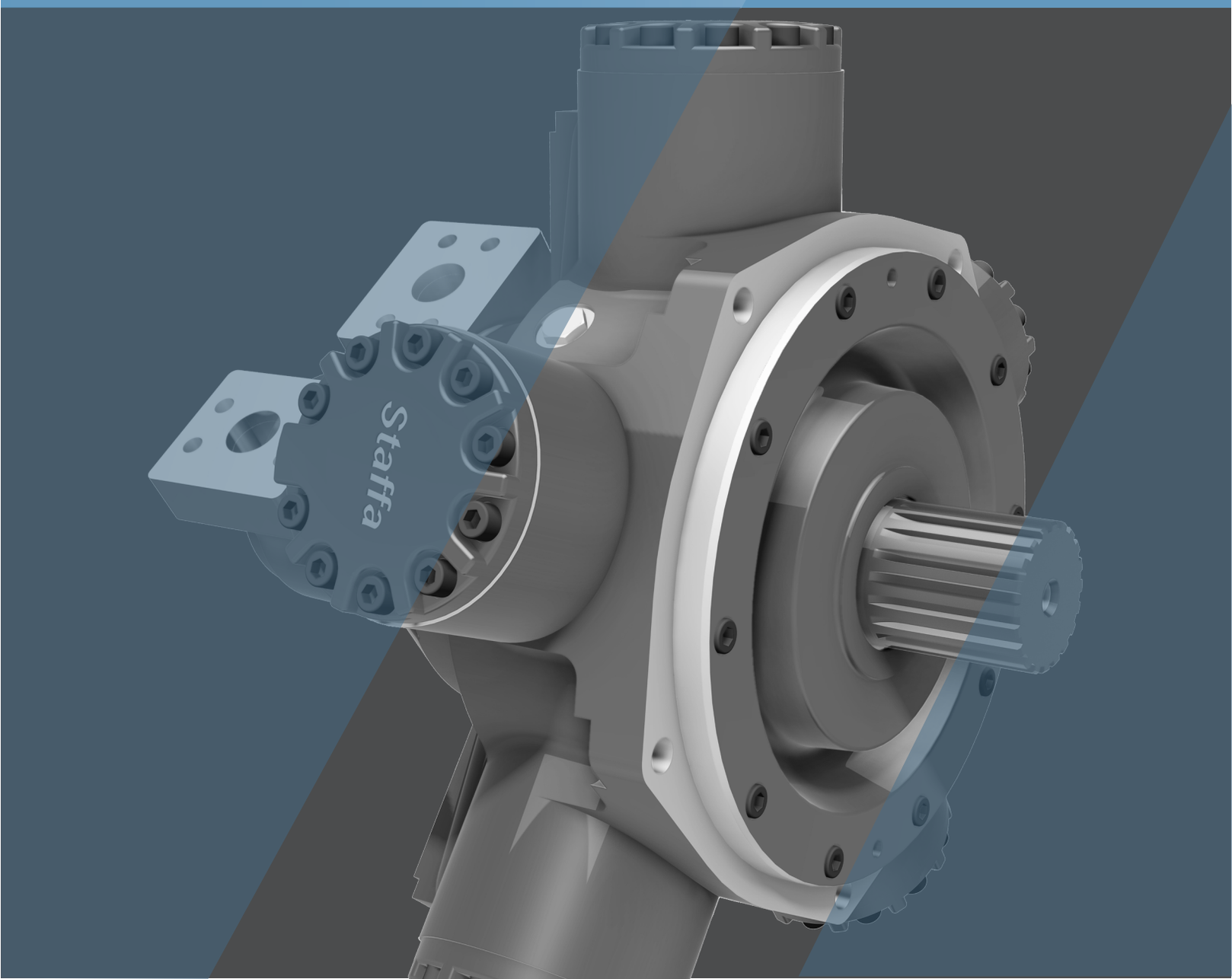
Kawasaki
Powering your potential

Precision Machinery Company

Fixed Displacement Radial Piston Staffa Motor

HMB Series



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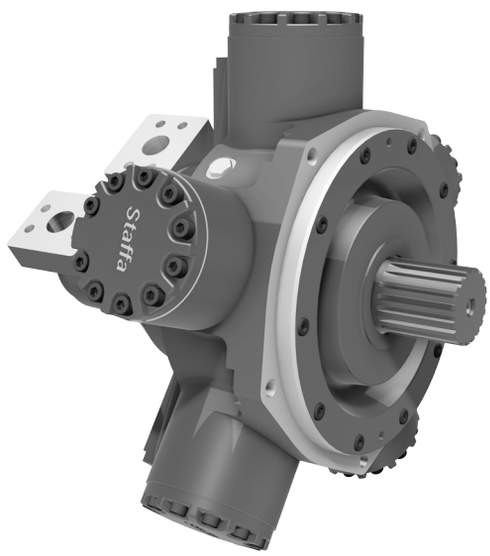
HMB Series

Fixed Displacement Radial Piston Hydraulic Motor



General Descriptions

The Kawasaki “Staffa” range of high torque low speed fixed displacement radial piston hydraulic motors consists of 13 frame sizes ranging from the HMB010 to HMB500. Capacity ranges from 188 to 8,000 cc/rev.

The rugged, well proven design incorporates high efficiency, combined with good breakout torque and smooth running capability.

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

The Kawasaki “Staffa” range also includes dual and continuously variable displacement motors. To obtain details of this product range please refer to data sheet M-2002/09.14.

Features

Rugged, reliable, proven design

Unique hydrostatic balancing provides minimum wear and extended life

High volumetric and mechanical efficiency

Capacities range from 50 to 8,200 cc/rev

Large variety of shaft and porting options

Output torque up to 25,250 Nm

Wide range of mounting interfaces available

Alternative displacements also available

1 Ordering Code

1-1 Model Coding

F11/HM*B 060 / S3 V/ FM3/Tj/ */ P*****

Fluid Type

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

Model Type

Blank	Standard (HMB)
HD	Heavy duty (HMHDB)*

** For B400 frame size, only Heavy Duty (HMHDB) is available.*

Motor Frame Size

See options page 24

Shaft Type

See shaft type option list on Page 6

Shaft Orientation

Blank	Horizontal and vertically down
V	Vertically Up

Main Port Connections

See Port Connection details on page 7

Special Features

P*****	Special features (see page 5)
PL***	Non-catalogued features, (*****) = number assigned by Kawasaki as required

Design Series Number

Current series for HMB 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.

See page 98

1-1 Model Coding

Special Features Suffix

/ P * * * * *

Shaft Seal Enhancements

A	High pressure shaft seal
B	Improved shaft seal life
C	High pressure shaft seal & improved shaft seal life
0	None

External Protection

A	Anti-pooling bolt heads
B	Marine-specification primer paint
C	Anti-pooling bolt heads & Marine-specification primer paint
0	None

Installation Features

A	Drain port adaptor x 1
B	Drain port adaptor x 2
C	Φ21 mm mounting holes
D	Φ22 mm mounting holes
E	Φ21 mm mounting holes & Drain port adaptor x 1
F	Φ21 mm mounting holes & Drain port adaptor x 2
G	Φ22 mm mounting holes & Drain port adaptor x 1
H	Φ22 mm mounting holes & Drain port adaptor x 2
0	None

Performance Enhancements

A	Increased starting torque
B	Increased power rating
C	Increased starting torque & increased power rating
0	None

Valve Enhancements

A	Improved cavitation resistance
B	Anti-clockwise
C	Thermal shock resistance
D	Improved caviation resistance & anti-clockwise
E	Improved cavitation resistance & thermal shock resistance
F	Anti-clockwise & thermal shock resistance
G	Improved cavitation resistance & anti-clockwise & thermal shock resistance
0	None

1-2 Shaft Options

Product type

HMB010

P	=	Parallel keyed 40mm diameter shaft
S	=	Splined shaft 13 teeth BS3550

HMB030 & HMB045

P	=	Parallel keyed 55mm diameter shaft
S	=	Splined shaft 17 teeth BS3550
Z	=	Splined shaft DIN5480 (W55x3x17x7h)

HMB060, HMB080 & HMB100

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

HMB125, HMB150 & HMB200

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

HMHDB125, HMHDB150 & HMHDB200

P2	=	Parallel keyed 100mm diameter shaft
S5	=	Splined shaft 23 teeth BS3550
Z5	=	Splined shaft DIN5480 (W100x4x24x7h)
T	=	Long taper keyed shaft - 120.52 key slot

HMB270 & HMB325

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

HMHDB270 & HMHDB325

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

HMHDB400 & HMB500

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

Note:
For installations where the shaft is vertically upwards specify “V” after the shaft type designator so as to ensure that an additional high level drain port is provided within the front cover of the motor.

1-3 Main Port Connections

Product type

HMB010

Blank	=	Two, four bolt flange ports of 20 mm Ω

HMB030 Monobloc

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

HMB045 Monobloc

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

HMB030/045 Two part build (TPB) & HMB060/080/100

SM3	=	1¼” symmetrical ports with through-holes for manifold connection
F3	=	SAE 1 ¼ 4-Bolt (UNC) flanges
FM3	=	SAE 1 ¼ 4-Bolt (Metric) flanges

HM(HD)B125/150/200

SM3	=	1¼” symmetrical ports with through-holes for manifold connection
F3	=	SAE 1 ¼ 4-Bolt (UNC) flanges
FM3	=	SAE 1 ¼ 4-Bolt (Metric) flanges
F4	=	SAE 1 ¼ 4-Bolt (UNC) flanges
FM4	=	SAE 1 ½ 4-Bolt (Metric) flanges

HM(HD)B270/325

F4	=	SAE 1 ½ 4-Bolt (UNC) flanges
FM4	=	SAE 1 ½ 4-Bolt (Metric) flanges

HMHDB400 & HMB500

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

1-4 Special Features

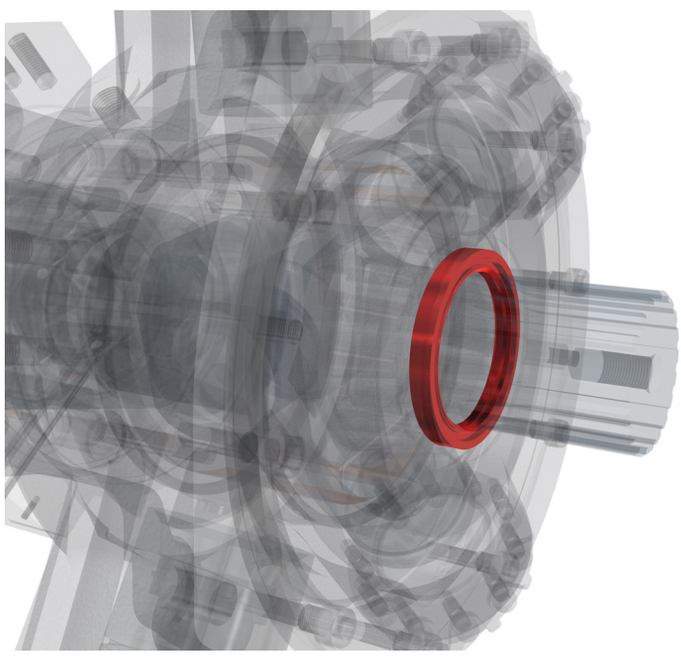
Feature	Page	HMB 010	HMB 030	HMB 045	HMB 045 - F(M)3 HMB 045 - SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/ 200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
High Pressure Shaft Seal	9	●	●	●	●	●	●	●	●	●	●	●	●
Improved Shaft Seal Life	10	●	●	●	●	●	●	●	●	●	●	●	●
Improved Cavitation Resistance	11	○	○	○	●	●	●	●	●	●	●	●	●
Anti-pooling Bolt Heads	12	●	●	●	●	●	●	●	●	●	●	●	●
Increased Starting Torque	13	●	●	●	●	●	●	●	●	●	●	●	○
Anti-clock-wise Rotation	15	●	●	●	●	●	●	●	●	●	●	●	●
Thermal Shock Resistance	16	○	○	○	●	●	●	●	●	●	●	●	○
Drain Port Adaptor - ½" BSPP	18	●	●	●	●	●	●	●	●	●	●	●	●
Φ21mm Mounting Holes	19	○	○	○	○	●	●	●	●	●	●	●	●
Φ22mm Mounting Holes	19	○	○	○	○	●	●	●	●	●	●	●	●
Marine-specification Primer Paint	20	●	●	●	●	●	●	●	●	●	●	●	●
Increased Power Rating	21	○	○	○	○	○	○	●	●	●	●	●	○

● Available
○ Not available

If a motor is to be ordered with any special features listed, please contact Kawasaki.

1-4 Special Features

High Pressure Shaft Seal



Description:

> 10 bar rated

> Recommended for cold climates

> Rugged aluminium construction

Technical Information

Where crankcase pressure will be higher than 3.5 bar, the high pressure shaft seal should be selected.

Case pressure	≤ 10 bar
Non-operating temperature limits	Below -30˚C and above 120˚C
Minimum operating temperature	-15˚C
Maximum operating temperature	80˚C
Minimum viscosity	2,000 cSt
Maximum viscosity	150 cSt

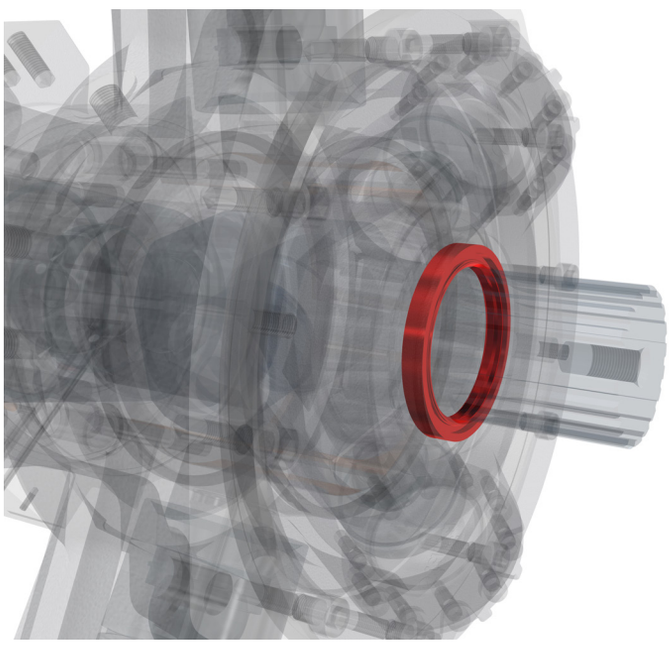
Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
●	●	●	●	●	●	●	●	●	●	●	●

Please contact Kawasaki to order this feature.

1-4 Special Features

Improved Shaft Seal Life



Description:

> **Stainless steel sleeve prevents corrosion**

> **Improved wear resistance**

> **Recommended for corrosive environments**

Technical Information

A well-established method of increasing rotary seal life in corrosive environments is to fit a thin-walled, stainless steel sleeve to the rotating shaft to provide a corrosion-resistant, wear-resistant counterface surface for the seal to run against. All HMB motors can be fitted with such sleeves upon request.

Sleeve material	A304/301 Stainless Steel
Sleeve surface finish	R_a 0.25 to 0.5 µm (10 to 20 µin)

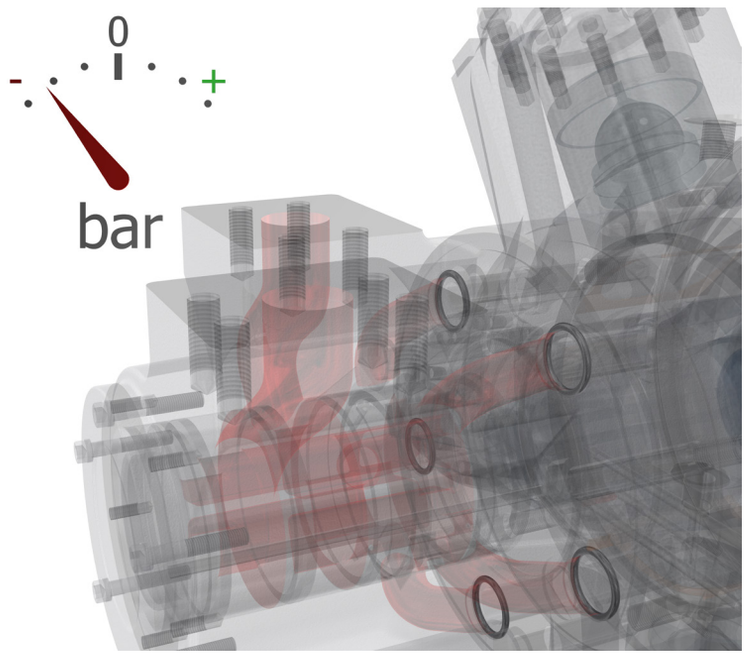
Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
●	●	●	●	●	●	●	●	●	●	●	●

Please contact Kawasaki to order this feature.

1-4 Special Features

Improved Cavitation Resistance



Description:

> Recommended for overunning applications

> Protects against seal damage for short periods of operation in vacuum inlet conditions.

Cavitation can occur due to many different factors. Although it is not possible to make the HMB motor resistant to cavitation, certain features can be added to improve the motor's resistance to short periods of lost port pressure.

In applications where the HMB motor can be driven (like a pump) a risk arises that insufficient fluid will be provided to maintain a positive pressure at both main ports of the motor causing cavitation. The results of extended running at these conditions can be catastrophic to the motor's function.

The improved cavitation resistance feature should be considered where:

- Overrunning conditions may occur (load driving the motor)
- Loss of main port pressure while motor is rotating

Note:
This feature comes as standard on monobloc HMB motors (HMB010, HMB030, HMB045).

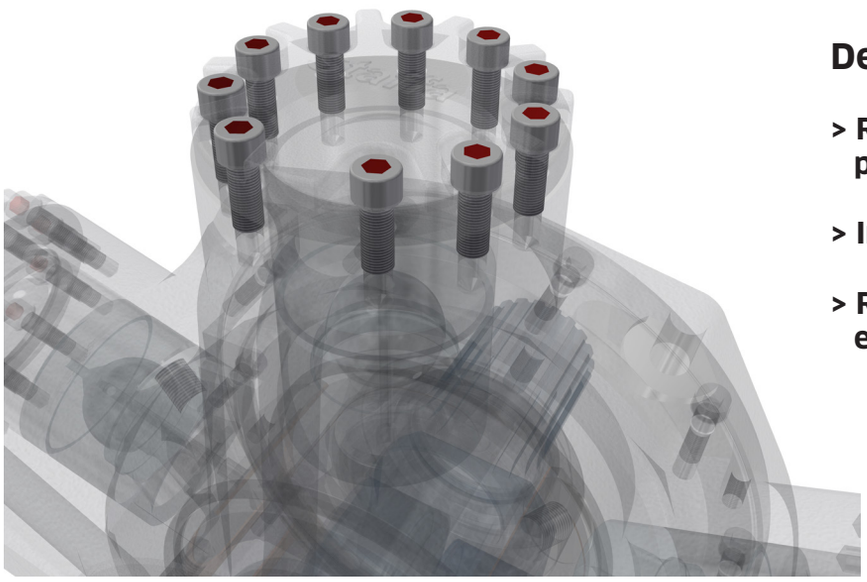
Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
○	○	○	●	●	●	●	●	●	●	●	●

Please contact Kawasaki to order this feature.

1-4 Special Features

Anti-pooling Bolt Heads



Description:

> **Removes potential for water pooling**

> **Improved corrosion resistance**

> **Recommended for marine environments**

Technical Information

In many marine applications, water pooling in socket head cap screw heads presents a significant corrosion risk. Corroded cap screws can make service and repair of affected units impossible.

To significantly reduce the risk of water damage through pooling, HMB motors can be supplied with silicone filler in all the bolt heads.

Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
●	●	●	●	●	●	●	●	●	●	●	●

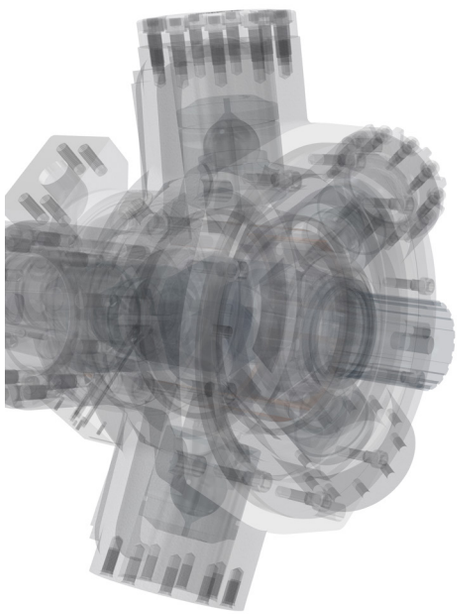
Please contact Kawasaki to order this feature.

1-4 Special Features

Increased Starting Torque

Description:

- **Optimised for high break-out torque**
- **Recommended for low speed operation**
- **Improved service life for low speed applications**

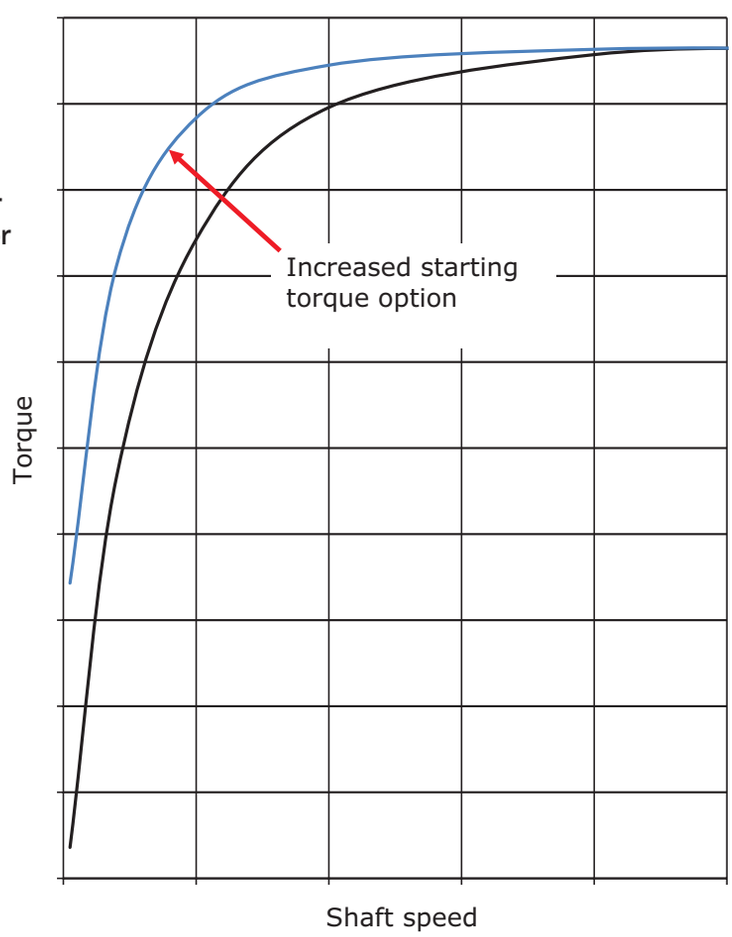


Technical Information

If an application demands the drive motor be run at speeds of less than 10 rpm for most of the duty cycle, or involves frequent start/stop or forward/reverse operation, the Staffa HMB motor range has it covered.

By optimising the HMB motor's design for low speeds, it is possible to increase the break out torque and low speed mechanical efficiency performance.

All figures given in Section 2-1 Performance Data are still valid when selecting this feature.



1-4 Special Features

Increased Starting Torque (cont)

Volumetric Performance

In order to achieve increased torque at low speeds the volumetric characteristics of the motor performance are changed.

When calculating leakage and volumetric efficiency use the constants shown here in place of those given for the standard motor on page 29.

Motor Type	Geometric Displacement	Zero Speed Constant	Speed Constant	Creep Speed Constant	Crankcase Leakage Constant
	cc/rev	K1	K2	K3	K4
HMB010	188	8.80	534.05	47.05	7.98
HMB030	442	8.51	57.67	19.37	8.06
HMB045	740	3.93	43.36	12.80	9.23
HMB060	983	9.19	29.91	9.95	9.35
HMB080	1,344	9.18	21.62	7.39	9.31
HMB100	1,639	9.30	17.74	5.47	9.35
HM(HD)B125	2,050	9.53	11.45	4.88	8.82
HM(HD)B150	2,470	9.09	9.98	4.02	8.86
HM(HD)B200	3,080	10.00	14.99	3.20	8.86
HM(HD)B270	4,310	13.63	21.16	3.11	12.26
HM(HD)B325	5,310	13.60	18.21	2.52	12.26
HMHDB400	6,800	19.00	10.18	2.73	17.29

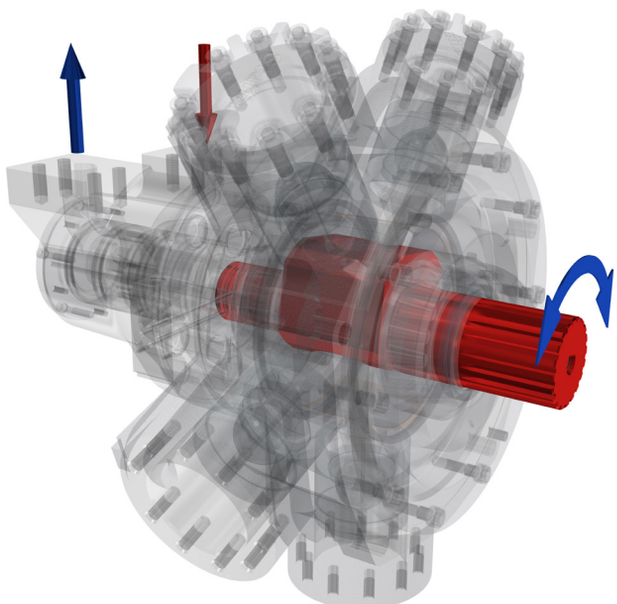
Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
●	●	●	●	●	●	●	●	●	●	●	○

Please contact Kawasaki to order this feature.

1-4 Special Features

Anti-Clockwise Rotation



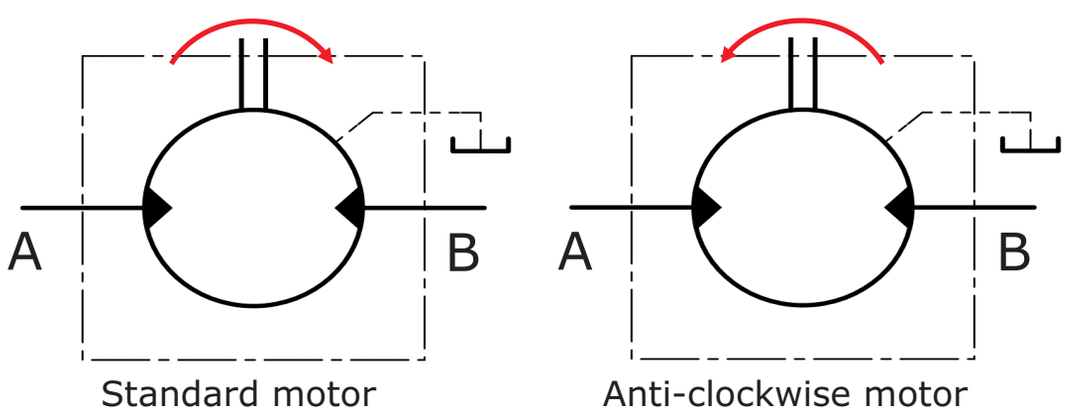
Description:

> Reduce installation complexity

> Standardise equipment designs

Technical Information

All HMB motors can be specified with an anti-clockwise rotation valve configuration. All performance and volumetric characteristics remain unchanged.



Standard motor

Anti-clockwise motor

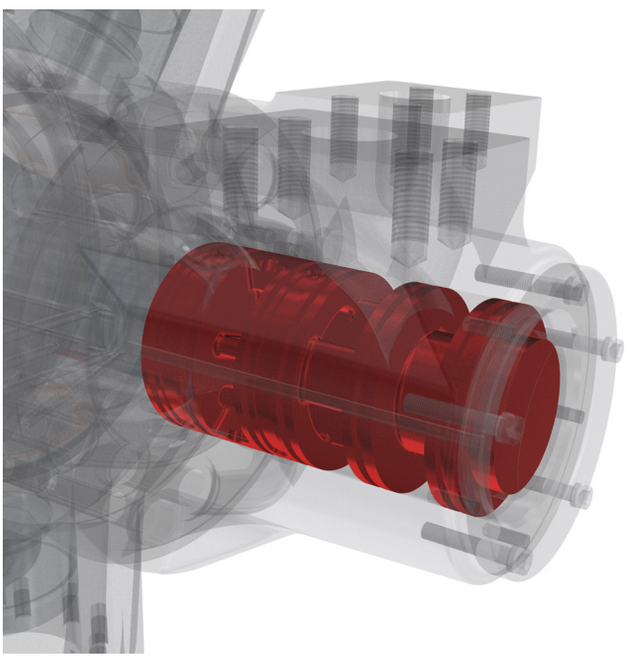
Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
●	●	●	●	●	●	●	●	●	●	●	●

Please contact Kawasaki to order this feature.

1-4 Special Features

Thermal Shock Resistance



Description:

> Recommended for cold climates

> Optimised for start-up in freezing temperatures

> Engineered for total peace of mind

Technical Information

Starting up a cold system with warm hydraulic fluid is a known cause of heavy wear and potential seizure of hydraulic machinery. To minimise this potential risk, the HMB motor can be configured to combat thermal shocks to give complete peace of mind when operating in very cold climates.

Volumetric Performance

In order to provide thermal shock resistance the volumetric characteristics of the motor performance are changed. When calculating leakage and volumetric efficiency use the constants shown on the next page in place of those given for the standard motor on page 29.

All figures given in Section 2-1 Performance Data are still valid when selecting this feature.

Note:
When operating at low temperature, consideration must be given to the guidance notes in Section 2-8 Motor Operation at Low Temperature (see page 36).

1-4 Special Features

Thermal Shock Resistance (cont)

Motor Type	Geometric Displacement	Zero Speed Constant	Speed Constant	Creep Speed Constant	Crankcase Leakage Constant
	cc/rev	K1	K2	K3	K4
HMB060	983	3.72	29.91	4.39	1.88
HMB080	1,344	3.71	21.62	3.32	1.84
HMB100	1,839	3.83	17.74	2.50	1.88
HM(HD)B125	2,050	4.41	11.45	2.21	1.35
HM(HD)B150	2,470	3.97	9.98	1.81	1.39
HM(HD)B200	3,080	4.88	14.99	1.43	1.39
HM(HD)B270	4,310	5.52	21.16	1.23	1.80
HM(HD)B325	5,310	5.49	18.21	0.99	1.80
HMHDB400	6,800	6.41	10.18	0.88	2.35

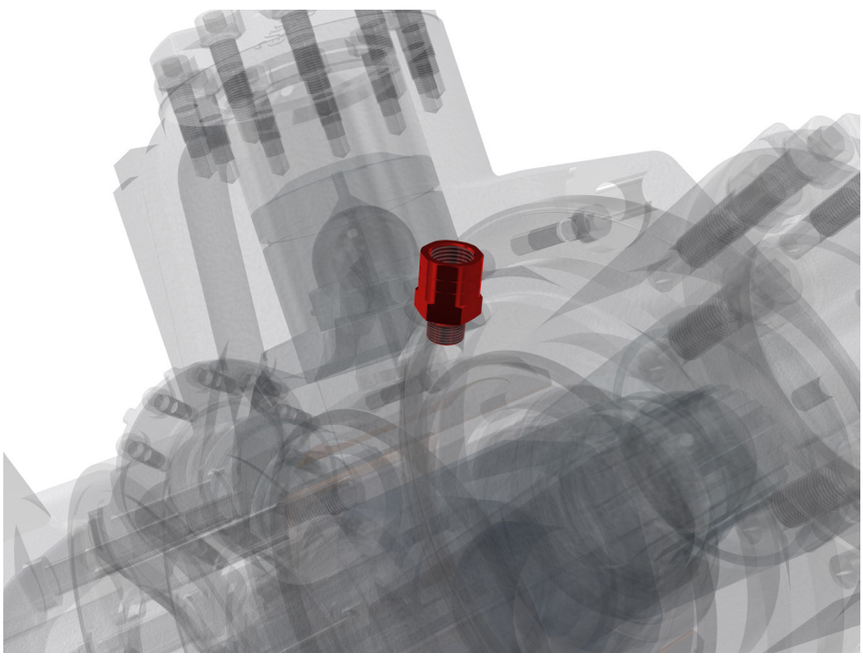
Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
○	○	○	●	●	●	●	●	●	●	●	○

Please contact Kawasaki to order this feature.

1-4 Special Features

Drain Port Adaptors



Description:

> **Improves manufacturing logistics**

> **Motor supplied ready for connection to 1½" BSPP male fitting**

Technical Information

Motor Type	Adaptor Supplied
HMB010	⅜" BSP to ½" BSPP
HMB030	⅜" BSP to ½" BSPP
HMB045	⅜" BSP to ½" BSPP
HMB045-F(M)3/SM3	¾" UNF 2B to ½" BSPP
HMB060	¾" UNF 2B to ½" BSPP
HMB080	¾" UNF 2B to ½" BSPP
HMB100	¾" UNF 2B to ½" BSPP

Motor Type	Adaptor Supplied
HM(HD)B125	¾" UNF 2B to ½" BSPP
HM(HD)B150	¾" UNF 2B to ½" BSPP
HM(HD)B200	¾" UNF 2B to ½" BSPP
HM(HD)B270	¾" UNF 2B to ½" BSPP
HM(HD)B325	¾" UNF 2B to ½" BSPP
HMHDB400	¾" UNF 2B to ½" BSPP
HMB500	¾" UNF 2B to ½" BSPP

One or two drain adaptors can be supplied.

