Kinitics Piston Pump

05 Frame

The Kinitics Piston Pump (KPP) is a shape memory alloy-based actuator that uses Bundled Wire technology to deliver a precision stroke in a compact package. Displacement and flow control is possible through the addition of a linear sensor while pressure control is possible through the use of a pressure sensor.

Features

- Wide range of compatible fluids
- Rated pressures up to 100 Bar [1450 psi]
- Strokes up to 7 mm [0.26”]
- Displacements up to 8.4 CC [0.5 cu.in]
- Flow rates up to 25 LPH [6.6 GPH]
- Configurable ports
- Flexible AC and DC power options
- Flying lead or SJOOW cable hook-up
- -40° C to 60° C operating range
- Rod and piston are the only moving parts
- IP67 environmental protection
- Compatible with ISO 21287 hardware

Accessory Add-ons

- Wide range of mounting brackets
- Adjustable home position switch

Possible Applications

- Master cylinder
- Braking / clutching
- Metering pump

Product Code

KPP 05 - 3 S - A1 - 25 - N - A 0 - M - C 10 - E - S

Actuator	Travel Modifier	Bore	Port 1	Coolant	Cable Length	Special
05 - KLA05	**S - Standard (Default)** O - Over-travel	08 - 8mm 12 - 12mm 18 - 18mm 25 - 25mm 40 - 40mm	**A - M5x0.75 (Default)** B - 1/8” NPT C - M10x1	A - Air **M - Oil (Default)**	03 - 30cm **10 - 100cm (Default)** 20 - 200cm XX - XX*10cm (Max 4m)	**Blank - None (Default)** S - Custom

Nominal Stroke	Nom. Voltage	Piston Seal	Port 2	Cable Type	Proximity Switch
2 - 2 mm 3 - 3 mm 4 - 4 mm 5 - 5 mm	D1 - 12V DC D2 - 24V DC A1 - 120V AC	**N - NBR (Default)** E - EPDM K - KFM	0 - None **A - M5x0.75 (Default)** B - 1/8” NPT C - M10x1	N - None H - Flying Leads **C - SJOOW (Default)**	N - None **E - End-of-travel (EoT) (Default)** B - EoT and Home

KPP05 Mechanical:

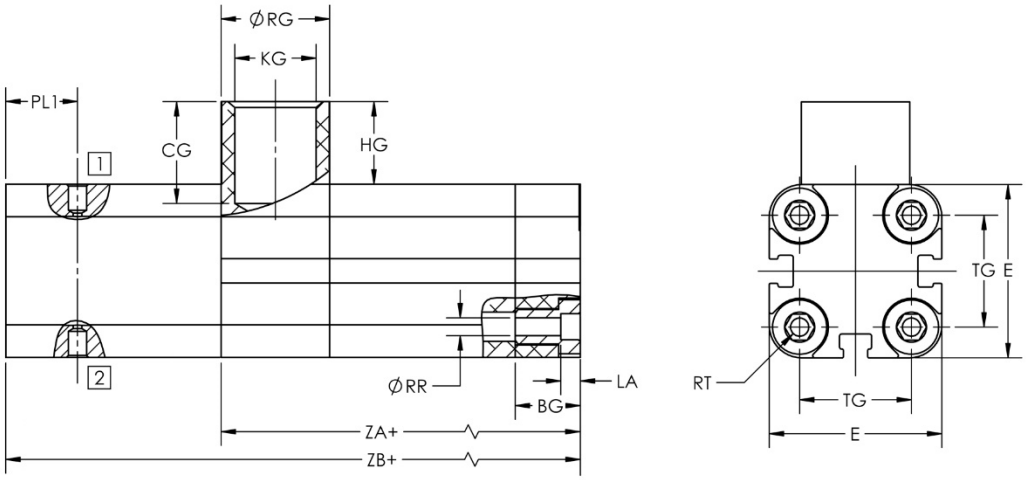

Figure 1 - KPP Dimensions.

Nom. Stroke	ZA	ZB	BG	RR	TG	E	RT	LA	PL1
2	137	175	32.5	4.1	26 ±0.4	40	M5	5.25	8
3	177	215							
4	217	255							
5	257	295							

Note: Primary port 1 and optional secondary port 2 per customer specification.

