The Safety of Experimental Amateur-Built Aircraft

Safety Study

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National Transportation Safety Board

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Abstract: Experimental amateur-built (E-AB) aircraft represent nearly 10 percent of the U.S. general aviation fleet, but these aircraft accounted for approximately 15 percent of the total—and 21 percent of the fatal—U.S. general aviation accidents in 2011. Experimental amateur-built aircraft represent a growing segment of the United States' general aviation fleet—a segment that now numbers nearly 33,000 aircraft.

The National Transportation Safety Board undertook this study because of the popularity of E-AB aircraft, concerns over their safety record, and the absence of a contemporary and definitive analysis of E-AB aircraft safety. The study employed several different methods and data collection procedures to carefully examine this segment of U.S. civil aviation. This comprehensive approach resulted in a detailed characterization of the current E-AB aircraft fleet, pilot population, and associated accidents.

Areas identified for safety improvement include expanding the documentation requirements for initial aircraft airworthiness certification, verifying the completion of Phase I flight testing, improving pilots' access to transition training and supporting efforts to facilitate that training, encouraging the use of recorded data during flight testing, ensuring that buyers of used E-AB aircraft receive necessary performance documentation, and improving aircraft identification in registry records.

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Abbreviations and Definitions

Aviation Safety Inspector (ASI)	Federal Aviation Administration (FAA) employees who provide oversight of operations or maintenance in commercial or general aviation. Maintenance safety inspectors hold an FAA Mechanic Certificate and have experience involving maintenance and repair of airframes, powerplants, and systems. They have responsibility for certifying airworthiness and the issuing of airworthiness certificates.
Commercial Assistance Provider	An individual or corporation that assists in the building of an E-AB in exchange for compensation.
Demonstration Flight	Pre-project test flights provided by kit manufacturers or other E-AB owners.
Designated Airworthiness Representative (DAR)	An individual appointed by the FAA to perform examination, inspection, and testing services necessary to the issuance of certificates. DARs authorized to issue special airworthiness certificates for the purpose of operating amateur-built aircraft must possess current knowledge relating to the fabrication, assembly, and operating characteristics of amateur-built aircraft. DARs are not FAA employees, and they may charge for their services.
Experimental Aircraft Association (EAA)	The EAA was established in 1953 by a small group of individuals interested in building their own aircraft. It has grown to an organization of nearly 170,000 members that exists to promote sport aviation and amateur builders. The EAA also provides a variety of technical instruction and support programs for aircraft owners and builders. Its headquarters are in Oshkosh, Wisconsin.
Experimental Aircraft Association (EAA) Flight Advisor	An EAA member volunteer who assists the owner/builder or buyer of a used E-AB plan the first flight, find an instructor, and suggest additional training in the aircraft.
Experimental Aircraft Association (EAA) Technical Counselor	An EAA member volunteer who is an experienced aircraft builder, restorer, or mechanic, and who provides builders with the technical advice on building or restoring E-AB aircraft.

Experimental Amateur-Built (E-AB) Aircraft	An aircraft, the major portion of which has been assembled by a person, or persons, who undertook the project for the sole purpose of self-education or recreation.
General Aviation Operations	An aviation operation that is operating under any part of the Federal Aviation Regulations, except Title 14 *Code of Federal Regulations* (CFR) Parts 121, 135, or 129.
Kit Built E-AB	An aircraft that is constructed from a manufactured kit that may include some major sub-assemblies and pre-assembled parts. These kits still require that the amateur builder perform more than one-half of the fabrication and assembly tasks in order to meet the "51 percent" rule.
Letter of Deviation Authority (LODA)	A letter issued by the Administrator of the FAA that allows the owner of an E-AB to offer his/her aircraft for compensation or hire for the purpose of flight instruction.
Original Design E-AB	An aircraft constructed based on plans designed completely by the owner/builder without the purchase of major sub-assemblies or pre-assembled kit components.
Phase I Flight Test	The flight testing phase following issuance of a special airworthiness certificate for operation of an amateur-built aircraft. Operating limitations issued for this phase restrict operation to a sparsely populated geographic area and prohibit the carrying of passengers.
Phase II Flight	Phase II begins when the builder/owner certifies that flight testing has been completed. The geographic limitations are generally relaxed and non-revenue passengers may be carried.
Plans Built E-AB	An aircraft constructed from raw materials according to published blueprints or plans prepared by an individual or commercial entity other than the owner/builder.
Transition Training	The training a pilot receives when beginning to fly an unfamiliar aircraft. This training is meant to familiarize the pilot with the systems and structures of the aircraft to a point that he/she can competently operate the aircraft on his/her own.

Federal Aviation Administration (FAA) Documents and Regulations

FAA Advisory Circulars (AC)

AC 20-27G Titled, Certification and Operation of Amateur-Built Aircraft, this AC provides information about FAA regulations and procedures for airworthiness certification of equipment for the purpose of operating amateur-built aircraft.

AC 90-89A Titled, Amateur-Built Aircraft and Ultralight Flight Testing Handbook, this AC provides suggestions and safety-related recommendations to assist amateur and ultra-light builders in developing individualized aircraft flight test plans.

AC 90-109 Titled, Airmen Transition to Experimental or Unfamiliar Airplanes, this AC provides information and guidance to owners and pilots of experimental airplanes and to flight instructors who teach in experimental airplanes. This AC also contains training recommendations for pilots of experimental airplanes in a variety of groupings based on performance and handling characteristics.

FAA Orders

Order 8130.2G This order establishes FAA procedures for airworthiness certification of aircraft and related equipment. The procedures contained in this order apply to FAA ASIs, and persons or organizations with delegated authority to issue airworthiness certificates and related approvals.

Order 8130.35 This order created the Amateur-Built Aircraft National Kit Evaluation Team (NKET) and established methodology to determine whether kits, as manufactured, allow the builder to meet the major portion requirement.

Order 8900.1 This order stipulates that aircraft holding an experimental certificate may not be used to provide flight training for compensation or hire, unless a Letter of Deviation Authority is issued.

Title 14 *Code of Federal Regulations* (CFR)

14 CFR 21.191(g) FAA regulation establishing the experimental airworthiness certificate for the purpose of operating amateur-built aircraft, including the major portion build requirement of amateur-built aircraft.

14 CFR 21.193 FAA regulation prescribing the procedures and document submission requirements for applicants for an experimental airworthiness certificate.

14 CFR 47.31 FAA regulation prescribing requirements for the registration or re-registration of U.S. civil aircraft.

14 CFR 65.104 FAA regulation prescribing the eligibility, privileges, and limitations of the FAA repairman certificate for the primary builder of an amateur-built aircraft.

14 CFR 91.319 FAA regulation prescribing operating limitations of aircraft having experimental airworthiness certificates.

Executive Summary

Experimental amateur-built (E-AB) aircraft represent nearly 10 percent of the U.S. general aviation fleet, but these aircraft accounted for approximately 15 percent of the total—and 21 percent of the fatal—U.S. general aviation (GA) accidents in 2011. Experimental amateur-built aircraft represent a growing segment of the United States' general aviation fleet—a segment that now numbers nearly 33,000 aircraft.

The National Transportation Safety Board (NTSB) undertook this study because of the popularity of E-AB aircraft, concerns over their safety record, and the absence of a contemporary and definitive analysis of E-AB aircraft safety. The study employed several different methods and data collection procedures to carefully examine this segment of U.S. civil aviation. This comprehensive approach resulted in a detailed characterization of the current E-AB aircraft fleet, pilot population, and associated accidents.

Four sources of data formed the basis of this study. First, the NTSB performed a retrospective analysis of accident and activity data over the last decade to compare the accident experience of E-AB aircraft with that of similar non-E-AB aircraft used in similar GA flight operations. Second, the NTSB conducted in-depth investigations of all E-AB aircraft accidents during 2011, which provided a case-series of accidents for more detailed analysis. Third, a broad survey of the community of aircraft owners and builders was conducted by the Experimental Aircraft Association (EAA) in July and August 2011, and the data were made available to the NTSB for analysis to understand the population of E-AB aircraft builders and owners. Finally, discussions with EAA representatives, Federal Aviation Administration (FAA) officials, E-AB aircraft builders and owners, kit manufacturers, and representatives of E-AB aircraft type clubs provided insights on E-AB aircraft safety issues and solutions.

Recommended Safety Actions

In response to the findings of this study, the National Transportation Safety Board issued 12 recommendations to the Federal Aviation Administration and 4 recommendations to the Experimental Aircraft Association. The recommendations include expanding the documentation requirements for initial aircraft airworthiness certification, verifying the completion of Phase I flight testing, improving pilots' access to transition training and supporting efforts to facilitate that training, encouraging the use of recorded data during flight testing, ensuring that buyers of used E-AB aircraft receive necessary performance documentation, and improving aircraft identification in registry records.

What the NTSB Found in This Study

The study compared the accident experience of E-AB aircraft with that of similar non-E-AB general aviation aircraft over the last decade. A detailed analysis was also conducted of the 224 accidents, involving 227 E-AB aircraft, that occurred during 2011.[1] These analyses revealed the following factors defining E-AB aircraft accidents:

- E-AB aircraft account for a disproportionate number of total accidents and an even more disproportionate share of fatal accidents when compared with similar non-E-AB aircraft conducting similar flight operations.
- Accident analyses indicate that powerplant failures and loss of control in flight are the most common E-AB aircraft accident occurrences by a large margin and that accident occurrences are similar for both new and used aircraft.
- Structural failures have not been a common occurrence among E-AB aircraft.
- In comparison with similar non-E-AB aircraft, a much higher proportion of accidents involving E-AB aircraft occur early in the operational life of the aircraft.
- A similarly large proportion of E-AB aircraft accidents occur shortly after being purchased by a subsequent owner. For example, 14 of the 224 study accidents during 2011 occurred during the first flight by a new owner of a used E-AB aircraft.

Through further analysis of the accident record and the results of an EAA survey of E-AB aircraft owners and builders, the study also found:

- The majority of E-AB aircraft are now built from commercial kits, rather than from purchased plans or original designs.
- Pilots of E-AB aircraft, whether involved in accidents or not, have similar, or higher, levels of total aviation experience than pilots of non-E-AB aircraft engaged in similar general aviation operations.
- Pilots of E-AB accident aircraft, on average, had significantly less flight experience in the type of aircraft they were flying than pilots of non-E-AB aircraft.

Finally, study analyses identified the following key issue areas to explain these findings and recommended actions to improve E-AB aircraft safety.

Airworthiness Certification and Flight Testing of the E-AB Aircraft

E-AB aircraft safety is largely managed by the community of E-AB aircraft builders, owners, and kit manufacturers rather than by FAA regulatory requirements. A primary focus of

[1] Three of the 224 accidents involved collisions between two E-AB aircraft, accounting for a total of 227 E-AB aircraft.

FAA regulations governing the E-AB aircraft building process seeks to ensure that the major portion of the construction work is done by the builder. Airworthiness certificates are granted to the E-AB aircraft builder by the FAA based only on a review of documentation and a one-time inspection of the aircraft after it has been completed. Unlike foreign civil aviation authorities' standards, there is no requirement for pre-approval of the project or in-process inspections of materials and workmanship. However, the study found that a large proportion of E-AB aircraft accidents involving loss of engine power could be reduced by requiring documentation of a functional test of aircraft fuel system as part of the initial airworthiness certification.

As part of the airworthiness certification process, E-AB aircraft are assigned operating limitations specifying how and where the aircraft can be flown. E-AB aircraft operating limitations specify two phases of operation: Phase I, which is applicable to the flight test period and Phase II, which governs normal operations once testing is complete. Builders of E-AB are required to certify that the flight test has been completed with an entry in the aircraft logbook. Although FAA guidance materials are explicit in advising the builder that the objective of the flight test is to carefully map the performance envelope of the aircraft and develop an aircraft flight manual, neither a flight test plan nor documentation of its accomplishment, in the form of an aircraft flight manual, are required to be submitted to, reviewed, or accepted by an FAA Aviation Safety Inspector (ASI) or FAA Designated Airworthiness Representative (DAR). The study found that verifying the completion of Phase I flight testing through a review of the flight test records and resulting aircraft flight manual by an FAA ASI or DAR could ensure the adequacy of E-AB aircraft flight testing prior to engaging in normal Phase II flight operations.

Glass cockpit avionics, which are capable of recording aircraft and engine performance data, have been shown to be useful in the accomplishment of flight test objectives. A majority of EAA survey respondents who were in the process of building their E-AB aircraft equipped their aircraft with such instrumentation, and 35 percent of the owner-built E-AB aircraft involved in accidents during 2011 were equipped with glass cockpit avionics. The study found that FAA guidance does not address the use of data recordings from avionics or other electronic devices as part of an E-AB aircraft flight test program, potentially limiting the use of an important data source in a critical aspect of the demonstration of the E-AB aircraft's airworthiness.

The Phase I flight test period is uniquely challenging for pilots who must learn the handling characteristics of an unfamiliar aircraft while also managing the challenges of the flight test environment and procedures. Of the 224 E-AB aircraft accidents during 2011 included in this study, 32 included aircraft in the Phase I flight testing period, suggesting that pilots would benefit from additional training in the safe performance of E-AB aircraft flight test operations. Current Phase I operating limitations preclude anyone "not essential to the purpose of flight" from flying in the aircraft during flight testing. The study determined that consideration should be given to permit an additional pilot in cases where test circumstances could be performed more safely and more effectively with a second qualified pilot on board.

Availability and Quality of Transition Training

Both the accident analyses and extensive discussions with EAA members, kit manufacturers, and E-AB aircraft builders emphasized the importance of the builder receiving appropriate and sufficient transition training to develop proficiency with the new type of aircraft prior to flying his/her E-AB aircraft. These discussions identified challenges in finding appropriate training aircraft and instructors. Their scarcity, in part, is a result of the difficulty in obtaining an exception to the FAA regulation prohibiting a qualified instructor who owns an E-AB aircraft from charging students for instruction in that aircraft. The study determined that pilots would benefit from improved guidance regarding transition training in E-AB aircraft.

Guidance for Purchasers of Used E-AB Aircraft

Purchasers of used E-AB aircraft face particular challenges in transitioning to the new aircraft, which are aggravated by the absence, in many cases, of the sort of comprehensive aircraft flight manual that would be available to the owner of a non-E-AB aircraft. The study found that, because there is no review of flight test results, not all builders create an aircraft flight manual or performance documentation for their aircraft. Absent that documentation, the purchaser of a used E-AB aircraft is not provided with sufficient information to understand the aircraft's controllability throughout all maneuvers, to detect any hazardous operating characteristics, or to understand emergency procedures.

FAA and NTSB Data Limitations

Finally, the study identified shortcomings in the FAA's Civil Aircraft Registry that affect the conduct of safety analyses and hamper notification of aircraft owners when aircraft- or engine-specific safety issues are discovered.

1. Introduction

Experimental amateur-built (E-AB) aircraft represent a significant, and growing, proportion of the General Aviation fleet in the United States and around the world. According to the FAA's 2010 General Aviation and Part 135 Activity Survey, they account for nearly 10 percent of general aviation aircraft, and 4 percent of the hours flown in general aviation. Despite a decade-long decline in overall general aviation flight activity, the E-AB segment has grown both in numbers of aircraft and flight activity during this period.

E-ABs have experienced a disproportionate number of accidents relative both to their proportion of the general aviation fleet, and their share of general aviation flight activity. The overall E-AB aircraft accident rate per 1,000 aircraft is nearly twice that of comparable[2] non-E-AB aircraft, and the fatal accident rate is between 2.5 and 3 times higher. Figure 1 shows that these differences have remained relatively constant across the last decade.

Considered as a function of hours of flight activity, the accident rate disparity between E-AB aircraft and non-E-AB aircraft has also been consistently wide. The total E-AB aircraft accident rate per 100,000 flight hours was between 2.5 and 3 times that of non-E-AB aircraft between 2001 and 2010, and the fatal accident rate was approximately 4 times greater, on average, than that of non-E-AB aircraft. The comparative accident rates per 100,000 flight hours are shown in Figure 2.

[2] The comparison group selected to most closely match E-AB aircraft included all single-engine, piston-powered airplanes; piston-powered helicopters; balloons; and gliders that were not certificated as experimental amateur-built aircraft.

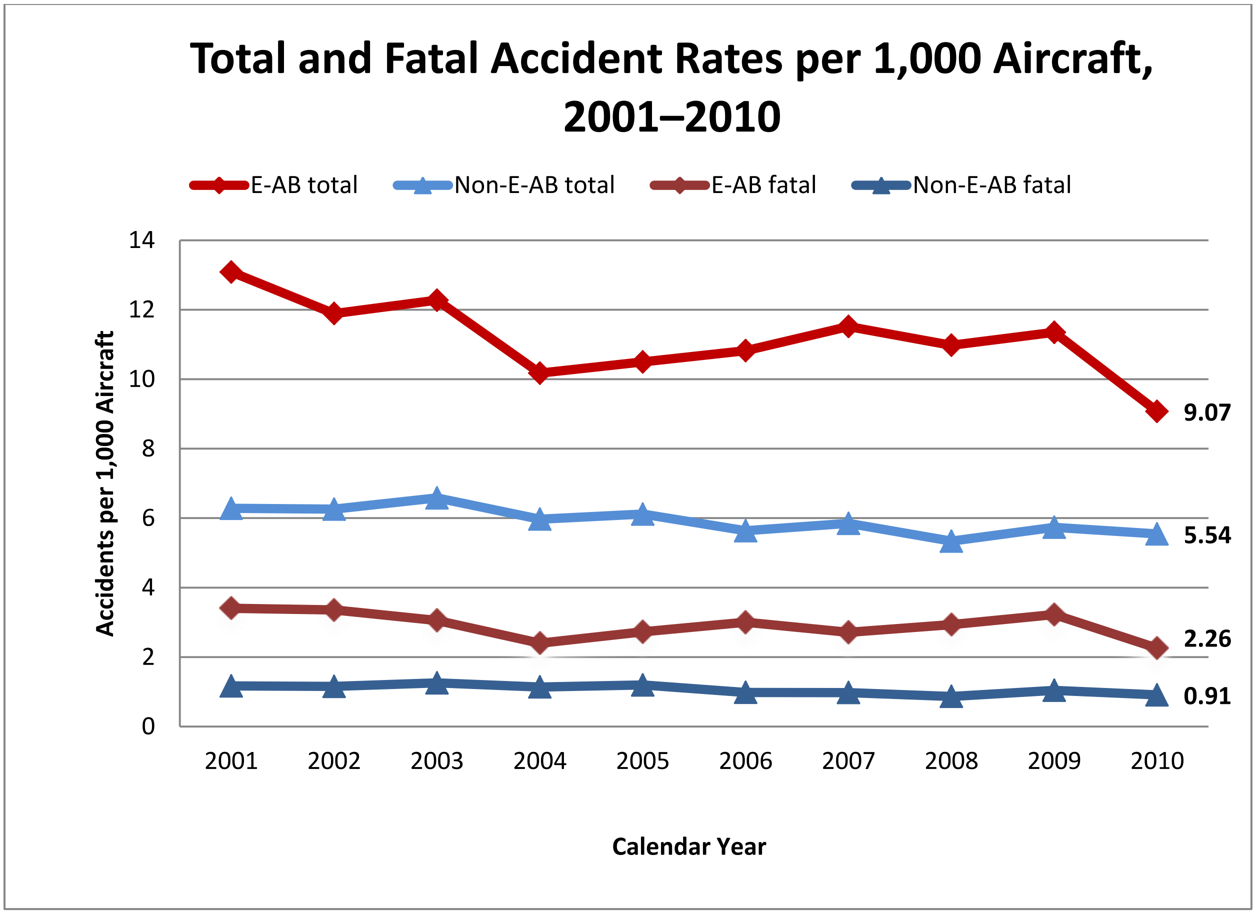

Figure 1. Comparison of accident rates per 1,000 E-AB and non-E-AB aircraft for the 2001-2010 period.

