Contents

Introduction

All about Motors...

Contents

Char-Lynn, Hydraulic Motors

Introduction...

For the past 45 years, the Char-Lynn®, brand has been recognized as the industry leader in high-torque hydraulic motor technology. The name Char-Lynn was coined by one of the son's of the original pioneers in the hydraulic industry, the late Mr. Lynn Charlson. The hydraulic motor designs developed by Lynn Charlson and his team use what is termed as the Orbit principal. This principal is the center of the designs pioneered by the Char-Lynn team and is based on the fact that a gerotor or Geroler®, star orbits multiple times (typically 6 to 8 times depending on specific star and ring geometry) for each complete single revolution within the outer ring. This principle is what gives Char-Lynn motors their reliable high power density and extremely compact size. Only three primary moving components are needed to transmit torque through the motor: the motor star, drive and output shaft. Shaft rotation can be instantly reversed by changing inlet / outlet flow while generating equal torque in either direction. A variety of displacement sizes are available in each motor family that provide a wide variety of speeds and torque ranges from any Series of motors. The results are compact, modular, economical, designs that can be easily customized to suit a wide variety of application needs.

Motor options include:

- Displacement size (cubic inches or cc's per revolution)
- Output shaft size and type
- Mounting flange type
- Porting interface
- A wide selection of special features such as integrated brakes, sensors, integrated cross-over relief valves, 2-speed capability, manifold valve packages, and environmental protection suited for corrosive environments.

Char-Lynn motors are extremely, reliable, compact, and have tremendous horsepower density. They provide a way to meet many needs for cost-effective power transmission requirements. Multiple motors can be driven by a single power source (pump) and controlled using a wide array of valves and variable displacement pump controls. Motors can even be configured with electronic sensors to provide digital feedback for sensing both motor direction and output speed RPM. .

The Char-Lynn motor range consists of three major types based on the type of valving used to distribute fluid through the Orbit gear set (geroler or Geroler). These three types are:

- **Spool Valve**
- **Disc Valve**
- **VIS (Valve-in-Star)**

Migration from one valve technology to the next enhances motor performance in terms of efficiency, pressure rating, displacements, and motor output torque capability. To help guide you to proper product selection, a quick guide is provided below. In addition, you will find product highlight's, summaries of motor option features and benefits, application formulas, and detailed specifications for each motor family.

MOTOR QUICK-GUIDE (BASED ON MAXIMUM CONTINUOUS RATINGS)

Type	Output Torque Nm [lb-in]	Pressure bar [psi]	Flow lpm [gpm]	Side Load kg [lbs]
Spool Valve	550 [4850]	165 [2400]	62 [18]	845 [1900]
Disc Valve	2700 [24000]	205 [3000]	170 [45]	1815 [4000]
VIS (valve-in-star)	3850 [34000]	345 [5000]	170 [45]	4535 [10000]

Hydraulic Circuit

Hydraulic drives can be divided into two basic types: 1) Traction Drives and 2) Non-Traction drives. Traction drives (also referred to as propel drives) are used to propel a wheeled or track-driven vehicle. A non-traction drive (also referred to as work drives) are used for some other vehicle function such as a winch, auger, conveyor or rotate function for a boom or crane.

These rotary drive systems can also be classified as either open-loop or closed-loop circuits.

Open Loop Circuit

In an open-loop circuit, oil is returned to a reservoir before returning to the motor. The motor/pump circuit is open to atmosphere. In an open loop circuit, the drive speed of a motor may be controlled by, varying the flow with a valve, changing pump input speed (engine or pump input speed), or varying flow using a variable displacement pump. Often these circuits use counter-balance valves to accomplish dynamic braking functions, and provide a flow (pressure) source to release a spring-applied, hydraulic release brake. It is common to use a shuttle valve for directing flow to release the spring-applied pressure-release brake. A shuttle valve is basically a double check valve that directs flow from the A or B side of the loop and is often the source of flow to create the pressure to release a brake.

Typical applications using open loop circuits include:

- Truck-Mounted Booms and cranes (boom – rotate function)
- Aerial Work Platforms (boom – rotate function)
- Winches
- Conveyors
- Grapples
- Others

Closed Loop Circuit

In a closed loop circuit, there is no reservoir between the inlet and outlet of the motor and pump.

That is, the motor and pump are connected directly pump inlet to motor outlet, and pump outlet to motor inlet, respectively. This circuit is in theory, closed to atmosphere. Motor speed is typically controlled using a variable displacement pump. This pump can also control motor output shaft direction (CW or CCW rotation).

These systems provide dynamic braking by control of flow through the motor/pump closed loop circuit. However, they are subject to some inherent level of internal leakage that results in the inability of the loop to hold a load over time. This is why a static brake is typically found in such systems to mechanically hold the load. Brakes used include mechanical caliper, disc or ball-ramp type brakes. In addition, spring-applied, hydraulic release brakes are used. The T Series Motor w/Parking Brake meets this need.

Typical applications using closed loop circuits include:

- Vehicle traction drives (propel function)
- Conveyors
- Winches
- Others

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 hydraulic motors allow the designer to put the power where it is needed. 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, the motors stand up against high hydraulic pressures.

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 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

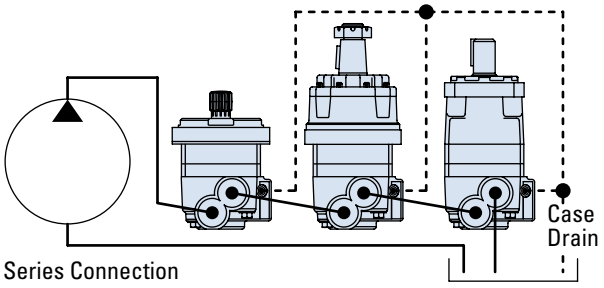
Char-Lynn motors have high efficiencies providing high output for the pressure and flow supplied. The high mechanical efficiency enables you to obtain a given torque with a smaller displacement motor.

