Pneumatic Products U.S.
A complete range of pneumatic system components
Catalog PDN1000US
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.

Roger Sherrard
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

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### Actuator Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tie Rod Cylinders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3MA Series</td>
<td>B6-B15</td>
<td>0900P-E</td>
</tr>
<tr>
<td>4MA/4ML Series</td>
<td>B16-B36</td>
<td>0900P-E</td>
</tr>
<tr>
<td>3MAJ/4MAJ Series</td>
<td>B37-B54</td>
<td>0900P-E</td>
</tr>
<tr>
<td>4MNR Series</td>
<td>B55-B61</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P1D Series</td>
<td>B62-B78</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Round Body Cylinders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR/GRM/GRD/GRDM Series</td>
<td>B79-B104</td>
<td>0900P-E</td>
</tr>
<tr>
<td>SX Series</td>
<td>B105-B112</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P1L Series</td>
<td>B113-B126</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P1A Series</td>
<td>B127-B130</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P Series</td>
<td>B131-B136</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Compact Cylinders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1G Series</td>
<td>B137-B144</td>
<td>0960P-E</td>
</tr>
<tr>
<td>P1M Series</td>
<td>B145-B156</td>
<td>0900P-E</td>
</tr>
<tr>
<td>LP/LFM Series</td>
<td>B157-B162</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Guided Cylinders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P5T Series</td>
<td>B163-B165</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P5T2 Series</td>
<td>B166-B168</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P5L Series</td>
<td>B169-B172</td>
<td>0900P-E</td>
</tr>
<tr>
<td>HB Series</td>
<td>B173-B176</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P5E Series</td>
<td>B177-B178</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Rodless Cylinders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSP-P Series</td>
<td>B179-B240</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P1X Series</td>
<td>B241-B252</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P1Z Series</td>
<td>B253-B264</td>
<td>0900P-E</td>
</tr>
<tr>
<td>GDL Series</td>
<td>B265-B269</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Rotary Actuators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV Series</td>
<td>B270-B272</td>
<td>0900P-E</td>
</tr>
<tr>
<td>PRN(A) Series</td>
<td>B273-B276</td>
<td>0900P-E</td>
</tr>
<tr>
<td>PGW Series</td>
<td>B277-B278</td>
<td>0915P-E</td>
</tr>
<tr>
<td>PTR Series</td>
<td>B279-B280</td>
<td>0900P-E</td>
</tr>
<tr>
<td>HP Series</td>
<td>B281-B282</td>
<td>0900P-E</td>
</tr>
<tr>
<td>P1V-S Series</td>
<td>B283-B284</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Grippers</td>
<td>B285-B286</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Actuator Accessories</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear Alignment Couplers</td>
<td>B287</td>
<td>0900P-E</td>
</tr>
<tr>
<td>4TK Air-Oil Tanks</td>
<td>B288</td>
<td>0900P-E</td>
</tr>
<tr>
<td>PRL Series</td>
<td>B289-B290</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Transition Kits</td>
<td>B291-B295</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Electronic Sensors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid State, Reed and Proximity Sensor</td>
<td>B296-B319</td>
<td>0900P-E</td>
</tr>
<tr>
<td>Shock Absorbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Shock Absorbers (Linear Decelerators)</td>
<td>B320-B331</td>
<td>0900P-E</td>
</tr>
</tbody>
</table>

---

### Vacuum Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFG Flat</td>
<td>C4-C16</td>
<td>0802-E</td>
</tr>
<tr>
<td>PBG Bellows</td>
<td>C17-C28</td>
<td>0802-E</td>
</tr>
<tr>
<td>P5V-CFS Flat</td>
<td>C29</td>
<td>0802-E</td>
</tr>
<tr>
<td>PJG Short Bellows</td>
<td>C30-C41</td>
<td>0802-E</td>
</tr>
<tr>
<td>PCG Multiple Bellows</td>
<td>C42-C49</td>
<td>0802-E</td>
</tr>
<tr>
<td>PUGB Flat Swivel</td>
<td>C50-C53</td>
<td>0802-E</td>
</tr>
<tr>
<td>Generators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCA, CV, CV-CK</td>
<td>C54-C55</td>
<td>0802-E</td>
</tr>
<tr>
<td>CHF</td>
<td>C56-C57</td>
<td>0802-E</td>
</tr>
<tr>
<td>MC22</td>
<td>C58-C60</td>
<td>0802-E</td>
</tr>
<tr>
<td>MC72</td>
<td>C61-C63</td>
<td>0802-E</td>
</tr>
<tr>
<td>CKE</td>
<td>C64-C66</td>
<td>0802-E</td>
</tr>
<tr>
<td>CVXCEK</td>
<td>C67-C68</td>
<td>0802-E</td>
</tr>
<tr>
<td>Generator Sensors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPS-23</td>
<td>C69-C70</td>
<td>0802-E</td>
</tr>
<tr>
<td>MVS-201 Genius</td>
<td>C71-C72</td>
<td>0802-E</td>
</tr>
<tr>
<td>Pressure Sensors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPS-33</td>
<td>C78-C79</td>
<td>0802-E</td>
</tr>
<tr>
<td>MPS-34</td>
<td>C80-C81</td>
<td>0802-E</td>
</tr>
<tr>
<td>ScP01</td>
<td>C82</td>
<td>0802-E</td>
</tr>
<tr>
<td>ScPSD</td>
<td>C83-C84</td>
<td>0802-E</td>
</tr>
<tr>
<td>Cables</td>
<td>C85</td>
<td>0802-E</td>
</tr>
</tbody>
</table>

