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

HMB 325

Staffa Fixed Displacement Hydraulic Motor

CONTENTS

1. GENERAL DESCRIPTION

The HM(HD)B325 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 cm^3/r (5.76 to 415 in^3/r) capacity. The rugged, well-proven design incorporates hydrostatic balancing techniques to achieve high efficiency, combined with good breakout torque and smooth running capability.

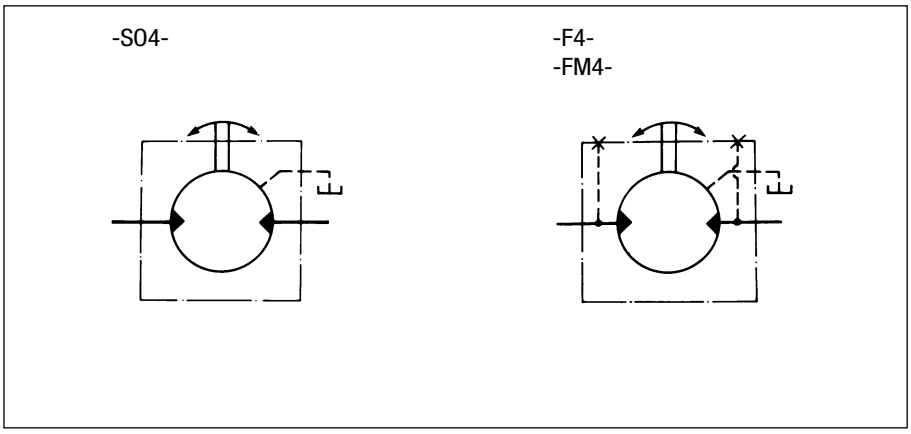
This motor is available with standard or with heavy duty shaft bearings, model types HMB325 and HMHDB325 respectively. Various features and options are available including, on request, mountings to match competitor interfaces.

The HMHDB325 is capable of torque outputs up to 23 300 Nm (17 200 lbf ft) and speeds to 100 r/min with a continuous output of up to 140 kW (188 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

All 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(**)B325-(H)**(V)-***-(**)-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")
HD = Heavy duty ("HMHDB")

3 SHAFT TYPE

Use "H" prefix code as noted to specify "hollow" shafts with through hole Ø 26,2 (1.03 dia). Hollow shafts are available only with type "S04" main port connection.

Code	Type
(H)P1*	Ø85mm (3.35 dia) cylindrical shaft with key; HMB325 only
(H)P2*	Ø100mm (3.94 dia); cylindrical shaft with key; HMHDB325 only
(H)S3*	Cylindrical, 20 splines to BS 3550; HMB325 only
(H)S5*	Cylindrical, 23 splines to BS 3550; HMHDB325 only
(H)Z*	Cylindrical shaft to DIN 5480; (W100 x 4 x 24 x 7h)
(H)Q*	Female, 34 splines to BS 3550; HMB325 only
T*	Long tapered, keyed shaft; HMB325 only
X*	Short tapered, keyed shaft

** 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

F2 = SAE 1 1/2", 4-bolt (UNC) flanges
FM4 = SAE 1 1/2", 4-bolt (metric) flanges
S04◆ = 6-bolt (UNF) flange (Staffa original valve housing)

◆ *Obligatory for hollow shafts.*

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 and when specifying shaft types "H".

6 DESIGN NUMBER, 3* SERIES

Subject to change. Installation and performance details remain unaltered for design numbers 30 to 39 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 HMB325 and HMHDB325 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▲	5310 cm^3/r (324 in^3/r)
Average actual running torque	79,4 Nm/bar (4.04 lbf ft/psi)
Max. continuous◆ speed	100 r/min
Max. continuous◆ output	140 kW (188 hp)
Max. continuous◆ pressure	250 bar (3625 psi)
Max. intermittent◆ pressure	293 bar (4250 psi)

▲ *Other displacements are available to special order*
◆ *See "Rating Definitions", this page*

LIMITS FOR FIRE RESISTANT FLUIDS

Fluid type	Pressure, bar (psi) Continuous	Intermittent	Max. speed r/min
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

