Altitude and Altimeters – Part 3

Before we dig into more new stuff let's do a quick review of what we learned in Parts 1 and 2.

International Standard Atmosphere (ISA) is when at sea level the Atmospheric Pressure (AP) is 29.92 inches of mercury ("hg) and the temperature is 15 degrees centigrade. The ISA standard lapse rates are 1"Hg pressure and 2 degrees centigrade temperature per 1,000 feet of altitude change. Less pressure and cooler temperature going up, higher pressure and warmer temperature coming down. The atmosphere is almost never at ISA standard. Warm temperatures lower the pressure, cool temperatures increase the pressure.

Altimeters show change in elevation in accordance with the ISA lapse rate. A one (1) "Hg change in atmospheric pressure results in a 1,000 foot change in altitude. As the AP decreases, the altimeter shows an increase in altitude. As the pressure increases, the altimeter shows a decrease in altitude.

Indicated Altitude is whatever the hands are currently showing on the face of the altimeter. For practicable purposes, if you have the Kollsman window set to the current altimeter setting issued from the closest reporting station, then the Indicated Altitude is an *indication* of your height above the average level of the sea (MSL). Pressure Altitude is your altitude in reference to a layer of atmosphere where the pressure is 29.92 "Hg.

<u>Absolute Altitude</u>

The final altitude to explore is Absolute Altitude, which is simply your actual height above the ground. As you can image it is constantly changing. The altimeter in the plane has no ability to tell you Absolute Altitude. There are other types of elevation measuring devices that can, such as some GPS setups, radar altimeters, etc., but your trusty round "steam gage" altimeter has no clue about Absolute Altitude.

Summary:

The altimeter in your plane is actually a rather simple device that only knows how to react to barometric pressure. As the pressure changes the hands on the altimeter move. If the pressure goes up, the hands go down, if the pressure goes down the hands go up. The altimeter has no knowledge about temperature, but because temperature effects pressure, then indirectly it effects the altimeter.

The altimeter was designed to follow the rules of the International Standard Atmosphere (ISA). The ISA standard pressure at sea level is 29.92 "Hg, the standard temperature at sea level is 15 degrees centigrade. The ISA standard lapse rate per 1,000 feet change in elevation is 1 "HG for pressure and 2 degrees centigrade for temperature. ISA pressure and temperature get less as you go up and more as you come down by the amount of their lapse rate. Using these figures you can calculate the ISA standard pressure and temperature for any elevation.

If atmospheric conditions were always "ISA standard" your altimeter would always read feet above the average level of the sea (MSL), but conditions aren't and altimeters don't.

To fix this problem the altimeter has an adjustable pressure scale called the Kollsman window. The Kollsman window is used to set a starting point pressure that makes the altimeter show field elevation (True Altitude) as you take off. However, as you fly away from the airport into "non-standard" ISA conditions the Indicated Altitude on the altimeter becomes less accurate in its ability to report your actual feet above sea level. It's very important to keep the Kollsman window set to the most current altimeter setting available from the closest reporting station thus giving you the best approximation possible of your altitude above sea level (MSL).

Various calculations can be made to give the pilot better information that is important to safe operation of the plane. Density Altitude is probably the most important one of these and is very important in making "go, no go" decisions before takeoff at high altitude airports on hot summer days. The most readily available method for determining Density Altitude is using a "chart graph", which is found in the Pilots Operating Handbook for the plane. The trusty type E-6B flight computers can do it, or you can use the math formulas. You should know that on the FAA private pilot written exam there will be Density Altitude questions requiring the use of the chart graph method.

The system for measuring altitude is not perfect and different methods for making calculations from the same data can/will give somewhat different results.

As a final thought consider this:

"Altitude above you, runway behind you, or gas in the fuel truck – doesn't do YOU any good".

And, a bad day is, when you "run out of altitude and ideas all at the same time".