Prologue to SAIB CE-11-17

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The FAA issued Special Airworthiness Information Bulletin (SAIB) CE-11-17 on January 18, 2011 to clarify the definition of design maneuvering speed, V_A, and its importance vis-à-vis airplane design limits. All pilots, but especially aviation educators need to understand that V_A is not a static value. By its very definition, V_A is fluid, varying with aircraft weight. It is equally important to appreciate that design limits are fluid as well, and when listed, are applicable to a specific set of conditions.

V_A is simply the stall speed corresponding to a particular design limit *g*-load. For example, in positive *g* flight at max gross weight, in the **Normal category**, and with flaps up and the pilot only pulling on the stick/yoke, V_A represents the airplane's +3.8 *g* stall speed as follows:

$$V_A = V_S \times \sqrt{\text{(design limit)}} = V_S \times \sqrt{3.8} = 1.95V_S$$

In other words, V_A (CAS) will be about twice the wings-level stall speed (CAS) under the conditions stipulated. Modern light aircraft certificated under CFR Part 23 generally cannot have either V_{SO} or V_{S1} speeds in excess of 61 knots CAS at max gross weight. Hence, V_A will not exceed about 120 knots (≈140 mph) CAS with flaps up at max gross weight; it will often and necessarily be slower than this in practice.

Design limits vary as well, as illustrated in the following table (max gross weight):

Flaps	Control Input	Positive *g* Design Limit	Corresponding CAS $V_A = V_S \times \sqrt{\text{(design limit)}}$
Up	Pulling Only	+3.8	$V_A = 2V_S$
Down	Pulling Only	+2.0 (unless AFM notes otherwise)	$V_A = 1.4V_{SO}$
Up	Simultaneous Rolling/Pulling	+2.5 (at least 2/3 of Flaps Up, Pulling Only value)	$V_A = 1.6V_S$

Another good example of the fluid nature of V_A and design limits occurs in the Acrobatic category. At max gross weight, with flaps up and pulling on the elevator control only, the positive design limit is typically +6.0 *g*. V_A in this case is 2.4 times the corresponding V_S (CAS). But given simultaneous inputs along multiple axes, the design limit shrinks to +4.0 *g*. V_A likewise decreases to 2 x V_S (CAS). The maximum recommended entry speed for snap rolls (accelerated stall/spins often initiated with rapid and full inputs along at least two axes simultaneously), therefore, are generally set so that the max load imposed will not exceed +4.0 *g* (simultaneous inputs) and not +6.0 *g* (elevator only input). In other words, snap roll speeds are usually equal to or slower than the +4.0 *g* design maneuvering speed.

Be careful not to confuse design maneuvering speed, V_A with operating maneuvering speed, V_O in newer designs. When it comes to discussions about "full or abrupt" use of controls, flying in turbulence, etc., V_A for the particular configuration is the key speed.

For additional information about V_A and design limits, visit the *Aerodynamics* section of the SAFE Library and check out the PDF document and PowerPoint presentation donated by Master Instructor Emeritus, Alan Davis.

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FAA
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SPECIAL AIRWORTHINESS INFORMATION BULLETIN

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This is information only. Recommendations aren't mandatory.

Introduction

This Special Airworthiness Information Bulletin informs you of an airworthiness concern that is relevant to all airplanes certificated under Title 14 of the Code of Federal Regulations (14 CFR) part 23, as well as those certificated under the previous Civil Air Regulations (CAR) part 3. This information is also relevant to any special light-sport category airplanes (S-LSA), experimental light-sport airplanes (E-LSA), and experimental amateur-built airplanes.

At this time, the Federal Aviation Administration (FAA) has determined that this airworthiness concern is not an unsafe condition that would warrant airworthiness directive (AD) action under 14 CFR part 39.

Background

On November 12, 2001, American Airlines Flight 587, crashed shortly after takeoff from New York's John F. Kennedy International Airport. The crash killed all 260 people aboard and 5 people on the ground. The National Transportation Safety Board (NTSB) determined "the probable cause of this accident was the in-flight separation of the vertical stabilizer as a result of the loads beyond ultimate design loads that were created by the first officer's unnecessary and excessive rudder pedal inputs." As a result of this accident and subsequent investigation, it was revealed that many pilots have a misunderstanding of what the design maneuvering velocity (speed), V_A, represents. Many pilots believe that as long as the airplane is at or below this maneuvering speed, they can make any control inputs they desire without any risk of harm to the airplane. This is not true.

The design maneuvering speed (**V_A**) is the speed below which you can move **a single** flight control, **one time,** to its full deflection, for **one axis** of airplane rotation only (pitch, roll or yaw), in **smooth air**, without risk of damage to the airplane.

Even though the accident discussed above is a part 25 airplane, V_A is applicable to part 23, CAR 3, and LSA airplanes. Also, even though experimental airplanes may not have a published V_A , they will still have some maximum maneuvering speed associated with the maximum structural design loads. Therefore, the pilot should be aware of what speed this is, and adhere to the guidance herein. The regulations governing the design strength requirements for airplane structure require adequate strength for full control deflection (below V_A). However, they do not require the manufacturer to make the airplane strong enough to withstand full control input followed by a full control input in the opposite direction, even below V_A. Neither do they require the manufacturer to design the airplane for more than one simultaneous full control input such as full ailerons with full elevator and/or rudder.

V_A, as published in the airplane flight manual (AFM) or pilot's operating handbook (POH), is valid for operation at the gross weight stated, which is typically at max gross weight. It is especially important to note that V_A decreases as the airplane weight decreases. At first, this may seem counter intuitive. All pilots understand that when the airplane is subjected to an external force, such as the aerodynamic force from a control surface, the airplane responds by accelerating (rotational acceleration) about one of the airplane's axes. This was stated many years ago in Newton's Second Law of Motion. The law states that when an object of mass 'm' is acted upon by a force 'F', it will undergo acceleration 'a' in the same direction as the force. More simply stated in the widely known equation "F = ma", which can be rewritten as "a = F/m". Rewritten this way, it is clear for a given control force 'F', as the airplane weight 'm' decreases then the acceleration 'a' will increase. This higher acceleration gives rise to higher loads on the airplane structure. Therefore, as the airplane weight decreases, the allowable maneuvering speed must also decrease, to ensure that the airframe is not damaged. Pilots may remember from their written exam that $V_{A\text{-}NEW} = V_A \sqrt{(W_{NEW}/W_{MAX\text{-}GROSS})}$ as the way to calculate the corrected (new) maneuvering speed due to operating at a weight less than the maximum gross weight. NOTE: This formula is for calculating the V_A change about the pitch axis; however, it can be used for all axes.

Recommendations

The FAA wants to clarify that operators should know what the maneuvering speed is and to caution pilots on what to avoid by adhering to the information described above and contained in the regulations. We recommend the following for maneuvering at, or even below, V_A:

- DO NOT apply a full deflection of a control, followed immediately by a full deflection in the opposite direction.
- DO NOT apply full multiple control inputs simultaneously; i.e., pitch, roll and yaw simultaneously, or in any combination thereof, even if you are below V_A.
- Reduce V_A when operating below gross weight, using the following formula:

$$V_{A\text{-}NEW} = V_A \sqrt{(W_{NEW}/W_{MAX\text{-}GROSS})}$$

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