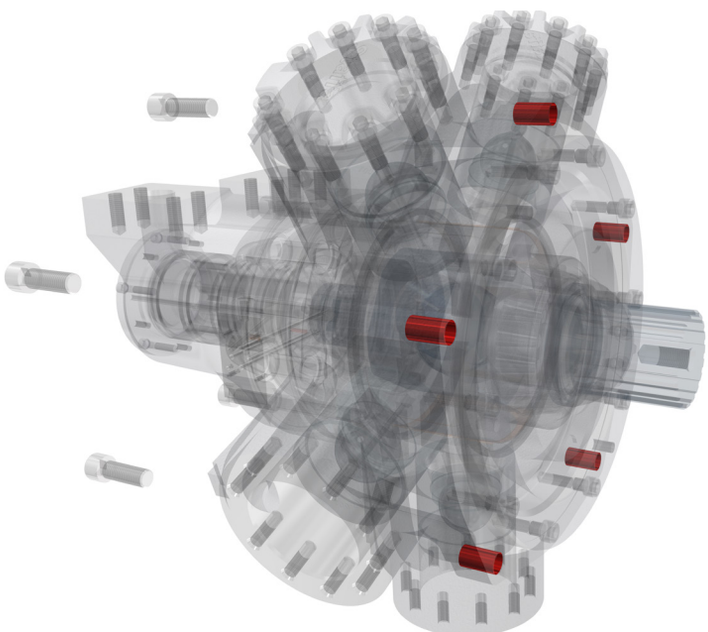
Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
●	●	●	●	●	●	●	●	●	●	●	●

Please contact Kawasaki to order this feature.

1-4 Special Features

Mounting Hole Diameter



Description:

> Matching mounting holes to bolts

> Φ21mm and Φ22mm options available

Technical Information

In different markets, different bolt standards are adopted which may not be best suited to the standard Φ20 mm mounting hole diameter on the HMB motors. To give a correct fit and optimum installation, Φ21 mm or Φ22 mm holes can be selected on larger frame sizes.

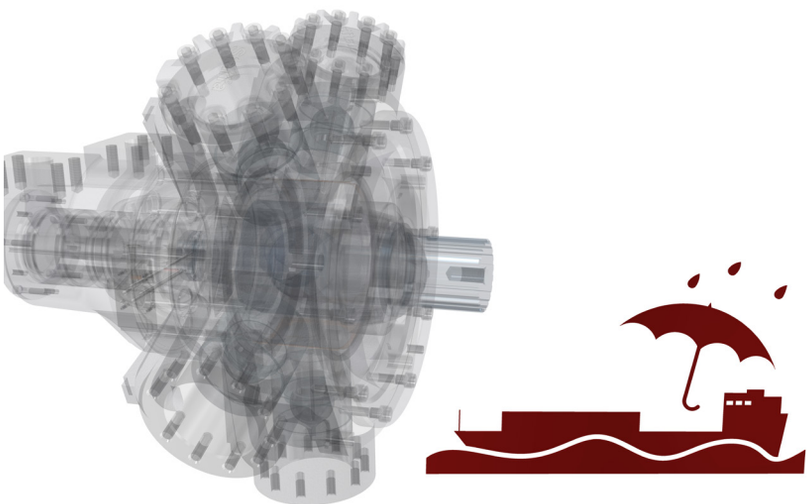
Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
○	○	○	○	●	●	●	●	●	●	●	●

Please contact Kawasaki to order this feature.

1-4 Special Features

Marine Specification Primer Paint



Description:

- > Improves corrosion and water resistance of the finishing system
- > Excellent adhesion strength
- > Recommended for marine applications

Technical Information

Colour	Red oxide
Type	Single pack epoxy etching primer
Standard	BS 3900 part A 8
Dry film thickness	> 12 µm

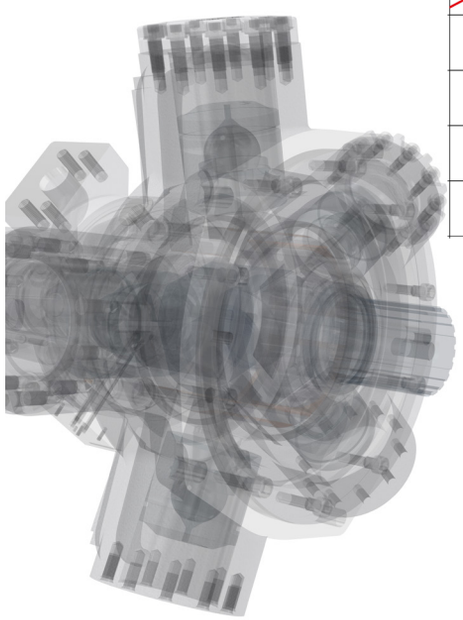
Applicable to:

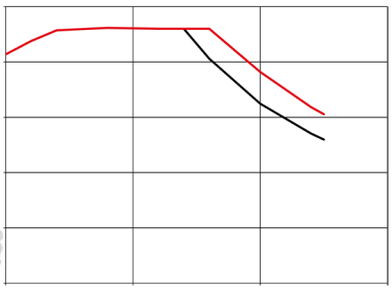
HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
●	●	●	●	●	●	●	●	●	●	●	●

Please contact Kawasaki to order this feature.

1-4 Special Features

High Power





Description:

> Enhanced power performance

> Improved efficiency

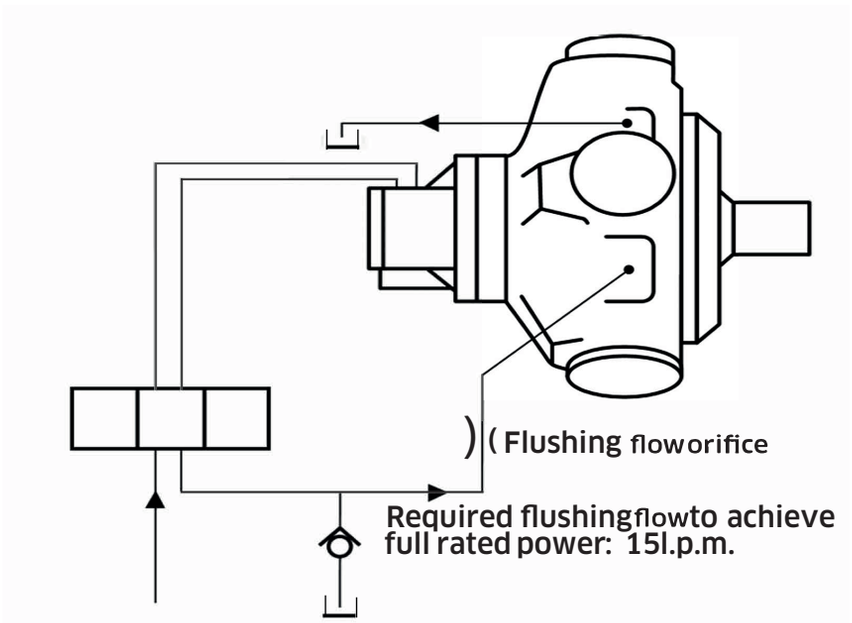
> Improved back pressure rating of 100 bar

Technical Information

The high power option for the HMB motors combines special low-friction components and a crankcase flushing flow to achieve increased shaft power limits. All other performance parameters are unchanged.

Crankcase Flushing

In order to achieve the maximum shaft power, a crankcase flushing flow of 15 l/min should be directed through the crankcase. To improve the cooling effect of the flushing flow the distance between the inlet and outlet drain port connections should be maximised.



1-4 Special Features

High Power (cont)

Check valve pressure (bar)*	Orifice diameter (mm)
3	4.4
4	4.1
5	3.9
6	3.7
7	3.6
8	3.5
9	3.4
10	3.3

*This assumes that the crankcase pressure is zero. If not, then the check valve pressure will need to be increased to maintain the pressure drop across the orifice.

Note:
If, due to crankcase flushing flow, the crankcase pressure continuously exceeds 3.5 bar, then the motor build should include a high pressure shaft seal.

Performance Data (crankcase flushing required):

Motor Type	Max. continuous output (kW)	Average actual running torque (Nm/bar)
HM(HD)B125	150	30.8
HM(HD)B150	160	37.3
HM(HD)B200	190	46.6
HM(HD)B270	210	64.1
HM(HD)B325	210	80.4
HMHDB400	280	101.4

Applicable to:

HMB 010	HMB 030	HMB 045	HMB 045 -F(M)3/ SM3	HMB 060/ 080	HMB 100	HM(HD)B 125	HM(HD)B 150/200	HM(HD)B 270	HM(HD)B 325	HMHDB 400	HMB 500
○	○	○	○	○	○	●	●	●	●	●	○

Please contact Kawasaki to order this feature.

2 Technical Information

2-1 Performance Data

Rating definitions

Continuous rating

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

Intermittent rating

Operation within the intermittent power rating (up to the maximum continuous speed) is permitted on a 15% duty basis, for periods up to 5 minutes maximum.

Intermittent max pressure

This pressure is allowable on the following basis:

a) Up to 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 405 bar.

Limits for fire resistant fluids

Fluid Type	Continuous Pressure (bar)	Intermittent Pressure (bar)	Max Speed (rpm)	Model Type
HFA 5/95 oil-in-water emulsion	130	138	50% of limits of mineral oil	All models
HFB 60/40 water-in-oil emulsion	138	172	As for mineral oil	All models
HFC water glycol	103	138	50% of limits of mineral oil	All models
HFD phosphate ester	207	241	As for mineral oil	HMB010
	207	293	As for mineral oil	HMB030
	250	293	As for mineral oil	HMB045 to HMHDBB400 inc.
	190	227	As for mineral oil	HMB500

2-1 Performance Data (cont)

Motor Type	Geometric displacement (cc/rev)	Average actual running torque (Nm/bar)	Max. continuous speed (rpm)	Max. continuous output (kW)	Max. continuous pressure (bar)	Max. intermittent pressure (bar)
HMB010	188	2.79	500	25	207	241
HMB030	442	6.56	450	42	207	241
HMB045	740	10.95	400	60	250	293
HMB060	983	14.5	300	80	250	293
HMB080	1,344	19.9	300	100	250	293
HMB100	1,639	24.3	250	110	250	293
HMB125	2,050	30.66	220	100	250	293
HMHDB125						
HMB150	2,470	36.95	220	115	250	293
HMHDB150						
HMB150 F3/FM3/SM3	2,470	36.95	168	115	250	293
HMB200	3,087	46.07	175	130	250	293
HMHDB200						
HMB200 F3/FM3/SM3	3,087	46.07	135	130	250	293
HMB270	4,310	63.79	125	140	250	293
HMHDB270						
HMB325	5,310	79.4	100	140	250	293
HMHDB325						
HMHDB400	6,800	101	120	190	250	293
HMB500	8,000	114	100	170	190	227

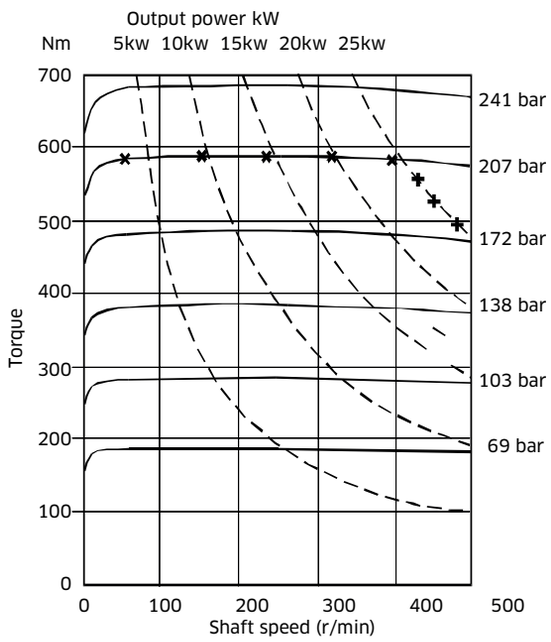
Other non standard displacements are possible - check with KPM UK for details.

2-1 Performance Data (cont)

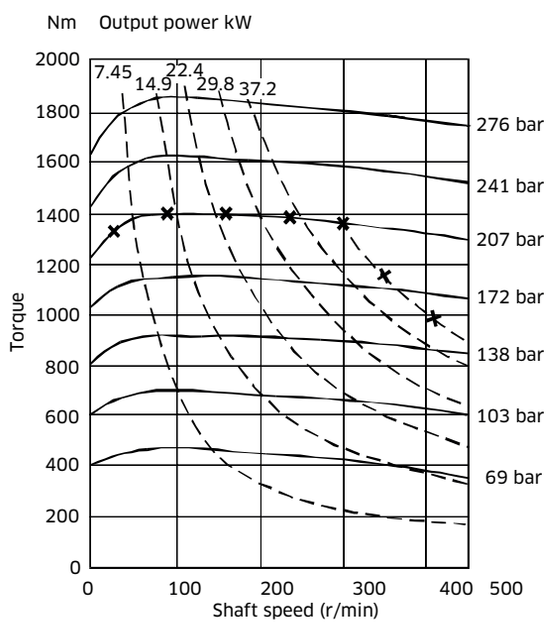
Output Torque Curves

These torque curves indicate the maximum output torque and power of a fully run-in motor for a range of pressures and speeds when operating with zero outlet pressure on Mineral Oil of 50 cSt (232 SUS) viscosity. High return line pressures will reduce torque for a given pressure differential. - x - x - x - Upper limit of continuous rating envelope.

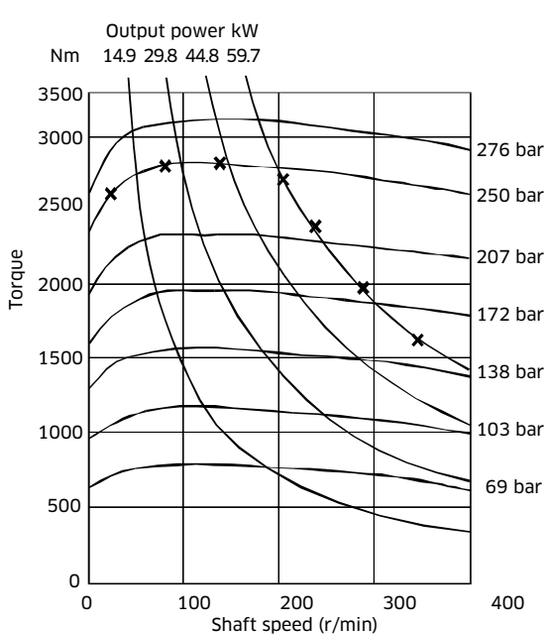
HMB010



HMB030



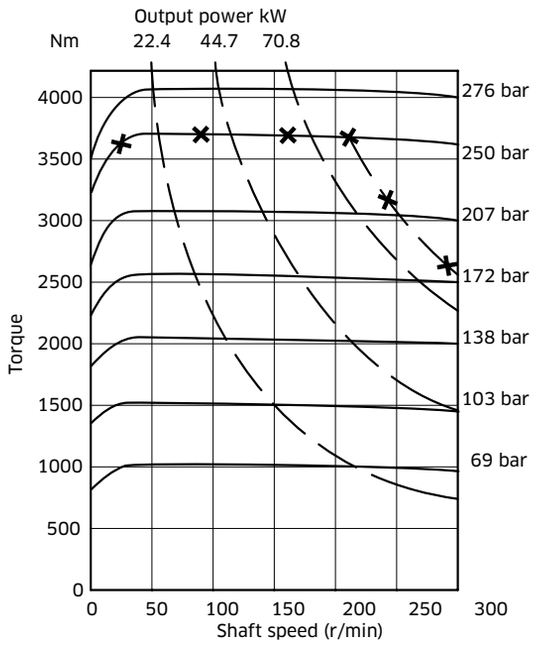
HMB045



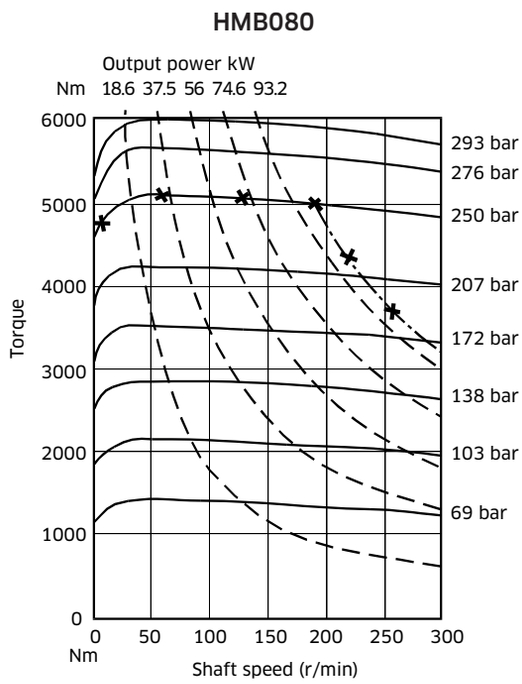
2-1 Performance Data (cont)

Output Torque Curves (cont)

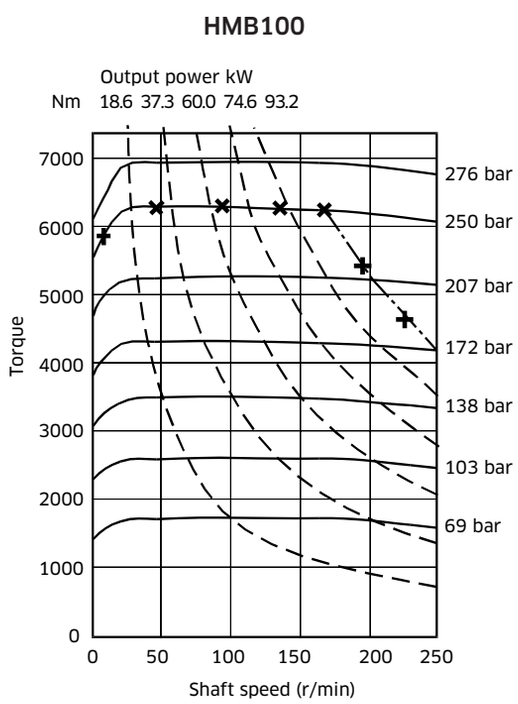
HMB060



HMB080



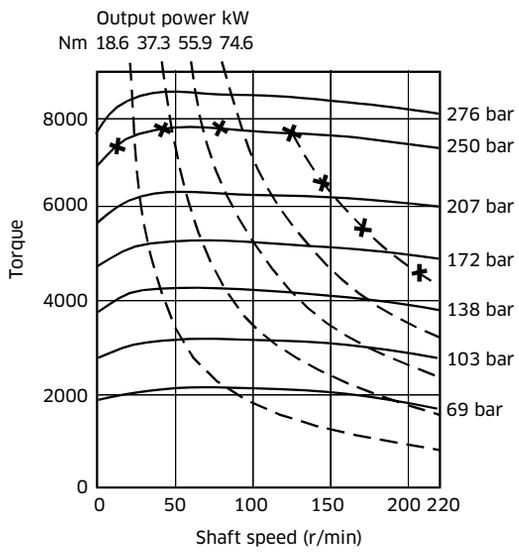
HMB100



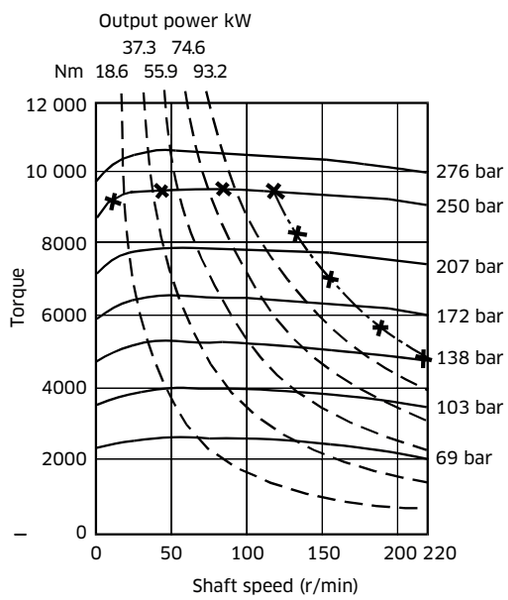
2-1 Performance Data (cont)

Output Torque Curves (cont)

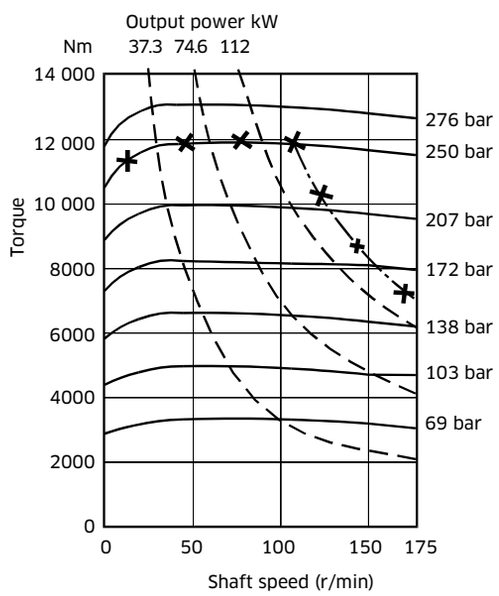
HM(HD)B125



HM(HD)B150



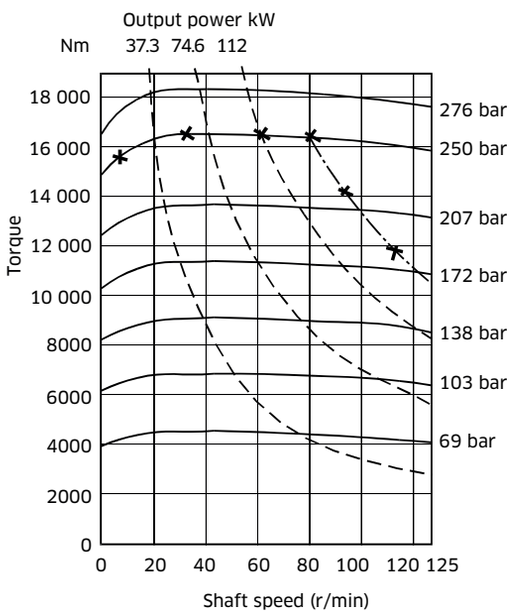
HM(HD)B200



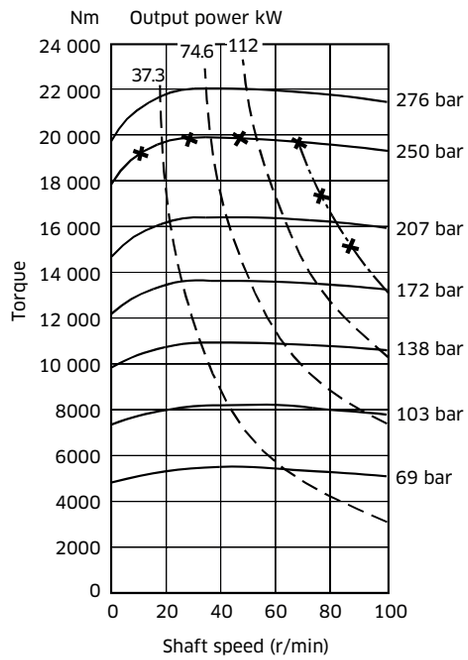
2-1 Performance Data (cont)

Output Torque Curves (cont)

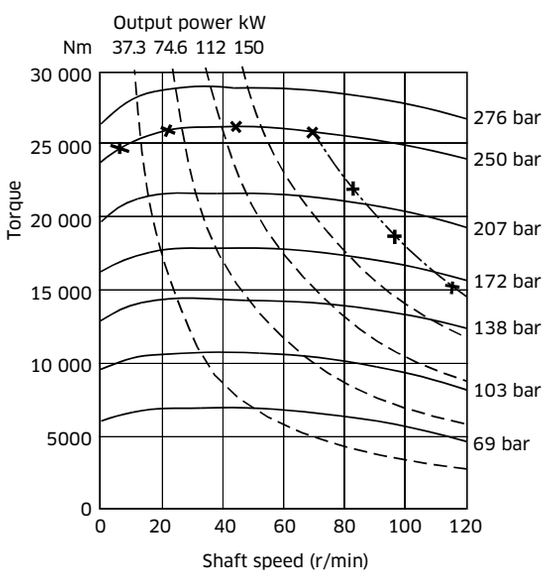
HM(HD)B270



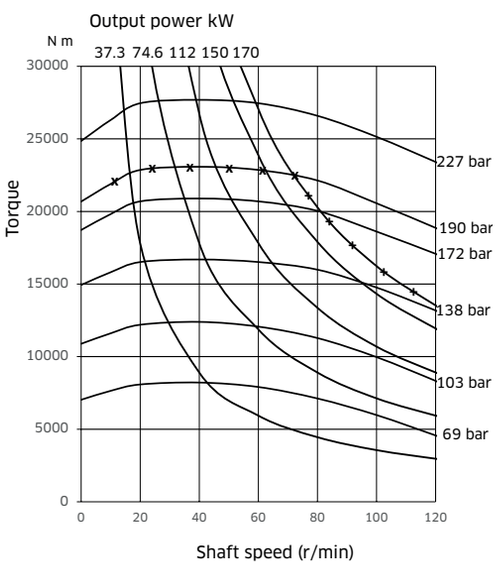
HM(HD)B325



HMHDB400



HMB500



2-2 Volumetric Efficiency Data

Motor Type	Geometric Displacement	Zero Speed Constant	Speed Constant	Creep Speed Constant	Crankcase Leakage Constant
HMB	cc/rev	K_1	K_2	K_3	K_4
HMB010	188	1.34	534.05	7.31	0.51
HMB030	492	1.04	57.67	2.47	0.59
HMB045	740	1.92	43.36	2.71	1.76
HMB060	983	1.72	29.91	2.35	1.88
HMB080	1,344	1.71	21.62	1.84	1.84
HMB100	1,639	1.83	17.74	1.41	1.88
HM(HD)B125	2,050	2.06	11.45	1.24	1.35
HM(HD)B150	2,470	1.62	9.98	1.00	1.39
HM(HD)B200	3,080	2.53	14.99	0.78	1.39
HM(HD)B270	4,310	3.17	21.16	0.68	1.80
HM(HD)B325	5,310	3.14	18.21	0.55	1.80
HMHDB400	6,800	4.06	10.18	0.53	2.35
HMB500	8,000	9.247	78.247	1.739	5.797

Fluid Viscosity	Viscosity Factor
cSt	Kv
20	1.58
25	1.44
30	1.30
40	1.10
50	1.00
60	0.88

Qt (total leakage) = $[K_1 + n/K_2] \times \Delta P \times Kv \times 0.005$ l/min

Creep speed = $K_3 \times \Delta P \times Kv \times 0.005$ rpm

Crankcase leakage = $K_4 \times \Delta P \times Kv \times 0.005$ l/min

ΔP = differential pressure bar

n = speed rpm

The motor volumetric efficiency can be calculated as follows:

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

Example:

HPC200 motor with displacement of 3.087 l/rev.

Speed 60 rpm

Differential pressure 200 bar

Fluid viscosity 50 cSt

Total leakage = $(K_1 + n/K_2) \times \Delta P \times Kv \times 0.005$ l/min

= (6.1+60/38.5) x 200 x 1 x 0.005

= 7.7 l/min

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

= 96%

2-3 Shaft Power Calculation

Example (see page 24)

Firstly, to find the maximum differential pressure ΔP at rated speed:

Select the rated shaft power (W) for the motor from the performance data table (page 24).
This is presented in kilowatts so must be converted to watts (x1000).

Then also take the Actual Average running torque in N.m/bar (T_o) and the rated shaft speed in rpm (n).

$$W = \frac{T_o \cdot \Delta P \cdot 2\pi \cdot n}{60}$$

Or to find maximum ΔP then use:

$$\Delta P = \frac{60 \cdot W}{2\pi \cdot T_o \cdot n}$$

HMB270 Example:

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

$$\Delta P = \frac{60 \times 140{,}000}{2\pi \times 63.79 \times 125}$$

ΔP= 167 bar (max.)

Secondly, to find the maximum speed at rated pressure (using the same information as before):

$$n = \frac{60 \cdot W}{2\pi \cdot T_o \cdot \Delta P}$$

Rated pressure (bar): 250

$$n = \frac{60 \times 140{,}000}{2\pi \times 63.79 \times 250}$$

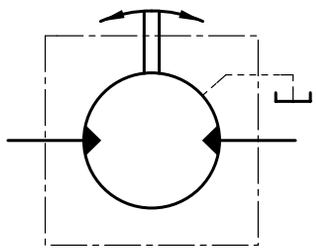
n = 83 rpm (max.)

In summary, operating the motor within its shaft power limit, at rated speed, would give a maximum pressure of 167 bar, and operating the motor at rated pressure, would give a maximum speed of 83 rpm.

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

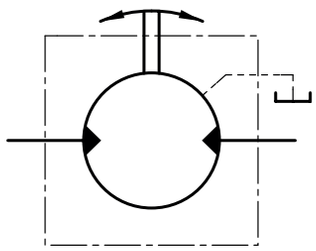
2-4 Functional Symbols

HMB010-
HMB030 (Monobloc)

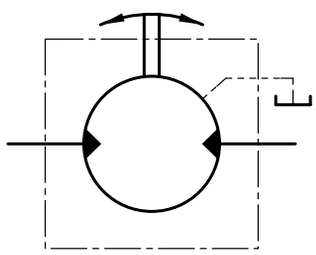


-S04-

HMB270
HMB325

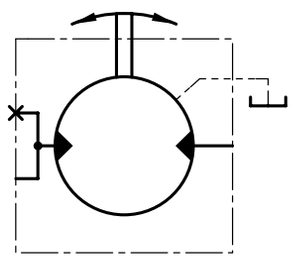


HMB045-**
(Monobloc)

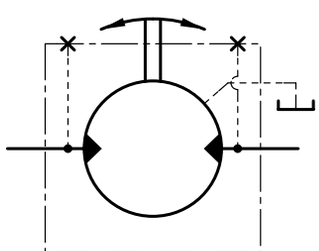


HMHDB400-**-
HMB500

Removable plug



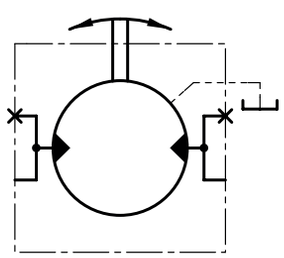
HMB045-**D-
(Monobloc)



HMHDB400-**-
HMB500

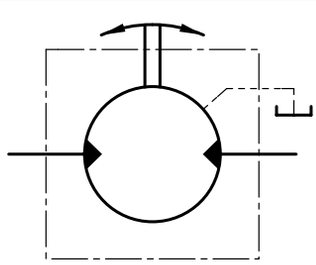
S045

Dual ports



S03-;-S04-

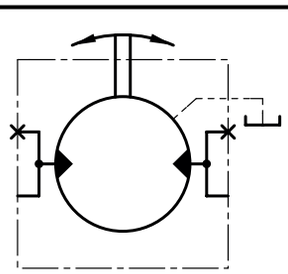
HMB030-045(TPB)
HMB060/080
HMB100/125
HMB150/200



-F(M)3-; F(M)4-

HMB030*/045*(TPB)
HMB060/080
HMB100/125
HMB150/200

*F(M)3 ONLY



2-5 Stress Limits

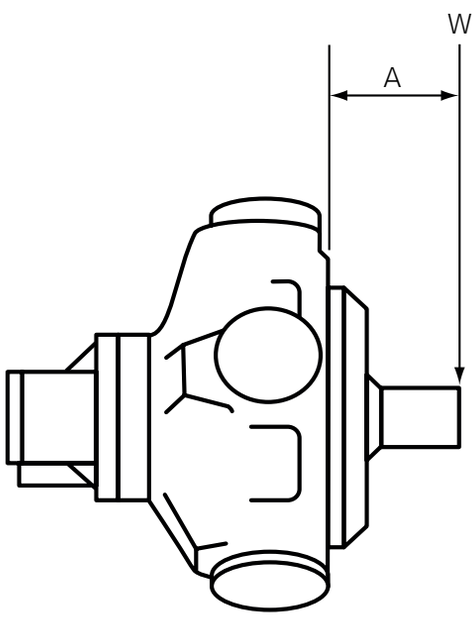
When applying large external radial loads, consideration should also be given to motor bearing lives (see page 33).

Motor Frame Size	Shaft Types	Maximum External Radial Bending Moment [Nm]
HMB010	P, S	1,550
HMB030	P, S & Z	2,400
HMB045	P, S & Z	3,240
HM060, 080 & 100	P, S & Z	5,500
HMB125, 150 & 200	P1, S3, S4, Z3, & T	6,600
HMHDB125, 150, 200	S5, Z5 & P2	12,750
HMB270 & 325	P1, S3, Z & T	7,500
HMHDB270 & 325	P2, S5 & Z	15,900
HMHDB400	P, S & Z	16,200
HMB500	P, S & Z	16,200

Example:

Determine the maximum radial shaft load of a HMB080 motor:

Radial load offset, A = 100 mm
Maximum radial load, W = 5,500 (see table)/100
= 55kN (5,607 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 KPM UK if this is not the case.

