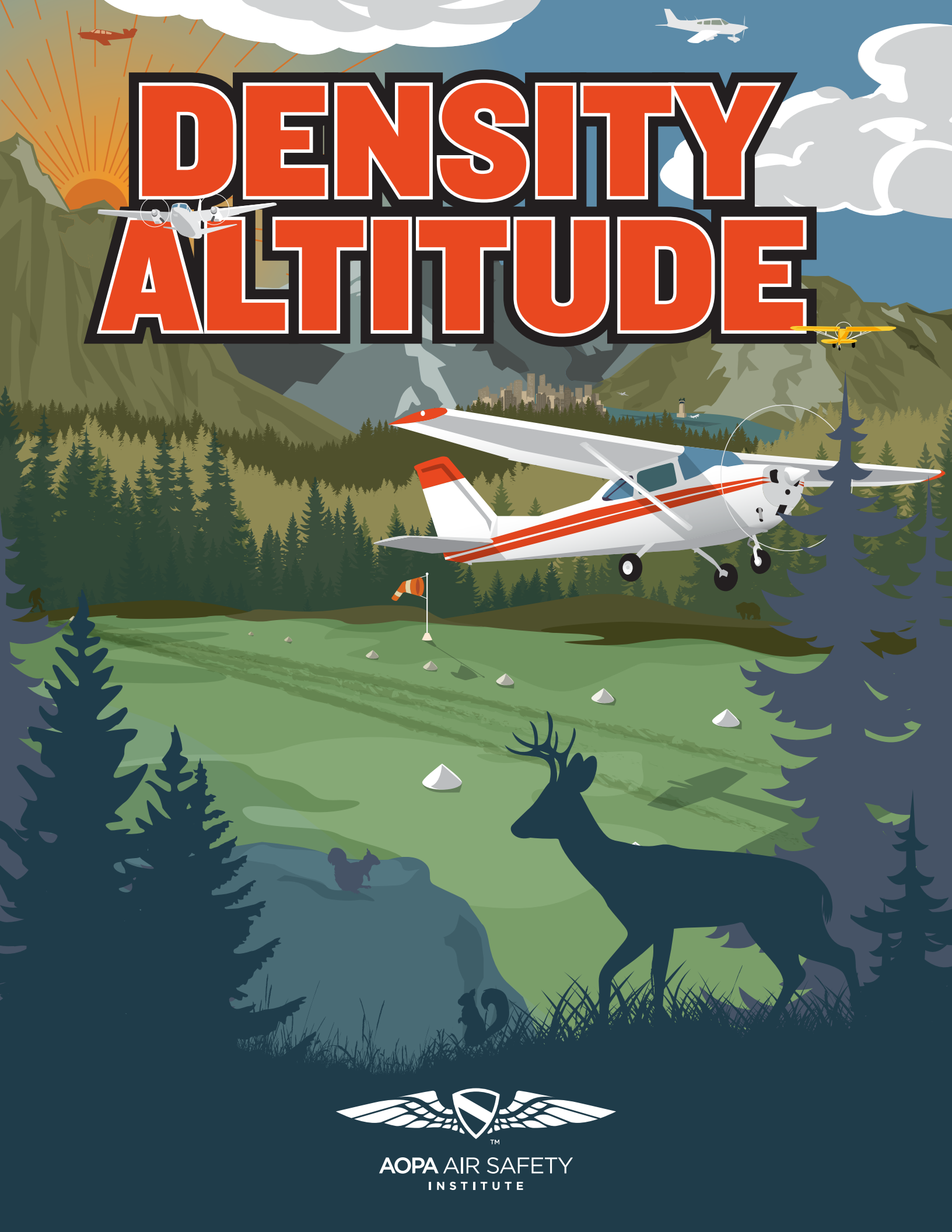


DENSITY ALTITUDE



AOPA AIR SAFETY
INSTITUTE

WHAT IS DENSITY ALTITUDE?

High altitude, high temperature, and high humidity create less dense or thinner air, contributing to a higher density altitude that adversely impacts aircraft and engine performance.

