Fabco-Air Multi-Power® Boosters provide a convenient, low cost way of adding the control, rigidity, and power of hydraulics to an air powered machine. Boosters use shop air to raise the pressure of another gas or liquid. They are compact, and versatile finding use in numerous applications such as clamping, shearing, pressing, crimping, bending, testing, and many more.

When relatively small volumes of high-pressure fluid are called for intermittently, boosters show obvious advantages over continuously running hydraulic systems.

For applications where high pressure must be maintained for prolonged times, boosters are ideal. After the booster strokes, there is no further energy input required and no heat build up.

A booster can be mounted in almost any convenient location, and most of its control valves are installed in the low-pressure circuit where lower cost components save costs over hydraulics.

The input is shop air, or any compatible gas, up to 150 psi; the output can be oil, liquid, air, or gas pressurized to 500 psi maximum.

By selecting the proper combination of bore size, stroke, power factor and regulating the input air pressure, the exact output pressure and required volume can be achieved and maintained.

Since it is a basic booster without controls built-in, it can be adapted and controlled to perform a wide variety of applications. Fabco-Air boosters are not limited to cylinder applications. They may be used wherever a small volume of high-pressure media is required.

**Multi-Power® Boosters**

**Atmospheric Pressure Inlet to Booster: Series BA**

- **Low initial cost**: Boosters can eliminate the need for costly hydraulic systems.
- **Low energy cost**: Boosters hold pressure indefinitely without energy loss.
- **Save space**: Boosters can usually be mounted directly on the machine unlike pumping units which are large and bulky.
- **Smooth power**: Boosters give the work cylinder the rigid, smooth, controlled motion of hydraulics.
- **Safe**: Boosters can be completely air operated to function safely in a potentially hazardous environment.
- **Clean**: Air to air boosters have no oil or liquid to contaminate the surroundings.

**Pressurized Inlet to Booster: Series BP**

- **2 Ports in boost chamber for inlet/outlet. Note: Check valves are not included.**
- **Internally lubricated Buna-N seals (-25° to + 250°F)**
- **U-Cup and O’Ring seals on the booster piston**
- **Heavy duty, corrosion resistant construction**
- **Aluminum tubing: Hard anodized ID, Clear anodized OD**
- **Black anodized heads.**
- **Plated tie rods and nuts.**
- **Outputs of 4.9 or 12.5 cu. in. per inch of stroke**
- **Standard strokes: 1" increments through 6"**
- **1.9 through 4.8 power factors**

These series are built for use on systems in which the input to the booster will be gravity fed (no pressure) fluid or atmospheric pressure gas. It requires a 4-way air valve for operation. Porting is provided on the unit for the multiple piston power stroke and the single piston reset stroke. (See example circuits on page 6.11.)
Sizing Guide and How to Order

Sizing Guide

<table>
<thead>
<tr>
<th>Bore</th>
<th>Number of Stages (Pistons)</th>
<th>Required Volume/Inch Theoretical Power Factor</th>
<th>Volume/Inch of Stroke</th>
<th>Required Volume/Inch of Stroke</th>
<th>Maximum psi</th>
<th>Required Volume/Inch of Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1/2</td>
<td>2</td>
<td>1.9</td>
<td>4.9</td>
<td>.021</td>
<td>9.7</td>
<td>4.5</td>
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<tr>
<td></td>
<td>3</td>
<td>2.8</td>
<td></td>
<td></td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3.7</td>
<td></td>
<td></td>
<td>19.3</td>
<td></td>
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<tr>
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<td>5</td>
<td>4.6</td>
<td></td>
<td></td>
<td>24.1</td>
<td></td>
</tr>
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<td>4</td>
<td>2</td>
<td>1.9</td>
<td>12.5</td>
<td>.054</td>
<td>25.1</td>
<td>11.8</td>
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<td></td>
<td>3</td>
<td>2.9</td>
<td></td>
<td></td>
<td>37.6</td>
<td></td>
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<tr>
<td></td>
<td>4</td>
<td>3.8</td>
<td></td>
<td></td>
<td>50.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4.8</td>
<td></td>
<td></td>
<td>62.6</td>
<td></td>
</tr>
</tbody>
</table>

Model Number Code

Example: BA 2½ X 2 X 3 FF – PA2
BA Series, 2½” Bore, 2” Stroke, 3 Stage (2.8 PF), Output End Flange Mounting, All Ports Position#2 (See page 6.6).

