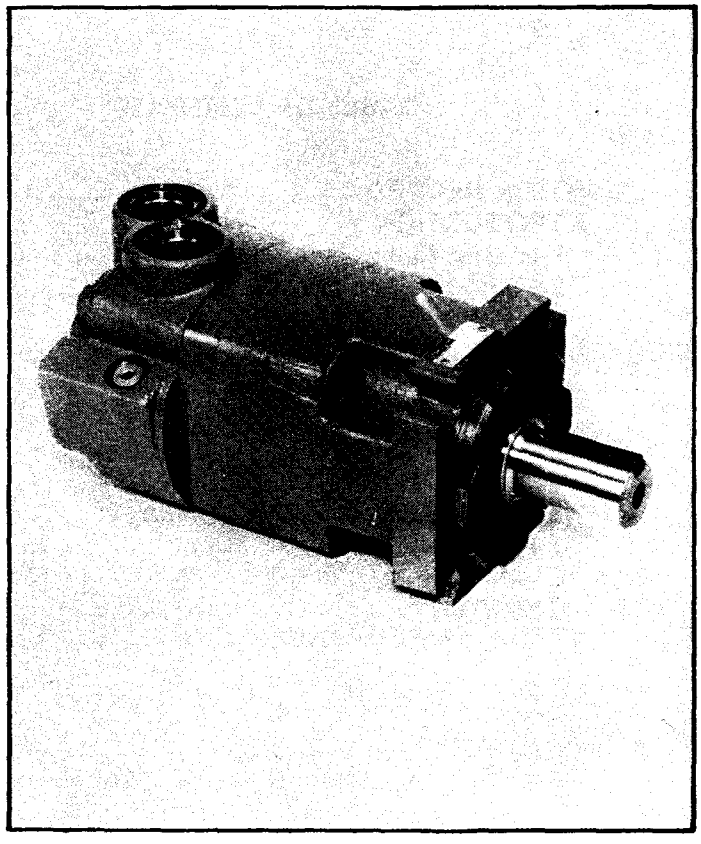


NO. 8-120

004

Char-Lynn®
Operator's Manual 4000 Series Motors

EATON Fluid Power Products

EATON
Fluid Power
Products

Motor Record

RECORDING THIS INFORMATION
NOW MAY SAVE TROUBLE LATER.

MOTOR PRODUCT NO. _____
MOTOR DATE CODE NO. _____
DATE OF PURCHASE _____
DEALER'S NAME _____

TABLE OF CONTENTS

HYDRAULIC MOTORS

A hydraulic motor is a device that converts fluid energy into mechanical energy. A hydraulic pump, which is driven mechanically, draws in fluid from a reservoir and pumps it to a motor converting mechanical energy to fluid energy. The fluid from the pump causes the motor output shaft to rotate and so drives its load by a mechanical link. The speed of the motor shaft is determined by the amount of fluid flowing through the motor (gallons per minute-gpm). Output torque, is produced by fluid under pressure operating against the displacement element (Geroler®). Displacement is the volume of fluid required to produce one revolution of a pump or motor output shaft. It is usually measured in cubic inches per revolution (cu. in./rev.). Char-Lynn®motor displacement is determined by the width of the Geroler.

Pressure (PSI) produces Torque (lb. in.)
Amount of Flow (GPM) determines Speed (RPM)

DISPLACEMENT – 1 Gallon= 231 cubic inches.

Formula for figuring theoretical torque–

$$T = \frac{\text{Pressure (psi)} \times \text{Displacement (cu. in.)}}{2\pi}$$

EXAMPLE

How much torque will a 4000 Series Series, 10 cubic inch displacement motor produce at 2000 psi?

$$T = \frac{2000 \times 10}{6.28} = \frac{20000}{6.28} = 3185 \text{ lb.in.}$$

This torque is theoretical. For actual torque, multiply by a percentage factor based on the efficiency of the motor. 4000 Series motors have a mechanical efficiency of 90%.

Actual torque = 3185 x 90% = 2866 lb.in.

