"P3P-R" Series

Electropneumatic Pressure Regulator

0 to 10 volt, 4 to 20 mA

B

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Pneumatic Division
Richland, Michigan
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Introduction

The P3P-R range of Electro-pneumatic Pressure Regulators are offered in 1/8", 1/4" and 1/2" port sizes. By means of an integrated electronic control system and pulse width modulated solenoid valves, the P3P-R Electro-pneumatic Pressure Regulator controls the output pressure proportionally to an analog electrical signal. A high degree of precision is achieved by means of internal feedback through an integrated pressure sensor.

Features:

- IP65
- Can be field calibrated
- Shock and vibration resistant
- Standard proportional outlet signal
- Adjustable Output Alarm Signal option can be used to indicate a drop in the inlet pressure
- Auto safe feature protects the electronics when a control signal is applied without any inlet pressure
- Built in pressure sensor

Applications:

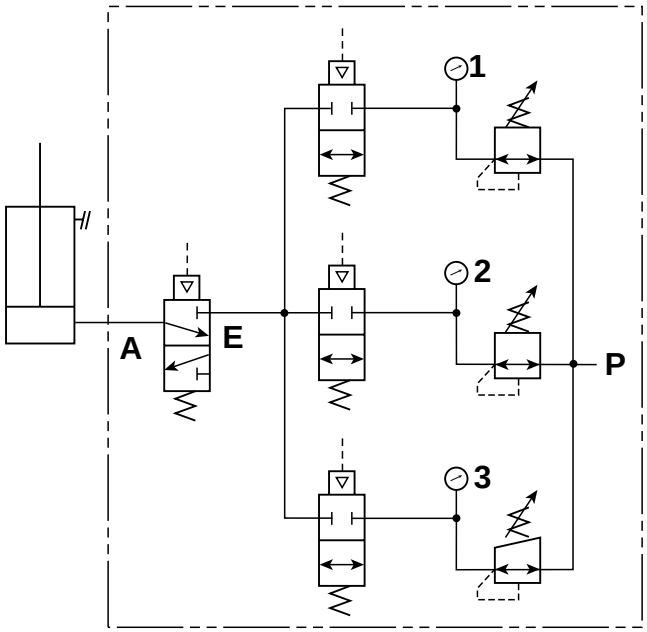
Pressure control independent of flow in electro-pneumatic control systems, particularly in the following industries:

- **Robotics**
  welding, painting lines, etc.
- **Paper and printing**
  tension regulation, speed and brake control for rolls
- **Machine Tools**
  Plastic molding, laser welding, presses, polishing, etc.

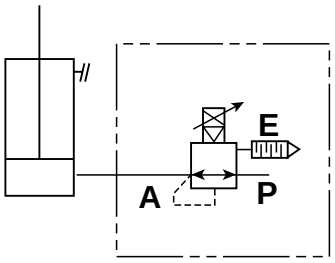
Benefits:

- Simplification of control systems by reducing the number of components
- More flexibility of the controls
- Very fast response times
- Excellent linearity and hysteresis
- No air consumption at rest position
- Increased productivity
- Direct interface to programmable controllers

Conventional Pneumatic Circuit



Pneumatic Circuit Simplification



P3P-R Circuit

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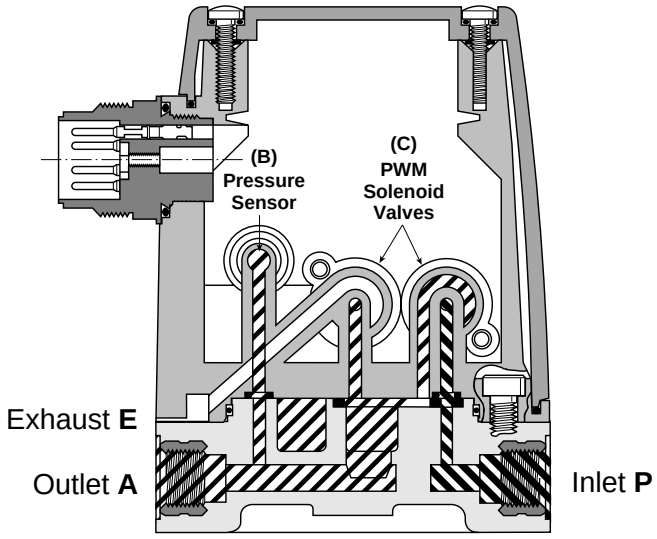
Description of Operation
1/8" EP Transducer

The P3P-RP EP Transducer allows regulation of the outlet pressure proportional to an electrical control signal. It comprises an integrated closed loop electronic control and two pulse width modulated (PWM) 2-way solenoid valves **(C)**. The pressure sensor **(B)** measures the outlet pressure and provides a feedback signal to the differential amplifier.

Any difference between the control signal and the feedback signal is converted to a digital signal to energize the coil of one or the other 2-way valves. This is accomplished without overshoot.

The control signal can be a voltage (0-10VDC) or a current (4-20mA). The inlet of the “filling valve” is connected directly with the inlet **(P)** of the transducer. When energized this valve will increase the pressure at the outlet **(A)**. When the “exhaust valve” is energized, the pressure at the outlet will decrease. The pressure will be exhausted through a discharge orifice **(E)** located between the cover and the body and directly fed to atmosphere without a silencer.



