PEAK OF FLIGHT NEWSLETTER

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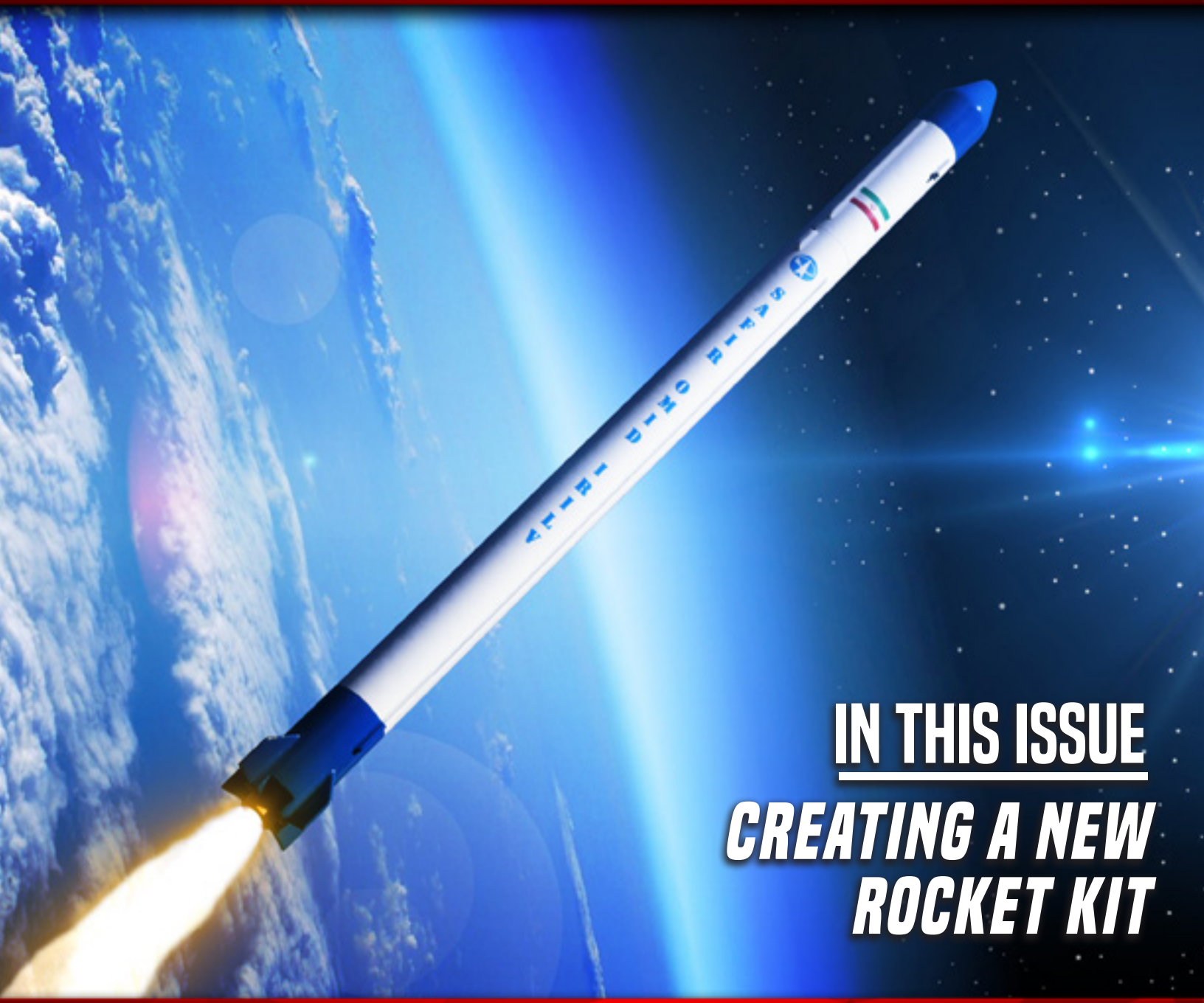

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APOGEE COMPONENTS

PEAK OF FLIGHT

Creating a New Rocket Kit

By Christopher Texler

When you get a model rocket kit from Apogee Components and build it, you might have wondered how that kit came to be or even what went through the minds of the people that developed it. In this article, we'll delve deep into the process of the product development and the chain of events that produces an Apogee kit. You'll get to peer into the mind of Apogee's product developer and unlock exactly what goes on to inspire such amazing kits. So come along as I show you, straight from the source, how Apogee brings rocket kits to life.