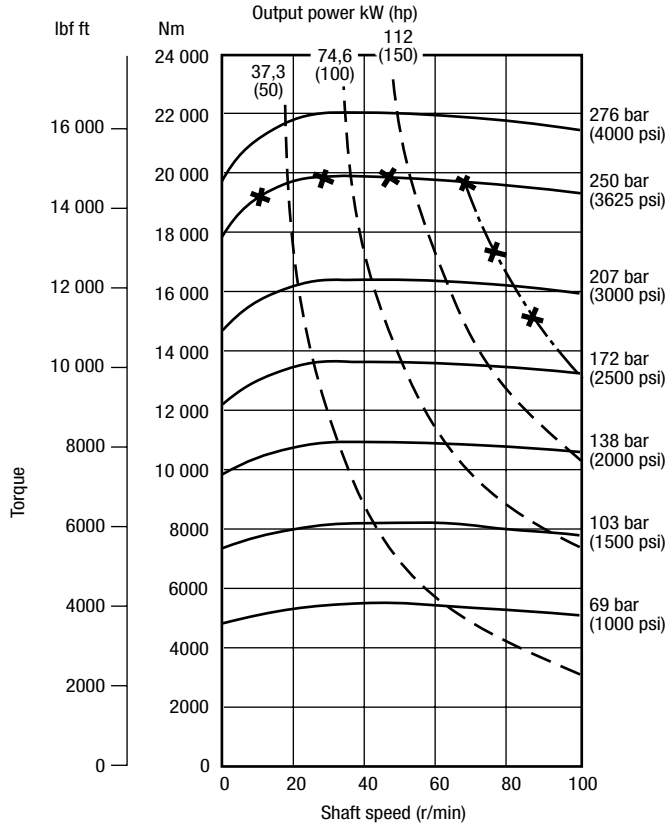
● CONTINUOUS RATING
For continuous duty the motor must be operating within each of the maximum values for speed, pressure and power.

● 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:
(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.

OUTPUT TORQUES

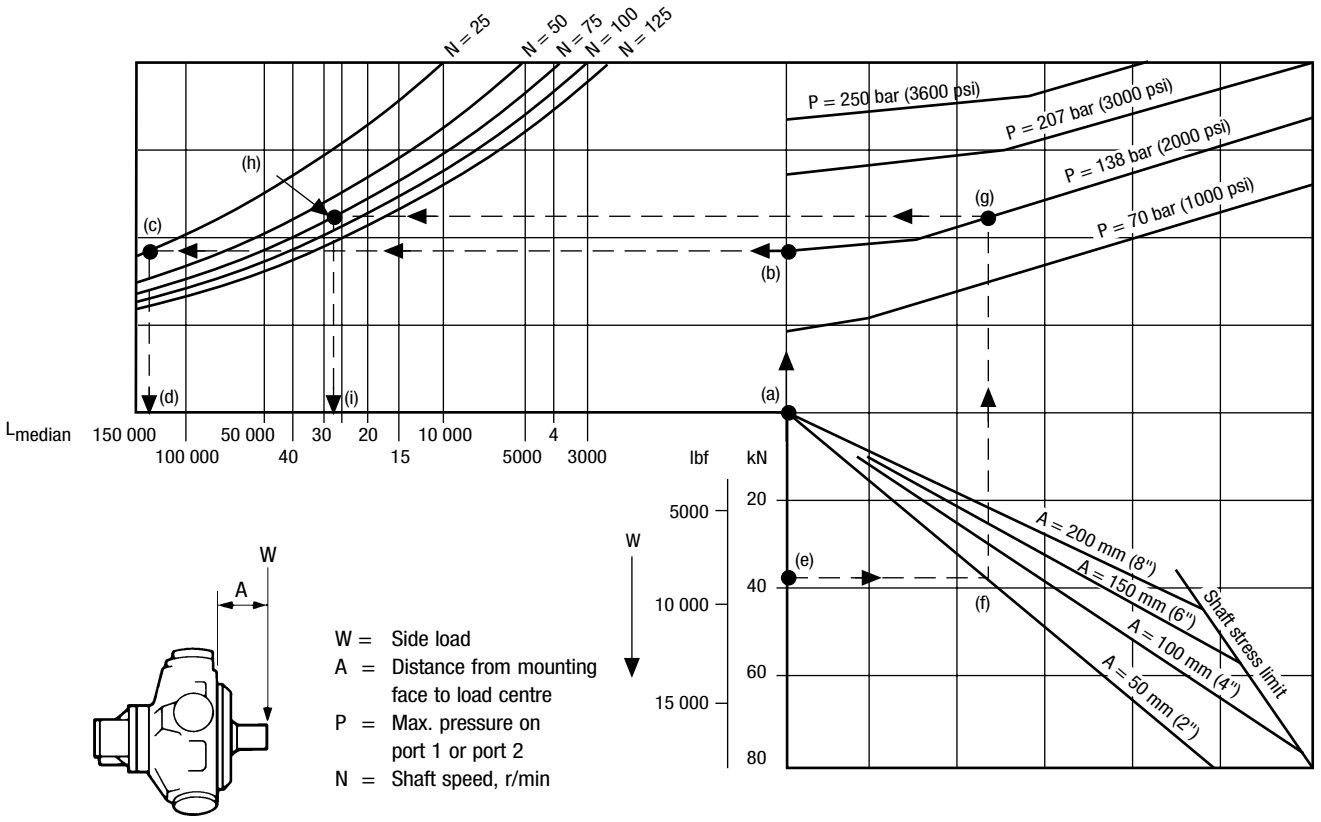
The torque curves indicate the maximum output torque and power of a fully run-in motor for a range of pressures and speeds when operating with zero outlet pressure on petroleum oil of 50 cSt (232 SUS) viscosity. High return line pressures will reduce torque for a given pressure differential.