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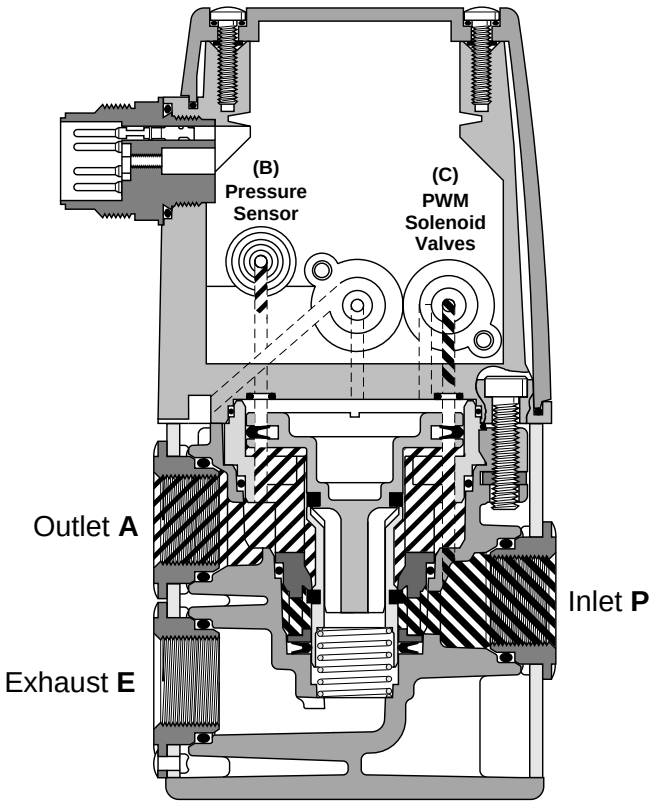
Description of Operation
1/4" & 1/2" Regulator

The P3P-RJ Series is a family of electrically remote-controlled pneumatic pressure regulators with closed loop integrated electronic control. It allows regulation of the outlet pressure proportional to an electrical control signal.

The P3P-R regulator comprises a pilot-operated pneumatic pressure regulator, where the pilot chamber is fed by one or the other of two pulse width modulated (PWM) 2-way solenoid valves **(C)**. The pressure sensor **(B)** measures the outlet pressure of the regulator and provides a feedback signal to the amplifier.

Any difference between the control signal and the feedback signal is converted to a digital signal to energize the coil of one or the other 2-way valves to correct the position of the regulator. The control signal can be a voltage (0-10VDC) or a current (4-20mA). The inlet of the “filling valve” is connected directly to the main inlet **(P)** of the regulator; when energized this valve will fill the pilot-chamber for increasing the pressure at the outlet **(A)** of the regulator. When the other “exhaust valve” is energized (reduction of pressure at the outlet **(A)** of the regulator), the pressure of the pilot-chamber will be exhausted through a discharge orifice located between the cover and the body and directly fed to the atmosphere without a silencer. The exhaust of the main regulated pressure will be made through the quick exhaust **(E)**. The use of a conventional silencer is recommended. Both solenoid valves assure the filling or emptying of the pilot-chamber in order to increase or decrease the pressure at the outlet of the regulator. In the rest position, all ports are blocked.



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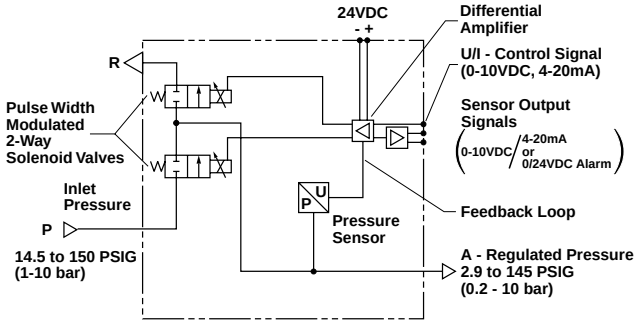
1/8" EP Transducer with Integrated Pressure Sensor, and Output Signal Module

Through a differential amplifier, the electronic control unit receives both the control signal (set pressure) and the feedback signal from the sensor (outlet pressure). Any difference between the two amplifier inputs results in a corresponding output which drives the appropriate 2-way pulse width modulated solenoid valve. The closing and opening of these pilots corrects the outlet pressure. An integrated output signal module allows the utilization of voltage and current output signals (0-10VDC, 4-20mA) proportional to the outlet pressure, or a voltage output signal (0-10VDC) and an Alarm Output Signal 0/24VDC or 24/0VDC. Adjustable Positive Alarm Signal (0V healthy, 24VDC alarm) or Negative Alarm Signal (24VDC healthy, 0V alarm) can be used to indicate a drop in the inlet pressure. The minimum span is 3 PSIG (0.2 bar) and the maximum span is 30% of the inlet pressure.

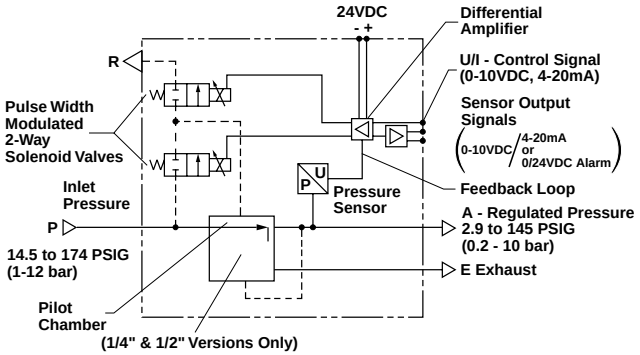
Example: 30 PSIG for 100 PSIG inlet



1/8" EP Version

1/4" & 1/2" version with Integrated Pressure Sensor and Output Signal Module

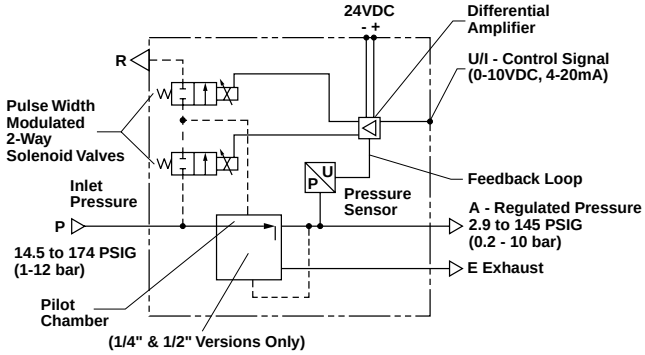
Similar principle of operation as explained above, except transducer output flow is amplified through pilot piston.



1/4" & 1/2" Body Type

1/4" & 1/2" version with Integrated Pressure Sensor without Output Signal Module

Similar principle of operation as previously explained, but without output signal module.

