May 26, 2014

Mr. John Duncan
Director, Flight Standards Service AFS-1
FAA National Headquarters
800 Independence Avenue S.W.
Washington, D.C. 20591

Dear Mr. Duncan:

EAA (the Experimental Aircraft Association) greatly appreciates the opportunity to provide comment on the draft of FAA Advisory Circular 90-89B, The Amateur-Built Aircraft and Ultralight Flight Testing Handbook. As you may know, EAA played a prominent role in the drafting of the initial document and our comments reflect our desire to keep the guidance up to date in accordance with current best practices and modern technology.

The suggested changes and modifications to the draft contained herein are based on input from our Homebuilt Aircraft Council, and where appropriate contain content written for our publications by some of the leading experts in the military and civilian flight testing communities.

Our recommendations follow:

1. Chapter 1 Section 1 Paragraph (b) (page 8)

EAA recommends adding the following sentence at the end of the paragraph:

Additionally, the plan should reference the use of checklists to assure that all relevant steps and elements are covered.

Checklists are a convenient and effective way to ensure the test plan is correctly implemented. They should be utilized whenever possible and/or practicable.

2. Chapter 1 Section 4 Paragraph (c) (pages 16-17)

EAA recommends adding an additional Item (11)

The test pilot should employ the use of checklists for both normal and emergency actions and procedures. The Emergency procedures should be also memorized. Add additional notes on the instrument panel to aid in their use if necessary.

Emergency procedures must be second nature to the test pilot. As in the airlines or military, these procedures should be memorized, studied, and if possible rehearsed before flight.

3. Chapter 1 Section 7 "FITNESS INSPECTION—AIRFRAME" (page 21)

EAA recommends adding the following at the end of the introductory paragraph:

A builder-developed comprehensive post assembly checklist should be used, and the results of that inspection should be recorded on the checklist to provide increased assurance that all items of concern have been addressed and the results documented.

This point is noted elsewhere in the section, but it bears repeating as this is the final inspection prior to flight and must be comprehensive.

4. Chapter 1 Section 7 "FIELD CHECK" Paragraph (f) (page 24)

EAA recommends adding the following at the end of the paragraph:

Angle of attack and data collection systems, when installed, must be checked as best as possible before flight. ***Angle of attack systems may require in-flight calibration,*** *and information prior to that calibration that may not be accurate. Similarly, electronic data collection of flight and engine instruments can be very useful, but only if it is ensured that accurate information is being collected. Therefore, verification of these data prior to flight is important.*

New AoA and electronic data collection systems hold promise for assisting in flight testing but require proper calibration to properly function. It is also important to for test pilots to understand that some AoA systems require in-flight calibration to be accurate.

5. Chapter 1 Section 9 Paragraph (a) (page 29)

EAA recommends adding the following at the end of the paragraph:

An equipment list must be developed and maintained to identify the appliances and articles installed in the aircraft at the time of weighing. ***It must also be kept current as installed equipment changes from additions or removals.***

This is a very useful way to keep track of equipment as it is added and removed, thereby influencing weight and balance.

6. Chapter 1 Section 11 (page 35)

EAA recommends adding an introductory paragraph as follows:

All of the engine and fuel system tests and inspections should be listed and recorded on a checklist designed for that purpose. That document should note the completion of each of the *above tests with information obtained during that test. Record the fuel flow, compression test, magneto timing, idle speed, oil pressure, hot and cold etc…*

7. Chapter 1 Section 11 Paragraph (a) (pages 35-36)

EAA recommends adding the following additional item (5)

Because most air-cooled aircraft engines need excessively rich fuel air mixtures to provide cooling for full throttle operation, the condition should be confirmed. This is most easily accomplished by running the engine at full throttle (with the aircraft properly secured), manually leaning the mixture, and observing an increase in exhaust gas temperatures (EGT) and in some cases an actual rise in RPM. While the amount of EGT rise is variable, the important aspect is that there is a rise of 25 to 50 degrees F or more. This will help alleviate engine overheating situations during the first few hours of inflight operation.

This will confirm that the engine is receiving sufficient excess fuel to aid in cooling the engine at full throttle operations.

8. Chapter 1 Section 11 Paragraph (a) "NOTE" (page 36)

EAA recommends adding the following at the end of the note:

Be aware that in some situations, particularly with light wing loading or low drag types of aircraft, adding 100 RPM to the idle speed could cause the landing distance to be increased significantly and also have an unexpected adverse effect on landing behavior.