Flying Leads wiring port dimensions:

KG	CG	HG	ØRG
1/2-14 NPSM	9	20.6	25

All dimensions in mm

KPP05 Electrical:

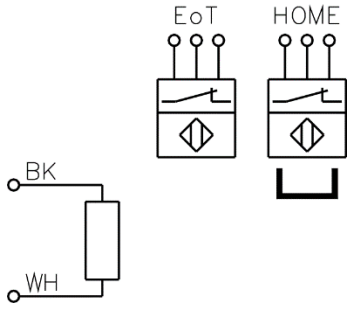

Figure 2 - DC Wiring Diagram

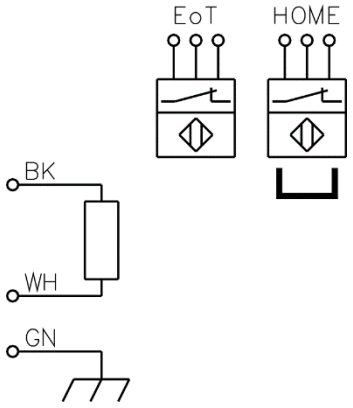

Figure 3 - AC Wiring Diagram

General Product Specifications

Parameter	Option	Product Code	Units	Value(s)			
Operating / Maximum Voltage	**D1** - 12VDC	KPP05-□□-**D1**-□-□-□□-□-□□-□	V	12 / 50 (DC)			
	D2 - 24VDC	KPP05-□□-**D2**-□-□-□□-□-□□-□	V	24 / 50 (DC)			
	A1 - 120VAC	KPP05-□□-**A1**-□-□-□□-□-□□-□	V	120 / 120 (AC)			
Rated Current	**D1** - 12VDC	KPP05-□□-**D1**-□-□-□□-□-□□-□	A	125			
	D2 - 24VDC	KPP05-□□-**D2**-□-□-□□-□-□□-□	A	100			
	A1 - 120VAC	KPP05-□□-**A1**-□-□-□□-□-□□-□	A	21			
Piston Positional Accuracy †		KPP05-□□-□-□-□-□□-□-□□-□	µm [mil]	±5 [±0.2]			
Nominal Stroke		KPP05-**#**□-□-□-□-□□-□-□□-□	mm	2	3	4	5
Rated Travel	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	mm [INCH]	2 [0.079]	3 [0.118]	4 [0.157]	5 [0.197]
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	mm [INCH]	2.7 [0.106]	4 [0.158]	5.4 [0.211]	6.7 [0.264]
Response Time (@ Operating Voltage)	**D1** - 12VDC	KPP05-□□-**D1**-□-□-□□-□-□□-□	ms	348	190	332	513
	D2 - 24VDC	KPP05-□□-**D2**-□-□-□□-□-□□-□	ms	196	190	332	513
	A1 - 120VAC	KPP05-□□-**A1**-□-□-□□-□-□□-□	ms	125	273	478	185
Resistance	**D1** - 12VDC	KPP05-□□-**D1**-□-□-□□-□-□□-□	Ω	0.26	0.10	0.13	0.16
	D2 - 24VDC	KPP05-□□-**D2**-□-□-□□-□-□□-□	Ω	0.58	0.39	0.52	0.65
	A1 - 120VAC	KPP05-□□-**A1**-□-□-□□-□-□□-□	Ω	9.3	13.9	18.6	5.8
Maximum Current Draw (@ Operating Voltage) ⇈	**D1** - 12VDC	KPP05-□□-**D1**-□-□-□□-□-□□-□	A	47	124	93	74
	D2 - 24VDC	KPP05-□□-**D2**-□-□-□□-□-□□-□	A	41	62	47	37
	A1 - 120VAC	KPP05-□□-**A1**-□-□-□□-□-□□-□	A	12.9	8.6	6.5	20.7
Maximum Power (@ Operating Voltage) ⇈	**D1** - 12VDC	KPP05-□□-**D1**-□-□-□□-□-□□-□	W	558	1,488	1,116	893
	D2 - 24VDC	KPP05-□□-**D2**-□-□-□□-□-□□-□	W	992	1,488	1,116	893
	A1 - 120VAC	KPP05-□□-**A1**-□-□-□□-□-□□-□	W	1,550	1,033	775	2,480
Weight	Air Cooled	KPP05-□□-□-□-□-□□-**A**-□□-□	kg [lbs]	0.59 [1.3]	0.69 [1.5]	0.83 [1.8]	0.93 [2.1]
	Oil Cooled	KPP05-□□-□-□-□-□□-**M**-□□-□	kg [lbs]	0.62 [1.4]	0.74 [1.6]	0.89 [2]	1.01 [2.2]
Operating Temperature Range	Air Cooled	KPP05-□□-□-□-□-□□-**A**-□□-□	°C [°F]	-40 to 60 [-40 to 140]			
	Oil Cooled	KPP05-□□-□-□-□-□□-**M**-□□-□	°C [°F]	-20 to 60 [-4 to 140]			
Storage Temperature Range		KPP05-□□-□-□-□-□□-□-□□-□	°C [°F]	-40 to 80 [-40 to 176]			
Ingress Protection Rating		KPP05-□□-□-□-□-□□-□-□□-□		IP67			

