SSF Soaring Safety Foundation

Density Altitude Dilemmas
By Stephen Dee

Whether you are a Self-Launching or Aero-towed glider pilot, this question is for you: when was the last time you calculated the Density Altitude (DA) as part of your pre-flight preparation? It doesn't matter if you use a Flight Computer, Electronic Calculator, or pencil and paper, but both common sense, and the FAR's dictate that you do it before every flight. Specifically, FAR 91.103 (b)(2) states*: "Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include, (2) For civil aircraft other than those specified in paragraph (b)(1) of this section, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature."*

I must admit that I do not routinely break out my "whiz wheel" to calculate DA, nor can I recall ever seeing any other glider pilot using a calculator or computer to do the same. (We are way too cool for that . . .) But, both prudence and regulatory compliance can be satisfied by following a few simple rules of thumb that require nothing more than the application of a little brainpower, and some math in public.

First, one must determine the Standard Temperature for the location in question. Start with the Standard Day Temperature at Mean Sea Level of 15 degrees Centigrade. Since temperature decreases with increasing altitude at a standard rate of 2 degrees Centigrade per thousand feet, simply multiply that rate times the difference between sea level and field elevation. For example, the Standard Temperature of an airfield at 4000 feet elevation would be 7 degrees C. (15C. minus (2 times 4))

Next, add 100 feet (it's actually just a bit more, but rounding off makes it easy) to Field Elevation for every degree Centigrade the ambient temperature is above your calculated Standard Temperature. The result is a good approximation of Density Altitude, arrived at without calculator, computer, or whiz wheel.

There are other factors that affect DA, such as non-standard altimeter setting and relative humidity, but both are minimal in most soaring applications. Each tenth of an inch the altimeter setting is below Standard (29.92) increases DA by 100 feet. Likewise, a relative humidity of 90% will decrease available horsepower by 6.5%. The latter may not sound like much, but could be a factor for some Self-Launchers that don't have a very big "excess power" margin, or a heavily ballasted Open Class ship about to latch on for a tow. Fortunately, both these factors are minimized on most good soaring days, since strong thermal generation is typically the result of dense, dry air.

One last variable could be significant, and very difficult to quantify, and that is the accuracy of the ambient temperature used in your calculation. Most reporting stations, whether AWOS, ASOS, or the thermometer at the FBO, are all located in the shade, and the runway usually is not. The air you will launching into may be a lot warmer than you

have planned on, and that's where a healthy "WAG" factor of safety may come in handy to prevent that "just airborne and sinking" feeling.

Let's consider all the above, and apply it to a typical summer soaring day in a popular western soaring location, like Parowan, Utah. The Field Elevation there is 5930 feet, so Standard Temperature would be about 3 Degrees Centigrade. (15 minus (2 times 6)) The midday temperature is commonly around 32 Degrees Centigrade, so if that were the case, the ambient temperature would be 29 degrees above Standard. That would make our Density Altitude equal to 5930 plus 2900, or about 8830 feet, subject to altimetry and humidity effects.

Every aircraft's POH will contain performance charts to indicate takeoff capability based on takeoff weight and DA. Without verifying that both are within limits, a takeoff can get very exciting as the end of the runway approaches and you're still hoping to get into the air. . .not to mention climbing out to clear obstacles and maintain a safe climb gradient.

So, armed with this knowledge of Density Altitude, and consulting with the tow pilot or your motorglider's POH for how it affects takeoff performance, every intrepid glider pilot can make an informed decision about his takeoff scenario. Specifically, there is a known safe arena for Self-Launching, and, there is a time when it's best to keep all the fuel onboard for in-flight use, and take an aero tow. Your tow pilot wants and deserves to know the weight and ballast condition of any glider he tows before he consults his POH. Either way, you are the Pilot in Command of your ship: choose wisely, or prepare to pay the consequences.