2-6 Bearing Life Notes

Consideration should be given to the required motor bearing life in terms of 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

[NOTE]
A heavy duty HM(HD)B motor can be ordered to further improve bearing life.
Consult KPM UK if you need a detailed bearing life calculation.

2-7 Circuit and Application Notes

Starting torque

The starting torques shown on the graphs on pages 25 to 28 are average and will vary with system parameters.

Low Speed Operations

Minimum operating speeds are determined by the hydraulic system and load conditions (load inertia, drive elasticity, etc.) Recommended minimum speeds are shown below:

Model Type	rpm
HMB010	20
HMB030	5
HMB045	6
HMB060/080/100	3
HM(HD)B/125/150/200	3
HM(HD)B270/325	2
HMHDB400/HMB500	2

High Back Pressure

When both inlet and outlet ports are pressurised continuously, the lower port pressure must not exceed 70 bar at any time.

Note: High back pressure reduces the effective torque output of the motor.

Boost Pressure

When operating as a motor the outlet pressure should equal or exceed the crankcase pressure. If pumping occurs (i.e. overrunning loads) then a positive pressure, "P", is required at the motor ports. Calculate "P" (bar) from the operating formula Boost Formula $P = 1 + \frac{N^2 \times V^2}{K} + C$

Where P is in bar, N = motor speed (rpm), V = motor displacement (cc/rev), C = Crankcase pressure (bar) and K=a constant from the table below:

Motor	Porting	Constant (K)
HMB010	Standard	8.0×10^8
HMB030	Standard - Monobloc	3.7×10^9
	F(M)3 SM3	7.5×10^9
HMB045	Standard - Monobloc	1.3×10^{10}
	F(M)3 SM3	1.6×10^{10}
HMB060, HMB080 & HMB100	F(M)3 SM3	1.8×10^{10}
HM(HD)B125, HM(HD)B150 & HM(HD)B200	FM(3) SM3	4.0×10^{10}
	FM(4)	8.0×10^{10}
HM(HD)B270 & HM(HD)B325	FM(4)	7.2×10^{10}
HMHDB400 & HMB500	S045	7.2×10^{10}

2-7 Circuit and Application Notes (cont)

The flow rate of oil needed for the make-up system can be estimated from the crankcase leakage data (see page 29 for calculation method). Allowances should be made for other system losses and also for “fair wear and tear” during the life of the motor, pump and system components.

Cooling Flow

Operating within the continuous rating does not require any additional cooling.

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

Motorcase pressure

With the standard shaft seal fitted, the motor casing pressure should not exceed 3.5 bar.

Notes

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

2) High pressure shaft seals are available for casing pressures of:
9 bar for HMB010
10 bar for all remaining frame sizes.

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

Hydraulic Fluids

Dependent on motor (see model code fluid type - page 4) 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 23.

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

Max. off load: **2,000 cSt** (9270 SUS)
Max. on load: **150 cSt** (695 SUS)
Optimum: **50 cSt** (232 SUS)
Minimum: **25 cSt** (119 SUS)

2-7 Circuit and Application Notes (cont)

Mineral oil recommendations

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

Temperature limits

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

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

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

Filtration

Full flow filtration (open circuit), or full boost flow filtration (close circuit) to ensure system cleanliness to ISO4406/1986 code 18/14 or cleaner.

Noise levels

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

Polar moment of intertia and mass table

Motor Frame Size	Polar Moment of Intertia ($kg.m^2$) (Typical data)	Mass (kg) (Approx. all models)
HMB010	0.0076	40
HMB030	0.0150	73
HMB045	0.0470	120
HMB060	0.0500	144
HMB080	0.0600	144
HMB100	0.0760	144
HMB125	0.2200	217
HMB150	0.2500	265
HMB200	0.2700	265
HMB270	0.4900	420
HMB325	0.5000	429
HMHDB400 - S04	0.5400	481
HMHDB400 - S05	0.5400	510
HMB500	0.5400	510

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.

	Non-operating temperature limits	Minimum operating temperature
Standard pressure shaft seal	below minus 40°C and above 100°C	minus 30°C
High pressure shaft seal	below minus 30°C and above 120°C	minus 15°C

All seals are very brittle below minus 40°C and are likely to break very easily and due to their sluggish response may not provide a 100% leak free condition.

It should be noted that the maximum continuous operating temperature within the motor crankcase is plus 80°C.

2-9 Freewheeling Notes

All Staffa motors can be used in freewheeling applications.

In all circumstances it is essential that the motor is unloaded (“A” and “B” ports connected together) and that the circuit is boosted.

The required boost pressure is dependent on both the speed and displacement conditions.

It should be noted that for “HMB” series motors, to achieve freewheel, large flows will have to re-circulate around the motor.

This will require a large recirculating valve and consideration of circuit cooling as the motor will be generating a braking torque.

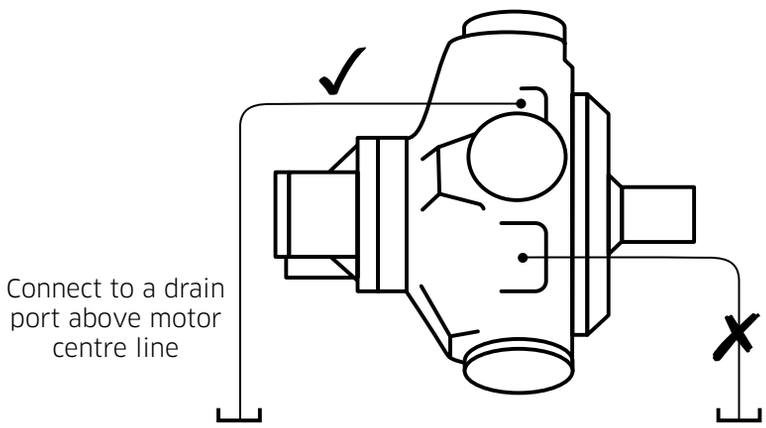
It is for these reasons that “HMC”, “HPC” or "HMF" series motors are the preferred option for freewheeling applications.

See catalogues M-2002/03.17, M-2003/03.17 and M-2005/03.17 for details.

2-10 Crankcase Drain Connections

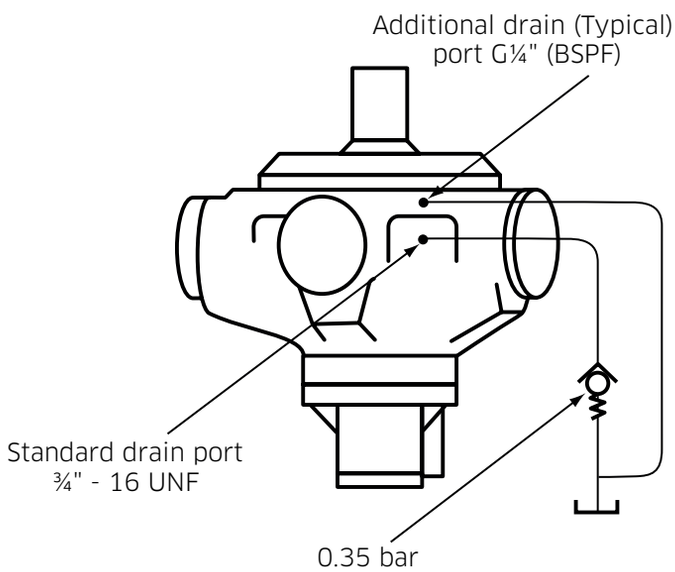
Motor axis - horizontal

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.



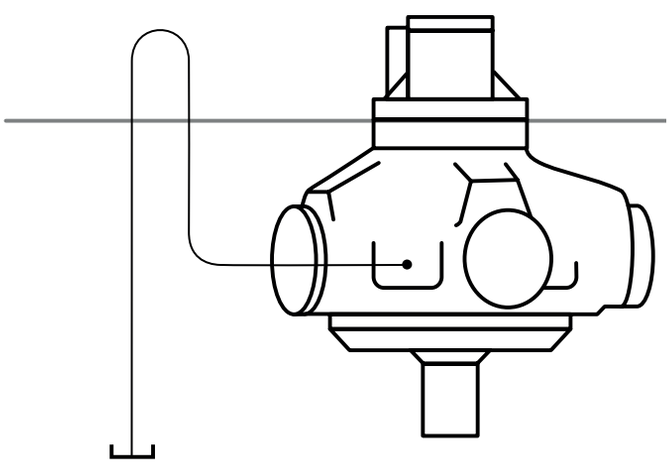
Motor axis - vertical shaft up

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.



2-11 Installation Data

Spigot

The motor should be located by the mounting spigot on a flat, robust surface using correctly sized bolts.

The diametrical clearance between the motor spigot and the mounting must not exceed 0.15 mm. If the application incurs shock loading, frequent reversing or high speed running, then high tensile bolts should be used, including one fitted bolt.

Bolt Torque

The recommended torque wrench setting for bolts is as follows:

M12	97 +/- 7Nm
M14	160 +/- 21Nm
M18	312 +/- 14 Nm
M20	407 +/- 14 Nm
M24	690 +/- 27 Nm
½" UNF	97 +/- 7 Nm
⅝“ UNF	265 +/- 14 Nm
¾“ UNF	393 +/- 14 Nm
1"	810 +/- 27 Nm

Shaft coupling:

Where the motor is solidly coupled to a shaft having independent bearings the shaft must be aligned to within 0.13 mm TIR.

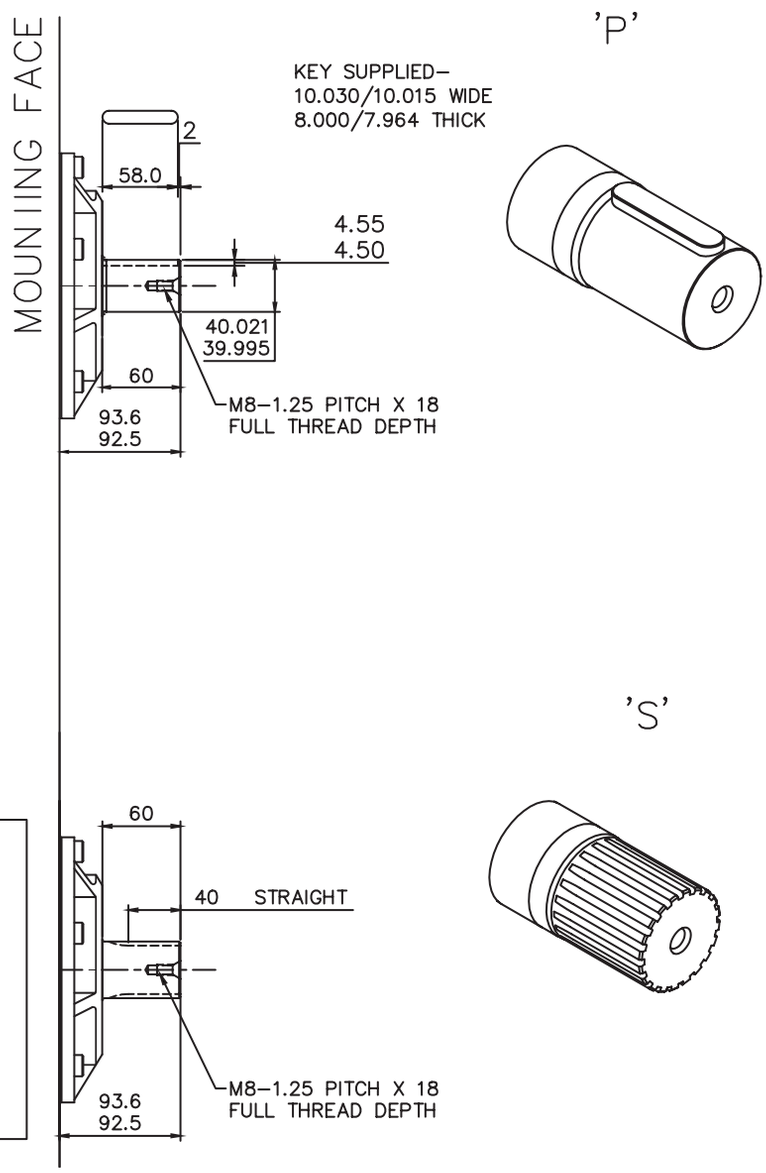
Conversion Table

Pressure	
bar	PSI
1	14.5
Flow	
l/min	gal/min
1	0.264 US
1	0.219 UK
Length	
mm	inch
25.4	1
Torque	
Nm	lbf ft
1	1.737
Power	
kW	hp
1	1.341
Mass	
kg	lb
1	2.2

3 Dimensions

3-1 HMB010

'P' & 'S' Shafts

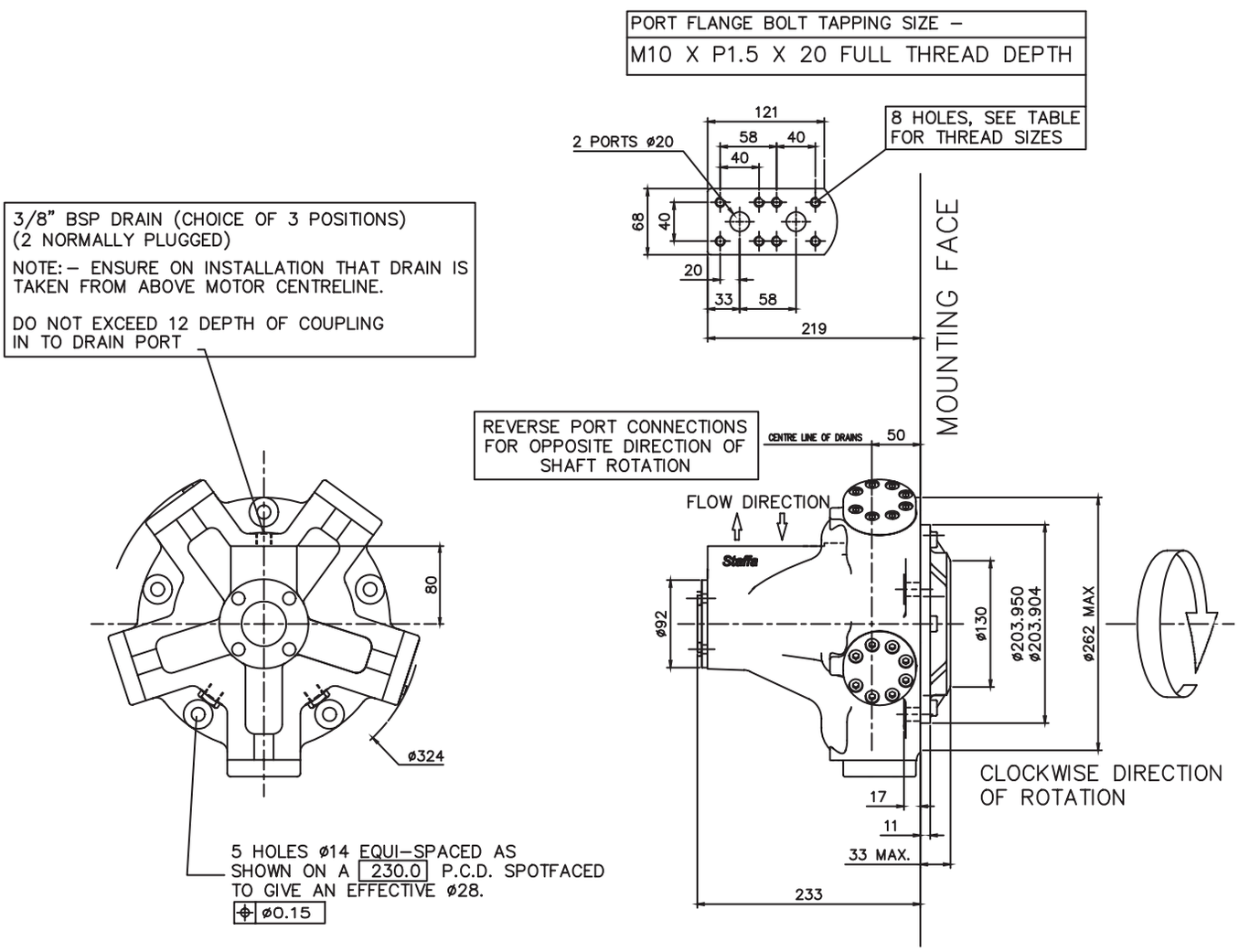


SPLINE DATA

'S'	
TO BS 3550 (ANSI B92.1 CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	13
PITCH	8/16
MAJOR DIAMETER	43.71/43.59
FORM DIAMETER	38.136
MINOR DIAMETER	37.36/36.91
PIN DIAMETER	6.096
DIAMETER OVER PINS	50.104/50.152

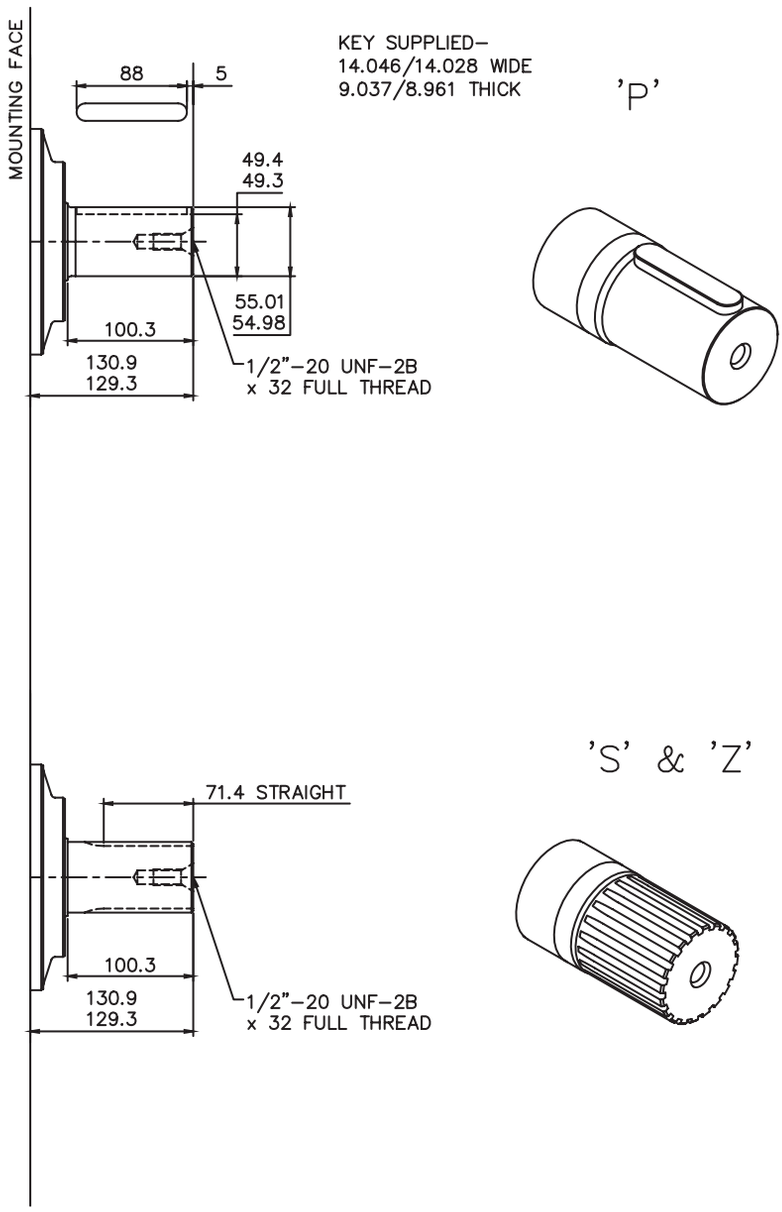
3-1 HMB010 (cont)

Installation



3-2 HMB030

Monobloc - 'P', 'S' and 'Z' Shafts



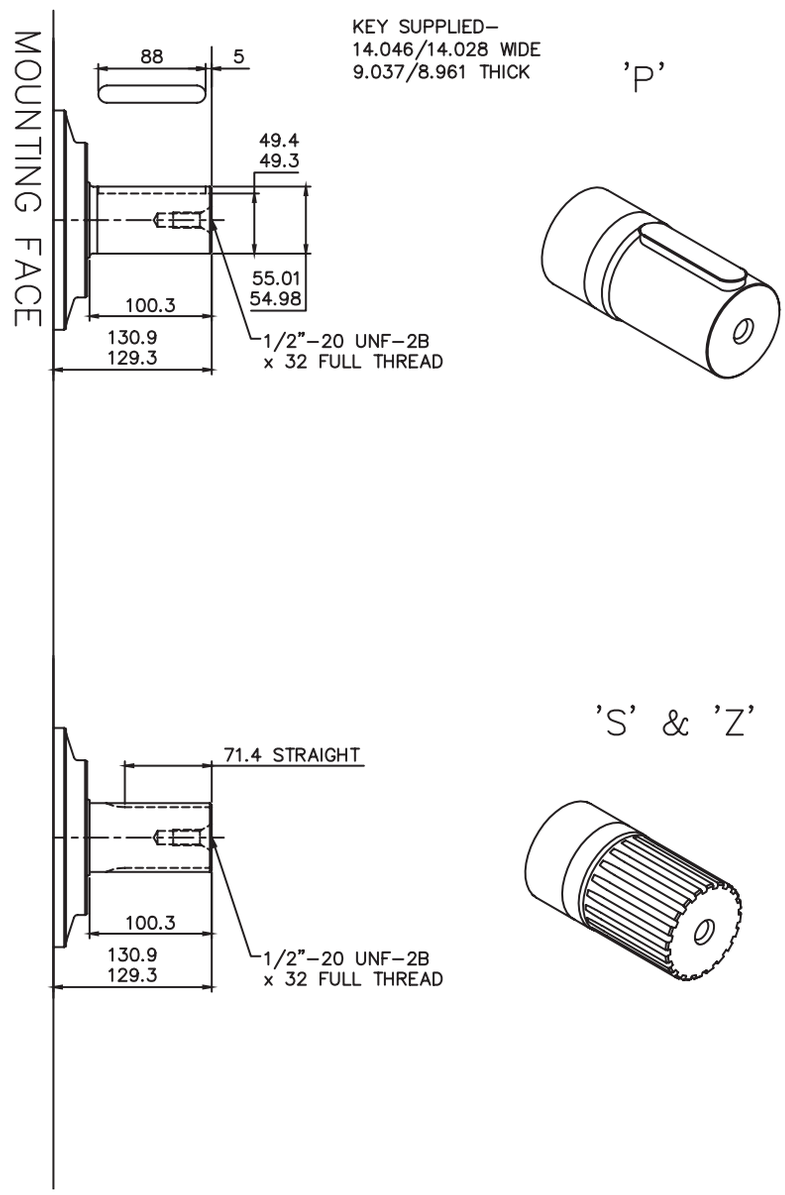
SPLINE DATA

'S'	
TO BS 3550 (ANSI B92.1 CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	17
PITCH	8/16
MAJOR DIAMETER	56.41/56.28
FORM DIAMETER	50.703
MINOR DIAMETER	50.07/49.60
PIN DIAMETER	6.096
DIAMETER OVER PINS	62.985/62.931

'Z'
DIN 5480, W55 X 3 X 17 X 7h

3-3 HMB030 (cont)

2 Piece - 'P', 'S' and 'Z' Shafts



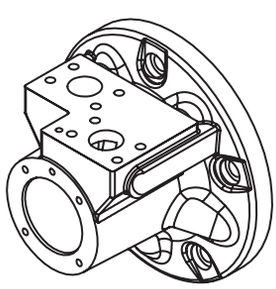
SPLINE DATA

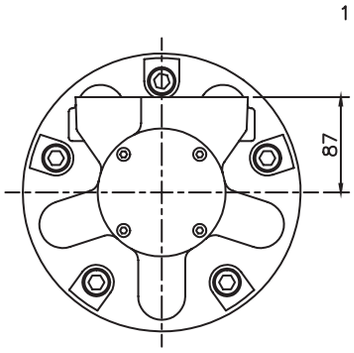
'S'	
TO BS 3550 (ANSI B92.1 CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	17
PITCH	8/16
MAJOR DIAMETER	56.41/56.28
FORM DIAMETER	50.703
MINOR DIAMETER	50.07/49.60
PIN DIAMETER	6.096
DIAMETER OVER PINS	62.985/62.931

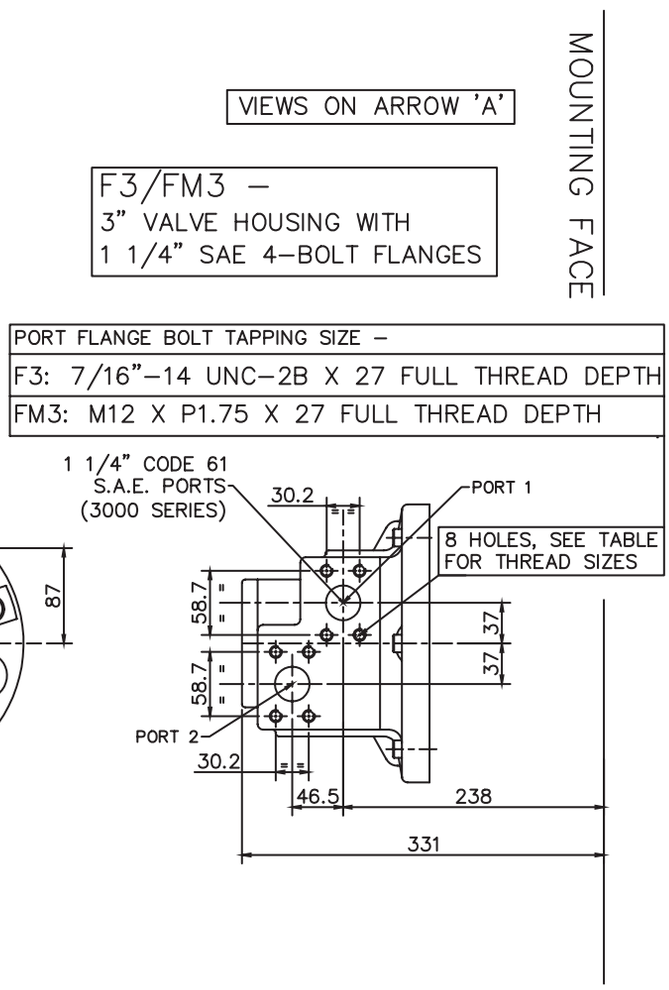
'Z'
DIN 5480, W55 X 3 X 17 X 7h

3-2 HMB030 (cont)

2 Piece - 'F3' & 'FM3' Valve Housings

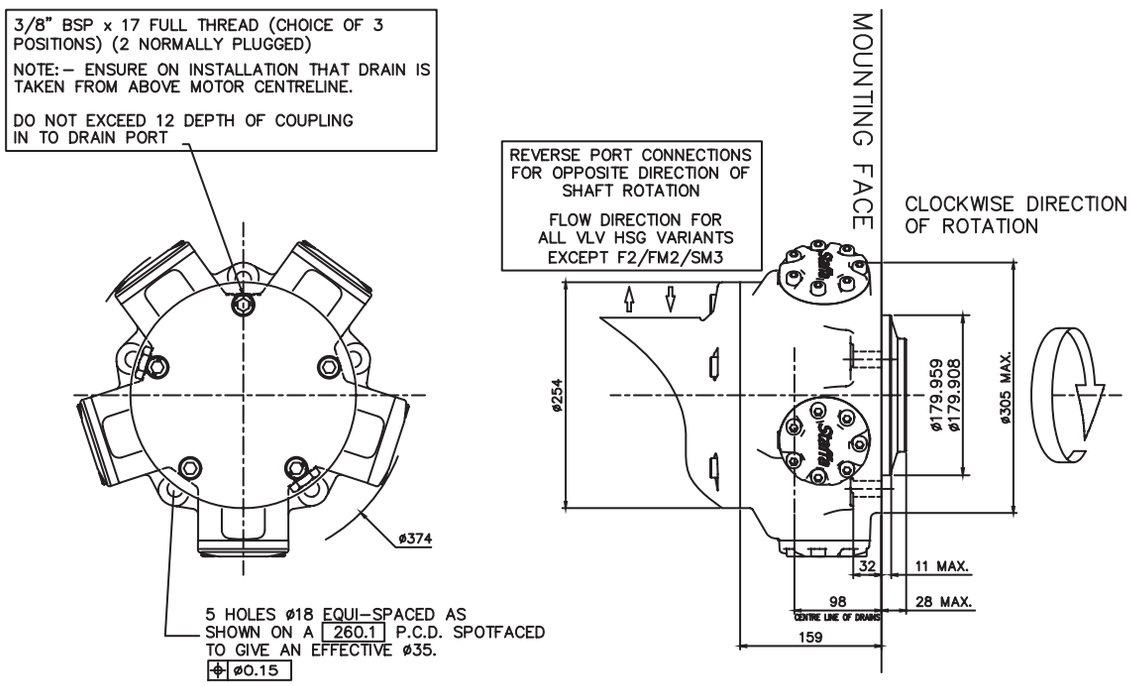




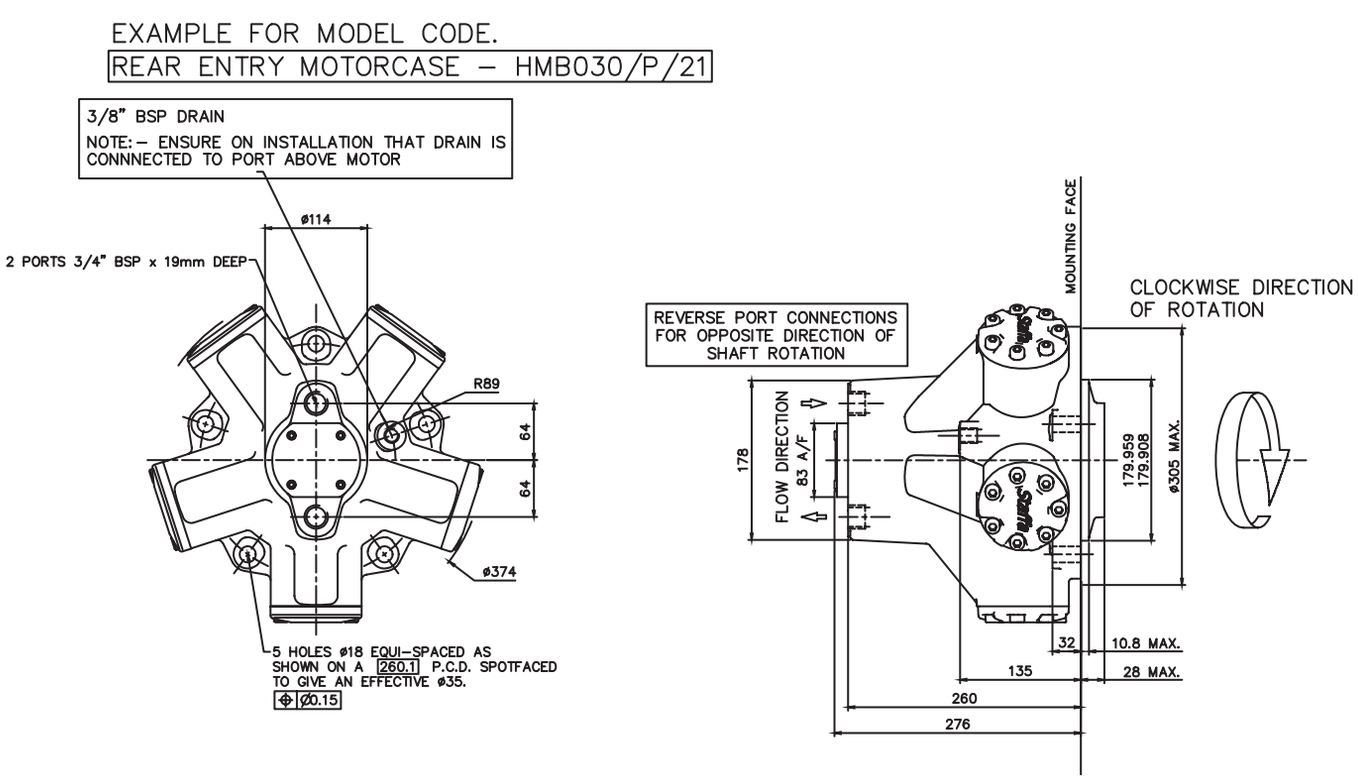


3-2 HMB030 (cont)

