



Kawasaki Motors Corp., U.S.A.
Precision Machinery Division

HMB 045

**Staffa Fixed Displacement
Hydraulic Motor**



CONTENTS

	Page
1. General Description	2
2. Functional Symbols	2
3. Model Code	2
4. Performance Data:	
Motor data	3
Rating definitions	3
Output torques	3
Bearing life	4
Volumetric efficiency	5
5. Circuit and Application Notes:	
Starting torques	6
Low speed operation	6
High back pressure	6
Boost pressure	6
Cooling flow	6
Motor casing pressure	6
6. Hydraulic Fluids	7
7. Temperature Limits	7
8. Filtration	7
9. Noise Levels	7
10. Polar Moment of Inertia	7
11. Mass	7
12. Installation Data:	
General	7
Crankcase drain	7
Start-up	7
13. Installation Dimensions	8 to 9

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.

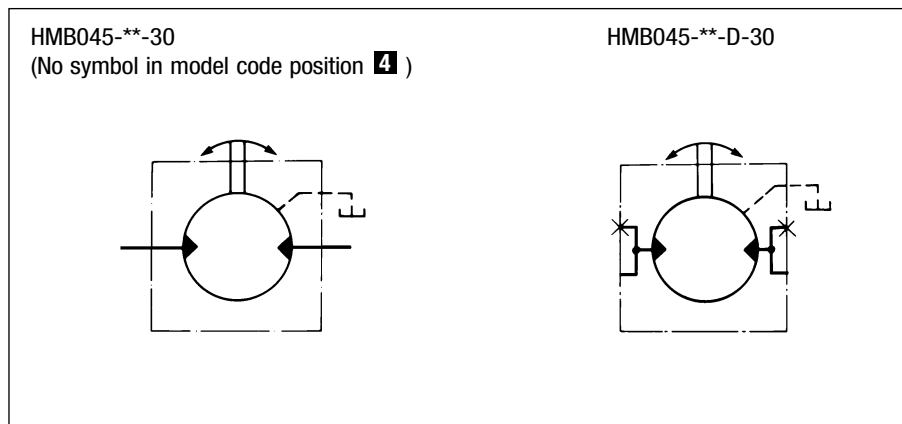
Various features and options are available including, on request, mountings to match competitor interfaces.

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**



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 **2** **3** **4** **5** **6** **7**

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

Geometric displacement▲	740 cm ³ /r (45 in ³ /r)
Average actual running torque	10,95 Nm/bar (0.557 lbf ft/psi)
Max. continuous♦speed	400 r/min
Max. continuous♦output	60 kW (80 hp)
Max. continuous♦pressure	250 bar (3625 psi)
Max. intermittent♦pressure	293 bar (4250 psi)

▲ Other displacements are made available to special order

♦ See "Rating Definitions", this page

LIMITS FOR FIRE RESISTANT FLUIDS

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

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.

