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My Ultralight becomes an Experimental LSA

CARTOON BY JAMIE REYNOLDS

Preparing for an Airworthiness

What to expect when the inspector calls

Michael Huffman

You've made the decision. It's time to certificate your ultralight-type vehicle as an experimental light-sport aircraft (E-LSA) in compliance with FAA regulations. (Remember, January 31, 2007, is the deadline to certificate you as a sport pilot; January 31, 2008, is the deadline to certificate your machine.) To get started in the process, as related in "Transitioning Your Ultralight," in the January 2006 issue, you have:

- Established contact with a local designated airworthiness representative (DAR) or an FAA inspector.
- Purchased EAA's *E-LSA Conversion Kit*, and have sent in the registration paperwork. (And have already received your registration or are waiting for it.)
- Applied N numbers, a fireproof data-plate, an EXPERIMENTAL placard, and placards on all instruments, switches, and controls.
- Installed an emergency locator transmitter (ELT), if your machine is a two-place, fixed-wing airplane.
- Performed a weight-and-balance check and filled out an equipment list.
- Checked for any airworthiness directives (ADs) that may apply to any type-certificated parts or equipment on your aircraft.
- Filled out all other required forms.

Now, it's time for you to inspect your aircraft to make certain it is ready for the airworthiness inspection. The DAR/FAA inspector's main job, aside from checking that your paperwork is correct, is to confirm your machine is "in a condition for safe operation." That's the official FAA regulatory language, and it is somewhat vague. Individual DARs/inspectors may interpret that language differently, but it is the inspector's opinion that matters because he or she will be the one signing the airworthiness certificate.

How does the inspector determine an aircraft is in a condition for safe operation? For type-certificated aircraft, it's easy; the inspector simply determines whether the aircraft was built in accordance with the design data and maintained per FAR Part 43, which governs maintenance of type-certificated aircraft. The aircraft manufacturer's maintenance documentation will specify any unique maintenance requirements for that particular model of aircraft. Beyond that, the inspector will determine whether the aircraft has been maintained in accordance with the standard aircraft practices described in Advisory Circular (AC) 43.13-1B, *Acceptable Methods, Techniques, And Practice—Aircraft Inspection And Repair*.

However, attempting to apply those rules to ultralights transitioning to E-LSA is problematic. First, FAA design approval is not required for ultralights. Consequently, there is no FAA-approved design data that says a particular bolt is required to be aircraft quality or that the fabric covering must be approved. Second, FAR 43

does not apply to most aircraft that have an experimental airworthiness certificate, including ultralights being converted to E-LSA. Third, the E-LSA manufacturer may or may not have supplied detailed maintenance instructions. Fourth, many of the AC 43.13-1B topics apply to larger and more complex airplanes than typical ultralights, and it has not been updated to include modern technology such as two-stroke engines.

Still, AC 43.13-1B is a valuable reference. FAA recommends its use for E-LSA, and DARs are trained to use it—modifying, adding, and interpreting its requirements as appropriate. I would recommend studying any sections of AC 43.13-1B that apply to inspecting an aircraft. This AC is available in print from various pilot supply stores or may be downloaded from the FAA website (*www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/MainFrame?OpenFrameSet*).

Other major references used by inspectors include any recommendations by the kit, aircraft, engine, prop, or reduction unit manufacturer, so you'll want to be aware of those as well.

FIGURE 1

PHOTOS BY MICHAEL HUFFMAN

Time to Inspect

With that background, perform the inspection of your aircraft. You are required to use a checklist—one provided by the manufacturer, obtained from another source, or created by you. (I ask applicants whose aircraft I'm going to inspect to use my detailed checklist and modify it to fit their aircraft. The checklist contains too many items to list here; if you would like a copy, please e-mail me at *SportAviation@kc.rr.com*.) Fill out the checklist, and be prepared to present it to the inspector.

