Char-Lynn®
Disc Valve Hydraulic Motors

2000, 4000, 6000, and 10,000 Series Hydraulic Motors

We Manufacture Solutions
In the late 1950s, 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 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.

Geroler® Star
Disc Valve
Motor Shaft and Bearings
Motor Shaft Drive and Valve Drive
Port A
Port B
2000 Series Motor
90% of Actual Size
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.
2000 Series

Geroler® Element........ 9 Displacements
Flow LPM [GPM] ...... 75 [20] Continuous* 
115 [30] Intermittent*

Speed ..................... Up to 924 RPM
Pressure Bar [PSI] ... 200 [3000] Cont.
300 [4500] Inter.
930 [8225] Inter.

2000 Series Displacement Size = cubic centimeter per shaft revolution (cm³/r)
= cubic inch per shaft revolution (in³/r)

- 80 [4.9]
- 100 [6.2]
- 130 [8.0]
- 160 [9.6]
- 195 [11.9]
- 245 [14.9]
- 305 [18.7]
- 695 [24.0]
- 930 [29.3]

Mounting Flange
- 4 Bolt (Bearingless) 101.6 [4.00] Pilot Dia. and 13.59 [0.535] Dia. Mounting Holes on 127.0 [5.00] Dia. B.C.
- 4 Bolt (Wheel) 107.9 [4.25] Pilot Dia. and 13.59 [0.535] Dia. Mounting Holes on 147.6 [5.81] Dia. B.C.
- 2 Bolt (SAE B) 101.6 [4.00] Pilot Dia. and 14.27 [0.562] Dia. Mounting Holes on 146.0 [5.75] Dia. B.C.

Output Shaft
- Bearingless
- 1 inch Dia. Straight with Woodruff Key, 1/4-20 Threaded Hole and 28.4 [1.12] Max. Coupling Length
- 1-1/4 inch Dia. Straight with Straight Key, 3/8-16 Threaded Hole and 47.3 [1.86] Max. Coupling Length
- 3/4 inch Dia. Straight with Straight Key, M8 x 1.25 -6H Threaded Hole and 56.4 [2.22] Max. Coupling Length
- 1-1/4 inch Dia. Tapered with Straight Key and Nut
- 7/8 inch Dia. Splined 13 T, 15.2 [0.60] Min. Full Spline Length and 30.8 [1.21] Max. Coupling Length
- 25 mm Dia. Straight with Straight Key, M8 x 1.25 -6H Threaded Hole and 38.1 [1.50] Max. Coupling Length

Port Type
- 7/8-14 O-ring (Staggered) with 7/16-20 O-ring Case Drain
- G1/2 (BSP) (Staggered) with G1/4 (BSP) Case Drain
- Manifold Mount with 3/8-16 UNC Mounting Threads (3) and 7/16-20 O-ring Case Drain
- Manifold Mount with M10 x 1.5 -6H Mounting Threads (3) and G1/4 (BSP) Case Drain
- 1-1/16—12 O-ring (Positioned 180° Apart) with 7/16-20 O-ring Case Drain
- 7/8-14 O-ring (End Ports) with 7/16-20 O-ring Case Drain (Rear)

Special Features
- Viton® Shaft Seal
- Viton Seals
- Free Running Geroler
- Speed Sensor
- Two Speed Option
- Hot Oil Shuttle
- Corrosion Protected
- Seal Guard Package

Viton® is a Registered Trade Name of Dupont Corp.
Disc Valve Hydraulic Motors

4000 Compact Series

Geroler® Element…….. 6 Displacements
115 [30] Intermittent*
Speed ...................... Up to 707 RPM
Pressure Bar [PSI] ... 200 [3000] Cont.
300 [4500] Inter.
1166 [10320] Inter.

4000 Compact Series Displacement Size = cubic centimeter per shaft revolution ( cm³/r )
• 160 [9.8]
• 200 [12.3]
• 250 [15.4]
• 325 [19.8]
• 395 [24.0]
• 490 [29.8]

Mounting Flange
• 4 Bolt (Bearless) 101.6 [4.00] Plot Dia. and 13.59 [0.535] Dia. Mounting Holes on 127.0 [5.00] Dia. B.C.
• 2 Bolt (SAE A) (Standard) 82.5 [3.25] Plot Dia. and 13.59 [0.535] Mounting Holes on 106.4 [4.19] Dia. B.C.
• 4 Bolt (Wheel) 107.9 [4.25] Plot Dia. and 13.59 [0.535] Dia. Mounting Holes on 147.6 [5.81] Dia. B.C.
• 4 Bolt (Standard) 82.5 [3.25] Plot Dia. and 13.59 [0.535] Dia. Mounting Holes on 106.4 [4.19] Dia. B.C.
• 4 Bolt Magneto 82.5 [3.25] Plot Dia. and 13.59 [0.535] Dia. Mounting Holes on 106.4 [4.19] Dia. B.C.
• 2 Bolt (SAE B-161.6 [4.00] Plot Dia. and 14.27 [0.562] Dia. Mounting Holes on 145.0 [5.75] Dia. B.C.

Output Shaft
• Bearingless
• 1–1/4 inch Dia. Straight with Straight Key; 3/8-16 Threaded Hole and 47.3 [1.86] Max. Coupling Length
• 1–1/2 inch Dia. Straight with Straight Key; 3/8-16 Threaded Hole and 67.0 [2.67] Max. Coupling Length
• 32 mm Dia. Straight with Straight Key, M 8 x 1.25 -6H Threaded Hole and 56.4 [2.22] Max. Coupling Length
• 40 mm Dia. Straight with Straight Key, M12 x 1.75 -6H Threaded Hole and 79.6 [3.13] Max. Coupling Length
• 1–1/4 inch Dia. Tapered with Straight Key and Nut
• 1–5/8 Inch Dia. Tapered with Straight Key and Nut

Port Type
• 7/8-14 O-ring (Staggered) with 7/16-20 O-ring Case Drain
• G 1/2 (BSP) (Staggered) with G 1/4 (BSP) Case Drain
• Manifold Mount with 3/8-16 UNC Mounting Threads (3)
• Manifold Mount with M10 x 1.5 -6H Mounting Threads (3)
• 1–1/16-12 O-ring (Positioned 180° Apart)
• 7/8-14 O-ring (End Ports) With 7/16-20 O-ring Case Drain (Rear)

Case Flow
• 3/16-20 UNF-2-B O-ring Port
• G 1/4 (BSP) Straight Thread Port
• Hot Oil Shuttle with 7/16-20 UNF-2-B O-ring Port
• Hot Oil Shuttle with G 1/4 (BSP) Straight Thread Port

Back-Pressure Relief Valve
• Set at 4.5 bar [65 PSI]

Special Features
• Viton® Seal
• Speed Sensor
• Corrosion Protected
• Seal Guard Package

Viton® is a Registered Trade Name of Dupont Corp.

See Catalog 11-01-113 for a Char-Lynn 4000 Compact Series hydraulic motor, this motor has the same package size as the 2000 Series with 4000 Series performance.

** Continuous— (Cont.) Continuous rating, motor may be run continuously at these ratings.
* Intermittent— (Inter.) Intermittent operation, 10% of every minute.
4000 Series

Disc Valve Hydraulic Motors

Gerol® Element .... 10 Displacements
Flow LPM [GPM] .... 95 [25] Continuous** 150 [40] Intermittent*
Speed ................. Up to 668 RPM
Pressure Bar [PSI] ... 200 [ 3000] Cont.
300 [ 4500] Inter.
1180 [10450] Inter.

Gerol® Element

Flow LPM [GPM] 95 [25] Continuous** 150 [40] Intermittent*
Speed Up to 668 RPM
300 [ 4500] Inter.
1180 [10450] Inter.

Special Features

• Viton Shaft Seal
• Viton Seals
• Hot Oil Shuttle
• Corrosion Protected

** Continuous—(Cont.) Continuous rating, motor may be run continuously at these ratings.
* Intermittent—(Int.) Intermittent operation, 10% of every minute.

** For performance and dimension data contact your Eaton Hydraulics representative.
Disc Valve Hydraulic Motors

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 [16550] Inter.

Geroler® Element

6000 Series Displacement Size = cubic centimeter per shaft revolution ( cm³/r )
= cubic inch per shaft revolution ( [ in³/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 (Bearless) 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.

Output Shaft

- Bearingless
- 1-1/2 inch Dia. Straight with Straight Key, 3/8-16 Threaded Hole and 56 [.223] 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. Spline with 10 T and 40 [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

** Continuous— (Cont.) Continuous rating, motor may be run continuously at these ratings.
* Intermittent— (Inter.) Intermittent operation, 10% of every minute.

For performance and dimension data contact your Eaton Hydraulics representative.
Disc Valve Hydraulic Motors

10,000 Series

10,000 Series

Geroler® Element ........ 4 Displacements
Flow LPM [GPM] ....... 170 [45] Continuous**
265 [70] Intermittent*

Speed........................ Up to 784 RPM
................................. 270 [4000] Inter.
................................. 3440 [30460] Inter.

10,000 Series Displacement Size = cubic centimeter per shaft revolution (cm³/r)
= cubic inch per shaft revolution (in³/r)

- 345 [21.9]
- 480 [29.2]
- 665 [40.6]
- 940 [57.4]

Mounting Flange
- 4 Bolt (Bearless) 152.4 [6.00] Pilot Dia. and 20.88 [0.82] Dia. Mounting Holes on 229.6 [9.00] Dia. B.C.
- 4 Bolt (Standard) 127.0 [5.00] Pilot Dia. and 17.02 [0.67] Dia. Mounting Holes on 161.9 [6.37] Dia. B.C.
- 4 Bolt (Wheel) 177.8 [7.00] Pilot Dia. and 17.02 [0.67] Dia. Mounting Holes on 209.5 [8.25] Dia. B.C.

Output Shaft
- Bearless
- 2-1/4 inch Dia. Straight with Straight Key and 97.5[3.84] Max. Coupling Length
- 2-1/4 inch Dia. Tapered with Straight Key and 1-1/2—18 UNF Slotted Hex. Nut
- 2-1/8 inch Dia. Splined 18 T with 52.1 [2.05] Min. Full Spline Length and 1/2-20 UNF Threaded Hole

Port Type
- 1-5/16-12 O-ring with 9/16-18 O-ring Case Drain
- 1-1/4 Split Range with 9/16-18 O-ring Case Drain

Special Features
- Viton Shaft Seal
- Viton Seals
- Two Speed Option
- Corrosion Protected

** Continuous—(Cont.) Continuous rating, motor may be run continuously at these ratings.
* Intermittent—(Inter.) Intermittent operation, 10% of every minute.
Disc Valve Hydraulic Motors

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 (Bearless 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.
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.

Disc Valve Hydraulic Motors

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.

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 revolution 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

Connections — Standard 4 prong Weatherpack connector with 18 AWG (American Wire Gage) cables:
- Position A (red) = power supply
- Position B (black) = common
- Position C (blue) = speed signal
- Position D (white) = direction

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

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
Disc Valve Hydraulic Motors

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

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.

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).
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**Motor Application Information**

- Vehicle Drive Calculations: Page 82-83
**Disc Valve Hydraulic Motors**

**Specifications**

**2000 Series**

<table>
<thead>
<tr>
<th>Continuous</th>
<th>Intermitent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Speed (RPM) @ Flow</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>Intermitent</td>
</tr>
</tbody>
</table>


**Maximum Case Pressure - without Case Drain** — 140 Bar [2000 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 15-19.

- **Maximum torque for 1 inch shaft** — 395 Nm [3500 lb-in] Continuous and 485 Nm [4300 lb-in] intermitent.
- For back pressure over 140 Bar [2000 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.
## Disc Valve Hydraulic Motors

### Performance Data

#### 2000 Series

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.

<table>
<thead>
<tr>
<th>Torque (lb•in.)</th>
<th>Speed RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 cm³/r [4.9 in³/r]</td>
</tr>
<tr>
<td>100 cm³/r [6.2 in³/r]</td>
</tr>
</tbody>
</table>

### Pressure Bar [PSI]

#### 80 cm³/r [4.9 in³/r]

<table>
<thead>
<tr>
<th>Flow [LPM (GPM)]</th>
<th>25</th>
<th>50</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
<th>350</th>
<th>400</th>
<th>450</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>219</td>
<td>420</td>
<td>840</td>
<td>1550</td>
<td>2080</td>
<td>2610</td>
<td>3140</td>
<td>3670</td>
<td>4200</td>
<td>4730</td>
</tr>
<tr>
<td>50</td>
<td>220</td>
<td>490</td>
<td>980</td>
<td>1780</td>
<td>2380</td>
<td>2980</td>
<td>3570</td>
<td>4160</td>
<td>4760</td>
<td>5360</td>
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<tr>
<td>100</td>
<td>220</td>
<td>490</td>
<td>980</td>
<td>1780</td>
<td>2380</td>
<td>2980</td>
<td>3570</td>
<td>4160</td>
<td>4760</td>
<td>5360</td>
</tr>
</tbody>
</table>

#### 100 cm³/r [6.2 in³/r]

<table>
<thead>
<tr>
<th>Flow [LPM (GPM)]</th>
<th>25</th>
<th>50</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
<th>350</th>
<th>400</th>
<th>450</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>146</td>
<td>292</td>
<td>584</td>
<td>1180</td>
<td>1770</td>
<td>2360</td>
<td>2950</td>
<td>3540</td>
<td>4130</td>
<td>4720</td>
</tr>
<tr>
<td>50</td>
<td>146</td>
<td>292</td>
<td>584</td>
<td>1180</td>
<td>1770</td>
<td>2360</td>
<td>2950</td>
<td>3540</td>
<td>4130</td>
<td>4720</td>
</tr>
</tbody>
</table>

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

**Performance Data**

**2000 Series**

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.

### 130 cm³ [8.0 in³/r]
- **Δ Pressure Bar [PSI]**
- **Flow LPM [GPM]**

<table>
<thead>
<tr>
<th>Flow LPM [GPM]</th>
<th>[25]</th>
<th>[30]</th>
<th>[35]</th>
<th>[40]</th>
<th>[45]</th>
<th>[50]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>220</td>
<td>250</td>
<td>280</td>
<td>310</td>
<td>340</td>
<td>370</td>
</tr>
<tr>
<td>2</td>
<td>230</td>
<td>260</td>
<td>280</td>
<td>300</td>
<td>320</td>
<td>340</td>
</tr>
<tr>
<td>3</td>
<td>240</td>
<td>270</td>
<td>290</td>
<td>310</td>
<td>330</td>
<td>350</td>
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<tr>
<td>4</td>
<td>250</td>
<td>280</td>
<td>300</td>
<td>320</td>
<td>340</td>
<td>360</td>
</tr>
<tr>
<td>5</td>
<td>260</td>
<td>290</td>
<td>310</td>
<td>330</td>
<td>350</td>
<td>370</td>
</tr>
<tr>
<td>6</td>
<td>270</td>
<td>300</td>
<td>320</td>
<td>340</td>
<td>360</td>
<td>380</td>
</tr>
<tr>
<td>7</td>
<td>280</td>
<td>310</td>
<td>330</td>
<td>350</td>
<td>370</td>
<td>390</td>
</tr>
<tr>
<td>8</td>
<td>290</td>
<td>320</td>
<td>340</td>
<td>360</td>
<td>380</td>
<td>400</td>
</tr>
<tr>
<td>9</td>
<td>300</td>
<td>330</td>
<td>350</td>
<td>370</td>
<td>390</td>
<td>410</td>
</tr>
<tr>
<td>10</td>
<td>310</td>
<td>340</td>
<td>360</td>
<td>380</td>
<td>400</td>
<td>420</td>
</tr>
<tr>
<td>11</td>
<td>320</td>
<td>350</td>
<td>370</td>
<td>390</td>
<td>410</td>
<td>430</td>
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<tr>
<td>12</td>
<td>330</td>
<td>360</td>
<td>380</td>
<td>400</td>
<td>420</td>
<td>440</td>
</tr>
</tbody>
</table>

### 160 cm³ [9.6 in³/r]
- **Δ Pressure Bar [PSI]**
- **Flow LPM [GPM]**

<table>
<thead>
<tr>
<th>Flow LPM [GPM]</th>
<th>[25]</th>
<th>[30]</th>
<th>[35]</th>
<th>[40]</th>
<th>[45]</th>
<th>[50]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>220</td>
<td>260</td>
<td>280</td>
<td>300</td>
<td>320</td>
<td>340</td>
</tr>
<tr>
<td>2</td>
<td>230</td>
<td>270</td>
<td>290</td>
<td>310</td>
<td>330</td>
<td>350</td>
</tr>
<tr>
<td>3</td>
<td>240</td>
<td>280</td>
<td>300</td>
<td>320</td>
<td>340</td>
<td>360</td>
</tr>
<tr>
<td>4</td>
<td>250</td>
<td>290</td>
<td>310</td>
<td>330</td>
<td>350</td>
<td>370</td>
</tr>
<tr>
<td>5</td>
<td>260</td>
<td>300</td>
<td>320</td>
<td>340</td>
<td>360</td>
<td>380</td>
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<tr>
<td>6</td>
<td>270</td>
<td>310</td>
<td>330</td>
<td>350</td>
<td>370</td>
<td>390</td>
</tr>
<tr>
<td>7</td>
<td>280</td>
<td>320</td>
<td>340</td>
<td>360</td>
<td>380</td>
<td>400</td>
</tr>
<tr>
<td>8</td>
<td>290</td>
<td>330</td>
<td>350</td>
<td>370</td>
<td>390</td>
<td>410</td>
</tr>
<tr>
<td>9</td>
<td>300</td>
<td>340</td>
<td>360</td>
<td>380</td>
<td>400</td>
<td>420</td>
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<tr>
<td>10</td>
<td>310</td>
<td>350</td>
<td>370</td>
<td>390</td>
<td>410</td>
<td>430</td>
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<tr>
<td>11</td>
<td>320</td>
<td>360</td>
<td>380</td>
<td>400</td>
<td>420</td>
<td>440</td>
</tr>
<tr>
<td>12</td>
<td>330</td>
<td>370</td>
<td>390</td>
<td>410</td>
<td>430</td>
<td>450</td>
</tr>
</tbody>
</table>

Performance data is typical at 120 SUS. Actual data may vary slightly from unit to unit in production.
### Performance Data 2000 Series

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.

