

Technical Information

Orbital Motors Type WS



TABLE OF CONTENTS

TECHNICAL INFORMATION

Operating Recommendations	4-5
Motor Connections	5
Product Testing (Understanding the Performance Charts)	6
Allowable Bearing & Shaft Loads	7
Vehicle Drive Calculations.....	8-9
Induced Side Loading	10
Hydraulic Equations	10
Shaft Nut Dimensions & Torque Specifications.....	11

OPTIONAL MOTOR FEATURES

Speed Sensor Options	12-13
Freeturning Rotor Option	13
Internal Drain	14
Valve Cavity Option	15
Slinger Seal Option	15

HEAVY DUTY HYDRAULIC MOTORS

WS 365 & 366 Product Line Introduction	16
WS 365 & 366 Displacement Performance Charts	17-22
365 & 366 Series Housings	23-24
365 & 366 Series Technical Information	25
365 & 366 Series Porting Options	26-27
365 & 366 Series Shafts.....	27-28
365 & 366 Series Short Motor Information	29
365 & 366 Series Ordering Information.....	30
WS 360 Product Line Introduction	31
WS 360 Displacement Performance Charts	32-36
360 Series Housings	37-38
360 Series Technical Information	39-40
360 Series Porting Options	41
360 Series Shafts.....	42-43
360 Series Short Motor Information	44
360 Series Ultra Short Motor Information	45-46
360 Series Ordering Information.....	47

OPERATING RECOMMENDATIONS

OIL TYPE

Hydraulic oils with anti-wear, anti-foam and demulsifiers are recommended for systems incorporating Impro Fluidtek motors. Straight oils can be used but may require VI (viscosity index) improvers depending on the operating temperature range of the system. Other water based and environmentally friendly oils may be used, but service life of the motor and other components in the system may be significantly shortened. Before using any type of fluid, consult the fluid requirements for all components in the system for compatibility. Testing under actual operating conditions is the only way to determine if acceptable service life will be achieved.

FLUID VISCOSITY & FILTRATION

Fluids with a viscosity between 20 - 43 cSt [100 - 200 S.U.S.] at operating temperature is recommended. Fluid temperature should also be maintained below 85°C [180° F]. It is also suggested that the type of pump and its operating specifications be taken into account when choosing a fluid for the system. Fluids with high viscosity can cause cavitation at the inlet side of the pump. Systems that operate over a wide range of temperatures may require viscosity improvers to provide acceptable fluid performance.

Impro Fluidtek recommends maintaining an oil cleanliness level of ISO 17-14 or better.

INSTALLATION & START-UP

When installing an Impro Fluidtek motor it is important that the mounting flange of the motor makes full contact with the mounting surface of the application. Mounting hardware of the appropriate grade and size must be used. Hubs, pulleys, sprockets and couplings must be properly aligned to avoid inducing excessive thrust or radial loads. Although the output device must fit the shaft snug, a hammer should never be used to install any type of output device onto the shaft. The port plugs should only be removed from the motor when the system connections are ready to be made. To avoid contamination, remove all matter from around the ports of the motor and the threads of the fittings. Once all system connections are made, it is recommended that the motor be run-in for 15-30 minutes at no load and half speed to remove air from the hydraulic system.

MOTOR PROTECTION

Over-pressurization of a motor is one of the primary causes of motor failure. To prevent these situations, it is necessary to provide adequate relief protection for a motor based on the pressure ratings for that particular model. For systems that may experience overrunning conditions, special precautions must be taken. In an overrunning condition, the motor functions as a pump and attempts to convert kinetic energy into hydraulic energy. Unless the system is properly

configured for this condition, damage to the motor or system can occur. To protect against this condition a counterbalance valve or relief cartridge must be incorporated into the circuit to reduce the risk of over-pressurization. If a relief cartridge is used, it must be installed upline of the motor, if not in the motor, to relieve the pressure created by the over-running motor. To provide proper motor protection for an over-running load application, the pressure setting of the pressure relief valve must not exceed the intermittent rating of the motor.

HYDRAULIC MOTOR SAFETY PRECAUTION

A hydraulic motor must not be used to hold a suspended load. Due to the necessary internal tolerances, all hydraulic motors will experience some degree of creep when a load induced torque is applied to a motor at rest. All applications that require a load to be held must use some form of mechanical brake designed for that purpose.

MOTOR/BRAKE PRECAUTION

Caution! - Impro Fluidtek motor/brakes are intended to operate as static or parking brakes. System circuitry must be designed to bring the load to a stop before applying the brake.

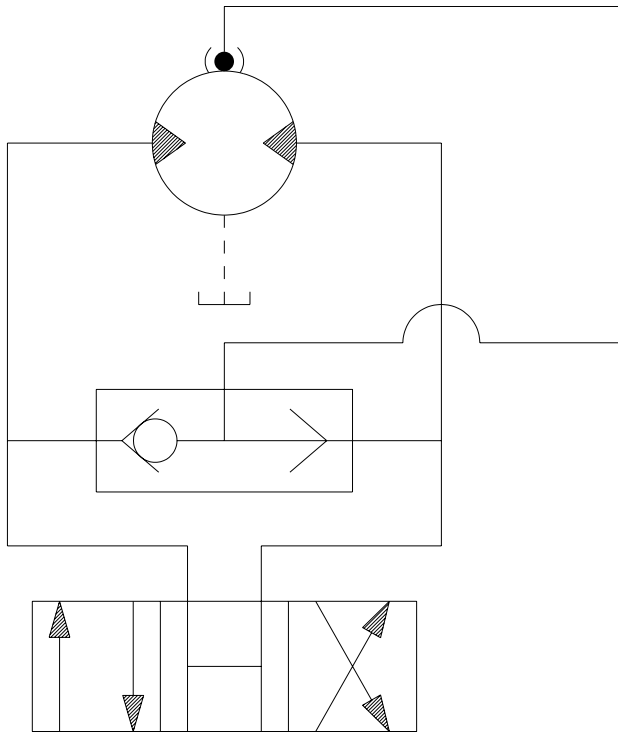
Caution! - Because it is possible for some large displacement motors to overpower the brake, it is critical that the maximum system pressure be limited for these applications. Failure to do so could cause serious injury or death. When choosing a motor/brake for an application, consult the performance chart for the series and displacement chosen for the application to verify that the maximum operating pressure of the system will not allow the motor to produce more torque than the maximum rating of the brake. Also, it is vital that the system relief be set low enough to insure that the motor is not able to overpower the brake.

To ensure proper operation of the brake, a separate case drain back to tank must be used. Use of the internal drain option is not recommended due to the possibility of return line pressure spikes. A simple schematic of a system utilizing a motor/brake is shown on page 5. Although maximum brake release pressure may be used for an application, a 34 bar [500 psi] pressure reducing valve is recommended to promote maximum life for the brake release piston seals. However, if a pressure reducing valve is used in a system which has case drain back pressure, the pressure reducing valve should be set to 34 bar [500 psi] over the expected case pressure to ensure full brake release. To achieve proper brake release operation, it is necessary to bleed out any trapped air and fill brake release cavity and hoses before all connections are tightened. To facilitate this operation, all motor/brakes feature two release ports. One or both of these ports may be used to release the brake in the

OPERATING RECOMMENDATIONS & MOTOR CONNECTIONS

MOTOR/BRAKE PRECAUTION (continued)

unit. Motor/brakes should be configured so that the release ports are near the top of the unit in the installed position.



TYPICAL MOTOR/BRAKE SCHEMATIC

Once all system connections are made, one release port must be opened to atmosphere and the brake release line carefully charged with fluid until all air is removed from the line and motor/brake release cavity. When this has been accomplished the port plug or secondary release line must be reinstalled. In the event of a pump or battery failure, an external pressure source may be connected to the brake release port to release the brake, allowing the machine to be moved.

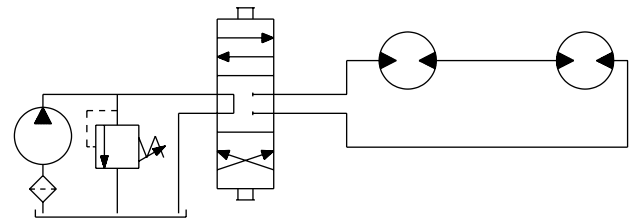
► NOTE: It is vital that all operating recommendations be followed. Failure to do so could result in injury or death.

MOTOR CIRCUITS

There are two common types of circuits used for connecting multiple numbers of motors – series connection and parallel connection.

SERIES CONNECTION

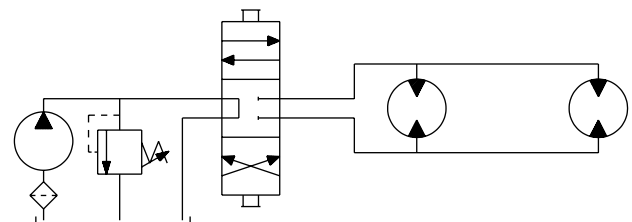
When motors are connected in series, the outlet of one motor is connected to the inlet of the next motor. This allows the full pump flow to go through each motor and provide maximum speed. Pressure and torque are distributed between the motors based on the load each motor is subjected to. The maximum system pressure must be no greater than the maximum inlet pressure of the first motor. The allowable back pressure rating for a motor must also be considered. In some series circuits the motors must have an external case drain connected. A series connection is desirable when it is important for all the motors to run the same speed such as on a long line conveyor.



SERIES CIRCUIT

PARALLEL CONNECTION

In a parallel connection all of the motor inlets are connected. This makes the maximum system pressure available to each motor allowing each motor to produce full torque at that pressure. The pump flow is split between the individual motors according to their loads and displacements. If one motor has no load, the oil will take the path of least resistance and all the flow will go to that one motor. The others will not turn. If this condition can occur, a flow divider is recommended to distribute the oil and act as a differential.

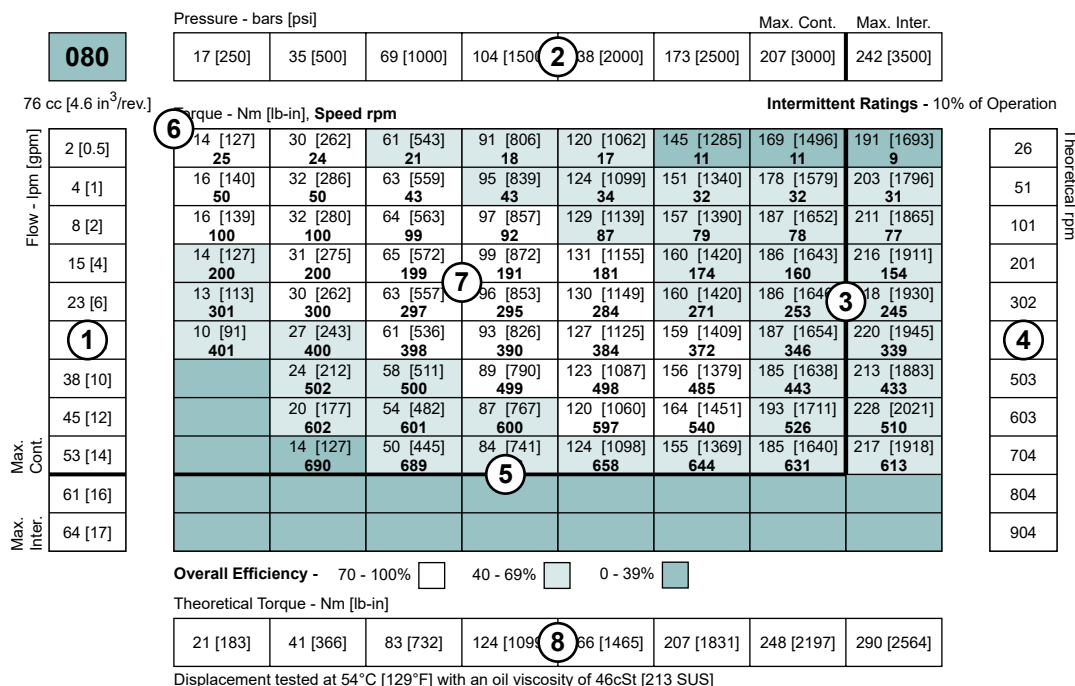


PARALLEL CIRCUIT

► NOTE: The motor circuits shown above are for illustration purposes only. Components and circuitry for actual applications may vary greatly and should be chosen based on the application.

PRODUCT TESTING

Performance testing is the critical measure of a motor's ability to convert flow and pressure into speed and torque. All product testing is conducted using an Impro Fluidtek state of the art test facility. This facility utilizes fully automated test equipment and custom designed software to provide accurate, reliable test data. Test routines are standardized, including test stand calibration and stabilization of fluid temperature and viscosity, to provide consistent data. The example below provides an explanation of the values pertaining to each heading on the performance chart.



- Flow represents the amount of fluid passing through the motor during each minute of the test.
- Pressure refers to the measured pressure differential between the inlet and return ports of the motor during the test.
- The maximum continuous pressure rating and maximum intermittent pressure rating of the motor are separated by the dark lines on the chart.
- Theoretical RPM represents the RPM that the motor would produce if it were 100% volumetrically efficient. Measured RPM divided by the theoretical RPM give the actual volumetric efficiency of the motor.
- The maximum continuous flow rating and maximum intermittent flow rating of the motor are separated by the dark line on the chart.
- Performance numbers represent the actual torque and speed generated by the motor based on the corresponding input pressure and flow. The numbers on the top row indicate torque as measured in Nm [lb-in], while the bottom number represents the speed of the output shaft.
- Areas within the white shading represent maximum motor efficiencies.
- Theoretical Torque represents the torque that the motor would produce if it were 100% mechanically efficient. Actual torque divided by the theoretical torque gives the actual mechanical efficiency of the motor.

ALLOWABLE BEARING & SHAFT LOADING

This catalog provides curves showing allowable radial loads at points along the longitudinal axis of the motor. They are dimensioned from the mounting flange. Two capacity curves for the shaft and bearings are shown. A vertical line through the centerline of the load drawn to intersect the x-axis intersects the curves at the load capacity of the shaft and of the bearing.

In the example below the maximum radial load bearing rating is between the internal roller bearings illustrated with a solid line. The allowable shaft rating is shown with a dotted line.

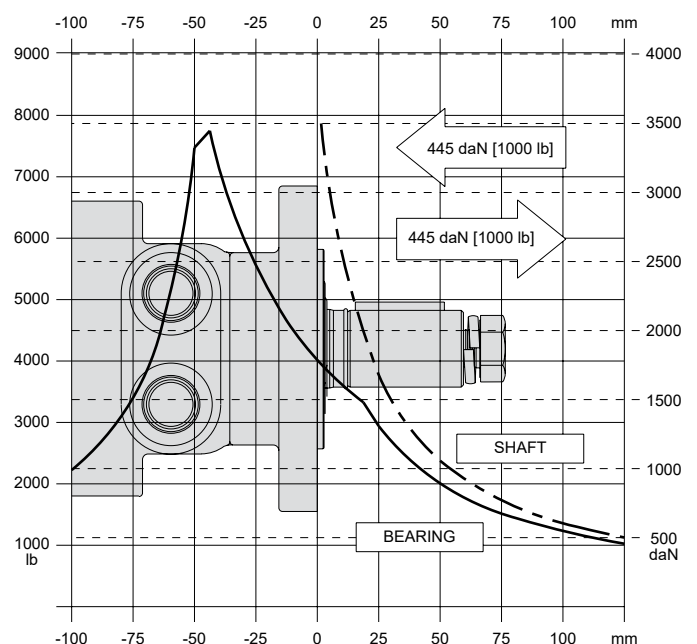
The bearing curves for each model are based on laboratory analysis and testing results constructed at Impro Fluidtek. The shaft loading is based on a 3:1 safety factor and 330 Kpsi tensile strength. The allowable load is the lower of the curves at a given point. For instance, one inch in front of the mounting flange the bearing capacity is lower than the shaft capacity. In this case, the bearing is the limiting load. The motor user needs to determine which series of motor to use based on their application knowledge.

ISO 281 RATINGS VS. MANUFACTURERS RATINGS

Published bearing curves can come from more than one type of analysis. The ISO 281 bearing rating is an international standard for the dynamic load rating of roller bearings. The rating is for a set load at a speed of 33 1/3 RPM for 500 hours (1 million revolutions). The standard was established to allow consistent comparisons of similar bearings between manufacturers. The ISO 281 bearing ratings are based solely on the physical characteristics of the bearings, removing any manufacturers specific safety factors or empirical data that influences the ratings.

Manufacturers' ratings are adjusted by diverse and systematic laboratory investigations, checked constantly with feedback from practical experience. Factors taken into account that affect bearing life are material, lubrication, cleanliness of the lubrication, speed, temperature, magnitude of the load and the bearing type.

The operating life of a bearing is the actual life achieved by the bearing and can be significantly different from the calculated life. Comparison with similar applications is the most accurate method for bearing life estimations.



EXAMPLE LOAD RATING FOR MECHANICALLY RETAINED NEEDLE ROLLER BEARINGS

$$\text{Bearing Life } L_{10} = (C/P)^p [10^6 \text{ revolutions}]$$

$$L_{10} = \text{nominal rating life}$$

$$C = \text{dynamic load rating}$$

$$P = \text{equivalent dynamic load}$$

$$\text{Life Exponent } p = 10/3 \text{ for needle bearings}$$

BEARING LOAD MULTIPLICATION FACTOR TABLE			
RPM	FACTOR	RPM	FACTOR
50	1.23	500	0.62
100	1.00	600	0.58
200	0.81	700	0.56
300	0.72	800	0.50
400	0.66		

VEHICLE DRIVE CALCULATIONS

When selecting a wheel drive motor for a mobile vehicle, a number of factors concerning the vehicle must be taken into consideration to determine the required maximum motor RPM, the maximum torque required and the maximum load each motor must support. The following sections contain the necessary equations to determine this criteria. An example is provided to illustrate the process.

Sample application (vehicle design criteria)

vehicle description..... 4 wheel vehicle
 vehicle drive..... 2 wheel drive
 GVW 1,500 lbs.
 weight over each drive wheel 425 lbs.
 rolling radius of tires 16 in.
 desired acceleration 0-5 mph in 10 sec.
 top speed..... 5 mph
 gradability..... 20%
 worst working surface..... poor asphalt

To determine maximum motor speed

$$\text{RPM} = \frac{2.65 \times \text{KPH} \times G}{r_m} \quad \text{RPM} = \frac{168 \times \text{MPH} \times G}{r_i}$$

Where:

MPH = max. vehicle speed (miles/hr)

KPH = max. vehicle speed (kilometers/hr)

r_i = rolling radius of tire (inches)

G = gear reduction ratio (if none, G = 1)

r_m = rolling radius of tire (meters)

$$\text{Example} \quad \text{RPM} = \frac{168 \times 5 \times 1}{16} = 52.5$$

To determine maximum torque requirement of motor

To choose a motor(s) capable of producing enough torque to propel the vehicle, it is necessary to determine the Total Tractive Effort (TE) requirement for the vehicle. To determine the total tractive effort, the following equation must be used:

$$\text{TE} = \text{RR} + \text{GR} + \text{FA} + \text{DP} \text{ (lbs or N)}$$

Where:

TE = Total tractive effort

RR = Force necessary to overcome rolling resistance

GR = Force required to climb a grade

FA = Force required to accelerate

DP = Drawbar pull required

The components for this equation may be determined using the following steps:

Step One: Determine Rolling Resistance

Rolling Resistance (RR) is the force necessary to propel a vehicle over a particular surface. It is recommended that the worst possible surface type to be encountered by the vehicle be factored into the equation.

$$\text{RR} = \frac{\text{GVW}}{1000} \times R \text{ (lb or N)}$$

Where:

GVW = gross (loaded) vehicle weight (lb or kg)

R = surface friction (value from Table 1)

$$\text{Example} \quad \text{RR} = \frac{1500}{1000} \times 22 \text{ lbs} = 33 \text{ lbs}$$

Table 1

Rolling Resistance	
Concrete (excellent).....	10
Concrete (good).....	15
Concrete (poor).....	20
Asphalt (good).....	12
Asphalt (fair).....	17
Asphalt (poor).....	22
Macadam (good).....	15
Macadam (fair).....	22
Macadam (poor).....	37
Cobbles (ordinary).....	55
Cobbles (poor).....	37
Snow (2 inch).....	25
Snow (4 inch).....	37
Dirt (smooth).....	25
Dirt (sandy).....	37
Mud.....	37 to 150
Sand (soft).....	60 to 150
Sand (dune).....	160 to 300

Step Two: Determine Grade Resistance

Grade Resistance (GR) is the amount of force necessary to move a vehicle up a hill or "grade." This calculation must be made using the maximum grade the vehicle will be expected to climb in normal operation.

To convert incline degrees to % Grade:

$$\% \text{ Grade} = [\tan \text{ of angle (degrees)}] \times 100$$

$$\text{GR} = \frac{\% \text{ Grade}}{100} \times \text{GVW} \text{ (lb or N)}$$

$$\text{Example} \quad \text{GR} = \frac{20}{100} \times 1500 \text{ lbs} = 300 \text{ lbs}$$

VEHICLE DRIVE CALCULATIONS

Step Three: Determine Acceleration Force

Acceleration Force (FA) is the force necessary to accelerate from a stop to maximum speed in a desired time.

$$FA = \frac{MPH \times GVW \text{ (lb)}}{22 \times t} \quad FA = \frac{KPH \times GVW \text{ (N)}}{35.32 \times t}$$

Where:

t = time to maximum speed (seconds)

Example $FA = \frac{5 \times 1500 \text{ lbs}}{22 \times 10} = 34 \text{ lbs}$

Step Four: Determine Drawbar Pull

Drawbar Pull (DP) is the additional force, if any, the vehicle will be required to generate if it is to be used to tow other equipment. If additional towing capacity is required for the equipment, repeat steps one through three for the towable equipment and sum the totals to determine DP.

Step Five: Determine Total Tractive Effort

The Tractive Effort (TE) is the sum of the forces calculated in steps one through three above. On low speed vehicles, wind resistance can typically be neglected. However, friction in drive components may warrant the addition of 10% to the total tractive effort to insure acceptable vehicle performance.

$$TE = RR + GR + FA + DP \text{ (lb or N)}$$

Example $TE = 33 + 300 + 34 + 0 \text{ (lbs)} = 367 \text{ lbs}$

Step Six: Determine Motor Torque

The Motor Torque (T) required per motor is the Total Tractive Effort divided by the number of motors used on the machine. Gear reduction is also factored into account in this equation.

$$T = \frac{TE \times ri}{M \times G} \text{ lb-in per motor} \quad T = \frac{TE \times rm}{M \times G} \text{ Nm per motor}$$

Where:

M = number of driving motors

Example $T = \frac{367 \times 16}{2 \times 1} \text{ lb-in/motor} = 2936 \text{ lb-in}$

Step Seven: Determine Wheel Slip

To verify that the vehicle will perform as designed in regards to tractive effort and acceleration, it is necessary to calculate wheel slip (TS) for the vehicle. In special cases, wheel slip may actually be desirable to prevent hydraulic system overheating and component breakage should the vehicle become stalled.

$$TS = \frac{W \times f \times ri}{G} \text{ (lb-in per motor)} \quad TS = \frac{W \times f \times rm}{G} \text{ (N-m per motor)}$$

Where:

f = coefficient of friction (see table 2)

W = loaded vehicle weight over driven wheel (lb or N)

Example $TS = \frac{425 \times .06 \times 16}{1} \text{ lb-in/motor} = 4080 \text{ lbs}$

Table 2

Coefficient of friction (f)	
Steel on steel.....	0.3
Rubber tire on dirt.....	0.5
Rubber tire on a hard surface	0.6 - 0.8
Rubber tire on cement	0.7

To determine radial load capacity requirement of motor

When a motor used to drive a vehicle has the wheel or hub attached directly to the motor shaft, it is critical that the radial load capabilities of the motor are sufficient to support the vehicle. After calculating the Total Radial Load (RL) acting on the motors, the result must be compared to the bearing/shaft load charts for the chosen motor to determine if the motor will provide acceptable load capacity and life.

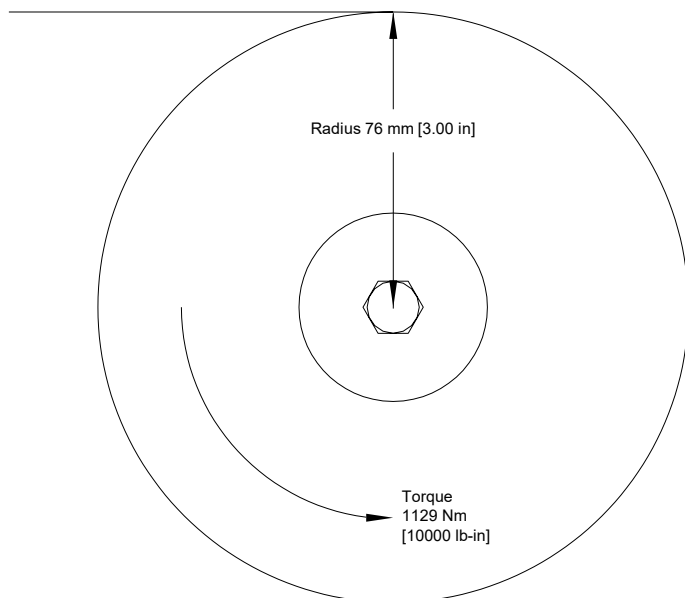
$$RL = \sqrt{W^2 + \left(\frac{T}{ri}\right)^2} \text{ lb} \quad RL = \sqrt{W^2 + \left(\frac{T}{rm}\right)^2} \text{ kg}$$

Example $RL = \sqrt{425^2 + \left(\frac{2936}{16}\right)^2} = 463 \text{ lbs}$

Once the maximum motor RPM, maximum torque requirement, and the maximum load each motor must support have been determined, these figures may then be compared to the motor performance charts and to the bearing load curves to choose a series and displacement to fulfill the motor requirements for the application.

