Hydraulics

# Char-Lynn®

Disc Valve Hydraulic Motors

11-01-878
EN-0201

EATON

# 6000 Series
# Hydraulic Motors

We Manufacture
Solutions

# Catalog of Disc Valve Hydraulic Motors from One of the World's Leading Manufacturers of Off Highway Mobile Components — Eaton Hydraulics

In the late 1950's the original low speed, high torque hydraulic motor was developed from a pump gerotor element consisting of an internal gear ring and a mating gear or star. While attaching the internal gear ring to the housing as a non moving part, oil was ported to pressurize and turn the internal star in an orbit around a center point. This slow turning star coupled with a splined drive to the output shaft became the Char-Lynn® Orbit® motor. A few years after this original Char-Lynn Orbit motor was introduced another original motor concept went into production. This motor had rolls incorporated into the internal gear ring, this element was identified by the name Geroler® and is a registered trade name of Eaton Hydraulics. From these early years the Geroler motor has seen many design changes to make these Geroler motors the best the industry has to offer. Examine the simplicity of these Geroler disc valve motors shown below. Also examine all the following pages for high value Char-Lynn disc valve motors from Eaton Hydraulics.

## Geroler® Displacement Mechanism

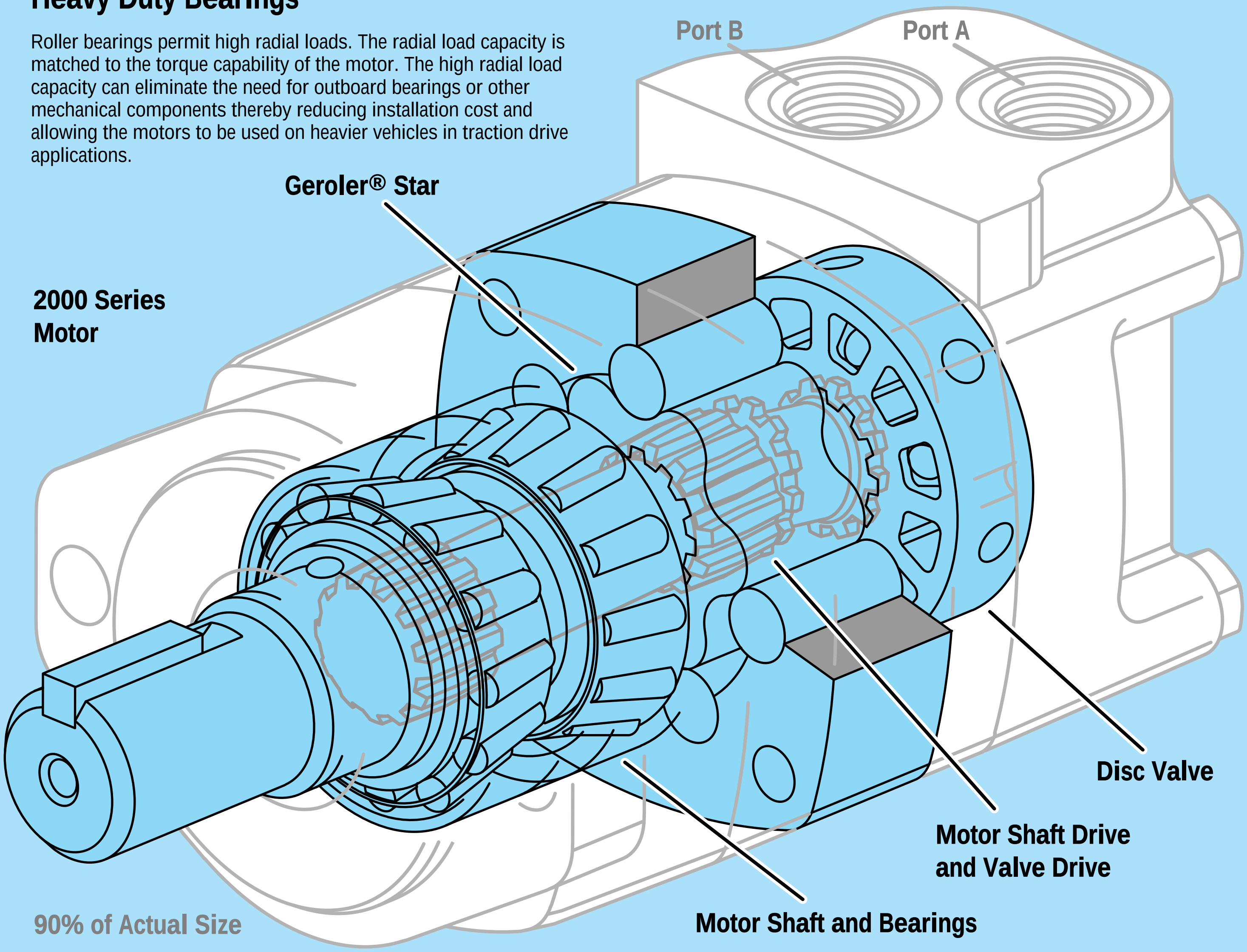
Motors with the Geroler element provide high starting and running torque. The Geroler element minimizes friction and thereby increases efficiency while providing smooth output shaft rotation even at very low speeds. Motor shaft rotation can be instantly reversed by changing direction of input/output flow while generating equal torque in either direction. The displacements available provide a wide variety of speeds and torques from any Series motor.

## Disc Valve

The function of the disc valve is to distribute fluid to the Geroler pockets. The pressure balanced sealing surface on the valve face maintains minimal leakage. Char-Lynn disc valve motors can be used in the same system with a radial piston pump and also in closed loop systems. The patented wear compensated disc valve provides top performance.

## Heavy Duty Bearings

Roller bearings permit high radial loads. The radial load capacity is matched to the torque capability of the motor. The high radial load capacity can eliminate the need for outboard bearings or other mechanical components thereby reducing installation cost and allowing the motors to be used on heavier vehicles in traction drive applications.



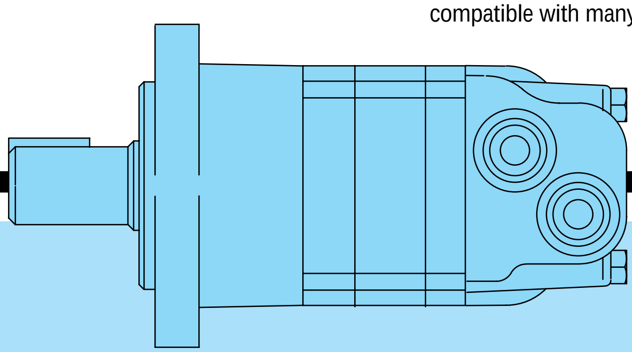
## Design Features

Char-Lynn Hydraulic motors provide design flexibility.  All disc valve motors are available with various configurations consisting of:

- Displacement (Geroler size)
- Output Shaft
- No Shaft and Bearing Assembly (Bearingless Motor)
- Port Configuration
- Mounting Flange
- Other Special Features

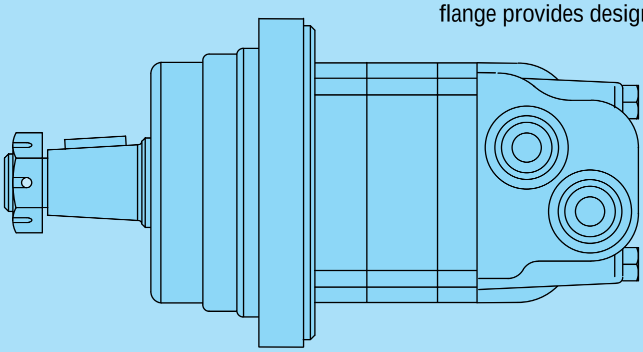
## Standard Motor

The standard motor mounting flange is located as close to the output shaft as possible.  This type of mounting supports the motor close to the shaft load. This mounting flange is also compatible with many standard gear boxes.



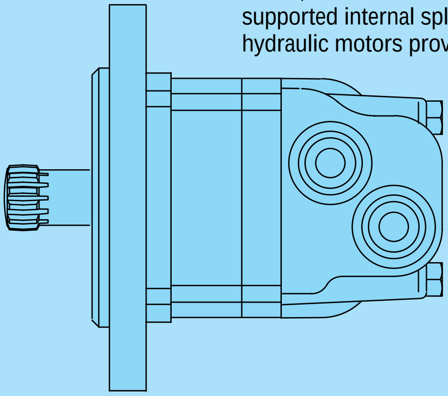
## Wheel Motor

The wheel motor mounting flange is located near the center of the motor which permits part or all of the motor to be located inside the wheel or roller hub. In traction drive applications, loads can be positioned over the motor bearings for best bearing life.  This wheel motor mounting flange provides design flexibility in many applications.

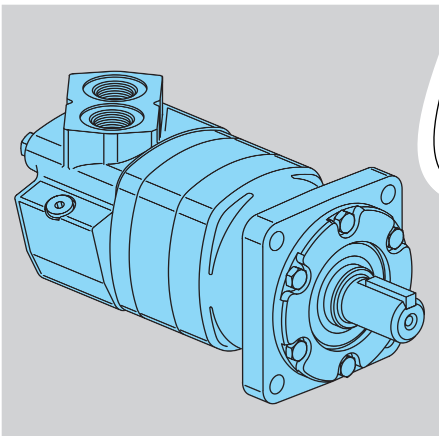


## Bearingless Motor

This bearingless motor has the same drive components as the standard and wheel motors (with the exception that the motor is assembled without the output shaft, bearings and bearing housing). The bearingless motor is especially suited for applications such as gear boxes, winch drives, reel and roll drives. Bearingless motor applications must be designed with a bearing supported internal spline to mate with the bearingless motor drive. Product designs using these hydraulic motors provide considerable cost savings.



# 6000 Series



## 6000 Series

**Geroler® Element ....... 9 Displacements**
**Flow LPM [GPM] ..... 150 [40] Continuous****
**225 [60] Intermittent***
**Speed ......................... Up to 866 RPM**
**Pressure Bar [PSI] ... 200 [ 3000] Cont.**
**300 [ 4500] Inter.**
**Torque Nm [lb-in].... 1685 [14920] Cont.**
**1875 [16580] Inter.**

**6000 Series Displacement Size** = cubic centimeter per shaft revolution ( $cm^3/r$ )
= cubic inch per shaft revolution ( [ $in^3/r$ ] )

- 195 [11.9]
- 245 [15.0]
- 310 [19.0]
- 390 [23.9]
- 490 [30.0]
- 625 [38.0]
- 740 [45.0]***
- 805 [49.0]***
- 985 [60.0]

**Mounting Flange**
- 4 Bolt (Bearingless) 127,0 [5.00] Pilot Dia. and 14,3 [.56] Dia. Mounting Holes on 161,9 [6.38] Dia. B.C.
- 4 Bolt (SAE CC)(Standard) 127,0 [5.00] Pilot Dia. and 14,3 [.56] Mounting Holes on 161,9 [6.38] Dia. B.C.
- 4 Bolt (Wheel) 139,7 [5.50] Pilot Dia. and 14,3 [.56] Dia. Mounting Holes on 184,1 [7.25] Dia. B.C.

**Output Shaft**
- Bearingless
- 1-1/2 inch Dia. Straight with Straight Key, 3/8-16 Threaded Hole and 56,7[2.23] Max. Coupling Length
- 1-3/4 inch Dia. Tapered with Straight Key and 1-1/4—18 UNEF Slotted Hex. Nut
- 1-1/2 inch Dia. Splined 17 T with 40,3 [1.59] Min. Full Spline Length and 3/8-16 Threaded Hole
- 40 mm Dia. Straight with Straight Key, M12 x 1,75-6H Threaded Hole

**Port Type**
- 1-5/16-12 O-ring with 7/16-20 O-ring Case Drain and Shuttle Valve
- G 1 (BSP) O-ring with G 1/4 (BSP) O-ring Case Drain and Check Valve
- 3/4 inch 4 Bolt Split Flange with 7/16-20 O-ring Case Drain and Check Valve

**Special Features**
- Viton Shaft Seal
- Viton Seals
- Hot Oil Shuttle
- Corrosion Protected

*** For performance and dimension data contact your Eaton Hydraulics representative.

** Continuous— (Cont.) Continuous rating, motor may be run continuously at these ratings.

* Intermittent— (Inter.) Intermittent operation, 10% of every minute.

## Design Flexibility

Char-Lynn motors are truly built for high torque low speed. A lot of power is derived from this small package. This power advantage provides the designer with a product that can be used for overall compactness in addition to taking full advantage of the high pressure ratings typical of present day hydraulic components.

Char-Lynn Disc Valve hydraulic motors allow the designer to put the power where it is needed. Indeed, these motors are small in size, big in output power. Hence, the small package can eliminate a lot of installation problems. Furthermore, the motors can be mounted directly on the driven device away from the original power source which eliminates other mechanical linkages such as chains, sprockets, belts, pulleys, gears, rotating drive shafts, and universal joints. Several motors can be driven from the same power source and can be connected in series or parallel to each other.

## Durability

The design and method of manufacture of three critical drive train components, valve drive, shaft drive, and output shaft, give these motors durability. Consequently, these durable disc valve motors stand up against high hydraulic pressures. Other built in features, such as the rugged **Tapered** roller bearings provide a good match to this tough design.

## Performance Rating

Our method of rating these motors recognizes that at slower speeds and flow, higher pressures and torque are permitted. Hence, our performance data shows the complete flow range (down to 1 liter per minute or 1/4 gallon per minute) and speed range (down to one revolution per minute depending on application).

## Controllable Speeds

Char-Lynn motors operate at low speeds that remain very near constant even when load varies. Shaft speed is varied smoothly, easily and economically using simple inexpensive controls. Also, these motors are reversible. Consequently, direction of shaft rotation can be changed instantly with equal output torque in either direction.

## Dependable Performance

Highly precise manufacturing of parts and the disc valve’s unique wear compensating design provide consistent, dependable performance and long life even under varying conditions.

## Reliability

Char-Lynn motors are self contained, with hydraulic fluid providing lubrication. These motors are completely sealed so they can operate safely and reliably in hostile environments such as dust, dirt, steam, water, and heat and provide reliable performance.

## High Efficiencies

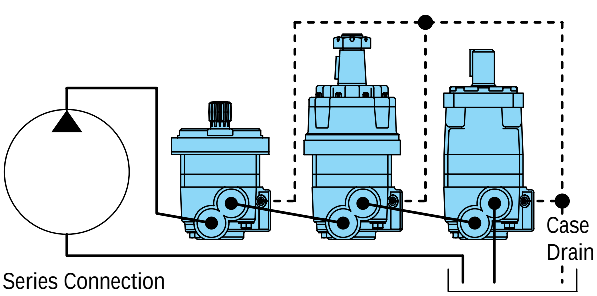
Char-Lynn disc valve motors have high efficiencies providing high output for the pressure and flow supplied. The high mechanical efficiency enables you to obtain a given torque with a smaller displacement motor.

Volumetric efficiency is high and speed is relatively constant with little variation due to changes in load. Speed is controlled easily and smoothly.

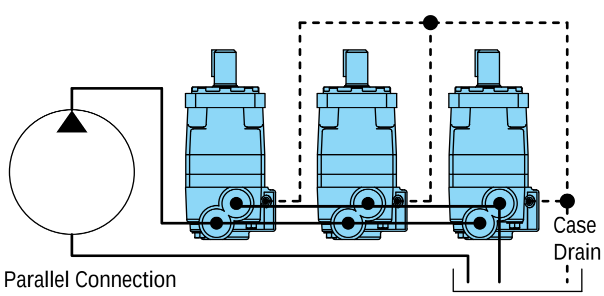
In conclusion, these efficiencies mean less heat buildup in the hydraulic system.

## Case Drain and Shuttle Valve Options

Many hydraulic systems can benefit from the use of a system case drain. Char-Lynn disc valve motors provide this feature built in. One of the advantages for case drain flow is that contamination is flushed from the system. This flushing also aids in cooling the system and lowering the case pressure which will extend motor seal life. With a case drain line in place, oil pressure in the gear box (Bearingless motor applications) can also be controlled. In applications where more system cooling and flushing is required, a shuttle valve option is available in 2000, 4000, and 6000 Series motors.

