MEMO

To: **The Airman Certification Standards Working Group**

From: **Rich Stowell, PO Box 1026, McCall, ID 83638, rich@richstowell.com**

Date: **August 30, 2016**

Subject: **FAA-S-ACS-6 (Change 1), June 2016**

Introduction

The following remarks pertain to requirements in the Private Pilot-Airplane Airman Certification Standards (ACS) regarding maneuvering during slow flight, specifically: PA.VII.A.S2 and PA.VII.A.S3.[1]

For some context, I have been a full time flight instructor since 1987. I am a nine-time Master Instructor, the 2014 National FAA Safety Team Representative of the Year, and the 2006 National Flight Instructor of the Year. I am a recognized subject matter expert on loss of control in general aviation with the following experience:

- 10,000 hours of total flight time
- 9,000 hours of flight instruction given
- 25,000 landings
- 34,000 spins in 235 general aviation aircraft
- 500 single-engine aircraft N-numbers in my logbook
- 380 aviation talks presented
- More than 75 aviation articles and three aviation textbooks published

At issue is wording in the ACS that requires applicants to demonstrate the following levels of skill while maneuvering during slow flight:

> Establish and maintain an airspeed, approximately 5-10 knots above the 1G stall speed, at which the airplane is capable of maintaining controlled flight without activating a stall warning.
>
> Accomplish coordinated straight-and-level flight, turns, climbs, and descents with landing gear and flap configurations specified by the evaluator without activating a stall warning.[2]

---

[1] FAA, *Private Pilot–Airplane, Airman Certification Standards* (FAA-S-ACS-6, Change 1), June 2016, 54.
[2] FAA, *Private Pilot–Airplane, Airman Certification Standards*, 54.

ACS Wording Versus Airworthiness Standards

Given FAA airworthiness standards concerning stall warning systems, the simultaneous requirements of "5–10 knots above the 1G stall speed" and "without activating a stall warning" are incompatible. Airworthiness standards in effect in 1993, for example, required the following:

> stall warning must begin at a speed exceeding the stalling speed by a margin of not less than 5 knots, but not more than the greater of 10 knots or 15 percent of the stalling speed…[3]

Airworthiness standards since 1996, on the other hand, have required stall warning activation to begin "at a speed exceeding the stalling speed by a margin of not less than 5 knots…"[4] This standard does not specify an upper speed limit for activation of stall warning systems. As a result, while stall warning could be activated—indeed, should be activated per airworthiness standards—no less than 5 knots before the reference stall speed, it could activate with a significantly greater margin to the stall speed.

The ACS requirement to fly without activating stall warning clearly conflicts with the simultaneous requirement to establish and maintain an airspeed 5–10 knots above the reference stall speed. Moreover, design parameters that determine when artificial stall warning activates are beyond the control of the applicant—so much so that an applicant may be forced to transition out of slow flight to prevent stall warning from activating, defeating the purpose of this task altogether.

FAA Justification

The incompatibility between the ACS wording and airworthiness standards notwithstanding, the FAA has offered the following justification:

> The guidance has always intended for there not [emphasis added] to be a stall warning—and that is consistent with slow flight guidance published in AC 120-111.[5]

The assertion regarding no stall warning activation during slow flight is demonstrably false. For at least several decades now, FAA guidance has been unambiguous about its intent to have stall warning activated while maneuvering during slow flight. For example, in the FAA's General Aviation Pilot Stall Awareness Training Study conducted in 1975–76 (the FAA Study):

> the student slowed the aircraft to the speed at which the visual or aural stall warning indicator was continually activated [emphasis added]…. Turns were also made at 30° angle of bank with the stall warning indicator continually activated [emphasis added].[6]

---

[3] FAA, Part 23–*Airworthiness Standards* (specifically §23.207), January 1, 1993, 164.
[4] FAA, Part 23–*Airworthiness Standards* (specifically §23.207), accessed August 19, 2016, available http://www.faa.gov/regulations_policies/faa_regulations/
[5] Email from 9-AVS-ACS-Focus-Team@faa.gov to Howard Wolvington, 10 June 2016.
[6] William C. Hoffman and Walter M. Hollister, *General Aviation Pilot Stall Awareness Training Study* (FAA-RD-77-26), September 1976, 24.

The objective during the FAA Study was for student-participants "to maintain desired heading and altitude at an airspeed and angle of attack which activated the stall warning device [emphasis added], but which did not cause the aircraft to stall."[7] Two noteworthy results from this study:

> The most effective additional training was slow flight with realistic distractions, which exposed the subjects to situations where they are likely to experience inadvertent stalls.[8]

> The extra stall and slow flight training was effective in preventing unintentional spins [emphasis added][9]

Training in slow flight with stall warning activated coupled with realistic distractions was effective in preventing unintentional spins. Read that again: Slow flight with stall warning activated coupled with realistic distractions *was effective in preventing unintentional spins*.