† - See Piston Positional Accuracy term.

⇈ - See Power, Current Draw, and Holding Current terms.

8mm Bore Specifications

Parameter	Option	Product Code	Units	Value(s)			
Piston Bore		KPP05-□□-□-**08**-□-□□-□-□□-□	mm [INCH]	8 [0.31]			
Rated Pressure	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	Bar [psig]	100 [1450]			
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	Bar [psig]	70 [1015]			
Nominal Stroke		KPP05-**#**□-□-□-□-□□-□-□□-□	mm	2	3	4	5
Maximum Displacement	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	CC [Cu.In.]	0.1 [0.006]	0.15 [0.009]	0.2 [0.012]	0.25 [0.015]
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	CC [Cu.In.]	0.13 [0.008]	0.2 [0.012]	0.27 [0.016]	0.34 [0.021]
Maximum Flow Rate (Oil Cooled)	**S**tandard	KPP05-□**S**-□-□-□-□□-**M**-□□-□	LPH [GPH]	0.3 [0.07]	0.4 [0.1]	0.5 [0.13]	0.6 [0.17]
	Overtravel	KPP05-□**O**-□-□-□-□□-**M**-□□-□	LPH [GPH]	0.4 [0.11]	0.6 [0.16]	0.7 [0.2]	1 [0.26]

12mm Bore Specifications

Parameter	Option	Product Code	Units	Value(s)			
Piston Bore		KPP05-□□-□-**12**-□-□□-□-□□-□	mm [INCH]	12 [0.47]			
Rated Pressure	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	Bar [psig]	44 [638]			
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	Bar [psig]	31 [450]			
Nominal Stroke		KPP05-**#**□-□-□-□-□□-□-□□-□	mm	2	3	4	5
Maximum Displacement	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	CC [Cu.In.]	0.23 [0.014]	0.34 [0.021]	0.45 [0.028]	0.57 [0.035]
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	CC [Cu.In.]	0.3 [0.018]	0.45 [0.028]	0.61 [0.037]	0.76 [0.046]
Maximum Flow Rate (Oil Cooled)	**S**tandard	KPP05-□**S**-□-□-□-□□-**M**-□□-□	LPH [GPH]	0.6 [0.16]	0.9 [0.23]	1.1 [0.29]	1.4 [0.38]
	Overtravel	KPP05-□**O**-□-□-□-□□-**M**-□□-□	LPH [GPH]	0.9 [0.24]	1.3 [0.35]	1.7 [0.44]	2.2 [0.59]

18mm Bore Specifications

Parameter	Option	Product Code	Units	Value(s)			
Piston Bore		KPP05-□□-□-**18**-□-□□-□-□□-□	mm [INCH]	18 [0.71]			
Rated Pressure	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	Bar [psig]	19 [276]			
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	Bar [psig]	14 [203]			
Nominal Stroke		KPP05-**#**□-□-□-□-□□-□-□□-□	mm	2	3	4	5
Maximum Displacement	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	CC [Cu.In.]	0.51 [0.031]	0.76 [0.047]	1.02 [0.062]	1.27 [0.078]
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	CC [Cu.In.]	0.68 [0.042]	1.02 [0.062]	1.36 [0.083]	1.7 [0.104]
Maximum Flow Rate (Oil Cooled)	**S**tandard	KPP05-□**S**-□-□-□-□□-**M**-□□-□	LPH [GPH]	1.3 [0.35]	1.9 [0.51]	2.4 [0.64]	3.2 [0.86]
	Overtravel	KPP05-□**O**-□-□-□-□□-**M**-□□-□	LPH [GPH]	2.1 [0.55]	3 [0.8]	3.8 [0.99]	5 [1.33]

