HIGH ELEVATION has a dramatic effect on performance. At sea level, a particular light airplane such as a Cessna 172 *(see chart below)* accelerates to takeoff speed in 805 feet. But at an elevation of 7,500 feet, the takeoff distance increases 83 percent to 1,475 feet. Similarly, the climb capability of that airplane diminishes as altitude increases. Also, the distance required to land and brake to a stop is increased at higher elevations.

This decrease in performance is due to air being less dense at high altitudes and elevations than at sea level. For example, the density of air at sea level is typically 0.076 pounds per cubic foot. At 7,500 feet, it is only 0.061 pounds per cubic foot, a reduction of 20 percent. Thin (or less dense) air reduces wing lift and propeller efficiency. Also, aircraft engines produce less power when using air that is less dense than the air at lower altitudes. One benefit of air that is less dense is that it reduces aircraft drag (air resistance).

Typical Performance Data for a Cessna 172

(For example only; do not use for flight planning.)

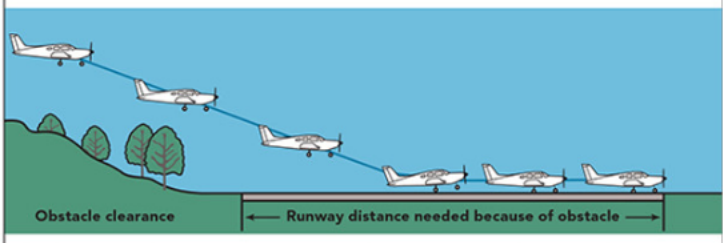
	Sea level and 59°F (15°C)	2,500 ft and 50°F (10°C)	5,000 ft and 41°F (5°C)	7,500 ft and 32°F (0°C)
Takeoff distance	805 ft	978 ft	1,195 ft	1,475 ft
Takeoff over a 50-ft obstacle	1,400 ft	1,753 ft	2,158 ft	2,717 ft
Landing distance	520 ft	560 ft	603 ft	653 ft
Landing over a 50-ft obstacle	1,250 ft	1,318 ft	1,393 ft	1,478 ft
Rate of climb	770 fpm	652 fpm	535 fpm	415 fpm

WEATHER CONDITIONS also affect aircraft performance. Higher-than-usual temperatures have an adverse effect on performance because hot air is less dense than cold air. For example, air at sea level with a temperature of 104°F (40°C) has the same density as air normally found at 3,000 feet above sea level. Conversely, cold air improves performance. Air at 5,000 feet above sea level with a temperature of −28°F (−33°C) has the same density as air normally found at sea level.

Humidity also decreases performance. Water vapor is lighter than air, and its presence in the atmosphere reduces air density. A reduction in barometric pressure also reduces air density and therefore decreases aircraft performance. An increase in barometric pressure has the opposite effect and is beneficial to performance.

At high temperatures, aircraft performance is reduced and more runway is needed for takeoff and landing.

RUNWAY CONDITIONS affect an airplane's landing performance. Landing on runways coated with snow, rain, or ice requires more stopping distance because there is less friction between the tires and the runway surface. The brakes are less effective. Puddles of water or slush on the runway can hinder takeoff acceleration. Taking off on a grass or dirt runway also decreases takeoff performance and increases takeoff distance. A slippery runway and a crosswind can make ground steering difficult.



An obstacle at the approach (or departure) end of a runway increases the amount of runway needed for landing (or takeoff) because of the space needed to clear the obstacle.