HYDRAULIC MOTORS LD I MD I HD

HYDRAULIC MOTOR I BRAKE UNITS

STEERING UNITS

HYDRAULIC BRAKES

HYDRAULIC PUMPS

FLOW DIVIDERS

HYDRAULIC MOTORS

Heavy Duty Series

Delivering The Power To Get Work Done

WHITE DRIVE PRODUCTS

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OIL TYPE

Hydraulic oils with anti-wear, anti-foam and demulsifiers are recommended for systems incorporating White Drive Products 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.

White Drive Products recommends maintaining an oil cleanliness level of ISO 17-14 or better.

INSTALLATION & START-UP

When installing a White Drive Products 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 overpressurization. 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! - White Drive Products' motors/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.

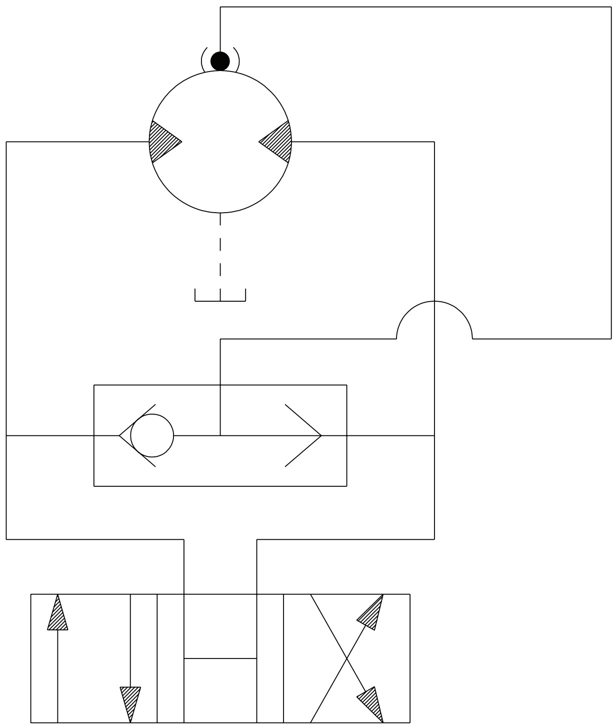
Caution! - Because it is possible for some large displacement motors to overpower the brake, it is critical that the maximum system pressure be limited for these applications. Failure to do so could cause serious injury or death. When choosing a motor/brake for an application, consult the performance 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 4. 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

OPERATING RECOMMENDATIONS & MOTOR CONNECTIONS

MOTOR/BRAKE PRECAUTION (continued)

both of these ports may be used to release the brake in the 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.

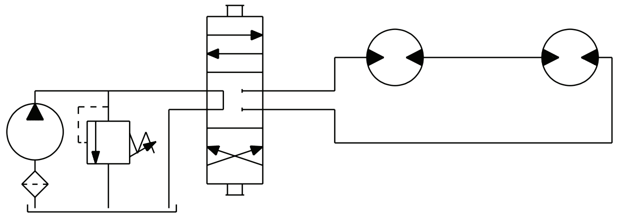
▶ NOTE: It is vital that all operating recommendations be followed. Failure to do so could result in injury or death.

MOTOR CIRCUITS

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

SERIES CONNECTION

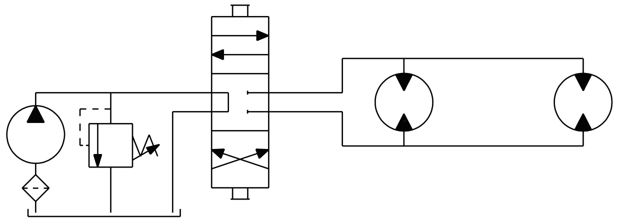
When motors are connected in series, the outlet of one motor is connected to the inlet of the next motor. This allows the full pump flow to go through each motor and provide maximum speed. Pressure and torque are distributed between the motors based on the load each motor is subjected to. The maximum 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.



SERIES 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.

WHITE DRIVE PRODUCTS

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 White Drive Products' 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.

080 — 76 cc [4.6 in³/rev.]

Pressure - bars [psi] (2) — Max. Cont. 207 [3000]; Max. Inter. 242 [3500]

Torque - Nm [lb-in], **Speed rpm** (6) — **Intermittent Ratings** - 10% of Operation

Flow - lpm [gpm] (1)	17 [250]	35 [500]	69 [1000]	104 [150… (2)	…38 [2000]	173 [2500]	207 [3000]	242 [3500]	Theoretical rpm (4)
2 [0.5]	14 [127] **25**	30 [262] **24**	61 [543] **21**	91 [806] **18**	120 [1062] **17**	145 [1285] **11**	169 [1496] **11**	191 [1693] **9**	26
4 [1]	16 [140] **50**	32 [286] **50**	63 [559] **43**	95 [839] **43**	124 [1099] **34**	151 [1340] **32**	178 [1579] **32**	203 [1796] **31**	51
8 [2]	16 [139] **100**	32 [280] **100**	64 [563] **99**	97 [857] **92**	129 [1139] **87**	157 [1390] **79**	187 [1652] **78**	211 [1865] **77**	101
15 [4]	14 [127] **200**	31 [275] **200**	65 [572] **199**	99 [872] **191**	131 [1155] **181**	160 [1420] **174**	186 [1643] **160**	216 [1911] **154**	201
23 [6]	13 [113] **301**	30 [262] **300**	63 [557… **297** (7)	…96 [853] **295**	130 [1149] **284**	160 [1420] **271**	186 [164… **253** (3)	…18 [1930] **245**	302
(1)	10 [91] **401**	27 [243] **400**	61 [536] **398**	93 [826] **390**	127 [1125] **384**	159 [1409] **372**	187 [1654] **346**	220 [1945] **339**	(4)
38 [10]		24 [212] **502**	58 [511] **500**	89 [790] **499**	123 [1087] **498**	156 [1379] **485**	185 [1638] **443**	213 [1883] **433**	503
45 [12]		20 [177] **602**	54 [482] **601**	87 [767] **600**	120 [1060] **597**	164 [1451] **540**	193 [1711] **526**	228 [2021] **510**	603
Max. Cont. 53 [14]		14 [127] **690**	50 [445] **689**	84 [741] (5)	124 [1098] **658**	155 [1369] **644**	185 [1640] **631**	217 [1918] **613**	704
61 [16]									804
Max. Inter. 64 [17]									904

Overall Efficiency - 70 - 100% 40 - 69% 0 - 39%

Theoretical Torque - Nm [lb-in] (8)

21 [183]	41 [366]	83 [732]	124 [109… (8)	…66 [1465]	207 [1831]	248 [2197]	290 [2564]

Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]

1. Flow represents the amount of fluid passing through the motor during each minute of the test.

2. Pressure refers to the measured pressure differential between the inlet and return ports of the motor during the test.

3. The maximum continuous pressure rating and maximum intermittent pressure rating of the motor are separated by the dark lines on the chart.

4. 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.

5. The maximum continuous flow rating and maximum intermittent flow rating of the motor are separated by the dark line on the chart.

6. 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.

7. Areas within the white shading represent maximum motor efficiencies.

8. 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.

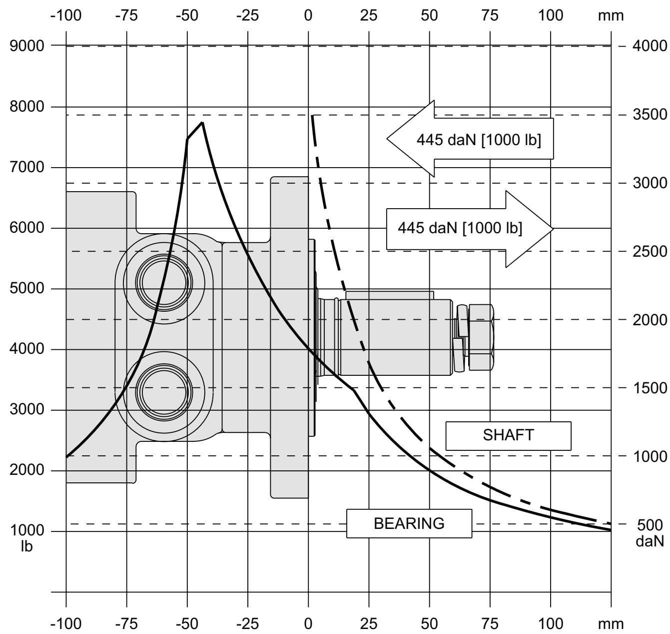
The bearing curves for each model are based on labratory analysis and testing results constructed at White Drive Products. The shaft loading is based on a 3:1 safety factor and 330 Kpsi tensile strength. The allowable load is the lower of the curves at a given point. For instance, one inch in front of 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

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

L_{10} = nominal rating life

C = dynamic load rating

P = equivalent dynamic load

Life Exponent ^{p} = 10/3 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

$$RPM = \frac{2.65 \times KPH \times G}{rm} \qquad RPM = \frac{168 \times MPH \times G}{ri}$$

Where:
MPH = max. vehicle speed (miles/hr)
KPH = max. vehicle speed (kilometers/hr)
ri = rolling radius of tire (inches)
G = gear reduction ratio (if none, G = 1)
rm = rolling radius of tire (meters)

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

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:

TE = RR + GR + FA + DP (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:

<u>Step One: Determine Rolling Resistance</u>

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.

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

Where:
GVW = gross (loaded) vehicle weight (lb or kg)
R = surface friction (value from Table 1)

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

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

<u>Step Two: Determine Grade Resistance</u>

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:
% Grade = [tan of angle (degrees)] x 100

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

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

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.

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

Where:

t = time to maximum speed (seconds)

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

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 (lb or N)

Example TE = 33 + 300 + 34 + 0 (lbs) = 367 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.

