



Aircraft Performance & Calculations

Accident investigations have discovered causal factors resulting from unreasonable expectations of aircraft performance – especially when operating at the edges of the aircraft weight and balance envelope. That’s why the Loss of Control Work Group suggests improvement in pilots’ understanding and calculation of aircraft performance.

When we speak of aircraft performance we’re usually answering three basic questions:

- How much can I haul?
- How far can I go?
- How long will it take?

It sounds simple but a specific set of interdependent variables must be considered in order to answer each of these questions. Most of these variables have to do with aircraft performance, but the most important variable does not.

Weight and Balance

A good way to plan a flight is to decide how much weight you want to haul to what destination. Start with the crew and passengers. Then add cargo. If these items alone exceed your aircraft’s capability, you’ll either have to make multiple trips, or get a bigger aircraft.

My Short Field Performance			
Aircraft	Gross Weight	Test Weight	
Airfield	Elevation	Density Alt.	
Wind Direction	Wind Speed	X-Wind Comp	
IAS	Landing Dist.	Flap Setting	
Takeoff Flap	Rotation Speed		
Rotation Speed x.70	Vx	Vy	
Distance to Rotation	Distance to 50'		

Once you know how much you want to haul, you can figure out how much fuel you can take, and that, together with your weather information, will tell you how far you can go. If you have enough to get to the destination plus alternate and reserve, you’re golden. If not, you’ll have to plan an en route fuel stop.

Be sure to consult the AFM/POH for the proper power setting and fuel consumption information at your planned cruising altitude. The winds aloft forecast will give you information from which you can calculate your expected ground speed. It’s also a good idea to keep an eye on your fuel state during the flight and check en route fuel availability before you launch.

Another important tip on fuel: Don’t wait until you’re close to your destination to refuel. The closer you get, the more you’ll be tempted to continue on your reserve fuel supply.

Takeoff and Landing Distance

When flight planning, consider your departure and arrival airport’s runway lengths, obstructions, and expected density altitude. Are the runways at your destination paved, grass, gravel, or mud? Are they contaminated with snow or water? These factors can affect your takeoff/landing distance and your ability to safely fly with a full load. Use your AFM/POH to help with your performance calculations before you fly.

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It's always a good idea to be conservative when you calculate your performance and to consider adding a safety factor. Some pilots add 50% to their takeoff and landing calculations for safety.

Now we can figure all of this out by consulting the POH, right? Maybe not. There's one more huge variable to consider, and I bet you know what it is.

The Greatest Variable

So what's the greatest variable in your calculations? That's right – it's you, the pilot. Let's face it. The POH figures and all of our calculations don't mean much if we can't duplicate them in our flying. That's why it's important to document your performance capability at least yearly with a flight instructor. Fly at a typical mission weight and try to duplicate or simulate mission density altitudes. That way you'll know what you and your aircraft can (and can't) do.

In order to know what performance you and your flying machine are capable of, you'll need to establish a baseline. Think of your baseline as an omnibus reference that relates pilot and aircraft performance under a given set of environmental circumstances on a given day.

To establish your baseline, we suggest you load your aircraft with a typical mix of fuel, cargo, and passengers. (Maybe one of those passengers could be your CFI.) Calculate your test weight and note runway condition, elevation, density altitude, and wind direction/speed.

Next you'll fly several takeoffs and landings noting your performance on each trial. When you're done, you can average your performance figures and complete your baseline chart.

Rules of Thumb for Takeoff Distance

⇒ Fixed pitch prop, add 15% to your calculated takeoff distance for each 1,000 foot increase in density

altitude up to 8,000 feet/ 12% per 1,000 feet up to 6,000 feet for constant speed prop.

- ⇒ When planning takeoff from short, unobstructed runways, establish a landmark at 50% of your calculated takeoff distance.
- ⇒ When on the takeoff roll, you should have 70% of your rotation speed at that point. If you don't, the safest thing to do is to abort the takeoff.
- ⇒ If you can't meet the above requirement, reduce weight or wait for more favorable wind and temperature conditions.
- ⇒ If you must clear obstructions on takeoff, you'll need to have 70% of your rotation speed by the time you've travelled 30% of your available takeoff distance.



Approach and Landing

You'll want to be stabilized on final approach with full flaps at 1.3 times the stalling speed in landing configuration. Don't cut your final short. Make it long enough to be stable and go around if you're unstable.

Resources

- *Aircraft Weight and Balance Handbook* – Chapter 6
<http://bit.ly/WB-handbook>
- *Pilot's Handbook of Aeronautical Knowledge* – Chapter 11
<http://bit.ly/phak-ch11>

