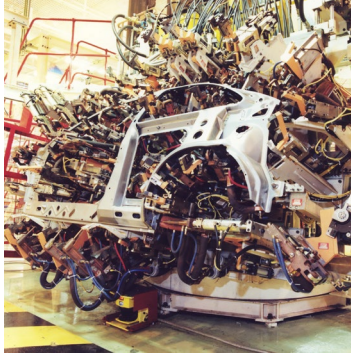
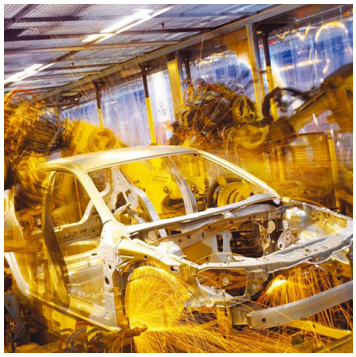
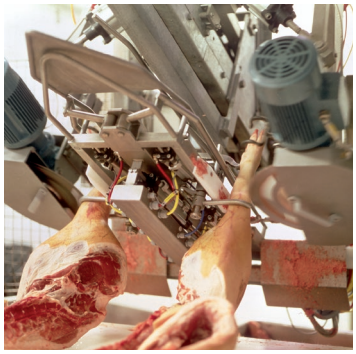
(01/28/20)







Electronic, Electric, Analog and IO-Link

P8S Series Sensor

Catalog 0981P

Parker

ENGINEERING YOUR SUCCESS.

Warning, Offer of Sale

Important
Before carrying out service activities, make sure the air motor is vented. Before disassembling the motor, disconnect the primary air hose to ensure that the air supply is interrupted.

Note
All technical data in the catalog are typical values. The air quality is a major factor in the service life of the motor, see ISO 8573-1.

⚠ WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application including consequences of any failure, and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

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Pneumatic Division
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P8S Electronic and Reed Sensors

The P8S Series magnetic cylinder sensor enables quick, precise and contactless sensing of the piston‘s position in cylinders. It is easy to mount, can be used in numerous applications and offers an outstanding price-performance ratio.

Product Overview

As the term magnetic switch suggests, these are operated by magnetic fields; another description widely used is magnetic “SENSOR”. As our eyes sense change of light, our ears sense the change of sound, magnetic sensors / switches sense the change of magnetic flux in pneumatic and hydraulic cylinders. When magnetic sensors sense a magnetic field it will give a switching signal, through a control circuit, allowing sensing or control operation to be achieved.

Because of the characteristics of magnetic sensors they can sense a change of magnetic field relative to the position of the magnet, such as in a pneumatic or hydraulic cylinder, whereby the magnet is attached to a moving piston and thus the position of the moving part (ie Piston) can be detected.

The magnet is mounted on the piston of the cylinder and thus moves with the piston.

The magnetic sensor (switch) is fixed either directly to the cylinder or with an additional mounting bracket. When the piston (magnet) moves to the position under a magnetic sensor, the switch will operate due to the change of the magnetic field and give a switching signal.

Thus the position of the piston can be identified and a resulting signal generated to continue the sequence of a circuit.

Magnetic sensors available can be classified into two different groups, they are sensors with contacts which are called mechanically operated or reed sensors and the other type is sensors without contacts and are called solid state type or electronic.

Parker P8S Series sensors are suitable for use with a large range of actuators. They can either be inserted directly into the cylinder tube extrusion or mounted using additional brackets. For direct mounting the sensor is positioned within the cylinder sensor groove, offering mechanical protection, then securely clamped into position by a simple turn of a screw. For other cylinder versions there are a number of optional sensors brackets that clamp to the cylinder and offer other mounting positions.

For easy installation there are several cable lengths available with either M8 connector or flying lead. The electronic sensors are “Solid State”, i.e. they have no moving parts. They are provided with short-circuit protection and transient protection as standard. The built-in electronics make the sensors suitable for applications with high on and off switching frequency where long service life is required.

Please note that for low temperature applications sensors are normally specified for full performance down to -30°C only. High temperature cylinders do not have a magnetic piston and therefore cannot be used with sensors.