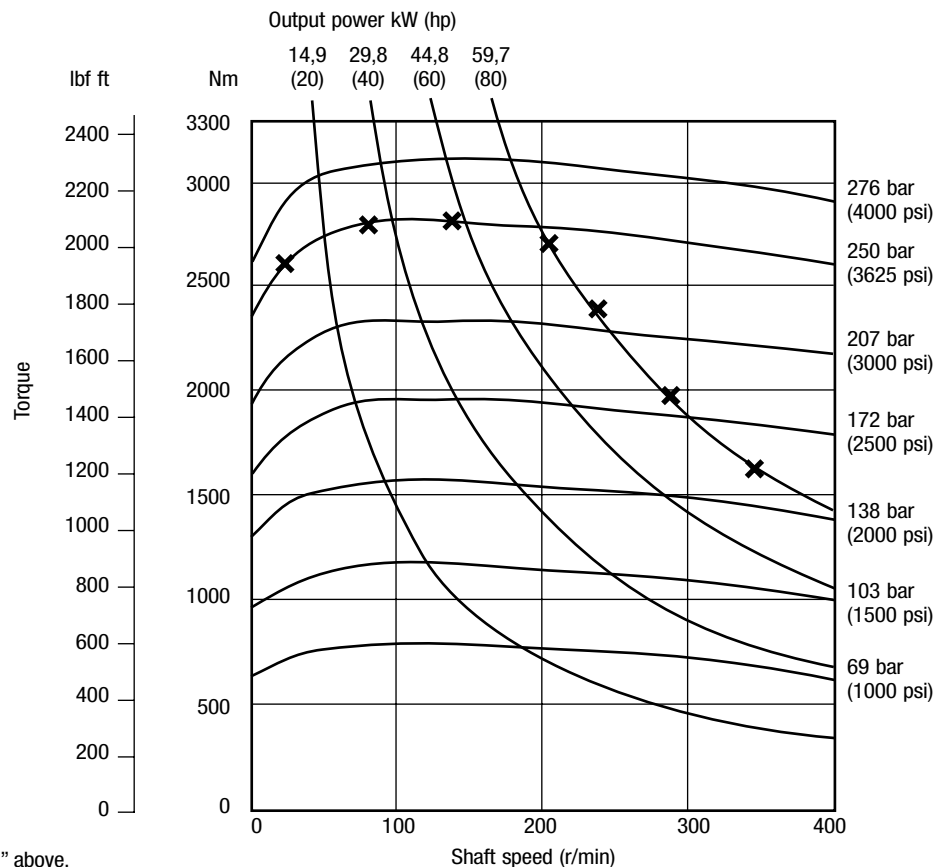
● INTERMITTENT MAX. PRESSURE

Up to 293 bar (4250 psi) is allowable on the following basis:

- Up to 50 r/min: 15% duty for periods up to 5 minutes maximum.
- Over 50 r/min: 2% duty for periods up to 30 seconds maximum.

