



PEAK OF FLIGHT

N E W S L E T T E R

In This Issue

Frequently Asked Questions About Dual Deployment Rockets



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PEAK OF FLIGHT

Dual-Deployment FAQ's

By Tim Van Milligan

Here at Apogee, we have become the go-to people to ask those technical rocketry questions. And as we have started to sell bigger rockets, we've been getting more and more questions about them too.

In this article, I go over some of the *Frequently Asked Questions* we get about the topic of Dual Deployment.

Q: What is dual deployment?

The purpose of dual deployment is to get a high-altitude rocket down to the ground quickly, so you don't have to walk far to retrieve it.

How it works, is that the rocket has two recovery devices inside of it that deploy at different times during descent. First, a small recovery device (like a streamer or small parachute) is ejected out of the rocket at the highest point in the flight (called apogee). This device is small enough that the rocket comes down rather quickly and doesn't have time to drift very far in the wind.

Because it is coming down fast, the problem would

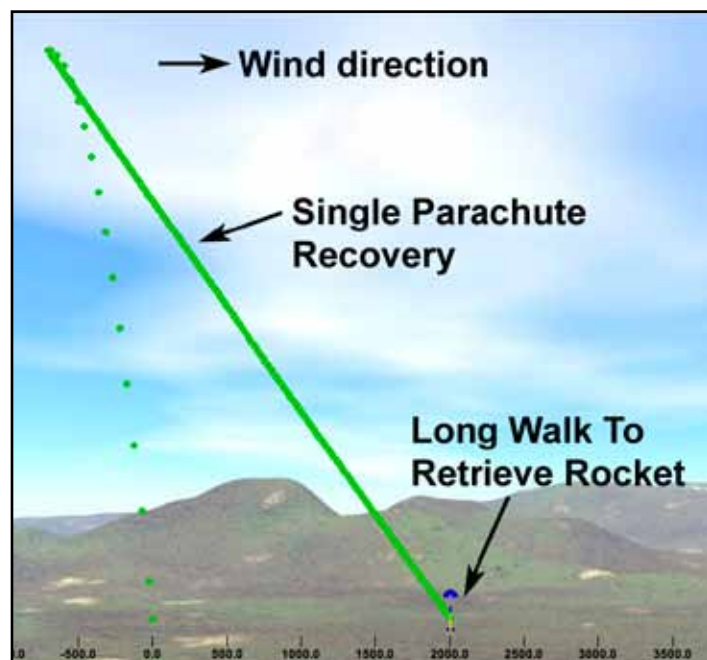


Figure 1: Single-Deployment means only one recovery device is deployed. On a high altitude flight, you'll have a long walk to retrieve the rocket.

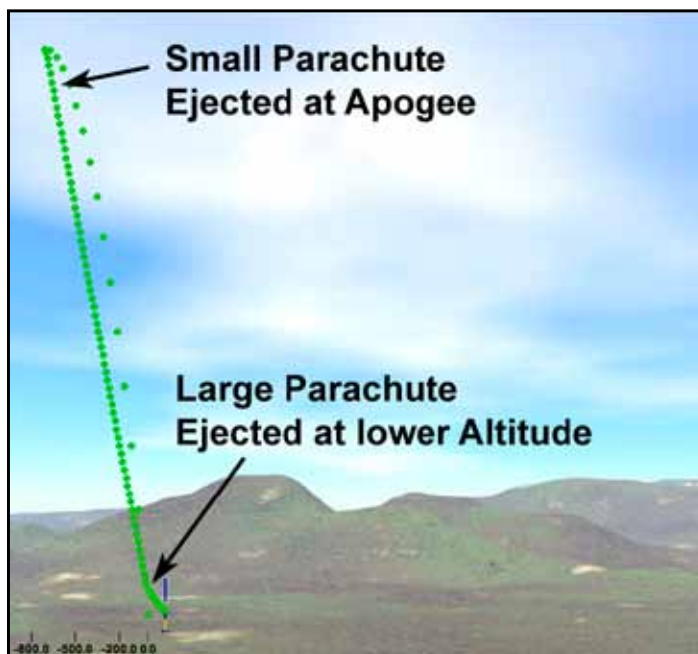


Figure 2: Dual-Deployment means two different recovery devices are unfurled during the flight. A small one at apogee, and a big parachute closer to the ground.

be if it hit the ground too hard. Things break when rockets land hard. Therefore, we need to slow the descent rate to something reasonable. This is where the second parachute comes in.