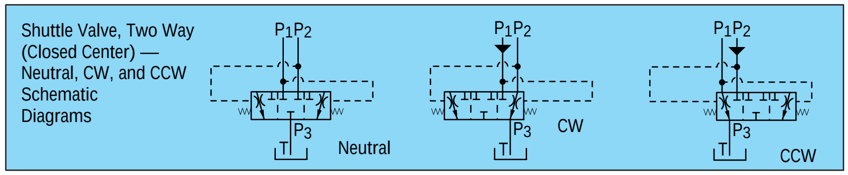


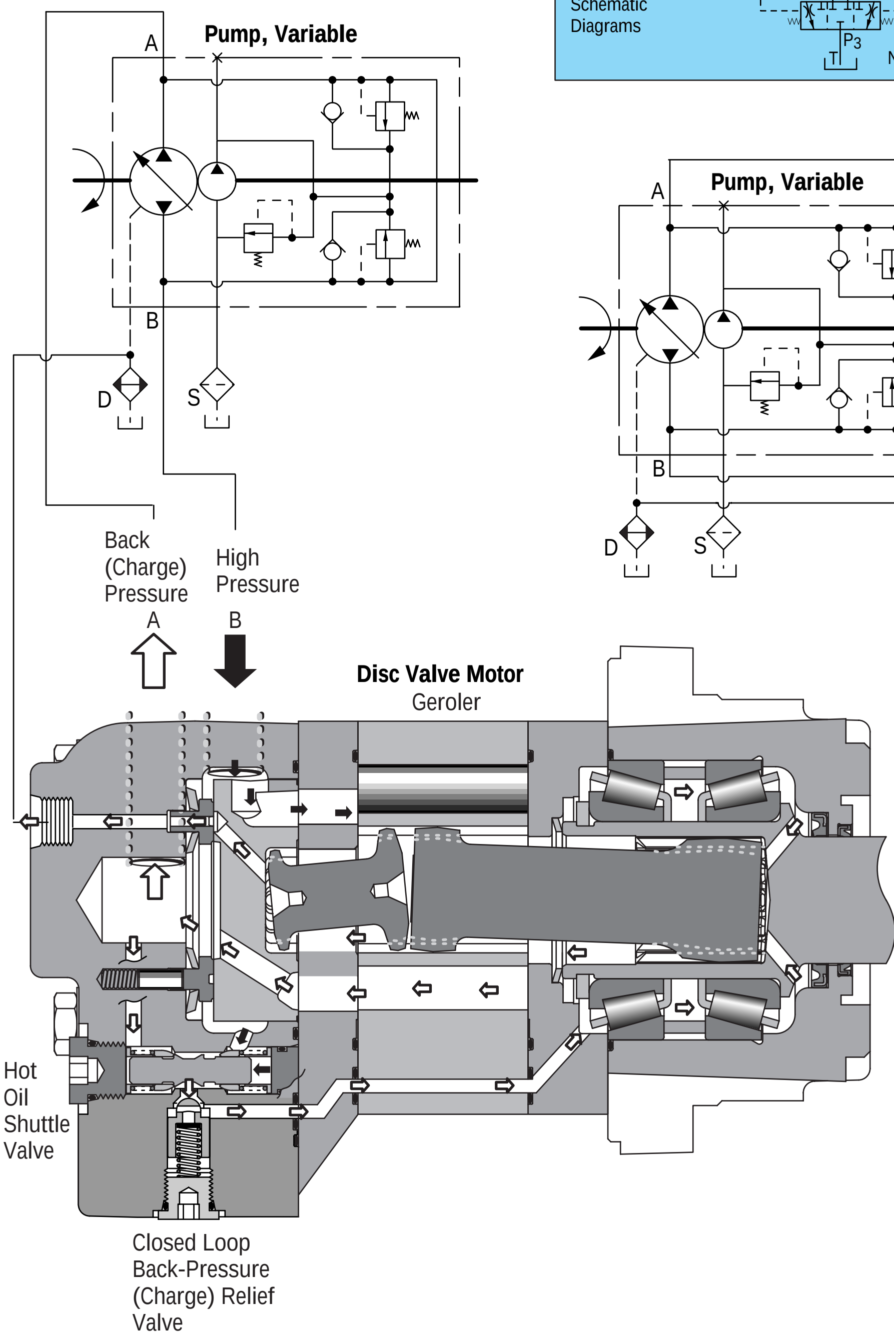
Series Connection

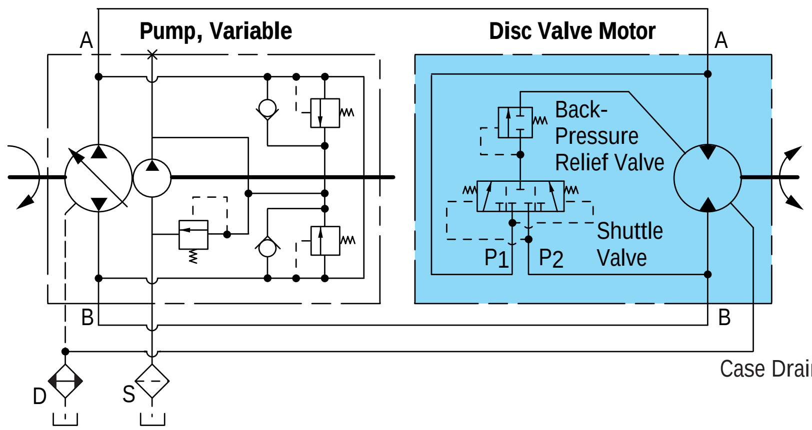


Parallel Connection

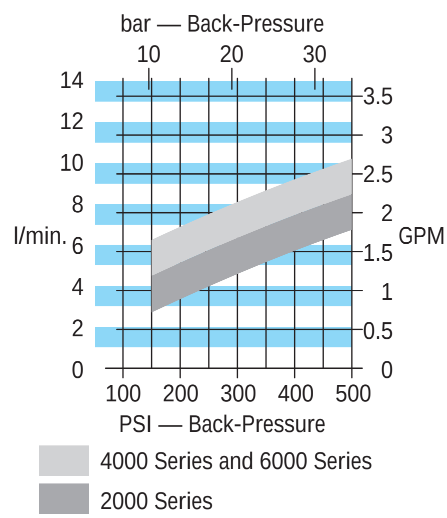
# Typical (Closed Loop) Hydraulic Circuit
# Shuttle Flow 2000, 4000, 6000 Series




**Typical Disc Valve Motor**
**Shuttle Flow with 4,5 bar [65 PSI]**
**Back-Pressure Relief Valve (Typical Data)**
Due to Machining Tolerances, Flow May be More or Less




Disc Valve Motor with shuttle valve **must have a case drain to tank**, without this drain line the internal drive splines will not have adequate lubrication.

Low Speed High Torque Hydraulic Motors
with Shuttle and Charge Pressure Relief
Valve — Patent No. U.S. 4,645,438.

# Speed Sensor
# 2000, 4000 and 6000 Series

Eaton has developed a speed sensor specifically designed for LSHT motors. The design is rugged and fully protected against accidental reverse polarity or short circuit hook up. A built in pull up resistor simplifies installation with control systems.

This sensor is fully compatible with mobile vehicle electrical systems and gives a reliable digital on/off signal over a wide speed range and temperature range. The sensor is field-serviceable; no factory setting or shimming is required.

**Supply Voltage:** 8 to 24 Vdc (compatible with 12V vehicle systems)

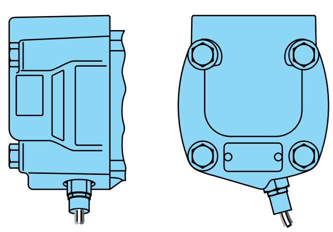
**Supply Current:** 20 mA max. (Vs) (including internal pull-up resistor)

**Output Voltage:** Low < .5 Vdc @ 10 mA; output is open collector with 10kΩ pull-up resistor.

**Connection** — standard 3 prong Weatherpack connector with 18 AWG (american wire gage) cables:
Position A (red) = power supply
Position B (white) = signal output
Position C (black) = common

## 2000 Series

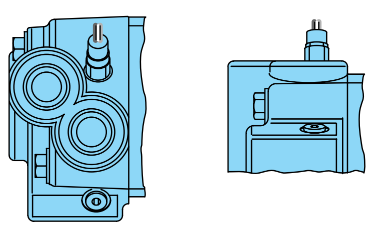
**Output Speed Sensor** — digital on/off signal from a Hall Effect switch; 30 pulses/revolution



**Output Quadrature Speed Sensor** — 60 pulses/revolution

## 4000 Series

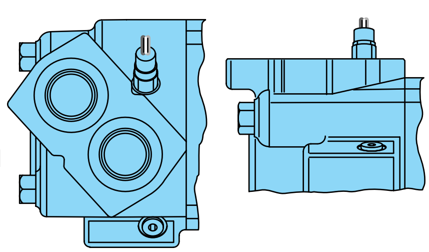
**Output Speed Sensor** — digital on/off signal from a Hall Effect switch; 36 pulses/revolution



**Output Quadrature Speed Sensor** — 72 pulses/revolution

## 6000 Series

**Output Speed Sensor** — digital on/off signal from a Hall Effect switch; 40 pulses/revolution



**Output Quadrature Speed Sensor** — 80 pulses/revolution

# Quadrature Speed Sensor
# 2000, 4000 and 6000 Series

Eaton has developed a new **speed** and **direction** sensor, based on the field proven technology of our standard sensor, designed for off road environments. The new sensor is based on the principle of quadrature and has two output versions.

- The first version has two output signals 90° out of phase. Each output provides one pulse per target tooth.
- The second version has a speed signal that is twice the output pulses per revolution and it also has a direction signal. For example, the 2000 Series versions provide 60 symmetrical pulses per revolu tion with the 30-tooth target.

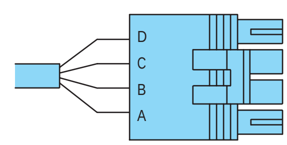
Outputs — Digital signals from NPN transistors (open collector output with internal 10K pull-up resistors).

**Supply Voltage:** 8 to 24 Vdc***** (compatible with 12V vehicle conditions)

**Supply Current:** 40 mA max. (Including internal pull-up resistors)

**Output Low Voltage:** 0.5 Vdc maximum @ 10 mA

The sensor has reverse polarity protection, short circuit protection, load dump protection and EMC (Electricalmagnetic Compatibility) protection (the customer should qualify the EMC protection in their specific application).




**Weatherpack Tower Connector**

**Connections —**
Standard 4 prong Weatherpack connector with 18 AWG (American Wire Gage) cables or M12 threaded connector:

**Weatherpack (Version 1)**
Position A (red) = power supply
Position B (black) = common
Position C (orange) = output one
Position D (yellow) = output two

**M12 Connector (Version 1)**
Pin 1 = power supply
Pin 2 = output one
Pin 3 = common
Pin 4 = output two

**Weatherpack (Version 2)**
Position A (red) = power supply
Position B (black) = common
Position C (blue) = speed signal
Position D (white) = direction

**M12 Connector (Version 2)**
Pin 1 = power supply
Pin 2 = direction
Pin 3 = common
Pin 4 = speed signal

**Note:** The speed sensor or quadrature speed sensor option does **NOT** include read-out display.
Possible sources for read-out display include:

Eaton Corporation
**Durant Products**
901 South 12th Street
Watertown, WI 57094
1-800-289-3866

## Shaft Seal

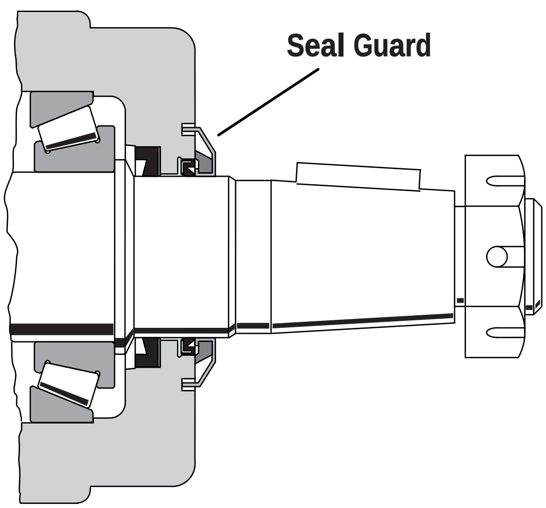
This time proven shaft seal design has a patented feature which allows the seal lip to follow shaft deflection under high side loads and therefore provides better sealing. Additionally, these seals can withstand case pressure up to: 140 Bar [2000 PSI] 2000 Series, 100 Bar [1500 PSI] 4000 Series, 70 Bar [1000 PSI] 6000 Series, and 20 Bar [300 PSI] 10,000 Series.

To optimize seal life, reduce case pressures (with case drain) at shaft speeds greater than 250 RPM.

## Internal Check Valves

An internal check valve is provided to relieve case pressure to the low pressure side of the motor. This check valve system is adequate for most applications. In addition, motors have an external case pressure drain port for use when continuous back pressure exceeds: 140 Bar [2000 PSI] 2000 Series, 100 Bar [1500 PSI] 4000 Series, 70 Bar [1000 PSI] 6000 Series, and 20 Bar [300 PSI] 10,000 Series.

## Optional Seal Guard Package for 2000, 4000, and 6000 Series




In response to the need for robust seal protection requirements, Eaton now offers a seal guard package. This feature consists of a metal shield that protects an internal wiper seal. The shield is interference-fit on the output shaft and rotates with the output shaft. For added protection, the shield is recessed into a special groove in the bearing housing face.

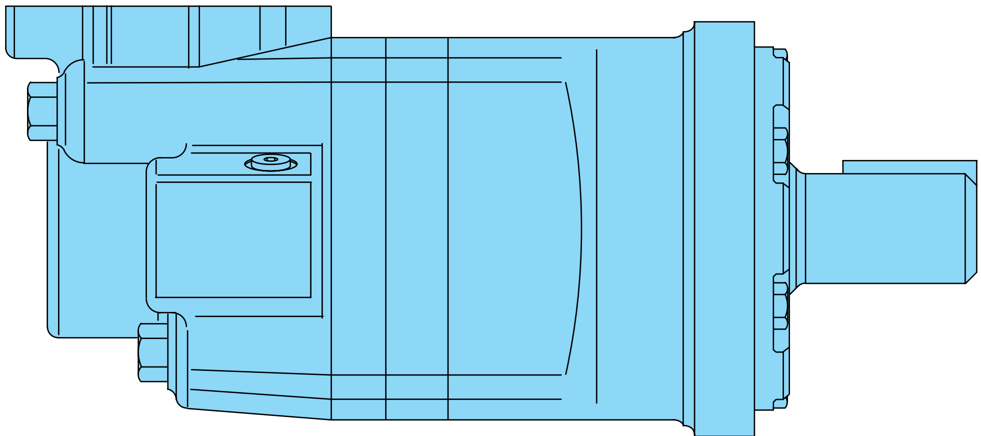
Centrifugal force causes foreign debris to be forced away from the high pressure shaft and dust seal area. The seal guard does not seal hydraulic fluid. Instead, it protects the standard seals from damage caused by foreign debris. Typical applications benefiting from this feature include street sweepers, industrial sweepers, and harvesting machinery.

**NOTE:** This option is used in conjunction with the special front retainer with shield groove. Special feature (Hardware) option code “28” for 2000, “13” for 4000, and “14” for 6000 Series, **these motors include the seal guard package, special front retainer and a special shaft with additional length** (6000 Series with design code -006 (effective December 1, 1995) will not require a special front retainer and standard shafts will accept the seal guard).

## Corrosion Protected Disc Valve Motors

2000, 4000, 6000, and 10,000 Series motors are available with a corrosion resistant coating for use in hostile environments. This coating protects the motor from salt water, and various chemicals and is especially effective in marine, food processing, cleansing, fishing, and agricultural applications. Motor output shaft plating helps eliminate seal damage caused by these caustic or acid materials. Char-Lynn disc valve motors are available with just the output shaft plated, or with plated shaft and entire motor exterior coating.

