

# TechTIPS

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## FORGET HYDRAULICS

Get The Control and All the Force You Need with Compressed Air

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Sponsored by **FABCO-AIR**

# TREMENDOUS FORCES

Courtesy of Fabco-Air

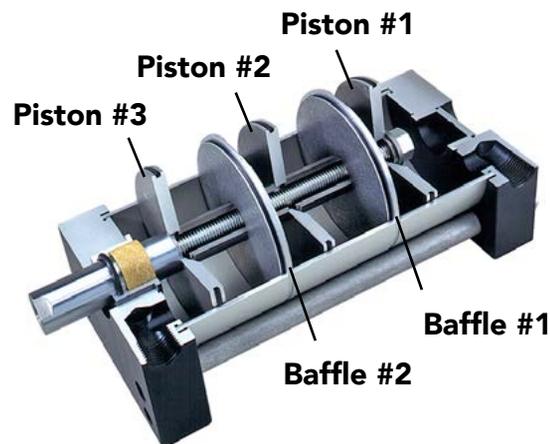
Let's begin by considering the tremendous forces you can get from some air cylinders. Multi-Power® Air Cylinders from Fabco-Air can provide the high forces you need for countless applications including riveting, hole punching and broaching. These force-multiplying cylinders operate on the principle of attaching multiple pistons to a common shaft with an internal air passage to all pistons. You can see that a Multi-Power® cylinder (depending on it being a 2, 3 or 4 piston unit) can achieve roughly 2, 3 or 4 times the force output of a conventional single piston cylinder.

Multi-Power® cylinders are available in ten bore sizes and can create forces up to 44,000 pounds rivaling many hydraulic systems! Having only two port connections, they are installed as easily as a standard cylinder.

## One application

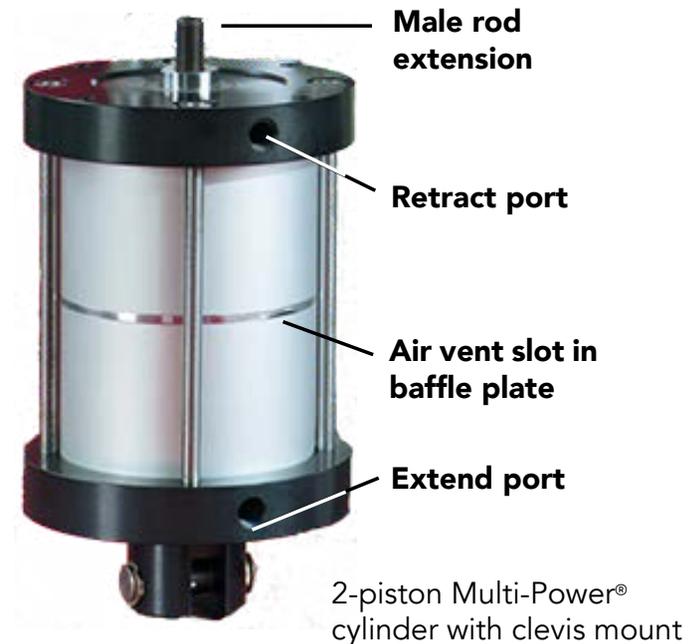
Let's consider an application that requires 4800 pounds of force for upsetting a rivet holding a stack of laminations together. Dividing 4800 lbs by 90 psi (our available shop air supply), we will require 53.3 in<sup>2</sup> of piston area to do the job.

From Figure 1, Cylinder Selection Guide, we see that two standard Multi-Power® cylinders meet the piston area requirements: a 5" bore 3-piston (3-stage) cylinder has 56.4-in<sup>2</sup>; a 6" bore 2-stage unit has 55.3-in<sup>2</sup>. At 90 psi, both will yield forces beyond our needs.



Bore Inches	Stages (No. of Pistons)	Total Effective Piston Area-Square Inches	Equivalent Bore of a Single Piston Cylinder	Force@ 90 psi	Single Stage Retract Piston Area, sq. in.
1/2	2	.35	.6	30	.15
	3	.50	.7	45	
	4	.65	.9	52	
4	2	24.4	5.6	2196	11.8
	3	36.1	6.8	3249	
	4	47.9	7.9	4311	
5	2	38.0	7.0	3420	18.4
	3	56.4	8.5	5076	
	4	74.8	9.7	6732	
6	2	55.3	8.4	4977	27.0
	3	82.3	10.2	7407	
	4	109.4	11.8	9846	
8	2	98.6	11.2	8874	48.5
	3	147.0	13.7	13230	
	4	195.4	15.8	17586	
10	2	153.9	14.0	13851	75.4
	3	229.3	17.1	20637	
	4	304.7	19.7	27423	
12	2	222.9	16.8	20061	109.9
	3	332.8	20.6	29952	
	4	442.7	23.7	39843	

Figure 1 - Cylinder Selection Guide



# CONTROLLING SPEED WITH AIR-OIL TANKS

Courtesy of Fabco-Air

Air-Oil tanks provide a nice alternative to hydraulic systems when precise cylinder motion is required. They cost less and take up far less space. No pumps. No noisy motors. No relief valves or the like. And of course, installation is a lot simpler too.

In combination with off-the-shelf air valves, air-oil tanks enable precise, smooth cylinder motion with absolute control using basic shop air pressure.

Fabco-Air's Air-Oil tanks are available in single tank and space-saving double tank versions with bore (I.D.) sizes of 1-1/4", 2" and 4" to suit most applications.

## Single Tank Units

Single tanks are used when hydraulic control of the cylinder is required in one direction only. If there is any question as to the integrity of the piston seal, a double tank is recommended. Single Tank Units are also used as fluid storage tanks for boosters, hydraulic shock options, and other applications.

Double Tank Units are used when hydraulic control of the cylinder is required in both directions. The one-piece heads that hold both tanks simplify mounting and save space.