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

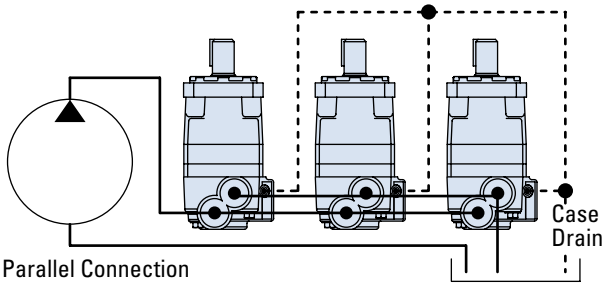
High efficiency reduces heat in the hydraulic system and increases output horsepower.

Case Port and Shuttle Valve Options

Many hydraulic systems can benefit from the use of a system case port. Char-Lynn motors provide this feature built in. One of the advantages for case port 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 port 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 W series, 2000, 4000 Compact, 4000, 6000 series, VIS 30, VIS 40 and VIS 45 series motors.



Series Connection



Parallel Connection

Motor Application Information

Vehicle Drive Calculations

Step One — Calculate Motor Speed (RPM)

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

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

If vehicle speed is expressed in m/second, multiply by 3.6 to convert to KPH. If vehicle speed is expressed in ft./second, divide by 1.47 to convert to MPH.

Step Two — Determine Rolling Resistance

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

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

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 footrise in ten feet of travel is a 1/10 or 10 percent grade.

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

TABLE 2

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

Step Four — Determine Acceleration Force (FA)

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

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

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

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

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

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:

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).

Motor Application Information

Vehicle Drive Calculations

Step Six — Total Tractive Effort

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

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

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

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

Step Seven — Calculate Hydraulic Motor Torque (T)

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

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

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

Step Eight—Wheel Slip

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

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

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

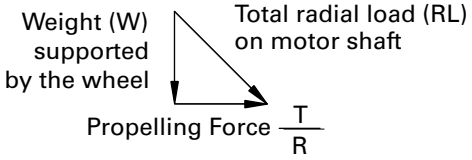
Where: f = coefficient of friction
W = loaded vehicle weight over drive wheel

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

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

Step Nine — Motor Radial Load Carrying Capacity

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



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

Refer to radial load rating of each motor series.

Shaft Torque

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

Shaft Speed

$$\frac{\text{bar} \times \text{cm}^3/\text{rev}}{62.8} \qquad Nm = \frac{PSI \times in^3/rev}{6.28} = lb -$$

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

$$RPM = \frac{1000 \times l/min}{cm^3/rev} \qquad RPM = \frac{231 \times}{in^3/r}$$

Power (into motor)

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

Power (out of motor)

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

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

Optional Features

OPTIONAL FEATURE	BENEFIT
2 Speed motors	Allows motor to have two displacements (higher speed has lower torque)
Seal Guard	Prevents physical damage to shaft seal from foriegn debris
High pressure Shaft Seal	More robust shaft seal that can withstand high case pressure spikes
Environmental protection	Epoxy coating for demanding application in harsh environment
Nickel Plated Shaft	For highly corrosive environment or food/sanitary applications
Integrated Parking Brake	Spring applied hydraulic release brake
Mechanical Disc Brake	Bolt on caliper brake for wheel motor applications
Free running option	Greater efficiency at high-speed/high-flow conditions
Speed sensors	To collect speed and/or direction information from a motor and provide electric signal
Shuttle valve	Redirect some low pressure oil for increased cooling in closed loop applications
Case port	To increase lubrication and flushing of the motor and reduce case pressure , extend seal life
Internal check valves	Relieves the case pressure to the low pressure port
Low speed valving	For better efficiency and smooth running at low speed conditions (<200 RPM)
Vented Two-Stage seal	Extends shaft seal life
Viton seals	For higher temperature or chemical resistance applications
Integral cross over valving	Cost effective design that limits the differential pressure across the motor
Metric Shafts, Ports, & Mounts	EU specific threads
Reverse Rotation	Allows clockwise shaft rotation with B port pressurized

Optional Features

OPTIONAL FEATURES	TYPICAL APPLICATIONS*													
	WINCH	SWING DRIVES	SWEEPER BRUSH DRIVES	AUGER	INDUSTRIAL CONVEYOR	CAR WASH	TURF PROPEL	IRRIGATION REELS	MIXERS/GRINDERS	PLASTIC INJECTION MOLDING	TRACTION DRIVES	TRENCHER CHAIN DRIVES	SALT SAND SPREADER	MARINE WINCHES
2 Speed motors	x			x				x			x			x
Seal Guard			x				x		x			x		
Viton seals					x					x				
High Pressure Shaft Seal	x								x					
Environmental protection					x	x							x	x
Nickel Plated Shaft					x	x							x	
Integrated Parking Brake	x	x			x			x			x			x
Mechanical Disc Brake							x				x			
Free running option		x												
Speed sensors					x			x	x	x		x	x	
Shuttle valve							x		x		x	x		
Case port	x	x	x	x	x		x		x		x	x		
Internal check valves					x	x	x							
Low speed valving		x			x		x				x		x	
Vented Two-Stage seal					x	x	x				x			
Integral cross over valving	x	x		x										x
Metric Shafts, Ports, & Mounts	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Reverse Rotation					x									

* These features are not limited to these applications. Final configuration depends on individual application needs.