The first step in any rocket kit that I develop at Apogee is getting an idea of what the feeling of this specific kit is going to be, or which niche it fills. Because every kit developed at Apogee is its own unique rocket and has an entire story/environment built around it, understanding what the setting for a new rocket is going to be is crucial before even starting the first steps.

Everything from the size of the rocket to what skill level we're aiming at making it to even how much of a scale/original design it's going to be can play a massive factor in approaching the initial concept phase and eventually the end product for the customer. We ask questions such as: Who would like this rocket? Why would they enjoy making this rocket? What things have a potential owner of this rocket done before in rocketry? Is there a need or desire for this type of rocket? We then take those questions and connect them with things such as the size, skill level, and other things to help craft a vision for each specific rocket.

The size of the rocket is often the starting place once the initial questions have been answered and parameters have been set. Frequently we'll decide what types of rockets to develop next based on what we see that people want in the community. An example of this is a kit that is currently in development where one of the base criteria was that there was a demand for rockets that utilized a BT-55 sized nose cone. Based on that size, it already starts giving me an idea of roughly what type of rocket I'm developing. I'm likely not going to be developing a large high-powered rocket with that nosecone, and I'm also not likely going to be developing a micro-scale rocket.

The skill level or guide that we put on each rocket to outline the level of expertise needed to build it also plays a large role, as it dictates how advanced the design will eventually be. If I'm given the objective that the rocket needs to be under "skill level 3 out of 5", then I can tweak how I'm thinking about the design to not include a high level of building techniques such as complex motor mounts or multi-piece fins. If it is required that it be a lower skill level, and we want to do something out of the ordinary, then we may have to supply parts that require more labor on our end before they go into the bag. For example, a tube with laser-cut slots will make the rocket easier to assemble for the customer, but requires more work here.

Even how much of a scale model Apogee wants to make the design can decide a lot of things in the very earliest development phase. If we want to have a high-fidelity-scale model of a real world rocket, then the development path is primarily focused on finding a real-world counterpart that is interesting and is possible to build as a scale kit, and figuring out the modifications that need to be made to make it flyable. However, if we decide to go for something totally original, then I need to figure out a shape or concept that people haven't thought about bringing into the model rocketry world, and yet is still possible to build out as a kit.

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The next step is to build out some concept sketches and put my ideas on paper. This is a critically important step, as even with the amount of communication involved in the previous step, often my takeaway will be slightly different from the desired outcome.

I'll start out by sketching individual features of the rocket that make it stand out such as the fin shape and any other unique features that could be a part of the kit. Then I'll take my sketches to Tim Van Milligan, and we'll meet to discuss what my thoughts were with the sketches and what improvements/changes could be made to the sketches. This will go around for a couple iterations before we are both satisfied with how the sketches are looking and we can move on to the next step.

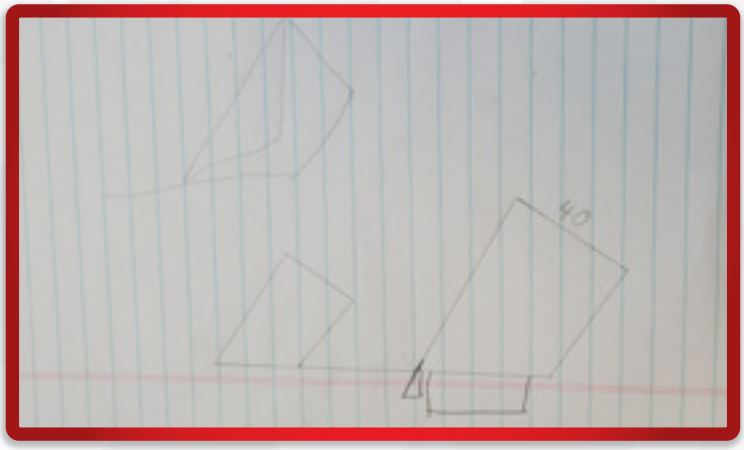

FIGURE 1: CONCEPT SKETCHES FOR FINS ON A KIT IN DEVELOPMENT

The next step in any kit that I develop is to digitally build it, first in the rocket simulation software, Rocksim (https://www.apogeerockets.com/RockSim/RockSim_Information). In Rocksim, I primarily try to get a rough shape of the whole rocket, incorporating all of the design elements that are featured in the concept sketches. This helps me not only start to see the whole rocket design for the first time, but also helps me make sure that the design will be possible to build using apogee parts and will actually fly safely. RockSim also is an extremely powerful software that, once I've built the file, lets me export it to something called the Launch Visualizer where I can get a feel for what the rocket will look like out on the launch pad and flying.

