Dual Displacement Radial Piston
High Power Staffa Motor
HPC Series
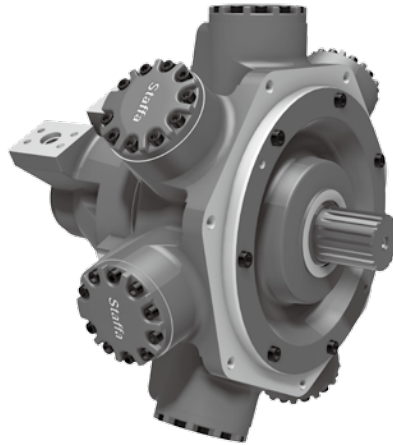
Staffa

Staffa

CONTENTS

HPC Series

Dual Displacement Radial Staffa Motor

■ General Descriptions

The enhanced version of the standard C series motor includes special low friction components combined with crankcase flushing flow to achieve increased shaft power.

The range of HP motors extends from the HPC080 of 1,600 cc/rev to the HPC325 of 5326 cc/rev.
There are 5 frame sizes in this product range for performance details see table below;

Motor Type	Max. torque @ 275 bar (Nm)	Continuous shaft power with flushing (kW)	Continuous shaft power without flushing (kW)
HPC080	6,630	165	138
HPC125	8,470	202	135
HPC200	12,980	261	174
HPC270	19,280	278	189
HPC325	22,440	278	189

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

The HPC series dual displacement models have two pre-set displacements which can be chosen from a wide range to suit specific application requirements. The displacements are hydraulically selected by a directional control valve which can be remote mounted or directly on the motor. Motor displacement can be changed with ease when the motor is running.

These motors are also available in a continuously variable version using either hydro-mechanical or electrohydraulic control methods.

Other mounting options are available on request to match many of the competitor interfaces.

■ Features

Enhanced Power Performance

Increased Speed

Improved Starting and Running Efficiency

Increased Back Pressure Capability

Speed Sensing Options

High Torques at Low Speed

Smooth Running

Wide Range of Displacements to suit specific applications

Displacement Changes with ease when the motor is running

Various Mounting Options available

1 Ordering Code

1-1 Model Coding

F11/HP/C125/S/V/125/70/FM3/CS/Tj/70/PL****

Fluid Type

(refer to page 6 for performance data)	
Blank	Mineral oil
F3	Phosphate ester (HFD fluid)
F11	Water-based fluids (HFA, HFB & HFC)
Alternative fluids contact KPM UK Nominate fluid type and make on order	

Model Type

HP	High Power

Motor Frame Size

C080	C200	C325
C125	C270	

Shaft Type

See shaft type option list on Page 4

Shaft

Vertically up

High Displacement Code

See displacement code details on pages 7 to 11

Low Displacement Code

See displacement code details on pages 7 to 11

Main Port Connections

See port connection details on page 5

Displacement Control Ports (pages 56)

Threaded ports/bi-directional shaft rotation:	
X	X and Y ports G¼" (BSPF to ISO 228/1)

ISO 4401 size 03 mounting face/bi-directional shaft rotation:	
C	No shuttle
CS	With shuttle valve (see options by product type).
ISO 4401 size 03 mounting face/uni-directional shaft rotation (viewed on shaft end)	

Additional Control Options

PL****:	Non-catalogued features, (****)= number assigned as required.
eg: High pressure shaft seals. Alternative port connections. Stainless steel shaft sleeves. Alternative encoder and tacho drives. Motor valve housing orientation. Special paint.	

Design Series Number

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 56

1-2 Shaft Options

◆Product type

HPC080
P	=	Parallel keyed 60 mm Diameter Shaft
S	=	Splined shaft 14 teeth BS3550 Splined
Z	=	shaft DIN5480 (W70x3x22x7h) Long
T	=	taper keyed shaft - 95.2 key slot

HPC125 & HPC200
P1	=	Parallel keyed 85 mm Diameter Shaft
S3	=	Splined shaft 20 teeth BS3550 Splined
S4	=	shaft 16 teeth BS3550 Splined shaft
Z3	=	DIN5480 (W85x3x27x7h) ong taper
T	=	keyed shaft - 133.4 key slot

HPC270 & HPC325
P1	=	Parallel keyed 85 mm Diameter Shaft
S3	=	Splined shaft 20 teeth BS3550 Splined
Z4	=	shaft DIN5480 (W90x4x21x7h) Long
T	=	taper keyed shaft - 133.4 key slot

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

1-3 Main Port Connections Options

◆Product type

HPC080
SO3	=	Staffa 3" 6-bolt flange
SO4	=	6-bolt UNF flange Staffa original valve
F3	=	housing 1¼" SAE 4-bolt flange
FM3	=	1¼" SAE 4-bolt flange
F4	=	SAE 1½" 4-bolt UNC flanges
FM4	=	SAE 1½" 4-bolt metric flanges

HPC125
SO3	=	Staffa 3" 6-bolt flange
SO4	=	6-bolt UNF flange Staffa original valve
F3	=	housing 1¼" 3000 series SAE 4-bolt flange
FM3	=	1¼" 3000 series SAE 4-bolt flange
F4	=	SAE 1½" 4-bolt UNC flanges
FM4	=	SAE 1½" 4-bolt metric flanges

HPC200
SO3	=	Staffa 3" 6-bolt flange
SO4	=	6-bolt UNF flange Staffa original valve
F3	=	housing 1¼" SAE code 61 4-bolt flange
FM3	=	1¼" SAE code 61 4-bolt flange
F4	=	SAE 1½" 4-bolt UNC flanges
FM4	=	SAE 1½" 4-bolt metric flanges

HPC270
SO4	=	Staffa 4" 6-bolt flange
F4	=	1½" SAE code 62 4-bolt flange
FM4	=	1½" SAE code 62 4-bolt flange

HPC325
SO4	=	Staffa 4" 6-bolt flange
F4	=	1½" SAE code 62 4-bolt flange
FM4	=	1½" SAE code 62 4-bolt flange

See pages 25 to 55 for full dimensional details.

2 Technical Information

2-1 Performance Data

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

The appropriate motor displacements can be selected using performance data shown on pages 7 to 11. Refer to the table on this page for pressures and speed limits when using fire-resistant fluids.

◆ 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	250	275	As for mineral oil	All models

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

◆ Rating definitions

Continuous rating

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

Intermittent rating Intermittent

max pressure: 275 bar.

This pressure is allowable on the following basis:

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

Static pressure to DNV rules 380 bar.

2-1 Performance Data (cont)

◆HPC080 Motor (Crankcase flushing required)

Displacement Code		97.6	90	85	80	75	70	65	60	55	50
Displacement	cc/rev	1,600	1,475	1,393	1,311	1,229	1,147	1065	983	901	819
Average actual running torque	Nm/bar	24.1	22.2	20.9	19.7	18.4	17.1	15.9	14.6	13.2	11.9
Average actual mechanical efficiency	%	94.5	94.5	94.3	94.2	94.0	93.8	93.5	93.0	92.2	91.5
Average actual start torque	Nm/bar	22.0	20.1	18.8	17.6	16.3	15.1	13.9	12.6	11.2	9.9
Average actual starting efficiency	%	86.2	85.7	84.9	84.1	83.4	82.6	81.5	80.1	78.2	75.8
Max continuous speed (SO3/F3/FM3)	rpm	270	300	320	340	365	390	420	450	475	500
Max continuous speed (SO4/F4/FM4)	rpm	365	400	415	430	445	460	475	490	500	515
Max continuous power (SO3/F3/FM3)	kW	165	157	152	147	145	140	134	131	125	120
Max continuous power (SO4/F4/FM4)	kW	165	157	152	147	145	140	134	131	125	120
Max continuous pressure	bar	250	250	250	250	250	250	250	250	250	250
Max intermittent pressure	bar	275	275	275	275	275	275	275	275	275	275

Displacement Code		45	40	35	30	25	20	15	10	00
Displacement	cc/rev	737	655	574	492	410	328	246	164	0
Average actual running torque	Nm/bar	10.6	9.3	8.0	6.6	5.3	4.1	2.8	1.6	0
Average actual mechanical efficiency	%	90.4	89.1	87.2	84.8	81.8	77.7	71.0	60.2	0
Average actual start torque	Nm/bar	8.5	7.2	5.9	4.5	3.3	2.0	0.7	/	0
Average actual starting efficiency	%	72.6	68.7	63.8	57.9	50.8	38.0	17.5	/	0
Max continuous speed (SO3/F3/FM3)	rpm	550	600	615	630	630	630	630	630	1,500
Max continuous speed (SO4/F4/FM4)	rpm	530	545	560	575	585	600	615	630	1,500
Max continuous power (SO3/F3/FM3)	kW	113	105	90	73	59	43	30	14	0
Max continuous power (SO4/F4/FM4)	kW	113	105	90	73	59	43	30	14	0
Max continuous pressure	bar	250	250	250	250	250	250	250	250	17
Max intermittent pressure	bar	275	275	275	275	275	275	275	275	17

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

2-1 Performance Data (cont)

◆HMC125 Motor (Crankcase flushing required)

Displacement Code		125	120	110	100	90	80	70
Displacement	cc/rev	2,048	1,966	1,02	1,639	1,475	1,311	1,147
Average actual running torque	Nm/bar	30.8	29.5	27.1	24.5	21.8	19.1	16.5
Average actual mechanical efficiency	%	94.5	94.4	94.3	94.0	93.0	91.7	90.3
Average actual start torque	Nm/bar	26.4	25.0	22.5	20.0	17.4	14.7	12.0
Average actual starting efficiency	%	81.0	80.1	78.4	76.6	74.2	70.6	65.4
Max continuous speed (SO3/F3/FM3)	rpm	215	225	240	270	300	340	390
Max continuous speed (SO4/F4/FM4)	rpm	300	310	340	365	400	430	460
Max continuous power (SO3/F3/FM3)	kW	173	173	171	170	157	147	123
Max continuous power (SO4/F4/FM4)	kW	202	196	183	171	157	147	123
Max continuous pressure	bar	250	250	250	250	250	250	250
Max intermittent pressure	bar	275	275	275	275	275	275	275

Displacement Code		60	50	40	30	20	10	00
Displacement	cc/rev	983	819	655	492	328	164	0
Average actual running torque	Nm/bar	13.8	11.3	8.8	6.4	4.1	0.8	0
Average actual mechanical efficiency	%	88.5	86.5	84.3	81.6	78.0	30.0	0
Average actual start torque	Nm/bar	9.1	6.3	3.2	/	/	/	0
Average actual starting efficiency	%	58.1	48.3	30.6	/	/	/	0
Max continuous speed (SO3/F3/FM3)	rpm	450	500	600	630	630	630	1,500
Max continuous speed (SO4/F4/FM4)	rpm	490	515	545	575	600	630	1,500
Max continuous power (SO3/F3/FM3)	kW	101	86	65	48	30	5	0
Max continuous power (SO4/F4/FM4)	kW	101	86	65	48	30	5	0
Max continuous pressure	bar	250	250	250	250	250	250	17
Max intermittent pressure	bar	275	275	275	275	275	275	17

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

2-1 Performance Data (cont)

◆HPC200Motor (Crankcase flushing required)

Displacement Code		188	180	170	160	150	140	130	120	110	100
Displacement	cc/rev	3,087	2,950	2,790	2,620	2,460	2,290	2,130	1,970	1,800	1,639
Average actual running torque	Nm/bar	47.2	45.2	42.6	40.0	37.3	34.7	32.0	29.4	26.7	24.1
Average actual mechanical efficiency	%	96.3	96.2	96.0	95.8	95.4	95.0	94.5	94.0	93.2	92.5
Average actual start torque	Nm/bar	42.6	40.6	38.0	35.5	33.0	30.6	28.0	25.5	22.9	20.2
Average actual starting efficiency	%	87.0	86.4	85.7	85.1	84.5	83.8	82.8	81.5	79.8	77.5
Max continuous speed (SO3/F3/FM3)	rpm	175	180	190	195	200	205	210	225	240	270
Max continuous speed (SO4/F4/FM4)	rpm	230	235	240	245	250	265	285	310	340	365
Max continuous power	kW	216	213	212	204	195	186	176	173	171	170
Max intermittent power	kW	261	261	261	247	234	222	208	196	183	171
Max continuous pressure	bar	250	250	250	250	250	250	250	250	250	250
Max intermittent pressure	bar	275	275	275	275	275	275	275	275	275	275

Displacement Code		90	80	70	60	50	40	30	20	10	00
Displacement	cc/rev	1,475	1,311	1,150	983	820	655	492	328	164	0
Average actual running torque	Nm/bar	21.5	18.9	16.3	13.8	11.3	8.8	6.4	4.2	1.0	0
Average actual mechanical efficiency	%	91.5	90.5	89.4	88.0	86.3	84.5	82.4	80.0	40.0	0
Average actual start torque	Nm/bar	17.5	14.8	12.0	9.4	6.0	3.4	/	/	/	0
Average actual starting efficiency	%	74.5	70.7	65.9	60.1	45.7	33.1	/	/	/	0
Max continuous speed (SO3/F3/FM3)	rpm	300	340	390	450	500	600	630	630	630	1,500
Max continuous speed (SO4/F4/FM4)	rpm	400	430	460	485	515	545	575	600	630	1,500
Max continuous power	kW	157	147	123	101	86	65	48	30	5	0
Max intermittent power	kW	157	147	123	101	86	65	48	30	5	0
Max continuous pressure	bar	250	250	250	250	250	250	250	250	250	17
Max intermittent pressure	bar	275	275	275	275	275	275	275	275	275	17

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

2-1 Performance Data (cont)

◆ **HPC270Motor** (Crankcase flushing required)

Displacement Code		280	250	220	200	180	160	140	120
Displacement	cc/rev	4,588	4,097	3,605	3,277	2,950	2,622	2,294	1,966
Average actual running torque	Nm/bar	70.1	62.3	54.5	49.3	44.3	39.0	33.8	28.6
Average actual mechanical efficiency	%	96.0	95.6	95.0	94.6	94.3	93.5	92.5	91.5
Average actual start torque	Nm/bar	64.0	56.6	48.9	43.6	38.4	33.2	28.3	23.5
Average actual starting efficiency	%	87.6	86.9	85.2	83.7	81.8	79.7	77.5	75.1
Max continuous speed	rpm	150	160	170	175	210	230	275	310
Max continuous power	kW	278	261	241	225	208	192	174	156
Max continuous pressure	bar	250	250	250	250	250	250	250	250
Max intermittent pressure	bar	275	275	275	275	275	275	275	275

Displacement Code		100	80	60	40	30	20	00
Displacement	cc/rev	1,639	1,311	983	655	492	328	00
Average actual running torque	Nm/bar	23.5	18.4	13.4	8.6	6.3	4.0	0
Average actual mechanical efficiency	%	90.0	88.0	85.5	82.0	80.0	76.0	0
Average actual start torque	Nm/bar	19.0	14.7	9.1	4.3	1.9	/	0
Average actual starting efficiency	%	72.6	70.2	57.8	40.7	23.5	/	0
Max continuous speed	rpm	375	430	460	490	515	545	1,500
Max continuous power	kW	133	109	85	48	39	21	0
Max continuous pressure	bar	250	250	250	250	250	250	17
Max intermittent pressure	bar	275	275	275	275	275	275	17

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

2-1 Performance Data (cont)

◆ **HPC325Motor** (Crankcase flushing required)

Displacement Code		325	310	300	220	200	180	160	140
Displacement	cc/rev	5,326	5,080	4,916	3,605	3,277	2,950	2,622	2,294
Average actual running torque	Nm/bar	81.6	77.8	75.2	54.5	49.3	44.1	38.8	33.6
Average actual mechanical efficiency	%	96.3	96.2	96.1	95.0	94.6	94.0	93.1	92.1
Average actual start torque	Nm/bar	74.5	71.1	68.7	49.0	43.9	38.8	33.8	28.8
Average actual starting efficiency	%	87.9	87.9	87.8	85.4	84.2	82.8	81.0	78.9
Max continuous speed	rpm	130	135	140	170	190	215	230	275
Max continuous power	kW	278	278	278	241	225	208	192	174
Max continuous pressure	bar	250	250	250	250	250	250	250	250
Max intermittent pressure	bar	275	275	275	275	275	275	275	275

Displacement Code		120	100	95	80	60	40	30	00
Displacement	cc/rev	1,966	1,639	1,557	1,311	983	655	492	0
Average actual running torque	Nm/bar	28.5	23.3	22.0	18.2	13.2	8.5	6.3	0
Average actual mechanical efficiency	%	91.0	89.2	88.8	87.2	84.6	81.6	80.0	0
Average actual start torque	Nm/bar	24.0	19.3	18.1	14.8	9.0	4.2	1.9	0
Average actual starting efficiency	%	76.5	73.8	73.0	70.7	57.8	40.7	23.5	0
Max continuous speed	rpm	330	370	405	440	460	495	515	1500
Max continuous power	kW	156	133	127	110	86	48	39	0
Max continuous pressure	bar	250	250	250	250	250	250	250	17
Max intermittent pressure	bar	275	275	275	275	275	275	275	17

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

2-2 Volumetric Efficiency Data

Motor Type	Geometric Displacement	Zero Speed Constant	Speed Constant	Creep Speed Constant	Crankcase Leakage Constant		Fluid Viscosity	Viscosity Factor
HPC	cc/rev	K_1	K_2	K_3	K_4		cSt	Kv
HPC080	1,639	9.5	45.7	5.8	7.9		20	1.58
HPC125	2,048	6.1	38.5	3	4.25		25	1.44
HPC200	3,087	6.1	38.5	2	4.25		30	1.30
HPC270	4,310	6.5	37.3	1.5	6		40	1.10
HPC325	5,210	6.8	40	1.3	6		50	1.00
							60	0.88

Qt (total leakage)	=	$[K_1 + n/K_2] \times \Delta P \times K_V \times 0.005$	l/min
Creep speed	=	$K_3 \times \Delta P \times K_V \times 0.005$	rpm
Crankcase leakage	=	$K_4 \times \Delta P \times K_V \times 0.005$	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 I/rev.

