<td>16,200</td>
</tr>
<tr>
<td>HMB500</td>
<td>P, S &amp; Z</td>
<td>16,200</td>
</tr>
</tbody>
</table>

**Example:**

Determine the maximum radial shaft load of a HMB080 motor:

Radial load offset, \( A \) = 100 mm  
Maximum radial load, \( W \) = 5,500 (see table)/100  
\( = 55 \text{ kN (5,607 kg)} \)

\[ A = \text{Distance from mounting face to load centre (mm)} \]

\[ W = \text{Side load (N)} \]

[Note]

The offset distance \( A \) is assumed to be greater than 50 mm.  
Contact KPM UK if this is not the case.
2-6 Bearing Life Notes

Consideration should be given to the required motor bearing life in terms of baring service life. The factors that will determine bearing life include:

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

[NOTE]
A heavy duty HM(HD)B motor can be ordered to further improve bearing life. Consult KPM UK if you need a detailed bearing life calculation.
2-7 Circuit and Application Notes

ביום השחרור:

◆ Starting torque

The starting torques shown on the graphs on pages 8 to 11 are average and will vary with system parameters.

◆ Low Speed Operations

Minimum operating speeds are determined by the hydraulic system and load conditions (load inertia, drive elasticity, etc.) Recommended minimum speeds are shown below:

<table>
<thead>
<tr>
<th>Model Type</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB010</td>
<td>20</td>
</tr>
<tr>
<td>HMB030</td>
<td>5</td>
</tr>
<tr>
<td>HMB045</td>
<td>6</td>
</tr>
<tr>
<td>HMB060/080/100</td>
<td>3</td>
</tr>
<tr>
<td>HM(HD)B125/150/200</td>
<td>3</td>
</tr>
<tr>
<td>HM(HD)B270/325</td>
<td>2</td>
</tr>
<tr>
<td>HMHDB400/HMB500</td>
<td>2</td>
</tr>
</tbody>
</table>

◆ High Back Pressure

When both inlet and outlet ports are pressurised continuously, the lower port pressure must not exceed 70 bar at any time.

Note: 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 operating formula Boost Formula $P = \frac{1 + N^2 \times V^2}{K} + C$

Where $P$ is in bar, $N =$ motor speed (rpm), $V =$ motor displacement (cc/rev), $C =$ Crankcase pressure (bar) and $K =$ a constant from the table below:

<table>
<thead>
<tr>
<th>Motor</th>
<th>Porting</th>
<th>Constant (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB010</td>
<td>Standard</td>
<td>$8.0 \times 10^6$</td>
</tr>
<tr>
<td>HMB030</td>
<td>Standard - Monobloc</td>
<td>$3.7 \times 10^6$</td>
</tr>
<tr>
<td></td>
<td>F(M)3 SM3</td>
<td>$7.5 \times 10^6$</td>
</tr>
<tr>
<td>HMB045</td>
<td>Standard - Monobloc</td>
<td>$1.3 \times 10^9$</td>
</tr>
<tr>
<td></td>
<td>F(M)3 SM3</td>
<td>$1.6 \times 10^9$</td>
</tr>
<tr>
<td>HMB060, HMB080 &amp; HMB100</td>
<td>F(M)3 SM3</td>
<td>$1.8 \times 10^9$</td>
</tr>
<tr>
<td>HM(HD)B125, HM(HD)B150 &amp; HM(HD)B200</td>
<td>FM(3) SM3</td>
<td>$4.0 \times 10^9$</td>
</tr>
<tr>
<td></td>
<td>FM(4)</td>
<td>$8.0 \times 10^9$</td>
</tr>
<tr>
<td>HM(HD)B270 &amp; HM(HD)B325</td>
<td>FM(4)</td>
<td>$7.2 \times 10^9$</td>
</tr>
<tr>
<td>HMHDB400 &amp; HMB500</td>
<td>S045</td>
<td>$7.2 \times 10^9$</td>
</tr>
</tbody>
</table>
2-7 Circuit and Application Notes (cont)

The flow rate of oil needed for the make-up system can be estimated from the crankcase leakage data (see page 12 for calculation method). Allowances should be made for other system losses and also for “fair wear and tear” during the life of the motor, pump and system components.

Cooling Flow

Operating within the continuous rating does not require any additional cooling.

For operating conditions above “continuous”, up to the “intermittent” rating, additional cooling oil may be required. This can be introduced through the spare crankcase drain holes, or in special cases through the valve spool end cap.

Consult KPM UK about such applications.

Motorcase pressure

With the standard shaft seal fitted, the motor casing pressure should not exceed 3.5 bar.

Notes

1) The casing pressure at all times must not exceed either the motor inlet or outlet pressure.

2) High pressure shaft seals are available for casing pressures of:
   9 bar for HMB010
   10 bar for all remaining frame sizes.

3) Check installation dimensions for maximum crankcase drain fitting depth.

Hydraulic Fluids

Dependent on motor (see model code fluid type - page 5) 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 23.

Viscosity limits when using any fluid except oil-in-water (5/95) emulsions are:

Max. off load: 2,000 cSt (9270 SUS)
Max. on load: 150 cSt (695 SUS)
Optimum: 50 cSt (232 SUS)
Minimum: 25 cSt (119 SUS)

Temperature limits

Ambient min. -30°C (-22ºF)
Ambient max. +70°C (158ºF)

Mineral oil

Min -20°C (-4ºF)
Max. +80°C (175ºF)

Water containing

Min +10°C (50ºF)
Max. +54°C (130ºF)

Note: To obtain optimum services life from both fluid and hydraulic systems components, a fluid operating temperature of 40°C is recommended.
2-7 Circuit and Application Notes (cont)

⚠️ Mineral oil recommendations

The fluid should be a good hydraulic grade, non-detergent Mineral 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.

⚠️ Biodegradable Fluid Recommendations

Well-designed environmentally acceptable lubricants (EALs) may be used with Staffa motors. The EAL must be designed for use in hydraulic systems and have a synthetic ester base. Additives should be as listed for mineral oils, above. The performance of EALs with hydraulic systems vary widely and so checks for seal compatibility, copper alloy compatibility, oxidation resistance and lubrication properties should be carried out before selecting an EAL. For help with EALs please contact KPMUK.

⚠️ 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.

