X3 axial piston pump

X3 single pump

X3 back-to-back pump

Powering Business Worldwide

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Introduction

In axial piston pumps, the pistons reciprocate parallel to the axis of rotation of the cylinder block. The simplest type of axial piston pump is the swash plate in-line design.

The cylinder block in this pump is turned by the drive shaft. Pistons fitted in bores of the cylinder block are connected through piston shoes and a shoe plate, so the shoes bear against an angled swash plate causing the pistons to reciprocate. The ports are arranged in the valve plate so that the pistons pass the inlet as they are pulled out and pass the outlet as they are forced back in.

The displacement of axial piston pumps is determined by the size and number of pistons, as well as the stroke length, which is determined by the angle of the swash plate.

Variable displacement piston pumps are used in closed-loop systems either as a single or tandem pump. Oil is circulated by the pump to the motor and then returned directly back to the pump. A charge supply is used to supplement the closed-loop system with oil. The charge supply may be supplied by an internal charge pump (standard) or an external source.

Typical applications

Construction equipment

- Skid steer loaders
- Utility vehicles
- Directional drills
- Trenchers

Harvester equipment

- Combines
- Fruit or vegetable pickers
- Windrowers

Paving equipment

- Pavers
- Rollers

Materials handling

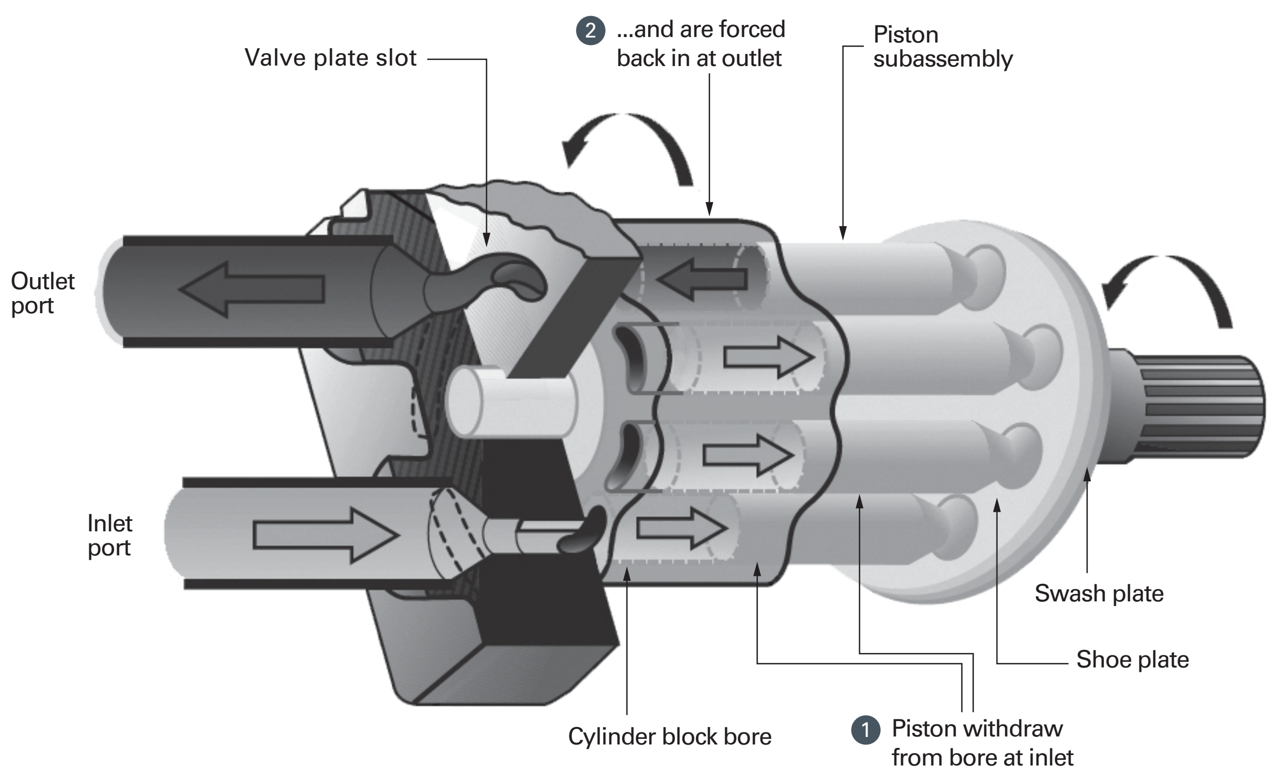
- Lift trucks
- Scissor lifts

Forestry equipment

- Log skidders
- Bark removers
- Limb removers

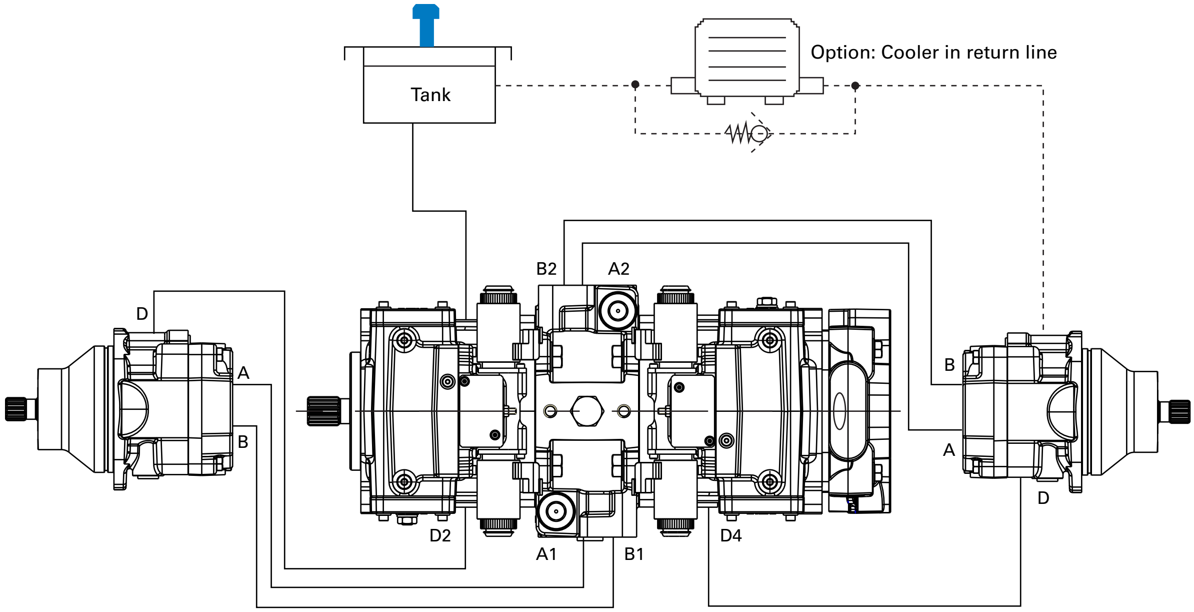
Turf care equipment

- Mowers

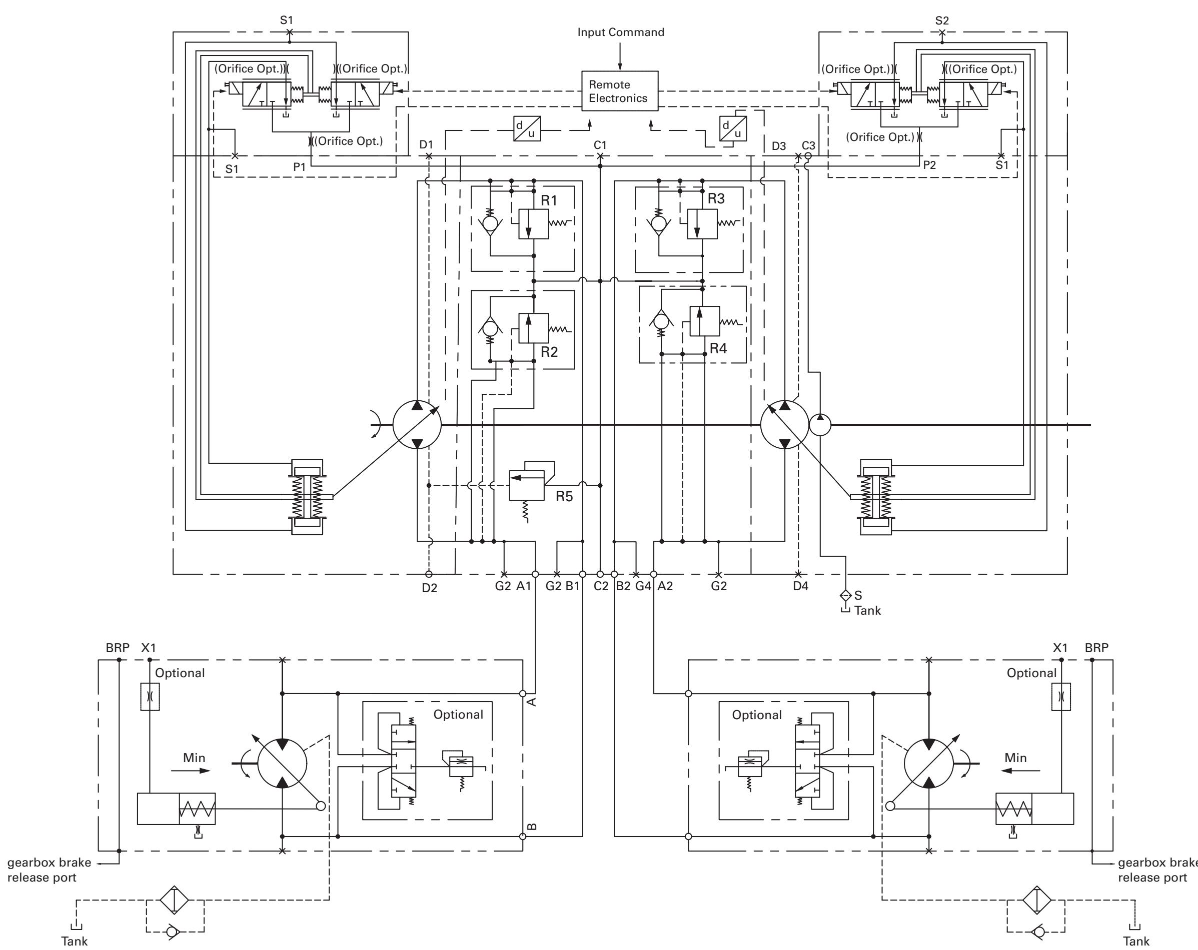


Closed-loop system

Functional diagram



Hydraulic schematic



Note: An alternative braking system independent of the hydraulic brake should be provided to ensure the stoppage and holding of the vehicle in the event of hydrostatic power loss.

Technical specifications

			X3 single	X3 B2B
Rated size	Maximum displacement	cm3/rev (in3/r)	40.6 (2.48), 49.2 (3.0)	40.6 (2.48), 49.2 (3.0)
Mount	Front mount flange	SAE	B	B
Flow	Flow @ rated speed & PSI	l/min (gal/min)	122 (32.2), 147.5(38.95)	122 (32.2), 147.5(38.95)
Speed	Rated speed Maximum speed	rpm	3000 3600	3000 3600
Pressure	Nominal pressure rating*	bar (psi)	345 (5000)	345 (5000)
	Peak pressure rating**	bar (psi)	380 (5500)	380 (5500)
Power	Max input torque (at nominal pressure and rated speed)	kw (HP)	84 (113), 102 (137)	84 (113), 102 (137)
		N-m (lbf-in)	338 (2991)	338 (2991)
	Continuous allowable case pressure	bar (psi)	1.72 (25)	1.72 (25)
	Maximum intermittent case drain temperature	°C (°F)	107 (225)	107 (225)
	Weight with charge pump	kg (lbs)	38.5 (85)	68.5 (151)
	Integral charge pump displacements	cm3/rev (in3/r)	13.9 (0.85)	17.2 (1.05)
	Input shafts		Splined	Splined
	Auxiliary mounting options-SAE		A Pad (9T, 11T), B Pad (13T), B-B Pad (15T), A & B Pad with cover plate	A Pad (9T, 11T), B Pad (13T), A & B Pad with cover plate
	Controls		Manual control-standard, electronic displacement control (EDC), electronic displacement control with feedback (EDCF)	Manual control-standard, electronic displacement control (EDC), electronic displacement control with feedback (EDCF)
	Main ports		Same side	Same side
	Additional options		Swash position sensor, bypass valve, de-stroke valve#, IPOR	Swash position sensor, bypass valve#, de-stroke valve#

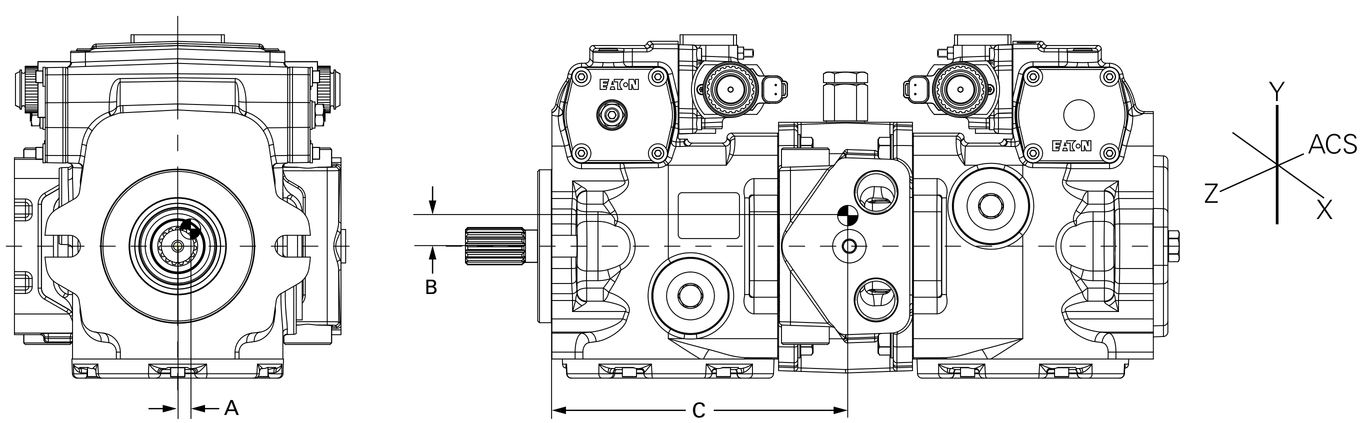
* Nominal pressure: Max system pressure at which component fatigue does not occur (pump life estimated by bearing life).

** Peak pressure: Max operation pressure which is permissible for a short duration of time (t < 1 sec).

*** Please contact Eaton representative for specific requirements.

Available on request

Centre of gravity



Dimension - mm (inch)	Single w/o charge pump	Single with charge pump	B2B w/o charge pump	B2B with charge pump
A	-0.2312(-0.0091)	-0.2340(-0.0092)	0.15 (0.0060)	0.12 (0.0047)
B	86 (3.3858)	85.91 (3.3823)	17.22 (0.6781)	16.50 (0.6495)
C	-116.60 (-4.5906)	-116.70 (4.5945)	-201.35 (-7.9274)	-215.56 (-8.4867)

Features and benefits

A Housing

- Compact
- Durable cast iron design
- Multiple drain options
- Improved serviceability
- Improved side load capacity

B Rotating group

- 40.6 cm3/r [2.48 in3/r]
- 49.2 cm3/r [3.00 in3/r]

C Controls

- Electronic displacement control
  - Without feedback (EDC)
  - With feedback (EDCF)
  - Patented design with best-in-class hysteresis
  - Pro-FX ready for seamless integration
  - Electronic protected (within envelope)
- Standard manual control (SMC)

D Valve plate

- Quieter operation
- Improved serviceability
- Improved mechanical efficiency

E Gerotor charge pump

- 13.9 cm3/r [0.85 in3/r] for single pump
- 17.2 cm3/r [1.05 in3/r] for B2B pump

F Charge pressure relief valve

- 17.2-20.7 bar [250-300 lbf/in2]
- 20.7-24.1 bar [300-350 lbf/in2]

G Auxiliary pump mounting flange

- SAE " A" or "B"

H High-pressure relief valve

- 104 to 345 bar [1500 to 5000 psi]

I Roller swash bearings

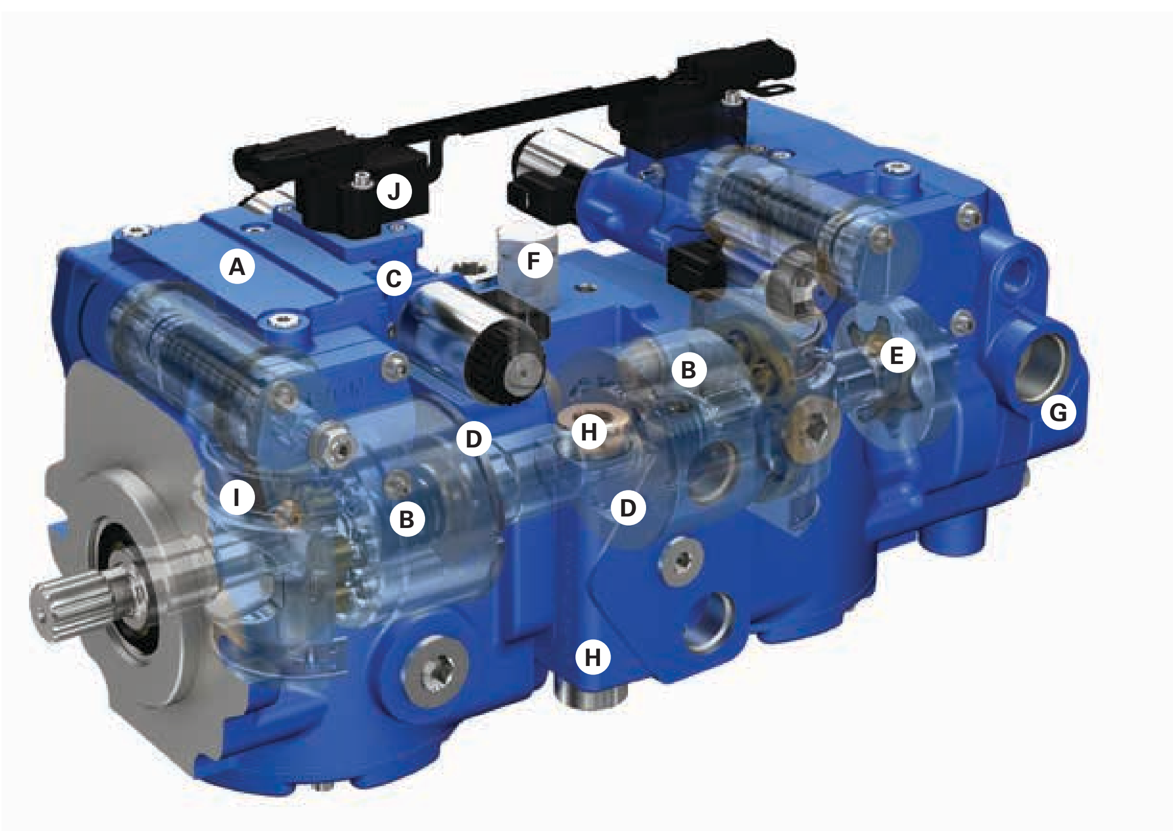
- Smooth functioning
- Improved control stability

J Swash position sensor

- Precise feedback
- Better efficiency

K IPOR valve

X3 B2B



Model code - Single pump

Ordering Instructions: The Model X3 servo controlled piston pumps are selected by using the following model code system tailoring the pump configuration to the requirement. Once a pump is built from the model code, a product number will be assigned to that configuration and the pump identified.

Make sure all positions are selected within the 32-digit code for each pump ordered.

