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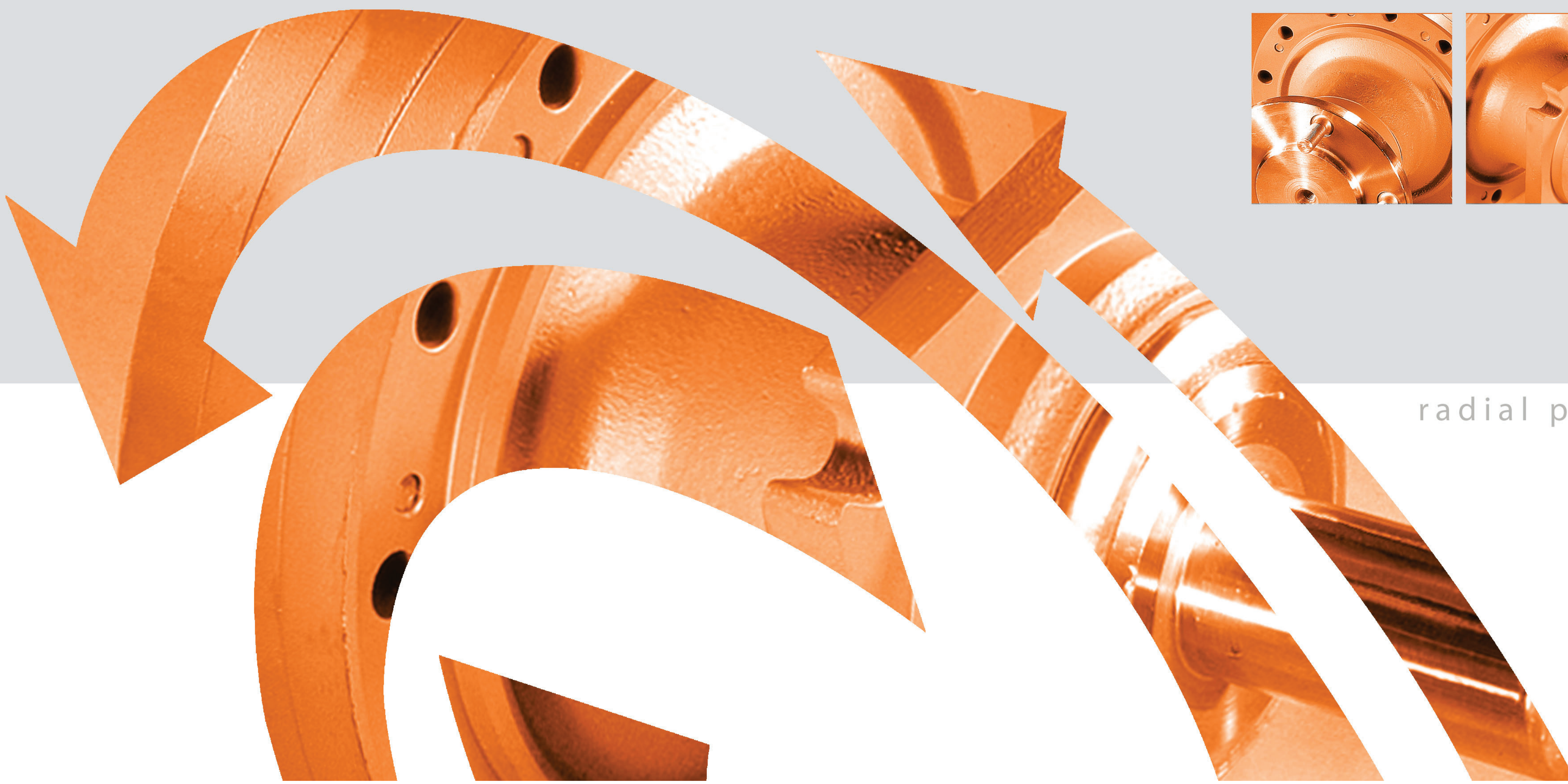
Issue 01
April 2012

XF10



XF | RANGE

radial piston motors

ROTARY POWER has over 40 years experience in the design and development of high quality Hydraulic equipment.

Our current product range includes :-

"A" Axial Piston Thruster Motors purpose designed for R.O.V applications. Fixed and variable capacities from 11.5 to 125 cm3/rev.

"C" Axial Piston Pumps for high accuracy fluid metering with precision flow controls and high-pressure capability. Specifically designed for the Polyurethane Industry. Capacities from 3 to 62 cm3/rev.

"XL" Cam Motors of radial piston configuration. Wheel/shaft/torque module configurations. Design offers high-speed capability. Capacities from 150 to 1120 cm3/rev.

"XF" Cam Motors of radial piston configuration. NEW generation design, developed from the proven technology of the "XL" but with a smaller envelope, radial ports & more displacement.

"XK" Cam Motors radial piston configuration offering static/dynamic brakes, single/2 speed, wheel/shaft & torque-module mount options. Heavy-Duty External Load & High-Speed options. Capacities from 1000 to 5000 cm3/rev.

"SMA" Motors heavy-duty radial piston/eccentric configuration, offering excellent life. Withstands high mechanical and hydraulic shock loads. 350bar Continuous pressure rating. Speed & power ratings significantly greater than standard HTLS motors. Displacements from 150 to 10500 cm3/rev.

Wholly owned subsidiaries in the USA and Germany and a network of distributors throughout the world provide product support in most countries.

ROTARY POWER is a company within British Engines (UK) Ltd group, which was established over 50 years ago.

The British Engines group of companies design manufacture and market a wide range of engineered products for offshore, electrical, construction, engineering and other industries, employing nearly 700 people on a 4600 sq m site in Newcastle upon Tyne, England.

XF FEATURES

Modular Concept

- Common torque unit with shaft or wheel motor housings

Pintle Design

- No axial bearing thrust support required

High Pressure Rating

- Designed to operate up to 420bar peak pressure

High Start Output Torque

- Pintle valve reduces mechanical losses

High Reliability

- Few moving parts

Low Maintenance

- Sealed/lubricated bearings in shaft and wheel motors

High Radial Load Capacity

- Heavy duty tapered roller bearings as standard

Freewheel

- True (zero displacement) available

Fully Reversible

- Equal torque in both rotation directions

Compact

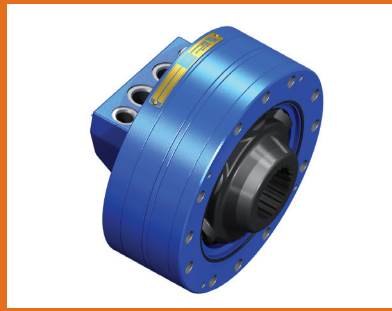
- High power to weight ratio and minimum overall dimensions

XF STANDARD OPTIONS

- Speed sensor
- SAE or "G" ports
- Axial ports
- Viton seals

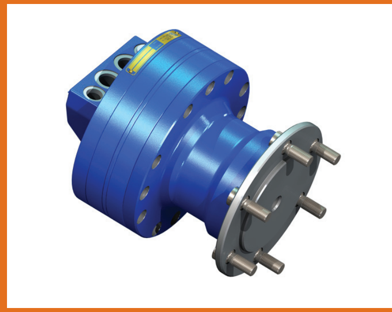
Customised solutions are available - Please consult Rotary Power

XF COMPACT PISTON MOTORS



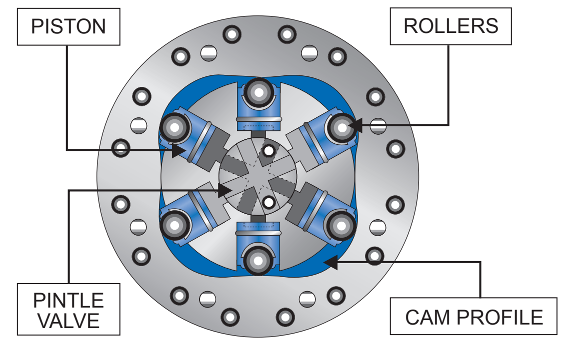
TORQUE UNIT

SHAFT MOTOR



WHEEL MOTOR

XF MOTOR OPERATION



Oil is fed under pressure through the valve and into the cylinders. The pistons attempt to move outwards. The rollers react on the incline of the cam profile and this action produces rotation of the cylinder block.

Each piston completes four strokes per revolution of the motor. The symmetrical arrangement balances hydraulic forces, eliminating the need for bearings.

