Beyond the Checkride

Flight Basics Your Instructor Never Taught You

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BRIEF CONTENTS

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CHAPTER 1

Basics Rarely Taught Completely

Once you have tasted flight, you will walk the earth with your eyes turned skyward. For there you have been, and there you long to return.

—LEONARDO DA VINCI

Maneuvering Speed

It's not marked on the airspeed indicator, although it may be placarded on the panel, and you may have to search through the FAA-approved (Federal Aviation Administration) *AFM* (*Airplane Flight Manual*) to find it, but one of the very most important numbers for the pilot to know is "V_a"—or maneuvering speed. It behooves every pilot to know and thoroughly understand maneuvering speed and why it is so important to go right to this speed especially when turbulence is encountered.

I know a flight instructor who has, for several years, taught his students to slow down in rough air by explaining that it works the same way as an automobile going down a rough road or crossing a set of bumpy railroad tracks. If the car is slowed down, it will ride the bumps, and although the ride may not be smooth, no damage will result. Conversely, if the driver takes the bumps at a high rate of speed something is likely to break. While this unique instruction technique may accomplish the purpose, it fails to properly explain what maneuvering speed is and why it works to prevent structural damage.

Sooner or later every pilot becomes acquainted with the definition of maneuvering speed as the maximum speed at which the pilot may make an abrupt, full-control deflection without causing structural damage. When reference is made to control deflection, it means all the controls, throttle, flaps, ailerons, rudder, and elevator. Which one is being emphasized? The elevator, because it will cause the airplane to go through high amounts of force with only a small deflection, much more so than any other control surface. Students are told to go to and maintain V_a whenever they encounter turbulence, or rough air, but I've found that seldom are they completely explained why, or what may happen to their aircraft if they don't.

In order to clearly see the answer to these questions, let's hypothesize two scenarios. First, assume you are charging through the air well above maneuvering speed. Now suddenly, grab the yoke with both hands and give a good healthy tug right to the stop. The aircraft will abruptly pitch up, your butt will be jammed down in the seat, your cheeks will sag down toward your chin, and all that force will bend the wings back, or worse, break 'em off! Airplanes just don't fly very well when the wings fall off. Now let's do the same thing while cruising at or below maneuvering speed. When we abruptly yank the yoke full back, right to the stop, the airplane will respond by zooming up until it runs out of poop (until all the energy is dissipated), and then it will what? Stall, that's what! Now which would you rather do, recover from a stall or attempt to fly an airplane from which the wings just departed? What we've seen is that maneuvering speed is simply the speed at which an airplane will stall instead of bend or break.

While cruising along in light chop receiving the occasional jolt that tightens the belt across the lap, everyone who operates a modern airplane with an audible stall-warning device has at one time or another heard the stall-warning horn sort of light ticking with an occasional *beep-beepity-beep*. And if the airplane has a visual (red light) stall-warning device, it will flicker in that situation. This device is letting the pilots know that they have encountered a vertical gust, an updraft, which by striking the underside of the wing has momentarily increased the angle of attack above the crucial stall point. The airplane has briefly stalled, but the stall was so quick and transitory that the application of recovery technique was unnecessary. The airplane simply flew out of it before the pilot could even react. However, if this same event, the vertical gust, should occur at high cruise speed, well above maneuvering speed, the airplane structure might well be damaged—and that's why it is necessary to go to and maintain maneuvering speed when penetrating turbulence.

The fact that maneuvering speed is that speed at or below which an airplane will stall rather than have the structure yield also explains why V_a is a higher speed for a heavily loaded airplane than for the same airplane operating substantially below maximum allowable gross weight. An airplane operating at maximum gross weight can withstand a harder shove upward on the underside of the wing before it bends or breaks than the same wing carrying a lighter load. Also, an airplane stalls at a higher speed when it is heavy than when it is lightly loaded. This explains why many approved flight manuals and pilot's operating handbooks list several different values for maneuvering speed, depending on the weight at which the airplane is being flown.

Another point to remember is that although the airplane may take the bumps resulting from flying through turbulence at a high rate of speed without bending or breaking, the structure is being weakened to the point that it may ultimately bend or break, even someday in the future. This is exactly why several years ago the FAA issued a huge AD (Airworthiness Directive) regarding the wing spar in Cherokee aircraft. The AD was later modified when it was realized that all the spars which had cracked were in airplanes used for pipeline patrol, which necessitated flying at low altitudes where the turbulence is more constant.