This accounts for the effect of idle RPM on drag, which as noted can be a problem in some types of aircraft.

9. Chapter 1 Section 11 Paragraph (d) Item (1) (page 37)

This item makes numerous references to a carburetor "venture." This appears to be an autocorrect/misspelling of "*venturi*."

10. Chapter 1 Section 11 Paragraph (e) (page 37)

EAA proposes the following language to replace Section 11 Paragraph (e)(Page 37):

e) fuel flow and unusable fuel check*: This series of tests is designed to ensure that the aircraft engine will get enough fuel to run properly in all normal flight attitudes. The recommended tests are intended to duplicate the conditions found in a maximum power climb near the edge of a power-on stall, a maximum rate of descent with power off and full flaps at the top of the white airspeed arc, or in a plane with no flaps, at the top of the green arc. Lastly, the tests verify that fuel flow remains steady in a slip with low fuel. All of these are normal flight attitudes. Fuel flow during aerobatic maneuvers is not considered.*

Any good fuel system will incorporate these important elements:

1) Adequate capacity and adequately-sized fuel and vent lines for the engine being used. Typically fuel lines will be 3/8" and vent lines will be ¼". Fuel quantity depends on the demands of engine.

2) Some way to remove water and other contamination from the fuel tank (sump drain, fuel filter, gascolator, etc.)

3) Fuel and vent line routing that will not allow water or sediment to collect in any low points. Unavoidable low points need their own drains.

4) A means of insuring adequate fuel flow to the engine in case the main fuel pump fails. Gravity fed systems without pumps do not need backups, but other systems do. The failure of a fuel pump should not cause an engine failure.

5) Some reasonable assurance through testing that the fuel system will work properly in all normal flight attitudes.

There are two basic standards that may apply to any particular aircraft. If the aircraft has a gravity fuel system, then that fuel system needs to provide 150% of maximum fuel flow in these tests. Gravity systems use either no fuel pump or a fuel pump that must rely on gravity as the backup if that pump fails. Typically these are high-wing aircraft, but some low-wing airplanes also have gravity systems. These aircraft have carburetors rather than fuel injection systems. If the airplane is fuel injected, an engine-driven fuel pump AND a back-up or auxiliary fuel pump will be needed. These are called pressure systems, and they must flow at least 125% of maximum fuel flow in these tests.

After determining the type of system (pressure or gravity) determine what the maximum fuel flow is for the aircraft. The manufacturer of the engine may provide a maximum fuel flow at full power or it may list horsepower and specific fuel consumption (also called brake specific fuel consumption or simply BSFC). Lycoming, for example lists BSFC for each engine in a publication it calls "Detailed Engine Specifications," which are available from their publications department for each major engine type.

If the BSFC for the engine is unavailable use the conservative figure of .55. The fuel flow for any particular engine is simply Horsepower x BSFC. This gives is in pounds (not gallons) per hour. This needs to be converted to ounces per minute so it can be easily measured.
Here is a sample calculation:

The Lycoming O-320-D1A engine produces 160 hp. It has a BSFC of .51 pounds/hp hour. Simply multiply 160 times .51 to get 81.6 pounds per hour, the maximum fuel flow at full power. Then divide pounds by 6 to get gallons per hour of 13.6. Next multiply by the fuel system factor of 125% or 150% and get 17 or 20 gallons/hour, depending on the type of fuel system.

Continuing on, divide gallons per hour by 60 to get gallons per minute and then multiply by 128 to get ounces per minute. The results are 43 or 36 ounces per minute, depending on the fuel system.

All of this can be simplified with these formulas:
Gravity: HP x BSFC x 1.5 x .36 + Ounces/minute or
Pressure: HP x BSFC x 1.25 x .36 + Ounces/minute

The first test is the maximum power in level flight test. For this test, level the aircraft both side-to-side and front-to-back. Then place one gallon of fuel in each tank. Be sure to shut the fuel valve off. Next, disconnect the fuel line where it goes into the carburetor or fuel injection servo. If the exit to the fuel line will not easily reach the measuring container, the fuel line may be extended as long as the exit point is at the same level as the carburetor or fuel servo input fitting. Open the fuel valve to verify fuel flow. Turn on the fuel pump if the airplane has a pressure system. Be sure to catch the fuel flowing out of the line and have a fire extinguisher handy in case of an accident. If no fuel flows when you open the valve, then add another gallon to each tank and try again until fuel begins to flow.