#### Flow LPM (GPM)

<table>
<thead>
<tr>
<th>Speed RPM</th>
<th>114</th>
<th>120</th>
<th>125</th>
<th>130</th>
<th>140</th>
<th>150</th>
<th>175</th>
<th>200</th>
<th>240</th>
<th>280</th>
<th>320</th>
<th>350</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>57.7</td>
<td>57.1</td>
<td>56.7</td>
<td>56.2</td>
<td>55.6</td>
<td>55.2</td>
<td>40.0</td>
<td>34.0</td>
<td>28.0</td>
<td>22.0</td>
<td>16.0</td>
<td>12.0</td>
<td>8.0</td>
</tr>
<tr>
<td>300</td>
<td>57.7</td>
<td>57.1</td>
<td>56.7</td>
<td>56.2</td>
<td>55.6</td>
<td>55.2</td>
<td>40.0</td>
<td>34.0</td>
<td>28.0</td>
<td>22.0</td>
<td>16.0</td>
<td>12.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

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

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

Dimensions —
2000 Series Standard Motor

2000 Series Standard Motor with 7/8-14 O-ring Staggered Ports, G 1/2 (BSP) Staggered Ports or Manifold Mount

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>80</th>
<th>100</th>
<th>130</th>
<th>160</th>
<th>195</th>
<th>245</th>
<th>305</th>
<th>395</th>
<th>490</th>
</tr>
</thead>
<tbody>
<tr>
<td>[in³/r]</td>
<td>4.9</td>
<td>6.2</td>
<td>8.0</td>
<td>9.6</td>
<td>11.9</td>
<td>14.9</td>
<td>18.7</td>
<td>24.0</td>
<td>29.8</td>
</tr>
<tr>
<td>Dim. mm</td>
<td>137.0</td>
<td>141.6</td>
<td>147.9</td>
<td>147.9</td>
<td>154.8</td>
<td>163.7</td>
<td>175.1</td>
<td>191.1</td>
<td>208.4</td>
</tr>
<tr>
<td>X [inch]</td>
<td>5.40</td>
<td>5.58</td>
<td>5.83</td>
<td>5.83</td>
<td>6.10</td>
<td>6.48</td>
<td>6.90</td>
<td>7.53</td>
<td>8.21</td>
</tr>
<tr>
<td>Dim. mm</td>
<td>184.5</td>
<td>189.0</td>
<td>195.4</td>
<td>195.4</td>
<td>202.2</td>
<td>211.1</td>
<td>222.6</td>
<td>238.6</td>
<td>255.8</td>
</tr>
</tbody>
</table>

2000 Series Standard Motor with 1-1/16-12 O-ring Ports (Positioned 180° Apart) and use Only Dim. Y for 7/8-14 O-ring End Ported Motors

| Dim. mm     | 139.3 | 143.9 | 150.2 | 150.2 | 157.1 | 166.0 | 177.4 | 193.4 | 210.7 |
| X [inch]    | 5.49 | 5.67 | 5.92 | 5.92 | 6.19 | 6.54 | 6.99 | 7.62 | 8.30 |
| Dim. mm     | 185.7 | 190.3 | 196.6 | 196.6 | 203.5 | 212.4 | 223.8 | 239.8 | 270.1 |
| Y [inch]    | 7.31 | 7.49 | 7.74 | 7.74 | 8.01 | 8.36 | 8.81 | 9.44 | 10.12 |

* Subtract 4, 1/3, 6 [.16/.14] when ordering motor with 4-bolt magneto flange

2000 Series Standard Motor with 7/8-14 O-ring End Ported

Case Drain Port — See Page 27 - 28

Port Dim. See Page 27 - 28

7/8-14 O-ring Staggered Ports, G 1/2 (BSP) Staggered Ports or Manifold Mount

Case Drain Port — See Page 27 - 28

Y Max.

1-1/16-12 O-ring Ports (Positioned 180° Apart)

7/8-14 O-ring End Ported

Y Max.

Port B

Range Dim. See 2 Bolt SAE B

Flange Dim. See 4 Bolt SAE A

SAE 6 B Splined Shaft

Standard Rotation
Viewed from Shaft End
Port A Pressurized — CW
Port B Pressurized — CCW
Disc Valve Hydraulic Motors

Dimensions — 2000 Series Wheel Motor

2000 Series Wheel Motor with 7/8-14 O-ring staggered Ports, G 1/2 (BSP) Staggered Ports or Manifold Mount

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>80</th>
<th>100</th>
<th>130</th>
<th>160</th>
<th>195</th>
<th>245</th>
<th>305</th>
<th>395</th>
<th>490</th>
</tr>
</thead>
<tbody>
<tr>
<td>[in³/r]</td>
<td>4.9</td>
<td>6.2</td>
<td>8.0</td>
<td>9.6</td>
<td>11.9</td>
<td>14.9</td>
<td>18.7</td>
<td>24.0</td>
<td>29.8</td>
</tr>
<tr>
<td>Dim. mm</td>
<td>96.9</td>
<td>101.4</td>
<td>107.8</td>
<td>114.6</td>
<td>123.5</td>
<td>135.0</td>
<td>151.0</td>
<td>168.2</td>
<td></td>
</tr>
<tr>
<td>X [inch]</td>
<td>3.82</td>
<td>4.00</td>
<td>4.25</td>
<td>4.52</td>
<td>4.87</td>
<td>5.32</td>
<td>5.95</td>
<td>6.63</td>
<td></td>
</tr>
<tr>
<td>Dim. mm</td>
<td>144.3</td>
<td>148.9</td>
<td>155.2</td>
<td>162.1</td>
<td>171.0</td>
<td>182.4</td>
<td>198.4</td>
<td>215.7</td>
<td></td>
</tr>
<tr>
<td>Y [inch]</td>
<td>5.68</td>
<td>5.86</td>
<td>6.11</td>
<td>6.38</td>
<td>6.73</td>
<td>7.18</td>
<td>7.81</td>
<td>8.49</td>
<td></td>
</tr>
</tbody>
</table>

2000 Series Wheel Motor with 1-1/16-12 O-ring Ports (Positioned 180° Apart) and use Only Dim. Y for 7/8-14 O-ring End Ported Wheel Motors

| Dim. mm     | 99.1 | 103.7 | 110.1 | 110.1 | 116.9 | 125.8 | 137.4 | 153.4 | 170.7 |
| X [inch]    | 3.90 | 4.09 | 4.34 | 4.34 | 4.61 | 4.96 | 5.41 | 6.04 | 6.72 |
| Dim. mm     | 145.6 | 150.2 | 156.5 | 156.5 | 163.4 | 172.3 | 183.7 | 199.7 | 217.0 |
| Y [inch]    | 5.73 | 5.91 | 6.16 | 6.16 | 6.43 | 6.78 | 7.23 | 7.86 | 8.54 |

Standard Rotation
Viewed from Shaft End
Port A Pressurized — CW
Port B Pressurized — CCW
## Dimensions — 2000 Series Bearingless Motor

**2000 Series Bearingless Motor** with 7/8-14 O-ring Staggered Ports, G 1/2 (BSP) Staggered Ports or Manifold Mount

<table>
<thead>
<tr>
<th>Displ.</th>
<th>80</th>
<th>100</th>
<th>130</th>
<th>160</th>
<th>195</th>
<th>245</th>
<th>305</th>
<th>395</th>
<th>490</th>
</tr>
</thead>
<tbody>
<tr>
<td>cm³/r</td>
<td>4.9</td>
<td>6.2</td>
<td>8.0</td>
<td>9.6</td>
<td>11.9</td>
<td>14.9</td>
<td>18.7</td>
<td>24.0</td>
<td>29.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dim.</th>
<th>79.0</th>
<th>83.5</th>
<th>89.9</th>
<th>98.9</th>
<th>105.6</th>
<th>117.1</th>
<th>133.1</th>
<th>150.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>3.11</td>
<td>3.29</td>
<td>3.54</td>
<td>3.81</td>
<td>4.16</td>
<td>4.61</td>
<td>5.24</td>
<td>5.92</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Dim.</th>
<th>126.8</th>
<th>131.4</th>
<th>137.7</th>
<th>144.6</th>
<th>153.5</th>
<th>164.9</th>
<th>180.9</th>
<th>198.2</th>
</tr>
</thead>
</table>

**2000 Series Bearingless Motor** with 7/8-14 O-ring End Ports or 1-1/16-12 O-ring Ports (Positioned 180° Apart)

<table>
<thead>
<tr>
<th>Dim.</th>
<th>81.3</th>
<th>85.8</th>
<th>92.2</th>
<th>92.2</th>
<th>99.0</th>
<th>107.9</th>
<th>119.4</th>
<th>135.4</th>
<th>152.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>3.20</td>
<td>3.38</td>
<td>3.63</td>
<td>3.63</td>
<td>3.90</td>
<td>4.25</td>
<td>4.70</td>
<td>5.33</td>
<td>6.00</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Dim.</th>
<th>128.0</th>
<th>132.6</th>
<th>139.0</th>
<th>139.0</th>
<th>145.8</th>
<th>154.7</th>
<th>166.1</th>
<th>182.1</th>
<th>199.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>5.04</td>
<td>5.22</td>
<td>5.47</td>
<td>5.47</td>
<td>5.74</td>
<td>6.09</td>
<td>6.54</td>
<td>7.17</td>
<td>7.65</td>
</tr>
</tbody>
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For 2000 Series Bearingless Motor application information contact your Eaton representative (mating coupling blanks available from Eaton Hydraulics). Note: After machining blank, part must be hardened per Eaton specification.
**Disc Valve Hydraulic Motors**

**Bearingless Installation — 2000 Series**

<table>
<thead>
<tr>
<th>Spline Pitch — 12/24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Angle — 30°</td>
</tr>
<tr>
<td>Number of teeth — 12</td>
</tr>
<tr>
<td>Class of Rt — Ref. 5</td>
</tr>
<tr>
<td>Type of Rt — Side</td>
</tr>
<tr>
<td>Pitch Diameter — Ref. 25,400000 [1.000000]</td>
</tr>
<tr>
<td>Base Diameter — Ref. 21,997045 [0.8660254]</td>
</tr>
<tr>
<td>Minor Diameter — 23.097 - 23.224 [0.9093 - 0.9143]</td>
</tr>
<tr>
<td>Form Diameter, Min. — 29.93 [1.060]</td>
</tr>
<tr>
<td>Fillet Radius — 0.64 - 0.76 [0.025 - 0.030]</td>
</tr>
<tr>
<td>Tip Radius — 0.25 - 0.38 [0.010 - 0.015]</td>
</tr>
<tr>
<td>Finish — 1.6 (63)</td>
</tr>
<tr>
<td>Involute Profile Variation — +0.000 - 0.025 [+0.0000 - 0.0010]</td>
</tr>
<tr>
<td>Total Index Variation — 0.038 [0.015]</td>
</tr>
<tr>
<td>Lead Variation — 0.013 [0.0005]</td>
</tr>
<tr>
<td>Circular Space Width:</td>
</tr>
<tr>
<td>Maximum Actual — 4.318 [1.700]</td>
</tr>
<tr>
<td>Minimum Effective — 4.216 [1.660]</td>
</tr>
<tr>
<td>Maximum Effective — Ref. 4.270 [1.681]</td>
</tr>
<tr>
<td>Minimum Actual — Ref. 4.247 [1.672]</td>
</tr>
<tr>
<td>Dimension Between Two Pins — Ref. 19.020 - 19.190 [0.7488 - 0.7555]</td>
</tr>
<tr>
<td>Pin Diameter — 4.496 [1.770] Pins to Have 3.38 [0.133] Wide Rat for Root Clearance</td>
</tr>
</tbody>
</table>

1. Internal spline in mating part to be per spline data. Specification material to be ASTM A304, 8620H vacuum degassed alloy steel carburize to a hardness of 59-62 HRC with case depth (to 50HRC) of 0.076 - 1.02 [0.030 - 0.040].
2. Mating part to have critical dimensions as shown. Oil holes must be provided and open for proper oil circulation.
3. Seal to be furnished with motor for proper oil circulation thru splines.
4. Some means of maintaining clearance between shaft and mounting flange must be provided.
 Dimensions — Mounting Options 2000 Series

2 Bolt SAE B

Four Bolt (Wheel Motor)

SAE A — Two Bolt (Standard Motor)
Disc Valve Hydraulic Motors

Dimensions — Shafts
2000 Series

1 Inch Straight

56,6/54,4 [2.23/2.14] End of Shaft to Mounting Surface (Std)

25,40 [1.000] Dia. x 6.38/6.35 [.251/.250] Woodruff Key

1/4-20 UNC x 15.5 [.61] Deep

28,28/27,88 [.113/.1098]

25,40/25.34 [1.000/.998] Dia.

395 [3500] Max. Torque Nm [lb-in]

38,4 [1.51] Max. Coupling

1-1/4 Inch Straight

52,4/49.7 [2.06/1.96] End of Shaft to Mounting Surface (Std)

12,7 [.50]

26,2/24.6 [.103/.97]

1-20 UNEF

31,7 [1.250] Dia.

55,1 [2.17]

4,1 [.16] Dia. Thru

3,97/3.63 [.156/.143] at Large End of Taper

SAE J501 Standard Tapered Shaft
125.00 ± 0.17 Taper per Meter
[1.500 ± 0.002 Taper per Foot]

768 [6800] Max. Torque Nm [lb-in]

Plus Torque required to align the slotted nut with the Shaft Crosshole.

