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Pneumatic Tie Rod Style Cylinders

Series VE for Valve Actuation



Parker Schrader Bellows®

ENGINEERING YOUR SUCCESS.

In line with our policy of continuing product improvement, specifications and information contained in this catalog are subject to change.

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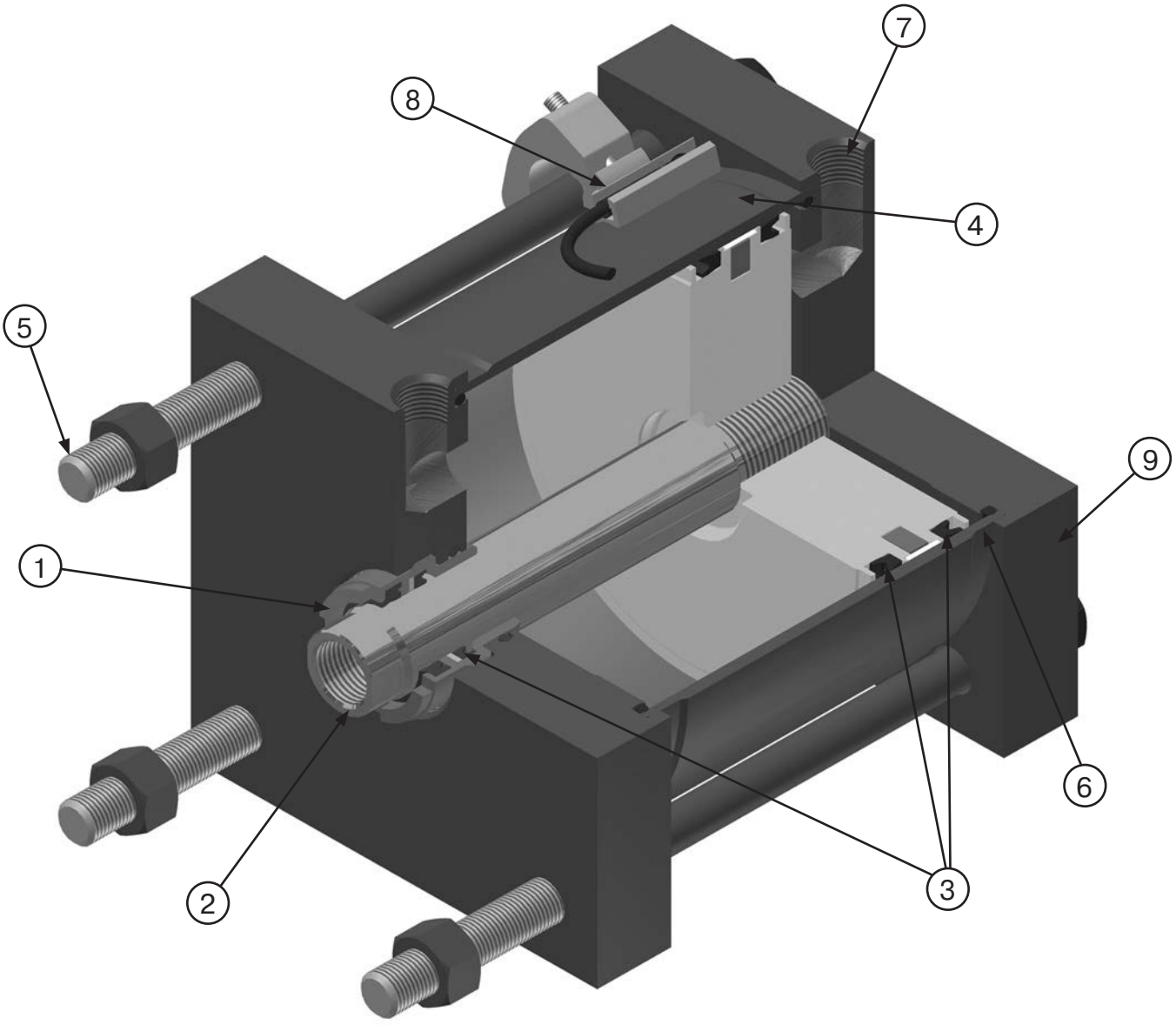
Offer of Sale

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Series VE
Pneumatic Tie Rod Cylinders



Series VE
Pneumatic Tie Rod Cylinders

Features Description

1. "Jewel" Rod Gland Assembly is externally removable without disassembling the cylinder. The "Jewel" rod gland incorporates a primary and secondary seal to assure leak-free service and longevity. The secondary seal acts as a rod wiper to prevent contamination from entering the cylinder. In addition, the secondary seal acts as a back up in the event of primary seal failure.

2. All piston rod assemblies utilize induction case hardened, medium carbon steel. All piston rods are hard chrome plated and polished to a 10 RMS surface finish. Each piston rod assembly comes standard with two wrench flats to facilitate rod end attachment.

3. Wear compensating lipseals are used throughout the rod gland and piston assembly to assure leak free operation and optimal performance over the life of the cylinder.

4. Cylinder body material options include steel with chrome plated I.D., aluminum, and composite to suit demanding application requirements.

5. All tie rods are made from high strength 100,000 psi minimum yield material.

6. Align-A-Groove design provides a 3/16" wide surface machined at each end of the cylinder body to assure tube to head alignment and leak free operation.

7. NPT ports are standard throughout the entire bore range.

8. Magnetic piston sensing option relays piston position throughout the entire stroke range. Solid state or reed switches are available with quick disconnect or flying lead terminations. This option is available on all bore sizes. Note: Wear band supplied with magnetic piston only.

9. Heads and caps are made from heavy duty steel and are machined to provide concentricity.

The Series VE cylinder provides OEM's and End Users a durable yet cost effective solution for knife gate valve actuation. Innovative options offer the ability to sense piston rod position, reduce weight, and increase corrosion resistance – resulting in improved system efficiency and reduced maintenance costs. Schrader Bellows' utilization of cutting edge design systems, proven seal technology, the highest quality materials, and stringent quality standards assure reliable service in the most demanding applications.

Standard Specifications

- Bore Diameters – 2.00" to 24.00"
- Maximum Working Pressure – 150 PSI Pneumatic
- Piston Rod Diameters – .625" to 3.500"
- Stroke Lengths – Bore Diameter Dependent
- Single and Double Piston Rod Construction Available
- Spring Extend or Retract
- Double Acting

In line with our policy of continuing product improvement, specifications in this catalog are subject to change.

Seal Class Table

Seal Classes	Typical Fluids	Temperature Range
1 - Standard Nitrile	Compressed Air (pneumatic)	-10°F (-23°C) to +165°F (+74°C)
4 - Optional (at extra cost) Low Temp Nitrile Seals	Compressed Air (pneumatic) Low Temperature	-50°F (-46°C) to +150°F (+66°C)
5 - Optional (at extra cost)[1] Fluorocarbon Seals	Compressed Air (pneumatic) High Temperature	-10°F (-23°C) to + 250°F (+121°C)

[1]Class 5 Seals are limited to bore diameters up to 14.00".

Cylinder Weight Chart

Bore Ø	Rod Ø	Weight at Zero Stroke with Steel Tube & Cast Iron Piston (lbs.)	Weight per in Stroke w/ Steel Tube & Cast Iron Piston (lbs.)	Weight at Zero Stroke with Aluminum Tube & Aluminum Piston (lbs.)	Weight per in Stroke w/ Aluminum Tube & Aluminum Piston (lbs.)	Weight at Zero Stroke with Composite Tube & Cast Iron Piston (lbs.)	Weight per in Stroke w/ Composite Tube & Cast Iron Piston (lbs.)
2.00	0.625	6.50	0.50	6.00	0.40	-	-
2.50	0.625	9.00	0.60	8.50	0.50	-	-
3.25	1.000	12.97	0.70	10.78	0.47	12.63	0.43
4.00	1.000	17.10	0.87	13.75	0.50	16.57	0.45
5.00	1.000	27.45	1.09	21.25	0.63	26.66	0.57
6.00	1.000	37.24	1.40	29.11	0.67	36.15	0.60
7.00	1.000	51.50	1.71	39.8	0.97	50.06	0.75
8.00	1.000	66.17	2.13	50.65	1.00	64.15	0.78
10.00	1.000	125.56	2.63	-	-	123.22	1.18
12.00	1.375	181.23	3.16	-	-	178.39	1.47
14.00	1.375	277.02	3.70	-	-	273.58	1.74
16.00	1.750	384.26	6.09	-	-	377.17	2.55
18.00	2.000	526.85	7.09	-	-	517.89	3.11
20.00	2.000	668.35	7.91	-	-	657.34	3.51
22.00	3.000	899.78	12.10	-	-	881.66	5.20
24.00	3.500	1295.20	14.99	-	-	1269.61	6.08