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Technical Data

Square body design, insert straight in T-slot, screw 1/4 turn

	Electronic PNP | NPN	Electric Reed
Cylinder type:	Profile with T-slot	
Cylinder type with adapter:	Profile with S-slot (dovetail) | Tie rods | Round cylinders	
Installation:	Quarter turn, fixed by allen key 2.5 mm or flathead screwdriver	
Housing length:	29.5 mm	29.5 mm 5 - 30 V AC/DC
	24 mm (NAMUR ATEX)	29.5 mm 5 -120 V AC/DC
		32.5 mm 5 - 230 V AC/DC
Output Type:	PNP | NPN	Reed
Switching (on/off) switching frequency:	± 1,000 Hz	± 400 Hz
Output Function:	Normally Open (NO) | Normally Closed (NC) 3-wire	Normally Open (NO) | Normally Closed (NC) 2-wire Normally Open (NO) 3-wire
Enclosure rating:	IP67	
	IP67 (NAMUR ATEX)	
Supply Voltage:	10 to 30 V DC	
	8.2 to 20 V DC (NAMUR 1GD)| 10 to 26 V DC (ATEX 3GD)	5 to 30 | 5 to 120 | 5 to 230 V AC/DC 2-wire, 3-wire depending on type
Power consumption:	<= 8 mA	-
	<= 10 mA (NAMUR, ATEX)	-
Voltage drop:	<= 2 V	<= 3.5 V 2-wire | <= 0.1 V 3-wire
	<= 2.2 V (NAMUR, ATEX)	-
Continuous output current Ia:	<= 100 mA	<= 100 mA 3-wire
	<= 60 mA (NAMUR) | <= 50 mA (ATEX)	<= 500 mA (DC) | <= 300 mA (AC)
Switching capacity:	-	<= 6 W
Protection class:	III	III | II 2-wire depending on type
		III 3-wire
Response sensitivity:	2.6 to 3.3 mT	2.1 to 3.4 mT
	2.8 mT (NAMUR, ATEX)	-
Overrun distance:	10 mm	
	9 mm (NAMUR, ATEX)	-
Hysteresis:	<= 0.8 mT	-
	<= 0.5 mT (NAMUR, ATEX)	-
Repeatability:	<= 0.1 mT	
Reverse polarity protection:	Yes	No 2-wire
	-	Yes 3-wire
Short circuit protection:	Yes	-
Power-up pulse protection:	Yes (NAMUR, ATEX)	-
Ambient operating temperature range:	-30 to +80 °C (PUR cable) | -30 to +70°C (PVC cable)	
	-25 to +80 °C (NAMUR 1GD) | -20 to +50°C (ATEX 3GD)	
Shock and vibration resistance:	30 g 11 ms / 10 … 55 Hz, 1 mm	
EMC:	According to EN 60947-5-2	
International standard:	CE | C UL US | RoHs | Ex | IEC | IEC Ex	
Housing material:	Plastic polyamid PA12	
Screw material:	Stainless steel	
Cable material:	PUR (Polyurethane) | PVC (Polyvinyl Chloride)	
Conductor cross-section:	0.14 mm² | 0,12 mm² depending on type 0.14 mm² (NAMUR, ATEX)	
Indication LED color:	Yellow, no LED reed NC	
Connector:	M8R (knurled nuts) | None (Flying lead)	

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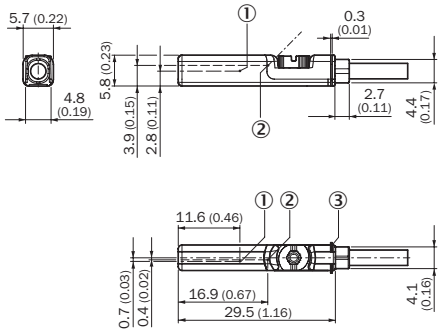
Dimensions

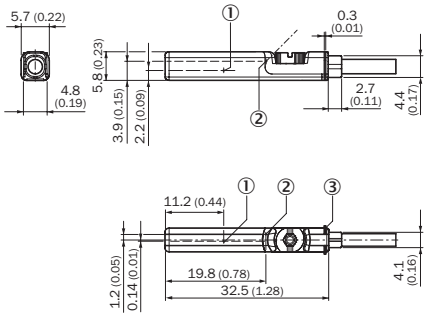
Dimensions in mm (inch)

PNP, NPN Output 10 to 30 V DC



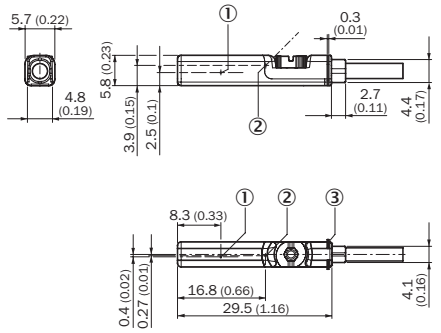
① Position sensor element
② Indication LED
③ Retaining ribs

Reed Output 5 to 230 V AC/DC



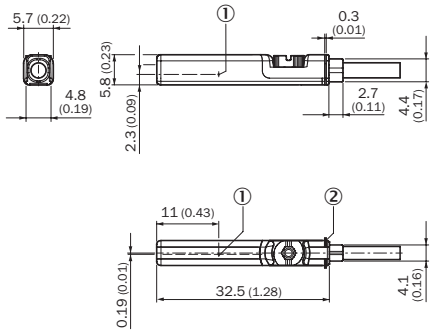
① Position sensor element
② Indication LED
③ Retaining ribs

Reed Output 5 to 30 V AC/DC



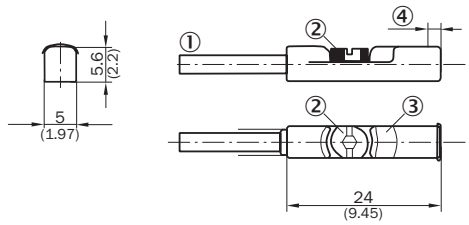
① Position sensor element
② Indication LED
③ Retaining ribs

Reed Output 5 to 120 V AC/DC



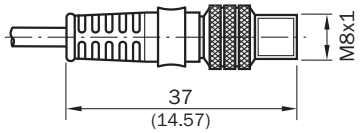
① Position sensor element
② Retaining ribs

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

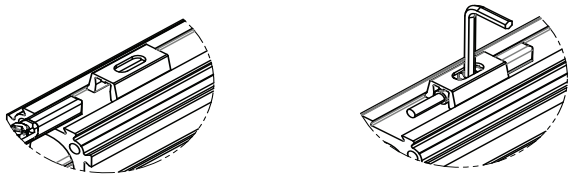
Connector M8R



Installation

Square body design, Insert straight in T-slot, screw 1/4 turn

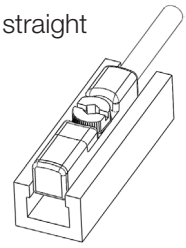
With Adapter in S-Dovetail Slot



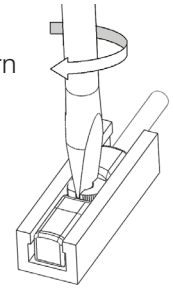
Note:
The adapter is delivered with each sensor.

