# PEAK OF FLIGHT NEWSLETTER

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## TERMINOLOGY USED IN DUAL DEPLOYMENT RECOVERY

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www.ApogeeRockets.com
4960 Northpark Dr, Colorado Springs CO 80918
Ph# 719-535-9335

Apogee Components

PEAK OF FLIGHT

# Terminology Used in Dual Deployment Recovery

## By Tim Van Milligan

Dual deployment is a technique typically used in high power model rocketry to try to get the high flying rocket to land closer to the launch pad. Who wouldn't want that? But it is an advanced technique because of the extra equipment required, so it can be a little confusing to rocketeers who might want to step up and try it out. In this article, I'll try to define the more common terminology that you might come across with dual deployment, so as to take some of the mystery out of it, and give you more confidence to try it.

This article is a lexicon of terms, not really "how-to-do-it." I highly recommend some of our build videos, such as the Level-2 rocket kit at: https://www.apogeerockets.com/Rocket_Kits/Skill_Level_4_Kits/Level-2. There are also some additional reference articles listed at the end of this one.

**Some Terms You'll Hear that Relate to Dual Deployment Rockets**

**Accelerometer:** A device used to measure the acceleration of the rocket. From acceleration, the speed of the rocket can be accurately calculated. The accelerometer is an extra sensor that the dual deployment altimeter can use to sense the position of the rocket. But not all dual deployment altimeters have accelerometers on them. People that want to know the speed of their rocket after the flight may be interested in purchasing a dual deployment altimeter with an accelerometer on it.

**Apogee:** The highest point of the rocket's flight. This is where the rocket reaches its maximum altitude before descending back to the ground.

**Arming Switch:** The switch used to turn the dual deployment altimeter on/off.

**Barometric Pressure Sensor:** The key electrical component on the dual deployment altimeter that is used to determine how high the rocket is above the ground. As the rocket ascends into the air, the atmospheric pressure decreases at a predictable rate. It measures the difference from the ground pressure to the current air pressure to determine how far above the ground it currently is.

**Bulkhead:** A solid disk inside the rocket. This provides a stable location where components can be securely mounted, such as the ejection charge canister and the terminal blocks.

**Cable Cutter:** (Also might be called a "Line Cutter" or "tether release") A device that reefs the main parachute of a dual deployment system so that it can't deploy. Typically used in Head-End dual deployment arrangements. Think of it like a Jolly Logic Chute Release, except that instead of using a rubber band to hold the parachute closed, it uses a plastic wire tie (zip tie). This plastic wire tie is cut, which releases the parachute, using a pyrotechnic charge controlled by the dual deployment altimeter. See: https://www.apogeerockets.com/Building-Supplies/Recovery-Equipment/Tender-Descender/Piranha-Line-Cutters

**Coupler:** A tube that slides inside another tube. They are used to join two tubes that are the same diameter. A coupler is often used as an e-bay, because it can be capped off on both ends with bulkhead disks.

**CPR:** Acronym for Close Proximity Recovery. Essentially it means dual deployment recovery, because that is how it is achieved.

**Data Port:** An electrical connector on a dual deployment altimeter that is specifically used to interface with a computer. This allows the user to either recover stored data recorded during the flight or to send instructions to the altimeter to set it up prior to flight. Example would be to set the specific altitude you want the main parachute to be ejected from the rocket.

**Deployment Bag:** A fabric pouch that a parachute is stowed into, which is then put inside the tube of the rocket. The primary reason for using a Deployment Bag (can also be called a D-bag) is to provide a slower and more orderly release of the parachute during the opening sequence. Parachutes can be "fouled" (tangled up) during the chaotic sequence of events during opening of the canopy. The deployment bag works by making sure the suspension lines

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**Newsletter Staff**

Writer: Tim Van Milligan
Proofreader: Michelle Mason
Layout: Sky Luther

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are fully extended and are straight before the canopy is pulled out of the bag. They can be used on any size model rocket, but are more common on larger rockets.

**Deployment Charge:** (also called "ejection charge") A small amount of black powder explosive that is intended for the ejection of the parachute from the rocket. The amount of black powder used is determined by the volume of air inside the rocket.