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

BEARING LIFE

For HMB325 models ◆
(See next page for HMHDB325, heavy duty models)



◆ *Except for "Q" type shafts; see text below*

The nomographs on this and the following page allow 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

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.

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

	HMB325
Example 1 (follow chain dotted line):	
Side load (W)	a) 0
System pressure (P)	b) 138 bar (2000 psi)
Speed (N)	c) 25 r/min
Median bearing life	d) 130 000 hrs
L10 bearing rating = median x 0.2	26 000 hrs
Example 2 (follow chain dotted line):	
Side load (W)	e) 38 kN (8540 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) 75 r/min
Median bearing life	i) 27 500 hrs
L10 bearing rating = median x 0.2	5500 hrs

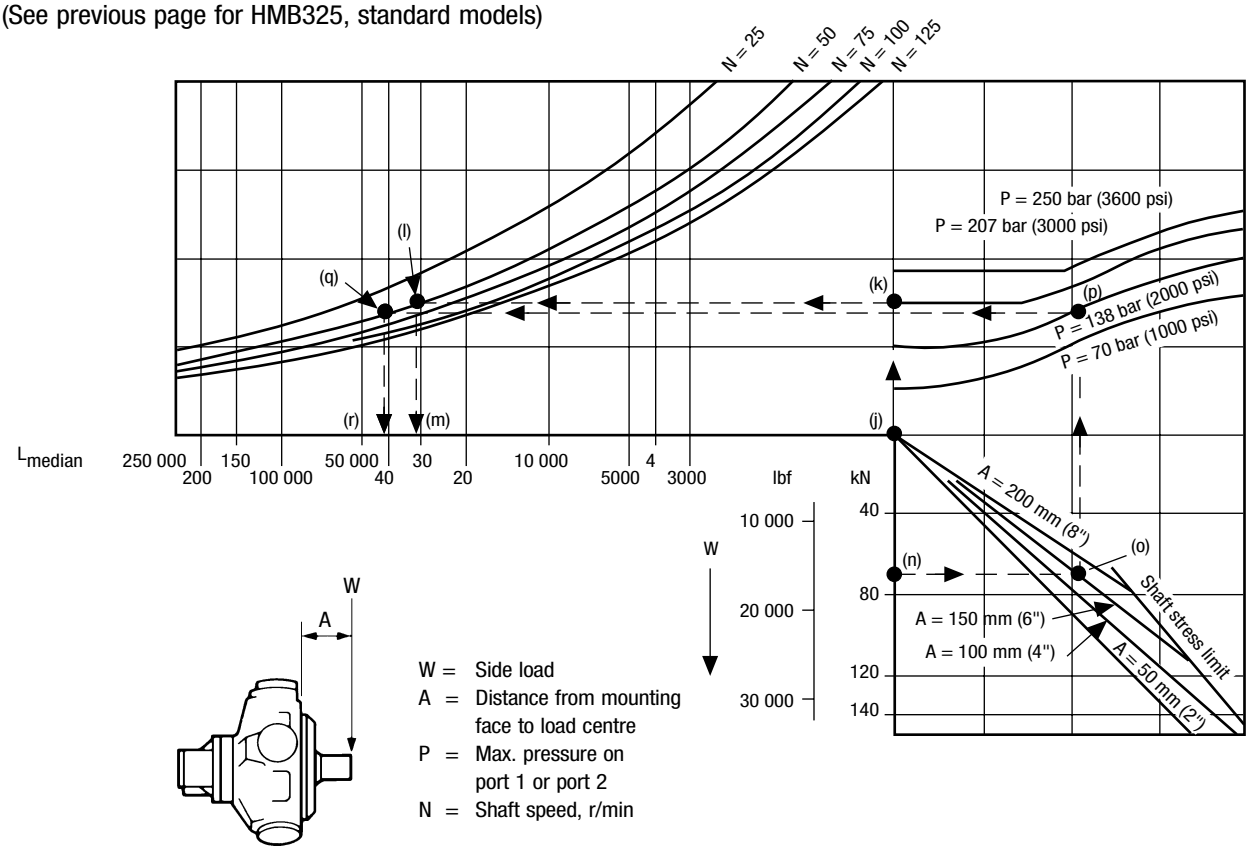
● SHAFT STRESS LIMIT
The shaft stress limit in the nomograph is based on the fatigue rating of shaft types "S" and "P". Infrequent loading above these limits may be permitted; consult Kawasaki.