Without Adapter directly in T-Slot

Put-in straight



Screw 1/4 turn



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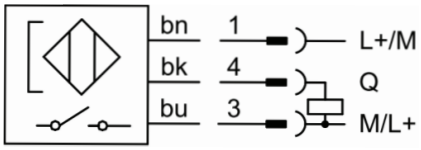
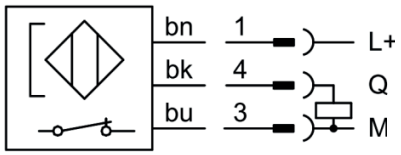
Connections

Connection type and diagram

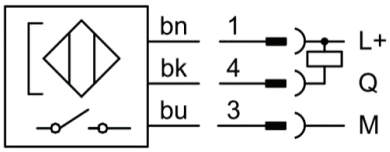
PNP NO



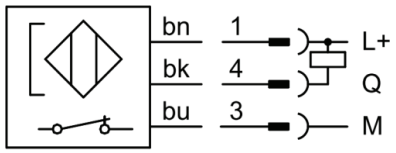
PNP NC



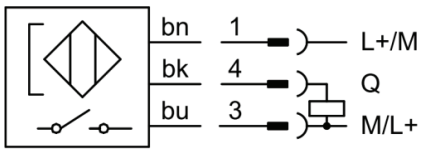
NPN NO



NPN NC



Reed NO 3-wire



bn: brown

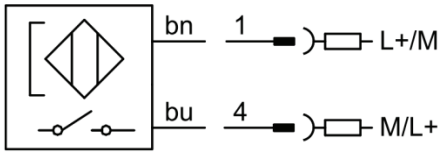
bk: black

bu: blue
Q: load

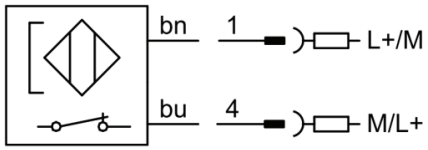
M: Mass

L+: Power

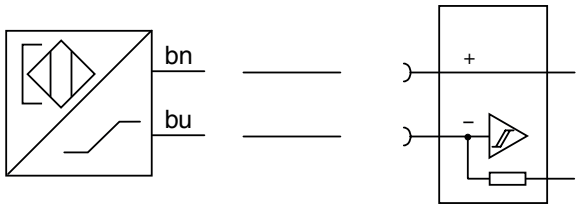
Reed NO 2-wire



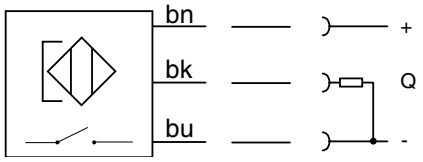
Reed NC 2-wire



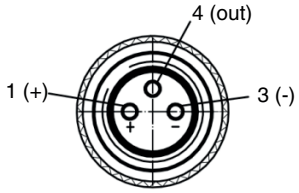
NAMUR NO ATEX 1G, 1D



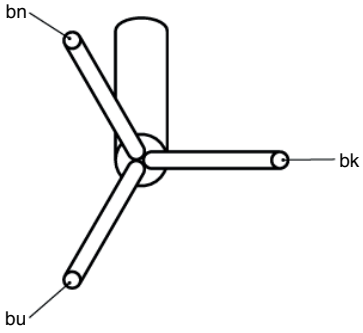
PNP NO ATEX 3G, 3D



Pin assignment, M8 with knurled nut



Flying leads



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Square body design, Insert straight in T-slot, screw 1/4 turn

NPN NORMALLY CLOSED	VOLTAGE	CONNECTION	CABLE	Part Number
NPN-NC, with LED, 3-wire	10-30 V DC	3 m Flying Lead	**PUR IP67**	**P8SAGMFAX**
NPN-NC, with LED, 3-wire	10-30 V DC	10 m Flying Lead	**PUR IP67**	**P8SAGMFDX**
NPN-NC, with LED, 3-wire	10-30 V DC	0.3 m M8	**PUR IP67**	**P8SAGMCHX**

NPN NORMALLY OPEN	VOLTAGE	CONNECTION	CABLE	Part Number
NPN-NO, with LED, 3-wire	10-30 V DC	3 m Flying Lead	**PUR IP67**	**P8SAGNFAX**
NPN-NO, with LED, 3-wire	10-30 V DC	10 m Flying Lead	**PUR IP67**	**P8SAGNFDX**
NPN-NO, with LED, 3-wire	10-30 V DC	0.3 m M8	**PUR IP67**	**P8SAGNCHX**