1-1/4 Tapered

52,4/49.7 [2.06/1.96] End of Shaft to Mounting Surface (Std)

7,999/7,965 [.3149/.3136]

32,8/31.2 [1.29/1.23]

8,7/4.5 [.34/18]

28,00/27.66 [.1102/.1089]

25 mm Straight

52,4/49.7 [2.06/1.96] End of Shaft to Mounting Surface (Std)

395 [3500] Max. Torque Nm [lb-in]

38,4 [1.51] Max. Coupling

32 mm Straight

56,7/54.3 [2.23/2.14] End of Shaft to Mounting Surface (Std)


1-1/4 14 Tooth Splined

26,36/26.11 [1.038/1.028]

SAE 6B Splined

42.2/39.8 [1.66/1.57] End of Shaft to Mounting Surface (Std)

141 [1250] Max. Torque Nm [lb-in]

15.2 [.60] Min. Full Spline

13 Tooth Splined
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.

<table>
<thead>
<tr>
<th>RPM</th>
<th>Multiplication Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1.23</td>
</tr>
<tr>
<td>100</td>
<td>1.00</td>
</tr>
<tr>
<td>200</td>
<td>.81</td>
</tr>
<tr>
<td>300</td>
<td>.72</td>
</tr>
<tr>
<td>400</td>
<td>.66</td>
</tr>
<tr>
<td>500</td>
<td>.62</td>
</tr>
<tr>
<td>600</td>
<td>.56</td>
</tr>
<tr>
<td>700</td>
<td>.56</td>
</tr>
<tr>
<td>800</td>
<td>.54</td>
</tr>
</tbody>
</table>

For 3,000,000 Shaft revolutions or 500 hours — Increase these shaft loads 52%.
Disc Valve Hydraulic Motors

Dimensions — Ports
2000 Series

Standard Rotation — 2000 Series
Viewed from Shaft End
Port A Pressurized — CW
Port B Pressurized — CCW

7/8-14 O-ring Ports (2)
or G 1/2 (BSP) Ports (2)

See Pages 20-22

7/16-20 UNF O-ring
or G 1/4 (BSP)
Case Drain Port

18,1/16,5
[.71/.65]

7/16-20 UNF O-ring
or G 1/4 (BSP)
Case Drain Port

18,1/16,5
[.71/.65]

See Pages 20-22

7/8-14 O-ring End Ports (2)

1-1/16-12
O-ring Ports (2)
Positioned
180° Apart

See Pages 20-22

18,1/16,5
[.71/.65]

18,1/16,5
[.71/.65]

See Pages 20-22

7/8-14 O-ring
End Ports (2)
Disc Valve Hydraulic Motors

Dimensions — Ports
2000 Series with Shuttle

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

7/8-14 O-ring Ports (2)
or G 1/2 (BSP) Ports (2)

This port option is available with shuttle and back pressure relief valve for closed loop applications.

Back-Pressure Relief Valve

Case Drain

7/16-20 UNF-2B O-ring Port

This port option is available with shuttle and back pressure relief valve for closed loop applications.
## Product Numbers—2000 Series

### Product Numbers—2000 Series

Use digit prefix —104-, 105-, or 106- plus four digit number from charts for complete product number—Example 106-1043.

Orders will not be accepted without three digit prefix.

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Shaft</th>
<th>Ports</th>
<th>Displacement cm³/r [ in³/r ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch Straight</td>
<td>7/8-14 O-ring Staggered</td>
<td>104-1001</td>
<td>-1002 -1003 -1004 -1005 -1006 -1007 -1143</td>
</tr>
<tr>
<td>1-1/16—12 O-ring 180° Apart</td>
<td>104-1037</td>
<td>-1038 -1039 -1040 -1041 -1042 -1043 -1044</td>
<td></td>
</tr>
<tr>
<td>2 Bolt SAE A Range</td>
<td>7/8-14 O-ring Staggered</td>
<td>104-1200</td>
<td>-1201 -1202 -1203 -1204 -1205 -1206 -1207</td>
</tr>
<tr>
<td>7/8 Inch SAE B Splined</td>
<td>7/8-14 O-ring Staggered</td>
<td>104-1193</td>
<td>-1194 -1195 -1196 -1197 -1198 -1199</td>
</tr>
<tr>
<td>2 Bolt SAE B Range</td>
<td>7/8-14 O-ring Staggered</td>
<td>104-1216</td>
<td>-1217 -1218 -1219 -1220</td>
</tr>
<tr>
<td>Standard with 4 Bolt Square Range</td>
<td>32 mm Straight</td>
<td>G 1/2 (BSP)</td>
<td>104-1384</td>
</tr>
<tr>
<td>1-1/4 Inch 14 T Splined</td>
<td>G 1/2 (BSP)</td>
<td>104-1376</td>
<td>-1377 -1378 -1379 -1380 -1381 -1382 -1383</td>
</tr>
<tr>
<td>1-1/4 Inch Straight</td>
<td>7/8-14 O-ring Staggered</td>
<td>105-</td>
<td>-</td>
</tr>
<tr>
<td>1-1/16—12 O-ring 180° Apart</td>
<td>105-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>32 mm Straight</td>
<td>G 1/2 (BSP)</td>
<td>105-1134</td>
<td>-1135 -1136 -1137 -1138 -1139 -1140 -1141</td>
</tr>
<tr>
<td>1-1/16—12 O-ring 180° Apart</td>
<td>105-1071</td>
<td>-1072 -1073 -1074 -1075 -1076 -1077 -1078</td>
<td></td>
</tr>
<tr>
<td>1-1/16—12 O-ring 180° Apart</td>
<td>105-1079</td>
<td>-1080 -1081 -1082 -1083 -1084 -1085 -1086</td>
<td></td>
</tr>
<tr>
<td>Bearingless</td>
<td>7/8-14 O-ring Staggered</td>
<td>106-1008</td>
<td>-1009 -1010 -1011 -1012 -1013 -1014 -1015 -1047</td>
</tr>
<tr>
<td>G 1/2 (BSP)</td>
<td>106-1038</td>
<td>-1039 -1040 -1041 -1042 -1043 -1044 -1045</td>
<td></td>
</tr>
</tbody>
</table>

### Product Numbers—2000 Series Motors with Corrosion Protection

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Shaft</th>
<th>Ports</th>
<th>Displacement cm³/r [ in³/r ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Bolt SAE A Range</td>
<td>1 inch Straight</td>
<td>7/8-14 O-ring Staggered</td>
<td>104-1528</td>
</tr>
</tbody>
</table>

For 2000 Series Motors with a configuration Not Shown in the charts above: Use model code number system on page 30 to specify product in detail.
Model Code for 2000 Series Motors

The following 14-digit coding system has been developed to identify all of the configuration options for the 2000 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 — 2000 Series Disc Valve Motor

Position 1  Product Series
M ...............  Motor
Position 2, 3  2000 Series
02 ...............  2000 Series
Position 4, 5  Displacement cm³/r [in³/r]
05 ...........  80 [4.9]  15 ............  245 [14.9]
06 ...........  100 [6.2]  19 ............  305 [18.7]
08 ...........  130 [8.0]  24 ............  395 [24.0]
10 ...........  160 [9.6]  30 ............  490 [29.8]
12 ...........  195 [11.9]
Position 6  Mounting Flange
D ...............  4 Bolt (Bearingless) 101.6 [4.00] Pilot Dia. and 13,59 [.535] Dia. Mounting Holes on 127,0 [5.00] Dia. B.C.
F ...............  2 Bolt SAE B (Std.) 101,6 [4.00] Pilot Dia. and 14,35 [.565] Dia. Mtg. Holes on 146,0 [5.75] Dia. B.C.
Position 7, 8  Output Shaft
00 ...............  None
01 ...............  1 inch Dia. Straight with Woodruff Key, 1/4-20 Threaded Hole and 38,4 [1.51] Max. Coupling Length
02 ...............  1–1/4 inch Dia. Straight with Woodruff Key, 3/8-16 Threaded Hole and 47,3 [1.86] Max. Coupling Length
23 ...............  32 mm dia. Straight with Straight Key, M8 x 1,25 -6H Threaded Hole and 56,4 [2.22] Max. Coupling Length
03 ...............  1–1/4 inch Dia. Tapered with Straight Key and Nut
05 ...............  1 inch SAE 6B Splined 6T, 1/4-20 Threaded Hole and 22,8 [.90] Min. Full Spline Length and 28,8 [1.13] Max. Coupling Length
24 ...............  1–1/4 inch Dia. Straight with Straight Key, 3/8-16 Threaded Hole and Corrosion Resistant (seal area to shaft end)
25 ...............  1–1/4 inch Dia. Tapered with Straight Key and Nut, Corrosion Resistant (seal area to shaft end)
26 ...............  25 mm Dia. Straight with Straight Key, M8 x 1,25 -6H Threaded Hole and 38,4 [1.51] Max. Coupling Length
Position 9  Port Type
A ...............  7/8-14 O-ring (Staggered) with 7/16-20 O-ring Case Drain
J ...............  G 1/2 (BSP) (Staggered) with G 1/4 (BSP) Case Drain
B ...............  Manifold Mount with 3/8-16 UNC Mounting Threads (3) and 7/16-20 O-ring Case Drain
G ...............  Manifold Mount with M10 x 1,5 -6H Mounting Threads (3) and G 1/4 (BSP) Case Drain
H ...............  1–1/16 - 12 O-ring (Positioned 180° Apart) with 7/16-20 O-ring Case Drain
F ...............  7/8-14 O-ring (End Ports) with 7/16-20 O-ring Case Drain (Rear)
6 ...............  7/8-14 O-ring (End Ports) with 7/16-20 O-ring Case Drain (Rear) and Hot Oil Shuttle Valve (must be used with Special Features Code 77)
Position 10, 11  Special Features (Hardware)
00 ...............  None
01 ...............  Range Rotated 90°
11 ...............  Viton® Shaft Seals
02 ...............  Viton Seals
21 ...............  Reverse Rotation
28 ...............  Seal Guard
45 ...............  Speed Sensor (Std.)
77 ...............  Low Pressure Relief Valve Set at 4,5 bar [65 PSI] (must be used with Port Code 6)
83 ...............  Quadrature Speed Sensor Version 2 with Weatherpak
88 ...............  Quadrature Speed Sensor Version 2 with M12
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
Disc Valve Hydraulic Motors

Two Speed Motor —
2000 Series

The Eaton 2000 Series motors are available with an integral two speed feature that changes the displacement in a ratio of 1 to 2 and shifts the motor from a low speed high torque (LSHT) mode to a high speed low torque (HSLT) mode. The open center selector valve shifts the speed mode from low to high speed when pilot pressure of 6.9 Δ Bar [100 Δ PSI] minimum is applied to the pilot port (6.9 Bar [100 PSI] higher than case pressure). In the high speed mode torque values are approximately one half with twice the speed of the conventional 2000 Series single speed motors.

An external two position three way valve is required for shifting the pilot pressure port between signal pressure (HSLT) and low pressure (LSHT).

Two speed motors are available with a return line closed center shuttle for closed circuit applications.

Low speed high torque mode is the normal position of the speed selector valve. When a differential pressure is supplied to the pilot port and 6.9 Bar [100 PSI] is reached, the selector valve overcomes the return spring force and the spool shifts to the high speed mode. The oil in the opposite side of the spool is drained internally. Pressure between the pilot supply and case drain or return line (depending on open or closed circuit system) must be maintained to keep the motor in the high speed mode.

When pilot pressure is removed from the pilot port the pressure in the pilot end of the spool valve is relieved and drained back through this three way valve, the spring force returns the spool valve to LSHT position.

Pilot pressure may come from any source that will provide uninterrupted pressure during the high speed mode operation. Pilot pressure 6.9 Δ Bar [100 Δ PSI] minimum, up to the full operating pressure of the motor.

In normal LSHT operation the Char-Lynn two speed motor will function with equal shaft output in either direction (CW or CCW), the same as the single speed Char-Lynn disc valve motors.

However, to prevent cavitation in the HSLT mode, the preferred direction of shaft rotation is counter clockwise (port B pressurized). This unique disc valve is not symmetrical in porting the fluid for the HSLT mode. Consequently, when the pressure is reversed for HSLT CW rotation, cavitation can occur. Installing a restriction (14 - 34 Bar [200 - 500 PSI]) in the hydraulic line that connects port B will prevent cavitation (see page 32).

If you are operating in a critical area and a restriction in the hydraulic line causes concern, these two speed motors can be ordered timed with CW preferred HSLT shaft rotation. Hence, with this option port B will have to be pressurized for CW preferred HSLT shaft rotation. The restriction recommended for the line connecting port B remains unchanged.

Finally in closed circuit applications a hydraulic line restriction is not required. Instead, the charge pump can be used to supply and maintain a minimum pressure of 14 Bar [200 PSI].

Note: Be certain in closed loop applications that the charge pump when used for back pressure on the B port, has sufficient displacement to maintain charge pressure especially in dynamic braking or overrunning load conditions.

Important! Due to potential problems in maintaining charge pump pressure at port B for uninterrupted back pressure during dynamic braking, Eaton does not recommend the two speed motor where overrunning conditions may exist.

Performance Data
Two Speed Motor —
2000 Series

In the high speed mode torque values are approximately one half with twice the speed of the conventional 2000 Series single speed motors. In the low speed mode torque and speed values are the same as the conventional 2000 Series motors (see Performance Data on pages 15-19). For Two Speed Motor Specifications, Dimensions, and Product Numbers see pages 33 through 35.
Disc Valve Hydraulic Motors

Two Speed Motor — 2000 Series

Pump Pressure and Return, and
Shaft Rotation Directional Control Valve

2000 Series
Motor — Two Speed

Optional Shuttle
Valve Location

Restriction 14 Bar [200 PSI] and Check Valve

Pilot Port

Port A

Port B

Check Valves

Two Speed Motor
Schematic

Case Drain

Case Drain (Option)

Maximum System
Horsepower Curve

Torque

Speed - RPM

2 - Speed Operating Range

Low Speed
High Torque

High Speed
Low Torque

...Optional Hot Oil Shuttle Valve
Specifications
Two Speed Motor — 2000 Series

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

Maximum Case Pressure - without Case Drain — 140 Bar [2000 PSI]

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.
### Dimensions — Two Speed Standard, Wheel, and Bearingless

#### Two Speed Standard Motor

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>80</th>
<th>100</th>
<th>130</th>
<th>160</th>
<th>195</th>
<th>245</th>
<th>305</th>
<th>395</th>
<th>490</th>
</tr>
</thead>
<tbody>
<tr>
<td>[in³/r]</td>
<td>[4.9]</td>
<td>[6.2]</td>
<td>[8.0]</td>
<td>[9.6]</td>
<td>[11.9]</td>
<td>[14.9]</td>
<td>[18.7]</td>
<td>[24.0]</td>
<td>[29.8]</td>
</tr>
<tr>
<td>Dim. X mm</td>
<td>137.4</td>
<td>142.0</td>
<td>148.5</td>
<td>148.5</td>
<td>155.2</td>
<td>164.2</td>
<td>175.7</td>
<td>191.5</td>
<td>209.0</td>
</tr>
<tr>
<td></td>
<td>[5.41]</td>
<td>[5.59]</td>
<td>[5.85]</td>
<td>[5.85]</td>
<td>[6.11]</td>
<td>[6.47]</td>
<td>[6.92]</td>
<td>[7.54]</td>
<td>[8.23]</td>
</tr>
<tr>
<td>Dim. Y mm</td>
<td>231.6</td>
<td>236.5</td>
<td>242.9</td>
<td>242.9</td>
<td>249.4</td>
<td>258.6</td>
<td>270.1</td>
<td>286.1</td>
<td>303.3</td>
</tr>
<tr>
<td></td>
<td>[9.12]</td>
<td>[9.31]</td>
<td>[9.56]</td>
<td>[9.56]</td>
<td>[9.82]</td>
<td>[10.18]</td>
<td>[10.63]</td>
<td>[11.28]</td>
<td>[11.94]</td>
</tr>
</tbody>
</table>

#### Two Speed Wheel Motor

| Dim. X mm   | 97.2 | 101.8 | 108.3 | 108.3 | 115.0 | 124.2 | 135.5 | 151.4 | 168.9 |
|             | [3.83] | [4.01] | [4.27] | [4.27] | [4.53] | [4.89] | [5.34] | [5.96] | [6.65] |
| Dim. Y mm   | 191.5 | 196.4 | 202.7 | 202.7 | 209.3 | 218.5 | 229.9 | 245.9 | 263.1 |
|             | [7.54] | [7.73] | [7.98] | [7.98] | [8.24] | [8.60] | [9.05] | [9.56] | [10.36] |

#### Two Speed Bearingless Motor

| Dim. X mm   | 79.3 | 83.8 | 90.3 | 90.3 | 97.0 | 106.2 | 117.8 | 133.6 | 150.9 |
|             | [3.13] | [3.30] | [3.56] | [3.56] | [3.82] | [4.18] | [4.64] | [5.26] | [5.94] |
| Dim. Y mm   | 174.0 | 178.9 | 185.2 | 185.2 | 191.8 | 201.0 | 212.4 | 228.4 | 245.6 |
|             | [6.85] | [7.04] | [7.29] | [7.29] | [7.55] | [7.91] | [8.36] | [8.99] | [9.67] |

7/16-20 UNF-2B O-ring Port — Pilot Control
Pilot Port Pressurized 6.9 Δ Bar [100 Δ PSI]
High Speed Low Torque (HSLT)
Pilot Port Depressurized (Tank)
Low Speed High Torque (LSHT)

---

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

---

### Two Speed Bearingless Motor

7/8-14 O-ring Ports (2)

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**Shaft Dim.**
See Page 25

**Mounting Range**
See Page 24
## Disc Valve Hydraulic Motors

### Product Numbers — Two Speed

#### 2000 Series

Use digit prefix — 104-, 105-, or 106- plus four digit number from charts for complete product number — Example 106-2007. Orders will not be accepted without three digit prefix.