**Dog Barf:** Parachute recovery wadding from household cellulose insulation. Literally, it is made from recycled newspaper that has been soaked in a flame retardant and then shredded into a fluffy wool. It is cheap and abundant compared to wadding from Estes. See Figure 1.

*FIGURE 1 - DOG BARF PARACHUTE RECOVERY WADDING*

**Drogue Parachute:** The smaller of the two parachutes used in dual deployment. This parachute is typically deployed at a higher altitude than the main parachute. Since it is small (undersized), the rocket falls fast and doesn't have a lot of time to drift with the wind.

**Drogueless Recovery:** A dual deployment rocket that does NOT have a small drogue parachute. This rocket would fall faster than one that does have a drogue chute, so the drift is further minimized. The nose cone is ejected at apogee, but is still connected to the body of the rocket by a shock cord. The rocket is unstable in this configuration, and tumbles quickly towards the ground. The shock cord also acts like a streamer, which helps to slow the tumbling rocket. It is not always necessary to have a drogue parachute! The disadvantage is that a small parachute or a streamer does add more visibility to the rocket in the sky (remember, it is really high in the sky and already hard to see).

**Dual Deployment:** the technique of rocket recovery that involves deploying two parachutes at different times during the descent of the rocket. The first parachute is ejected and deployed at apogee (highest point in the flight). This parachute is relatively small, so that the rocket falls quickly. It falls so fast, that it doesn't drift very far. When the rocket is closer to the ground (maybe at an altitude of 600 feet), a large parachute is released from the rocket, slowing the rocket down to a safe landing speed.

**Dual Deployment Altimeter:** A special type of altimeter that not only determines the altitude of the rocket, but also acts like an onboard launch controller, sending electrical current to at least two igniters that fire off the ejection charges to deploy the parachutes at the proper altitudes during the flight.

**E-Bay:** Also can be called the "avionics bay" (or av-bay). This is the compartment inside the rocket where the electronic devices that control the release of the parachutes are housed.

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**E-Bay Rails:** The name given to the threaded rods that run through the ebay to which the sled slides along. The threaded rod(s) are primarily used to connect the eyebolts that connect the shock cords to the ends of the e-bay.

**E-Match:** The special igniter used for dual deployment. Traditional rocket motor igniters require high voltage and current to fire them off, which makes them unsuitable for dual deployment. Inside a rocket, a heavy-duty battery would be too heavy. Smaller and lightweight batteries are used so the rocket can fly higher. But these batteries have lower voltage capability. The E-match will fire off with low voltage, so they are ideal for dual deployment. They produce just enough spark and heat to set off the black powder deployment charge. But usually they are not hot enough to set off a rocket motor.

**Ejection Charge Calculator:** A spreadsheet or app that is used to determine how much black powder (measured in grams) is required to pressurize the rocket in order to push out the parachute. The required inputs into the calculator are the diameter and the length of the tube where the parachute is stowed during flight. You can find an ejection charge calculator by using your favorite search engine.

**Ejection Charge Canister:** A small cup or some sort of container that holds the deployment charge and the igniter that is used to set it off. If the cup is open-ended, it is often called an "ejection charge well." The cup is usually capped off with tape to keep the black powder inside until it is fired off.

**FFFF Black Powder:** This the preferred explosive that is used as the ejection charge for rocketry. There is only one type of black powder. The FFFF in front of the words black powder just refers to the particle size of the powder. 4F's is the smallest particle size, and resembles particles that look like pepper. FFF is slightly larger particles. If you can't find the FFFF particle size, it is possible to grind down larger particles into FFFF size using a non-metallic mortar and pestle. Grind only small amounts, and always outdoors wearing appropriate safety gear - as black powder is an explosive. Black powder is regulated by the government, but can be purchased from a gun store that specializes in muzzle-loading supplies. You must be at least 18 years old to own or handle loose black powder. Some people say that they have substituted Pyrodex P or Triple 7 Easy Clean Muzzleloading Propellant for black powder ejection charges.

**Firmware:** The specific computer code installed onto the altimeter to make it function correctly. Normally a user wouldn't need to know anything about this. But some Flight Computers can be reprogrammed by users, so the firmware would be updated in this case.

