Technical Information

Motor Brakes
Type DR

TABLE OF CONTENTS

TECHNICAL INFORMATION

OPTIONAL MOTOR FEATURES

HYDRAULIC MOTOR/BRAKES

OPERATING RECOMMENDATIONS

OIL TYPE

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

We recommend maintaining an oil cleanliness level of ISO 17-14 or better.

INSTALLATION & START-UP

When installing a 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! - The 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.

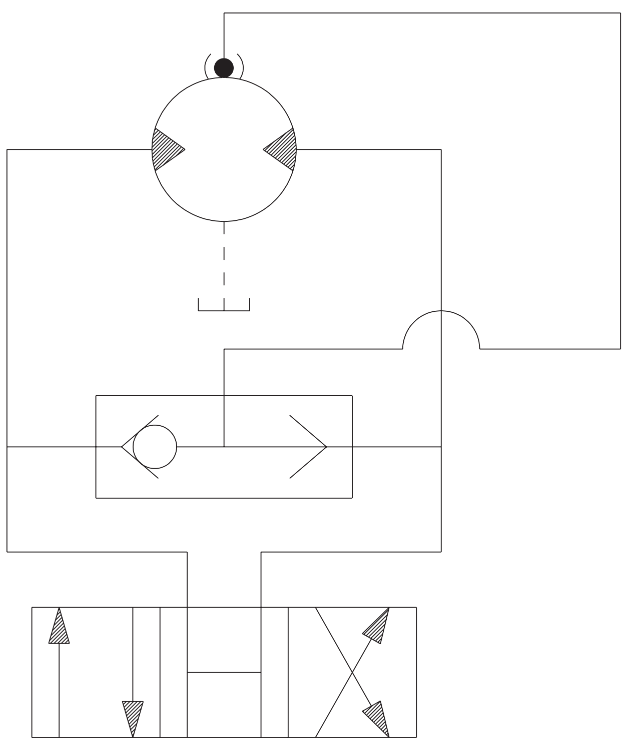
Caution! - Because it is possible for some large displacement motors to overpower the brake, it is critical that the maximum system pressure be limited for these applications. Failure to do so could cause serious injury or death. When choosing a motor/brake for an application, consult the performance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

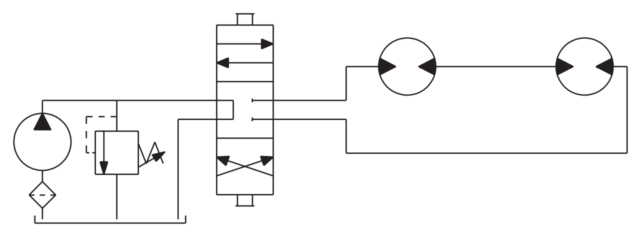
▶ NOTE: It is vital that all operating recommendations be followed. Failure to do so could result in injury or death.

MOTOR CIRCUITS

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

SERIES CONNECTION

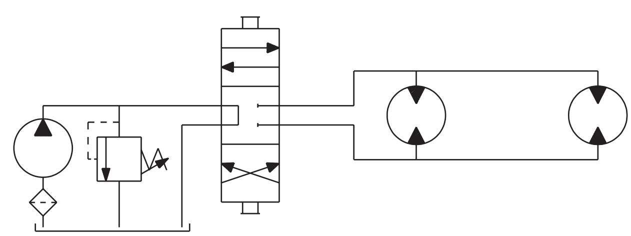
When motors are connected in series, the outlet of one motor is connected to the inlet of the next motor. This allows the full pump flow to go through each motor and provide maximum speed. Pressure and torque are distributed between the motors based on the load each motor is subjected to. The maximum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



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.

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 a 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 in^3/rev.]

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

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

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [150 (2)	38 [2000]	173 [2500]	207 [3000]	242 [3500]	Theoretical rpm
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] (7) **297**	96 [853] **295**	130 [1149] **284**	160 [1420] **271**	186 [164 (3) **253**	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]

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.

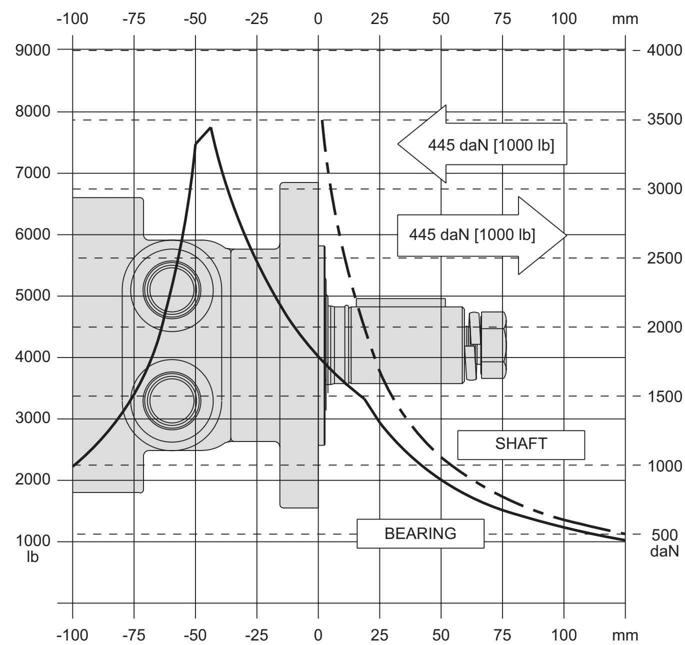
The bearing curves for each model are based on labratory analysis and testing results constructed at the organization. The shaft loading is based on a 3:1 safety factor and 330 Kpsi tensile strength. The allowable load is the lower of the curves at a given point. For instance, one inch in front of the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

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.

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

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

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

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

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.

$$TS = \frac{W \times f \times ri}{G} \qquad TS = \frac{W \times f \times rm}{G}$$

(lb-in per motor) (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.

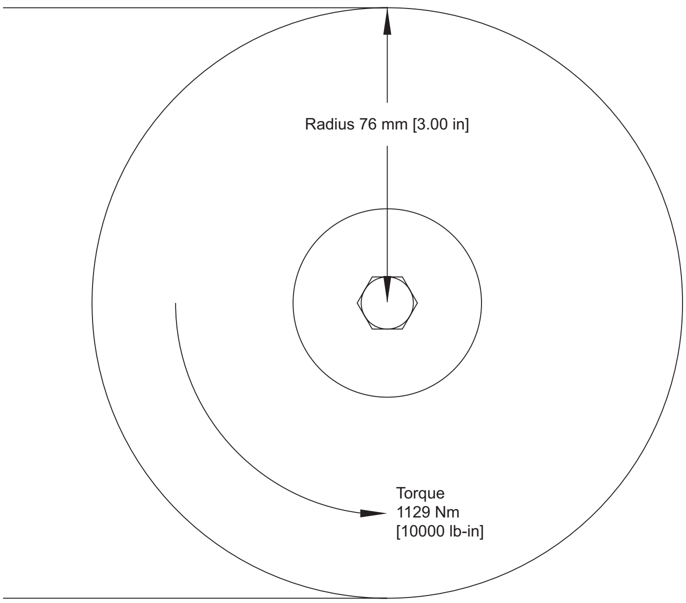
$$RL = \sqrt{W^2 + \left(\frac{T}{ri}\right)^2}\ lb \qquad RL = \sqrt{W^2 + \left(\frac{T}{rm}\right)^2}\ kg$$