⚠️ Noise levels

The airborne noise level is less than 66.7 dB(A) DIN & dB(A) NFPA 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 resonances 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 and mass table

<table>
<thead>
<tr>
<th>Motor Frame Size</th>
<th>Polar Moment of Intertia (kg.m²) (Typical data)</th>
<th>Mass (kg) (Approx. all models)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB010</td>
<td>0.0076</td>
<td>40</td>
</tr>
<tr>
<td>HMB030</td>
<td>0.0150</td>
<td>73</td>
</tr>
<tr>
<td>HMB045</td>
<td>0.0470</td>
<td>120</td>
</tr>
<tr>
<td>HMB060</td>
<td>0.0500</td>
<td>144</td>
</tr>
<tr>
<td>HMB080</td>
<td>0.0600</td>
<td>144</td>
</tr>
<tr>
<td>HMB100</td>
<td>0.0760</td>
<td>144</td>
</tr>
<tr>
<td>HMB125</td>
<td>0.2200</td>
<td>217</td>
</tr>
<tr>
<td>HMB150</td>
<td>0.2500</td>
<td>265</td>
</tr>
<tr>
<td>HMB200</td>
<td>0.2700</td>
<td>265</td>
</tr>
<tr>
<td>HMB270</td>
<td>0.4900</td>
<td>420</td>
</tr>
<tr>
<td>HMB325</td>
<td>0.5000</td>
<td>429</td>
</tr>
<tr>
<td>HMHDB400 - S04</td>
<td>0.5400</td>
<td>481</td>
</tr>
<tr>
<td>HMHDB400 - S05</td>
<td>0.5400</td>
<td>510</td>
</tr>
<tr>
<td>HMB500</td>
<td>0.5400</td>
<td>510</td>
</tr>
</tbody>
</table>
2-8 Motor Operation at Low Temperature

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 2,000 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 at least 5 l/min 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>Standard pressure shaft seal</td>
<td>below minus 40(^\circ)C and above 100(^\circ)C</td>
<td>minus 30(^\circ)C</td>
</tr>
<tr>
<td>High pressure shaft seal</td>
<td>below minus 30(^\circ)C and above 120(^\circ)C</td>
<td>minus 15(^\circ)C</td>
</tr>
</tbody>
</table>

All seals are very brittle below minus 40\(^\circ\)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\(^\circ\)C.
2-9 Freewheeling Notes

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 is dependent on both the speed and displacement conditions.

It should be noted that for "HMB" series motors, to achieve freewheel, large flows will have to re-circulate around the motor.

This will require a large recirculating valve and consideration of circuit cooling as the motor will be generating a braking torque.

It is for these reasons that "HMC", "HPC" or "HMF" series motors are the preferred option for freewheeling applications.

See catalogues M-2002/03.17, M-2003/03.17 and M-2005/12.17 for details.
2-10 Crankcase Drain Connections

**Motor axis - horizontal**

The recommended minimum pipe size for drain line lengths up to approx. 5m is 12.0 mm (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. (refer to installation drawing for details).

**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.
2-11 Installation Data

❖ 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 0.15 mm. 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:

<table>
<thead>
<tr>
<th>Bolt Size</th>
<th>Torque Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12</td>
<td>97 +/- 7 Nm</td>
</tr>
<tr>
<td>M14</td>
<td>160 +/- 21 Nm</td>
</tr>
<tr>
<td>M18</td>
<td>312 +/- 14 Nm</td>
</tr>
<tr>
<td>M20</td>
<td>407 +/- 14 Nm</td>
</tr>
<tr>
<td>M24</td>
<td>690 +/- 27 Nm</td>
</tr>
<tr>
<td>½&quot; UNF</td>
<td>97 +/- 7 Nm</td>
</tr>
<tr>
<td>¾&quot; UNF</td>
<td>265 +/- 14 Nm</td>
</tr>
<tr>
<td>1&quot;</td>
<td>393 +/- 14 Nm</td>
</tr>
<tr>
<td>1½&quot; UNF</td>
<td>810 +/- 27 Nm</td>
</tr>
</tbody>
</table>

❖ Shaft coupling:

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

❖ End of Motor Life

The motor unit, hydraulic fluid and packaging must be disposed of carefully to avoid pollution to the environment. The motor unit must be completely empty upon disposal, it must be disposed of according to national regulations and you must also follow safety information for disposal of the hydraulic fluid.

All individual parts of the motor unit must be recycled. Separate the motor unit parts according to: cast parts, steel, aluminium, non-ferrous metal, electronic waste, plastic, and seals.
# 2-12 Special Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Page</th>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030 - F(M)3</th>
<th>HMB 045 - F(M)3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HM(HDB) 125</th>
<th>HM(HDB) 150/200</th>
<th>HM(HDB) 270</th>
<th>HM(HDB) 325</th>
<th>HM(HDB) 400</th>
<th>HM(HDB) 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Pressure Shaft Seal</td>
<td>9</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Improved Shaft Seal Life</td>
<td>10</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Improved Cavitation Resistance</td>
<td>11</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Anti-pooling Bolt Heads</td>
<td>12</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Increased Starting Torque</td>
<td>13</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Anti-clockwise Rotation</td>
<td>15</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Thermal Shock Resistance</td>
<td>16</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Drain Port Adaptor - ½” BSPP</td>
<td>18</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Φ21mm Mounting Holes</td>
<td>19</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Φ22mm Mounting Holes</td>
<td>19</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Marine-specification Primer Paint</td>
<td>20</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Increased Power Rating</td>
<td>21</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

● Available  
○ Not available

If a motor is to be ordered with any special features listed, please contact Kawasaki.
2-12 Special Features (cont)

High Pressure Shaft Seal

Description:

- > 10 bar rated
- > Recommended for cold climates
- > Rugged aluminium construction

Technical Information

Where crankcase pressure will be higher than 3.5 bar, the high pressure shaft seal should be selected.

<table>
<thead>
<tr>
<th>Case pressure</th>
<th>≤ 10 bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-operating temperature limits</td>
<td>Below -30°C and above 120°C</td>
</tr>
<tr>
<td>Minimum operating temperature</td>
<td>-15°C</td>
</tr>
<tr>
<td>Maximum operating temperature</td>
<td>80°C</td>
</tr>
<tr>
<td>Minimum viscosity</td>
<td>2,000 cSt</td>
</tr>
<tr>
<td>Maximum viscosity</td>
<td>150 cSt</td>
</tr>
</tbody>
</table>

Applicable to:

<table>
<thead>
<tr>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030 -F(M)3/SM3</th>
<th>HMB 045</th>
<th>HMB 045 -F(M)3/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HMB(HD)B 125</th>
<th>HMB(HD)B 150/200</th>
<th>HMB(HD)B 270</th>
<th>HMB(HD)B 325</th>
<th>HMB(HD)B 400</th>
<th>HMB 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

**Improved Shaft Seal Life**

**Description:**
- Stainless steel sleeve prevents corrosion
- Improved wear resistance
- Recommended for corrosive environments

**Technical Information**

A well-established method of increasing rotary seal life in corrosive environments is to fit a thin-walled, stainless steel sleeve to the rotating shaft to provide a corrosion-resistant, wear-resistant counterface surface for the seal to run against. All HMB motors can be fitted with such sleeves upon request.

