Fixed Displacement Radial Piston
Staffa Motor
HMB Series
Specifications and Features

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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>
</tr>
<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>
</tr>
<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>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>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>2,587</td>
<td>38.65</td>
<td>175</td>
<td>130</td>
<td>250</td>
<td>293</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>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>HMB400</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.

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# HMB Series

## 1-1 Model Coding

<table>
<thead>
<tr>
<th>Fluid Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blank</td>
<td>Mineral oil</td>
</tr>
<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>
<tr>
<td>Other</td>
<td>Alternative fluids contact Kawasaki</td>
</tr>
</tbody>
</table>

### Fluid Type

- Blank: Mineral oil
- F3: Phosphate ester (HFD fluid)
- F11: Water based fluids (HFA, HFB, & HFC)
- Other: Alternative fluids contact Kawasaki

### Model Type

- HMB: Standard
- HMHDB: Heavy duty

### Motor Frame Size

See options page 4

### Shaft Type

See shaft type options in installation drawings

### Shaft Orientation

- Blank: Horizontal and vertically down
- V: Vertically Up

### 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

- Blank: None
- 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.

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

Special Features Suffix

/ P * * * *

Shaft Seal Enhancements

A High pressure shaft seal
B Improved shaft seal life
C High pressure shaft seal & improved shaft seal life
D None

See pages 25 & 26 for details

Valve Enhancements

A Improved cavitation resistance
B Anti-clockwise
C Thermal shock resistance
D Improved cavitation resistance & anti-clockwise
E Improved cavitation resistance & thermal shock resistance
F Anti-clockwise & thermal shock resistance
G Improved cavitation resistance & anti-clockwise & thermal shock resistance
H None

See pages 27, 31 & 32 for details

External Protection

A Anti-pooling bolt heads
B Marine-specification primer paint
C Anti-pooling bolt heads & Marine-specification primer paint
D None

See pages 28 & 30 for details

Performance Enhancements

A Increased starting torque
B Increased power rating
C Increased starting torque & increased power rating
D None

See pages 30 & 37-8 for details

Installation Features

A Drain port adaptor x 1
B Drain port adaptor x 2
C Ø21 mm mounting holes
D Ø22 mm mounting holes
E Ø21 mm mounting holes & Drain port adaptor x 1
F Ø21 mm mounting holes & Drain port adaptor x 2
G Ø22 mm mounting holes & Drain port adaptor x 1
H Ø22 mm mounting holes & Drain port adaptor x 2
I None

See pages 29 & 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 50 rpm 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 HMB0840 inc.</td>
</tr>
<tr>
<td></td>
<td>190</td>
<td>227</td>
<td>As for mineral oil</td>
<td>HMB500</td>
</tr>
</tbody>
</table>

See pages 25 & 26 for details

See pages 34 & 35 for details

See pages 27, 31 & 32 for details

See pages 30 & 37-8 for details
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.
### 2-2 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</td>
<td>1.34</td>
<td>534.05</td>
<td>7.31</td>
<td>0.51</td>
</tr>
<tr>
<td>HMB030</td>
<td>442</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</td>
<td>1.04</td>
<td>57.67</td>
<td>2.47</td>
<td>0.59</td>
</tr>
<tr>
<td>HMB045</td>
<td>740</td>
<td>1.92</td>
<td>43.36</td>
<td>2.71</td>
<td>1.76</td>
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<td>HMB060</td>
<td>983</td>
<td>1.72</td>
<td>29.91</td>
<td>2.35</td>
<td>1.88</td>
</tr>
<tr>
<td>HMB080</td>
<td>1,344</td>
<td>1.71</td>
<td>21.62</td>
<td>1.84</td>
<td>1.84</td>
</tr>
<tr>
<td>HMB100</td>
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<td>1.83</td>
<td>17.74</td>
<td>1.41</td>
<td>1.88</td>
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<tr>
<td>HMB125</td>
<td>2,050</td>
<td>2.06</td>
<td>11.45</td>
<td>1.24</td>
<td>1.35</td>
</tr>
<tr>
<td>HMB150</td>
<td>2,470</td>
<td>1.62</td>
<td>9.98</td>
<td>1.00</td>
<td>1.39</td>
</tr>
<tr>
<td>HMB200</td>
<td>3,080</td>
<td>2.53</td>
<td>14.99</td>
<td>0.78</td>
<td>1.39</td>
</tr>
<tr>
<td>HMB2270</td>
<td>4,310</td>
<td>3.17</td>
<td>21.16</td>
<td>0.68</td>
<td>1.80</td>
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<td>HMB2325</td>
<td>5,310</td>
<td>3.14</td>
<td>18.21</td>
<td>0.55</td>
<td>1.80</td>
</tr>
<tr>
<td>HMB300</td>
<td>6,800</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</td>
<td>9.247</td>
<td>78.247</td>
<td>1.739</td>
<td>5.797</td>
</tr>
</tbody>
</table>

