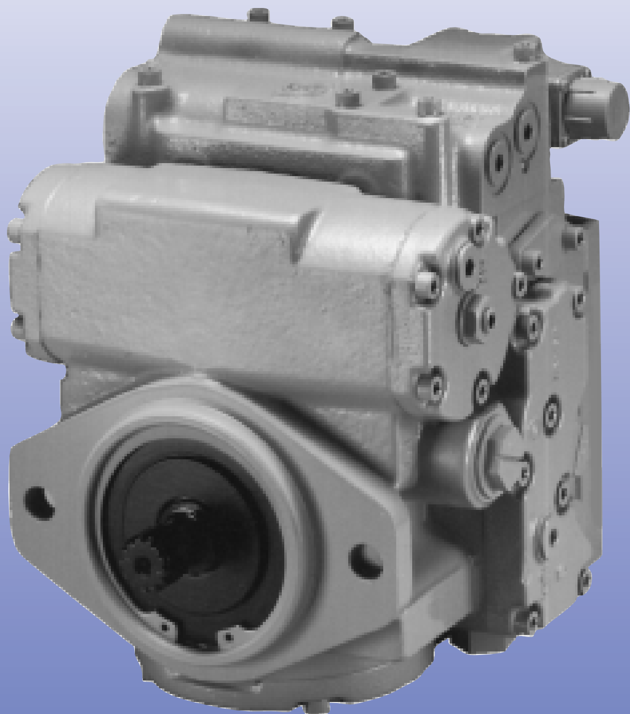
CONTENTS

SAUER SUNDSTRAND

Series 42



Axial Piston
Pumps
Technical Information

Series 42 Pumps

The Series 42 pumps are advanced hydrostatic units designed for "medium power" applications with maximum loads of 350 bar (5000 psi). These pumps can be combined with a suitable Sauer-Sundstrand motor or other products in a system to transfer and control hydraulic power.

The Series 42 variable displacement pump is a compact, high power density unit, using 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 oil from the pump, and thus reverses the direction of rotation of the motor output. Series 42 pumps provide an infinitely variable speed range between zero and maximum in both forward and reverse modes of operation.

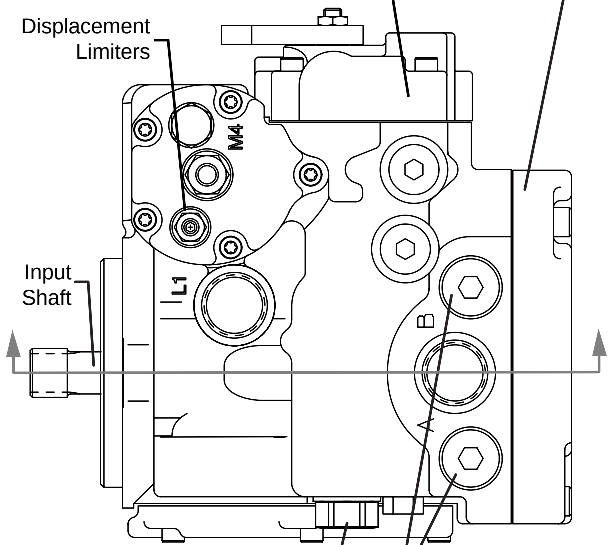
Series 42 pumps utilize a cradle swashplate design with a hydraulic servo control cylinder. Control is provided through a compact servo control system. A choice of servo controls are available. These include mechanically- or electrically-actuated feedback controls, hydraulic or electric proportional controls, and a three-position electric control. These controls are designed for low hysteresis and responsive performance.

- **Series 42 - Advanced Technology Today**
- **2 Sizes of Variable Displacement Pumps**
- **Complete Family of Control Systems**
- **Proven Reliability and Performance**
- **Optimum Product Configurations**
- **Compact Profile**
- **Quiet Operation**
- **Worldwide Sales and Service**

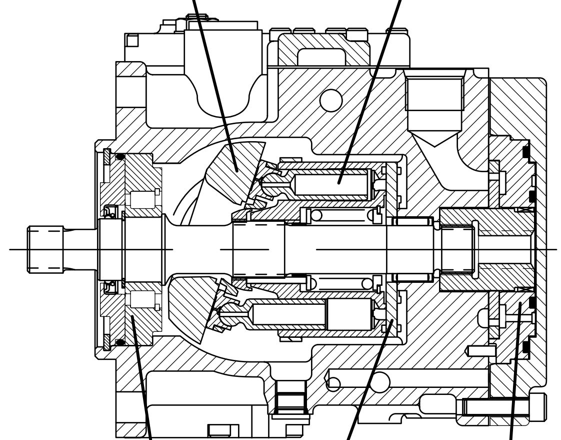
Contents

Series 42 Variable Pump Features

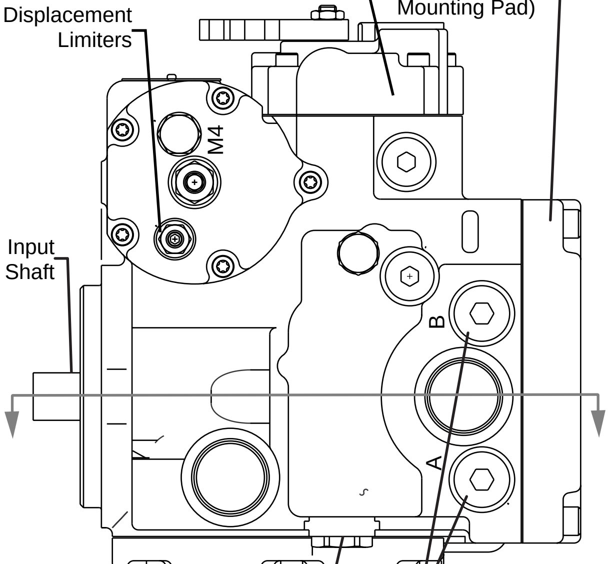
(Outline dimensions on p. 38)



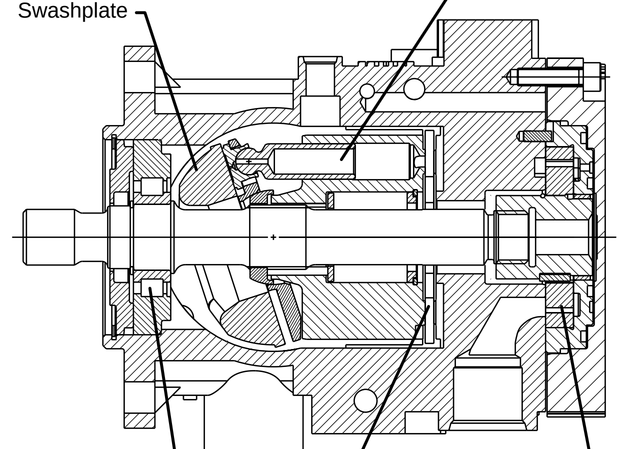
Series 42 - 28 cm³ Pump (PV)



Series 42 - 28 cm³ Pump Sectional View

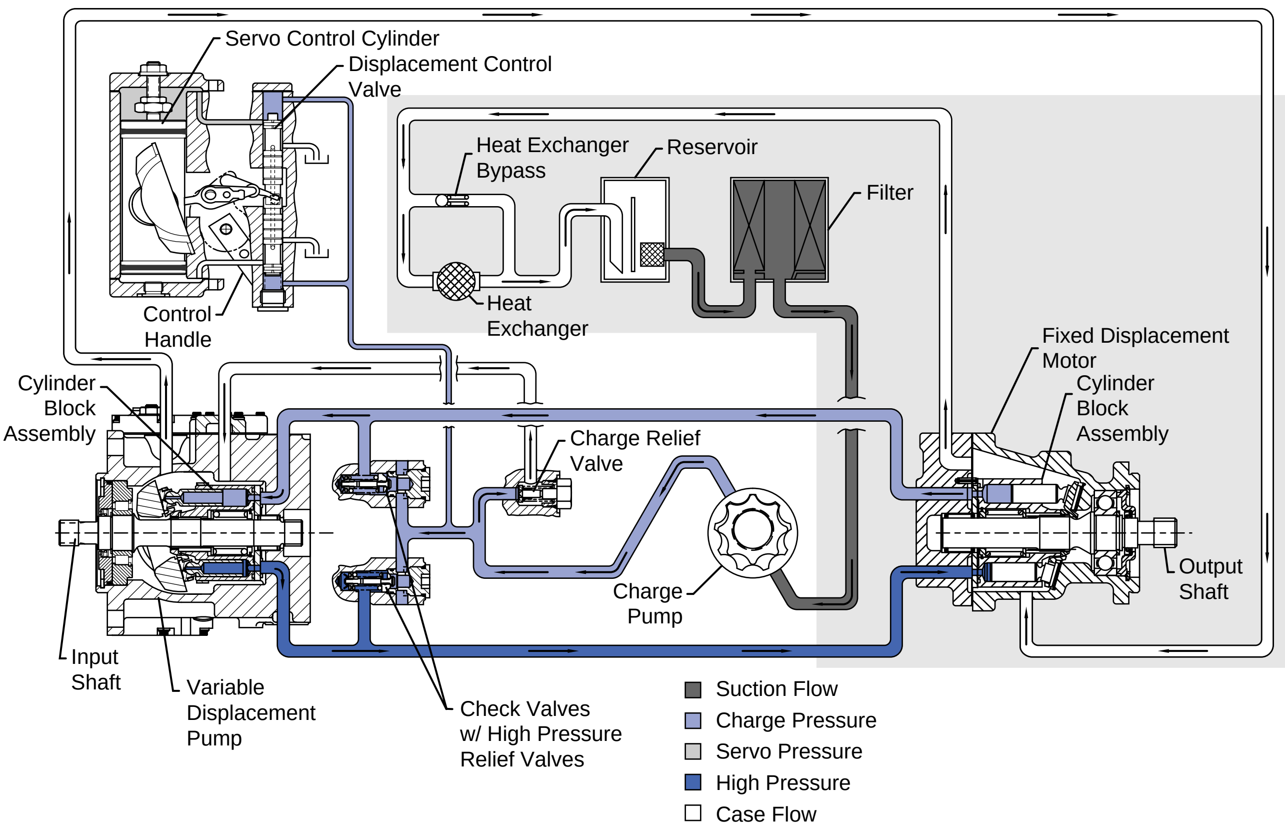


Series 42 - 41 cm³ Pump (PV)



Series 42 - 41 cm³ Pump Sectional View

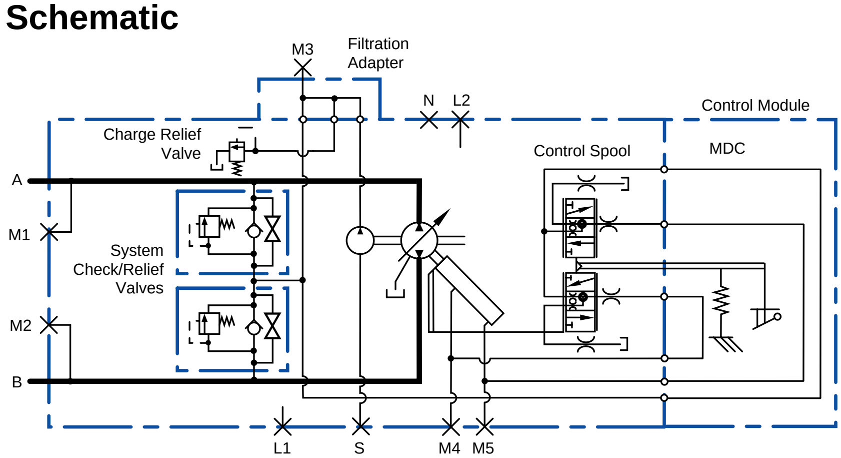
System Circuit Description



P100 384E

A Series 42 variable pump (left) is shown in a hydraulic circuit with a Series 40 - M35 fixed motor. The white half of the circuit includes pump components. A suction filtration configuration is shown. Pressure regulation valves are included on the pump. Note the position of the reservoir and heat exchanger.

Pump Circuit Schematic



P100 385E

A Series 42 pump schematic is shown above. The system ports "A" and "B" connect to the high pressure work lines. The pump receives return fluid in its inlet port and discharges pressurized fluid through the outlet port. Flow direction is determined by swashplate position. System port pressure can be gauged through ports M1 and M2. The pump has two case drains (L1 and L2) to ensure there is lubricating fluid in the system. This pump includes a manual displacement control. For other control schematics see the related control section (see p. 27)

Technical Specifications

Most specifications for Series 42 pumps 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 42 Pump Model Code Supplement or Price Book for more information.

General Specifications

Product Line	Series 42 Pumps
Pump Type	In-line, axial piston, positive displacement variable pumps including cradle swashplate and servo control
Direction of Input Rotation	Clockwise or Counterclockwise Available
Installation Position	Discretionary, the housing must be filled with hydraulic fluid.
Filtration Configuration	Suction or charge pressure filtration
Other System Requirements	Independent braking system, suitable reservoir and heat exchanger

Hardware Specifications

Model	**28**	**41**
Pump Configuration	Single Variable Pump	Single Variable Pump
Displacement cm^3/rev (in^3/rev)	28 (1.71)	41 (2.50)
Weight kg (lb)	34.5 (76)	42 (92)
Moment of Inertia $kg•m^2•10^{-3}$ ($lb•ft^2•10^{-3}$)	1.8 (43)	3.6 (86)

Hardware Features

Model	**28**	**41**
Type of Mounting (SAE flange size per SAE J744)	SAE "B"	SAE "B"
Port Connections	SAE-Twin Ports, Radial	SAE-Twin Ports, Radial
Integral Charge Pump Options cm^3/rev (in^3/rev)	11 (0.67) 15 (0.92)	11 (0.67) 15 (0.92)
Charge Relief Valve Settings (std) bar (psi)	14 (205) 20 (294)	14 (205) 20 (294)
System Pressure Regulation	140-345 bar (2030-5000 psi)	140-345 bar (2030-5000 psi)
Displacement Limiters	Option	Option
Input Shaft Options	Splined, Tapered, or Straight Key	Splined, Tapered, or Straight Key
Auxiliary Mounting Pad (SAE Pad per SAE J744)	SAE "A" (9T & 11T), SAE "B", SAE "B-B"	SAE "A" (9T & 11T), SAE "B", SAE "B-B"
Control Options	MDC, EDC, FNR, NFPH, NFPE	MDC, EDC, FNR, NFPH, NFPE
Filtration Configuration	Suction or Remote Pressure Filtration	Suction or Remote Pressure Filtration
Loop Flushing	Option	Option

System Parameters

Model	28	41
Case Pressure bar (psi)		
Continuous	3.4 (50)	3.4 (50)
Maximum	10.3 (150)	10.3 (150)
Speed Limits rev/min		
Rated @ max disp	3400	3400
Maximum @ max disp	3900	3900*
Minimum	500	500
System Pressure bar (psi)		
Continuous	210 (3000)	210 (3000)
Maximum	350 (5075)	350 (5075)
Theoretical Max Flow at Rated Speed l/min (gpm)	95.2 (25.1)	139 (36.8)
Inlet Vacuum absolute bar (in Hg vacuum)		
Continuous	0.8 (6)	0.8 (6)
Maximum	0.2 (24)	0.2 (24)

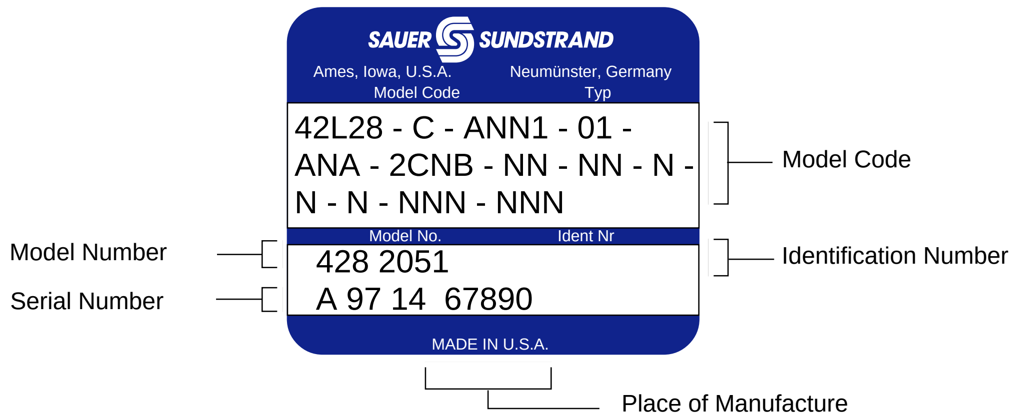
* Any operation above Rated Speed requires Sauer-Sundstrand application approval.

