Three-Speed Radial Piston Staffa Motors

Kawasaki
Hydraulic Products

HMF
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HMF Series
Three-Speed Staffa Motor

General Descriptions

The HMF series three-speed models have three pre-set displacements which can be chosen from a wide range to suit specific application requirements. The displacement are hydraulically selected using remotely mounted directional control valves. Motor displacement can be changed with ease while the motor is running.

The range of three speed motors extends from the HMF080 in 1,475 cc/rev to the HMF325 in 5,326 cc/rev.

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

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Max torque @ 275 bar (Nm)</th>
<th>Continuous shaft power</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMF080</td>
<td>6,560</td>
<td>138</td>
</tr>
<tr>
<td>HMF200</td>
<td>12,820</td>
<td>174</td>
</tr>
<tr>
<td>HMF270</td>
<td>19,090</td>
<td>189</td>
</tr>
<tr>
<td>HMF325</td>
<td>22,110</td>
<td>189</td>
</tr>
</tbody>
</table>

“Staffa” high torque, low speed radial piston motors use hydrostatic balancing techniques to achieve high efficiency, combined with good breakout torque and smooth running capability.

Features

- 3 displacement modes
- Freewheel options available
- High torque at low speed
- Smooth running
- Wide range of displacements to suit specific applications
- Displacement changes with ease when the motor is running
- Speed sensing options
1 Ordering Code

1-1 Model Coding

F11/HMF270 / S3 V/280/140/00/FM4/X/Tj/10/PL***

Fluid Type
(refer to page 8 for performance data)

Blank Mineral oil
F3 Phosphate ester (HFD fluid)
F11 Water based fluids (HFA, HFB & HFC)
Alternative fluids contact Tech. Dept.

Model Type

HM Standard
HMHD Heavy duty

Motor Frame Size

F080 F270
F200 F325

Shaft Type

See shaft type option list on Page 6

Shaft Orientation

Blank Standard orientation
V Vertically Up (extra drain)

High Displacement Code

### See displacement code details on pages 9 to 13

Medium Displacement Code

### See displacement code details on pages 9 to 13

Low Displacement Code

### See displacement code details on pages 9 to 13

Special Features

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

eg:
High pressure shaft seals
Alternative port connections
Stainless steel shaft sleeves
Alternative encoder and tacho drives
Motor valve housing orientation
Special paint
etc.

Design Series Number

10 Current series for HMF 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.

Displacement Control Ports

Threaded ports/bi-directional rotation

X X, Y and Z ports G 1/4” (BSPF to ISO 228/1)

Main Port Connections

### See port connection details on pages 7
1-2 Shaft Options

Product type

**HMF080**

- **P** = Parallel keyed 60mm diameter shaft
- **S** = Splined shaft 14 teeth BS3550
- **Z** = Splined shaft DIN5480 (W70x3x22x7h)
- **T** = Long taper keyed shaft - 95.2 key slot

**HMF200**

- **P1** = Parallel keyed 85mm 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

**HMF270**

- **P1** = Parallel keyed 85mm diameter shaft
- **S3** = Splined shaft 20 teeth BS3550
- **Z4** = Splined shaft DIN5480 (W90x4x21x7h)
- **T** = Long taper keyed shaft - 133.4 key slot

**HMF325**

- **P1** = Parallel keyed 85mm diameter shaft
- **S3** = Splined shaft 20 teeth BS3550
- **Z4** = Splined shaft DIN5480 (W90x4x21x7h)
- **T** = Long taper keyed shaft - 133.4 key slot

**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

## Product type

### HMF080
- **SM3** = 1 1/4” symmetrical ports with through-holes for manifold connection
- **F3** = 1 1/4” SAE 4-bolt flange
- **FM3** = 1 1/4” SAE 4-bolt flange
- **F4** = SAE 1 1/2” 4-bolt UNC flanges
- **FM4** = SAE 1 1/2” 4-bolt metric flanges

### HMF200
- **SM3** = 1 1/4” symmetrical ports with through-holes for manifold connection
- **F3** = 1 1/4” SAE code 61 4-bolt flange
- **FM3** = 1 1/4” SAE code 61 4-bolt flange
- **F4** = SAE 1 1/2” 4-bolt UNC flanges
- **FM4** = SAE 1 1/2” 4-bolt metric flanges

### HMF270
- **F4** = 1 1/2” SAE code 62 4-bolt flange
- **FM4** = 1 1/2” SAE code 62 4-bolt flange

### HMF325
- **F4** = 1 1/2” SAE code 62 4-bolt flange
- **FM4** = 1 1/2” SAE code 62 4-bolt flange

See pages 26 to 47 for full dimensional details.
Technical Information

2-1 Performance Data

Performance data is valid for the range of HMF motors when fully run-in and operating with mineral oil.