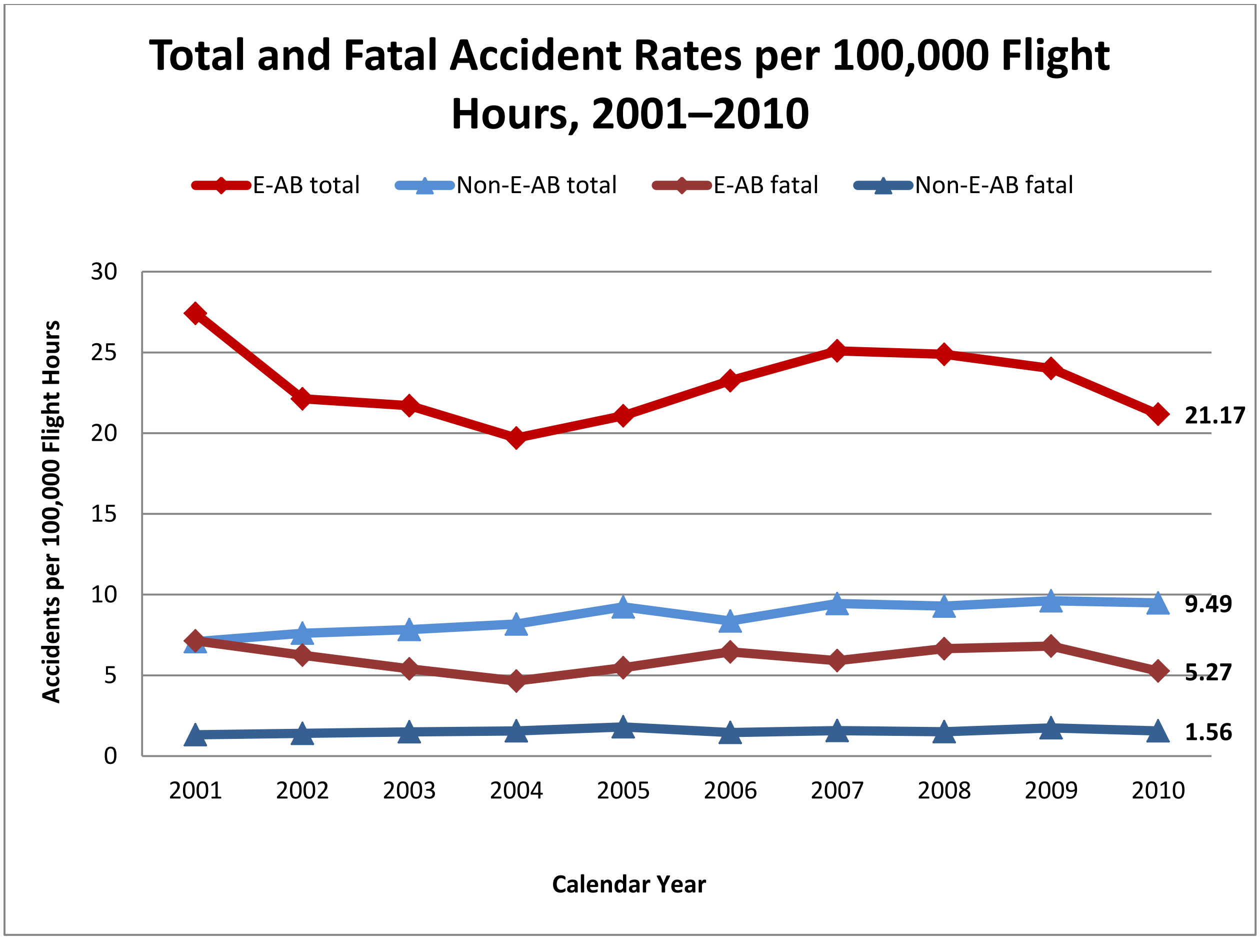

Figure 2. Comparison of accident rates per 100,000 flight hours for E-AB and non-E-AB aircraft for the 2001–2010 period.

These differences in accident risk for E-AB aircraft have been widely noted in the aviation community. Former FAA Administrator Randy Babbitt told a Sun'N Fun audience[3] in 2010, that amateur-built aircraft have "too high an accident rate", and that "they account for 10 percent of the GA fleet, but 27 percent of accidents." Aviation analysts such as Wanttaja,[4,5] have also recognized the elevated accident risk for amateur-built aircraft, while pointing out flaws in both registration and accident data that may affect these analyses.

Believing there to be a strong basis for a safety concern, the National Transportation Safety Board (NTSB) undertook this study to identify, and provide an in-depth assessment of, the salient issues that affect this important segment of the U.S. general aviation fleet. A necessary context for this study is the unique regulatory environment, within U.S. civil aviation, in which these aircraft are built and operated.

[3] Grady, Mary "FAA Administrator Babbitt Takes in Sun'N Fun," April 14, 2010, AVWeb.

[4] Wanttaja, Ron, Homebuilt Aircraft Safety: 1998-2006, *Kitplanes*, October, 2008.

[5] Wanttaja, Ron, Amateur-Built Accident Report: Reviewing the Past Five Years, *EAA Sport Aviation*, Vol. 6, No. 4, April, 2012, 30–35.

1.1 Background

Most of the aircraft used in general aviation operations in the United States are built under a type certificate issued to the manufacturer upon demonstration of compliance with 14 Code of Federal Regulation (CFR) Part 23. General aviation operations also include, however, aircraft within one of several categories of the type of special airworthiness certificate[6] known as experimental. Most experimental airworthiness certificates are issued to amateur-built aircraft. These aircraft are built, or assembled, by hobbyists or amateur builders.

1.1.1 The FAA's Definition of an E-AB Aircraft

The FAA first identifies an aircraft as amateur-built when it is registered with the FAA Registration Branch.[7] FAA regulations allow for aircraft constructed from an amateur builder's original design, purchased plans, or pre-fabricated kit, to be registered as an E-AB aircraft provided that the builder (or builders) demonstrate that he or she has fabricated or assembled over one-half of the aircraft. While FAA Advisory Circular (AC) 20-27G provides general guidance to amateur builders regarding the planning and construction of an E-AB aircraft and refers builders to technical support available from the EAA and others, its principal focus is to communicate and ensure compliance with the "major proportion" or "51-percent" rule, namely:

> The major portion of the aircraft is defined as more than 50 percent of the fabrication and assembly tasks, commonly referred to as the "51-percent rule." For example, an amateur-built kit found on the FAA List of Amateur-Built Aircraft Kits has 40 percent of the fabrication/assembly completed by the kit manufacturer. In order to be eligible for an experimental amateur-built airworthiness certificate, and per the major portion rule, the fabrication and assembly tasks that may be contracted out (for hire) to another individual (or builder/commercial assistance center) needs to be less than 10 percent.

The experimental amateur-built category was first adopted in Civil Aeronautics Manual 1[8] in 1952, and early E-AB aircraft were primarily the original designs of their builders or aircraft built from plans shared between builders. The first kits, which consisted of factory-fabricated components and sub-assemblies, were introduced in the 1970s and kit-built E-AB aircraft now constitute the largest proportion of experimental aircraft. The FAA publishes, on its website, a listing of kits that have been evaluated and found eligible in meeting the 'major portion' requirement of 14 CFR 21.191(g). The FAA also issued Order 8130.35, which created the Amateur-Built Aircraft National Kit Evaluation Team (NKET) and established a standard

[6] Per 14 CFR 21.175(b), the special airworthiness certificate categories include primary, restricted, limited, light-sport, and provisional airworthiness certificates, special flight permits, and experimental certificates. The special light-sport and experimental light-sport certificates were added in 2004. Light-sport aircraft are manufactured, or built from kits, that conform to the ASTM International consensus standard rather than a type certificate. Appendix G contains further descriptions of light-sport aircraft.

[7] Ford, Edsel W. Jr. "Breaking the Code," FAA Aviation News, Sept 22, 2011.

[8] U.S. Department of Commerce, Civil Aeronautics Administration, Civil Aeronautics Manual 1: Certification, Identification and Marking of Aircraft and Related Products, October, 1952.

methodology to determine whether kits, as manufactured, allow the amateur builder to meet the major portion requirement. There is no FAA evaluation of the airworthiness of kits.

Some kit manufacturers offer both standard kits and so-called quick-build kits to reduce the time required to complete the E-AB aircraft project. For example, Van's Aircraft Company,[9] offers both standard build and quick-build kits for several of its models and claims that quick-build kits cut building time by 35–40 percent. Figure 3 shows the standard Van's kit for its RV-7, a 20-foot, 4-inch-long, two-seat, tailwheel airplane with a wing span of 25 feet. Figure 4 shows the quick-build kit for the same airplane. The FAA lists both as meeting the "51-percent" rule.

Figure 3. The standard build kit for Van's RV-7 airplane.

[9] http://www.vansaircraft.com/public/kit-qb.htm.

Figure 4. The quick-build kit of Van's RV-7 airplane.

1.1.2 Registration and Certification of an E-AB Aircraft

Figure 5, from FAA AC 20-27G, details the steps a builder must follow to register and certify an E-AB aircraft. This AC provides general advice to the builder regarding FAA regulations and invites the builder to contact the applicable Manufacturing Inspection District Office or Flight Standards District Office if he/she requires further guidance. There is no requirement for pre-registration of the aircraft building project, and the builder is advised to complete the registration forms for the new aircraft 60 to 120 days before the construction is expected to be completed.

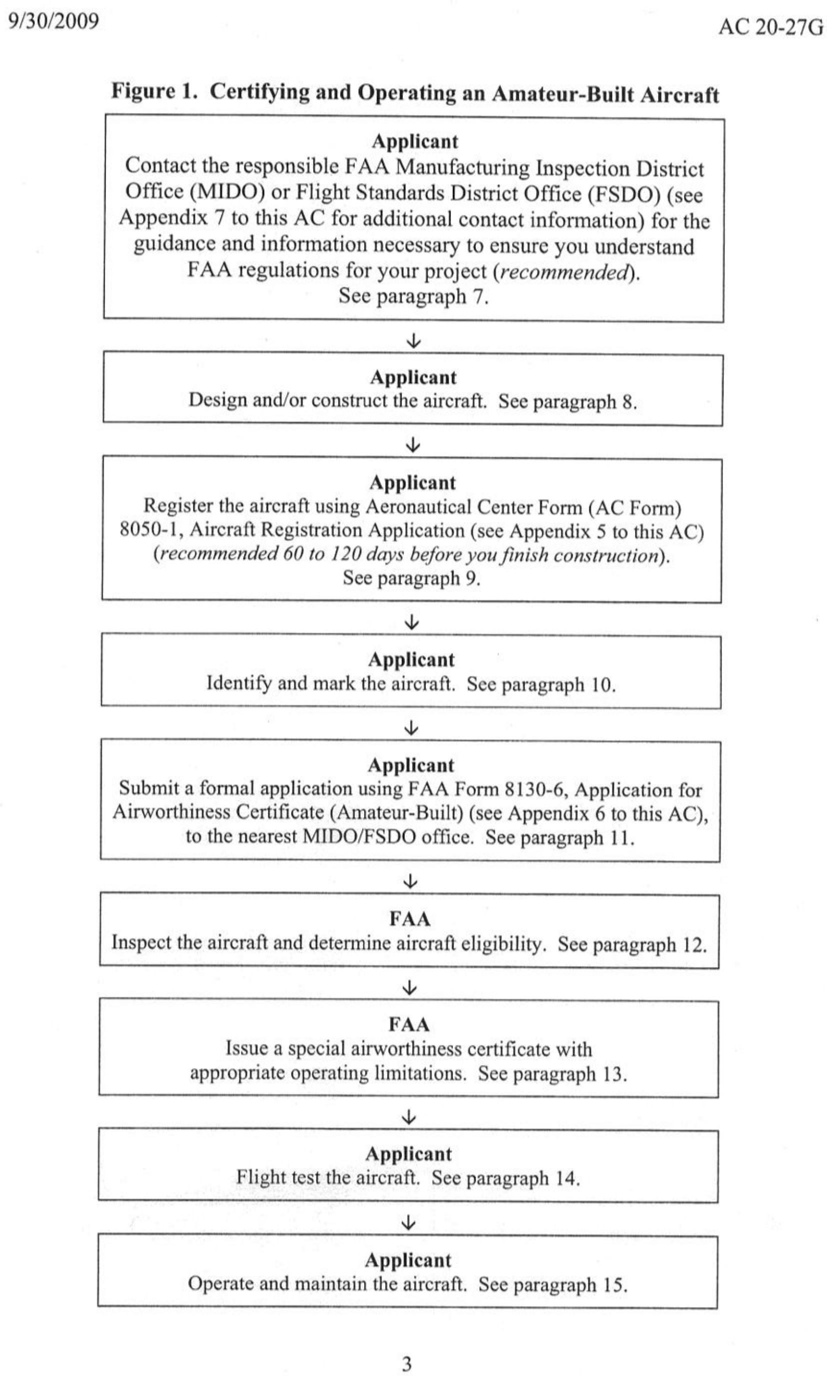
9/30/2009 AC 20-27G

Figure 1. Certifying and Operating an Amateur-Built Aircraft

Applicant
Contact the responsible FAA Manufacturing Inspection District Office (MIDO) or Flight Standards District Office (FSDO) (see Appendix 7 to this AC for additional contact information) for the guidance and information necessary to ensure you understand FAA regulations for your project (*recommended*).
See paragraph 7.

↓

Applicant
Design and/or construct the aircraft. See paragraph 8.

↓

Applicant
Register the aircraft using Aeronautical Center Form (AC Form) 8050-1, Aircraft Registration Application (see Appendix 5 to this AC) (*recommended 60 to 120 days before you finish construction*).
See paragraph 9.

↓

Applicant
Identify and mark the aircraft. See paragraph 10.

↓

Applicant
Submit a formal application using FAA Form 8130-6, Application for Airworthiness Certificate (Amateur-Built) (see Appendix 6 to this AC), to the nearest MIDO/FSDO office. See paragraph 11.

↓

FAA
Inspect the aircraft and determine aircraft eligibility. See paragraph 12.

↓

FAA
Issue a special airworthiness certificate with appropriate operating limitations. See paragraph 13.

↓

Applicant
Flight test the aircraft. See paragraph 14.

↓

Applicant
Operate and maintain the aircraft. See paragraph 15.

3

Figure 5. Registering and certifying an E-AB aircraft, according to FAA AC 20-27G.

As a part of his/her registration application, the builder must provide a notarized Affidavit of Ownership for Experimental Aircraft (AC Form 8050-88), which identifies the aircraft and engine (if the aircraft is powered) and records the builder's attestation that he/she has complied with the major portion rule. No inspection of the aircraft is conducted at this stage.

Amateur-built aircraft do not receive FAA type design approval but instead are issued a special airworthiness certificate in the experimental category following submission of an Application for Airworthiness Certificate[10] and the successful completion of an FAA airworthiness inspection and documentation review, which is conducted either by an ASI or a DAR. In addition to satisfying the major portion requirement, E-AB builders must provide evidence that the aircraft complies with acceptable aeronautical standards and practices. The ASI or DAR will conduct an inspection of the completed aircraft as well as a review of the builder's documentation of the building process, which may include construction logs, photographs, and reports of inspections by EAA Technical Counselors.

Following successful completion of the inspection of the aircraft and the documentation review, the ASI or DAR will issue an airworthiness certificate[11] and a set of operating limitations that are unique to the aircraft and become part of the special airworthiness certificate. Two sets of operating limitations are typically established at the time the airworthiness certificate is issued. Phase I operating limitations are associated with an initial flight testing period during which the aircraft must be subjected to operational testing to demonstrate that it meets the requirements of 14 CFR 91.319(b) (i.e., the aircraft is controllable throughout its normal range of speeds and throughout all the maneuvers to be executed and the aircraft has no hazardous operating characteristics or design features). Once the Phase I period has been completed, the Phase II operating limitations go into effect for an indefinite period, unless a major modification is made to the aircraft. Therefore, Phase I operating limitations can be described as applicable to flight testing, and Phase II can be described as normal operation of an E-AB aircraft.