INDUCED SIDE LOAD

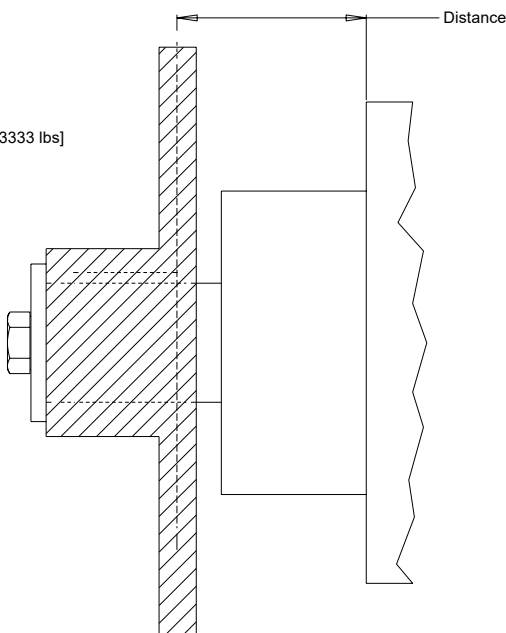
In many cases, pulleys or sprockets may be used to transmit the torque produced by the motor. Use of these components will create a torque induced side load on the motor shaft and bearings. It is important that this load be taken into consideration when choosing a motor with sufficient bearing and shaft capacity for the application.



To determine the side load, the motor torque and pulley or sprocket radius must be known. Side load may be calculated using the formula below. The distance from the pulley/sprocket centerline to the mounting flange of the motor must also be determined. These two figures may then be compared to the bearing and shaft load curve of the desired motor to determine if the side load falls within acceptable load ranges.

$$\text{Side Load} = \frac{\text{Torque}}{\text{Radius}}$$

$$\text{Side Load} = 14855 \text{ Nm [3333 lbs]}$$



HYDRAULIC EQUATIONS

Multiplication Factor	Abbrev.	Prefix
10^{12}	T	tera
10^9	G	giga
10^6	M	mega
10^3	K	kilo
10^2	h	hecto
10^1	da	deka
10^{-1}	d	deci
10^{-2}	c	centi
10^{-3}	m	milli
10^{-6}	u	micro
10^{-9}	n	nano
10^{-12}	p	pico
10^{-15}	f	femto
10^{-18}	a	atto

Theo. Speed (RPM) =

$$\frac{1000 \times \text{LPM}}{\text{Displacement (cm}^3\text{/rev)}} \quad \text{or} \quad \frac{231 \times \text{GPM}}{\text{Displacement (in}^3\text{/rev)}}$$

Theo. Torque (lb-in) =

$$\frac{\text{Bar} \times \text{Disp. (cm}^3\text{/rev)}}{20 \pi} \quad \text{or} \quad \frac{\text{PSI} \times \text{Displacement (in}^3\text{/rev)}}{6.28}$$

Power In (HP) =

$$\frac{\text{Bar} \times \text{LPM}}{600} \quad \text{or} \quad \frac{\text{PSI} \times \text{GPM}}{1714}$$

Power Out (HP) =

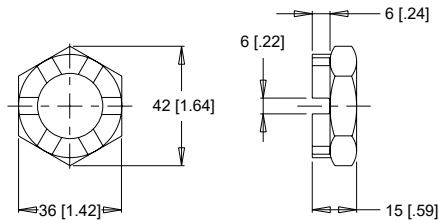
$$\frac{\text{Torque (Nm)} \times \text{RPM}}{9543} \quad \text{or} \quad \frac{\text{Torque (lb-in)} \times \text{RPM}}{63024}$$

SHAFT NUT INFORMATION

35MM TAPERED SHAFTS

M24 x 1.5 Thread

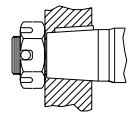
A Slotted Nut



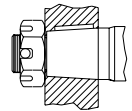
Torque Specifications: 32.5 daNm [240 ft.lb.]

PRECAUTION

The tightening torques listed with each nut should only be used as a guideline. Hubs may require higher or lower tightening torque depending on the material. Consult the hub manufacturer to obtain recommended tightening torque. To maximize torque transfer from the shaft to the hub, and to minimize the potential for shaft breakage, a hub with sufficient thickness must fully engage the taper length of the shaft.



incorrect

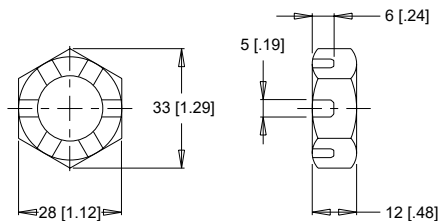


correct

1" TAPERED SHAFTS

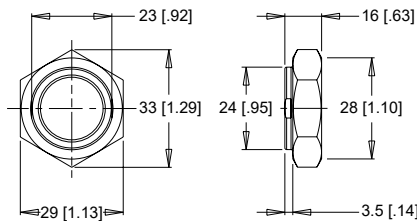
3/4-28 Thread

A Slotted Nut



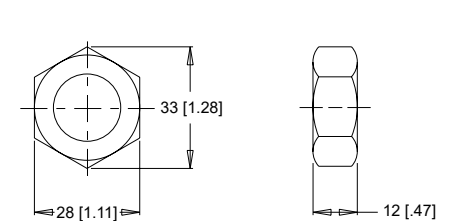
Torque Specifications: 20 - 23 daNm [150 - 170 ft.lb.]

B Lock Nut



Torque Specifications: 24 - 27 daNm [180 - 200 ft.lb.]

C Solid Nut

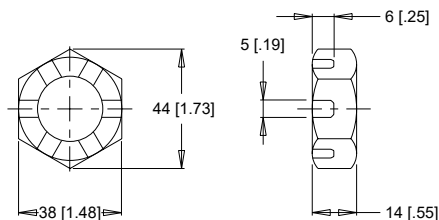


Torque Specifications: 20 - 23 daNm [150 - 170 ft.lb.]

1-1/4" TAPERED SHAFTS

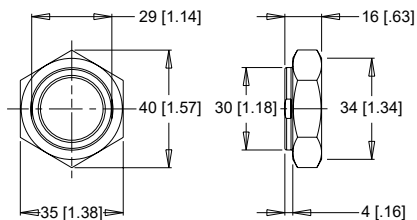
1-20 Thread

A Slotted Nut



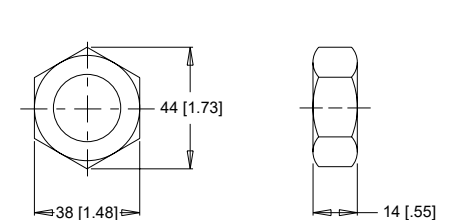
Torque Specifications: 38 daNm [280 ft.lb.] Max.

B Lock Nut



Torque Specifications: 33 - 42 daNm [240 - 310 ft.lb.]

C Solid Nut

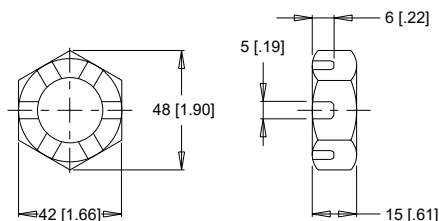


Torque Specifications: 38 daNm [280 ft.lb.] Max.

1-3/8" & 1-1/2" TAPERED SHAFTS

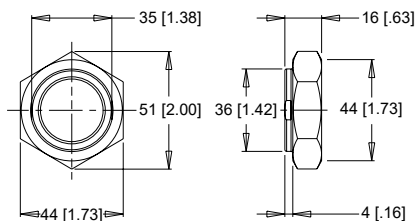
1 1/8-18 Thread

A Slotted Nut



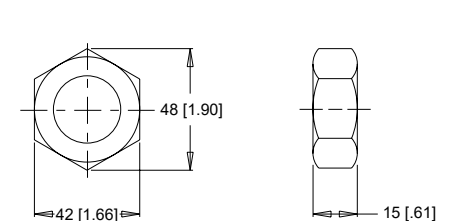
Torque Specifications: 41 - 54 daNm [300 - 400 ft.lb.]

B Lock Nut



Torque Specifications: 34 - 48 daNm [250 - 350 ft.lb.]

C Solid Nut



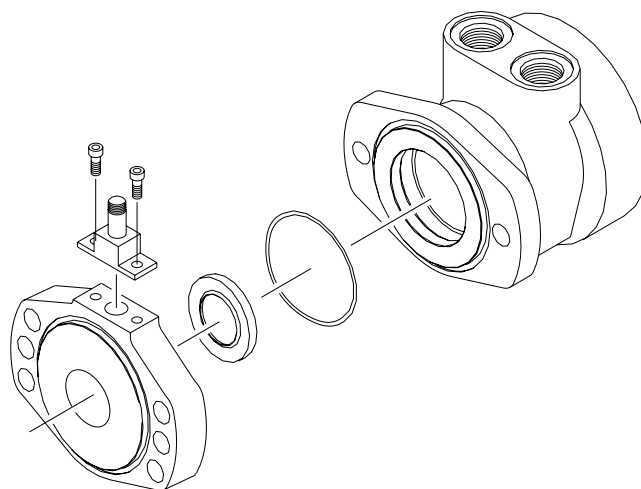
Torque Specifications: 41 - 54 daNm [300 - 400 ft.lb.]

SPEED SENSORS

Impro Fluidtek offers both single and dual element speed sensor options providing a number of benefits to users by incorporating the latest advancements in sensing technology and materials. The single element sensors provide 50 pulses per revolution with the dual element providing 100 pulses per revolution.” Higher resolution is especially beneficial for slow speed applications, where more information is needed for smooth and accurate control. The dual sensor option also provides a direction signal allowing end-users to monitor the direction of shaft rotation.

Unlike competitive designs that breach the high pressure area of the motor to add the sensor, the Impro Fluidtek speed sensor option utilizes an add-on flange to locate all sensor components outside the high pressure operating environment. This eliminates the potential leak point common to competitive designs. Many improvements were made to the sensor flange including changing the material from cast iron to acetal resin, incorporating a Buna-N shaft seal internal to the flange, and providing a grease zerk, which allows the user to fill the sensor cavity with grease. These improvements enable the flange to withstand the rigors of harsh environments.

Another important feature of the new sensor flange is that it is self-centering, which allows it to remain concentric to the magnet rotor. This produces a consistent mounting location for the new sensor module, eliminating the need to adjust



the air gap between the sensor and magnet rotor. The o-ring sealed sensor module attaches to the sensor flange with two small screws, allowing the sensor to be serviced or upgraded in the field in under one minute. This feature is especially valuable for mobile applications where machine downtime is costly. The sensor may also be serviced without exposing the hydraulic circuit to the atmosphere. Another advantage of the self-centering flange is that it allows users to rotate the sensor to a location best suited to their application. This feature is not available on competitive designs, which fix the sensor in one location in relationship to the motor mounting flange.

FEATURES / BENEFITS

- Grease fitting allows sensor cavity to be filled with grease for additional protection.
- Internal extruder seal protects against environmental elements.
- M12 or weatherpack connectors provide installation flexibility.
- Dual element sensor provides up to 100 pulses per revolution and directional sensing.
- Modular sensor allows quick and easy servicing.
- Acetal resin flange is resistant to moisture, chemicals, oils, solvents and greases.
- Self-centering design eliminates need to set magnet-to-sensor air gap.
- Protection circuitry

SENSOR OPTIONS

Z - 4-pin M12 male connector

This option has 50 pulses per revolution on all series. This option will not detect direction.

Y - 3-pin male weatherpack connector*

This option has 50 pulses per revolution on all series. This option will not detect direction.

X - 4-pin M12 male connector

This option has 100 pulses per revolution on all series. This option will detect direction.

W - 4-pin male weatherpack connector*

This option has 100 pulses per revolution on all series. This option will detect direction.

*These options include a 610mm [2 ft] cable.

SPEED SENSORS

SINGLE ELEMENT SENSOR - Y & Z

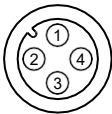
Supply voltages..... 7.5-24 Vdc
 Maximum output off voltage..... V
 Maximum continuous output current..... < 25 ma
 Signal levels (low, high)..... 0.8 to supply voltage
 Operating Temp-30°C to 83°C [-22°F to 181°F]

DUAL ELEMENT SENSOR - X & W

Supply voltages..... 7.5-18 Vdc
 Maximum output off voltage..... V
 Maximum continuous output current..... < 20 ma
 Signal levels (low, high)..... 0.8 to supply voltage
 Operating Temp-30°C to 83°C [-22°F to 181°F]

SENSOR CONNECTORS

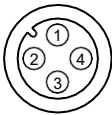
Z Option



PIN

1	positive	brown or red
2	n/a	white
3	negative	blue
4	pulse out	black

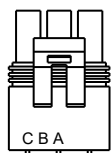
X Option



PIN

1	positive	brown or red
2	direction out	white
3	negative	blue
4	pulse out	black

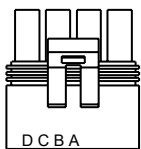
Y Option



PIN

A	positive	brown or red
B	negative	blue
C	pulse out	black
D	n/a	white

W Option



PIN

A	positive	brown or red
B	negative	blue
C	pulse out	black
D	direction out	white

PROTECTION CIRCUITRY

The single element sensor has been improved and incorporates protection circuitry to avoid electrical damage caused by:

- reverse battery protection
- overvoltage due to power supply spikes and surges (60 Vdc max.)
- power applied to the output lead

The protection circuit feature will help “save” the sensor from damage mentioned above caused by:

- faulty installation wiring or system repair
- wiring harness shorts/opens due to equipment failure or harness damage resulting from accidental conditions (i.e. severed or grounded wire, ice, etc.)
- power supply spikes and surges caused by other electrical/electronic components that may be intermittent or damaged and “loading down” the system.

While no protection circuit can guarantee against any and all fault conditions. The single element sensor from Impro Fluidtek with protection circuitry is designed to handle potential hazards commonly seen in real world applications.

Unprotected versions are also available for operation at lower voltages down to 4.5V.

FREE TURNING ROTOR

The ‘AC’ option or “Free turning” option refers to a specially prepared rotor assembly. This rotor assembly has increased clearance between the rotor tips and rollers allowing it to turn more freely than a standard rotor assembly. For spool valve motors, additional clearance is also provided between the shaft and housing bore. The ‘AC’ option is available for all motor series and displacements.

There are several applications and duty cycle conditions where ‘AC’ option performance characteristics can be beneficial. In continuous duty applications that require high flow/high rpm operation, the benefits are twofold. The additional clearance helps to minimize internal pressure drop at high flows. This clearance also provides a thicker oil film at metal to metal contact areas and can help extend the life of the motor in high rpm or even over speed conditions. The ‘AC’ option should be considered for applications that require continuous operation above 57 LPM [15 GPM] and/or 300 rpm. Applications that are subject to pressure spikes due to frequent reversals or shock loads can also benefit by specifying the ‘AC’ option. The additional clearance serves to act as a buffer against spikes, allowing them to be bypassed through the motor rather than being absorbed and transmitted through the drive link to the output shaft. The trade-off for achieving these benefits is a slight loss of volumetric efficiency at high pressures.

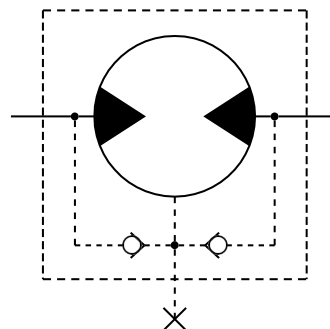
INTERNAL DRAIN

The internal drain is standard on all WD, WP, WR, WS360. Typically, a separate drain line must be installed to direct case leakage of the motor back to the reservoir when using WS365/366. However, the internal drain option eliminates the need for a separate drain line through the installation of two check valves in the motor. This simplifies plumbing requirements for the motor.

The two check valves connect the case area of the motor to each port of the endcover. During normal motor operation, pressure in the input and return lines of the motor close the check valves. However, when the pressure in the case of the motor is greater than that of the return line, the check valve between the case and low pressure line opens, allowing the case leakage to flow into the return line. Since the operation of the check valves is dependent upon a pressure differential, the internal drain option operates in either direction of motor rotation.

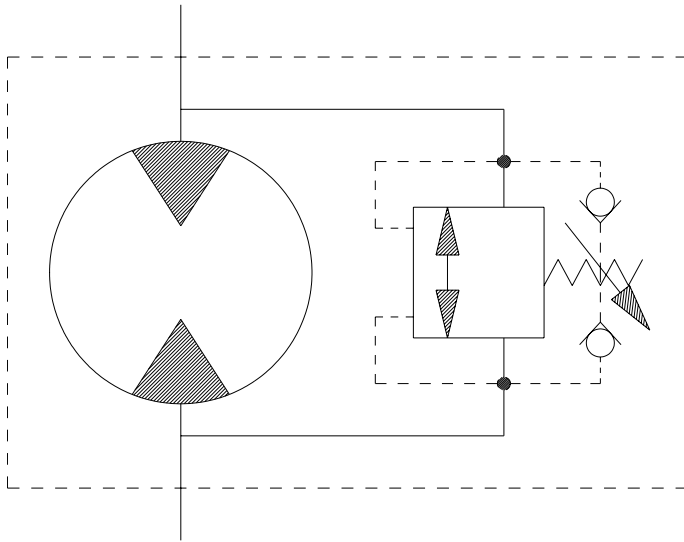
Although this option can simplify many motor installations, precautions must be taken to insure that return line pressure remains below allowable levels (see table below) to insure proper motor operation and life. If return line pressure is higher than allowable, or experiences pressure spikes, this pressure may feed back into the motor, possibly causing catastrophic seal failure. Installing motors with internal drains in series is not recommended unless overall pressure drop over all motors is below the maximum allowable backpressure as listed in the chart below. If in doubt, contact your authorized Impro Fluidtek representative.

MAXIMUM ALLOWABLE BACK PRESSURE		
Series	Cont. bar [psi]	Inter. bar [psi]
Brakes	34 [500]	34 [500]



VALVE CAVITY

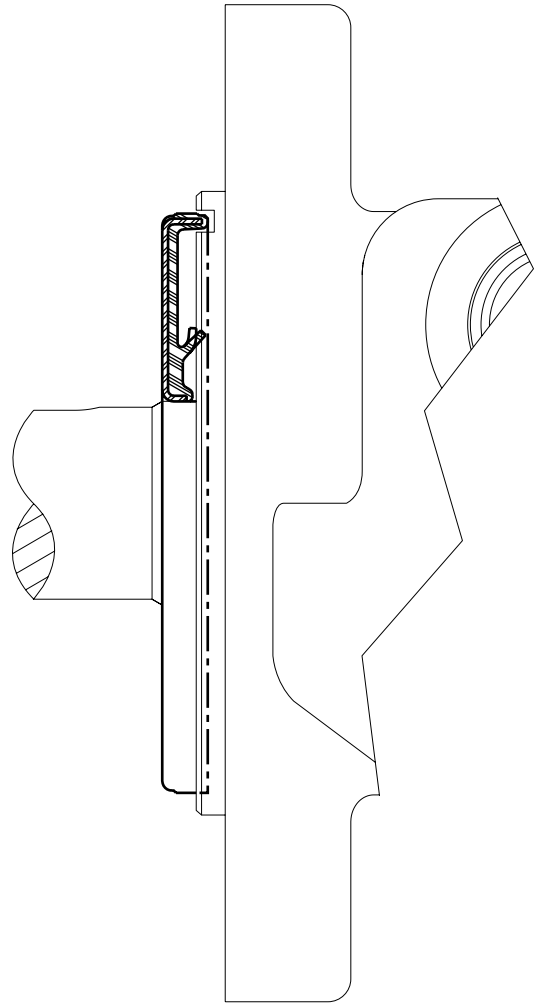
The valve cavity option provides a cost effective way to incorporate a variety of cartridge valves integral to the motor. The valve cavity is a standard 10 series 2-way cavity that accepts numerous cartridge valves, including over-running check valves, relief cartridges, flow control valves, pilot operated check fuses, and high pressure shuttle valves. Installation of a relief cartridge into the cavity provides an extra margin of safety for applications encountering frequent pressure spikes. Relief cartridges from 69 to 207 bar [1000 to 3000 psi] may also be factory installed.



For basic systems with fixed displacement pumps, either manual or motorized flow control valves may be installed into the valve cavity to provide a simple method for controlling motor speed. It is also possible to incorporate the speed sensor option and a programmable logic controller with a motorized flow control valve to create a closed loop, fully automated speed control system. For motors with internal brakes, a shuttle valve cartridge may be installed into the cavity to provide a simple, fully integrated method for supplying release pressure to the pilot line to actuate an integral brake. To discuss other alternatives for the valve cavity option, contact an authorized Impro Fluidtek distributor.

SLINGER SEAL

Slinger seals are available on select series offered by Impro Fluidtek. Slinger seals offer extended shaft/shaft seal protection by prevented a buildup of material around the circumference of the shaft which can lead to premature shaft seal failures. The Impro Fluidtek slinger seals are designed to be larger in diameter than competitive products, providing greater surface speed and 'slinging action'.



Slinger seals are also available on 4-hole flange mounts on select series. Contact a Impro Fluidtek Customer Service Representative for additional information.

OVERVIEW

The WS targets agricultural equipment, skid steer attachments, and other applications that require greater torque under demanding conditions. A distinguishing feature of the WS in relation to competitive products is its heavy duty drive link with a larger pitch diameter. This enables the WS to better withstand pressure and torque spikes and is reflected in its intermittent and peak performance ratings.

Additional product features include a three zone commutator valve, heavy-duty tapered roller bearings, and case drain with integral internal drain.

FEATURES / BENEFITS

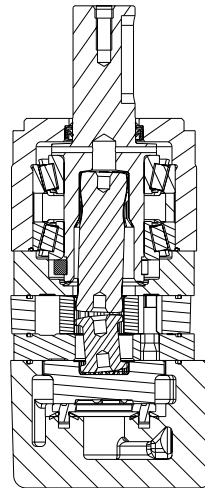
- Ten shaft and six mounting options to meet the most common SAE and European requirements.
- Heavy-duty tapered roller bearings for extra side load capacity.
- Heavy-duty drive link with larger pitch diameter than competitors for greater resistance to pressure and torque spikes.
- Three zone commutator valve for high flow capacity.
- Standard case drain with integral internal drain for extended shaft seal life.

TYPICAL APPLICATIONS

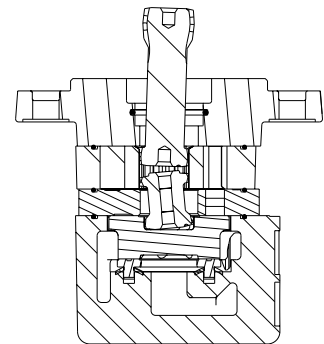
Heavy-duty wheel drives, sweepers, grain augers, spreaders, feed rollers, brush drives, mowers, harvesting equipment gear box mounts and more

SERIES DESCRIPTIONS

365/366 - Hydraulic Motor
Compact



365-366 - Hydraulic Motor
Short Motor



SPECIFICATIONS

CODE	Displacement cm ³ [in ³ /rev]	Max. Speed rpm		Max. Flow lpm [gpm]		Max. Torque Nm [lb-in]		Max. Pressure bar [psi]		
		cont.	inter.	cont.	inter.	cont.	inter.	cont.	inter.	peak
080	79 [4.8]	843	929	68 [18]	76 [20]	230 [2036]	305 [2699]	207 [3000]	276 [4000]	310 [4500]
100	100 [6.1]	756	945	76 [20]	95 [25]	270 [2390]	362 [3204]	207 [3000]	276 [4000]	310 [4500]
110	112 [6.8]	669	837	76 [20]	95 [25]	312 [2761]	418 [3699]	207 [3000]	276 [4000]	310 [4500]
130	129 [7.9]	588	734	76 [20]	95 [25]	370 [3328]	499 [4416]	207 [3000]	276 [4000]	310 [4500]
160	161 [9.8]	471	707	76 [20]	114 [30]	472 [4177]	627 [5549]	207 [3000]	276 [4000]	310 [4500]
200	201 [12.3]	377	566	76 [20]	114 [30]	579 [5124]	765 [6770]	207 [3000]	276 [4000]	310 [4500]
230	229 [14.0]	330	495	76 [20]	114 [30]	655 [5779]	872 [7717]	207 [3000]	276 [4000]	310 [4500]
250	248 [15.1]	305	459	76 [20]	114 [30]	657 [5814]	769 [6806]	190 [2750]	224 [3250]	259 [3750]
320	322 [19.6]	235	352	76 [20]	114 [30]	861 [7620]	1003 [8877]	190 [2750]	224 [3250]	259 [3750]
400	396 [24.2]	191	285	76 [20]	114 [30]	858 [7593]	1048 [9275]	155 [2250]	190 [2750]	224 [3250]
500	495 [30.2]	153	229	76 [20]	114 [30]	851 [7531]	1064 [9416]	121 [1750]	155 [2250]	172 [2500]

► Performance data is typical. Performance of production units varies slightly from one motor to another. Running at intermittent ratings should not exceed 10% of every minute of operation.

