PEAK OF FLIGHT NEWSLETTER

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IN THIS ISSUE

THE LATEST ROCKETRY INNOVATIONS FROM AROUND THE WORLD

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APOGEE COMPONENTS

PEAK OF FLIGHT

Latest Rocketry Innovations From Around the World

By Tim Van Milligan

I wanted to write my thoughts down of the cool stuff that I saw at the World SpaceModeling Championships in Bazau, Romania in early October 2021. Whenever I go to any launch, I keep my eyes open for anything new that I haven't seen before, that might be useful for the Apogee community of rocketeers.

PHOTO 1

This year's event, because of the Covid situation, was smaller than usual. There were a lot of countries that did not send representatives, like China, Japan, and Germany. And even of those countries that did have representation, the teams were smaller because many individuals did not want to risk being caught in a different country, sequestered and isolated because of Covid. Our team from the USA was about half of its normal size for this very reason. Fortunately, everything turned out fine, and nobody that I know that went over caught the illness.

Because there was reduced participation, there was less to see than from years before. But there were some things that caught my eye, and I wanted to share them with you. It is hodge-podge of variety, and there isn't any real theme to this. Just lots of photos.

Photo 1 and photo 2 are the launch tower that Catherine Lui of the USA used for her A-engine rocket glider.

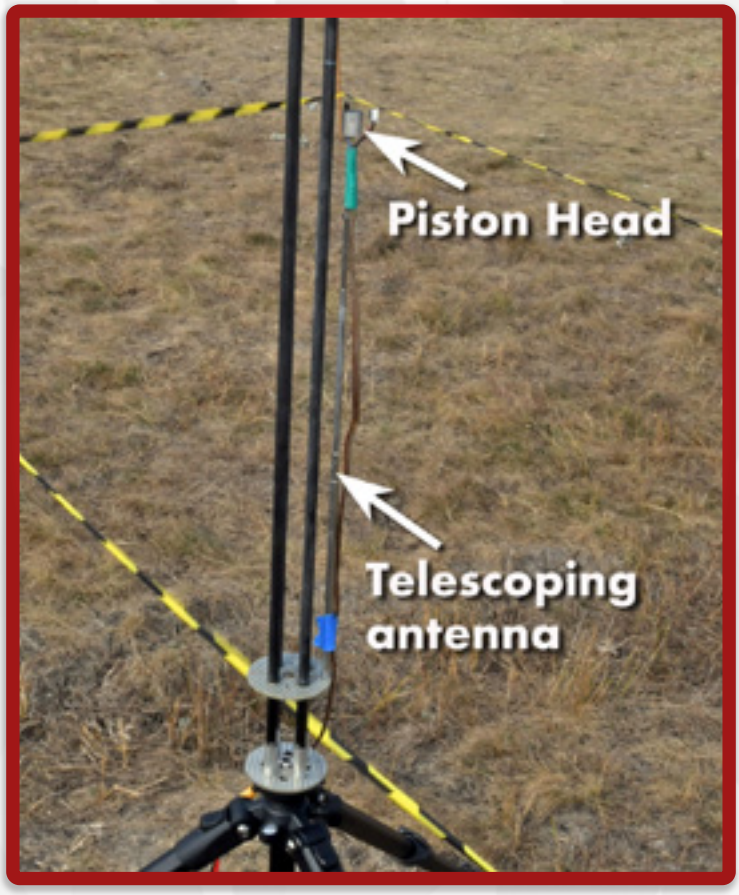

PHOTO 2

What struck me about this was that as far as I could recall, I've never seen a Scissors-Wing-Flop-Tip style glider that was ever launched out of a tower. I've only seen them launched off what is called a naked-piston launcher or off a traditional launch rod. So typically, a piston launcher is staked into the ground, and the glider is placed right onto it and launched that way.

The problem with a rod is that the glider can swing around too easily in a breeze, and pull out the igniter. That goes away when launching from a piston launcher. But that still leaves the possibility that the glider could tip-off immediately at launch and go in a direction other than "up."

