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APOGEE

PEAK OF FLIGHT

NEWSLETTER

How To Trick RockSim To Allow Tip Mounted Fins

How To Use Bulkheads In Model Rockets

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APOGEE

PEAK OF FLIGHT

Simulating Fins-on-Fins With RockSim v7

By Bruce S. Levison

Bruce S. Levison has asked us to share this article with other RockSim users. It describes a method that he feels will help to simulate the effect of fins placed on fins in RockSim. Bruce feels that the CP will be in the right location on the rocket. Please note: The user assumes all risk for the information obtained with this method.

This article contains links to download the RockSim version 7.01 designs. You can find the file at:

http://www.apogeerockets.com/education/downloads/jayhawk.zip

After downloading and unzipping it, place these files in the "Design" folder within the RockSim Folder on your hard drive. These files can also be viewed using the demo version of the RockSim software.

This "contortion" of the RockSim program will allow you to simulate rocket designs where the fins are located on other fins (like the out board fins on the Jayhawk) or the fins aren't radially arranged out from the centerline of the core body tube (like the wing on the Pegasus).

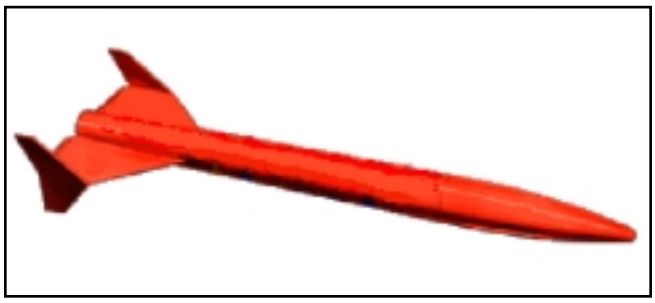

Figure 1: This article will show you how to simulate fins-attached-to-fins, like on this jayhawk rocket. The picture displayed will not look like this, but the simulation results will be usable.

A word processing program (such as Microsoft Word or WordPad) can be used to edit a RockSim version 7 .rkt file to accomplish these tasks. This advanced simulation technique exploits the Extended Markup Language (XML) format of the latest versions of RockSim. I have been able to do these types of simulations on versions 5 and 6 but since version 7 allows for asymmetric fin designs the task is now much simpler.

First you need to be familiar with the layout of RockSim's .rkt files. Open the JHWK.rkt file in RockSim 7 and look under the Rocket design components tab:

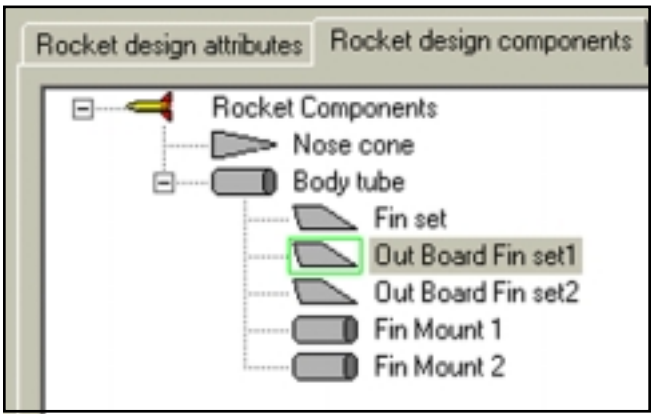

Figure 2: The part's tree shows the arrangement of the components in the rocket. When a part is indented under another, that means it is associated with the one it is indented under.

Click on all the plus [+] signs along the left hand side to expand all the branches of the component tree. Notice how all the parts that are assigned to another part appear shifted to the right (indented) and under the assigned part. Keep this spatial relationship in mind for the next step. The picture above is a 3D rendering of the model used for this simulation, it is for demonstration purposes only and was not necessarily designed to fly.