# Specifications
# 6000 Series



## Specification Data—6000 Series

| Displ. cm³/r [in³/r] | | | 195 [11.9] | 245 [15.0] | 310 [19.0] | 390 [23.9] | 490 [30.0] | 625 [38.0] | 985 [60.0] |
|---|---|---|---|---|---|---|---|---|---|
| Max. Speed (RPM) @ ...................... Flow | | Continuous | 775 | 615 | 485 | 387 | 307 | 241 | 153 |
| | | Intermittent | 866 | 834 | 698 | 570 | 454 | 355 | 230 |
| Flow LPM [GPM] | | Continuous | 150 [40] | 150 [40] | 150 [40] | 150 [40] | 150 [40] | 150 [40] | 150 [40] |
| | | Intermittent | 170 [45] | 210 [55] | 225 [60] | 225 [60] | 225[60] | 225 [60] | 225 [60] |
| Torque ☆ Nm [lb-in] | 1-3/4 Inch Dia. Tapered Shaft | Continuous | 575 [5100] | 735 [6510] | 930 [ 8230] | 1155 [10230] | 1445 [12800] | 1480 [13100] | 1685 [14920] |
| | | Intermittent | 860 [7620] | 1100 [9740] | 1355 [11990] | 1635 [14490] | 1885 [16670] | 1898 [16800] | 1875 [16580] |
| Pressure ☆ Δ Bar [Δ PSI] | 1-3/4 Inch Dia. Tapered Shaft | Continuous | 205 [3000] | 205 [3000] | 205 [3000] | 205 [3000] | 205 [3000] | 170 [2500] | 140 [2000] |
| | | Intermittent | 310 [4500] | 310 [4500] | 310 [4500] | 310 [4500] | 275 [4000] | 221 [3200] | 140 [2000] |
| | | Peak | 310 [4500] | 310 [4500] | 310 [4500] | 310 [4500] | 310 [4500] | 240 [3500] | 170 [2250] |
| Maximum Case Pressure - without Case Drain * — 70 Bar [1000 PSI] | | | | | | | | | |

**A simultaneous maximum torque and maximum speed NOT recommended.** For permissible continuous and intermittent operating combinations of pressure and flow refer to performance data on pages 52-53.

☆ **Maximum torque for 1-1/2 inch shaft** — 1325 Nm [11750 lb-in] Continuous and 1650 Nm [14600 lb-in] intermittent.

* For back pressure over 70 Bar [1000 PSI] use an external case drain. Install case drain lines so that the motor case remains filled at all times.

**Maximum inlet pressure** — 310 Bar [4500 PSI]. Do not exceed Δ pressure rating (see chart above).

* **Maximum return pressure** — 310 Bar [4500 PSI]. Do not exceed Δ pressure rating (see chart above).

Δ **Bar [Δ PSI]** — True pressure difference between inlet port and outlet port.

**Continuous Rating** — Motor may be run continuously at these ratings.

**Intermittent Operation** — 10% of every minute.

**Peak Operation** — 1% of every minute.

**Recommended Fluids** — Premium quality, anti-wear type hydraulic oil with a viscosity of not less than 70 SUS at operating temperature (see page 81).

**Recommended Maximum System Operating Temp.** — Is 82° C [180° F]

**Recommended Filtration** — per ISO Cleanliness Code, level 18/13

**To assure best motor life, run motor for approximately one hour at 30% of rated pressure before application to full load. Be sure motor is filled with fluid prior to any load applications.**

# Performance Data 6000 Series

### 195 cm³/r [11.9 in³/r]
Δ Pressure Bar [PSI]

| Flow LPM [GPM] | [250] 15 | [500] 35 | [1000] 70 | [1500] 105 | [2000] 140 | [2500] 170 | [3000] 205 | [3500] 240 | [4000] 275 | [4500] 310 |
|---|---|---|---|---|---|---|---|---|---|---|
| [.5] **1,9** | [280] 30 **9** | [650] 75 **7** | [1450] 165 **5** | [2290] 260 **2** | | | | | | |
| [2] **7,5** | [290] 35 **38** | [680] 75 **37** | [1500] 170 **35** | [2340] 265 **34** | [3100] 350 **30** | [3880] 440 **26** | [4140] 470 **18** | | | |
| [4] **15** | [300] 35 **77** | [710] 80 **76** | [1500] 175 **74** | [2390] 270 **72** | [3210] 365 **66** | [4030] 455 **62** | [4600] 520 **46** | [5200] 590 **32** | [5790] 655 **18** | |
| [8] **30** | [310] 35 **154** | [740] 85 **153** | [1590] 180 **148** | [2450] 275 **144** | [3280] 370 **131** | [4120] 465 **119** | [4810] 545 **116** | [5530] 625 **99** | [6250] 705 **83** | [6900] 780 **65** |
| [12] **45** | [320] 35 **232** | [750] 85 **230** | [1610] 180 **225** | [2480] 280 **221** | [3330] 375 **212** | [4190] 475 **203** | [4990] 565 **186** | [5810] 655 **167** | [6630] 750 **148** | [7320] 825 **118** |
| [16] **61** | [300] 35 **309** | [730] 80 **307** | [1600] 180 **303** | [2470] 280 **300** | [3340] 375 **291** | [4210] 475 **283** | [5090] 575 **258** | [5900] 665 **236** | [6710] 760 **214** | [7470] 845 **181** |
| [20] **76** | [270] 30 **387** | [720] 80 **384** | [1590] 180 **379** | [2460] 280 **374** | [3350] 380 **365** | [4240] 480 **356** | [5100] 575 **332** | [5950] 670 **306** | [6800] 770 **280** | [7620] 860 **247** |
| [24] **91** | [240] 25 **465** | [700] 80 **462** | [1570] 175 **456** | [2440] 275 **450** | [3330] 375 **440** | [4220] 475 **429** | [5080] 575 **413** | [5940] 670 **388** | [6810] 770 **363** | |
| [28] **106** | [190] 20 **542** | [660] 75 **539** | [1530] 175 **532** | [2400] 270 **526** | [3300] 375 **514** | [4200] 475 **502** | [5060] 570 **476** | [5940] 670 **448** | [6810] 770 **421** | |
| [32] **121** | [160] 20 **620** | [630] 70 **617** | [1500] 170 **609** | [2370] 270 **602** | [3270] 370 **589** | [4160] 470 **576** | [5040] 570 **542** | [5920] 670 **511** | [6790] 765 **480** | |
| [36] **136** | [120] 15 **697** | [620] 70 **692** | [1480] 165 **683** | [2350] 265 **674** | [3240] 365 **659** | [4130] 465 **645** | [5000] 565 **601** | [5880] 665 **564** | [6760] 765 **527** | |
| [40] **151** | [80] 10 **775** | [610] 70 **770** | [1450] 165 **759** | [2320] 260 **749** | [3210] 365 **733** | [4100] 465 **718** | [4960] 560 **666** | [5840] 660 **624** | | |
| [45] **170** | | [590] 65 **866** | [1410] 160 **854** | [2280] 260 **843** | [3170] 360 **825** | [4060] 460 **808** | [4920] 555 **749** | [5790] 655 **702** | | |

### 245 cm³/r [15.0 in³/r]
Δ Pressure Bar [PSI]

| Flow LPM [GPM] | [250] 15 | [500] 35 | [1000] 70 | [1500] 105 | [2000] 140 | [2500] 170 | [3000] 205 | [3500] 240 | [4000] 275 | [4500] 310 |
|---|---|---|---|---|---|---|---|---|---|---|
| [.5] **1,9** | [430] 50 **7** | [860] 95 **4** | [1890] 215 **1** | | | | | | | |
| [2] **7,5** | [440] 50 **30** | [900] 100 **29** | [1940] 220 **26** | [2990] 340 **24** | [3960] 445 **21** | [4920] 555 **17** | [5040] 570 **11** | [5930] 670 **6** | | |
| [4] **15** | [460] 50 **61** | [940] 105 **60** | [2000] 225 **56** | [3060] 345 **54** | [4080] 460 **48** | [5090] 575 **42** | [5680] 640 **39** | [6630] 750 **30** | [7570] 855 **12** | [8520] 965 **6** |
| [8] **30** | [470] 55 **122** | [960] 110 **120** | [2060] 235 **116** | [3150] 355 **113** | [4210] 475 **104** | [5260] 595 **95** | [6180] 700 **81** | [7100] 800 **67** | [8020] 905 **53** | [9020] 1020 **37** |
| [12] **45** | [480] 55 **183** | [970] 110 **182** | [2080] 235 **178** | [3180] 360 **174** | [4270] 480 **165** | [5360] 605 **157** | [6390] 720 **141** | [7420] 840 **125** | [8450] 955 **109** | [9510] 1075 **92** |
| [16] **61** | [450] 50 **245** | [960] 110 **244** | [2070] 235 **240** | [3180] 360 **236** | [4290] 485 **228** | [5420] 610 **221** | [6480] 730 **202** | [7490] 845 **184** | [8480] 960 **165** | [9540] 1180 **145** |
| [20] **76** | [420] 45 **307** | [940] 105 **306** | [2050] 230 **301** | [3160] 355 **297** | [4290] 485 **287** | [5440] 615 **277** | [6510] 735 **257** | [7580] 855 **238** | [8660] 980 **218** | [9740] 1100 **197** |
| [24] **91** | [380] 45 **368** | [920] 105 **365** | [2020] 230 **361** | [3120] 355 **358** | [4260] 480 **348** | [5400] 610 **338** | [6490] 735 **316** | [7590] 860 **294** | [8680] 980 **271** | |
| [28] **106** | [330] 35 **430** | [870] 100 **426** | [1980] 225 **421** | [3100] 350 **416** | [4240] 480 **404** | [5380] 610 **376** | [6480] 730 **358** | [7580] 855 **340** | [8670] 980 **322** | |
| [32] **121** | [290] 35 **491** | [800] 90 **489** | [1920] 215 **481** | [3050] 345 **475** | [4170] 470 **461** | [5290] 600 **448** | [6410] 725 **423** | [7520] 850 **398** | [8640] 975 **373** | |
| [36] **136** | [250] 30 **556** | [730] 80 **549** | [1850] 210 **543** | [2980] 335 **537** | [4060] 460 **524** | [5150] 580 **509** | [6300] 710 **482** | [7440] 840 **456** | | |
| [40] **151** | [200] 25 **615** | 690] 80 **612** | [1790] 200 **606** | [2940] 330 **599** | [4010] 455 **585** | [5130] 580 **570** | [6190] 700 **540** | [7100] 800 **510** | | |
| [45] **170** | | [570] 65 **688** | [1760] 200 **682** | [2860] 325 **674** | [3960] 445 **658** | [5070] 575 **641** | [6080] 685 **608** | [6690] 755 **574** | | |
| [50] **189** | | | [1720] 195 **758** | [2800] 315 **749** | [3890] 440 **731** | [4920] 555 **712** | [5940] 670 **676** | | | |
| [55] **208** | | | [1670] 190 **834** | [2740] 310 **824** | [3820] 430 **804** | [4890] 550 **783** | [5880] 665 **744** | | | |

**Motors run with high efficiency in all areas designated with a number for torque and speed, however for best motor life select a motor to run with a torque and speed range shown in the light blue area.**

[5790] } Torque [lb-in]
655 } Nm
**702** } **Speed RPM**

Continuous

Intermittent

**Performance data is typical at 120 SUS. Actual data may vary slightly from unit to unit in production**

### 310 cm³/r [19.0 in³/r]
Δ Pressure Bar [PSI]

| Flow LPM [GPM] | [250] 15 | [500] 35 | [1000] 70 | [1500] 105 | [2000] 140 | [2500] 170 | [3000] 205 | [3500] 240 | [4000] 275 | [4500] 310 |
|---|---|---|---|---|---|---|---|---|---|---|
| [.5] **1,9** | [530] 60 **6** | [1120] 125 **4** | [2440] 275 **1** | | | | | | | |
| [2] **7,5** | [540] 60 **24** | [1150] 130 **23** | [2460] 280 **22** | [3620] 410 **20** | [4780] 540 **17** | [5690] 645 **14** | [6670] 755 **10** | [7780] 880 **4** | | |
| [4] **15** | [550] 60 **48** | [1180] 135 **47** | [2560] 290 **45** | [3800] 430 **42** | [5030] 570 **38** | [6050] 685 **32** | [7070] 800 **24** | [8260] 935 **17** | [9070] 1025 **10** | [9530] 1075 **3** |
| [8] **30** | [560] 65 **96** | [1250] 140 **95** | [2650] 300 **91** | [3970] 450 **87** | [5280] 595 **81** | [6480] 730 **73** | [7710] 870 **64** | [8740] 985 **55** | [9770] 1105 **46** | [10990] 1240 **35** |
| [12] **45** | [570] 65 **144** | [1260] 140 **143** | [2690] 305 **140** | [4050] 460 **135** | [5420] 610 **129** | [6730] 760 **121** | [8040] 910 **111** | [9260] 1045 **99** | [10490] 1185 **88** | [11800] 1335 **76** |
| [16] **61** | [540] 60 **193** | [1230] 140 **192** | [2660] 300 **188** | [4060] 460 **184** | [5450] 615 **178** | [6800] 770 **167** | [8150] 920 **156** | [9400] 1060 **141** | [10660] 1205 **126** | [11990] 1355 **109** |
| [20] **76** | [510] 60 **242** | [1200] 135 **241** | [2630] 295 **236** | [4040] 455 **232** | [5450] 615 **226** | [6820] 770 **216** | [8190] 925 **201** | [9520] 1075 **184** | [10840] 1225 **167** | |
| [24] **91** | [480] 55 **290** | [1160] 130 **289** | [260] 295 **282** | [4020] 455 **279** | [5440] 615 **273** | [6840] 775 **260** | [8230] 930 **248** | [9560] 1080 **232** | [10900] 1230 **215** | |
| [28] **106** | [420] 45 **339** | [1130] 130 **336** | [2570] 290 **333** | [3990] 450 **328** | [5420] 610 **320** | [6820] 770 **308** | [8220] 930 **295** | [9520] 1075 **276** | [10840] 1225 **257** | |
| [32] **121** | [360] 40 **388** | [1100] 125 **384** | [2510] 285 **381** | [3920] 445 **375** | [5330] 600 **368** | [6750] 765 **354** | [8170] 920 **341** | [9440] 1065 **320** | | |
| [36] **136** | [300] 35 **436** | [1060] 120 **430** | [2440] 275 **421** | [3830] 435 **416** | [5220] 590 **410** | [6660] 750 **396** | [8100] 915 **383** | [9330] 1055 **360** | | |
| [40] **151** | [270] 30 **485** | [1020] 115 **478** | [2400] 270 **466** | [3780] 425 **461** | [5150] 580 **456** | [6580] 745 **441** | [8020] 905 **427** | [9220] 1040 **403** | | |
| [50] **189** | | [982] 110 **597** | [2180] 245 **582** | [3420] 385 **576** | [4660] 525 **570** | [6050] 685 **551** | [7440] 840 **534** | | | |
| [60] **227** | | | [1960] 220 **698** | [3250] 365 **691** | [4540] 515 **684** | [5750] 650 **661** | [7080] 800 **641** | | | |

