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Igniting the Aerotech D10 and D21 Motors

By Tim Van Milligan

This past December, Aerotech made some changes to the igniters for the D10 and D21 motors (available at: www.apogeerockets.com/aerotech_motors.asp). Actually it is a good change, as it will make it easier to get a successful launch the first time you push the launch button.

The change was that Aerotech swapped out the standard 4-inch long Copperhead™ igniter with one of the new Quest Q2G2 igniters (www.apogeerockets.com/igniters.asp). Getting rid of the Copperhead was a very wise move. A lot of people have problems with the igniter, as they can't figure out how to attach the alligator clips to it. A two-wire igniter like the Quest Q2G2 is going to make it much more intuitive to hook up and launch the motor.

Incidentally, if you need instructions on using the Copperhead igniter with regular alligator clips, you'll find instructions on the Apogee Components web site at: www.apogeerockets.com/Copperhead_igniter.asp

But Aerotech did one other thing though. They re-dipped the Q2G2 igniter so it has more pyrogen on the tip (see Figure 1). This should give more heat and fire inside the motor to ignite the composite propellant motors.

There is only one drawback that I can see. The wires on the Q2G2 are not long enough to stick far out the nozzle when inserted into either the D10 or the high thrust D21. I anticipate that this will change over time (I suggested to the folks at Quest that they should get longer lead igniters from their supplier when the Q2G2 igniters first came out).

But for the mean time, I thought I'd give you some advice on using the short length Q2G2 igniters in the 18mm diameter composite propellant rocket motors.

First, insert the igniter into the motor. Because the Q2G2 igniters have a larger head on them, it may take a little extra time to find the slot in the propellant grain (see Figure 2). With these newer igniters, it is going to be a matter of trial and error to find the slot. The D10 will be a little harder, just because it has a smaller nozzle throat.

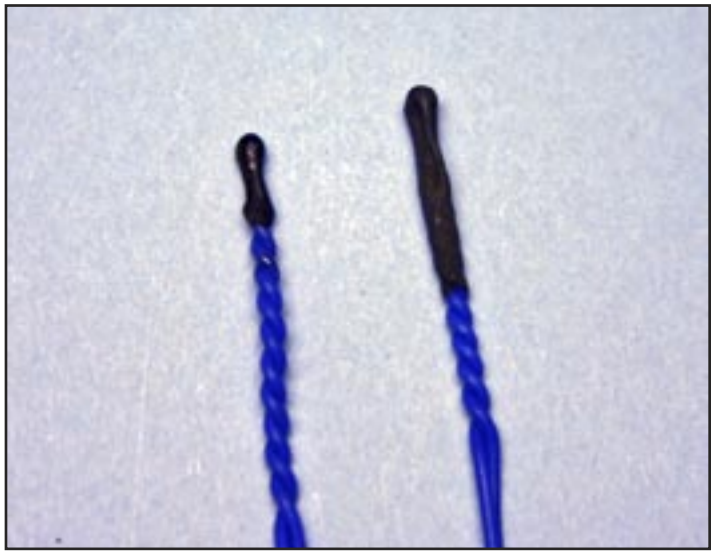

Figure 1: The standard Quest Q2G2 igniter (left), and the one (right) that now comes with the D10 and D21 composite rocket motors.

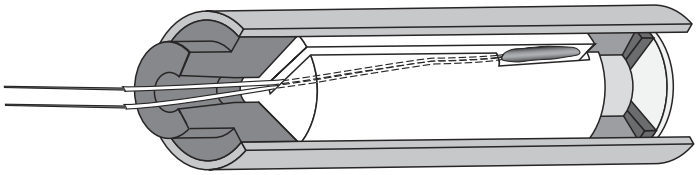

Figure 2: The igniter MUST be inserted all the way into the motor so it touches the top bulkhead.

Once the igniter is in the slot, you must get it all the way down to the front end of the motor. And IT MUST STAY THERE. This is very important.

The reason I mention it is because the insulation on the wires may not stick out through the nozzle. This is normal on some of the igniters. But don't pull the igniter back out to get some insulation through the nozzle.

If the igniter tip is not all the way at the front end of the motor, then it may not start properly when you try to launch it. You'll usually get a chuff, which is like hearing the motor cough. That is one indicator that the igniter was not all the way inserted when it was fired off.