The appropriate motor displacements can be selected using performance data shown on pages 9 to 13. Refer to the table on this page for pressures and speed limits when using re-resistant fluids.

Limits for fire resistant fluids

<table>
<thead>
<tr>
<th>Fluid Type</th>
<th>Continuous Pressure (bar)</th>
<th>Intermittent Pressure (bar)</th>
<th>Max Speed (rpm)</th>
<th>Model Type</th>
</tr>
</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>250</td>
<td>275</td>
<td>As for mineral oil</td>
<td>All models</td>
</tr>
</tbody>
</table>

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

Rating definitions

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

Intermittent rating
Intermittent max pressure: 275 bar.

This pressure is allowable on the following basis:

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

Static pressure to DNV rules 380 bar.

Intermittent power rating
This is permitted on a 15% duty basis for periods up to 5 minutes maximum.
2-1 Performance Data (cont)

Available displacements

When selecting displacement modes on the HMF motors, there is an important rule that must be followed: due to physical constraints there is a minimum achievable difference between the medium and low displacement modes which varies across the frame sizes as shown in the table below:

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Minimum allowable difference between medium and low displacements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cc/rev</td>
</tr>
<tr>
<td>HMF080</td>
<td>655</td>
</tr>
<tr>
<td>HMF200</td>
<td>1,230</td>
</tr>
<tr>
<td>HMF270</td>
<td>1,720</td>
</tr>
<tr>
<td>HMF325</td>
<td>1,720</td>
</tr>
</tbody>
</table>

Minimum allowable medium displacement = low displacement + table value

Examples:

For HMF270 with 280 in³/rev. (4,588 cc/rev.) maximum displacement and 00 in³/rev. minimum displacement, the medium displacement must be above 105 in³/rev. (1,720 cc/rev).

Minimum allowable medium displacement = 0 + 105 = 105 in³/rev (1,720 cc/rev)

For HMF200 with 188 in³/rev. (3,087 cc/rev.) maximum displacement and 40 in³/rev. (655 cc/rev.) minimum displacement, the medium displacement must be above 115 in³/rev. (1,885 cc/rev).

Minimum allowable medium displacement = 40 + 75 = 115 in³/rev (1,885 cc/rev)
### 2-1 Performance Data (cont)

#### HMF080 Motor
(see page 15 for power calculation limits)

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>97.6</th>
<th>90</th>
<th>85</th>
<th>80</th>
<th>75</th>
<th>70</th>
<th>65</th>
<th>60</th>
<th>55</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>1.600</td>
<td>1.475</td>
<td>1.393</td>
<td>1.311</td>
<td>1.229</td>
<td>1.147</td>
<td>1.065</td>
<td>0.983</td>
<td>0.901</td>
<td>0.819</td>
</tr>
<tr>
<td>Average actual running torque</td>
<td>23.90</td>
<td>22.00</td>
<td>20.75</td>
<td>19.50</td>
<td>18.25</td>
<td>17.02</td>
<td>15.78</td>
<td>14.55</td>
<td>13.20</td>
<td>12.00</td>
</tr>
<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>93.9</td>
<td>93.7</td>
<td>93.6</td>
<td>93.5</td>
<td>93.3</td>
<td>93.2</td>
<td>93.1</td>
<td>93.0</td>
<td>92.1</td>
</tr>
<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
<td>87.1</td>
<td>86.0</td>
<td>85.2</td>
<td>84.3</td>
<td>83.3</td>
<td>82.1</td>
<td>80.8</td>
<td>79.2</td>
<td>77.4</td>
</tr>
<tr>
<td>Max continuous speed (SM3/F3/FM3) rpm</td>
<td></td>
<td>270</td>
<td>300</td>
<td>320</td>
<td>340</td>
<td>365</td>
<td>390</td>
<td>420</td>
<td>450</td>
<td>475</td>
</tr>
<tr>
<td>Max continuous speed (F4/FM4) rpm</td>
<td></td>
<td>365</td>
<td>400</td>
<td>415</td>
<td>430</td>
<td>445</td>
<td>460</td>
<td>475</td>
<td>490</td>
<td>500</td>
</tr>
<tr>
<td>Max continuous power kW</td>
<td>138</td>
<td>138</td>
<td>134</td>
<td>129</td>
<td>127</td>
<td>123</td>
<td>118</td>
<td>115</td>
<td>110</td>
<td>105</td>
</tr>
<tr>
<td>Max intermittent power kW</td>
<td></td>
<td>170</td>
<td>170</td>
<td>165</td>
<td>159</td>
<td>156</td>
<td>151</td>
<td>145</td>
<td>142</td>
<td>135</td>
</tr>
<tr>
<td>Max continuous pressure bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Max intermittent pressure bar</td>
<td></td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>45</th>
<th>40</th>
<th>35</th>
<th>30</th>
<th>25</th>
<th>20</th>
<th>15</th>
<th>10</th>
<th>5</th>
<th>00</th>
<th>00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>737</td>
<td>655</td>
<td>574</td>
<td>492</td>
<td>410</td>
<td>328</td>
<td>246</td>
<td>164</td>
<td>82</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>10.60</td>
<td>9.24</td>
<td>7.87</td>
<td>6.48</td>
<td>5.31</td>
<td>3.93</td>
<td>2.56</td>
<td>1.57</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>90.4</td>
<td>88.6</td>
<td>86.1</td>
<td>82.8</td>
<td>81.4</td>
<td>75.3</td>
<td>65.4</td>
<td>60.2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
<td>72.4</td>
<td>69.0</td>
<td>64.4</td>
<td>58.6</td>
<td>50.3</td>
<td>38.0</td>
<td>17.5</td>
<td>/</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Max continuous speed (SM3/F3/FM3) rpm</td>
<td></td>
<td>550</td>
<td>600</td>
<td>615</td>
<td>630</td>
<td>630</td>
<td>630</td>
<td>630</td>
<td>1,000</td>
<td>1,000</td>
<td>1,500**</td>
</tr>
<tr>
<td>Max continuous speed (F4/FM4) rpm</td>
<td></td>
<td>530</td>
<td>545</td>
<td>560</td>
<td>575</td>
<td>585</td>
<td>600</td>
<td>615</td>
<td>630</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Max continuous power kW</td>
<td>99</td>
<td>92</td>
<td>79</td>
<td>64</td>
<td>52</td>
<td>38</td>
<td>26</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Max intermittent power kW</td>
<td></td>
<td>122</td>
<td>113</td>
<td>97</td>
<td>97</td>
<td>64</td>
<td>47</td>
<td>32</td>
<td>15</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Max continuous pressure bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>17*</td>
<td>17*</td>
<td>17*</td>
</tr>
<tr>
<td>Max intermittent pressure bar</td>
<td></td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>17*</td>
<td>17*</td>
</tr>
</tbody>
</table>

