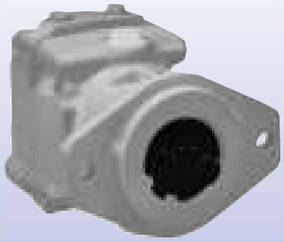
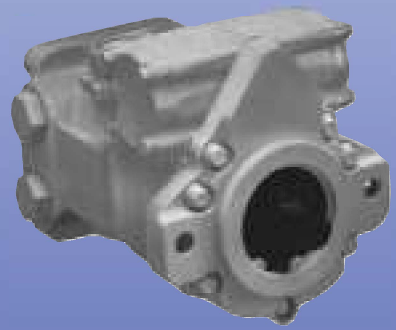
It's About Time...®

Series 40





Axial Piston

Motors

Technical Information

Series 40 Family of Pumps and Motors

Series 40 is a family of hydrostatic pumps and motors for "medium power" applications with maximum loads of 345 bar (5000 psi). These pumps and motors can be applied together or combined with other products in a system to transfer and control hydraulic power.

Series 40 pump + motor transmissions provide an infinitely variable speed range between zero and maximum in both forward and reverse modes of operation. The pumps and motors each come in four frame sizes: M25, M35, M44, and M46.

Series 40 pumps are compact, high power density units. All models utilize the parallel axial piston / slipper concept in conjunction with a tiltable swashplate to vary the pump's displacement. Reversing the angle of the swashplate reverses the flow of fluid from the pump and thus reverses the direction of rotation of the motor output.

Series 40 - M35, M44, and M46 pumps may include an integral charge pump to provide system replenishing and cooling fluid flow, as well as servo control fluid flow on M46 pumps. M25 pumps are designed to receive charge flow from an auxiliary circuit or from a gear pump mounted on the auxiliary mounting pad.

Series 40 pumps feature a range of auxiliary mounting pads to accept auxiliary hydraulic pumps for use in complementary hydraulic systems.

Series 40 - M46 pumps offer proportional controls with either manual, hydraulic, or electronic actuation. An electric three-position control is also available. The M25, M35, and M44 pumps include a trunnion style direct displacement control.

Series 40 motors also use the parallel axial piston / slipper design in conjunction with a fixed or tiltable swashplate. There are M25, M35, M44, M46 fixed motor units and M35, M44, M46 variable motor units.

The M35 and M44 variable motors feature a trunnion style swashplate and direct displacement control. The M46 variable motors utilize a cradle swashplate design and a two-position hydraulic servo control.

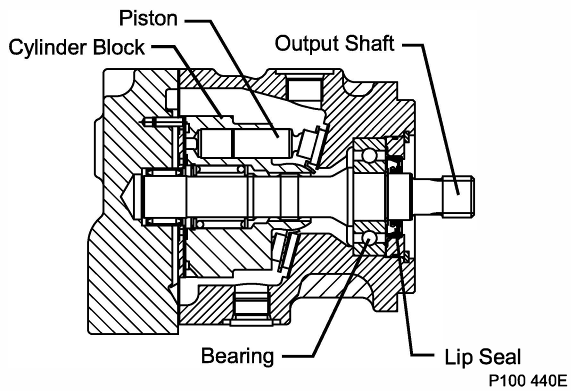
The M46 variable motor is available in a cartridge flange version, which is designed to be compatible with CW and CT compact planetary gearboxes. This combination provides a short final drive length for applications with space limitations.

- **4 Sizes of Variable Displacement Pumps**
- **4 Sizes of Tandem Pumps**
- **3 Sizes of Variable Displacement Motors**
- **4 Sizes of Fixed Displacement Motors**
- **High Performance at Low Cost**
- **Efficient Axial Piston Design**
- **Complete Family of Control Systems**
- **Proven Reliability and Performance**
- **Optimum Product Configurations**
- **Compact, Lightweight**
- **Worldwide Sales and Service**

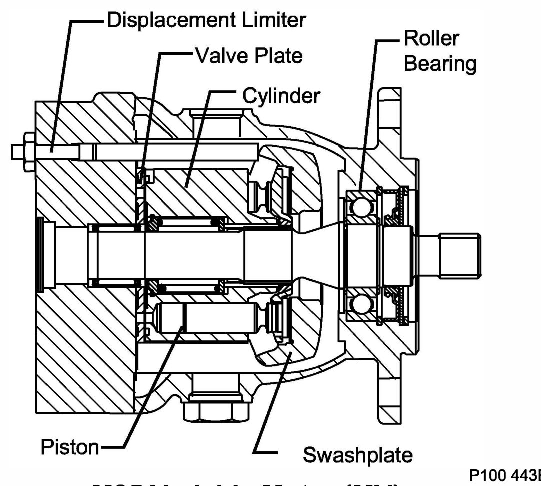
Contents

Series 40 Motor Features

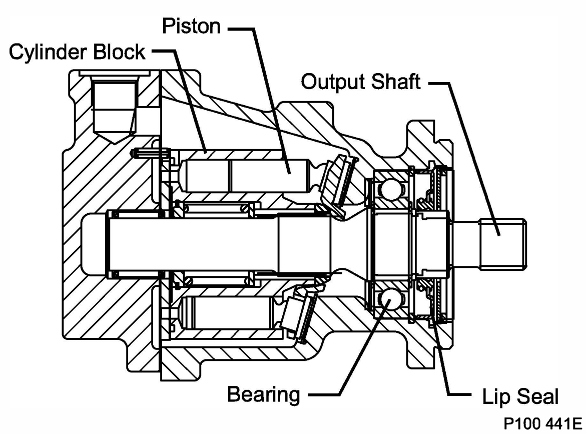
(Outline dimensions start on p. 22)



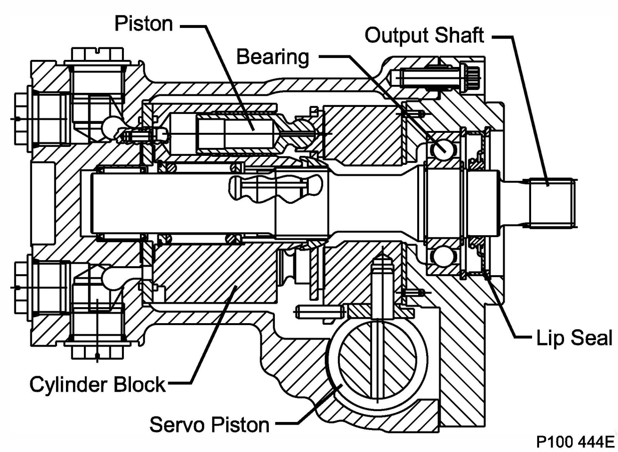
M25 Fixed Motor (MF)