**Flight Computer:** A device that is similar to a dual deployment altimeter, but is more sophisticated and more versatile. It usually has more "pyro channels" and more sensors on it (such as multiple axis accelerometers, magnetometers, gyroscopes, or horizon sensors in addition to the barometric pressure sensor). They are also user programmable, so it is possible to write specific computer code to control a number of distinct events. An example might be air starting several rocket motors at different times during the flight.

**Ground Test:** Also called a "bench test". This is an experiment while the rocket is on the ground to verify that the dual deployment altimeter is functioning properly and has been set up correctly. An example is at: https://youtu.be/NxfoFFwjx58

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**Head-End Ejection:** A configuration of a dual deployment rocket where the electronics bay or the main parachute is stored in the nose cone. It is used for the situation where you don't want to lengthen the rocket to add a separate e-bay compartment but still use dual deployment recovery. This is a more complex arrangement because both the drogue and the main parachute are ejected at the same time. Because of this, the main parachute has to be bound up in such a way that it doesn't open until the rocket descends to the correct altitude. The Jolly Logic Chute Release (https://www.apogeerockets.com/Electronics-Payloads/Dual-Deployment/Chute-Release) is one example of how head-ejection can be made to operate successfully. See also Peak-of-Flight Newsletter #329 (https://www.apogeerockets.com/education/downloads/Newsletter329.pdf)

**Launch Trigger:** Since the altimeters operate independently from any physical input from the user, these are the conditions that are required for the altimeter to know for certain that the rocket has been launched and that it should start its deployment pyro events. For example, on a barometric sensor altimeter, the launch trigger conditions might be that it has sensed a change in altitude of 20 meters that occurred during a span of less than 5 seconds. Another example is for an accelerometer sensor to indicate a 2 Gee acceleration that occurred in 5 milli-seconds. The launch trigger is meant to filter out false signals that a rocket has moved, such as a gust of wind hitting the rocket or the rocket being lifted off the pad because the user is swapping out the motor's igniter.

**Mach Delay:** A setting on older dual-deployment altimeters used to prevent premature ejection of of the parachute when the rocket reaches supersonic speed. Don't worry about this if someone mentions it to you. It is not important anymore, since ALL modern dual deployment altimeters are designed to sense if the rocket has reached supersonic speeds and to ignore the associated air pressure spike that could trigger early deployment.

**Main Parachute:** The larger of the two parachutes used in dual deployment. This is the parachute that is deployed second and is sized so that the rocket lands slowly in order that no damage occurs at landing.

**Motor Adapter:** A tube-like device that allows you to put a smaller diameter motor into a rocket kit designed for larger diameter motors. For example, an adapter allows you to insert a 29mm diameter motor into a kit that was intended for 38mm diameter motors. Adapters allow you more motor choices that can be used in your dual-deployment rocket.

**Mounting Hardware:** The screws, nuts, posts and other components that are used to securely attach the altimeter to the e-bay sled.

**Parachute Protector:** A fire resistant cloth that is used to protect the parachute from the heat of the ejection charges. https://www.apogeerockets.com/Building-Supplies/Parachute-Protection/Cloth

**Pressure Relief Hole:** A small hole in the side of the rocket to allow air inside the rocket to escape so that it doesn't prematurely separate on the way up into the sky. See Peak-of-Flight Newsletter #68 (https://www.apogeerockets.com/education/downloads/Newsletter68.pdf).

**Pyro Channel:** A reference to the distinct electrical outputs the dual deployment altimeter has. For example, a two channel altimeter can fire off two igniters. A four channel altimeter can fire off four distinct igniters. If the altimeter has more than two channels, it is probably used to perform ignition of rocket engines during the flight - such as multi-stage or cluster engines (this is typically called air starting). You only need a two channel altimeter for basic dual deployment.

**Pyro Event:** The name given to the situation where the dual deployment altimeter sends electrical current to the igniter and sets it off so it burns.

FIGURE 2 - QUICK LINK AND SWIVEL CONNECTED TO PARACHUTE

**Quick Link:** A "O-shaped" metal part that can easily be used as a connector to join two parts. For example, it can be used to join a parachute to an eyebolt on the base of a nose cone. The advantage is that the parachute doesn't have to be untied to remove it from the rocket. The Quick Link can be opened quickly. They can also be called a D-link if they are "D-shaped" instead of O-shaped. See Figure 2.