PNP NORMALLY CLOSED	VOLTAGE	CONNECTION	CABLE	Part Number
PNP-NC, with LED, 3-wire	10-30 V DC	3 m Flying Lead	**PUR IP67**	**P8SAGQFAX**
PNP-NC, with LED, 3-wire	10-30 V DC	3 m Flying Lead	**PVC IP67**	**P8SAGQFLX**
PNP-NC, with LED, 3-wire	10-30 V DC	10 m Flying Lead	**PUR IP67**	**P8SAGQFDX**
PNP-NC, with LED, 3-wire	10-30 V DC	0.3 m M8	**PUR IP67**	**P8SAGQCHX**

PNP NORMALLY OPEN	VOLTAGE	CONNECTION	CABLE	Part Number
PNP-NO, with LED, 3-wire	10-30 V DC	3 m Flying Lead	**PUR IP67**	**P8SAGPFAX**
PNP-NO, with LED, 3-wire	10-30 V DC	3 m Flying Lead	**PVC IP67**	**P8SAGPFLX**
PNP-NO, with LED, 3-wire	10-30 V DC	10 m Flying Lead	**PUR IP67**	**P8SAGPFDX**
PNP-NO, with LED, 3-wire	10-30 V DC	10 m Flying Lead	**PVC IP67**	**P8SAGPFTX**
PNP-NO, with LED, 3-wire	10-30 V DC	0.3 m M8	**PUR IP67**	**P8SAGPCHX**

REED NORMALLY CLOSED	VOLTAGE	CONNECTION	CABLE	Part Number
Reed-NC, No LED, 2 wire	5-30 V AC/DC	10 m Flying Lead	**PUR IP67**	**P8SAGEFRX**
Reed-NC, No LED, 2-wire	5-120 V AC/DC	10 m Flying Lead	**PUR IP67**	**P8SAGEFRX1**
Reed-NC, No LED, 2-wire	5-30 V AC/DC	0.3 m M8	**PUR IP67**	**P8SAGECNX**

REED NORMALLY OPEN	VOLTAGE	CONNECTION	CABLE	Part Number
Reed-NO, with LED, 2-wire	5-30 V AC/DC	3 m Flying Lead	**PUR IP67**	**P8SAGRFAX**
Reed-NO, with LED, 2-wire	5-120 V AC/DC	3 m Flying Lead	**PVC IP67**	**P8SAGRFLX1**
Reed-NO, with LED, 2-wire	5-230 V AC/DC	3 m Flying Lead	**PVC IP67**	**P8SAGRFLX2**
Reed-NO, with LED, 2-wire	5-230 V AC/DC	10 m Flying Lead	**PUR IP67**	**P8SAGRFDX2**
Reed-NO, with LED, 2-wire	5-120 V AC/DC	10 m Flying Lead	**PVC IP67**	**P8SAGRFTX1**
Reed-NO, with LED, 2-wire	5-30 V AC/DC	0.3 m M8	**PUR IP67**	**P8SAGRCHX**

REED NORMALLY OPEN	VOLTAGE	CONNECTION	CABLE	Part Number
Reed-NO, with LED, 3-wire	5-30 V AC/DC	3 m Flying Lead	**PUR IP67**	**P8SAGSFAX**
Reed-NO, with LED, 3-wire	5-30 V AC/DC	3 m Flying Lead	**PVC IP67**	**P8SAGSFLX**
Reed-NO, with LED, 3-wire	5-30 V AC/DC	10 m Flying Lead	**PUR IP67**	**P8SAGSFDX**
Reed-NO, with LED, 3-wire	10-30 V AC/DC	10 m Flying Lead	**PVC IP67**	**P8SAGSFTX**
Reed-NO, with LED, 3-wire	5-30 V AC/DC	0.3 m M8	**PUR IP67**	**P8SAGSCHX**

ATEX IP67	VOLTAGE	CONNECTION	CABLE	Order Code
PNP-NO, with LED, 3-wire	10-26 V DC	3 m Flying lead	**PUR IP67**	**P8SAGPFAXS**
NAMUR-NO, with LED, 2-wire	8.2-20 V DC	5 m Flying Lead	**PVC IP67**	**P8SAGDFMXW ***
NAMUR-NO, with LED, 2-wire	8.2-20 V DC	10 m Flying Lead	**PVC IP67**	**P8SAGDFTXW ***

Note:
-30 to +80 °C (PUR cable) I -30 to + 70 °C (PVC cable) I -25 to +80 °C (NAMUR 1GD I -20 to +50 °C (ATEX 3GD)
All sensors come with an adapter for S-dovetail Parker type OSP grooves.
* with an aluminium adapter

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P8S Continuous Position Sensors

Many applications require more than just end of stroke sensing of an actuator, but traditional methods of continuous sensing are expensive to implement. Parker's CPS (Continuous Position Sensor) enables quick, precise and contactless continuous position sensing of a magnetic piston.

CPS sensors continuously supply data via analog outputs or IO-Link. Analog position sensors have a voltage output of 0 V ... 10 V as well as a current output of 4 mA ... 20 mA. CPS enables flexible machine concepts, making it possible to solve tasks in areas such as quality monitoring and process control in conjunction with pneumatic cylinders. This continuous transfer of position data upgrades the functionality of the pneumatic cylinders by making them more intelligent, and as a result, more versatile. CPS settings can be adjusted during or after installation using a teach button or using IO-Link.