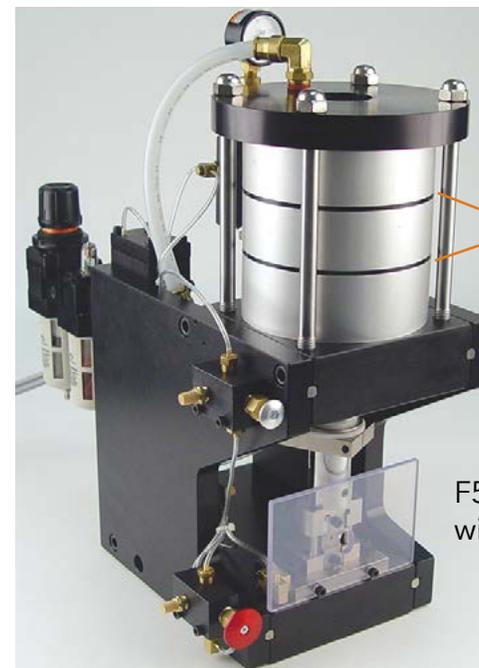
## Combining a Single Air-Oil Tank with the Power Cylinder on an Air Press

Let's assume we want to punch holes in a stack of laminations. We'll use a Fabco-Air F55 Series air press for this example.

Notice that the power unit of the press is a 5" bore, 3-piston, Multi-Power® air cylinder with beefed up construction to meet the rigors of press type applications. All three pistons are simultaneously pressurized for the power stroke; only one piston drives the retract stroke. At 90 psi, the three piston thrust will be over 5,000 pounds. More than enough for the job at hand.



Fabco-Air Air-Oil Tanks: 2" Bore x 9" high



Baffles separate the three pistons and have vents to atmosphere

F55 Series Press shown with customer tooling

# CONTROLLING SPEED & SHOCK

Courtesy of Fabco-Air

As you know, we must make accommodations for the inertial and impact forces that will be released when our tooling breaks through the work piece. To capture these potentially destructive forces, and prevent damage to the power cylinder and tooling, an air-over-oil tank is incorporated in the circuit between the directional control valve and the cylinder return port.

## How It Works

Fluid in the tank is used for the cylinder's return media only. (Reference Figure 3, above.) Fluid flow and cylinder speed can be controlled by a needle or flow control valve. In our example we have chosen a flow control valve because we want to control the speed of the "work" stroke while allowing a full speed retract stroke. When the material shears and the cylinder tries to complete the stroke, the non-compressible fluid resists rapid movement. It "catches" the built-up forces, dissipating them before the cylinder can bottom out. Thus the piston cannot "pound" on the piston stop.

**Standard Hydraulic Shock options are offered on all Multi-Power® Cylinders and Presses.** Seals on the piston, piston rod, and cylinder tube are increased in the single-stage retract section (Shown yellow in Figure 4). Dynamic Poly-Pak® seals combine an automatic lip type seal with an O-spring energizer for excellent sealing from zero to 500 psi. Piston thickness is increased.

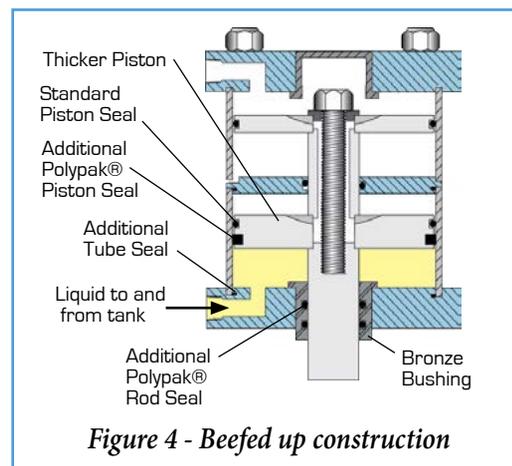


Figure 4 - Beefed up construction

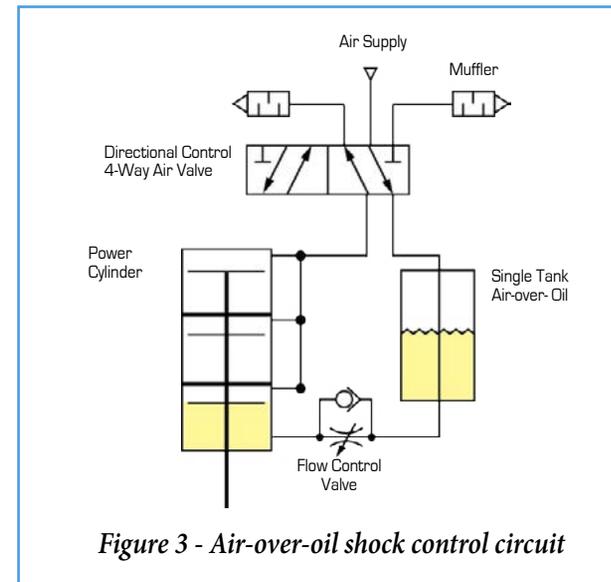
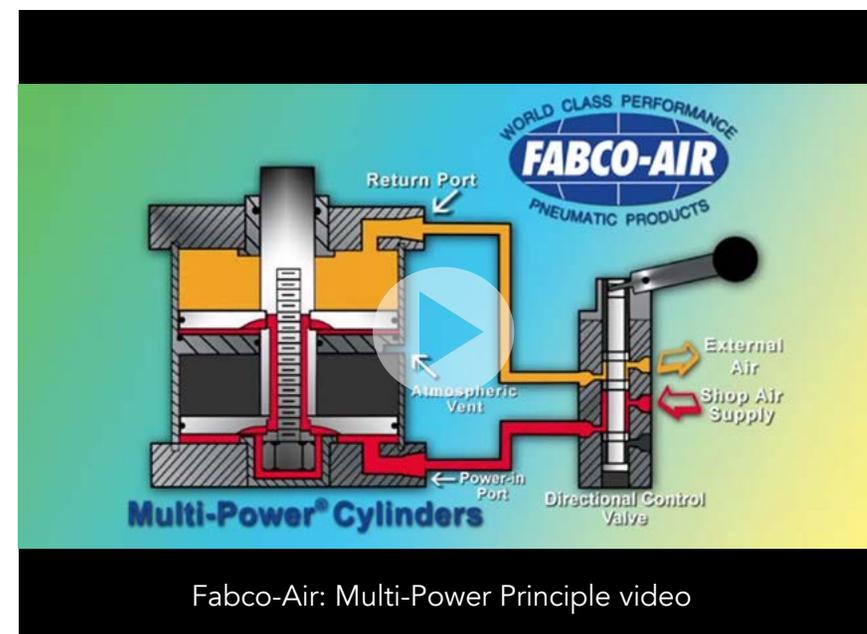


Figure 3 - Air-over-oil shock control circuit



Fabco-Air: Multi-Power Principle video

The Multi-Power® Cylinder has multiple pistons attached to a common rod with internal air passages thus allowing much higher forces without having to use a bulky, larger bore cylinder or high pressure hydraulics.