---

### Valve Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Acting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XM Series</td>
<td>D4-D7</td>
<td>0600P-E</td>
</tr>
<tr>
<td>15mm Solenoid</td>
<td>D8-D10</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Inline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Series</td>
<td>D11-D32</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Viking Xrtreme Series</td>
<td>D33-D42</td>
<td>0600P-E</td>
</tr>
<tr>
<td>ADEX Series</td>
<td>D43-D52</td>
<td>0600P-E</td>
</tr>
<tr>
<td>N Series</td>
<td>D53-D59</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Subbase &amp; Manifold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moduflex</td>
<td>D60-D83</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Isys Micro Series</td>
<td>D84-D94</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Isys ISO Series</td>
<td>D95-D127</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Fieldbus</td>
<td>D128-D146</td>
<td>0600P-E</td>
</tr>
<tr>
<td>DX ISOMAX Series</td>
<td>D147-D159</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Valvair II</td>
<td>D160-D167</td>
<td>0600P-E</td>
</tr>
</tbody>
</table>
## Valve Products – Continued

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual / Mechanical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Directair 2, Directair 4 Series</td>
<td>D168-D176</td>
<td>0600P-E</td>
</tr>
<tr>
<td>42 Lever / Pedal Series</td>
<td>D177-D178</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Viking Xtreme Lever Series</td>
<td>D179-D183</td>
<td>0600P-E</td>
</tr>
<tr>
<td>MO Series</td>
<td>D184-D187</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Lockout Valves – LV-EZ Series</td>
<td>D188</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Brass Poppet / Sliding Seal</td>
<td>D189-D191</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Valve Accessories</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Panel Products</td>
<td>D192-D195</td>
<td>0600P-E</td>
</tr>
<tr>
<td>Sensing / Limit Switches</td>
<td>D196-D204</td>
<td>0600P-E</td>
</tr>
</tbody>
</table>

## Air Preparation Products

### Modular

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate Filters</td>
<td>E3-E4</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Coalescing and Adsorber Filters</td>
<td>E5-E6</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Regulators</td>
<td>E7-E8</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Common Regulators</td>
<td>E9-E10</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Filter / Regulators</td>
<td>E11-E12</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Lubricators</td>
<td>E13-E14</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Combinations</td>
<td>E15-E16</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Electronic Proportional Regulators</td>
<td>E17-E18</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Soft Start / Dump Valves</td>
<td>E19-E20</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Solenoid Operators</td>
<td>E21-E22</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Accessories</td>
<td>E23-E26</td>
<td>0700P-E</td>
</tr>
</tbody>
</table>

### General Industrial

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Separator</td>
<td>E27-E29</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Particulate Filters</td>
<td>E30-E37</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Coalescing Filters</td>
<td>E39-E46</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Regulators</td>
<td>E47-E59</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Filter / Regulators</td>
<td>E60-F67</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Lubricators</td>
<td>E68-E76</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Combs</td>
<td>E77-E83</td>
<td>0700P-E</td>
</tr>
</tbody>
</table>

### Stainless Steel

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filters</td>
<td>E84-E85</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Regulators</td>
<td>E86-E87</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Filter / Regulators</td>
<td>E88-E89</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Lubricators</td>
<td>E90</td>
<td>0700P-E</td>
</tr>
</tbody>
</table>