CPS can be mounted directly in standard T-slots without the need for additional accessories. Mounting on other cylinder types, (round, tie rod) is possible with adapters.

- Continuous position sensing
- IO-Link communication with M12 connector
- No modification to the actuator
- Analog version with M8 connector
- 5 sizes with sensing ranges from 32 mm to 256 mm
- IP67 design suitable for any industrial application
- Yellow teach button for easy set-up

Technical specification:

1 ms sampling rate
0.03% full scale resolution
0.06% full scale repeatability
0.3 mm Linearity error

How it works:

The CPS product detects the position of an actuator via the magnet on the piston. The sensor settings can easily be adjusted during installation using the yellow teach button or during operation over the IO-Link communication. This upgrades the functionality of the pneumatic actuator by making it more intelligent and versatile in support of the Industry 4.0 initiative.

How it connects:

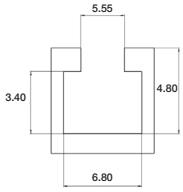
Analog version has a M8 connector and a voltage output of 0-10V as well as a current output of 4-20mA. IO-Link version has a M12 connector and transmits position via 2 bytes of process input data and also allows for parameter control of measuring range and locking of the teach button.
It can be controlled by Class A or Class B IO-Link Masters.

How it installs:

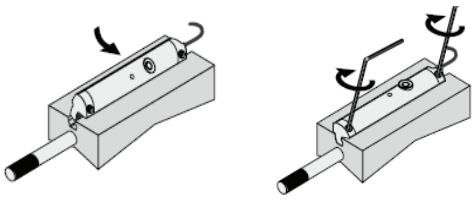
The Parker CPS requires the use of a magnetic piston. The product will ft T-slot cylinders without any additional mounting hardware.

Without Adapter:

Direct drop-in T-slot
T-slot dimensions [mm ± 0.1]



1) Pivot sensor into the slot
2) Teach the CPS unit the desired measuring range
3) Tighten set screws



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Technical Data

Cylinder type:	Profile with T-slot
Installation:	Drop in, fixed by allen key 1.5 mm
Measuring range:	32 to 256 mm depending on type [1]
Housing length:	45 to 269 mm depending on type
Output Function:	Analog | IO-Link
Analog output (voltage):	0 to 10 V | -
Analog output (current):	4 to 20 mA | -
Teach-in:	Yes
Enclosure rating:	IP 67 (according to EN 60529)
Supply Voltage: [2]	15 to 30 V DC
Power consumption: [3]	<= 22 mA (analog) | <= 25 ma (IO-Link)
Max load resistance: [4]	<= 500 Ω
Min load resistance: [5]	<= 2 kΩ
Protection class:	III
Time delay before availability:	1.5 s
Required magnetic field sensitivity:	3 mT / 2 mT (analog) | 3 mT (IO-Link)
Resolution: [6]	0.03% full scale range (max >=0.05 mm)
Linearity error: [7]	0.3 mm
Repeat accuracy: [8]	0.06% full scale range (>= 0.1 mm)
Sampling rate: [9]	1 ms
Indication LED color:	Yellow (analog)
Reserve polarity protection:	Yes (analog)
Short circuit protection:	Yes (analog)
Ambient operating temperature range:	-20 to +70 °C (PUR cable)
Shock and vibration resistance:	30 g 11 ms / 10 … 55 Hz, 1 mm
EMC: [10]	According to EN 60947-5-2
International standard:	CE | C UL US | CCC (not applicable) | RoHs | IO-Link
UL file No:	On request
Housing material:	Plastic polyamid PA12
Screw material:	Stainless steel
Cable material:	PUR (Polyurethane)
Conductor cross-section:	0.08 mm²
Connector:	M12 (IO-Link) or M8 (analog)

[1] ± 1 mm
[2] Reverse-polarity protected, operation in short-circuit protected network: max. 8 A.
[3] Without load
[4] Power output, at 24 V
[5] Voltage output
[6] FSR: Full Scale Range; max. measuring range.
[7] At 25 °C, linearity error (maximum deviation) depending on response curve and minimal deviation function.
[8] At 25 °C, repeatability magnet movement in one direction.
[9] Only in standard mode, not in IO-Link mode.
[10] The analogue measured value can deviate under transient conditions.

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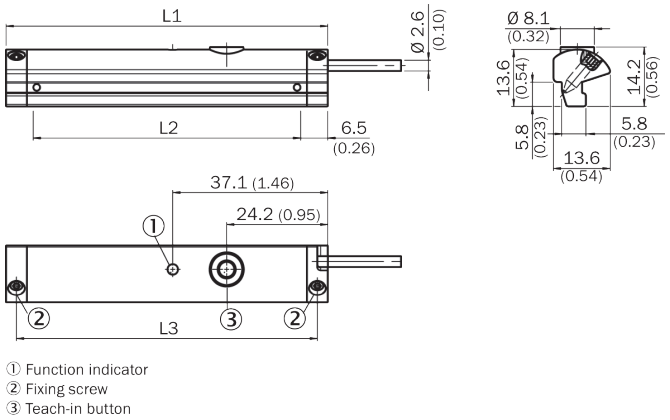
Dimensions, Ordering Information

Dimensions in mm (inch)



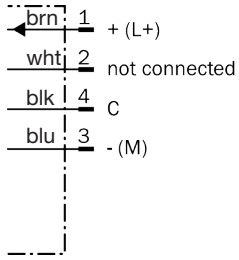
			Part number	
L1	**L2 ***	**L3**	**Analog**	**IO-Link**
45	32	40	**P8SAGACHA**	**P8SAGHMHA**
77	64	72	**P8SAGACHB**	**P8SAGHMHB**
141	128	136	**P8SAGACHD**	**P8SAGHMHD**
205	192	200	**P8SAGACHF**	**P8SAGHMHF**
269	256	264	**P8SAGACHH**	**P8SAGHMHH**

*L2 equal to the measuring range.