Once I've built the rocket in RockSim and verified its feasibility, I can then re-build it in a 3D design software called Fusion 360. This CAD software allows me to basically build the entire rocket piece-by-piece in the same way as I would in the physical world, without needing to set aside the physical resources. The difference between RockSim and CAD software is that RockSim does the launch simulation part really well, where the CAD software doesn't do any of that. But full-blow CAD software allows for precise fitting of the parts, each with their own unique shapes. For example, think of the plastic loop or a screw-eye added to the base of a nose cone. RockSim doesn't do that part, but the CAD software does. The CAD software allows me to check for any interferences between parts, and also get the "look and feel" of the rocket and what further changes may be needed to the design.

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Gyro Chaser Helicopter Rocket

- Unique 'transforming' rocket - looks like a normal rocket, but then rotor blades pop out at ejection
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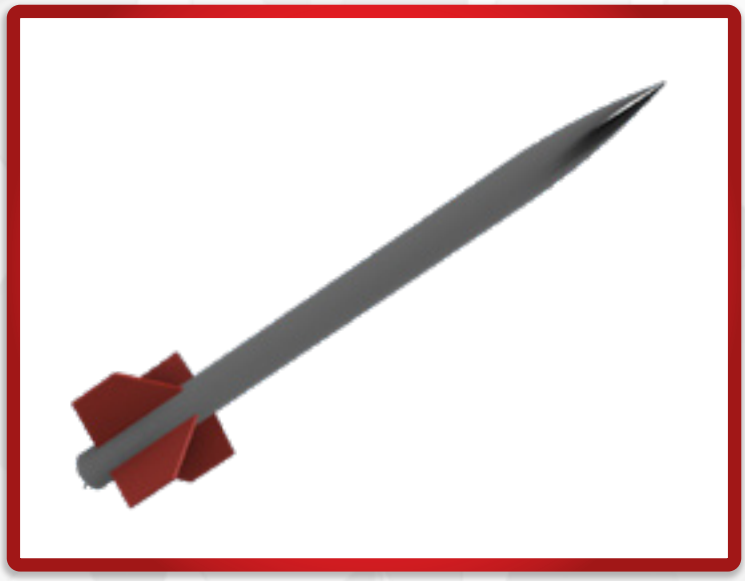

FIGURE 2: SCREENSHOT OF EARLY DIGITAL MODEL OF TWO STAGE ROCKET IN DEVELOPMENT

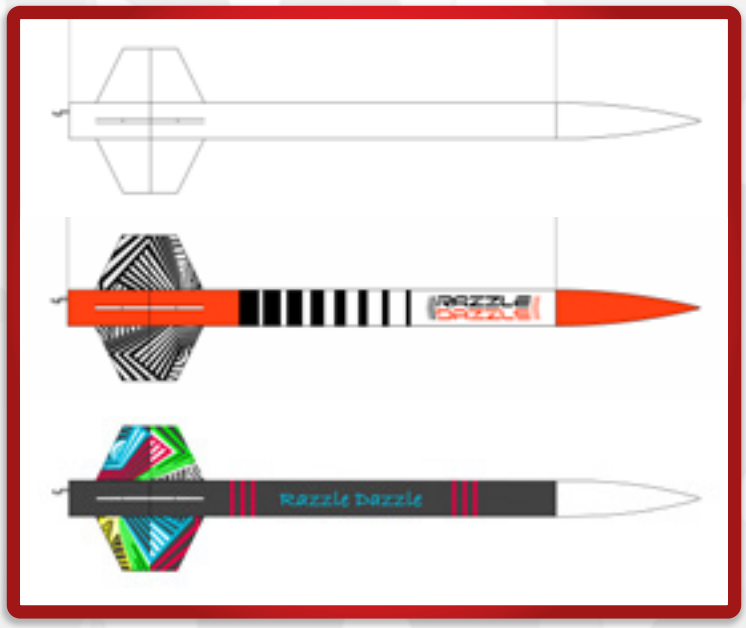

FIGURE 3: TWO STAGE ROCKET IN DEVELOPMENT 2D DRAWING BEFORE AND AFTER SOME GRAPHICS WORK

Fusion 360 also allows me to export the 3D design into a 2D drawing, which I can then send to our in-house graphic designer to start making the graphics. By this point in the process, we've all been in communication through every step, and we all have a rough idea of the design, "feeling" and sometimes even the theme of the rocket, but it's the graphic designer's job to add the flair to the design that brings the original vision to life.