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

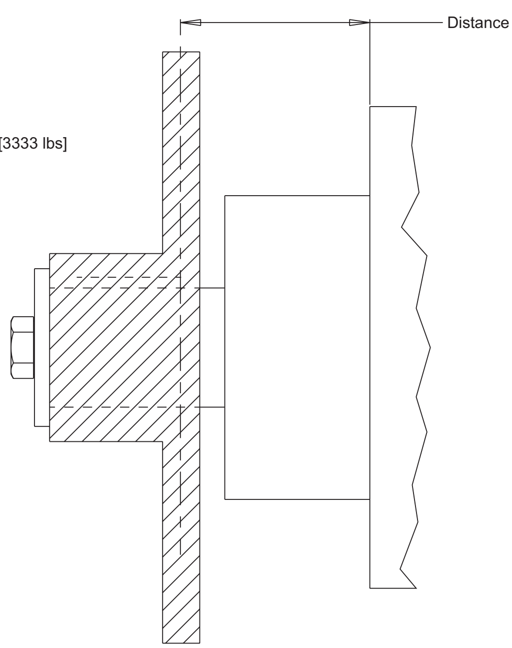
In many cases, pulleys or sprockets may be used to transmit the torque produced by the motor. Use of these components will create a torque induced side load on the motor shaft and bearings. It is important that this load be taken into consideration when choosing a motor with sufficient bearing and shaft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

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

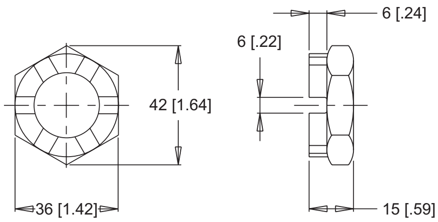
Power Out (HP) =

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

SHAFT NUT INFORMATION

35MM TAPERED SHAFTS
M24 x 1.5 Thread

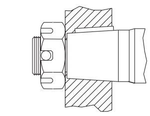
A Slotted Nut



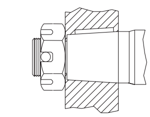
Torque Specifications: 32.5 daNm [240 ft.lb.]

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.



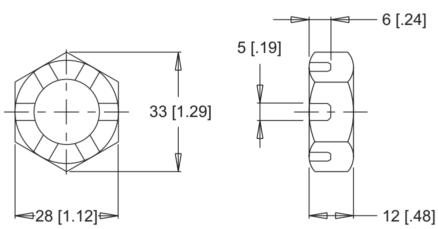
incorrect



correct

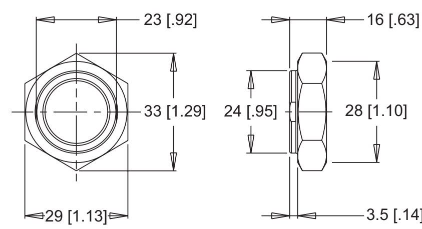
1" TAPERED SHAFTS
3/4-28 Thread

A Slotted Nut



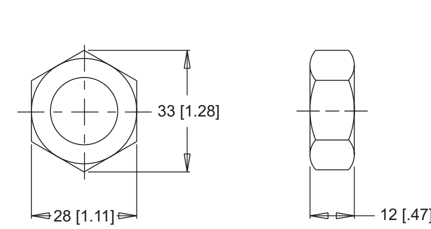
Torque Specifications: 20 - 23 daNm [150 - 170 ft.lb.]

B Lock Nut



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

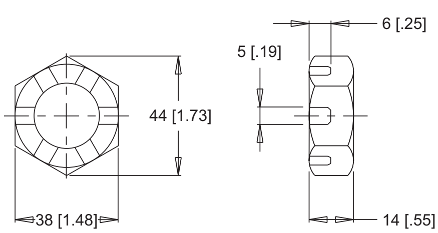
C Solid Nut



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

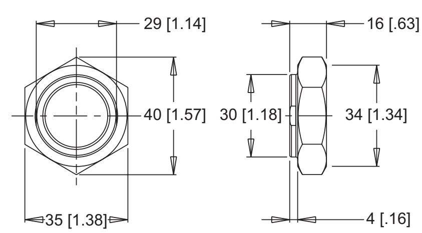
1-1/4" TAPERED SHAFTS
1-20 Thread

A Slotted Nut



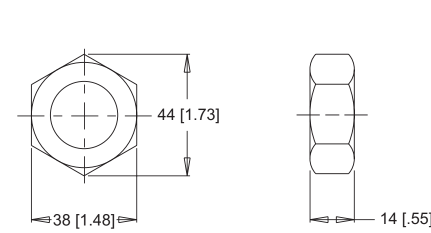
Torque Specifications: 38 daNm [280 ft.lb.] Max.

B Lock Nut



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

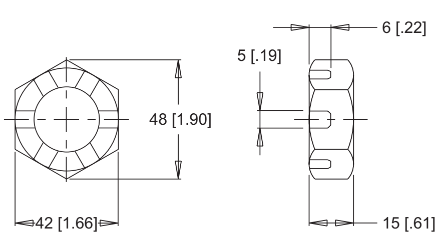
C Solid Nut



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

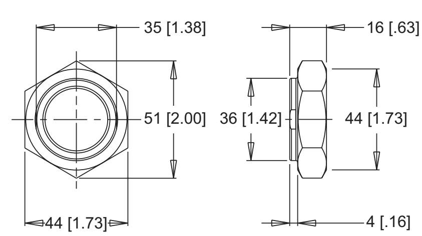
1-3/8" & 1-1/2" TAPERED SHAFTS
1 1/8-18 Thread

A Slotted Nut



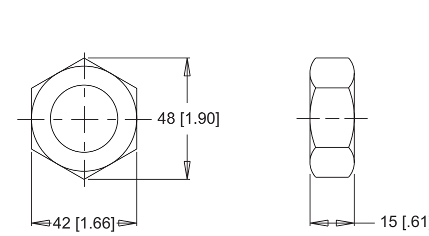
Torque Specifications: 41 - 54 daNm [300 - 400 ft.lb.]

B Lock Nut



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

C Solid Nut



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

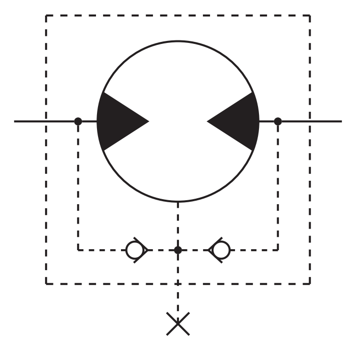
INTERNAL DRAIN

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.

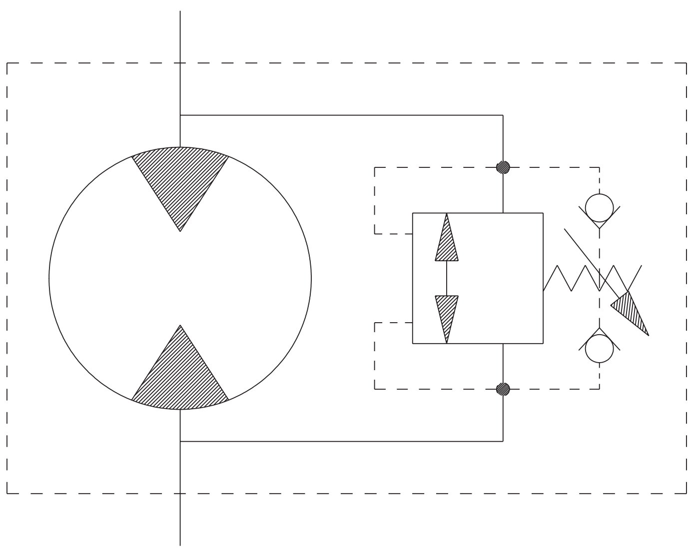
Although this option can simplify many motor installations, precautions must be taken to insure that return line pressure remains below allowable levels (see table below) to insure proper motor operation and life. If return line pressure is higher than allowable, or experiences pressure spikes, this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

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.