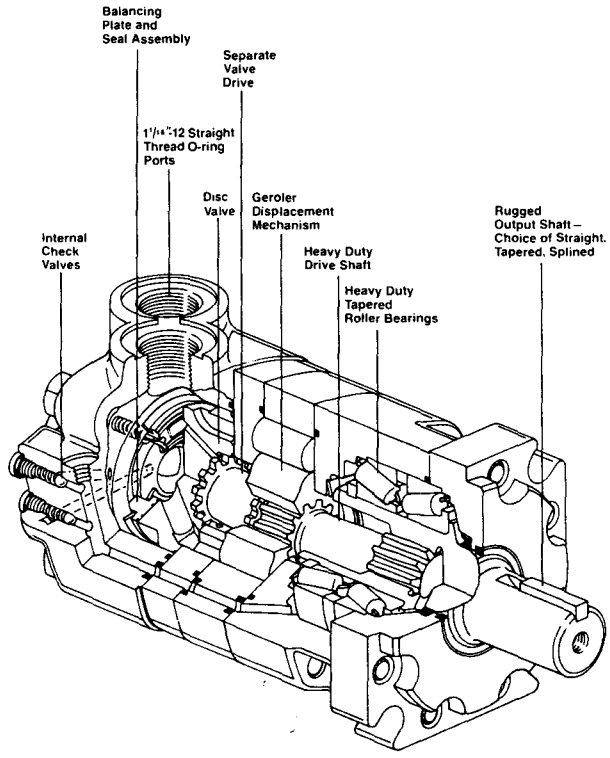
4 Introduction

CHAR-LYNN® 4000 SERIES MOTORS

The 4,000 Series Motors are simple in design, compact and powerful. Using the same basic principle as the other Char-Lynn hydraulic motors, they provide high torque at low speeds through an effective 6:1 internal reduction. Few moving parts, all self-lubricated using the hydraulic system fluid, minimize friction and wear within the motor. All motors are individually tested to insure the highest possible quality.

This manual has been prepared to help install the motor in a manner that will help to obtain long and useful life. For more information concerning the servicing of the motor, a Repair Manual (7-118) is available which gives complete disassembly and reassembly instructions plus other pertinent information about the repair of the motor.

If you have any questions which are not answered in these manuals, contact your local representative or the Eaton Corporation, Hydraulics Division.



SPECIFICATIONS

Displacement (cu. in./rev.)		6.6	7.9	9.9	12.5	15	19	24
Speed (RPM)	Continuous Flow and Pressure	595	513	414	343	288	236	185
	Peak Flow and Continuous Pressure	752	645	522	432	365	296	233
Flow (GPM)	Continuous	20						
	Peak	25						
Torque (lb. in.)	@ Continuous Pressure	3150	3550	4500	4800	4800	4800	4800
	@ Peak Pressure	4150	4950	6250	6850	6850	6850	6850
Pressure (△PSI)	Continuous	3300	3200	3150	2650	2250	1750	1400
	Peak	4500	4500	4500	3900	3250	2600	2000
	Peak Back Pressure *	1000						

***For continuous back pressure over 300 PSI use an external case drain. Install case drain lines to provide a 25 to 50 PSI case pressure. Always use external case drain in closed loop circuits.**

Maximum inlet pressure 4500 **PSI. Do not exceed △ PSI rating above**

Maximum return pressure 4500 **PSI. Do not exceed △ PSI rating above**

Peak conditions assumed to be less than 10% of every minute
Recommended maximum system operating temperature 180° F
Recommended viscosity 100 SUS at operating temperature
Recommended filtration 10 micrometer
For frequent peak pressure conditions or flow and pressures beyond peak ratings consult Hydraulics Division Sales Department.

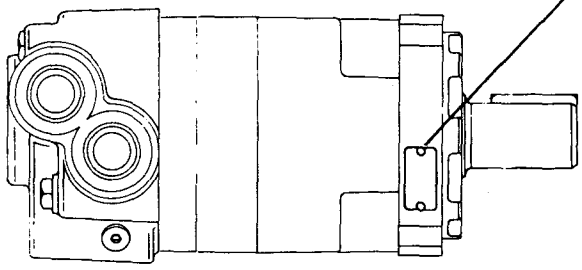
To assure optimum motor life, run motor for approximately one hour at 30% of rated pressure before application of full load. Be sure motor is filled with fluid prior to any load applications.

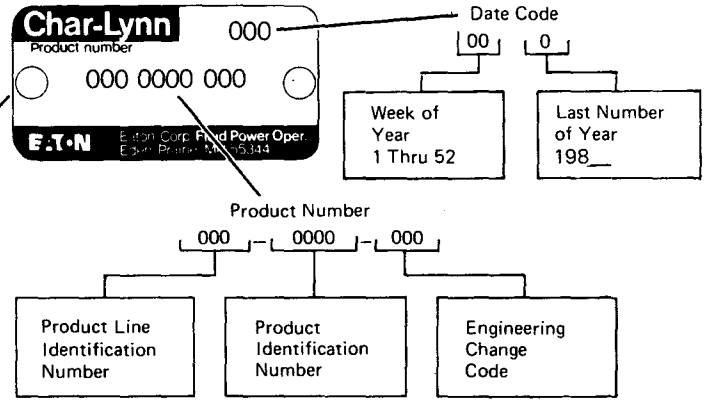
6 Introduction

MOTOR IDENTIFICATION

Both the product number and the date code number are stamped on the motor I.D. tag. Record these numbers in the place provided on page 2 of this manual and keep it handy for a quick reference when ordering parts or requesting information on the motor.

ALWAYS INCLUDE THE DATE CODE NUMBER AND PRODUCT NUMBER WHEN ORDERING REPLACEMENT PARTS.