# TIP: DETERMINING FORCE REQUIREMENTS

Courtesy of Fabco-Air

## HOW MUCH FORCE DOES IT TAKE TO CRIMP A PIECE OF TUBING OR PRESS A BEARING INTO ITS HOUSING?

Use this simple, economical circuit for the job.

1. Adjust regulator to zero pressure.
2. Situate work under the work stroke.
3. Shift valve to extend position.
4. Slowly adjust regulator to raise pressure.
5. Rod will move to the application.
6. Continue increasing pressure while watching the application.
7. At the moment application is completed, read pressure gauge.
8. Multiply gauge pressure by the effective piston area of your cylinder (find piston areas in a "Selection Guide." Sample guide shown in Figure 1, page 2)
9. Result is the force (lb.) required by your application.

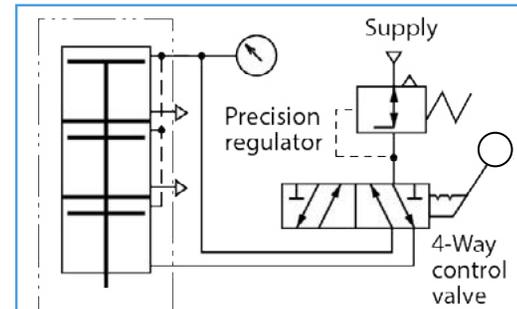


Figure 5 - Determining Force Requirements



Fabco-Air: Multi-Power Cylinders & Pneumatic Crimper video

The Fabco-Air 300 Series of pneumatic power tools is designed to perform numerous manufacturing functions, improving product quality and increasing productivity on the production line. Now you can tackle a variety of assembly applications with confidence.

# FABCO FAST



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# TIP: PRESSURE SENSING CONTROL

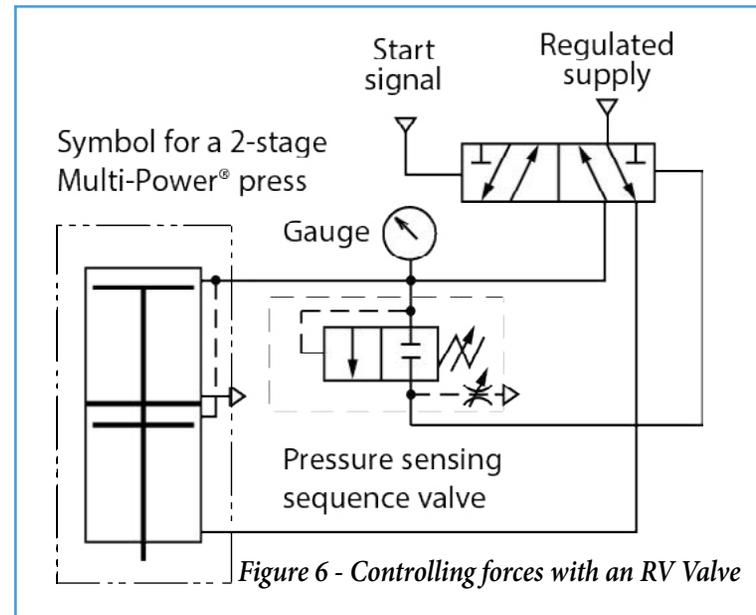
Courtesy of Fabco-Air

## PRODUCING EXACT, REPEATABLE FORCES WITH A PRESSURE SENSING CONTROL

Fabco's "RV" Valve, with its unique poppet type seal, senses the pressure being applied and opens at a pre-adjusted set point to provide a pilot signal for circuit control. Because force is a direct function of pressure multiplied by area, the "RV" provides direct and precision adjustable force sensing. If the application requires that a predetermined force be applied to an object at a point that may vary in physical dimensions (such as crimping, riveting, etc.) the "RV" is the control to use. It assures that the desired force (due to its sensing the pressure) is applied regardless of variations in part thickness.

**If system pressure should drop** below the "RV's" set point, it cannot open. The cycle will hold and wait for the required pressure rather than produce an unacceptable rivet or crimp.

**Once pressure is restored**, the cycle will continue. The part that had been under the work stroke will be finished as a "good part". The pressure gauge confirms the sensed pressure.



Cut-away view of an RV Sequence Valve

# PNEUMATIC BOOSTERS

## Another Way to Get Hydraulic Power

Combining an Air-Oil Tank with a pressure booster provides a convenient, low cost way of adding the control, rigidity, and power of hydraulics to an air powered machine. Fabco-Air Multi-Power® Boosters use basic 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.

### Two considerations

(1) When relatively small volumes of high-pressure fluid are called for intermittently, boosters show obvious advantages over continuously running hydraulic systems. (2) 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.

### How They Work

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. Multiple pistons compress the oil or fluid in the output end of the booster. Check valves insure the direction of fluid flow.

### Sizing Boosters

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



BA Series 2-Stage Pressure Booster

### Versatility

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.

The BA Series is 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 booster for the multiple piston power stroke and single piston reset stroke.