Continued on page 3

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Proofreader: Michelle Mason

Continued from page 2

Catherine's tower solves that issue by using the four vertical rods to guide the rocket in the correct direction. She even had a piston launcher built into the side of the tower as well, as seen in Photo 2.

I didn't notice it at the event, but when I looked at the photos, I noticed the rod for the inside of the piston was made from a telescoping antenna. That allows the position of the head to be adjusted easily to match the location of the glider in the tower. So if the glider is longer or shorter, the piston head can be moved quickly to the right height.

In photo 3, we see a flop-tip glider by USA contestant Kevin Kuczek. What is unique about this glider is that instead of rubber bands to flip out the wing tips (see the issue with this in *Peak-of-Flight* Newsletter #560 - https://www.apogeerockets.com/Peak-of-Flight/Newsletter560), he uses z-bend music wire. These would be called Torque Rods..

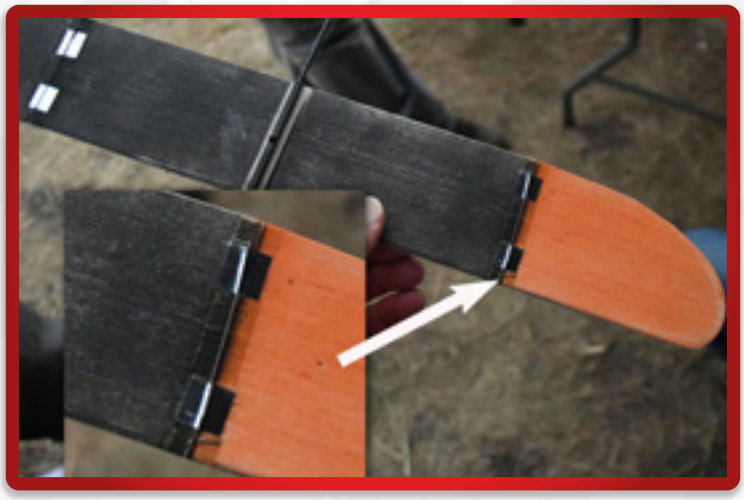

PHOTO 3

Kevin isn't the first one to fly gliders with torque rods, but I thought that I'd pass along a picture of what it looks like when installed on the glider wings.

PHOTO 4

Photo 4 shows a glider built by USA modeler Chris Flanigan. I took this photo during the middle of the contest. To my pleasant surprise, this model was actually the Gold medal winner for Chris.

Continued on page 4

Continued from page 3

What I like about it, is that it shows that you don't have to have a highly finished model to win. Notice that he used some black magic marker to put a little color on the vertical tail in order to make it easier to see in the sky. The balsa wood looks totally unfinished.

PHOTO 5

The criteria he used for success is that it has to be consistent: good boost, good deployment, and good trim, and a little help with picking thermals. It doesn't look like he used any exoctic materials on the glider at all.

But speaking of thermals, there was some advancement in this area as well. Kevin Kuczek of the USA cobbled together a new piece of equipment to track thermals for the USA team. This is shown in Photo 5.

It really isn't anything fancy, just a new way of plotting temperature changes on the launch field.

In the past, the USA team used several temperature/wind gauges that were spread around the launch site. Each one had to be manned by a person with a radio. When their devices indicated a temperature rise, they would contact the fliers at the launch pads and tell them that a thermal was coming through.

That old system worked OK, except it was man-power intensive. The people monitoring the equipment were dedicated to that task, and couldn't be used to help find lost rockets - which were downwind of the range, not upwind by the temperature gauges.

Since our team was smaller this time around, we were short of rocket-retrievers as it was. So it was good that Kevin came up with this system.

What it consisted of was a temperature probe that was hooked up to a wi-fi radio signal. The probe could be stationed as far away as 400 feet from the receiver at the pad.

Continued on page 5

Continued from page 4

What is shown in photo 5 is a sunlight-readable e-book reader. It just picks up the wi-fi signal from the temperature probe, and with a simple app, plots out the temperature versus time on a graph.

