



IHST

International Helicopter Safety Team

Our Goal is to Reduce the Civil Helicopter Accident Rate by 80% by 2016.

Training Fact Sheet - Density Altitude

Contact: Nick Mayhew
Phone: (321) 567 0386

The Invisible Factor of Helicopter Performance.



Have you ever run out of power up a mountain and weren't sure why?

Do you always consult your performance graphs whenever you move to a new geographical operating area?

Of the 3 factors that govern helicopter performance, density altitude is the most difficult to perceive. Wind (speed & direction) and gross weight are very recognizable in flight operations. Density altitude on the other hand takes some head work and situational awareness.

In flight operations, being aware of the effects and understanding the elements of density altitude will give pilots the ability to make performance decisions.

By definition, density altitude (DA) is pressure altitude corrected for non-standard temperature. It is actually defined by the equation:

$$DA = PA \times 120 T$$

Where PA is the Pressure Altitude (with 29.92 set) and T is the temperature difference between the standard temperature at that PA and the actual temperature. But let's not worry too much

about the math....simply put, increasing temperature at a particular atmospheric pressure causes the density of the air at that pressure to appear as though it resides at a higher altitude.

The problem of density altitude for pilots begins with the fact that helicopters fly through an atmosphere of air that is composed of invisible gases. Only when there is an excess of particulate matter or water vapor in the air can anything actually be seen in the flight environment. It is not possible to see that air becomes thinner due to increased spacing between air molecules when an air mass is raised in elevation (high), when it is warmed (hot), or when water vapor is added to it (humid).

Any mix of high, hot or humid atmospheric conditions creates what is called "high density altitude" situations. Density altitude can be quite dangerous, especially if the helicopter is operating at, or close to, its maximum gross weight.

With elements of pressure, elevation, humidity and temperature considered, density altitude is computed. During flight operations pilots can have a DA chart available to refer to or they can develop a sense of how the individual elements affect DA will limit performance.

Knowing that humidity is absent from the DA chart shows us that it has the least affect on performance but should be considered when large changes in humidity take place. 3 to 4% decreases in performance can take place from a dry atmosphere to a high humidity atmosphere.

Barometric pressure will also add to or decrease the DA small amounts overall.

Elevation or altitude will thin the air density and should be considered an important factor for decreases in helicopter performance.

Temperature has the greatest effect on DA and is the most recognizable using an OAT gage. Noting the OAT prior to take offs and landings will give pilots the ability to judge power available and power required to complete the desired maneuvers.

A good operational technique to instill is noting the highest seasonal Density Altitude values for your training or operational flight area. Remember that temperature has the greatest effect on DA so note seasonal high temperatures.

When operating in a new area, seasonal DA extremes should be computed prior to flights and considered during flights for judging helicopter performance. Preflight planning will make DA a performance consideration by pilots as they check helicopter performance charts and get a mental picture of DA and gross weight limitations.

As density altitude increases helicopter performance decreases. Consider carrying less weight as it is the only performance factor that the pilot can control.

Noting changes in DA will allow pilots to determine reserve power and permit the Go/No-go decision process to be valid. An understanding of the three factors governing helicopter performance will give pilots the information to use head working skills for constant performance decisions.



Summary

- Density altitude is invisible but is a factor that always governs helicopter performance.
- Temperature is the element that has the greatest effect on density altitude.
- Know your seasonal high temperatures and how they affect DA in the current operational area.
- Create a habit of noting/calling temperatures prior to take off and prior to initiating an approach to consider DA & performance or lack thereof.
- High, Hot & Humid equates to high density altitude and greatly reduced performance of the helicopter.
- High, Hot & Humid is a poor condition and High, Hot & Heavy is worse.
- Pre-flight planning and evaluating performance charts with consideration for DA and gross weight operations will make the effects of DA visible to pilots.
- Most flight manuals or Pilot Operating Handbooks have DA charts in the performance section.
- Respect the factors governing helicopter performance during all flight operations and fly as light as possible in high DA conditions.



More information about the IHST, its reports, its safety tools, and presentations can be obtained at its web site: (www.IHST.org).