DISPLACEMENT PERFORMANCE

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

		Pressure - bar [psi]					Max. Cont.		Max. Inter.	
080		17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	172 [2500]	207 [3000]	242 [3500]	276 [4000]
79 cm³ [4.8 in³] / rev		Intermittent Ratings are below and to the right of the BOLD line.					Intermittent Ratings - 10% of Operation			
Flow - lpm [gpm]	2 [0.5]	18 [159] 23	38 [336] 22	74 [655] 19						
	4 [1]	18 [159] 50	40 [354] 47	77 [682] 42	115 [1018] 38	150 [1328] 30	182 [1611] 23			
	8 [2]	18 [159] 100	39 [345] 96	77 [682] 91	117 [1036] 82	154 [1363] 74	192 [1699] 63	224 [1983] 53		
	15 [4]	18 [159] 187	39 [345] 182	78 [690] 179	118 [1044] 169	156 [1381] 154	194 [1717] 138	230 [2036] 126	260 [2301] 107	
	23 [6]	17 [150] 290	37 [327] 282	77 [682] 272	116 [1027] 264	155 [1372] 248	192 [1699] 229	223 [1974] 217	264 [2337] 193	302 [2673] 168
	30 [8]	16 [142] 379	36 [319] 369	76 [673] 348	117 [1036] 349	155 [1372] 335	194 [1717] 315	224 [1983] 300	266 [2354] 277	304 [2691] 242
	38 [10]	14 [124] 480	34 [301] 468	73 [646] 457	114 [1009] 451	153 [1354] 435	191 [1690] 414	230 [2036] 390	265 [2345] 383	305 [2699] 340
	45 [12]	13 [115] 565	33 [292] 556	72 [637] 544	113 [1000] 537	152 [1345] 518	190 [1682] 496	223 [1974] 477	265 [2345] 447	304 [2691] 424
	53 [14]		30 [266] 655	69 [611] 642	115 [1018] 630	148 [1310] 616	189 [1673] 585	223 [1974] 572	264 [2337] 545	305 [2699] 519
	61 [16]		26 [230] 752	66 [584] 747	103 [912] 736	146 [1292] 705	182 [1611] 678	225 [1991] 650	262 [2319] 644	303 [2682] 600
Max. Max. Inter. Cont.	68 [18]		26 [230] 843	65 [575] 830	106 [938] 825	147 [1301] 798	186 [1646] 769	218 [1929] 768	260 [2301] 753	303 [2682] 682
	76 [20]			61 [540] 929	101 [894] 924	140 [1239] 898	174 [1540] 873	214 [1894] 848	258 [2283] 803	302 [2673] 772
Rotor Width		Torque - Nm [lb-in], Speed rpm								
		Overall Efficiency - 70 - 100% 40 - 69% 0 - 39%								
15.7 [617]		22 [192]	45 [394]	88 [778]	132 [1172]	176 [1556]	219 [1939]	264 [2334]	308 [2728]	351 [3111]
mm [in]		Theoretical Torque - Nm [lb-in] Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]								

		Pressure - bar [psi]					Max. Cont.		Max. Inter.						
100		17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	172 [2500]	207 [3000]	242 [3500]	276 [4000]					
100 cm³ [6.1 in³] / rev		Intermittent Ratings are below and to the right of the BOLD line.					Intermittent Ratings - 10% of Operation								
Flow - lpm [gpm]	Max. Cont.	2 [0.5]	14 [124] 19	38 [336] 19	77 [681] 17										
		4 [1]	17 [150] 39	42 [372] 39	86 [761] 37	130 [1151] 35	169 [1496] 31	205 [1814] 24							
		8 [2]	15 [133] 79	43 [381] 78	89 [788] 76	135 [1195] 73	179 [1584] 68	220 [1947] 61	259 [2292] 52	290 [2567] 35					
		15 [4]	14 [124] 148	43 [381] 148	91 [805] 145	136 [1204] 140	181 [1602] 134	224 [1982] 125	267 [2363] 113	308 [2726] 98	341 [3018] 67				
		23 [6]	14 [124] 228	43 [381] 228	90 [797] 224	137 [1212] 218	182 [1611] 209	226 [2000] 197	270 [2390] 185	314 [2779] 164	354 [3133] 135				
		30 [8]	12 [106] 299	41 [363] 298	88 [779] 294	136 [1204] 286	181 [1602] 275	225 [1991] 262	270 [2390] 246	314 [2779] 226	356 [3151] 194				
		38 [10]	10 [89] 372	38 [336] 372	85 [752] 369	132 [1168] 365	178 [1575] 351	223 [1974] 337	269 [2381] 319	315 [2788] 296	360 [3186] 263				
		45 [12]		37 [327] 444	84 [743] 435	132 [1168] 434	178 [1575] 419	223 [1974] 403	270 [2390] 384	317 [2805] 361	362 [3204] 325				
		53 [14]		35 [310] 525	82 [726] 520	129 [1142] 514	176 [1558] 498	221 [1956] 481	269 [2381] 457	317 [2805] 432	363 [3213] 397				
		61 [16]		33 [292] 604	79 [699] 600	126 [1115] 592	172 [1522] 576	218 [1929] 558	266 [2354] 533	314 [2779] 503	361 [3195] 474				
Max. Inter.	Rotor Width	68 [18]		31 [274] 675	75 [664] 674	123 [1089] 662	169 [1496] 643	216 [1912] 622	263 [2328] 597	313 [2770] 566	360 [3186] 532				
		76 [20]		29 [257] 756	71 [628] 754	120 [1062] 742	167 [1478] 723	214 [1894] 700	262 [2319] 673	310 [2744] 640	359 [3177] 600				
		83 [22]			69 [611] 825	117 [1035] 813	164 [1451] 794	211 [1967] 769	259 [2292] 743	308 [2726] 708	356 [3151] 669				
		91 [24]			65 [575] 905	114 [1009] 893	161 [1425] 875	208 [1841] 853	256 [2266] 823	305 [2699] 781	352 [3115] 749				
		95 [25]			62 [549] 945	111 [982] 931	159 [1407] 908	206 [1823] 882	254 [2248] 854	304 [2690] 805	351 [3106] 750				
		Torque - Nm [lb-in], Speed rpm					Overall Efficiency - 70 - 100%			40 - 69%			0 - 39%		
19.7 [776]		27 [239]	56 [493]	110 [972]	166 [1465]	220 [1944]	274 [2423]	329 [2916]	385 [3409]	439 [3888]					
mm [in]		Theoretical Torque - Nm [lb-in]					Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]								

DISPLACEMENT PERFORMANCE

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

		Pressure - bar [psi]								Max. Cont.		Max. Inter.	
110		17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	172 [2500]	207 [3000]	242 [3500]	276 [4000]			
112 cm ³ [6.8 in ³] / rev		Intermittent Ratings are below and to the right of the BOLD line. Intermittent Ratings - 10% of Operation											
Flow - lpm [gpm]	2 [0.5]	22 [195] 17	49 [434] 17	98 [867] 15								18	
	4 [1]	23 [204] 35	51 [451] 35	102 [903] 34	149 [1319] 32	197 [1743] 29						36	
	8 [2]	23 [204] 70	51 [451] 70	105 [929] 68	156 [1381] 66	204 [1805] 63	242 [2142] 56	281 [2487] 40	302 [2673] 24			71	
	15 [4]	22 [195] 133	50 [443] 131	103 [912] 128	156 [1381] 123	207 [1832] 117	256 [2266] 107	304 [2690] 92	345 [3053] 73	371 [3283] 41		134	
	23 [6]	22 [195] 203	48 [425] 202	101 [894] 198	156 [1381] 192	209 [1850] 184	261 [2310] 173	312 [2761] 159	361 [3195] 136	405 [3584] 106		205	
	30 [8]	20 [177] 267	45 [398] 265	100 [885] 260	155 [1372] 252	208 [1841] 242	260 [2301] 231	312 [2761] 215	363 [3213] 192	412 [3646] 159		268	
	38 [10]	19 [168] 337	42 [372] 336	95 [841] 330	153 [1354] 320	205 [1814] 308	258 [2283] 292	312 [2761] 278	363 [3213] 254	415 [3673] 224		339	
	45 [12]	17 [150] 400	42 [372] 399	94 [832] 392	151 [1336] 383	204 [1805] 370	257 [2274] 355	312 [2761] 336	366 [3239] 313	418 [3699] 277		402	
	53 [14]		38 [336] 470	93 [823] 463	148 [1310] 452	201 [1779] 437	254 [2248] 418	309 [2735] 399	364 [3221] 372	418 [3699] 338		473	
	61 [16]		36 [319] 542	90 [797] 534	142 [1257] 524	198 [1752] 509	252 [2230] 489	308 [2726] 465	362 [3204] 438	417 [3690] 407		545	
Max. Cont.	68 [18]		32 [283] 606	87 [770] 598	143 [1266] 586	195 [1726] 571	249 [2204] 549	305 [2699] 525	360 [3186] 497	415 [3673] 461		607	
	76 [20]		28 [248] 669	82 [726] 668	138 [1221] 656	191 [1690] 641	245 [2168] 618	300 [2655] 593	357 [3159] 560	412 [3646] 521		679	
	83 [22]			78 [690] 731	134 [1186] 719	185 [1637] 702	239 [2115] 679	296 [2620] 652	352 [3115] 621	408 [3611] 576		741	
	91 [24]			72 [637] 803	127 [1124] 790	181 [1602] 771	235 [2080] 747	291 [2575] 721	349 [3089] 683	406 [3593] 635		813	
	95 [25]			70 [620] 837	125 [1106] 821	179 [1584] 801	233 [2062] 780	289 [2558] 751	346 [3062] 714	403 [3567] 668		848	
Rotor Width		Torque - Nm [lb-in], Speed rpm											
		Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐											
22.1 [.871]		30 [268]	62 [552]	123 [1089]	185 [1641]	246 [2177]	307 [2713]	369 [3266]	431 [3181]	492 [4354]			
mm [in]		Theoretical Torque - Nm [lb-in] Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]											

		Pressure - bar [psi]						Max. Cont.		Max. Inter.	
130		17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	172 [2500]	207 [3000]	242 [3500]	276 [4000]	
129 cm ³ [7.9 in ³] / rev		Intermittent Ratings are below and to the right of the BOLD line.						Intermittent Ratings - 10% of Operation			
Flow - lpm [gpm]	2 [0.5]	23 [204] 15	53 [469] 15								16
	4 [1]	24 [212] 30	55 [487] 30	113 [1000] 30	167 [1478] 29	225 [1991] 27					31
	8 [2]	25 [221] 61	57 [504] 61	119 [1053] 60	179 [1584] 58	234 [2071] 54	290 [2567] 46	331 [2929] 29			62
	15 [4]	26 [230] 115	58 [513] 115	122 [1080] 113	186 [1646] 109	247 [2186] 103	306 [2708] 93	363 [3213] 77	416 [3682] 55		116
	23 [6]	25 [221] 177	57 [504] 177	122 [1080] 174	187 [1655] 169	250 [2213] 161	312 [2761] 147	373 [3301] 130	431 [3814] 105	483 [4275] 70	178
	30 [8]	23 [204] 232	57 [504] 232	120 [1062] 228	186 [1646] 222	250 [2213] 212	313 [2770] 197	376 [3328] 179	437 [3867] 156	494 [4372] 125	233
	38 [10]	22 [195] 294	54 [478] 294	118 [1044] 290	184 [1628] 283	248 [2195] 273	312 [2761] 257	376 [3328] 237	439 [3885] 212	499 [4416] 182	295
	45 [12]	20 [177] 348	53 [469] 348	116 [1027] 343	183 [1620] 334	246 [2177] 321	310 [2744] 304	375 [3319] 282	439 [3885] 255	499 [4416] 221	349
	53 [14]		49 [434] 410	113 [1000] 405	179 [1584] 395	243 [2151] 380	307 [2717] 361	373 [3301] 336	437 [3867] 311	499 [4416] 275	411
	61 [16]		46 [407] 472	110 [974] 467	176 [1558] 456	240 [2124] 439	304 [2690] 417	370 [3275] 392	435 [3850] 364	497 [4398] 328	473
Max. Cont.	68 [18]		42 [372] 526	106 [938] 521	172 [1522] 510	236 [2089] 493	300 [2655] 470	366 [3239] 442	432 [3823] 411	495 [4381] 376	527
	76 [20]		38 [336] 588	102 [903] 583	167 [1478] 572	232 [2053] 553	297 [2628] 527	363 [3213] 499	428 [3788] 467	491 [4345] 423	589
	83 [22]		33 [292] 642	98 [867] 638	164 [1451] 627	228 [2018] 607	293 [2593] 581	359 [3177] 549	423 [3744] 517	485 [4292] 473	643
	91 [24]		30 [266] 704	93 [823] 702	158 [1398] 692	222 [1965] 677	288 [2549] 648	354 [3133] 625	421 [3726] 576	483 [4275] 531	705
	95 [25]		27 [239] 734	91 [805] 733	158 [1398] 720	220 [1947] 703	286 [2531] 672	351 [3106] 639	419 [3708] 602	483 [4275] 559	736
Rotor Width		Torque - Nm [lb-in], Speed rpm									
		Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐									
25.4 [1.000]		35 [309]	72 [636]	142 [1254]	214 [1890]	283 [2508]	353 [3125]	425 [3761]	497 [4397]	567 [5015]	
mm [in]		Theoretical Torque - Nm [lb-in]									
Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]											

DISPLACEMENT PERFORMANCE

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

		Pressure - bar [psi]					Max. Cont.		Max. Inter.				
160		17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	172 [2500]	207 [3000]	242 [3500]	276 [4000]			
161 cm³ [9.8 in³] / rev		Intermittent Ratings are below and to the right of the BOLD line.					Intermittent Ratings - 10% of Operation						
Flow - lpm [gpm]	Max. Cont.	2 [0.5]	21 [186] 11	65 [575] 10							12	Theoretical rpm	
		4 [1]	29 [257] 24	67 [593] 24	140 [1239] 23	209 [1850] 21					25		
		8 [2]	31 [274] 49	71 [628] 48	143 [1266] 47	214 [1894] 46	285 [2522] 43	352 [3115] 36			50		
		15 [4]	34 [301] 92	75 [664] 92	154 [1363] 91	231 [2044] 88	306 [2708] 84	380 [3363] 77	454 [4018] 64	519 [4593] 43	93		
		23 [6]	32 [283] 142	75 [664] 141	155 [1372] 140	235 [2080] 139	314 [2779] 133	390 [3452] 123	466 [4124] 108	537 [4752] 85	604 [5345] 52		143
		30 [8]	31 [274] 185	73 [646] 185	154 [1363] 184	234 [2071] 183	315 [2788] 178	394 [3487] 166	472 [4177] 151	547 [4841] 130	615 [5443] 99		186
		38 [10]	28 [248] 233	72 [637] 231	153 [1354] 229	231 [2044] 229	311 [2752] 223	391 [3460] 210	471 [4168] 194	548 [4850] 175	620 [5487] 144		236
		45 [12]	25 [221] 280	67 [593] 280	151 [1336] 272	229 [2027] 269	310 [2744] 260	391 [3460] 243	466 [4124] 227	544 [4814] 202	624 [5522] 159		280
		53 [14]	23 [204] 328	63 [558] 327	145 [1283] 320	227 [2009] 312	307 [2717] 303	388 [3434] 288	467 [4133] 271	548 [4850] 247	622 [5505] 216		329
		61 [16]		58 [513] 378	139 [1230] 372	221 [1956] 366	302 [2673] 361	386 [3416] 350	468 [4142] 328	549 [4859] 305	626 [5540] 273		379
68 [18]		53 [469] 418	135 [1195] 412	217 [1920] 410	298 [2637] 406	380 [3363] 389	468 [4142] 370	549 [4859] 348	627 [5549] 312	422			
76 [20]		53 [469] 471	133 [1177] 467	216 [1912] 455	296 [2620] 440	377 [3336] 423	461 [4080] 397	544 [4814] 368	609 [5390] 348	472			
83 [22]		44 [389] 515	126 [1115] 514	205 [1814] 513	282 [2496] 504	359 [3177] 491	440 [3894] 467	523 [4629] 434	602 [5328] 384	516			
91 [24]		38 [336] 560	119 [1053] 556	207 [1832] 547	284 [2513] 546	368 [3257] 532	440 [3894] 515	521 [4611] 493	606 [5363] 461	565			
95 [25]		34 [301] 585	112 [991] 580	194 [1717] 579	276 [2443] 574	365 [3230] 555	445 [3938] 540			590			
114 [30]			94 [832] 707	177 [1566] 706	269 [2381] 687	341 [3018] 676	418 [3699] 654			708			
Rotor Width		Torque - Nm [lb-in], Speed rpm											
Overall Efficiency - 70 - 100%		40 - 69% 0 - 39%											
31.8 [1.251]		44 [386]	90 [794]	177 [1565]	266 [2358]	354 [3130]	441 [3901]	530 [4694]	620 [5488]	707 [6259]			
mm [in]		Theoretical Torque - Nm [lb-in]											
Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]													

		Pressure - bar [psi]					Max. Cont.			Max. Inter.				
200		17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	172 [2500]	190 [2750]	207 [3000]	242 [3500]	276 [4000]			
201 cm ³ [12.3 in ³] / rev		Intermittent Ratings are below and to the right of the BOLD line.					Intermittent Ratings - 10% of Operation							
Flow - lpm [gpm]	Max. Cont.	4 [1]	40 [354] 19	87 [770] 18	189 [1673] 17	282 [2496] 15						20	Theoretical rpm	
		8 [2]	44 [389] 39	97 [858] 39	192 [1699] 38	286 [2531] 37	370 [3275] 36	456 [4036] 33				40		
		15 [4]	45 [398] 74	99 [876] 74	198 [1752] 73	298 [2637] 71	391 [3460] 67	481 [4257] 63	526 [4655] 60	566 [5009] 57	645 [5708] 50	75		
		23 [6]	42 [372] 113	97 [858] 113	196 [1735] 112	296 [2620] 108	389 [3443] 104	478 [4230] 98	523 [4629] 93	568 [5027] 93	653 [5779] 80	724 [6407] 66		114
		30 [8]	40 [354] 148	94 [832] 147	194 [1717] 146	293 [2593] 142	388 [3434] 136	478 [4230] 129	525 [4646] 125	568 [5027] 121	658 [5823] 109	724 [6407] 96		149
		38 [10]	36 [319] 188	91 [805] 187	191 [1690] 186	292 [2584] 181	388 [3434] 175	483 [4275] 167	533 [4717] 162	579 [5124] 158	672 [5947] 146	759 [6717] 126		189
		45 [12]	32 [283] 223	87 [770] 222	186 [1646] 221	288 [2549] 217	386 [3416] 208	482 [4266] 198	532 [4708] 194	579 [5124] 188	675 [5974] 175	765 [6770] 162		224
		53 [14]	30 [266] 263	81 [717] 262	181 [1602] 261	283 [2505] 257	382 [3381] 248	479 [4239] 236	528 [4673] 235	576 [5098] 224	673 [5956] 212	765 [6770] 194		264
		61 [16]	27 [239] 302	72 [637] 301	172 [1522] 299	276 [2443] 297	375 [3319] 288	473 [4186] 276	524 [4637] 269	571 [5053] 263	667 [5903] 248	761 [6735] 231		303
		68 [18]		66 [584] 337	167 [1478] 336	269 [2381] 332	368 [3257] 324	466 [4124] 312	518 [4584] 303	566 [5009] 297	664 [5876] 279	757 [6699] 262		338
Max. Inter.		76 [20]		58 [513] 377	157 [1389] 375	260 [2301] 372	359 [3177] 364	457 [4044] 353	510 [4514] 343	559 [4947] 336	656 [5806] 320	751 [6646] 302	378	
		83 [22]		50 [443] 412	153 [1354] 410	251 [2221] 408	352 [3115] 398	449 [3974] 387	503 [4452] 377	550 [4868] 372			413	
		91 [24]		41 [363] 452	145 [1283] 450	244 [2159] 448	346 [3062] 436	445 [3938] 421	496 [4390] 415	538 [4761] 410			453	
		95 [25]			139 [1230] 472	239 [2115] 466	339 [3000] 456	438 [3876] 441	491 [4345] 430	539 [4770] 423			473	
		114 [30]			116 [1027] 566	213 [1885] 561	313 [2770] 549	416 [3682] 531	468 [4142] 521	512 [4531] 519			567	
Rotor Width		Torque - Nm [lb-in], Speed rpm										Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐		
39.4 [1.552] mm [in]		54 [481]	112 [991]	221 [1954]	333 [2944]	441 [3907]	550 [4870]	608 [5379]	662 [5861]	774 [6852]	883 [7814]			
		Theoretical Torque - Nm [lb-in]					Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]							

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

17	l theoretical ppm
35	
66	
100	
131	
166	
197	
231	
266	
297	
332	
362	
397	
415	
498	

16	theoretical ppm
32	
60	
93	
121	
153	
181	
214	
246	
274	
306	
335	
367	
383	
460	

DISPLACEMENT PERFORMANCE

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

		Pressure - bar [psi]								Max. Cont.		Max. Inter.		
320		17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	155 [2250]	172 [2500]	190 [2750]	207 [3000]	224 [3250]			
322 cm³ [19.6 in³] / rev		Intermittent Ratings are below and to the right of the BOLD line.								Intermittent Ratings - 10% of Operation				
Flow - lpm [gpm]	4 [1]	68 [602] 11	145 [1283] 9									12	Theoretical rpm	
	8 [2]	77 [681] 24	156 [1381] 24	311 [2752] 23	455 [4027] 21	590 [5222] 20	640 [5664] 19					25		
	15 [4]	77 [681] 46	160 [1416] 45	311 [2752] 43	458 [4053] 40	594 [5257] 36	655 [5797] 32	705 [6239] 28	770 [6815] 24	835 [7390] 18		47		
	23 [6]	73 [646] 70	157 [1389] 69	316 [2797] 68	478 [4230] 64	628 [5558] 57	698 [6177] 53	768 [6797] 48	841 [7443] 43	910 [8054] 38	975 [8629] 30	71		
	30 [8]	69 [611] 92	154 [1363] 90	316 [2797] 87	479 [4239] 83	631 [5584] 77	705 [6239] 73	780 [6903] 68	860 [7611] 63	929 [8222] 57	998 [8832] 49	93		
	38 [10]	64 [566] 116	150 [1328] 114	311 [2752] 111	480 [4248] 106	631 [5584] 100	709 [6275] 96	784 [6938] 90	861 [7620] 83	930 [8231] 79	1000 [8850] 72	118		
	45 [12]	59 [522] 138	143 [1266] 136	305 [2699] 133	471 [4168] 127	632 [5593] 119	705 [6239] 115	783 [6930] 110	860 [7611] 105	934 [8266] 98	1000 [8850] 86	140		
	53 [14]	49 [434] 162	137 [1212] 160	297 [2628] 157	463 [4098] 151	627 [5549] 142	697 [6168] 138	778 [6885] 132	858 [7593] 126	937 [8292] 120	1003 [8877] 113	165		
	61 [16]	41 [363] 187	128 [1133] 185	288 [2549] 182	457 [4044] 175	616 [5452] 167	689 [6098] 161	769 [6806] 156	847 [7496] 150					189
	68 [18]	35 [310] 210	120 [1062] 208	282 [2496] 201	452 [4000] 192	609 [5390] 182	683 [6045] 176	762 [6744] 170	841 [7443] 163					211
Max. Cont.	76 [20]	26 [230] 235	113 [1000] 230	273 [2416] 225	443 [3921] 216	603 [5337] 203	664 [5876] 199	744 [6584] 192	830 [7346] 184				236	
	83 [22]		99 [876] 256	262 [2319] 247	430 [3806] 240	590 [5222] 225	660 [5841] 219	741 [6558] 212	820 [7257] 202				258	
	91 [24]		85 [752] 282	246 [2177] 273	415 [3673] 267	576 [5098] 249	654 [5788] 242	731 [6469] 233	810 [7169] 225				283	
	95 [25]		76 [673] 294	241 [2133] 286	404 [3575] 281	571 [5053] 261	648 [5735] 254	719 [6363] 246	804 [7115] 236				295	
	114 [30]		44 [389] 352	204 [1805] 345	371 [3283] 337	538 [4761] 321	602 [5328] 314	685 [6062] 304	766 [6779] 293				354	
Rotor Width		Torque - Nm [lb-in], Speed rpm												
63.5 [2.501]		Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐												
mm [in]		87 [771]	179 [1587]	354 [3130]	533 [4717]	707 [6259]	794 [7030]	881 [7801]	974 [8618]	1061 [9389]	1148 [10160]			
		Theoretical Torque - Nm [lb-in] Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]												

