THE PISTON SOLUTION – EUROCAST

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exhibit no. 6

While building a series of low-cost, long-throw pneumatic cylinders from PVC pipe, I encountered the problem of creating a practical piston. For the cylinder to work effectively the piston needs to form a tight seal around a 1″ cold rolled steel rod, as well as fit snuggly inside of the PVC. To prevent air loss, the design requires that the piston also be grooved for the placement of 2 O-rings which create the air-tight seal against the cylinder walls. (See Figure 1) Previous plans published about the construction of PVC pneumatic cylinders, had suggested both wood and steel solutions to this problem. (*Yale Tech Brief #1124)* Each had their own difficulties. Turning a piece of wood on a lathe to create the piston, left too much room for error and resulted in a loose seal. Machining a steel piston was too costly. In addition, neither solution accounted for the inner wall irregularities that I discovered are unique to each piece of PVC pipe.

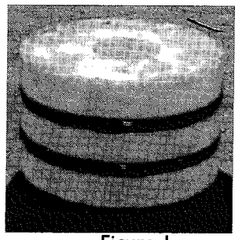
Figure 1

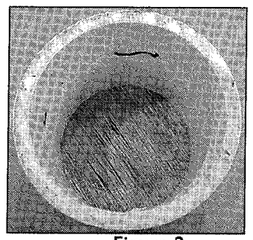
Figure 2

The solution to these problems was to develop a custom molded piston. To create the piston I used a two-part urethane casting resin called Eurocast. This product has a relatively low cost, and the resulting casting is durable, millable and resilient to wear from repetitive motion. Eurocast creates a white casting that exothermically cures in five minutes and is completely cool within thirty to forty-five minutes. It will not stick to most rubbers, metals and plastics.

A detailed description of the piston creation process can be found below. You will need the following special equipment: toothpicks, a dulled 1″ wood boring bit, a 3/8″ Dremel Router bit, and a Dremel tool in a Dremel Router guide, mounted as in figure 5.

1. Cut a 3″ length of the PVC pipe.
2. Cut a circular base out of Lauan and attach it to the pipe securely. (Figure 2) To create an easier release, you may want to cover the Lauan with tin foil prior to assembly.
3. Coat the inside of the mold with a mold release agent (I suggest Synlube).
4. Pour part A and part B of Eurocast together into a paper cup at a 1:1 ratio, mix for 30 seconds and slowly pour a piston of 2″ depth into the mold to avoid air bubbles. Eurocast has only a 2 minute pot life, so you need to work quickly.
5. Remove any bubbles by inserting a toothpick into the resin to bring them to the surface. (Figure 3)
6. Allow the Eurocast to cure and cool.

