General Descriptions

The Kawasaki “Staffa” range of high torque low speed fixed displacement radial piston hydraulic motors consists of 12 frame sizes ranging from the HMB010 to HMHDB400. Capacity ranges from 50 to 6,800 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 continuously variable displacement motors. To obtain details of this product range please refer to data sheet M-2002/09.14.

Features

- Rugged, Reliable, Proven Design
- Unique Hydrostatic Balancing provides minimum wear and extended life
- High Volumetric and Mechanical Efficiency
- Capacities Range from 50 to 6,800 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
1-1 Model Coding

F11/HM*B/060/S3/V/FM3/Tk/*/PL**

**Fluid Type**
- Blank: Mineral oil
- F3: Phosphate ester (HFD fluid)
- F11: Water-based fluids (HFA, HFB & HFC)
- *: Consult

**Model Type**
- Blank: Standard (HMB)
- HD: Heavy duty (HMHDB)

**Frame Size**
See options page 7

**Additional Control Options**
- PL**: Non-catalogued features, (**) = number assigned as required
  - eg:
    - Stainless steel shaft sleeves
    - Alternative port connections
    - Shaft variants
    - Alternative displacement
    - Special mountings
    - Special paint
    - etc.

**Shaft Type**
See shaft type option list on Page 4

**Shaft**
Vertically Up

**Main Port Connections**
See Port Connection details on Page 5

**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

See page 78
1-2 Shaft Options

Product type

HMB010
P = Parallel keyed 40 mm Diameter Shaft
S = Splined shaft 13 teeth BS3550

HMB030 & HMB045
P = Parallel keyed 55 mm Diameter Shaft
S = Splined shaft 17 teeth BS3550
Z = Splined shaft DIN5480 (W55x3x17x7h)

HMB060, HMB080 & HMB100
P = Parallel keyed 60 mm Diameter Shaft
S = Splined shaft 14 teeth BS3550
Z = Splined shaft DIN5480 (W70x3x22x7h)
T = Long taper keyed shaft - 95.2 key slot

HMB125, HMB150 & HMB200
P1 = Parallel keyed 85 mm Diameter Shaft
S3 = Splined shaft 20 teeth BS3550
S4 = Splined shaft 16 teeth BS3550
Z3 = Splined shaft DIN5480 (W85x3x27x7h)
T = Long taper keyed shaft - 133.4 key slot

HMHDB125, HMHDB150 & HMHDB200
P2 = Parallel keyed 100 mm Diameter Shaft
S5 = Splined shaft 23 teeth BS3550
Z5 = Splined shaft DIN5480 (W100x4x24x7h)
T = Long taper keyed shaft - 120.52 key slot

HMB270 & HMB325
P1 = Parallel keyed 85 mm Diameter Shaft
S3 = Splined shaft 20 teeth BS3550
Z = Splined shaft DIN5480 (W100x4x24x7h)
T = Long taper keyed shaft - 133.4 key slot

HMHDB270 & HMHDB325
P2 = Parallel keyed 100 mm Diameter Shaft
S5 = Splined shaft 23 teeth BS3550
Z = Splined shaft DIN5480 (W100x4x24x7h)
T = Long taper keyed shaft - 120.52 key slot

HMHDB400
P = Parallel keyed 100 mm Diameter Shaft (2 keys
S = Splined shaft 23 teeth BS3550
Z = Splined shaft DIN5480 (W100 x 4 x 24 x 7h)

[Note]
For installations where the shaft is vertically upwards specify "V" after the shaft type designator so as to ensure that an additional high level drain port is provided within the front cover of the motor.
1-3 Main Port Connections Options

◆ Product type

HMB010
Blank = Two, four bolt flange ports of 20 mm Ø

HMB030 Monobloc
Blank = Rear entry ports G ¾” (BSPF)
F = Side port SAE 1” 4-Bolt (UNC) flange
FM = Side port SAE 1” 4-Bolt (Metric) flange

HMB045 Monobloc
Blank = Rear entry ports G 1” (BSPF)
D = Dual entry ports G 1” (BSPF)

HMB030/045 Two part build (TPB)
See detail below

HMB060/080/100
S03 = 6-Bolt (UNF) flange. (Staffa original valve housing)
F3 = SAE 1¼ 4-Bolt (UNC) flanges
FM3 = SAE 1¼” 4-Bolt (Metric) flanges
S04 = 6 Bolt (UNF) flanges. (Staffa original valve housing)

HMB125/150/200 + Heavy Duty Variants Details
S03 = 6-Bolt (UNF) flange. (Staffa original valve housing)
F3 = SAE 1¼ 4-Bolt (UNC) flanges
FM3 = SAE 1¼” 4-Bolt (Metric) flanges
S04 = 6 Bolt (UNF) flanges. (Staffa original valve housing)
F4 = SAE 1½” 4-Bolt (UNC) flanges
FM4 = SAE 1½” 4-Bolt (Metric) flanges

HM(HD)B270/325 + Heavy Duty Variants
F4 = SAE 1½” 4-Bolt (UNC) flanges
FM4 = SAE 1½” 4-Bolt (Metric) flanges
S04 = 6 Bolt (UNF) flanges. (Staffa original valve housing)

HMHDB400
Blank = Combined 6-Bolt flange and 4-Bolt SAE connection
Ports ‘B’ and ‘C’ 6-Bolt UNF flange
Ports ‘A’ and ‘C’ SAE, 2” 4-Bolt UNF flanges
S045 = 2 x 6-Bolts (UNF) flanges (2 inlet and 2 outlet ports available)
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.

