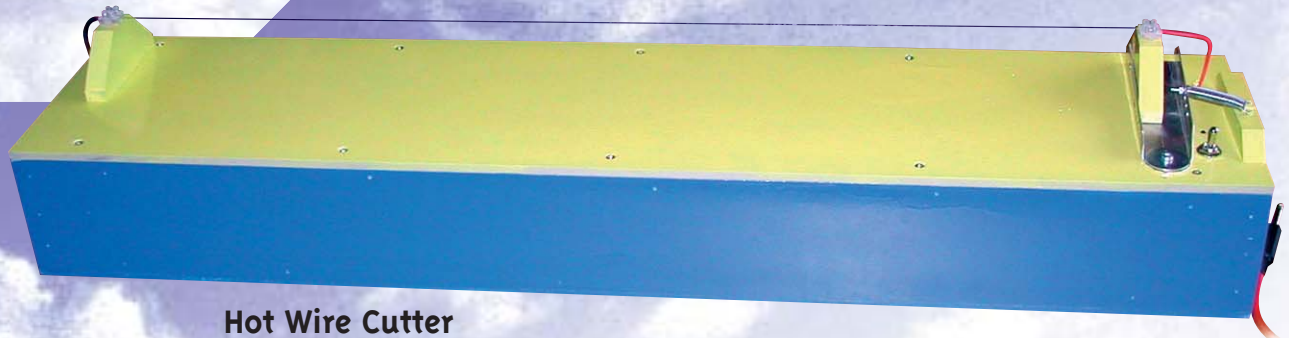


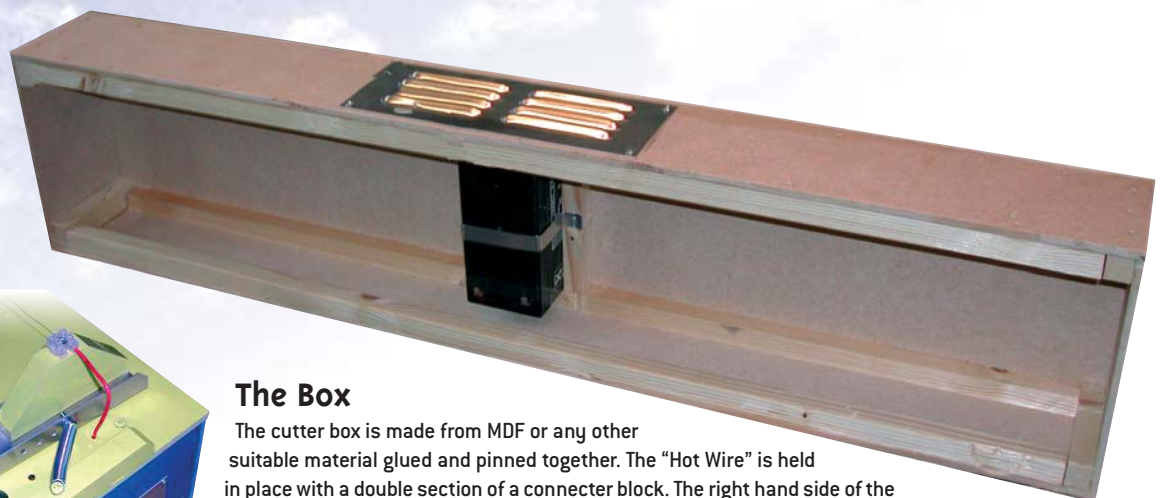
Polystyrene Cutter for Wing Profiles

In the last issue of News and Views we looked at making flying models using the TEP Air Motors as a power source. One of the main problems with making a flying model aircraft is getting the weight down as low as possible and a good material for doing this is expanded polystyrene. But as anyone who has tried knows, cutting polystyrene with a knife or a saw can be quite difficult and messy. An alternative to a knife or a saw is a hot wire cutter.