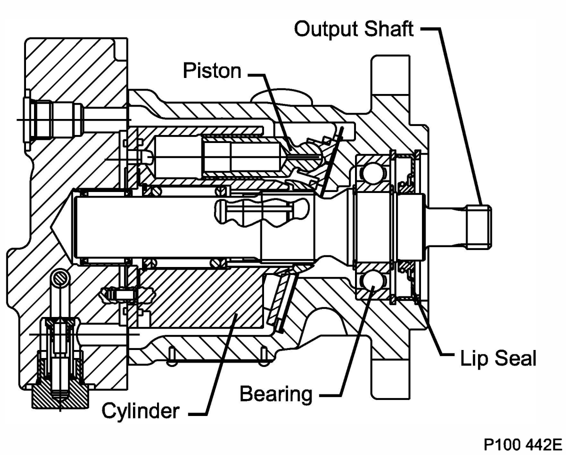
M35 Variable Motor (MV)



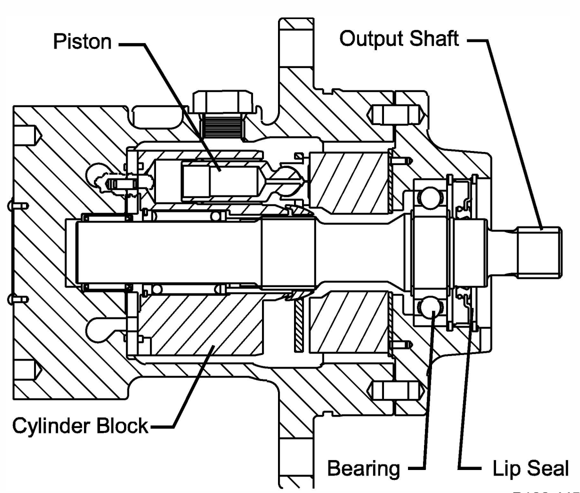
M35 Fixed Motor (MF)



M46 Variable Motor (MV) (SAE Flange)

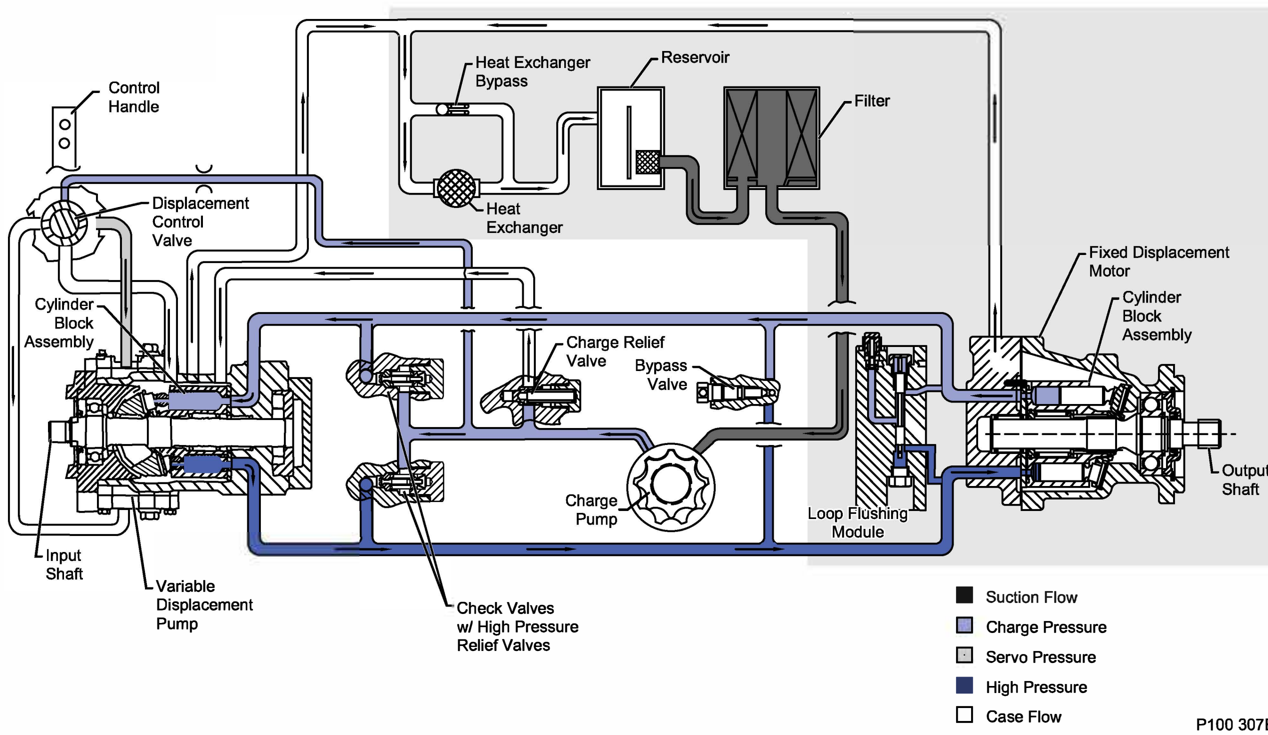


M46 Fixed Motor (MF)



M46 Variable Motor (MV) (Cartridge Flange)

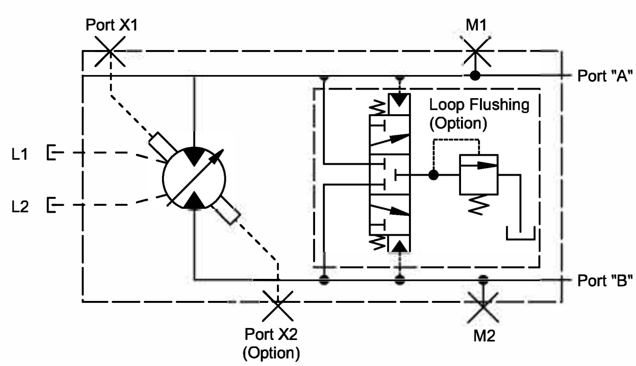
System Circuit Description



P100 307E

A Series 40-M35 fixed motor (right) is shown in a hydraulic circuit with a Series 40-M46 variable pump. The white half of the circuit includes pump features. A suction filtration configuration is shown. Pressure regulation valves are included on the pump. A loop flushing module is included on the motor. Note the position of the reservoir and heat exchanger.

Motor Circuit Description



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A Series 40 - M46 variable motor circuit schematic is shown above. The system ports "A" and "B" hook up to the high pressure work lines. The motor receives pressurized fluid in its inlet port and discharges de-energized fluid through the outlet port. Either port can act as inlet or outlet; flow can be bidirectional. System port pressure can be gauged through ports M1 and M2. The motor has two case drains (L1 and L2). The motor may or may not include loop flushing. Loop flushing provides additional cooling and filtration capacity.

Technical Specifications

Specifications for Series 40 motors are listed on these two pages. For definitions of the various specifications, see the related pages in this publication. Not all hardware options are available for all configurations; consult the Series 40 Motor Model Code Supplement or Price Book for more information.

