Safety, Comfort, Reliability

Keep them in that **order!**

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As pilots for the 89th Airlift Wing at Andrews Air Force Base (now Joint Base Andrews), we had hammered into our heads the credo: "Safety, Comfort, Reliability." We were to do everything possible to provide our passengers a reliable trip, but we were not allowed to sacrifice their comfort to make that happen. Similarly, we were told to ensure they had a comfortable ride but were forbidden to sacrifice safety.

So, our unofficial motto became: "Safety, Comfort, Reliability — in that order!" This code of conduct should be familiar to most business and commercial aviation crews. But there is a problem with it.

Grammatically, you can think of those commas standing for a sequential order. Be safe, then provide a comfortable ride, and then look out for the schedule. But each of these factors tends to be interrelated and sometimes we find ourselves thinking about all three, but prioritizing the wrong element. As with many things in aviation, a mathematical treatment can lend some clarity. Our motto might be better expressed as: "Safety > Comfort > Reliability." The preceding elements are "greater than" the subsequent. But theory is often overwhelmed by reality.

When Reliability > Safety

Broken down to its simplest form, the job of any pilot is to take off, land and everything in between as safely as possible. We are often judged as aviation professionals by our ability to leave here and land there as scheduled; and therein lies the temptation to invert the Safety > Reliability relationship. This pressure exists on airline pilots as well as business and corporate aviators; the NTSB database is filled with countless examples. Examining a few can help illustrate how even highly respected pilots can place reliability over safety.

Some pilots have the ill-conceived notion that faster means better in all aspects of aviation, even if that involves skipping a long list of required pre-takeoff checks. The 2014 crash of a Gulfstream IV from Hanscom Field in Bedford, Massachusetts, left the industry stunned. It was inconceivable that two professional pilots would

Two VC-25A aircraft of the 89th Airlift Wing

intentionally skip a required flight control check prior to takeoff, a step that would have revealed that they had forgotten to disengage their flight control gust lock prior to engine start.

To get a sense of how widespread the problem is, the NBAA conducted a review of 379 business aircraft operations from 2013 through 2015, examining over 144,000 flights for adherence to required flight control checks prior to takeoff. In 16% of the takeoffs, pilots did only a partial check, and in 2%, the pilots failed to perform any check of the flight controls at all. A proper flight control check can be accomplished in less than half a minute in most aircraft; can the need to save so little time really have corrupted so many pilots?

Even when the time saved is much more than a few minutes, the schedule cannot overrule safety. In the case of the 1982 crash of Air Florida Flight 90 into the Potomac River, the captain was loath to return to the gate for deicing since doing so could have delayed the flight an hour or more. However, not only were the wings contaminated with snow, the aircraft's left engine pressure probe was blocked. That caused the engine pressure ratio indicator to underreport thrust settings and the crew attempted the takeoff with insufficient thrust. The first officer noted, " . . . that's not right . . ." early during the takeoff, but the captain convinced him otherwise. Rejecting the takeoff would have delayed the trip even longer; but continuing the takeoff cost 74 lives. Only one crewmember and four passengers were fished out of the icy Potomac alive.

Even after you've made it off the ground, the pressure to achieve the all-important schedule continues. When faced with an aircraft malfunction, we often decide we can press on to our destination, overflying viable airports. In 1983, all 10 occupants of Air Illinois Flight 710 were killed when the captain made such a decision. One of the aircraft's generators failed shortly after takeoff and the first officer erroneously isolated the remaining generator, causing it to fail as well. At that point the captain could have returned to the departure airport in VFR conditions in less than 6 min. He elected to continue to his destination in IMC using only battery power. His decision proved fatal to all.

The greatest temptation to make it to one's destination may occur just 200 ft. above the runway's surface since going missed approach to the alternate can delay passengers by hours or even days. While this pressure certainly exists in every airline cockpit, it is nowhere greater than on a business jet with the owner or principal passenger in the jump seat.