2 Piece - Installation

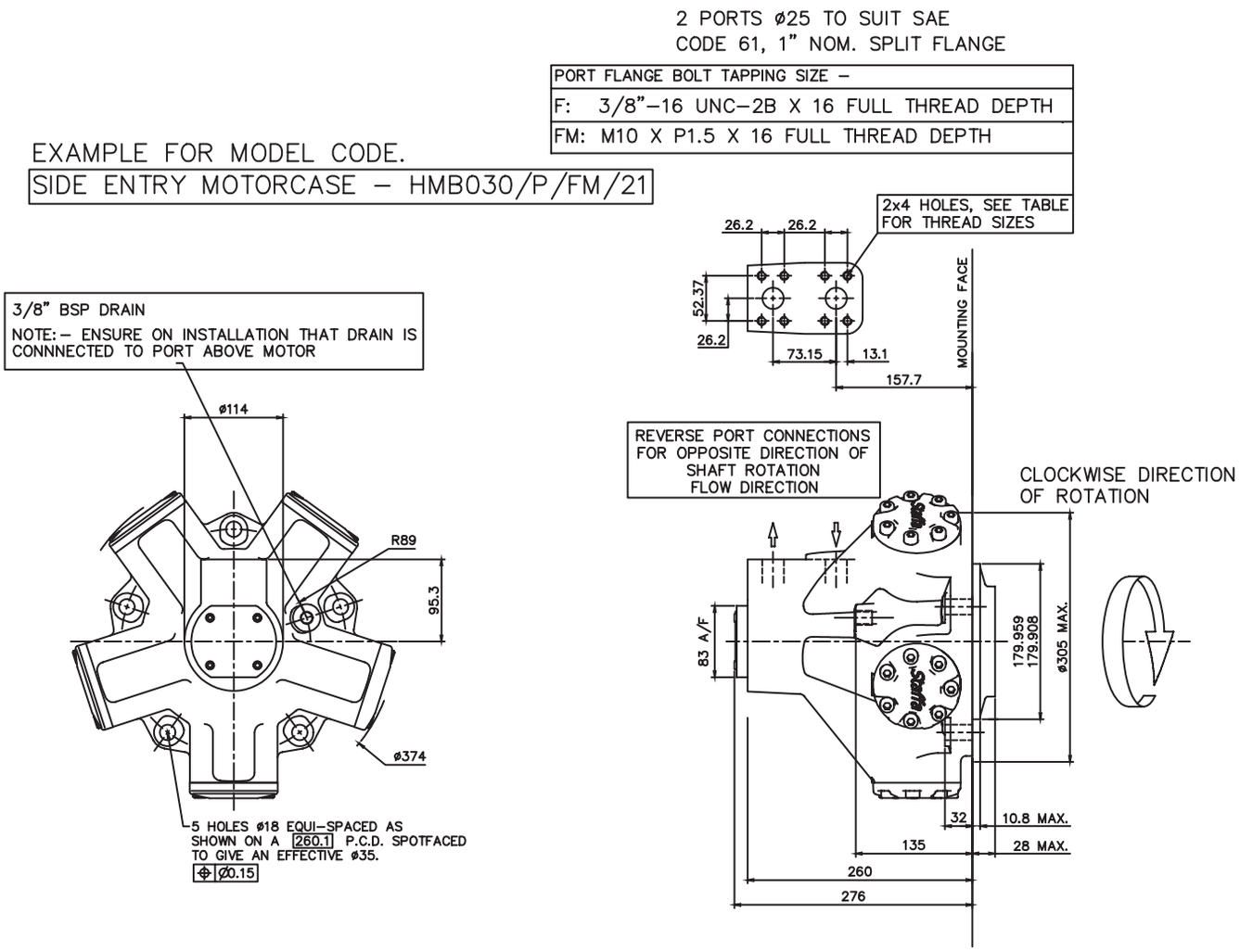


Monobloc - Rear Port Installation



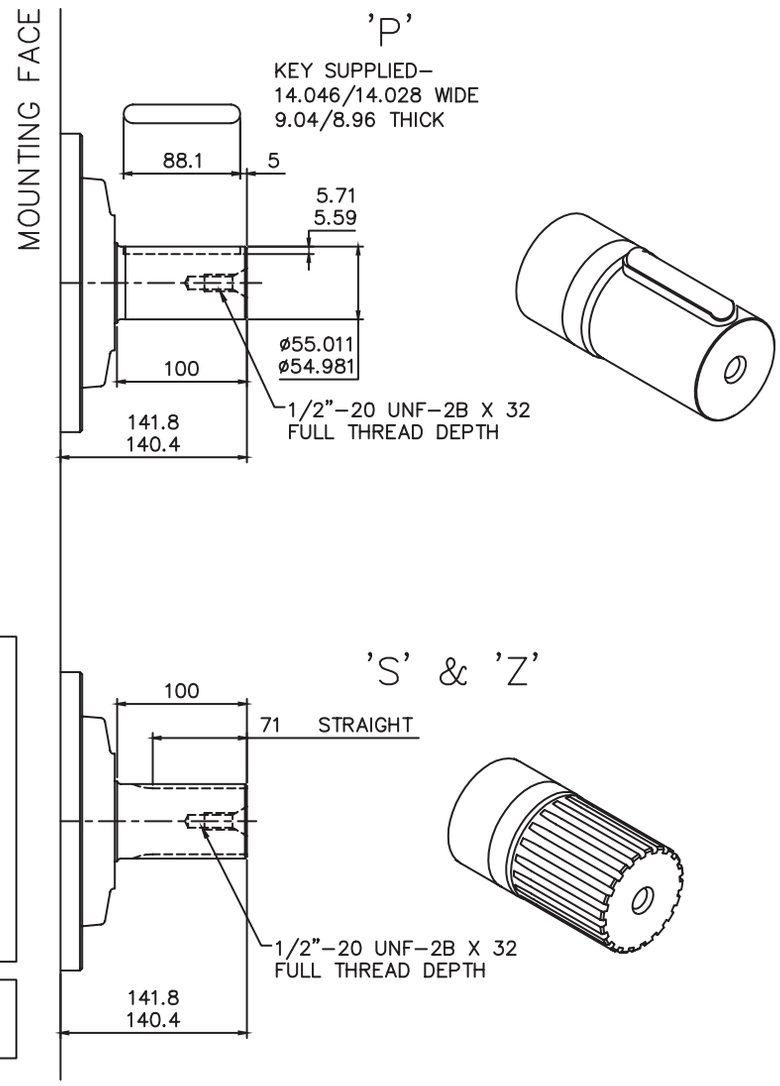
3-2 HMB030 (cont)

Monobloc - Side Port Installation



3-3 HMB045

Monobloc - 'P', 'S' & 'Z' Shafts



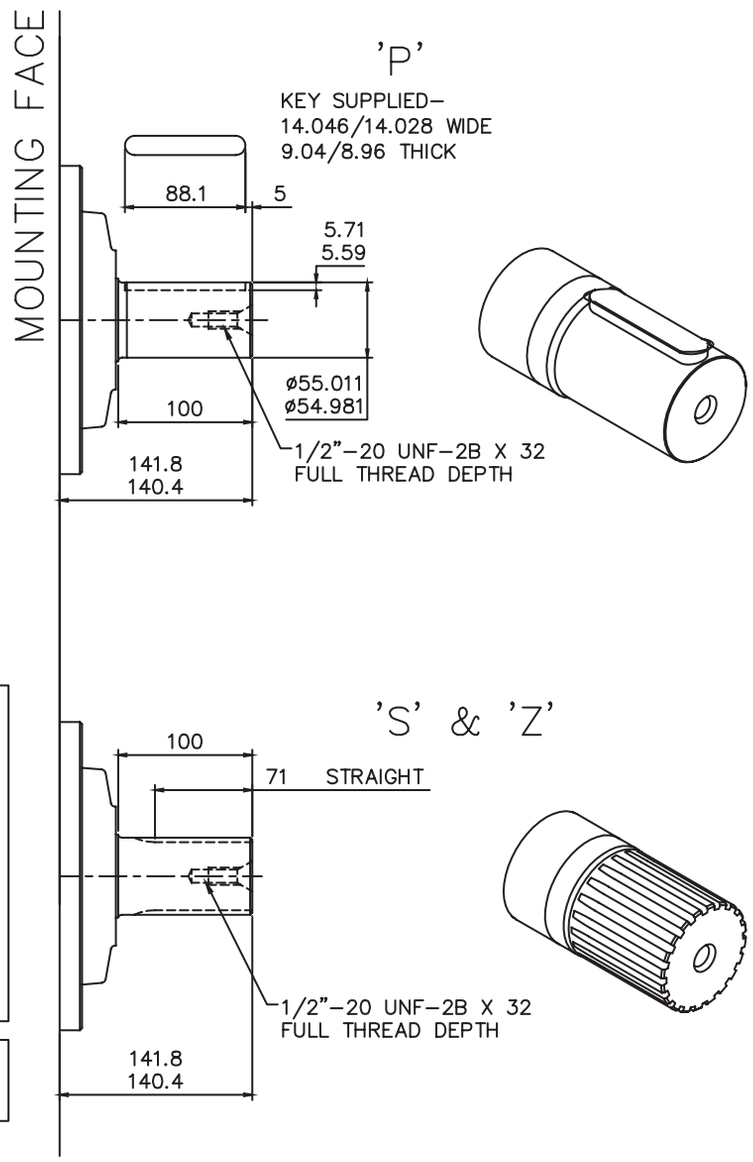
SPLINE DATA

'S'	
TO BS 3550 (ANSI B92.1 CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	17
PITCH	8/16
MAJOR DIAMETER	56.41/56.29
FORM DIAMETER	50.703
MINOR DIAMETER	50.06/49.60
PIN DIAMETER	6.096
DIAMETER OVER PINS	62.984/62.931

'Z'
DIN 5480 W55 x 3 x 17 x 7h

3-3 HMB045 (cont)

2 Piece - 'P', 'S' & 'Z' Shafts



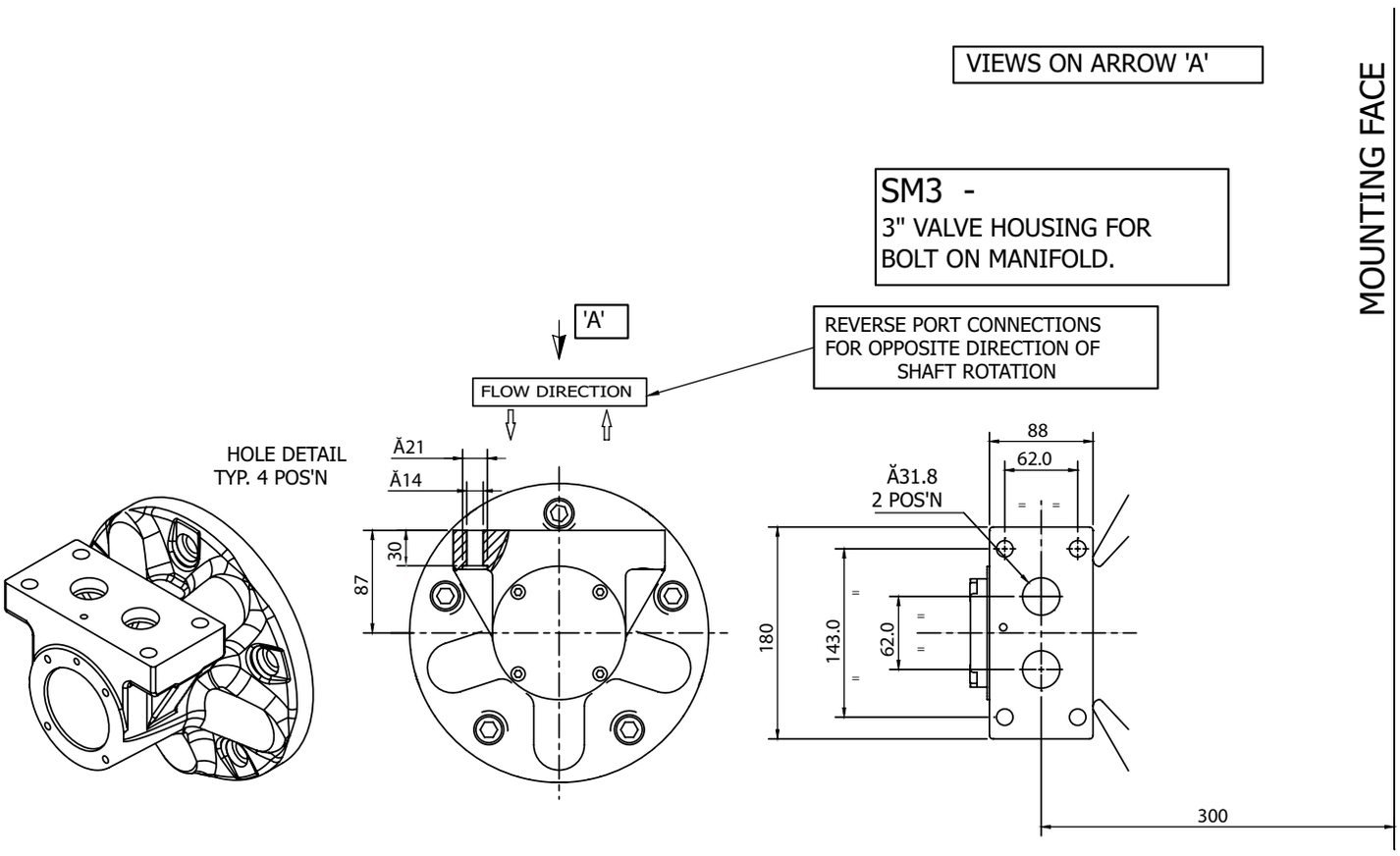
SPLINE DATA

'S'	
TO BS 3550 (ANSI B92.1 CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	17
PITCH	8/16
MAJOR DIAMETER	56.41/56.29
FORM DIAMETER	50.703
MINOR DIAMETER	50.06/49.60
PIN DIAMETER	6.096
DIAMETER OVER PINS	62.984/62.931

'Z'
DIN 5480 W55 x 3 x 17 x 7h

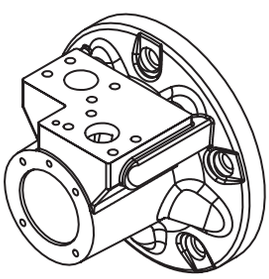
3-3 HMB045 (cont)

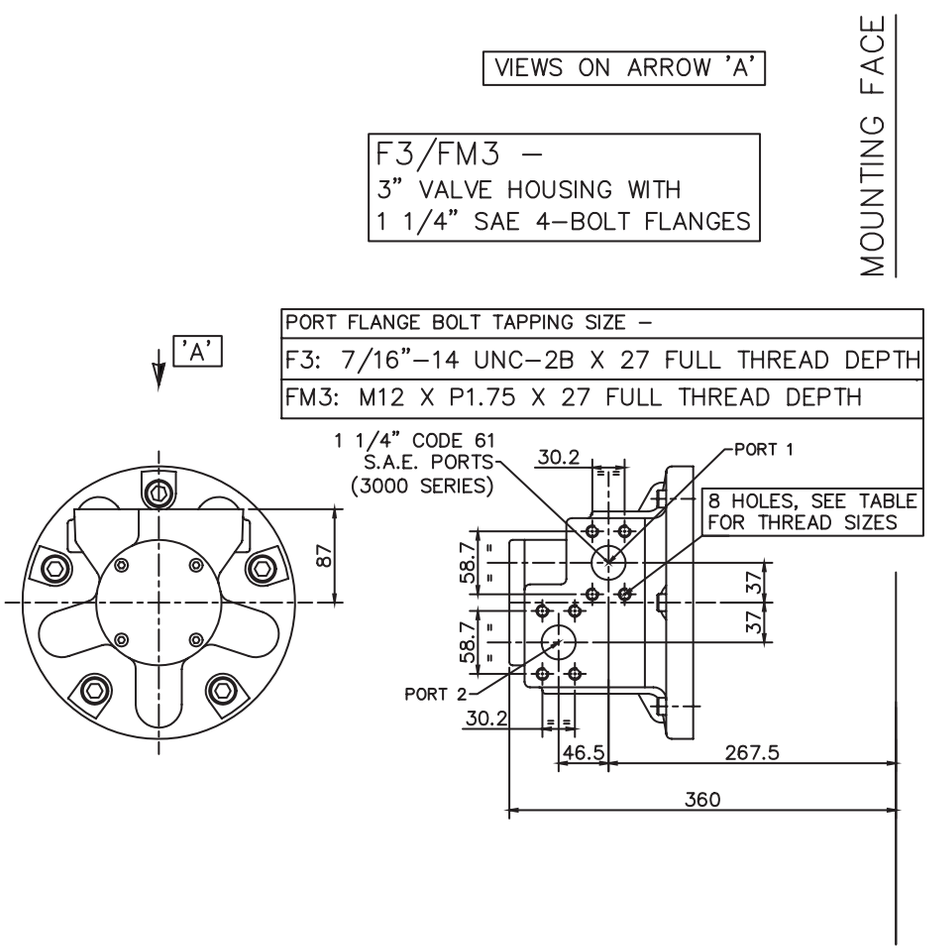
2 Piece -'SM3' Valve Housing



3-3 HMB045 (cont)

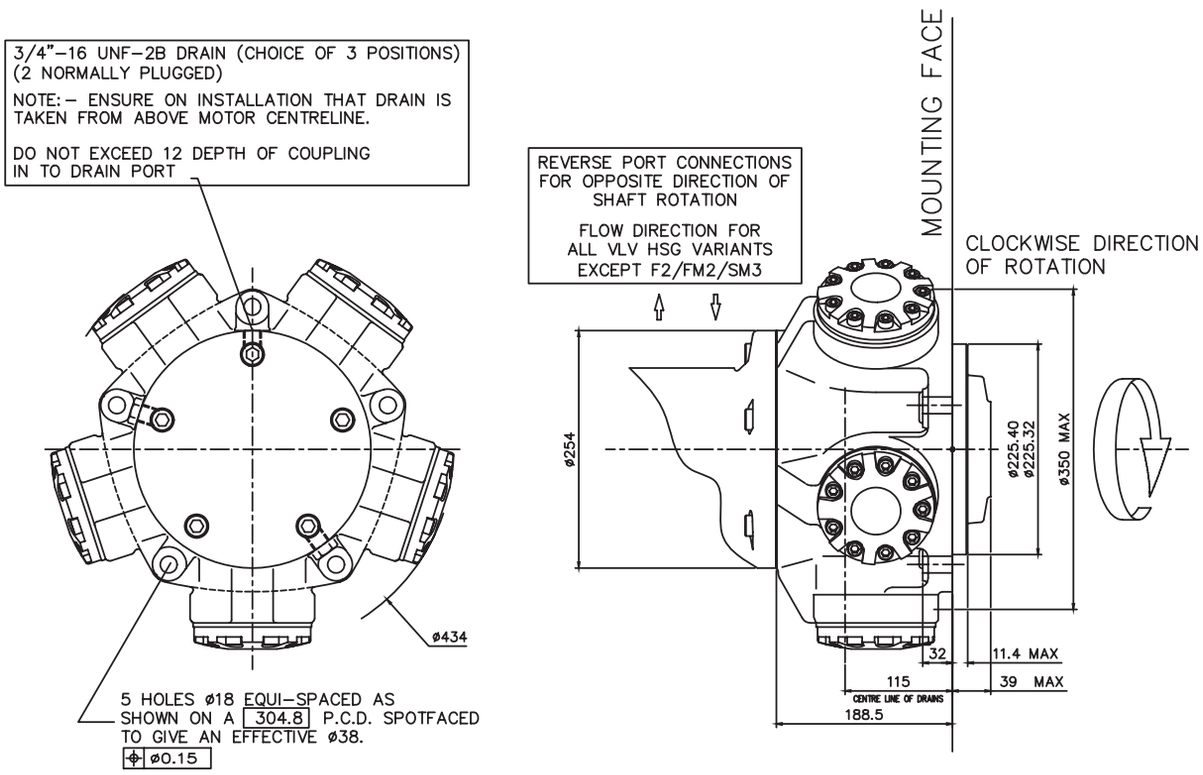
2 Piece - 'F3' & 'FM3' Valve Housings



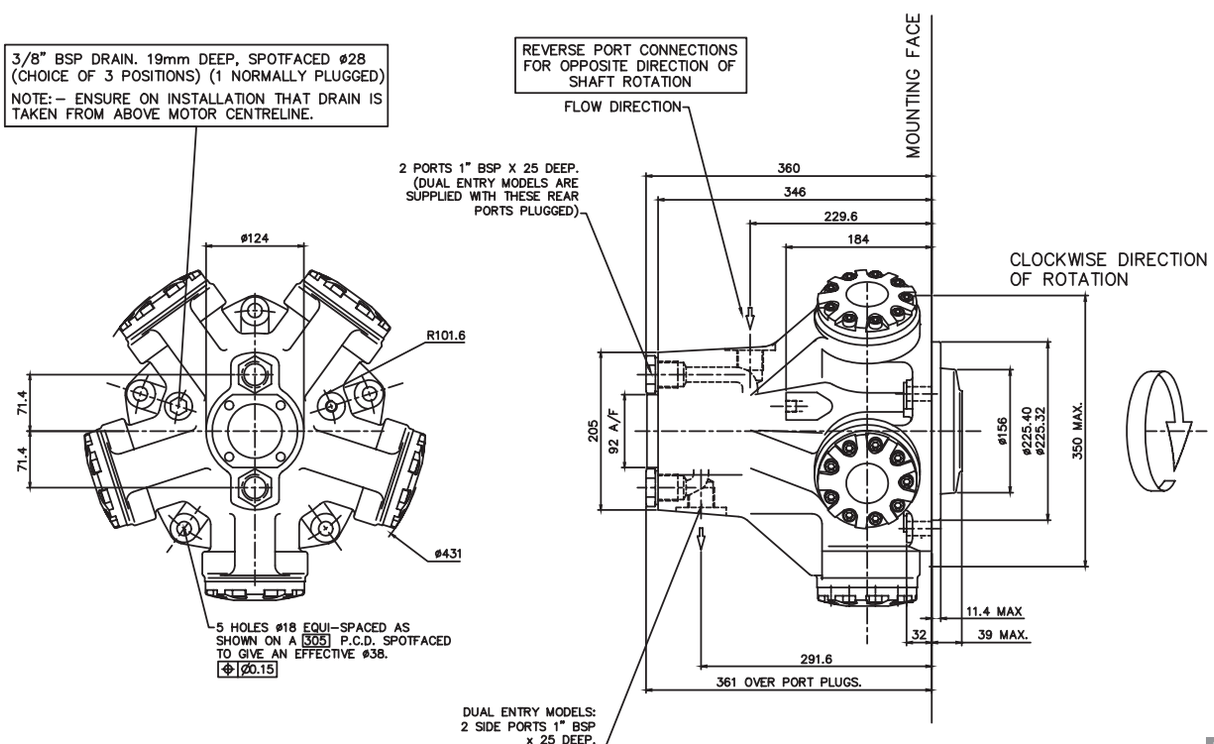


3-3 HMB045 (cont)

2 Piece - Installation

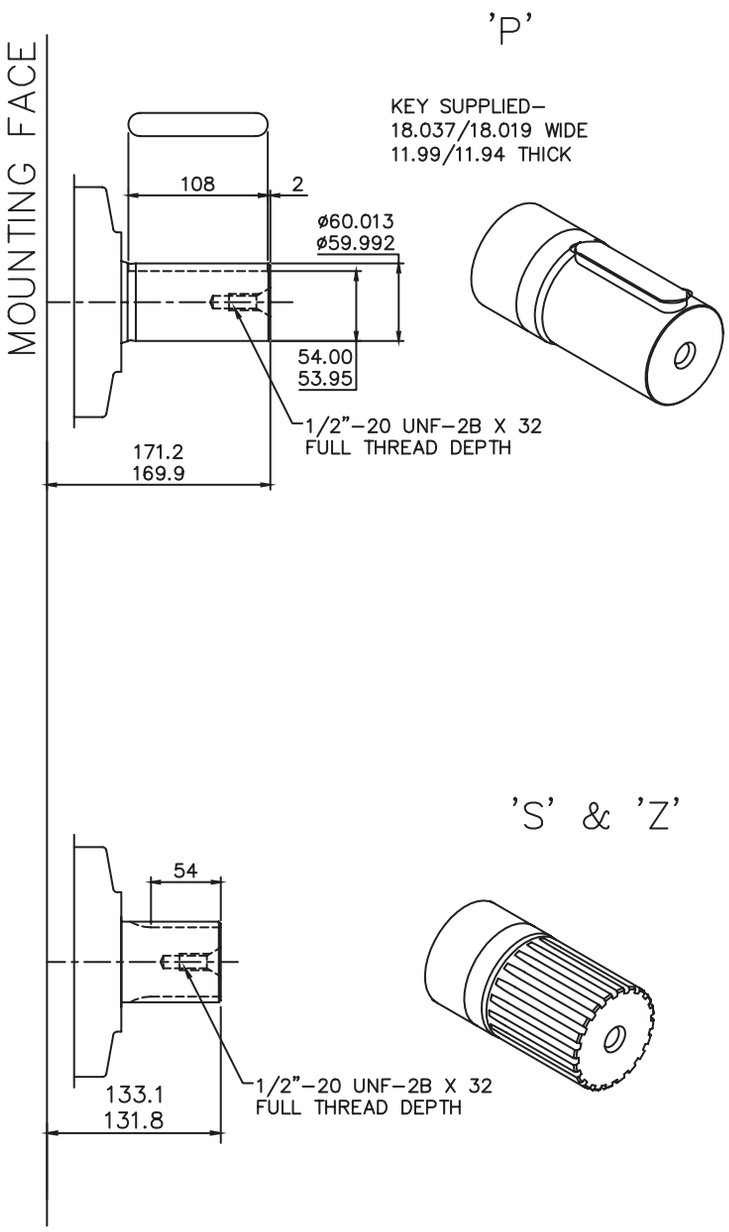


Monobloc - Installation



3-4 HMB060/080

'P', 'S' & 'Z' Shafts



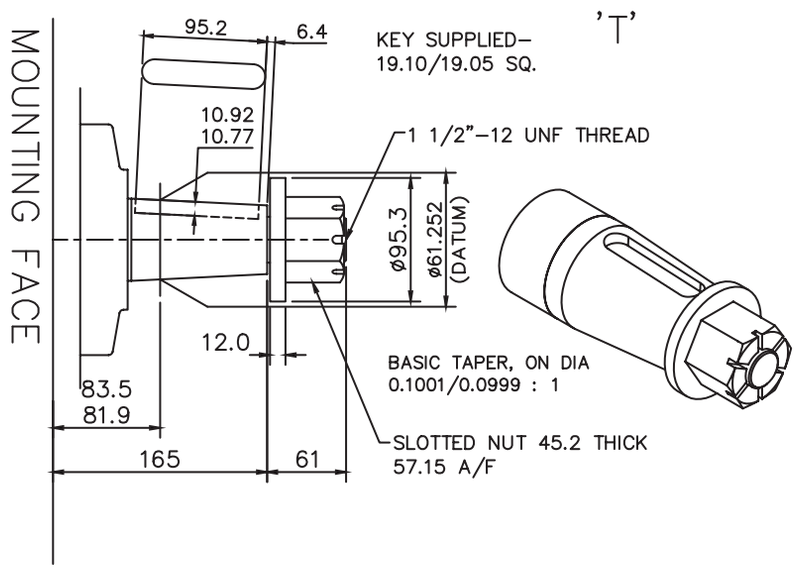
SPLINE DATA

'S'	
TO BS 3550 (ANSI B92.1 CLASS 5) FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	14
PITCH	6/12
MAJOR DIAMETER	62.553/62.425
FORM DIAMETER	55.052
MINOR DIAMETER	54.084/53.525
PIN DIAMETER	8.128
DIAMETER OVER PINS	71.593/71.544

'Z'
DIN 5480 W70 x 3 x 30 x 22 x 7h

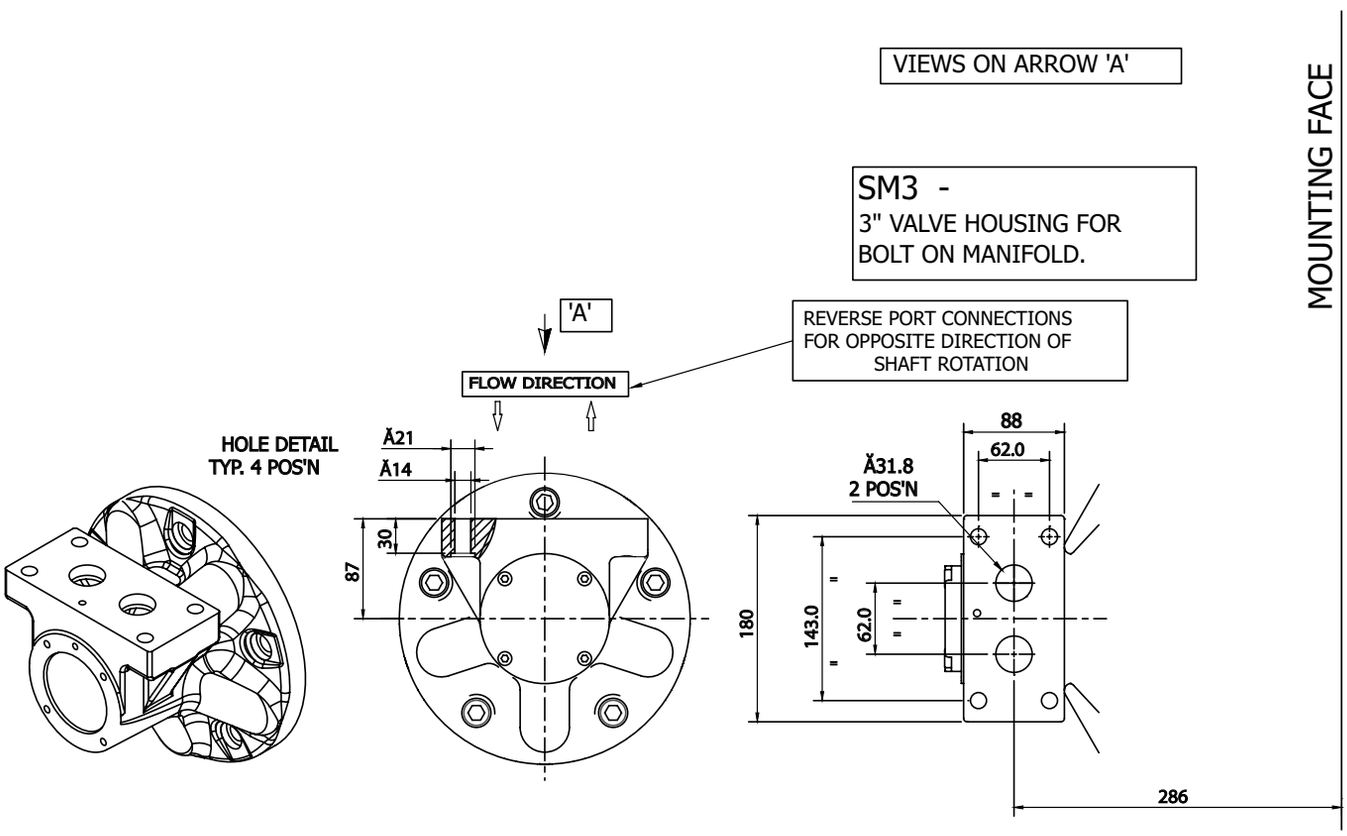
3-4 HMB060/080 (cont)

'T' Shaft



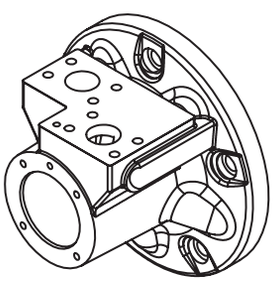
3-4 HMB060/080 (cont)

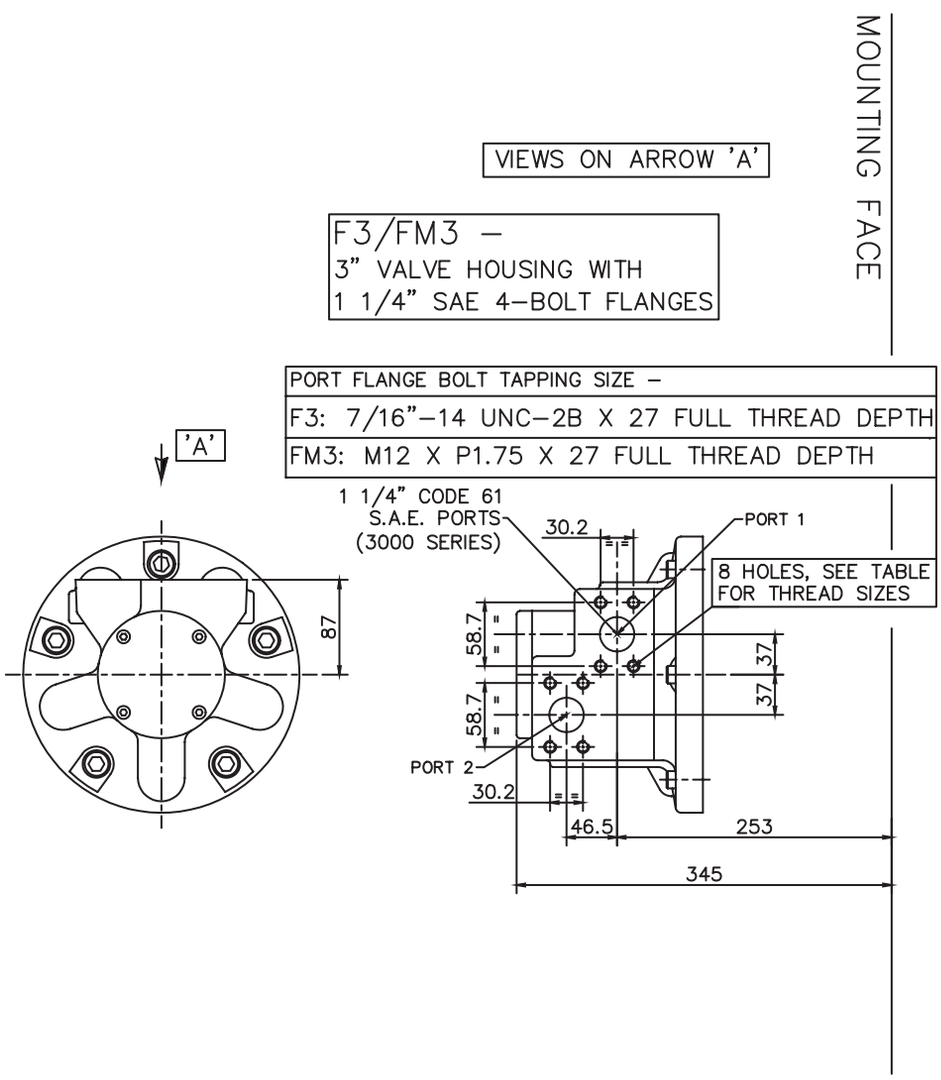
'SM3' Valve Housing



3-4 HMB060/080 (cont)