### Product Numbers — 2000 Series Motors — Two Speed

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Shaft</th>
<th>Ports</th>
<th>Displ. cm³/r [in³/r]</th>
<th>Product Number</th>
</tr>
</thead>
</table>

2000 Series Motors with a configuration *NotShown* in the charts above: Contact your Eaton Representative.

---

**Eaton**
Hayes M15WM Brake System
2000 Series Wheel Motors

Hayes Industrial Brakes, Inc. supplies its Model M15WM mechanical parking/service brake for use with 2000 Series wheel motors on commercial turf and specialty-vehicle applications. Basic packages available are:

M15WM for 203.2 [8.0] wheels (152.4 [6.0] rotor diameter)
M15WM for 254 [10.0] wheels (209.6 [8.25] rotor diameter)

Features
• Up to 1450 lb. of clamping force available
• Simple single-piece caliper bridge design
• Fewer moving parts
• Comprehensive braking system design includes:
  - Aluminum caliper
  - Ductile cast iron bracket
  - Ductile cast iron hub/disc
• Several shaft sizes and hub mounting hole options available.

Note: Brake systems must be purchased directly from Hayes Industrial Brake. Eaton does not sell the brake nor does it install on motors. For more information, contact:
Hayes Industrial Brake, Inc.
5800 West Donges Bay Road
Mequon, WI 57092
Phone: (262) 242-4300; Fax: (262) 242-0524

Dimensions — Mounting

8-Inch Wheel
305 N-m (2700 lb-in) Max. Torque
Requires special 2K mounting code “P”.

10-Inch Wheel
429.4 N-m (3800 lb-in) Max. Torque
Compatible with standard 4-bolt wheel configuration

Diagram: 8-Inch Wheel Dimensions
Diagram: 10-Inch Wheel Dimensions
Disc Valve Hydraulic Motors

Specifications
4000 Series

Maximum Case Pressure - without Case Drain * — 100 Bar [1500 PSI]

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).


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 is typical at 120 SIS. Actual data may slightly from unit to unit and speed range shown in the light blue area.
### Performance Data

#### 4000 Series

<table>
<thead>
<tr>
<th>RPM</th>
<th>Torque [lb-in]</th>
<th>Speed [RPM]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1195</td>
<td>125</td>
</tr>
<tr>
<td>10</td>
<td>1130</td>
<td>125</td>
</tr>
<tr>
<td>20</td>
<td>1065</td>
<td>125</td>
</tr>
<tr>
<td>30</td>
<td>1000</td>
<td>125</td>
</tr>
<tr>
<td>40</td>
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<td>125</td>
</tr>
<tr>
<td>50</td>
<td>870</td>
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</tr>
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<td>60</td>
<td>805</td>
<td>125</td>
</tr>
<tr>
<td>70</td>
<td>740</td>
<td>125</td>
</tr>
<tr>
<td>80</td>
<td>675</td>
<td>125</td>
</tr>
<tr>
<td>90</td>
<td>610</td>
<td>125</td>
</tr>
<tr>
<td>100</td>
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<td>125</td>
</tr>
<tr>
<td>110</td>
<td>480</td>
<td>125</td>
</tr>
<tr>
<td>120</td>
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<td>125</td>
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<tr>
<td>130</td>
<td>350</td>
<td>125</td>
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<tr>
<td>140</td>
<td>285</td>
<td>125</td>
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<tr>
<td>150</td>
<td>220</td>
<td>125</td>
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<tr>
<td>160</td>
<td>165</td>
<td>125</td>
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<td>170</td>
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<td>180</td>
<td>65</td>
<td>125</td>
</tr>
<tr>
<td>190</td>
<td>30</td>
<td>125</td>
</tr>
</tbody>
</table>

#### 310 cm³/r [19.0 in³/r]

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
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<td>1195</td>
<td>125</td>
<td>1150</td>
</tr>
<tr>
<td>10</td>
<td>1130</td>
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<td>40</td>
<td>935</td>
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<td>60</td>
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<td>125</td>
<td>125</td>
</tr>
<tr>
<td>120</td>
<td>415</td>
<td>125</td>
<td>125</td>
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<tr>
<td>130</td>
<td>350</td>
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<td>125</td>
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<tr>
<td>140</td>
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<td>165</td>
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<td>125</td>
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<tr>
<td>170</td>
<td>110</td>
<td>125</td>
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<tr>
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<td>125</td>
</tr>
<tr>
<td>190</td>
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<td>125</td>
<td>125</td>
</tr>
</tbody>
</table>

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.

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

#### 4000 Series

<table>
<thead>
<tr>
<th>Flow LPM (GPM)</th>
<th>40</th>
<th>35</th>
<th>30</th>
<th>25</th>
<th>20</th>
<th>15</th>
<th>10</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
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<td>6</td>
<td>12</td>
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<td>350</td>
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<td>15</td>
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<td>55</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>400</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
<td>55</td>
<td>60</td>
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<td>70</td>
</tr>
<tr>
<td>Flow LPM (GPM)</td>
<td>40</td>
<td>35</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>250</td>
<td>0</td>
<td>6</td>
<td>12</td>
<td>18</td>
<td>24</td>
<td>30</td>
<td>36</td>
<td>42</td>
<td>48</td>
<td>54</td>
<td>60</td>
<td>66</td>
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<tr>
<td>350</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
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<td>400</td>
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<td>20</td>
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<td>50</td>
<td>55</td>
<td>60</td>
<td>65</td>
<td>70</td>
</tr>
<tr>
<td>Flow LPM (GPM)</td>
<td>40</td>
<td>35</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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<td>250</td>
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<td>40</td>
<td>45</td>
<td>50</td>
<td>55</td>
<td>60</td>
<td>65</td>
<td>70</td>
</tr>
</tbody>
</table>

#### 495 cm³/r [30.0 in³/r]

<table>
<thead>
<tr>
<th>Δ Pressure Bar [PSI]</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
<th>350</th>
<th>400</th>
<th>450</th>
<th>500</th>
<th>550</th>
<th>600</th>
<th>650</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque [lb-in]</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>550</td>
<td>600</td>
<td>650</td>
<td>700</td>
</tr>
</tbody>
</table>

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.

---

### 395 cm³/r [24.0 in³/r]

<table>
<thead>
<tr>
<th>Δ Pressure Bar [PSI]</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
<th>350</th>
<th>400</th>
<th>450</th>
<th>500</th>
<th>550</th>
<th>600</th>
<th>650</th>
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<tbody>
<tr>
<td>Torque [lb-in]</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>550</td>
<td>600</td>
<td>650</td>
<td>700</td>
</tr>
</tbody>
</table>

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

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

Dimensions — 4000 Series Standard Motor

<table>
<thead>
<tr>
<th>Port B</th>
<th>4000 Series Standard Motor with 1-1/16-12 O-ring Ports</th>
<th>40 mm Dia. Straight</th>
<th>93.42/92.51</th>
<th>[3.678/3.642]</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Dim.</td>
<td>mm</td>
<td>158.3</td>
<td>162.3</td>
<td>168.7</td>
</tr>
<tr>
<td></td>
<td>[inch]</td>
<td>[6.23]</td>
<td>[6.39]</td>
<td>[6.64]</td>
</tr>
<tr>
<td>Y Dim.</td>
<td>mm</td>
<td>214.4</td>
<td>218.4</td>
<td>224.7</td>
</tr>
<tr>
<td></td>
<td>[inch]</td>
<td>[8.44]</td>
<td>[8.60]</td>
<td>[8.86]</td>
</tr>
</tbody>
</table>

| 4000 Series Standard Motor with 3/4 inch Split Flange Ports |
|---|---|---|---|---|
| X Dim. | mm | 166.7 | 170.8 | 177.0 | 185.6 | 177.1 | 185.6 | 196.3 | 209.2 | 226.2 |
| | [inch] | [6.57] | [6.73] | [6.97] | [7.31] | [6.97] | [7.31] | [7.73] | [8.24] | [8.91] |
| Y Dim. | mm | 246.3 | 250.4 | 256.7 | 265.2 | 256.7 | 265.2 | 275.9 | 288.8 | 305.9 |
| | [inch] | [9.70] | [9.86] | [10.11] | [10.44] | [10.11] | [10.44] | [10.88] | [11.37] | [12.04] |

Standard Flange—Similar to SAE B Type

| 1-1/8 Inch Dia. Tapered Shaft |
|---|---|---|---|
| X Dim. | mm | 94.0/91.4 | [3.70/3.60] | 17.6/15.4 | [.69/.61] | 71.7/68.5 | [2.82/2.70] |

<table>
<thead>
<tr>
<th>X Max.</th>
<th>Y Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>119.1</td>
<td>[4.69]</td>
</tr>
<tr>
<td>Max. Square</td>
<td></td>
</tr>
</tbody>
</table>

Port B |

1-5/8 Inch Dia. Tapered Shaft |

<table>
<thead>
<tr>
<th>Y Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>214.4</td>
</tr>
<tr>
<td>[8.44]</td>
</tr>
</tbody>
</table>

Port Dim. See Page 48

Case Drain Port See Page 48

40mm Dia. Straight

1-1/2 Inch Dia. 17T Splined Shaft

40mm Straight Shaft

89.28/88.27 | [3.515/3.475] |

SAE C Flange

14,53/14,15 | [.572/.557] |

Dia. Thru Max.

127.0[5.00] | Dia. Bolt Circle |

15.2/14.5 | [.60/.57] |

101.60/101.47 | [4.000/3.995] |

4.2 [.17] to X and Y Dim. (see Chart- left)
Disc Valve Hydraulic Motors

Dimensions — 4000 Series Wheel Motor

4000 Series Wheel Motor with 1-1/16-12 O-ring Ports
or G 3/4 (BSP) Ports

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>110</th>
<th>130</th>
<th>160</th>
<th>205</th>
<th>245</th>
<th>310</th>
<th>395</th>
<th>495</th>
<th>625</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.7</td>
<td>7.9</td>
<td>9.9</td>
<td>12.5</td>
<td>15.0</td>
<td>19.0</td>
<td>24.0</td>
<td>30.0</td>
<td>38.0</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>X Dim. mm</th>
<th>87.4</th>
<th>91.5</th>
<th>97.8</th>
<th>106.3</th>
<th>97.8</th>
<th>106.3</th>
<th>117.0</th>
<th>129.9</th>
<th>146.8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[3.44]</td>
<td>[3.60]</td>
<td>[3.85]</td>
<td>[4.19]</td>
<td>[3.85]</td>
<td>[4.19]</td>
<td>[4.61]</td>
<td>[5.12]</td>
<td>[5.78]</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Y Dim. mm</th>
<th>143.3</th>
<th>147.3</th>
<th>153.6</th>
<th>162.2</th>
<th>153.6</th>
<th>162.2</th>
<th>172.8</th>
<th>185.8</th>
<th>202.8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[5.64]</td>
<td>[5.80]</td>
<td>[6.05]</td>
<td>[6.38]</td>
<td>[6.05]</td>
<td>[6.38]</td>
<td>[6.80]</td>
<td>[7.31]</td>
<td>[7.98]</td>
</tr>
</tbody>
</table>

4000 Series Wheel Motor with 3/4 inch Split Flange Ports

<table>
<thead>
<tr>
<th>X Dim. mm</th>
<th>95.0</th>
<th>99.1</th>
<th>105.5</th>
<th>114.0</th>
<th>105.5</th>
<th>114.0</th>
<th>124.7</th>
<th>137.6</th>
<th>154.4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[3.74]</td>
<td>[3.90]</td>
<td>[4.16]</td>
<td>[4.49]</td>
<td>[4.49]</td>
<td>[4.49]</td>
<td>[4.91]</td>
<td>[5.42]</td>
<td>[6.08]</td>
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</table>

<table>
<thead>
<tr>
<th>Y Dim. mm</th>
<th>174.5</th>
<th>178.5</th>
<th>184.9</th>
<th>193.4</th>
<th>184.9</th>
<th>193.4</th>
<th>204.1</th>
<th>217.0</th>
<th>234.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[6.87]</td>
<td>[7.03]</td>
<td>[7.29]</td>
<td>[7.61]</td>
<td>[7.28]</td>
<td>[7.61]</td>
<td>[8.03]</td>
<td>[8.54]</td>
<td>[9.21]</td>
</tr>
</tbody>
</table>

Standard Rotation
Viewed from Shaft End
Port A Pressurized — CW
Port B Pressurized — CCW
**Disc Valve Hydraulic Motors**

**Dimensions — 4000 Series Bearingless Motor**

*4000 Series Bearingless Motor* with 1-1/16-12 O-ring Ports or G 3/4 (BSP) Ports

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>110</th>
<th>130</th>
<th>160</th>
<th>205</th>
<th>245</th>
<th>310</th>
<th>395</th>
<th>495</th>
<th>625</th>
</tr>
</thead>
<tbody>
<tr>
<td>[in³/r]</td>
<td>6.7</td>
<td>7.9</td>
<td>9.9</td>
<td>12.5</td>
<td>15.0</td>
<td>19.0</td>
<td>24.0</td>
<td>30.0</td>
<td>36.0</td>
</tr>
</tbody>
</table>

**X Dim.**

- mm: 91.0, 95.0, 101.4, 109.9, 101.4, 109.9, 120.6, 133.5, 150.5
- [inch]: [3.58], [3.74], [4.00], [4.33], [4.00], [4.33], [4.75], [5.26], [5.93]

**Y Dim.**

- mm: 146.8, 150.8, 157.1, 165.7, 157.1, 165.7, 176.3, 189.2, 206.3
- [inch]: [5.78], [5.94], [6.19], [6.19], [6.19], [6.94], [7.45], [8.12]

*4000 Series Bearingless Motor* with 3/4 inch Split Flange Ports

**X Dim.**

- mm: 99.4, 103.5, 109.7, 118.3, 109.7, 118.3, 129.0, 141.9, 159.0
- [inch]: [3.92], [4.08], [4.32], [4.66], [4.66], [4.66], [5.08], [5.99], [6.26]

**Y Dim.**

- mm: 178.7, 182.8, 189.1, 197.6, 189.1, 197.6, 208.3, 221.2, 238.3
- [inch]: [7.04], [7.20], [7.44], [7.78], [7.44], [7.78], [8.20], [8.71], [9.38]

For 4000 Series Bearingless Motor application information contact your Eaton representative (matting coupling blanks available from Eaton Hydraulics).

Note: After machining blank, part must be hardend per Eaton specification.
Disc Valve Hydraulic Motors

Bearingless Installation — 4000 Series

Spline Pitch — 10/20
Pressure Angle — 30°
Number of teeth — 12
Class of Fit — Ref. 5
Type of Fit — Side
Pitch Diameter — Ref. 30,480000 [1.200000] [0.20 [.008] H
Base Diameter — Ref. 26,396455 [1.0392305]
Minor Diameter — 28,40 - 28,58 [1.118 - 1.125]
Form Diameter, Min. — 32,59 [1.283]
Fillet Radius — 0,63 - 0,76 [0.025 - 0.030]
Tip Radius — 0,26 · 0,51 [0.10 - 0.20]
Finish — 1,6 [63]
Involute Profile Variation — +0,000 · 0,025 [+,.0000 · 0010]
Total Index Variation — 0,038 [0.0015]
Lead Variation — 0,013 [0.0005]
Circular Space Width:
  Maximum Actual — 5,045 [1.986]
  Minimum Effective — 4,995 [1.951]
  Maximum Effective — Ref. 5,009 [1.972]
  Minimum Actual — Ref. 4,986 [1.963]
Dimension Between Two Pins — Ref. 22,783 - 22,929 [0.8970 - .9027]

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 - 1.27 [0.030 - .050]
(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 Counterbore designed to adapt to a standard
sleeve bearing 50,010 - 50,040 [1.9689 - 1.9700] ID
by 60,050 - 60,080 [2.3642 - 2.3653] (Oilite bronze
sleeve bearing).

