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Hot Spots

Understanding Experimental vs Type Certificated Aircraft

One of the first things pilots learn is that aviation, like so many other aspects of life, is full of trade-offs. A trade-off usually refers to losing one quality or aspect of something in return for gaining another quality or aspect. It implies a decision to be made with full comprehension of both the benefits and costs of a particular choice. For example, your trusty Cessna *Skyhawk* may have four seats, but you probably have to leave one of them empty if you choose to top off the fuel tanks. You may relish the freedom of personal transportation that your airplane offers, but the trade-off is accepting the reality that light aircraft cannot be safely flown in all kinds of weather. Those pilots who try to have it all—be it a fully loaded and fully fueled airplane, an airline-style schedule in a small airplane, or some other combination—too often trip on the trade-offs and find themselves immortalized in the annals of aircraft accident history.

Unfortunately, recent aircraft accident history bespeaks some pilots' failure to understand another aviation trade-off: The difference between aircraft categorized as "experimental" and those manufactured according to the standards of Title 14 Code of Federal Regulations (14CFR) part 23 (or the predecessor regulations). Statistics on amateur-built accidents show that the fatal accident rate is increasing and amateur-built aircraft fatal accidents account for an astounding 24 percent of all general aviation (GA) fatal accidents in fiscal year 2008. The numbers show three distinct spikes in accidents grouped around total hours accumulated on the airframe: The first five hours of flight for just-completed amateur-built aircraft, another spike just after the 40-hour test-flight period, and a third spike at 100 hours.

The data also indicate that "fast glass"—high-performance composite amateur-built aircraft—continue to drive amateur-built accident numbers. Since 2002, for instance, there have been 25 accidents involving amateur-built aircraft constructed from kits for the Lancair IV and IV-P. Many occurred at some point in the airport traffic pattern, and 14 of the 25 accidents involving aircraft built from these kits were fatal. These numbers suggest that some amateur aircraft builders may not entirely understand the trade-offs they are inherently making when they opt for an experimental amateur-built aircraft over an aircraft type certificated in accordance with 14 CFR part 23.

Experimental

In regulatory parlance, "experimental aircraft" is a specific term for an aircraft flown with an airworthiness certificate in the experimental category. The FAA issues experimental certificates for several purposes. These include air racing, exhibition, market surveys (e.g., sales demonstration), research and development, testing for compliance, and operating amateur-built aircraft.

Aircraft in the experimental category must be physically marked as experimental with the marks displayed near the entrance to the cabin, flight deck, or pilot station. For amateur-built aircraft, FAA Order 8130.2F, *Airworthiness Certification of Aircraft and Related Products*, also specifies that the operating limitations for the aircraft contain a requirement for a passenger warning placard to be displayed in full view of all occupants. This placard must state that "this aircraft is amateur-built and does not comply with the federal safety regulations for standard aircraft."

Even those experimental aircraft based on conventional designs may have very *un*conventional performance and flight characteristics.

At least 30,000 amateur-built aircraft exist in just the United States. Although many are based on conventional designs, others are very non-conventional—sometimes in terms of appearance and often in terms of performance and operating characteristics.

Part 23

The airworthiness standards for airplanes in the normal, utility, acrobatic, and commuter categories are described in 14 CFR part 23. By contrast with experimental category aircraft, those produced in accordance with 14 CFR part 23 must meet a number of requirements intended to ensure airworthiness in areas such as performance, stability, controllability, and safety mechanisms. The nature of the type design and production approval processes for aircraft produced in accordance with 14 CFR part 23 ensures that the flight characteristics of each aircraft sold under a particular make and model are precisely predictable.

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Specifically, a type certificate (TC) means that the design of the aircraft has been fully evaluated and tested. The TC includes the type design, operating limitations, the Type Certificate Data Sheet (TCDS), applicable regulations, and other conditions or limitations prescribed by the Administrator. The TC is the foundation for other FAA approvals, including production and airworthiness approvals.

During the type certification process, the design is developed and tested by the company to show compliance with the various requirements of part 23. These tests, including flight tests, usually begin with a proof-of-concept, or prototype, airplane. Once the testing has shown compliance with the regulations and meets the desired performance parameters, then the manufacturer will build "conforming" airplanes for final testing. When the company is satisfied with these test results, the FAA reviews the data and will conduct its flight tests. These tests usually occur over time and in the end the FAA makes the "finding of compliance" to the regulations. After all the data is approved and FAA completes the various flight tests, including those associated with flight performance and handling characteristics, then FAA issues a Type Certificate.

The next step requires the manufacturer to develop processes to ensure that production will precisely and consistently replicate the approved prototype. When production and assembly processes have been approved, the manufacturer obtains a production certificate authorizing full production of the aircraft.

There is continued FAA surveillance of the manufacturer's processes as long as the aircraft remains in production. If problems emerge in an aircraft after it enters production and service, the FAA issues airworthiness directives (AD) requiring specific action to correct the identified problems.