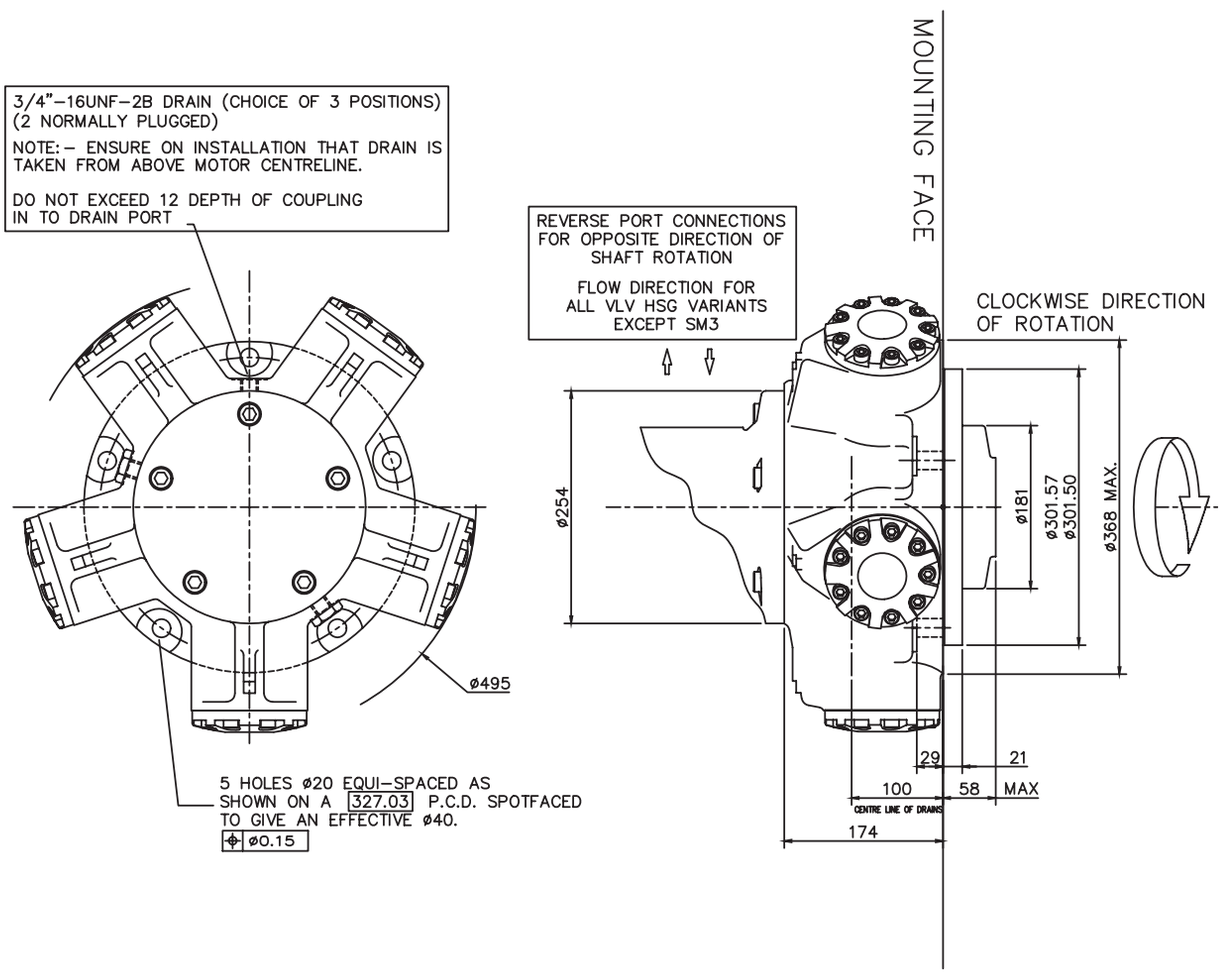
'F3' & 'FM3' Valve Housings





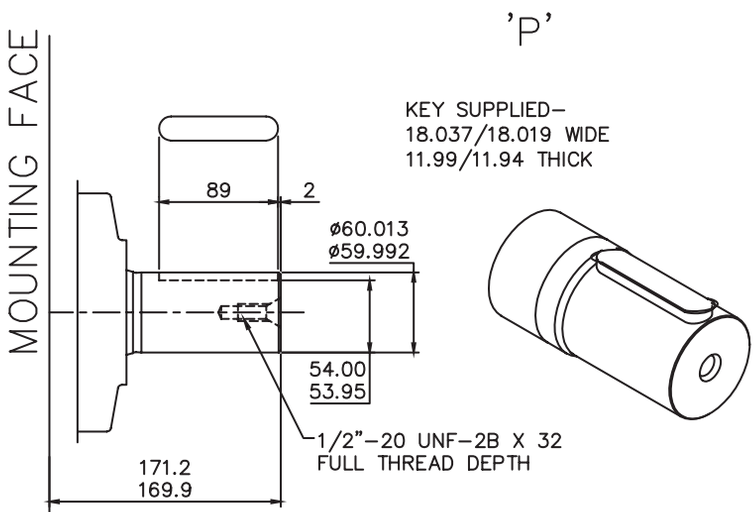
3-4 HMB060/080 (cont)

Installation



3-5 HMB100

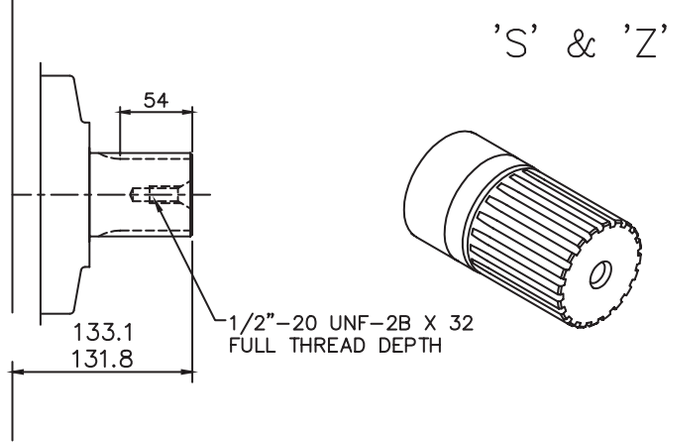
'P', 'S' & 'Z' Shafts



SPLINE DATA

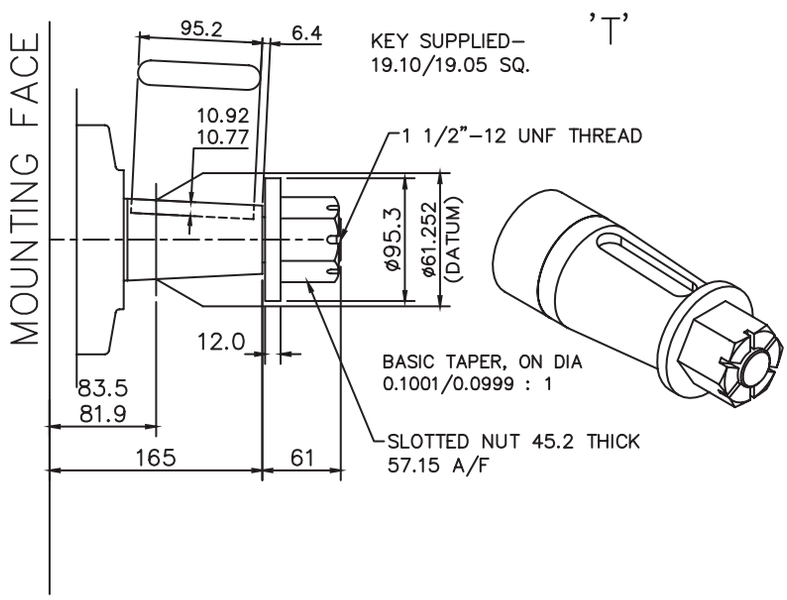
'S'	
TO BS 3550 (ANSI B92.1 CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	14
PITCH	6/12
MAJOR DIAMETER	62.553/62.425
FORM DIAMETER	55.052
MINOR DIAMETER	54.084/53.525
PIN DIAMETER	8.128
DIAMETER OVER PINS	71.593/71.544

'Z'
DIN 5480 W70 x 3 x 30 x 22 x 7h



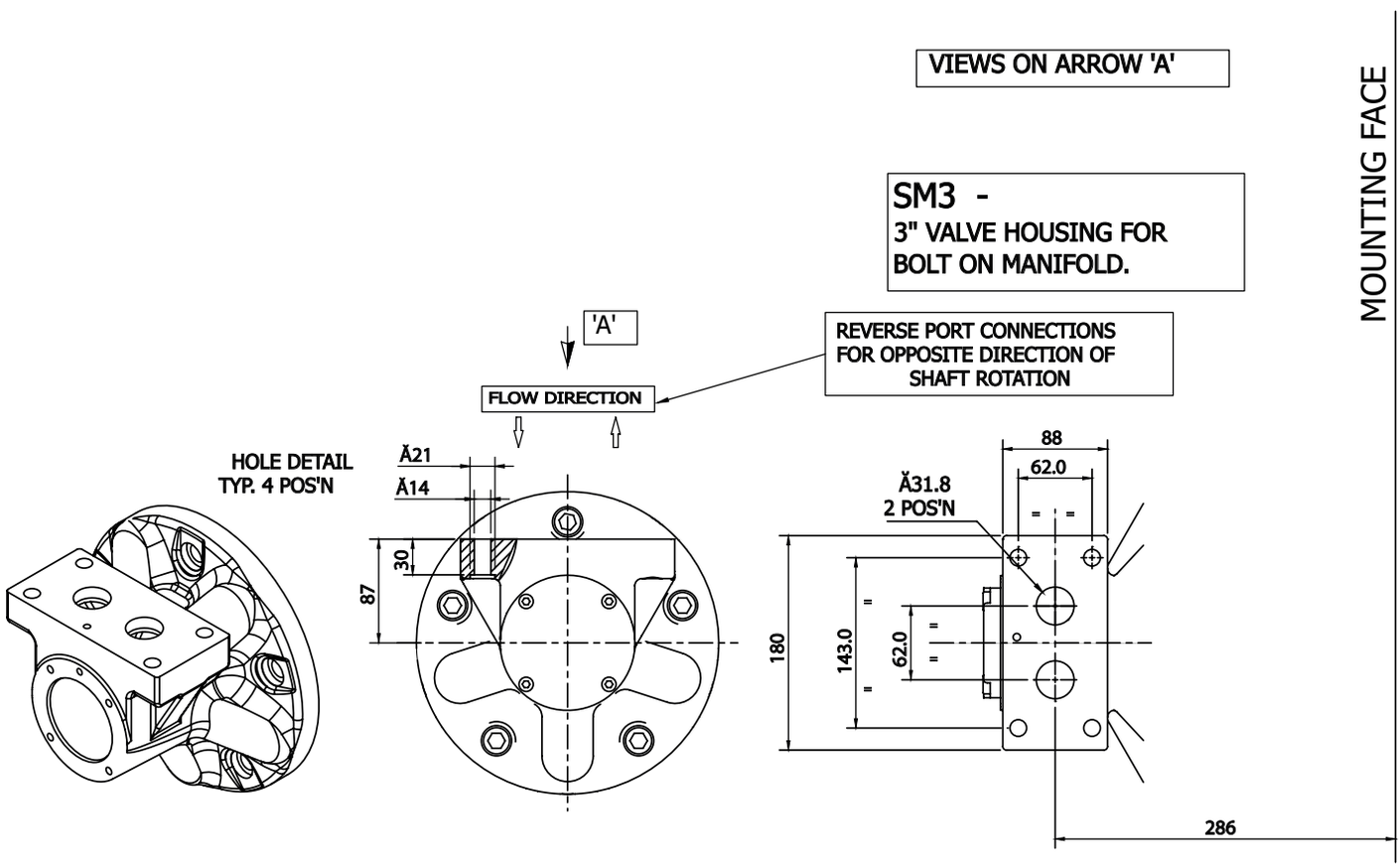
3-5 HMB100 (cont)

'T' Shaft



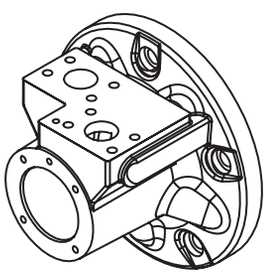
3-5 HMB100 (cont)

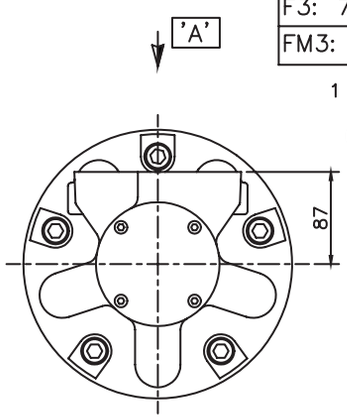
'SM3' Valve Housing

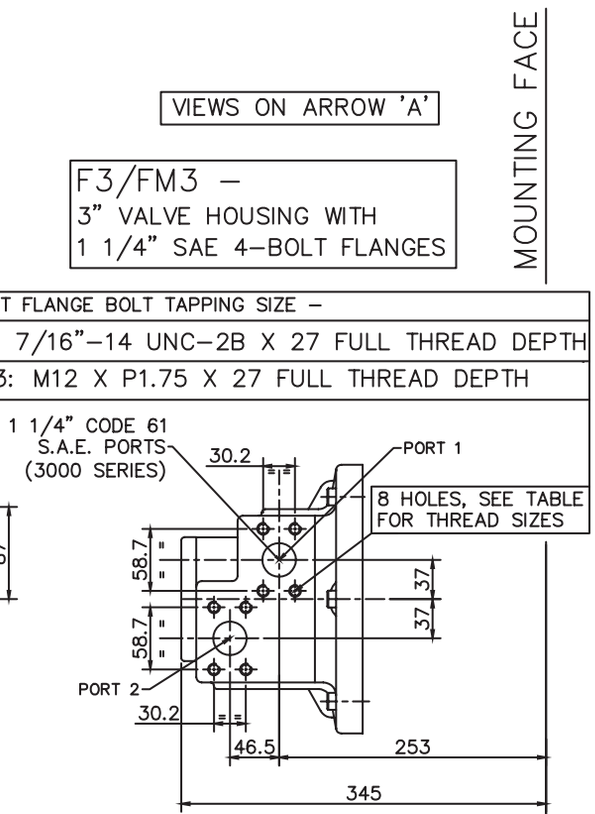


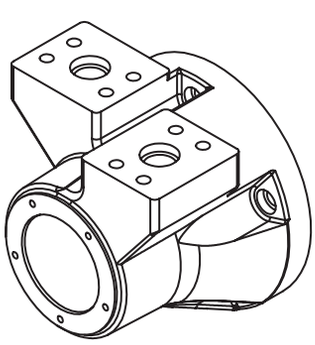
3-5 HMB100 (cont)

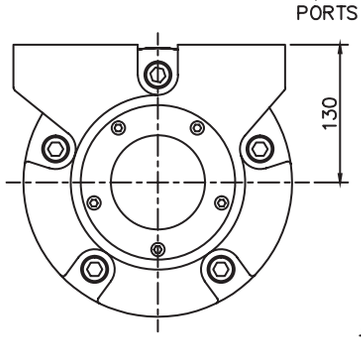
'F3' & 'FM3' Valve Housings

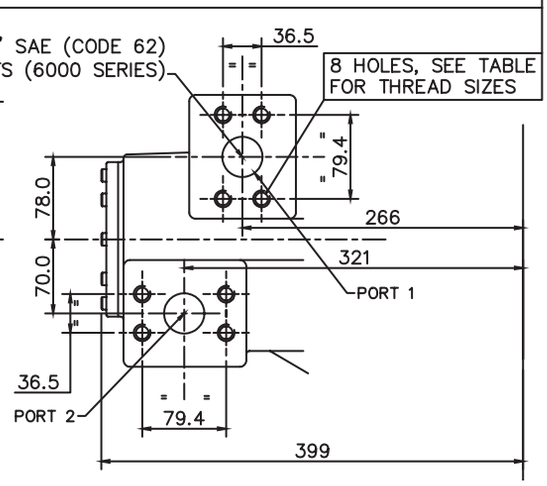






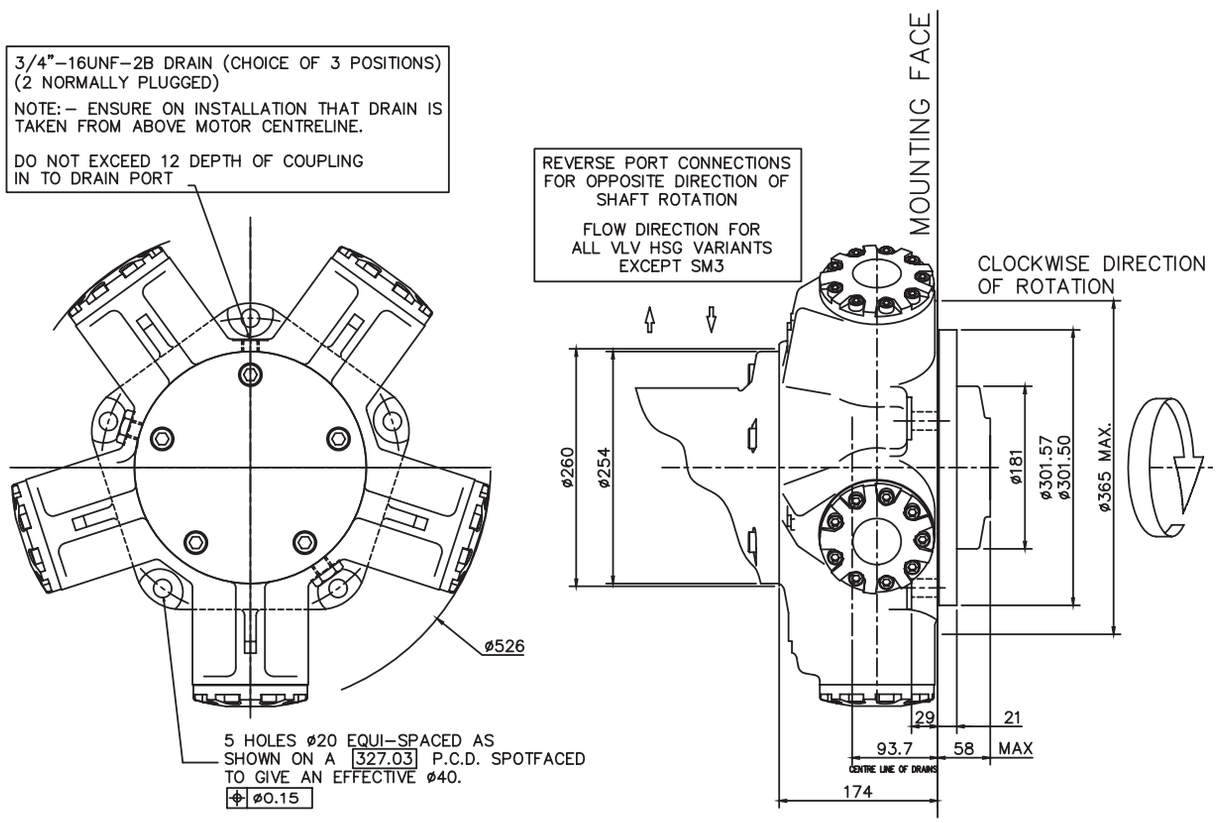






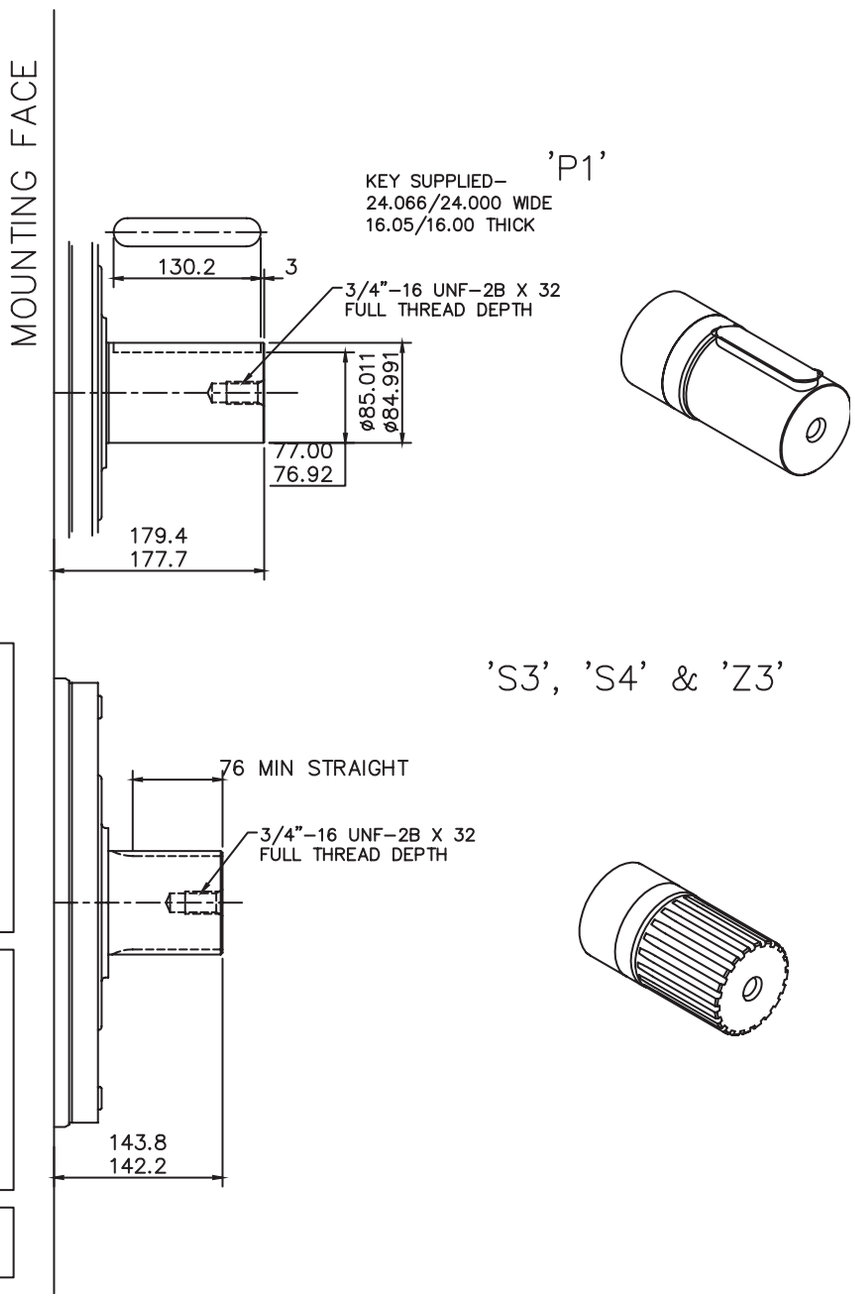
3-5 HMB100 (cont)

Installation



3-6 HM(HD)B125

HMB125 - 'P1', 'S3', 'S4' & 'Z3' Shafts



SPLINE DATA

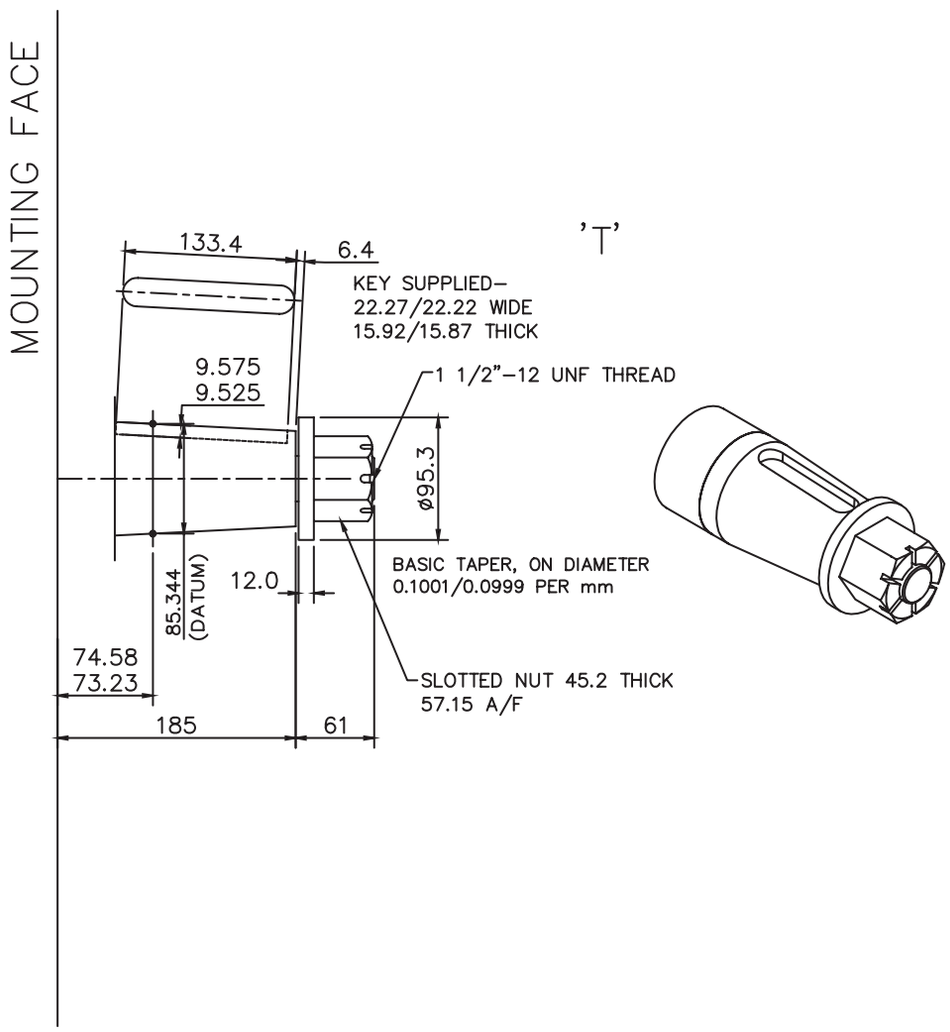
'S3'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	20
PITCH	6/12
MAJOR DIAMETER	87.953/87.825
FORM DIAMETER	80.264
MINOR DIAMETER	79.485/78.925
PIN DIAMETER	8.128
DIAMETER OVER PINS	97.084/97.030

'S4'	
PRESSURE ANGLE	20°
NUMBER OF TEETH	16
PITCH	5/10
MAJOR DIAMETER	86.360/86.233
FORM DIAMETER	76.124
MINOR DIAMETER	74.93/72.39
PIN DIAMETER	8.636
DIAMETER OVER PINS	92.710/92.581

'Z3'
DIN 5480 W85 x 3 x 27 x 7h

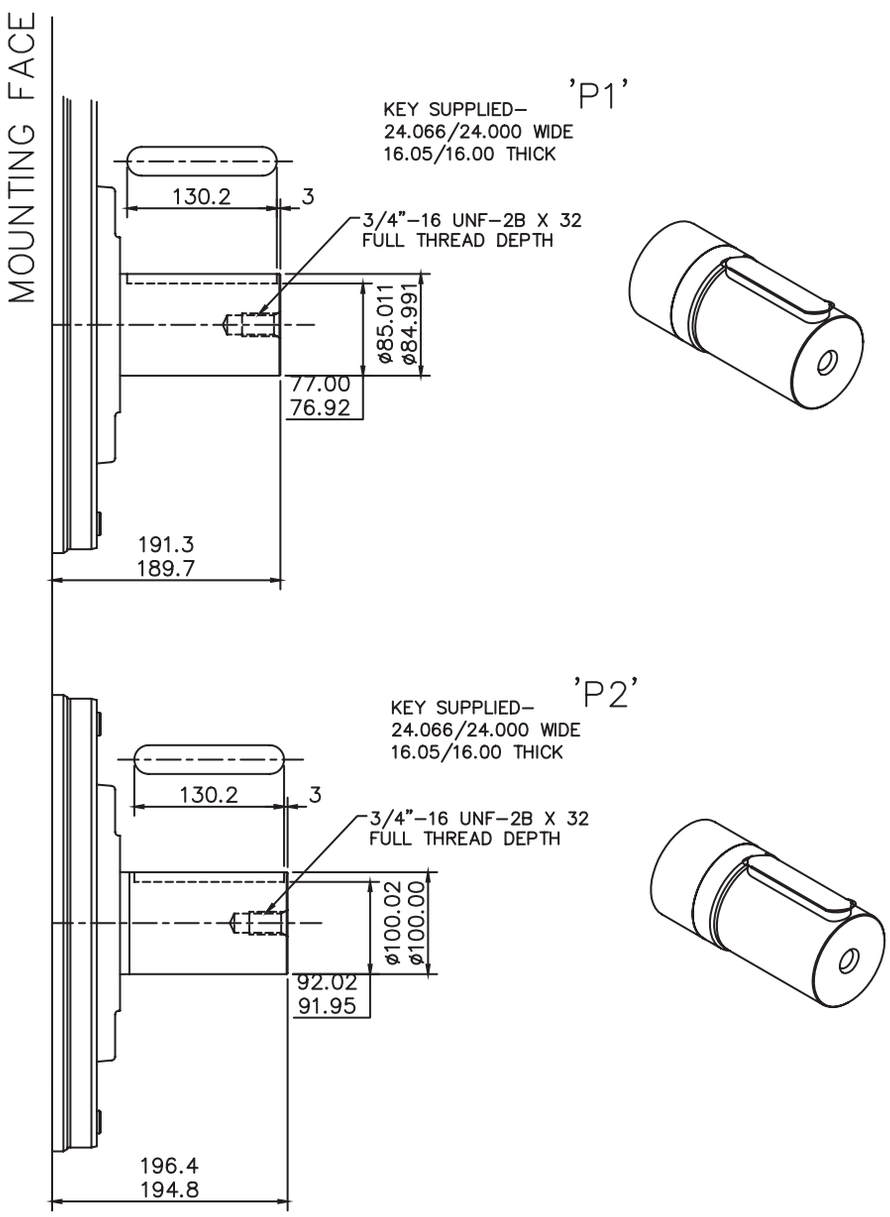
3-6 HM(HD)B125 (cont)

HMB125 - 'T' Shaft



3-6 HM(HD)B125 (cont)

HMHDB125 - 'P1' & 'P2' Shafts



3-6 HM(HD)B125 (cont)

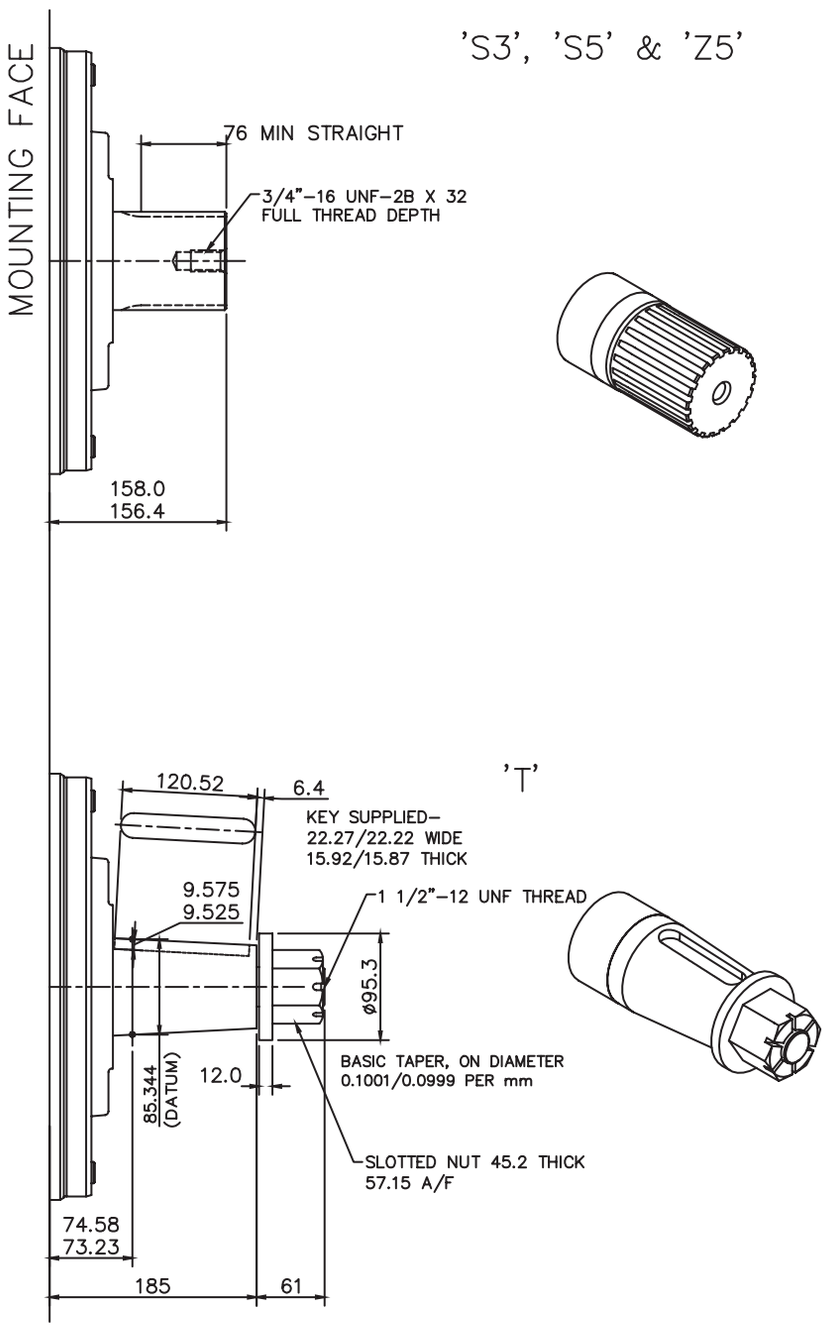
HMHDB125 - 'S3', 'S5', 'Z5' & 'T' Shafts