X3P	41	R	B	1	A	M1	0	0	0	A	A	F	F	A	3	B	00	00	00	1	B	00	A
1 2 3	4 5	6	7	8	9	10 11	12	13	14	15	16	17	18	19	20	21	22 23	24 25	26 27	28	29	30 31	32

Position 4,5 - Displacement

41 = 40.6 cc [2.48 in^3/r]

49 = 49.2 cc [3.00 in^3/r]

Position 6 - Rotation

L = Left hand rotation (CCW)

R = Righthand rotation (CW)

Position 7 - Mounting flange

B = SAE J744, 101-2 (B mount)

Position 8 - Input shaft

1 = Splined 15 tooth 16/32 DP

2 = Splined 14 tooth 12/24 DP

3 = Splined 13 tooth 16/32 DP

Position 9 - Porting

A = SAE O-ring ports (1.3125-12)
(if this option is called all ports on the pump will be SAE O-ring port)

B = ISO O-ring ports (M33X2)
(if this option is called all ports on the pump will be ISO O-ring port)

C = Split flange port

Position 10, 11 - Pump control

M1 = Standard manual

E1 = Electronic displacement control (EDC)

E2 = Electronic displacement control with swash sensor feedback (EDCF)

Position 12 - POR valve

0 = None

1 = POR Valve

Position 13 - Valving

0 = None

1 = Bypass valve

*2 = Destroke valve

*3 = Bypass and Destroke valve

Position 14 - Control solenoid

0 = None

1 = DEUTSCH / 12V

2 = DEUTSCH / 24V

Position 15 - Control supply orifice

0 = No control supply orifice

D = Diameter 0.9 mm [.04 inch]

F = Diameter 1.1 mm [.04 inch]

K = Diameter 1.6 mm [.06 inch]

Position 16 - Control servo orifices S1 & S2

0 = None

D = Diameter 0.9 mm [.04 inch]

F = Diameter 1.1 mm [.04 inch]

K = Diameter 1.6 mm [.06 inch]

Position 17 - System relief valve port A

A = 207 bar [3000 psi]

D = 259 bar [3750 psi]

G = 310 bar [4500 psi]

J = 345 bar [5000 psi]

Position 18 - System relief valve port B

A = 207 bar [3000 psi]

D = 259 bar [3750 psi]

G = 310 bar [4500 psi]

J = 345 bar [5000 psi]

Position 19 - Charge pump

0 = No charge pump

A = 13.9 cc [.85 in3/r] Charge pump

B = 13.9 cc [.85 in3/r] Charge pump with remote filter ports

Position 20 - Charge relief setting

0 = None

1 = 17.2-20.7 BAR [250-300 lbf/in2]

2 = 20.7-24.1 BAR [300-350 lbf/in2]

Position 21 - Auxiliary mounting

0 = None

A = SAE J744, 82-2 (A mount), with cover plate

B = SAE J744, 82-2 (A mount), Dual, 9T 16/32 DP

C = SAE J744, 82-2 (A mount), Dual, 11T 16/32 DP

D = SAE J744, 101-2 (B mount), with cover plate

E = SAE J744, 101-2 (B mount), Dual, 13T 16/32 DP

F = SAE J744, 101-2 (B-B mount), Dual, 15T 16/32 DP

Position 22, 23 - Displacement setting port A

00 = Catalog displacement

AA = Externally adjustable

Position 24, 25 - Displacement setting port B

00 = Catalog displacement

AA = Externally adjustable

Position 26, 27 - Special feature

00 = None

*AA = Quiet valve plate

Position 28 - Seal option

0 = Nitrile

1 = Viton

Position 29 - Paint

0 = Anti rust conservation oil

A = Primer per spec 209-13A

G = Blue primer per spec 209-13CD

Position 30, 31 - Identification

00 = Standard

Position 32 - Design code

A = A

* = Option available on request

Model code - Back-to-back pump

X3B	49	L	B	1	A	E1	0	1	2	0	B	J	J	49	E1	0	2	0	B	J	J	A	2
1 2 3	4 5	6	7	8	9	10 11	12	13	14	15	16	17	18	19 20	21 22	23	24	25	26	27	28	29	30

Position 4, 5 - Displacement (Front pump)

41 = 40.6 cc [2.48 in^3/r]

49 = 49.2 cc [3.00 in^3/r]

Position 6 - Rotation

L = Left hand rotation (CCW)

R = Righthand rotation (CW)

Position 7 - Mounting flange

B = SAE J744, 101-2 (B mount)

Position 8 - Input shaft

A = Splined 15T 16/32 DP, Extended

1 = Splined 15T 16/32 DP

2 = Splined 14T 12/24 DP

Position 9 - Porting

A = SAE O-ring ports (1.0625-12)
(if this option is called all ports on the pump will be SAE O-ring port)

B = ISO O-ring port (M27 X 2)
(if this option is called all ports on the pump will be ISO O-ring port)

Position 10, 11 - Pump control (Front pump)

M1 = Standard manual

E1 = Electronic displacement control (EDC)

E2 = Electronic displacement control with swash sensor feedback (EDCF)

Position 12 - POR setting (Front pump)

0 = None

Position 13 - Valving

0 = None

*1 = Bypass valve

*2 = Destroke valve

*3 = Bypass and destroke valve

Position 14- Control solenoid (Front pump)

0 = None

1 = DEUTSCH / 12V

2 = DEUTSCH / 24V

Position 15 - Control supply orifice (Front pump)

0 = No control supply orifice

D = Diameter 0.9 mm [.04 inch]

F = Diameter 1.1 mm [.04 inch]

K = Diameter 1.6 mm [.06 inch]

Position 16 - Control servo orifices S1 & S2 (Front pump)

0 = None

D = Diameter 0.9 mm [.04 inch]

F = Diameter 1.1 mm [.04 inch]

K = Diameter 1.6 mm [.06 inch]

Position 17 - System relief valve port A (Front pump)

A = 207 bar [3000 psi]

D = 259 bar [3750 psi]

G = 310 bar [4500 psi]

J = 345 bar [5000 psi]

Position 18 - System relief valve port B (Front pump)

A = 207 bar [3000 psi]

D = 259 bar [3750 psi]

G = 310 bar [4500 psi]

J = 345 bar [5000 psi]

Position 19, 20 - Displacement (Rear pump)

41 = 40.6 cc [2.48 in^3/r]

49 = 49.2 cc [3.00 in^3/r]

Position 21, 22 - Pump control (Rear pump)

M1 = Standard manual

E1 = Electronic displacement control (EDC)

E2 = Electronic displacement control with swash sensor feedback (EDCF)

Position 23 - POR setting (Rear pump)

0 = None

Position 24 - Control solenoid (Rear pump)

0 = None

1 = DEUTSCH / 12V

2 = DEUTSCH / 24V

Position 25 - Control supply orifice (Rear pump)

0 = No control supply orifice

D = Diameter 0.9 mm [.04 inch]

F = Diameter 1.1 mm [.04 inch]

K = Diameter 1.6 mm [.06 inch]

Position 26 - Control servo orifices S1 & S2 (Rear pump)

0 = None

D = Diameter 0.9 mm [.04 inch]

F = Diameter 1.1 mm [.04 inch]

K = Diameter 1.6 mm [.06 inch]

Position 27 - System relief valve port A (Rear pump)

A = 207 bar [3000 psi]

D = 259 bar [3750 psi]

G = 310 bar [4500 psi]

J = 345 bar [5000 psi]

Position 28 - System relief valve port B (Rear pump)

A = 207 bar [3000 psi]

D = 259 bar [3750 psi]

G = 310 bar [4500 psi]

J = 345 bar [5000 psi]

Position 29 - Charge pump

0 = No charge pump

A = 17.2cc [1.05in3/r] Charge pump

Position 30 - Charge relief setting

0 = None

1 = 17.2-20.7 bar [250-300 psi]

2 = 20.7-24.1 bar [300-350 psi]

Model code - Back-to-back pump

B	00	0	B	00	A
31	32 33	34	35	36 37	38

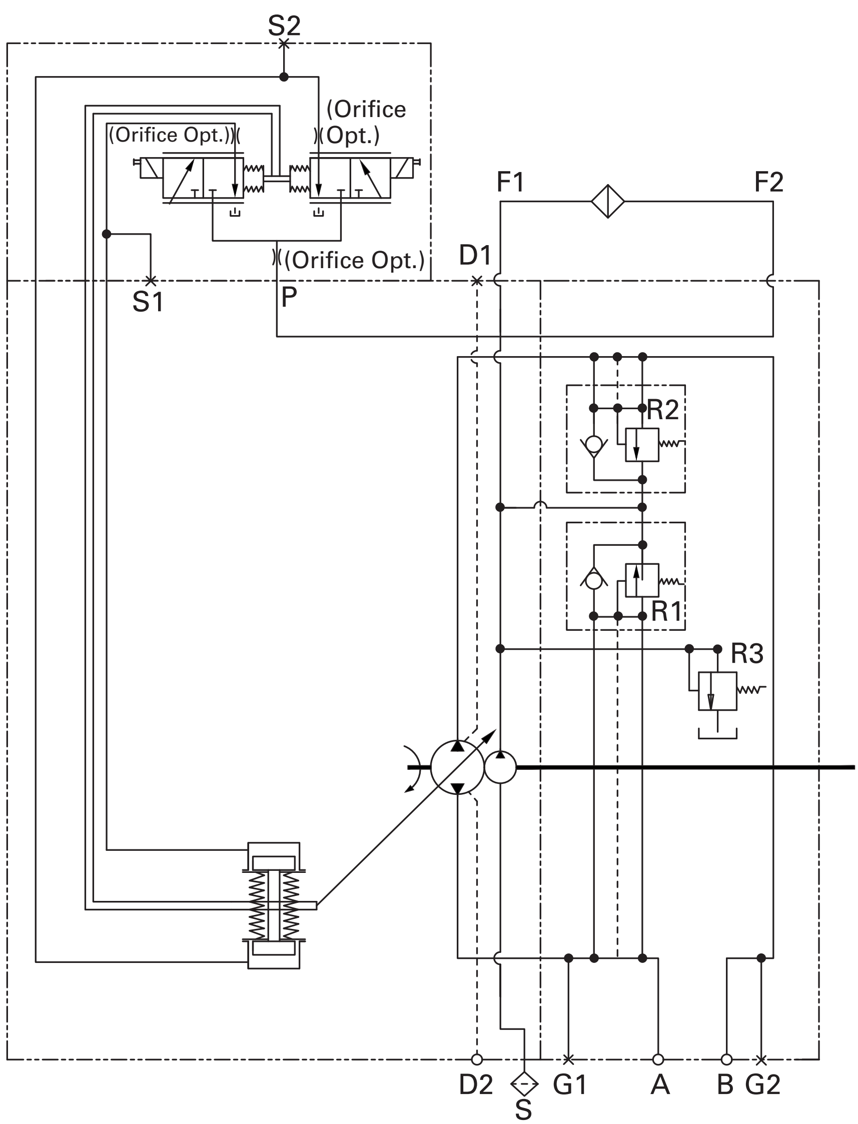
Position 31 - Auxiliary mounting & coupling		
A	=	SAE J744, 82-2 (A mount), with cover plate
B	=	SAE J744, 82-2 (A mount), Dual, 9T 16/32 DP
C	=	SAE J744, 82-2 (A mount), Dual, 11T 16/32 DP
D	=	SAE J744, 101-2 (B mount), with cover plate
E	=	SAE J744, 101-2 (B mount), Dual, 13T 16/32 DP
Position 32, 33 - Special feature		
00	=	None
*AA	=	Quiet valve plate
Position 34 - Seal option		
0	=	Nitrile
1	=	Viton
Position 35 - Paint		
0	=	Anti rust conservation oil
A	=	Primer per spec 209-13A
G	=	Blue primer per spec 209-13CD
Position 36, 37 - Identification		
00	=	Standard
Position 38 - Design code		
A	=	First design

* = Option available on request

Single pump

Schematic for servo controlled pump with electronic displacement control, charge pump and auxiliary ports.

A, B	Main pressure ports
D1,D2	Drain ports
G1,G2	Gauge ports
p	Control supply (orifice optional)
R1, R2,	High-pressure relief valves
R3	Charge/low pressure relief valve
S	Charge suction
s1,s2	Servo pressure gauge port (orifice optional)
F1, F2	Remote filter port

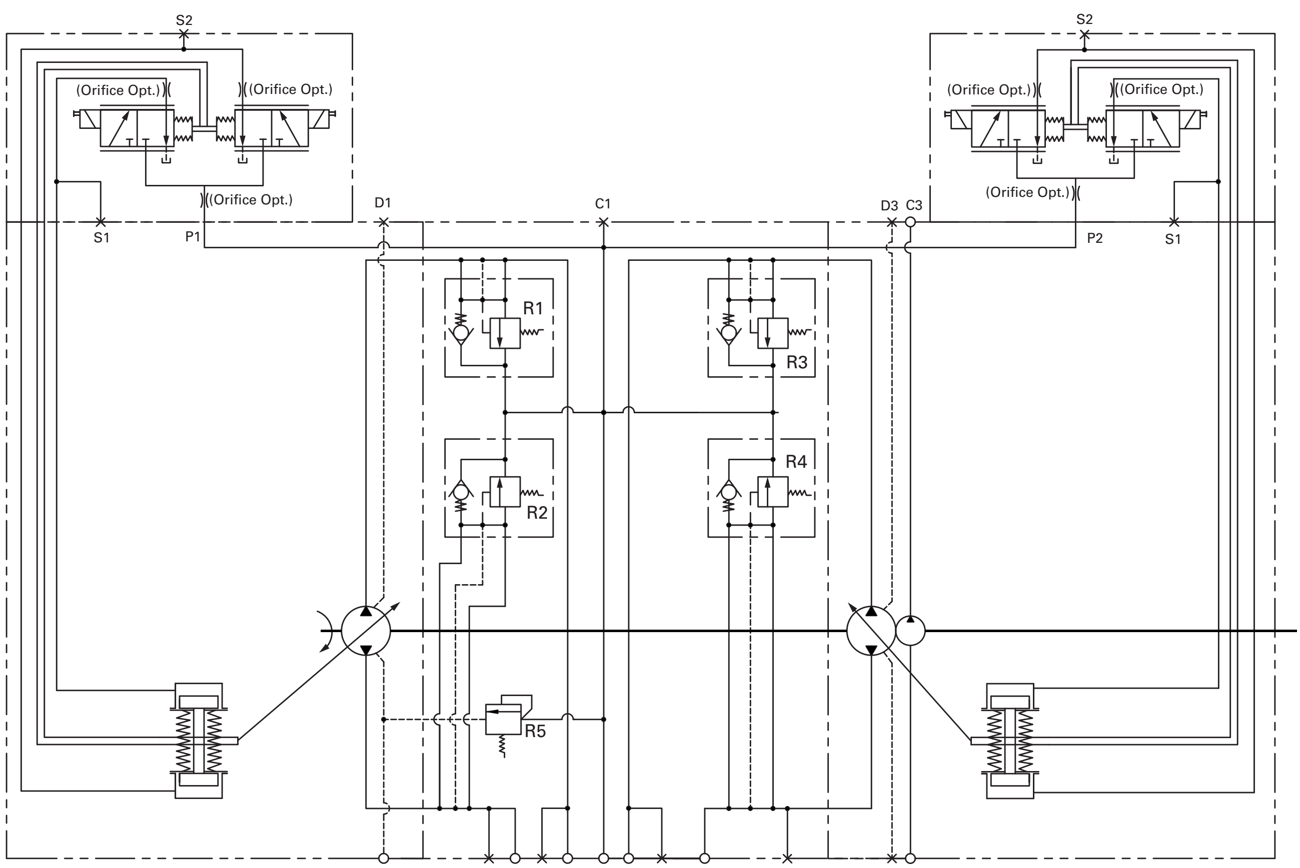


Back-to-back pump

When two piston pumps are mounted so their rotating kits are facing each other, the arrangement is called a back-to-back arrangement. These pumps share the same center manifold, which includes the flow paths and high-pressure ports for both the front and rear pump. Back-to-back pumps works as a single unit, and the front/rear pump cannot be separated. Auxiliary piston/gear pumps can be added as per the requirement.

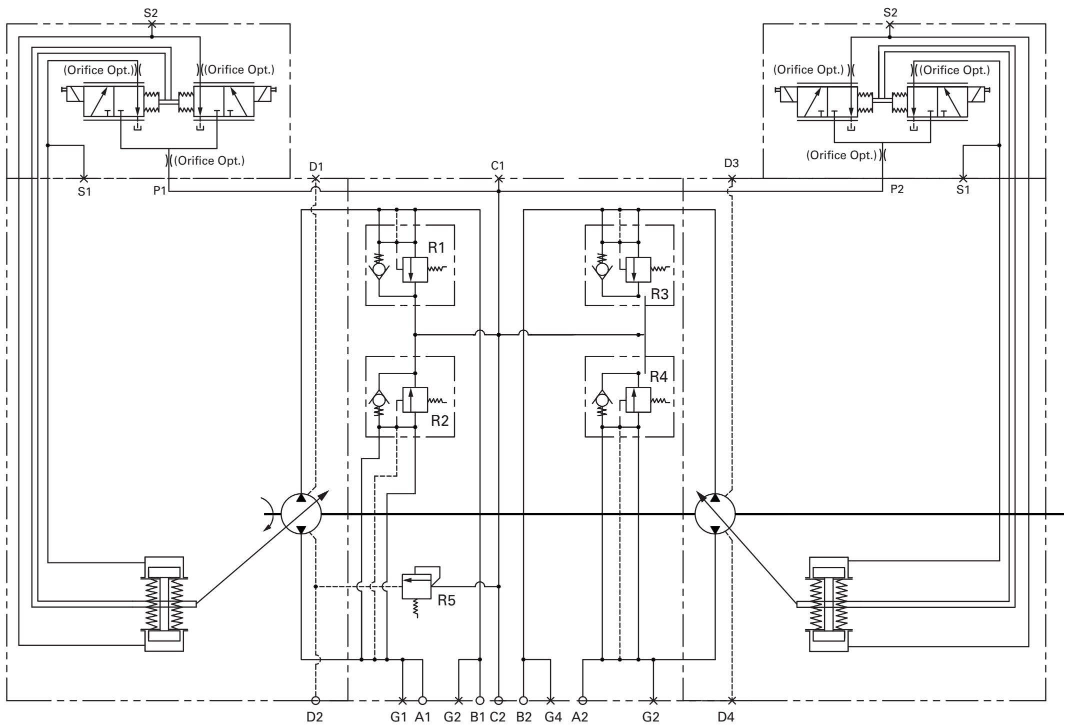
Please refer to the following schematic for the servo-controlled pump with electronic displacement control with auxiliary ports.

A1, A2, B1, B2	Main pressure ports
C1, C2, C3	Auxiliary ports
D1, D2, D3, D4	Drain ports
G1,G2,G3,G4	Gauge port
p1/p2	Control supply front/rear pump (orifice optional)
S	Charge suction
R1, R2, R3, R4	High-pressure relief valves
R5	Charge/low-pressure relief valve
s1,s2	Servo pressure gauge port (orifice optional)



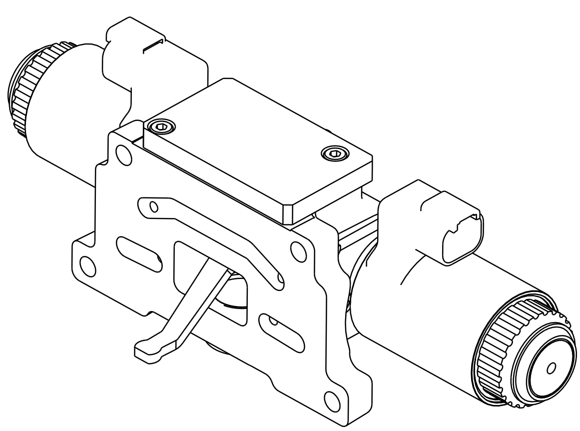
Note: An alternative braking system independent of the hydraulic brake should be provided to ensure the stoppage and holding of the vehicle in the event of hydrostatic power loss.

Electronic displacement control (EDC)



The Electronic displacement control (EDC) is ideal for applications requiring electronic pump displacement control. The EDC provides the flexibility of three command input choices. Control components include a proportional solenoid actuated valve assembly and an electronic solenoid driver module mounted on the pump.

The EDC has been designed to withstand the rigors of off-highway equipment environmental conditions.

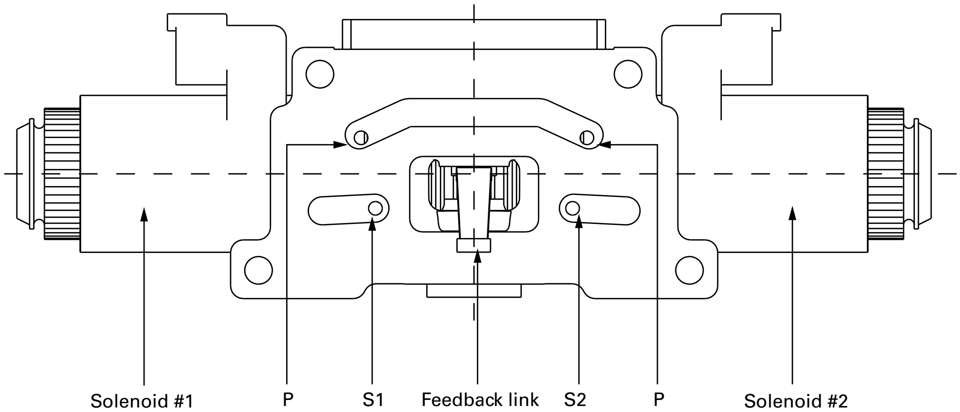


Electronic displacement control features

- Ease of installation
- Operates from 12 or 24 V DC power supply
- Operating temperature range -40° C to +85° C
- Closed-loop current control compensates for resistance change of the proportional solenoids due to temperature variations
- Return to neutral for loss of power, or loss of command input signal
- Mechanical feedback of swashplate position for closed loop control
- External neutral adjustment
- Manual override capability

Pump control code option	Description	Control solenoid code option	Command input signal	Coil resistance temperature (Ω) @ 20°C	Coil resistance temperature (Ω) @ 80°C	Inductance* (mH)	Rated continuous Current A	Typical input devices
E1	EDC control w/ deutsch connector	1	12V	3.66	4.52	33	1.9	Requires customer supplied electronics
	EDC control w/ deutsch connector	2	24V	14.2	17.52	140	0.9	

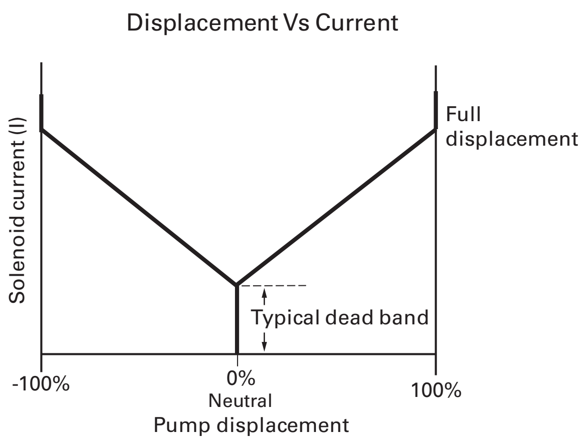
Solenoid actuated valve assembly

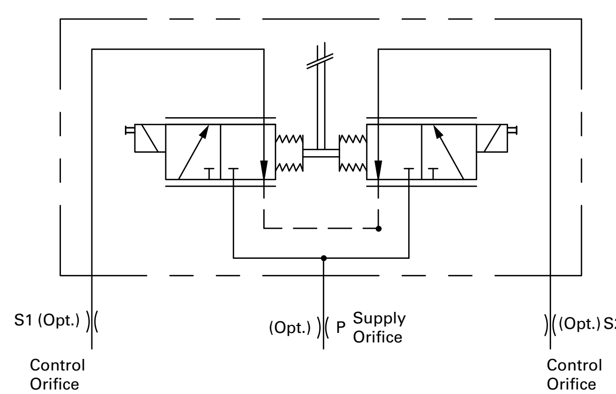


Electronic proportional control valve guidelines

Description		12 V	24 V
Maximum current		1800 mA	920 mA
Nominal coil resistance	@ 20°C (68 °F)	3.66Ω	14.20 Ω
	@ 80°C (176 °F)	4.52Ω	17.52 Ω
Inductance		33mH	140mH
PWM			
	Frequency (preferred)	100 Hz	
IP rating	IEC 60 529	IP 67	
	DIN 40 050, part 9	IP 69K with Mating connector	
Connector color		Black	

Signal profile





PWM configuration

Closed-loop current control of the solenoid current via PWM duty-cycle variation.