DR (610 Series)

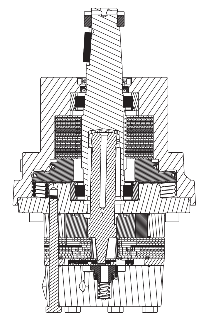
Heavy Duty Hydraulic Motor Brake

OVERVIEW

Due to its case drain design, the DR Series motor is an excellent medium size motor for applications with high- duty cycles or frequent direction reversal. The case drain design produces a number of benefits including reduction of pressure on the shaft seal and the ability to provide a cooling loop for the system. The case flow also lubricates the vital drive components, extending motor life. An internal drain option is also available. A laminated manifold and three-zone orbiting valve are used to produce higher overall efficiencies and more usable power. A steel faced seal in the orbiting valve also reduces the risk of the seal extruding or melting, which is possible in competitive designs.

SERIES DESCRIPTIONS

610 - Hydraulic Motor
With Integral Hydraulic Brake



FEATURES / BENEFITS

- Four Bearing Options allow load carrying capabilities of motor to be matched to application.
- Heavy-Duty Drive Link is the most durable in its class and receives case flow lubri-cation for reduced wear and increased life.
- Three-Zone Orbiting Valve precisely meters oil to produce exceptional volumetric efficiency.
- Rubber Energized Steel Face Seal does not extrude or melt under high pressure or high temperature.
- Standard Case Drain increases shaft seal life by reducing pressure on seal.

TYPICAL APPLICATIONS

Medium-duty wheel drives, augers, mixers, winch drives, swing drives, grapple heads, feed rollers, broom drives, chippers, mining equipment, forrestry equipment and more

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
200	204 [12.4]	470	560	95 [25]	114 [30]	554 [4900]	644 [5700]	207 [3000]	241 [3500]	276 [4000]
260	261 [15.9]	360	440	95 [25]	114 [30]	745 [6590]	859 [7600]	207 [3000]	241 [3500]	276 [4000]
300	300 [18.3]	320	380	95 [25]	114 [30]	842 [7450]	972 [8600]	207 [3000]	241 [3500]	276 [4000]
350	348 [21.2]	270	320	95 [25]	114 [30]	972 [8600]	1107 [9800]	207 [3000]	241 [3500]	276 [4000]
375	375 [22.8]	250	300	95 [25]	114 [30]	1085 [9600]	1243 [11000]	207 [3000]	241 [3500]	276 [4000]
470	465 [28.3]	200	240	95 [25]	114 [30]	1107 [9800]	1316 [11650]	172 [2500]	207 [3000]	241 [3500]
540	536 [32.7]	180	210	95 [25]	114 [30]	1034 [9150]	1277 [11300]	138 [2000]	172 [2500]	207 [3000]
750	748 [45.6]	130	150	95 [25]	114 [30]	1040 [9200]	1390 [12300]	103 [1500]	138 [2000]	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

200 — 204 cm³ [12.4 in³] / rev

Pressure - bar [psi] (Max. Cont. 207 [3000]; Max. Inter. 241 [3500])

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

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000] (Max. Cont.)	241 [3500] (Max. Inter.)	Theoretical rpm
2 [0.5]	38 [335] **7**	77 [683] **4**							10
4 [1]	39 [342] **16**	85 [748] **15**	174 [1543] **13**	258 [2284] **9**	329 [2913] **5**				19
8 [2]	38 [339] **35**	90 [795] **34**	178 [1579] **32**	271 [2396] **28**	361 [3192] **23**	454 [4016] **16**	519 [4594] **11**	562 [4977] **3**	38
15 [4]	36 [323] **73**	85 [749] **72**	178 [1576] **69**	283 [2506] **64**	378 [3346] **57**	459 [4059] **54**	555 [4909] **44**	636 [5625] **35**	75
23 [6]		78 [690] **110**	177 [1562] **106**	273 [2413] **101**	362 [3202] **97**	462 [4085] **89**	551 [4880] **80**	645 [5711] **70**	112
30 [8]		74 [654] **148**	172 [1518] **145**	268 [2368] **141**	357 [3156] **133**	469 [4154] **126**	558 [4936] **117**	653 [5778] **105**	150
38 [10]			168 [1491] **184**	260 [2301] **178**	349 [3091] **174**	444 [3933] **167**	541 [4783] **156**	638 [5646] **144**	187
45 [12]			156 [1381] **221**	255 [2256] **215**	350 [3096] **209**	450 [3985] **204**	542 [4793] **199**	634 [5607] **179**	224
53 [14]			150 [1332] **259**	251 [2219] **254**	330 [2919] **250**	435 [3850] **241**	526 [4653] **231**	638 [5643] **213**	261
61 [16]			133 [1180] **297**	241 [2129] **293**	336 [2970] **286**	430 [3803] **278**	522 [4616] **276**	613 [5423] **256**	299
68 [18]			122 [1082] **335**	227 [2012] **332**	328 [2899] **325**	417 [3692] **319**	510 [4510] **310**	602 [5329] **298**	336
76 [20]			112 [993] **372**	214 [1897] **371**	309 [2732] **365**	401 [3547] **356**	496 [4391] **348**	587 [5198] **337**	373
83 [22]				199 [1757] **409**	303 [2680] **404**	384 [3401] **396**	493 [4358] **384**	579 [5121] **374**	410
91 [24]				184 [1625] **447**	285 [2526] **443**	380 [3366] **433**	474 [4192] **423**	562 [4970] **417**	448
Max. Cont. 95 [25]				166 [1472] **465**	277 [2453] **461**	367 [3244] **454**	463 [4101] **443**	560 [4953] **432**	466
Max. Inter. 114 [30]					219 [1935] **558**	332 [2934] **553**			559

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

Theoretical Torque - Nm [lb-in]

Rotor Width mm [in]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000]	241 [3500]
17.3 [.682]	56 [494]	112 [987]	223 [1975]	335 [2962]	446 [3949]	558 [4936]	669 [5924]	781 [6911]

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

260 — 261 cm³ [15.9 in³] / rev

Pressure - bar [psi] (Max. Cont. 207 [3000]; Max. Inter. 241 [3500])