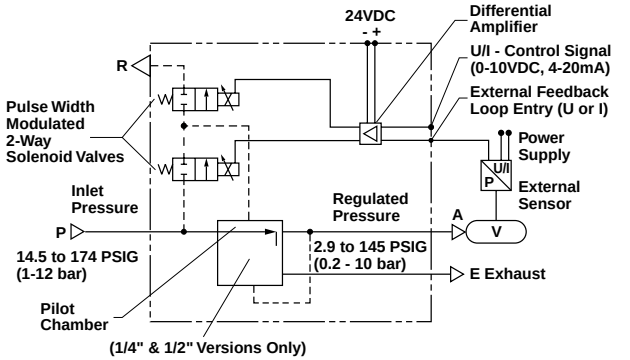


1/4" & 1/2" Body Type

With External Feedback and without Output Signal Module

Similar principle of operation as previously explained, but without integrated pressure sensor and without output signal module, but with external feedback loop entry. A vast range of sensors can be used such as proximity, level pressure sensors etc., provided the regulation system responds proportionally to the pressure.

Example: Opening of a large valve through a pneumatically driven actuator. If the angle of rotation of the gate is proportional to the pressure, the P3P-R can be controlled by a proximity sensor.



1/4" & 1/2" Body Type

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P3P-R Series Pressure Regulator

Body Type	Thread Type	Port Size	Control	Sensor Signal	Output Signal Options	Options	Connection
P3P-R	**J**	**1**	**2**	**C1**	**0**	**0**	**D**

Body Type

P	EP Transducer 1/8" Port Size[1]
J	**Transducer with Servo Chamber 1/4" & 1/2" Port Size [2]**

Thread Type

1	BSP
9	**NPT**

Port Size

1	**1/8"**
2	**1/4"**
4	**1/2"**

Control Signal

C1	**0-10VDC**
C4	**4-20mA**

Connection

G	Cable Gland
D	**DIN 43651 [5]**

Sensor Options

0	**Integrated**
1	External Feedback 0-10VDC [3]
4	External Feedback 4 - 20mA [3]

Output Signal Options

0	**Without**
6	0-10VDC & 4-20mA [4]
7	0-10VDC & Positive Alarm Signal 0VDC - Healthy Signal 24VDC - Alarm Signal [4]
9	0-10VDC & Negative Alarm Signal 24VDC - Healthy Signal 0VDC - Alarm Signal [4]

Notes:

1. EP transducer body only available with 1/8" port size.
2. Transducer with servo chamber only available with 1/4" and 1/2" port size.
3. Only available without any output signal options.
4. Only available with DIN 43651 connection.
5. Field wireable DIN connector included.
6. Standard items are in bold.

Common Part Numbers

Control Signal	Output Signal Options	Connection	1/8" Port Size
4-20ma	Without	Cable Gland	P3P-RP91C400G
4-20ma	**Without**	**DIN Connector**	**P3P-RP91C400D**
4-20ma	0-10VDC, 4-20mA	DIN Connector	P3P-RP91C406D
0-10VDC	Without	Cable Gland	P3P-RP91C100G
0-10VDC	**Without**	**DIN Connector**	**P3P-RP91C100D**
0-10VDC	0-10VDC, 4-20mA	DIN Connector	P3P-RP91C106D
0-10VDC	0-10VDC, 24VDC-Healthy 0V-Faulty	DIN Connector	P3P-RP91C107D
Control Signal	**Output Signal Options**	**Connection**	**1/4" Port Size**
4-20ma	Without	Cable Gland	P3P-RJ92C400G
4-20ma	**Without**	**DIN Connector**	**P3P-RJ92C400D**
4-20ma	0-10VDC, 4-20mA	DIN Connector	P3P-RJ92C406D
0-10VDC	Without	Cable Gland	P3P-RJ92C100G
0-10VDC	**Without**	**DIN Connector**	**P3P-RJ92C100D**
0-10VDC	0-10VDC, 4-20mA	DIN Connector	P3P-RJ92C106D
0-10VDC	0-10VDC, 24VDC-Healthy 0V-Faulty	DIN Connector	P3P-RJ92C107D
Control Signal	**Output Signal Options**	**Connection**	**1/2" Port Size**
4-20ma	Without	Cable Gland	P3P-RJ94C400G
4-20ma	**Without**	**DIN Connector**	**P3P-RJ94C400D**
4-20ma	0-10VDC, 4-20mA	DIN Connector	P3P-RJ94C406D
0-10VDC	Without	Cable Gland	P3P-RJ94C100G
0-10VDC	**Without**	**DIN Connector**	**P3P-RJ94C100D**
0-10VDC	0-10VDC, 4-20mA	DIN Connector	P3P-RJ94C106D
0-10VDC	0-10VDC, 24VDC-Healthy	DIN Connector	P3P-RJ94C107D

Note: All model numbers shown include the integrated sensor.

Brackets

Angle Bracket	**P3P-KA00MRN**
Foot Bracket	**P3P-KA00MFN**

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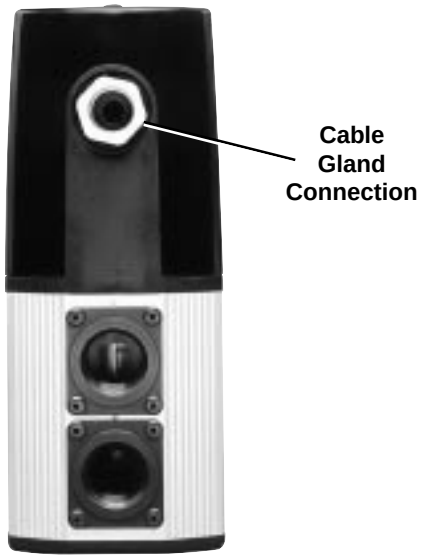
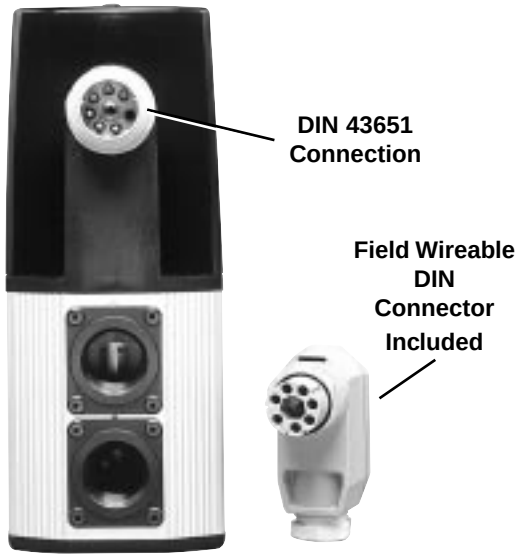
P3P-R Series Pressure Regulator with Cable Gland