Cylinder Weight Chart

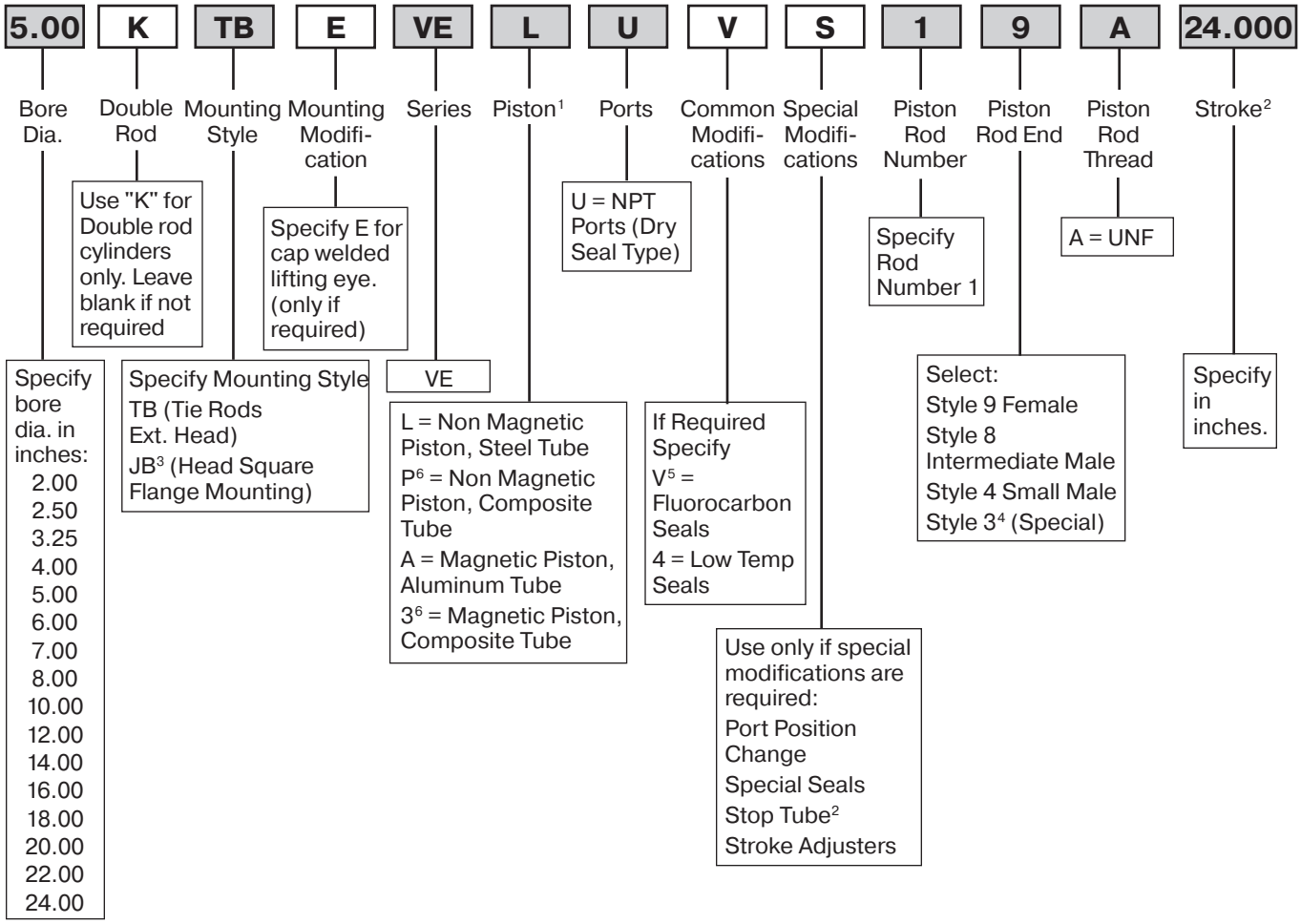
Bore Ø	Rod Ø	Weight at Zero Stroke with Composite Tube & Aluminum Piston (lbs.)	Weight per in Stroke w/ Composite Tube & Aluminum Piston (lbs.)
2.00	0.625	-	-
2.50	0.625	-	-
3.25	1.000	10.73	0.43
4.00	1.000	13.69	0.45
5.00	1.000	21.26	0.57
6.00	1.000	29.02	0.6
7.00	1.000	39.47	0.75
8.00	1.000	50.32	0.78
10.00	1.000	99.82	1.18
12.00	1.375	143.4	1.47
14.00	1.375	224.19	1.74
16.00	1.750	303.44	2.55
18.00	2.000	412.92	3.11
20.00	2.000	513.34	3.51
22.00	3.000	698.71	5.20
24.00	3.500	1031.15	6.08

Weight Adder Double Rod Cylinders

Bore Ø	Rod Ø	0" Stroke	Per Inch Adder
2.00	0.625	0.10	0.22
2.50	0.625	0.10	0.22
3.25	1.000	0.17	0.22
4.00	1.000	0.17	0.22
5.00	1.000	0.17	0.22
6.00	1.000	0.19	0.22
7.00	1.000	0.19	0.22
8.00	1.000	0.19	0.22
10.00	1.000	0.22	0.22
12.00	1.375	0.42	0.42
14.00	1.375	0.42	0.42
16.00	1.750	0.85	0.68
18.00	2.000	1.33	0.89
20.00	2.000	1.33	0.89
22.00	3.000	4.50	2.00
24.00	3.500	6.12	2.72

How to Order Series VE Air Cylinders for Valve Actuation

How to Order Code



Available Special Options

- Stainless Steel Piston Rods
- Spring Extend or Retract
- Double Rod End Style
- High Temperature Seals
- Water Service – consult factory for applications above 100°F (38°C)
- Lifting Eyes (welded on cap face)
- Stroke Adjuster (infrequent)
- Tie Rods Extended Head and Cap (Consult Factory)
- Low Temperature Nitrile Seals

Shaded boxes identify required model number fields.

[1] Lipseal Piston is Standard for all piston options.
The following lists standard tube and optional tube materials by bore diameter range with available piston codes:
L - Steel Tube is Standard for 2.00" - 8.00" bore (Non Magnetic Piston); Optional at extra cost 10.00" - 24.00"
P - Composite Tube is Optional for 3.25" - 8.00" (Non Magnetic Piston); Standard 10.00" - 24.00"
A - Aluminum Tube is Standard for 2.00" - 8.00" (Magnetic Piston); not available 10.00" - 24.00"
3 - Composite Tube is Optional for 3.25" - 8.00" (Magnetic Piston); Standard 10.00" - 24.00"

[2] If stop tube is required, please provide gross stroke length (gross stroke = stop tube + net stroke).

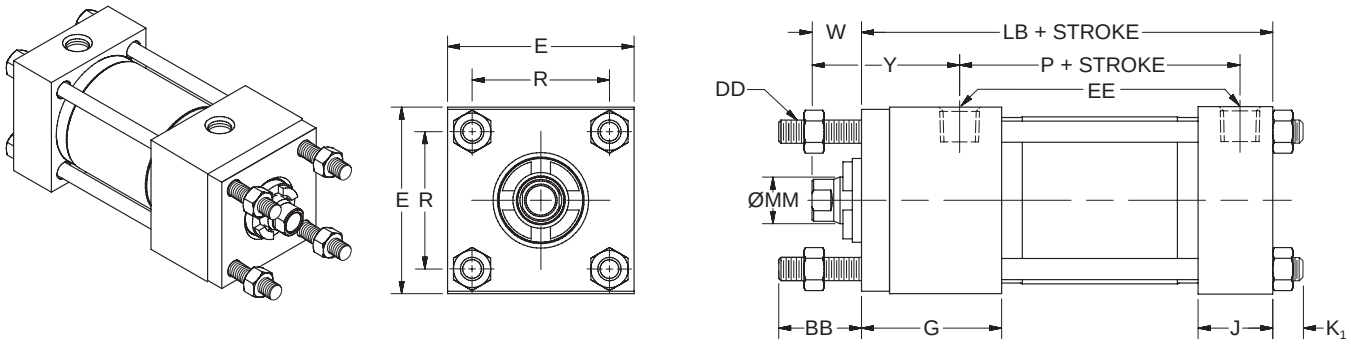
[3] JB Mount is available in bore diameters 7.00" through 20.00" only.

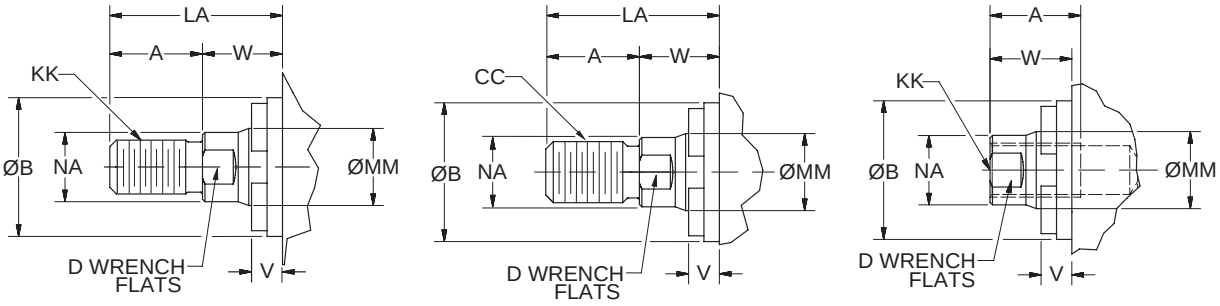
[4] Style #3 Rod End is deemed a "special". When ordering, please supply KK, A and W Dimensions.