**Qt (total leakage)**: \( (K_1 + n/K_3) \times \Delta P \times K_4 \times 0.005 \) l/min

**Crankcase leakage**: \( K_4 \times \Delta P \times K_4 \times 0.005 \) l/min

**Creep speed**: \( K_3 \times \Delta P \times K_4 \times 0.005 \) rpm

**ΔP**: differential pressure bar

**n**: speed rpm

The motor volumetric efficiency can be calculated as follows:

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

**Example**: HMB200 motor with displacement of 3,080 l/rev.
- Speed: 60 rpm
- Differential pressure: 200 bar
- Fluid viscosity: 50 cSt

\[
\text{Total leakage} = (K_1 + n/K_3) \times \Delta P \times K_4 \times 0.005 = (2.53 \times 60/14.99) \times 200 \times 1 \times 0.005 = 6.53 \text{ l/min}
\]

\[
\text{Volumetric efficiency} = \left( \frac{60 \times 3,080}{60 \times 3,080 + 6.53} \right) \times 100 = 96.5\%
\]

### 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 \( n \).

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

Or to find maximum \( \Delta P \) then use:

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

**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

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

\[
\Delta P = \frac{60 \times 125}{2\pi \times 63.79} = 167 \text{ bar (max.)}
\]

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

\[
\Delta P = \frac{60 \times 140,000}{2\pi \times 63.79} = \frac{60 \times 125}{2\pi \times 63.79 \times 125} = 83 \text{ rpm (max.)}
\]

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.
2-5 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>HMB060, 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 kN (5,607 kg)

\[ W = \frac{A}{100} \times 5,500 \]

A = Distance from mounting face to load centre (mm)

W = 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 barring 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

#### 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>HM(HD)B400/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:

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

Where \( P \) is in bar, \( N \) = motor speed (rpm), \( V \) = motor displacement (cc/rev), \( C \) = Crankcase pressure (bar) and \( K \) is 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 x 10^8</td>
</tr>
<tr>
<td>HMB030</td>
<td>Standard - Monobloc</td>
<td>3.7 x 10^9</td>
</tr>
<tr>
<td>HMB045</td>
<td>Standard - Monobloc</td>
<td>1.3 x 10^9</td>
</tr>
<tr>
<td>HMB060, HMB080 &amp; HMB100</td>
<td>F(M)3 SM3</td>
<td>1.6 x 10^9</td>
</tr>
<tr>
<td>HM(HD)B125, HM(HD)B150 &amp; HM(HD)B200</td>
<td>F(M)3 SM3</td>
<td>1.8 x 10^9</td>
</tr>
<tr>
<td>HM(HD)B270 &amp; HM(HD)B325</td>
<td>F(M)4</td>
<td>4.0 x 10^9</td>
</tr>
<tr>
<td>HM(HD)B400 &amp; HMB500</td>
<td>F(M)4</td>
<td>8.0 x 10^9</td>
</tr>
<tr>
<td>HM(HD)B500 &amp; HMB600 &amp; HMB700</td>
<td>5045</td>
<td>7.2 x 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). 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 and 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:

- Antwear hydraulic oils
- Phosphate ester (HFD fluids)
- Water glycols (HFC fluids)
- 60/40% water-in-oil emulsions (HFB fluids)
- 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 (-22°F)
Ambient max. +70°C (158°F)
Max. operating temperature range.
Min.: -20°C (-4°F)
Max.: +80°C (175°F)

Note: To obtain optimum services life from both fluid and hydraulic systems components, a fluid operating temperature of 40°C is recommended.

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 antwear or EP additives. Automatic transmission fluids and motor oils are not recommended.