		Pressure - bar [psi]						Max. Cont.		Max. Inter.				
400		17 [250]	35 [500]	69 [1000]	86 [1250]	104 [1500]	121 [1750]	138 [2000]	155 [2250]	172 [2500]	190 [2750]			
396 cm³ [24.2 in³] / rev														
Intermittent Ratings are below and to the right of the BOLD line.														
Intermittent Ratings - 10% of Operation														
Flow - lpm [gpm]	4 [1]	78 [690] 9	180 [1593] 8								10			
	8 [2]	84 [743] 19	185 [1637] 19	380 [3363] 18	460 [4071] 18	555 [4912] 17	640 [5664] 15				20			
	15 [4]	84 [743] 37	185 [1637] 36	374 [3310] 36	468 [4142] 35	559 [4947] 34	648 [5735] 30	736 [6514] 26			38			
	23 [6]	77 [681] 57	182 [1611] 56	374 [3310] 55	469 [4151] 53	567 [5018] 50	650 [5753] 46	747 [6611] 41	839 [7425] 37	920 [8142] 30	1002 [8868] 24	58		
	30 [8]	76 [673] 75	181 [1602] 74	376 [3328] 71	473 [4186] 69	575 [5089] 65	670 [5930] 61	763 [6753] 56	854 [7558] 50	944 [8354] 43	1043 [9231] 36	76		
	38 [10]	67 [593] 95	175 [1549] 94	375 [3319] 91	473 [4186] 89	575 [5089] 84	671 [5938] 79	764 [6761] 74	858 [7593] 68	951 [8416] 62	1048 [9275] 55	96		
	45 [12]	57 [504] 113	165 [1460] 112	367 [3248] 109	467 [4133] 106	572 [5062] 102	668 [5912] 97	762 [6744] 90	852 [7540] 82	943 [8346] 77	1044 [9239] 69	114		
	53 [14]	44 [389] 133	154 [1363] 132	355 [3142] 130	454 [4018] 127	560 [4956] 123	659 [5832] 118	756 [6691] 112	851 [7531] 104	943 [8346] 96	1032 [9133] 84	134		
	61 [16]	32 [283] 153	142 [1257] 153	343 [3036] 149	444 [3929] 146	549 [4859] 141	647 [5726] 135	743 [6576] 129	837 [7407] 123	932 [8248] 114		154		
	68 [18]		123 [1089] 170	332 [2938] 166	432 [3823] 162	538 [4761] 156	635 [5620] 150	726 [6425] 145	827 [7319] 137			172		
Max. Cont.	76 [20]		106 [938] 191	316 [2797] 185	418 [3699] 181	523 [4629] 176	619 [5478] 169	717 [6345] 162	812 [7186] 156			192		
	83 [22]		100 [885] 208	299 [2646] 205	402 [3558] 201	506 [4478] 195	601 [5319] 191	700 [6195] 183	797 [7053] 176			210		
	91 [24]		69 [611] 229	277 [2451] 226	378 [3345] 223	479 [4239] 219	579 [5124] 213	676 [5983] 206	773 [6841] 199			230		
	99 [26]		46 [407] 249	257 [2274] 247	353 [3124] 245	454 [4018] 241	555 [4912] 236	658 [5823] 228	752 [6655] 222			250		
Max. Inter.	114 [30]			210 [1859] 285	307 [2717] 283	416 [3682] 279	517 [4575] 273	614 [5434] 266	710 [6284] 259			288		
Rotor Width		Torque - Nm [lb-in], Speed rpm												
63.5 [2.501]		Overall Efficiency - 70 - 100%										☐ 40 - 69%	☐ 0 - 39%	☒
mm [in]		107 [948]	221 [1952]	435 [3849]	542 [4797]	655 [5801]	763 [6749]	870 [7698]	977 [8646]	1084 [9594]	1198 [10598]			
		Theoretical Torque - Nm [lb-in]										Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]		

WS (365/366 Series)

Heavy Duty Hydraulic Motor



DISPLACEMENT PERFORMANCE

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

		Pressure - bar [psi]						Max. Cont.		Max. Inter.	
500		17 [250]	35 [500]	52 [750]	69 [1000]	86 [1250]	104 [1500]	121 [1750]	138 [2000]	155 [2250]	
495 cm³ [30.2 in³] / rev											
Intermittent Ratings are below and to the right of the BOLD line.											
Intermittent Ratings - 10% of Operation											
Flow - lpm [gpm]	8 [2]	110 [974] 15	236 [2089] 15	352 [3115] 15	467 [4133] 14	581 [5142] 14	699 [6186] 13				16
	15 [4]	108 [956] 29	241 [2133] 29	365 [3230] 29	488 [4319] 28	605 [5354] 28	739 [6540] 27	836 [7399] 25			30
	23 [6]	106 [938] 45	240 [2124] 45	366 [3239] 45	488 [4319] 44	610 [5399] 44	738 [6531] 42	851 [7531] 37	961 [8505] 31		46
	30 [8]	98 [867] 60	234 [2071] 60	359 [3177] 60	483 [4275] 59	604 [5345] 58	734 [6496] 56	849 [7514] 52	964 [8531] 45	1063 [9408] 37	61
	38 [10]	87 [770] 76	224 [1982] 76	348 [3080] 76	473 [4186] 75	595 [5266] 74	723 [6399] 71	840 [7434] 67	955 [8452] 61	1063 [9408] 53	77
	45 [12]	76 [673] 90	210 [1859] 90	336 [2974] 90	463 [4098] 89	586 [5186] 88	714 [6319] 85	835 [7390] 80	952 [8425] 73	1064 [9416] 65	91
	53 [14]	60 [531] 106	194 [1717] 106	319 [2823] 106	445 [3938] 105	570 [5045] 104	699 [6186] 101	819 [7248] 96	935 [8275] 88	1050 [9293] 79	107
	61 [16]	40 [354] 122	177 [1566] 122	303 [2682] 121	426 [3770] 121	550 [4868] 120	681 [6027] 117	805 [7124] 106	918 [8124] 106		123
	68 [18]		154 [1363] 136	284 [2513] 136	408 [3611] 135	535 [4735] 134	665 [5885] 131	785 [6947] 126			137
	Max. Cont.	76 [20]		128 [1133] 153	261 [2310] 153	386 [3416] 152	510 [4514] 150	638 [5646] 147	761 [6735] 142		
83 [22]			108 [956] 167	237 [2097] 167	361 [3195] 166	487 [4310] 165	606 [5363] 163	738 [6531] 157			168
91 [24]				206 [1823] 183	343 [3036] 182	465 [4115] 180	595 [5266] 175	719 [6363] 170			184
99 [26]				181 [1602] 199	317 [2805] 198	435 [3850] 196	574 [5080] 191	697 [6168] 184			200
Max. Inter.	114 [30]			117 [1035] 229	251 [2221] 229	381 [3372] 226	516 [4567] 221	641 [5673] 214			230
Rotor Width											
78.9 [3.105]											
mm [in]											
		</									

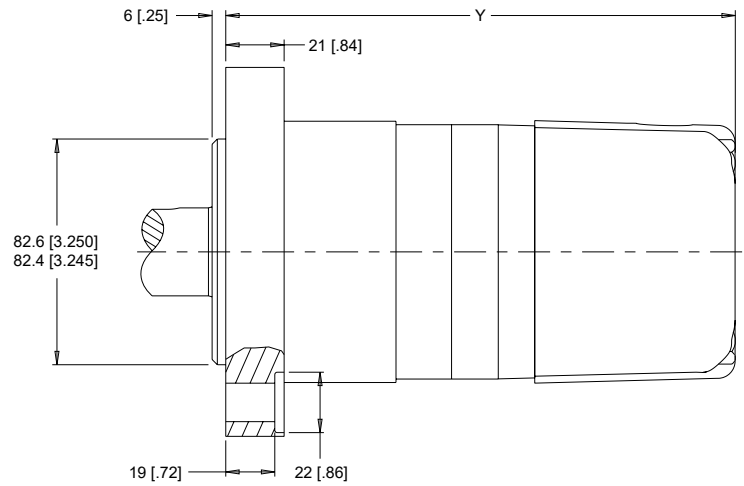
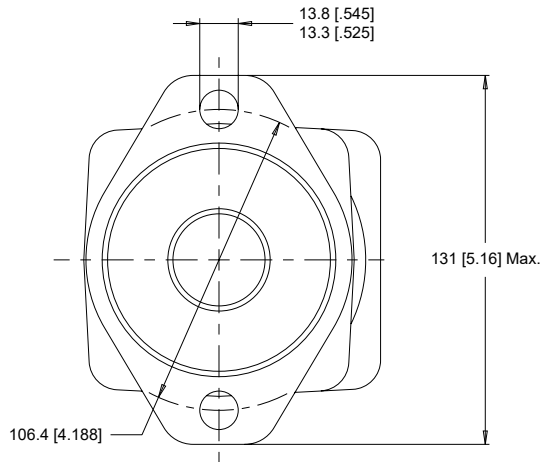
HOUSINGS

► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

2-HOLE, SAE A MOUNT

A0 End Ports

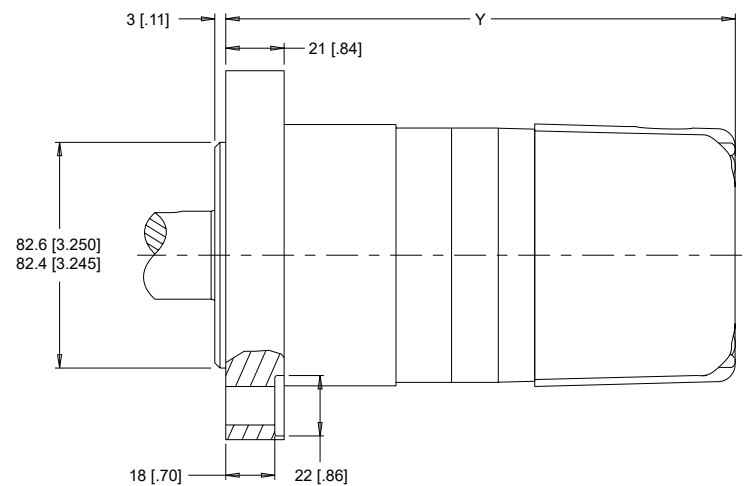
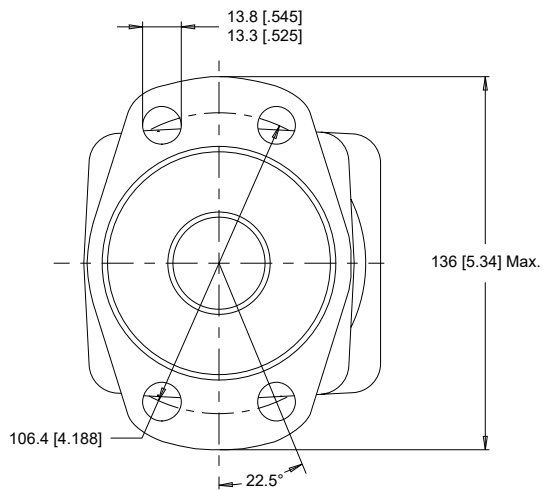
A7 Side Ports



4-HOLE, MAGNETO MOUNT

A2 End Ports

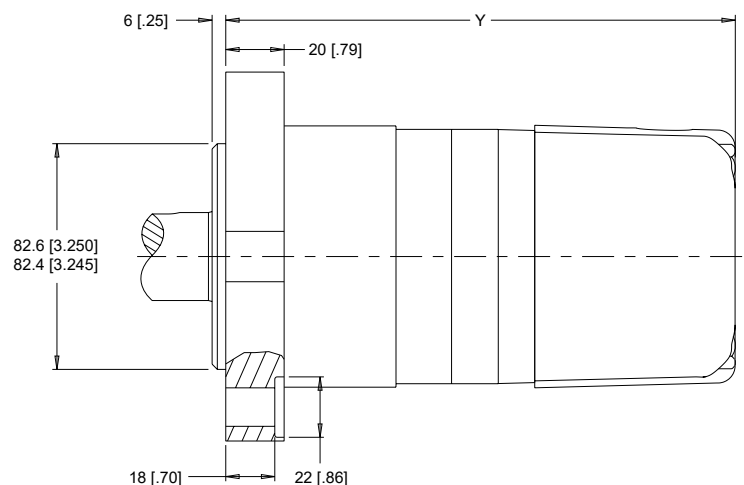
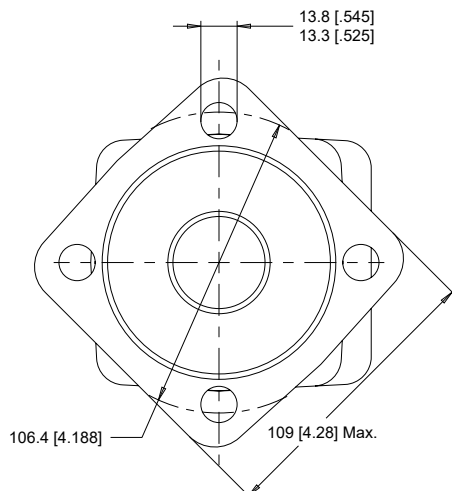
A8 Side Ports



4-HOLE, SAE A MOUNT

AG End Ports

AH Side Ports

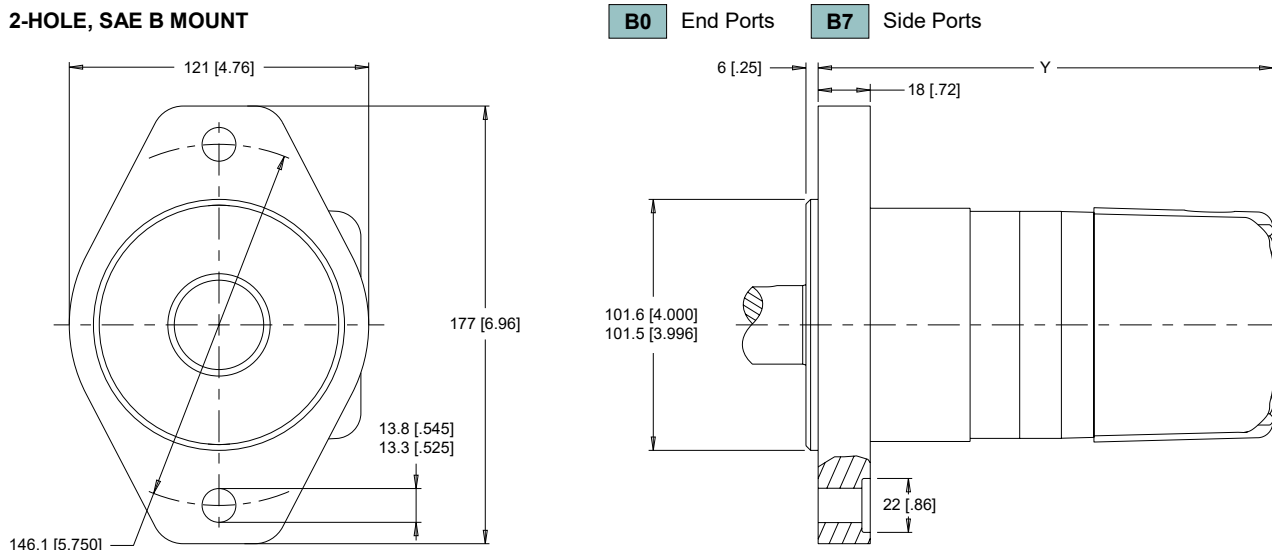


► Dimension Y is charted on page 24.

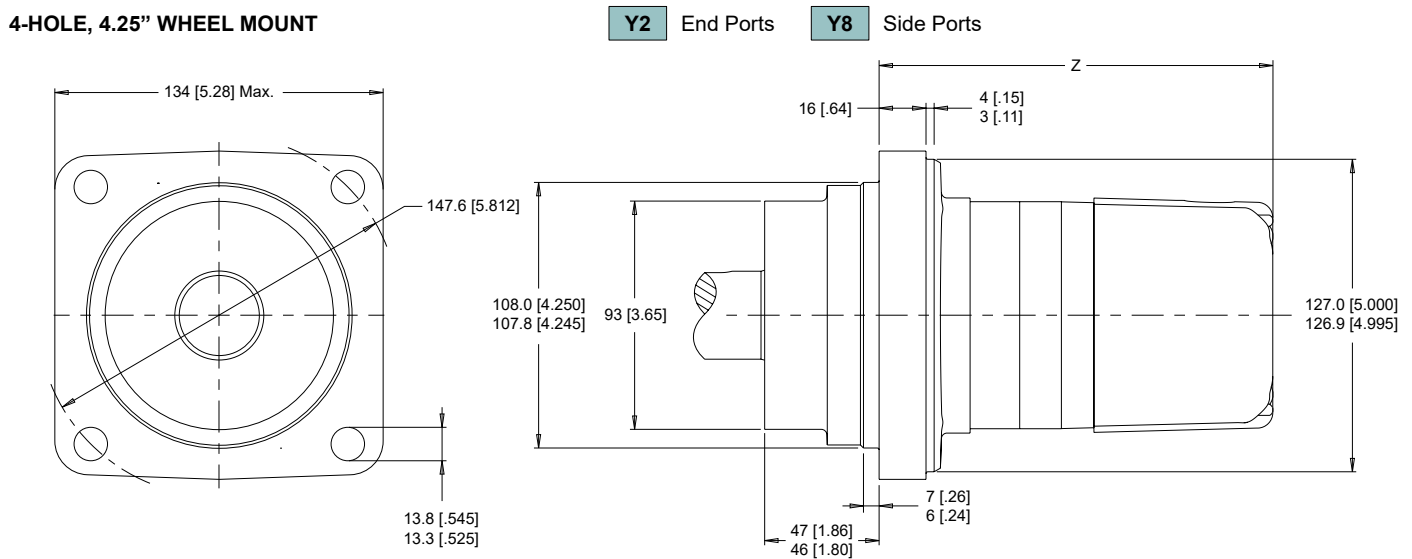
HOUSINGS

► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

2-HOLE, SAE B MOUNT



4-HOLE, 4.25" WHEEL MOUNT



► Dimensions Y & Z are charted on page 24. Porting options listed on pages 26-27.

LENGTH & WEIGHT CHARTS

Dimension Y is the overall motor length from the rear of the motor to the mounting flange surface and is referenced on detailed housing drawings listed on pages 23 & 24.

Y	SAE A & B Mounts	Magneto Mounts	Weight
#	mm [in]	mm [in]	kg [lb]
080	181 [7.12]	185 [7.27]	11.0 [24.2]
100	185 [7.27]	189 [7.42]	11.3 [24.9]
110	187 [7.36]	191 [7.51]	11.4 [25.1]
130	190 [7.49]	194 [7.64]	11.5 [25.3]
160	197 [7.74]	201 [7.89]	11.8 [26.0]
200	204 [8.04]	208 [8.19]	12.2 [26.8]
230	210 [8.28]	214 [8.43]	12.6 [27.7]
250	204 [8.04]	208 [8.19]	12.2 [26.8]
320	228 [8.99]	232 [9.14]	13.5 [29.7]
400	228 [8.99]	232 [9.14]	13.5 [29.7]
500	244 [9.60]	248 [9.75]	14.2 [31.2]

► Add 1.2 kg [2.6 lb] to the weight listed to the right for SAE B mount housings.

Dimension Z is the overall motor length from the rear of the motor to the mounting flange surface and is referenced on the detailed housing drawing above.

Z	Length	Weight
#	mm [in]	kg [lb]
080	141 [5.55]	12.2 [26.9]
100	145 [5.69]	12.5 [27.5]
110	147 [5.78]	12.6 [27.7]
130	150 [5.91]	12.7 [27.9]
160	157 [6.16]	13.0 [28.6]
200	164 [6.46]	13.4 [29.5]
230	170 [6.70]	13.8 [30.4]
250	164 [6.46]	13.4 [29.5]
320	188 [7.41]	14.7 [32.3]
400	188 [7.41]	14.7 [32.3]
500	204 [8.02]	15.4 [33.9]

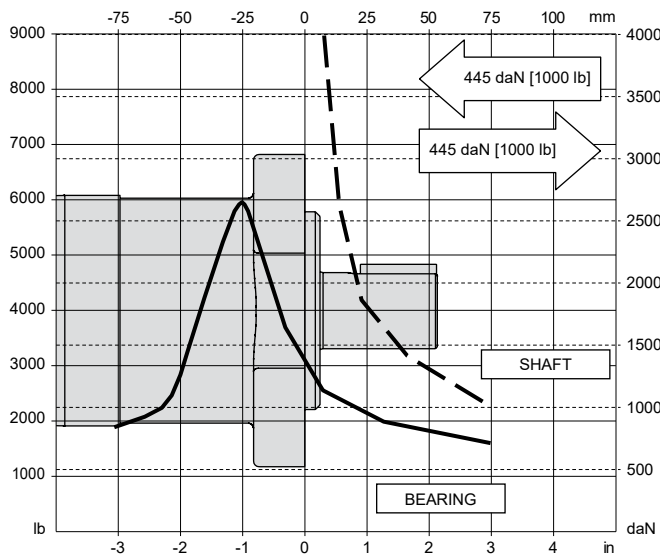
► 360 series motor weights can vary $\pm$ 1kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

TECHNICAL INFORMATION

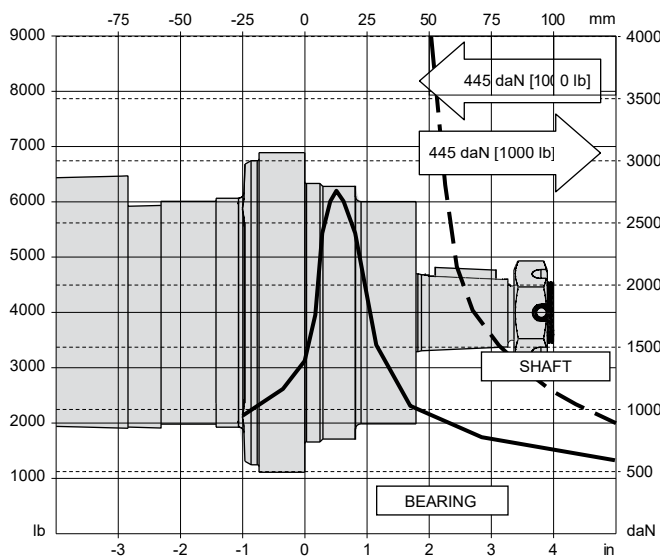
ALLOWABLE SHAFT LOAD / BEARING CURVE

The bearing curve represents allowable bearing loads for a B10 life of 2,000 hours at 100 rpm. The curve includes effects of 1,000 lbs inward/outward net thrust*. Radial loads for speeds other than 100 rpm may be calculated using the multiplication factor on page 7.

SAE A, SAE B & MAGNETO MOUNTS



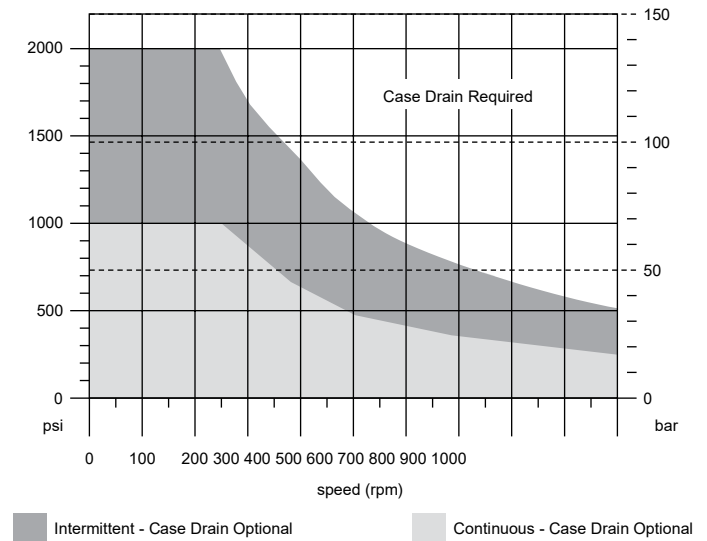
4.25" WHEEL MOUNT



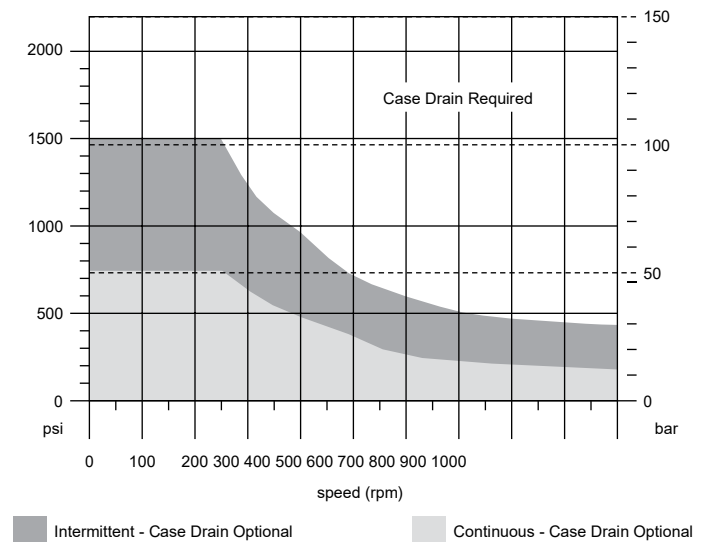
* Case pressure will push outward on the shaft. If case drain line is attached and routed directly to tank, case pressure should be negligible. If case drain line is not attached, case pressure will be nearly the same as motor return pressure. When case pressure is acting, the allowable inward axial load can be increased and the allowable outward axial load must be decreased at a rate of 59 kg / 7 bar [130 lb / 100 psi] for shaft codes 02, 10, 12, 20, 21, 22 & 23. The rate for shaft codes 28 & 31 is 78 kg / 7 bar [175 lb / 100 psi].