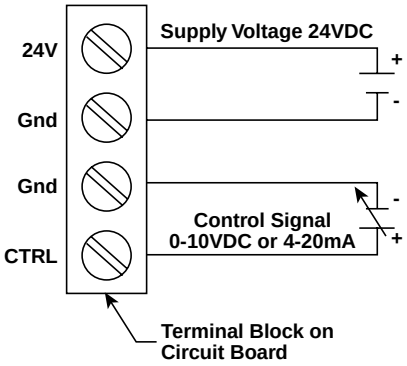
1/2" Port Size Shown

P3P-R Series Pressure Regulator with DIN 43651 and Female Connector (Field Wireable)

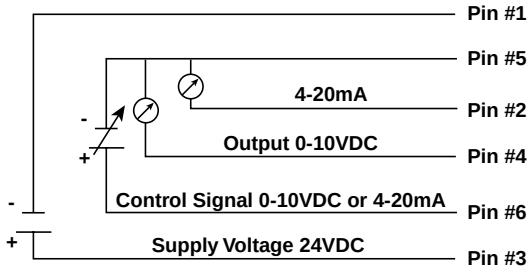


1/2" Port Size Shown

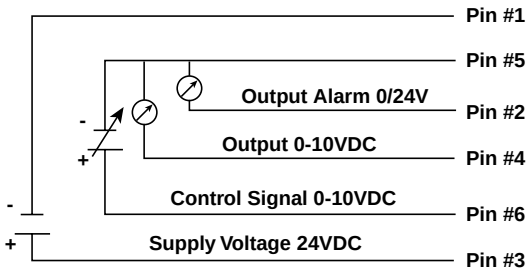
Connecting Diagrams



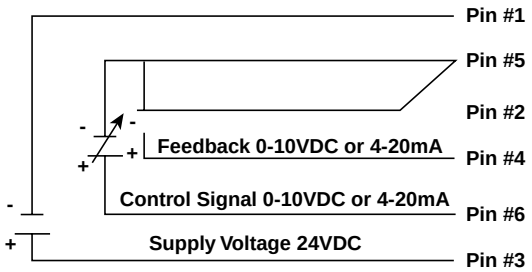
P3P-R....0G with Cable Gland Connection



P3P-R....06D with DIN Connection and with Output Signal Options



P3P-R....07D with DIN Connection and with Output Signal Options



P3P-R....10D or P3P-R....40D with DIN Connection and External Feedback

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Technical information

Air Consumption at Constant Control Signal:
0 (Zero)

Assembly:
Silicone free

Control Signal:
Analog 0-10VDC
Impedance: 10 K ohms

Analog 4-20mA
Impedance: 0.5 K ohms

Degree of Protection:
IP65

Electrical Connection:
4 screw terminals under the protection cover with PG 13.5 threaded cable gland or through DIN 43651 connector (6 Pins + Earth Ground). A field wireable connector is shipped with every unit with the DIN connector option.

Electromagnetic Compatibility:
In accordance with IEC 801-4 part 4 standards.

External Sensors:

All pressure sensors with following characteristics are compatible with the EP-transducer:

Sensitivity: 0.5 V/14.5 PSI up to 10 V/14.5 PSI

Zero offset: – 3 V to + 3 V.

Fluid:
Standard shop air, lubricated or non-lubricated (recommended filtration: 25-50 μ)

Hysteresis:
2 PSIG (100 mbar) (Factory set up) for 1/4" & 1/2" versions.

1 PSIG (50 mbar) (Factory set up) for 1/8" EP Transducer version.

Can be field adjusted.

Indicative Response Time:
1/8" EP Transducer Version
Volume of 1.83 inch^3 (30 cm^3) at outlet of the regulator
Filling: 29 to 58 PSIG (2 to 4 bar)
Step Response: 70 ms
Emptying: 58 to 29 PSIG (4 to 2 bar)
Step Response: 150 ms

1/4" & 1/2" Version
Volume of 20.14 inch^3 (330 cm^3) at outlet of the regulator
Filling: 29 to 58 PSIG (2 to 4 bar)
Step Response: 60 ms
Emptying: 58 to 29 PSIG (4 to 2 bar)
Step Response: 70 ms
Filling: 29 to 116 PSIG (2 to 8 bar)
Step Response: 120 ms
Emptying: 116 to 29 PSIG (8 to 2 bar)
Step Response: 130 ms

Inlet Pressure Range:
3 to 175 PSIG (0.2 bar to 12 bar)

Installation and Setting Instructions:
Refer to Bulletin 407659 supplied with the product.

Life Expectancy:
> 50 Million changes of control signal steps.

Linearity:
1% Full Scale Operation

Materials:
Housing - Aluminum
Cover - Plastic

Mounting Position:
Any direction (recommended position: upright; electronic part on top).

Operating Temperature Range:
32° to 122° F (0 to 50° C)

Outlet Pressure Range:
3 to 145 PSIG (0.2 to 10 bar)

Outlet Sensor Signal Options:
A) Proportional pressure outlet signal 0-10VDC from integrated sensor (recommended load resistance 10 K ohms)

B) Proportional pressure outlet signal 4-20mA from integrated sensor (recommended load resistance 0.5 K ohms max.)
Note: Voltage and current can be received simultaneously. Both are protected against short circuit.