◆ Limits for fire resistant fluids

<table>
<thead>
<tr>
<th>Fluid Type</th>
<th>Pressure (bar)</th>
<th></th>
<th>Max Speed (rpm)</th>
<th>Model type</th>
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<tr>
<td></td>
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<td>Continuous</td>
<td></td>
<td></td>
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<tr>
<td>HFA 5/95 oil-in-water emulsion</td>
<td>103</td>
<td>138</td>
<td>50% of limits for 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>
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<tr>
<td>HFC water glycolol</td>
<td>103</td>
<td>138</td>
<td>50% of limits or Mineral Oil</td>
<td>All models</td>
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<tr>
<td>HFD phosphate ester</td>
<td>207</td>
<td>241</td>
<td>As for Mineral Oil</td>
<td>B010</td>
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<tr>
<td></td>
<td>207</td>
<td>293</td>
<td>-</td>
<td>B030</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>293</td>
<td>-</td>
<td>B045 to B400 inc.</td>
</tr>
</tbody>
</table>
### 2-1 Performance Data (cont)

<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>
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</thead>
<tbody>
<tr>
<td>B10</td>
<td>188</td>
<td>2.79</td>
<td>500</td>
<td>25</td>
<td>207</td>
<td>241</td>
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<tr>
<td>B030</td>
<td>442</td>
<td>6.56</td>
<td>450</td>
<td>42</td>
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<tr>
<td>B045</td>
<td>740</td>
<td>10.95</td>
<td>400</td>
<td>60</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>B060</td>
<td>983</td>
<td>14.5</td>
<td>300</td>
<td>80</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>B080</td>
<td>1,344</td>
<td>19.9</td>
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<td>100</td>
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<td>100</td>
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<td>293</td>
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<td>36.95</td>
<td>220</td>
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<td>250</td>
<td>293</td>
</tr>
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<td>B150 F3/FM3/S03</td>
<td>2,470</td>
<td>36.95</td>
<td>168</td>
<td>115</td>
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<td>293</td>
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<tr>
<td>B200</td>
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<td>135</td>
<td>130</td>
<td>250</td>
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<td>B270</td>
<td>4,310</td>
<td>63.79</td>
<td>125</td>
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<td>B325</td>
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<td>79.4</td>
<td>100</td>
<td>140</td>
<td>250</td>
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<td>6,800</td>
<td>101</td>
<td>120</td>
<td>190</td>
<td>250</td>
<td>293</td>
</tr>
</tbody>
</table>

Other non standard displacements are possible - check with KPM UK for details.
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.

B010

B030

B045

B060
2-1 Performance Data (cont)

**Output Torque Curves (cont)**

**B080**

Output power kW
Nm 186 375 56 746 932

**B100**

Output power kW
Nm 186 373 600 746 932

**B125**

Output power kW
Nm 186 373 559 746

**B150**

Output power kW
Nm 186 559 932
2-1 Performance Data (cont)

◼ Output Torque Curves (cont)

**B200**

<table>
<thead>
<tr>
<th>Torque (Nm)</th>
<th>Shaft speed (r/min)</th>
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<tbody>
<tr>
<td>0</td>
<td>50</td>
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<tr>
<td>2000</td>
<td>100</td>
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<tr>
<td>4000</td>
<td>150</td>
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<tr>
<td>6000</td>
<td>175</td>
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**B270**

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<tr>
<th>Torque (Nm)</th>
<th>Shaft speed (r/min)</th>
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<tbody>
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<td>0</td>
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<td>2000</td>
<td>40</td>
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<tr>
<td>4000</td>
<td>60</td>
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<tr>
<td>6000</td>
<td>80</td>
</tr>
<tr>
<td>8000</td>
<td>100</td>
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**B325**

<table>
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<tr>
<th>Torque (Nm)</th>
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<td>0</td>
<td>20</td>
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<td>2000</td>
<td>40</td>
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<tr>
<td>4000</td>
<td>60</td>
</tr>
<tr>
<td>6000</td>
<td>80</td>
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**B400**

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<tr>
<th>Torque (Nm)</th>
<th>Shaft speed (r/min)</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>2000</td>
<td>40</td>
</tr>
<tr>
<td>4000</td>
<td>60</td>
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</table>

