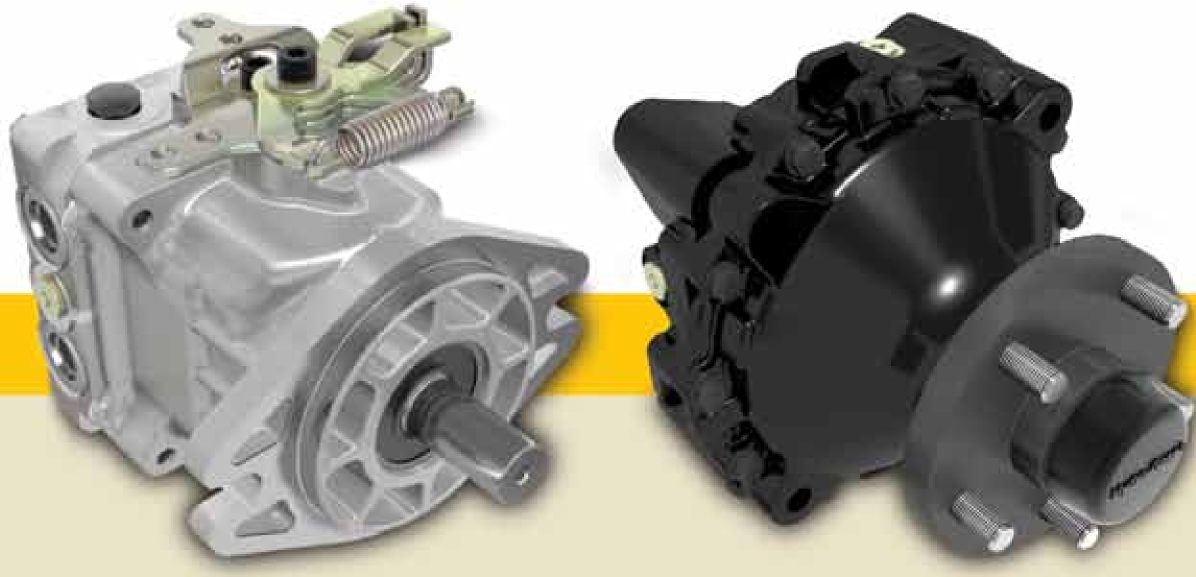
HYDRO-GEAR®



PUMP & MOTOR


HYDRO-GEAR
COMMERCIAL

Hydro-Gear®

Headquartered in Sullivan, IL, Hydro-Gear is a global leader in the design and manufacture of precision drive systems. Working in partnership with OEMs worldwide, Hydro-Gear produces an extensive line of high-performance, efficient hydrostatic transmissions and transaxles; gear reduction drives; variable displacement piston pumps and wheel motors; electric drive systems; and infinitely variable transmissions for industrial, commercial, and consumer markets. With multiple manufacturing sites and global operations, Hydro-Gear's goal is to ensure our products and services meet our customers' rigorous requirements and exceed their expectations.

Forward Motion Through Forward Thinking®

HYDRO-GEAR®

Contents

**Specifications subject to change without notice.*

HYDRO-GEAR®

HYDRO-GEAR®

RESPONSIVE.
RELIABLE.
INNOVATIVE.

P-Series & T-Series Overview

Hydro-Gear P-Series hydrostatic pumps have an axial piston design with spherical nosed pistons. The P-Series pumps provide an infinitely variable pump displacement range between zero and maximum in both forward and reverse modes of operation. The variable displacement pumps feature cradle-mounted swashplate design with manual direct-proportional displacement control that regulates the pump and oil flow direction. Reversing the angle of the swashplate past the neutral position reverses the pump oil flow which reverses the direction of a hydraulic motor output rotation.

A fixed displacement gerotor charge pump is provided on the standard P-Series pumps. Oil from a separate external reservoir and filter is pumped into the pump-motor closed loop circuit by the charge pump. Fluid not required for replenishment of the closed loop circuit flows either into the pump housing through a cooling orifice or back to the charge pump inlet through the charge pressure relief valve. The P-Series pumps are available with an optional auxiliary pump. The auxiliary pump incorporates the principles of the standard charge system and provides the source for a separate hydraulic circuit to operate accessories.

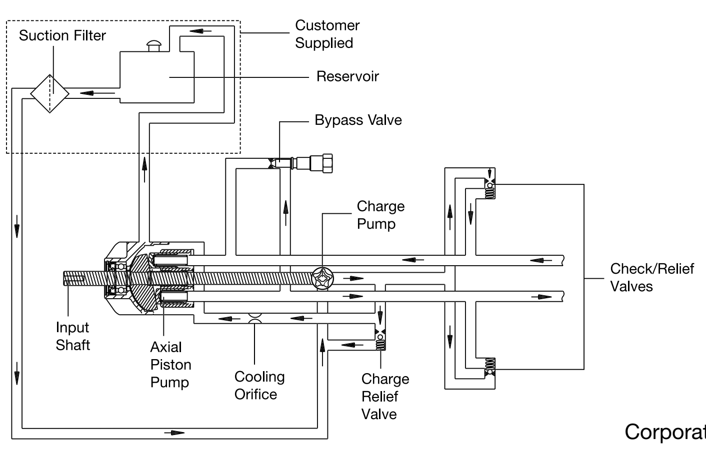
The P-Series pumps are equipped with shock valves. Shock valves are both check valves and factory preset direct acting system pressure relief valves. They are available in various relief pressure settings and bleed orifice sizes. Two shock valves are included in the pump end cap to control the makeup oil flow for the system and provide relief protection. The selection of the shock valves plays an important role on the system pressures, response, and the amount of heat generated.

A screw-type bypass valve is included in the pumps to permit limited unpowered movement of the machine. When opened, the bypass valve allows oil to route from one side of the closed loop circuit to the other.

The P-Series also has several options and optional features to ease installation. Standard options include control arm location, input rotation direction, and input shaft options. Additional optional features include Return-to-Neutral (RTN) control type and orientation, RTN spring type, and control arm location options.

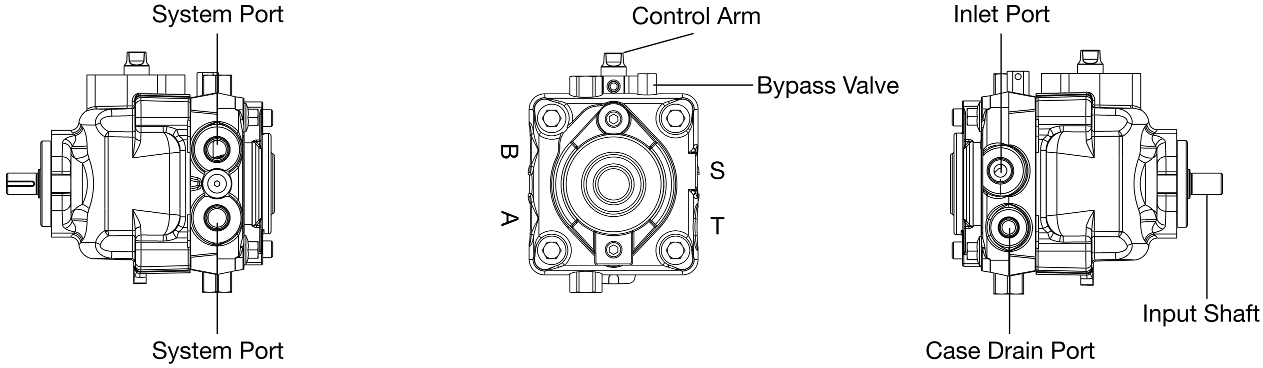
The P-Series pumps can be configured in several tandem T-Series combinations. The T-Series provides an effective method to drive the pumps with a single input shaft and allows the option of an increased auxiliary flow and pressure source with the addition of a gear pump.

The P-Series and T-Series pumps can be combined with hydraulic wheel motors or other remotely located units to complete a fluid power transmission system. The pumps are primarily used for traction drive propulsion in a wide variety of mobile applications but are capable of many other applications.

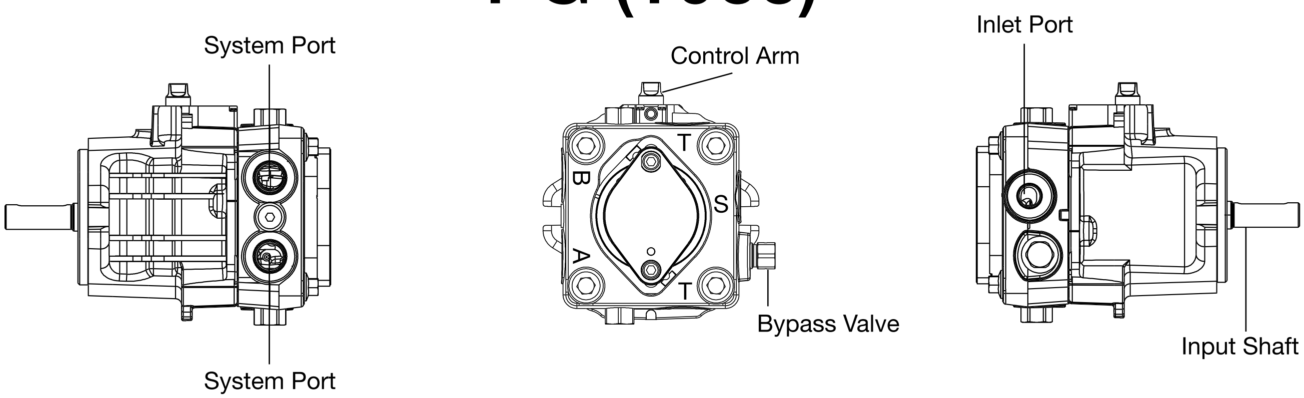


BASIC P-SERIES HYDRAULIC FLOW DIAGRAM

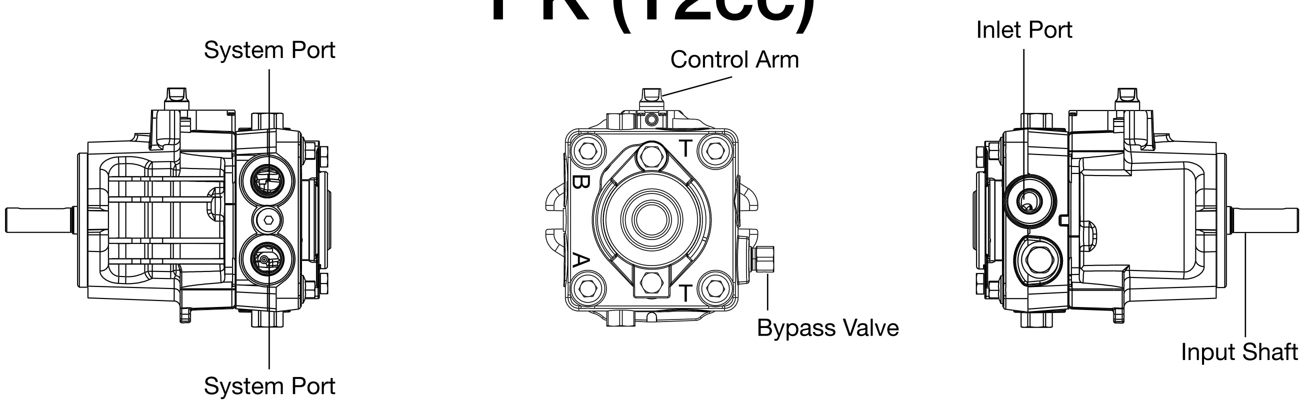
PC (6cc)



PG (10cc)

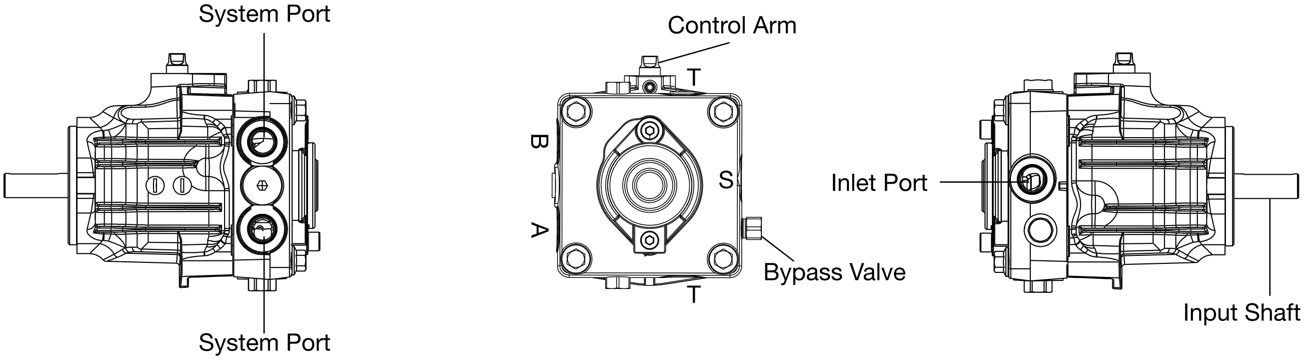


PK (12cc)

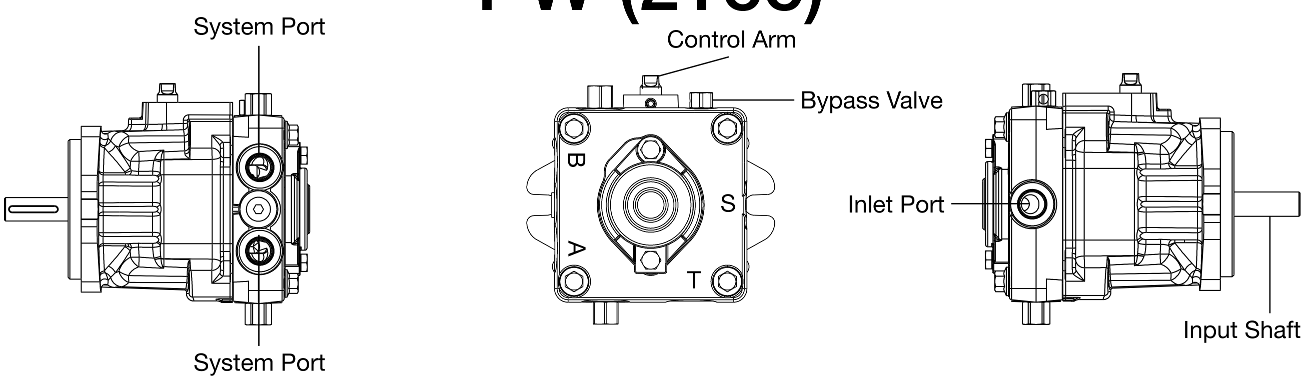


S= Supply Inlet Port T= Case Drain/Tank Port

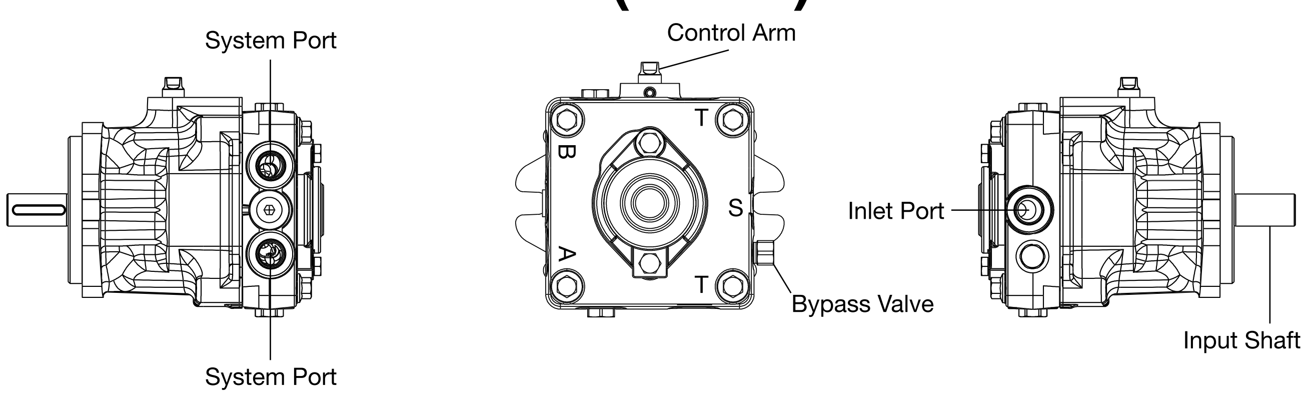
PR (16cc)



PW (21cc)



PY (21cc)

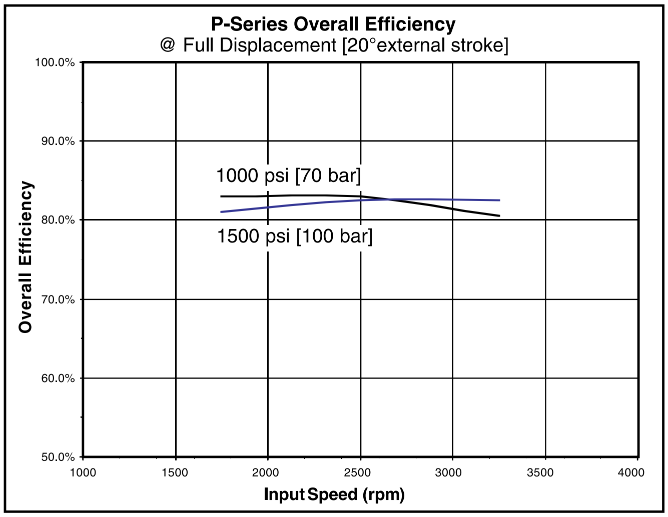


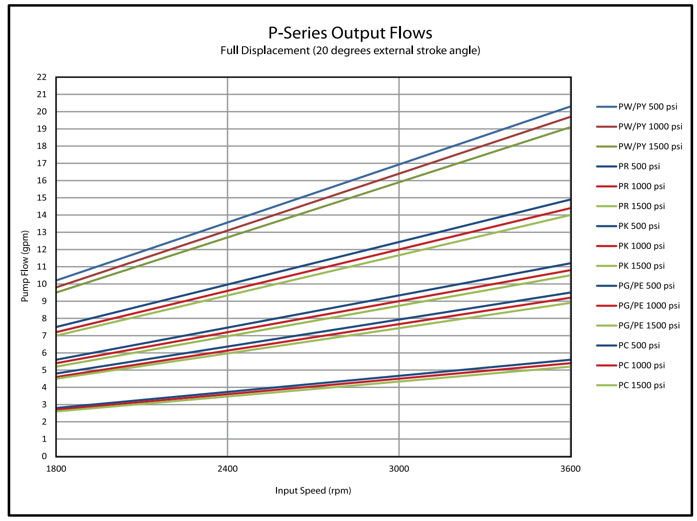
P-Series Overview

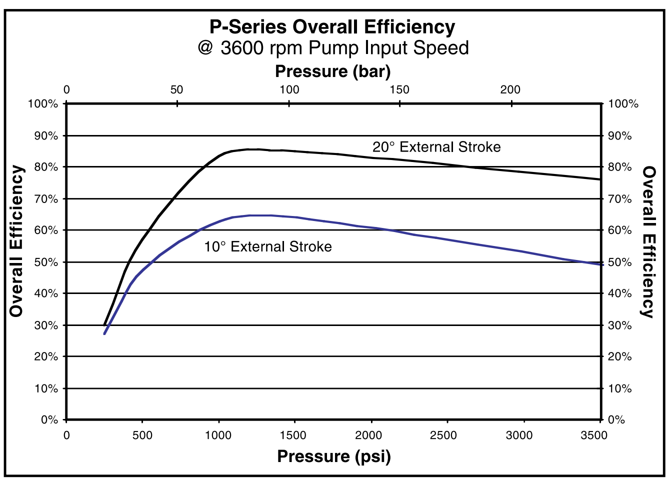
Technical Specifications - Variable Displacement, Bi-directional Pumps

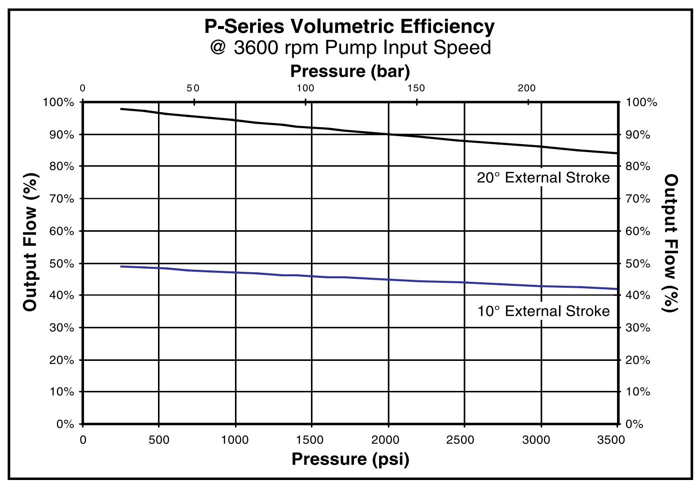
Specifications		PC	PG	PK	PR	PW	PY
Displacement	in^3/rev [cc/rev]	0.37 [6.1]	0.62 [10.2]	0.73 [12]	0.97 [16]	1.33 [21.8]	1.33 [21.8]
Input Speed Maximum Hi-Idle [No Load] Minimum [Loaded]	 rpm rpm	 3600 1800	 3600 1800	 3600 1800	 3600 1800	 3600 1800	 3600 1800
System Operating Pressure Continuous Intermittent Peak	 psi [bar] psi [bar] psi [bar]	 750 [51] 1750 [120] 2500 [172]	 1000 [70] 2100 [145] 3500 [240]	 1000 [70] 2100 [145] 3500 [240]	 1250 [86] 2500 [172] 3750 [260]	 1250 [86] 2500 [172] 3750 [260]	 1500 [103] 2750 [190] 3750 [260]
Pump Performance @ 2400 rpm/1000 psi @ 3000 rpm/1000 psi @ 3600 rpm/1000 psi	 gpm [l/min] gpm [l/min] gpm [l/min]	 3.6 [13.6] 4.5 [17.0] 5.4 [20.4]	 6.1 [23.1] 7.6 [28.8] 9.2 [34.8]	 7.1 [26.8] 8.9 [33.6] 10.8 [40.8]	 9.6 [36.3] 12 [45.4] 14.4 [54.5]	 13.1 [49.6] 16.4 [62.1] 19.6 [74.2]	 13.1 [49.6] 16.4 [62.1] 19.6 [74.2]
Case Pressure Maximum @ Cold Start Continuous - Max.	 psi [bar] psi [bar]	 10 [0.7] 4 [0.3]	 10 [0.7] 4 [0.3]	 10 [0.7] 4 [0.3]	 25 [1.7] 10 [0.7]	 25 [1.7] 10 [0.7]	 25 [1.7] 10 [0.7]
Inlet Vacuum Maximum Continuous Inches Mercury		4	4	4	4	4	4
Charge Pump Displacement(s)	in^3/rev [cc/rev]	0.13 [2.1]	0.11/0.13 [1.9/2.1]	0.19 [3.2]	0.13/0.19/0.25 [2.1/3.2/4.1]	0.13/0.19/0.25 [2.1/3.2/4.1]	0.25 [4.1]
Auxiliary Pump Displacement	in^3/rev [cc/rev]	0.19 [3.2]	0.19 [3.2]	0.19 [3.2]	0.19 [3.2]	0.19 [3.2]	0.19 [3.2]
Auxiliary Pump Relief Setting	psi [bar]	650 [45]	650 [45]	650 [45]	650 [45]	650 [45]	650 [45]
Auxiliary Pump Performance @3200 rpm, 500 psi, 70 SUS [13 Cst] oil, & 180°F	gpm [l/min]	1.8 - 2.0 [6.8 - 7.6]	1.8 - 2.0 [6.8 - 7.6]	1.8 - 2.0 [6.8 - 7.6]	1.8 - 2.0 [6.8 - 7.6]	1.8 - 2.0 [6.8 - 7.6]	1.8 - 2.0 [6.8 - 7.6]
Control Torque Req'd to Stroke Pump* [Approximate - 20° External Stroke Angle] **Tested with 20w50 engine oil API rating SM/SL*	lb-in/1000 psi [Nm/70 bar] lb-in/500 psi [Nm/35 bar]	75 [8.5] 55 [6.2]	85 [9.6] 60 [6.8]	85 [9.6] 60 [6.8]	95 [10.7] 75 [8.5]	135 [15.3] 85 [9.6]	170 [19.2] 125 [14.1]
Pump Oil Temperature Max. Intermittent (hottest point) Normal Operating Range	 °F [°C] °F [°C]	 230 [110] -10 to 200 [-23 to 93]	 230 [110] -10 to 200 [-23 to 93]	 230 [110] -10 to 200 [-23 to 93]	 230 [110] -10 to 200 [-23 to 93]	 230 [110] -10 to 200 [-23 to 93]	 230 [110] -10 to 200 [-23 to 93]
Fluid Viscosity Limits @ 230° F [110°C] Optimum Minimum	 SUS [Cst] SUS [Cst]	 70 [13] 55 [9]	 70 [13] 55 [9]	 70 [13] 55 [9]	 70 [13] 55 [9]	 70 [13] 55 [9]	 70 [13] 55 [9]
Weight of Unit	lbs [kg]	7 [3.2]	8 [3.6]	9.4 [4.3]	12 [5.4]	14 [6.3]	14 [6.3]
Inlet Filtration Requirement Nominal	 micron	25	25	25	25	25	25

P-Series Performance

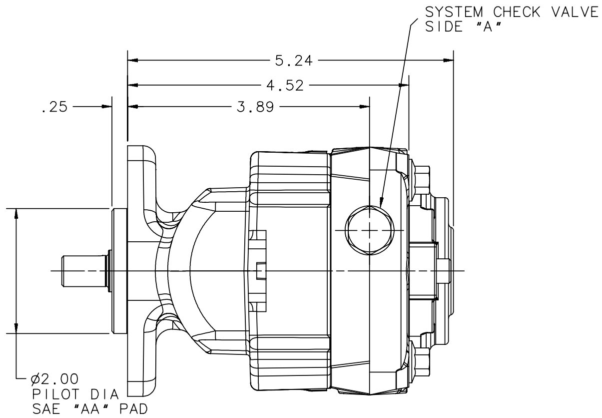


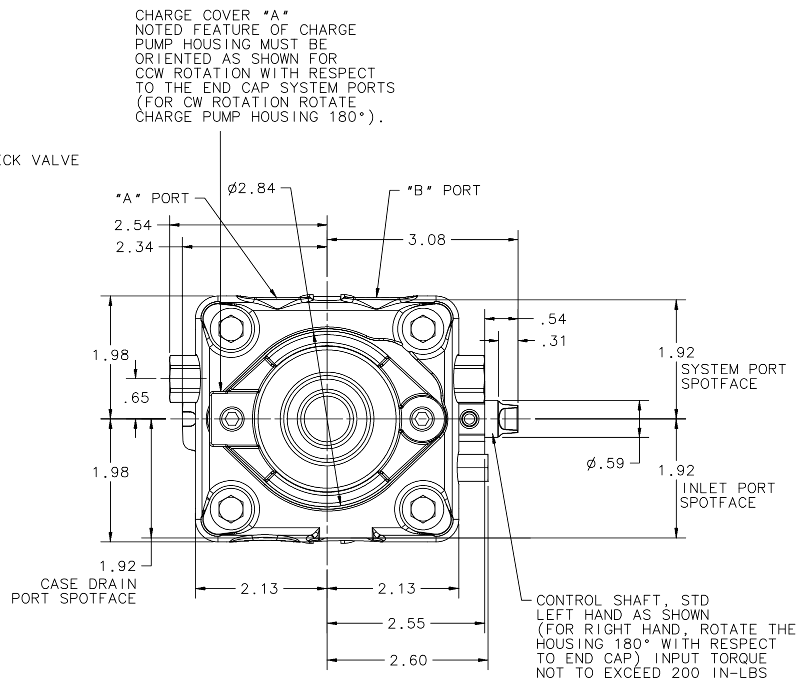


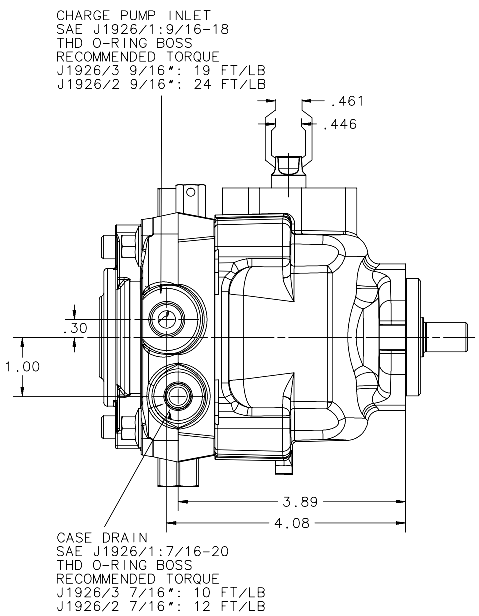


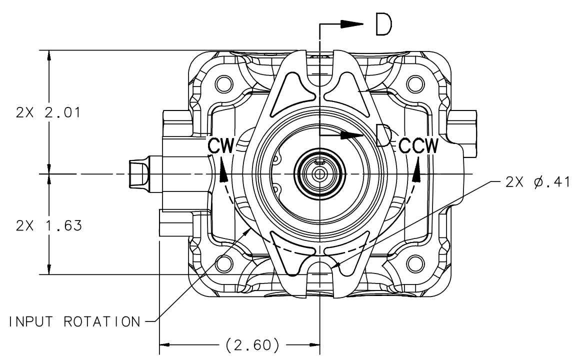


PC (6cc) Series Reference Dimensions

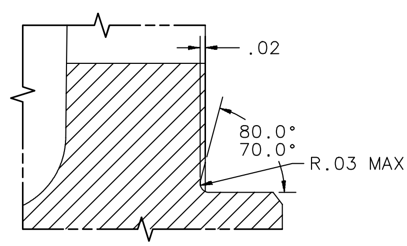








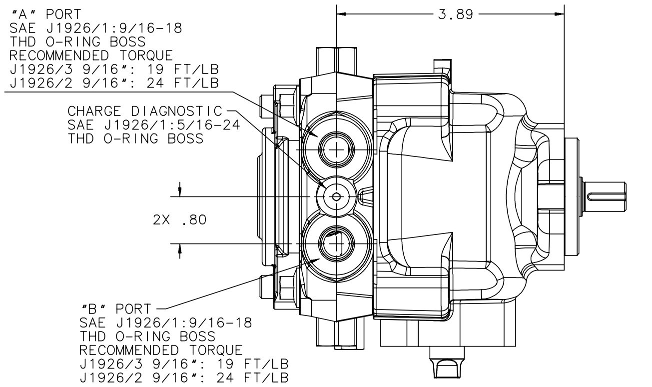
FRONT MOUNT

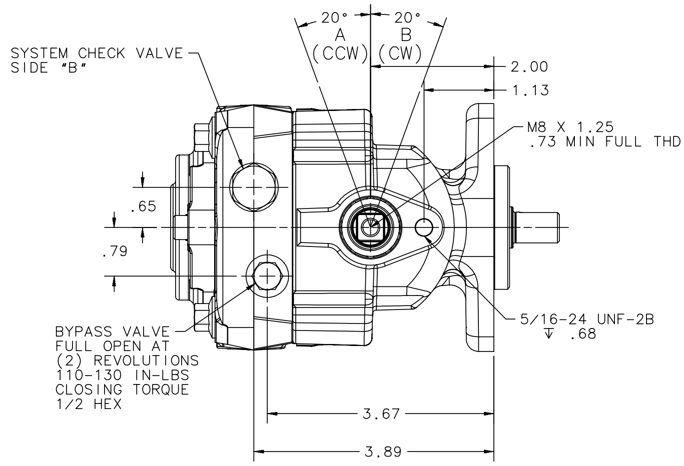


SECTION D-D

SCALE 4:1

PC (6cc) Series Reference Dimensions

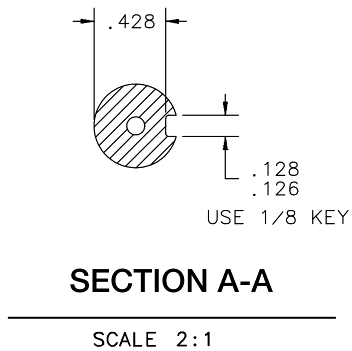


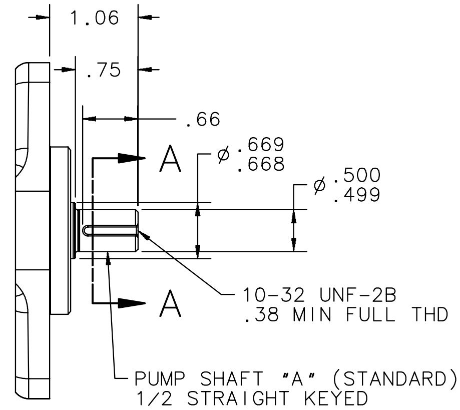


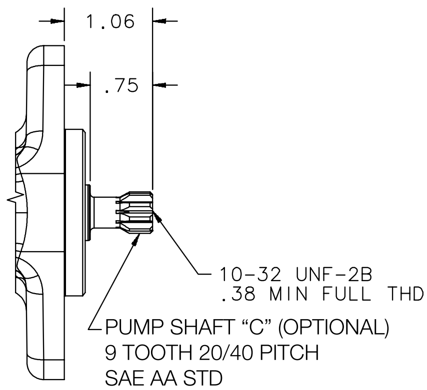
OIL FLOW CHART

CONTROL SHAFT SIDE	LEFT HAND				RIGHT HAND			
INPUT SHAFT ROTATION	CW		CCW		CW		CCW	
CONTROL SHAFT ROTATION (DIRECTION)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)
SYSTEM PORT A FLOW	IN	OUT	OUT	IN	OUT	IN	IN	OUT
SYSTEM PORT B FLOW	OUT	IN	IN	OUT	IN	OUT	OUT	IN

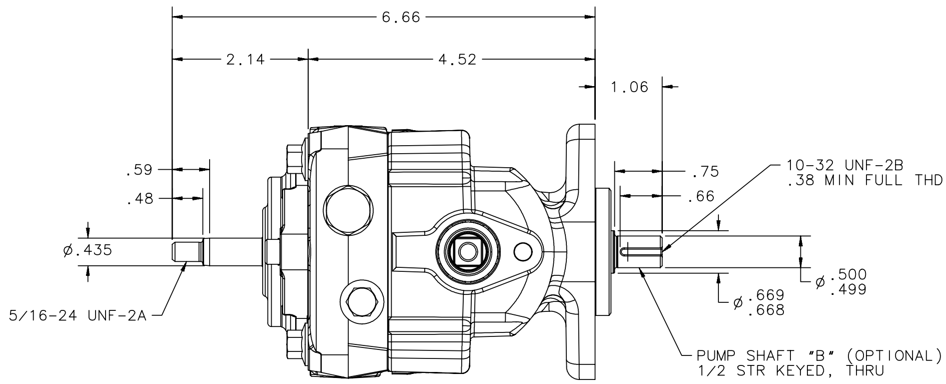
PC (6cc) Series Shaft Options



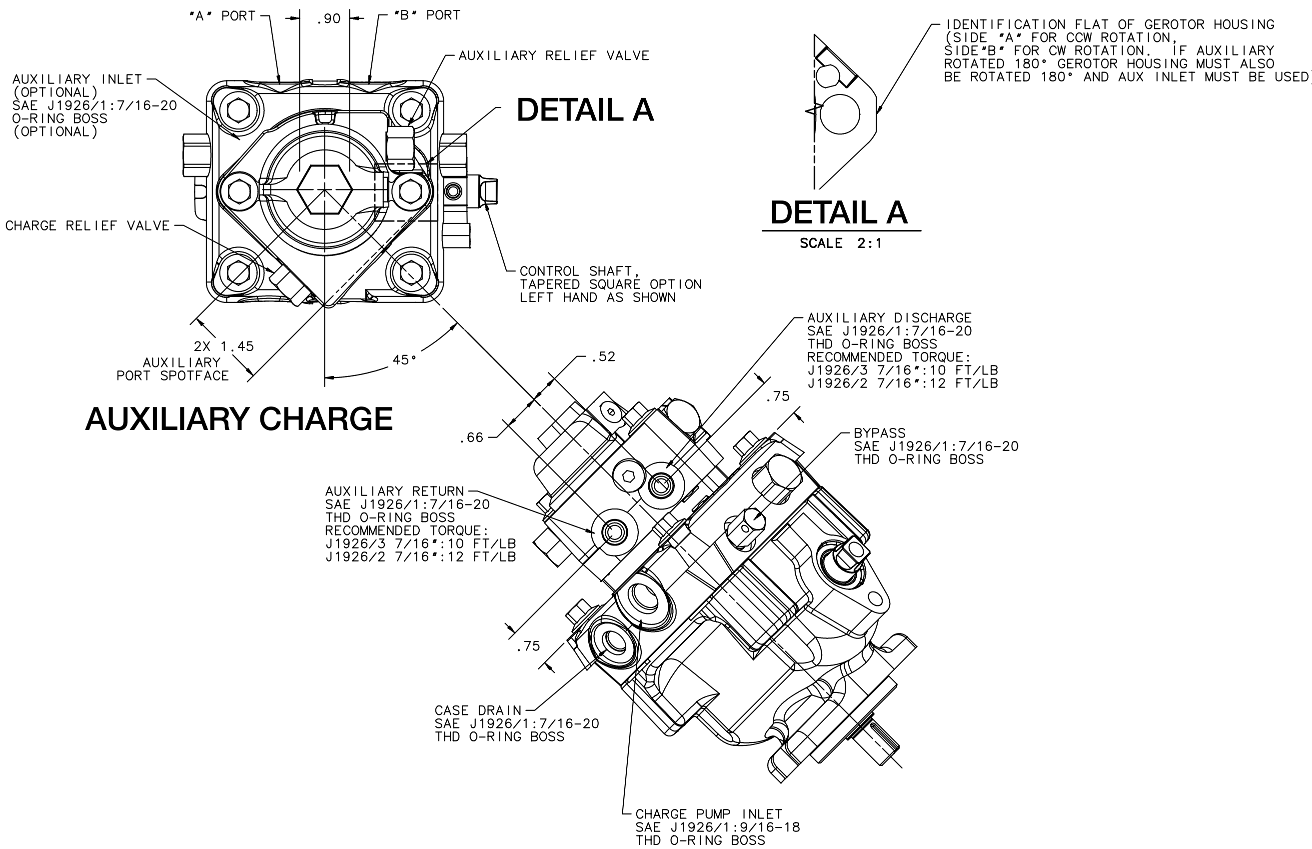


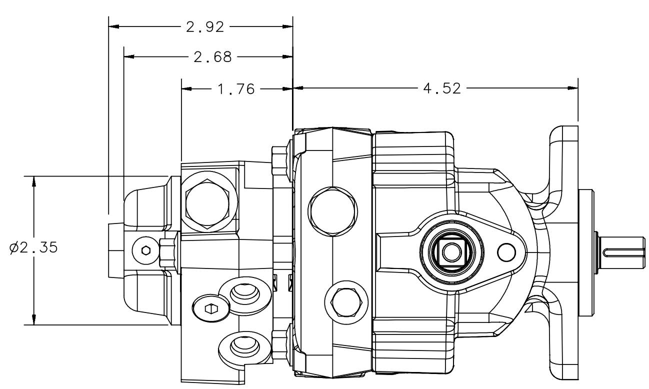


PC (6cc) Series Shaft Options (For Fans)

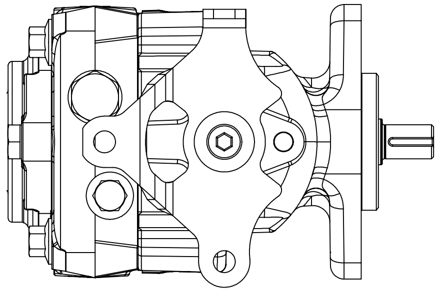


PC (6cc) Series Auxiliary Options

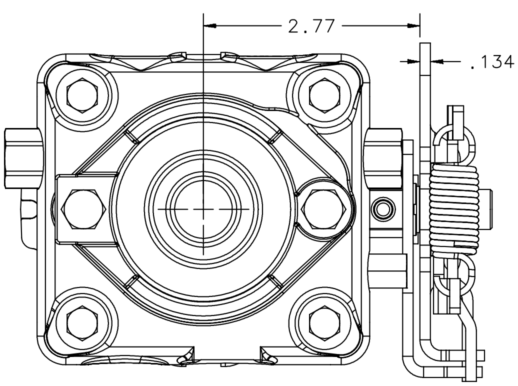


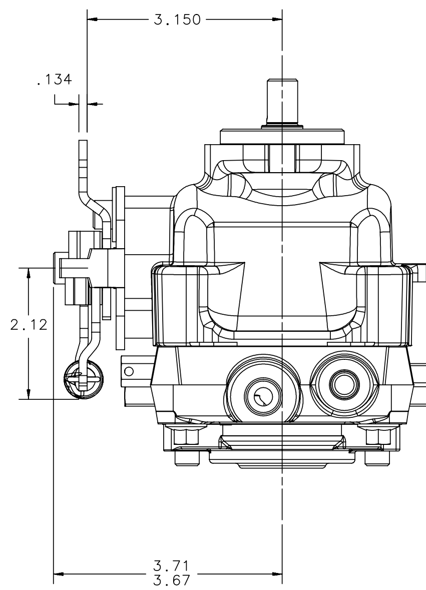


PC (6cc) Series RTN Control



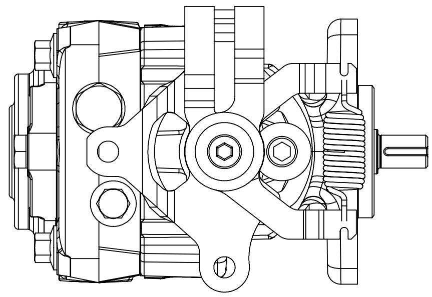
CONTROL ARM ONLY
(PRIMARY CONNECT NEAR END CAP)



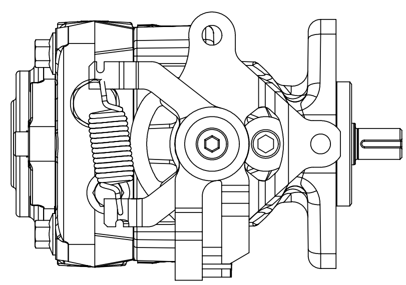


All: (Optional orientation) - Control arm may be rotated 180° with respect to trunnion shaft.

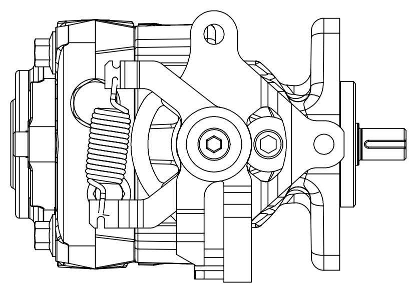
PC (6cc) Series RTN Control



STD RETURN TO NEUTRAL
(SPRING NEAR END CAP)



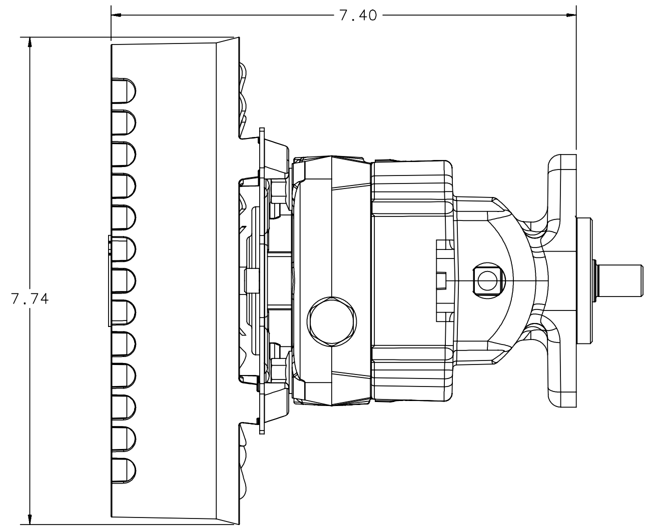
CW RETURN TO NEUTRAL



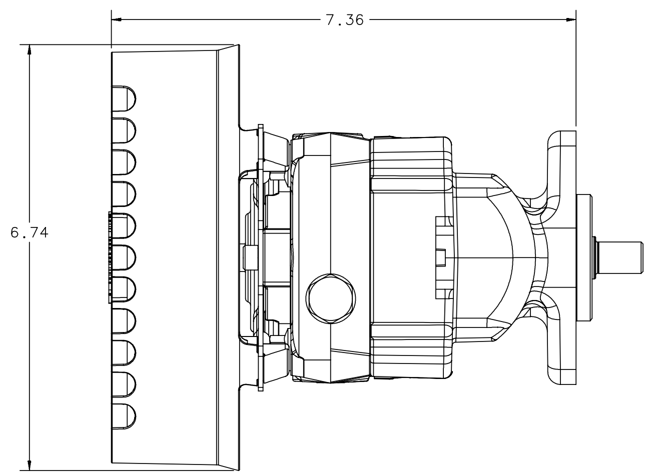
CCW RETURN TO NEUTRAL

All: (Optional orientation) - Control arm may be rotated 180° with respect to trunnion shaft.