### 390 cm³/r [23.9 in³/r]
Δ Pressure Bar [PSI]

| Flow LPM [GPM] | [250] 15 | [500] 35 | [1000] 70 | [1500] 105 | [2000] 140 | [2500] 170 | [3000] 205 | [3500] 240 | [4000] 275 | [4500] 310 |
|---|---|---|---|---|---|---|---|---|---|---|
| [1] **3,8** | [760] 85 **4** | [1570] 175 **2** | [3230] 365 **1** | | | | | | | |
| [2] **7,5** | [780] 90 **19** | [1610] 180 **18** | [3270] 370 **17** | [4910] 555 **16** | [6440] 730 **14** | [7760] 875 **12** | [9080] 1025 **9** | [10590] 1195 **4** | | |
| [4] **15** | [800] 90 **38** | [1640] 185 **38** | [3300] 375 **37** | [4970] 560 **35** | [6570] 740 **33** | [8160] 920 **29** | [9570] 1080 **22** | [11270] 1275 **14** | [12120] 1370 **5** | [14490] 1635 **1** |
| [8] **30** | [810] 90 **77** | [1650] 185 **76** | [3370] 380 **74** | [5080] 575 **72** | [6740] 760 **68** | [8430] 950 **65** | [10050] 1135 **55** | [11620] 1315 **45** | [12880] 1455 **33** | [14480] 1635 **21** |
| [12] **45** | [800] 90 **115** | [1620] 185 **115** | [3390] 385 **112** | [5130] 580 **109** | [6810] 770 **105** | [8520] 965 **100** | [10190] 1150 **91** | [11860] 1340 **81** | [13640] 1540 **79** | |
| [16] **61** | [750] 85 **154** | [1600] 180 **154** | [3380] 380 **151** | [5120] 580 **147** | [6820] 770 **143** | [8560] 965 **132** | [10230] 1155 **126** | [11920] 1345 **116** | | |
| [20] **76** | [680] 75 **193** | [1580] 180 **193** | [3360] 380 **189** | [5120] 580 **187** | [6840] 775 **182** | [8590] 970 **175** | [10280] 1160 **162** | [11980] 1355 **152** | | |
| [24] **91** | [620] 70 **232** | [1520] 170 **230** | [3280] 370 **229** | [5060] 570 **225** | [6780] 765 **220** | [8530] 965 **212** | [10240] 1155 **204** | | | |
| [28] **106** | [570] 65 **270** | [1460] 165 **268** | [3210] 365 **266** | [5000] 565 **261** | [6730] 760 **256** | [8480] 960 **248** | [10200] 1150 **236** | | | |
| [32] **121** | [530] 60 **309** | [1420] 160 **306** | [3140] 355 **304** | [4930] 555 **299** | [6640] 750 **292** | [8380] 945 **282** | [10120] 1145 **269** | | | |
| [36] **136** | [450] 50 **348** | [1370] 155 **346** | [3010] 340 **340** | [4840] 545 **336** | [6500] 730 **329** | [8250] 930 **317** | [10000] 1130 **301** | | | |
| [40] **151** | [380] 45 **387** | [1320] 150 **386** | [2880] 325 **380** | [4740] 535 **375** | [6460] 730 **368** | [8120] 915 **359** | | | | |
| [50] **189** | | [1140] 130 **482** | [2650] 300 **475** | [4540] 515 **469** | [6440] 730 **460** | [8050] 910 **449** | | | | |
| [60] **227** | | | [2460] 280 **570** | [4430] 500 **562** | [6360] 720 **552** | [7860] 890 **538** | | | | |

# Performance Data 6000 Series

### 490 cm³/r [30.0 in³/r]

Δ Pressure Bar [PSI]

| Flow LPM [GPM] | [250] 15 | [500] 35 | [1000] 70 | [1500] 105 | [2000] 140 | [2500] 170 | [3000] 205 | [3500] 240 | [4000] 275 |
|---|---|---|---|---|---|---|---|---|---|
| [1] 3,8 | [1010] 115 **7** | [1200] 235 **7** | [4260] 480 **5** | [6140] 695 **3** | | | | | |
| [2] 7,5 | [1020] 115 **15** | [2110] 240 **14** | [4270] 480 **13** | [6280] 710 **12** | [8350] 945 **11** | [10420] 1175 **8** | [12140] 1370 **3** | | |
| [4] 15 | [1030] 115 **30** | [2100] 235 **30** | [4280] 485 **29** | [6410] 725 **28** | [8500] 960 **27** | [10590] 1195 **25** | [12500] 1410 **21** | [14580] 1645 **17** | [16670] 1885 **12** |
| [8] 30 | [1020] 115 **60** | [2090] 235 **60** | [4290] 485 **59** | [6490] 735 **57** | [8620] 975 **54** | [10740] 1215 **51** | [12800] 1445 **45** | [14930] 1685 **38** | |
| [12] 45 | [1000] 115 **91** | [2080] 235 **91** | [4290] 485 **89** | [6500] 735 **87** | [8650] 975 **84** | [10800] 1220 **79** | [12890] 1455 **71** | | |
| [16] 61 | [110] 960 **122** | [2060] 235 **122** | [4260] 480 **121** | [6480] 730 **118** | [8650] 975 **114** | [10820] 1220 **109** | [12900] 1460 **100** | | |
| [20] 76 | [900] 100 **153** | [1980] 225 **152** | [4180] 470 **150** | [6420] 725 **147** | [8620] 975 **144** | [10820] 1220 **139** | | | |
| [24] 91 | [850] 95 **184** | [1930] 220 **184** | [4150] 470 **181** | [6390] 720 **180** | [8580] 970 **176** | [10770] 1215 **171** | | | |
| [28] 106 | [740] 85 **215** | [1840] 210 **214** | [4070] 460 **211** | [6290] 710 **208** | [8500] 960 **204** | [10720] 1210 **198** | | | |
| [32] 121 | [690] 80 **245** | [1710] 195 **244** | [3970] 450 **241** | [6190] 700 **237** | [8420] 950 **232** | [10660] 1205 **226** | | | |
| [36] 136 | [670] 75 **276** | [1560] 175 **275** | [3860] 435 **272** | [6080] 685 **265** | [8340] 940 **260** | [10420] 1175 **255** | | | |
| [40] 151 | [570] 65 **307** | [1400] 160 **306** | [3750] 425 **303** | [5970] 675 **295** | [8140] 920 **290** | [10180] 1150 **284** | | | |
| [50] 189 | | [1140] 130 **382** | [3240] 365 **379** | [5220] 590 **369** | [7620] 860 **362** | | | | |
| [60] 227 | | | [2860] 325 **454** | [4860] 550 **442** | [7140] 805 **435** | | | | |

### 625 cm³/r [38.0 in³/r]

Δ Pressure Bar [PSI]

| Flow LPM [GPM] | [250] 15 | [500] 35 | [1000] 70 | [1500] 105 | [2000] 140 | [2500] 170 | [3000] 205 | [3200] 221 |
|---|---|---|---|---|---|---|---|---|
| [1] 3,8 | [1060] 120 **5** | [2205] 250 **5** | [4515] 510 **4** | [6690] 755 **2** | | | | |
| [2] 7,5 | [1090] 125 **12** | [2300] 260 **12** | [4720] 535 **13** | [7025] 795 **10** | [9360] 1060 **6** | | | |
| [4] 15 | [1145] 130 **24** | [2450] 275 **24** | [5052] 570 **24** | [7520] 850 **21** | [9410] 1065 **16** | [12700] 1434 **13** | | |
| [8] 30 | [1195] 135 **45** | [2600] 295 **45** | [5350] 605 **44** | [8195] 925 **42** | [11220] 1270 **37** | [13100] 1480 **35** | [15800] 1785 **32** | [16800] 1898 **30** |
| [12] 45 | [1200] 135 **72** | [2600] 295 **72** | [5390] 610 **71** | [8145] 920 **68** | [11770] 1330 **64** | [13000] 1469 **60** | [15700] 1774 **56** | |
| [16] 61 | [1120] 125 **94** | [2530] 285 **94** | [5340] 605 **92** | [8105] 915 **89** | [11740] 1325 **85** | [13000] 1469 **83** | | |
| [20] 76 | [1050] 120 **120** | [2465] 280 **119** | [5285] 595 **117** | [8080] 915 **115** | [11725] 1325 **110** | | | |
| [24] 91 | [950] 105 **144** | [2365] 265 **143** | [5180] 585 **140** | [7990] 905 **138** | [11705] 1320 **132** | | | |
| [28] 106 | [855] 95 **169** | [2255] 255 **168** | [5080] 575 **165** | [7915] 895 **162** | [11640] 1315 **156** | | | |
| [32] 121 | [730] 80 **193** | [2140] 240 **192** | [4960] 560 **188** | [7775] 880 **185** | [11505] 1300 **179** | | | |
| [36] 136 | [555] 65 **217** | [1965] 220 **216** | [4780] 540 **213** | [7585] 855 **210** | | | | |
| [40] 151 | [380] 45 **241** | [1790] 200 **240** | [4600] 520 **238** | [7395] 835 **236** | | | | |
| [50] 189 | | | [4180] 470 **296** | [6985] 790 **290** | | | | |
| [60] 227 | | | [3800] 430 **353** | [6600] 745 **345** | | | | |

Motors run with high efficiency in all areas designated with a number for torque and speed, however for best motor life select a motor to run with a torque and speed range shown in the light blue area.

Continuous

Intermittent

[3800] 430 **353** } Torque [lb-in] Nm **Speed RPM**

Performance data is typical at 120 SUS. Actual data may vary slightly from unit to unit in production

### 805 cm³/r [49.0 in³/r]

Δ Pressure Bar [PSI]

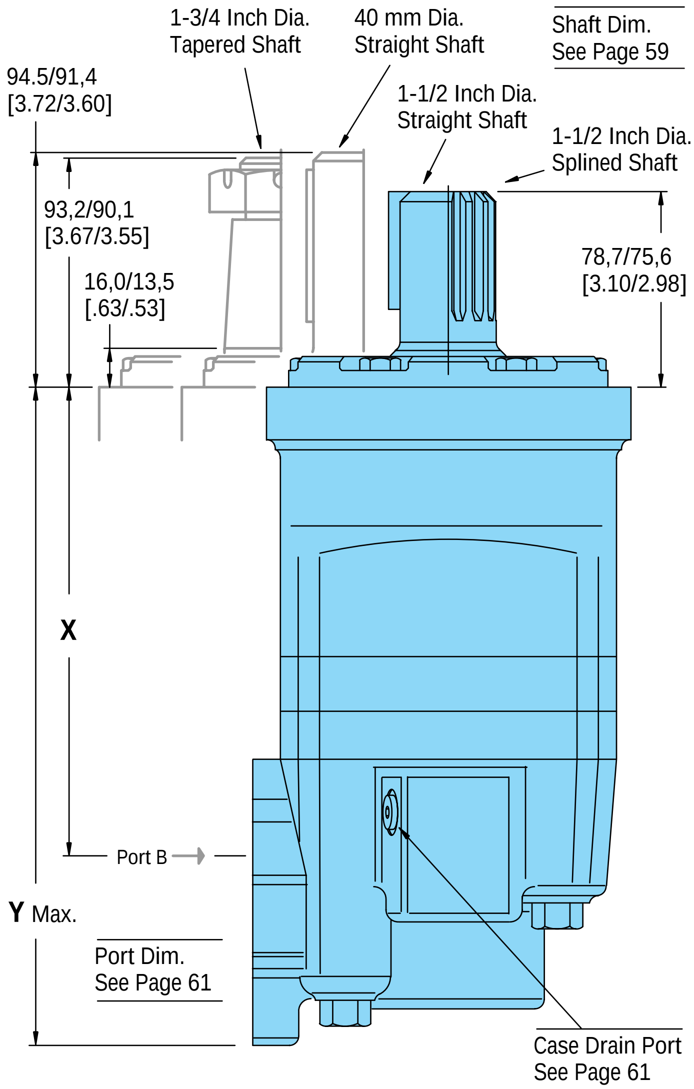
| Flow LPM [GPM] | [250] 15 | [500] 35 | [750] 50 | [1000] 70 | [1250] 85 | [1500] 105 | [1750] 120 | [2000] 140 | [2250] 155 | [2500] 170 |
|---|---|---|---|---|---|---|---|---|---|---|
| [1] 3,8 | [1455] 164 **4** | [3100] 350 **4** | [4680] 529 **2** | [6031] 681 **2** | [7799] 881 **1** | | | | | |
| [2] 7,5 | [1483] 168 **9** | [3173] 359 **9** | [5121] 579 **9** | [6432] 727 **8** | [8510] 961 **7** | [9633] 1088 **6** | [11319] 1279 **5** | [12127] 1370 **5** | | |
| [4] 15 | [1547] 175 **19** | [3331] 376 **19** | [5292] 598 **18** | [6744] 762 **17** | [8714] 984 **16** | 10075] 1138 **15** | [11352] 1283 **14** | [12539] 1417 **12** | [14564] 1645 **11** | [16377] 1850 **10** |
| [8] 30 | [1599] 181 **35** | [3473] 392 **35** | [5415] 612 **34** | [7039] 795 **33** | [8934] 1009 **32** | [10629] 1201 **31** | [11842] 1338 **29** | [14004] 1582 **29** | [15441] 1745 **28** | |
| [12] 45 | [1599] 181 **56** | [3469] 392 **56** | [5415] 612 **55** | [7093] 801 **53** | [9024] 1020 **53** | [10658] 1204 **52** | [12283] 1388 **50** | [13726] 1551 **50** | | |
| [16] 61 | [1543] 174 **73** | [3395] 384 **73** | [5357] 605 **72** | [7032] 794 **70** | [8983] 1015 **69** | [10640] 1202 **68** | [12010] 1357 **67** | | | |
| [20] 76 | [1457] 165 **93** | [3312] 374 **92** | [5292] 598 **91** | [6968] 787 **89** | [8943] 1010 **88** | [10583] 1196 **87** | [12146] 1372 **86** | | | |
| [24] 91 | [1352] 153 **112** | [3183] 360 **112** | [5088] 575 **111** | [6811] 769 **110** | [8812] 996 **108** | [10411] 1176 **106** | | | | |
| [28] 106 | [1213] 137 **131** | [3055] 345 **131** | [5047] 570 **131** | [6713] 758 **129** | [8681] 981 **128** | [10411] 1176 **127** | | | | |
| [32] 121 | [1075] 121 **150** | [2907] 328 **149** | [4884] 552 **149** | [6546] 740 **146** | [8395] 949 **145** | [10060] 1137 **144** | | | | |
| [36] 136 | [823] 93 **168** | [2692] 304 **168** | [4663] 527 **168** | [6320] 714 **167** | [8118] 917 **165** | | | | | |
| [40] 151 | [592] 67 **187** | [2477] 280 **186** | [4426] 500 **186** | [6085] 688 **185** | [7832] 885 **184** | | | | | |
| [50] 189 | | [2730] 308 **234** | [4214] 476 **233** | [5849] 661 **231** | [7603] 859 **230** | | | | | |
| [60] 227 | | | [3806] 430 **280** | [5459] 617 **277** | [7407] 837 **275** | | | | | |

### 985 cm³/r [60.0 in³/r]

Δ Pressure Bar [PSI]

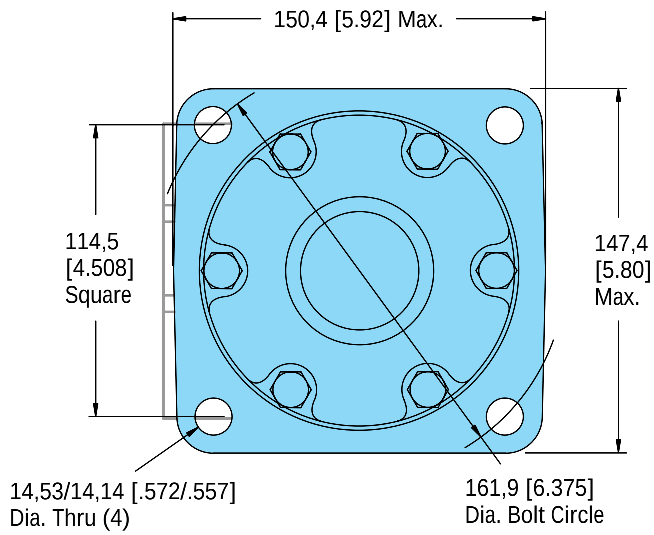
| Flow LPM [GPM] | [250] 15 | [500] 35 | [750] 50 | [1000] 70 | [1250] 85 | [1500] 105 | [1750] 120 | [2000] 140 |
|---|---|---|---|---|---|---|---|---|
| [1] 3,8 | [1890] 215 **3** | [4110] 465 **3** | [5730] 645 **2** | [7640] 865 **2** | [9550] 1080 **1** | | | |
| [2] 7,5 | [1910] 215 **8** | [4140] 470 **8** | [6270] 710 **7** | [8300] 940 **7** | [10420] 1175 **6** | [12500] 1410 **5** | [13860] 1565 **4** | [14920] 1685 **3** |
| [4] 15 | [1980] 225 **15** | [4290] 485 **15** | [6480] 775 **15** | [8540] 965 **14** | [10670] 1205 **14** | [12800] 1445 **13** | [13900] 1570 **13** | [15850] 1790 **12** |
| [8] 30 | [2030] 230 **30** | [4400] 495 **30** | [6630] 750 **30** | [8790] 995 **29** | [10940] 1235 **28** | [13090] 1480 **27** | [14500] 1640 **26** | [16580] 1875 **25** |
| [12] 45 | [2020] 230 **45** | [4390] 495 **45** | [6630] 750 **45** | [8860] 1000 **44** | [11050] 1250 **43** | [13240] 1495 **42** | [15040] 1700 **41** | |
| [16] 61 | [2010] 225 **61** | [4320] 490 **61** | [6560] 740 **61** | [8790] 995 **60** | [11000] 1245 **59** | [13260] 1500 **58** | | |
| [20] 76 | [1910] 215 **77** | [4220] 475 **77** | [6480] 730 **76** | [8720] 985 **76** | [10950] 1235 **75** | [13160] 1485 **74** | | |
| [24] 91 | [1810] 205 **92** | [4060] 460 **92** | [6230] 705 **92** | [8500] 960 **91** | [10790] 1220 **90** | [12990] 1470 **89** | | |
| [28] 106 | [1620] 185 **107** | [3920] 445 **107** | [6180] 700 **107** | [8420] 950 **106** | [10630] 1200 **105** | [12820] 1450 **103** | | |
| [32] 121 | [1480] 165 **123** | [3740] 425 **123** | [5980] 675 **122** | [8200] 925 **121** | [10280] 1160 **120** | | | |
| [36] 136 | [1140] 130 **138** | [3490] 395 **138** | [5710] 645 **138** | [7930] 895 **137** | [9940] 1125 **135** | | | |
| [40] 151 | [850] 95 **153** | [3240] 365 **153** | [5420] 610 **152** | [7640] 865 **151** | [9590] 1085 **150** | | | |
| [50] 189 | | [2960] 325 **191** | [5160] 585 **190** | [7350] 830 **189** | [9310] 1050 **188** | | | |
| [60] 227 | | | [4660] 525 **230** | [7160] 810 **229** | [9070] 1025 **226** | | | |