Note:
PUR cable with M12 (IO-Link) or M8 (Analog) male connector knurled nut, 4-pin, 0,3 meter length.
Please consult for measuring range 96, 160 & 224 mm.

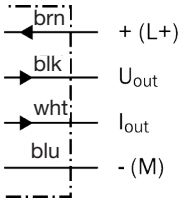
Connection type and diagram

IO Link version



PUR 0.3 meter length
with M12 male connector
knurled nut, 4-pin

Analog version



PUR 0.3 meter length
with M8 male connector
knurled nut, 4-pin

Ordering Information - Drop-in T-slot

Output	Measuring length	Configuration option	Part number	Weight [g]	For product series
Analog	32 mm	Teach Button	**P8SAGACHA**	16	With T-slot groove *
	64 mm		**P8SAGACHB**	26	
	128 mm		**P8SAGACHD**	46	
	192 mm		**P8SAGACHF**	66	
	256 mm		**P8SAGACHH**	86	
IO-Link	32 mm	Teach Button or IO-Link parameter	**P8SAG HMHA**	20	With T-slot groove *
	64 mm		**P8SAGHMHB**	30	
	128 mm		**P8SAGHMHD**	50	
	192 mm		**P8SAGHMHF**	70	
	256 mm		**P8SAGHMHH**	90	

***** Required magnetic field sensitivity: 3mT / -2 mT (Analog) / 3mT (IO-Link)

Note:
PUR cable with M12 (IO-Link) or M8 (Analog) male connector knurled nut, 4-pin, 0,3 meter length.
Please consult for measuring range 96, 160 & 224 mm.

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Accessories

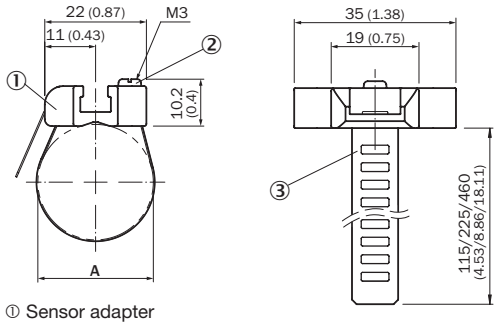
Mountings and brackets

For products series	Part number	Weight [g]
Tie rods, 4MA, P1F, P1D, PTR, 2MNR	**P8S-TMAOX**	65
Tie rods, P1D-T Ø 32-100	**P8S-TMA07**	10
Tie rods, P1D-T Ø 125-320	**P8S-TMA08**	32
T-Slot OSP Ø 10	**8872FIL**	3
T-Slot P Series Ø 16	**8865FIL**	4
T-Slot P Series Ø 25-80	**8866FIL**	5
Round cylinder Ø10-25	**P8S-TMC01**	27
Round cylinder Ø 32-63	**P8S-TMC02**	29
Round cylinder Ø 80-125	**P8S-TMC03**	32
S-Dovetail OSP, pack of 10	**P8S-TMA09**	10
Ambient temperature -30 to +80 °C		

All mountings can be moved on the cylinder body before screwing in place and then putting sensors in the slots.

Dimensions in mm (inch)

P8S-TMC01, 02 & 03

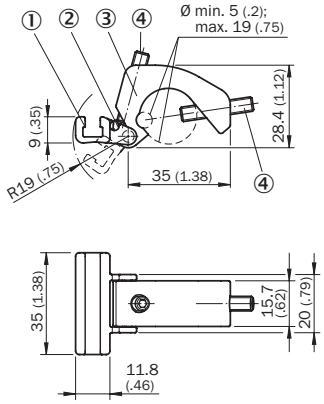


① Sensor adapter
② Fixing screw
③ Strap

Part number	D [mm]	
P8S-TMC01	8 to 25	Clamping ring in nickel silver, screw in stainless steel, sensor mounting zinc diecast
P8S-TMC02	32 to 63	
P8S-TMC03	80 to 130	

P8S-TMAOX

(Zinc diecast, zinc plated screws.)



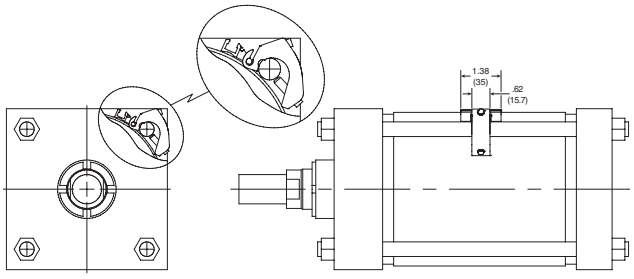
① Sensor adapter with T-Slot
② Fixing for cable < Ø 3.2 mm (0.126 inch)
③ Cylinder adapter
④ Mounting screws M5

Tie Rod Bracket Assembly

Tie Rod Bracket Assembly is necessary for Global and Mini-Global Sensor installation on all tie rod construction cylinders. This includes all Intermediate Trunnion mounts (Style DD or MT4); and all 6"-8" bore Sensors and bracket assemblies must be ordered separately.