6 Similar to SAE “C” Four Bolt Range.

7 52.8 [2.08] Max. dimension to be maintained when assembling,
shipping and installing unit to insure valve drive engagement
with valve (this is required on displacement code
number 24 only).
Disc Valve Hydraulic Motors

Dimensions — Shafts 4000 Series

1-1/4 Inch Straight

71.7/68.5 [2.82/2.70] End of Shaft to Mounting Surface (Std)

Spline to Fit
ANSI B92.1 1976
Flat Root Side Fit
14 Tooth 12/24 Spline

3/8-16 UNC
18.7 [.74] Deep

768 [6800]
Max. Torque Nm [lb-in]

40 mm Straight

65.8/63.5 [2.59/2.50] End of Shaft to Mounting Surface (Std)

Spline to Fit
ANSI B92.1 1976
Flat Root Side Fit
14 Tooth 12/24 Spline

3/8-16 UNC
18.7 [.74] Deep

768 [6800]
Max. Torque Nm [lb-in]

1-1/4 Inch 14 Tooth Splined

93.4/92.5 [3.678/3.642] End of Shaft to Mounting Surface (Std)

12,000/11,957 [.4724/.4708]

8,000/7,900 [.3149/.3115]

43.03/42.72
[1.694/1.682]

M12 x 1.75 -6H
24.9 [.98] Deep

40,02/39.99
[1.576/1.575] Dia.

972 [8600] Max. Torque Nm [lb-in]

1-5/8 Inch Tapered

59.1/56.8
[2.325/2.235]

55.4 [2.18]

1-1/4-18 UNEF

11,138/11,112
[.4385/.4375] Sq. Key

Recommended Torque:
(645 Nm [475 lb-ft] Dry)
(510 Nm [375 lb-ft] Lub)

Plus Torque required to
align the slotted nut with
the Shaft Crosshole.

Tapered Shaft Hub Data

972 [8600]
Max. Torque Nm [lb-in]

31.2 [1.23] Min. Full Spline

51.8 [2.04] Max. Coupling

Slotted Hexagon Nut

4.1 [.16]

55,4/54,3 [2.18/2.12]

1-1/4-18 UNEF

31.7 [1.25]

41.326/41.275
[1.6270/1.6250] Dia.

Spline to Fit
ANSI B92.1 1976
Flat Root Side Fit
17 Tooth 12/24 Spline

38.10 [1.500] Dia.

8.000/7,900 [.3149/.3115]


70.7/69.3
[2.78/2.73]

Max. Coupling

76,6 [3.00]

31,7/31,69

31,75/31,69

40.02/39.99
[1.576/1.575] Dia.

43,03/42.72
[1.694/1.682]

972 [8600] Max. Torque Nm [lb-in]

31,7/31,69

40.02/39.99
[1.576/1.575] Dia.

43,03/42.72
[1.694/1.682]

972 [8600] Max. Torque Nm [lb-in]

8.000/7,900 [.3149/.3115]

43,03/42.72
[1.694/1.682]
Disc Valve Hydraulic Motors

Shaft Side Load Capacity
4000 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.

<table>
<thead>
<tr>
<th>RPM</th>
<th>Multiplication Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1.23</td>
</tr>
<tr>
<td>100</td>
<td>1.00</td>
</tr>
<tr>
<td>200</td>
<td>0.81</td>
</tr>
<tr>
<td>300</td>
<td>0.72</td>
</tr>
<tr>
<td>400</td>
<td>0.66</td>
</tr>
<tr>
<td>500</td>
<td>0.62</td>
</tr>
<tr>
<td>600</td>
<td>0.58</td>
</tr>
<tr>
<td>700</td>
<td>0.56</td>
</tr>
<tr>
<td>800</td>
<td>0.54</td>
</tr>
</tbody>
</table>

For 3,000,000 Shaft revolutions or 500 hours — Increase these shaft loads 52%.
Disc Valve Hydraulic Motors

**Dimensions — Ports 4000 Series**

**4000 Series with Shuttle Valve**

1-1/16-12 O-ring Ports (2) or G 3/4 (BSP) Ports (2)

- 7/16-20 UNF O-ring or G 1/4 (BSP) Case Drain Port
- 9/16-18 UNF O-ring or M22 x 1,5-6H Case Drain Port

Standard Rotation — 4000 Series Viewed from Shaft End
- Port A Pressurized — CW
- Port B Pressurized — CCW

See Pages 42-44

**7/8-14 O-ring Ports (2) or M22 x 1,5-6H Ports (2)**

- 6.73/5.99 [0.265/0.235]
- 6.9 [0.27] Material Removed from this Housing for 7/8-14 O-ring Ports and M22 x 1,5-6H Ports

**4 Bolt 3/4 Inch Split Flange Ports to Fit SAE J518 c (2)**

- 23.9 [.94]
- 47.63 [1.875]
- 19.02/18.77 [.749/.739]
- 22.23 [.875]
- 54.9 [2.16]
- 11.2 [.44]
- 45°

See Pages 42-44

**58.9 [2.32] Max.**

77.0 [3.03] Max.

Max.

- 10.59/9.83 [.417/.387]
- 17°

- 52.6/51.3 [2.07/2.02]
- 42.7/38.1 [1.68/1.50]

Port A

Port B

**Max.**

- 15.7 [.62]
- 13.2 [.52]
- 7/16-20 UNF O-ring or G 1/4 (BSP) Case Drain Port
- 9/16-18 UNF O-ring or M22 x 1,5-6H O-ring Case Drain Port

**See Pages 42-44**

**Max.**

- 76.5 [3.01]
- 17°

- 70.1 [2.76]
- 58.9 [2.32]
- 52.6/51.3 [2.07/2.02]

- 29.5/29.0 [1.16/1.14]
## Disc Valve Hydraulic Motors

### Product Numbers

#### 4000 Series

**Product Numbers—4000 Series Motors**

Use digit prefix — 109-, 110-, or 111- plus four digit number from charts for complete product number—Example 111-1057.

Orders will not be accepted without three digit prefix.

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Shaft</th>
<th>Ports</th>
<th>Displ. cm³/r [ in³/r]</th>
<th>Product Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>110 [ 6.7]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>130 [ 7.9]</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>160 [ 9.9]</td>
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<td></td>
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<td>205 [12.5]</td>
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<td></td>
<td></td>
<td>245 [15.0]</td>
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<td></td>
<td>310 [19.0]</td>
</tr>
<tr>
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<td></td>
<td>395 [24.0]</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>495 [30.0]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>625 [38.0]</td>
</tr>
<tr>
<td>1-1/4 inch Straight</td>
<td></td>
<td>1-1/16 O-ring</td>
<td>109-1100</td>
<td>-1101</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-1/4 inch 14 T Splined</td>
<td>1-1/16 O-ring</td>
<td>109-1114</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-1/4 inch Straight</td>
<td>1-1/16 O-ring</td>
<td>110-1074</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 mm Straight</td>
<td>G3/4 (BSP)</td>
<td>110-1108</td>
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<tr>
<td></td>
<td></td>
<td>1-1/6 O-ring</td>
<td>110-1081</td>
<td>-1082</td>
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<tr>
<td></td>
<td></td>
<td>3/4 inch Split Range</td>
<td>110-1006</td>
<td>-1044</td>
</tr>
<tr>
<td>Wheel Motor</td>
<td>1-1/4 inch 14 T Splined</td>
<td>1-1/16 O-ring</td>
<td>110-1088</td>
<td>-1089</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3/4 inch Split Range</td>
<td>110-1011</td>
<td>-1048</td>
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<tr>
<td></td>
<td></td>
<td>Bearingless</td>
<td>1-1/16 O-ring</td>
<td>111-1033</td>
</tr>
</tbody>
</table>

For 4000 Series Motors with a configuration *Not Shown* in the charts above: Use model code number system on page 50 to specify product in detail.
Disc Valve Hydraulic Motors

Model Code for 4000 Series Motors

The following 14-digit coding system has been developed to identify all of the configuration options for the 4000 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 — 4000 Series Disc Valve Motors

<p>| | | | | | | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<td>4</td>
<td>5</td>
<td>6</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Position 1**  
**Product Series**

**Position 2, 3**  
**4000 Series**

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

**Position 6**  
**Mounting Flange**

**Position 7, 8**  
**Output Shaft**

**Position 9**  
**Port Type**

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

**Position 12**  
**Paint/Special Packaging**

**Position 13**  
**Eaton Assigned Code when Applicable**

**Position 14**  
**Eaton Assigned Design Code**

---

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

---

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

2. **C**  
   G 3/4 (BSP) O-ring with G 1/4 (BSP) O-ring Case Drain and Check Valve

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

4. **A**  
   7/8-14 O-ring with 9/16-18 O-ring Case Drain with Hot Oil Shuttle Valve

5. **H**  
   M22 x 1,5-6H (ISO) O-ring with M12 x 1,5-6H O-ring Case Drain with Hot Oil Shuttle Valve

6. **00**  
   None

7. **01**  
   Viton Shaft Seal

8. **07**  
   Viton Seals

9. **13**  
   Seal Guard

10. **17**  
    Speed Sensor (Std.)

11. **0**  
    No Paint

12. **A**  
    Painted Low Gloss Black

13. **C**  
    Corrosion Protected

14. **0**  
    Assigned Code

15. **0**  
    Assigned Design Code
Disc Valve Hydraulic Motors

Specifications
6000 Series

Maximum Case Pressure - without Case Drain * — 70 Bar [1000 PSI]

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

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

<table>
<thead>
<tr>
<th>Pressure Bar (PSI)</th>
<th>Flow LPM</th>
<th>Torque (in-lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>35</td>
<td>300</td>
<td>200</td>
</tr>
<tr>
<td>40</td>
<td>350</td>
<td>250</td>
</tr>
<tr>
<td>45</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>50</td>
<td>450</td>
<td>350</td>
</tr>
</tbody>
</table>

#### 245 cm³/r [15.0 in³/r]

<table>
<thead>
<tr>
<th>Pressure Bar (PSI)</th>
<th>Flow LPM</th>
<th>Torque (in-lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>50</td>
<td>450</td>
<td>350</td>
</tr>
<tr>
<td>55</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>60</td>
<td>550</td>
<td>450</td>
</tr>
<tr>
<td>65</td>
<td>600</td>
<td>500</td>
</tr>
</tbody>
</table>

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.

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

### Continuous

<table>
<thead>
<tr>
<th>Pressure Bar (PSI)</th>
<th>Flow LPM</th>
<th>Torque (in-lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>50</td>
<td>450</td>
<td>350</td>
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<td>55</td>
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<td>450</td>
</tr>
<tr>
<td>65</td>
<td>600</td>
<td>500</td>
</tr>
</tbody>
</table>

### Intermittent

<table>
<thead>
<tr>
<th>Pressure Bar (PSI)</th>
<th>Flow LPM</th>
<th>Torque (in-lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>50</td>
<td>450</td>
<td>350</td>
</tr>
<tr>
<td>55</td>
<td>500</td>
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<tr>
<td>65</td>
<td>600</td>
<td>500</td>
</tr>
</tbody>
</table>
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.

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

Continuous

Intermittent
Disc Valve Hydraulic Motors

Dimensions — 6000 Series Standard Motor

<table>
<thead>
<tr>
<th>X Dim. mm</th>
<th>187.7</th>
<th>193.3</th>
<th>200.7</th>
<th>209.3</th>
<th>220.5</th>
<th>235.2</th>
<th>274.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y Dim. mm</td>
<td>270.1</td>
<td>275.6</td>
<td>283.0</td>
<td>291.6</td>
<td>302.8</td>
<td>318.5</td>
<td>357.4</td>
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</table>

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[in³/rev]</td>
<td>7.56</td>
<td>9.61</td>
<td>12.00</td>
<td>15.90</td>
<td>20.20</td>
<td>27.40</td>
<td>49.60</td>
</tr>
</tbody>
</table>

1-3/4 Inch Dia. Tapered Shaft
40 mm Dia. Straight Shaft
1-1/2 Inch Dia. Straight Shaft
1-1/2 Inch Dia. Spline Shaft

Shaft Dim.
See Page 59

Port B

Port Dim.
See Page 61

Case Drain Port
See Page 61

Shaded area

161.9 [6.375] Dia. Bolt Circle

127.00/126.87 [5.000/4.995] Dia.

13.59/12.57 [.535/.495]

94.5/91.4 [3.72/3.60]
93.2/90.1 [3.67/3.55]
16.0/13.5 [.63/.53]
78.7/75.6 [3.10/2.98]

Y Max.

Max. Port Dim.
See Page 61

114.5 [4.508] Square

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

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

Standard SAE CC Flange

40 mm Dia.
Straight Shaft
1-3/4 Inch Dia.
Tapered Shaft

150.4 [5.92] Max.

147.4 [5.80] Max.

24.6/24.1 [.97/.95]
Disc Valve Hydraulic Motors

Dimensions —
6000 Series
Wheel Motor

Port B

1-1/2 Inch Dia. Straight Shaft or
1-1/2 Inch Dia. Splined Shaft

40 mm Dia. Straight Shaft

1-3/4 Inch Dia. Tapered Shaft

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

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

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>195</th>
<th>245</th>
<th>310</th>
<th>390</th>
<th>490</th>
<th>625</th>
<th>985</th>
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<tbody>
<tr>
<td>[in³/r]</td>
<td>[11.9]</td>
<td>[15.0]</td>
<td>[19.0]</td>
<td>[23.9]</td>
<td>[30.0]</td>
<td>[38.0]</td>
<td>[60.0]</td>
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<tr>
<td>X Dim. mm</td>
<td>102.9</td>
<td>108.4</td>
<td>115.8</td>
<td>124.7</td>
<td>135.6</td>
<td>149.9</td>
<td>190.0</td>
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<td>[inch]</td>
<td>[4.05]</td>
<td>[4.27]</td>
<td>[4.56]</td>
<td>[4.91]</td>
<td>[5.34]</td>
<td>[5.90]</td>
<td>[7.48]</td>
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<tr>
<td>Y Dim. mm</td>
<td>185.2</td>
<td>190.8</td>
<td>198.2</td>
<td>207.1</td>
<td>216.0</td>
<td>233.0</td>
<td>272.6</td>
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<td>[inch]</td>
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<td>[7.80]</td>
<td>[8.15]</td>
<td>[8.58]</td>
<td>[9.17]</td>
<td>[10.73]</td>
</tr>
</tbody>
</table>
Disc Valve Hydraulic Motors

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

6000 Series Standard Motor with G 1 (BSP) Ports

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>310</th>
<th>390</th>
<th>490</th>
<th>625</th>
<th>800</th>
<th>800</th>
<th>800</th>
<th>985</th>
</tr>
</thead>
<tbody>
<tr>
<td>cm³/r</td>
<td>[19.0]</td>
<td>[24.0]</td>
<td>[38.0]</td>
<td>[45.0]</td>
<td>[49.0]</td>
<td>[60.0]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X Dim. mm</td>
<td>182.4</td>
<td>191.0</td>
<td>202.2</td>
<td>216.7</td>
<td>229.4</td>
<td>226.7</td>
<td>256.5</td>
<td></td>
</tr>
<tr>
<td>[inch]</td>
<td>[7.18]</td>
<td>[7.52]</td>
<td>[7.96]</td>
<td>[8.54]</td>
<td>[9.03]</td>
<td>[9.32]</td>
<td>[10.10]</td>
<td></td>
</tr>
<tr>
<td>Y Dim. mm</td>
<td>262.6</td>
<td>271.5</td>
<td>282.4</td>
<td>297.2</td>
<td>309.6</td>
<td>317.0</td>
<td>337.0</td>
<td></td>
</tr>
<tr>
<td>[inch]</td>
<td>[10.34]</td>
<td>[10.69]</td>
<td>[11.12]</td>
<td>[11.70]</td>
<td>[12.19]</td>
<td>[12.48]</td>
<td>[13.27]</td>
<td></td>
</tr>
</tbody>
</table>

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

Port Dim. (see page 61)

Case Drain Port (see page 61)

X

Y Max.

179,0 [7.04] Max.