BP 4 X 6 X 5 WF
BP Series, 4” Bore, 6” Stroke, 5 Stage (4.8 PF), Extended Tie Rods (Output End Only) Mounting.

How to Order
1. Specify Series and Bore
2. Specify Stroke
3. Specify stages (Power Factor)
4. Specify Mounting
5. Specify Option(s)
**Multi-Power® Boosters**

**FF**  
Front Face Mount;  
Output End Rectangular Flange  
Fabco mounting pattern

**FFA**  
Front Face Mount;  
Output End Rectangular Flange  
NFPA (MF1) mounting pattern

---

**WF**  
Extended Tie Rod Mount, Output End Only  
**WR**  
Driving End Only  
**WFR**  
Both Ends

**To order Extended Tie Rod Mount**  
Specify Suffix  
Output End Only **WF**  
Driving End Only **WR**  
Both Ends **WFR**

If a non-standard extension is required, specify by adding the required length to the suffix.  
E.g. If WF length required is 2.5"
Specify **WF2.5**

---

**Dimensions (inches)**

<table>
<thead>
<tr>
<th>Bore</th>
<th>Dimension Y‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1/2 or 4</td>
<td></td>
</tr>
<tr>
<td>2-1/2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5.61</td>
</tr>
<tr>
<td>5</td>
<td>6.46</td>
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<table>
<thead>
<tr>
<th>Bore</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>N</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>X</th>
<th>Z</th>
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</thead>
<tbody>
<tr>
<td>2-1/2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<td>4</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dim. A: (No. stages x stroke) + Y‡

See Y‡ chart above
**Mounting Styles with Dimensions**

**RF**  
Rear Face Mount;  
Driving End Rectangular Flange  
Fabco mounting pattern

**RFA**  
Rear Face Mount;  
Driving End Rectangular Flange  
NFPA (MF2) mounting pattern

**FT**  
Foot Mount

---

### Approximate Weight, Oz.

<table>
<thead>
<tr>
<th>Bore</th>
<th>Stages (Pistons)</th>
<th>Theoretical Power Factor</th>
<th>Series BA Zero Stroke</th>
<th>Series BP Zero Stroke</th>
<th>BA or BP Per Inch of Stroke</th>
<th>Internally Lubricated Buna-N</th>
<th>Viton</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1/2</td>
<td>2</td>
<td>1.9</td>
<td>46</td>
<td>44</td>
<td>12</td>
<td>BA/BP2(\frac{1}{2})-2SK</td>
<td>BA/BP2(\frac{1}{2})-2SKV</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.8</td>
<td>55</td>
<td>53</td>
<td>17</td>
<td>BA/BP2(\frac{1}{2})-3SK</td>
<td>BA/BP2(\frac{1}{2})-3SKV</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3.7</td>
<td>64</td>
<td>62</td>
<td>23</td>
<td>BA/BP2(\frac{1}{2})-4SK</td>
<td>BA/BP2(\frac{1}{2})-4SKV</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4.6</td>
<td>73</td>
<td>71</td>
<td>30</td>
<td>BA/BP2(\frac{1}{2})-5SK</td>
<td>BA/BP2(\frac{1}{2})-5SKV</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1.9</td>
<td>111</td>
<td>115</td>
<td>17</td>
<td>BA/BP4-2SK</td>
<td>BA/BP4-2SKV</td>
</tr>
<tr>
<td></td>
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<td>2.9</td>
<td>130</td>
<td>124</td>
<td>24</td>
<td>BA/BP4-3SK</td>
<td>BA/BP4-3SKV</td>
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<td>142</td>
<td>32</td>
<td>BA/BP4-4SK</td>
<td>BA/BP4-4SKV</td>
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<tr>
<td></td>
<td>5</td>
<td>4.8</td>
<td>166</td>
<td>160</td>
<td>41</td>
<td>BA/BP4-5SK</td>
<td>BA/BP4-5SKV</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>AO</th>
<th>BB</th>
<th>CC</th>
<th>DD</th>
<th>FF</th>
<th>FO</th>
<th>HC</th>
<th>HT</th>
<th>WF</th>
<th>WR</th>
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</thead>
<tbody>
<tr>
<td>3/8-16</td>
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<td>2.19</td>
<td>4.50</td>
<td>.34</td>
<td>4.38</td>
<td>1.75</td>
<td>3.25</td>
<td>1.30</td>
<td>1.30</td>
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<tr>
<td>1/2-13</td>
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<td>3.32</td>
<td>6.38</td>
<td>.41</td>
<td>6.38</td>
<td>2.75</td>
<td>5.25</td>
<td>1.40</td>
<td>1.40</td>
</tr>
</tbody>
</table>