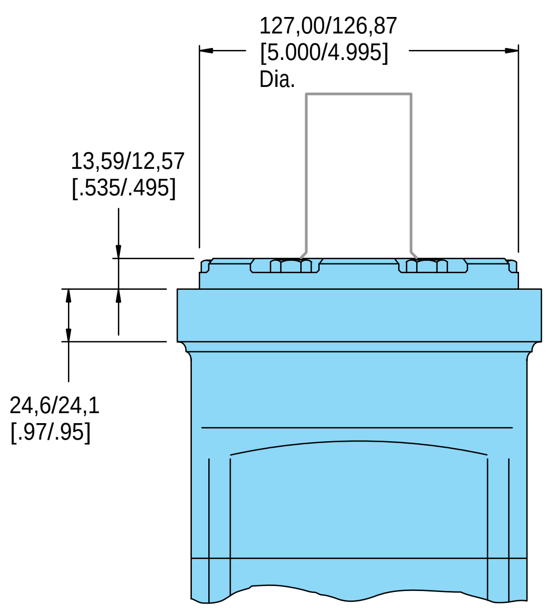
# Dimensions — 6000 Series Standard Motor




**Standard Rotation**
Viewed from Shaft End
Port **A** Pressurized — CW
Port **B** Pressurized — CCW

## Standard SAE CC Flange

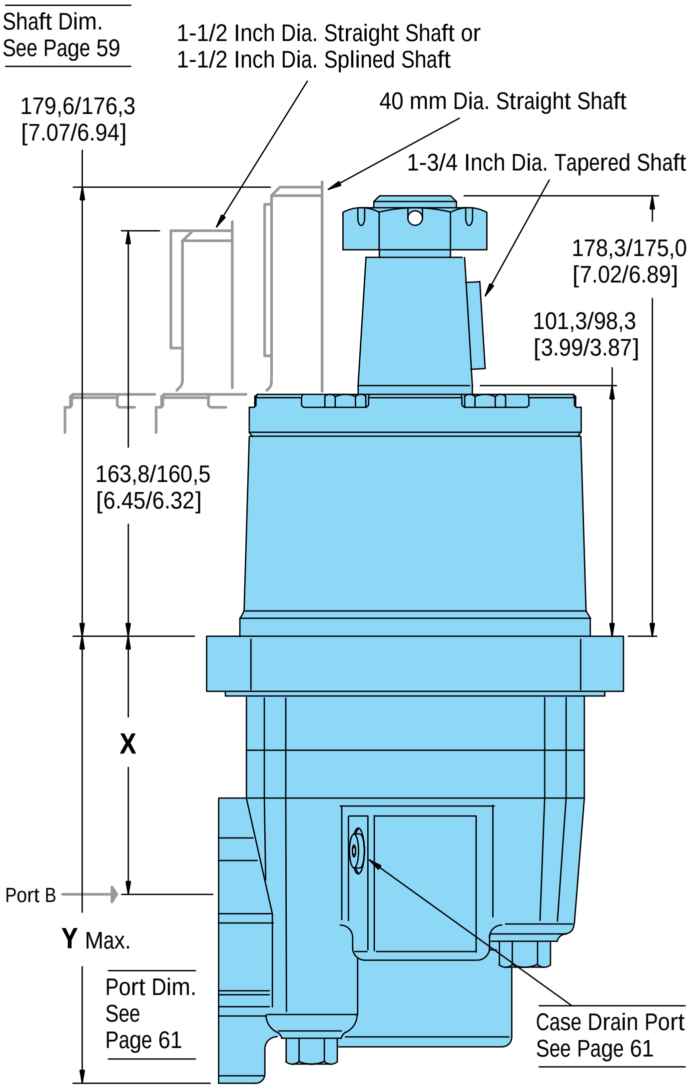


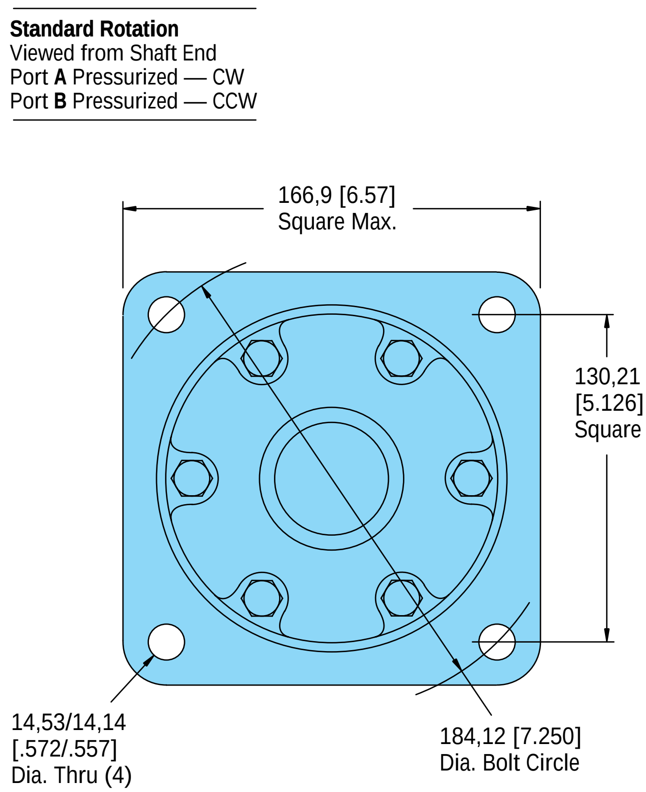



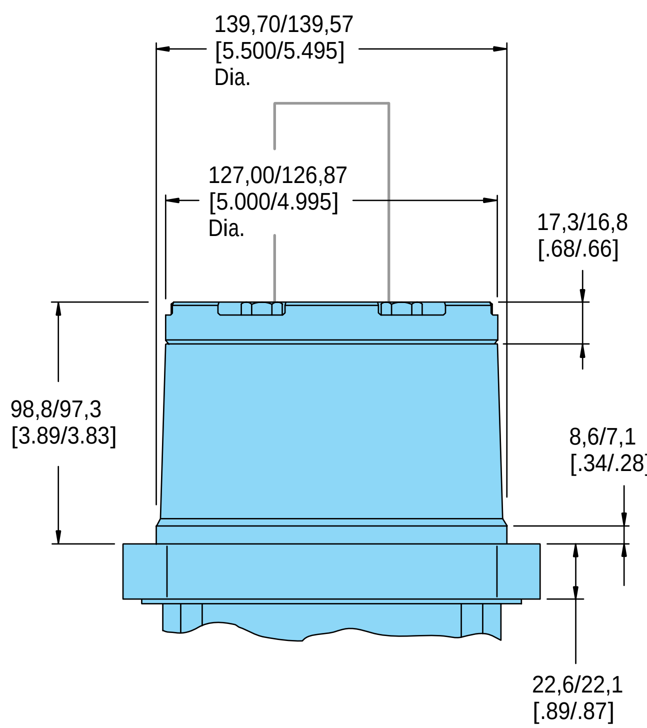

**6000 Series Standard Motor** **with 1-5/16-12 O-ring Ports, G 1 (BSP) Ports, and 3/4 inch Split Flange Ports**

| Displ. cm³/r [in³/r] | 195 [11.9] | 245 [15.0] | 310 [19.0] | 390 [23.9] | 490 [30.0] | 625 [38.0] | 985 [60.0] |
|---|---|---|---|---|---|---|---|
| **X** Dim. mm [inch] | 187,7 [ 7.39] | 193,3 [ 7.61] | 200,7 [ 7.90] | 209,3 [ 8.24] | 220,5 [ 8.68] | 235,2 [ 9.26] | 274,8 [10.82] |
| **Y** Dim. mm [inch] | 270,1 [10.63] | 275,6 [10.85] | 283,0 [11.14] | 291,6 [11.48] | 302,8 [11.92] | 318,5 [12.54] | 357,4 [14.07] |

# Dimensions — 6000 Series Wheel Motor



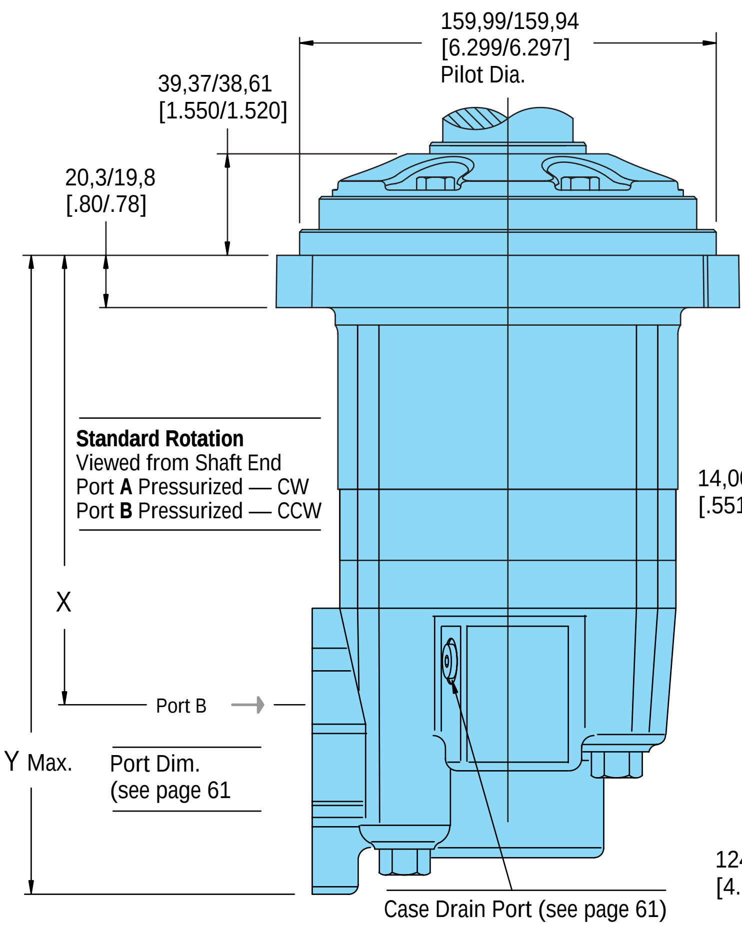



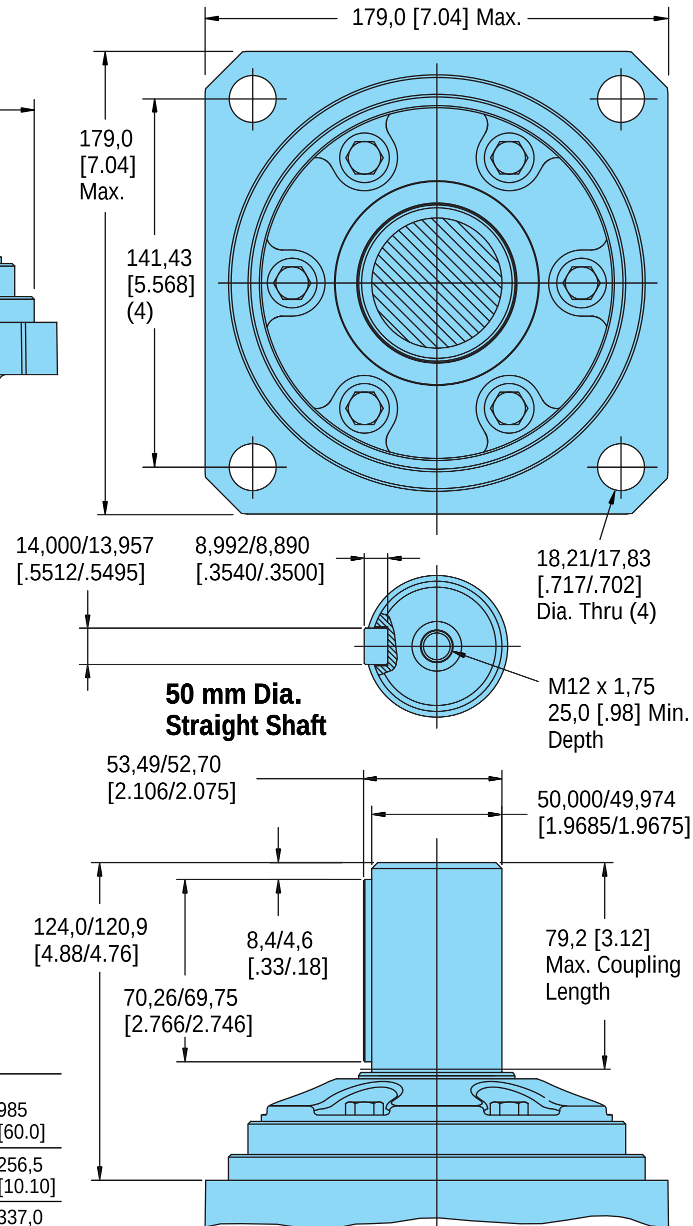




**6000 Series Wheel Motor** with 1-5/16-12 O-ring Ports, G 1 (BSP) Ports, and 3/4 inch Split Flange Ports

| Displ. cm³/r [in³/r] | 195 [11.9] | 245 [15.0] | 310 [19.0] | 390 [23.9] | 490 [30.0] | 625 [38.0] | 985 [60.0] |
|---|---|---|---|---|---|---|---|
| **X** Dim. mm [inch] | 102,9 [4.05] | 108,4 [4.27] | 115,8 [4.56] | 124,7 [4.91] | 135,6 [5.34] | 149,9 [5.90] | 190,0 [7.48] |
| **Y** Dim. mm [inch] | 185,2 [7.29] | 190,8 [7.51] | 198,2 [7.80] | 207,1 [8.15] | 218,0 [8.58] | 233,0 [9.17] | 272,6 [10.73] |