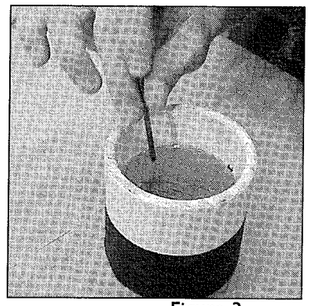
Figure 3

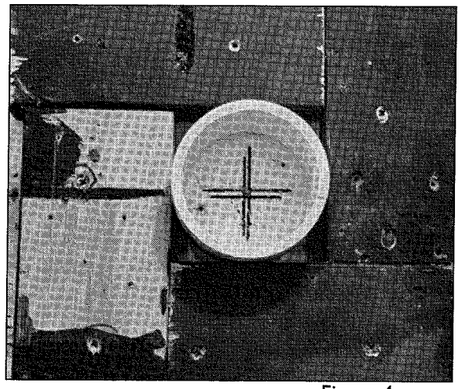
Figure 4

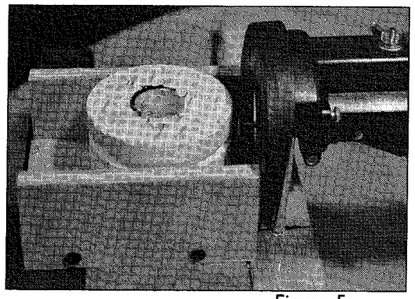
Figure 5

7. Remove casting from the mold.
8. Drill a 1″ diameter hole through the casting using a dulled wood-boring bit. A dulled bit will cause the casting to melt, creating a smooth wall. To ensure the hole is centered I suggest using a shop built fixture to mark the center point. The fixture is made of scrap plywood and 1x material and holds a short length of PVC with a nail sticking up through the center. (Figure 4) By inserting the casting into the PVC and pushing down, the exact center of the casting is marked accurately every time.
9. Mill 2 grooves 7/32″ deep, 1/2″ in from either end, on the outside of the piston. Use a Dremel with a 3/8″ bit in the Dremel router guide mounted on end. (Figure 5)
10. Add a 234 dash O-ring into each of the grooves and test the fit in the pipe, if the piston cannot be pushed into the pipe by hand the groove depth must be adjusted.

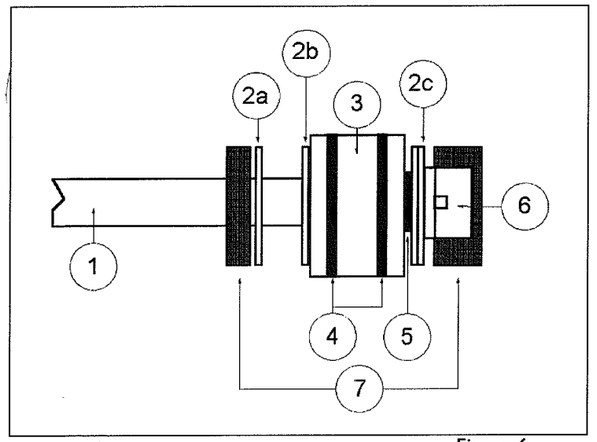

Figure 6

Once the piston is completed it is attached to the rod (numbers correspond to parts in figure 6):

1. Thread one end of the rod (1).
2. Weld a 1″ washer onto the rod 2 3/4″ from the threaded end (2b), braze another washer 3 3/4″ from the threaded end (2a)
3. Add the piston behind the welded washer (2b), slide on a 213 dash O-ring (5), followed by 2 to 3 filler washers (2c).
4. Tighten a 3/4″ pipe cap (6) down to the point that it compresses the O-ring.
5. Next add silicone caulk around washer (2b) sealing the space between the piston and washer and allow the caulk to cure.
6. Attach at least 1/2″ of high density foam (7) onto the front washer (2a) and the pipe cap (6) with five-minute epoxy. (The foam provides a bumper inside of the cylinder to prevent the cylinder from cracking at the stop at each end).
7. 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.

This by far is not the only use for Eurocast but simply how I've used it to solve one of the large problems in the creation of shop built pneumatics. It is a very versatile resin that is easy to work with and has limitless possibilities. I purchased the Eurocast resin from the IASCO catalog (Industrial Arts Supply Company) at a total cost of $17.95 for 16 oz. of both parts A and B, which, for the results achieved, make it a cost effective solution. All of the other items mentioned in this article can be found with prices and purchase information on the attached parts list. ▼

PARTS

Parts are listed with purchase price and the part number from the given catalog, if no number is listed the part was purchased locally.

Eurocast	$17.95 (32oz)	#DU-32 IASCO
Synlube (release agent)	$8.50	#1711 IASCO
334 Dash Buna-N O-ring	$13.26 (50)	#9452K54 McMaster-Carr Supply Catalog
Cold rolled steel rod (1″)	$1.35 per ft	
1″ steel washers	$0.52 each	
213 Dash Buna-N O-ring	$6.37 (100)	#9452K33 McMaster-Carr Supply Catalog
Steel pipe cap	$0.69 each	
GE Silicone II caulk	$6.39	
DEVCON five-minute epoxy	$5.59	
Loctite silicone lubricant	$11.44(5.3oz)	#5E201 Grainger Supply
High-density block foam	Stock	