● "Q" SHAFT BEARING LIFE
The life ratings for the bearing used with "Q" shaft on HMB325 motors are lower than for the standard shaft bearing (the "Q" shaft is not normally subject to high side loading). For life ratings of type "Q" shaft bearings use 50% of the ratings found from the graph for HMB325 models.

Where unsatisfactory life ratings for type "Q" shaft are found using the above HMB325 graph, consult your Kawasaki representative for more accurate data, or possible alternative solutions.

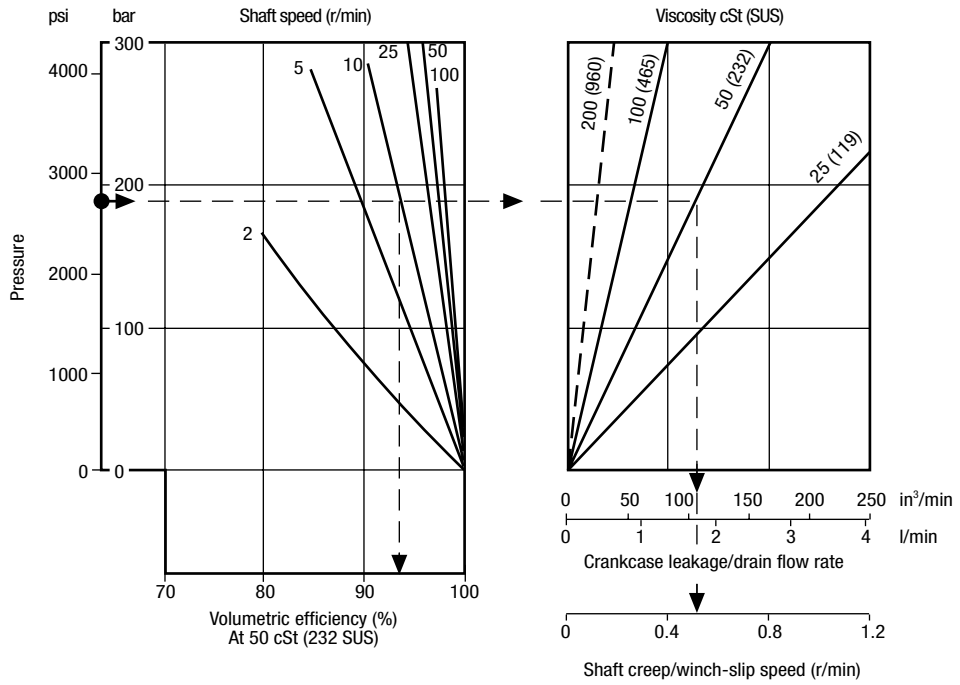
BEARING LIFE

For HMHDB325 (heavy duty) models
(See previous page for HMB325, standard models)



	HMHDB325
Example 1 (follow chain dotted line):	
Side load (W)	j) 0
System pressure (P)	k) 207 bar (3000 psi)
Speed (N)	l) 50 r/min
Median bearing life	m) 32 000 hrs
L10 bearing rating = median x 0.2	6400 hrs
Example 2 (follow chain dotted line):	
Side load (W)	n) 70 kN (15 730 lbf)
Load offset (A) from motor mounting face	o) 150 mm (6.0 in)
System pressure (P)	p) 138 bar (2000 psi)
Speed (N)	q) 50 r/min
Median bearing life	r) 42 000 hrs
L10 bearing rating = median x 0.2	8400 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 .....190 bar (2756 psi)
2. Speed .....10 r/min
3. Viscosity .....50 cSt (232 SUS)

To obtain:
4. Volumetric efficiency 93.5%
5. Crankcase leakage .....1,71 l/min (104 in^3/min)
6. Shaft creep speed .....0.52 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 4 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 2 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:

$$P\ (bar) = 1 + \frac{N^2}{3900} + C\ bar$$

$$P\ (psi) = 14.5 + \frac{N^2}{269} + C\ psi$$

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 above). 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 9) 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 4.*

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: 0,95 kg m^2 (3250 lb in^2)

11. MASS

Approx., all models: 429 kg (994 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

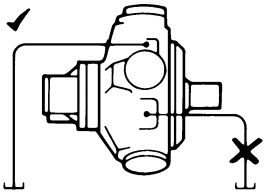
The recommended torque wrench settings for the mounting bolts are:
M20 bolts .....407±14Nm (300±10 lbf ft)
3/4" bolts.....393±14Nm (290±10 lbf ft)

● Shaft coupling

Where the motor is solidly coupled to a shaft having independent bearings the shafts must be aligned to within 0,13 mm (0.005 in) TIR.