Check out our Facebook page
www.facebook.com/ApogeeRockets

Once the Fusion 360 and RockSim designs have been made, revised and approved, work can begin on the first physical prototypes.

When actually building the prototype, I start by making prototype laser-cutting templates for the fins, centering rings and any other parts. These are prototype templates at this point, just to check to make sure the parts will fit together perfectly. Later on in the process, these cutting templates will need to be optimized for production. For example, if you just need a single set of fins to build a rocket, you don't really care how they are laid out on a sheet of wood. You just are concerned about accuracy. But for production, the fins need to be oriented properly on the

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wood, the little tick-marks added that prevent the fin from falling out of the sheet, and then a part number etched onto it as well. I try to keep this in mind when creating the template files, but what happens in reality is that our production department will almost always ask me later to revise the files. They want to make the production process faster, more efficient and produce less waste in order to keep the cost of the kit down for the customer.

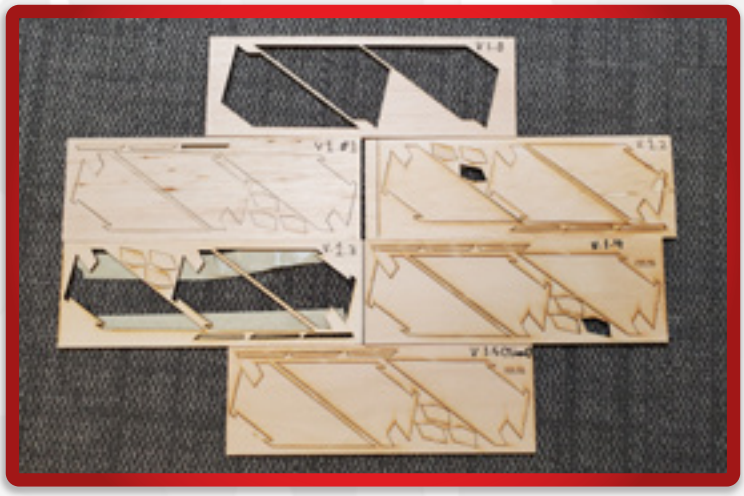

FIGURE 4: FIN TEMPLATE PROTOTYPES FOR ZEPHYR JR.

Then, I create a bil of materials (BOM) of all the parts that go into the kit. This allows us keep track of where our raw materials are going. This can be a little more time consuming that it sounds, because it is an iterative process. We're constantly going back and tweaking the design, sometimes using different parts in order to reduce the cost for our customers. Most times, the BOM isn't finalized until just before the kit enters production.

By this point, I've also usually cut out the first pieces according to the templates I made, found any errors and iterated the templates to fix those errors until I have good parts. Using the finished parts, I can build the first prototype(s) which usually end up being the "flight model" for the kit.

The "flight model" is the term given to the first prototype of a rocket that is built well enough to use in a flight testing campaign to verify the design in the real world. This model is normally built to the same standard as a customer might build it, to proof out how smoothly the design goes together, whether any parts need to be changed to make them stronger, and to also finalize what skill level the kit should be placed in.

The flight model is also sometimes used as a test bed for the graphic design for the rocket. Sometimes when you paint and decorate the rocket, it just doesn't look right in the real world. You like to find out that information early in the process. And sometimes you look in the hardware store at what colors of paints are available to customers, and our graphics department has to design the decals around those colors.

FIGURE 5: ZEPHYR JR. FLIGHT MODEL

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While the flight model is being built, work also begins on the instruction manual, which normally ends up being the longest and most time-consuming portion of developing a new kit.

The instruction manual begins with me revisiting the Fusion 360 design assembly file, tearing it apart to its individual pieces, and then slowly rebuilding it in the way that it will be built in the instruction manual. The goal is to show, in a realistic looking sense, how the parts are fitted together in real life. These individual images will be used to make the step-by-step illustrations in the printed instruction sheets.

While rebuilding it in Fusion 360, I'll export the partially rebuilt "snapshots" in a format that another program called SketchUp can use. SketchUp will export the final drawings in line-art format, instead of being shaded images. We've found that line drawings are clearer and less confusing for customers than shaded raster images (like a photograph). This is important when you consider that the quality of printing can change in each batch of instructions that is printed up. For example, you probably know how hard it is to read a sheet of paper when the printer is low on toner. Shaded drawings look terrible when the printer's toner cartridge is low, while line-art drawings are still legible. That's why we always use drawings instead of photographs in our instruction manuals.