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

*See page 19: small displacements.

**A crankcase flushing flow of 15 l/min is required when freewheeling at 1,500 rpm.
### 2-1 Performance Data (cont)

#### HMF200 Motor

(see page 15 for power calculation limits)

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>188</th>
<th>180</th>
<th>170</th>
<th>160</th>
<th>150</th>
<th>140</th>
<th>130</th>
<th>120</th>
<th>110</th>
<th>100</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>cc/rev</td>
<td>3.087</td>
<td>2.950</td>
<td>2.790</td>
<td>2.620</td>
<td>2.460</td>
<td>2.290</td>
<td>2.130</td>
<td>1.970</td>
<td>1.800</td>
<td>1.639</td>
</tr>
<tr>
<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>46.6</td>
<td>44.0</td>
<td>41.7</td>
<td>39.1</td>
<td>36.6</td>
<td>34.0</td>
<td>31.3</td>
<td>28.7</td>
<td>26.3</td>
<td>23.6</td>
</tr>
<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>94.8</td>
<td>93.7</td>
<td>93.9</td>
<td>93.8</td>
<td>93.5</td>
<td>93.3</td>
<td>92.3</td>
<td>91.5</td>
<td>91.8</td>
<td>90.5</td>
</tr>
<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
<td>85.4</td>
<td>84.9</td>
<td>83.9</td>
<td>83.1</td>
<td>81.8</td>
<td>80.7</td>
<td>79.1</td>
<td>77.2</td>
<td>75.4</td>
<td>72.8</td>
</tr>
<tr>
<td>Max continuous speed (SM3/F3/FM3)</td>
<td>rpm</td>
<td>175</td>
<td>180</td>
<td>190</td>
<td>195</td>
<td>200</td>
<td>205</td>
<td>210</td>
<td>225</td>
<td>240</td>
<td>270</td>
</tr>
<tr>
<td>Max continuous speed (F4/FM4)</td>
<td>rpm</td>
<td>230</td>
<td>235</td>
<td>240</td>
<td>245</td>
<td>250</td>
<td>265</td>
<td>285</td>
<td>310</td>
<td>340</td>
<td>365</td>
</tr>
<tr>
<td>Max continuous power</td>
<td>kW</td>
<td>174</td>
<td>174</td>
<td>174</td>
<td>165</td>
<td>148</td>
<td>148</td>
<td>139</td>
<td>131</td>
<td>122</td>
<td>114</td>
</tr>
<tr>
<td>Max intermittent power</td>
<td>kW</td>
<td>195</td>
<td>195</td>
<td>195</td>
<td>185</td>
<td>175</td>
<td>166</td>
<td>156</td>
<td>147</td>
<td>137</td>
<td>128</td>
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<tr>
<td>Max continuous pressure</td>
<td>bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Max intermittent pressure</td>
<td>bar</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>50</th>
<th>40</th>
<th>30</th>
<th>20</th>
<th>10</th>
<th>5</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>cc/rev</td>
<td>1.311</td>
<td>1.150</td>
<td>0.983</td>
<td>0.820</td>
<td>0.655</td>
<td>0.492</td>
<td>0.328</td>
<td>0.164</td>
<td>0.082</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>18.3</td>
<td>15.7</td>
<td>12.8</td>
<td>10.6</td>
<td>8.1</td>
<td>5.9</td>
<td>3.8</td>
<td>0.6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>87.7</td>
<td>85.8</td>
<td>81.8</td>
<td>81.2</td>
<td>77.7</td>
<td>75.3</td>
<td>72.8</td>
<td>23.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
<td>66.1</td>
<td>61.1</td>
<td>54.8</td>
<td>45.7</td>
<td>32.1</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Max continuous speed (SM3/F3/FM3)</td>
<td>rpm</td>
<td>340</td>
<td>390</td>
<td>450</td>
<td>500</td>
<td>600</td>
<td>630</td>
<td>630</td>
<td>1,000</td>
<td>1,000</td>
<td>1,500</td>
<td>**</td>
</tr>
<tr>
<td>Max continuous speed (F4/FM4)</td>
<td>rpm</td>
<td>430</td>
<td>460</td>
<td>485</td>
<td>515</td>
<td>545</td>
<td>575</td>
<td>600</td>
<td>630</td>
<td>1,000</td>
<td>1,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Max continuous power</td>
<td>kW</td>
<td>98</td>
<td>88</td>
<td>81</td>
<td>72</td>
<td>62</td>
<td>48</td>
<td>25</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Max intermittent power</td>
<td>kW</td>
<td>110</td>
<td>99</td>
<td>91</td>
<td>81</td>
<td>70</td>
<td>54</td>
<td>33</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Max continuous pressure</td>
<td>bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Max intermittent pressure</td>
<td>bar</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