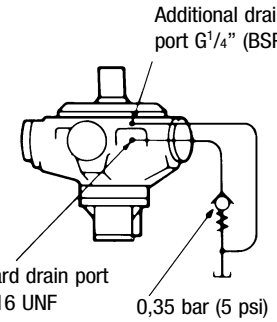
CRANKCASE DRAIN

Motor axis horizontal



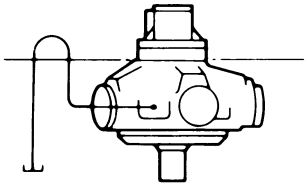
The crankcase drain must be taken from a position above the horizontal centre line of the motor.

Axis vertical, shaft up



An additional G1/4" (BSPF) drain port is provided in the front cover 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 any drain position. The drain line should be run above the level of the uppermost bearing; if there is risk of syphoning then a syphon breaker should be fitted.

START-UP

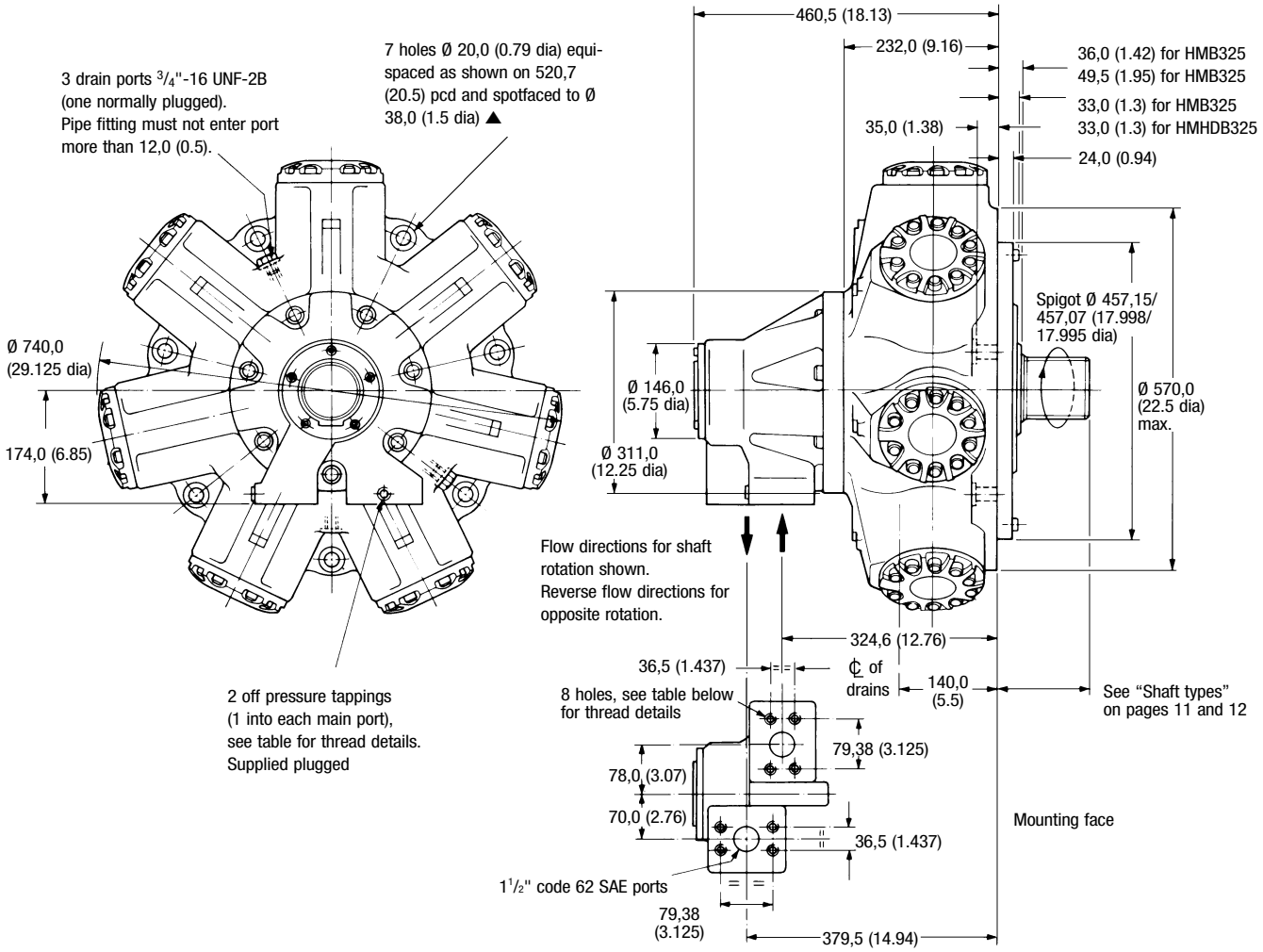
Fill the crankcase with system fluid. Where practical, a short period (30 minutes) of "running in" should be carried out.

