

# ADVANCED INFORMATION REPORT #4

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## ACE FUGUE SHROUD METHOD *PIONEERED BY KOREY KLINE*

Expanded and written  
by Jerry Irvine



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## ACE FUGUE SHROUD METHOD

Basic method pioneered by Korey Kline

Report authored and method expanded by Jerry Irvine

### INTRODUCTION

The ACE shroud was developed by Korey Kline as an alternative to wimpy paper shrouds which are difficult to construct and easy to damage. It is also an excellent substitute for balsa reducers for most applications.

To put it simply, the body tube is cut to form a reducer which meets the smaller diameter tube. Triangular sections are removed from the large tube to permit reduction of the end to a smaller diameter. To facilitate easy bending of the panels to meet the smaller tube, notches are cut at the point of the triangles.

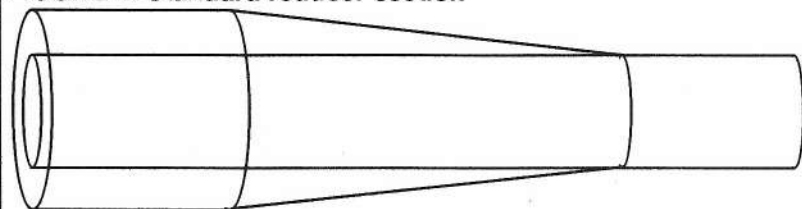
Once the two body tubes are glued together using centering rings, the shroud tips are glued to the small tube. Seams can be strengthened with cyanoacrylate, epoxy, or wood glue and filled with common Spackle.

In the case of a drag reduction shroud the panels can go between the fins for a clean and aerodynamic shape.

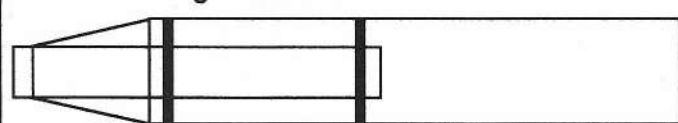
### REDUCERS

Reducers at the middle of the rocket are a primary application for ACE shrouds. The advantages of low weight, low cost and relatively simple construction make the system superior for model rockets. It is also applicable to experimental rockets where weight is a primary concern. The parts are commonly available. A couple of centering rings and the two tubes are the only requirements. The remainder is explained by this report. Kits which use this system for reducer sections generally include pattern sheets to follow. These sheets can generally be used for fin placement guides as well. Follow the pattern and mark or cut at the triangle lines and cut a single horizontal relief slot at the apex of the triangle.

**FIGURE 1: Standard reducer section**



**FIGURE 2: Drag reduction tail cone**



## TAIL CONES

The old system of tracing a shroud from paper rarely allowed the use of fins through the shroud. With the ACE shroud system this is the primary forte. Even complex shrouds on clustered models are a breeze with this method. The shroud panels fit between the fins which are already bonded in place on the motor mount tube. This provides two effective fin glue joints.

The number of seams used depends on your preference or the number of fins to be used. More sections gives a rounder shape shroud. Once again you will need a centering ring or two and the tubes. Kits which utilize this system generally come with a pattern.

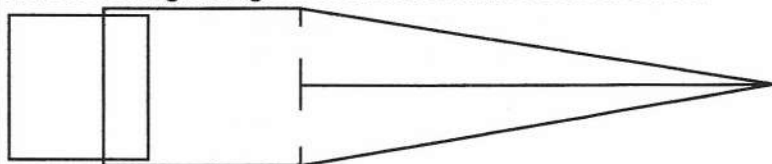
## CONICAL NOSE CONES

It is sometimes a difficult problem to find nose cones for odd tube sizes and custom cones are expensive. If your project can tolerate a conical or multi-conical shape cone, this method is for you. Once again it is the lightest alternative available to most tube sizes. A conical nose cone is fairly easy to make (skill 3), and a single length of tube provides two nose cones!