Fluid Specifications

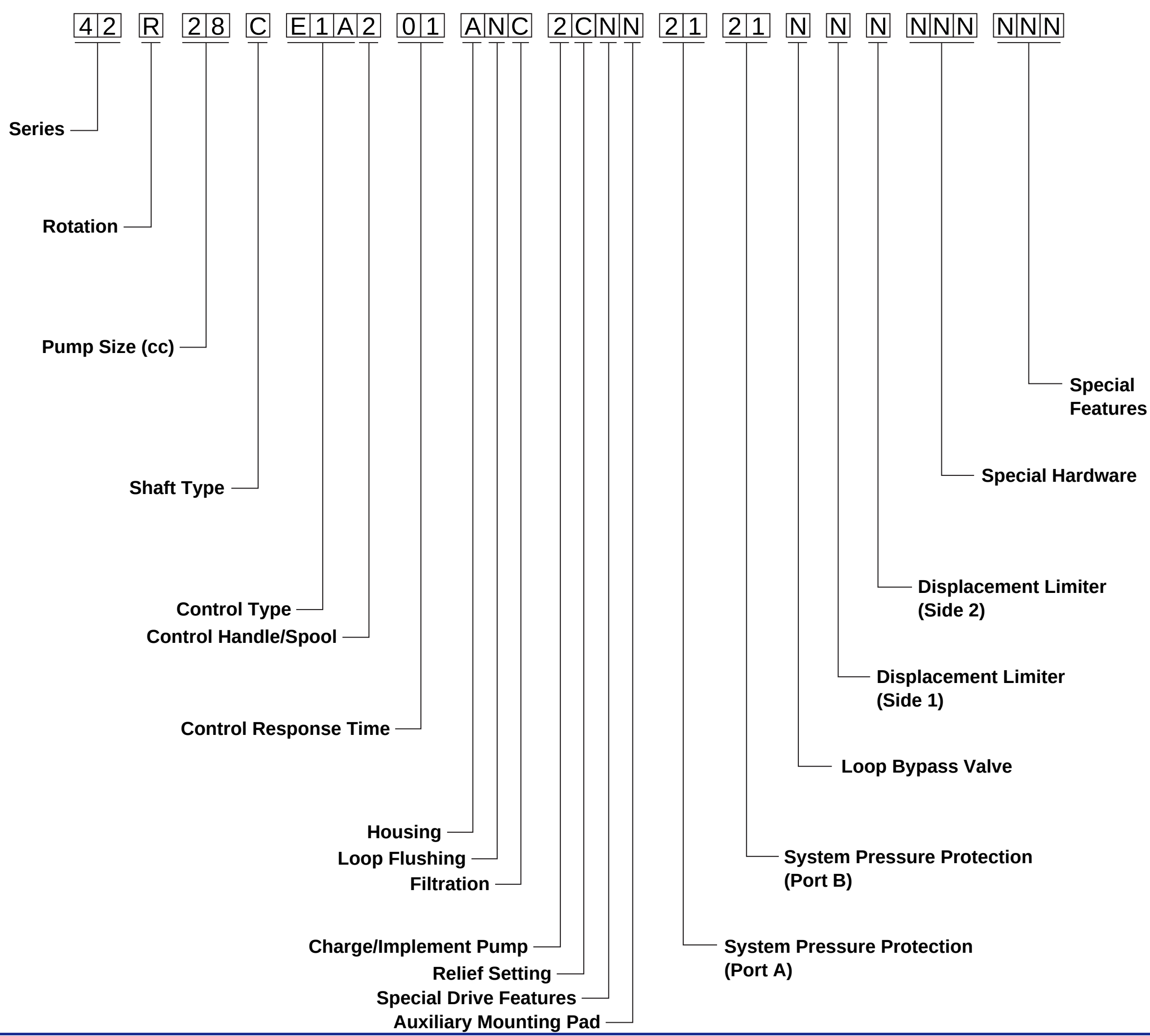
Hydraulic Fluid	Ratings and data are based on operation with premium petroleum-based hydraulic fluids containing oxidation, rust, and foam inhibitors. See page 11.	
Viscosity mm^2/s or cSt (SUS)		
Continuous Range	12 - 60	(70 - 278)
Minimum	7	(47)
Maximum	1600	(7500)
Temperature °C (°F)		
Minimum	-40	(-40)
Continuous	104	(220)
Maximum	115	(240)
Fluid Cleanliness Level	ISO 4406 Class 18/13	
Recommended Filtration Efficiency		
Suction Filtration	$\beta_{35-45} = 75$	$(\beta_{10} \geq 2)$
Charge Filtration	$\beta_{15-20} = 75$	$(\beta_{10} \geq 10)$

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 42 Model Code Supplement or the Series 42 Price Book.



Model Code Modules



Hydraulic Equations for Pump Selection

The equations below will help determine the pump size required for a specific application.

Inch-System:

Pump output flow	Q	=	$\frac{PD \cdot PS \cdot EV}{231}$	gpm
Input Torque	PT	=	$\frac{PD \cdot p}{2 \cdot \pi \cdot ET}$	lbf•in
Input Power	p	=	$\frac{PD \cdot PS \cdot p}{396\,000 \cdot ET}$	hp

Metric-System:

Pump output flow	Q_e	=	$\frac{Vg \cdot n \cdot \eta_v}{1000}$	l/min
Input torque	M_e	=	$\frac{Vg \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$	Nm
Input power	P_e	=	$\frac{M_e \cdot n}{9550} = \frac{Q_e \cdot \Delta p}{600 \cdot \eta_{mh}}$	kW

Description:

Inch-System:

PD	=	Pump displacement per rev.	in^3
PS	=	Hydrostatic pump speed	rpm
p	=	Differential hydraulic pressure	psi
EV	=	Pump volumetric efficiency	
ET	=	Pump mechanical - hydraulic (Torque) efficiency	

Metric-System:

Vg	=	Pump displacement per rev.	cm^3
n	=	Hydrostatic pump speed	rpm
Δp	=	$p_{HD} - p_{ND}$ (differential hydraulic pressure)	bar
η_v	=	Pump volumetric efficiency	
η_{mh}	=	Pump mechanical - hydraulic (Torque) efficiency	
p_{HD}	=	high pressure	bar
p_{ND}	=	low pressure	bar

System Parameters

Case Pressure

Under normal operating conditions, case pressure must not exceed the **continuous case pressure** rating. Momentary case pressure exceeding this rating is 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	3.4	50
Maximum	10.3	150

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	28	41
Rated @ max disp	3400	3400
Maximum @ max disp	3900	3900*
Minimum	500	500

*Any operation above Rated Speed requires Sauer-Sundstrand application approval.

Pressure Limits

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. There are load-to-life relationships for the rotating group and for the shaft anti-friction bearings (see p. 24).

Continuous pressure is the average, regularly occurring pressure. **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	350	5075

Inlet Vacuum

Charge pump inlet conditions must be controlled in order to achieve expected life and performance. A **continuous inlet vacuum** of not less than 0.8 abs bar (not more than 5 in Hg vac) is recommended. Normal vacuums less than 0.7 abs bar (greater than 10 in Hg vac) would indicate inadequate inlet design or a restricted filter. Vacuums less than 0.7 abs bar (greater than 10 in Hg vac) during cold start should be expected, but should improve quickly as the fluid warms. Inlet vacuum should never exceed the **maximum inlet vacuum**.

Inlet Vacuum	bar, absolute	in Hg vacuum
Continuous	0.8	6
Maximum	0.2	24

Theoretical Output

The **theoretical maximum flow at rated speed** is a simple function of pump displacement and speed. This is a good gauge for sizing a companion motor.

This does not take into account losses due to leakage or variations in displacement.

Fluid Specifications

Hydraulic Fluid

Ratings and data for Series 42 products are based on operating with premium hydraulic fluids containing oxidation, rust and foam inhibitors.

These include premium turbine oils, API CD engine oils per SAE J183, M2C33F or G automatic transmission fluids (ATF), Dexron II (ATF) 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 Sauer-Sundstrand 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 42 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 Sauer-Sundstrand 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	104	220
Maximum	115	240

Viscosity	mm²/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 42 pumps are available with provisions for either suction or charge pressure filtration to filter the fluid entering the charge circuit (see next page).

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 $\beta_{35\text{-}45} = 75$ ($\beta_{10} \geq 2$) 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 $\beta_{15\text{-}20} = 75$ ($\beta_{10} \geq 10$) 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.

Filtration Configuration

(Outline dimensions on p. 42)

Suction Filtration

The suction filter is placed in the circuit between the reservoir and the inlet to the charge pump as shown in the accompanying illustration.

Charge Pressure Filtration

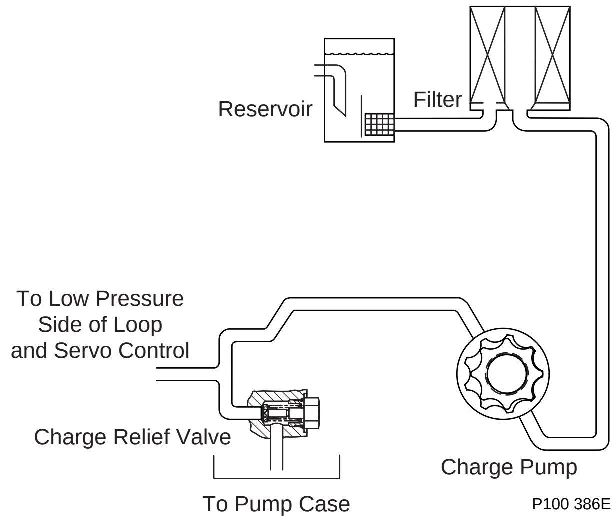
Provision for charge pressure filtration is available on all Series 42 pumps. The pressure filter is remotely mounted and is situated in the circuit after the charge pump, as shown in the accompanying illustration. Charge pressure filtration can reduce inlet vacuum in cold start-ups and provides fluid filtration immediately prior to entrance to the loop and the control system.

Filters used in charge pressure filtration circuits must be rated to at least 34.5 bar (500 psi) pressure. A 100 - 125 µm screen located in the reservoir or in the charge inlet line is recommended when using charge pressure filtration.

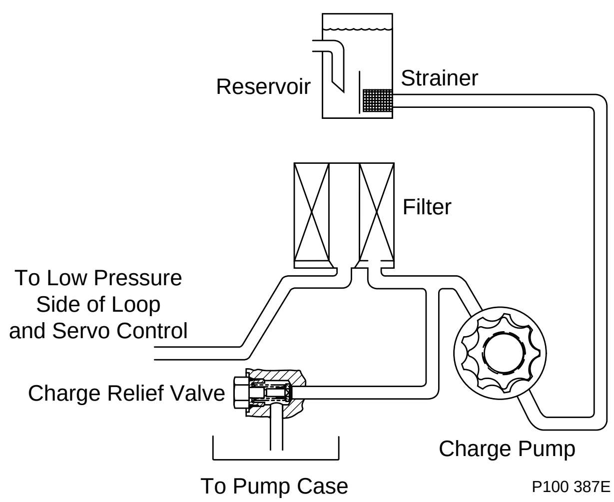
Partial filter flow is achieved by incorporating the charge pressure relief valve ahead of the filter element. Filter flow is only that needed by the high pressure loop and required by the control. A non-bypass filter is recommended. Insufficient flow through the filter will result in inadequate charge pressure and will be reflected in machine performance. A filter must be selected which is capable of withstanding a pressure drop equal to charge pressure while maintaining the filter $ß_x$-ratio at or above a value of one (no additional contaminants introduced into system).

Full filter flow is achieved by incorporating the charge pressure relief valve behind the filter element. Total charge flow is passed through the filter increasing the rate of contaminant removal from the system.

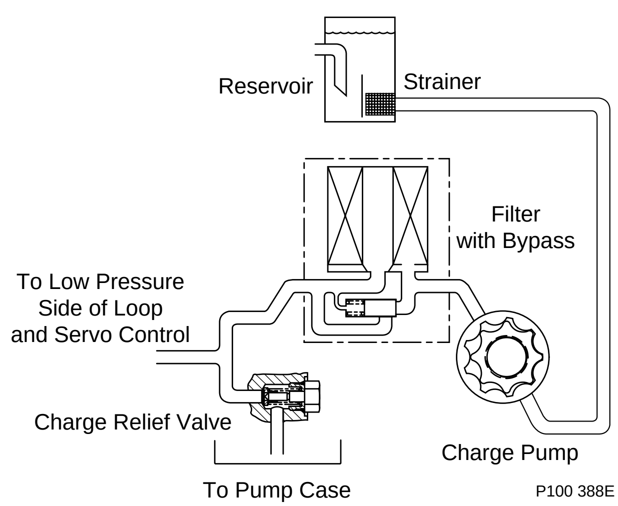
A filter bypass valve is necessary to prevent filter damage and to avoid contaminants from being forced through the filter media by high pressure differentials across the filter. In the event of high pressure drop associated with a blocked filter or cold start-up conditions, fluid will bypass the filter. Working with an open bypass for several hours should be avoided. A visual or electrical dirt indicator is recommended. Proper filter maintenance is mandatory.



Suction filtration



Charge pressure filtration, partial flow



Charge pressure filtration, full flow

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.

A suggested **minimum reservoir volume** is 5/8 of the maximum charge pump flow per minute with a **minimum fluid volume** equal to 1/2 of the maximum charge pump flow per minute. This allows 30 seconds fluid dwell for removing entrained air at the maximum return flow. This is usually adequate to allow for a closed reservoir (no breather) in most applications.

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.

Product Features and Options

Charge Pump

Charge flow is required on all Series 42 units applied in closed circuit installations to make up for internal leakage, maintain positive pressure in the main circuit, provide flow for cooling, replace any leakage losses from external valving or auxiliary systems, and to provide flow and pressure for the pump control system.

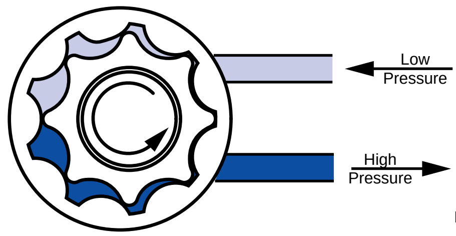
Note: Charge pressure must be maintained under all conditions of operation to prevent damage to the transmission.

Many factors influence the charge flow requirements and the resulting charge pump size selection. These factors include system pressure, pump speed, pump swashplate angle, type of fluid, temperature, size of heat exchanger, length and size of hydraulic lines, control response characteristics, auxiliary flow requirements, hydraulic motor type, etc.

The total charge flow requirement is the sum of the charge flow requirements of each of the components in the system. When initially sizing and selecting hydrostatic units for an application, it is frequently not possible to have all of the information necessary to accurately evaluate all aspects of charge pump size selection. The following procedure will assist the designer in arriving at an initial charge pump selection for a typical application.

In most Series 42 applications a general guideline is that the charge pump displacement (CPD) should be equal to or greater than 10% of the total displacement (TD) of all units in the system (see example at right). This rule assumes that all units are of high speed, piston design.

Both Series 42 pumps may be equipped with integral charge pumps. These charge pump sizes have been selected to meet the needs of a majority of Series 42 applications.



Gerotor Style Charge Pump used in Series 42 Pumps

Charge Pump Availability			
Charge Pump Displacement		Series 42 Pump	
cm^3/rev	(in^3/rev)	28	41
None		❍	❍
11	(0.67)	●	●
15	(0.92)	❍	❍

❍ = Option ● = Standard

Charge pump sizing example: A system consists of a single Series 42 - 28 Variable Pump driving two Series 40 -M35 Fixed Motors:

$$TD = 28 + 35 + 35 = 98\ \text{cm}^3$$

$$CPD = 10\% \times TD = 9.8\ \text{cm}^3$$

A charge pump displacement of 9.8 cm³ or more is required. The standard 11 cm³ charge pump should provide sufficient charge flow for this application.

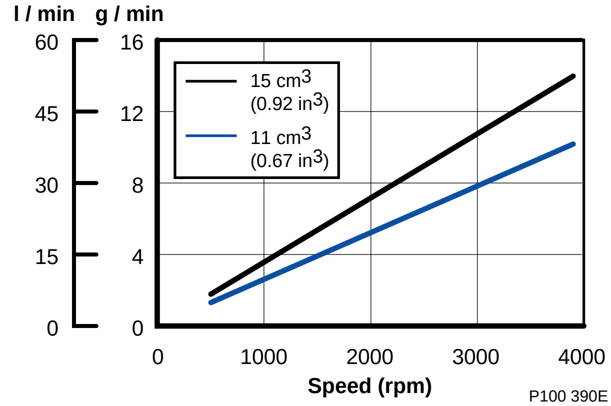
It is emphasized that particular application conditions may require a more detailed review of charge pump sizing. System features and conditions that may invalidate the "10% of displacement rule" include (but are not limited to):

- operation at low input speeds (below 1500 RPM)
- shock loadings
- excessively long system lines
- auxiliary flow requirements
- use of high torque low speed motors

If a charge pump of sufficient displacement to meet the 10% of displacement rule is not available or if any of the above conditions exist which could invalidate the 10% rule, contact your Sauer-Sundstrand representative.

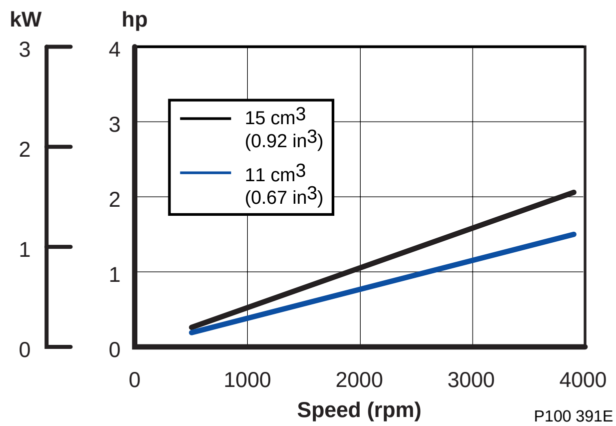
Series 42 pumps are also available without charge pumps. When a pump is equipped without a charge pump, an external charge supply is required to ensure adequate charge pressure and cooling.

Charge Pump Output Flow
(Flow at standard charge pressure setting, 160°F (70° C) inlet)



P100 390E

Charge Pump Power Requirements
(Power at standard charge pressure setting, 160°F (70° C) inlet)



P100 391E

Charge Relief Valve

Charge relief valves maintain charge pressure at a designated level. Series 42 pumps come with charge relief valves of direct-acting poppet design. The valve setting is set at the factory. The setting is shim adjustable.

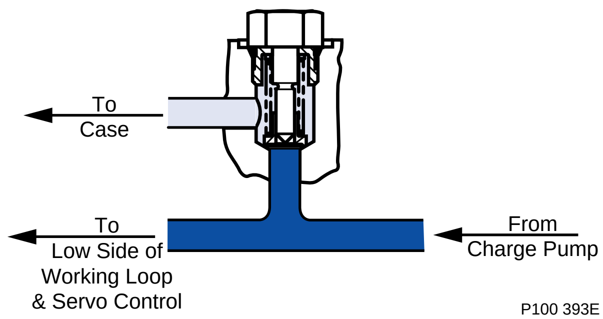
The charge pressure settings are nominal values and are based on the charge flow across the charge relief valve with a fluid viscosity of 28 mm²/s (130 SUS) and an pump input speed of 1800 rpm. Actual charge pressure will differ slightly from the nominal setting when different input speeds are used. The charge setting is a differential pressure (referenced to case pressure) and measured with the piston pump at zero swashplate angle ("neutral"). Charge pressure will drop slightly when the pump is in stroke due to flow demands not incurred when the pump is in neutral.

The charge pressure setting for pumps without an internal charge pump is set with an assumed charge flow of 19 l/min (5 gpm). These units must have adequate charge flow supplied to the charge inlet in order to maintain charge pressure at all times.

Note: 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.

Charge Relief Valve Specs

		28	41
Type		Direct-Acting Poppet	
Setting bar (psi)	14 (205)	●	●
	20 (294)	❍	❍
Adjustment		Shim Adjustable	



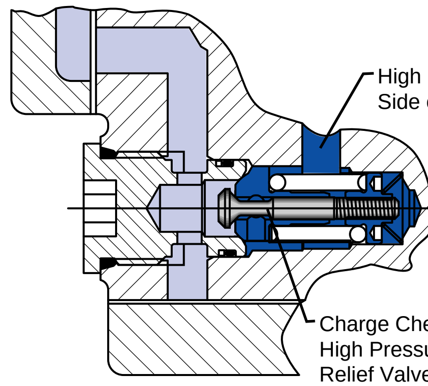
Charge Relief Valve

Overpressure Protection

Series 42 pumps are available with a combination charge check and high pressure relief valve assembly. High pressure relief valves are available in a range of settings as shown in the Model Code. Individual port pressure settings may be specified. The high pressure relief valve settings are a differential pressure (referenced to charge pressure) and are set at 3.8 l/min (1 gpm) of flow.