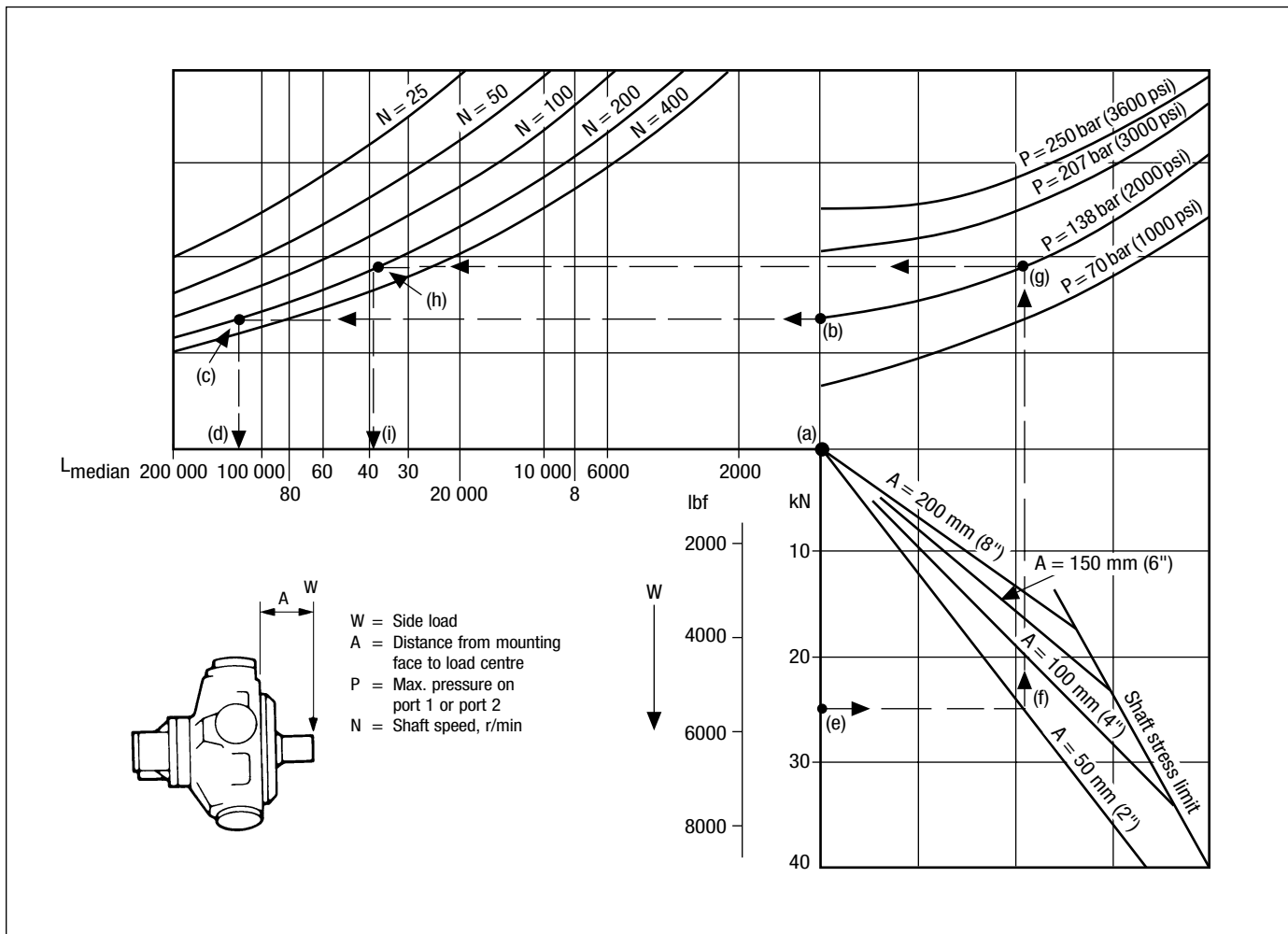
OUTPUT TORQUES

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.



—x—x—x— Upper limit of continuous rating envelope, see "Rating definitions" above.

BEARING LIFE



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.

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.