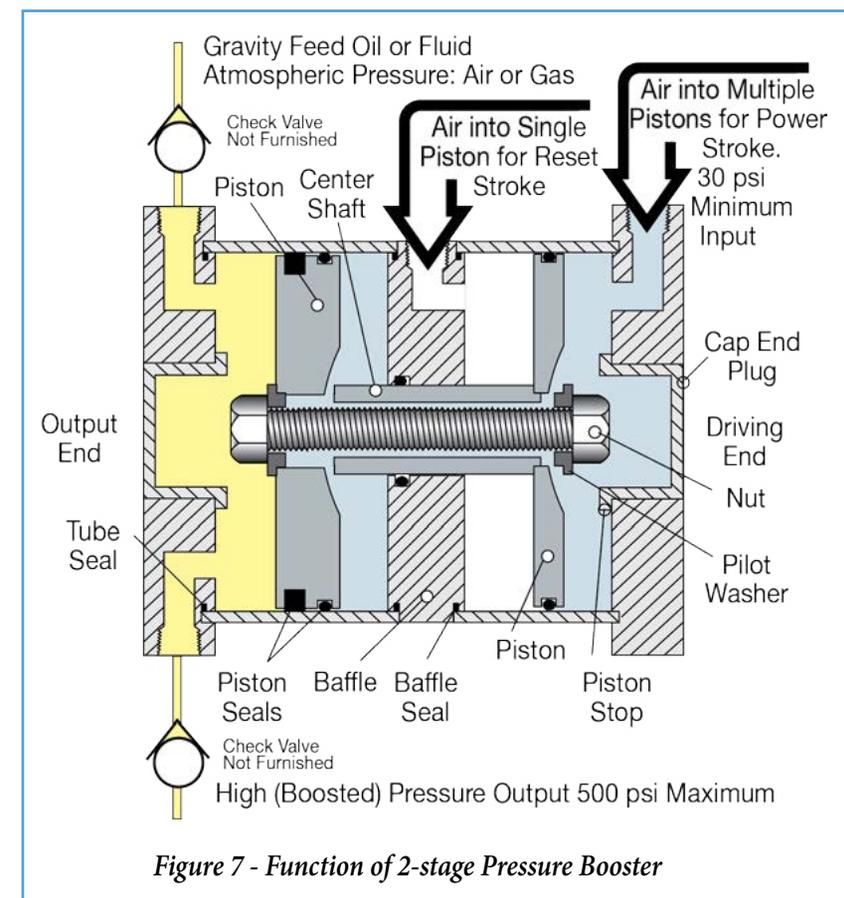


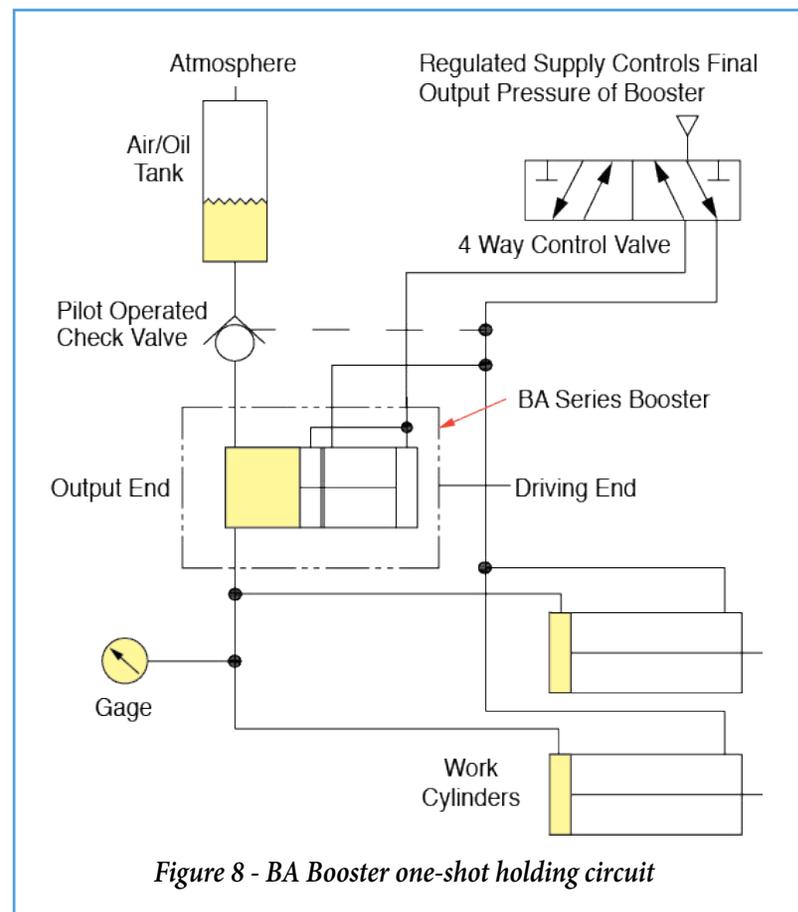
Figure 7 - Function of 2-stage Pressure Booster