What we desire is for the second (LARGE) parachute to eject when the rocket is close to the ground, to slow the descent rate to the point that it lands softly. But it is near enough to the ground that the rocket doesn't drift very far.

Q: What controls the release of the two different recovery devices?

The timing of the release of the parachutes is controlled by an electronic brain that is inside of the rocket. This is called the "dual-deployment altimeter."

The dual-deployment altimeter does two different things.

First, it senses the altitude of the rocket. It needs to

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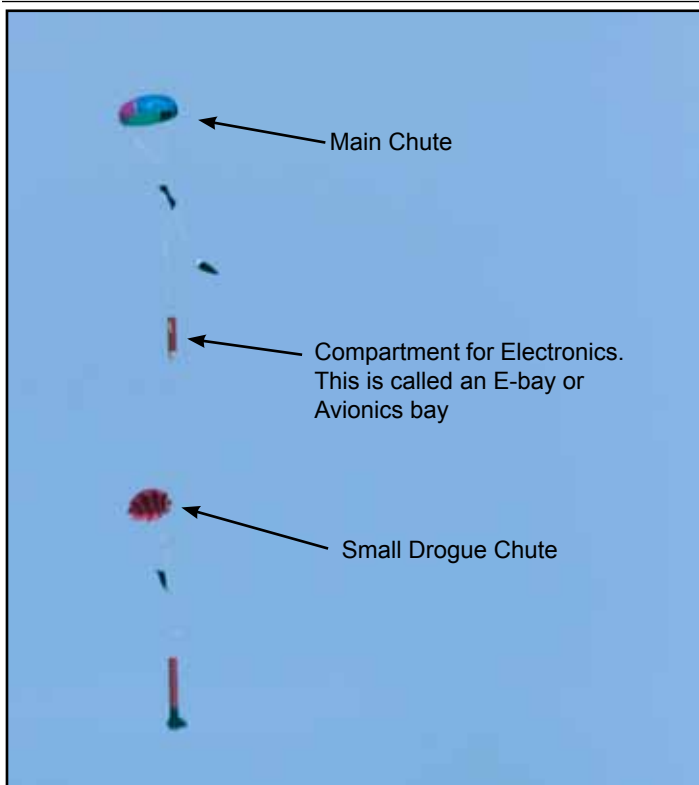


Figure 3: The arrangement of parts in a traditional "dual-deployment" rocket. Photo by Kenneth Brown.

know how high the rocket is above the ground at any given moment during the flight.

Second, it has circuitry to send electricity to two different igniters. It is these igniters that fire off the deployment charges. In other words, it controls the release of the two different recovery devices.

Q. What pushes out the recovery devices?

The recovery devices are ejected out of the rocket

by small pyrotechnic charges. These are called ejection charges or "deployment charges." Basically, it is a small amount of black-powder (gun powder).

When the black-powder burns, it produces a sudden release of gas inside the rocket. This pressurizes the inside of the rocket and pushes it apart (such as pushing off the nose cone), thereby releasing the recovery devices.

Q. What ignites the deployment charges?

Remember those igniters coming out of the dual-deployment altimeter? The tips of these igniters are buried in the container holding the black-powder. When the igniters flare up, they set the black-powder burning, which pressurizes the inside of the rocket and pushes out the recovery device.

