ISSUE 63

APOGEE

PEAK OF FLIGHT

NEWSLETTER

Paper Centering Rings for HPR.

By Tim Van Milligan

In the last issue of this e-zine, I talked about the neat advantages of paper. (Newsletter 62) In the same theme, this time I thought I'd talk about using paper centering rings for high power rockets.

I know what your thinking... "Paper? Are you nuts?"

Again and again, I hear people say that for high power rockets, you need to use plywood or fiberglass for the centering rings. In fact, I'm asked all the time about the rings for the Saturn V kit. Some people seem to think that if it doesn't have plywood rings, that it is somehow inferior.

The Saturn V is a big model. It has a single 29mm motor mount centered in a 5.65 inch diameter tube. This is a pretty good size ring!

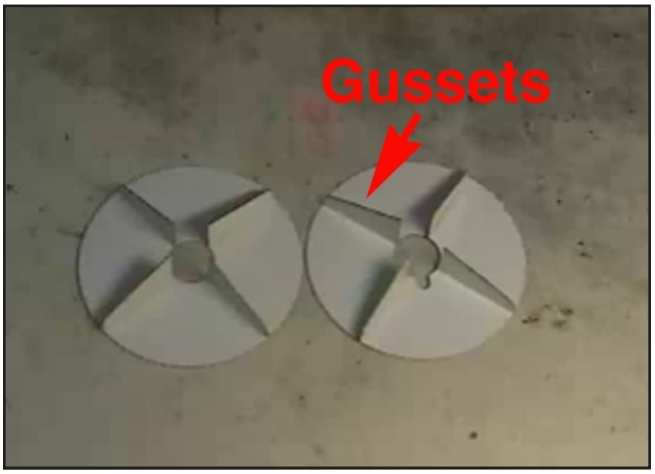
Let me tell you that the Saturn V kit will use a heavy paper-cardstock for the centering rings. IT WORKS GREAT! And I've launched it on some big motors, and the rings have performed just fine.

The reason it works is that the flat paper disk are not the main structural part of the of motor mount. The centering rings have been reinforced in such a way that they actually carry only a small part of the forces of the rocket thrust. The main loads are carried by the reinforcing members that were engineered into the rocket.

Our goal with this design was to use the disks to concentrically center the engine mount tube inside the big diameter tube; which is why they are called "centering" rings, and not "thrust" rings. We tried to remove the thrust loads from the rings so that they could be made as light as possible, and from an inexpensive material.

Additionally, the only other purpose they server is to provide a gas seal to allow the ejection charge to function adequately. This allows the parachute to be ejected with good vigorousness.

What are the reinforcing members that give the rings their strength?



The first is vertically mounted gussets. These are radially spaced around the ring, and glued directly to the ring to stiffen it up. But they do far more than stiffen the ring. They transfer nearly all the forces from the engine mount tube to the walls of the rocket.

The amount of force that they can take is incredible. I haven't done a stress analysis of the arrangement, but my guess is they add 100 times to the strength of the ring.

If you've used through-the-wall fins that attach to the engine mount tube; then you've used this strength-building technique. It is very common among high power builders. But people don't realize that it not only stiffens the fins up, but that it also removes the stress from the rings. So the rings can be made thinner and out of lighter materials like paper.

The other reinforcing member incorporated into the Saturn V kit is a thrust ring on the inside wall of the large tube. You probably use thrust rings all the time just in front of the motor to transfer the force loads from the engine to the motor mount tube. Our second thrust ring on the inside of the big tube allows the forces to be transferred from the rings and the gussets to the walls of the tube. In essence, it removes the load

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from the typical glue joint around the perimeter of the rings. The rings aren't pushing on a thin glue joint, but against a ring along the wall.

These reinforcing techniques are not new. They've been around for a long time. In fact, you can find pictures of them in the book: *"Model Rocket Design and Construction."* (http://www.apogeerockets.com/design_book.asp)

I know that most modelers know about these techniques. But they seem to believe that they need to build bullet-proof models. They go overboard and they use heavier and more expensive materials. The main drawback of this is that "bullet-proof" is not "safer." It is heavier; requiring a bigger and more expensive motor to lift. Plus it falls faster; meaning it needs a bigger and more expensive parachute to bring it down. And if the rocket crashes, it can cause a lot of damage to whatever it hits. I'd rather see a rocket that is lightweight and can absorb its own impact energy.

In conclusion, just because your rocket may be made out of paper does not mean it isn't strong. It is possible to make very-very strong and durable centering rings out of paper.

People have given paper a bad reputation, but only because they haven't designed the model properly. If the disk has to carry the entire load of the motor's thrust, then it is likely to fail by delaminating, tearing, or become unglued. But if you remove the loads from the ring and transfer them to structural members; you can get a powerfully strong engine mount that has the benefit of being ultra light weight!

About the Author:

Tim Van Milligan is the owner of Apogee Components (http://www.apogeerockets.com) and the curator of the rocketry education web site: http://www.apogeerockets.com/education. He is also the author of the books: "*Model Rocket Design and Construction," "69 Simple Science Fair Projects with Model Rockets: Aeronautics"* and publisher of the FREE e-zine newsletter about model rockets. You can subscribe to the e-zine at the Apogee Components web site, or sending an email to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message.

6 Degrees Of Freedom

splash

What does this mean to you?

6 Degrees of Freedom software means it can find the position of the rocket in the X (vertical), Y (downrange), and Z (cross-wind) coordinates, as well as Pitch, Yaw, and Roll. Splash is the first affordable rocketry simulation program that can perform this complex scenereo. This means it can give you an accurate indication of where your high altitude flights will land.

You tell Splash what conditions might vary during the flight, such as wind speed vs altitude; or the failure likelihood of the parachute failing. You can vary 18 different variables during the flight, and Splash will give you a plot of the likely landing zone. If you're flying sub-orbital flights, then you'll need this data to get permission from the FAA to launch your rocket. Right now, Splash is the only software that can do this.

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