C) "Positive Alarm" output signal 0/24VDC with adjustable triggering level. (Difference between control signal and sensor pressure signal) (Imax. = 40mA)

- factory set up:
diff.signal = ± 0.8 V to ± 1 V

- possible set up:
diff.signal = ± 0.1 V to ± 5 V

To neutralize the alarm output signal during the control signal changes, the use of a synchronized time lag relay is required

D) "Negative Alarm" output signal 24/0VDC with adjustable triggering level. Similar to C but with 24VDC healthy signal and 0V on alarm.

Power Consumption:
Max. 6 W with 24VDC and constant changes of the control signal < 1 W without change of control signal.

Resistance to Vibrations:
30 g in all directions.

Safety Position:
In case of control signal failure or if it is less than 1% of its full scale value, the regulated pressure drops automatically to 0 bar (atmospheric pressure).

In case of voltage supply failure, the regulated pressure will be kept constant (with eventual discrepancy due to loss of pressure in the pilot-chamber).

Supply Voltage:
24VDC ± 15 % (Max. ripple 1VDC)

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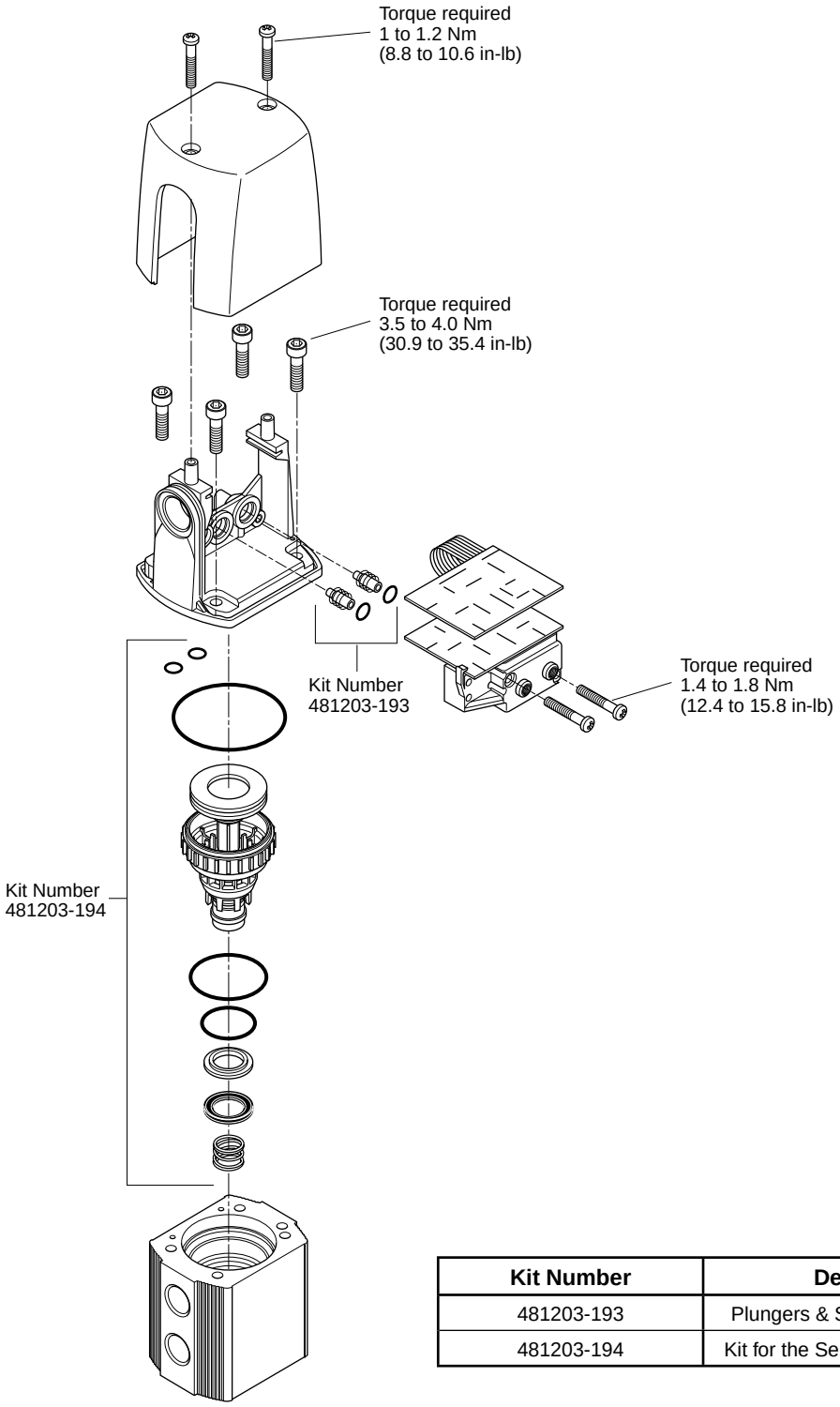

Kit Number	Description
481203-193	Plungers & Seals for Pilot Valves
481203-194	Kit for the Servo Chamber Section