1.1.3 Flight Testing During Phase I

FAA Order 8130.2G provides guidance for applicants to show compliance with 14 CFR 91.319(b) after the airworthiness certificate is issued by developing and executing an explicit flight test program in accordance with FAA AC 90-89A[12] or comparable guidance. The order identifies two purposes for this test program:

(1) They ensure the aircraft has been adequately tested and determined to be safe to fly within the aircraft's flight envelope.

(2) The flight test data is used to develop an accurate and complete aircraft flight manual and to establish emergency procedures.

The length of this Phase I flight test period is not established by regulation, but FAA Order 8130.2G recommends a minimum Phase I test period of 25 hours for aircraft equipped with type-certificated engine/propeller combinations and a minimum of 40 hours for aircraft with non-type-certificated engine, propeller, or engine/propeller combinations.[13] There is

[10] FAA Form 8130-6, Application for Airworthiness Certificate.

[11] FAA Form 8130-7, Special Airworthiness Certificate.

[12] Federal Aviation Administration Advisory Circular, AC 90-89A. *Amateur-Built Aircraft and Ultralight Flight Testing Handbook*, FAA, Washington, D.C. 1995.

[13] Type-certificated engines and propellers have been manufactured according to an FAA type certificate, non-certificated engines and propellers have not.

no requirement that the test plan be presented to, or reviewed by, the FAA when the airworthiness certificate and Phase I operating limitations are issued. Operating limitations issued with the airworthiness certificate restrict the Phase I test flights to a geographic area that avoids populated areas or busy airspace. During Phase I, only those persons essential to safe flight may be carried in the aircraft. Usually this is interpreted to preclude other than solo operations. The completion of Phase I flight test requirements is self-certified by the builder with an entry in the aircraft logs. There is no requirement for the FAA to review or confirm the flight test data intended to demonstrate that the aircraft was "safe to fly within the aircraft's flight envelope" or that "an accurate and complete aircraft flight manual" had been developed.

1.1.4 Continuing Airworthiness of the E-AB Aircraft—Phase II

After Phase I flight testing is certified as complete by the E-AB aircraft owner, the more liberal Phase II operating limitations become effective. In Phase II, the geographical restrictions are relaxed and non-revenue passengers are permitted. Ordinarily the Phase II operating limitations are assigned for an unlimited time period. An experimental amateur-built aircraft may be piloted in Phase II by individuals holding a private pilot or higher certificate.[14] The operating limitations of Phase II require an annual condition inspection, which is recorded in the aircraft logbook. Unlike type-certificated aircraft, there is no restriction on who may perform maintenance on an E-AB aircraft, other than major changes. The annual condition inspection requirement may be carried out by the aircraft builder, if he/she holds a repairman certificate[15] for that aircraft. Otherwise the condition inspection must be performed by an appropriately-rated FAA-certificated mechanic. The repairman certificate is unique to the aircraft and its builder and does not transfer with the sale of the E-AB aircraft.

[14] Certain aircraft that are sport pilot eligible may be piloted by individuals holding a sport pilot certificate.

[15] Title 14 CFR 65.104 defines the eligibility, privileges, and limitations of a repairman certificate—experimental aircraft builder. The original builder of an E-AB aircraft may apply for a repairman certificate, authorizing him or her to perform condition inspections in accordance with the operating limitations of the aircraft he or she constructed. The repairman certificate is specific to the individual and aircraft and does not transfer with the sale of an aircraft.

2. Accident Trends Across the Decade

NTSB aviation accident investigation records were used to compare the accident history of amateur-built aircraft with comparable non-E-AB aircraft from 2001 through 2010. An extensive review was conducted of these data to ensure that accident-involved aircraft were correctly identified as E-AB aircraft or non-E-AB aircraft.[16] In particular, aircraft identified as having special light-sport, experimental light-sport,[17] or other categories of experimental airworthiness certificates were removed from the amateur-built aircraft accident data.[18]

Because general aviation operations include a wide range of aircraft types, a subset of general aviation operations and aircraft was selected to provide comparisons to the E-AB aircraft accident record and exposure data. The bulk of the E-AB aircraft fleet is comprised of single-engine, piston-powered airplanes, but it also includes other categories of aircraft such as helicopters, balloons, gliders, and gyroplanes.[19] Therefore, the comparison group selected to most closely match E-AB aircraft includes all single-engine, piston-powered airplanes; piston-powered helicopters; balloons; and gliders that are not certificated as experimental amateur-built. This group included aircraft with both standard category and light-sport airworthiness certificates. Similarly, the activity and accident records associated with the comparison aircraft were limited to personal and business flights to most closely match the activity of E-AB aircraft[20] that are built for personal education and recreation and are restricted from operating for compensation or hire.[21] Throughout the remainder of this chapter, the two groups of aircraft will be referred to as the "E-AB" and "non-E-AB" aircraft groups.

[16] Previous analyses, such as Cook, Mark, 2010. Commentary: "Homebuilt Aircraft Safety Picture Blurred by Bad Data," *Kitplanes*, March, 2010, have criticized the accuracy in identifying amateur-built aircraft. NTSB staff worked with the FAA to validate the airworthiness certification of aircraft involved in general aviation accidents from 2001 through 2010, resulting in a net reduction of the number of E-AB accidents during the period.

[17] Title 14 CFR 1.1 defines the design and performance characteristics of a group of simple, small, lightweight, low-performance aircraft; identified as *light-sport aircraft*. Title 14 CFR 21.190 also prescribes requirements for the issuance of a special airworthiness certificate for light-sport category aircraft. A detailed discussion of light-sport aircraft and associated aircraft and airworthiness certification is included in appendix H of this report.

[18] A summary of the methodology and results of the data validation effort is included in Appendix A of this report.

[19] The 2,134 accident aircraft from 2001 through 2010 validated as E-AB aircraft included 97 helicopters, 75 gyroplanes, 16 gliders, and 4 balloons.

[20] Although the non-E-AB group was limited to personal and business flights, the E-AB accident aircraft were reportedly engaged in a variety of activities other than personal flying, including business, flight instruction, and air show or air racing. In addition, there were 39 non-E-AB aircraft that were engaged in activities other than personal or business flying but are included in some analyses in this section because they were involved in ground or midair collision accidents with E-AB aircraft.

[21] This approach likely underestimates active aircraft and flight activity and, therefore, overestimates accident rates associated with the comparison group of non-E-AB aircraft. However, this conservative approach was selected to avoid overestimating the increased risks associated with amateur-built aircraft.

2.1 Aircraft Fleet and Activity

Exposure data obtained from the FAA's annual General Aviation and Part 135 Activity Survey were used to calculate accident rates per 100,000 flight hours, which provided normalized comparisons of E-AB and non-E-AB aircraft accident experiences.

Figure 6 shows the estimated active aircraft and Figure 7 shows the annual flight hours from 2001 through 2010 for E-AB and non-E-AB aircraft.

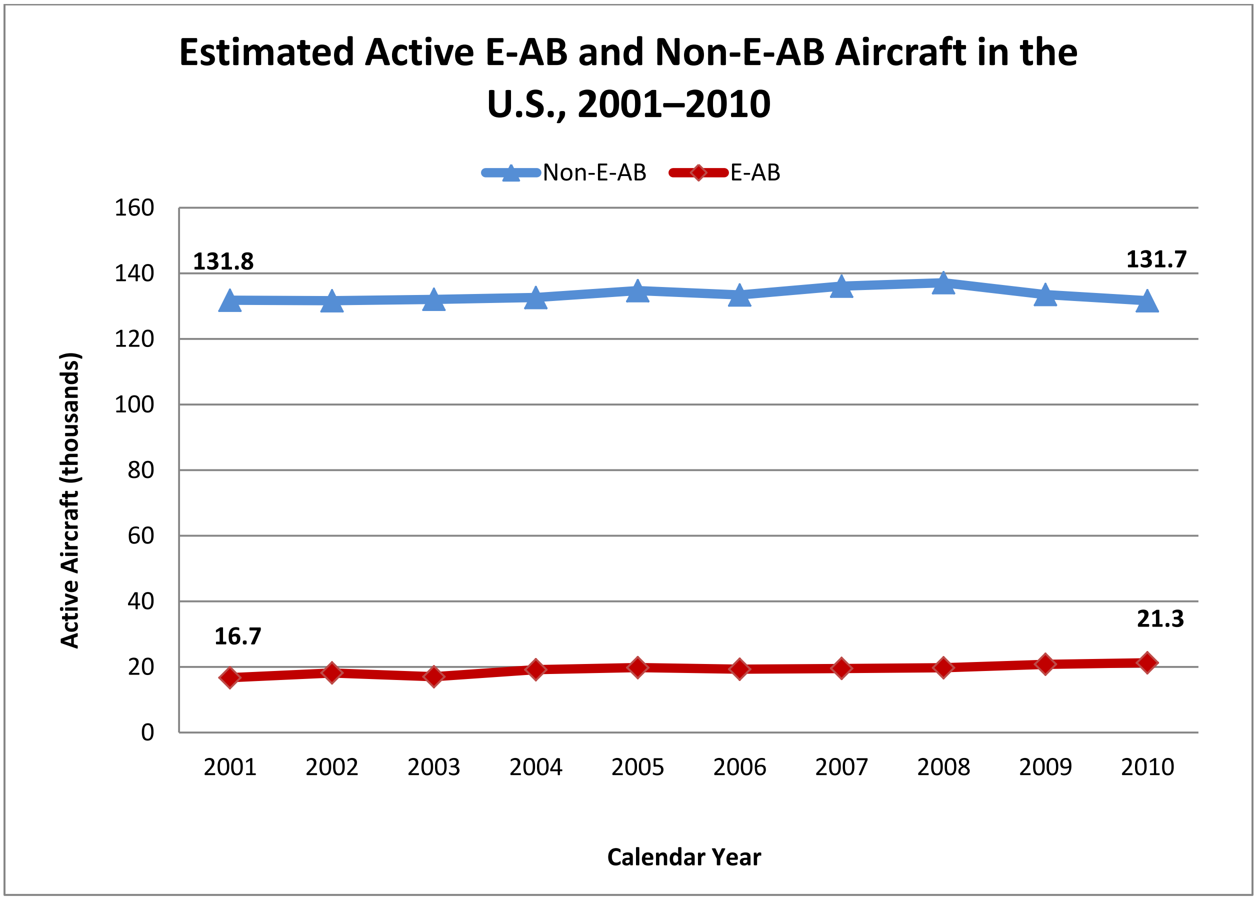

Figure 6. Number of active E-AB and non-E-AB aircraft annually from 2001 to 2010.

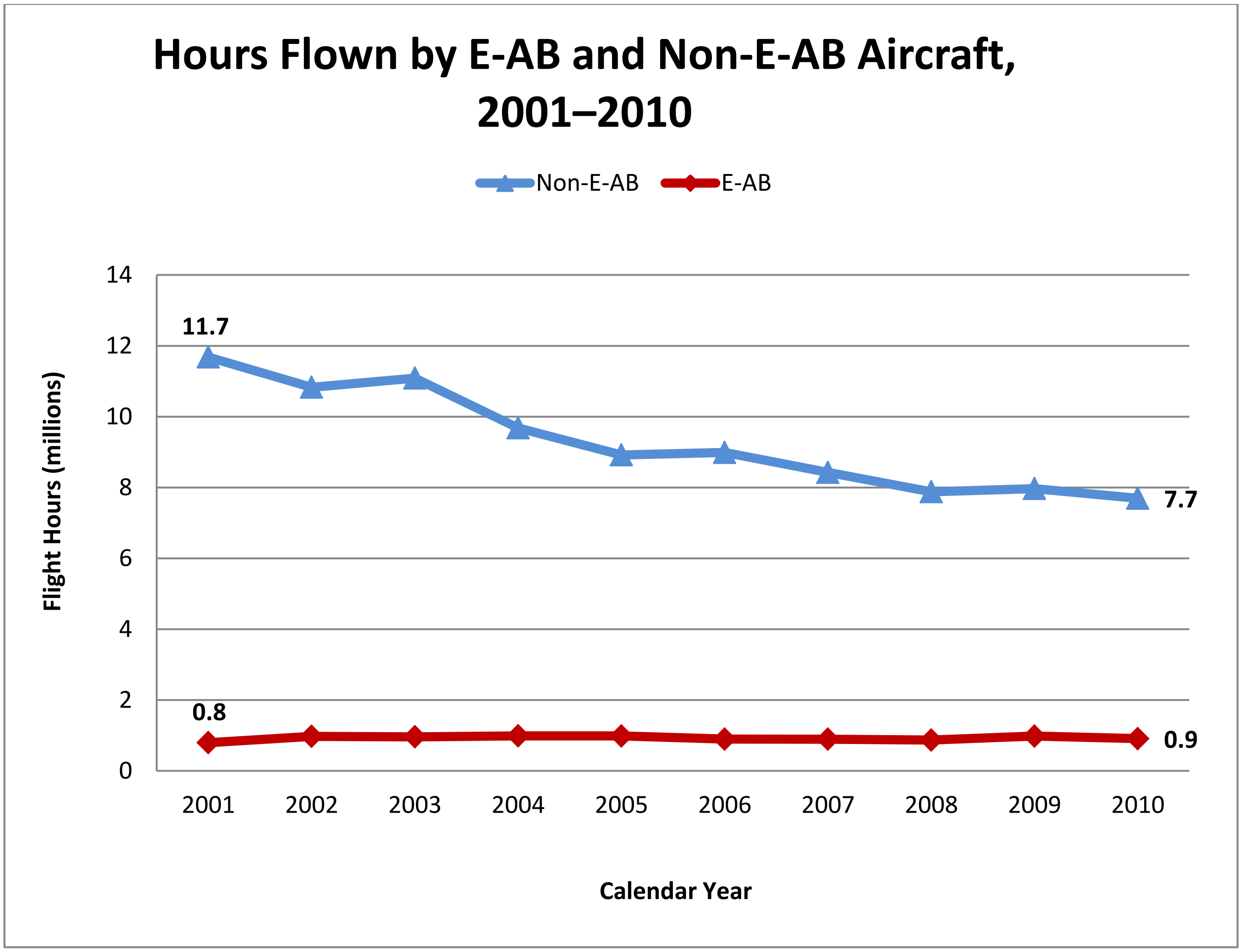

Figure 7. FAA-reported number of hours flown for E-AB and non-E-AB aircraft annually from 2001 through 2010.

2.2 Accidents as a Function of Aircraft Age

Previous comparisons of E-AB aircraft accident rates to other segments of general aviation[22] have sought explanations for the substantially elevated accident rates, either as a proportion of the active aircraft fleet or of flight hours.[23] One observation is that much higher proportions of E-AB aircraft accidents occur early in the operational life of the aircraft, particularly during the Phase I flight test as a condition of airworthiness certification. Figure 8 compares the cumulative distributions of accident aircraft from 2001 through 2010 at various points in the total airframe lifespan (in hours) for E-AB and non-E-AB aircraft. Direct comparison of the airframe hours at the time of the accident is difficult because of the likely differences in the operational history of the two groups of aircraft. However, the large difference in the number of E-AB aircraft accidents occurring very early in the operational life of the aircraft suggests underlying differences between the two fleets of aircraft. For example, 152 of

[22] Wanttaja, Ron. *Examining Homebuilt Aircraft Accidents*, 2010.

[23] See, for example FAA Advisory Circular 90-109, http://www.faa.gov/documentLibrary/media/Advisory_Circular/90-109.pdf..

the 1,622 accident E-AB aircraft (9 percent) with airframe data had fewer than 10 airframe hours at the time of the accident, compared with only 18 of the 6,450 non-E-AB aircraft (.3 percent) with airframe data. This is despite a total fleet of, and number of accidents involving, non-E-AB aircraft being several times greater than that of E-AB aircraft.

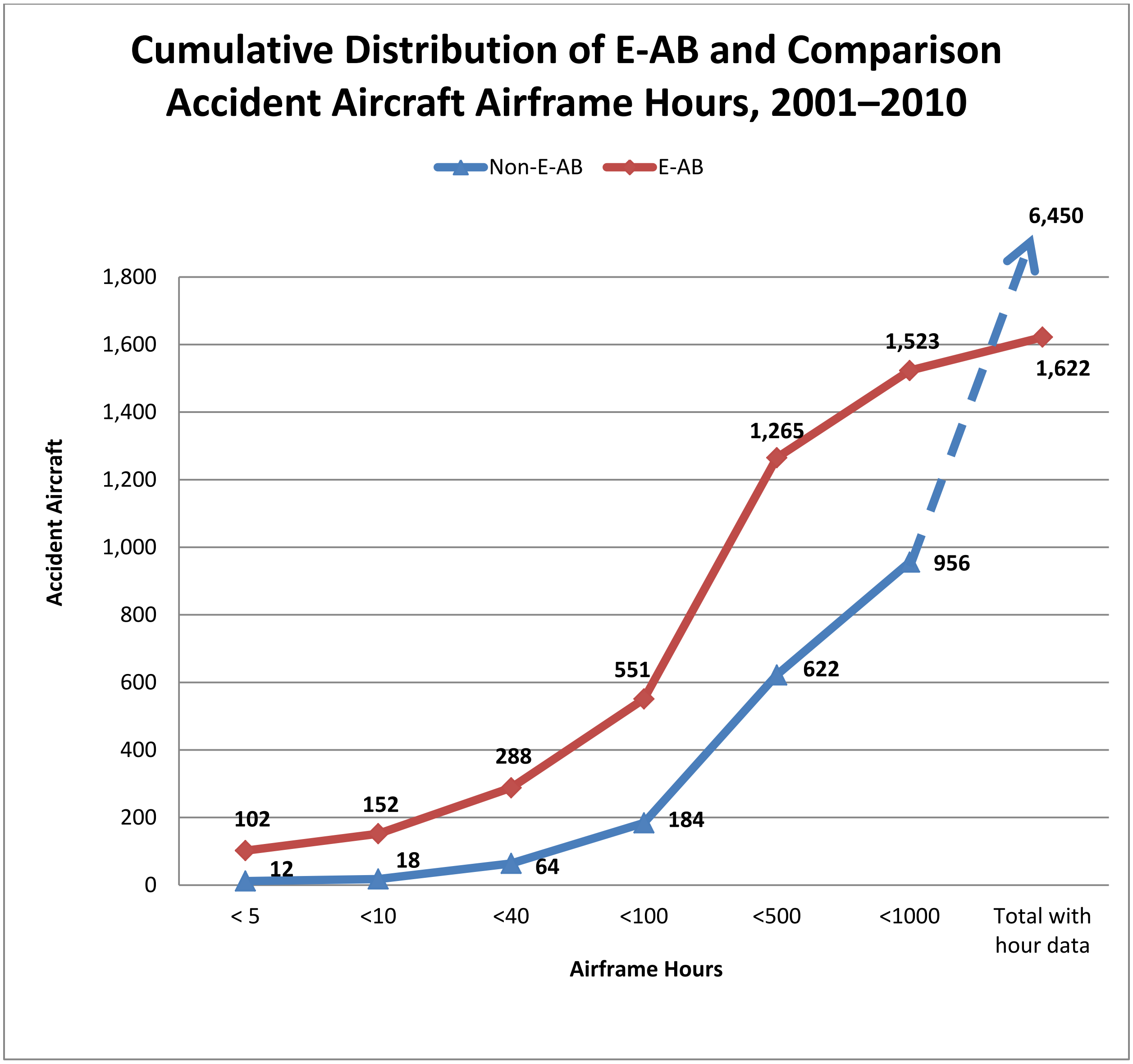

Figure 8. Cumulative distribution of airframe hours of E-AB and non-E-AB aircraft involved in accidents from 2001 through 2010; 8,072 accident aircraft with available airframe hours information.