<table>
<thead>
<tr>
<th>Sleeve material</th>
<th>A304/301 Stainless Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleeve surface finish</td>
<td>$R_s$ 0.25 to 0.5 μm (10 to 20 μin)</td>
</tr>
</tbody>
</table>

**Applicable to:**

<table>
<thead>
<tr>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030 -F(M)3/SM3</th>
<th>HMB 045</th>
<th>HMB 045 -F(M)3/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HMB(HD)B 125</th>
<th>HMB(HD)B 150/200</th>
<th>HMB(HD)B 270</th>
<th>HMB(HD)B 325</th>
<th>HMB(HD)B 400</th>
<th>HMHDB 400</th>
<th>HMB 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

- Improved Cavitation Resistance

Description:

- Recommended for overrunning applications
- Protects against seal damage for short periods of operation in vacuum inlet conditions.

Cavitation can occur due to many different factors. Although it is not possible to make the HMB motor resistant to cavitation, certain features can be added to improve the motor’s resistance to short periods of lost port pressure.

In applications where the HMB motor can be driven (like a pump) a risk arises that insufficient fluid will be provided to maintain a positive pressure at both main ports of the motor causing cavitation. The results of extended running at these conditions can be catastrophic to the motor’s function.

The improved cavitation resistance feature should be considered where:

- Overrunning conditions may occur (load driving the motor)
- Loss of main port pressure while motor is rotating

Note:
This feature comes as standard on monobloc HMB motors (HMB010, HMB030, HMB045).

Applicable to:

<table>
<thead>
<tr>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030-F(M)3/SM3</th>
<th>HMB 045</th>
<th>HMB 045-F(M)3/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HM(HD)B125</th>
<th>HM(HD)B150/200</th>
<th>HM(HD)B270</th>
<th>HM(HD)B325</th>
<th>HMDB400</th>
<th>HMB 500</th>
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<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

Anti-pooling Bolt Heads

Description:
> Removes potential for water pooling
> Improved corrosion resistance
> Recommended for marine environments

Technical Information
In many marine applications, water pooling in socket head cap screw heads presents a significant corrosion risk. Corroded cap screws can make service and repair of affected units impossible.

To significantly reduce the risk of water damage through pooling, HMB motors can be supplied with silicone filler in all the bolt heads.

Applicable to:

<table>
<thead>
<tr>
<th></th>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030 -F(M)3/SM3</th>
<th>HMB 045</th>
<th>HMB 045 -F(M)3/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HM(HD)B 125</th>
<th>HM(HD)B 150/200</th>
<th>HM(HD)B 270</th>
<th>HM(HD)B 325</th>
<th>HMHDB 400</th>
<th>HMB 500</th>
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<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

Increased Starting Torque

Description:

- Optimised for high break-out torque
- Recommended for low speed operation
- Improved service life for low speed applications

Technical Information

If an application demands the drive motor be run at speeds of less than 10 rpm for most of the duty cycle, or involves frequent start/stop or forward/reverse operation, the Staffa HMB motor range has it covered.

By optimising the HMB motor’s design for low speeds, it is possible to increase the break out torque and low speed mechanical efficiency performance.

All figures given in Section 2-1 Performance Data are still valid when selecting this feature.
2-12 Special Features (cont)

Increased Starting Torque (cont)

Volumetric Performance

In order to achieve increased torque at low speeds the volumetric characteristics of the motor performance are changed.

When calculating leakage and volumetric efficiency use the constants shown here in place of those given for the standard motor on page 29.

<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></td>
<td>cc/rev</td>
<td>K1</td>
<td>K2</td>
<td>K3</td>
<td>K4</td>
</tr>
<tr>
<td>HMB010</td>
<td>188</td>
<td>8.80</td>
<td>534.05</td>
<td>47.05</td>
<td>7.98</td>
</tr>
<tr>
<td>HMB030</td>
<td>442</td>
<td>8.51</td>
<td>57.67</td>
<td>19.37</td>
<td>8.06</td>
</tr>
<tr>
<td>2-piece HMB030</td>
<td>492</td>
<td>8.51</td>
<td>57.67</td>
<td>19.37</td>
<td>8.06</td>
</tr>
<tr>
<td>HMB045</td>
<td>740</td>
<td>3.93</td>
<td>43.36</td>
<td>12.80</td>
<td>9.23</td>
</tr>
<tr>
<td>HMB060</td>
<td>983</td>
<td>9.19</td>
<td>29.91</td>
<td>9.95</td>
<td>9.35</td>
</tr>
<tr>
<td>HMB080</td>
<td>1,344</td>
<td>9.18</td>
<td>21.62</td>
<td>7.39</td>
<td>9.31</td>
</tr>
<tr>
<td>HMB100</td>
<td>1,639</td>
<td>9.30</td>
<td>17.74</td>
<td>5.47</td>
<td>9.35</td>
</tr>
<tr>
<td>HM(HD)B125</td>
<td>2,050</td>
<td>9.53</td>
<td>11.45</td>
<td>4.88</td>
<td>8.82</td>
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<tr>
<td>HM(HD)B150</td>
<td>2,470</td>
<td>9.09</td>
<td>9.98</td>
<td>4.02</td>
<td>8.86</td>
</tr>
<tr>
<td>HM(HD)B200</td>
<td>3,080</td>
<td>10.00</td>
<td>14.99</td>
<td>3.20</td>
<td>8.86</td>
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<tr>
<td>HM(HD)B270</td>
<td>4,310</td>
<td>13.63</td>
<td>21.16</td>
<td>3.11</td>
<td>12.26</td>
</tr>
<tr>
<td>HM(HD)B325</td>
<td>5,310</td>
<td>13.60</td>
<td>18.21</td>
<td>2.52</td>
<td>12.26</td>
</tr>
<tr>
<td>HMHDB400</td>
<td>6,800</td>
<td>19.00</td>
<td>10.18</td>
<td>2.73</td>
<td>17.29</td>
</tr>
</tbody>
</table>

Applicable to:

- HMB 010
- HMB 030
- HMB 030 - F(M)3/SM3
- HMB 045
- HMB 045 - F(M)3/SM3
- HMB 060/080
- HMB 100
- HM(HD)B 125
- HM(HD)B 150/200
- HM(HD)B 270
- HM(HD)B 325
- HMHDB 400
- HMB 500

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

Anti-Clockwise Rotation

Description:
> Reduce installation complexity
> Standardise equipment designs

Technical Information

All HMB motors can be specified with an anti-clockwise rotation valve configuration. All performance and volumetric characteristics remain unchanged.