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

Where:

M = number of driving motors

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

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

Where:

f = coefficient of friction (see table 2)
W = loaded vehicle weight over driven wheel (lb or N)

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

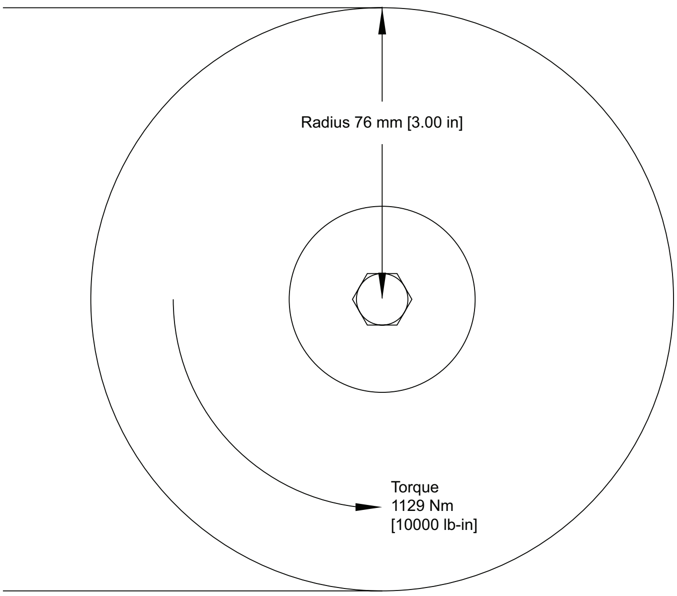
$$RL = \sqrt{W^2 + \left(\frac{T}{ri}\right)^2} \text{ lb} \qquad RL = \sqrt{W^2 + \left(\frac{T}{rm}\right)^2} \text{ kg}$$

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

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

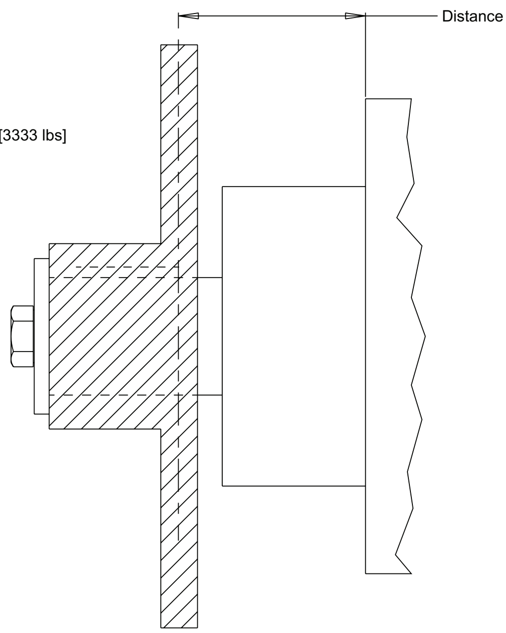
In many cases, pulleys or sprockets may be used to transmit the torque produced by the motor. Use of these components will create a torque induced side load on the motor shaft and bearings. It is important that this load be taken into consideration when choosing a motor with sufficient bearing and shaft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

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

Side Load = 14855 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) =

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

Power In (HP) =

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

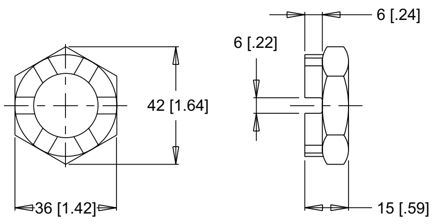
Power Out (HP) =

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

SHAFT NUT INFORMATION

35MM TAPERED SHAFTS
M24 x 1.5 Thread

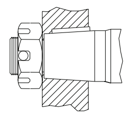
A Slotted Nut



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.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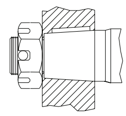
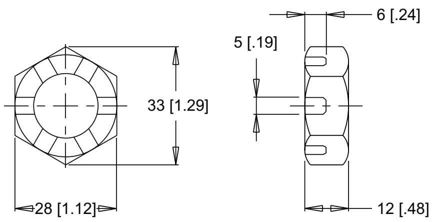

correct

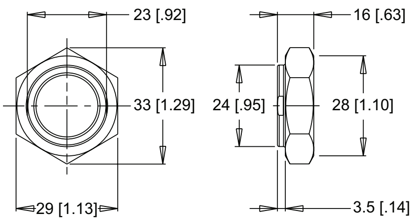
1" TAPERED SHAFTS
3/4-28 Thread

A Slotted Nut



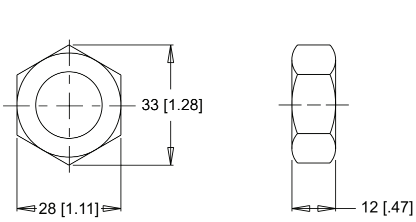
Torque Specifications: 20 - 23 daNm [150 - 170 ft.lb.]

B Lock Nut



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

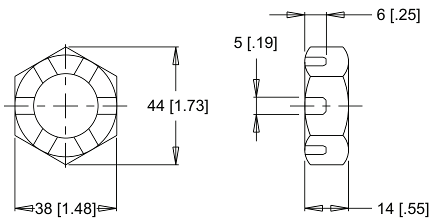
C Solid Nut



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

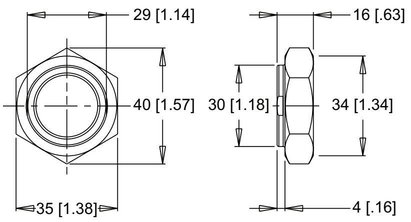
1-1/4" TAPERED SHAFTS
1-20 Thread

A Slotted Nut



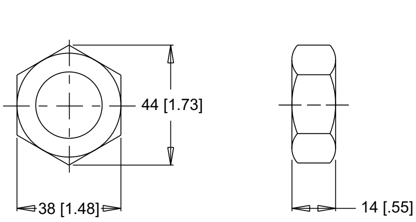
Torque Specifications: 38 daNm [280 ft.lb.] Max.

B Lock Nut



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

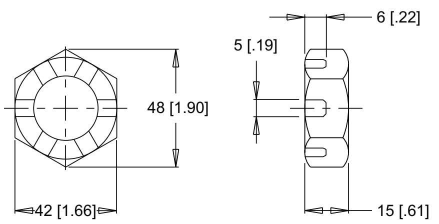
C Solid Nut



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

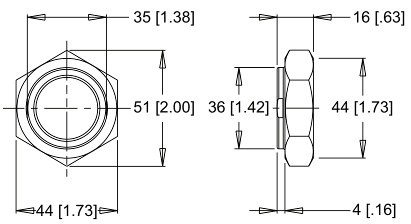
1-3/8" & 1-1/2" TAPERED SHAFTS
1 1/8-18 Thread

A Slotted Nut



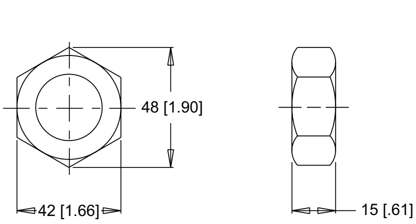
Torque Specifications: 41 - 54 daNm [300 - 400 ft.lb.]

B Lock Nut



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

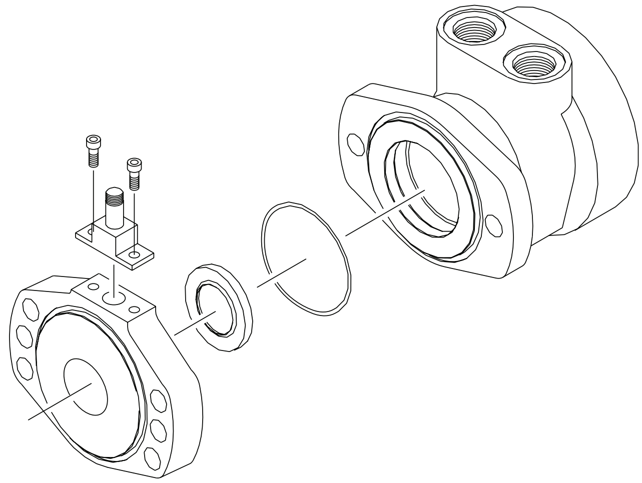
C Solid Nut



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

SPEED SENSORS

White Drive Products 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 700 & 800 series motors single element sensors provide 60 pulses per revolution with the dual element providing 120 pulses per revolution, with all other series providing 50 & 100 pulses respectively. 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 White Drive Products 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 120 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 except the DT which has 60 pulses per revolution. This option will not detect direction.

Y - 3-pin male weatherpack connector*
This option has 50 pulses per revolution on all series except the DT which has 60 pulses per revolution. This option will not detect direction.

X - 4-pin M12 male connector
This option has 100 pulses per revolution on all series except the DT which has 120 pulses per revolution. This option will detect direction.

W - 4-pin male weatherpack connector*
This option has 100 pulses per revolution on all series except the DT which has 120 pulses per revolution. This option will detect direction.

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

SPEED SENSORS

SINGLE ELEMENT SENSOR - Y & Z

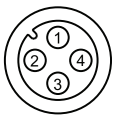
Supply voltages .... 7.5-24 Vdc
Maximum output off voltage .... 24 V
Maximum continuous output current .... < 25 ma
Signal levels (low, high).................... 0.8 to supply voltage
Operating Temp ....-30°C to 83°C [-22°F to 181°F]

DUAL ELEMENT SENSOR - X & W

Supply voltages .... 7.5-18 Vdc
Maximum output off voltage .... 18 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]

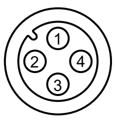
SENSOR CONNECTORS

Z Option



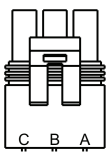
PIN		
1	positive	brown or red
2	n/a	white
3	negative	blue
4	pulse out	black

X Option



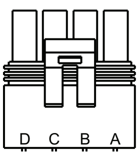
PIN		
1	positive	brown or red
2	direction out	white
3	negative	blue
4	pulse out	black

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 White Drive Products 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.

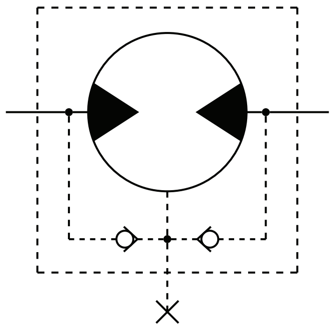
INTERNAL DRAIN

The internal drain is an option available on all HB, DR, and DT Series motors, and is standard on all WP, WR, WS, and D9 series motors. Typically, a separate drain line must be installed to direct case leakage of the motor back to the reservoir when using a HB, DR, or DT Series motor. However, the internal drain option eliminates the need for a separate drain line through the installation of two check valves in the motor endcover. 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.

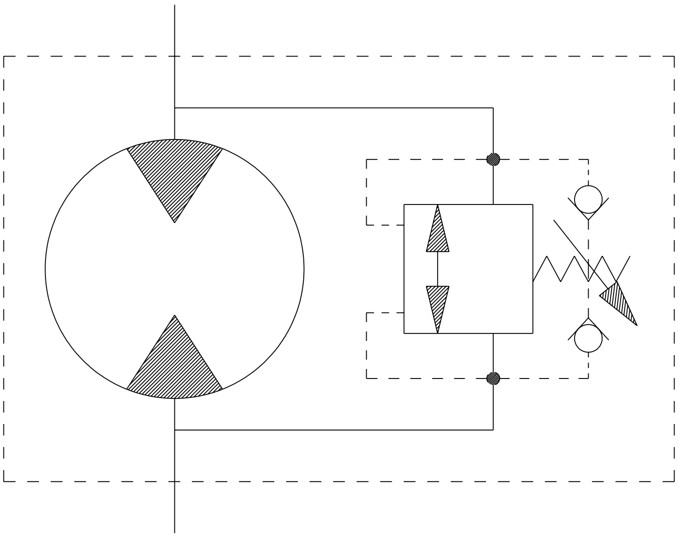
Although this option can simplify many motor installations, precautions must be taken to insure that return line pressure remains below allowable levels (see table below) to insure proper motor operation and life. If return line pressure is higher than allowable, or experiences pressure spikes, this 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 White Drive Products representative.