### Precision / Proportional

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-Precision Regulators</td>
<td>E91</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Semi-Precision Dial Regulators</td>
<td>E93-E93</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Precision Filter / Regulators</td>
<td>E94-E95</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Precision Pneumatic Input Signal Amplifier</td>
<td>E96</td>
<td>0700P-E</td>
</tr>
<tr>
<td>High Precision Regulators</td>
<td>E97-E98</td>
<td>0700P-E</td>
</tr>
<tr>
<td>High Precision Relief Valve</td>
<td>E99</td>
<td>0700P-E</td>
</tr>
<tr>
<td>High Precision Vacuum Regulator</td>
<td>E100</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Electronic Proportional Regulator</td>
<td>E101-E102</td>
<td>0700P-E</td>
</tr>
</tbody>
</table>

## Air Preparation Products – Continued

### Dryers

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDRD Refrigeration Dryers</td>
<td>E103-E104</td>
<td>0722P-E</td>
</tr>
<tr>
<td>Inline Desiccant Dryers</td>
<td>E105</td>
<td>0722P-E</td>
</tr>
<tr>
<td>Regenerative Desiccant Dryers</td>
<td>E106</td>
<td>0722P-E</td>
</tr>
<tr>
<td>Heatless Desiccant Dryers</td>
<td>E107-E108</td>
<td>0722P-E</td>
</tr>
<tr>
<td>Zero Air Loss Condensate Drains</td>
<td>E109</td>
<td>0722P-E</td>
</tr>
<tr>
<td>Automatic Electrical Drain Valves</td>
<td>E110</td>
<td>0722P-E</td>
</tr>
</tbody>
</table>

## Accessories

### Tank Valves & Air Chucks

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mufflers &amp; Silencers</td>
<td>F4</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Quick Exhaust, Shuttle &amp; Relief</td>
<td>F5</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Blow Guns &amp; Drip Leg Drain</td>
<td>F6</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Quick Connect Couplers</td>
<td>F7-F9</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Ball Valves / Plug Valves</td>
<td>F10</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Integrated Fittings</td>
<td>F11-F16</td>
<td>0700P-E</td>
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<tr>
<td>Hose &amp; Fittings</td>
<td>F16-F17</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Tubing</td>
<td>F17-F18</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Prestolok Composite</td>
<td>F19-F28</td>
<td>0700P-E</td>
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<tr>
<td>Prestolok Metal</td>
<td>F28-F34</td>
<td>0700P-E</td>
</tr>
<tr>
<td>Pipe Fittings</td>
<td>F35-F39</td>
<td>0700P-E</td>
</tr>
</tbody>
</table>

## Safety Guide, Offer of Sale

<table>
<thead>
<tr>
<th>Product</th>
<th>Page</th>
<th>Additional Technical Data on CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Guide – Actuator Products</td>
<td>G2-G3</td>
<td></td>
</tr>
<tr>
<td>Safety Guide – Control Products</td>
<td>G4-G5</td>
<td></td>
</tr>
<tr>
<td>Offer of Sale</td>
<td>G6</td>
<td></td>
</tr>
</tbody>
</table>
Tie Rod Cylinders

3MA Series - Economy NFPA Cylinder
- Bore sizes 1-1/2 through 5 inch
- 18 standard mounting styles
- Pressures up to 250 PSI
- Temperatures -10°F to 165°F
- Aluminum body construction

4MA Series - Flexible NFPA Cylinder
- Bore sizes 1-1/2 through 8 inch
- 20 standard mounting styles
- Pressures up to 250 PSI
- Temperatures -50°F to 250°F
- Aluminum body construction

4MNR Series - Non-Rotating Cylinder
- Bore sizes 1-1/8 through 4 inch
- 14 standard mounting styles
- Pressures up to 250 PSI
- Temperatures -10°F to 165°F
- Aluminum body construction

Round Body Cylinders

P Series - Repairable
- Bore sizes 1-1/8 through 4 inch
- 4 mounting styles
- Pressures up to 150 PSI
- Temperatures -10°F to 250°F
- Aluminum body construction

P1A Series - ISO Non-Repairable
- Bore sizes 10mm through 25mm
- 5 mounting styles
- Pressures up to 145 PSI
- Temperatures -40°F to 302°F
- Stainless steel body construction

SRX Series - Position Feedback
- Bore sizes 1-1/16 through 3 inch
- Continuous position feedback
- Pressures up to 150 PSI
- Temperatures 40°F to 165°F
- Stainless steel body construction
Compact Cylinders