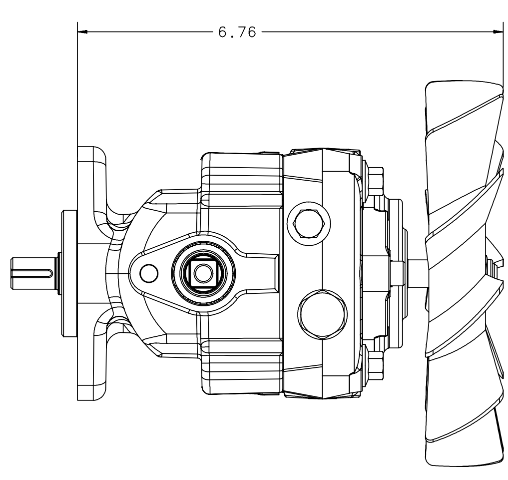
PC (6cc) Series Fan Kits



THRU CHARGE WITH Ø7" FAN
(51601, CW INPUT, 52354 SHROUD)



THRU CHARGE WITH Ø6" FAN
(52014, CW INPUT, 52059 SHROUD)



THRU CHARGE WITH Ø6" FAN
(52014, CW INPUT)

PC (6cc) Series Configurator

Character	1	2	3	4	5	6	7
			Pump Shaft	**Input Rotation, Pump Control Arm Location And Case Drain Location**	**System Check Valve "A" (RH)**	**System Check Valve "B" (LH)**	**Charge Or Adapter Plate Options**
	P	C	**Standard Pump**				M = 51214 (.13 std), 50654 spring
			A = 52053 - 1/2 straight keyed (Std) B = 52056 - 1/2 straight keyed (Thru) C = 52131 9T 20/40 (Std)	**Standard Pump, CW Input:**			
				A = RH control, Rear drain D = LH control, Rear drain	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	H = 51075 .19 Al Auxiliary, 3101536 spring
				Standard Pump, CCW Input:	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	
				G = RH control, Rear drain K = LH control, Rear drain	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	

		Condition:	Values:	
Notes		**If:**	**Then:**	**And:**
	1	Character 3 = A or C	Character 7 = E, H, M or 9	Character 10 = X
	2	Character 3 = B	Character 7 = N or A	Character 10 = A, B, C, D, E, Y, Z or X
	3	Character 3 = M or N	Character 4 = 1, 3, N, P, T, U, V or W	
	4	Character 12 is A	Character 8 = A, B, C, D, E, F, N, P, Q, R, T, U, V, W, 1, 2, 3	
	5	Character 8 = A, B, C, D, E, F, N, P, Q, R, T, U	Character 10 = A, B, C, D, E, X, Z	
		If:	**And:**	**Then:**
	6	Character 3 = M or N	Character 7 = 5	Character 10 = X
	7	Character 3 = N	Character 4 = T, U, V or W	Character 11 = X
	8	Character 4 = A, D, G, K, N, P	Character 7 = H	Character 11 = X

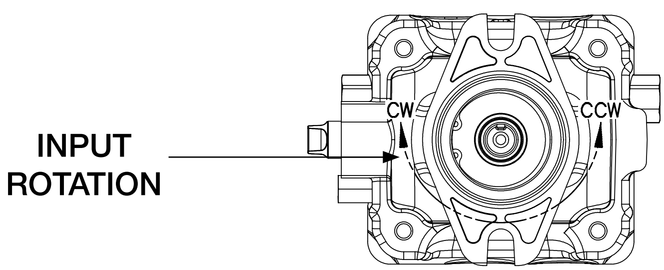
EXAMPLE

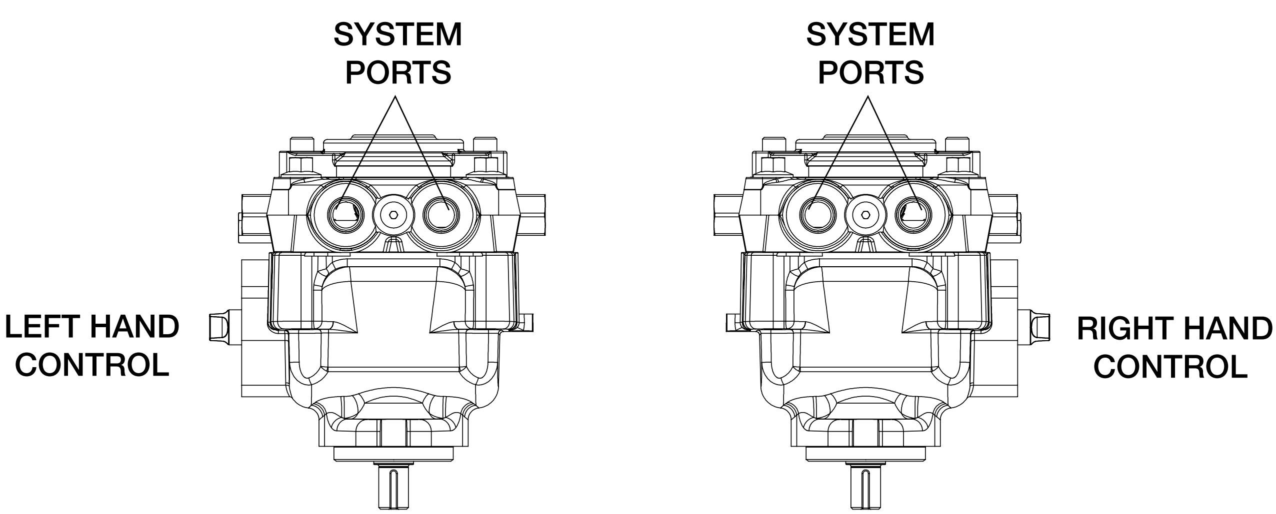
1	2		3	4	5	6		7	8	9	10		11	12	13	14
P	C	-	A	G	F	F	-	M	B	1	X	-	X	X	X	X

3: Pump Shaft [A] = 52053 - 1/2 Straight keyed (Std)
4: Input Rotation, Etc. [G] = CCW Input, RH control, rear drain
5: System Check Valve "A" [F] = shock, 160 bar .024
6: System Check Valve "B" [F] = shock, 160 bar .024
7: Charge Options [M] = 51214 (.13 std), 50654 spring
8: Control Arm Options [B] = Std, RTN spring near endcap
9: Bypass Valve [1] = blank
10: Fan Kit [X] = N/A
11: Adapter Plate [X] = N/A
12: Special Information [X] = N/A
13: Future Use [X] = N/A
14: Future Use [X] = N/A

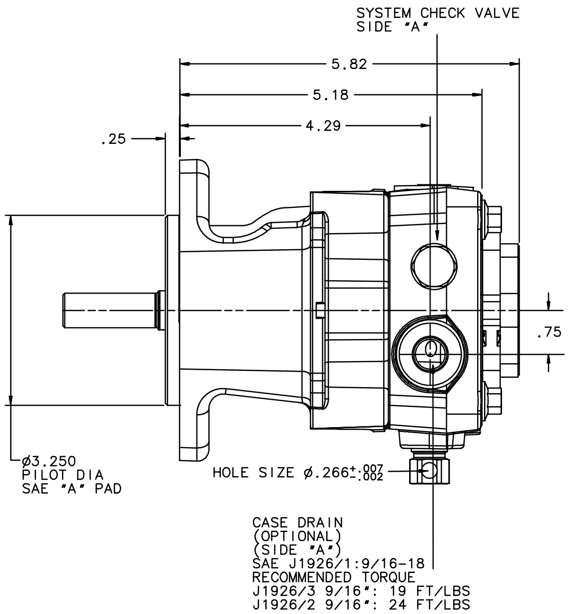
PC (6cc) Series Configurator

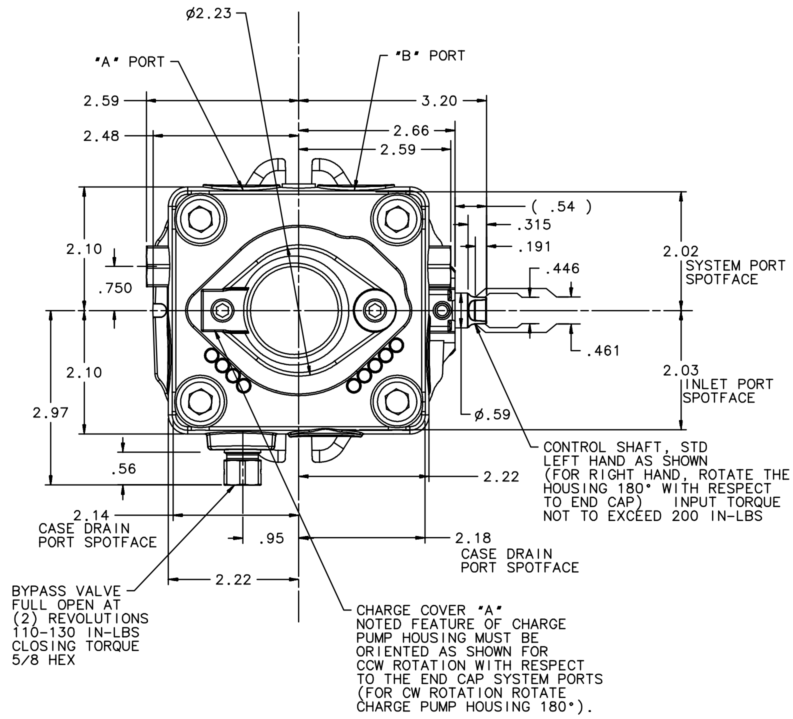
8	9	10	11	12	13	14
Control Arm Options	**Bypass Valve Type**	**Fan Kit CW/CCW Refers To Input Shaft Rotation**	**Adapter Plate**	**Special Information**	**Future Use**	**Future Use**
1 = tapered square trunnion arm only (Std)	1 = blank	X = NA	X = NA	X = NA	X = NA	X = NA
Light Spring (52401, 40 in-lbs) (Silver Spring)		**Fan/Shroud**	C = Adapter Plate			
A = Std RTN spring near input shaft B = Std RTN spring near endcap C = CW RTN spring near input shaft D = CW RTN spring near endcap E = CCW RTN spring near input shaft F = CCW RTN spring near endcap		A = 6” CCW 52014 fan C = 6” CCW 52014 fan with bracket AND shroud installed, Bracket positioned 90° from System Ports. E = 6” CCW 52014 fan with bracket AND shroud installed, Bracket positioned NEAR System Ports. Y = 7” CW 51601 fan with bracket AND shroud installed, Bracket positioned NEAR system ports				
RTN Style Control Arm, No Spring						
V = control arm only, primary connect hole near endcap W = control arm only, primary connect hole near input shaft						

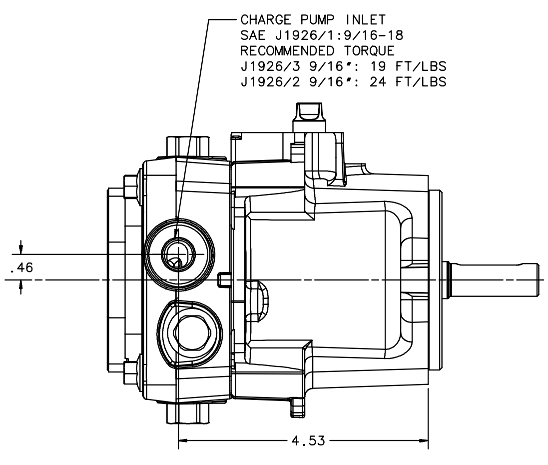


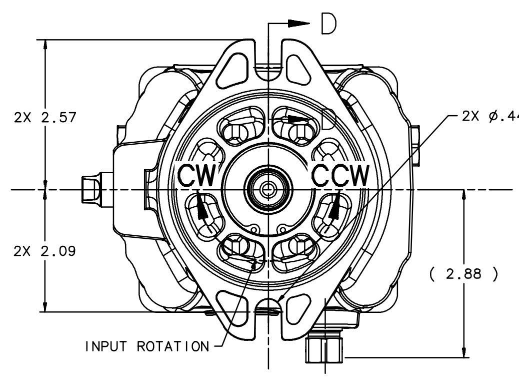


PG (10cc) Series Reference Dimensions

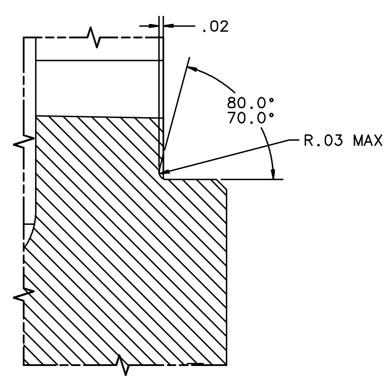








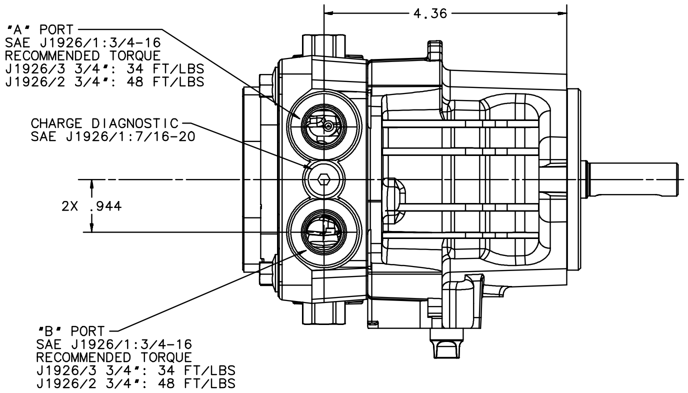
FRONT MOUNT

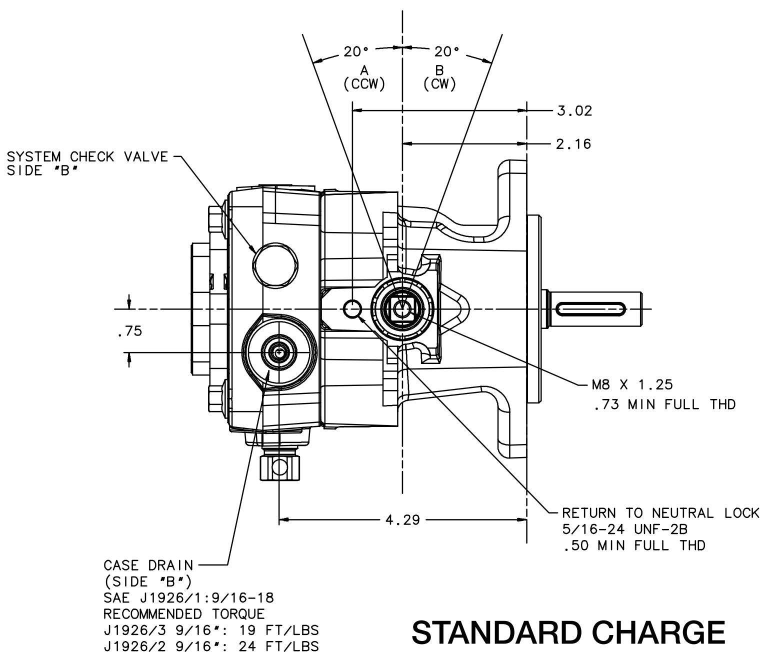


SECTION D-D

SCALE 4:1

PG (10cc) Series Reference Dimensions



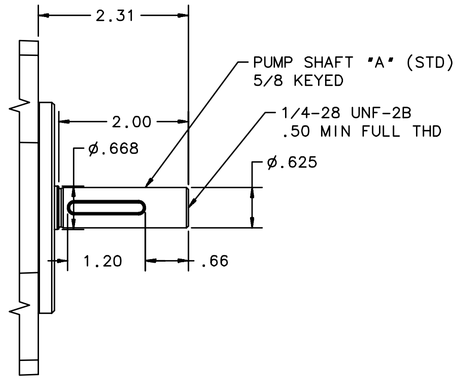


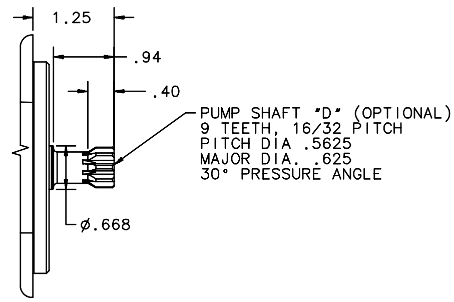
STANDARD CHARGE

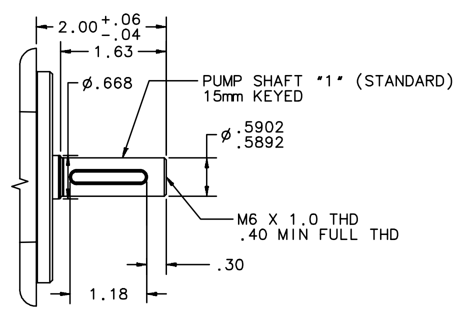
OIL FLOW CHART

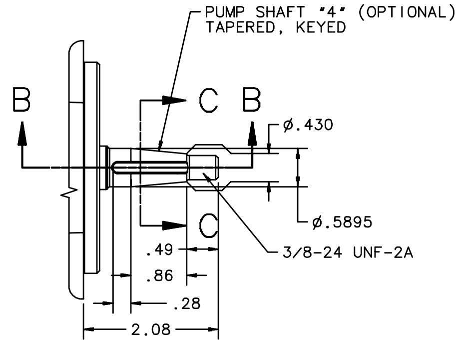
CONTROL SHAFT SIDE	LEFT HAND				RIGHT HAND			
INPUT SHAFT ROTATION	CW		CCW		CW		CCW	
CONTROL SHAFT ROTATION (DIRECTION)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)
SYSTEM PORT A FLOW	IN	OUT	OUT	IN	OUT	IN	IN	OUT
SYSTEM PORT B FLOW	OUT	IN	IN	OUT	IN	OUT	OUT	IN

PG (10cc) Series Shaft Options

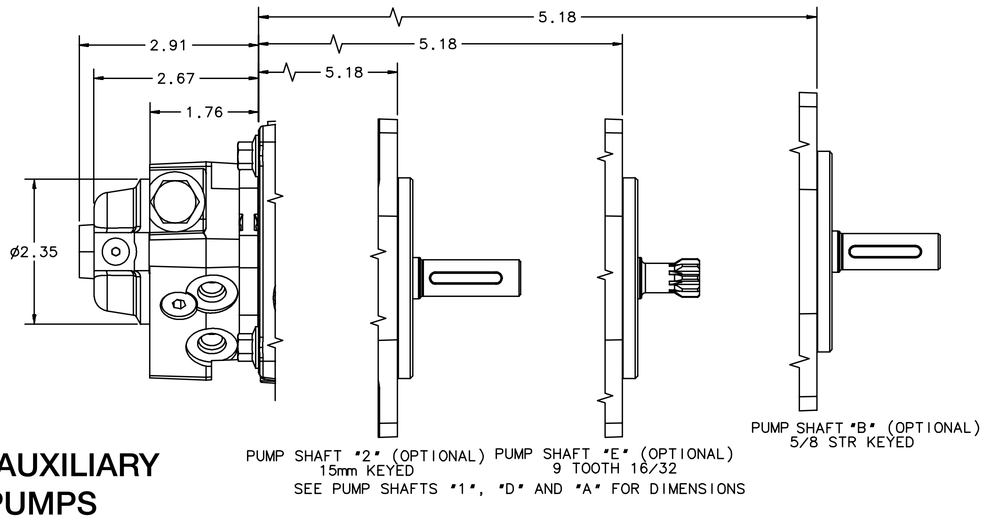






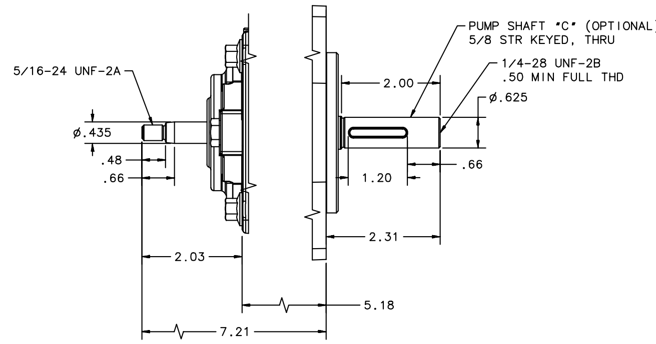


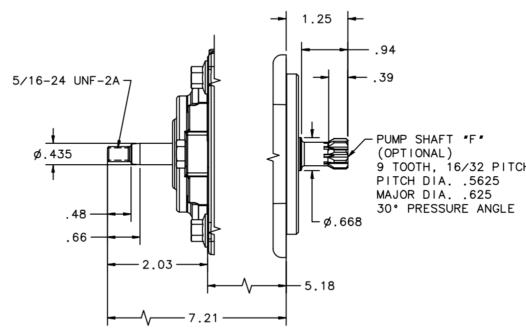
PG (10cc) Series Shaft Options (For Aux.)

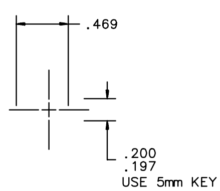


FOR AUXILIARY PUMPS

PG (10cc) Series Shaft Options (For Fans)

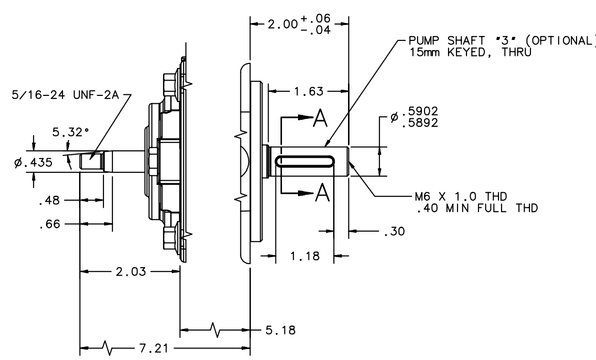


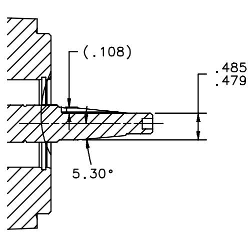




SECTION A-A

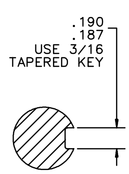
SCALE 2:1





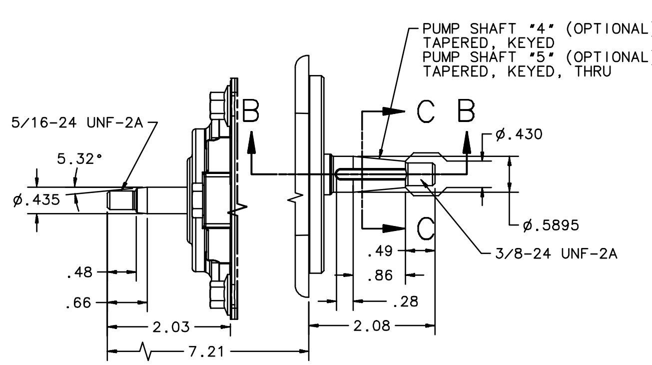
SECTION B-B

SCALE 1:1

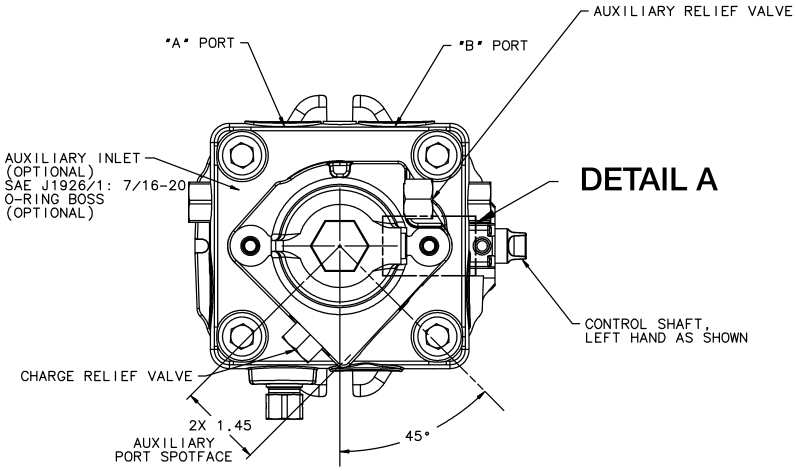


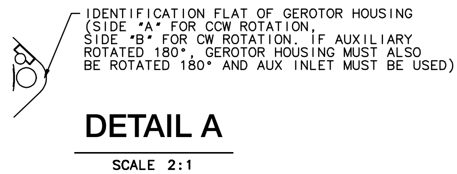
SECTION C-C

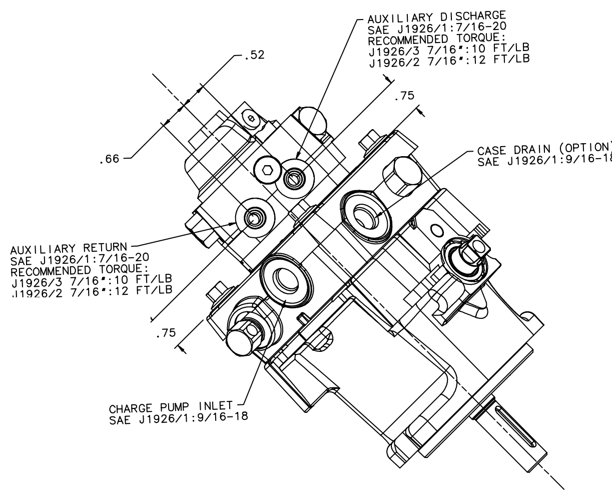
SCALE 2:1



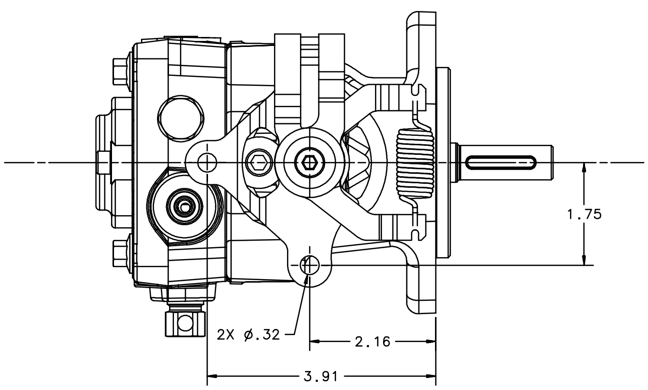
PG (10cc) Series Auxiliary Options



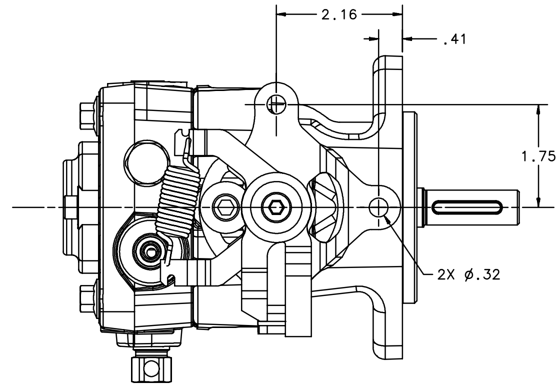




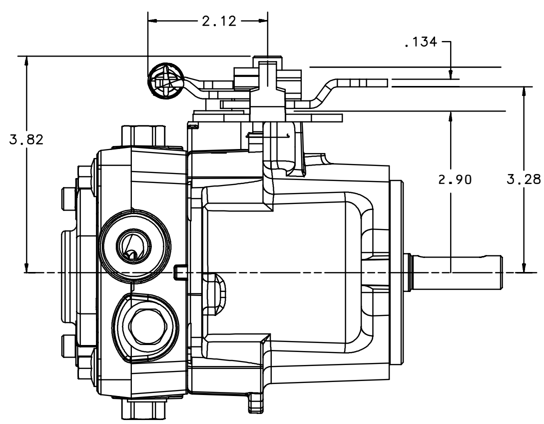
PG (10cc) Series RTN Control



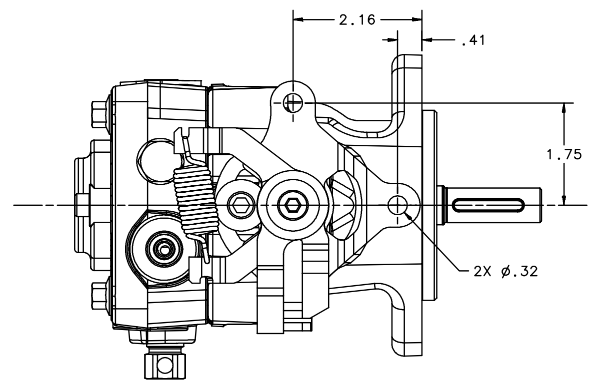
STD RETURN TO NEUTRAL
(SPRING NEAR INPUT)



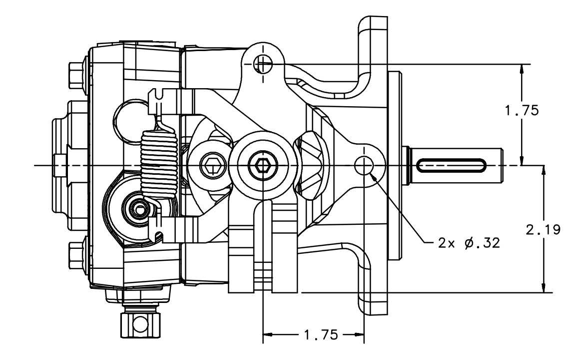
CCW RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)



STD RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)



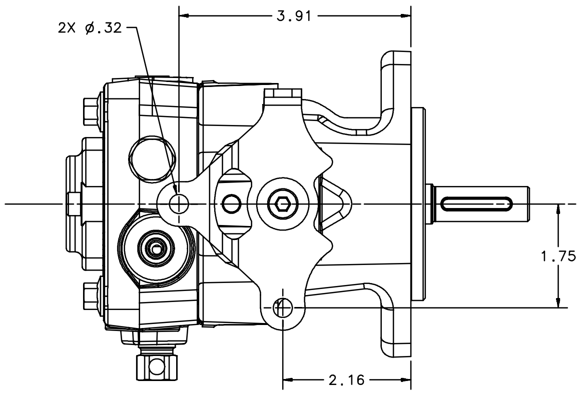
CW RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)



STD RETURN TO NEUTRAL
(SPRING NEAR INPUT)

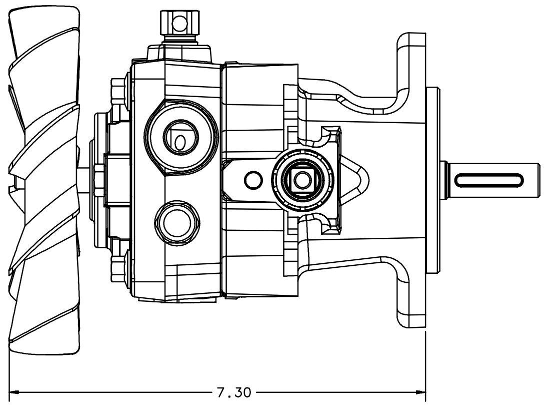
All: (Optional orientation) - Control arm may be rotated 180° with respect to trunnion shaft.

PG (10cc) Series RTN Control

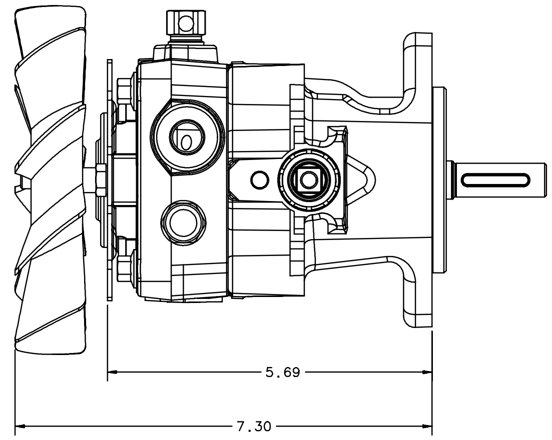


CONTROL ARM ONLY
(PRIMARY MOUNTING HOLE NEAR ENDCAP)

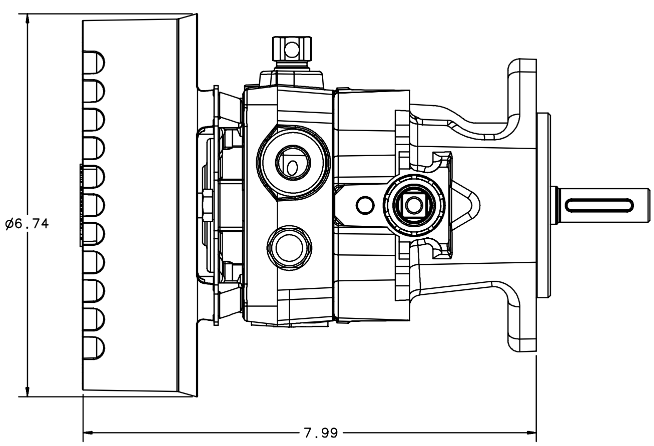
PG (10cc) Series Fan Kits



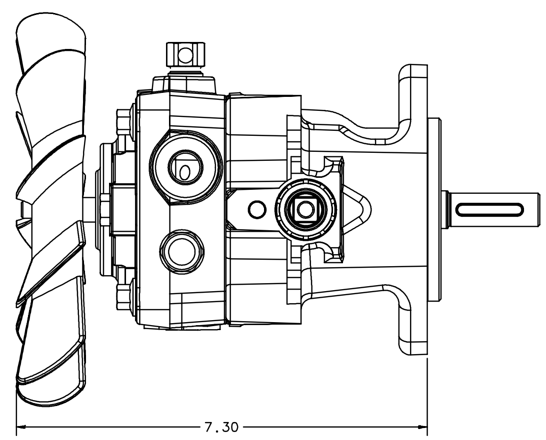
THRU CHARGE WITH ø6" FAN
(52014, CCW INPUT)



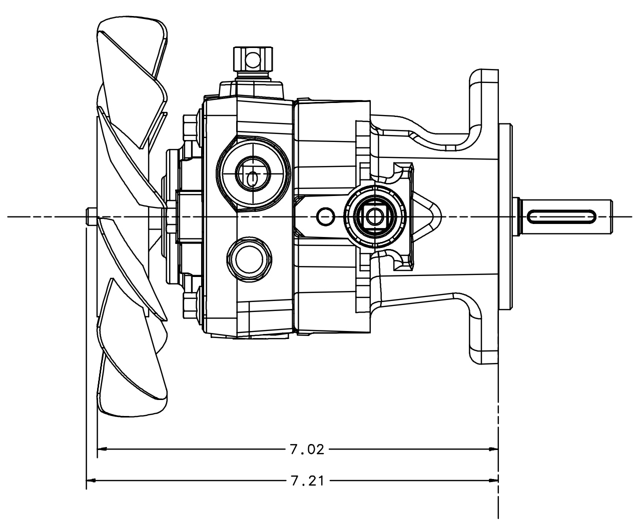
THRU CHARGE WITH ø6" FAN
(52014, CCW INPUT, WITH BRKT)



THRU CHARGE WITH ø6" FAN
(52014, CCW INPUT, WITH BRKT & SHROUD)



THRU CHARGE WITH ø7" FAN (STD)
(51691,CCW INPUT,70811 KIT)



THRU CHARGE WITH ø7" FAN (STD)
(51601,CW INPUT,70793 KIT)

RESPONSIVE.
RELIABLE.
INNOVATIVE.

PG (10cc) Series Configurator

Character	1	2	3	4	5	6
			Pump Shaft	**Input Rotation, Pump Control Arm Location And Case Drain Location**	**System Check Valve "A" (RH)**	**System Check Valve "B" (LH)**
	P	G	**Standard Pump**			
			A = 51998 - 5/8 straight keyed (Std) B = 51999 - 5/8 straight keyed (Aux) C = 52000 - 5/8 straight keyed through shaft (for fan) D = 51237 - 9 tooth 16/32 pitch (Std); SAE E = 51238 - 9 tooth 16/32 pitch (Aux); SAE F = 51538 - 9 tooth 16/32 pitch through shaft (for fan), SAE 1 = 51235 - 15 mm straight keyed (Std) 2 = 51236 - 15 mm straight keyed (Aux) 3 = 51240 - 15 mm straight keyed through shaft (for fan) 4 = 51239 - 15 mm tapered keyed (Std) 5 = 52013 - 15 mm tapered keyed through shaft (for fan)	**Standard Pump, CW Input:**		
				A = RH control, RH case drain B = RH control, LH case drain C = LH control, LH case drain D = LH control, RH case drain	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044
				Standard Pump, CCW Input:	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044
				G = RH control, RH case drain H = RH control, LH case drain J = LH control, LH case drain K = LH control, RH case drain	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044

		Condition:	Values:		
Notes		**If:**	**Then:**	**And:**	**And:**
	1	Character 3 = A, D, 1 or 4	Character 7 = D	Character 10 = X	
	2	Character 3 = B, E or 2	Character 7 = H, T, U or 5	Character 10 = X	
	3	Character 3 = C, F, 3 or 5	Character 7 = F, N, or Y	Character 10 = X, 1, 2,4, A, B, C, D, E or G	Character 11 = X
	4	Character 4 = A, C, G or J	Character 8 = 1, V, W, Y, Z, A, C, E, G, J, L, N, Q, T		
	5	Character 7 = H, T, U or 5	Character 11 = X		
	6	Character 4 = A, B, G or H	Character 11 = X, 2, 3, or 4		
	7	Character 4 = C, D, J or K	Character 11 = X, 1, 2, or 4		
	8	Character 12 = B	Character 8 = 1	Character 3 = 1	

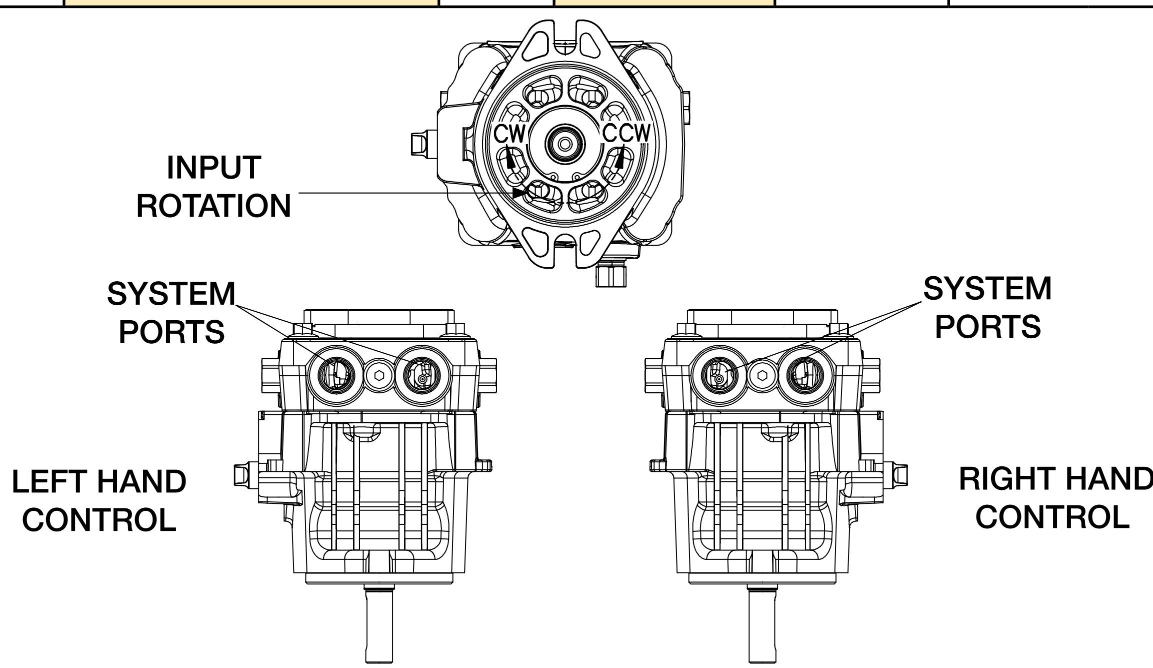
EXAMPLE

1	2		3	4	5	6		7	8	9	10		11	12	13	14
P	G	-	A	G	F	F	-	D	B	1	1	-	1	X	X	X

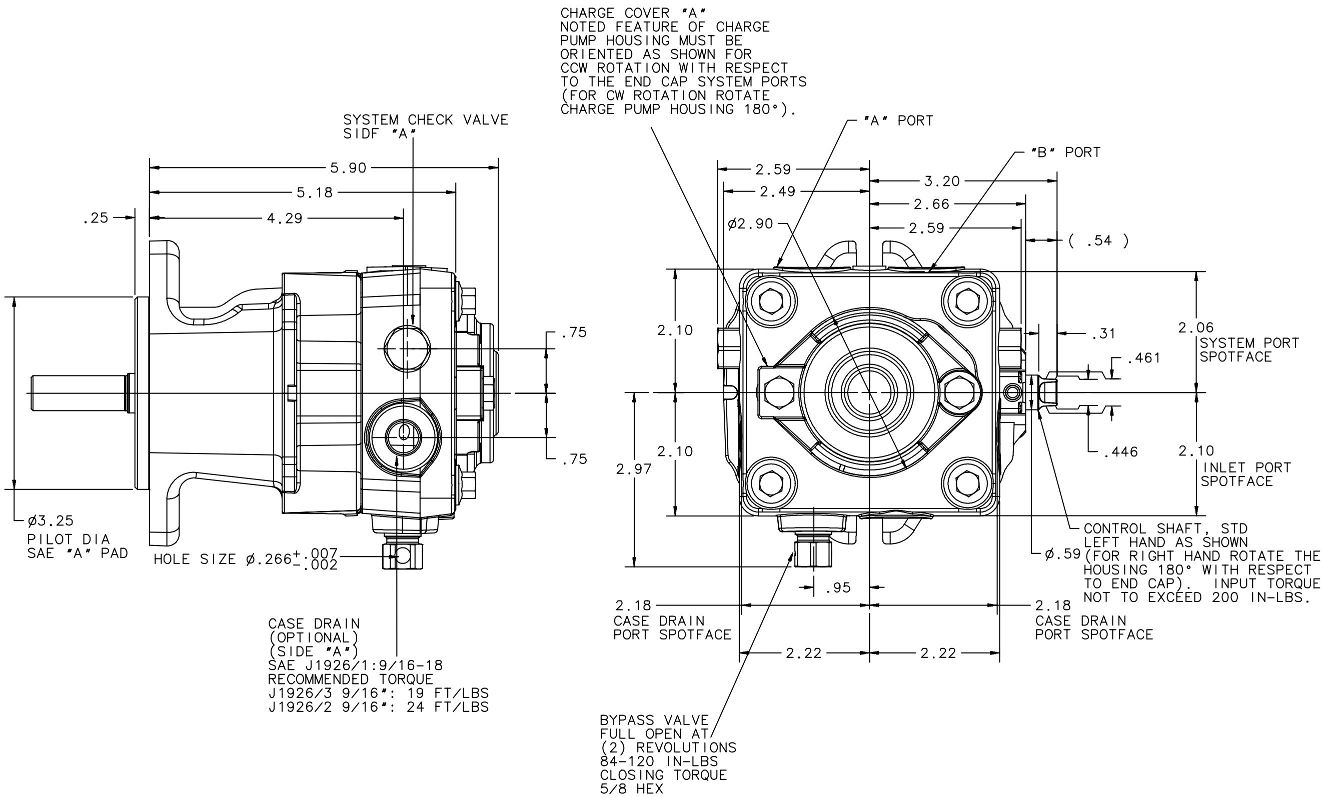
3: Pump Shaft [A] = 51988 - 5/8 Straight keyed (Std)
4: Input Rotation, Etc. [G] = CCW Input, RH control, RH case drain
5: System Check Valve "A" [F] = shock, 160 bar .024
6: System Check Valve "B" [F] = shock, 160 bar .024
7: Charge Options [D] = 52610 .11, 2000029 spring (Std)
8: Control Arm Options [B] = Std, RTN spring near endcap
9: Bypass Valve [1] = blank
10: Fan Kit [1] = 7" CW 70793 (51601 fan)
11: Torque Bracket & Adapter Plate [1] = Torque bracket to right
12: Special Information [X] = N/A
13: Future Use [X] = N/A
14: Future Use [X] = N/A

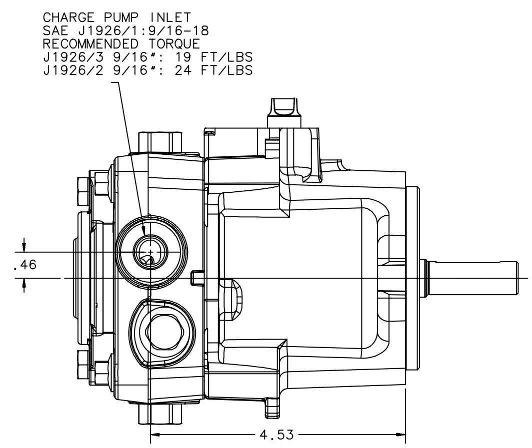
PG (10cc) Series Configurator

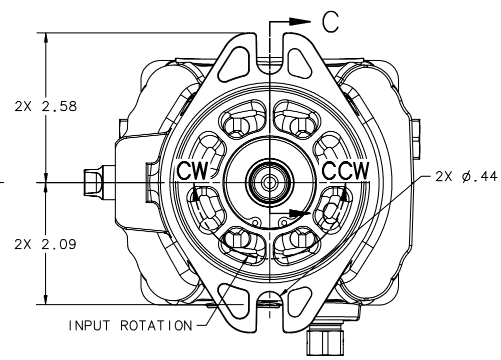
7	8	9	10	11	12	13	14
Charge Or Adapter Plate Options	**Control Arm Options**	**Bypass Valve Type**	**Fan Kit CW/CCW Refers To Input Shaft Rotation**	**Torque Bracket & Adapter Plate**	**Special Information**	**Future Use**	**Future Use**
D = 52610 .11, 2000029 spring (Std)	1 = tapered square trunnion arm only (Std)	1 = Blank	X = NA	X = NA	X = NA	X = NA	X = NA
F = 50962 .13, through shaft, 2000029 spring H = 51075 .19, Al Auxiliary, 3101536 spring	**Light Spring (52401, 40 in-lb) (Silver Spring)**		1 = 7” CW 70793 (51601 fan) 2 = 7” CCW 70811 (51691 fan)	1 = Torque bracket to right 2 = Torque bracket opposite 3 = Torque bracket to left 4 = Torque bracket same			
	A = Std RTN spring near input shaft B = Std RTN spring near endcap C = CW RTN spring near input shaft D = CW RTN spring near endcap E = CCW RTN spring near input shaft F = CCW RTN spring near endcap						
	Heavy Spring (51605, 80 in-lbs) (Yellow Spring)						
	G = Std RTN spring near input shaft H = Std RTN spring near endcap J = CW RTN spring near input shaft K = CW RTN spring near endcap L = CCW RTN spring near input shaft M = CCW RTN spring near endcap						
	RTN Style Control Arm, No Spring:		**Fan/Shroud**				
	V = Control arm only, primary connect hole near endcap W = Control arm only, primary connect hole near input shaft		C = 6” CCW 52014 fan with bracket AND shroud installed. Bracket positioned 90° from System Ports.				



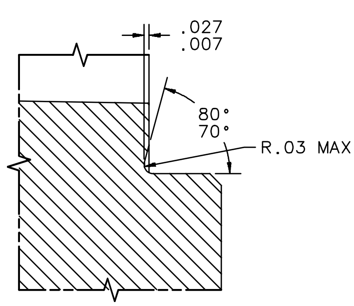
PK (12cc) Series Reference Dimensions







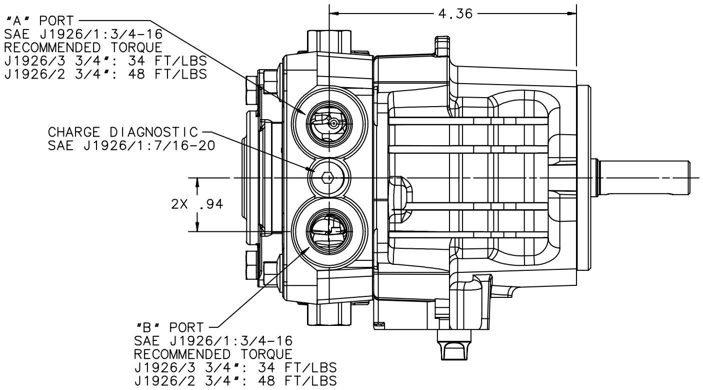
FRONT MOUNT

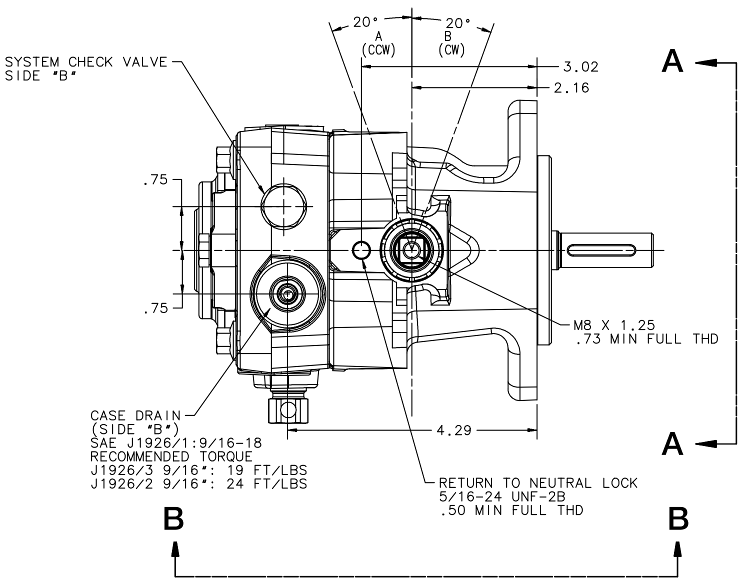


SECTION C-C

SCALE 4:1

PK (12cc) Series Reference Dimensions

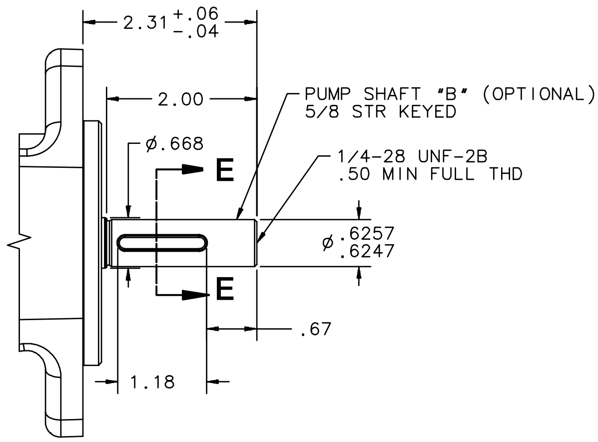


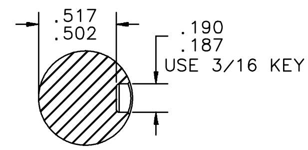


OIL FLOW CHART

CONTROL SHAFT SIDE	LEFT HAND				RIGHT HAND			
INPUT SHAFT ROTATION	CW		CCW		CW		CCW	
CONTROL SHAFT ROTATION (DIRECTION)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)
SYSTEM PORT A FLOW	IN	OUT	OUT	IN	OUT	IN	IN	OUT
SYSTEM PORT B FLOW	OUT	IN	IN	OUT	IN	OUT	OUT	IN

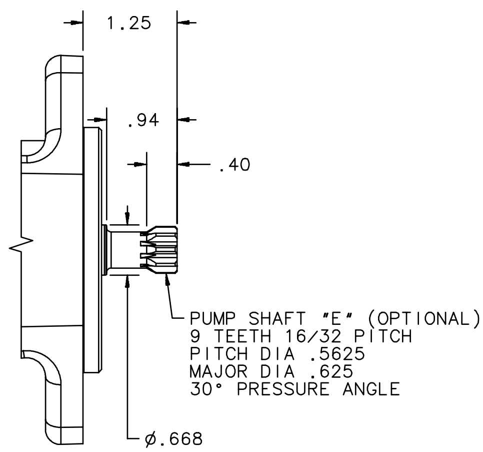
PK (12cc) Series Shaft Options

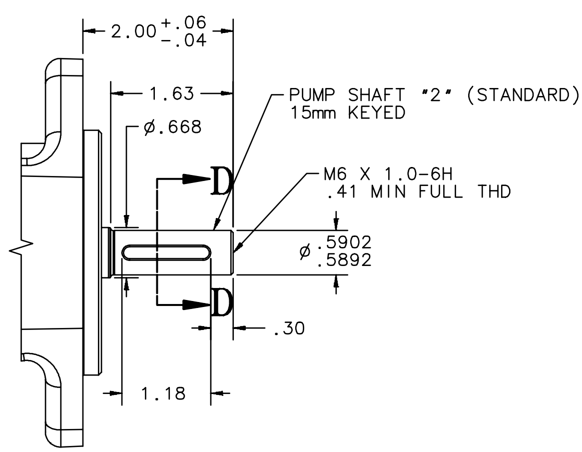


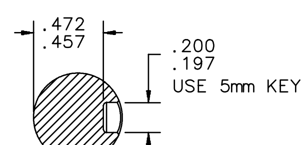


SECTION E-E

SCALE 1:1



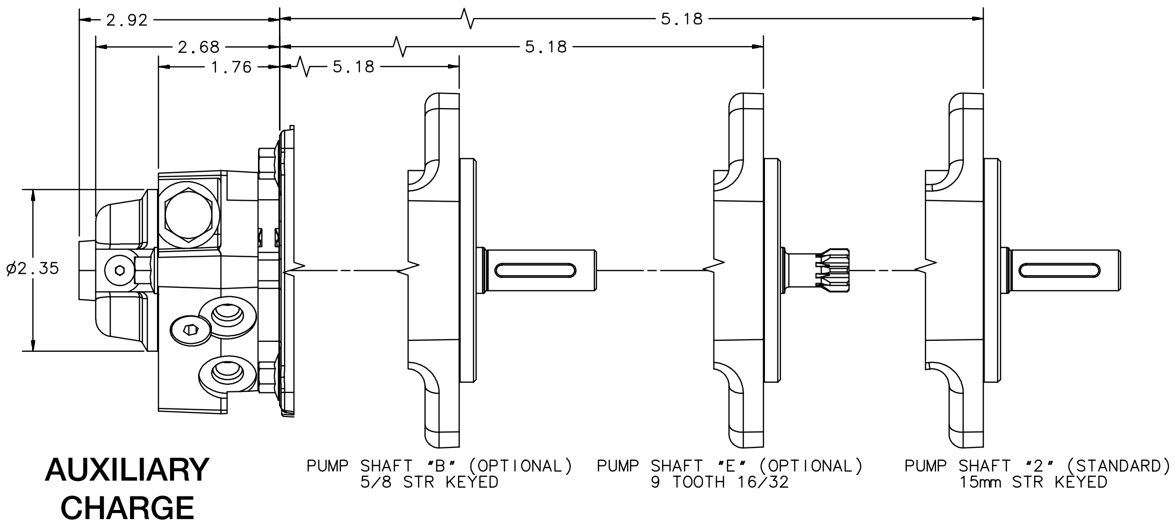




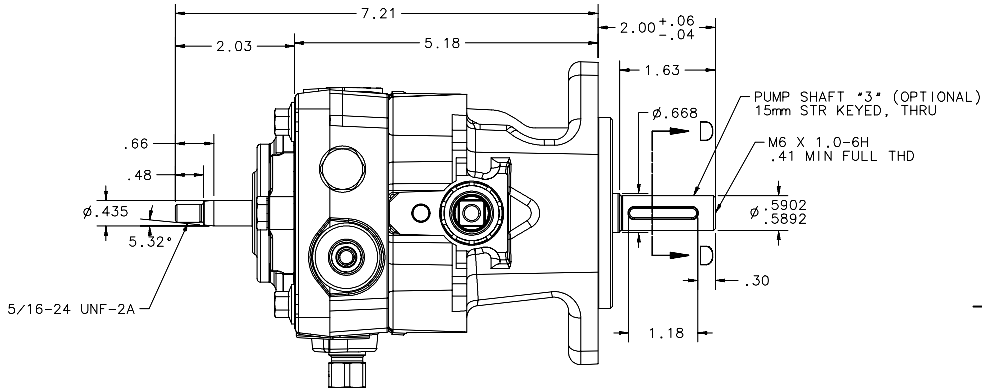
SECTION D-D

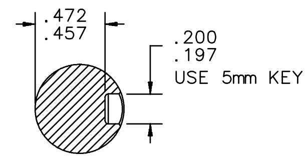
SCALE 2:1

PK (12cc) Series Shaft Options (For Aux)



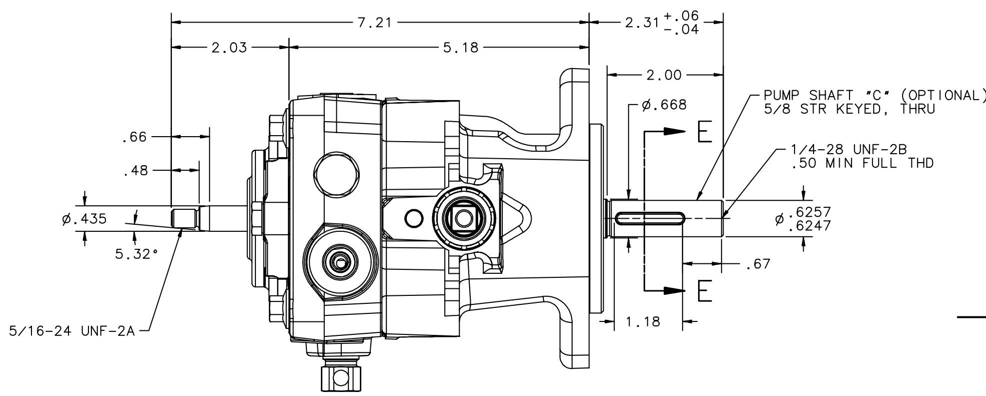
PK (12cc) Series Shaft Options (For Fans)