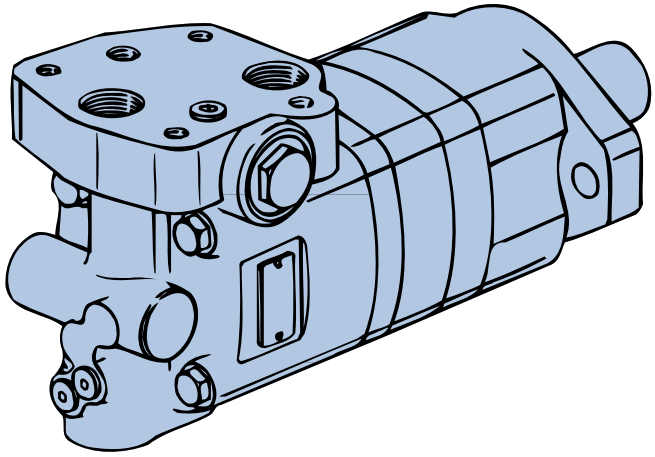
Optional Features

		SPOOL VALVE MOTORS					DISC VALVE MOTORS					VIS MOTORS		
FEATURE DESCRIPTION	CATALOG PAGE NUMBER	J Series	H Series	S Series	T Series	W series	2000 Series	4000 Compact Series	4000 Series	6000 Series	10000 Series	VIS 30	VIS 40	VIS 45
2 Speed motors	A-11	---	---	---	---	---	O	---	---	---	O	O	O	O
Seal Guard	A-12	---	O	O	O	---	O	O	O	O	O	O	O	O
Viton seals	A-12	O	O	O	O	O	O	O	O	O	O	O	O	O
High pressure Shaft Seal	A-13	---	O	O	O	---	O	O	---	---	---	---	---	---
Environmental protection	A-13	O	O	O	O	O	O	O	O	O	O	O	O	O
Integrated Parking Brake	A-14	---	---	---	O	O	---	---	---	---	---	O	O	O
Mechanical Disc Brake	A-14	---	---	---	---	O	O	O	---	---	---	---	---	---
Free running option	A-15	O	O	O	O	O	O	O	O	O	O	O	O	O
Speed sensors	A-16	O	O	O	O		O	O	O	O	O	O	O	O
Shuttle valve	A-17					O	O	O	O	O	---	O	O	O
Case port	A-18	O	O	O	O	O	S	S	S	S	S	S	S	S
Internal check valves	A-18	S	O	S	O	O	---	---	---	---	---	---	---	---
Low speed valving	A-19	---	O	O	O	S	---	---	---	---	---	---	---	---
Vented Two-Stage seal	A-20	---	O	O	O		---	---	---	---	---	---	---	---
Integral cross over valving	A-21	---	---	---	---		O	O	---	---		---	---	---
Metric Shafts, Ports, & Mounts	–	O	O	O	O	O	O	O	O	O	O	O	O	O
Reverse Rotation	–	O	O	O	O	O	O	O	O	O	O	O	O	O

O Optional
S Standard
— Not applicable

Two Speed Motors

This option is available on all 2000, 10,000, VIS 30, VIS 40 and VIS 45 motors.



Features:

This option gives the user the ability to switch the displacement of the motor thus providing a different speed at a different torque without changing the input flow or pressure. An external 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.

Benefits:

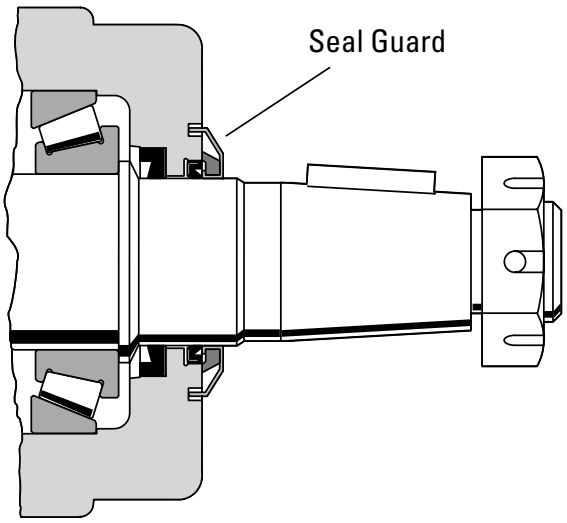
- Two operating speeds and torque levels with one motor
- Switch from one set of parameters to another with pilot pressure to a three way valve
- Ratio of 1 to 2 that shifts the motor from a low speed high torque (LSHT) to a high speed low torque (HSLT) mode

Application:

- Conveyors
- Winches
- Traction drives
- Augers
- Irrigation/utility cable reels

Seal Guard

This option is available on H, S, T, 2000, 4000, 6000, 10,000, VIS 30, VIS 40 and VIS 45 series motors



Features:

This option consists of a metal shield that protects an internal wiper seal. The shield is interference- fit on the output shaft and rates with the output shaft. For added protection, the shield is recessed into a special groove in the bearing housing face.

Benefits:

Centrifugal force causes foreign debris to be forced away from the high pressure shaft and dust seal area. The seal does not seal hydraulic fluid, instead it protects the standard seals from damage caused by foreign debris.

Applications:

- Street sweepers
- Industrial sweepers
- Lawn and turf equipment (ZTR)
- Harvesting machinery
- Mining equipment

Viton Seals

This option is available on all Char-Lynn motors.

Features:

Higher chemical compatibility and temperature tolerance make Viton the material of choice for demanding application in extremely corrosive, harsh environment.

Benefits:

- Longer seal life in chemically aggressive environment

Applications:

- Industrial conveyors
- Plastic injection molding

High Pressure Seals

This option is available on H, S, T and 2000 series motors.

Features:

Eaton has introduced a high-pressure shaft seal option for its H, S and T and 2000 series motors. The seal geometry is optimized for applications that operate under extreme conditions. The seal geometry increases the clamping force of the sealing lip against the output shaft to prevent seal leakage at extreme pressure conditions. Case pressure forces the lip of the seal to clamp more tightly against the output shaft. The result is a seal the handles high pressure spike conditions without failure. The seal is designed to withstand case pressures up to 200 bar [2900 PSI] at 150 rpm. The standard seal in the H, S and T series is rated at 103 bar [1500] psi. The seal is designed to withstand case pressures up to 200b (3000 PSI) for the 1000 Series motor.