Speed	60 rpm
Differential pressure	200 bar
Fluid viscosity	50 cSt

Total leakage	=	$(K_1+n/K_2) \times \Delta P \times K_V \times 0.005$	l/min
	=	$(6.1+60/38.5) \times 200 \times 1 \times 0.005$	
	=	7.7	l/min

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

$$= \underline{96\%}$$

2-3 Shaft Power Calculation

◆ **Example:** (see page 10):

HPC270 motor with a displacement code of 140:

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

Rated shaft power (W):   174,000
Average actual running torque (Nm/bar):   28.3
Rated shaft speed (rpm):   275

$$174{,}000 = 28.3 \times \Delta P \times 275 \times 2 \times p/60$$

$$\underline{\Delta P = 213 \text{ bar (max.)}}$$

Secondly, to find the maximum speed at rated pressure :

Rated shaft power (W) :   174,000
Average actual running torque (Nm/bar) :   28.3
Rated pressure (bar) :   250

$$174{,}000 = 28.3 \times 250 \times n \times 2 \times p/60$$

$$\underline{n = 235 \text{ rpm (max.)}}$$

In summary, operating the motor within its shaft power limit, at rated speed, would give a maximum pressure of 213 bar, and operating the motor at rated pressure, would give a maximum speed of 235 rpm.

Notes

1) The maximum calculated speed is based on a rated inlet pressure of 250 bar.

2) The maximum shaft power is only allowable if the motor drain temperature remains below 80°C.

3) The maximum calculated differential pressure assumes that the low pressure motor port is less than 30 bar.

2-4 Functional Symbols

◆ **Example model code:**

HPC***/P/***/**/FM3/X/...

X - external pilot supply to 'X' and 'Y' ports
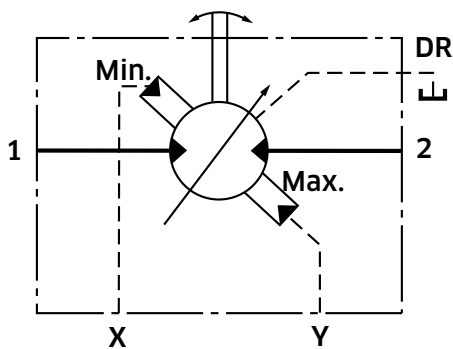
◆ **Example model code:**

HPC***/P/***/**/FM3/C/...

C - single external supply to PC port
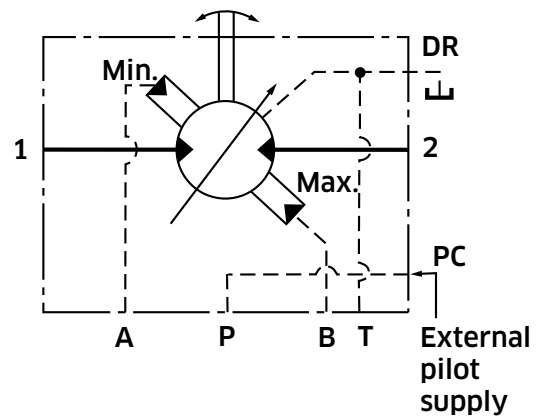
◆ **Example model code:**

HPC***/P/***/**/FM3/CS/...

CS - internally shuttled pilot supply
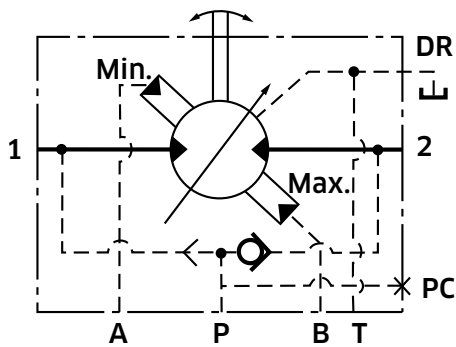
◆ **Example model code:**

HPC***/P/***/**/FM3/C1/...

C1 - internal pilot supply from port 1 for clockwise rotation only
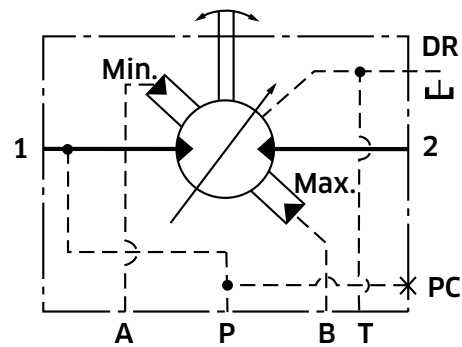
There is a single port (PC) in the 'C' spacer.

Pressure ports in FM3 & FM4 valve housings can be called up as special features when required.

2-5 Shaft Stress Limits

When applying large external radial loads, consideration should also be given to motor bearing lives, (see page 16).

Motor type	Maximum external radial bending moment (kNm)
HPC080	4,500
HPC125	6,500
HPC200	6,750
HPHDC200	12,200
HPC270	8,250
HPHDC270	16,000
HPC325	8,250

Example:

Determine the maximum radial shaft load of a HMC motor:

Radial load offset, A   = 100 mm

Maximum radial load, W   = 4,500 (see table)/100

                                          = 45N (4587 kg)
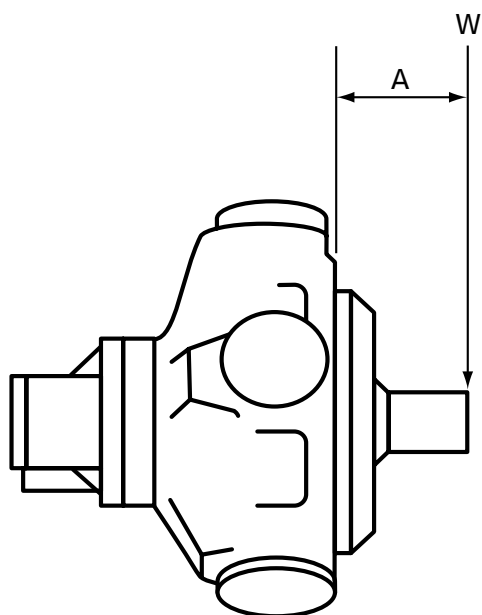
A = Distance from mounting face to load centre (m)

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 bearing 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, type, cleanliness and temperature

5) External radial shaft load

6) External axial shaft load

2-7 Circuit and Application Notes

◆ Limits for fire resistant fluids

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

◆ Starting torque

Refer to performance data, (see pages 7 to 11).

◆ Low speed operation

The minimum operating speed is determined by load inertia, drive elasticity, motor displacement and system internal leakage. If the application speed is below 3 rpm, then consult KPM UK.

If possible, always start the motor in high isplacement.

◆ Small displacements

The pressures given in the table on pages 7 to 11 for displacement code "00" are based on 1,000 rpm output shaft speed. This pressure can be increased for shaft speeds less than 1,000 rpm; consult KPM UK for details. Speeds greater than 1,000 rpm may be applied but only after the machine duty cycle has been considered in conjunction with KPM UK. A zero swept volume displacement (for freewheeling requirements) is available on request, consult KPM UK.

◆ High back pressure

When both inlet and outlet ports are pressurised continuously, the lower pressure port must not exceed **100 bar** at any time. Note that high back pressure reduces the effective torque output of the motor.

◆ Boost pressure

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

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

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

Motor	Porting	Constant (K)
HPC080	FM3, S03, F3	1.6×10^{10}
HPC125	FM3, S03, F3	1.6×10^{10}
HPC200	F3, FM3, S03	1.6×10^{10}
	F4, FM4, S04	3.3×10^{10}
HPC270	S04, F4, FM4	4×10^{10}
HPC325	S04, F4, FM4	4×10^{10}

2-7 Circuit and Application Notes (cont)

The flow rate of oil for the make-up system can be estimated from the crankcase leakage data (see page 12) plus an allowance for changing displacement:

e.g.

HPC080	To change high to low in 0.25 sec requires 32 l/min
HPC0125	To change high to low in 0.5 sec requires 15 l/min
HPC0200	To change high to low in 0.5 sec requires 15 l/min
HPC270	To change high to low in 1 sec requires 24 l/min
HPC325	To change high to low in 1 sec requires 20 l/min

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

◆ Motorcase pressure

The motorcase pressure should not continuously exceed 3.5 bar with a standard shaft seal fitted. On installations with long drain lines a relief valve is recommended to prevent over-pressurising the seal.

Notes

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

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

3) Check installation dimensions (pages 25 to 55) for maximum crankcase drain fitting depth.

◆ Hydraulic fluids

Dependent on motor (see model code fluid type - page 3) 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)

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)

◆ 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.

2-7 Circuit and Application Notes (cont)

◆ Temperature limits

Ambient min. -30°C
Ambient max. +70°C

Max. operating temperature range.	**Mineral oil**	**Water-containing**
Min	-20°C	+10°C
Max. *	+80°C	+54°C

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

◆ Filtration

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

◆ Noise levels

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

◆ Polar moment of Inertia

Typical data

Motor	Displacement code	Kgm2
HPC080	90	0.052
	45	0.044
HPC125	125	0.20
	50	0.14
HPC200	188	0.23
	75	0.18
HPC270	280	0.83
	100	0.61
HPC325	325	0.87
	100	0.61

◆ Mass

HPC080 Approx. all models 172 kg.
HPC125 Approx. all models 235 kg.
HPC200 Approx. all models 282 kg.
HPC270 Approx. all models 450 kg.
HPC325 Approx. all models 460 kg.

2-8 Crankcase Flushing Flow

In order to achieve the maximum shaft power, a crankcase flushing flow of 15 l/min should be directed through the motorcase. To improve the cooling effect of flushing flow, the distance between the inlet and outlet drain port connections should be maximised. If a flushing flow is not used, please consult KPM UK to verify performance parameters.

Flushing flow orifice

Required flushing flow to achieve full rated power : 15 l.p.m.
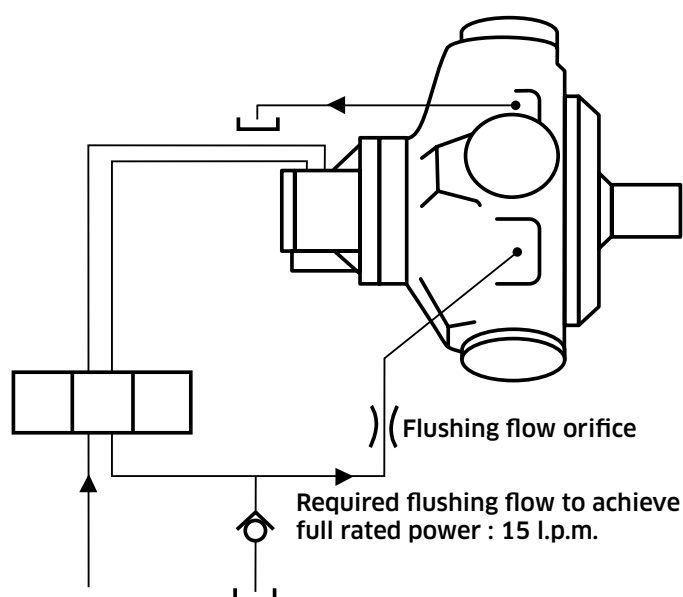
Check valve pressure (bar) *	Orifice diameter (mm)
3	4.4
4	4.1
5	3.9
6	3.7
7	3.6
8	3.5
9	3.4
10	3.3

* 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.

2-9 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 I/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 40^0 and above 100^{0}C	minus 30^{0}C
High pressure shaft seal	below minus 30^0 and above 120^{0}C	minus 15^{0}C

All seals are very brittle below minus 40^{0}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^{0}C.

It is recommended that the motor is operated by observing the rule for viscosity and the minimum operating temperature.

# 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.

Connect to a drain port above motor centre line
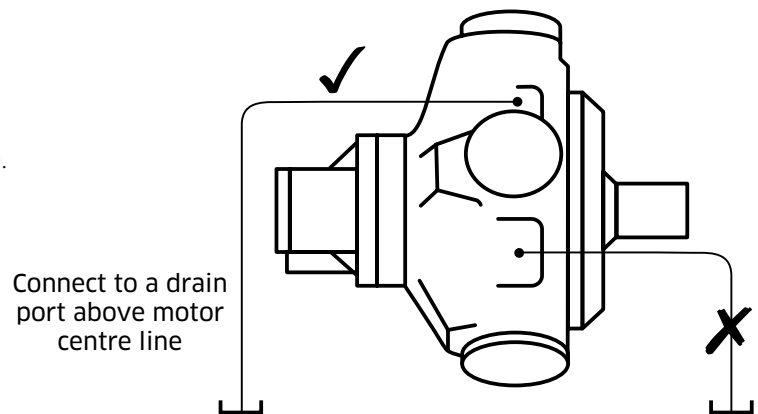
◆ Motor axis - vertical shaft up

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).