Click on one of the "inner tubes" I assigned to the main body tube. I labeled these tubes as *"Fin Mounts"* for reasons that will be obvious later. These inner tubes were given an outside diameter equal to the thickness of the fins that the out board fins are going to be mounted on. The tube was made to

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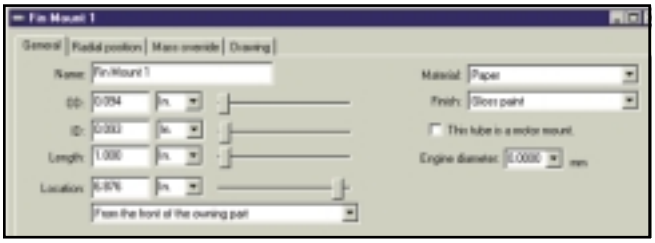

Figure 3: Create phantom tubes. We'll attach the outer fins to these tubes latter.

Fins-on-Fins

Continued from page 2

be very thin, 0.001 inch thick, and lightweight, the material was selected to be paper. The tube length was set equal to the length of the fin root.

Under the Radial Position tab, these inner tubes were then given a radial distance equal to the fin span and a radial angle of 0 and 90 degrees respectively corresponding to the angular location of the wing fins.

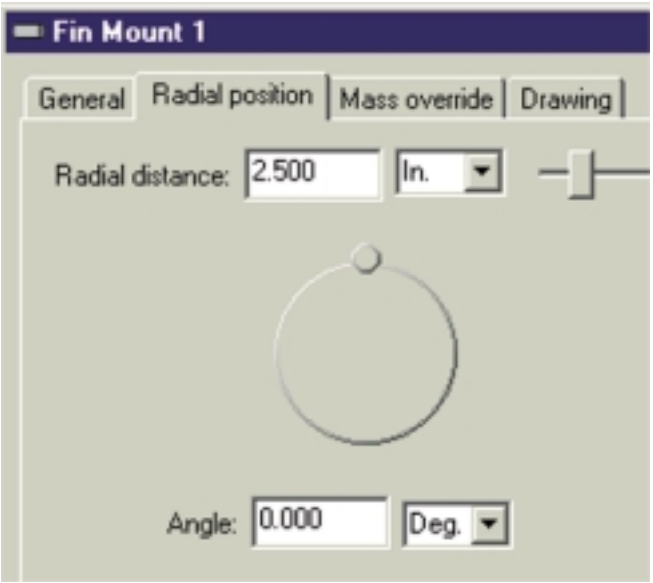

Figure 4: Both "Fin Mount 1" and "Fin Mount 2" are moved to the tips of the main fins with the radial position feature of RockSim.

Note that these inner tubes are the only parts that RockSim allows both a radial distance and angle to be specified.

Close the JHWK.rkt file in RockSim and open a word processor (I prefer WordPad but Microsoft Word will also work) and open the same Jayhawk.rkt file in the word processing program, select File, then Open JHWK.rkt which should be under:

`C:\ProgramFiles\Apogee\RockSim701\DESIGNS`

be sure to select File of type, All Documents (*.*) to see the .rkt files. What you will see looks like this:

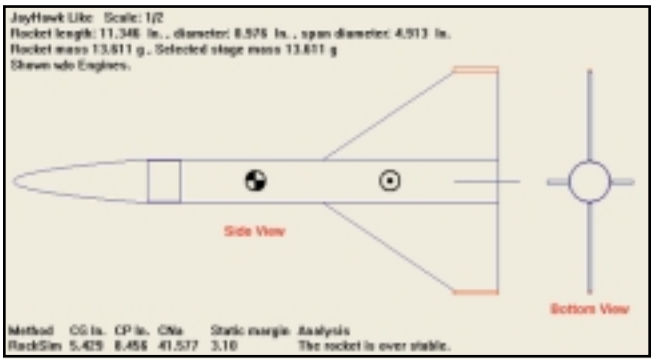

Figure 5: The "inside tubes" have now been moved to the fin tips.

```
<RockSimDocument>
 <FileVersion>2</FileVersion>
 <DesignInformation>
  <RocketDesign>
   <Name>JayHawk Like</Name>
   <CalculateCD>1</CalculateCD>
   <FixedCd>0.75</FixedCd>
   <FixedCd2>0.78</FixedCd2>
   <FixedCd3>0.8</FixedCd3>
   <StageCount>1</StageCount>
   <Stage3Mass>0.</Stage3Mass>
   <Stage2Mass>0.</Stage2Mass>
   <Stage1Mass>0.</Stage1Mass>
   <Stage321CG>0.</Stage321CG>
   <Stage32CG>0.</Stage32CG>
   <Stage3CG>0.</Stage3CG>
   <CPCalcFlags>4</CPCalcFlags>
  <LaunchGuideLength>914.4</LaunchGuideLength>
   <UseKnownMass>0</UseKnownMass>
   <DefaultFinish>1</DefaultFinish>
   <FinishMedium>0</FinishMedium>
   <FinishCoatCount>2</FinishCoatCount>
   <GlueType>0</GlueType>
  <Comments>Basic Unaltered Design File</Com-
     ments>
   <Designer>Bruce S. Levison</Designer>
   <CPSimFlags>4</CPSimFlags> ...
```

Scroll down the list and notice how the parts hierarchy from the RockSim components tab appears in the file list. Below is a pared down version the file to show how the parts

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Fins-on-Fins

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hierarchy appears.

```
      :
  <Stage3Parts>
      :
   <NoseCone>
      :
   <BodyTube>
            :
     <FinSet>
            :
     <FinSet>
            :
     <FinSet>
            :
     <BodyTube>
            :
     <BodyTube>
            :
```

The next step is the trick I use to convert these inner tubes to outer tubes that will accept fins. Once converted into outer tubes fins can be assigned to these tubes at any specified radial angle, as you would for a main body tube.

Using the word processor Scroll down to the end of the JHWK.rkt file you should see something like:

```
        <OD>2.3876</OD>
        <ID>2.3622</ID>
        <Len>25.4</Len>
        <FinishCode>1</FinishCode>
        <IsMotorMount>0</IsMotorMount>
        <MotorDia>0.</MotorDia>
        <EngineOverhang>0.</EngineOverhang>
        <FrontExtension>0.</FrontExtension>
        <RearExtension>0.</RearExtension>
            <IsInsideTube>1</IsInsideTube>
      [change the one to a zero e.g. <IsInsideTube>0</
      IsInsideTube>]
        <AttachedParts>
        </AttachedParts>
       </BodyTube>
      </AttachedParts>
     </BodyTube>
    </Stage3Parts>
    <Stage2Parts>
    </Stage2Parts>
    <Stage1Parts>
    </Stage1Parts>
   </RocketDesign>
  </DesignInformation>
  <SimulationResultsList>
  </SimulationResultsList>
</RockSimDocument>
```

Use the word processor to change (edit) the line: `<IsInsideTube>1</IsInsideTube>` to: `<IsInsideTube>0</IsInsideTube>` for ***both*** of the body tubes which are located towards the end of the file (see highlighted area above). You will have to do some hunting for this program line in the first inside tube, look about 70 lines up from the end of the document. Save the file in the same format, and close the word processor program. Re-open the modified file in RockSim and view the Rocket design components tab. Cut and paste the Out Board fin set 1 to Fin Mount 1 and Out Board fin set 2 to Fin Mount 2. Open each of the Out Board fins and edit their location to the proper distance from the front of the owning part (0 inches on the Fin Mount).

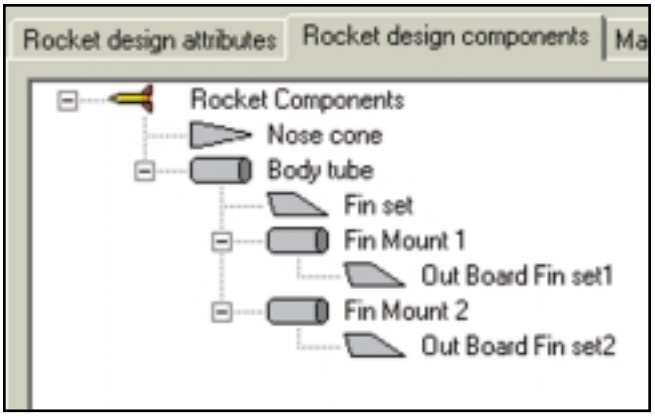

Figure 6: After the modification, the outboard fin sets are now attached to the tubes which we moved to the tips of the main fins.