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

*See page 19: small displacements.

**A crankcase flushing flow of 15 l/min is required when freewheeling at 1,500 rpm.
### 2-1 Performance Data (cont)

#### HMF270 Motor

(see page 15 for power calculation limits)

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>80</th>
<th>60</th>
<th>40</th>
<th>30</th>
<th>20</th>
<th>10</th>
<th>00</th>
<th>00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>cc/rev</td>
<td>1,311</td>
<td>983</td>
<td>655</td>
<td>492</td>
<td>328</td>
<td>164</td>
<td>0</td>
</tr>
<tr>
<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>17.1</td>
<td>12.2</td>
<td>7.9</td>
<td>5.2</td>
<td>2.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>82.0</td>
<td>78.0</td>
<td>75.8</td>
<td>65.8</td>
<td>46.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
<td>66.3</td>
<td>57.8</td>
<td>40.7</td>
<td>23.5</td>
<td>/</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Max continuous speed</td>
<td>rpm</td>
<td>430</td>
<td>460</td>
<td>490</td>
<td>515</td>
<td>545</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Max continuous power</td>
<td>kW</td>
<td>73</td>
<td>57</td>
<td>38</td>
<td>26</td>
<td>14</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Max intermittent power</td>
<td>kW</td>
<td>95</td>
<td>80</td>
<td>55</td>
<td>38</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Max continuous pressure</td>
<td>bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>17*</td>
<td>17*</td>
</tr>
<tr>
<td>Max intermittent pressure</td>
<td>bar</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>17*</td>
<td>17*</td>
</tr>
</tbody>
</table>

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

*See page 19: small displacements.