TECHNICAL DATA

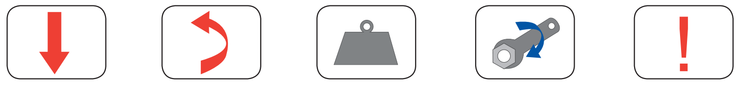
Displacement Code	A	B	C	D	E	F	G	-
Displacement Nominal	780	880	980	1050	1120	1240	1360	cc
Displacement Actual	785.4	885.8	986.2	1051.7	1117.2	1239.5	1361.8	cc
Theoretical Torque at 100 bar	1250	1410	1570	1674	1778	1973	2168	NM
Max Speed	320	285	255	240	225	205	188	rpm
Max Freewheel Speed	850	850	850	850	850	850	850	rpm
Max Power	100							kW
Max Main Port Pressure*	420							bar
Max Case Port Pressure	7							bar
Min Viscosity	15							cSt
Max Viscosity	2000							cSt
Optimum Viscosity Operating Range	35 to 200							cSt
Fluid Type Min Requirements	HL; HLP to DIN 51524							
Fluid Cleanliness	NAS 1638 Class 9 ISO Code 18/15							
Min Fluid Operating Temperature	-30 *(Nitrile)*; -20 *(Viton)*							°C
Max Fluid Operating Temperature	+80							°C
Optimum Temperature Range	+40 to +70							°C

*Peak; Max 1% of every 1 duty cycle minute (Typical Relief Valve pressure spike)

GENERAL NOTES ON FOLLOWING TECHNICAL DATA

- All dimensions are in mm.
- General dimension tolerances; +/- 0.25mm
- Material specifications provided are for guidance & should only be used to support end-user's finalised design.
- Motor performance data is provided to assist in the optimum selection of displacement & frame size. However, where system pump maximum capacity is close to full utilisation, actual flow & case leakage measurements should be obtained, under worst-case operating conditions.
- All tightening torques given are based on the safe motor operation at the specified external load envelope & maximum output torque. Screws are assumed to be un-lubricated & exhibiting a friction coefficient (Torque /Induced Tensile Load x Nominal Diameter)in the range 0.19 – 0.25 {Screw Grades are minimum requirements}

Symbols;



Motor inlet flow direction — Motor shaft rotation direction — Dry weight — Screw tightening torque (unlubricated) — Care warning

ORDER CODE

digits	1,2,3,4	5	6,7	8	9	10	11	12,13	14,15
	XF10	D	S2	A	1	N	0	AA	02

CC/REV (digit 5)

A	780cc
B	880cc
C	980cc
D	1050cc
E	1120cc
F	1240cc
G	1360cc

FRONT HOUSING STYLE (digits 6,7)

N0	Torque unit	No front housing
S0	Shaft	Metric splined shaft
S1		Metric keyed shaft
S2		ANSI splined shaft
W0	Wheel Flange	Flange with clearance holes
W1		Flange with threaded mounting holes
W2		Flange fitted with studs
W3		Flange fitted with studs + nuts

REAR HOUSING STYLE/PORTS (digit 8)

Standard mount	A	Radial SAE O-ring ports
	B	Radial 'G' ports
	C	Axial SAE O-ring ports
	D	Axial 'G' ports
Steering pivot mounting #	R	Radial SAE O-ring ports
	S	TBA
	T	TBA
	U	TBA

Consult Rotary Power for details

REAR HOUSING OPTIONS (digit 9)

0	None
1	Rear mounted speed sensor facility
2	Oversized drain ports ##
3	Options 1+2 combined

Axial ports only

SEALS (digit 10)

N	Nitrile
V	Viton

GENERAL OPTIONS (digit 11)

0	Standard
1	Shaft-up air vent port

SPECIAL CODES (consult RP) (digits 12,13)

AA	Standard

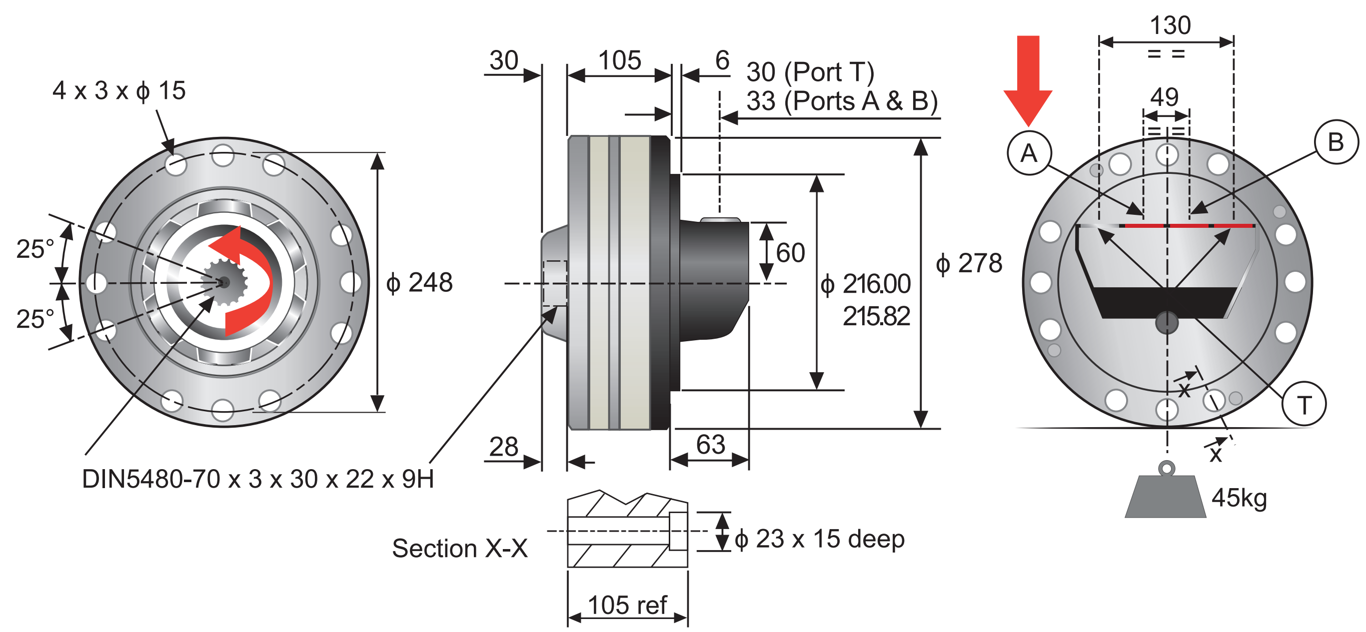
DESIGN SERIES (digits 14,15)

02	Factory specified

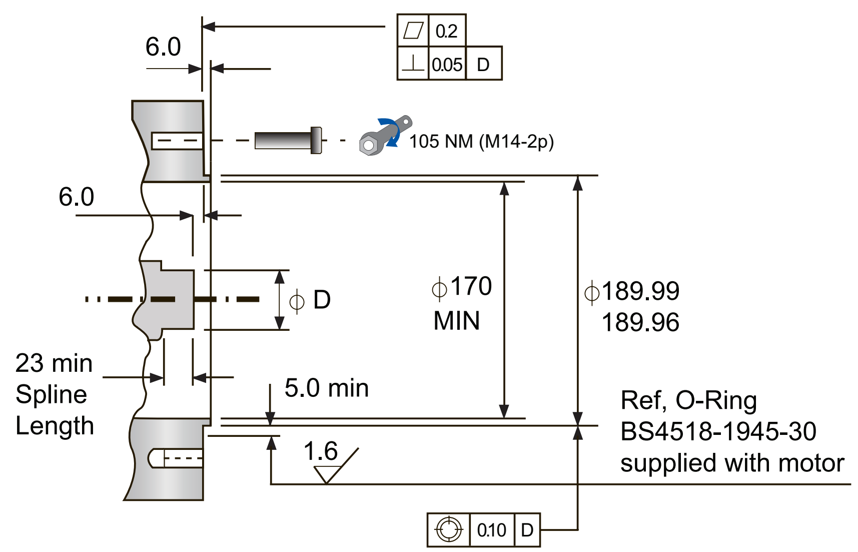
EXAMPLE SHOWN;

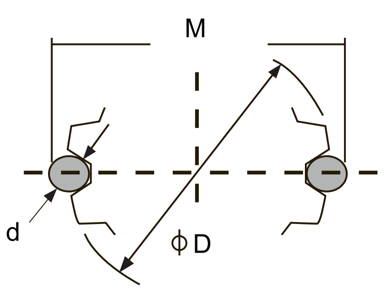
XF10-D-S2-A-1-N-0-AA-02
1050cc
ANSI splined shaft
Standard mount
Radial SAE O-ring ports
Rear mounted speed sensor facility
Nitrile seals

TORQUE UNIT (XF10*N0A0*0AA**)



CUSTOMER MOUNTING





N = Number of Teeth

DIN 5480-W70x3x30x22 (non-standard tooth thickness)	M	D	d	N
Max	75.698	68.50	6.0	22
Min	75.621	68.40		

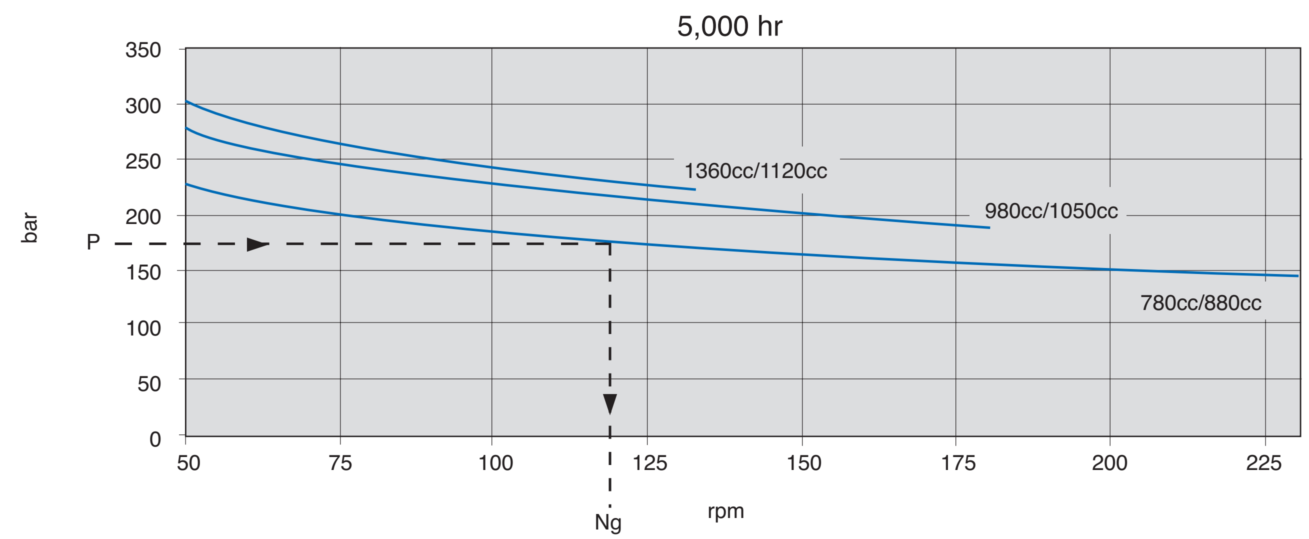
Shaft Material; BS970 -709M40 or equivalent - hardened to achieve Rm = 775 - 925 N/mm2