PERMISSIBLE SHAFT SEAL PRESSURE

MOTORS WITH SHAFT DIAMETERS 1-1/4" OR LESS



MOTORS WITH SHAFT DIAMETERS LARGER THAN 1-1/4"



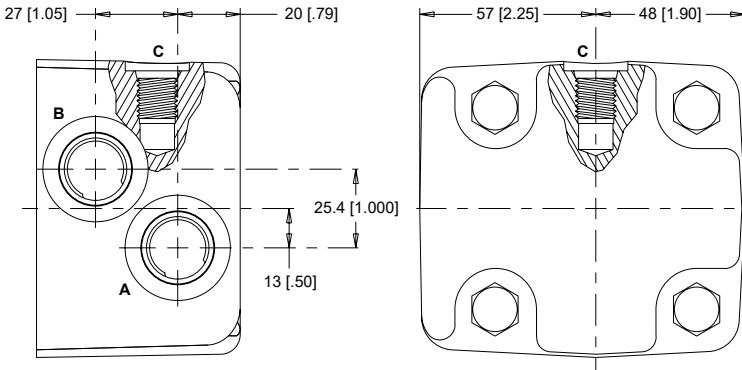
PORTING

SIDE PORTED - OFFSET

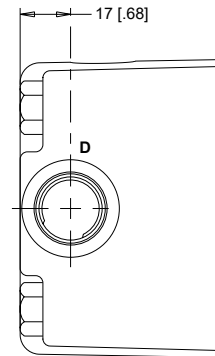
1 Main Ports **A, B:** 7/8-14 UNF
Drain Port **C:** 7/16-20 UNF

2 Main Ports **A, B:** G 1/2
Drain Port **C:** G 1/4

STANDARD



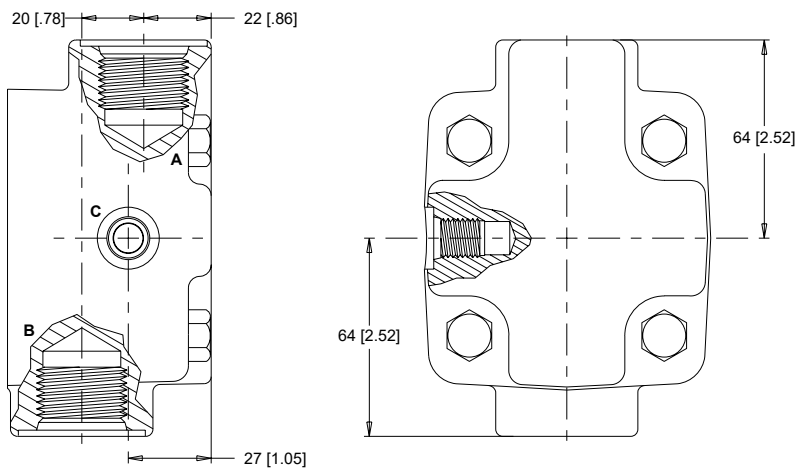
OPTIONAL



D: 10 Series/2-Way Valve Cavity 7/8-14 UNF

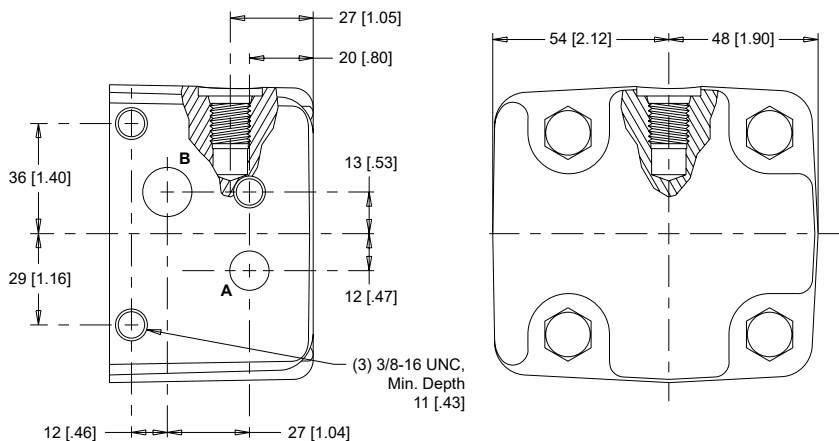
SIDE PORTED - 180° OPPOSED

6 Main Ports **A, B:** 1 1/16-12 UN
Drain Port **C:** 7/16-20 UNF



SIDE PORTED - OFFSET MANIFOLD

B Main Ports **A:** 12.7 [.500] Drilled **B:** 15.9 [.625] Drilled
Drain Port **C:** 7/16-20 UNF

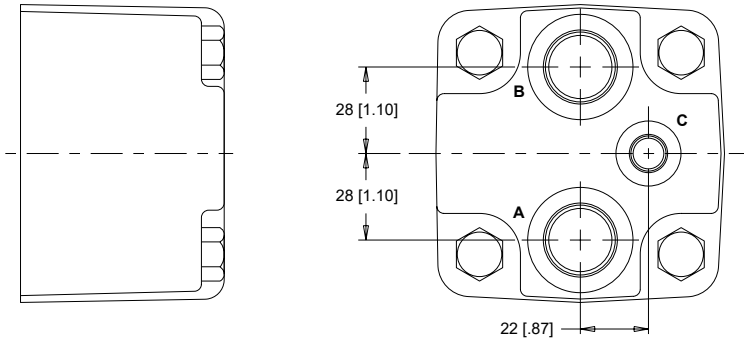


PORTING

END PORTED - ALIGNED

1 Main Ports **A, B:** 7/8-14 UNF
Drain Port **C:** 7/16-20 UNF

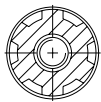
2 Main Ports **A, B:** G 1/2
Drain Port **C:** G 1/4



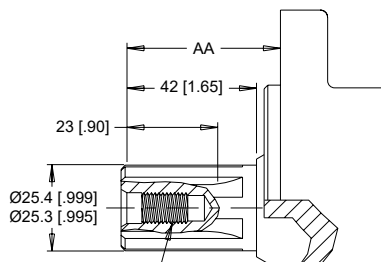
SHAFTS

02 1" 6B Spline

6B Spline
SAE J499 Standard

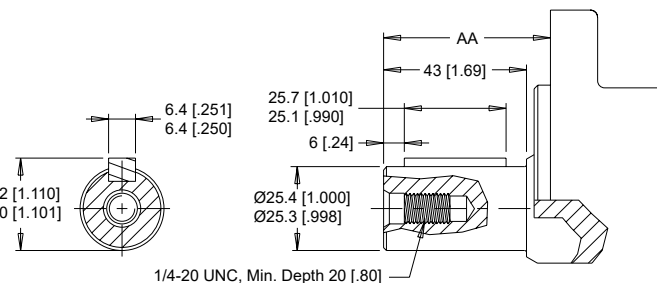


1/4-20 UNC, Min. Depth 20 [.80]



Max. Torque: 678 Nm [6000 lb-in]

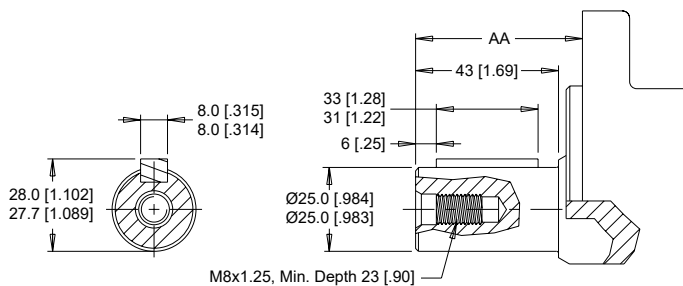
10 1" Straight



1/4-20 UNC, Min. Depth 20 [.80]

Max. Torque: 655 Nm [5800 lb-in]

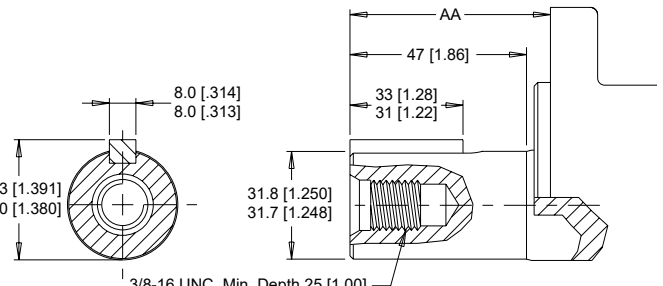
12 25mm Straight



M8x1.25, Min. Depth 23 [.90]

Max. Torque: 678 Nm [6000 lb-in]

20 1-1/4" Straight



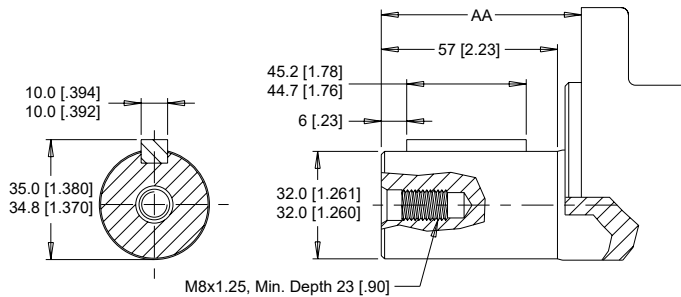
3/8-16 UNC, Min. Depth 25 [1.00]

Max. Torque: 881 Nm [7800 lb-in]

► Dimension AA is charted on page 28.

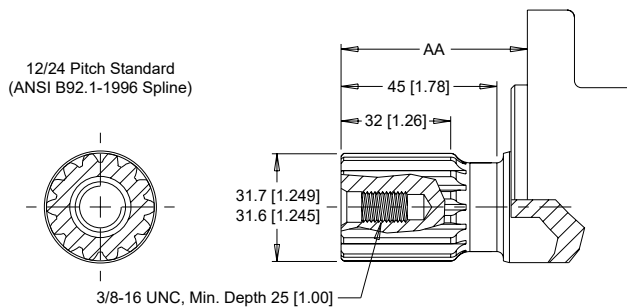
SHAFTS

21 32mm Straight



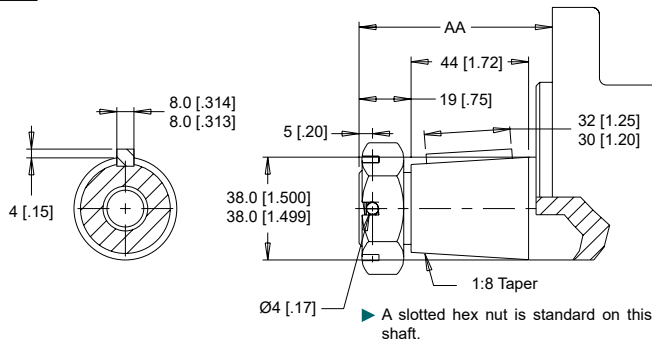
Max. Torque: 881 Nm [7800 lb-in]

23 14 Tooth Spline



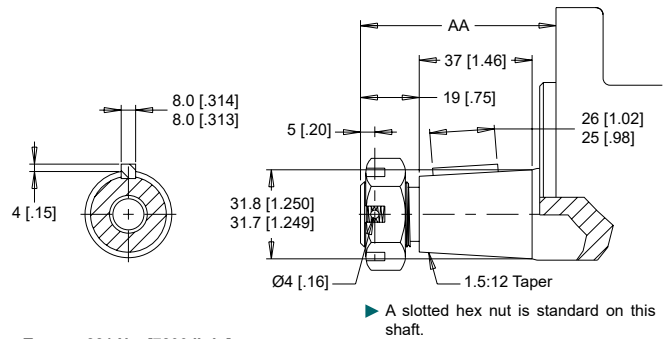
Max. Torque: 881 Nm [7800 lb-in]

31 1-1/2" Tapered



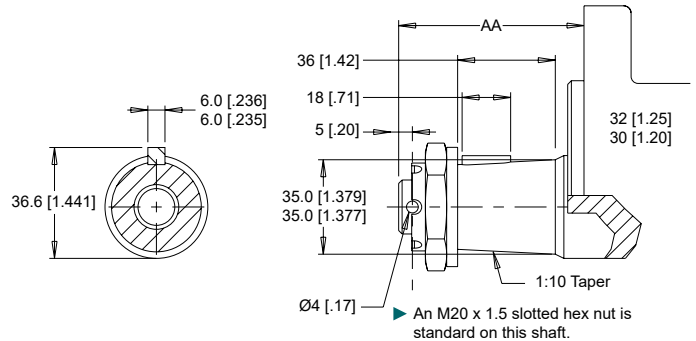
Max. Torque: 881 Nm [7800 lb-in]

22 1-1/4" Tapered



Max. Torque: 881 Nm [7800 lb-in]

28 35mm Tapered



Max. Torque: 881 Nm [7800 lb-in]

MOUNTING / SHAFT LENGTH CHART

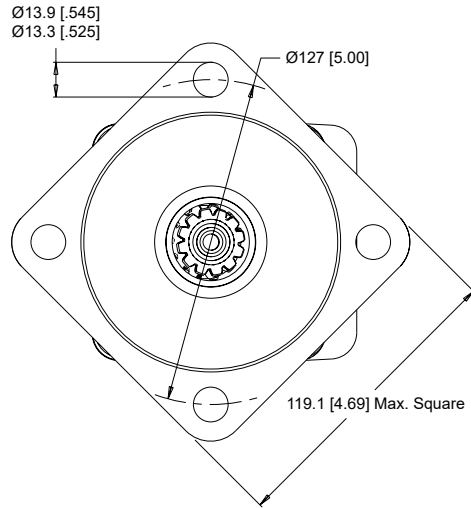
Dimension AA is the overall distance from the motor mounting surface to the end of the shaft and is referenced on detailed shaft drawings above as well as shafts on page 27.

► Shaft lengths vary ± 0.8 mm [0.030 in.]

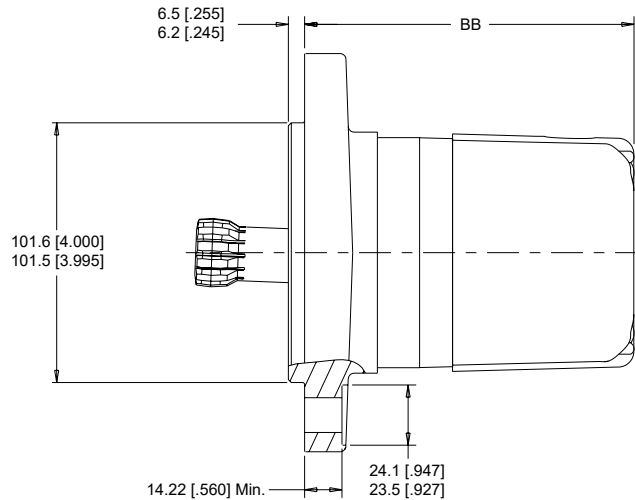
AA	SAE A & B Mounts	Magneto Mounts	Wheel Mounts
#	mm [in]	mm [in]	mm [in]
02	51 [2.00]	47 [1.85]	91 [3.58]
10	51 [2.00]	47 [1.85]	91 [3.58]
12	51 [2.00]	47 [1.85]	91 [3.58]
20	55 [2.17]	52 [2.03]	96 [3.76]
21	65 [2.54]	61 [2.39]	105 [4.12]
22	64 [2.51]	60 [2.36]	104 [4.09]
23	55 [2.17]	52 [2.03]	96 [3.76]
28	N/A	N/A	107 [4.20]
31	N/A	N/A	123 [4.86]

HOUSINGS

4-HOLE, 4.00" PILOT MOUNT



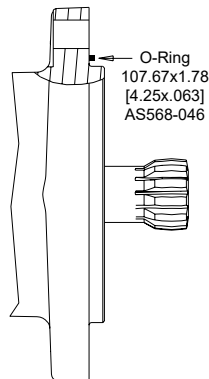
S2 End Ports S8 Side Ports



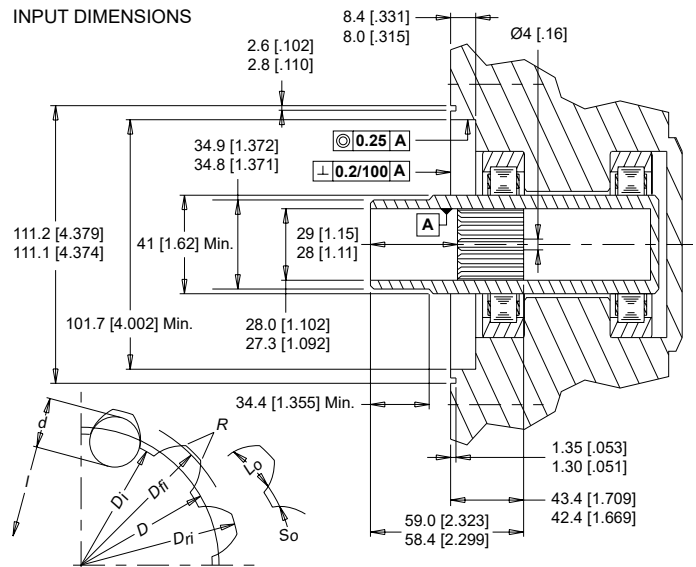
SHAFTS

0B Cardan (For Use With S2 & S8 Mounts)

Fillet Root Side Fit	
Number of Teeth	12
Pitch	12/24
Pressure Angle	30°
Pitch Diameter D	25.4 [1.000]
Base Diameter	21.997 [8660]
Major Diameter D_{ri}	27.74 [1.092] - 27.59 [1.086]
Form Diameter (Min.) D_{fi}	26.93 [1.060]
Minor Diameter D_j	23.224 [9143] - 23.097 [9093]
Space Width (Circular) L_0^*	
Max. Actual	4.318 [1.700]
Min. Effective	4.216 [1.660]
Fillet Radius R	0.76 [0.030] - 0.64 [0.025]
Max. Distance Between Pins L	19.190 [7555] - 19.020 [7488]
Pin Diameter d	4.496 [1.770]
with 3.38 [1.33] Flat for Root Clearance.	



INPUT DIMENSIONS



- The recommended shaft material is SAE 8620 or similar case hardening steel such as 20 MoCr4 (900 N/mm²) hardened to 59 - 62 HRC to a depth of 0.762 - 1.016 [0.030 - .040].
*Dimensions apply after heat treatment.

LENGTH & WEIGHT CHART

Dimension BB is the overall motor length from the rear of the motor to the mounting flange surface and is referenced on the detailed housing drawing above.

BB	Length	Weight
#	mm [in]	kg [lb]
080	124 [4.88]	12.2 [26.8]
100	128 [5.04]	12.5 [27.5]
110	130 [5.14]	12.6 [27.8]
130	134 [5.27]	12.8 [28.2]
160	140 [5.52]	13.3 [29.2]
200	148 [5.82]	13.6 [29.9]
230	154 [6.06]	14.0 [30.8]
250	148 [5.82]	13.6 [29.9]
320	172 [6.77]	15.0 [32.9]
400	172 [6.77]	15.0 [32.9]
500	187 [7.37]	15.8 [34.7]

- 360 series short motor weights can vary ± 1 kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

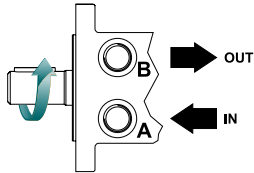
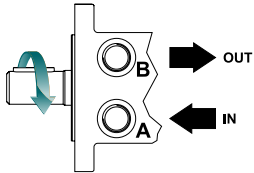
ORDERING INFORMATION



1. CHOOSE SERIES DESIGNATION

365 Clockwise Rotation

366 Counterclockwise Rotation



► The 365 & 366 series are bi-directional. Reversing the inlet hose will reverse shaft rotation.

2. SELECT A DISPLACEMENT OPTION

080 80 cm³/rev [4.9 in³/rev]

100 100 cm³/rev [6.1 in³/rev]

110 112 cm³/rev [6.8 in³/rev]

130 129 cm³/rev [7.9 in³/rev]

160 161 cm³/rev [9.8 in³/rev]

200 201 cm³/rev [12.3 in³/rev]

230 229 cm³/rev [14.0 in³/rev]

250 248 cm³/rev [15.1 in³/rev]

320 322 cm³/rev [19.6 in³/rev]

400 396 cm³/rev [24.2 in³/rev]

500 495 cm³/rev [30.2 in³/rev]

3a. SELECT MOUNT TYPE

▼ END MOUNT

A0 2-Hole, SAE A Mount

A2 4-Hole, Magneto Mount

AG 4-Hole SAE A Mount

B0 2-Hole SAE B Mount

S2 4-Hole Short Motor Mount

Y2 4-Hole Wheel Mount

▼ SIDE MOUNT

A7 2-Hole, SAE A Mount

A8 4-Hole, Magneto Mount

AH 4-Hole SAE A Mount

B7 2-Hole SAE B Mount

S8 4-Hole Short Motor Mount

Y8 4-Hole Wheel Mount

3b. SELECT PORT SIZE

▼ END PORT OPTIONS

1 7/8-14 UNF Aligned

2 G 1/2 Aligned

▼ SIDE PORT OPTIONS

1 7/8-14 UNF, Offset

2 G 1/2, Offset

6 1 1/16-20 UN, 180° Opposed

B Drilled Offset Manifold

► The S2 and S8 Mounts are only available with the 0B cardan shaft.



4. SELECT A SHAFT OPTION

0B Cardan

02 1"6B Spline

10 1" Straight

12 25mm Straight

20 1-1/4" Straight

21 32mm Straight

22 1-1/4" Tapered

23 14 Tooth Spline

28 35mm Tapered

31 1-1/2" Tapered

► The 28 and 31 shafts are only available on the AG, AH, Y2 and Y8 mounts.

5. SELECT A PAINT OPTION

A Black

B Black, Unpainted Mounting Surface

Z No Paint

► The S2 and S8 mounts are only available with no paint.

6. SELECT A VALVE CAVITY / CARTRIDGE OPTION

A None

B Valve Cavity Only

C 69 bar [1000 psi] Relief

D 86 bar [1250 psi] Relief

E 104 bar [1500 psi] Relief

F 121 bar [1750 psi] Relief

G 138 bar [2000 psi] Relief

J 173 bar [2500 psi] Relief

L 207 bar [3000 psi] Relief

► Valve cavity is only available on side ports 1 & 2.

7. SELECT AN ADD-ON OPTION

A Standard

B Lock Nut

C Solid Hex Nut

8. SELECT A MISCELLANEOUS OPTION

AA None

AC Freeturning Rotor

MA Mounting Rotated 90°

MB Freeturning Rotor With Mounting Rotated 90°

► Rotated mounting not available on the 4-Hole SAE A & wheel mounts

OVERVIEW

The WS targets agricultural equipment, skid steer attachments, and other applications that require greater torque under demanding conditions. Additional product features include a three zone commutator valve, heavy-duty tapered roller bearings, and case drain with integral internal drain*. The WS offers numerous housing, displacement and shaft options to meet most common SAE and European requirements.

FEATURES / BENEFITS

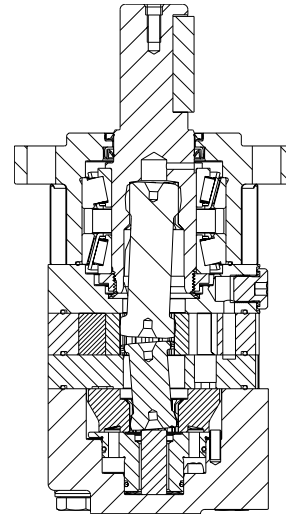
- Twelve shaft and ten mounting options to meet the most common SAE and European requirements.
- Heavy-duty tapered roller bearings for extra side load capacity.
- Three zone commutator valve for high flow capacity.
- Standard case drain with integral internal drain for extended shaft seal life.

