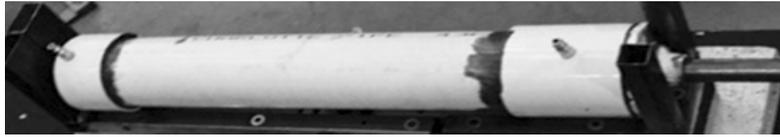


Low Cost Long Throw – Pneumatic Cylinders



This project developed long throw (8' & 12' stroke) low cost pneumatic cylinders using PVC pipe. The cylinders operate at pressures as low as 60 psi. moving loads over 1,500 lbs. An initial review found a design by Michael Bianco from the January, 1983 *Yale Tech Notes #1124* using PVC pipe. This project modifies that design, with a new size, piston design, and front end seal assembly. The cylinder described here has passed a 1,000 cycle test with less than 0.001" wear on the seals and components. The PVC pipe has been tested at pressures up to 125 psi.

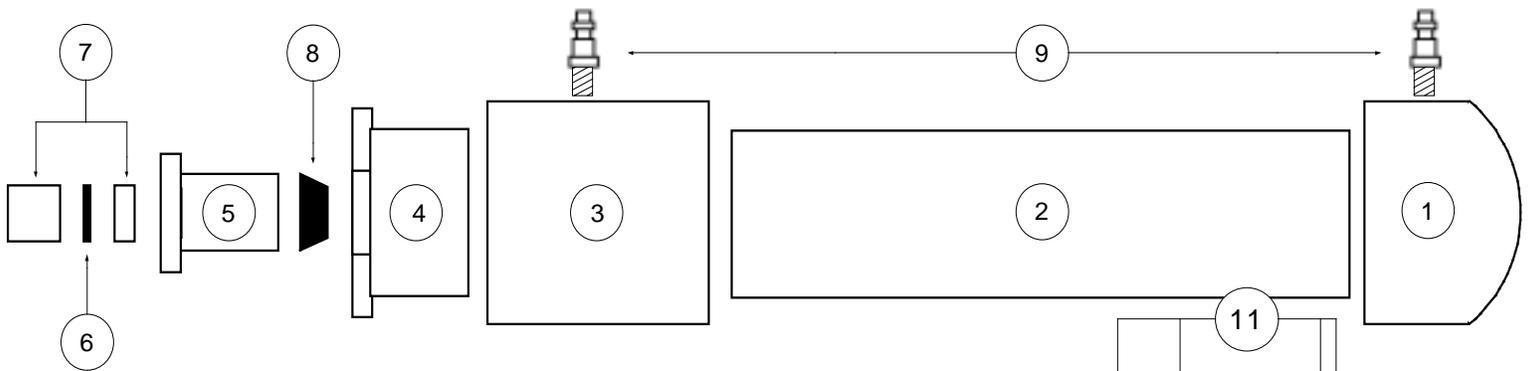


Figure 1a

Item numbers correspond with part list numbers.

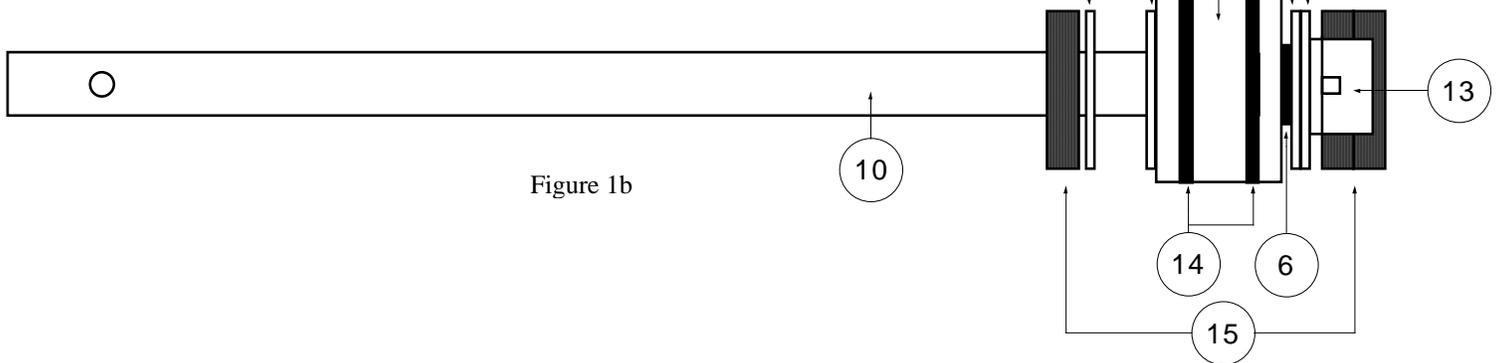


Figure 1b

Piston Assembly

1. Cast the piston (12) in a 3" length of the PVC pipe, Eurocast is recommended because it produces a lightweight millable piece.

2. Drill a 1" hole through the casting.
3. Mill 2 grooves 7/32" deep, 1/2" in from either end. Use a Dremel with a 3/8" bit in the Dremel router guide mounted on end (Figure 2).
4. Add an o-ring (14) into each of the grooves and test the fit in the pipe.