If high pressure relief valve protection is not desired, pumps may be equipped with charge check valves only. In unidirectional applications where free-wheel overrunning is required in one port, neither the high pressure relief or charge check functions are specified for that port.

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.



Charge check and high pressure relief valve

Check / High Pressure Relief Valves Specs	
Type	Cartridge-style poppet valve
Settings	140-345 bar (2030-5000 psi)
Options	Check only / no relief valve, No check / no relief valve

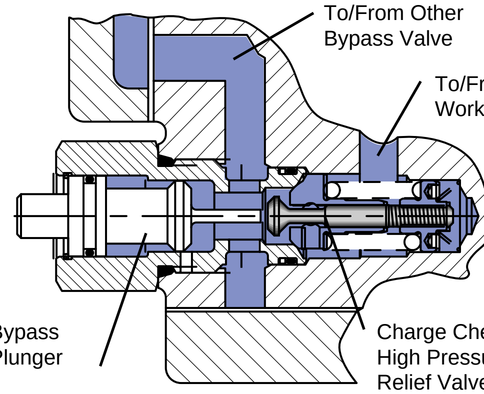
Bypass Valves

In some applications it is desirable to bypass fluid around the variable displacement pump when pump shaft rotation is either not possible or not desired. For example, a "down" vehicle may be moved to a service or repair location or winched on a trailer without operating the prime mover. This is accomplished with bypass valves.

Series 42 pumps are available with a bypass function which, when open, connects both sides of the main hydraulic circuit. This allows fluid to circulate without rotating the pump and prime mover.

The bypass valve is integral with the combination charge check and high pressure relief valve assembly. A plunger located in the plug of the valve assembly must be manually depressed to open the valve. The valve remains open until the prime mover is restarted and charge pressure automatically closes it. The plungers in both of the check/relief valve assemblies should be depressed for proper bypass operation.

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.



Charge check and high pressure relief valve with bypass

Displacement Limiters

(Outline dimensions on p. 43)

Series 42 pumps are available with mechanical displacement (stroke) limiters located in the servo covers. The maximum displacement of the pump can be limited to any value from its maximum displacement to zero in either direction.

Displacement limits can be adjusted by loosening the sealing lock nut, rotating the limiter screw, then locking the adjustment by torquing the lock nut. For each full revolution of the adjusting screw, the maximum pump displacement will change as shown in the accompanying table.

Note that adjustment occurs only when the adjusting screw is contacting the servo piston.

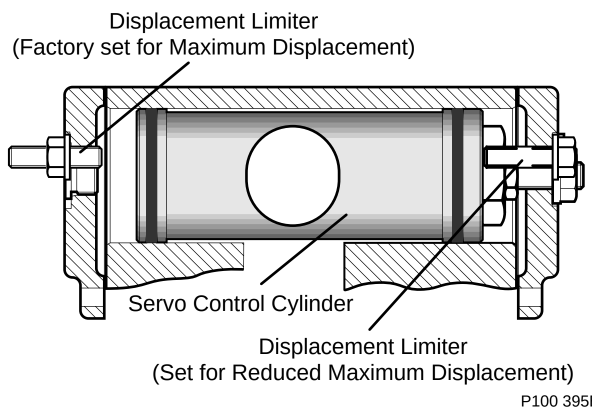
The limiters are factory set slightly beyond the maximum displacement of the pump.

WARNING
Care should be taken in adjusting displacement limiters to avoid an undesirable condition of output flow or speed. The sealing lock nut must be retorqued after every adjustment to prevent an unexpected change in output conditions and to prevent external leakage during pump operation.

Displacement limiters may not be suited to all applications.

Displacement Limiter Specs

	28	41
Approx Δ Disp per Rev of Adjusting Screw (cm³/rev) (in³/rev)	3.6 (0.22)	5.0 (0.31)
Maximum Displacement Limiter Range	Near 0% to 100% of Full Displacement	



Displacement Limiters on Series 42 Pump

Speed Sensor

(Outline dimension on p. 44)

Series 42 pumps are available with a speed sensor option for direct measurement of pump input speed.

A special magnetic speed ring is pressed onto the outside diameter of the block and a Hall effect pulse pickup sensor is located in the pump 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.

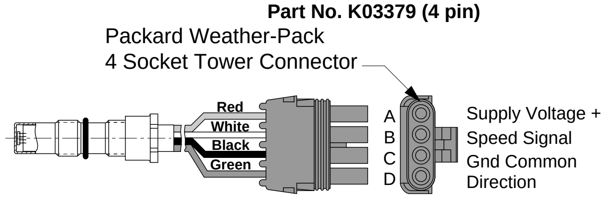
This sensor will operate with a supply voltage of 4.5 to 15 VDC, and requires a current of 12 mA at 5.0 VDC under no load. Maximum operating current is 20 mA at 5 VDC. Maximum operating frequency is 15 kHz. Output voltage in “High State” (VOH) is sensor supply voltage minus 0.5 VDC, minimum. Output voltage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

The sensor is available with a Packard Weather-Pack 4-pin sealed connector or a Turck Eurofast M12x1 4-pin connector.

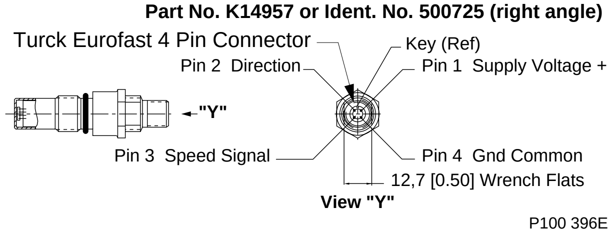
Contact your Sauer-Sunstrand representative for production availability on specific pump frame sizes, or for special speed sensor options.

Speed Sensor Specs		
Supply Voltage	4.5-15 VDC	
Required Current	12 mA @ 5 VDC (no load)	
Max Current	20mA @ 5 VDC	
Max Frequency	15 kHz	
VOH	Supply VDC – 0.5 VDC	
VOL	0.5 VDC Max	
Pulse/Rev	**28 cm^3**	**41 cm^3**
	41	51
Connector	Packard Weather-Pack 4-pin or Turck Eurofast M12X1 4-pin	

SAUER-SUNDSTRAND
Mating Parts Kit
Part No. K03379 (4 pin)



SAUER-SUNDSTRAND
Mating Parts Kit
Part No. K14956 or Ident. No. 500724 (straight)
Part No. K14957 or Ident. No. 500725 (right angle)



Pulse Pickup and Connectors

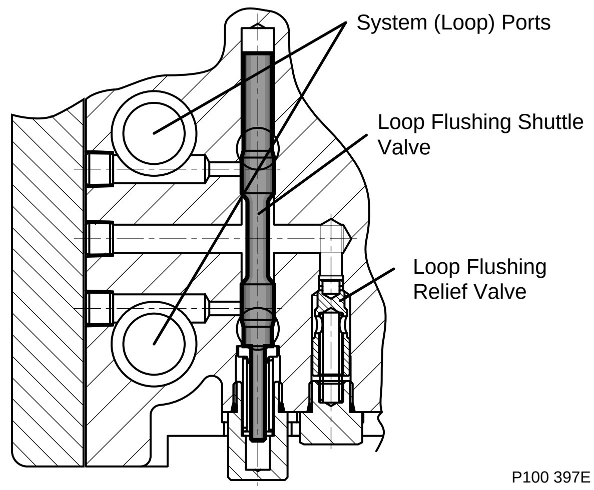
Loop Flushing

Series 42 pumps 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.

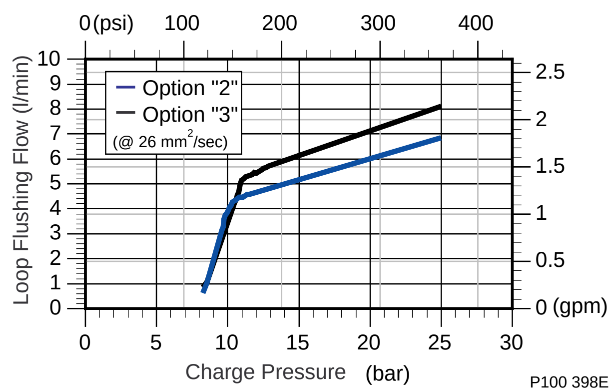
Series 42 pumps equipped with an integral loop flushing relief valve also include a loop flushing relief valve. The loop flushing relief valve poppet includes an orifice which controls flushing flow under most conditions. A combination of orifice size and charge pressure relief setting will produce a specific flushing flow, as illustrated in the accompanying graph. A loop flushing flow of 5 to 8 l/min (1.5 - 2 gpm) is generally suitable for most applications.

When a Series 42 pump is used with a loop flushing valve either located in a motor or installed remotely, the setting of the loop flushing relief valve should be equal to or less than the charge pressure setting of the pump. Contact your Sauer-Sundstrand 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.



Loop Flushing Valve



Loop Flushing Flow

Shaft Options

(Outline dimensions start on p.38)

Series 42 pumps are available with a variety of splined, straight keyed, and tapered shaft ends. Nominal shaft sizes and torque ratings are shown in the accompanying table.

Torque ratings assume no external radial loading. **Continuous 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)		28		41	
Spline 13 tooth, 16/32 pitch	Cont	140	(1240)	140	(1240)
	Max	226	(2000)	226	(2000)
Spline 15 tooth, 16/32 pitch	Cont	192	(1700)	192	(1700)
	Max	362	(3200)	362	(3200)
Spline 19 tooth, 16/32 pitch	Cont	–		340	(3000)
	Max	–		734	(6500)
Tapered 25.4 mm (1 in) Dia 1/8 (1.5 in/ft) taper	Max	362	(3200)	362	(3200)*
Straight Keyed 25.4 mm (1 in) Dia	Max	362	(3200)	362	(3200)*
Tapered 31.75 mm (1-1/4 in) Dia 1/8 (1.5 in/ft) taper	Max	–		734	(6500)
Straight Keyed 31.75 mm (1-1/4 in) Dia	Max	–		734	(6500)

† The limitations of these input shafts constrain the allowable auxiliary coupling torque (see p. 23).

* Not recommended for all applications.

NOTE: ***Recommended mating splines for Series 42 splined output shafts should be in accordance with ANSI B92.1 Class 5.*** *Sauer-Sundstrand 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 Sauer-Sundstrand representative for availability.

Auxiliary Mounting Pads

(Outline dimensions on p.45)

Auxiliary mounting pads are available on all Series 42 pumps to mount auxiliary hydraulic pumps. A sealed (oil tight) shipping cover is included as standard equipment on all mounting pads. The shipping cover is designed to seal case pressure and therefore can be used as a "running cover" if desired.

Since the auxiliary mounting pad operates under case pressure, an O-ring must be used to seal the auxiliary pump mounting flange to the pad. The drive coupling is lubricated with oil from the main pump case.

Spline specifications and torque ratings are shown in the accompanying table.

- All mounting pads meet SAE J744 specifications.
- The combination of auxiliary pad shaft torque, plus the main pump torque should not exceed the maximum pump input shaft rating shown in the “Shaft Availability and Torque Ratings” table on the previous page.
- All torque values assume a 58 R_c shaft spline hardness on mating pump shaft. **Continuous (Cont) torque** ratings for splines are based on spline tooth wear. **Maximum torque** is based on maximum torsional strength and 200 000 load reversals.
- Applications subject to severe vibratory or high "G" loading may require an additional structural support. This is necessary to prevent leaks and possible mounting flange damage. Refer to the "Mounting Flange Loads" section (p. 26) for additional information.

See page 46 for the dimensions of the auxiliary pump mounting flange and shaft. Pump mounting flanges and shafts with the dimensions noted are compatible with the auxiliary mounting pads on the Series 42 pumps.

Auxiliary Pad Specs †

Internal Spline Size	Pad Size	Torque Rating			Availability	
			Nm	(in•lbf)	28	41
9 tooth 16/32 pitch	SAE A	Cont: Max:	51 107	(450) (950)	❍	❍
11 tooth 16/32 pitch	SAE A	Cont: Max:	90 147	(800) (1300)	❍	❍
13 tooth 16/32 pitch	SAE B	Cont: Max:	124 248	(1100) (2200)	❍	❍
15 tooth 16/32 pitch	SAE B-B	Cont: Max:	243 347	(2090) (2990)	❍	❍

† Allowable auxiliary coupling torque is subject to limitations of the input shaft (see p. 22).

Loading, Life, and Efficiency

External Shaft Load and Bearing Life

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 (p. 25).

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 42 pumps 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. In applications where external shaft loads cannot be avoided, the impact on bearing life can be minimized by orienting the load to the 90 or 270 degree position.

The maximum allowable radial loads (R_e), based on the maximum external moment (M_e) and the distance (L) from the mounting flange to the load, may be determined from the table and drawing at right.

The 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 are 25% of the maximum allowable or more, or thrust loads are known to occur, contact your Sauer-Sundstrand representative for an evaluation of unit bearing life.

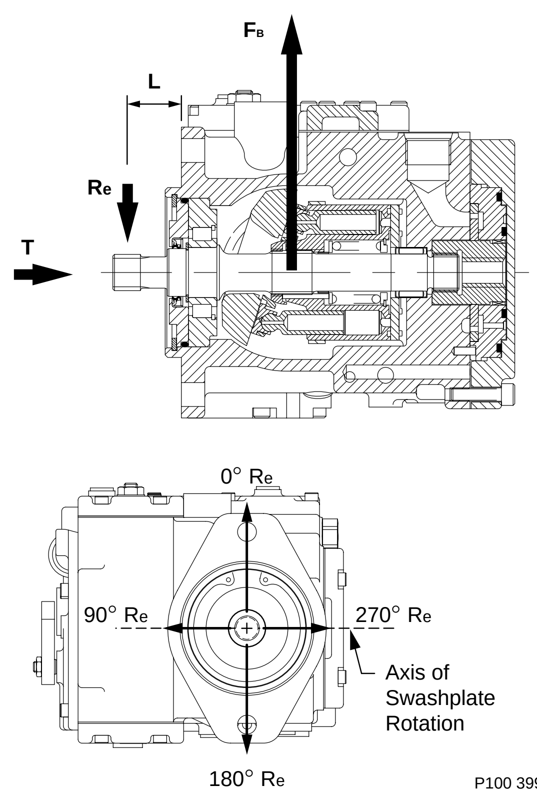
Tapered output shafts or “clamp-type” couplings are recommended for applications where radial shaft side loads are present.

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

Allowable Shaft Loads

		28	41
M_e	Nm (in•lbf)	98 (867)	111 (982)
T	N (lbf)	±1100 (250)	±1100 (250)



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 Sauer-Sundstrand 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.

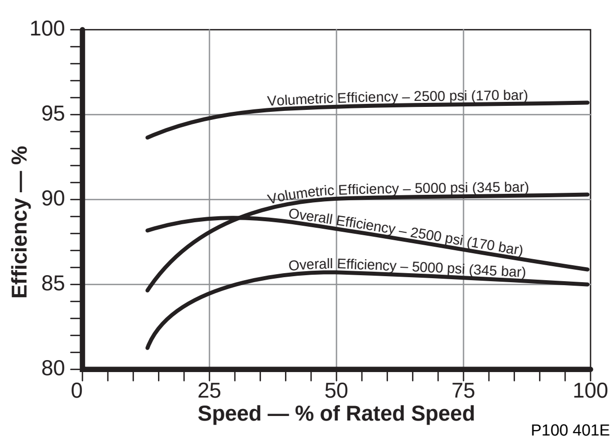
Series 42 pumps will meet satisfactory life expectancy if applied within the parameters specified in this bulletin (see p. 10). For more detailed information on hydraulic unit life see BLN-9884, "Pressure and Speed Limits".

Efficiency Graphs

The following performance graph provides typical volumetric and overall efficiencies for Series 42 pumps. These efficiencies apply for all Series 42 pumps at maximum displacement.

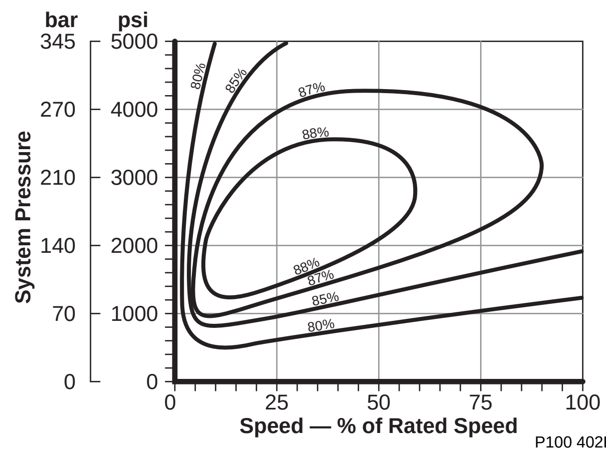
The performance map provides typical pump overall efficiencies at various operating parameters. These efficiencies also apply for all Series 42 pumps at maximum displacement.

Pump Performance as a Function of Operating Speed*



P100 401E

Pump Performance at Select Operating Parameters*



P100 402E

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

Mounting Flange Loads

Adding tandem mounted auxiliary pumps and/or subjecting pumps to high shock loads may result in excessive loading of the mounting flange. Pump applications should be designed to stay within the allowable shock load moment and allowable continuous load moment. **Shock load moment** is the result of an instantaneous jolt to the system. **Continuous load moments** are generated by the typical vibratory movement of the application.

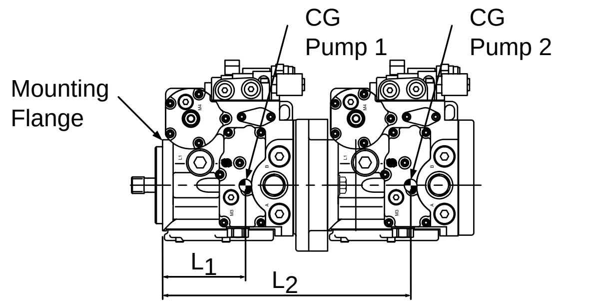
The overhung load moment for multiple pump mounting may be estimated as:

$$M_S = G_S (W_1L_1 + W_2L_2 + ... + W_nL_n)$$
$$M_C = G_C (W_1L_1 + W_2L_2 + ... + W_nL_n)$$

Refer to outline drawings to find "L". Refer to Hardware Specifications (page 6) to find "W".