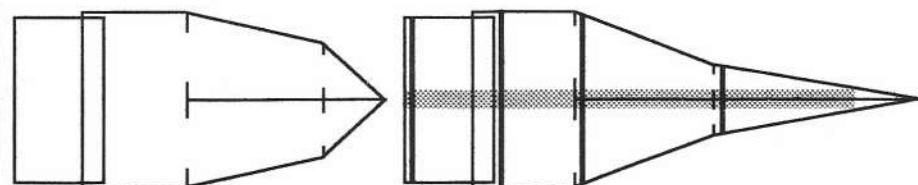
The shoulder consists of a coupler or a piece of the tube cut along its length with a section removed so the piece fits snugly inside the main tube. The ends should meet and be glued while inside an actual tube for proper fit. Be careful not to bond the coupler inside the main tube. The base of the cone is simply a wood plate which the screw eye goes into.

This nose cone is not very strong, so attach the recovery system in a way that the cone lands last. One way to strengthen it is to run a dowel or tube up the middle for support. With this method the disc or a ring is optional but a good idea for round shape. The central dowel is also optional. Assemble the nose cone with the coupler in the rear to maintain round shape. Put tape on the outside to hold the panels together while the glue dries.

**FIGURE 3: Lightweight hollow nose cones with shoulder**



**FIGURE 4: Multiple tapers at any angle**



## VARIATIONS

Multiple conical sections are fairly simple with this method also. This provides a slightly more aesthetic appearance to the rocket. There are probably also applications in scale modelling. The diameter of the central kink must be used in calculations on two separate sections. The pattern is a bit more difficult to draw. Glue the larger diameter sections together first using tape to hold it together until the glue dries. Relief slots will have to be made at the cone base and at the "kink". Put a disc at the kink.

## CURVED TAPERS

This is clearly the most difficult and rewarding aspect of the ACE shroud method. It is probably necessary to plot the diameters at each 1/2" or so to get a fairly smooth curve. Discs should be placed at each high and low point for strength and maintainance of shape. A central support is critical to prevent flexing and breaking of glue joints.

To permit the desired curved shape, you will have to increase the number of panels. Thin tube sections flex more easily. Keep in mind that for the part to end up curved, the cuts must also be curved.

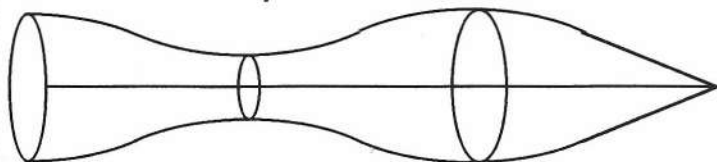
## UNUSUAL APPLICATIONS

Aside from symmetrical shapes, the ACE shroud method is perfectly suited to forming nacells, inlets, wings and anything your mind can imagine. An inlet or canopy can be formed from a triangle shaped piece of tube glued on the main tube in such a way that the desired shape is maintained.

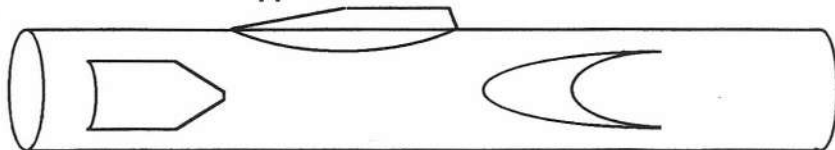
Unusual shapes required for fantasy rockets are quite simple to make with a section of tube or two and a sharp knife. The tube bends to the desired shape.

Rounded shapes can be formed by cutting in an arc from the line. Be sure both ends of the arc are on the line. Cutting less tube away will form a convex shape, cutting more away will form a concave reducer. Of course cutting exactly on the line will form a conical shape. Use this in most cases.

**FIGURE 5: Curved tapers**



**FIGURE 6: Unusual applications**



## CALCULATING AND MARKING FOR CUTTING

In the case of a simple shroud or reducer, the circumference (distance around the tube) of the small tube is subtracted from the circumference of the large tube. This figure is the amount of the large tube circumference which must be removed. The figure is divided by the number of panels you will have (let's say four) to get the amount to be cut from each panel line (fin line).

### Example: BT-39 to BT-11, four sections, 6" long.

Circumference BT-39 =  $4.0" \times 3.14 = 12.56"$

Circumference BT-11 =  $1.22" \times 3.14 = 3.83"$

Amount to be removed (difference) =  $8.73"$

Divide by 4 for 4 panels or fins =  $2.18"$

Shroud length =  $6"$

**Triangle dimension =  $2.18 \times 6"$**

Also note that on thicker tubes the amount remaining on the larger tube should be measured along the inside circumference so gaps are not formed.