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

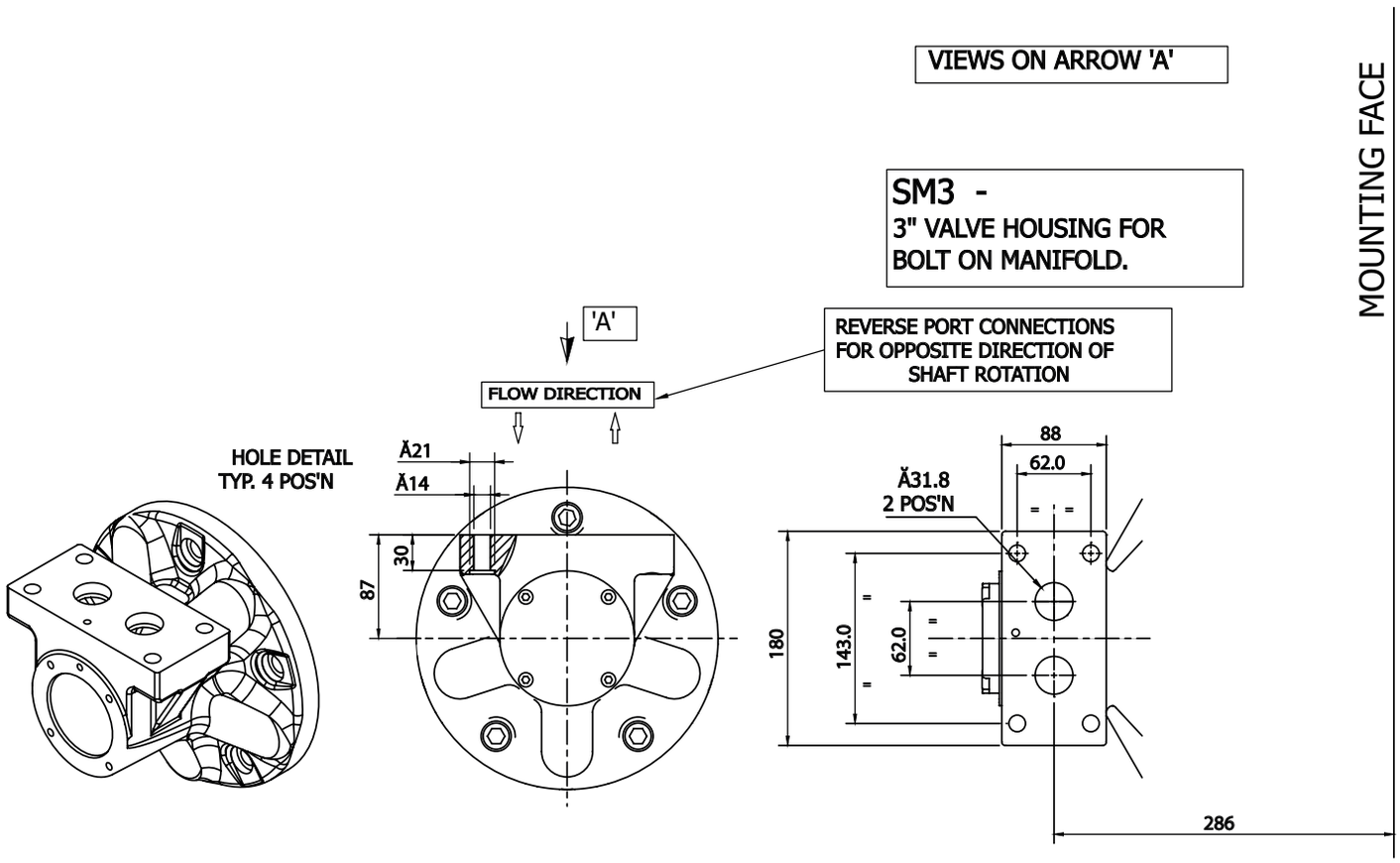
'S5'	
PRESSURE ANGLE	20°
NUMBER OF TEETH	23
PITCH	6/12
MAJOR DIAMETER	100.652/100.526
FORM DIAMETER	92.939
MINOR DIAMETER	92.184/91.626
PIN DIAMETER	8.128
DIAMETER OVER PINS	109.573/109.517

'Z5'
DIN 5480 W100 x 4 x 24 x 7h



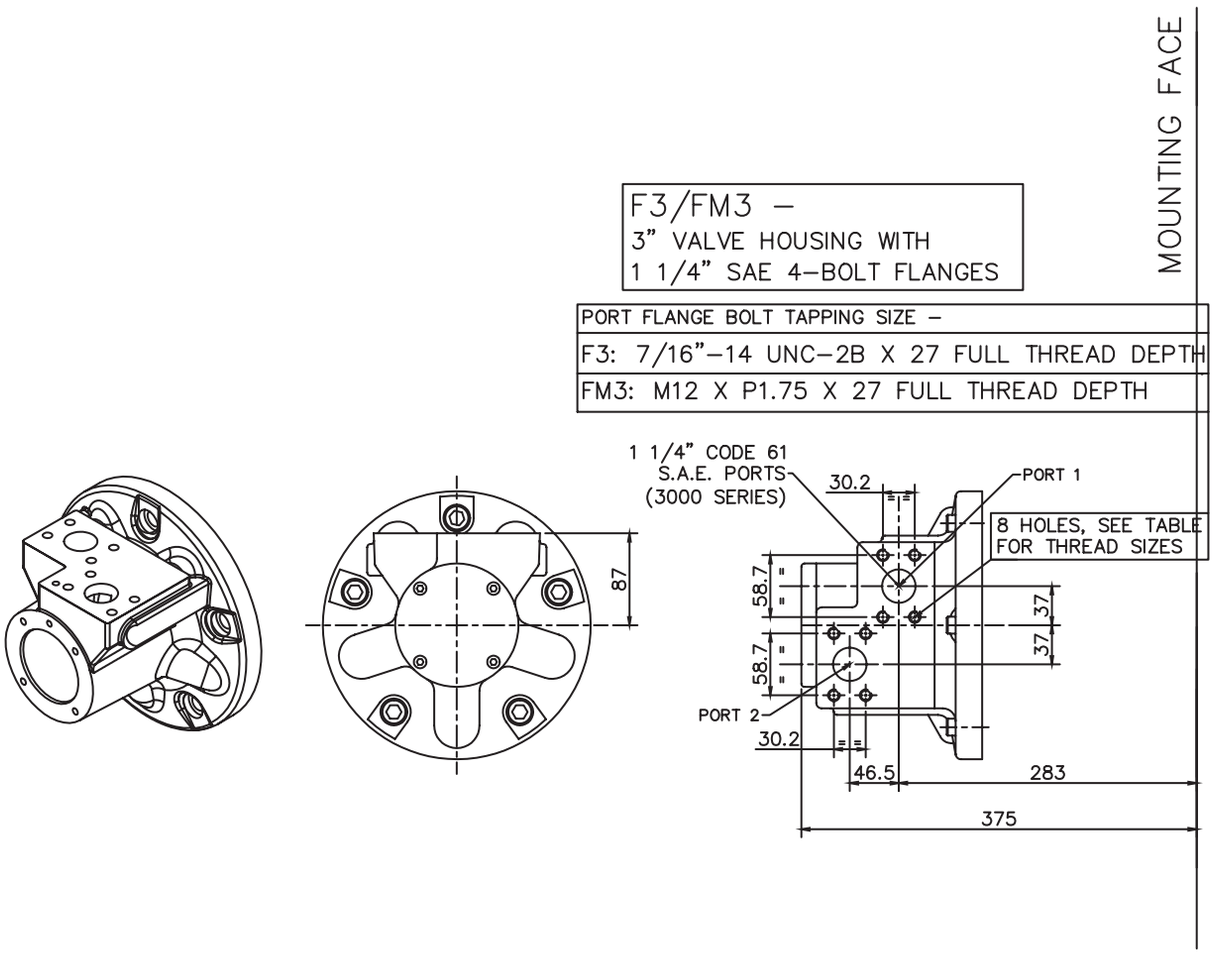
3-6 HM(HD)B125 (cont)

'SM3' Valve Housing



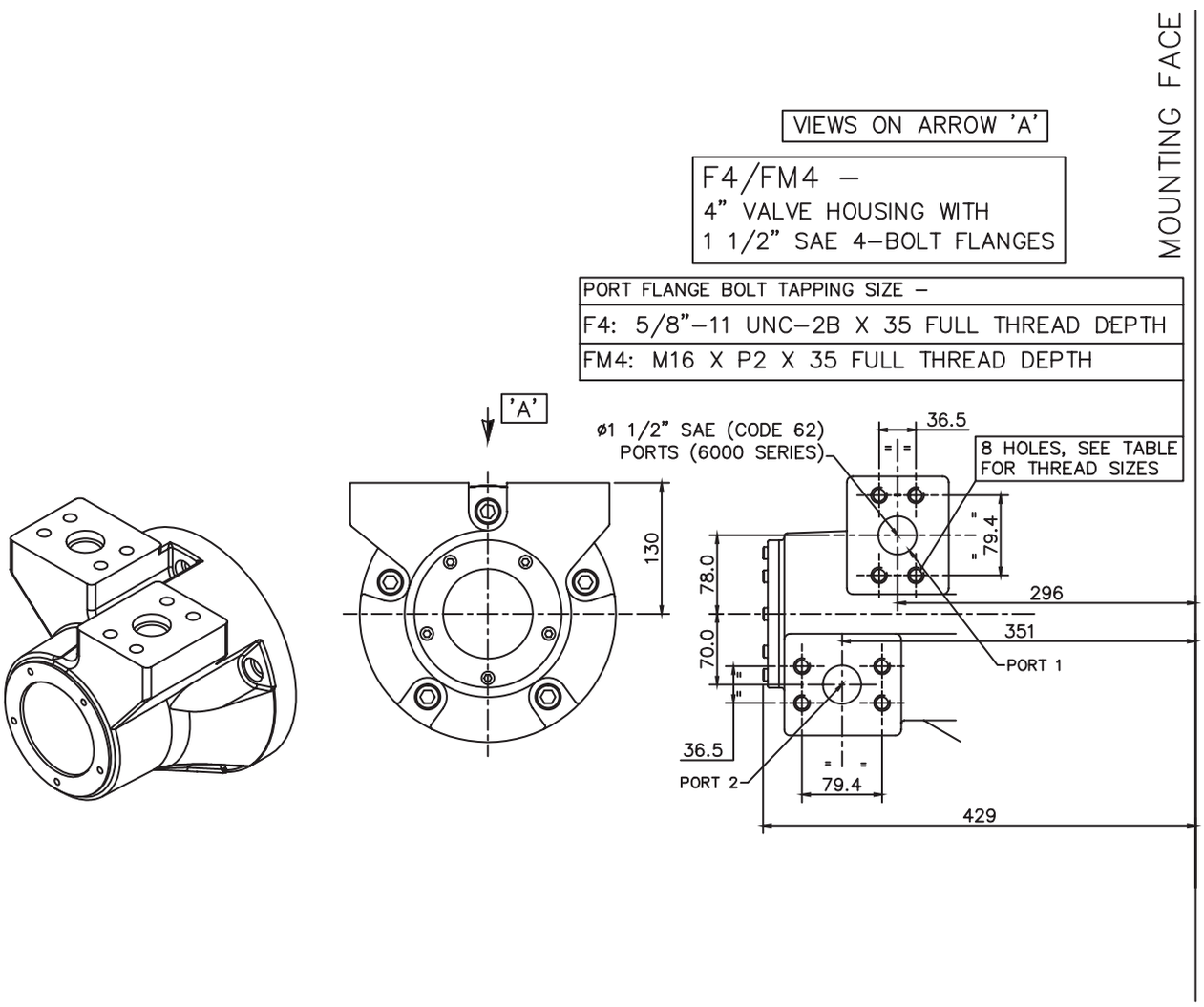
3-6 HM(HD)B125 (cont)

'F3' & 'FM3' Valve Housings



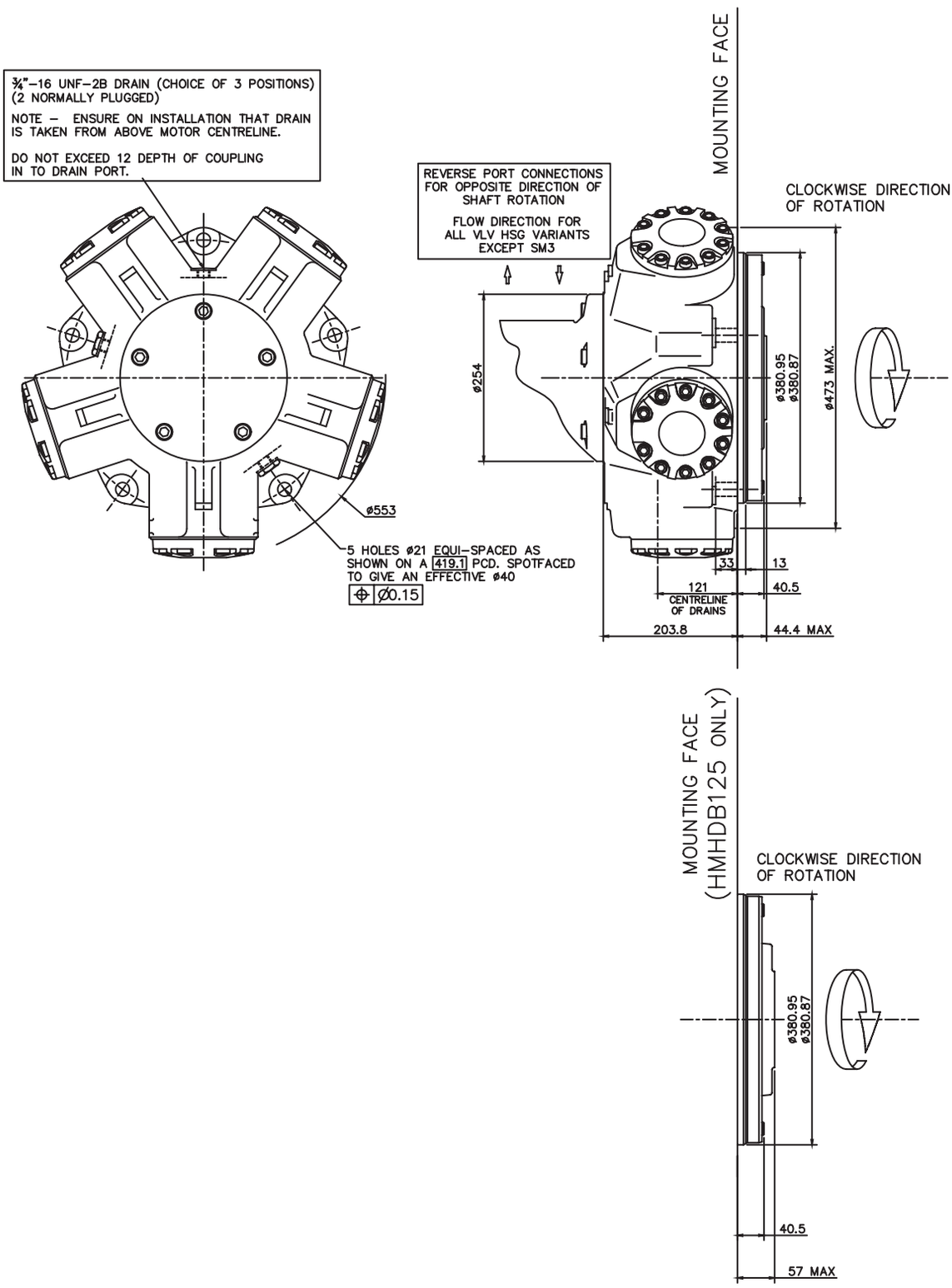
3-6 HM(HD)B125 (cont)

'F4' & 'FM4' Valve Housings



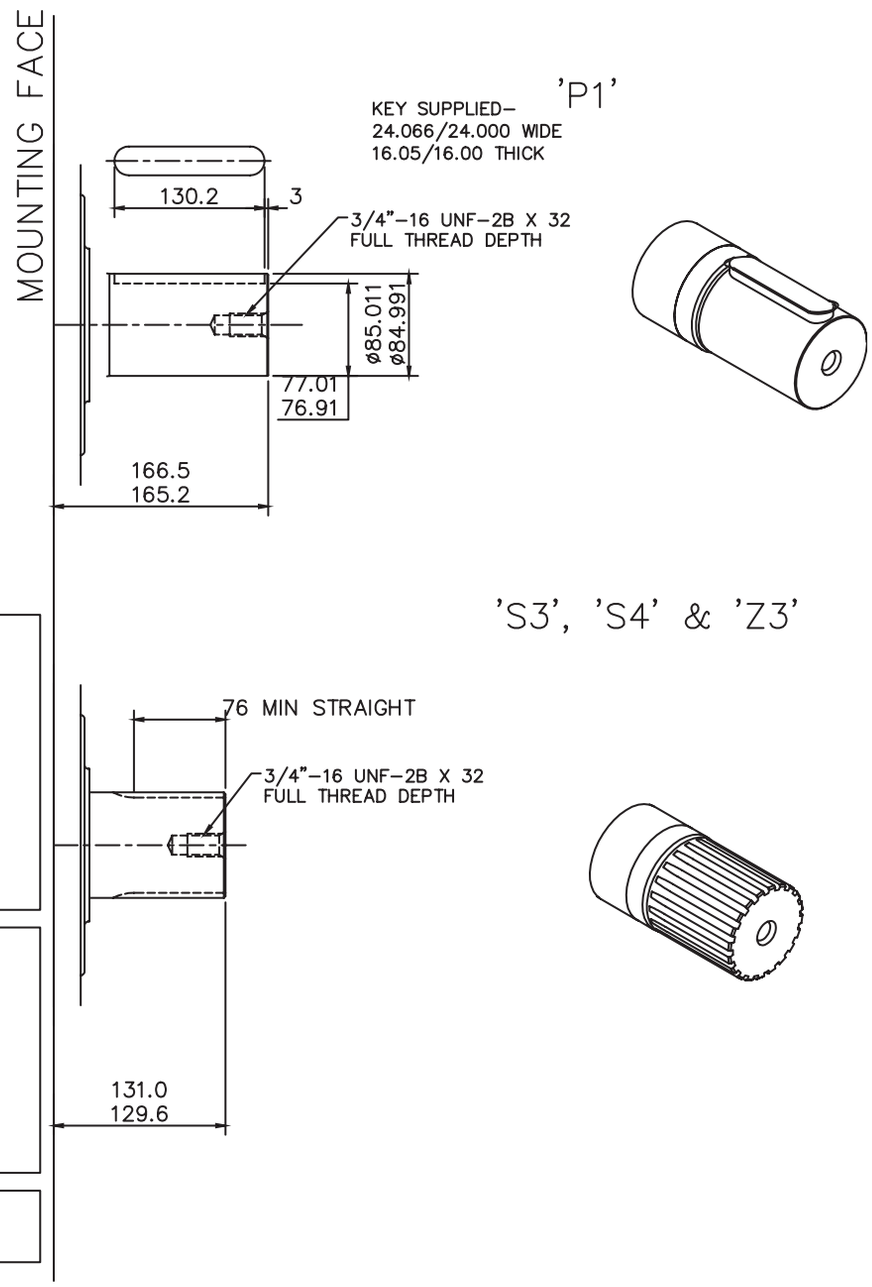
3-6 HM(HD)B125 (cont)

Installation



3-7 HM(HD)B150/200

HMB150/200 - 'P1', 'S3', 'S4' & 'Z3' Shafts



SPLINE DATA

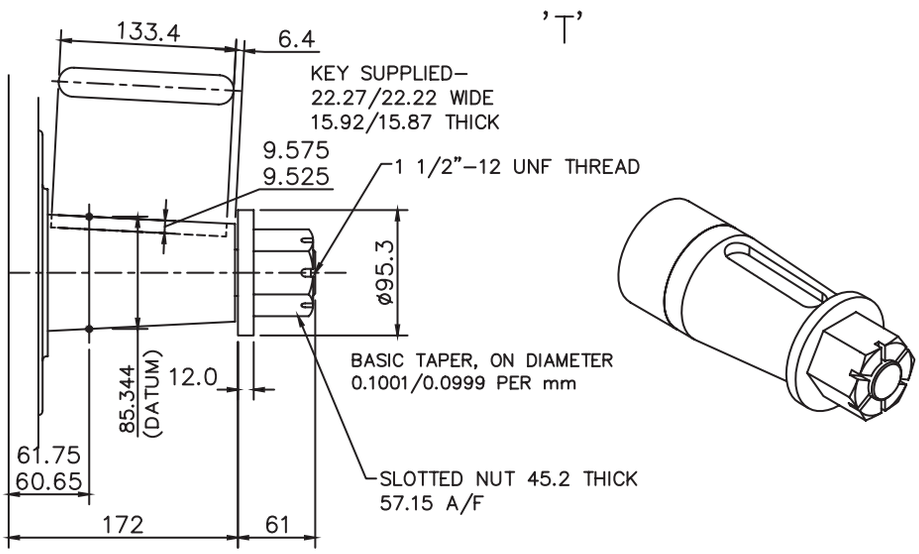
'S3'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	20
PITCH	6/12
MAJOR DIAMETER	87.953/87.825
FORM DIAMETER	80.264
MINOR DIAMETER	79.485/78.925
PIN DIAMETER	8.128
DIAMETER OVER PINS	97.084/97.030

'S4'	
PRESSURE ANGLE	20°
NUMBER OF TEETH	16
PITCH	5/10
MAJOR DIAMETER	86.360/86.233
FORM DIAMETER	76.124
MINOR DIAMETER	74.93/72.39
PIN DIAMETER	8.636
DIAMETER OVER PINS	92.710/92.581

'Z3'
DIN 5480 W85 x 3 x 27 x 7h

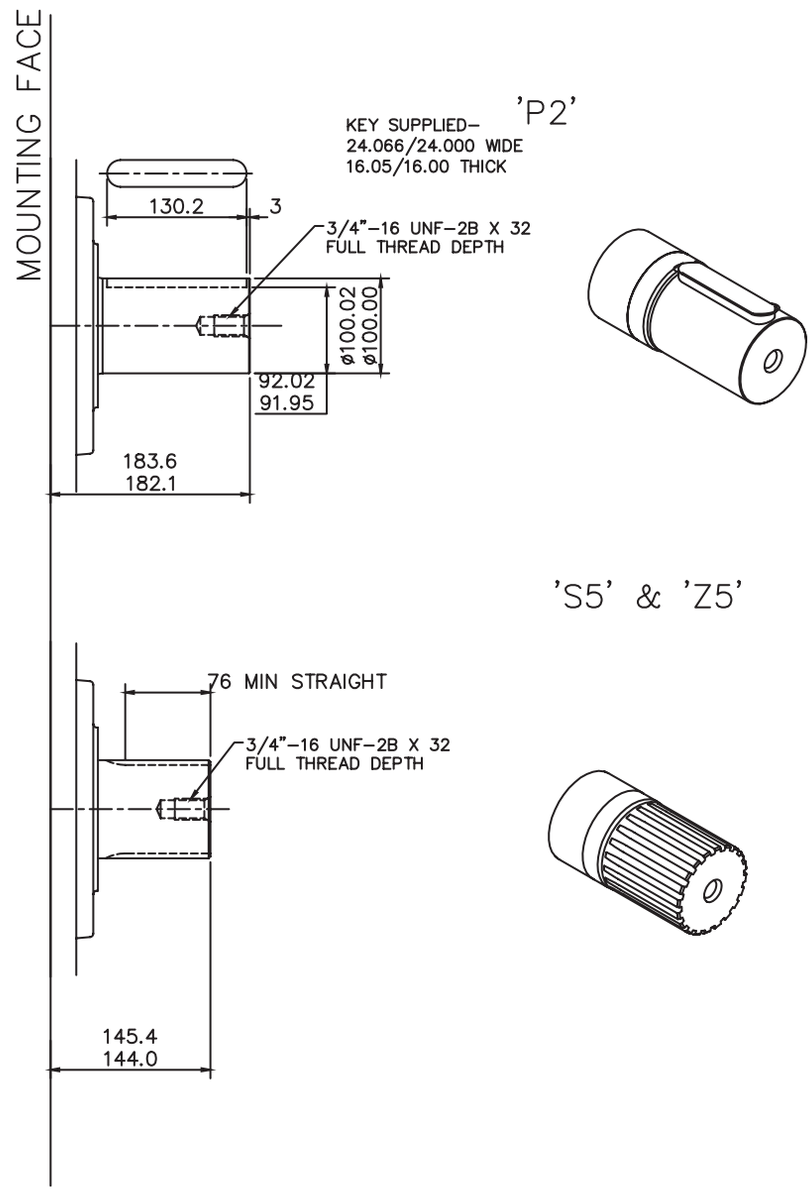
3-7 HM(HD)B150/200 (cont)

HMB150/200 - 'T' Shaft



3-7 HM(HD)B150/200 (cont)

HMHDB150/200 - 'P2', 'S5' & 'Z5' Shafts



SPLINE DATA

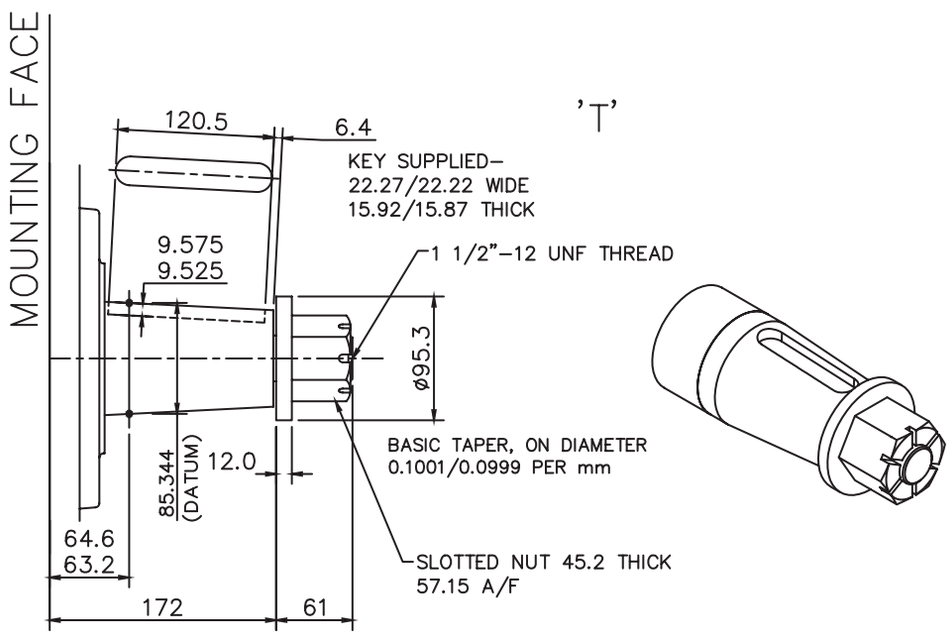
'S3'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	20
PITCH	6/12
MAJOR DIAMETER	87.953/87.825
FORM DIAMETER	80.264
MINOR DIAMETER	79.485/78.925
PIN DIAMETER	8.128
DIAMETER OVER PINS	97.084/97.030

'S5'	
PRESSURE ANGLE	30°
NUMBER OF TEETH	23
PITCH	6/12
MAJOR DIAMETER	100.652/100.526
FORM DIAMETER	92.939
MINOR DIAMETER	92.184/91.626
PIN DIAMETER	8.128
DIAMETER OVER PINS	109.573/109.517

'Z5'
DIN 5480 W100 x 4 x 24 x 7h

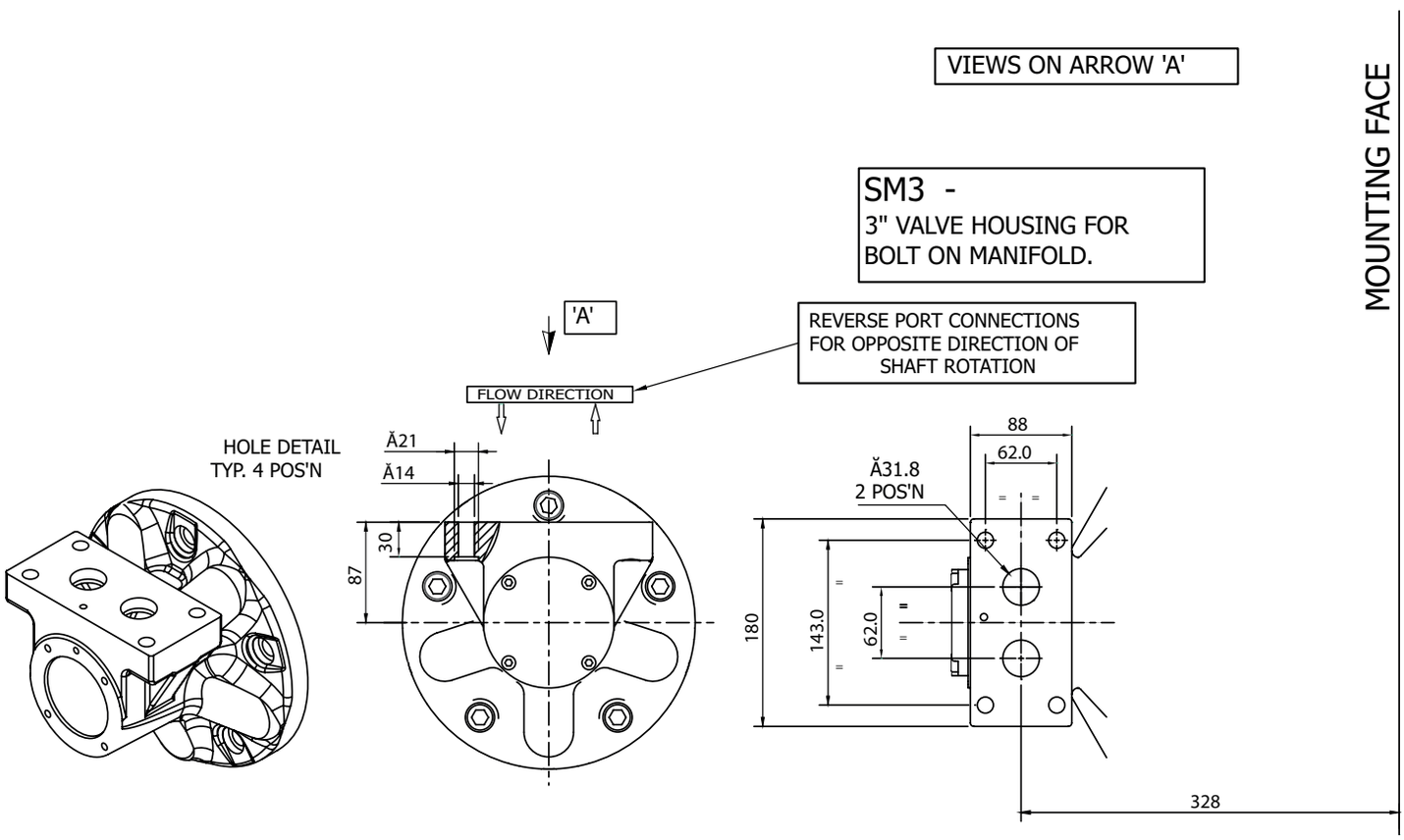
3-7 HM(HD)B150/200 (cont)