MOTOR IDENTIFICATION

Type of Motor	Ports	Type of Shaft	Displacement (cu. in./rev.)						
			6.6	7.92	9.87	12.51	15	19	24
Standard Motor	1-1/16" Straight Thread O-ring	1-1/4"Str. Keyed	109-1100	109-1101	109-1102	109-1103	109-1104	109-1105	109-1106
		1-5/8"Tapered	109-1107	109-1108	109-1109	109-1110	109-1111	109-1112	109-1113
		1-1/4" Splined	109-1114	109-1115	109-1116	109-1117	109-1118	109-1119	109-1120
Wheel Motor	1-1/16" Straight Thread O-ring	1-1/4"Str. Keyed	110-1074	110-1075	110-1076	110-1077	110-1078	110-1079	110-1080
		1-5/8"Tapered	110-1081	110-1082	110-1083	110-1084	110-1085	110-1086	110-1087
		1-1/4"Splined	110-1088	110-1089	110-1090	110-1091	110-1092	110-1093	110-1094
Bearingless	1-1/16" Str. Thread O-ring		111-1033	111-1034	111-1035	111-1036	111-1037	111-1038	111-1039

HYDRAULIC CIRCUITS

Hydraulic motor circuits can be reduced to three basic types. The single motor circuit, series circuit and parallel circuit (both of the later types incorporating two or more motors). The figures below illustrate these circuits.

SINGLE MOTOR CIRCUIT

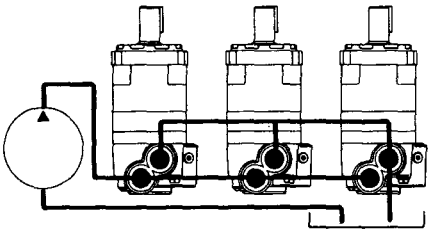
A 3-way open center valve can be used to start and stop the motor. When the valve is moved to the stop position, the motor is allowed to "coast" to a stop. A 4-way valve can be used if the motor is to be reversed.

PARALLEL MOTOR CIRCUIT

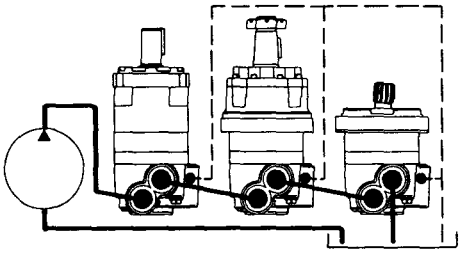
The two or more motors hooked in parallel share the same oil supply. With equal loads, two motors in parallel will operate at ½ the speed of a single motor at the same GPM. Torque will remain constant. 4000 Series motors will operate satisfactorily in this type installation with no back pressure.

SERIES MOTOR CIRCUIT

Two or more motors in series will divide the pump pressure according to the load on each, but will operate at approximately equal speed. An external case drain is required whenever 2 or more motors are used in series. See Page 21.



Parallel Connection



Series Connection

The Reservoir

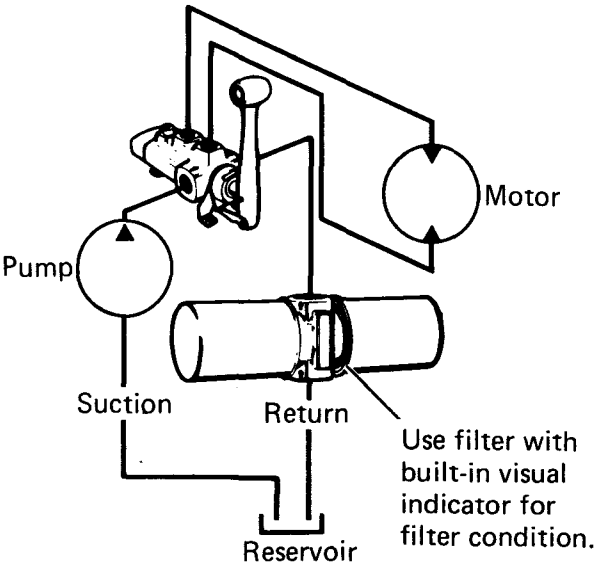
Reservoir size varies with the type of circuit and the application. A ratio of 1:1* is adequate to supply most systems and maintain the proper temperature. The size or ratio (reservoir to pump) also provides for release of air from fluid. This temperature should be around 120°with 180° considered the absolute maximum. If oil temperatures go beyond this range, a larger reservoir or heat exchanger should be added to the circuit. Black iron pipes can be used to replace hoses in some instances. These help keep the temperatures down and also give a more economical installation. The pipe should be in accordance with recognized pressure maximums i.e. STD., XH or XXH. Pipe must be cleaned before installation.

*** 1 gallon or reservoir capacity for each GPM pumped.**

The Filter

This motor is sensitive to contamination because of close part tolerances. Therefore, it is very important that adequate filtration is included in the system. A 10 micron filter or finer is recommended; It should be installed in the return line. Welding slag, dirt or sand in a new reservoir can cause contamination throughout the system at startup. Be sure to flush out the reservoir through the filtering system without the motor and other components connected and operating.

Filter Circuit.



PETROLEUM BASE FLUIDS FOR USE IN CHAR-LYNN® MOTORS

Viscosity

Proper viscosity at operating temperature is probably the most important property the fluid must possess. Viscosity affects efficiency and life. In the past, the most common measurement of viscosity

For optimum performance Eaton recommends that a fluid used in Char-Lynn products have a viscosity of not less than 100 SUS or 20 centistokes at operating temperature and preferably between 100 and 200 SUS or 20 to 43 centistokes at operating temperature of the system when running continuously. If system temperatures exceed 180° F. (86° C) contact Eaton, Minneapolis Division Service Dept. for recommendations.