TYPICAL APPLICATIONS

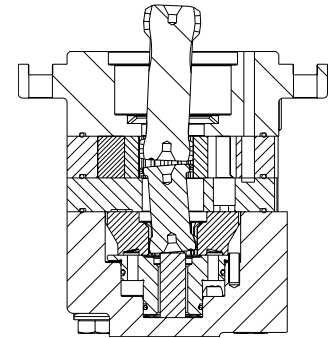
Heavy-duty wheel drives, sweepers, grain augers, spreaders, feed rollers, brush drives, mowers, harvesting equipment gear box mounts and more

SERIES DESCRIPTIONS

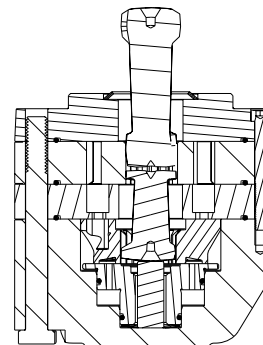
360 - Hydraulic Motor
Standard



360 - Hydraulic Motor
Short



360 - Hydraulic Motor
Ultra Short



SPECIFICATIONS

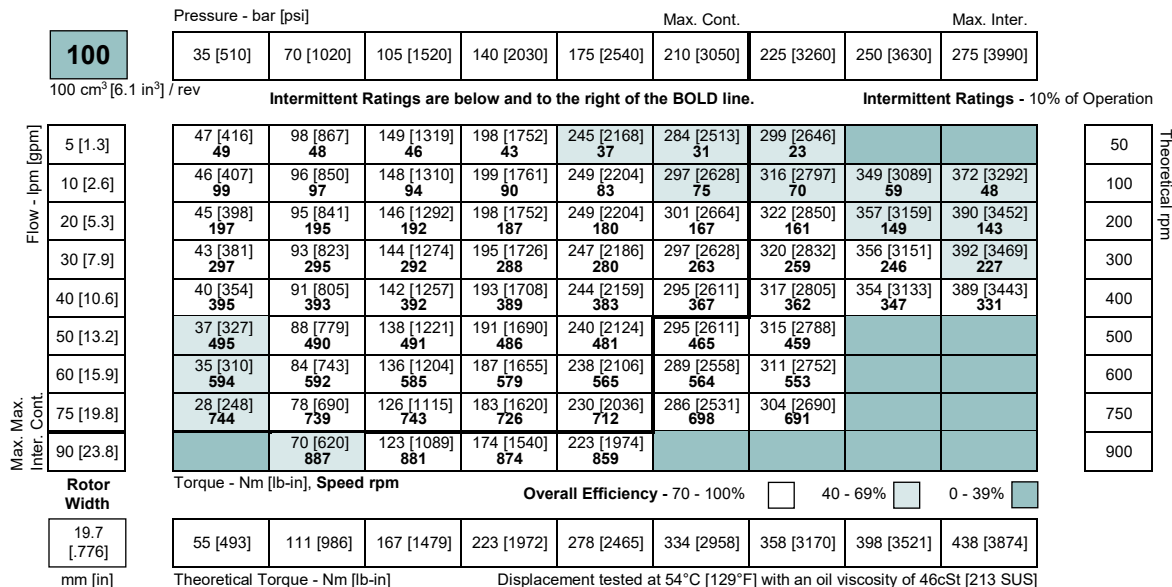
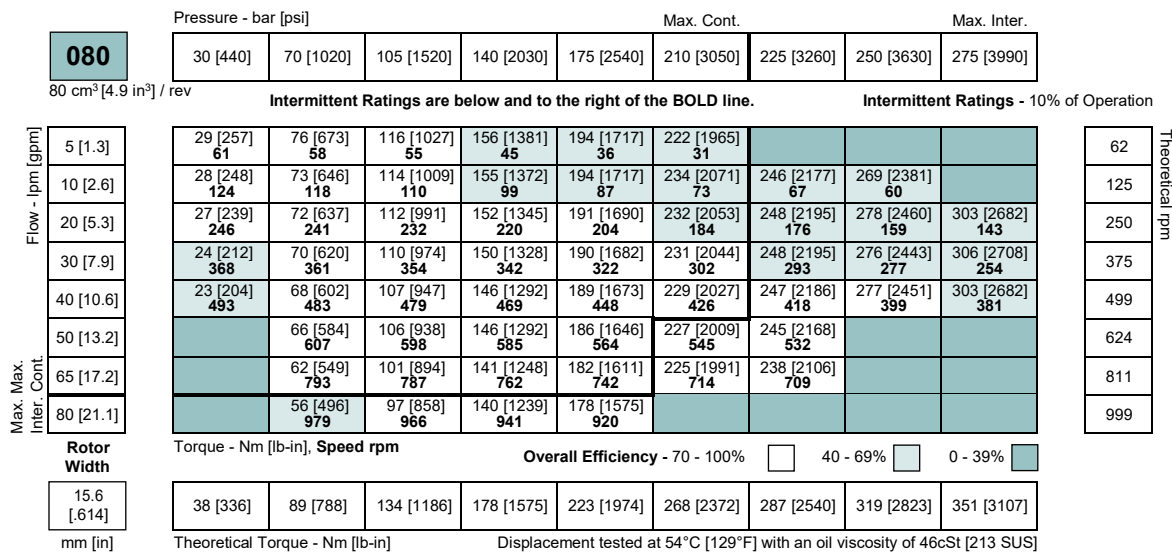
CODE	Displacement cm ³ [in ³ /rev]	Max. Speed rpm		Max. Flow lpm [gpm]		Max. Torque Nm [lb-in]		Max. Pressure bar [psi]		
		cont.	inter.	cont.	inter.	cont.	inter.	cont.	inter.	peak
080	80 [4.9]	793	979	65 [17]	80 [21]	234 [2071]	306 [2708]	210 [3050]	275 [3990]	295 [4280]
100	100 [6.1]	744	887	75 [20]	90 [24]	301 [2664]	392 [3470]	210 [3050]	275 [3990]	295 [4280]
125	125 [7.6]	596	711	75 [20]	90 [24]	364 [3222]	478 [4231]	210 [3050]	275 [3990]	295 [4280]
160	160 [9.7]	471	561	75 [20]	90 [24]	466 [4125]	577 [5107]	210 [3050]	260 [3770]	280 [4060]
200	200 [12.2]	377	448	75 [20]	90 [24]	599 [5302]	705 [6240]	210 [3050]	250 [3630]	270 [3920]
230	226 [13.8]	324	389	75 [20]	90 [24]	652 [5771]	812 [7187]	200 [2900]	250 [3630]	270 [3920]
250	250 [15.2]	298	363	75 [20]	90 [24]	703 [6222]	851 [7532]	200 [2900]	250 [3630]	270 [3920]
315	305 [18.6]	240	293	75 [20]	90 [24]	872 [7718]	1024 [9063]	200 [2900]	240 [3480]	260 [3770]
400	393 [24.0]	185	225	75 [20]	90 [24]	910 [8054]	1069 [9462]	160 [2320]	190 [2760]	210 [3050]
500	493 [30.1]	149	180	75 [20]	90 [24]	848 [7506]	1001 [8860]	120 [1740]	140 [2030]	160 [2320]

► Performance data is typical. Performance of production units varies slightly from one motor to another. Running at intermittent ratings should not exceed 10% of every minute of operation.

WS (360 Series)

Heavy Duty Hydraulic Motor

DISPLACEMENT PERFORMANCE



► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

DISPLACEMENT PERFORMANCE

		Pressure - bar [psi]					Max. Cont.		Max. Inter.			
125		35 [510]	70 [1020]	105 [1520]	140 [2030]	175 [2540]	210 [3050]	225 [3260]	250 [3630]	275 [3990]		
125 cm ³ [7.6 in ³] / rev		Intermittent Ratings are below and to the right of the BOLD line.							Intermittent Ratings - 10% of Operation			
Flow - lpm [gpm]	5 [1.3]	51 [451] 39	113 [1000] 38	176 [1558] 35	229 [2027] 31	301 [2664] 26	327 [2894] 16				40	Theoretical rpm
	10 [2.6]	50 [443] 79	113 [1000] 77	176 [1558] 74	241 [2133] 67	300 [2655] 60	353 [3124] 49	377 [3336] 46	411 [3637] 37		80	
	20 [5.3]	48 [425] 159	109 [965] 157	174 [1540] 151	238 [2106] 146	301 [2664] 130	364 [3221] 115	386 [3416] 108	431 [3814] 95	475 [4204] 78	160	
	30 [7.9]	46 [407] 239	109 [965] 235	172 [1522] 232	235 [2080] 222	298 [2637] 212	363 [3213] 190	391 [3460] 183	436 [3859] 168	478 [4230] 151	240	
	40 [10.6]	43 [381] 319	106 [938] 314	169 [1496] 311	233 [2062] 302	296 [2620] 291	363 [3213] 268	390 [3452] 260	431 [3814] 248	477 [4221] 229	320	
	50 [13.2]	40 [354] 399	101 [894] 395	167 [1478] 387	233 [2062] 379	296 [2620] 362	363 [3213] 346	387 [3425] 341			400	
	60 [15.9]	38 [336] 477	100 [885] 472	163 [1443] 466	232 [2053] 457	295 [2611] 441	356 [3151] 433	383 [3390] 422			480	
	75 [19.8]	28 [248] 596	93 [823] 592	155 [1372] 582	218 [1929] 570	283 [2505] 556	352 [3115] 533	376 [3328] 527			600	
90 [23.8]		81 [717] 711	148 [1310] 702	214 [1894] 685	274 [2425] 672					720		
Rotor Width		Torque - Nm [lb-in], Speed rpm										
		Overall Efficiency - 70 - 100% 40 - 69% 0 - 39%										
19.7 [.776]		69 [616]	139 [1232]	208 [1849]	278 [2465]	348 [3081]	417 [3698]	447 [3962]	493 [4402]	547 [4842]		
mm [in]		Theoretical Torque - Nm [lb-in] Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]										

		Pressure - bar [psi]					Max. Cont.		Max. Inter.	
160		35 [510]	70 [1020]	105 [1520]	140 [2030]	160 [2320]	175 [2540]	210 [3050]	225 [3260]	260 [3770]
160 cm ³ [9.7 in ³] / rev		Intermittent Ratings are below and to the right of the BOLD line.							Intermittent Ratings - 10% of Operation	
Max. Max. Inter. Cont.	Flow - lpm [gpm]	5 [1.3]	10 [2.6]	20 [5.3]	30 [7.9]	40 [10.6]	50 [13.2]	60 [15.9]	75 [19.8]	90 [23.8]
		71 [628] 30	150 [1328] 29	232 [2053] 28	307 [2717] 24	356 [3151] 20	385 [3407] 18			
		71 [628] 62	149 [1319] 61	230 [2036] 58	310 [2744] 53	355 [3142] 47	386 [3416] 42	459 [4062] 33	488 [4319] 31	
		69 [611] 123	147 [1301] 122	230 [2036] 119	309 [2735] 113	355 [3142] 107	388 [3434] 101	465 [4115] 84	498 [4407] 77	
		65 [575] 185	143 [1266] 184	225 [1991] 182	307 [2717] 177	353 [3124] 168	387 [3425] 163	466 [4124] 143	500 [4425] 135	577 [5106] 110
		60 [531] 247	138 [1221] 246	220 [1947] 243	303 [2682] 239	349 [3089] 234	383 [3390] 227	463 [4098] 207	497 [4398] 200	574 [5080] 176
		55 [487] 308	133 [1177] 307	215 [1903] 304	296 [2620] 296	342 [3027] 291	376 [3328] 285	458 [4053] 265	490 [4337] 258	
		47 [416] 372	127 [1124] 368	207 [1832] 366	289 [2558] 361	336 [2974] 354	371 [3283] 348	452 [4000] 328	487 [4310] 318	
	36 [319] 468	114 [1009] 467	196 [1735] 466	279 [2469] 455	323 [2859] 449	361 [3195] 442	442 [3912] 422	472 [4177] 415		
		24 [212] 561	106 [938] 557	183 [1620] 549	266 [2354] 540	311 [2752] 533				
Rotor Width		Torque - Nm [lb-in], Speed rpm								
		Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐								
25.4 [1.000]		89 [789]	178 [1578]	267 [2366]	359 [3156]	407 [3606]	445 [3944]	534 [4733]	573 [5071]	662 [5860]
mm [in]		Theoretical Torque - Nm [lb-in] Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]								

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

WS (360 Series)

Heavy Duty Hydraulic Motor

DISPLACEMENT PERFORMANCE

		Pressure - bar [psi]						Max. Cont.		Max. Inter.			
200		35 [510]	70 [1020]	105 [1520]	140 [2030]	160 [2320]	175 [2540]	210 [3050]	225 [3260]	250 [3630]			
200 cm ³ [12.2 in ³] / rev		Intermittent Ratings are below and to the right of the BOLD line.								Intermittent Ratings - 10% of Operation			
Flow - lpm [gpm]	5 [1.3]	78 [690] 24	191 [1690] 21	289 [2558] 23	383 [3390] 20						25		
	10 [2.6]	77 [681] 49	191 [1690] 48	292 [2584] 47	382 [3381] 44	448 [3965] 39	487 [4310] 35	573 [5071] 26			50		
	20 [5.3]	73 [646] 99	189 [1673] 98	291 [2575] 96	393 [3478] 93	451 [3991] 88	494 [4372] 83	591 [5230] 70	632 [5593] 63	694 [6142] 52	100		
	30 [7.9]	71 [628] 149	186 [1646] 147	289 [2558] 146	389 [3443] 145	453 [4009] 137	491 [4345] 133	599 [5301] 119	633 [5602] 111	704 [6230] 95	150		
	40 [10.6]	66 [584] 197	181 [1602] 196	283 [2505] 196	385 [3407] 195	443 [3921] 191	486 [4301] 187	591 [5230] 174	631 [5584] 169	705 [6239] 154	200		
	50 [13.2]	59 [522] 249	176 [1558] 247	277 [2451] 246	378 [3345] 244	438 [3877] 241	481 [4257] 237	582 [5151] 227	625 [5531] 220		250		
	60 [15.9]	51 [451] 297	168 [1487] 295	269 [2381] 294	371 [3283] 292	428 [3788] 287	474 [4195] 278	571 [5053] 264	611 [5407] 256		300		
	75 [19.8]	40 [354] 371	154 [1363] 377	256 [2266] 375	352 [3115] 369	409 [3620] 362	454 [4018] 355	556 [4921] 338	601 [5319] 327		375		
	90 [23.8]	26 [230] 448	139 [1230] 444	238 [2106] 448	338 [2991] 436	398 [3523] 429					450		
Rotor Width		Torque - Nm [lb-in], Speed rpm											
		Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐											
31.8 [1.252]		111 [986]	222 [1972]	334 [2958]	445 [3944]	509 [4508]	557 [4930]	668 [5917]	716 [6339]	795 [7044]			
mm [in]		Theoretical Torque - Nm [lb-in]										Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]	

		Pressure - bar [psi]								Max. Cont.		Max. Inter.			
230		35 [510]	70 [1020]	95 [1380]	125 [1810]	140 [2030]	155 [2250]	175 [2540]	200 [2900]	225 [3260]	250 [3630]				
226 cm³ [13.8 in³] / rev		Intermittent Ratings are below and to the right of the BOLD line.								Intermittent Ratings - 10% of Operation					
Flow - lpm [gpm]	5 [1.3]	113 [1000] 21	232 [2053] 20	320 [2832] 19									22		
	10 [2.6]	112 [991] 42	228 [2018] 41	321 [2841] 40	419 [3708] 37	465 [4115] 36	518 [4584] 34	569 [5036] 33	651 [5761] 30				44		
	20 [5.3]	111 [982] 86	227 [2009] 85	315 [2788] 83	415 [3673] 78	461 [4080] 75	514 [4549] 72	582 [5151] 69	652 [5770] 65	735 [6505] 61	812 [7186] 55		89		
	30 [7.9]	108 [956] 128	223 [1974] 126	311 [2752] 124	412 [3647] 119	463 [4098] 116	512 [4531] 113	576 [5098] 108	658 [5823] 102	738 [6531] 97			133		
	40 [10.6]	103 [912] 171	220 [1947] 169	306 [2708] 166	410 [3629] 161	460 [4071] 158	510 [4514] 153	572 [5062] 148	651 [5761] 142	729 [6452] 136			177		
	50 [13.2]	97 [858] 216	214 [1894] 215	296 [2620] 213	407 [3602] 206	446 [3947] 203	503 [4452] 199	571 [5053] 192					222		
	60 [15.9]	89 [788] 259	212 [1876] 256	290 [2567] 253	399 [3531] 247	440 [3894] 244	496 [4390] 239	554 [4903] 234					266		
	75 [19.8]	76 [673] 324	190 [1682] 321	275 [2434] 320	388 [3434] 310	425 [3761] 309	481 [4257] 304	546 [4832] 300					332		
Max. Max. Inter. Cont.	90 [23.8]	56 [496] 389	174 [1540] 386	257 [2274] 383	361 [3195] 378	411 [3637] 374							399		
	Rotor Width														
		Torque - Nm [lb-in], Speed rpm													
		Overall Efficiency - 70 - 100%											☐ 40 - 69%	☐ 0 - 39%	☐
45.4 [1.787]		126 [1115]	251 [2222]	341 [3018]	449 [3974]	503 [4452]	557 [4930]	628 [5558]	718 [6355]	808 [7152]	898 [7948]				
mm [in]		Theoretical Torque - Nm [lb-in]											Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]		

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

DISPLACEMENT PERFORMANCE

		Pressure - bar [psi]								Max. Cont.		Max. Inter.		
250		35 [510]	70 [1020]	95 [1380]	125 [1810]	140 [2030]	155 [2250]	175 [2540]	200 [2900]	225 [3260]	250 [3630]			
250 cm³ [15.2 in³] / rev		Intermittent Ratings are below and to the right of the BOLD line.								Intermittent Ratings - 10% of Operation				
Flow - lpm [gpm]	5 [1.3]	115 [1018] 19										20	Theoretical rpm	
	10 [2.6]	116 [1027] 39	239 [2115] 38	331 [2929] 37	439 [3885] 35	481 [4257] 33	532 [4708] 31	595 [5266] 27				40		
	20 [5.3]	114 [1009] 79	239 [2115] 78	330 [2921] 76	438 [3876] 73	491 [4345] 70	546 [4832] 67	619 [5478] 62	703 [6222] 54	778 [6885] 45	851 [7531] 38	80		
	30 [7.9]	110 [974] 119	236 [2089] 118	329 [2912] 117	437 [3868] 115	489 [4328] 112	543 [4806] 109	618 [5469] 103	704 [6230] 93	790 [6992] 78		120		
	40 [10.6]	106 [938] 159	232 [2053] 158	323 [2859] 155	430 [3806] 154	486 [4301] 153	539 [4770] 150	624 [5522] 145	702 [6213] 133	793 [7018] 124		160		
	50 [13.2]	100 [885] 198	225 [1991] 197	318 [2814] 194	429 [3797] 195	480 [4248] 193	530 [4691] 191	609 [5390] 185				200		
	60 [15.9]	91 [805] 239	215 [1903] 237	311 [2752] 240	414 [3664] 235	470 [4160] 234	524 [4637] 233	594 [5257] 223				240		
	75 [19.8]	78 [690] 298	206 [1823] 295	293 [2593] 295	405 [3584] 292	453 [4009] 291	507 [4487] 285	581 [5142] 277				300		
90 [23.8]	59 [522] 359	184 [1628] 357	272 [2407] 363	384 [3398] 353	422 [3735] 350							360		
Rotor Width		Torque - Nm [lb-in], Speed rpm												
		Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐												
39.4 [1.551]		139 [1232]	278 [2465]	378 [3346]	497 [4402]	557 [4930]	616 [5458]	696 [6163]	795 [7043]	895 [7924]	994 [8804]			
mm [in]		Theoretical Torque - Nm [lb-in]											Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]	

		Pressure - bar [psi]								Max. Cont.	Max. Inter.	
315		35 [510]	70 [1020]	100 [1450]	120 [1740]	140 [2030]	160 [2320]	175 [2540]	200 [2900]	225 [3260]	240 [3480]	
305 cm³ [18.6 in³] / rev		Intermittent Ratings are below and to the right of the BOLD line.								Intermittent Ratings - 10% of Operation		
Flow - lpm [gpm]	5 [1.3]	147 [1301] 15	310 [2744] 14	426 [3770] 13							16	
	10 [2.6]	153 [1354] 32	308 [2726] 30	441 [3903] 29	527 [4664] 25	600 [5310] 23	670 [5930] 20				33	
	20 [5.3]	151 [1336] 64	304 [2690] 62	441 [3903] 60	530 [4691] 57	610 [5399] 52	705 [6239] 46				66	
	30 [7.9]	146 [1292] 94	303 [2682] 94	439 [3885] 92	532 [4708] 88	617 [5460] 83	700 [6196] 76	764 [6761] 73	872 [7717] 65	980 [8673] 64	1024 [9062] 59	98
	40 [10.6]	139 [1230] 127	295 [2611] 125	431 [3814] 124	520 [4602] 121	613 [5425] 117	701 [6205] 111	766 [6779] 105	883 [7815] 95	940 [8319] 94		131
	50 [13.2]	130 [1151] 160	288 [2549] 158	423 [3744] 156	514 [4549] 153	604 [5345] 149	694 [6143] 144	759 [6717] 139				164
	60 [15.9]	126 [1115] 191	277 [2451] 191	417 [3690] 187	506 [4478] 186	594 [5257] 182	684 [6054] 174	749 [6629] 168				197
	75 [19.8]	99 [876] 240	258 [2283] 237	394 [3487] 237	483 [4275] 234	573 [5071] 226	651 [5762] 222					246
	90 [23.8]	74 [655] 293	231 [2044] 293	371 [3283] 284	460 [4071] 281	543 [4806] 276						295
Max. Max. Inter. Cont.	Rotor Width	Torque - Nm [lb-in], Speed rpm										
		Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐										
49.2 [1.937] mm [in]		170 [1505]	339 [3000]	485 [4293]	582 [5151]	679 [6010]	776 [6868]	848 [7506]	970 [8585]	1091 [9656]	1163 [10294]	
		Theoretical Torque - Nm [lb-in] Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]										

► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

DISPLACEMENT PERFORMANCE

		Pressure - bar [psi]								Max. Cont.	Max. Inter.
		30 [440]	60 [870]	80 [1160]	105 [1520]	120 [1740]	140 [2030]	160 [2320]	175 [2540]	190 [2760]	
400											
393 cm ³ [24.0 in ³] / rev		Intermittent Ratings are below and to the right of the BOLD line.									
Max. Max. Inter. Cont.	Flow - lpm [gpm]	167 [1478] 12	352 [3115] 12								
	10 [2.6]	176 [1531] 24	345 [3053] 23	461 [4080] 22	606 [5363] 21						
	20 [5.3]	170 [1505] 49	342 [3027] 48	463 [4098] 47	610 [5399] 46	695 [6151] 43	809 [7160] 39	910 [8054] 33	987 [8735] 29		
	30 [7.9]	163 [1443] 74	337 [2982] 73	456 [4036] 73	605 [5354] 71	691 [6115] 69	806 [7134] 64	916 [8107] 58	990 [8762] 45	1069 [9461] 39	
	40 [10.6]	153 [1354] 98	327 [2894] 98	445 [3938] 98	593 [5248] 96	681 [6027] 95	799 [7072] 90	911 [8062] 82	982 [8691] 69		
	50 [13.2]	142 [1257] 123	317 [2805] 123	435 [3850] 122	575 [5089] 121	667 [5903] 120	787 [6966] 115				
	60 [15.9]	131 [1159] 149	301 [2664] 148	419 [3708] 147	566 [5009] 146	653 [5779] 144	774 [6851] 140				
	75 [19.8]	100 [885] 185	276 [2443] 185	393 [3478] 184	541 [4788] 183	628 [5558] 181					
	90 [23.8]	72 [637] 224	247 [2186] 222	360 [3186] 221	511 [4522] 220						
	Rotor Width	Torque - Nm [lb-in], Speed rpm									
	63.5 [2.500]	Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐									
mm [in]		187 [1655]	375 [3319]	500 [4426]	656 [5806]	750 [6638]	875 [7745]	1000 [8851]	1093 [9674]	1187 [10506]	
		Theoretical Torque - Nm [lb-in] Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]									

13	Theoretical rpm
25	
51	
76	
102	
127	
153	
191	
229	

		Pressure - bar [psi]							Max. Cont.	Max. Inter.
		25 [360]	50 [730]	80 [1160]	90 [1300]	105 [1520]	120 [1740]	140 [2030]		
500										
493 cm ³ [30.1 in ³] / rev		Intermittent Ratings are below and to the right of the BOLD line.								
Max. Max. Inter. Cont.	Flow - lpm [gpm]	191 [1690] 19	355 [3142] 18							
	10 [2.6]	175 [1549] 39	354 [3133] 39	571 [5053] 36	646 [5717] 34	760 [6726] 31				
	20 [5.3]	164 [1451] 59	344 [3044] 58	565 [5000] 56	637 [5637] 55	743 [6576] 52	848 [7506] 48	1001 [8859] 38		
	30 [7.9]	147 [1301] 79	333 [2947] 78	551 [4876] 77	623 [5514] 76	730 [6461] 74	833 [7373] 70			
	40 [10.6]	136 [1204] 99	317 [2805] 99	537 [4752] 96	610 [5399] 95	717 [6345] 93	830 [7346] 86			
	50 [13.2]	118 [1044] 119	302 [2673] 118	523 [4629] 116	597 [5283] 114	704 [6230] 110				
	60 [15.9]	94 [832] 148	270 [2390] 149	490 [4337] 145	566 [5009] 143	674 [5965] 141				
	75 [19.8]	55 [487] 179	237 [2097] 180	457 [4044] 175	530 [4691] 174					
	90 [23.8]									
	Rotor Width	Torque - Nm [lb-in], Speed rpm								
	78.8 [3.102]	Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐								
mm [in]		196 [1735]	392 [3470]	627 [5550]	706 [6249]	823 [7284]	941 [8329]	1098 [9718]		
		Theoretical Torque - Nm [lb-in] Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]								

20	Theoretical rpm
41	
61	
81	
102	
122	
152	
183	

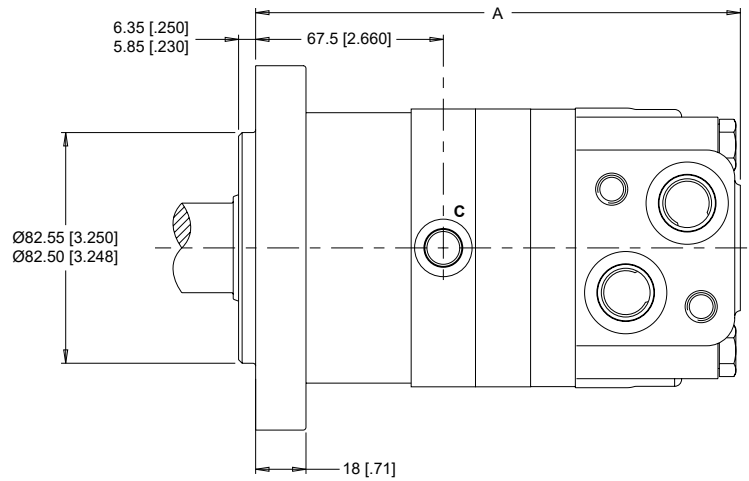
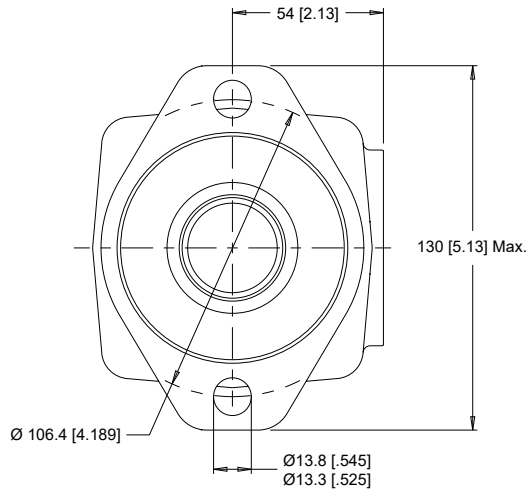
► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