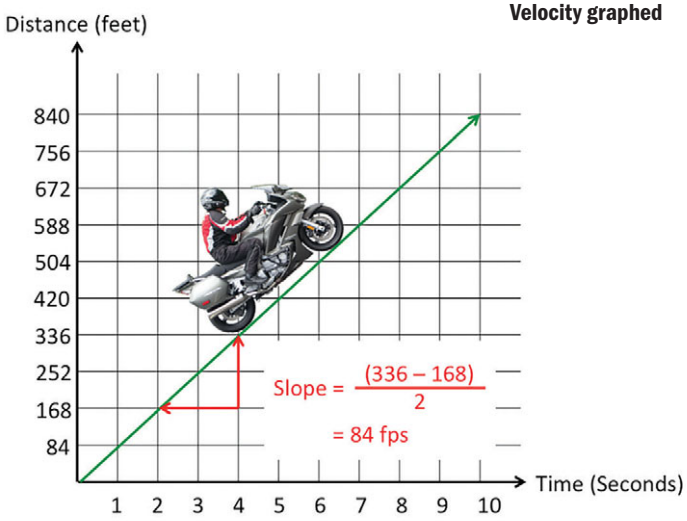
In 2001, the crew of a chartered Gulfstream III (N303GA) made many procedural errors that appear to defy logic during their evening instrument approach into Aspen Airport, Colorado (ASE). For example, why would experienced professional pilots execute an instrument approach into mountainous terrain and then descend below the minimum descent altitude without visual contact with the runway or its environment? There is no doubt the charter customer placed pressure on the captain following their delayed departure; but the captain's ultimate responsibility is to ensure safety concerns outweigh the need to meet a schedule.

Safety > Reliability (Always)

There is an old saying in business aviation: "You pay me to say 'No.'" Anyone can succumb to the pressures of having to make a less than airworthy airplane fly, to make a scheduled departure time despite weather and other external factors, and to land at the requested destination despite fuel, weather and other concerns. It takes a consummate professional to always keep in mind that Safety > Reliability. But how does one beat back the pressures sure to come when things don't go strictly to plan?

The departure end of Runway 31, La Guardia Airport

GOOGLE EARTH



Velocity graphed

(1) Have a firm grasp on aircraft limitations set forth by its manufacturer, on government regulations and on industry best practices. If you elevate the decision to those who have come before you, you increase the weight of evidence on the side of safety. You cannot fly at night with inoperative position lights, for example, because 14 CFR 91.209 forbids it.

(2) Frame your decision in terms of safety and make safety a prerequisite, not an option. You insist on fuel reserves well above the legal minimum, for example, because air traffic and weather are unpredictable and the extra fuel gives you options that make safe flight possible even when things change.

(3) Make each Safety > Reliability decision a conspicuous one. Doing so reinforces your priorities with your employer and serves as an example for your peers.

While these Reliability > Safety miscalculations have brought down many airplanes over the years, the solution would seem straightforward: Follow all published guidance and make common-sense decisions. However, pilots often fall prey to a more insidious error, striving to provide the greatest comfort at the expense of safety. Most pilots will tell you they would never do that, but what then explains the tendency to land long?

When Comfort > Safety

We professional pilots fall into two categories when along for the ride in someone else's cabin: disinterested, "too cool to care" aviators or armrest gripping white knucklers. I was a passenger on a commercial airline flight into New York's LaGuardia Airport (LGA) two years ago that turned me from the former to the latter. I will never again be able to sleep through an airline pilot's landing as a result.

I was sitting on the right side of the airplane, just forward of the wing for our approach, doing my best to appear the nonchalant passenger. "Yeah, I'm a pilot," my look was designed to telegraph. "I've done this approach a hundred times and it is no big deal." Every now and then I would steal a glance out the window and deduced we were on the ILS to Runway 31. Gear, flaps and engine pitch told me were established on the glideslope. When the throttles came to idle my eyes were shut, feigning the sleep of a weary traveler. And then . . . nothing. As a pilot, I shoot for idle thrust at touchdown and don't mind another pilot getting the throttles a little early. But I would never tolerate a 5 sec. flare. I opened my eyes just as the wheels kissed the pavement and I saw the single-bar fixed-distance marker disappear under our wing.

