PEAK OF FLIGHT NEWSLETTER

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THE NARTREK PROGRAM

https://www.apogeerockets.com/Rocket-Kits/Skill-Level-2-Model-Rocket-Kits/Frit-Single-Stage-Payload-Altitude

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APOGEE COMPONENTS

PEAK OF FLIGHT

The NARTREK Program

By Bobby Potter

What is NARTREK?

NARTREK is an acronym that stands for the "National Association of Rocketry Training Rocketeers for Experience and Knowledge." I like to think of this in just two parts, NAR being the organization that hosts the program and TREK being the journey from novice to expert. At its core, that journey is what NARTREK is all about.

NARTREK is broken into 2 different programs, the NARTREK Skills program, for modelers of any age, and the NARTREK Cadet program, specifically geared towards younger rocketeers who might have limitations in physics or mathematics, or minimal construction skills. This article will be discussing the NARTREK Skills program, but we do have a similar piece on the Cadet version which you can find in Newsletter 414: https://www.apogeerockets.com/education/downloads/Newsletter414.pdf

NARTREK was built to help new rocketeers get their footing; to teach the wide range of skills needed for advanced rocketry in a fun and engaging manner. The program is designed around an accountability system that helps to verify their understanding while they progress to more and more complicated tasks.

Essentially, you learn skills by building and flying different types of rockets. As you build and launch, you accomplish an achievement level. Each achievement level must be completed before moving on to the next, but the entire program is at your own pace; progress as quickly as you choose. To complete an achievement level, a series of flights must be attempted to meet specific goals. These flights are observed and validated by another NAR member.

This program is designed solely for your engagement and education. For these tasks, you can use any rocket kit, or design the rocket yourself. You are not required to make any particular purchases and the fees associated with the program are only to cover the costs of running it. You'll find them to be extremely reasonable (about $5 a level, depending on how you go about it).

On the other side of that coin, this program is bursting with value for young or novice rocketeers. By the time a rocketeer has completed the third level of this program, they will have a well rounded skill set and experience with a majority of the styles of rockets, recovery systems, and building techniques.

In this article, we'll talk you through those levels, let you know what you should expect and give you a few resources that could aid you in accomplishing each task. We also have a page dedicated to recommendations specifically for this program, and you can find that information here: https://www.apogeerockets.com/NARTREK.

Bronze Level

FIGURE 1: BRONZE LEVEL ROCKET KITS

In your journey to accomplish the tasks set forth in the Bronze level of the NARTREK program, you will experiment with recovery systems and low to mid power motors, as well as receive an introduction into multi-staging. You can

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do these tasks in any order.

The first two tasks focus on the two most common forms of recovery in the rocketry community - parachutes and streamers. Similar to competitions, you are required to make a duration flight with each of these systems, which means your goal is to keep it in the air as long as possible. These flights must last at least 60 seconds on a parachute and 30 seconds on a streamer, both using no more than a "B" class motor.

The third task is designed to get the NARTREK participant some experience on larger motors. This task is pretty straightforward, requiring only a single flight on a "D" class motor or larger.

Finally, to complete the bronze achievement level, you are required to make a flight on any 2-stage rocket. This must still be completed on solid propellant (no staged water rockets), but a couple of "A" motors can get you through it pretty cost effectively.

Are you stuck in Bronze?

Well, you are in luck, as Apogee is definitely the place to be for information on model rockets. I don't want to do your research for you, but I will give you a list of resources that might help.

- Completely new to rocketry? Start here https://www.apogeerockets.com/New-to-Model-Rocketry
- For the parachutes and streamers, you should be able to find everything you need here https://www.apogeerockets.com/How-To/Recovery_Systems_for_Model_Rockets
- This is a complete guide to staging model rockets https://www.apogeerockets.com/Tech/How_2-Stage_Rockets_Work

FIGURE 2: SEE THIS ANIMATION ON 2-STAGE ROCKETS! (https://www.apogeerockets.com/Advanced_Rocket_Designs#StagedRockets)

Silver Level

The Silver achievement level diversifies the tasks a bit more, branching out into different schools of rocketry. In the silver level you will perform duration flights with gliders, launch clustered motor kits, build a scale or sport scale model rocket, and complete a flight with a payload. Again, these can be completed in any order.

The glider task is similar to the recovery system duration event in the bronze level, being that your goal is to keep this in the air as long as possible. To succeed in this task, your glider must achieve a minimum of a 30 second flight. Although there are no motor restrictions placed on this task, you could increase the difficulty by making your attempt on an A or B motor, as with the lower the altitude it will be harder to keep it airborne for the duration.