Applicable to:

<table>
<thead>
<tr>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030-F(M)3/SM3</th>
<th>HMB 045</th>
<th>HMB 045-F(M)3/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HM(HD)B 125</th>
<th>HM(HD)B 150/200</th>
<th>HM(HD)B 270</th>
<th>HM(HD)B 325</th>
<th>HMHDB 400</th>
<th>HMB 500</th>
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<tbody>
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<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
2-12 Special Features (cont)

 Thermal Shock Resistance

Description:
> Recommended for cold climates
> Optimised for start-up in freezing temperatures
> Engineered for total peace of mind

Technical Information
Starting up a cold system with warm hydraulic fluid is a known cause of heavy wear and potential seizure of hydraulic machinery. To minimise this potential risk, the HMB motor can be configured to combat thermal shocks to give complete peace of mind when operating in very cold climates.

Volumetric Performance
In order to provide thermal shock resistance the volumetric characteristics of the motor performance are changed. When calculating leakage and volumetric efficiency use the constants shown on the next page in place of those given for the standard motor on page 29.

All figures given in Section 2-1 Performance Data are still valid when selecting this feature.

Note:
When operating at low temperature, consideration must be given to the guidance notes in Section 2-8 Motor Operation at Low Temperature (see page 20).
2-12 Special Features (cont)

- Thermal Shock Resistance (cont)

<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></td>
<td>cc/rev</td>
<td>K1</td>
<td>K2</td>
<td>K3</td>
<td>K4</td>
</tr>
<tr>
<td>HMB060</td>
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<td>HMB080</td>
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<td>HMB100</td>
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<td>1.88</td>
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<td>1.35</td>
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<td>1.39</td>
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<td>HM(HD)B200</td>
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<td>4.88</td>
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<td>1.43</td>
<td>1.39</td>
</tr>
<tr>
<td>HM(HD)B270</td>
<td>4,310</td>
<td>5.52</td>
<td>21.16</td>
<td>1.23</td>
<td>1.80</td>
</tr>
<tr>
<td>HM(HD)B325</td>
<td>5,310</td>
<td>5.49</td>
<td>18.21</td>
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<td>1.80</td>
</tr>
<tr>
<td>HMHDB400</td>
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<td>6.41</td>
<td>10.18</td>
<td>0.88</td>
<td>2.35</td>
</tr>
</tbody>
</table>

Applicable to:

<table>
<thead>
<tr>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030-F(M)3/SM3</th>
<th>HMB 045</th>
<th>HMB 045-F(M)3/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HM(HD)B 125</th>
<th>HM(HD)B 150/200</th>
<th>HM(HD)B 270</th>
<th>HM(HD)B 325</th>
<th>HMHDB 400</th>
<th>HMB 500</th>
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<tbody>
<tr>
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</tr>
</tbody>
</table>

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

Drain Port Adaptors

Description:

> Improves manufacturing logistics
> Motor supplied ready for connection to \(\frac{3}{4}\)" BSPP male fitting

Technical Information

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Adaptor Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB010</td>
<td>(\frac{3}{4})&quot; BSP to (\frac{1}{2})&quot; BSPP</td>
</tr>
<tr>
<td>HMB030</td>
<td>(\frac{3}{4})&quot; BSP to (\frac{1}{2})&quot; BSPP</td>
</tr>
<tr>
<td>HMB045</td>
<td>(\frac{3}{4})&quot; BSP to (\frac{1}{2})&quot; BSPP</td>
</tr>
<tr>
<td>HMB045-F(M)/SM3</td>
<td>(\frac{3}{4})&quot; UNF 2B to (\frac{1}{2})&quot; BSPP</td>
</tr>
<tr>
<td>HMB060</td>
<td>(\frac{3}{4})&quot; UNF 2B to (\frac{1}{2})&quot; BSPP</td>
</tr>
<tr>
<td>HMB080</td>
<td>(\frac{3}{4})&quot; UNF 2B to (\frac{1}{2})&quot; BSPP</td>
</tr>
<tr>
<td>HMB100</td>
<td>(\frac{3}{4})&quot; UNF 2B to (\frac{1}{2})&quot; BSPP</td>
</tr>
</tbody>
</table>

One or two drain adaptors can be supplied.

Applicable to:

```
HMB 010  HMB 030  HMB 030-F(M)/SM3  HMB 045  HMB 045-F(M)/SM3  HMB 060/080  HMB 100  HMB(HD)B 125  HMB(HD)B 150/200  HMB(HD)B 270  HMB(HD)B 325  HMBDB 400  HMBDB 500
.        .        .                      .        .                      .        .                          .                      .                          .                      .                          .                      .        .
```

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

Mounting Hole Diameter

Description:

> Matching mounting holes to bolts

> $\Phi 21$mm and $\Phi 22$mm options available

Technical Information

In different markets, different bolt standards are adopted which may not be best suited to the standard $\Phi 20$ mm mounting hole diameter on the HMB motors. To give a correct fit and optimum installation, $\Phi 21$ mm or $\Phi 22$ mm holes can be selected on larger frame sizes.

Applicable to:

<table>
<thead>
<tr>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030-F(M)/SM3</th>
<th>HMB 045</th>
<th>HMB 045-F(M)/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HM(HD)B 125</th>
<th>HM(HD)B 150/200</th>
<th>HM(HD)B 270</th>
<th>HM(HD)B 325</th>
<th>HMHDB 400</th>
<th>HMB 500</th>
</tr>
</thead>
<tbody>
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<td>○</td>
</tr>
</tbody>
</table>

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

Marine Specification Primer Paint

Description:

> Improves corrosion and water resistance of the finishing system
> Excellent adhesion strength
> Recommended for marine applications

Technical Information

<table>
<thead>
<tr>
<th>Colour</th>
<th>Red oxide</th>
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</thead>
<tbody>
<tr>
<td>Type</td>
<td>Single pack epoxy etching primer</td>
</tr>
<tr>
<td>Standard</td>
<td>BS 3900 part A 8</td>
</tr>
<tr>
<td>Dry film thickness</td>
<td>&gt; 12 μm</td>
</tr>
</tbody>
</table>

Applicable to:

<table>
<thead>
<tr>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030 F(M)3/SM3</th>
<th>HMB 045</th>
<th>HMB 045 F(M)3/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HM(HD)B 125</th>
<th>HM(HD)B 150/200</th>
<th>HM(HD)B 270</th>
<th>HM(HD)B 325</th>
<th>HMHDB 400</th>
<th>HMB 500</th>
</tr>
</thead>
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<tr>
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<td>●</td>
</tr>
</tbody>
</table>

Please contact Kawasaki to order this feature.
2-12 Special Features (cont)

High Power

Description:

- Enhanced power performance
- Improved efficiency
- Improved back pressure rating of 100 bar

Technical Information

The high power option for the HMB motors combines special low-friction components and a crankcase flushing flow to achieve increased shaft power limits. All other performance parameters are unchanged.