If the insulation on the wires of the igniter does not reach all the way out, you can still use the igniter. You'll just have to make sure that the bare metal on the wires does not touch each other.

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Igniting the Aerotech D10 and D21 Motors

Then fold the wires over the side of the nozzle as shown in Figure 3. You'll now tape the wires to the side of the nozzle to hold them in place. If you're taping directly over the bare wire, that is OK. As long as the two bare wires are not touching each other, they are still insulated by the tape and the phenolic plastic case.

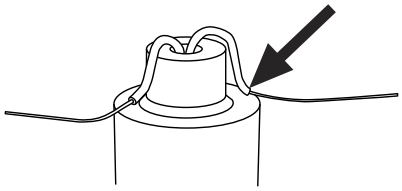


Figure 3: Fold the wires over the side of the nozzle. Make the igniter wires are on opposite sides of the nozzle. Wrap 1/4" wide tape around the nozzle to hold the wires in place.

When you hook up the clips in anticipation of your launch, attach them as close to the nozzle as possible. That way there is less tendency for them to sag and get close enough where they could touch each other (Figure 4).

Conclusion

I'd have to say that there is just as much effort using the new Q2G2 igniter in the composite motors as there was using the Copperhead. Only the type of effort is a little different. But on the plus side of things, I think you'll like the convenience of hooking up the alligator clips like you would

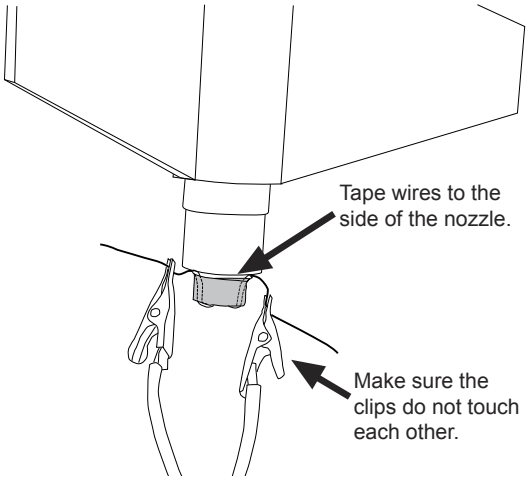


Figure 4: Attach the clips as close to the nozzle as possible. But don't let them touch each other.

for a normal black-powder propellant motor. I know it can be a pain to hook up Copperheads.

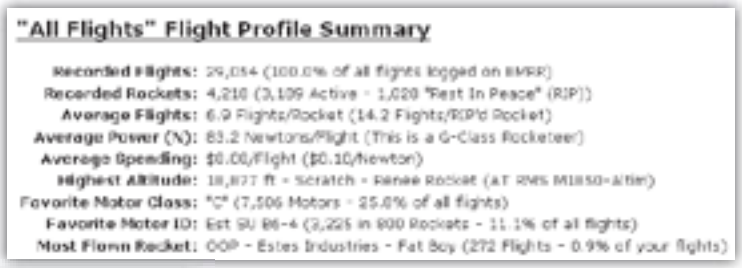
Here is some more good news: the Q2G2 igniters should also work well in the Apogee E6 and the F10 motors. Since these are end-burn motors and don't have deep slots, a lot of insulated wire should stick out the nozzle. But the method of securing that wire to the motors is exactly the same as the procedure described here.

Will they also work in the 24mm Aerotech E15 and E30? Great question. Unfortunately I think the current wires are a little too short. But if Quest gets longer insulated wires from their supplier, I think the Q2G2 igniters will work just fine. Let us know how it goes for you.

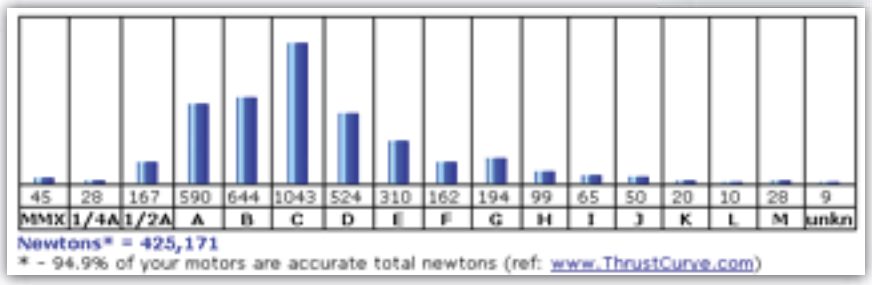
Which Rocket? What Motor? When Was That?

