Staffa Fixed Displacement Hydraulic Motor
1. GENERAL DESCRIPTION

The HMB045 fixed displacement motor is one of 12 frame sizes in the Kawasaki “Staffa” range of high torque, low speed radial piston motors which extends from 94 to 6800 cm³/r (5.76 to 415 in³/r) capacity. The rugged, well-proven design incorporates hydrostatic balancing techniques to achieve high efficiency, combined with good breakout torque and smooth running capability.

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

The HMB045 is capable of torque outputs up to 3230 Nm (2380 lbf ft) and speeds to 400 r/min with a continuous output of up to 60 kW (80 hp).

The Kawasaki “Staffa” range also includes dual and continuously variable displacement motors, plus matching brakes and gearboxes to extend the available torque range.

2. FUNCTIONAL SYMBOLS

Model types with variants in model code position 4

HMB045-**-30
(No symbol in model code position 4)

HMB045-**-D-30

3. MODEL CODE

Features shown in brackets ( ) may be left blank according to requirements. All other features must be specified.

(F**) - HM(*)B045-**-*(*)-**-3*- (PL**)

1 FLUID TYPE
Blank = Petroleum oil
F3 = Phosphate ester (HFD fluid)
F11 = Water-based fluids (HFA, HFB & HFC)

2 MODEL TYPE
Blank = Standard (“HMB”)
M = To NCB (UK) specification 463/1981 (“HMMB”)

3 SHAFT TYPE
P* = Cylindrical shaft with key
S* = Cylindrical, 17 splines to BS 3550
Z* = Cylindrical, splines to DIN 5480 (W55 x 3 x 17 x 7h)
Q* = Internally splined shaft to BS 3550; 21 splines

* For installations where shaft is vertically upwards specify “V” after shaft type letter to ensure that additional high level drain port is provided.

4 MAIN PORT CONNECTIONS
Blank = Rear entry ports G1” (BSPF)
D = Dual entry ports G1” (BSPF)

5 TACHO/ENCODER DRIVE
T = Staffa original tacho drive
T1 = Suitable for Hohner 3000 series encoders. (Encoder to be ordered separately).
Omit if not required.

6 DESIGN NUMBER, 3* SERIES
Subject to change. Installation and performance details remain unaltered for design numbers 30 to 70 inclusive.

7 SPECIAL FEATURES
PL** = non-catalogued features, e.g:
Stainless steel shaft sleeves
Alternative encoder and tacho drives
Alternative port connections
Shaft variants
Alternative capacities
Special mountings
Special paint

** Number assigned as required to specific customer build.
4. PERFORMANCE DATA
Performance data is valid for Staffa HMB045 motors fully run in and operating with petroleum oil. See separate table for pressure and speed limits when using fire-resistant fluids. Leakage values are at fluid viscosity of 50 cSt (232 SUS).

MOTOR DATA
<table>
<thead>
<tr>
<th></th>
<th>740 cm³/r (45 in³/r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometric displacement</td>
<td>740 cm³/r (45 in³/r)</td>
</tr>
<tr>
<td>Average actual running torque</td>
<td>10,95 Nm/bar (0.557 lbf ft/psi)</td>
</tr>
<tr>
<td>Max. continuous speed</td>
<td>400 r/min</td>
</tr>
<tr>
<td>Max. continuous output</td>
<td>60 kW (80 hp)</td>
</tr>
<tr>
<td>Max. continuous pressure</td>
<td>250 bar (3625 psi)</td>
</tr>
<tr>
<td>Max. intermittent pressure</td>
<td>293 bar (4250 psi)</td>
</tr>
</tbody>
</table>

\* Other displacements are made available to special order
\* See “Rating Definitions”, this page

LIMITS FOR FIRE RESISTANT FLUIDS

<table>
<thead>
<tr>
<th>Fluid type</th>
<th>Pressure, bar (psi)</th>
<th>Max. speed r/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFA, 5/95% oil-in-water emulsion</td>
<td>103 (1500)</td>
<td>138 (2000) 50% of limits for petroleum oil</td>
</tr>
<tr>
<td>HFB, 60/40% water-in-oil emulsion</td>
<td>138 (2000)</td>
<td>172 (2500) As for petroleum oil</td>
</tr>
<tr>
<td>HFC, water glycol</td>
<td>103 (1500)</td>
<td>138 (2000) 50% of limits for petroleum oil</td>
</tr>
<tr>
<td>HFD, phosphate ester</td>
<td>250 (3625)</td>
<td>293 (4250) As for petroleum oil</td>
</tr>
</tbody>
</table>

OUTPUT TORQUES

The 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 petroleum oil of 50 cSt (232 SUS) viscosity. High return line pressures will reduce torque for a given pressure differential.