And as you can see, the screen is nice and large and can be stationed on the ground right next to the launch controller. When the temperature starts increasing, you know a thermal is over the spot where the measurement probe is located. You wait a few seconds, and you know it is time to launch your rocket to catch that thermal. It looks like the group of people is standing around sipping on a beer, but actually, they are watching the plot to see if the temperature is rising.

Even people that could never pick up subtle signals that a thermal was coming through could figure out when to launch. Just wait for the temperature graph to go up.

Photo 6 shows some of the launch systems used by other countries. There are two pads in the picture; one leaning against the canvas tent, and the other staked into the ground.

I took this photo because I wanted to show that the equipment used by many countries is nothing fancy. They prefer to stake towers to the ground using a central shaft on the base. The advantage of this is that it is less complicated and lighter weight for transporting the equipment to the launch field.

PHOTO 6

The disadvantage is that in the rock-hard ground here in Colorado, I'd never be able to get it to stand upright because I wouldn't be able to pound it into the ground. The other disadvantage with the stake method is that they have to move it around a lot to get the correct launch angle that they want. I like it for its simplicity, but it needs better adjustment. The shorter piece of equipment shown in photo 6 looks like it might have an adjustable head on top to allow whatever is attached to be pivoted into the right direction.

Continued on page 6

Continued from page 5

Photo 7 shows a typical Rocket Glider used in the E-engine RC glider event.

PHOTO 7

What is competitive and often used in this event is a off-the-shelf 2-meter wingspan discus launched RC glider - that has a motor pod tacked to the upper surface.

You can see the little finger-holder on the tip of the left wing that is typically used to swing the glider up into the sky for a practice hand launch. At the field prior to the event, that is what you see over and over again -- rows of flyers slinging the gliders into the air to practice hunting for thermals and for precision landings.

Photos 8 and 9 show a couple of views of a Russian helicopter duration model that I found out in the field at the end of the contest day.

PHOTO 8

Whenever I'm out searching for a rocket, it never seems to fail that I stumble across someone else's model. I think the reason for this is that I seem to look for things out of the ordinary when I'm scanning the field, where other people are just looking for their rocket only.

So when I find a rocket from another country, I whip out my phone or camera, and take some pictures of it. I want to get it documented so that I can remember later how other people build their rockets. I think of the photo documentation as the price they pay me to retrieve their rocket and turn it back over to them. It is a great mutual exchange.

Continued on page 7

Continued from page 6

The underside of the helicopter hub is seen in photo 8, and the topside showing the hub is shown in Photo 9.

I am hoping to import some of these models to sell to Apogee's customers in the future, so I'll wait to see if that happens before commenting on them.

PHOTO 9

The rest of the photos I have to show you come from the "Scale Model" day. These models are beautiful, and the level of minute detail on them is incredible. But the one complaint I have on the tiny details is that they over exaggerate on the size of the details. For example, in Photo 10, the height of the rivet heads is way too much. I think the builders must assume that the judges are old, so their eyesight must be going… so enlarged details seem to be their preference.

PHOTO 10

But the models are gorgeous, and you can tell with the amount of detail that they put in a huge amount of time building the model.

In photo 11, what I really wanted to show was the little compartments made for the parachutes that extend forward from the tube of the rocket. Instead of laying the parachutes in the bottom of the tube, this modeler made these semi-round compartments for them. Why? This is what intrigues me…

In this event, you absolutely MUST get the parachutes to open reliably. If even one parachute doesn't open, you get disqualified for the flight. So the modeler here must