REVIEW CORNER EMRR

Recording flight logs is a fun way to track your flying experience. EMRR now lists over 29,000 flight logs from nearly 1,400 different rocketeers on over 3,000 different rockets.



EMRR Flight Logs for 2008



Flight Profiles provide statistics (like above), that are fun to track and monitor year-over-year.

Your flight log and experiences are also helpful to other rocketeers and they review your motor choices and results. So, add to the FUN!

EMRR also has the largest Manufacturer Recommended Motor database on the Internet!

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Stiffening Transition Sections - English Style!

By Dave Beeton

I have just started to build the Saturn V that I bought from you a couple of years (OK - several!) ago. I have just been assembling the Upper Stage and thought you might like to hear of my tip for fitting the stiffening ring in the upper transition. It gives a lot more room to play with if you loose fit the transition backwards onto the upper body tube and then slide the stiffener ring into the open end. You can even tack it into place while it is still centered onto the tube. When it has dried, it slides off easily and can be refitted the correct way round. It is a trick I have used to build the cone-shaped boosters on a Vostok model where I actually fitted three stiffeners to each cone.

Photo 1: Because the transition section is large, it can feel squishy. We'll stiffen it up by installing a centering ring in the middle of the part.

Photo 2: Carefully fit the transition cone onto the tube backwards, and gently push down towards the centering unit, to leave part of the body tube showing.

Carry out the first steps of the construction as per the video clips. In Step #44, on page 49 of the Saturn V instruction manual, this is where I changed the assembly method.

Great kit - by the way!

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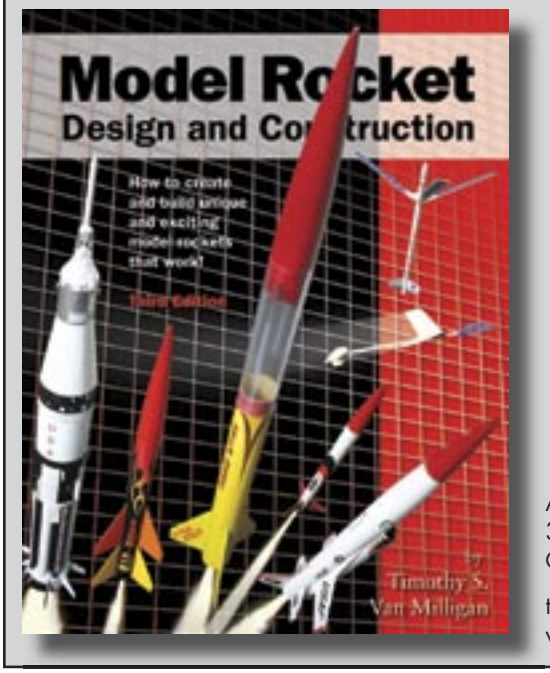

Model Rocket Design and Construction

By Timothy S. Van Milligan

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Stiffening Transition Sections

Photo 3: Fit your reinforcing ring over the body tube, and slide it down into the cone.

Photo 4: Gently press the ring into place with a blunt probe, such as a wood dowel. If you want to, you can carefully slide the cone back towards the "top" of the body tube, for easier access. Use the coffee stirrer to set the ring at the same level all round. Tip: If you hold the cone up to the light you will be able to check that the ring is evenly seated.

About the Author:

Dave Beeton is a modeler that lives in the United Kingdom. Besides building Apogee's Saturn V, he also builds competition scale models.

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Stiffening Transition Sections

Photo 5: Tack the cone and ring together as in the original video clip. I use a gap-filling CA.