HOUSINGS

► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

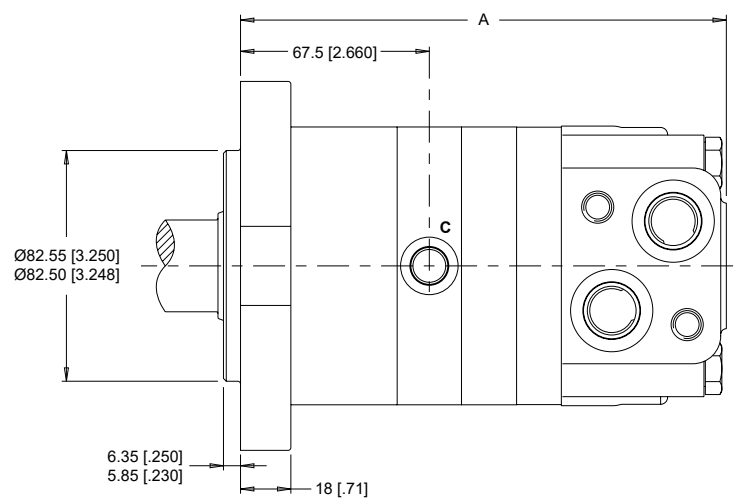
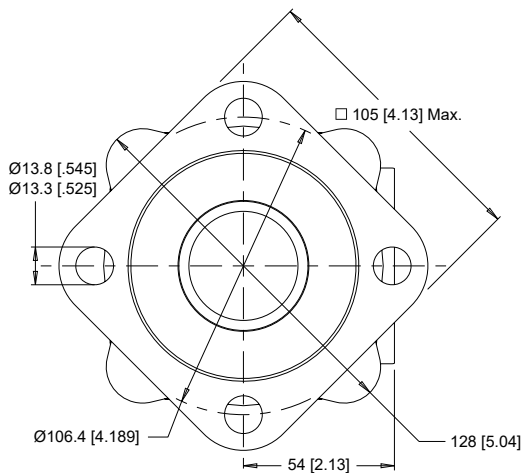
2-HOLE, SAE A MOUNT

A7 Side Ports



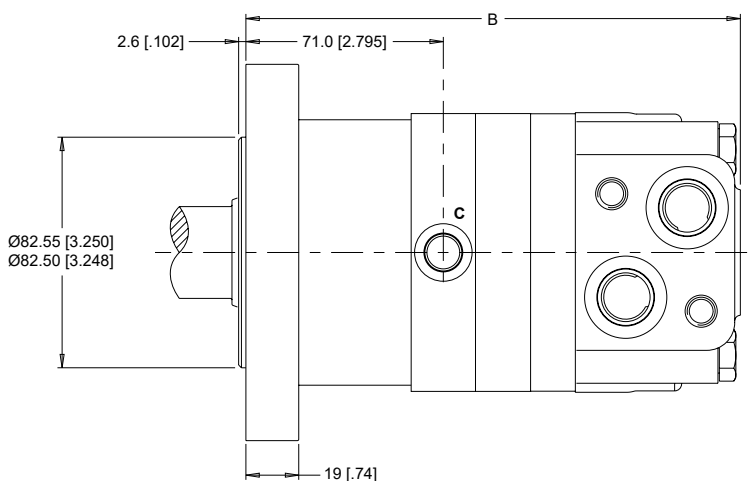
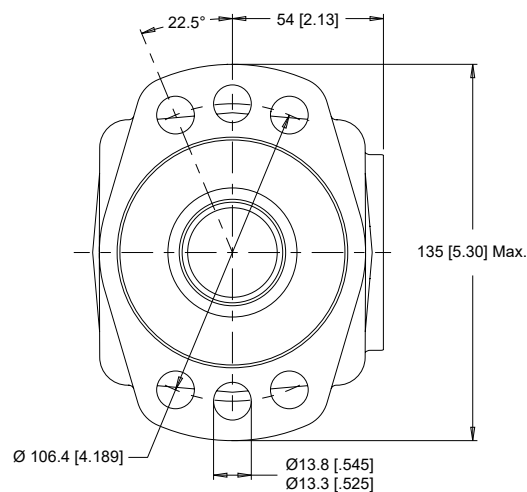
4-HOLE, SAE A MOUNT

AH Side Ports



6-HOLE, MAGNETO MOUNT

AT Side Ports



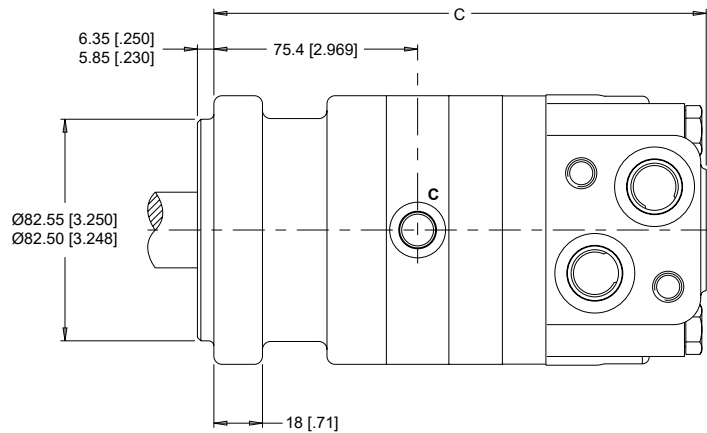
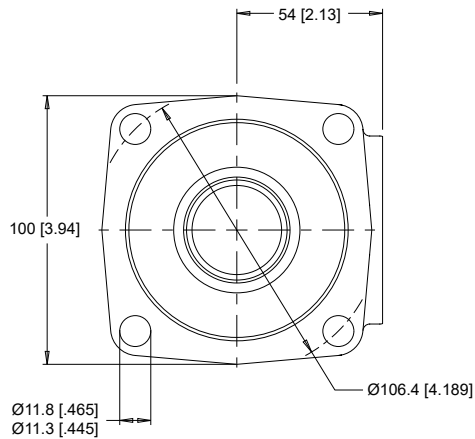
► Dimension A & B are charted on page 40.

HOUSINGS

► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

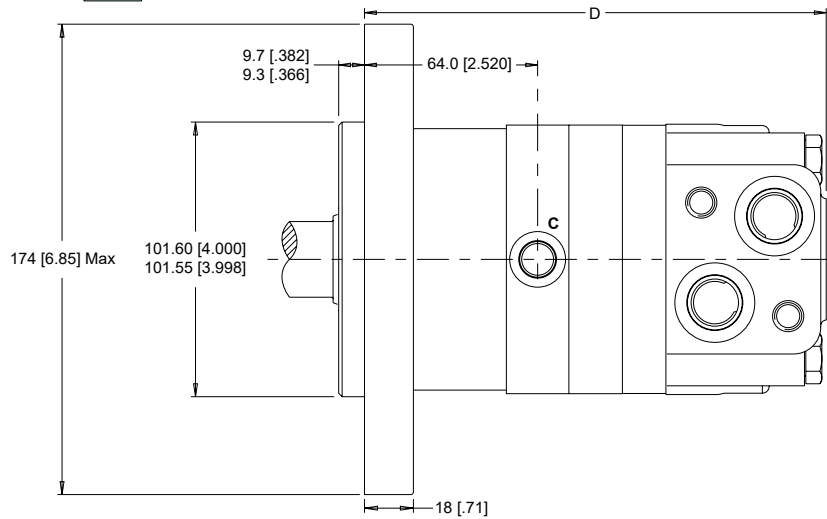
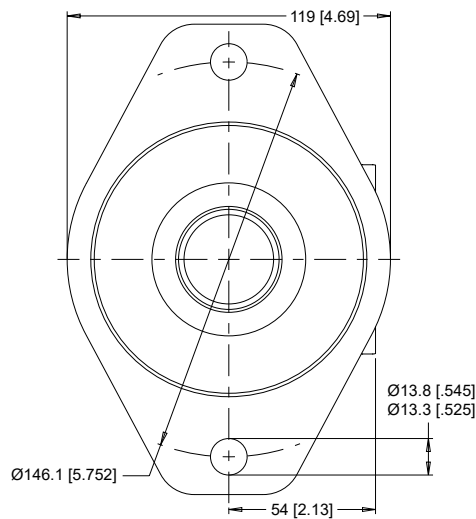
4-HOLE, SQUARE EURO MOUNT

AU Side Ports



2-HOLE, SAE B MOUNT

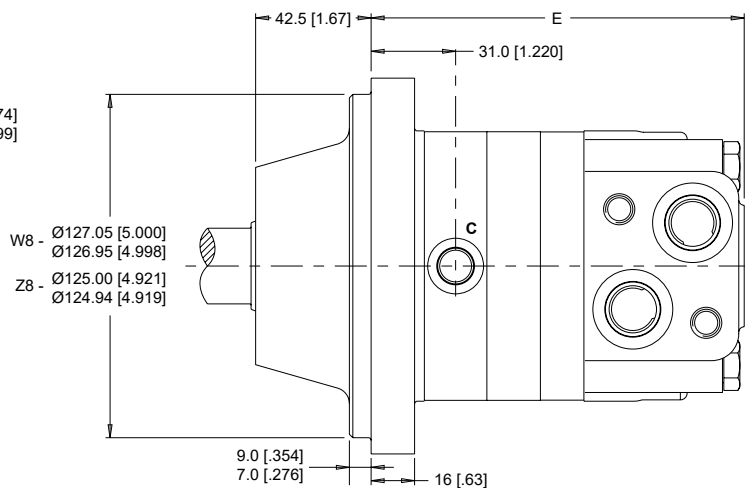
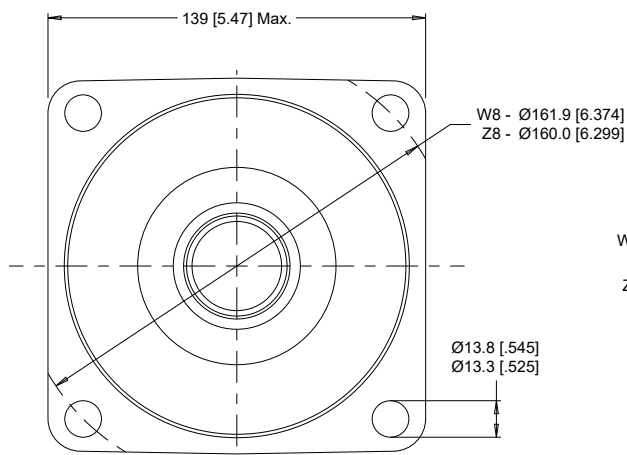
B7 Side Ports



4-HOLE, WHEEL MOUNT

W8 Side Ports - 5" Pilot

Z8 Side Ports - 125mm Pilot



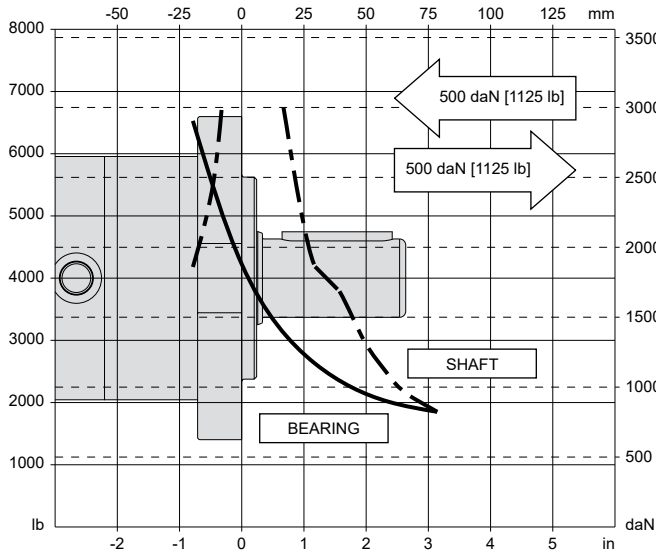
► Dimension C, D & E are charted on page 40.

TECHNICAL INFORMATION

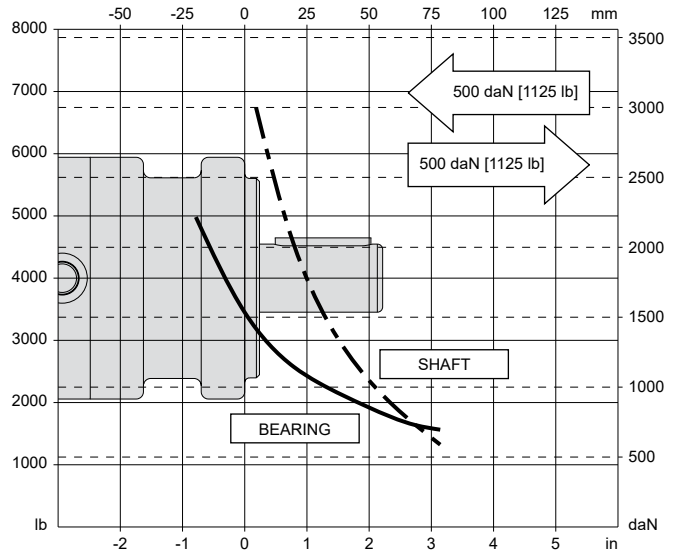
ALLOWABLE SHAFT LOAD / BEARING CURVE

The bearing curve represents allowable bearing loads for a B10 life of 2,000 hours at 100 rpm. Radial loads for speeds other than 100 rpm may be calculated using the multiplication factor table on page 7.

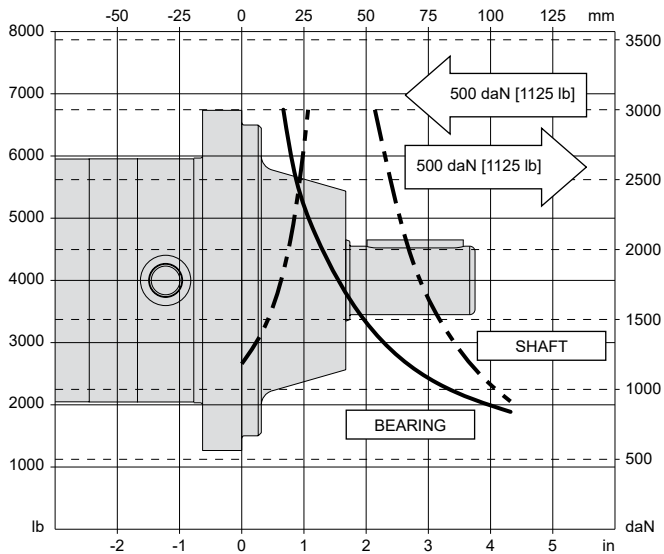
SAE A, SAE B & MAGNETO MOUNTS



SQUARE EURO MOUNT



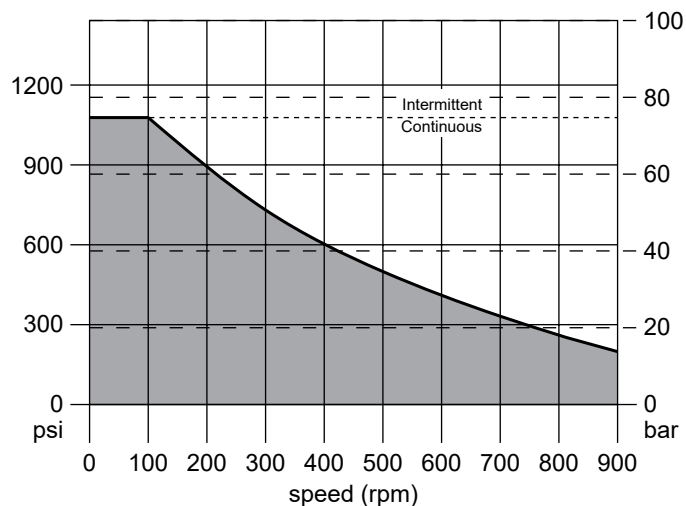
WHEEL MOUNTS



► Case pressure will push outward on the shaft. If case drain line is attached and routed directly to tank, case pressure should be negligible. If case drain line is not attached, case pressure will be nearly the same as motor return pressure. When case pressure is acting, the allowable inward axial load can be increased and the allowable outward axial load must be decreased at a rate of 88 kg / 7 bar [194 lb / 100 psi].

TECHNICAL INFORMATION

PERMISSIBLE SHAFT SEAL PRESSURE



LENGTH & WEIGHT CHARTS

The following charts list the overall motor length from the rear of the motor to the mounting flange surface and are referenced on detailed housing drawings listed on pages 37 & 38.

A	Length	Weight
#	mm [in]	kg [lb]
080	170 [6.69]	10.2 [22.5]
100	174 [6.85]	10.5 [23.2]
125	174 [6.85]	10.5 [23.2]
160	180 [7.09]	11.0 [24.3]
200	186 [7.32]	11.4 [25.1]
230	200 [7.87]	12.2 [26.9]
250	193 [7.60]	11.9 [26.2]
315	203 [8.00]	12.4 [27.3]
400	218 [8.58]	13.3 [29.3]
500	233 [9.17]	14.2 [31.3]

B	Length	Weight
#	mm [in]	kg [lb]
080	173 [6.81]	10.2 [22.5]
100	177 [6.97]	10.5 [23.2]
125	177 [6.97]	10.5 [23.2]
160	183 [7.20]	11.0 [24.3]
200	189 [7.44]	11.4 [25.1]
230	203 [7.99]	12.2 [26.9]
250	197 [7.76]	11.9 [26.2]
315	207 [8.15]	12.4 [27.3]
400	221 [8.70]	13.3 [29.3]
500	236 [9.29]	14.2 [31.3]

C	Length	Weight
#	mm [in]	kg [lb]
080	178 [7.01]	10.1 [22.3]
100	182 [7.17]	10.4 [22.9]
125	182 [7.17]	10.4 [22.9]
160	187 [7.36]	10.9 [24.0]
200	194 [7.64]	11.3 [24.9]
230	208 [8.19]	12.1 [26.7]
250	201 [7.91]	11.8 [26.0]
315	211 [8.31]	12.3 [27.1]
400	225 [8.86]	13.2 [29.1]
500	240 [9.45]	14.1 [31.1]

D	Length	Weight
#	mm [in]	kg [lb]
080	166 [6.54]	11.2 [24.7]
100	170 [6.69]	11.5 [25.4]
125	170 [6.69]	11.5 [25.4]
160	176 [6.93]	12.0 [26.5]
200	182 [7.17]	12.4 [27.3]
230	196 [7.72]	13.2 [29.1]
250	190 [7.48]	12.9 [28.4]
315	200 [7.87]	13.4 [29.5]
400	214 [8.43]	14.3 [31.5]
500	229 [9.02]	15.2 [33.5]

E	Length	Weight
#	mm [in]	kg [lb]
080	133 [5.24]	11.0 [24.3]
100	137 [5.39]	11.3 [24.9]
125	137 [5.39]	11.3 [24.9]
160	143 [5.63]	11.8 [26.0]
200	149 [5.87]	12.2 [26.9]
230	163 [6.42]	13.0 [28.7]
250	157 [6.18]	12.7 [28.0]
315	167 [6.57]	13.2 [29.1]
400	181 [7.13]	14.1 [31.1]
500	196 [7.72]	15.0 [33.1]

► 360 series motor weights can vary ± 1 kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

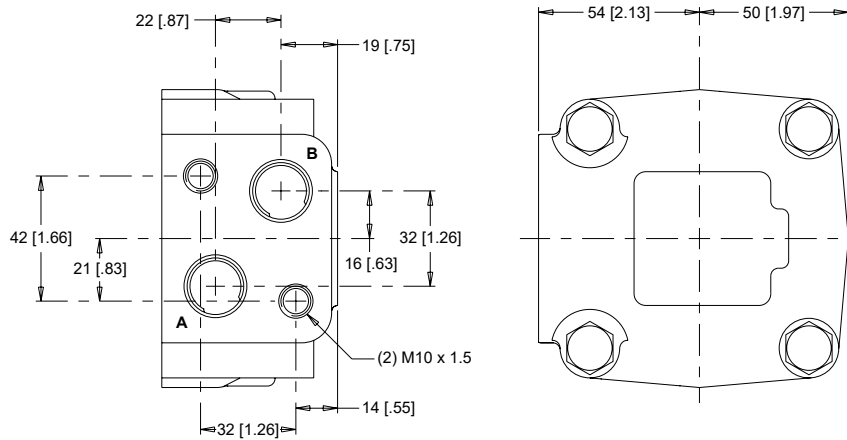
PORTING

SIDE PORTED - OFFSET MANIFOLD

- | | |
|---|--|
| <div style="border: 1px solid black; padding: 2px; display: inline-block; width: 30px; text-align: center; margin-bottom: 5px;">1</div> Main Ports A, B: 7/8-14 UNF
Drain Port C: 7/16-20 UNF | <div style="border: 1px solid black; padding: 2px; display: inline-block; width: 30px; text-align: center; margin-bottom: 5px;">3</div> Main Ports A, B: G 1/2
Drain Port C: G 1/4 |
|---|--|

- 4** Main Ports **A, B**: M22x1.5
Drain Port **C**: M14x1.5

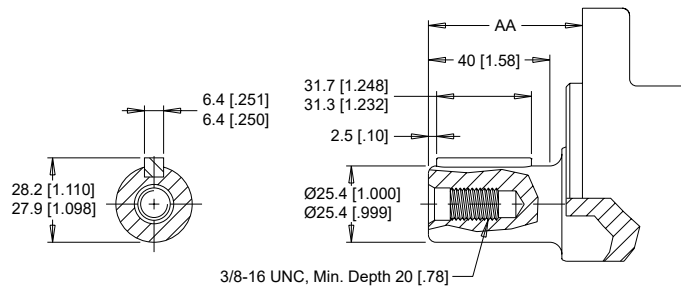
STANDARD



► Drain port C is referenced on housing drawings listed on pages 37, 38 and 44.

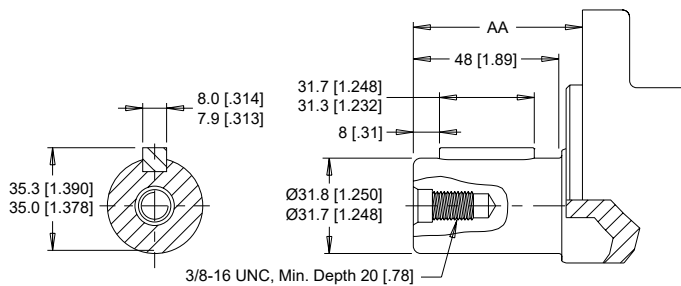
SHAFTS

10 1" Straight



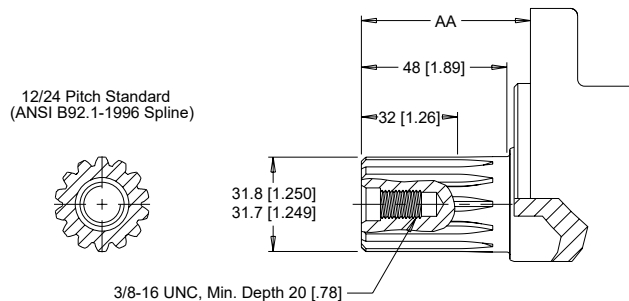
Max. Torque: 655 Nm [5800 lb-in]

20 1-1/4" Straight



Max. Torque: 881 Nm [7800 lb-in]

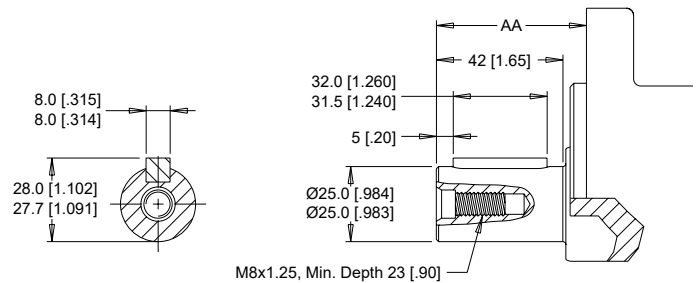
23 14 Tooth Spline



Max. Torque: 881 Nm [7800 lb-in]

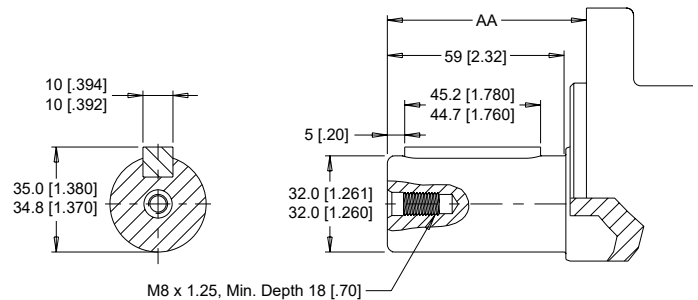
► Dimension AA is charted on page 43.