With fuel flow established open the valve for one minute and see how much fuel flows out. Then let fuel flow out of the line until no more comes out. Measure this fuel and subtract it from what was put in the tanks to determine unusable fuel. Compare the fuel drained in one minute to the number calculated previously. As long as it is equal to this number or more the test result is sufficient.
Do not run the engine during this test! Record the results of these tests in the builder's log.
The completion of this test will be a sufficient evaluation of the fuel system if ALL of the following conditions are met:

1) The kit manufacturer has designed and tested a fuel system for this aircraft and found it to provide adequate fuel flow in all normal flight attitudes.

2) The fuel system has been installed in this aircraft that matches exactly the kit manufacturer's design, including the fuel lines, fuel tank, fuel valves and drains, fuel pumps, and vent system.

3) An engine approved by the kit manufacturer has been installed.

If any of these conditions have not been met then the following fuel tests should be performed:

***Maximum Climb Test**. With the level flight test complete proceed to the climbing flight test. For this test put the aircraft in a nose-up position to simulate a maximum climb. Here are some possible ways to determine the required angle:*

Consult with the kit or plans designer or measure the angle in a similar aircraft using a Smart level. Then add 5 degrees to that number for the test. If that number is unavailable, use 25 degrees for the test and later verify that angle in Phase I flight testing. Don't add 5 degrees to the 25 degree number.

With the angle established position the aircraft at that angle by some combination of raising the nose and/or lowering the tail. Get some help to do this safely. A hole or ditch may be available to lower the tail. Do not dig a hole on the airport property without the permission of the airport manager. A flatbed tow truck may be useful to raise and lower the plane for these fuel tests. Repeat the fuel flow test as before. Do not run the engine during this test. Record the results in the builders' log. Note – the unusable fuel quantity may be more in this configuration.

The Maximum Descent Test*. This test is similar to the previous tests but with the nose down. Again, determine the down angle, which should be the angle in a full-flaps, power-off descent at the top of the white arc (Vfe), or if no flaps a power-off descent at the top of the green arc (Vno). As before consult the designer for this angle, or measure the angle in a similar plane, or assume 15 degrees and verify it later in flight testing. You do not need to add an extra 5 degrees for this test.*

As before, carefully position the plane at the proper down angle. Take care to avoid damage to the aircraft or injury to people. Conduct the fuel flow test as before. A fuel flow of 25% of maximum is sufficient for this test, due to the lower fuel flow required in a power-off descent. Do not run the engine during this test. Record the results in the builder's log.

The Maximum Slip Test. *This test cannot be conducted on the ground; it must be done in flight. While flying over an airport at a safe altitude, burn off fuel until the fuel remaining equals the amount of fuel needed to sustain 75% power for 45 minutes. Then place the aircraft in a landing configuration and slow to 1.3 Vso.*

Consult with the airplane designer regarding any limitations on slipping with flaps extended! Perform a maximum-rudder-deflection slip to the right and hold for 30 seconds. Then repeat to the left. During this test no loss of fuel pressure or engine power should occur. If it does, land safely, add fuel and repeat the test until a minimum safe amount of fuel can be determined. Record results in builder's log book.

Insufficient Fuel Flow. *If fuel flow is insufficient in any of these tests here are some possible things to consider. Also use AC43.13.1B as a reference in addition to the manufacturer's design.*

1) Any small piece of debris left in a fuel line can significantly reduce fuel flow. This especially likely to occur with rubber or rubber lined fuel lines. Be sure all fuel lines and tanks are perfectly clean prior to final assembly. Be sure no small flap of rubber is left in any rubber fuel line.

2) More fittings create more flow loss in a fuel system. Reduce the number of fittings and valves as much as possible. Simplify the fuel system whenever it is possible and safe to do so.

3) Try to replace 90 degree fittings with 45 degree fittings if possible, or better yet replace angle fittings with sweeping bends in fuel lines.

4) Consider installing a header tank if fuel flow cannot be maintained in any normal flight attitude.

Many manufacturers of aircraft kits will perform these tests for their builders and make the results available. If the fuel system is installed exactly as per the kit manufacturer's recommendations in every detail, only the level flight test would be necessary. Exactly the same means even to the fuel flow sensor and the venting system, especially the venting system. If any of these tests are not performed it should be noted in the builder's log, citing manufacturer's testing where appropriate.