Housing Material; Rm ≥ 320 N/mm2 (fixing screw thread engagement of 20mm minimum is assumed)

XF10 RADIAL PISTON MOTORS

TORQUE UNIT

L10 LIFE



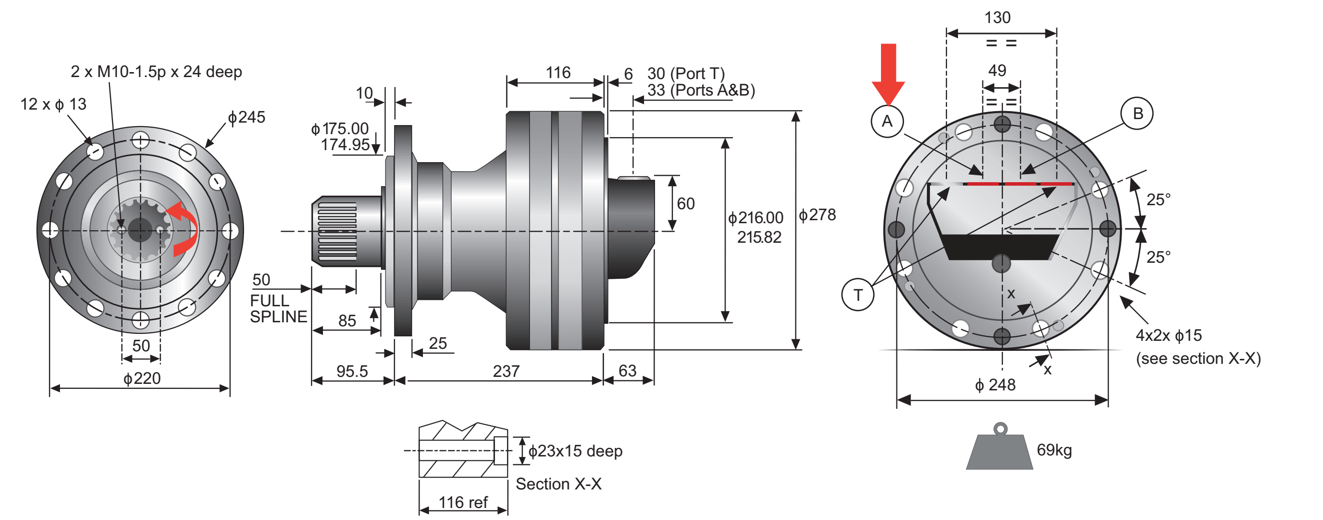
L10 values predict that 90% of a given population of motors will meet or exceed this life. Actual life will be dependent on oil viscosity, temperature and oil cleanliness together with application factors. For optimum life, oil viscosity should be in the “optimum” range specified on page 3. Consult RP, for motor applications where low speeds form a significant part of the duty cycle. For max weighted ΔP > 150bar consult RP –see duty cycle pg.12

For a given pressure P [bar] & speed N [rpm];
Ng[rpm] = Graph speed, for given cam displacement & pressure P.
New L10 [hr]= Graph Hours x Ng / N

Example;
For 780cc motor, Pressure P = 175bar & speed N = 200 rpm;
From graph, using the 780cc line @ 175bar; Ng = 120 rpm
Thus; L10 = 5,000 x 120/200 = 3,000 hr

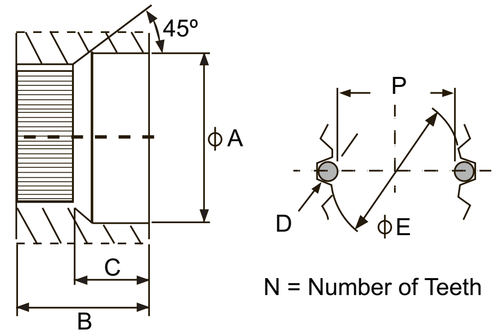
SHAFT MOTOR

SHAFT MOTOR SPLINED



METRIC SPLINE (XF10*S0A0*0AA**)							
DIN 5480-N80x3x30x25x9H	P	E	d	N	A	B	C
Max	69.099	74.19	5.25	25	80.0	84	35
Min	69.010	74.00					

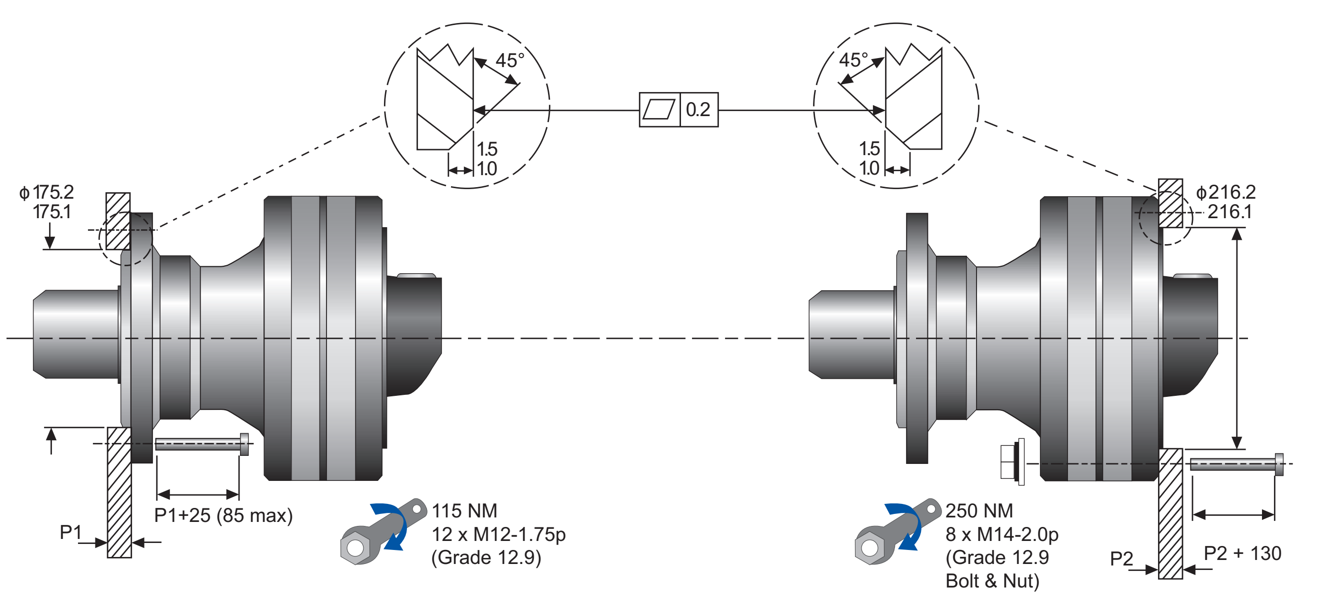
ANSI SPLINE (XF10*S2A0*0AA**)							
ANSI B92.1 Flat Root, Side Fit 8/16 Pitch, Class 5, 30° PA	P	E	d	N	A	B	C
Max	68.415	73.15	5.49	24	80.0	84	35
Min	68.341	73.03					



N = Number of Teeth

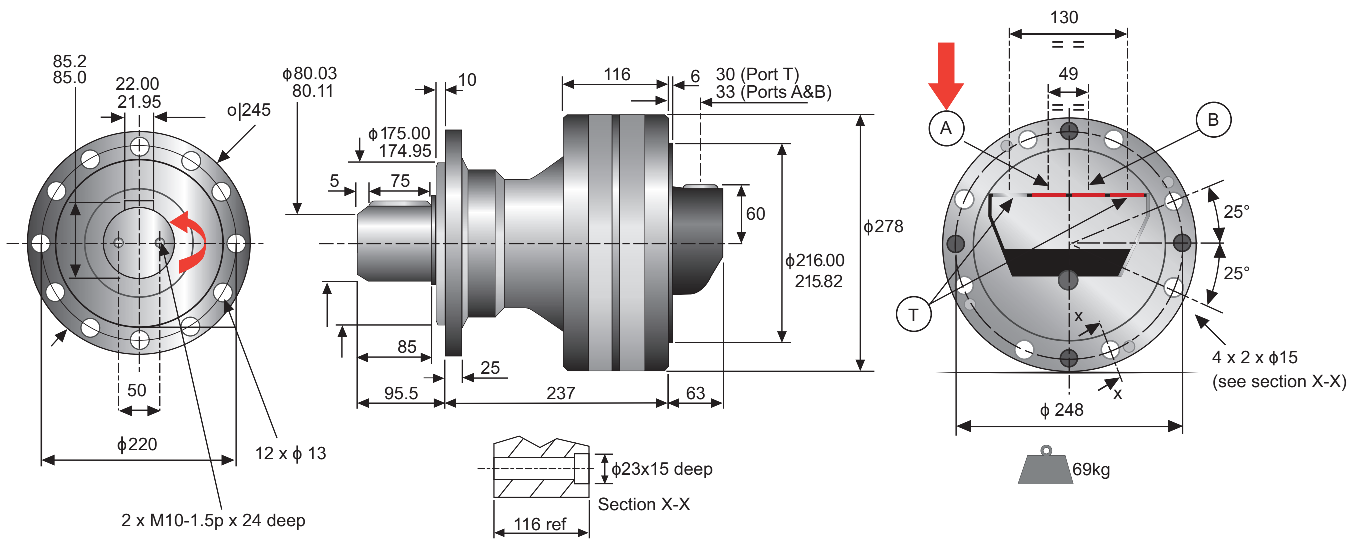
Material; BS970 -709M40 or equivalent - hardened to achieve Rm = 775 - 925 N/mm²