General Specifications

Product Line	Series 40 Motors
Motor Type	In-line, axial piston, positive displacement motors.
Direction of Rotation	Bidirectional, see outline drawings for rotation vs. flow direction information.
Installation Position	Discretionary, the housing must be filled with hydraulic fluid.
Filtration Configuration	Suction or charge pressure filtration
Other System Requirements	Independent braking system, circuit overpressure protection, suitable reservoir

Hardware Specifications

Model	**M25 MF**	**M35 MF**	**M44 MF**	**M46 MF**	**M35 MV**	**M44 MV**	**M46 MV**
Motor Configuration	Fixed	Fixed	Fixed	Fixed	Variable	Variable	Variable
Displacement cm^3/rev (in^3/rev)	25 (1.50)	35 (2.14)	44 (2.65)	46 (2.80)	35 (2.14)	44 (2.65)	46 (2.80)
Weight kg (lb)	11 (25)	11 (26)	11 (26)	14 (30)	21 (47)	21 (47)	23 (51)
Moment of Inertia $kg•m^2•10^{-3}$ ($lb•ft^2•10^{-3}$)	1.7 (40)	2.9 (67)	2.8 (65)	4.6 (110)	2.9 (67)	2.8 (65)	4.9 (116)

Hardware Features

Model	**M25 MF**	**M35 MF**	**M44 MF**	**M46 MF**	**M35 MV**	**M44 MV**	**M46 MV**
Type of Mounting (SAE Flange size per SAEJ744*)	SAE "B"	SAE "B"	SAE "B"	SAE "B"	SAE "B"	SAE "B"	SAE "B" or Cartridge
Port Connections	Twin, Axial	Side, Twin, Axial	Side, Twin, Axial	Side, Twin, Axial	Twin	Twin	Side, Twin, Axial
Output Shaft Options	Splined	Splined Tapered Strght Key	Splined Tapered Strght Key	Splined Tapered Strght Key	Splined	Splined	Splined Tapered
Control Options	–	–	–	–	DDC	DDC	HDC
Loop Flushing	Option	Option	Option	Option	Option	Option	Option
Displacement Limiters	Option	Option	Option	Option	Option	Option	Option
Speed Sensors	Option	Option	Option	Option	–	–	Option

– = not available
* Some features may not conform to SAEJ744

System Parameters

Model		M25 MF	M35 MF	M44 MF	M46 MF	M35 MV	M44 MV	M46 MV
Case Pressure	bar (psi)							
Continuous		1.7 (25)						
Maximum		5.2 (75)						
Speed Limits	rev/min							
Rated @ max disp		4000	3600	3300	3600	3600	3300	4000
Maximum @ max disp		5000	4500	4100	3600	4500	4100	4100
Rated @ min disp		–	–	–	–	5300	4850	5000
System Pressure	bar (psi)							
Continuous		210 (3000)						
Maximum		345 (5000)						

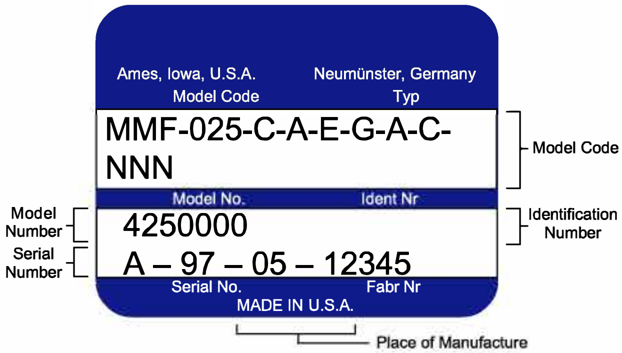
Fluid Specifications

Hydraulic Fluid		Ratings and data are based on operation with premium petroleum-based hydraulic fluids containing oxidation, rust, and foam inhibitors. See page 11.	
Viscosity	mm²/s or cSt (SUS)		
Continuous Range		12 - 60	(70 - 278)
Minimum		7	(47)
Maximum		1600	(7500)
Temperature	°C (°F)		
Minimum		-40	(-40)
Continuous		82	(180)
Maximum		104	(220)
Fluid Cleanliness Level		ISO 4406 Class 18/13	
Recommended Filtration Efficiency			
Suction Filtration		$\beta_{35\text{-}44} = 75$	$(\beta_{10} \geq 2)$
Charge Filtration		$\beta_{15\text{-}20} = 75$	$(\beta_{10} \geq 10)$

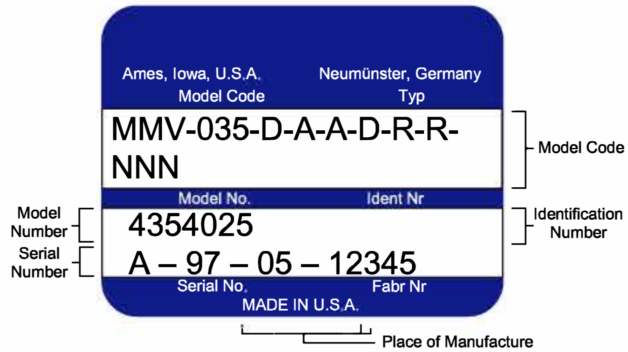
Model Code

The model code is a modular description of a specific product and its options. To create a model code to include the specific options desired, see the Series 40 Motor Model Code Supplement or the Series 40 Price Book.

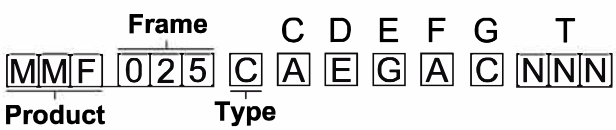
Name Plate (Fixed Motor)



Name Plate (Variable Motor)

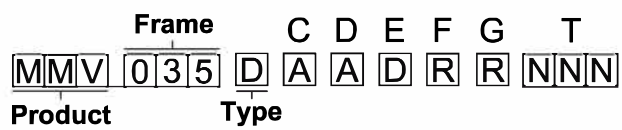


Model Code Modules



Module	**Description**
Product:	Fixed Displacement Pump
Frame:	Displacement
Type:	Product Version
C:	Seal Group
D:	Output Shaft / Through Shaft Configuration
E:	End Cap Configuration
F:	Cylinder Block Group
G:	Housing Type
T:	Special Hardware Features

Model Code Modules



Module	**Description**
Product:	Variable Displacement Pump
Frame:	Displacement
Type:	Product Version
C:	Seal Group
D:	Output Shaft / Through Shaft Configuration
E:	Minimum Swashplate Angle
F:	Control Features
G:	End Cap Configuration
T:	Special Hardware Features

Hydraulic Equations for Motor Selection

The motor size required for a specific application can be calculated using the equations below.