Filtration

Full flow filtration (open circuit), or full boost flow filtration (closed 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 intertia 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>HMBHDB400 - 504</td>
<td>0.5400</td>
<td>481</td>
</tr>
<tr>
<td>HMBHDB400 - 505</td>
<td>0.5400</td>
<td>510</td>
</tr>
<tr>
<td>HMB500</td>
<td>0.5400</td>
<td>510</td>
</tr>
</tbody>
</table>

For trouble free operation the motor’s crankcase pressure must always be lower than both of the motor port pressures:

\[ P_{\text{case}} < P_{\text{in}} \text{ and } P_{\text{case}} < P_{\text{out}} \]
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°C and above 100°C</td>
<td>minus 30°C</td>
</tr>
<tr>
<td>High pressure shaft seal</td>
<td>below minus 30°C and above 120°C</td>
<td>minus 15°C</td>
</tr>
</tbody>
</table>

All seals are very brittle below 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.

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 Setting</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 +/- 14 Nm</td>
</tr>
<tr>
<td>M24</td>
<td>690 +/- 14 Nm</td>
</tr>
<tr>
<td>½&quot; UNF</td>
<td>97 +/- 7 Nm</td>
</tr>
<tr>
<td>⅝&quot; UNF</td>
<td>265 +/- 14 Nm</td>
</tr>
<tr>
<td>¾&quot; UNF</td>
<td>393 +/- 14 Nm</td>
</tr>
<tr>
<td>1&quot;</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.
## 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>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>HM(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>

If a motor is to be ordered with any special features listed, please contact Kawasaki.
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.

Sleeve material
- A304/301 Stainless Steel

Sleeve surface finish
- Rz 0.25 to 0.5 μm (10 to 20 μin)

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</th>
<th>HMB 060 F(M)3/SM3</th>
<th>HMB 100</th>
<th>HMB(125)</th>
<th>HMB(150)</th>
<th>HMB(180)</th>
<th>HMB(325)</th>
<th>HMB(400)</th>
<th>HMB(500)</th>
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<td>●</td>
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<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</th>
<th>HMB 060 F(M)3/SM3</th>
<th>HMB 100</th>
<th>HMB(125)</th>
<th>HMB(150)</th>
<th>HMB(180)</th>
<th>HMB(325)</th>
<th>HMB(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>
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<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)

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>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(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>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>
</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>cc/rev</td>
<td>K1</td>
<td>K2</td>
<td>K3</td>
<td>K4</td>
<td></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>576.77</td>
<td>19.37</td>
<td>8.06</td>
</tr>
<tr>
<td>2-piece HMB030</td>
<td>492</td>
<td>8.51</td>
<td>576.77</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>
</tr>
<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>
</tr>
<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>5,510</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:

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:

Please contact Kawasaki to order this feature.
### 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).

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Geometric Displacement (cc/rev)</th>
<th>Zero Speed Constant (K1)</th>
<th>Speed Constant (K2)</th>
<th>Creep Speed Constant (K3)</th>
<th>Crankcase Leakage Constant (K4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB060</td>
<td>983</td>
<td>3.72</td>
<td>29.91</td>
<td>4.39</td>
<td>1.88</td>
</tr>
<tr>
<td>HMB080</td>
<td>1,344</td>
<td>3.71</td>
<td>21.62</td>
<td>3.32</td>
<td>1.84</td>
</tr>
<tr>
<td>HMB100</td>
<td>1,839</td>
<td>3.83</td>
<td>17.74</td>
<td>2.50</td>
<td>1.88</td>
</tr>
<tr>
<td>HM(HD)B125</td>
<td>2,050</td>
<td>4.41</td>
<td>11.45</td>
<td>2.21</td>
<td>1.35</td>
</tr>
<tr>
<td>HM(HD)B150</td>
<td>2,470</td>
<td>3.97</td>
<td>9.98</td>
<td>1.81</td>
<td>1.39</td>
</tr>
<tr>
<td>HM(HD)B200</td>
<td>3,080</td>
<td>4.88</td>
<td>14.99</td>
<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>
<td>0.99</td>
<td>1.80</td>
</tr>
<tr>
<td>HMHDB400</td>
<td>6,800</td>
<td>6.41</td>
<td>10.18</td>
<td>0.88</td>
<td>2.35</td>
</tr>
</tbody>
</table>