**B200**

<table>
<thead>
<tr>
<th>Torque (Nm)</th>
<th>Output power kW</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>37.3</td>
</tr>
<tr>
<td>2000</td>
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**B270**

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<thead>
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<th>Torque (Nm)</th>
<th>Output power kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>276</td>
</tr>
<tr>
<td>2000</td>
<td>150</td>
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</table>

**B325**

<table>
<thead>
<tr>
<th>Torque (Nm)</th>
<th>Output power kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>207</td>
</tr>
<tr>
<td>2000</td>
<td>175</td>
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</table>

**B400**

<table>
<thead>
<tr>
<th>Torque (Nm)</th>
<th>Output power kW</th>
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</thead>
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<tr>
<td>0</td>
<td>138</td>
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<tr>
<td>2000</td>
<td>103</td>
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</table>

**B400**

<table>
<thead>
<tr>
<th>Torque (Nm)</th>
<th>Output power kW</th>
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<tr>
<td>0</td>
<td>69</td>
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<tr>
<td>2000</td>
<td>69</td>
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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>K₁ 1.34</td>
<td>K₂ 534.05</td>
<td>K₃ 7.31</td>
<td>K₄ 0.51</td>
</tr>
<tr>
<td>HMB030</td>
<td>492 cc/rev</td>
<td>1.04</td>
<td>57.67</td>
<td>2.47</td>
<td>0.59</td>
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<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>
</tr>
<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>
</tr>
<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>1,839 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>HMB125</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>HMB150</td>
<td>2,470 cc/rev</td>
<td>1.62</td>
<td>9.98</td>
<td>1.00</td>
<td>1.39</td>
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<tr>
<td>HMB200</td>
<td>3,080 cc/rev</td>
<td>2.53</td>
<td>14.99</td>
<td>0.78</td>
<td>1.39</td>
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<tr>
<td>HMB270</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>HMB325</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>HHHDB400</td>
<td>6,800 cc/rev</td>
<td>4.06</td>
<td>10.18</td>
<td>0.53</td>
<td>2.35</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Fluid Viscosity</th>
<th>Viscosity Factor</th>
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<tbody>
<tr>
<td>cSt</td>
<td>Kv</td>
</tr>
<tr>
<td>20</td>
<td>1.58</td>
</tr>
<tr>
<td>25</td>
<td>1.44</td>
</tr>
<tr>
<td>30</td>
<td>1.30</td>
</tr>
<tr>
<td>40</td>
<td>1.10</td>
</tr>
<tr>
<td>50</td>
<td>1.00</td>
</tr>
<tr>
<td>60</td>
<td>0.88</td>
</tr>
</tbody>
</table>

\[ Qt \text{ (total leakage)} = \left( K_1 + \frac{n}{K_2} \right) \times \Delta P \times K_v \times 0.005 \text{ l/min} \]

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

\[ \text{Crankcase leakage} = K_4 \times \Delta P \times K_v \times 0.005 \text{ l/min} \]

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

\[ n = \text{speed} \text{ rpm} \]

The motor volumetric efficiency can be calculated as follows:

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

**Example:**

HPC200 motor with displacement of 3.087 l/rev.

**Speed**

60 rpm

**Differential pressure**

200 bar

**Fluid viscosity**

50 cSt

**Total leakage**

\[ = \left( K_1 + n/K_2 \right) \times \Delta P \times K_v \times 0.005 \text{ l/min} \]

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

\[ = 7.7 \text{ l/min} \]

**Volume efficiency**

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

\[ = 96\% \]
2-3 Shaft Power Calculation

**Example:** (see page 7):

HMB270:

**Firstly, to find the maximum differential pressure ∆P at rated speed:**

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

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

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

**Secondly, to find the maximum speed at rated pressure:**

Rated shaft power (W): 140,000  
Average actual running torque (Nm/bar): 63.79  
Rated pressure (bar): 250

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

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

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)

-S04-
HMB270
HMB325

HMB045***
(Monobloc)

HMHDB400***-
S045

HMB045***D-
(Monobloc)

HMHDB400***-
S045
Dual ports

S03-S04-
HMB030-045(TPB)
HMB060/080
HMB100/125
HMB150/200

-HMHB400***-
Removable plug

-F(M)3- F(M)4-
HMB030*/045*(TPB)
HMB060/080
HMB100/125
HMB150/200
*F(M)3 ONLY
**2-5 Shaft Stress Limits**

When applying large external radial loads, consideration should also be given to motor bearing lives, (see page 15).