# Dimensions — 6000 Series Global Mount (Similar to ISO 3019/2)

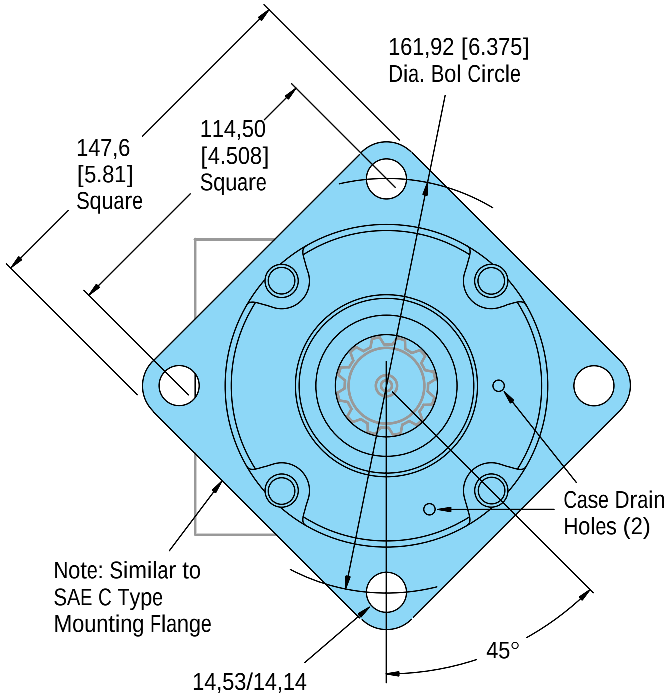


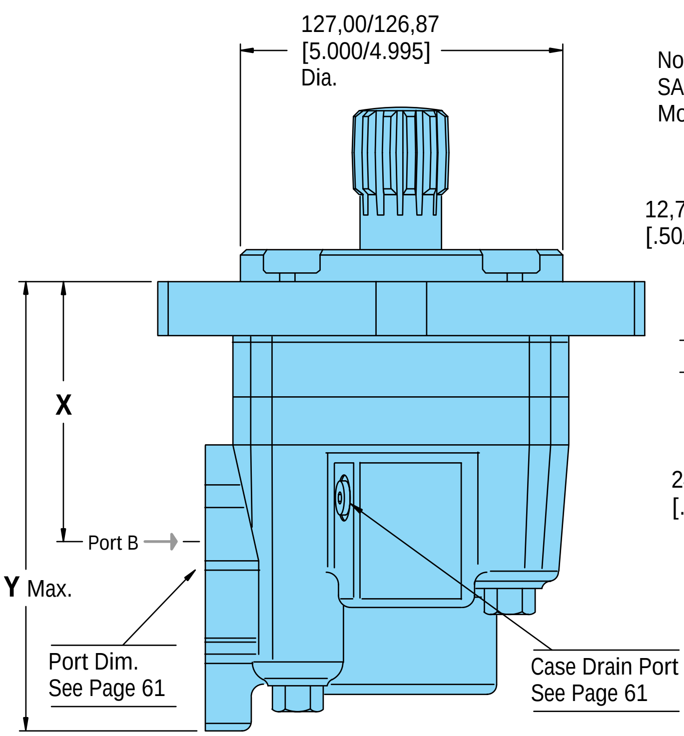



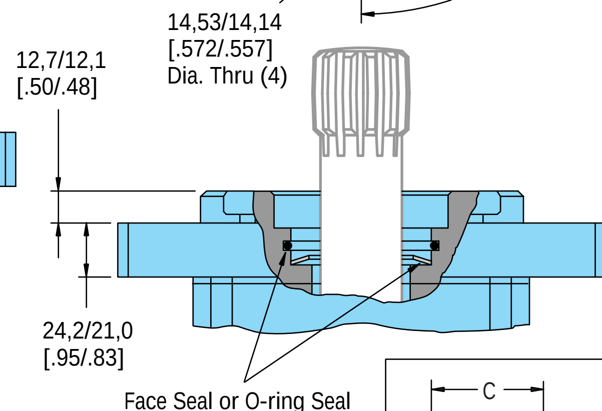

**6000 Series Standard Motor** with G 1 (BSP) Ports

| Displ. cm³/r [in³/r] | 310 [19.0] | 390 [24.0] | 490 [30.0] | 625 [38.0] | 800 [45.0] | 800 [49.0] | 985 [60.0] |
|---|---|---|---|---|---|---|---|
| X Dim. mm [inch] | 182,4 [ 7.18] | 191,0 [ 7.52] | 202,2 [ 7.96] | 216,7 [ 8.54] | 229,4 [ 9.03] | 236,7 [ 9.32] | 256,5 [10.10] |
| Y Dim. mm [inch] | 262,6 [10.34] | 271,5 [10.69] | 282,4 [11.12] | 297,2 [11.70] | 309,6 [12.19] | 317,0 [12.48] | 337,0 [13.27] |

# Dimensions — 6000 Series Bearingless Motor



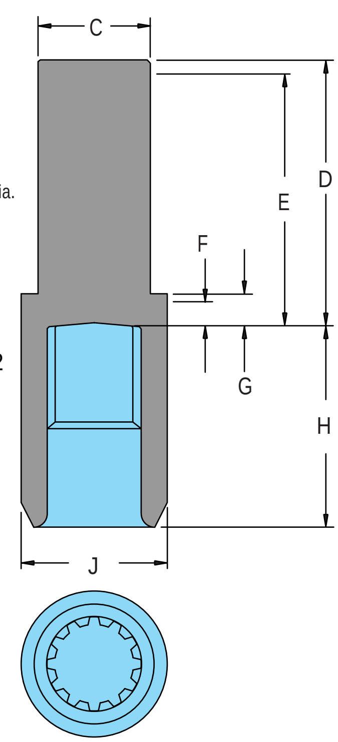




**Standard Rotation**
Viewed from Drive End
Port **A** Pressurized — CW
Port **B** Pressurized — CCW

| | | | |
|---|---|---|---|
| C | 47,2 | [1.86] | Dia. |
| D | 111,5 | [4.39] | Max. |
| E | 106,4 | [4.19] | Full Form Dia. |
| F | 6,9 | [ .27] | Min. Full Form Dia. |
| G | 10,2 | [ .40] | Min. |
| H | 86,1 | [3.39] | Max. |
| J | 66,5 | [2.62] | Dia. |

Mating Coupling Blank
Eaton Part No. 12778-002

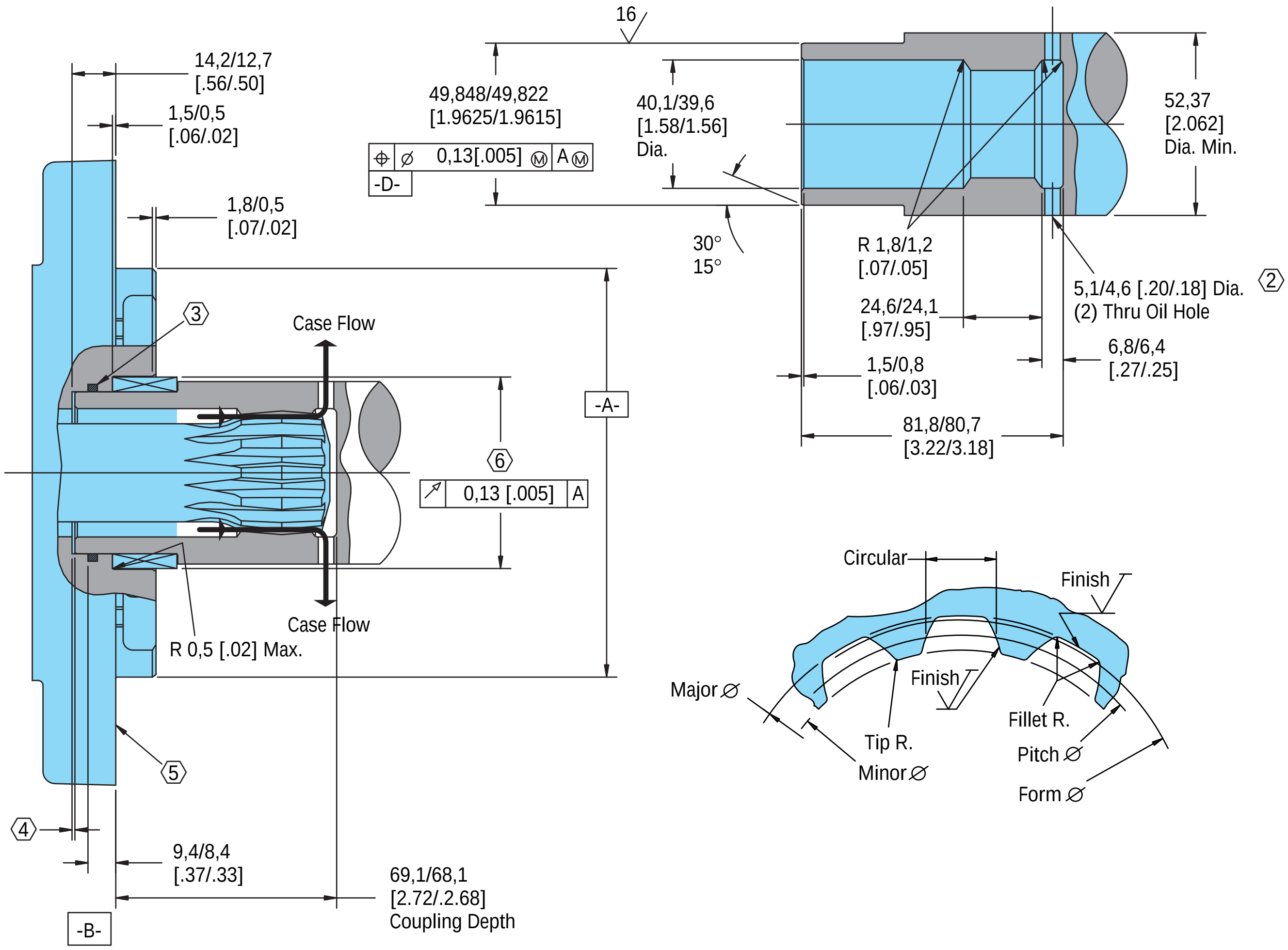



**6000 Series Bearingless Motor** **with 1-5/16-12 O-ring Ports, G 1 (BSP) Ports, 3/4 inch Split Flange Ports**

| Displ. cm³/r [in³/r] | 195 [11.9] | 245 [15.0] | 310 [19.0] | 390 [23.9] | 490 [30.0] | 625 [38.0] | 985 [60.0] |
|---|---|---|---|---|---|---|---|
| **X** Dim. mm [inch | 105,7 [ 4.16] | 111,2 [ 4.38] | 118,3 [ 4.66] | 127,5 [ 5.02] | 138,7 [ 5.46] | 152,9 [ 6.02] | 193,0 [ 7.60] |
| **Y** Dim. mm [inch] | 188,0 [ 7.40] | 193,6 [ 7.62] | 200,7 [ 7.90] | 209,6 [ 8.25] | 220,8 [ 8.69] | 235,5 [ 9.27] | 275,1 [10.83] |

**For 6000 Series Bearingless Motor application information contact your Eaton representative (mating coupling blanks available from Eaton Hydraulics). Note: After machining blank, part must be hardend per Eaton specification.**

# Bearingless Installation —
# 6000 Series




Spline Pitch — 8.5/17
Pressure Angle — 30°
Number of teeth — 12
Class of Fit — Ref. 5
Type of Fit — Side
Pitch Diameter — Ref. 35,858823 [1.4117647] | ◎ | 0,20 [.008] | H |
Base Diameter — Ref. 31,054652 [1.2226241]
Major Diameter — 39,17 [1.542] Max. 38,97 [1.534] Min.
Minor Diameter — 33,30 - 33,48 [1.311 - 1.318]
Form Diameter, Min. — 38,33 [1.509]
Fillet Radius — 0,64 - 0,76 [.025 - .030]
Tip Radius — 0,25 - 0,51 [.010 - .020]
Finish — 1,6 [63]
Involute Profile Variation — +0,000 -0,025 [+.0000 -.0010]
Total Index Variation — 0,038 [.0015]
Lead Variation — 0,013 [.0005]
Circular Space Width:
- Maximum Actual — 5,898 [.2322]
- Minimum Effective — 5,804 [.2285]
- Maximum Effective — Ref. 5,857 [.2306]
- Minimum Actual — Ref. 5,834 [.2297]

Dimension Between Two Pins — Ref. 26,929 - 27,084 [1.0602 - 1.0663]
Pin Diameter — 6,223 [.2450] Pins to Have 4,0 [.160] Wide Flat for Root Clearance

1 Internal spline in mating part to be as follows: Material to be ASTM A304, 8620H. Carborize to a hardness of 60-64 HRc with case depth (to 50HRc) of 0,076 - 1,02 [.030 - .040] (dimensions apply after heat treat).

② Mating part to have critical dimensions as shown. Oil holes must be provided and open for proper oil circulation.

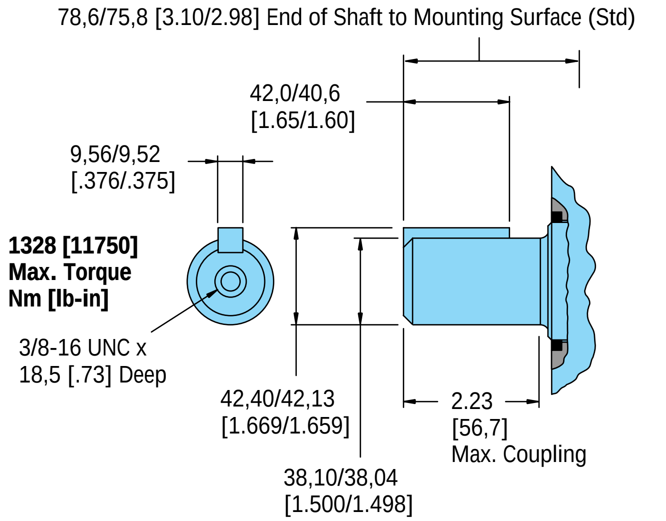
③ Some means of maintaining clearance between shaft and mounting flange must be provided.

④ Seal to be furnished with motor for proper oil circulation thru splines.

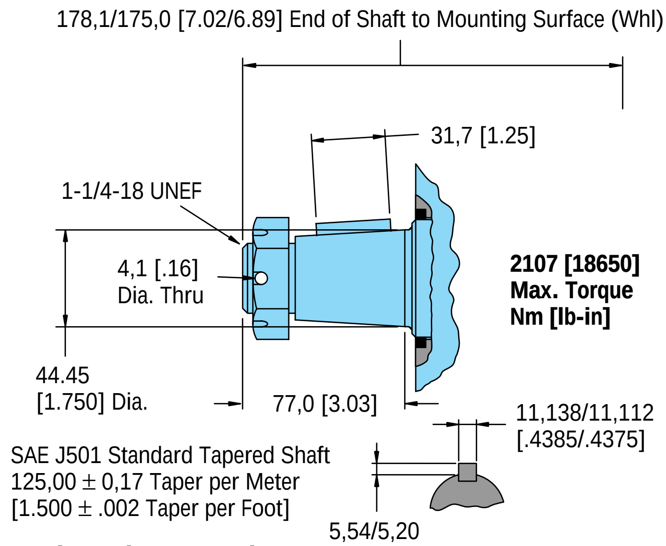
⑤ Similar to SAE "C" Four Bolt Flange.

⑥ Counterbore designed to adapt to a standard sleeve bearing 50,010 - 50,038 [1.9689 - 1.9700] ID by 60,051 - 60,079 [2.3642 - 2.3653] O.D. (Oilite bronze sleeve bearing).