25mm Bore Specifications

Parameter	Option	Product Code	Units	Value(s)			
Piston Bore		KPP05-□□-□-**25**-□-□□-□-□□-□	mm [INCH]	25 [0.98]			
Rated Pressure	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	Bar [psig]	10 [145]			
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	Bar [psig]	7 [102]			
Nominal Stroke		KPP05-**#**□-□-□-□-□□-□-□□-□	mm	2	3	4	5
Maximum Displacement	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	CC [Cu.In.]	0.98 [0.06]	1.47 [0.09]	1.96 [0.12]	2.45 [0.15]
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	CC [Cu.In.]	1.32 [0.08]	1.97 [0.12]	2.63 [0.16]	3.29 [0.2]
Maximum Flow Rate (Oil Cooled)	**S**tandard	KPP05-□**S**-□-□-□-□□-**M**-□□-□	LPH [GPH]	2.6 [0.68]	3.7 [0.99]	4.7 [1.24]	6.2 [1.65]
	Overtravel	KPP05-□**O**-□-□-□-□□-**M**-□□-□	LPH [GPH]	4 [1.06]	5.8 [1.54]	7.2 [1.91]	9.7 [2.57]

40mm Bore Specifications

Parameter	Option	Product Code	Units	Value(s)			
Piston Bore		KPP05-□□-□-**40**-□-□□-□-□□-□	mm [INCH]	40 [1.57]			
Rated Pressure	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	Bar [psig]	4 [58]			
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	Bar [psig]	2.7 [39]			
Nominal Stroke		KPP05-**#**□-□-□-□-□□-□-□□-□	mm	2	3	4	5
Maximum Displacement	**S**tandard	KPP05-□**S**-□-□-□-□□-□-□□-□	CC [Cu.In.]	2.51 [0.15]	3.77 [0.23]	5.03 [0.31]	6.28 [0.38]
	Overtravel	KPP05-□**O**-□-□-□-□□-□-□□-□	CC [Cu.In.]	3.37 [0.21]	5.05 [0.31]	6.74 [0.41]	8.42 [0.51]
Maximum Flow Rate (Oil Cooled)	**S**tandard	KPP05-□**S**-□-□-□-□□-**M**-□□-□	LPH [GPH]	6.6 [1.73]	9.6 [2.53]	12 [3.18]	16 [4.22]
	Overtravel	KPP05-□**O**-□-□-□-□□-**M**-□□-□	LPH [GPH]	10.2 [2.71]	14.9 [3.93]	18.5 [4.89]	24.9 [6.57]

End-of-Travel and Home Proximity Switch Specifications (p/n: PSC-050-030-001)

Parameter	Units	Value(s)
Operating Voltage Range	V	10 - 30 (DC)
Rated Operating Voltage	V	24 (DC)
Rated Operating Current	A	0.2
Switching Output		PNP Normally Closed
Repeatability	µm [mil]	±100 [±4]
Operating Temperature Range	°C [°F]	-25 to 85 [-13 to 185]
Ingress Protection Rating		IP67
Cable Length	m [INCH]	2 [79]

Behavior curves:

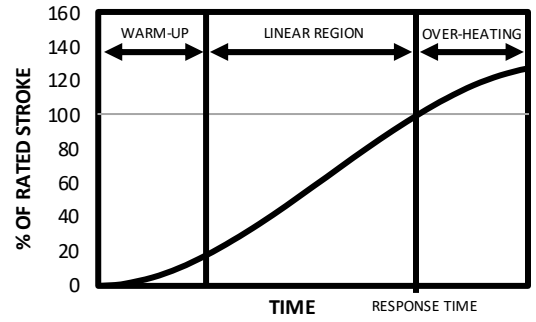

Figure 4 – Response Time @ 20°C [68°F]