MAXIMUM ALLOWABLE BACK PRESSURE		
Series	**Cont. bar [psi]**	**Inter. bar [psi]**
HB	69 [1000]	103 [1500]
DR	69 [1000]	103 [1500]
DT	21 [300]	34 [500]
D9	21 [300]	21 [300]
Brakes	34 [500]	34 [500]



VALVE CAVITY

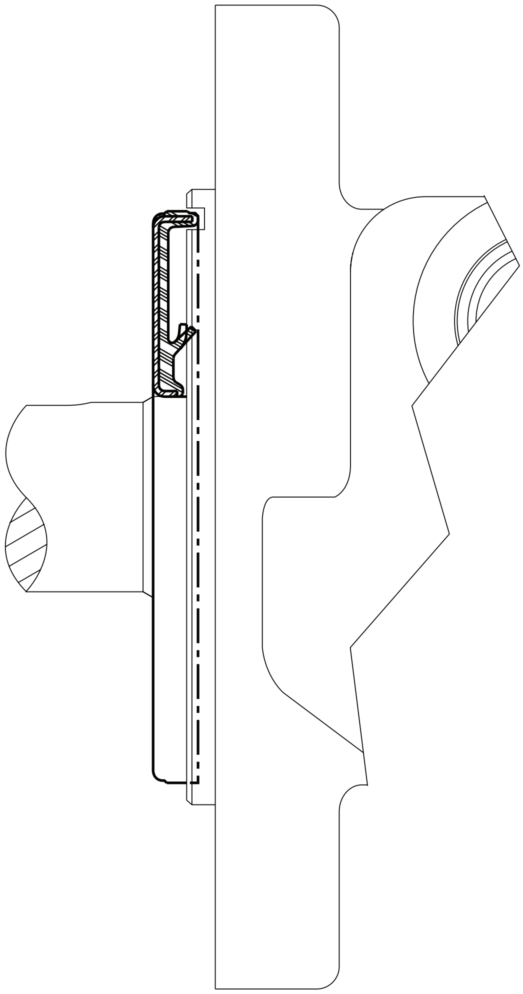
The valve cavity option provides a cost effective way to incorporate a variety of cartridge valves integral to the motor. The valve cavity is a standard 10 series (12 series on the 800 series motor) 2-way cavity that accepts numerous cartridge valves, including overrunning check valves, relief cartridges, 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 White Drive Products distributor.

SLINGER SEAL

Slinger seals are available on select series offered by White Drive Products. Slinger seals offer extendes 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 White Drive 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 White Drive Products Customer Service Representative for additional information.

WS (360 Series)

Heavy Duty Hydraulic Motor

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

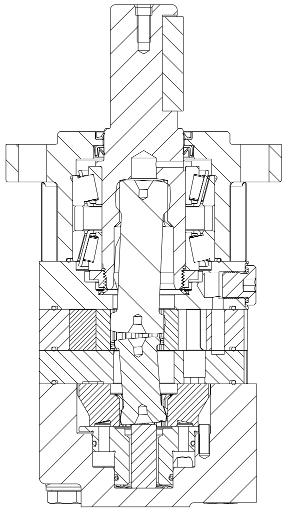
- Twelve shaft and ten mounting options to meet the most common SAE and European requirements.
- Heavy- duty tapered roller bearings for extra side load capacity.
- Three zone commutator valve for high flow capacity.
- Standard case drain with integral internal drain for extended shaft seal life.

TYPICAL APPLICATIONS

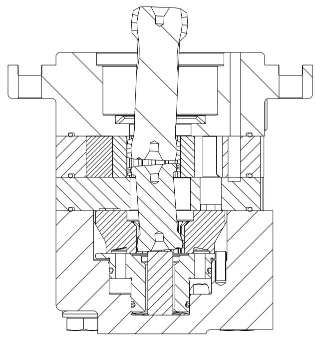
Medium-duty wheel drives, sweepers, grain augers, spreaders, feed rollers, brush drives, mowers, harvesting equipment gear box mounts and more

SERIES DESCRIPTIONS

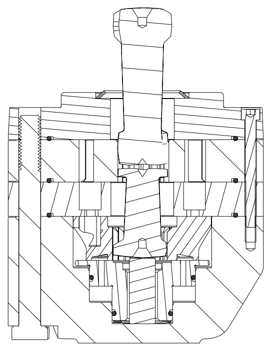
360 - Hydraulic Motor
Standard



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.

DISPLACEMENT PERFORMANCE

080 — 80 cm³ [4.9 in³] / rev

Pressure - bar [psi] — Max. Cont.: 210 [3050]; Max. Inter.: 275 [3990]

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Cell values: Torque - Nm [lb-in], **Speed rpm**

Flow - lpm [gpm]	30 [440]	70 [1020]	105 [1520]	140 [2030]	175 [2540]	210 [3050]	225 [3260]	250 [3630]	275 [3990]	Theoretical rpm
5 [1.3]	29 [257] **61**	76 [673] **58**	116 [1027] **55**	156 [1381] **45**	194 [1717] **36**	222 [1965] **31**				62
10 [2.6]	28 [248] **124**	73 [646] **118**	114 [1009] **110**	155 [1372] **99**	194 [1717] **87**	234 [2071] **73**	246 [2177] **67**	269 [2381] **60**		125
20 [5.3]	27 [239] **246**	72 [637] **241**	112 [991] **232**	152 [1345] **220**	191 [1690] **204**	232 [2053] **184**	248 [2195] **176**	278 [2460] **159**	303 [2682] **143**	250
30 [7.9]	24 [212] **368**	70 [620] **361**	110 [974] **354**	150 [1328] **342**	190 [1682] **322**	231 [2044] **302**	248 [2195] **293**	276 [2443] **277**	306 [2708] **254**	375
40 [10.6]	23 [204] **493**	68 [602] **483**	107 [947] **479**	146 [1292] **469**	189 [1673] **448**	229 [2027] **426**	247 [2186] **418**	277 [2451] **399**	303 [2682] **381**	499
50 [13.2]		66 [584] **607**	106 [938] **598**	146 [1292] **585**	186 [1646] **564**	227 [2009] **545**	245 [2168] **532**			624
65 [17.2] (Max. Cont.)		62 [549] **793**	101 [894] **787**	141 [1248] **762**	182 [1611] **742**	225 [1991] **714**	238 [2106] **709**			811
80 [21.1] (Max. Inter.)		56 [496] **979**	97 [858] **966**	140 [1239] **941**	178 [1575] **920**					999

Overall Efficiency - 70 - 100% (white) 40 - 69% (light grey) 0 - 39% (dark grey)

Rotor Width mm [in]	30 [440]	70 [1020]	105 [1520]	140 [2030]	175 [2540]	210 [3050]	225 [3260]	250 [3630]	275 [3990]
15.6 [.614]	38 [336]	89 [788]	134 [1186]	178 [1575]	223 [1974]	268 [2372]	287 [2540]	319 [2823]	351 [3107]

Theoretical Torque - Nm [lb-in]

Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]

100 — 100 cm³ [6.1 in³] / rev

Pressure - bar [psi] — Max. Cont.: 210 [3050]; Max. Inter.: 275 [3990]

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Cell values: Torque - Nm [lb-in], **Speed rpm**

Flow - lpm [gpm]	35 [510]	70 [1020]	105 [1520]	140 [2030]	175 [2540]	210 [3050]	225 [3260]	250 [3630]	275 [3990]	Theoretical rpm
5 [1.3]	47 [416] **49**	98 [867] **48**	149 [1319] **46**	198 [1752] **43**	245 [2168] **37**	284 [2513] **31**	299 [2646] **23**			50
10 [2.6]	46 [407] **99**	96 [850] **97**	148 [1310] **94**	199 [1761] **90**	249 [2204] **83**	297 [2628] **75**	316 [2797] **70**	349 [3089] **59**	372 [3292] **48**	100
20 [5.3]	45 [398] **197**	95 [841] **195**	146 [1292] **192**	198 [1752] **187**	249 [2204] **180**	301 [2664] **167**	322 [2850] **161**	357 [3159] **149**	390 [3452] **143**	200
30 [7.9]	43 [381] **297**	93 [823] **295**	144 [1274] **292**	195 [1726] **288**	247 [2186] **280**	297 [2628] **263**	320 [2832] **259**	356 [3151] **246**	392 [3469] **227**	300
40 [10.6]	40 [354] **395**	91 [805] **393**	142 [1257] **392**	193 [1708] **389**	244 [2159] **383**	295 [2611] **367**	317 [2805] **362**	354 [3133] **347**	389 [3443] **331**	400
50 [13.2]	37 [327] **495**	88 [779] **490**	138 [1221] **491**	191 [1690] **486**	240 [2124] **481**	295 [2611] **465**	315 [2788] **459**			500
60 [15.9]	35 [310] **594**	84 [743] **592**	136 [1204] **585**	187 [1655] **579**	238 [2106] **565**	289 [2558] **564**	311 [2752] **553**			600
75 [19.8] (Max. Cont.)	28 [248] **744**	78 [690] **739**	126 [1115] **743**	183 [1620] **726**	230 [2036] **712**	286 [2531] **698**	304 [2690] **691**			750
90 [23.8] (Max. Inter.)		70 [620] **887**	123 [1089] **881**	174 [1540] **874**	223 [1974] **859**					900

Overall Efficiency - 70 - 100% (white) 40 - 69% (light grey) 0 - 39% (dark grey)

Rotor Width mm [in]	35 [510]	70 [1020]	105 [1520]	140 [2030]	175 [2540]	210 [3050]	225 [3260]	250 [3630]	275 [3990]
19.7 [.776]	55 [493]	111 [986]	167 [1479]	223 [1972]	278 [2465]	334 [2958]	358 [3170]	398 [3521]	438 [3874]

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 7.