Kit Number	Description
491092	DIN Connector

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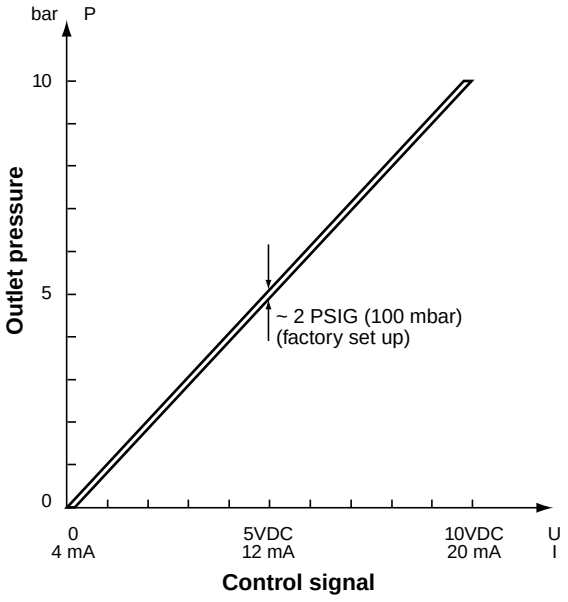
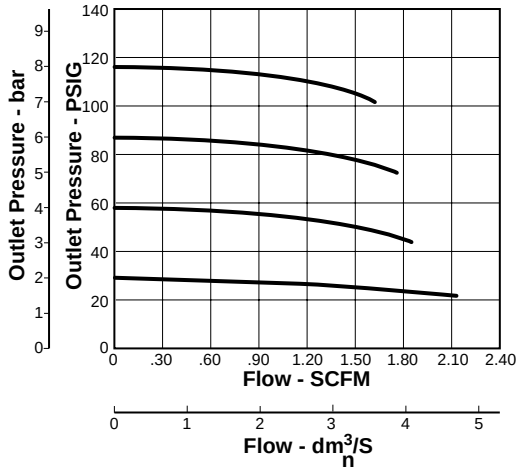
Hysteresis Chart



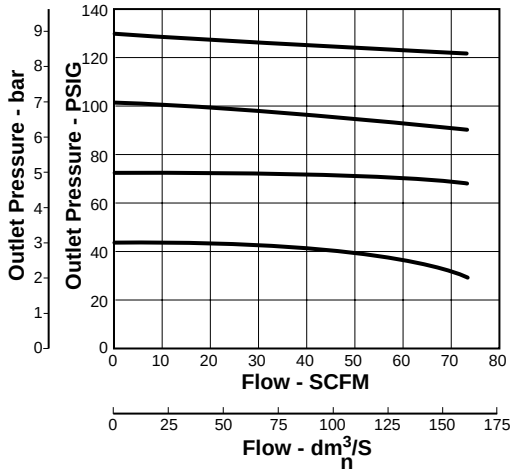
Flow Characteristics

@ 145 PSIG (10 bar) Inlet Pressure and Constant Control Signal

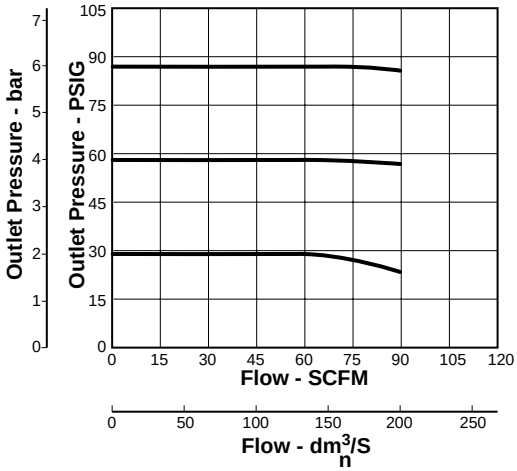
1/8" EP Version



1/4" Version



1/2" Version



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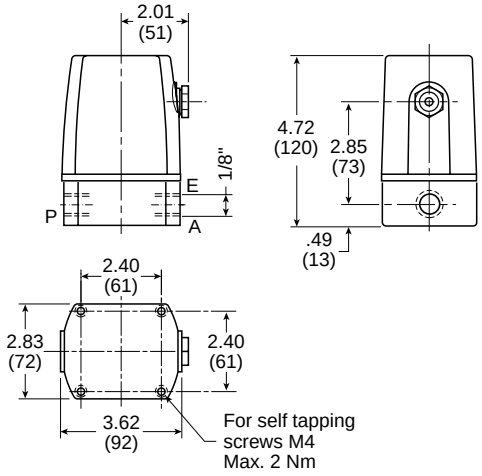
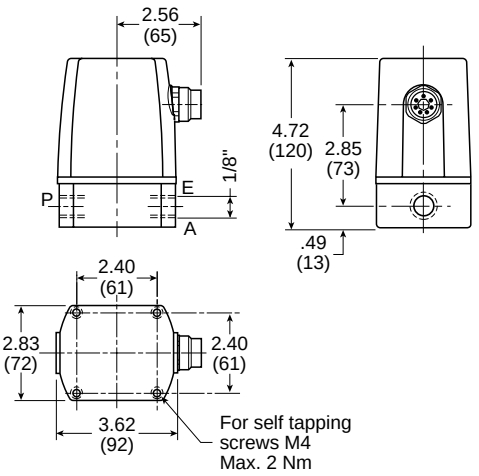
P3P-R (1/8" EP Version)

with PG 13.5 Threaded Cable Gland Connection



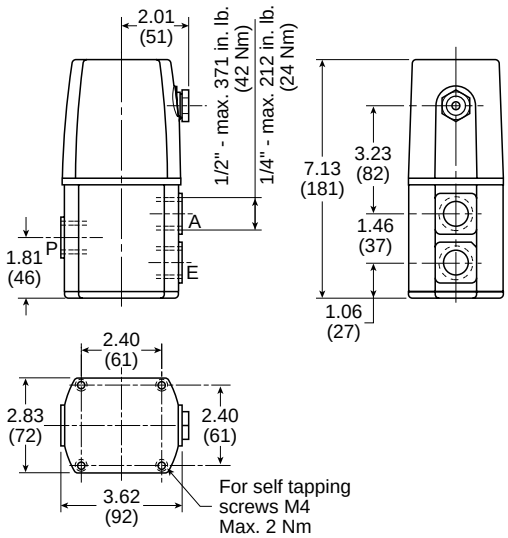
P3P-R (1/8" EP Version)

with DIN Circular Plug-in Connection 6 Pins +Earth Ground (Connector Included)