Premium Quality, Industrial Anti-Wear Hydraulic Fluids

In hydraulic systems where the oil serves as a hydraulic fluid only, premium quality, anti-wear type hydraulic oils are recommended. These products are balanced to protect Char-Lynn products, maintain proper viscosity for extended periods of time and provide trouble free filtering capabilities.

System operating temperature is the main factor in determining which Viscosity Grade to specify. Fluids are identified by and can be ordered by Viscosity Grade. For example, in a system with operating temperatures up to 154° F. (68° C) the chart indicates 315 SUS or 68 centistokes premium grade, industrial anti-wear fluid will provide the required viscosity range.

The chart gives a comparison of viscosity grade identification for ISO Viscosity Grade and Saybolt Universal Viscosity Grade at a wide range of system operating temperatures.

Viscosity Requirements of Industrial Anti-Wear Hydraulic Oils

Operating Temperature Range		Viscosity Grade Industry Identification		Viscosity Range at Operating Temperature	
° Celsius	° Fahrenheit	ISO-VG Cst @ 40°C	SUS @ 100°F	Centi-stokes	SUS
32/52	90/125	32	150	20/43	100/200
41/60	105/140	46	225	20/43	100/200
48/68	118/154	68	315	20/43	100/200
57/77	134/172	100	465	20/43	100/200
66/88	150/190	150	700	20/43	100/200

Multi-Grade Automotive Engine Oils (API Service Classification SE)

These oils are acceptable, basically because of general availability. Because different additives are required for internal combustion engines than for hydraulic service, certain filtering problems can arise when these fluids are placed in hydraulic service. However, when high operating temperatures become the prime consideration and premium hydraulic oils of the proper viscosity are not available, a multi-grade engine oil of the API Service Classification SE quality level may be used with the expectation of more frequent servicing of the filter element. Keep in mind, also, that multi-grade oils may tend to lose viscosity after extended service, therefore the oil should be changed more frequently.

The chart shows temperature and viscosity ranges of both multi-grade and single grade SAE oils, however, multi-grade oils will provide the required viscosity over a wider range of operating temperatures than will single grade oils.

Example: For operation with system temperatures up to 180° F use a 10W/40 multi-grade API service classification SE oil.

Examples of Automotive Engine Oils Straight and Multi-Grade SAE—Classification SE

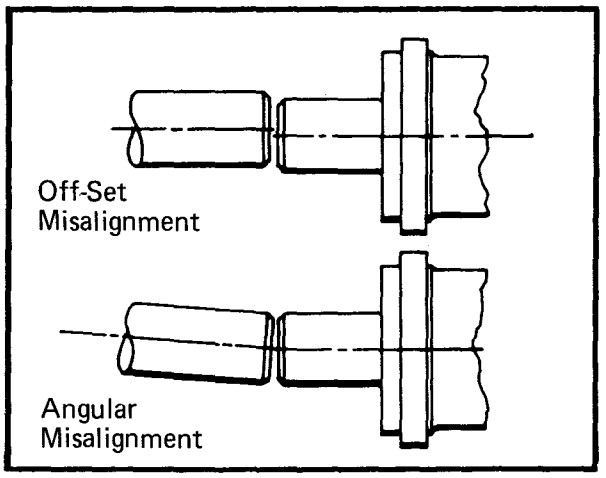
Operating Temperature Range		SAE Viscosity Grade API SE Classification		Viscosity Range at Operating Temperature	
°C	°F			Centistokes	SUS
49/74	120/165	Multi Grade	SAE 10W/30	20/43	100/200
57/82	135/180	Multi Grade	SAE 10W/40	20/43	100/200
61/85	143/185	Multi Grade	SAE 15W/40	20/43	100/200
54/74	130/165	Straight Grade	SAE 30	20/43	100/200
61/84	143/183	Straight Grade	SAE 40	20/43	100/200

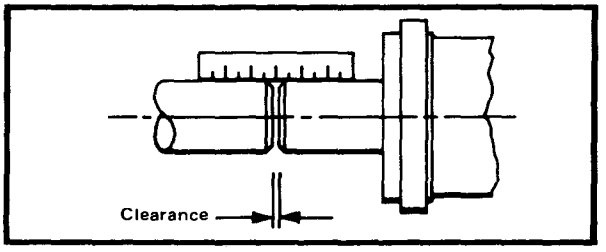
12 Installation

SHAFT ALIGNMENT

Avoid poor installation practices which lead to shaft misalignment. The motors are adequately designed to withstand substantial side and thrust loads, but to impose an unnecessary continuous force on the motor shaft can accelerate wear and reduce the work life of the motor and coupling.

As shown here, there are two types of misalignment problems. For most applications, a 6" scale and visual inspection can determine the correct alignment. For example, place one half of the scale's edge up against the motor shaft. The other half of the scale on the output shaft. If the two shafts are aligned, the edge of the scale will be one continuous solid line between both shafts. If the shafts are not aligned, there will be a visible gap between the scale's edge and the output shaft. This visual method of checking alignment is shown in the bottom Figure.





