Pneumatic Products U.S.
A complete range of pneumatic system components
Catalog PDN1000-2US
The Parker 5-Year Extended Warranty

Parker Hannifin Corporation will extend its warranty on all pneumatic components to sixty (60) months providing they are correctly installed and protected by Parker pneumatic filters which are properly maintained. Components covered by this warranty include all cylinders, valves and pneumatic automation components manufactured by Parker in any of our global facilities. This warranty covers our components anywhere in the world you may ship your equipment.

Parker’s obligation under this warranty is limited to the replacement or repair of any failed components. The buyer understands that the seller will not be liable for any other costs or damages.

The buyers of quality Parker components and filters benefit by having ONE source for all pneumatic needs - Parker.

Yoon “Michael” Chung
President
Automation Group
At Parker, we have the largest global distribution network in motion and control, with over 7,500 distributors serving more than 422,000 customers.

To find the distributor nearest you, please visit our DISTRIBUTOR LOCATOR at http://www.parker.com/pneu/distributor

⚠️ 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.

Offer of Sale

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated on the separate page of this document entitled “Offer of Sale”.

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<td><img src="image" alt="B6" /></td>
<td><img src="image" alt="B83" /></td>
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<td>• Bore sizes 1-1/2 through 5 inch</td>
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<tr>
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<tr>
<td>• Aluminum body construction</td>
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<tr>
<td><strong>4MNR Series - Non-Rotating Cylinder</strong></td>
<td><strong>P1A Series - ISO Non-Repairable</strong></td>
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<td>• Bore sizes 1-1/8 through 4 inch</td>
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<tr>
<td>• 14 standard mounting styles</td>
<td>• 5 mounting styles</td>
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<tr>
<td>• Pressures up to 250 PSI</td>
<td>• Pressures up to 145 PSI</td>
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<tr>
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<td>• Aluminum body construction</td>
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<tr>
<td><strong>P1D Series - ISO 15552 / ISO 6431</strong></td>
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<td>• 5 available for maximum flexibility</td>
<td>• Bore sizes 1-1/8 through 4 inch</td>
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<tr>
<td>• Bore sizes 32mm through 200mm</td>
<td>• 4 mounting styles</td>
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<tr>
<td>• 10 standard mounting styles</td>
<td>• Pressures up to 150 PSI</td>
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<tr>
<td>• Pressures up to 145 PSI</td>
<td>• Temperatures -10°F to 250°F</td>
</tr>
<tr>
<td>• Temperatures -10°F to 250°F</td>
<td>• Aluminum body construction</td>
</tr>
<tr>
<td>• Aluminum body construction</td>
<td></td>
</tr>
</tbody>
</table>
**Compact Cylinders**

**P1Q Series - Economy Compact Cylinder**
- Bore sizes 12mm through 100mm
- 4 flexible mounting options
- Pressures up to 145 PSIG
- Temperatures 23°F to 158°F
- Aluminum body construction

**LP / LPM Series - Compact Cylinder**
- Bore sizes 9/16 through 4 inch
- 6 mounting styles
- Pressures up to 150 PSIG
- Temperatures -10°F to 200°F
- Aluminum body construction

**P1M Series - Compact Cylinder**
- Bore sizes 12mm through 100mm
- 6 mounting options
- Pressures up to 145 PSIG
- Temperatures -4°F to 250°F
- Aluminum body construction

**Guided Cylinders**

**P5T Series - Compact Guided**
- Bore sizes 16mm through 100mm
- Pressures up to 145 PSIG
- Temperatures 0°F to 250°F
- Aluminum body construction
- Flexible porting: top, rear, side

**P5T2 Series - Compact Guided**
- Bore sizes 12mm through 100mm
- Pressures up to 145 PSIG
- Temperatures 0°F to 250°F
- Aluminum body construction
- Through hole mounting

**P5L Series - Guided**
- Bore sizes 20mm through 100mm
- Direct mounting
- Pressures up to 145 PSIG
- Temperatures 0°F to 250°F
- Extruded aluminum body construction

**HB Series - Heavy Duty Guided**
- Bore sizes 1-1/2 through 2-1/2 inch
- Thrust, reach and compact versions available
- Air service pressure up to 250 PSIG, hydraulic service up to 750 PSIG
- Temperatures 0°F to 250°F
- Aluminum body construction
- Rod lock version available