Save this RockSim file (see JHWKMOD.rkt file), and open it back up in the word processor used before. Note the new parts hierarchy.

```
      :
  <Stage3Parts>
      :
   <NoseCone>
      :
   <BodyTube>
            :
     <FinSet>
            :
     <BodyTube>
            :
       <FinSet>
            :
     <BodyTube>
```

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Fins-on-Fins

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```
        :
    <FinSet>
        :
```

Also notice that the outboard fins are located along the centerline in the 3D drawing even though the calculations of the CP use the outboard fin location. This is because "The fin positioning code assumes that all fins are radius lines from the center of the airframe." as per Paul Fossey, RockSim's creator and programmer. See Figure 7.

Without assigning the outboard fins to the wing tips RockSim calculates a CP at 8.456 inches from the tip of the nose cone. The word processor modified file with the out board fins assigned to the wing tips gives a CP at 7.249 inches from the tip of the nose cone. This new CP makes sense because you would expect the rocket to be less stable if the fins were located closer together and farther from the centerline as they are on the outboard fins.

Summary

This article introduces the use of a thin section of inner tube that can be radially located then converted outside of the RockSim program into an outer tube that will accept fin sets. The versatile location of the inner tube allows it to be situated at any radial location and at any radial angle to the centerline. The conversion of the inner tube to a fin mount gives a versatile platform that allows fins to protrude at any angle and any location along the airframe.

In closing I must again mention that this simulation work is only a theoretical approximation that has yet to be confirmed with real flight data; use this unproven technique at your own risk.

I welcome any comments and criticism on this work.

Bruce S. Levison, NAR #69055

Send Mail to: teflonrocketry1@yahoo.com

About the Author:

Bruce S. Levison (NAR #69055, MTMA #606), A.K.A. *Teflon Rocketry*, is a rocketeer from Ohio, a member of the National Association of Rocketry (NAR), and NAR section #606, the Mantua Township Missile Agency (MTMA). He has published articles on ejection charge proof expanded Teflon recovery systems (hence the nickname), camera tripod mounted launch pads, ablative blast deflectors, a horizontal painting swivel for model rockets, a method for the simulation of tube fin rocket designs, a RockSim method to determine how far away from the launch pad a parachute recovered model rocket will land, and the simulation of ring fin designs using RockSim. Bruce earned an advanced degree in chemistry, and works as a research scientist at the Cleveland Clinic Foundation.

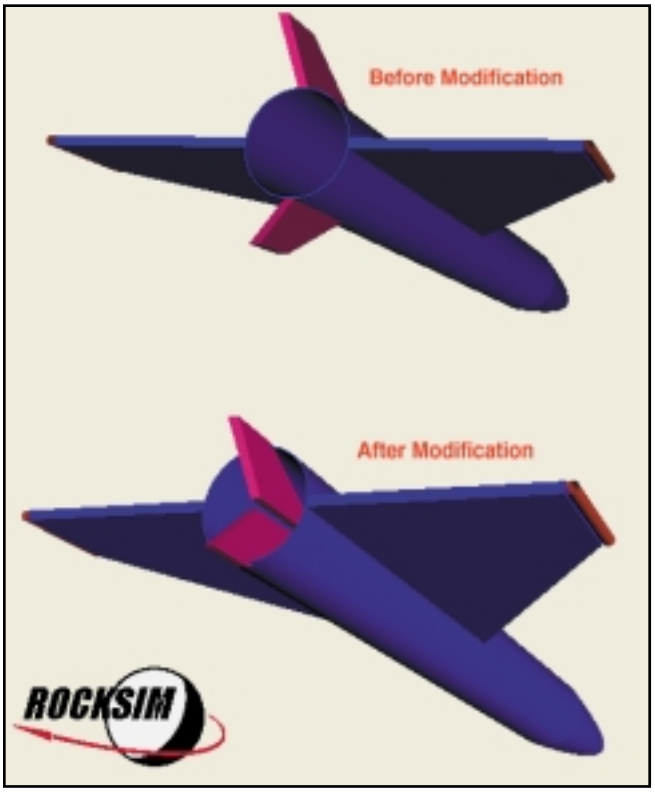

Figure 7: The span of the tip fins was reduced. There are actually two sets of fins, they just overlap so you can't distinguish them visually -- but RockSim does for the simulations.

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How To Use Bulkheads In Rockets

By Tim Van Milligan

This article is about using bulkheads in model rockets. The reason I'm writing it is because I'm shipping a free bulkhead in the new centering ring set that goes with the new size tube that Apogee sells. It is the 2.217" diameter BT-70. I just wanted to give you some ideas on how to use this free new bulkhead in your next rocketry project.

The "BT-70" (Apogee P/N 10160) is a great size body tube to make egglofter rockets. An egg will fit nicely inside it, with a little bit of extra room to allow some padding to protect the egg from breaking.

To go with the BT-70 size tube, Apogee Components is also stocking some tube couplers. This allows you to take the BT-70 size tubes, and join them together to make longer size rockets. It's fun to make long rockets, isn't it?

Additionally, I have created a new die-cut centering ring for the BT-70 tube. This will allow you to take a BT-50 (24mm) tube (Apogee P/N 10099), and use it as an engine mount inside the BT-70 size tube. The rings are made from a thick cardboard, which is very strong but it is still fairly lightweight.

With the new centering rings, you'll be able to fly your BT-70 size rockets on "D", "E" or "F21" size motors. This is the mid-power range that is more impressive than beginner kits, but still are under the 1 pound weight limit, so you don't need a permit to fly your rockets.

But wait. There's more.