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

B157

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

B145

P1Q Series - Economy Compact Cylinder
- Bore sizes 12mm through 100mm
- 4 flexible mounting options
- Pressures up to 10 PSIG
- Temperatures 23°F to 158°F
- Aluminum body construction

B137

Guided Cylinders

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

B173

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

B177

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

B169

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

B163

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

B166
Actuator Products – (Shown Alphabetically)

Index - www.parker.com/pneu/actuators

Rodless Cylinders

GDL Series - Rails & Cassettes
- 6 sizes available
- Speed up to 10m/s (33 ft/s)
- Aluminum alloy rail
- Aluminum body construction

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

P1X Series - Band Type Rodless
- 7 bore sizes 16mm through 63mm
- Integral sensor mounting rail
- Aluminum body construction

P1Z Series - Magnetically Coupled Rodless
- 3 bore sizes 16mm, 20mm & 32mm
- Pressures 29 to 100 PSIG
- Aluminum body construction

Rotary Actuators

HP Series - Large Rack & Pinion Rotary
- 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

PRN(A) Series - Vane Rotary
- 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
- 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

PV Series - Vane Rotary
- 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

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

P5W Series - Rotary Table
- 7 bore sizes (10 to 63mm)
- Pressures 1 to 8 bar max.
- Temperatures 41°F to 140°F
- Theoretical torque .28 to 39 Nm at 6 bar
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

Electronic Sensors

- Solid state
- Reed
- NAMUR
- Proximity

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

Shock Absorbers

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

PRL Series - Stand Alone Rodlock

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

Transition Kits

- Plate kits – attach component to slide / guided cylinder
- Coupler kits – attach component to rotary actuator

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

(Revised 10-05-11)
<table>
<thead>
<tr>
<th><strong>Vacuum Cups</strong></th>
<th><strong>Vacuum Generators</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PBG Bellows Cups</strong></td>
<td><strong>CEK Integrated Generators</strong></td>
</tr>
<tr>
<td>- Versatile bellows cup design provides a flexible sealing lip for products with irregular, smooth, curved surfaces, and flexible products</td>
<td>- Air-economic functions with emergency stop logic that maintains degree of vacuum with loss of output power</td>
</tr>
<tr>
<td>- Cup sizes: 10mm to 150mm</td>
<td>- Includes vacuum and blow-off solenoids, check valve, vacuum filter and optional MPS-23 pressure sensor</td>
</tr>
<tr>
<td><strong>PCG Multiple Bellows Cups</strong></td>
<td><strong>CHF Inline Generators</strong></td>
</tr>
<tr>
<td>- Versatile bellows cup design provides a flexible sealing lip for products with irregular, smooth, or curved surfaces</td>
<td>- CHF: High Flow Series is a multistage vacuum generator</td>
</tr>
<tr>
<td>- 2-1/2 bellows design minimizes contact pressure applied to products</td>
<td>- Intended for high flow vacuum applications</td>
</tr>
<tr>
<td>- Cup sizes: 5mm to 90mm</td>
<td>- Ideal for porous applications</td>
</tr>
<tr>
<td><strong>PFG Flat Cups</strong></td>
<td><strong>CVXCEK Integrated Generators</strong></td>
</tr>
<tr>
<td>- Precision molded single lip flat cup for smooth or slightly curved surfaces.</td>
<td>- Basic 2 station CEK generator manifold with additional electrical capabilities</td>
</tr>
<tr>
<td>- Low profile design makes flat pads ideal for fast response</td>
<td>- Integrates MPS-23 sensor for on board air-economicizing programming</td>
</tr>
<tr>
<td>- Cup Sizes: 1.5mm to 200mm</td>
<td>- M12 electrical wiring package with optional 18-pin single connection</td>
</tr>
<tr>
<td><strong>PJG Short Bellows Cups</strong></td>
<td><strong>MCA, CV, CV-CK Inline Generators</strong></td>
</tr>
<tr>
<td>- Versatile bellows cup design provides a flexible sealing lip for products with irregular, smooth, curved surfaces, and slightly flexible products</td>
<td>- MCA: Light weight vacuum generator</td>
</tr>
<tr>
<td>- Shorter stroke provides fast response</td>
<td>- CV: Basic aluminum body vacuum generator</td>
</tr>
<tr>
<td>- Cup sizes: 6mm to 80mm</td>
<td>- CV-CK: Basic aluminum body vacuum generator with mechanical switch for part present confirmation</td>
</tr>
<tr>
<td><strong>PUGB Flat Swivel Cups</strong></td>
<td><strong>MC22 Integrated Generators</strong></td>
</tr>
<tr>
<td>- 30° swivel single lip flat cup for smooth surfaces, slightly curved surfaces, and flexible products</td>
<td>- Compact vacuum generator includes vacuum and blow-off solenoids and vacuum filters</td>
</tr>
<tr>
<td>- Rigid stem or level compensator provides good stability for horizontal lift</td>
<td>- Optional check valve and MPS-23 pressure sensor</td>
</tr>
<tr>
<td>- Cup Sizes: 60mm to 100mm</td>
<td>- Air-economicizing function with MVS-201 pressure sensor</td>
</tr>
<tr>
<td><strong>P5V-CFS Flat Cups</strong></td>
<td><strong>MC72 Integrated Generators</strong></td>
</tr>
<tr>
<td>- Precision molded double lip flat cup for slightly curved surfaces</td>
<td>- Light weight vacuum generator includes vacuum and blow-off solenoids.</td>
</tr>
<tr>
<td>- Double lip for additional security. If outside lip bends and looses its seal, the inner lip remains sealed.</td>
<td>- Includes check valve, vacuum filter and optional MPS-23 pressure sensor</td>
</tr>
<tr>
<td>- Outer ribs prevent the cup lip from being cut</td>
<td>- Air-economicizing function with MVS-201 pressure sensor</td>
</tr>
<tr>
<td>- Cup Sizes: 50mm to 150mm</td>
<td>- Inline version can be mounted on manifolds up to 5 stations</td>
</tr>
</tbody>
</table>
### Vacuum Generator Accessories