Q. When does the dual-deployment altimeter fire off the igniters?

The dual-deployment altimeter is pre-programmed on

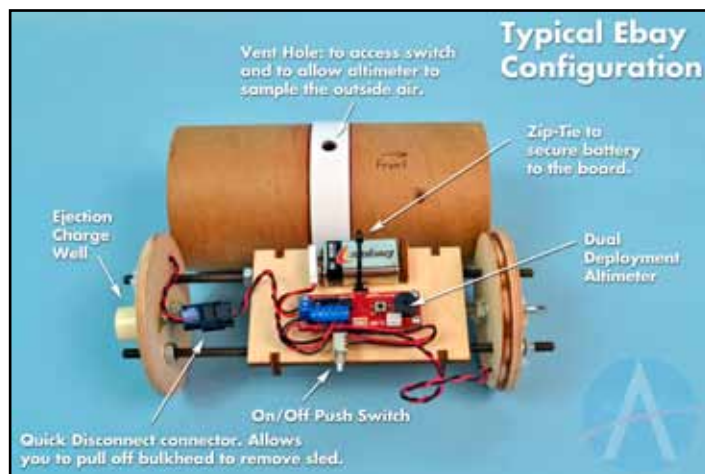


Figure 4: The dual deployment altimeter mounted in an E-bay compartment.

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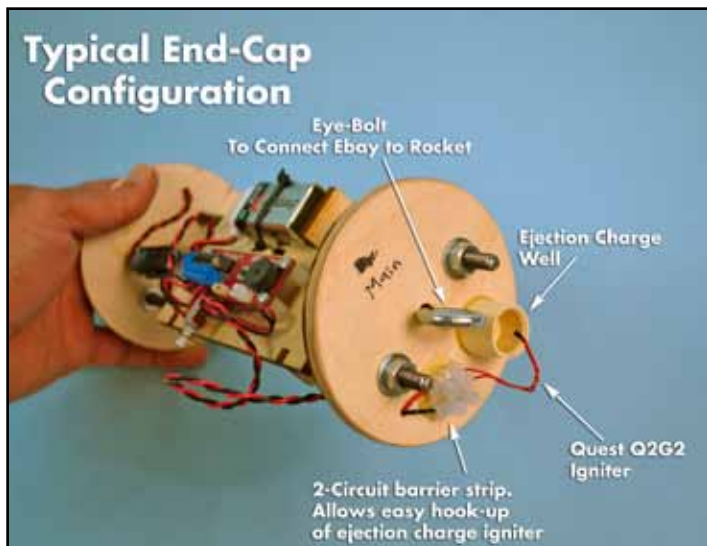


Figure 5: A typical end-view of the E-bay compartment.

the ground by the flyer. They choose when the altimeter fires the igniters.

Typically the first igniter is fired at the apogee point in the flight. This is the highest point in the flight, and more importantly, it is the slowest point in the trajectory because the rocket has no vertical velocity. Because it is the slowest point in the flight, ejecting a recovery device is the least stressful. That means the air forces trying to rip the recovery device apart are at a minimum.

Think about this... When would you rather eject a

parachute out of a rocket when it is going zero miles-per-hour, or when it is going 600 miles-per-hour? If the rocket is traveling at 600 miles-per-hour, there is a good chance that you'll strip the shroud lines off the parachute. Even at 60 miles per hour, there is a lot more force on the parachute trying to shred it than if it were going zero.

In other words, the chute or streamer is more likely to survive deployment when the speed is low. That lowest speed is always at the apogee point.

Once the rocket as the small parachute or streamer deployed, it will come down rather fast. But that is OK. We want it to come down relatively quickly, in the range of 50-60 miles per hour. That way it won't drift very far.

The second chute is the big one, designed to bring the rocket down slow and safe. When the rocket descends to a low altitude, then we want it to come out and inflate fully. When? Good question. In fact, it is our next FAQ.

Q. When should the main parachute be deployed?

This is up to the flyer, and is pre-programmed into the dual-deployment altimeter.

It ends up being a trade-off of sorts. Obviously, you don't want to walk far to retrieve your rocket, so you want it to be as low as possible.

