

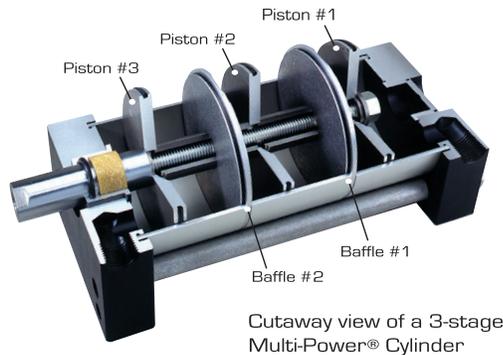
Using Pneumatic Cylinders in Rivet, Hole Punch & Broaching applications

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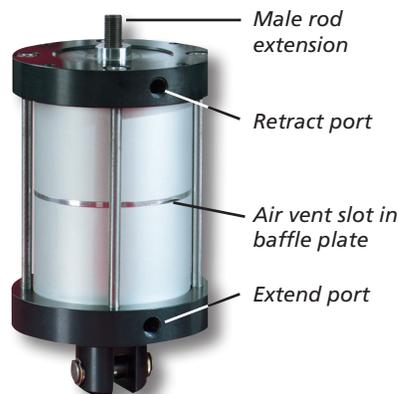
FABCO-AIR

Begin with force-multiplying Pneumatic Cylinders

Multi-Power® Air Cylinders from Fabco-Air provide the high forces necessary in applications such as riveting, hole punching and broaching. The cylinders operate on the principle of attaching multiple pistons to a common shaft with an internal air passage to all pistons. In this way, a Multi-Power® cylinder (depending on 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 lbs. of force rivaling many hydraulic systems! They are easy to install having only two port connections.



2-piston Multi-Power® cylinder with clevis mount

Today's application requires 4800 lbs of force for upsetting a rivet holding a stack of laminations together. Dividing 4800 lbs by 90 psi (our standard shop air supply), we will require 53.3 in². 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-in².; a 6" bore 2-stage unit has 55.3-in². 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	
	3	.50	.7	45	.15
	4	.65	.9	52	
4	2	24.4	5.6	2196	
	3	36.1	6.8	3249	11.8
	4	47.9	7.9	4311	
5	2	38.0	7.0	3420	
	3	56.4	8.5	5076	18.4
	4	74.8	9.7	6732	
6	2	55.3	8.4	4977	
	3	82.3	10.2	7407	27.0
	4	109.4	11.8	9846	
8	2	98.6	11.2	8874	
	3	147.0	13.7	13230	48.5
	4	195.4	15.8	17586	
10	2	153.9	14.0	13851	
	3	229.3	17.1	20637	75.4
	4	304.7	19.7	27423	
12	2	222.9	16.8	20061	
	3	332.8	20.6	29952	109.9
	4	442.7	23.7	39843	

Figure 1 - Cylinder Selection Guide

Controlling speed and shock when punching holes

Holes could also be punched in the laminations using a Multi-Power® cylinder. If needed, we can get as much as 39,843 lbs force at 90 psi supply pressure from a 12 in. bore, 4-stage cylinder. But it is important that we 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 cylinder and tooling, an air-over-oil tank is incorporated in the circuit between the directional control valve and the cylinder return port. (Figure 2)

How it works–

Fluid in the tank is used for the cylinder's return media only. Fluid flow and cylinder speed are 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 won't "pound" on the piston stop.

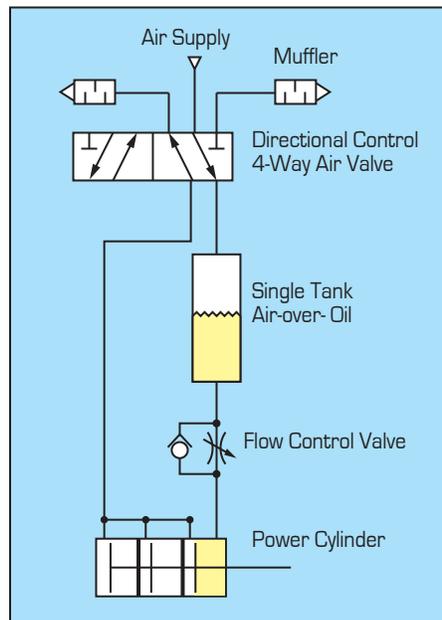


Figure 2 - Air-over-oil shock control circuit

Hydraulic Shock option–

Seals on the piston, piston rod, and cylinder tube are increased in the single-stage retract section (Shown yellow in Figure 3). 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.