**Applicable to:**

| HMB 010 | HMB 030 | HMB 030/045  | HMB 045  | HMB 050/060 | HMB 100 | HM(HD)B 125 | HM(HD)B 150 | HM(HD)B 200 | HM(HD)B 270 | HM(HD)B 325 | HMHDB 1400 | HMHDB 500 |
|---------|---------|--------------|---------|------------|---------|-------------|-------------|-------------|-------------|-------------|-------------|-----------|-----------|
| O       | O       | O            | O       | ●          | ●       | ●           | ●           | ●           | ●           | ●           | ●          | O         | O         |

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 ½" BSPP male fitting

Technical Information

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Adaptor Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB010</td>
<td>⅜&quot; BSP to ½&quot; BSPP</td>
</tr>
<tr>
<td>HMB030</td>
<td>⅜&quot; BSP to ½&quot; BSPP</td>
</tr>
<tr>
<td>HMB045</td>
<td>⅜&quot; BSP to ½&quot; BSPP</td>
</tr>
<tr>
<td>HMB045-F(M)/SM3</td>
<td>⅜&quot; UNF 2B to ½&quot; BSPP</td>
</tr>
<tr>
<td>HMB060</td>
<td>¼&quot; UNF 2B to ½&quot; BSPP</td>
</tr>
<tr>
<td>HMB080</td>
<td>¼&quot; UNF 2B to ½&quot; BSPP</td>
</tr>
<tr>
<td>HMB100</td>
<td>¼&quot; UNF 2B to ½&quot; BSPP</td>
</tr>
</tbody>
</table>

One or two drain adaptors can be supplied.

Applicable to:

HMB 010  HMB 030  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  HMB(HD)B 400  HMB 500

Please contact Kawasaki to order this feature.

2-12 Special Features (cont)

◆ Mounting Hole Diameter

Description:

> Matching mounting holes to bolts

> 21 mm and 22 mm options available

Technical Information

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

Applicable to:

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>
</tr>
</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(M3)/SM3</th>
<th>HMB 045</th>
<th>HMB 045 -F(M3)/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>HM(HD)B 400</th>
<th>HMB 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
</tr>
</tbody>
</table>

  Please contact Kawasaki to order this feature.

- **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.
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>
</tr>
<tr>
<td>6</td>
<td>3.7</td>
</tr>
<tr>
<td>7</td>
<td>3.6</td>
</tr>
<tr>
<td>8</td>
<td>3.5</td>
</tr>
<tr>
<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/HDB125</td>
<td>150</td>
<td>30.8</td>
</tr>
<tr>
<td>HM/HDB150</td>
<td>160</td>
<td>37.3</td>
</tr>
<tr>
<td>HM/HDB200</td>
<td>190</td>
<td>46.6</td>
</tr>
<tr>
<td>HM/HDB270</td>
<td>210</td>
<td>64.1</td>
</tr>
<tr>
<td>HM/HDB325</td>
<td>210</td>
<td>80.4</td>
</tr>
<tr>
<td>HM/HDB400</td>
<td>280</td>
<td>101.4</td>
</tr>
</tbody>
</table>

Applicable to: HMB 010, HMB 030, HMB 060, HMB 045, HMB 060/080, HMB 100, HMB 125, HMB 150/200, HMB 270, HMB 325, HMB 400, HMB 500

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: IP66
- Output frequency: 16 pulses/revolution