On the other hand, it can take several seconds for a parachute to eject out of the rocket and fully deploy to

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Penny shown for size comparison

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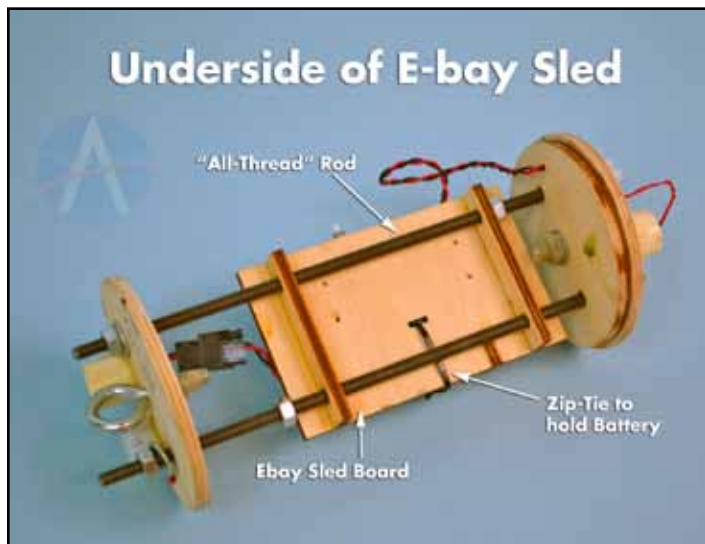


Figure 6: The underside of an E-bay sled.

its full size. So you need some altitude to fall while it fully inflates and slows the rocket down to a safe descent speed for landing (typically around 15 miles-per-hour or slower).

A lot of different altimeters are pre-programmed to fire at an altitude of 600 feet. This is probably a minimum altitude. Some people will adjust that to be a little higher – say 1000 feet. This gives a little bit more descent time, and the rocket will drift a bit further with the wind. But the safety factor is increased, which can be important on a complex project.

Q. How are the parachutes stowed in the rocket?

Since the parachutes have to be deployed at two separate times, the typical arrangement is to have them in two separate compartments in the rocket. The dual-deployment altimeter is held in a special compartment called an “elec-

tronics bay” (ebay for short), or “avionics bay” (av-bay). This compartment separates the two parachute bays.

The ejection charges are placed on opposite ends of the compartment so that only one parachute is ejected at a time.

Q. How is the dual-deployment altimeter mounted in the ebay?

Typically, there is a removable platform that is held in the ebay onto which the dual-deploy altimeter, its battery, and a switch are mounted by screws (or other mounting hardware – such as plastic zip-ties).

The bigger the ebay, the more room you have for mounting the dual-deployment altimeter and the battery. For people just starting out, we like to point them to rockets that are at least 4 inches in diameter, which gives a lot of room for mounting electronics.

Q. How are ejection charges held in the rocket?

You will need some sort of container to hold the black-powder and the igniter that fires it off. The most common are plastic caps attached to the outside bulkheads on the ebay, or canisters that are a bit more floppy in the rocket. Both work fine. But if you use canisters, be sure that they can't shift around inside the rocket where they might yank the wires out of the dual-deployment altimeter.

Q. Which dual-deployment altimeter works the best?

They all work great, which makes this a hard question to answer.

NOTE: Electronics are constantly changing. What you read here may be different in the future. Go to the Apogee

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Electronics Hardware Installation Kit

Think of the convenience of getting everything to professionally install your dual-deployment or other electronic payload into a e-bay of your rocket!



Includes: nylon stand-offs, screws & nuts, wire, push-switch, drill & tap, ejection charge cannisters, barrier strips, wire ties, and step-by-step DVD instructions.

www.apogeerockets.com/electronic_mounting_kit.asp

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Components web site and read up on the different altimeters, or ask your friends that may have done dual-deployment in the past.

The most basic are those that contain a single pressure sensor. It is this pressure sensor that senses how high the rocket is at any given time.

The single pressure-sensor dual-deployment altimeters are usually the simplest to operate. They are often pre-programmed so you can mount them in your rocket and just go out and fly them. They work fine! At the current time, we have simple ones from PerfectFlite and Entacore. But more are coming out all the time, so be sure to check with our web site or ask your friends.

Q. Which of these simple altimeters works the best?

It usually comes down to the buyer flipping a coin to make a selection. They all work just fine.

We carry multiple brands at Apogee, because we sell so many altimeters that we run out of stock often. By selling different brands, it gives us a little bit of insurance that we'll have something on hand at all times for people that need an altimeter shipped out right away.

Q. What about other dual-deployment altimeters? What makes them different?

Other dual-deployment altimeters have additional sensors on them that gather information that you may want to gather. For example, the device might also have an accelerometer on board to measure the speed of the rocket. This gives you additional information that you might want to see after the launch.