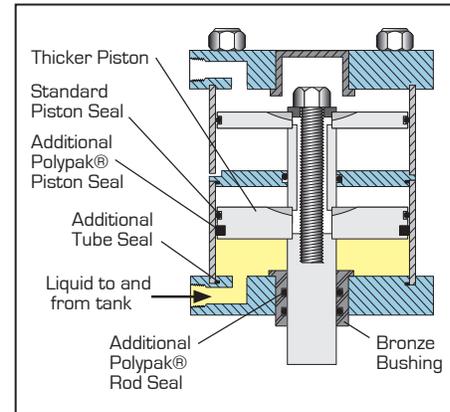


Figure 3 - Beefed up construction

Determining force requirements –

How much force does it take to crimp a piece of tubing or press a bearing into its housing?

Here's a simple, economical circuit to use 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 effective piston area of your cylinder (find piston areas in a "Selection Guide." Sample guide shown in Figure 1, page 1)
9. Result is the force (lb.) required by your application.

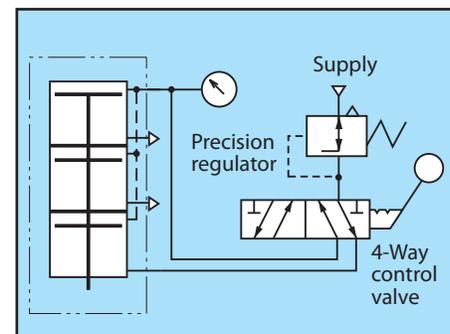


Figure 4 - Determining force requirements

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.



Cut-away view of an RV Sequence Valve

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.

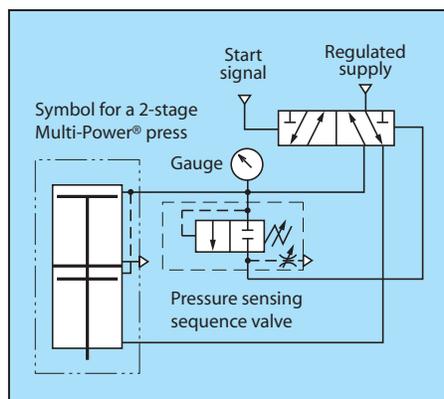


Figure 5 - Producing exact forces

Two speed work stroke with shock control

A single air/oil tank with a sequence, needle and shut-off valves, as shown in Figure 6, provides us with 2-speed work stroke operation.

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" actuates the 2-way shut-off valve forcing fluid flow through the speed controlling needle valve.