Although these differences in accumulated airframe hours might suggest differences in airworthiness between the two groups of aircraft, they may also be influenced by differences in the way the aircraft are operated and maintained and by the pilots who fly them.

2.3 Comparison of Accident Characteristics

An analysis of the accident occurrences and associated phases of flight provides further insight. E-AB and non-E-AB aircraft accident characteristics were summarized using a coding structure developed by the Commercial Aviation Safety Team (CAST) and the International Civil Aviation Organization (ICAO) that are useful in describing the characteristic circumstances of aviation accidents.[24] For ease of aggregate analysis and interpretation, the NTSB identifies one of the CAST-ICAO Common Taxonomy Team (CICTT) event codes as the defining event for each accident and that is the categorization used in this report to characterize accident circumstances. Each accident occurrence can also be associated with a CICTT phase code, identifying the phase of flight during which an accident occurred.

Figure 9 compares E-AB and non-E-AB aircraft groups relative to the defining event for all accidents investigated between 2001 and 2010. Figure 10 compares the percentage of fatal accidents in each major event category for E-AB and non-E-AB aircraft during this period.

[24] The CAST/ICAO Common Taxonomy Team (CICTT), comprised of U.S. and international government and industry experts, has developed consensus coding of aircraft accident occurrences categories and associated phases of flight. CICTT occurrence and phase of flight definitions and usage notes can be found at the CICTT website: http://www.intlaviationstandards.org/.

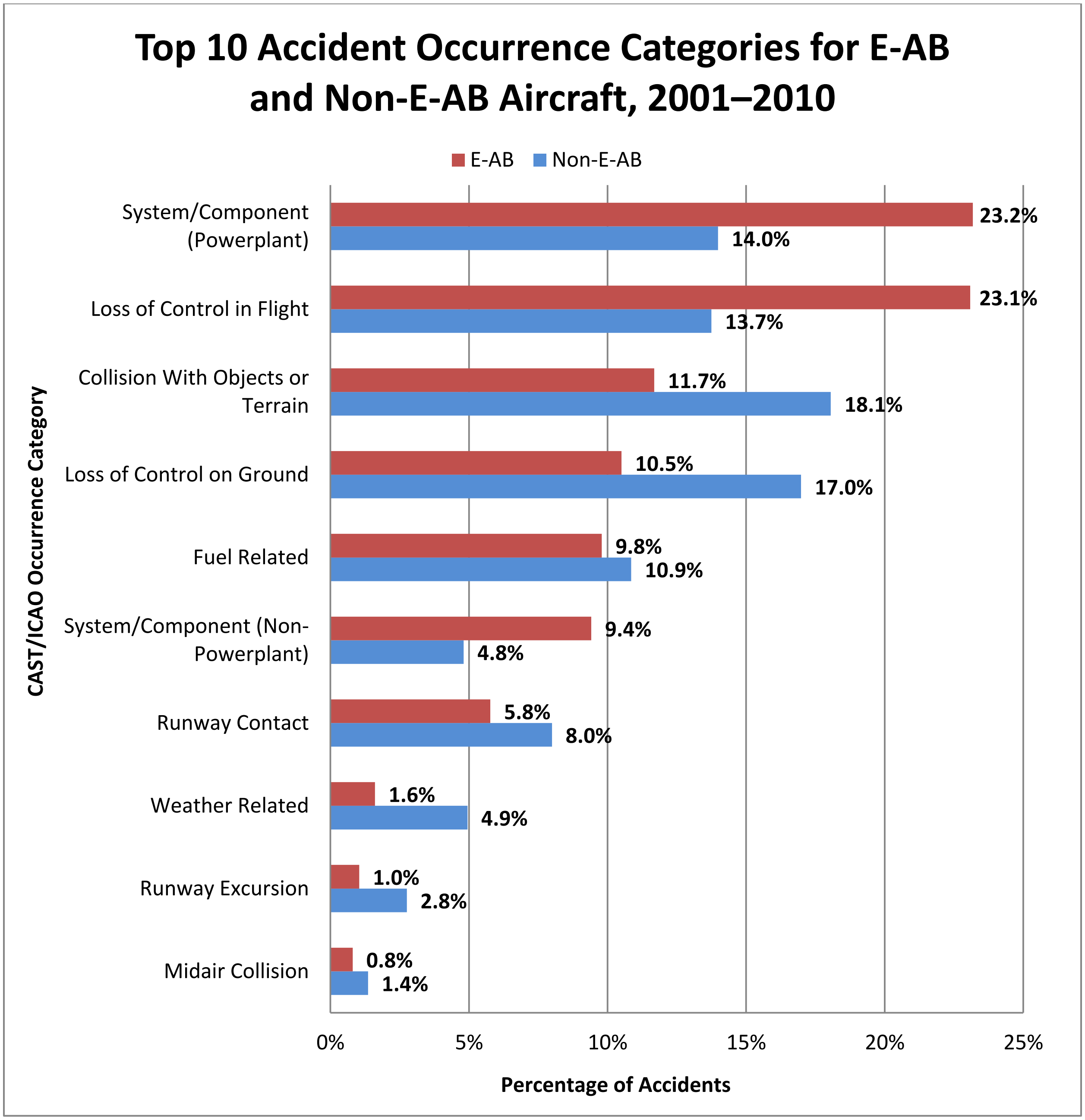

Figure 9. Distribution of accidents involving E-AB and non-E-AB aircraft involving the 10 most common CAST/ICAO occurrence categories from 2001 through 2010.

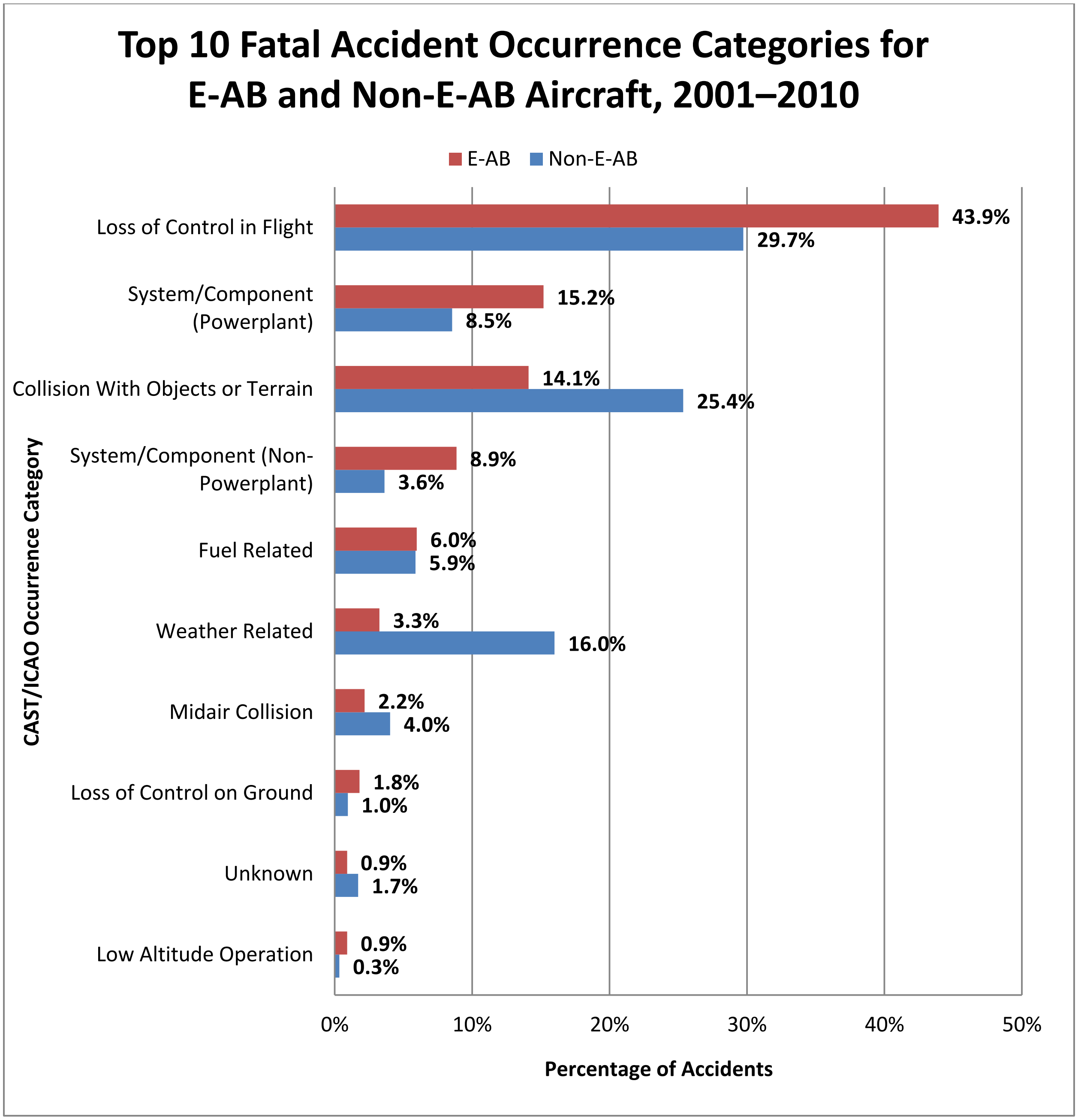

Figure 10. Distribution of fatal accidents involving E-AB and non-E-AB aircraft involving the 10 most common occurrence categories from 2001 through 2010.

Powerplant failures and loss of aircraft control in flight were the most common accident events for E-AB aircraft, while collisions with objects or terrain and loss of control on ground were the most common accident events for the non-E-AB aircraft. A noticeably larger proportion of E-AB aircraft accidents and fatal accidents involved system failures (either powerplant or non-powerplant). The difference in accident event types, and the typical impact forces involved with those events, identifies an important source of the historic difference in the fatal accident rates for E-AB aircraft.

Loss of aircraft control in flight was the most common event in fatal accidents for both groups of aircraft, but E-AB aircraft experienced a noticeably greater proportion of loss of control in flight events than the non-E-AB aircraft group. There is also a noticeable difference between the fatal accident histories of the two groups related to weather, with weather-related accident events being much less common for E-AB aircraft. This likely reflects differences in aircraft usage associated with a smaller proportion of E-AB aircraft certified for flight in instrument meteorological conditions.

2.4 Accident Pilot Demographics

Accident records were reviewed to gain a better understanding of the role of the pilot in the accident history. Pilots of E-AB aircraft involved in accidents between 2001 and 2010 were older (median age was 57 years) than the accident pilots of non-E-AB aircraft (median age was 53 years).[25] Figure 11 shows the median age of accident pilots involving these two groups of aircraft each year from 2001 through 2010. Accident pilots of E-AB aircraft were consistently older than those of comparison aircraft and the difference increased slightly over the period.

[25] This difference was statistically significant (*Mann-Whitney U* = 6848562.0, *N* (non-E-AB aircraft) = 7,975, *N* (E-AB aircraft = 2,104), $p < 0.001$).

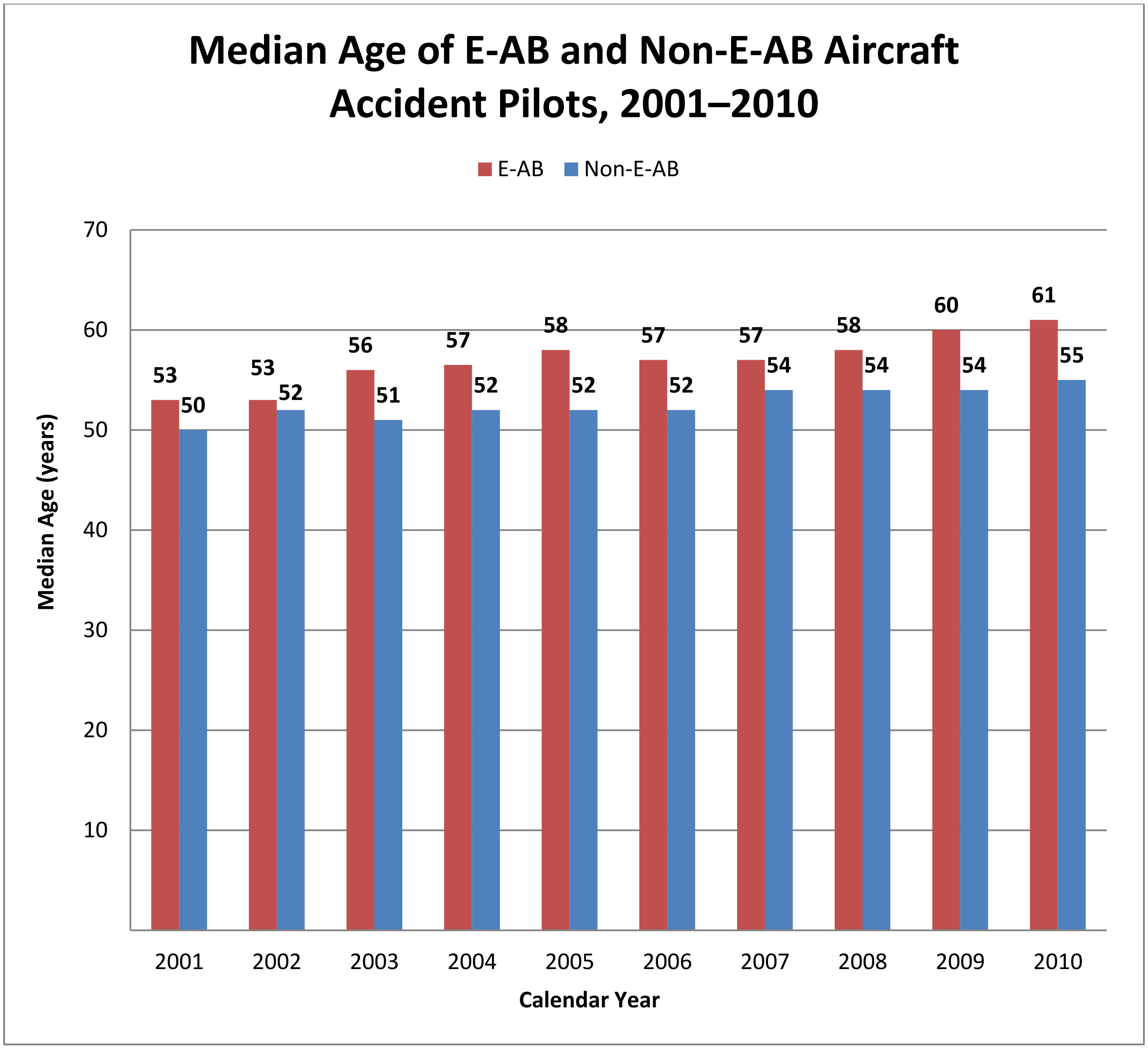

Figure 11. Median accident pilot age for E-AB and non-E-AB aircraft, 2001–2010.

The E-AB aircraft accident pilots had more total flying time (median flight hours were 1,000 hours) than the non-E-AB aircraft pilots (median flight hours were 810 hours),[26] and a slightly higher proportion of E-AB aircraft pilots held commercial or airline transport pilot certificates. These results indicate that pilots of E-AB aircraft have similar, or higher, levels of total aviation experience than pilots of comparable aircraft engaged in similar general aviation operations. However, E-AB aircraft accident pilots had less than half (median flight hours were

[26] This difference was statistically significant (*Mann-Whitney* $U = 7248897.5$, N (non-E-AB aircraft) = 7,824, N (E-AB aircraft = 2,024), $p < 0.001$).

61 hours) of the time in the accident aircraft type than did the pilots of non-E-AB accident aircraft (median flight hours were 152 hours).[27]

2.5 Limitations in the Analysis of Retrospective Data

The use of historical accident data alone is insufficient to provide a comprehensive analysis of E-AB aircraft safety issues. Several important matters cannot be resolved. For example, these data do not reliably identify whether the pilot of the accident-involved E-AB aircraft was the builder, the owner, or someone else. Nor do these accident data reliably identify whether the accident flight occurred during the flight test of the aircraft. The accident records also do not distinguish between owner/operator-built aircraft and E-AB aircraft that have been purchased used. Further, available data fail to provide a description and understanding of the broader population of E-AB aircraft and aviators who are not involved in accidents.

In an effort to overcome these data limitations, the NTSB analyzed two additional datasets for this study, a detailed case-series dataset of E-AB aircraft accidents investigated by the NTSB during 2011 and a survey of amateur aircraft builders and operators that was conducted by the EAA. These are the subject of the following chapters.