# PNEUMATIC BOOSTERS

## Helpful Application Circuitry

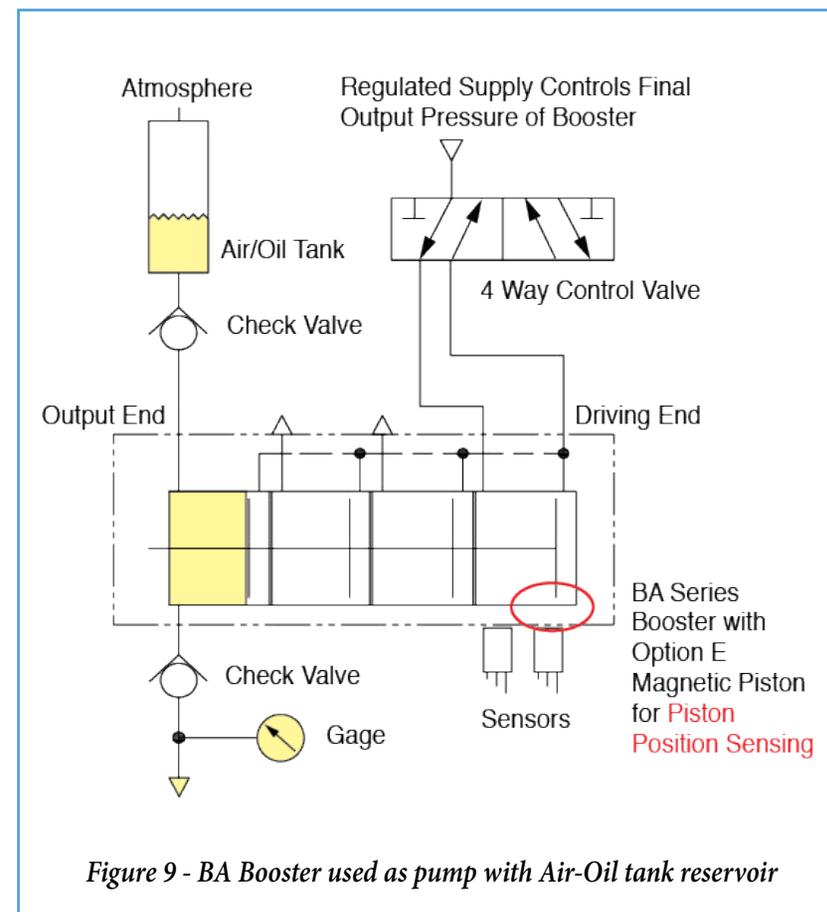
### One-shot Holding Cycle

Here a single tank air-to-oil booster feeds two (2) clamping cylinders. The clamp-off position of the 4-way pneumatic control releases the clamp cylinders and simultaneously opens the pilot-operated check valve allowing oil to flow back into the tank.



### Booster Becomes a Pump

Adding a magnet piston enables position sensing. Electronic sensors can then control a 4-way solenoid valve causing the booster pistons to reciprocate and pump high pressure liquid. Exhaust liquid is returned to the tank's top port from the driven device.



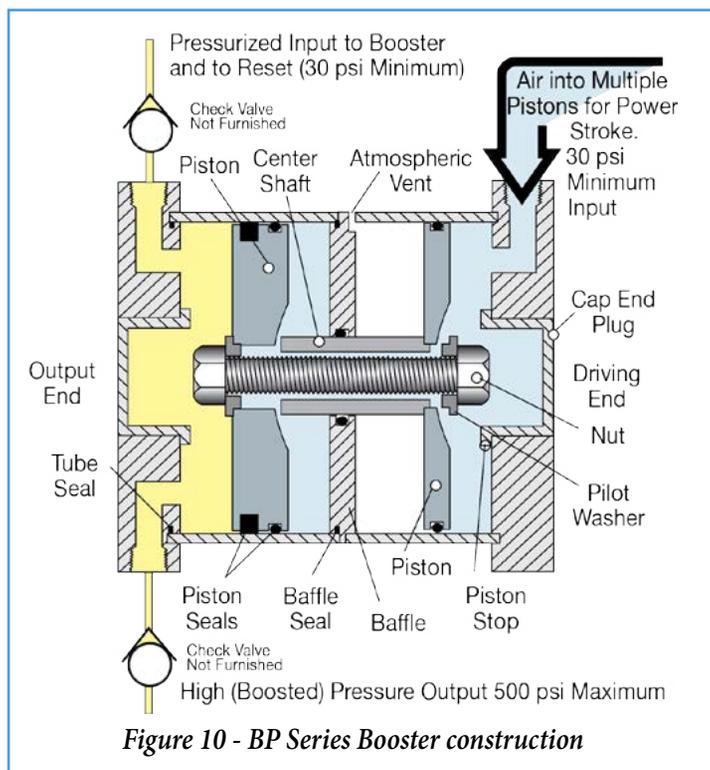
# PNEUMATIC BOOSTERS

## Helpful Application Circuitry (continued)

### Nice to know

When you don't need hydraulic control, but just need to bump up your air pressure, the BP Series air boosters will do the trick with pressure outputs up to 500 psi!

This series is built for use on systems in which the input to the booster will be pressurized fluid or gas. It requires a 3-way air valve for operation. Porting is provided on the unit for the power stroke only. When power stroke air is removed, the pressurized booster input will reset the pistons.



## BOOSTER BENEFITS

- **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 a cylinder the rigid, smooth, controlled motion of hydraulics.
- **Safe:** Boosters can be completely air operated to function safely in a potentially hazardous environment

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# SOLVING A MACHINING PROBLEM

On the Production Floor



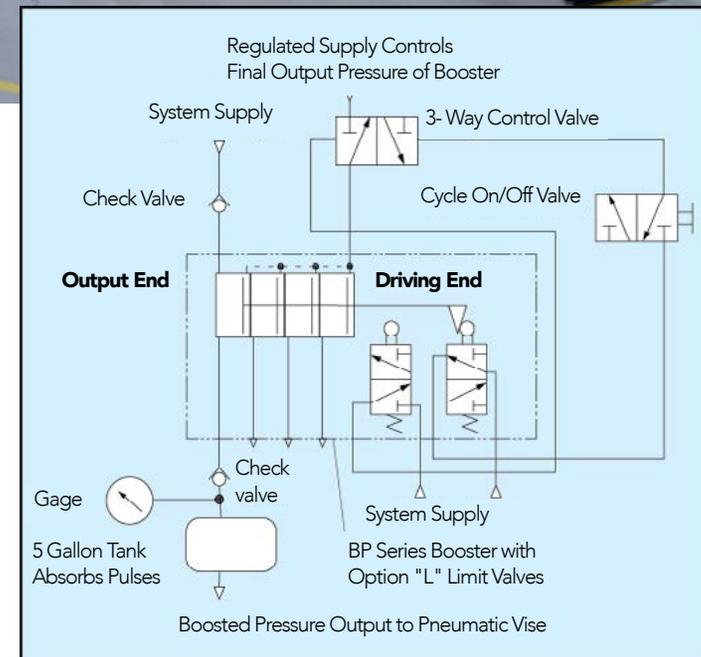
The job at hand for one machining center was to produce pneumatic valve bodies. The problem? Inadequate air pressure. Because of the extreme distance away from the factory's main compressor, pressure at the machine had dropped too low for its pneumatic vise to hold parts securely during a vital thread milling operation that was creating 1/4 NPT ports.

Inadequate clamping forces from the vise was putting valuable CNC tooling at risk and, of course, risked damaging the workpieces at a late stage in their production.

A Multi-Power® booster provided the convenient, low-cost solution that brought production up to speed producing defect-free threads with no rejected parts.

In addition to the booster, a 5-gallon tank, a 3-way valve, two check valves, a regulator and an extra pressure gauge were all that it took to remedy the clamping problem.