WHITE DRIVE PRODUCTS

DISPLACEMENT PERFORMANCE

125 — 125 cm³ [7.6 in³] / rev

Pressure - bar [psi] (Max. Cont. 210 [3050]; Max. Inter. 275 [3990])

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Torque - Nm [lb-in], **Speed rpm**

Flow - lpm [gpm]	35 [510]	70 [1020]	105 [1520]	140 [2030]	175 [2540]	210 [3050]	225 [3260]	250 [3630]	275 [3990]	Theoretical rpm
5 [1.3]	51 [451] **39**	113 [1000] **38**	176 [1558] **35**	229 [2027] **31**	301 [2664] **26**	327 [2894] **16**				40
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
Max. Cont. 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
Max. Inter. 90 [23.8]		81 [717] **711**	148 [1310] **702**	214 [1894] **685**	274 [2425] **672**					720

Overall Efficiency - 70 - 100% (white) 40 - 69% (light grey) 0 - 39% (dark grey)

Rotor Width mm [in]	Theoretical Torque - Nm [lb-in]								
19.7 [.776]	69 [616]	139 [1232]	208 [1849]	278 [2465]	348 [3081]	417 [3698]	447 [3962]	493 [4402]	547 [4842]

Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]

160 — 160 cm³ [9.7 in³] / rev

Pressure - bar [psi] (Max. Cont. 210 [3050]; Max. Inter. 260 [3770])

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Torque - Nm [lb-in], **Speed rpm**

Flow - lpm [gpm]	35 [510]	70 [1020]	105 [1520]	140 [2030]	160 [2320]	175 [2540]	210 [3050]	225 [3260]	260 [3770]	Theoretical rpm
5 [1.3]	71 [628] **30**	150 [1328] **29**	232 [2053] **28**	307 [2717] **24**	356 [3151] **20**	385 [3407] **18**				31
10 [2.6]	71 [628] **62**	149 [1319] **61**	230 [2036] **58**	310 [2744] **53**	355 [3142] **47**	386 [3416] **42**	459 [4062] **33**	488 [4319] **31**		62
20 [5.3]	69 [611] **123**	147 [1301] **122**	230 [2036] **119**	309 [2735] **113**	355 [3142] **107**	388 [3434] **101**	465 [4115] **84**	498 [4407] **77**		125
30 [7.9]	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**	187
40 [10.6]	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**	250
50 [13.2]	55 [487] **308**	133 [1177] **307**	215 [1903] **304**	296 [2620] **296**	342 [3027] **291**	376 [3328] **285**	458 [4053] **265**	490 [4337] **258**		312
60 [15.9]	47 [416] **372**	127 [1124] **368**	207 [1832] **366**	289 [2558] **361**	336 [2974] **354**	371 [3283] **348**	452 [4000] **328**	487 [4310] **318**		375
Max. Cont. 75 [19.8]	36 [319] **468**	114 [1009] **467**	196 [1735] **466**	279 [2469] **455**	323 [2859] **449**	361 [3195] **442**	442 [3912] **422**	472 [4177] **415**		468
Max. Inter. 90 [23.8]	24 [212] **561**	106 [938] **557**	183 [1620] **549**	266 [2354] **540**	311 [2752] **533**					562

Overall Efficiency - 70 - 100% (white) 40 - 69% (light grey) 0 - 39% (dark grey)

Rotor Width mm [in]	Theoretical Torque - Nm [lb-in]								
25.4 [1.000]	89 [789]	178 [1578]	267 [2366]	359 [3156]	407 [3606]	445 [3944]	534 [4733]	573 [5071]	662 [5860]

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 7.

DISPLACEMENT PERFORMANCE

200 — 200 cm³ [12.2 in³] / rev

Pressure - bar [psi] (Max. Cont. 210 [3050]; Max. Inter. 250 [3630])

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Flow - lpm [gpm]	35 [510]	70 [1020]	105 [1520]	140 [2030]	160 [2320]	175 [2540]	210 [3050]	225 [3260]	250 [3630]	Theoretical rpm
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] (Max. Cont.)	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] (Max. Inter.)	26 [230] **448**	139 [1230] **444**	238 [2106] **448**	338 [2991] **436**	398 [3523] **429**					450

Torque - Nm [lb-in], **Speed rpm**

Overall Efficiency - 70 - 100% / 40 - 69% / 0 - 39%

Rotor Width mm [in]	Theoretical Torque - Nm [lb-in]								
31.8 [1.252]	111 [986]	222 [1972]	334 [2958]	445 [3944]	509 [4508]	557 [4930]	668 [5917]	716 [6339]	795 [7044]

Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]

230 — 226 cm³ [13.8 in³] / rev

Pressure - bar [psi] (Max. Cont. 200 [2900]; Max. Inter. 250 [3630])

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Flow - lpm [gpm]	35 [510]	70 [1020]	95 [1380]	125 [1810]	140 [2030]	155 [2250]	175 [2540]	200 [2900]	225 [3260]	250 [3630]	Theoretical rpm
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] (Max. Cont.)	76 [673] **324**	190 [1682] **321**	275 [2434] **320**	388 [3434] **310**	425 [3761] **309**	481 [4257] **304**	546 [4832] **300**				332
90 [23.8] (Max. Inter.)	56 [496] **389**	174 [1540] **386**	257 [2274] **383**	361 [3195] **378**	411 [3637] **374**						399

Torque - Nm [lb-in], **Speed rpm**

Overall Efficiency - 70 - 100% / 40 - 69% / 0 - 39%

Rotor Width mm [in]	Theoretical Torque - Nm [lb-in]									
45.4 [1.787]	126 [1115]	251 [2222]	341 [3018]	449 [3974]	503 [4452]	557 [4930]	628 [5558]	718 [6355]	808 [7152]	898 [7948]

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 7.

DISPLACEMENT PERFORMANCE

250

250 cm³ [15.2 in³] / rev

Pressure - bar [psi] (Max. Cont. 200 [2900]; Max. Inter. 250 [3630])

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Cells: Torque - Nm [lb-in], **Speed rpm**

Flow - lpm [gpm]	35 [510]	70 [1020]	95 [1380]	125 [1810]	140 [2030]	155 [2250]	175 [2540]	200 [2900]	225 [3260]	250 [3630]	Theoretical rpm
5 [1.3]	115 [1018] **19**										20
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] (Max. Cont.)	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] (Max. Inter.)	59 [522] **359**	184 [1628] **357**	272 [2407] **363**	384 [3398] **353**	422 [3735] **350**						360

Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐

Rotor Width mm [in]	35 [510]	70 [1020]	95 [1380]	125 [1810]	140 [2030]	155 [2250]	175 [2540]	200 [2900]	225 [3260]	250 [3630]
39.4 [1.551]	139 [1232]	278 [2465]	378 [3346]	497 [4402]	557 [4930]	616 [5458]	696 [6163]	795 [7043]	895 [7924]	994 [8804]

Theoretical Torque - Nm [lb-in]. Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]

315

305 cm³ [18.6 in³] / rev

Pressure - bar [psi] (Max. Cont. 200 [2900]; Max. Inter. 240 [3480])

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Cells: Torque - Nm [lb-in], **Speed rpm**

Flow - lpm [gpm]	35 [510]	70 [1020]	100 [1450]	120 [1740]	140 [2030]	160 [2320]	175 [2540]	200 [2900]	225 [3260]	240 [3480]	Theoretical rpm
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] (Max. Cont.)	99 [876] **240**	258 [2283] **237**	394 [3487] **237**	483 [4275] **234**	573 [5071] **226**	651 [5762] **222**					246
90 [23.8] (Max. Inter.)	74 [655] **293**	231 [2044] **293**	371 [3283] **284**	460 [4071] **281**	543 [4806] **276**						295

Overall Efficiency - 70 - 100% ☐ 40 - 69% ☐ 0 - 39% ☐

Rotor Width mm [in]	35 [510]	70 [1020]	100 [1450]	120 [1740]	140 [2030]	160 [2320]	175 [2540]	200 [2900]	225 [3260]	240 [3480]
49.2 [1.937]	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 7.

DISPLACEMENT PERFORMANCE

400

393 cm³ [24.0 in³] / rev

Pressure - bar [psi] (Max. Cont.: 160 [2320]; Max. Inter.: 190 [2760])

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Torque - Nm [lb-in], **Speed rpm**

Flow - lpm [gpm]	30 [440]	60 [870]	80 [1160]	105 [1520]	120 [1740]	140 [2030]	160 [2320]	175 [2540]	190 [2760]	Theoretical rpm
5 [1.3]	167 [1478] **12**	352 [3115] **12**								13
10 [2.6]	176 [1531] **24**	345 [3053] **23**	461 [4080] **22**	606 [5363] **21**						25
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**		51
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**	76
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**		102
50 [13.2]	142 [1257] **123**	317 [2805] **123**	435 [3850] **122**	575 [5089] **121**	667 [5903] **120**	787 [6966] **115**				127
60 [15.9]	131 [1159] **149**	301 [2664] **148**	419 [3708] **147**	566 [5009] **146**	653 [5779] **144**	774 [6851] **140**				153
75 [19.8] (Max. Cont.)	100 [885] **185**	276 [2443] **185**	393 [3478] **184**	541 [4788] **183**	628 [5558] **181**					191
90 [23.8] (Max. Inter.)	72 [637] **224**	247 [2186] **222**	360 [3186] **221**	511 [4522] **220**						229

Overall Efficiency - 70 - 100% (white), 40 - 69% (light grey), 0 - 39% (dark grey)

Theoretical Torque - Nm [lb-in]

Rotor Width mm [in]	30 [440]	60 [870]	80 [1160]	105 [1520]	120 [1740]	140 [2030]	160 [2320]	175 [2540]	190 [2760]
63.5 [2.500]	187 [1655]	375 [3319]	500 [4426]	656 [5806]	750 [6638]	875 [7745]	1000 [8851]	1093 [9674]	1187 [10506]

Displacement tested at 54°C [129°F] with an oil viscosity of 46cSt [213 SUS]

500

493 cm³ [30.1 in³] / rev

Pressure - bar [psi] (Max. Cont.: 120 [1740]; Max. Inter.: 140 [2030])

Intermittent Ratings are below and to the right of the BOLD line. **Intermittent Ratings -** 10% of Operation

Torque - Nm [lb-in], **Speed rpm**

Flow - lpm [gpm]	25 [360]	50 [730]	80 [1160]	90 [1300]	105 [1520]	120 [1740]	140 [2030]	Theoretical rpm
10 [2.6]	191 [1690] **19**	355 [3142] **18**						20
20 [5.3]	175 [1549] **39**	354 [3133] **39**	571 [5053] **36**	646 [5717] **34**	760 [6726] **31**			41
30 [7.9]	164 [1451] **59**	344 [3044] **58**	565 [5000] **56**	637 [5637] **55**	743 [6576] **52**	848 [7506] **48**	1001 [8859] **38**	61
40 [10.6]	147 [1301] **79**	333 [2947] **78**	551 [4876] **77**	623 [5514] **76**	730 [6461] **74**	833 [7373] **70**		81
50 [13.2]	136 [1204] **99**	317 [2805] **99**	537 [4752] **96**	610 [5399] **95**	717 [6345] **93**	830 [7346] **86**		102
60 [15.9]	118 [1044] **119**	302 [2673] **118**	523 [4629] **116**	597 [5283] **114**	704 [6230] **110**			122
75 [19.8] (Max. Cont.)	94 [832] **148**	270 [2390] **149**	490 [4337] **145**	566 [5009] **143**	674 [5965] **141**			152
90 [23.8] (Max. Inter.)	55 [487] **179**	237 [2097] **180**	457 [4044] **175**	530 [4691] **174**				183

Overall Efficiency - 70 - 100% (white), 40 - 69% (light grey), 0 - 39% (dark grey)

Theoretical Torque - Nm [lb-in]

Rotor Width mm [in]	25 [360]	50 [730]	80 [1160]	90 [1300]	105 [1520]	120 [1740]	140 [2030]
78.8 [3.102]	196 [1735]	392 [3470]	627 [5550]	706 [6249]	823 [7284]	941 [8329]	1098 [9718]

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 7.

