

How does a barometric pressure altimeter work?

The altimeter measures the air pressure surrounding the rocket. Air pressure near the ground is greater than air pressure high in the air (remember, air pressure decreases with altitude, until you reach the vacuum of space, where there is no air pressure). What the unit does is to compare the pressure it senses, to the air pressure on the ground. Using a simple formula, it automatically computes the altitude difference that caused the change in pressure. This simple way of computing altitude has been used for decades by airline pilots. It is accurate, and easy to determine.

ALTIMETER GUIDELINES

An altimeter must be mounted in a "sealed" chamber with a vent or vents to the outside. A sealed bulkhead below the altimeter chamber is necessary to avoid the vacuum caused by the aft end of a rocket during flight or pressure pulses from the motor ejection charge. A sealed bulkhead above the altimeter chamber is necessary to avoid any pressure fluctuations that may be created at the nose end of the rocket. If the front of the payload section slip fits to another section such as a nosecone, then the fit must be as free as possible from turbulence. A breathing hole or vent (also known as a static port) to the outside of the rocket must be in an area where there are no obstacles above it that can cause turbulent air flow over the vent hole. Do not allow screws, ornamental objects, or anything that protrudes out from the rocket body to be in line with and forward of a vent hole. Vents must be neat and burr free and on an outside surface that is smooth and vertical where airflow is smooth without turbulence. Some competitors use multiple static ports (vent holes) instead of just one. Very strong wind blowing directly on a single static port could affect the altimeter. Multiple ports evenly spaced around the rocket tube may help cancel the effects of strong wind on the ground, the effects of transitioning through wind shears during flight, the pressure effects of a non-stable liftoff, or the pressure effects that occur due to flipping and spinning after deployment. If you wish to use multiple ports, then use three or four. **Never use two.** Ports must be the same size and evenly spaced in line around the tube.

The general guideline for choosing port size is to use one 3mm diameter vent hole (or equivalent area, if multiple smaller holes are used) per 400 cubic centimeters of volume in the altimeter chamber. In other words, the total area of the vent holes must be approximately 0.0005 times the volume of the altimeter chamber. Try to keep hole sizes within -50% or +100% of the general guideline. Do not make the holes too small, and especially do not make them too large.

Vent holes should be a minimum of four body diameters below the junction of the nosecone with the rocket body with high performance (close to Mach 1) rockets. The tremendous pressure on the nosecone leeches down the rocket body as much as four diameters before it dissipates. With lower speed rockets such as FAI, the "minimum of four body diameters" rule may be reduced to one or two.

Here is a path that you may wish to follow to take you through the design process of your altimeter bay, along with some additional explanation of the design implications of rocketry terminology used in the event rules.

Accommodate the instrumentation: Determine what size compartment is required to contain the altimeter and cushion it against the shocks of rocket launch, recovery system deployment in flight, and impact with the ground at the end of flight.

The electronic altimeters specified for the event must be used in your rocket, and will be the sole basis for measuring the rocket's achieved maximum altitude. It is very important that the compartment in which the altimeter is placed be properly positioned on the rocket and vented with holes as described previously, so that the air pressure inside it is always at equilibrium with the outside air pressure. The instrument measures altitude on the basis of the air pressure changes it senses during flight.

Competition Tips:

Place the altimeter in a compartment that is totally sealed on the bottom against intrusion by high-pressure gases from the rocket motor's ejection charge. These gases will make the altitude reading inaccurate.

Place the altimeter compartment away from the nose cone. Turbulent flow over the rocket's nose cone-body tube joint at the top of the rocket will introduce pressure fluctuations down the body tube and this will make the altimeter readings unreliable.

Secure the altimeter in place mechanically in its compartment, don't let it "rattle" around or rely on foam padding to hold it in place (such padding might interfere with proper pressure equalization of the compartment, anyway). But make it easy to remove, because you will have to remove the altimeter both before and after flight for inspection by event officials.

Avoid Black! Black may not be the best color for a rocket with an altimeter. Electronics fail at high temperatures. The temperature inside a rocket painted black that's sitting in the sun on a hot day may get hot enough to cause a failure, such as causing the altimeter to think that the rocket has launched when it's really sitting on the pad.

Ambient Temperature: Let your rocket reach the ambient temperature before flying it. If the temperature is 40 degrees and your car is 70 degrees let the rocket cool before flying, and vice versa. But remember that cold is bad for batteries. Be sure to use a fresh battery.

Venting: An altimeter bay must be vented so that the air pressure in the bay equalizes with the air pressure outside of the rocket. If venting is not provided, the altimeter will not function correctly. Follow the altimeter manufacturer's recommendations for venting.

The altimeter's bay must be sealed from the ejection charge. If gases from the apogee charge leak into the bay the altimeter will sense the pressure rise in the bay and give incorrect readings.

Use a Fresh Battery: Most altimeters can make several flights on the same battery. But batteries are cheap and your rocket is expensive. Check the expiration date on the battery. Just because you purchased a new battery recently doesn't mean it's fresh.