When you order a set of rings, you don't get just one or two rings, you get a "bulkhead disk plate" too. What is it good for? Great question.

Imagine you're building a rocket with a payload bay. As I've already mentioned, the BT-70 size tube is perfect for large diameter payloads, like eggs or electronic altimeters. You want to house the payload in a section of the rocket and protect it from the heat of the ejection charge.

What most modelers do is create a compartment near the front of the rocket, just below the nose cone (see figure 1). To seal off the base of this compartment, you need a solid disk. But at the same time, you also have to attach the payload compartment to the rest of the rocket. To do that, you use a tube coupler. What this new disk does is fit inside the tube coupler.

Why put the bulkhead disk inside? Why not just size the disk so that it seals of the inside of the the larger BT-70 tube? The reason is for extra strength. Instead of positioning the disk at the end of the tube coupler, you recess it slightly into one end. By doing this, you can put a glue fillet on both sides of

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Bulkheads

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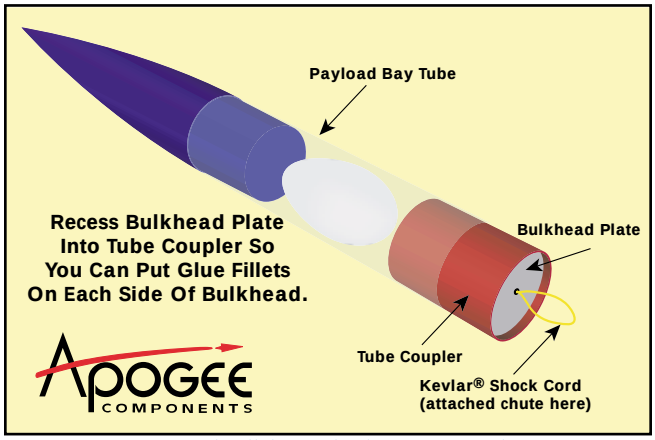

Figure 1: Use a bulkhead plate to make a payload bay on your next rocket.

the bulkhead; effectively doubling its strength!

Another use for the bulkhead disk would be in a "sliding piston assembly," like used on a lot of high power rockets. The piston is used to pop the parachute out of the rocket, so you don't have to use wadding. Again, you put it on the inside of the couple, as shown in Figure 2.

The anti-zipper design rockets also use a bulkhead plate, like shown in Figure 3. This time, you cut some extra holes to allow the ejection charge gases to pass through.

For more information on making payload bays, or pistons to eject your parachutes out of the rocket, or anti-zipper designs, see the book: *Model Rocket Design and Construction*. http://www.apogeerockets.com/design_book.asp

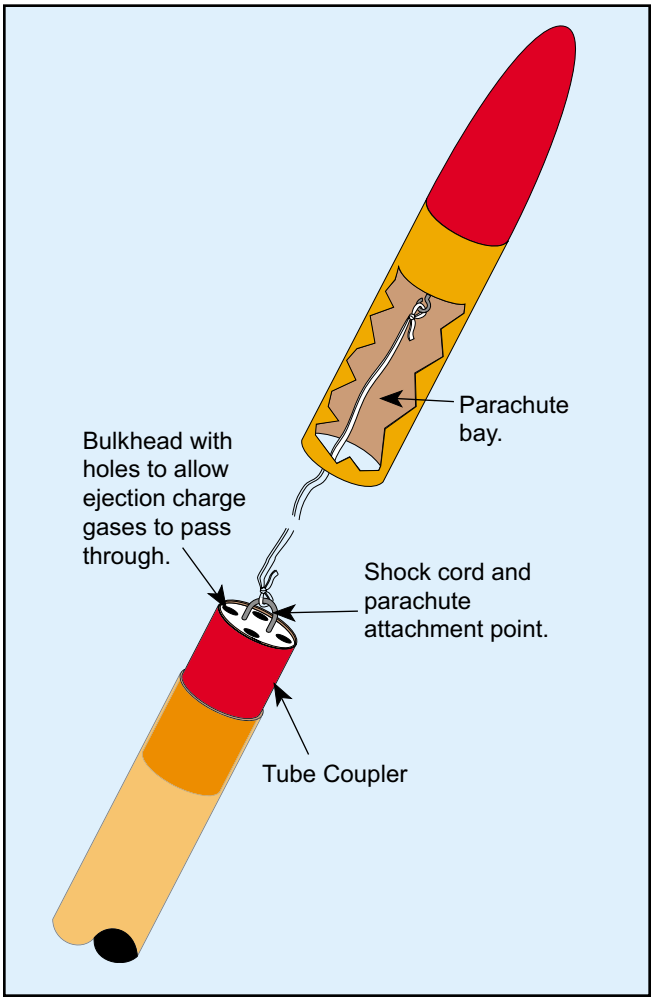

Figure 3: Anti-zipper design also uses a bulkhead plate inside a tube coupler.

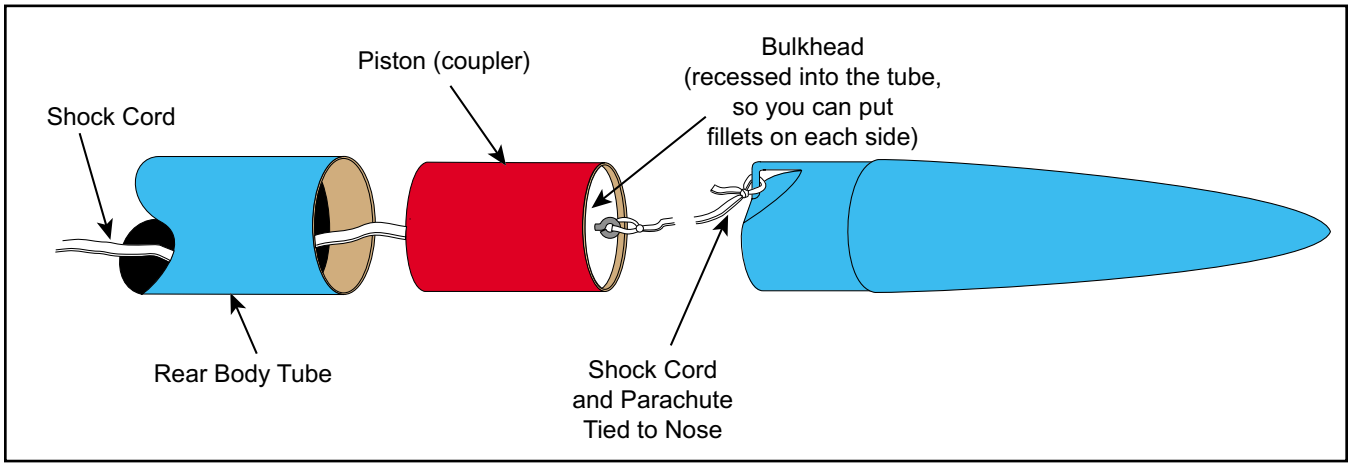

Figure 2: A piston pushes out the parachute. This is useful on larger diameter rockets.