13. INSTALLATION DIMENSIONS IN MM (INCHES)

FRONT-MOUNTING MODELS
HMB325 & HMHDB325 MOTORS WITH TYPE "F4"/"FM4" (1 1/2" SAE) PORT CONNECTION

3rd angle projection

See additional views for shaft types and "SO4" port connection.



Port tappings

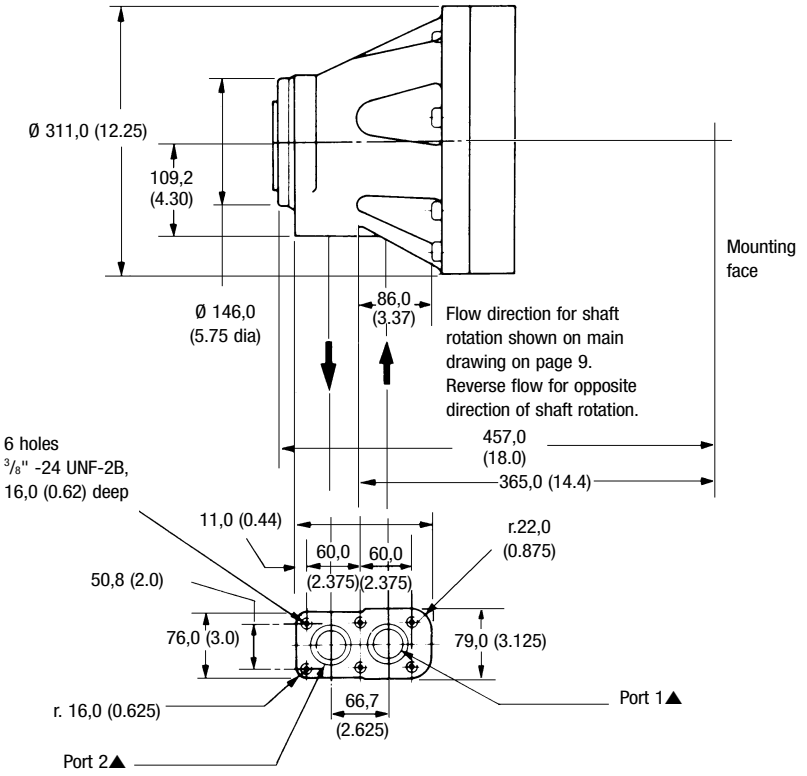
Model code 4	Tapping size for flange bolts	Gauge tappings
F4	5/8"-11 UNC-2B x 35,0 (1.38) full thread depth	9/16"-18 UNF-2B, SAE J475
FM4	M16 x P2.0 x 35,0 (1.38) full thread depth	G1/4" (BSPF)

◆ ⌖ Ø 0,15 (0.006)

6-BOLT FLANGE, "SO4" IN MODEL CODE POSITION 4

Supplied with cover plate, 6 bolts and 2 O-ring seals

For details of port adaptor block see rear page of this bulletin.

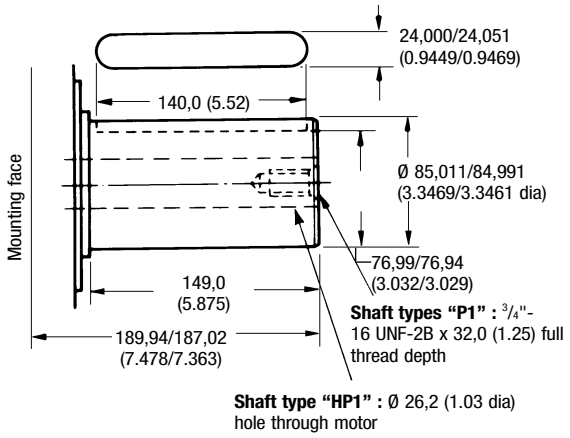


▲ *Ø 35,0 (1.325 dia), with recess for 38,1 (1.5) i/d x Ø 3,53 (0.139 dia) section O-ring*

SHAFT TYPES "P1" & "HP1", MODEL CODE POSITION 3

Ø 85,0 (3.35 dia) cylindrical shaft with key, with optional through hole.

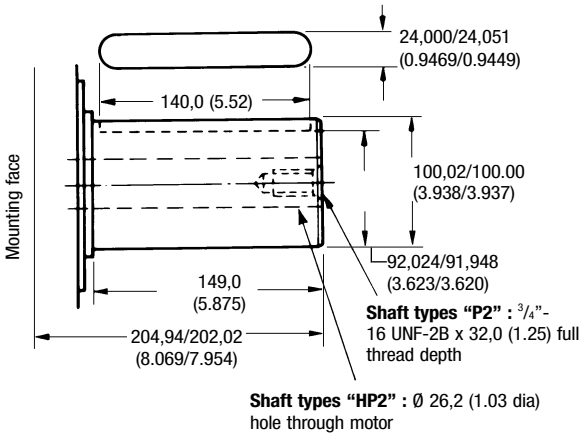
Key (supplied) 24,067/24,000 (0.9475/0.9449) wide x
16,053/15,999 (0.6320/0.6299) thick



SHAFT TYPES "P2" & "HP2", MODEL CODE POSITION 3

Ø100,0 (3.94 dia) cylindrical shaft with key, with optional through hole.

