Tutorials

- Back to list

Site

- Home
- Contact me

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TungstenTech Rocketry

Shear Pin Tutorial

Introduction

The following is a brief description of an easy way to install shear pins in a medium diameter rocket. The rocket in question is a Public Missiles Eclipse, a dual deploy 4" rocket of about 7 feet. It's rather heavy so it only goes to about 1500' on an I357BT.

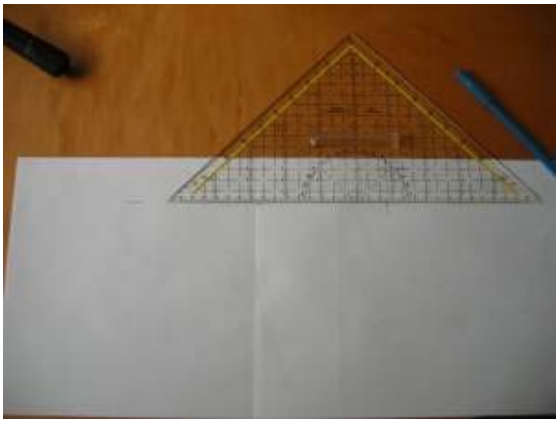
During a recent launch the nose cone separated shortly after the aft section was ejected. This meant that the main chute got deployed at apogee instead of the planned 300' that was preset in the altimeter. The altimeter in fact fired the ejection charge at the right moment, the bang could be heard as the rocket descended.

So after asking the Lunar list for help it was suggested that I use shearpins instead of making the nose cone fit tighter. This tutorial illustrates some of the techniques I used.

I started by reading the article on Rocketry Online.

Measuring

I started by taking two sheets of paper and taping them together so they would fit around the rocket. I then wrapped the paper around the rocket and made a mark where the pager overlapped. Since I wanted to have 3 shear pins I measured the distance and divided by three. I then measured the shoulder of the nose cone to figure out where I wanted the shearpins. I decided 4 cm below the cone was about right. Using a convenient tool called a geo-triangle I marked the spots where the shear pin holes would end up, a little over 10cm apart in my case:



Picture 1

I then wrapped the paper back around the rocket, taped it and made markings on the nose cone corresponding with the drill marks on the paper. The picture I took wasn't focused but it looked the same as picture 4 below. Make sure one mark is distinguishable from the others so that you can allign the holes properly. In an ideal world the holes would be perfect and alligning could be done with any hole pair but we all know how that goes in reality.

Brass reinforcements, nylon screws

I happened to have some thin brass strip in the garage that I got at a hobby store. This stuff seemed ideal to provide a strong and somewhat sharp edge to cut the nylon screws I had selected. Thankfully it had the label still on it: **Steelworks Brass Flat Strip .016 x 1/2" . 1 ft**.

A word about those screws. I selected McMaster Carr part# **91766A077 - Nylon Pan Head Phillips Machine Screw 2-56 Thread, 1/4" Length, Packs of 100** for less than $5. I also got 3/4" and 1" but the 1/4" seem to be the most useful. I tried several drill bits till I found that 3/16" gave a tight fit.

Making strips and slots

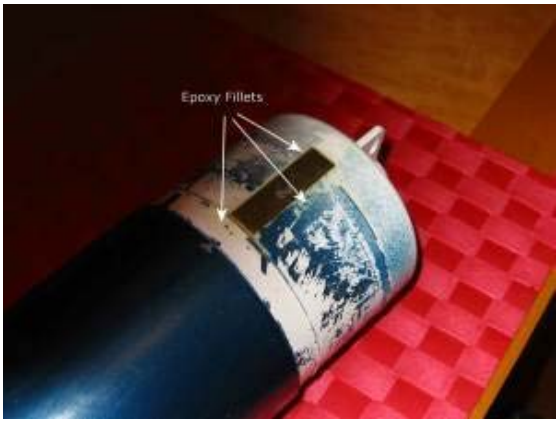


Picture 2

On the picture above you can see how I cut three pieces of brass strip, each 5 cm long. I folded the last 3mm back to make an 'L' shape. The reason for this is that I was concerned that the brass would not adhere to the plastic nose cone with epoxy. By making the connection mechanical rather than just chemical I figured I'd have an extra margin of error.

My particular nose cone has two ridges in it that center the cone in the tube. I used the top ridge as a guide to make slots for the strips. Using a small hack saw I made small incisions. I then used a knife to cut all the way through the plastic. This slot turned out to be too narrow for the copper so I took a saw blade, removed the little stopper at the end and used it to widen the slot. Sorry for the lack of pictues. I then used a chisel to flatten and clean the plastic below the slots.

Epoxying the strips



Picture 3

Then came the time to glue the strips to the nose cone. I took a heavy duty ziplock bag and cut a long strip from it that fit around the nose cone shoulder. A taped one end to the cone between two strips and test fit wrapping it. I then made up some 15 minute epoxy and glued each strip to the cone. Then wrapped it with the plastic, fastening it with tape. This was then tightned with more tape. I cured the whole thing in the sun. The result is in the picture above. No sanding was needed except to remove some epoxy that had been squeezed out.

Drilling



Picture 4

Here I've refitted the nose cone and realligned it with the mark I had made earlier. I don't have a drill press so I simply put the rocket on my workmate with the jaws a few inches apart. An old towel served as a gentle shock absorber and paint-scratcher-preventer. Using a very low drill speed I carefully drilled a hole using the 3/16" bit on each mark.



Picture 5

This is the result. As you can see the hole is close to perfectly centered in the strip. The other two looked just as good.

The result



Picture 6

Here's one of the shear pins mounted. I used the handle of a pocket knife to push the pin in. Needle nose pliers (leatherman) pull the pin back out.

Test

I tested the setup with a single shearpin and 1.5g of BP. I tied the rocket to a lawnchair and wired a single ematch outside the rocket. The back end rested against a workmate folding bench. Wow. That was a tad powerful! The nose cone got launched like a cannon ball and ripped loose from the shock cord. Needless to say the shear pin sheared wonderfully. Both ends were still in their respective sides.

A few days later I launched for the first time with a single shear pin and 1 gram of BP. The rocket arched over, fired the drogue charge with the nose pointing down and the shear pin kept the cone attached as planned. Then the main charge went off and the cone ejected, parachute deployed. I'd say this is a great way to secure a nose cone!

Alternate Method

Fellow rocketeer and LUNAR member Steve Kendall reported that he used a 0.071" drill bit to make 3 holes in his 2" airframe. Shear pins were made of 0.060" Styrene rods from a hobby store. Cheap stuff at $2 for 8ft. Since these pins measure about 0.084" diagonally they need to be installed with needle nose pliers and can be cut flush afterwards. The screws I use can also be cut flush but I don't bother as they are tiny compared to the rest of the rocket. Max alt rocketeers should consider cutting the pins/screws flush, of course.

Using about 1/2 grams of BP the pins sheared cleanly. Steve's rocket uses a piston ejection system like my Eclipse.