[5] Class 5 Seals are limited to bore diameters up to 14.00".

[6] Composite tubing is not to be exposed to fluids which have a pH level lower than 3 or higher than 11.

Cylinder Dimensions 2.00" - 2.50"





Style 4 – Small Male **Style 8 – Intermediate Male** **Style 9 – Female**

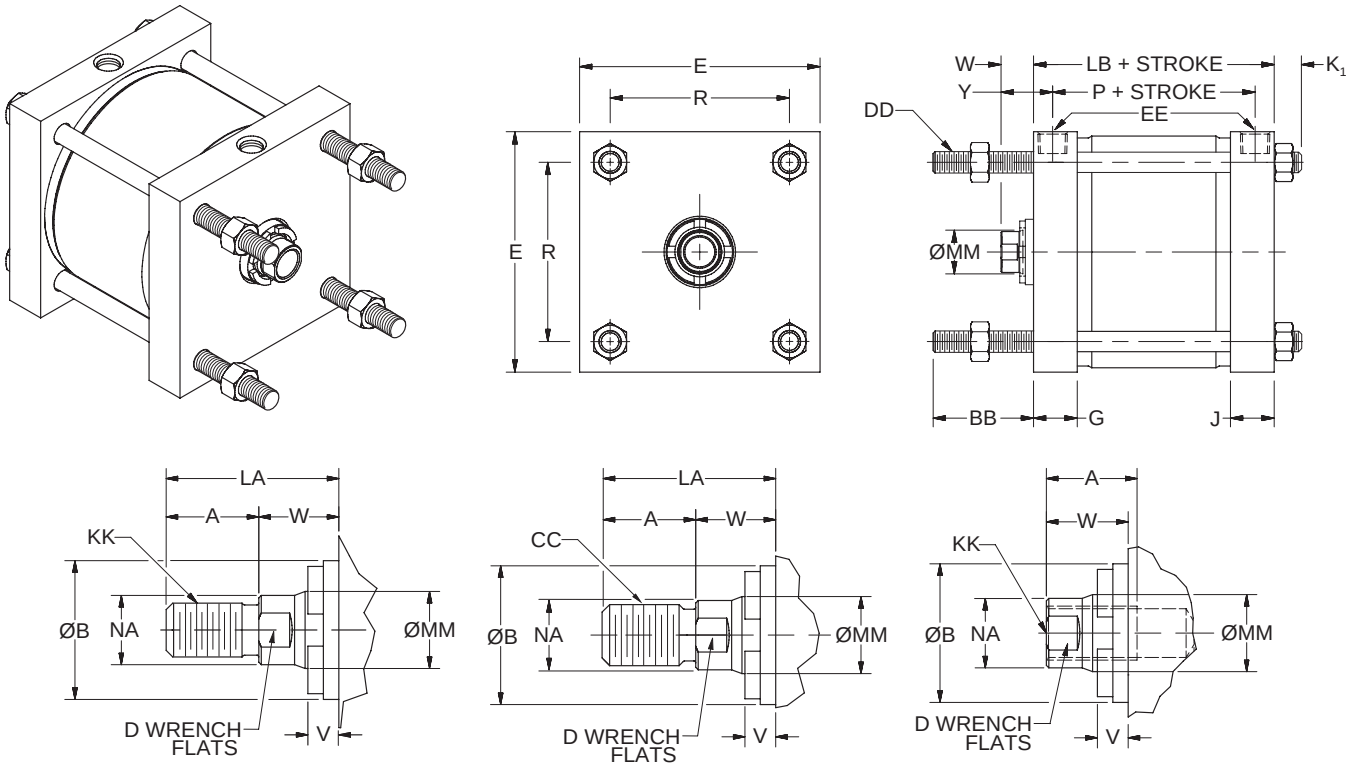
Cylinder Dimensional Table

Bore Ø	MM Rod Ø	BB	DD	E	EE (NPTF)	G	J	K_1	R	Y	Add Stroke		Max Stroke
											LB	P	
2.00	0.625	1.13	5/16-24	2.50	1/4	1.88	1.00	0.44	1.84	1.94	4.00	2.25	60"
2.50	0.625	1.13	5/16-24	3.00	1/4	1.88	1.00	0.44	2.19	1.94	4.13	2.38	50"

Rod End Dimensional Table

Bore Ø	MM Rod Ø	Style 4 KK	Style 8 CC	Style 9 KK	A	B Ø +.000 -.002	D	LA	NA	V	W
2.00	0.625	7/16-20	1/2-20	7/16-20	0.75	1.124	0.50	1.38	0.56	0.25	0.63
2.50	0.625	7/16-20	1/2-20	7/16-20	0.75	1.124	0.50	1.38	0.56	0.25	0.63

Cylinder Dimensions 3.25" - 8.00"



Style 4 – Small Male **Style 8 – Intermediate Male** **Style 9 – Female**

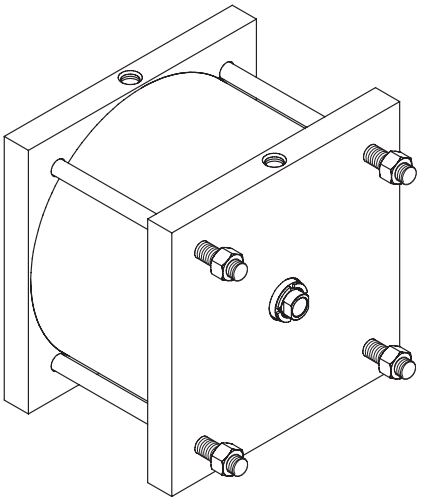
Cylinder Dimensional Table

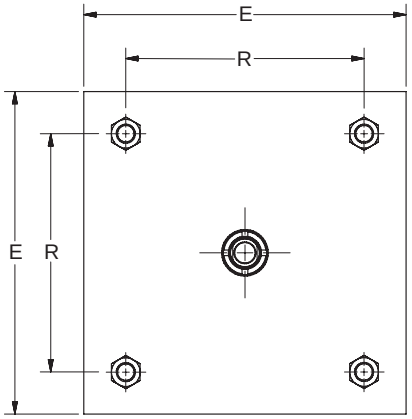
Bore Ø	MM Rod Ø	BB	DD	E	EE (NPTF)	G	J	K_1	R	Y	Add Stroke		Max Stroke
											LB	P	
3.25	1.000	1.38	3/8-24	4.00	1/4	1.00	1.00	0.50	2.76	1.19	3.25	2.38	100"
4.00	1.000	1.38	3/8-24	4.50	3/8	1.00	1.00	0.50	3.32	1.19	3.25	2.38	80"
5.00	1.000	1.81	1/2-20	5.50	3/8	1.00	1.00	0.63	4.10	1.19	3.50	2.63	65"
6.00	1.000	1.81	1/2-20	6.50	3/8	1.00	1.00	0.63	4.88	1.31	3.38	2.50	55"
7.00	1.000	2.00	5/8-18	7.50	3/8	1.00	1.00	0.75	5.73	1.31	3.50	2.63	45"
8.00	1.000	2.00	5/8-18	8.50	3/8	1.00	1.00	0.75	6.44	1.31	3.50	2.63	40"

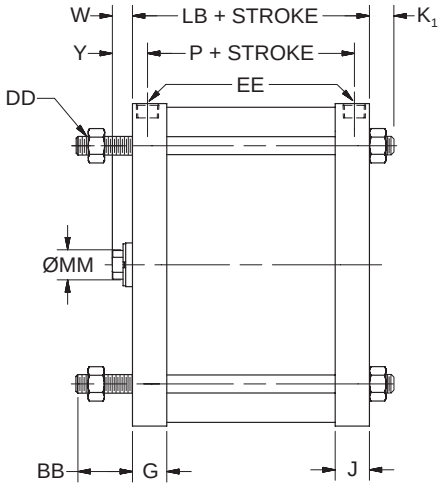
Rod End Dimensional Table

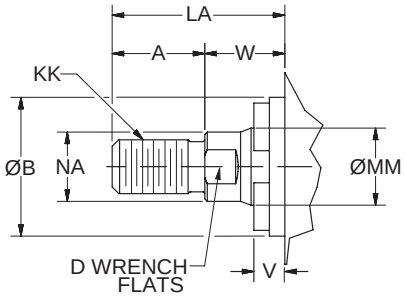
Bore Ø	MM Rod Ø	Style 4 KK	Style 8 CC	Style 9 KK	A	B Ø +.000 -.002	D	LA	NA	V	W
3.25	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	1.88	0.94	0.31	0.75
4.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	1.88	0.94	0.31	0.75
5.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	1.88	0.94	0.31	0.75
6.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88
7.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88
8.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88

Cylinder Dimensions 10.00" - 24.00"

