

Hydraulics

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# Char-Lynn®

Disc Valve Hydraulic Motors

11-01-878  
EN-0201



## 6000 Series Hydraulic Motors

We Manufacture

Solutions

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

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

to make these Geroler motors the best the industry has to offer. Examine the simplicity of these Geroler disc valve motors shown below. Also examine all the following pages for high value Char-Lynn disc valve motors from Eaton Hydraulics.

## Geroler® Displacement Mechanism

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

direction. The displacements available provide a wide variety of speeds and torques from any Series motor.

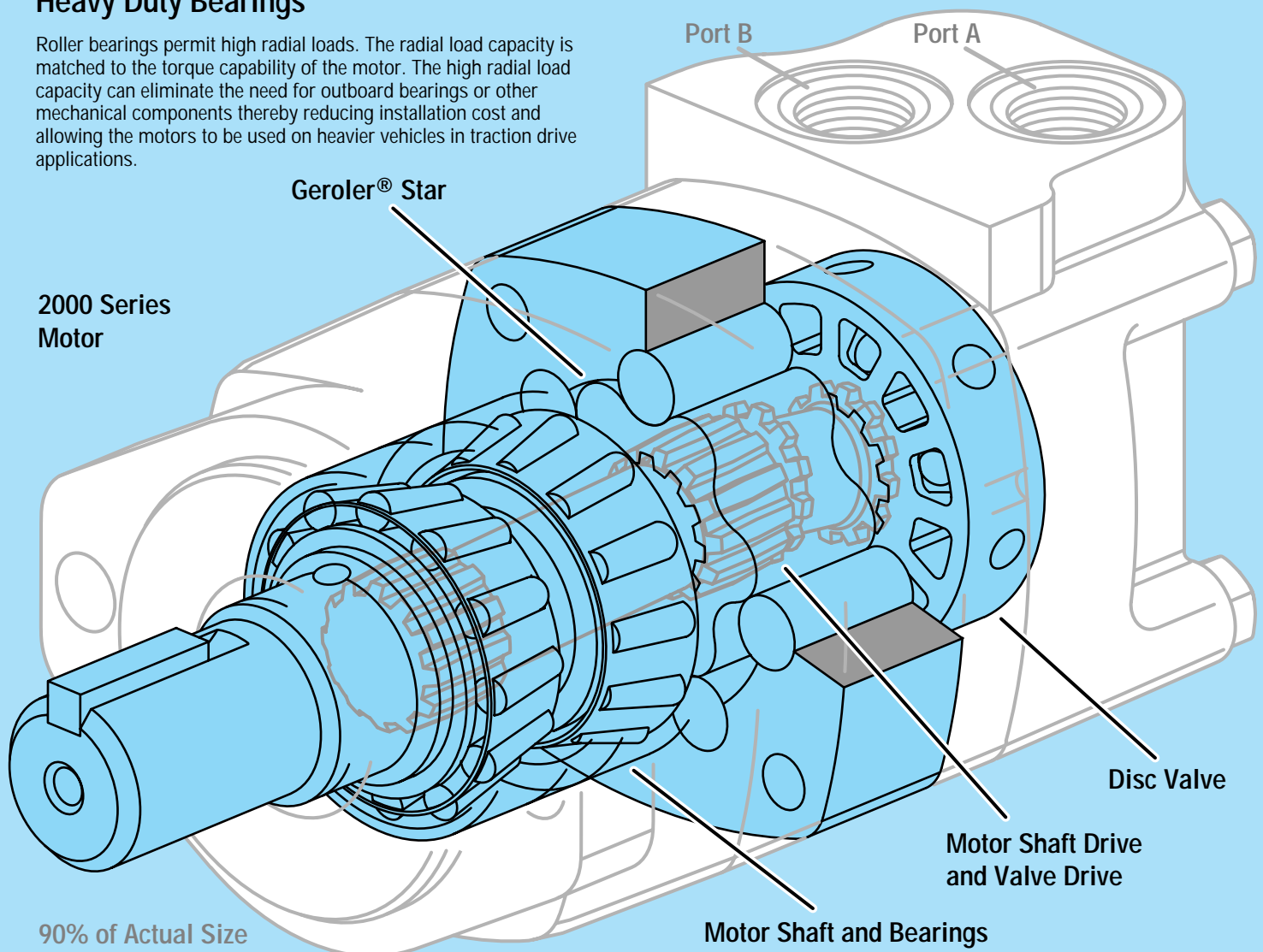
## Disc Valve

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

## Heavy Duty Bearings

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

## 2000 Series Motor



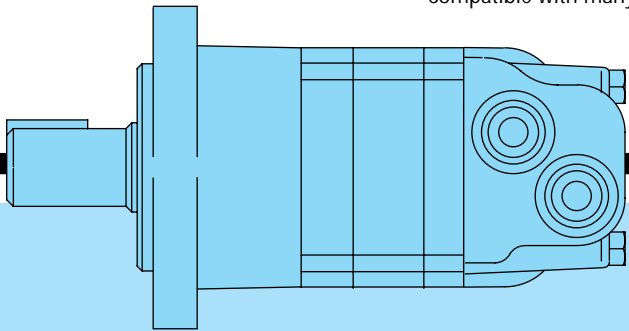
## Design Features

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

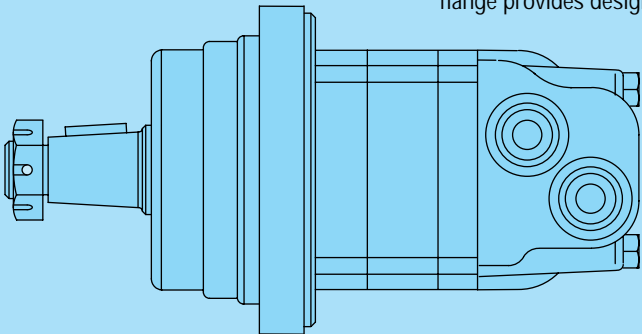
### Standard Motor

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.



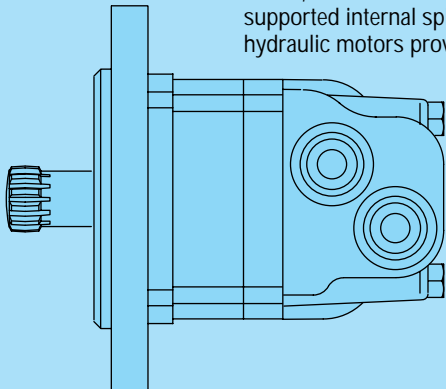
### Wheel Motor

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.





## Design Flexibility

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

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

## Durability

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

## Performance Rating

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

## Controllable Speeds

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

## Dependable Performance

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

## Reliability

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

## High Efficiencies

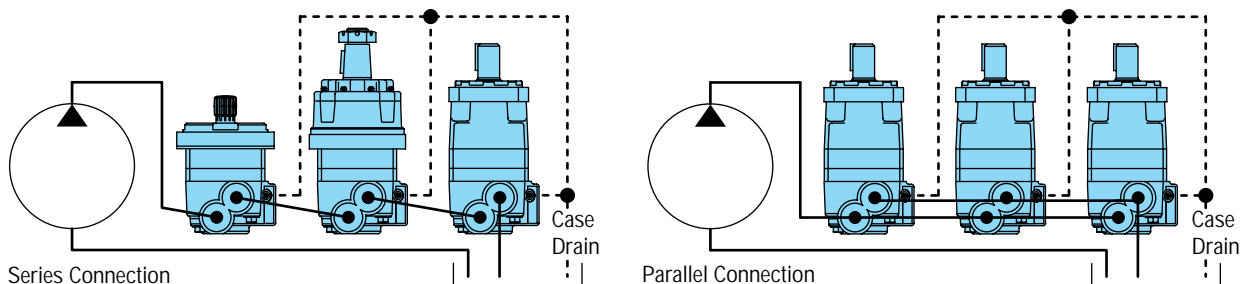
Char-Lynn disc valve motors have high efficiencies providing high output for the pressure and flow supplied. The high mechanical efficiency enables you to obtain a given torque with a smaller displacement motor.

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

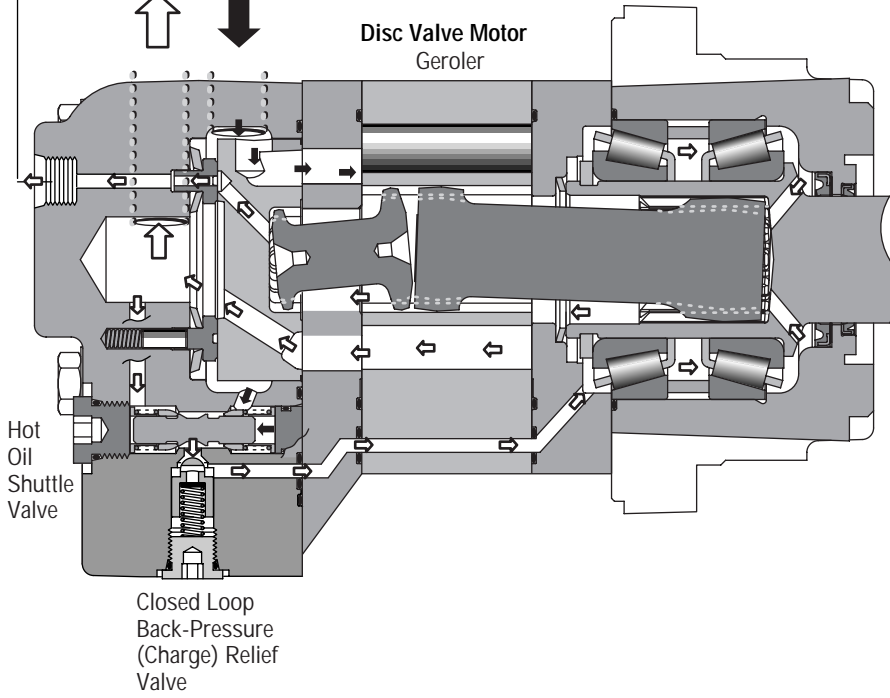
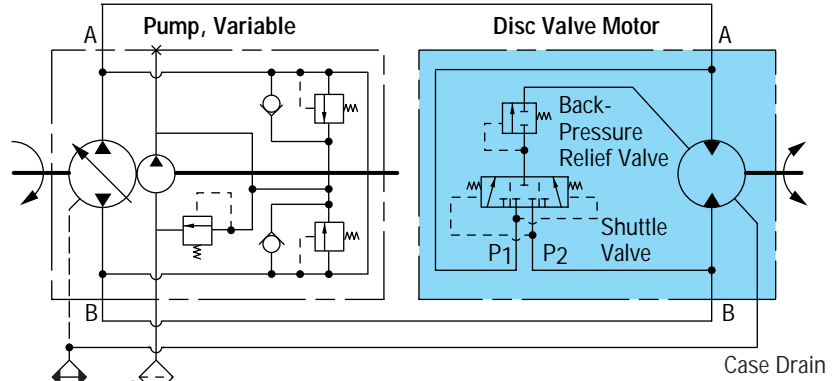
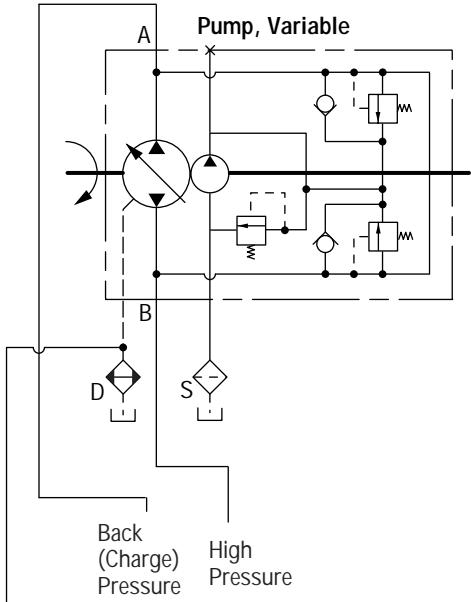
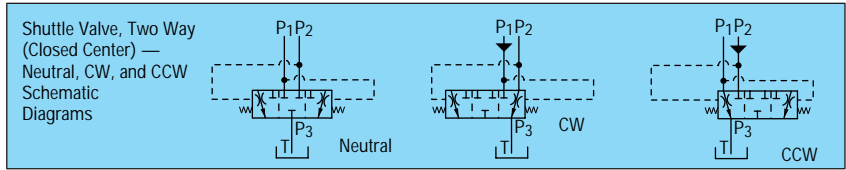
In conclusion, these efficiencies mean less heat buildup in the hydraulic system.