Additional drain (Typical) port G¼" *(BSPF)*

Standard drain port ¾" - 16 UNF

0.35 bar
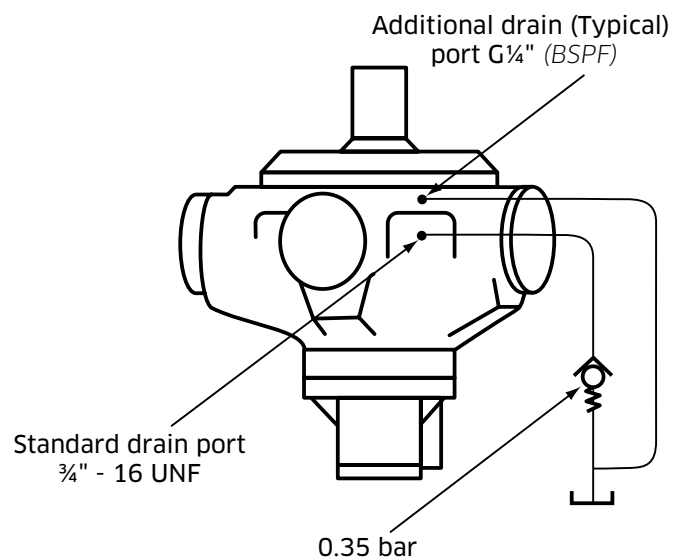
◆ Motor axis - vertical shaft down

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.
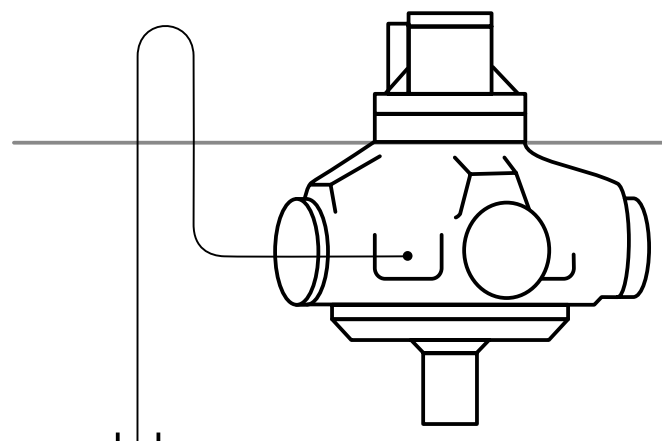
2-11 Freewheeling Notes

All Staffa motors can be used in freewheeling applications. In all circumstances it is essential that the motor is unloaded ("A" and "B" ports connected together) and that the circuit is boosted. The required boost pressure is dependent on both the speed and displacement conditions of the motor determined by the maximum overrunning load condition (see boost pressure calculation method on page 17)

It should be noted that for "B" motors large flows will re-circulate around the motor. This will require a large recirculating valve and consideration of circuit cooling as the motor will be generating a braking torque. It is for these reasons that "C" series motors are the preferred option for freewheeling applications. It is normal to select displacement codes 00, 05 or 10.

Selecting the lowest zero displacement option (00) will allow the motor shaft to be rotated at high speed without pumping fluid and with a minimum boost and drive torque requirement. Consideration must also be given when freewheeling that the load does not drive the motor above its rated freewheeling speed condition. (see pages 7 to 13).

◆ Displacement selection

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

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

◆ Boost requirement

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

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

◆ Crankcase cooling

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

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

For speeds above this up to 1,500 rpm then crankcase flushing flow must be used.

Boost Supply
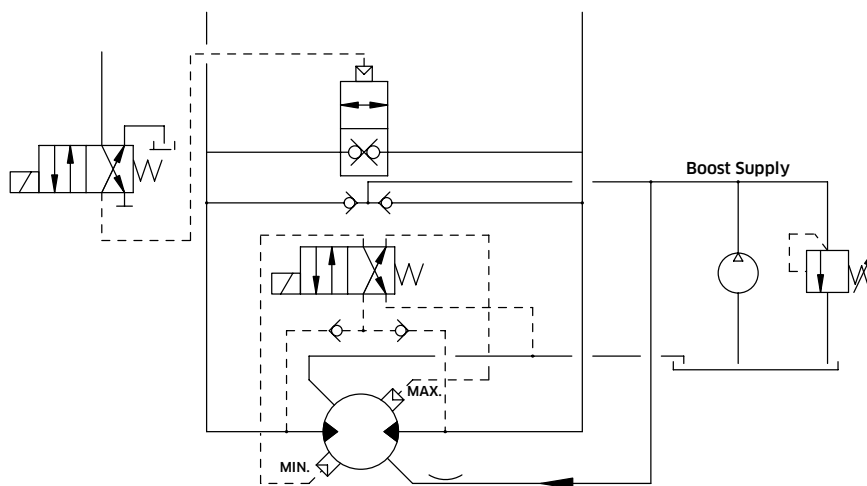
2-12 Installation Data

◆ General

Spigot
The motor should be located by the mounting spigot on a flat, robust surface using correctly sized bolts. The diametrical clearance between the motor spigot and the mounting must not exceed 0.15 mm. If the application incurs shock loading, frequent reversing or high speed running, then high tensile bolts should be used, including one fitted bolt.

Bolt torque
The recommended torque wrench setting for bolts is as follows:

M18	312 +/_ 7 Nm
⅝" UNF	265 +/_ 14 Nm
M20	407 +/_ 14 Nm
¾" UNF	393 +/_ 14 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.

Motor axis - horizontal
The crankcase drain must be taken from a position above the horizontal centre line of the motor, (see page 22).

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

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

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

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

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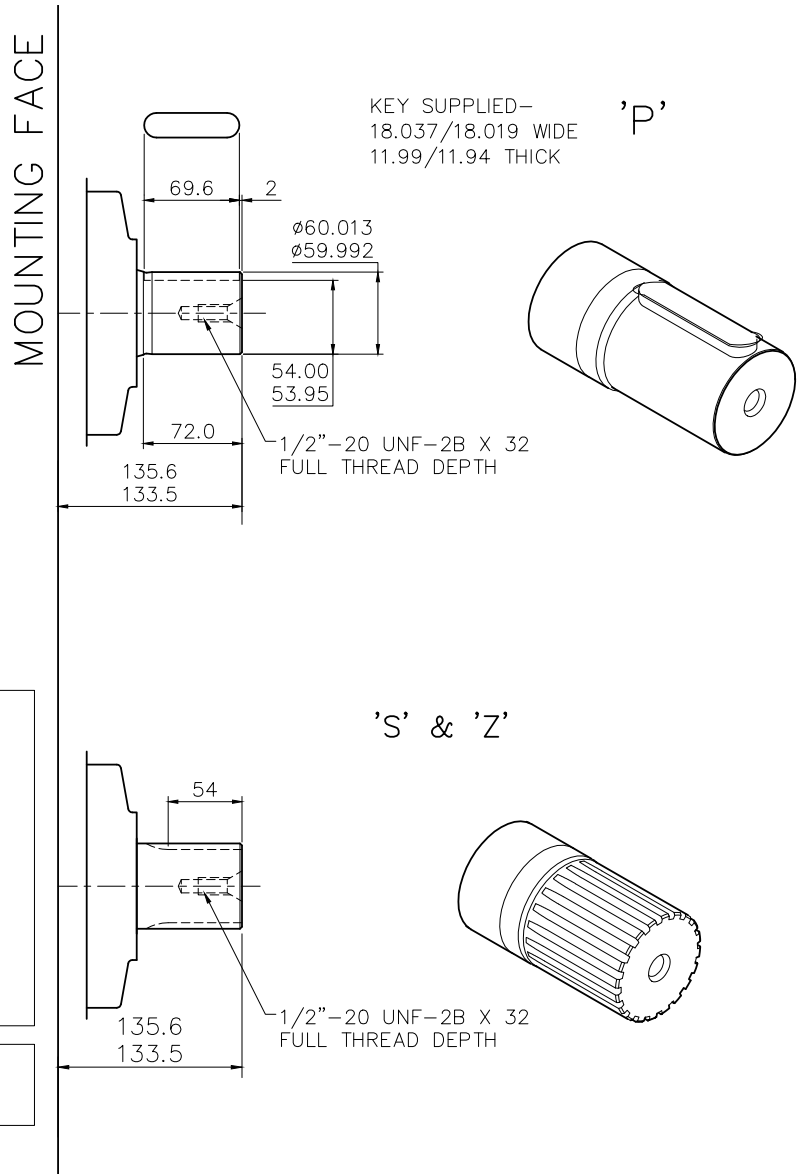
◆ Start - up

Fill the crankcase with system fluid. Where practical, a short period (30 minutes) of "running in" should be carried out with the motor unloaded and set to its high displacement.

3 Dinmensions

3-1 HPC080 Installation
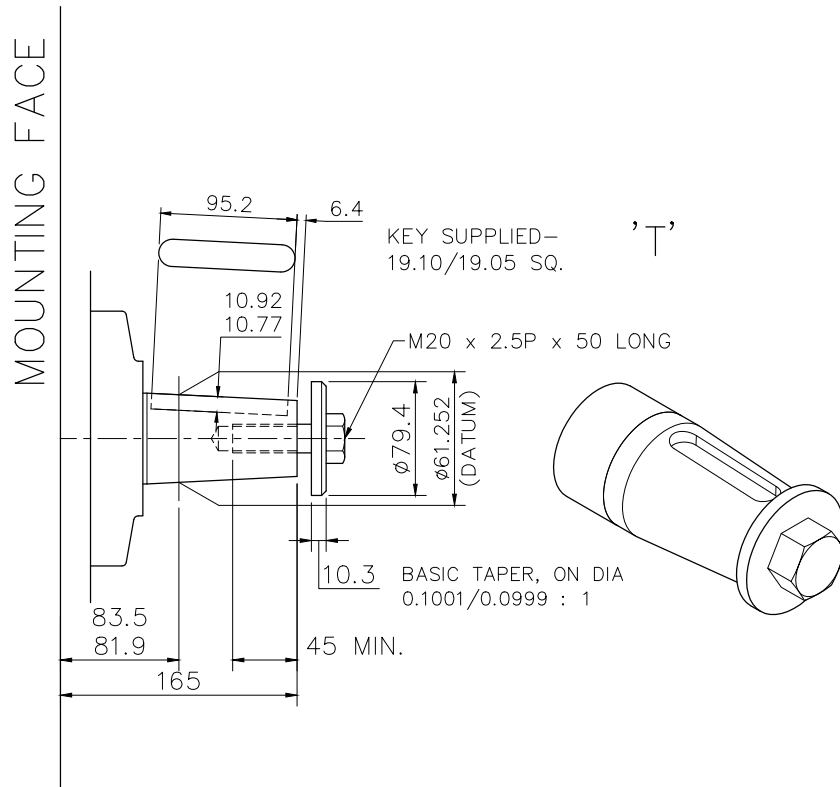
◆ **3-1-1 HPC080** - 'P', 'S' & 'Z' Shafts

MOUNTING FACE

KEY SUPPLIED—
18.037/18.019 WIDE
11.99/11.94 THICK

'P'

69.6   2

ø60.013
ø59.992

54.00
53.95

72.0

1/2"—20 UNF—2B X 32
FULL THREAD DEPTH

135.6
133.5

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

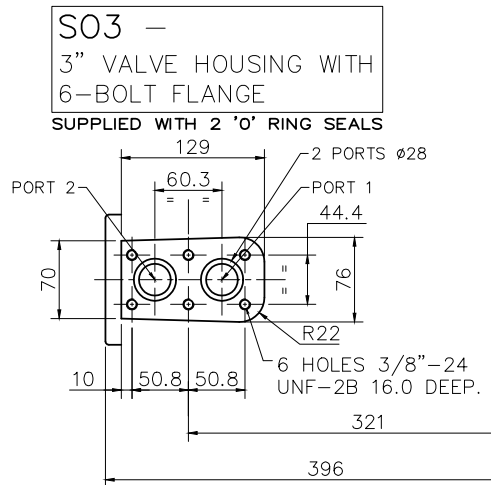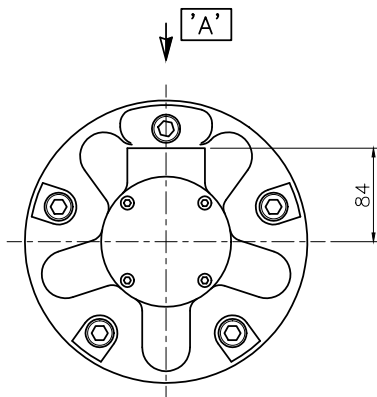| 'Z' |
|---|
| DIN 5480 W70 x 3 x 30 x 22 x 7h |

'S' & 'Z'

54

1/2"—20 UNF—2B X 32
FULL THREAD DEPTH

135.6
133.5

3-1 HPC080 Installation (cont)

◆ 3-1-2 HPC080 - 'T' Shaft

MOUNTING FACE

95.2

6.4

KEY SUPPLIED— 'T'
19.10/19.05 SQ.

10.92
10.77

M20 x 2.5P x 50 LONG

⌀79.4

⌀61.252
(DATUM)

10.3 BASIC TAPER, ON DIA
0.1001/0.0999 : 1
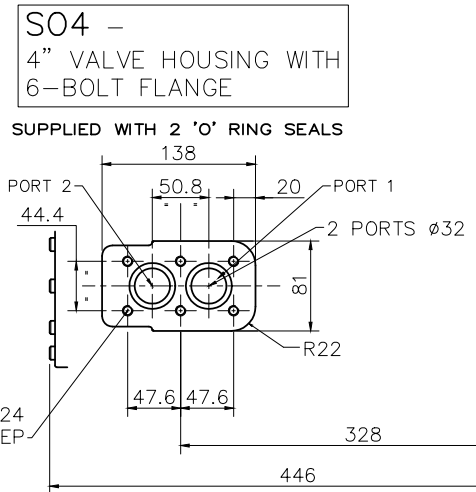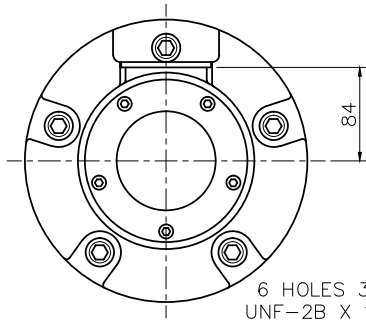
83.5
81.9

45 MIN.

165

3-1 HPC080 Installation (cont)

◆ **3-1-3 HPC080** - 'SO3' & 'SO4' Valve Housings

VIEWS ON ARROW 'A'

MOUNTING FACE

'A'

SO3 –
3" VALVE HOUSING WITH
6-BOLT FLANGE
SUPPLIED WITH 2 'O' RING SEALS

84

129
60.3
PORT 2
PORT 1
44.4
2 PORTS ⌀28
70
76
R22
10   50.8   50.8
6 HOLES 3/8"-24
UNF-2B 16.0 DEEP.
321
396

SO4 –
4" VALVE HOUSING WITH
6-BOLT FLANGE
SUPPLIED WITH 2 'O' RING SEALS

84

138
PORT 2   50.8   20   PORT 1
44.4
2 PORTS ⌀32
81
R22
6 HOLES 3/8"-24
UNF-2B X 16 DEEP
47.6   47.6
328
446
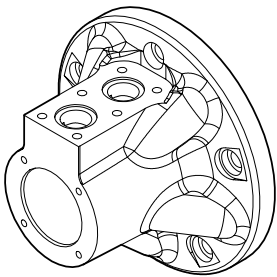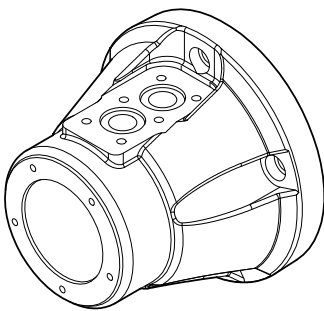
3-1 HPC080 Installation (cont)

◆ 3-1-4 HPC080 - 'F2', 'FM2', 'F3' & 'FM3' Valve Housings

MOUNTING FACE

VIEWS ON ARROW 'A'

F2/FM2 —
2 1/4" VALVE HOUSING WITH
1" SAE 4—BOLT FLANGES

PORT FLANGE BOLT TAPPING SIZE —

F2:	3/8"—16 UNC—2B X 22 FULL THREAD DEPTH
FM2:	M10 X P1.5 X 22 FULL THREAD DEPTH

'A'

FLOW DIRECTIONS FOR
SHAFT ROTATION SHOWN.
REVERSE FLOW DIRECTIONS
FOR OPPOSITE ROTATION.