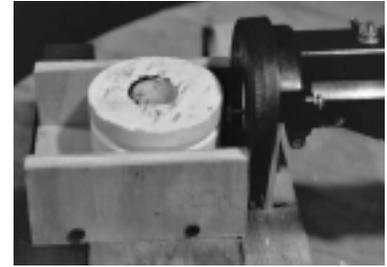
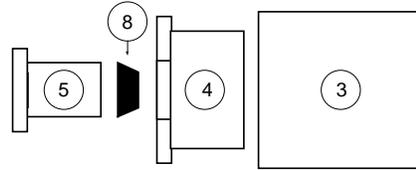


Figure 2

Front End Seal Assembly



1. Sand the inside of the ballcock shank washer (8) for a snug fit on a 1" rod jig. (Figure 3a)
2. Apply contact cement to the non-flanged end of the 1 1/2" – 1" bushing (5) and to the large end of the washer, let stand open for 15 minutes.
3. Press the two components together using the rod jig to stretch the washer and maintain the opening size (Figure 3b), let dry.
4. Surround the joint between the washer and bushing with 2-ton high strength epoxy (Figure 3c) and let dry.
5. Sand off any extra epoxy from the sides of the bushing.
6. Cement the 1 1/2" – 1" bushing (5) into the 3" – 1 1/2" bushing (4).
7. Cement the 3" – 1 1/2" bushing (4) into one end of the coupler (3).



Figure 3a



Figure 3b



Figure 3c

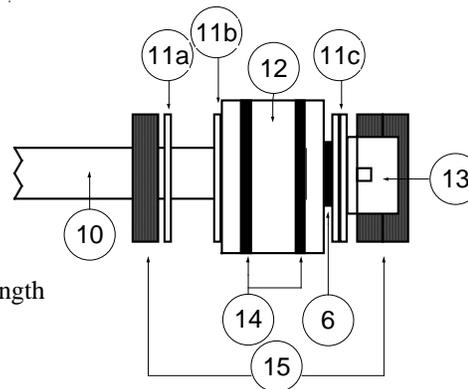
Rod and Piston Assembly

Compute the rod and piston

Sizes using these formulas

$$\text{PVC pipe length} - 3 \frac{1}{2}'' = \text{Desired stroke length}$$

$$\text{Rod length} = \text{PVC pipe length} + 5''$$



1. Thread one end of the rod (10).
2. Weld a 1" washer onto the rod 2 3/4" from the threaded end (11b), braze another washer 3 3/4" from the threaded end (11a)
3. Add the piston behind the welded washer (11b), slide on an o-ring (6), followed by 2 to 3 filler washers (11c).
4. Tighten the pipe cap (13) down to the point that it compresses the o-ring.

5. Next caulk around washer (11b) sealing the space between the piston and washer, allow to cure.
6. Attach at least 1/2" of high density foam (15) onto the front washer (11a) and the pipe cap (13) with 5-minute epoxy. (The foam provides a bumper inside of the cylinder to prevent cracking from the impact at the stop at each end).

General Assembly Process



Use PVC cement and clamp all assemblies together, for a tight fit. All fixtures need at least 6 hours to cure before the clamps are removed.

1. Cement the end cap (1) onto the end of the pipe (2).
2. Drill a 15/32" hole 1 1/2" from end through the pipe cap (1) and PVC pipe for the NPT plug (9).
3. Push down on the male NPT plug (9) and turn it in the hole, this will allow it to thread its own hole.
4. Add silicone lubricant to the inside of the cylinder and around the o-rings on the piston. Insert the rod and piston into the cylinder by pushing on the end of the rod until it becomes difficult to move, remove and add more lubricant. Repeat the process until the rod is completely inserted and moves smoothly by hand.
5. Add a small amount of lubricant to the rod and carefully slide on the front end seal assembly (3,4,5 & 8). Cement the assembly to the end of the pipe, and clamp it in place (note if clamped too tightly the entire cylinder may bend).
6. Drill a 15/32" hole 1 3/4" from the front end of the coupler (3) and insert NPT plug (9) as before.
7. Create the front rod seal by inserting a 1/4" piece of 1" PVC (7b) into the bushing (5), add an o-ring (6) and push it into place with a 5/8" piece of 1" PVC (7a).
8. Add a small bit of PVC cement to part 7a to seal the o-ring it firmly in place.

Parts

Parts are listed with purchase price and part number if they were not purchased locally. Parts are also numbered correspondingly to their positions in Figures 1a & 1b.

1. PVC* End Cap (3" - slip)	\$1.97	
2. PVC* Pipe (3")	\$1.28 per ft	
3. PVC* Coupler (3" - slip)	\$2.27 ea	
4. PVC* reducer bushing (3" - 1 1/2")	\$2.18 ea	
5. PVC* reducer bushing (1 1/2" - 1")	\$0.49 ea	
6. 213 Dash Buna N O-Ring	\$6.37 (100)	#9452K33 M*
7. PVC* Pipe (1")	\$0.32 per ft	
8. Hoover-R Ballcock Shank Washer	\$0.99 ea	
9. Male NPT plugs (1/4")	\$0.98 ea	#2X169 G*
10. Cold Rolled Steel rod (1")	\$1.35 per ft	
11. 1" Steel Washers	\$0.52 ea	
12. 2" Piston from Eurocast	\$17.95 (32oz)	#DU-32 I*
13. 3/4" Steel Pipe Cap	\$0.69 ea	
14. 334 Dash Buna N O-Ring	\$13.26 (50)	#9452K54 M*
15. High Density Block Foam	In Stock	

*All PVC is for pressure SCHD 40.

Other Items Required

Synlube (Release Agent)	\$8.50	#1711 I*
GE Silicone II Caulk	\$6.39	
DEVCON 5-Minute Epoxy	\$5.59	
DEVCON 2-Ton High Strength Epoxy	\$2.99	
Weld-Wood Contact Cement	\$2.99	
Loctite Silicone Lubricant	\$11.44 (5.3oz)	#5E201 G*
PVC Pipe Cleaner	\$2.81 (16oz)	#1RG60 G*
Purple Primer	\$6.04 (32oz)	#1RG58 G*
Heavy Duty PVC Cement	\$3.99 (16oz)	#1RG50 G*

M* = McMaster-Carr Supply Catalog

G* = Grainger Supply Catalog

I* = Iasco Catalog