These seals can withstands case pressure up to :

- 100 bars (1500 PSI) for H, S, T motors
- 140 bars (2000PSI) for 2000 Series
- 100 bars (1500 PSI) for 4000 Series
- 70 bars (1000 PSI) for 6000 Series
- 20 bars (300 PSI) for the 10,000 Series
- 20 bars (300 PSI) for VIS 30, 40, 45

Benefits:

- Increases ability to handle high-pressure spike conditions.
- Eliminates the use of case port line in application with intermittent extreme operating conditions.
- Can be an effective alternative to additional case port plumbing.

Applications:

- Harvesters
- Sweepers
- Turf Equipment
- Wood Chippers
- Stump Grinders
- Skid Steer Loader Attachments (often loaders have no case line available)
- Any application with extreme intermittent operating conditions or where no case return line is available.

Special Notes:

1. Intermittent* operation is defined as 10% of every minute.
2. The standard seal with case port option is preferred for maximum life – especially for continuous duty at high pressure conditions.
3. Seal kits are available to convert motors with the standard shaft seal to the high pressure shaft seal. (complete motor seal kits include high pressure shaft seal).

Part Numbers:

H Series – Kit No. 60572-000

S Series – Kit No. 60578-000

T Series – Kit No. 60579-000

Shaft Seal –
Part No. 14778-001

2000 Series –
Kit No. 61329-000.

Shaft Seal – No. 14857-001

Environmental Protection

(epoxy paint) (plated shafts)

This option is available on all Char-Lynn motors.

Features:

All motors are available with a corrosion resistant coating for use in hostile environments. The Char Lyn line is also available with the output shaft plated, or with plated shaft and entire motor exterior coating.

Benefits:

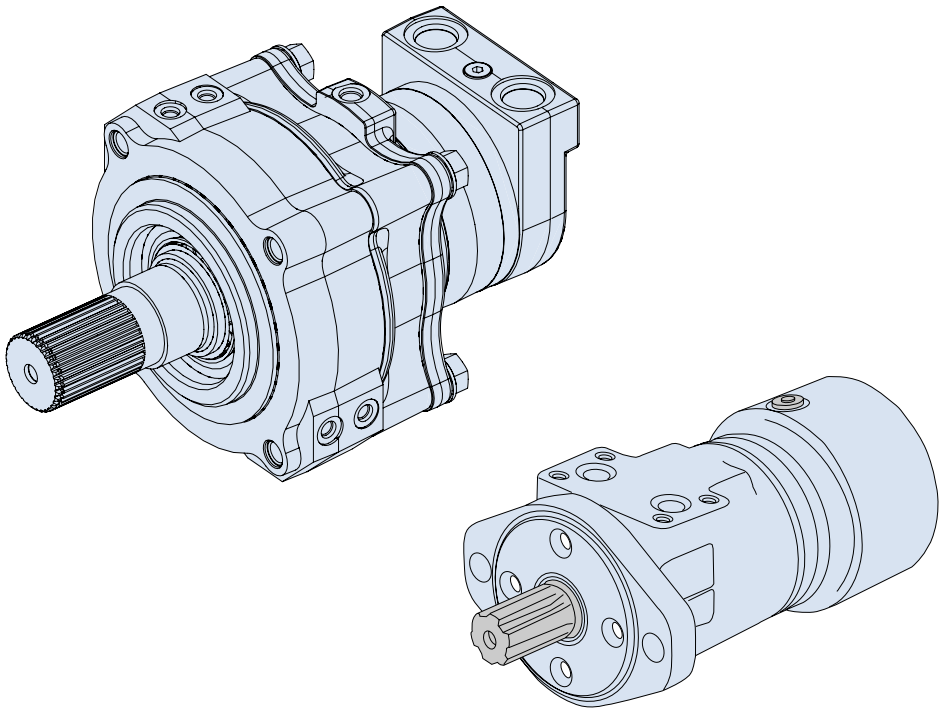
This coating protects the motor from salt water and various chemicals. Motor output shaft plating helps eliminate seal damage caused by caustic or acid materials.

Applications:

- Marine
- Food processing,
- Cleansing
- Fishing and agricultural applications

Brake Solutions

Integrated brake options are available for all T, W, VIS 30, VIS 40 and VIS 45 series motors. Mechanical bolt-on packages are available for all W, 2000 and 4000 compact series motors.



Features:

Eaton continues to develop and bring new brake solutions to market that are performance matched to each motor series. These include:

- T Series with Integrated Parking Brake
- W Series with Integrated Parking Brake
- VIS Series with Integrated Brakes

In addition, Eaton brake motors can be mated with bolt-on valve packages to provide dynamic braking hydraulically using state of the art counter-balance valve technology.

There are also a variety of bolt-on mechanical brake options including Hayes brake system. This compact brake package can be used on 2000 Series and W Series wheel motors.

Benefits:

- Complete compact system package
- Performance-matched brake / motor solution
- Increases design flexibility
- Reduces assembly costs and simplifies service requirements
- Streamlines inventory and order processing.
- Ability to direct port release pressure (eliminate brake release hose correction)

Applications:

- Aerial Work Platforms
- Boom Lifts
- Track Cranes
- Forestry Grapples
- Winches
- Traction Drives
- Anywhere load holding is a requirement in a LSHT motor application

---

For 2000 and 4000 compact Series, Hayes brakes are available. They provide up to 1450 lb. of clamping force. These are mechanical parking/service brakes.

Contact:

Hayes Industrial Brake, Inc
5800 West Donges Bay Rd
Mequon, WI 57092
Phone: (262) 242-4300
Fax: (262) 242-0524

Free Running Geroler Sets/ Gerotor Sets

This feature is available in all Char-Lynn motors.