Installation Details

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
**Dimensions**

### 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
```

**Installation**

2/8" BSP DRILL (CHOICE OF 3 POSITIONS)
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

8 HOLES, SEE TABLE FOR THREAD SIZES

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION

**Flow Direction**

CLOCKWISE DIRECTION OF ROTATION

**Mounting Face**

M8-1.25 PITCH X 18 FULL THREAD DEPTH

M8-1.25 PITCH X 18 FULL THREAD DEPTH
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
- MAJOR DIAMETER 56.41/56.28
- FORM DIAMETER 50.705
- 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
- MAJOR DIAMETER 56.41/56.28
- FORM DIAMETER 50.705
- 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

**Monobloc - Rear 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.

- Reverse port connections for opposite direction of shaft rotation.

- Flow direction for all blank variants except 75/90/24.

**2 Piece - Installation**

- 2 Ports 3/4" BSP + 18mm deep

- Reverse port connections for opposite direction of shaft rotation.

- Clockwise direction of rotation.
3-2 HMB030 (cont)

Monobloc - Side Port Installation

EXAMPLE FOR MODEL CODE
SIDE ENTRY MOTORCASE – HMB030/P/F/M/21

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

2 PORTS #25 TO SUIT SAE
CODE 61, 1” NOM. SPLIT FLANGE

PORT FLANGE BOLT TAPPING SIZE –
T: 3/8"-16 UNC – 2B X 16 FULL THREAD DEPTH

EXAMPLE MOTORCASE HMB030/P/F/M/21

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 58.41/56.29
FORM DIAMETER 50.703
MINOR DIAMETER 50.06/49.60
PIN DIAMETER 6.086
DIAMETER OVER PINS 62.984/62.931

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

3-3 HMB045

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

MOUNTING FACE

'P'
4.71 5.59

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

'S' & 'Z'
1/2"-20 UNF – 2B X 32 FULL THREAD DEPTH
3-3 HMB045 (cont)

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

HOLE DETAIL

SPLINE DATA

'S'
- To BS 3555 (ANSI 892.1 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: 62.954/62.931

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

SM3 -
3" Valve Housing for Bolt On Manifold.

Reverse Port Connections for Opposite Direction of Shaft Rotation

Flow Direction
3-3 HMB045 (cont)

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

**Views on Arrow 'A'**

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

5 Holes #18 equally spaced as shown on a No. 10-32 SAE size tapped to give an effective dia. 0.1094 in.

5/16"-18 LH RRAIN (Choice of 3 positions)
(A normally plugged)

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

Do not exceed 12" depth of coupling in to drain port.

Reverse Port Connections for opposite direction of shaft rotation.

Flow direction for all x x nos. variants except F3/FM3/FM3.

- 2 Piece - Installation

Monobloc - Installation

Clockwise direction of rotation

Reversal port connections for opposite direction of shaft rotation.

Flow direction

Clockwise direction of rotation
**SPLINE DATA**

*S*
- TO BS 3505 (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’ SHAFT**
- KEY SUPPLIED: 18.037/18.018 WIDE
- 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

**'T’ SHAFT**
- KEY SUPPLIED: 19.10/19.05 SQ.
- 1/2"-12 UNF THREAD
- SLOTTED NUT 45.2 THICK 57.15 A/F
- BASIC TAPER ON DIA 0.1000/0.0899: 1
3-4 HMB060/080 (cont)

- **SM3** Valve Housing
  - 3” Valve Housing for Bolt On Manifold.
  - Reverse Port Connections for Opposite Direction of Shaft Rotation.

3-4 HMB060/080 (cont)

- **F3** & **FM3** Valve Housings
  - Views on Arrow 'A'
  - Port Flange Bolt Tapping Size:
    - F3: 7/16"-14 UNC-2A X 27 Full Thread Depth