HMHDB150/200 - 'T' Shaft



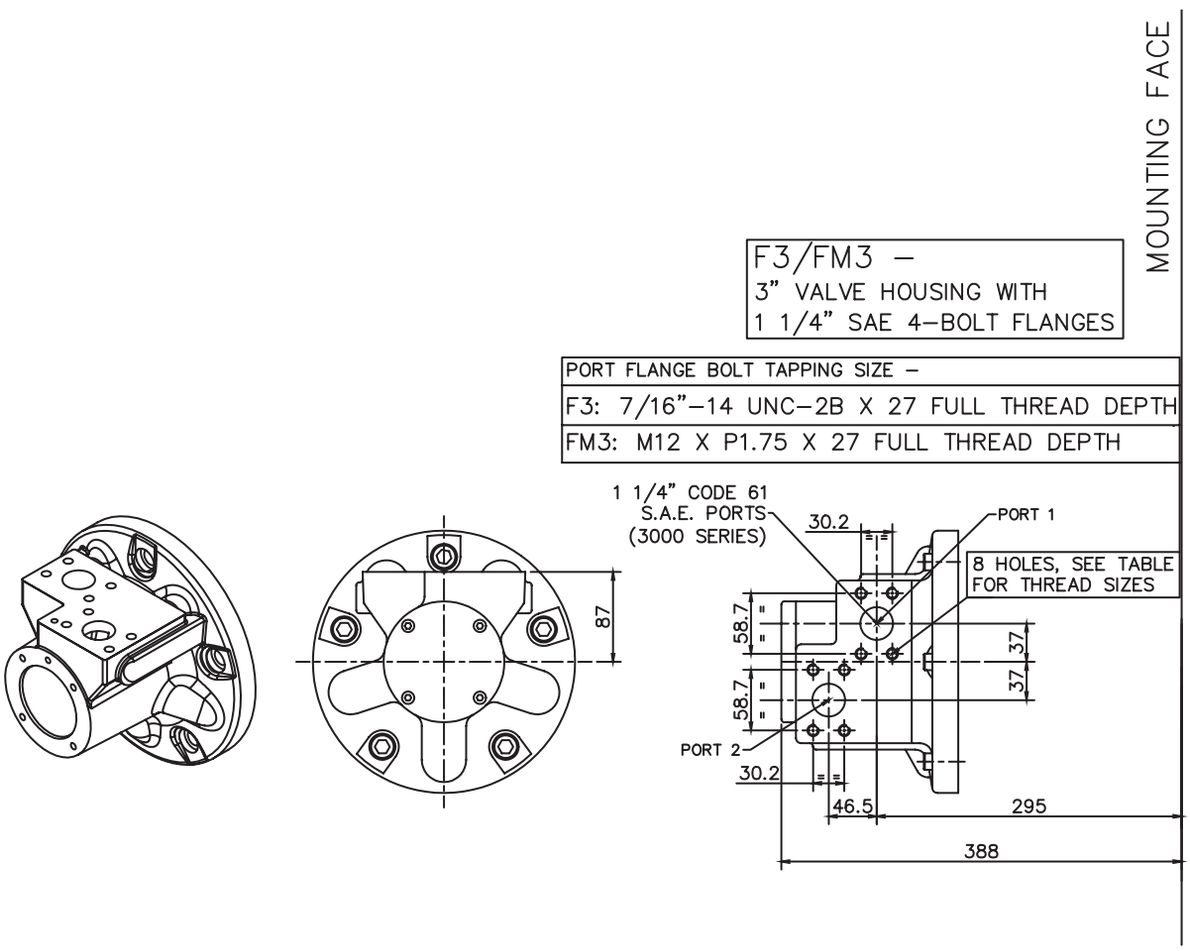
3-7 HM(HD)B150/200 (cont)

'SM3' Valve Housing



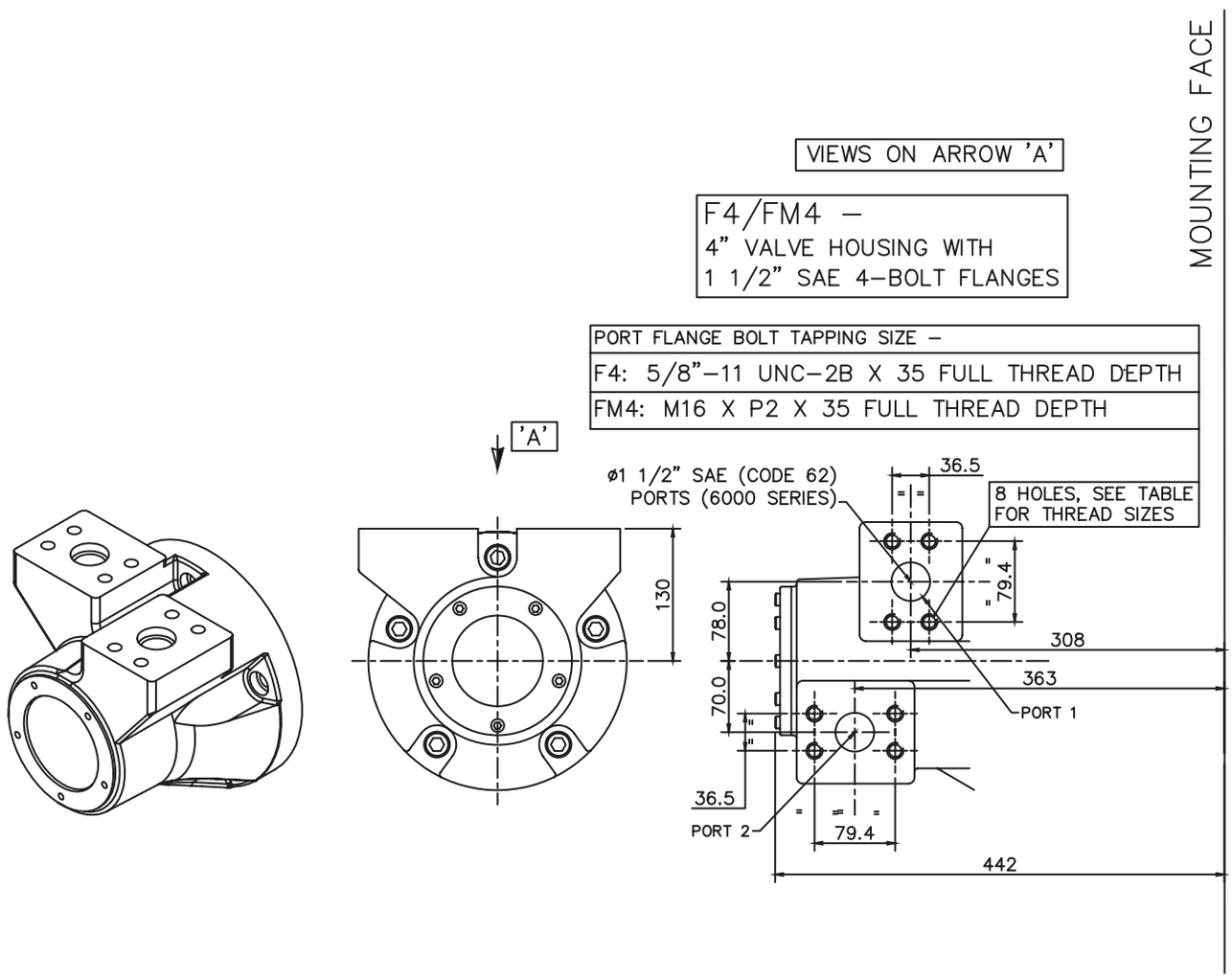
3-7 HM(HD)B150/200 (cont)

'F3' & 'FM3' Valve Housings



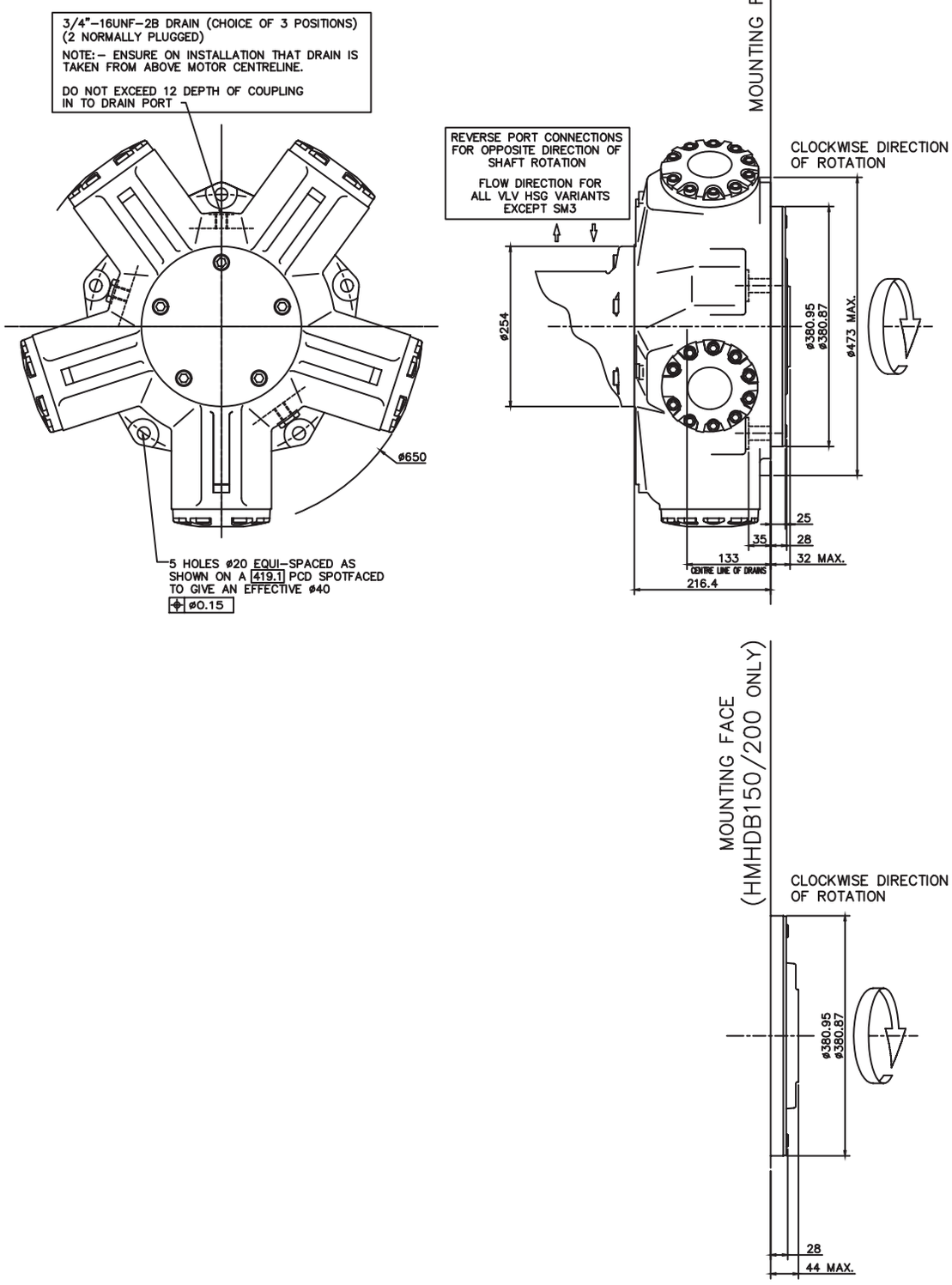
3-7 HM(HD)B150/200 (cont)

'F4' & 'FM4' Valve Housings



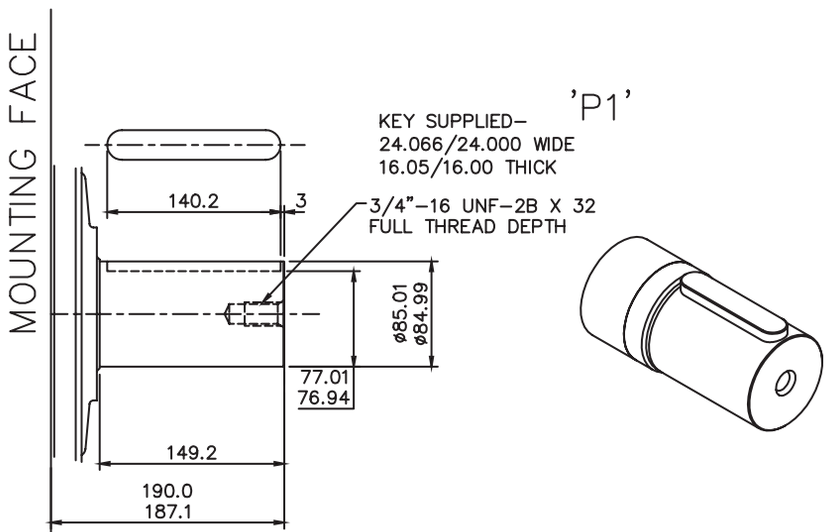
3-7 HM(HD)B150/200 (cont)

Installation



3-8 HM(HD)B270

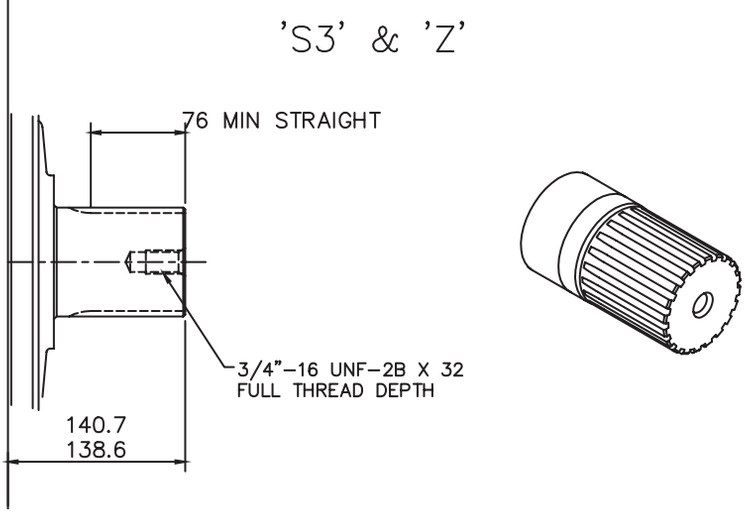
HMB270 - 'P1', 'S3' & 'Z' Shafts



SPLINE DATA

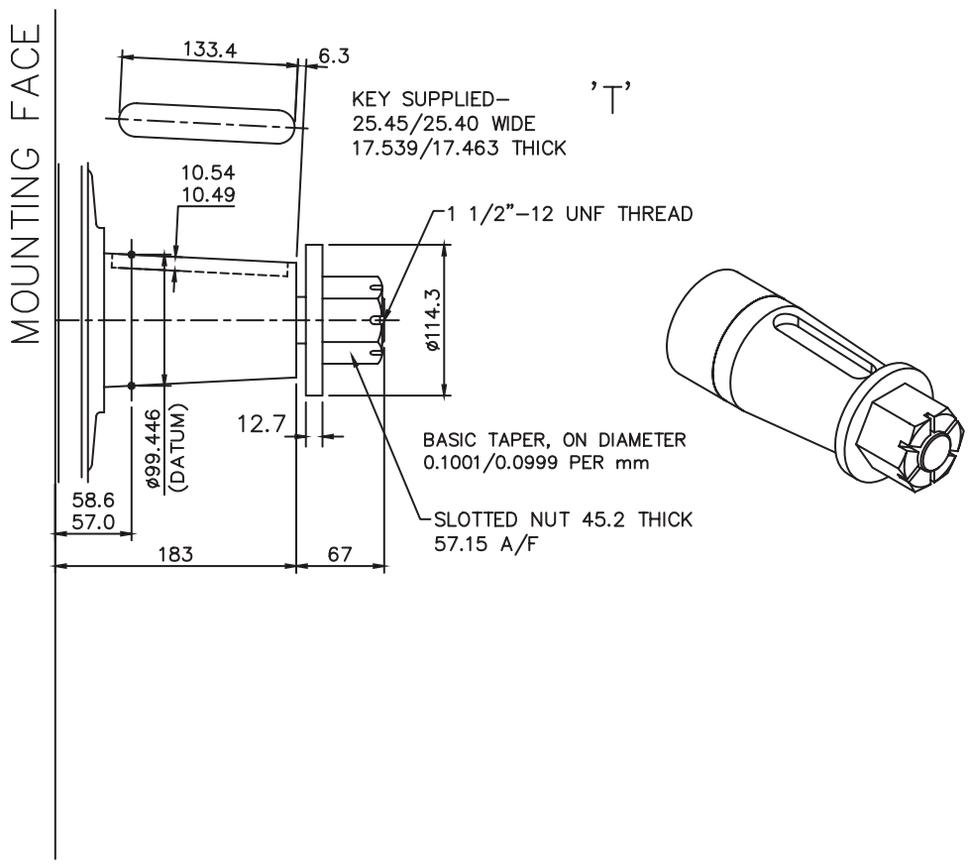
'S3'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	20
PITCH	6/12
MAJOR DIAMETER	87.953/87.825
FORM DIAMETER	80.264
MINOR DIAMETER	79.485/78.925
PIN DIAMETER	8.128
DIAMETER OVER PINS	97.084/97.030

'Z'
DIN 5480 W100 x 4 x 24 x 7h



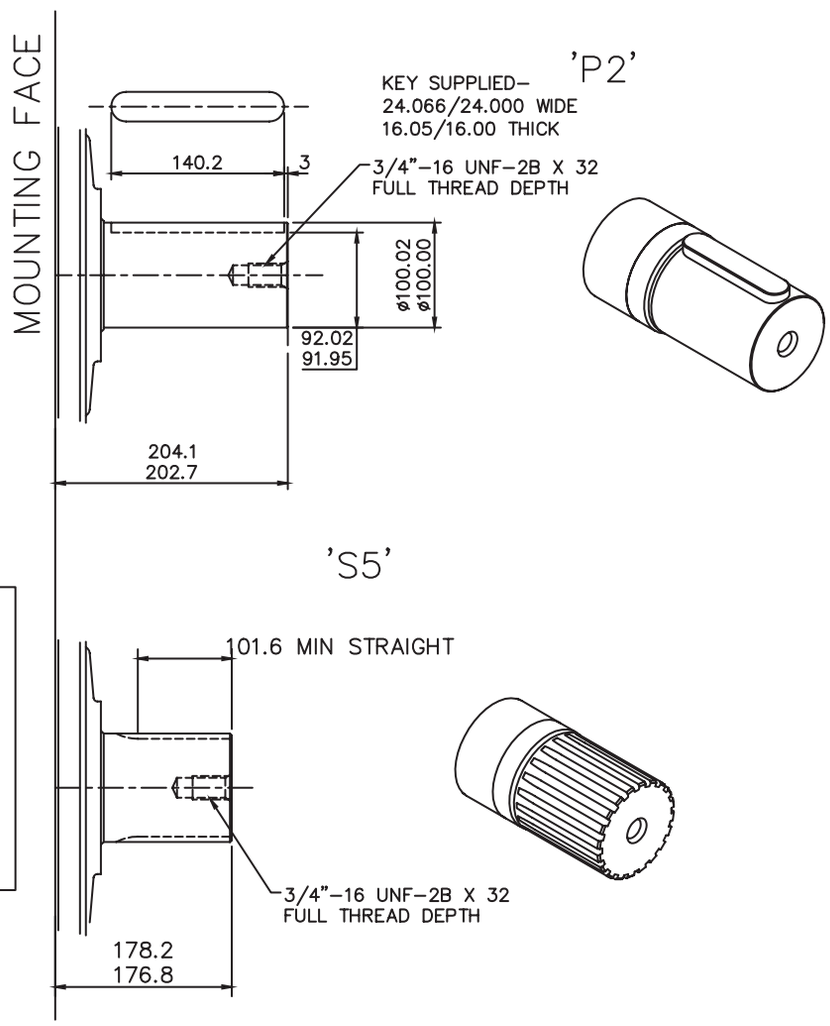
3-8 HM(HD)B270 (cont)

HMB270 - 'T' Shaft



3-8 HM(HD)B270 (cont)

HMHDB270 - 'P2' & 'S5' Shafts

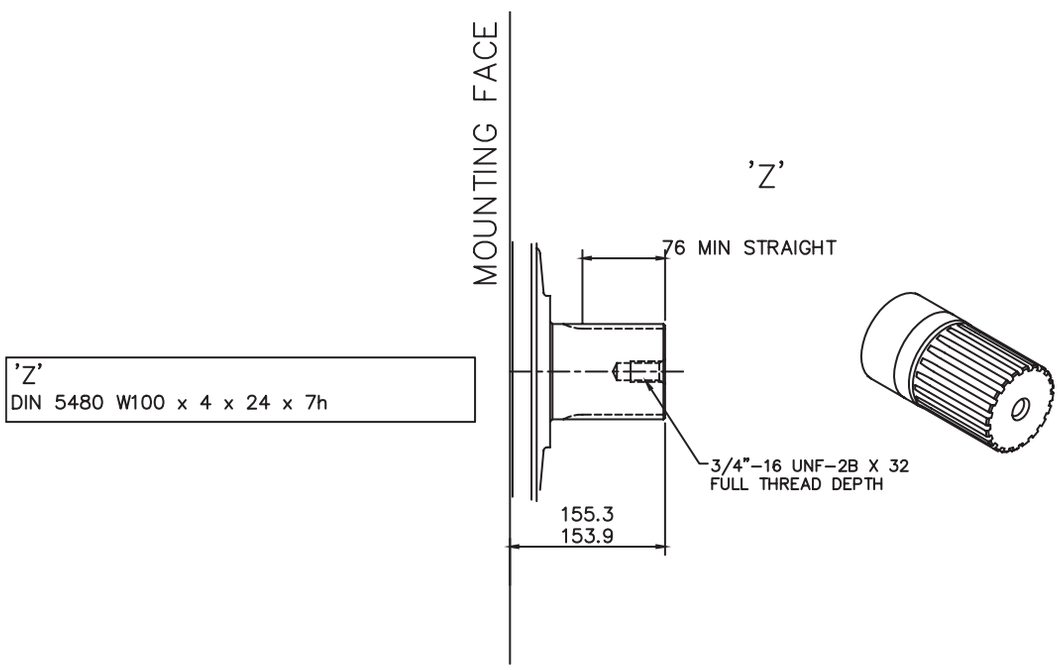


SPLINE DATA

'S3'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	23
PITCH	6/12
MAJOR DIAMETER	100.653/100.526
FORM DIAMETER	92.939
MINOR DIAMETER	92.184/91.625
PIN DIAMETER	8.128
DIAMETER OVER PINS	109.573/109.517

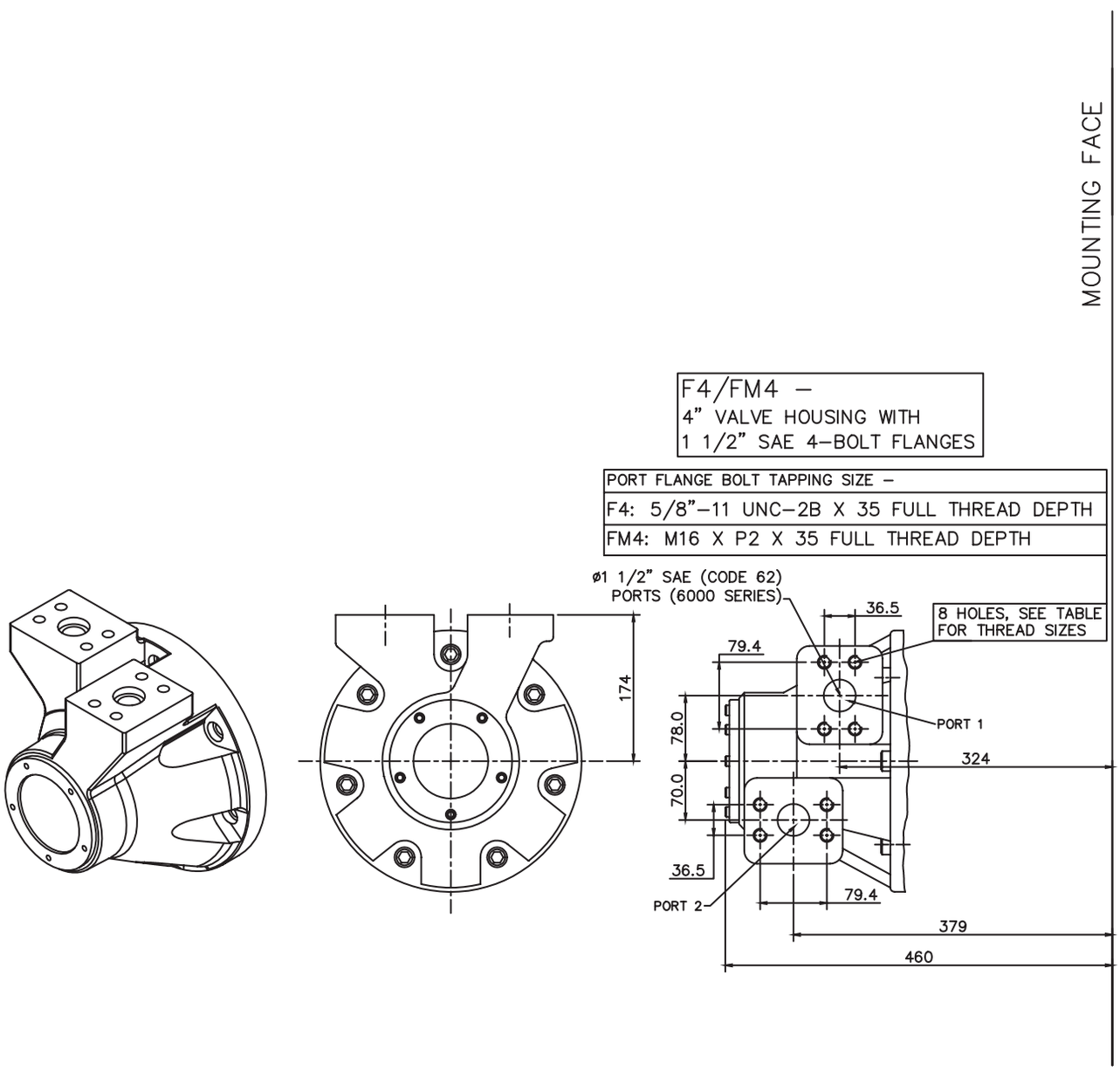
3-8 HM(HD)B270 (cont)

HMHDB270 - 'Z' Shaft



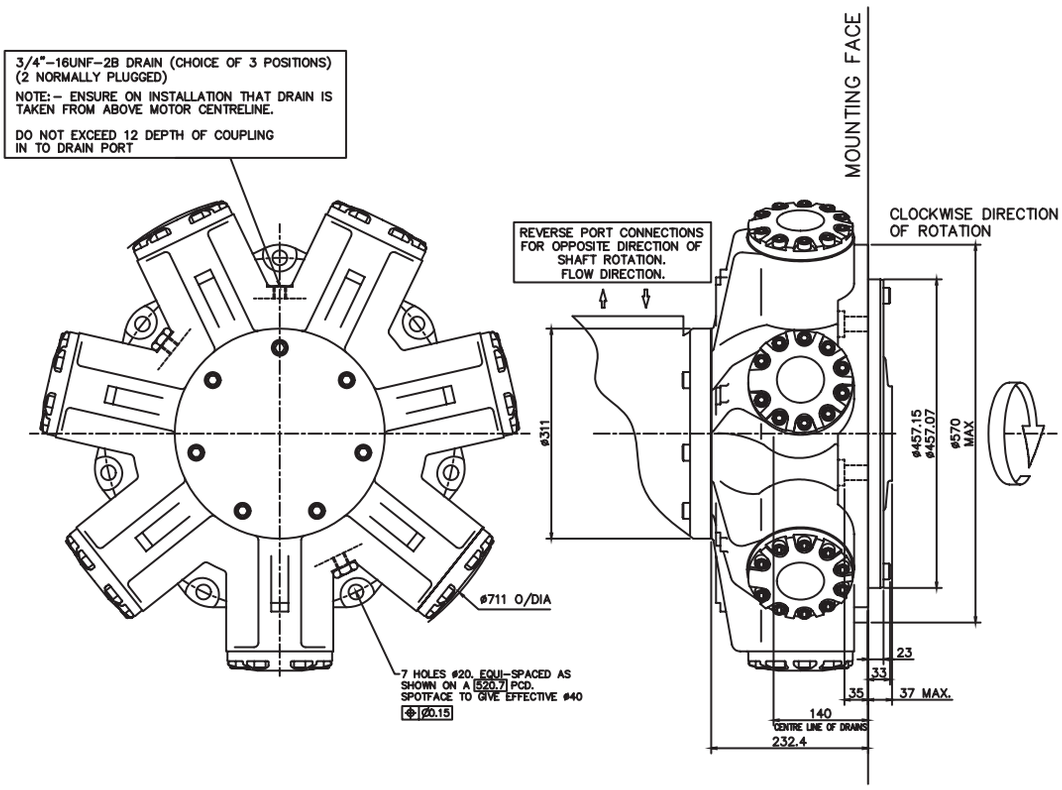
3-8 HM(HD)B270 (cont)

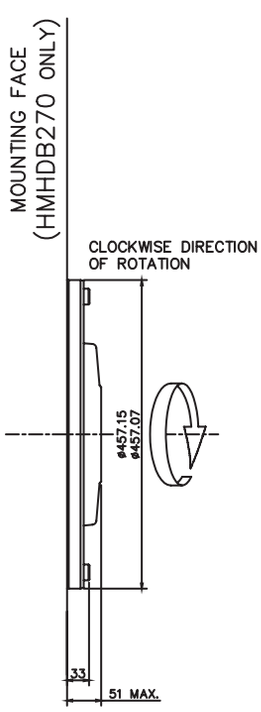
'F4' & 'FM4' Valve Housings



3-8 HM(HD)B270 (cont)

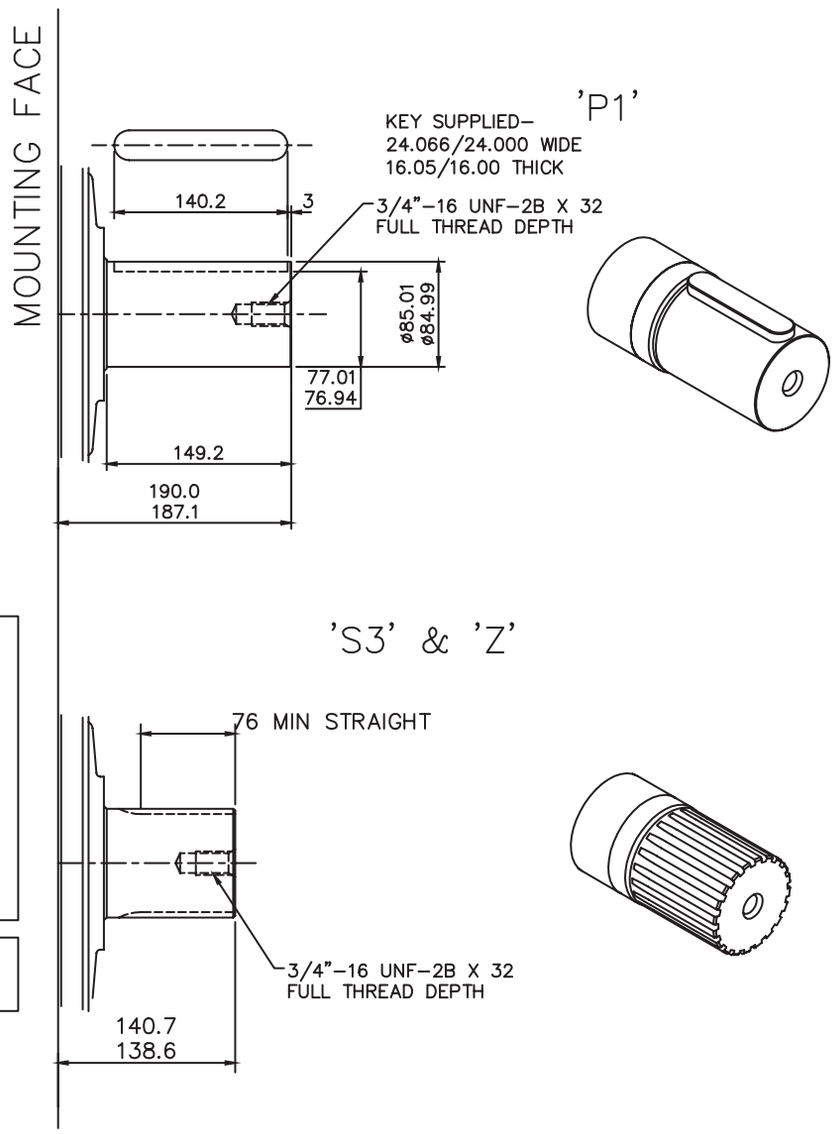
Installation





3-9 HM(HD)B325

HMB325 - 'P1', 'S3' & 'Z' Shafts



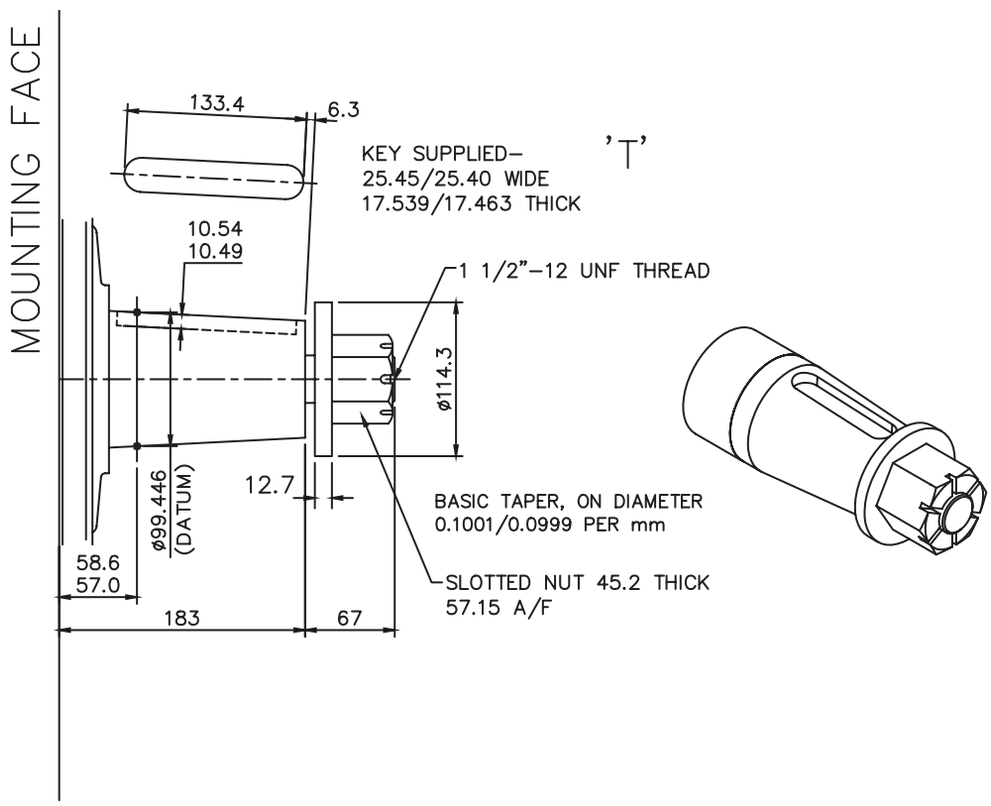
SPLINE DATA

'S3'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	20
PITCH	6/12
MAJOR DIAMETER	87.953/87.825
FORM DIAMETER	80.264
MINOR DIAMETER	79.485/78.925
PIN DIAMETER	8.128
DIAMETER OVER PINS	97.084/97.030