Hot Wire Cutter

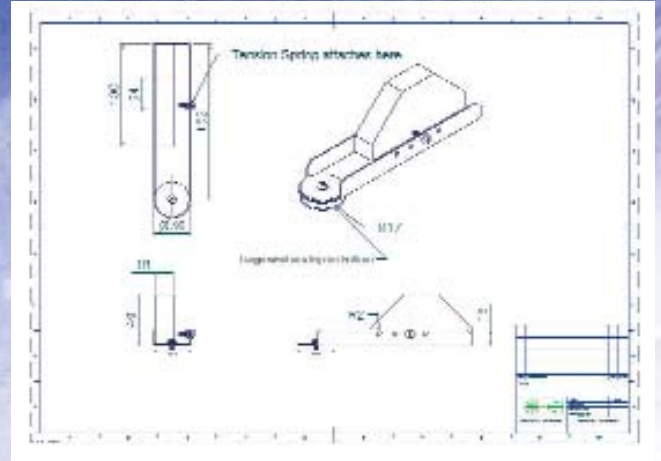
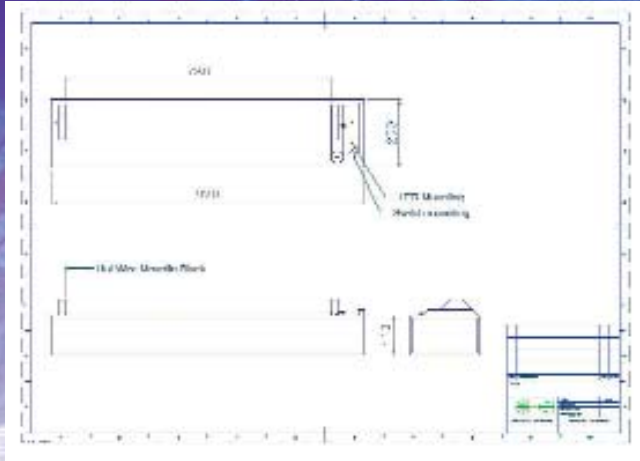
Contrary to popular belief, hot wire cutters are not dangerous if used with the usual amount of caution applied to all equipment used in a workshop. If the voltage of the wire is set so that it does not over heat the polystyrene to the point where it visibly fumes and good ventilation is used then there will be no dangerous build up of toxic gasses, **but it is a good idea to familiarize yourself with the COSHH regulations from CLEAPSS before using one in your workshop** ⚠



The Box

The cutter box is made from MDF or any other suitable material glued and pinned together. The "Hot Wire" is held in place with a double section of a connector block. The right hand side of the wire is held on a hinged block which is tensioned with a spring. This keeps the wire tight when it expands whilst it is in use and hot.

🔍 Detail showing tension spring



Hot Wire Cutter construction drawings. Also available on the TEP website at: www.tep.org.uk