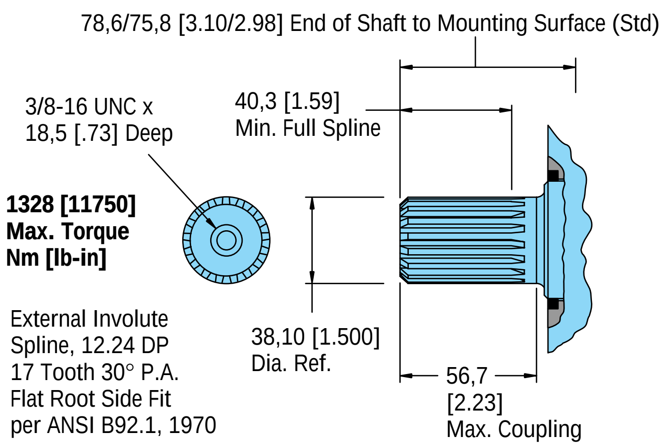
# Dimensions — Shafts
# 6000 Series



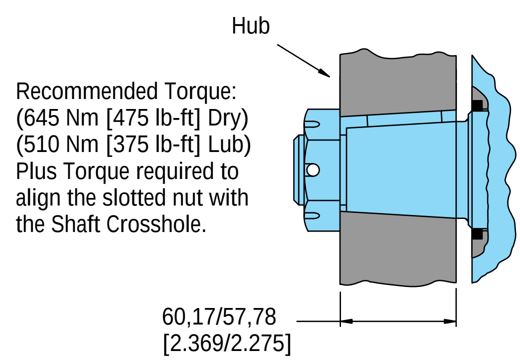

## 1-1/2 Inch Straight



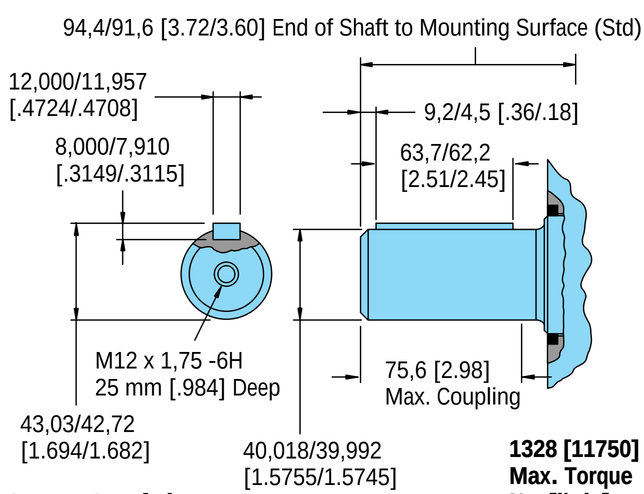

## 1-3/4 Inch Tapered



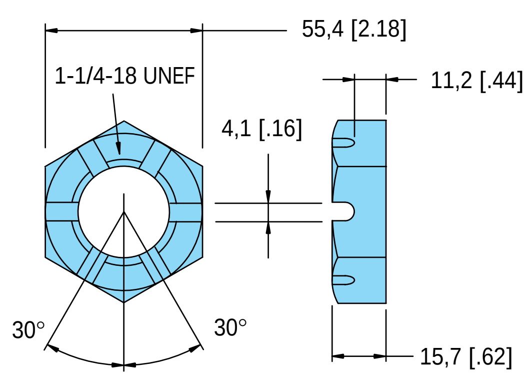

## 1-1/2 Inch 17 Tooth Splined




## Tapered Shaft Hub Data




## 40 mm Straight




## Slotted Hexagon Nut

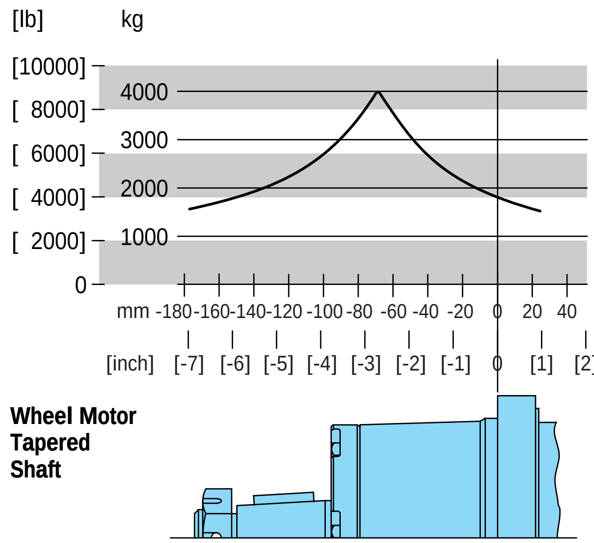
# Shaft Side Load Capacity
# 6000 Series

These curves indicate the radial load capacity on the motor shaft(s) at various locations.

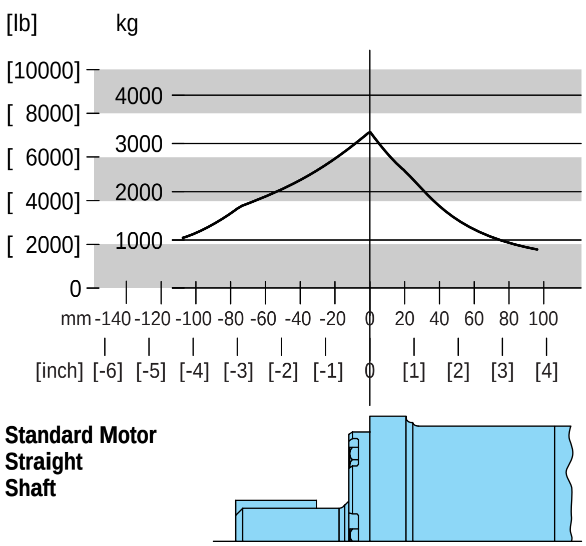
**The curve is based on B 10 Bearing life (2000 hours or 12,000,000 shaft revolutions at 100 RPM ) at rated output torque.** To determine radial load at speeds other than 100 RPM, multiply the load values given on the bearing curve by the factors in the chart below.

| RPM | Multiplication Factor |
|---|---|
| 50 | 1.23 |
| 100 | 1.00 |
| 200 | .81 |
| 300 | .72 |
| 400 | .66 |
| 500 | .62 |
| 600 | .58 |
| 700 | .56 |
| 800 | .54 |

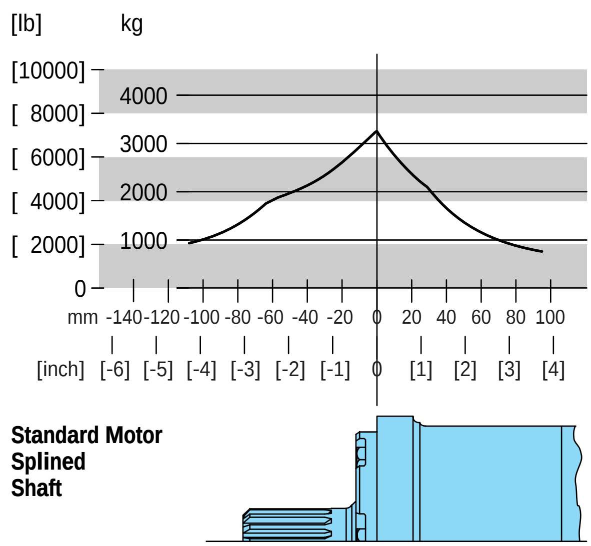
**For 3,000,000 Shaft revolutions or 500 hours — Increase these shaft loads 52%.**




**Wheel Motor Tapered Shaft**



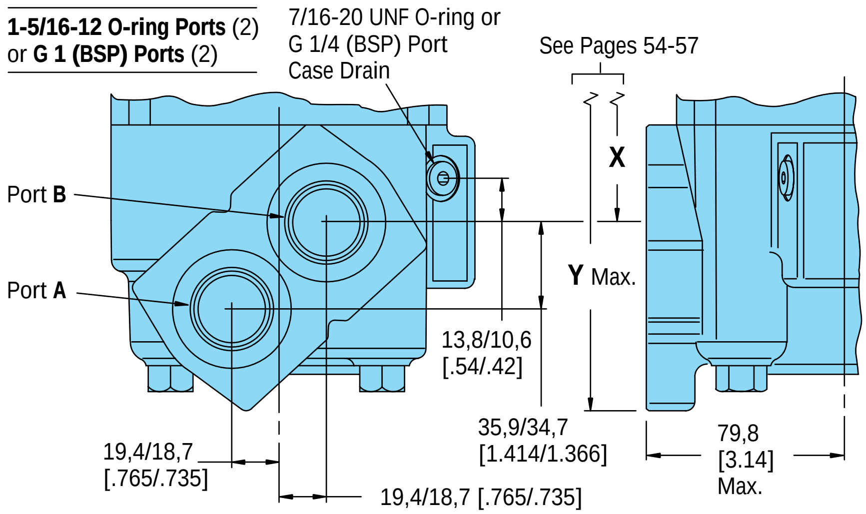

**Standard Motor Straight Shaft**



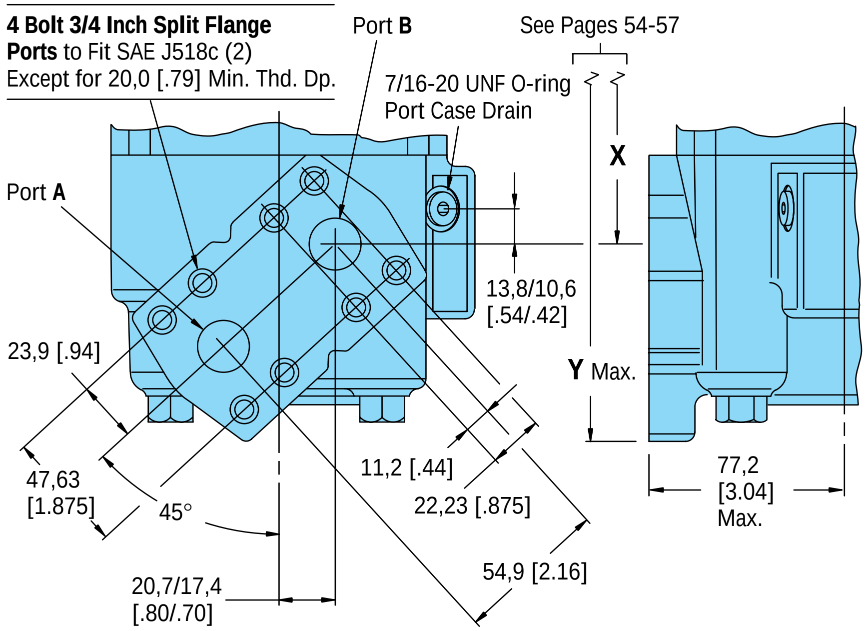

**Standard Motor Splined Shaft**

# Dimensions — Ports 6000 Series

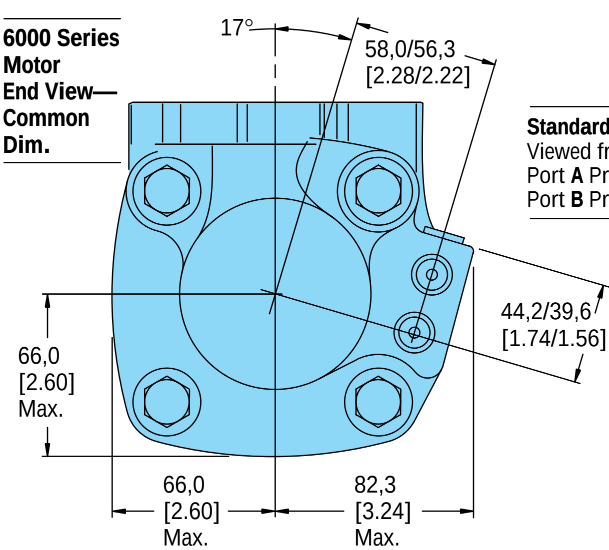
**1-5/16-12 O-ring Ports** (2) or **G 1 (BSP) Ports** (2)




**4 Bolt 3/4 Inch Split Flange Ports** to Fit SAE J518c (2)
Except for 20,0 [.79] Min. Thd. Dp.



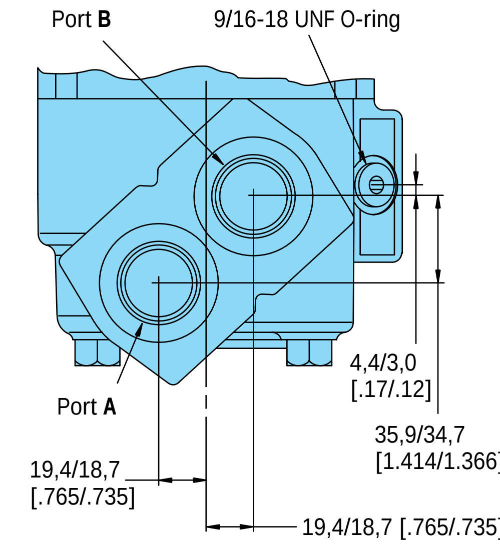

**6000 Series Motor End View— Common Dim.**

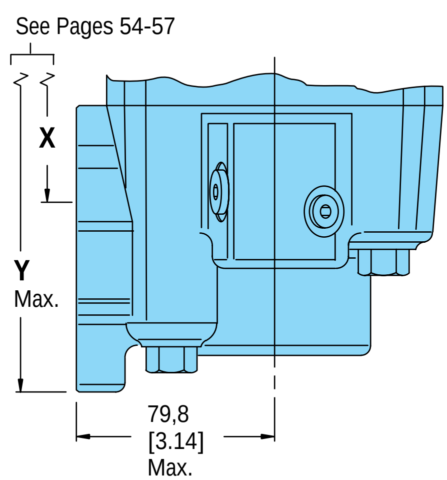


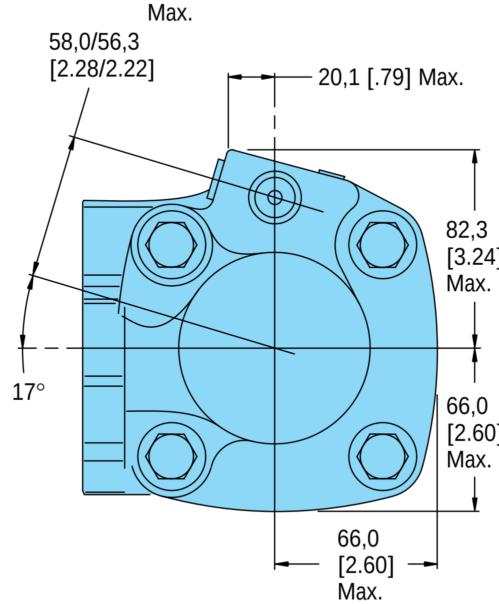

**Standard Rotation — 6000 Series**
Viewed from Shaft End
Port **A** Pressurized — CW
Port **B** Pressurized — CCW

## 6000 Series with Shuttle Valve

**1-5/16-12 O-ring Ports** (2) with Shuttle



# Product Numbers
# 6000 Series

## Product Numbers—6000 Series Motors

Use digit prefix —**112**-, **113**-, or **114**- plus four digit number from charts for complete product number—Example **114**-1047.
**Orders will not be accepted without three digit prefix.**

| Mounting | Shaft | Ports | Displacement cm³/r [ in³/r ] and Product Number<br>195 [11.9] | 245 [ 15.0] | 310 [19.0] | 390 [23.9] | 490 [30.0] | 625 [38.0] | 985 [60.0] |
|---|---|---|---|---|---|---|---|---|---|
| Standard | 1-1/2 inch Straight | 1-5/16 O-ring | **112**-1064 | -1065 | -1066 | -1067 | -1068 | -1107 | -1069 |
| Standard | 40 mm Straight | G 1 (BSP) | **112**-1094 | -1095 | -1096 | -1097 | -1098 | — | -1099 |
| Standard | 1-1/2 Inch 17 T Splined | 1-5/16 O-ring | **112**-1058 | -1059 | -1060 | -1061 | -1062 | -1109 | -1063 |
| Standard | 1-1/2 Inch 17 T Splined | G 1 (BSP) | **112**-1088 | -1089 | -1090 | -1091 | -1092 | — | -1093 |
| Wheel Motor | 40 mm Straight | G 1 (BSP) | **113**-1082 | -1083 | -1084 | -1085 | -1086 | -1100 | -1087 |
| Wheel Motor | 1-3/4 Inch Tapered | 1-5/16 O-ring | **113**-1070 | -1071 | -1072 | -1073 | -1074 | -1093 | -1075 |
| Bearingless | | 1-5/16 O-ring | **114**-1031 | -1032 | -1033 | -1034 | -1035 | -1055 | -1036 |
| Bearingless | | G 1 (BSP) | **114**-1043 | -1044 | -1045 | -1046 | -1047 | — | -1048 |

**114**-1047

## Product Numbers – 6000 Series

**Mounting Type - Standard (Code H), 4 Bolt:**
- **160,0 [6.30] Pilot Dia.**
- **18,01 [.709] Dia. Mounting Holes**
- **200,0 [7.87] Dia. Bolt Circle**

**Output Shaft - Straight (Code 21)**
**Ports - G1 (BSP) Staggered G 1/4 Case Drain (Code C)**
**Paint - Low Gloss Black (Code A)**

Use digit prefix —**112-** plus four digit number from charts for complete product number—Example **112**-1215.
**Orders will not be accepted without three digit prefix.**

112-1215

| Mounting | Shaft | Ports | Displacement cm³/r [ in³/r ] and Product Number<br>310 [19.0] | 390 [23.9] | 490 [30.0] | 625 [38.0] | 737 [45.0] | 800 [49.0] | 985 [60.0] |
|---|---|---|---|---|---|---|---|---|---|
| Standard | 50 mm Straight | G 1 (BSP) | 112-1217 | -1218 | -1215 | -1216 | -1247 | -1219 | -1220 |

**For 6000 Series Motors with a configuration *Not Shown* in the charts above: Use model code number system on page 63 to specify product in detail.**

# Model Code for 6000 Series Motors

The following 14-digit coding system has been developed to identify all of the configuration options for the 6000 Series Motor. Use this model code to specify a motor with the desired features. All 14-digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

## Model Code — 6000 Series Disc Valve Motors

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | 0 | 6 | | | | | | | | | | 0 | 0 |

Position 1 **Product Series**

**M** ............ Motor

Position 2, 3 **6000 Series**

**06** ........... 6000 Series

Position 4, 5 **Displacement cm³/r [in³/r]**

**12** ........... 195 [11.9]
**15** ........... 245 [15.0]
**19** ........... 310 [19.0]
**24** ........... 390 [23.9]
**30** ........... 490 [30.0]
**38** ........... 625 [38.0]
**45** ........... 740 [45.0]*
**49** ........... 805 [49.0]*
**60** ........... 985 [60.0]

*For performance and dimension data contact your Eaton Hydraulics representitive.