The level fuel system test, at a minimum, should be repeated whenever there is any addition to or modification of the fuel system, after which an appropriate entry should be made in the aircraft log book.

This language was developed by EAA's Homebuilt Aircraft Council as a comprehensive guide to fuel flow testing, a critical system test.

11. Chapter 1 Section 12 Paragraph (e) (page 40)

EAA recommends the text of item (e) be replaced as follows and that this item be re-sequenced as item (a):

Never approach the vicinity of the propeller unless the ignition switches have been confirmed to be in the OFF position and the key is removed.

This text reinforces proper prop discipline, which should be exercised at all times.

12. Chapter 1 Section 12 "WOOD PROPELLER INSPECTION" Paragraph (c) (page 43)

"Sent" should be replaced with "send it" in the introductory paragraph.

13. Chapter 2 Section 1 "OBJECTIVES" (page 44)

EAA recommends adding the following at the end of the first paragraph on taxi tests:

Now is the time for the pilot at the controls to have identified all the controls and devices necessary to fly the aircraft. The checklist should be in an advanced state of development, the seating and seat belts must be fully fitted, the seat height position must be established. Seating the pilot too low is a major problem in properly identifying pitch attitude during operation.

14. Chapter 2 Section 2 (pages 45-46)

EAA proposes replacing the entire section on high speed taxi testing with the following language as follows:

Decide on whether to use High Speed Taxi Tests

Because so many airplanes suffer unnecessary minor damage and sometimes worse, this is a serious topic that deserves attention.

Stabilizing at speeds at or near flying speed requires reducing power so as to not fly away. The maneuver uses significant runway, and we are deliberately extending the time spent in a regime that has limited margin for error if directional control issues arise. Stopping from these maneuvers can also potentially overheat the wheels and brakes. On the other hand, the high-speed taxi and runway flight can help you discover handling qualities issues while still able to stop straight ahead. If you have unexpected, significant out of trim conditions, or unexpected flight control responsiveness, having planned ahead of time to stay on or just above the runway may result in less total risk than fighting the aircraft around the pattern and trying to land with it. Also, if done in an incremental build-up fashion, high-speed taxi and runway flights can give you better feel for the aircraft before the first full approach and landing. Additionally, if you are flying a common design, you will be able to cross check your takeoff and stopping distance performance against the published data and potentially discover discrepancies that point to aircraft problems before you fly away for real. If you're taking a lot more distance to rotate, is it a power issue, an elevator authority or rigging issue, or something else? Find it and fix it before you make that first full up and away flight.

If you elect to conduct high speed taxi tests prior to first flight, *calculate expected takeoff and landing distances and derive a minimum acceptable runway length. You must also account for the time/distance you will spend at the target airspeed (at or near the takeoff speed) if you perform high-speed taxi and runway flights. Calculate the distance used at the target condition by converting the speed to feet per second. (Note: One knot = 1.69 feet per second). If your target speed for a test run is 60 knots, the aircraft will be using up just over 100 feet for every second you hold the target speed. You should plan on 5-10 seconds once you get to the target speed.*

Choose target speeds that build up gradually to flying speed, say in 5-knot increments. At each target speed, make small control inputs in each axis and observe the response. Allow adequate time for the wheels and brakes to cool before another test – and take off the wheel pants if the aircraft has them. If you can perform your tests at a runway with distance remaining markers you can also get distance performance data as you perform the test points. Complete the sequence with a brief liftoff to a few feet off the runway to check trim and control response prior to that first up and away flight.

15. Chapter 3 Section 4 (page 51)

EAA recommends adding the following NOTE after the "OBJECTIVES" section:

There is hardly a phase of test flying that does not benefit more from the use of well developed checklist than the first flight. This is the time to use the checklist that has been developed during all the work that has led to this point.

We have seen time and time again accidents and incidents that could have been prevented with a more procedural approach to flight testing and again feel the need to drive home this point here.