Continued on page 8

Continued from page 7

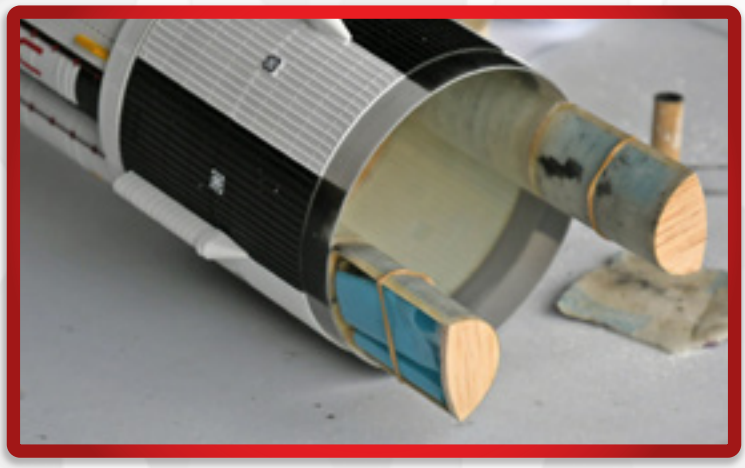

PHOTO 11

PHOTO 12

be building in some sort of reliability system to make sure the parachutes are out of the rocket so they have a better chance of deploying.

Photo 12 shows the back end of a Saturn 1 scale model.

What is unique about this model is that the four central nozzles will fold out so that the rocket motor can be installed in the central core. Why fold the nozzles? The reason is that in this scale event, you get deducted points if you remove any details from the rocket for flight. So if you added the nozzles on the back of the rocket in order to get static-score points, the rocket has to fly with them attached. They can be moved out of the way… they just can't be removed completely.

Photo 13 shows how the nozzles completely fold aside and the rocket motors are installed.

PHOTO 13

Continued on page 9

Continued from page 8

With the fake nozzles folded out of the way, the central motor mount is open so that a rocket motors can be inserted. This central motor is typically a high thrust motor to get the rocket into the sky.

The motors in the outside ring are mostly there for effect. They just have to ignite, but don't really need to provide much thrust to lift the rocket. In fact, they are typically plugged motors, and don't control the ejection of the parachute. The central core motor would do that.

PHOTO 14

The Ariane rocket, shown in Photo 14, shows a similar arrangement of rocket motors. The central motor (the short one in the photo) is the one that does the heavy lifting of getting the rocket off the pad.

The smaller ones in the outer nozzle bells are plugged and are there to provide visual effect and to get points for the number of motors in the rocket. In this event, the more rocket motors you ignite, the more points you can accumulate.

Photo 15 shows another Saturn 1B rocket with eight motors in the cluster.

PHOTO 15

You can tell by the way that the motors are arranged, that there is a good chance that they are all plugged and don't fire off ejection charges. Why? Because they are all sticking out of the nozzles. If they were inserted into a

Continued on page 10

Continued from page 9

motor mount tube, they could be slid a lot further into the rocket than just hanging out the back as shown.

For a big rocket like this, it isn't much of a concern, as there is enough room inside to carry electronic systems to fire off the deployment charges to push out the parachutes. However, you still have to worry about the CG being too far back in the rocket for stability, and that the motors are secured and can't snap off in flight. That is what I'd worry about the most -- they look so fragile hanging out the rear end of the rocket like that.

What fascinates me the most though, is how people solve stability issues with the rockets being multi-stage. These scale rockets are almost always three or four stages because you get a lot of extra points in the competition for staging and having more motors in the model.

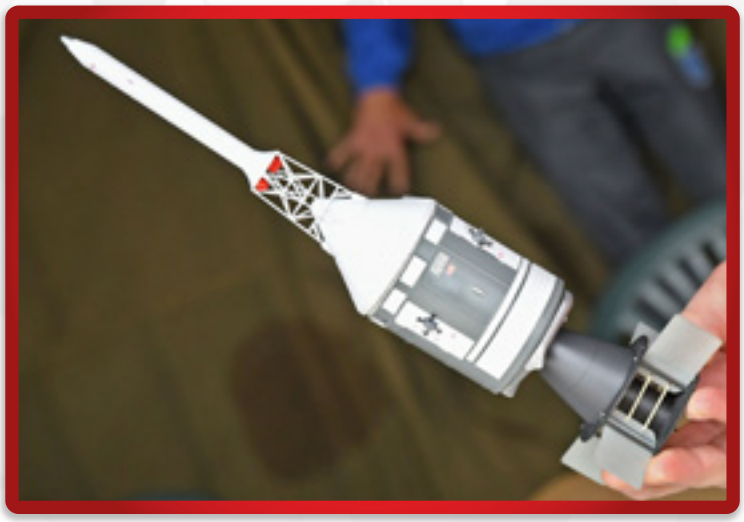

PHOTO 16

Since the upper stages don't have fins on the outside, they have to have hidden fins on the inside of the rocket that pop out during flight. There are three common ways to deploy hidden fins in flight. These are shown in the following photos.

