An Aviator's Field Guide to Middle-Altitude Flying

Practical skills and tips for flying between 10,000 and 25,000 feet MSL

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Introduction

When a pilot upgrades to flying aircraft that are larger or capable of flying at higher altitudes, this brings opportunities to enhance flying efficiency but also presents new risks that must be considered. Flying at higher altitudes, for longer distances, and in aircraft that are pressurized and/or turbocharged greatly expands a pilot's flight possibilities. Pilots flying piston aircraft with these increased capabilities will find that they gain some of the options available to turbine pilots, but there are still key differences between the two. A savvy piston pilot will be aware of, learn about, and fully consider these differences in order to safely fly these more capable aircraft at altitudes higher than smaller, light general aviation aircraft fly but below the flight levels where most jets fly.

Legacy aircraft like the Aero Commander, Piper Navajo, Beechcraft Baron or Duke, and Cessna 300/400 series are prime examples of mid-size, twin-engine piston aircraft capable of flying at mid-altitude levels. Single-engine piston aircraft like the Beechcraft Bonanza, Piper Malibu, Mooney, and Cirrus SR20/22 are also capable at flying to altitudes well above 10,000 feet MSL. These aircraft often will be equipped with turbocharged engines to increase performance and can be either pressurized or non-pressurized with an onboard oxygen system.

Many of these aircraft (with the exception of the SR20/22) are legacy aircraft that were produced primarily between the 1960s and the mid-1980s. The legacy aircraft still flying and those few that are still manufactured today are typically owner-operated within general aviation. A few are used in air taxi services and small cargo operations, but the overwhelming majority of flights are 14 CFR Part 91 operations, which include flights such as taking vacations, visiting family or friends out of state, or business professionals traveling to and from meetings. In general, these aircraft fill a niche market for higher-performance and higher-capability aircraft with greater payloads, increased range, and enhanced anti- and deicing equipment compared to what you will find on lighter aircraft, such as a Cessna 172 or twin-engine Piper Seneca. They do not have the same ranges and capabilities as bigger, faster, higher-climbing jets, but they can take advantage of some of the same flight planning processes and operational environments to a limited degree.

All of these piston aircraft reach their maximum operating altitudes much lower than turbine-powered aircraft, such as the King Air, Learjet, or Citation, which fall into higher performance categories. This type of turbine-powered aircraft has the capability to climb much higher, often traveling faster and farther.

An inability to travel to flight altitudes above 25,000 feet MSL will limit some of the options available to a pilot. However, the ability to climb and operate at middle altitudes from 10,000 feet up to 25,000 feet MSL allows for a significant improvement in performance and capabilities when compared to flying lighter, non-oxygen equipped, non-turbocharged general aviation aircraft.

The following text will further explore middle-altitude flight levels, determine why a pilot might want to climb higher into these altitudes, weigh the opportunities and risks, identify planning considerations that need to be taken into account, and explain how pilots can improve flight operations in piston-powered aircraft when operating at these middle altitude levels.

Chapter 1

Why Some Piston-Powered Aircraft Can Fly Higher

Many pilots learn in aircraft such as the traditional Cessna 172 or Piper Warrior, which are limited to lower altitudes. The aircraft capable of flying at higher altitudes are typically larger and equipped with advanced equipment that makes them capable of achieving these higher altitudes.

Most of the aircraft that operate at these middle altitude levels are equipped with single-stage turbochargers with engines from 160 to 500 horsepower, which allow the aircraft to provide high engine power output up to 25,000 feet MSL. In some turbocharged engine systems, inner cooling allows a portion of the turbocharger output to be used for cabin pressurization. These systems are the key that allows pilots to fly aircraft at higher altitudes.

Aircraft equipped with normally aspirated piston engines "run out of power" as they climb, as they do not have the advantage of the turbocharger system that allows for maintaining power at these higher altitudes.

I know this is a pretty simple explanation of why piston-powered aircraft are capable of flying higher, but it really is that simple. More complex systems offer pilots greater opportunities to operate in different ways. Later chapters will cover the systems considerations in more detail, but first, let's discuss why pilots would want to fly at these middle altitude levels when they have an aircraft capable of doing so—and additionally, when a pilot may decide it's better to avoid these altitudes.

Chapter 2

Why Fly Higher?

Flying higher comes with benefits and opportunities, but also a few additional dangers that a pilot must be aware of and mitigate when operating at these middle altitudes.

Compared to lower-flying aircraft, aircraft capable of middle-altitude flight offer pilots several additional advantages. These include climbing above potentially hazardous weather, attaining greater terrain clearance, taking advantage of stronger tailwinds, and gaining operational efficiency in relation to fuel burn and true airspeed. These added benefits may allow for more direct routes of flight and/or increases in operating ranges.