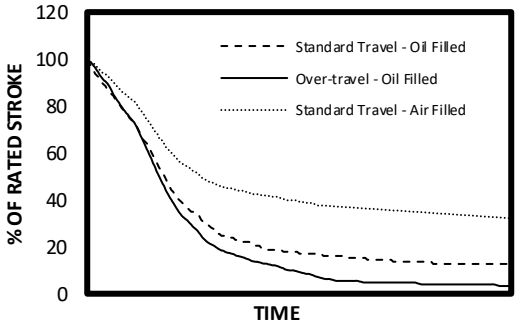

Figure 5 - Return Time

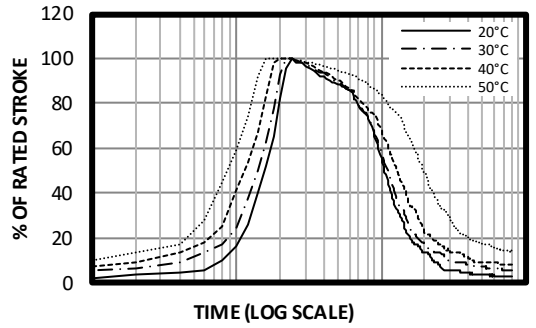

Figure 6 - Actuator Temperature Effect

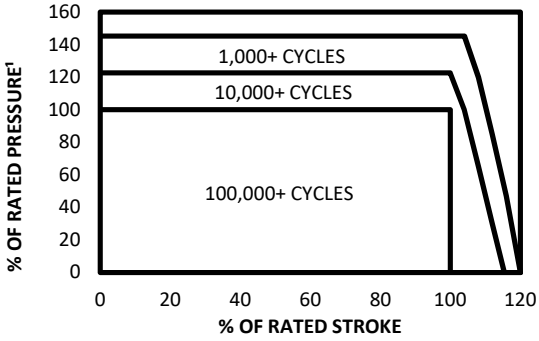

Figure 7 - Cycle Life

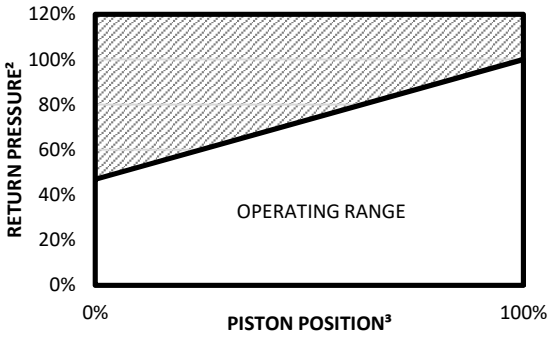

Figure 8 - Standard Operating Range

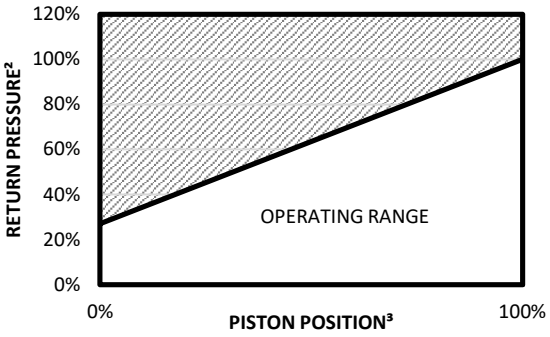

Figure 9 - Over-travel Operating Range

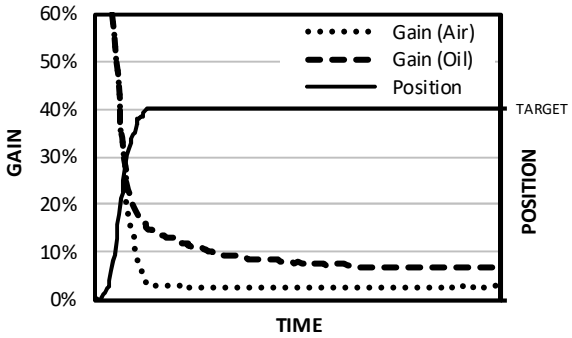

Figure 10 - Holding Current

[1] - Maximum pressure applied during stroke, including shock loading
[2] - Return pressure as a percentage of rated pressure
[3] - Piston position as a percentage of rated stroke

Glossary of Terms:

Actuator Temperature Effect and Operating Temperature Range:

The actuator is a thermo-mechanical device and its performance is affected by changes in the ambient temperature as illustrated in the Actuator Temperature Effect figure. Increasing the ambient temperature will reduce the power needed to actuate, reduce the available stroke, and increase the return time. Decreasing the ambient temperature will increase the power needed to actuate, increase the available stroke, and reduce the return time.