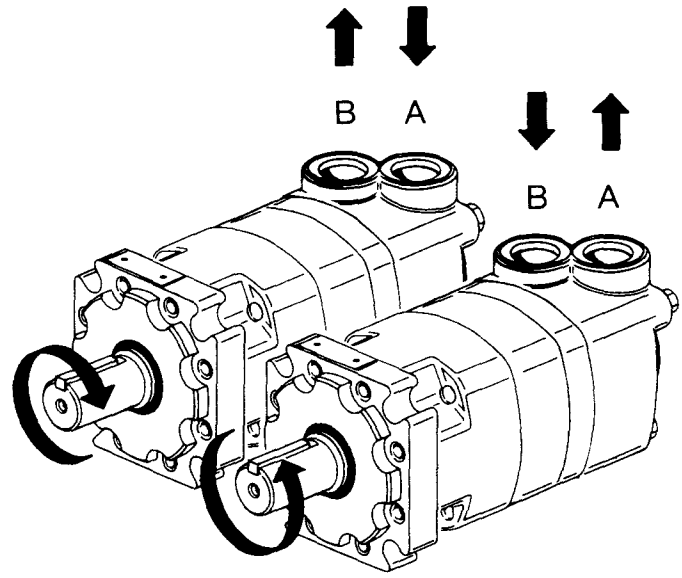
SHAFT ROTATION

The ports in the 4000 Series Motors will accept standard 1-1/16" straight thread o-ring fittings.

The motors operate equally well in either direction, depending on which port is connected to pressure.

These motors are set at the factory to rotate in a clockwise direction when pressurized as shown. The direction of rotation can be reversed simply by reversing the oil lines.

If for some reason this is impossible, the position and relationship of the valve and Geroler must be changed to effect a reversal. The procedure for this is outlined in the 4000 Series Repair Manual.



Rotation—Viewed from Shaft End
Port A Pressurized—Clockwise
Port B Pressurized—Counter Clockwise

RADIAL LOAD CHARACTERISTICS

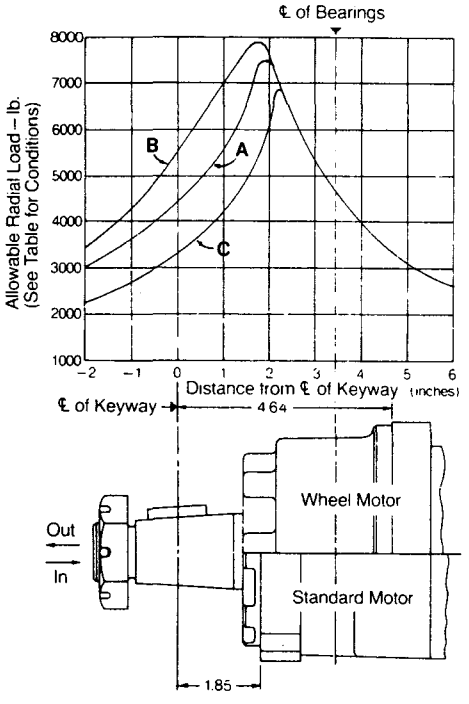
	Conditions	
	External Thrust (lb.)	Internal Back Pressure (PSI)
A	0	25
B	1000 in	25
C	1000 out	25
	1000 in	1000
	1000 out	1000
	0	1000

These curves indicate the radial load capacity of the 4000 Series Industrial and Wheel Motors depending on the location of the radial load.

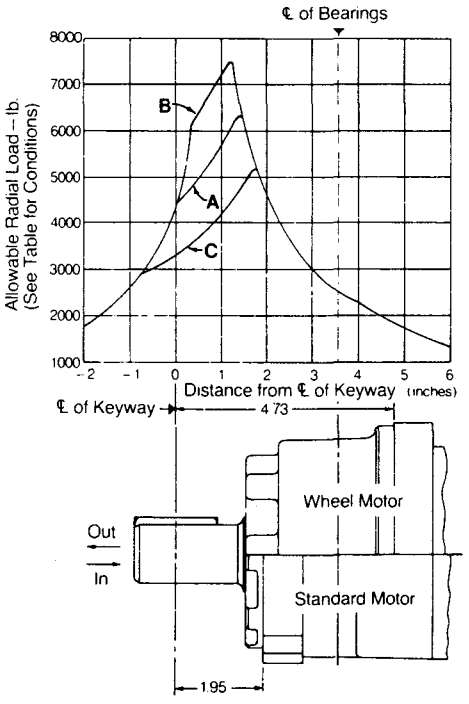
The curves are based on 2000 hr. B-10 bearing life at 100 RPM and at rated output torque. To determine the allowable radial load in speeds other than 100 RPM, multiply the load values given on the bearing curves by the factors given in the chart at right.