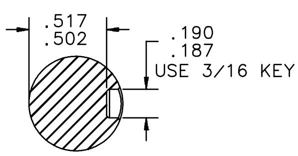




SECTION D-D

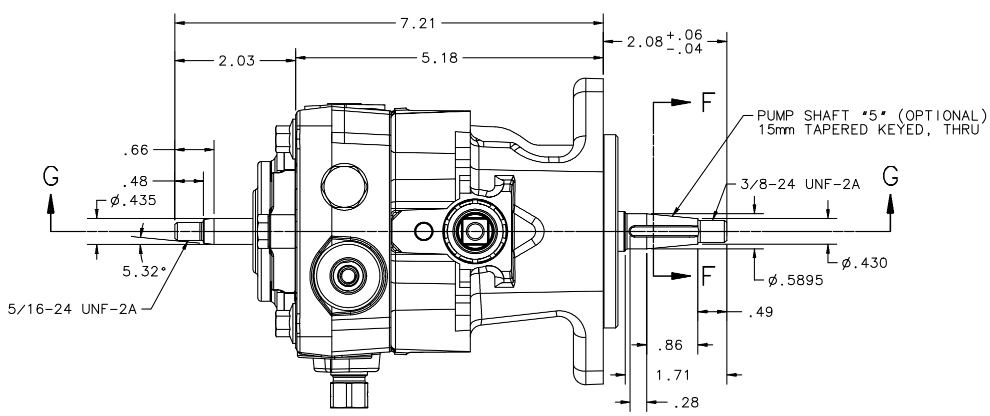
SCALE 2:1

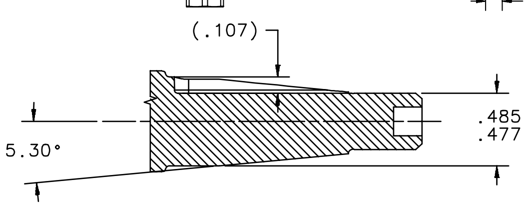




SECTION E-E

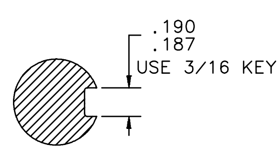
SCALE 1:1





SECTION G-G

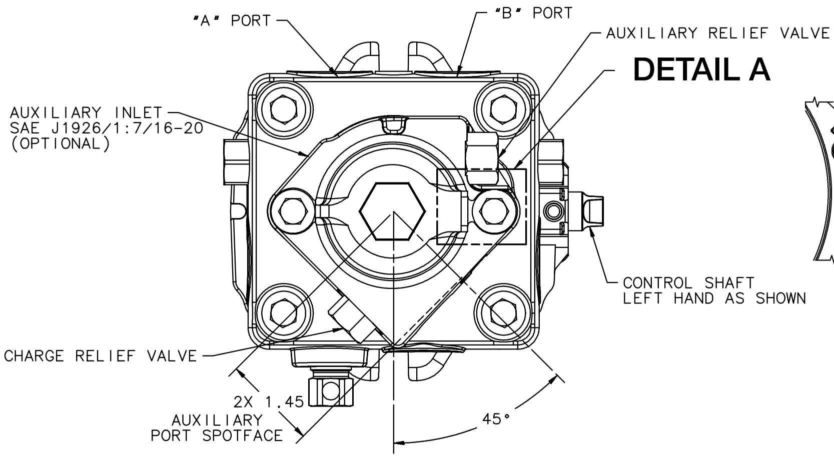
SCALE 2:1

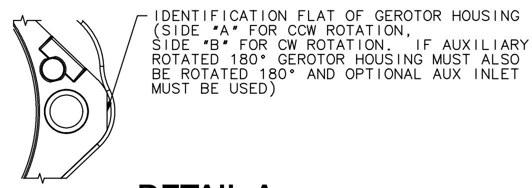


SECTION F-F

SCALE 2:1

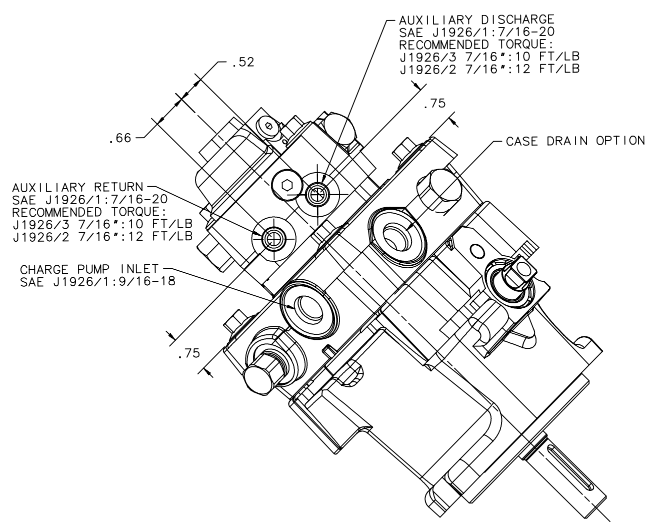
PK (12cc) Series Auxiliary Options



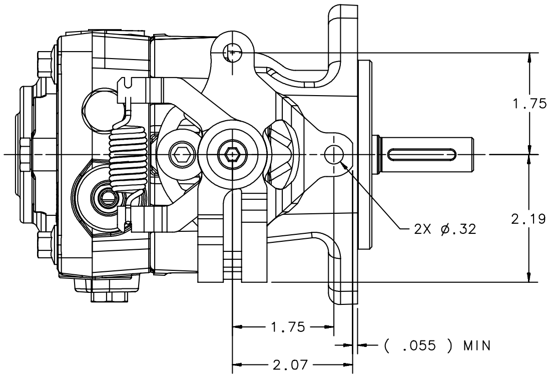


DETAIL A

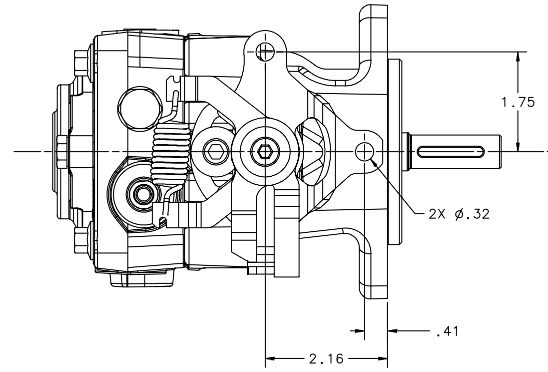
SCALE 2:1



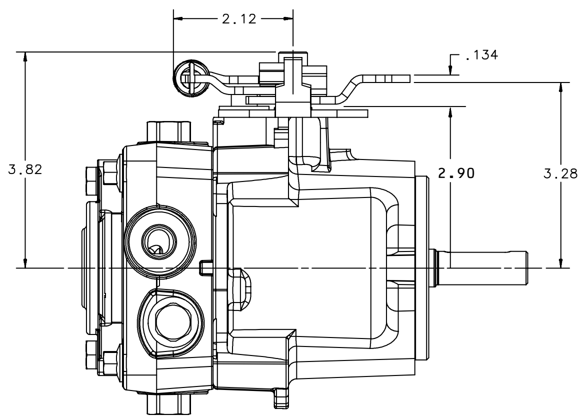
PK (12cc) Series RTN Control



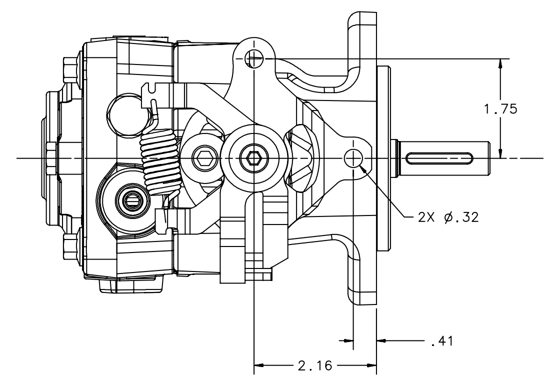
STD RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)



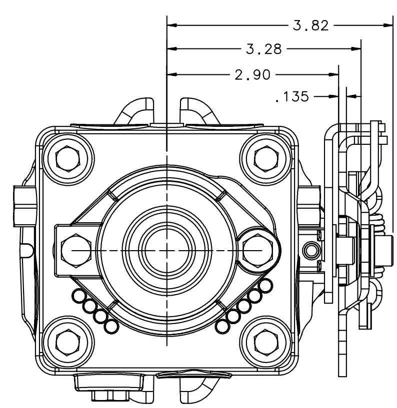
CCW RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)



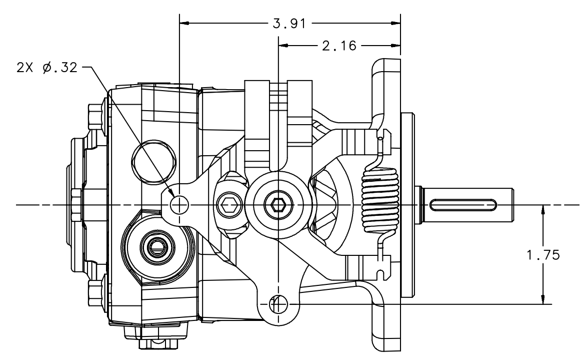
STD RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)



CW RETURN TO NEUTRAL
(SPRING TO ENDCAP)



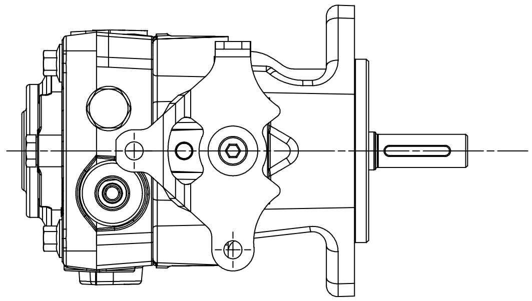
STD RETURN TO NEUTRAL
(SPRING NEAR INPUT SHAFT)



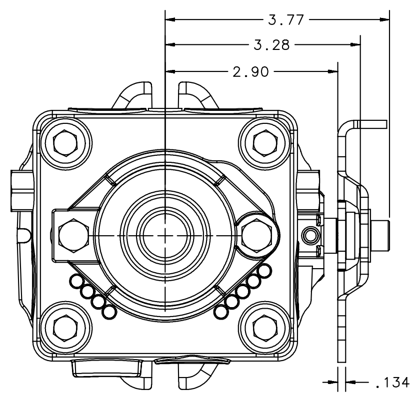
STANDARD RETURN TO NEUTRAL
(SPRING NEAR INPUT SHAFT)

All: (Optional orientation) - Control arm may be rotated 180° with respect to trunnion shaft.

PK (12cc) Series RTN Control

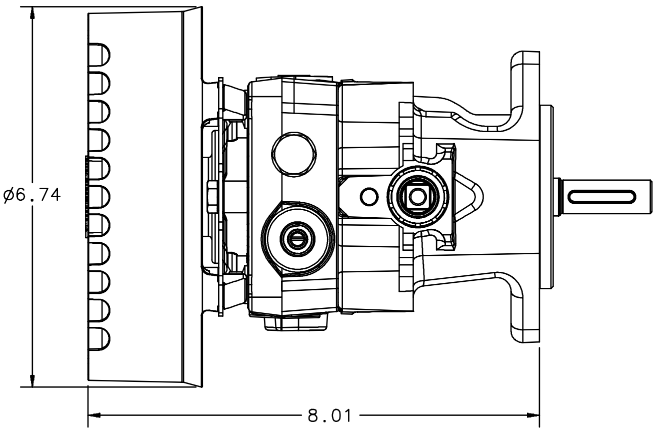


CONTROL ARM ONLY
(PRIMARY CONNECT NEAR ENDCAP)

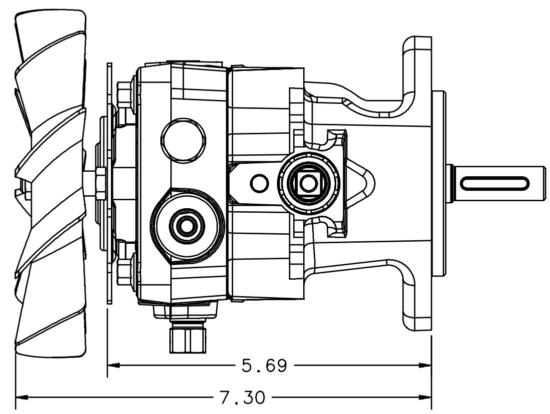


CONTROL ARM ONLY
(PRIMARY CONNECT NEAR ENDCAP)

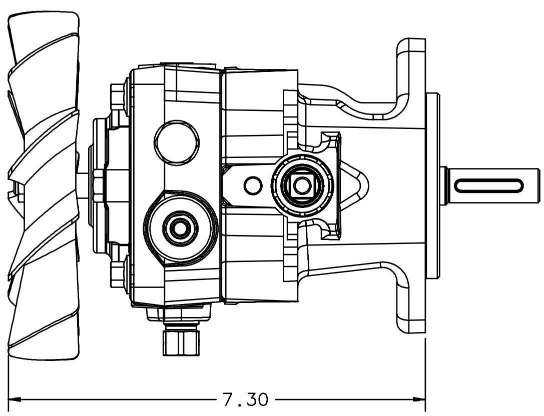
PK (12cc) Series Fan Kits



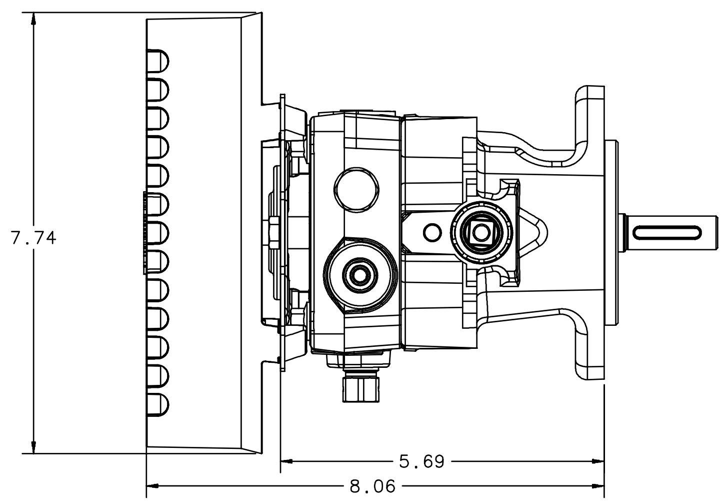
THRU CHARGE WITH ø6" FAN
(52014, CCW INPUT)
WITH BRACKET & SHROUD



THRU CHARGE WITH ø6" FAN
(52014, CCW INPUT)
WITH SHROUD BRACKET

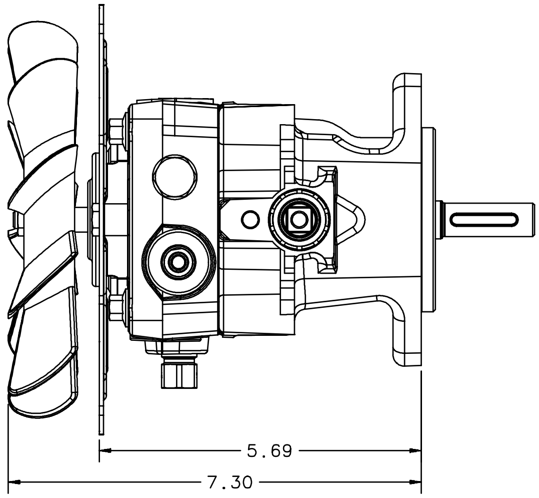


THRU CHARGE WITH ø6" FAN
(52014, CCW INPUT)

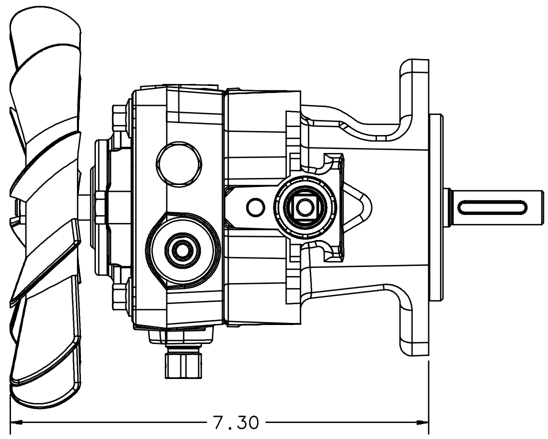


THRU CHARGE WITH ø7" FAN
(51691, CCW INPUT)
WITH BRACKET & SHROUD

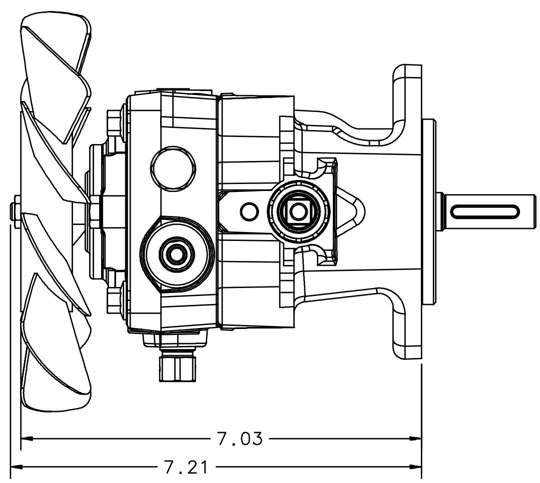
PK (12cc) Series Fan Kits



THRU CHARGE WITH Ø7" FAN
(51691, CCW INPUT W/ BRACKET)

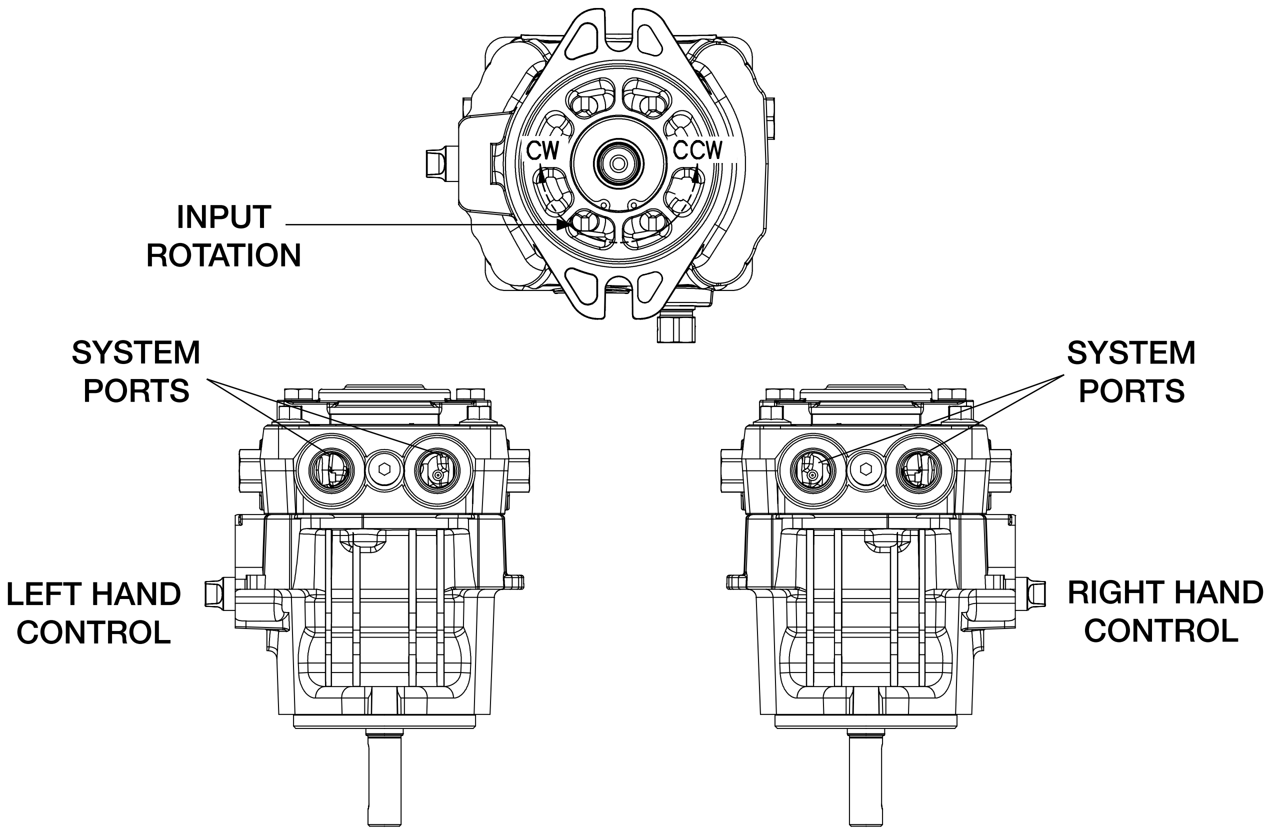


THRU CHARGE WITH Ø7" FAN
(51691, CCW INPUT)



THRU CHARGE WITH Ø7" FAN
(51601, CW INPUT)

PK (12cc) Series Configurator



	1	2		3	4	5	6		7	8	9	10		11	12	13	14
EXAMPLE	P	K	-	B	G	F	F	-	E	G	1	C	-	1	X	X	X

3: Pump Shaft [B] = 51999 - 5/8 Straight keyed (Std and Aux)
4: Input Rotation, Etc. [G] = CCW Input, RH control, RH case drain
5: System Check Valve “A” [F] = shock, 160 bar .024
6: System Check Valve “B” [F] = shock, 160 bar .024
7: Charge Options [E] = 50617 (.19 nonthru-shaft) 2000029 spring (Std)
8: Control Arm Options [G] = Std, RTN spring near input shaft
9: Bypass Valve [1] = blank
10: Fan Kit [C] = 6” CCW 52014 fan with bracket, AND shroud installed, bracket positioned 90° from system ports
11: Torque Bracket & Adapter Plate [1] = Torque bracket to right
12: Special Information [X] = N/A
13: Future Use [X] = N/A
14: Future Use [X] = N/A

PK (12cc) Series Configurator

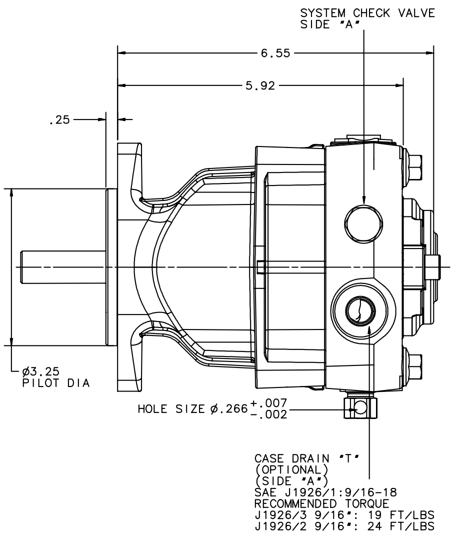
Character	1	2	3	4	5	6
			Pump Shaft	**Input Rotation, Pump Control Arm Location And Case Drain Location**	**System Check Valve "A" (RH)**	**System Check Valve "B" (LH)**
	P	K	**Standard Pump**			
			B = 51999 - 5/8 straight keyed (Std & Aux) C = 52000 - 5/8 straight keyed through shaft (for fan) E = 51238 - 9 tooth 16/32 pitch (Std & Aux); SAE F = 51538 - 9 tooth 16/32 pitch through shaft (for fan), SAE 2 = 51236 - 15 mm straight keyed (Std & Aux) 3 = 51240 - 15 mm straight keyed through shaft (for fan) 5 = 52013 - 15 mm tapered keyed through shaft (for fan)	**Standard Pump, CW Input:**		
				A = RH control, RH case drain B = RH control, LH case drain C = LH control, LH case drain D = LH control, RH case drain	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044
				Standard Pump, CCW Input:	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044
				G = RH control, RH case drain H = RH control, LH case drain J = LH control, LH case drain K = LH control, RH case drain	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044
			PK (12 cc) Tandem (PK + Gear Pump or PK + PK)	**PK With Gear Pump Only**		
			H = 5/8 keyed PK + Gear Pump K = 15mm PK + Gear Pump L = 9T PK + Gear Pump	1 = RH control, RH drain 2 = RH control, LH drain 3 = LH control, LH drain 4 = LH control, RH drain		
				T Series, Input Pump, Input N/A:		
				N = RH control, common drain P = LH control, common drain		
				T Series Second Pump, CW Input:		
				T = RH control, no drain U = LH control, no drain		
				T Series Second Pump, CCW Input:		
				V = RH control, no drain W = LH control, no drain		

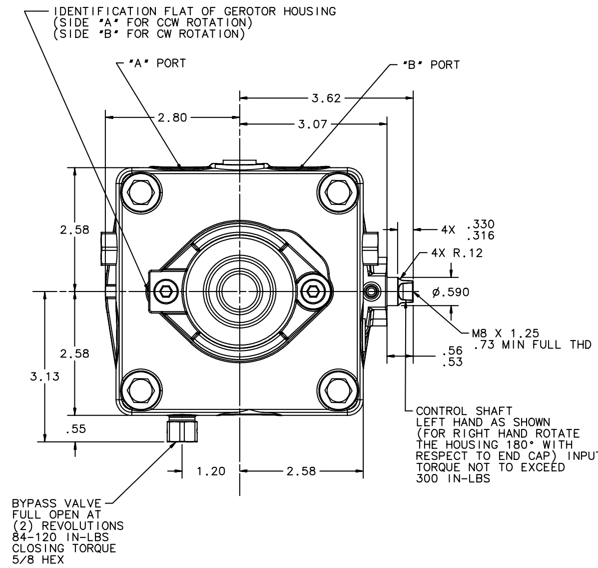
		Condition:	Values:		
Notes		**If:**	**Then:**	**And:**	**And:**
	1	Character 3 = B, E or 2	Character 7 = E, J, L, M, W	Character 10 = X	
	2	Character 3 = C, F, 3 or 5	Character 7 = F, G, N, Z	Character 10 = X, A, B, C, D, E, F, G, H, J, 1 or 2	Character 11 = X
	3	Character 4 = A, C, G or J	Character 8 = 1, V, W, Y, A, C, E, G, J, L, N, Q or T		
	4	Character 3 = B, C, E, F, 2, 3 or 5	Character 4 = A, B, C, D, G, H, J or K		
	5	Character 4 = A, B, G or H	Character 11 = X, 2, 3 or 4		
	6	Character 4 = C, D, J or K	Character 11 = X, 1, 2 or 4		
	7	Character 7 = 5 or 6	Character 11 = X, A or C		
		If:	**And:**	**Then:**	
	8	Character 3 = B, C, E, F, 2, 3 or 5	Character 7 = J or W	Character 11 = X	
	9	Character 3 = H, K or L	Character 4 = 1, 2, 3, 4, N or P	Character 7 = 5 or 6	
	10	Character 3 = H, K or L	Character 4 = T, U, V or W	Character 7 = E, J	
	11	Character 3 = H, K or L	Character 7 = 5 or 6	Character 10 = X	
	12	Character 3 = H, K or L	Character 7 = J or W	Character 11 = X, 1, 3, 4	

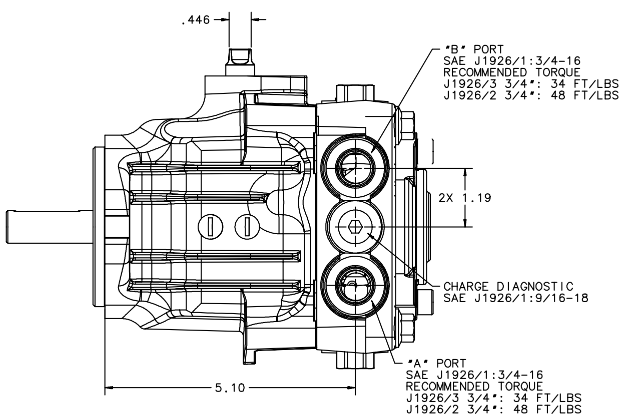
PK (12cc) Series Configurator

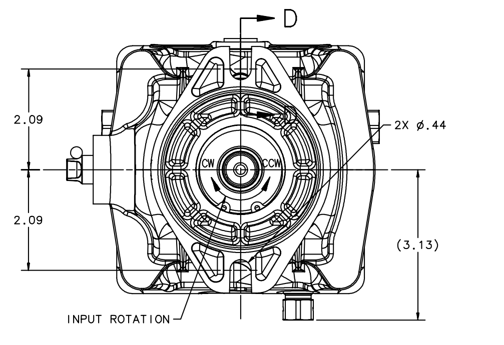
7	8	9	10	11	12	13	14
Charge Or Adapter Plate Options	**Control Arm Options**	**Bypass Valve Type**	**Fan Kit CW/CCW Refers To Input Shaft Rotation**	**Torque Bracket & Adapter Plate**	**Special Information**	**Future Use**	**Future Use**
E = 50617 (.19 non-thru-shaft), 2000029 spring (Std) G = 51737 (.19 thru-shaft), 2000029 spring	1 = tapered square trunnion arm only (Std)	1 = Blank	X = NA	X = NA	X = NA	X = NA	X = NA
J = 51075 (.19 Al Aux) 51241 spring (75 - 105 psi) 5 = AA Gear Pump Adapter - 52267 6 = A Gear Pump/ Tandem Adapter - 52264	**Heavy Spring (51605, 80 in-lbs) (Yellow Spring)** G = Std RTN spring near input shaft H = Std RTN spring near endcap J = CW RTN spring near input shaft K = CW RTN spring near endcap L = CCW RTN spring near input shaft M = CCW RTN spring near endcap **Medium Spring (51833, 60 in-lbs) (Black Spring)** N = Std RTN spring near input shaft P = Std RTN spring near endcap Q = CW RTN spring near input shaft R = CW RTN spring near endcap T = CCW RTN spring near input shaft U = CCW RTN spring near endcap **RTN Style Control Arm, No Spring:** V = Control arm only, primary connect hole near endcap W = Control arm only, primary connect hole near input shaft		1 = 7" CW 70793 (51601 fan) 2 = 7" CCW 70811 (51691 fan) **Fan/Shroud** C = 6" CCW 52014 fan with bracket AND shroud installed. Bracket positioned 90° from System Ports. G = 7" CCW 51691 fan with bracket, AND shroud installed, bracket positioned 90° from System Ports	1 = Torque bracket to right of system ports 2 = Torque bracket opposite system ports 3 = Torque bracket to left of system ports 4 = Torque bracket on system port side C = Adapter plate			

PR (16cc) Series Reference Dimensions

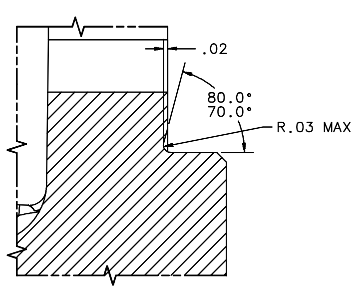








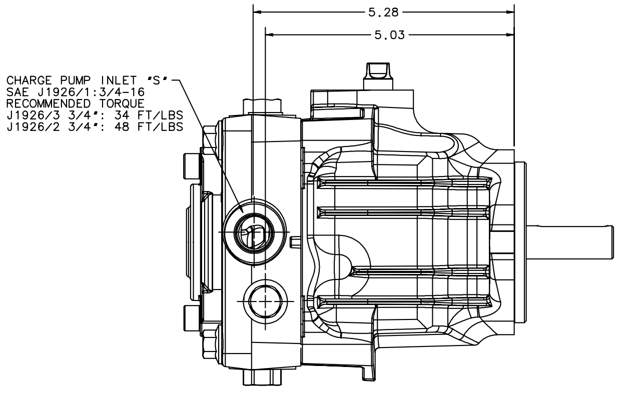
FRONT MOUNT

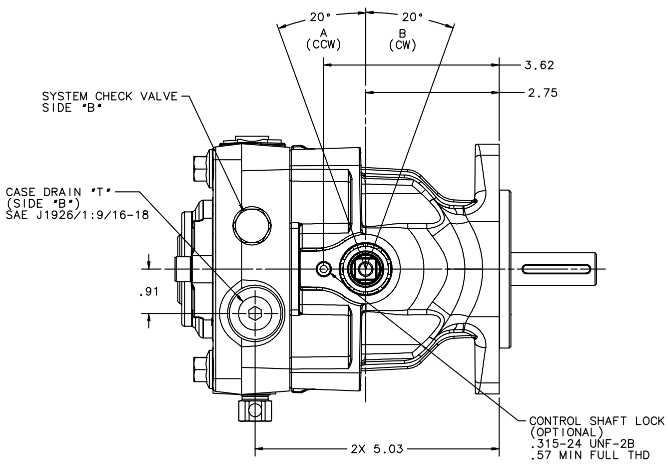


SECTION D-D

SCALE 4:1

PR (16cc) Series Reference Dimensions

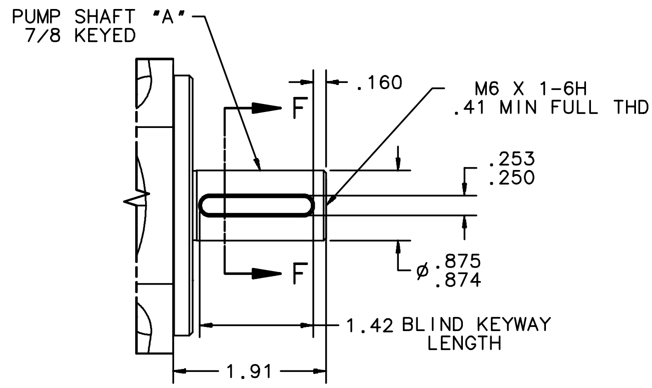


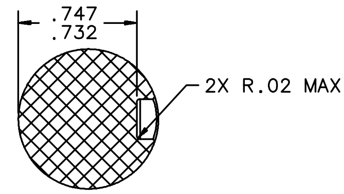


OIL FLOW CHART

CONTROL SHAFT SIDE	LEFT HAND				RIGHT HAND			
INPUT SHAFT ROTATION	CW		CCW		CW		CCW	
CONTROL SHAFT ROTATION (DIRECTION)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)
SYSTEM PORT A FLOW	IN	OUT	OUT	IN	OUT	IN	IN	OUT
SYSTEM PORT B FLOW	OUT	IN	IN	OUT	IN	OUT	OUT	IN

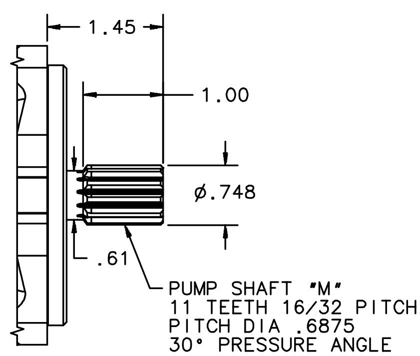
PR (16cc) Series Shaft Options

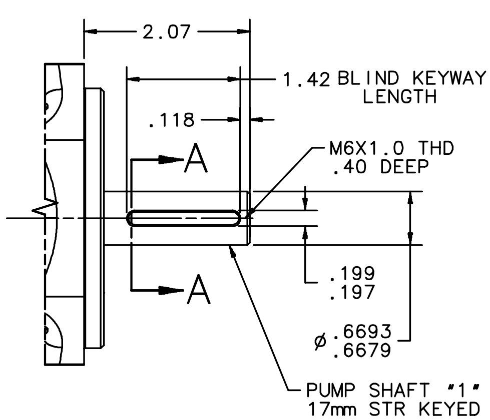


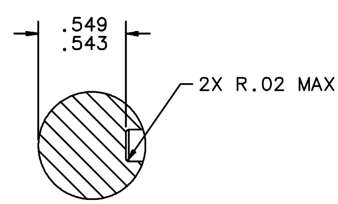


SECTION F-F

SCALE 2:1



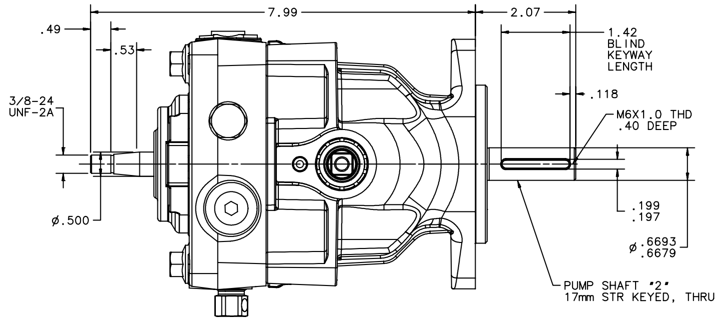




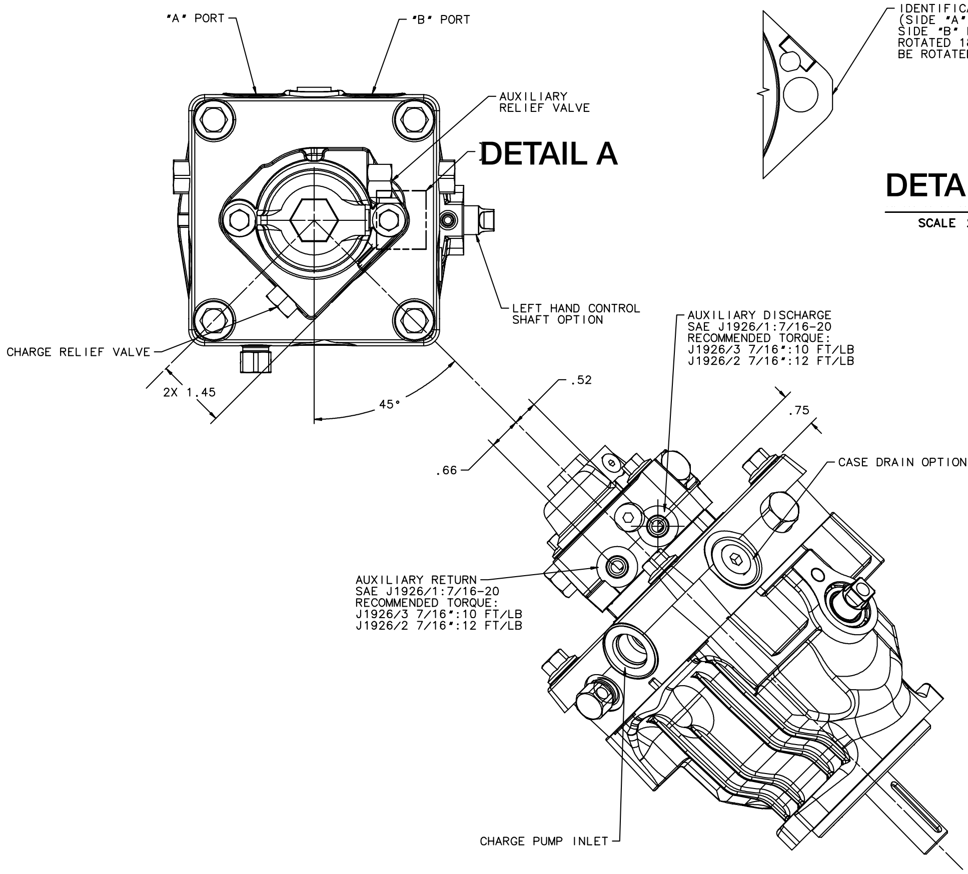
SECTION A-A

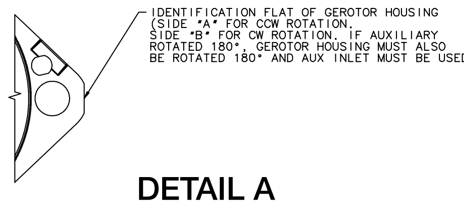
SCALE 2:1

PR (16cc) Series Shaft Options (For Fans)



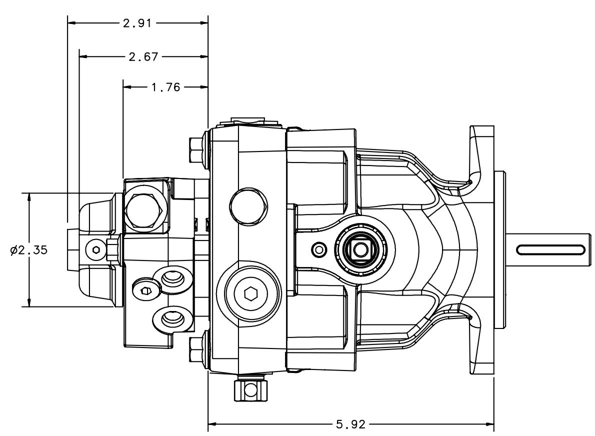
PR (16cc) Series Auxiliary Options





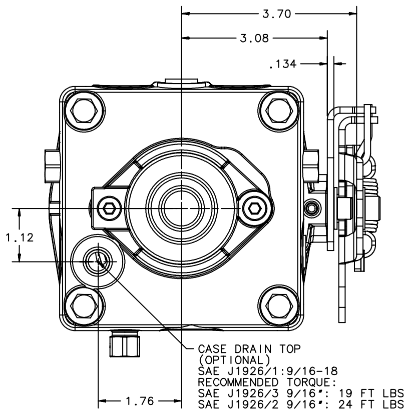
DETAIL A

SCALE 2:1

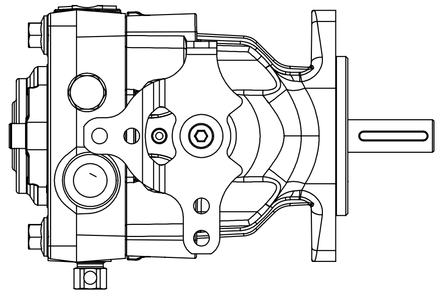


AUXILIARY CHARGE

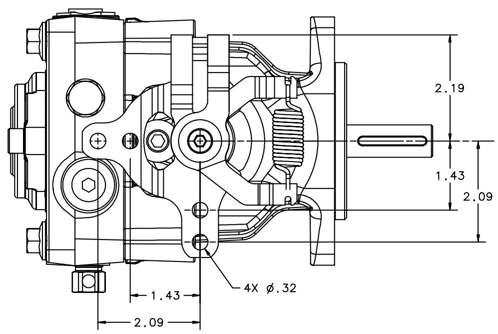
PR (16cc) Series RTN Control



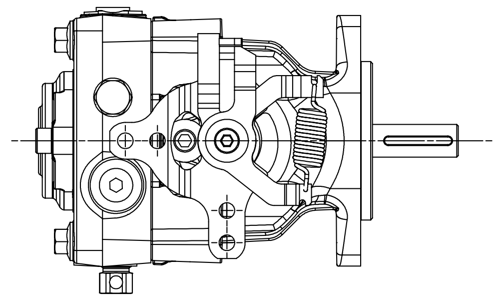
STD RETURN TO NEUTRAL
(SPRING NEAR INPUT)



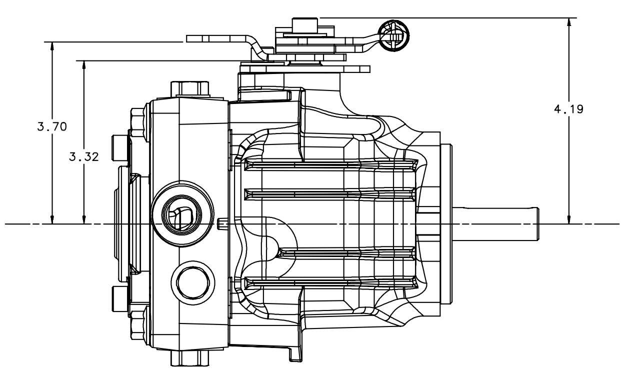
CONTROL ARM ONLY
(PRIMARY CONNECTION NEAR ENDCAP)



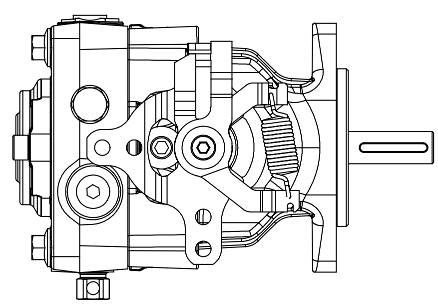
STD RETURN TO NEUTRAL
(SPRING NEAR INPUT)



CCW RETURN TO NEUTRAL
(SPRING NEAR INPUT)



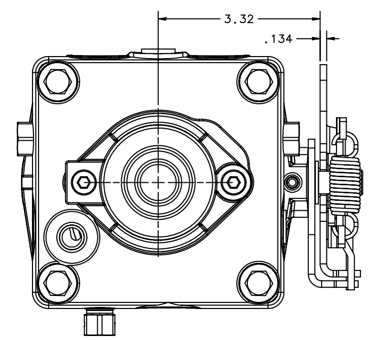
STD RETURN TO NEUTRAL
(SPRING NEAR INPUT)



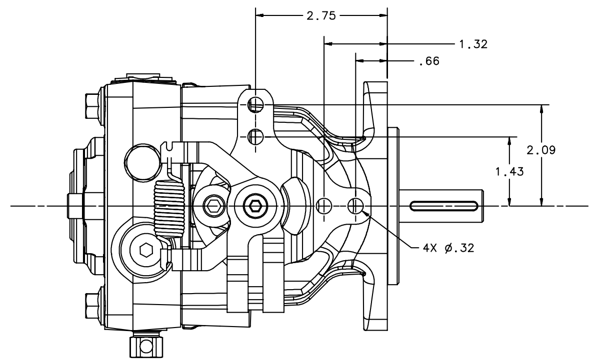
CW RETURN TO NEUTRAL
(SPRING NEAR INPUT)

All: (Optional) - Control arm may be rotated 180° with respect to trunnion shaft.
(Optional) - 2X heavier return spring. (Optional) - Control arm only.

PR (16cc) Series RTN Control

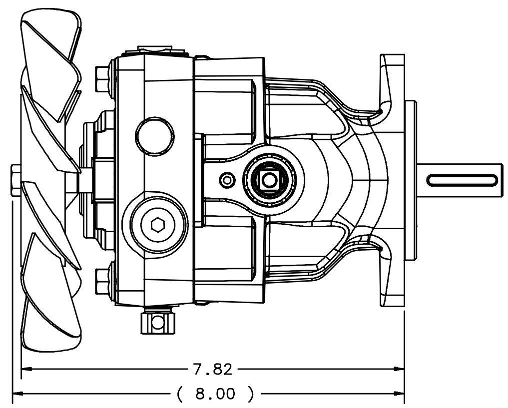


STD RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)

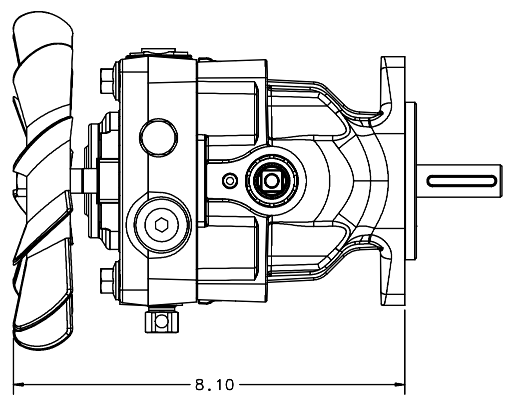


STD RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)

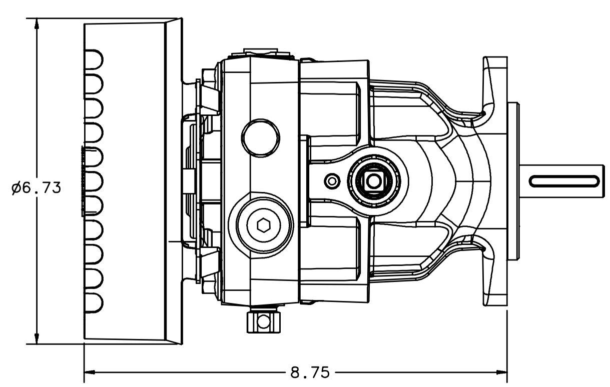
PR (16cc) Series Fan Kits



THRU CHARGE WITH Ø7" FAN (STD)
(70916 KIT W/ 51601 FAN, CW INPUT)



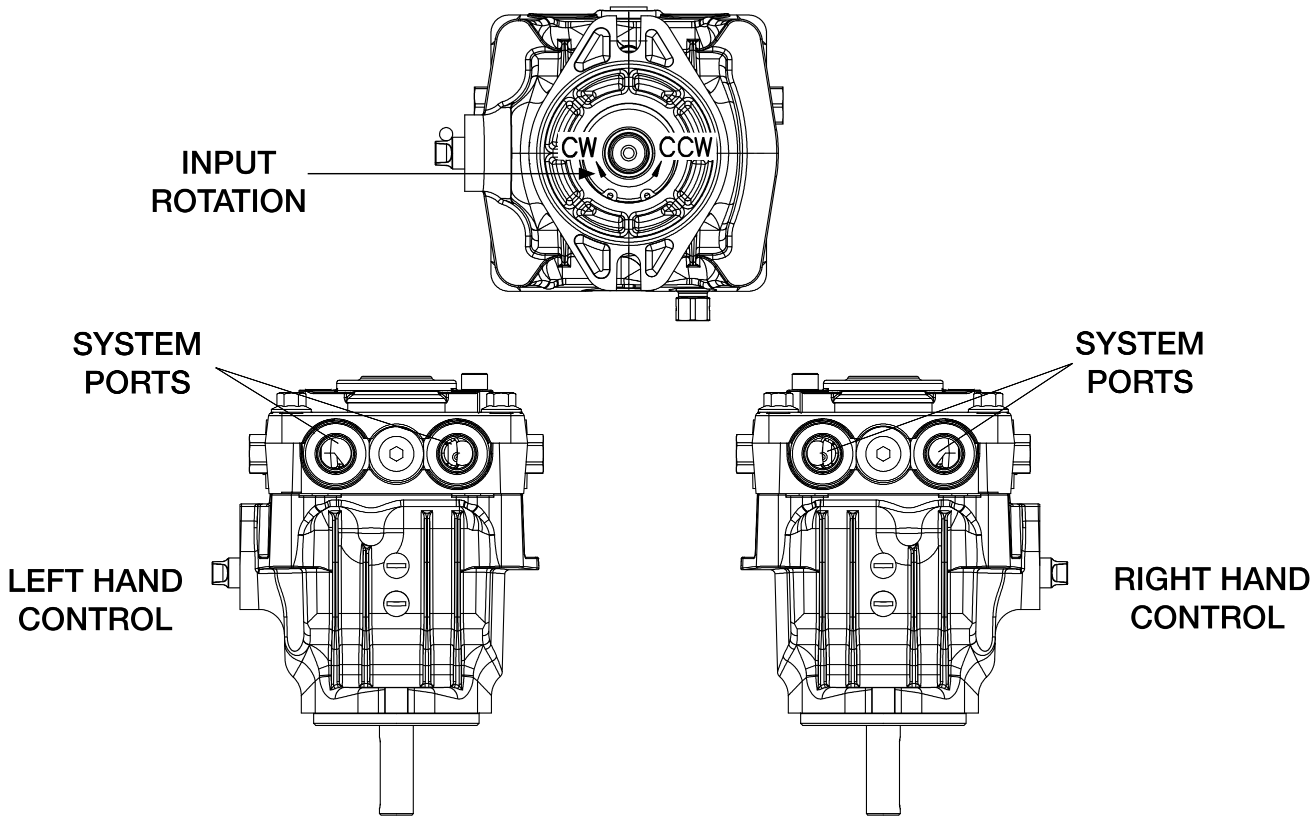
THRU CHARGE WITH Ø7" FAN (STD)
(70888 KIT W/ 51691 FAN, CCW INPUT)



THRU CHARGE WITH Ø6" FAN
(52014, CCW INPUT, WITH BRKT & SHROUD)

RESPONSIVE.
RELIABLE.
INNOVATIVE.