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**Rail Buttons:** A replacement for the launch lugs on a large rocket. They are shaped like a tall button, and are designed to slide into a launch rail. The launch rail is larger than a rod, and is stiffer and capable of holding a larger rocket than the simple rods used on smaller rockets. When you're flying larger rockets, you'll be using either rail buttons (https://www.apogeerockets.com/Building_Supplies/Rail_Buttons/1in_1010_Rail_Button_Standard), or rail guides (https://www.apogeerockets.com/Building-Supplies/Launch-Lugs-Rail-Buttons/Rail-Buttons-Guides/Universal-Rail-Guides)

**Recording Altimeter:** An altimeter that logs and stores any information that it might collect during the flight (altitude, speed, or other sensors) so that it can be examined later. A dual deployment altimeter is not necessarily a recording altimeter, nor is a recording altimeter a dual deployment altimeter.

**Recovery Harness:** The name given to a shock cord, but which has an extra attachment point in the middle of the cord where the parachute can be conveniently attached.

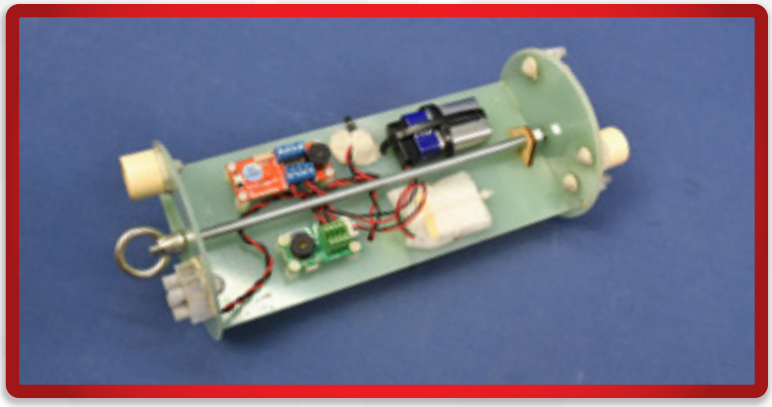

*FIGURE 3 - REDUNDANT ALTIMETER SETUP IN E-BAY*

**Redundant Altimeter:** A second and independent dual deployment altimeter system inside the rocket used to provide back-up in case the first altimeter malfunctions (loses power, fails to sense lift-off, or is somehow damaged during the flight). The purpose is to provide extra safety to ensure that the rocket still functions properly in the event of unforeseen events. See Figure 3.

**Retainer:** A device that holds the rocket engine in the model. It is designed to prevent the motor from sliding either forward or aft. On smaller rockets, the motor retainer is the simple metal engine hook. On larger rockets, they can take several forms (see https://www.apogeerockets.com/Building_Supplies/Motor_Retainers_Hooks), but the most popular is the two piece screw-on engine retainer. One half of the retainer is glued onto the outside of the engine mount tube, and the other half will screw onto it after the motor is inserted into the rocket. They can be made of either plastic or aluminum. See also: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_208

**Rivets:** Small removable posts that lock a tube to either a coupler or nose cone shoulder (https://www.apogeerockets.com/Building_Supplies/Misc_Hardware/Removable_Plastic_Rivets). In rocketry, rivets are usually made from plastic. They are similar to fasteners, which are usually made from small screws (https://www.apogeerockets.com/Building-Supplies/Misc-Hardware/Aluminum-2-56-Tube-Fasteners-3-pk). The advantage of a rivet or fastener to hold the tubes together is that they can be easily disassembled when necessary. See Figure 4. For example, you may need to take the rocket apart to gain access to the e-bay, or to break a big rocket into smaller sections so you can transport it to/from the launch site. Tubes can also be held together with friction fit (tape on the outside of the coupler), or by wrapping tape over the outside of the joint between the tube tubes.