<table>
<thead>
<tr>
<th>Motor Frame Size</th>
<th>Shaft Types</th>
<th>Maximum External Radial bending Moment [kNm]</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>
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<tr>
<td>HMB060, 080 &amp; 100</td>
<td>P, S &amp; Z</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>
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<tr>
<td>HMHDB125, 150 &amp; 200</td>
<td>S5, Z5 &amp; P2</td>
<td>12,750</td>
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<tr>
<td>HMB270 &amp; 325</td>
<td>P1, S3, Z &amp; T</td>
<td>7,500</td>
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<tr>
<td>HMHDB270 &amp; 325</td>
<td>P2, S5, &amp; Z</td>
<td>15,900</td>
</tr>
<tr>
<td>HMHDB400</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, \( W \) = 4,500 (see table)/100  
\[ \text{Maximum radial load, } W = \frac{4,500}{100} = 45 \text{N (4,587 kg)} \]

\( A = \text{Distance from mounting face to load centre (m)} \)

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

**[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 bearing 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, type, cleanliness and temperature
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 10 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>B010</td>
<td>20</td>
</tr>
<tr>
<td>B030</td>
<td>5</td>
</tr>
<tr>
<td>B045</td>
<td>6</td>
</tr>
<tr>
<td>B060/080/100/125/150/200</td>
<td>3</td>
</tr>
<tr>
<td>B270/B325/HMB400</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:

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

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</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMB010</td>
<td>Standard</td>
<td>8.0 x 10^9</td>
</tr>
<tr>
<td>HMB030</td>
<td>Standard - Monobloc</td>
<td>3.7 x 10^9</td>
</tr>
<tr>
<td></td>
<td>FM(3) S03</td>
<td>7.5 x 10^9</td>
</tr>
<tr>
<td>HMB045</td>
<td>Standard - Monobloc</td>
<td>1.3 x 10^10</td>
</tr>
<tr>
<td></td>
<td>FM(3) S03</td>
<td>1.6 x 10^10</td>
</tr>
<tr>
<td>HMB060, HMB080 &amp; HMB100</td>
<td>FM(3) S03</td>
<td>1.8 x 10^10</td>
</tr>
<tr>
<td>HM(HD)B125, HM(HD)B150 &amp; HM(HD)B200</td>
<td>FM(3) S03</td>
<td>4.0 x 10^10</td>
</tr>
<tr>
<td></td>
<td>FM(4) S04</td>
<td>8.0 x 10^10</td>
</tr>
<tr>
<td>HM(HD)B270 &amp; HM(HD)B325</td>
<td>FM(4) S04</td>
<td>7.2 x 10^10</td>
</tr>
<tr>
<td>HMHDB400</td>
<td>SO4</td>
<td>6.0 x 10^10</td>
</tr>
<tr>
<td></td>
<td>SO45</td>
<td>7.2 x 10^10</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 figure (see page 11 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.

◆ Motor Casing 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 HMB 010
   - 10 bar for all remaining frame sizes.

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

◆ Hydraulic Fluids

Dependent on motor (see Ordering Code.) 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, see page 6.

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

<table>
<thead>
<tr>
<th>Condition</th>
<th>Viscosity Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. off load</td>
<td>2,000 cSt (9270 SUS)</td>
</tr>
<tr>
<td>Max. on load</td>
<td>150 cSt (695 SUS)</td>
</tr>
<tr>
<td>Optimum</td>
<td>50 cSt (232 SUS)</td>
</tr>
<tr>
<td>Minimum</td>
<td>25 cSt (119 SUS)</td>
</tr>
</tbody>
</table>
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 should contain antiwear or EP additives. Automatic transmission fluids and motor oils are not recommended.

◆ Temperature limits
Ambient min. -30°C (-22°F)
Ambient max. + 70°C (158°F)
Max. operating temperature range:
Min -20°C (-4°F) +10°C (50°F)
Max. + 80°C (175°F) +54°C (130°F)

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

◆ 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.

Table: Polar Moment of Inertia & Mass:

<table>
<thead>
<tr>
<th>Model Type</th>
<th>Polar moment of Inertia (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 - SO4</td>
<td>0.5400</td>
<td>481</td>
</tr>
<tr>
<td>HMHDB400 - SO45</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 2000 cSt. The maximum fluid viscosity before load is applied to the motor shaft is 150 cSt.

If low ambient temperature conditions exist, then a crankcase flushing flow of 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 will be dependent on the required 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 re-circulating valve and consideration of circuit cooling as the motor will generate a large braking torque.

It is for these reasons that ‘HMC’ or ‘HPC’ series motors are the preferred option for freewheeling applications.

2-9 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.
2-10 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 are as follows:

<table>
<thead>
<tr>
<th>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 +/- 27 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; bolts</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.