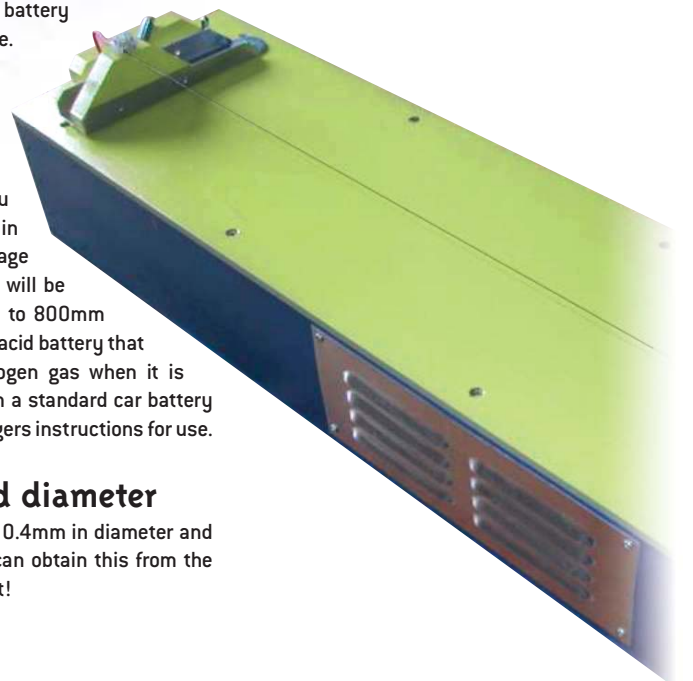
Power Supply

Power supply to the cutter is the critical factor for its success. If you have access to a variable voltage power supply this is ideal provided it can supply 3 to 4 amps output at between 6 and 12 volts. The cheap plug-in power supplies can not usually supply anything near this output and are definitely not suitable for the cutter. It is possible to make your own power supply, but unless you are very good at electronics and can get it tested when it is completed it is not a good idea if you are going to use it in the workshop - (a circuit for one is on www.myra-simon.com/bike/charger.html).

If you can afford it many companies sell very good variable power supplies and a look on the internet is always worthwhile. The alternative is to use a battery and this project is going to do that as a reasonably cheap alternative.

Battery operation and voltage

Choosing a battery for a polystyrene cutter is a matter of preference, but I would say that the best type are the sealed lead/acid batteries as they are heavy duty and easy to maintain. You can buy them in a range of voltages and power ratings and they are in an acceptable price bracket of around £12.00 to £14.00. The voltage depends on the length of the cutting wire you want to use; 6volts will be suitable for lengths up to 300mm long and 12volts for lengths up to 800mm long. It is important to remember that if you do choose to use a lead acid battery that the case must be well ventilated as the battery produces hydrogen gas when it is charging and discharging. Charging of the battery can be done with a standard car battery charger and a suitable adaptor. Remember to follow the battery chargers instructions for use.



Resistance wire ohms/metre, length and diameter

The resistance wire for the cutter needs to be between 0.3mm and 0.4mm in diameter and have a rating of 3.9 ohms per metre to 5.5 ohms per metre. You can obtain this from the usual suppliers of electronic components or the Science department!

Current and temperature

The temperature of the wire will depend on the current flowing through it. To get the required heat to melt the polystyrene without visible fumes a current of between 1.8 amps and 2.4 amps is required. This can best be found from experimentation and with 5.5 ohm/m wire; an 800mm length of wire will give around 2amps with a 12 volt battery. The table below gives some approximate values.

These figures are only approximate, see the notes below.

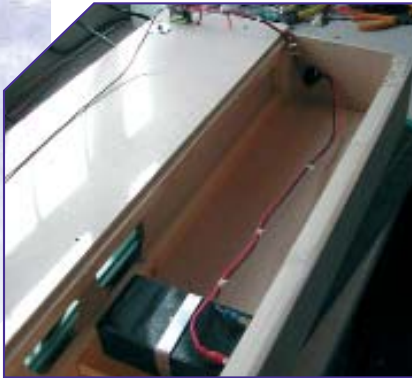
Battery	Wire Rating	Length	Current	Diameter
6 volts	5.5 ohms/m	600 mm	2amps	0.3 mm dia
12 volts	3.3 ohms/m	800 mm	2amps	0.4 mm dia

The problem with batteries is that the actual voltage is rarely the same as the stated voltage, a freshly charged 12 volt battery will give out anything from 13.5 to nearly 14 volts, which makes a mess of any calculations that you may do, so experiment with the lengths to get the power rating i.e. temperature that you want.

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Polystyrene Cutter for Wing Profiles

Continued



Position of battery power supply

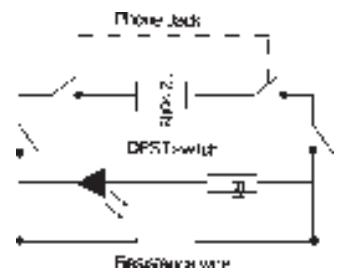
Circuit layout

The battery is fitted into the box and held in place with a strap and connections are made to it with spade connectors. The on/off switch is a double pole single throw switch rated at 4amps and both poles of the battery are connected to it.