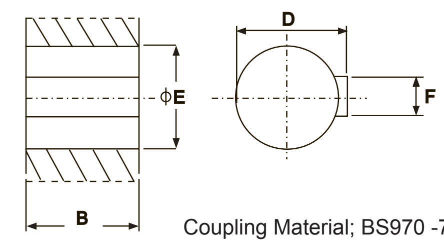
SHAFT MOTOR - FRAME MOUNTING OPTIONS



SHAFT MOTOR

SHAFT MOTOR KEYED (XF10*S1A0*0AA**)





	E #	B	D	F
Max	80.080	84	86.0	22.12
Min	80.030		85.7	22.05

This clearance fit is only suitable for motoring ΔP < 150bar. Use interference fit for motoring ΔP > 150bar, to prevent yield of key material

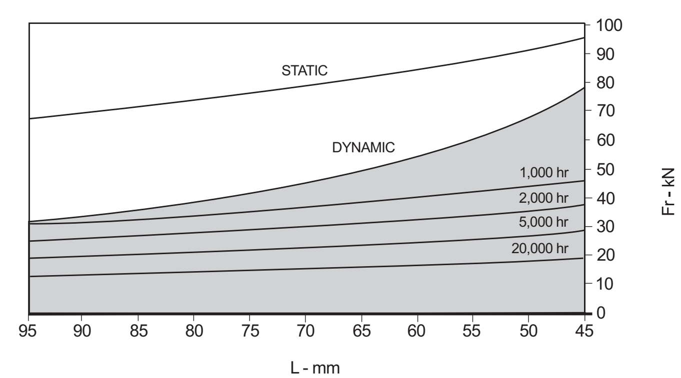
Coupling Material; BS970 -709M40 or equivalent - hardened to achieve Rm = 775 - 925 N/mm2

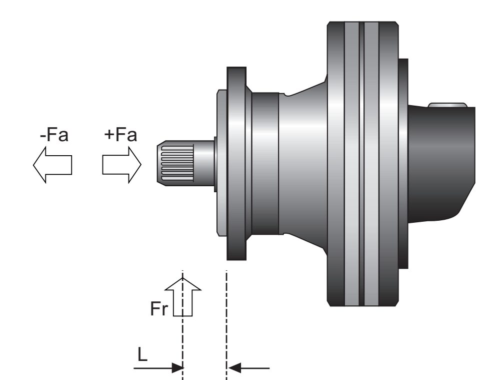
SHAFT MOTOR - EXTERNAL RADIAL LOADS

Maximum Static Axial Load Fa = +/- 52kN (Fr = 0)

Consult Rotary Power, for applications combining radial & axial dynamic loads.

Radial Load Limits & L10 Life;

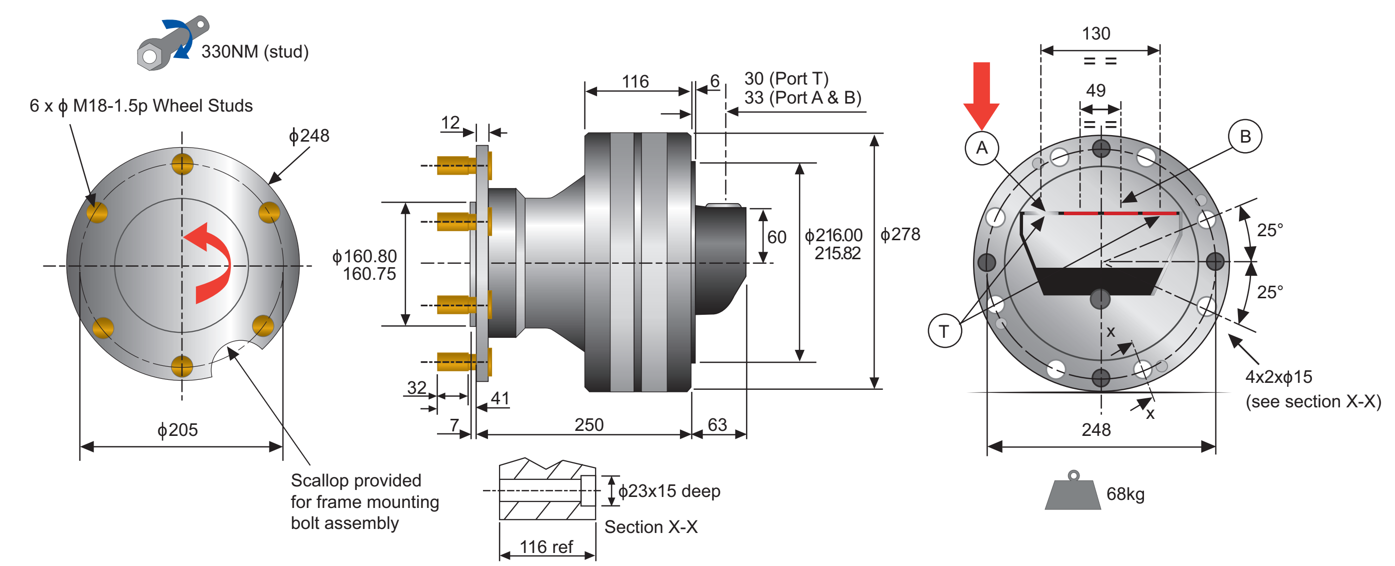




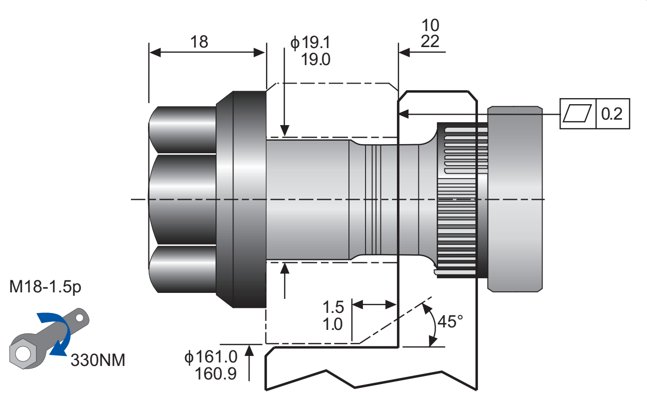
L10 values predict that 90% of a given population of motors will meet or exceed this life.
Actual life will be dependent on oil viscosity, temperature and oil cleanliness together with application factors.
Graph shows motor bearing housing taper roller bearing L10 data @ 100rpm* & ISOVG 37 oil @ 40C (38cSt)
(*L10 hours@ N rpm; multiply "Graph L10" by ratio "100rpm/N rpm")
Pressure has no direct effect on the L10 data shown (see also Torque Unit L10)
Graph Max Dynamic loads assume ΔP = 150 bar (max weighted motor rating)
For ΔP > 150 bar consult RP. (See duty cycle pg.12)

WHEEL MOTOR

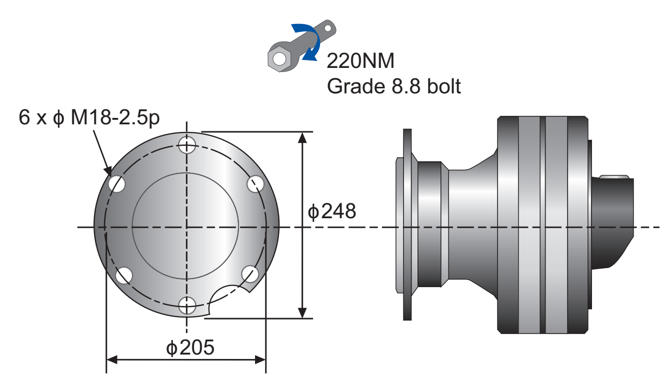
WHEEL STUDS (XF10*W2*0*0AA*)