## Case Drain and Shuttle Valve Options

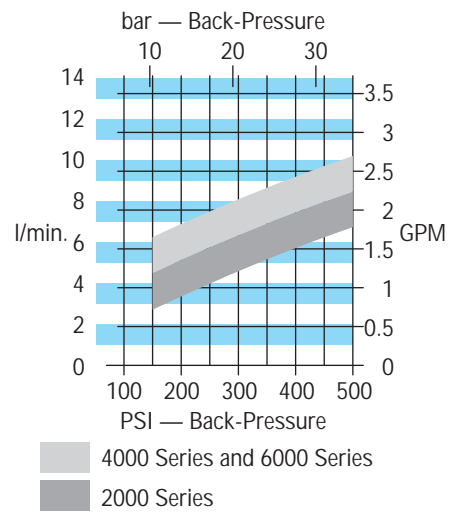
Many hydraulic systems can benefit from the use of a system case drain. Char-Lynn disc valve motors provide this feature built in. One of the advantages for case drain flow is that contamination is flushed from the system. This flushing also aids in cooling the system and lowering the case pressure which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



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



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



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

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

## Speed Sensor 2000, 4000 and 6000 Series

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

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

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

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

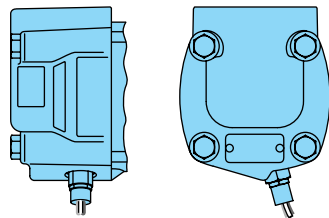
**Output Voltage:** Low < .5 Vdc @ 10 mA; output is open collector with 10kΩ pull-up resistor.

**Connection** — standard 3 prong Weatherpack connector with 18 AWG (american wire gage) cables:

Position A (red) = power supply  
Position B (white) = signal output  
Position C (black) = common

### 2000 Series

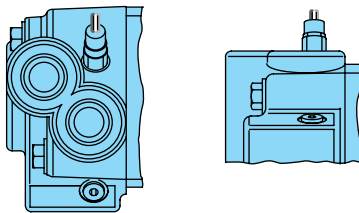
**Output Speed Sensor** — digital on/off signal from a Hall Effect switch; 30 pulses/revolution



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

### 4000 Series

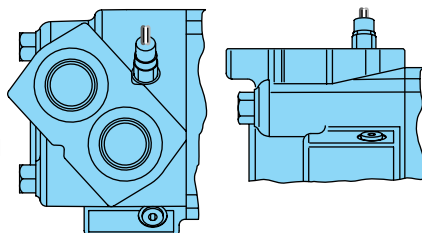
**Output Speed Sensor** — digital on/off signal from a Hall Effect switch; 36 pulses/revolution



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

### 6000 Series

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



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

## Quadrature Speed Sensor 2000, 4000 and 6000 Series

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

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

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

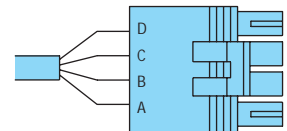
**Supply Voltage:** 8 to 24 Vdc\* (compatible with 12V vehicle conditions)

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

**Output**

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

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



Weatherpack Tower Connector

**Connections** —

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

#### Weatherpack (Version 1)

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

#### M12 Connector (Version 1)

Pin 1 = power supply  
Pin 2 = output one  
Pin 3 = common  
Pin 4 = output two

#### Weatherpack (Version 2)

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

#### M12 Connector (Version 2)

Pin 1 = power supply  
Pin 2 = direction  
Pin 3 = common  
Pin 4 = speed signal

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

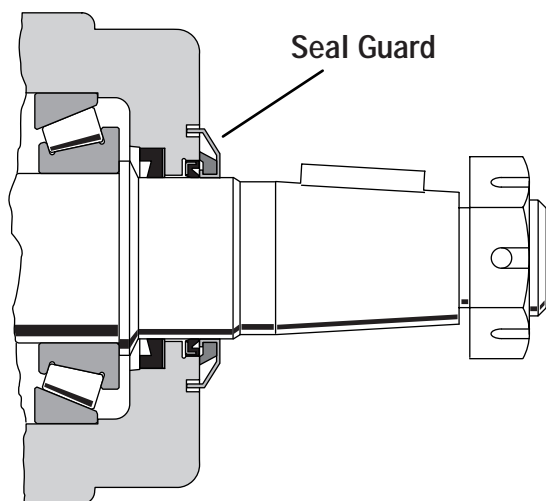
Eaton Corporation  
**Durant Products**  
901 South 12th Street  
Watertown, WI 57094  
1-800-289-3866

## Shaft Seal

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

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

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



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

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

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

## Internal Check Valves

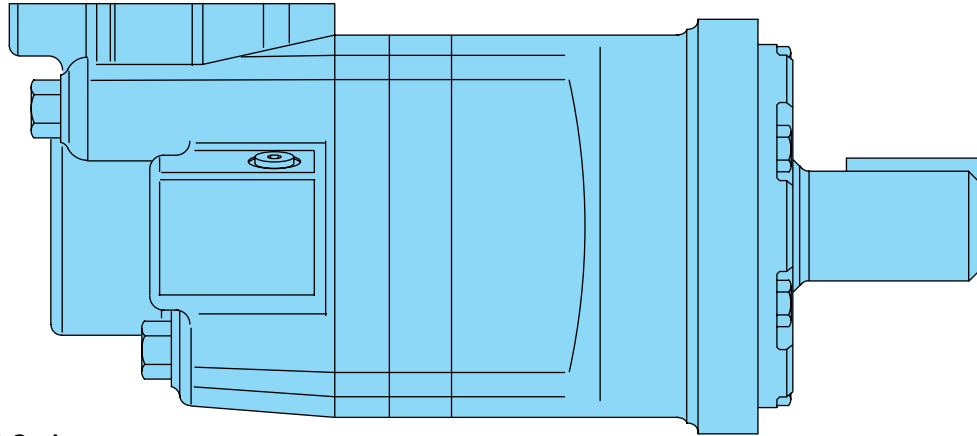
An internal check valve is provided to relieve case pressure to the low pressure side of the motor. This check valve system is adequate for most applications. In addition, motors have an external case pressure drain port for use when continuous back pressure exceeds: 140 Bar [2000 PSI] 2000 Series, 100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

## Corrosion Protected Disc Valve Motors

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

# Specifications

## 6000 Series



### Specification Data—6000 Series

Displ. cm <sup>3</sup> /r [in <sup>3</sup> /r]		195 [11.9]	245 [15.0]	310 [19.0]	390 [23.9]	490 [30.0]	625 [38.0]	985 [60.0]	
Max. Speed (RPM) @ ..... Flow	Continuous	775	615	485	387	307	241	153	
	Intermittent	866	834	698	570	454	355	230	
Flow LPM [GPM]	Continuous	150 [40]	150 [40]	150 [40]	150 [40]	150 [40]	150 [40]	150 [40]	
	Intermittent	170 [45]	210 [55]	225 [60]	225 [60]	225 [60]	225 [60]	225 [60]	
Torque Nm [lb-in]	★ 1-3/4 Inch Dia. Tapered Shaft	Continuous	575 [5100]	735 [6510]	930 [ 8230]	1155 [10230]	1445 [12800]	1480 [13100]	1685 [14920]
		Intermittent	860 [7620]	1100 [9740]	1355 [11990]	1635 [14490]	1885 [16670]	1898 [16800]	1875 [16580]
Pressure Δ Bar [Δ PSI]	★ 1-3/4 Inch Dia. Tapered Shaft	Continuous	205 [3000]	205 [3000]	205 [3000]	205 [3000]	205 [3000]	170 [2500]	140 [2000]
		Intermittent	310 [4500]	310 [4500]	310 [4500]	310 [4500]	275 [4000]	221 [3200]	140 [2000]
		Peak	310 [4500]	310 [4500]	310 [4500]	310 [4500]	310 [4500]	240 [3500]	170 [2250]

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# Performance

## Data 6000 Series

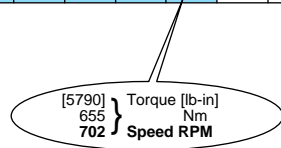
195 cm<sup>3</sup>/r [11.9 in<sup>3</sup>/r]  
Δ Pressure Bar [PSI]