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
Up to 293 bar (4250 psi) is allowable on the following basis:
(a) Up to 50 r/min: 15% duty for periods up to 5 minutes maximum.
(b) Over 50 r/min: 2% duty for periods up to 30 seconds maximum.
The nomograph allows the median bearing life to be determined for conditions of:
1. No side load and no axial thrust
2. Side load and no axial thrust

To determine L10 life predictions per ISO 281-1-1977 multiply the median figure by 0.2.

**HMB045**

**Example 1 (follow chain dotted line):**
- Side load (W) a) 0
- System pressure (P) b) 138 bar (2000 psi)
- Speed (N) c) 200 r/min
- Median bearing life d) 115 000 hrs
- L10 bearing rating = median x 0.2 e) 23 000 hrs

**Example 2 (follow chain dotted line):**
- Side load (W) e) 25 kN (5600 lbf)
- Load offset (A) from motor mounting face f) 50 mm (2.0 in)
- System pressure (P) g) 138 bar (2000 psi)
- Speed (N) h) 200 r/min
- Median bearing life i) 39 000 hrs
- L10 bearing rating = median x 0.2 j) 7800 hrs

For more precise life prediction, or where axial thrusts are incurred, a computer analysis can be provided by Kawasaki on receipt of machine duty cycle.

**SHAFT STRESS LIMIT**
The shaft stress limit in the nomograph is based on the fatigue rating of shaft types “S” and “P”. Infrequent loading above these limits may be permitted; consult Kawasaki.
This nomograph enables the average volumetric efficiency, crankcase (drain) leakage and “winch slip”/shaft creep speed to be estimated.

Example (follow chain dotted line):
Given:
1. Pressure ............... 170 bar (2500 psi)
2. Speed ......................... 50 r/min
3. Viscosity .................... 50 cSt (232 SUS)

To obtain:
4. Volumetric efficiency ............ 93.6%
5. Crankcase leakage ............. 1.5 l/min
   (90 in³/min)
6. Shaft creep speed ............. 2.3 r/min

The shaft creep speed occurs when the load attempts to rotate the motor against closed ports as may occur, for example, in winch applications.
5. CIRCUIT AND APPLICATION NOTES

STARTING TORQUES
The starting torques shown on the graph on page 3 are average and will vary with system parameters.

LOW SPEED OPERATION
Minimum operating speeds are determined by load conditions (load inertia, drive elasticity, etc.). For operation at speeds below 6 r/min consult Kawasaki.

HIGH BACK PRESSURE
When both inlet and outlet ports are pressurized continuously, the lower pressure in one port must not exceed 70 bar (1000 psi). Consult Kawasaki on applications beyond this limit. Note that high back pressures reduce 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 inlet ports. Calculate “P” from:

\[
P \text{ (bar)} = 1 + \frac{N^2}{23 \ 200} + C \text{ bar}
\]

\[
P \text{ (psi)} = 14.5 + \frac{N^2}{1600} + C \text{ psi}
\]

Where:
N = speed, r/min
C = crankcase pressure

The flow rate of oil needed for the make-up system can be estimated from the crankcase leakage figure (see Volumetric Efficiency graph on page 5). Allowance should be made for other system losses and also for “fair wear and tear” during the life of the motor, pump and other system components.

COOLING FLOW
Operation within the continuous ratings does not require any additional cooling.

For operating conditions above “continuous”, up to the “intermittent” ratings, additional cooling oil may be required. This can be introduced through the spare crankcase drain hole or, in special cases, through the valve spool end cap. Consult Kawasaki about such applications.

MOTOR CASING PRESSURE
With the standard shaft seal fitted, the motor casing pressure should not exceed 3.5 bar (50 psi). On installations with long drain lines a relief valve is recommended to prevent overpressurizing the seal.

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 to special order for casing pressures of:
   Continuous: 10 bar (150 psi)
   Intermittent: 15 bar (225 psi)
3. Check installation dimensions (page 8) for maximum crankcase drain fitting depth.
6. HYDRAULIC FLUIDS
Dependent on motor (see Model Code position 1) suitable fluids include:
- Antiwear hydraulic oils
- Phosphate esters (HFD fluids)
- Water glycols (HFC fluids) ▲
- 60/40% water-in-oil emulsions (HFB fluids) ▲
- 5/95% oil-in-water emulsions (HFA fluids) ▲
▲ Reduced pressure and speed limits, see page 3.
Viscosity limits when using any fluid except oil-in-water (5/95%) emulsions are:
Max. off load .......... 2000 cSt (9270 SUS)
Max. on load .......... 150 cSt (695 SUS)
Optimum .................. 50 cSt (232 SUS)
Minimum .................. 25 cSt (119 SUS)

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

7. TEMPERATURE LIMITS
Ambient min. ............... -30°C (-22°F)
Ambient max. ............... +70°C (158°F)
Max. operating temperature range

<table>
<thead>
<tr>
<th>Petroleum oil containing</th>
<th>Water oil containing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.</td>
<td>-20°C (-4°F)</td>
</tr>
<tr>
<td></td>
<td>+10°C (50°F)</td>
</tr>
<tr>
<td>Max.*</td>
<td>+80°C (175°F)</td>
</tr>
<tr>
<td></td>
<td>+54°C (130°F)</td>
</tr>
</tbody>
</table>

* To obtain optimum service life from both fluid and hydraulic system components 65°C (150°F) normally is the maximum temperature except for water-containing fluids.