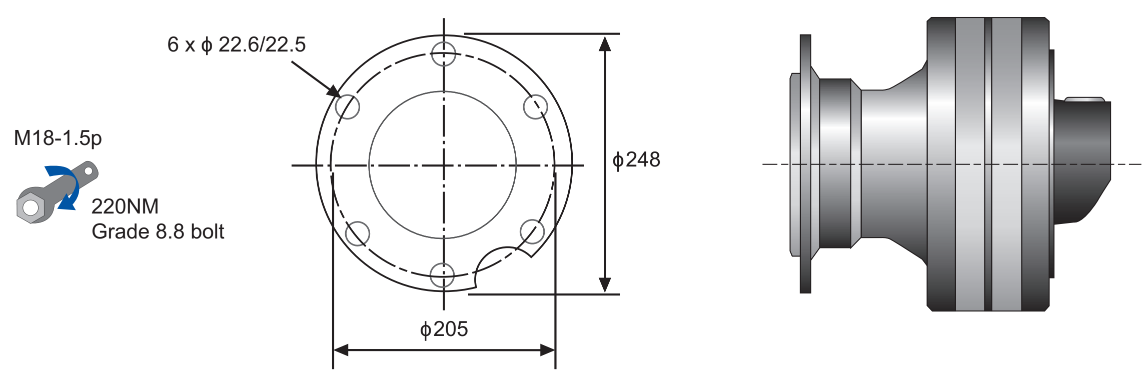
WHEEL STUDS WITH NUTS - XF10*W3*0*0AA**



THREADED MOUNTING HOLES - XF10*W1*0*AA*

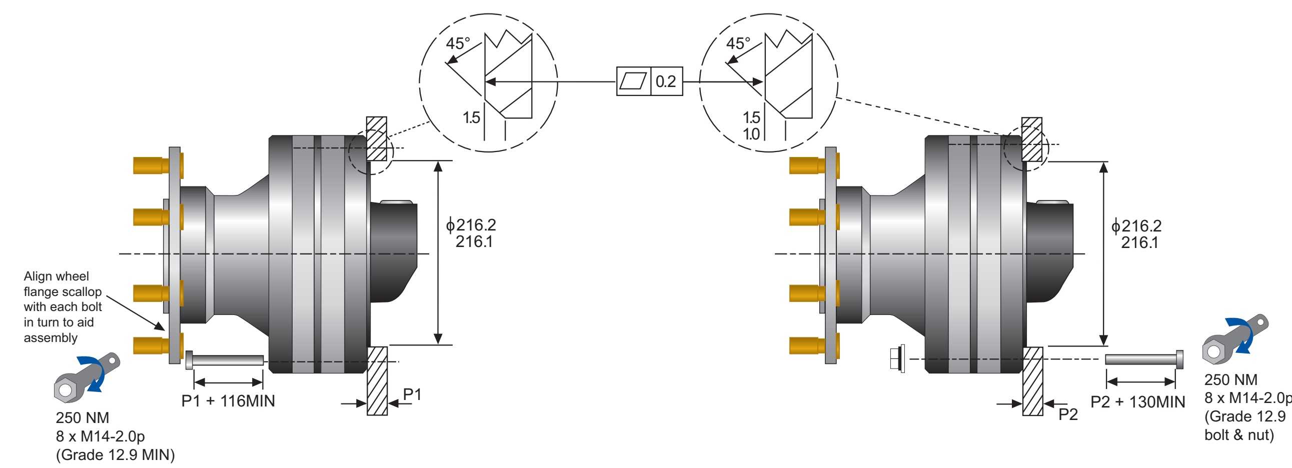


CLEARANCE MOUNTING HOLES - XF10*W0*0*0AA



WHEEL MOTOR

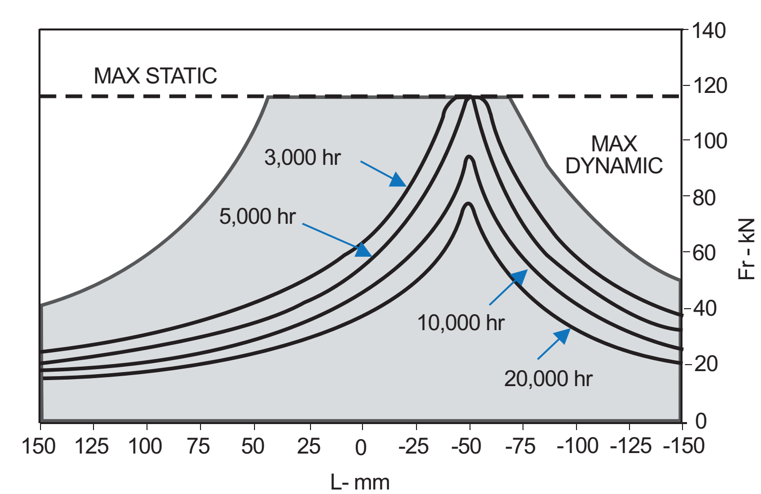
WHEEL MOTOR FRAME MOUNTING OPTIONS

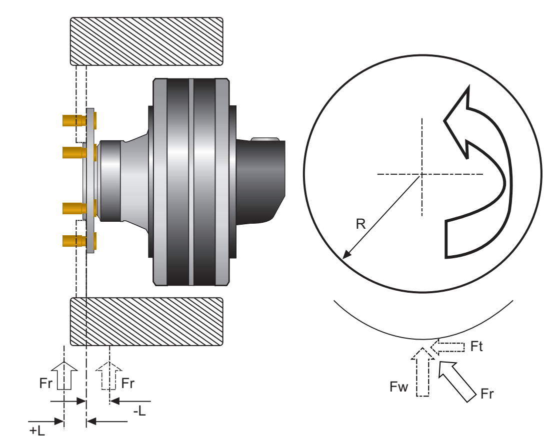


EXTERNAL RADIAL LOADS & L10 LIFE

Consult Rotary Power, for applications combining radial & axial loads.

Radial Load Limits & L10 Life;



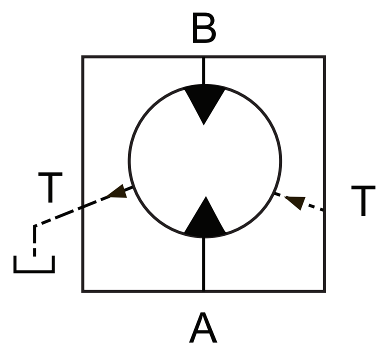


Graph data @ 100rpm*, 20bar back pressure & ISOVG 37 oil @ 40C (38cSt)
(*L10 hours@ N rpm; multiply "Graph L10" by ratio "100rpm/N rpm")
Pressure has no direct effect on the L10 data shown (see also Torque Unit L10)
Graph Max Dynamic loads assume ΔP = 150 bar (max weighted motor rating)
For ΔP > 150 bar consult RP
Fr= $\sqrt{(Ft^2 + Fw^2)}$ where; Ft [kN]= Motor Torque [kN.M]/R[M] & Fw = Wheel Vertical Load[kN]

(Motor torque may be derived from "Torque Output" graphs on page 15, once the actual pressure differential at the motor ports is determined)

HYDRAULIC CONNECTIONS

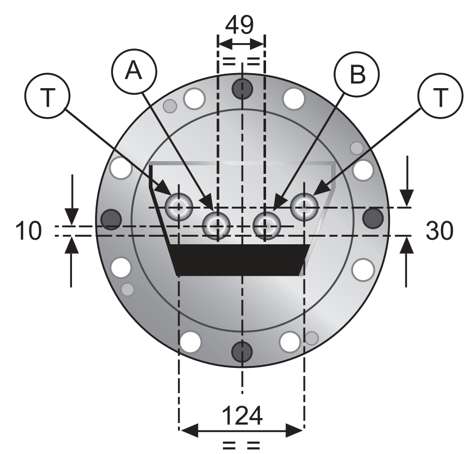
STANDARD PORTS



MOTOR CODE	PORTS "A" & "B"	PORT "T"
XF10***A0*0AA**	3/4" SAE J514 (1 1/16" - 12 UNF)	5/8" SAE J514 (7/8" - 14 UNF)
XF10***A1*0AA**		
XF10***B0*0AA**	ISO228/1 G 3/4"	ISO228/1 G 1/2"
XF10***B1*0AA**		

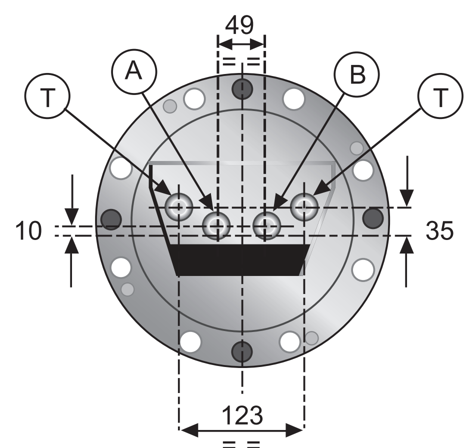
AXIAL PORTS

MOTOR CODE	PORTS "A" & "B"	PORT "T"
XF10***C0*0AA**	3/4" SAE J514 (1 1/16" - 12 UNF)	5/8" SAE J514 (7/8" - 14 UNF)
XF10***C1*0AA**		
XF10***D0*0AA**	ISO228/1 G 3/4"	ISO228/1 G 1/2"
XF10***D1*0AA**		



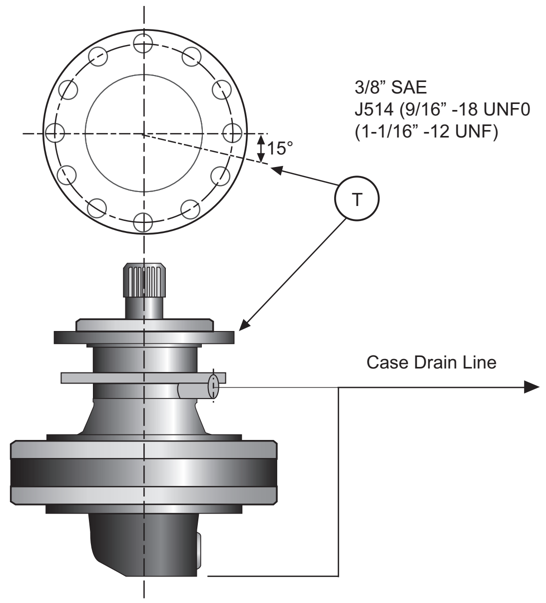
OVERSIZE DRAIN PORTS (AXIAL PORTS ONLY)