	[250] 15	[500] 35	[1000] 70	[1500] 105	[2000] 140	[2500] 170	[3000] 205	[3500] 240	[4000] 275	[4500] 310
[.5] 1.9	[280] 30 9	[650] 75 7	[1450] 165 5	[2290] 260 2						
[2] 7.5	[290] 35 38	[680] 75 37	[1500] 170 34	[2340] 265 30	[3100] 350 26	[3880] 440 18	[4140] 470 18			
[4] 15	[300] 35 77	[710] 80 76	[1500] 175 74	[2390] 270 72	[3210] 365 66	[4030] 455 62	[4600] 520 46	[5200] 590 32	[5790] 655 18	
[8] 30	[310] 35 154	[740] 85 155	[1590] 180 148	[2450] 275 144	[3280] 370 131	[4120] 465 119	[4810] 545 116	[5530] 625 99	[6250] 705 83	[6900] 780 61
[12] 45	[320] 35 232	[750] 85 230	[1610] 180 225	[2480] 280 221	[3330] 375 212	[4190] 475 203	[4990] 565 186	[5810] 655 167	[6630] 750 148	[7320] 825 118
[16] 61	[300] 35 309	[730] 80 307	[1600] 180 303	[2470] 280 300	[3340] 375 291	[4210] 475 283	[5090] 575 258	[5900] 665 236	[6710] 760 214	[7470] 845 181
[20] 76	[270] 30 387	[720] 80 384	[1590] 180 379	[2460] 280 374	[3350] 380 365	[4240] 480 356	[5100] 575 332	[5950] 670 306	[6800] 770 280	[7620] 860 247
[24] 91	[240] 25 465	[700] 80 462	[1570] 175 456	[2440] 275 450	[3330] 375 440	[4220] 475 429	[5080] 575 413	[5940] 670 388	[6810] 770 363	
[28] 106	[190] 20 542	[660] 75 539	[1530] 175 532	[2400] 275 526	[3300] 375 514	[4200] 475 502	[5060] 575 476	[5940] 670 448	[6810] 770 421	
[32] 121	[160] 20 620	[630] 70 617	[1500] 170 609	[2370] 270 602	[3270] 370 589	[4160] 470 576	[5040] 570 542	[5920] 670 511	[6790] 765 480	
[36] 136	[120] 15 697	[620] 70 692	[1480] 165 683	[2350] 265 674	[3240] 365 659	[4130] 465 645	[5000] 565 601	[5880] 665 564	[6760] 765 527	
[40] 151	[80] 10 775	[610] 70 770	[1450] 165 759	[2320] 260 749	[3210] 365 733	[4100] 465 718	[4960] 560 666	[5840] 660 624		
[45] 170		[590] 65 866	[1410] 160 854	[2280] 260 843	[3170] 360 825	[4060] 460 808	[4920] 555 749	[5790] 655 702		

245 cm<sup>3</sup>/r [15.0 in<sup>3</sup>/r]  
Δ Pressure Bar [PSI]

	[250] 15	[500] 35	[1000] 70	[1500] 105	[2000] 140	[2500] 170	[3000] 205	[3500] 240	[4000] 275	[4500] 310
[.5] 1.9	[430] 50 7	[860] 95 4	[1890] 215 1							
[2] 7.5	[440] 50 30	[900] 100 29	[1940] 220 26	[2990] 340 24	[3960] 445 21	[4920] 555 17	[5040] 570 11	[5930] 670 6		
[4] 15	[460] 50 61	[940] 105 60	[2000] 225 56	[3060] 345 54	[4080] 460 48	[5090] 575 42	[5680] 640 39	[6630] 750 30	[7570] 855 12	[8520] 965 6
[8] 30	[470] 55 122	[960] 110 120	[2060] 235 116	[3150] 355 113	[4210] 475 104	[5260] 595 95	[6180] 700 81	[7100] 800 67	[8020] 905 53	[9020] 1020 37
[12] 45	[480] 55 183	[970] 110 182	[2080] 235 180	[3180] 360 178	[4270] 480 165	[5360] 605 157	[6390] 720 141	[7420] 840 125	[8450] 955 109	[9510] 1075 92
[16] 61	[450] 50 245	[960] 110 244	[2070] 235 240	[3180] 360 236	[4290] 480 228	[5420] 610 221	[6480] 730 202	[7490] 845 184	[8480] 940 165	[9540] 1100 145
[20] 76	[420] 45 307	[940] 105 306	[2050] 230 301	[3160] 355 297	[4290] 485 287	[5440] 615 277	[6510] 735 257	[7580] 855 238	[8660] 960 218	[9740] 1100 197
[24] 91	[380] 45 368	[920] 105 365	[2020] 230 361	[3120] 355 358	[4260] 480 348	[5400] 610 338	[6490] 735 316	[7590] 860 294	[8680] 980 271	
[28] 106	[330] 35 430	[870] 100 426	[1980] 225 421	[3100] 350 416	[4240] 480 404	[5380] 610 376	[6480] 730 358	[7580] 855 340	[8670] 980 322	
[32] 121	[290] 35 491	[800] 90 489	[1920] 215 481	[3050] 345 475	[4170] 470 461	[5290] 600 448	[6410] 725 423	[7520] 850 398	[8640] 975 373	
[36] 136	[250] 30 556	[730] 80 549	[1850] 210 543	[2980] 335 524	[4060] 460 509	[5150] 580 482	[6300] 710 456	[7440] 840 456		
[40] 151	[200] 25 615	[690] 80 612	[1790] 200 606	[2940] 330 599	[4010] 455 585	[5130] 580 570	[6190] 700 540	[7100] 800 510		
[45] 170		[570] 65 688	[1760] 200 682	[2860] 325 674	[3960] 445 658	[5070] 575 641	[6080] 685 608	[6690] 755 574		
[50] 189			[1720] 195 758	[2800] 315 749	[3890] 440 731	[4920] 555 712	[5940] 670 676			
[55] 208			[1670] 190 834	[2740] 310 824	[3820] 430 804	[4890] 550 783	[5880] 665 744			

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



Continuous  
Intermittent

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

310 cm<sup>3</sup>/r [19.0 in<sup>3</sup>/r]  
Δ Pressure Bar [PSI]

	[250] 15	[500] 35	[1000] 70	[1500] 105	[2000] 140	[2500] 170	[3000] 205	[3500] 240	[4000] 275	[4500] 310
[.5] 1.9	[530] 60 6	[1120] 125 4	[2440] 275 1							
[2] 7.5	[540] 60 24	[1150] 130 23	[2460] 280 22	[3620] 410 20	[4780] 540 14	[5690] 645 10	[6670] 755 4	[7780] 880 4		
[4] 15	[550] 60 48	[1180] 135 47	[2560] 290 45	[3800] 430 42	[5030] 570 38	[6050] 685 32	[7070] 800 24	[8260] 935 17	[9070] 1025 10	[9530] 1075 3
[8] 30	[560] 65 96	[1250] 140 95	[2650] 300 91	[3970] 450 87	[5280] 595 81	[6480] 730 73	[7710] 870 64	[8740] 985 55	[9770] 1105 46	[10990] 1240 35
[12] 45	[570] 65 144	[1260] 140 143	[2690] 305 140	[4050] 460 135	[5420] 610 129	[6730] 760 121	[8040] 910 111	[9260] 1045 99	[10490] 1185 88	[11800] 1335 76
[16] 61	[540] 60 193	[1230] 140 192	[2660] 300 188	[4060] 460 184	[5450] 615 178	[6800] 770 167	[8150] 920 156	[9400] 1060 141	[10660] 1205 126	[11990] 1355 109
[20] 76	[510] 60 242	[1200] 135 241	[2630] 295 236	[4040] 455 232	[5450] 615 226	[6820] 770 216	[8190] 925 201	[9520] 1075 184	[10840] 1225 167	
[24] 91	[480] 55 290	[1160] 130 289	[260] 295 282	[4020] 455 279	[5440] 615 273	[6840] 775 260	[8230] 930 248	[9560] 1080 232	[10900] 1230 215	
[28] 106	[420] 45 339	[1130] 130 336	[2570] 290 333	[3990] 450 328	[5420] 610 320	[6820] 770 308	[8220] 930 295	[9520] 1075 276	[10840] 1225 257	
[32] 121	[360] 40 388	[1100] 125 384	[2510] 285 381	[3920] 445 375	[5330] 600 354	[6750] 765 354	[8170] 920 341	[9440] 1065 320		
[36] 136	[300] 35 436	[1060] 120 430	[2440] 275 421	[3830] 435 416	[5220] 590 410	[6660] 750 396	[8100] 915 383	[9330] 1055 360		
[40] 151	[270] 30 485	[1020] 115 478	[2400] 270 466	[3780] 425 461	[5150] 580 445	[6580] 745 427	[8020] 905 407	[9220] 1040 403		
[50] 189		[982] 110 597	[2180] 245 582	[3420] 385 576	[4660] 525 551	[6050] 685 551	[7440] 840 534			
[60] 227			[1960] 220 698	[3250] 365 691	[4540] 515 684	[5750] 650 661	[7080] 800 641			

390 cm<sup>3</sup>/r [23.9 in<sup>3</sup>/r]  
Δ Pressure Bar [PSI]

	[250] 15	[500] 35	[1000] 70	[1500] 105	[2000] 140	[2500] 170	[3000] 205	[3500] 240	[4000] 275	[4500] 310
[1] 3.8	[760] 85 4	[1570] 175 2	[3230] 365 1							
[2] 7.5	[780] 90 19	[1610] 180 18	[3270] 370 17	[4910] 555 16	[6440] 730 14	[7760] 875 12	[9080] 1025 9	[10590] 1195 4		
[4] 15	[800] 90 38	[1640] 185 38	[3300] 375 37	[4970] 560 35	[6570] 740 33	[8060] 920 29	[9570] 1080 22	[11270] 1275 14	[12120] 1370 5	[14490] 1635 1
[8] 30	[810] 90 77	[1650] 185 76	[3370] 380 74	[5080] 575 72	[6740] 760 68	[8430] 950 65	[10050] 1135 55	[11620] 1315 45	[12880] 1455 33	[14480] 1635 21
[12] 45	[800] 90 115	[1620] 185 115	[3390] 385 112	[5130] 580 109	[6810] 770 105	[8520] 965 100	[10190] 1150 91	[11860] 1340 81	[13640] 1540 79	
[16] 61	[750] 85 154	[1600] 180 154	[3380] 380 151	[5120] 580 147	[6820] 770 143	[8560] 965 132	[10230] 1155 126	[11920] 1345 116		
[20] 76	[680] 75 193	[1580] 180 193	[3360] 380 189	[5120] 580 187	[6840] 775 182	[8590] 970 175	[10280] 1160 162	[11980] 1355 152		
[24] 91	[620] 70 232	[1520] 170 230	[3280] 370 229	[5060] 570 225	[6780] 765 220	[8530] 965 212	[10240] 1155 204			
[28] 106	[570] 65 270	[1460] 165 268	[3210] 365 266	[5000] 565 261	[6730] 760 256	[8480] 960 248	[10200] 1150 236			
[32] 121	[530] 60 309	[1420] 160 306	[3140] 355 304	[4930] 555 299	[6640] 750 292	[8380] 945 282	[10120] 1145 269			
[36] 136	[450] 50 348	[1370] 155 346	[3010] 340 340	[4840] 545 336	[6500] 730 329	[8250] 930 317	[10000] 1130 301			
[40] 151		[380] 45 387	[1320] 150 386	[2880] 325 380	[4740] 535 375	[6460] 730 368	[8120] 915 359			
[50] 189			[1140] 130 482	[2650] 300 475	[4540] 515 469	[6440] 730 460	[8050] 910 449			
[60] 227				[2460] 280 570	[4430] 500 562	[6360] 720 552	[7860] 890 538			