The results of this landmark study have driven FAA stall/spin training policy ever since, starting with the introduction of realistic distractions in 1980, followed by the shift from "stall avoidance training" to "stall and spin awareness training" in 1991.[10,11]

Derived from the FAA study, the series of Advisory Circulars (ACs) entitled, Stall and Spin Awareness Training has offered "guidance to flight instructors who provide that training."[12] The following wording appears in AC 61-67B published in May 1991 through AC 61-67C (Change 2) published in January 2016. All of these ACs recommend the following in Chapter 2, "Stall Avoidance Practice at Slow Airspeeds":

> (1) Assign a heading and an altitude. Have the student reduce power and slow to an airspeed just above the stall speed…

> (2) Have the student maintain heading and altitude with the stall warning device activated [emphasis added].[13,14]

FAA guidance for at least a quarter century has been crystal clear, and for good reason: Training in slow flight with stall warning activated, coupled with realistic distractions, is effective in preventing unintentional spins.

Regarding the reference to AC 120-111, slow flight is described therein as "flight just above the stall speed."[15] This specialized flight training element is intended to expose pilots to "how to maneuver the airplane…without stalling."[16] The status of the stall warning system during slow flight is not mentioned in this AC. However, the AC does list "manually controlled slow flight"

---

[7] William C. Hoffman and Walter M. Hollister, *General Aviation Pilot Stall Awareness Training Study*, 29.
[8] William C. Hoffman and Walter M. Hollister, *General Aviation Pilot Stall Awareness Training Study*, 57.
[9] William C. Hoffman and Walter M. Hollister, *General Aviation Pilot Stall Awareness Training Study*, 56.
[10] See *Use of Distractions During Pilot Certification Flight Tests* (AC 61-91), January 25, 1980.
[11] See *Stall and Spin Awareness Training* (AC 61-67B), May 17, 1991.
[12] FAA, *Stall and Spin Awareness Training* (AC 61-67B), May 17, 1991, 1.
[13] FAA, *Stall and Spin Awareness Training*, 10.
[14] FAA, *Stall and Spin Awareness Training* (AC 61-67C, Change 2), January 6, 2016, 9.
[15] FAA, *Upset Prevention and Recovery Training* (AC 120-111), April 14, 2015, Appendix 1, 9.
[16] FAA, *Upset Prevention and Recovery Training*, Appendix 1, 9.

under the heading "Extended Envelope Training."[17] Revising the long-understood meaning of slow flight as a condition "with the stall warning system activated" now to one "without activation" is incongruous with, and a move away from, the whole concept of "Extended Envelope Training" mandated by CFR §121.423.

In reality, the treatment of slow flight in AC 120-111 is consistent with recommendations made by the International Civil Aviation Organization (ICAO). ICAO describes this specialized training element as follows:

> Slow flight exposes the trainee to flight right above the stall speed of the aeroplane and to manoeuvring [*sic*] the aeroplane at this speed without stalling. The purpose is to reinforce the basic stall characteristics learned in academics and allow the pilot to obtain handling experience and motion sensations when operating the aeroplane at slow speeds during the entire approach-to-stall regime in various aeroplane attitudes, configurations and bank angles.[18]

The "approach-to-stall regime" referenced by ICAO is defined as "Flight conditions bordered by stall warning and aerodynamic stall."[19] Activation of the stall warning system during slow flight is an obvious and integral part of ICAO's Upset Prevention and Recovery Training (UPRT) framework—the very same framework that informed AC 120-111.[20]

The assertion that no activation of stall warning is somehow "consistent with guidance on slow flight published in AC 120-111" is unsubstantiated at best, disingenuous at worst.

Further Rationalization

The August 2016 issue of DPE Tips offers further justification for the ACS wording: "*The FAA does not advocate disregarding a stall warning while maneuvering an airplane.*"[21]

It does not follow that having a student learn to maneuver in slow flight with stall warning activated advocates "intentional disregard" for stall warning. I am not aware of any studies that show a correlation between exposure to stall warning and increased inoculation to it. Recall the FAA Study found that training in slow flight with stall warning activated coupled with realistic distractions *was effective in preventing unintentional spins*.