**A crankcase flushing flow of 15 l/min is required when freewheeling at 1,500 rpm.
### 2-1 Performance Data (cont)

#### HMF325 Motor (see page 15 for power calculation limits)

<table>
<thead>
<tr>
<th>Displacement Code</th>
<th>325</th>
<th>310</th>
<th>300</th>
<th>280</th>
<th>250</th>
<th>220</th>
<th>200</th>
<th>180</th>
<th>160</th>
<th>140</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>cc/rev</td>
<td>5,326</td>
<td>5,080</td>
<td>4,916</td>
<td>4,588</td>
<td>4,097</td>
<td>3,605</td>
<td>3,277</td>
<td>2,950</td>
<td>2,622</td>
<td>2,294</td>
</tr>
<tr>
<td>Average actual running torque</td>
<td>Nm/bar</td>
<td>80.4</td>
<td>76.6</td>
<td>74.1</td>
<td>69.1</td>
<td>61.6</td>
<td>53.9</td>
<td>49.0</td>
<td>43.6</td>
<td>38.3</td>
<td>33.2</td>
</tr>
<tr>
<td>Average actual mechanical efficiency</td>
<td>%</td>
<td>94.8</td>
<td>94.7</td>
<td>94.7</td>
<td>94.6</td>
<td>94.5</td>
<td>93.9</td>
<td>94.0</td>
<td>92.9</td>
<td>91.8</td>
<td>90.9</td>
</tr>
<tr>
<td>Average actual starting efficiency</td>
<td>%</td>
<td>85.7</td>
<td>85.4</td>
<td>85.2</td>
<td>84.7</td>
<td>83.8</td>
<td>82.7</td>
<td>81.8</td>
<td>80.6</td>
<td>79.2</td>
<td>77.3</td>
</tr>
<tr>
<td>Max continuous speed</td>
<td>rpm</td>
<td>130</td>
<td>135</td>
<td>140</td>
<td>150</td>
<td>160</td>
<td>170</td>
<td>190</td>
<td>215</td>
<td>230</td>
<td>275</td>
</tr>
<tr>
<td>Max continuous power</td>
<td>kW</td>
<td>189</td>
<td>189</td>
<td>189</td>
<td>189</td>
<td>176</td>
<td>161</td>
<td>150</td>
<td>139</td>
<td>128</td>
<td>116</td>
</tr>
<tr>
<td>Max intermittent power</td>
<td>kW</td>
<td>213</td>
<td>213</td>
<td>213</td>
<td>213</td>
<td>198</td>
<td>181</td>
<td>169</td>
<td>156</td>
<td>144</td>
<td>132</td>
</tr>
<tr>
<td>Max continuous pressure</td>
<td>bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Max intermittent pressure</td>
<td>bar</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
<td>275</td>
</tr>
</tbody>
</table>

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

*See page 19: small displacements.

**A crankcase flushing flow of 15 l/min is required when freewheeling at 1,500 rpm.
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>HMF</td>
<td>cc/rev</td>
<td>K₁</td>
<td>K₂</td>
<td>K₃</td>
<td>K₄</td>
</tr>
<tr>
<td>HMF080</td>
<td>1,344</td>
<td>9.50</td>
<td>45.70</td>
<td>5.80</td>
<td>7.90</td>
</tr>
<tr>
<td>HMF200</td>
<td>3,080</td>
<td>6.10</td>
<td>38.50</td>
<td>2.00</td>
<td>4.25</td>
</tr>
<tr>
<td>HMF270</td>
<td>4,310</td>
<td>6.50</td>
<td>37.30</td>
<td>1.50</td>
<td>6.00</td>
</tr>
<tr>
<td>HMF325</td>
<td>5,310</td>
<td>6.80</td>
<td>40.00</td>
<td>1.30</td>
<td>6.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fluid Viscosity</th>
<th>Viscosity Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>cSt</td>
<td>Kv</td>
</tr>
<tr>
<td>20</td>
<td>1.58</td>
</tr>
<tr>
<td>25</td>
<td>1.44</td>
</tr>
<tr>
<td>30</td>
<td>1.30</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 (total leakage) = \((K₁ + n/K₂) \times ΔP \times K_v \times 0.005\) l/min

Creep speed = \(K₃ \times ΔP \times K_v \times 0.005\) rpm

Crankcase leakage = \(K₄ \times ΔP \times K_v \times 0.005\) l/min

ΔP = differential pressure bar

n = speed rpm

The motor volumetric efficiency can be calculated as follows:

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

Example:

HMF200 motor with displacement of 3.087 l/rev.
Speed = 60 rpm
Differential pressure = 200 bar
Fluid viscosity = 50 cSt

Total leakage = \((K₁ + n/K₂) \times ΔP \times K_v \times 0.005\) l/min

\[\text{Total leakage} = (6.1 + 60/38.5) \times 200 \times 1 \times 0.005 = 7.7\text{ l/min}\]

Volume efficiency = \(\frac{(60 \times 3.087)}{(60 \times 3.087) + 7.7}\) x 100

\[\text{Volume efficiency} = 96\%\]
2-3 Shaft Power Calculation

Example: (see page 12)

HMF270 motor with a displacement code of 280:

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

Rated shaft power (W): 189,000
Average actual running torque (Nm/bar): 69.4
Rated shaft speed (rpm): 150

$$189,000 = 69.4 \times \Delta P \times 150 \times 2 \times \pi/60$$

$\Delta P = 174$ bar (max.)

Secondly, to find the maximum speed at rated pressure:

Rated shaft power (W): 189,000
Average actual running torque (Nm/bar): 69.4
Rated pressure (bar): 250

$$189,000 = 69.4 \times \Delta P \times 250 \times 2 \times \pi/60$$

$n = 104$ rpm (max.)