Learn why it's important to carefully calculate aircraft performance during high-density-altitude conditions to avoid an accident during takeoff, climb, cruise, and landing.

**Please call AOPA's Pilot Information Center with questions
800-USA-AOPA (872-2672)
Monday through Friday, 8:30 to 6:00 EST.**

▶▶▶▶ OVERVIEW

IN ORDER TO PROTECT OURSELVES FROM THE EFFECTS OF DENSITY ALTITUDE, WE MUST FIRST UNDERSTAND WHAT IT IS AND HOW IT IMPACTS FLIGHT.

Learn about density altitude, get safety tips for operating in high-density-altitude conditions, and review an example of one of several methods used to calculate density altitude.

▶ What is density altitude?

Density altitude is pressure altitude corrected for nonstandard temperature.

As temperature and altitude increase, air density decreases. In a sense, it's the altitude at which the airplane "feels" it's flying.

▶ How will high density altitude affect flight?

On a hot and humid day — and in high terrain — the aircraft will accelerate more slowly down the runway, will need to move faster to attain the same lift, and will climb more slowly, resulting in a shallow climb gradient. **The less dense the air, the less lift, the more lackluster the climb, and the longer the distance needed for takeoff and landing.** Fewer air molecules in a given volume of air also result in reduced propeller efficiency and therefore reduced net thrust.



TIPS FOR FLYING IN HIGH DENSITY ALTITUDE CONDITIONS

- **Fly** in the evening or early in the morning **when temperatures are lower.**
- **Call a flight instructor** at your destination airport **to discuss density altitude procedures** at that airport.
- Before flying to a high-elevation airport, **know whether your aircraft climbs more efficiently with the first increment of flaps.** Many aircraft do, but results vary and that first notch of flaps may add more drag than lift.
- Be sure your aircraft's **weight is below 90 percent of maximum gross weight.**
- Don't fill the tanks to the top (see previous tip).
- Fly **shorter legs** and make **extra fuel stops** (tough suggestion to accept, but it results in fewer exciting takeoffs).
- **Be ready to ferry one passenger** to an airport with a lower density altitude, **then come back for the other.** If you are unsure of conditions, fly around the pattern once alone without baggage to test your aircraft's performance.
- **Have 80 percent of your takeoff speed at the runway's halfway point, or abort.**

CALCULATING DENSITY ALTITUDE ▶▶▶▶

Density altitude in feet = pressure altitude in feet + (120 x (OAT - ISA temperature))

- Pressure altitude is determined by setting the altimeter to 29.92 and reading the altitude indicated on the altimeter.
- OAT stands for outside air temperature.
- ISA stands for international standard atmosphere.

The standard temperature at sea level is 15 degrees Celsius (or 59 degrees Fahrenheit). It decreases about 2 degrees Celsius (or 3.5 degrees Fahrenheit) per 1,000 feet of altitude above sea level. Therefore, the standard temperature at 7,000 feet msl is only 1 degree Celsius (or 34 degrees Fahrenheit).

For example, the density altitude at an airport 7,000 feet above sea level, with a temperature of 18 degrees Celsius and a pressure altitude of 7,000 (assuming standard pressure) would be calculated as follows.

- $18 - 1 = 17$
- $17 \times 120 = 2,040$
- $2,040 + 7,000 = 9,040$ feet density altitude

This means the aircraft will perform as if it were at 9,040 feet.

Note: Altimeter settings below 29.92 will increase density altitude and decrease aircraft performance.

ADDITIONAL RESOURCES

Mountain Flying Safety Spotlight

Explore AOPA's Air Safety Institute spotlight on challenges and risks of flying in high terrain.

Backcountry Resource Center

Get ready for the challenges, risks, and rewards of backcountry flying.

Air Safety Institute Quiz on Density Altitude

Density Altitude: Heat, Humidity, Altitude

View the video for more tips on density altitude.

Accident Case Study: Into Thin Air

Join the AOPA Air Safety Institute as we follow a Bonanza's likely encounter with high density altitude.