PR (16cc) Series Configurator



	1	2		3	4	5	6		7	8	9	10		11	12	13	14
EXAMPLE	P	R	-	A	G	F	F	-	E	G	1	C	-	1	X	X	X

3: Pump Shaft A = 52235 - 7/8 keyed (Chg); SAE

4: Input Rotation, Etc. G = CCW Input, RH control, RH case drain

5: System Check Valve "A" F = shock, 160 bar .024

6: System Check Valve "B" F = shock, 160 bar .024

7: Charge Options E = 50617 (.19) 2000029 spring (Std)

8: Control Arm Options G = Std, RTN spring near input shaft

9: Bypass Valve 1 = blank

10: Fan Kit C = 6" CCW 52014 fan with bracket, AND shroud installed, bracket positioned 90° from system ports

11: Torque Bracket & Adapter Plate 1 = Torque bracket to right

12: Special Information X = N/A

13: Future Use X = N/A

14: Future Use X = N/A

PR (16cc) Series Configurator

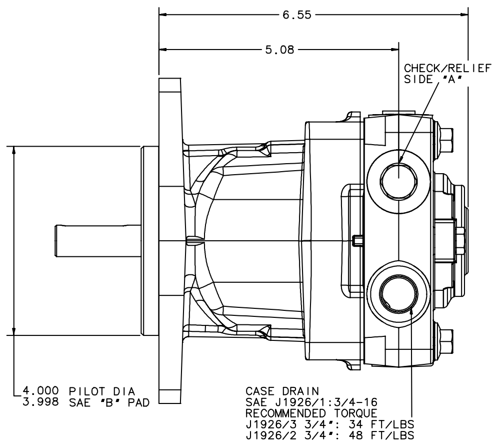
Character	1	2	3	4	5	6
			Pump Shaft	**Input Rotation, Pump Control Arm Location And Case Drain Location**	**System Check Valve "A" (RH)**	**System Check Valve "B" (LH)**
	P	R	**Standard Pump**			
			A = 52235 - 7/8 keyed (Chg); SAE M = 52208 - 11T 16/32 shaft (for single PR) 1 = 50602 - 17 mm straight keyed (Chg) 2 = 51342 - 17 mm straight keyed thru shaft (for fan) J = 52857 - 7/8 keyed through (for fan)	**Standard Pump, CW Input:**		
				A = RH control, RH drain B = RH control, LH drain C = LH control, LH drain D = LH control, RH drain	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044
				Standard Pump, CCW Input:	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044
				G = RH control, RH drain H = RH control, LH drain J = LH control, LH drain K = LH control, RH drain	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044
			T Series, Input Pump	**T Series, Input Pump, Input N/A:**		
			C = 51876 - 11T 16/32 pitch, chg D = 52001 - 7/8 keyed (Tandem) N = 51962 - 11T 16/32 pitch (A GP) P = 51540 - 7/8 straight keyed (A GP or PG) T = 51490 - 13T 16/32 pitch (A GP or PG) U = 51273 - 13T 16/32 pitch (Tandem) 6 = 51304 - 7/8 tapered keyed (Tandem) 7 = 51505 - 17mm straight keyed (AA GP or PG)	N = RH control, common drain P = LH control, common drain		
			T Series, Second Pump	**Gear Pump (only) (as 2nd pump)**		
			V = 51274 - 20T 32/64 (Tandem) W = 51547 - 9T 16/32 (A GP) Y = 51516 - 9T 20/40 (AA GP)	1 = RH control, RH drain 2 = RH control, LH drain 3 = LH control, LH drain 4 = LH control, RH drain		
				T Series Second Pump, Input N/A: (with Gear Pump)		
				Q = RH control, no drain R = LH control, no drain		
				T Series Second Pump, CW Input: (with Chg/Aux)		
				T = RH control, no drain U = LH control, no drain		
				T Series Second Pump, CCW Input:		
				V = RH control, no drain W = LH control, no drain		

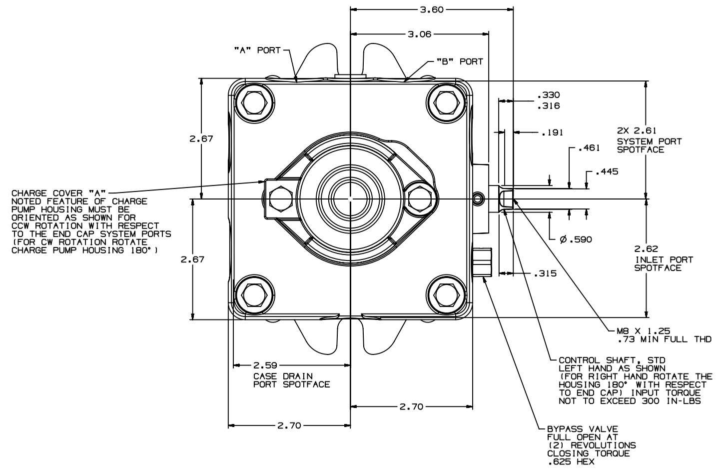
PR (16cc) Series Configurator

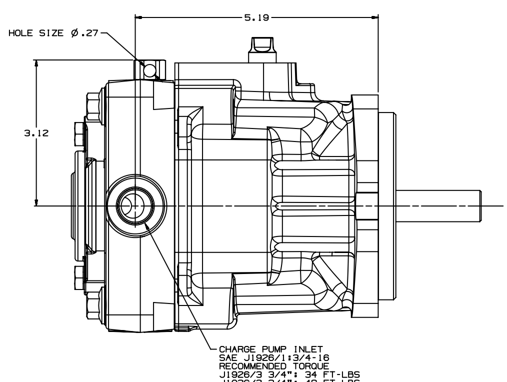
7	8	9	10	11	12	13	14
Charge Or Adapter Plate Options	**Control Arm Options**	**Bypass Valve Type**	**Fan Kit CW/CCW Refers To Input Shaft Rotation**	**Torque Bracket & Adapter Plate**	**Special Information**	**Future Use**	**Future Use**
1 = 51536 AA Adapter (GP) 2 = 51887 A Adapter (GP) 3 = 51560 Adapter (Tandem)	1 = tapered square trunnion arm only (Std)	1 = Blank	X = NA	X = NA	X = NA	X = NA	X = NA
E = 50617 .19, 2000029 spring (Std) G = 51737 .19 through, 2000029 spring (hi) J = 51075 .19 Al Aux., 51241 spring (75-105 psi) P = 51075 .19, Al Aux., 3101536 spring (40-70 psi) Q = 51075 - .19 Al Aux., 51090 spring (135-165 psi)	**Light Spring (52401, 40 in-lbs) (Silver Spring)** A = Std RTN spring near input shaft B = Std RTN spring near endcap C = CW RTN spring near input shaft D = CW RTN spring near endcap E = CCW RTN spring near input shaft F = CCW RTN spring near endcap **Heavy Spring (51605, 80 in-lbs) (Yellow Spring)** G = Std RTN spring near input shaft H = Std RTN spring near endcap J = CW RTN spring near input shaft K = CW RTN spring near endcap L = CCW RTN spring near input shaft M = CCW RTN spring near endcap **RTN Style Control Arm, No Spring:** V = Control arm only, primary connect hole near endcap W = Control arm only, primary connect hole near input shaft		1 = 7” CW 70916 (51601 fan) 2 = 7” CCW 70888 (51691 fan) **Fan/Shroud** C = 6” CCW 52014 fan with bracket AND shroud installed. Bracket positioned 90° from System Ports. G = 7” CCW 51691 fan with bracket AND shroud installed. Bracket positioned 90° from System Ports.	1 = Torque bracket to right 2 = Torque bracket opposite 3 = Torque bracket to left 4 = Torque bracket same A = Adapter plate No torque bracket C = Adapter plate	2 = Aux connectors P/N 51583 face seal		

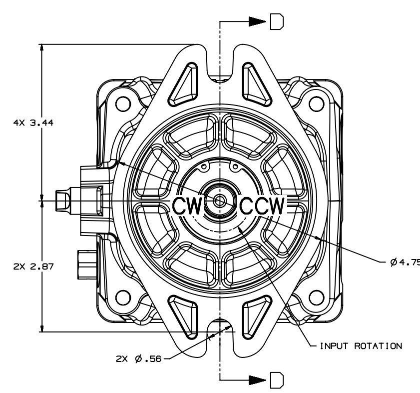
Notes		Condition:	Values:	
		If:	**Then:**	**And:**
	1	Character 3 = 1, 3, 4, A or M	Character 7 = E, J, K, L, M, P, Q, R or T	Character 10 = X
	2	Character 3 = J, 2 or 5	Character 7 = F, G, N or U	Character 10 = X, 1, 2, 4, A, B, C, D, E, F, G, H, J or K
	3	Character 3 = N, P, T or W	Character 7 = 2	Character 10 = X
	4	Character 3 = C, U, D or 6	Character 7 = 3	Character 10 = X
	5	Character 3 = 7 or Y	Character 7 = 1	Character 10 = X
	6	Character 4 = E, F, L or M	Character 7 = E, F, G, K, L, M, N, R, T, U	Character 11 = X, 2, 3 or 4
	7	Character 4 = E, F, L or M	Character 10 = X, 1, 2, 4, A	
	8	Character 7 = 2 or 3	Character 11 = A, X or C	
	9	Character 12 = 2	Character 7 = J, P or Q	
	10	Character 3 = V	Character 7 = E, J, K, L, M, P or Q	Character 10 = X
	11	Character 4 = A, C, G or J	Character 8 = 1, V, W, Y, A, C, E, G, J, L, N, Q, T	
	12	Character 4 = A, B, G or H	Character 11 = 2, 3, 4 or X	
	13	Character 4 = Q, T, V or 6	Character 11 = 2, 3, 4, A, C or X	
	14	Character 4 = C, D, J or K	Character 11 = 1, 2, 4 or X	
	15	Character 4 = R, U, W or 5	Character 11 = 1, 2, 4, A, C, 7 or X	
	16	Character 12 = 3	Character 3 = 7	
		If:	**And:**	**Then:**
	17	Character 3 = A, M, 1, 2, 3, 4, 5 or 8	Character 7 = J, P or Q	Character 11 = X

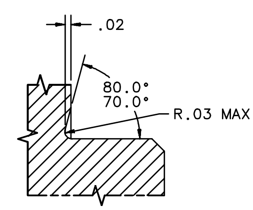
PW (21cc) Series Reference Dimensions







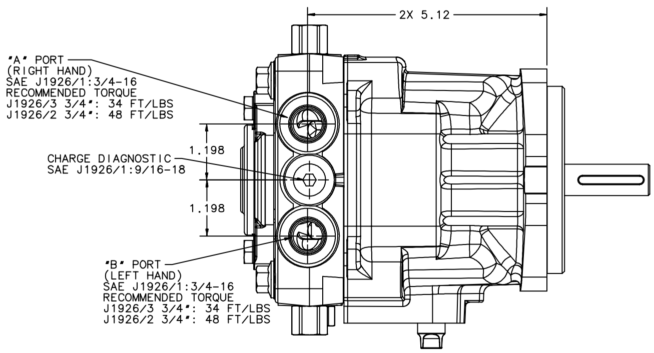


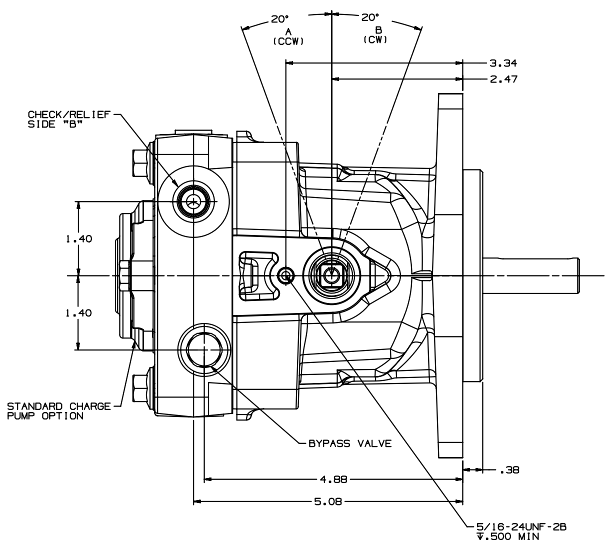


SECTION D-D

SCALE 4:1

PW (21cc) Series Reference Dimensions

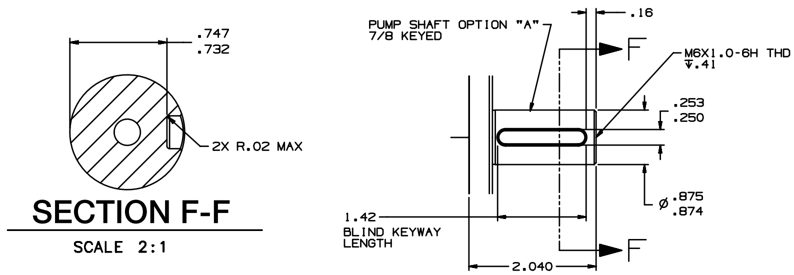


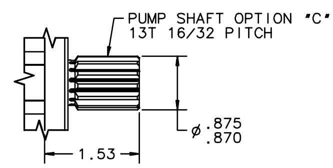


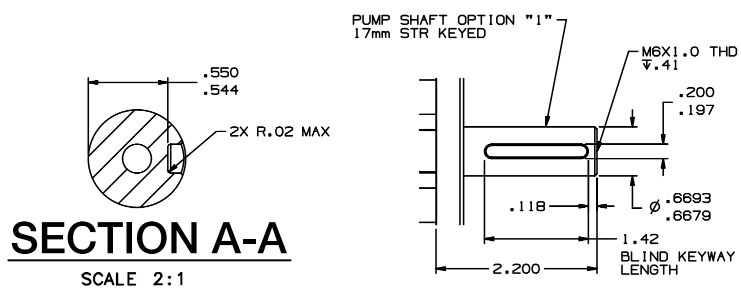
OIL FLOW CHART

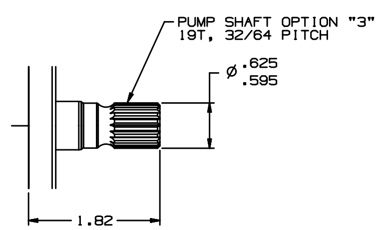
CONTROL SHAFT SIDE	LEFT HAND				RIGHT HAND			
INPUT SHAFT ROTATION	CW		CCW		CW		CCW	
CONTROL SHAFT ROTATION	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)
PORT A FLOW	IN	OUT	OUT	IN	OUT	IN	IN	OUT
PORT B FLOW	OUT	IN	IN	OUT	IN	OUT	OUT	IN

PW (21cc) Series Shaft Options

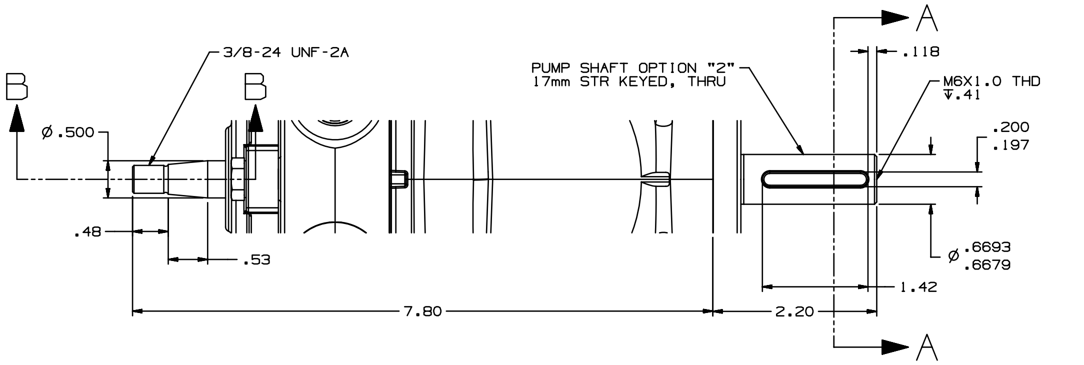


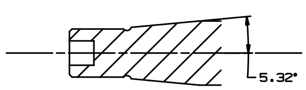






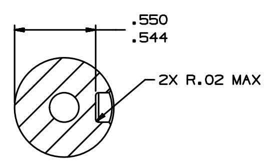
PW (21cc) Series Shaft Options (For Fans)





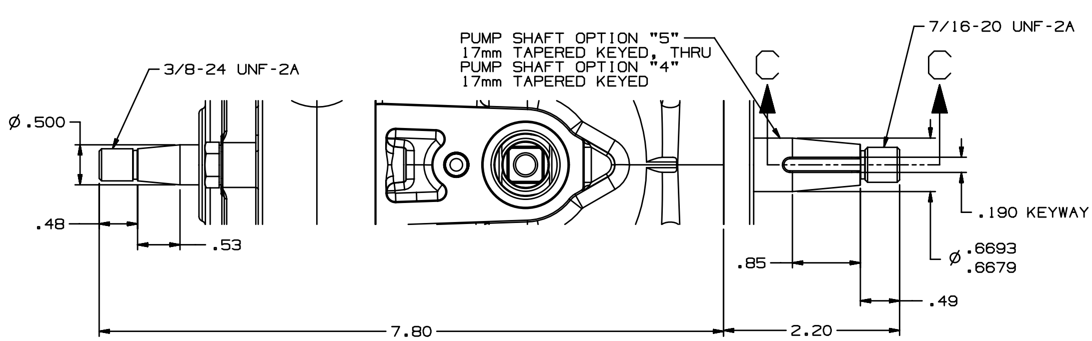
SECTION B-B

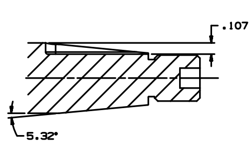
SCALE 2:1



SECTION A-A

SCALE 2:1

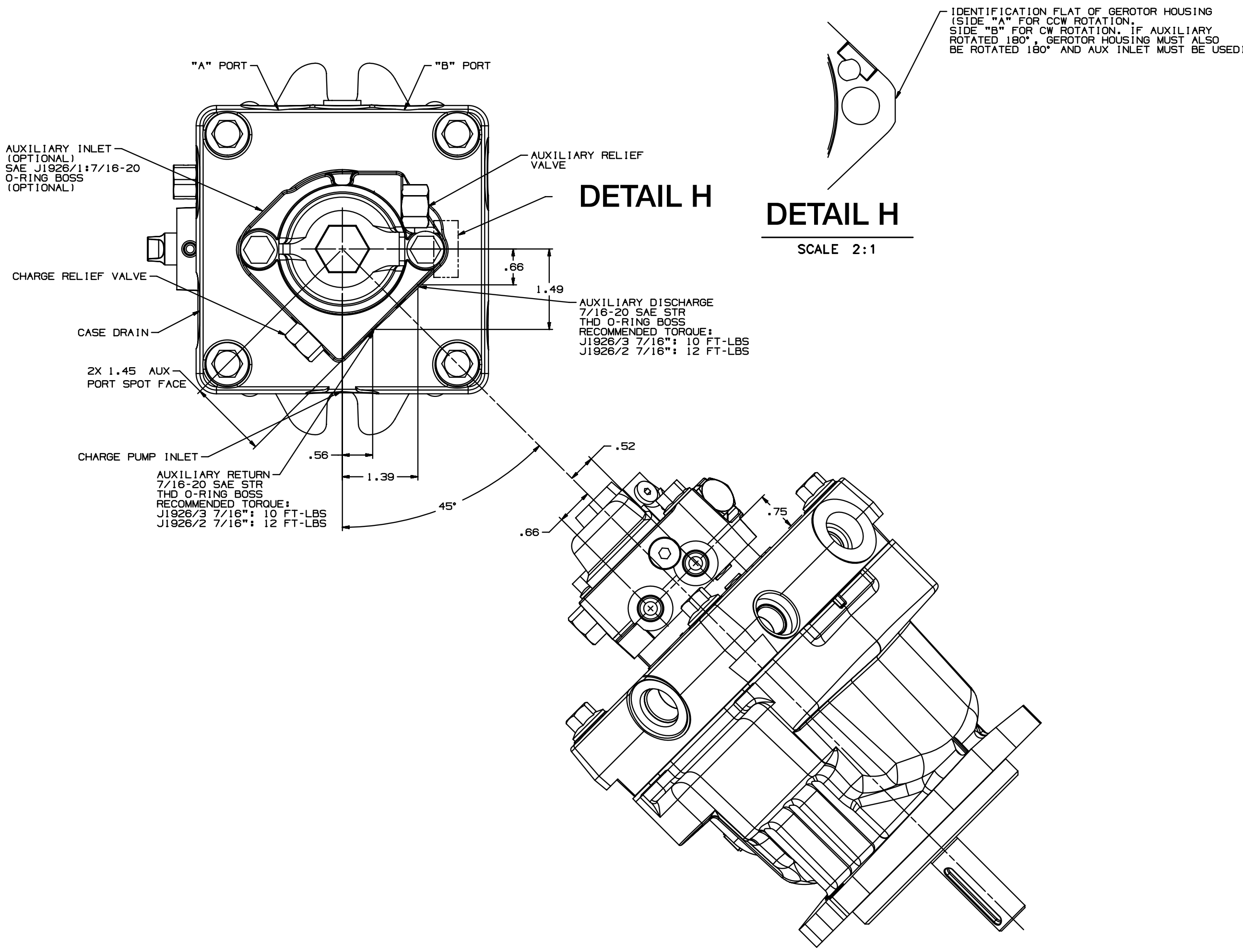


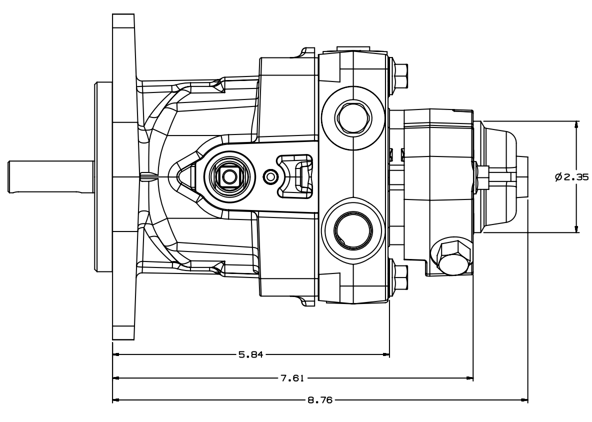


SECTION C-C

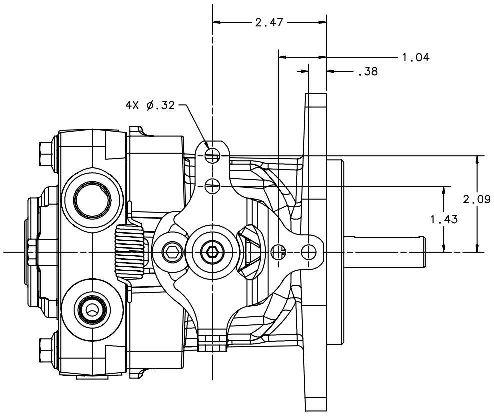
SCALE 2:1

PW (21cc) Series Auxiliary Options

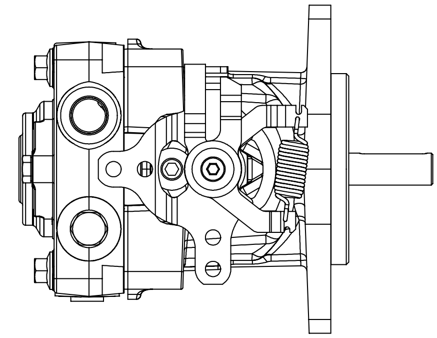




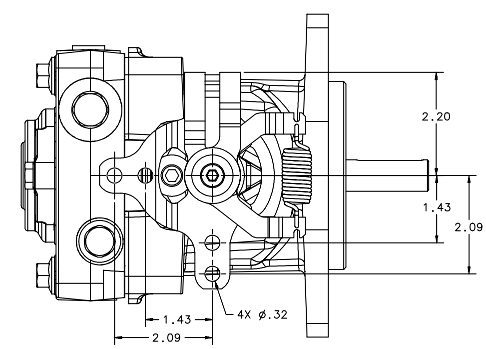
PW (21cc) Series RTN Control



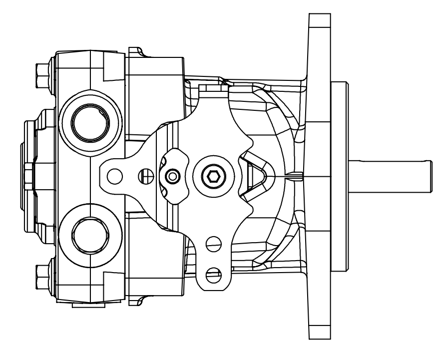
STANDARD RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)



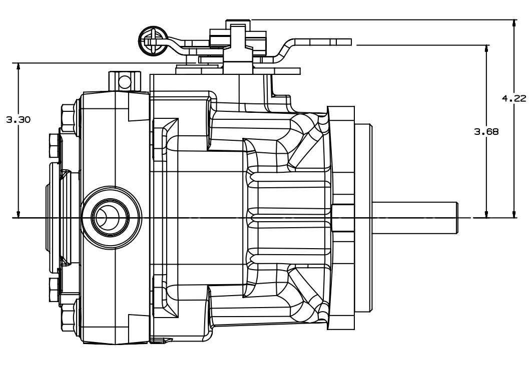
CCW RETURN TO NEUTRAL
(SPRING NEAR INPUT SHAFT)



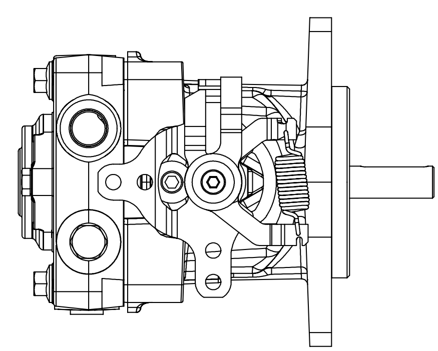
STD RETURN TO NEUTRAL
(SPRING NEAR INPUT)



STD CONTROL ARM ONLY
(PRIMARY CONNECT
NEAR ENDCAP)



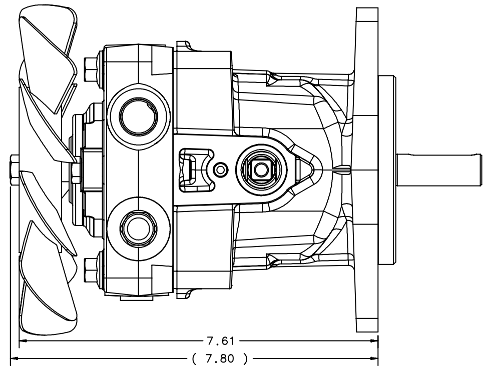
STD RETURN TO NEUTRAL
(SPRING NEAR ENDCAP)



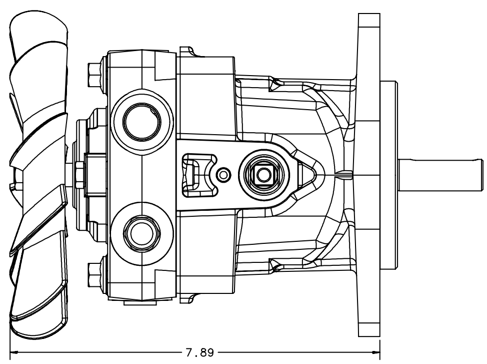
CW RETURN TO NEUTRAL
(SPRING NEAR INPUT SHAFT)

All: (Optional orientation) - Control arm may be rotated 180° with respect to trunnion shaft.
(Optional) - 2x Heavier return spring. (Optional) - Control arm only.

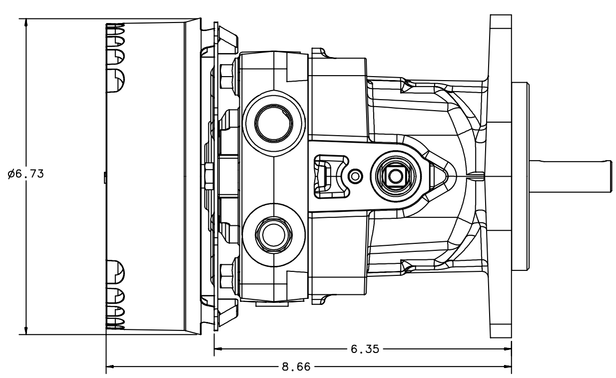
PW (21cc) Series Fan Kits



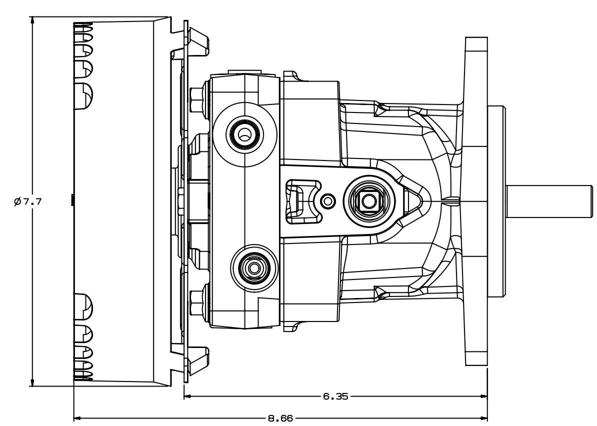
THRU CHARGE WITH Ø7" FAN (STD)
(70916 KIT W/ 51601 FAN, CW INPUT)



THRU CHARGE WITH Ø7" FAN (STD)
(70888 KIT W/ 51691 FAN, CCW INPUT)

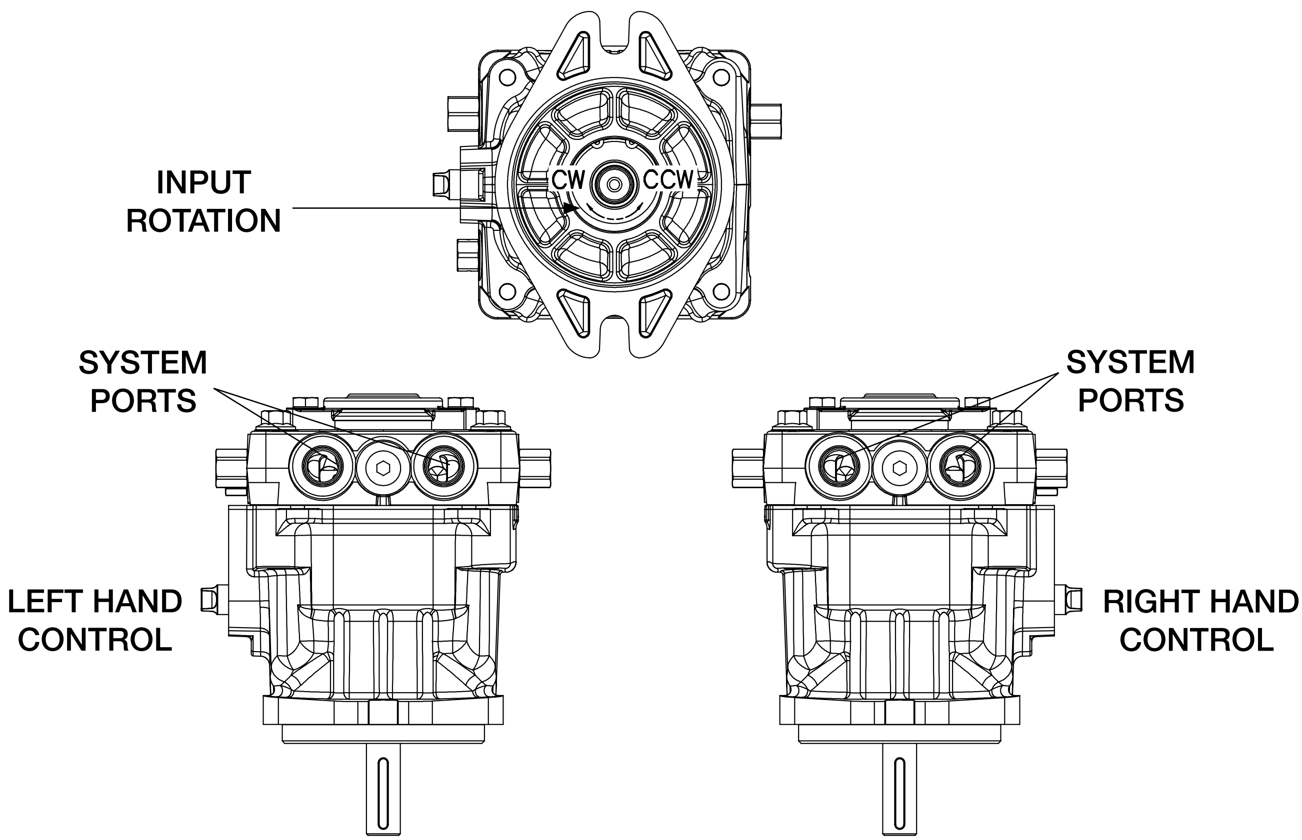


THRU CHARGE WITH Ø6" FAN
(52014 FAN, CCW INPUT, W/ BRKT & SHROUD)



THRU CHARGE WITH Ø7" FAN
(51691 FAN, CCW INPUT, W/BRKT & SHROUD)

PW (21cc) Series Configurator



EXAMPLE

1	2		3	4	5	6		7	8	9	10		11	12	13	14
P	W	-	A	G	F	F	-	E	G	1	C	-	1	X	X	X

3: Pump Shaft A = 52235 - 7/8 keyed (Chg); SAE
4: Input Rotation, Etc. G = CCW Input, RH control, RH case drain
5: System Check Valve “A” F = shock, 160 bar .024
6: System Check Valve “B” F = shock, 160 bar .024
7: Charge Options E = 50617 (.19) 2000029 spring (Std)
8: Control Arm Options G = Std, RTN spring near input shaft
9: Bypass Valve 1 = blank
10: Fan Kit C = 6” CCW 52014 fan with bracket, AND shroud installed, bracket positioned 90° from system ports
11: Torque Bracket & Adapter Plate 1 = Torque bracket to right
12: Special Information X = N/A
13: Future Use X = N/A
14: Future Use X = N/A

PW (21cc) Series Configurator

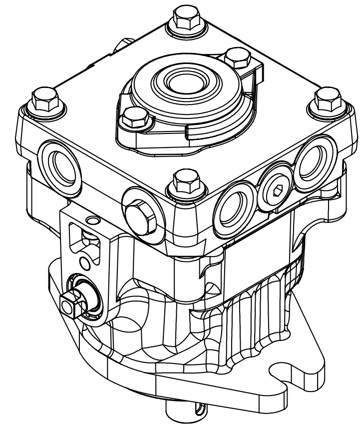
Character	1	2	3	4	5	6
			Pump Shaft	**Input Rotation, Pump Control Arm Location And Case Drain Location**	**System Check Valve "A" (RH)**	**System Check Valve "B" (LH)**
	P	W	**Standard Pump**			
			A = 52235 - 7/8 keyed (Chg); SAE C = 51911 - 13T 16/32 pitch (Chg); SAE 1 = 50602 - 17 mm straight keyed (Chg) 2 = 51342 - 17 mm straight keyed thru (for fan) 3 = 50601 - 19T 16/32 pitch 5 = 51038 - 17 mm tapered keyed thru shaft (for fan) J = 52857 - 7/8 keyed thru (for fan) M = 52208 - 11T 16/32 / 20T 32/64 Spline SAE std	**Standard Pump, CW Input:** A = RH control, RH drain D = LH control, RH drain **Standard Pump, CCW Input:** G = RH control, RH drain K = LH control, RH drain	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044 E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044 J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044 E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044 J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044
			T Series, Input Pump	**T Series, Input Pump, Input N/A: (with 2nd pump)**		
			P = 51540 - 7/8 straight keyed (A GP or 10A); SAE D = 52001 - 7/8 keyed (Tandem) T = 51490 - 13T 16/32 pitch (A GP or 10A); SAE U = 51273 - 13T 16/32 pitch (Tandem); SAE 6 = 51304 - 7/8 tapered keyed (Tandem); SAE 7 = 51505 - 17mm straight keyed (AA GP or 10A)	N = RH control, common drain P = LH control, common drain		
			T Series, Second Pump	**Gear Pump (only) (as 2nd pump)**		
			V = 51274 - 20T 32/64 (Tandem) W = 51547 - 9T 16/32 (A GP) Y = 51516 - 9T 20/40 (AA GP)	1 = RH control, RH drain 4 = LH control, RH drain		
				T Series Second Pump, Input N/A: (with Gear Pump)		
				Q = RH control, no drain R = LH control, no drain		
				T Series Second Pump, CW Input: (with Chg/Aux)		
				T = RH control, no drain U = LH control, no drain		
				T Series Second Pump, CCW Input: (with Chg/Aux)		
				V = RH control, no drain W = LH control, no drain		

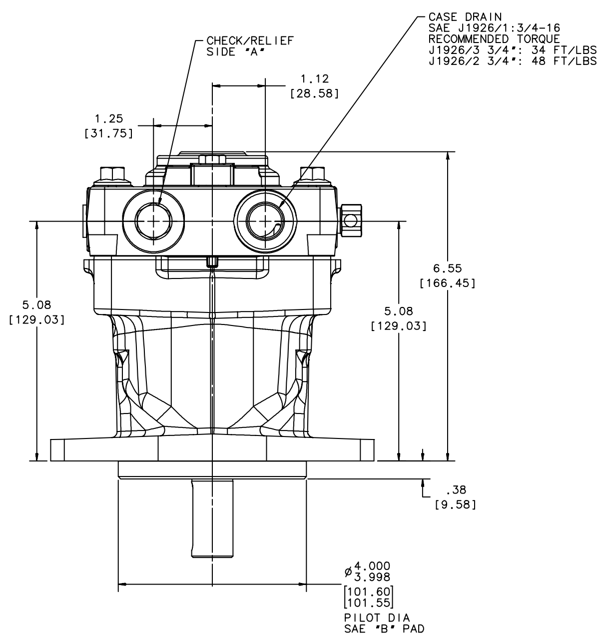
PW (21cc) Series Configurator

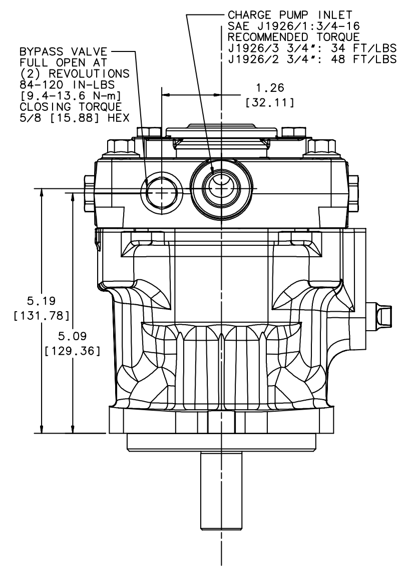
<table>
<tr><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th></tr>
<tr><th>Charge Or Adapter Plate Options</th><th>Control Arm Options</th><th>Bypass Valve Type</th><th>Fan Kit CW/CCW Refers To Input Shaft Rotation</th><th>Torque Bracket & Adapter Plate</th><th>Special Information</th><th>Future Use</th><th>Future Use</th></tr>
<tr><td></td><td>1 = tapered square trunnion arm only (Std)</td><td>1 = Blank</td><td>X = NA</td><td>X = NA</td><td>X = NA</td><td>X = NA</td><td>X = NA</td></tr>
<tr><td>1 = 51536 AA Adapter (GP)
2 = 51887 A Adapter (GP)
3 = 51272 Adapter (Tandem)</td><td>Light Spring (52401, 40 in-lbs) (Silver Spring)</td><td rowspan="8"></td><td>1 = 7” CW 70916 (51601 fan)
4 = 7” CCW 70888 (51691 fan)</td><td rowspan="8">1 = Torque bracket to right
2 = Torque bracket opposite
3 = Torque bracket to left
4 = Torque bracket same
A = Adapter plate No torque bracket
C = Adapter plate</td><td rowspan="8">2 = Aux connectors P/N 51583 face seal</td><td rowspan="8"></td><td rowspan="8"></td></tr>
<tr><td rowspan="2">E = 50617 .19, 2000029 spring (Std)
G = 51737 .19 through, 2000029 spring (hi)</td><td rowspan="2">A = Std RTN spring near input shaft
B = Std RTN spring near endcap
C = CW RTN spring near input shaft
D = CW RTN spring near endcap
E = CCW RTN spring near input shaft
F = CCW RTN spring near endcap</td><td>Fan/Shroud</td></tr>
<tr><td rowspan="6">C = 6” CCW 52014 fan with bracket AND shroud installed. Bracket positioned 90° from System Ports.
G = 7” CCW 51691 fan with bracket AND shroud installed. Bracket positioned 90° from System Ports.</td></tr>
<tr><td rowspan="5">J = 51075 .19 Al Aux., 51241 spring (75-105 psi)
P = 51075 .19, Al Aux., 3101536 spring (40-70 psi)
Q = 51075 .19 Al Aux., 51090 spring (135-165 psi)</td><td>Heavy Spring (51605, 80 in-lbs) (Yellow Spring)</td></tr>
<tr><td>G = Std RTN spring near input shaft
H = Std RTN spring near endcap
J = CW RTN spring near input shaft
K = CW RTN spring near endcap
L = CCW RTN spring near input shaft
M = CCW RTN spring near endcap</td></tr>
<tr><td>RTN Style Control Arm, No Spring:</td></tr>
<tr><td>V = Control arm only, primary connect hole near endcap
W = Control arm only, primary connect hole near input shaft</td></tr>
</table>

		Condition:	Values:	
Notes		**If:**	**Then:**	**And:**
	1	Character 3 = 1, 3, 4, A or C	Character 7 = B, E, J, K, L, M, P, Q, T, Y or Z	Character 10 = X
	2	Character 3 = J, 2 or 5	Character 7 = G, F, N or U	Character 10 = X, 1, 3, 4, A, B, C, D, E, F, G, H, J or K
	3	Character 3 = P, T or W	Character 7 = 2	Character 10 = X
	4	Character 3 = U, D or 6	Character 7 = 3 or 4	Character 10 = X
	5	Character 3 = 7 or Y	Character 7 = 1	Character 10 = X
	6	Character 4 = E, F, L or M	Character 7 = B, E, F, G, K, L, M, N, T, U	Character 11 = X, 2, 3 or 4
	7	Character 4 = E, F, L or M	Character 10 = X, 1, 3, 4, A	
	8	Character 7 = 3	Character 11 = X or A	
	9	Character 7 = J, P, Q	Character 12 = X or 2	
	10	Character 4 = A, D, G, K	Character 12 = X, 1, 2	
	11	Character 3 = V	Character 7 = E, J, P, Q, K, L, M, N, Y, Z	Character 10 = X
	12	Character 4 = A or G	Character 11 = X, 2, 3, or 4	
	13	Character 4 = 1, T, or V	Character 11 = 2, 3, 4, A, or C	
	14	Character 4 = D or K	Character 11 = X, 1, 2 or 4	
	15	Character 4 = 4, U or W	Character 11 = 1, 2, 4, A, C or 7	
		If:	**And:**	**Then:**
	17	Character 3 = A, C, 1, 2, 3, 4 or 5	Character 7 = J, P or Q	Character 11 = X

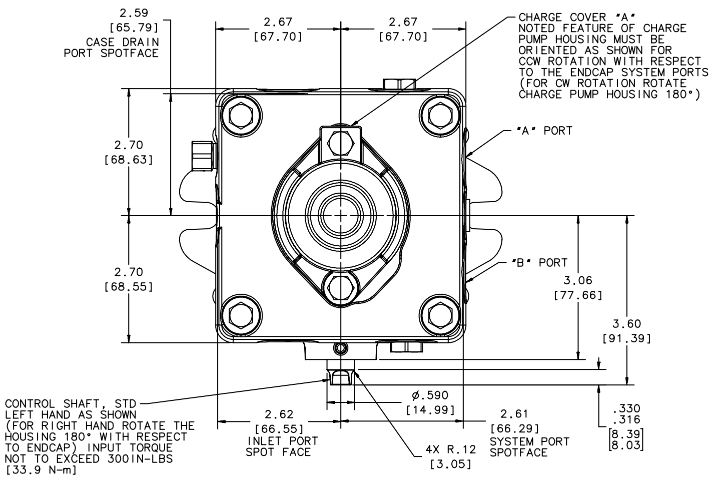
PY (21cc) Series Reference Dimensions

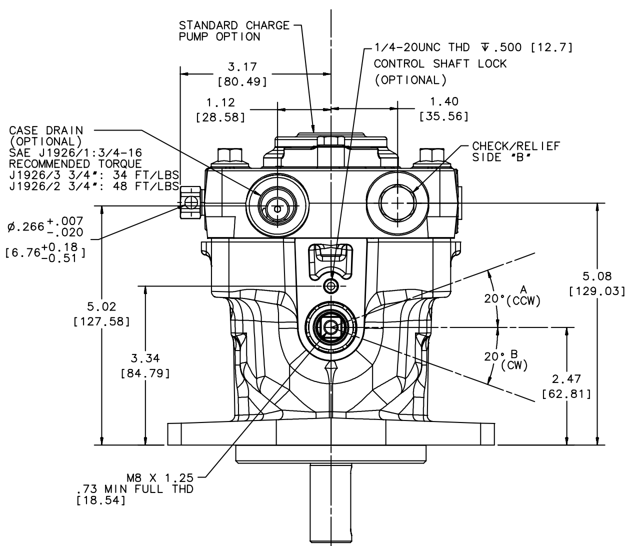


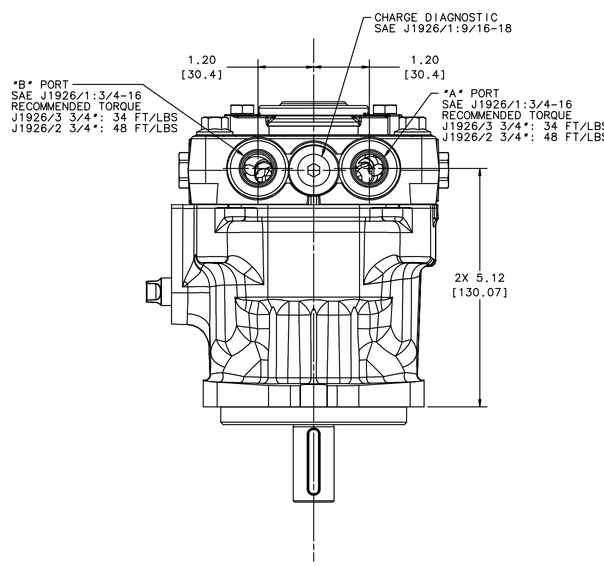


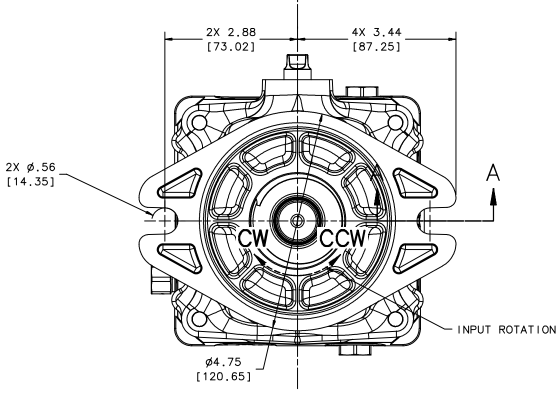


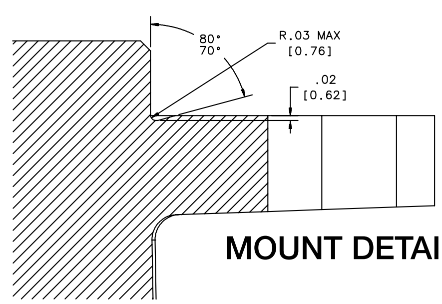
PY (21cc) Series Reference Dimensions











MOUNT DETAILS

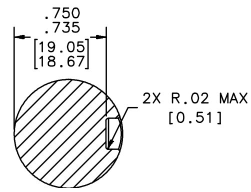
SECTION A-A

SCALE 4:1

OIL FLOW CHART

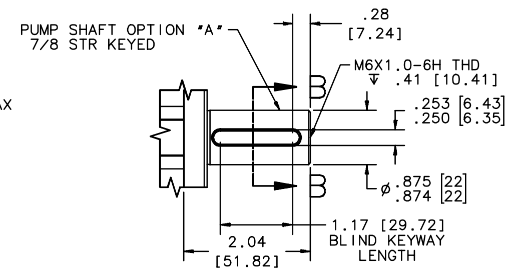
CONTROL SHAFT SIDE	LEFT HAND				RIGHT HAND			
INPUT SHAFT ROTATION	CW		CCW		CW		CCW	
CONTROL SHAFT ROTATION	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)	A (CCW)	B (CW)
PORT A FLOW	IN	OUT	OUT	IN	OUT	IN	IN	OUT
PORT B FLOW	OUT	IN	IN	OUT	IN	OUT	OUT	IN

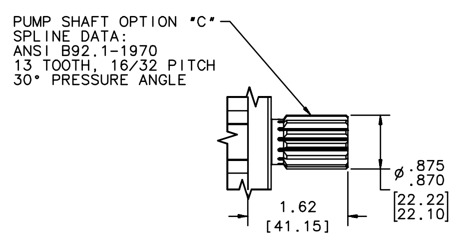
PY (21cc) Series Shaft Options



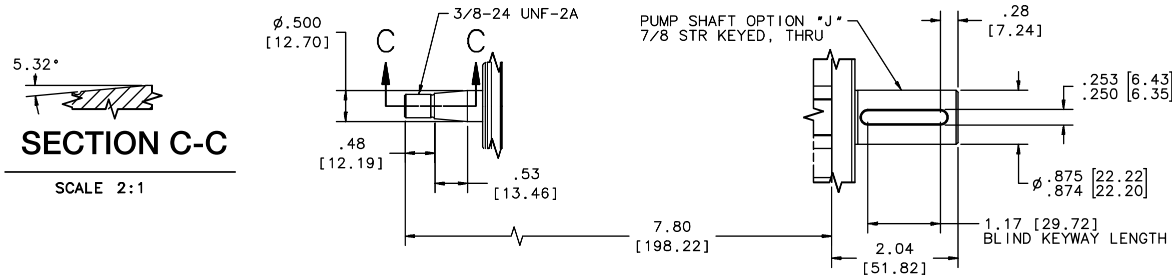
SECTION B-B

SCALE 2:1



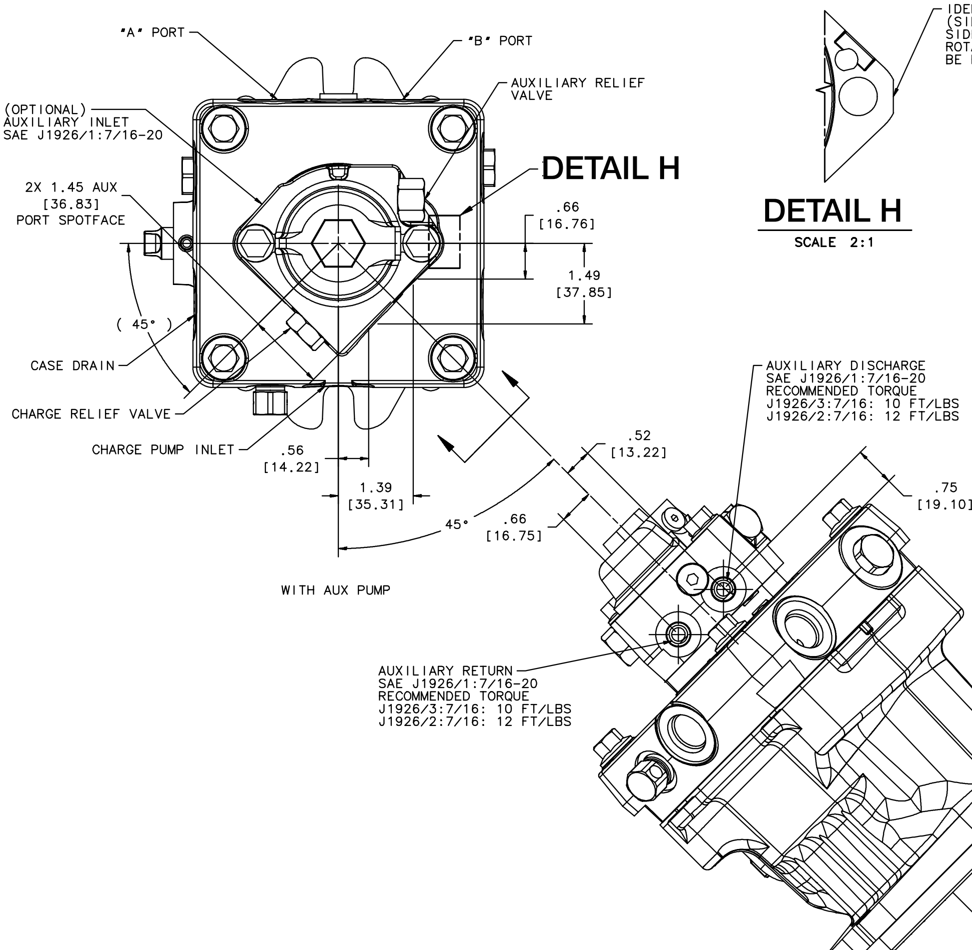


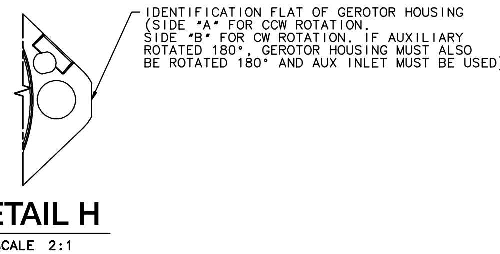
PY (21cc) Series Shaft Options (For Fans)

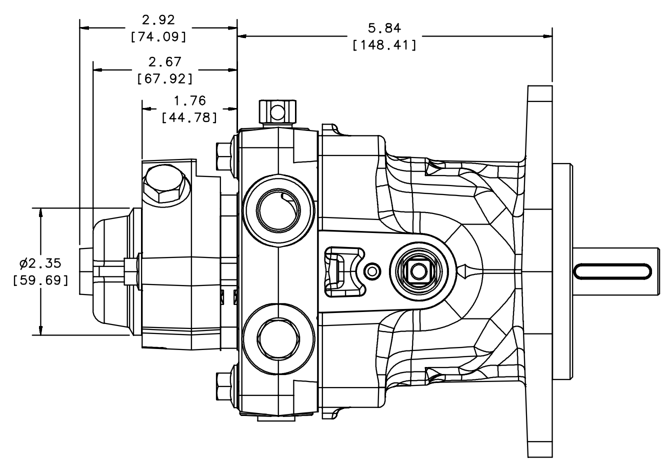


PY (21cc) Series Auxiliary Options

(Hydro-Gear 3.2 cc Auxiliary)

