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APOGEE COMPONENTS

How To Select An Altimeter

By Tim Van Milligan

With the increasing number of altimeters available, it can be a daunting challenge for a new user to select one. In this article, we'll try to simplify things to make it a little easier in the selection.

Figure 1: Several altimeter options to choose from.

Why the confusion? What makes selecting an altimeter difficult?

I think the main reason is there is a lot of misinformation that people have heard other rocketeers say. A friend of theirs may have said something in an insignificant conversation, and they only caught a snippet of what was said. Maybe their mind was wandering (like mine does when the conversation is long-winded), and then out of the corner of their ear, they hear something like: "that altimeter is inaccurate." Because their mind wasn't paying particularly good attention to the entire conversation, they may have missed a key qualifier about when the altimeter is inaccurate. They only caught the word "inaccurate."

On top of that situation, altimeter technology is rapidly advancing. What was said by your friend in a conversation a year ago may no longer apply today. For example, the pressure sensors are getting smaller and more accurate. Because of this, even the "size of the vent hole" conversation is not very relevant anymore. I can't tell you how many times people have asked us "how big of a vent hole you need in the side of the rocket for the altimeter to sample the air?"

Figure 2: An example of a pre-cut vent hole on the Aero-Dactyl TS kit.

In reality, the altimeters are so fast responding because of the newer sensors, that you don't need to worry about the size of the hole. Just look at the size of the hole on the sensor itself -- it is probably 0.3mm in diameter, if that. When I fly competition rockets, my new habit is to NOT drill any hole in the side of the rocket. There is enough airflow getting into the rocket from air leaks around the shoulder of the nose cone for the sensor to sample. Yes this works. You can confirm this yourself with a simple launch test. Just drop an altimeter into the rocket and see what altitude you get back.

I can understand why selecting an altimeter can be confusing. With things changing in the industry so quickly, it is easy to get inaccurate or outdated information.

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About this Newsletter

You can subscribe to receive this e-zine FREE at the Apogee Components website **www.ApogeeComponents.com**, or by clicking the link here Newsletter Sign-Up

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The First Question

When a customer calls us on the phone, we have a very standard way of helping them to select an altimeter. It isn't anything special - all we really do is to ask a few questions to find out what is most important to them. In essence, we are just trying to focus the attention on their real need.

The most important question we ask is the first one: "What are you trying to accomplish with this purchase?"

The question we NEVER ask is: "how much do you want to spend?" This is a silly question and it wastes time, because we know you want to spend the least amount of money. Who doesn't?

What we think makes Apogee Components different from other rocketry suppliers is that we don't want to sell an item that doesn't get used. To us, that is very expensive for the customer, and the worst possible situation. That customer will never buy from us again. No matter how inexpensive the altimeter might be, if it doesn't get used because it doesn't have the capabilities that a customer wants, it is the most expensive altimeter they will ever buy. They got no benefit for the money they spent.

So we ask the question "what are you trying to accomplish?" up front in order to make sure we understand the situation so that we don't recommend a product that won't end up being used.

Figure 3: An example of a 2017 TARC approved Altimeter: The PerfectFlite Pnut.

For example, if the customer answers the question by saying: "I'm trying to build a TARC rocket," that makes our job much simpler. Currently, as I write this today in 2017, the rules of the TARC contest specify only a few altimeters from PerfectFlite. The selection process is often one of eliminating the products that can't work for the customer, not just figuring out the perfect solution. Because in reality, there is probably more than one altimeter that will work for them.

Did you see what I did there? I qualified the recommendation by saying "today in 2017, the rules"... If you're reading this article in 2020, the rules for TARC may be different and more altimeters may be allowed. So read the the current rules to know which altimeters you can select from.

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Key Words and Phrases

With the first question we ask customers, we're listening for some key words. As I said, one them in the word: "TARC."

Another phrase may be "NAR competition."

In the case of a NAR competitor, we'll follow it up by asking which specific event they are flying. The reason is that smaller size and lower weight can be a big advantage in events that use smaller rocket motors. For example, if the customer says they are flying "A-engine Altitude," we know that they are probably most interested in the one with the smallest size and the lightest weight. We'd probably point the customer to the MicroPeak or the Adrel altimeter. The smaller the altimeter, the smaller the rocket it can go into, and the higher it will fly.

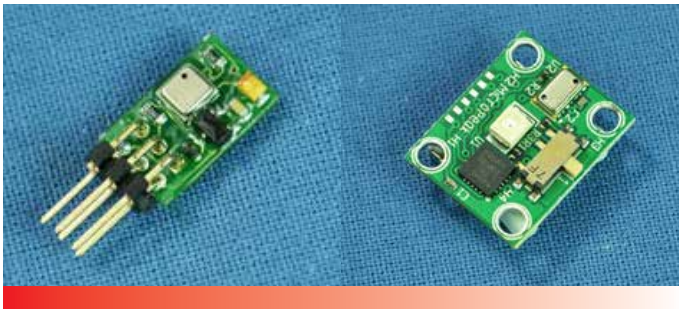

Figure 4: Smaller altimeter options: Adrel Altimeter (left), MicroPeak Altimeter (Right).