Specifications subject to change without notice or incurring obligation
**Viton Seals**

Use for elevated temperatures (–15° to + 400°F) or compatibility with exotic media. Consult engineering for compatibility information.

**Extend Port Bushing**

<table>
<thead>
<tr>
<th>Option</th>
<th>EF38</th>
<th>ER38</th>
<th>EFR38</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 NPT Output End</td>
<td>-EF38</td>
<td>-ER38</td>
<td>-EFR38</td>
</tr>
<tr>
<td>3/8 NPT Driving End</td>
<td>-EF38</td>
<td>-ER38</td>
<td>-EFR38</td>
</tr>
<tr>
<td>3/8 NPT Both Ends</td>
<td>-EF38</td>
<td>-ER38</td>
<td>-EFR38</td>
</tr>
<tr>
<td>1/2 NPT Output End</td>
<td>-EF12</td>
<td>-ER12</td>
<td>-EFR12</td>
</tr>
<tr>
<td>1/2 NPT Driving End</td>
<td>-EF12</td>
<td>-ER12</td>
<td>-EFR12</td>
</tr>
<tr>
<td>1/2 NPT Both Ends</td>
<td>-EF12</td>
<td>-ER12</td>
<td>-EFR12</td>
</tr>
</tbody>
</table>

The end plug is replaced with an extended plug of black anodized aluminum with a female NPT port. The standard end port is plugged.

Use for plumbing convenience, or when higher flows are required for higher cycle speeds and/or viscous fluids. Also see 1/2 NPT ports in heads, Options -TF, -TR, -TFR below.

**Dimensions (inches)**

<table>
<thead>
<tr>
<th>Bore</th>
<th>AZ</th>
<th>BZ</th>
<th>CZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1/2</td>
<td>.31</td>
<td>.50</td>
<td>.94</td>
</tr>
<tr>
<td>4</td>
<td>.38</td>
<td>1.13</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>.76</td>
<td>1.25</td>
<td>1.25</td>
</tr>
</tbody>
</table>

**1/2 NPT Ports in Heads**

<table>
<thead>
<tr>
<th>Option</th>
<th>TF</th>
<th>TR</th>
<th>TFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output End Head</td>
<td>-TF</td>
<td>-TR</td>
<td>-TFR</td>
</tr>
<tr>
<td>Driving End Head</td>
<td>-TF</td>
<td>-TR</td>
<td>-TFR</td>
</tr>
<tr>
<td>Both Heads</td>
<td>-TF</td>
<td>-TR</td>
<td>-TFR</td>
</tr>
</tbody>
</table>

Thicker heads to accept 1/2 NPT ports, replace the standard heads. Because of the thicker heads, there is an increase in the Dimension “A” and a reduction of the optional rod extension as charted below.