Metric System:

Input flow $Q_e = \dfrac{Vg \cdot n}{1000 \cdot \eta_v}$ l/min

Output torque $M_e = \dfrac{Vg \cdot \Delta p \cdot \eta_m}{20 \cdot \pi}$ Nm

Output power $P_e = \dfrac{Vg \cdot n \cdot \Delta p \cdot \eta_m}{600\ 000}$ kW

Motor Speed $n = \dfrac{Q_e \cdot 1000 \cdot \eta_v}{Vg}$ min^{-1}

Vg	=	Motor displacement per rev.	cm^3
n	=	Hydrostatic motor speed	min^{-1}
Δp	=	Differential hydraulic pressure	bar
η_v	=	Motor volumetric efficiency	
η_m	=	Motor mechanical efficiency	

Inch System:

Input flow $Q_e = \dfrac{MD \cdot MS}{231 \cdot EV}$ gpm

Output torque $MT = \dfrac{MD \cdot p \cdot ET}{2 \cdot \pi}$ in•lbf

Output power $P = \dfrac{MD \cdot MS \cdot p \cdot ET}{396\ 000}$ hp

Motor Speed $MS = \dfrac{Q_e \cdot 231 \cdot EV}{MD}$ rpm

MD	=	Motor displacement per rev.	in^3
MS	=	Hydrostatic motor speed	rpm
p	=	Differential hydraulic pressure	psi
EV	=	Motor volumetric efficiency	
ET	=	Motor mechanical efficiency	

System Parameters

Case Pressure

Under normal operating conditions, case pressure must not exceed the **continuous case pressure** rating. Momentary case pressures exceeding this rating are acceptable under cold start conditions, but still must stay below the **maximum case pressure** rating. Operation with case pressure in excess of these limits may result in external leakage due to damage to seals, gaskets, and/or housings.

Case Pressure	bar	psi
Continuous	1.7	25
Maximum	5.2	75

Speed Limits

Rated speed is the speed limit recommended at full power condition and is the highest value at which normal life can be expected.

Maximum speed is the highest operating speed permitted and cannot be exceeded without reduction in the life of the product or risking immediate failure and loss of drive line power (which may create a safety hazard). Mobile applications must have an applied speed below the stated maximum speed. **In addition, applications must have a braking system, redundant to the transmission, which will stop and hold the vehicle should hydrostatic drive line power be lost.** Consult Bulletin BLN-9884 ("Pressure and Speed Limits") when determining speed limits for a particular application.

Speed Limits rev/min	M25 MF	M35 MF	M44 MF	M46 MF	M35 MV	M44 MV	M46 MV
Rated @ max disp	4000	3600	3300	3600	3600	3300	4000
Maximum @ max disp	5000	4500	4100	3600	4500	4100	4100
Rated @ min disp	–	–	–	–	5300	4850	5000

System Pressure

System pressure is the differential pressure between system ports referenced to case pressure. It is a dominant operating variable affecting hydraulic unit life. High pressure, which results from high load, reduces expected life in a manner similar to many mechanical assemblies such as engines and gear boxes. There are load-to-life relationships for the rotating group and for the shaft bearings (see p. 18).

Continuous pressure is the average, regularly occurring operating pressure that should yield satisfactory product life. **Maximum pressure** is the highest intermittent pressure allowed, and is the relief valve setting. It is determined by the maximum machine load demand. For most systems, the load should move at this pressure. Maximum pressure is assumed to occur a small percentage of operating time, usually less than 2% of the total. Both the continuous and maximum pressure limits must be satisfied to achieve the expected life.

All pressure limits are differential pressures (referenced to charge pressure) and assume normal charge pressure and no externally applied shaft loads.

Pressure Limits	bar	psi
Continuous	210	3000
Maximum	345	5000

Fluid Specifications

Hydraulic Fluid

Ratings and data for Series 40 products are based on operation with premium hydraulic fluids containing oxidation, rust and foam inhibitors.

These include API CD engine oils per SAE J183, M2C33F or G automatic transmission fluids, Dexron II or IIE (not Dexron III) meeting Allison C3 or Caterpillar TO-2 specifications and certain agricultural tractor fluids. Hydraulic fluids per DIN 51524, part 2 (HLP) and part 3 (HVLP) are suitable. Fire resistant fluids are also suitable at modified operating conditions. For more information see QCC LLC publication BLN-9887 or 697581.

Refer to publication ATI-E 9101 for information relating to biodegradable fluids.

While fluids containing anti-wear additives are not necessary for the satisfactory performance of the Series 40 units, they are often required for associated equipment. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion, and corrosion of the internal components.

It is not permissible to mix hydraulic fluids. Contact your QCC LLC representative for more information.

Temperature and Viscosity

Temperature and viscosity requirements must be concurrently satisfied. The data shown at right assumes petroleum-based fluids.

The high temperature limits apply at the hottest point in the transmission, which is normally the case drain. The pump should generally be run at or below the **continuous temperature**. The **maximum temperature** is based on material properties and should never be exceeded.

Cold oil will generally not affect the durability of the transmission components, but it may affect the ability to flow oil and transmit power; therefore temperatures should remain 16°C (30°F) above the pour point of the hydraulic fluid. The **minimum temperature** relates to the physical properties of component materials.

For maximum unit efficiency and bearing life the fluid viscosity should remain in the **continuous viscosity range**. The **minimum viscosity** should be encountered only during brief occasions of maximum ambient temperature and severe duty cycle operation. The **maximum viscosity** should be encountered only at cold start.

Heat exchangers should be sized to keep the fluid within these limits. Testing to verify that these temperature limits are not exceeded is recommended.

Temperature	°C	°F
Minimum	-40	-40
Continuous	82	180
Maximum	104	220

Viscosity	mm^2/s (cSt)	SUS
Continuous Range	12 - 60	70 - 278
Minimum	7	47
Maximum	1600	7500

Fluid and Filtration

To prevent premature wear, it is imperative that only clean fluid enter the hydrostatic transmission circuit. A filter capable of controlling the fluid cleanliness to ISO 4406 Class 18/13 (SAE J1165) or better under normal operating conditions is recommended.

The filter may be located either on the inlet (suction filtration) or discharge (charge pressure filtration) side of the charge pump. Series 40 pumps are available with provisions for either suction or charge pressure filtration to filter the fluid entering the charge circuit (see BLN-9989).

The selection of a filter depends on a number of factors including the contaminant ingression rate, the generation of contaminants in the system, the required fluid cleanliness, and the desired maintenance interval. Filters are selected to meet the above requirements using rating parameters of efficiency and capacity.

Filter efficiency may be measured with a Beta ratio[1] (β_x). For simple suction-filtered closed circuit transmissions and open circuit transmissions with return line filtration, a filter with a β-ratio within the range of $\beta_{35-45} = 75$ ($\beta_{10} \geq 2$) or better has been found to be satisfactory. For some open circuit systems, and closed circuits with cylinders being supplied from the same reservoir, a considerably higher filter efficiency is recommended. This also applies to systems with gears or clutches using a common reservoir. For these systems, a filter within the range of $\beta_{15-20} = 75$ ($\beta_{10} \geq 10$) or better is typically required.