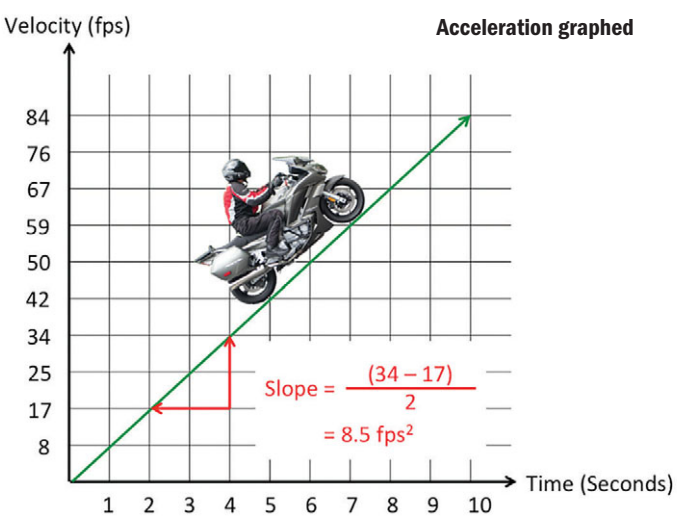
It wasn't as bad as I had imagined, I thought. The single-bars are 2,500 ft. down the runway, so it was a long landing but not terrible. But then I saw the double-bar fixed distance marker. (See photo on page 43)

We hadn't touched down just 2,500 ft. from the approach end of Runway 31 but with just over 2,500 ft. remaining from the departure end. The runway is 7,003 ft. long so our long landing was 4,500 ft. from the approach end.

Predictably, the pilot gave the aircraft all the brakes he could muster and I could feel the anti-skid system doing its best to keep the tires from turning into a pool of liquefied rubber. The airplane came to an unceremonious stop and we made a 90-deg. turn to the left, our wing tracing a line over the opposite runway's edge and giving us on the right side of the aircraft a close-up view of Flushing Bay.

My thoughts ran back to three airliners that ended up in the water here, all due to pilot error. An Eastern Air Lines flight in 1945 failed to stop after an approach that was too high and too fast. A USAir flight crashed after the pilot was unable to keep the airplane on the runway during takeoff because his rudder trim was misset. In 1992, another USAir flight failed to take off because it was not properly deiced. And now, in 2014, we almost added another to the list.

As we passengers deplaned, the captain stood at the entry door, beaming a major airline smile, ready to accept the accolades for his "grease job" landing. I looked him in the eye and said, "I know where you touched down and I don't appreciate it." He diverted his eyes to his shoes and said, "I know, I'm sorry."



Acceleration graphed

Safety > Comfort (Always)

Some pilots pride themselves on making the smoothest possible touchdown — what other gauge does the passenger have to judge a pilot's performance? — while paying lip service for the need to always fly a stabilized approach and to land in the touchdown zone and on speed. But they often end up much farther down the runway and going much slower than a minimum safe flying speed.

Boeing 777 lands in Washington Dulles International Airport (KIAD)

But this touchdown roulette isn't the only gamble some pilots make in an effort to provide that extra level of comfort. An excessively slow rate of takeoff rotation can completely negate obstacle clearance planning. Routinely selecting "half-bank" autopilot turns can place an airplane outside of protected airspace. Choosing a lower than optimal altitude to improve cabin pressurization puts an airplane in denser air traffic. Forgoing reverse thrust after touchdown to keep noise levels down not only wears brakes but also gives them more work to do when they are needed the most.