Conversion Table

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pressure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bar</td>
<td>PSI</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td><strong>Flow</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L/min</td>
<td>Gal/min</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.264 US</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.219 UK</td>
<td></td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mm</td>
<td>Inch</td>
<td></td>
</tr>
<tr>
<td>25.4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Torque</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nm</td>
<td>lbf ft</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.737</td>
<td></td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kW</td>
<td>hP</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1.341</td>
<td></td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kg</td>
<td>lb</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.2</td>
<td></td>
</tr>
</tbody>
</table>
3-1 HMB010 Installation

3-1-1 HMB010 - 'P' & 'S' Shafts

SPLINE DATA

'S'
TO BS 3550 (ANSI B92.1 CLASS 5)
FLAT ROOT SIDE FIT, CLASS I
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

KEY SUPPLIED—
10.030/10.015 WIDE
8.000/7.964 THICK

M8-1.25 PITCH X 18 FULL THREAD DEPTH
3-1 HMB010 Installation (cont)

◆ 3-1-2 HMB010 - 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

FLOW DIRECTION

CLOCKWISE DIRECTION
OF ROTATION

5 HOLES Ø14 EQU-SPACED AS
SHOWN ON A 200.0 P.C.D. SPOTFACED
TO GIVE AN EFFECTIVE Ø28.

#324
### 3-2 HMB030 Installation

#### 3-2-1 HMB030 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 56.41/56.28
  - 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

---

**‘P’**

KEY SUPPLIED—
- 14.046/14.028 WIDE
- 9.037/9.981 THICK

1/2”-20 UNF-2B x 32 FULL THREAD

---

**‘S’ & ‘Z’**

7/16 STRAIGHT

1/2”-20 UNF-2B x 32 FULL THREAD
3-2 HMB030 Installation (cont)

◆ 3-2-2 HMB030 2 Piece - ‘P’, ‘S’ & ‘Z’ Shafts

**SPLINE DATA**

**‘S’**
- 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 Installation (cont)

3-2-3 HMB030 2 Piece - ‘SO3’ Valve Housings

SO3 —
3” VALVE HOUSING WITH 6-BOLT FLANGE

SUPPLIED WITH 2 ‘O’ RING SEALS

MOUNTING FACE
3-2 HMB030 Installation (cont)

3-2-4 HMB030 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 S.A.E. PORTS (5000 SERIES)

PORT 1

PORT 2

PORT 3

PORT 4

PORT 5

PORT 6

PORT 7

PORT 8

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

3-2-5 HMB030 2 Piece - Installation
3-2 HMB030 Installation (cont)

3-2-6 HMB030 Monobloc - Rear Port Installation

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

3/8” BSP DRAIN
NOTE: ENSURE DRAIN IS CONNECTED TO PORT ABOVE MOTOR

5 HOLES #10 EQUALLY SPACED AS SHOWN ON DRAWING. HOLES SPOTFACED TO GIVE AN EFFECTIVE #8s.
3-2 HMB030 Installation (cont)

♦ 3-2-7 HMB030 Monobloc - Side Port Installation

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

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

2 PORTS Ø25 TO SUIT SAE CODE 61, 1” NOM. SPLIT FLANGE

PORT FLANGE HOLE TAPING SIZE –

F: 3/8”-16 UNC-2B X 16 FULL THREAD DEPTH
FM: M10 X P1.5 X 16 FULL THREAD DEPTH

2x4 HOLES, SEE TABLE FOR THREAD SIZES

REVERSE PORT CONNECTIONS FOR OPPOSITE DIRECTION OF SHAFT ROTATION FLOW DIRECTION

CLOCKWISE DIRECTION OF ROTATION

5 HOLES #10 SPACED AS SHOWN ON A#120 P.C.D. SPOTTED TO GIVE AN EFFECTIVE #30.
3-3 HMB045 Installation

3-3-1 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 Installation (cont)

3-3-2 HMB045 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
3-3 HMB045 Installation (cont)

- 3-3-3 HMB045 2 Piece - ‘SO3’ Valve Housings

VIEWS ON ARROW ‘A’

SO3 —
3” VALVE HOUSING WITH
6-BOLT FLANGE

SUPPLIED WITH 2 ‘O’ RING SEALS

PORT 2

PORT 1

2 PORTS #28

44.4

6 HOLES 3/8”-24

UNF-2B 16.0 DEEP

R22

50.8

360
3-3 HMB045 Installation (cont)

◆ 3-3-4 HMB045 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

8 HOLES, SEE TABLE FOR THREAD SIZES
3-3 HMB045 Installation (cont)

3-3-5 HMB045 2 Piece - Installation

3/4"-18 UNF-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 Ø18 EQUALLY-SPACED AS SHOWN ON A P.C.O. SPOTFACE TO GIVE AN EFFECTIVE Ø38.
3-3 HMB045 Installation (cont)

3-3-6 HMB045 Monobloc - Installation

- 3/8" BSP drain, 18mm deep, spotfaced #216 (choice of 3 positions) (1" normally plugged)
  Note: Ensure on installation that drain is taken from above motor centreline.

