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Maneuvering Speed Myth... **The myth is:** I can apply full and multiple control movements as long as I'm below maneuvering speed.

The NTSB has pointed out that this broader definition, although widespread among pilots, **is Incorrect**. Engineers consider each axis separately in designing for the air loads accompanying an abrupt, full control input at maneuvering speed. "Full inputs in more than one axis at the same time and multiple inputs in one axis are not considered in designing for these [VA] flight conditions." The particular "multiple inputs" that prompted NTSB comment were the rudder reversals leading to a yaw over swing followed by a final reversal that destroyed the vertical tail of American Airlines Flight 587 on November 12, 2001.

Where do pilots get that idea?

FAA's AC 61-23C, "Pilot's Handbook of Aeronautical Knowledge," says that "any **combination of flight control usage**, including full deflection of the controls, or gust loads created by turbulence should not create an excessive air load if the airplane is operated below maneuvering speed." Our Cessna 172XP Pilot Operating Handbook refers to maneuvering speed, Va, as follows: "The maximum speed at which you may use abrupt control travel", and "Do not make full or abrupt control **movements** above this speed." However, the FAA says Va only considers a single full control input in any single axis. The design standards also consider an abrupt return of control to the neutral position. The standards do not address full control inputs in more than one axis at the same time or multiple inputs in the same axis. Therefore, the structural design requirements do not ensure the airplane structure can withstand multiple control inputs in one axis or control inputs in more than one axis at a time at any speed, even below Va.

Regulations for the certification of the normal category airplane require that it be able to withstand a derived gust velocity of 30 feet per second (fps) at **maximum level flight speed and normal-rated power**. (i.e. normal cruise speed and configuration). Moderate turbulence is classified as a derived gust velocity of 20-35 fps. This means anytime you encounter moderate or greater turbulence, you should slow to maneuvering speed.

So, you are flying the C172 with two passengers. You determine from the POH that you are operating in the Normal Category, (+3.8G, -1.52G) and you are about 300lbs shy of gross weight. What is your Va? Maneuvering speed is based on multiplying the *power off* stall speed (V_{S1}) by the square root of the limit positive maneuvering load factor (in this case +3.8G). Vs1 (59mph) is based on gross weight. 59MPH X √ 3.8 = 115 MPH. In this case, you are not at gross weight, but 300 lbs lighter and may be using power at the time of control deflection (or turbulence). Either would cause you to have a lower stall speed, so estimate 50 MPH as your stall speed for the calculation. That would bring Va down to 97MPH for this flight. This is much lower than the 120 MPH in the POH. The plane should stall before damage occurs if flown at *about* 97 or slower in the event of a *positive load of more than 3.8G* (for reference, a steep turn is about 2G's). Your negative load limit is *only -1.52G!* 50MPH X √ 1.52G = only 62MPH. This is why you don't want to try to maintain altitude if caught in heavy turbulence or in a thunderstorm! **So when do you use Va**? When the air is rough, or abrupt maneuvering is anticipated, get down to ***estimated* Va** based **on weight**, which will probably be ***slower*** than published in your POH, avoid abrupt asymmetric maneuvers that involve rolling and pulling on the controls, and move the rudder as little as necessary. Maybe the myth should be rephrased: I can apply a **single** full control **movement** as long as I'm below Va based on **estimated stall speed** as determined by actual weight and power setting. A couple of good links on the subject: How Maneuvering Speed Is Calculated and Mountain Turbulence and Va