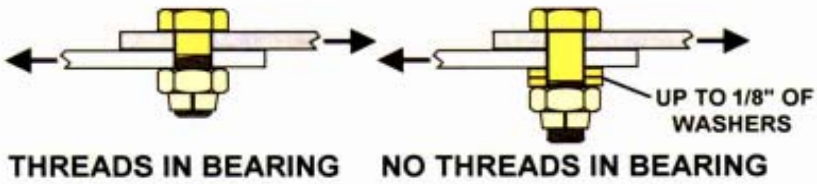
In the process, pay particular attention to the following items, which often need attention on typical ultralights.

- N numbers—E-LSA are allowed to use 3-inch high numbers. It may be tempting to apply stick-on numbers from your local hardware store; however, FAR 45 has specific requirements for N numbers including not only the height of the letters, but also the font, width, stroke, and spacing. They must be applied with "paint or a similar method of permanence." If you want to use stick-on numbers, order them from one of the aviation supply stores.

- Data Plate—Make certain that the information on your aircraft's data plate *exactly* matches the information you've entered on your application for airworthiness certificate (FAA Form 8130-6). There can be no discrepancy between the information on the data plate and on the application. For example, if the builder name listed on the data plate is "Kolb," the application must also say "Kolb," and not "New Kolb" or "Kolb Aircraft."

  If you are the builder, and you use your name on the data plate, if you include your middle initial on the data plate, it must be on the application. Also, if you list your last name first on the data plate, make sure it's the same on the application. The same goes for the aircraft model and aircraft serial number. For example, don't list "001" as the serial number on the data plate and only put "1" on the application. All identification data must match exactly.

FIGURE 2



BONNIE BARTEL

- Corrosion—Inspect your aircraft for corrosion of any type, including rust on steel parts. Depending on what you find, you may be able to remove the corrosion and apply a good paint primer or grease to prevent further corrosion. Serious corrosion may require replacement of parts.

- Cracks—Cracks are especially serious because the local stress around the tip of the crack may be hundreds of times higher than the normal stress on the part. That added stress often leads to crack growth and part failure. Cracks in nonstructural areas such as windows or access panels may be stop-drilled at the tip of the crack to reduce the possibility of crack growth.

- Fabric covering strength—If the fabric covering on your aircraft is old or if the aircraft has been parked

outside, ultraviolet degradation of the fabric may be an issue. The inspector may want to know that you have tested its strength. The accepted AC 43.13-1B fabric test requires that you cut out a strip of fabric and pull test it. This is generally not done because of the resulting damage to the aircraft. However, there are other ways, including the use of a Maule fabric tester or the inexpensive Quicksilver fabric tester available from ultralight parts suppliers. See Figure 1.

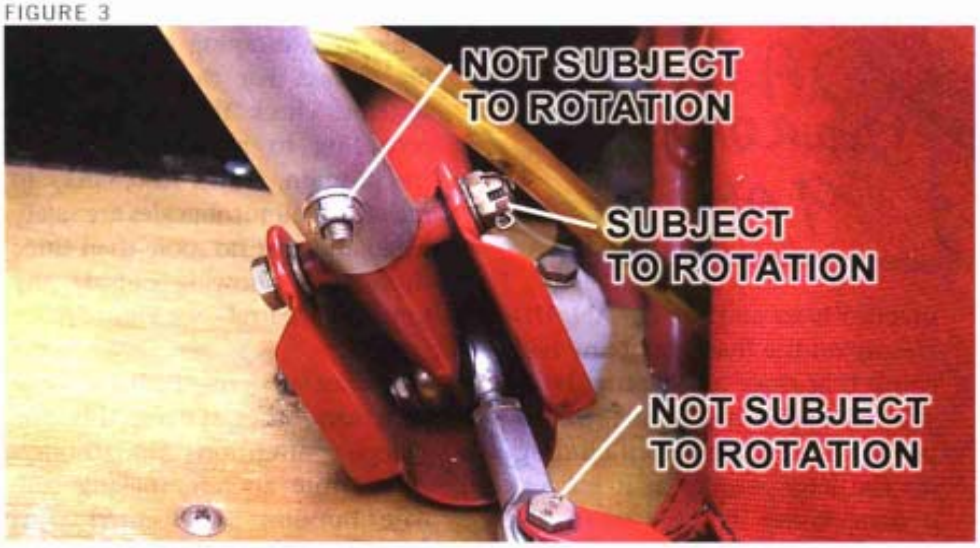
- Nuts and bolts—Aircraft-quality (AN) nuts and bolts are recommended for E-LSA, but they are not required. Regardless, there are some often-abused standard aircraft practices you should inspect for. One standard practice is to install bolts with the heads pointed up, forward, or outboard, where possible. The idea is that if the nut falls off, gravity may still hold the bolt in place. In some cases, the designer of the aircraft has a specific reason to install a fastener contrary to standard aircraft practices. If this is the case on your aircraft, have documentation available to the inspector to show that the installation is done in accordance with the designer or kit manufacturer's instructions.