Since each system is unique, the filtration requirement for that system will be unique and must be determined by test in each case. It is essential that monitoring of prototypes and evaluation of components and performance throughout the test program be the final criteria for judging the adequacy of the filtration system. See publication BLN-9887 or 697581 and ATI-E9201 for more information.

[1] Filter $ß_x$-ratio is a measure of filter efficiency defined by ISO 4572. It is defined as the ratio of the number of particles greater than a given diameter ("x" in microns) upstream of the filter to the number of these particles downstream of the filter.

System Requirements

Independent Braking System

The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or "neutral" mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

Reservoir

The reservoir should be designed to accommodate maximum volume changes during all system operating modes and to promote de-aeration of the fluid as it passes through the tank.

The reservoir should be designed to accommodate a fluid dwell time of between 30 and 90 seconds to allow entrained air in the fluid to escape. The fluid volume in the reservoir would be 50% of the maximum charge pump flow per minute at 30 seconds dwell and 150% of maximum charge flow at 90 seconds dwell. The reservoir capacity is recommended to be 125% of the fluid volume to accommodate fluid expansion with temperature.

The reservoir outlet to the charge pump inlet should be above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the charge inlet line. A 100-125 µm screen over the outlet port is recommended.

The reservoir inlet (fluid return) should be positioned so that flow to the reservoir is discharged below the normal fluid level, and also directed into the interior of the reservoir for maximum dwell and efficient de-aeration. A baffle (or baffles) between the reservoir inlet and outlet ports will promote de-aeration and reduce surging of the fluid.

Overpressure Protection

Series 40 motors (as well as other system components) have pressure limitations. Relief valves or pressure limiters should be present in the high pressure circuit to protect components from excessive pressures.

Series 40 pumps are available with a range of high pressure relief valve settings. Refer to publication BLN-9989 for more information.

Note: High pressure relief valves are intended for transient overpressure protection and are not intended for continuous pressure control. Operation over relief valves for extended periods of time may result in severe heat build up. High flows over relief valves may result in pressure levels exceeding the nominal valve setting and potential damage to system components.

Bypass Valves

In some applications it is desirable to bypass fluid around the variable displacement pump allowing, for example, a vehicle to be moved short distances at low speeds without running the prime mover. This is accomplished by a manually operated bypass valve. When open, this valve connects both sides of the pump/motor circuit and allows the motor to turn. This valve must be fully closed for normal operation.

Bypass valves are available in Series 40 pumps. Refer to publication BLN-9989 for more information.

Note: Bypass valves are intended for moving a machine or vehicle for very short distances at very slow speeds. They are NOT intended as "tow" valves.

Product Features and Options

Loop Flushing Valve

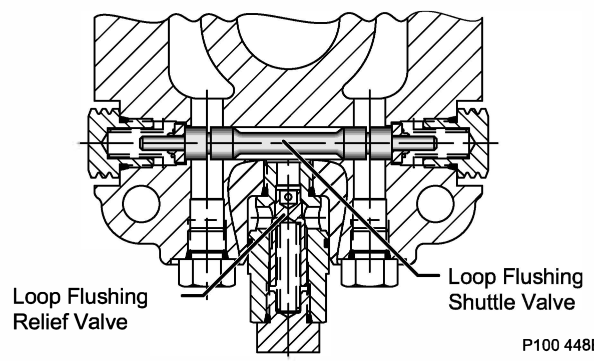
Series 40 motors may incorporate an integral loop flushing valve. Installations that require additional fluid to be removed from the main hydraulic circuit because of fluid cooling requirements, or circuits requiring the removal of excessive contamination, will benefit from loop flushing. A loop flushing valve will remove heat and contaminants from the main loop at a rate faster than otherwise possible. (Contact your QCC LLC representative for produc-tion availability on specific frame size motors.)

Series 40 motors equipped with an integral loop flushing valve include a loop flushing relief valve and may include an orifice with the valve. The flushing flow will be a function of the relative settings of the motor charge relief, the pump charge relief valve, and the orifice size (if present). The motor relief must be set to a pressure less than or equal to the pump relief to provide loop flushing.

Loop flushing flows of 3.8 to 7.6 l/min (1 to 2 gpm) are adequate for most applications. Contact your QCC LLC representative for assistance.

WARNING
Incorrect charge pressure settings may result in the inability to build required system pressure and/or inadequate loop flushing flows. Correct charge pressure must be maintained under all conditions of operation to maintain pump control performance of hydraulically controlled pumps.

Loop Flushing Specs	
Typical Flow Rate	3.8-7.6 l/min (1-2 gpm)
Relief Setting	14-25 bar (200-355 psi)
Orifice Size	None, 1.4 mm (0.055")



Loop Flushing Valve - M25 MF

Speed Sensor Option

Series 40 motors are available with a speed sensor option for direct measurement of motor output speed. This sensor may also be used to sense the direction of motor rotation.

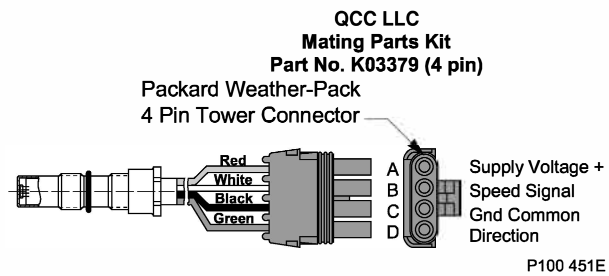
A special magnetic speed ring is pressed onto the outside diameter of the cylinder block and a Hall effect pulse pickup sensor is located in the motor housing. The sensor accepts supply voltage and outputs a digital pulse signal in response to the speed of the ring. The output changes its high/low state as the north and south poles of the permanently magnetized speed ring pass by the face of the sensor. The digital signal is generated at frequencies suitable for microprocessor based controls.

This sensor will operate with a supply voltage of 4.5 to 15 VDC, and requires a current of 12 mA at 5.0 VDC under no load. Maximum operating current is 20 mA at 5 VDC. Maximum operating frequency is 15 kHz. Output voltage in "High State" (VOH) is sensor supply voltage minus 0.5 VDC, minimum. Output voltage in "Low State" (VOL) is 0.5 VDC, maximum.

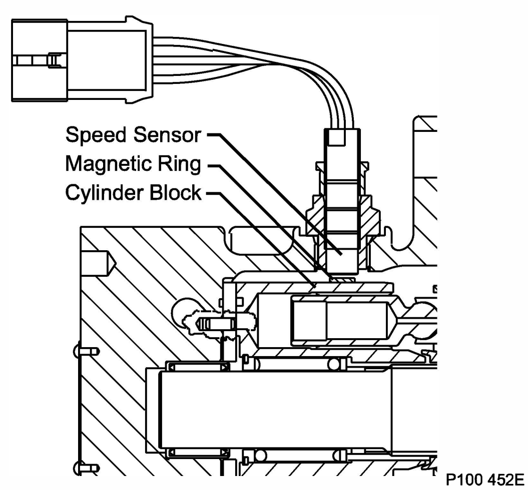
The sensor is available with a Packard Weather-Pack 4-pin sealed connector.