SketchUp exports a vector drawing format ".eps" (encapsulated post script). We want a vector format so that the drawings can be enlarged or reduced in scale, and they will always remain crisp and legible. Did you ever download one of our instruction sheets and zoom in on an illustration? No matter how far you zoom in, the image is perfect and readable. You can't do that with a photograph, which begins to pixelate if you zoom too far.

Once I have an .eps file for every step of the build process, I can open them in Adobe Illustrator and clean them up which usually involves fixing any disconnected lines and adding free-hand elements like parachutes that need to be captured separately. During the cleanup process, I also build a digital storyboard of where all the steps will go. This allows me to see if any steps are missing. If they are, I have to go back and re-create them in Fusion and export them to line-drawings in SketchUp.

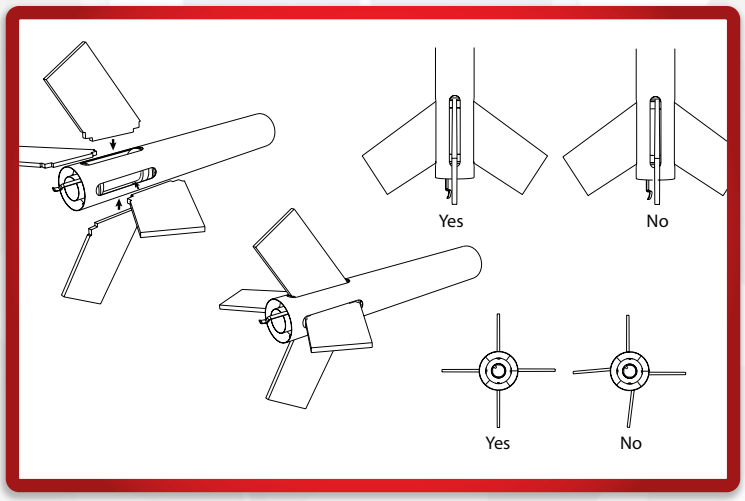

FIGURE 6: ROCKET IN DEVELOPMENT ADOBE ILLUSTRATOR STEP

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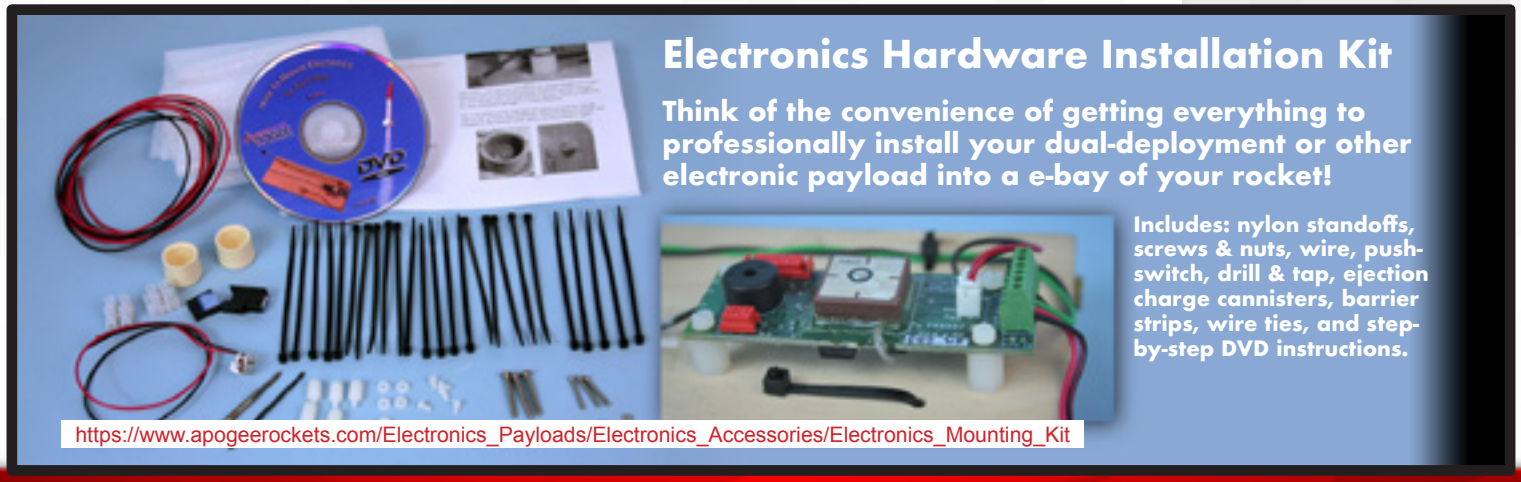

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Once I have all of the graphics done, I can then add the written text for each step. This explanation helps explain nuances that the graphics don't give - such as the specific type of glue you might want to use.