If it is for a larger motor power class, we'd probably recommend one that has different features other than size. For example, if you've got room in the rocket and weight is not the primary consideration, then a different altimeter might be an option.

In another example, "ease-of-use" might be a consideration. Not just ease-of-use for the modeler, but for the judges at the contest who have to confirm the altitude after the flight is complete. This is one of the reasons that in the TARC contest all the altimeters come from just one manufacturer; because you only have to train them how to download data from just a couple of altimeters instead of a wide variety of altimeters. It makes it easier for the organizers of the contest.

Another thing we listen for is the phrase "setting a record" with a rocket. In this case, the modeler is going to need an altimeter with a "data logging" feature. The organizations that authorize a new altitude record (like the National Association of Rocketry) require a data logging altimeter so that the data can be analyzed after the flight.

When we competed in a contest in Ukraine in 2016, one of the other competitors had a fantastic flight. It went 50% higher than all the other rockets in the competition. It was really strange because it was such an outlier compared to dozens of other models with very similar altitudes. Since the data (pressure vs time) was recorded by the altimeter and saved after the flight, the contest judges were able to see if everything was OK with the flight. From the data, they backed out the acceleration of the rocket (see https://www.apogeerockets.com/education/downloads/Newsletter208.pdf). What was discovered was that the modeler had put a larger motor into the rocket than was allowable for the contest. This

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was confirmed because the burn time of the motor as seen in the flight data was twice as long as it should have been. Therefore, the modeler must have used an inappropriate rocket motor for the event.

Higher Accuracy

The one phrase that isn't helpful for selecting an altimeter is the one where the customer asks for one with "higher accuracy."

As I mentioned at the beginning, ALL the altimeters we sell here at Apogee Components are so accurate, they can tell the difference of pressure of just a few inches. This has to be put into perspective…

I did this experiment a while back when I made a video about the Jolly Logic AltimeterOne to show how sensitive the pressure sensor is (https://www.youtube.com/watch?v=tXSCKVIakkk).

Figure 5: Jolly Logic AltimeterOne

It can sense the air currents in the room while it is at a standstill. In other words, the altimeter thinks it is moving up and down just from micro-currents of air in a room. The air swirling around in the room is enough to cause the altimeter to think it is moving up and down by a couple of meters.

What does this mean? It means that the sensors are so sensitive to pressure differences that they are more accurate than the air around them. If a small micro-current of air is enough to make the altimeter think it is 3 meters higher than it really is, then how can you say you know for sure that the rocket reached an altitude of 110.0 versus 111.0 meters. There could easily have been a micro-current of air when the rocket was at peak altitude.

It is the difference between "precision" and "accuracy." The pressure sensors in the altimeters are very precise. But they are only as accurate as the air is when dead still.

Does that mean that electronic altimeters are not useful? Of course not. They are as accurate and far more convenient than the old method of determining a rocket's altitude, which is optical tracking (see https://www.apogeerockets.com/education/downloads/Newsletter93.pdf).

Science Experiments

If your purpose for purchasing an altimeter is to perform science experiments, that opens up a lot of choices. So we'll probably ask you specifically what you are trying to test.

In the younger grade levels, students do

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experiments like: "What fin shape gives the highest altitude?" If you've followed me (https://www.apogeerockets.com/education/downloads/Newsletter442.pdf), you know that I don't think much of this experiment. But for younger students, it can be useful to teach the scientific method and how to keep the control variable limited.

In this case, we'd probably ask the age of the modeler and their level of understanding of rocketry. We'd also ask if they have an adult working with them and their level of rocketry experience. Why? Because we would want to see if they were ready for the massive amount of data they could get with a data-logging altimeter. If the student is working alone and they don't have an adult with some degree of knowledge of rocketry, we'll recommend a simple "peak altitude only" altimeter.

Furthermore, if they are a newbie to rocketry, I'd try to steer them toward an altimeter that has a digital read-out, like the Jolly Logic AltimeterOne (**Figure 5, Page 5**). The reason isn't to make more money off of them because the AltimeterOne costs more. It is because I'd want to simplify the experimental process for them as much as possible. It is much easier and quicker for them to read the altitude of the display than to count the number of beeps or flashes put out from the altimeter that doesn't have a display. Our goal is customer satisfaction, and I truly believe that for a young student, the convenience of a digital display leads to a greater chance of completing the project. I want them to use the rocket and the altimeter, rather than it being a little cheaper but a little more complicated to use.