Cable Type:

The two primary cable types are *SJOOW* and *Flying Leads*. *SJOOW* is a heavy-duty flexible cord that is oil and water resistant. *Flying leads* are loose hook-up wire that exit out of a ½" NPT port that permits connections to conduit or a terminal box. *None* means no electrical connections are provided and the user must physically control the core temperature of the actuator to effect movement. Body ports to circulate temperature regulating fluid through the actuator body may be added through a *special* order in combination with the *N - none* option.

Coolant:

Coolant type has a large impact on return time and power consumption during continuous operation. *A – Air* coolant slows down the return time and is appropriate for long duration holding and positioning applications. *M – Oil* coolant speeds up the return time as is appropriate for rapid cycling and pumping applications. Forced cooling may be used in conjunction with oil coolant to increase cycle rate while insulation may be used in conjunction with air coolant to reduce continuous power draw.

Cycle Life:

The Cycle Life figure provides an approximate estimation of cycle life for reoccurring actuations. As noted in the figure it is possible to over-stroke and over-load the actuator at the expense of cycle life. Rapid cycling beyond the actuator's maximum duty cycle will also reduce cycle life. The actuators cycle life can be extended by minimizing shock loads and providing some margin between operating and rated force and stroke.

Displacement:

Displacement is a volumetric quantity based on the bore diameter and piston stroke. Maximum Displacement is based on the piston stroking between its home and end-of-travel positions when operating in a 20°C [68°F] ambient environment. Maximum Displacement can be increased, or decreased, by specifying a custom bore size. The actual displacement can be modified by adjusting the home and end-of-travel positions or by using closed loop control techniques. See the *Proximity Switch*, *Piston Positional Accuracy*, and *Special* terms for more information.

Holding Current

Holding current is the average current needed to hold the actuator at a fixed position. The Holding Current figure illustrates gain over time for actuators using Air and Oil coolants in a 20°C [68°F] ambient environment. It is the product of the nominal current and the gain needed to hold position and can be calculated as:

$$I_{holding}[A] = Gain_{holding}[\%] \cdot I_{nominal}[A]$$

See the *Coolant* and *Resistance and Current Draw* terms for more information.

Maximum Flow Rate:

Maximum Flow Rate is the cumulative pump displacement over time when operating in a 20°C [68°F] ambient environment without forced cooling. The maximum rate is achieved by setting the home proximity switch to an optimal position that minimizes cycle time. Actuator temperature, ambient temperature, coolant type, applied voltage, operating return position, and power gain will affect the maximum possible flow rate.

Nominal Voltage and Maximum Voltage:

The Nominal Voltage is the recommended voltage and power type for the actuator. Both *D1 – 12V DC* and *D2 -24V DC* options are intended for use with direct current. The *A1 – 120V AC* option is intended for use with alternating current. The applied voltage, or operating voltage, can be different from the nominal voltage provided the maximum voltage and rated current are not exceeded. See the *Resistance and Current Draw* terms for more information.

Piston Seal:

The Piston Seal material should be selected for its compatibility with the fluid being pumped. For example, NBR is appropriate for pumping water and mineral based oils while KFM is appropriate for pumping synthetic oils. Operating inside of an anodized aluminum chamber it is the only elastomer material that is exposed to the pumped fluid.

Ports:

The Piston Pump can be provided with one or more ports to suit the application. When operating as a master cylinder one port is required. When operating as a pump two ports are typically required and means to control the fluid flow in and out of the pump (eg. check valves) are not included and need to be factored into the overall system design. It is possible to remove the pump body from the actuator in order to machine additional ports into the body provided that they do not interfere with the piston seal.