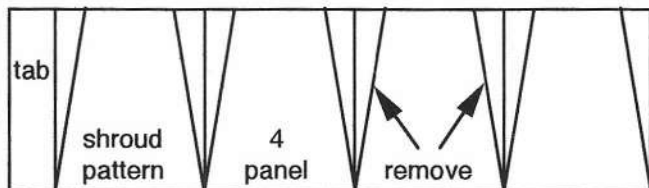
## ASSEMBLY

To facilitate easy bending of the shroud panels, once cut, to the small tube, the top of the triangle apex must have cross cut slots to allow panel movement. They should be cut about  $1/4$  to  $1/3$  of the way to the next seam on each side. This allows a narrower section of tube to act as a hinge. Bend the panel in place to the smaller tube. Be sure the corners of the shroud panel slide on the outside of the main tube. The steeper the shroud the more overlap there will be. Once the shroud panels are in place on the smaller tube, the overlap sections can be trimmed off to provide a perfect fit.

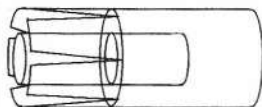
Trim the shroud panels as necessary prior to gluing the shroud in place.

A centering ring should be placed at the apex of the reducer or shroud to hold the shape. Another ring may be put inside the larger tube to align the smaller tube. In the case of a rear shroud, a short piece of tube should extend to allow a motor mount space.

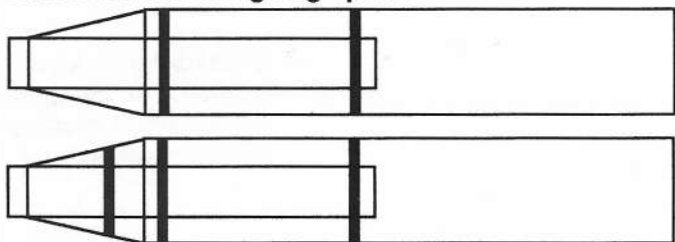
**FIGURE 7: Sample shroud pattern**



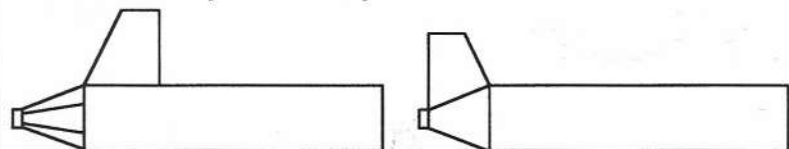
**FIGURE 8: Shroud after cutting**



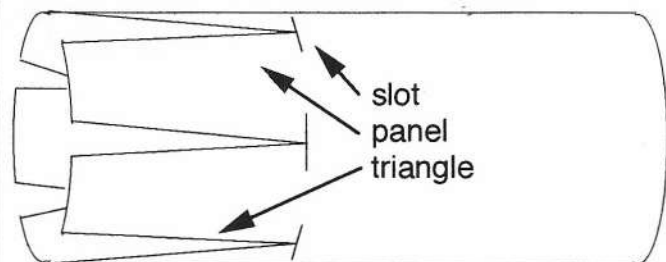
**FIGURE 9: Centering ring options**



**FIGURE 10: Fin placement options**

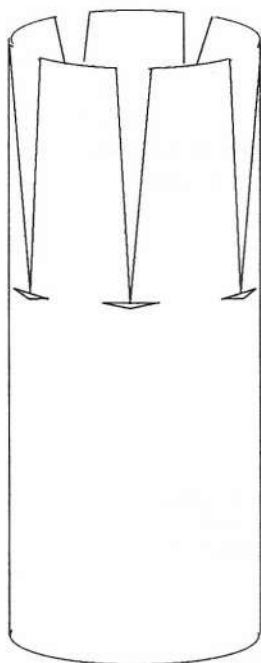
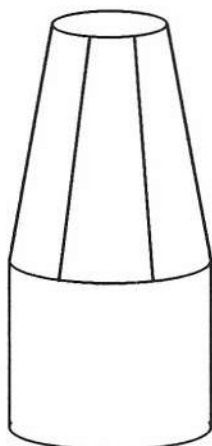
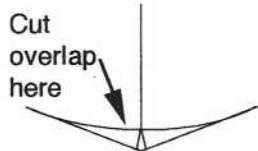


**FIGURE 11: Relief cuts**



As the angle becomes steeper to the small tube, the need for an angular cut at the peak of the triangle increases. A slot must be cut in any case to allow the panel to flex.