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

Notes:

1) The maximum calculated speed is based on a rated inlet pressure of 250 bar.
2) The maximum shaft power is only allowable if the motor drain temperature remains below 80°C.
3) The maximum calculated differential pressure assumes that the low pressure motor port is less than 30 bar.
2-4 Functional Symbols

Example model code:

HMF***/P/***/**/**/FM3/X/... 

X - external pilot supply to 'X' and 'Y' ports
2-5 Stress Limits

When applying large external radial loads, consideration should also be given to motor bearing lives (see page 18).

<table>
<thead>
<tr>
<th>Motor Frame Size</th>
<th>Maximum External Radial Bending Moment [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMF080</td>
<td>4,500</td>
</tr>
<tr>
<td>HMF200</td>
<td>6,750</td>
</tr>
<tr>
<td>HMF270</td>
<td>8,250</td>
</tr>
<tr>
<td>HMF325</td>
<td>8,250</td>
</tr>
</tbody>
</table>

**Example:**

Determine the maximum radial shaft load of a HMF motor:

Radial load offset, A = 100 mm  
Maximum radial load, W = 4,500 (see table)/100  
= 45kN (4,587 kg)

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 our Tech. Dept. if this is not the case.
2-6 Bearing Life Notes

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

1) Duty cycle - time spent on and off load
2) Speed
3) Differential pressure
4) Fluid viscosity
5) External radial shaft load
6) External axial shaft load
2-7 Circuit and Application Notes

⚠️ Limits for fire resistant fluids
To select either displacement, a pressure at least equal to 67% of the motor inlet/outlet pressure (whichever is higher) is required. In most applications the motor inlet pressure will be used. If the inlet/outlet pressure is below 3.5 bar, a minimum control pressure of 3.5 bar is required. In the event of loss of control pressure the motor will shift to its highest displacement.

⚠️ Starting torque
Refer to performance data, (see pages 9 to 15).

⚠️ Low speed operation
The minimum operating speed is determined by load inertia, drive elasticity, motor displacement and system internal leakage. If the application speed is below 3 rpm, then consult our Tech. Dept. If possible, always start the motor in high displacement.

⚠️ Small displacements
The pressures given in the table on pages 9 to 15 for displacement code “00” are based on 1,000 rpm output shaft speed. This pressure can be increased for shaft speeds less than 1,000 rpm; consult our Tech. Dept. for details. Speeds greater than 1,000 rpm may be applied but only after the machine duty cycle has been considered in conjunction with Tech. Dept. A zero swept volume displacement (for freewheeling requirements) is available on request.

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

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

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

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

<table>
<thead>
<tr>
<th>Motor Frame Size</th>
<th>Porting</th>
<th>Constant (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMF080</td>
<td>SM3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FM(3)</td>
<td>1.6 x 10^{10}</td>
</tr>
<tr>
<td></td>
<td>FM(4)</td>
<td>3.3 x 10^{10}</td>
</tr>
<tr>
<td>HMF200</td>
<td>SM3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FM(3)</td>
<td>1.6 x 10^{10}</td>
</tr>
<tr>
<td></td>
<td>FM(4)</td>
<td>3.3 x 10^{10}</td>
</tr>
<tr>
<td>HMF270 &amp; HMF325</td>
<td>FM(4) S04</td>
<td>4.0 x 10^{10}</td>
</tr>
</tbody>
</table>
The flow rate of oil for the make-up system can be estimated from the crankcase leakage data (see page 14) plus an allowance for changing displacement:

\[ \text{e.g.} \]

- **HMF080**: To change high to low in 0.25 sec requires 32 l/min
- **HMF200**: To change high to low in 0.5 sec requires 15 l/min
- **HMF270**: To change high to low in 1 sec requires 24 l/min
- **HMF325**: To change high to low in 1 sec requires 20 l/min

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

**Motorcase pressure**

Dependent on motor (see model code fluid type - page 5) suitable fluids include:

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

Reduce pressure and speed limits, as per table on page 8.

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

- **Max. off load**: 2,000 cSt (9,270 SUS)
- **Max. on load**: 150 cSt (695 SUS)
- **Optimum**: 50 cSt (232 SUS)
- **Minimum**: 25 cSt (119 SUS)

**Mineral oil recommendations**

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

**Notes**

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

2) High pressure shaft seals are available to special order for casing pressures of: 10 bar continuous and 15 bar intermittent.