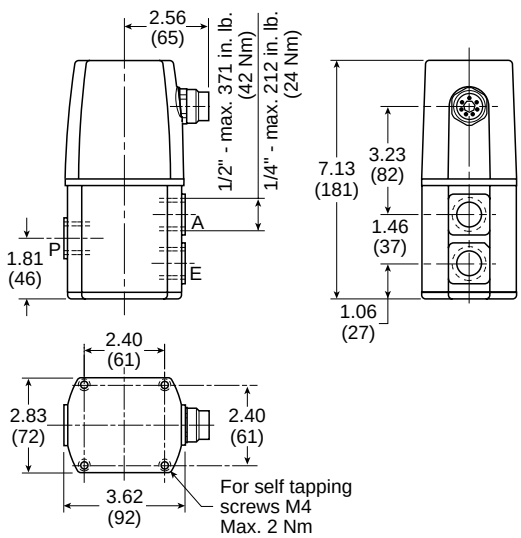
P3P-R (1/4" & 1/2" Body Type)

with PG 13.5 Threaded Cable Gland Connection

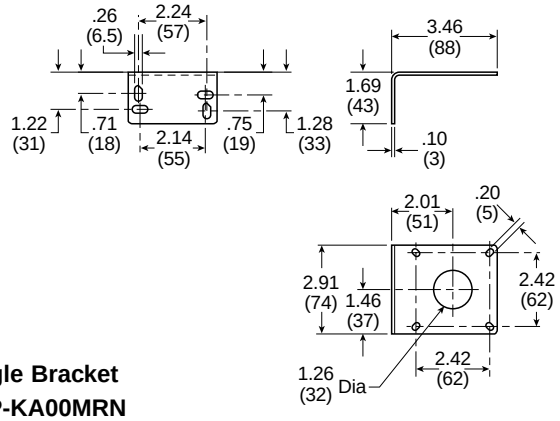


P3P-R (1/4" & 1/2" Body Type)

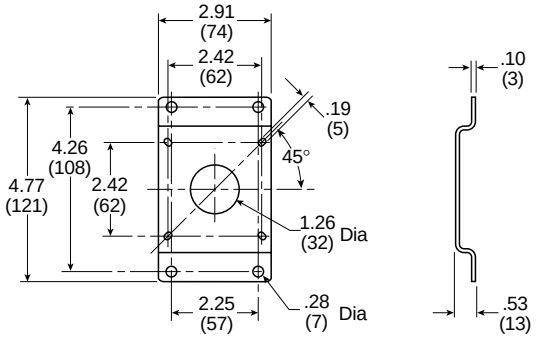
with DIN Circular Plug-in Connection 6 Pins +Earth Ground (Connector Included)



Accessories – **Mounting Brackets,** Supplied with 4 x M4 Screws



Angle Bracket
P3P-KA00MRN



Foot Bracket
P3P-KA00MFN

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Safety Guide For Selecting And Using Pneumatic Division Products And Related Accessories

⚠ WARNING:

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF PNEUMATIC DIVISION PRODUCTS, ASSEMBLIES OR RELATED ITEMS ("PRODUCTS") CAN CAUSE DEATH, PERSONAL INJURY, AND PROPERTY DAMAGE. POSSIBLE CONSEQUENCES OF FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THESE PRODUCTS INCLUDE BUT ARE NOT LIMITED TO:

- Unintended or mistimed cycling or motion of machine members or failure to cycle
- Work pieces or component parts being thrown off at high speeds.
- Failure of a device to function properly for example, failure to clamp or unclamp an associated item or device.
- Explosion
- Suddenly moving or falling objects.
- Release of toxic or otherwise injurious liquids or gasses.

Before selecting or using any of these Products, it is important that you read and follow the instructions below.

1. GENERAL INSTRUCTIONS

1.1. Scope: This safety guide is designed to cover general guidelines on the installation, use, and maintenance of Pneumatic Division Valves, FRLs (Filters, Pressure Regulators, and Lubricators), Vacuum products and related accessory components.

1.2. Fail-Safe: Valves, FRLs, Vacuum products and their related components can and do fail without warning for many reasons. Design all systems and equipment in a fail-safe mode, so that failure of associated valves, FRLs or Vacuum products will not endanger persons or property.

1.3 Relevant International Standards: For a good guide to the application of a broad spectrum of pneumatic fluid power devices see: ISO 4414:1998, Pneumatic Fluid Power – General Rules Relating to Systems. See www.iso.org for ordering information.

1.4. Distribution: Provide a copy of this safety guide to each person that is responsible for selection, installation, or use of Valves, FRLs or Vacuum products. Do not select, or use Parker valves, FRLs or vacuum products without thoroughly reading and understanding this safety guide as well as the specific Parker publications for the products considered or selected.

1.5. User Responsibility: Due to the wide variety of operating conditions and applications for valves, FRLs, and vacuum products Parker and its distributors do not represent or warrant that any particular valve, FRL or vacuum product is suitable for any specific end use system. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the appropriate valve, FRL, Vacuum component, or accessory.
- Assuring that all user's performance, endurance, maintenance, safety, and warning requirements are met and that the application presents no health or safety hazards.
- Complying with all existing warning labels and / or providing all appropriate health and safety warnings on the equipment on which the valves, FRLs or Vacuum products are used; and,
- Assuring compliance with all applicable government and industry standards.

1.6. Safety Devices: Safety devices should not be removed, or defeated.

1.7. Warning Labels: Warning labels should not be removed, painted over or otherwise obscured.

1.8. Additional Questions: Call the appropriate Parker technical service department if you have any questions or require any additional information. See the Parker 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. PRODUCT SELECTION INSTRUCTIONS

2.1. Flow Rate: The flow rate requirements of a system are frequently the primary consideration when designing any pneumatic system. System components need to be able to provide adequate flow and pressure for the desired application.

2.2. Pressure Rating: Never exceed the rated pressure of a product. Consult product labeling, Pneumatic Division catalogs or the instruction sheets supplied for maximum pressure ratings.

2.3. Temperature Rating: Never exceed the temperature rating of a product. Excessive heat can shorten the life expectancy of a product and result in complete product failure.

2.4. Environment: Many environmental conditions can affect the integrity and suitability of a product for a given application. Pneumatic Division products are designed for use in general purpose industrial applications. If these products are to be used in unusual circumstances such as direct sunlight and/or corrosive or caustic environments, such use can shorten the useful life and lead to premature failure of a product.