Crankcase Flushing

In order to achieve the maximum shaft power, a crankcase flushing flow of 15 l/min should be directed through the crankcase. To improve the cooling effect of the flushing flow the distance between the inlet and outlet drain port connections should be maximised.

Required flushing flow to achieve full rated power: 15 l.p.m.
2-12 Special Features (cont)

High Power (cont)

<table>
<thead>
<tr>
<th>Check valve pressure (bar)*</th>
<th>Orifice diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4.4</td>
</tr>
<tr>
<td>4</td>
<td>4.1</td>
</tr>
<tr>
<td>5</td>
<td>3.9</td>
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<td>3.5</td>
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<td>9</td>
<td>3.4</td>
</tr>
<tr>
<td>10</td>
<td>3.3</td>
</tr>
</tbody>
</table>

*This assumes that the crankcase pressure is zero. If not, then the check valve pressure will need to be increased to maintain the pressure drop across the orifice.

Note:
If, due to crankcase flushing flow, the crankcase pressure continuously exceeds 3.5 bar, then the motor build should include a high pressure shaft seal.

Performance Data (crankcase flushing required):

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Max. continuous output (kW)</th>
<th>Average actual running torque (Nm/bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HM(HD)B125</td>
<td>150</td>
<td>30.8</td>
</tr>
<tr>
<td>HM(HD)B150</td>
<td>160</td>
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<td>HM(HD)B200</td>
<td>190</td>
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<tr>
<td>HM(HD)B270</td>
<td>210</td>
<td>64.1</td>
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<td>HM(HD)B325</td>
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<tr>
<td>HMHDB400</td>
<td>280</td>
<td>101.4</td>
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Applicable to:

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<tr>
<th></th>
<th>HMB 010</th>
<th>HMB 030</th>
<th>HMB 030-F(M)3/SM3</th>
<th>HMB 045</th>
<th>HMB 045-F(M)3/SM3</th>
<th>HMB 060/080</th>
<th>HMB 100</th>
<th>HM(HD)B 125</th>
<th>HM(HD)B 150/200</th>
<th>HM(HD)B 270</th>
<th>HM(HD)B 325</th>
<th>HMHDB 400</th>
<th>HMB 500</th>
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</thead>
<tbody>
<tr>
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<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
</tbody>
</table>

Please contact Kawasaki to order this feature.
**2-12 Special Features (cont)**

* Tj speed sensor with Tk readout option

**Tj Speed Sensor Technical Specification**

The Tj speed sensor is a hall effect dual channel speed probe that can provide feedback of both speed and direction.

- **Signal Outputs:** Square wave plus directional signal
- **Power Supply:** 8 to 32 V @ 40 mA
- **Protection class:** IP68
- **Output frequency:** 16 pulses/revolution

**Installation Details**

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

**TO SUIT: F4/FM4/SO4**

**Tk Output Module**

The Tk option consists of the Tj speed sensor together with the optional T401 output module.

The addition of the T401 module provides a software configured single channel tachometer and relay with a 0/4-20 mA analogue current output.

The software and calibration cable is also provided.

* Cannot be fitted to HMB010
3-1 HMB010

"P" & "S" Shafts

**SPLINE DATA**

- **"S"**
  - TO BS 3550 (ANSI B92.1 CLASS 5)
  - FLAT ROOT SIDE FIT, CLASS 1
  - PRESSURE ANGLE 30°
  - NUMBER OF TEETH 13
  - PITCH 8/16
  - MAJOR DIAMETER 43.71/43.59
  - FORM DIAMETER 38.136
  - MINOR DIAMETER 37.36/36.91
  - PIN DIAMETER 6.096
  - DIAMETER OVER PINS 50.104/50.152

- **"P"**
  - KEY SUPPLIED:
    - 10.030/10.015 WIDE
    - 8.000/7.996 THICK

- **"S"**
  - M8-1.25 PITCH X 18
  - FULL THREAD DEPTH
3-1 HMB010 (cont)

◆ Installation

3/8" BSP DRAIN (choice of 3 positions)
(2 normally plugged)

NOTE: Ensure on installation that drain is taken from above motor centreline.
Do not exceed 12 depth of coupling in to drain port.

PORT FLANGE BOLT TAPPING SIZE -
M10 x P1.5 x 20 FULL THREAD DEPTH

9 HOLES, SEE TABLE FOR THREAD SIZES

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION

CLOCKWISE DIRECTION OF ROTATION

FLOW DIRECTION

STUFFING

DEPARTURE LINE OF SHAFT

5 HOLES Ø14 FULL-SPACED AS SHOWN ON A Ø350 D.I.D. S.P.O.F. TO GIVE AN EFFECTIVE Ø25.
3-2 HMB030

Monobloc - ‘P’, ‘S’ and ‘Z’ Shafts

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 56.41/56.28
FORM DIAMETER 50.703
MINOR DIAMETER 50.07/49.60
PIN DIAMETER 6.096
DIAMETER OVER PINS 62.985/62.931

'Z'
DIN 5480, W55 X 3 X 17 X 7h
3-3 HMB030 (cont)

2 Piece - ‘P’, ‘S’ and ‘Z’ Shafts

**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 56.41/56.28
- FORM DIAMETER 50.703
- MINOR DIAMETER 50.07/49.60
- PIN DIAMETER 6.096
- DIAMETER OVER PINS 62.985/62.931

**‘Z’**
- DIN 5480, W55 X 3 X 17 X 7h
3-2 HMB030 (cont)

- 2 Piece - ‘F3’ & ‘FM3’ Valve Housings

**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

1 1/4” Code 61 SAE Ports (3000 Series)