With this construction, an O-ring replaces the fiber gasket cylinder tube seal.

Use when higher cycle speeds or viscous fluids are required.

**Rubber Bumpers**

<table>
<thead>
<tr>
<th>Option</th>
<th>BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving End only</td>
<td>-BR</td>
</tr>
</tbody>
</table>

A ring of rubber is bonded to the cylinder head, on the driving end, to act as a piston stop and absorb the impact of the piston. This reduces noise and absorbs energy.

Because of the temperature limitations of the adhesives used (-25° to +220°F), the rubber bumper is available in boosters with standard internally lubricated Buna-N seals only.

**Use where noise reduction and impact absorption is desired.**
**Option Specifications**

**Adjustable Extend Stroke**

For strokes through 6’’

Option -AS

Full stroke adjustment is standard.

Note!

To maintain operator safety features of this option, it is **NOT** available with mounting styles: WR and WFR. Use caution when mounting to avoid creating pinch points.

Dial-A-Stroke® provides a rugged and precision adjustment of the extend stroke of the cylinder. The stop tube, adjustment nut with skirt, and minimum clearances combine to eliminate pinch points, thus providing operator safety. **Note!** Use caution when mounting to avoid creating pinch points with other parts of your machine design.

The stop tube is black anodized aluminum, the adjustment nut is blackened steel with a black anodized aluminum skirt, and the nut stop is red anodized aluminum; all for corrosion resistance and appearance. The adjustment nut, steel for long life, includes a lock screw with a plastic plug so that the adjustment nut can be locked in place without damaging the threads. The nut stop is mounted on the end of the adjustment rod so that the nut cannot come off. The fine pitch threads on the adjustment rod and nut provide precision adjustment. Adjustment settings are simplified by convenient scale markings applied to nut skirt and stop tube.

---

**Port Positions**

(Facing Output End, see Drawings on pages 6.3 & 6.4)

All Ports with Mounts: FF, FFA, RF, RFA, WF, WR, WFR

<table>
<thead>
<tr>
<th>Output</th>
<th>Vent</th>
<th>Driving</th>
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</thead>
<tbody>
<tr>
<td>1&amp;3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2&amp;4</td>
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<tr>
<td>1&amp;3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2&amp;4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

All Ports with Mount FT

<table>
<thead>
<tr>
<th>Output</th>
<th>Vent</th>
<th>Driving</th>
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</thead>
<tbody>
<tr>
<td>2&amp;4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1&amp;3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2&amp;4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>1&amp;3</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

For all other combinations of port locations specify each port location per the chart on the right. Any port or vent not specified will be in position shown on pages 6.3 & 6.4.

**High Flow Vents**

Option -HF

The atmospheric vent in the baffle is cut larger to provide less resistance to the air flow.

*Use when higher cycle speeds are required.*

**Atmospheric Vent or Ported Baffle Port**

Specify

<table>
<thead>
<tr>
<th>Ported Baffle Port</th>
<th>Specify</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Standard</td>
</tr>
<tr>
<td>2</td>
<td>-PB2</td>
</tr>
<tr>
<td>3</td>
<td>-PB3</td>
</tr>
<tr>
<td>4</td>
<td>-PB4</td>
</tr>
</tbody>
</table>

**Mounts: FF, FFA, RF, RFA, WF, WR, WFR**

<table>
<thead>
<tr>
<th>Output Ports</th>
<th>Specify</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&amp;3</td>
<td>Standard</td>
</tr>
<tr>
<td>2&amp;4</td>
<td>-PR2</td>
</tr>
<tr>
<td>1&amp;2</td>
<td>-PR3</td>
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<tr>
<td>1&amp;4</td>
<td>-PR4</td>
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<td>2&amp;3</td>
<td>-PR5</td>
</tr>
<tr>
<td>3&amp;4</td>
<td>-PR6</td>
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</table>