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

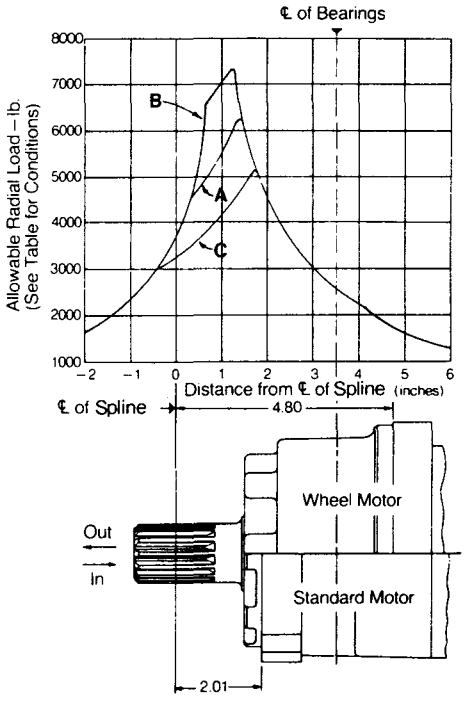
Tapered Shaft



Straight Shaft



Splined Shaft



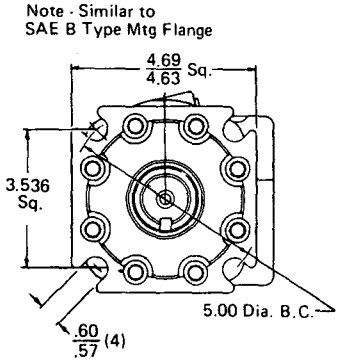
16 Installation

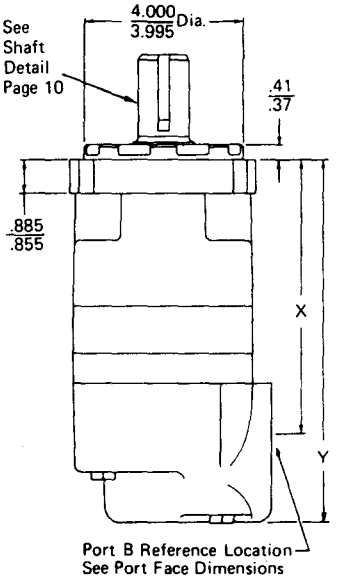
DIMENSIONS & MOUNTING DATA

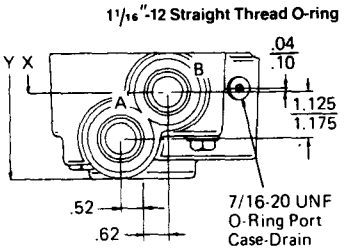
STANDARD MOTOR

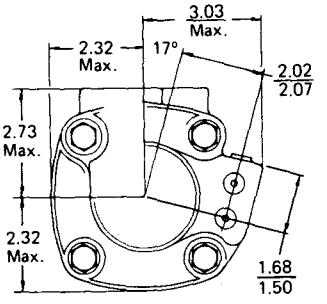
Rotation—Viewed from Shaft End
A Port Pressurized—Clockwise
B Port Pressurized—Counter Clockwise

Displacement cu. in/rev.	X	Y max.
6.6	6.27/6.16	8.47
7.9	6.44/6.33	8.64
9.9	6.69/6.58	8.89
12.5	7.03/6.92	9.23
15	6.69/6.58	8.89
19	7.03/6.92	9.23
24	7.45/7.34	9.65







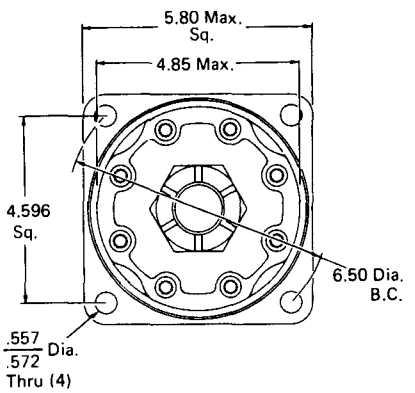


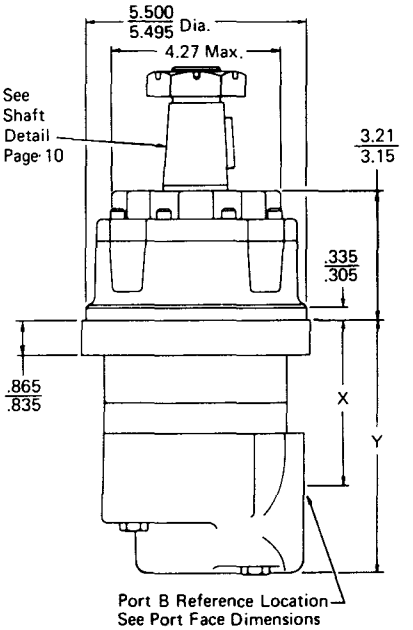
DIMENSIONS & MOUNTING DATA

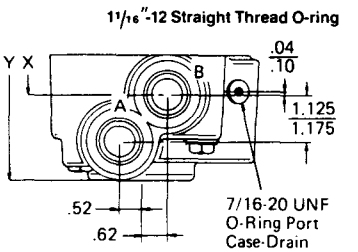
WHEEL MOTOR

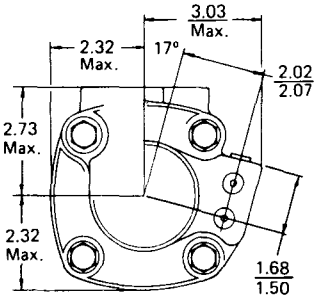
Rotation—Viewed from Shaft End
A Port Pressurized—Clockwise
B Port Pressurized—Counter Clockwise