Sometimes it is easier to cut off the excess tube right at the slot after the shroud is glued down to shape. Sometimes it is part of the pattern.



## **CUTTING**

To mark the tube for cutting, wrap a piece of paper around the circumference which is marked for all shroud and fin positions. Align the paper with the fin/shroud seam lines on the tube. Put marks on the end of the tube for the two cutting lines for each seam. Mark the length of the shroud to define the cutting limits. Using masking tape as a guide, cut between the two end marks and the end of the shroud to cut out triangular sections.

When the panels have been cut to size and the relief cuts have been made, put the small tube assembly into the larger tube. Bend the panels in place one at a time and watch the amount of overlap at the relief lines. This is where you cut the corners of the panels (generally less than 1/8"). Cut off only what is required so you will get a smooth transition and limited gaps.

## **SEAM AND GAP FILLING**

Once completed, your shroud or reducer will have to have the seams filled for an asthetic appearance. Hot Stuff and baking soda may be applied and sanded to shape. This will also strengthen the joints. Spackle may be used to fill large gaps in clusters and is easily sanded to shape.

Adhesive tape is an easier solution to the seam problem. Simply paint the reducer flat black and cover the seams with black tape.

## **CUTTING FROM EXISTING PATTERNS**

Most kits which use ACE Fugue shrouds come with pattern sheets to aid construction by providing a cutting pattern. Any modifications to the stock pattern may be made using the principals in this report. However, stock designs are proven and generally represent careful design and engineering.

Simply wrap the pattern around the tube and mark the lines. Remove the pattern and cut using the method previously described with masking tape. Sand edges as needed.

## **HOW TO MAKE PAPER SHROUD COVERS**

1. Draw the reducer in full scale.
2. Extend the reducer sides until the lines cross. This apex point is used to measure the next steps.
3. On your shroud material draw an arc using a compass or pencil and string with a radius equal to the distance from the drawing apex to the first horizontal reducer line.
4. On your shroud material draw an arc with a radius equal to the distance from the apex to the second horizontal line.
5. The result is an arc with a width equal to the reducer length you drew and the correct arc shapes.
6. Determine the circumference of the larger tube and mark that distance on



the larger arc of your shroud.

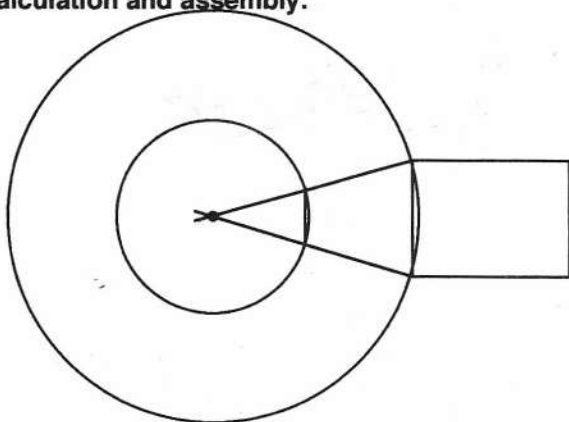
7. Draw a line from the apex of your new shroud drawing to each end of the circumference. This defines the final shroud size.

8. Add a tab to one side to allow gluing.

9. NOTE: This system rarely works the first time. You will have to adjust the shroud angle when gluing and cutting to get the proper fit.

**FIGURE 12: Paper shroud calculation and assembly.**

Pattern drawn with a compass at intersection formed by a side drawing of the shroud. Note rings intersect at tube outside edges. The portion of the shroud pattern used for the shroud itself is the circumference of the tube measured along the larger ring, plus 1/4" or so for a glue tab.



Since this method is approximate, you will have to make a couple practice shrouds and adjust the glue angle at the tab to get a perfect fit.

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