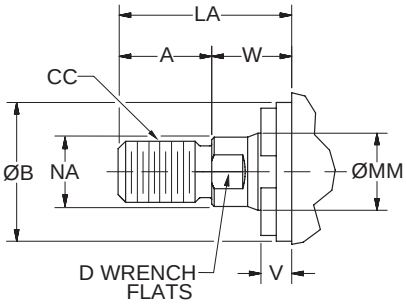




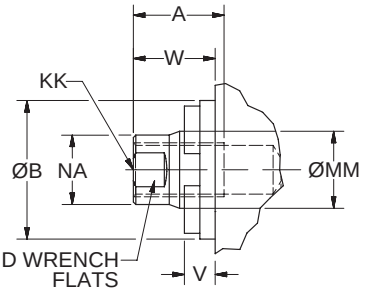




Style 4 – Small Male



Style 8 – Intermediate Male



Style 9 – Female

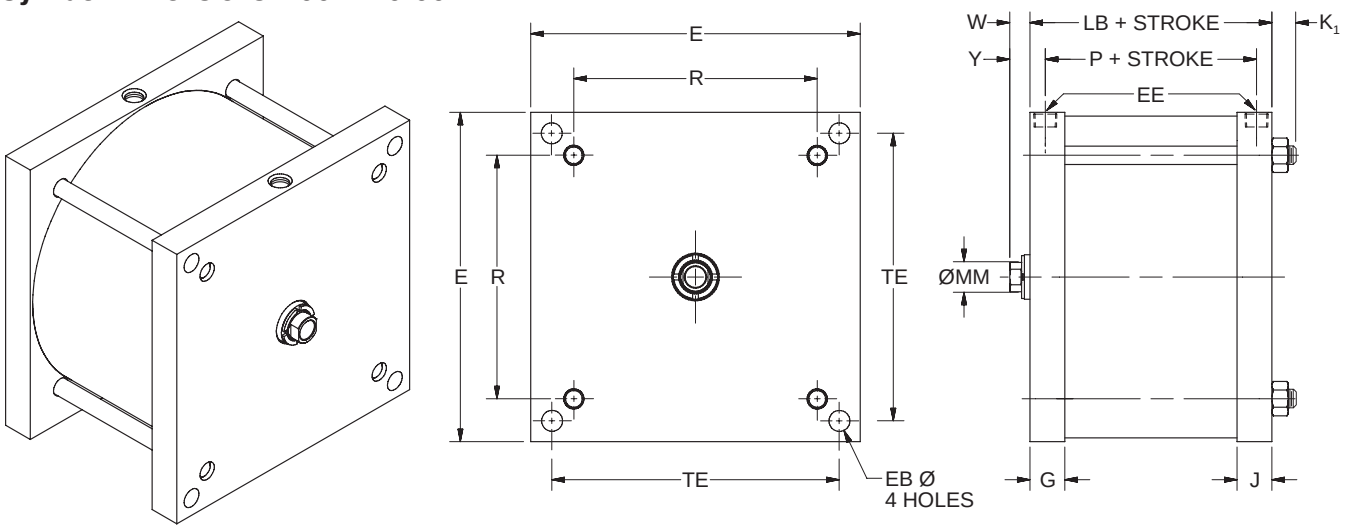
Cylinder Dimensional Table

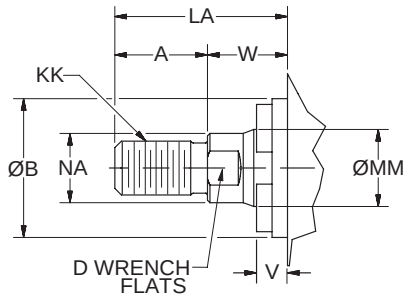
Bore Ø	MM Rod Ø	BB	DD	E	EE (NPTF)	G	J	K_1	R	Y	Add Stroke		Max Stroke
											LB	P	
10.00	1.000	2.25	3/4-16	10.63	1/2	1.31	1.31	0.88	7.92	1.56	4.25	3.13	30"
12.00	1.375	2.25	3/4-16	12.75	1/2	1.31	1.31	0.88	9.40	1.56	4.31	3.19	50"
14.00	1.375	2.50	7/8-14	14.75	3/4	1.56	1.56	1.00	10.90	1.69	4.88	3.50	40"
16.00	1.750	2.75	1-14	17.00	3/4	1.56	1.56	1.13	12.59	1.94	5.13	3.75	60"
18.00	2.000	3.25	1 1/8-12	19.00	3/4	1.69	1.69	1.25	14.14	2.19	5.63	4.25	70"
20.00	2.000	3.25	1 1/4-12	21.00	3/4	1.69	1.69	1.38	15.77	2.19	5.88	4.50	65"
22.00	3.000	3.50	1 1/4-12	23.00	3/4	1.94	1.94	1.38	17.18	3.06	6.50	4.88	60"
24.00	3.500	3.50	1 1/4-12	25.25	3/4	2.44	2.44	1.38	18.74	3.56	7.75	5.13	60"

Rod End Dimensional Table

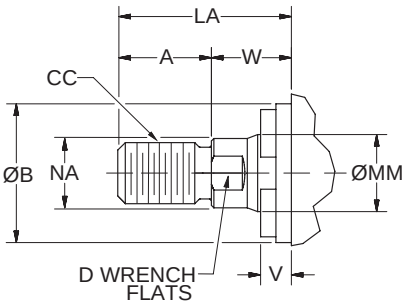
Bore Ø	MM Rod Ø	Style 4 KK	Style 8 CC	Style 9 KK	A	B Ø +.000 -.002	D	LA	NA	V	W
10.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.13	0.94	0.38	1.00
12.00	1.375	1-14	1 1/4-12	1-14	1.63	1.999	1.13	2.63	1.31	0.38	1.00
14.00	1.375	1-14	1 1/4-12	1-14	1.63	1.999	1.13	2.63	1.31	0.38	1.00
16.00	1.750	1 1/4-12	1 1/2-12	1-14	1.63	2.374	1.50	2.88	1.69	0.50	1.25
18.00	2.000	1 1/2-12	1 3/4-12	1 1/2-12	2.25	2.624	1.69	3.75	1.94	0.56	1.50
20.00	2.000	1 1/2-12	1 3/4-12	1 1/2-12	2.25	2.624	1.69	3.75	1.94	0.56	1.50
22.00	3.000	2 1/4-12	2 3/4-12	2 1/4-12	3.50	3.749	2.63	5.75	2.88	0.63	2.25
24.00	3.500	2 1/2-12	3 1/4-12	2 1/2-12	3.50	4.249	3.00	5.75	3.38	0.63	2.25

Cylinder Dimensions 7.00" - 20.00"

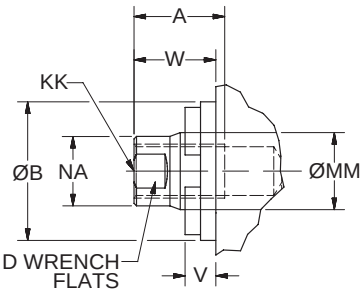




Style 4 – Small Male



Style 8 – Intermediate Male



Style 9 – Female

Cylinder Dimensional Table

Bore Ø	MM Rod Ø	E	EB	EE (NPTF)	G	J	K_1	R	TE	Y	Add Stroke		Max Stroke
											LB	P	
7.00	1.000	7.50	0.56	3/8	1.00	1.00	0.75	5.73	6.75	1.31	3.50	2.63	45"
8.00	1.000	8.50	0.69	3/8	1.00	1.00	0.75	6.44	7.57	1.31	3.50	2.63	40"
10.00	1.000	10.63	0.81	1/2	1.31	1.31	0.88	7.92	9.40	1.56	4.25	3.13	30"
12.00	1.375	12.75	0.81	1/2	1.31	1.31	0.88	9.40	11.10	1.56	4.31	3.19	50"
14.00	1.375	14.75	0.94	3/4	1.56	1.56	1.00	10.90	12.87	1.69	4.88	3.50	40"
16.00	1.750	17.00	1.06	3/4	1.56	1.56	1.13	12.59	14.85	1.94	5.13	3.75	60"
18.00	2.000	19.00	1.19	3/4	1.69	1.69	1.25	14.14	16.69	2.19	5.63	4.25	70"
20.00	2.000	21.00	1.31	3/4	1.69	1.69	1.38	15.77	18.46	2.19	5.88	4.50	65"

Rod End Dimensional Table

Bore Ø	MM Rod Ø	Style 4 KK	Style 8 CC	Style 9 KK	A	B Ø +.000 -.002	D	LA	NA	V	W
7.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88
8.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88
10.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.13	0.94	0.38	1.00
12.00	1.375	1-14	1 1/4-12	1-14	1.63	1.999	1.13	2.63	1.31	0.38	1.00
14.00	1.375	1-14	1 1/4-12	1-14	1.63	1.999	1.13	2.63	1.31	0.38	1.00
16.00	1.750	1 1/4-12	1 1/2-12	1-14	1.63	2.374	1.50	2.88	1.69	0.50	1.25
18.00	2.000	1 1/2-12	1 3/4-12	1 1/2-12	2.25	2.624	1.69	3.75	1.94	0.56	1.50
20.00	2.000	1 1/2-12	1 3/4-12	1 1/2-12	2.25	2.624	1.69	3.75	1.94	0.56	1.50