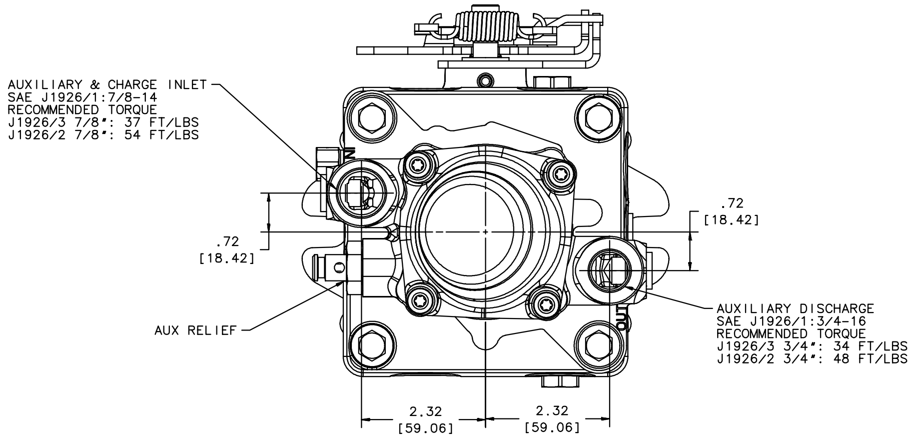


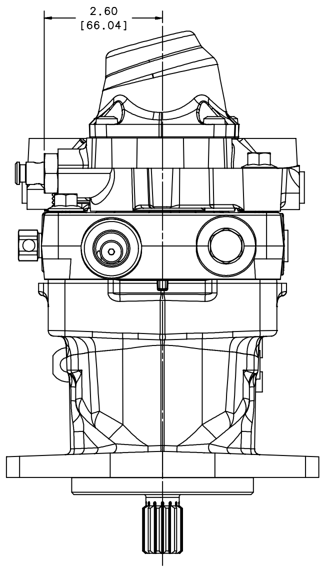


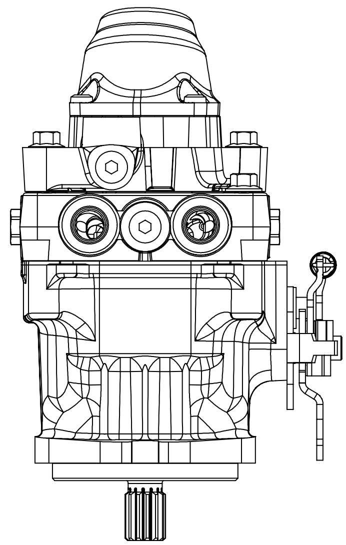


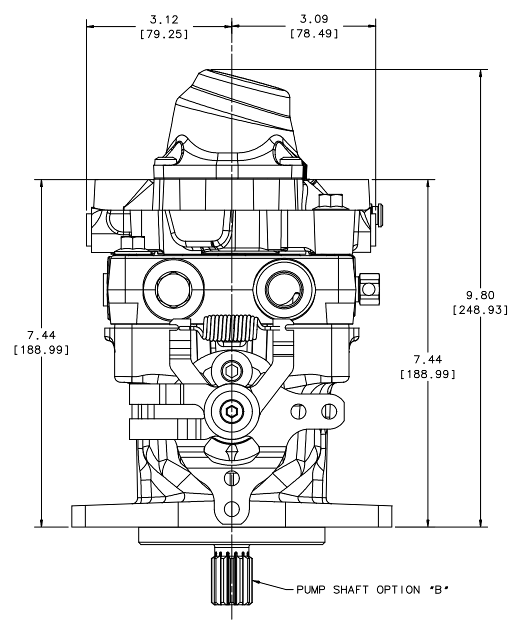
PY (21cc) Series Auxiliary Options

(Hydro-Gear 6.0 cc Auxiliary)

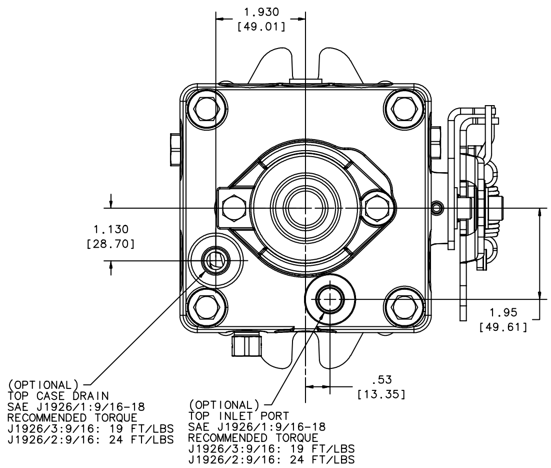


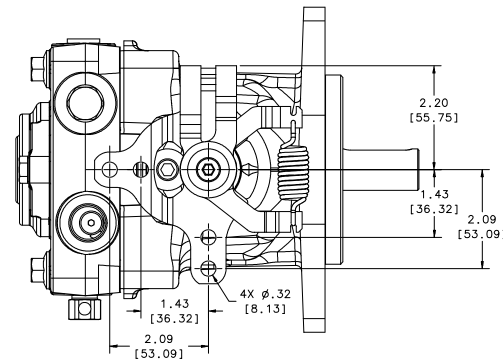




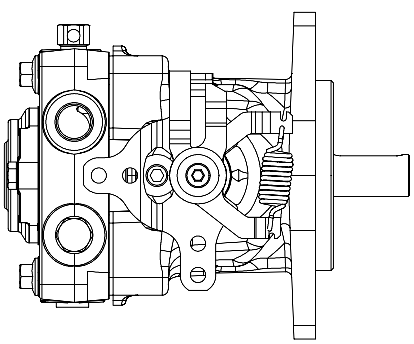


PY (21cc) Series RTN Control

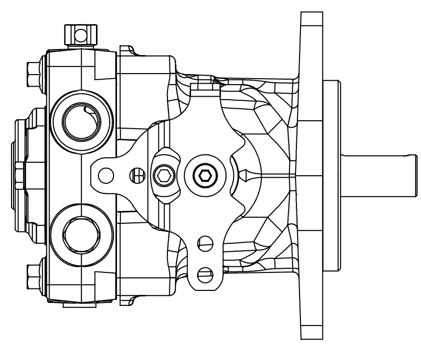




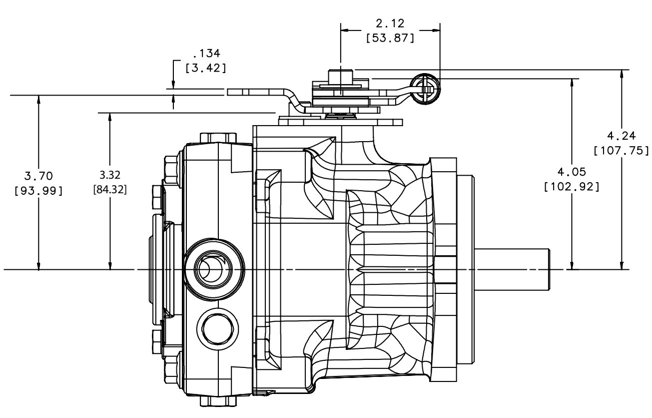
STD RETURN TO NEUTRAL
(SPRING NEAR INPUT)

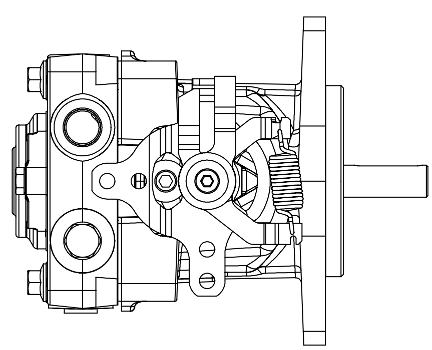


CCW RETURN TO NEUTRAL



STD CONTROL ARM ONLY
(PRIMARY CONNECT NEAR ENDCAP)

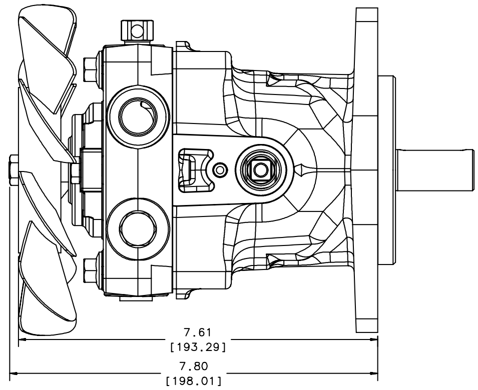




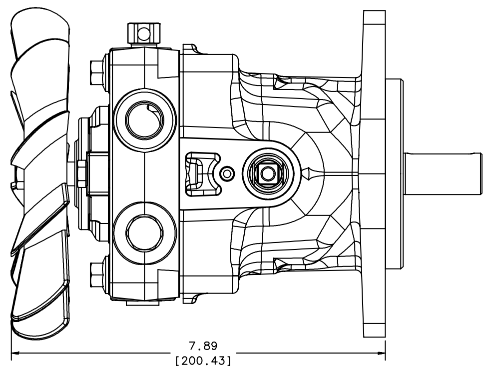
CW RETURN TO NEUTRAL
(SPRING NEAR INPUT)

Standard orientation shown throughout.
All: (Optional) - Control arm may be rotated 180° with respect to trunnion shaft.
(Optional) - 2x Heavier return spring. (Optional) - Control arm only.

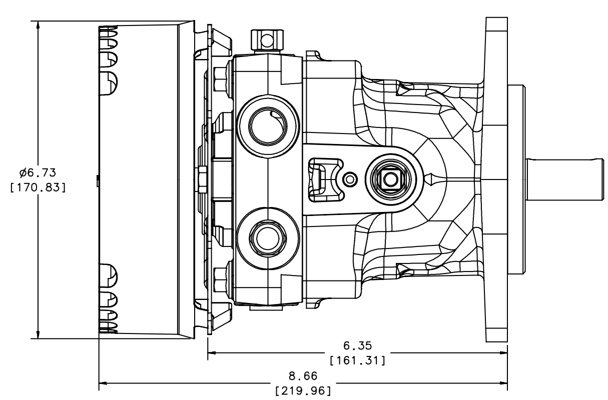
PY (21cc) Series Fan Kits



THRU CHARGE WITH Ø7" [177.8] FAN (STD)
(70916 KIT W/ 51601 FAN, CW INPUT)



THRU CHARGE WITH Ø7" [177.8] FAN (STD)
(70888 KIT W/ 51691 FAN, CCW INPUT)



THRU CHARGE WITH Ø6" [152.4] FAN
(52014 FAN, CCW INPUT, W/ BRKT & SHROUD)

PY (21cc) Series Configurator

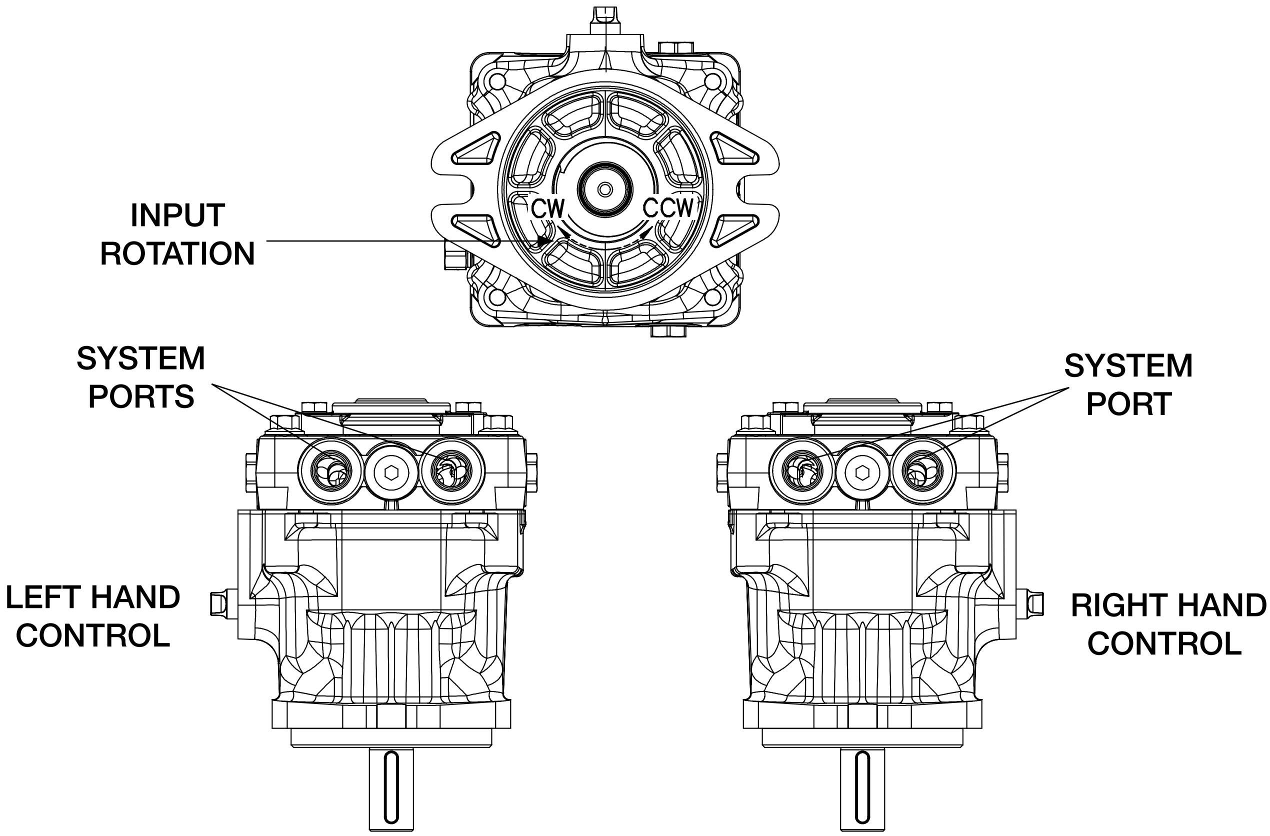
Character	1	2	3	4	5	6
			Pump Shaft	**Input Rotation, Pump Control Arm Location And Case Drain Location**	**System Check Valve "A" (RH)**	**System Check Valve "B" (LH)**
	P	Y	**Standard Pump**			
			A = 52235 - 7/8 keyed (Chg); SAE C = 51911 - 13T 16/32 pitch (Chg); SAE J = 52857 - 7/8 keyed through (for fan)	**Standard Pump, CW Input:**		
				A = RH control, RH case drain B = RH control, LH case drain C = LH control, LH case drain D = LH control, RH case drain	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044
				Standard Pump, CCW Input:	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044
				G = RH control, RH case drain H = RH control, LH case drain J = LH control, LH case drain K = LH control, RH case drain	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044
			T Series, Input Pump	**T Series, Input Pump, Input N/A: (with 2nd pump)**		
			P = 51540 - 7/8 straight keyed (A GP or 10A); SAE D = 52001 - 7/8 keyed (Tandem) T = 51490 - 13T 16/32 pitch (A GP or 10A); SAE U = 51273 - 13T 16/32 pitch (Tandem); SAE 6 = 51304 - 7/8 tapered keyed (Tandem); SAE	N = RH control, common drain P = LH control, common drain		
			T Series, Second Pump	**Gear Pump (only) (as 2nd pump)**		
			V = 51274 - 20T 32/64 (Tandem) W = 51547 - 9T 16/32 (A GP) Y = 51516 - 9T 20/40 (AA GP)	1 = RH control, RH case drain 2 = RH control, LH case drain 3 = LH control, LH case drain 4 = LH control, RH case drain		
				T Series Second Pump, Input N/A: (with Gear Pump)		
				Q = RH control, no drain R = LH control, no drain		
				T Series Second Pump, CW Input: (with Chg/Aux)		
				T = RH control, no drain U = LH control, no drain		
				T Series Second Pump, CCW Input: (with Chg/Aux)		
				V = RH control, no drain W = LH control, no drain		

PY (21cc) Series Configurator

7	8	9	10	11	12	13	14
Charge Or Adapter Plate Options	**Control Arm Options**	**Bypass Valve Type**	**Fan Kit CW/CCW Refers To Input Shaft Rotation**	**Torque Bracket & Adapter Plate**	**Special Information**	**Future Use**	**Future Use**
1 = 51536 AA Adapter (GP) 2 = 51887 A Adapter (GP) 3 = 51272 Adapter (Tandem)	1 = tapered square trunnion arm only (Std)	1 = Blank	X = NA 1 = 7" CW 70916 (51601 fan) 4 = 7" CCW 70888 (51691 fan)	X = NA	X = NA	X = NA	X = NA
A = 52739 .25 std, 2000029 spring B = 52739 .25 std, 52338 spring (hi) E = 50617 .19 std, 2000029 spring G = 51737 .19 through, 2000029 spring J = 51075 .19 Al Aux., 51241 spring (75-105 psi) P = 51075 .19, Al Aux., 3101536 spring (40-70 psi) Q = 51075 .19 Al Aux., 51090 spring (135-165 psi)	**Heavy Spring (51605, 80 in-lbs) (Yellow Spring)** G = Std RTN spring near input shaft H = Std RTN spring near endcap J = CW RTN spring near input shaft K = CW RTN spring near endcap L = CCW RTN spring near input shaft M = CCW RTN spring near endcap **RTN Style Control Arm, No Spring:** V = Control arm only, primary connect hole near endcap W = Control arm only, primary connect hole near input shaft		**Fan/Shroud** C = 6" CCW 52014 fan with bracket AND shroud installed. Bracket positioned 90° from System Ports. G = 7" CCW 51691 fan with bracket AND shroud installed. Bracket positioned 90° from System Ports.	1 = Torque bracket to right 2 = Torque bracket opposite 3 = Torque bracket to left 4 = Torque bracket same A = Adapter plate - No torque bracket C = Adapter plate	2 = Aux connectors P/N 51583 face seal		

	Condition:	Values:			
	If:	**Then:**	**And:**	**And:**	**And:**
1	Character 3 = A or C	Character 7 = A, B, E, J, P, Q or T	Character 10 = X		
2	Character 3 = J	Character 7 = G or U	Character 10 = X, 1, 3, 4, A, B, C, D, E, F, G, H, J or K		
3	Character 3 = P, T or W	Character 7 = 2	Character 10 = X		
4	Character 3 = U, D or 6	Character 7 = 3 or 4	Character 10 = X		
5	Character 3 = Y	Character 7 = 1	Character 10 = X		
6	Character 4 = E, F, L or M	Character 7 = A, B, E, G, T or U	Character 11 = X, 2, 3 or 4		
7	Character 4 = E, F, L or M	Character 10 = X, 1, 3, 4 or A			
8	Character 7 = 3	Character 11 = X or A			
9	Character 7 = J, P, Q	Character 12 = X, L, or 2			
10	Character 4 = A, B, C, D, G, H, J or K	Character 12 = X, L, or 1			
11	Character 3 = V	Character 7 = A, B, E, J, P, Q or T	Character 10 = X		
12	Character 4 = A, B, G or H	Character 11 = X, 2, 3 or 4			
13	Character 4 = 1, 2, Q, T or V	Character 11 = X, 2, 3, 4, A or C			
14	Character 4 = C, D, J or K	Character 11 = X, 1, 2 or 4			
15	Character 4 = 3, 4, R, U or W	Character 11 = X, 1, 2, 4, A or C			
16	Character 3 = B, E	Character 7 = H	Character 10 = X	Character 11 = X	Character 4 = Y
	If:	**And:**	**Then:**		
17	Character 3 = A or C	Character 7 = J, P or Q	Character 11 = X		

PY (21cc) Series Configurator



	1	2		3	4	5	6		7	8	9	10		11	12	13	14
EXAMPLE	P	Y	-	A	G	F	F	-	E	G	1	C	-	1	X	X	X

3: Pump Shaft [A] = 52235 - 7/8 keyed (Chg); SAE

4: Input Rotation, Etc. [G] = CCW Input, RH control, RH case drain

5: System Check Valve “A” [F] = shock, 160 bar .024

6: System Check Valve “B” [F] = shock, 160 bar .024

7: Charge Options [E] = 50617 (.19) 2000029 spring

8: Control Arm Options [G] = Std, RTN spring near input shaft

9: Bypass Valve [1] = blank

10: Fan Kit [C] = 6” CCW 52014 fan with bracket, AND shroud installed, bracket positioned 90° from system ports

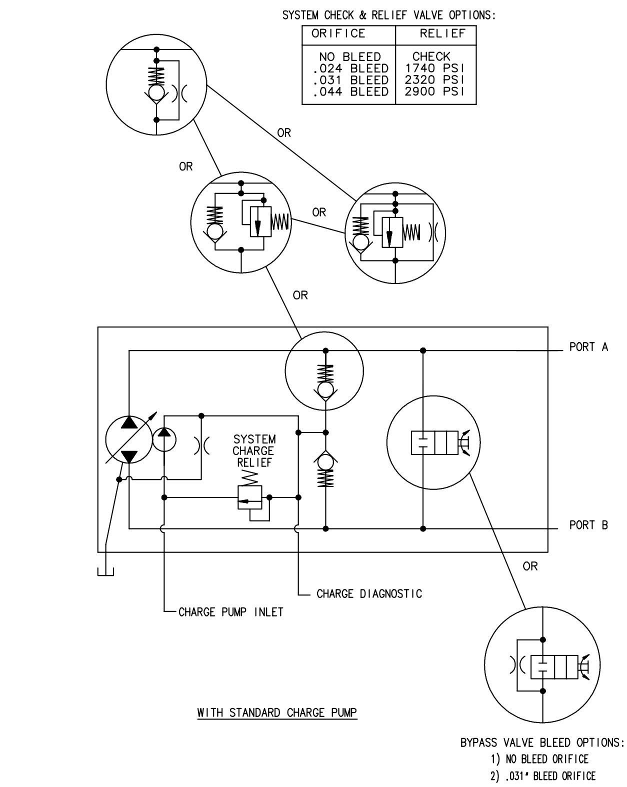
11: Torque Bracket & Adapter Plate [1] = Torque bracket to right

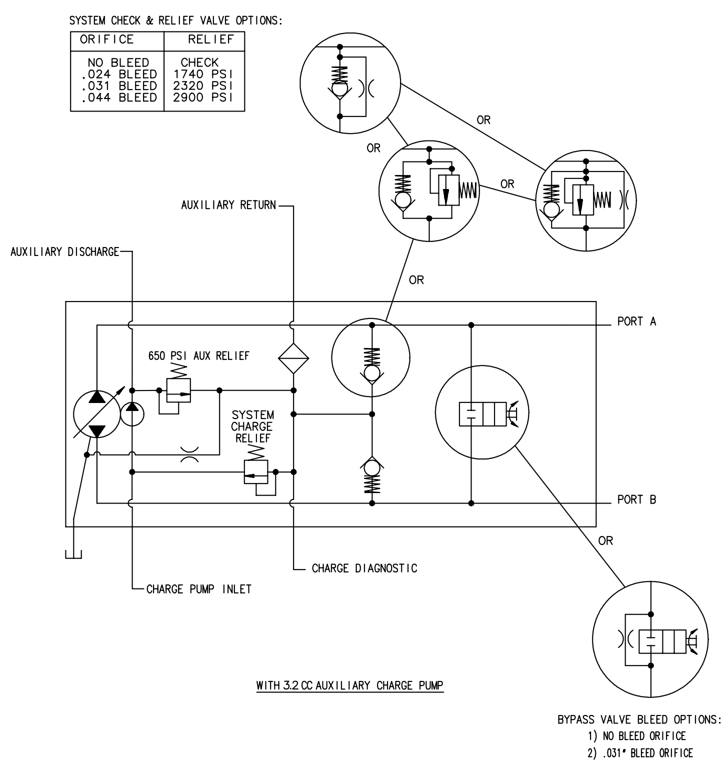
12: Special Information [X] = N/A

13: Future Use [X] = N/A

14: Future Use [X] = N/A

P-Series Hydraulic Circuit Diagrams

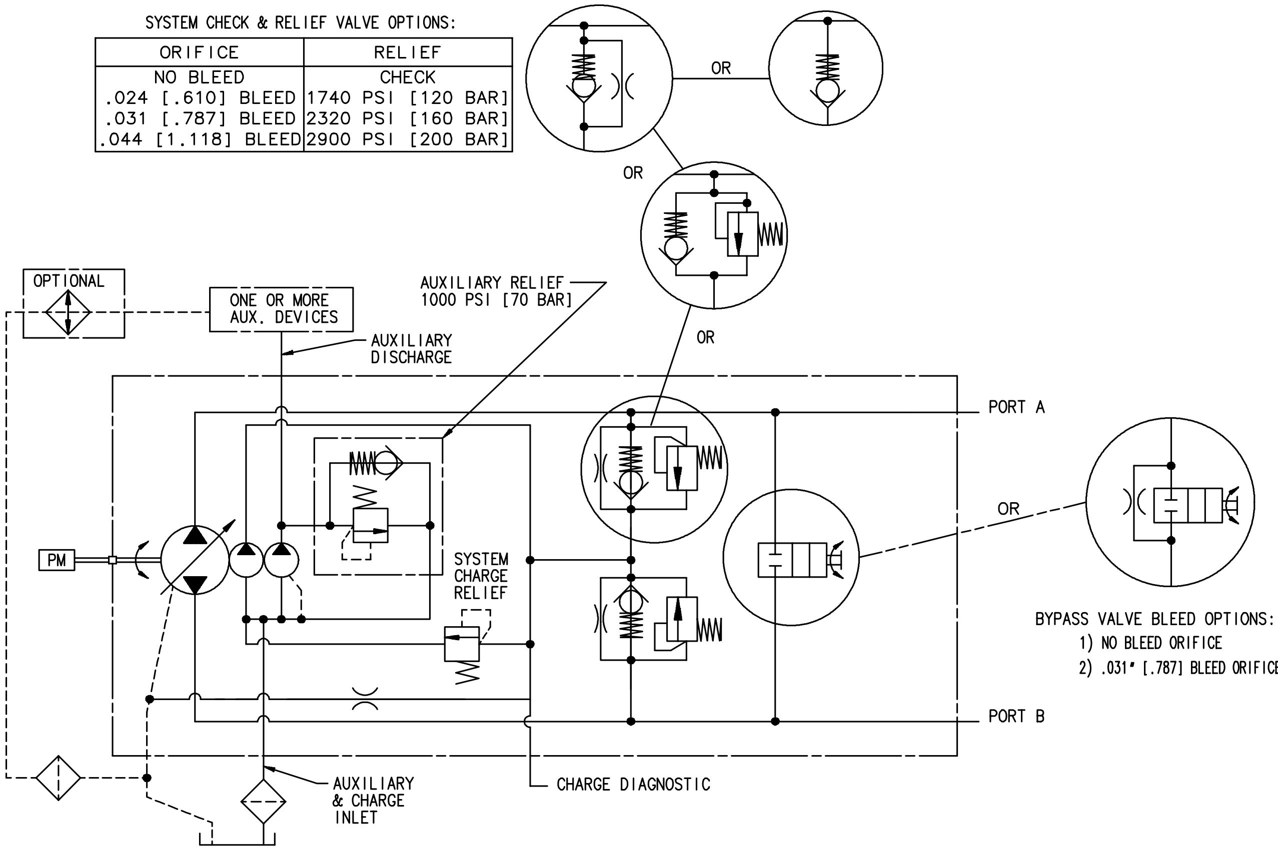




P-Series Hydraulic Circuit Diagrams

SYSTEM CHECK & RELIEF VALVE OPTIONS:

ORIFICE	RELIEF
NO BLEED	CHECK
.024 [.610] BLEED	1740 PSI [120 BAR]
.031 [.787] BLEED	2320 PSI [160 BAR]
.044 [1.118] BLEED	2900 PSI [200 BAR]



HYDRO-GEAR®

T-Series Pumps

The P-Series pumps can be configured in several tandem T-Series combinations. The tandem pumps can be assembled in three different configurations:

- Single P-Series pump with a fixed displacement gear pump
- Two P-Series pumps with a common charge pump or auxiliary pump
- Two P-Series pumps with a fixed displacement gear pump

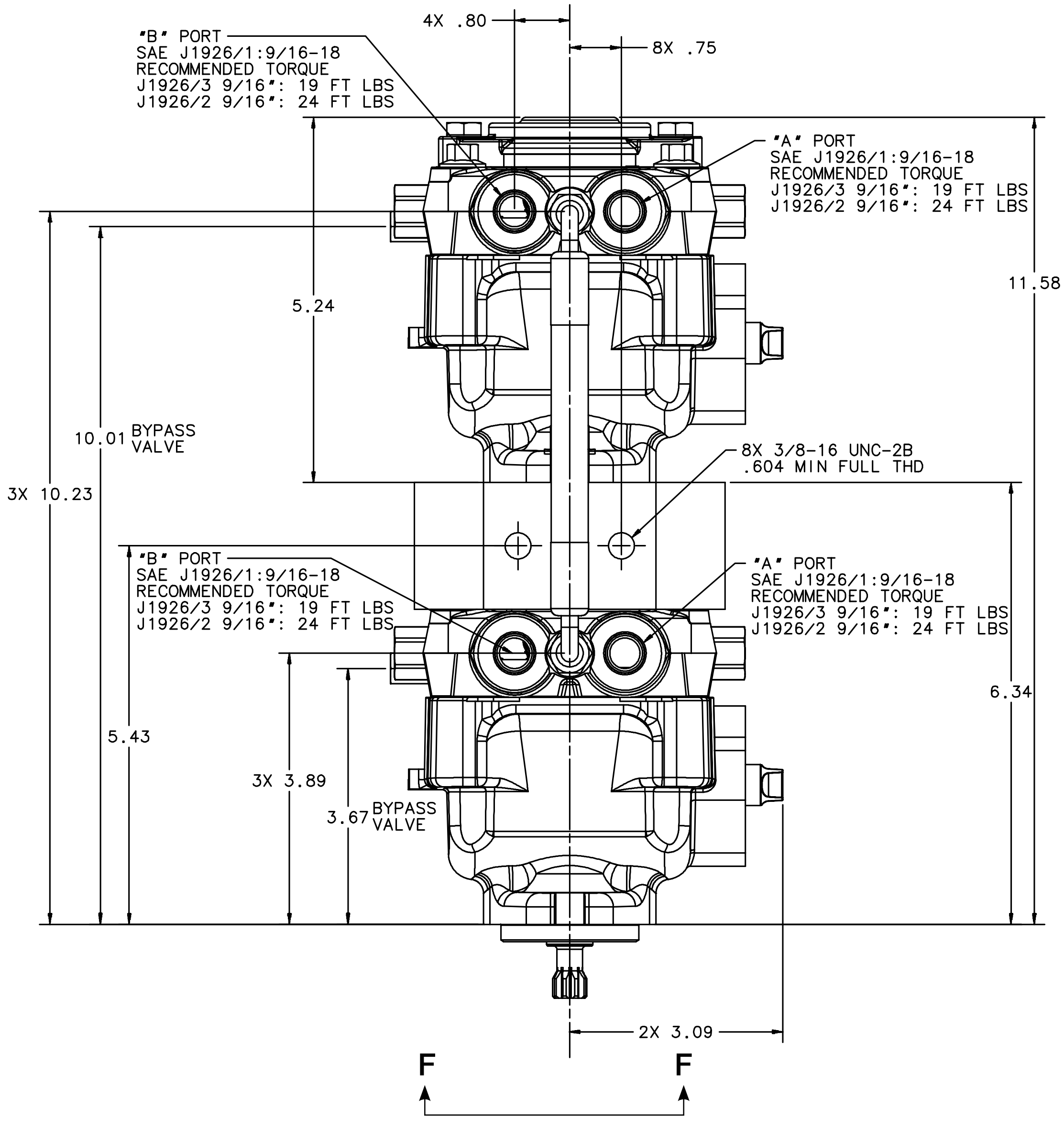
The T-Series provides an effective method to drive the pumps with a single input shaft and allows the option of an increased auxiliary flow and pressure source with the addition of a gear pump. The T-Series is also available “gear pump ready”, in case a specialized gear pump is needed for the application. Most of the optional features on the P-Series pumps are also available on the T-Series pumps for the same high level of flexibility.

Two check valves are included in the pump end cap to control the makeup oil flow for the system. The selection of the check valves plays an important role on the system pressures, response, and the amount of heat generated. Additionally, the T-Series pumps are equipped with shock valves. Shock valves are both check valves and factory preset direct acting system pressure relief valves. They are available in various relief pressure settings and bleed orifice sizes.

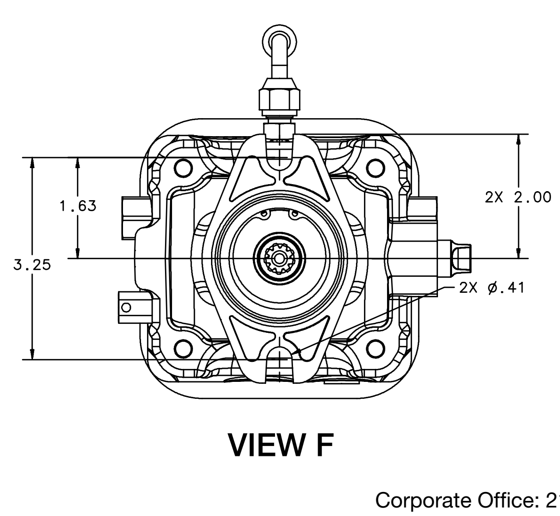
A screw type bypass valve is included in the pumps to permit limited unpowered movement of the machine. When opened, the bypass valve allows oil to route from one side of the closed loop circuit to the other.

The P-Series and T-Series pumps can be combined with hydraulic wheel motors or other remotely located units to complete a fluid power transmission system. The pumps are primarily used for traction drive propulsion in a wide variety of mobile applications but are capable of many other applications.

T-Series Reference Dimensions (PC)

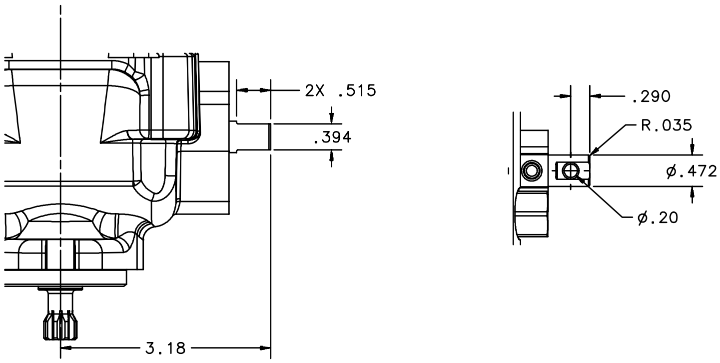


TANDEM PC (6cc) PUMP

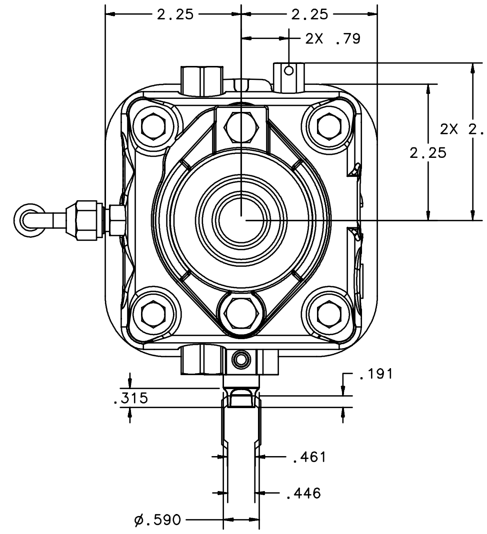


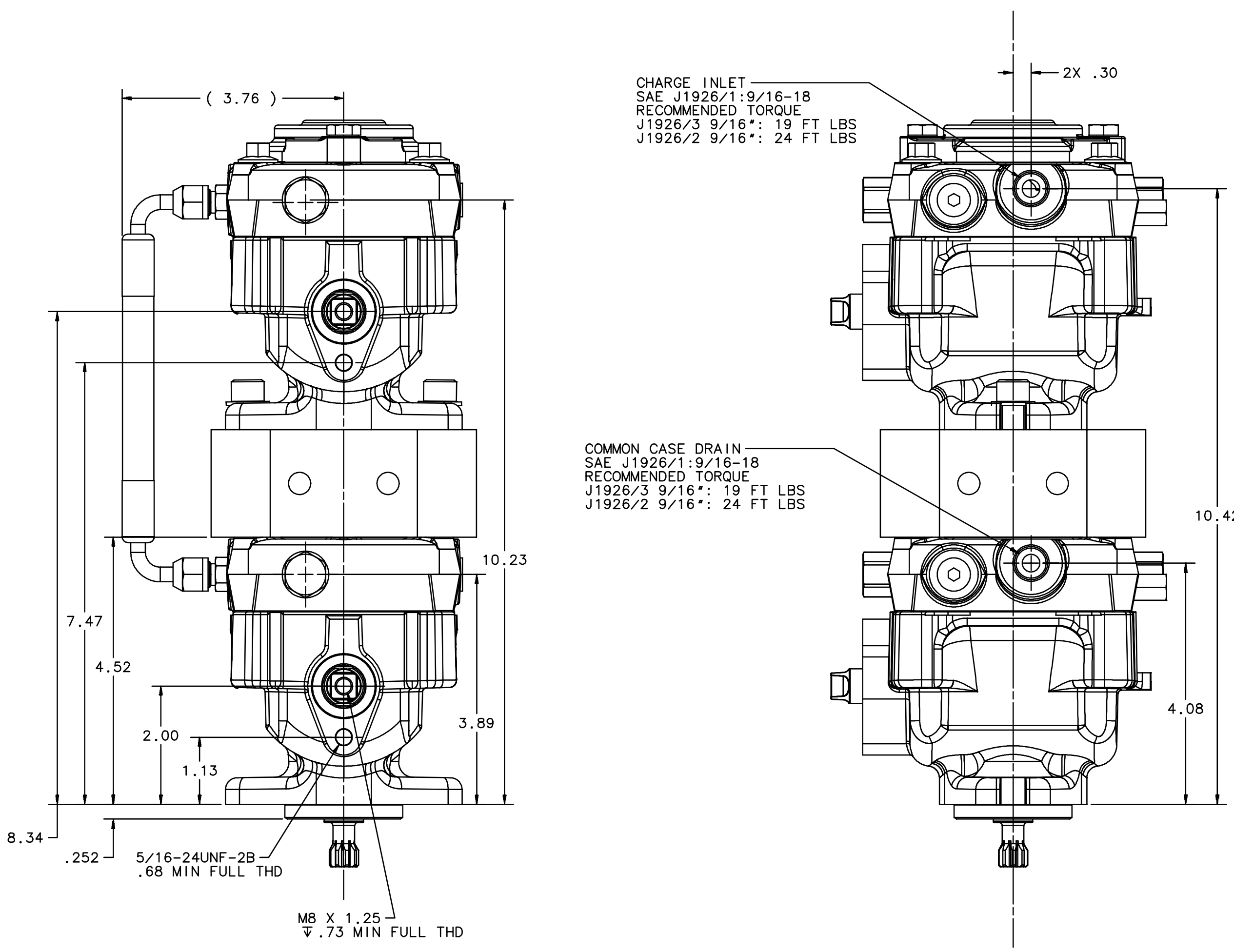
VIEW F

T-Series Reference Dimensions (PC)



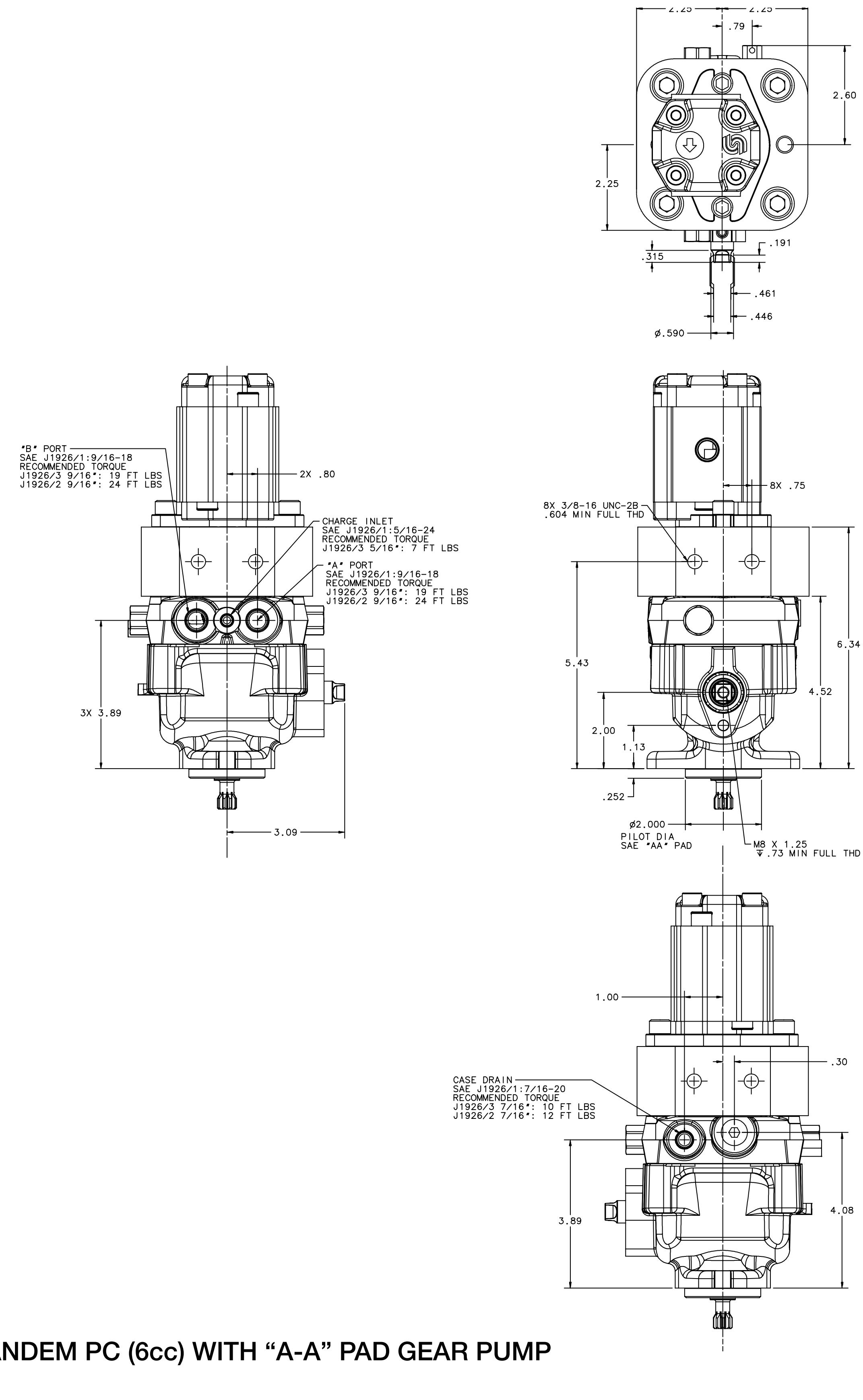
PC (6cc) OPTIONAL DD TRUNNION





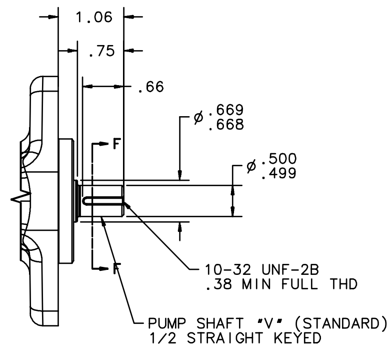
TANDEM PC (6cc) PUMP

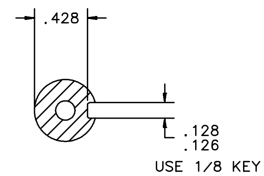
T-Series Reference Dimensions (PC)



TANDEM PC (6cc) WITH "A-A" PAD GEAR PUMP

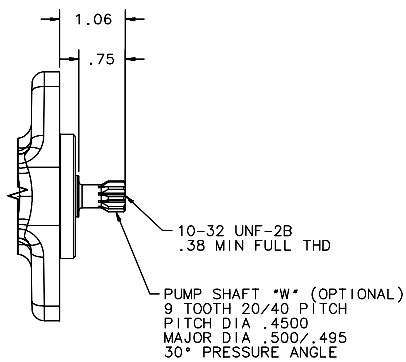
T-Series Shaft Options (PC)



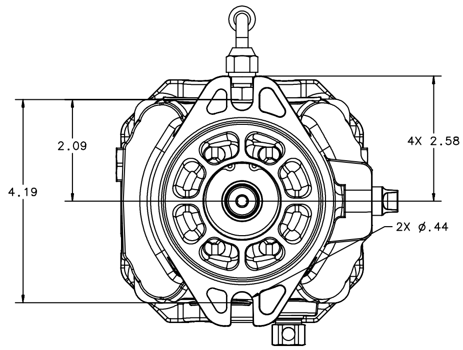


SECTION F-F

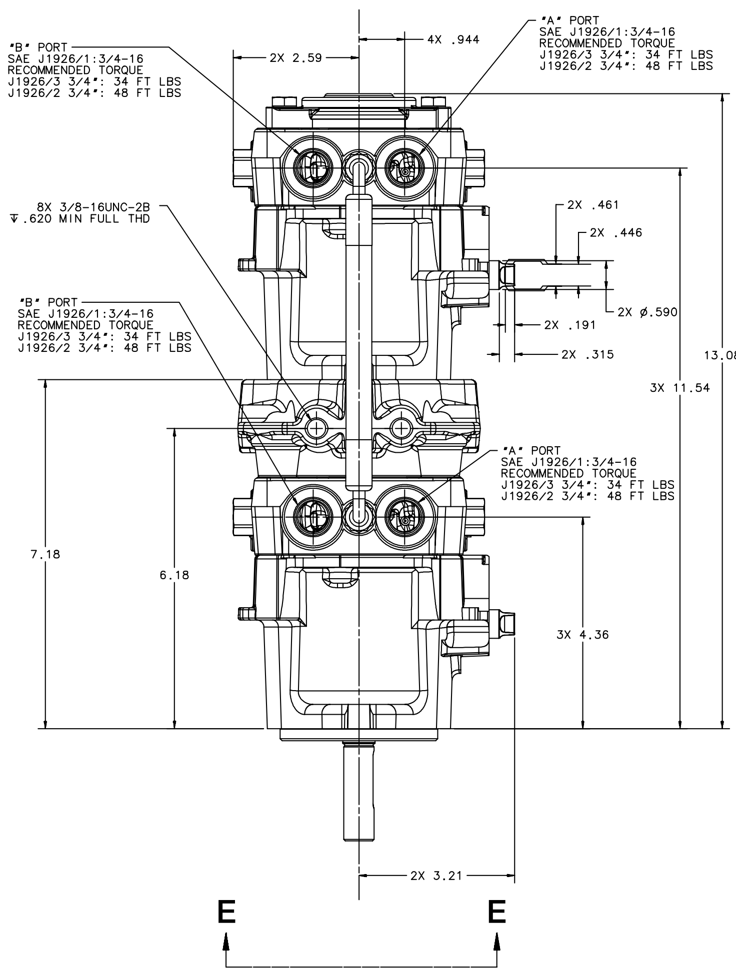
SCALE 2:1

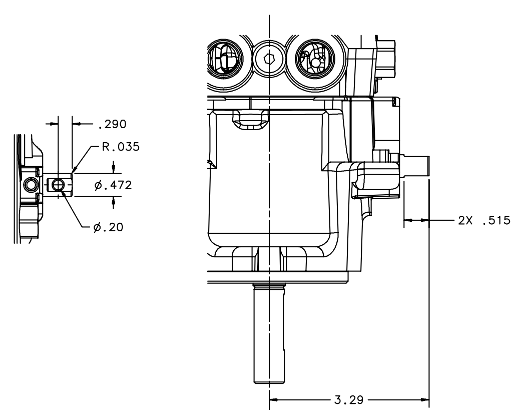


T-Series Reference Dimensions (PK)



VIEW E
SCALE 1:1

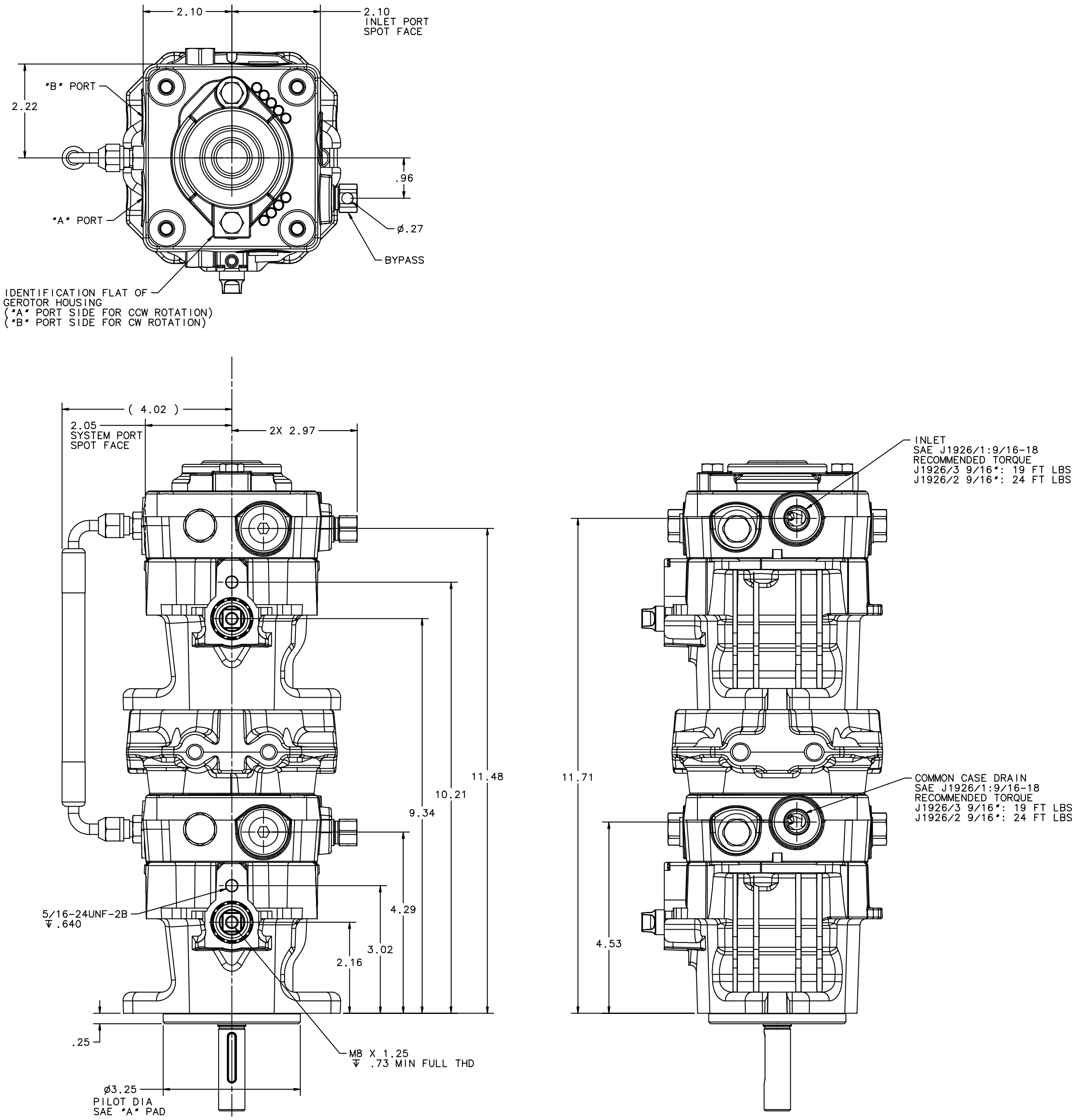




PK OPTIONAL DD TRUNNION

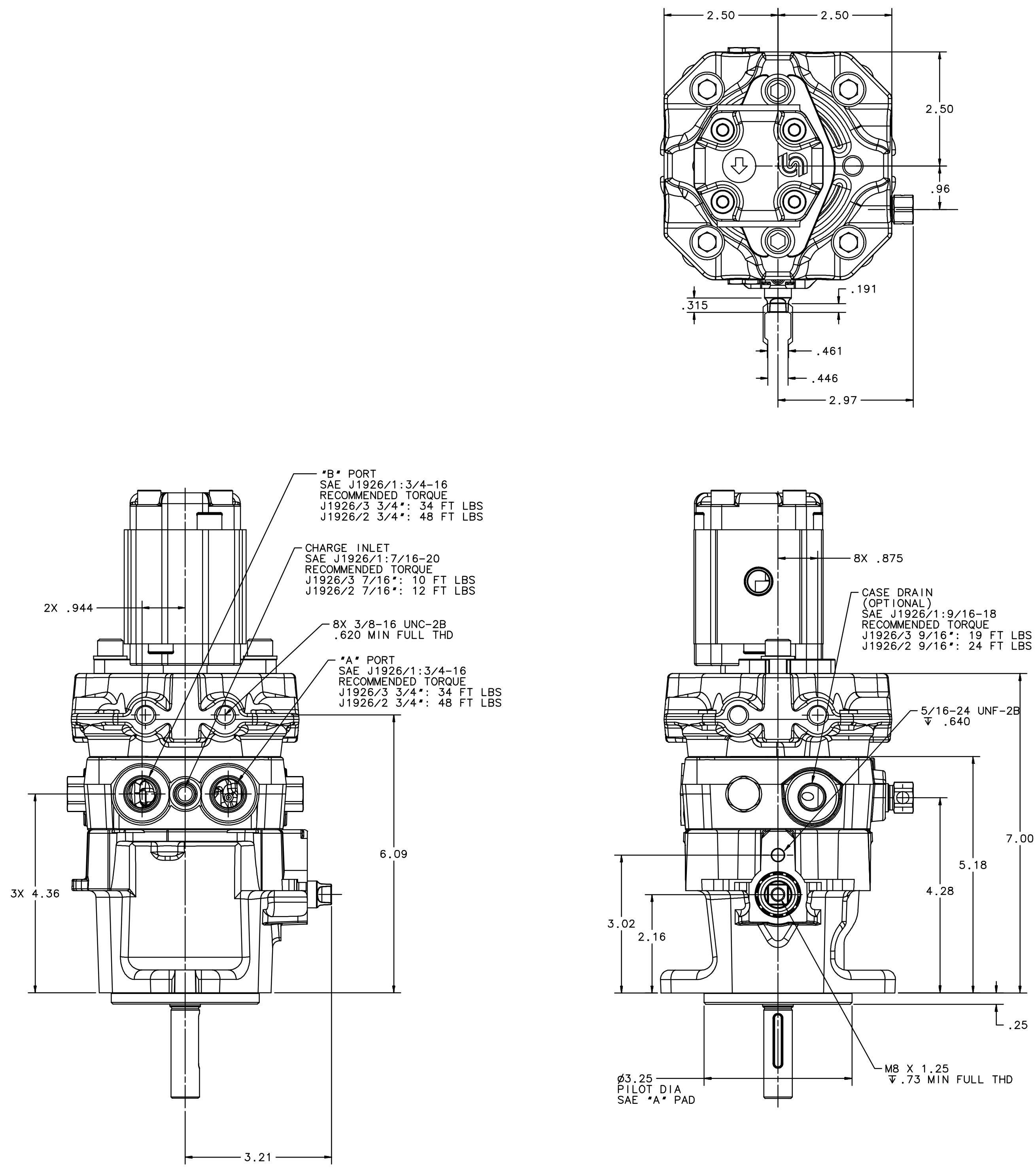
TANDEM PK (12cc)