Photo 6: When the CA has gone off, gently remove the cone and ring from the body tube

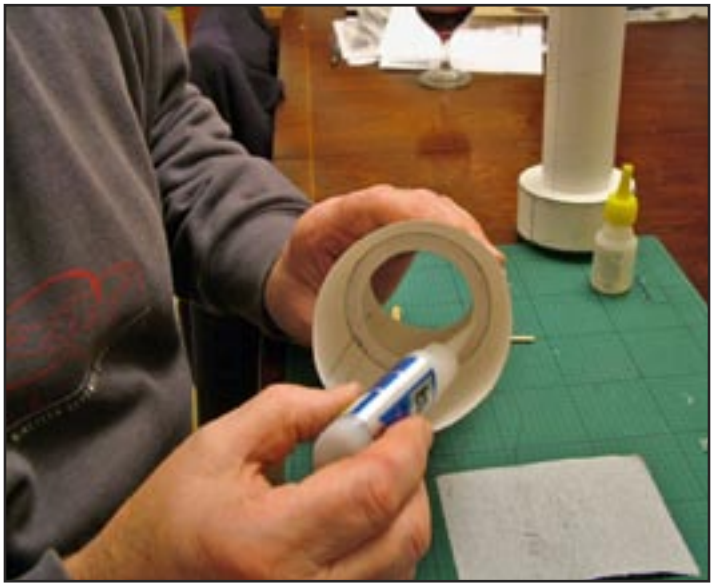

Photo 7: Wick some normal or thin CA into the joint as directed on the video. At this point, the alternate method of attaching the stiffening ring is complete and you can resume following the videos!

How to Set Up Staging and Air-Starting in RockSim

Reader Questions and Answers By Tim Van Milligan

Terry Leright writes: *"I have built a 2 stage rocket, and I am trying to set the staging correctly to see the altitude of the booster.*

If I set the ejection delay in the booster to say 2 seconds will this simulate separation? Then do I set the ignition delay in the sustainer to light the sustainer motor?"

I'll give you an Absolute Rule that tells you how RockSim handles staging. Then you'll be able to set up the software to handle your particular complex simulation.

RockSim Rule For Staging: "When (during a flight), a multi-stage comes apart, it is controlled by the ***ejection delay*** of the booster stage motor."

What does this mean? I want you to imagine a small rocket like the Quest Zenith II kit (www.apogeerockets.com/Quest_Zenith.asp) that uses black-powder engines that have ejection delays. To stage a kit like this, you would put a motor with a zero-second delay charge in the booster stage, right? For example, you might use a C6-0 rocket motor, where the zero on the end tells you how many seconds it would be between motor burnout and ejection of the upper stage off the booster stage. This is simple so far, right?

What happens if you use a C6-3 in the bottom stage? Why, the stages would stay together and the rocket would coast upward for three seconds after the booster propellant had been consumed. At that point, the stages would separate. At the same time, the upper stage would ignite because it is set up to use direct staging (see www.apogeerockets.com/education/how_to_multi-stage.asp for a description of direct staging).

This is how RockSim is set up to work. It was set up to mimic small model rockets.

"But Tim," you might say, "high-power rockets don't have delay or ejection charges built into them. What am I supposed to do then?"

Fortunately we did realize that most high power motors do not have delays or ejection charges built into them. So we put in a way for you to TRICK RockSim to thinking they are small motors. What is this trick you ask?

Simple. When you are running a simulation and you go to load the motor into your design, you simple hi-lite whatever is currently in the ejection delay field with your mouse cursor, and then type over it. If you want a zero second delay, then type in a "0." IMPORTANT: For RockSim to accept the new value, you must hit the Tab key or the Enter key on your computer keyboard. This will move the cursor to the

Continued on page 8

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Simulating High-Power Two Stage Rockets

Figure 1: Hi-lite the ejection delay field with your cursor, and simply type a new value with your keyboard. Then hit enter or tab to force RockSim to accept the new delay you typed in.

next column over to the right.

For example, if you typed in a zero, you now have the rocket set to separate and *start the ignition sequence* of the top stage as soon as the propellant in the booster stage motor is consumed.

"Tim, what do you mean by 'start the ignition sequence' of the stop stage?" you might ask.

Great question. That is where the ignition delay field comes in.

You don't necessarily have to have the upper stage motor ignite as soon as the stages separate. You may want the top stage to coast a ways and then air-start. The effect is spectacular to see in real life.

But to do this in RockSim, you have to pause the ignition of the upper stage motor. So any number in the ignition delay field on the sim prep screen will be the number of seconds after the stages saperate until the motor begins producing thrust.