Bolts should have no "threads in bearing," that is, they should be long enough that there are no threads inside the pieces being joined—see Figure 2.

Another standard practice is that most nuts and bolts should be safetied in one way or another—use safety wire, cotter pins, lock washers, or self-locking nuts—to prevent loosening in service.

Any self-locking nut should have at least one full thread protruding from the nut. In addition, self-locking nuts should be used only in places where they are not "subject to rotation." If the bolt and nut are not clamped tight, the bolt is free to rotate, with the possibility that the nut might come off. In those cases—which includes many pivot bolts in E-LSA control linkages—a castellated nut and cotter pin should be used.

FIGURE 3



One notable exception is with spherical rod end joints; there, the bolt and nut are clamped tight on the spherical "ball," thus allowing the use of a self-locking nut. Figure 3 shows examples of all three situations.

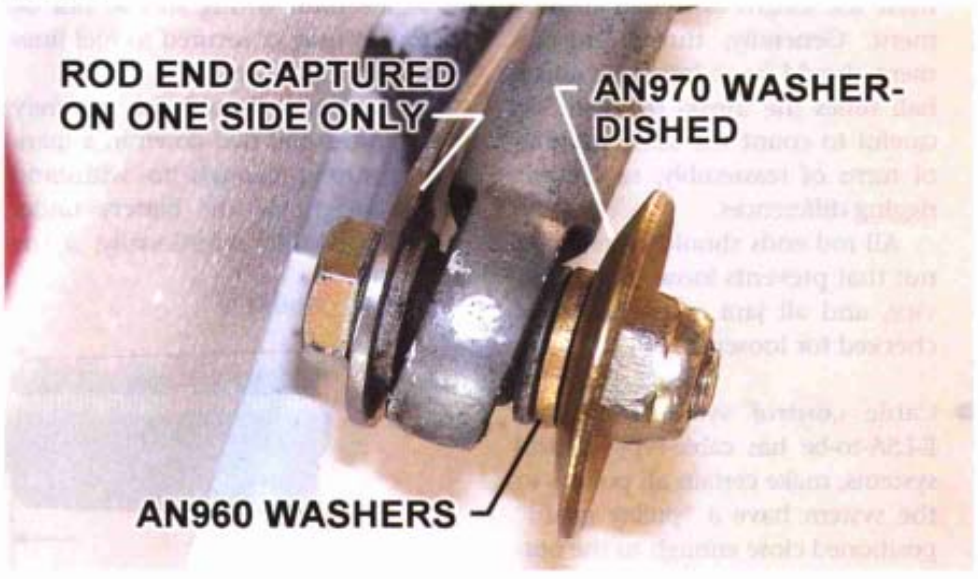
Also, self-locking nuts in high-heat areas, such as inside the engine cowling, should be all metal instead of the nylon-insert type.