3) Check installation dimensions (pages 26 to 47) for maximum crankcase drain fitting depth.
2-7 Circuit and Application Notes (cont)

Temperature limits

<table>
<thead>
<tr>
<th></th>
<th>Mineral oil</th>
<th>Water containing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient min.</td>
<td>-30°C</td>
<td></td>
</tr>
<tr>
<td>Ambient max.</td>
<td>+70°C</td>
<td></td>
</tr>
<tr>
<td>Max. operating temperature range.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min</td>
<td>-20°C</td>
<td>+10°C</td>
</tr>
<tr>
<td>Max. *</td>
<td>+80°C</td>
<td>+54°C</td>
</tr>
</tbody>
</table>

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

Filtration

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

Noise levels

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

Polar moment of intertia and mass table

<table>
<thead>
<tr>
<th>Motor Frame Size</th>
<th>Displacement code</th>
<th>Polar Moment of Intertia (kg.m²) (Typical)</th>
<th>Mass (kg) (Approx. all models)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMF080</td>
<td>90</td>
<td>0.0520</td>
<td>172</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>0.0440</td>
<td></td>
</tr>
<tr>
<td>HMF200</td>
<td>188</td>
<td>0.2300</td>
<td>282</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>0.1800</td>
<td></td>
</tr>
<tr>
<td>HMF270</td>
<td>280</td>
<td>0.4900</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>0.4700</td>
<td></td>
</tr>
<tr>
<td>HMF325</td>
<td>325</td>
<td>0.5000</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>0.4700</td>
<td></td>
</tr>
</tbody>
</table>

Mass

HMF080 Approx. all models 172 kg.
HMF200 Approx. all models 282 kg.
HMF270 Approx. all models 450 kg.
HMF325 Approx. all models 460 kg.
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.

It is recommended that the motor is operated by observing the rule for viscosity and the minimum operating temperature.
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 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 of the motor determined by the maximum overrunning load condition (see boost pressure calculation method on page 1).

It should be noted that for "B" motors large flows will 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 "C" series motors are the preferred option for freewheeling applications. It is normal to select displacement codes 00, 05 or 10.

Selecting the lowest zero displacement option (00) will allow the motor shaft to be rotated at high speed without pumping fluid and with a minimum boost and drive torque requirement. Consideration must also be given when freewheeling that the load does not drive the motor above its rated freewheeling speed condition. (see pages 9 to 13).

Displacement selection

Under all operating conditions the control pressure port should be at least 67% of the motor inlet/outlet pressure whichever is the higher.

A minimum control pressure at the low displacement selection port of 3.5 bar is necessary to ensure that the motor remains in its minimum displacement condition. A separate pressure supply may be necessary to ensure this condition is always maintained. It should be noted that with the loss of control pressure, the motor will shift to its high displacement condition, which could result in damage to the motor.

Boost requirement

The minimum required boost pressure as noted above can be ascertained utilising the calculation method shown on page 21. The maximum motor and control pressure at 100 rpm is 17 bar and must not be exceeded since higher pressures will increase motor losses at the conrod slipper interface and valve assembly and thereby will significantly increase the motor operating temperature.

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

Crankcase cooling

A crankcase flushing flow of up to 15 l/min can be used to control and reduce the temperature rise of the motor during the freewheel operation.

This should not be necessary for speeds below 1,000 rpm.

For speeds above this up to 1,500 rpm then crankcase flushing flow must be used.
2-11 Installation Data

General

Spigot
The motor should be located by the mounting spigot on a flat, robust surface using correctly sized bolts. The diametrical clearance between the motor spigot and the mounting must not exceed 0.15 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>Size</th>
<th>Torque Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>M18</td>
<td>312 +/- 7 Nm</td>
</tr>
<tr>
<td>5/8&quot; UNF</td>
<td>265 +/- 14 Nm</td>
</tr>
<tr>
<td>M20</td>
<td>407 +/- 14 Nm</td>
</tr>
<tr>
<td>3/4&quot; UNF</td>
<td>393 +/- 14 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.

Motor axis - horizontal
The crankcase drain must be taken from a position above the horizontal centre line of the motor, (refer to installation drawing for details).

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

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

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

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

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

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

## Conversion Table

<table>
<thead>
<tr>
<th></th>
<th>Pressure</th>
<th>Torque</th>
<th>Power</th>
<th>Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bar</td>
<td>PSI</td>
<td>Nm</td>
<td>kg</td>
</tr>
<tr>
<td>1</td>
<td>14.5</td>
<td></td>
<td>0.737</td>
<td></td>
</tr>
<tr>
<td></td>
<td>l/min</td>
<td>gal/min</td>
<td>kW</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.264 US</td>
<td></td>
<td>1.341</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.219 UK</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>25.4</td>
</tr>
</tbody>
</table>

## 3-1 HMF080

### 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 EQU-SPACED AS SHOWN ON A #27.03 P.C.D. SPOTFACED TO GIVE AN EFFECTIVE #40.
3-1 HMF080 (cont)

- '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: 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