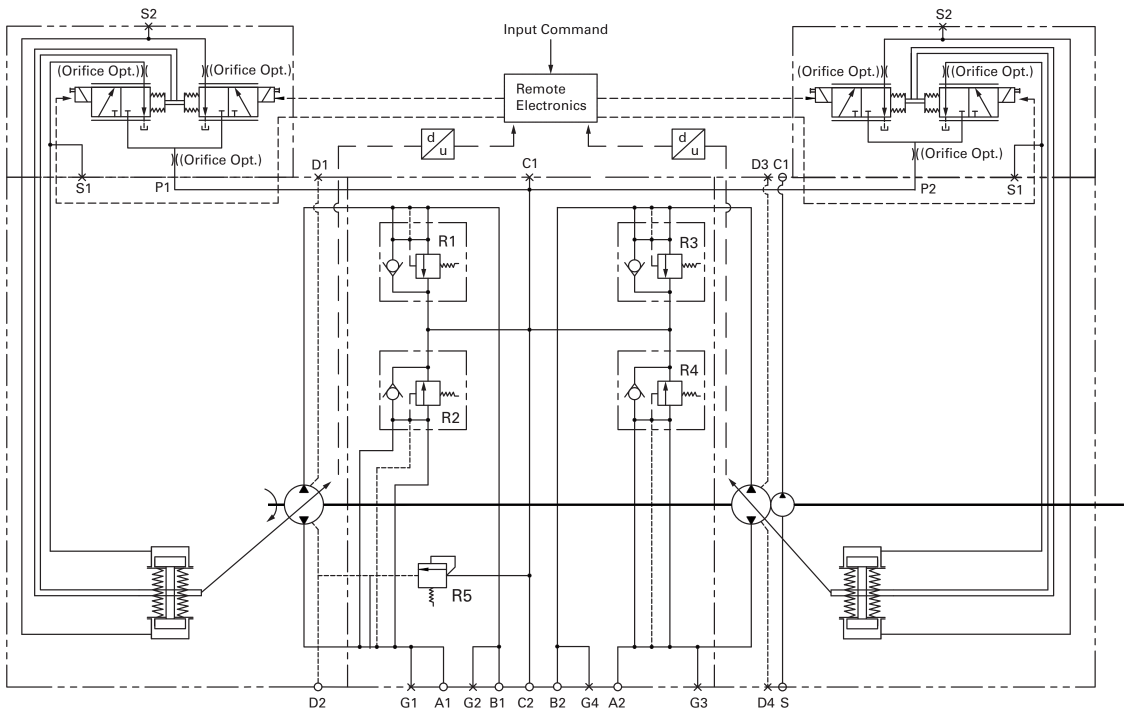
Note: Coil currents must be limited to not exceed solenoid coil specifications.

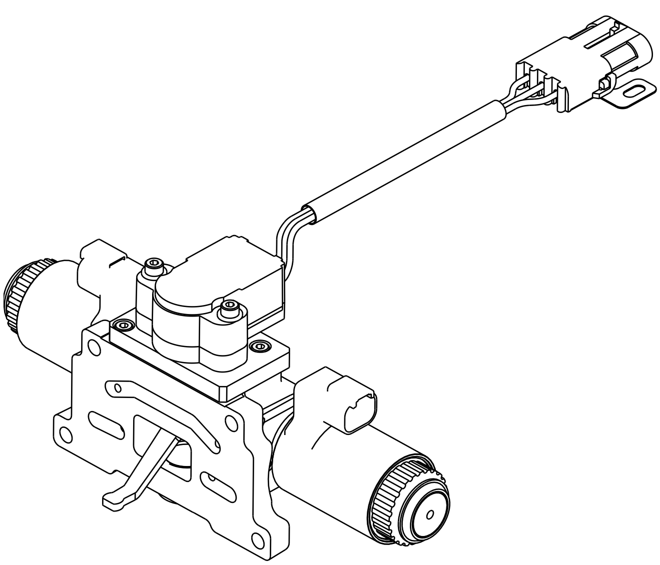
Dither signal

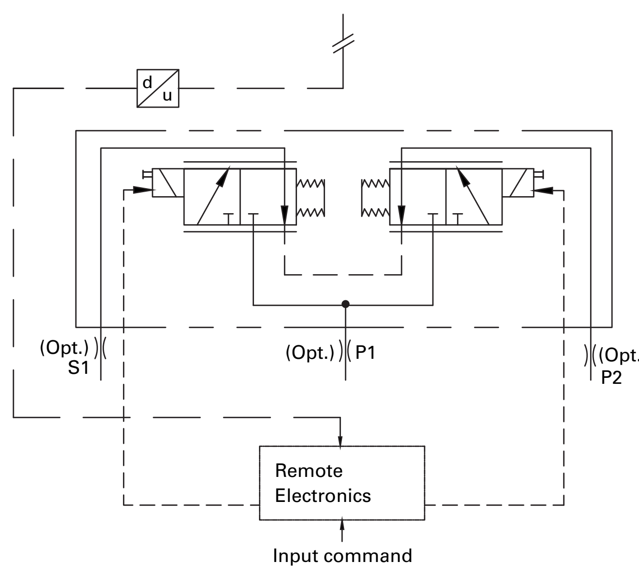
The design must provide for a separate dither signal to be added to the input command.

Waveform: Square
Frequency: 75 (+ 25,-15) Hz
Amplitude: .250 +.100 -.050A pk-pk

Electronic displacement control with swash feedback sensor (EDCF)





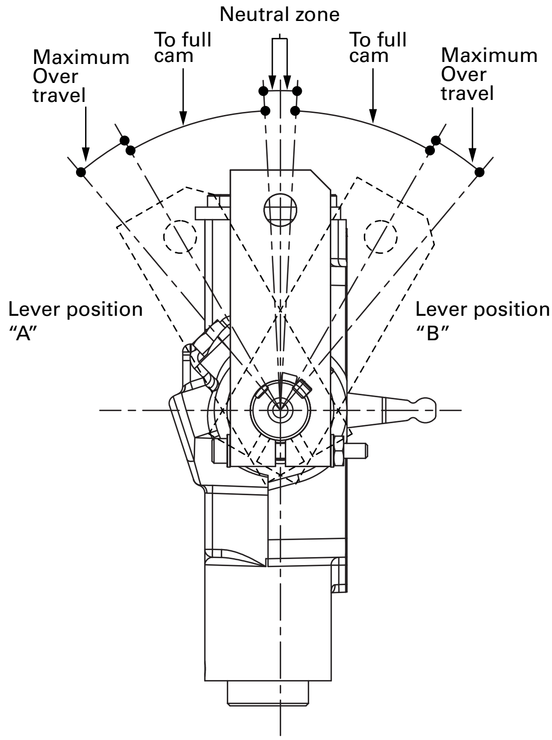


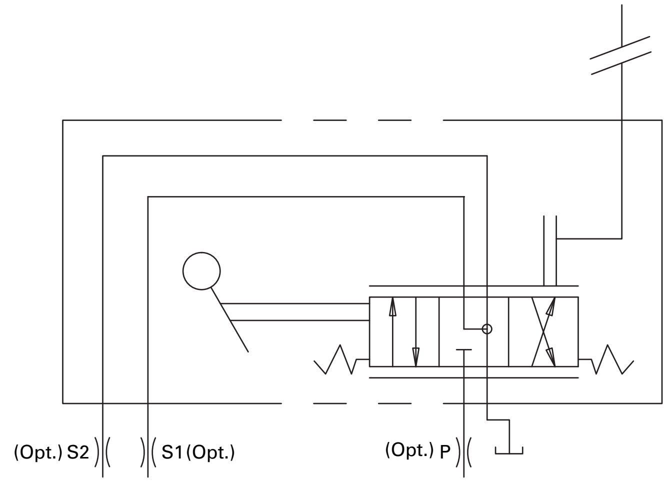
This control has an additional swash position sensor, which provides angular position of the swash plate very precisely at any point of time during pump operation. Swash position signal is converted in electrical signal and supplied to the Electronic Control Unit (ECU) of the hydraulic system. This signal is used to compare the input command to the pump and the output flow.

Any deviation in the demand Vs pump output flow is corrected by electric signal from ECU to solenoids, which in turn will stroke or de-stroke the pump to match the flow.

Refer to the swash sensor section for further details.

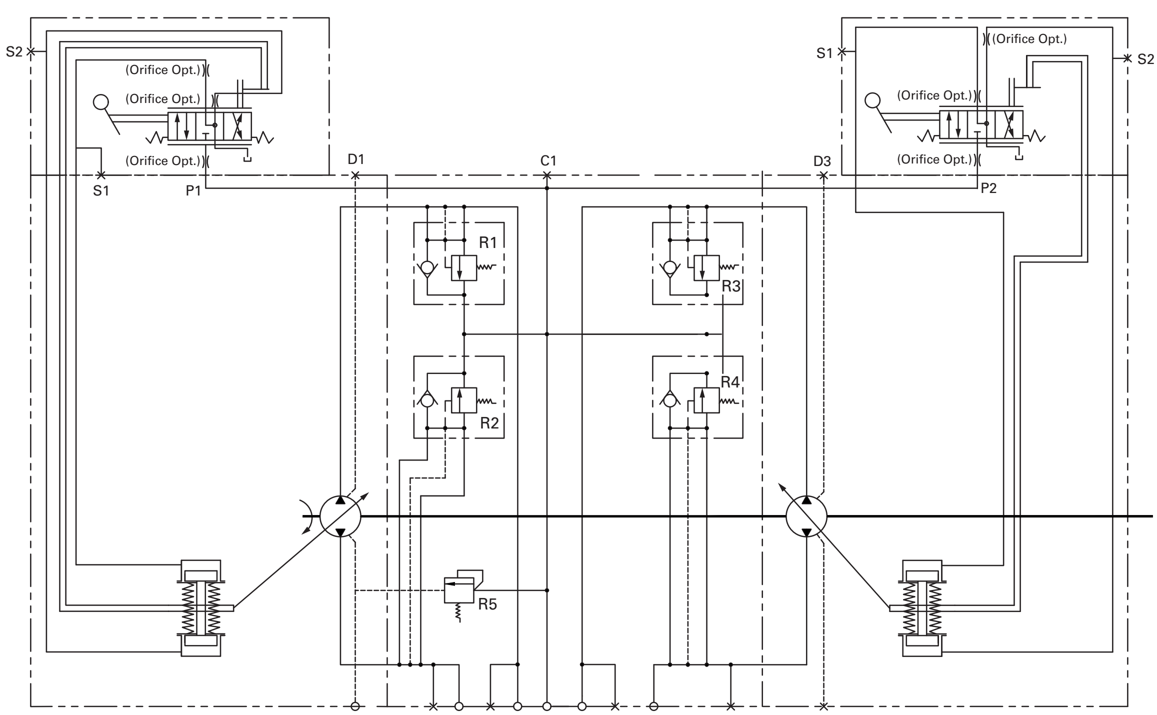
Manual control





Torque required to move manual control lever – 4.52 N-m [40 lbf-in]

Control lever travel	Standard band
Neutral zone	3°
Maximum displacement	27°
Maximum over travel	10°



Additional pump features

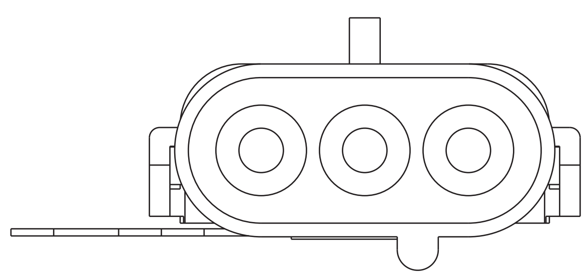
Swash position sensor

- The swash feedback sensor enables the system to accurately signal the swash position and provide input to the Electronic Control Unit (ECU).
- This signal can be used by ECU to indicate pump neutral/ stroking position to operator and to actuate any auxiliary attachment/implement on vehicle.
- Pump neutral signal can be used as safety mechanism that avoids accidental start of engine/implement when the pump is in stroke.

Technical specifications

Input voltage	5 +/- 0.05 VDC
Input current	12 mA
Output voltage	2.5 +/- 0.02 VDC
Output current	-1 to 1 mA
Sensitivity	1.0 volt per 10° shaft rotation
Temperature range	-40 °C to 120 °C

Connector	Mating connector	Harness length (inch)
Delphi packard weather pack- 3 way connector (Shroud)	Delphi packard weather pack- 3 way connector (Tower)	5.25 ± 0.50
Delphi packard weather pack- 3 way connector (Tower)	Delphi packard weather pack- 3 way connector (Shroud)	5.25 ± 0.50

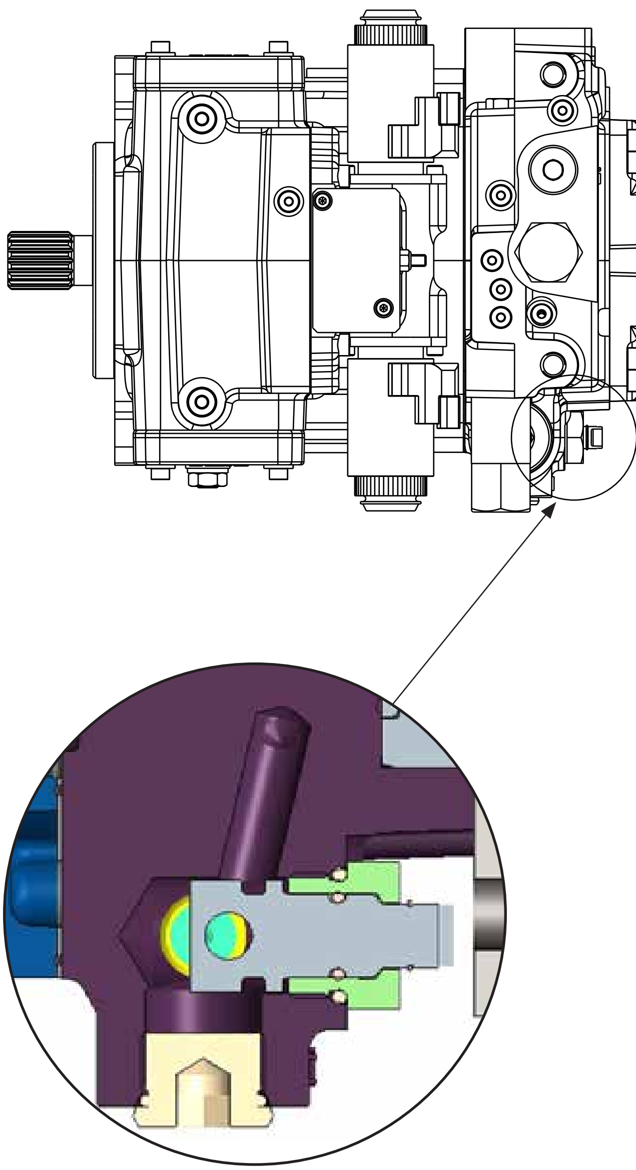


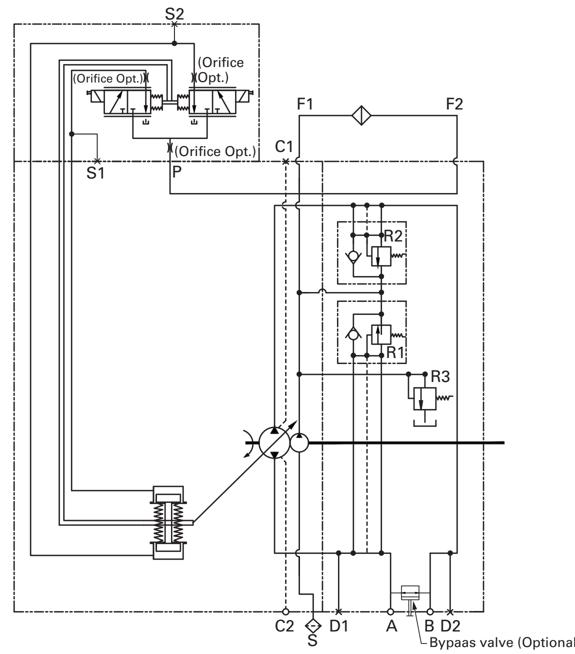
Additional pump features

Function of bypass valve:

The bypass valve allows the opening of the closed-loop hydraulic circuit, which facilitates limited travel of any vehicle to tow it out of danger zone. The operation does not require any prime mover or pump shaft rotation.

Before towing the vehicle, the bypass valve needs to be turned by 90° in any direction (CW/CCW) to declutch. The pump should be stopped before turning the bypass valve. The bypass valve in a normal condition (when towing is not permitted) is shown below.

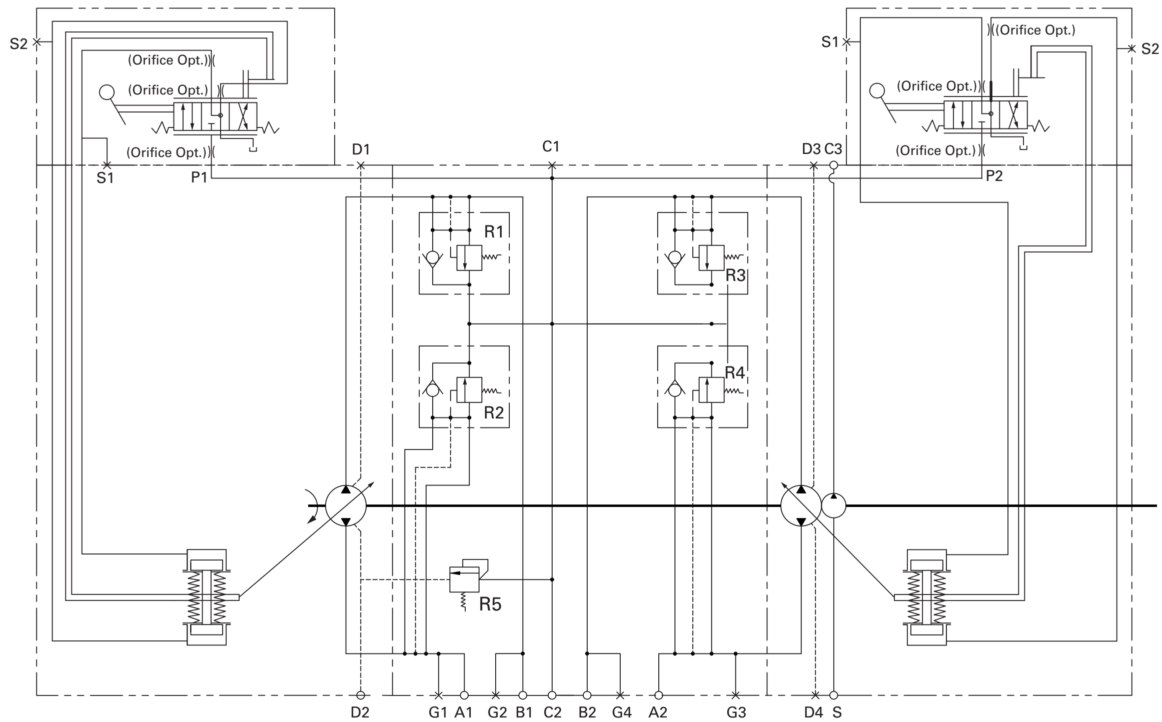




Caution: Towing for a prolonged time and distance may result in internal heat generation damaging the hydraulic system. Hence with appropriate safety accessories, check the oil level and bleed the air from the pump (If any) before restarting the pump.

Additional pump features

Supply & control Orifice



Calculated time from neutral to full stroke (seconds)

Control orifice size, mm [in]

Supply orifice size mm [in]	0.71 [0.03]	0.81 [0.03]	0.91 [0.04]	1.02 [0.04]	1.12 [0.04]	1.32 [0.05]	1.45 [0.06]	None
0.71 [0.03]	1.25	1.15	1.09	1.04	1.02	0.98	0.97	0.95
0.81 [0.03]	1.20	1.09	1.01	0.96	0.93	0.88	0.87	0.83
0.91 [0.04]	1.17	1.05	0.97	0.91	0.86	0.81	0.79	0.74
1.02 [0.04]	1.16	1.03	0.94	0.87	0.82	0.76	0.73	0.66
1.12 [0.04]	1.15	1.02	0.92	0.85	0.79	0.72	0.69	0.60
1.32 [0.05]	1.14	1.00	0.90	0.82	0.76	0.67	0.63	0.51
1.45 [0.06]	1.13	1.00	0.89	0.81	0.75	0.65	0.61	0.47
1.65 [0.07]	1.13	0.99	0.89	0.80	0.73	0.63	0.59	0.41
1.85 [0.07]	1.13	0.99	0.88	0.80	0.73	0.62	0.58	0.36
None	1.13	0.98	0.88	0.79	0.72	0.61	0.55	0.14

Additional pump features

Adjustable displacement limiter

Adjustable displacement limiter

- Externally adjustable displacement
- Settings are zero to maximum pump displacement
- Independent adjustment for both main ports
- Field adjustable

All factory units shipped with adjustable stops are set at maximum pump displacement.

See re-adjustment instructions (right).

To calculate displacement required

The displacement required divided by displacement of one turn of set screw equals the number of turns of set screw to obtain displacement.