    - FM3: M12 X P1.75 X 27 Full Thread Depth
3-4 HMB060/080 (cont)

Installation

3/4"-16NF-2B DRAIN (CHOICE OF 3 POSITIONS)
(3 NORMALY PLUGGED)

NOTE: ENSURE ON INSTALLATION THAT DRAIN IS
TAKEN FROM ABOVE MOTOR CENTRELINE.
DO NOT EXCEED 12 DEPTH OF COUPLING IN T/DRAIN PORT

5 HOLS AND CAVITY SPACED AS
SHOWN ON A 90/120 DEG. SPACED
TO GIVE AN EFFECTIVE HNO.

HMB MOTORS
3-5 HMB100

‘P’, ‘S’ & ‘Z’ Shafts

SPLINE DATA

‘S’

TO BS 3550 (ANSI 992.1 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
DIAMETER OVER PINS 71.593/71.544

‘Z’

DIN 5480 W70 x 3 x 30 x 22 x 7h

‘P’
KEY SUPPLIED-
16.037/16.019 WIDE
11.99/11.94 THICK

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

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

MOUNTING FACE
3-5 HMB100 (cont)

- 'T' Shaft

- 'SM3' Valve Housing

MOUNTING FACE

HOLE DETAIL

SM3 - 3" VALVE HOUSING FOR BOLT ON MANIFOLD.

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION

VIEWS ON ARROW 'A'

30

286
3-5 HMB100 (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

1 1/4" CODE 81
S.A.E. PORTS
(3000 SERIES)

PORT 1
B HOLES, SEE TABLE FOR THREAD SIZES

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 82)
PORTS (6000 SERIES)

B HOLES, SEE TABLE FOR THREAD SIZES

Installation

3/4" - 15 L.P. - 2B Drain (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
5 to drain point

Reverse port connections for opposite direction of shaft rotation
Flow direction for all 3 valve variants except 34L63423

5 HOLES #20, CIRCULAR, AS SHOWN ON A (2013.02) P.C.D. SPACED TO GIVE AN EFFECTIVE M4.6 PORT AREA

CLOCKWISE DIRECTION
OF ROTATION

MOUNTING FACE

VIEW ON ARROW "A"
3-6 HM(HD)B125

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

SPLINE DATA

'S3'
- TO BS 3550 (ANSI 892.1, CLASS 6)
- FLAT ROOT SIDE FIT, CLASS 1
- PRESSURE ANGLE: 30°
- NUMBER OF TEETH: 20
- PITCH: 6/12
- MAJOR DIAMETER: 87.025 / 87.025
- FORM DIAMETER: 80.264
- MINOR DIAMETER: 79.485 / 79.425
- PIN DIAMETER: 8.128
- DIAMETER OVER PINS: 97.078 / 97.030

'Z3'
- ON 5480 WW5 x 3 x 27 x 7h

26 MIN STRAIGHT

KEY SUPPLIED—
- 1/2"-12 UNIF
- THREAD: 15.92/15.87 THICK

'S3' & 'Z3'

KEY SUPPLIED—
- 3/4"-15 UNIF-39 x 32
- FULL THREAD DEPTH

130.2

3

20

179.4

76.62

3-6 HM(HD)B125 (cont)

HMB125 - 'T' Shaft

SLOTTED NUT 45.2 THICK
57.15 A/F

MOUNTING FACE

133.4

2.4

9.5/75

74.58

73.23

2.4

12.0

1.1/2"-12 UNIF THREAD

6.4

43.5

9.525

61

185

45.3
3-6 HM(HD)B125 (cont)

HMHDB125 - 'P2' Shafts

KEY SUPPLIED:
24.068/24.000 WIDE
16.00/16.00 THICK

3/4"-16 UNC-2B x 32
FULL THREAD DEPTH

SPLINE DATA

'S5'

PRESSURE ANGLE 20º
NUMBER OF TEETH 23
PITCH 6/12
MAJOR DIAMETER 100.652/100.526
FORM DIAMETER 92.539
MINOR DIAMETER 92.184/91.626
PIN DIAMETER 8.128
DIAMETER OVER PINS 109.573/109.517

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

'S5' & 'Z5'

3-6 HM(HD)B125 (cont)

HMHDB125 - 'S5' & 'Z5' Shafts

MOUNTING FACE

25 MIN STRAIGHT

3/4"-16 UNC-2B x 32
FULL THREAD DEPTH
3-6 HM(HD)B125 (cont)

- 'SM3' Valve Housing

- 'F3' & 'FM3' Valve Housings

VIEWS ON ARROW 'A'

SM3 •
3" VALVE HOUSING FOR BOLT ON MANIFOLD.

MOUNTING FACE

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

PORT FLANGE BOLT TAPPING SIZE —
F3: 7/16"-14 UNC – 28 X 27 FULL THREAD DEPTH
FM3: M12 X P1.75 X 27 FULL THREAD DEPTH

HOLE DETAIL

TYPE 4 POSN

A1
A14

^31.8
2 POSN

REVISE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION

MOUNTING FACE

286

378

30.2

PORT 1

PORT 2

PORT 3

PORT 4
3-6 HM(HD)B125 (cont)

- 'F4' & 'FM4' Valve Housings

**Installation**

- Views on Arrow "A"
- F4/FM4 - 4" Valve Housing with 1-1/2" SAC 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
- Ø1/2" SAC (Code 62) Ports (6000 Series)
- 8 Holes, Six Table for Thread Sizes
- 36.5
- 79.4
- 429