MOTOR CODE	PORTS "A" & "B"	PORT "T"
XF10***C2*0AA**	3/4" SAE J514 (1 1/16" - 12 UNF)	3/4" SAE J514 (1 1/16" - 12 UNF)
XF10***C3*0AA**		
XF10***D2*0AA**	ISO228/1 G 3/4"	ISO228/1 G 3/4"
XF10***D3*0AA**		



OPTIONS

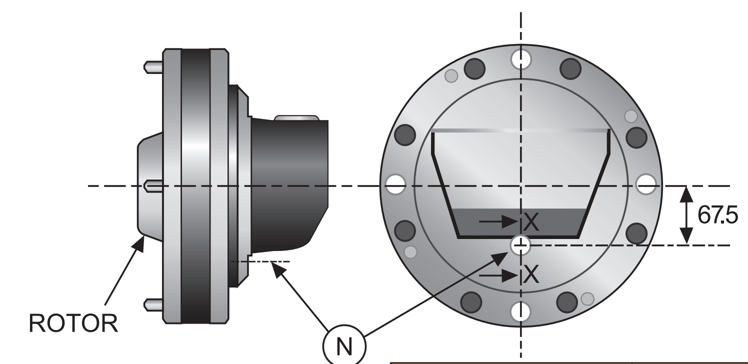
SHAFT-UP AIR VENT PORT (XF10******1AA**)



! Ensure drain line routing prevents air traps forming

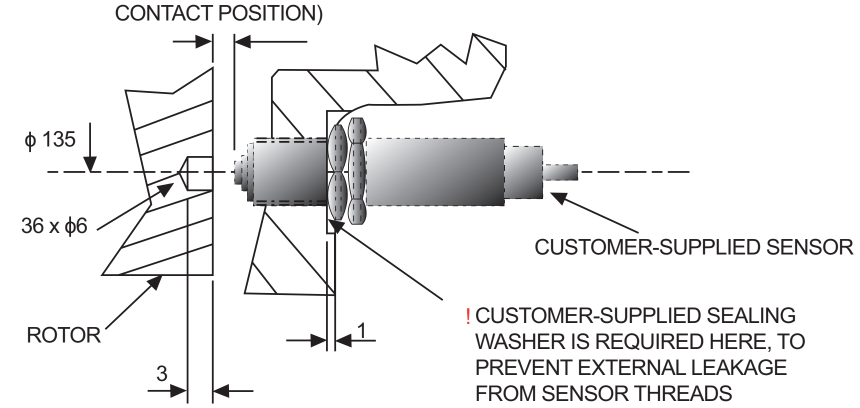
SPEED SENSOR

! PRIOR TO ADJUSTING THE SPEED SENSOR ENSURE THE ROTOR IS POSITIONED TOWARDS THE PORTS. THIS CAN BE ACHIEVED BY STANDING THE MOTOR VERTICALLY, WITH THE PORTS ALONG THE BOTTOM.



MOTOR CODE	PORT "N"
XF10****1*0AA**	M12-1.0p
XF10****3*0AA**	

MAINTAIN 0.5 GAP!
(0.5 COUNTER-CLOCKWISE ROTATION FROM SENSOR CONTACT POSITION)

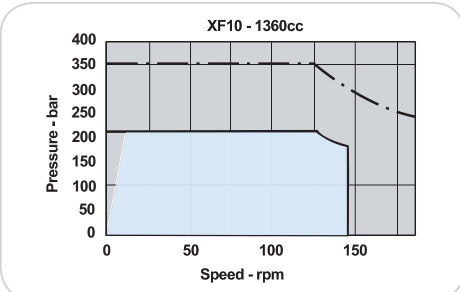


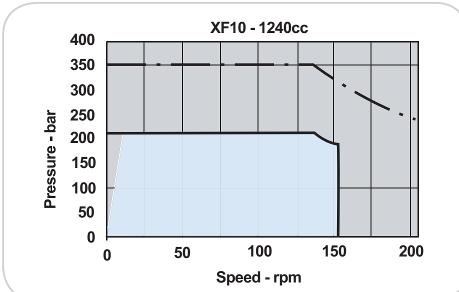
! CUSTOMER-SUPPLIED SEALING WASHER IS REQUIRED HERE, TO PREVENT EXTERNAL LEAKAGE FROM SENSOR THREADS

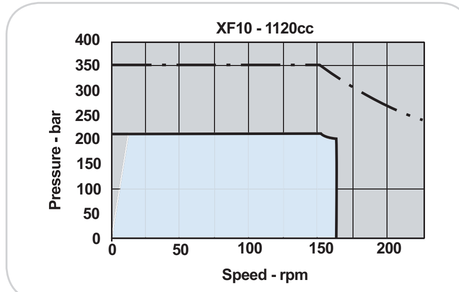
SECTION X-X

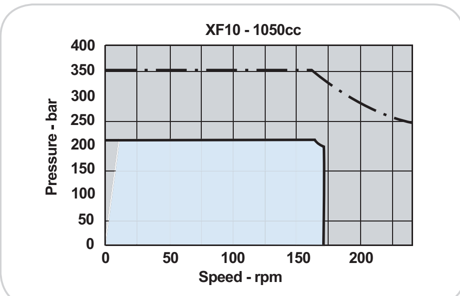
PERFORMANCE

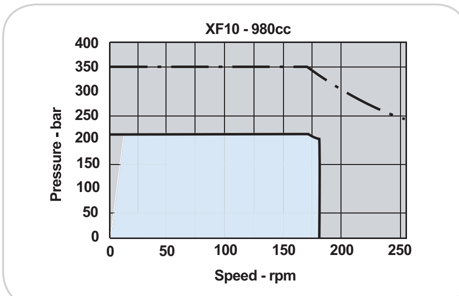
POWER ENVELOPES

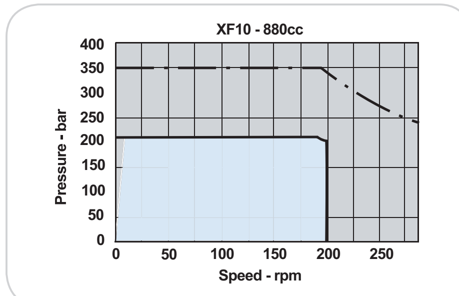


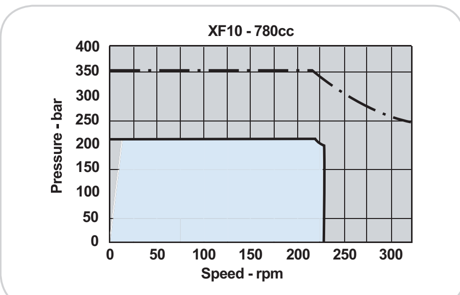


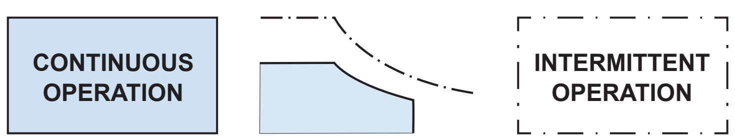












For optimum motor life, operation should be limited to the “Continuous Operation” envelope of the above graphs. Intermittent operation may occur for 10% of every minute, as part of a known duty cycle. Maximum Intermittent Pressure would typically be the Relief Valve setting, for mobile applications. For operation with sustained periods >10% of every minute outside the “Continuous Operation” envelope, consult RP.

DUTY CYCLE

Pressure (weighted) Maximum = 150bar - **Example;**

TIME (%)	SPEED (rpm)	PRESSURE (bar)
5	50	210
70	200	80
25	100	160

TIME (%)	SPEED (rpm)	REVOLUTIONS IN 10,000 HOUR LIFE #	%N REVOLUTIONS #	p(10/3) x %N
5	50	1.5 x 10°	1.5%	825,700
70	200	84 x 10°	83.5%	1,842,128
25	100	15 x 10°	15%	3,335,476
	Σ	**100.5 x 10°**	**100%**	**6,003,304**

#Example;
50rpm x 60 = 3,000 revolutions/hr
5% of 10,000hr = 500hr
Thus;
Revolutions = 500 x 3,000 = 1.5 million