141,43 [5.568] (4)

18,21/17,83 [.717/.702] Dia. Thru (4)

50 mm Dia. Straight Shaft

14,000/13,957 [.5512/.5495]

8,992/8,890 [.3540/.3500]

53,49/52,70 [.2106/2.075]

70,26/69,75 [2.766/2.746]

124,0/120,9 [4.88/4.76]

8,4/4,6 [.33/.18]


20,3/19,8 [.80/.78]

39,37/38,61 [1.550/1.520]

M12 x 1,75 [25,0 [.98] Min. Depth

Depth 50,000/49,974 [1.9685/1.9675]


Global Mount (Similar to ISO 3019/2)

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

182.4/179.0 [.717/7.04]

53,49/52,70 [.2106/2.075]

70,26/69,75 [2.766/2.746]

124,0/120,9 [4.88/4.76]

8,4/4,6 [.33/.18]


20,3/19,8 [.80/.78]

39,37/38,61 [1.550/1.520]
Disc Valve Hydraulic Motors

Dimensions —
6000 Series Bearingless Motor

<table>
<thead>
<tr>
<th>X Dim. mm (inch)</th>
<th>105.7 [4.16]</th>
<th>111.2 [4.38]</th>
<th>118.3 [4.66]</th>
<th>127.5 [5.02]</th>
<th>138.7 [5.46]</th>
<th>152.9 [6.02]</th>
<th>193.0 [7.60]</th>
</tr>
</thead>
</table>

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 hardened per Eaton specification.
Disc Valve Hydraulic Motors

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 [1.417647]
Base Diameter — Ref. 31.054652 [1.2226241]
Minor Diameter — 33.30 - 33.46 [1.311 - 1.318]
Form Diameter, Min. — 38.33 [1.508]
Fillet Radius — 0.64 - 0.76 [0.025 - 0.030]
Tip Radius — 0.25 - 0.51 [0.010 - 0.020]
Finish — 1.6 [63]
Involute Profile Variation — 0.000 - 0.025 [+0.0000 - 0.0010]
Total Index Variation — 0.038 [0.0015]
Lead Variation — 0.013 [0.005]
Circular Space Width:
  Maximum Actual — 5.898 [2322]
  Minimum Effective — 5.804 [2286]
  Maximum Effective — Ref. 5.857 [2306]
  Minimum Actual — Ref. 5.834 [2297]
Dimension Between Two Pins — Ref. 52.929 - 54.084 [2.062 - 2.106]
Pin Diameter — 6.223 [0.2450] Pins to Have 4.0 [0.160] Wide Flats 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 50 HRC) of 0.075 - 1.02 [0.030 - 0.040]
   (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. Countersbore designed to adapt to a standard
   sleeve bearing 50.010 - 50.038 [1.9898 - 1.9900] ID
Disc Valve Hydraulic Motors

Dimensions — Shafts

6000 Series

1-1/2 Inch Straight

78,6/75,8 [3.10/2.98] End of Shaft to Mounting Surface (Std)

9,56/9.52 [.376/.375]

42,0/40,6 [1.65/1.60]

1328 [11750]
Max. Torque Nm [lb-in]

3/8-16 UNC x 18.5 [.73] Deep

42.40/42,13 [1.669/1.659]

2,23 [.087]

38,10/38.04 [1.500/1.498]

Max. Coupling

1-3/4 Inch Tapered

78,6/75,8 [3.10/2.98] End of Shaft to Mounting Surface (Std)

3/8-16 UNC x 18.5 [.73] Deep

40,3 [1.59]

Min. Full Spline

1328 [11750]
Max. Torque Nm [lb-in]

External Involute Spline, 12.24 DP
17 Tooth 30° P.A.
Flat Root Side Fit
per ANSI B92.1, 1970

38,10 [1.500]

Dia. Ref.

56,7 [.223]

Max. Coupling

SAE J501 Standard Tapered Shaft
125.00 ± 0.17 Taper per Meter
[1.500 ± .002 Taper per Foot]

44.45 [1.750] Dia.

77,0 [3.03]

1-1/4-18 UNEF

11,138/11.112 [.4385/ .4375]

5,54/5.20 [.218/.205]

1-1/2 Inch 17 Tooth Splined

94,4/91.6 [3.72/3.60] End of Shaft to Mounting Surface (Std)

12,000/11,957 [.4724/.4708]

8,000/7,910 [.3149/.3115]

43,03/42.72 [1.694/1.682]

M12 x 1.75 -6H
25 mm [.984] Deep

40,018/39.992 [1.5755/1.5745]

75,6 [2.98]

Max. Coupling

40 mm Straight

178,1/175,0 [7.02/6.89] End of Shaft to Mounting Surface (Whl)

4,1 [.16]

Dia. Thru

2107 [18650]
Max. Torque Nm [lb-in]

44.45 [1.750] Dia.

178,1/175,0 [7.02/6.89] End of Shaft to Mounting Surface (Whl)

55,4 [2.18]

4,1 [.16]

1-1/4-18 UNEF

11,138/11.112 [.4385/.4375]

5,54/5.20 [.218/.205]

1-3/4 Inch Tapered

Tapered Shaft Hub Data

Hub

60,17/57.78 [.2369/2.275]

55,4 [2.18]

4,1 [.16]

1-1/4-18 UNEF

11,2 [.44]

178,1/175,0 [7.02/6.89] End of Shaft to Mounting Surface (Whl)

15,7 [.62]

Slotted Hexagon Nut

Recommended Torque:
(645 Nm [475 lb-ft] Dry)
(510 Nm [375 lb-ft] Lub)
Plus Torque required to align the slotted nut with the Shaft Crosshole.

38,10/38.04 [1.500/1.498]

Max. Coupling

3/8-16 UNC x 18.5 [.73] Deep

External Involute Spline, 12.24 DP
17 Tooth 30° P.A.
Flat Root Side Fit
per ANSI B92.1, 1970

40,18/39.992 [1.5755/1.5745]

Max. Torque Nm [lb-in]

1328 [11750]

Slotted Hexagon Nut

11,2 [.44]

15,7 [.62]

55,4 [2.18]

4,1 [.16]

1-1/4-18 UNEF

5,54/5.20 [.218/.205]
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.

<table>
<thead>
<tr>
<th>RPM</th>
<th>Multiplication Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1.23</td>
</tr>
<tr>
<td>100</td>
<td>1.00</td>
</tr>
<tr>
<td>200</td>
<td>.81</td>
</tr>
<tr>
<td>300</td>
<td>.72</td>
</tr>
<tr>
<td>400</td>
<td>.66</td>
</tr>
<tr>
<td>500</td>
<td>.62</td>
</tr>
<tr>
<td>600</td>
<td>.58</td>
</tr>
<tr>
<td>700</td>
<td>.56</td>
</tr>
<tr>
<td>800</td>
<td>.54</td>
</tr>
</tbody>
</table>

For 3,000,000 Shaft revolutions or 500 hours — Increase these shaft loads 52%.
Dimensions — Ports 6000 Series

- **1-5/16-12 O-ring Ports** (2) or **G 1 (BSP) Ports** (2)
- **7/16-20 UNF O-ring** or **G 1/4 (BSP) Port Case Drain**

See Pages 54-57

6000 Series with Shuttle Valve

- **1-5/16-12 O-ring Ports** (2) with Shuttle
- **9/16-18 UNF O-ring**

See Pages 54-57

**4 Bolt 3/4 Inch Split Flange**
- **Ports to Fit SAE J518c** (2)

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

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

---

See Pages 54-57

---

<table>
<thead>
<tr>
<th>Port A</th>
<th>Port B</th>
</tr>
</thead>
<tbody>
<tr>
<td>58.0/56.3 [2.28/2.22]</td>
<td>66.0/66.0 [2.60/2.60] Max.</td>
</tr>
<tr>
<td>66.0/66.0 [2.60/2.60] Max.</td>
<td>82.3/82.3 [3.24/3.24] Max.</td>
</tr>
<tr>
<td>44.2/39.6 [1.74/1.56]</td>
<td>13.8/10.6 [.54/.42]</td>
</tr>
<tr>
<td>20.7/17.4 [.80/.70]</td>
<td>22.23 [.875]</td>
</tr>
<tr>
<td>23.9 [.94]</td>
<td>11.2 [.44]</td>
</tr>
<tr>
<td>47.63 [1.875]</td>
<td>22.23 [.875]</td>
</tr>
<tr>
<td>35.9/34.7 [1.414/1.366]</td>
<td>19.4/18.7 [.765/.735]</td>
</tr>
</tbody>
</table>

---

| 7/16-20 UNF O-ring or G 1/4 (BSP) Port Case Drain |
| 19.4/18.7 [.765/.735] | 35.9/34.7 [1.414/1.366] |
| 19,4/18,7 [.765/.735] | 47,63 [1.875] |
| 45° | 11,2 [.44] |
| 22.23 [.875] | 20,7/17,4 [.80/.70] |
| 23,9 [.94] | 47,63 [1.875] |
| 45° | 11,2 [.44] |
| 22.23 [.875] | 20,7/17,4 [.80/.70] |
## Disc Valve Hydraulic Motors

### 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.

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Shaft</th>
<th>Ports</th>
<th>Displacement cm³/r [in³/r] and Product Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>1-1/2 inch Straight</td>
<td>1-5/16 O-ring</td>
<td>1065 -1066 -1067 -1068 -1107 -1069</td>
</tr>
<tr>
<td></td>
<td>40 mm Straight</td>
<td>G1 (BSP)</td>
<td>112-1094 -1095 -1096 -1097 -1098 — -1099</td>
</tr>
<tr>
<td></td>
<td>1-1/2 inch T Splayed</td>
<td>1-5/16 O-ring</td>
<td>112-1058 -1059 -1060 -1061 -1062 -1109 -1063</td>
</tr>
<tr>
<td></td>
<td>G1 (BSP)</td>
<td>112-1088 -1089 -1090 -1091 -1092 — -1093</td>
<td></td>
</tr>
<tr>
<td>Wheel Motor</td>
<td>40 mm Straight</td>
<td>G1 (BSP)</td>
<td>113-1082 -1083 -1084 -1085 -1086 -1100 -1087</td>
</tr>
<tr>
<td>Bearingless</td>
<td></td>
<td>G1 (BSP)</td>
<td>114-1031 -1032 -1033 -1034 -1035 -1055 -1036</td>
</tr>
<tr>
<td></td>
<td></td>
<td>114-1043 -1044 -1045 -1046 -1047 — -1048</td>
<td></td>
</tr>
</tbody>
</table>

**Product Numbers – 6000 Series**

Mounting Type - Standard (Code H), 4 Bolt:
- • 160.0 [6.30] Pilot Dia.
- • 18.01 [0.709] 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.

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Shaft</th>
<th>Ports</th>
<th>Displacement cm³/r [in³/r] and Product Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>50 mm Straight</td>
<td>G1 (BSP)</td>
<td>112-1217 -1218 -1215 -1216 -1247 -1219 -1220</td>
</tr>
</tbody>
</table>

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.
Disc Valve Hydraulic Motors

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

<table>
<thead>
<tr>
<th>Position 1</th>
<th>Product Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>M ..........</td>
<td>Motor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 2, 3</th>
<th>6000 Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>06 ...........</td>
<td>6000 Series</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 4, 5</th>
<th>Displacement cm³/r [in³/r]</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 ...........</td>
<td>195 [11.9]</td>
</tr>
<tr>
<td>15 ...........</td>
<td>245 [15.0]</td>
</tr>
<tr>
<td>19 ...........</td>
<td>310 [19.0]</td>
</tr>
<tr>
<td>24 ...........</td>
<td>390 [23.9]</td>
</tr>
<tr>
<td>30 ...........</td>
<td>490 [30.0]</td>
</tr>
<tr>
<td>38 ...........</td>
<td>625 [38.0]</td>
</tr>
<tr>
<td>45 ...........</td>
<td>740 [45.0]*</td>
</tr>
<tr>
<td>49 ...........</td>
<td>805 [49.0]*</td>
</tr>
<tr>
<td>60 ...........</td>
<td>985 [60.0]</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Position 6</th>
<th>Mounting Flange</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ..........</td>
<td>4 Bolt (Bearingless 127,0 [5.00] Pilot Dia. and 14,3 [.56] Dia. Mounting Holes 161,9 [6.38] Dia. B.C.</td>
</tr>
<tr>
<td>B ..........</td>
<td>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.</td>
</tr>
<tr>
<td>H ..........</td>
<td>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</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 7, 8</th>
<th>Output Shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 ..........</td>
<td>Bearingless</td>
</tr>
<tr>
<td>01 ..........</td>
<td>1–1/2 inch Dia. Straight with Straight Key, 3/8-16 Threaded Hole and 56,7 [2.23] Max. Coupling Length</td>
</tr>
<tr>
<td>02 ..........</td>
<td>1–3/4 inch Dia. Tapered with Straight Key and 1–1/4 - 18 UNEF Slotted Hex. Nut</td>
</tr>
<tr>
<td>03 ..........</td>
<td>1–1/2 inch Dia. Splined 17T with 40,3 [1.59] Min. Full Spline Length and 3/8-16 Threaded Hole</td>
</tr>
<tr>
<td>10 ..........</td>
<td>40 mm Dia. Straight with Straight Key, M12 x 1,75-6H Threaded Hole</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 9</th>
<th>Port Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ..........</td>
<td>1–5/16 - 12 O-ring with 7/16-20 O-ring Case Drain and Check Valve</td>
</tr>
<tr>
<td>B ..........</td>
<td>3/4 inch 4 Bolt Split Range with 7/16-20 O-ring Case Drain and Check Valve</td>
</tr>
<tr>
<td>C ..........</td>
<td>G 1/4 (BSP) O-ring with G 1/4 (BSP) O-ring Case Drain and Check Valve</td>
</tr>
<tr>
<td>D ..........</td>
<td>1–5/16-20 O-ring with (2) 9/16-18 O-ring Case Drain and Hot Oil Shuttle Valve</td>
</tr>
<tr>
<td>R ..........</td>
<td>1–5/16-12 O-ring with (2) 9/16-18 O-ring Ports for External Lubrication Circuit (both case ports must be connected)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 10, 11</th>
<th>Special Features (Hardware)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 ...........</td>
<td>None</td>
</tr>
<tr>
<td>10 ..........</td>
<td>Viton Shaft Seal</td>
</tr>
<tr>
<td>07 ..........</td>
<td>Viton Seals</td>
</tr>
<tr>
<td>13 ..........</td>
<td>Reverse Rotation</td>
</tr>
<tr>
<td>14 ..........</td>
<td>Seal Guard</td>
</tr>
<tr>
<td>21 ..........</td>
<td>Speed Sensor (Std.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 12</th>
<th>Paint/Special Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 ..........</td>
<td>No Paint</td>
</tr>
<tr>
<td>A ..........</td>
<td>Painted Low Gloss Black</td>
</tr>
<tr>
<td>B ..........</td>
<td>Corrosion Protected</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 13</th>
<th>Eaton Assigned Code when Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 ..........</td>
<td>Assigned Code</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 14</th>
<th>Eaton Assigned Design Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 ..........</td>
<td>Assigned Design Code</td>
</tr>
</tbody>
</table>
Disc Valve Hydraulic Motors

Specifications 10,000 Series

Specifications 10,000 Series

![Diagram of disc valve hydraulic motor]

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

**Continuous**

- Maximum Case Pressure - without Case Drain — 20 Bar [300 PSI]

**Intermittent**

- Peak Operation — 1% of every minute.

**Peak Operation**

- 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.

### Specification Data — 10,000 Series

<table>
<thead>
<tr>
<th>Displ. cm³/r [m³/hr]</th>
<th>345 [21.0]</th>
<th>480 [29.3]</th>
<th>665 [40.6]</th>
<th>940 [57.4]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Speed (RPM) @ Flow</td>
<td>Continuous</td>
<td>501</td>
<td>354</td>
<td>254</td>
</tr>
<tr>
<td></td>
<td>Intermittent</td>
<td>784</td>
<td>552</td>
<td>396</td>
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<tr>
<td></td>
<td>Intermittent</td>
<td>265 [70]</td>
<td>265 [70]</td>
<td>265 [70]</td>
</tr>
</tbody>
</table>

*For back pressure over 20 Bar [300 PSI] use an external case drain. Install case drain lines so that the motor case remains filled at all times.

Maximum inlet pressure — 275 Bar [4000 PSI]. Do not exceed Δ pressure rating (see chart above).

Maximum return pressure — 275 Bar [4000 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 — 1% of every minute.

Peak Operation — 1% of every minute.

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 65-66.
## Performance Data
### 10,000 Series

<table>
<thead>
<tr>
<th>Disc Valve Hydraulic Motors</th>
<th>345 cm³/r [21.0 in³/r]</th>
<th>480 cm³/r [29.3 in³/r]</th>
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<tbody>
<tr>
<td><strong>Flow LPM</strong></td>
<td>Δ Pressure Bar [PSI]</td>
<td>Δ Pressure Bar [PSI]</td>
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<tr>
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<td>235</td>
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<tr>
<td>2500</td>
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<td>240</td>
</tr>
<tr>
<td>2550</td>
<td>245</td>
<td>245</td>
</tr>
<tr>
<td>2600</td>
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<td>250</td>
</tr>
<tr>
<td>2650</td>
<td>255</td>
<td>255</td>
</tr>
</tbody>
</table>

**Torque (lb-in) Nm** | **Speed RPM**
--- | ---
250 | 265 | 768 | Continuous | Intermittent

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.