# Performance Data 6000 Series

490 cm<sup>3</sup>/r [30.0 in<sup>3</sup>/r]  
Δ Pressure Bar [PSI]

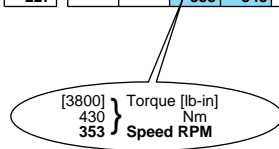
625 cm<sup>3</sup>/r [38.0 in<sup>3</sup>/r]  
Δ Pressure Bar [PSI]

	[250] 15	[500] 35	[1000] 70	[1500] 105	[2000] 140	[2500] 170	[3000] 205	[3500] 240	[4000] 275
[1] 3.8	[1010] 115 7	[1200] 235 7	[4260] 480 5	[6140] 695 3					
[2] 7.5	[1020] 115 15	[2110] 240 14	[4270] 480 13	[6280] 710 12	[8350] 945 11	[10420] 1175 8	[12140] 1370 3		
[4] 15	[1030] 115 30	[2100] 235 30	[4280] 485 29	[6410] 725 28	[8500] 960 27	[10590] 1195 25	[12500] 1410 21	[14580] 1645 17	[16670] 1885 12
[8] 30	[1020] 115 60	[2090] 235 60	[4290] 485 59	[6490] 735 57	[8620] 975 54	[10740] 1215 51	[12800] 1445 45	[14930] 1685 38	
[12] 45	[1000] 115 91	[2080] 235 91	[4290] 485 89	[6500] 735 87	[8650] 975 84	[10800] 1220 79	[12890] 1455 71		
[16] 61	[110] 960 122	[2060] 235 122	[4260] 480 121	[6480] 730 118	[8650] 975 114	[10820] 1220 109	[12900] 1460 100		
[20] 76	[900] 100 153	[1980] 225 152	[4180] 470 150	[6420] 725 147	[8620] 975 144	[10820] 1220 139			
[24] 91	[850] 95 184	[1930] 220 184	[4150] 470 181	[6390] 720 180	[8580] 970 176	[10770] 1215 171			
[28] 106	[740] 85 215	[1840] 210 214	[4070] 460 211	[6290] 710 208	[8500] 960 204	[10720] 1210 198			
[32] 121	[690] 80 245	[1710] 195 244	[3970] 450 241	[6190] 700 237	[8420] 950 232	[10660] 1205 226			
[36] 136	[670] 75 276	[1560] 175 275	[3860] 435 272	[6080] 685 265	[8340] 940 260	[10420] 1175 255			
[40] 151	[570] 65 307	[1400] 160 306	[3750] 425 303	[5970] 675 295	[8140] 920 290	[10180] 1150 284			
[50] 189		[1140] 130 382	[3240] 365 379	[5220] 590 369	[7620] 860 362				
[60] 227			[2860] 325 454	[4860] 550 442	[7140] 805 435				

	[250] 15	[500] 35	[1000] 70	[1500] 105	[2000] 140	[2500] 170	[3000] 205	[3200] 221
[1] 3.8	[1060] 120 5	[2205] 250 5	[4515] 510 4	[6690] 755 2				
[2] 7.5	[1090] 125 12	[2300] 260 12	[4720] 535 13	[7025] 795 10	[9360] 1060 6			
[4] 15	[1145] 130 24	[2450] 275 24	[5052] 570 24	[7520] 850 21	[9410] 1065 16	[12700] 1434 13		
[8] 30	[1195] 135 45	[2600] 295 45	[5350] 605 44	[8195] 925 42	[11220] 1270 37	[13100] 1480 35	[15800] 1785 32	[16800] 1898 30
[12] 45	[1200] 135 72	[2600] 295 72	[5390] 610 71	[8145] 920 68	[11770] 1330 64	[13000] 1469 60	[15700] 1774 56	
[16] 61	[1120] 125 94	[2530] 285 94	[5340] 605 92	[8105] 915 89	[11740] 1325 85	[13000] 1469 83		
[20] 76	[1050] 120 120	[2465] 280 119	[5285] 595 117	[8080] 915 115	[11725] 1325 110			
[24] 91	[950] 105 144	[2365] 265 143	[5180] 585 140	[7990] 905 138	[11705] 1320 132			
[28] 106	[855] 95 169	[2255] 255 168	[5080] 575 165	[7915] 895 162	[11640] 1315 156			
[32] 121	[730] 80 193	[2140] 240 192	[4960] 560 188	[7775] 880 185	[11505] 1300 179			
[36] 136	[555] 65 217	[1965] 220 216	[4780] 540 213	[7585] 855 210				
[40] 151	[380] 45 241	[1790] 200 240	[4600] 520 238	[7395] 835 236				
[50] 189			[4180] 470 296	[6985] 790 290				
[60] 227			[3800] 430 353	[6600] 745 345				

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

Continuous  
Intermittent



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

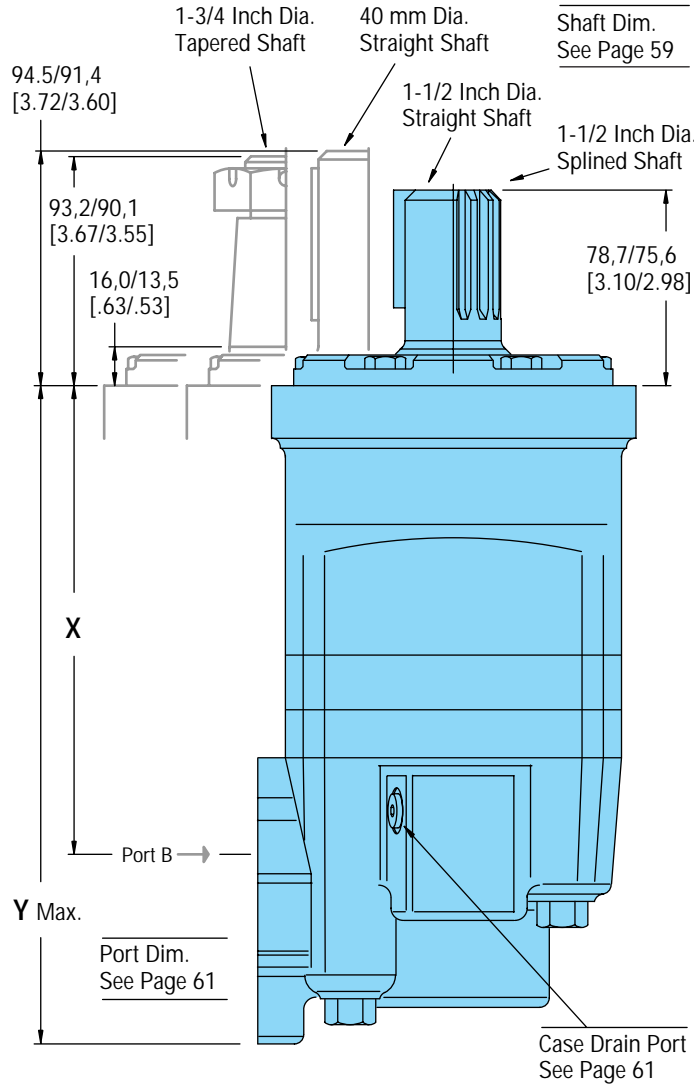
805 cm<sup>3</sup>/r [49.0 in<sup>3</sup>/r]  
Δ Pressure Bar [PSI]

985 cm<sup>3</sup>/r [60.0 in<sup>3</sup>/r]  
Δ Pressure Bar [PSI]

	[250] 15	[500] 35	[750] 50	[1000] 70	[1250] 85	[1500] 105	[1750] 120	[2000] 140	[2250] 155	[2500] 170
[1] 3.8	[1455] 164 4	[3100] 350 4	[4680] 529 2	[6031] 681 2	[7799] 881 1					
[2] 7.5	[1483] 168 9	[3173] 359 9	[5121] 579 9	[6432] 727 8	[8510] 961 7	[9633] 1088 6	[11319] 1279 5	[12127] 1370 5		
[4] 15	[1547] 175 19	[3331] 376 19	[5292] 598 18	[6744] 762 17	[8714] 984 16	[10075] 1138 15	[11352] 1283 14	[12539] 1417 12	[14564] 1645 11	[16377] 1850 10
[8] 30	[1599] 181 35	[3473] 392 35	[5415] 612 34	[7039] 795 33	[8934] 1009 32	[10629] 1201 31	[11842] 1338 29	[14004] 1582 29	[15441] 1745 28	
[12] 45	[1599] 181 56	[3469] 392 56	[5415] 612 55	[7093] 795 53	[9024] 1020 53	[10658] 1204 52	[12283] 1388 50	[13726] 1551 50		
[16] 61	[1543] 174 73	[3395] 384 73	[5357] 605 72	[7032] 794 70	[8983] 1015 69	[10640] 1202 68	[12010] 1357 67			
[20] 76	[1457] 165 93	[3312] 374 92	[5292] 598 91	[6968] 787 89	[8943] 1010 88	[10583] 1196 87	[12146] 1372 86			
[24] 91	[1352] 153 112	[3183] 360 112	[5088] 575 111	[6811] 769 110	[8812] 996 108	[10411] 1176 106				
[28] 106	[1213] 137 131	[3055] 345 131	[5047] 570 131	[6713] 758 129	[8681] 981 128	[10411] 1176 127				
[32] 121	[1075] 121 150	[2907] 328 149	[4884] 552 149	[6546] 740 146	[8395] 949 145	[10060] 1137 144				
[36] 136	[823] 93 168	[2692] 304 168	[4663] 527 168	[6320] 714 167	[8118] 917 165					
[40] 151	[592] 67 187	[2477] 280 186	[4426] 500 186	[6085] 688 185	[7832] 885 184					
[50] 189		[2730] 308 234	[4214] 476 233	[5849] 661 231	[7603] 859 230					
[60] 227			[3806] 430 280	[5459] 617 277	[7407] 837 275					