Features:

The free running option is accomplished using a specially precision-machined gerotor assembly. This feature increases the clearance between the gerotor star and mating gerotor ring, allowing the motor to turn more freely with less mechanical drag. The increased clearance also improves lubrication across the wear surfaces of the gerotor star and ring and provides a greater pressure-relieving flow path reducing pressure spikes. Flow is by-passed internally across the star tips, reducing shock loads to the main drive components. This feature provides an effective method for reducing shock leads to the main drive components.

Benefits:

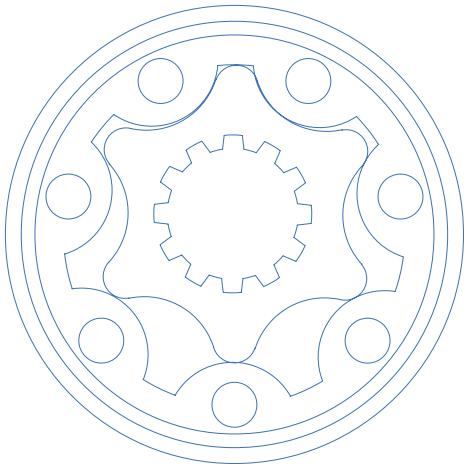
- Suited for applications with rapid stop/start or rapid reversals.
- Reduces starting pressure and increases starting torque efficiency.
- Reduces pressure spikes through the orbit gear set.

Applications:

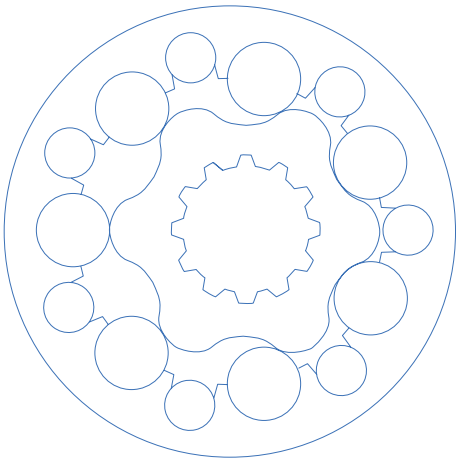
- Harvesters
- Stump Grinders
- Skid Steer Loader Attachments
- Machine Tools
- Especially suited for continuous high speed/ high flow applications.
- Also suited for applications with high-pressure spikes from rapid reversals.

Special Notes:

Volumetric Efficiency will be reduced with the free-running option.



Geroter



Geroler

Gerotor or Geroler?

The H series motor uses a Gerotor while the rest of the motors use a Geroler. The difference is shown in the picture below:

Essentially a Geroler, has rolls added to the lobes of the outer ring of the Orbit gear set. These rolls act as a roller bearing and reduce friction, increase mechanical efficiency and reduce wear in systems with low fluid viscosity. In addition, the Geroler type typically provides smoother performance at low speed conditions. The basic formula and guideline to determine whether a gerotor or Geroler should be used is as follows:

20 x psi / RPM = SUS (use this formula to determine minimum fluid viscosity)

RPM = speed of output shaft in revolutions per minute

SUS = minimum viscosity measured in SUS.

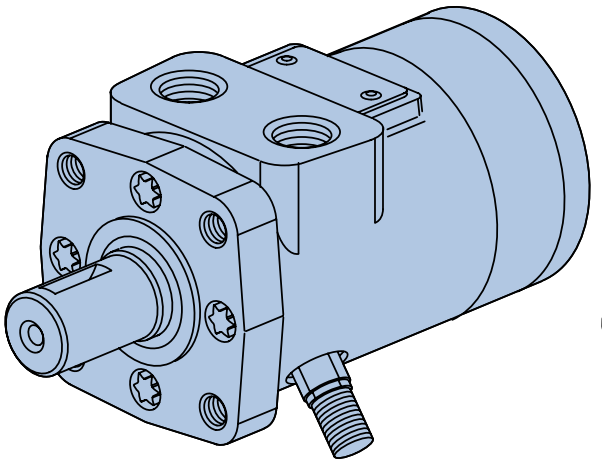
The recommended viscosity limits are as follows:

1) A Gerotor Orbit gear set requires a minimum fluid viscosity of 100 SUS or the valve calculated by the formula 20 psi/RPM = SUS.

2) A Geroler Orbit gear set requires a minimum fluid viscosity of 70 SUS.

In addition, applications running at less than 100 rpm should consider using a Geroler, motor.

Speed Sensors



Note:

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

Eaton Corporation Durant Products 901 South 12 Street Watertown, WI 57094 — Phone 1-800-289-3866.

Features:

Eaton has developed speed sensors specifically designed for LHST motors.

The single output speed sensor:

This 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 the 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.

The dual output speed sensor:

This sensor features speed and direction. Based on the field proven technology of our standard sensor and is designed for off road environments. The new sensor is based on the principle of quadrature.

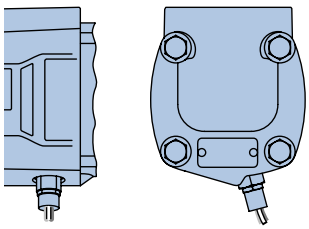
- The first version has two output signals 90 degrees out of phase.
- Each output provides one pulse per target.
- The second version has a speed signal that is twice the output pulses per revolution and it also has a direction signal.

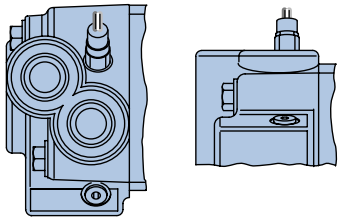
Benefits:

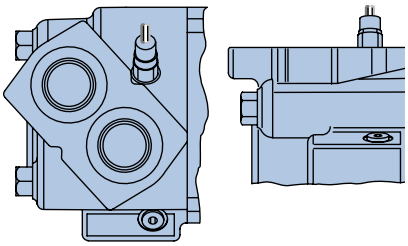
These speed sensors provide vital information that can be collected and interpreted by a PLC or other device.