If the project the customer is researching is complicated, I might recommend to them an altimeter with an accelerometer in it as well as a barometric sensor. The reason is the extra data from the accelerometer can give them speed and acceleration as well as altitude. An example of this is a project where you need a clear indication of the Cd value for the rocket (example: https://www.apogeerockets.com/education/downloads/Newsletter303.pdf). Even though these extra sensors make the altimeter more expensive, the extra data is well worth it.

Dual Deployment

If the person mentions something about high-power rocketry when asked what they want to accomplish, I lean towards recommending a dual-deployment altimeter, even if they just want

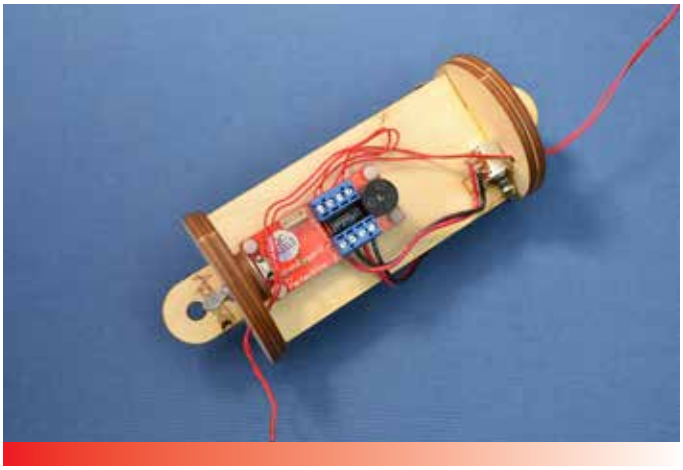

Figure 6: An example of a dual deployment altimeter setup.

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to know the peak altitude of the flight. The reason is that once a person goes down the path of high-power rocketry, I assume that they are probably in the hobby for the long haul. If they are in it for the long haul, they might as well make the investment now and get a dual-deployment altimeter that they can use in the future for doing dual deployment. It will save them money rather than having the customer spend money on two altimeters - one now and a dual deployment altimeter in the future.

Which dual deployment altimeter? That is a whole different rabbit hole to go down. There are a lot of additional questions we'd ask. For one thing, we'd ask what they plan to do next, after their current project is complete. Again, we're about saving the customer money, and it may make more sense to spend a few extra dollars now for additional features they might need for their next project than having to buy a completely new altimeter that has extra capabilities later.

Notice that we are making an assumption… That assumption is that they will complete their current project and it will be successful. For a lot of companies, this is a big assumption to make. But not for us here at Apogee. We are different than many other companies. That is, we help our customers be successful. The proof of this is our history as documented by the more than 700 customer testimonials on our web site (https://www.apogeerockets.com/Testimonials).

How high do you want to go?

The more sensitive the altimeter is, the higher it can go and measure the altitude in the rarified regions of the atmosphere. Most flights from modelers are under 20,000 feet (6096m), so we don't usually ask this question when making an altimeter recommendation. And this question is also fast losing its relevance as technology improves.

But we usually get a hint of how high the modeler wants to fly when they tell us what they are trying to accomplish. In reality, there are two classes of people that want to go higher than 20,000 feet. The first is the Elon Musk wannabe who justs wants to show off for his family and friends. I'm sure you've met people like him. This is the guy that has zero knowledge of the high power certification program that you have to complete to buy the rocket motors capable of going that high. For this person, we have to bring their head down out of the clouds and give them a reality check by explaining all the rules and regulations governing rocketry. Again, even though they have money to spend, I'm not going to take it from them by having them buy something that they won't ever use.

The second person is the high-power flier that is going through the certification process, and genuinely has a grasp on reality. They're asking for our recommendation for the same reason I'd ask if I was in their shoes: Technology is changing fast, and I'd want to know if something better

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has come along since I did my original research.

For this person, I'd probably recommend using two altimeters, and one of those being a GPS unit. We're talking some serious money at this point, but with a GPS-based altitude I'd have more confidence that the altitude is more accurate.

Conclusion

The response we get when we ask the question: "What do you want to accomplish with this purchase of an altimeter?" usually results in these reasons:

- TARC contest
- Science project
- NAR Competition
- High Power Dual Deployment
- Setting an altitude record
- "I just want to see how high my rocket flew."

Each of these responses will start us down a path that should lead to a good recommendation for the altimeter. In many cases, there might be more than one altimeter that we'd recommend that has similar features.

We get that question a lot: "Why do you have multiple altimeters with such similar features and capabilities?" Yes, I know that can be confusing. It is one of the reasons we get asked so often for an altimeter recommendation. The real answer is that we sell our inventory so fast that we often run out. I hate being out of stock, because then we can't help customers get the item they need to be successful. Our suppliers have a very hard time keeping up with our demand for inventory. So we buy similar items so that we have something in stock at any given time.

I have one last confession to make. The additional reason I wrote this article is actually for internal training of our company teammates. We have a process of dealing with customers, and this article describes how we do it and what our values are. We live by these values every day, because it is what makes us different.

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.