Example for 3.00 in3/r re-adjustment:

2.0 in3/r ÷ .2854 in3/r = 7 turns of set screw

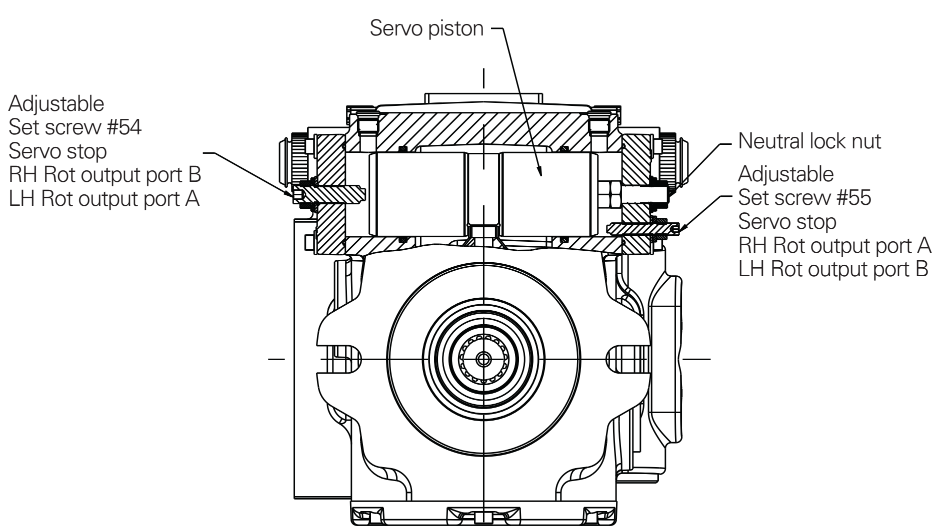
Pump displacement per turn

2.48 in3/r Pump Displacement @ Full Cam

Turns of set screw	Item # 54 stop	Item # 55 stop
0	2.48 in3/r	2.48 in3/r
1	2.22 in3/r	2.26 in3/r
2	1.98 in3/r	2.05 in3/r
3	1.73 in3/r	1.84 in3/r
4	1.49 in3/r	1.63 in3/r
5	1.26 in3/r	1.43 in3/r
6	1.03 in3/r	1.23 in3/r
7	0.80 in3/r	1.03 in3/r
8	0.57 in3/r	0.83 in3/r
9	0.34 in3/r	0.63 in3/r
10	0.12 in3/r	0.44 in3/r
10.5	0.01 in3/r	0.34 in3/r
11	N/A	0.25 in3/r
12.0	N/A	0.05 in3/r
12.3	N/A	0.00 in3/r

3.0 in3/r Pump Displacement @ Full Cam

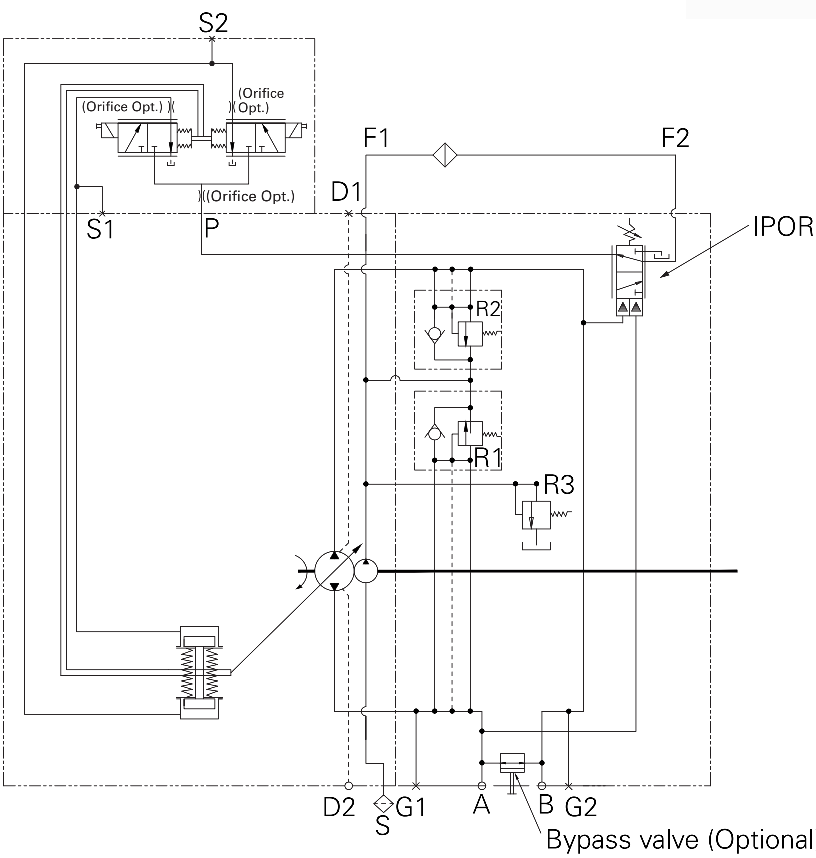
Turns of set screw	Item # 54 stop	Item # 55 stop
0	3.00 in3/r	3.00 in3/r
1	2.71 in3/r	2.75 in3/r
2	2.40 in3/r	2.49 in3/r
3	2.11 in3/r	2.23 in3/r
4	1.82 in3/r	1.98 in3/r
5	1.53 in3/r	1.74 in3/r
6	1.25 in3/r	1.49 in3/r
7	0.97 in3/r	1.25 in3/r
8	0.69 in3/r	1.01 in3/r
9	0.42 in3/r	0.77 in3/r
10	0.14 in3/r	0.54 in3/r
10.5	0.01 in3/r	0.42 in3/r
11	N/A	0.30 in3/r
12.0	N/A	0.07 in3/r
12.3	N/A	0.00 in3/r



Additional pump features

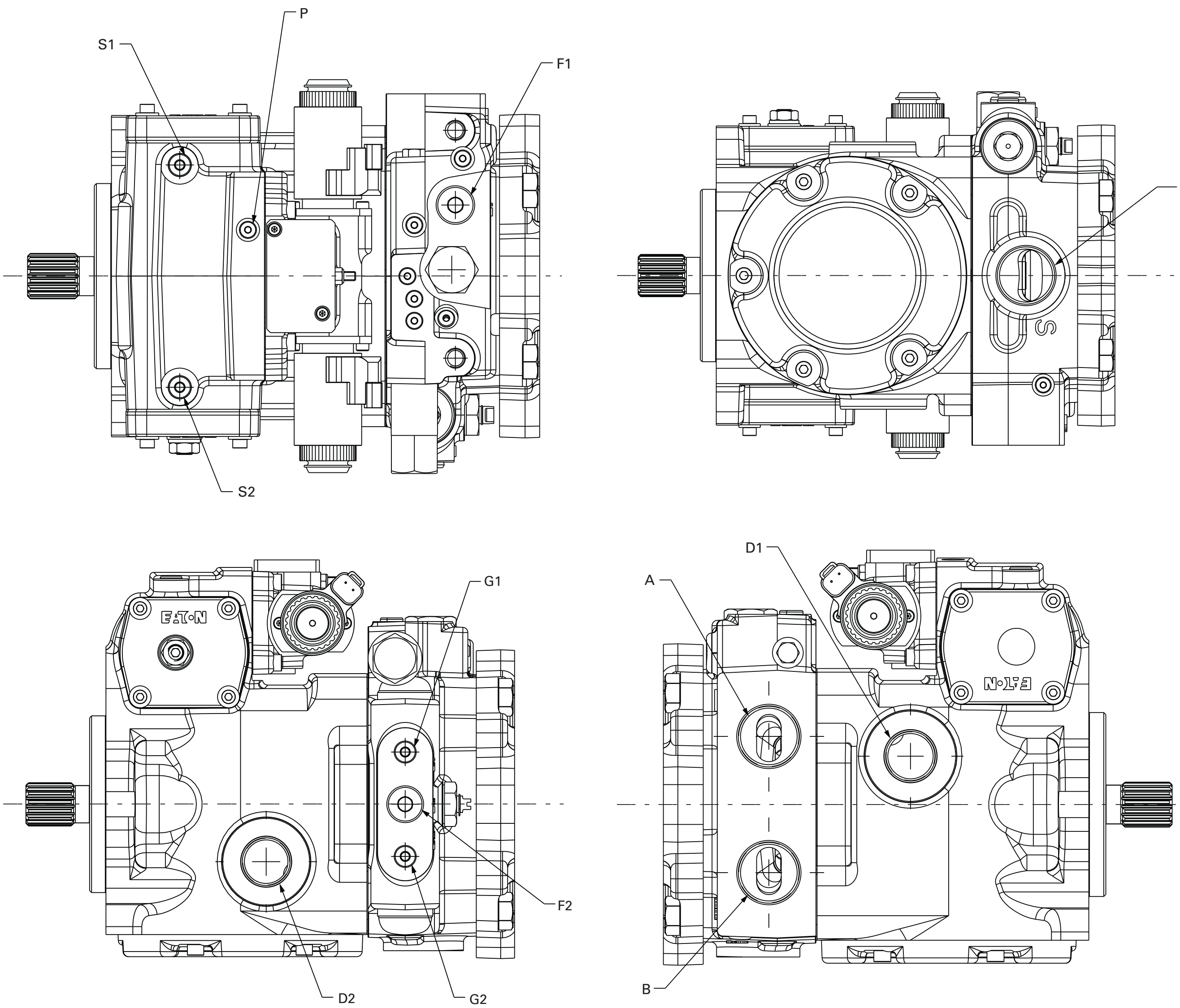
Internal pressure override control (IPOR) (Only available on X3 single pump)

The internal pressure override (IPOR) protects the transmission from running at overload conditions for extended periods. It senses system pressure and allows the pump to de-stroke if pressures exceed a preset limit (500 psi less than HPRV pressure). The override pressure setting is shim adjustable. Since the IPOR is built into the pump end cover, it is not a field conversion option.



Installation dimensions

Installation drawing

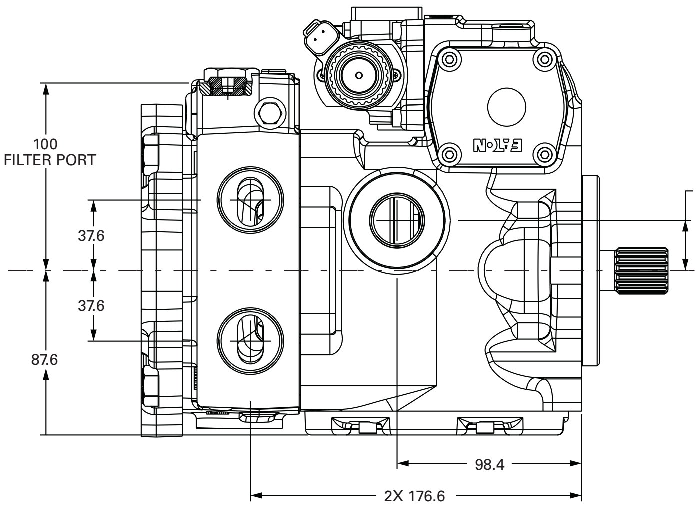


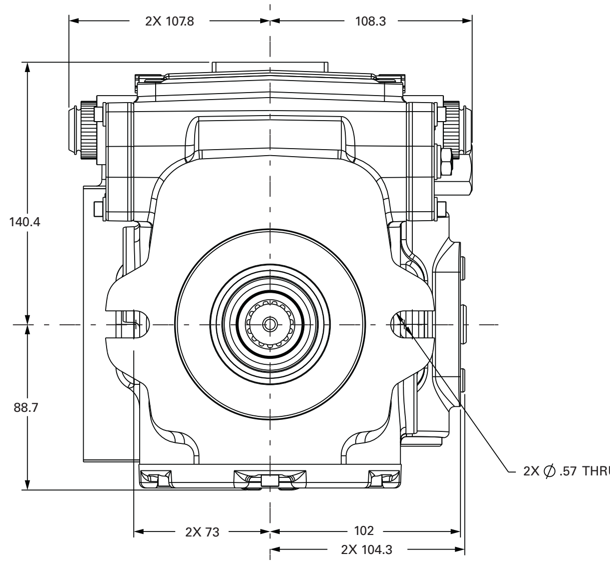
Description

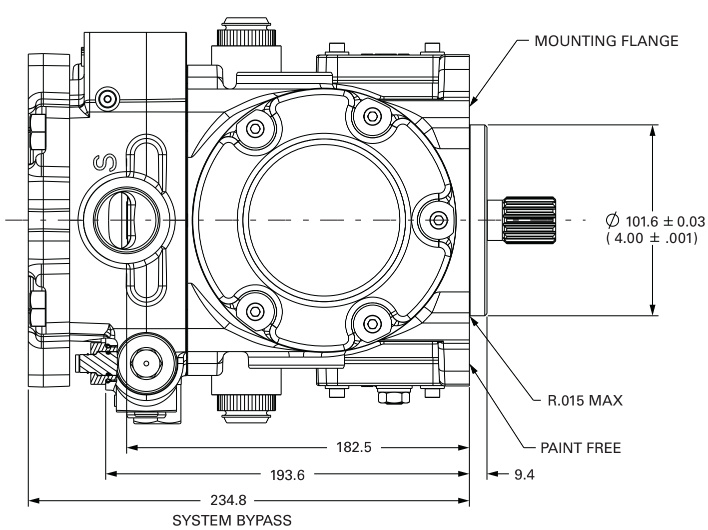
Port	Description	Code	Size
A/B	System Port	Inch	1 5/16-12
		Metric	M33 X 2
D1/D2	Case Drain	Inch	1 1/16-12
G1/G2	System Gauge	Inch	7/16-20
S	Charge Pump Inlet	Inch	1 5/16-12
F1/F2	Filter Port	Inch	3/4-16
F1	Charge Gauge	Inch	3/4-16
s1/s2	Servo Gauge	Inch	7/16-20

Installation drawing for X3 single pump

X3 single 41/49 dimension with EDC controller





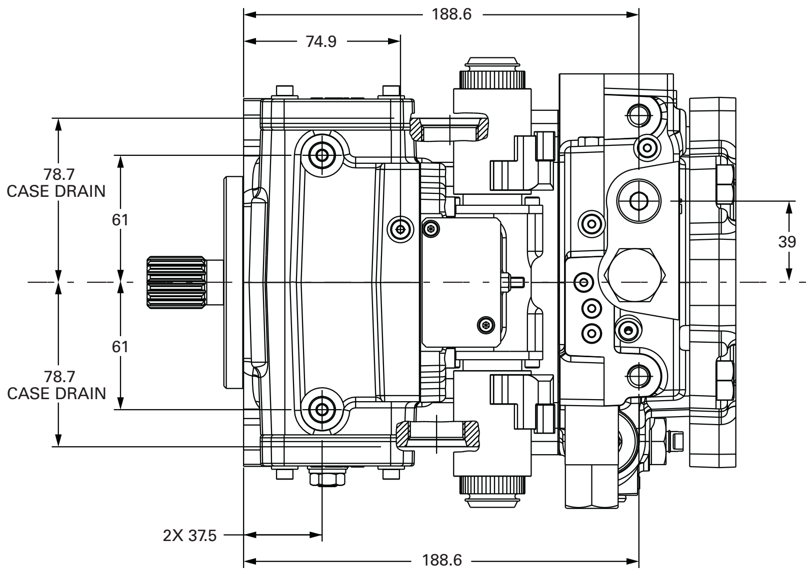


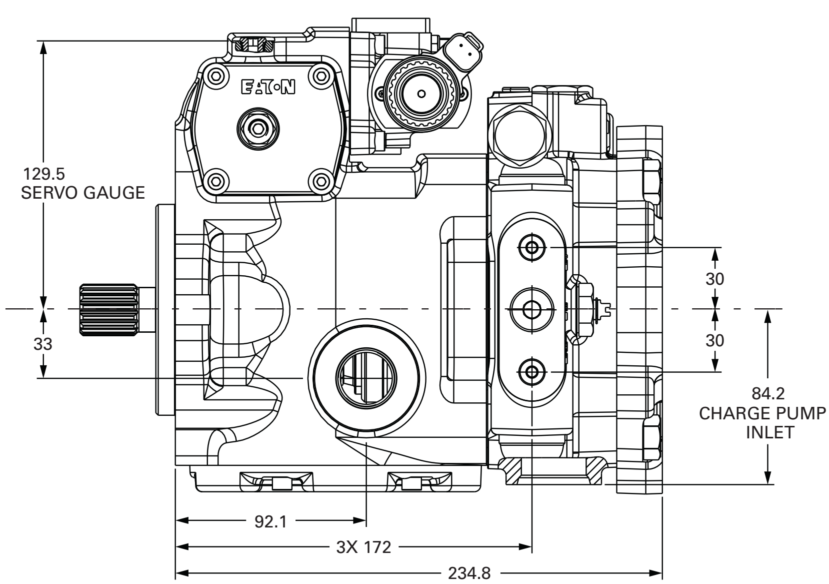
Note: The combined torque required for multiple pumps must not exceed the torque rating of the input drive shaft of the front piston pump. Consult an Eaton representative and/or Eaton engineering on side load recommendations.

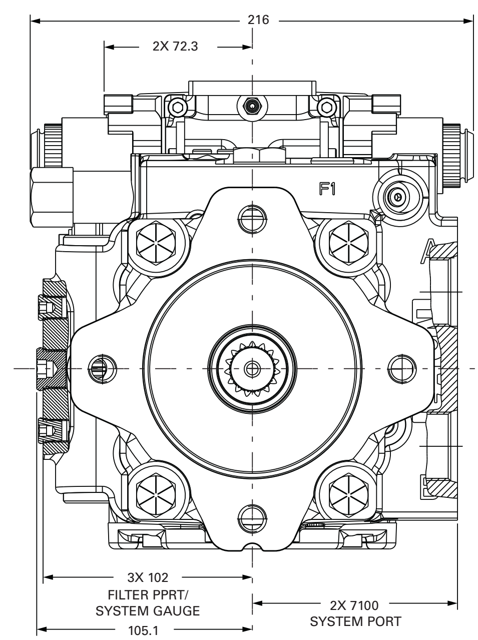
Auxiliary rear mounts and output shafts

Installation drawing for X3 single pump

X3 single 41/49 dimension with EDC controller (continued)