Applications:

- Salt/Sand Spreaders
- Irrigation Drives
- Machine Tools
- Mixors/Grinders
- Industrial Conveyors
- Food Processing Equipment
- Underground Boring Equipment







TECHNICAL INFORMATION

Motors	Speed Sensor Pulses Per Rev	Quadrature Pulses Per Rev
H,S,T,W	30	60
2000 series	30	60
4000 series	36	72
6000 series	40	80
10,000 series	30	60
VIS 30, 40, 45	30	60

Single and Two Outputs:

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 10kW pull-up resistor

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

Shuttle Valve

Lubricating Shuttle

The shuttle valve option is available in W, 2000, 4000, 6000, and VIS series motors.

Features

Case Port allows for combination to be flushed and cools the system. In applications where more system cooling and flushing is required.

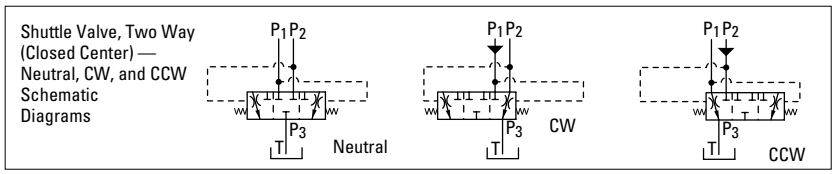
Benefits

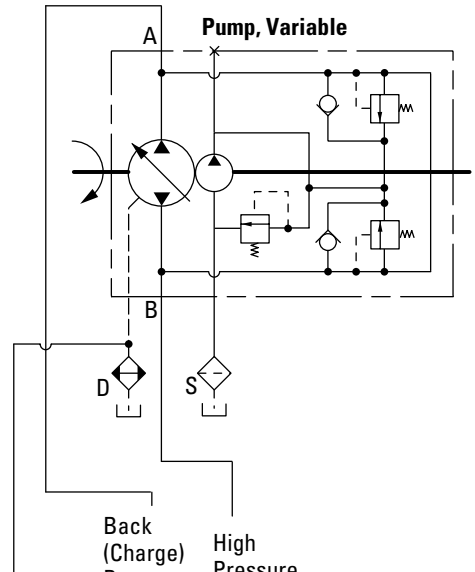
- Flushing
- Cooling
- Longer system life

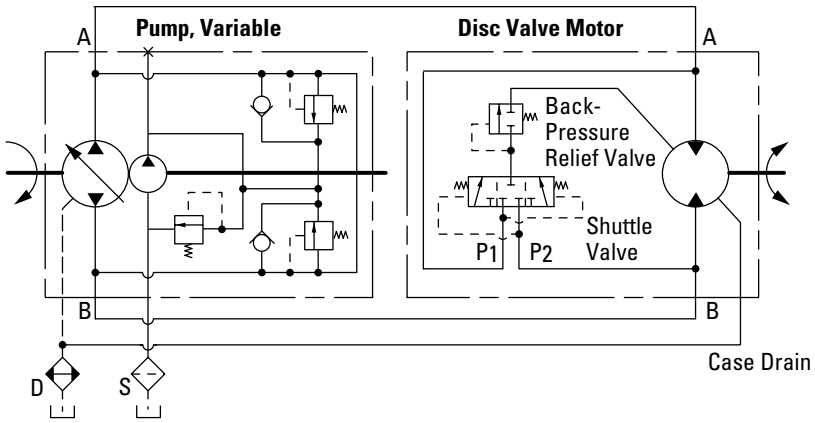
Applications

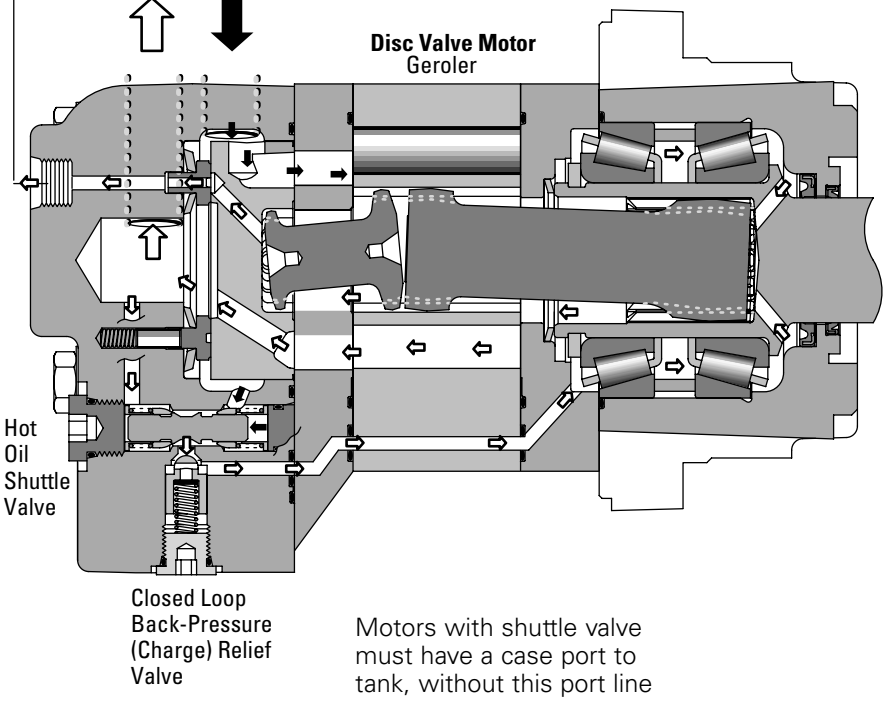
- Turf Propel
- Mixers/Grinders
- Traction drives
- Trencher chain drives