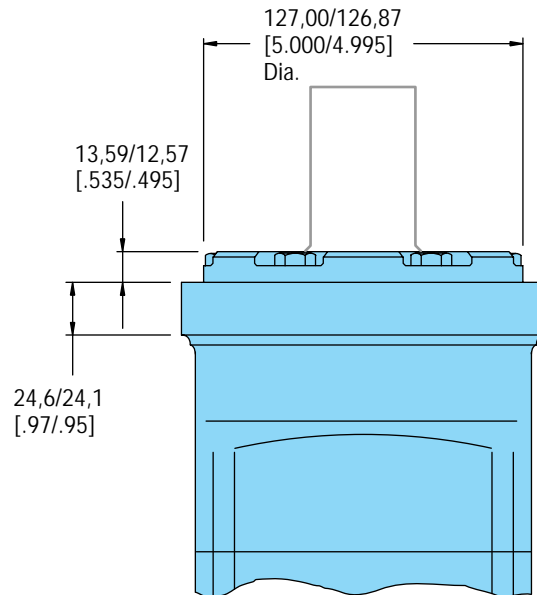
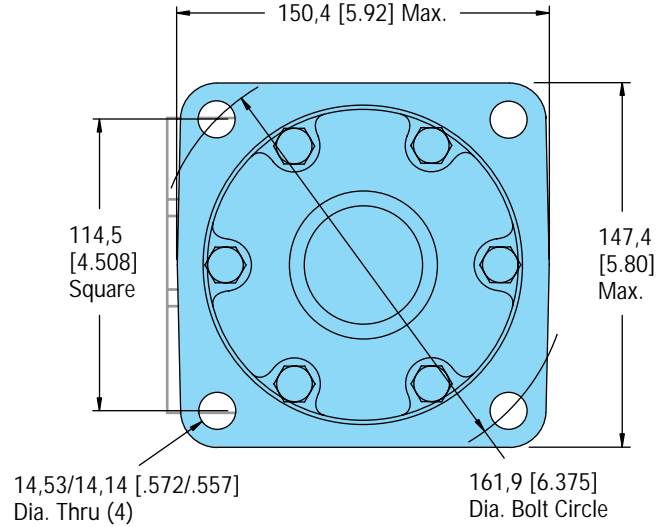
	[250] 15	[500] 35	[750] 50	[1000] 70	[1250] 85	[1500] 105	[1750] 120	[2000] 140
[1] 3.8	[1890] 215 3	[4110] 465 3	[5730] 645 2	[7640] 865 2	[9550] 1080 1			
[2] 7.5	[1910] 215 8	[4140] 470 8	[6270] 710 7	[8300] 940 7	[10420] 1175 6	[12500] 1410 5	[13860] 1565 4	[14920] 1685 3
[4] 15	[1980] 225 15	[4290] 485 15	[6480] 775 15	[8540] 965 14	[10670] 1205 14	[12800] 1445 13	[13900] 1570 13	[15850] 1790 12
[8] 30	[2030] 230 30	[4400] 495 30	[6630] 750 30	[8790] 995 29	[10940] 1235 28	[13090] 1480 27	[14500] 1640 26	[16580] 1875 25
[12] 45	[2020] 230 45	[4390] 495 45	[6630] 750 45	[8800] 995 44	[11050] 1250 43	[13240] 1495 42	[15040] 1700 41	
[16] 61	[2010] 225 61	[4320] 490 61	[6560] 740 61	[8790] 995 60	[11000] 1245 59	[13260] 1500 58		
[20] 76	[1910] 215 77	[4220] 475 77	[6480] 730 76	[8720] 985 76	[10950] 1235 75	[13160] 1485 74		
[24] 91	[1810] 205 92	[4060] 460 92	[6230] 705 92	[8500] 960 91	[10790] 1220 90	[12990] 1470 89		
[28] 106	[1620] 185 107	[3920] 445 107	[6180] 700 107	[8420] 950 106	[10630] 1200 105	[12820] 1450 103		
[32] 121	[1480] 165 123	[3740] 425 123	[5980] 675 122	[8200] 925 121	[10280] 1160 120			
[36] 136	[1140] 130 138	[3490] 395 138	[5710] 645 138	[7930] 895 137	[9940] 1125 135			
[40] 151	[850] 95 153	[3240] 365 153	[5420] 610 152	[7640] 865 151	[9590] 1085 150			
[50] 189		[2960] 325 191	[5160] 585 190	[7350] 830 189	[9310] 1050 188			
[60] 227			[4660] 525 230	[7160] 810 229	[9070] 1025 226			

# Dimensions — 6000 Series Standard Motor



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

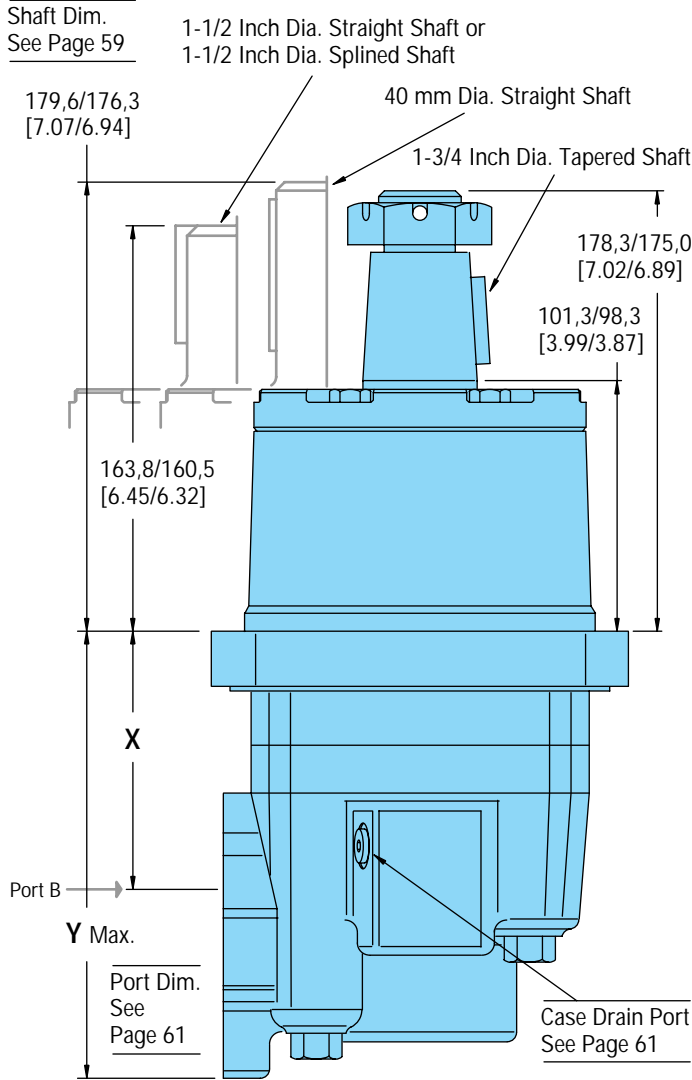
### Standard SAE CC Flange



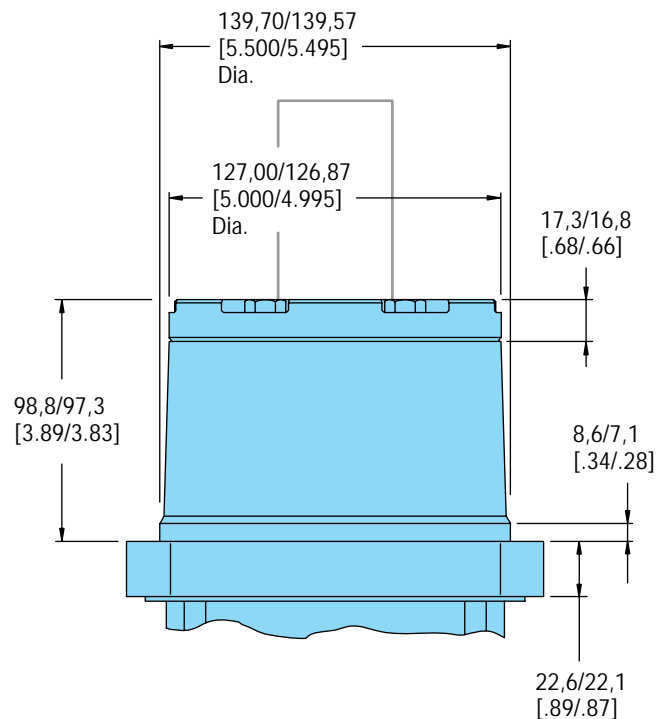
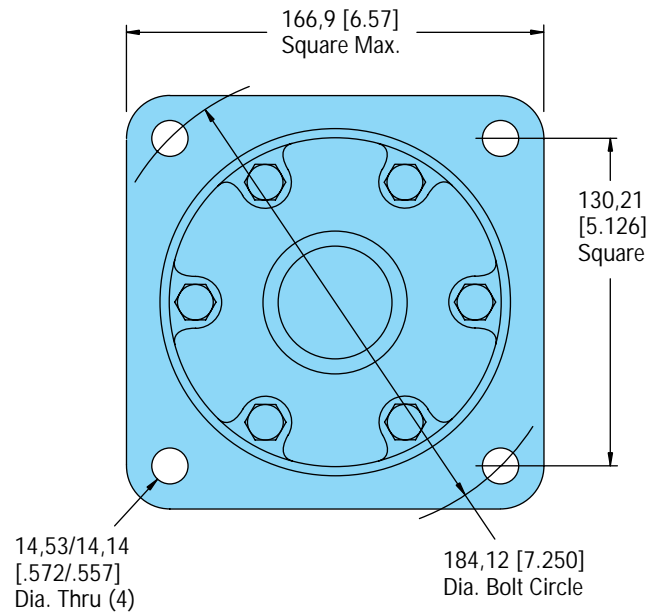
### 6000 Series Standard Motor with 1-5/16-12 O-ring Ports, G 1 (BSP) Ports, and 3/4 inch Split Flange Ports