Piston Positional Accuracy:

High positional accuracy may be achieved using a position sensor in combination with closed-loop control techniques. To attach a linear sensor the actuator rod can be extended out the opposite side of the pump, as a special feature. For applications that require a higher degree of accuracy and precision the use of DC power is recommended over AC.

Power:

Power draw is the average power draw of the actuator when actuated at its operating voltage at full gain. Voltage droop and in-line resistance of additional cabling and electrical connections will affect the average power draw. When operating at voltages other than nominal the average power draw can be calculated as:

$$P_{nominal}[W] = V_{actual}[V_{RMS}] \cdot I_{nominal}[A]$$

or

$$P_{nominal}[W] = \frac{(V_{actual}[V_{RMS}])^2}{R_{actuator}[\Omega]}$$

Proximity Switch:

The *E* - E*nd-of-travel (EoT)* option provides the actuato'r with a proximity switch that is factory set to switch at the actuators rated stroke. Set inside of a T-slot and against a hard-stop the switch may be slid down the T-slot to reduce stroke. The *B – EoT and Home* option provides the EoT proximity switch, as described above, in addition to a second proximity switch that is factory set at the actuator home position. Set inside of a T-slot the home position proximity switch may be adjusted to switch before the actuator positon reaches home. This can be done to speed up the cycle rate of the actuator. The *N – None* options means that no proximity switches are provided and the user should provide other means to prevent the actuator from stroking past its rated stroke.

Rated Pressure:

The actuator's pressure rating is based on its ability to develop positive pressure in a hydraulic system. The rated pressure is inclusive of shock loading and pressure spikes. Rated Pressure can be increased, or decreased, by specifying a custom bore size. See the *Return Pressure* and *Special* terms for more information.

Rated Stroke:

The rated stroke of the actuator is the maximum recommended stroke distance for the actuator at 20°C [68°F]. It is possible to over stroke the actuator by driving it past its rated stroke distance but this will reduce cycle life and/or cause internal damage to the actuator. Utilization of the factory set end-of-travel proximity switch is strongly recommended to prevent over stroking. If the stroke required by the application is close to the rated stroke of the actuator the designer is encouraged to select an actuator configuration with a higher stoke rating to provide some operating margin.

Resistance and Current Draw:

The actuator is a resistive device and will ship from the factory with a wire-to-wire resistance approximate (±10%) to the resistance value shown in the Product Specifications table. This value is based on an actuator in its home position, with 100cm of cable length, at 20°C [68°F]. This resistance will vary slightly during actuation and is influenced by the applied load. The actuators resistance can be altered, within a range, as a special order. Specifying a custom resistance value will affect the actuators nominal current draw and response time. The actuator behaves according to Ohm's law. Its nominal current draw can be calculated as:

$$I_{nominal}[A] = \frac{V_{actual}[V_{RMS}]}{R_{actuator}[\Omega]}$$

See the *Holding Current* term for more information.

Response Time:

The response time is the time required for an actuator at 20°C [68°F] to reach its rated stroke when its Operating Voltage is applied to it. Changes in actuator temperature, operating voltage, resistance, and power gain will affect the actuator's response time. After a warm-up phase the actuator will operate inside of a linear region, as illustrated in the Response Time figure.

Return Pressure:

During the return stroke a return pressure may be applied to the piston. To maximize actuator life this return pressure should be limited to the operating range illustrated in the Standard and Over-travel figures.

Return Time:

The actuator is a thermo-mechanical device that will reject heat to its environment during the return phase of its operating cycle. An actuator with oil coolant will return faster than one with air coolant as illustrated in the Return Time figure. The travel modifier selection, external return force, actuator temperature, and ambient temperature will also influence return time. Forced cooling may be used to lower the actuator temperature.

Special:

Typically left blank, a custom piston pump can be specified by selecting the *S – Custom* option. Details of the custom feature should be included in the order comments. Examples of a custom order include custom actuator resistance, custom piston ports, non-standard port locations, non-standard cable lengths, custom piston bore diameters, and the inclusion of a rod extension to permit mounting of a piston position sensor.

Travel Modifier:

A travel modifier option can be used to extend the stroke of the actuator past the standard nominal stroke. The *over-travel* option extends the available stroke of the actuator at the expense of its rated pressure.

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