FLYING LESSONS uses recent mishap reports to consider what might have contributed to accidents, so you can make better decisions if you face similar circumstances. In almost all cases design characteristics of a specific airplane have little direct bearing on the possible causes of aircraft accidents—but knowing how your airplane’s systems respond can make the difference as a scenario unfolds. So apply these FLYING LESSONS to the specific airplane you fly. Verify all technical information before applying it to your aircraft or operation, with manufacturers’ data and recommendations taking precedence. You are pilot in command, and are ultimately responsible for the decisions you make.

FLYING LESSONS is an independent product of MASTERY FLIGHT TRAINING, INC. www.mastery-flight-training.com

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This week’s LESSONS:

This NTSB preliminary report was posted this week:

On July 7, 2020, about 1344 mountain daylight time, a Mooney M20TN airplane, Canadian registered…was substantially damaged when it was involved in an accident at the Central Colorado Regional Airport, Buena Vista, Colorado. The pilot was seriously injured.

A witness, who was located at the airport, reported that he observed the airplane takeoff from runway 15 with no problems noted. The airplane then suddenly impacted the runway surface. A post crash fire ensued. The witness responded to the accident location to assist the pilot.

We don’t yet know what may have happened in this tragedy. We do know, however, that a common summertime scenario certainly didn’t make things any easier for the pilot, if it was not itself the proximate cause of the crash.

Buena Vista (KAEJ) is in the central valley of Colorado, just south of the famous Leadville airport (KLXV)—the highest elevation airport in the United States. Although KAEJ’s field elevation is almost 2000 feet lower than KLXV, it’s still 7950 feet above sea level…a considerable challenge in its own right.

The accident airplane is identified as an M20TN. The “TN” identifies it as one of the later Mooney Acclaims fitted with a factory turbonormalized, 280 horsepower engine. “Turbonormalized” means the engine’s induction air is boosted to maintain sea level manifold pressure to what’s called “critical altitude,” which in most airplanes in this class is around 17,000 – 18,000 feet density altitude. The pilot was alone in the airplane—so it had plenty of power and a good thrust-to-weight ratio, just waiting to be converted into thrust for takeoff.

It was mid-afternoon in mid-July. The recorded weather report includes a surface temperature of 26°C, dew point -3°C, altimeter setting 30.23 and winds from 150° at 18 gusting to 25 knots right down the runway.
Put this all together and the calculated density altitude was 10,679 feet. The takeoff headwind would help in some ways, but the strength of the wind in mountainous terrain, and especially the gust factor, would also likely create significant turbulence that would cause airspeed and angle of attack fluctuations during takeoff and initial climb.

Recall last week’s LESSON about runway temperature. The actual density altitude in ground effect over the runway may have been even higher than this computation suggests. See https://www.mastery-flight-training.com/20200709-flying-lessons.pdf

The Mooney was registered near Vancouver, Canada—close to sea level, but also near mountains. There was no recent FlightAware track history on the aircraft, so it’s impossible to tell if high-elevation flying was routine for this pilot or if this was his first flight in the mountains. In the spirit of FLYING LESSONS, however, let’s use the known facts of this awful event as the jumping-off point to review what might affect us under similar circumstances.

You can argue that lift is generated by the Bernoulli effect, Newtonian action and reaction, the Coanda Effect, or some combination of the three—and perhaps other factors as well. Over a century into controlled heavier-than-air flight, it’s still called the theory of lift for a reason…there is no definitive agreement even among experts.

But there’s no debating that, whatever physical process generates the lift needed to overcome aircraft weight, it’s done by air flow. If there’s enough air passing over and around the wings, engineering the engine for combustion, and engaging the rotating airfoil (the propeller, in prop-driven aircraft) to create the lift we call “thrust,” then the airplane will fly. If there’s not enough air flow, it won’t.

As density altitude increases, that is, the air becomes less dense, that means there are fewer air molecules in a given volume of space. Neither view is precisely correct from a scientific standpoint, but you can think of the effect of higher density altitude in two ways: to get the necessary airflow over the wings:

1. You must travel a greater distance to encounter the necessary volume of air; or alternatively,

2. You must travel faster to encounter the necessary amount of air in the same amount of time.

Either is a crude way of visualizing the concepts that (a) takeoff distances will be greater at higher density altitudes, and (b) true airspeed is greater for a given indicated airspeed as density altitude increases.

Still, you need to fly the same indicated airspeeds you do at lower altitudes to get optimal performance.

There’s a good amount of information among U.S. FAA sources as well:

- FAA Pamphlet FAA-P-8740-2, “Density Altitude,” states: Whether due to high altitude, high temperature, or both, reduced air density (reported in terms of density altitude) adversely affects aerodynamic performance and decreases the engine’s horsepower output. Takeoff distance, power available (in normally aspirated engines) and climb rate are all adversely affected.

  At power settings of less than 75 percent, or at density altitude above 5000 feet, it is also essential to lean normally-aspirated engines for maximum power on takeoff (unless the aircraft is equipped with an automatic altitude mixture control). Otherwise, the excessively rich mixture is another detriment to overall performance.
• The FAA Airplane Flying Handbook (FAA-H-8083-3B) states: Under conditions of high density altitude, the airplane may be able to become airborne at an insufficient airspeed but be unable to climb out of ground effect. Consequently, the airplane may not be able to clear obstructions.

• In the FAA’s Pilot’s Handbook of Aeronautical Knowledge (FAA-H-8083-25B), it says: Due to the reduced drag in ground effect, the aircraft may seem capable of takeoff well below the recommended speed. As the aircraft rises out of ground effect with a deficiency of speed, the greater induced drag may result in marginal climb performance. In extreme conditions, such as...high density altitude...a deficiency of airspeed during takeoff may permit the aircraft to become airborne but incapable of sustaining flight out of ground effect.