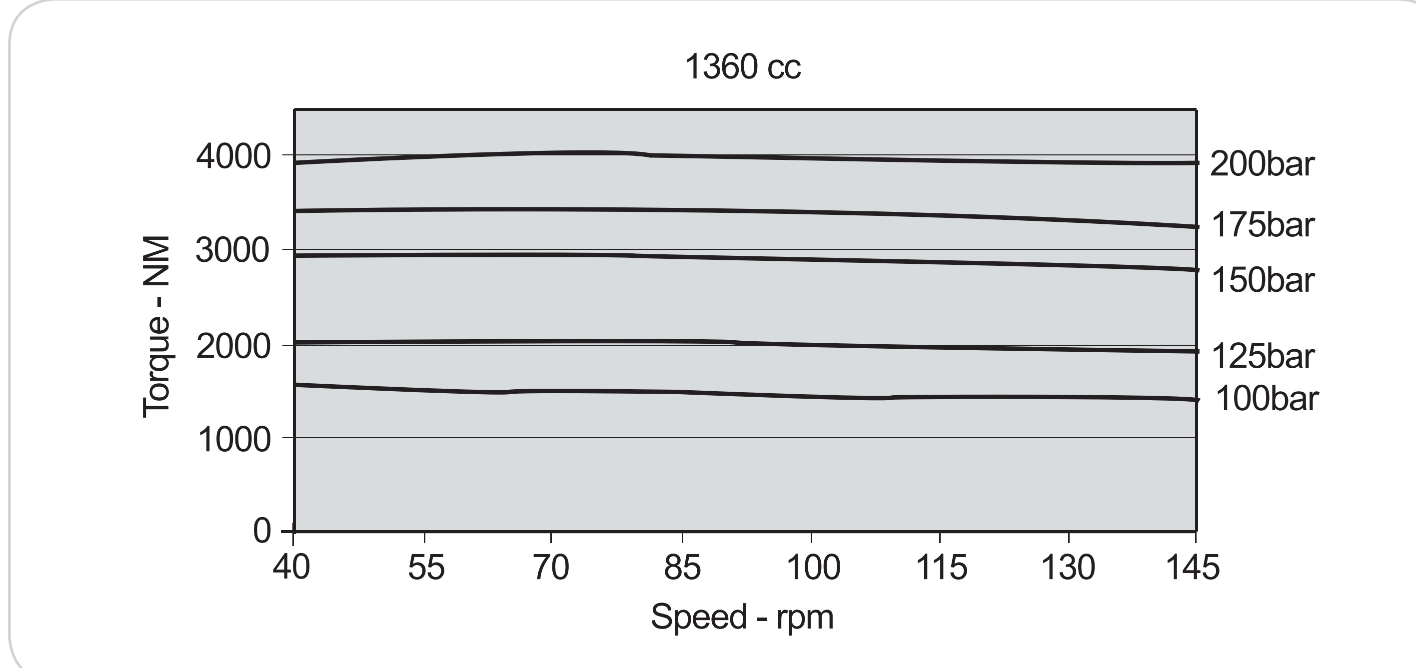
Total Revolutions in 10,000 hr = 100.5 million
Thus;
% Revolutions in 10,000 hr
@ 50rpm/210bar = 1.5/100.5 = 1.5%

P (weighted) = $(6,003,304)^{0.3}$ = 108 bar

! If P (weighted) > 150bar, consult RP

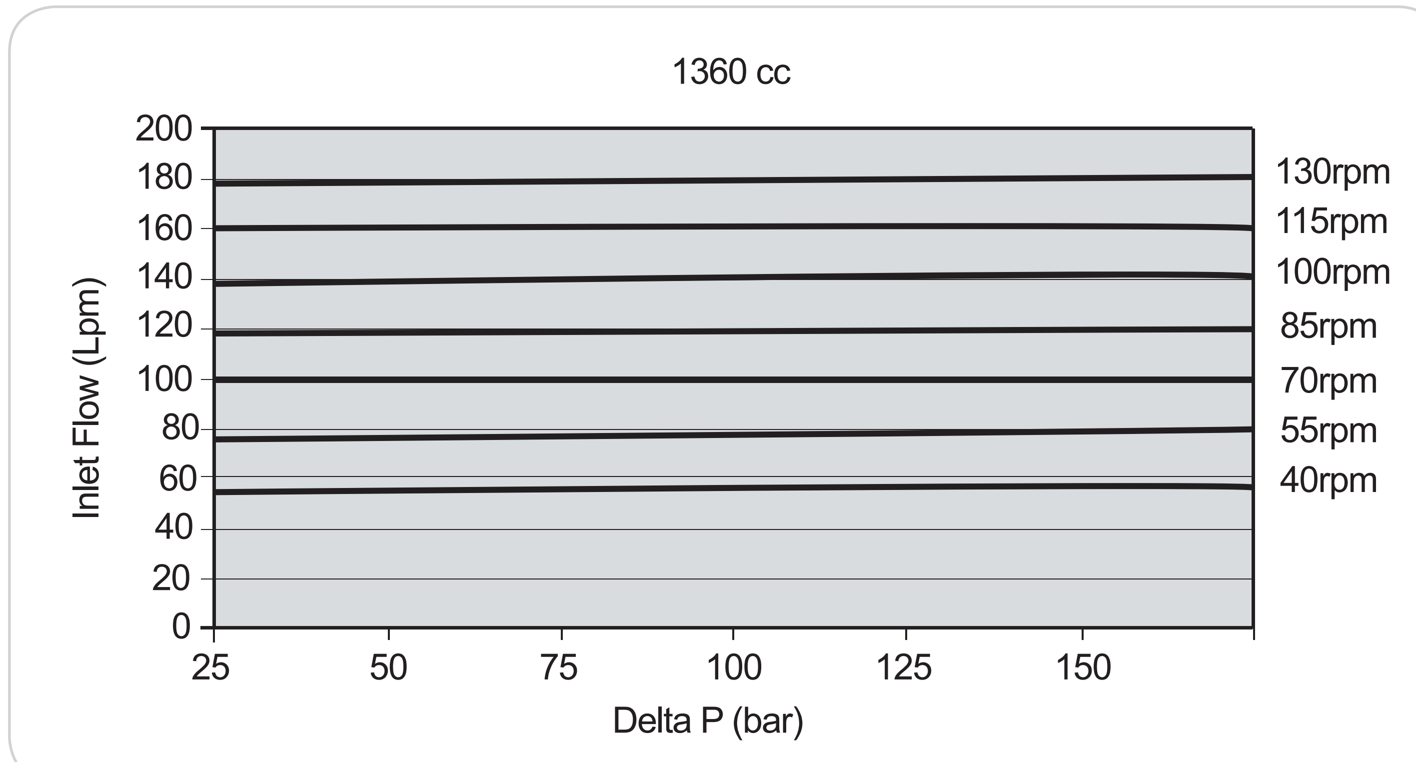
PERFORMANCE

TORQUE OUTPUT



20bar back pressure & ISOVG 37 oil @ 40C (38cSt) Above performance is indicative only. Actual performance is dependent on the motor running-in period, operating viscosity & motor return-line pressure.

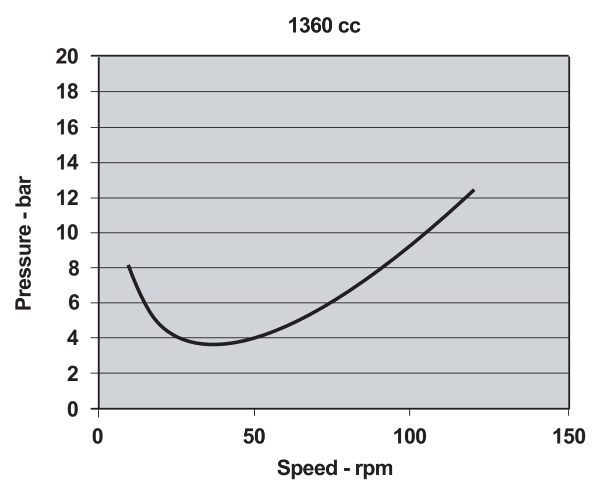
INPUT FLOW

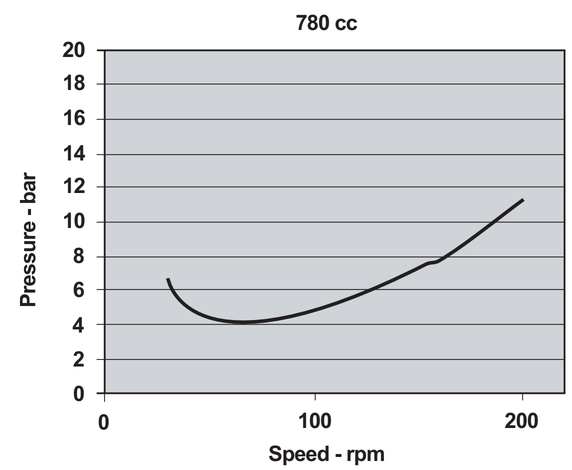


20bar back pressure & ISOVG 37 oil @ 40C (38cSt) Above performance is indicative only. Actual performance is dependent on the motor running-in period, operating viscosity & motor return-line pressure..