Additionally, staff visited manufacturers of E-AB aircraft kits, interviewed FAA officials and contractors, participated in discussions with the General Aviation Joint Steering Committee, and held numerous discussions with officials and members of the EAA, including its Homebuilders Aircraft Council. NTSB staff also reviewed industry and government training resources applicable to E-AB aircraft construction, certification, and oversight, such as the FAA's Initial Amateur-Built and Light-Sport DAR Seminar training course covering mandatory DAR training for amateur-built or light-sport certification,[28] and the EAA's RV Assembly, SportAir workshop.[29]

[27] This difference was statistically significant (Mann-Whitney U = 3759648.5, N (non-E-AB aircraft) = 6,819, N (E-AB aircraft = 1,604), $p < 0.001$). Statistical test results are provided here to illustrate differences between the characteristics of the two groups of accident pilots. A similar pattern of E-AB aircraft pilot experience was observed in the 2011 accident data, but no similar comparisons were evaluated through statistical testing.

[28] The purpose of this course is to ensure that DARs understand FAA expectations, regulations, policy, procedures, forms, records, and any issues unique to amateur-built and light-sport aircraft. FAA inspectors also attend this course.

[29] This is one of a group of similarly organized workshops offered by the EAA on topics pertaining to the assembly and operation of amateur-built aircraft such as the Code of Federal Regulations regarding amateur-built aircraft, tools required during assembly, workshop requirements, insurance, engine and propeller selection, and flight testing. The RV assembly workshop curriculum included a classroom presentation followed by "hands-on" sheet metal projects, including a small airfoil section patterned after a Van's Aircraft Company RV wing intended to include the majority of skills necessary to build the aircraft.

3. The Calendar Year 2011 Case-Series of E-AB Aircraft Accidents

In order to facilitate a fuller understanding of the circumstances of E-AB aircraft accidents, beyond that possible from the historical record, the NTSB conducted detailed investigations of all 224 E-AB aircraft accidents involving 227 E-AB aircraft during calendar year 2011.[30] These detailed investigations employed the supplementary data form shown in appendix A. This form was completed for each of these accidents to collect additional information on aircraft performance, builder and pilot characteristics, and other factors to augment the data routinely collected in NTSB accident investigations. In addition, FAA airworthiness certification files and FAA registration files were obtained for each of the accident aircraft for which such files were available.[31]

Fifty-four of the 224 accidents were fatal, claiming the lives of 67 of the 300 individuals carried aboard the accident aircraft.[32] Figure 12 shows the locations of these accidents in the continental United States. The complete list of accidents is shown in appendix F.

[30] Three of the 224 accidents involved collisions between two E-AB aircraft, accounting for a total of 227 E-AB aircraft.

[31] Two accidents involved unregistered aircraft for which such files were not available.

[32] At the time of this report, 40 percent of the 227 accidents did not yet have published probable cause statements.

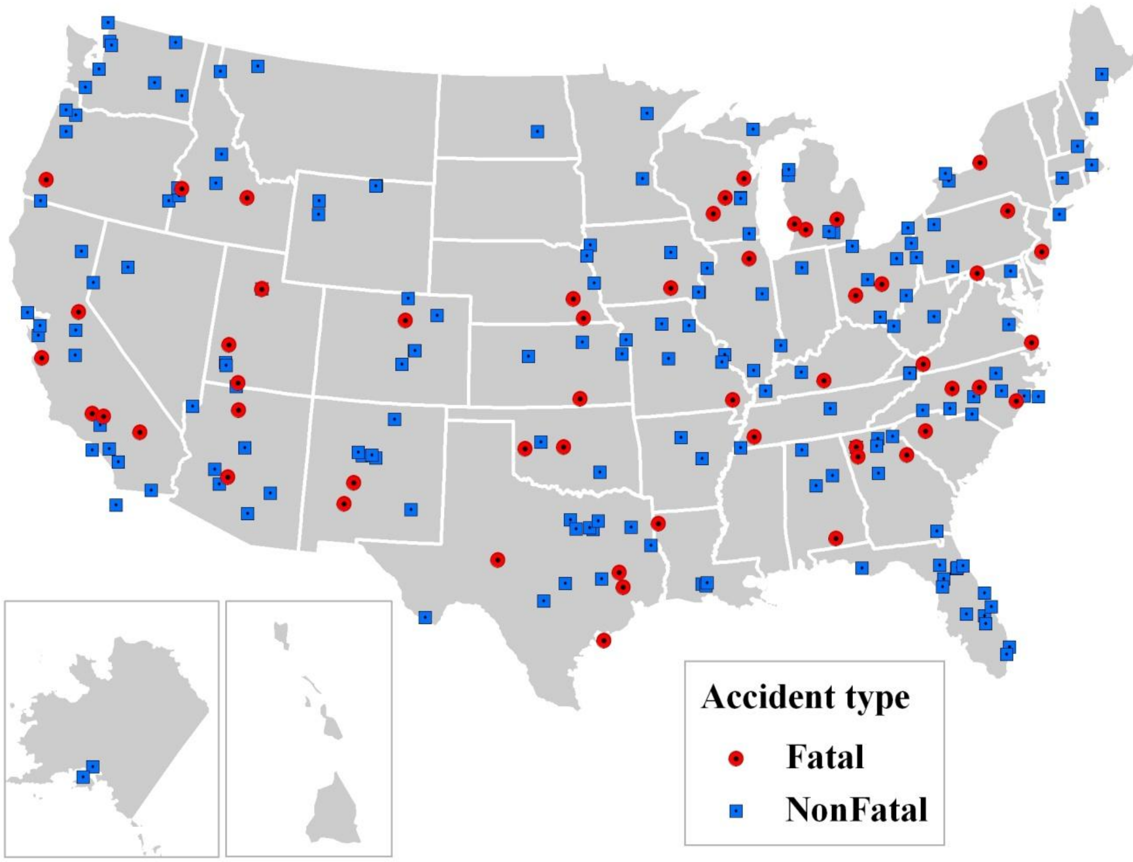

Figure 12. Locations of the 224 E-AB aircraft accidents occurring in the United States during calendar year 2011.

An analysis of these accidents illustrates several important characteristics and features. The most notable is that powerplant failure and loss of control in flight were the most common factors associated with E-AB aircraft accidents occurring in 2011, the same pattern seen among E-AB aircraft accidents occurring between 2001 and 2010.

Additional review of the 2011 accident data provided detail about E-AB accident aircraft and pilots not available from review of the 2001–2010 accident records. Some of the more interesting findings are summarized below. It was found that:

- A larger proportion of E-AB aircraft accidents in 2011 involved used E-AB aircraft compared with accidents involving aircraft owned by the original builder.
- A high proportion of these used E-AB aircraft accidents occurred shortly after being purchased.
- There were a greater number of accidents occurring during the first flight by the new owner of a used E-AB aircraft compared with the first flight of a newly built aircraft.

- Loss of control in flight was the most common occurrence for first flights of both newly built and newly purchased aircraft.

Other key findings associated with the detailed E-AB aircraft accidents occurring in 2011 are provided below.

3.1 Characteristics of the 224 E-AB Aircraft Accidents Occurring in 2011

Figure 13 plots the CICTT[33] codes for the 227 E-AB aircraft involved in 224 accidents during calendar year 2011. Powerplant failures were observed in 57 of the accident aircraft, including 8 fatal accidents—by far the leading type of occurrence. Most (53 of 57) of the powerplant failures involved airplanes, the remaining 4 accidents involved helicopters. Type-certificated aircraft engines failed in 40 percent of these accidents, 37 percent involved non-type-certificated aircraft engines, and 23 percent of the powerplant failures occurred in automotive conversion engines. Of the 49 engines for which the origin could be established, 57 percent were new (including one that had been “mothballed” for 60 years) and 33 percent were overhauled or factory reconditioned. The remaining 10 percent were used engines that had not been overhauled.[34] A wide variety of failures were observed in these powerplant-involved accidents. These include:

- A bearing on a builder-designed secondary shaft of a Rotorway helicopter equipped with a new non-type-certificated aircraft engine froze, causing a fatal accident.
- An improperly installed coolant hose fitting failed on an airplane powered by a new Subaru automotive conversion engine, causing engine overheating and loss of power.
- Loose, or cross-threaded, spark plugs on a type-certificated Continental engine that had been overhauled by an FAA certified mechanic, and on a factory-reconditioned Rotax aircraft engine led to two accidents.
- The rupture of an oil supply line because of abrasion from an improperly positioned hose clamp led to the failure of a new Jabiru engine.

In many cases, the investigator was only able to determine that the engine had experienced total or partial loss of power for undetermined reasons.

Loss of control in flight was the next highest overall occurrence and accounted for the most fatal occurrences. Half of the loss of control accidents occurred on takeoff or initial climb. In a number of these accidents, insufficient takeoff speed, early rotation, or too steep a climb on

[33] International Civil Aviation Organization, Common Taxonomy Team, Aviation Occurrence Categories – Definitions and Usage Notes, October 2008.

[34] Among the population of E-AB aircraft accidents in 2011, 50 percent of the aircraft used type-certificated aircraft engines, 34 percent used non-type-certificated aircraft engines, 15 percent used automotive conversion engines, and 1 percent were unpowered gliders. For the engines whose origin could be determined, 60 percent were new, 29 percent were overhauled, and 11 percent were used.

takeoff led to aerodynamic stalls and loss of control. In at least two cases, pilots admitted that their aircraft was at or over maximum gross weight, resulting in compromised climb performance, aerodynamic stall, and loss of control. Inadequate airspeed management on approach and landing also led to aerodynamic stall and loss of control in a number of other accidents. In one instance, a pilot was surprised on takeoff when the tail came up more quickly than he expected on the first flight of the tailwheel airplane that he had built, and he flew the aircraft into a nose-high stall and lost control. The 64-year-old student pilot had never flown a tailwheel airplane before and did not have a tailwheel endorsement.

The next most common accident occurrences were loss of control on the ground, abnormal runway contact, and failures of systems or components other than the powerplant. Three of these accidents were fatal. Controlled flight into terrain accounted for five fatal and five non-fatal accidents.

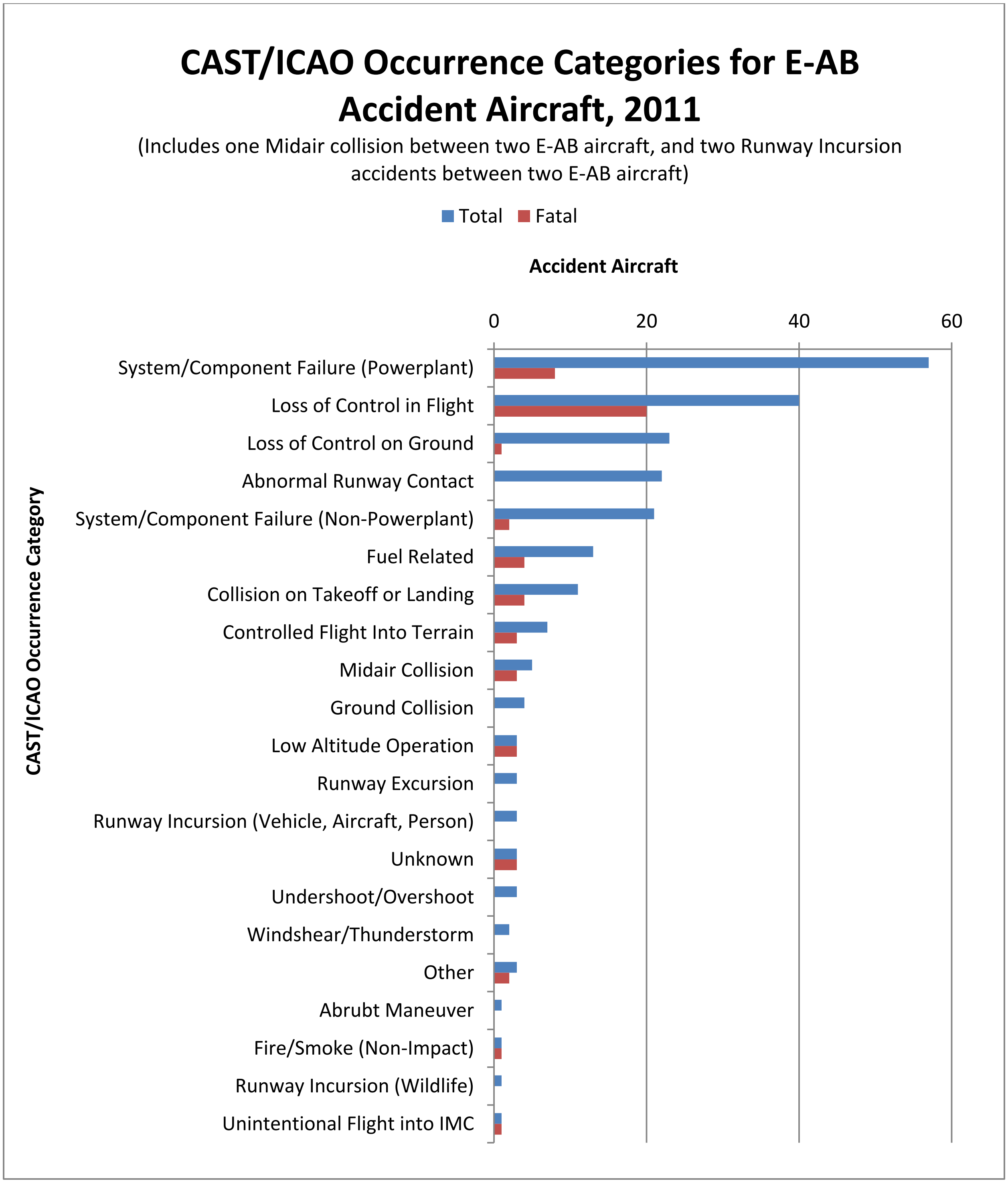

Figure 13. CAST/ICAO occurrence categories for E-AB accident aircraft, 2011.

Figure 14 summarizes the phase of flight of the 227 aircraft at the time of the accident occurrence in 2011. Landing was the phase of flight most often associated with E-AB aircraft accidents, although only one of these accidents was fatal. As indicated previously, many of the loss of control in flight accidents occurred during takeoff and initial climb or during approach and landing.

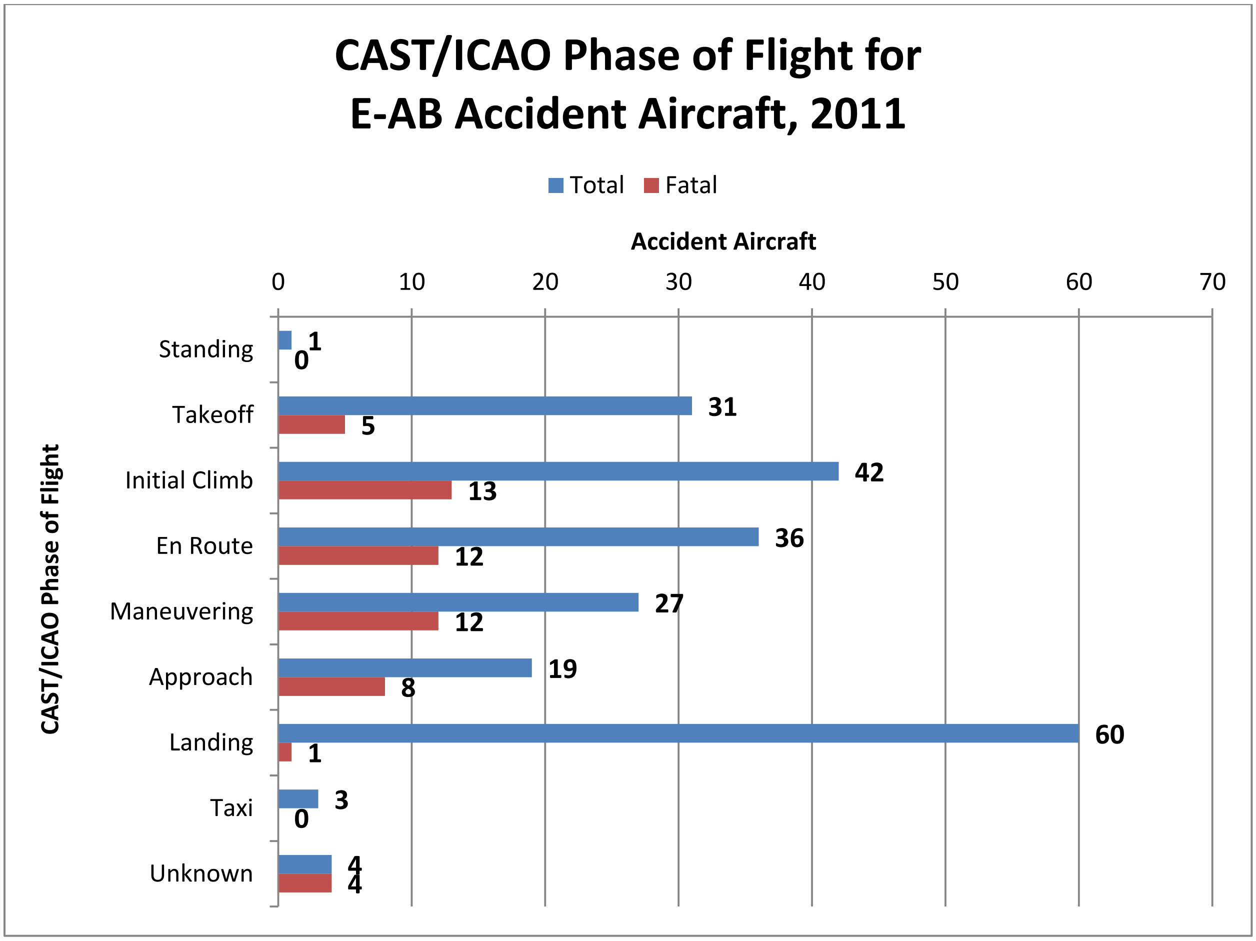

Figure 14. Phase of flight for the 227 aircraft involved in the 2011 E-AB aircraft accidents.

3.1.1 E-AB Aircraft Built by Owner Versus E-AB Aircraft Bought Used

More than one-half (125 of 227) of the aircraft involved in accidents during 2011 had been bought used rather than having been built by their current owner.[35]

Figure 15 compares CAST/ICAO occurrence categories for the accidents involving E-AB aircraft built by their owners compared with those purchased used. The two groups of accident aircraft appear similar with respect to the types of accidents in which they were involved.