Contact your QCC LLC representative for production availability on specific motor frame sizes, or for special speed sensor options.

Speed Sensor Specs				
Supply Voltage	4.5-15 VDC			
Required Current	12mA @ 5 VDC (no load)			
Max Current	20 mA @ 5VDC			
Max Frequency	15kHz			
VOH	Supply VDC – 0.5 VDC			
VOL	0.5 VDC Max			
Pulse/Rev	**M25**	**M35**	**M44**	**M46**
	43	46	46	51
Connector	Packard Weather-Pack 4-pin			



Pulse Pickup and Connector



Cross-Section of Speed Sensor on Cylinder Kit

Shaft Options

Series 40 motors are available with a variety of splined, straight keyed, and tapered shaft ends. Nominal shaft sizes and torque ratings for some available shafts are shown in the accompanying table.

Torque ratings assume no external radial loading. **Continuous (Cont) torque** ratings for splined shafts are based on spline tooth wear, and assume the mating spline has a minimum hardness of R_c 55 and full spline depth with good lubrication.

Maximum torque ratings are based on shaft torsional strength and assume a maximum of 200 000 load reversals.

Shaft Availability and Torque Ratings

Nm (in•lbf)		M25 MF	M35 MF	M44 MF	M46 MF	M35 MV	M44 MV	M46 MV
Spline 13 tooth, 16/32 pitch	Cont	85 (750)	73 (650)	73 (650)	73 (650)	73 (650)	73 (650)	73 (650)
	Max	140 (1240)	226 (2000)	226 (2000)	226 (2000)	226 (2000)	226 (2000)	226 (2000)
Spline 15 tooth, 16/32 pitch	Cont	-	153 (1350)	153 (1350)	153 (1350)	153 (1350)	153 (1350)	153 (1350)
	Max	-	362 (3200)	362 (3200)	362 (3200)	362 (3200)	362 (3200)	362 (3200)

*NOTE: **Recommended mating splines for Series 40 splined output shafts should be in accordance with ANSI B92. 1 Class 5.** QCC LLC external splines are modified Class 5 Fillet Root Side Fit. The external spline Major Diameter and Circular Tooth Thickness dimensions are reduced in order to assure a clearance fit with the mating spline.*

NOTE: Other shaft options may exist. Contact your QCC LLC representative for availability.

Through-Shaft Options

Optional through-shafts are available on Series 40 fixed and variable displacement motors (as noted in the accompanying table). Through-shafts are provided for use in secondary (parking) braking systems. Through-shaft ends are not intended for continuous power transmission.

WARNING
Exceeding these torque limits could cause shaft breakage, which could result in a loss of braking function and machine control, and a potential runaway condition.

Through-Shaft Availability and Torque limitations

Frame Size	Shaft Spline	Max. Torque Limit Nm (in•lbf)
M35 MF	13T 16/32 P	328 (2900)
M44 MF	13T 16/32 P	328 (2900)
M46 MF/MV(SAE)	13T 16/32 P	328 (2900)

Loading, Life, and Efficiency

Bearing Life and External Shaft Loading

Bearing life is a function of speed, pressure and swashplate angle plus any external loads. Other life factors include oil type and viscosity.

In vehicle propulsion drives with no external loads, where the speed, pressure, and swashplate angle are often changing, normal bearing B10 (90% survival) life will exceed the hydraulic unit life.

In non-propel drives, such as conveyors or fan drives, the operating speed and pressure may be nearly constant leading to a distinctive duty cycle compared to that of a propulsion drive. In these types of applications, a bearing life review is recommended.

Series 40 motors are designed with bearings that can accept some incidental external radial and thrust loads. However, any amount of external load will reduce the expected bearing life.

The allowable radial shaft loads are a function of the load position, the load orientation, and the operating pressures of the hydraulic unit. All external shaft loads will have an effect on bearing life. In motor applications where external shaft loads cannot be avoided, the impact on bearing life can be minimized by orienting the load to the 180 degree position.

The recommended maximum radial load (R_e) is based on an external moment (M_e) and the distance (L) from the mounting flange to the load, see table at right. The loads in the table reflect a worst case external load orientation (0 degrees), a continuously applied working pressure of 140 bar (2000 psi), 20 bar (285 psi) charge pressure, 1800 rpm, and a bearing life (B10) of 2000 hours.

The recommended maximum allowable radial load is calculated as:

$$R_e = M_e / L$$

Thrust loads in either direction should be avoided.

If continuously applied external radial loads exceed the recommended maximum allowable, or thrust loads are known to occur, contact QCC LLC for an evaluation of unit bearing life. Optional high capacity bearings are available.

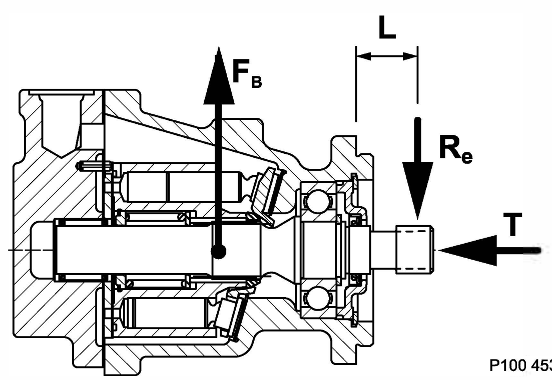
Tapered output shafts or "clamp-type" couplings are recommended for applications where radial shaft side loads are present.

Shaft Loading Parameters

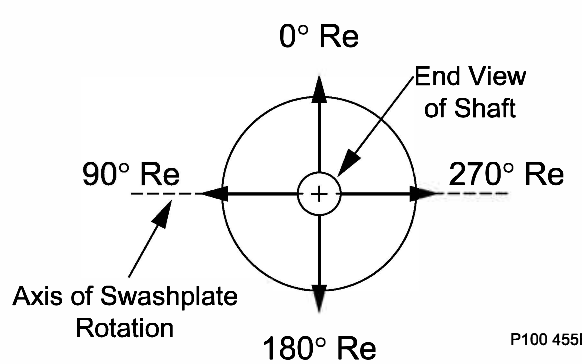
R_e	Maximum Radial Side Load
M_e	Maximum External Moment
L	Distance from Mounting Flange to Point of Load
F_B	Force of Block (applies at Center of Gravity)
T	Thrust Load

Recommended Maximum External Shaft Moments

	M25	M35/44	M46
M_e Nm (in•lbf)	29 (255)	25 (225)	24 (215)



Shaft Loading
(with 180˚ Side Load, R_e)



External Shaft Load Orientation

Hydraulic Unit Life

Hydraulic unit life is defined as the life expectancy of the hydraulic components. Hydraulic unit life is a function of speed and system pressure; however, system pressure is the dominant operating variable affecting hydraulic unit life. High pressure, which results from high load, reduces expected life in a manner similar to many mechanical assemblies such as engines and gear boxes.