8 Holes, See Table for Thread Sizes
3-2 HMB030 (cont)

2 Piece - Installation

3/8" BSP x 17 FULL THREAD (CHOICE OF 3 POSITIONS) (2 NORMALLY PLUGGED)
NOTE: ENSURE ON INSTALLATION THAT DRILL IS TAKEN FROM ABOVE MOTOR CENTRELINE
DO NOT EXCEED 12 DEPTH OF COUPLING IN TO DRAIN PORT

Monobloc - Rear Port Installation

EXAMPLE FOR MODEL CODE
REAR ENTRY MOTORCASE = HMB030/P/21

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION
FLOW DIRECTION FOR ALL VLV HSG VARIANTS EXCEPT F2/FG2/SMS

CLOCKWISE DIRECTION OF ROTATION

MONITORING FACE

5 HOLES Ø18 EQUI-Spaced AS SHOWN ON A DIRECT P.C.D. SPOTFACED TO GIVE AN EFFECTIVE Ø35.
3-2 HMB030 (cont)

Monobloc - Side Port Installation

EXAMPLE FOR MODEL CODE:
REAR ENTRY MOTORCASE - HMB030/P/21

3/8" BSP DRAIN
NOTE - ENSURE ON INSTALLATION THAT DRAIN IS CONNECTED TO PORT ABOVE MOTOR

2 PORTS 3/4" BSP x 16mm DEEP

5 HOLES 918 FULL-SPACED AS SHOWN ON A CENTERED P.C.D. SPACED TO GIVE AN EFFECTIVE #30.
3-3 HMB045

Monobloc - 'P', 'S' & 'Z' Shafts

**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: 50.703
- 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
3-3 HMB045 (cont)

2 Piece - 'P', 'S' & 'Z' Shafts

**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 50.703
- 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

'P'
- KEY SUPPLIED—14.046/14.028 WIDE
- 9.04/8.96 THICK

'S' & 'Z'
- 1/2"-20 UNF-2B X 32
- FULL THREAD DEPTH
2 Piece - 'SM3' Valve Housing

3-3 HMB045 (cont)

SM.3 —
3" VALVE HOUSING FOR BOLT ON MANIFOLD.

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION

FLOW DIRECTION

HOLE DETAIL
TYP. 4 POS'N

8.21
φ14

50

47

80

143.0

300
2 Piece - 'F3' & 'FM3' Valve Housings

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

B Holes, see Table for Thread Sizes
3-3 HMB045 (cont)

2 Piece - Installation

3/4”-16 UNF-2B DRAM (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)
NOTE: ENSURE ON INSTALLATION THAT DRAM IS
TAKEN FROM ABOVE MOTOR CENTRELINE.

DO NOT EXCEED 12 DEPTH OF COUPLING
IN TO DRUM PORT.

5 HOLES #38 EQUALLY SPACED AS
SHOWN ON A 380° C.D. SPOTFACED
TO GIVE AN EFFECTIVE #38.

Monobloc - Installation

3/8” BSP DRAM (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)
NOTE: ENSURE ON INSTALLATION THAT DRAM IS
TAKEN FROM ABOVE MOTOR CENTRELINE.

2 HOLES 1” BSP X 25 DRAM
SHOWN BOTH SIDES ARE
SUPPLIED WITH THREE HOLES FLUSHED.
3-4 HMB060/080

- 'P', 'S' & 'Z' Shafts

**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

'**P**'
- KEY SUPPLIED—
  18.037/18.019 MDE
  11.99/11.94 THICK

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

'**S**' & '**Z**'
- 1/2"-20 UNF-2B X 32
FULL THREAD DEPTH
3-4 HMB060/080 (cont)

'T' Shaft

KEY SUPPLIED—19.10/19.05 SQ.

1 1/2”-12 UNF THREAD

BASIC TAPER, ON DIA 0.1001/0.0999: 1

SLOTTED NUT 45.2 THICK 57.15 A/F

MOUNTING FACE

92
6.4
10.92
10.77
83.5
81.9
165
61
61.25
65.3
3-4 HMB060/080 (cont)

'SM3' Valve Housing

SM3 —
3" VALVE HOUSING FOR BOLT ON MANIFOLD.

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION

HOLE DETAIL TYP. 4 POS’N

FLOW DIRECTION
3-4 HMB060/080 (cont)

◆ 'F3' & 'FM3' Valve Housings

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

8 HOLES, SEE TABLE FOR THREAD SIZES
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 12 DEPTH OF COUPLING IN TO DRAIN PORT

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION
FLOW DIRECTION FOR ALL VLV HSG VARIANTS EXCEPT SW3

CLOCKWISE DIRECTION OF ROTATION

MOUNTING FACE

5 HOLES #20 EQU-SPACED AS SHOWN ON A 327.03 P.C.D. SPOTFACED TO GIVE AN EFFECTIVE #40.
3-5 HMB100

‘P’, ‘S’ & ‘Z’ Shafts

**SPLINE DATA**

<table>
<thead>
<tr>
<th>‘S’</th>
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</thead>
<tbody>
<tr>
<td>TO BS 3550 (ANSI B92.1 CLASS 5)</td>
<td></td>
</tr>
<tr>
<td>FLAT ROOT SIDE FIT, CLASS 1</td>
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</tr>
<tr>
<td>PRESSURE ANGLE 30°</td>
<td></td>
</tr>
<tr>
<td>NUMBER OF TEETH 14</td>
<td></td>
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<tr>
<td>PITCH 6/12</td>
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<tr>
<td>MAJOR DIAMETER 62.535/62.425</td>
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<tr>
<td>FORM DIAMETER 55.052</td>
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<tr>
<td>MINOR DIAMETER 54.084/53.525</td>
<td></td>
</tr>
<tr>
<td>PIN DIAMETER 8.128</td>
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</tr>
<tr>
<td>DIAMETER OVER PINS 71.593/71.544</td>
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</table>

<table>
<thead>
<tr>
<th>‘Z’</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>DIN 5480 W70 x 3 x 30 x 22 x 7h</td>
<td></td>
</tr>
</tbody>
</table>
3-5 HMB100 (cont)

'T' Shaft

KEY SUPPLIED:
19.10/19.05 SQ.

1 1/2"-12 UNF Thread

Basic Taper, on Dia
0.1001/0.0999 : 1

Slotted Nut 45.2 Thick
57.15 A/F

Mounting Face

95.2
10.92
10.77

6.4

95.3

461.242 (Datum)

63.5
81.9

165
61
3-5 HMB100 (cont)

'SM3' Valve Housing

SM3 —
3" VALVE HOUSING FOR BOLT ON MANIFOLD.