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

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000] (Max. Cont.)	241 [3500] (Max. Inter.)	Theoretical rpm
2 [0.5]	47 [417] **5**	109 [962] **4**							8
4 [1]	51 [454] **13**	110 [972] **11**	238 [2104] **11**	355 [3139] **8**	460 [4074] **5**				15
8 [2]	52 [462] **28**	113 [1004] **27**	242 [2145] **25**	367 [3244] **22**	485 [4292] **18**	603 [5334] **14**	715 [6323] **11**		30
15 [4]	49 [430] **57**	111 [985] **56**	239 [2115] **54**	367 [3247] **51**	491 [4343] **45**	619 [5474] **41**	746 [6598] **36**	859 [7600] **30**	59
23 [6]	44 [391] **87**	107 [950] **86**	234 [2067] **83**	364 [3225] **78**	487 [4311] **72**	617 [5458] **67**	738 [6530] **60**	854 [7557] **54**	88
30 [8]		100 [884] **115**	228 [2016] **113**	355 [3146] **107**	478 [4230] **103**	612 [5418] **95**	733 [6487] **89**	868 [7677] **82**	117
38 [10]		90 [797] **145**	220 [1947] **143**	348 [3080] **138**	468 [4143] **132**	605 [5351] **123**	734 [6498] **115**	852 [7541] **107**	146
45 [12]		84 [748] **174**	212 [1877] **172**	340 [3011] **168**	463 [4094] **162**	596 [5272] **152**	722 [6390] **143**	845 [7481] **133**	175
53 [14]		71 [631] **203**	205 [1813] **201**	330 [2921] **198**	452 [4004] **185**	587 [5195] **179**	706 [6244] **173**	846 [7491] **163**	204
61 [16]			191 [1688] **231**	317 [2807] **228**	444 [3927] **223**	574 [5077] **214**	703 [6221] **203**	824 [7291] **196**	233
68 [18]			174 [1540] **261**	305 [2698] **256**	429 [3798] **251**	560 [4952] **246**	690 [6111] **230**	815 [7214] **220**	262
76 [20]			156 [1383] **290**	289 [2558] **289**	418 [3700] **282**	544 [4817] **268**	675 [5977] **262**	810 [7166] **247**	291
83 [22]			143 [1270] **319**	275 [2431] **317**	405 [3585] **313**	533 [4717] **300**	659 [5828] **293**	787 [6961] **277**	320
91 [24]			131 [1158] **348**	255 [2253] **346**	387 [3421] **342**	515 [4554] **333**	613 [5421] **322**	769 [6805] **311**	349
Max. Cont. 95 [25]				239 [2115] **362**	373 [3301] **357**	505 [4471] **348**	628 [5559] **342**	772 [6832] **328**	364
Max. Inter. 114 [30]				157 [1388] **434**	298 [2637] **432**	426 [3768] **427**			436

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

Theoretical Torque - Nm [lb-in]

Rotor Width mm [in]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000]	241 [3500]
22.1 [.872]	72 [633]	143 [1266]	286 [2532]	429 [3798]	572 [5064]	715 [6330]	858 [7596]	1001 [8861]

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.

DR (610 Series)

Heavy Duty Hydraulic Motor Brake

DISPLACEMENT PERFORMANCE

300

300 cm³ [18.3 in³] / rev

Pressure - bar [psi]; Torque - Nm [lb-in], **Speed rpm**

Intermittent Ratings - 10% of Operation

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000] Max. Cont.	241 [3500] Max. Inter.	Theoretical rpm
2 [0.5]	58 [509] **5**	117 [1039] **4**	253 [2236] **4**						7
4 [1]	58 [517] **12**	122 [1081] **11**	266 [2353] **11**	384 [3396] **11**	509 [4501] **9**	633 [5599] **9**			13
8 [2]	58 [516] **25**	128 [1134] **24**	267 [2360] **24**	404 3572] **23**	553 [4893] **22**	683 [6045] **21**	813 [7198] **20**	917 [8112] **20**	26
15 [4]	56 [491] **50**	132 [1173] **49**	274 [2425] **49**	417 [3691] **48**	553 [4890] **47**	703 [6225] **44**	836 [7397] **43**	962 [8513] **42**	51
23 [6]	53 [466] **75**	123 [1092] **75**	269 [2384] **74**	406 [3590] **73**	559 [4949] **71**	701 [6207] **69**	831 [7356] **66**	954 [8445] **63**	76
30 [8]	44 [386] **100**	117 [1036] **99**	256 [2263] **97**	419 [3710] **96**	548 [4847] **95**	707 [6256] **93**	846 [7485] **88**	974 [8619] **85**	101
38 [10]		107 [947] **126**	251 [2222] **126**	390 [3448] **125**	561 [4961] **121**	691 [6119] **119**	836 [7396] **113**	976 [8637] **109**	127
45 [12]		95 [841] **151**	238 [2108] **150**	400 [3538] **150**	529 [4685] **149**	696 [6160] **144**	833 [7371] **140**	969 [8573] **135**	152
53 [14]		84 [748] **176**	232 [2053] **175**	366 [3237] **174**	530 [4688] **173**	676 [5978] **168**	825 [7302] **164**	964 [8533] **158**	177
61 [16]		71 [629] **201**	217 [1920] **200**	370 [3277] **198**	508 [4494] **197**	654 [5786] **196**	803 [7104] **187**	952 [8428] **182**	202
68 [18]			202 [1792] **227**	339 [2996] **226**	503 [4448] **226**	645 [5712] **221**	781 [6914] **214**	933 [8253] **211**	228
76 [20]			184 [1631] **252**	326 [2887] **251**	467 [4129] **249**	635 [5619] **244**	772 [6831] **236**	927 [8205] **230**	253
83 [22]			164 [1449] **277**	308 [2726] **275**	446 [3943] **274**	604 [5346] **271**	745 [6592] **269**	896 [7926] **267**	278
91 [24]			147 [1304] **302**	286 [2535] **301**	437 [3871] **300**	580 [5137] **296**	723 [6401] **293**	861 [7620] **285**	303
Max. Cont. 95 [25]			116 [1024] **315**	291 [2574] **314**	441 [3902] **312**	575 [5085] **310**	707 [6255] **309**	848 [7500] **302**	316
Max. Inter. 114 [30]				204 [1805] **378**	347 [3067] **376**	499 [4416] **370**			379

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

Theoretical Torque - Nm [lb-in]

Rotor Width mm [in]								
25.4 [1.000]	82 [729]	165 [1457]	329 [2914]	494 [4371]	659 [5828]	823 [7285]	988 [8742]	1152 [10199]