PHOTO 17

PHOTO 18

In photo 16, we see the first common way - to have the fins folded sideways in the rocket, like they are wrapped around the motor mount tube.

In photo 17, the fins are hinged at the front edge, and swing upward (forward) towards the tip of the rocket.

In photo 18, the fins are mounted further back on the rocket and swing rearward toward the tail of the rocket as they deploy.

Continued on page 11

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What I like about photos 16, 17, and 18, are that they are all used on the base of the Apollo Service Module - so essentially the rocket is the same. This goes to show that there isn't just "one method" that will work in the situation. All three will work fine to stabilize the rocket.

So that begs the question, which I can't answer… why did the builder choose the particular method for fin deployment that they used? My guess it comes down to how comfortable they are with their chosen course of action.

I saw the exact same thing of three different ways to deploy fins on the base of the Saturn SIV-B stage, which is shown in photos 19 through 22.

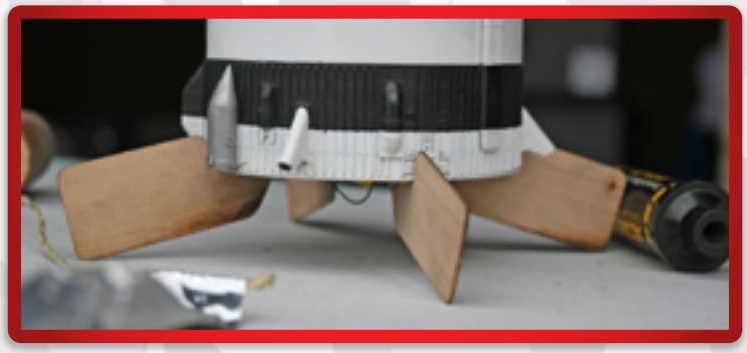

PHOTO 20

PHOTO 19

PHOTO 21

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PHOTO 22

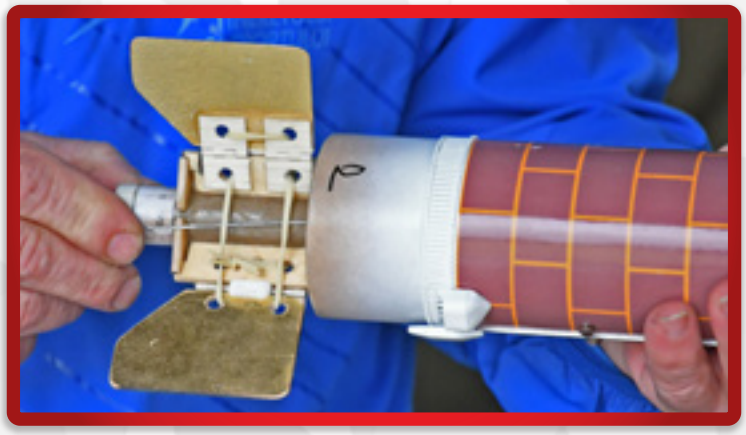

PHOTO 23

PHOTO 24

Two other rockets that I was able to catch a glimpse of are shown in Photos 23 and 24 They also feature flip out fins in a 2-stage rocket.

Photo 23 shows the flip out fins on a stage from the Ariane rocket, and Photo 24 is of a scale model of the Russian Cosmos rocket.