The simple circuit shown below was "teed" into the existing supply line to maintain the pressure required for reliable vise operation.



# MULTI-POWER® PRINCIPLE

Fabco-Air applies its Multi-Power® Principle to a number of other devices.

## Multi-Power® Linear Slides

Applying the Multi-Power® principle to linear slides increases slide thrust without increasing the bore or the mounting footprint. Shown below is a Fabco-Air slide model SE1000, utilizing a 4-stage Multi-Power® cylinder capable of producing 1,830 pounds extend force at 100 psi supply pressure. A conventional cylinder would yield only 491 pounds force at the same supply pressure.

*Model SE1000 4-stage,  
2-1/2" bore linear slide*



*The Pancake® II Family*

## Four families of Multi-Power® air cylinders

Standard Multi-Power options are offered on the following Fabco-Air cylinder families.



*The Pancake® Family*



*The Square1® Family*



*The Longstroke™ Family*

**FABCO-AIR**

Designing,  
Prototyping,  
& Delivering

~  
Custom  
Pneumatic  
Solutions  
in 72 hours



# MULTI-POWER® PRINCIPLE

(continued)

## Multi-Power® Assembly Tool

Pneumatic tools for making cable and wire rope assemblies achieve tremendous crimping power from force-multiplying air cylinders combined with cam-operated jaws. The power cylinder has three (3) pistons. When energized they produce over 1700 pounds force directly to the cam and power head. Force is increased through the cam and jaws to approximately 4000 pounds at 1" away from the tool and approximately 2500 lbs at a 2" distance.

These crimp tools drastically reduce cable assembly time thereby lowering "total installed cost". They are available as both hand-held and bench-mounted models, so you can bring the tool to the work or centralize production assembly work at a bench. The units are lightweight and completely portable so production lines can be readily moved and adjusted to optimize production.

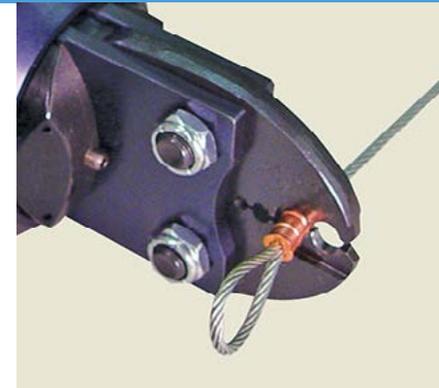
Tools from FABCO-AIR can tackle the broadest range of wire sizes in the industry, 1/32" through 3/8" diameters. They run on standard shop air pressure of 85 to 95 psi. Dual triggers allow the tool to be operated using either the left or right hand with or without gloves.

Ergonomically balanced at the triggers, the tool minimizes operator fatigue. A convenient shoulder strap allows one hand operation.

*Handled Crimp  
Tool for Splicing  
Application*



*Multi-groove jaws with completed eye splice*

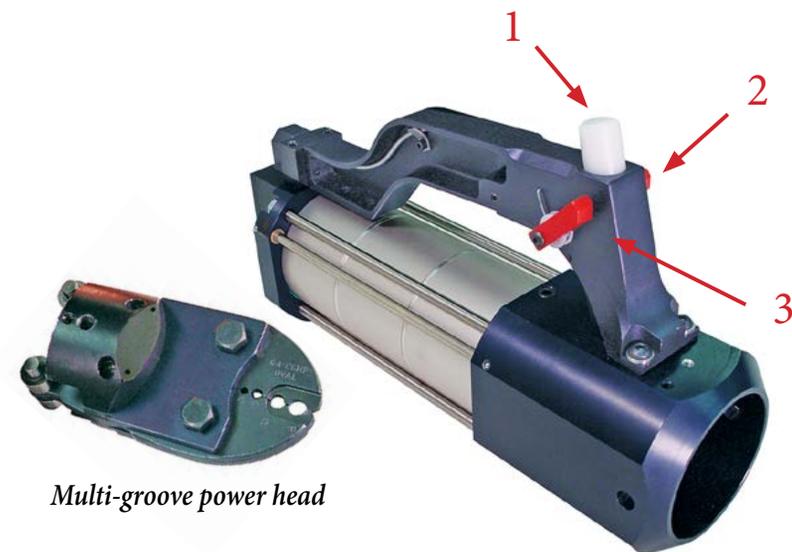


## Power Heads

A wide selection of single groove and multi-groove power heads is available. The power heads can be interchanged in less than a minute on either bench mounted or portable tools.

## Making the Crimp

Depressing the white button (1) at the top of the handle opens the jaws to receive the work piece. Releasing the button allows the jaws to spring closed and grip the parts securely. Pulling either of the red triggers (2 or 3) releases a lock so that the valve can be tripped by squeezing the index finger. This actuates the power cylinder driving the cam-operated jaws into their closed crimping position.



*Multi-groove power head*

*Tool with head removed*

# BENCH-MOUNTED TOOLS

Courtesy of Fabco-Air

As with the handled models, crimping jaws for bench models are spring loaded normally closed for safety.

Foot pressure on Valve A, shown in the photo below, opens the jaws for the wire and sleeve assembly to be inserted in the jaws. Releasing Valve A allows the crimp jaws to close lightly and hold the assembly securely in place.

Next, foot pressure on Valve B actuates the heart of the tool, a force-multiplying air cylinder that powers the cam operated jaws to the closed crimping position.

## Built-in quality control

The circuitry in the foot operated control box includes a pressure sensing valve that can be adjusted for various crimp pressures. The valve is extremely accurate and in essence delivers continuous QC.

For example, if the supply pressure should fall below the sensing valve's pressure setting, the valve will not provide a "crimp" signal to the tool. Thus the tool will stall at this point without making a bad crimp and without ruining the parts.

Once pressure is restored, the cycle will continue. The parts that were in the jaws will then be finished as a "good assembly".

## Booster Accessory Installs Quickly

Some jobs may require higher forces for proper crimping. An optional booster accessory is available to increase the supply air pressure to an acceptable level. It is attached with four allen bolts to the rear of any Fabco-Air crimping tool. Change-over takes only minutes.