**P5E Series - P1D ISO Guided**
- Bore sizes 32mm through 100mm
- Pressures up to 145 PSIG
- Temperatures 14°F to 165°F
- Aluminum body construction
- Rod lock version available
A6

Catalog PDN1000-2US
Parker Pneumatic

Pictorial Index
- www.parker.com/pneumatics

Actuator Products
- www.parker.com/pneu/actuators

Rodless Cylinders

OSP-P Series - Band Type Rodless
- B223
  - Bore sizes 10mm through 60mm
  - Pressures to max. 8 bar
  - Temperatures -10°F to 80°F
  - Aluminum body construction

P1X Series - Band Type Rodless
- B241
  - 7 bore sizes 16mm through 63mm
  - Integral sensor mounting rail
  - Pressures 29 to 100 PSIG
  - Temperatures 15°F to 140°F
  - Aluminum body construction

P1Z Series - Magnetically Coupled Rodless
- B253
  - 3 bore sizes 16mm, 20mm & 32mm
  - Pressures 29 to 100 PSIG
  - Temperatures 15°F to 140°F
  - Stainless steel body construction

GDL Series - Rails & Cassettees
- B265
  - 6 sizes available
  - Speed up to 10m/s (33 ft/s)
  - Temperatures -10°C to 80°C
  - Aluminum alloy rail
  - Aluminum body construction

Rotary Actuators

PV Series - Vane Rotary
- B270
  - 8 model sizes
  - Single or double vane models
  - Pressures to 150 PSIG
  - Temperatures 30°F to 250°F
  - 7 to 1800 lb-in output torque

PRN(A) Series - Vane Rotary
- B274
  - 5 miniature and 4 standard models
  - Temperatures -23°F to 176°F
  - 1.33 to 2355 in-lb torque at 100 PSIG

PTR Series - Rack & Pinion Rotary
- B279
  - Bore sizes 1 through 3-1/4 inch
  - Pressures to 250 PSIG
  - Temperatures 0°F to 250°F
  - 39 to 2281 lb-in output torque

HP Series - Large Rack & Pinion Rotary
- B282
  - 2 large bore models
  - 3 standard rotations
  - Pressures to 100 PSIG
  - Temperatures 0°F to 250°F
  - 4500 and 10,000 lb-in output at 100 PSIG

P1V-S Series - Air Motors
- B285
  - Power from 20 through 1200 watts
  - Speeds 5 to 24,000 RPM
  - Pressures to max. 7 bar
  - Temperatures -30°C to 100°C

Actuator Products
- www.parker.com/pneu/actuators

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Vacuum Products

Valve Products

Air Preparation Products

Dryer Products

Accessories

Application Engineering Data

Safety Guides

Offer of Sale

Parker Hannifin Corporation
Pneumatic Division
Richland, Michigan
www.parker.com/pneumatics
Grippers

- Stroke ranges: 0.12 to 6.0 inches
- Grip forces: up to 2800 lbs
- Operating characteristics:
  - Single acting
  - Double acting
  - Spring assist and spring return

Actuator Accessories

Linear Alignment Couplers

- 12 standard thread sizes
- Maximum reliability for trouble-free operation, long life and lower operating costs
- Increased cylinder life by reducing wear on piston and rod bearings
- Stainless steel versions available

4TK Series - Air-Oil Tanks

- 6 standard bore sizes
- Lightweight aluminum / fiberglass design
- 2 fluid flow baffles reduce agitation and aeration
- 8 standard mounting styles

PRL Series - Stand Alone Rodlock

- 5 different sizes
- Large holding forces
- 2 different mounting styles
- Case-hardened rod material available

Electronic Sensors

Sensors

- Solid state
- Reed
- NAMUR
- Proximity

Shock Absorbers

- Miniature - self-compensating
- Heavyweight - soft contact and self-compensating
- Miniature - soft contact and self-compensating
- Magnum series - adjustable
- Heavy - self-compensating
- Heavy - adjustable
### Vacuum Cups

**PFG Flat Cups**
- Precision molded single lip flat cup for smooth or slightly curved surfaces.
- Low profile design makes flat pads ideal for fast response.
- Cup Sizes: 1.5mm to 200mm

**PBG Bellows Cups**
- Versatile bellows cup design provides a flexible sealing lip for products with irregular, smooth, curved surfaces, and flexible products.
- Cup sizes: 10mm to 150mm