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

350

348 cm³ [21.2 in³] / rev

Pressure - bars [psi]; Torque - Nm [lb-in], **Speed rpm**

Intermittent Ratings - 10% of Operation

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000] Max. Cont.	241 [3500] Max. Inter.	Theoretical rpm
2 [0.5]	69 [606] **4**	140 [1243] **3**	262 [2318] **2**						6
4 [1]	75 [660] **10**	153 [1350] **9**	309 [2733] **7**	454 [4014] **6**					11
8 [2]	75 [667] **21**	158 [1395] **20**	325 [2880] **17**	489 [4326] **16**	647 [5727] **14**	784 [6937] **13**	917 [8119] **11**		22
15 [4]	73 [648] **43**	159 [1405] **42**	333 [2943] **38**	502 [4443] **36**	677 [5988] **33**	830 [7342] **31**	984 [8704] **29**	1123 [9935] **26**	44
23 [6]	67 [594] **65**	152 [1346] **63**	328 [2901] **61**	502 [4439] **55**	670 [5926] **51**	841 [7444] **49**	1010 [8940] **49**	1155 [10220] **46**	66
30 [8]	56 [494] **87**	143 [1268] **85**	317 [2808] **83**	494 [4368] **78**	678 [6002] **72**	833 [7376] **67**	1018 [9010] **65**	1172 [10367] **65**	88
38 [10]		129 [1141] **108**	305 [2700] **105**	477 [4219] **99**	655 [5798] **92**	830 [7345] **88**	994 [8801] **85**	1159 [10260] **83**	109
45 [12]		121 [1068] **130**	291 [2578] **128**	465 [4113] **122**	641 [5672] **115**	817 [7231] **107**	991 [8766] **101**	1169 [10342] **100**	131
53 [14]		103 [907] **151**	275 [2437] **148**	452 [4001] **145**	630 [5572] **136**	815 [7212] **130**	972 [8604] **123**	1162 [10284] **115**	153
61 [16]		85 [755] **174**	258 [2281] **172**	431 [3818] **168**	609 [5390] **161**	790 [6991] **152**	983 [8696] **144**	1141 [10099] **136**	175
68 [18]		66 [587] **196**	246 [2174] **193**	432 [3823] **190**	583 [5161] **185**	768 [6800] **171**	944 [8355] **164**	1131 [10012] **159**	197
76 [20]			223 [1969] **217**	391 [3459] **211**	568 [5026] **206**	750 [6637] **196**	925 [8186] **185**	1101 [9742] **176**	218
83 [22]			193 [1704] **239**	372 [3293] **236**	545 [4825] **230**	724 [6408] **219**	909 [8049] **209**	1092 [9666] **198**	240
91 [24]			169 [1492] **261**	349 [3085] **257**	537 [4755] **253**	698 [6179] **243**			262
Max. Cont. 95 [25]				325 [2874] **272**	507 [4491] **265**	687 [6082] **254**			273
Max. Inter. 114 [30]				255 [2258] **326**	429 [3796] **320**	605 [5354] **315**			327

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

Theoretical Torque - Nm [lb-in]

Rotor Width mm [in]								
39.4 [1.553]	95 [844]	191 [1688]	381 [3376]	572 [5064]	763 [6752]	954 [8439]	1144 [10127]	1335 [11815]

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

375

375 cm³ [22.8 in³] / rev

Pressure - bar [psi] (Max. Cont. = 207 [3000]; Max. Inter. = 241 [3500])

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

Intermittent Ratings - 10% of Operation

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000] Max. Cont.	241 [3500] Max. Inter.	Theoretical rpm
2 [0.5]	69 [611] **4**								6
4 [1]	74 [651] **9**	161 [1425] **8**	330 [2920] **8**	494 [4369] **7**	653 [5783] **6**	823 [7283] **5**			11
8 [2]	76 [676] **20**	173 [1527] **19**	354 [3133] **18**	518 [4582] **17**	685 [6065] **15**	860 [7611] **13**	1021 [9038] **13**		21
15 [4]	73 [649] **40**	158 [1399] **40**	350 [3098] **38**	535 [4731] **37**	706 [6250] **34**	883 [7814] **32**	1032 [9130] **30**	1191 [10541] **30**	41
23 [6]	66 [588] **60**	159 [1407] **60**	346 [3058] **59**	547 [4841] **57**	712 [6300] **54**	899 [7956] **49**	1080 [9561] **47**	1231 [10898] **45**	61
30 [8]	57 [502] **81**	147 [1301] **80**	337 [2980] **79**	537 [4749] **77**	700 [6192] **74**	898 [7948] **70**	1088 [9628] **65**	1236 [10941] **62**	82
38 [10]		134 [1190] **101**	323 [2856] **100**	510 [4512] **99**	694 [6139] **95**	887 [7849] **90**	1066 [9437] **85**	1246 [11029] **79**	102
45 [12]		124 [1097] **121**	309 [2730] **120**	496 [4385] **119**	679 [6009] **114**	883 [7817] **109**	1073 [9493] **104**	1244 [11010] **99**	122
53 [14]		109 [961] **141**	290 [2563] **140**	477 [4217] **138**	680 [6016] **136**	854 [7556] **130**	1041 [9214] **123**	1230 [10888] **117**	142
61 [16]		82 [728] **162**	267 [2362] **161**	453 [4005] **159**	637 [5641] **157**	846 [7489] **150**	1041 [9209] **144**	1209 [10702] **136**	163
68 [18]			248 [2198] **182**	434 [3842] **180**	619 [5474] **175**	812 [7190] **171**	1002 [8864] **165**	1148 [10161] **162**	183
76 [20]			229 [2026] **202**	416 [3685] **201**	600 [5309] **199**	790 [6994] **192**	979 [8664] **183**	1145 [10137] **180**	203
83 [22]			199 [1764] **222**	385 [3406] **221**	572 [5065] **219**	761 [6738] **215**	953 [8435] **210**	1111 [9834] **201**	223
91 [24]			168 [1490] **243**	362 [3204] **241**	566 [5007] **240**	731 [6471] **235**			244
95 [25] Max. Cont.				347 [3073] **253**	554 [4905] **250**	721 [6384] **245**			254
114 [30] Max. Inter.				261 [2314] **303**	440 [3891] **301**	623 [5514] **300**			304

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

Theoretical Torque - Nm [lb-in]

Rotor Width mm [in]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000]	241 [3500]
31.8 [1.252]	103 [908]	205 [1815]	410 [3631]	615 [5446]	821 [7261]	1026 [9076]	1231 [10892]	1436 [12707]

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

470

465 cm³ [28.3 in³] / rev

Pressure - bar [psi] (Max. Cont. = 173 [2500]; Max. Inter. = 207 [3000])

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

Intermittent Ratings - 10% of Operation

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500] Max. Cont.	207 [3000] Max. Inter.	Theoretical rpm
2 [0.5]	92 [815] **3**	195 [1723] **2**	374 [3306] **1**					5
4 [1]	109 [967] **7**	188 [1661] **6**	418 [3701] **5**	615 [5447] **4**				9
8 [2]	99 [875] **15**	217 [1924] **14**	440 [3892] **13**	668 [5910] **12**	871 [7709] **9**	1066 [9436] **7**	1227 [10855] **5**	17
15 [4]	93 [825] **32**	213 [1887] **30**	441 [3906] **29**	688 [6086] **28**	907 [8027] **25**	1131 [10008] **22**	1343 [11886] **18**	33
23 [6]	85 [751] **48**	200 [1771] **48**	434 [3841] **46**	686 [6074] **44**	906 [8017] **40**	1141 [10098] **35**	1362 [12056] **30**	49
30 [8]	72 [635] **65**	186 [1645] **64**	422 [3738] **63**	659 [5834] **61**	889 [7871] **58**	1142 [10106] **50**	1352 [11963] **45**	66
38 [10]	53 [472] **81**	169 [1493] **80**	404 [3579] **79**	639 [5657] **77**	874 [7734] **74**	1115 [9871] **66**	1351 [11958] **59**	82
45 [12]		152 [1348] **97**	402 [3561] **96**	608 [5377] **94**	855 [7563] **89**	1111 [9836] **82**	1340 [11861] **76**	98
53 [14]		133 [1175] **114**	364 [3221] **113**	598 [5292] **112**	833 [7374] **107**	1090 [9643] **98**	1319 [11673] **90**	115
61 [16]		103 [910] **130**	333 [2947] **129**	569 [5037] **128**	803 [7110] **123**	1063 [9410] **114**	1294 [11450] **104**	131
68 [18]		75 [661] **146**	305 [2701] **144**	555 [4908] **143**	764 [6765] **141**	1021 [9033] **133**	1267 [11214] **124**	147
76 [20]			281 [2489] **163**	507 [4490] **162**	745 [6597] **156**	985 [8719] **150**	1236 [10940] **141**	164
83 [22]			227 [2011] **179**	473 [4189] **178**	714 [6322] **176**	948 [8391] **168**	1182 [10462] **162**	180
91 [24]			193 [1705] **194**	432 [3827] **192**	687 [6079] **191**	915 [8093] **186**		196
95 [25] Max. Cont.				423 [3743] **204**	651 [5759] **201**	896 [7928] **191**		205
114 [30] Max. Inter.				321 [2840] **244**	538 [4761] **242**	784 [6938] **238**		245