Another important advantage of flying at a higher altitude is that it provides the pilot with more time and ability to cover a greater gliding distance over the ground in the event of an emergency or loss of power.

Without digging too deeply into atmospheric and aerodynamic principles, the basic fact that air is less dense at higher altitudes means that it creates less drag on the airframe. This means that at a given power setting, the reduced drag essentially allows the aircraft to fly "faster" than it would at a lower altitude where drag is greater. This increases the aircraft's range of flight.

In regards to weather considerations, many times a pilot will be able to climb above average clouds by flying somewhere between 10,000 feet and 25,000 feet MSL, except in cases where thunderstorms are present. Climbing above the weather allows a pilot to get out of icing conditions, avoid turbulence, and obtain better flight visibility, benefits which are often not possible for aircraft incapable of reaching these higher altitudes. Climbing to these altitudes can also offer the pilot the chance to get "on-top" of the clouds and see and avoid weather en route. Pilots may be able to fly around severe weather such as thunderstorms instead of trying to fly through the weather, which could potentially result in encountering embedded thunderstorms that were not visible flying in clouds at lower altitudes.

In some areas of the country, pilots of non-turbocharged aircraft must very carefully consider terrain factors, but these factors can be more easily mitigated by pilots flying aircraft capable at higher altitudes. From both a safety and comfort perspective, it is certainly desirable for a pilot to be able to climb and fly at 18,000 feet MSL, 4,000 feet above the highest peaks in Colorado, while using an oxygen system or pressurized cabin compared to trying to fly down at 11,000 feet MSL, zig-zagging between the peaks with less terrain clearance while staying under oxygen requirement altitudes. Certain areas will require the pilot to be able to fly at altitudes where regulations require the use of oxygen in order to maintain IFR routing, terrain/obstacle clearance, or reception altitudes.

Flights at higher altitudes will commonly encounter higher wind speeds than those at lower altitudes. Although this can certainly be a negative factor when it is a headwind, it can be very positive for a flight plan when it is a tailwind. A pilot may find that flying at 8,000 feet MSL will provide 10–15 knots of tailwind across a route, while the same route flown at 18,000 feet MSL will provide the aircraft with 50–60 knots of tailwind. This difference in winds can extend range or reduce flight times across a route.

With these benefits in mind, it is also important to consider some of the negative aspects of flying at middle altitude levels.

The most commonly discussed danger when flying at higher altitudes is hypoxia. While it is certainly a very dangerous factor, hypoxia is mitigated in most of these aircraft through pressurization or on-demand, personal-delivery oxygen systems for the pilot(s) or passengers. While I won't say that hypoxia is less dangerous at middle altitude levels compared to higher altitudes, in general, a properly identified problem with oxygen systems below 25,000 feet MSL does offer a pilot a longer period of useful consciousness to manage the problem than it would for a pilot operating a turbine aircraft at much more extreme altitudes. (This will be discussed in more detail in Chapter 5.)

As mentioned earlier, the higher wind speeds at middle altitudes can be a benefit if pilots can take advantage of greater tailwinds, but the inverse of this can become a disadvantage if pilots instead face headwinds. A quick and easy response to this might be simply that pilots should not fly at higher altitudes when there are greater headwinds, but this may not always be the best decision when other factors are considered. If a route has terrain or weather that the pilot must climb over, this may force the flight to be operated with greater headwinds to mitigate or avoid even more dangerous factors across the route. This can decrease range, increase flight times, or both.

Another challenge of flying aircraft at middle altitudes is determining when it is beneficial to climb to these altitudes and when it is not, once the distance of the flight is taken into consideration. The longer the flight leg, the more likely that it will be beneficial to climb to a higher altitude. For shorter routes, a climb to a higher altitude may be inefficient. But when flying longer legs, the ability to descend for longer distances can increase speed across a route while burning less fuel; however, this longer descent may also introduce potential detrimental effects of engine cooling if the descent is conducted too rapidly.

Like most things in life, along with benefits come some potential disadvantages or dangers. However, when managed properly by a competent pilot, these negative aspects can be mitigated and allow a pilot flying piston-powered aircraft at middle altitudes opportunities to improve the efficiency of flight profiles as well as pilot and passenger comfort.

About the Author

Jason Blair is an active instructor and FAA-designated pilot examiner who has worked for many years in the aviation training industry. He has flown and instructed in more than 90 makes and models of general aviation aircraft, and through his experience has learned enough to share some knowledge that may be useful to others. He writes for multiple aviation publications and has worked for and with aviation associations and the FAA as an industry representative within the general aviation community.

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