16. Chapter 3 Section 4 Paragraph (h) (page 51)

EAA recommends adding the following language to the end of the paragraph:

Global Positioning Satellite (GPS) can be used to quickly check that the indicated airspeed is at least close to the expected airspeed for takeoff. Prior to takeoff, calculate an expected groundspeed from takeoff by subtracting the reported wind (adjusted for angle to the runway) from the expected true airspeed. This will produce an expected ground speed at takeoff. Place this ground speed number near the GPS in the aircraft as a reference, and quickly check it against the airspeed at takeoff. Any large difference in excess of 10 knots is a cause for an aborted takeoff. A small difference should be factored into the indicated airspeeds used for further flight and landing until adjustments can be made to the airspeed indicator or pitot/static system.

17. Chapter 3 Section 5 Paragraphs (a) and (b) (page 52)

EAA recommends replacing the entirety of paragraph (a) and paragraph (b) items 1-10 with the following:

Coordinate as appropriate with the airport, tower, and emergency services. Recruit and brief a ground observer, who should have a copy of the test card and a radio.

Objectives are a basic check of controllability and engine reliability.

If appropriate for your airplane, make the first takeoff with the flaps up to reduce variables. If the landing gear retracts, do not jeopardize a safe first flight by testing this system - leave the gear down.

After liftoff climb in a loose box pattern that remains over the runway pattern. When leveling off set the power to maintain a speed well above stall speed but slower than cruise speed; at least 1.5 times the predicted stall speed works well. For high performance airplanes, 150 knots or the extended landing gear speed (V_{LE}) are reasonable first flight limits that allow you to evaluate controllability and reduce the threat of flutter. If you elected to use a chase, compare your airspeed and altitude readings with that aircraft.

Trim the aircraft for straight and level flight and relax your control inputs for the initial controllability test. Note how well (or not) the aircraft maintains a trimmed condition and where the control surfaces and trim tabs have to be for this middle of the envelope stable point.

Monitor and record any significant engine readings. Verify the trueness of the wing by noting the aileron deflection required for straight and level flight.

After checking the ailerons, make a gentle rudder input that yaws the nose 5 degrees to the left, and then the right, and note what percentage of the pedal travel this input requires. This input should not induce an excessive pitch change, and the airplane should center itself after removing the rudder input.

***Testing stall speed on the first flight is neither necessary nor advisable**, but experiencing the airplane's characteristics at the approach speed is desirable before your first landing. At a safe altitude, make a controlled deceleration to the target touchdown speed, or to the limit of your comfort. Your lift-off airspeed is a good target. You should go no slower than the onset of airframe buffet. Note the slowest speed attained and increase it 40 percent to determine your target approach speed. Then use this speed to make a practice landing at altitude, recording the power settings and descent rate. Repeat these settings to make a safe landing.*

18. Chapter 4 Section 2 (page 56)

EAA recommends adding the following Paragraph (d) and NOTE to this section:

***d)** If installed, calibrate the angle of attack indicator (AOAI) or lift reserve indicator as per the manufacturer's instructions and use it during all subsequent flights. This will require wings-level stalls in various flight configurations. Be sure to climb to a safe altitude of at least 5000 feet AGL before performing these tests.*

***NOTE:** In an effort to reduce maneuvering accidents in all aircraft the FAA and the Experimental Aircraft Association (EAA) strongly urge all amateur builders to install an angle of attack indicator or lift reserve indicator in their aircraft and learn how to use it effectively. Since most experimental amateur-built aircraft do not have any stall warning device installed, the AOAI can fulfill the need to serve that safety function. In addition it is very useful to determine best angle and rate of climb airspeeds and best glide airspeed. The potential life-saving benefit of these devices should not be underestimated.*

19. Chapter 4 Section 3 "AIRSPEED IN-FLIGHT ACCURACY CHECK" (pages 58-59)

EAA recommends adding the following language to replace paragraphs (a) through (c), inclusive:

*a. **GPS provides the most accurate and easy-to-use means of determining speed** during the flight test period. Since it measures ground speed it will be necessary to calculate true airspeed, and from that confirm indicated airspeed.*

*b. **A triangular course with each leg 120 degrees apart** from the previous one will ensure accurate results in any wind condition. The ground speeds from each of the three legs should be averaged to get the no-wind ground speed, which is equal to the true airspeed.*

*c. **A true airspeed can be calculated using an E6B** or other aviation computer if the indicated airspeed, temperature, altitude and barometric pressure are noted for each test course.*

This true airspeed can be compared to the previously determined no-wind ground speed to determine any inaccuracy in the airspeed indicator. Variations can usually be corrected with adjustments to the pitot/static system.

d. ***The pilot must fly precisely*** *during these tests to get accurate numbers. Altitude, airspeed, heading and engine rpm need to be held as steady as possible during each test. Allow the aircraft to stabilize for at least one minute after any change in heading, altitude or power setting before taking a speed reading.*

e. ***Most errors will be found*** *at the low end of the speed range due to the angle of the pitot mast to the relative wind and/or the location of the static port(s).*

This updates the section to reflect modern-day use of GPS systems.