Part number P8S-TMAOX fits 1-1/2" to 8" bores and 32-200mm bores for Global Sensors

P8S-TMAOX



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Male connectors for connecting cables

Cable connectors for producting your own connecting cables.
The conncectors can be quickly attached to the cable without special tools. Only the outer sheath of the cable is removed.
The connectors are available for M8 screw connector and meet protection class IP65.

Technical Data

Operating voltage:	max. 32 V AC/DC
Opertaing current per contact:	max. 4 A
Connection cross section:	0.25... 0.5 mm² (conductor diameter min 0.1 mm)
Protection class:	IP65 and IP67 when plugged and screwed down (EN 60529)
Temperature range:	- 25... + 85°C

Connector	Weight [kg]	Part number
M8 screw connector		**P8CS0803J**
M12 screw connector	0.022	**P8CS1204J**

Cables to extend cable sensor lengths with M8*

Description	Part number	Weight [g]	For Product Series
Cable flex PVC 3 meter with 8mm snap-in connector / flying leads	**9126344341**	70	P8S Sensors with M8
Cable flex PVC 10 meter with 8mm snap-in connector / flying leads	**9126344342**	210	P8S Sensors with M8
Cable PUR 3 meter with 8mm snap-in female connector / flying leads	**9126344345**	70	P8S Sensors with M8
Cable flex PUR 10 meter with 8mm snap-in connector / flying leads	**9126344346**	210	P8S Sensors with M8
Cable PVC 2.5 meter with M8 screw connector / flying leads	**KC3102**	60	P8S Sensors with knurled M8
Cable PVC 5 meter with M8 screw female connector / flying leads	**KC3104**	120	P8S Sensors with knurled M8

*Note: not applicable for P8S CPS Sensors as no cable available

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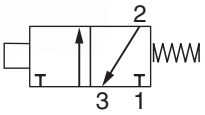
Pneumatic sensor for Tie-Rods Cylinders

An ideal solution where a direct pneumatic signal is wanted from a cylinder sensor to a pneumatic control system, for example. This could be a machine or device in which only compressed air is available, and an electricity supply to normal cylinder sensors would involve serious problems or considerable expense.



Function:

Non-contacting sensing of a pneumatic cylinder, triggering an output signal (conn. 2) from the integrated 3/2 NC valve, which is activated by a magnetic field or iron core and has a return spring.

If more than one sensor is used with a cylinder there must be a distance of at least 20 mm between sensors to prevent them influencing each other.

To avoid interference, there must be a minimum spacing of 15 mm to steel details.

The outlet (conn. 3) must not be blocked or restricted as this can impair the function of the sensor.

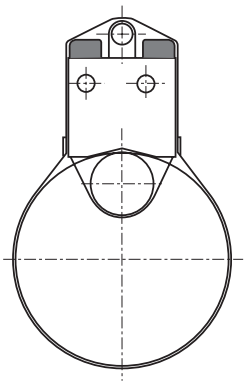
The sensor is fastened to the cylinder using the special sensor fixing.

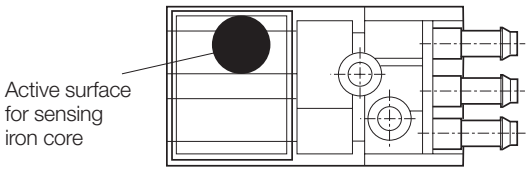
Technical data:

Working pressure:	min 2 to max 6 bar
Temperature:	-15 to +60 °C
Air quality:	3.4.3 to ISO 8573-1 (must be oil free)
Function:	3/2 NC valve
Flow:	40 Nl per minute
Connection:	for plastic pipe with 2,5-3 mm internal diameter
Activation distance:	for magnet: min 9 mm
Activation distance:	for Fe: approx. 2 mm
Repetition accuracy:	+/- 0.2 mm
Cylinder velocity:	max 1 m/s (depends on magnetic field, interference from steel in environment, signal length requirement from control system….)
Distance between sensors:	min 20 mm
Distance from sensor to steel details:	min 15 mm
Fixing:	with sensor fixing or with an M4 thread in case
Sensing:	non-contacting (also through a wall of non-magnetic material)

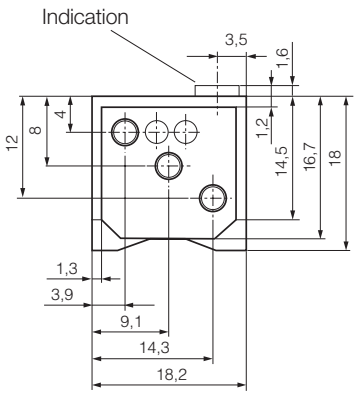
Description	Weight [kg]	Part number
Pneumatic sensor	0.02	**P8S-A34X**
Cylinder fixing bore Ø32 to Ø125 mm	0.01	**P8S-AMA1**

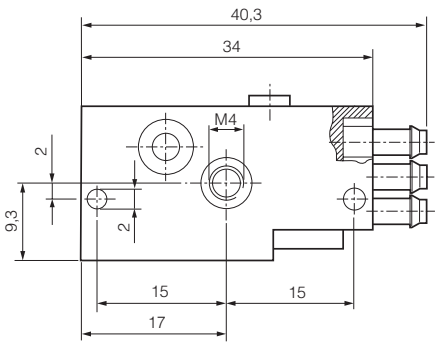
Cylinder fixing - Tie-Rod Cylinders Ø 32 to 100 mm





Dimensions (mm)





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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 (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 1-800-CPARKER, 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 review 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.