Displacement cu. in./rev.	X	Y max.
6.6	3.48/3.38	5.68
7.9	3.65/3.55	5.85
9.9	3.90/3.80	6.09
12.5	4.24/4.14	6.43
15	3.90/3.80	6.09
19	4.24/4.14	6.43
24	4.66/4.56	6.85









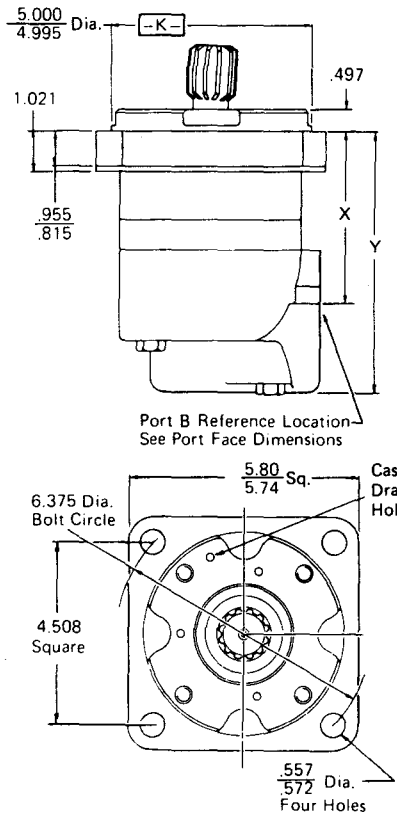
18 Installation

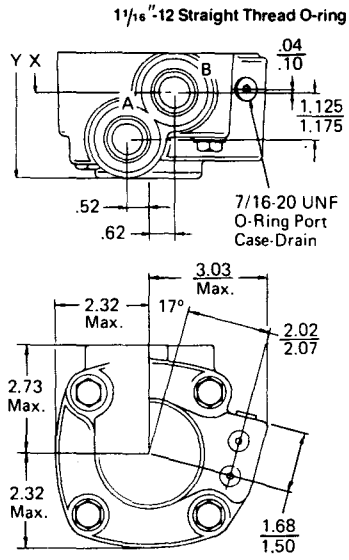
DIMENSIONS & MOUNTING DATA

BEARINGLESS MOTOR

Rotation—Viewed from Drive End
A Port Pressurized—Clockwise
B Port Pressurized—Counter Clockwise

Displacement cu. in./rev.	X	Y max.
6.6	3.61/3.53	5.81
7.9	3.78/3.70	5.98
9.9	4.03/3.95	6.23
12.5	4.37/4.29	6.57
15	4.03/3.95	6.23
19	4.37/4.29	6.57
24	4.79/4.71	6.99

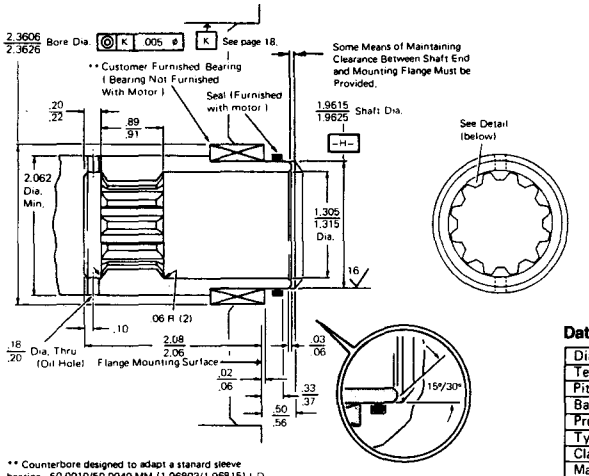




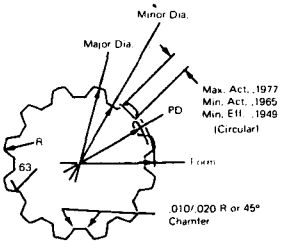
Bearingless Motor

Internal spline is mating part to be as follows: Material to be AISI E8620H vacuum degassed stl. heat treat to hardness of 60-64 R_c with an effective case depth of .030 to .040.

Mating part to have critical dimensions as shown. Oil hole must be provided and open for proper oil circulation (.187 dia. min.).



** Counterbore designed to adapt a stanard sleeve bearing 50.0010/50.0040 MM (1.96803/1.96815) I.D. by 60.0080/60.0050 MM (2.36231/2.36219) O.D. (Ref. Oilite Bearing Bronze Sleeve Bearing AAM 50-60)



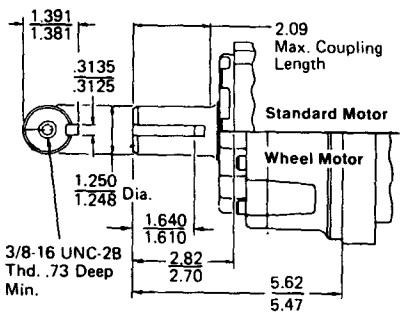
Data for Internal Involute Splines

Diametrical Pitch	10/20
Teeth Number	12
Pitch Diameter	1.2000 Ⓜ H .008 Ⓜ
Base Circle Diameter	1.0392 (Ref.)
Pressure Angle	30°
Type of Fit	Side Fit
Class of Fit	5
Major Diameter	1.316/1.308
Minor Diameter	1.125/1.118
Form Diameter (Min.)	1.283
Fillet Rad. (R)	.025/.030
Inspection Dimensions	
Involute Profile Variation	+.000 -.001
Total Index Variation	.0015
Lead Variation	.0006
Dim. Between Two Pins	.9005/8975 (Ref.)
Pin Diameter	.2100
Out-of Roundness (Pd)	.0010