- Control systems—Inspect all flight and engine control systems by moving each control through its range of travel, looking for excessive friction, bending, binding, looseness, damage, missing cotter pins, or loose jam nuts. Verify that carburetor, mixture, carburetor heat, and other such controls move all the way from one stop to the other.

This would also be a good time to verify that your primary control travels are set to the manufacturer's specifications. For E-LSA, control stops in primary control systems are not required, but they are recommended.

- Spherical rod ends—Spherical rod end bearings have been known to become loose enough that the ball falls out of the housing. If that happened on your elevator control system, you could definitely have a bad day. To prevent such an occurrence, standard aircraft

FIGURE 4



practice is to add a large AN 970 washer on the free side of any bell crank that does not capture both sides of the rod end. Sometimes, to prevent the rod end from binding on the large washer as it moves, it is necessary to use a small AN 960 washer under the large washer. Another technique is to "dish" the washer by squeezing it in a vise using a large and a small socket wrench, as shown in Figure 4.

Aircraft-quality spherical rod ends generally have a "witness hole" in the threaded shank that provides evidence of adequate thread engagement—see Figure 5. However, rod ends used on ultralights often do not have a witness hole. Therefore, you will need to devise a method of verifying that all your rod ends have adequate thread engagement. One way is to unscrew each rod end, carefully counting turns. Knowing the thread pitch will then let you determine the length of thread engagement. Generally, thread engagement should be at least one and a half times the thread diameter. Be careful to count the same number of turns of reassembly, to prevent rigging differences.

All rod ends should have a jam nut that prevents loosening in service, and all jam nuts should be checked for looseness.

- Cable control systems—If your E-LSA-to-be has cable-type control systems, make certain all pulleys in the system have a "pulley guard" positioned close enough to the outside of the pulley to prevent a slack cable from escaping from the pulley groove. For closed-loop cable systems, check the cable tension according to the manufacturer's specification, if any. Also, check to make sure all turnbuckles are safety wired and that no more than three threads are showing outside any turnbuckle barrel—see Figure 6.

- Electrical system—Perhaps more than any other system, this one deserves attention. Go through your entire aircraft, making sure wire bundles are secured with clamps or tie wraps. Look for places where wires are likely to chafe. Clamping wires directly to the airframe without cushioning material is not considered good practice—in time, the insulation could be abraded away, resulting in a short circuit and the possibility of fire.

FIGURE 5

Electrical wiring should not be routed near or secured to fuel lines for obvious reasons.

Batteries should be securely mounted and tied down in a manner strong enough to withstand the weight of the battery under heavy *g*-loads. Additionally, if the battery is of the unsealed, wet-cell, lead-acid type, provisions should be made to drain acid leakage overboard clear of the aircraft structure. Check battery terminals and the battery mounting carefully for corrosion; clean and neutralize if corrosion is found.

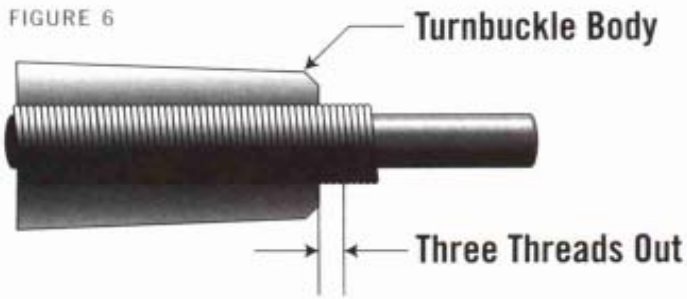
Insulation boots or other insulation guards should be present on the terminals of the battery, master relay, starter relay, and starter motor.

- Fuel system—Many accidents in homebuilt aircraft are fuel-related. It is critical the fuel system deliver sufficient flow to supply the maximum engine requirements. Before the inspector's visit, replace any inline fuel filters. There is no easy way to check if typical ultralight fuel filters are plugged, so frequent replacement is the only good alternative.