1" CODE 61
S.A.E. PORTS
(2 POSITIONS)

26.2

84

84

52.4

2x4 HOLES, SEE TABLE
FOR THREAD SIZES

320

359

F3/FM3 —
3" VALVE HOUSING WITH
1 1/4" SAE 4—BOLT FLANGES

PORT FLANGE BOLT TAPPING SIZE —

F3:	7/16"—14 UNC—2B X 27 FULL THREAD DEPTH
FM3:	M12 X P1.75 X 27 FULL THREAD DEPTH

1 1/4" CODE 61
S.A.E. PORTS
(3000 SERIES)

30.2

PORT 1

8 HOLES, SEE TABLE
FOR THREAD SIZES

87

58.7

58.7

37 37

PORT 2

30.2

46.5

303

396

3-1 HPC080 Installation (cont)

◆ 3-1-5 HPC080 - 'F4' & 'FM4' Valve Housings

MOUNTING FACE

VIEWS ON ARROW 'A'

F4/FM4 —
4" VALVE HOUSING WITH
1 1/2" SAE 4−BOLT FLANGES

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

'A'

ø1 1/2" SAE (CODE 62)
PORTS (6000 SERIES)

8 HOLES, SEE TABLE
FOR THREAD SIZES

36.5

79.4

130

78.0

70.0

316

371

PORT 1

36.5

PORT 2

79.4

450
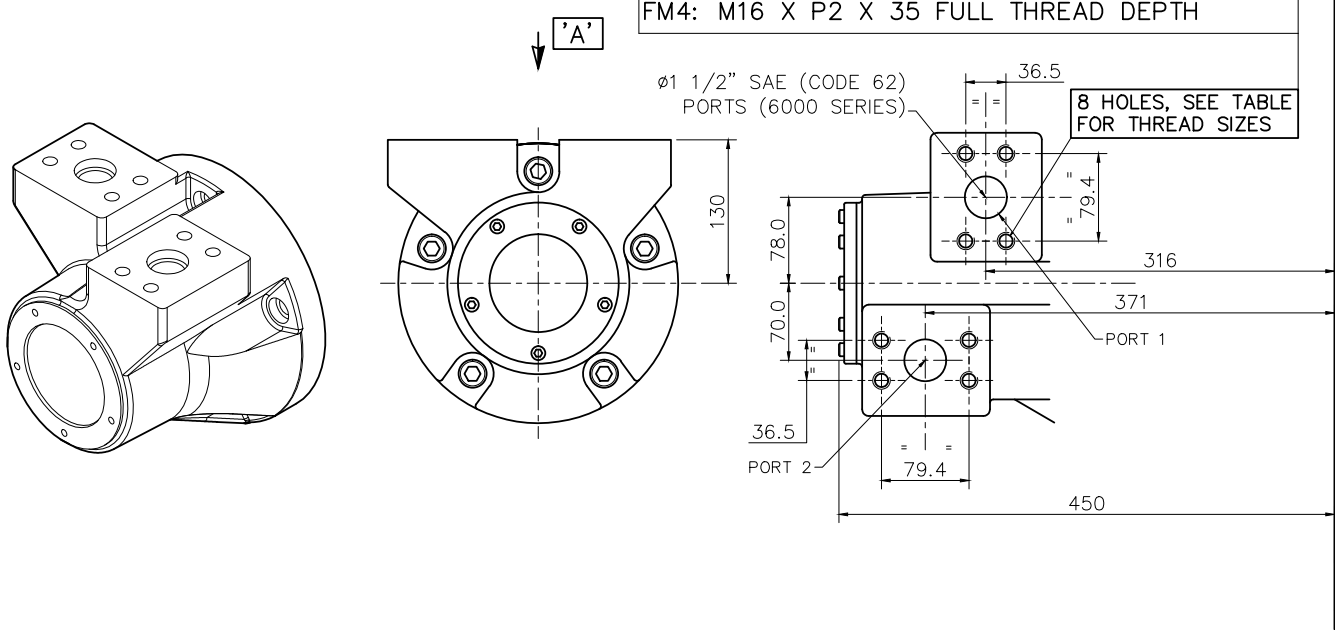
3-1 HPC080 Installation (cont)

◆ 3-1-6 HPC080 - 'C', 'CS' & 'X' C Spacers

DISPLACEMENT SELECTION (VIA REMOTELY LOCATED VALVE*)
HIGH DISPLACEMENT: P TO Y; X TO T
LOW DISPLACEMENT: P TO X; Y TO T
*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED WITH MOTOR; SPECIFY & ORDER SEPARATELY

27.2
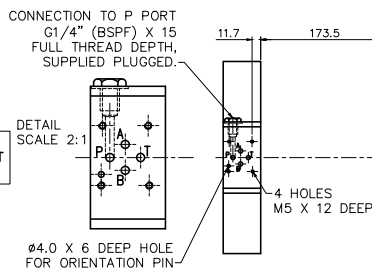13.0
11.0
17.0

2 PORTS G1/4" (BSPF) X 15 FULL THREAD DEPTH
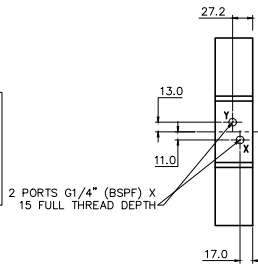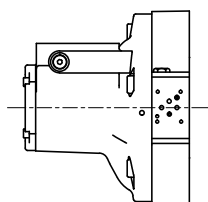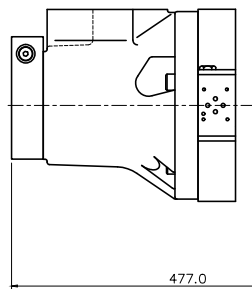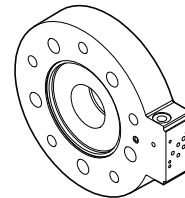
MOUNTING FACE

TYPE X
DISPLACEMENT CONTROL

MOUNTING INTERFACE FOR DIRECTIONAL CONTROL VALVE* TO: ISO 4401 SIZE 03/ANSI B93,7M SIZE D03
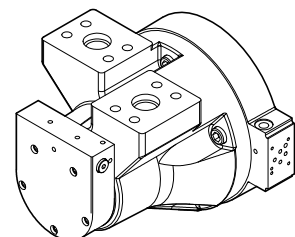*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED WITH MOTOR; SPECIFY & ORDER SEPARATELY

DISPLACEMENT SELECTION:
HIGH DISPLACEMENT: P TO B; A TO T
LOW DISPLACEMENT: P TO A; B TO T

CONNECTION TO P PORT G1/4" (BSPF) X 15 FULL THREAD DEPTH, SUPPLIED PLUGGED.

DETAIL SCALE 2:1

11.7   173.5

4 HOLES M5 X 12 DEEP

ø4.0 X 6 DEEP HOLE FOR ORIENTATION PIN

TYPES C, CS & C1
DISPLACEMENT CONTROL

477.0

CS TYPE SHUTTLE ON F3 & FM3 ASSEMBLIES ONLY

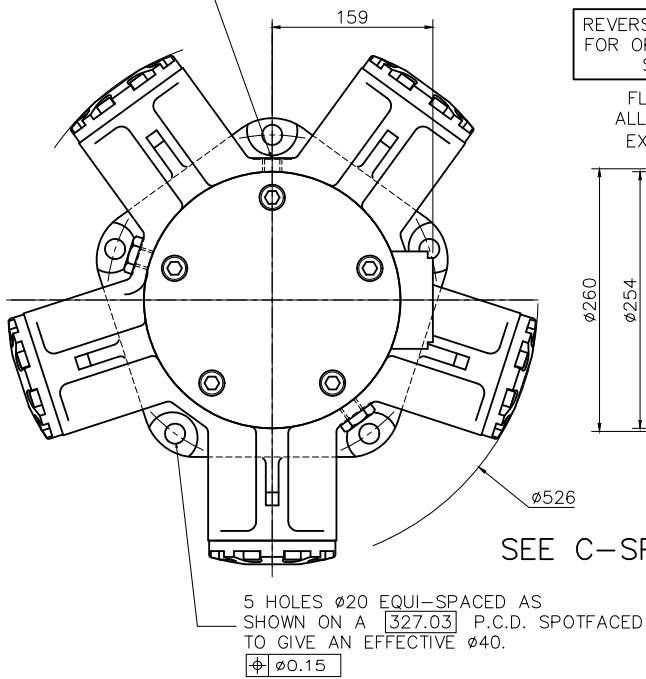CS TYPE SHUTTLE ENDCAP ON F4 & FM4 ASSEMBLIES ONLY

3-1 HPC080 Installation (cont)

◆ 3-1-7 HPC080 - Installation

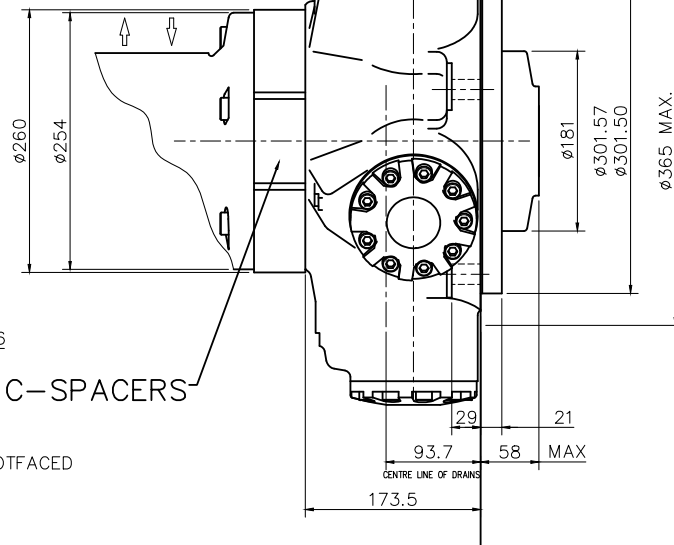3/4"-16UNF-2B DRAIN (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)

NOTE:- ENSURE ON INSTALLATION THAT DRAIN IS
TAKEN FROM ABOVE MOTOR CENTRELINE.

DO NOT EXCEED 12 DEPTH OF COUPLING
IN TO DRAIN PORT

159

ø526

SEE C-SPACERS

5 HOLES ø20 EQUI-SPACED AS
SHOWN ON A 327.03 P.C.D. SPOTFACED
TO GIVE AN EFFECTIVE ø40.
⌖ ø0.15

REVERSE PORT CONNECTIONS
FOR OPPOSITE DIRECTION OF
SHAFT ROTATION

FLOW DIRECTION FOR
ALL VLV HSG VARIANTS
EXCEPT F2/FM2/SM3

ø260
ø254

MOUNTING FACE

CLOCKWISE DIRECTION
OF ROTATION

ø181
ø301.57
ø301.50
ø365 MAX.

29   21
93.7   58   MAX
CENTRE LINE OF DRAINS
173.5

3-2 HPC125 Installation

◆ **3-2-1 HPC125** - 'P1', 'S3' & 'Z3' Shafts

MOUNTING FACE

'P1'

KEY SUPPLIED—
24.066/24.000 WIDE
16.05/16.00 THICK

89.9   3

3/4"—16 UNF—2B X 32
FULL THREAD DEPTH

⌀85.01
⌀84.99

77.0
76.9

97

144.3
142.5

'S3' & 'Z3'

SPLINE DATA

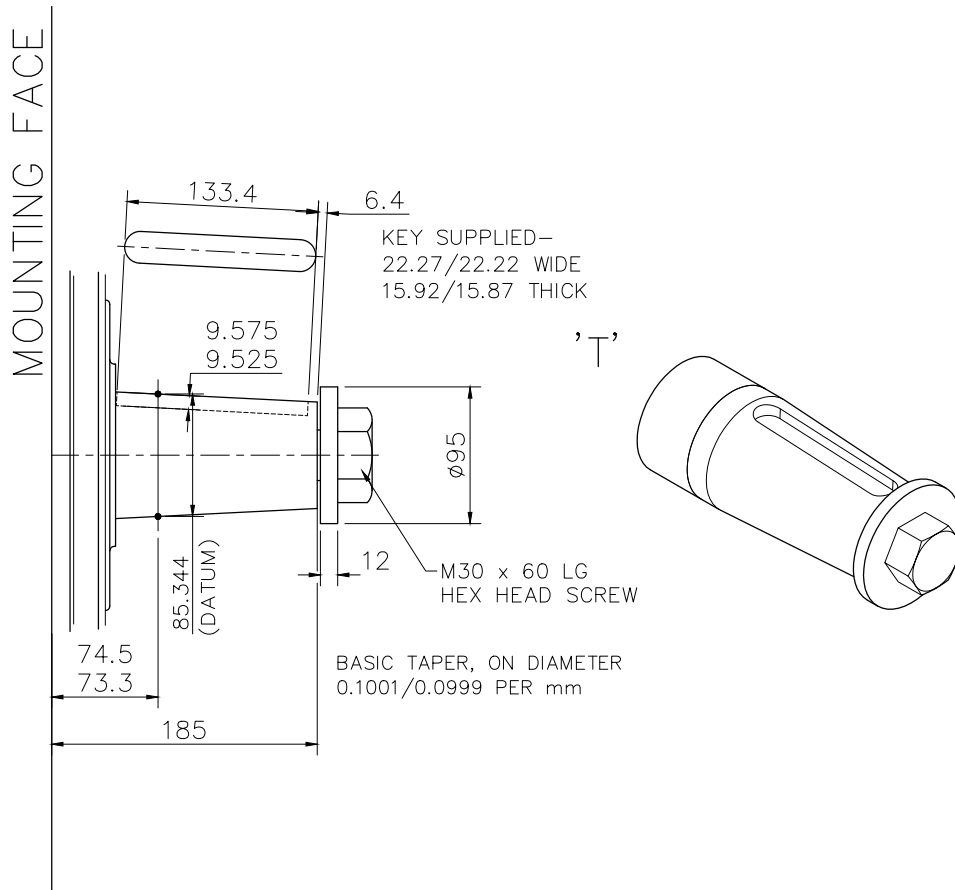| 'S'	
TO BS 3550 (ANSI B92.1, CLASS 5)	
FLAT ROOT SIDE FIT, CLASS 1	
PRESSURE ANGLE	30˚
NUMBER OF TEETH	20
PITCH	6/12
MAJOR DIAMETER	87.953/87.825
FORM DIAMETER	80.264
MINOR DIAMETER	79.485/78.925
PIN DIAMETER	8.128
DIAMETER OVER PINS	97.084/97.030

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

76 MIN STRAIGHT

3/4"—16 UNF—2B X 32
FULL THREAD DEPTH

97

144.3
142.5

3-2 HPC125 Installation (cont)

◆ 3-2-2 HPC125 - 'T' Shaft

MOUNTING FACE

133.4

6.4

KEY SUPPLIED—
22.27/22.22 WIDE
15.92/15.87 THICK

9.575
9.525

'T'

Ø95

85.344
(DATUM)

12

M30 x 60 LG
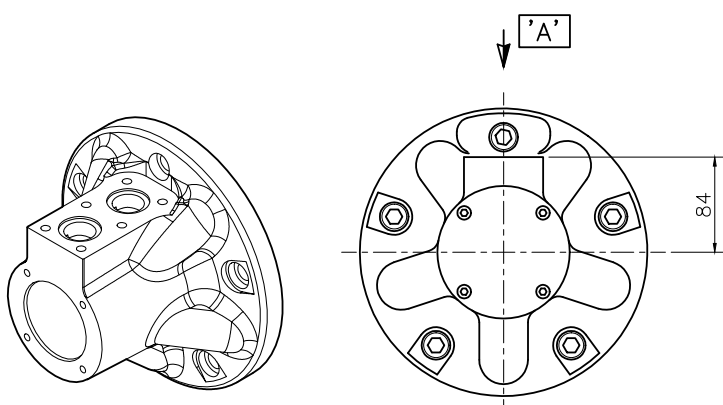HEX HEAD SCREW

74.5
73.3

BASIC TAPER, ON DIAMETER
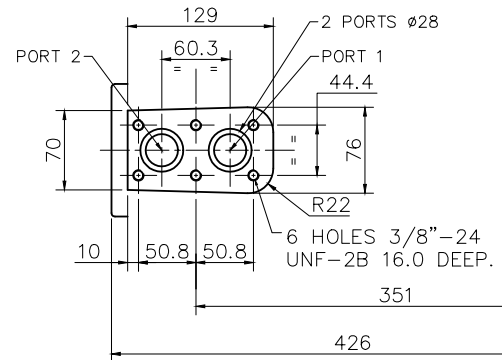0.1001/0.0999 PER mm