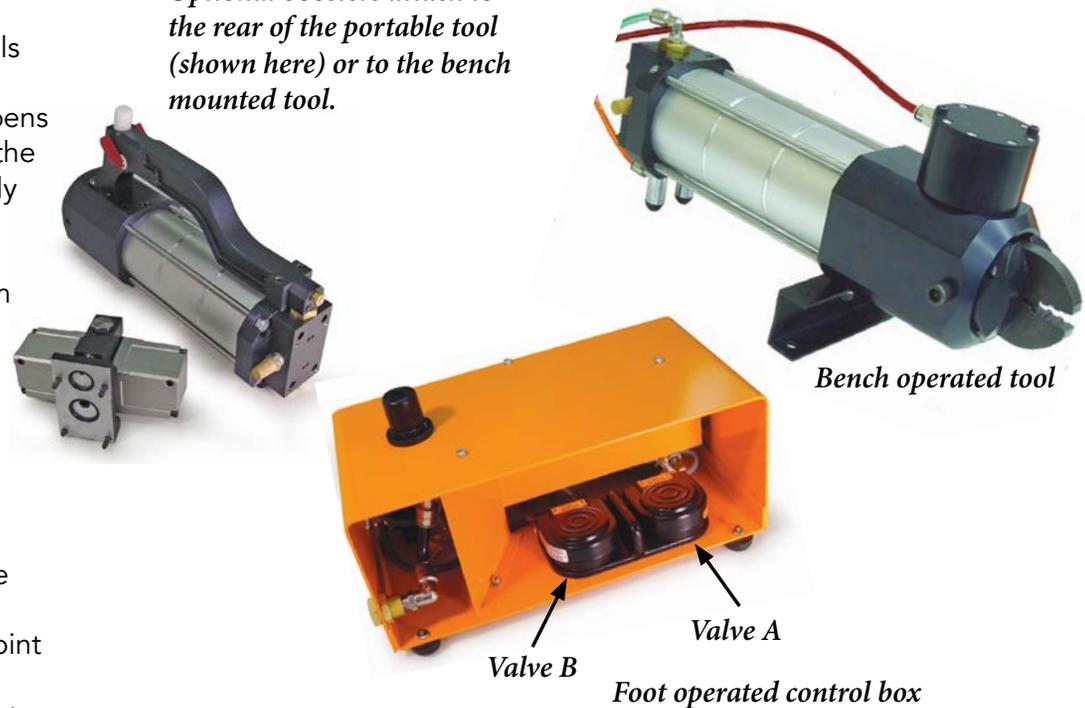
## More Than a Crimping Tool

The FABCO-AIR 300 Series of pneumatic assembly tools has the functionality to perform any number of manufacturing operations, improving product quality and increasing productivity on the production line.



Power head for Pex plumbing installations

Optional boosters attach to the rear of the portable tool (shown here) or to the bench mounted tool.



**NOW, IN ADDITION TO WIRE AND CABLE APPLICATIONS, YOU CAN TACKLE A VARIETY OF ASSEMBLY APPLICATIONS WITH CONFIDENCE, INCLUDING:**

- Making plumbing assemblies
- Crimping electrical terminals and connectors
- Swaging mechanical fasteners
- Staking, punching, piercing and flaring subassembly components
- Sealing, embossing and notching
- Clamping and holding assemblies
- Special custom applications

# MORE USEFUL IDEAS

## For Using Air/Oil Tanks

### Two-Speed Work Stroke with Shock Control

With a slight modification to the circuit in Figure 3, using a sequence valve, a needle valve and a shut-off valve, our single air/oil tank provides us with 2-speed work stroke operation shown in Figure 11 below.

The sequence is as follows:

1. Rapid "extend" stroke to approach the work.
2. Automatic switch to controlled rate when resistance is met and pressure builds up to the point where a Fabco-Air RV "Sequence Valve," (refer to Figure 6 on page 6) actuates the 2-way shut-off valve forcing fluid flow through the speed controlling needle valve.
3. Fluid catches the cylinder motion, thus controlling the shock that could otherwise occur.
4. Automatic return to rapid rate on the "Cylinder Retract" stroke.

### Double Air-Oil Tanks

Earlier we discussed controlling cylinder speed in one direction only. When control is required in both directions, two air-oil tanks are needed.

As you can see from the circuit shown below, double Air-Oil Tanks used in conjunction with two flow control valves enables hydraulic control with one speed in each direction.