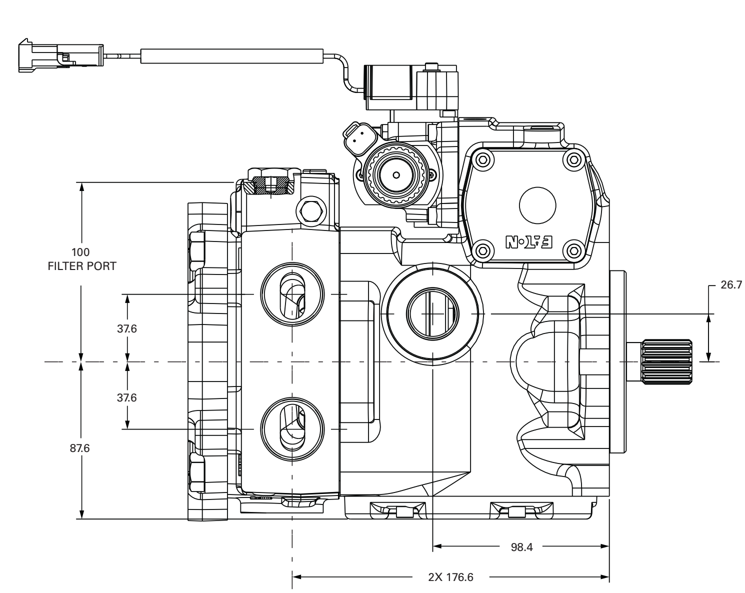


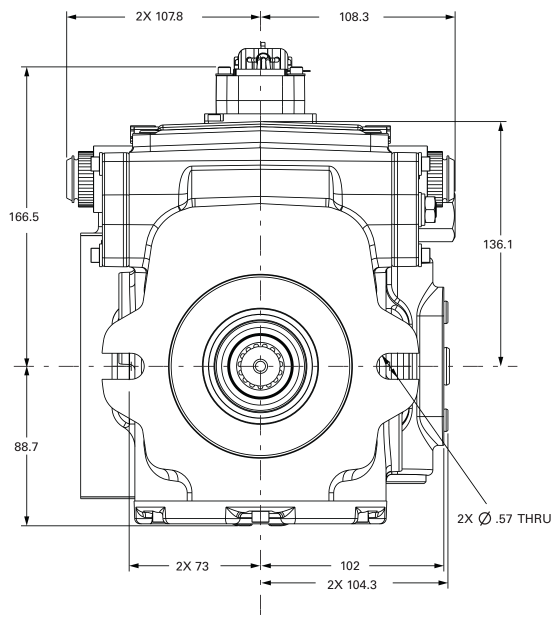


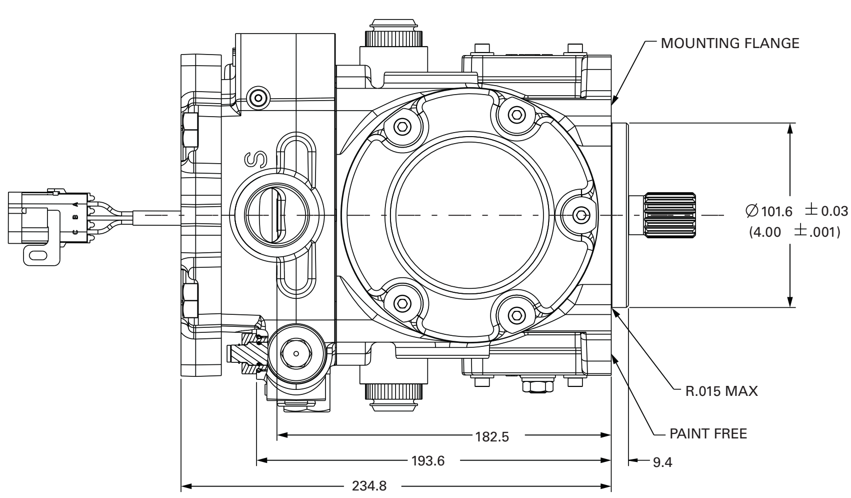


Installation drawing for X3 single pump

X3 single 41/49 dimension with EDCF controller

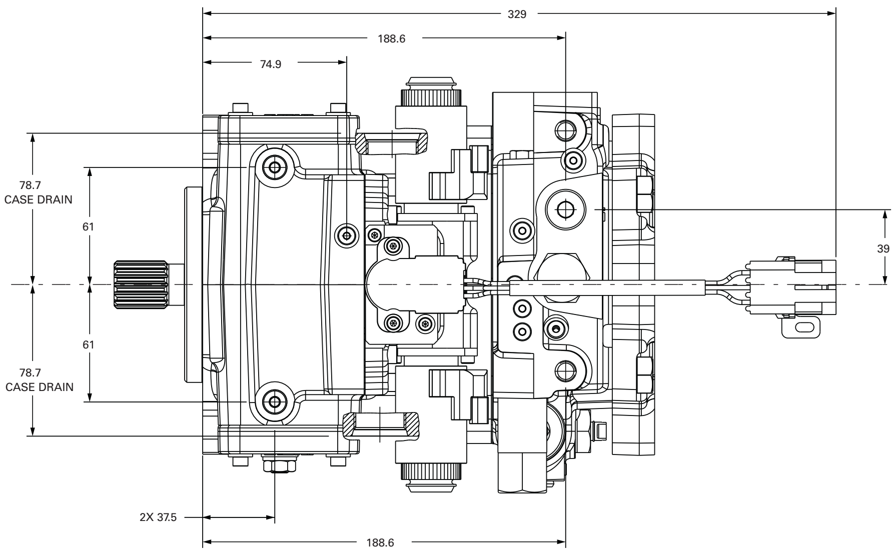


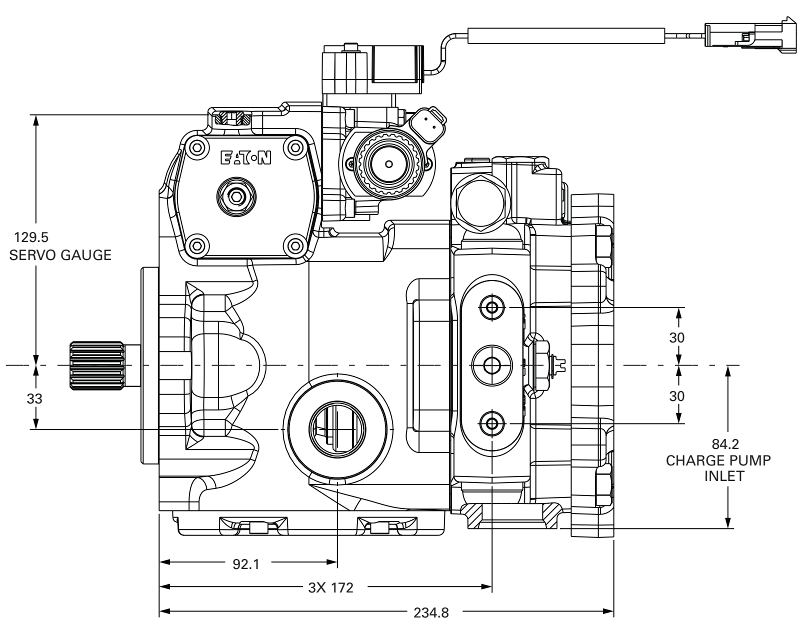


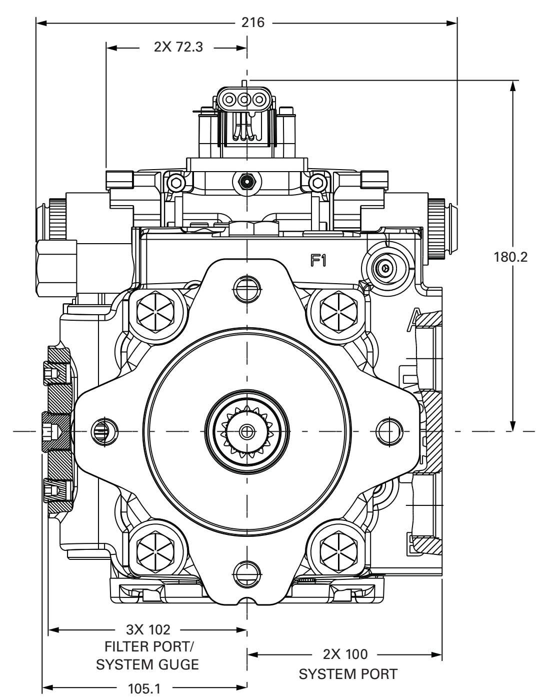


Installation drawing for X3 single pump

X3 single 41/49 dimension with EDCF controller (continued)



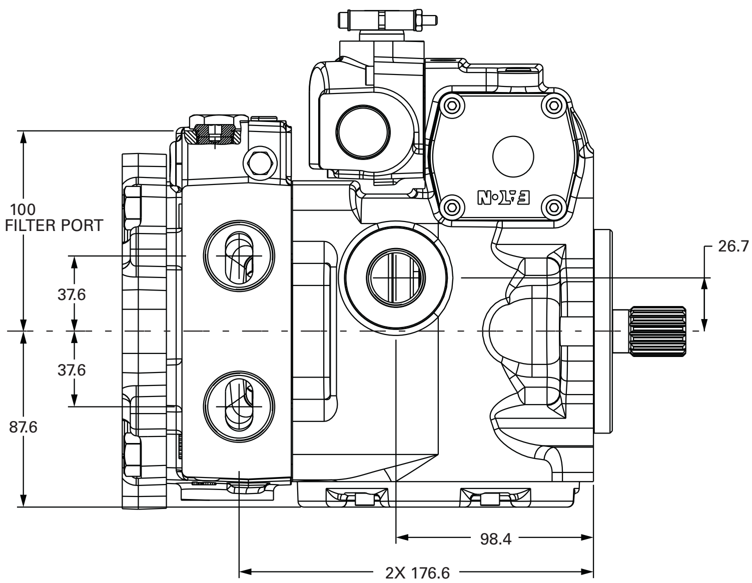


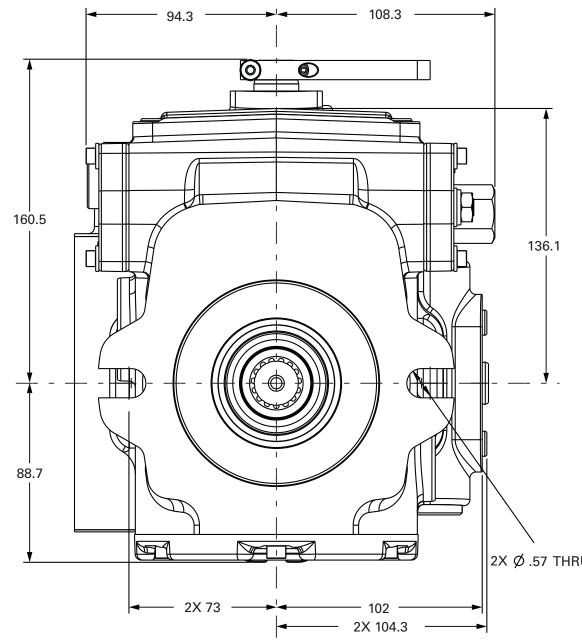


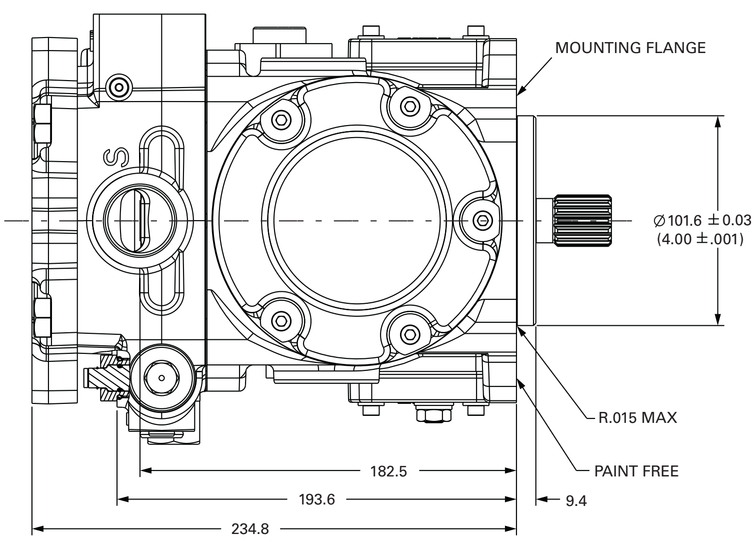
Features and port sizes

Installation drawings for X3 single pump

X3 single 41/49 dimension with manual controller



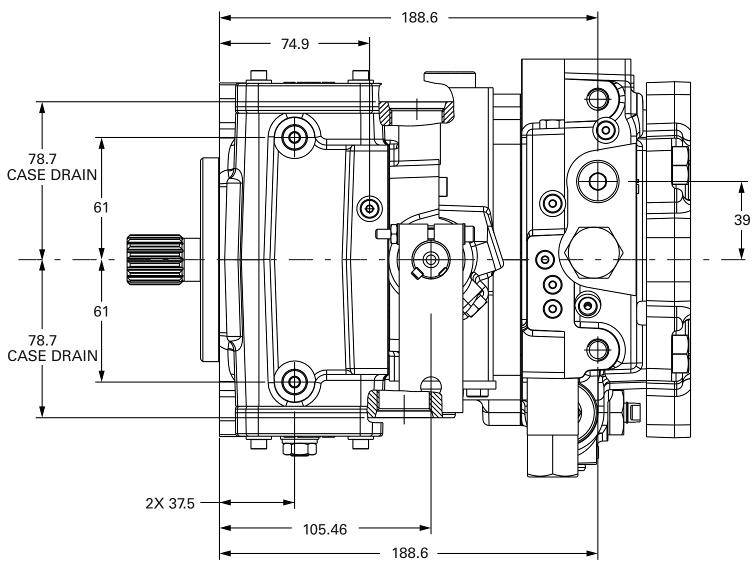


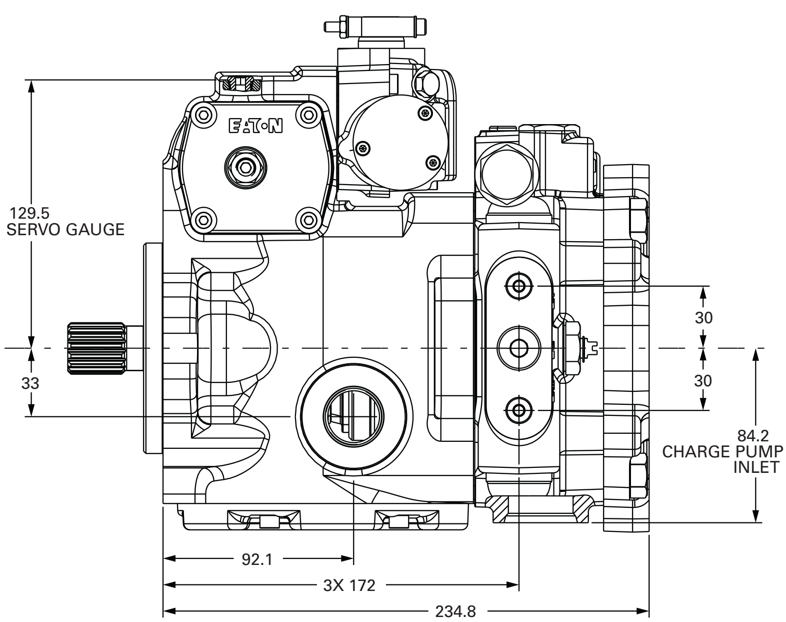


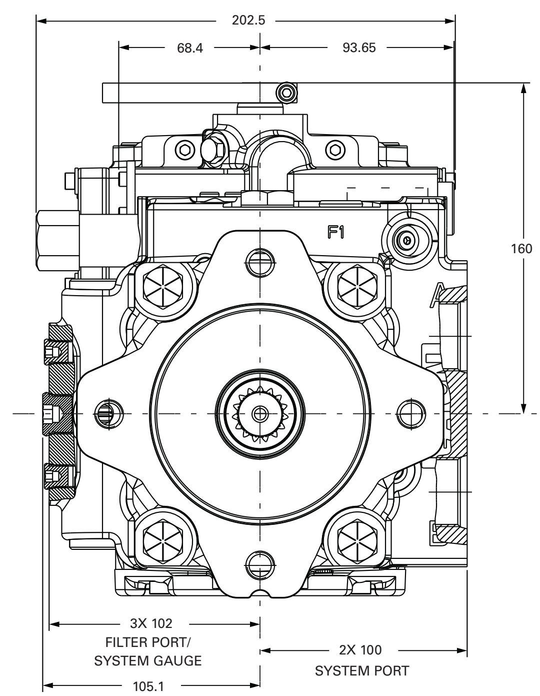
Features and port sizes

Installation drawings for X3 single pump

X3 single 41/49 dimension with manual controller (continued)

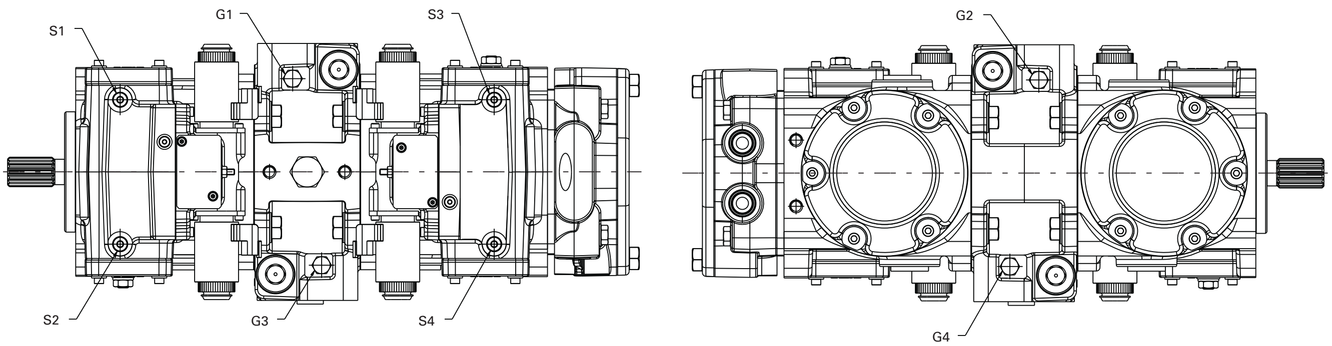


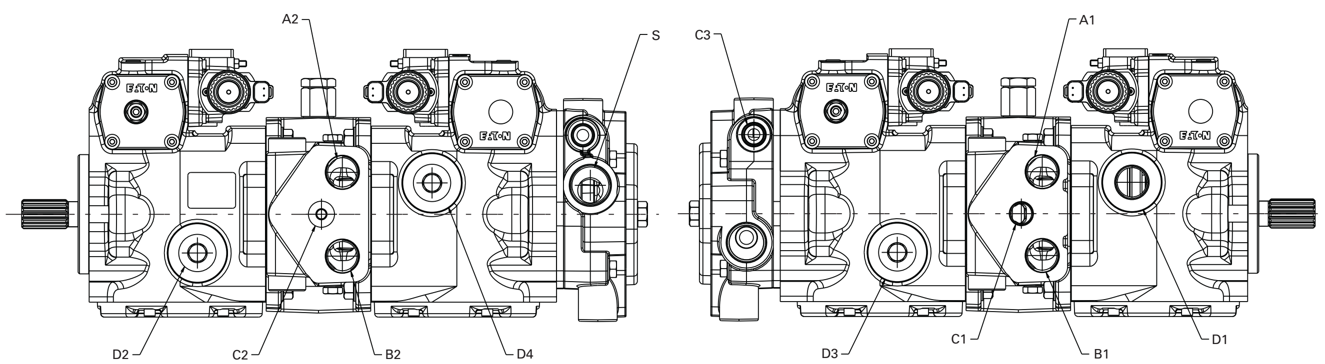




Installation drawings for X3 single pump

X3 single 41/49 dimension with manual controller (continued)





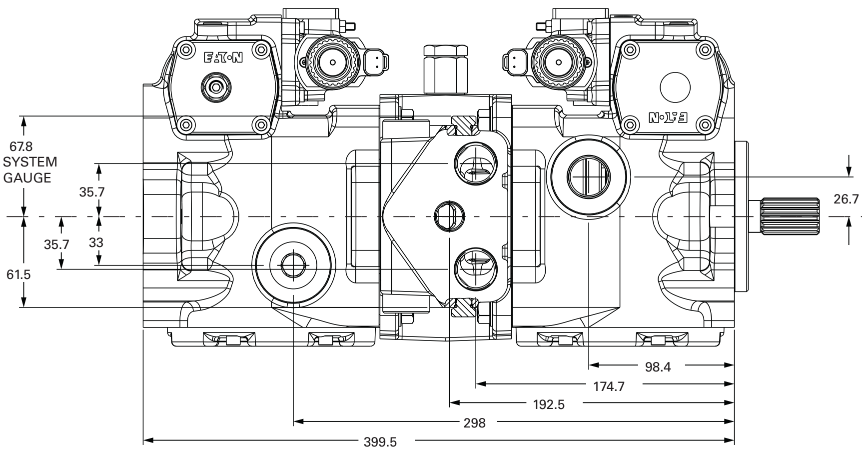
Description

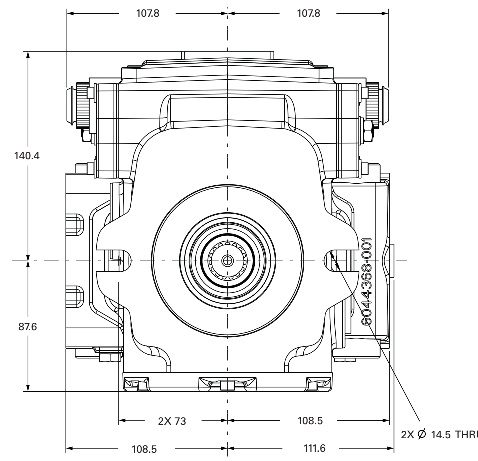
Port	Description	Code	Size
A1/A2/B1/B2	System Port	Inch	1 1/16-12
		Metric	M27 X 2
D1/D2/D3/D4	Case Drain	Inch	1 1/16-12
G1/G2/G3/G4	System Gauge	Inch	7/16-20
S	Charge Pump Inlet	Inch	1 5/16-12
C1/C2	Charge Pressure Inlet	Inch	3/4-16
C3	Charge Pressure Discharge	Inch	7/16-20
s1/s2/s3/s4	Servo Gauge	Inch	7/16-20

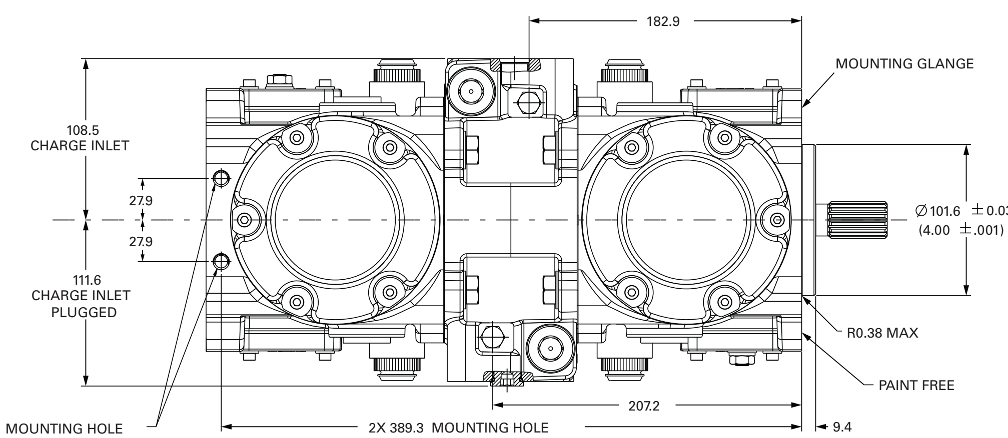
Features and port sizes

Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with EDC controller without charge pump



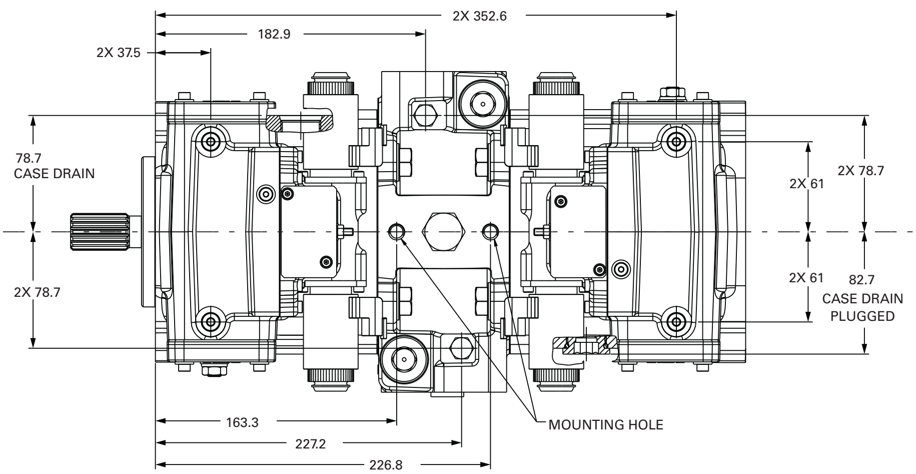


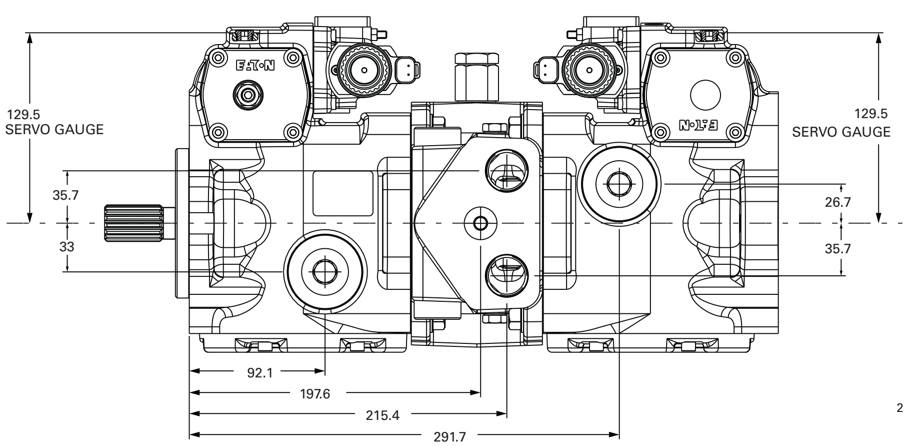


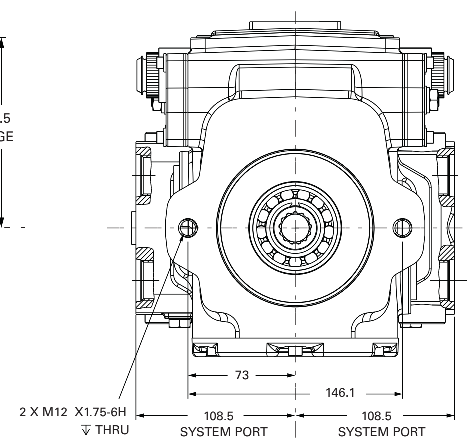
Features and port sizes

Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with EDC controller without charge pump (continued)