- 2 ports 1" BSP x 29 deep (not dual entry models supplied with these ports plugged)

- Dual entry models: 2 ports 1" BSP x 29 deep spotfaced to #63
3-4 HMB060/080 Installation

3-4-1 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 8.125
- DIAMETER OVER PINS 71.593/71.544

'Z'
- DIN 5480 W70 x 3 x 30 x 22 x 7h
3-4 HMB060/080 Installation (cont)

3-4-2 HMB060/080 - ‘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
3-4 HMB060/080 Installation (cont)

◆ 3-4-3 HMB060/080 - ‘SO3’ & ‘SO4’ Valve Housings
3-4 HMB060/080 Installation (cont)

◆ 3-4-4 HMB060/080 - ‘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

B HOLES, SEE TABLE FOR THREAD SIZES
3-4 HMB060/080 Installation (cont)

3-4-5 HMB060/080 - Installation

3/4"-16UNF-2B DRAIN (Choice of 3 Positions) (2 Normally Plugged)

NOTE - Ensure on installation that drain is taken from above motor centreline.

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

5 HOLES #20 Equi-spaced as shown on a 377.03 P.C.D. spotfaced to give an effective #40.

Reverse port connections for opposite direction of shaft rotation.

Flow direction for all VLV HSG variants except SM3.
3-5 HMB100 Installation

◆ 3-5-1 HMB100 - ‘P’, ‘S’ & ‘Z’ Shafts

**SPLINE DATA**

<table>
<thead>
<tr>
<th></th>
<th>‘S’</th>
<th>‘S’ &amp; ‘Z’</th>
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</thead>
<tbody>
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<td>FLAT ROOT SIDE FIT, CLASS 1</td>
<td>FLAT ROOT SIDE FIT, CLASS 1</td>
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<tr>
<td>PRESSURE ANGLE</td>
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<td>PITCH</td>
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<td>MAJOR DIAMETER</td>
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<td>MINOR DIAMETER</td>
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<td>PIN DIAMETER</td>
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<td>DIAMETER OVER PINS</td>
<td>71.593/71.544</td>
<td>1/2”-20 UNF-2B X 32</td>
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<td></td>
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<td>FULL THREAD DEPTH</td>
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3-5 HMB100 Installation (cont)

3-5-2 HMB100 - ‘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
93.5
12.0
81.9
165
61
3-5 HMB100 Installation (cont)

◆ 3-5-3 HMB100 - ‘SO3’ & ‘SO4’ Valve Housings

VIEWS ON ARROW 'A'

SO3 -
3” VALVE HOUSING WITH 6-BOLT FLANGE

SUPPLIED WITH 2 ‘O’ RING SEALS

PORT 2
2 PORTS #28

129
72
6 HOLES 3/8”-24

UNF-2B 16.0 DEEP

50.8
47.6
395

SO4 -
4” VALVE HOUSING WITH 6-BOLT FLANGE

SUPPLIED WITH 2 ‘O’ RING SEALS

PORT 2
2 PORTS #32

138
47.6

47.6

277
3-5 HMB100 Installation (cont)

3-5-4 HMB100 - ‘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

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
3-5 HMB100 Installation (cont)

◆ 3-5-5 HMB100 - 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 #525 P.C.D.
SPOTFACED TO GIVE AN EFFECTIVE #40.

REVERSE PORT CONNECTIONS
FOR OPPOSITE DIRECTION OF
SHAFT ROTATION

FLOW DIRECTION FOR
ALL VLV HSG VARIANTS
EXCEPT SW3

CLOCKWISE DIRECTION
OF ROTATION

MOUNTING FACE
3-6 HM(HD)B125 Installation

◆ 3-6-1 HMB125 - ‘P1’, ‘S3’, ‘S4’ & ‘Z3’ Shafts

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<td>FLAT ROOT SIDE FIT, CLASS 1</td>
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<td>PRESSURE ANGLE</td>
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<td>NUMBER OF TEETH</td>
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<td>PITCH</td>
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<tr>
<td>MAJOR DIAMETER</td>
<td>87.953/87.825</td>
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<tr>
<td>FORM DIAMETER</td>
<td>80.264</td>
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<tr>
<td>MINOR DIAMETER</td>
<td>79.485/78.925</td>
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<tr>
<td>PIN DIAMETER</td>
<td>8.128</td>
</tr>
<tr>
<td>DIAMETER OVER PINS</td>
<td>97.084/97.030</td>
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<td>NUMBER OF TEETH</td>
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<td>PITCH</td>
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<tr>
<td>MAJOR DIAMETER</td>
<td>86.360/86.233</td>
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<td>FORM DIAMETER</td>
<td>76.124</td>
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<td>MINOR DIAMETER</td>
<td>74.93/72.39</td>
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<td>PIN DIAMETER</td>
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<td>DIAMETER OVER PINS</td>
<td>92.710/92.581</td>
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<thead>
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<th>Z3’</th>
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<tbody>
<tr>
<td>DIN 5480 W65 x 3 x 27 x 7h</td>
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</table>
3-6 HM(HD)B125 Installation (cont)