[35] By comparison, 23.5 percent of survey respondents reported owning a used E-AB aircraft. The FAA's aircraft registry does not include the detail necessary to determine this breakdown for all E-AB aircraft.

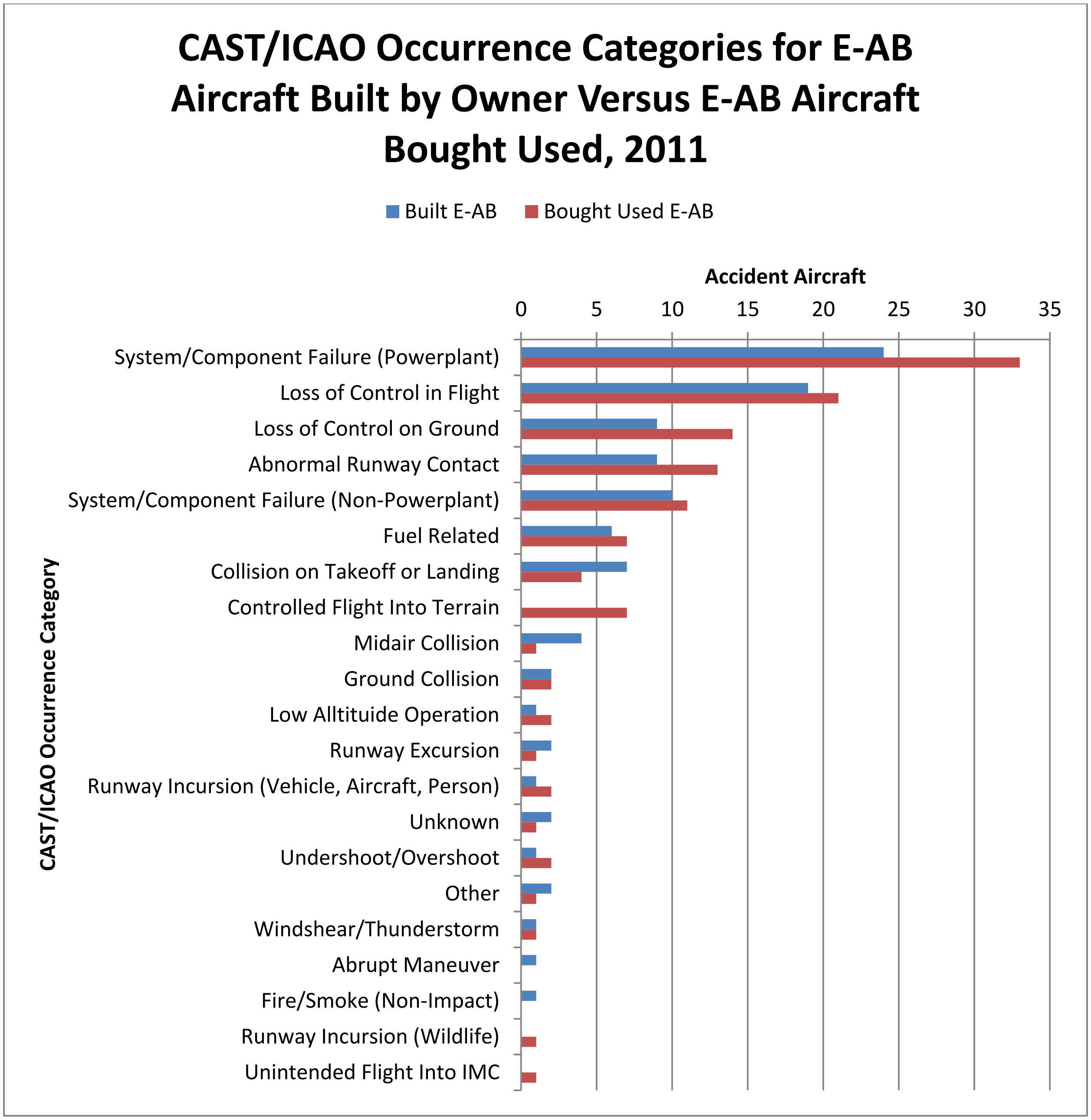

Figure 15. CAST/ICAO occurrence categories for E-AB aircraft built by owner versus E-AB aircraft bought used, 2011.

Figure 16 shows the age of the accident aircraft (years since certification) for both the built-by-owner and bought-used aircraft. As might be expected, the accident E-AB aircraft that had been bought used, were older than those built by the owner at the time of the accident. The median years since certification was 14 for the accident aircraft purchased used, compared with 3 years for those built by the owners. Figure 17 presents a slightly different picture. This figure plots the years that the accident aircraft has been owned by the two groups of owners. The two distributions are very similar and, in fact, the median time owned for the accident aircraft bought used was 2 years, compared with 3 years for the aircraft built by their owners.

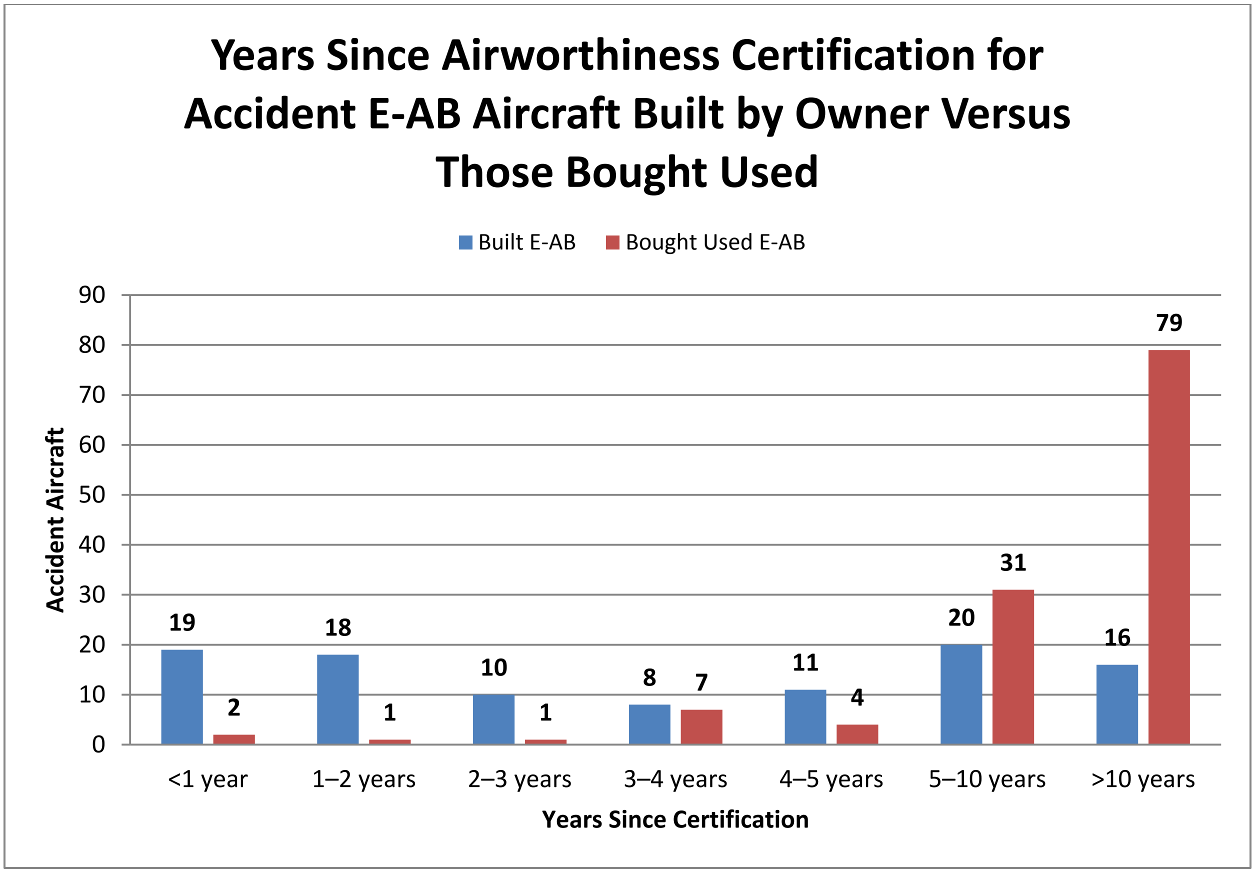

Figure 16. Years since certification for E-AB aircraft built by the owner versus those bought used.

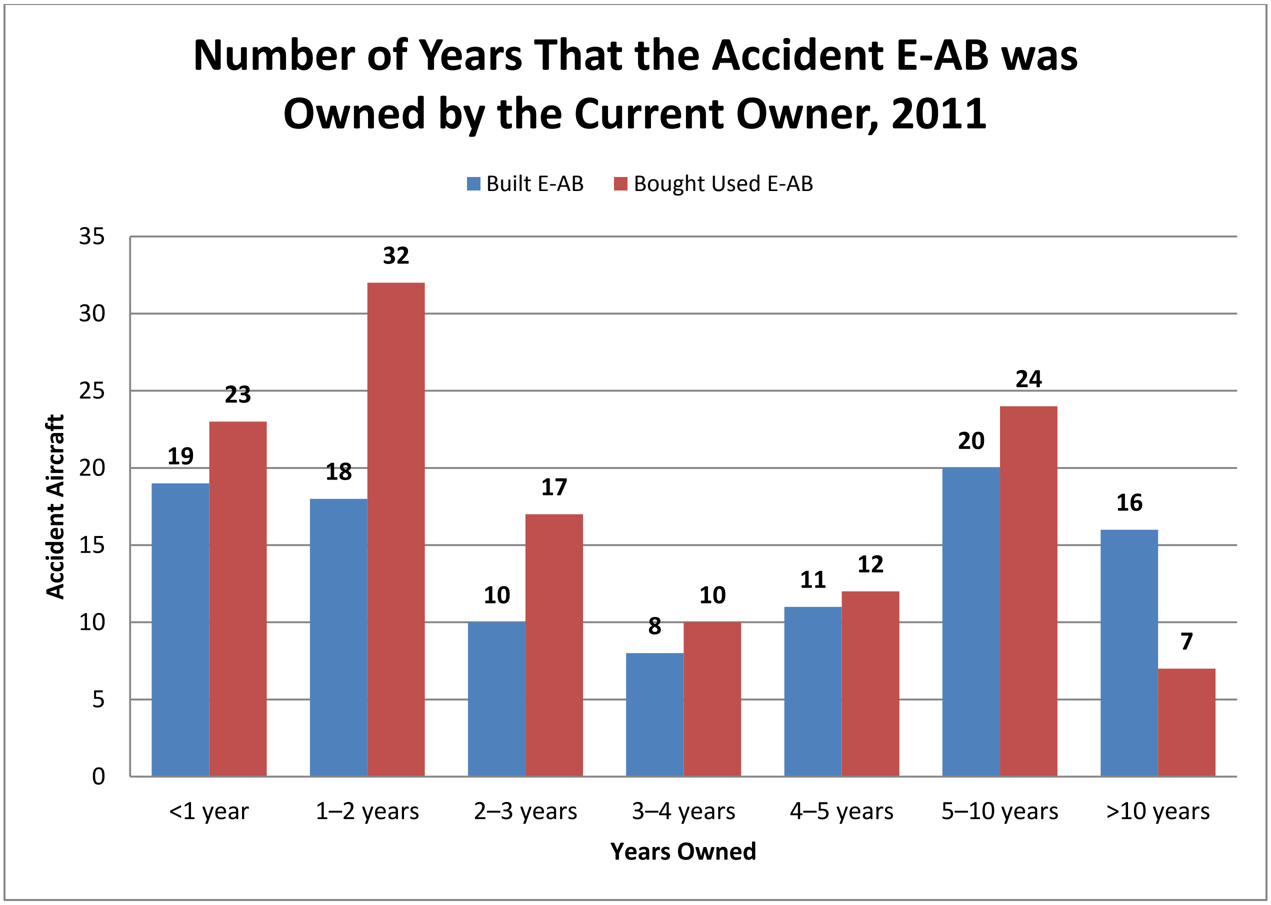

Figure 17. Years that the accident E-AB aircraft has been owned by the current owner.

3.2 Accident Pilot Demographics

The median age of accident pilots who had bought used E-AB aircraft was 62 years (ranging from 20–88), while for those who had built their aircraft the median age was 58 (ranging from 16–83). Figure 18 shows the age distribution for these two groups of accident pilots.

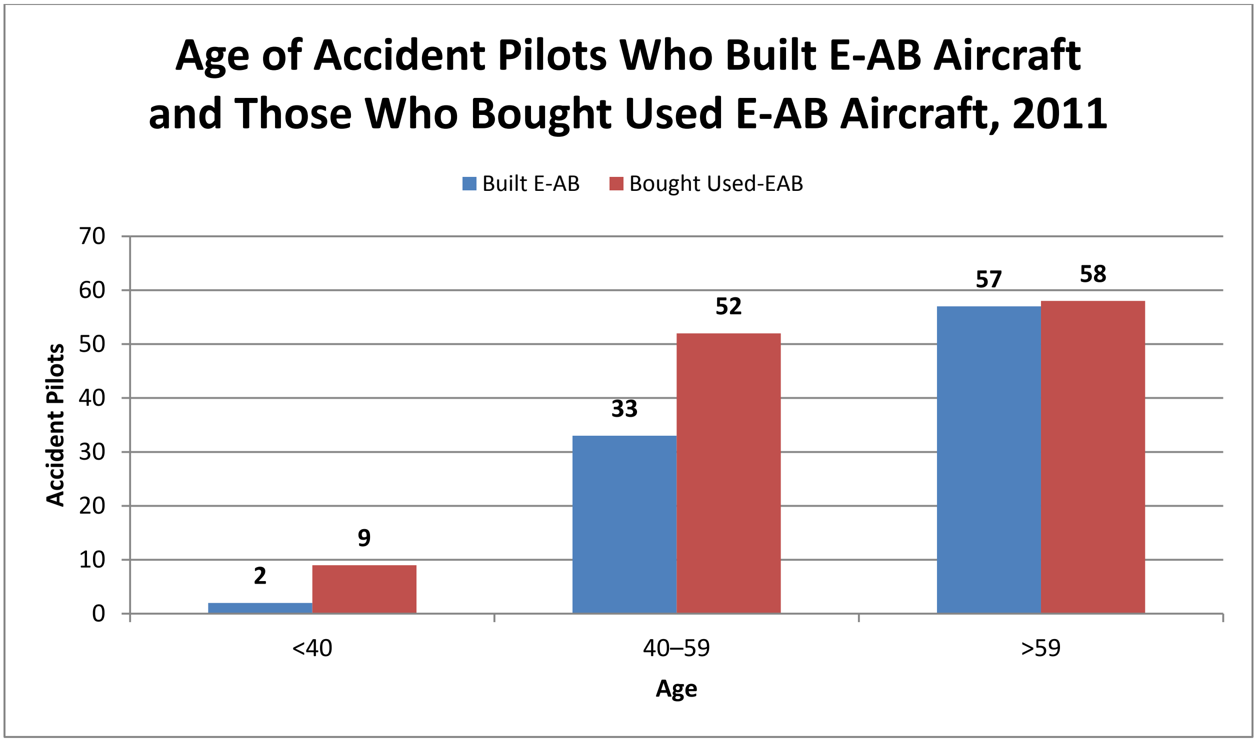

Figure 18. Age distributions of accident pilots who had built their E-AB aircraft and those who had bought them used.

As shown in Figure 19, most accident pilots held private pilot or higher certificates, whether they had built their E-AB aircraft or bought it used. The two groups were also similar in total flight hours. The distribution of total flight hours are shown in Figure 20, and the total hours in the accident aircraft are shown in Figure 21. The bought-used group showed slightly more experience with a median of 1,550 total flight hours, compared with 1,248 hours for the pilots who had built their E-AB aircraft. Relative to experience in flying the accident E-AB aircraft, those who had built their E-AB aircraft had somewhat more time in the aircraft (median equals 100 hours) than those who had bought their aircraft used (median equals 70 hours).

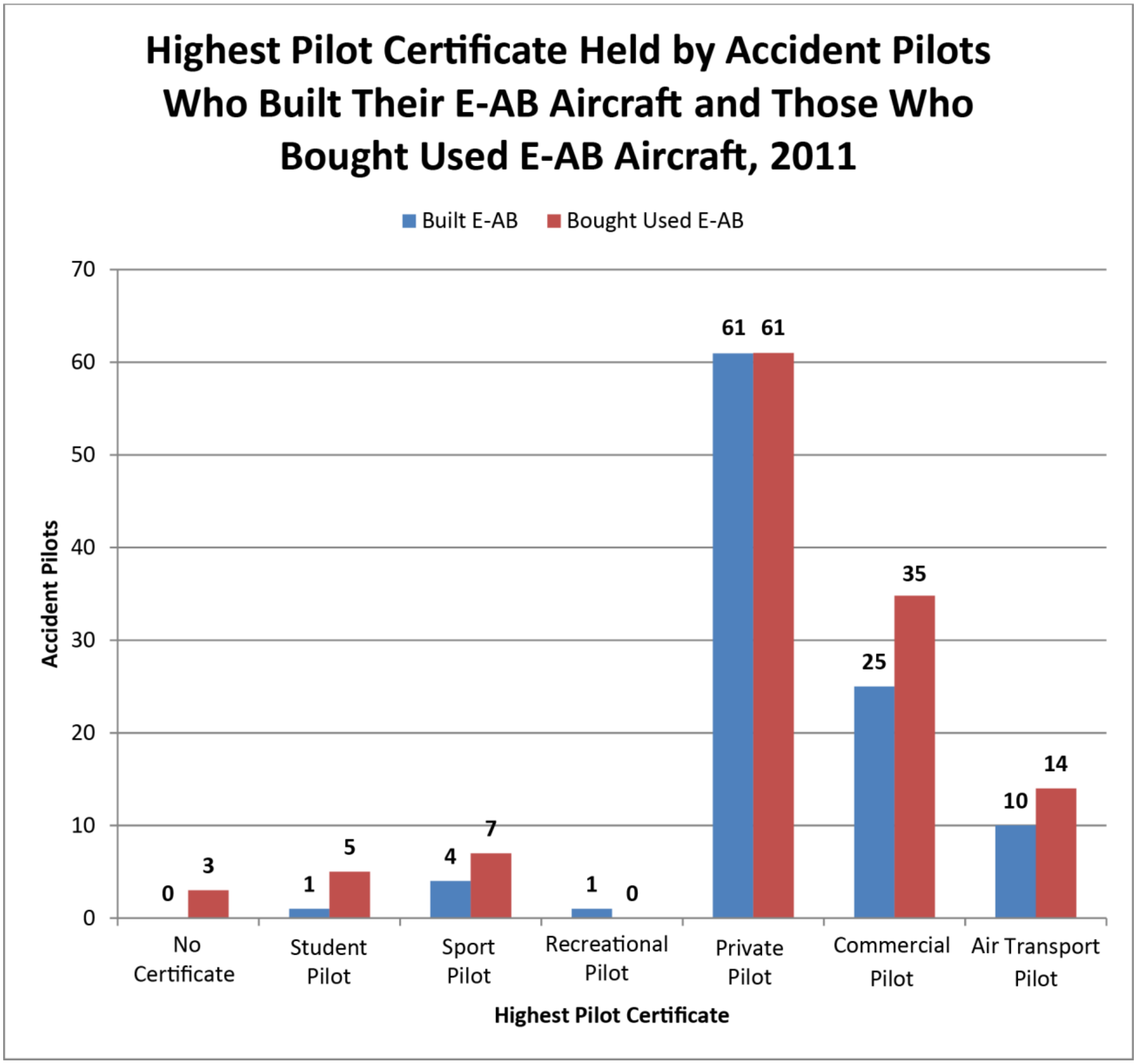

Figure 19. Highest pilot certificate for accident pilots who bought used E-AB aircraft and those who built their E-AB aircraft.