HMB045

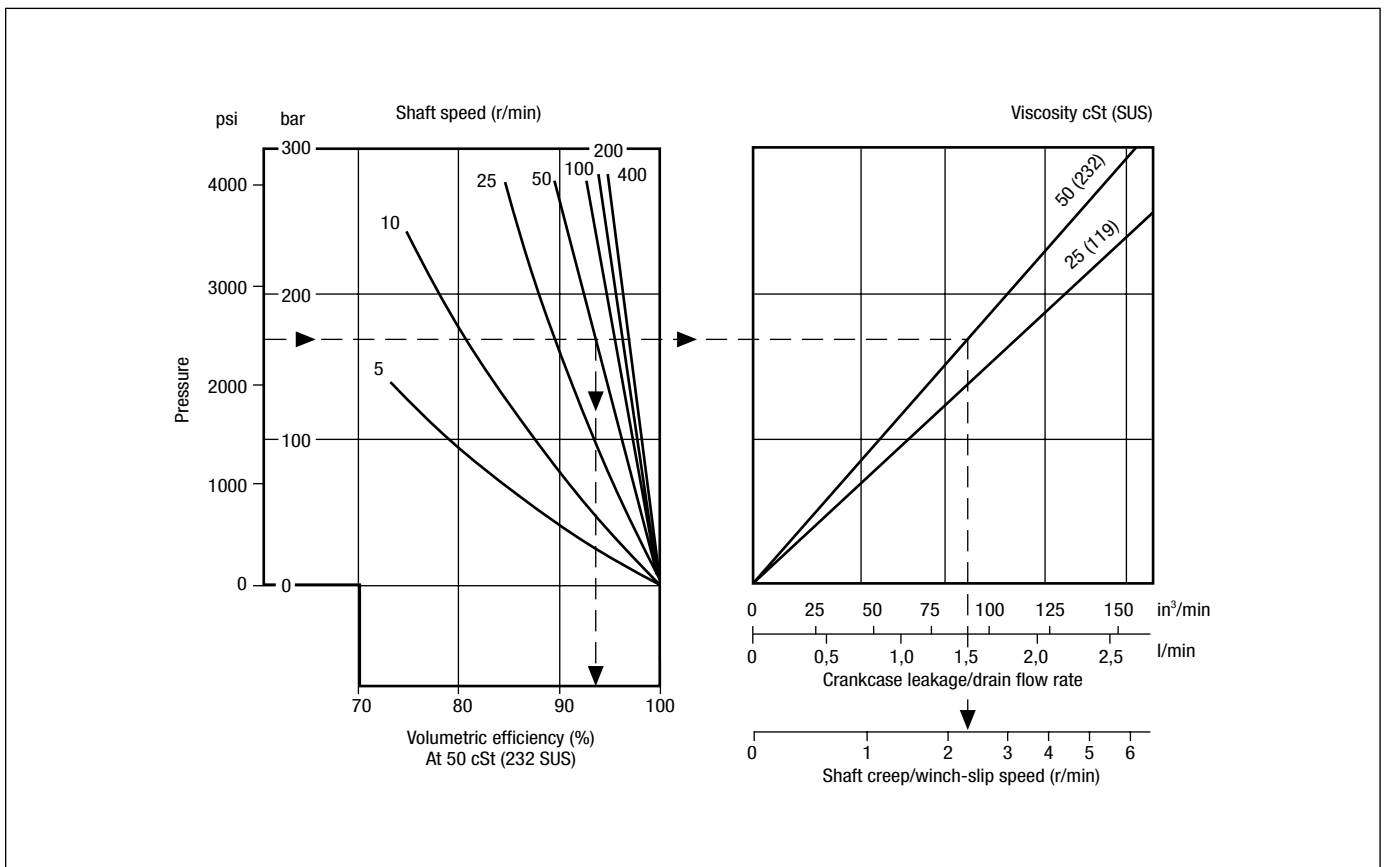
Example 1 (follow chain dotted line):

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	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	7800 hrs

VOLUMETRIC EFFICIENCY



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 over-pressurizing 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

	Petroleum oil	Water-containing
Min.	-20°C (-4°F)	+10°C (50°F)
Max.*	+80°C (175°F)	+54°C (130°F)

* *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

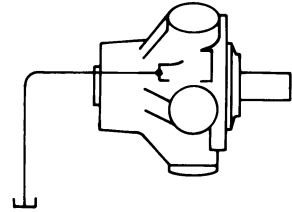
● **Spigot**
The motor should be located by the mounting spigot on a flat, robust surface using correctly sized bolts. The diametral clearance between the motor spigot and the mounting must not exceed 0,15 mm (0.006 in). If the application incurs shock loading, frequent reversing or high speed running, then high tensile bolts should be used, including one fitted bolt.

● **Bolt torque**
The recommended torque wrench settings for the mounting bolts are:
M18312 ±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.

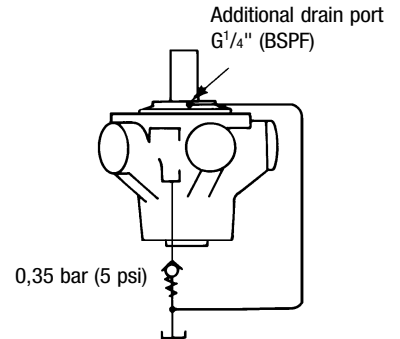
CRANKCASE DRAIN

Motor axis horizontal



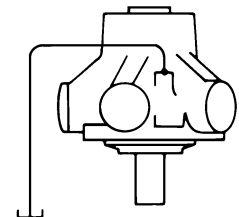
The crankcase drain must be taken from a position above the horizontal centre line of the motor.

Axis vertical, shaft up



An additional G¹/₄" (BSPF) drain port is provided when the “V” (shaft vertically upwards) designator is given after the shaft type letter in position **3** of the model code. This additional drain should be connected into the main motor casing drain line downstream of a 0,35 bar (5 psi) check valve to ensure lubrication of the upper bearing, see above diagram.