3-6-2 HMB125 - 'T' Shaft

- Key supplied:
  - 22.27/22.22 WDE
  - 15.92/15.87 THICK

- 1 1/2"-12 UNF thread

- Basic taper, on diameter 0.1001/0.0999 PER mm

- Slotted nut 45.2 THICK 57.16 A/F
3-6 HM(HD)B125 Installation (cont)

◆ 3-6-3 HMHDB125 - ‘P1’ & ‘P2’ Shafts
3-6-4 HMHDB125 - ‘S3’, ‘S5’, ‘Z5’ & T Shafts

### 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

### 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 Installation (cont)

◆ 3-6-5 HMB125 & HMHDB125 - 'SO3' & 'SO4' Valve Housings
3-6 HM(HD)B125 Installation (cont)

◆ 3-6-6 HMB125 & HMHDB125 - ‘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
3-6-7 HMB125 & HMHDB125 - ‘F4’ & ‘FM4’ Valve Housings
3-6 HM(HD)B125 Installation (cont)

3-6-8 HMB125 & HMHDB125 - Installation
### 3-7 HMB(HD)150/200 Installation

#### 3-7-1 HMB150/200 - ‘P1’, ‘S3’, ‘S4’ & Z3 Shafts

**SPLINE DATA**

<table>
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<tr>
<th>Spline</th>
<th>Description</th>
<th>Dimensions</th>
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<td><strong>S3</strong></td>
<td>BS 3550 (ANSI B92.1, CLASS 5)</td>
<td>Major Diameter: 87.953/87.825</td>
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<td></td>
<td>Flat Root Side Fit, Class 1</td>
<td>Minor Diameter: 79.485/78.925</td>
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<td>Pressure Angle: 30°</td>
<td>Pitch: 6/12</td>
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<td></td>
<td>Number of Teeth: 20</td>
<td>Pin Diameter: 8.128</td>
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<tr>
<td></td>
<td>Pitch: 6/12</td>
<td>Diameter over Pins: 97.084/97.030</td>
</tr>
</tbody>
</table>

| **S4** | Pressure Angle: 20° | Number of Teeth: 16 |
|        | Major Diameter: 86.360/86.233 | Pitch: 5/10 |
|        | Form Diameter: 76.124 | Minor Diameter: 74.93/72.39 |
|        | Pin Diameter: 8.636 | Diameter over Pins: 92.710/92.581 |

| **Z3** | DIN 5480 W85 x 3 x 27 x 7h |

**KEY SUPPLIED**

- 24.066/24.000 Wide
- 16.05/16.00 Thick

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

7/6 Min Straight

3/4"-16 UNF-2B x 32
Full Thread Depth
3-7 HMB(HD)150/200 Installation (cont)

◆ 3-7-2 HMB150/200 - ‘T’ Shaft

- Key supplied:
  - 22.27/22.22 Wide
  - 15.92/15.87 Thick

- Taper, on diameter:
  - 0.100/0.0999 per mm

- Slotted nut 45.2 thick
  - 57.15 A/F

- 1 1/2”-12 UNF thread

- 61.75
  - 60.65

- Width
  - 12.0

- Length
  - 172

- Width
  - 61

- Height
  - 85.74

- Length
  - 133.4

- Key length
  - 6.4
3-7 HMB(HD)150/200 Installation (cont)

◆ 3-7-3 HMBHD150/200 - 'P2', 'S3', 'S5' & 'Z5' Shafts

**SPLINE DATA**

'S3'
TO BS 3550 (ANSI B92.1, CLASS 5)
FLAT ROOT SIDE FT, CLASS 1
PREASURE 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

'S5'
PREASURE ANGLE 30°
NUMBER OF TEETH 23
PITCH 6/12
MAJOR DIAMETER 100.652/100.526
FORM DIAMETER 92.839
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 HMB(HD)150/200 Installation (cont)

◆ 3-7-4 HMBHD150/200 - ‘T’ Shaft

![Diagram of 'T' Shaft with dimensions and notes]

- Key supplied: 22.27/22.22 wide, 15.92/15.87 thick
- 1 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 HMB(HD)150/200 Installation (cont)

- 3-7-5 HMB150/200 & HMBHD150/200 - ‘SO3’ & ‘SO4’ Valve Housings

**SO3**
- 3” VALVE HOUSING WITH 6-BOLT FLANGE
- SUPPLIED WITH 2 ‘O’ RING SEALS
- PORT 1: 60.3 mm
- PORT 2: 60.3 mm
- 6 HOLES 3/8”-24 UNF-2B 16.0 DEEP
- MOUNTING FACE: 388 mm

**SO4**
- 4” VALVE HOUSING WITH 6-BOLT FLANGE
- SUPPLIED WITH 2 ‘O’ RING SEALS
- PORT 1: 50.8 mm
- PORT 2: 50.8 mm
- 2 PORTS #32
- 6 HOLES 3/8”-24 UNF-2B 16.0 DEEP
- MOUNTING FACE: 320 mm
3-7 HMB(HD)150/200 Installation (cont)