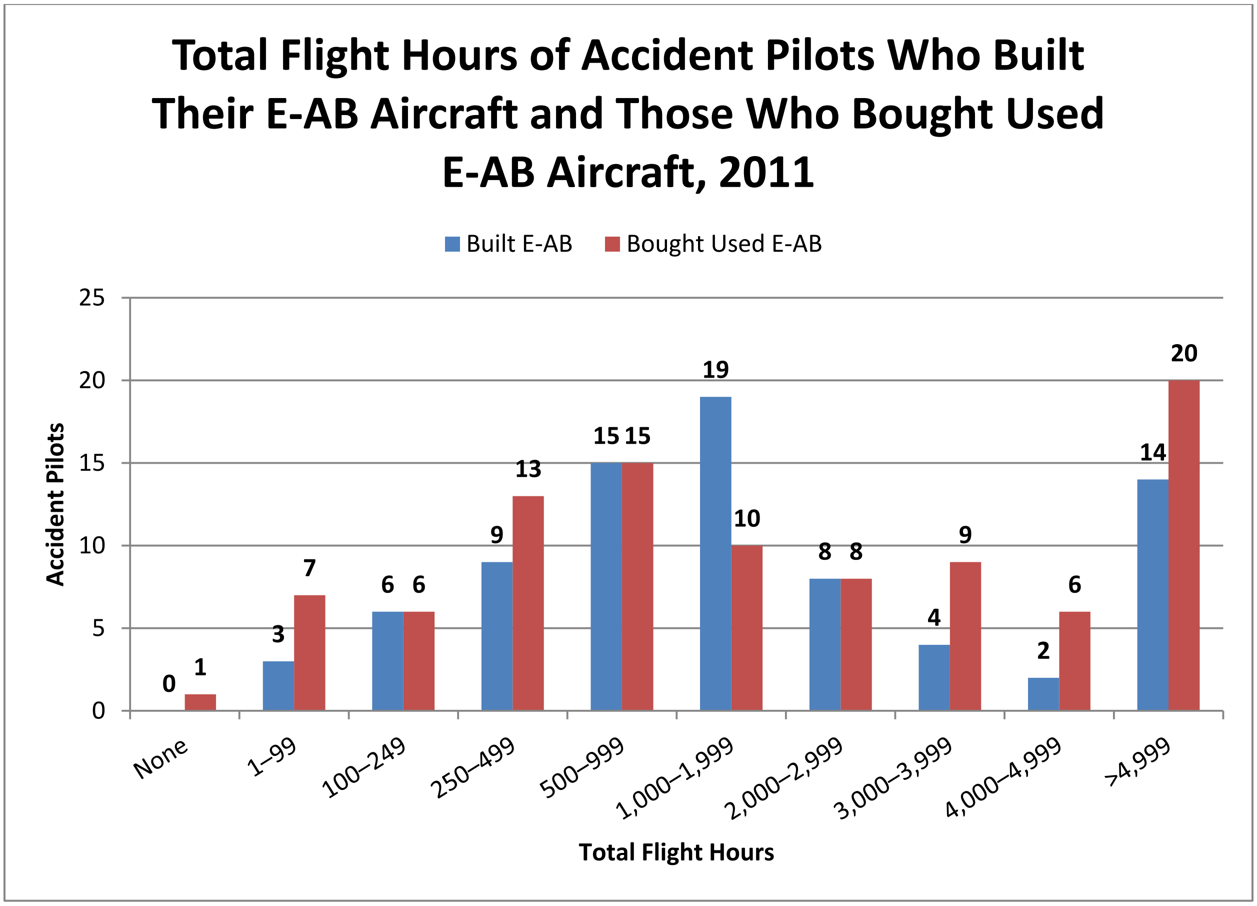

Figure 20. Total flight hours for accident pilots who built their E-AB aircraft and those who bought used E-AB aircraft (based on data from 175 of 227 accident pilots).

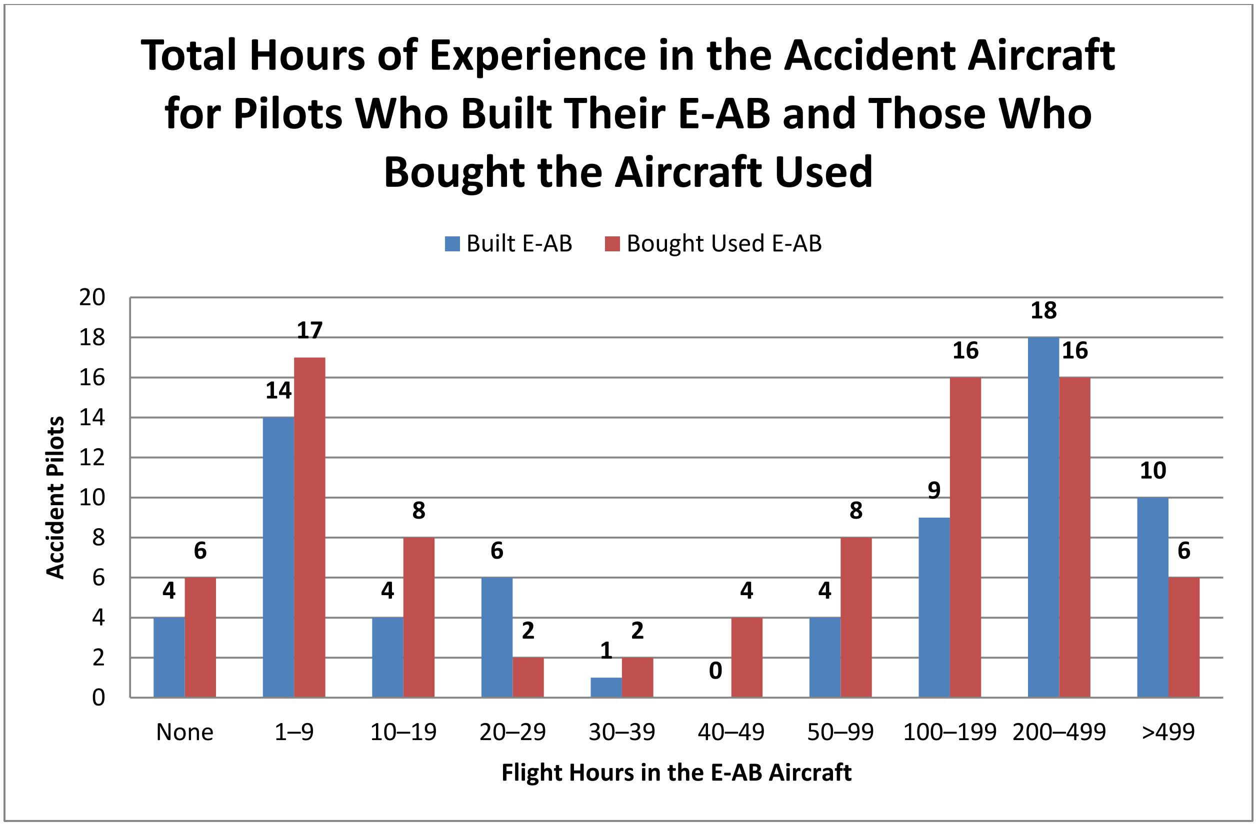

Figure 21. Total E-AB aircraft flight hours for those who built their aircraft and those who bought used aircraft (based on data from 155 of 227 accident pilots).

3.3 E-AB Aircraft Characteristics Requiring FAA Certificate Endorsements

E-AB aircraft vary considerably with respect to structural and performance characteristics, some of which require specific training or a pilot logbook endorsement. Section 61.31(f) of 14 CFR stipulates that ground and flight training and an endorsement in the pilot's logbook are required to operate as the pilot-in-command of an airplane with an engine exceeding 200 horsepower. Section 61.31(i) of 14 CFR stipulates that pilots must receive training and a logbook endorsement to operate tailwheel airplanes. Finally, retractable landing gear is one of the characteristics of a complex airplane,[36] requiring an endorsement under section 61.31(e).

Table 1 shows the percentage of accident aircraft bought used and built by the owner with each of these design features that would have required specific training or a logbook endorsement. Unfortunately, data on whether these logbook endorsements were held were not available for most accident pilots.

[36] A "complex" airplane is defined in 14 CFR 61.1(b)(3) as having retractable landing gear, flaps, and a controllable pitch propeller.

Table 1. Accident aircraft displaying design features that would require specific training or logbook endorsements.

Aircraft Feature	Built by Owner	Used E-AB Aircraft
Engine >200 HP	18%	11%
Tailwheel Equipped	40%	54%
Retractable Landing Gear	12%	11%
Total Accident Aircraft	102	125

Few accident aircraft met the "high performance" definition of being powered by engines of more than 200 horsepower and even fewer would have required a complex aircraft endorsement by virtue of being equipped with a retractable landing gear. However, nearly half of the accident aircraft were equipped with tailwheel landing gear.

3.4 Characteristics of Builders and Their Aircraft

NTSB investigators were able to gather a limited amount of information on the building experiences and building choices of the 102 accident E-AB aircraft owners who had built their aircraft. Approximately 80 percent of the aircraft built by owners of accident aircraft were kit-built and 19 percent were plans-built. Only one accident involved an aircraft that was an original design. Most of the accident aircraft were built at the owner's home and/or in an airport hangar. A small number (less than 10 percent) were constructed at a kit manufacturer's factory or in a commercial aircraft service facility. Most were individual, rather than group, projects. About 14 percent of builders received assistance from EAA Technical Counselors and about 9 percent received assistance from aircraft kit manufacturers. About 12 percent reported receiving assistance from various friends, while 25 percent claimed to have received no assistance during their building project. Only 24 percent of these 102 builders reported having had their work inspected by EAA Technical Counselors, DARs, aircraft mechanics, or other experts during the building project.

Table 2 summarizes the principal characteristics of the accident E-AB aircraft built by the owners by the type of building project.

Table 2. Characteristics of accident E-AB aircraft built by owners.

Aircraft Characteristic	Kit-Built	Plans-Built	Original Design
Engine Type			
Type-Certificated Aircraft Engine	46%	48%	100%
Non-Type-Certificated Aircraft Engine	38%	26%	0%
Automotive Conversion	16%	26%	0%
Propeller Type			
Fixed Pitch	43%	69%	0%
Ground Adjustable	24%	19%	0%
Constant Speed	33%	12%	100%
Avionics			
Conventional	61%	87%	100%
Glass Cockpit	39%	13%	0%
Landing Gear Configuration			
Tailwheel	39%	44%	100%
Tricycle	52%	56%	0%
Other	9%	0%	0%
Landing Gear Type			
Fixed	90%	79%	100%
Retractable	10%	21%	0%
Number of Seats			
One	5%	26%	100%
Two	83%	63%	0%
Three or More	12%	11%	0%
Total Accident Aircraft	82	19	1

The single accident involving an original design E-AB aircraft was a single seat, tailwheel airplane with a type-certificated aircraft engine, constant-speed propeller, and conventional avionics. Most kit-built and plans-built aircraft were two-seat, fixed tricycle gear aircraft with aircraft engines (type-certificated or non- certificated) and conventional avionics.

3.5 Airworthiness Certification and Transition Training

Of the 102 accident aircraft built by the owners, 2 were unregistered and 2 had incomplete certification records. Certification records of the remaining 98 accident aircraft showed that FAA inspectors had issued an airworthiness certificate for 43 aircraft and DARs had issued the certificate for the remaining 54 aircraft. In most cases (83 of 98), the Phase I flight test period prescribed for these aircraft was 40 hours within a restricted test area and constrained by an explicit set of operating limitations. For 14 of the 97 accident aircraft, a Phase I requirement of 25 hours was established, while 1 accident aircraft was assigned a 50 hour requirement.

Investigators determined the identity of the person performing the first test flight for 73 of the 102 accident aircraft built by the owner. In most of these cases (84 percent), the builder was the test pilot.[37] In the remaining cases for which information was available, the first test flight was performed by a more experienced pilot, frequently a friend of the builder.

Only 9 of the 102 accident aircraft builders reported having been subject to a requirement for transition training. In most cases, that requirement was imposed by their insurance company. Fifty-six of these builder/owners were issued repairman certificates that authorized them to perform required aircraft condition inspections, and an additional 12 owners held an FAA airframe and powerplant certificate, which also permitted them to perform both maintenance and inspections.

3.5.1 E-AB Aircraft Purchased Used

A total of 125 of the accident E-AB aircraft had been bought used. Most (119 of 125) were airplanes, 3 were gyroplanes, 2 were gliders, and 1 was a helicopter. Table 3 summarizes the important characteristics of the used accident E-AB aircraft, separated by kit-built, plans-built, and original design.

[37] References to "test pilot" throughout the report are intended to reflect the individual who performed the test flight and do not imply any specific level of qualifications.

Table 3. Characteristics of accident E-AB aircraft bought used.

Aircraft Characteristic	Kit-Built	Plans-Built	Original Design
Engine Type			
Type-Certificated Aircraft Engine	43%	72%	100%
Non-Type-Certificated Aircraft Engine	45%	8%	0%
Automotive Conversion	12%	15%	0%
Other/None	0%	5%	0%
Propeller Type			
Fixed Pitch	51%	69%	100%
Ground Adjustable	22%	8%	0%
Constant Speed	27%	18%	0%
Avionics			
Conventional	82%	86%	100%
Glass Cockpit	18%	14%	0%
Landing Gear Configuration			
Tailwheel	48%	67%	100%
Tricycle	49%	26%	0%
Other	3%	7%	0%
Landing Gear Type			
Fixed	86%	95%	100%
Retractable	14%	5%	0%
Number of Seats			
One	6%	28%	0%
Two	89%	59%	100%
Three or More	5%	13%	0%
Total Accident Aircraft	84	39	2

Most of the accident E-AB aircraft that had been bought used were two-seat, kit-built airplanes with aircraft engines (either type-certificated or non-type-certificated) and conventional avionics. Roughly equal numbers of these airplanes were equipped with tricycle and tailwheel landing gear. The majority of the 39 plans-built aircraft purchased used were similarly equipped, including the only two E-AB gliders involved in accidents during 2011.