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

Theoretical Torque - Nm [lb-in]

Rotor Width mm [in]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]	207 [3000]
39.4 [1.553]	127 [1127]	255 [2253]	509 [4506]	764 [6760]	1018 [9013]	1273 [11266]	1528 [13519]

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

540

536 cm³ [32.7 in³] / rev

Pressure - bar [psi] (Max. Cont. = 138 [2000]; Max. Inter. = 173 [2500])

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

Intermittent Ratings - 10% of Operation

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000] Max. Cont.	173 [2500] Max. Inter.	Theoretical rpm
2 [0.5]	108 [953] **3**	215 [1900] **2**					4
4 [1]	107 [946] **6**	225 [1995] **6**	476 [4212] **5**	710 [6284] **5**	920 [8138] **3**		8
8 [2]	113 [998] **13**	241 [2133] **12**	498 [4403] **11**	748 [6620] **11**	980 [8674] **9**	1220 [10798] **8**	15
15 [4]	115 [1014] **28**	242 [2137] **27**	508 [4491] **26**	779 [6893] **25**	1038 [9188] **24**	1266 [11201] **20**	29
23 [6]	102 [902] **42**	234 [2067] **42**	505 [4465] **40**	771 [6821] **38**	1019 [9022] **36**	1274 [11275] **32**	43
30 [8]	89 [792] **56**	222 [1962] **56**	494 [4373] **55**	764 [6759] **52**	1020 [9029] **48**	1280 [11325] **43**	57
38 [10]	71 [630] **70**	201 [1782] **70**	477 [4224] **68**	750 [6639] **66**	1016 [8994] **62**	1277 [11299] **57**	71
45 [12]	47 [417] **84**	188 [1661] **84**	455 [4027] **84**	729 [6455] **81**	1001 [8858] **76**	1288 [11394] **69**	85
53 [14]		158 [1397] **98**	430 [3803] **97**	702 [6214] **96**	995 [8803] **89**	1264 [11184] **82**	99
61 [16]		132 [1170] **113**	403 [3564] **112**	670 [5930] **110**	944 [8353] **106**	1240 [10970] **98**	114
68 [18]		97 [856] **127**	366 [3236] **127**	640 [5664] **126**	935 [8276] **120**	1193 [10557] **113**	128
76 [20]		63 [554] **141**	335 [2962] **140**	604 [6345] **139**	878 [7767] **135**	1156 [10228] **129**	142
83 [22]			303 [2680] **155**	562 [4972] **153**	838 [7420] **152**	1115 [9868] **145**	156
91 [24]			242 [2141] **169**	522 [4622] **167**	813 [7194] **164**	1075 [9517] **161**	170
Max. Cont. 95 [25]			226 [1998] **176**	490 [4338] **175**	772 [6832] **174**	1075 [9514] **165**	177
Max. Inter. 114 [30]			98 [864] **211**	380 [3365] **210**	659 [5834] **209**		212

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

Theoretical Torque - Nm [lb-in]

Rotor Width	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]	173 [2500]
45.5 [1.791] mm [in]	147 [1302]	294 [2604]	588 [5207]	883 [7811]	1177 [10414]	1471 [13018]

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

750

748 cm³ [45.6 in³] / rev

Pressure - bar [psi] (Max. Cont. = 104 [1500]; Max. Inter. = 138 [2000])

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

Intermittent Ratings - 10% of Operation

Flow - lpm [gpm]	17 [250]	35 [500]	69 [1000]	104 [1500] Max. Cont.	138 [2000] Max. Inter.	Theoretical rpm
2 [0.5]	126 [1118] **1**	277 [2450] **1**				3
4 [1]	156 [1378] **4**	287 [2537] **3**	627 [5552] **3**	922 [8155] **2**		6
8 [2]	153 [1357] **9**	322 [2853] **9**	664 [5873] **8**	986 [8722] **7**	1308 [11579] **6**	11
15 [4]	148 [1312] **20**	327 [2898] **19**	686 [6071] **18**	1027 [9085] **17**	1374 [12161] **16**	21
23 [6]	139 [1230] **30**	323 [2860] **29**	691 [6113] **28**	1040 [9200] **27**	1393 [12328] **25**	31
30 [8]	123 [1085] **40**	306 [2712] **40**	681 [6026] **39**	1040 [9207] **36**	1380 [12211] **34**	41
38 [10]	99 [874] **50**	291 [2571] **49**	666 [5897] **48**	1035 [9162] **47**	1399 [12382] **45**	51
45 [12]	75 [664] **60**	274 [2423] **59**	643 [5688] **58**	1018 [9012] **57**	1392 [12318] **55**	61
53 [14]	46 [408] **70**	239 [2113] **70**	616 [5451] **69**	996 [8814] **68**	1372 [12146] **64**	71
61 [16]		190 [1682] **81**	575 [5089] **80**	958 [8479] **78**	1327 [11742] **76**	82
68 [18]		150 [1325] **91**	535 [4738] **90**	921 [8150] **88**	1299 [11494] **86**	92
76 [20]		107 [949] **101**	486 [4298] **100**	878 [7771] **100**	1253 [11090] **97**	102
83 [22]			449 [3978] **111**	822 [7273] **110**	1198 [10598] **108**	112
91 [24]			384 [3401] **121**	761 [6736] **120**	1143 [10117] **117**	122
Max. Cont. 95 [25]			369 [3268] **126**	737 [6523] **125**	1111 [9830] **124**	127
Max. Inter. 114 [30]			116 [1025] **151**	494 [4374] **149**		152

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

Theoretical Torque - Nm [lb-in]

Rotor Width	17 [250]	35 [500]	69 [1000]	104 [1500]	138 [2000]
63.5 [2.501] mm [in]	205 [1815]	410 [3631]	821 [7261]	1231 [10892]	1641 [14522]

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

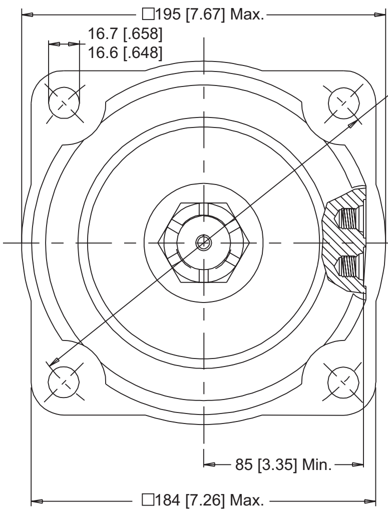
► Performance data is typical. Performance of production units varies slightly from one motor to another. Operating at maximum continuous pressure and maximum continuous flow simultaneously is not recommended. For additional information on product testing please refer to page 6.