At this point, I use the illustrations and written text to start building the showroom model of the kit.

FIGURE 7: ZEPHYR JR. SHOWROOM MODEL (FLIGHT MODEL ON LEFT FOR COMPARISON)

The showroom model of the rocket is built to be the "ambassador" of the model. We use it to showcase the rocket and in all the marketing that will be done. But for me, I use its construction as a test of the steps in the instruction manual. This kit is built like anyone might build the production version, however, extra care is taken to make sure that it looks as close to perfect as possible.

This means things such as filling the seams in the paper tubes and grain in the wooden fins with putty and sanding it flush, sanding flat surfaces to a near mirror polish, and painting everything in such a way that it is nearly impossible to even tell what materials the rocket is made out of.

The reason for all of this effort and work is to create not only a really good looking rocket that can be used in the show room, but also to represent the idea and vision that goes along with the kit that people will be getting. This cements the concept of the rocket and sets it apart from other rockets as an Apogee kit in which people can either discover a new passion, or relive the rocket that got them into the hobby.

The work to develop the kit is far from over, though, and the next and final part is the website.

On the Apogee website, you'll find that every kit we sell has its own page, with its own pictures and its own content unique to that rocket, and all of that needs to be constructed and added before the kit can be released to the public. The major parts of each kit page on the website consist of:

- A related documentation section which normally houses a PDF of the instruction sheet so people can download it when they lose the on in the kit
- An "about" section that introduces the rocket
- A section outlining what makes the rocket a certain skill level
- The features of the rocket
- A recommended motors chart, outlining a list of motors that can be flown on each rocket
- A RockSim file
- A section outlining the tools needed for the assembly of the kit
- Some frequently asked questions about the kit
- Reviews of the kit - we don't write these, but the webpage will display these automatically once

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customers start submitting them after the kit is released.

- A section for any unique replacement parts of the kit if a customer needs to replace something after a rough landing.
- And finally, a section outlining other stuff people might like if they liked this kit

All of this needs to have content written for it, pictures taken, and pdfs and other files linked, just to make one webpage for one kit. This is a process that is just as challenging and time consuming as designing a kit.

The process of actually building the website also requires that an actual bagged kit being taken into our onsite photo studio, and pictures of every part taken. Those pictures are then edited, put up onto the website and tied to the correct sections/content that they belong with. The marketing text (why you should buy this item) is custom written and added to the webpage based on both the pictures and the sections that are being written for. Finally, all of the "backend" work is done to make the website functional such as connecting links, adding shipping dimensions and specifying the prices/taxes/costs of each kit.

Once this is all done, then the website needs to go through proofreading and testing which usually means going back thorough and changing parts or redoing them.

And just like that (and weeks and weeks of work), a new rocket kit is brought onto the market. All of this work eventually results in the small plastic bag containing the parts that ignite the joy of a new hobby for some, and the reawakening of an old passion for others. You've now gotten the chance to see what most people haven't been able to see until now: the monumental, multi-faceted effort that goes into making what are, in this humble product developer's opinion, some of the best rocket kits in and outside of this world.

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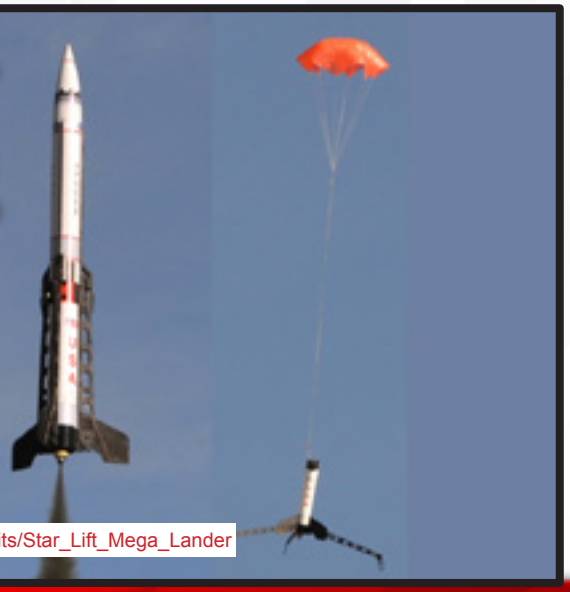

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