185

3-2 HPC125 Installation (cont)

◆ 3-2-3 HPC125 - 'SO3' & 'SO4' Valve Housings

VIEWS ON ARROW 'A'

'A'

SO3 –
3" VALVE HOUSING WITH
6–BOLT FLANGE

SUPPLIED WITH 2 'O' RING SEALS

129
60.3
PORT 2
PORT 1
44.4
70
76
84
2 PORTS ⌀28
R22
10   50.8   50.8
6 HOLES 3/8"–24
UNF–2B 16.0 DEEP.
351
426

MOUNTING FACE

SO4 –
4" VALVE HOUSING WITH
6–BOLT FLANGE

SUPPLIED WITH 2 'O' RING SEALS

138
50.8   20
PORT 2   PORT 1
44.4
2 PORTS ⌀32
81
84
R22
47.6   47.6
6 HOLES 3/8"–24
UNF–2B X 16 DEEP
359
476
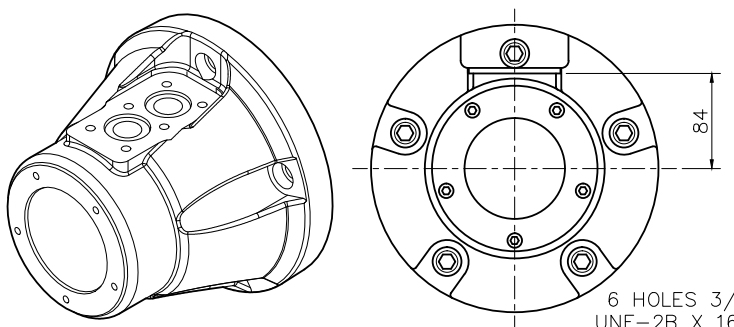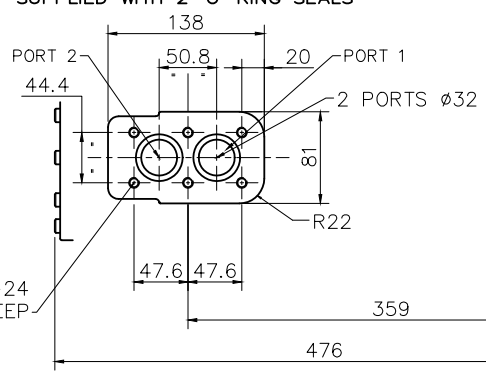
3-2 HPC125 Installation (cont)

◆ 3-2-4 HPC125 - 'F2', 'FM2', 'F3' & 'FM3' Valve Housings

MOUNTING FACE

VIEWS ON ARROW 'A'

F2/FM2 —
2 1/4" VALVE HOUSING WITH
1" SAE 4—BOLT FLANGES

PORT FLANGE BOLT TAPPING SIZE —
F2:   3/8"—16 UNC—2B X 22 FULL THREAD DEPTH
FM2: M10 X P1.5 X 22 FULL THREAD DEPTH

'A'

FLOW DIRECTIONS FOR
SHAFT ROTATION SHOWN.
REVERSE FLOW DIRECTIONS
FOR OPPOSITE ROTATION.

1" CODE 61
S.A.E. PORTS
(2 POSITIONS)

26.2

84

84

52.4

2x4 HOLES, SEE TABLE
FOR THREAD SIZES

350

389

F3/FM3 —
3" VALVE HOUSING WITH
1 1/4" SAE 4—BOLT FLANGES

PORT FLANGE BOLT TAPPING SIZE —
F3: 7/16"—14 UNC—2B X 27 FULL THREAD DEPTH
FM3: M12 X P1.75 X 27 FULL THREAD DEPTH

1 1/4" CODE 61
S.A.E. PORTS
(3000 SERIES)

30.2

PORT 1

8 HOLES, SEE TABLE
FOR THREAD SIZES

87

58.7

58.7

37   37

37   37

PORT 2

30.2

46.5

334

426

3-2 HPC125 Installation (cont)

◆ **3-2-5 HPC125** - 'F4' & 'FM4' Valve Housings

VIEWS ON ARROW 'A'

F4/FM4 —
4" VALVE HOUSING WITH
1 1/2" SAE 4−BOLT FLANGES

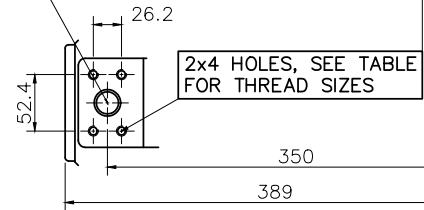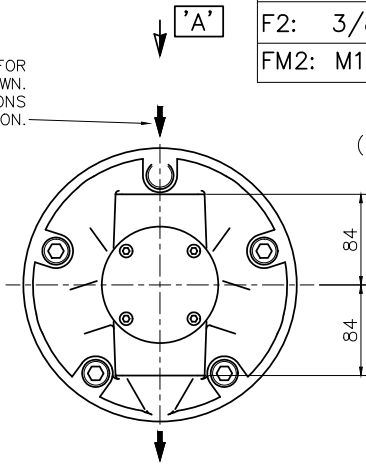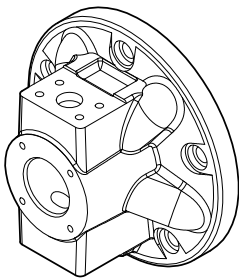PORT FLANGE BOLT TAPPING SIZE —
F4: 5/8"−11 UNC−2B X 35 FULL THREAD DEPTH
FM4: M16 X P2 X 35 FULL THREAD DEPTH

'A'

ø1 1/2" SAE (CODE 62)
PORTS (6000 SERIES)

36.5

8 HOLES, SEE TABLE
FOR THREAD SIZES

130
79.4
78.0
70.0
347
402
PORT 1
36.5
79.4
PORT 2
480

MOUNTING FACE
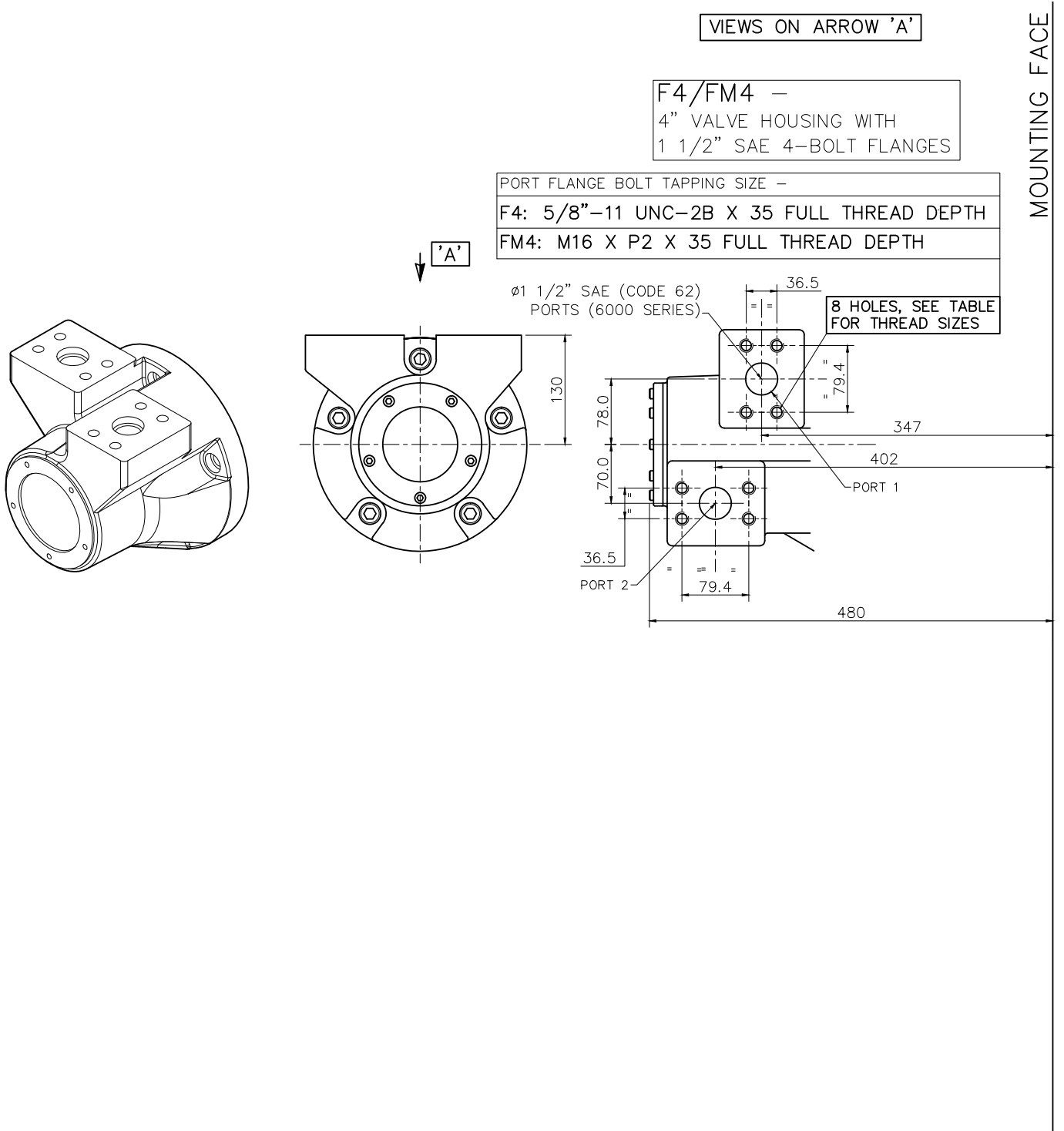
3-2 HPC125 Installation (cont)

◆ **3-2-6 HPC125** - 'C', 'CS' & 'X' C Spacers

MOUNTING FACE

TYPE X
DISPLACEMENT CONTROL

27.2   203.5

13.0

11.0

2 PORTS G1/4" (BSPF) X
15 FULL THREAD DEPTH

17.0

DISPLACEMENT SELECTION (VIA
REMOTELY LOCATED VALVE*)
HIGH DISPLACEMENT: P TO Y; X TO T
LOW DISPLACEMENT: P TO X; Y TO T
*DISPLACEMENT SELECTOR VALVE IS
NOT SUPPLIED WITH MOTOR; SPECIFY
& ORDER SEPARATELY

CONNECTION TO P PORT
G1/4" (BSPF) X 15
FULL THREAD DEPTH,
SUPPLIED PLUGGED.

11.7

MOUNTING INTERFACE FOR DIRECTIONAL CONTROL
VALVE* TO: ISO 4401 SIZE 03/ANSI B93,7M SIZE D03
*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED
WITH MOTOR; SPECIFY & ORDER SEPARATELY

DISPLACEMENT SELECTION:
HIGH DISPLACEMENT: P TO B; A TO T
LOW DISPLACEMENT: P TO A; B TO T

DETAIL
SCALE 2:1

TYPES C, CS & C1
DISPLACEMENT CONTROL

4 HOLES
M5 X 12 DEEP

Ø4.0 X 6 DEEP HOLE
FOR ORIENTATION PIN

507.0

CS TYPE SHUTTLE ON
F3 & FM3 ASSEMBLIES
ONLY

CS TYPE SHUTTLE
ENDCAP ON F4 & FM4
ASSEMBLIES ONLY

37

3-2 HPC125 Installation (cont)

◆ **3-2-7 HPC125** - **Installation**

¾"−16 UNF−2B DRAIN (CHOICE OF 3 POSITIONS)
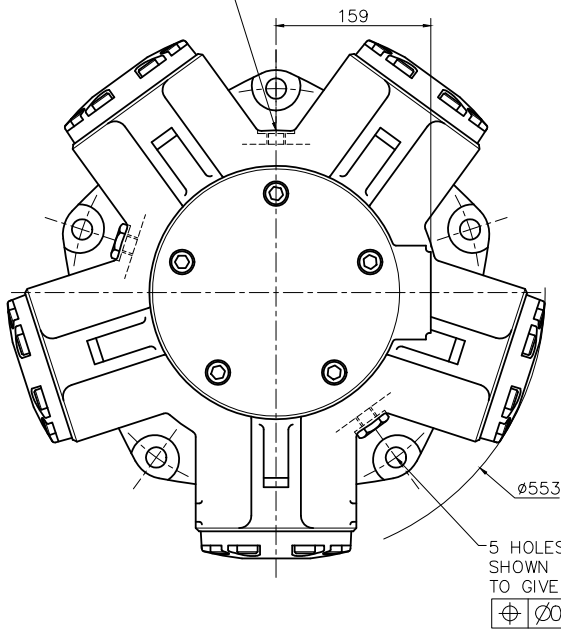(2 NORMALLY PLUGGED)

NOTE − ENSURE ON INSTALLATION THAT DRAIN
IS TAKEN FROM ABOVE MOTOR CENTRELINE.

DO NOT EXCEED 12 DEPTH OF COUPLING
IN TO DRAIN PORT.

159

∅553

5 HOLES ∅21 EQUI−SPACED AS
SHOWN ON A 419.1 PCD. SPOTFACED
TO GIVE AN EFFECTIVE ∅40
⊕ ∅0.15

REVERSE PORT CONNECTIONS
FOR OPPOSITE DIRECTION OF
SHAFT ROTATION

FLOW DIRECTION FOR
ALL VLV HSG VARIANTS
EXCEPT F2/FM2/SM3

∅260
∅254

SEE C−SPACERS

MOUNTING FACE

CLOCKWISE DIRECTION
OF ROTATION

∅380.95
∅380.87

∅473 MAX.