20. Chapter 5 Section 2 (page 60)

EAA recommends adding the following NOTE following the “OBJECTIVE” statement

Stall speeds, best rate of climb, best angle of climb, best glide speed, and various slow flight maneuvers are best and most safely performed with the aid of an angle of attack indicator (AOAI). The installation, calibration and proper use of such a device is highly recommended.

21. Chapter 5 Section 2 Paragraph (a) (page 60)

EAA recommends replacing Paragraph (a) with the following language:

The stall test objective is to verify the aircraft conforms to the expected responses for this particular design in this flight regime. Acquire a thorough description of how the aircraft is expected to behave near, at, and after stall. This provides the detailed reference point to compare against the flight test results.

The expected behavior description needs to cover all configurations, all types of entry, stall warning types, expected stall speeds and margin before stall, what cue “defines” stall , the best means to break the stall, and altitude loss in recovery. A thorough description comes from the manufacturer, in the case of a kit, or through independent research and analysis for a unique design.

Verify that weight and balance for the test is correct and determine where to load the aircraft for each test. Begin at light weights and forward CG, and move progressively to aft CG, then to heavier weights throughout the CG envelope.

Make sure the engine’s idle speed is properly set; faster idle speeds result in higher nose-up attitudes and lower indicated stall speeds.

22. Chapter 5 Section 2 Paragraph (d) (page 61)

EAA recommends replacing the content of this paragraph with the following language:

Use the same procedures as on the first flight. Secure cockpit items and put on carburetor heat. Begin by stabilizing in level flight at 15-20 knots above the predicted stall speed, at a safe altitude. 8,000 feet AGL is good for most homebuilts, but it depends on the aircraft type. When stable, make a control input in each axis; roll, pitch and yaw. The inputs should be just enough to generate about 3-5 degrees of aircraft response, then move the controls right back to neutral (usually a 1-2 second input pulse). Then watch for the aircraft response. In roll, is there any accompanying adverse yaw? Does the aircraft stop rolling when the input is released to neutral? In pitch, does the aircraft return to the previous attitude? Is there any tendency for the pitch to continue to rise after releasing the stick? Does the pitch attitude continue to oscillate? The same questions apply in the yaw axis. If all is as expected, slow 3-5 knots and repeat the process.

At each incremental airspeed point ensure that you still have nose down control authority, since that is your most important recovery input. Make note of any changes in response as the aircraft gets slower (it is normal for the aircraft to be more sluggish, but it should still respond positively). Make note of any warning cues. Watch closely for any uncommanded motions. At the first sign of any uncommanded motion (nose rise, or nose slice, wing rock, or nose drop), recover the aircraft by lowering the nose, adding power and increasing speed. Uncommanded motions are likely linked to being at a higher angle of attack than previously flown. The most correct initial response is to lower that angle of attack with a nose down input. Even if the uncommanded motion is a roll off, the quickest way to stop it is most likely a pitch down, **not** *a countering roll input.*

23. Chapter 5 Section 2 Paragraph (e) (page 61)

EAA recommends replacing the content of this paragraph with the following language:

If there are no surprises down to 3-5 knots above expected stall speed, then continue to a complete stall by applying backpressure on the stick/yoke to slow the airplane down at roughly 1 knot/mph per second. Stall warning should occur about 5 knots/mph before the stall itself. Do not depend too much on an uncalibrated stall warning system.

As the airplane decelerates, ensure that the airplane requires an increasingly heavier pull force. If the force lightens or changes to a push force, **abandon the test.** *Once you get to the stall, initiate recovery and record the altitude required to return to level flight as well as the stall speed. Also make note of aircraft responses during the recovery such as wing rock, secondary stall or any uncommanded motions. All these observations need to be compared in your post-flight analysis to the expected behavior written down before the test.*

NOTE: *Some airplanes reach the up elevator stop before the wing stalls. This is acceptable as long as the elevator has the authority to flare the aircraft at its maximum landing weight with the forward most CG allowed for that weight. Also, at the stall, many airplanes tend to roll toward one wing or the other. A properly designed and rigged airplane will be able to maintain the wings within 15 degrees of level with normal aileron inputs.*

Make sure you're not cross-controlling the airplane (the slip-skid ball is centered). If you need excessive aileron or rudder inputs to keep the airplane straight and the wings level, abort the test. On the ground assess the airplane for miss-rigging or some inadvertent wing twist or asymmetry.