Continued on page 13

Continued from page 12

The other thing that I saw that was cool was the rockets that Kevin Kuczek and I worked on for the A-engine streamer duration contest. This was the event that Kevin won a silver medal in the Senior division, and my daughter Ashley won a bronze medal in the Junior division. What was unique about the rockets were that they were ultra-lightweight. They were made from carbon-fiber/epoxy rather than fiberglass/epoxy. I would say that the airframe tubes were almost half the weight of the fiberglass/epoxy tubes that I made previously. Not only that, but they were nearly glass smooth on the surface, so the skin friction drag was ultra low.

We labored for almost two years to refine the construction technique to get them to that point, battling dozens and dozens of individual problems along the way.

I am currently working on a video series that will walk you through the process of making similar tubes, if you wish to squeeze every last gram of performance from your rockets. I'll have that series done soon, and I'll post information about it on our website at: https://www.apogeerockets.com/How-to-Make-Carbon-Fiber-Tubes

Conclusion

Those are the cool things that I saw at this past year's World Spacemodeling Championships. I hope that it may have sparked a few new ideas in your head that you might want to experiment with in your rocketry future.

If you'd like to learn more about being part of the US team so that you can stay up to date on the cutting edge techniques, be sure to check out the NAR's web page: https://www.nar.org/fai-spacemodeling/

About The Author:

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. He is an avid rocketry competitor and is Level 3 high power certified. He is often asked what is the biggest rocket he's ever launched. His answer is that before he started writing articles and books about rocketry, he worked on the Delta II rocket that launched satellites into orbit. He has a B.S. in Aeronautical Engineering from Embry-Riddle Aeronautical University in Daytona Beach, Florida, and has worked toward an M.S. in Space Technology from the Florida Institute of Technology in Melbourne, Florida. Currently, he is the owner of Apogee Components (http://www.apogeerockets.com) and also the author of the books: *Model Rocket Design and Construction*, *69 Simple Science Fair Projects with Model Rockets: Aeronautics* and publisher of the "*Peak-of-Flight*" newsletter, a FREE ezine newsletter about model rockets. You can email him by using the contact form at https://www.apogeerockets.com/Contact.

Ring-O Rocket Plan

Download the ***RockSim*** design file for the Ring-O at:
https://www.apogeerockets.com/Peak-of-Flight-Rocket-Plans

Ring-O Parts List

14811 - (1) FNC-56mm Foam (1/pk)
10164 - (1) AT-56/18" (4/pk)
13043 - (1) Coupler AC-56 (2/pk) BT-70
44002 - (1) Centering Ring Cardstock
10086 - (1) AT-18/18" (6/pk)
10202 - (1) AT-74/18" (4/pk)
13028 - (1) CR-13/18 (6/pk)
13052 - (1) 1/8" Launch Lug (6/pk)
14099 - (1) Balsa Sheet 1/8" x 3" x 18" (1/pk)
30326 - (10) Kevlar Shock Cord 300#
29126 - (1) 18"/15"/12" Cut-to-Size Plastic Parachute (1/pk)

Build Notes

- Refer to the advanced construction video series on construction paper transitions - https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_11 to help in making the transition for this plan
- Refer to our video on foam nosecones - https://www.youtube.com/watch?v=6MoBVXvuwa4 to see how to attach the shock cord to the nosecone.
- Make sure to set the aft centering ring level and at the correct distance, as the coupler backs up against it.
- Apply wood glue to the outside of the 13mm to 18mm centering ring before inserting it as a thrust ring; use a spent 18mm motor to push the thrust ring until only 0.25 inches of the motor is poking out the bottom. This should result in the thrust ring being glued in place 2.5 inches from the bottom of the body

Ring-O *By Christopher Texler*

About the Design

This design was born out of the concept of, "Can I make a rocket with a ringtail nearly the same diameter of the main body tube?" Some features that resulted from this concept include the lengthy transition and foam nose cone which give this rocket both the appearance of a submarine and the Apogee International Thermal Sailor kit (ITS).

The reason behind the lengthy transition is to give time for the air passing over the rocket to "settle down" and reduce turbulence by the time it gets to the aft end of the transition so the fins can be effective.

The foam nose cone also acts to give this rocket not only some nose weight, but also causes more drag, making this rocket fly lower and slower to not put as much stress on the tail assembly.