T-Series Reference Dimensions (PK)



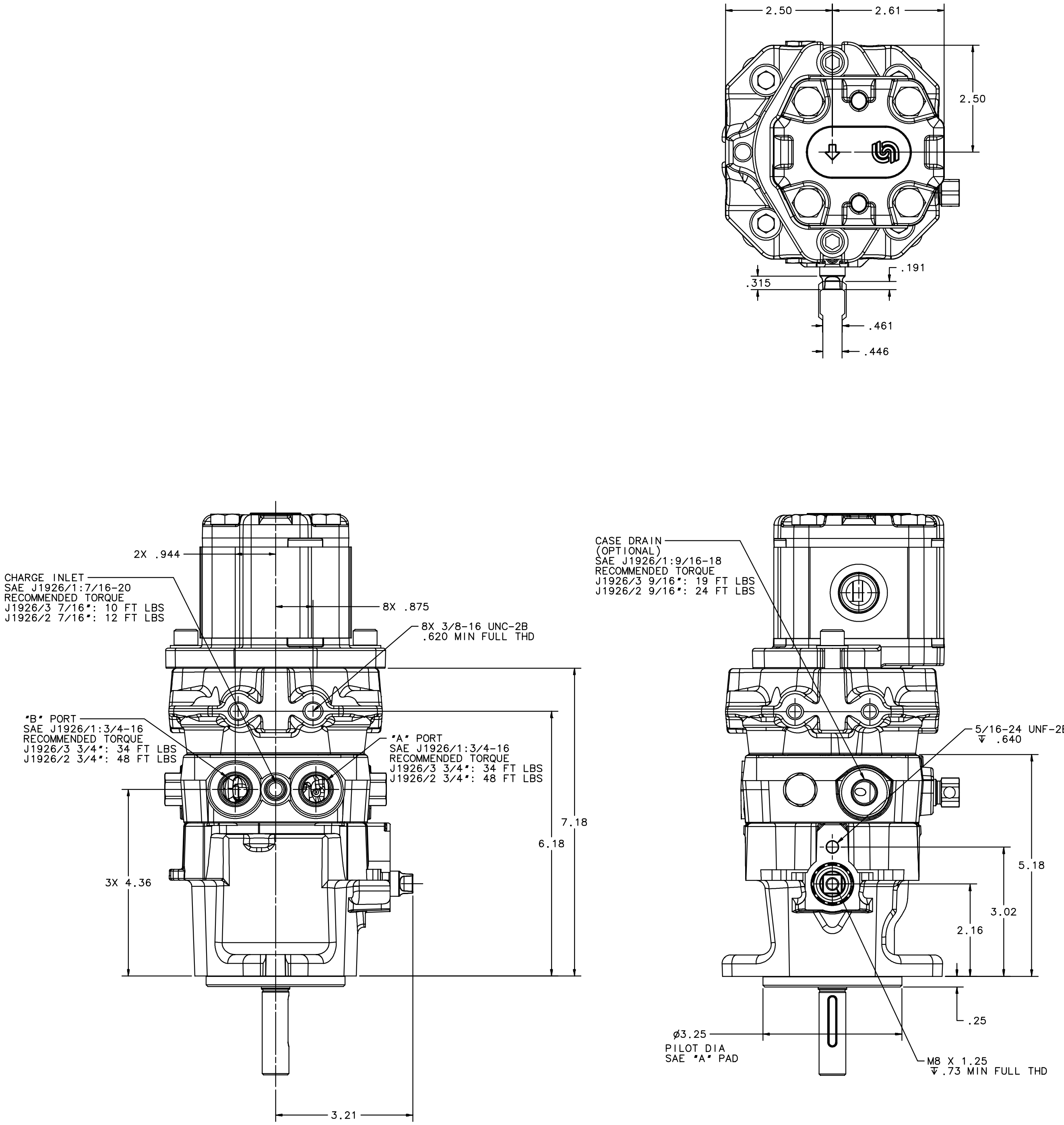
TANDEM PK (12cc)

T-Series Reference Dimensions (PK)



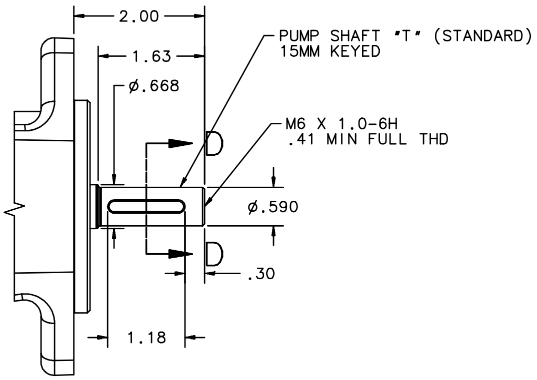
TANDEM PK (12cc) WITH "A-A" PAD GEAR PUMP

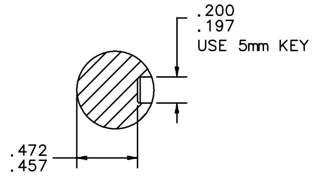
T-Series Reference Dimensions (PK)



TANDEM PK (12cc) WITH “A” PAD GEAR PUMP

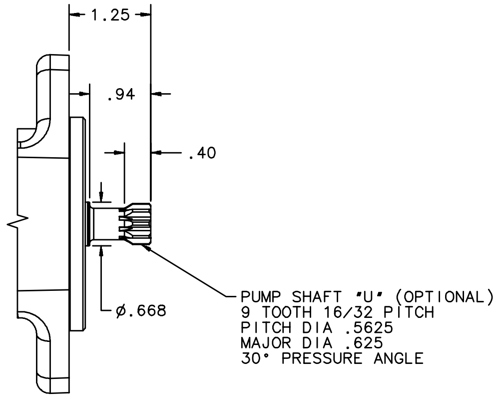
T-Series Shaft Options (PK)

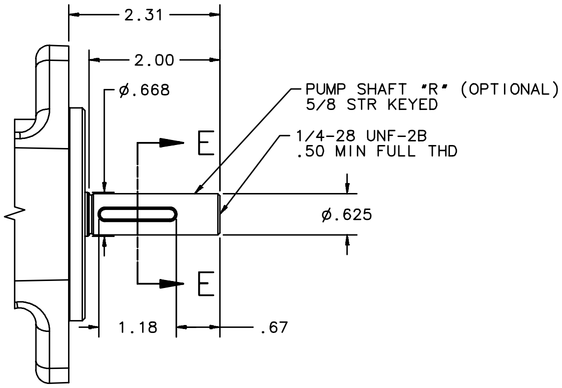


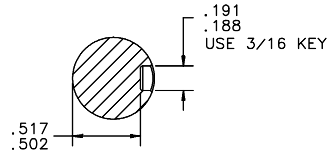


SECTION D-D

SCALE 2:1



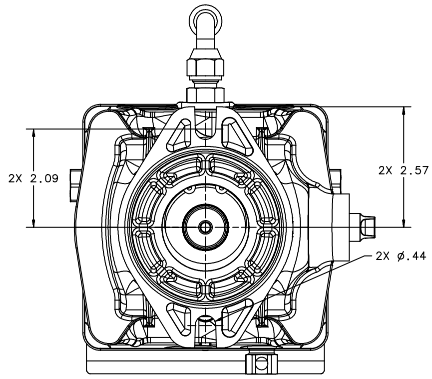




SECTION E-E

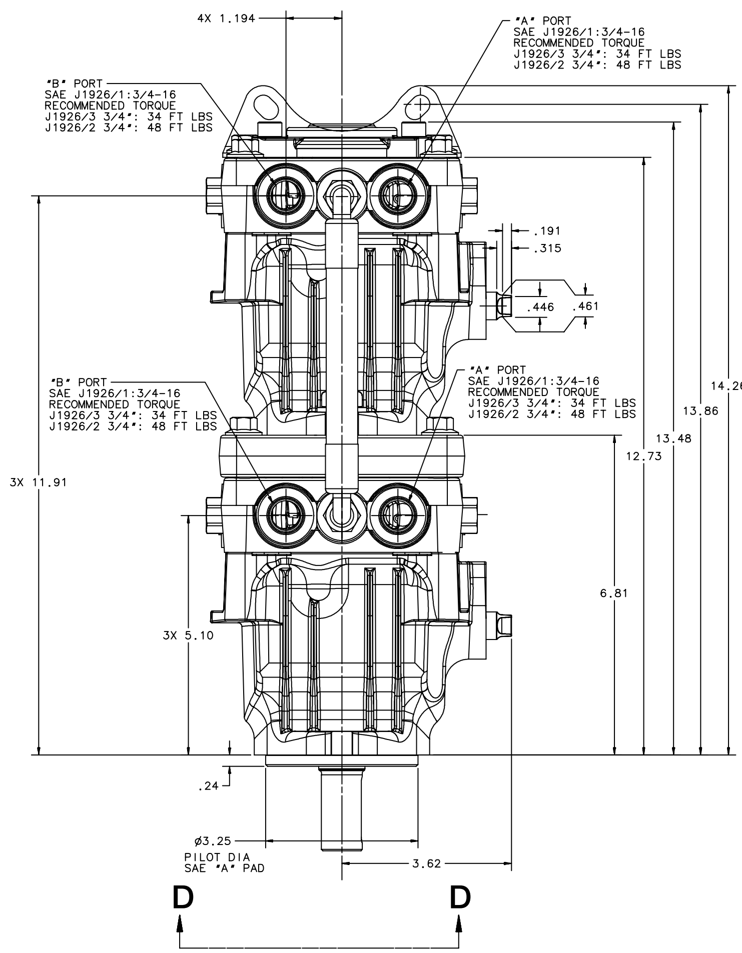
SCALE 2:1

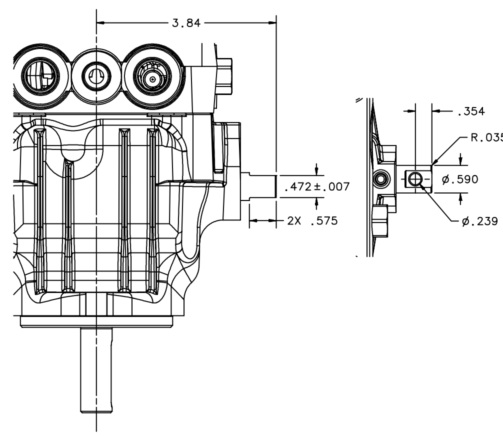
T-Series Reference Dimensions (PR)



VIEW D

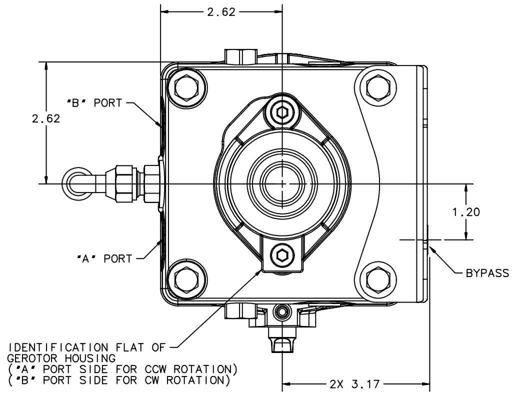
SCALE 1:1

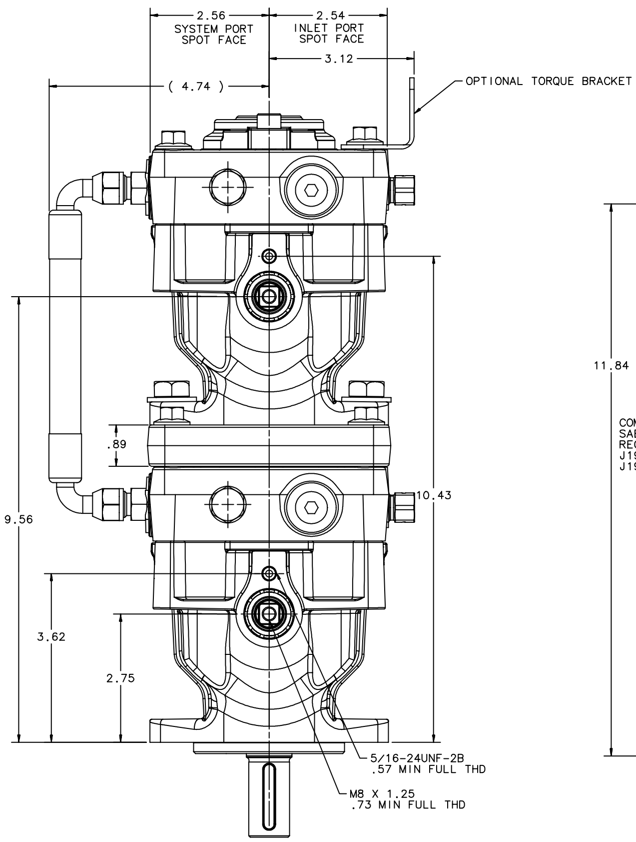


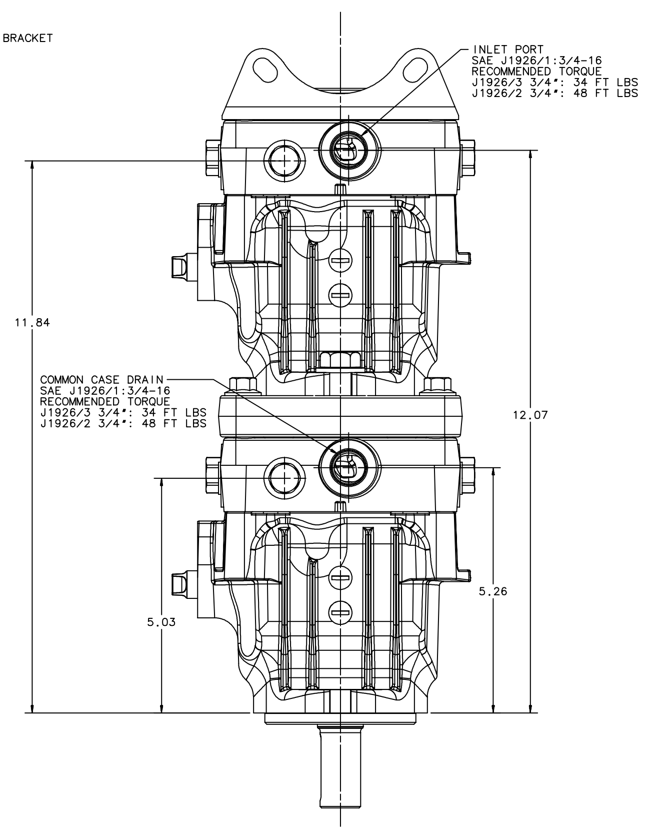


PR OPTIONAL DD TRUNNION

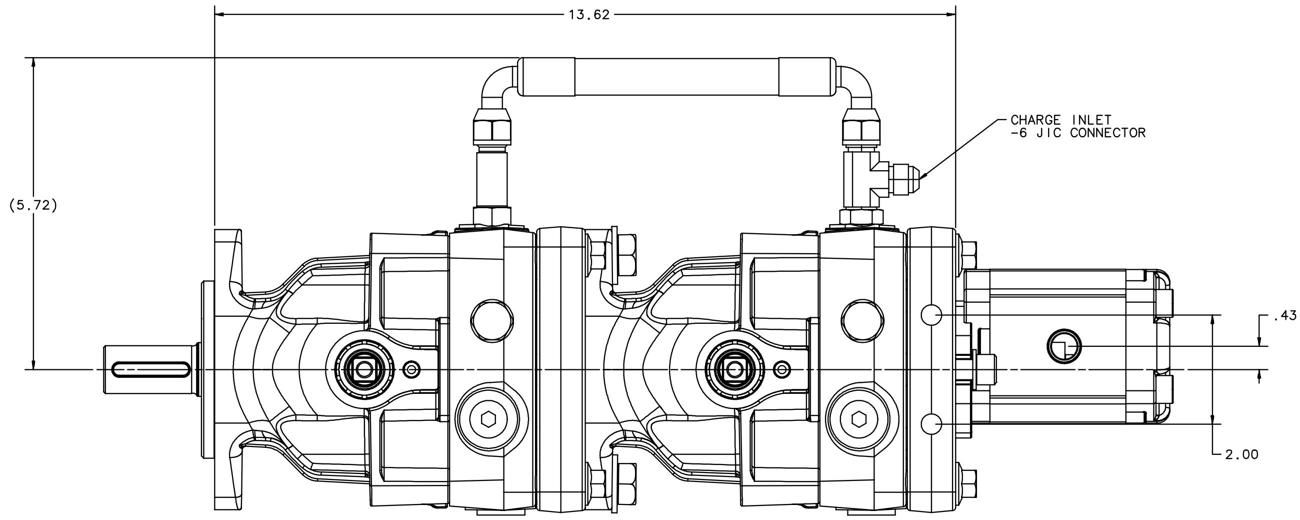
T-Series Reference Dimensions (PR)



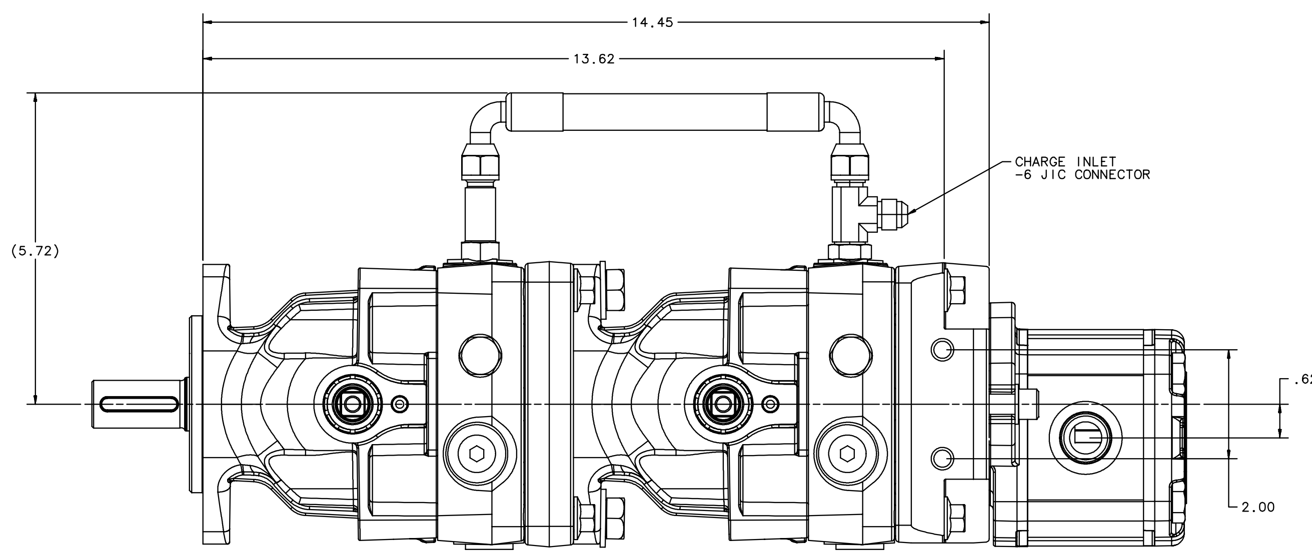




T-Series Reference Dimensions (PR)

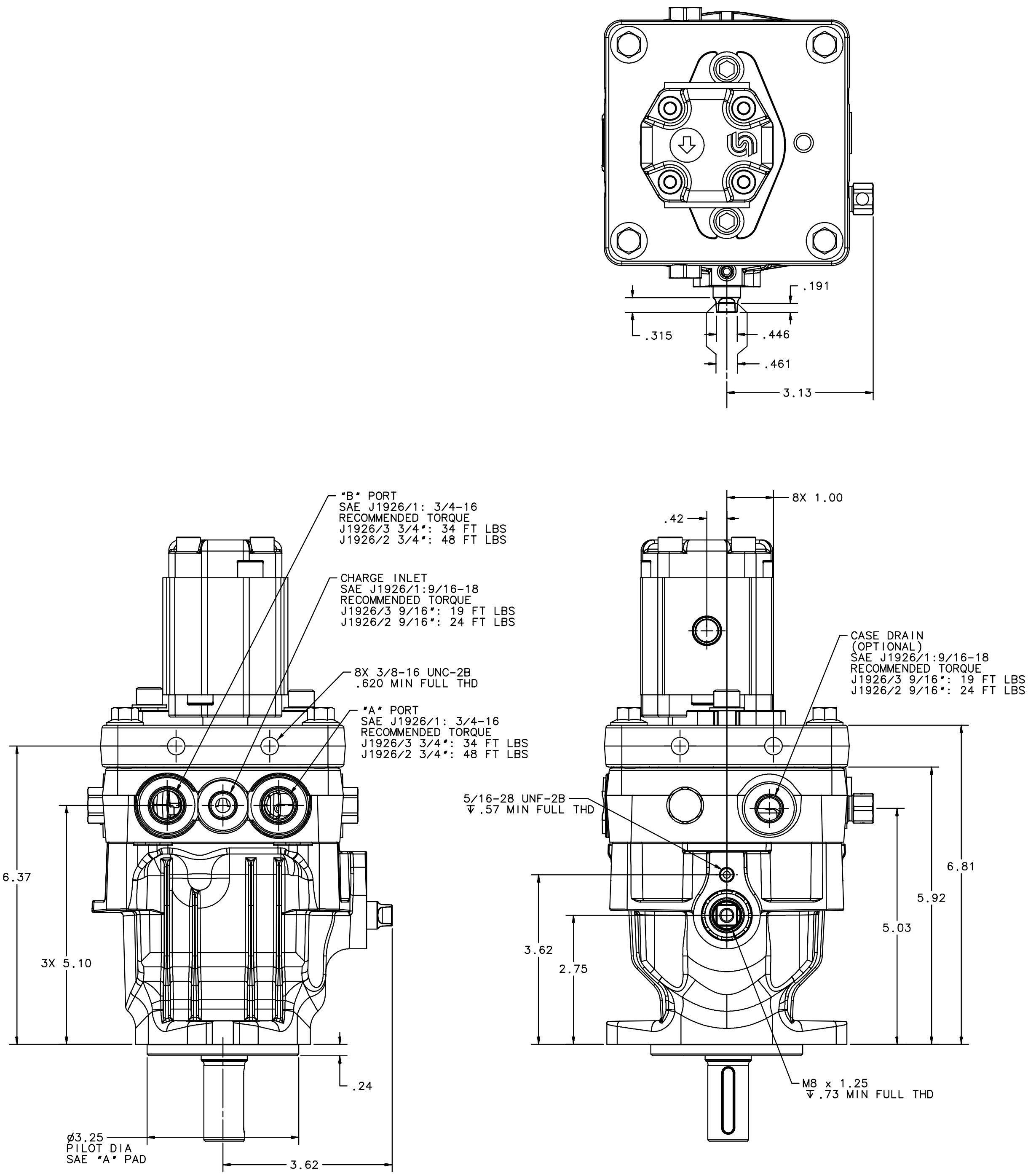


TANDEM PR WITH “A-A” PAD GEAR PUMP



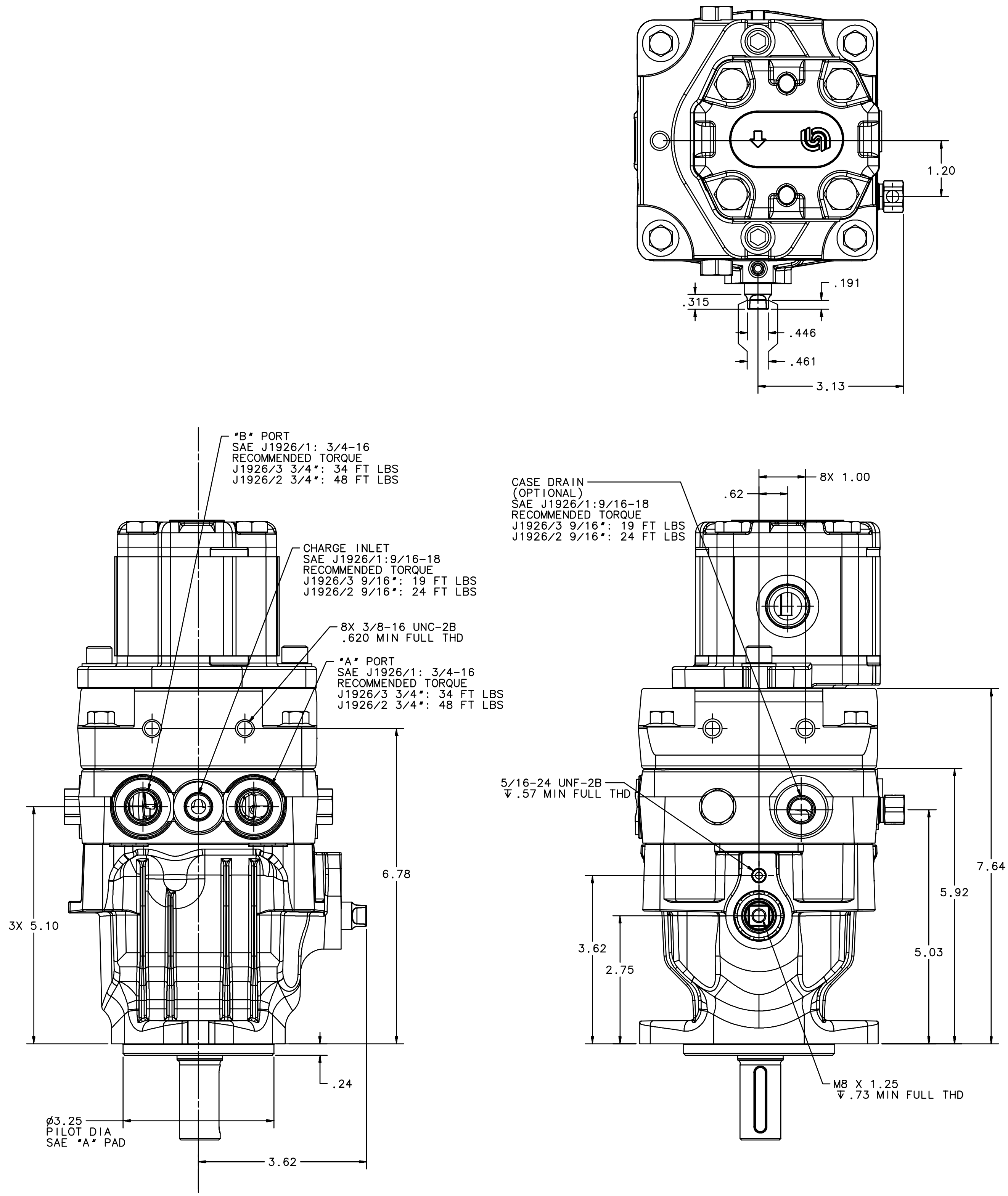
TANDEM PR WITH “A” PAD GEAR PUMP

T-Series Reference Dimensions (PR)



PR WITH "AA" GEAR PUMP

T-Series Reference Dimensions (PR)

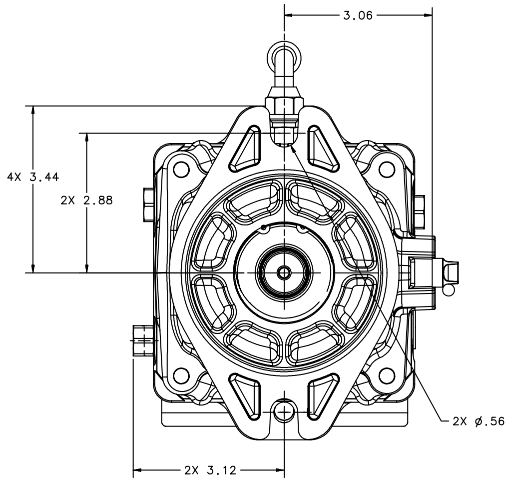


PR WITH "A" GEAR PUMP

HYDRO-GEAR®

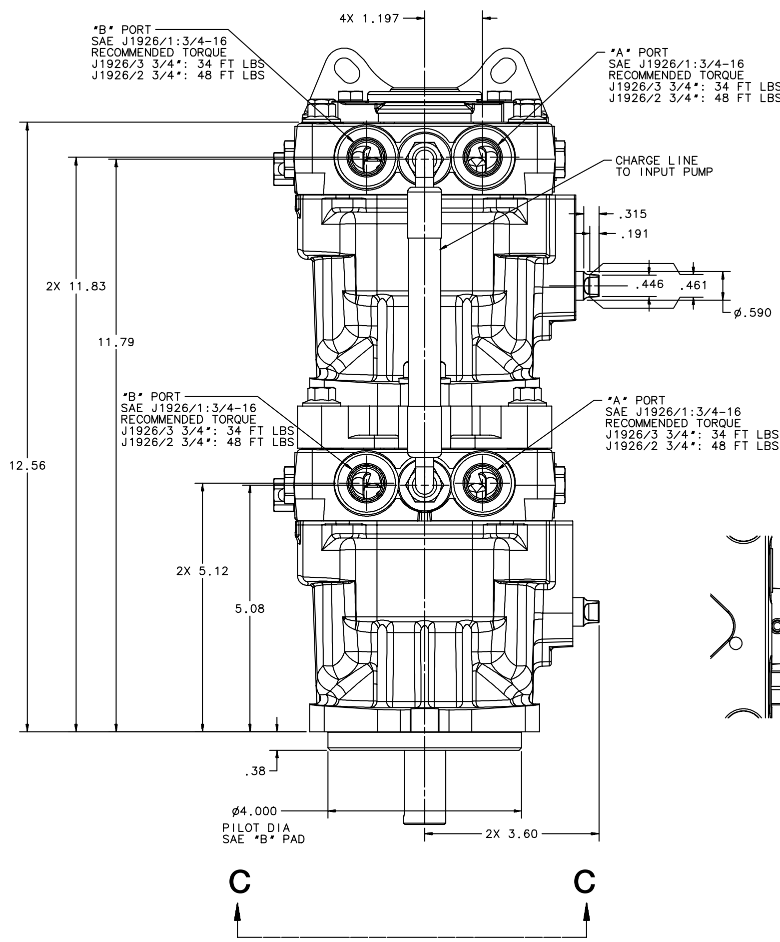
RESPONSIVE.
RELIABLE.
INNOVATIVE.

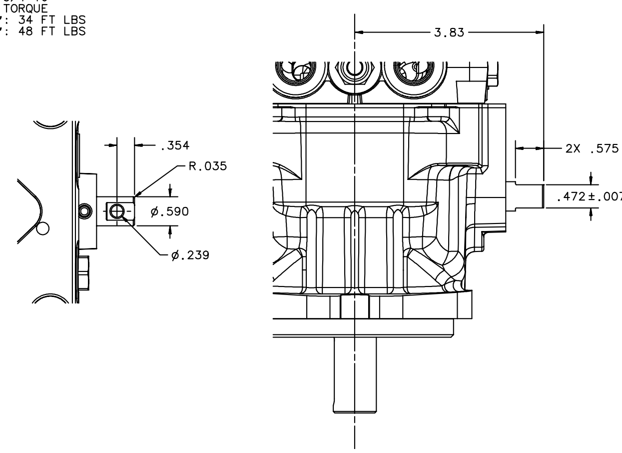
T-Series Reference Dimensions (PW)



VIEW C

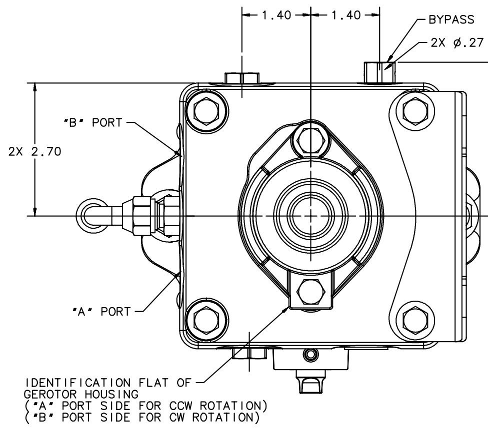
SCALE 1:1

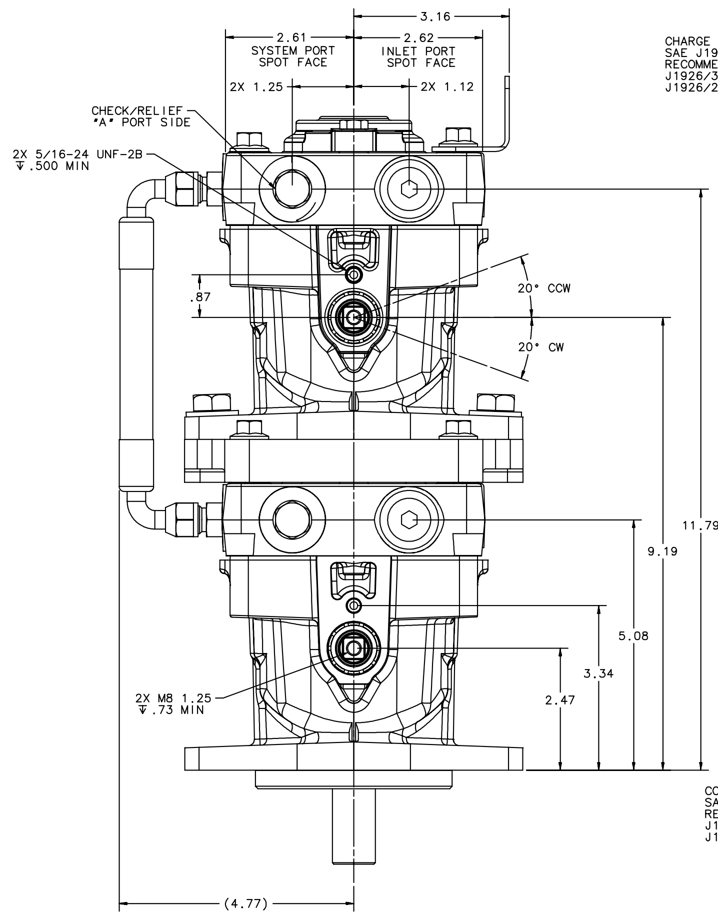


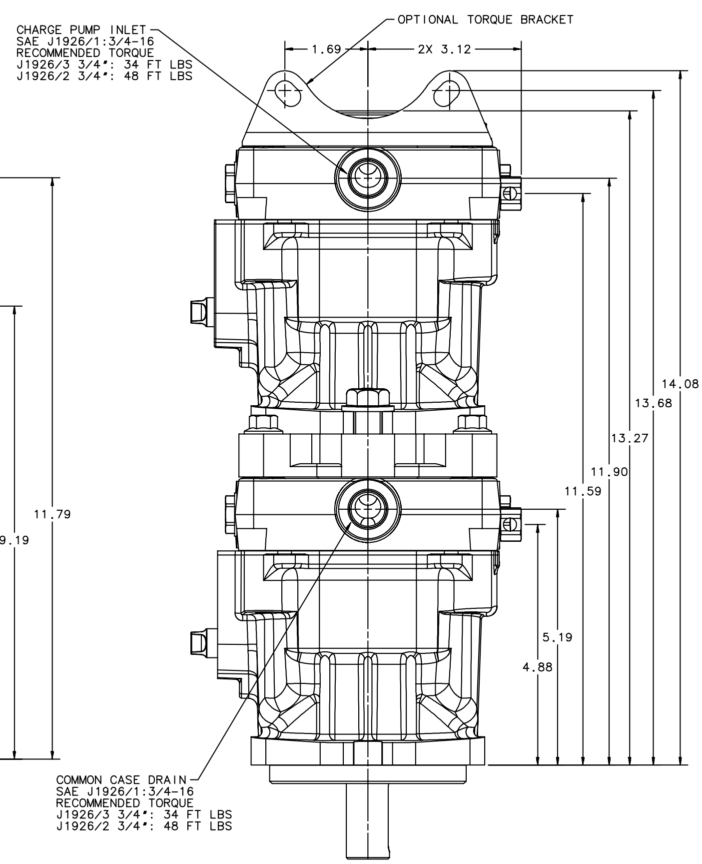


PW OPTIONAL DD TRUNNION

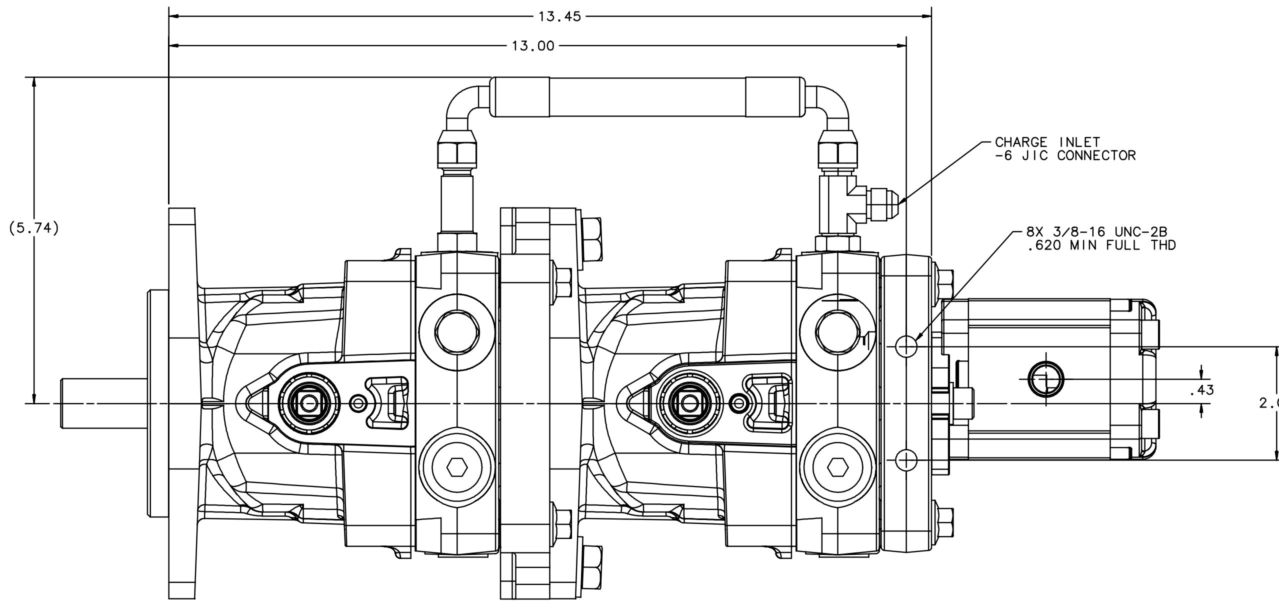
T-Series Reference Dimensions (PW)



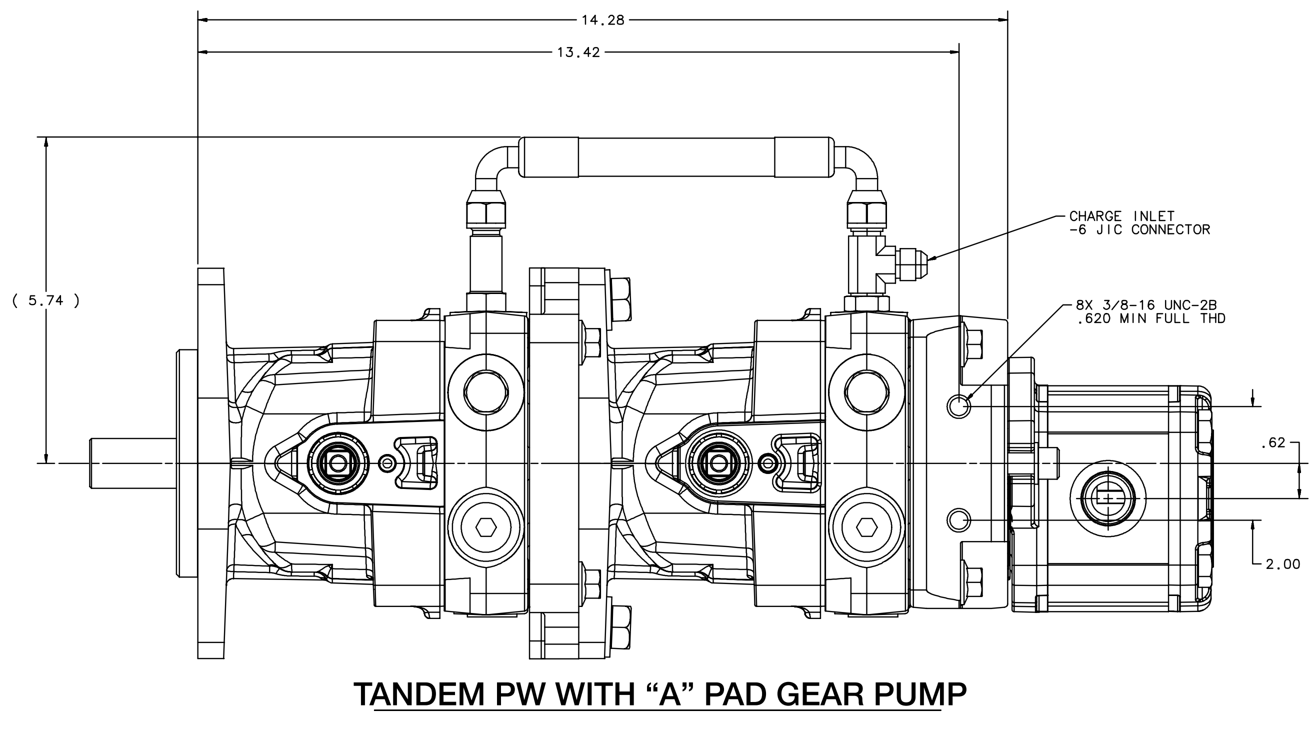




T-Series Reference Dimensions (PW)

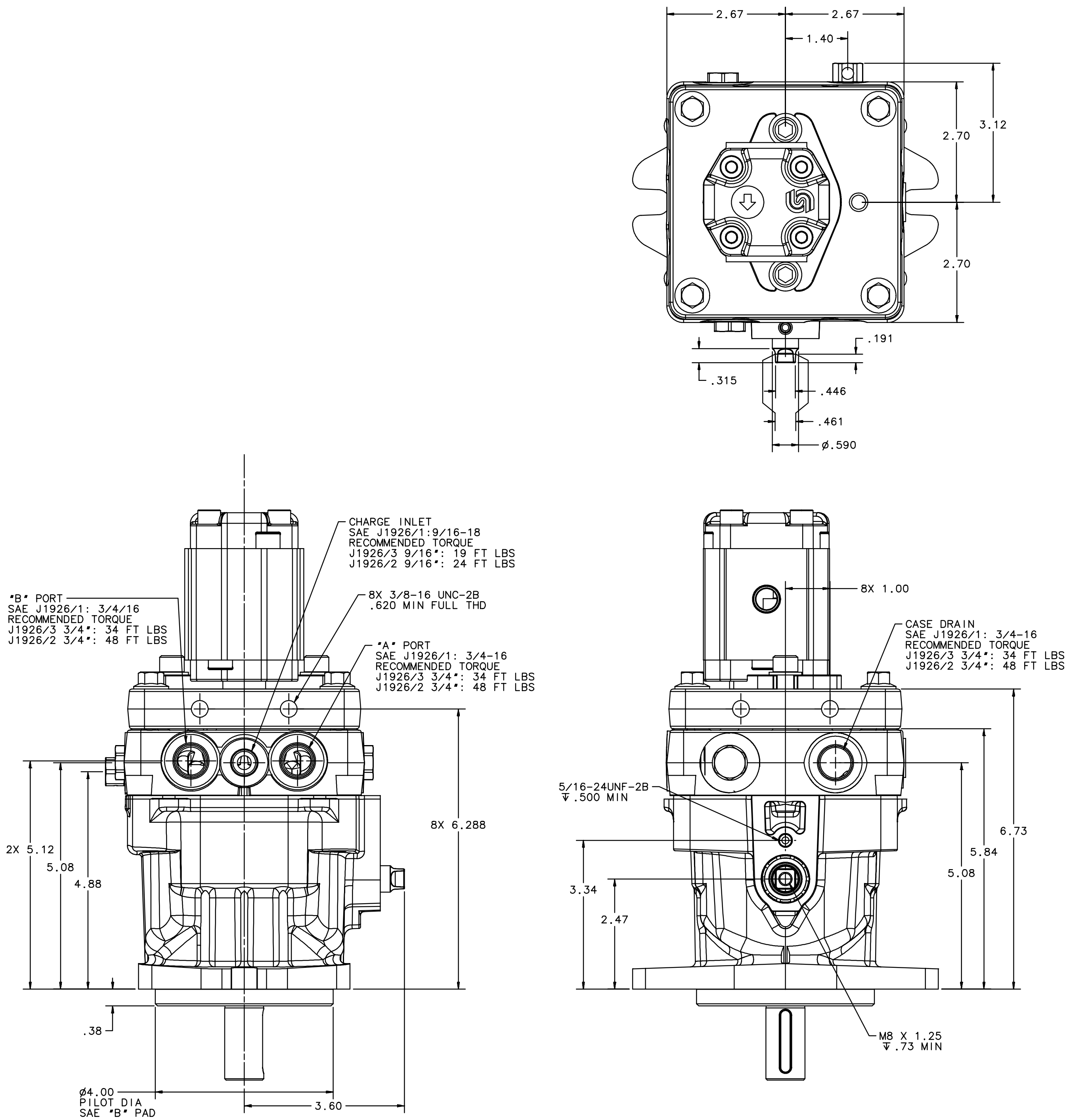


TANDEM PW WITH “A-A” PAD GEAR PUMP



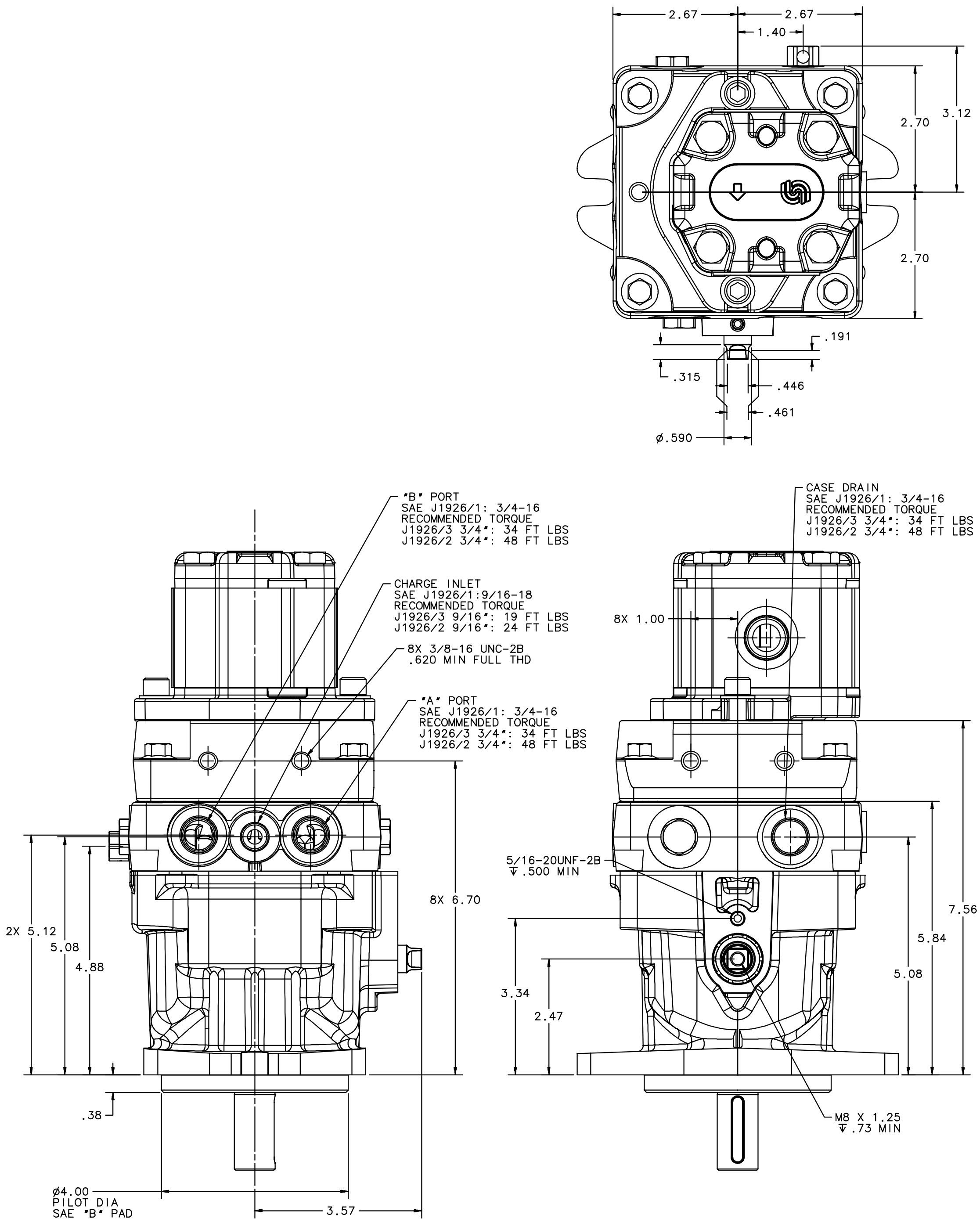
TANDEM PW WITH “A” PAD GEAR PUMP

T-Series Reference Dimensions (PW)



PW WITH "AA" GEAR PUMP

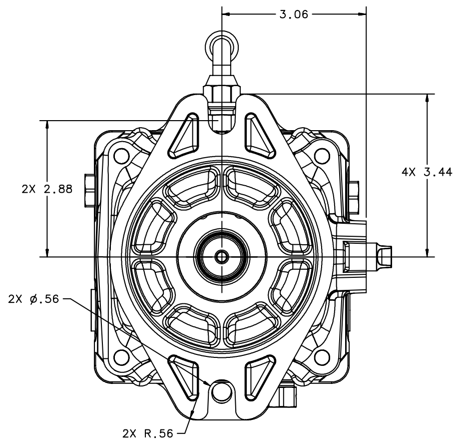
T-Series Reference Dimensions (PW)