Another popular sensor is a GPS receiver. This tracks the position of the rocket in 3D from lift-off to landing.

Adding a transmitter to the device allows you to track the rocket in real-time from where you are viewing the launch. This greatly aids you in finding the rocket after the launch, because you know exactly the coordinates of where the rocket it landed.

Some dual-deployment altimeters also have the ability to air-start rocket motors during the ascent too. This allows you to launch multiple-stage rockets and still have dual-deployment capability. These are a little more complex, but it might be worth keeping this in mind if you think you might want to have that capability for future rocket projects.

Adding extra features usually adds to the cost of the dual-deployment altimeter. Just be aware of that when making your decision.

There is usually software involved with these feature-packed dual-deployment altimeters, so keep that in mind too. The software allows you to view data after the flight, as well as to program the dual-deployment altimeter for the altitude when the parachutes are ejected. You'll want to check to make sure that the software is compatible with your computer system before you purchase the altimeter.

Q. Can any rocket be used for dual-deployment?

For people just starting out, here at Apogee Components, we recommend that you purchase a rocket that is designed to be used for dual deployment. This means that the rocket has two different parachute compartments and a separate ebay for the dual-deployment altimeter.

As complex as this sounds, it is simplest from the perspective of wrapping your mind around the concept. We have seen, from the people we helped through the process, that this separate e-bay method isolates each important

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Dual Deployment FAQ's

step. This helps to make sure all the important aspects of dual deployment are covered.

Q. What is the difference between a "payload bay" and an "ebay"?

A payload can be anything, even biological cargo (like insects, eggs, etc). Or a payload bay can hold electronics too, like a camera.

Most payload bays are like you see in a small model rocket, where the compartment holds the cargo between the nose cone and a single parachute.

However, when we use the term "ebay," what most people assume is that the rocket is set up for dual-deployment. That means it has a compartment for the electronics, and a separate compartment for the parachute.

Q. Can a payload bay be converted to an ebay?

I understand this question... I really do. The intent of the flyer is to take a rocket that you really, really like, and convert it to a dual deployment rocket. The advantage is that you save a step in your progression as a high power flyer. You take a normal rocket, and convert it to a dual-deployment rocket, and in the process, you save a lot of money.

The problem is that for a new flyer, it is more complicated to make the conversion from a simple high-power rocket to a dual-deployment rocket. It can be done, but is more complicated than you might think.

We find that most people are confused by the dual-deployment process, and adding new components to the rocket makes dual-deployment even harder. It is much easier to start with a kit that is designed to be dual-deployment, and use it as a learning tool. Once you have a few dual-

deployment flights to gain experience, you'll understand the complexity of trying to convert a high power rocket into a dual-deployment vehicle.

Q. What is a single-tube dual-deployment rocket?

These are more complex than rockets with a separate ebay between the two chute compartments. If you are just starting out in dual-deployment, we recommend that stay away from these until you have more experience with dual-deployment. You will need a tether-release device in order to put both parachutes in the same tube.

Q. What comes with a dual-deployment rocket? What will I have to buy to go with the rocket?

A dual-deployment rocket is not a complete kit, unfortunately... Here is a list of extra items you will have to buy:

Dual-deployment altimeter – You'll need to select a dual-altimeter. See the previous FAQ to determine what options you have to choose from.

Battery – the dual-deployment altimeter will need electronic power. Not only for the electronic sensor, but to fire off the igniters too. You'll need to download the instruction manual for the dual-deployment altimeter to see which type of battery the manufacturer recommends.

Mounting Hardware – There are little screws, switches, and connectors that you will need to securely mount the electronics, the battery, and switches in the ebay of the rocket. We do offer an electronics mounting hardware package that contains most of the items that you'll need.

Rocket motors – Like any kit, the package does not include a rocket motor.

Black-powder. The ejection charges require this to

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pop out the chutes. Black-powder is considered an explosive by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (BATFE). But there are exemptions that allow you to purchase it without an explosive's permit in small quantities. Look for a gun dealer that specializes in muzzle-loading supplies.