12 25mm Straight



Max. Torque: 678 Nm [6000 lb-in]

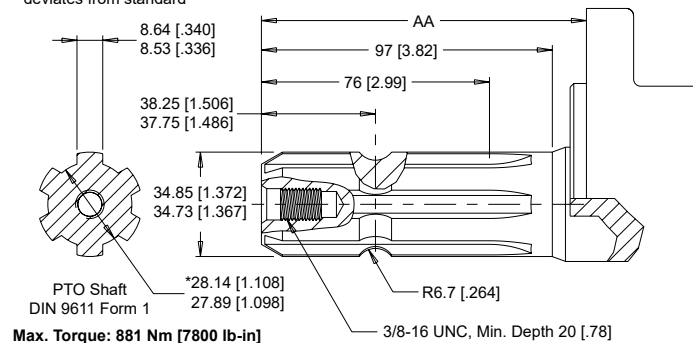
21 32mm Straight



Max. Torque: 881 Nm [7800 lb-in]

78 1-3/8" 6B Spline PTO

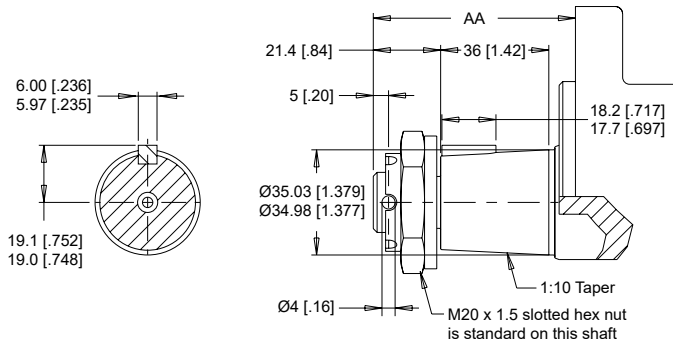
* deviates from standard



Max. Torque: 881 Nm [7800 lb-in]

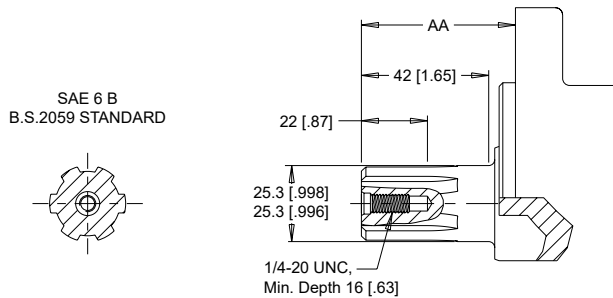
SHAFTS

N4 35mm Tapered



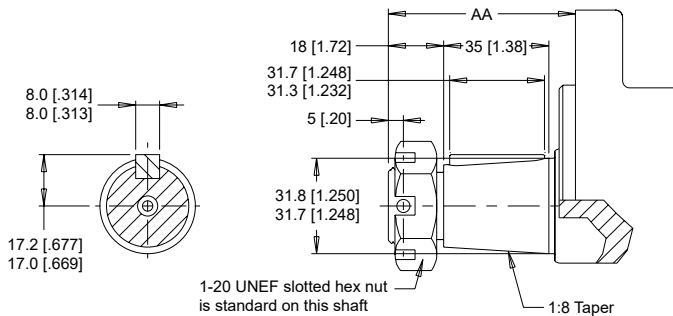
Max. Torque: 881 Nm [7800 lb-in]

G4 1" 6B Spline



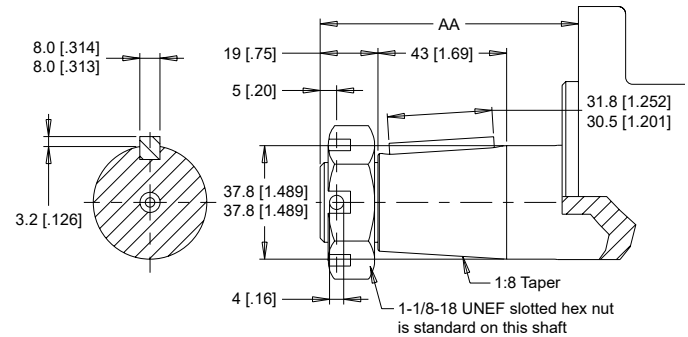
Max. Torque: 678 Nm [6000 lb-in]

N5 1-1/4" Tapered



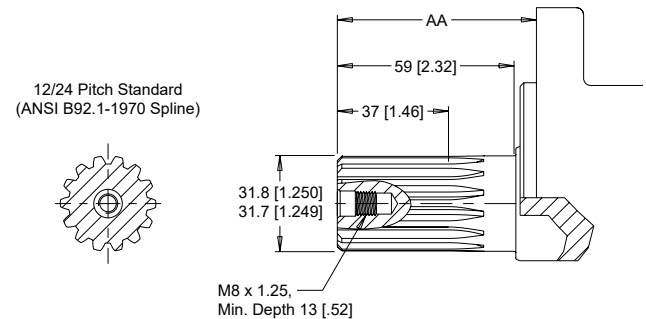
Max. Torque: 881 Nm [7800 lb-in]

31 1-1/2" Tapered



Max. Torque: 881 Nm [7800 lb-in]

N3 1-1/4" 14 Tooth Spline



Max. Torque: 881 Nm [7800 lb-in]

MOUNTING / SHAFT LENGTH CHART

Dimension AA is the overall distance from the motor mounting surface to the end of the shaft and is referenced on detailed shaft drawings above as well as shafts on page 42.

AA	SAE A Mounts	Magneto Mounts	Sq. Euro Mounts	SAE B Mounts	Wheel Mounts
#	mm [in]	mm [in]	mm [in]	mm [in]	mm [in]
10	52 [2.05]	48 [1.89]	44 [1.73]	55 [2.17]	88 [3.46]
12	51 [2.01]	47 [1.85]	43 [1.69]	54 [2.13]	87 [3.43]
20	57 [2.24]	53 [2.09]	49 [1.93]	60 [2.36]	93 [3.66]
21	67 [2.63]	63 [2.48]	59 [2.32]	70 [2.76]	103 [4.06]
23	57 [2.24]	53 [2.09]	49 [1.93]	60 [2.36]	93 [3.66]
31	86 [3.39]	83 [3.27]	79 [3.11]	90 [3.54]	123 [4.84]
78	109 [4.29]	105 [4.13]	101 [3.98]	112 [4.41]	145 [5.71]
G4	52 [2.05]	48 [1.89]	44 [1.73]	55 [2.17]	88 [3.46]
N3	67 [2.63]	63 [2.48]	59 [2.32]	70 [2.76]	103 [4.06]
N4	67 [2.63]	63 [2.48]	59 [2.32]	70 [2.76]	103 [4.06]
N5	63 [2.48]	59 [2.32]	55 [2.17]	66 [2.60]	99 [3.90]

► Shaft lengths vary ± 0.8 mm [.030 in.]

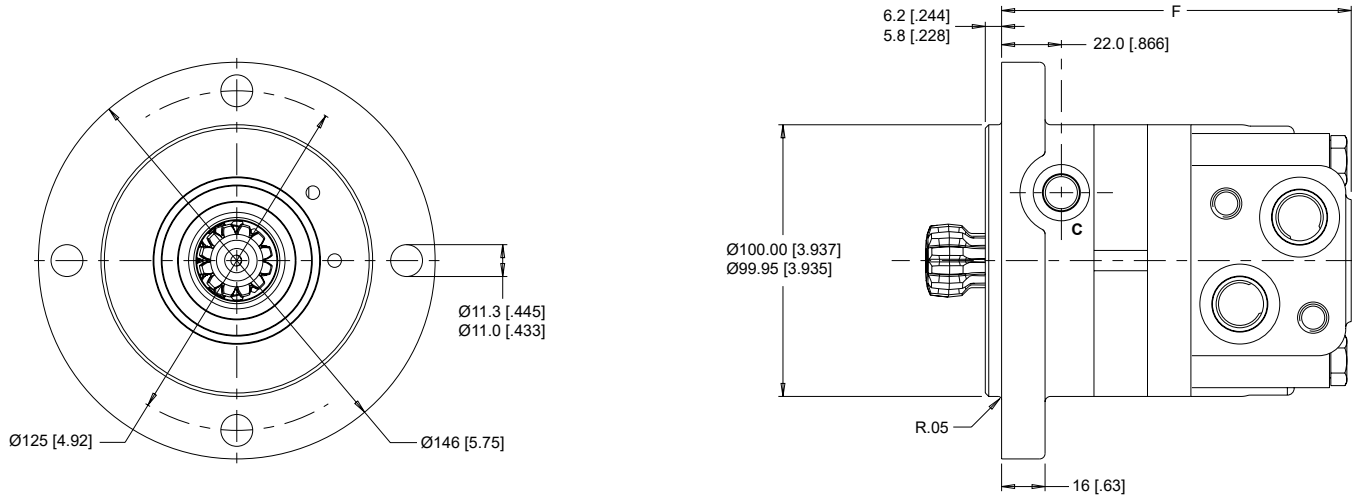
WS (360 Series)

Heavy Duty Hydraulic Short Motor

HOUSINGS

4-HOLE, SHORT MOTOR MOUNT

SH Side Ports



► Porting options listed on page 41.

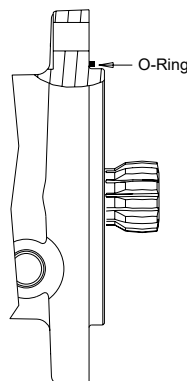
SHAFTS

00 Cardan (For Use With The SH Mount)

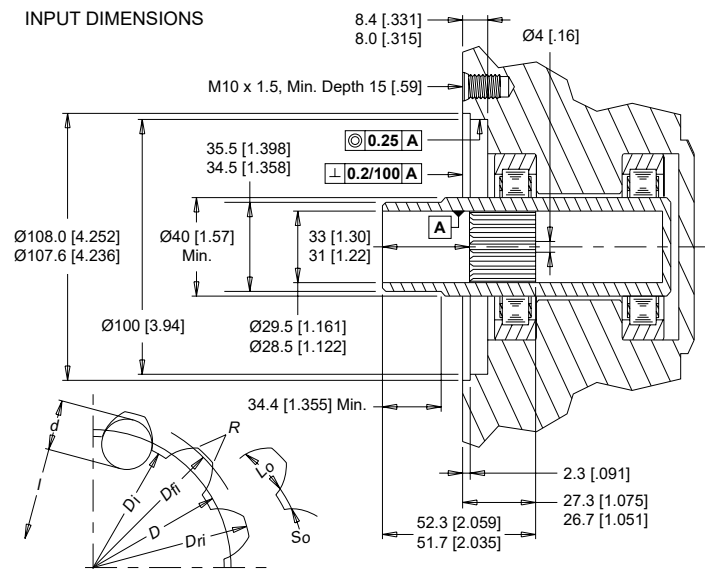
Fillet Root Side Fit	
Number of Teeth	12
Pitch	12/24
Pressure Angle	30°
Pitch Diameter D	25.4 [1.000]
Major Diameter D_{ri}	28.0 [1.10] - 27.9 [1.096]
Form Diameter (Min.) D_{fi}	27.6 [1.09]
Minor Diameter D_j	23.033 [.9068] - 23.0 [.9055]
Space Width (Circular) L_o^*	4.328 [.1704] - 4.288 [.1688]
Tooth Thickness (Circular) S_o	2.341 [.09217]
Fillet Radius R min	0.2 [.008]
Max. Distance Between Pins l	17.77 [.700] - 17.62 [.694]
Pin Diameter d	4.836 [.19034] - 4.834 [.19026]

Internal involute spline data per ANSI B92.1-1970,
class 5 (corrected $m \cdot X = 0.8$; $m = 2.1166$)

- The recommended shaft material is SAE 8620 or similar case hardening steel such as 20 MoCr4 (900 N/mm²) hardened to 59 - 62 HRC to a depth of 0.762 - 1.016 [.030 - .040].
*Dimensions apply after heat treatment.



INPUT DIMENSIONS



LENGTH & WEIGHT CHART

Dimension F is the overall motor length from the rear of the motor to the mounting flange surface and is referenced on the detailed housing drawing listed above.

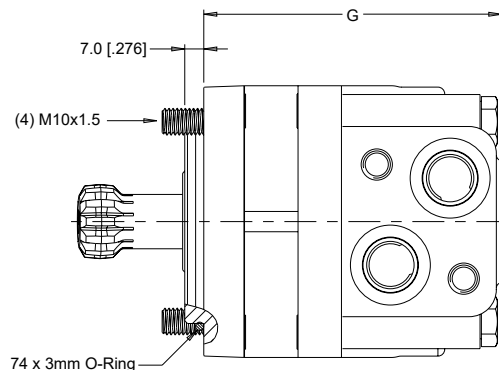
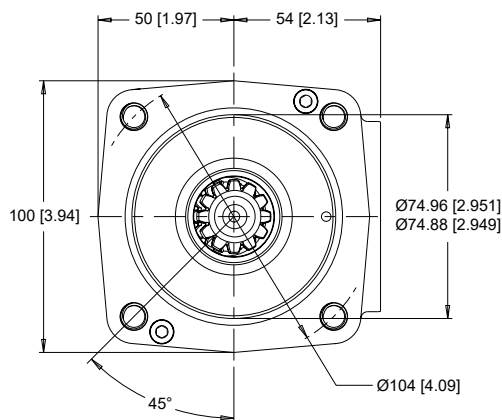
F	Length	Weight
#	mm [in]	kg [lb]
080	125 [4.92]	7.8 [17.2]
100	129 [5.08]	8.1 [17.9]
125	129 [5.08]	8.1 [17.9]
160	134 [5.28]	8.6 [19.0]
200	141 [5.55]	9.0 [19.8]
230	155 [6.10]	9.8 [21.6]
250	148 [5.83]	9.5 [20.9]
315	158 [6.22]	10.0 [22.0]
400	173 [6.81]	10.9 [24.0]
500	188 [7.40]	11.8 [26.0]

- 360 series short motor weights can vary $\pm$ 1kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

HOUSINGS

4-HOLE, ULTRA SHORT MOTOR MOUNT

U8 Side Ports



► Porting options listed on page 41.

SHAFTS

00 Cardan (For Use With The U8 Mount)

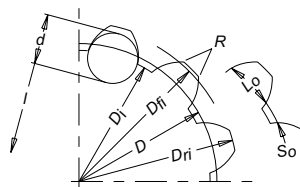
Fillet Root Side Fit

Number of Teeth	12
Pitch	12/24
Pressure Angle	30°
Pitch Diameter D	25.4 [1.000]
Major Diameter D_{ri}	28.0 [1.10] - 27.9 [1.096]
Form Diameter (Min.) D_{fi}	27.6 [1.09]
Minor Diameter D_j	23.033 [0.9068] - 23.0 [0.9055]
Space Width (Circular) L_o^*	4.328 [0.1704] - 4.288 [0.1688]
Tooth Thickness (Circular) S_o	2.341 [0.09217]
Fillet Radius R min	0.2 [0.008]
Max. Distance Between Pins l	17.77 [0.700] - 17.62 [0.694]
Pin Diameter d	4.836 [0.19034] - 4.834 [0.19026]

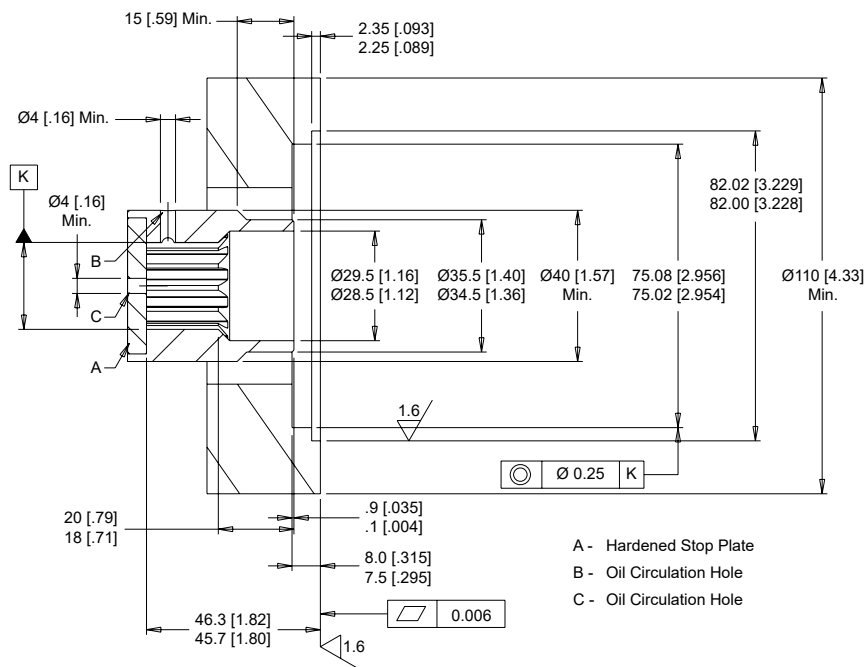
Internal involute spline data per ANSI B92.1-1970, class 5 (corrected $m \cdot X = 0.8$; $m = 2.1166$)

► The recommended shaft material is SAE 8620 or similar case hardening steel such as 20 MoCr4 (900 N/mm²) hardened to 59 - 62 HRC to a depth of 0.762 - 1.016 [0.030 - 0.040].

*Dimensions apply after heat treatment.



INPUT DIMENSIONS



A - Hardened Stop Plate
B - Oil Circulation Hole
C - Oil Circulation Hole

LENGTH & WEIGHT CHART

Dimension G is the overall motor length from the rear of the motor to the mounting flange surface and is referenced on the detailed housing drawing listed above.

G	Length	Weight
#	mm [in]	kg [lb]
080	106 [4.16]	6.3 [13.9]
100	110 [4.32]	6.6 [14.6]
125	110 [4.32]	6.6 [14.6]
160	115 [4.54]	7.1 [15.7]
200	122 [4.79]	7.5 [16.5]
250	129 [5.09]	8.0 [17.6]

► 360 series ultra short motor weights can vary ± 1 kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

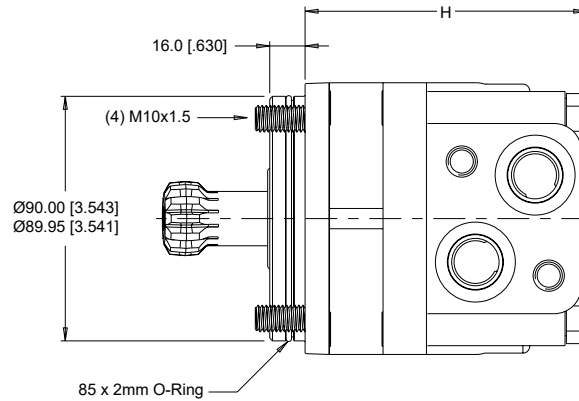
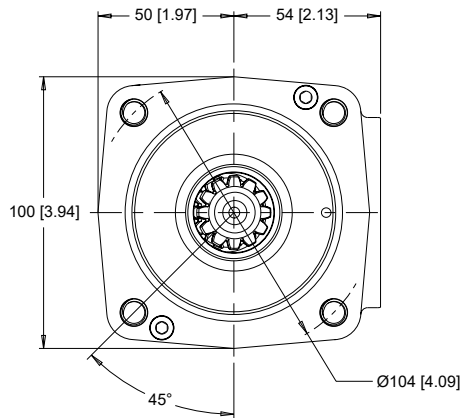
WS (360 Series)

Heavy Duty Hydraulic Ultra Short Motor

HOUSINGS

4-HOLE, ULTRA SHORT MOTOR MOUNT

V8 Side Ports



► Porting options listed on page 41.

SHAFTS

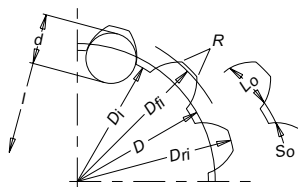
00 Cardan (For Use With The V8 Mount)

Fillet Root Side Fit

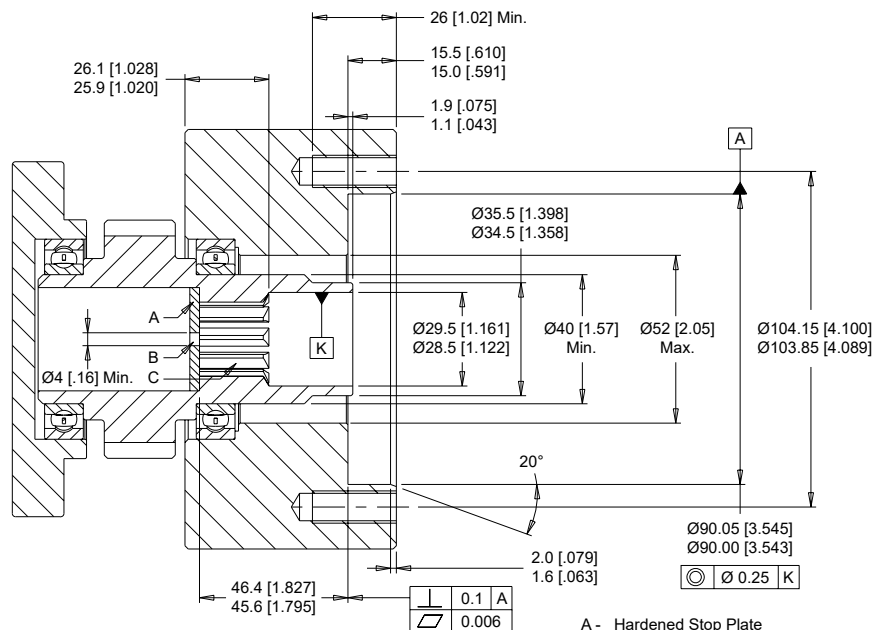
Number of Teeth	12
Pitch	12/24
Pressure Angle	30°
Pitch Diameter D	25.4 [1.000]
Major Diameter D_{fj}	28.0 [1.10] - 27.9 [1.096]
Form Diameter (Min.) D_{fi}	27.6 [1.09]
Minor Diameter D_i	23.033 [.9068] - 23.0 [.9055]
Space Width (Circular) L_o^*	4.328 [.1704] - 4.288 [.1688]
Tooth Thickness (Circular) S_o	2.341 [.09217]
Fillet Radius R min	0.2 [.008]
Max. Distance Between Pins l	17.77 [.700] - 17.62 [.694]
Pin Diameter d	4.836 [.19034] - 4.834 [.19026]

Internal involute spline data per ANSI B92.1-1970,
class 5 (corrected $m \cdot X = 0.8$; $m = 2.1166$)

► The recommended shaft material is SAE 8620 or similar case hardening steel such as 20 MoCr4 (900 N/mm²) hardened to 59 - 62 HRC to a depth of 0.762 - 1.016 [.030 - .040].
*Dimensions apply after heat treatment.



INPUT DIMENSIONS



- A - Hardened Stop Plate
- B - Oil Circulation Hole
- C - Internal Spline
- Dp 12/24 ANSI B92.1-76

LENGTH & WEIGHT CHART

Dimension H is the overall motor length from the rear of the motor to the mounting flange surface and is referenced on the detailed housing drawing listed above.

► 360 series ultra short motor weights can vary ± 1 kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

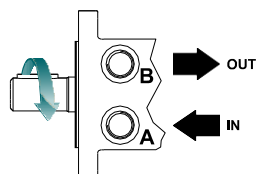
H	Length	Weight
#	mm [in]	kg [lb]
080	100 [3.92]	6.3 [13.9]
100	104 [4.08]	6.6 [14.6]
125	104 [4.08]	6.6 [14.6]
160	109 [4.31]	7.1 [15.7]
200	116 [4.56]	7.5 [16.5]
250	123 [4.86]	8.0 [17.6]

ORDERING INFORMATION

1		2		3a			

1. CHOOSE SERIES DESIGNATION

360 Clockwise Rotation



► The 360 series is bi-directional. Reversing the inlet hose will reverse shaft rotation.

2. SELECT A DISPLACEMENT OPTION

080	80 cm ³ /rev [4.9 in ³ /rev]	230	226 cm ³ /rev [13.8 in ³ /rev]
100	100 cm ³ /rev [6.1 in ³ /rev]	250	250 cm ³ /rev [15.2 in ³ /rev]
125	125 cm ³ /rev [7.6 in ³ /rev]	315	305 cm ³ /rev [18.6 in ³ /rev]
160	160 cm ³ /rev [9.7 in ³ /rev]	400	393 cm ³ /rev [24.0 in ³ /rev]
200	200 cm ³ /rev [12.2 in ³ /rev]	500	493 cm ³ /rev [30.1 in ³ /rev]

3a. SELECT MOUNT TYPE

▼ SIDE MOUNT

A7	2-Hole, SAE A Mount
AT	6-Hole, Magneto Mount
AH	4-Hole, SAE A Mount
AU	4-Hole, Square Euro Mount
B7	2-Hole, SAE B Mount
SH	4-Hole, Short Motor Mount
U8	4-Hole, Ultra Short (75mm Pilot)
V8	4-Hole, Ultra Short (90mm Pilot)
W8	4-Hole, Wheel Mount (5" Pilot)
Z8	4-Hole, Wheel Mount (125mm Pilot)

3b. SELECT PORT SIZE

▼ SIDE PORT OPTIONS

1	7/8-14 UNF Offset Manifold
3	G 1/2 Offset Manifold
4	M22x1.5 Offset Manifold

► The SH, U8 and V8 Mounts are only available with the 00 cardan shaft

3b	4	5	6	7	8		

4. SELECT A SHAFT OPTION

00	Cardan	31	1-1/2" Tapered
10	1" Straight	78	1-3/8" 6B Spline PTO
12	25mm Straight	G4	1" 6B Spline
20	1-1/4" Straight	N3	14 Tooth Spline, M8 Tap
21	32mm Straight	N4	35mm Tapered
23	14 Tooth Spline, 3/8" Tap	N5	1-1/4" Tapered

► The cardan shaft is only available with the SH, U8 and V8 Mounts.

5. SELECT A PAINT OPTION

A	Black
B	Black, Unpainted Mounting Surface
Z	No Paint

► The SH, U8 and V8 mounts are only available with no paint.

6. SELECT A VALVE CAVITY / CARTRIDGE OPTION

A	None
----------	------

7. SELECT AN ADD-ON OPTION

A	Standard
----------	----------

8. SELECT A MISCELLANEOUS OPTION

AA	None
-----------	------