**P5V-CFS Flat Cups**
- Precision molded double lip flat cup for slightly curved surfaces.
- Double lip for additional security. If outside lip bends and loses its seal, the inner lip remains sealed.
- Outer ribs prevent the cup lip from being cut.
- Cup Sizes: 50mm to 150mm

**PJG Short Bellows Cups**
- Versatile bellows cup design provides a flexible sealing lip for products with irregular, smooth, curved surfaces, and flexible products.
- Shorter stroke provides fast response.
- Cup sizes: 6mm to 80mm

**PCG Multiple Bellows Cups**
- Versatile bellows cup design provides a flexible sealing lip for products with irregular, smooth, or curved surfaces.
- 2-1/2 bellows design minimizes contact pressure applied to products.
- Cup sizes: 5mm to 90mm

**PUBG Flat Swivel Cups**
- 30° swivel single lip flat cup for smooth surfaces, slightly curved surfaces, and flexible products.
- Rigid stem or level compensator provides good stability for horizontal lift.
- Cup Sizes: 60mm to 100mm

### Vacuum Generators

**MCA, CV, CV-CK Inline Generators**
- MCA: Light weight vacuum generator.
- CV: Basic aluminum body vacuum generator.
- CV-CK: Basic aluminum body vacuum generator with mechanical switch for part present confirmation.

**CHF Inline Generators**
- CHF: High Flow Series is a multistage vacuum generator.
- Intended for high flow vacuum applications.
- Ideal for porous applications.
- Standard with flow thru exhaust mufflers to reduce clogging in dirty environments.

**MC22 Integrated Generators**
- Compact vacuum generator includes vacuum and blow-off solenoids and vacuum filters.
- Optional check valve and MPS-23 pressure sensor.
- Air-economizing function with MVS-201 pressure sensor.
- Inline version can be mounted on manifolds up to 8 stations.

**MC72 Integrated Generators**
- Light weight vacuum generator includes vacuum and blow-off solenoids.
- Includes check valve, vacuum filter and optional MPS-23 pressure sensor.
- Air-economizing function with MVS-201 pressure sensor.
- Inline version can be mounted on manifolds up to 5 stations.

**CEK Integrated Generators**
- Air-economizing functions with emergency stop logic that maintains degree of vacuum with loss of output power.
- Includes vacuum and blow-off solenoids, check valve, vacuum filter and optional MPS-23 pressure sensor.
- Inline versions can be mounted in manifolds up to 5 stations.

**CVXCEK Integrated Generators**
- Basic 2 station CEK generator manifold with additional electrical capabilities.
- Integrates MPS-23 sensor for on board air-economizing programming.
- M12 electrical wiring package with optional 18-pin single connection.
### Vacuum Generator Accessories

#### MPS-23 Integrated Generator Sensors
- 0 to -30 inHg, -14.7 to 72.5 PSIG
- Output type: (2) NPN / PNP
- Media: air, non-corrosive gas
- IP65
- Hysteresis output mode: variable, 100% F.S.
- Output setting: push button
- LED display (Red)

#### MVS-201 Integrated Generator Sensors
- 0 to -30 inHg, -14.7 to 72.5 PSIG
- Output type: (2) NPN / PNP
- Media: air, non-corrosive gas
- IP65
- Hysteresis output mode: variable, 100% F.S.
- Output setting: push button
- LED display (Red)

### Pressure Sensors / Cables

#### FSV Metered Flow Sensing Valve
- Pick and place randomly placed products
- Minimize vacuum loss when cup seal is lost
- Direct mounting to cups
- 1/8 to G3/8 connection
- Integrated bronze filter

#### CH01 One Way Check Valve
- Poppet design
- Low leakage
- Low cracking pressure

#### VF & VFL Vacuum Filters
- Filters the vacuum system to protect the components from damaging particles absorbed from the environment
- Elements easily replaced

#### VFP Vacuum Filters
- Provides easy monitoring, economy and safety
- 10 micron porous plastic element prolongs element life
- Shatterproof and airtight
- Replaceable filter element

### Convum Vacuum Silencers
- Pressure up to 128 PSIG
- Temperature 41°F to 132°F (5°C to 55.5°C)
- Silencing effect 20 dB

### Pressure Sensors / Cables

#### MPS-33 Pressure Sensors
- 0 to -30 inHg, 0 to 145 PSIG
- Output type: (2) PNP or (1) NPN with analog
- Media: air, non-corrosive gas
- IP50
- Hysteresis output mode: variable, 100% F.S.
- Output setting: push button
- LED display (Red)