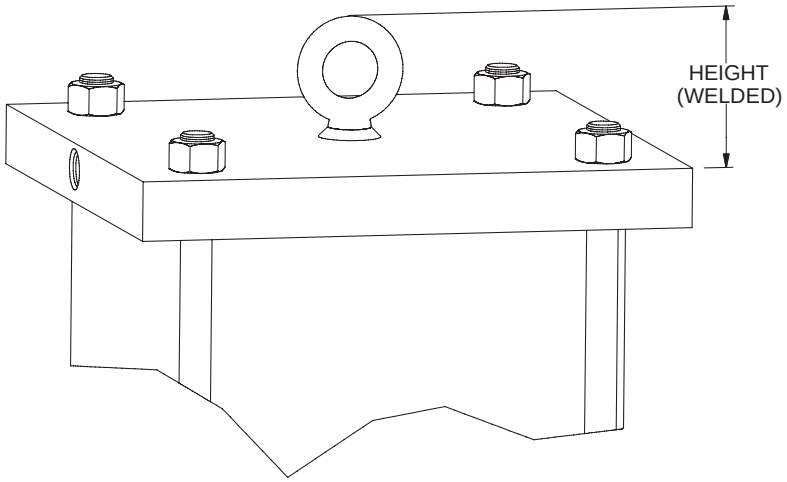


Table 1 – Lifting Eyes

Bore Ø	Welded Lifting Eye Height	Welded Lifting Eye Capacity (lbs. per eye)
2.00	1.63	500
2.50	1.63	500
3.25	3.19	2000
4.00	3.19	2000
5.00	3.19	4000
6.00	3.19	4000
7.00	3.19	4000
8.00	3.19	4000
10.00	3.19	4000
12.00	3.19	4000
14.00	3.19	4000
16.00	3.19	4000
18.00	3.19	4000
20.00	3.19	4000
22.00	3.19	4000
24.00	3.19	4000

Table 2 – Tie Rod Torque

Bore Ø	Tie Rod Size (inches)	Tie Rod Nut Torque Steel Tube		Tie Rod Nut Torque Aluminum Tube		Tie Rod Nut Torque Composite Tube	
		ft. lbs.	N-m	ft. lbs.	N-m	ft. lbs.	N-m
2.00	5/16-24	12	16	6	8	-	-
2.50	5/16-24	12	16	6	8	-	-
3.25	3/8-24	25	34	18	24	13	17
4.00	3/8-24	25	34	18	24	13	17
5.00	1/2-20	60	81	37	50	30	41
6.00	1/2-20	60	81	37	50	30	41
7.00	5/8-18	90	122	60	81	55	75
8.00	5/8-18	110	149	60	81	55	75
10.00	3/4-16	148	201	-	-	78	106
12.00	3/4-16	172	233	-	-	78	106
14.00	7/8-14	275	373	-	-	118	160
16.00	1-14	390	529	-	-	250	339
18.00	1 1/8-12	540	732	-	-	350	475
20.00	1 1/4-12	745	1010	-	-	450	610
22.00	1 1/4-12	745	1010	-	-	500	678
24.00	1 1/4-12	745	1010	-	-	500	678

Global Position Sensing Switches



- Low Profile Keeps Switch Within Cylinder Envelope
- Both Reed and Solid State Switch Versions
- Switches Available World-Wide
- Solid State Switches use GMR Technology
- 3 Different Connection Styles
- Allow Position Sensing Anywhere Along Cylinder Stroke
- CE Approved

Global Drop-In Solid State Switches

Wiring	PNP Switch	NPN Switch	PNP Switch ATEX Certified	PNP Switch High Temperature
3m Flying Leads	P8SAGPFAX	P8SAGNFAX	P8SAGPFAXS	P8S-GPFLH[1]
10m Flying Leads	P8SAGPFDX	P8SAGNFDX	N/A	N/A
0.3m Lead with 8mm Connector	P8SAGPCHX	P8SAGNCHX		

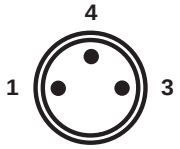
[1] High Temperature switch is not UL Listed.

Specifications

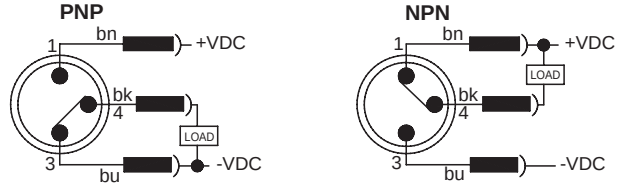
Switch Classification	Standard PNP or NPN	ATEX Certified PNP	High Temperature PNP
Type	Electronic	Electronic	Electronic
Output Function	Normally Open	Normally Open	Normally Open
Switch Output	PNP/NPN	PNP	PNP
Operating Voltage	10 - 30VDC	10 - 30VDC	10 - 30VDC
Continuous Current	100 mA max.	50 mA max.	200 mA max.
Magnetic Field Sensitivity	2.6 - 3.3mT	2.8 mT	25 Gauss
Switching Frequency	1 kHz	1 kHz	10 kHz
Power Consumption	8 mA max.	10 mA max.	15 mA max.
Voltage Drop	2 VDC max.	2.2 VDC max.	3.1 VDC max.
Ripple	10% of Operating Voltage	10% of Operating Voltage	15% of Operating Voltage
Hysteresis	1.5 mm max.	1.5 mm max.	1.5 mm max.
Repeatability	0.1 mm max.	0.1 mm max.	0.1 mm max.
EMC	EN 60 947-5-2	EN 60 947-5-2	EN 60 947-5-2
Short-circuit Protection	Yes	Yes	Yes
Power-up Pulse Suppression	Yes	Yes	Yes
Reverse Polarity Protection	Yes	Yes	Yes
Enclosure Rating	IP67	IP67	IP67
Shock and Vibration Stress	30g, 11 ms, 10 to 55Hz, 1 mm	30g, 11 ms, 10 to 55Hz, 1 mm	30g, 11 ms, 10 to 55Hz, 1 mm
Operating Temperature Range	-30°C to +80°C (-22°F to +176°F)	-20°C to +50°C (-4°F to +122°F)	-25°C to +105°C (-13°F to +221°F)
Housing Material	PA 12 Black	PA 12 Black	Aluminum
Connector Cable	PUR	PUR	PUR
Connector	PUR	–	–
Approval for ATEX	–	3D/3G	–

Global solid state switch outputs may be influenced by an external magnetic field. Care must be taken to avoid external magnetic field exposure.

Solid State Switch – Wiring Connection
Flying Lead or 8 mm Connector



Pin	Wire	Function
1	Brown	Operating Voltage (+VDC)
4	Black	Output signal (N.O.)
3	Blue	-VDC

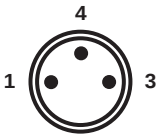


Global Drop-In Reed Switches

Wiring	Reed Switch
3m Flying Leads	P8SAGRFAX
10m Flying Leads	P8SAGEFRX
0.3m Lead with 8mm Connector	P8SAGRCHX

Reed Switch – Wiring Connection

Flying Lead or 8 mm Connector



Pin	Wire	Function
1	Brown	Operating Voltage (+V)
4	Black	Not Used
3	Blue	Output Signal (-V or Ground)

Specifications

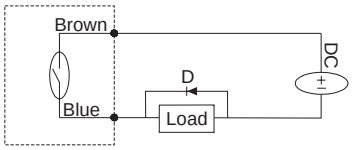
Type ..... 2-Wire Reed
Output Function ..... Normally Open
Operating Voltage ..... 5 - 30 VDC
Switching Power..... 6 W
Continuous Current ..... 100 mA max.
Response Sensitivity ..... 2.1 - 3.4mT
Switching Frequency ..... 400 Hz
Voltage Drop ..... 3.5 VDC max.
Ripple ..... 10% of Operating Voltage
Hysteresis..... 1.5 mm max.
Repeatability..... 0.2 mm max.
EMC ..... EN 60 947-5-2
Reverse Polarity Protection..... No
Enclosure Rating ..... IP 67
Shock and Vibration Stress..... 30g, 11 ms, 10 to 55 Hz, 1 mm
Operating Temperature Range... -30°C to +80°C (-22°F to 176°F)
Housing Material ..... PA 12 Black
Connector Cable ..... PUR
Connector ..... PUR

Global Reed Switch output may be influenced by external magnetic fields. Care must be taken to avoid external magnetic field exposure.

Circuit for Switching Contact Protection (Inductive Loads)

(Required for proper operation 24V DC)

Put Diode parallel to loads following polarity as shown below.



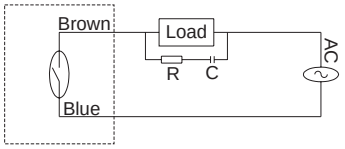
D: Diode: select a Diode with the breakdown voltage and current rating according to the load.