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

# Dimensions — 6000 Series Wheel Motor



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



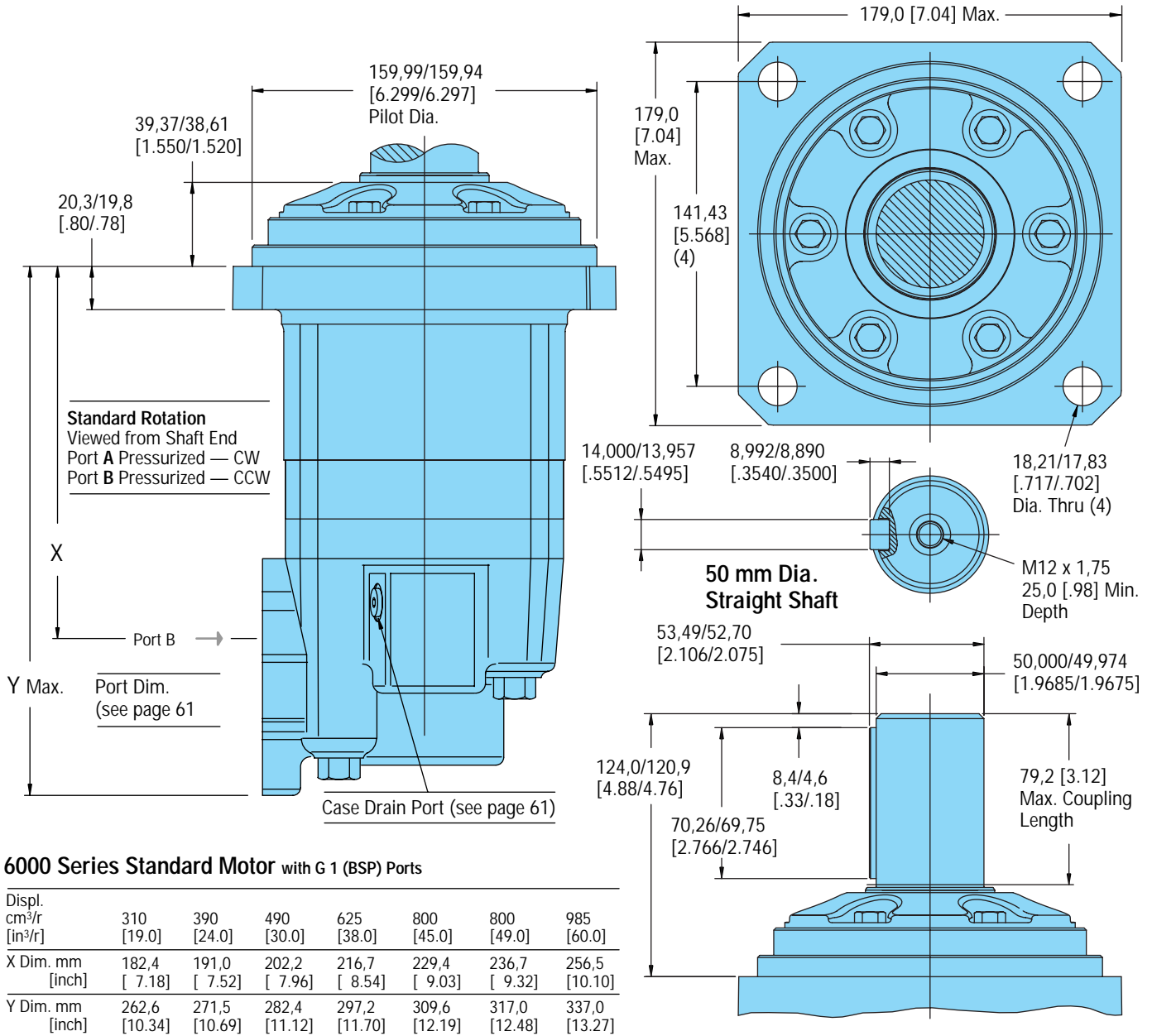
**6000 Series Wheel Motor with 1-5/16-12 O-ring Ports, G 1 (BSP) Ports, and 3/4 inch Split Flange Ports**

Displ. cm <sup>3</sup> /r [in <sup>3</sup> /r]	195 [11.9]	245 [15.0]	310 [19.0]	390 [23.9]	490 [30.0]	625 [38.0]	985 [60.0]
X Dim. mm [inch]	102,9 [4.05]	108,4 [4.27]	115,8 [4.56]	124,7 [4.91]	135,6 [5.34]	149,9 [5.90]	190,0 [7.48]
Y Dim. mm [inch]	185,2 [7.29]	190,8 [7.51]	198,2 [7.80]	207,1 [8.15]	218,0 [8.58]	233,0 [9.17]	272,6 [10.73]

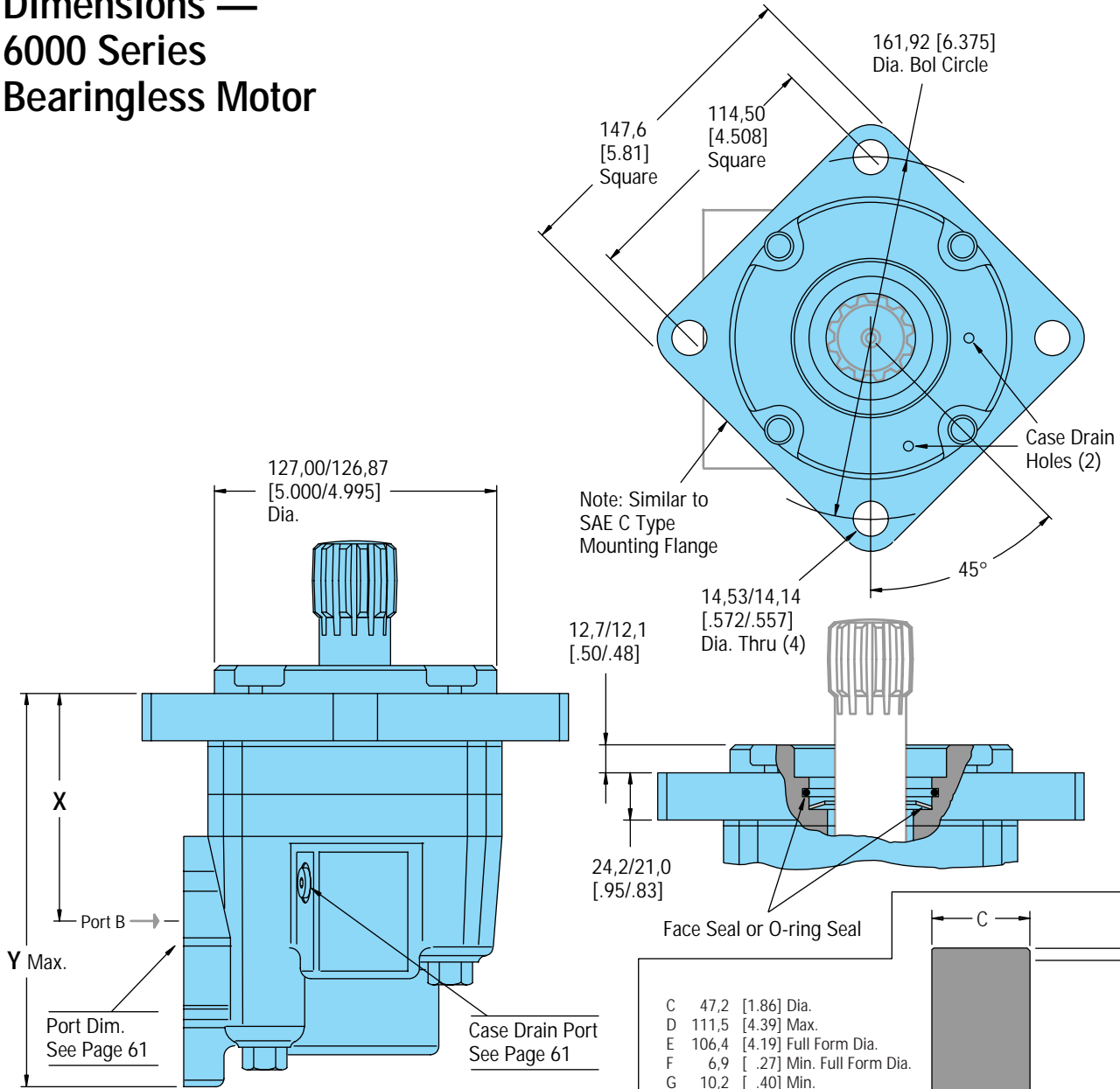
# Dimensions — 6000 Series

## Global Mount

(Similar to ISO 3019/2)



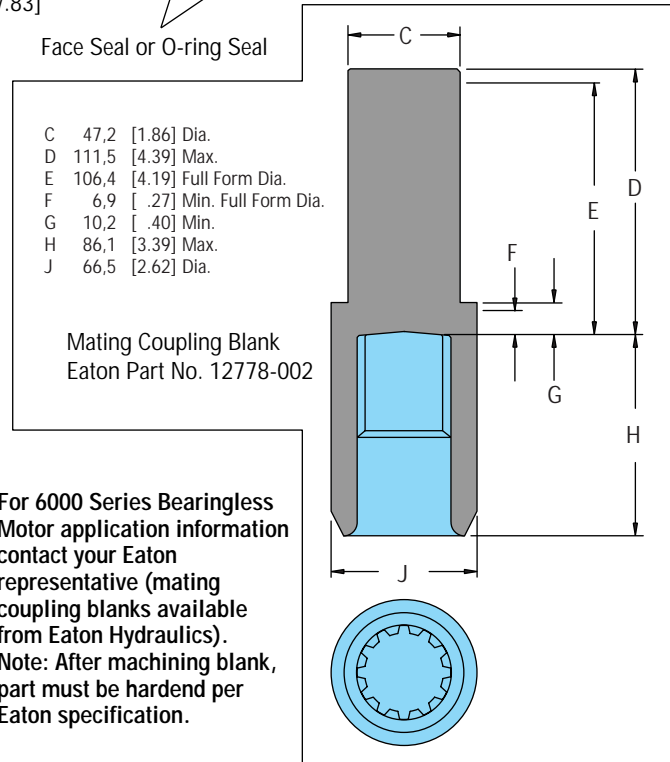
# Dimensions — 6000 Series Bearingless Motor