33   13

121   40.5
CENTRELINE
OF DRAINS

203.8   44.4 MAX
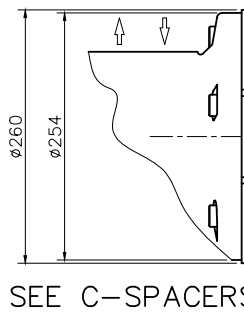
3-3 HPC200 Installation

◆ **3-3-1 HPC200** - 'P1', 'S3' & 'Z3' Shafts

MOUNTING FACE

'P1'

KEY SUPPLIED—
24.066/24.000 WIDE
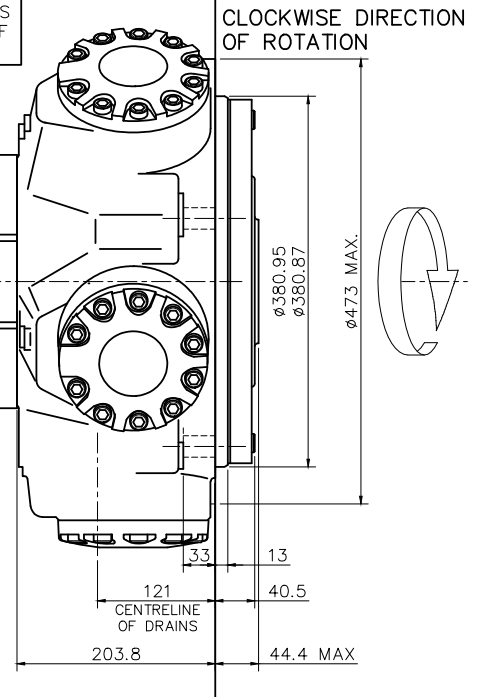16.05/16.00 THICK

89.9   3

3/4"—16 UNF—2B X 32
FULL THREAD DEPTH

⌀85.01
⌀84.99

97

77.0
76.9

131.5
129.9

'S3' & 'Z3'

SPLINE DATA

'S'
TO BS 3550 (ANSI B92.1, CLASS 5)
FLAT ROOT SIDE FIT, CLASS 1
PRESSURE ANGLE   30°
NUMBER OF TEETH   20
PITCH   6/12
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 W85 x 3 x 27 x 7h

76 MIN STRAIGHT

3/4"—16 UNF—2B X 32
FULL THREAD DEPTH

97

131.5
129.9

3-3 HPC200 Installation (cont)

◆ **3-3-2 HPC200** - 'T' Shaft

KEY SUPPLIED—
22.27/22.22 WIDE
15.92/15.87 THICK

'T'

M30 x 60 LG
HEX HEAD SCREW

BASIC TAPER, ON DIAMETER
0.1001/0.0999 PER mm

MOUNTING FACE

133.4 6.4
9.575
9.525
85.344
(DATUM) 12
61.8
60.6
172
⌀95

3-3 HPC200 Installation (cont)

◆ **3-3-3 HPC200** - 'SO3' & 'SO4' Valve Housings

VIEWS ON ARROW 'A'

'A'

MOUNTING FACE

SO3 —
3" VALVE HOUSING WITH
6—BOLT FLANGE

SUPPLIED WITH 2 'O' RING SEALS

129
60.3
PORT 2
2 PORTS ⌀28
PORT 1
44.4
70
76
84
10 50.8 50.8
R22
6 HOLES 3/8"—24
UNF—2B 16.0 DEEP.
364
439

SO4 —
4" VALVE HOUSING WITH
6—BOLT FLANGE

SUPPLIED WITH 2 'O' RING SEALS

138
50.8
20
PORT 2
PORT 1
44.4
2 PORTS ⌀32
81
84
R22
47.6 47.6
6 HOLES 3/8"—24
UNF—2B X 16 DEEP
371
489
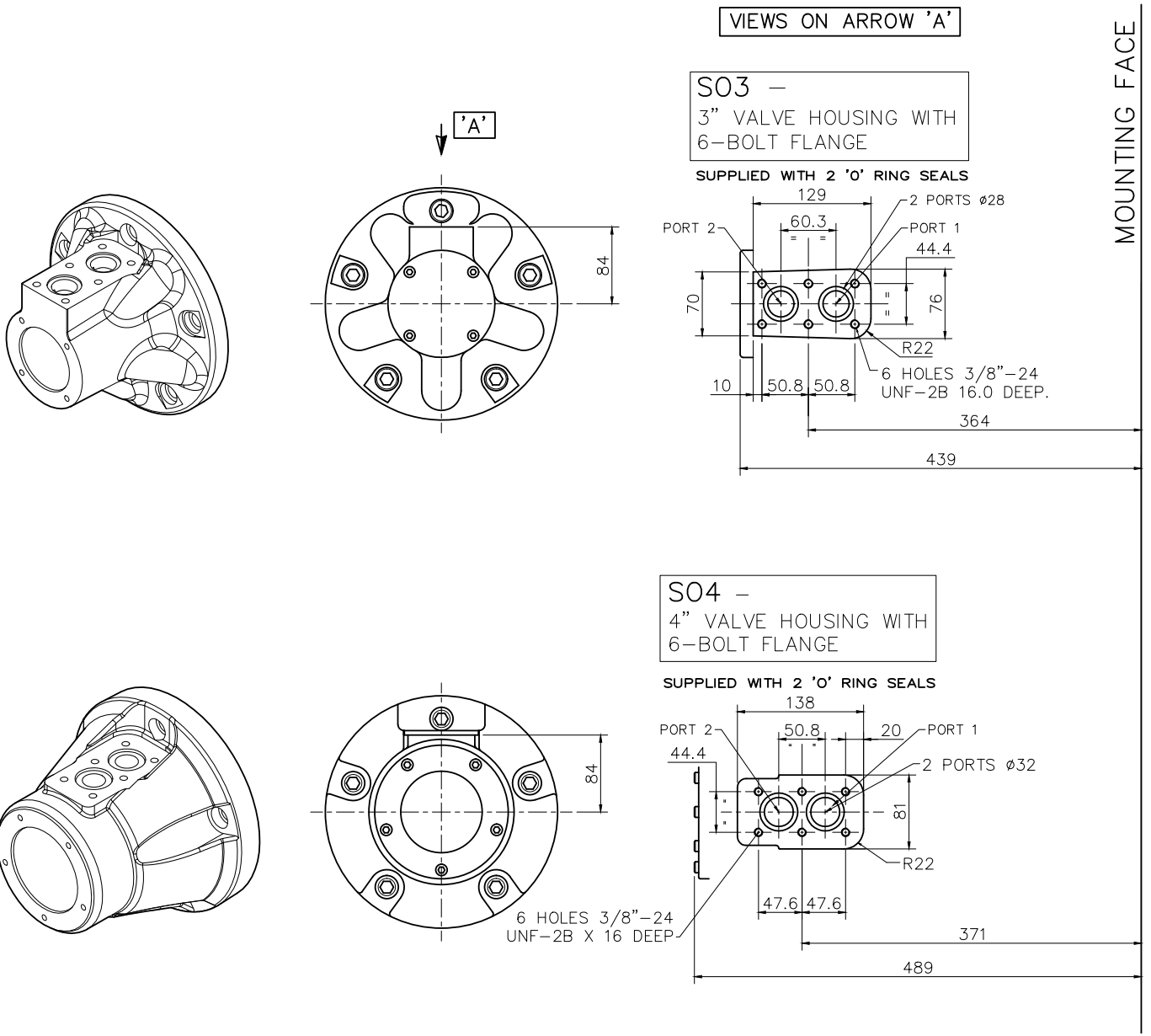
3-3 HPC200 Installation (cont)

◆ **3-3-4 HPC200** - 'F2', 'FM2', 'F3' & 'FM3' Valve Housings
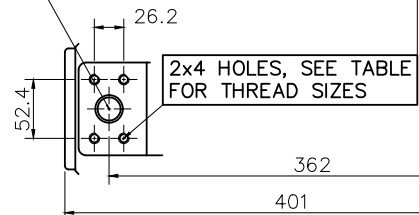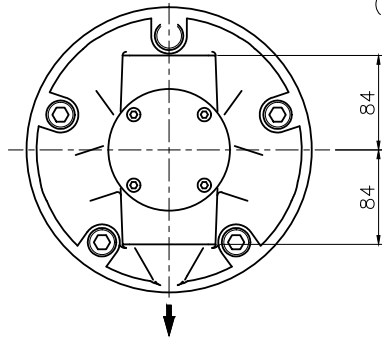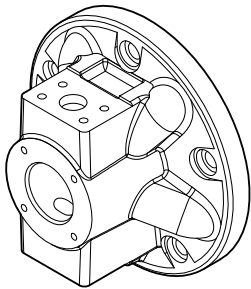
VIEWS ON ARROW 'A'

F2/FM2 —
2 1/4" VALVE HOUSING WITH
1" SAE 4—BOLT FLANGES

PORT FLANGE BOLT TAPPING SIZE —

| F2: 3/8"—16 UNC—2B X 22 FULL THREAD DEPTH |
| FM2: M10 X P1.5 X 22 FULL THREAD DEPTH |

'A'

FLOW DIRECTIONS FOR
SHAFT ROTATION SHOWN.
REVERSE FLOW DIRECTIONS
FOR OPPOSITE ROTATION.

1" CODE 61
S.A.E. PORTS
(2 POSITIONS)

26.2

2x4 HOLES, SEE TABLE
FOR THREAD SIZES

84

84

52.4

362

401

MOUNTING FACE

F3/FM3 —
3" VALVE HOUSING WITH
1 1/4" SAE 4—BOLT FLANGES

PORT FLANGE BOLT TAPPING SIZE —

| F3: 7/16"—14 UNC—2B X 27 FULL THREAD DEPTH |
| FM3: M12 X P1.75 X 27 FULL THREAD DEPTH |

1 1/4" CODE 61
S.A.E. PORTS
(3000 SERIES)

30.2

PORT 1

8 HOLES, SEE TABLE
FOR THREAD SIZES

87

58.7

58.7

37 37

37 37

PORT 2

30.2

46.5

346

438
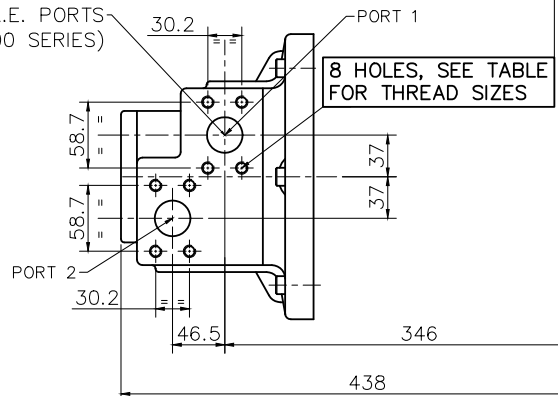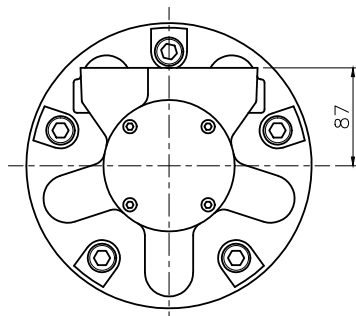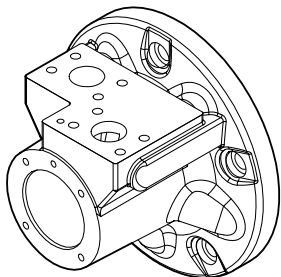
3-3 HPC200 Installation (cont)

◆ 3-3-5 HPC200 - 'F4' & 'FM4' Valve Housings

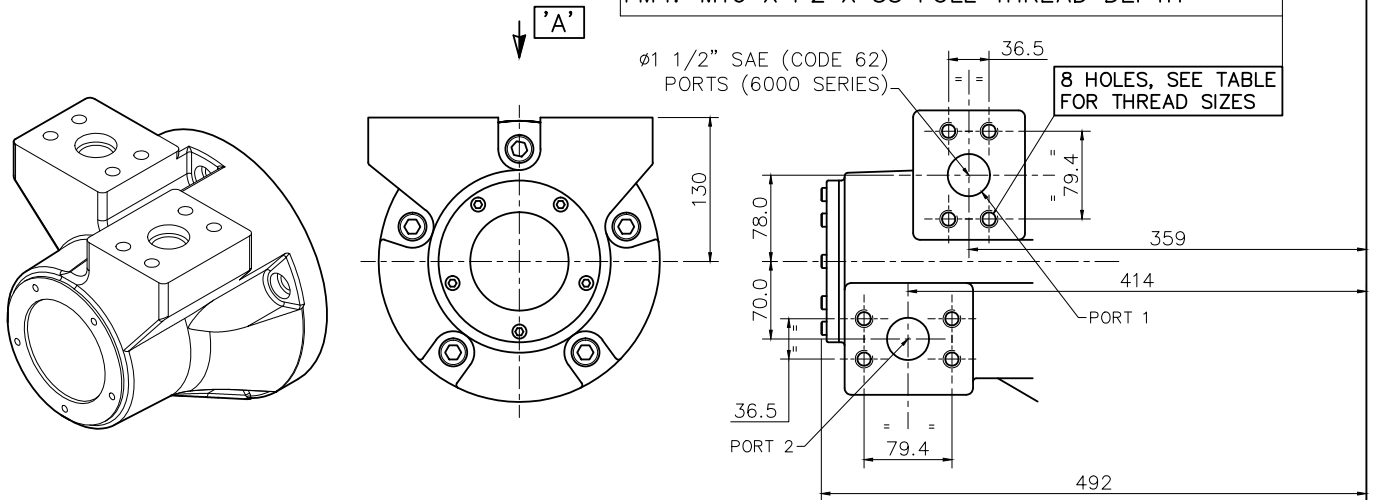VIEWS ON ARROW 'A'

F4/FM4 —
4" VALVE HOUSING WITH
1 1/2" SAE 4-BOLT FLANGES

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

ø1 1/2" SAE (CODE 62)
PORTS (6000 SERIES)

8 HOLES, SEE TABLE
FOR THREAD SIZES

36.5
79.4
130
78.0
70.0
359
414
PORT 1
36.5
PORT 2
79.4
492

MOUNTING FACE

3-3 HPC200 Installation (cont)

◆ 3-3-6 HPC200 - 'C', 'CS' & 'X' C Spacers

MOUNTING FACE

27.2   216.5

13.0

11.0

DISPLACEMENT SELECTION (VIA
REMOTELY LOCATED VALVE*)
HIGH DISPLACEMENT: P TO Y; X TO T
LOW DISPLACEMENT: P TO X; Y TO T
*DISPLACEMENT SELECTOR VALVE IS
NOT SUPPLIED WITH MOTOR; SPECIFY
& ORDER SEPARATELY

2 PORTS G1/4" (BSPF) X
15 FULL THREAD DEPTH

17.0

MOUNTING INTERFACE FOR DIRECTIONAL CONTROL
VALVE* TO: ISO 4401 SIZE 03/ANSI B93,7M SIZE D03
*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED
WITH MOTOR; SPECIFY & ORDER SEPARATELY

CONNECTION TO P PORT
G1/4" (BSPF) X 15
FULL THREAD DEPTH,
SUPPLIED PLUGGED.

11.7

DETAIL
SCALE 2:1

DISPLACEMENT SELECTION:
HIGH DISPLACEMENT: P TO B; A TO T
LOW DISPLACEMENT: P TO A; B TO T

4 HOLES
M5 X 12 DEEP

ø4.0 X 6 DEEP HOLE
FOR ORIENTATION PIN

520.0

TYPE X
DISPLACEMENT CONTROL

TYPES C, CS & C1
DISPLACEMENT CONTROL

CS TYPE SHUTTLE ON
F3 & FM3 ASSEMBLIES
ONLY

CS TYPE SHUTTLE
ENDCAP ON F4 & FM4
ASSEMBLIES ONLY

3-3 HPC200 Installation (cont)

◆ 3-3-7 HPC200 - Installation

3/4"–16UNF–2B DRAIN (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)

NOTE:– ENSURE ON INSTALLATION THAT DRAIN IS
TAKEN FROM ABOVE MOTOR CENTRELINE.

DO NOT EXCEED 12 DEPTH OF COUPLING
IN TO DRAIN PORT

159

⌀650

5 HOLES ⌀20 EQUI–SPACED AS
SHOWN ON A 419.1 PCD SPOTFACED
TO GIVE AN EFFECTIVE ⌀40

⊕ ⌀0.15

MOUNTING FACE

REVERSE PORT CONNECTIONS
FOR OPPOSITE DIRECTION OF
SHAFT ROTATION

FLOW DIRECTION FOR
ALL VLV HSG VARIANTS
EXCEPT F2/FM2/SM3

CLOCKWISE DIRECTION
OF ROTATION

⌀260
⌀254

⌀380.95
⌀380.87

⌀473 MAX.