Typical Example—100 Volt, 1 Amp Diode
CR: Relay coil (under 0.5W coil rating)

(Recommended for longer life 120 VAC)

Put a resistor and capacitor in parallel with the load. Select the resistor and capacitor according to the load.

Typical Example:
CR: Relay coil (under 2W coil rating)
R: Resistor 1 K Ω - 5 K Ω, 1/4 W
C: Capacitor 0.1 Ω F, 600 V

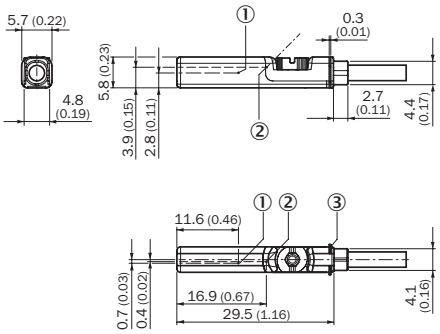


⚠Caution

– Use an ampmeter to test reed switch current. Testing devices such as incandescent light bulbs may subject the reed sensor to high in-rush loads.
– **NOTE:** When checking an unpowered reed switch for continuity with a digital ohmmeter the resistance reading will change from infinity to a very large resistance (2 M ohm) when the sensor is activated. This is due to the presence of a diode in the reed switch.
– Anti-magnetic shielding is recommended for reed switches exposed to high external RF or magnetic fields.
– The magnetic field strength of the piston magnet is designed to operate with our switches. Other manufacturers' switches may not operate correctly in conjunction with these magnets.
– Use relay coils for reed switch contact protection.
– The operation of some 120 VAC PLC's (especially some older Allen-Bradley PLC's) can overload the reed switch. The switch may fail to release after the piston magnet has passed. This problem may be corrected by the placement of a 700 to 1K OHM resistor between the switch and the PLC input terminal. Consult the manufacturer of the PLC for appropriate circuit.
– Switches with long wire leads (greater than 15 feet) can cause capacitance build-up and sticking will result. Attach a resistor in series with the reed switches (the resistor should be installed as close as possible to the switches). The resistor should be selected such that R (ohms) >E/0.3.
– Global reed switch outputs may be influenced by an external magnetic field. Care must be taken to avoid external magnetic field exposure.

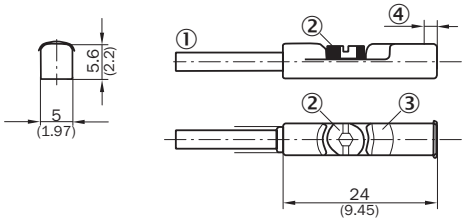
Dimensions in mm (inch)

PNP, NPN Output 10 to 30 V DC



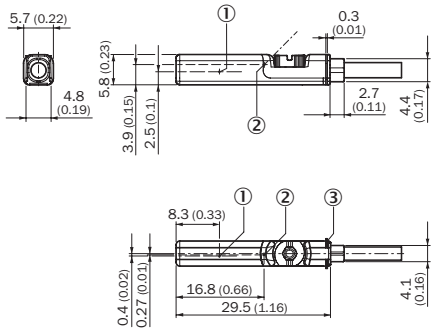
① Position sensor element
② Indication LED
③ Retaining ribs

NAMUR ATEX 1G, 1D, ATEX 3G, 3D



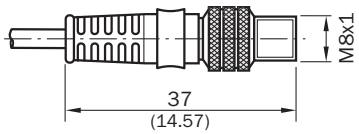
① Connection
② Fixing screw
③ Indication LED
④ Position of sensor element; short overrun distance: 2 mm; long overrun distance: 1.7 mm

Reed Output 5 to 30 V AC/DC



① Position sensor element
② Indication LED
③ Retaining ribs

Connector M8R



8mm Cordset for Global Switches

A female connector is available for all switches with the male 8mm quick connect option. The cordsets are available with a right angle or straight connector. Cordset part numbers are listed below.

8mm Cordset

Cable Length	Threaded Connector	Snap On Connector
5 meters	086620T005	086620S005
2 meters	086620T002	086620S002

Cordset Specifications

Connector ..... Oil resistant polyurethane body material, PA 6 (Nylon) contact carrier, spacings to VDE 0110 Group C, (150 AC/DC)

Contacts ..... Gold plated beryllium copper, machined from solid stock

Coupling Method ..... Snap-Lock or chrome plated brass nut

Cord Construction ..... Oil resistant black PUR jacket, non-wicking, non-hygroscopic, 300V. Cable end is stripped and tinned.

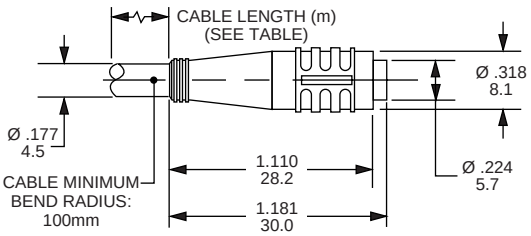
Conductors ..... Extra high flex stranding, PVC insulation

Temperature ..... -40 to 194°F (-40 to 90°C)

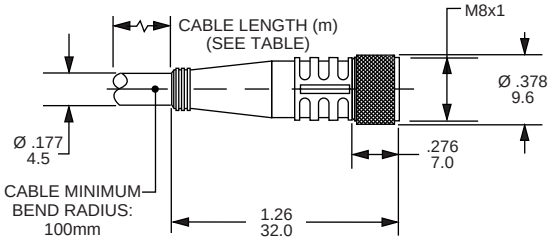
Protection ..... NEMA 1, 3, 4, 6P and IEC 1P67

Cable Length ..... 6.56 ft (2m) or 16.4 ft (5m)

8mm Snap-On Straight Connector



8mm Threaded Straight Connector



Safety Guide for Selecting and Using Hydraulic, Pneumatic Cylinders and Their Accessories

WARNING: ⚠ FAILURE OF THE CYLINDER, ITS PARTS, ITS MOUNTING, ITS CONNECTIONS TO OTHER OBJECTS, OR ITS CONTROLS CAN RESULT IN:

- **Unanticipated or uncontrolled movement of the cylinder or objects connected to it.**
- **Falling of the cylinder or objects held up by it.**
- **Fluid escaping from the cylinder, potentially at high velocity.**

THESE EVENTS COULD CAUSE DEATH OR PERSONAL INJURY BY, FOR EXAMPLE, PERSONS FALLING FROM HIGH LOCATIONS, BEING CRUSHED OR STRUCK BY HEAVY OR FAST MOVING OBJECTS, BEING PUSHED INTO DANGEROUS EQUIPMENT OR SITUATIONS, OR SLIPPING ON ESCAPED FLUID.

Before selecting or using Parker Hannifin Corporation (the Company) cylinders or related accessories, it is important that you read, understand and follow the following safety information. Training is advised before selecting and using the Company's products.

1.0 General Instructions

1.1 Scope – This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) cylinder products. This safety guide is a supplement to and is to be used with the specific Company publications for the specific cylinder products that are being considered for use.

1.2 Fail Safe – Cylinder products can and do fail without warning for many reasons. All systems and equipment should be designed in a fail-safe mode so that if the failure of a cylinder product occurs people and property won't be endangered.

1.3 Distribution – Provide a free copy of this safety guide to each person responsible for selecting or using cylinder products. Do not select or use the Company's cylinders without thoroughly reading and understanding this safety guide as well as the specific Company publications for the products considered or selected.

1.4 User Responsibility – Due to very wide variety of cylinder applications and cylinder operating conditions, the Company does not warrant that any particular cylinder is suitable for any specific application. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The hydraulic and pneumatic cylinders outlined in this catalog are designed to the Company's design guidelines and do not necessarily meet the design guideline of other agencies such as American Bureau of Shipping, ASME Pressure Vessel Code etc. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the cylinders and related accessories.
- Determining if the cylinders are required to meet specific design requirements as required by the Agency(s) or industry standards covering the design of the user's equipment.
- Assuring that the user's requirements are met, OSHA requirements are met, and safety guidelines from the applicable agencies such as but not limited to ANSI are followed and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the cylinders are used.

1.5 Additional Questions – Call the appropriate Company technical service department if you have any questions or require any additional information. See the Company publication for the product being considered or used, or call 1-847-298-2400, or go to www.parker.com, for telephone numbers of the appropriate technical service department.

2.0 Cylinder and Accessories Selection

2.1 Seals – Part of the process of selecting a cylinder is the selection of seal compounds. Before making this selection, consult the "seal information page(s)" of the publication for the series of cylinders of interest.

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod wiper and or the primary seal and must be taken into account when selecting and specifying seal compounds.

Dynamic seals will wear. The rate of wear will depend on many operating factors. Wear can be rapid if a cylinder is mis-aligned or if the cylinder has been improperly serviced. The user must take seal wear into consideration in the application of cylinders.