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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 Cylinder 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.

Parker Hannifin Corporation
Pneumatic Division
Wadsworth, Ohio
www.parker.com/pneumatics

PARKER-HANNIFIN CORPORATION
OFFER OF SALE

1. Definitions. As used herein, the following terms have the meanings indicated.

Buyer:	means any customer receiving a Quote for Products from Seller.
Goods:	means any tangible part, system or component to be supplied by the Seller.
Products:	means the Goods, Services and/or Software as described in a Quote provided by the Seller.
Quote:	means the offer or proposal made by Seller to Buyer for the supply of Products.
Seller:	means Parker-Hannifin Corporation, including all divisions and businesses thereof.
Services:	means any services to be supplied by the Seller.
Software:	means any software related to the Products, whether embedded or separately downloaded.
Terms:	means the terms and conditions of this Offer of Sale or any newer version of the same as published by Seller electronically at www.parker.com/saleterms.

2. Terms. All sales of Products by Seller are contingent upon, and will be governed by, these Terms and, these Terms are incorporated into any Quote provided by Seller to any Buyer. Buyer's order for any Products whether communicated to Seller verbally, in writing, by electronic date 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 of purchase. No modification to these Terms will be binding on Seller unless agreed to in writing and signed by an authorized representative of Seller.

3. Price; Payment. The Products set forth in Seller's Quote are offered for sale at the prices indicated in Seller's Quote. Unless otherwise specifically stated in Seller's 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 at any time to adjust for any raw material price fluctuations. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). All sales are contingent upon credit approval and payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). 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.

4. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate. Seller is not responsible for damages resulting from any delay. 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 shipment carrier at Seller's facility. Unless otherwise agreed, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective indicated shipping date will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.

5. Warranty. The warranty related to the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of twelve (12) 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 completion of the Services by Seller; 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:
DISCLAIMER OF WARRANTY: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING 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. BUYER AGREES AND ACKNOWLEDGES THAT 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".

6. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to the 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.

7. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCT, 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 ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, NON-COMPLETION OF SERVICES, USE, LOSS OF USE OF, OR INABILITY TO USE THE PRODUCTS OR ANY PART THEREOF, LOSS OF DATA, IDENTITY, PRIVACY, OR CONFIDENTIALITY, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, 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.**

8. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which are or become 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 such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Special Tooling. Special Tooling includes but is not limited to tooling, jigs, fixtures and associated manufacturing equipment acquired or necessary to manufacture Products. A tooling charge may be imposed for any Special Tooling. Such Special Tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in Special Tooling belonging to Seller that is utilized in the manufacture of the Products, even if such Special Tooling has been specially converted or adapted for such manufacture 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 in its sole discretion at any time.

10. Security Interest. To secure payment of all sums due, 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 its security interest.

11. User Responsibility. The 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. The Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and other technical information provided with the Product. If Seller provides Product options based upon data or specifications provided by the Buyer, the 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 the Buyer is not the end-user, 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 Products. **Unauthorized Uses**. If Buyer uses or resells the Products for any uses prohibited in 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. 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, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, application, design, specification or other misuse of Products provided by Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, tooling, equipment, plans, drawings, designs or specifications or other information or things furnished by Buyer; (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 or tampering with the Products for any reason; or (e) Buyer's failure to comply with these Terms. 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 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. Seller, at any time, may change Product features, specifications, designs and availability.

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

15. Force Majeure. Seller does not assume the risk and is not liable for delay or failure to perform any of Seller's obligations by reason of events or circumstances beyond its reasonable control ("Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

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

17. Termination. Seller may 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) appoints a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or one if filed by a third party (d) makes an assignment for the benefit of creditors; or (e) dissolves its business or liquidates all or a majority of its assets.

18. Ownership of Software. Seller retains ownership of all Software supplied to Buyer hereunder. In no event shall Buyer obtain any greater right in and to the Software than a right in the nature of a license limited to the use thereof and subject to compliance with any other terms provided with the Software.

19. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights ("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 sold hereunder infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by the Seller to the 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 sold hereunder 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 so as 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; or (ii) directed to any Products provided hereunder 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 provided hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for such claims of infringement of Intellectual Property Rights.

20. Governing Law. These Terms 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.

21. Entire Agreement. These Terms, along with the terms set forth in the main body of any Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. In the event of a conflict between any term set forth in the main body of a Quote and these Terms, the terms set forth in the main body of the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. These Terms may not be modified unless in writing and signed by an authorized representative of Seller.

22. 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 acknowledges 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 Product from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws.

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