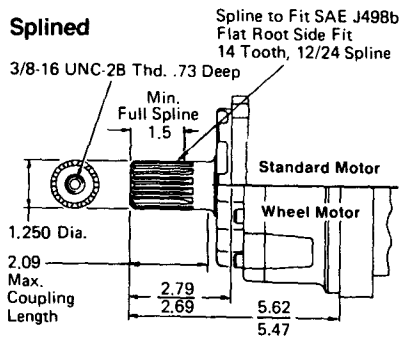
20 Installation

OUTPUT SHAFT DIMENSIONS

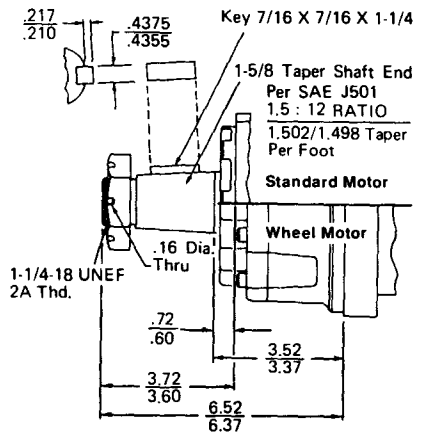
Straight



Splined



Tapered



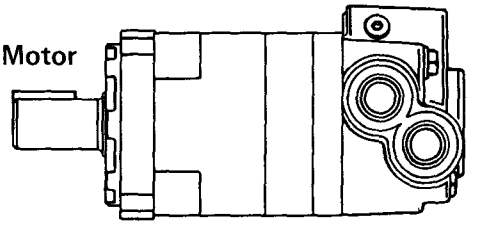
CASE DRAIN

Use an external case drain when continuous back pressure exceeds 300 PSI and when motors are connected in series or closed loop applications. When using an external case drain, be sure to maintain the oil level in the motor to provide internal lubrication. Place the case drain port above the centerline of the motor or use an elevated case drain line or a 5 PSI check valve.

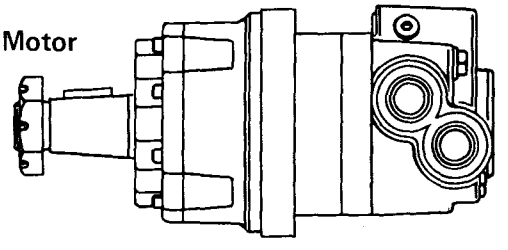
To install on the standard motor, remove one of the 7/16-20 UNF O-ring Plugs and install a case drain line. This may be tubing, pipe or hose and should have at least 1/4" inside diameter.

On the bearingless motor, we recommend a case drain be provided on the driven device. When this is not possible install a case drain in the motor housing. This requires a 7/16-20 UNF O-ring fitting.

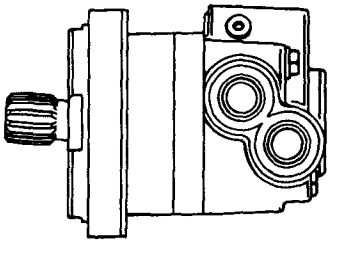
Standard Motor



Wheel Motor



Bearingless Motor



22 Motor Maintenance

A Char-Lynn® hydraulic motor is built to extremely high standards and should be treated as such. It should be returned to your nearest service center or to the factory if in need of repair. Trained personnel repair and test returned motors so that they meet the highest quality repair and test standards. Upon request, before repairs are made, the owner will be notified of the cost and probable cause of the failure.

INSURE TROUBLE–FREE SERVICE

The Char-Lynn hydraulic motor was designed and is manufactured to very strict tolerances and assembled under closely controlled conditions. If properly installed and with a minimum of attention it will give long trouble-free service.

****Avoid nuisance fluid-leaks. Typical causes are: dirty, scratched, bowed or inadequately bolted joints; vibrating, unsupported lengths of flexible and rigid piping. The cure: careful assembly, use proper seals. Only compatible seal materials (resistant to fluid and temperatures involved) should be used. DO NOT USE LEAK ADDITIVES.

****Eliminate vacuum leaks in suction lines to pumps. Suction leaks lead to noisy pump operation, cavitation, and early pump failure.

****Avoid shock–limit the rate of pressure build-up. Adjust relief valves, avoid chatter, sudden pressure surges and higher-than-needed working pressures. Pressure and flow are energy-use them efficiently.

****Be aware of temperatures. Use oils that will not be too heavy when cold or too light when hot. Either may affect operation and lubrication. (See pages 10 and 11).

****Include adequate filtration in the system (10 micron filter.)

If you encounter problems with the motor during operation, please contact Field Services Department, Eaton Corp., Hydraulics Division, Eden Prairie, Minnesota or the supplier of the motor or the product on which it is used.