It is desirable to have a projected machine duty cycle with percentages of time at various loads and speeds. An appropriate design pressure can be calculated by QCC LLC from this information. This method of selecting operating pressure is recommended whenever duty cycle information is available. In the absence of duty cycle data, an estimated design pressure can usually be established based on normal input power and maximum pump displacement.

Note that all pressure limits are differential pressures (referenced to charge pressure) and assume normal charge pressure.

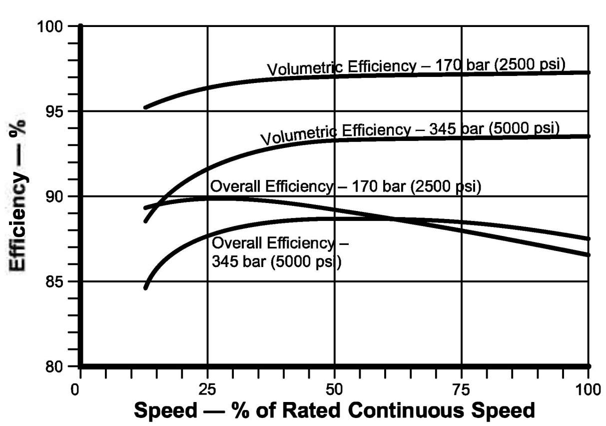
Series 40 motors will meet satisfactory life expectancy if applied within the parameters specified in this bulletin (see p. 10). For more detailed information on hydraulic unit life see BLN-9884, "Pressure and Speed Limits."

Efficiency Graphs

The following performance graph provides typical volumetric and overall efficiencies for Series 40 motors. These efficiencies apply for all Series 40 motors at maximum displacement.

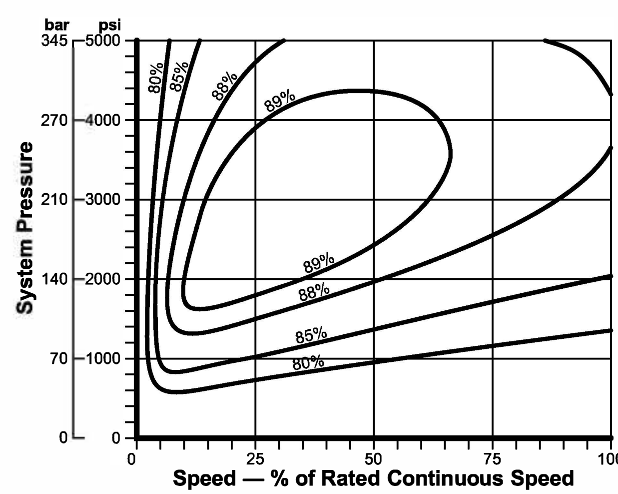
The performance map provides typical motor overall efficiencies at various operating parameters. These efficiencies also apply for all Series 40 motors at maximum displacement.

Motor Performance as a Function of Operating Speed*



P100 455E

Motor Performance at Select Operating Parameters*



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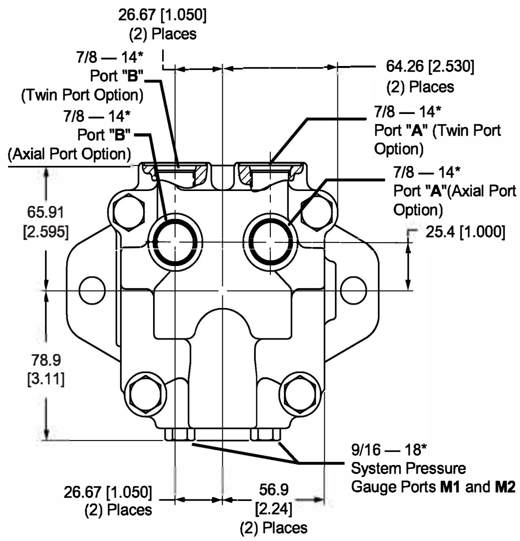
* At maximum displacement, assumes fluid viscosity in continuous range (p. 11).

M25 MF Dimensions

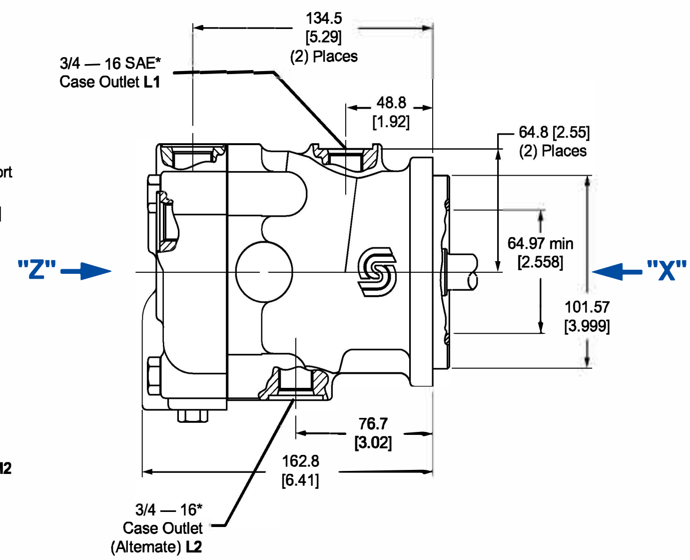
M25 MF: Axial Ports, Twin Ports, Loop Flushing, Speed Sensor

mm
[in.]

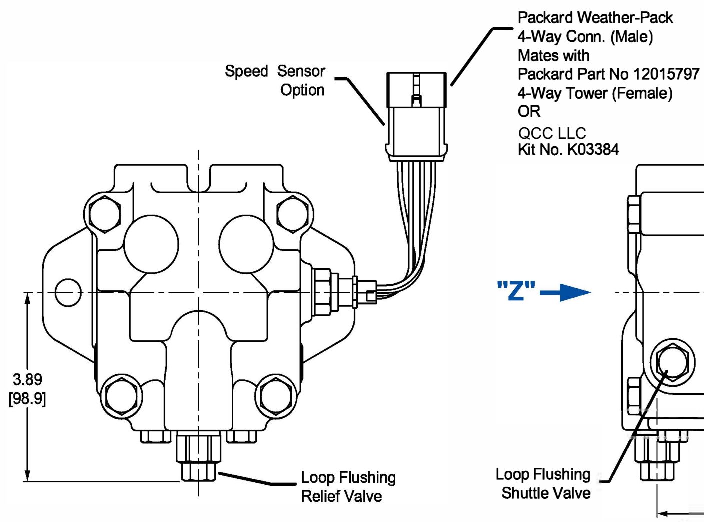
Motor Shaft Rotation	Flow Direction	
	Port "A"	Port "B"
Clockwise (CW)	In	Out
Counterclockwise (CCW)	Out	In