Axis vertical, shaft down



Use either drain position. The drain line should be run above the level of the uppermost bearing; if there is a risk of siphoning then a siphon breaker should be fitted.

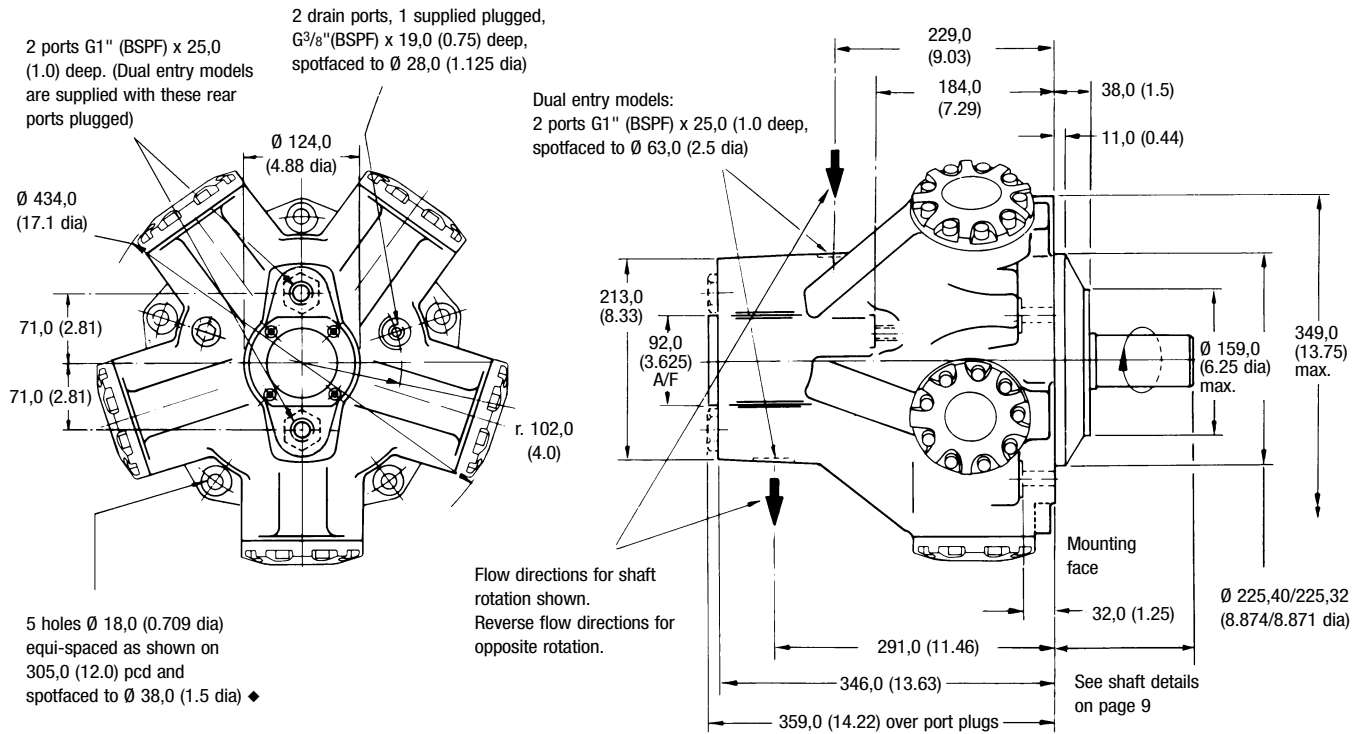
START-UP

Fill the crankcase with system fluid. Where practical, a short period (30 minutes) of “running in” should be carried out.