See:
https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/
https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/airplane_handbook/
https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/airplane_handbook/
https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/

All of these points and citations come together to tell us that an aircraft will not perform as well at a higher density altitude than it will at a lower density altitude. But there are a few additional points:

1. **Even turbocharged and turbonormalized airplanes will not perform as well at a higher density altitude as the same aircraft will at a lower density altitude.** Even if the engine develops the same manifold pressure it does “down low,” the additional turbo action necessary to make that happen usually decreases air density in the combustion chambers (cylinders), decreasing power output for a given manifold pressure (and intercoolers won’t be truly effective until reaching climb speed for cooling airflow.

2. **Rated engine power does not necessarily mean rated engine thrust** since the propeller is less capable of turning that power into thrust as generated by the propeller spinning in less-dense air.

3. **Power is not the only determinant of takeoff and climb performance**, because of the high true airspeed necessary to generate a given amount of lift by the wing.

4. **Airspeed and angle of attack precision becomes critical** as a result of these other factors. The pitch attitude that results in a given indicated airspeed or AoA is lower at high density altitudes because of power, thrust and lift degradation compared to lower density altitudes.

5. **Human nature will make us impatient** if performance is much less than we’d expect based on our more routine flying. This impatience will nag you to ease back on the controls, trying to “force” the airplane to “fly better.” But that increase in control deflection and angle of attack, and reduction in indicated airspeed, only increase drag and make matters even worse. If you’re not careful you’ll increase back pressure even more in response, in a feedback loop that—all too often in the hot times of the year—result in a tragic loss of control and/or collision with terrain.

**In short,** not only do you need to account for the reduced performance at higher density altitudes, you have to fly more precisely to get the optimal performance of that which is still available.

**Is it possible** to safely take off from a 10,000 foot+ density altitude? Sure. I’ve done it myself with some instructor friends from Australia, showing them what for them is an impossibly high density altitude during their stay here in the United States. But we did so on a very long, downhill-sloping runway into a light wind, with the ground dropping slowly away off the end of the runway, and knowing we needed to fly precise attitudes and airspeeds and not become impatient with the 400 foot per minute optimal climb rate once we got to climbing speed.

**But in most cases** it’s even better to avoid taking off at the hottest time of the day when density altitude is a threat. Time your departures and arrivals for a cooler, better performing temperature.
Some miscellaneous items
For any spare time you might have this week

Sim time
Simulation, even using home computer-based “simulators” are a great way to maintain proficiency and enhance your instrument. U.S. readers may now log time toward instrument currency in certain flight simulation devices in just the same way you do in an aircraft. The training device you use must be FAA approved to use it to log time for recency of experience. Here’s the current list of FAA approved aviation training devices and simulators for light aircraft. See https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afx/afs/afs800/afs810/media/FAA_Approved_Airplane_ATDs.pdf

SimVenture
Speaking of home simulation, PilotEdge—a subscription service that provides live, audio feed air traffic control to dramatically increase the realism of your simulated flight—is hosting “Simventure.” This unique event provides the opportunity to fly into Oshkosh on home flight simulators using X-Plane, Prepar3D or FSX and following what would have been the Oshkosh AirVenture 2020 Arrival NOTAM procedures.

During EAA’s Spirit of Aviation Week, real-world air traffic controllers will be staffing [the simulated] Fisk Approach and Oshkosh Tower to allow pilots to fly the famous Fisk Arrival into Oshkosh complete with wing rocks, fast-paced ATC and hundreds of other aircraft, all from the comfort of your flight simulator.

For the schedule, system requirements and all other details of this truly unique experience see PilotEdge’s SimVenture page. See https://www.pilotedge.net/pages/simventure

Is flying safe? You’re asking the wrong question
It’s a “legacy” article, but FLYING LESSONS Weekly reader John Zimmerman’s article “Is Flying Safe? Wrong Question” re-ran this week in Air Facts Journal. It’s a great read about how it’s the
pilot who determines whether or not flight by general aviation aircraft is “safe.” Take a look and let me know what you think.

See https://airfactsjournal.com/2012/05/is-flying-safe-wrong-question-2/

Spin cycle
Increasingly legendary flight instructor, host of the outstanding Aviation News Talk weekly podcast, and also FLYING LESSONS reader, the newly COVID-mustached Max Trescott has posted a new, in-depth video interview with 2020 National Flight Instructor of the Year Catherine Cavagnaro titled “Stalls and Spins Explained.” Max himself took the National CFI of the Year honors in 2008, beating me out that year (I’m not bitter). Max writes:

I’m excited about a new video I just posted, and I wanted to share it with you. In it, you’ll see me talking with Dr. Catherine Cavagnaro about lift, slipping and skidding stalls, spin recovery, wake turbulence, PIO (pilot induced oscillation) when landing and more. Plus, you’ll see all of her videos that we talked about during the interview. They include early smoke tunnel research on lift, views of yarn tiffs on her airplane as it stalls and spins in different configurations, and wake turbulence demonstrations.

The video is here. Subscribe free to Max’s ANT podcast, which each week covers recent general aviation news and human interest features, and a focus topic usually on flying safety or performance, often with interesting guests.

See:
https://youtu.be/JMMgJ5AhK-o
https://aviationnewstalk.com

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Thomas P. Turner, M.S. Aviation Safety
Flight Instructor Hall of Fame 2015 Inductee
2010 National FAA Safety Team Representative of the Year
2008 FAA Central Region CFI of the Year
Three-time Master CFI