Allowable overhung load moment values are shown in the accompanying table. Exceeding these values will require additional pump support.

Estimated maximum and continuous acceleration factors for some typical Series 42 applications are shown in the last table. Applications which experience extreme resonant vibrations may require additional pump support.



Overhung Load Moments

Overhung Loading Parameters	
M_s	Shock Load Moment
M_c	Continuous Load Moment
G_s	Maximum Shock Acceleration ("G"s)
G_c	Continuous (Vibratory) Acceleration ("G"s)
W_n	Weight of *n*th Pump
L_n	Distance from Mounting Flange to Center of Gravity of *n*th Pump

Allowable Overhung Load Moments

Frame Size	Continuous Load Moment (M_c)		Shock Load Moment (M_s)	
	Nm	(in•lbf)	Nm	(in•lbf)
28	1441	(12 750)	3413	(30 200)
41	1441	(12 750)	3413	(30 200)

G-factors for Sample Applications*

Application	Continuous (Vibratory) Acceleration (G_c)	Maximum (Shock) Acceleration (G_s)
Skid Steer Loader	4	10
Trencher (Rubber Tires)	3	8
Asphalt Paver	2	6
Windrower	2	5
Aerial Lift	1.5	4
Turf Care Vehicle	1.5	4
Vibratory Roller	6	10

* Applications which experience extreme resonant vibrations may require additional pump support.

Control Options

Series 42 pumps have a servo control system with a choice of a controls. Manual and Electric Displacement Controls (MDC and EDC) are feedback controls that provide and maintain a set displacement for a given input. The MDC includes options for a Neutral Start Switch, Backup Alarm, and a Solenoid Override to Neutral. Non-feedback controls are available to provide smooth control of the pump without mechanical linkage.

All controls are designed to provide smooth, stepless, and positive control of the transmission in either direction. Optional servo supply and drain orifices are available for special response needs.

Control Options

	28	41
Linear Manual Displacement Control (Linear MDC)	●	●
Non-Linear Manual Displacement Control (Non-Linear MDC)	❍	❍
Electric Displacement Control (EDC)	❍	❍
Three-Position Electric Control (FNR)	❍	❍
Hydraulic Non-Feedback Proportional (NFPH)	❍	❍
Electric Non-Feedback Proportional (NFPE)	❍	❍

❍ = Option ● = Standard

Typical Control Applications

Machine	Function	MDC	EDC	FNR	NFPH	NFPE
Roller/Compactor	Propel Vibratory Drive	❍ ❍	❍ ❍	 ❍	❍	
Asphalt Paver	Propel Conveyor Drive	❍	❍ ❍	 ❍		
Skid Steer Loader	Propel	❍	❍		❍	❍
Articulated Loader	Propel					❍
Utility Tractor	Propel	❍			❍	❍
Windrower	Propel	❍	❍		❍	
Trencher	Propel Chain Drive	❍ ❍	❍ ❍	 ❍	❍	
Ag Sprayer	Propel	❍				
Specialized Harvesters (Sod, Fruit, Nut, etc.)	Propel Auxiliary Drive	❍ ❍	❍ ❍	❍ ❍	❍	
Commercial Mower	Propel	❍			❍	
Rock Drill	Propel	❍	❍			
Machine Tool	Spindle Drive		❍			
Drill Rig	Drill Drive Pull Down				❍ ❍	
Sweeper	Propel Fan	❍ ❍	❍ ❍	 ❍		❍
Aerial Lift	Propel		❍			❍
Fork Lift	Propel				❍	❍
Brush / Stump Cutter	Propel Cutter Drive	❍ ❍		 ❍	❍	
Airport Vehicle	Propel		❍		❍	❍
Dumper	Propel	❍			❍	

Manual Displacement Control • MDC

(Outline dimensions on p. 47)

The Manual Displacement Control (MDC) converts a mechanical input signal to a hydraulic signal that tilts the swashplate through an angular rotation, varying the pump's displacement from full displacement in one direction to full displacement in the opposite direction.

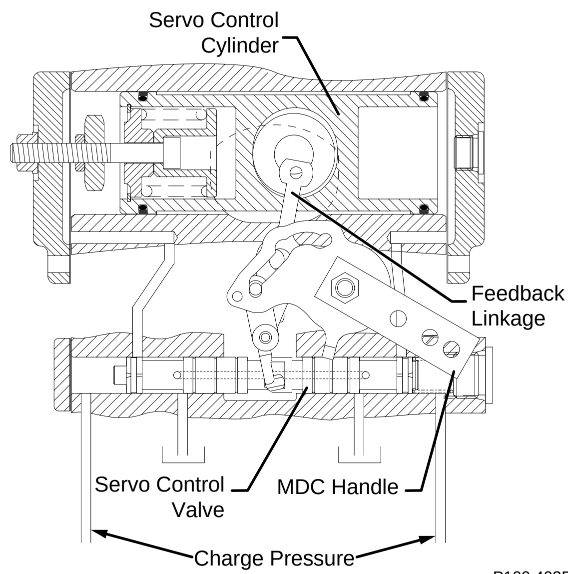
The MDC is designed so that the angular rotation of the swashplate is proportional to the mechanical input signal. The control has a mechanical feedback mechanism which moves the servo valve in proper relation to the input signal to maintain the angular position of the swashplate.

The servo control valve has been designed with variable geometry porting which regulates swashplate response relative to input command. Small displacement change commands are performed with maximum controllability throughout the entire stroking range of the pump. Large displacement change commands are completed with rapid swashplate response. Although the control is designed for fast response AND smooth control, optional servo supply and drain orifices are available for applications having special response needs.

The control is also designed with a full over-travel spool which allows the mechanical input to be moved at a faster rate than the resulting movement of the swashplate without damage to the control. Any swashplate position error is sensed by the feedback mechanism and a servo valve correction is automatically commanded.

Features and Benefits of MDC

- The MDC is a high gain control. With a small movement of the control handle (input signal), the servo valve moves to the full open position porting maximum flow to the swashplate servo control cylinder.
- The MDC provides a fast response with low input force.
- The full over-travel spool design allows rapid changes in input signal without damaging the control mechanism.
- Precision parts provide repeatable and accurate displacement settings with a given input signal.
- Mechanical feedback mechanism maintains pump displacement for a given input signal.



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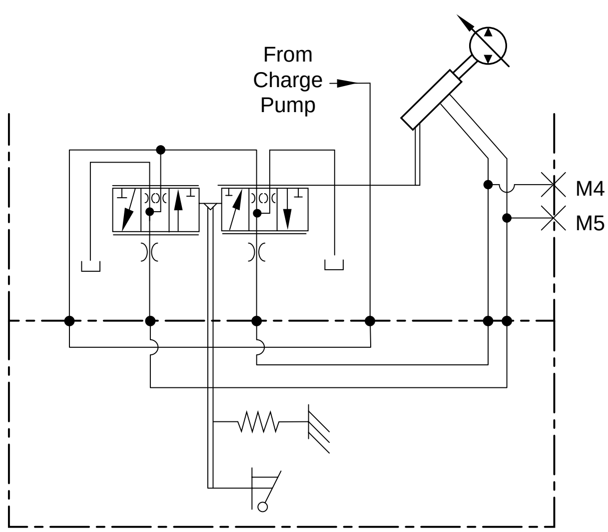
Cross-Section of Manual Displacement Control



P100 404E

MDC Schematic

- Swashplate vibration is not transmitted to the operator's hands.
- The swashplate and double-acting servo control cylinder are coupled to a spring centering mechanism. The servo control valve is spring centered so that with "no input signal" the servo cylinder is cross ported.

So the pump will return to "neutral"

- if the prime mover is shut down;
- if the external control linkage fails at the control handle;
- if there is a loss of charge pressure.

Response Time

The time required for the pump output flow to change from zero to maximum can be tailored by orifice selection. Optional orifices are available to assist in matching the rate of swashplate response to the acceleration and deceleration requirements of the application. **Testing should be conducted to verify the proper orifice selection.**

Neutral to maximum swashplate response is approximately 60% of the response for maximum to maximum swashplate travel.

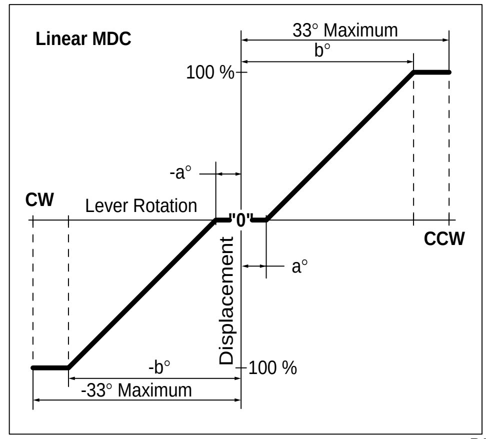
For response times other than those shown please contact your Sauer-Sundstrand representative.

Non-Linear Manual Displacement Control

The Non-Linear Manual Displacement Control provides very small changes in pump output flow relative to input handle rotation when operating near the "neutral" (zero flow) position, and larger changes as the handle nears its maximum flow position. This non-linear relationship between the control input and pump output flow enhances vehicle control and "inching" capabilities.

Control Input Signal

Torque required to move control handle to maximum displacement is 1.36±0.23 Nm (12±2 in•lbf). In order to prevent damage to the control, stops must be provided in the control linkage to limit the maximum linkage travel and maximum torque on the control handle. Maximum allowable input torque at the control handle is 17 Nm (150 in•lbf).



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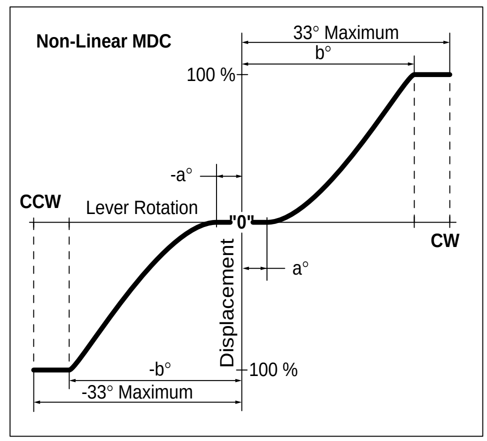


P100 406E

Pump Displacement vs Control Lever Rotation

Handle Angle Required for Swashplate Position

Configuration	Swashplate Position (ref above graphs)	
	Swashplate Movement Begins (point "a")	Full Displacement Reached (point "b")
Linear - Std	5.3°	28°
Linear - Narrow	4.0°	24°
Non-Linear - Std	5.3°	28°

MDC Response Time

Frame Size	Response (sec)		
	Fast	Medium	Slow (Std)
28	0.5	1.3	2.5
41	0.6	1.6	2.5

14 bar (200 PSI) charge pressure, maximum to maximum displacement

"High-Force" Control Handle Spring

This option provides higher control handle forces for foot-pedal control systems. Torque required to move the control handle to maximum displacement is 2.71 ± 0.23 Nm (24 ± 2 in•lbf).

Control Handles

Either "straight" or "clevis" ("offset") style control handles are available for the MDC. The "straight" style handle minimizes the overall height of the pump and control. The clevis style handle provides additional clearance between the handle and control housing and is suited for clevis style linkage installations.

Maximum allowable input torque at the control handle is 17 Nm (150 lbf•in). The maximum allowable bending moment is 4 Nm (35 in•lbf).

Electric Solenoid Override to "Neutral"

This solenoid connects both ends of the pump displacement control piston together when de-energized. This prevents the pump from going "into stroke."

The normal position of the valve is "off" which allows the pump to return to "neutral." This control option is ideally suited for "operator presence" or "auto-resume" functions without prime mover shut down. This solenoid is available for 12 or 24 VDC with 2 ampere maximum current draw. It is available with terminals for a DIN 43650 connector or with a Packard Weather-Pack 2-way shroud connector.

Emergency Electric Solenoid Override to "Neutral" with Port for Brake Pressure Release

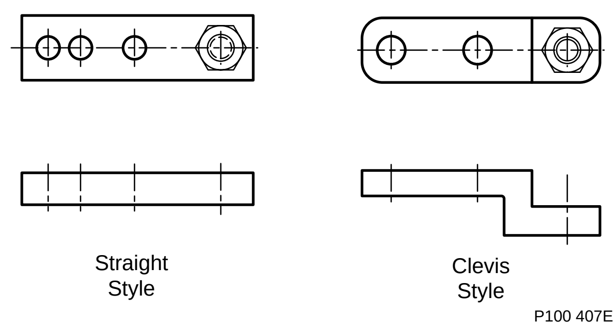
The solenoid connects both ends of the pump displacement control piston together, and drains a spring applied, hydraulically released brake when de-energized. An optional external drain to the reservoir (port L4) is available for conditions where case backpressure on the spring applied brake is critical.

The normal position of the valve is "off" which permits the pump to return to "neutral" and drains the brake port (port X7). This control option is ideally suited for "emergency stop" functions without prime mover shut down. This solenoid is available for 12 or 24 VDC with 2 ampere maximum current draw. It is available with terminals for a DIN 43650 connector or with a Packard Weather-Pack 2-way shroud connector.

Pump Flow Direction with MDC Control

	Input Shaft Rotation			
	CW		CCW	
Handle Rotation	CW	CCW	CW	CCW
Port A Flow	In	Out	Out	In
Port B Flow	Out	In	In	Out
High Pressure Servo Gauge Port	M4	M5	M4	M5

Refer to pump outline drawings for port locations.



MDC Handle Options

Electric Override to Neutral Specs

Solenoid at Override Activatation	De-energized
Voltage	12 or 24 VDC
Max Current	2 A
Connector Type	DIN 43650 or Weather-Pack 2-pin shroud

Electric Override to Neutral Connectors

Connector	Mating Parts Kit Part No. (Ident No.)
DIN 46350	K09129 (514117)
Packard Weather Pack 2-Way Shroud	K03383

Neutral Start Switch (NSS)

This option provides an electrical switch contact which is closed when the control handle is in its "neutral" (0°) position. The switch contact will open when the control handle is rotated 1.5 to 2° clockwise (CW) or counterclockwise (CCW) from "neutral." The switch is rated at 5 amperes inductive load at 12 or 24 VDC.

This switch is available with screw terminals (no connector) or with a Packard Weather-Pack 2-way tower connector.

The Neutral Start Switch should be wired in series with the engine starting circuit and is intended to verify the "neutral" position of the pump before allowing the engine to be started.

Neutral Start with Back-Up Alarm (BUA) Switch

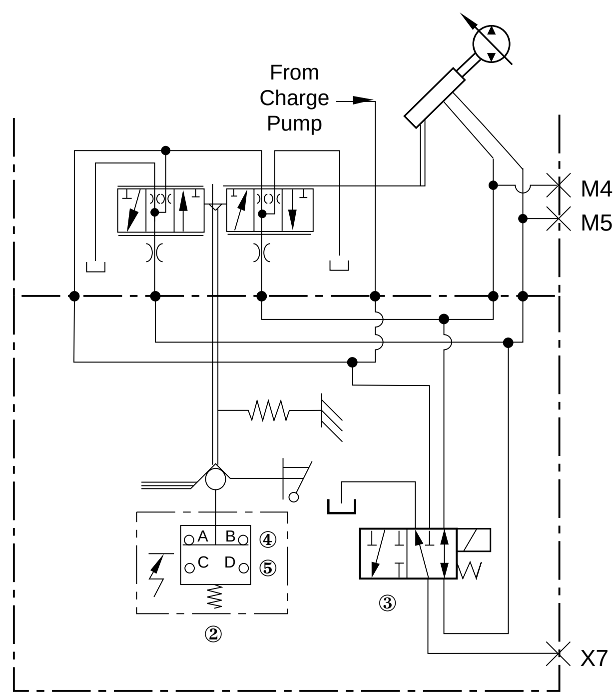
The Back-Up Alarm switch contact is open until the control handle is rotated 2.6 to 3.75° from "neutral." The Back-Up Alarm switch closes when the control handle is rotated either clockwise (CW) or counterclockwise (CCW) from "neutral" (one direction only). The Back-Up Alarm switch is rated at 2.5 amperes resistive load at 12 or 24 VDC. The Neutral Start Switch contact will open when the control handle is rotated 1.5 to 2° clockwise (CW) or counterclockwise (CCW) from "neutral." The Neutral Start Switch is rated at 5 amperes inductive load at 12 or 24 VDC.

This switch is available with screw terminals (no connector) or with a Packard Weather-Pack 4-way tower connector.

The Neutral Start Switch should be wired in series with the engine starting circuit and is intended to verify the "neutral" position of the pump before allowing the engine to be started. The Back-Up Alarm switch is normally wired in series to a horn.

NSS Specs	
Switch Neutral Position	Closed
Voltage	12 or 24 VDC
Current Rating	5 A
Neutral Play	±2°
Backup Alarm Switch Option	
Switch Neutral Position	Open
Voltage	12 or 24 VDC
Current Rating	2.5 A
Alarm Direction	Either CW or CCW
Switch Closes At	±2.6 ~ 3.75°

Neutral Start Switch Connectors	
Connector	Mating Parts Kit Part No.
Screw Terminals	-
Packard Weather Pack 2-Way Tower	K03377
Packard Weather Pack 4-Way Tower	K03379



2 Neutral Start Switch w/ Backup Alarm
③ Electric Solenoid Override to Neutral w/ Brake Release
④ Neutral Start Switch Contacts (A and B) (Closed in Neutral)
5 Backup Alarm Switch Contacts (C and D) (Closed in Reverse)

Hydraulic Schematic for MDC with Safety Options

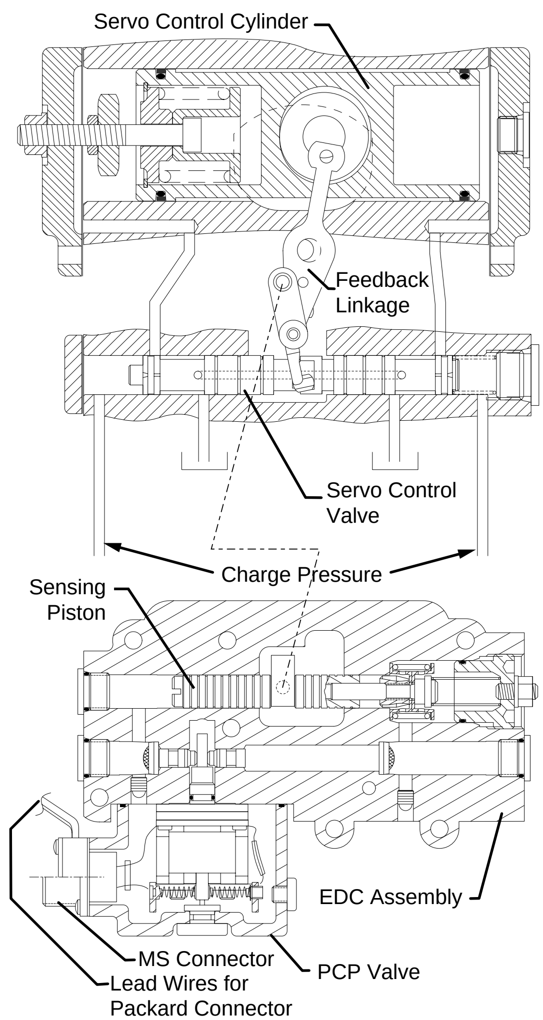
Electrical Displacement Control • EDC

(Outline dimensions on p. 48)

The Electrical Displacement Control (EDC) uses an electrohydraulic Pressure Control Pilot (PCP) stage to control a differential pilot pressure. The PCP stage converts an electrical input signal to a hydraulic input signal to operate a spring centered sensing piston. The sensing piston produces a mechanical input to the servo control valve which ports hydraulic pressure to either side of the double acting servo control cylinder. The servo cylinder tilts the swashplate, thus varying the pump's displacement from full displacement in one direction to full displacement in the opposite direction.