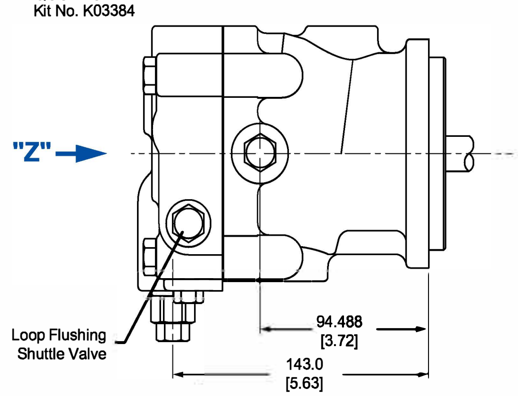
VIEW "Z" (REAR VIEW)
AXIAL OR TWIN PORTS



LEFT SIDE VIEW
AXIAL OR TWIN PORTS



VIEW "Z" (REAR VIEW)
W/ LOOP FLUSHING



LEFT SIDE VIEW
W/ LOOP FLUSHING

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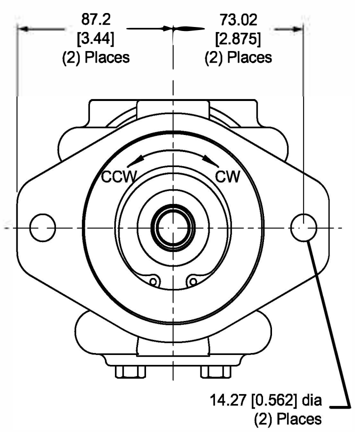
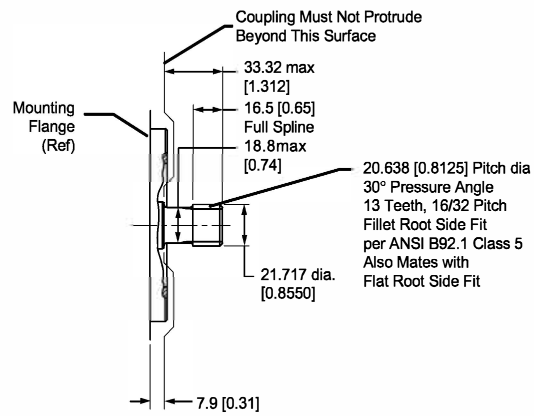
*All SAE straight thread O-Ring ports per SAE J1926.
Shaft rotation is determined by viewing motor from output shaft end.
Contact your QCC LLC representative for specific installation drawings.

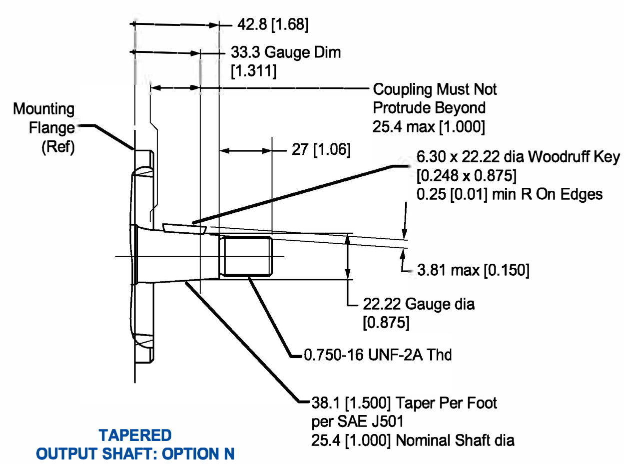
M25 MF: Mounting Flange, Shaft



VIEW "X"
(FRONT VIEW)



SPLINED
OUTPUT SHAFT: OPTION E



TAPERED
OUTPUT SHAFT: OPTION N

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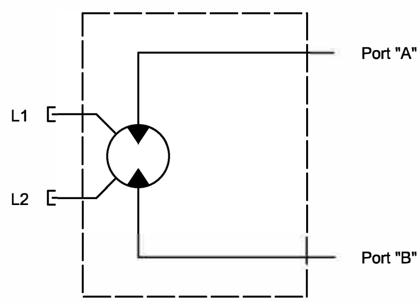
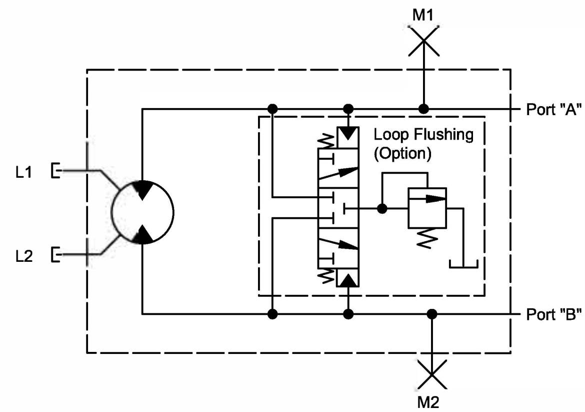
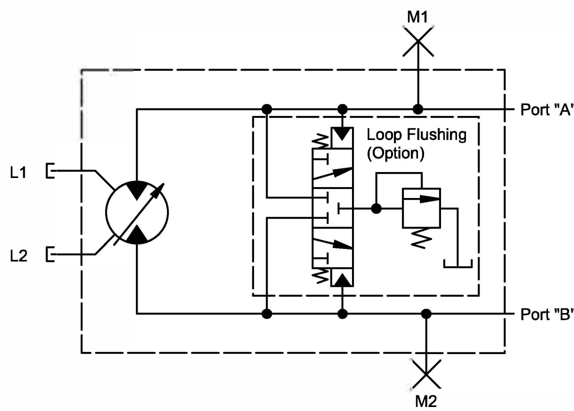
S40 Motor Schematics



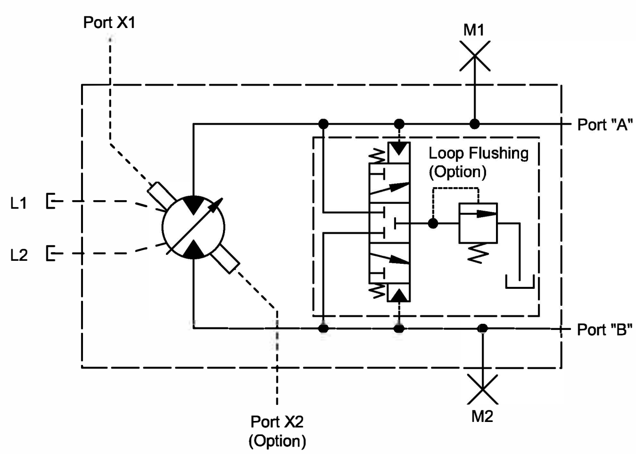
Series 40 - M25 Fixed Motor Schematic (No Loop Flushing)



Series 40 - M25/M35/M44/M46 Fixed Motor Schematic



Series 40 - M25/M35/M44 Variable Motor Schematic



Series 40 - M46 Variable Motor Schematic

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