2.2 Piston Rods – Possible consequences of piston rod failure or separation of the piston rod from the piston include, but are not limited to are:

- Piston rod and or attached load thrown off at high speed.
- High velocity fluid discharge.
- Piston rod extending when pressure is applied in the piston retract mode.

Piston rods or machine members attached to the piston rod may move suddenly and without warning as a consequence of other conditions occurring to the machine such as, but not limited to:

- Unexpected detachment of the machine member from the piston rod.
- Failure of the pressurized fluid delivery system (hoses, fittings, valves, pumps, compressors) which maintain cylinder position.
- Catastrophic cylinder seal failure leading to sudden loss of pressurized fluid.
- Failure of the machine control system.

Follow the recommendations of the "Piston Rod Selection Chart and Data" in the publication for the series of cylinders of interest. The suggested piston rod diameter in these charts must be followed in order to avoid piston rod buckling.

Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod to fail. If these types of additional loads are expected to be imposed on the piston rod, their magnitude should be made known to our engineering department.

The cylinder user should always make sure that the piston rod is securely attached to the machine member.

On occasion cylinders are ordered with double rods (a piston rod extended from both ends of the cylinder). In some cases a stop is threaded on to one of the piston rods and used as an external stroke adjuster. On occasions spacers are attached to the machine member connected to the piston rod and also used as a stroke adjuster. In both cases the stops will create a pinch point and the user should consider appropriate use of guards. If these
external stops are not perpendicular to the mating contact surface, or if debris is trapped between the contact surfaces, a bending moment will be placed on the piston rod, which can lead to piston rod failure. An external stop will also negate the effect of cushioning and will subject the piston rod to impact loading. Those two (2) conditions can cause piston rod failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

The piston rod to piston and the stud to piston rod threaded connections are secured with an anaerobic adhesive. The strength of the adhesive decreases with increasing temperature. Cylinders which can be exposed to temperatures above +250°F (+121°C) are to be ordered with a non studded piston rod and a pinned piston to rod joint.

2.3 Cushions – Cushions should be considered for cylinder applications when the piston velocity is expected to be over 4 inches/second.

Cylinder cushions are normally designed to absorb the energy of a linear applied load. A rotating mass has considerably more energy than the same mass moving in a linear mode. Cushioning for a rotating mass application should be reviewed by our engineering department.

2.4 Cylinder Mountings – Some cylinder mounting configurations may have certain limitations such as but not limited to minimum stroke for side or foot mounting cylinders or pressure de-ratings for certain mounts. Carefully review the catalog for these types of restrictions.

Always mount cylinders using the largest possible high tensile alloy steel socket head cap screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

2.5 Port Fittings – Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at piston rod end.

The rod end pressure is approximately equal to:

$$\frac{\text{operating pressure x effective cap end area}}{\text{effective rod end piston area}}$$

Contact your connector supplier for the pressure rating of individual connectors.

3.0 Cylinder and Accessories Installation and Mounting

3.1 Installation

3.1.1 – Cleanliness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.

3.1.2 – Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.

3.1.3 – Proper alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Improper alignment will result in excessive rod gland and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

3.1.4 – Sometimes it may be necessary to rotate the piston rod in order to thread the piston rod into the machine member. This operation must always be done with zero pressure being applied to either side of the piston. Failure to follow this procedure may result in loosening the piston to rod-threaded connection. In some rare cases the turning of the piston rod may rotate a threaded piston rod gland and loosen it from the
cylinder head. Confirm that this condition is not occurring. If it does, re-tighten the piston rod gland firmly against the cylinder head.

For double rod cylinders it is also important that when attaching or detaching the piston rod from the machine member that the torque be applied to the piston rod end of the cylinder that is directly attaching to the machine member with the opposite end unrestrained. If the design of the machine is such that only the rod end of the cylinder opposite to where the rod attaches to the machine member can be rotated, consult the factory for further instructions.

3.2 Mounting Recommendations

3.2.1 – Always mount cylinders using the largest possible high tensile alloy steel socket head screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

3.2.2 – Side-Mounted Cylinders – In addition to the mounting bolts, cylinders of this type should be equipped with thrust keys or dowel pins located so as to resist the major load.

3.2.3 – Tie Rod Mounting – Cylinders with tie rod mountings are recommended for applications where mounting space is limited. The standard tie rod extension is shown as BB in dimension tables. Longer or shorter extensions can be supplied. Nuts used for this mounting style should be torqued to the same value as the tie rods for that bore size.

3.2.4 – Flange Mount Cylinders – The controlled diameter of the rod gland extension on head end flange mount cylinders can be used as a pilot to locate the cylinders in relation to the machine. After alignment has been obtained, the flanges may be drilled for pins or dowels to prevent shifting.

3.2.5 – Trunnion Mountings – Cylinders require lubricated bearing blocks with minimum bearing clearances. Bearing blocks should be carefully aligned and rigidly mounted so the trunnions will not be subjected to bending moments. The rod end should also be pivoted with the pivot pin in line and parallel to axis of the trunnion pins.

3.2.6 – Clevis Mountings – Cylinders should be pivoted at both ends with centerline of pins parallel to each other. After cylinder is mounted, be sure to check to assure that the cylinder is free to swing through its working arc without interference from other machine parts.

4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement

4.1 Storage – At times cylinders are delivered before a customer is ready to install them and must be stored for a period of time. When storage is required the following procedures are recommended.

4.1.1 – Store the cylinders in an indoor area which has a dry, clean and noncorrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.

4.1.2 – Whenever possible cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder. This will also minimize seal damage.

4.1.3 – Port protector plugs should be left in the cylinder until the time of installation.

4.1.4 – If a cylinder is stored full of hydraulic fluid, expansion of the fluid due to temperature changes must be considered. Installing a check valve with free flow out of the cylinder is one method.

4.1.5 – When cylinders are mounted on equipment that is stored outside for extended periods, exposed unpainted surfaces, e.g. piston rod, must be coated with a rust-inhibiting compound to prevent corrosion.

4.2 Cylinder Trouble Shooting

4.2.1 – **External Leakage**

4.2.1.1 – Rod seal leakage can generally be traced to worn or damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

Rod seal leakage could also be traced to gland wear. If clearance is excessive, replace rod bushing and seal. Rod seal leakage can also be traced to seal deterioration. If seals are soft or gummy or brittle, check compatibility of seal material with lubricant used if air cylinder, or operating fluid if hydraulic cylinder. Replace with seal material, which is compatible with these fluids. If the seals are hard or have lost elasticity, it is usually due to exposure to temperatures in excess of 165˚F. (+74˚C). Shield the cylinder from the heat source to limit temperature to 350˚F. (+177˚C.) and replace with fluorocarbon seals.

4.2.1.2 – Cylinder body seal leak can generally be traced to loose tie rods. Torque the tie rods to manufacturer's recommendation for that bore size.

Excessive pressure can also result in cylinder body seal leak. Determine maximum pressure to rated limits. Replace seals and retorque tie rods as in paragraph above. Excessive pressure can also result in cylinder body seal leak. Determine if the pressure rating of the cylinder has been exceeded. If so, bring the operating pressure down to the rating of the cylinder and have the tie rods replaced.

Pinched or extruded cylinder body seal will also result in a leak. Replace cylinder body seal and retorque as in paragraph above.

Cylinder body seal leakage due to loss of radial squeeze which shows up in the form of flat spots or due to wear on the O.D. or I.D. – Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

4.2.2 – **Internal Leakage**

4.2.2.1 – Piston seal leak (by-pass) 1 to 3 cubic inches per minute leakage is considered normal for piston ring construction. Virtually no static leak with lipseal type seals on piston should be expected. Piston seal wear is a usual cause of piston seal leakage. Replace seals as required.

4.2.2.2 – With lipseal type piston seals excessive back pressure due to over-adjustment of speed control valves could be a direct cause of rapid seal wear. Contamination in a hydraulic system can result in a scored cylinder bore, resulting in rapid seal wear. In either case, replace piston seals as required.

4.2.2.3 – What appears to be piston seal leak, evidenced by the fact that the cylinder drifts, is not always traceable to the piston. To make sure, it is suggested that one side of the cylinder piston be pressurized and the fluid line at the opposite port be disconnected. Observe leakage. If none is evident, seek the cause of cylinder drift in other component parts in the circuit.

4.2.3 – **Cylinder Fails to Move the Load**

4.2.3.1 – Pneumatic or hydraulic pressure is too low. Check the pressure at the cylinder to make sure it is to circuit requirements.

4.2.3.2 – Piston Seal Leak – Operate the valve to cycle the cylinder and observe fluid flow at valve exhaust ports at end of cylinder stroke. Replace piston seals if flow is excessive.

4.2.3.3 – Cylinder is undersized for the load – Replace cylinder with one of a larger bore size.

4.3 Erratic or Chatter Operation

4.3.1 – Excessive friction at rod gland or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

4.3.2 – Cylinder sized too close to load requirements – Reduce load or install larger cylinder.

4.3.3 – Erratic operation could be traced to the difference between static and kinetic friction. Install speed control valves to provide a back pressure to control the stroke.