Co-Author's Corner: Maneuvering Speed

As Howard Fried stated above, if you are experiencing air turbulence at any time, or expect to, it's wise to slow down to the aircraft's V_a (*maneuvering speed*). And often, it's not that much of a slowdown; surely you're not going slower than the cars below you. For example, a Piper Archer II's *Pilot Operating Handbook*, with a 181-horsepower engine, typically shows a *Maximum Structural Cruising Speed* of 125 KIAS (*Knots Indicated Airspeed*). The Green Arc, known as the *Normal Operating Range*, lists speeds in the range of 55 to 125 knots. The *Design Maneuvering Speed* (V_a) is listed at 89 KIAS when the gross weight is at or above 1,634 pounds, and 113 KIAS when the aircraft's gross weight is 2,550 pounds or more. A *caution* added to the information states:

> Maneuvering speed decreases at lighter weight as the effects of aerodynamic forces become more pronounced. Linear interpolation may be used for intermediate gross weights. Maneuvering speed should not be exceeded while operating in rough air.

Hopefully Howard's important information regarding spars will provide factual evidence for today's pilots that even though we may not see a physical aircraft problem after an encounter with turbulent air, damage may indeed have occurred internally. (A picture of a wing's spar is shown in Figure 1-1.)

Figure 1-1 Photo of the Van's RV 12 LSA experimental aircraft wing displays the main and rear spars (solid, lengthwise rails)—and attached ribs, which give the wing its shape and added strength. (Photo courtesy of Jim Olson, NC.)

In his explanation of in-flight breakups, Howard hopes to make it clear that airplanes can and do come apart when mishandled. Shortly after earning their pilot's certificate, too many new pilots have a feeling of invulnerability; about themselves as well as their airplanes. They can easily fail to comprehend that in-flight breakups really do happen, often occurring when VFR (visual flight rules) pilots mistakenly fly into IMC (instrument meteorological conditions) weather.

Additionally, pilots often see clouds a distance from thunderstorms and don't easily recognize that trouble is brewing. One pilot, Rod McDermott, who encountered a lone cloud described it in the July 2012 issue of AOPA PILOT's column "Never Again." The article shares how the pilot was flying over the stormy Sierra mountain range near Lake Tahoe and Reno, Nevada. Descending on instruments for landing at Reno/Tahoe International Airport (at an elevation of 4,415 feet above sea level) from FL 220 (Flight Level 22,000 feet mean sea level) to 17,000 feet in his Piper Malibu Mirage, he continued down to 9,000 feet on reduced power due to a few PIREPs (pilot reports) of severe turbulence, adding:

> … Since I could clearly see the airport in the distance, I said this seemed like a good approach. He cleared me to descend to 9,000 and proceed direct to Reno, expecting a left downwind approach.

The power was back, the gear was down, and I started a gradual descent, keeping the airspeed below 120 KIAS the entire way. This was going well. We had experienced only light to moderate chop, and we were going to make our destination of Reno.

As I neared the runways at Reno, flying directly perpendicular to my intended landing runway, a lone cloud sat directly over the airport at about 10,000 or 11,000 feet. It didn't seem big, was definitely not a cumulous cloud, didn't seem too far around, and wasn't very high. I didn't think anything of it since I would be safely below it by at least 1,000 to 2,000 feet. As I neared the cloud it started to get bumpy, and I told everyone to make sure they were buckled tight. I turned off the autopilot and allowed the airplane to float over the waves, if we were going to hit any. I also began pulling the power back even more as I didn't care if we lost pressurization being at 9,000 feet now.

Right underneath the western edge of the cloud, I immediately hit a wall of rising air and it drove the vertical speed indicator to 2,500 fpm in an instant. We were pushed into the cloud and tossed around violently. I watched the altimeter and airspeed indicator to make sure my speed didn't pick up too much and to make sure I still had some good distance between us and the ground. The altimeter read 11,000 feet, but had read 9,000 an instant before. My attitude was all over the place, and I was doing everything I could to maintain some semblance of straight-and-level flight. I pulled the power back to idle and watched the airspeed yo-yo from 100 to 130 KIAS. The G500 PFD flashed Fail twice, meaning it couldn't get accurate attitude information.

We were out of control, in a cloud, and I was just hoping we could get in the clear without losing part of the airplane so I could get an attitude reference the old-fashioned way—with my eyes.

After what seemed like five minutes but probably was only 30 seconds of terror, we made it to the other side of the cloud, into the clear, and I could see we were right side up, going about 100 KIAS, and still at about 11,000 feet. I told the NorCal controller that we encountered severe and possibly extreme turbulence but that I didn't think any damage was done and no one was hurt. My wife, sitting next to me in the right seat, had her head in her hands and was praying, which was good because she was doing everything she could to remain calm. I told the controller I wanted direct to the airport, and he asked if I could cancel IFR and said he could clear me direct if I would.