In between the battery and the switch is the charger connection; this is made from a 5mm mono phone plug and socket, wired so that it disconnects the cutter wire from the battery when it is plugged in allowing the battery to be charged without the wire heating up. **The cutter wire should never be used whilst the battery is charging.** The charger should be connected to the socket by wiring the male plug to it making sure that the positive terminal of the charger is connected to the positive terminal of the battery when it is plugged in.

⚠ Caution - Serious damage could result to the battery if it is connected in the wrong direction for any length of time (reverse polarity).

To ensure that it is only the cutter wire that heats up connections in the circuit should be made with suitably rated wire. In this example I used single strand copper wire stripped out of standard lighting cable, because it was available and works well.

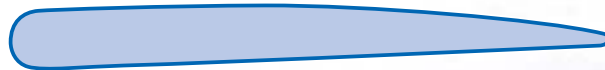


Hot Wire circuit

The LED is in the circuit to act as an indicator for when the cutter is switched on and R1 is a suitably rated resistor for the voltage (470ohm). Do not leave the circuit switched on when it is not in use (even if you are using a power supply) to prevent overheating of the wire and the production of excess fumes.

Cutting a Profile

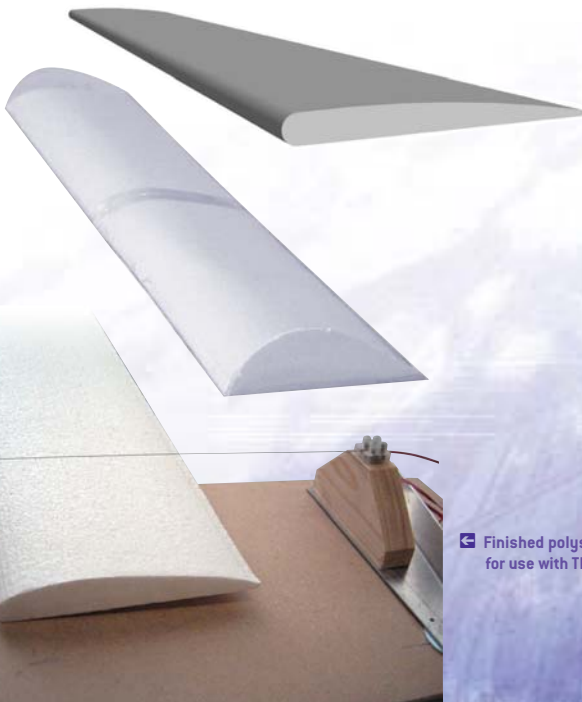
The simplicity of the idea behind this cutter is the horizontal wire, which allows gravity to assist with the cutting of the profile. This cutter was specifically designed for cutting wing profiles for model aircraft, but it could be very easily modified for cutting any type of shape for all kinds of modelling.



The profile for the wing is cut out of thin aluminium sheet to the size you want the finished wing to be and the edges are carefully filed smooth so that they will not snag on the hot wire. Two profiles are needed, one for each end of the wing. If they are identical they can be filed together, but tapered wings would have a different sized profile for each end.

A block of polystyrene is cut to be just bigger than the wing shape and the profiles are stuck on each end with a small piece of double sided tape. The cutter is switched on and the polystyrene block is rested on top of the wire. The wire will cut through the polystyrene down to the profile, then, holding it lightly; gently push the block across the wire allowing its own weight to hold the profile in contact with the wire. Continue all around the profile. There is a knack to doing this accurately as the tendency is to push too hard, so practice on some scrap until you get the feel for it.

You will soon find that you can produce very good wings up to 800mm long in less than two minutes and they will only need very light finishing off when they are done. Two wings can be joined together to make one big wing using PVA glue and wrapping the joint in tissue paper coated with glue.



Finished polystyrene wings ready for use with TEP air motors