The final thing of note about this design is that, although it carries the same shape as the ITS kit, it's scaled up to BT-70 as opposed to the ~BT-60 tubes that the ITS uses. This was done, both to make the kit a little easier to build, and to allow for a more impressive launch.

Continued on page 15

Ring-O Rocket Plan

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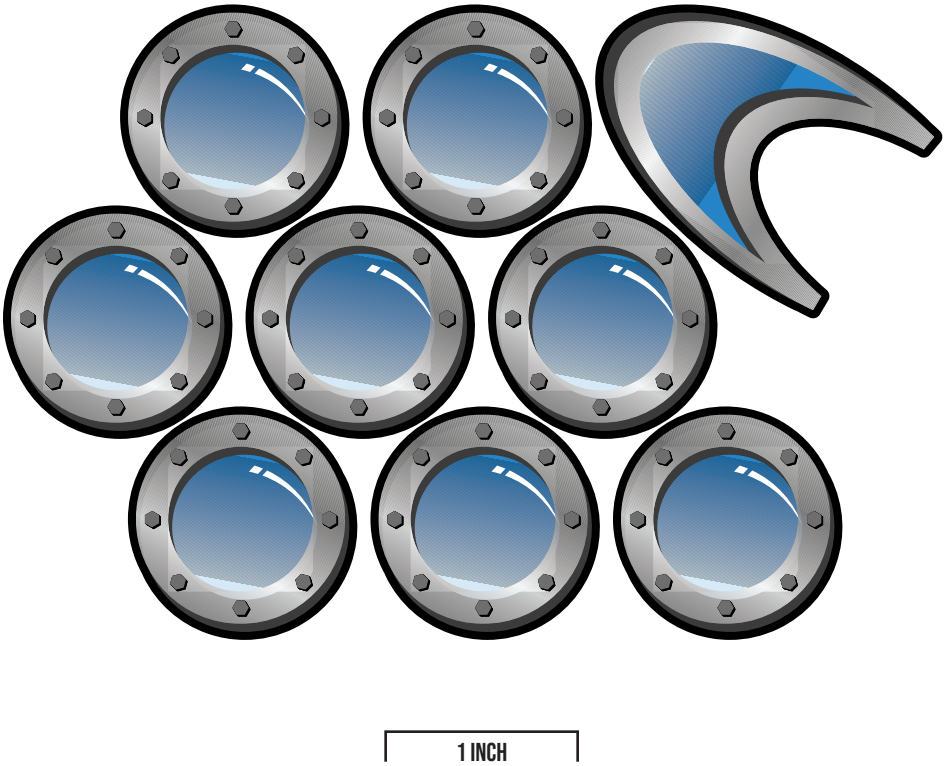
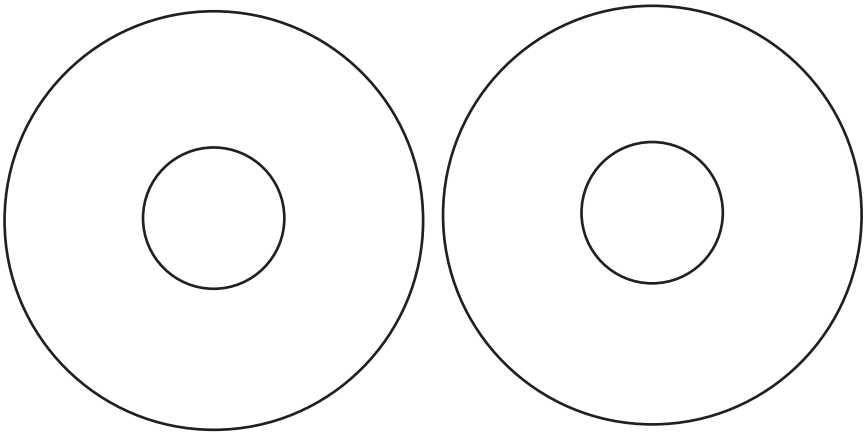
Decals
White