Type Certificates, Production Certificates, and Airworthiness Certificates

Type Certificate (TC): A TC is a design approval issued by the FAA when the applicant demonstrates that a product complies with the applicable regulations. As defined by Title 14 Code of Federal Regulations (CFR) section 21.41, the TC includes the type design, the operating limitations, the Type Certificate Data Sheet (TCDS), the applicable regulations with which the Administrator records compliance, and other conditions or limitations prescribed by the Administrator. The TC is the foundation for other FAA approvals, including production and airworthiness approvals.

Type Certificate Data Sheet (TCDS): The TCDS is a formal description of the aircraft, aircraft engine, or propeller. It lists limitations and information required for type certification, including airspeed limits, weight limits, thrust limitations, etc.

Production Certificate: The production certificate is an approval to manufacture duplicate products under an FAA-approved type design (i.e., type certificate or supplemental type certificate). The holder of a production certificate may obtain an airworthiness certificate for aircraft produced under the production certificate without further showing that it complies with the appropriate airworthiness standards. The applicant must follow production application and approval processes.

Airworthiness Certificate: An airworthiness certificate is an FAA document which grants authorization to operate an aircraft in flight. An airworthiness certificate is issued to a properly registered aircraft that has been found to conform to its Type Certificate and to be in a condition for safe operations.

Supplemental Type Certificate (STC): An STC is issued when an applicant has received FAA approval to modify an aircraft from its original design. The STC, which incorporates by reference the related TC, approves not only the modification, but also how that modification affects the original design.

Note: Special-light sport aircraft (S-LSA) are not designed or manufactured in accordance with 14 CFR part 23. Rather, they are designed and produced in accordance with consensus standards developed by American Society for Testing and Materials (ASTM) and found acceptable to the FAA. These consensus standards permit the serial production of duplicate aircraft without a type certificate or a production certificate.

What's the Trade-off?

The basic trade-off between a certificated (14 CFR part 23) airplane and an experimental, amateur-built aircraft is that the experimental, amateur-built aircraft has not met any minimum performance standards. For example, a single-engine airplane certificated under 14 CFR part 23 cannot have a maximum stall speed (V_s0) greater than 61 knots, and it cannot exceed 15 degrees of roll or yaw with normal use of the flight controls during entry and recovery from a stall. An experimental aircraft, on the other hand, can have a stall speed that is much greater, and it can significantly exceed 15 degrees of roll or yaw during stall entry and recovery.

Because of the freedom that the rules provide for experimental amateur-built aircraft, even those experimental aircraft based on conventional designs may have very *un*conventional performance and flight characteristics. Designs that produce higher cruising speeds may offer those benefits at the expense of the more docile low-speed flying characteristics that pilots have learned to expect when flying conventional 14 CFR part 23 aircraft. It is imperative for amateur builders to recognize that the trade-offs inherent in some of today's designs may not be benign. For more information, go to http://www.faa.gov/aircraft/gen_av/ultralights/amateur_built/.

Safety Tips

A thorough understanding of performance and handling characteristics is important for safe operation of any aircraft, but accident statistics strongly suggest that amateur builder/pilots need to go the proverbial extra mile. In aircraft designed for higher speed cruise, pilots must become extremely familiar with the aircraft's handling characteristics at lower speeds and consider installation or retrofit of devices that enhance stall awareness. Expert flight instruction on a regular basis is also a good idea.

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Photo courtesy of Garmin

Improving Amateur-Built Aircraft Safety

High-performance composite amateur-built aircraft, sometimes known as "fast-glass" airplanes, continue to drive amateur-built accident numbers. The speed and performance of these aircraft make them well-suited for personal transportation use and, because higher speed results in higher energy crashes, the lethality of these accidents is significant. Since 2002, for example, there have been 25 accidents involving amateur-built aircraft constructed from kits for the Lancair IV and IV-P, and 14 of the 25 were fatal. Aviation safety professionals in government and industry are concerned that a number of these accidents took place not in instrument meteorological conditions (IMC), but rather in day VFR (visual flight rules) conditions. Many involved loss of control at some point in the airport traffic pattern.

To address this concern, as well as accidents involving other amateur-built aircraft, government and industry have teamed up to form the Amateur-built Aircraft Subcommittee of the General Aviation Joint Steering Committee (GAJSC). This group is charged with gathering and analyzing aviation accident data and using this information to make aviation safer. Accordingly, the Amateur-built Aircraft Subcommittee will analyze fatal and non-fatal accident numbers and look for ways to improve the amateur-built safety record. It may develop initiatives on its own or turn to its members—Experimental Aircraft Association (EAA), FAA, the EAA Homebuilt Aircraft Council, and industry groups—to develop safety programs or other initiatives.

Earl Lawrence, EAA's vice president of industry and regulatory affairs, and John Duncan, manager of the FAA's General Aviation and Commercial Division, co-chair the subcommittee. Its members include other EAA and FAA officials and amateur-built industry leaders.