Q. What igniter should I use for ejection charges?

The best and most reliable is an e-match. Unfortunately, e-matches are regulated as an explosive device by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (BATFE). That means you need a special explosives permit to buy, store, and use an e-match. Because of this regulation, we do not sell e-matches. Nor do we know where you can buy them. Check Google or your favorite search engine after you have obtained your explosive's permit from the government.

We recommend the Quest Q2G2 igniter as a good substitute. They ignite quickly and with minimal battery power.

You should also read the instruction manual for the dual-deployment altimeter. The manufacturer of the device will also have additional recommendations on which igniters you can use. NOTE: We are not experts on every dual-deployment altimeter. You do have to do research of your own.

Additional Article Resources

Construction Ideas for Electronics Bays - Peak of Flight Newsletter #288 (www.ApogeeRockets.com/Education/Downloads/Newsletter288.pdf)

Shaving Weight For Supersonic Flight - Peak of Flight Newsletter #319 (www.ApogeeRockets.com/Education/Downloads/Newsletter319.pdf)

Achieving Extreeme Altitude Deployment - Peak of Flight Newsletter #286 (www.ApogeeRockets.com/Education/Downloads/Newsletter286.pdf)

An Inexpensive Method Of Making Your Rocket's Dual Deploy - Peak of Flight Newsletter #258 (www.ApogeeRockets.com/Education/Downloads/Newsletter258.pdf)

Build a Parachute Release Device For Your Short/Stubby High Power Rockes - Peak of Flight Newsletter #277 (www.ApogeeRockets.com/Education/Downloads/Newsletter277.pdf)

Build a Vaccum Chamber To Test Your Dual-Deployment Altimeter - Peak of Flight Newsletter #256 (www.ApogeeRockets.com/Education/Downloads/Newsletter256.pdf)

Make Your Own Electronic Matches - Peak of Flight Newsletter #48 (www.ApogeeRockets.com/Education/Downloads/Newsletter48.pdf)

Make Your Own Pyrotechnic Bolt - Peak of Flight Newsletter #266 (www.ApogeeRockets.com/Education/Downloads/Newsletter266.pdf)

How-To Videos

Setting Up Dual Deployment Electronics - www.ApogeeRockets.com/Advanced_Construction_Videos/Rocketry_Video_26

Make Your Own Ejection Charge Cannisters - www.ApogeeRockets.com/Advanced_Construction_videos/Rocketry_Video_95

Is Your Dual Deployment Altimeter Firing At The Correct Altitude? (www.ApogeeRockets.com/Advanced_Construction_videos/Rocketry_Video_94)

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Dual Deployment Altimeters - www.ApogeeRockets.com/Electronics_Payloads/Dual-Deployment

Dual Deployment Rocket Kits - www.ApogeeRockets.com/Rocket_Kits/Dual_Deployment

Setting Up Dual Deployment - *Modern High Power Rocketry 2* book: www.apogeerockets.com/Rocket_Books_Videos/Books/Modern_High_Power_Rocketry_2

Electronic Bays - www.ApogeeRockets.com/Electronics_Payloads/Electronic_Bays

Electronic Mounting Kit - www.ApogeeRockets.com/Electronics_Payloads/Electronics_Accessories/Electronics_Mounting_Kit

Misc. Electronic Components like switches, battery connectors, terminal blocks: www.ApogeeRockets.com/Electronics_Payloads/Electronics_Accessories

Tender Descender - www.ApogeeRockets.com/Electronics_Payloads/Tender_Descender

Quest Q2G2 Igniters - ApogeeRockets.com/Rocket_Motors/Quest_Accessories/Quest_Q2G2_Igniter_6pk

Ejection Cannisters - www.ApogeeRockets.com/Ejection_Systems/Ejection_Canisters

CD-3 Ejection System for high-Altitude Rockets - www.ApogeeRockets.com/Building_Supplies/Parachutes_Recovery_Equipment/CD3_Ejection_System

About The Author:

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. 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 a 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 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.



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0:02	20	20	20	0	0
0:03	30	30	30	0	0
0:04	40	40	40	0	0
0:05	50	50	50	0	0
0:06	60	60	60	0	0
0:07	70	70	70	0	0
0:08	80	80	80	0	0
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