**Mount FT**

<table>
<thead>
<tr>
<th>Output Ports</th>
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</thead>
<tbody>
<tr>
<td>2&amp;4</td>
<td>Standard</td>
</tr>
<tr>
<td>1&amp;3</td>
<td>-PR2</td>
</tr>
<tr>
<td>1&amp;2</td>
<td>-PR3</td>
</tr>
<tr>
<td>1&amp;4</td>
<td>-PR4</td>
</tr>
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<td>2&amp;3</td>
<td>-PR5</td>
</tr>
<tr>
<td>3&amp;4</td>
<td>-PR6</td>
</tr>
</tbody>
</table>

---

2 1/2” Bore = 1.00 + (2 x Stroke)
4” Bore = .75 + Stroke

2 1/2” Bore = 1.90 + (2 x Stroke)
4” Bore = 1.67 + (2 x Stroke)

2-1/2” Bore =1.50 Dia.
4” Bore = 2.00 Dia.

2.00 Diameter

.063 Stroke adjustment per revolution

1/2’’ Minimum Clearance when fully stroked

Note: Use caution when mounting to avoid creating pinch points

Specifications subject to change without notice or incurring obligation
**Specifications subject to change without notice or incurring obligation**

---

### Magnetic Piston

**Option -E** consists of a magnet bonded into the piston head. When the piston magnet moves past an external sensor, the magnetic field activates the sensor without physical contact.

**Mounting** – The sensor is attached to a 2-part clamp that attaches rigidly to a tie rod and can be positioned anywhere along the length of the cylinder for very precise signaling.

Two sensor styles are used – (a) the **9-2A197 Series** for 2 1/2” bore requires a tie rod clamp, and (b) the **749 Series** which accommodates the larger diameter tie rods of the 4” bore with an integral clamp.

**Reliability** – The annular piston magnet is permanently bonded into a groove in the piston. It is a polarized permanent magnet of rubber bonded barium ferrite that is very stable and is not affected by shock. Under normal usage it will remain magnetized indefinitely.

**Warning** – External magnetic fields and/or ferrous objects may affect the strength of the piston magnet therefore affecting sensor actuation and piston position indication. Labels noting this are affixed to the cylinder.

Please note there is an increase in base length of the booster to accommodate the magnet. The driving end stage only, is increased by 1”.

---

### Sensor & Clamp Ordering Guide

**Temperature Range:** –20° to + 80°C (–4° to + 176°F)


---

### LED Lighted Magnetic Piston Position Sensors: 2 1/2” Bore

<table>
<thead>
<tr>
<th>Product Type</th>
<th>9 ft. Part No.</th>
<th>Quick Disconnect Part Number</th>
<th>Electrical Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reed Switch</td>
<td>9-2A197-1004</td>
<td>9-2A197-1304</td>
<td>5-120 VDC/VAC, 0.5 Amp Max., 10 Watt Max., SPST N.O., 3.5 Voltage Drop</td>
</tr>
<tr>
<td>Electronic</td>
<td>9-2A197-1033</td>
<td>9-2A197-1333</td>
<td>Sourcing, PNP, 6-24 VDC, 0.5Amp Max., 1.0 Voltage Drop</td>
</tr>
<tr>
<td>Electronic</td>
<td>9-2A197-1034</td>
<td>9-2A197-1334</td>
<td>Sinking, NPN, 6-24 VDC, 0.5Amp Max., 1.0 Voltage Drop</td>
</tr>
</tbody>
</table>

### LED Lighted Magnetic Sensor Mountings – Part Number 800-200-000

| Reed Switch  | 749-000-004    | 749-000-504                   | 5-240 VDC/VAC, 1 Amp Max., 30 Watt Max., SPST N.O., 3.0 Voltage Drop |
| Electronic   | 749-000-031    | 749-000-531                   | Sourcing, PNP, 6-24 VDC, 1.0 Amp Max., 0.5 Voltage Drop |
| Electronic   | 749-000-032    | 749-000-532                   | Sinking, NPN, 6-24 VDC, 1.0 Amp Max., 0.5 Voltage Drop |