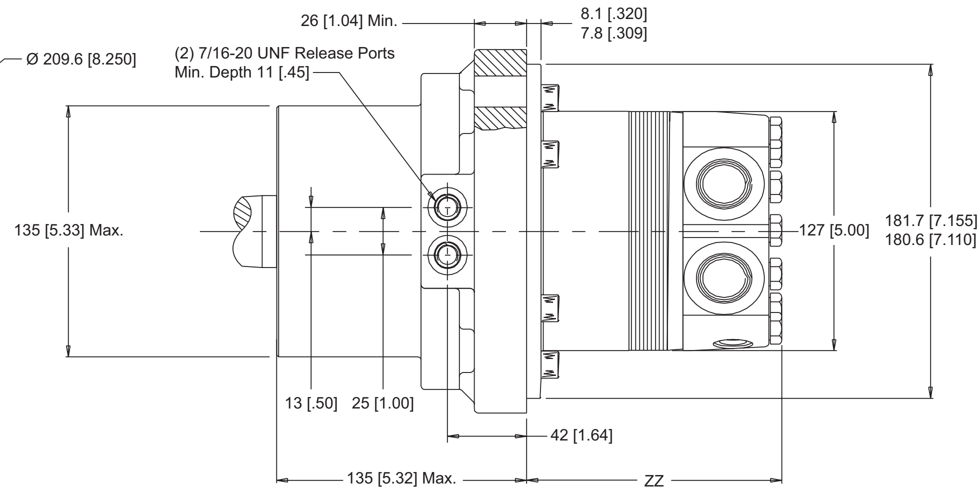
HOUSINGS

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

4-HOLE, WHEEL BRAKE MOUNT

W2 End Ports **W8** Side Ports





TECHNICAL INFORMATION

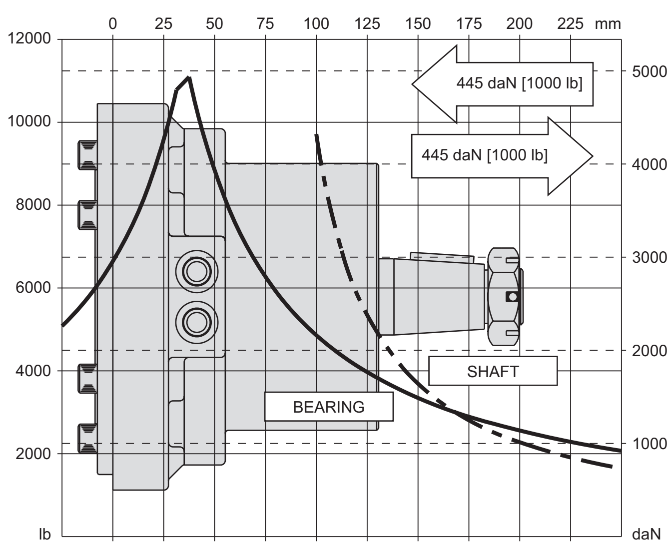
ALLOWABLE SHAFT LOAD / BEARING CURVE

The bearing curve represents allowable bearing loads based on ISO 281 bearing capacity for an L_{10} 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.

SPECIFICATIONS

Rated brake torque......................... 1582 Nm [14000 lb-in]
Initial release pressure .... 19 bar [275 psi]
Full release pressure .... 33 bar [475 psi]
Maximum release pressure .... 207 bar [3000 psi]
Release volume .... 13-16 cm^3 [0.8 - 1.0 in^3]

WHEEL BRAKE MOUNTS



LENGTH & WEIGHT CHART

Dimension ZZ is the overall motor length from the rear of the motor to the mounting surface.

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

ZZ	Endcovers on pg. 20	Endcovers on pg. 21	Weight
#	mm [in]	mm [in]	kg [lb]
200	104 [4.11]	107 [4.22]	26.5 [58.4]
260	109 [4.30]	112 [4.41]	26.9 [59.4]
300	112 [4.43]	115 [4.54]	27.2 [60.0]
350	126 [4.98]	129 [5.09]	28.3 [62.5]
375	119 [4.68]	122 [4.79]	27.7 [61.1]
470	126 [4.98]	129 [5.09]	28.3 [62.5]
540	132 [5.22]	135 [5.33]	28.8 [63.6]
750	150 [5.93]	153 [6.04]	30.3 [66.9]

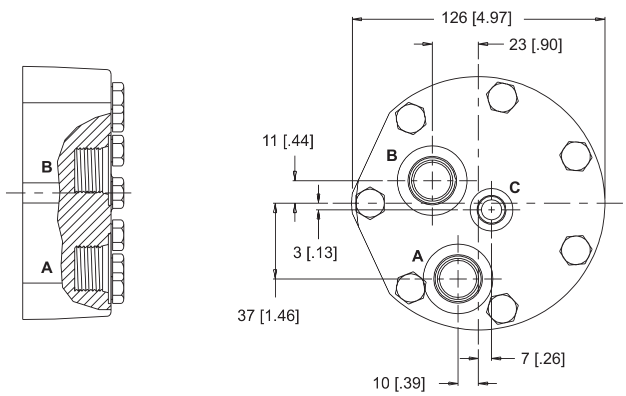
PORTING

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

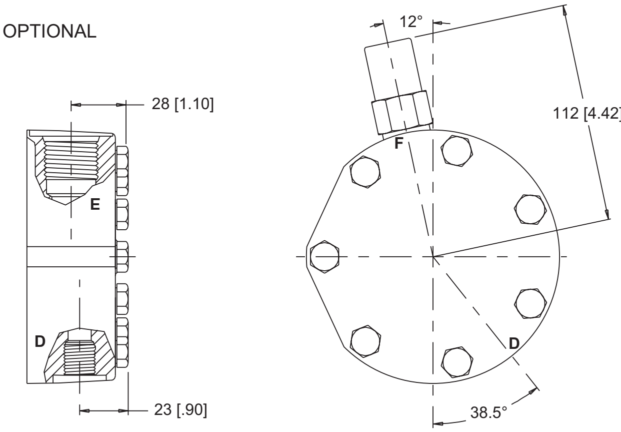
END PORTED - OFFSET

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

STANDARD



OPTIONAL



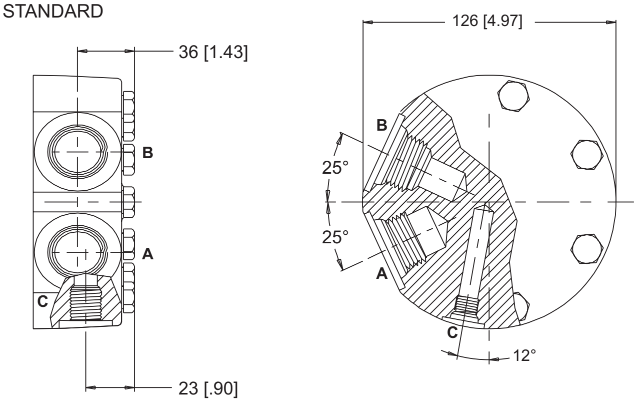
D: Internal Drain **E**: 10 Series/2-Way Valve Cavity 7/8-14 UNF **F**: Valve Cartridge Installed