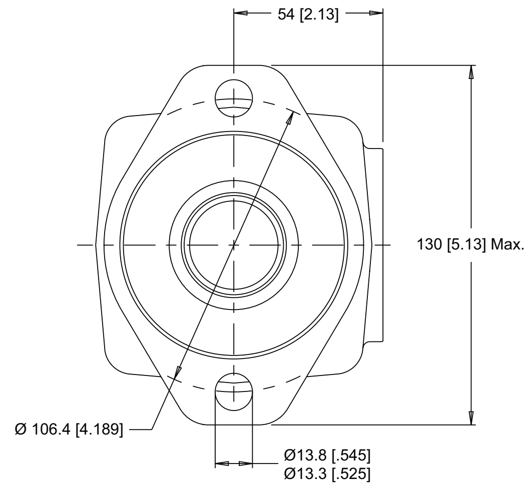
WS (360 Series)

Heavy Duty Hydraulic Motor

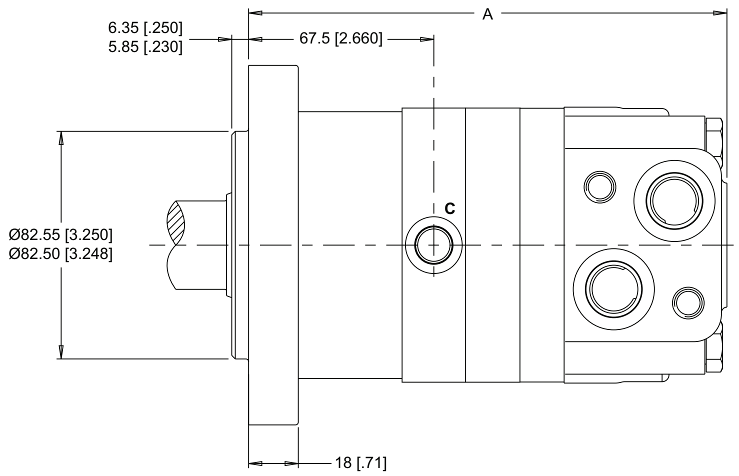
HOUSINGS

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

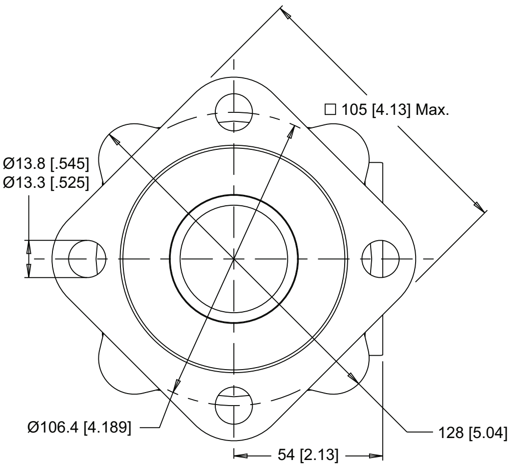
2-HOLE, SAE A MOUNT



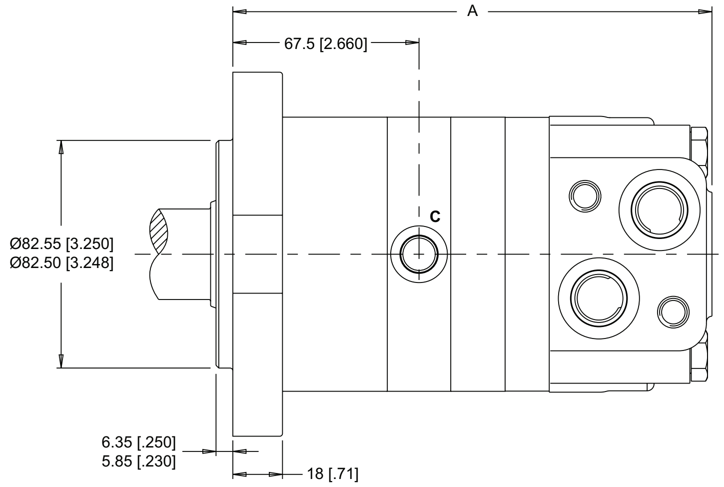
A7 Side Ports



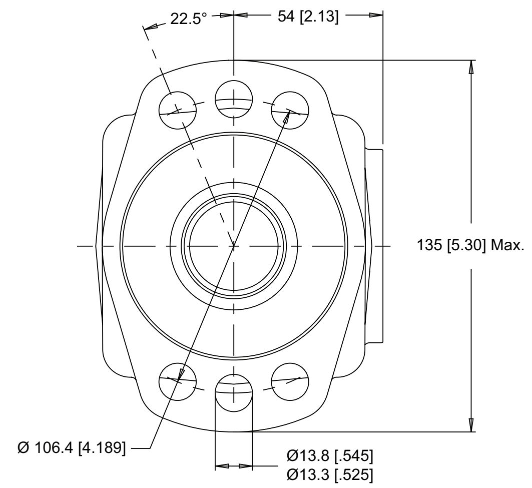
4-HOLE, SAE A MOUNT



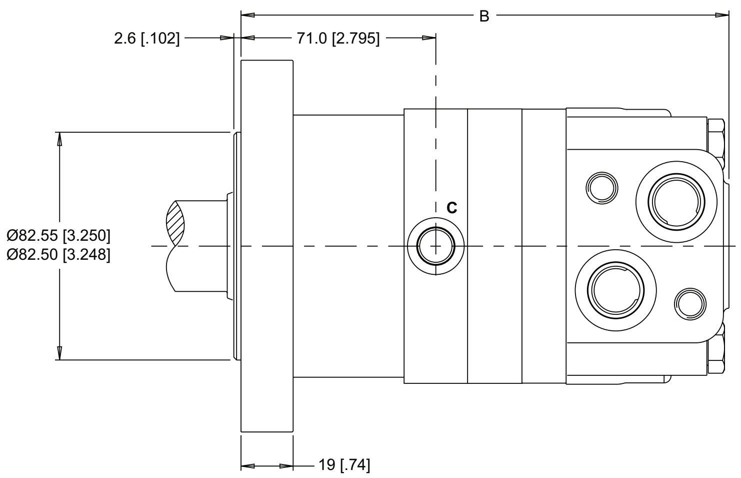
AH Side Ports



6-HOLE, MAGNETO MOUNT



AT Side Ports



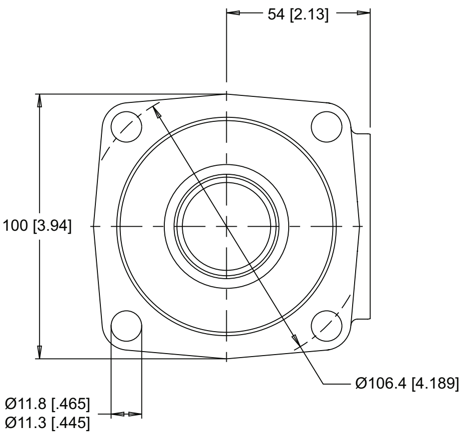
▶ Dimension A & B are charted on page 41.