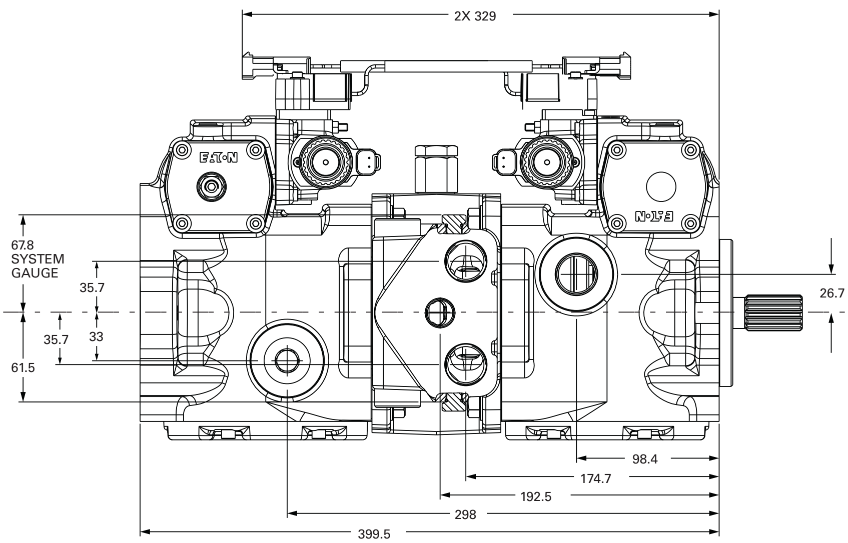


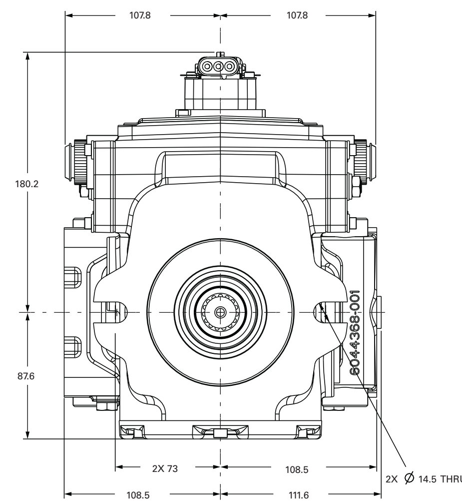


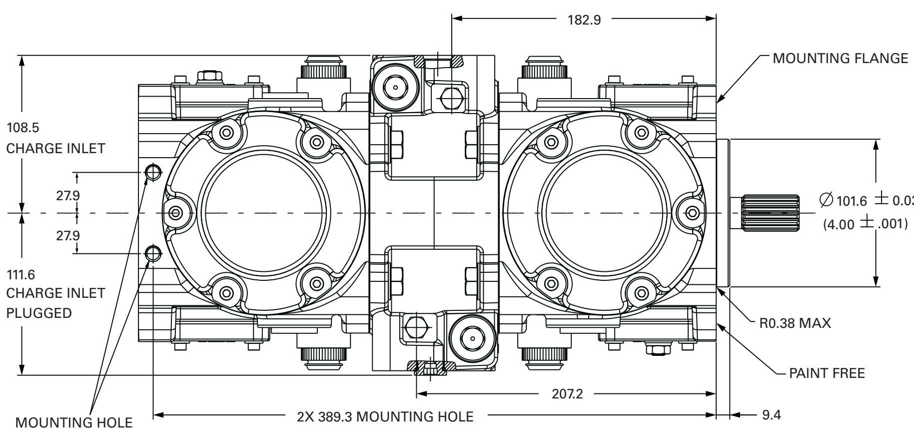
Features and port sizes

Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with EDCF controller without charge pump

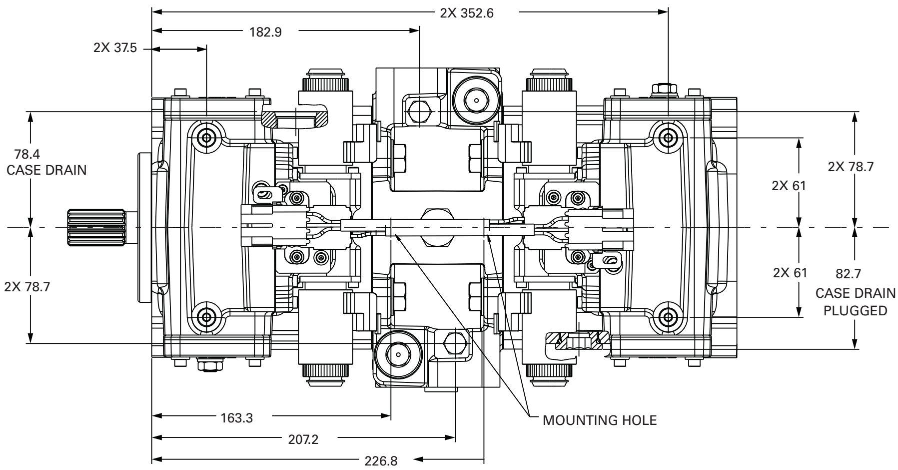


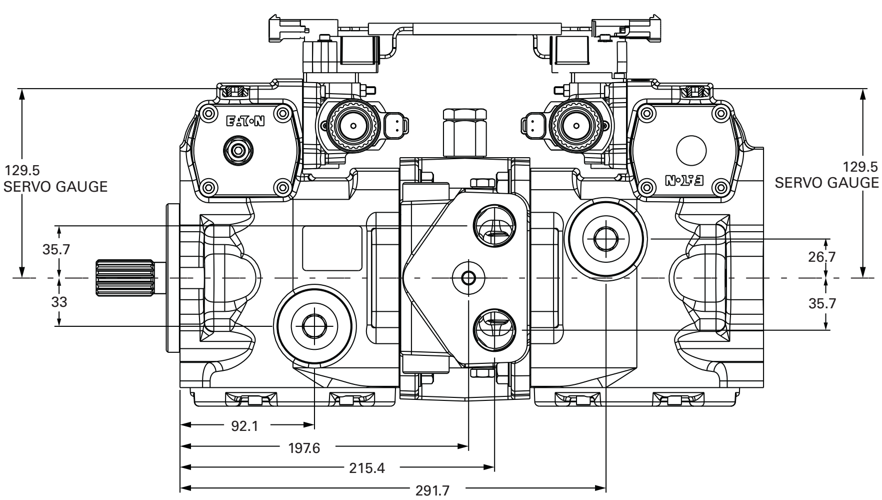


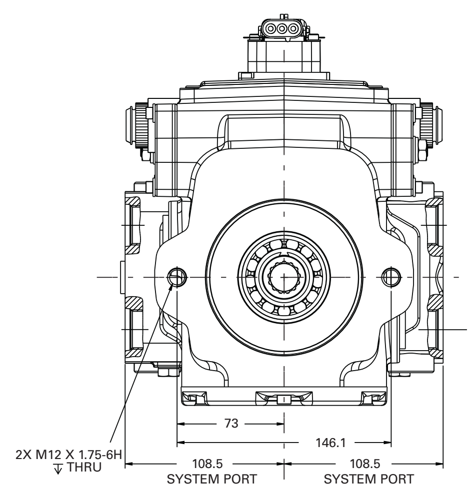


Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with EDCF controller without charge pump (continued)

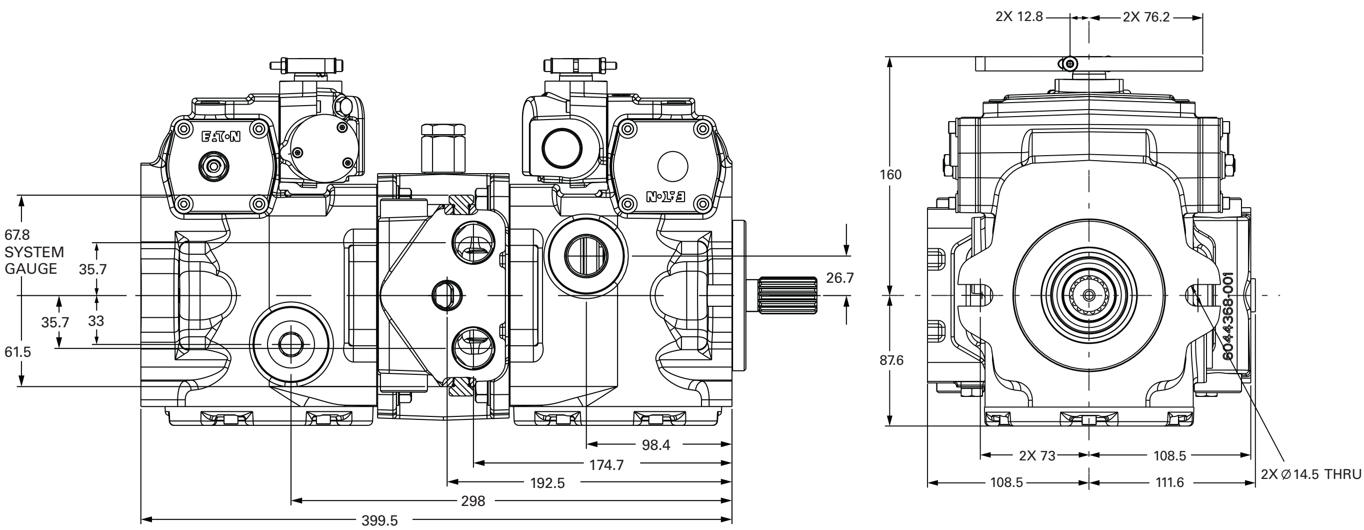


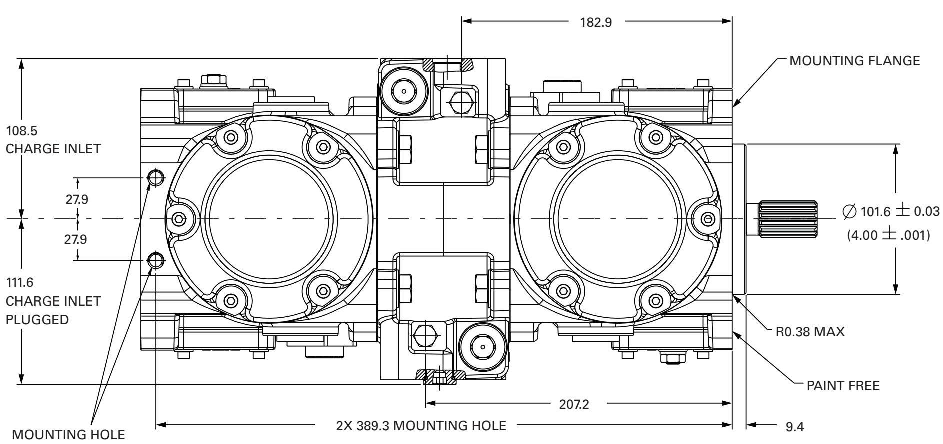




Installation drawings for X3 back-to-back pump

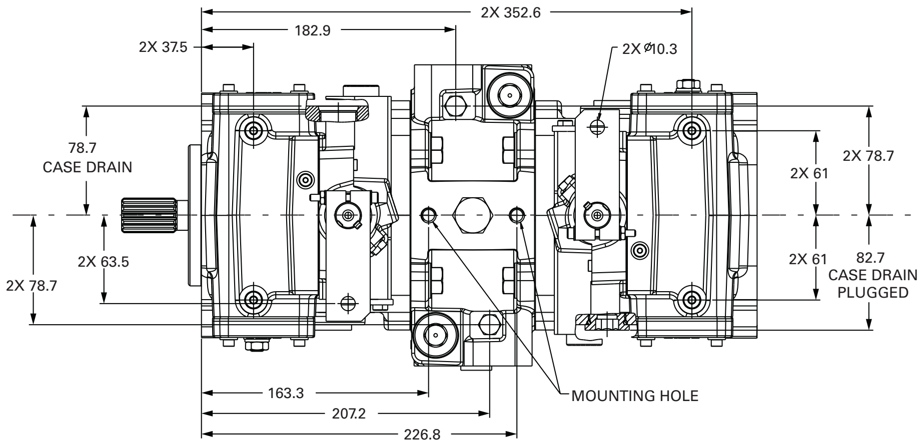
X3 back-to-back 41/49 dimension with manual controller without charge pump

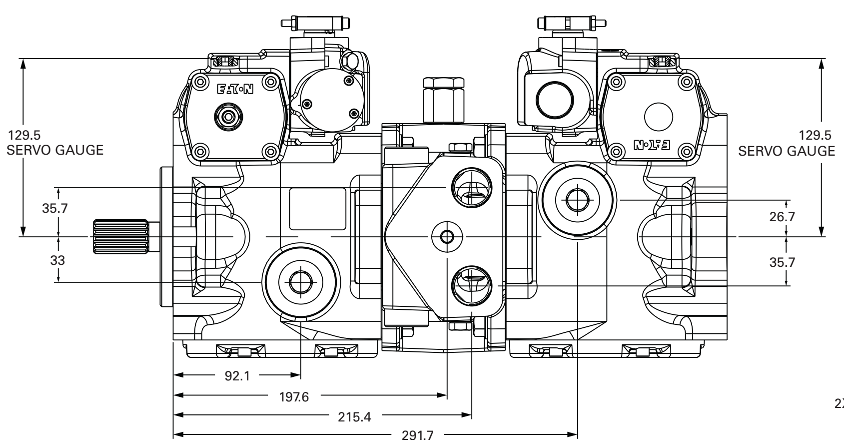


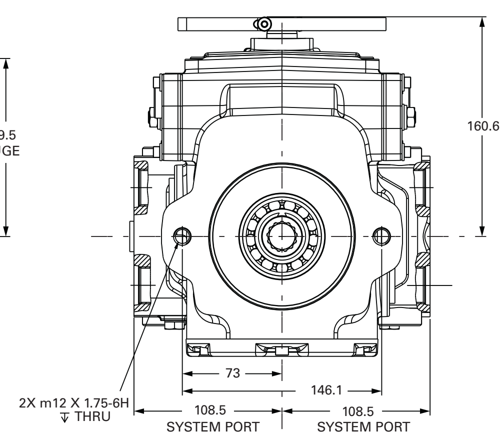


Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with manual controller without charge pump (Continued)

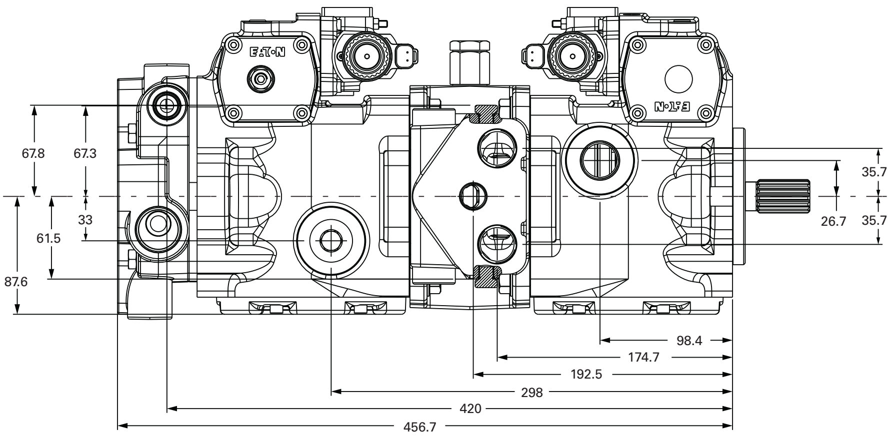


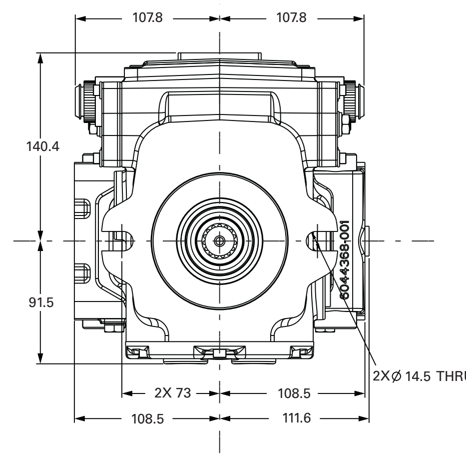


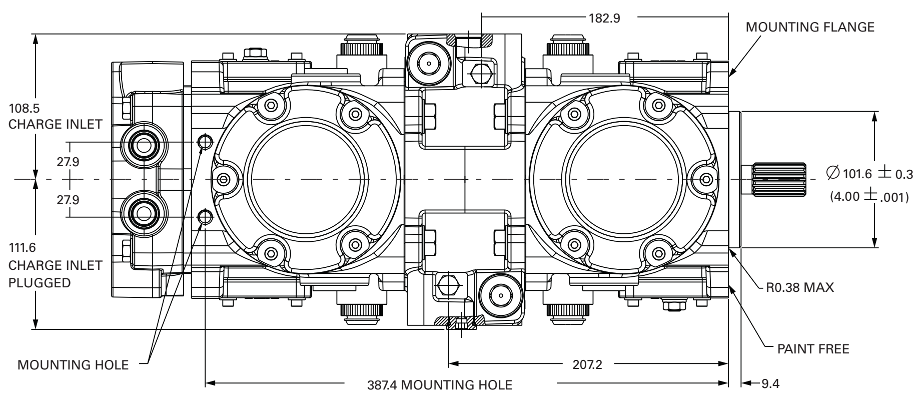


Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with EDC controller with charge pump



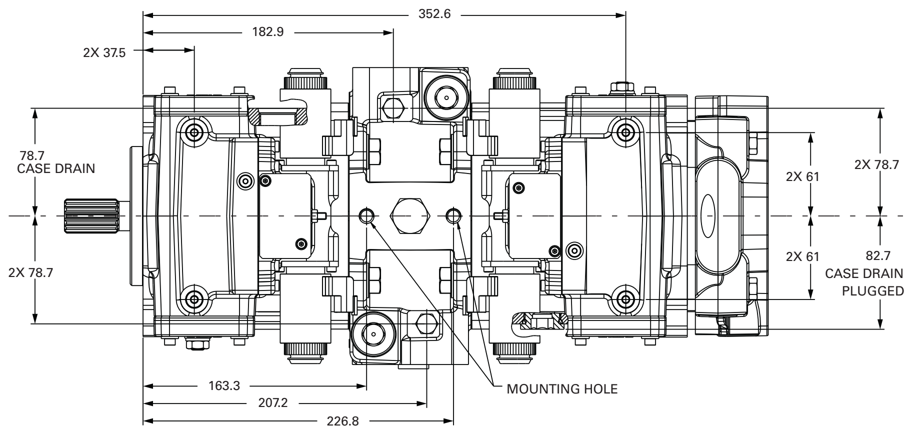


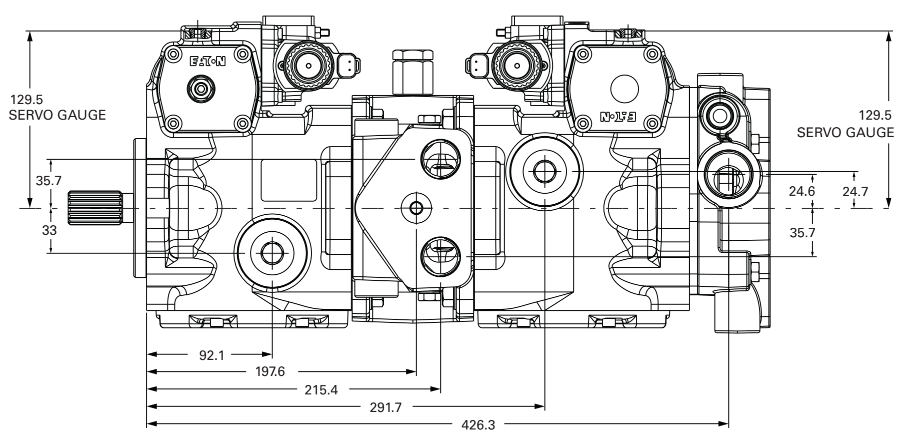


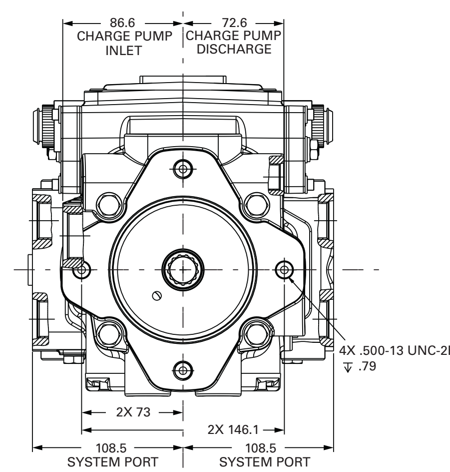
Features and port sizes

Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with EDC controller with charge pump (Continued)