Consistent with longstanding FAA guidance on stall and spin awareness training, pilots should be taught to integrate sight, sound, and feel while maneuvering in slow flight. They should also be taught to acknowledge stall warning and understand its ramifications. The ability to fly the airplane precisely while stall warning is activated can be a confidence building exercise as well as a way to incorporate angle of attack (AOA) and G-load awareness in real time. While many permutations are possible, following is an example of dialogue that might occur between an instructor (CFI) and student (STU) while practicing slow flight with stall warning activated:

[17] FAA, *Upset Prevention and Recovery Training*, Appendix 1, 2.
[18] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, 2014, 3-9.
[19] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, x.
[20] FAA, *Upset Prevention and Recovery Training*, 1.
[21] *DPE Tips* (Vol 1, Issue 3), August 2016), 1.

CFI: Do you hear the stall warning?
STU: Yes.
CFI: From now on, I want you at least to verbally acknowledge it every time you hear it.

CFI: We are hearing stall warning in this particular configuration, but when else might we hear it?
STU: At any speed, in any attitude, at any power setting.

CFI: Is mechanical stall warning 100 percent reliable?
STU: No.
CFI: What other indications of reduced margin to the stall might we expect?
STU: Reduced control effectiveness and more pronounced engine effects.

CFI: What conditions could cause you to miss hearing the stall warning?
STU: High workload in the traffic pattern, distractions, stress, lack of proficiency.

CFI: I dropped my pencil, please pick it up for me.
STU: Not now, I'm busy aviating!

CFI: What does stall warning mean?
STU: We are operating at high angle of attack, close to the critical angle.
CFI: With regard to your control inputs, what else does stall warning mean?
STU: Do not pull the elevator control any farther aft.

CFI: Are we in a stall?
STU: No, it's just stall warning.

CFI: What will happen if you apply additional back elevator pressure now?
STU: We'll stall the airplane.
CFI: What could happen if we encountered a vertical gust right now?
STU: We could stall the airplane.

CFI: What will happen if we increase the G-load by trying to execute a steep turn now?
STU: We'll probably stall the airplane.

CFI: What should you do if we encounter the stall?
STU: Push the elevator forward.
CFI: What should you do if the engine were to quit now?
STU: Push the elevator forward.
CFI: What should you do to increase our margin of safety to the stall?
STU: Push the elevator forward.

CFI: What should you do to silence stall warning?
STU: Push the elevator forward.
CFI: What should you do to lower the angle of attack?
STU: Push the elevator forward.
CFI: Outside of this training exercise, what will you do if you inadvertently trigger stall warning?
STU: Push the elevator forward.

CFI: If you're not sure what to do when stall warning activates, what should you do?
STU: Push the elevator forward.

CFI: Do you see a trend in the answers to the above questions?
STU: Yes, push on the elevator, don't pull.

Despite the ACS wording and attempts to justify it, the FAA "*still expects a pilot to know and understand the aerodynamics behind how the airplane performs from the time the stall warning is activated to reaching a full stall*."[22] Based on this, it seems not only logical to continue to train and test this critical task as it was done in the FAA Study and as recommended since in FAA guidance on stall and spin awareness training, but also imperative for safety since doing this has been shown to be effective in preventing unintentional spins.

Recommendations

As worded, ACS PA.VII.A.S2 and PA.VII.A.S3:

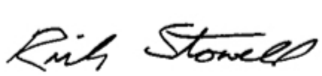
- Retreat from an established training paradigm shown to be "effective in preventing unintentional spins" and, in combination with realistic distractions, the "most effective" training for situations where pilots "are likely to experience inadvertent stalls." [23,24]
- Diminish the importance of gaining valuable experience and confidence with degradation in flight control responsiveness and more pronounced engine effects, as well as the importance of proper coordination in slow flight near the critical angle of attack.
- Contradict longstanding FAA policy and guidance on stall and spin awareness training, as well as recent ICAO recommendations on upset prevention and recovery training.
- Will impede efforts to reduce fatal loss of control accidents in general aviation.

Rather than moving away from a training and testing strategy proven effective in preventing unintentional spins, as well as from the current trend toward incorporating UPRT into all levels of pilot training, I strongly urge FAA to:

1. Realign the ACS wording with longstanding FAA guidance and more recent ICAO recommendations on training and testing within the approach-to-stall regime.
2. Abandon any plans to revise FAA publications to reflect the current ACS wording.
3. Redouble its efforts to emphasize and encourage stall/spin awareness training according to longstanding guidance.
4. Ensure that ground and flight instructors are indeed well-versed in stall/spin dynamics in theory and in practice, as well as available training guidance.
5. Promote AOA and G-load awareness per recommendations from the SAFE Symposium Curricula Breakout Group.[25]

The current ACS wording on slow flight is a step backwards, discourages incorporation of UPRT concepts and extended envelope training, and has the potential to reduce safety.