Key (supplied) 24,067/24,000 (0.947/0.9449 wide x
16,053/15,999 (0.6320/0.6299) thick

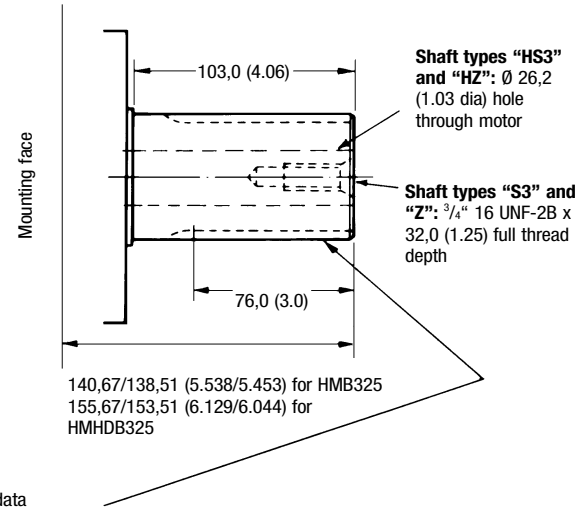


SHAFT TYPES "S3" & "HS3", MODEL CODE POSITION 3

Cylindrical shaft with 20 splines to BS 3550-1963, with optional through hole.

SHAFT TYPES "Z" & "HZ", MODEL CODE POSITION 3

Cylindrical shaft with splines to DIN 5480, with optional through hole.



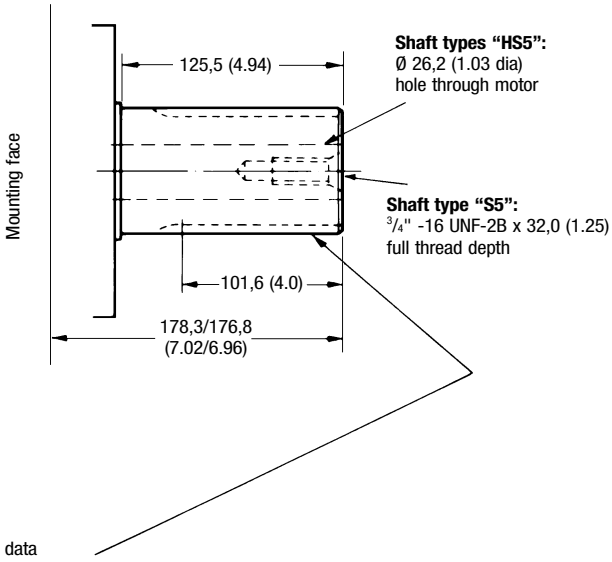
Spline data

For shaft types "S3" and "HS3"	
To BS 3550/SAE J498c (ANSI B92.1 1970 class 5)	
Flat root side fit, class 1	
Pressure angle	30°
Number of teeth	20
Pitch	6/12
Major diameter	87,953/87,825 (3.4627/3.4577)
Form diameter	80,264 (3.160)
Minor diameter	79,485/78,925 (3.1293/3.1073)
Pin diameter	8,128 (0.3200)
Diameter over pins	97,084/97,030 (3.8222/3.8201)

For shaft types "Z" and "HZ"
DIN 5480, W100 x 4 x 24 x 7h

SHAFT TYPES "S5" & "HS5", MODEL CODE POSITION 3

Cylindrical shaft with 23 splines to BS 3550-1963, with optional through hole.