'Z'
DIN 5480 W100 x 4 x 24 x 7h

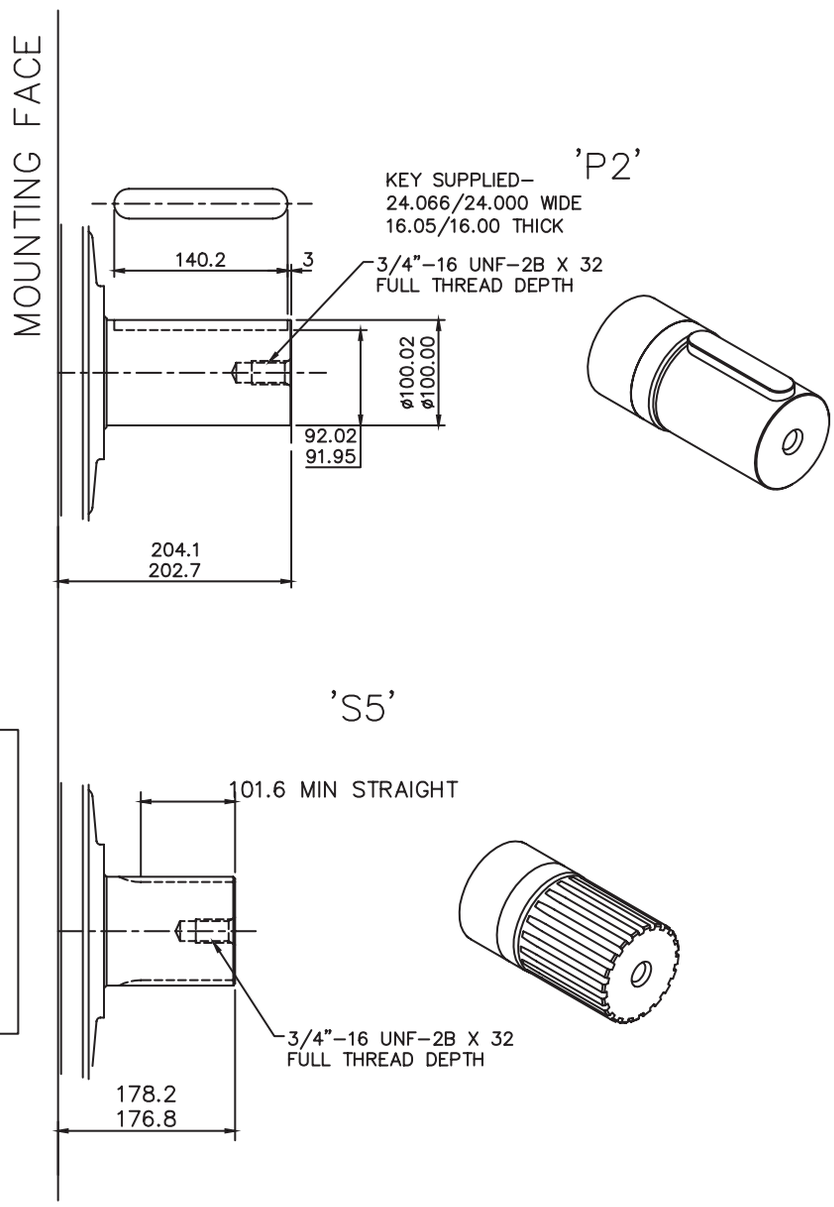
3-9 HM(HD)B325 (cont)

HMB325 - 'T' Shaft



3-9 HM(HD)B325 (cont)

HMHDB325 - 'P2' & 'S5' Shafts

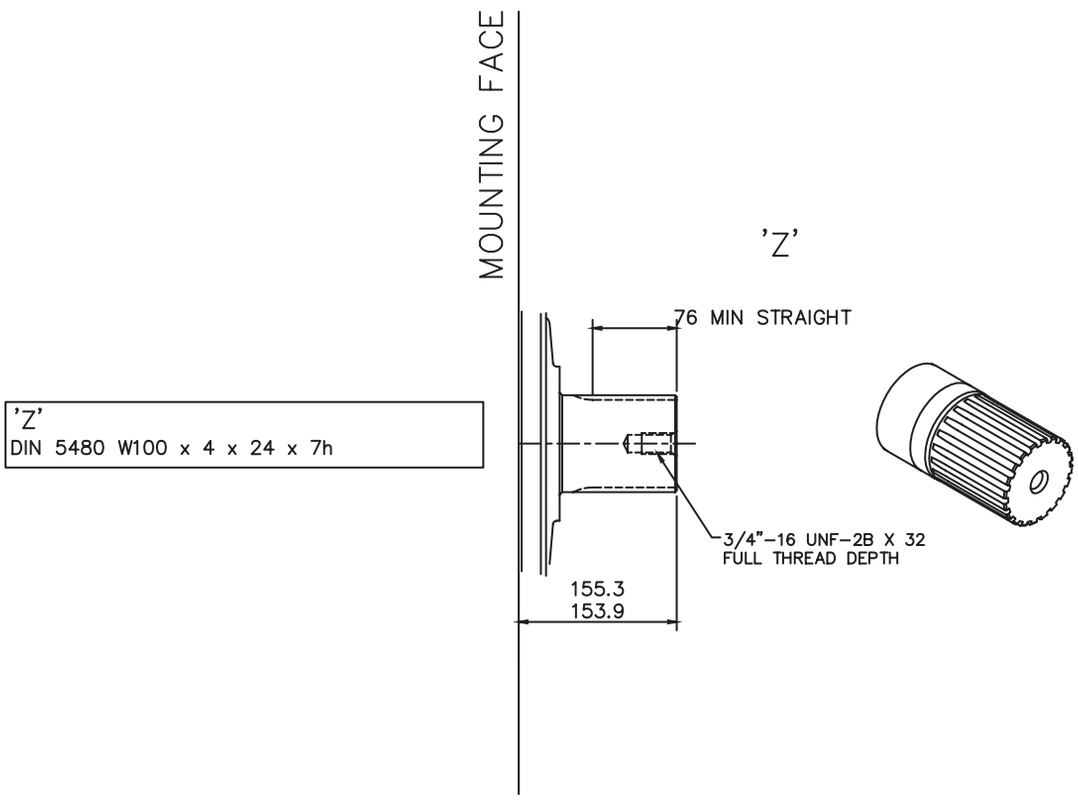


SPLINE DATA

'S3'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	23
PITCH	6/12
MAJOR DIAMETER	100.653/100.526
FORM DIAMETER	92.939
MINOR DIAMETER	92.184/91.625
PIN DIAMETER	8.128
DIAMETER OVER PINS	109.573/109.517

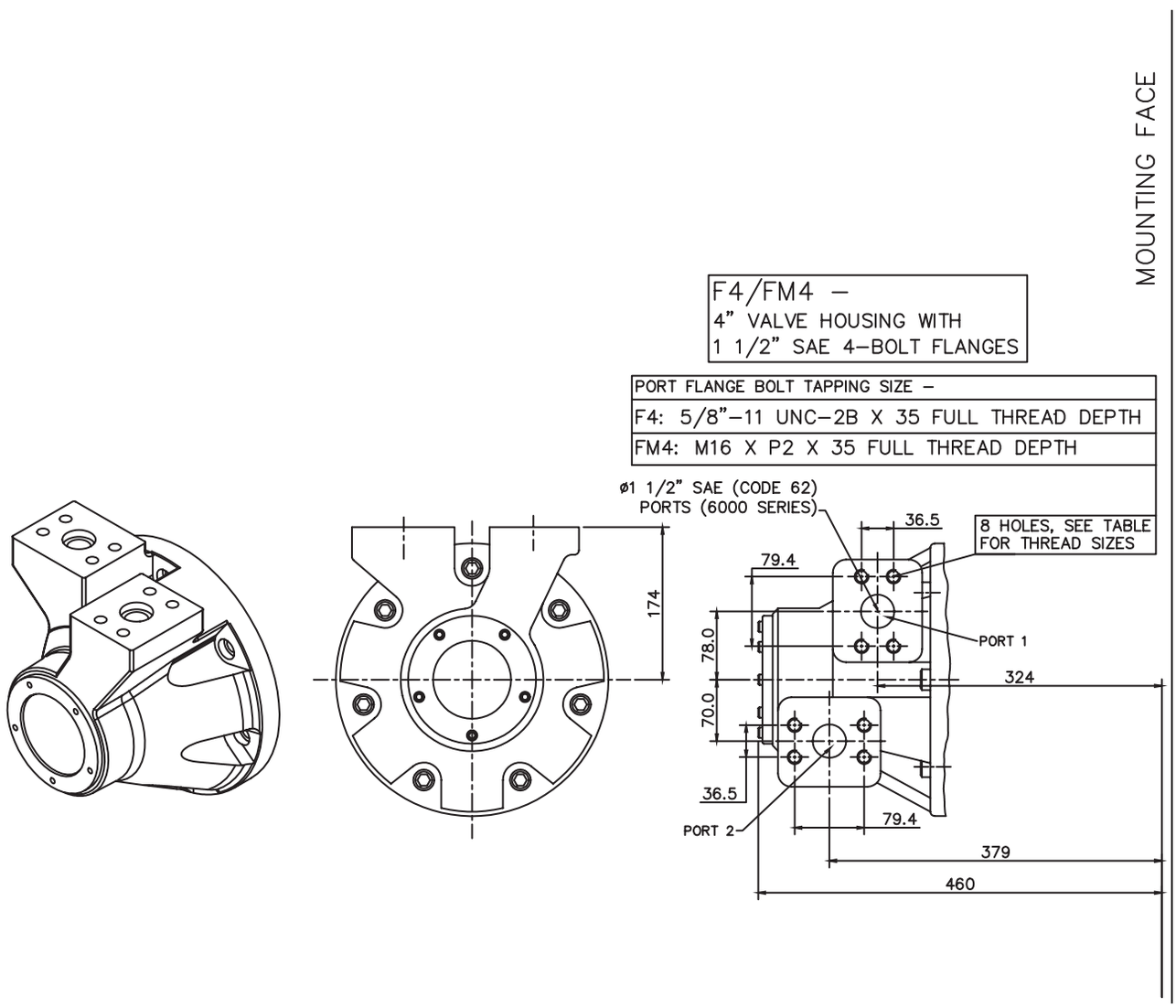
3-9 HM(HD)B325 (cont)

HMHDB325 - 'Z' Shaft



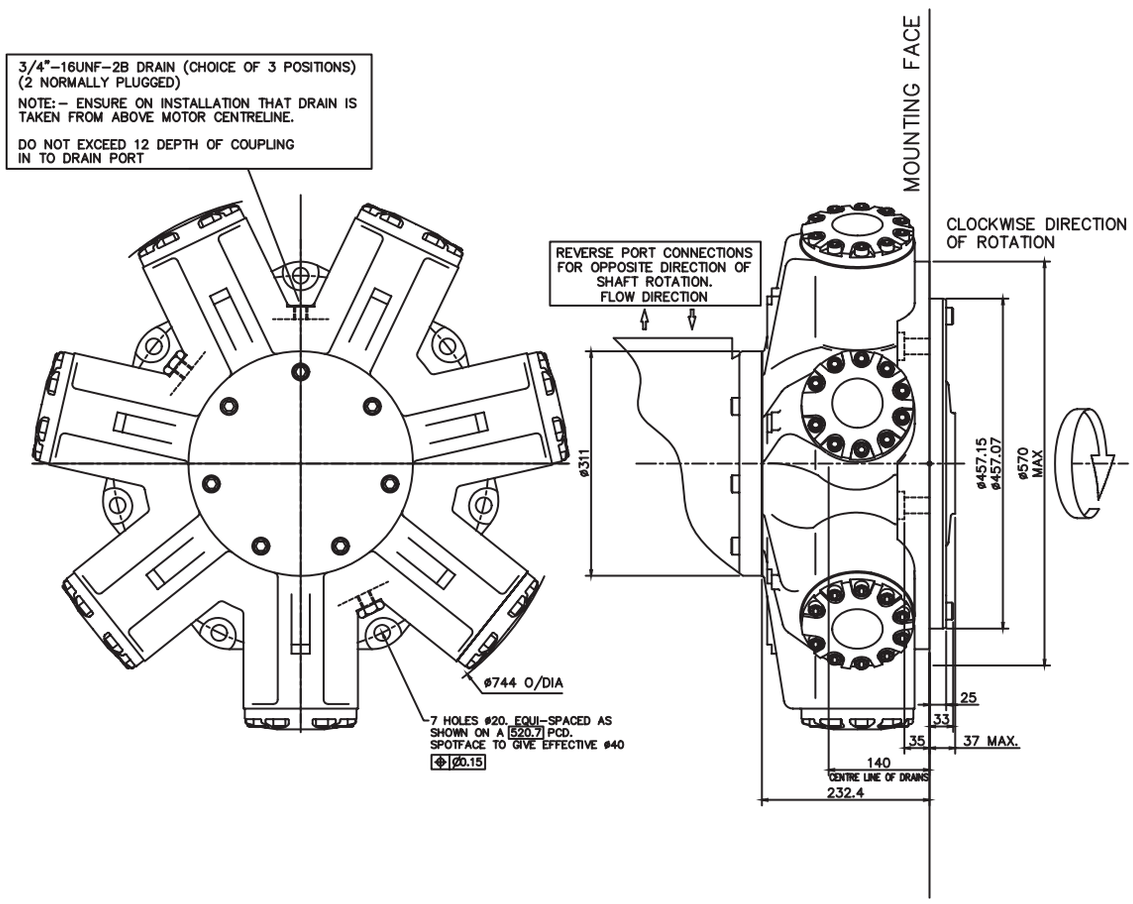
3-9 HM(HD)B325 (cont)

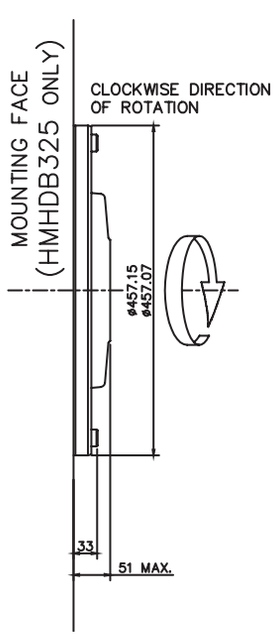
'F4' & 'FM4' Valve Housings



3-9 HM(HD)B325 (cont)

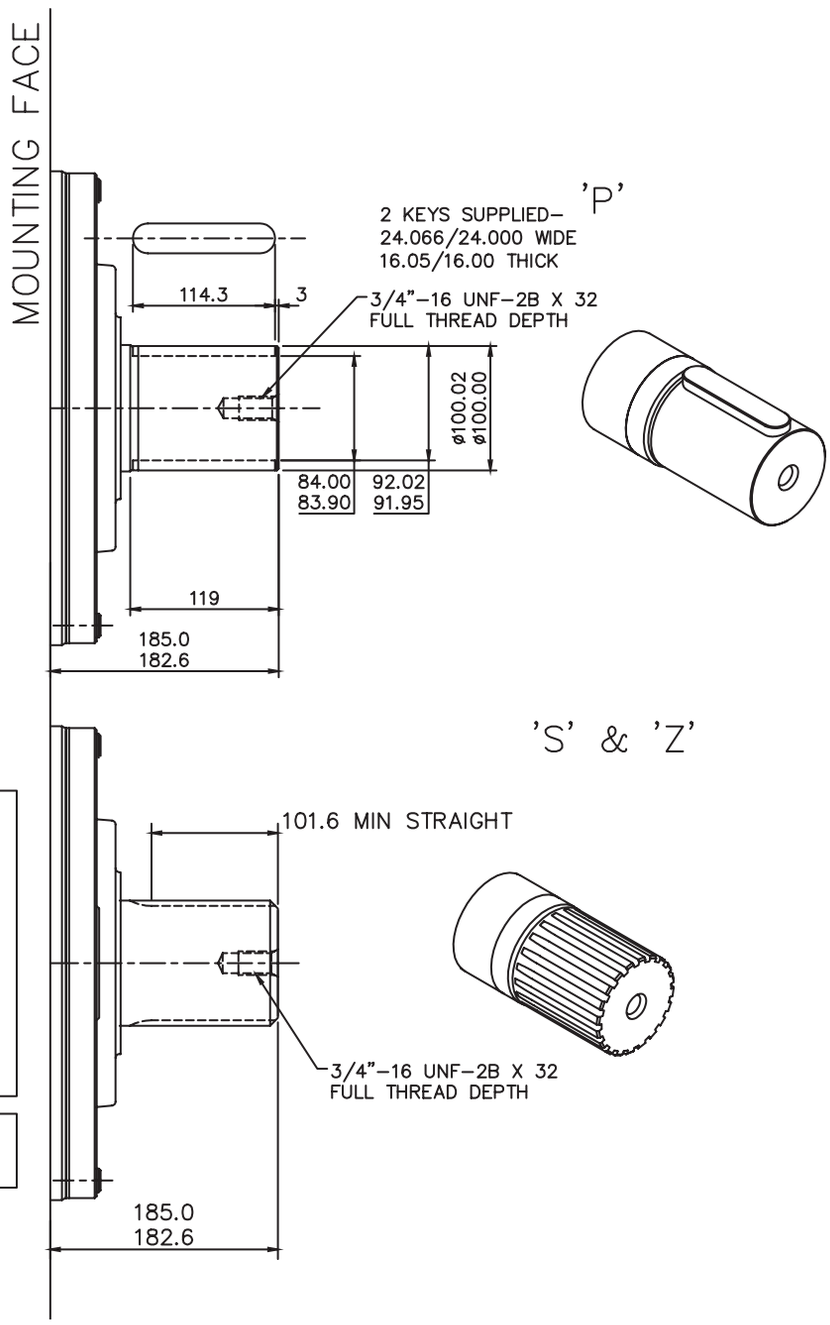
Installation





3-10 HMHDB400

'P', 'S' & 'Z' Shafts



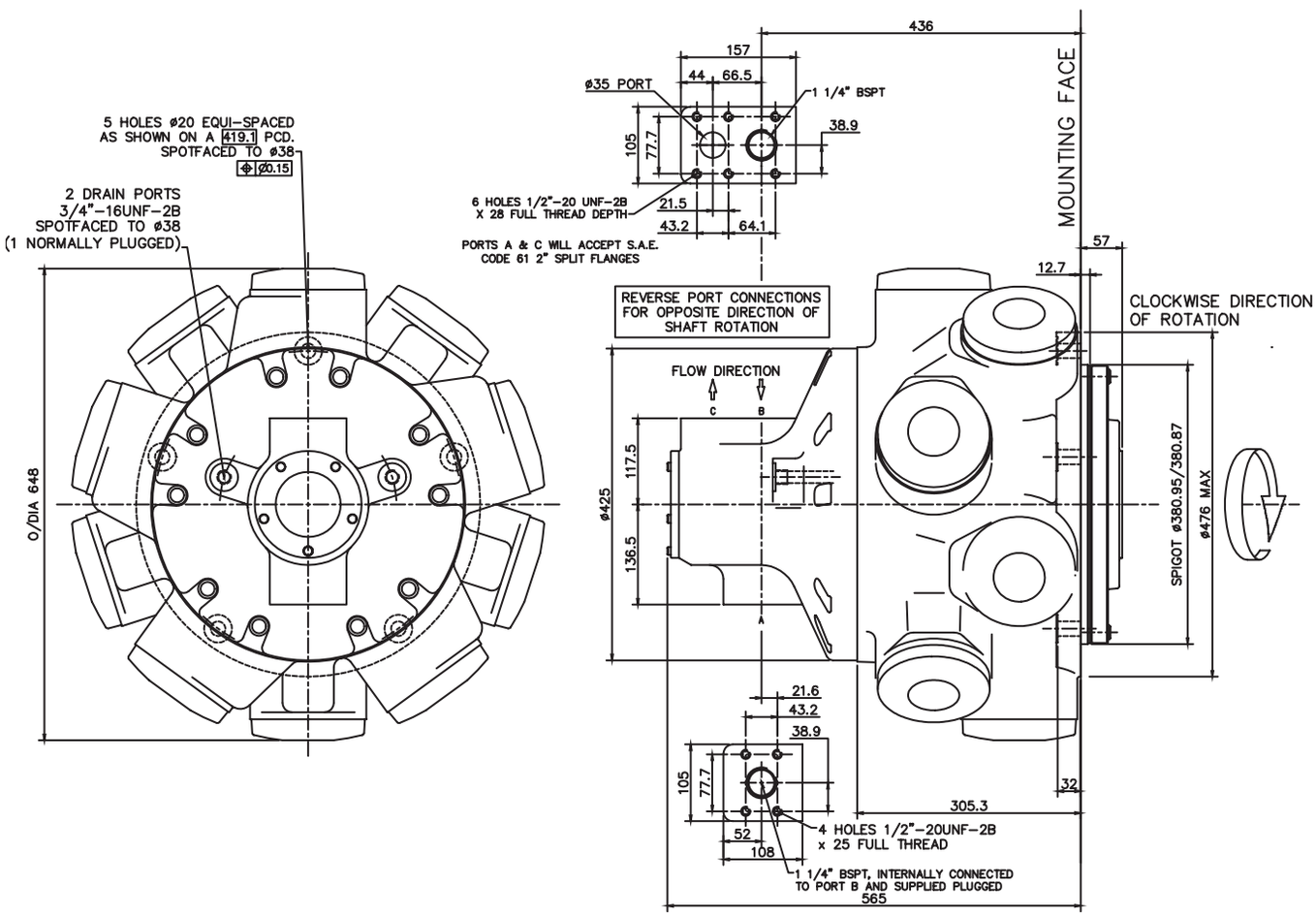
SPLINE DATA

'S'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	23
PITCH	6/12
MAJOR DIAMETER	100.653/100.526
FORM DIAMETER	92.939
MINOR DIAMETER	92.184/91.625
PIN DIAMETER	8.128
DIAMETER OVER PINS	109.573/109.517

'Z'
DIN 5480 W100 x 4 x 24 x 7h

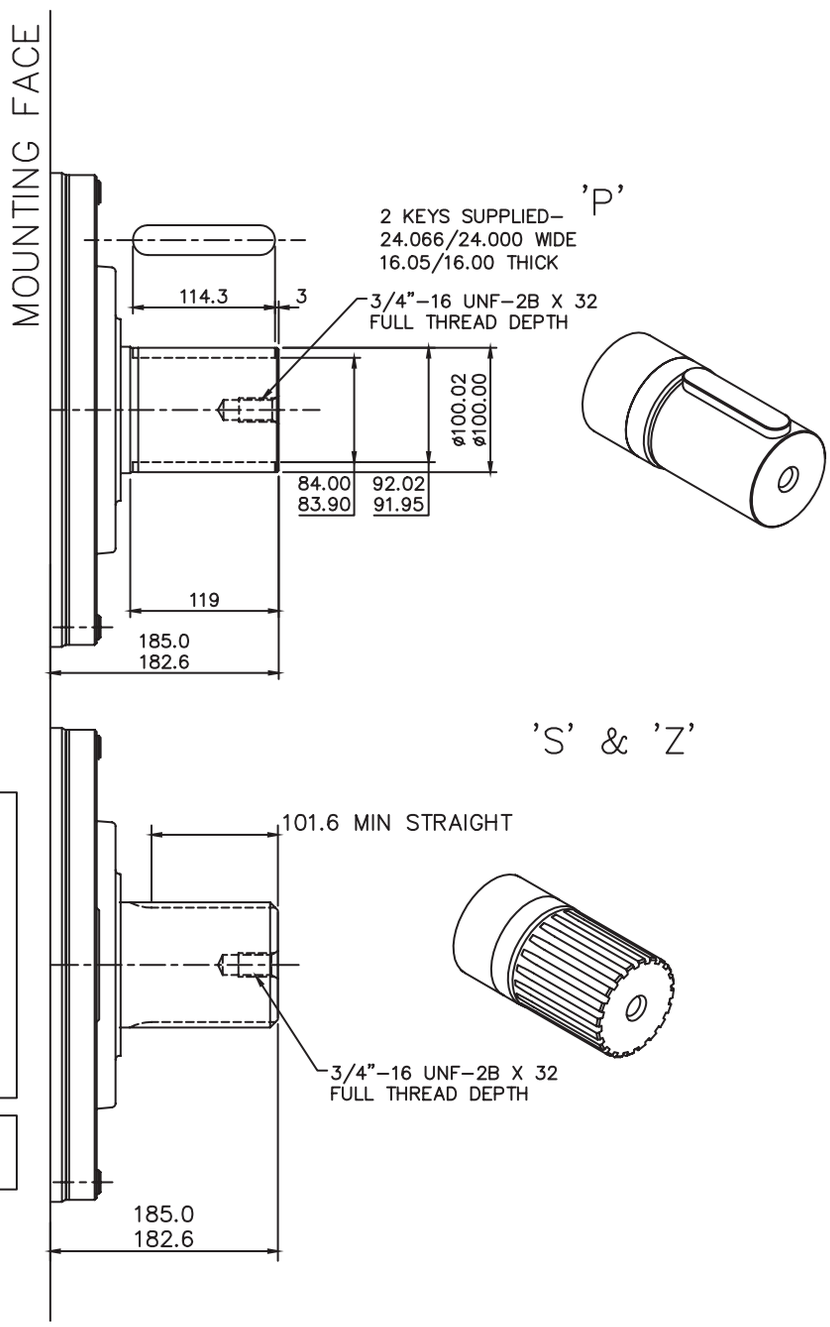
3-10 HMHDB400 (cont)

Installation



3-11 HMB500

'P', 'S' & 'Z' Shafts



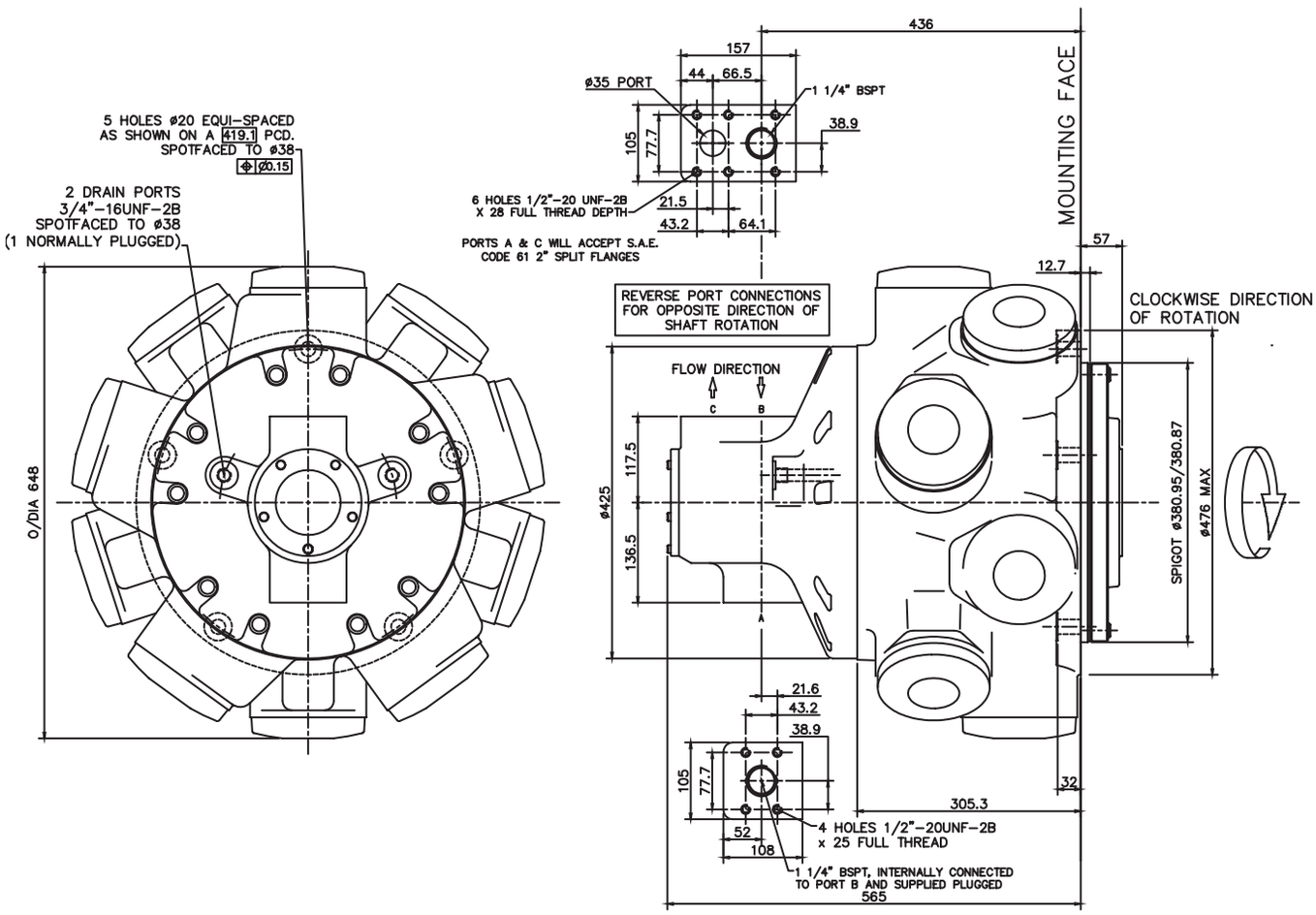
SPLINE DATA

'S'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30°
NUMBER OF TEETH	23
PITCH	6/12
MAJOR DIAMETER	100.653/100.526
FORM DIAMETER	92.939
MINOR DIAMETER	92.184/91.625
PIN DIAMETER	8.128
DIAMETER OVER PINS	109.573/109.517

'Z'
DIN 5480 W100 x 4 x 24 x 7h

3-11 HMB500 (cont)

Installation



3-12 Speed Sensing Options

Tj speed sensor with Tk readout option

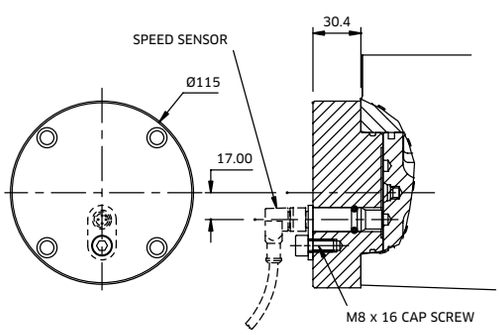
Tj Speed Sensor Technical Specification

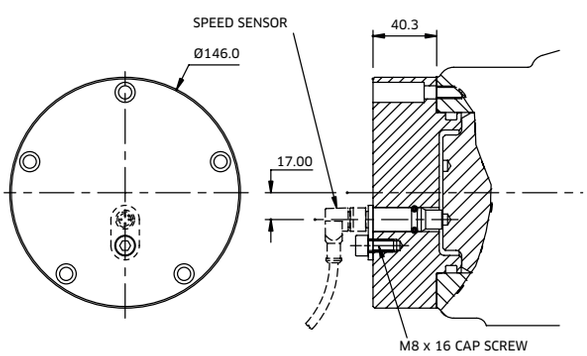
The Tj speed sensor is a hall effect dual channel speed probe that can provide feedback of both speed and direction.

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

TO SUIT: F3/FM3/SO3 'Tj' TO SUIT: F4/FM4/SO4



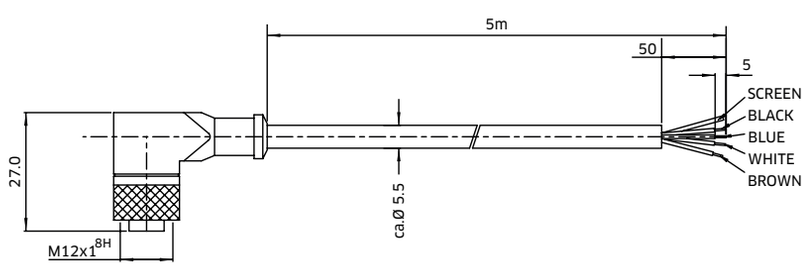


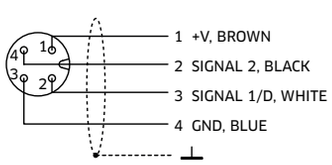
Tk Output Module

The Tk option consists of the Tj speed sensor together with the optional T401 output module.

The addition of the T401 module provides a software configured single channel tachometer and relay with a 0/4-20 mA analogue current output.

The software and calibration cable is also provided.





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