Respectfully,



Rich Stowell, MCFI-A

---

[22] *DPE Tips*, 2.
[23] William C. Hoffman and Walter M. Hollister, *General Aviation Pilot Stall Awareness Training Study*, 56.
[24] William C. Hoffman and Walter M. Hollister, *General Aviation Pilot Stall Awareness Training Study*, 57.
[25] Society of Aviation and Flight Educators, *Pilot Training Reform Symposium: Preliminary Report* (June 6, 2011), 29.

U.S. Department
of Transportation
**Federal Aviation
Administration**

SAFO

Safety Alert for Operators

SAFO 16010
DATE: 8/30/16

Flight Standards Service
Washington, DC

http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo

A SAFO contains important safety information and may include recommended action. SAFO content should be especially valuable to air carriers in meeting their statutory duty to provide service with the highest possible degree of safety in the public interest. Besides the specific action recommended in a SAFO, an alternative action may be as effective in addressing the safety issue named in the SAFO.

Subject: Maneuvering During Slow Flight in an Airplane

Purpose: This SAFO advises pilots, flight instructors, and evaluators of a change to the evaluation standard for the slow flight maneuver. The Private Pilot Airplane Airman Certification Standards (ACS) (FAA-S-ACS-6), which became effective June 15, 2016, reflects this change. The revised evaluation standard states:

> *Establish and maintain an airspeed, approximately 5-10 knots above the 1G stall speed, at which the airplane is capable of maintaining controlled flight without activating a stall warning.*

Background: Loss of control in flight is the leading cause of fatal general aviation accidents in the U.S. and commercial aviation worldwide. As a result, the National Transportation Safety Board has listed the prevention of loss of control in flight in general aviation on its Most Wanted List of Safety Improvements for 2016. To address loss of control in flight in general aviation, the Federal Aviation Administration (FAA) revised the evaluation standard for the slow flight maneuver and is aligning the associated guidance accordingly.

A pilot's fundamental responsibility is to prevent a loss of control. Loss of control in flight is defined as a significant deviation of an aircraft from the intended flight path and often results from an airplane upset. Low altitude, low speed maneuvering is the most common condition for general aviation in flight loss of control accidents; however, in flight loss of control accidents can occur in all phases of flight. To prevent these types of accidents, it is important for pilots to recognize and to maintain a heightened awareness of situations that increase the risk of loss of control. One such situation is slow flight. A pilot can learn to prevent a loss of control by understanding how an airplane performs in the slow flight regime and by being proficient at controlling the airplane in slow flight.

Airplanes operate at low airspeeds and at high angles of attack during the takeoff/departure and approach/landing phases of flight. It is essential that pilots learn: (1) the airplane cues in that flight condition, (2) how to smoothly manage coordinated flight control inputs, and (3) the progressive signals that a stall may be imminent when deviating further from this condition. In these phases of flight, the airplane's close proximity to the ground could make loss of control catastrophic; therefore, the pilot must be proficient in slow flight.[1]

[1] Title 14 of the Code of Federal Regulations (14 CFR) section 61.107(b), requires a private pilot applicant in the airplane category with a single-engine class rating to receive ground and flight training in slow flight and stalls. To receive the certificate, the pilot must demonstrate proficiency to the established standard.

Discussion: The purpose of performing the slow flight maneuver has not changed from the Private Pilot Airplane Practical Test Standards (PTS), FAA-S-8081-14B. One objective of the slow flight maneuver is to understand the flight characteristics and how the airplane feels with less airflow over the flight control surfaces while in the region of reverse command (i.e., back side of the power curve) near its aerodynamic buffet or stall warning.[2] These flight characteristics include the degraded response to control inputs, the difficulty of maintaining altitude, the need for larger power inputs to accelerate compared to normal flight, and the associated instrument indications. Additional sensory perceptions include seeing less or no horizon as a result of the higher pitch attitude and the reduced ambient sound.

These slow flight characteristics can be experienced, and therefore the learning objective achieved, in climbs, turns, descents, and straight and level flight without intentionally flying the airplane with the stall warning activated. The FAA does not advocate disregarding a stall warning while maneuvering an airplane.[3] With the exception of performing a thoroughly briefed full stall maneuver, a pilot should always perform the stall recovery procedure when a stall warning is activated.

As a result of the Private Pilot Airplane ACS development, and a review of all related guidance material,[4] inconsistencies were discovered. The previous standard for maneuvering during slow flight in the Private Pilot Airplane PTS was for the applicant to establish and to maintain "an airspeed at which any further increase in angle of attack, increase in load factor, or reduction in power, would result in an immediate stall."