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

### 10,000 Series

**Torque [lb-in]**

| RPM | 3 | 4 | 5 | 6 | 7 | 10 | 12 | 15 | 18 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 150 | 180 | 200 | 220 | 250 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1500 | 1800 | 2000 | 2200 | 2500 | 3000 | 3500 | 4000 | 5000 | 6000 | 7000 | 8000 | 10000 |
| 3600 | 340 | 330 | 320 | 310 | 300 | 290 | 280 | 270 | 260 | 250 | 240 | 230 | 220 | 210 | 200 | 190 | 180 | 170 | 160 | 150 | 140 | 130 | 120 | 110 | 100 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 | 4 | 3 |

**Speed RPM**

### 940 cm³/r (57.4 in³/r)

**Pressure Bar [PSI]**

| RPM | 12 | 15 | 18 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 150 | 180 | 200 | 220 | 250 | 300 | 350 | 400 | 450 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1500 | 1800 | 2000 | 2200 | 2500 | 3000 | 3500 | 4000 | 5000 | 6000 | 7000 | 8000 | 10000 |
| 3600 | 67 | 70 | 73 | 76 | 80 | 83 | 86 | 89 | 92 | 95 | 98 | 101 | 104 | 107 | 110 | 113 | 116 | 119 | 122 | 125 | 128 | 131 | 134 | 137 | 140 | 143 | 146 | 149 | 152 | 155 | 158 | 161 | 164 | 167 | 170 | 173 | 176 | 180 | 183 | 186 | 190 |

---

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.

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

Dimensions —
10,000 Series
Standard Motor

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>345</th>
<th>480</th>
<th>665</th>
<th>940</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[21.0]</td>
<td>[29.2]</td>
<td>[40.6]</td>
<td>[57.4]</td>
</tr>
<tr>
<td>X Dim, mm</td>
<td>282.4</td>
<td>295.1</td>
<td>295.1</td>
<td>313.4</td>
</tr>
<tr>
<td></td>
<td>[11.12]</td>
<td>[11.62]</td>
<td>[11.62]</td>
<td>[12.34]</td>
</tr>
<tr>
<td>Y Dim, mm</td>
<td>381.0</td>
<td>393.7</td>
<td>393.7</td>
<td>412.0</td>
</tr>
<tr>
<td></td>
<td>[15.00]</td>
<td>[15.50]</td>
<td>[15.50]</td>
<td>[16.22]</td>
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</tbody>
</table>

Standard Rotation
Viewed from Shaft End
Port A Pressurized — CW
Port B Pressurized — CCW
Disc Valve Hydraulic Motors

Dimensions —
10,000 Series Wheel Motor

<table>
<thead>
<tr>
<th>X Dim. mm</th>
<th>345 [21.0]</th>
<th>480 [29.2]</th>
<th>665 [40.6]</th>
<th>940 [57.4]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>166.9 [6.57]</td>
<td>179.6 [7.07]</td>
<td>179.6 [7.07]</td>
<td>197.8 [7.79]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y Dim. mm</th>
<th>266.2 [10.48]</th>
<th>278.9 [10.98]</th>
<th>278.9 [10.98]</th>
<th>297.5 [11.71]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>10.48</td>
<td>10.98</td>
<td>10.98</td>
<td>11.71</td>
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</tbody>
</table>

Displ.

<table>
<thead>
<tr>
<th>cm³/r</th>
<th>345</th>
<th>480</th>
<th>665</th>
<th>940</th>
</tr>
</thead>
<tbody>
<tr>
<td>m³/h</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Shaft Dim. See Page 71

2-1/4 Inch Dia. Straight Shaft

2-1/4 Inch Dia. Tapered Shaft

2-1/8 Inch Dia. Splined Shaft

184.9 [7.28] Square Max.

Port B

134.1/133.8 [5.28/5.27]

230.9/226.5 [9.09/8.92]

208.3/204.2 [8.20/8.04]

9/16-18 UNC O-ring Case

Drain Port

17,02/16,51 [.670/.650] Dia. (4)

209.55 [8.250] Dia. Bolt Circle

Port A

130.5/128.0 [5.14/5.04]

5.9/4.8 [.23/.19]

2-1/4 Inch Dia. Straight Shaft

2-1/4 Inch Dia. Tapered Shaft

2-1/8 Inch Dia. Splined Shaft

177.80/177.67 [7.000/6.995] Dia. (2)

146.0 [5.75] Dia.

127.0 [5.00] Dia.


130.5/128.0 [5.14/5.04]

2-1/4 Inch Dia. Splined Shaft

2-1/2 Inch Dia. O-ring Case

Drain Port

134.1/133.8 [5.28/5.27]

208.3/204.2 [8.20/8.04]

17,02/16,51 [.670/.650] Dia. (4)

209.55 [8.250] Dia. Bolt Circle

Port B

Shaft Dim. See Page 71

209.55 [8.250] Dia. Bolt Circle

17,02/16,51 [.670/.650] Dia. (4)
Disc Valve Hydraulic Motors

Dimensions —
10,000 Series Bearingless Motor

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

10,000 Series Bearingless Motor

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X Dim. mm</td>
<td>189.5 [7.46]</td>
<td>202.2 [7.96]</td>
<td>202.2 [7.96]</td>
<td>221.0 [8.70]</td>
</tr>
</tbody>
</table>

For 10,000 Series bearingless motor motor application information contact your Eaton representative (mating coupling blanks available from Eaton Corporation).

Note: After machining blank, part must be hardend per Eaton specification.

Mating Coupling Blank
Eaton Part No. 13280-001
Dimension D mm [inch]
13280-001 133.6/128.5 [5.26/5.06]

Mating Coupling Blank
Eaton Part No. 13280-002
Dimension D mm [inch]
13280-002 156.0/150.9 [6.14/5.94]
Bearingless Installation —
10,000 Series

Spline Pitch — 10/20
Pressure Angle — 30°
Number of teeth — 16
Class of Fit — Ref. 5
Type of Fit — Side
Pitch Diameter — Ref. 40.640000 [1.6000000] • 0.25 [0.010] D
Base Diameter — Ref. 35.195272 [1.3856406]
Minor Diameter — 36.83 - 37.08 [1.450 - 1.460]
Form Diameter, Min. — 42.47 [1.672]
Rillet Radius — 0.64 - 0.76 [.025 -.030]
Tip Radius — 0.25 - 0.51 [.010 -.020]
Finish — 1.6 [63]
Involute Profile Variation — +0.000 - 0.028 [+0000 -.0011]
Total Index Variation — 0.041 [.0016]
Lead Variation — 0.013 [.0005]
Circular Space Width:
  Maximum Actual — 4.105 [.1616]
  Minimum Effective — 3.995 [.1573]
  Maximum Effective — Ref. 4.056 [.1597]
  Minimum Actual — Ref. 4.018 [.1582]
Dimension Between Two Pins — Ref. 34.272 - 34.450 [1.3493 - 1.3563]

1 Internal spline in mating part to be as follows:
  Material to be ASTM A304, 8620H.
  Carborize to a hardness of 58-64 HRc with case depth (to 50HRc) of 0.076 - 1.02 [.030 - .040]
  (dimensions apply after heat treat).
Disc Valve Hydraulic Motors

Dimensions — Shafts
10,000 Series

2-1/4 Inch Straight

Involute Spline
Flat Root Major Dia. Fit
8/16 Pitch 16 Tooth
per ANSI B92.1, 1976

2712 [24000]
Max. Torque Nm [lb-in]

1/2-20 UNF
x 23.8 [.94]
Deep

62.92/62.66
[2.477/2.467]

57.15/57.137
[2.250/2.2495]
Dia.

114.0/112.0 [4.49/4.41] End of Shaft to Mounting Surface (Std)

12.73/12.70
[.501/.500]
Sq. Key

120.836
[4.730]

57.5 [2.250]
Max. Coupling

63.5 [2.50]

2-1/8 Inch 16 Tooth Splined

Involute Spline
Flat Root Major Dia. Fit
8/16 Pitch 16 Tooth
per ANSI B92.1, 1976

2712 [24000]
Max. Torque Nm [lb-in]

1/2-20 UNF
x 23.8 [.94]
Deep

53.972
[2.1249]
Major Dia.

57.15
[2.250]
Dia.

75.0 [2.95] Max. Coupling

52.1 [2.05]

2-1/4 Inch Tapered

SAE J501 Standard Tapered Shaft
125.00 ± 0.17 Taper per Meter
[1.500 ± .02 Taper per Foot]


4.07/3.55
[.160/.140]
Dia. Thru

57.15
[2.250]
Dia. 1-1/2-18 UNEF

95.0
[3.74]

50.8 [2.00]

2712 [24000]
Max. Torque Nm [lb-in]

14.313/14.287
[.5635/.5625]
Sq. Key

7.14/6.80 [.281/.268]

Max. Coupling

57.15
[2.250]
Dia.

1-1/2-18 UNEF

57.150/57,137
[2.250/2.2495]
Dia.

97.5 [3.84] Max. Coupling

End of Shaft to Mounting Surface (Std)

91.7/89.7 [3.61/3.53]

End of Shaft to Mounting Surface (Whl)

114.0/112.0 [4.49/4.41]

Max. Torque Nm [lb-in]

2712 [24000]

60.0
[2.37]

10.9 [.43]

1/2-20 UNF
1.52 [.06] x 45°
Chamfer

4.1 [.16]

15.7 [.62]

30°

30°

Slotted Hexagon Nut

Hub

Tapered Shaft Hub Data

Recommended Torque:
(1150 Nm [850 lb-ft] Dry)
( 880 Nm [650 lb-ft] Lub)
Plus Torque required to align the slotted nut with the Shaft Crosshole.

Max. Coupling

57.15
[2.250]
Dia.

95.0
[3.74]
Shaft Side Load Capacity
10,000 Series

This curve indicates 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.

<table>
<thead>
<tr>
<th>RPM</th>
<th>Multiplication Factor</th>
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<td>100</td>
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<tr>
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<td>700</td>
<td>.56</td>
</tr>
<tr>
<td>800</td>
<td>.54</td>
</tr>
</tbody>
</table>

For 3,000,000 Shaft revolutions or 500 hours — Increase these shaft loads 52%.
Disc Valve Hydraulic Motors

Dimensions — Ports 10,000 Series

1-1/4 Inch Split Flange Ports (2)

Port B
15.10 [.594] (2)
30.20 [1.188] (2)
75.5/74.9 [2.97/2.95]
9/16-18 UNF O-ring Case Drain Port

Port A
29.40 [1.156]
30.8/29.2 [1.21/1.15]

7/16-14 UNC x 29.2 [1.15] Deep (8)

See Pages 67-69

9/16-18 UNF O-ring Case Drain Port

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

Port B
76.2/74.1 [3.00/2.92]

Port A
30.8/29.2 [1.21/1.15]

7/16-14 UNC x 29.2 [1.15] Deep (8)

See Pages 67-69

9/16-18 UNF O-ring Case Drain Port

10,000 Series Motor End View — Common Dim.

154.0 [6.06] Max.

74.0/72.1 [2.91/2.84]

9/16-18 UNF O-ring Case Drain Port

16.8/15.7 [.66/.62]

Standard Rotation 10,000 Series Viewed from Shaft End
Port A Pressurized — CW
Port B Pressurized — CCW

See Pages 67-69
## Product Numbers—10,000 Series Motors

Use digit prefix —119-, 120-, or 121- plus four digit number from charts for complete product number—Example 121-1014. Orders will not be accepted without three digit prefix.

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Shaft</th>
<th>Product Numbers</th>
<th>Displacement cm³/r [in³/r]</th>
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</thead>
<tbody>
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<td></td>
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<td>345</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>480</td>
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<td></td>
<td></td>
<td></td>
<td>665</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>940</td>
</tr>
<tr>
<td>2-1/4 inch Straight</td>
<td>1-5/16 O-ring</td>
<td>119-1028</td>
<td>-1029 -1030 -1031</td>
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<tr>
<td></td>
<td>1-1/4 Split Range</td>
<td>119-1040</td>
<td>-1041 -1042 -1043</td>
</tr>
<tr>
<td>2-1/8 Inch 16 T Spline</td>
<td>1-5/16 O-ring</td>
<td>119-1032</td>
<td>-1033 -1034 -1035</td>
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<td></td>
<td>1-1/4 Split Range</td>
<td>119-1044</td>
<td>-1045 -1046 -1047</td>
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<td>2-1/4 Inch Tapered</td>
<td>1-5/16 O-ring</td>
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<td>-1037 -1038 -1039</td>
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<td>1-1/4 Split Range</td>
<td>119-1048</td>
<td>-1049 -1050 -1051</td>
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<td>Wheel Motor</td>
<td>2-1/4 inch Straight</td>
<td>120-1005</td>
<td>-1006 -1007 -1008</td>
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<td>1-1/4 Split Range</td>
<td>120-1017</td>
<td>-1018 -1019 -1020</td>
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<td></td>
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<td>1-1/4 Split Range</td>
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<td>-1022 -1023 -1024</td>
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<td>2-1/4 Inch Tapered</td>
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</tr>
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<td>1-1/4 Split Range</td>
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<td>Bearingless</td>
<td>1-5/16 O-ring</td>
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<td>-1008 -1009 -1010</td>
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<td>1-1/4 Split Range</td>
<td>121-1011</td>
<td>-1012 -1013 -1014</td>
</tr>
</tbody>
</table>

For 10,000 Series motors with a configuration *Not Shown* in the charts above: Contact your Eaton representative.
## Disc Valve Hydraulic Motors

### Model Code for 10,000 Series Motors

The following 14-digit coding system has been developed to identify all of the configuration options for the 10000 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 — 10,000 Series Disc Valve Motors**

<table>
<thead>
<tr>
<th>Position 1</th>
<th>Product Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>M ..........</td>
<td>Motor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 2, 3</th>
<th>10 000 Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ...........</td>
<td>10 000 Series</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 4, 5</th>
<th>Displacement cm³/r [in³/r]</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 ...........</td>
<td>345 [21.0]</td>
</tr>
<tr>
<td>29 ...........</td>
<td>480 [29.2]</td>
</tr>
<tr>
<td>40 ...........</td>
<td>665 [40.6]</td>
</tr>
<tr>
<td>57 ...........</td>
<td>940 [57.4]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 6</th>
<th>Mounting Flange</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Position 7, 8</th>
<th>Output Shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 ...........</td>
<td>2–1/4 inch Dia. Straight with 12.7 [.50] Square Key x 63.5 [2.50] and 1/2 - 20 Threaded Hole</td>
</tr>
<tr>
<td>02 ...........</td>
<td>2–1/4 inch Dia. Tapered with 14.3 [.56] Square Key x 50.8 [2.00] and 1–1/2 - 18 UNEF-2A Threaded Shaft End and Slotted Hex Nut</td>
</tr>
<tr>
<td>03 ...........</td>
<td>2–1/8 inch 16 Tooth Splined with 52.1 [2.05] Min. Full Spline Length 1/2 - 20 UNF Threaded Hole</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 9</th>
<th>Port Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ..........</td>
<td>1–5/16—12 UN O-ring End Ports (Size -16), 9/16-18 UNF O-ring Case Drain Port (Size -6)</td>
</tr>
<tr>
<td>B ..........</td>
<td>1–1/4 Inch Split Flange Ports, 9/16 - 18 UNF O-ring Case Drain Port (Size -6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 10, 11</th>
<th>Special Features (Hardware)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 ............</td>
<td>None</td>
</tr>
<tr>
<td>01 ............</td>
<td>Free Running Geroler</td>
</tr>
<tr>
<td>03 ............</td>
<td>Reverse Rotation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 12</th>
<th>Paint/Special Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ............</td>
<td>No Paint</td>
</tr>
<tr>
<td>A ............</td>
<td>Painted Low Gloss Black</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 13</th>
<th>Eaton Assigned Code when Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ............</td>
<td>Assigned Code</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position 14</th>
<th>Eaton Assigned Design Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ............</td>
<td>Assigned Design Code</td>
</tr>
</tbody>
</table>
Two Speed Motor —
10,000 Series

The Eaton 10,000 Series motors are available with an integral two speed feature that changes the displacement in a ratio of 1 to 2 and shifts the motor from a low speed high torque (LSHT) mode to a high speed low torque (HSLT) mode. The open center selector valve shifts the speed mode from low to high speed when pilot pressure of 6.9 Bar [100 PSI] minimum is applied to the pilot port (6.9 Bar [100 PSI] higher than case pressure). In the high speed mode torque values are approximately one half with twice the speed of the conventional 10,000 Series single speed motors.

An external two position three way valve is required for shifting the pilot pressure port between signal pressure (HSLT) and low pressure (LSHT).