PERFORMANCE

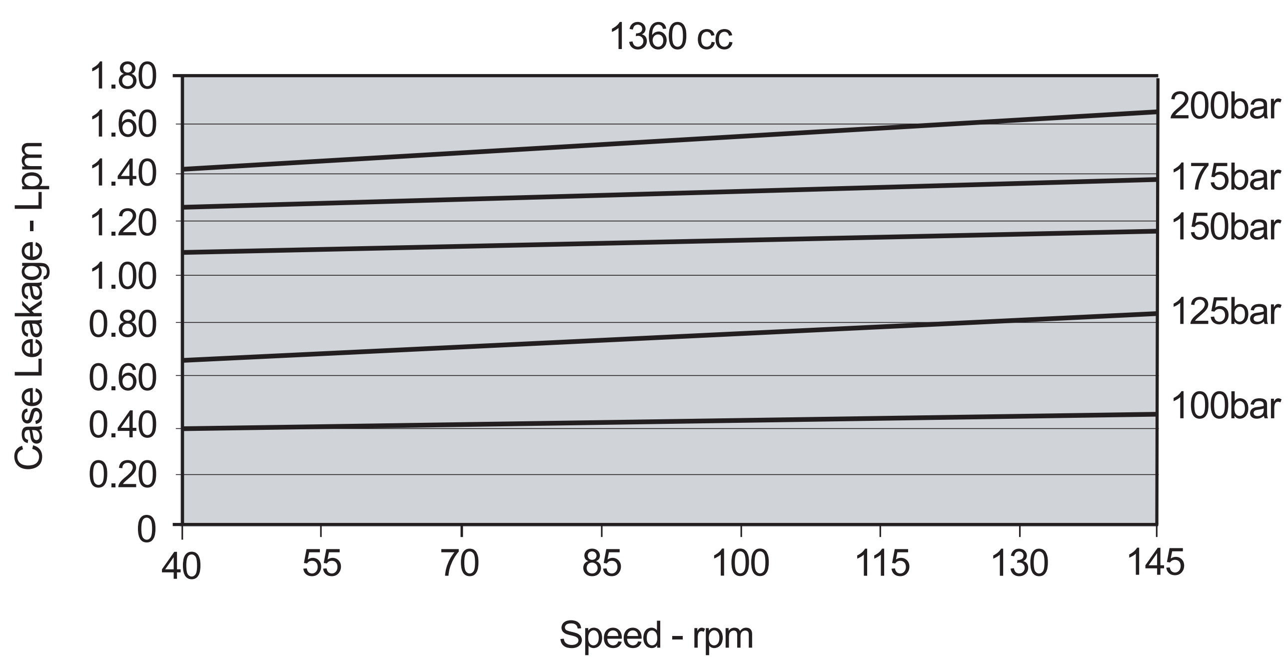
NO LOAD PRESSURE DROP





Differential pressure across the main ports required to drive the motor over its speed range, with the output shaft disconnected.
20bar back pressure & ISOVG 37 oil @ 40C (38cSt) Above performance is indicative only. Actual performance is dependent on the motor running-in period, operating viscosity & motor return-line pressure.

CASE LEAKAGE

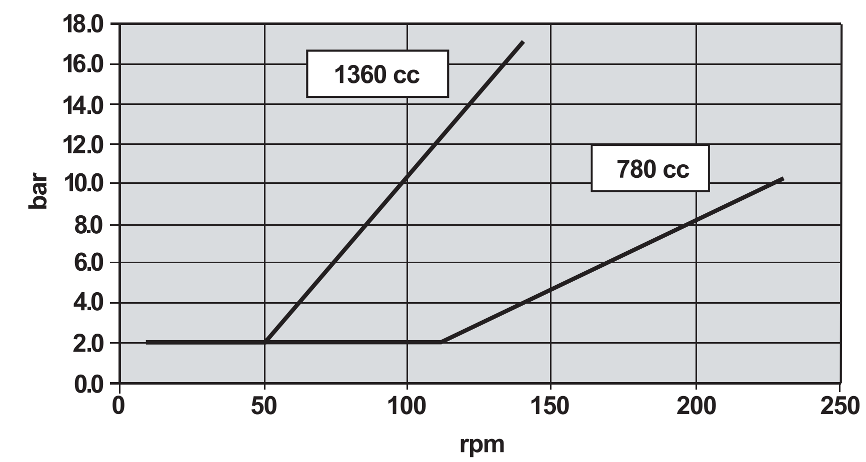


20 bar back pressure & ISOVG 37 oil @ 40C (38cSt) Above performance is indicative only. Actual performance is dependent on the motor running-in period, operating viscosity & motor return-line pressure. It may be necessary to provide a cooling flow (typically 2 LPM) through the motor case, where continuous running conditions produce oil temperature or viscosity values outside the recommended operating range (see Technical Data – page 2)

XF10 RADIAL PISTON MOTORS

PERFORMANCE

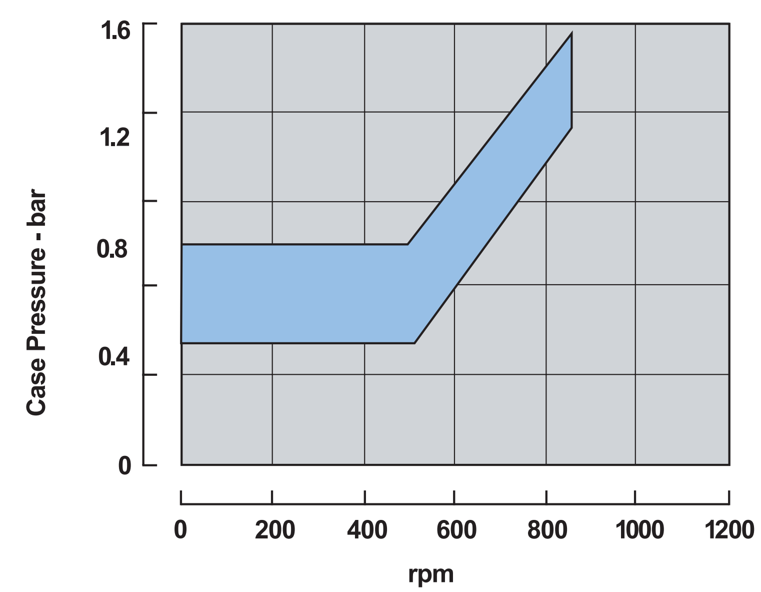
MINIMUM BOOST PRESSURE (PUMPING)

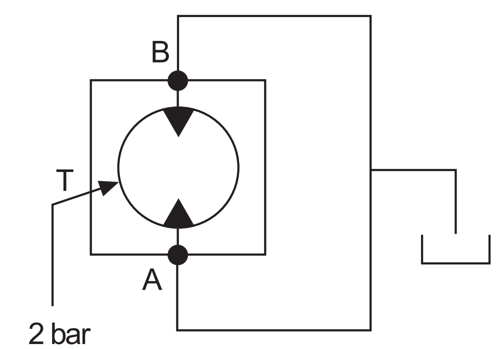


ISOVG 37 oil @ 50C (25cSt)

! Where the shaft torsion load can overrun the motor (i.e. motor is operating as a pump) it is important to ensure sufficient supply boost pressure, to avoid incomplete filling of the cylinders & cavitation. To prevent damaging cavitation, the minimum boost pressure required at the motor inlet port is equal to the sum of the above graph & the actual case pressure.

FREEWHEELING





Graph shows case pressure (differential above port pressure) required to retract the motor pistons, for freewheeling operation; 2 bar differential being sufficient to maintain freewheel, under all speed conditions.

Transition into & out of freewheeling is normally accomplished with the motor stationary. ! If this is not practical, then a "soft" re-engagement of the pistons with the cam track is advised, to prevent potential damage to the motor piston bush. This can be achieved by either limiting the pressure in the main lines to 50bar during this transition or by restricting the speed at which the supply pump increases to max flow (1 second minimum, for max freewheel speed)

! In designing the freewheel circuit, care must be taken to ensure that the max case pressure limit, shown on page3, is not exceeded.

INSTALLATION

- Detailed installation drawings are available on request.
- Motor shaft drives should be designed to eliminate unnecessary axial & radial loads; thus prolonging output housing bearing life.
- Keyed shafts are recommended for a flexible coupling output connection.
- Splined shafts are suited to installations where the driven shaft & motor are rigidly mounted. *(Alignment between motor & driven shaft should be maintained within 0.05mm)*
- For maximum life, splines should be lubricated with Molybdenum Disulphide grease, on assembly, or preferably run in oil lubrication.
- Do not remove protective plugs from hydraulic or speed sensor ports until immediate connection into the system pipe work is made.
- Always examine the motor externally to ensure no damage has been caused in transit.
- Case drain lines, connected to either of the “T” ports indicated, should be returned directly to tank.
- The “T” port should be positioned as the uppermost port, to ensure air is properly vented from the pipe work.
- Where the motor is mounted with shaft uppermost, an air vent port is necessary to ensure proper lubrication of the bearing housing shaft seal *(General Option “1” in Product Code).*
- The bore size of the case drain line should be sufficient to ensure that case pressure does not exceed the maximum specified in “Technical Data” on page 3, under all operating conditions *(especially during cold-start)*
- !If the difference between motor case drain temperature & the tank temperature is > 40°C, then a case warming flow must be provided, to prevent possible thermal shock damage to the motor.
- For series connection of motors consult ROTARY POWER

COMMISSIONING

- Prior to motor assembly, thoroughly de-scale, clean & flush all pipe work, fittings & oil tank.
- Fill the system with new, filtered oil *(refer to “Technical Data” on page 3 for motor oil requirements)*
- Fill the motor case & drain line with oil through the case drain port “T” & re-connect case drain pipe work.
- Check rotation direction required is consistent with the direction of inlet flow *(see relevant motor dimensional data)*
- Start the drive pump at lowest practical speed to prime the system *(for combustion engines turn over the starter motor for a few seconds at a time. For electric motors use a series of rapid on/off cycles)*
- Run the system at high flow & low pressure & actuate all systems in all modes until all entrained air is purged.
- Check & top-up oil levels if necessary
- Check & adjust settings where necessary, in compliance with all system & component supplier requirements.
- Check steady state operating temperature is in compliance with all system & component supplier requirements.
- Check for & repair any external leaks.
- After the first few hours of running, clean or renew all filters, as appropriate.
- IF IN DOUBT CONSULT ROTARY POWER

XF10 RADIAL PISTON MOTORS

APPLICATIONS

AUGER FEEDER DRIVE

CUTTER-HEAD DRIVE

DRUM SCREENER

ASPHALT PAVER

HARVESTER

ROAD PLANER