#### MPS-34 Pressure Sensors
- 0 to -30 inHg, 0 to 145 PSIG
- Output type: (2) PNP or (1) NPN with analog
- Media: air, non-corrosive gas
- IP50
- Hysteresis output mode: variable, 100% F.S.
- Output setting: push button
- LED display (Red)

#### SCPSD Pressure Sensors
- CV-CK is a Venturi Generator with adjustable open contact mechanical switch for vacuum confirmation.
- Great for low cost vacuum confirmation

#### Cables
- M8, M12 male / female connector
- Length: 2m or 5m
- Cover: PVC or PUR
- Connection type: swivel straight or angled
- IP67 swivel connector
Direct Acting Valves

XM Series - Direct Acting
- Inline or stacking
- 1/8 inch ports
- Pressures 0 to 125 PSIG
- Temperatures 32°F to 125°F
- Flow - .15 Cv

15mm Series - Direct Acting
- Subbase or manifold
- 1/8 inch ports
- Pressures VAC to 145 PSIG
- Temperatures 5°F to 140°F
- Flow - .033 to .05 Cv

Inline Valves

B Series - Inline
- Inline, subbase or bar manifold
- 1/8 through 3/4 inch ports
- Pressures VAC to 145 PSIG
- Temperatures 5°F to 120°F
- Flow - .75 to 7.0 Cv

Viking Xtreme Series - Inline
- Inline or bar manifold
- 1/8 through 1/2 inch ports
- Pressures VAC to 232 PSIG
- Temperatures -40°F to 158°F
- Flow - .7 to 2.7 Cv

ADEX Series - Inline
- Inline, subbase or bar manifold
- M3, M5, 1/8 inch ports
- Pressures VAC to 100 PSIG
- Temperatures 32°F to 122°F
- Flow - .1 to .47 Cv

Inline – continued

N Series - Inline Poppet
- Inline mounted
- 3/8 through 1-1/2 inch ports
- Pressures 30 to 250 PSIG
- Temperatures 0°F to 200°F
- Flow - 3.6 to 29.9 Cv

Subbase & Manifold Valves

Moduflex Series Valves
- Inline or stacking
- 4mm tube, 1/4, 3/8 inch ports
- Pressures VAC to 120 PSIG
- Temperatures 5°F to 140°F
- Flow - .18 to .80 Cv

Isys Micro Series - Subbase
- Subbase or manifold
- 4mm through 1/4 tube
- Pressures VAC to 145 PSIG
- Temperatures 5°F to 120°F
- Flow - .36 Cv

Isys ISO Series
- Subbase or manifold
- 1/8 through 3/4 inch ports
- Pressures VAC to 145 PSIG
- Temperatures 5°F to 120°F
- Flow - .55 to 6.0 Cv

Fieldbus Systems
- Fieldbus interface for Isys and Moduflex valves
- Up to 256 inputs
- Up to 256 outputs
- Digital or analog
Subbase & Manifold – continued

DX ISOMAX Series
- Subbase or manifold
- 1/8 through 3/4 inch ports
- Pressures VAC to 145 PSIG
- Temperatures 0°F to 200°F
- Flow .55 to 4.15 Cv

Valvair II Series - Plug-in
- Subbase or manifold
- 3/8 through 1-1/2 inch ports
- Pressures VAC to 225 PSIG
- Temperatures 0°F to 200°F
- Flow 1.9 to 12.0 Cv

Manual / Mechanical – continued

M0 Series - Inline
- Air Pilot, Manual / mechanical
- 1/4 and 1 inch ports
- Pressures VAC to 225 PSIG
- Temperatures -15°F to 200°F
- Flow .5 to 1.25 Cv

LV / EZ Lockout Valves
- Port sizes 3/8 through 1-1/4 inch
- Max. supply pressure 300 PSIG
- Max. operating temperature 175°F
- Cv from 3.7 to 14

Brass Poppet, Sliding Seal
- 4-way, 3-position rotary disc, direct air operated valves
- Pressures 0 to 150 PSIG
- Temperatures 18°F to 200°F
- Flow 2.5 to 6.2 Cv

Valve Products

Control Panel Products
- A wide variety of push buttons and selector switches
- Visual indicators
- Foot pedal switches
- Modular pneumatic / electric push buttons