Closed Loop Circuit



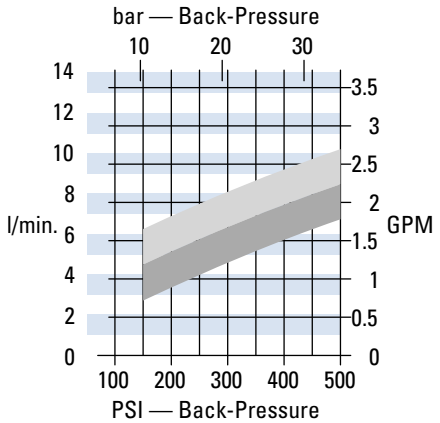






Typical Disc Valve Motor Shuttle Flow with 4,5 bar [65 PSI] Back-Pressure Relief Valve (Typical Data)

Due to Machining Tolerances, Flow May be More or Less



4000 Series and 6000 Series

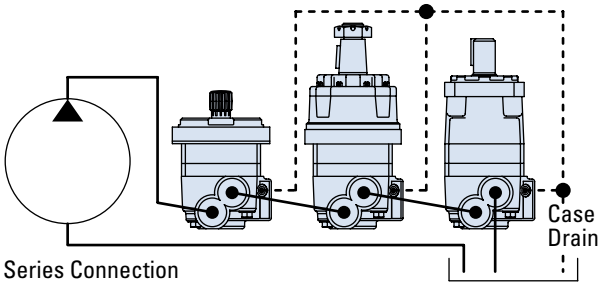
2000 Series and 4000 Compact Series

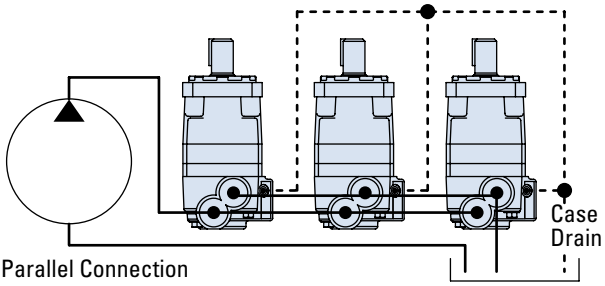
Motors with shuttle valve must have a case port to tank, without this port line the internal drive splines will not have adequate lubrication.

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

Case Porting

This option is available on all Char-Lynn Motors.





Features:

This feature provides for connection of a port line connected to the motor case.

A port is located in the motor direct to motor case pressure that allows the case pressure to be returned directly to tank. Internal leakage to the motor case cavity can be drained directly which reduces case pressure and provides flushing of the system circuit.

Benefits:

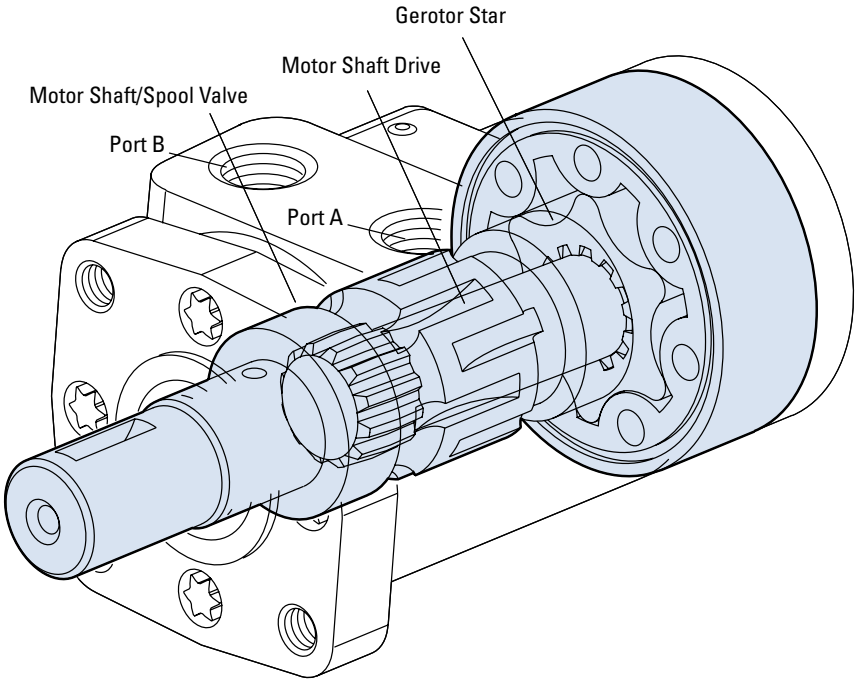
- Extends shaft seal life
- Extends thrust bearing life
- Reduces shaft seal leakage problems
- Improves flushing of the circuit to reduce system contaminates and cooling the system.

Applications:

- Especially suited for continuous running industrial applications and where motors are operating under high back pressure conditions (e.g. series circuit applications).
- Conveyers
- Car washes
- Harvesters
- Recommended for applications running with high case pressure conditions

Low Speed Valving

This option is available on H, S, T and W series motors.



Features:

This feature optimizes the motor for low-speed performance. It greatly improves smooth operation at speeds below 200 rpm. The valving is optimized with increased sealing and tighter clearances. Motors with this feature are designed to run continuously up to 200 rpm at standard rated pressures.