SEE C–SPACERS

23
35   25
133   31
CENTRE LINE OF DRAINS
216.4

3-4 HPC270 Installation

◆ **3-4-1 HPC270** - 'P1', 'S3' & 'Z4' Shafts

MOUNTING FACE

KEY SUPPLIED —
24.066/24.000 WIDE
16.05/16.00 THICK

'P1'

3
140.2
77.01
76.94
⌀85.01
⌀84.99
3/4"−16 UNF−2B X 32
FULL THREAD DEPTH
149.2
189.4
187.7

'S3' & 'Z4'

76 MIN STRAIGHT
3/4"−16 UNF−2B X 32
FULL THREAD DEPTH
139.9
138.2

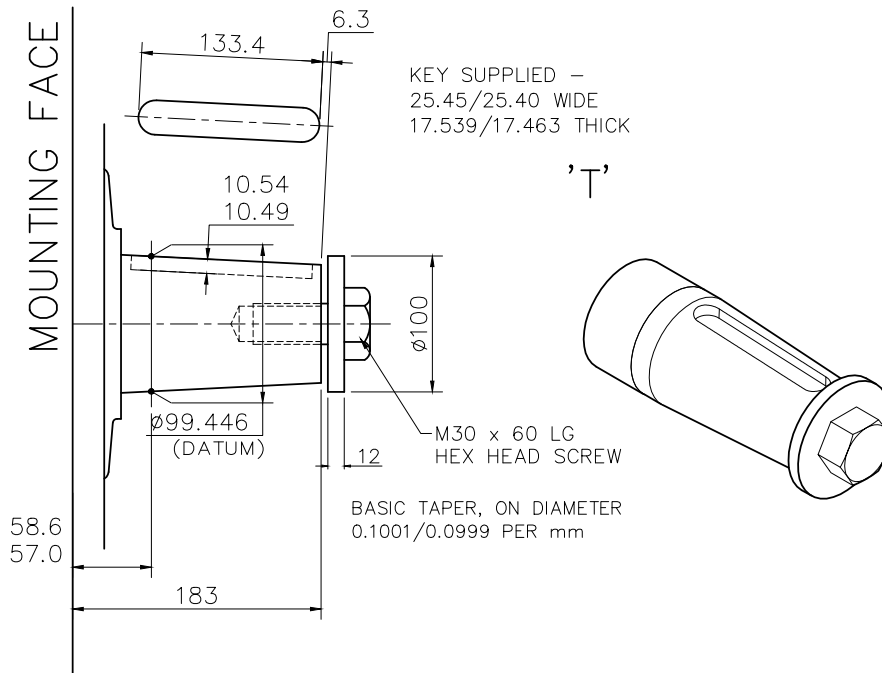SPLINE DATA

'S'
TO BS 3550 (ANSI B92.1, CLASS 5)
FLAT ROOT SIDE FIT, CLASS 1
PRESSURE ANGLE   30°
NUMBER OF TEETH   20
PITCH   6/12
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 W90 x 4 x 21 x 7h
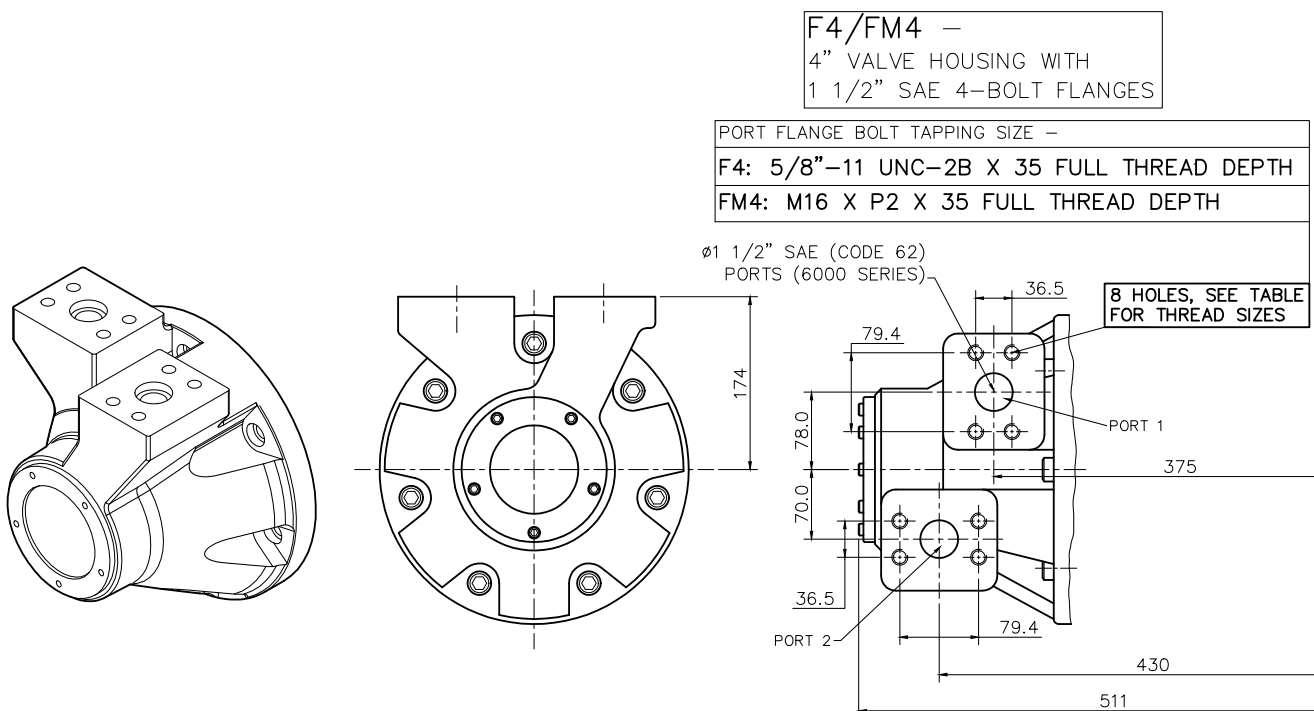
3-4 HPC270 Installation (cont)

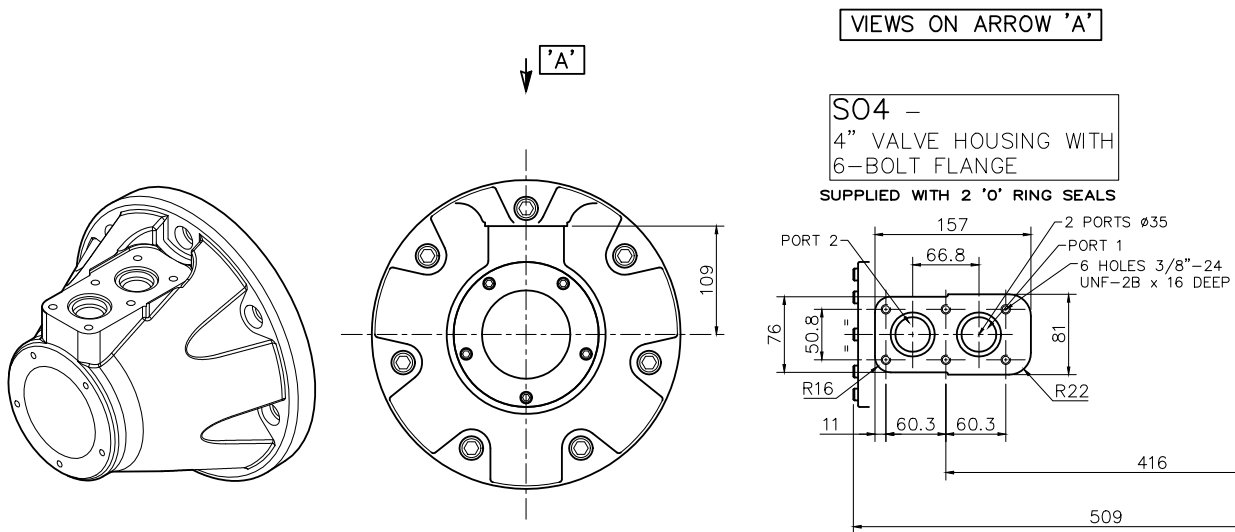◆ **3-4-2 HPC270** - 'T' Shaft

MOUNTING FACE

133.4

6.3

KEY SUPPLIED —
25.45/25.40 WIDE
17.539/17.463 THICK

'T'

10.54
10.49

Ø100

Ø99.446
(DATUM)

12

M30 x 60 LG
HEX HEAD SCREW

58.6
57.0

BASIC TAPER, ON DIAMETER
0.1001/0.0999 PER mm

183

3-4 HPC270 Installation (cont)

◆ **3-4-3 HPC270** - 'SO4', 'F4' & 'FM4' Valve Housings

MOUNTING FACE

'A'

VIEWS ON ARROW 'A'

SO4 –
4" VALVE HOUSING WITH
6–BOLT FLANGE
SUPPLIED WITH 2 'O' RING SEALS

109

157
66.8
PORT 2
2 PORTS ø35
PORT 1
6 HOLES 3/8"–24
UNF–2B x 16 DEEP
76
50.8
81
R16
R22
11
60.3
60.3
416
509

F4/FM4 –
4" VALVE HOUSING WITH
1 1/2" SAE 4–BOLT FLANGES

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

ø1 1/2" SAE (CODE 62)
PORTS (6000 SERIES)
36.5
8 HOLES, SEE TABLE
FOR THREAD SIZES
79.4
174
78.0
PORT 1
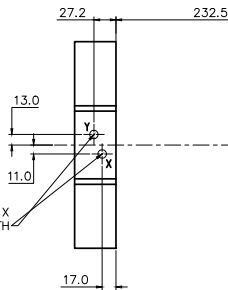375
70.0
36.5
79.4
PORT 2
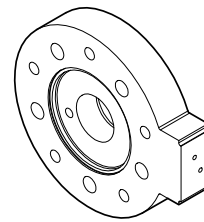430
511

3-4 HHPC270 Installation (cont)

◆ 3-4-4 HPC270 - 'C', 'CS' & 'X' C Spacers

MOUNTING FACE

DISPLACEMENT SELECTION (VIA
REMOTELY LOCATED VALVE*)
HIGH DISPLACEMENT: P TO Y; X TO T
LOW DISPLACEMENT: P TO X; Y TO T
*DISPLACEMENT SELECTOR VALVE IS
NOT SUPPLIED WITH MOTOR; SPECIFY
& ORDER SEPARATELY

2 PORTS G1/4" (BSPF) X
15 FULL THREAD DEPTH

27.2   232.5

13.0

11.0

17.0

TYPE X
DISPLACEMENT CONTROL

CONNECTION TO P PORT
G1/4" (BSPF) X 15
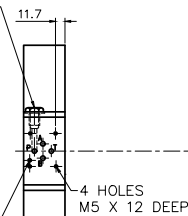FULL THREAD DEPTH,
SUPPLIED PLUGGED.

11.7

MOUNTING INTERFACE FOR DIRECTIONAL CONTROL
VALVE* TO: ISO 4401 SIZE 03/ANSI B93,7M SIZE D03
*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED
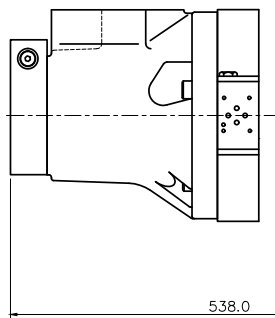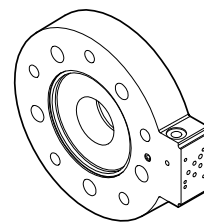WITH MOTOR; SPECIFY & ORDER SEPARATELY

DISPLACEMENT SELECTION:
HIGH DISPLACEMENT: P TO B; A TO T
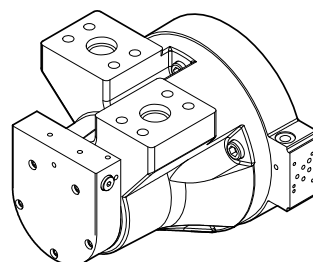LOW DISPLACEMENT: P TO A; B TO T

DETAIL
SCALE 2:1

P   T
B

Ø4.0 X 6 DEEP HOLE
FOR ORIENTATION PIN

4 HOLES
M5 X 12 DEEP

TYPES C, CS & C1
DISPLACEMENT CONTROL

538.0

CS TYPE SHUTTLE
ENDCAP ON F4 & FM4
ASSEMBLIES ONLY

3-4 HPC270 Installation (cont)

◆ 3-4-5 HPC270 - Installation

3/4"−16UNF−2B DRAIN (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)

NOTE:− ENSURE ON INSTALLATION THAT DRAIN IS
TAKEN FROM ABOVE MOTOR CENTRELINE.

DO NOT EXCEED 12 DEPTH OF COUPLING
IN TO DRAIN PORT

188

MOUNTING FACE

REVERSE PORT CONNECTIONS
FOR OPPOSITE DIRECTION OF
SHAFT ROTATION

CLOCKWISE DIRECTION
OF ROTATION

FLOW DIRECTION FOR
ALL VLV HSG VARIANTS

ø311

ø457.15
ø457.07

ø570
MAX

ø711 O/DIA

SEE C−SPACERS

7 HOLES ø20. EQUI−SPACED AS
SHOWN ON A 520.7 PCD.
SPOTFACE TO GIVE EFFECTIVE ø40
⌖ ø0.15

23

33

35 36

140
CENTRE LINE OF DRAINS
232.4
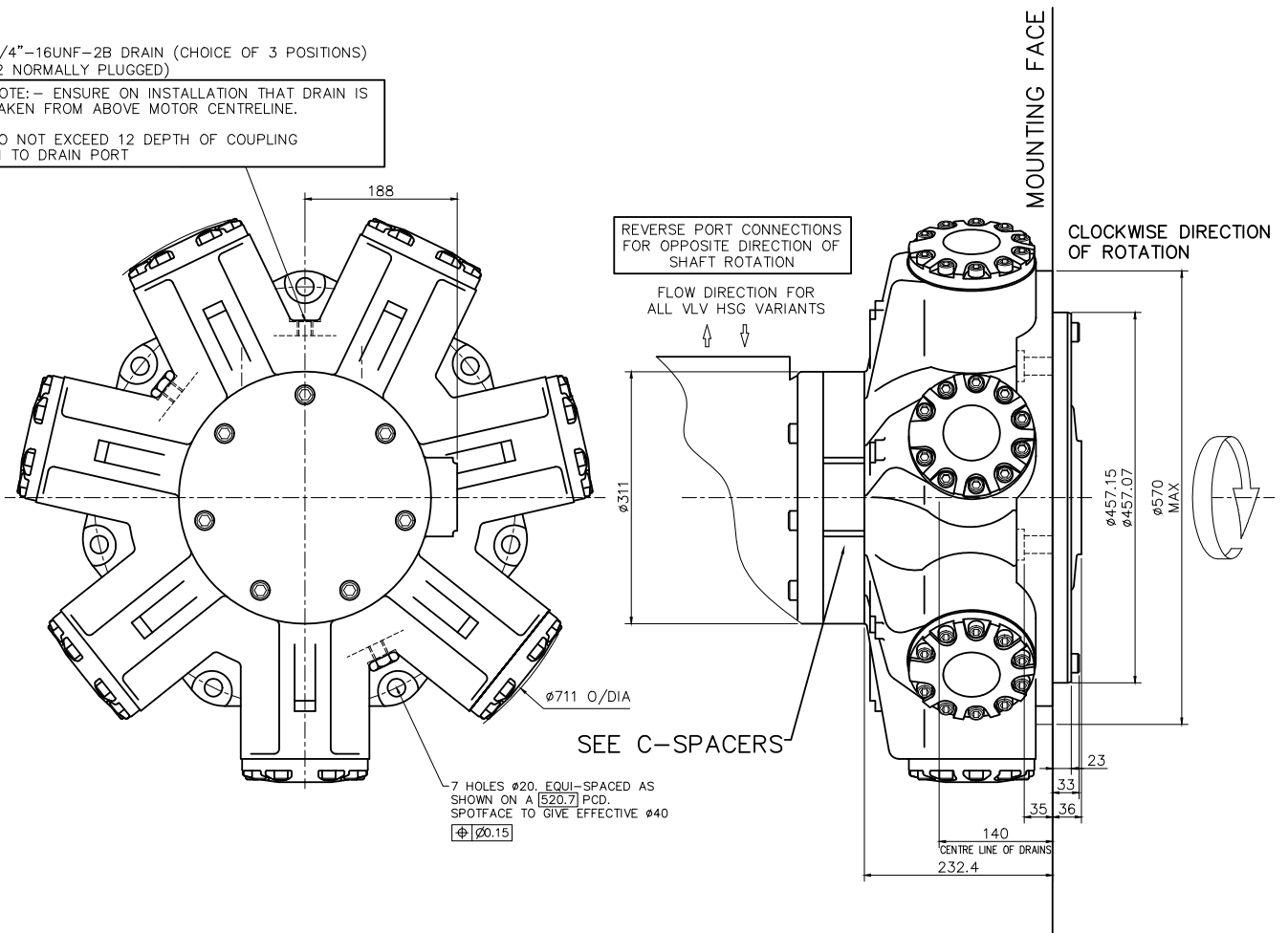
3-5 HPC325 Installation

◆ **3-5-1 HPC325** - 'P1', 'S3' & 'Z4' Shafts

MOUNTING FACE

KEY SUPPLIED —
24.066/24.000 WIDE
16.05/16.00 THICK

'P1'