Two speed motors are available with a return line closed center shuttle for closed circuit applications.

Low speed high torque mode is the normal position of the speed selector valve. When a differential pressure is supplied to the pilot port and 6.9 Bar [100 PSI] is reached, the selector valve overcomes the return spring force and the spool shifts to the high speed mode. The oil in the opposite side of the spool is drained internally. Pressure between the pilot supply and case drain or return line (depending on open or closed circuit system) must be maintained to keep the motor in the high speed mode.

When pilot pressure is removed from the pilot port the pressure in the pilot end of the spool valve is relieved and drained back through this three way valve, the spring force returns the spool valve to LSHT position.

Pilot pressure may come from any source that will provide uninterrupted pressure during the high speed mode operation. Pilot pressure 6.9 Bar [100 PSI] minimum, up to the full operating pressure of the motor.

In normal LSHT operation the Char-Lynn two speed motor will function with equal shaft output in either direction (CW or CCW), the same as the single speed Char-Lynn disc valve motors.

However, to prevent cavitation in the HSLT mode, the preferred direction of shaft rotation is counter clockwise (port B pressurized). This unique disc valve is not symmetrical in porting the fluid for the HSLT mode. Consequently, when the pressure is reversed for HSLT CW rotation, cavitation can occur. Installing a restriction (14 - 34 Bar [200 - 500 PSI]) in the hydraulic line that connects port B will prevent cavitation (see page 75).

If you are operating in a critical area and a restriction in the hydraulic line causes concern, these two speed motors can be ordered timed with CW preferred HSLT shaft rotation. Hence, with this option port B will have to be pressurized for CW preferred HSLT shaft rotation. The restriction recommended for the line connecting port B remains unchanged.

Finally in closed circuit applications a hydraulic line restriction is not required. Instead, the charge pump can be used to supply and maintain a minimum pressure of 14 Bar [200 PSI].

Note: Be certain in closed loop applications that the charge pump when used for back pressure on the B port, has sufficient displacement to maintain charge pressure especially in dynamic braking or overrunning load conditions.

Important! Due to potential problems in maintaining charge pump pressure at port B for uninterrupted back pressure during dynamic braking, Eaton does not recommend the two speed motor where overrunning conditions may exist.

Performance Data
Two Speed Motor —
10,000 Series

In the high speed mode torque values are approximately one half with twice the speed of the conventional 10,000 Series single speed motors. In the low speed mode torque and speed values are the same as the conventional
Disc Valve Hydraulic Motors

Two Speed Motor — 10,000 Series

Pump Pressure and Return, and Shaft Rotation Directional Control Valve

Schematic diagram below applies to 10,000 Series two speed motors — differs only in orientation of shift valve spool and spring (this orientation of spool and spring positions the pilot port on the opposite side of the port face).

Two Speed Motor — 10,000 Series

Torque - RPM
2 - Speed Operating Range

Low Speed
High Torque

Maximum System Horsepower Curve

High Speed
Low Torque
### Specifications — Two Speed 10,000 Series

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

**Maximum Case Pressure — without Case Drain**

* For back pressure over 20 Bar [300 PSI] use an external case drain. Install case drain lines so that the motor case remains filled at all times.

* Maximum inlet pressure — 275 Bar [4000 PSI]. Do not exceed Δ pressure rating (see chart above).

* Maximum return pressure — 275 Bar [4000 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.

**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

---

### Specification Data — 10,000 Series Two Speed

<table>
<thead>
<tr>
<th>Displ. cm³/r. [in³/r]</th>
<th>High Speed Mode</th>
<th>Low Speed Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>169 [10.3]</td>
<td>239 [14.6]</td>
</tr>
<tr>
<td></td>
<td>332.7 [20.3]</td>
<td>470 [28.7]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. Speed (RPM) @ Continuous Flow</th>
<th>High Speed Mode</th>
<th>Low Speed Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>750</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flow LPM [GPM]</th>
<th>High Speed Mode</th>
<th>Low Speed Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>130 [35]</td>
<td>170 [45]</td>
</tr>
<tr>
<td></td>
<td>170 [45]</td>
<td>170 [45]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Torque Nm [lb-in]</th>
<th>High Speed Mode</th>
<th>Low Speed Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>440 [3900]</td>
<td>1015 [9000]</td>
</tr>
<tr>
<td>Intermittent</td>
<td>585 [5200]</td>
<td>1355 [12000]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pressure Δ Bar [Δ PSI]</th>
<th>Continuous</th>
<th>Intermittent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>205 [3000]</td>
<td>275 [4000]</td>
</tr>
<tr>
<td></td>
<td>205 [3000]</td>
<td>205 [3000]</td>
</tr>
<tr>
<td></td>
<td>190 [2750]</td>
<td>260 [3750]</td>
</tr>
<tr>
<td></td>
<td>240 [3500]</td>
<td>275 [4000]</td>
</tr>
</tbody>
</table>

**Maximum Speed (RPM) @ Continuous Flow**

**Low Speed Mode**

### Reduced Motor Displacement

- Maximum torque and flow must not occur simultaneously. For permissible continuous and intermittent operating combinations of pressure and flow refer to performance data on pages 65-66 (LSHT only).

- For back pressure over 20 Bar [300 PSI] use an external case drain. Install case drain lines so that the motor case remains filled at all times.

- Maximum inlet pressure — 275 Bar [4000 PSI]. Do not exceed Δ pressure rating (see chart above).

- Maximum return pressure — 275 Bar [4000 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.

- 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.
Dimensions — Two Speed 10,000 Series Standard, Wheel, and Bearingless

### Two Speed Standard Motor

<table>
<thead>
<tr>
<th>Displ. cm³/r</th>
<th>345</th>
<th>480</th>
<th>665</th>
<th>940</th>
</tr>
</thead>
<tbody>
<tr>
<td>[in³/r]</td>
<td>[21.0]</td>
<td>[29.2]</td>
<td>[40.6]</td>
<td>[57.4]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>X Dim. mm</th>
<th>270.8</th>
<th>283.5</th>
<th>283.5</th>
<th>301.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>[10.66]</td>
<td>[11.16]</td>
<td>[11.16]</td>
<td>[11.88]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y Dim. mm</th>
<th>392.7</th>
<th>405.4</th>
<th>405.4</th>
<th>423.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>[15.46]</td>
<td>[15.96]</td>
<td>[15.96]</td>
<td>[16.69]</td>
</tr>
</tbody>
</table>

### Two Speed Wheel Motor

<table>
<thead>
<tr>
<th>X Dim. mm</th>
<th>155.2</th>
<th>167.6</th>
<th>167.6</th>
<th>186.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>[6.11]</td>
<td>[6.60]</td>
<td>[6.60]</td>
<td>[7.33]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y Dim. mm</th>
<th>278.1</th>
<th>290.8</th>
<th>290.8</th>
<th>309.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>[10.95]</td>
<td>[11.45]</td>
<td>[11.45]</td>
<td>[12.17]</td>
</tr>
</tbody>
</table>

### Two Speed Bearingless Motor

<table>
<thead>
<tr>
<th>X Dim. mm</th>
<th>146.0</th>
<th>159.0</th>
<th>159.0</th>
<th>177.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>[5.75]</td>
<td>[6.26]</td>
<td>[6.26]</td>
<td>[6.99]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y Dim. mm</th>
<th>265.5</th>
<th>281.2</th>
<th>281.2</th>
<th>299.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inch]</td>
<td>[10.57]</td>
<td>[11.07]</td>
<td>[11.07]</td>
<td>[11.79]</td>
</tr>
</tbody>
</table>

### Port Locations — Same as Shown Below

- **1 1/4 Inch Split Flange Ports (2)**
- **1-5/16-12 O-ring Ports (2)**
- **1/2-20 UNF-2B O-ring Case Drain Port Size 5**
- **3/8-24 O-ring Case — Pilot Control**
- **33.1/31.4 [1.30/1.24]**
- **36.1/35.0 [1.42/1.38]**
- **71.9/70.3 [2.83/2.77]**
- **90.0/87.0 [3.54/3.46]**
- **188.5 [7.42] Max.**
- **3/4-16 UNF-2B O-ring Case Drain Port Size 8**
- **105.5/104.3 [4.15/4.11]**
- **188.5 [7.42] Max.**
- **58.7/57.1 [2.31/2.25]**
- **19.6/18.5 [.77/.73]**
- **39.2/37.0 [1.54/1.46]**
- **59.2/58.1 [2.33/2.29]**
- **169.2 [6.66] Max.**
- **93.3/87.6 [3.47/3.45]**
- **13.8/13.2 [.54/.52]**
- **Standard Rotation Viewed from Shaft or Drive End**
- **Port A Pressurized — CW**
- **Port B Pressurized — CCW**

### Mounting and Roding Ranges

- **See Page 67-68**
- **See Page 71**
- **See Page 69**

---

<table>
<thead>
<tr>
<th>Shaft Dim.</th>
<th>Y Max.</th>
<th>X Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Speed Standard Motor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Two Speed Wheel Motor</th>
<th>Y Max.</th>
<th>X Max.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Two Speed Bearingless Motor</th>
<th>Y Max.</th>
<th>X Max.</th>
</tr>
</thead>
</table>
## Disc Valve Hydraulic Motors

### Product Numbers — Two Speed

#### 10,000 Series

**Product Numbers—10,000 Series Motors—2 Speed**

Use digit prefix — 119-, 120-, or 121- plus four digit number from charts for complete product number—Example 121-2002. Orders will not be accepted without three digit prefix.

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Shaft</th>
<th>Ports</th>
<th>Displ. cm³/r [in³/r]</th>
<th>Product Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>480 [29.3]</td>
<td></td>
</tr>
<tr>
<td>2-1/4 inch Straight</td>
<td>1-5/16 O-ring</td>
<td>119-2013</td>
<td>-2014</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-1/4 Split Range</td>
<td>119-2001</td>
<td>-2002</td>
<td>-2003</td>
</tr>
<tr>
<td>2-1/8 inch 16 T Splined</td>
<td>1-5/16 O-ring</td>
<td>119-2021</td>
<td>-2022</td>
<td>-2023</td>
</tr>
<tr>
<td></td>
<td>1-1/4 Split Range</td>
<td>119-2009</td>
<td>-2010</td>
<td>-2011</td>
</tr>
<tr>
<td></td>
<td>1-1/4 Split Range</td>
<td>120-2001</td>
<td>-2002</td>
<td>-2003</td>
</tr>
<tr>
<td>2-1/8 inch 16 T Splined</td>
<td>1-1/4 Split Range</td>
<td>120-2009</td>
<td>-2010</td>
<td>-2011</td>
</tr>
<tr>
<td></td>
<td>1-1/4 Split Range</td>
<td>121-2001</td>
<td>-2002</td>
<td>-2003</td>
</tr>
</tbody>
</table>

10,000 Series Motors with a configuration Not Shown in the charts above: Contact your Eaton Representative.
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.

<table>
<thead>
<tr>
<th>Cleanliness Code</th>
<th>Minimum</th>
<th>Best Range</th>
<th>ISO Cleanliness Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>18/13</td>
<td>20-43 cSt</td>
<td>100-200 SUS</td>
<td>70 SUS 13 cSt</td>
</tr>
</tbody>
</table>

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.

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.

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.
Disc Valve Hydraulic Motors

Motor Application
Information — Vehicle Drive Calculations

Step One — Calculate Motor Speed (RPM)

$$\text{RPM} = \frac{2.65 \times \text{KPH} \times G}{\text{R}_m} \quad \text{RPM} = \frac{168 \times \text{MPH} \times G}{\text{R}_1}$$

where KPH = vehicle speed (kilometers per hour)
where MPH = vehicle speed (miles per hour)
$\text{R}_m =$ rolling radius of tires (meter)
$\text{R}_1 =$ 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.

$$\text{RR} = \text{GVW} \times \rho \quad \text{(kg)} \quad \text{(lb)}$$

where GVW = gross (loaded) vehicle weight lb/Kg
$\rho =$ value from Table 1

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

<table>
<thead>
<tr>
<th>Surface</th>
<th>$\rho$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete, excellent</td>
<td>.010</td>
</tr>
<tr>
<td>Concrete, good</td>
<td>.015</td>
</tr>
<tr>
<td>Concrete, poor</td>
<td>.020</td>
</tr>
<tr>
<td>Asphalt, good</td>
<td>.012</td>
</tr>
<tr>
<td>Asphalt, fair</td>
<td>.017</td>
</tr>
<tr>
<td>Asphalt, poor</td>
<td>.022</td>
</tr>
<tr>
<td>Macadam, good</td>
<td>.015</td>
</tr>
<tr>
<td>Macadam, fair</td>
<td>.022</td>
</tr>
<tr>
<td>Macadam, poor</td>
<td>.037</td>
</tr>
<tr>
<td>Snow, 2 inch</td>
<td>.025</td>
</tr>
<tr>
<td>Snow, 4 inch</td>
<td>.037</td>
</tr>
<tr>
<td>Dirt, smooth</td>
<td>.025</td>
</tr>
<tr>
<td>Dirt, sandy</td>
<td>.040</td>
</tr>
<tr>
<td>Mud</td>
<td>.037 to .150</td>
</tr>
<tr>
<td>Sand, Gravel</td>
<td>.060 to .150</td>
</tr>
<tr>
<td>Sand, loose</td>
<td>.160 to .300</td>
</tr>
</tbody>
</table>

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.

$$\text{GR} = \text{GVW} \left( \sin \theta + \rho \cos \theta \right)$$

Table 2

<table>
<thead>
<tr>
<th>Comparison Grade (%)</th>
<th>Table Slope (Degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>0°35°</td>
</tr>
<tr>
<td>2%</td>
<td>1°9'</td>
</tr>
<tr>
<td>5%</td>
<td>2°51'</td>
</tr>
<tr>
<td>6%</td>
<td>3°26'</td>
</tr>
<tr>
<td>8%</td>
<td>4°35'</td>
</tr>
<tr>
<td>10%</td>
<td>5°43'</td>
</tr>
<tr>
<td>12%</td>
<td>6°5'</td>
</tr>
<tr>
<td>15%</td>
<td>8°31'</td>
</tr>
<tr>
<td>20%</td>
<td>11°19'</td>
</tr>
<tr>
<td>25%</td>
<td>14°3'</td>
</tr>
<tr>
<td>32%</td>
<td>18°</td>
</tr>
<tr>
<td>60%</td>
<td>31°</td>
</tr>
</tbody>
</table>

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:

$$\text{FA} = \frac{\text{KPH} \times \text{GVW} \times \rho}{3.6 \times t}$$

$$\text{FA} = \frac{\text{MPH} \times \text{GVW} \times \rho}{22 \times t}$$

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:

$$\text{FA} = \frac{\text{KPH} \times \text{GVW}}{3.6 \times t}$$

$$\text{FA} = \frac{\text{MPH} \times \text{GVW}}{22 \times t}$$

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).
Disc Valve Hydraulic Motors

**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.

\[
TE = RR + GR + FA + DP \quad \text{(Kg. or lb.)}
\]

- **Drawbar pull desired**
- **Force required to accelerate**
- **Force required to climb a grade**
- **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)**

\[
T = \frac{TE \times R}{N \times G \times Eg} \quad \text{(Nm / Motors)}
\]

\[
T = \frac{TE \times R}{N \times G \times Eg} \quad \text{(lb - in / Motors)}
\]

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.

\[
TS = \frac{W \times f \times R}{G \times Eg} \quad \text{(Nm / Motor)}
\]

\[
TS = \frac{W \times f \times R}{G \times Eg} \quad \text{(lb - in / Motor)}
\]

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**

\[
T = \frac{q \Delta P \times 1000}{62.8} \quad \text{Nm} = \frac{PSI \times GPM}{1714} \quad \text{lb - in}
\]

**Shaft Speed**

\[
\text{RPM} = \frac{\text{Row}}{\text{Displacement}}
\]

\[
\text{RPM} = \frac{1000 \times \text{cm}^3 / \text{rev}}{\text{displacement} \times \text{cm}^3 / \text{rev}} = \frac{231 \times \text{GPM}}{\text{in}^3 / \text{rev}}
\]

**Power (into motor)**

\[
Kw = \frac{\text{bar} \times \text{l/min}}{600} \quad \text{HP} = \frac{\text{PSI} \times \text{GPM}}{1714}
\]

**Power (out of motor)**

\[
Kw = \frac{\text{Nm} \times \text{RPM}}{9549} \quad \text{HP} = \frac{\text{lb - in} \times \text{RPM}}{63,025}
\]

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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