Benefits:

- Improves smoothness at low speed conditions (less than 200 rpm)
- Improves volumetric efficiency

Applications:

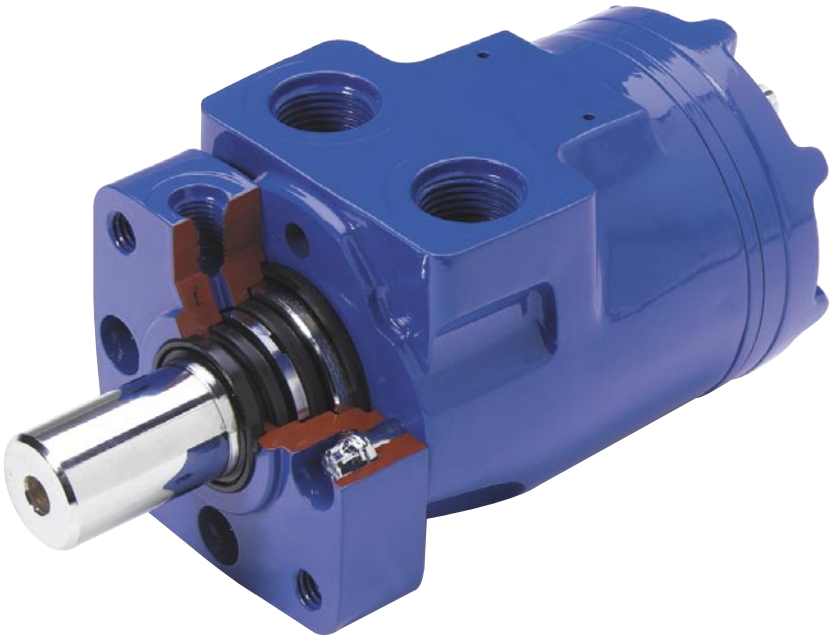
- Salt-sand spreaders
- Machine tools
- Irrigation drives
- Consider for applications running at low speed conditions below 200 rpm.

Notes:

Motors with this valving are not intended for low pressure applications (41 bar [600 psi minimum]

Vented Two-Stage Seal

This option is available on H, S and T series motors



Features:

- Patent-Pending design splits seal requirements into two stages
- In-board (1) (high-pressure) and out-board (2) (low-pressure) seal designs are optimized for pressure conditions at each stage
- Combines latest low and high pressure sealing technologies into one design
- Vented port connection (3) allows seal lube flow to be returned to system

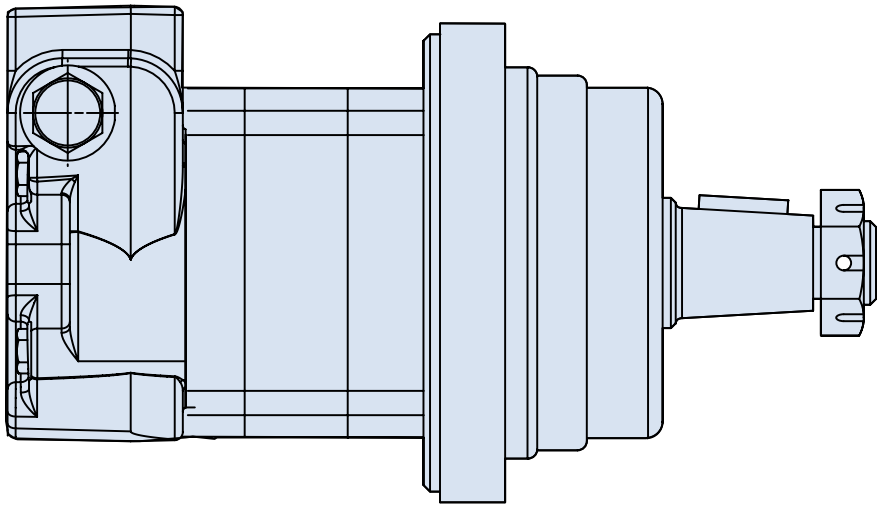
Benefits:

- Significantly increases seal life
- Higher case-pressure conditions increase motor performance
- Dependable leak free performance

Applications:

- Harvesters
- Car Washes
- Sweeper Brush drives
- Consider for applications running high case pressures for extending seal life and maximizing efficiency.

Integral Valves for 2000 Series



Features:

Complete packaged system solution, single source for motors with relief valve capability

Relief valves as close to Geroler as possible, providing added protection

Eliminate leak points from in-line or bolt-on relief's

Valves capable of full motor pressure

Provides added flexibility to system design by allowing motors to have individual relief valve settings

Simplifies assembly, purchasing and system design requirements

Benefits:

- This compact and efficient package offers increased value and cost effectiveness to designing Eaton into your applications.
- Minimizing the use of hoses, tubing and fittings will reduce production and assembly time significantly.

Applications:

- Skid steer Attachments
- Swing Motors
- Brush utters & Mowers
- Harvesting equipment
- Directional boring
- Winch
- Auger

Any place where pressure relief is optimal for system or motor performance and life

Replacement cartridges can be obtained by ordering the Item part number as listed below.

REPLACEMENT CARTRIDGES

Item part #	Item desc.	Relief valve setting
02-199291	RV5A-10-F-0-35/15	1500 PSI
02-199292	RV5A-10-F-0-35/17.5	1750 PSI
02-199293	RV5A-10-F-0-35/20	2000 PSI
02-199295	RV5A-10-F-0-35/22.5	2250 PSI
02-198563	RV5A-10-F-0-35/25	2500 PSI
02-199294	RV5A-10-F-0-35/27.5	2750 PSI
02-199296	RV5A-10-F-0-35/30	3000 PSI

Fluid Recommendations

Product Line	Viscosity Minimum	Viscosity Best Range	ISO Cleanliness Requirements
J-2, S, W, T Series	70 SUS 13 cst	100-200 SUS 20-43 cst	18/13
H Series	100 SUS 20 cst	100-200 SUS 20-43 cst	18/13

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 characteristic 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. Viscosity requirements, see chart below.

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 mm and a maximum of 80 particles per milliliter greater than 15 mm. Cleanliness requirements for specific products are given in the table below.

OEM's and distributors who use Eaton hydraulic components in their products should provide for these requirements in their designs. A reputable filter supplier can supply filter information.

Fluid Maintenance

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

Fluid Selection

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

SAE grade crankcase oils may be used in systems

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

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

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

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.
- 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.