FLOW DIRECTION

HOLE DETAIL
TYP. 4 POS’N

#21
#14

87
54

88
62.0

#31.8
2 POS’N

180

286

VIEWS ON ARROW ‘A’

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION
3-5 HMB100 (cont)

- 'F3' & 'FM3' Valve Housings

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

MOUNTING FACE

- 'F4' & 'FM4' Valve Housings

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

MOUNTING FACE
3-5 HMB100 (cont)

Installation

3/4"-18UNF-2B DRAIN (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)
NOTE: ENSURE ON INSTALLATION THAT DRAIN IS
TAKEN FROM ABOVE MOTOR CENTRELINE.
DO NOT EXCEED 12 DEPTH OF COUPLING
IN TO DRAIN PORT

5 HOLES #20 EQUI-SPACED AS
SHOWN ON A .877.033 P.C.D. SPOTFACED
TO GIVE AN EFFECTIVE #40.
[40.15]
3-6 HM(HD)B125

HMB125 - 'P1', 'S3' & 'Z3' Shafts

**SPLINE DATA**

<table>
<thead>
<tr>
<th>'S3'</th>
<th>30°</th>
<th>20</th>
<th>6/12</th>
<th>87.953/87.825</th>
<th>80.264</th>
<th>79.485/78.925</th>
<th>6.128</th>
<th>97.084/97.030</th>
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<td>'S4'</td>
<td>20°</td>
<td>16</td>
<td>5/10</td>
<td>86.360/86.233</td>
<td>76.124</td>
<td>74.93/72.39</td>
<td>8.636</td>
<td>92.710/92.581</td>
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<tr>
<td>'Z3'</td>
<td></td>
<td></td>
<td></td>
<td>DIN 5480 W85 x 3 x 27 x 7h</td>
<td></td>
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</tbody>
</table>
3-6 HM(HD)B125 (cont)

HMB125 - 'T' Shaft

MOUNTING FACE

133.4
6.4
9.575
9.525
12.0
5.8

KEY SUPPLIED:
22.27/22.22 WIDE
15.92/15.87 THICK

1/2"-12 UNF THREAD

BASIC TAPER, ON DIAMETER
0.001/0.0009 PER mm

SLOTTED NUT 45.2 THICK
57.15 A/F
3-6 HM(HD)B125 (cont)

HMHDB125 - 'P2' Shafts

KEY SUPPLIED:
24.066/24.000 WIDE
16.05/16.00 THICK

3/4"-16 UNF-2B X 32
FULL THREAD DEPTH

92.02
91.95

196.4
194.8
### SPLINE DATA

**'S5'**
- Pressure Angle: 20°
- Number of Teeth: 23
- Pitch: 6/12
- Major Diameter: 100.652/100.526
- Form Diameter: 92.939
- Minor Diameter: 92.184/91.626
- Pin Diameter: 8.128
- Diameter Over Pins: 109.573/109.517

**'Z5'**
- DIN 5480 W100 x 4 x 24 x 7h
3-6 HM(HD)B125 (cont)

'SM3' Valve Housing
3-6 HM(HD)B125 (cont)

'F3' & 'FM3' Valve Housings

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
3-6 HM(HD)B125 (cont)

'F4' & 'FM4' Valve Housings
**3-7 HM(HD)B150/200**

**HMB150/200 - 'P1', 'S3', 'S4' & 'Z3' Shafts**

**SPLINE DATA**

<table>
<thead>
<tr>
<th>Shaft</th>
<th>Pressure Angle</th>
<th>Teeth</th>
<th>Pitch</th>
<th>Major Diameter</th>
<th>Form Diameter</th>
<th>Minor Diameter</th>
<th>Diameter Over Pins</th>
</tr>
</thead>
<tbody>
<tr>
<td>'S3'</td>
<td>30°</td>
<td>20</td>
<td>6/12</td>
<td>87.95/87.825</td>
<td>80.264</td>
<td>79.485/78.925</td>
<td>97.084/97.030</td>
</tr>
<tr>
<td>'S5'</td>
<td>30°</td>
<td>23</td>
<td>6/12</td>
<td>100.652/100.526</td>
<td>92.939</td>
<td>92.184/91.626</td>
<td>109.573/109.517</td>
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<tr>
<td>'Z5'</td>
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</table>

**Diagram**

- 'P2'
- 'S3', 'S5' & 'Z5'

KEY SUPPLIED:
- 24.066/24.000 WIDE
- 16.05/16.00 THICK
- 3/4"-16 UNF-2B X 32 FULL THREAD DEPTH

76 MIN STRAIGHT
- 3/4"-16 UNF-2B X 32 FULL THREAD DEPTH

145.4

144.0
3-7 HM(HD)B150/200 (cont)

- HMB150/200 - 'T' Shaft

KEY SUPPLIED:
22.27/22.22 WIDE
15.92/15.87 THICK

1/2"-12 UNF THREAD

BASIC TAPER, ON DIAMETER
0.1001/0.0999 PER mm

-SLOTTED NUT 45.2 THICK
57.15 A/F
3-7 HM(HD)B150/200 (cont)

HMB Motors

HMHDB150/200 - 'P2', 'S5' & 'Z5' Shafts

Spline Data

'S5'
- Pressure Angle: 30°
- Number of Teeth: 23
- Pitch: 6/12
- Major Diameter: 100.652/100.526
- Form Diameter: 92.939
- Minor Diameter: 92.184/91.626
- Pin Diameter: 8.128
- Diameter Over Pins: 109.573/109.517

'Z5'
- DIN 5480 W100 x 4 x 24 x 7h
3-7 HM(HD)B150/200 (cont)

'SM3' Valve Housing

VIEWS ON ARROW 'A'

SM3 – 3" Valve Housing for Bolt On Manifold.

HOLE DETAIL TYP. 4 POS'N

Reverse Port Connections for Opposite Direction of Shaft Rotation
3-7 HM(HD)B150/200 (cont)

'F3' & 'FM3' Valve Housings

<table>
<thead>
<tr>
<th>F3/FM3</th>
<th>3” VALVE HOUSING WITH 1 1/4” SAE 4-BOLT FLANGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORT FLANGE BOLT TAPPING SIZE</td>
<td></td>
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<tr>
<td>F3: 7/16”-14 UNC-2B X 27 FULL THREAD DEPTH</td>
<td></td>
</tr>
<tr>
<td>FM3: M12 X P1.75 X 27 FULL THREAD DEPTH</td>
<td></td>
</tr>
</tbody>
</table>

PORT 1

PORT 2

87

388

295

1 1/4” CODE 61 S.A.E. PORTS (3000 SERIES)
3-7 HM(HD)B150/200 (cont)

- 'F4' & 'FM4' Valve Housings

Views on Arrow 'A'

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
3-7 HM(HD)B150/200 (cont)

Installation

3/4"-11HF-3B drain (choice of 3 positions)
(2 normally plugged)
NOTE: Ensure on installation that drain is
taken from above motor centreline.
Do not exceed 12 depth of coupling
in to drain port.