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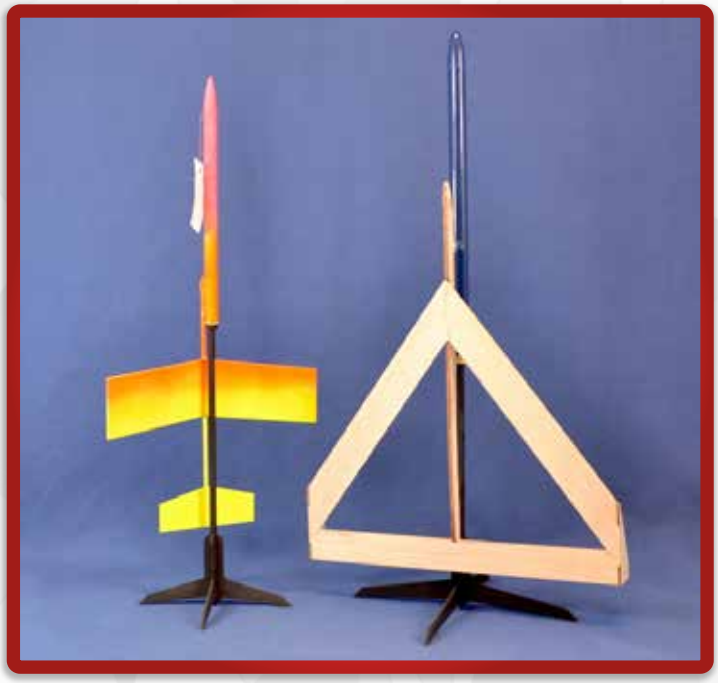

FIGURE 3: A COUPLE OF INTERESTING GLIDER DESIGNS

The payload task gives you some interesting options. For those of you going for a minimum cost, completing this task with an egg or standard competition payload will keep your costs down. Those of you interested in electronics like cameras or avionics can use this opportunity to build those into your rocket. Any of these options would count toward the completion of this task, and the simple validation process makes these alternatives easy to work in.

Finally, to complete the silver level, you need to build and successfully fly a scale model rocket as well as a clustered rocket. These tasks really kick up the complexity, and you get to engage in some more in-depth projects. For a scale model rocket, the rocket is judged on the quality of the design and construction. A scale model rocket is a true test of your attention to detail, care in construction, and aptitude with advanced construction techniques. That may sound intimidating, but don't be discouraged - scale kits range in complexity from beginner to very advanced. There is a scale kit for every skill level.

FIGURE 4: THE HYDRA VII HOUSES A SEVEN MOTOR CLUSTER.

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A clustered engine refers to a model rocket that uses multiple motors. For this task, your rocket needs to utilize at least three engines, but people can and do cluster any number of motors. Clustering a model rocket could include learning techniques like venting ejection charges or electronic deployment of your recovery system, but neither would be required if you build a simpler cluster kit.

By the time you have completed the silver achievement level, you should have a good amount of experience with all the major variations in low power rocketry. Now, as we move to the gold level, the door to experimentation really opens.

Are you stuck in Silver?

- Looking for information on gliders and clustered rockets? https://www.apogeerockets.com/Advanced_Rocket_Designs
- Depending on the payload you select, you'll find great information on payloads here https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_9 or https://www.apogeerockets.com/How-To/Payloads_for_Model_Rockets
- Here's a great article on creating scale model rockets from 3D files https://www.apogeerockets.com/Peak-of-Flight/Newsletter502

Gold Level

During the bronze and silver levels, you demonstrate your knowledge of the principles behind rocketry and your capabilities in the workshop. However gold is unique compared to the previous two levels and is all about the application of rocket science. "Rocket science" being the operative words.

Instead of launching a variety of rockets, this task can be completed with just one. This flight doesn't need to include anything special either; no particular electronics, recovery systems, motors, flight durations, etc.

Instead, to complete the gold achievement level, you must design and custom build your own rocket. This can be done using software like RockSim or by hand calculations, but either way you are required to show your work. To complete this stage, you need to deliver:

1 - Design drawing, including dimensions
2 - Center-of-Pressure calculation
3 - Center-of-Gravity measurement and stability calculations
4 - Altitude potential calculations assuming different drag coefficients
5 - Actual altitude achieved (you'll need to measure it with an altimeter)
6 - Methodology behind altitude calculations
7 - The probable drag coefficient
8 - A photograph of the completed rocket

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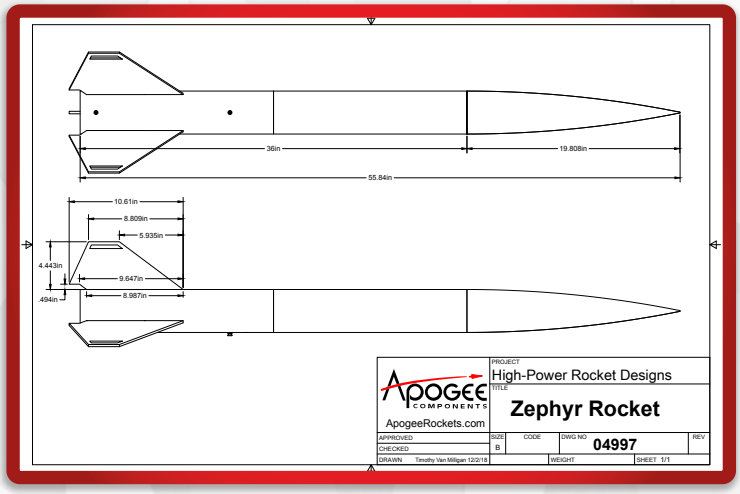