PW WITH “A” GEAR PUMP

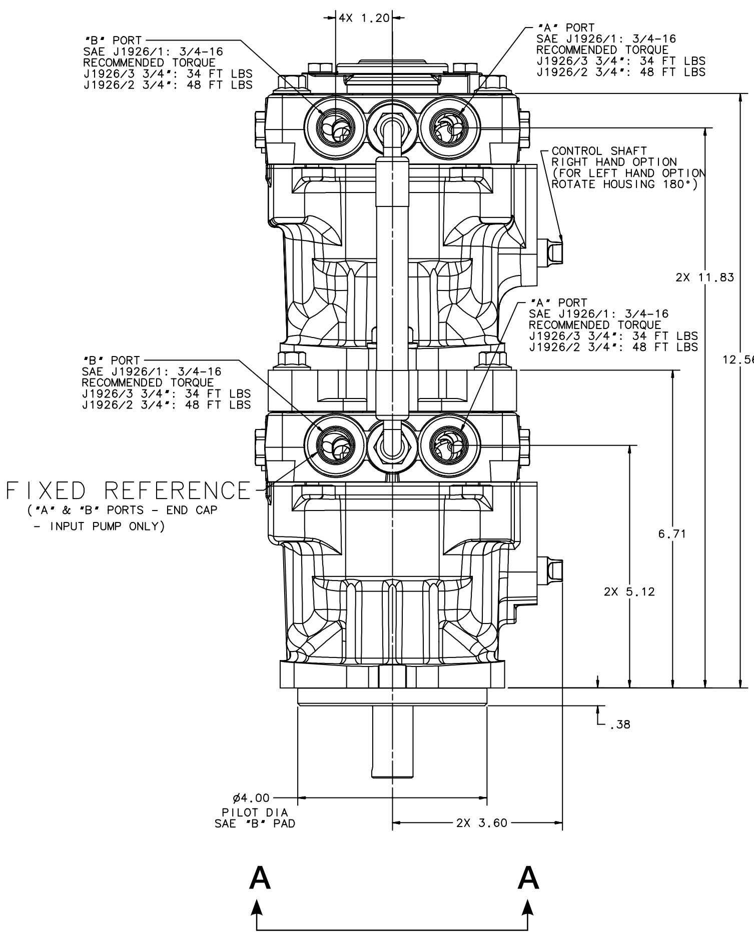
HYDRO-GEAR®

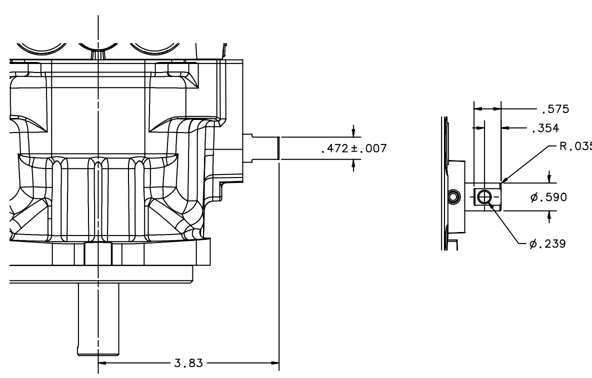
T-Series Reference Dimensions (PY)



VIEW A

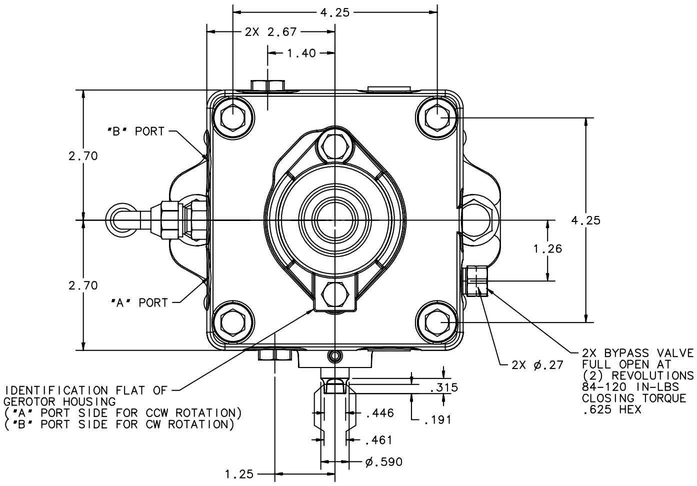
SCALE 1:1

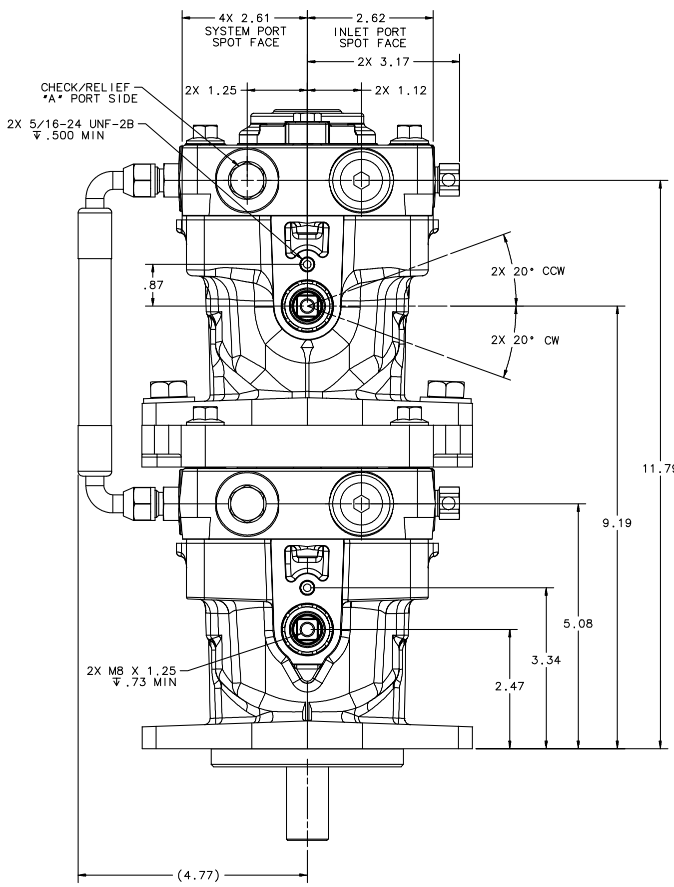


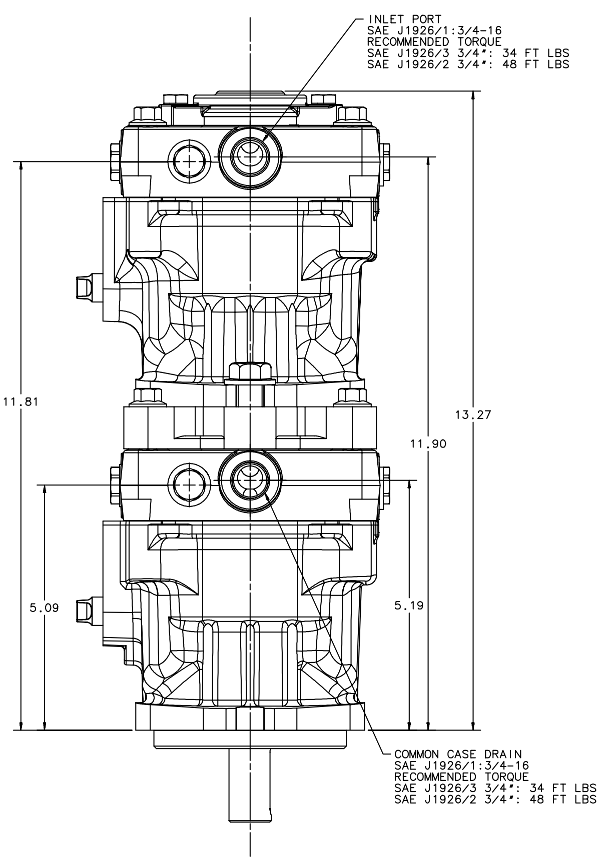


OPTIONAL DD TRUNNION

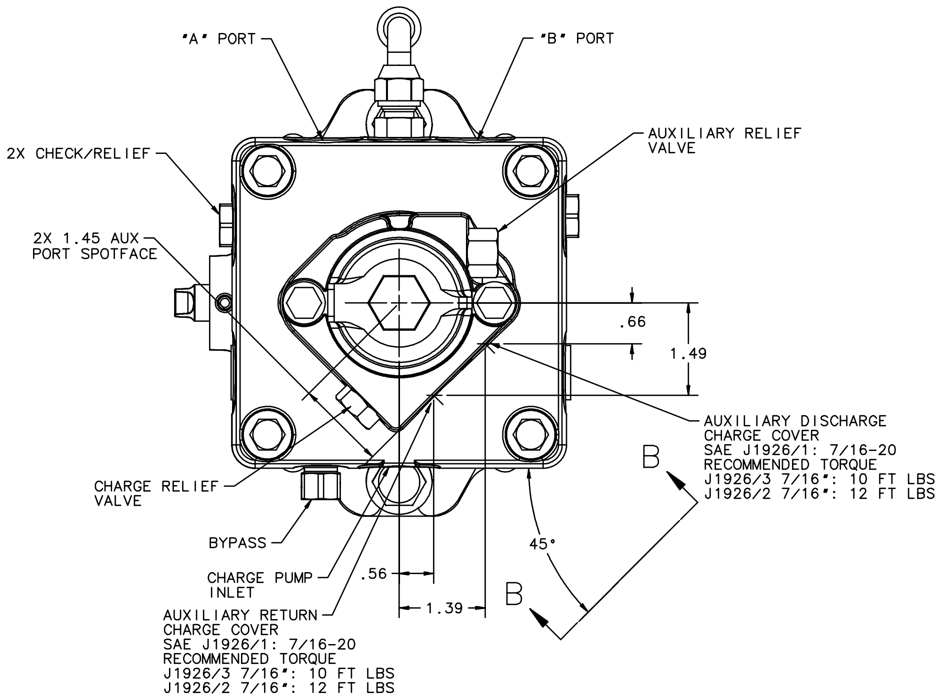
T-Series Reference Dimensions (PY)

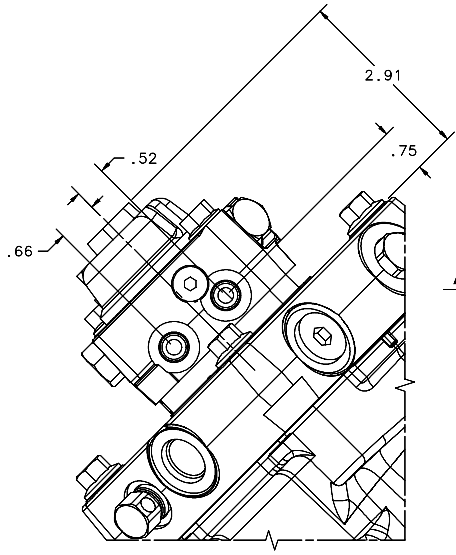






T-Series Auxiliary Options (PY)

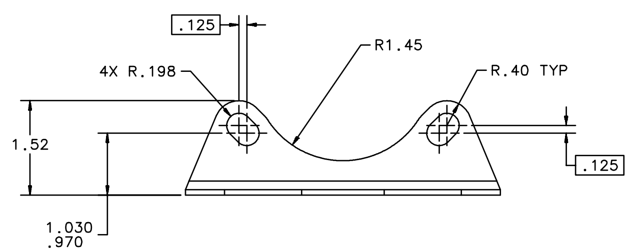




AUXILIARY

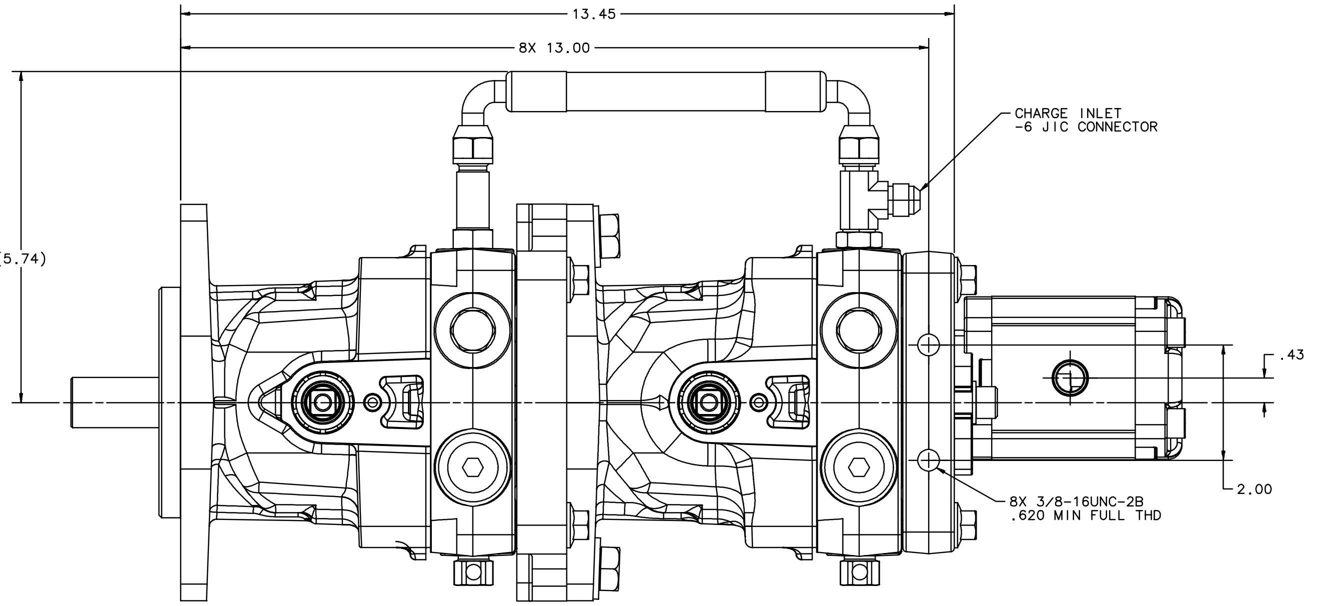
VIEW B

SCALE 1:1

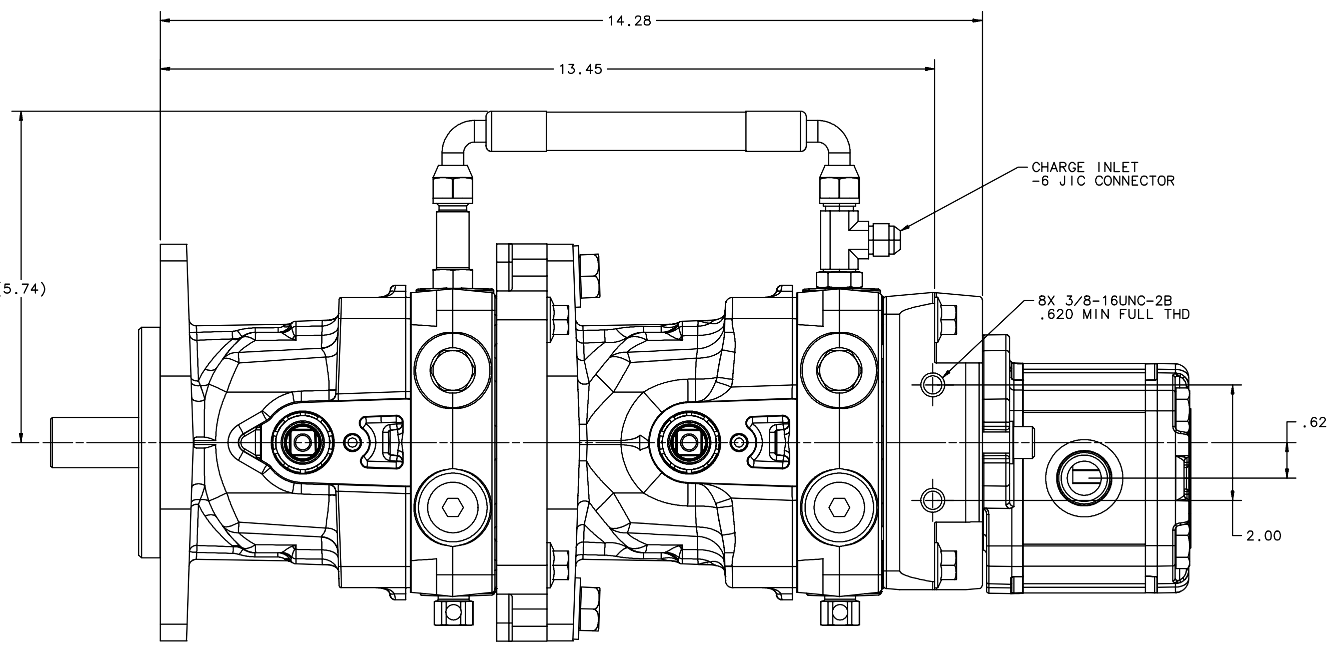


OPTIONAL TORQUE BRACKET FOR PY, PW, PR

T-Series Reference Dimensions (PY)

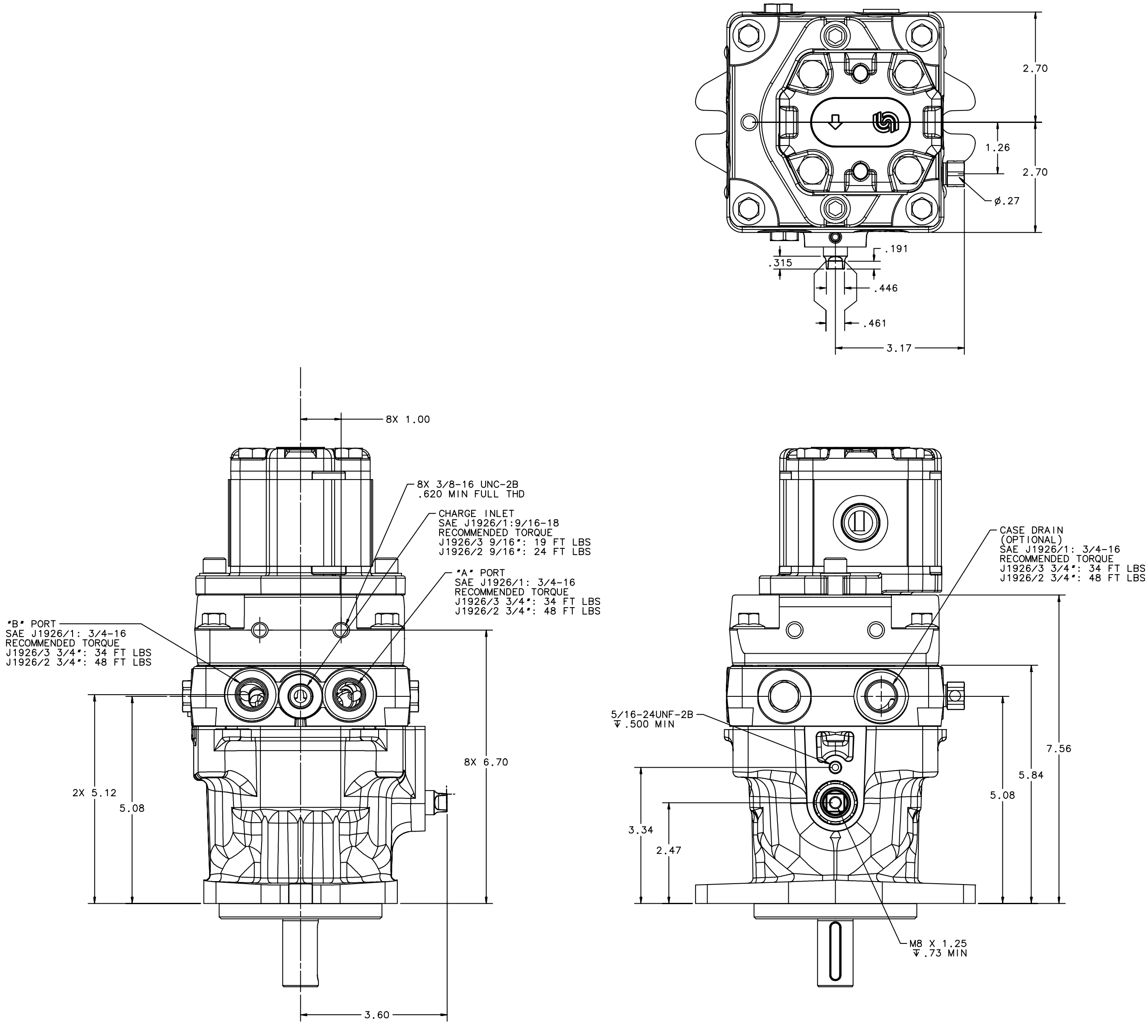


TANDEM PY WITH “AA” PAD GEAR PUMP



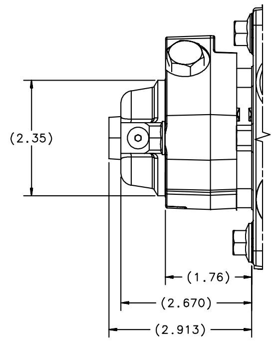
TANDEM PY WITH “A” PAD GEAR PUMP

T-Series Shaft Options (PY)

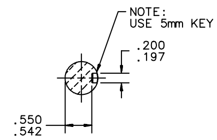


PY WITH "A" GEAR PUMP

T-Series Reference Dimensions

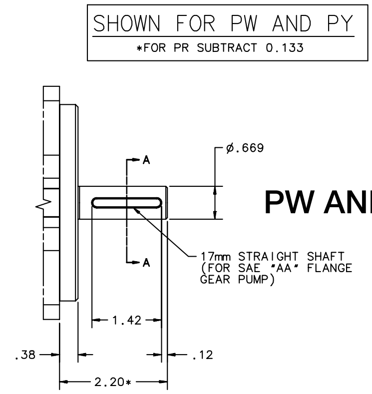


3.2 CC AUXILIARY OPTION

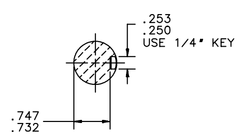


SECTION A-A

SCALE 1:1

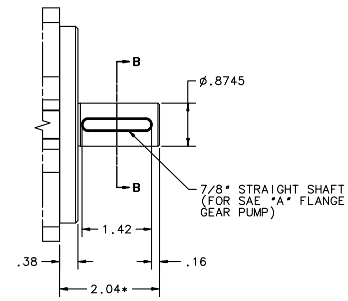


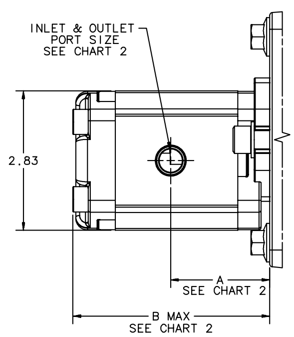
PW AND PR ONLY



SECTION B-B

SCALE 1:1



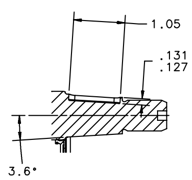


SAE "A-A" PAD GEAR PUMP OPTION

CHART 2

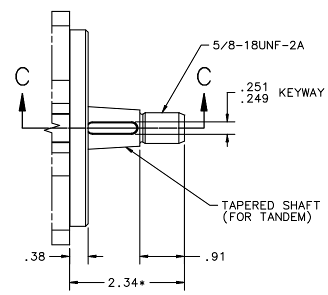
		GEAR PUMPS RELEASED FOR PRODUCTION								
		DISPLACEMENT cc								
		*2.2	*3.8	*6.0	*7.8	4.0	6.0	8.0	11.	14.
DESIGNATION		22	38	60	78	40	60	80	11	14
DIMENSIONS	A	1.732	.850	2.018	2.146	1.703	1.772	1.850	1.920	2.047
	B	3.445	3.681	4.016	4.272	3.543	3.839	4.232	4.390	4.783
SAE PAD SIZE		A-A				A				
INLET PORT SIZE		3/4-16 UNF-2A				1 1/16-12 UNF-2B				
OUTLET PORT SIZE		9/16-18 UNF-2A				7/8-14 UNF-2B				

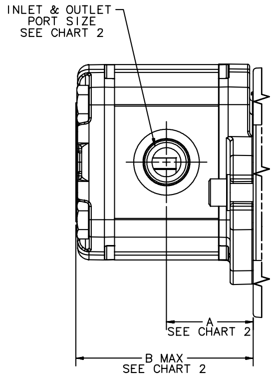
NOTE:
ADDITIONAL INFORMATION ON GEAR PUMP MAY BE OBTAINED FROM sauer-danfoss.com

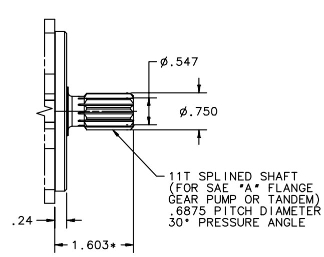


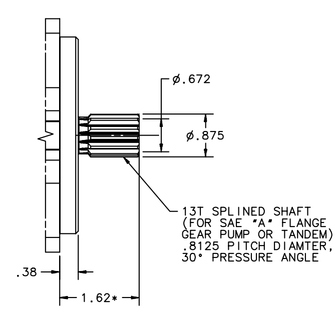
SECTION C-C

SCALE 1:1









SAE "A" PAD GEAR PUMP OPTION

T-Series Reference Dimensions (PY)

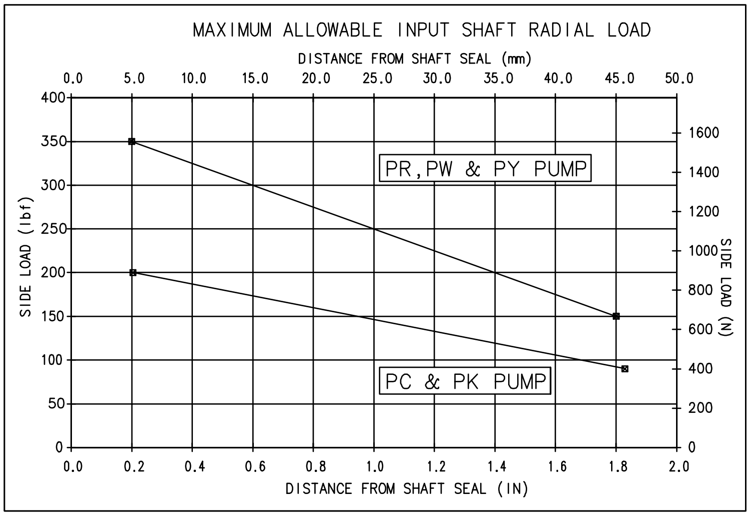


CHART 1

WHEN INPUT PUMP AND SECOND PUMP ORIENTATION IS THE SAME, USE THIS CHART FOR BOTH PUMPS. ORIENTATION IS WITH INPUT SHAFT DOWN AND INPUT PUMP SYSTEM PORTS FACING YOU.

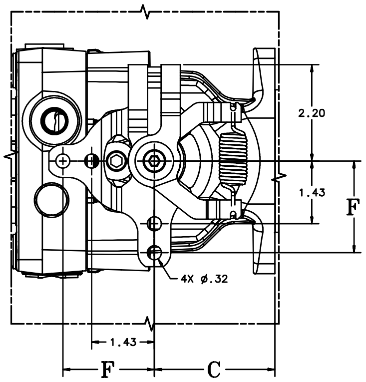
CONTROL SHAFT, INPUT PUMP OR 2ND PUMP	LEFT HAND				RIGHT HAND			
INPUT SHAFT ROTATION	CW		CCW		CW		CCW	
CONTROL SHAFT ROTATION	CCW	CW	CCW	CW	CCW	CW	CCW	CW
PORT ‘A’ FLOW (INPUT PUMP & 2ND PUMP)	IN	OUT	OUT	IN	OUT	IN	IN	OUT
PORT ‘B’ FLOW (INPUT PUMP & 2ND PUMP)	OUT	IN	IN	OUT	IN	OUT	OUT	IN

WHEN SECOND PUMP ORIENTATION IS OPPOSITE THE INPUT PUMP, USE THIS CHART FOR SECOND PUMP ONLY.

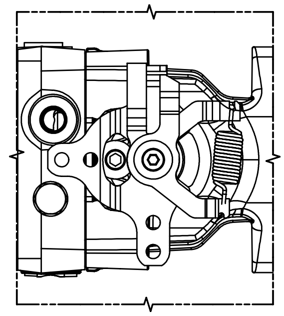
CONTROL SHAFT, INPUT PUMP OR 2ND PUMP	RIGHT HAND				LEFT HAND			
INPUT SHAFT ROTATION	CW		CCW		CW		CCW	
CONTROL SHAFT ROTATION	CCW	CW	CCW	CW	CCW	CW	CCW	CW
PORT ‘A’ FLOW (2ND PUMP)	IN	OUT	OUT	IN	OUT	IN	IN	OUT
PORT ‘B’ FLOW (2ND PUMP)	OUT	IN	IN	OUT	IN	OUT	OUT	IN

T-Series Control Options

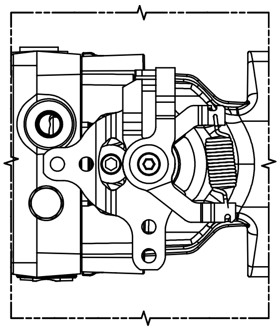
PR Models Shown: For PY, PW, PK or PC See Chart 3



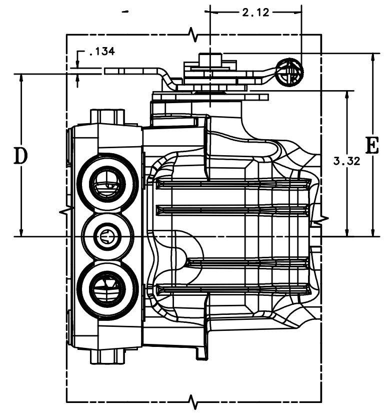
STD RETURN TO NEUTRAL OPTION
(SPRING NEAR INPUT SHAFT)



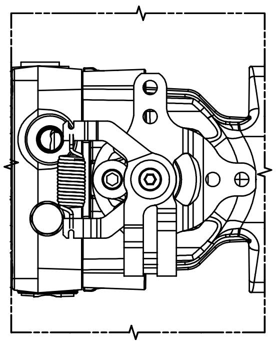
CCW RETURN TO NEUTRAL OPTION
(SPRING NEAR INPUT SHAFT)



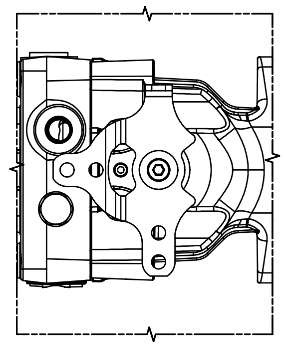
CW RETURN TO NEUTRAL OPTION
(SPRING NEAR INPUT SHAFT)



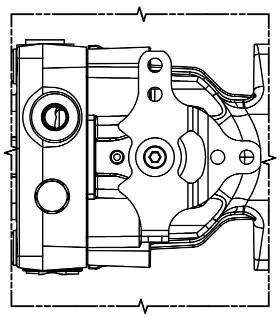
RETURN TO NEUTRAL SIDE VIEW



STD RETURN TO NEUTRAL OPTION
(SPRING NEAR ENDCAP)



CONTROL ARM ONLY
(PRIMARY MOUNTING HOLE NEAR ENDCAP)



CONTROL ARM ONLY
(PRIMARY MOUNTING HOLE
NEAR INPUT SHAFT)

DIM	PY/PW	PR	PK	PC
C	2.47	2.75	2.16	2.00
D	3.68	3.70	3.28	3.15
E	4.24	4.26	3.82	3.69
F	2.09	2.09	1.75	1.75

T-Series Configurator

Character	1	2	3	4	5	6	7
		Input Pump	**Model, Control Arm, Case Drain**	**System Check Setting Valve "A" port (RH)****	**System Check Setting Valve "B" (LH)****	**Control Arm Options**	**Second Pump Control Arm, Case Drain**
	T	**Shaft**				1 = Tapered Sq. Trunnion Arm Only	X = NA
		PY (21CC), PW (21CC) & PR (16CC)	**PY (21CC)**			**Light Spring 52401 (40 in-lbs)**	**PY (21CC)**
		B = 51540 - 7/8 keyed (pump + A GP) C = 52001 - 7/8 keyed (tandem) E = 51490 - 13T 16/32 (pump + A GP) F = 51273 - 13T 16/32 (tandem) G = 51304 - 7/8 taper (tandem)	G = RH control, common case drain, opposite H = LH control, common case drain, opposite	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	A = Std RTN, Spring to Input B = Std RTN, Spring to End Cap C = CW RTN, Spring to Input D = CW RTN, Spring to End Cap E = CCW RTN, Spring to Input F = CW RTN, Spring to End Cap	G = RH Control No Case Drain H = LH Control No Case Drain
			PY + Gear Pump Only No 2nd Pump	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044		
			J = RH control, RH case drain K = RH control, LH case drain L = LH control, LH case drain M = LH control, RH case drain	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044		
		PW (21CC) & PR (16CC)	**PW (21CC)**				**PW (21CC)**
		H = 51505 - 17mm keyed (pump + AA GP)	A = RH control, common case drain, opposite B = LH control, common case drain, opposite				A = RH Control No Case Drain B = LH Control No Case Drain
			PW + Gear Pump Only No 2nd Pump			**Heavy Spring 51605 (80 in-lbs)**	
			1 = RH control, RH case drain 2 = LH control, RH case drain			G = Hvy RTN, Spring to Input H = Hvy RTN, Spring to End Cap J = Hvy CW RTN, Spring to Input K = Hvy CW RTN, Spring to End Cap L = Hvy CCW RTN, Spring to Input M = Hvy CCW RTN, Spring to End Cap V = Control Arm Only Primary connect hole to end cap W = Control Arm Only Primary connect to hole input	
		PR (16CC) (SAE Standard)	**PR (16CC)**				**PR (16CC)**
		N = 51876 - 11T 16/32 pump tandem P = 51962 - 11T 16/32 (pump + A GP)	C = RH control, common case drain, opposite D = LH control, common case drain, opposite				C = RH Control No Case Drain D = LH Control No Case Drain
			PR + Gear Pump Only No 2nd Pump				
			3 = RH control, RH case drain 4 = RH control, LH case drain 5 = LH control, LH case drain 6 = LH control, RH case drain				
		PK (12CC)	**PK + PK (12CC)**				**PK (12CC)**
		K = 51999 - 5/8 keyed (PK + gear pump or PK + PK) L = 51236 - 15mm (PK + gear pump or PK + PK) M = 51238 - 9T (PK + gear pump or PK + PK)	S = RH control, common case drain T = LH control, common case drain				E = RH Control No Case Drain F = LH Control No Case Drain
			PK (12CC) + Gear Pump, No 2nd Pump				
			U = RH control, RH case drain V = RH control, LH case drain W = LH control, LH case drain Y = LH control, RH case drain				
		PC (6CC)	**PC + PC (6CC)**				**PC (6CC)**
		V = 52053 1/2 straight keyed (PC + gear pump or PC + PC) W = 52131 9T 20/40 (PC + gear pump or PC + PC)	Q = RH control, common case drain R = LH control, common case drain				N = RH Control No Case Drain P = LH Control No Case Drain
			PC (6CC) + Gear Pump, No 2nd Pump				
			N = RH control, rear case drain P = LH control, rear case drain				

T-Series Configurator

8	9	10	11	12	13	14
System Check Setting Valve "A" port (RH)**	**System Check Setting Valve "B" port (LH)****	**Control Arm Options**	**Second Pump Orientation, Charge Pump or Gear Pump**	**Torque Bracket Location, Adapter Plate and/or Gear Pump Orientation**	**Input Rotation, Bypass (Input/ Second)**	**Additional Info.**
X = NA	X = NA	X = NA		X = NA (Standard Tandem)		X = NA
		1 = Tapered Sq. Trunnion Arm Only	**2nd Pump System Ports Same As Front Or No Second Pump**	**Torque Bracket Only, Tandem**	**CW Input**	
A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	A = shock, 200 bar blank B = shock, 200 bar .024 C = shock, 200 bar .031 D = shock, 200 bar .044	**Light Spring 52401 (40 in-lbs)**	1 = .19 Std Charge pump 2 = .19 Aux pump 9 = .25 Charge pump (52338) A = .19 Std. Charge pump (52255 spring & poppet) E = .19 Std Charge pump (52338 spring) 3 = AA Adapter only (for gear pump) Y = AA Gear pump - 2.2 cc B = AA Gear pump - 3.8 cc C = AA Gear pump - 6.0 cc D = AA Gear pump - 7.8 cc 4 = A Adapter only (for gear pump) F = A Gear pump - 4.0 cc G = A Gear pump - 6.0 cc H = A Gear pump - 8.0 cc J = A Gear pump - 11.0 cc K = A Gear pump - 14.0 cc	1 = Torque bracket to right 2 = Torque bracket opposite 3 = Torque bracket to left 4 = Torque bracket same	A = Blank/None B = Blank/ Blank C = Blank/ .031 D = .031/ None E = .031/ Blank F = .031/ .031	
E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	E = shock, 160 bar blank F = shock, 160 bar .024 G = shock, 160 bar .031 H = shock, 160 bar .044	A = Std RTN, Spring to Input B = Std RTN, Spring to End Cap C = CW RTN, Spring to Input D = CW RTN, Spring to End Cap E = CCW RTN, Spring to Input F = CCW RTN, Spring to End Cap				
J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044	J = shock, 120 bar blank K = shock, 120 bar .024 L = shock, 120 bar .031 M = shock, 120 bar .044					
				Pump + Gear Pump, No Torque Bracket	**CCW Input**	
		Heavy Spring 51605 (80 in-lbs)	**2nd Pump System Ports 180 Degrees From Front Pump**	6 = No Gear pump E = Gear pump inlet to right F = Gear pump inlet - opposite G = Gear pump inlet to left H = Gear pump inlet - same side	G = Blank/ None H = Blank/ Blank J = Blank/ .031 K = .031/ None L = .031/ Blank M = .031/ .031	
		G = Hvy RTN, Spring to Input H = Hvy RTN, Spring to End Cap J = Hvy CW RTN, Spring to Input K = Hvy CW RTN, Spring to End Cap L = Hvy CCW RTN, Spring to Input M = Hvy CCW RTN, Spring to End Cap V = Control Arm Only Primary connect hole toward end cap W = Control Arm Only Primary connect hole toward input	5 = .19 Std Charge pump 6 = .19 Aux pump S = .25 Charge pump (52338) L = .19 Std Charge pump (52255 spring & poppet) Q = .19 Std Charge pump (52338 spring) 7 = AA Adapter only (for gear pump) Z = AA Gear pump - 2.2 cc M = AA Gear pump - 3.8 cc N = AA Gear pump - 6.0 cc P = AA Gear pump - 7.8 cc 8 = A Adapter only (for gear pump) R = A Gear pump - 4.0 cc T = A Gear pump - 6.0 cc U = A Gear pump - 8.0 cc V = A Gear pump - 11.0 cc W = A Gear pump - 14.0 cc		**N/A Input No Charge/ Gear Pump** N = Blank/ None P = Blank/ Blank Q = Blank/ .031 R = .031/ None T = .031/ Blank U = .031/ .031	

T-Series Configurator

Notes		If:	And:	Then:
PY + PY	1	Character 2 = C, F or G	Character 3 = G or H	Character 7 = G or H
PY + GP	2	Character 2 = B or E	Character 3 = J, K, L or M	Character 7-10 = X
PW + PW	3	Character 2 = C, F or G	Character 3 = A or B	Character 7 = A, B, C or D
PW + GP	4	Character 2 = B or E	Character 3 = 1 or 2	Character 7-10 = X
PR + PR	5	Character 2 = C, F, G or N	Character 3 = C, D, E or F	Character 7 = C or D
PR + GP	6	Character 2 = B, E or P	Character 3 = 3, 4, 5 or 6	Character 7-10 = X
(PW or PR) + GP	7	Character 2 = H	Character 3 = 1, 2, 3, 4, 5 or 6	Character 7-10 = X
PK + PK or PK + PC	8	Character 2 = K, L or M	Character 3 = S or T	Character 7 = E, F, N or P
PK + GP	9	Character 2 = K, L or M	Character 3 = U, V, W or Y	Character 7-10 = X
PC + PC	10	Character 2 = V or W	Character 3 = Q or R	Character 7 = N or P
PC + GP	11	Character 2 = V or W	Character 3 = N or P	Character 7-10 = X
PC + PC	12	Character 2 = V or W	Character 4 = A, E, J, N	Character 5 = A, B, C, E, F, G, J, K, L, N, P, Q
PC + PC	13	Character 2 = V or W	Character 4 = D, H, M, R	Character 5 = B, C, D, F, G, H, K, L, M, P, Q, R
PC + PC	14	Character 2 = V or W	Character 8 = A, E, J, N	Character 9 = A, B, C, E, F, G, J, K, L, N, P, Q
PC + PC	15	Character 2 = V or W	Character 8 = D, H, M, R	Character 9 = B, C, D, F, G, H, K, L, M, P, Q, R

T-Series Configurator

If:	And:	Then:
		Character 13 = B, C, E, F, H, J, L, M, P, Q, T or U
Character 11 = 4, F, G, H, J, K, 8, R, T, U, V or W		Character 13 = A, D, G, K, N or R
		Character 13 = B, C, E, F, H, J, L, M, P, Q, T or U
Character 11 = 4, F, G, H, J, K, 8, R, T, U, V or W		Character 13 = A, D, G, K, N or R
		Character 13 = B, C, E, F, H, J, L, M, P, Q, T or U
Character 11 = 4, F, G, H, J, K, 8, R, T, U, V or W		Character 13 = A, D, G, K, N or R
Character 11 = 3, Y, B, C, D, 7, Z, M, N or P		Character 13 = A, D, G, K, N or R
Character 11 = 1, 2, A, E, 5, 6, L or Q		Character 13 = B, H or P
Character 11 = 3, Y, B, C, D, 4, F, G, H, 7, Z, M, N, P, 8, R, T or U		Character 13 = A, G or N
Character 11 = 1, 2, A, E, 5, 6, L or Q	Character 12 = 2, 4 or X	Character 13 = B, H or P
Character 11 = 3, Y, B, C, D, 7, Z, M, N or P	Character 12 = 2, 4, 6, E, F, G or H	Character 13 = A, G or N

EXAMPLE

1	2		3	4	5	6		7	8	9	10		11	12	13	14
T	F	-	G	A	F	G	-	G	A	F	F	-	B	F	B	X

2: Pump Shaft F = 51273 - 13T 16/32 (Tandem)

3: Model Control Arm G = PY (21cc), RH control, common case drain, opposite

4: System Check Valve "A" Port (RH) A Shock, 200 bar, blank

5: System Check Valve "B" Port (LH) F = Shock, 160 bar .024

6: Control Arm Options G = HVY RTN, spring to input

7: Second Pump - Control Arm, Case Drain G = PY (21cc), RH control, no case drain

8: System Check Valve "A" Port (RH) A Shock, 200 bar, blank

9: System Check Valve "B" Port (LH) F = Shock, 160 bar .024

10: Control Arm Options F = CCW RTH, Spring to end cap

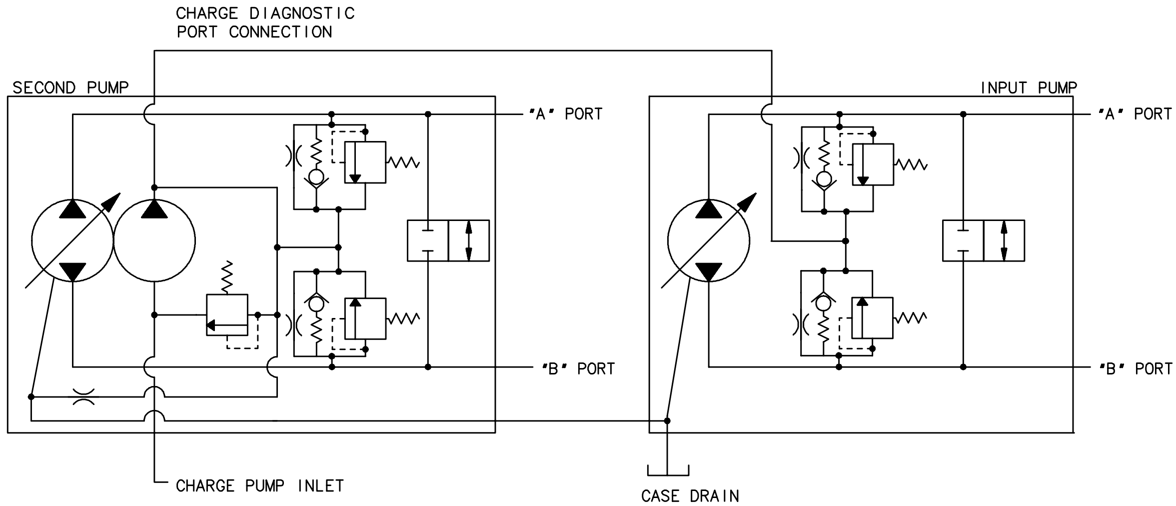
11: Second Pump Orientation, Charge Pump/Gear Pump B = "AA" gear pump - 3.8 cc

12: Torque Bracket, Adapter Plate/Gear Pump Orientation F = GP inlet - opposite

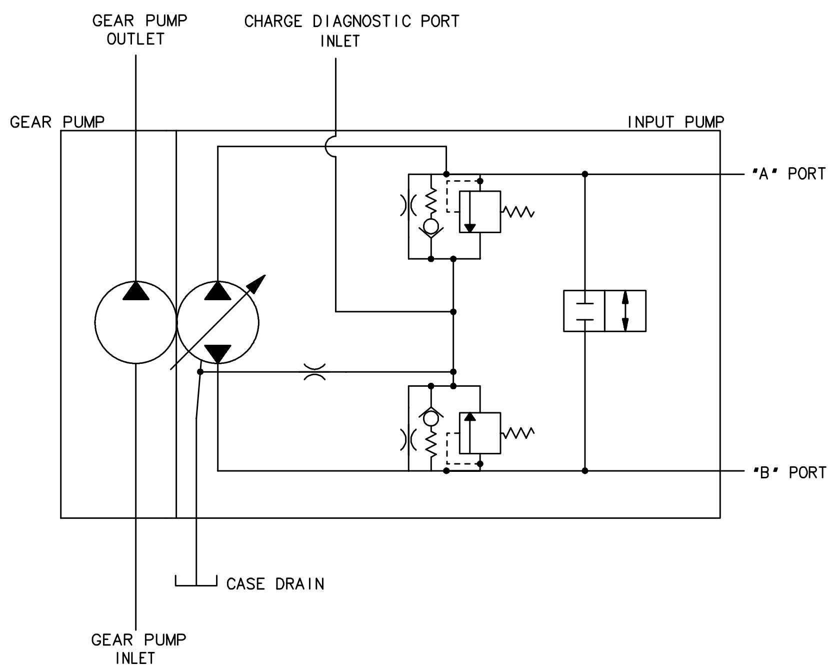
13: Input Rotation - Bypass (Input/Second) B = CW input, blank/blank

14: Additional Information X = N/A

T-Series Hydraulic Circuit Diagrams

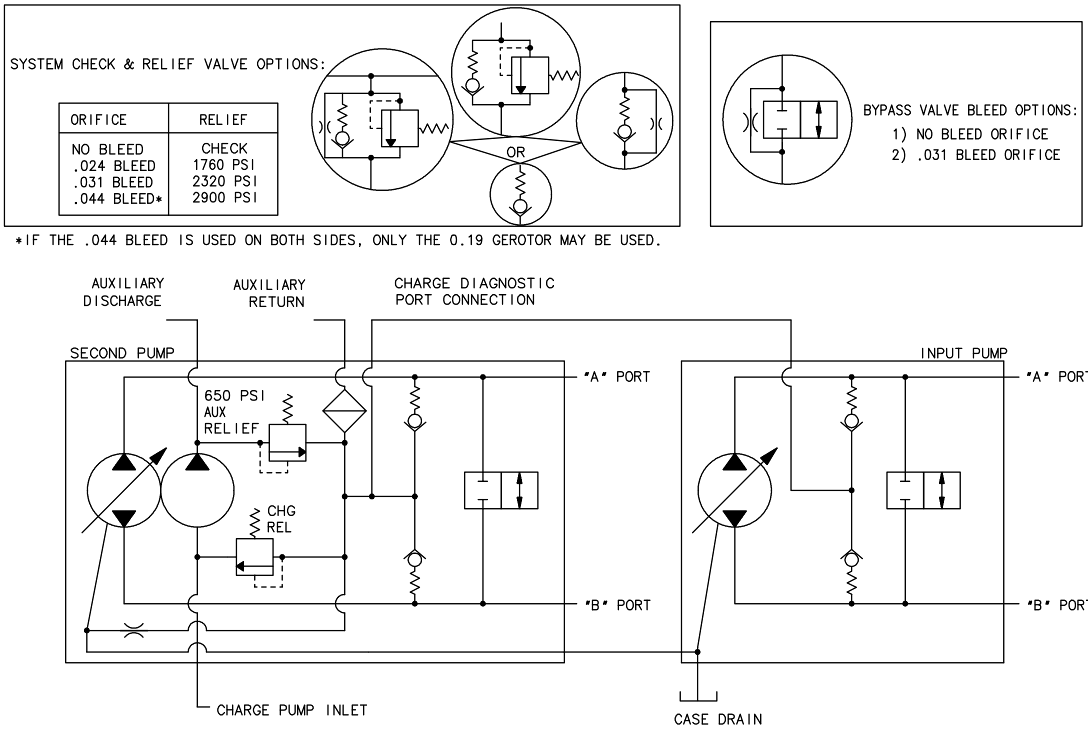


STANDARD TANDEM
(Two variable displacement pumps with standard charge pump)

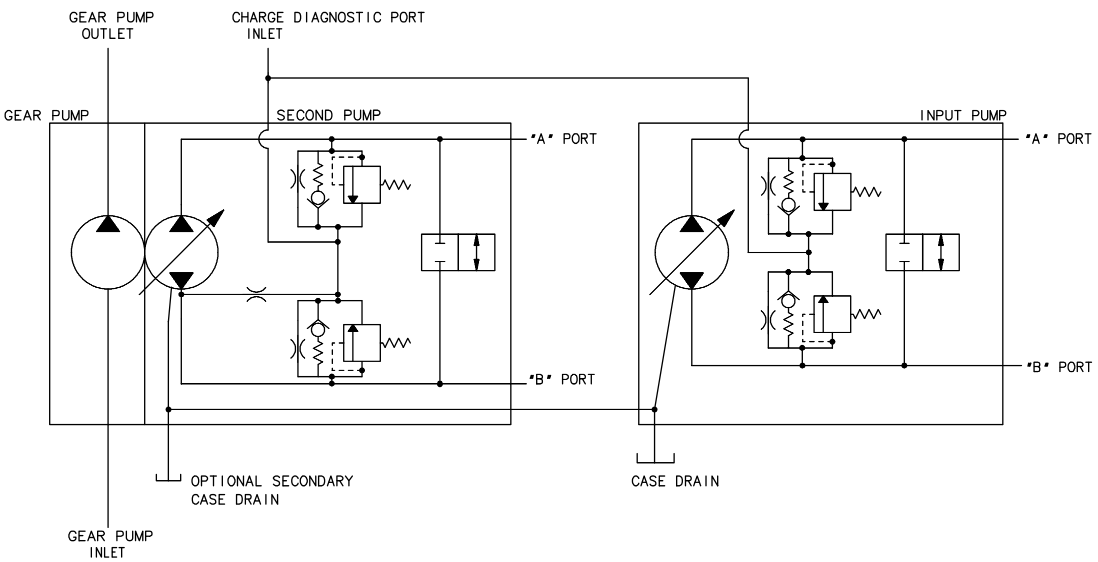


SINGLE T SERIES W/GEAR PUMP
(Single variable displacement pump with one gear pump)

T-Series Hydraulic Circuit Diagrams



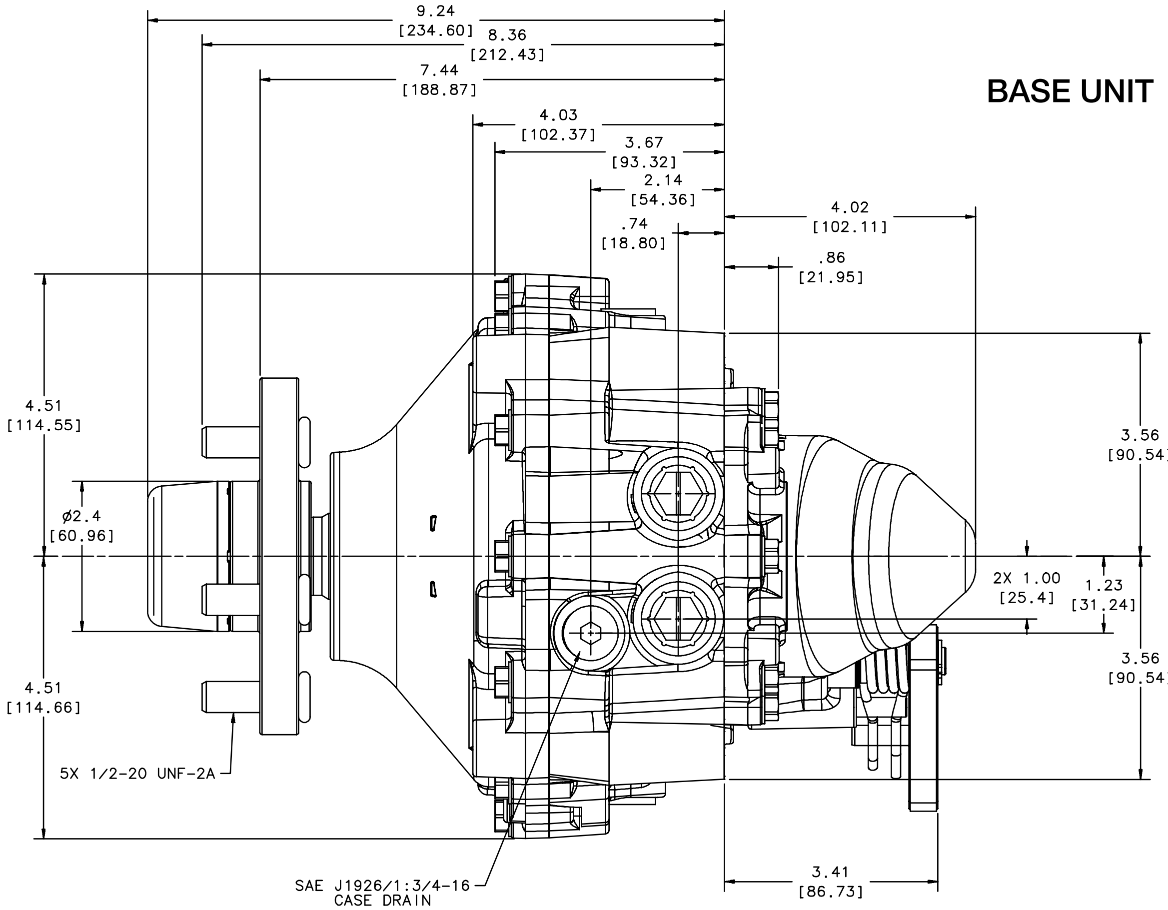
TANDEM WITH AUXILIARY CHARGE PUMP
(Two variable displacement pumps with Hydro-Gear 3.2 cc auxiliary pump/charge pump)