24. Chapter 5 Section 3 (page 64)

EAA recommends that the entire discussion about stability and control be moved into a much earlier segment of the test plan. It is highly recommended that the test pilot have a basic knowledge of Stability and Control before he/she begin test flying any aircraft. The simplest of flaws such as tight control bearings and stiff/tight control cable installations can mask some basic handling behaviors and should be known in advance to any test pilot.

25. Chapter 5 Section 6 (page 72)

EAA recommends replacing this section with the following language:

Perform wings level stall tests first. Review the techniques described for that test card and apply them here as well.

If you are not spin-qualified and comfortable, hire a professional test pilot for these tests. Start with light forward CG

Fuel: 1 hour minimum

1. Normal takeoff and climb to 8,000 feet AGL
2. Verify engine readings in the green
3. Trim airplane to 1.5 times estimated stall speed
4. Set the flaps (and landing gear) appropriate to test
5. Power to idle (carb heat)
6. Establish—and maintain—a coordinated 30-degree bank turn
7. Decelerate at 1 knot/mph
8. Note positive stick/yoke force: it should increase
9. Note control reversal: abort if evident
10. Note speed of pre-stall buffet
11. Recover, climb to starting altitude, and continue series until complete, or
At stall note indicated airspeed, pitch changes, roll direction and amount
12. Recover, climb to starting altitude, and continue series until complete

You should have a detailed description of the expected behavior in an accelerated stall available (either from the kit manufacturer or through design analysis) prior to beginning the test. The objective is to verify (or not) that the behavior of your aircraft matches the expected behavior.
Make separate test flights to evaluate the airplane's performance at different weights and CG locations. Start with lighter gross weight and forward CG locations.

Each test series includes six runs, left and right coordinated turns with the indicated flap settings. If your airplane has retractable gear, run the series with the gear up and down. For each stall test fly the aircraft at a safe altitude (8,000 feet AGL or as appropriate for aircraft type, in smooth air), trim the airplane to 1.5 times the predicted stall speed and set the flaps as required for the test (this should be slower than VFE).

Apply carburetor heat (if required), pull the power to idle, and establish a coordinated turn in a 30-degree bank; ensure the slip/skid ball is centered. Reduce speed to 10 knots/mph above the straight and level stall speed for that flap setting. Then decelerate at 1 knot/mph per second.

As the airplane slows, make sure it requires an increasingly greater stick/yoke pull force. ***If the force lightens or changes to a push force—abort the test.*** *This may indicate an aft CG location or insufficient elevator authority. Either of these may cause the nose to pitch up at stall.*

As the airplane slows normal control inputs should maintain the 30-degree bank attitude and nose position. When you feel the pre-stall buffet, note the speed, roll level, and recover to straight and level flight.

Stalling the airplane is a personal decision that should be based on the wing drop it exhibited in your wings-level stall tests. Accelerated stalls usually exacerbate this roll, especially when you're turning to the direction the wing drops. Even a properly rigged airplane may roll up to 60 degrees into the turn, or up to 30 degrees in the opposite direction. ***If the possibility of a roll to 60 degrees is deemed unsafe—do not perform this test.***

26. Chapter 6 Section 3 Quote (page 75)

Finally, EAA submits that this is a common misquote of Mr. Armstrong's first words on the moon. The correct quote is *"That's one small step for a man, one giant leap for mankind."*

Conclusion

EAA once again thanks the Agency for the opportunity to comment on this important and useful document for ensuring safe and effective flight testing in amateur-built and ultralight aircraft. While we already consider AC 90-89A an outstanding manual in its present form, there is always room for improvement and we believe the changes suggested above will update the guidance to be even more relevant to the next generation of homebuilts.

Thank you very much for your consideration and please do not hesitate to contact us with any questions.

Respectfully submitted,

/s/

Sean Elliott
Vice President, Advocacy and Safety