Sensing / Limit Switches
- Limit switches in a variety of sizes and configurations
- Pressure switches with many adjustable ranges
- Components designed specifically for pneumatic technology using pressure variation, air bleen or blocking for detection
Global Modular Air Preparation Products

Global Modular FRL’s
- Port size: 1/4 through 3/4 inch
- Maximum supply pressure: 300 PSIG
- Operating temperature: -13°F through 150°F
- Flows to 212 SCFM
- Filters, regulators, filter / regulators, lubricators and accessories

General Industrial Air Preparation Products

Miniature, Compact, Standard, Hi-Flow
- Port size: 1/8 through 3 inch
- Maximum supply pressure: 250 PSIG
- Operating temperature: -14°F through 176°F
- Flows to 2900 SCFM
- Filters, regulators, filter / regulators, lubricators and accessories
- 4” & 6” Separators & filters

Stainless Steel Air Preparation Products

Stainless Steel FRL’s
- Port sizes: 1/4 and 1/2 inch
- Stainless steel construction handles most corrosive environments
- Fluorocarbon seals standard
- Meets NACE specifications MR-01-75/ISO 15156
- Filters, regulators, filter / regulators, lubricators and accessories

Precision & Proportional Regulator Air Preparation Products

Precision & Proportional Regulators
- Port sizes: 1/4 through 2 inch
- Maximum supply pressure: 300 PSIG
- Operating temperature: -40°F through 200°F
- Flows to 1600 SCFM
- Electronic proportional

Dryer Products

Dryer Products
- Refrigeration (10-2400 SCFM)
- Inline desiccant (15-60 SCFM)
- Regenerative desiccant (3-900 SCFM)
- Heatless desiccant dryers
- Zero loss & timer drains
- Auto electrical drain valves

Accessories

Ball Valves / Plug Valves
- Forged brass, general purpose, industrial ball valves
- Stainless steel, general purpose, industrial ball valves
- One piece extruded brass body plug valves

Hose & Fittings
- 801 General purpose hose
- Push-on hose barb fittings

Integrated Fittings
- Flow control regulators
- Inline check valves
- Blocking valves
- Threshold sensors

Miscellaneous Accessories
- Tank valves & air chucks
- Mufflers & silencers
- Relief valves
- Quick exhaust / shuttle valves
- Pressure switches
- Blow guns
- Ports from M5 through 3/4 inch
Accessories – continued

Quick Couplings

- Industrial interchange nipples
  -1/4" to 3/4" body size
- Sleevematic couplers
  -1/4" to 1/2" body size
- Safromatic couplers
  -1/4" to 3/4" body size
- Economatic quick connect couplings
  -1/4" body size

Tubing & Fittings

- Push-to-connect, Prestolok composite fittings
- Push-to-connect, Prestolok metal fittings
- Pipe fittings
- E: instrument grade tubing, N: flexible tubing, FRPE: flame resistant tubing, NR: semi-rigid high strength tubing, U: polyether base tubing

Application Engineering Data

- Fluid Power Graphic Symbols
- Valve Product Selection Data
- Technical Data
- Application Engineering Data

Safety Guides, Offer of Sale

- Safety Guide – Actuator Products
- Safety Guide – Control Products
- Offer of Sale
Safety Guide for Selecting and Using Hydraulic, Pneumatic Cylinders and Their Accessories

WARNING: \textit{A. 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.

\textbf{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 pages” 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:

- 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 rod joint.

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

\[
\text{operating pressure} \times \text{effective cap end area}
\]

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 – Cleanness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.
3.1.2 – Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.

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

3.1.4 – Sometimes it may be necessary to rotate the piston rod in order to thread the piston rod into the machine member. This operation must always be done with zero pressure being applied to either side of the piston. Failure to follow this procedure may result in loosening the piston to rod-threaded connection. In some rare cases the turning of the piston rod may rotate a threaded piston rod gland and loosen it from the cylinder head. Confirm that this condition is not occurring. If it does, retighten 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 – All 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 – Cylinders sized too close to load requirements – Reduce load or install larger cylinder.

4.2.2 – Internal Leaks

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 lip seal 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 lip seal 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

4.4.1 – 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.
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Catalog PDN1000-2US

Pneumatic Products

Safety Guide, Control Products

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.


1.4. 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, ketones, 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.

Parker Hannifin Corporation
Richland, Michigan
www.parker.com/pneumatics
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.