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

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

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

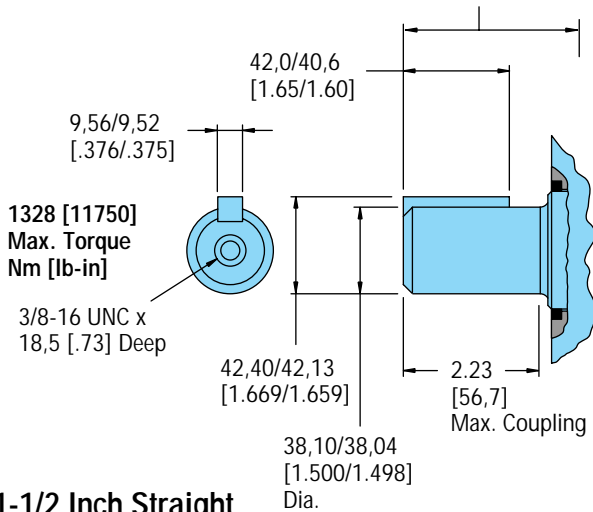




# Dimensions — Shafts

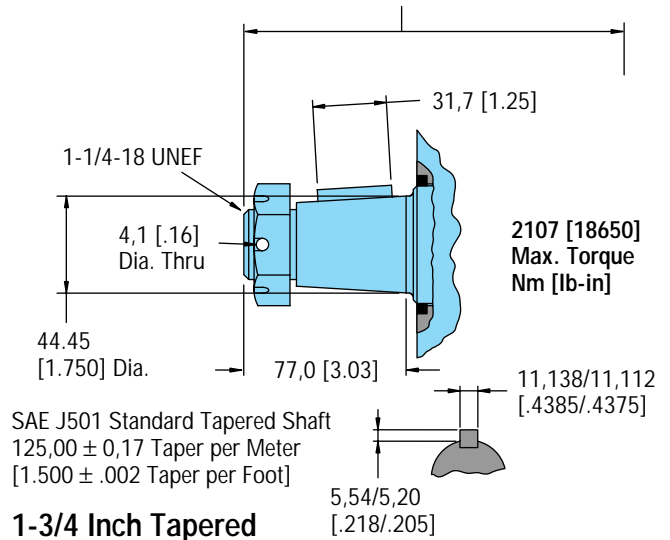
## 6000 Series

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



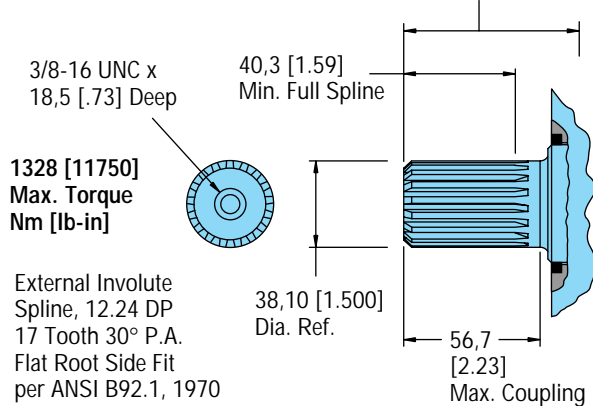
**1-1/2 Inch Straight**

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

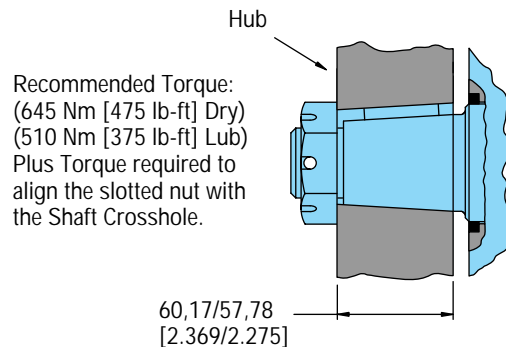


**1-3/4 Inch Tapered**

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

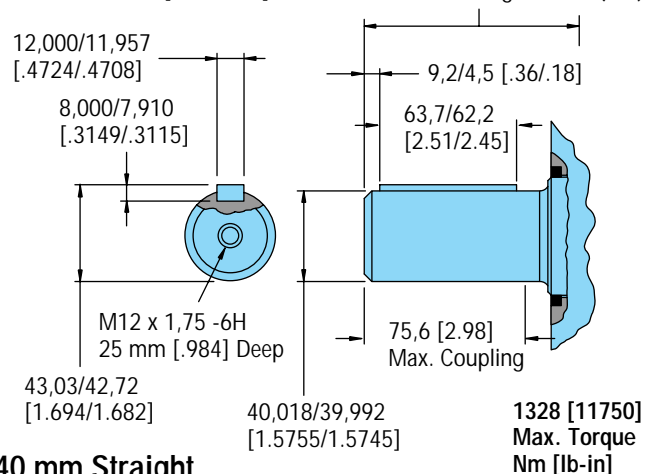


**1-1/2 Inch 17 Tooth Splined**

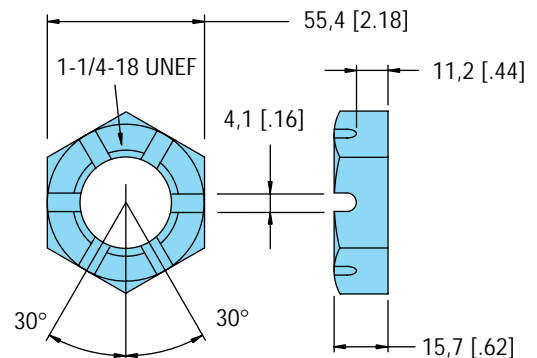


**Tapered Shaft Hub Data**

94,4/91,6 [3.72/3.60] End of Shaft to Mounting Surface (Std)



**40 mm Straight**



**Slotted Hexagon Nut**

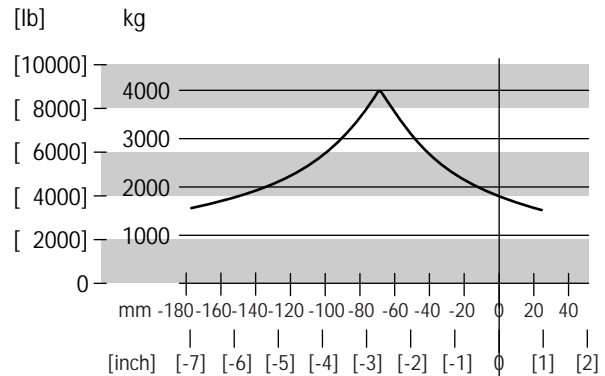
# Shaft Side Load Capacity 6000 Series

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

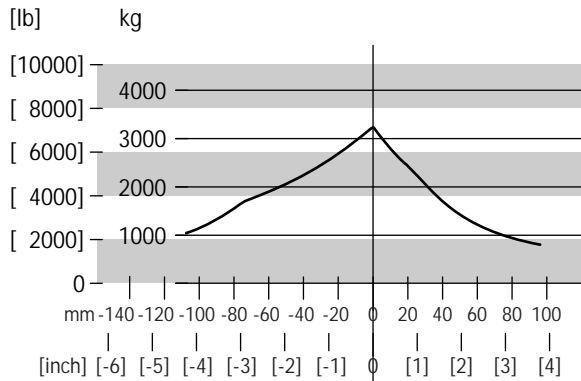
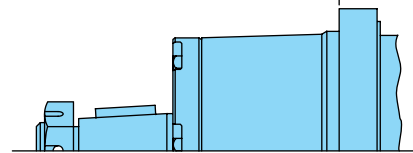
The curve is based on B 10 Bearing life (2000 hours or 12,000,000 shaft revolutions at 100 RPM ) at rated output torque. To determine radial load at speeds other than 100 RPM, multiply the load values given on the bearing curve by the factors in the chart below.

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

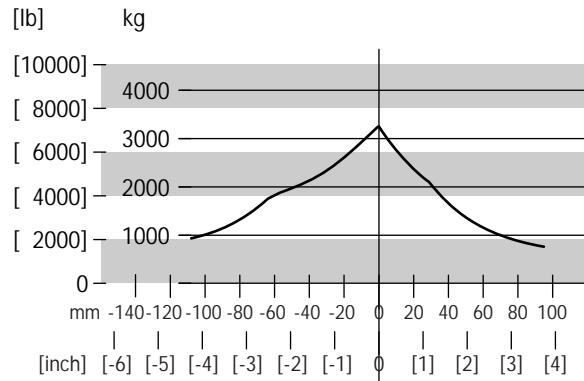
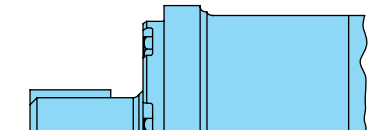
For 3,000,000 Shaft revolutions or 500 hours — Increase these shaft loads 52%.



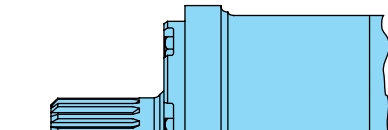
Wheel Motor  
Tapered  
Shaft



Standard Motor  
Straight  
Shaft



Standard Motor  
Splined  
Shaft



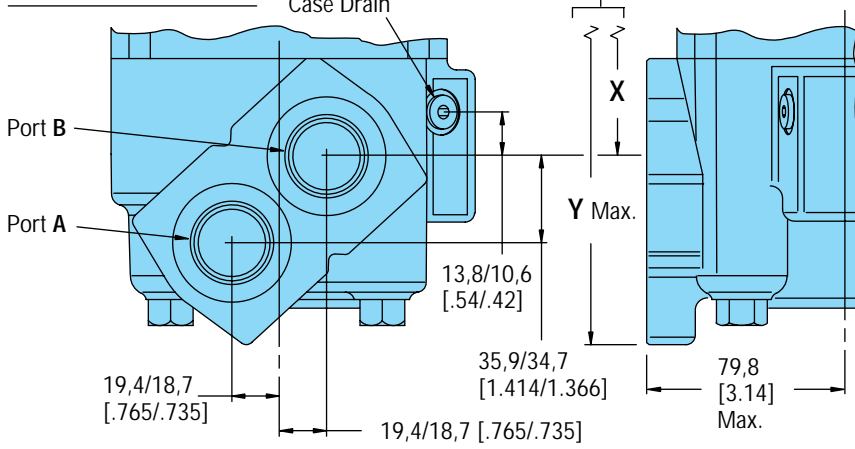
# Dimensions — Ports 6000 Series

# 6000 Series with Shuttle Valve

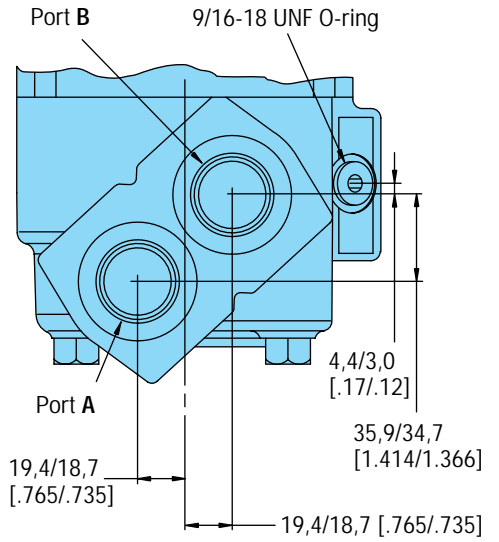
1-5/16-12 O-ring Ports (2)  
or G 1 (BSP) Ports (2)