The EDC is designed so that the angular rotation of the swashplate is proportional to the electrical input signal. The control has a mechanical feedback mechanism which moves the servo valve in the proper relation to the input signal and the angular position of the swashplate. Any swashplate position error is sensed by the feedback mechanism and a servo valve correction is automatically commanded.

The servo control valve has been designed with variable geometry porting which regulates swashplate response relative to input command. Small displacement change commands are performed with maximum controllability throughout the entire stroking range of the pump. Large displacement change commands are completed with rapid swashplate response. Although the control is designed for fast response AND smooth control, optional servo supply and drain orifices are available for applications having special response needs.



Cross-Section of Electrical Displacement Control

Feature and Benefits of EDC

- The EDC is a high gain control. With a small change in the input current, the servo valve moves to the full open position porting maximum flow to the servo control cylinder.
- Silicon oil filled pilot stage lengthens control life by preventing moisture ingression and dampening component vibrations.
- The majority of all EDC's are equipped with dual coil pilot stages. An optional low input current control is configured in single coil only. When dealing with a dual coil EDC, the user has the option of using a single coil or both coils, either in series or in parallel.

- A full over-travel servo valve allows rapid changes in input signal voltages without damaging the control mechanism.
- Precision parts provide repeatable and accurate displacement settings with a given input signal.
- Mechanical feedback mechanism maintains pump displacement for a given input.
- Pulse Width Modulation (PWM) is not required.
- The swashplate and double-acting servo control cylinder are coupled to a spring centering mechanism. The servo control valve is spring centered so that with “no input signal” the servo cylinder is cross ported returning .

So the pump will return to "neutral"

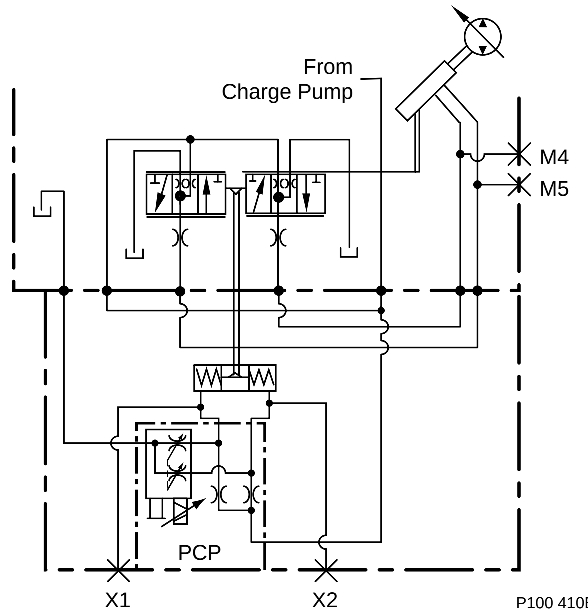
- if the prime mover is shut down;
- if the external electrical input signal is lost;
- if there is a loss of charge pressure.

Response Time

The time required for the pump output flow to change from zero to maximum can be tailored by orifice selection. Optional orifices are available to assist in matching the rate of swashplate response to the acceleration and deceleration requirements of the application. **Testing should be conducted to verify the proper orifice selection.**

Neutral to maximum swashplate response is approximately 60% of the response for maximum to maximum swashplate travel.

For response times other than those shown please contact your Sauer-Sundstrand representative.



EDC Hydraulic Schematic

EDC Response Time

Frame Size	Response (sec)		
	Fast	Medium	Slow (Std)
28	0.5	1.3	2.5
41	0.6	1.6	2.5

14 bar (200psi) charge pressure, maximum to maximum displacement.

Pump Flow Direction with EDC Control

	Input Shaft Rotation			
	CW		CCW	
Voltage to Pin:	A (C)	B (D)	A (C)	B (D)
Port A Flow	In	Out	Out	In
Port B Flow	Out	In	In	Out
Hi Servo Gauge Port	M4	M5	M4	M5
EDC Pilot Gauge Port	X2	X1	X2	X1

Refer to pump outline drawings for port locations.

Control Input Signal

The required input signal to provide a given swashplate position is shown in the chart and table at right. The point of initial swashplate movement is defined as a system differential pressure of 3.5 bar (50 psi).

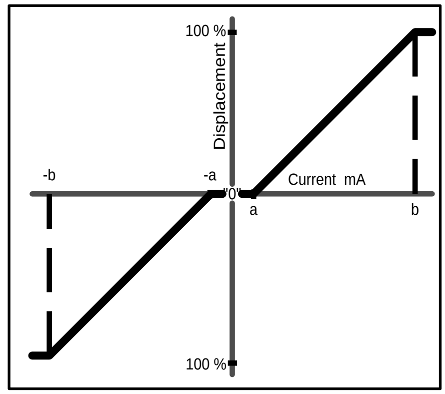
Coil Options

There are two types of coils available: the standard "normal" coil and a low current coil option.

The optional low input current control (5-18 mA) allows an EDC to be used in conjunction with a microprocessor without the need for an amplifier board.

Connectors

The EDC solenoid may be equipped with either an Military Spec (MS) connector or a Weather Pack 2- or 4-way shroud connector.



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Pump Displacement vs Electrical Signal

EDC Signal Required for Swashplate Postion

Coil Configuration	Swashplate Postion (ref above chart)		Pin Connection
	Movement Begins (point "a") mA @ VDC	Full Disp. Reached (point "b") mA @ VDC	
Single Coil	14 @ 0.3	85 @ 1.7	A=(+), B=(-)
	14 @ 0.23	85 @ 1.36	C=(+), D=(-)
Single Coil (Low Current)	5 @ 3.25	18 @ 11.65	A=(+), B=(-)
Dual Coil in Series	7 @ 0.25	43 @ 1.55	A=(+), D=(-) C=B
Dual Coil in Parallel	14 @ 0.13	85 @ 0.75	A=C + B=D

EDC Input Specs

	Normal Current	Low Current
Coil Resistance (Ω at 24˚C [75˚F])	Coil A/B: 20 Coil C/D: 16	650
(Ω at 104˚C [220˚F])	-	850
Max Input Current mA @ VDC	350 @ 6	46 @ 30

EDC Connectors

Connector	Mating Parts Kit Part No. (Ident No.)
MS3102C-14S-2P	K08106 (615062)
Packard Weather Pack 4-Way Shroud	K03384
Packard Weather Pack 2-Way Shroud	K03383

Non-Feedback, Proportional Hydraulic Control • NFPH

(Outline dimensions on p. 48)

The Non-Feedback Proportional Hydraulic (NFPH) control is a hydraulic displacement control in which an input signal pressure is supplied to the pump servo control cylinder (via control ports X1 and X2) to control pump displacement.

Series 42 pumps equipped with an NFPH control have a special servo cylinder capable of providing proportional control with a hydraulic input.

The pump displacement is proportional to the signal pressure, but is also dependent upon pump input speed and system pressure. This characteristic provides a power limiting function by reducing the pump swashplate angle as system pressure increases. A typical characteristic is shown in the accompanying graph.

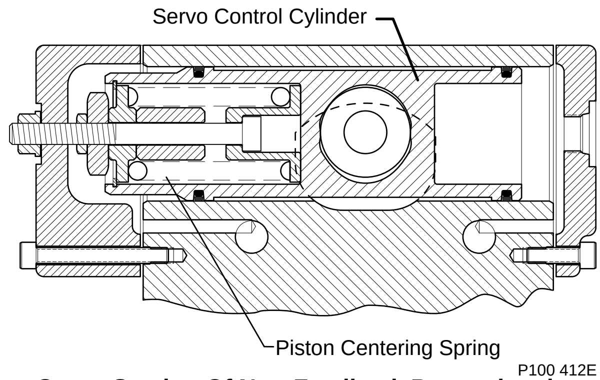
Features and Benefits of the NFPH Control

- Eliminates mechanical linkage for flexibility of control design.
- Power limiting characteristic reduces machine power requirements.
- Compatible with dual axis joysticks for dual path applications.
- Smooth operation.

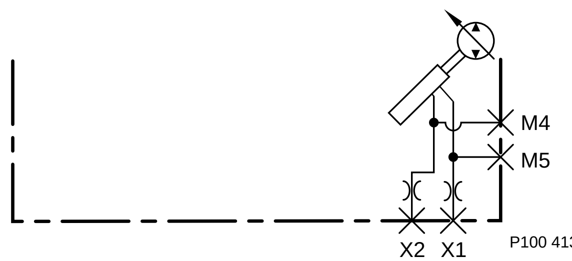
Pump Flow Direction with NFPH Control

	Input Shaft Rotation			
	CW		CCW	
Higher Pressure into Control Port:	X1	X2	X1	X2
Port A Flow	Out	In	In	Out
Port B Flow	In	Out	Out	In
High Servo Gauge Port	M4	M5	M4	M5

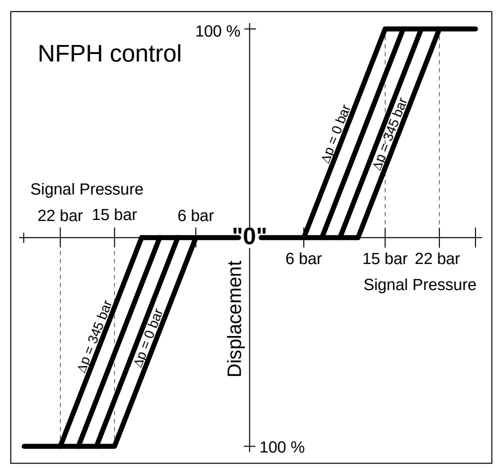
Refer to pump outline drawings for port locations.



Cross-Section Of Non-Feedback Proportional Hydraulic Control



Non-Feedback Proportional Hydraulic Control Hydraulic Schematic



Pump Displacement vs Signal Pressure

P100 414E

Non-Feedback, Proportional Electric Control • NFPE

(Outline dimensions on p. 49)

The Non-Feedback Proportional Electric (NFPE) control is a hydraulic control in which an electric input signal activates one of two solenoids which port charge pressure to either side of the pump servo control cylinder.

Series 42 pumps equipped with an NFPE control have a special servo cylinder capable of providing proportional control with an electric input.

The pump displacement is proportional to the solenoid signal current, but is also dependent upon pump input speed and system pressure. This characteristic provides a power limiting function by reducing the pump swashplate angle as system pressure increases. A typical response characteristic is shown in the accompanying graph.

Features and Benefits of the NFPE Control

- Electric control.
- Eliminates mechanical linkage for flexibility of control design.
- Power limiting characteristic reduces machine power requirements.
- Smooth operation.

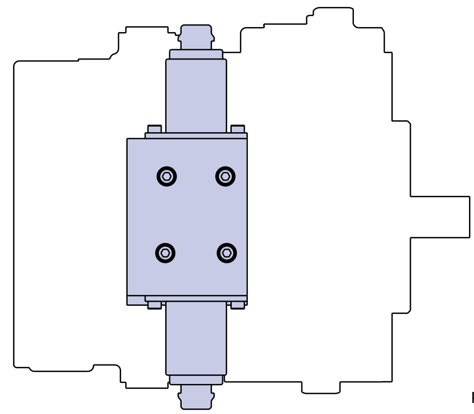
Input Signal Requirements

The NFPE control requires a pulse-width-modulated (PWM) input current to optimize performance. The recommended PWM frequency is 200 Hz. The minimum PWM frequency is 80 Hz. Coil resistance is 5.6 Ω at 22°C.

The NFPE control utilizes AMP Junior Power Timer connectors. The solenoids are compatible with Sauer-Sundstrand microprocessors, electric circuit boards and handles.

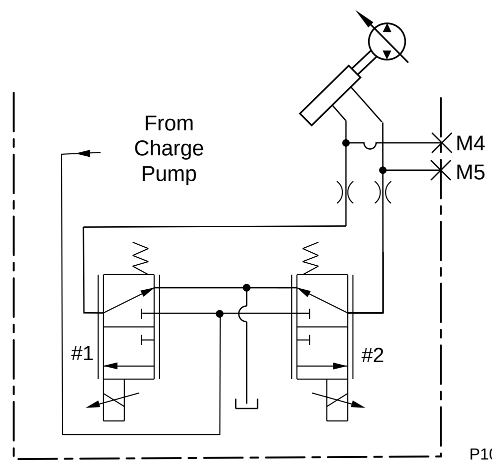
Pump Flow Direction with NFPE Control				
	Input Shaft Rotation			
	CW		CCW	
Higher Pressure into Control Port:	A	B	A	B
Port A Flow	In	Out	Out	In
Port B Flow	Out	In	In	Out
High Servo Gauge Port	M4	M5	M4	M5

Refer to pump outline drawings for port locations.



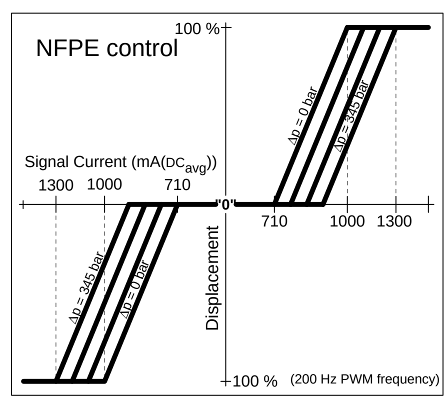
P100 415

NFPE Control on Series 42 Pump



P100 416E

NFPE Hydraulic Schematic



P100 417E

NFPE Pump Displacement vs Input Signal

NFPE Connectors	
Connector	Mating Parts Kit Part No. (Ident No.)
AMP Junior Power Timer	K19815 (508388)

Three-Position Electric Displacement Control • FNR

(Outline dimensions on p. 49)

The Three-Position Electric Displacement Control (FNR) uses a solenoid-operated 3-position, 4-way valve to control pump displacement from “neutral” to maximum displacement in either direction.

When a solenoid is energized, charge pressure is directed to one end of the pump servo control cylinder, which results in the pump going to maximum displacement. The direction of pump output flow is determined by which solenoid is energized (see the accompanying table).

Features and Benefits of FNR Control

- Electronic control.
- If voltage is lost, the control returns pump to neutral.
- If charge pressure is lost, the control returns to neutral.
- Simple, low-cost design.
- Ideal for applications that do not require proportional control.

Input Signal Requirements

The solenoids are available in versions for 12 or 24 VDC. Maximum power consumption is 30 Watts. They are available with terminals for a DIN 43650 connector or with a Packard Weather-Pack 2-way sealed connector. An AMP Jr Power Timer connector is also available.*

Pump Flow Direction with FNR Control

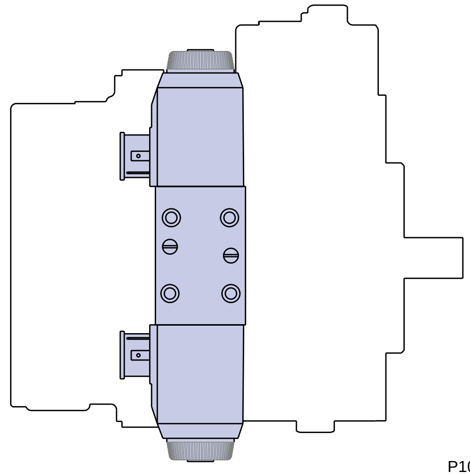
	Input Shaft Rotation			
	CW		CCW	
Solenoid Energized:	2	1	2	1
Port A Flow	Out	In	In	Out
Port B Flow	In	Out	Out	In
Hi Servo Gauge Port	M4	M5	M4	M5

Refer to pump outline drawings for port locations.

FNR Connectors

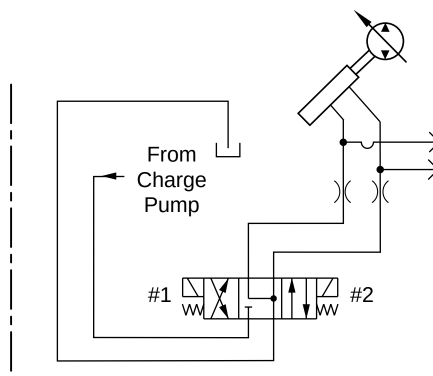
Connector	Mating Parts Kit Part No. (Ident No.)
DIN 46350	K09129 (514117)
Packard Weather Pack 2-Way Shroud	K03383
AMP Junior Power Timer*	K19815 (508388)

*Special temperature requirements, consult Sauer-Sundstrand.