13. INSTALLATION DIMENSIONS IN MM (INCHES)

HMB045--3* MOTOR WITH REAR ENTRY PORTS (NO SYMBOL IN MODEL CODE POSITION 4)**

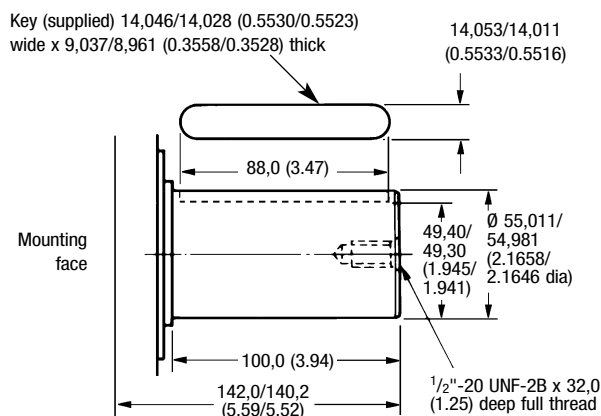
HMB045--D-3* MOTOR WITH DUAL ENTRY PORTS ("D" IN MODEL CODE POSITION 4)**



◆ ⊕ Ø 0,15 (0.006)

SHAFT TYPE "P", MODEL CODE POSITION 3

Cylindrical shaft with key

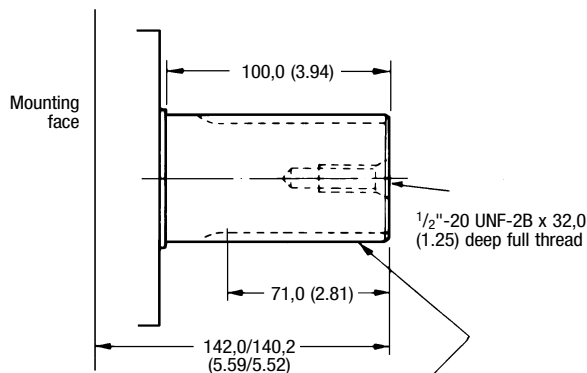


SHAFT TYPE "S", MODEL CODE POSITION 3

Cylindrical shaft with 17 splines to BS 3550-1963

SHAFT TYPE "Z", MODEL CODE POSITION 3

Cylindrical shaft to DIN 5480



Spline data

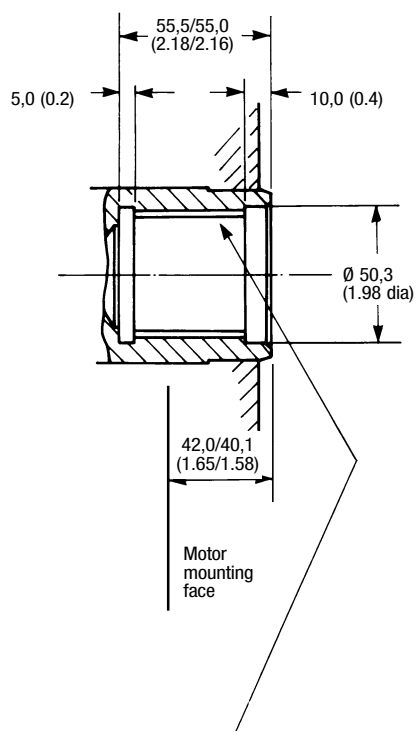
For shaft type "S"
To BS 3550-1963 and ASA.B5.15-1960
Flat root side fit, class 1
Pressure angle 30°
Number of teeth 17
Pitch 8/16
Major diameter 56,41/56,28 (2.221/2.216)
Form diameter 50,703 (1.9962)
Minor diameter 50,07/49,60 (1.971/1.953)
Pin diameter 6,096 (0.2400)
Diameter over pins 62,985/62,931 (2.4797/2.4776)

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

SHAFT TYPE "Q", MODEL CODE POSITION 3

Internally splined to BS 3550; 21 splines

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.



Spline data

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 flattened to 3,556 (0.1400)
Diameter between pins 39,169/39,103 (1.5421/1.5395)

NOTES

NOTES

Presented by:



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