

# Air Muscles:

## A step-by-step guide to construction

Mark Harmsworth is a TEP associate, is Head of D&T at Rhyl High School and Gatsby Teacher Fellow who featured Pandora his life size robot at the D&T show at the NEC 2003. This issue he encourages us to reconsider pneumatics and the low cost and high fun factor possible.



When I first thought about pneumatics some years ago, I remembered clunky rams and cylinders and the 'pisst' of air. That was the outdated image that I had until I came across the air muscles being used by Salford University robotics lab. Since then I have discovered that there are a number of companies that utilise and manufacture air muscles for robotic work. However air muscles are not a revolutionary idea. They were originally conceived in the 1950's in America, by McKibben, for applications with prosthetic limbs.

Over the past years I have been looking into developing a low cost version, specifically to encourage students and teachers, to re-vitalise pneumatics and make robotics even more exciting. What follows is merely a guide to how I have achieved this and I am sure that it can be constructed even more cheaply with a little ingenuity.

To make a single exceptionally powerful air muscle follow these simple steps:



### Step 1.

You will need the following:

- 1 bicycle inner tube
- 1 length expandable braid
- 2 aluminium end pieces
- 2 jubilee clips
- 1 1/8th inch BSP air fitting



### Step 2.

Mark out and cut with a hacksaw

Two 30mm lengths of 25mm diameter aluminium.



### Step 3.

Cut a 200mm length of bicycle inner tube.



### Step 4.

Cut using scissors a 250mm length of braiding.



### Step 5.

Using a lathe face off a drill a 4mm hole through one of the aluminium ends, then drill and tap the hole for the 1/8th BSP fitting.



### Step 6.

Using PTFE tape wrapped around the thread and fix this into the threaded hole.



### Step 7.

Push the end pieces onto the inner tube.



### Step 8.

Feed over the expandable braiding.



### Suppliers of equipment:

- inner tube and jubilee clips can be bought from a good bicycle shop
- expandable braiding was from RS Supplies. They do a variety of sizes but for this occasion I have used min 45mm-max 73mm. This is sold as a 5-metre roll.
- 1/8th BSP fittings can either be bought through any educational supplier or taken off of older pneumatics equipment.

### Step 9.

Finally secure both ends using the jubilee clips.

You may choose to develop some low cost reservoirs as shown in the pictures below but only test these with a bicycle pump and teacher supervision as they could over pressurise and go BANG!



➤ The inside of a leather football contained with a netting. The fittings on this are held with a device normally used to re-inforce a camping tent eyelet.



➤ An old aluminium fire extinguisher.

### Applications and future ideas:

Since starting the Pandora project I have developed, some would say an unhealthy fascination with robotics, and more recently with exoskeletons. In the latest creation shown on the right you can see it incorporates both air muscles and the more traditional pneumatic rams. This idea is still at an early stage, but I believe that it has great potential, specifically with regard to rehabilitation aids.

In a future issue of News and Views I will explore in more depth the rapid prototyping that I use, and explain how this exoskeleton took about 3 hours to make.