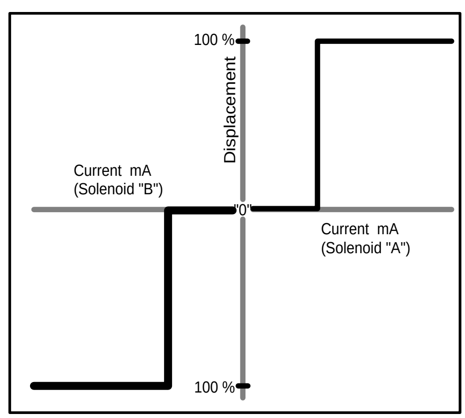
P100 418

FNR on Series 42 Pump



P100 419E

FNR Hydraulic Schematic



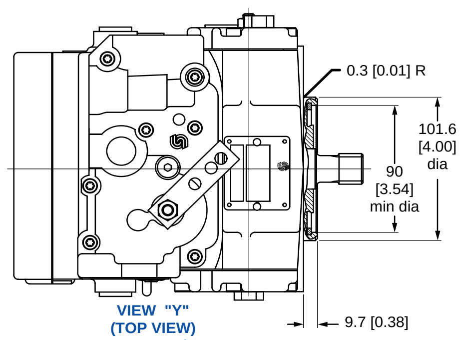
P100 420E

Pump Displacement vs Electrical Signal

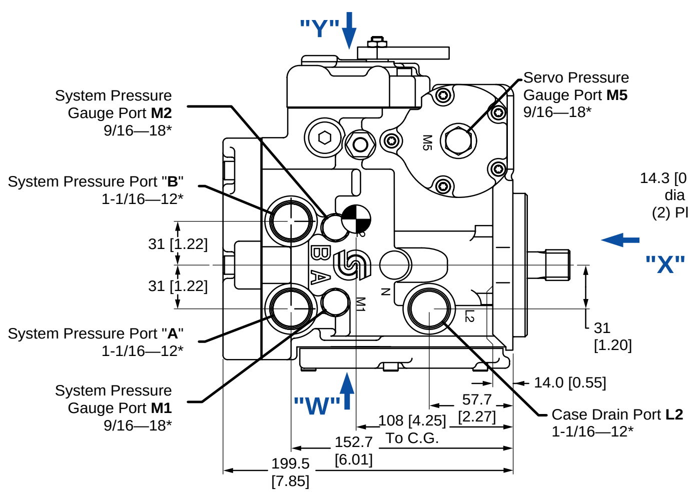
Series 42 PV - General Dimensions • 28 cm³ Frame Size

28 cm³ PV: Base Unit with MDC

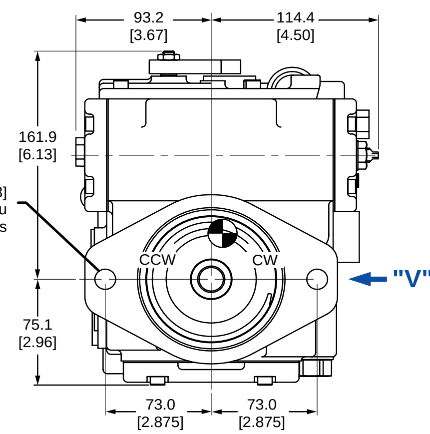
mm
[in]



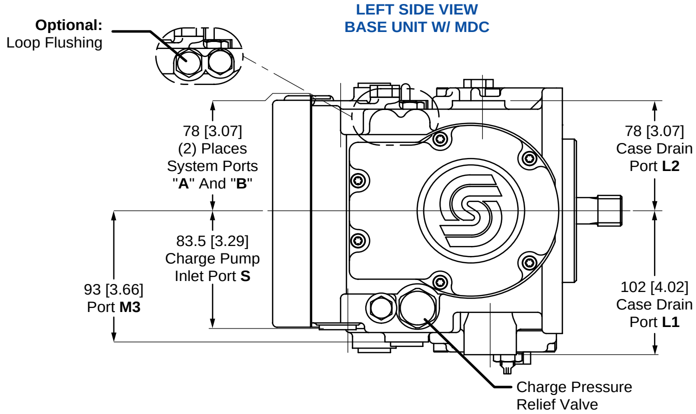
VIEW "Y"
(TOP VIEW)
BASE UNIT W/ MDC



LEFT SIDE VIEW
BASE UNIT W/ MDC



VIEW "X"
(FRONT VIEW)
BASE UNIT W/ MDC

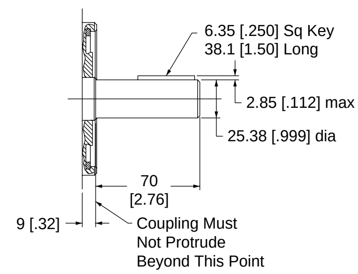


VIEW "W"
(BOTTOM VIEW)
BASE UNIT W/ MDC AND SUCTION FILTRATION

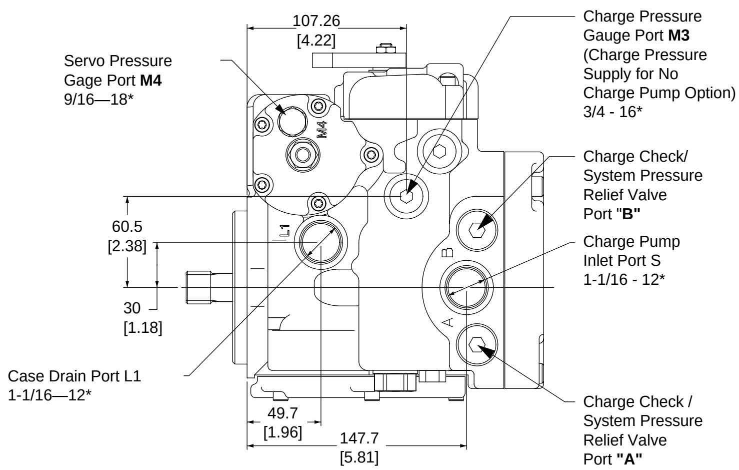
P100 421E

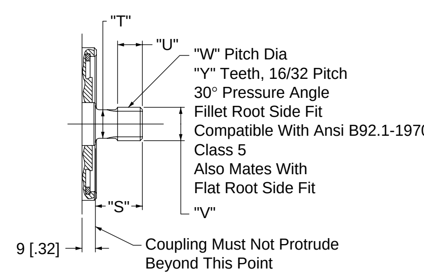
28 cm³ PV: Shaft Options

mm
[in]



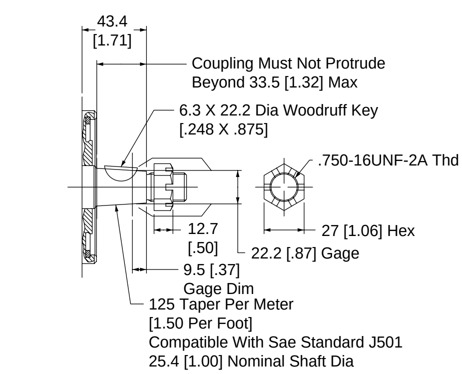
STRAIGHT KEY SHAFT CONFIGURATION





SPLINED
SHAFT CONFIGURATION (SEE TABLE)

VIEW "V"
(RIGHT SIDE VIEW)
BASE UNIT W/ MDC AND SUCTION FILTRATION



Splined Input Shaft Options					
Max. Coupling Engagement S	Max. Shaft Diameter T	Full Spline Length U	Major Diameter V	Pitch Diameter W	Number Of Teeth Y
32.6 [1.29]	19 [0.75]	16.7 [0.66]	22.16 [0.872]	20.638 [0.8125]	13
38 [1.50]	22 [0.87]	23.5 [0.92]	25.34 [0.998]	23.813 [0.9375]	15

TAPERED
SHAFT CONFIGURATION

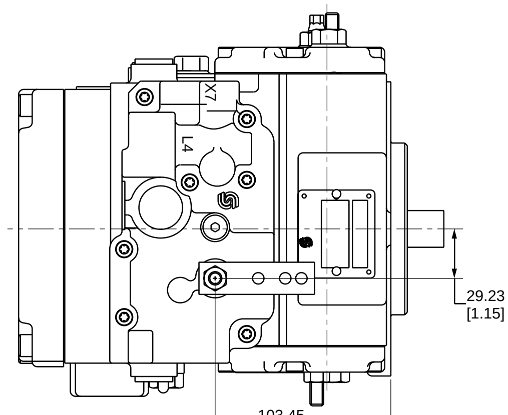
P100 422E

*All SAE straight thread O-ring ports per SAE J1926, unless otherwise specified
Shaft rotation is determined by viewing pump from input shaft end.
Contact your Sauer-Sundstrand representative for specific installation drawings.

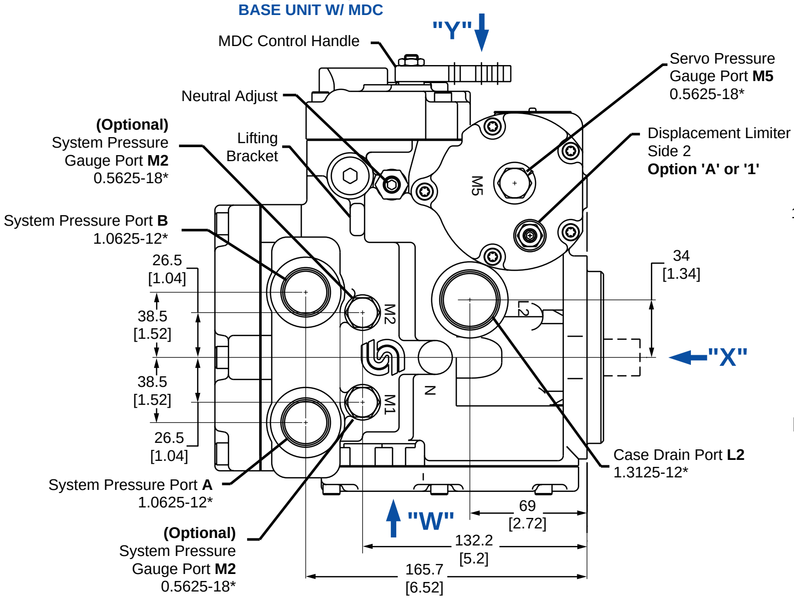
Series 42 PV - General Dimensions • 41 cm³ Frame Size

41 cm³ PV: Base Unit with MDC

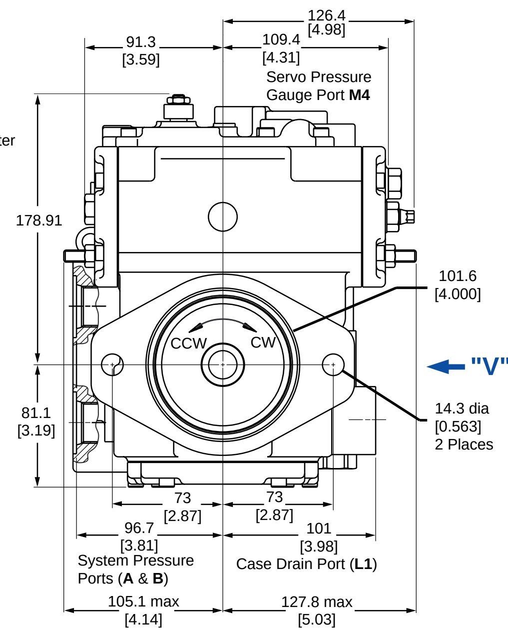
mm
[in]



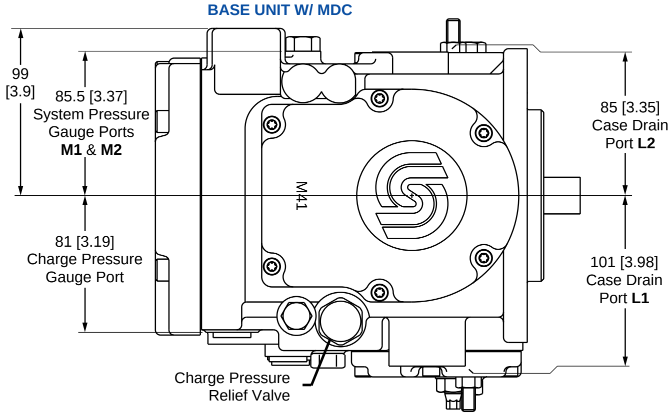
VIEW "Y"
(TOP VIEW)
BASE UNIT W/ MDC



LEFT SIDE VIEW
BASE UNIT W/ MDC



VIEW "X"
(FRONT VIEW)
BASE UNIT W/ MDC



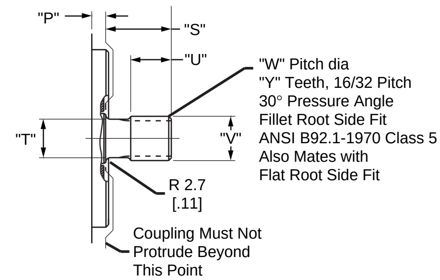
VIEW "W"
(BOTTOM VIEW)
BASE UNIT W/ MDC AND SUCTION FILTRATION

P100 423E

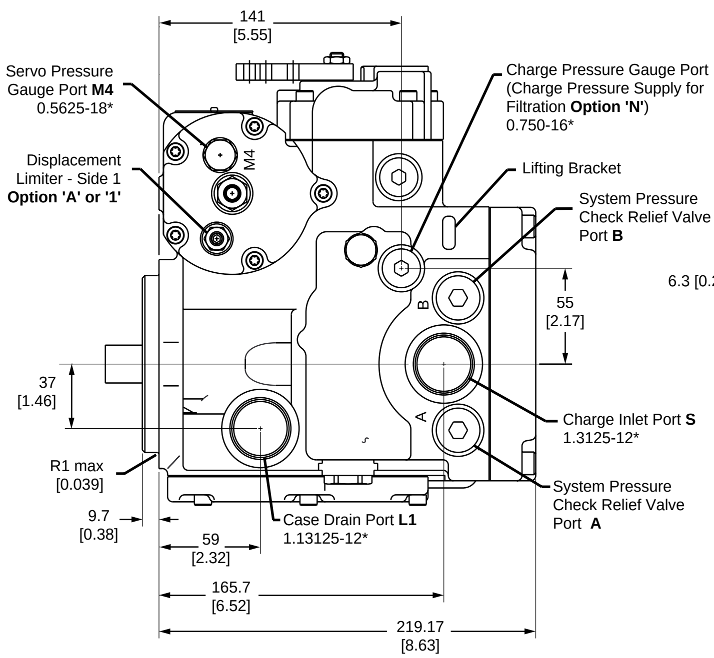
41 cm³ PV: Shaft Options

Splined Input Shaft Options							
	Mounting Face Dim. P	Max. Coupling Engagement S	Shaft Diameter T	Full Spline Length U	Major Diameter V	Pitch Diameter W	Number of Teeth Y
Option C	8 [0.32]	32.6 [1.29]	19.13 [0.753]	16.7 [0.66]	22.16 [0.872]	20.638 [0.8125]	13
Option D	8 [0.32]	38 [1.5]	22.13 [0.87]	23.5 [0.92]	23.34 [0.998]	23.813 [0.9375]	15
Option E	8.5 [0.34]	55 [2.17]	27.83 [1.1]	33.8 [1.33]	31.24 [1.23]	30.163 [1.1875]	19

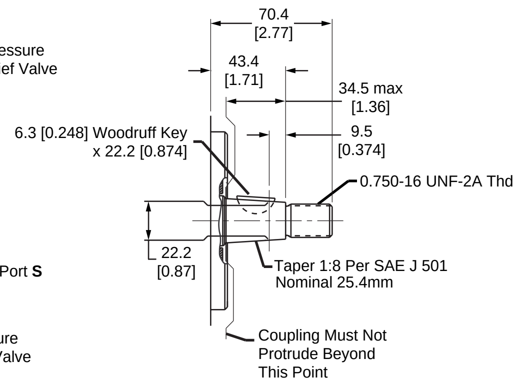
mm
[in]



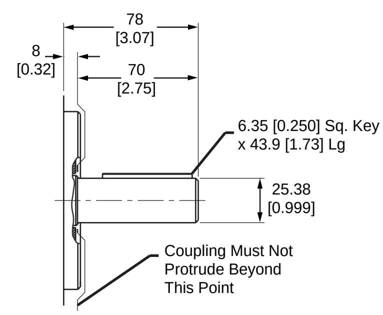
SPLINED
SHAFT CONFIGURATION (SEE TABLE)



VIEW "V"
(RIGHT SIDE VIEW)
BASE UNIT W/ MDC AND SUCTION FILTRATION)



TAPERED
SHAFT: OPTION K



STRAIGHT KEYED
SHAFT: OPTION G

P100 424E

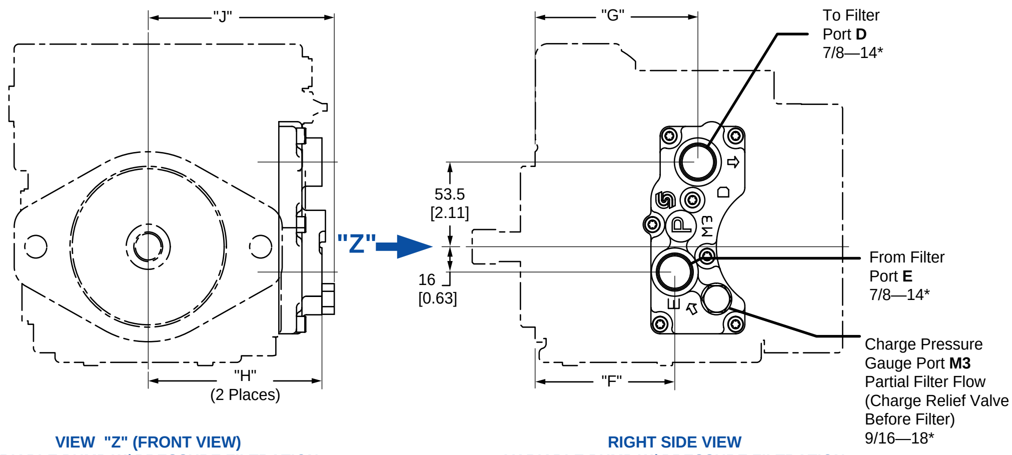
*All SAE straight thread O-ring ports per SAE J1926, unless otherwise specified
Shaft rotation is determined by viewing pump from input shaft end.
Contact your Sauer-Sundstrand representative for specific installation drawings.