---

### Multi-Power® Boosters

**Female Cordsets for 9-2A197 Series Quick Disconnect Sensors**

<table>
<thead>
<tr>
<th>Length</th>
<th>Part No.</th>
<th>CFC-1M</th>
<th>CFC-2M</th>
<th>CFC-5M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Meter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Meter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Meter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Female Cordsets for 749 Series Quick Disconnect Sensors**

<table>
<thead>
<tr>
<th>Length</th>
<th>Part No.</th>
<th>CFC-2M-12</th>
<th>CFC-5M-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Meter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Meter</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**WARNING**

This cylinder is equipped with a Magnetic Piston for use with Magnetically Operated Sensors. Other Magnetic Sensitive Devices Should be Kept at a Distance to Avoid Inadvertent Operation.

---

**Sensor Clamp Stick Out Dimensions**

<table>
<thead>
<tr>
<th>Bore</th>
<th>Stick Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1/2&quot;</td>
<td>0.38&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
<td>0.36&quot;</td>
</tr>
</tbody>
</table>

---

**LED Lighted Magnetic Piston Position Sensors: 4” Bore**

---

**Warning!** Do not exceed sensor ratings. Permanent damage to sensor may occur. Power supply polarity **MUST** be observed for proper operation of sensors. See wiring diagrams included with each sensor.
Option Specifications

A piston rod is incorporated in the driving end. Two limit valves are mounted on the driving end head and a piston rod guide and limit valve actuators are attached to the piston rod. The limit valves control a 3 or 4 way control valve (not included, see Section 11) which in turn controls the booster. When the system is “powered up” the booster strokes, raising the fluid pressure in the output end. When it fully strokes, a limit valve is actuated, reversing the booster, resetting it. When it is fully reset, the other limit valve is actuated shifting the control valve for another power stroke. This cycle continues until the output pressure reaches the desired level. The booster then stalls out and holds that pressure until some of the fluid is used. The booster then resumes cycling until output fluid again reaches desired pressure and the booster stalls out. This cycling will continue as long as the system is “powered up.”

During the stall mode there is no energy used, making the air powered booster an extremely efficient and quiet method of maintaining that high pressure. A hydraulic power unit, for instance, requires continuous energy input.

Because of the piston rod, the Power Factors change slightly as shown in the chart below. A typical circuit and sizing instructions are shown in example 1 on page 6.9.

Use when the application requires pumping action (e.g. keeping a surge tank at high pressure for a test fixture) and/or there is no electricity involved (e.g. an explosive atmosphere). Also see Option -E on page 6.7 for electronic position sensors.

<table>
<thead>
<tr>
<th>Bore</th>
<th># Stages (Pistons)</th>
<th>Theoretical Power Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1/2</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Provisions for operator protection are always the full responsibility of the user.
To size an Air to Air booster Boyle’s Law must be used because air is compressible. Boyle’s Law states: “When the temperature of a confined gas remains constant, the volume varies inversely as its absolute pressure.”

This can be stated mathematically as a simple equation: initial absolute pressure \( P_1 \) x initial volume \( V_1 \) = final absolute pressure \( P_2 \) x final volume or \( P_1 \times V_1 = P_2 \times V_2 \)

**EXAMPLE 1:** Pump cycle, Air to Air Booster

Required output = 100 cu. in. per minute @ 250 psi

Available air pressure = 70 psi

**Solution:**

\[
\text{Power} = \frac{\text{Required Pressure psig}}{\text{Available Pressure psig}} = \frac{250}{70} = 3.6
\]

Minimum Required Power Factor

Choose either: 2-1/2” Bore – 4 Stage

or 4” Bore – 4 Stage (See Sizing Guide on page 6.2)

**Solution (2-1/2” Bore): Volume - using Boyle’s Law**

\[
V_1 = 4.9 \text{ cu. in./in.}
\]

\[
P_1 = 70 + 14.7 = 84.7
\]

\[
P_2 = 250 + 14.7 = 264.7
\]

\[
V_2 = \frac{P_1 \times V_1}{P_2} = \frac{84.7 \times 4.9}{264.7} = 1.5 \text{ cu. in./in. @ 250 psig}
\]

On the basis of 20 strokes/minute (typical average)

Booster stroke = \( \frac{\text{Required Vol/min.}}{\text{vol/in. stroke x strokes/min}} \)

Booster stroke = \( \frac{100}{1.5 \times 20} \) = 3.3 in.