SIDE PORTED - RADIAL

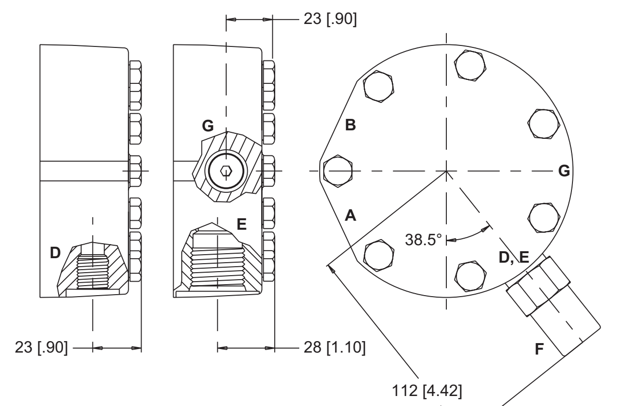
2 Main Ports **A, B**: G 3/4
Drain Port **C**: G 1/4

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

STANDARD



OPTIONAL



D: Internal Drain **E**: 10 Series/2-Way Valve Cavity 7/8-14 UNF **F**: Valve Cartridge Installed **G**: Internal Drain Placement With Valve Cavity

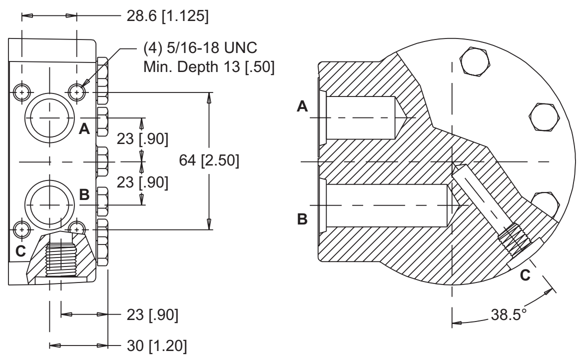
PORTING

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

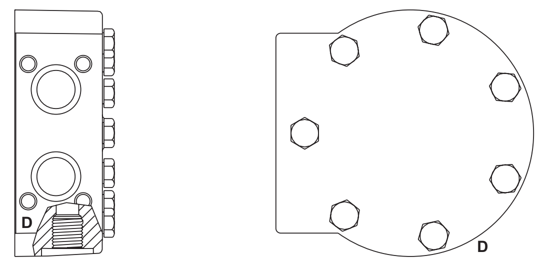
SIDE PORTED - MANIFOLD ALIGNED

3 Main Ports **A, B**: 11/16” Drilled
Drain Port **C**: 7/16-20 UNF

STANDARD



OPTIONAL



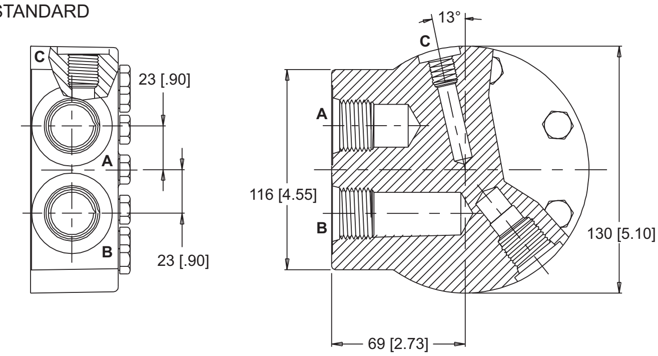
D: Internal Drain

SIDE PORTED - ALIGNED

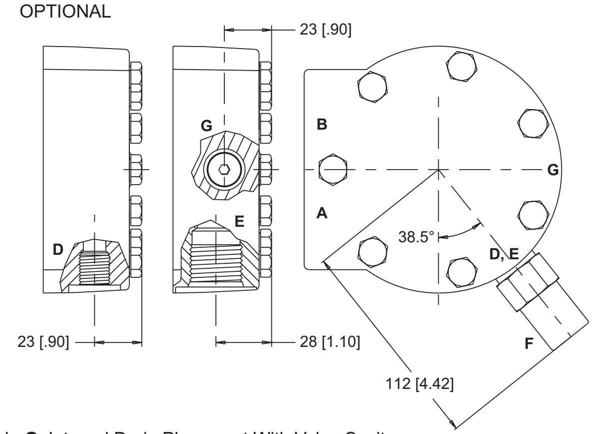
6 Main Ports **A, B**: 1 1/16-12 UN
Drain Port **C**: 7/16-20 UNF

7 Main Ports **A, B**: G 3/4
Drain Port **C**: G 1/4

STANDARD



OPTIONAL

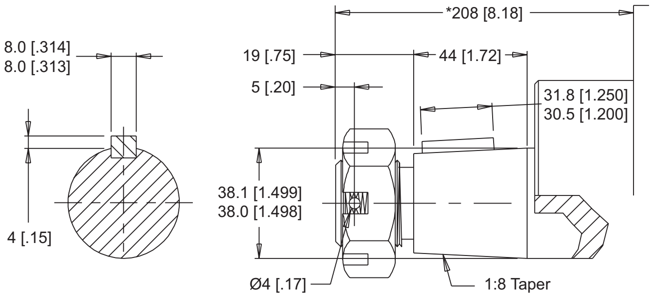


D: Internal Drain **E**: 10 Series/2-Way Valve Cavity 7/8-14 UNF **F**: Valve Cartridge Installed **G**: Internal Drain Placement With Valve Cavity

DR (610 Series)
Heavy Duty Hydraulic Motor Brake

SHAFTS

31	1-1/2” Tapered



▶ A slotted hex nut is standard on this shaft.

Max. Torque: 1200 Nm [10600 lb-in]

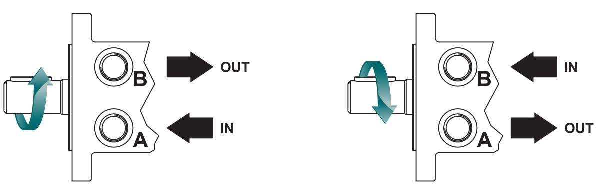
▶ *Shaft lengths vary ± 0.8 mm [.030 in.]

ORDERING INFORMATION

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

1. CHOOSE SERIES DESIGNATION

610	Hydraulic Motor With Integral Hydraulic Brake



▶ The 610 series is bi-directional.

2. SELECT A DISPLACEMENT OPTION

200	204 cm^3/rev	[12.4 in^3/rev]
260	261 cm^3/rev	[15.9 in^3/rev]
300	300 cm^3/rev	[18.3 in^3/rev]
350	348 cm^3/rev	[21.2 in^3/rev]
375	375 cm^3/rev	[22.8 in^3/rev]
470	465 cm^3/rev	[28.3 in^3/rev]
540	536 cm^3/rev	[32.7 in^3/rev]
750	748 cm^3/rev	[45.6 in^3/rev]

3a. SELECT MOUNT TYPE

▼ **END MOUNTS**

W2	4-Hole, Wheel Mount

▼ **SIDE MOUNTS**

W8	4-Hole, Wheel Mount

3b. SELECT PORT SIZE

▼ **END PORT OPTIONS**

1	7/8-14 UNF Offset

▼ **SIDE PORT OPTIONS**

2	G 3/4, Radial
3	11/16” Hole, Aligned Manifold
5	1 1/16-12 UN, Radial
6	1 1/16-12 UN, Aligned
7	G 3/4, Radial

4. SELECT A SHAFT OPTION

31	1-1/2” Tapered

5. SELECT A PAINT OPTION

A	Black
Z	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 not available on port option 3.

7. SELECT AN ADD-ON OPTION

A	Standard
C	Solid Hex Nut

8. SELECT A MISCELLANEOUS OPTION

AA	None
AC	Freeturning Rotor