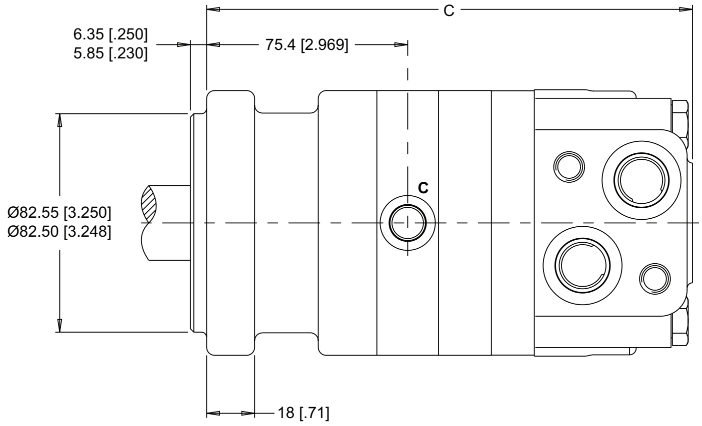
HOUSINGS

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

4-HOLE, SQUARE EURO MOUNT

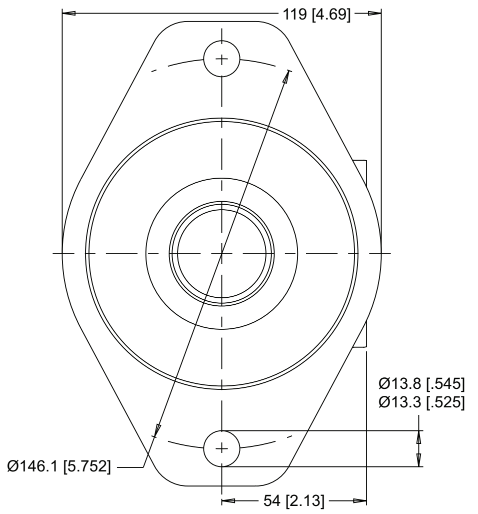
AU Side Ports

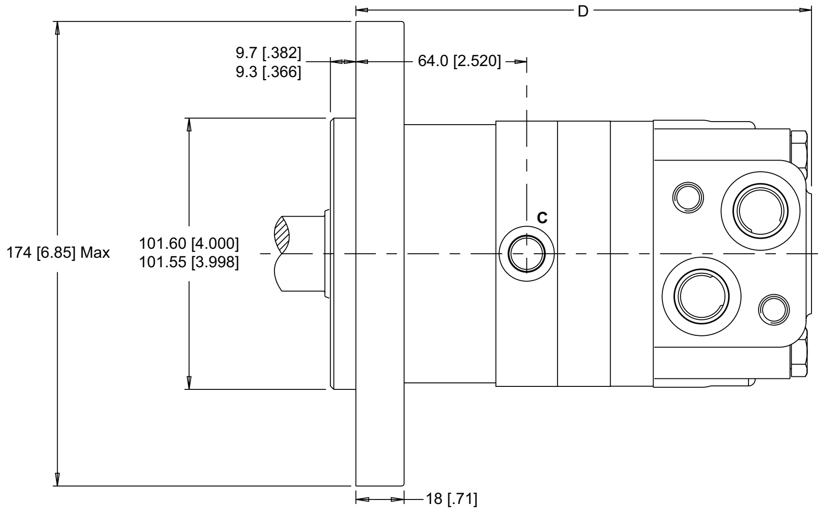




2-HOLE, SAE B MOUNT

B7 Side Ports

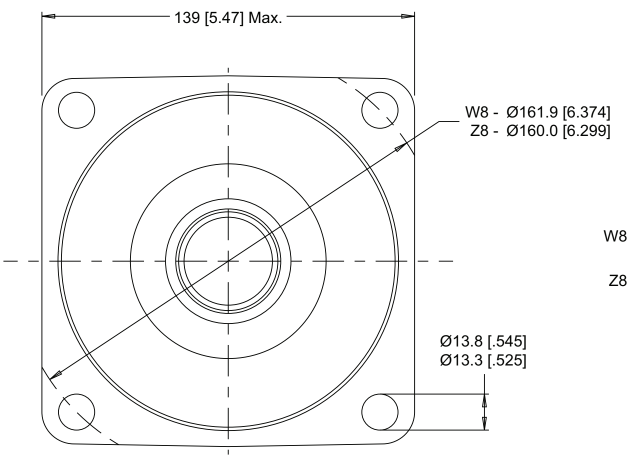


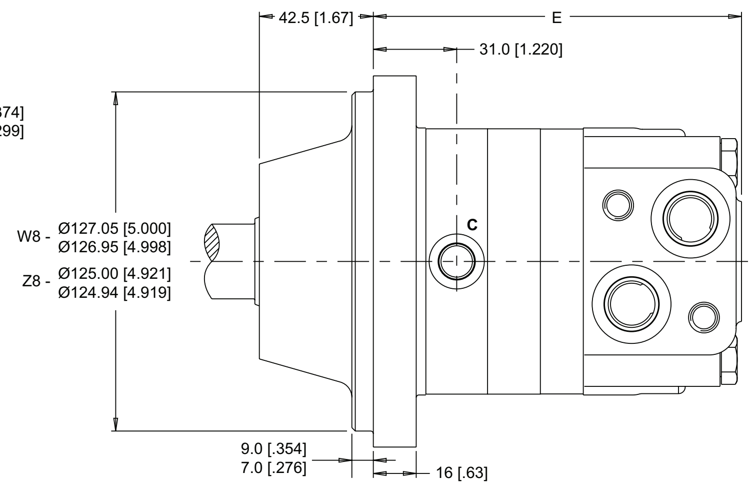


4-HOLE, WHEEL MOUNT

W8 Side Ports - 5” Pilot

Z8 Side Ports - 125mm Pilot





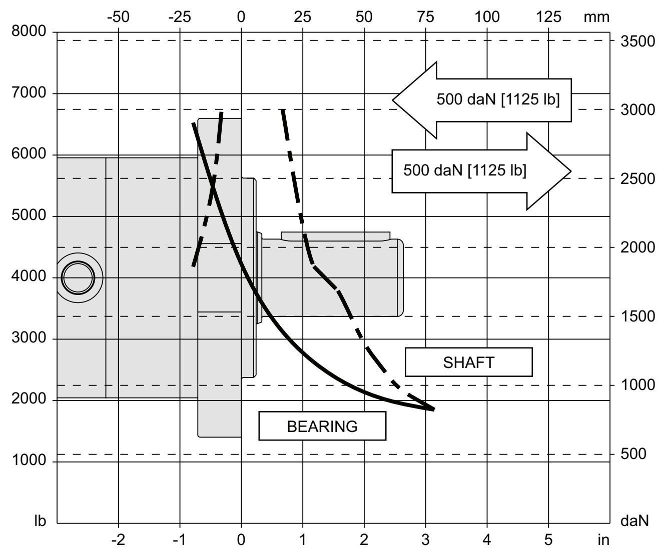
▶ Dimension C, D & E are charted on page 41.

TECHNICAL INFORMATION

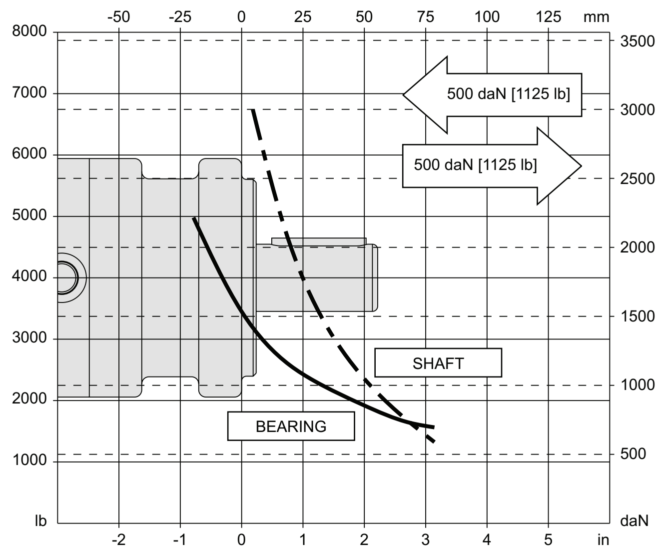
ALLOWABLE SHAFT LOAD / BEARING CURVE

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 8.

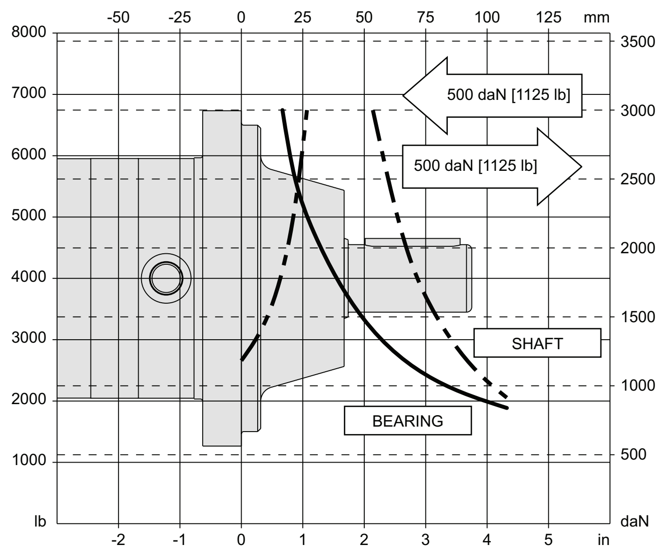
SAE A, SAE B & MAGNETO MOUNTS



SQUARE EURO MOUNT



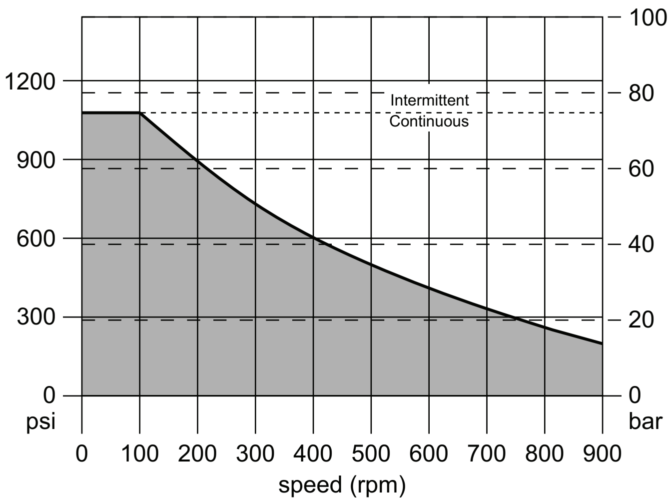
WHEEL MOUNTS



▶ 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 38 & 39.

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]

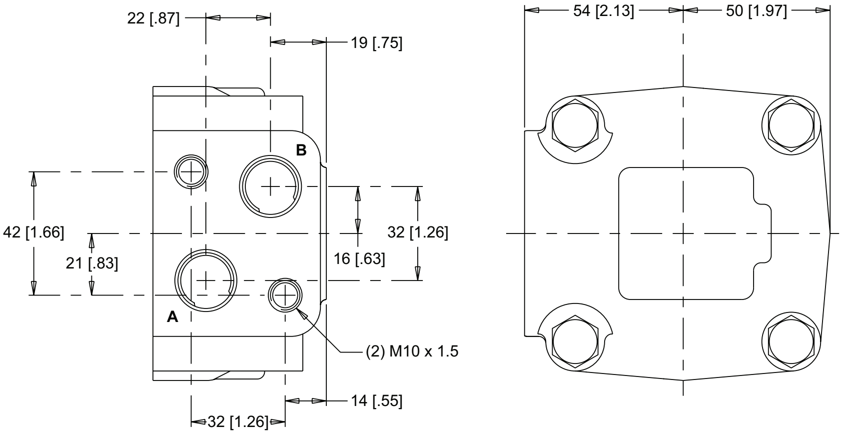
- 360 series motor weights can vary ± 1kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

PORTING

SIDE PORTED - OFFSET MANIFOLD

Code	Port		Size
1	Main Ports	**A, B**:	7/8-14 UNF
	Drain Port	**C**:	7/16-20 UNF
3	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

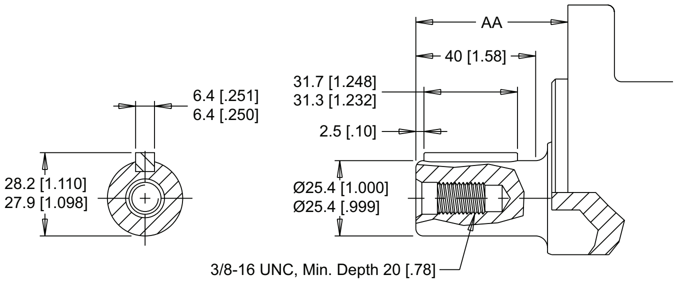
STANDARD



► Drain port C is referenced on housing drawings listed on pages 38, 39 and 45.