**KEY SUPPLIED**
- 1/8”-20 UNF-2B X 32 FULL THREAD DEPTH

**MOUNTING FACE**

- 11.08/11.95 THICK

- 1/2”-20 UNF-2B X 32 FULL THREAD DEPTH
3-1 HMF080 (cont)

'T' Shaft

![Diagram of 'T' Shaft with dimensions and labels]
3-1 HMF080 (cont)

'SM3' Valve Housing
3-1 HMF080 (cont)


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
Three-Speed Radial
Piston Staffa Motors HMF

3-1 HMF080 (cont)

‘X’ C Spacers

TYPE X
DISPLACEMENT CONTROL

DISPLACEMENT SELECTION (VIA REMOTELY
LOCATED VALVE*)
HIGH DISPLACEMENT: P TO Y; X TO T
LOW DISPLACEMENT: P TO X; Y TO T
MID DISPLACEMENT: P TO X AND Z; Y TO T
SEE TIMING CHART.
*DISPLACEMENT SELECTOR VALVE IS NOT
SUPPLIED WITH MOTOR.
3-2 HMF200

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.

SEE C-SPACERS
3-2 HMF200 (cont)

- 'P1', 'S3' and 'Z3' 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: 78.485/78.625
- PIN DIAMETER: 8.128
- DIAMETER OVER PINS: 97.084/97.030

**'Z3'**
- DIN 5480 M85 x 3 x 27 x 7h
3-2 HMF200 (cont)

"T" Shaft

![Diagram of 'T' Shaft]
3-2 HMF200 (cont)

*SM3* Valve Housing
3-2 HMF200 (cont)

‘F3’, ‘FM3’, ‘F4’ & ‘FM4’ 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
3-2 HMF200 (cont)

‘X’ C Spacers

TYPE X
DISPLACEMENT CONTROL

DISPLACEMENT SELECTION (VIA REMOTELY
LOCATED VALVE)
HIGH DISPLACEMENT: P TO Y; X TO T
LOW DISPLACEMENT: P TO X; Y TO T
MID DISPLACEMENT: P TO X AND Z; Y TO T
SEE TIMING CHART.
*DISPLACEMENT SELECTOR VALVE IS NOT
SUPPLIED WITH MOTOR.
3-3 HMF270

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.
3-3 HMF270 (cont)

- ‘P1’, ‘S3’ and ‘Z4’ 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

**‘Z4’**
- DIN 5480 W90 x 4 x 21 x 7h
3-3 HMF270 (cont)

‘T’ Shaft

KEY SUPPLIED —
25.45/25.40 WDE
17.538/17.463 THICK

M30 x 60 LG
HEX HEAD SCREW

BASIC TAPER, ON DIAMETER
0.1001/0.0999 PER mm
3-3 HMF270 (cont)

‘F4’ & ‘FM4’ Valve Housings
Three-Speed Radial Piston Staffa Motors HMF

3-3 HMF270 (cont)

‘X’ C Spacers

- Displacement Selection (via remotely located valve):
  - High Displacement: P to Y, X to T
  - Low Displacement: P to Z, Y to T
  - Mid Displacement: P to X and Z, Y to T

See timing chart.

*Displacement Selector Valve is not supplied with motor.
Three-Speed Radial Piston Staffa Motors HMF

3-4 HMF325

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

SEE C-SPACERS

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

CLOCKWISE DIRECTION OF ROTATION

MOUNTING FACE

HT 18 / C / 201 / 0916 / E  Pag. 43
3-4 HMF325 (cont)

◇ ‘P1’, ‘S3’ and ‘Z4’ Shafts

SPLINE DATA

'S'
- TO BS 3550 (ANSI B92.1, CLASS 5)
- FLAT ROOT SIDE FIT, CLASS 1
- PRESSURE ANGLE: 30°
- NUMBER OF TEETH: 20
- PITCH: 6/10
- 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 W90 x 4 x 21 x 7h
3-4 HMF325 (cont)

‘T’ Shaft
'F4' & 'FM4' Valve Housings

**F4/FM4**

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

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

VIEW ON ARROW 'A'

PORT 1

PORT 2

36.5

79.4

174

PORTS (6000 SERIES)

8 HOLES, SEE TABLE FOR THREAD SIZES

79.4

375

511

430
3-4 HMF325 (cont)

- X C Spacers

Displacement selection (via remotely located valve)

- High displacement: P to Y; X to T
- Low displacement: P to X; Y to T
- Mid displacement: P to X and Z; Y to T

*Displacement selector valve is not supplied with motor.
Three-Speed Radial
Piston Staffa Motors HMF

3-5 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.
As HANSA-TMP has a very extensive range of products and some products have a variety of applications, the information supplied may often only apply to specific situations.

If the catalogue does not supply all the information required, please contact HANSA-TMP.
In order to provide a comprehensive reply to queries we may require specific data regarding the proposed application.

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