140.2

3

77.01
76.94

⌀85.01
⌀84.99

3/4"—16 UNF—2B X 32
FULL THREAD DEPTH

149.2

189.4
187.7

'S3' & 'Z4'

SPLINE DATA

'S'
TO BS 3550 (ANSI B92.1, CLASS 5)
FLAT ROOT SIDE FIT, CLASS 1
PRESSURE ANGLE   30°
NUMBER OF TEETH   20
PITCH   6/12
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 W90 x 4 x 21 x 7h

76 MIN STRAIGHT

3/4"—16 UNF—2B X 32
FULL THREAD DEPTH

139.9
138.2

3-5 HPC325 Installation (cont)

◆ 3-5-2 HPC325 - 'T' Shaft

MOUNTING FACE

133.4

6.3

KEY SUPPLIED —
25.45/25.40 WIDE
17.539/17.463 THICK

'T'

10.54
10.49

ø100

ø99.446
(DATUM)

M30 x 60 LG
HEX HEAD SCREW

12

BASIC TAPER, ON DIAMETER
0.1001/0.0999 PER mm

58.6
57.0

183
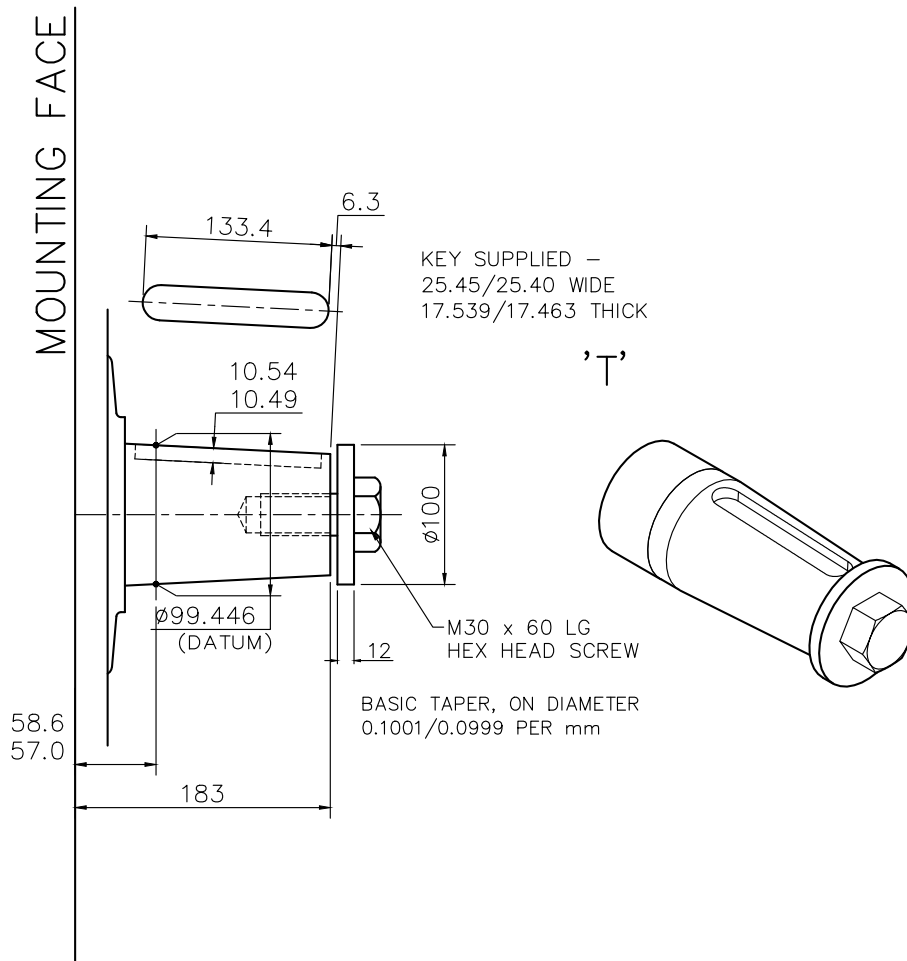
3-5 HPC325 Installation (cont)

◆ **3-5-3 HPC325** - 'SO4', 'F4' & 'FM4' Valve Housings

MOUNTING FACE

'A'

VIEWS ON ARROW 'A'

SO4 –
4" VALVE HOUSING WITH
6–BOLT FLANGE

SUPPLIED WITH 2 'O' RING SEALS

109

PORT 2
157
66.8
2 PORTS ø35
PORT 1
6 HOLES 3/8"–24
UNF–2B x 16 DEEP
76
50.8
81
R16
R22
11
60.3 60.3
416
509

F4/FM4 –
4" VALVE HOUSING WITH
1 1/2" SAE 4–BOLT FLANGES

PORT FLANGE BOLT TAPPING SIZE –

F4: 5/8"–11 UNC–2B X 35 FULL THREAD DEPTH

FM4: M16 X P2 X 35 FULL THREAD DEPTH

ø1 1/2" SAE (CODE 62)
PORTS (6000 SERIES)

36.5
8 HOLES, SEE TABLE
FOR THREAD SIZES
79.4
174
78.0
PORT 1
70.0
375
36.5
79.4
PORT 2
430
511

3-5 HPC325 Installation (cont)

◆ 3-5-4 HPC325 - 'C', 'CS' & 'X' C Spacers

MOUNTING FACE

27.2   232.5

13.0

11.0

DISPLACEMENT SELECTION (VIA
REMOTELY LOCATED VALVE*)
HIGH DISPLACEMENT: P TO Y; X TO T
LOW DISPLACEMENT: P TO X; Y TO T
*DISPLACEMENT SELECTOR VALVE IS
NOT SUPPLIED WITH MOTOR; SPECIFY
& ORDER SEPARATELY

2 PORTS G1/4" (BSPF) X
15 FULL THREAD DEPTH

17.0

CONNECTION TO P PORT
G1/4" (BSPF) X 15
FULL THREAD DEPTH,
SUPPLIED PLUGGED.

11.7

MOUNTING INTERFACE FOR DIRECTIONAL CONTROL
VALVE* TO: ISO 4401 SIZE 03/ANSI B93,7M SIZE D03
*DISPLACEMENT SELECTOR VALVE IS NOT SUPPLIED
WITH MOTOR; SPECIFY & ORDER SEPARATELY

DETAIL
SCALE 2:1

DISPLACEMENT SELECTION:
HIGH DISPLACEMENT: P TO B; A TO T
LOW DISPLACEMENT: P TO A; B TO T

A
P   T
B

4 HOLES
M5 X 12 DEEP

ø4.0 X 6 DEEP HOLE
FOR ORIENTATION PIN

538.0

TYPE X
DISPLACEMENT CONTROL

TYPES C, CS & C1
DISPLACEMENT CONTROL

CS TYPE SHUTTLE
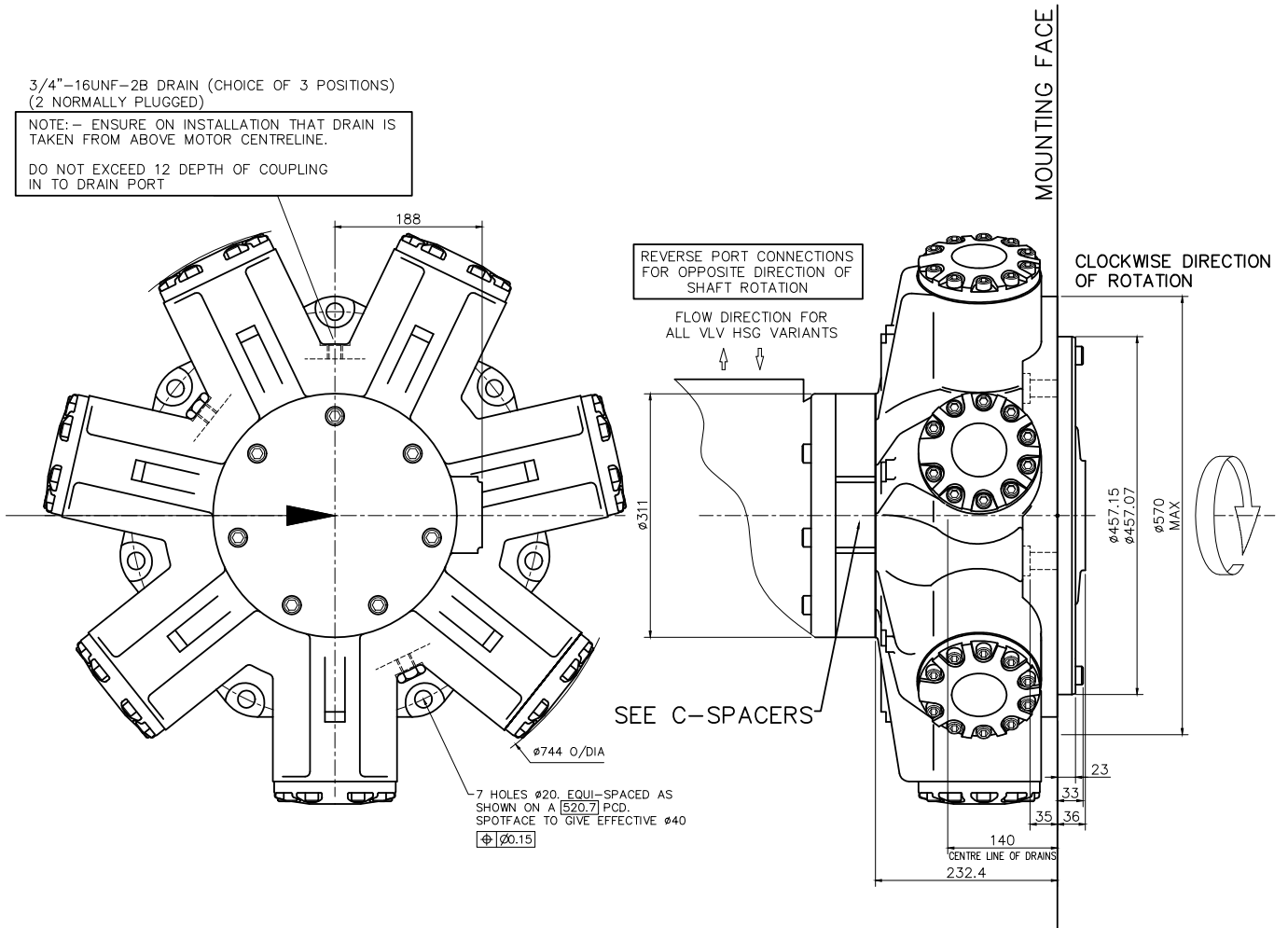ENDCAP ON F4 & FM4
ASSEMBLIES ONLY

3-5 HPC325 Installation (cont)

◆ 3-5-5 HPC325 - Installation

3/4"–16UNF–2B DRAIN (CHOICE OF 3 POSITIONS)
(2 NORMALLY PLUGGED)

NOTE:– ENSURE ON INSTALLATION THAT DRAIN IS
TAKEN FROM ABOVE MOTOR CENTRELINE.

DO NOT EXCEED 12 DEPTH OF COUPLING
IN TO DRAIN PORT

188

ø744 O/DIA

7 HOLES ø20. EQUI–SPACED AS
SHOWN ON A 520.7 PCD.
SPOTFACE TO GIVE EFFECTIVE ø40
⊕ Ø0.15

REVERSE PORT CONNECTIONS
FOR OPPOSITE DIRECTION OF
SHAFT ROTATION

FLOW DIRECTION FOR
ALL VLV HSG VARIANTS

ø311

SEE C–SPACERS

MOUNTING FACE

CLOCKWISE DIRECTION
OF ROTATION

ø457.15
ø457.07
ø570 MAX

23
33
35 36

140
CENTRE LINE OF DRAINS
232.4

3-6 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.
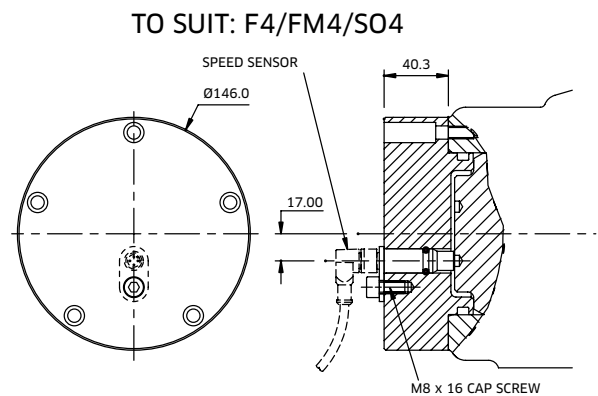
Signal Outputs: Square wave plus directional signal
Power Supply: 8 to 32 V @ 40 mA
Protection class: IP68
Output frequency: 16 pulses/revolution

Installation Details

TO SUIT: F3/FM3/SO3   'Ţj'   TO SUIT: F4/FM4/SO4
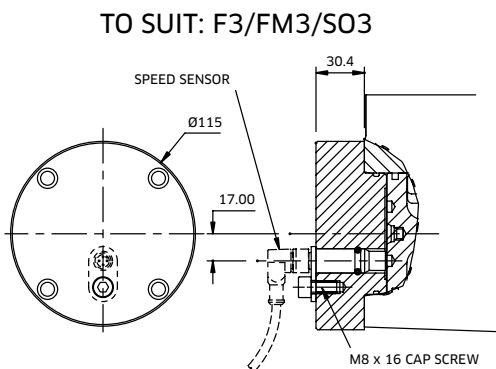
Tk Output Module

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.

1 +V, BROWN
2 SIGNAL 2, BLACK
3 SIGNAL 1/D, WHITE
4 GND, BLUE
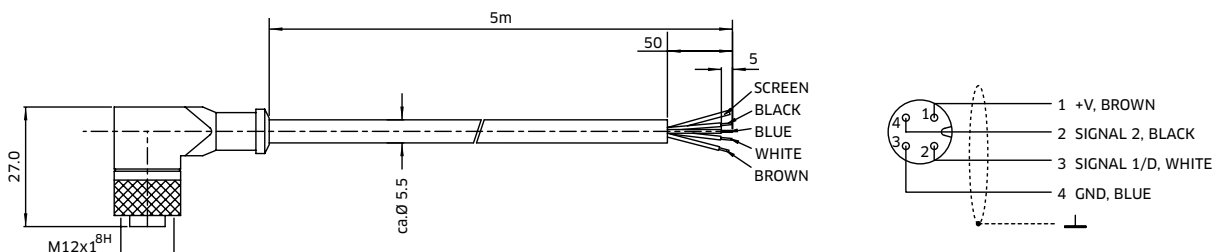
NOTES

NOTES

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**The specified data is for product description purposes only
and may not be deemed to be guaranteed unless expressly
confirmed in the contract.**

Data sheet: M-2003/09.14