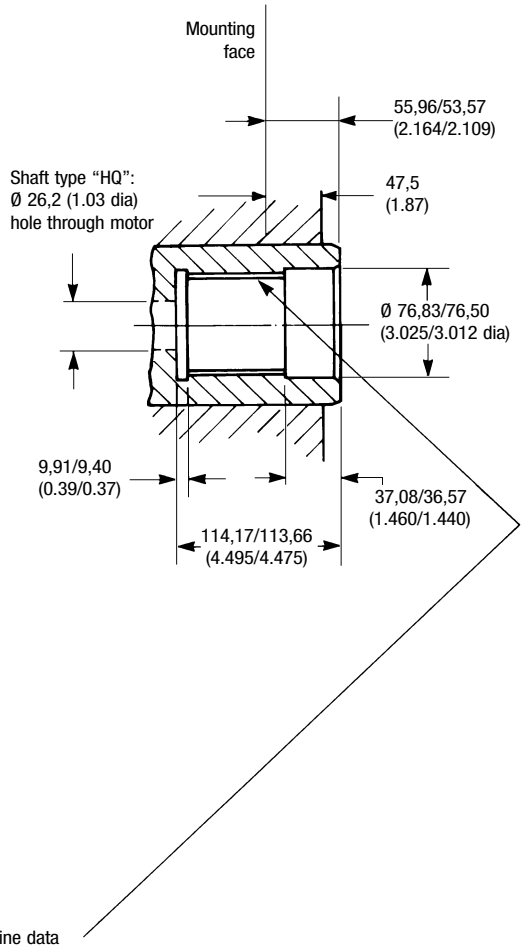
Spline data

For shaft types "S5" and "HS5"	
To BS 3550/SAE J498c (ANSI B92.1 1970 class 5)	
Flat root side fit, class 1	
Pressure angle	30°
Number of teeth	23
Pitch	6/12
Major diameter	100,66/100,52 (3.9627/3.9577)
Form diameter	92,939 (3.6590)
Minor diameter	92,185/91,625 (3.6292/3.6073)
Pin diameter	8,128 (0.3200)
Diameter over pins	109,58/109,51 (4.3140/4.3117)

SHAFT TYPES “Q” & “HQ”, MODEL CODE POSITION 3

Female shaft with 34 splines to BS 3550

Note: The “Q” and “HQ” shafts will transmit the maximum torque given on page 4. However, customers should ensure that their own mating shaft will transmit the torque required in their application.



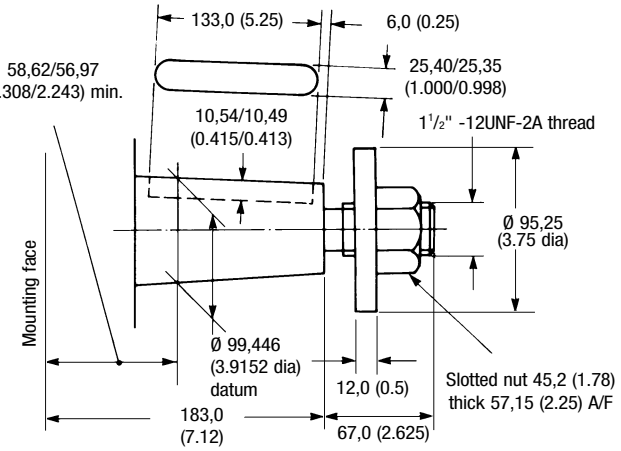
Spline data

To BS 3550-1963 and ASA. B5.15-1960	
Flat root side fit,	
Pressure angle	30°
Number of teeth	34
Pitch	12/24
Major diameter	74,414/75,227 (2.9297/2.9167)
Minor diameter	69,977/69,850 (2.7750/2.7500)
Pin diameter	3,658 (0.1440)
Pin flatted to	3,566 (0.1400)
Diameter between pins	66,744/66,815 (2.6277/2.6305)

SHAFT TYPE “T”, MODEL CODE POSITION 3

Long taper, with key

Key size: 25,45/25,40 (1.002/1.000) wide x 17,539/17,463 (0.6905/06875) thick

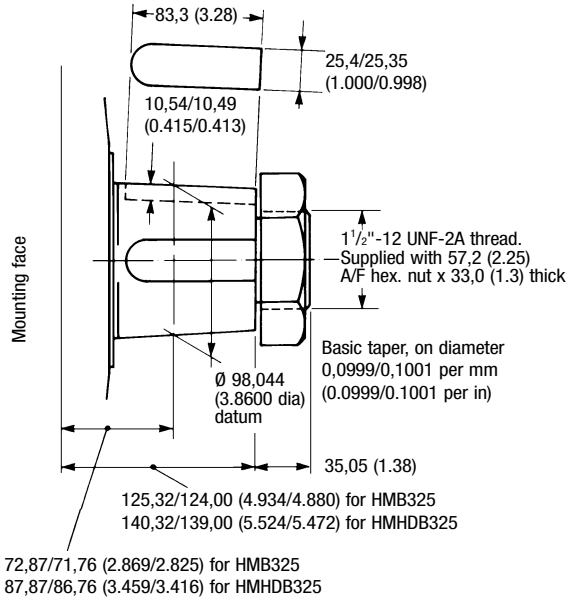


Basic taper, on diameter 0,0999/0,1001 per mm (0.0999/0.1001 per in)

SHAFT TYPE “X”, MODEL CODE POSITION 3

Short taper, with 2 keys

2 keys supplied:
25,48/25,40 (1.003/1.000) wide x
17,539/17,463 (0.6905/0.6875) thick



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Staffa hydraulic motors are manufactured to the highest quality standards in a Kawasaki ISO 9001 certified facility. Certification No. 891150