Reverse port connections
for opposite direction of
simple rotation.
Flow direction for
all Y and HS variants
except 543.
3-8 HM(HD)B270

HMB270 - 'P1', 'S3' & 'Z' Shafts

SPLINE DATA

'S3'
TO BS 3550 (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

'Z'
DIN 5480 W100 x 4 x 24 x 7h

KEY SUPPLIED—
24.066/24.000 WIDE
16.05/16.00 THICK
3/4"—16 UNF—2B X 32 FULL THREAD DEPTH

76 MIN STRAIGHT

3/4"—16 UNF—2B X 32 FULL THREAD DEPTH
3-8 HM(HD)B270 (cont)

HMB270 - 'T' Shaft

KEY SUPPLIED—
25.45/25.40 WIDE
17.539/17.463 THICK

BASIC TAPER, ON DIAMETER
0.1001/0.0999 PER mm

SLOTTED NUT 45.2 THICK
57.15 A/F
3-8 HM(HD)B270 (cont)

HMHDB270 - 'P2' & 'S5' Shafts

SPLINE DATA

'S3'
TO BS 3550 (ANSI B92.1, CLASS 5)
FLAT ROOT SIDE FT, CLASS 1
PRESSURE ANGLE 30'
NUMBER OF TEETH 23
PITCH 6/12
MAJOR DIAMETER 100.653/100.526
FORM DIAMETER 92.939
MINOR DIAMETER 92.184/91.625
PIN DIAMETER 8.128
DIAMETER OVER PINS 109.573/109.517

KEY SUPPLIED—24.066/24.000 WIDE
16.05/16.00 THICK
3/4"—16 UNF—2B X 32
FULL THREAD DEPTH

MOUNTING FACE

'P2'

101.6 MIN STRAIGHT

3/4"—16 UNF—2B X 32
FULL THREAD DEPTH
3-8 HM(HD)B270 (cont)

HMHDB270 - 'Z' Shaft

'Z'
DIN 5480 W100 x 4 x 24 x 7h

'Z'
76 MIN STRAIGHT

3/4"-16 UNF-2B X 32
FULL THREAD DEPTH

155.3
153.9
3-8 HM(HD)B270 (cont)

- 'F4' & 'FM4' Valve Housings

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

#1 1/2" SAE (CODE 62)
PORTS (8000 SERIES)

8 HOLES, SEE TABLE
FOR THREAD SIZES

PORT 1

PORT 2

460
Installation

3/4"-11NP-28 DRAIN (choice of 3 positions)
(2 normally flush)
Note—Ensure on installation that drain is taken from above motor coverland.
Do not exceed 12 depth of coupling
in 10 drain point
3-9 HM(HD)B325

HMB325 - 'P1', 'S3' & 'Z' Shafts

SPLINE DATA

'S3'
TO BS 3550 (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

'Z'
DIN 5480 W100 x 4 x 24 x 7h

KEY SUPPLIED-
24.066/24.000 WIDE
16.05/16.00 THICK
3/4"-16 UNF-2B X 32
FULL THREAD DEPTH

76 MIN STRAIGHT

3/4"-16 UNF-2B X 32
FULL THREAD DEPTH
3-9 HM(HD)B325 (cont)

HMB325 - 'T' Shaft

Key supplied:
- 25.45/25.40 wide
- 17.539/17.463 thick

1 1/2"-12 UNF thread

Basic taper, on diameter:
- 0.1001/0.0999 per mm

Serrated nut 45.2 thick
- 57.15 A/F
3-9 HM(HD)B325 (cont)

HMHDB325 - 'P2' & 'S5' Shafts

SPLINE DATA

'S3'

TO BS 3550 (ANSI B92.1, CLASS 5)
FLAT ROOT SIDE FIT, CLASS 1
PRESSURE ANGLE 30°
NUMBER OF TEETH 23
PITCH 6/12
MAJOR DIAMETER 100.653/100.526
FORM DIAMETER 92.939
MINOR DIAMETER 92.184/91.625
PIN DIAMETER 8.128
DIAMETER OVER PINS 109.573/109.517
3-9 HM(HD)B325 (cont)

HMHDB325 - 'Z' Shaft

DIN 5480 W100 x 4 x 24 x 7h

76 MIN STRAIGHT

3/4"-16 UNF-2B X 32 FULL THREAD DEPTH

155.3
153.9
3-9 HM(HD)B325 (cont)

"F4' & 'FM4' Valve Housings
Installation

3/8"-18 FFL—20 DR (choice of 3 positions)
(2 normally plugged)
NOTE: Ensure on installation, that drain is taken from above motor centerline.
Do not exceed 12 depth of coupling in to drain port.
3-10 HMHDB400

'P', 'S' & 'Z' Shafts

SPLINE DATA

'S'
TO BS 3550 (ANSI B92.1, CLASS 5)
FLAT ROOT SIDE FIT, CLASS 1
PRESSURE ANGLE 30°
NUMBER OF TEETH 23
PITCH 6/12
MAJOR DIAMETER 100.653/100.526
FORM DIAMETER 92.939
MINOR DIAMETER 92.184/91.625
PIN DIAMETER 8.128
DIAMETER OVER PINS 109.573/109.517

'Z'
DIN 5480 W100 x 4 x 24 x 7h
3-10 HMHDB400 (cont)

Installation
3-11 HMB500

- 'P', 'S' & 'Z' Shafts

**SPINDLE DATA**

**'S'**
- TO BS 3550 (ANSI B92.1, CLASS 5)
- FLAT ROOT SIDE FIT, CLASS 1
- PRESSURE ANGLE: 30°
- NUMBER OF TEETH: 23
- PITCH: 6/12
- MAJOR DIAMETER: 100.653/100.526
- FORM DIAMETER: 92.939
- MINOR DIAMETER: 92.184/91.625
- PIN DIAMETER: 8.128
- DIAMETER OVER PINS: 109.573/109.517

**'Z'**
- DIN 5480 W100 x 4 x 24 x 7h
3-11 HMB500 (cont)

Installation
**NOTES**

**Conversion Table**

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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-10.18