8. FILTRATION
Full flow filtration (open circuit), or full boost flow filtration (closed circuit) to ensure system cleanliness of ISO 4406/1986 code 18/14 or cleaner.

9. NOISE LEVELS
The airborne noise level is less than 66.7 dB(A) DIN (70 dB(A) NFPA) throughout 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 (30 to 70 psi).

10. POLAR MOMENT OF INERTIA
Typical data: 0.047 kg m² (160 lb in²).

11. MASS
Approx., all models: 120 kg (265 lb).

12. INSTALLATION DATA
GENERAL
- Spigot
The motor should be located by the mounting spigot on a flat, robust surface using correctly sized bolts. The diametral clearance between the motor spigot and the mounting must not exceed 0.15 mm (0.006 in). 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 settings for the mounting bolts are:
M18 ............312 ±14 Nm (230 ±10 lbf ft)
5/8" ..........265 ±14 Nm (195 ±10 lbf ft)
- Shaft coupling
Where the motor is solidly coupled to a shaft having independent bearings the shafts must be aligned to within 0.10 mm (0.004 in) TIR.

START-UP
Fill the crankcase with system fluid. Where practical, a short period (30 minutes) of “running in” should be carried out.
13. INSTALLATION DIMENSIONS IN MM (INCHES)

HMB045-**-3* MOTOR WITH REAR ENTRY PORTS (NO SYMBOL IN MODEL CODE POSITION)
HMB045-**-D-3* MOTOR WITH DUAL ENTRY PORTS ("D" IN MODEL CODE POSITION)

2 ports G1" (BSPF) x 25.0 (1.0) deep. (Dual entry models are supplied with these rear ports plugged)

Ö 434,0 (17.1 dia)
71,0 (2.81)
71,0 (2.81)

5 holes Ø 18.0 (0.709 dia) equi-spaced as shown on 305,0 (12.0) pcd and spotfaced to Ø 38.0 (1.5 dia)

2 drain ports, 1 supplied plugged, G1/4" (BSPF) x 19.0 (0.75) deep, spotfaced to Ø 28,0 (1.125 dia)

2 ports G1" (BSPF) x 25.0 (1.0) deep. (Dual entry models are supplied with these rear ports plugged)

Ö 124,0 (4.88 dia)

Flow directions for shaft rotation shown. Reverse flow directions for opposite rotation.

See shaft details on page 9

Mounting face
Ø 225,40/225,32 (8.874/8.871 dia)
349,0 (13.75) max.

3rd angle projection
SHAFT TYPE “P”, MODEL CODE POSITION 3
Cylindrical shaft with key

Key (supplied) 14,046/14,028 (0.5530/0.5523)
wide x 9,037/8,961 (0.3556/0.3528) thick

Mounting face

SHAFT TYPE “S”, MODEL CODE POSITION 3
Cylindrical shaft with 17 splines to BS 3550-1963
SHAFT TYPE “Z”, MODEL CODE POSITION 3
Cylindrical shaft to DIN 5480

Note: The type “Q” shaft will transmit the maximum torques given on page 3. However, customers should ensure that their own mating shaft will transmit the torque required in their application.

SHAFT TYPE “Q”, MODEL CODE POSITION 3
Internally splined to BS 3550; 21 splines

For shaft type “S”
To BS 3550-1963 and ASA.B5.15-1960
Flat root side fit, class 1
Pressure angle 30°
Number of teeth 17
Pitch 8/16
Major diameter 56.41/56.28 (2.221/2.216)
Form diameter 50.703 (1.9962)
Minor diameter 50.07/49.60 (1.971/1.953)
Pin diameter 6.096 (0.2400)
Diameter over pins 62.985/62.931 (2.4797/2.4776)

For shaft type “Z”
DIN 5480, W55 x 3 x 17 x 7h

Internal spline to BS 3550-1963
Flat root, side fit
Pressure angle 30°
Number of teeth 21
Pitch 12/24
Major diameter 46.566/46.896 (1.8333/1.8463)
Minor diameter 42.334/42.461 (1.6667/1.6717)
Pin diameter 3.658 (0.1440)
Pin flatted to 3.556 (0.1400)
Diameter between pins 39.169/39.103 (1.5421/1.5395)
Staffa hydraulic motors are manufactured to the highest quality standards in a Kawasaki ISO 9001 certified facility. Certification No. 891150