Position 6 **Mounting Flange**

**A** ............ 4 Bolt (Bearingless 127,0 [5.00] Pilot Dia. and 14,3 [.56] Dia. Mounting Holes 161,9 [6.38] Dia. B.C.

**B** ............ 4 Bolt (SAE CC) (Standard) 127,0 [5.00] Pilot Dia. and 14,3 [.56] Mounting Holes on 161,9 [6.38] Dia. B.C.

**C** ............ 4 Bolt (Wheel) 139,7 [5.50] Pilot Dia. and 14,3 [.56] Dia. Mounting Holes on 184,1 [7.25] Dia. B.C.

**H** ............ 4 Bolt (Global) (Standard) 160,0 [6.30] Pilot Dia. and 18,0 [.709] Dia. Mounting Holes on 200,0 [7.87] Dia. Bolt Circle

Position 7, 8 **Output Shaft**

**00** ........... Bearingless

**01** ........... 1–1/2 inch Dia. Straight with Straight Key, 3/8-16 Threaded Hole and 56,7 [2.23] Max. Coupling Length

**02** ........... 1–3/4 inch Dia. Tapered with Straight Key and 1–1/4 - 18 UNEF Slotted Hex. Nut

**03** ........... 1–1/2 inch Dia. Splined 17T with 40,3 [1.59] Min. Full Spline Length and 3/8-16 Threaded Hole

**10** ........... 40 mm Dia. Straight with Straight Key, M12 x 1,75-6H Threaded Hole

**21** ........... 50 mm Dia. Straight with Straight Key, 14W x 9H x 70L, M12 x 1,75-6H Thread in End (Available with Mounting Flange Code H Only)

**24** ........... 60 mm Dia. 10:1 Tapered Shaft with M42 x 3-6H Threaded End (Available with Mounting Flange Code H Only)

**25** ........... 2 1/8 inch Dia. Splined 16 Tooth, 55,9 mm [2.20] Min. Full Spline Length (Available with Mounting Flange Code H Only)

Position 9 **Port Type**

**A** .............. 1–5/16 - 12 O-ring with 7/16-20 O-ring Case Drain and Check Valve

**B** .............. 3/4 inch 4 Bolt Split Flange with 7/16-20 O-ring Case Drain and Check Valve

**C** .............. G 1 (BSP) O-ring with G 1/4 (BSP) O-ring Case Drain and Check Valve

**D** .............. 1– 5/16-12 O-ring with (2) 9/16-18 O-ring Case Drain Ports and Hot Oil Shuttle Valve

**R** .............. 1– 5/16-12 O-ring with (2) 9/16-18 O-ring Ports for External Lubrication Circuit (both case ports must be connected)

Position 10, 11 **Special Features (Hardware)**

**00** ............. None
**10** ............. Viton Shaft Seal
**07** ............. Viton Seals
**13** ............. Reverse Rotation
**14** ............. Seal Guard
**21** ............. Speed Sensor (Std.)

Position 12 **Paint/Special Packaging**

**0** ............... No Paint
**A** .............. Painted Low Gloss Black
**B** .............. Corrosion Protected

Position 13 **Eaton Assigned Code when Applicable**

**0** ............... Assigned Code

Position 14 **Eaton Assigned Design Code**

**0** ............... Assigned Design Code

# Fluid Recommendations
# Char-Lynn Disc Valve Motors

**Introduction**
The ability of Eaton hydraulic components to provide the desired performance and life expectancy depends largely on the fluid used. The purpose of this section is to provide readers with the knowledge required to select the appropriate fluids for use in systems that employ Eaton hydraulic components.

One of the most important characteristics to consider when choosing a fluid to be used in a hydraulic system is viscosity. Viscosity choice is always a compromise; the fluid must be thin enough to flow easily but thick enough to seal and maintain a lubricating film between bearing and sealing surfaces. See chart below for viscosity requirements.

**Viscosity and Temperature**
Fluid temperature affects viscosity. In general, as the fluid warms it gets thinner and its viscosity decreases. The opposite is true when fluid cools. When choosing a fluid, it is important to consider the start-up and operating temperatures of the hydraulic system. Generally, the fluid is thick when the hydraulic system is started. With movement, the fluid warms to a point where a cooling system begins to operate.
From then on, the fluid is maintained at the temperature for which the hydraulic system was designed. In actual applications this sequence varies; hydraulic systems are used in many environments from very cold to very hot. Cooling systems also vary from very elaborate to very simple, so ambient temperature may affect operating temperature. Equipment manufacturers who use Eaton hydraulic components in their products should anticipate temperature in their designs and make the appropriate fluid recommendations to their customers.

**Cleanliness**
Cleanliness of the fluid in a hydraulic system is extremely important. Eaton recommends that the fluid used in its hydraulic components be maintained at ISO Cleanliness Code 18/13 per SAE J1165. This code allows a maximum of 2500 particles per milliliter greater than 5 µm and a maximum of 80 particles per milliliter greater than 15 µm. Cleanliness requirements for specific products are given in the table below.
OEM’s and distributors who use Eaton hydraulic components in their products should provide for these requirements in their designs.
A reputable filter supplier can supply filter information.

**Fluid Maintenance**
Maintaining correct fluid viscosity and cleanliness level is essential for all hydraulic systems. Since Eaton hydraulic components are used in a wide variety of applications it is impossible for Eaton to publish a fluid maintenance schedule that would cover every situation. Field testing and monitoring are the only ways to get accurate measurements of system cleanliness. OEM’s and distributors who use Eaton hydraulic components should test and establish fluid maintenance schedules for their products. These maintenance schedules should be designed to meet the viscosity and cleanliness requirements laid out in this document.

**Fluid Selection**
Premium grade petroleum based hydraulic fluids will provide the best performance in Eaton hydraulic components. These fluids typically contain additives that are beneficial to hydraulic systems. **Eaton recommends fluids that contain anti-wear agents, rust inhibitors, anti-foaming agents, and oxidation inhibitors.** Premium grade petroleum based hydraulic fluids carry an ISO VG rating.

SAE grade crankcase oils may be used in systems that employ Eaton hydraulic components, but it should be noted that these oils may not contain all of the recommended additives. This means using crankcase oils may increase fluid maintenance requirements.

Hydraulic fluids that contain V.I. (viscosity index) improvers, sometimes called multi-viscosity oils, may be used in systems that employ Eaton hydraulic components. These V.I. improved fluids are known to “shear-down” with use. This means that their actual viscosity drops below the rated value. Fluid maintenance must be increased if V.I. improved fluids are used. Automotive automatic transmission fluids contain V.I. improvers.

Synthetic fluids may be used in Eaton hydraulic components.
A reputable fluid supplier can provide information on synthetic fluids. Review applications that require the use of synthetic fluids with your Eaton representative.

| | Viscosity | | ISO Cleanliness Requirements |
|---|---|---|---|
| | Minimum | Best Range | |
| Char-Lynn Disc Valve Motors | 70 SUS<br>13 cSt | 100-200 SUS<br>20-43 cSt | 18/13 |

**Additional Notes:**
- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. **Motor cavitation is not a problem during cold start-ups (with one exception — two speed motors).**
- Minimum / Maximum operating temperatures are -29° C / 82° C [-20° F / 180° F].
- When choosing a hydraulic fluid, all the components in the system must be considered and the best viscosity range adjusted accordingly. For example, when a medium duty piston pump is combined with a Geroler motor the best viscosity range becomes 100 - 150 SUS [20 - 32 cSt] and viscosity should never fall below 70 SUS [13 cSt].
- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky a water contamination problem may exist.
- Take fluid level reading when the system is cold.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydraulic components.

# Motor Application Information — Vehicle Drive Calculations

**Step One — Calculate Motor Speed (RPM)**

$$RPM = \frac{2.65 \times KPH \times G}{R_m} \quad RPM = \frac{168 \times MPH \times G}{R_I}$$

where KPH = vehicle speed (kilometers per hour)
where MPH = vehicle speed (miles per hour)
Rm = rolling radius of tires (meter)
$R_1$ = rolling radius of tires (inch)
G = gear reduction ratio (if any) between motors and wheels. If no gear box or other gear reduction devices are used G = 1.

If vehicle speed is expressed in m/second, multiply by 3.6 to convert to KPH.

If vehicle speed is expressed in ft./second, divide by 1.47 to convert to MPH.

**Step Two — Determine Rolling Resistance**
Rolling resistance (RR) is the force required to propel a vehicle over a particular surface. The values in Table 1 are typical of various surfaces per 1000 lb. of vehicle weight.

RR = GVW x ρ (kg) (lb)
where GVW = gross (loaded) vehicle weight lb/Kg
ρ = value from Table 1

**Table 1 - Rolling Resistance Coefficients for Rubber Tires on Various Surfaces**

| Surface | ρ |
|---|---|
| Concrete, excellent | .010 |
| Concrete, good | .015 |
| Concrete, poor | .020 |
| Asphalt, good | .012 |
| Asphalt, fair | .017 |
| Asphalt, poor | .022 |
| Macadam, good | .015 |
| Macadam, fair | .022 |
| Macadam, poor | .037 |
| Snow, 2 inch | .025 |
| Snow, 4 inch | .037 |
| Dirt, smooth | .025 |
| Dirt, sandy | .040 |
| Mud | .037 to .150 |
| Sand, Gravel | .060 to .150 |
| Sand, loose | .160 to .300 |

**Step Three — Tractive Effort to Ascend Grade**
The largest grade a vehicle can ascend is called its “gradability.” Grade is usually expressed as a percent rather than in degrees. A rise of one meter in ten meters or one foot rise in ten feet of travel is a
1/10 or 10 percent grade.

$$GR = GVW (\sin \theta + \rho \cos \theta)$$

**Table 2**

| Comparison Grade (%) | Table Slope (Degrees) |
|---|---|
| 1% | 0°35' |
| 2% | 1° 9' |
| 5% | 2°51' |
| 6% | 3°26' |
| 8% | 4°35' |
| 10% | 5°43' |
| 12% | 6°5' |
| 15% | 8°31' |
| 20% | 11°19' |
| 25% | 14° 3' |
| 32% | 18° |
| 60% | 31° |

**Step Four — Determine Acceleration Force (FA)**
The force (FA) required to accelerate from stop to maximum speed (KPH) or (MPH) in time (t) seconds can be obtained from the following equation:

**Step Five — Determine Drawbar Pull**
Drawbar Pull (DP) is total force available at the drawbar or “hitch” after the above forces have been subtracted from the total propelling force produced by the hydraulic motors. This value is established as either:

$$FA = \frac{KPH \times GVW (kg)}{3.6\ t}$$

FA = Acceleration Force (Newton)
t = Time (Seconds)

$$FA = \frac{MPH \times GVW (lb)}{22\ t}$$

FA = Acceleration Force (lb)
t = Time (Seconds)

1. A goal or objective of the designer.
2. A force required to pull a trailer (Repeat steps two through four above using trailer weight and add the three forces together to obtain DP).

**Step Six — Total Tractive Effort**

The tractive effort (TE) is the total force required to propel the vehicle and is the sum of the forces determined in Steps 2 through 5.

TE = RR + GR + FA + DP (Kg. or lb.)

- DP — Drawbar pull desired
- FA — Force required to accelerate
- GR — Force required to climb a grade
- RR — Force required to overcome rolling resistance

Wind resistance forces can usually be neglected. However, it may be wise to add 10% to the above total to allow for starting resistances caused by friction in bearings and other mechanical components.

**Step Seven — Calculate Hydraulic Motor Torque (T)**

$$T = \frac{TE \times R_m}{N \times G \times Eg} \text{(Nm / Motors)}$$

$$T = \frac{TE \times R_l}{N \times G \times Eg} \text{(lb – in / Motors)}$$

where N = number of driving motors

Eg = gear box mechanical efficiency

**Step Eight—Wheel Slip**

If the torque required to slip the wheel (TS) is less than the torque calculated in Step 7, the performance objectives cannot be achieved.

$$TS = \frac{W \times f \times R_m}{G \times Eg} \text{(Nm / Motor)}$$

$$TS = \frac{W \times f \times R_l}{G \times Eg} \text{(lb – in / Motor)}$$

Where: f = coefficient of friction

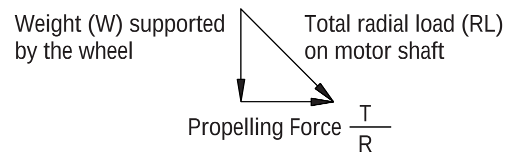
W = loaded vehicle weight over drive wheel

| | Coefficient of friction (f) |
|---|---|
| Steel on steel | 0.15 to 0.20 |
| Rubber tire on dirt | 0.5 to 0.7 |
| Rubber tire on asphalt | 0.8 to 1.0 |
| Rubber tire on concrete | 0.8 to 1.0 |
| Rubber tire on grass | 0.4 |

It may be desirable to allow the wheel to slip to prevent hydraulic system overheating when excessive loads are imposed should the vehicle stall. In this case TS should be just slightly larger than T.

**Step Nine — Motor Radial Load Carrying Capacity**

When a motor is used to drive a vehicle with the wheel mounted directly on the motor shaft or rotating hub, the Total Radial Load (RL) acting on the motor shaft is the vector summation of two forces acting at right angles to each other.




$$RL = \sqrt{W^2 + \left(\frac{T}{R}\right)^2}$$

Refer to radial load rating of each motor (see table of catalog contents page 10 for page listing of the Shaft Side Load Capacity for each motor series).

**Shaft Torque**

$$\frac{T = q\Delta P}{2\pi}$$

$$\frac{\text{bar x cm}^3\text{/rev}}{62.8} \text{ Nm} = \frac{\text{PSI x in}^3\text{/rev}}{6.28} = \text{lb – in}$$

**Shaft Speed**

$$= \frac{\text{Flow}}{\text{Displacement}}$$

$$RPM = \frac{1000 \text{ x l/min}}{\text{cm}^3\text{/rev}} \quad RPM = \frac{231 \text{ x GPM}}{\text{in}^3\text{/rev}}$$

**Power (into motor)**

$$Kw = \frac{\text{bar x l/min}}{600} \quad HP = \frac{\text{PSI x GPM}}{1714}$$

**Power (out of motor)**

$$Kw = \frac{\text{Nm x RPM}}{9549} \quad HP = \frac{\text{lb - in x RPM}}{63{,}025}$$

where:
- Kw = Kilowatt
- HP = Horsepower
- LPM = Liters per Minute
- GPM = Gallons per Minute
- Nm = Newton Meters
- lb-in = Pound inch
- Bar = 10 Newtons per Square Centimeter
- PSI = Pounds per Square Inch
- q = Displacement

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