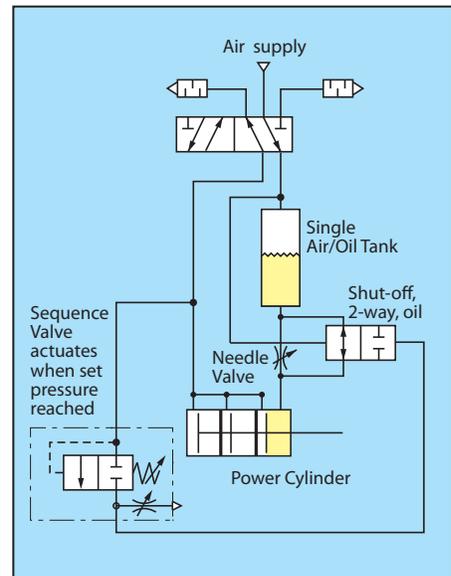


Figure 6 - 2-Speed work stroke circuit

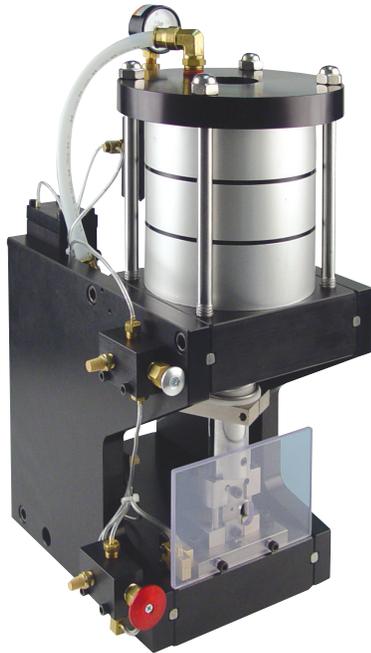
3. Fluid catches cylinder, again as described in our previous hole punching application, thus controlling the shock that could otherwise occur.
4. Automatic return to rapid rate on "Cylinder Retract" stroke.

Multi-Power® Principle applied to other devices

Multi-Power® Air Presses –

Fabco-Air applies its unique Multi-Power® principle to a precision framework and base, providing the ultimate in a powerful, compact, air-powered bench press for production or laboratory use.

The power cylinder has all the Multi-Power® features plus beefed up construction to meet the rigors of press type applications. Plated steel keys mate the cylinder head and a base plate to high-strength aluminum frame plates. The keyed and bolted construction provides you with the precision and long press life unobtainable from any other "C" frame or post type construction.



Model F55 press with 3-stage power cylinder

Multi-Power® Assembly Tool –

Hand-held or bench-mounted pneumatic tools can perform numerous manufacturing functions: make plumbing assemblies; splice wire rope and cable; crimp electrical components; swage mechanical fasteners; stake, punch, pierce and flare; seal, emboss and notch; clamp and hold assemblies and more.



Bench mounted Assembly Tool

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

Dial-A-Stroke® – a very useful option for Multi-Power® devices

Adjustable Extend Stroke–

Available for strokes up to 6", Dial-A-Stroke® provides a rugged, precision adjustment of the cylinder's extend stroke. One revolution of the adjustment nut adjusts the stroke by .050 to .071 inches depending on the cylinder size. Settings are simplified by convenient scale markings on the nut skirt and stop tube. Totally enclosed contact surfaces and minimum clearances combine to eliminate pinch points.

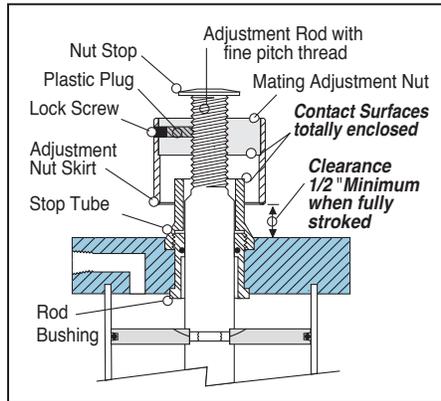


Figure 7 - Dial-A-Stroke® construction

Dial-A-Stroke® is not limited to Multi-Power® cylinders. In fact it can be applied to any number of actuators including air presses, linear slide products, pneumatic grippers (Figure 8) and, of course, conventional single-piston cylinders (Figure 9).



Figure 8: Dial-A-Stroke® unit on a pneumatic gripper facilitates quick change-overs on production line.



Figure 9: Dial-A-Stroke® unit on a 1-1/8" bore Pancake® air cylinder.

about FABCO-AIR



One of Fabco-Air's 24/7 lights-out machining centers

Fabco has all the popular off-the-shelf pneumatic components you want, ready for immediate shipment. Yet almost half of our business comes from helping customers solve design problems with special pneumatic solutions. We can design, prototype and deliver custom samples within 72 hours! **Fabco-Air solves problems. Let us help!**

FABCO-AIR since 1958

With operations housed in 61,000 sq. ft. in Gainesville, Florida, Fabco is dedicated to developing and providing advanced fluid power technology to give our customers the competitive edge they need in their field.

24/7 lights-out precision machining centers drive production, assure product quality and enable reliable delivery.