- 331
- 266

- "F4" & "FM4" Valve Housings (Choice of 3 Positions)
- 2 Normally Plugged
- Note: Ensure on Installation that Drain is Tapped from Inside Motor Centreline.
- Do Not Exceed 12 Depth of Coupling Ø1/2" Under Port

- Noting Port Connections for Opposite Direction of Shaft Rotation
- Flow Direction for All "F4" & "FM4" Housings
- Clockwise Direction of Rotation
- Mounting Face (HMDB125 Only)
- Clockwise Direction of Rotation
- 97 Max
3-7 HM(HD)B150/200

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

SPLINE DATA

'S3'
- To BS 3550 (ANSI B92.1, Class D)
- 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 M6 x 3 x 27 x 7h

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

HMB150/200 - 'T' Shaft

KEY SUPPLIED:
- 22.27/22.27 Wide
- 15.02/15.87 Thick

'P1'
- 3/4"-16 UNF-2B x 32 Full Thread Depth

'S3' & 'Z3'
- 3/4"-16 UNF-2B x 32 Full Thread Depth

BASIC TAPER, ON DIAMETER: 0.009/0.009 PER mm

SLOTTED NUT 45.2 Thick
- 57.15 A/F

MOUNTING FACE
- 133.4 x 6.4
- 3/8"-12 UNF THREAD
3-7 HM(HD)B150/200 (cont)

- HMDB150/200 - 'P2', 'S5' & 'Z5' Shafts

**SPLINE DATA**

- '50'
  - Pressure Angle: 30°
  - Number of Teeth: 23
  - Pitch: 6.128
  - Major Diameter: 100.526
  - Form Diameter: 92.339
  - Minor Diameter: 91.626
  - Diameter Over Pins: 109.573

- 'Z5'
  - DIN: 5480 W100 x 4 x 24 x 7

**'SM3' Valve Housing**

- 3" valve housing for bolt-on manifold.

**MOUNTING FACE**

- Views on arrow 'A'

**REVERSE PORT CONNECTIONS**

For opposite direction of shaft rotation.
3-7 HM(HD)B150/200 (cont)

- 'F3' & 'FM3' Valve Housings

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

Installation

3-8 HM(HD)B270

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

SPLINE DATA

'S3'
- TO BS 3050 (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
- 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

1/4"-16 UNF-2B x 32 FULL THREAD DEPTH

76 MIN STRAIGHT
HMB MOTORS

3-8 HM(HD)B270 (cont)

HMB270 - 'T' Shaft

HMHDB270 - '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: 92.333
- MINOR DIAMETER: 92.194/91.825
- PIN DIAMETER: 8.128
- DIAMETER OVER PINS: 109.573/109.517

'P2'
- KEY SUPPLIED: 24.005/24.000 WID 16.02/16.00 THICK
- 3/4"-16 UNF-2B X 32 FULL THREAD DEPTH

'S5'
- 3/4"-16 UNF-2B X 32 FULL THREAD DEPTH

101.6 MIN STRAIGHT

178.0
176.6
3-8 HM(HD)B270 (cont)

HMHDB270 - 'Z' Shaft

3-8 HM(HD)B270 (cont)

'F4' & 'FM4' Valve Housings
3-8 HM(HD)B270 (cont)

- Installation

3-9 HM(HD)B325

- HMB325 - 'P1', 'S3' & 'Z' Shafts
3-9 HM(HD)B325 (cont)

HMB325 - 'T' Shaft

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 92.184/91.825
PIN DIAMETER 8.128
DIAMETER OVER PINS 106.573/106.517

HMB325 - 'P2' & 'S5' Shafts

MOUNTING FACE

KEY SUPPLIED
24.005/24.000 WOE
16.03/16.00 THICK
3/4"-16 UNF-2B X 32
FULL THREAD DEPTH

MOUNTING FACE

KEY SUPPLIED
92.02
1/8-32 UNF-2B X 32
FULL THREAD DEPTH

101.6 MIN STRAIGHT
3-9 HM(HD)B325 (cont)

- **HMHDB325 - 'Z' Shaft**

- **'F4' & 'FM4' Valve Housings**
3-9 HM(HD)B325 (cont)

Installation

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: 6/2  
- MAJOR DIAMETER: 100.653/100.526  
- FORM DIAMETER: 92.939  
- MINOR DIAMETER: 92.184/91.625  
- PIN DIAMETER: 8.129  
- 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

SPLINE DATA

‘S’

TO BS 3350 (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 8.125
DIAMETER OVER PINS 109.573/109.517

‘Z’

DIN 5480 W100 x 4 x 24 x 7h

2 KEYS SUPPLIED- 24.006/24.000 WIDE 16.05/16.00 THICK
3/4”-16 UNF-2B X 32 FULL THREAD DEPTH

114.5
84.00
82.02
81.95

101.6 MIN STRAIGHT

3/4”-16 UNF-2B X 32 FULL THREAD DEPTH
### 3-11 HMB500 (cont)

#### Installation

![Diagram of HMB500 installation](image)

#### 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-2005/08.18