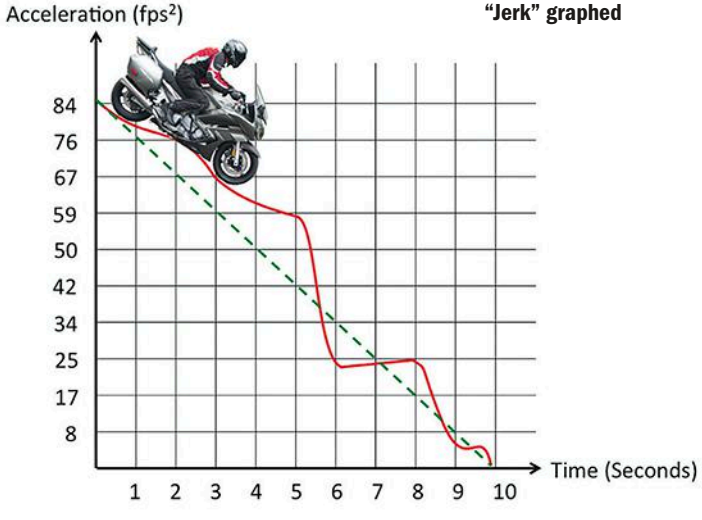
Pilots who came of age fighting for that smooth "grease job" landing will argue that touching down at a slower speed actually helps the brakes and reduces component wear from the jolt of a firmer arrival. They neglect to consider that an airplane is at its most vulnerable in the flare with the engines at idle and the angle of attack high and getting higher. One gust of wind can drop a wing in an instant and the engine spool-up time can make an escape questionable. But won't passengers object to the "rougher" treatment?

Let's consider a more earthbound example to fully understand what smoothness really is. If a motorcyclist is riding along a marked course and passes the 336-ft. mark 2 sec. after the 168-ft. mark, his progress can be plotted by subtracting distance markers and dividing the result by the elapsed time. In our example, the biker is doing (336 – 168) / 2 = 84 ft. per sec. On a graph this is known as the slope of the plot. This "distance divided by time" is the pure definition of velocity.

Now if it took the biker 10 sec. to go from a standing start to that velocity, and if the biker went from a standing start to that velocity smoothly, his increasing velocity can also be plotted graphically. If we were to take a snapshot of the bike's speedometer at two instances and divide that by the elapsed time, we will have the acceleration. In this case, the bike is accelerating (34 – 17) / 2 = 8.5 ft. per sec. per sec. (His velocity is increasing 8.5 ft. per sec., every second.)

But our debate is over smoothness; wouldn't it be nice to have a similar mathematical description akin to velocity or acceleration? We have just such a thing and it is called "jerk." (Note: deceleration is negative acceleration, but it is acceleration nonetheless.)

"Jerk" graphed



We can take snapshots of the bike's acceleration and divide that by the elapsed time yet again. Let's say our biker spots an obstacle on the road and decides to slow down a little at first, and then a lot, and then rethinks it and eases up on the brakes again. This on and off braking will end up with a jerky deceleration that can even be seen in the motorcyclist's heading bobbing fore and aft.

There is a direct correlation with our motorcyclist's braking and that of an airplane. You can set the airplane down and apply a constant brake pedal pressure to start the deceleration. As the brakes heat up and become more effective they will increase the rate of deceleration. From the airplane's cabin there will not be any "jerk" because the rate of increase in the deceleration is constant.

The micro-lesson from this brief sojourn into physics is that you can have a firm landing followed by a smooth deceleration and still have the passengers think nothing of the experience. (In the end, isn't that what we want?) Or you can gamble on your touchdown point and risk having a jerky braking effort to follow.

The macro-lesson applies to all facets of aviation, not just the landing phase. Your efforts to make the act of flying seem smooth also risks making the act of defying gravity more risky. A safer approach is to learn to fly the aircraft as safely as possible while understanding where smooth works in your favor or only to increase the risks.

While I was a pilot for the 89th Airlift Wing we had a cynical motto for those pilots who lost sight of "Safety, Comfort, Reliability." These pilots, we said, believed in "Reliability, Reliability, Reliability." It is a mindset we are all susceptible to adopting. If in a long career you have never canceled a flight due to a mechanical issue or have never gone missed approach in the weather, it could be that you have been very lucky. Or it could be that your math is wrong.

It is never too late for a refresher: Safety > Comfort > Reliability. **BCA**