**Model Choice:** BP2-1/2 X 4 X 4

**Alternate Solution (4” Bore): Volume - using Boyle’s Law**

\[
V_1 = 12.6 \text{ cu. in./in.}
\]

\[
P_1 = 70 + 14.7 = 84.7
\]

\[
P_2 = 250 + 14.7 = 264.7
\]

\[
V_2 = \frac{P_1 \times V_1}{P_2} = \frac{84.7 \times 12.6}{264.7} = 4.0 \text{ cu. in./in. @ 250 psig}
\]

On the basis of 20 strokes/minute (typical average)

Booster stroke = \( \frac{\text{Required Vol/min.}}{\text{vol/in. stroke x strokes/min}} \)

Booster stroke = \( \frac{100}{4.0 \times 20} \) = 1.25 in.

**Model Choice:** BP4 X 2 X 4

**Input Air Usage, Pump Cycle** (See Example 1 above; Model BP 2-1/2 X 4 X 4, 20 stroke/min. @ 70 psi)

**Solution:**

\[
\text{Pressure} = \frac{\text{Required Final Pressure}}{\text{Booster Power Factor}} = \frac{250}{3.7} = 67.6 \text{ psi regulated input required}
\]

**Solution: Volume (CFM) = \( \frac{\text{Input Volume/Inch Stroke}}{\text{Stroke}} \times \text{CPM} \times \frac{\text{1728 cu. in./cu.ft.}}{\text{CFM}} \)**

\[
\text{Input Volume/Inch Stroke} = 19.3 \text{ (See Sizing Guide on page 6.2), Stroke} = 4", \text{ CPM} = 20
\]

\[
\text{Volume} = \frac{19.3 \times 4 \times 20}{1728} = 0.89 \text{ CFM} \times 67.6 \text{ psi}
\]

\[
\text{Converting Volume to SCFM:} \quad \text{SCFM} = \frac{\text{CFM} \times \text{psia}}{\text{Atmosphere}} = \frac{0.89 \times (67.6 + 14.7)}{14.7} = 5.0 \text{ SCFM required}
\]
EXAMPLE 2: One shot cycle, Air to Air Booster to extend cylinders with boosted (high) pressure. Application shown: 2 cylinders, 1-5/8” bore x 4” stroke must extend to full stroke at 145 psi, then retract at system (80 psi) pressure.

Solution: Power = \( \frac{\text{Required Pressure psig}}{\text{Available Pressure psig}} = \frac{145}{80} = 1.8 \) Minimum Required Power Factor

Choose either: 2-1/2” Bore – 2 Stage
or 4” Bore – 2 Stage (See Sizing Guide on page 6.2)

Solution: Volume - using Boyle's Law

\[ V_1 = \frac{P_2 \times V_2 \times P_1}{94.7} \]

Note! Add a recommended factor of 25% to 50% to allow for volumetric efficiency and other losses: 30.5 x 150% = 45.8 cu. in. required in booster.

Solution (2-1/2” Bore): Stroke = \( \frac{\text{Required Volume}}{\text{Volume/Inch Stroke}} \)

\( \frac{18.1}{4.9} = 3.6 \) in.

Alternate Solution (4” Bore): Stroke = \( \frac{\text{Required Volume}}{\text{Volume/Inch Stroke}} \)

\( \frac{18.6}{12.6} = 1.5 \) in.