At this point, you should stop and try to diagram out what you want to occur. Do you want the motors to separate as soon as the booster motor burns out? Do you want the two stages to stay together after the booster burns out? Think how you want the flight to sequence. This is the most critical step of the preparation process. There is a tool that can help you with this. It is called a pencil and a piece of paper.

Make a timeline of events for your rocket. Or draw a simple flight profile and annotate on it the various events. I can tell you from experience that NASA does this for all its launches. They want to anticipate things before they start their simulations and actually build the rocket.

Once you do this, putting it into RockSim is much easier. Just remember that the separation point is controlled by the delay of the booster stage motor.

Then after you run your simulation, you can use the plot feature to see if your simulation matches what your anticipated timeline would look like. For example, I like to plot out the thrust and the mass curves for two-stage rockets to make the comparison (See Figure 2).

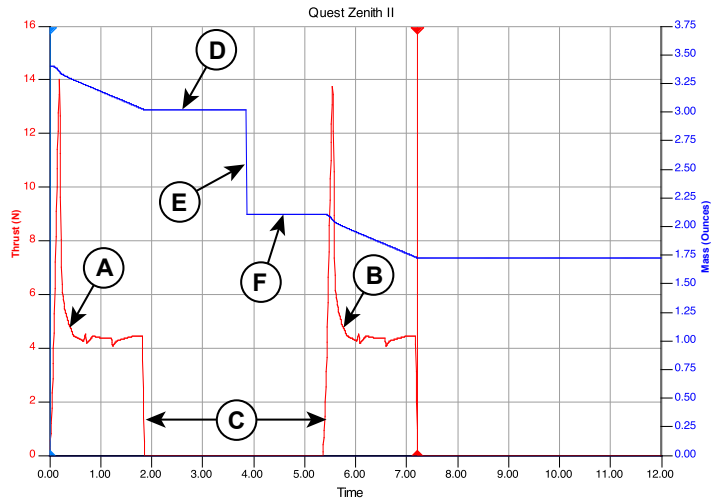

Figure 2: Thrust and Mass curves for a two-stage rocket with delayed staging

In Figure 2, we see the thrust curves of both the booster (A) and the sustainer (B). They are identical curves, which tells us they are identical motors. I'll tell you that they are both Estes C6 motors. The time between the curves (C) where there is no thrust indicates that there is a coasting period of over three seconds.

What is happening during the coasting period can be determined by looking at the Mass curve (blue line). At point D, the mass curve is flat for two whole seconds, meaning that nothing is happening to make the rocket lighter. At point E, there is a big drop in mass. This is what you'd see if the stages separated at this point in time. Then the curve is flat again at point F, which seems to indicate that the rocket is coasting again for 1.5 seconds.

We now have enough information to determine how the simulation was set up in RockSim. Up to point E, the rocket would be the controlled by the booster motor. Since there is a two second period of coasting, we can assume the motor used in the booster is a C6-2 (a fictional motor).

During point F, the sustainer stage of the rocket is

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coasting by itself. The motor of the sustainer must have an ignition delay of 1.5 seconds for this to occur.

We can't tell from this graph what the delay time of the sustainer motor is. But that isn't critical to our discussion. It may be that a flight event was used for the ejection of the parachute.

But the timeline graph (Figure 2) is extremely useful. If you were to look on the simulation summary screen, the motors would listed as: [C6-2] [C6-X-1.5]. The X would be the delay of the upper stage motor (which we don't know), and the -1.5 at the end is the ignition delay of the sustainer motor.

For more information on setting up complex launch simulation, please see the references listed below.

References:

How RockSim's 2D Flight Profile Can Help Your Flight Evaluations. *Peak-of-Flight Newsletter 163*. www.ApogeeRockets.com/education/downloads/newsletter163.pdf

How to Set Up Multiple Flight Events in RockSim. *Peak-of-Flight Newsletter 176*. www.ApogeeRockets.com/education/downloads/newsletter176.pdf

How to Set Up Electronically Staged Rockets in RockSim. *Peak-of-Flight Newsletter 216*. www.ApogeeRockets.com/education/downloads/newsletter216.pdf

About The Author:

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. Currently, he 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 a FREE e-zine newsletter about model rockets. You can subscribe to the e-zine at the Apogee Components web site or by sending an e-mail to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message.