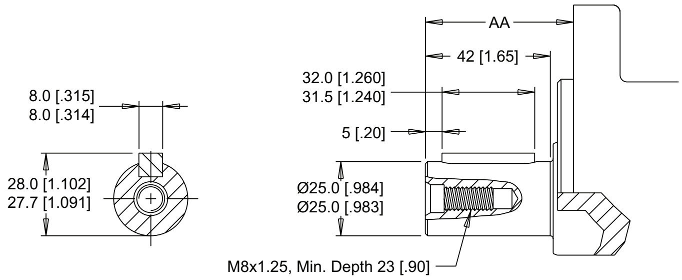
SHAFTS

10 1” Straight



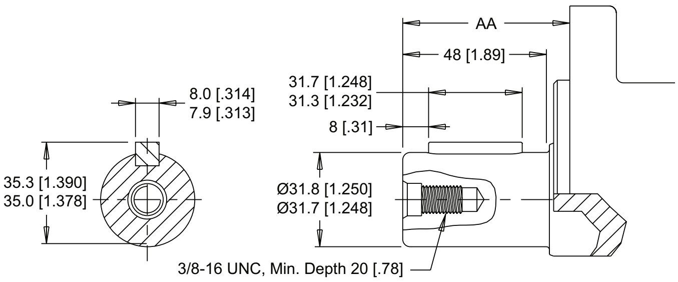
Max. Torque: 655 Nm [5800 lb-in]

12 25mm Straight



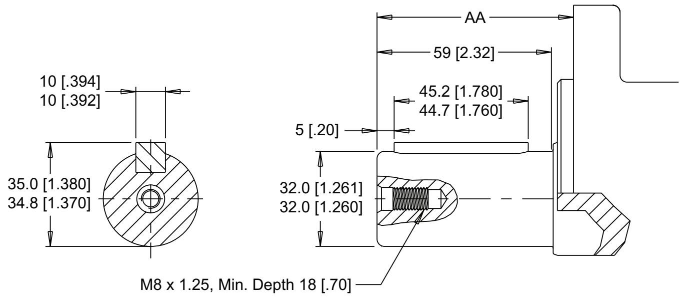
Max. Torque: 678 Nm [6000 lb-in]

20 1-1/4” Straight



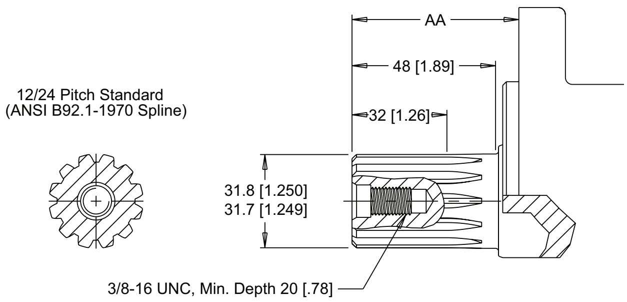
Max. Torque: 881 Nm [7800 lb-in]

21 32mm Straight



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

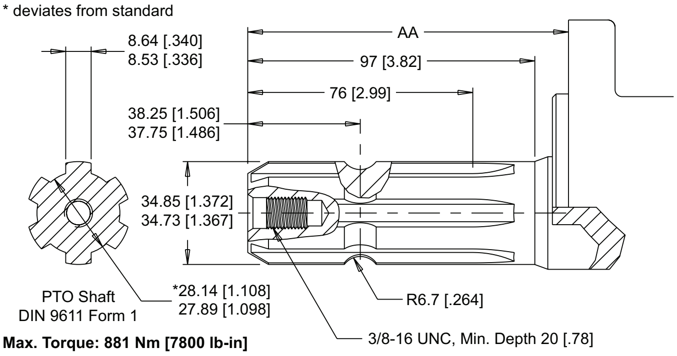
23 14 Tooth Spline



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

78 1-3/8” 6B Spline PTO

* deviates from standard

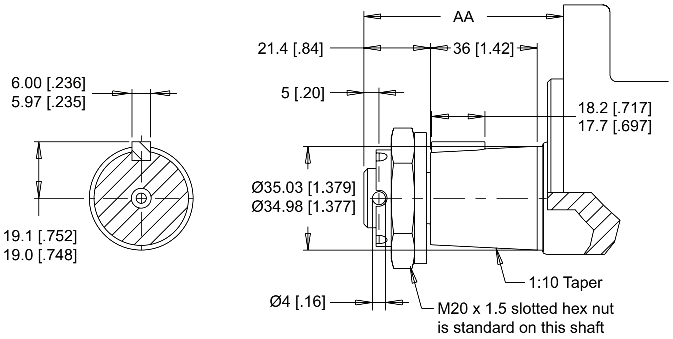


Max. Torque: 881 Nm [7800 lb-in]

▶ Dimension AA is charted on page 44.

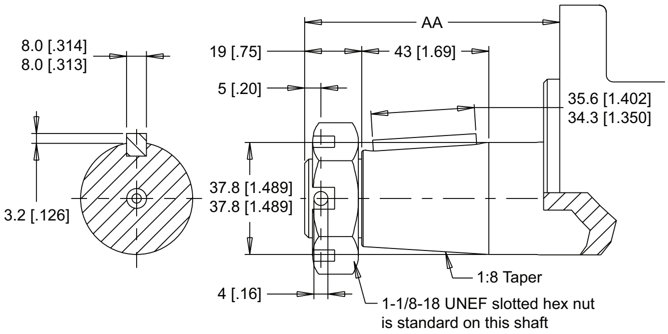
SHAFTS

N4 35mm Tapered



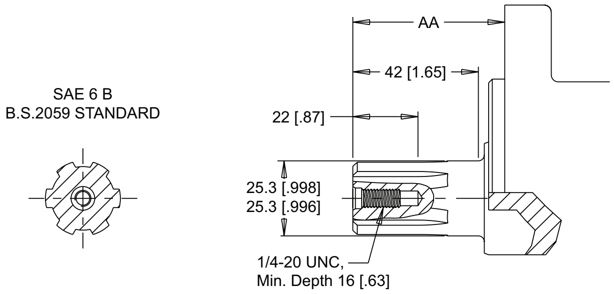
Max. Torque: 881 Nm [7800 lb-in]

31 1-1/2" Tapered



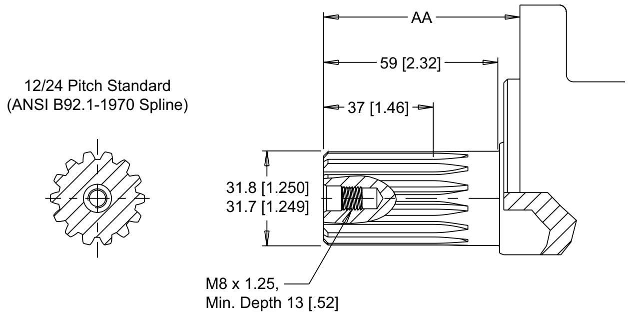
Max. Torque: 881 Nm [7800 lb-in]

G4 1" 6B Spline



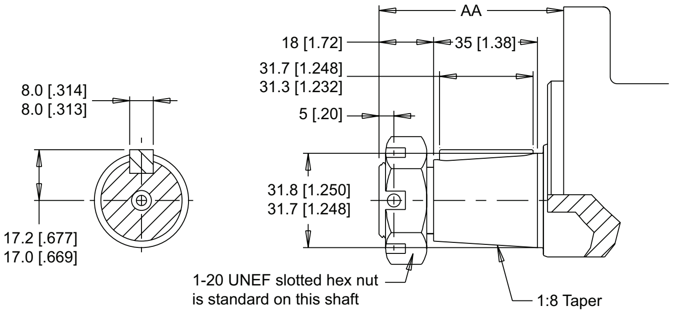
Max. Torque: 678 Nm [6000 lb-in]

N3 1-1/4" 14 Tooth Spline



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

N5 1-1/4" 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 43.

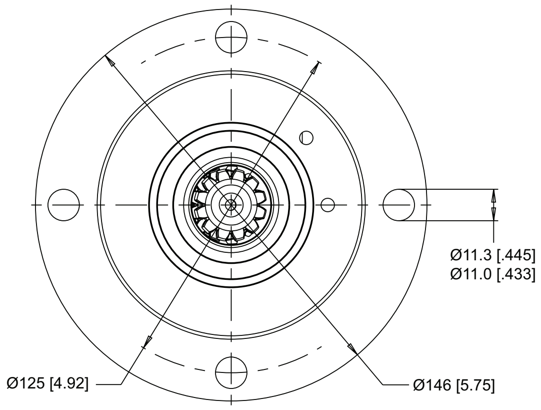
AA	SAE A Mounts	Magneto Mounts	Sq. Euro Mounts	SAE B Mounts	Wheel Mounts
#	mm [in]	mm [in]	mm [in]	mm [in]	mm [in]
10	52 [2.05]	48 [1.89]	44 [1.73]	55 [2.17]	88 [3.46]
12	51 [2.01]	47 [1.85]	43 [1.69]	54 [2.13]	87 [3.43]
20	57 [2.24]	53 [2.09]	49 [1.93]	60 [2.36]	93 [3.66]
21	67 [2.63]	63 [2.48]	59 [2.32]	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]

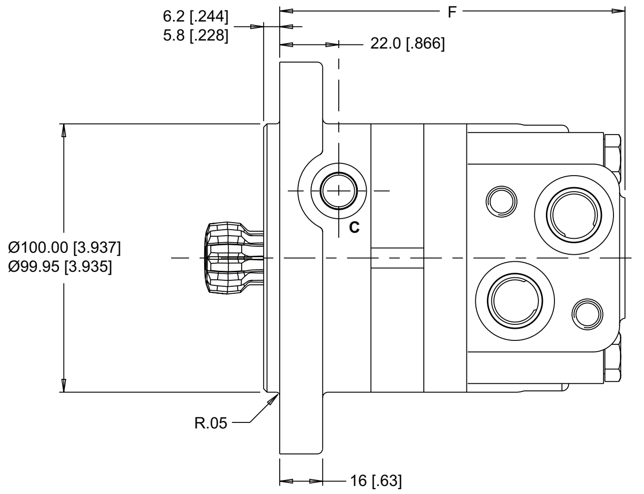
▶ Shaft lengths vary ± 0.8 mm [.030 in.]

HOUSINGS

4-HOLE, SHORT MOTOR MOUNT

SH Side Ports





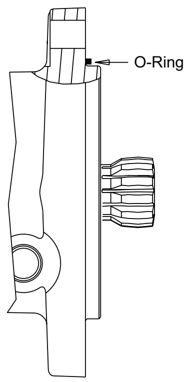
▶ Porting options listed on pages 42.