The Airplane Flying Handbook (AFH), FAA-H-8083-3, explains slow flight and recommends how to perform the slow flight maneuver. Version A (2004) of the AFH states that one of the elements of slow flight in pilot training and testing is to maneuver the airplane at "the slowest airspeed at which the airplane is capable of maintaining controlled flight without indications of a stall—usually 3 to 5 knots above stalling speed."

According to § 23.207(a), part 23 certificated airplanes must have a "distinctive stall warning." That distinctive warning alerts a pilot of an impending stall and therefore prompts a pilot to perform a stall recovery. When the manufacturer conducts airplane certification testing, the stall warning is required to "begin at a speed exceeding the stalling speed by a margin of not less than 5 knots and must continue until the stall occurs."[5]

Based on the airplane certification standard for a stall warning, a pilot following the AFH guidance of 3-5 knots above the stall speed would most likely be intentionally flying with the stall warning activated, which is a stall indication. Therefore, the AFH guidance to maneuver "without indication of a stall," is

---

[2] Understanding there is variability in when the stall warning activates in different airplanes, pilots should select an airspeed just above the stall warning activation to perform the slow flight maneuver. The 5-10 knot range above the stall speed is a general guide.

[3] This is consistent with the guidance published in Advisory Circular 120-111, Upset Prevention and Recovery Training.

[4] Through the Aviation Rulemaking Advisory Committee (ARAC) the Airman Certification Standards Workgroup (ACS WG) was established. In addition to the development of the various ACS documents, this group of industry representatives was tasked with reviewing the FAA Handbooks and recommending changes to the guidance so they are aligned with the standard. The FAA considered those recommendations as part of its review of the handbooks and will be publishing revisions where necessary. For more information visit: https://www.faa.gov/training_testing/testing/acs/

[5] 14 CFR § 23.207(c)

inconsistent with the suggested airspeed range of 3-5 knots above the stalling speed provided in that same handbook. The PTS requirement to fly at an airspeed at which any further increase in angle of attack would result in a stall means the applicant would have to perform the maneuver with the stall warning activated, which is also inconsistent with the AFH. Advocating maneuvering the airplane just below the critical angle of attack with the stall warning activated is neither desirable nor intended.

While not specifically performed or evaluated as part of the slow flight maneuver, the FAA still expects a pilot to know and understand the aerodynamics behind how the airplane performs from the time the stall warning is activated to reaching a full stall. This can be learned in ground training and further consolidated in the airplane while practicing the Stall Task skills in the ACS. The training should build off of what was learned from the slow flight maneuver and highlight the continued degradation of the flight control response, the more pronounced left-turning tendencies in reciprocated-engine airplanes, and the importance of maintaining coordinated flight. This all contributes to a better understanding of slow flight aerodynamics, stalls, and the necessary actions to recover from a stall, which can ultimately prevent a loss of control in flight.

The revised evaluation standard requires the pilot to maintain a speed referenced to the 1G stall speed. One way to set up for the maneuver is to slow the airplane to the stall warning in the desired configuration and note the airspeed. Next, pitch down slightly to eliminate the stall warning, adjust power to maintain altitude, and note the airspeed required to perform the slow flight maneuver in accordance with the standard. For example, the pilot may first note that the stall warning comes on at 50 knots. A slight pitch down to eliminate the warning, while adjusting the power to maintain altitude, might then cause the airspeed to increase to 52 knots. That 52 knots would be the base airspeed to perform the slow flight maneuver. The pilot can adjust pitch and power as necessary during the maneuver to stay within the ACS airspeed standard of +10/-0 knots (i.e., using the example, the range would be 52-62 knots) without activating the stall warning. By setting up the maneuver this way, the pilot can achieve similar angles of attack for the maneuver, regardless of weight or density altitude, and meet the objectives of the slow flight task.

To remove the inconsistencies, the FAA is revising the AFH, which includes a significant rewrite of Chapter 4. The revised slow flight standard in the Private Pilot ACS will be reflected in that chapter. The FAA anticipates publication of the AFH revision in October 2016.

Recommended Action: Student pilots, flight instructor applicants, flight instructors, flight schools, part 141 pilot schools, part 142 training centers, and private pilot – airplane evaluators should familiarize themselves with the information in this SAFO and adjust training and testing for the slow flight maneuver accordingly.

Contact: Questions or comments regarding this SAFO should be directed to the General Aviation and Commercial Division, AFS-800, at 202-267-1100.