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

See Pages 54-57



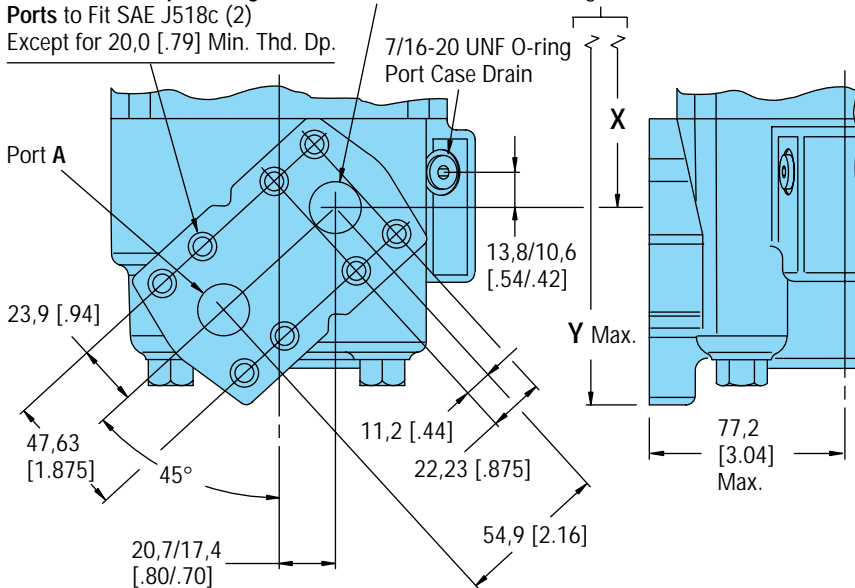
1-5/16-12 O-ring Ports (2) with Shuttle



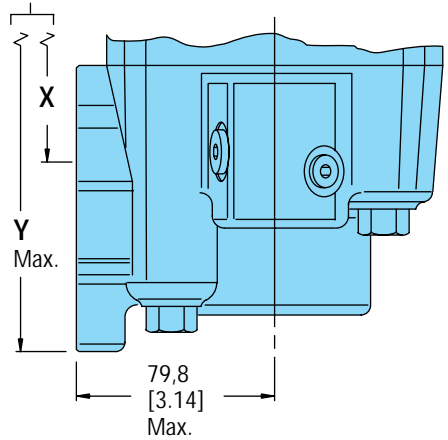
4 Bolt 3/4 Inch Split Flange  
Ports to Fit SAE J518c (2)  
Except for 20,0 [.79] Min. Thd. Dp.

Port B

See Pages 54-57



See Pages 54-57

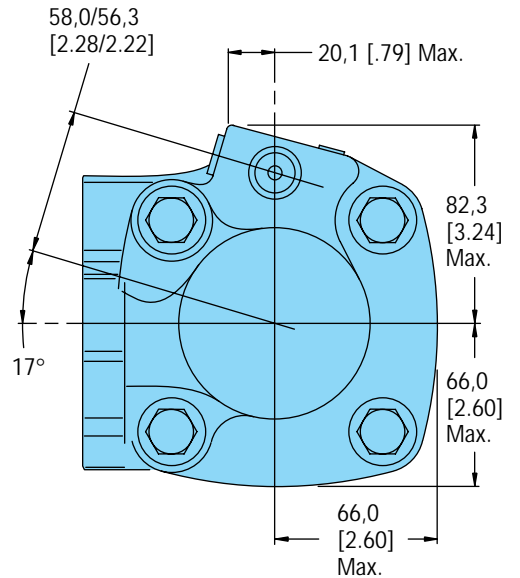
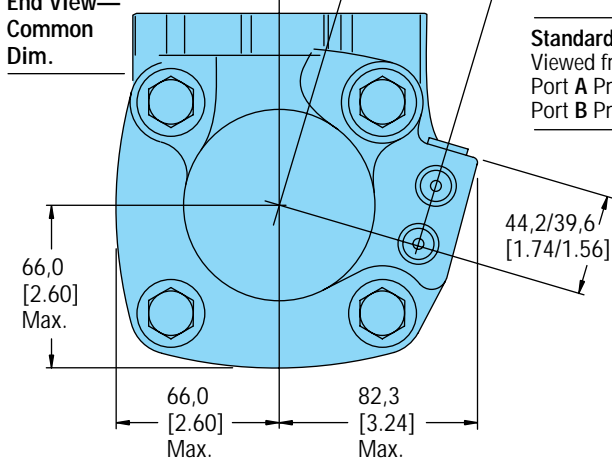


6000 Series  
Motor  
End View—  
Common  
Dim.

17°

58,0/56,3  
[2.28/2.22]

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



# Product Numbers 6000 Series

## Product Numbers—6000 Series Motors

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

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

114-1047

## Product Numbers – 6000 Series

Mounting Type - Standard (Code H), 4 Bolt:

- 160,0 [6.30] Pilot Dia.
- 18,01 [.709] Dia. Mounting Holes
- 200,0 [7.87] Dia. Bolt Circle

Output Shaft - Straight (Code 21)

Ports - G1 (BSP) Staggered G 1/4 Case Drain (Code C)

Paint - Low Gloss Black (Code A)

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

112-1215

Mounting	Shaft	Ports	Displacement cm <sup>3</sup> /r [ in <sup>3</sup> /r ] and Product Number						
			310 [19.0]	390 [23.9]	490 [30.0]	625 [38.0]	737 [45.0]	800 [49.0]	985 [60.0]
Standard	50 mm Straight	G 1 (BSP)	112-1217	-1218	-1215	-1216	-1247	-1219	-1220

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

# Model Code for 6000 Series Motors

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

## Model Code — 6000 Series Disc Valve Motors

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

**Position 1 Product Series**

**M**..... Motor

**Position 2, 3 6000 Series**

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

**Position 4, 5 Displacement cm<sup>3</sup>/r [in<sup>3</sup>/r]**

**12**..... 195 [11.9]

**15**..... 245 [15.0]

**19**..... 310 [19.0]

**24**..... 390 [23.9]

**30**..... 490 [30.0]

**38**..... 625 [38.0]

**45**..... 740 [45.0]\*

**49**..... 805 [49.0]\*

**60**..... 985 [60.0]

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

**Position 6 Mounting Flange**

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

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

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

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

**Position 7, 8 Output Shaft**

**00**..... Bearingless

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

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

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

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

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

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

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

**Position 9 Port Type**

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

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

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

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

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

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

**00**..... None

**10**..... Viton Shaft Seal

**07**..... Viton Seals

**13**..... Reverse Rotation

**14**..... Seal Guard

**21**..... Speed Sensor (Std.)

**Position 12 Paint/Special Packaging**

**0**..... No Paint

**A**..... Painted Low Gloss Black

**B**..... Corrosion Protected

**Position 13 Eaton Assigned Code when Applicable**

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

**Position 14 Eaton Assigned Design Code**

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

# Fluid Recommendations

## Char-Lynn Disc Valve Motors

### Introduction

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

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

### Viscosity and Temperature

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

### Cleanliness

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

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

### Additional Notes:

- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. **Motor cavitation is not a problem during cold start-ups (with one exception — two speed motors).**
- Minimum / Maximum operating temperatures are -29° C / 82° C [-20° F / 180° F].
- When choosing a hydraulic fluid, all the components in the system must be considered and the best viscosity range adjusted accordingly. For example, when a medium duty piston pump is combined with a Geroler motor the best viscosity range becomes

### Fluid Maintenance

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

### Fluid Selection

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

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

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

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

100 - 150 SUS [20 - 32 cSt] and viscosity should never fall below 70 SUS [13 cSt].

- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky a water contamination problem may exist.
- Take fluid level reading when the system is cold.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydraulic components.

## Motor Application Information — Vehicle Drive Calculations

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

$$\text{RPM} = \frac{2.65 \times \text{KPH} \times G}{R_m} \quad \text{RPM} = \frac{168 \times \text{MPH} \times G}{R_1}$$

where KPH = vehicle speed (kilometers per hour)  
 where MPH = vehicle speed (miles per hour)  
 R<sub>m</sub> = rolling radius of tires (meter)  
 R<sub>1</sub> = 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.

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

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

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

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

### Step Three — Tractive Effort to Ascend Grade

The largest grade a vehicle can ascend is called its "gradability." Grade is usually expressed as a percent rather than in degrees. A rise of one meter in ten meters or one foot rise in ten feet of travel is a 1/10 or 10 percent grade.

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

**Table 2**

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

### Step Four — Determine Acceleration Force (FA)

The force (FA) required to accelerate from stop to maximum speed (KPH) or (MPH) in time (t) seconds can be obtained from the following equation:

### Step Five — Determine Drawbar Pull

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

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

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

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

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

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

**Step Six — Total Tractive Effort**

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

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

$\swarrow$  Drawbar pull desired  
 $\swarrow$  Force required to accelerate  
 $\swarrow$  Force required to climb a grade  
 $\swarrow$  Force required to overcome rolling resistance

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

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

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

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

where N = number of driving motors  
 Eg = gear box mechanical efficiency

**Step Eight—Wheel Slip**

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

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

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

Where: f = coefficient of friction  
 W = loaded vehicle weight over drive wheel

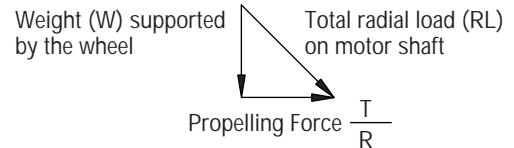
**Coefficient of friction (f)**

Steel on steel	0.15 to 0.20
Rubber tire on dirt	0.5 to 0.7
Rubber tire on asphalt	0.8 to 1.0
Rubber tire on concrete	0.8 to 1.0
Rubber tire on grass	0.4

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

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

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



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

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

**Shaft Torque**

$$\frac{T}{2\pi} = \frac{q\Delta P}{62.8} \text{ Nm} = \frac{\text{PSI} \times \text{in}^3/\text{rev}}{6.28} = \text{lb-in}$$

**Shaft Speed**

$$\text{RPM} = \frac{\text{Flow}}{\text{Displacement}} = \frac{1000 \times \text{l/min}}{\text{cm}^3/\text{rev}} \text{ RPM} = \frac{231 \times \text{GPM}}{\text{in}^3/\text{rev}}$$

**Power (into motor)**

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

**Power (out of motor)**

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

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



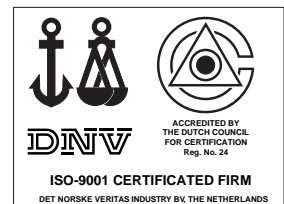
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Information contained in this catalog is accurate as of the publication date and is subject to change without notice. Performance values are typical values. Customers are responsible for selecting products for their applications using normal engineering methods.

### Eaton Hydraulics

14615 Lone Oak Road  
Eden Prairie, MN 55344  
Telephone: 952 937-7254  
Fax: 952 937-7130  
[www.eatonhydraulics.com](http://www.eatonhydraulics.com)

46 New Lane, Havant  
Hampshire PO9 2NB  
England  
Telephone: (44) 23 92-486-451  
Fax: (44) 23 92-487-110



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