Make certain all fuel tank vents (including vent holes in fuel caps) are open. Check the routing and supporting of all fuel plumbing in a manner similar to the electrical system. Check the operation of the fuel valve and make sure it is placarded to depict its operation.

Perform a fuel flow test. Have a minimum amount of fuel in the tank and place the aircraft in whatever attitude (nose up/nose down) that will reduce the fuel flow the most. Then, remove the fuel hose at the carburetor and, using a measuring cup and stopwatch, deter-

FIGURE 6



mine the fuel flow. If your fuel system does not gravity feed, you'll obviously need to turn on the electric fuel pump. The fuel flow you observe should be at least 50 percent greater than the engine requires at maximum power.

- Engine, prop, and reduction unit—Perform any operations recommended by the engine, propeller, and propeller speed reduction unit (PSRU) manufacturers at an annual inspection. On two-stroke engines, carefully inspect the rubber carburetor-to-engine boots for cracks. If you have Bing carburetors, assure that the service bulletin to prevent the jet needle from spinning has been complied with. Inspect your exhaust system for leaks, cracks, and safetying/vibration damping of exhaust springs. To prevent spark plug wires on inverted engines from falling off, assure that connector tips on spark plugs are not the screw-on variety and that spark plug connectors are tied in place. Perform a differential or direct compression test if recommended by the engine manufacturer.

- Instruments—The FAA regulations do not require an E-LSA to have any instruments. However, if you have instruments installed, they must be maintained in accordance with FAR requirements. For an E-LSA, that primarily means if you have a transponder and encoder, per FAR 91.413 you will need to have it re-certificated by an avionics shop every 24 months.

  One interesting note concerning electronic flight information systems (EFIS) and engine information systems (EIS), the alarms they display when pre-programmed operational parameters such as speeds, rpm, or temperatures are exceeded essentially take the place of the required markings on traditional steam gauges. Be certain your alarms are programmed correctly

to agree with the aircraft or engine manufacturer's specifications.

- ELT—If you have a fixed-wing two-place airplane, per FAR 91.207 you'll need to obtain an emergency locator transmitter, install it in accordance with the manufacturer's instructions, inspect it for battery area corrosion, make note of the battery expiration dates, test it for operation of the crash sensor, and test it for the presence of a sufficient radiated signal.

  After performing the inspections and tests, you'll need to record the results of the inspection in the aircraft logbooks along with the expiration dates on the batteries. Don't forget there are often two sets of batteries, the main batteries and a small lithium battery in a dash-mounted remote panel—you'll need to record both dates. Your DAR can supply the wording for the logbook entry.

- Logbooks—A common practice in the ultralight community is to log flights and maintenance in the same "flight log." However, prior to certification, you'll need to initiate a separate maintenance logbook. Preferably, you'll have one logbook for the aircraft and another for the engine. You might also want one for the propeller. Multiple maintenance logbooks, while not required, are handy because engines and props are often swapped, which can lead to confusion if all the information is in one logbook.

  After you complete your inspection, make a maintenance logbook entry to that effect. Again, the DAR/inspector can supply the wording.

- Operational checks—The inspector may ask you to start the engine and check operation of instruments, controls, and avionics. Make certain you have not left any tools in the aircraft.

Success Is Attainable

If you read the inspection sections of AC 43.13-1B, follow those guidelines, and use a good checklist, chances are any minor squawks the inspector finds can be corrected on the spot and the airworthiness certificate will be issued.

If you feel an inspector is requiring something unreasonable, you have the option to appeal to a higher FAA authority; if you do, be prepared to wait for a decision. The best advice is to fix the easy squawks, even if you don't agree; you'll be flying sooner.

Have specific questions? E-mail Mike at SportAviation@kc.rr.com, *call 816/838-6235, or visit* www.SportAviationSpecialties.com. *EAA's Aviation Services staff can also answer airworthiness questions; e-mail* info@eaa.org *or call 888/322-4636.*