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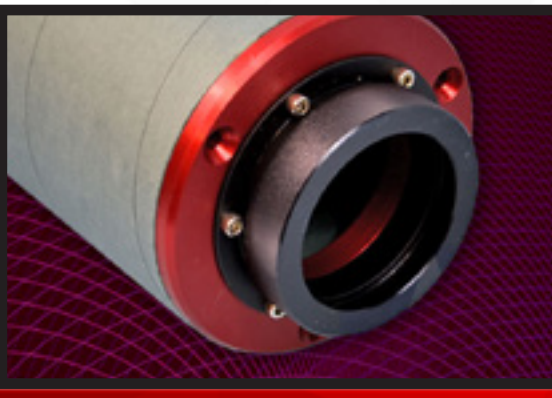

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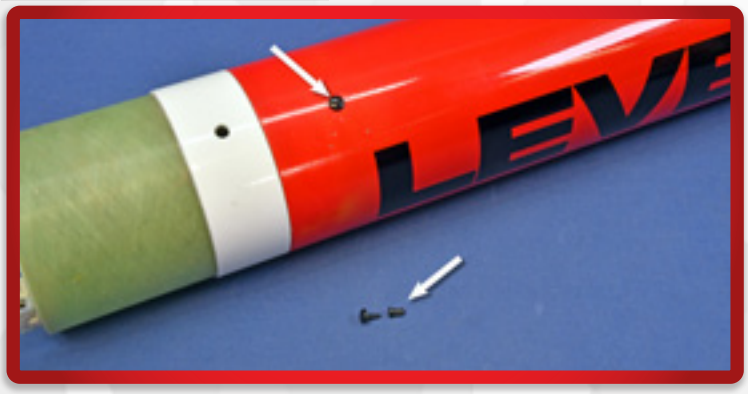

FIGURE 4 - RIVETS FOR ATTACHING THE E-BAY TO THE MAIN TUBE

**Shear Pins:** Small plastic posts that temporarily hold two tubes together during launch. They are intended to be cut apart when the ejection charge pushes the two tubes apart. Therefore, they are not reusable. (https://www.apogeerockets.com/Building-Supplies/Misc-Hardware/Nylon-Shear-Pins-20-pack)

**Sled:** A removable platform in the e-bay to which the altimeter, battery, and other electronic components are mounted. Because it is removable, it is easier to mount the electronics and hook up the necessary wiring than if it was fixed inside the rocket. See Figure 5.

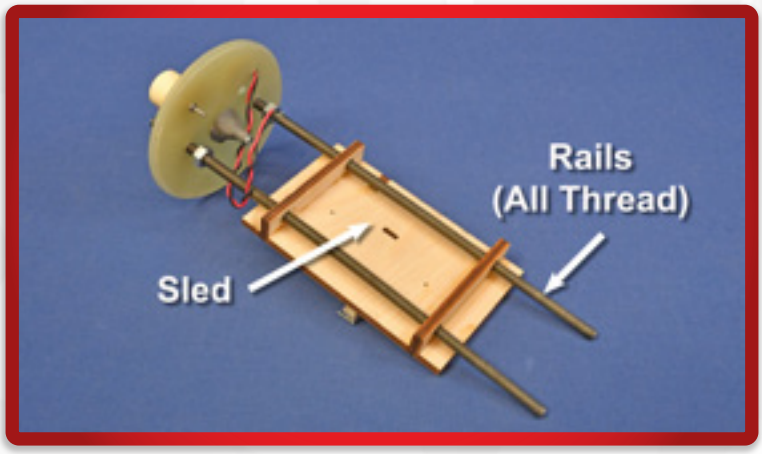


FIGURE 5 - REMOVABLE SLED FROM THE E-BAY, AND THE "ALL THREAD" RAILS

**Switch Band:** A short tube over the middle of the tube coupler that houses the electronics of the rocket. This tube is the same diameter as the main tube of the rocket, which makes it the only external part of the typical e-bay. It is called a switch band, because this is where the arming switch that turns on the altimeter is located. See figure 6.