◆ 3-7-6 HMB150/200 & HMBHD150/200 - ‘F3’ & ‘FM3’ Valve Housings
3-7 HMB(HD)150/200 Installation (cont)

3-7-7 HMB150/200 & HMBHD150/200 - ‘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

Ø1 1/2” SAE (CODE 62) PORTS (6000 SERIES)
3-7 HMB(HD)150/200 Installation (cont)

◆ 3-7-8 HMB150/200 & HMBHD150/200 - Installation

- 5 holes 90° equally spaced as shown on a rectangular pattern to give an effective 90°
- Reverse port connections for opposite direction of shaft rotation from direction for all 1P65 variants except 50S
- Clockwise direction of rotation
3-8 HMB(HD)270 Installation

◆ 3-8-1 HMB270 - 'P1', 'S3' & 'Z' Shaft

**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
3-8 HMB(HD)270 Installation (cont)

◆ 3-8-2 HMB270 - ‘T’ Shaft

- KEY SUPPLIED:
  - 25.45/25.40 WIDE
  - 17.539/17.483 THICK

- 1 1/2"-12 UNF THREAD

- BASIC TAPER, ON DIAMETER:
  - 0.1001/0.0999 PER mm

- SLOTTED NUT 45.2 THICK
  - 57.15 A/F
3-8 HMB(HD)270 Installation (cont)

◆ 3-8-3 HMBHD270 - ‘P2’ & ‘S5’ Shafts

**SPLINE DATA**

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<tbody>
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<td>TO BS 3550 (ANSI B92.1, CLASS 5)</td>
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<td>FLAT ROOT SIDE FIT, CLASS 1</td>
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<td>PRESSURE ANGLE 30'</td>
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<td>NUMBER OF TEETH 23</td>
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<td>PITCH 6/12</td>
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<td>FORM DIAMETER 92.939</td>
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<td>PIN DIAMETER 8.128</td>
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<tr>
<td>DIAMETER OVER PINS 109.573/109.517</td>
</tr>
</tbody>
</table>

‘P2’

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

‘S5’

- 101.6 MIN STRAIGHT
- 3/4”-16 UNF-2B X 32 FULL THREAD DEPTH
3-8 HMB(HD)270 Installation (cont)

◆ 3-8-4 HMBHD270 - ‘Z’ Shaft
3-8 HMB(HD)270 Installation (cont)

- 3-8-5 HMB270 & HMHDB270 - ‘F4’, ‘FM4’ & ‘SO4’ Valve Housings

![Diagram of valve housings]
3-8 HMB(HD)270 Installation (cont)

◆ 3-8-6 HMB270 & HMBHD270 - Installation
3-9 HMB(HD)325 Installation

◆ 3-9-1 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—
24.055/24.000 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 HMB(HD)325 Installation (cont)

- 3-9-2 HMB325 - ‘T’ Shaft
3-9 HMB(HD)325 Installation (cont)

◆ 3-9-3 HMBHD325 - ‘P2’ & ‘S5’ Shafts

**SPLINE DATA**

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<tr>
<td>PIN DIAMETER</td>
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<td>DIAMETER OVER PINS</td>
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KEY SUPPLIED—
24.056/24.000 WIDE
16.05/16.00 THICK

3/4”-16 UNF-2B X 32
FULL THREAD DEPTH

101.6 MIN STRAIGHT

3/4”-16 UNF-2B X 32
FULL THREAD DEPTH
3-9 HMB(HD)325 Installation (cont)

◆ 3-9-4 HMBHD325 - ‘Z’ Shaft

![Diagram of 3-9-4 HMBHD325 - ‘Z’ Shaft]

- Z
- DIN 5480 W100 x 4 x 24 x 7h
- 76 MIN STRAIGHT
- 3/4"-16 UNF-2B x 42
- FULL THREAD DEPTH

155.3
153.9
3-9 HMB(HD)325 Installation (cont)

3-9-5 HMB325 & HMBHD325 - ‘F4’, ‘FM4’ & ‘SO4’ Valve Housings

SO4 –
4” VALVE HOUSING WITH 6-BOLT FLANGE

SUPPLIED WITH 2 ‘O’ RING SEALS

PORT 2

PORT 1

- 8 HOLES 3/8”-24 UNF-2B x 18 DEEP

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

ø1 1/2” SAE (CODE 62)
PORTS (8000 SERIES)
3-9 HMB(HD)325 Installation (cont)

◆ HMB325 & HMBHD325 - Installation
3-10 HMBHD400 Installation

3-10-1 HMBHD400 - ‘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 HMBHD400 Installation (cont)

◆ 3-10-2 HMBHD400 - Installation
3-11 Speed Sensing Options

◆ 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

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.
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Website: www.flutek.co.kr

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and may not be deemed to be guaranteed unless expressly
confirmed in the contract.

Data sheet: M-2001/11.15