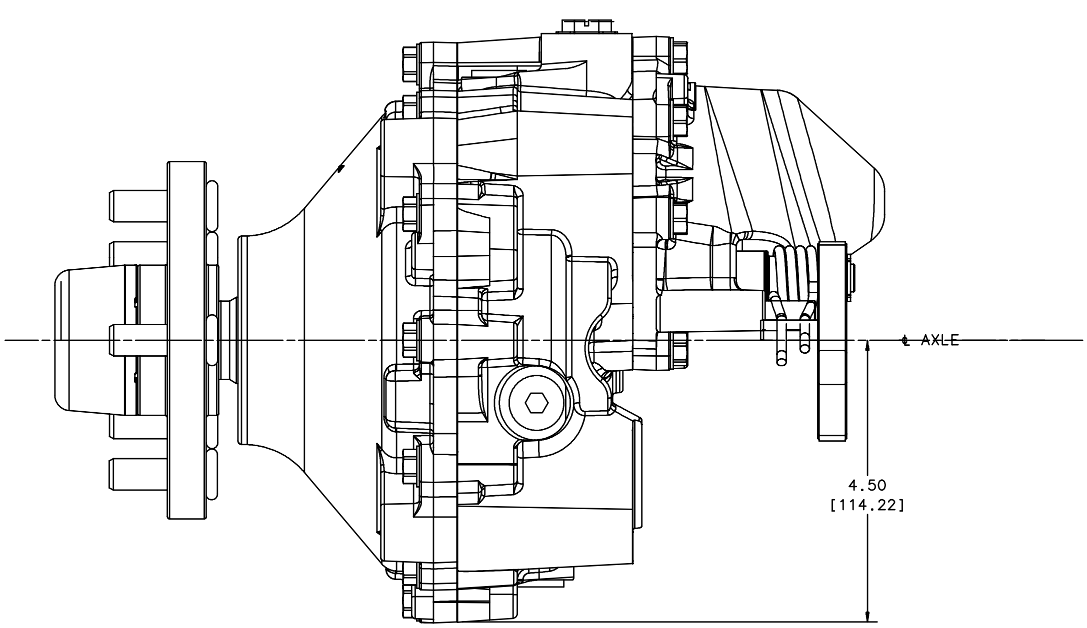


TANDEM W/GEAR PUMP
(Two variable displacement pumps with single gear pump on rear)

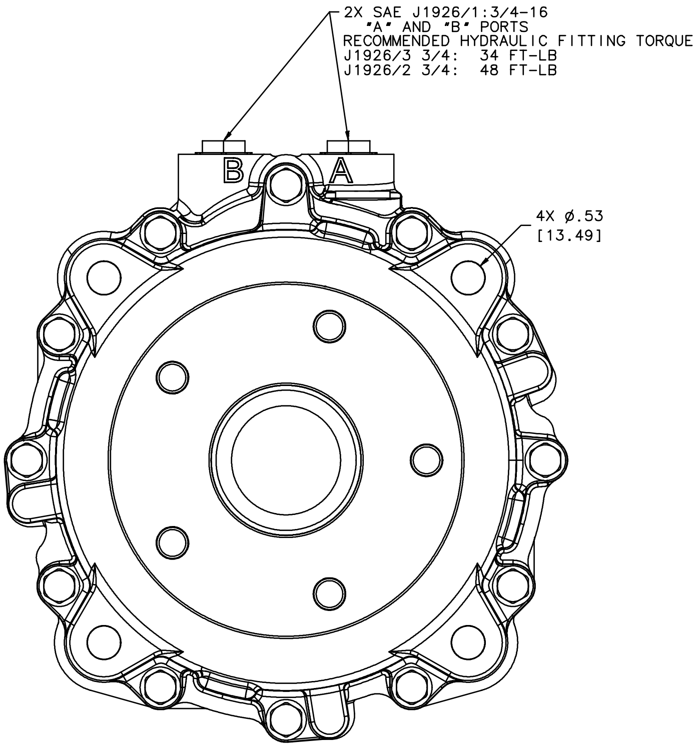
HGM-H Reference Dimensions

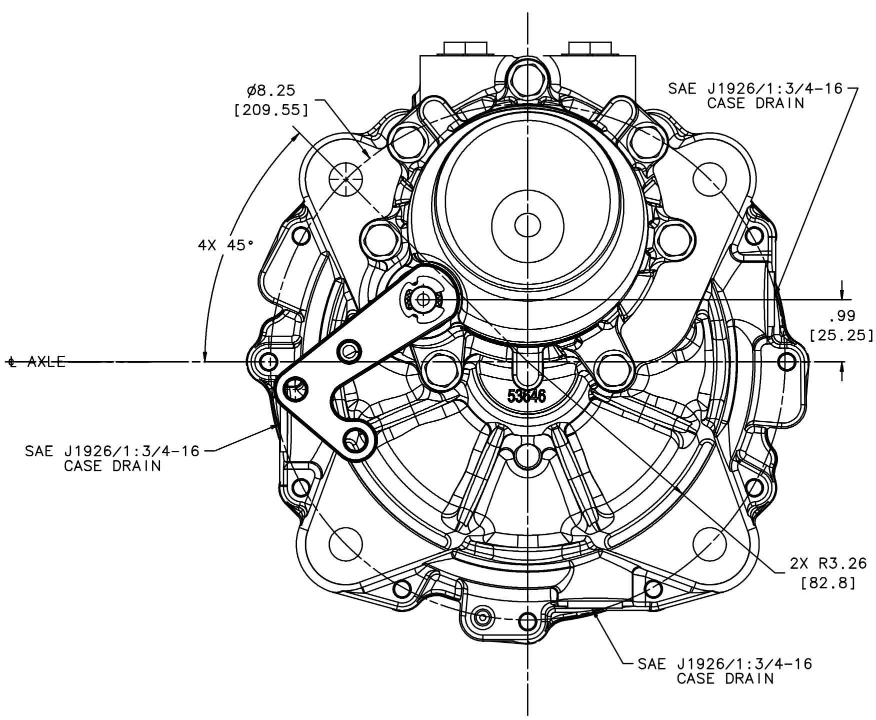
BASE UNIT



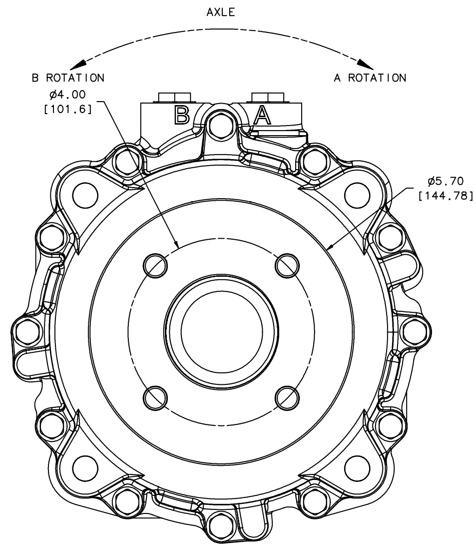


HGM-H Reference Dimensions

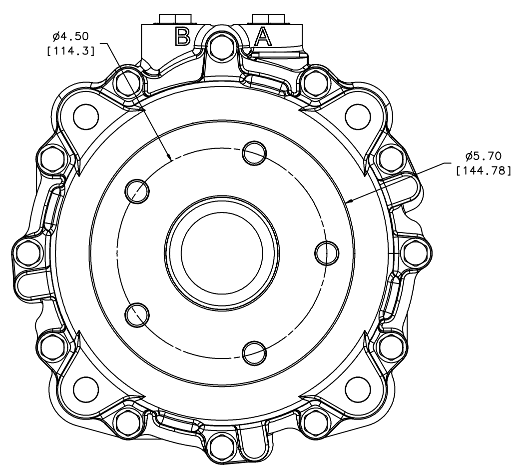




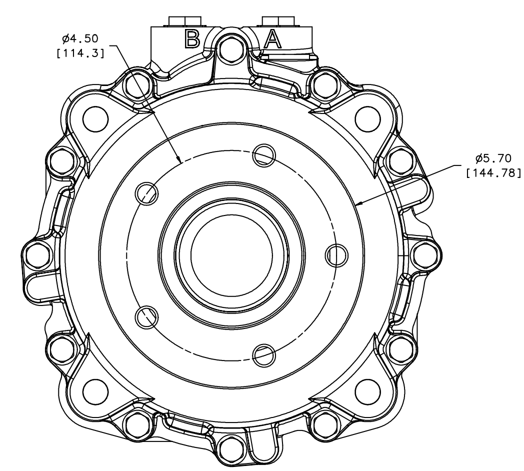
HGM-H Hub Options



HUB OPTION "B"
4 1/2-20 UNF-2A STUDS

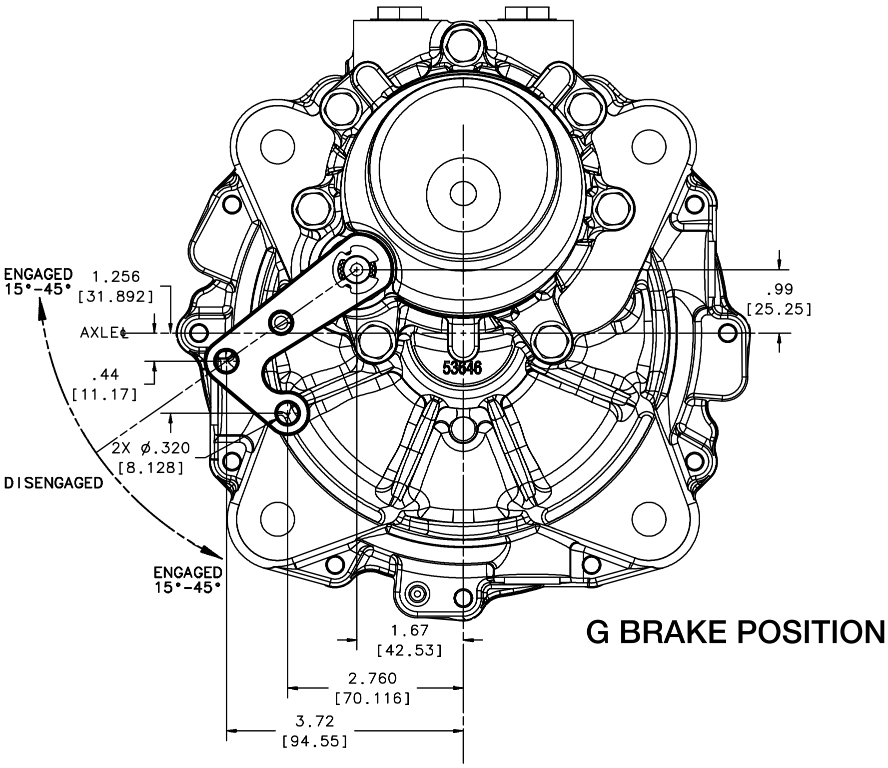


HUB OPTION "C"
5 1/2-20 UNF-2A STUDS

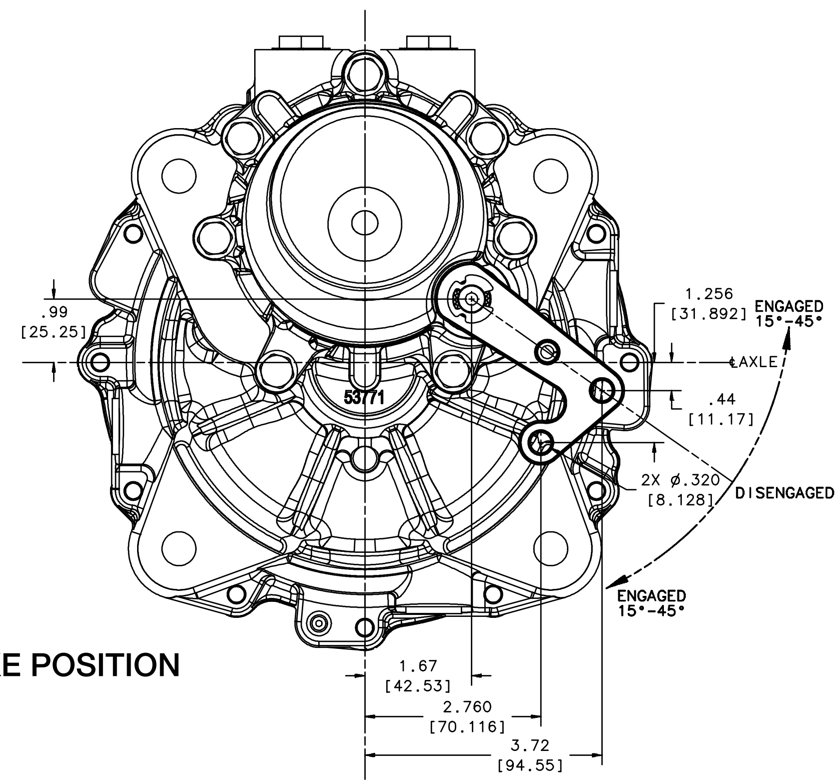


HUB OPTION "D"
ACCEPTS 5 7/16-20 LUG BOLTS

HGM-H Brake Options

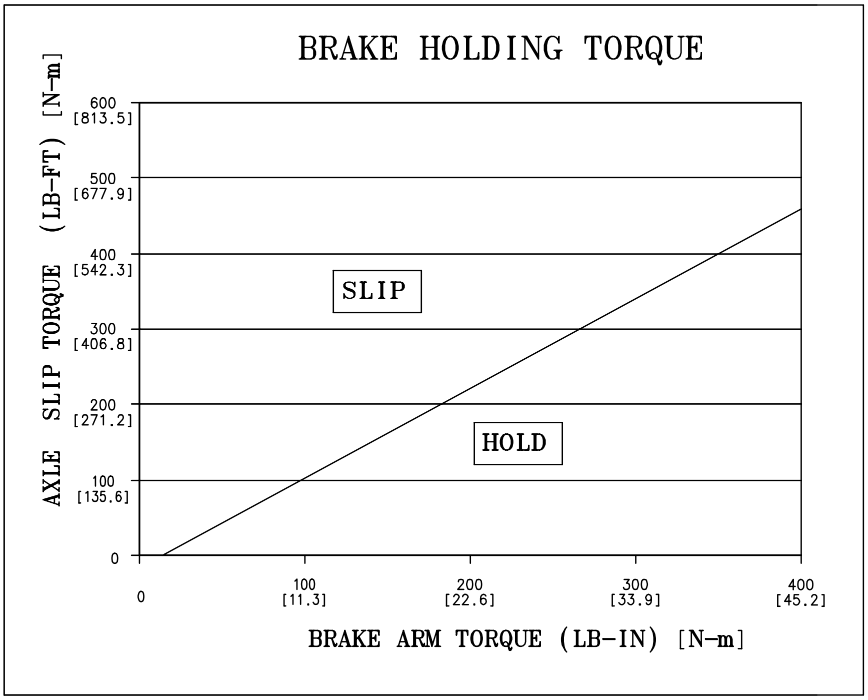


G BRAKE POSITION



K BRAKE POSITION

HGM-H Brake Holding Torque



SUPPLY PORT	RETURN PORT	ROTATION
A	B	A
B	A	B

WHEEL MOTOR DISPLACEMENT	TIRE SIZE
15 IN^3/REV	23-24 IN
18 IN^3/REV	23-26 IN

NOTES:

1. ADD 1000mL OIL (MINIMUM) TO WHEEL MOTOR CASE BEFORE START-UP.

HGM-H Series Configurator

Character	1	2	3	-	4	5		6	-	7	8	9	10
					Displacement			Motor Series		Future Use	Future Use	Axle End	Brake Location
	H	G	M		1	5	= 15 (IN^3/REV)	H = PS-0261		X = Standard Middle Housing	X = N/A	B = 4 Bolt Hub	G = A Location
					1	8	= 18 (IN^3/REV)					C = 5 Bolt Hub	K = B Location
												D = 5 Bolt Tapped Hub	

EXAMPLE

1	2	3		4	5	6	7	8	9	10
H	G	M	-	1	5	H	X	X	B	G

4: Displacement
5: Displacement
6: Motor Series
7: Future Use
8: Future Use
9: Axle End
10: Brake Location

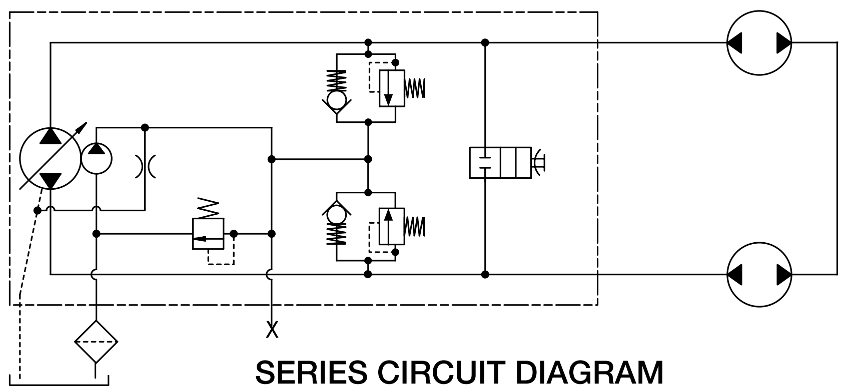
Motor Circuit Calculations

Motor Circuit

Series circuits and parallel circuits are the two basics types of systems used for connecting multiple hydraulic motors.

Series Circuit

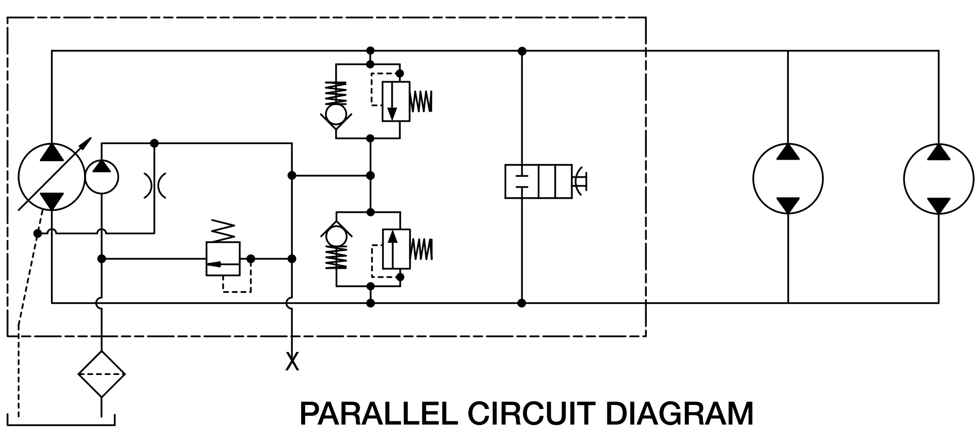
When connecting motors in series, the outlet port of one motor is connected to the inlet of the next motor. This setup allows the full pump flow to go through each motor. Each motor is exposed to maximum flow and output speed. The pressure and torque are distributed between the motors, depending on the load each motor is encountering. The maximum system pressure must be no higher than the maximum inlet pressure of the first motor. A series type system is generally used when it is important for all the motors to run at the same speed such as a belt conveyor system or simulating a locked differential setup.



SERIES CIRCUIT DIAGRAM

Parallel Circuit

Parallel circuits differ in that all of the motor inlets are connected to the pump outlet. This arrangement makes the maximum system pressure available to each motor allowing each motor to produce full torque at a given pressure. However, the pump flow is divided between the individual motors according to their loads and displacements. The oil will take the path of least resistance, so if one motor has no load the oil will take this easier path. The other motors with a load will not turn. If this condition can occur and is a problem for your application, a flow divider is recommended to distribute the oil and act as a differential.



PARALLEL CIRCUIT DIAGRAM

Note: The motor circuits shown above are for illustration purposes only. Components and system layout for actual applications may vary greatly and should be designed for the application.

Motor Circuit Calculations

Zero Turn Applications/Dual Path Systems

Zero turn applications or a dual path system is a method of configuring a hydrostatic vehicle. Hydro-Gear® pumps and motors are often used in dual path systems to achieve a zero turning radius vehicle. A standard dual path system has a complete pump and motor circuit on each side of the vehicle. These systems function independently of each other even though they may share a common reservoir or suction filter. There is a separate control for each pump to change speed and direction of each system as the operator desires. This allows the operator to stop or reverse one side of the vehicle while increasing the speed of the other side. This causes the vehicle to make a very tight turn, reversing back next to previous path. Some examples of vehicles with dual path systems are commercial zero turn mowers, skidsteers and bulldozers.

Vehicle Drive Calculations

When selecting a wheel motor for a mobile vehicle system, a number of factors concerning the vehicle and its application must be taken into consideration. Some factors are needed to determine the required maximum motor speed, the maximum torque required, and the maximum load each motor must support. The following sections contain the necessary equations to determine these loads.

Example Application - Vehicle Specifications

General vehicle configuration	4 wheel vehicles
Vehicle propel system	2 wheel drive, 2 motors, no gear reduction, zero turn vehicle
Gross Vehicle Weight (GVW)	1,500 lb heaviest configuration (including operator, attachments, etc.)
Weight on each drive tire	450 lb on each drive wheel
Rolling radius of tire (Tr)	8.75 inch
Top speed	10 mph
Required acceleration	0 - 10 mph in 5 seconds
Gradability	20%
Worst working surface	Dirt (sandy)

Calculate Maximum Motor Shaft Speed

$$\text{Shaft Speed (rpm)} = \frac{168 \times \text{mph} \times g}{Tr}$$

$$\text{Shaft Speed (rpm)} = \frac{2.65 \times \text{kph} \times g}{Tm}$$

Where:
mph = maximum vehicle speed in miles/hour
kph = maximum vehicle speed in kilometers/hour
Tr = rolling radius of tire in inches
Tm = rolling radius of tire in meters
g = gear reduction ratio (if applicable)

Example:

$$\text{Shaft Speed} = \frac{168 \times 10 \times 1}{8.75} = 192 \text{ rpm}$$

Motor Circuit Calculations

Calculate Maximum Torque Requirement For Motor

To select a motor(s) capable of producing enough torque to propel the vehicle, it is necessary to calculate the total Tractive Effort (TE) requirement for the vehicle. To determine the total tractive effort, the following equation must be used:

TE = RR + GR + FA + DP (lb or kg)

Where:
TE = tractive effort
RR = force necessary to overcome rolling resistance
GR = force required to climb a grade
FA = force required to accelerate
DP = drawbar pull required
The components for this equation may be determined using the following steps:

Calculate Rolling Resistance

Rolling Resistance (RR) is the force necessary to propel a vehicle over a particular surface. It is recommended that the worst possible surface type to be encountered by the vehicle be factored into the equation.

RR (lb or kg) = GVW x r

Where:
GVW = gross vehicle weight (lb or kg)
r = rolling resistance coefficient (see Table 1)

Example:
RR = 1500 x .037 = 55.5 lb

Table 1 - Rolling Resistance Chart	
Asphalt	.012 to .022
Cobbles	.037 to .055
Concrete	.010 to .020
Dirt	.025 to .037
Mud	.037 to .150
Sand	.060 to .300
Snow	.025 to .037

Note:
The harder it would be to push an unpowered vehicle across a surface, the higher the rolling resistance will be.

Motor Circuit Calculations

Calculate Grade Resistance

Grade Resistance (GR) is the force necessary to move a vehicle up a hill or a grade. This calculation should be made using the maximum grade the vehicle will be expected to climb during normal operation.

To convert incline degrees to % Grade:
% Grade = [tangent of angle (degrees)] x 100%

$$GR = \frac{\%\ Grade \times GVW\ (lb/kg)}{100} \quad \text{or} \quad GR = GVW\ (lb/kg) \times \text{sine of angle (degrees)}$$

Example:

$$GR = \frac{20 \times 1500}{100} = 300\ lb$$

Calculate Acceleration Force

Acceleration Force (FA) is the force necessary to accelerate from a stop to maximum speed in a desired time. The equation calculates this force assuming an average acceleration.

$$FA = \frac{mph \times GVW\ (lb)}{22 \times t} \quad \text{or} \quad FA = \frac{kph \times GVW\ (kg)}{35.32 \times t}$$

Where:
t = time to maximum speed (seconds)
mph = maximum vehicle speed in miles/hour
kph = maximum vehicle speed in kilometers/hour
GVW = Gross vehicle weight

Example:

$$FA = \frac{10 \times 1500}{22 \times 5} = 136.4\ lb$$

Calculate Drawbar Pull

Drawbar Pull (DP) is the additional force, if any, the vehicle will be required to produce if it has to tow other equipment. If vehicle is to be used for towing, additional capacity is required for the equipment. Repeat steps one thru three for the towed equipment and sum to determine DP. If different items are towed, use the item with the highest drawbar pull for sizing hydraulic system components.

Calculate Total Tractive Effort

The Tractive Effort (TE) is the sum of the forces calculated in previous steps. On low speed vehicles, wind resistance can typically be neglected. However, friction in drive components may warrant the addition to the total tractive effort to insure acceptable vehicle performance.

TE = RR + GR + FA + DP (lb or kg)   TE = 55.5 + 300 + 136.4 = 491.9 lb

Motor Circuit Calculations

Calculate Motor Torque

The Motor Torque (T) required per motor is the Tractive Effort divided by the number of motors used on the machine. Gear reduction is also factored into account in this equation.

$T = \frac{TE \times Tr}{m \times g} = $ (lb-in) per motor   or $T = \frac{TE \times Tm}{m \times g}$ (N-m) per motor

Where:
TE = tractive effort
Tr = tire rolling radius in inches
Tm = tire rolling radius in meters
m = number of motors
g = gear reduction

Example:
$T = \frac{491.9 \times 8.75}{2} = 2152$ lb - in

Calculate Wheel Slip

To verify that the vehicle will perform as designed in regards to tractive effort and acceleration, it is necessary to calculate wheel slip (TS) for the vehicle. In special cases, wheel slip may actually be desirable to prevent hydraulic system overheating and component breakage should the vehicle become stalled.

$TS = \frac{w \times f \times Tr}{g} = $ (lb-in) per motor; $TS = \frac{w \times f \times Tm}{g} = $ (N-m) per motor

Where:
f = coefficient of friction (see Table 2)
w = loaded vehicle weight over driven wheel
Tr = rolling radius of tire in inches
Tm = rolling radius of tire in meters
g = gear reduction ratio

Example:
TS = 425 x .5 x 8.75 = 1859.4 lb-in

Table 2 - Coefficient of Friction (f)	
Steel on steel	0.3
Rubber tire on dirt	0.5
Rubber tire on a hard surface	0.6 - 0.8
Rubber tire on cement	0.7

Motor Circuit Calculations

When a motor used to drive a vehicle has the wheel or hub attached directly to the motor shaft, it is critical that the radial load capabilities of the motor are sufficient to support the vehicle. After calculating the Total Radial Load (RL) acting on the motors, the result must be compared to the bearing/shaft load charts for the chosen motor to determine if the motor will provide acceptable load capacity and life.

$RL = \sqrt{W^2 + \frac{(T)^2}{Tr}}$ $RL = \sqrt{W^2 = \frac{(T)^2}{Tm}}$

Where:
w = loaded vehicle weight over driven wheel
T = motor torque
Tr = rolling radius in inches
Tm = rolling radius in meters

Example:
$RL = \sqrt{425^2 = \frac{(1859)^2}{8.75}} = 475.15$ lb

Once the maximum motor speed, maximum torque requirement, and the maximum load each motor must support have been determined, these figures may then be compared to the motor performance charts, bearing load curves, and pump performance charts to choose a displacement to fulfill the motor requirements for the application. Pump displacement, and system pressures and wheel motor displacement all effect each other. They all need to be considered as a complete system to achieve the desired performance and reliability.

Side Load Calculations

In many applications, pulleys or sprockets may be used to drive pumps or transmit the torque produced by the hydraulic motor. These type applications will create a torque induced side load on the shafts and bearings. It is important that this load be considered when choosing a pump drive system or sizing a wheel motor with sufficient bearing and shaft capacity for the application.

To calculate the side load, the pump input torque or motor output torque and pulley or sprocket radius must be known. The side load may then be calculated using the formula below. The distance from the pulley/sprocket centerline to the mounting flange of the pump/motor must also be known. The results may then be compared to the bearing and shaft load curve of the desired pump or motor to determine if the side load falls within acceptable load ranges.

$$\text{Side Load} = \frac{\text{Shaft Torque}}{\text{Radius (Pulley/Sprocket)}}$$

Motor Circuit Calculations

Pump & Motor System Selection

The output torque and output speed for a specific application are used to select the correct pump and motor for a given application. The pump performance charts contain the flow information and pressure information for the different pump models. The motor technical specifications contain the comparable information for output speed, pressure, and motor displacement. The pump performance specifications should be used to determine motor displacement. There may be more than one possible pump motor combination to achieve the desired speed and torque output requirements. It is a good practice to choose the system that has the lower system pressure, which allows the system to run cooler and component life to be increased.

Hydraulic Formulas

English

$$\text{Pump Output Flow (gpm)} = \frac{\text{disp (in}^3\text{/rev) x rpm x efficiency}}{231}$$

$$\text{Torque (lbf x in)} = \frac{\text{disp (in}^3\text{) x pressure (psi)}}{2\prod}$$

$$\text{Pump Input Horsepower (hp)} = \frac{\text{flow (gpm) x pressure (psi)}}{\text{1714 x efficiency}}$$

$$\text{Theoretical Speed (rpm)} = \frac{\text{231 x flow (gpm)}}{\text{motor disp (in}^3\text{/rev)}}$$

$$\text{Power Out (hp)} = \frac{\text{torque (in-lb) x speed (rpm)}}{63025}$$

Metric

$$\text{Pump Output Flow (lpm)} = \frac{\text{disp (cm}^3\text{/rev) x rpm x efficiency}}{1000}$$

$$\text{Pump Input Horsepower (hp)} = \frac{\text{flow (lpm) x pressure (bar)}}{\text{600 x efficiency}}$$

$$\text{Theoretical Speed (rpm)} = \frac{\text{1000 x flow (lpm)}}{\text{motor disp (cm}^3\text{/rev)}}$$

$$\text{Theoretical Torque (N-m)} = \frac{\text{pressure (bar) x disp (cm}^3\text{/rev)}}{20\prod}$$

$$\text{Power Out (kW)} = \frac{\text{torque (N-m) x speed (rpm)}}{9543}$$

Motor Circuit Calculations

Length
1 m = 100 cm = 1000 mm
1 km = 1000 m = 0.6214 mi
1 m = 3.281 ft = 39.37 in.
1 cm = 0.3937 in.
1 in. = 2.540 cm
1 ft = 30.48 cm
1 mi = 5280 ft = 1.609 km

Area
1 cm^2 = 0.155 in^2
1 m^2 = 10^4 cm^2 = 10.76 ft^2
1 in^2 = 6.452 cm^2
1 ft^2 = 144 in^2 = 0.0929 m^2

Volume
1 liter = 1000 cm^3 = $10^{-3} m^3$ = 0.03531 ft^3 = 61.02 in^3
1 ft^3 = 0.02832 m^3 = 28.32 liters = 7.477 gallons
1 gallon = 3.788 liters = 231 in^3

Time
1 m = 60 s
1 hr = 3600 s
1 day = 86,400 s = 24 hr

Angles
1 rad = 57.30° = 180°/∏
1° = 0.01745 rad = ∏/180 rad
1 revolution = 360° = 2∏ rad
1 rev/min (rpm) = 0.1047 rad/s

Speed
1 m/s = 3.281 ft/s
1 ft/s = 0.3048 m/s
1 mi/min = 60 mi/hr = 88 ft/s
1 km/hr = 0.2778 m/s = 0.6214 mi/hr
1 mi/hr = 1.466 ft/s = 0.4470 m/s = 1.069 km/hr

Temperature
Degrees Celsius = (F - 32) x 5/9
Degrees Fahrenheit = (C x 9/5) + 32

Acceleration
1 m/s^2 = 100 cm/s^2 = 3.281 ft/s^2
1 cm/s^2 = 0.01 m/s^2 = 0.03281 ft/s^2
1 ft/s^2 = 0.3048 m/s^2 = 30.48 cm/s^2
1 mi/hr x s = 1.467 ft/s^2

Mass
1 lb = 0.454 kg
1 oz = 28.35 g
1 kg = 2.2 lb
1 g = 0.035 lb

Force
1 N = 10^5 dyn = 0.2248 lb
1 lb = 4.448 N x 10^5 dyn

Pressure
1 Pa = 1 N/m^2 = 1.451 x 10^{-4} lb/in^2 = 0.209 lb/ft^2
1 bar = 10^5 Pa
1 lb/in^2 = 6891 Pa
1 lb/ft^2 = 47.85 Pa
1 atm = 1.013 x 10^5 Pa = 1.013 bar
= 14.7 lb/in^2 = 2117 lb/ft^2
1 mm Hg = 1 torr = 133.3 Pa

Energy
1 ft-lb = 1.356 J
1 Btu = 1055 J = 252 cal = 778 ft-lb
1 kg = 2.2 lb
1 g = 0.035 lb

Torque
1 N-m = 8.85 lb-in
1 N-m = 0.738 lb-ft

Power
1 W = 1 J/s
1 hp = 746 W = 550 ft-lb/s = 2546 Btu/hr
1 Btu/hr = 0.293 W

Note: One U.S. gallon of water weighs 8.34 lb (U.S.) at 60° F
one cubic foot of water weighs 62.4 lb (U.S.)

Application Guidelines

General Guidelines

The following guidelines are general descriptions and recommendations for designing hydraulic systems. These guidelines follow common design practices for hydraulic systems. These guidelines give a path to follow for selecting and placing hydraulic components in the hydraulic system. These general guidelines are to help provide a basic hydraulic system design.

Reservoirs

Reservoirs perform five basic functions as follows: store hydraulic oil volume, remove heat from oil, remove air from oil, separation of contaminates, and separation of water condensation. A good basic hydraulic system design practice is to locate the reservoir slightly higher (vertically) than the pump inlet ports. This provides positive inlet fluid head pressure and reduces charge pump workload. The reservoir outlet should be near (but not at) the bottom of the reservoir and must always be covered with fluid. The reservoir inlet (fluid return, usually from case drain) should be below the fluid level and as far away as possible from the outlet port. If possible, the reservoir should be located where air flow can move around the exterior of the reservoir to maximize convective heat transfer. Reservoir breathers should keep foreign contaminants from entering reservoir.

Oil Viscosity

Oil viscosity is of paramount importance to system life. For optimum performance of Hydro-Gear® products, the oil should maintain an optimum viscosity of 13 cSt [70 SUS]. The minimum oil viscosity to prevent component wear is 9 cSt [55 SUS]. These viscosity requirements are for an oil temperature of 110° C [230° F]. Typically, standard SAE 20W-50 multi-viscosity motor oils will meet this requirement. Oil viscosity reduction due to oil shear must also be considered. If the operating temperatures are elevated then synthetic oil with greater viscosity index, or more viscosity at elevated temperatures, may be needed to meet viscosity requirements. Oil selection must be acceptable for all components in the hydraulic system.

Plumbing

Plumbing hose lengths should be minimized and hose and fitting diameters maximized to reduce fluid pressure drop. The number of fittings and use of angled fittings should be minimized to reduce fluid pressure drop. Flared or o-ring seals are recommended joint types; pipe threads are not recommended. Case drain pressures must not exceed pressures in the technical specifications (page 10). Some general guidelines for fluid velocity in the system plumbing are as follows: main system lines 20-30 ft/sec (610-915 cm/sec), case drain lines 10-15 ft/sec (305-460 cm/sec), and suction lines 4-6 ft/sec (120-180 cm/sec). Pressure drop and velocity will be ultimate factors in determining hose plumbing size. The addition of oil coolers, length of plumbing, and bend radius are all factors effecting pressure drop. Consult a hydraulic hose and tube supplier for recommendations on calculating pressure drop and for applicable pressure ratings.

Fluid Conditioning

A filter is typically placed in the inlet line (suction filter). This suction filter should be a 20-25 micron nominal rating. Another method is to filter the case drain line, but for this configuration an additional screen filter should be placed in the inlet line. This setup requires an inlet with a 200 mesh suction screen and a 10 micron nominal rated filter in the case drain line. The tandem pumps require the same filtering except if equipped with a gear pump. Gear pump systems recommend a 100-125 mesh inlet screen and a 10 micron nominal rated filter placed between the gear pump work function and the inlet to the axial piston pump. The filter media surface area (filter physical size) should be selected to limit inlet line pressure drop. One filter may be used to supply both piston pumps in some applications. For this configuration, after the filter the inlet hose tees off to supply both pumps. The single inlet hose prior to the tee should be a larger diameter and the lines after the tee should be of equal length, if possible. The pumps require a fluid cleanliness of 22/20/15, per ISO 4406:99, or cleaner. Bypass filters are not required except for vehicles that normally experience cold starts with high inlet vacuums. A bypass filter should open at approximately 15 in Hg to prevent oil cavitation of the pump.

Inlet Vacuum

Inlet vacuum is affected by oil viscosity, temperature, inlet plumbing pressure drop, inlet volumetric flow rate (charge pump demand), and filter pressure drop. Increased inlet vacuums will reduce pump durability. If wheel motor case drains are used, the charge pump work load and inlet vacuums may increase. Maximum operating and cold start vacuums are given in the technical specifications (page 10) for each model and should not be exceeded.

System Cooling Via Heat Exchangers And Fans

On some applications a heat exchanger will be required to lower the oil temperature to an acceptable level. Heat exchangers should be sized so that they keep fluid within recommended temperature limits (page 10). This is normally done by selecting the worst continuous operating condition at the highest ambient temperature and then size accordingly. Testing is recommended to verify that temperature limits are maintained. Heat exchangers should be placed in the case drain lines and located perpendicular to the air flow for optimum forced convection heat transfer. A heat exchanger with minimal oil pressure drop through the system should be selected to prevent excessive pump case pressure. A heat exchanger is needed in most 21cc pump applications and in some 16cc pump and 10cc pump applications. An alternative is to use a fan, either one of our through-shaft models, or an externally mounted one to provide the necessary cooling. In extreme cases, both a heat exchanger and a fan may prove necessary. In all cases where heat is a problem, pay particular attention to locations of heat sources (engine, exhaust, etc.) and the path for the cooling airflow to the heat exchanger and/or pump. In some cases additional heat baffles and or chassis openings will be required.

Shaft And Bearing Loading

The pump bearing life is dependent on shaft speed, load (belt pull), and distance of pulley from the bearing. If the pump is belt driven the pulley should be mounted as close to the pump seal as reasonably possible. Pulleys with large offsets away from the pump should be avoided as bearing loads increase as the belt centerline moves away from the bearing. Belt tensioning is best accomplished with a spring loaded tensioner. The spring tensioned idler will help keep the correct tension on the belt while operating in varying conditions and take out the human error of over or under tensioning of the belt (which affects belt and bearing life). See pages 112 and 138 for a belt load vs. belt centerline location chart.

Application Guidelines

Pressure Limits

System pressure is a dominant operating variable affecting hydraulic pump life. High system pressures increase the loads on pump components. System life is directly dependent on system operating pressures and should be kept to a minimum to achieve maximum pump life. Pump maximum continuous and peak pressure ratings are given in the technical specifications (page 10) and should not be exceeded.

Special Notes

- The requirements are examples based on typical hydraulic applications. The same requirement may not be adequate for all applications. All components should be selected specific to the application.

- Hydrostatic systems provide for some dynamic braking when the unit is operating correctly. A redundant static braking system is mandatory on all hydrostatic systems. Braking systems must be capable of dynamically braking and stopping a vehicle in all operating conditions and machine configurations. Also a static parking brake must be used to prevent machine motion.

- Pump input rotation direction should match thru shaft fan option for maximum cooling. In this orientation the fan will push air across the pump.

- Some models of tandem pumps require rear support. All tandems with two variable displacement axial piston pumps should have an additional rear support. Some single tandems with a gear pump on rear may also need rear support depending on application.

Application Guidelines

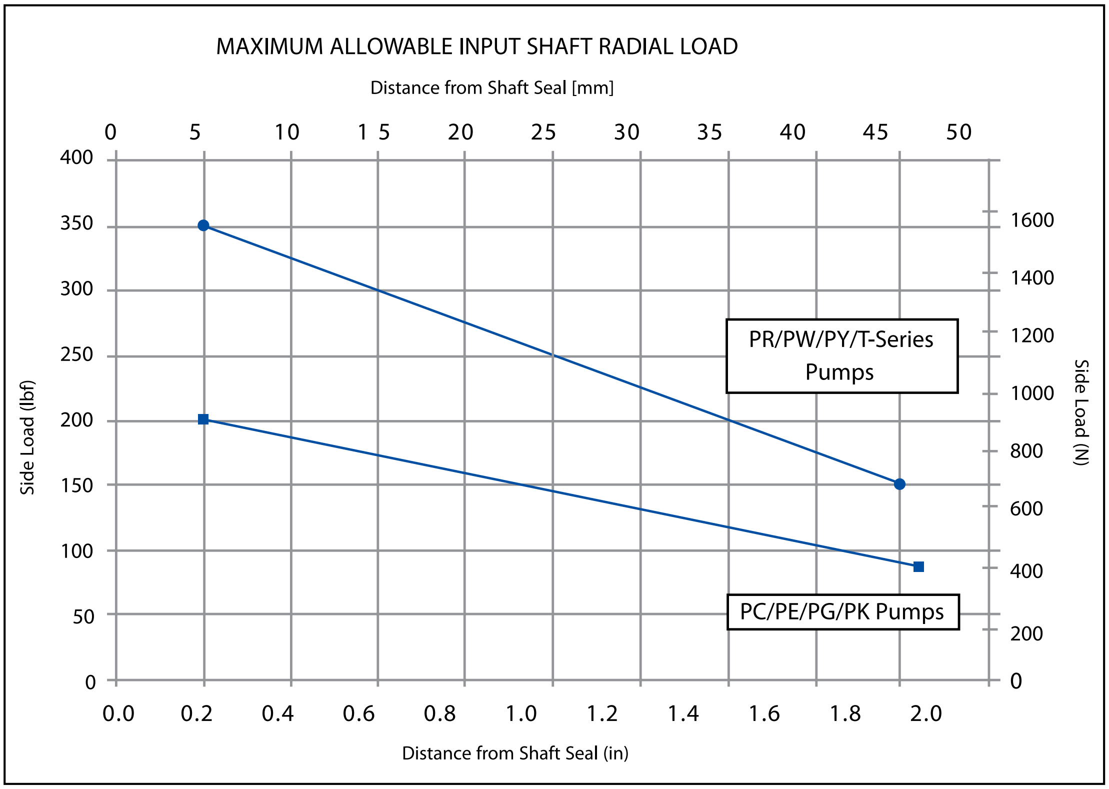
Minimum System Reservoir And Plumbing Recommendation		
	PC (6cc)/PE (10cc)/PG (10cc)/PK (12cc)	**PR (16cc)/PW (21cc)/PY (21cc)**
Reservoir		
Minimum Volume	.75-1 gal [3-4 l] for 1 or 2 pumps	1-1.15 gal [4-6 l] for 1 or 2 pumps
Oil Volume	7/8 of reservoir	7/8 of reservoir
Plumbing		
System Hose Minimum Dia.	1/2 inch [12 mm]	1/2 inch [12 mm]
Case Drain Minimum Dia.	3/8 inch [10 mm]	3/8 inch [10 mm]
Inlet Hose Minimum Dia.	3/8 inch [10 mm]	1/2 inch [12 mm]
Bypass		
Required Tightening Torque	84-120 in-lb [9.5 - 13.5 N-m]***	84-120 in-lb [9.5 - 13.5 N-m]***
Input Options		
Straight Keyed	Yes	Yes
Tapered Shaft	Yes *(Except PC)*	Yes
Splined	Yes	Yes

* Note that reservoirs should be designed to accommodate maximum volume changes during all system operating modes and promote de-aeration of the fluid as it passes through the tank. The design should accommodate 30 second minimum dwell time for axial piston tandems and 60 - 180 seconds for gear pump equipped tandems. Normally, a fluid volume of 1 to 3 times the charge or gear pump output flow (per minute) is satisfactory. The oil volume is recommended to be 7/8 of the reservoir capacity.

** Note that tandem pumps equipped with gear pumps might require significantly larger plumbing in order to accommodate high open loop flow rates.

*** Do not over torque, damage to seat or threads can occur.

Application Guidelines



System Start-up

Warnings: The following procedure may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing the procedure in order to prevent injury to the technician and bystanders.

At system start-up, several things need to be accomplished to ensure a properly running system.

1) Fill the system reservoir to appropriate level and ensure reservoir does not empty during the following procedure.
2) Next tighten all fittings to the manufacturer's recommended torque.
3) Open bypass valve(s) one full turn (min of half turn, max of two turns).
4) Start engine and increase throttle to at least 2/3 speed. Adjust control linkage(s) so that pump(s) are stroking full forward.
5) Move control(s) into forward for 3 sec; move control(s) to reverse for 3 sec; repeat two additional times.
6) Tighten and torque bypass valve(s) (bypass valve torque = 84-120 in-lb or 9.5-13.5 N-m).
7) With engine still at same speed, move control(s) to forward for 3 sec; move control(s) to reverse for 3 sec; repeat two additional times.
8) Move control(s) to neutral.
9) Check engine speed. Adjust to recommended maximum engine rpm.
10) Adjust neutral position.
11) Adjust forward stop(s) to recommended axle speed.
12) Adjust reverse stop(s) to recommended axle speed.
13) If axle speed is not achieved, ensure linkage allows proper movement of pump controls.
14) If pump is stroking fully but recommended axle speed is not achieved, repeat start-up procedure.
15) Refill reservoir to recommended level.

Glossary

Axial Piston: Type of design for hydraulic motors and pumps in which the pistons are arranged parallel with the spindle (input or output shaft).

Bi-Directional: Functioning or allowing movement in two directions. Sometimes called over-centered.

Bypass Valve: A valve whose primary function is to open a path for the fluid to bypass the motor or pump. Also referred to occasionally as the freewheel valve or dump valve.

Case Drain Line (Return Line): A line returning fluid from the component housing to the reservoir.

Cavitation: A phenomenon of boiling in a flowing liquid at normal temperatures, as a result of low pressure condition. The gas liberated from the fluid implodes rapidly and damages pump components.

Center Section: A device which acts as the valve body and manifold of the transmission.

Charge Pump: A device which supplies replenishing fluid to the fluid power system (closed loop).

Charge Pressure: The pressure at which replenishing fluid is forced into a fluid power system.

Charge Relief Valve: A pressure control valve whose primary function is to limit pressure in the charge circuit.

Check Valve: A valve whose primary function is to restrict flow in one direction.

Closed Loop: A sealed and uninterrupted circulating path for fluid flow from the pump to the motor and back.

Decay Rate: The ratio of pressure decay over time.

End Cap: See “Center Section”

Entrained Air: A mechanically generated mixture of air bubbles having a tendency to separate from the liquid phase.

Gerotor: A fixed displacement pump frequently used as a charge pump.

Hydraulic Motor: A device which converts hydraulic fluid pressure and flow into mechanical force and motion.

Hydraulic Pump: A device which converts mechanical force and motion into hydraulic fluid pressure and flow.

Hydrostatic Transaxle: A multicomponent assembly including a gear case and a hydrostatic transmission.

Hydrostatic Transmission: The combination of a hydraulic pump and motor in one housing to form a device for the control and transfer of power.

Inlet Line: A supply line to the pump.

Integrated Hydrostatic Transaxle (IHT): The combination of a hydrostatic transmission and gear case in one housing to form a complete transaxle.

Manifold: A conductor which provides multiple connection ports.

Neutral: Typically described as a condition in which fluid flow and system pressure is below that which is required to turn the output shaft of the motor.

Pressure Decay: A falling pressure.

Priming: The filling of the charge circuit and closed loop of the fluid power system during start up, frequently achieved by pressurizing the fluid in the inlet line.

Purging: The act of replacing air with fluid in a fluid power system.

Rated Flow: The maximum flow that the power supply system is capable of maintaining at a specific operating pressure.

Scoring: Scratches in the direction of motion of mechanical parts caused by abrasive contaminants.

Swash Plate: A mechanical device used to control the displacement of the pump pistons in a fluid power system.

System Charge Check Valve: A valve controlling the replenishing flow of fluid from a charge circuit to the closed loop in a fluid power system.

System Pressure: The pressure which overcomes the total resistance in a system, including all efficiency losses.

Valve: A device which controls fluid flow direction, pressure, or flow rate.

Variable Displacement Pump: A pump in which the displacement per revolution can be varied.

Volumetric Displacement: The fluid volume for one revolution.

Vehicle Name: ______________________________
Reviewer: ______________________________
Reviewer: ______________________________
Project Name: ______________________________

Hydro-Gear® Application Information Sheet

Sullivan, IL 61951 • Phone: (217) 728-2581 • Fax: (217) 728-7665

Date: ______________________________
Application Manufacturer: ______________________________
Address: ______________________________
City: ______________ State: ________ Zip: ______________
Phone: ______________ Fax: ______________
Contacts: ______________________________

Production Plans

Date Samples Required ______________ Pilot Date ________ # of Pilot Units ______________
Production Date ______________ Production Estimated Annual Usage ______________

Vehicle Specifications

Vehicle Name/Number/Function ______________________________
Hydro-Gear Pump Model ______________ Motor Size, Make & Model ______________
Other Hydro-Gear Model ______________ Gear Pump Size & Model ______________
OEM P/N(s) ______________________________

New Production Machine	☐ Yes	☐ No: *Model Replaced*		
Application Type	☐ Commercial	☐ Consumer	Life Expectancy (hr) ______________	
Operator Controls	☐ Foot	☐ Hand	☐ Return to Neutral	☐ Friction Pack
RTN/Friction Pack By	☐ OEM	☐ Hydro-Gear	Driveline Style	☐ Belt ☐ Shaft
External Stroke Limiter	☐ OEM	☐ Hydro-Gear		

Vehicle Weight (Without Operator) ______________________________
Weight On Drive Tires (Without Operator) ______________________________
Attachment(s) & Weight(s) ______________________________
Engine Size (hp) ______________ Vehicle Speed (mph) ______________
Engine Speed (Max Unloaded rpm) ______________ rpm To Drive Unit(s) And Rotation ______________
Engine Pulley Size (in) ______________ Driven Pulley Size (in) ______________
Pulley Distance From Seal (in) ______________ *Belt Tension (lb) ______________
Tire (track) Size (in) ______________ Rolling Radius (in) ______________
*Filter (number/location/micron) ______________ *Inlet Hose Size And Length (in) ______________
* Reservoir Size & Location ______________ * Type And Brand Of Oil ______________
* Heat Exchanger/Fan Style ______________ * Heat Stabilization Temperature ______________
* Plumbing Size/Style/Description ______________________________

____
____
____
____

*System design practices and operating parameters should follow recommendations in this catalog.

Application Comments

Date Of Review: ______________________________
Comments: ______________________________

____
____
____

CC: OEM / Sales Distributor / Hydro-Gear Applications
Any changes that affect the operating conditions of the Hydro-Gear product should be re-reviewed.
Note: Include hydraulic circuit diagram of system.

HYDRO-GEAR®

RESPONSIVE.
RELIABLE.
INNOVATIVE.

1411 S. Hamilton St. • Sullivan, IL 61951
Ph: (217) 728-2581 • Fax: (217) 728-7665

www.Hydro-Gear.com

07/13