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

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

**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

**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)

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

### Pressure Sensors

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

**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)

### Cables

**VF & VL Vacuum Filters**
- M8, M12 male / female connector
- Length: 2m or 5m
- Cover: PVC or PUR
- Connection type: swivel straight or angled
- IP67 swivel connector

**SCP01 Pressure Sensor**
- Stainless steel body
- Compact construction
- Shock and vibration proof
- Resistant to pressure spikes
- Accuracy +/- 0.5% FS
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

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

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

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

DX ISOMAX Series
- Subbase or manifold
- 1/8 through 3/4 inch ports
- Pressures VAC to 145 PSIG
- Temperatures 14°F to 140°F
- Flow - .55 to 4.15 Cv

Fieldbus Series
- Fieldbus interface for Isys and Moduflex valves
- Up to 256 inputs
- Up to 256 outputs
- Digital or analog

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

Isys Micro Series - Subbase
- Subbase or manifold
- 4mm through 1/4 inch
- Pressures VAC to 145 PSIG
- Temperatures 5°F to 120°F
- Flow - .35 Cv
Moduflex Series Valves
- Inline or stacking
- 4mm tube, 1/4, 3/8 inch ports
- Pressures VAC to 120 PSIG
- Temperatures 8°F to 140°F
- Flow - .18 to .80 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

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

Directair 2 & 4 Series - Inline
- Manual / mechanical
- 1/8 and 1/4 inch ports
- Pressures VAC to 150 PSIG
- Temperatures 32°F to 175°F
- Flow - .20 to .84 Cv

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

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

Valve Accessories
- 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
**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

**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

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

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

**Flow Controls & Accessories**
- Full range of flow controls, mufflers, silencers, drain valves, blow guns, relief, shuttle and quick exhaust valves
- Ports from M5 through 3/4 inch

**Dryer Products**

**Dryer Products**
- Refrigeration (10-2400 SCFM)
- Inline desiccant (15-60 SCFM)
- Regenerative desiccant (3-800 SCFM)
- Zero loss & timer drains
- Environmentally friendly refrigerant

**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

**Precision / Proportional Regulator 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

**Modular Air Preparation Products**

**Global FRL’s**
- Port size: 1/4 through 3/4 inch
- Maximum supply pressure: 200 PSIG
- Operating temperature: -13°F through 150°F
- Flows to 212 SCFM
- Filters, regulators, filter / regulators, lubricators and accessories

**Dryer Products**

**Drier Products**
- Refrigeration (10-2400 SCFM)
- Inline desiccant (15-60 SCFM)
- Regenerative desiccant (3-800 SCFM)
- Zero loss & timer drains
- Environmentally friendly refrigerant
Accessories – continued

Mufflers & Silencers

- Compact
- Lightweight
- Easy to install
- Excellent noise reduction
- Protects components from contamination
- NPT & BSPT threads available

Quick Couplings

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

Tank Valves & Air Chucks

- Maximum operating pressure 185 PSIG
- Temperature range -40°F to 220°F
- N/P finish
- Model No. 05499 0000 ball-foot air chuck, 1/4" female port
- Model No. 06739 0000 ball-foot air chuck with clip, 1/4" female port

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

WARNING: 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.