EXAMPLE 3: One shot cycle, Air to Air Booster to extend cylinders with low (system) pressure, then boost to high pressure. Application shown: 2 cylinders, 1-5/8” bore x 4” stroke must extend to full stroke at system (80 psi) pressure, then apply full (145 psi) clamp load. Cylinders are to retract at system (80 psi) pressure.

Solution: Power = \( \frac{\text{Required Pressure psig}}{\text{Available Pressure psig}} = \frac{145}{80} = 1.8 \) Minimum Required Power Factor

Choose either: 2-1/2” Bore – 2 Stage
or 4” Bore – 2 Stage (See Sizing Guide on Page 6.2)

Solution: Volume - using Boyle's Law

\[ V_1 = \frac{P_2 \times V_2 \times P_1}{94.7} \]

Note! In this cycle, the volume of the cylinders and tubing may be deducted because it is a part of the final volume; thus, 30.5 - 18.1 = 12.4 cu.in. Add a recommended factor of 25% to 50% to allow for volumetric efficiency and other losses: 12.4 x 150% = 18.6 cu. in. required in booster.

Solution (2-1/2” Bore): Stroke = \( \frac{\text{Required Volume}}{\text{Volume/Inch Stroke}} \)

\( \frac{18.6}{4.9} = 3.8 \) in.
To size an Air to Oil booster, Boyle’s Law need not be taken into account because oil is considered an incompressible fluid. Consult Fabco-Air Engineering for fluid compatibility with standard internally lubricated Buna-N seals or optional Viton seals.

EXAMPLE 4: One shot cycle, Air to Oil Booster
Application shown: 2 cylinders, 1-5/8” bore x 4” stroke must extend to full stroke at 145 psi, then retract at system (80 psi) pressure.

Solution: Power = Required Pressure psig = 145
Available Pressure psig 80
= 1.8 Minimum Required Power Factor
Choose either: 2-1/2” Bore – 2 Stage
or 4” Bore – 2 Stage (See Sizing Guide on page 6.2)

Solution: Volume of Booster = Displacement of Cylinders + Margin
Displacement = Area of Bore x Stroke x Quantity of Cylinders
Margin = 25% Recommended to allow for losses and make-up fluid
Booster Volume = [2.07 (area of 1-5/8” bore) x 4” (stroke) x 2 (quantity)]
x 125% (margin)
= [16.6] x 1.25 = 20.8 cu. in.

Solution (2-1/2” Bore): Stroke = Required Volume
Volume per Inch Stroke = 4.3 in.

Alternate Solution (4” Bore): Stroke = Required Volume
Volume per Inch Stroke = 12.6 in.

Model Choice: BA2-1/2 X 5 X 2

EXAMPLE 5: Pump cycle, Air to Oil Booster
Required output = 1000 cu. in./min. @ 250 psi
Available air pressure = 70 psi

Solution: Power = Required Pressure psig = 250
Available Pressure psig 70
= 3.6 Minimum Required Power Factor
Choose either: 2-1/2” Bore – 4 Stage
or 4” Bore – 4 Stage (See Sizing Guide on page 6.2)

Solution (2-1/2” Bore): Stroke = Required Volume
Volume per Inch Stroke = 4.9 in.

Alternate Solution (4” Bore): Stroke = Required Volume
Volume per Inch Stroke = 12.6 in.

Model Choice: BA2-1/2 X 11 X 4

Input Air Usage, Pump Cycle (See Example 5 above; Model BA 2-1/2 X 11 X 4, 20 stroke/min. @ 70 psi)

Solution: Pressure = Required Final Pressure psig = 250
Booster Power Factor 3.7

Solution: Volume (CFM) = [ Input Volume per Inch Stroke + Reset Volume per Inch Stroke] x Stroke x CPM

Input Volume per Inch Stroke = 19.3; Reset Volume per Inch Stroke = 4.5 (See Sizing Guide on page 6.2)

Model Choice: BA4 X 4 X 4