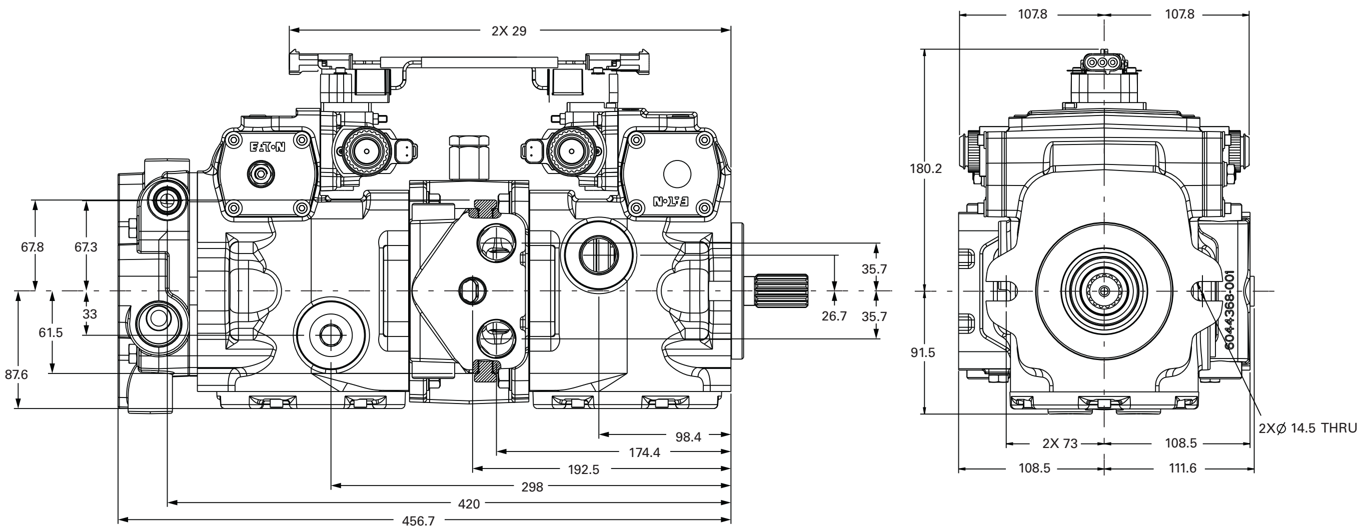


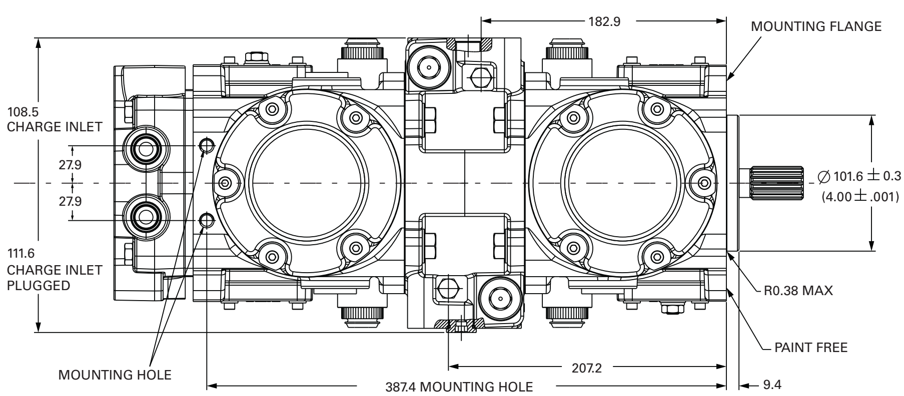


Features and port sizes

Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with EDCF controller with charge pump

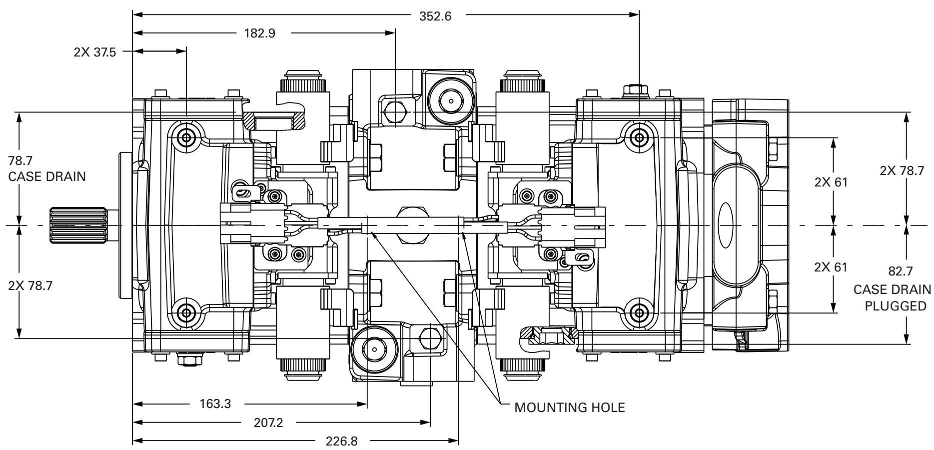


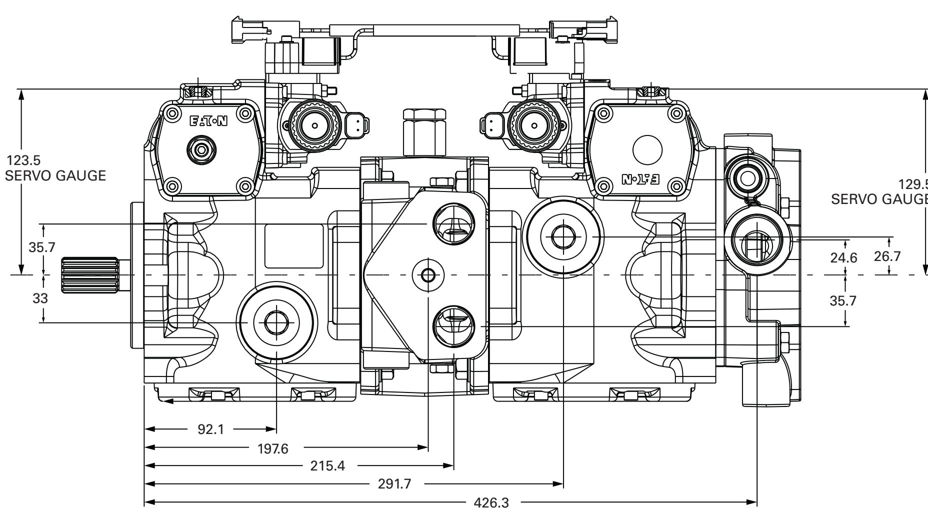


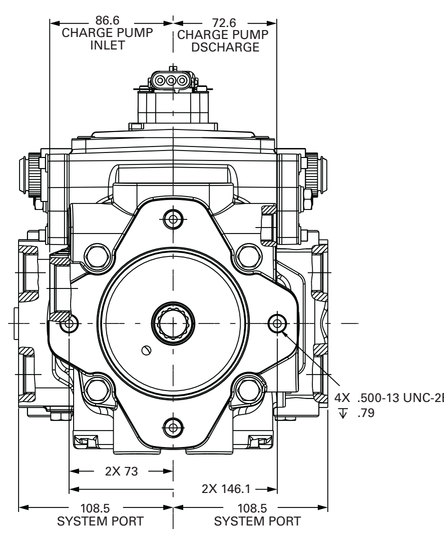
Features and port sizes

Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with EDCF controller with charge pump (Continued)



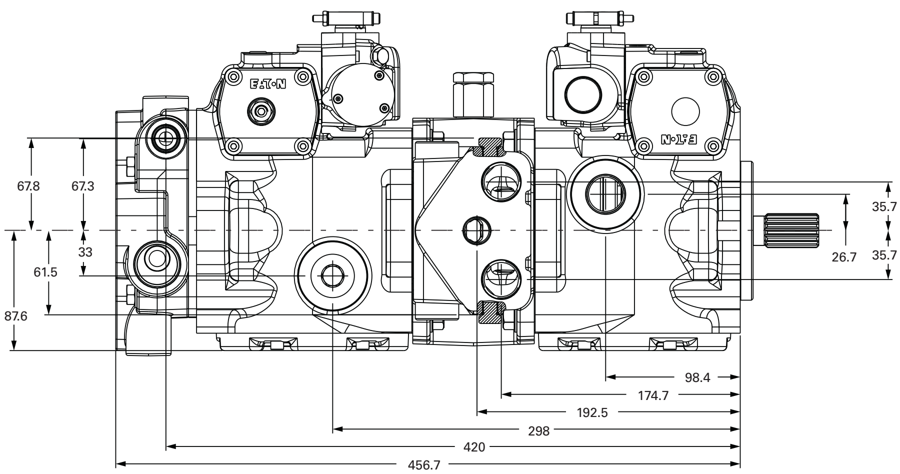


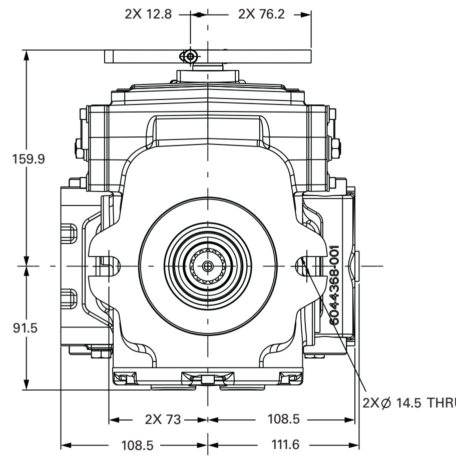


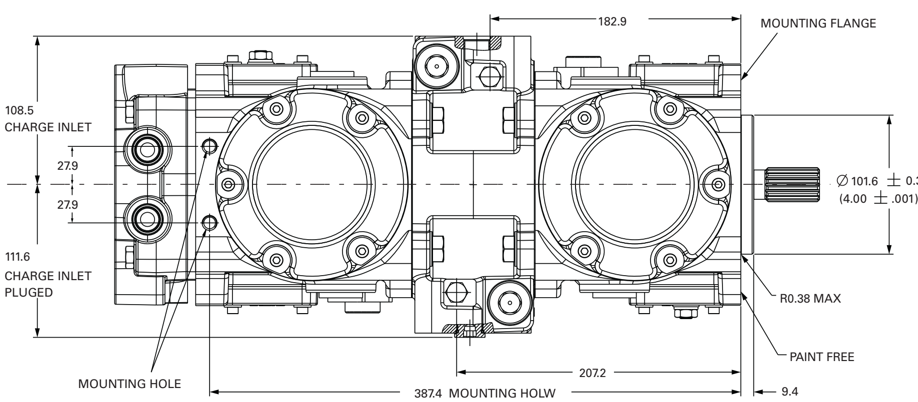
Features and port sizes

Installation drawings for X3 back-to-back pump

X3 back-to-back 41/49 dimension with manual controller with charge pump

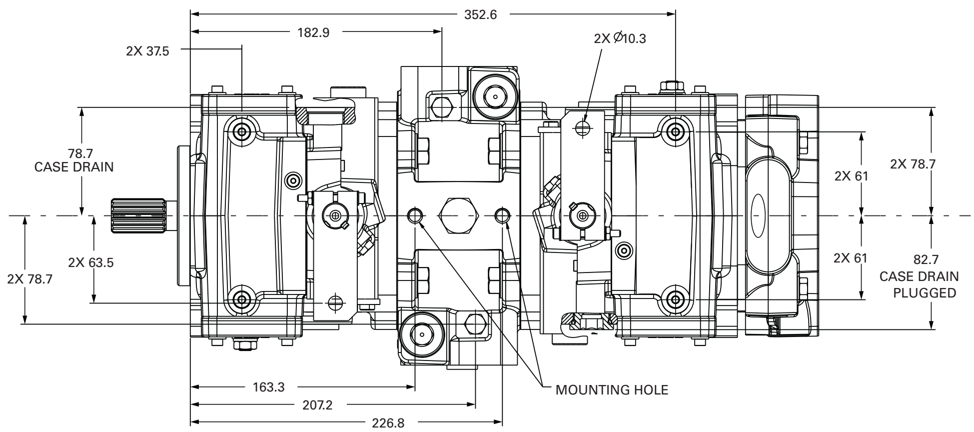


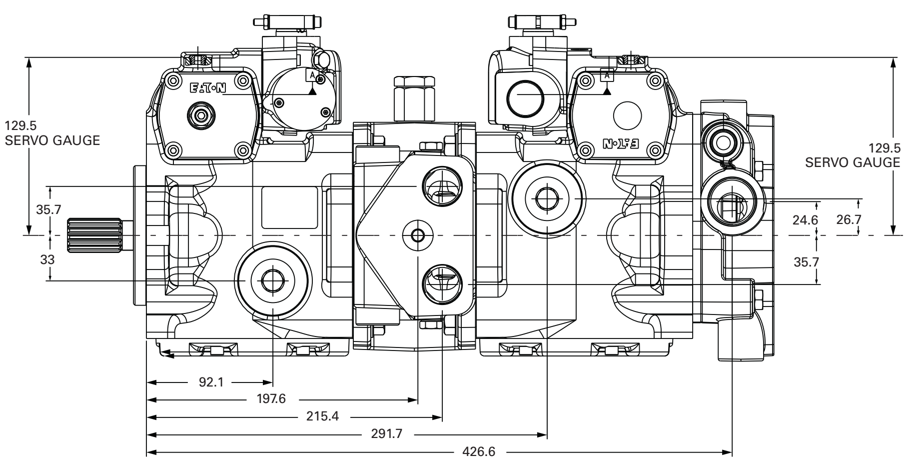


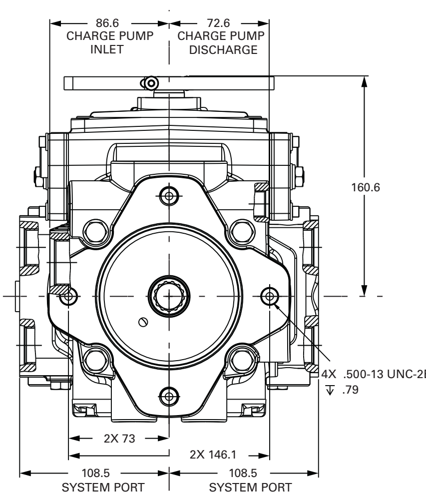


Installation drawings for X3 back-to-back pump

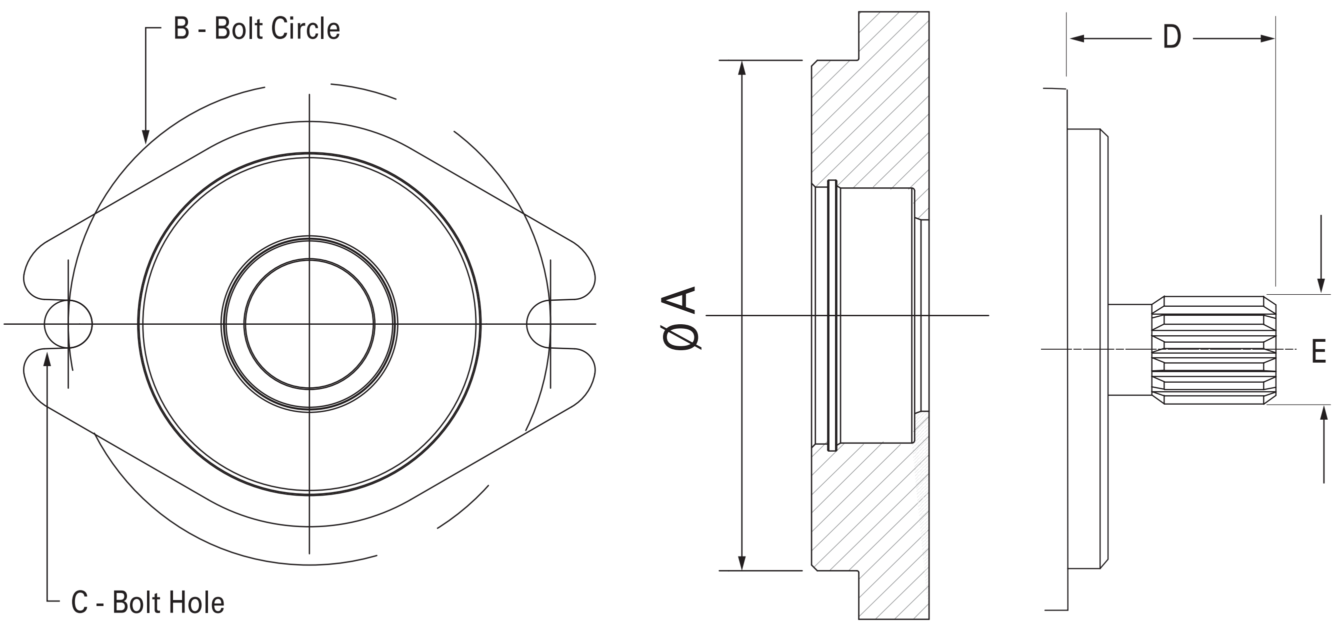
X3 back-to-back 41/49 dimension with manual controller with charge pump (Continued)







Installation drawings for X3 single & back-to-back pump



Mounting flange as per SAE J744	For size (cm³/r)	Pilot dia. A (mm)	Bolt circle B (mm)	Bolt hole C (mm)	Screw	Washer (mm)	Torque 8.8 (N-m)	Torque 10.9* (N-m)
SAE B, B-B, 2 Bolt	41,49	101.6	146	14.3	M12	12.5x 25x 4	80	110

Input shaft options and torque carrying capacity

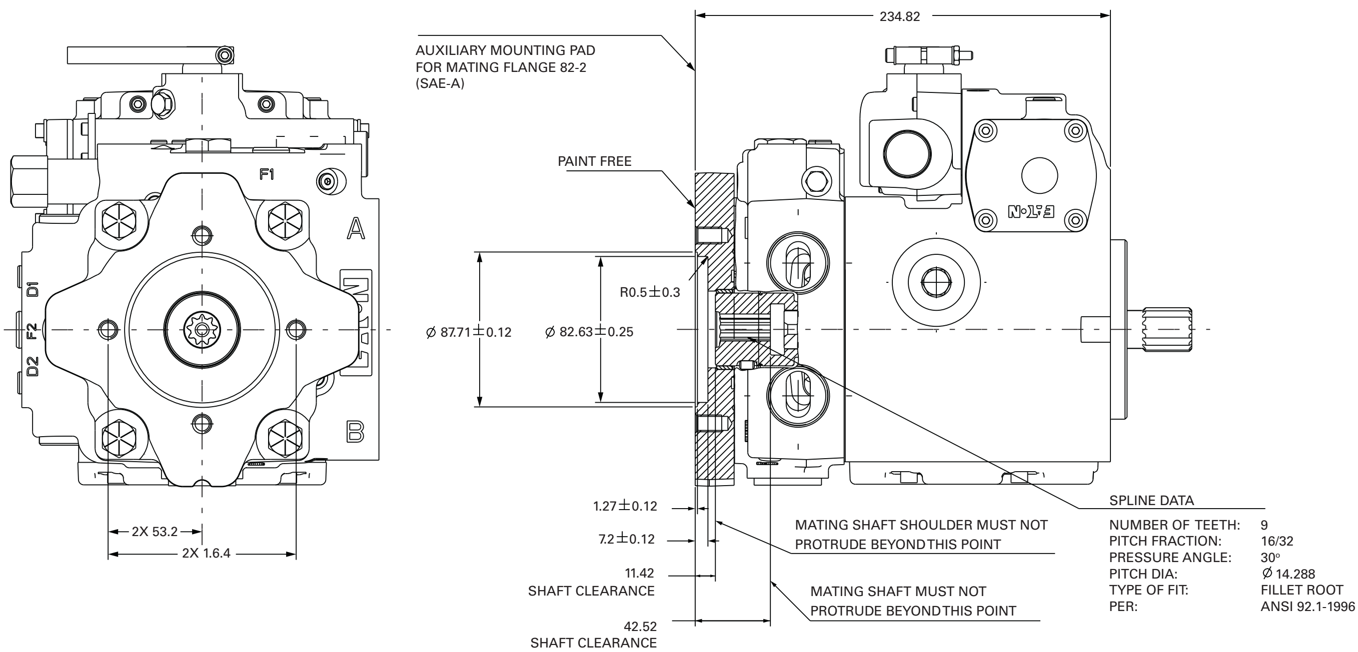
	Model code option		Shaft extn. - D	OD - E	Displacement cm³/rev (in3/r)		Torque
Shaft per ANSI B92.1	X3 Single	X3 B2B	mm [in]	mm [in]	40.6 (2.48)	49.2 (3.0)	N-m [lbf-in]
Splined-14T, 12/24 pitch #	2	2	55.6 [2.19]	31.15[1.226]	√	√	338[2987]
Splined-15T, 16/32 pitch	1	1	46.[1.81]	24.98 [.983]	√	√	338 [2987]

Available on request

Note: The combined torque required for multiple pumps must not exceed the torque rating of the input drive shaft of the front piston pump. Consult an Eaton representative and/or Eaton engineering on side load recommendations.