4.4. 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.
The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer’s order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods or work described will be referred to as “Products”.

1. Terms and Conditions. Seller’s willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of such terms and conditions. Invoices and Delivery Conditions are written on line at www.parker.com/term/seller. Seller objects to any contrary or additional terms or conditions of Buyer’s order or any other document issued by Buyer.

2. Price Adjustments; Payments. Prices stated on Seller’s quote or other documentation are subject to change and are valid for 30 days, and do not include any state or other taxes unless specifically stated, unless otherwise specified by Seller, all prices are F.C.A. Seller’s facility (INCOTERMS 2010). Payment is subject to credit approval and is due a date of invoice or such shorter period as required by Seller’s Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Delivery Dates; Title and Risk; Shipments. All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipper at Seller’s facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No detriment of shipment at Buyers’ request beyond the respective dates indicated 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 expenses incurred by Seller for Buyer’s acts or omissions.

4. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of such terms and conditions. Invoices and Delivery Conditions are written on line at www.parker.com/term/seller. Seller’s products are based upon the exclusive limited warranty stated above, and to Buyer or 2,000 hours of normal use, whichever occurs first. The prices charged for Seller’s products are subject to Buyer’s assumption of all warranty liability, including without limitation, costs associated with Buyer’s testing and evaluation of the Seller’s products or systems. The user, through its own analysis and testing, is solely responsible for the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the applicable laws and regulations are fully met, and continue using the Product in conformance with all applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Product or systems.

5. Limitation of Liability. Upon notification, Seller will, at its option, repair or replace a defective Product, or refund the purchase price in no event shall Seller be liable to Buyer for any special, indirect, incidental or consequential damages arising out of, or as the result of, the sale, delivery, non-delivery, servicing, use or loss or use of the Products or any part thereof, or for any charges or expenses of any nature incurred without Seller’s written consent, even if Seller has been negligent, whether in contract, tort or other legal theory. In no event shall Seller’s liability under any claim made by Buyer exceed the purchase price of the Product hereunder.

6. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the applicable laws and regulations are fully met, and continue using the Product in conformance with all applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

7. Loss to 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 obsolescent and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property or its possession or control.

8. Special Tools. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller’s property notwithstanding payment of any or all thereof, and no event will Buyer acquire any interest in any or all thereof to Seller which is utilized in the manufacture of the Products, 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 possession at any time.

9. Buyer’s Obligation; Rights of Seller. To secure payment of all sums due or otherwise payable hereunder, Buyer shall, in the event of non-payment of any invoice delivered, and in all other instances as required by the Uniform Commercial Code, Buyer shall be deemed 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.

10. Indemnity. Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer’s employees, or any other person, arising out of: (a) improper selection, improper application or other use of Seller’s products; (b) Buyer’s or seller’s negligence; or otherwise, of Buyer; (c) Buyer’s use of patterns, plans, drawings, or specifications furnished by Seller to manufacture Product; or (d) Buyer’s failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as specifically provided.

11. Cancellations and Changes. Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller’s written consent and upon terms, conditions and changes as stated by Seller. Buyer shall indemnify, defend and hold Seller harmless against any costs, direct, indirect, or consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

12. Limitation on Assignment. Buyer may not assign its rights or obligations under this agreement without Seller’s prior written consent.

13. Force Majeure. Seller does not assume the risk 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, 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 control.

14. Waiver and Severability. Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller’s right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

15. Governing Law. This agreement and the sale and delivery of all Products hereunder shall be 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 this agreement.

16. 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 Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (“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 a Product sold pursuant to this Agreement 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, agreements or compromises over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product 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 a noninfringing substitute Product, or offer to accept return of the Product and refund 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 Products delivered hereunder for which the designs are specified in whole or in part by Buyer, or for infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller’s sole and exclusive liability and Buyer’s sole and exclusive remedy for infringement of Intellectual Property Rights.

17. Entire Agreement. This agreement contains the entire agreement between the parties and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

18. Compliance with Law. U. K. Bribery Act and U.S. Foreign Corrupt Practices Act. Buyer agrees to comply with all relevant laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which the Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA") and the U.S. Ant-Kickback Act (the “Anti-Kickback Act”), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U. K. Bribery Act and the FCPA and agree to abide by all such laws. Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, any political party, any commercial entity, or the furthering of any political purpose by influencing such person to purchase products or otherwise benefit the business of Seller.

02/12