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 guidelines 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(ies) 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-C-PARKER, or go to www.parker.com for telephone numbers of the appropriate technical service department.

2.0 Cylinder and Accessories Selection

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

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod, wiper and the orifice 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 fast 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, its 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. These two (2) conditions can cause piston rod failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

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

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

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

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

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

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

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

effective rod end piston area

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

3.0 Cylinder and Accessories Installation and Mounting

3.1 Installation

3.1.1 – Cleanliness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.
3.12 – 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.

3.13 – 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.

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

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

3.2 Mounting Recommendations

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

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

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

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

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

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

4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement

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

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

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

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

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

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

4.2 Cylinder Troubleshooting

4.2.1 – External Leakage

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

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

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

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

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

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

4.2.2 – Internal Leakage

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

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

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

4.2.3 – Cylinder Fails to Move the Load

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

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

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

4.3 Erratic or Chatter Operation

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

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

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

4.4 Cylinder Modifications, Repairs, or Failed Component – Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done by 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.
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, 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.
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.
- Do not exceed the maximum primary pressure rating of any pressure regulator or any system component.
- Do not connect pressure regulators or other Pneumatic Division products to bottled gas cylinders.
- 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.
1. **Terms and Conditions.** Seller’s willingness to offer Products, or accept an offer for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of these Terms and Conditions found on-line at www.parker.com/saleterms/. 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 document 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 30 days from the date of invoice or such other term as required by Seller, unless otherwise agreed in writing. Seller’s sole and exclusive liability and Buyer’s sole and exclusive remedy for non-payment is repossession of the Products delivered hereunder. Seller may terminate this agreement for any reason and at any time without the prior written consent of Buyer.

3. **Delivery Dates; Title and Risk; Shipment.** 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 all products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipment carrier 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 shipping charges incurred by Seller due to 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 to Buyer or 2,000 hours of normal use, whichever occurs first. The prices charged for Seller’s Products are subject to the exclusive benefit warranty stated above and the following disclaimer: DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PRODUCED, SOLD, FURNISHED, OR OTHERWISE DISPOSED OF, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

5. **Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery, Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Buyer may replace the defective portion of the Product as an exception to this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date of breach is discovered.

6. **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 A RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF 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 NEGLECTIVE, 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.

7. **User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuming that all performance, endurance, maintenance, safety and warning requirements of the applicable rules, laws, codes, and standards and 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 such Products or systems.

8. **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 obselete 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 in possession or control of Seller.

9. **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 consideration for same. No part of any Product or tooling charge will be returned to Buyer. In order to avoid Buyer’s use of such tooling without Seller’s authorization, Seller reserves the right to place the necessary tooling in a secure location until such time as such tooling shall be needed by Seller, and may have the same destroyed at any time.

10. **Buyer’s Obligation; Rights of Seller.** To secure payment of all sums due or otherwise owed to Seller for the security interest in the Product, Seller may retain title to, deliver and this agreement 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.

11. **Indemnity.** Seller 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 acts committed by Buyer; (b) any breach of this agreement or otherwise, of Buyer; (c) Buyer’s use of patterns, plans, drawings, or specifications furnished by Buyer 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 otherwise provided.

12. **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 penalties as agreed to by Buyer and Seller.

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

14. **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 reasonable control.

15. **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.

16. **Termination.** Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days written notice of termination. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of this agreement (b) appoints a trustee, receiver or custodian for all or any part of Buyer’s property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) the dissolves or liquidates all or a majority of its assets.

17. **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.

18. **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 by Buyer based on an allegation that the Products sold hereunder infringe 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 control 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 such legal protection as Buyer may require, or may, at its sole expense, and option, modify the Product so as to make it non-infringing, or offer to accept return of the Product 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 Products delivered hereunder for which the designs are specified in whole or in part by Buyer, or 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.

19. **Entire Agreement.** This agreement contains the entire agreement between the parties, supersedes all prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

20. **Compliance with Law.** U. K. Bribery Act and U.S. Foreign Corrupt Practices Act. Buyer agrees to comply with all laws and regulations, including both those of the United Kingdom and the United States of America, and of the countries or countries of the Territory in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act (“FCPA”) and the U.S. Anti-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, the FCPA and 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 agrees that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and 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 agrees that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and 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.