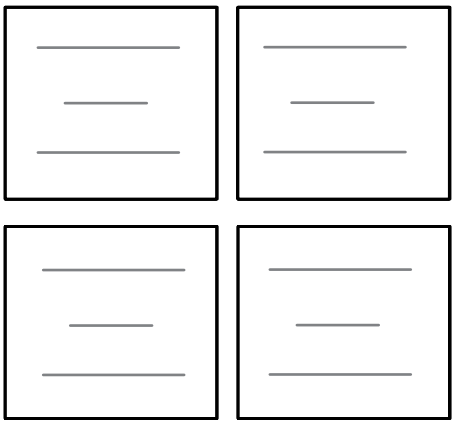


THE RING-O IN FLIGHT.

Centering Ring Template



Fin Template



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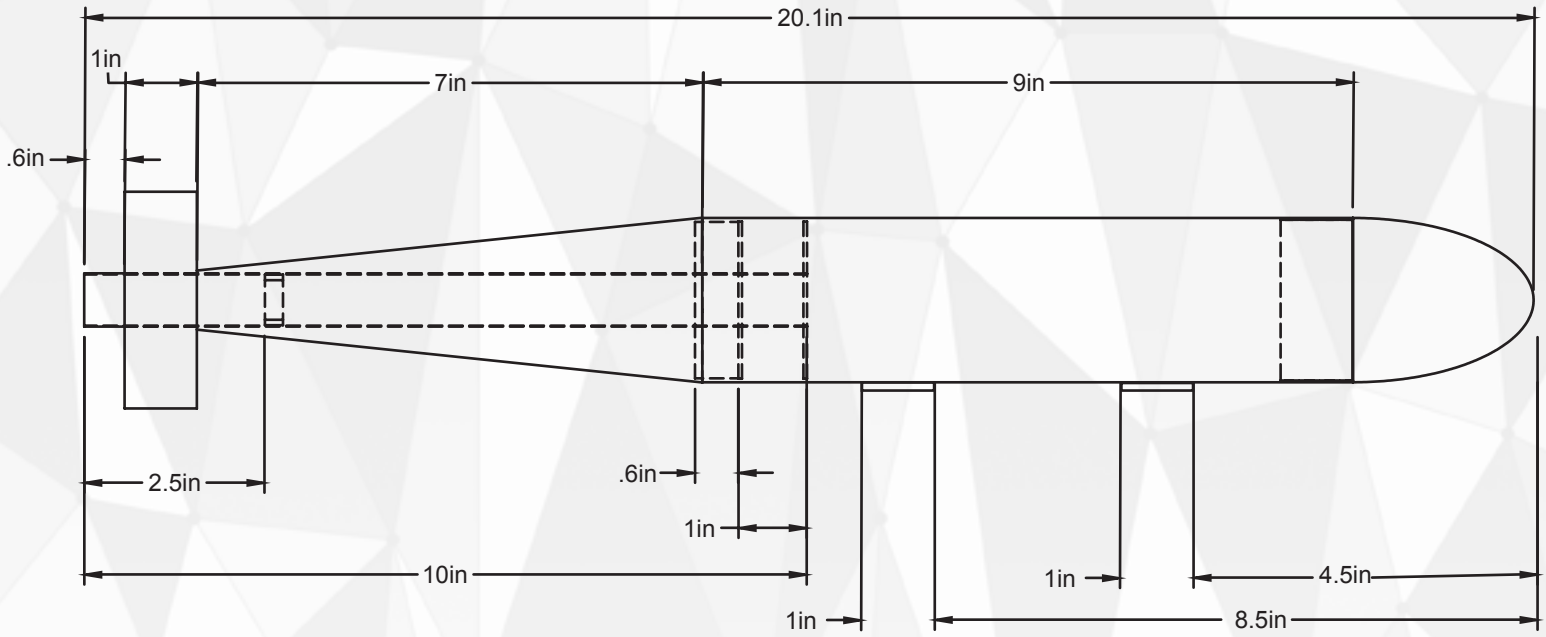
Ring-O Rocket Plan

Continued from page 15

Side View



Rear View