FIGURE 5: DIMENSIONAL DESIGN DRAWING OF THE APOGEE ZEPHYR

This might sound like a lot at first glance, and it is, but those who carry the NARTREK Gold know how to design and build a rocket, and this stage is here to make sure of it. The center-of-pressure, center-of-gravity, and the drag coefficient are some of the most important concepts in rocketry. This test not only determines you know what they mean, but it verifies you can navigate the mathematics that drive them. Those calculations function as a critical tool for any expert rocketeer, and for you they open up a huge world of experimentation. Like any other tool, you'll gain confidence in those concepts with repeated use, and you'll use them a lot if you continue your journey with rocketry.

I can't stress how much better it is to complete this task with the appropriate software. This is rocket science, and tools like RockSim exist to make it easy, accurate and more accessible. You could do these calculations manually but it will be pretty complicated and add a dimension of human error; OR RockSim will guide you through it, give you more accurate data, and it never forgets to carry the 1. This isn't cheating, this isn't some sort of shortcut; this is how the professionals do it. At Apogee, we would never build a rocket without doing our due diligence in RockSim first

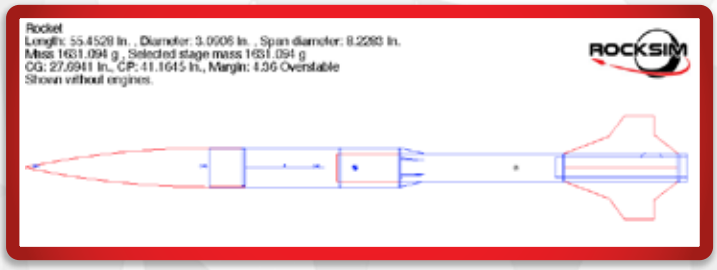

FIGURE 6: CREATING A ROCKET DESIGN FILE IN ROCKSIM

Are you stuck in Gold?

Unfortunately, there is no one stop shop here (besides RockSim) to help you get through this process. Different people are going to get stuck on different parts of this achievement level. That being said, you should have built up quite the knowledge base from the silver and bronze levels, and here are a few other links that you might find useful.

- Additional information on Rocksim https://www.apogeerockets.com/RockSim/RockSim_Information
- Here's an article on inspiring new designs https://www.apogeerockets.com/education/downloads/Newsletter461.pdf
- And here's the Peak-of-Flight "designing rockets" index. If it can be done, you can find out how through the Peak-of-Flight. https://www.apogeerockets.com/Peak-of-Flight?pof_list=topics&m=education&#Designing_Rockets

Advanced Achievements

Once you have completed the requirements to acquire your NARTREK Gold, you can access some of the ad-

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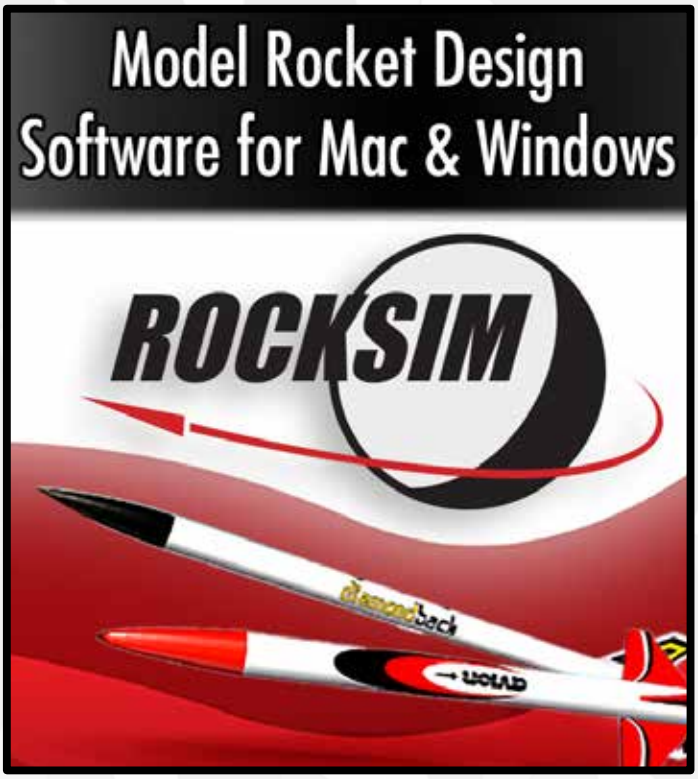
vanced rocketry goals they've set forth. These goals can get your toes wet in research and development, competitions, builds of extreme complexity, radio controlled equipment and more.

Currently there are 7 different advanced achievement categories, but that list is changing and growing with time.

Want to get started?

Sign-up is easy and can be done AFTER you finish the Bronze tasks! The documentation you need to get started can be found https://www.nar.org/members/nartek-skills-program/, and you can find even more great advice and recommendations on our page dedicated to the NARTREK skills program www.apogeerockets.com/NARTREK.