2.5. Lubrication and Compressor Carryover: Some modern synthetic oils can and will attack nitrile seals. If there is any possibility of synthetic oils or greases migrating into the pneumatic components check for compatibility with the seal materials used. Consult the factory or product literature for materials of construction.

2.6. Polycarbonate Bowls and Sight Glasses: To avoid potential polycarbonate bowl failures:

- Do not locate polycarbonate bowls or sight glasses in areas where they could be subject to direct sunlight, impact blow, or temperatures outside of the rated range.
- Do not expose or clean polycarbonate bowls with detergents, chlorinated hydro-carbons, keytones, esters or certain alcohols.
- Do not use polycarbonate bowls or sight glasses in air systems where compressors are lubricated with fire resistant fluids such as phosphate ester and di-ester lubricants.

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2.7. Chemical Compatibility: For more information on plastic component chemical compatibility see Pneumatic Division technical bulletins Tec-3, Tec-4, and Tec-5

2.8. Product Rupture: Product rupture can cause death, serious personal injury, and property damage.
- Do not connect pressure regulators or other Pneumatic Division products to bottled gas cylinders.
- Do not exceed the maximum primary pressure rating of any pressure regulator or any system component.
- Consult product labeling or product literature for pressure rating limitations.

3. PRODUCT ASSEMBLY AND INSTALLATION INSTRUCTIONS

3.1. Component Inspection: Prior to assembly or installation a careful examination of the valves, FRLs or vacuum products must be performed. All components must be checked for correct style, size, and catalog number. DO NOT use any component that displays any signs of nonconformance.

3.2. Installation Instructions: Parker published Installation Instructions must be followed for installation of Parker valves, FRLs and vacuum components. These instructions are provided with every Parker valve or FRL sold, or by calling 1-800-CPARKER, or at www.parker.com.

3.3. Air Supply: The air supply or control medium supplied to Valves, FRLs and Vacuum components must be moisture-free if ambient temperature can drop below freezing

4. VALVE AND FRL MAINTENANCE AND REPLACEMENT INSTRUCTIONS

4.1. Maintenance: Even with proper selection and installation, valve, FRL and vacuum products service life may be significantly reduced without a continuing maintenance program. The severity of the application, risk potential from a component failure, and experience with any known failures in the application or in similar applications should determine the frequency of inspections and the servicing or replacement of Pneumatic Division products so that products are replaced before any failure occurs. A maintenance program must be established and followed by the user and, at minimum, must include instructions 4.2 through 4.10.

4.2. Installation and Service Instructions: Before attempting to service or replace any worn or damaged parts consult the appropriate Service Bulletin for the valve or FRL in question for the appropriate practices to service the unit in question. These Service and Installation Instructions are provided with every Parker valve and FRL sold, or are available by calling 1-800-CPARKER, or by accessing the Parker web site at www.parker.com.

4.3. Lockout / Tagout Procedures: Be sure to follow all required lockout and tagout procedures when servicing equipment. For more information see: OSHA Standard – 29 CFR, Part 1910.147, Appendix A, The Control of Hazardous Energy – (Lockout / Tagout)

4.4. Visual Inspection: Any of the following conditions requires immediate system shut down and replacement of worn or damaged components:
- Air leakage: Look and listen to see if there are any signs of visual damage to any of the components in the system. Leakage is an indication of worn or damaged components.
- Damaged or degraded components: Look to see if there are any visible signs of wear or component degradation.
- Kinked, crushed, or damaged hoses. Kinked hoses can result in restricted air flow and lead to unpredictable system behavior.
- Any observed improper system or component function: Immediately shut down the system and correct malfunction.
- Excessive dirt build-up: Dirt and clutter can mask potentially hazardous situations.

Caution: Leak detection solutions should be rinsed off after use.

4.5. Routine Maintenance Issues:
- Remove excessive dirt, grime and clutter from work areas.
- Make sure all required guards and shields are in place.

4.6. Functional Test: Before initiating automatic operation, operate the system manually to make sure all required functions operate properly and safely.

4.7. Service or Replacement Intervals: It is the user's responsibility to establish appropriate service intervals. Valves, FRLs and vacuum products contain components that age, harden, wear, and otherwise deteriorate over time. Environmental conditions can significantly accelerate this process. Valves, FRLs and vacuum components need to be serviced or replaced on routine intervals. Service intervals need to be established based on:
- Previous performance experiences.
- Government and / or industrial standards.
- When failures could result in unacceptable down time, equipment damage or personal injury risk.

4.8. Servicing or Replacing of any Worn or Damaged Parts: To avoid unpredictable system behavior that can cause death, personal injury and property damage:
- Follow all government, state and local safety and servicing practices prior to service including but not limited to all OSHA Lockout Tagout procedures (OSHA Standard – 29 CFR, Part 1910.147, Appendix A, The Control of Hazardous Energy – Lockout / Tagout).
- Disconnect electrical supply (when necessary) before installation, servicing, or conversion.
- Disconnect air supply and depressurize all air lines connected to system and Pneumatic Division products before installation, service, or conversion.
- Installation, servicing, and / or conversion of these products must be performed by knowledgeable personnel who understand how pneumatic products are to be applied.
- After installation, servicing, or conversions air and electrical supplies (when necessary) should be connected and the product tested for proper function and leakage. If audible leakage is present, or if the product does not operate properly, do not put product or system into use.
- Warnings and specifications on the product should not be covered or painted over. If masking is not possible, contact your local representative for replacement labels.

4.9. Putting Serviced System Back into Operation: Follow the guidelines above and all relevant Installation and Maintenance Instructions supplied with the valve FRL or vacuum component to insure proper function of the system.

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Offer of Sale

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1. Terms and Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that the Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 18 months from date of shipment from Parker Hannifin Corporation. THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.

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6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitations, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. 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 apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer, or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are 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. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter "Intellectual Property Rights"). 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 an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgements resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

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