Filtration Options - Dimensions • All Frame Sizes

mm
[in]

Dimensions	Frame Size	
	28 cm³	41 cm³
F	91.2 [3.59]	101.5 [4.00]
G	105.7 [4.16]	116 [4.57]
H	112.4 [4.43]	117.9 [4.64]
J	123.3 [4.88]	128.8 [5.07]

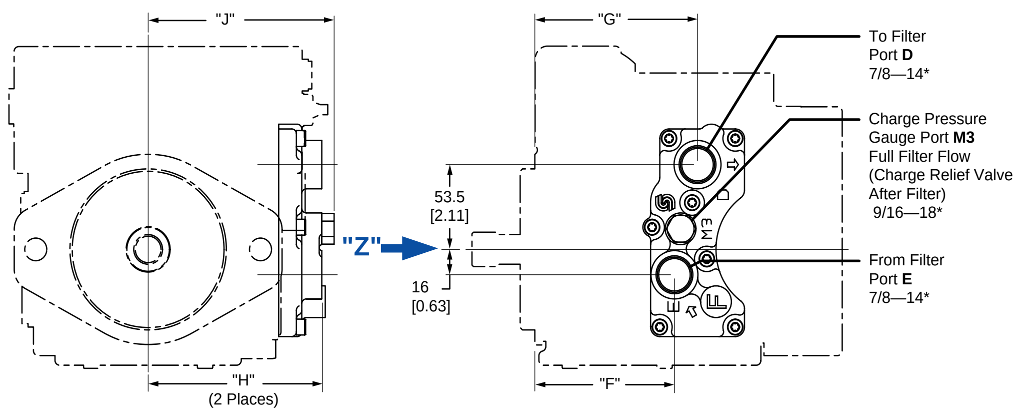
Charge Pressure Filtration — Partial Filter Flow



VIEW "Z" (FRONT VIEW)
VARIABLE PUMP W/ PRESSURE FILTRATION

RIGHT SIDE VIEW
VARIABLE PUMP W/ PRESSURE FILTRATION

Charge Pressure Filtration — Full Filter Flow



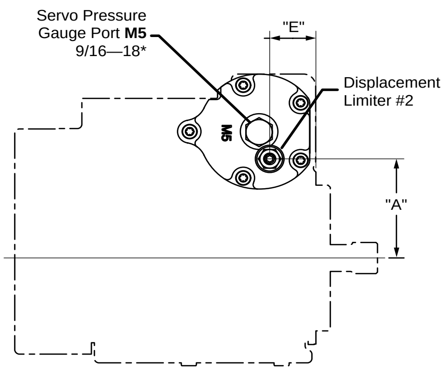
VIEW "Z" (FRONT VIEW)
VARIABLE PUMP W/ PRESSURE FILTRATION

RIGHT SIDE VIEW
VARIABLE PUMP W/ PRESSURE FILTRATION

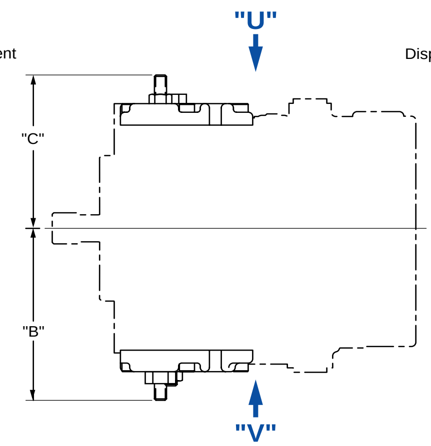
P100 425E

Displacement Limiter Options - Dimensions • All Frame Sizes

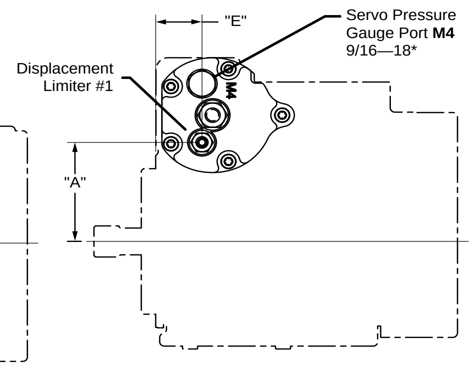
mm
[in]



VIEW "U"
(LEFT SIDE VIEW)
VARIABLE PUMP W/ DISPLACEMENT LIMITER

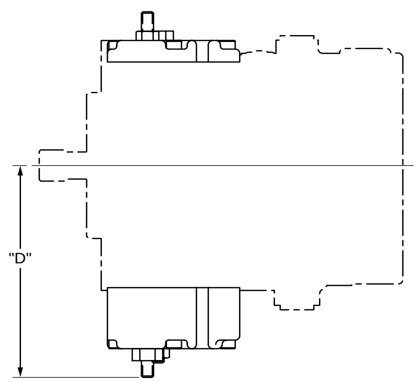


TOP VIEW
VARIABLE PUMP W/ DISPLACEMENT LIMITERS



VIEW "V"
(RIGHT SIDE VIEW)
VARIABLE PUMP W/ DISPLACEMENT LIMITER

Dimension	Frame Size	
	28 cm³	41 cm³
A	69 [2.72]	72 [2.83]
B	120.1 max [4.73]	127.8 max [5.03]
C	107.1 max [4.22]	105.1 max [4.14]
D	144.5 max [5.69]	159.6 max [6.28]
E	30.6 [1.20]	33.6 [1.32]



TOP VIEW
VARIABLE PUMP W/ NFPH OR NFPE CONTROL AND DISPLACEMENT LIMITERS

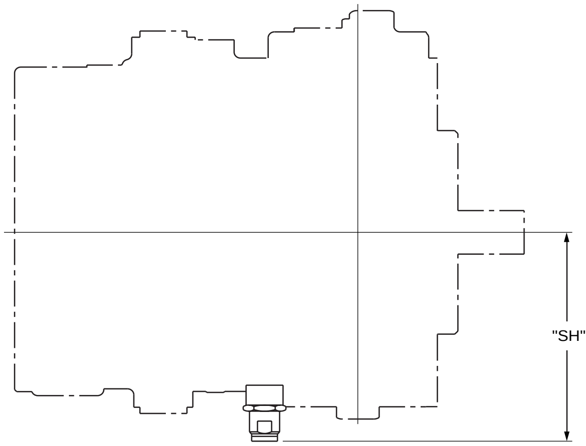
Optional Adjustable Displacement Limiters				
Shaft Rotation	CW		CCW	
Displacement Limiter#	1	2	1	2
Limits Flow Out Port	B	A	A	B

P100 426E

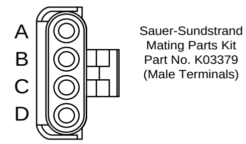
*All SAE straight thread O-ring ports per SAE J1926, unless otherwise specified
Shaft rotation is determined by viewing pump from input shaft end.
Contact your Sauer-Sundstrand representative for specific installation drawings.

Speed Sensor Option* - Dimensions • All Frame Sizes

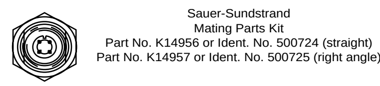
mm
[in]



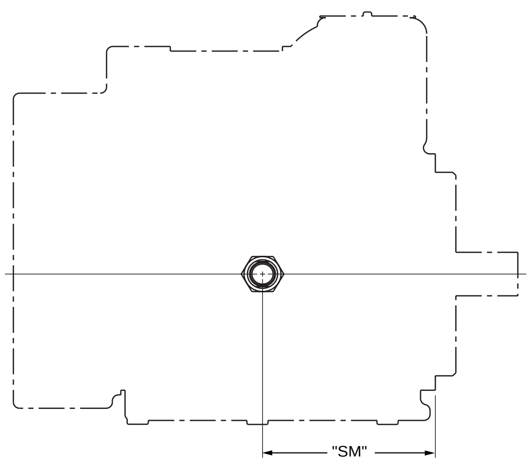
TOP VIEW



Packard Weather-Pack 4-Way Tower Connector
(Female Terminals)



Turck Eurofast 4 Pin Connector



LEFT SIDE VIEW

Speed Sensor Height		
	"SH"	"SM"
28cm³	104.24 [4.1]	81.7 [3.2]
41cm³	107.84 [4.2]	89.35 [3.5]

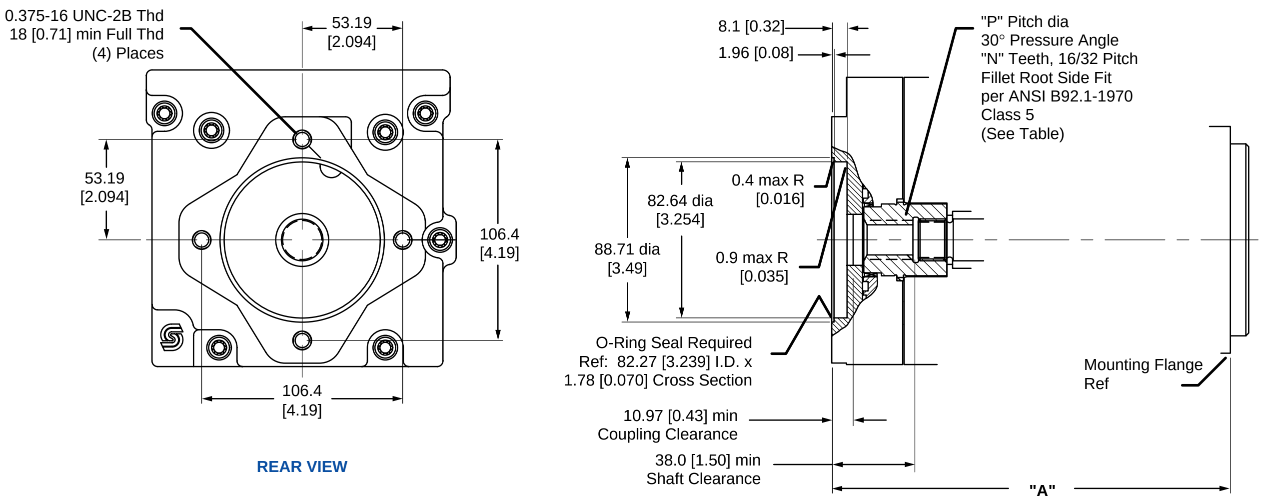
P100 427E

* Contact your Sauer-Sundstrand representative for availability

Auxiliary Mounting Pads - Dimensions • All Frame Sizes

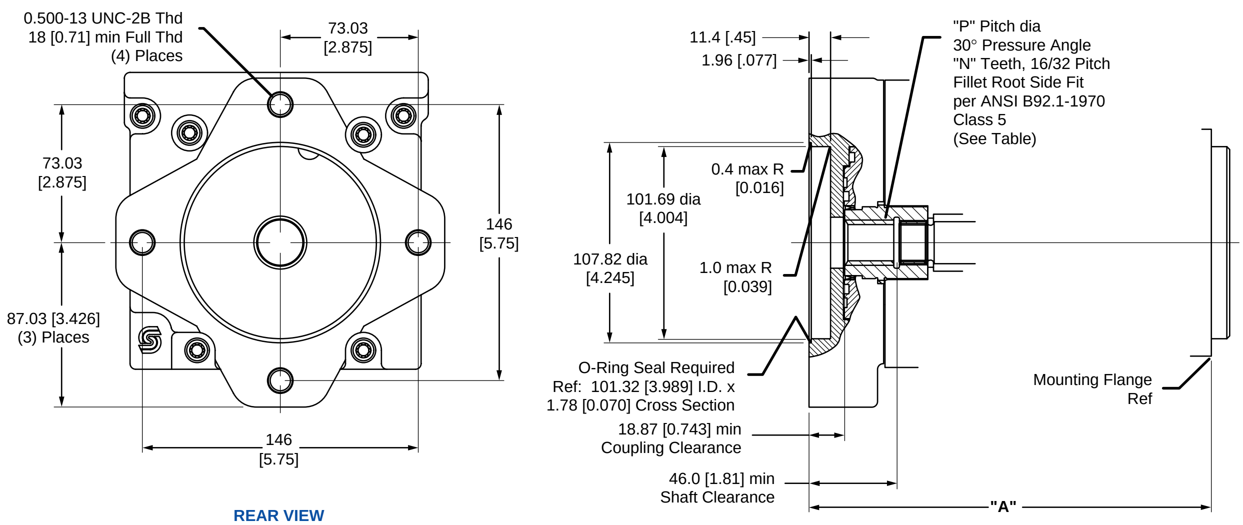
SAE “A” Auxiliary Mounting Pad

mm
[in]



P100 428E

SAE “B” Auxiliary Mounting Pad



P100 429E

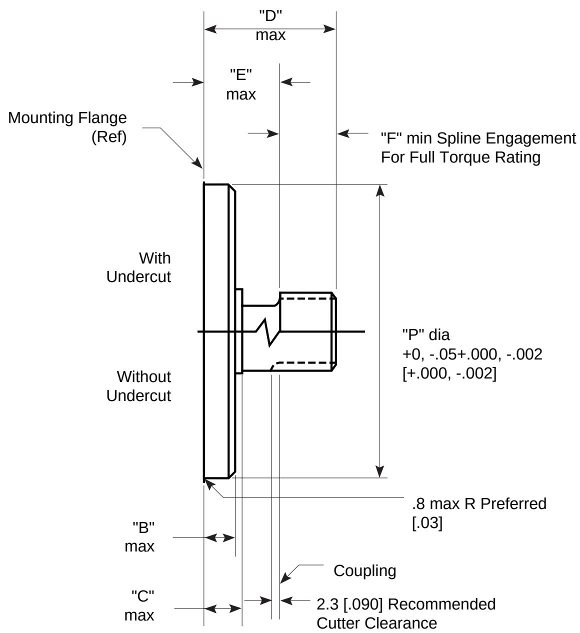
Auxiliary Mounting Flange and Coupling Options

Auxiliary Mounting Flange	Spline Pitch Dia. P	Number Of Teeth N	Frame Size Dimension "A"	
			28	41
SAE A	14.30 [0.563]	9	211.6 [8.33]	230.9 [9.02]
SAE A Option "T"	17.46 [0.688]	11	211.6 [8.33]	230.9 [9.02]
SAE B	20.64 [0.813]	13	213.3 [8.40]	232.6 [9.16]
SAE B Option "V"	23.81 [0.937]	15	213.3 [8.40]	232.6 [9.16]

*All SAE straight thread O-ring ports per SAE J1926, unless otherwise specified
Shaft rotation is determined by viewing pump from input shaft end.
Contact your Sauer-Sundstrand representative for specific installation drawings.

Auxiliary Pump Mating - Dimensions • All Frame Sizes

mm
[in]



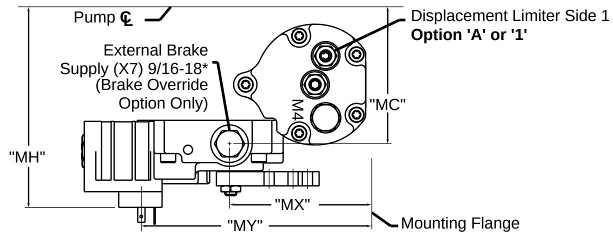
P100 430E

Auxiliary Pump Mating Dimensions						
Pad Size	"P"	"B"	"C"	"D"	"E"	"F"
SAE A	82.55 [3.250]	6.35 [0.250]	12.70 [0.500]	58.2 [2.29]	15.0 [0.59]	13.5 [0.53]
SAE B	101.60 [4.000]	9.65 [0.380]	15.2 [0.60]	53.1 [2.09]	17.5 [0.69]	14.2 [0.56]

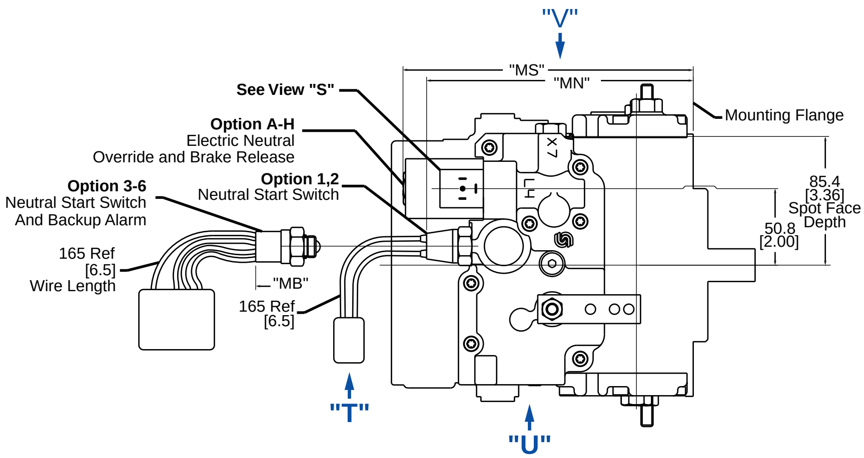
Control Modules - Dimensions • All Frame Sizes

Manual Displacement Control (MDC) Options - Dimensions

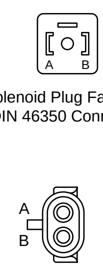
mm
[in]



VIEW "V"
(RIGHT SIDE VIEW)



TOP VIEW
VARIABLE PUMP W/ DISPLACEMENT LIMITERS



Sauer-Sundstrand
Mating Parts Kit
Part No. K09129
Ident. No. 514117

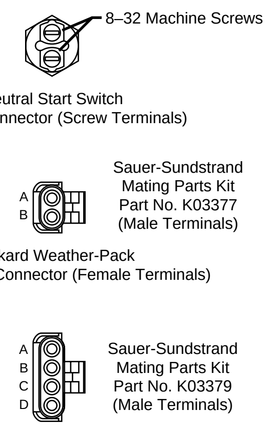
Solenoid Plug Face For
DIN 46350 Connector

Sauer-Sundstrand
Mating Parts Kit
Part No. K03383
(Female Terminals)

Packard Weather-Pack
2-Way Shroud Connector (Male Terminals)

VIEW "S"
ELECTRIC NEUTRAL OVERRIDE AND BRAKE
RELEASE CONNECTORS

Manual Displacement Control										
Frame Size	"MB"	"MC"	"MH"	"MN"	"MS"	"MX"	"MY"	"HB"	"HH"	"CH"
28 cm³	177.4 [6.98]	127.2 [5.01]	169.4 [6.67]	175.4 [6.91]	192.7 [7.58]	94.3 [3.71]	152.8 [6.02]	156.4 [6.16]	163 [6.42]	166.1 [6.54]
41 cm³	187.4 [7.38]	144.2 [5.68]	186.4 [7.34]	185.4 [7.30]	202.7 [7.98]	104.3 [4.11]	162.8 [6.41]	173.4 [6.83]	180 [7.09]	183.1 [7.21]



Neutral Start Switch
With No Connector (Screw Terminals)

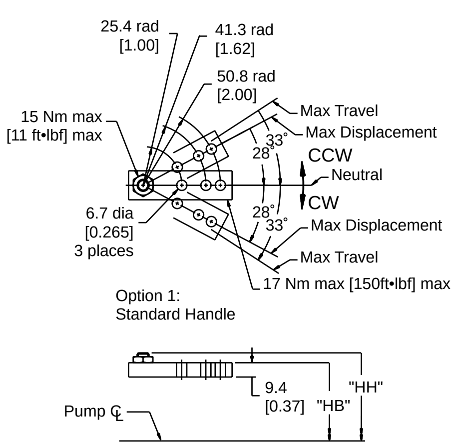
Sauer-Sundstrand
Mating Parts Kit
Part No. K03377
(Male Terminals)

Packard Weather-Pack
2-Way Tower Connector (Female Terminals)