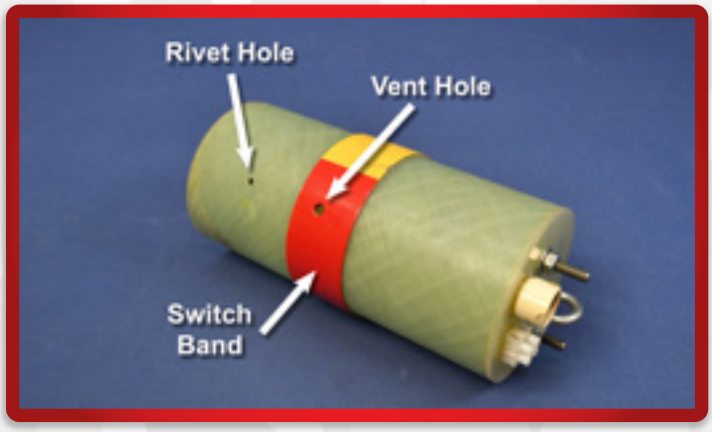


FIGURE 6 - SWITCH BAND MOUNTED TO E-BAY

**Swivel:** A connection put between two parts to allow them to rotate independently of each other. A parachute is often connected to a swivel so that it can spin without twisting up the suspension lines, which would collapse the canopy of the chute.

**Terminal Block:** Connectors that are used to secure wires to each other (wire-to-wire) or to a Printed Circuit Board (PCB). They typically have a hole where the wire is inserted, and a screw head that will lock the wire in place.

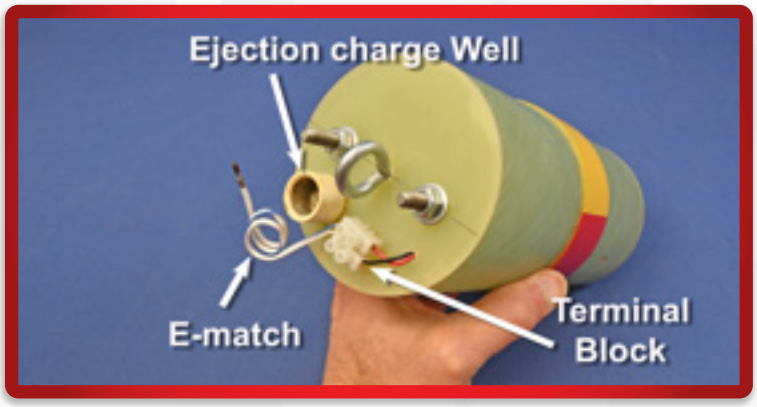


FIGURE 7 - TERMINAL BLOCK, E-MATCH, AND AN EJECTION CHARGE WELL

All dual deployment altimeters will have a set of terminal blocks for each output channel (one connector for each wire of the igniter). Wire-to-wire terminal blocks are often used near the ejection charge canister on the outside of the e-bay. This makes it convenient to hook up the igniter to the altimeter without having to completely open up the e-bay to gain access to the inside. See Figure 7.

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**Tether:** Some sort of rope that connects to parts together. For example, a shock cord tethers two parts (nose cone and body tube) together so they come down as one piece.

**Tubular Nylon:** A shock cord that is made from braided nylon thread. When it is created by the manufacturer, it is formed into a tube. But then it is smashed flat, and looks like a ribbon. But it is stronger than a single ribbon strand, because it is two layers thick. See figure 8.

*FIGURE 8 - TUBULAR NYLON SHOCK CORD*

**Vent Hole:** A small hole in the side of the e-bay that is specifically for the altimeter to sense the atmospheric air pressure in order to determine the height of the rocket above the ground. See Peak-of-Flight Newsletter #543 (https://www.apogeerockets.com/Peak-of-Flight/Newsletter543).

**Zipper:** A slicing of the paper body tube of the rocket by the shock cord. It looks like rocket was split open down the side.

Did I miss any terms? If I did, please send me an email, and I may update this article in the future.

**References:**

Frequently Asked Questions About Dual-Deployment - Peak-of-Flight Newsletter #324 (https://www.apogeerockets.com/education/downloads/Newsletter324.pdf)

What Do You Need for Dual-Deployment - Peak-of-Flight Newsletter #362 (https://www.apogeerockets.com/education/downloads/Newsletter362.pdf)

**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 e-zine newsletter about model rockets. You can email him by using the contact form at https://www.apogeerockets.com/Contact.