Installation drawings for X3 single pump

Auxiliary mounting: option (SAE A, 9 teeth)



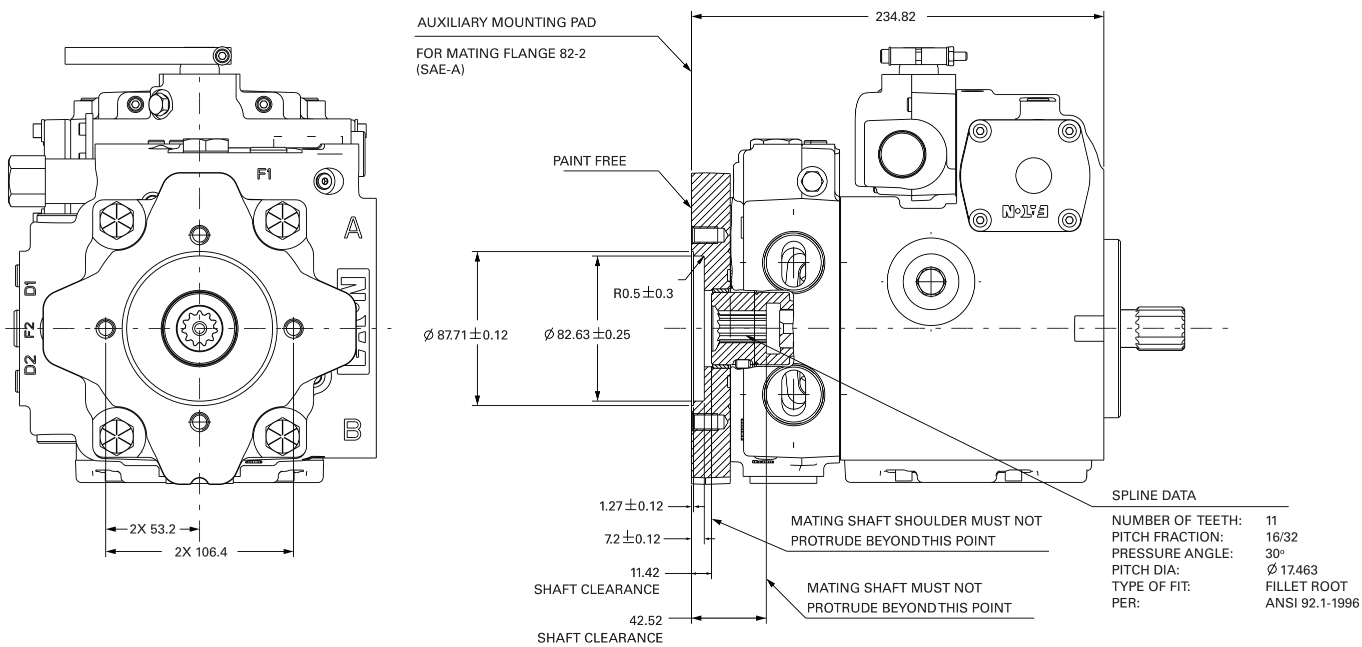
SPECIFICATIONS

OPTION	B
SPLINE	9 TEETH, 16/32 PITCH
MAXIMUM TORQUE	480 lbf.in

Features and port sizes

Installation drawings for X3 single pump

Auxiliary mounting: option (SAE A, 11 teeth)



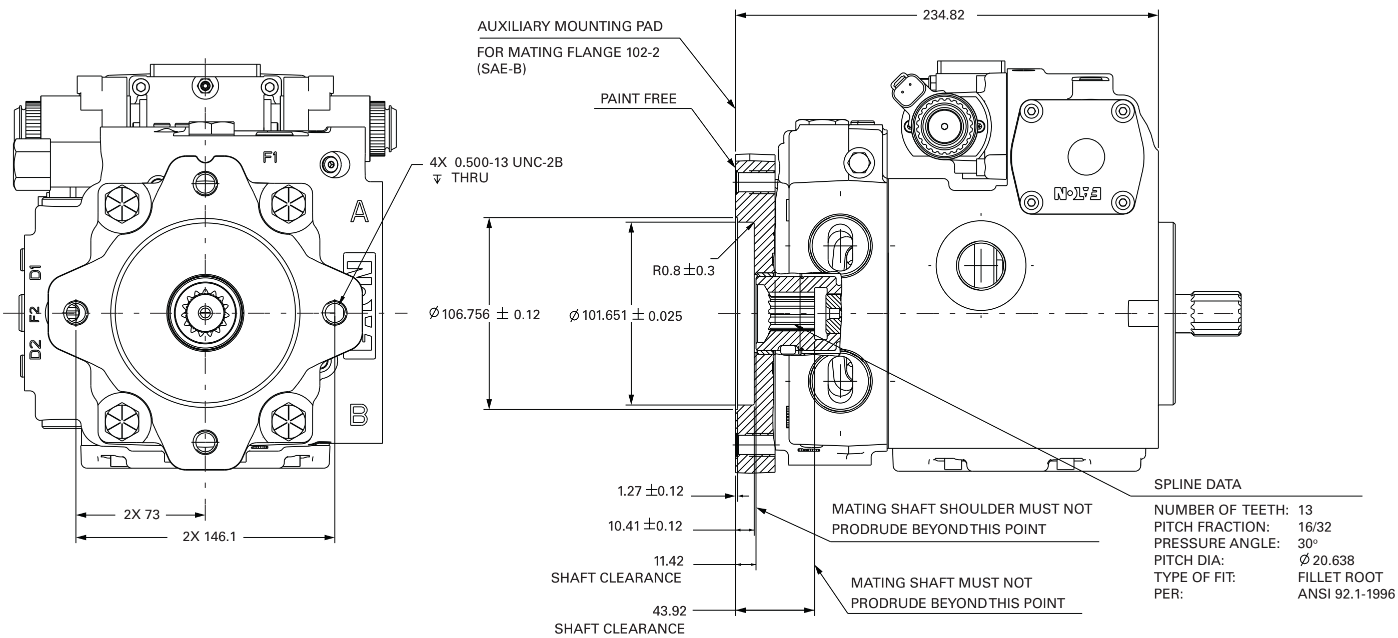
SPECIFICATIONS

OPTION	C
SPLINE	11 TEETH, 16/32 PITCH
MAXIMUM TORQUE	1167 lbf.in

Features and port sizes

Installation drawings for X3 single pump

Auxiliary mounting: option (SAE B, 13 teeth)



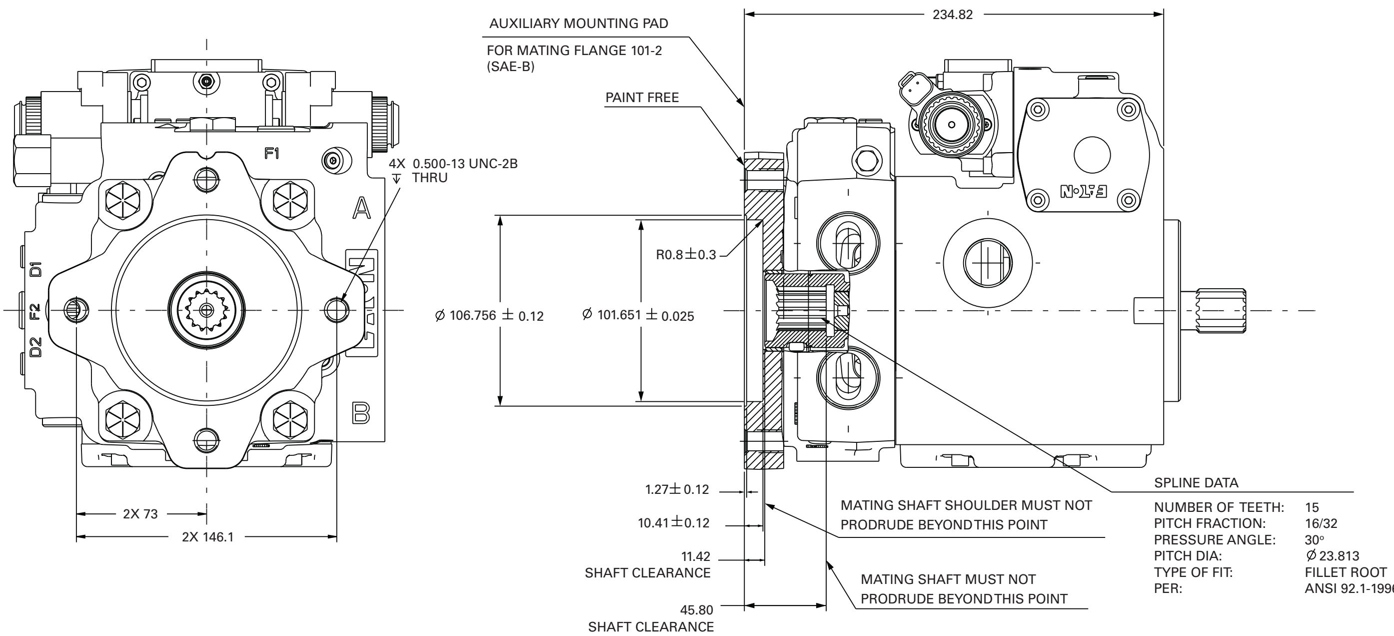
SPECIFICATIONS

OPTION	E
SPLINE	13 TEETH, 16/32 PITCH
MAXIMUM TORQUE	1852 lbf.in

Features and port sizes

Installation drawings for X3 single pump

Auxiliary mounting: option (SAE B-B, 15 teeth)

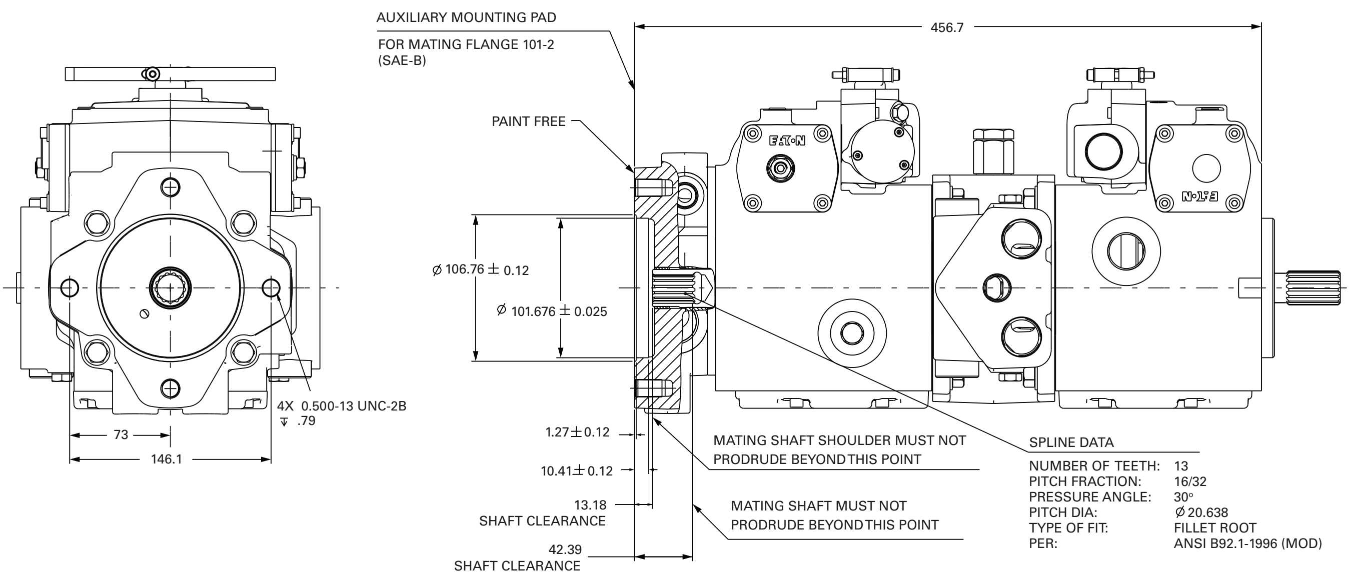


SPECIFICATIONS

OPTION	F
SPLINE	15 TEETH, 16/32 PITCH
MAXIMUM TORQUE	2987 lbf.in

Installation drawings X3 back-to-back pump

Auxiliary mounting: option (SAE B, 13 teeth)



SPECIFICATIONS

OPTION	E
SPLINE	13 TEETH, 16/32 PITCH
MAXIMUM TORQUE	1852 lbf.in

The long service life of Eaton hydrostatic transmissions is largely dependent on the proper selection and installation of the components necessary for transmission operation. The following components are necessary for transmission operation:

- Variable displacement pump
- Fixed or variable displacement motor
- Reservoir
- Filter
- Charge pump inlet line
- Pump and motor case drain lines
- High-pressure lines
- Heat exchanger
- Heat exchanger bypass valve
- Reservoir return line

Variable displacement pump

Eaton hydrostatic variable displacement pumps are an axial piston design. They are equipped with standard SAE mounts, shafts and port connections.

Fixed or variable displacement motor

Eaton hydrostatic motors are an axial piston design. They are equipped with standard SAE mounts, shafts and port connections.

Sizing equations

For sizing/selecting the right pump for your application please carryout following basic calculations.

Flow requirements
Pump flow rate

$$\text{Pump displacements (DP)} = \frac{\text{Nm X Dm}}{\text{Np X np (vol.) X m (Vol.)}}$$

Where,

Nmn = Necessary loaded motor speed (RPM)

Dm = Motor displacement (in3/rev)

Np = Pump input speed (RPM)

ηp (vol.) = Pump volumetric efficiency

ηm (vol.) = Motor volumetric efficiency

$$\text{Q (gpm)} = \frac{\text{Pump displacement (in}^3\text{/rev) X Speed (rpm) X } \eta \text{ (vol.eff.) Np X } \eta p \text{ (vol.) X} \eta m \text{ (Vol.)}}{231}$$

$$\text{Pump input power (HP)} = \frac{\text{Flaw rate output (GPM) X Pressure (psi)}}{1714 \text{ X } \eta \text{ (overall)}}$$

Torque

$$\text{Torque (lbf-in)} = \frac{\text{Pump displacement (in}^3\text{/rev) X Pressure (psi)}}{2 \text{ x } \pi) \text{ x } \eta \text{ (mech. eff.)}}$$

Charge pump displacement

$$D = \frac{0.156 \, (n_p \text{ X } D_p + n_m \text{ X } D_m}{2}$$

Dcp = Charge pump displacement

np = Number of pumps

nm= Number of motors

Dp = Pump displacement

Dm = Motor displacement

Reservoir

The reservoir is an important part of the hydrostatic transmission system. It should provide adequate oil storage and allow easy oil maintenance.

The reservoir must hold enough oil to provide a continuous oil supply to the charge pump inlet. It must also have enough room for the hydraulic oil to expand as the system warms up. Consider charge pump flow when sizing the reservoir: One half (.5) minute times (X) the maximum charge pump flow should be the minimum oil volume in the reservoir. Maintaining this oil volume will give the oil a minimum of thirty (30) seconds in the reservoir. This will allow any entrained air to escape and contamination to settle out of the oil.

To allow for oil expansion, the reservoir’s total volume should be at least six tenths (.6) minute times (X) the maximum charge pump flow.

The reservoir’s internal structure should cut down turbulence and prevent oil aeration.

The line returning flow to the reservoir should be fitted with a diffuser to slow the incoming oil to 1 to 1.2 meters [3-4 feet] per second to help reduce turbulence. The return flow line should also be positioned so that returning oil enters the reservoir below the liquid surface. This will help reduce aeration and foaming of the oil.

The reservoir should have baffles between the return line and suction line. Baffles prevent return flow from immediately reentering the pump.

A sixty-mesh screen placed across the suction chamber of the reservoir will act as a bubble separator. The screen should be placed at a 30° angle to the horizon.

The entrance to the suction line should be located well below the fluid surface so there is no chance of air being drawn into the charge pump inlet. However, the suction line entrance should not be located on the bottom of the reservoir where there may be a buildup of sediment. The suction line entrance should be flared and covered with a screen.

The reservoir should be easily accessible. The fill port should be designed to minimize the possibility of contamination during filling and to help prevent over filling. There should be a drain plug at the lowest point of the reservoir and it should also have a clean-out and inspection cover so the reservoir can be thoroughly cleaned after prolonged use. A vented reservoir should have a breather cap with a micronic filter.

Sealed reservoirs must be used at altitudes above 2500 feet. These reservoirs should be fitted with a two- way micronic filter pressure cap to allow for fluid expansion and contraction.

In both cases the caps must be designed to prevent water from entering the reservoir during bad weather or machine washing.

A hydrostatic transmission with a well designed reservoir will run quieter, stay cleaner and last longer.

Filter

A filter must be used to keep the hydraulic fluid clean. Either a suction filter or a pressure side filter may be used. The filter must be a no-bypass type. System oil particle levels should not exceed ISO 18/15 per ISO 4406. Refer to Eaton hydraulic fluid recommendations.

Recommended filters
Pressure line – 5 micrometer
Suction line = 3 OR 5 micrometer

When a suction filter is used, its flow capacity must be large enough to prevent an excessive pressure drop between the reservoir and charge pump inlet. The pressure at the charge pump inlet port must not be less than 0.80 bar absolute [6 in. Hg.] at normal continuous operating temperatures.

Charge pump inlet line

The inlet line to the charge pump should be large enough to keep the pressure drop between the reservoir and charge pump inlet within the limits described in the filter section. Fittings will increase the pressure drop, so their number should be kept to a minimum. It is best to keep fluid velocities below 1.25 meters [4 feet] per second.

Fluid and temperature compatibility must be considered when selecting the inlet line.

Pump and motor case drain

The case drain lines should be large enough to limit the pump and motor case pressures (Medium Duty to 2 bar [25 PSI]) at normal operating temperatures. Fluid and temperature compatibility must also be considered when selecting the case drain lines.

High-pressure lines

The high-pressure lines that connect the pump and motor must be able to withstand the pressures generated in the high pressure loop.

Heat exchanger

Use of a heat exchanger is dependent on the transmission’s duty cycle and on machine layout. The normal continuous operating fluid temperature measured in the pump and motor cases should not exceed 80˚C [180°F] for most hydraulic fluids.The maximum fluid temperature should not exceed 107˚C [225°F].

The heat exchanger should be sized to dissipate 25% of the maximum input power available to the transmission. It must also be sized to prevent the case pressures in the pump and motor from getting too high. Medium duty case pressure up to 2 bar [25 psi], at normal operating temperatures, are acceptable.

Heat exchanger bypass valve

The heat exchanger bypass valve is a pressure and/or temperature valve in parallel with the heat exchanger. Its purpose is to prevent case pressures from getting too high. The heat exchanger bypass valve opens when the oil is thick, especially during cold starts.

Reservoir return line

The same general requirements that apply to case drain lines apply to the reservoir return line.

Bearing life estimation

Bearing life is defined as the length of time in terms of revolutions or time until a fatigue failure. Bearing load is calculated as a reaction which is derived from the moment created by the piston side load. Magnitude of the side load directly related to the speed and pressure at which a unit can be operated.

Bearing life is a function of the side loads coming on the bearings. Other factors such as fluid type, viscosity of fluid and cleanliness also affects the life of bearing. If detail bearing life analysis is required, you can contact Eaton representative.

Installation requirements

The mounting orientation of pumps and motors is unrestricted provided the case drain of the pump and motor remain full.Position the case drain such that it assures an oil level at or above unit center line at start-up. The case drain line that carries the flow leaving the pump or motor should be connected to the highest drain port on each of the units. This assures that the pump and motor cases remain full.

The combined torque required to turn two or more pumps must not exceed the torque rating of the input drive shaft of the front piston pump. Installer to provide centering and a secure neutral for pump swashplate control shaft. An external support is recommended for all tandems.

Open-loop circuits

Eaton pumps and motors may be used in open-loop circuits under certain operating conditions. Consult your Eaton representative for details.

Hydraulic fluid recommendations

Introduction

Hydraulic fluids are one of the vital components of hydraulic system. Proper selection of oil assures satisfactory life and operation of system components. The purpose of this section is to provide readers with the knowledge required to select the appropriate fluids for use in systems that employ Eaton hydraulic components.

Viscosity and temperature

Viscosity is the measure of a fluid's resistance to flow. The most important characteristics to consider when choosing a fluid to be used in a hydraulic system is viscosity. The fluid must be thin enough to flow easily but thick enough to maintain adequate lubricating film between components and to maintain proper sealing at the operating temperatures of the hydraulic system.

For viscosity requirements, see table Viscosity of any fluid is relative to temperature, as the fluid warms the viscosity decreases and vice versa. When choosing a fluid, it is important to consider the start-up and operating temperatures of the hydraulic system. A high VI fluid shows relatively small change of viscosity with temperature.

Lubricants used for hydraulic applications may contain viscosity index improvers (VII). They refer to these fluids as viscosity index improved or multi-viscosity fluids. The viscosity of these fluids may drop down in use due to shearing of VI improvers used in the formulations. Anti-wear hydraulic oils containing polymeric thickeners, viscosity index improvers (VII) are generally used for wide band operating temperature applications These fluids experience temporary and permanent viscosity loss during use in hydraulic system. Check the extent of viscosity loss (shear stability) to avoid hydraulic service below the recommended minimum viscosity. Oil with good shear stability is recommended for wide band temperature applications.

Multi-grade engine oils, ATFs, UTTOs, etc., also contain VIIs, and viscosity loss will be encountered during use.

Cleanliness

Cleanliness of the fluid in a hydraulic system is extremely important. More than 70% of all failures are caused by contamination Eaton recommends that the fluid used in its hydraulic components be maintained per ISO 4406. Cleanliness level requirements vary with the hydraulic components. The cleanliness of a hydraulic system is dictated by the cleanliness requirements of the most stringent component in the system.

Cleanliness requirements for specific products are given in the table.

OEM's and distributors who use Eaton hydraulic components in their hydraulic systems should provide these requirements in their designs.

Contact Eaton filter representative for filtration information.

Fluid maintenance

The condition of a fluid has a direct effect on the performance and reliability of the system. Maintaining proper fluid viscosity, cleanliness level, water content, and additive level is essential for excellent hydraulic system performance. Routine fluid condition monitoring is recommended.

Fluid selection

Premium grade anti-wear (AW) petroleum based hydraulic fluids will provide the best performance with Eaton hydraulic components. Fluids that meet Eaton Hydraulic Fluid Specification E-FDGNTB002-E are considered good quality anti-wear hydraulic fluids. These fluids pass Eaton VickersR 35VQ25A high pressure vane pump test (Eaton ATS-373 test procedure, ASTM D 6973). Automotive crank case oils with American Petroleum Institute (API) letter designation SF, SG, SH, SJ, or higher per SAE J 183 classes of oils are recommended for applications using Eaton DG valves Automotive crankcase oils generally exhibit less shear stability compared to industrial anti-wear hydraulic fluids, which can result in higher loss of viscosity during service life. Other mineral oil-based lubricants commonly used in hydraulic systems are automatic transmission fluids (ATF) and universal tractor transmission oils (UTTO).

Synthetic hydrocarbon base stocks, such as polyalphaolefins (PAO) are also used to formulate hydraulic fluids, engine oils, ATFs and UTTOs Alternate fluids are recommended when specific properties, such as fire resistance biodegradability etc., are necessary for the application. Keep in mind that alternative fluids may differ from AW petroleum fluids in properties.

Additional notes

When choosing a hydraulic fluid, all the components in the system must be considered. Viscosity limitations have to meet the most stringent component requirements.

For any system where the fluid is non-petroleum oil, set the target one ISO code cleaner for each particle size than that of petroleum fluids.

Keep adequate fluid level in the reservoir. Take fluid level reading when the system is cold.

Contact your Eaton representative, if you have specific questions about the fluid requirements of Eaton hydraulic components.

Hydraulic fluid recommendations

Viscosity & cleanliness recommendation

Product	Minimum *	Optimum	Maximum	ISO cleanliness
Medium duty piston pumps and motors charged systems	6.0 cSt (45 SUS)	10 – 39 cSt (60-180 SUS)	2158 cSt (10000 SUS)	21/18/13

Additional notes

- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. Motor cavitation is not a problem during cold start-ups, except for two speed motors. Thick oil can cause high case pressures which in turn cause shaft seal problems
- When choosing a hydraulic fluid, all the components in the system must be considered and the optimum viscosity range adjusted accordingly. For example, when a medium duty piston pump is combined with a Disk Valve Motor the optimum viscosity range becomes 100 - 180 SUS [20 - 39 cSt] and viscosity should never fall below 70 SUS [13 cSt]
- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky, water contamination may be a problem
- Take fluid level reading when the system is cold.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydraulic components

Note: The flow specified by operator may differ from the actual flow due to internal contamination, causing the spool valve to get struck in the control unit. Check for the possible alternatives as per application to bring the spool valve to its normal position. For any assistance, contact your Eaton representative

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Document No. E-PUID-CC002-E
April 2021

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