4.4 Cylinder Modifications, Repairs, or Failed Component – Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done at company locations or by the Company's certified facilities. The Hydraulic Actuator Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, tie rod, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided with the seal kits.

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods, services or work described will be referred to as "Products".

1. Terms. All sales of Products by Seller will be governed by, and are expressly conditioned upon Buyer's assent to, these Terms. These Terms are incorporated into any Quote provided by Seller to Buyer. Buyer's order for any Products whether communicated to Seller verbally, in writing, by electronic data interface or other electronic commerce, shall constitute acceptance of these Terms. Seller objects to any contrary or additional terms or conditions of Buyer. Reference in Seller's order acknowledgement to Buyer's purchase order or purchase order number shall in no way constitute an acceptance of any of Buyer's terms or conditions of purchase. Any Quote made by Seller to Buyer shall be considered a firm and definite offer and shall not be deemed to be otherwise despite any language on the face of the Quote. Seller reserves all rights to accept or reject any purported acceptance by Buyer to Seller's Quote if such purported acceptance attempts to vary the terms of the Quote. If Seller ships Products after Buyer issues an acceptance to the Quote, any additional or different terms proposed by Buyer will not become part of the parties' business relationship unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence. If the transaction proceeds without such agreement on the part of Seller, the business relationship will be governed solely by these Terms and the specific terms in Seller's Quote.

2. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices for any reason and at any time by giving ten (10) days prior written notice. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Under any circumstances, Buyer may not withhold or suspend payment of any amounts due and payable as a deduction, set-off or recoupment of any amount, claim or dispute with Seller. Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law. Seller reserves the right to require advance payment or provision of securities for first and subsequent deliveries if there is any doubt, in Seller's sole determination, regarding the Buyer's creditworthiness or for other business reasons. If the requested advance payment or securities are not provided to Seller's satisfaction, Seller reserves the right to suspend performance or reject the purchase order, in whole or in part, without prejudice to Seller's other rights or remedies, including the right to full compensation. Seller may revoke or shorten any payment periods previously granted in Seller's sole determination. The rights and remedies herein reserved to Seller are cumulative and in addition to any other or further rights and remedies available at law or in equity. No waiver by Seller of any breach by Buyer of any provision of these terms will constitute a waiver by Seller of any other breach of such provision.

3. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and Seller is not responsible for damages or additional costs resulting from any delay. All deliveries are subject to our ability to procure materials from our suppliers. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

4. Warranty. The warranty for the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of eighteen (18) months from the date of delivery or 2,000 hours of use, whichever occurs first; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the date of completion of the Services; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **EXEMPTION CLAUSE; DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR FAULT-TOLERANT, OR THAT BUYER'S USE THEREOF WILL BE SECURE OR UNINTERRUPTED, UNLESS OTHERWISE AUTHORIZED IN WRITING BY SELLER, THE SOFTWARE SHALL NOT BE USED IN CONNECTION WITH HAZARDOUS OR HIGH-RISK ACTIVITIES OR ENVIRONMENTS. EXCEPT AS EXPRESSLY STATED HEREIN, ALL PRODUCTS ARE PROVIDED "AS IS".**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

6. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCTS, RE-PERFORM THE SERVICES, OR REFUND THE PURCHASE PRICE PAID WITHIN A REASONABLE PERIOD OF TIME. IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING ANY LOSS OF REVENUE OR PROFITS, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCTS.

7. Confidential Information. Buyer acknowledges and agrees that Confidential Information has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller and shall return all such Confidential Information to Seller within thirty (30) days upon request.

8. Loss to Buyer's Property. Buyer's Property will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Also, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

9. Special Tooling. Seller may impose a tooling charge for any Special Tooling. Special Tooling shall be and remain Seller's property. In no event will Buyer acquire any interest in the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any Special Tooling or other property owned by Seller in its sole determination at any time.

10. Security Interest. To secure payment of all sums due from Buyer, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect Seller's security interest.

11. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

12. Use of Products, Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Quote or the Products. If Buyer uses or resells the Products in any way prohibited by Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Further, Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, intellectual property infringement or any other claim, arising out of or in connection with: (a) improper selection, design, specification, application, or any misuse of Products; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of Buyer's Property; (d) damage to the Products from an external cause, repair or attempted repair by anyone other than Seller, failure to follow instructions, guides and specifications provided by Seller, use with goods not provided by Seller, or opening, modifying, deconstructing, tampering with or repackaging the Products; or (e) Buyer's failure to comply with these Terms, including any legal or administrative proceedings, collection efforts, or other actions arising from or relating to such failure to comply. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

13. Cancellations and Changes. Buyer may not cancel or modify, including but not limited to movement of delivery dates for the Products, any order for any reason except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

14. Assignment. Buyer may not assign its rights or obligations without the prior written consent of Seller.

15. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of any events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, cyber related disruptions, cyber-attacks, ransomware sabotage, delays or failures in delivery from carriers or suppliers, shortages of materials, sudden increases in the price of raw material or components, shutdowns or slowdowns affecting the supply of raw materials or components, or the transportation thereof, oil shortages or oil price increases, energy crisis, energy or fuel interruption, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, embargoes, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by an event of force majeure shall be tolled for the duration of such event of force majeure and rescheduled for mutually agreed dates as soon as practicable after the event of force majeure ceases to exist. The right to allocate capacity is in the Seller's sole discretion. An event of force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or sub¬contractors. An event of force majeure in the meaning of these Terms means any circumstances beyond Seller's control that permanently or temporarily hinders performance, even where that circumstance was already foreseen. Buyer shall not be entitled to cancel any orders following its claim of an event of force majeure.

16. Waiver and Severability. Failure to enforce any provision of these Terms will not invalidate that provision; nor will any such failure prejudice either party's right to enforce that provision in the future. Invalidation of any provision of these Terms shall not invalidate any other provision herein and, the remaining provisions will remain in full force and effect.

17. Duration. Unless otherwise stated in the Quote, any agreement governed by or arising from these Terms shall: (a) be for an initial duration of one (1) year; and (b) shall automatically renew for successive one-year terms unless terminated by Buyer with at least 180-days written notice to Seller or if Seller terminates the agreement pursuant to Section 19 of these Terms.

18. Termination. Seller may, without liability to Buyer, terminate any agreement governed by or arising from these Terms for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate, in writing, if Buyer: (a) breaches any provision of these Terms, (b) becomes or is deemed insolvent, (c) appoints or has appointed a trustee, receiver or custodian for all or any part of Buyer's property,(d) files a petition for relief in bankruptcy on its own behalf, or one is filed against Buyer by a third party, (e) makes an assignment for the benefit of creditors; or (f) dissolves its business or liquidates all or a majority of its assets.

19. Ownership of Rights. Buyer agrees that (a) Seller (and/or its affiliates) owns or is the valid licensee of Seller's IP and (b) the furnishing of information, related documents or other materials by Seller to Buyer does not grant or transfer any ownership interest or license in or to Seller's IP to Buyer, unless expressly agreed in writing. Without limiting the foregoing, Seller retains ownership of all Software supplied to Buyer. In no event shall Buyer obtain any greater right in and to the Software than a right in a license limited to the use thereof and subject to compliance with any other terms provided with the Software. Buyer further agrees that it will not, directly or through intermediaries, reverse engineer, decompile, or disassemble any Software (including firmware) comprising or contained within a Product, except and only to the extent that such activity may be expressly permitted, either by applicable law or, in the case of open source software, the applicable open source license.

20. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any Intellectual Property Rights except as provided in this Section. Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on a third-party claim that one or more of the Products infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by Seller to Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products is subject to such a claim, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Products, replace or modify the Products to render them non-infringing, or offer to accept return of the Products and refund the purchase price less a reasonable allowance for depreciation. Seller has no obligation or liability for any claim of infringement: (i) arising from information provided by Buyer (including Seller's use of Buyer's Property); or (ii) directed to any Products for which the designs are specified in whole or part by Buyer; or (iii) resulting from the modification, combination or use in a system of any Products. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for claims of infringement of Intellectual Property Rights.

21. Governing Law. These Terms, the terms of any Quote, and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to the sale and delivery of the Products.

22. Entire Agreement. These Terms, along with the terms set forth in the Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale and purchase. In the event of a conflict between any term set forth in the Quote and these Terms, the terms set forth in the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. No modification to these Terms will be binding on Seller unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence, 'clickwrap' or other purported electronic assent to different or additional terms. Sections 2-25 of these Terms shall survive termination or cancellation of any agreement governed by or arising from these Terms.

23. No 'Wrap' Agreements/No Authority to Bind. Seller's clicking any buttons or any similar action, such as clicking "I Agree" or "Confirm," to utilize Buyer's software or webpage for the placement of orders, is NOT an agreement to Buyer's Terms and Conditions. NO EMPLOYEE, AGENT OR REPRESENTATIVE OF SELLER HAS THE AUTHORITY TO BIND SELLER BY THE ACT OF CLICKING ANY BUTTON OR SIMILAR ACTION ON BUYER'S WEBSITE OR PORTAL.

24. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer represents that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Law. 9/22

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