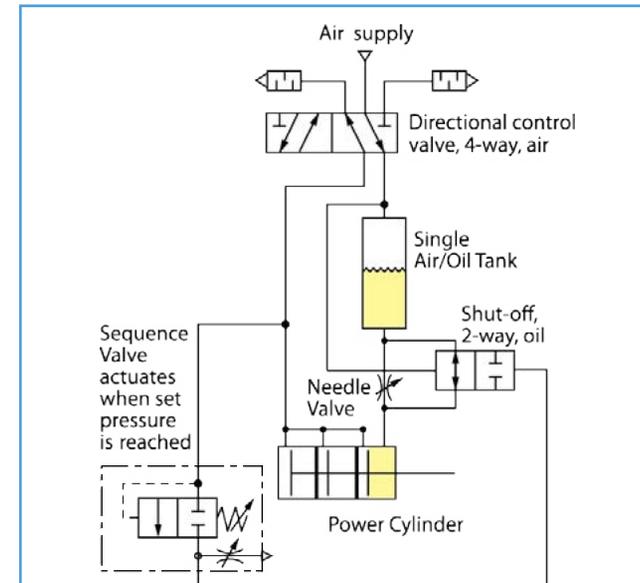


Figure 11 - Two-Speed work stroke with shock control

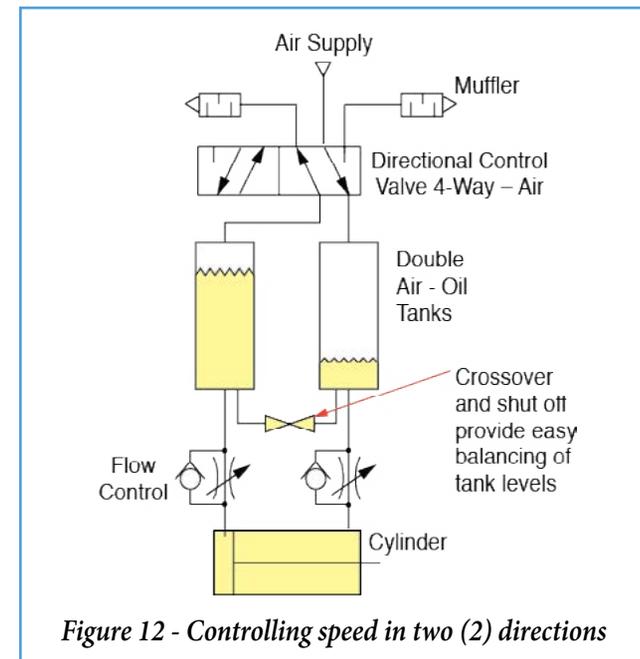


Figure 12 - Controlling speed in two (2) directions

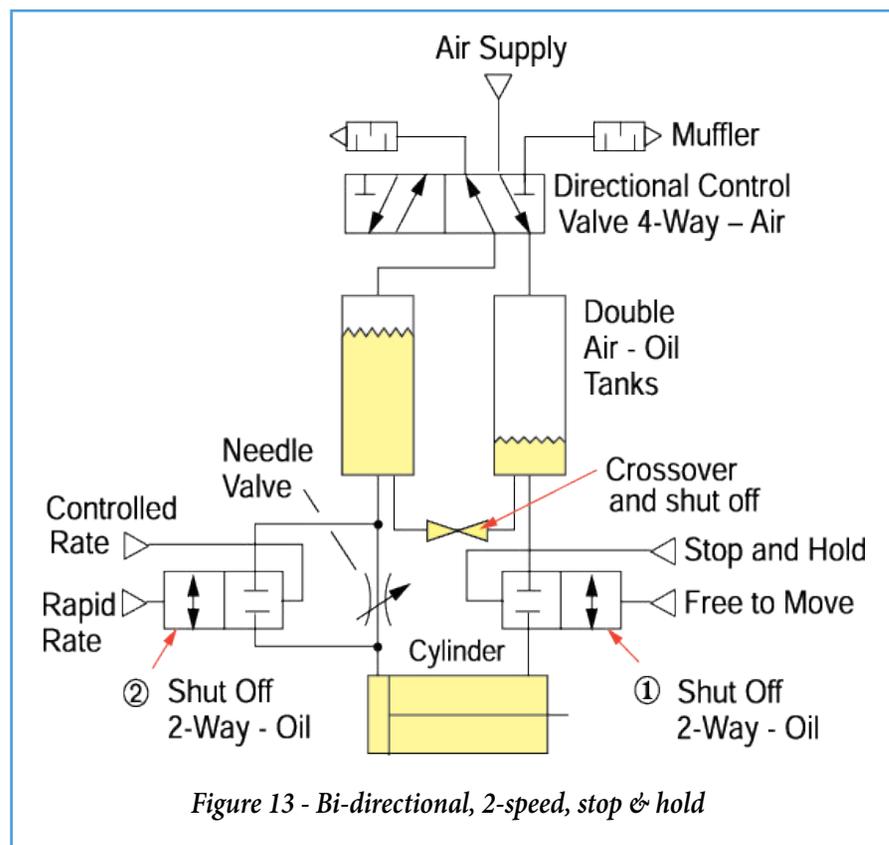
# MORE USEFUL IDEAS

## For Using Air/Oil Tanks (continued)

### Bi-Directional, Two-Speed Stop & Hold

Here's another helpful circuit showing double Air-Oil Tanks used with shut-off valves & needle valves to provide:

- (1) Stop & hold in either direction at any point in cylinder travel.
- (2) Choice of rapid or control rate in either direction at any point of cylinder travel.

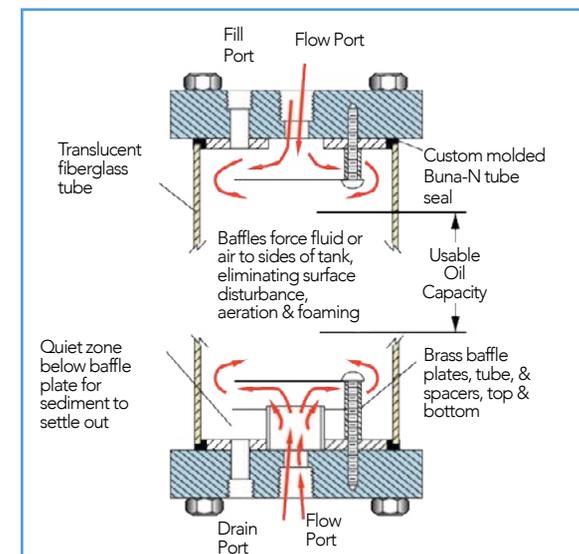


## TIPS FOR INSTALLING AIR-OIL SYSTEMS

1. The best control is achieved by installing the speed control valves so that the fluid being forced out of the cylinder is being controlled.
2. The piping between the cylinder and the speed controlling valve should be rigid enough to maintain the required rigidity of the system.
3. It is best to mount the tanks so that the bottoms of the tanks are higher than the cylinder. Cylinder ports should be up with piping running as straight as possible to the tanks. This aids in purging the cylinder of air, by allowing the air to rise through the piping and into the tank where it will dissipate.

### Monitoring fluid through the translucent fiberglass

1. The highest fluid level should be kept reasonably near the top baffle to avoid excessive air usage, providing the quickest cycle reversal, and to allow for possible fluid loss.
2. If the fluid levels in the tanks become unbalanced, the fluid is bypassing the cylinder's piston seal. This can occur in a new cylinder with U-Cups designed for air service or side loading on the piston rod. In old systems the bypass can be a result of seal and cylinder wear, seal shrinkage, or other reasons. A crossover valve can allow for fluid level balancing. (See Figure 12)
3. Fluid aeration and foaming can reduce intended cylinder control and make its operation "mushy." Properly designed air-oil tanks have special baffling top and bottom which eliminates such disturbance (Figure 17.)



# CONTACT US

**FABCO-AIR**

[www.fabco-air.com](http://www.fabco-air.com)

**352.373.3578**