SHAFTS

00 Cardan (For Use With The SH Mount)

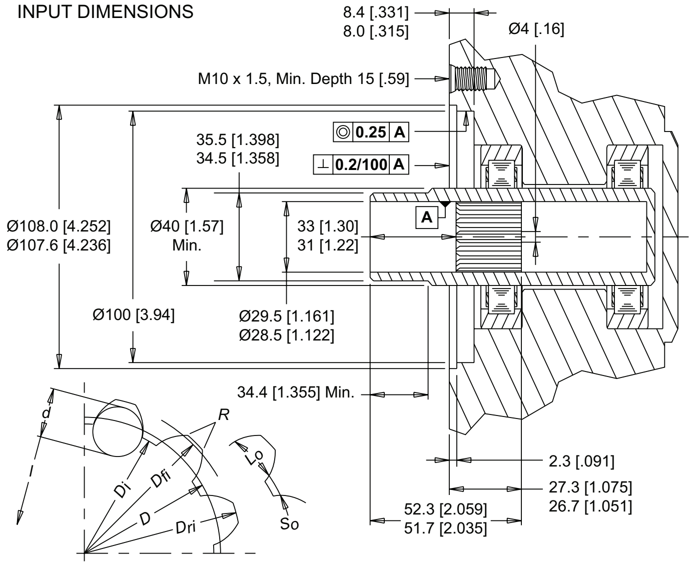
Fillet Root Side Fit
Number of Teeth 12
Pitch 12/24
Pressure Angle .... 30°
Pitch Diameter *D* .... 25.4 [1.000]
Major Diameter D_{ri} .... 28.0 [1.10] - 27.9 [1.096]
Form Diameter (Min.) D_{fi} .... 27.6 [1.09]
Minor Diameter D_i .... 23.033 [.9068] - 23.0 [.9055]
Space Width (Circular) L_o* .... 4.328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

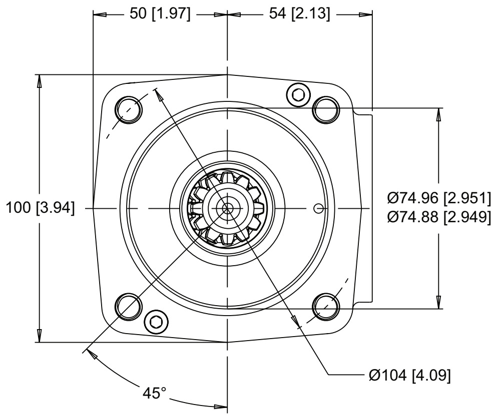
F	Length	Weight
#	mm [in]	kg [lb]
080	125 [4.92]	7.8 [17.2]
100	129 [5.08]	8.1 [17.9]
125	129 [5.08]	8.1 [17.9]
160	134 [5.28]	8.6 [19.0]
200	141 [5.55]	9.0 [19.8]
230	155 [6.10]	9.8 [21.6]
250	148 [5.83]	9.5 [20.9]
315	158 [6.22]	10.0 [22.0]
400	173 [6.81]	10.9 [24.0]
500	188 [7.40]	11.8 [26.0]

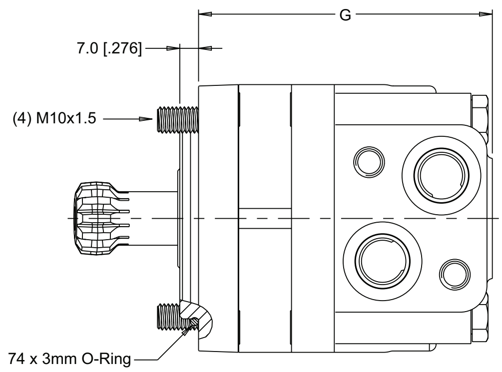
▶ 360 series short motor weights can vary ± 1kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

HOUSINGS

4-HOLE, ULTRA SHORT MOTOR MOUNT

U8 Side Ports





► Porting options listed on pages 42.

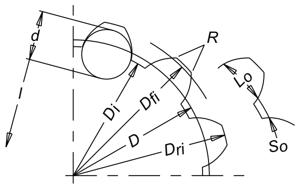
SHAFTS

00 Cardan (For Use With The U8 Mount)

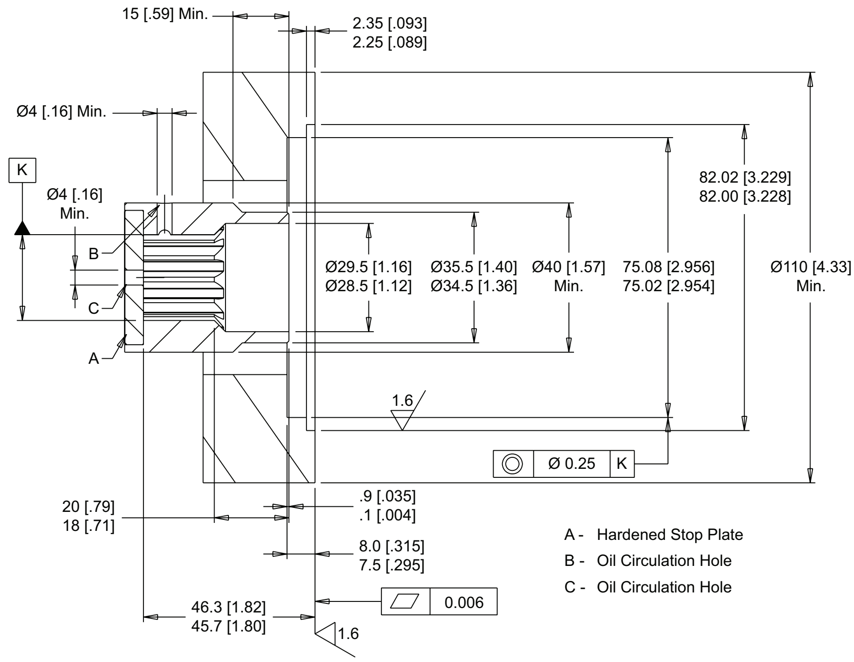
Fillet Root Side Fit
Number of Teeth 12
Pitch 12/24
Pressure Angle .... 30°
Pitch Diameter *D* .... 25.4 [1.000]
Major Diameter D_{ri} .... 28.0 [1.10] - 27.9 [1.096]
Form Diameter (Min.) D_{fi} .... 27.6 [1.09]
Minor Diameter D_i .... 23.033 [.9068] - 23.0 [.9055]
Space Width (Circular) L_o* .... 4.328 [.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 • 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 - 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.

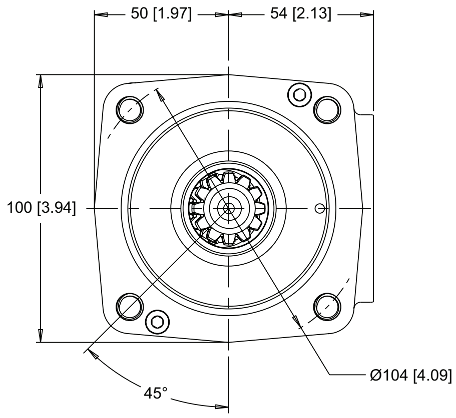
► 360 series ultra short motor weights can vary ± 1kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

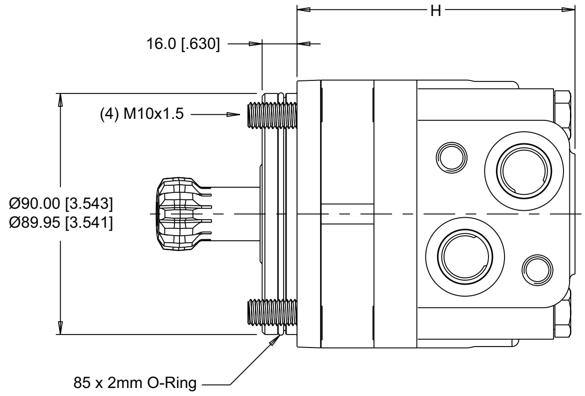
G	Length	Weight
#	mm [in]	kg [lb]
080	106 [4.16]	6.3 [13.9]
100	110 [4.32]	6.6 [14.6]
125	110 [4.32]	6.6 [14.6]
160	115 [4.54]	7.1 [15.7]
200	122 [4.79]	7.5 [16.5]
250	129 [5.09]	8.0 [17.6]

HOUSINGS

4-HOLE, ULTRA SHORT MOTOR MOUNT

V8 Side Ports





▶ Porting options listed on pages 42.

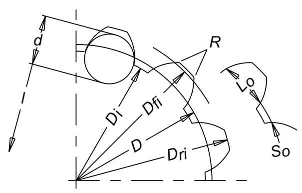
SHAFTS

00 Cardan (For Use With The V8 Mount)

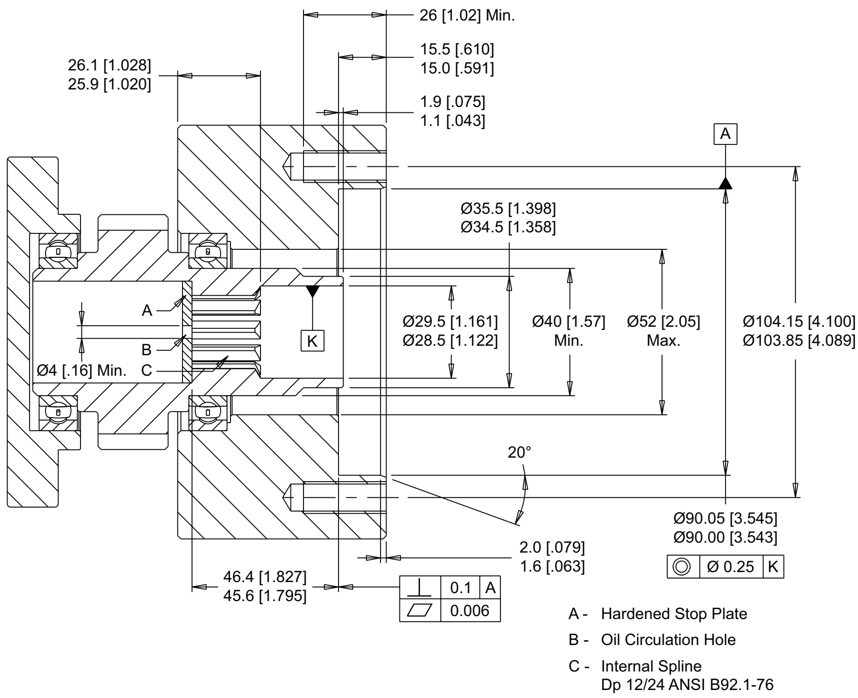
Fillet Root Side Fit
Number of Teeth 12
Pitch 12/24
Pressure Angle .... 30°
Pitch Diameter *D* .... 25.4 [1.000]
Major Diameter D_{ri} .... 28.0 [1.10] - 27.9 [1.096]
Form Diameter (Min.) D_{fi} .... 27.6 [1.09]
Minor Diameter D_i .... 23.033 [.9068] - 23.0 [.9055]
Space Width (Circular) L_o* .... 4.328 [.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 • 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 ± 1kg [2 lb] depending on model configurations such as housing, shaft, endcover, options etc.

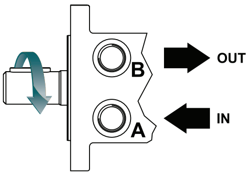
H	Length	Weight
#	mm [in]	kg [lb]
080	100 [3.92]	6.3 [13.9]
100	104 [4.08]	6.6 [14.6]
125	104 [4.08]	6.6 [14.6]
160	109 [4.31]	7.1 [15.7]
200	116 [4.56]	7.5 [16.5]
250	123 [4.86]	8.0 [17.6]

ORDERING INFORMATION

1	1	1	2	2	2	3a	3a	3b	4	4	5	6	7	8	8

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)

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

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

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