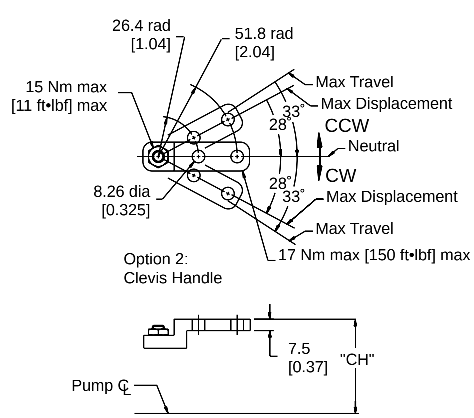
Sauer-Sundstrand
Mating Parts Kit
Part No. K03379
(Male Terminals)

Packard Weather-Pack
4-Way Tower Connector (Female Terminals)

VIEW "T"
NEUTRAL START
SWITCH CONNECTORS



Option 1:
Standard Handle

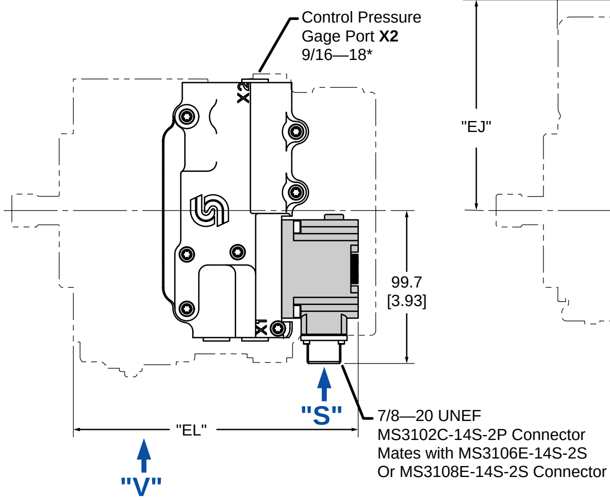


Option 2:
Clevis Handle

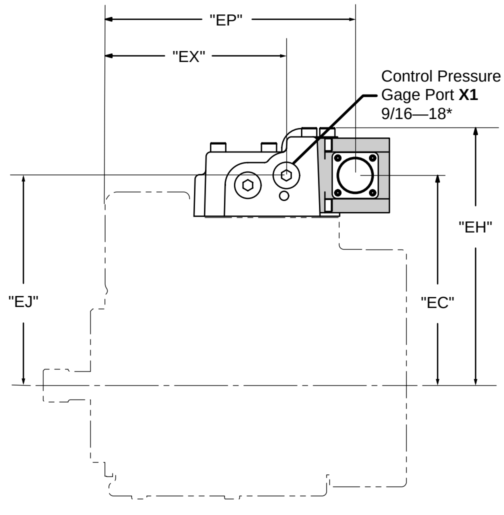
P100 431E

Electric Displacement Control (EDC) Options - Dimensions

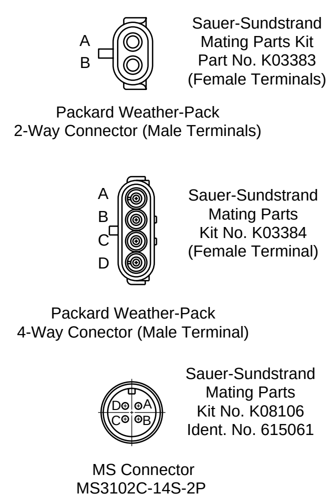
mm
[in]



TOP VIEW
VARIABLE PUMP W/ EDC
MS CONNECTOR



VIEW "V"
RIGHT SIDE VIEW
VARIABLE PUMP W/ EDC
MS CONNECTOR

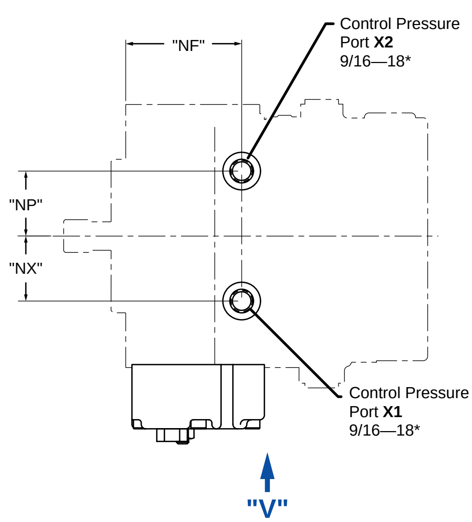


VIEW "S"
EDC CONNECTORS

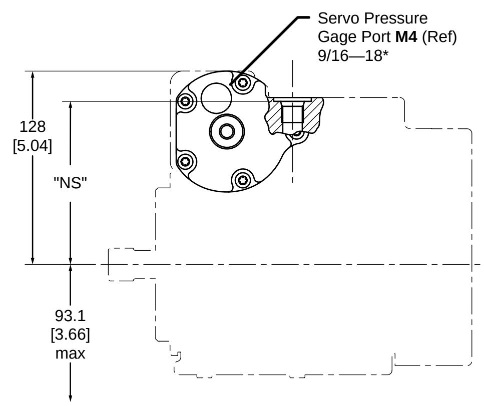
P100 432E

Electrical Displacement Control						
Frame Size	"EC"	"EH"	"EJ"	"EL"	"EP"	"EX"
28 cm³	138.7 [5.46]	170.2 [6.70]	138.7 [5.46]	188 [7.40]	165.7 [6.52]	119.9 [4.72]
41 cm³	155.7 [6.13]	187.2 [7.37]	155.7 [6.13]	198 [7.80]	175.7 [6.92]	129.9 [5.11]

Non-Feedback Proportional Hydraulic Control (NFPH) Options - Dimensions



TOP VIEW
VARIABLE PUMP W/ NFPH CONTROL



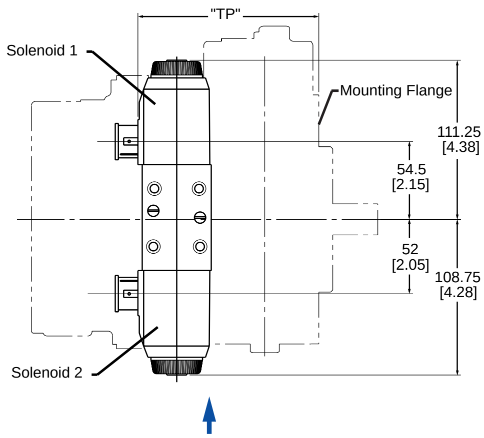
VIEW "V"
(RIGHT SIDE VIEW)
VARIABLE PUMP W/ NFPH CONTROL

P100 433E

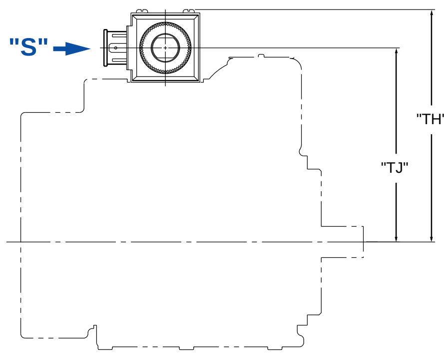
Non-Feedback Proportional Control				
Frame Size	"NF"	"NS"	"NP"	"NX"
28 cm³	76.6 [3.02]	111.3 [4.38]	43 [1.69]	56 [2.20]
41 cm³	84.6 [3.33]	128.3 [5.05]	41 [1.61]	64 [2.52]

Three - Position Electric Control (FNR) Options - Dimensions

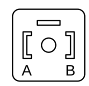
mm
[in]



TOP VIEW
VARIABLE PUMP W/ FNR CONTROL

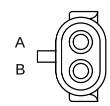


VIEW "U"
(LEFT SIDE VIEW)



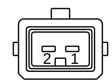
Sauer-Sundstrand Mating Parts Kit Part No. K09129 Ident. No. 514117

Solenoid Plug Face for DIN 46350 Connector



Sauer-Sundstrand Mating Parts Kit Part No. K03383 (Female Terminals)

Packard Weather-Pack 2-Way Shroud Connector (Male Terminals)



Sauer-Sundstrand Mating Parts Kit No. K19815 Ident. No. 508388 (Female Terminal)

AMP Junior Power Timer* 2 Pin Connector (Male Terminal)

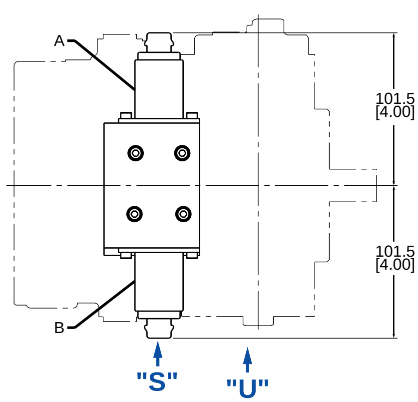
VIEW "S"
FNR CONNECTORS

3-Position (FNR) Control			
Frame Size	"TP"	"TH"	"TJ"
28 cm³	130.5 [5.14]	162 [6.38]	135.3 [5.33]
41 cm³	138.2 [5.44]	179.6 [7.07]	152.9 [6.02]

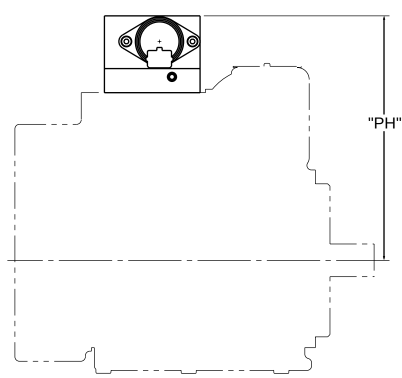
* Special temperature requirements, see your Sauer-Sundstrand representative when considering this option

P100 434E

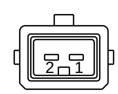
Electric Non-Feedback Proportional Control (NFPE) Options - Dimensions



TOP VIEW
VARIABLE PUMP W/ NFPE CONTROL



VIEW "U"
(LEFT SIDE VIEW)



Sauer-Sundstrand Mating Parts Kit No. K19815 Ident. No. 508388 (Female Terminal)

AMP Junior Power Timer 2 Pin Connector (Male Terminal)

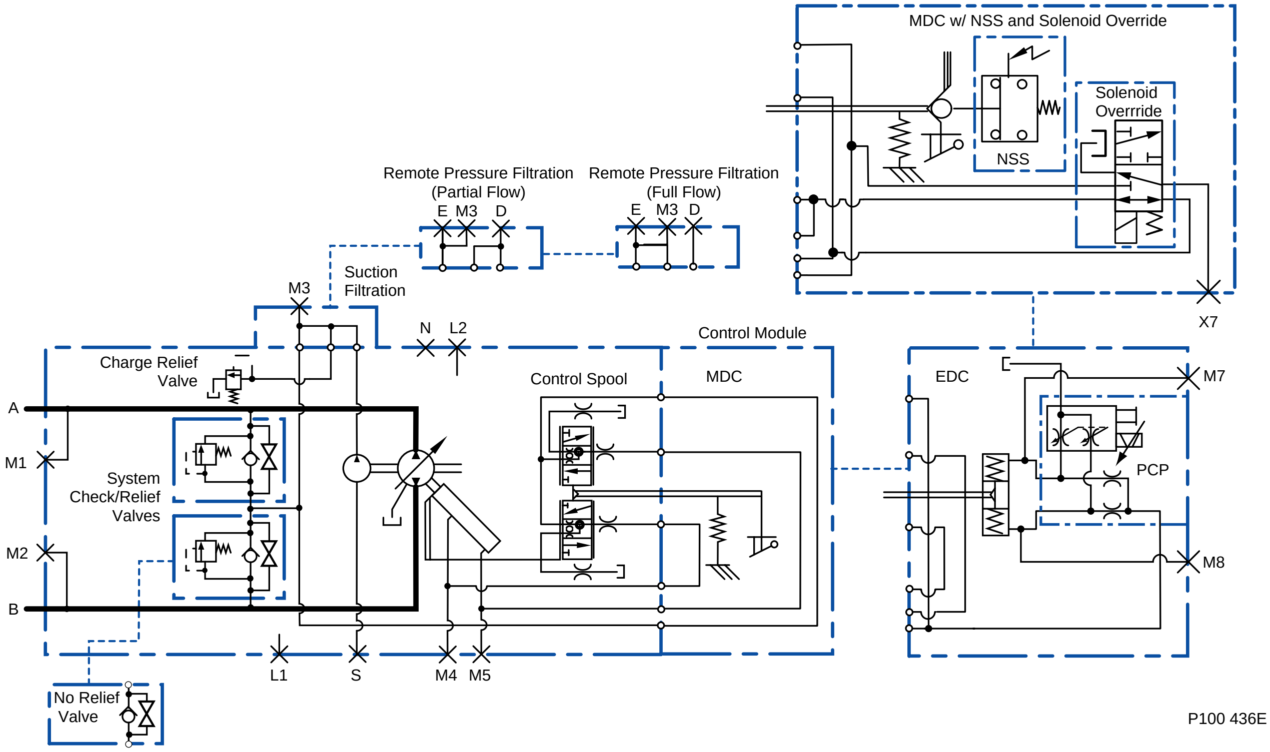
VIEW "S"
NFPE CONNECTOR

Manifold Height	
Frame Size	"PH"
28 cm³	162.3 [6.39]
41 cm³	179.3 [7.06]

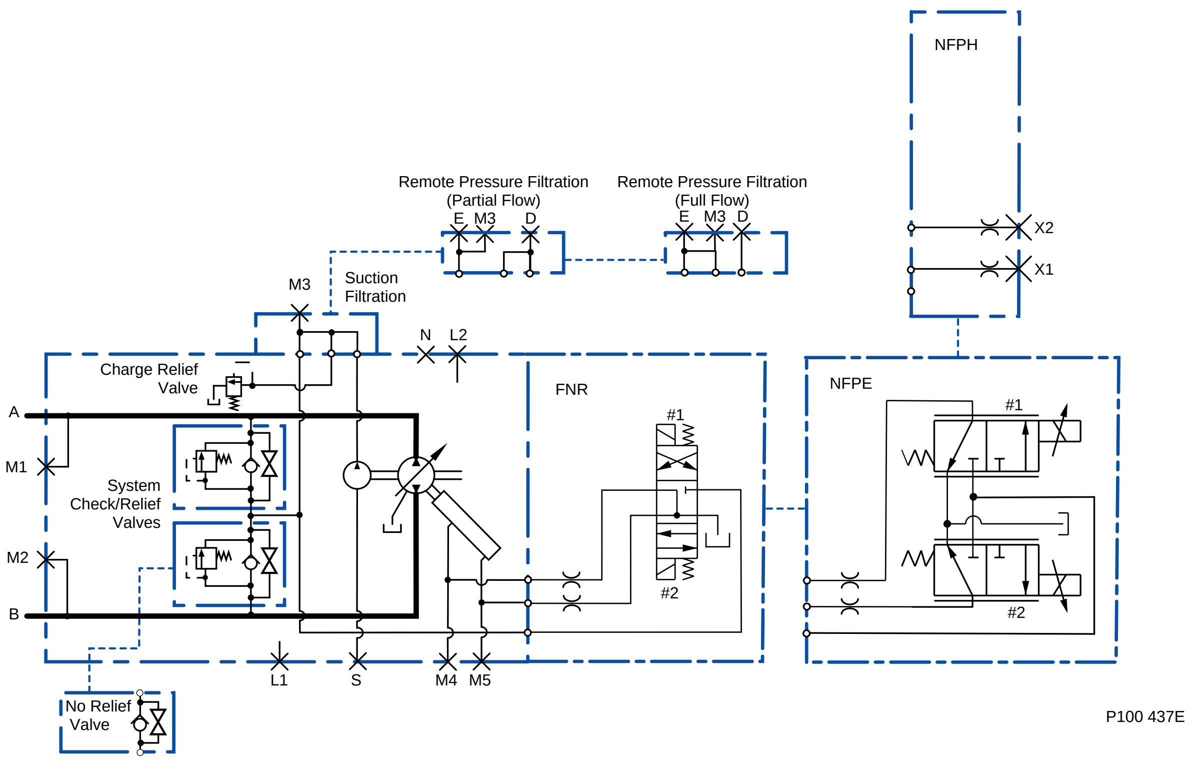
P100 435E

Contact your Sauer-Sundstrand representative for specific installation drawings.

Series 42 Pump Schematics



Series 42 Feedback Controls



Series 42 Non-Feedback Controls

Notes

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SAUER-SUNDSTRAND Hydraulic Power Systems - Market Leaders Worldwide

SAUER-SUNDSTRAND is a world leader in the design and manufacture of Hydraulic Power Systems. Research and development resources in both North America and Europe enable SAUER-SUNDSTRAND to offer a wide range of design solutions utilizing hydraulic power system technology.

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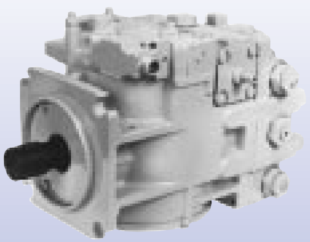
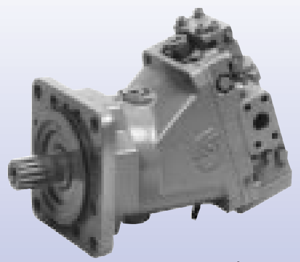
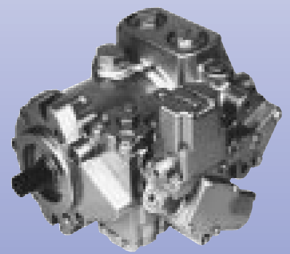


Heavy Duty Axial Piston
Pumps and Motors

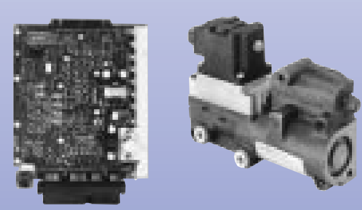


Heavy Duty Bent Axis
Variable Motors

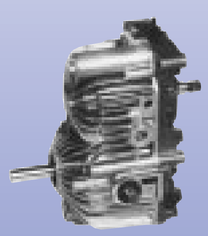
Cartridge Motors/
Compact Wheel Drives



Medium Duty Axial Piston
Pumps and Motors

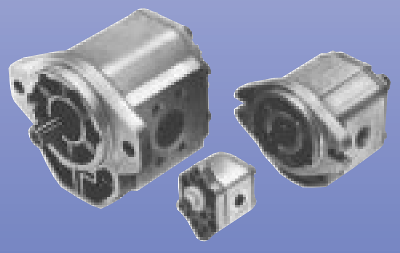


Microcontrollers and
Electrohydraulic Controls



Hydrostatic Transmission
Packages

Open Circuit Axial Piston Pumps



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Krokamp 35 • D-24539 Neumünster • Germany
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