3.6 Accidents as a Function of Airframe Hours

Airframe hours were available for 67 of the 102 E-AB aircraft built by their owners and for 76 of the 125 E-AB aircraft that had been bought used. Figure 22 shows the cumulative percentages of each group of accident aircraft as a function of total airframe hours since manufacture. It is notable, but not unexpected, that substantially greater proportions of the built-by-owner aircraft were involved in accidents relatively soon after completion. Nearly 50 percent of the built-by-owner aircraft had less than 50 airframe hours at the time of the 2011 accident, compared with approximately 10 percent of the E-AB aircraft that had been bought used.[38]

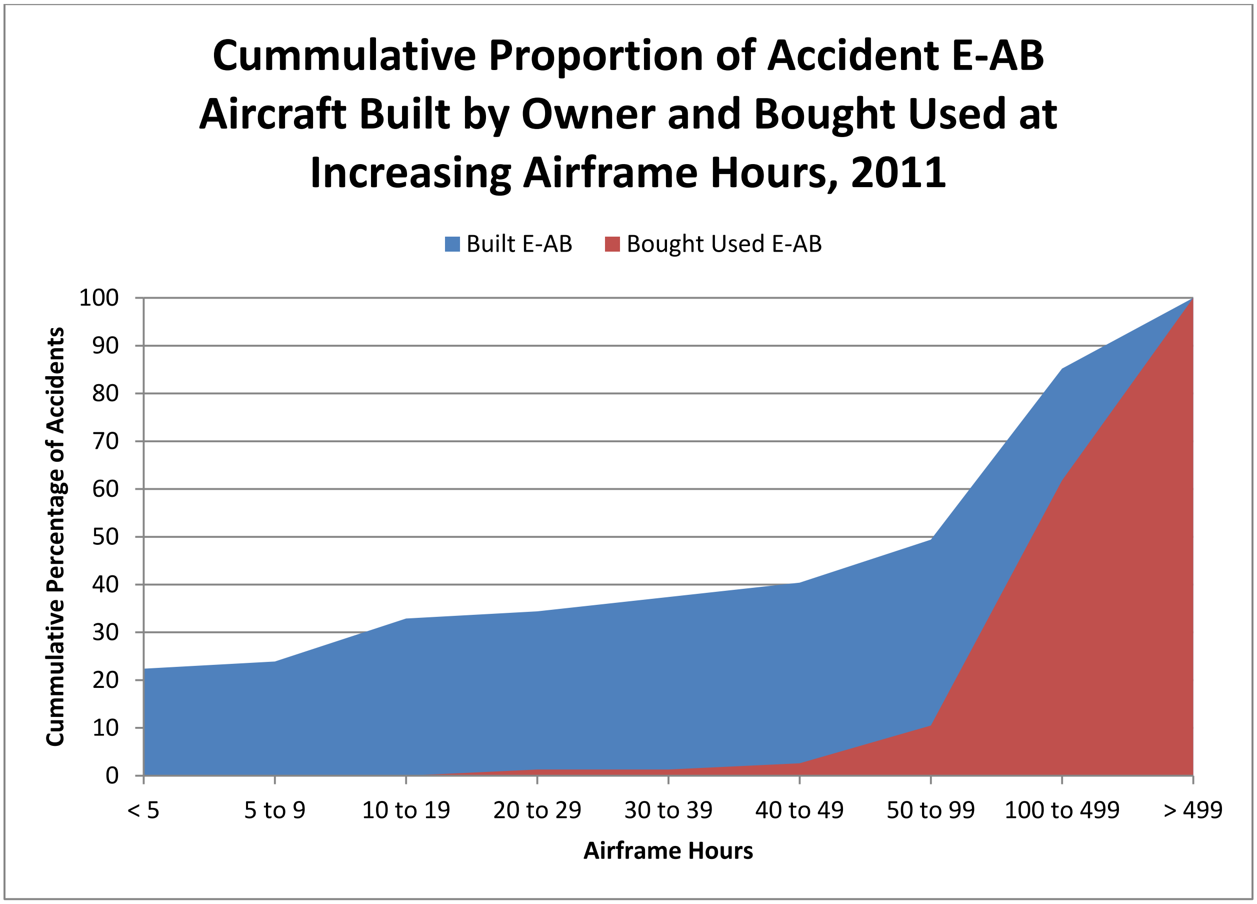

Figure 22. Cumulative proportion of built-by-owner and bought used E-AB aircraft as a function of airframe hours.

3.7 Accidents During Phase I Flight Testing

Thirty-four of the calendar year 2011 accidents occurred during the Phase I flight test period required for the airworthiness certification of newly built E-AB aircraft. Thirty-one of these aircraft were built by their owner at the time of the accident, while two had been sold as used aircraft before completing the Phase I flight test period. Most (30 of 34) of these aircraft were airplanes and four were gyroplanes. Twenty-four were kit-built, 9 were plans-built, and 1 was built from an original design. Eight of the Phase I accidents were fatal.

Figure 23 shows the CAST/ICAO occurrence category for these accidents, all of which involved a single aircraft.

[38] Insufficient data were available to compare the number of Phase I hours flown by the current owner for those aircraft that were bought used.

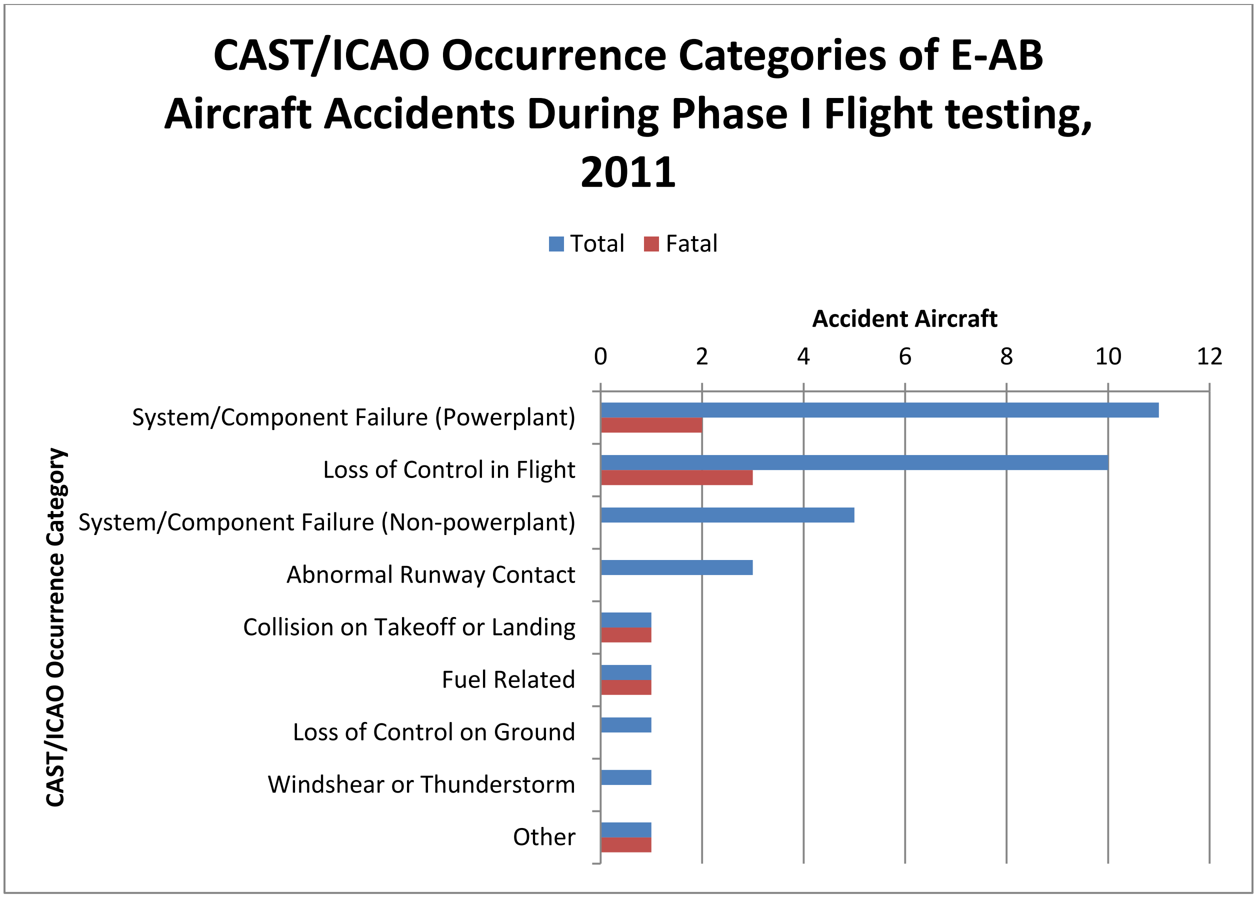

Figure 23. CAST/ICAO occurrence category for the 2011 E-AB accidents during Phase I of the flight test program.

All 11 of the Phase I aircraft that suffered powerplant failures were airplanes, comprising 6 kit-built, 4 plans-built, and 1 original design. Four of the aircraft that suffered powerplant failures were equipped with type-certificated aircraft engines, two were equipped with non-type-certificated aircraft engines, and five were equipped with automotive conversion engines.

Ten of the 34 Phase I accidents involved loss of control in flight. Eight of these accidents involved airplanes and two accidents involved gyroplanes. Six of these aircraft were kit-built and four were built from published plans.

A requirement for 40 Phase I flight test hours had been established for 33 of the builders, and one was assigned a 25-hour requirement when their airworthiness certificate was issued. Figure 24 shows the total airframe hours accumulated at the time of the accident for each of the 34 Phase I accident aircraft.

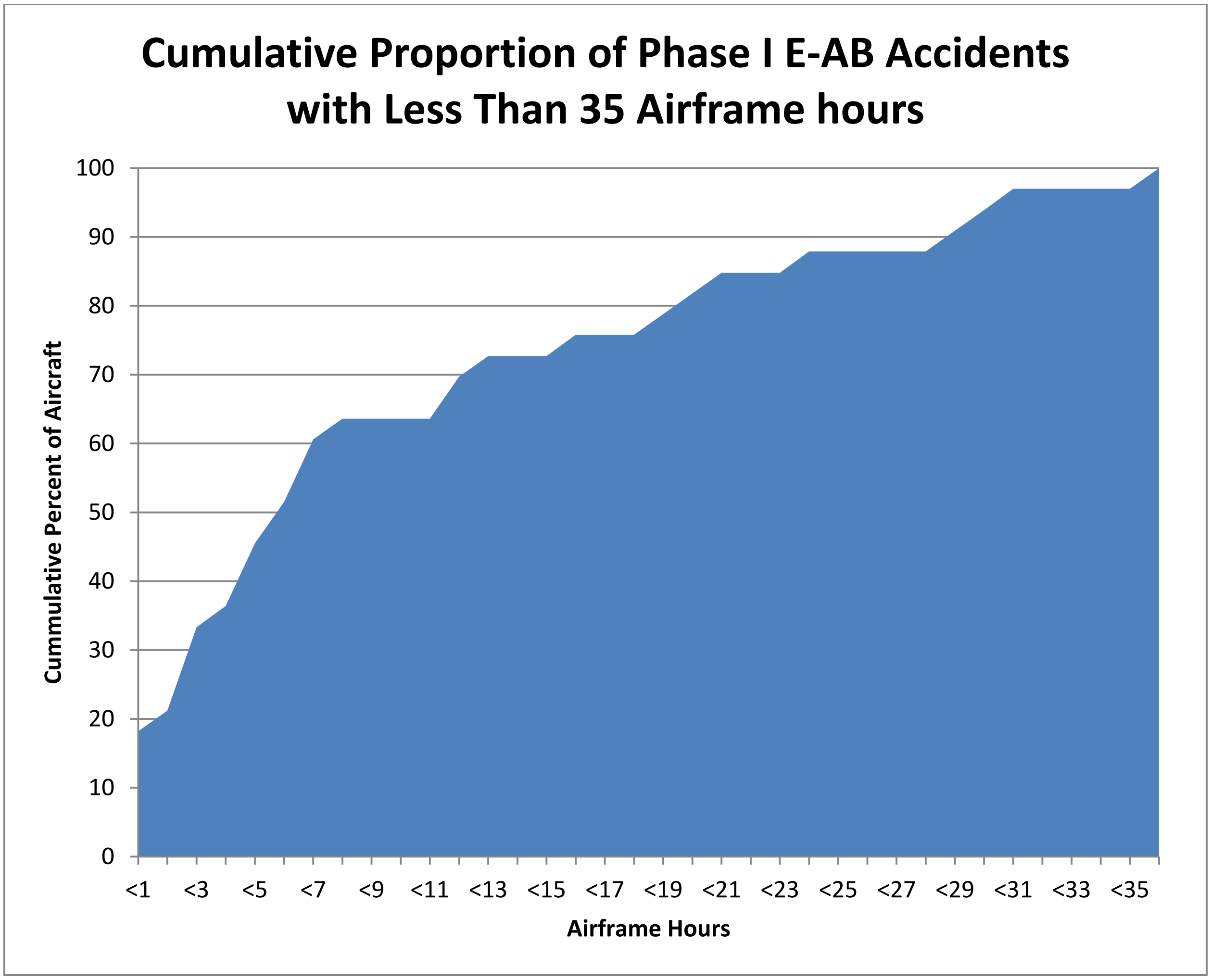

Figure 24. Airframe hours at time of accident.

The E-AB aircraft builder was the accident pilot in 29 of the 34 accidents. Two of the accident aircraft were piloted by individuals who had bought the aircraft used during its Phase I test period, two were piloted by individuals recruited to perform the flight test, and one was piloted by the builder's spouse. The accident pilot was alone in the aircraft in 32 of the accidents, but a second individual was aboard the aircraft in 2 of the accidents, including 1 accident that was fatal to both individuals. It could not be determined whether the second individual was performing an explicit flight test function in either of those cases. The builder had performed the first test flight of the aircraft in 29 of the 34 E-AB aircraft accidents, including the 8 accidents that occurred on the first test flight.

3.8 Accidents During the First Flight for E-AB Aircraft Built by Owner

Ten of the 224 E-AB aircraft accidents during calendar year 2011 occurred during the first flight of the aircraft, including the 8 Phase I aircraft mentioned previously as well as the 2 unregistered aircraft without airworthiness certificates. Seven of these aircraft were airplanes and three were gyroplanes. Seven were kit-built aircraft, and three were plans-built aircraft. Nine of the ten test pilots were the aircraft builder, while the other test pilot was a certificated flight instructor who had been commissioned to perform the test flight. Five of the builders/test pilots held a private pilot certificate, three held a commercial pilot certificate (including the certificated flight instructor performing the test flight), one held an air transport pilot certificate, and one held a student certificate. Table 4 summarizes the first flight accidents investigated during calendar year 2011.

Table 4. Characteristics of the 10 accidents in 2011 that occurred during the first test flight of the newly built E-AB aircraft.

NTSB Case #	Aircraft Category	Aircraft Type	Occurrence Category	Phase	Test Pilot
ERA11LA208	Airplane	JTD Minimax	Collision During Takeoff/Landing	Takeoff	Builder
ERA11LA213	Airplane	Volksplane VP1	System/Component Malfunction or Failure (Powerplant)	Initial Climb	Builder
CEN11CA336	Gyroplane	KB3 Gyroplane	Collision During Takeoff/Landing	Takeoff	Builder
CEN11FA346	Airplane	Cassutt III	Other	Initial Climb	Builder
CEN11LA432	Airplane	Zenith CH-750	Loss of Control in Flight	Take Off	Builder
CEN11LA488	Airplane	Volksplane VP1	System/Component Malfunction or Failure (Powerplant)	Initial Climb	Certified Flight Instructor
CEN11FA537	Airplane	E-Racer	Loss of Control in Flight	Maneuvering	Builder
ERA11LA459	Airplane	Pegazair STOL 100	Loss of Control in Flight	Initial Climb	Builder
CEN12LA013	Gyroplane	Calidus Autogyro	Loss of Control on Ground	Landing	Builder
CEN12CA029	Gyroplane	American Autogyro Sparrow Hawk	System/Component Malfunction or Failure – (Non-Powerplant)	Takeoff	Builder

3.9 Accidents During the First Flight for E-AB Aircraft Bought Used

Fourteen of the E-AB aircraft accidents in 2011 involved used aircraft being flown for the first time by their new owners. Five were fatal accidents, killing six occupants. All of these aircraft were airplanes, 11 kit-built and 3 plans-built. The accident pilot was the second owner of six of these airplanes, but two had had 2 previous owners, and five had had 3 or more previous owners. The new owner was the pilot-in-command in nine of these accidents, and was aboard the aircraft with a flight instructor in one case, and with a more experienced pilot in another. Two of the accidents involved the ferry flight of E-AB aircraft by commercial pilots, and one occurred during an evaluation flight conducted for the potential purchaser of a used E-AB aircraft by an air transport-rated pilot. Six of the nine owners piloting their aircraft held private pilot certificates, one held a commercial certificate, one held an air transport pilot certificate, and one new owner did not hold a pilot certificate.

Table 5 summarizes the accidents involving the first flight of E-AB aircraft bought used that were investigated during 2011.

Table 5. Accidents involving the first flight after purchase of E-AB aircraft bought used.

NTSB Case #	Aircraft Category	Aircraft Type	Occurrence Category	Phase	Pilot
CEN11CA326	Airplane	Quickie Q2	System/Component Malfunction or Failure – (Non-Powerplant)	Maneuvering	Owner
ERA11LA336	Airplane	Kitfox II	Loss of Control in Flight	Initial Climb	Friend
CEN11FA434	Airplane	Lancair 320	Loss of Control in Flight	Approach	Ferry Pilot
CEN11LA455	Airplane	Rans S-17	Loss of Control in Flight	Initial Climb	Owner
ERA11CA432	Airplane	Rans S-6S	Abnormal Runway Contact	Takeoff	Owner
ERA11FA463	Airplane	Quad City Ultralight Challenger II	Controlled Flight into Terrain	Maneuvering	Owner
CEN11FA597	Airplane	Lancair 235	Loss of Control on Ground	Takeoff	Owner
CEN11FA616	Airplane	Christen Eagle II	System/Component Malfunction or Failure (Powerplant)	Initial Climb	Owner
CEN11LA669	Airplane	Vans RV-10	System/Component Malfunction or Failure (Powerplant)	En Route	Owner
ERA12LA011	Airplane	Rand Robinson KR-2	Loss of Control in Flight	Initial Climb	Owner
CEN12CA081	Airplane	Davis DA-2A	Loss of Control on Ground	Landing	Owner
ERA12CA096	Airplane	Loehle P-5151	Windshear/Thunderstorm	Approach	Evaluation Pilot
CEN12LA102	Airplane	Rans S-12	Loss of Control in Flight	Approach	Certified Flight Instructor
WPR11CA321	Airplane	Thorp T-211	Fuel Related	En Route	Ferry Pilot

4. The EAA Survey of E-AB Aircraft Owners and Builders

Past evaluations of E-AB aircraft safety have been limited by the lack of background information about E-AB aircraft builders, pilots, and owners. In order to establish a better understanding of this population, the EAA conducted a voluntary, anonymous web-based survey of E-AB aircraft owners from July 15 through August 31, 2011. The EAA shared the resulting anonymous data with the NTSB to support this study. The survey, shown in appendix B, collected demographic and flying experience information from respondents as well as detailed information about their E-AB aircraft and their experiences building, testing, and flying them. The survey data were analyzed by the NTSB and the results are reported in this chapter.

The EAA promoted the survey with e-mail invitations to its members and announcements in the EAA *e-Hotline* electronic newsletter. In addition, the NTSB mailed 22,000 postcards to E-AB aircraft owners listed on the FAA's aircraft registry, encouraging them to participate in the EAA survey. Other members of the E-AB aircraft community, including Van's Aircraft Company, publicized the EAA survey and encouraged participation. The EAA received more than 5,000 responses to the survey and a total of 4,923 responses were considered sufficiently complete to support data analysis.

Survey respondents indicated whether they had already built an E-AB aircraft, were currently building their E-AB aircraft, or had purchased a used E-AB aircraft. Figure 25 shows the distribution of respondents among these categories by the kind of E-AB aircraft they owned.

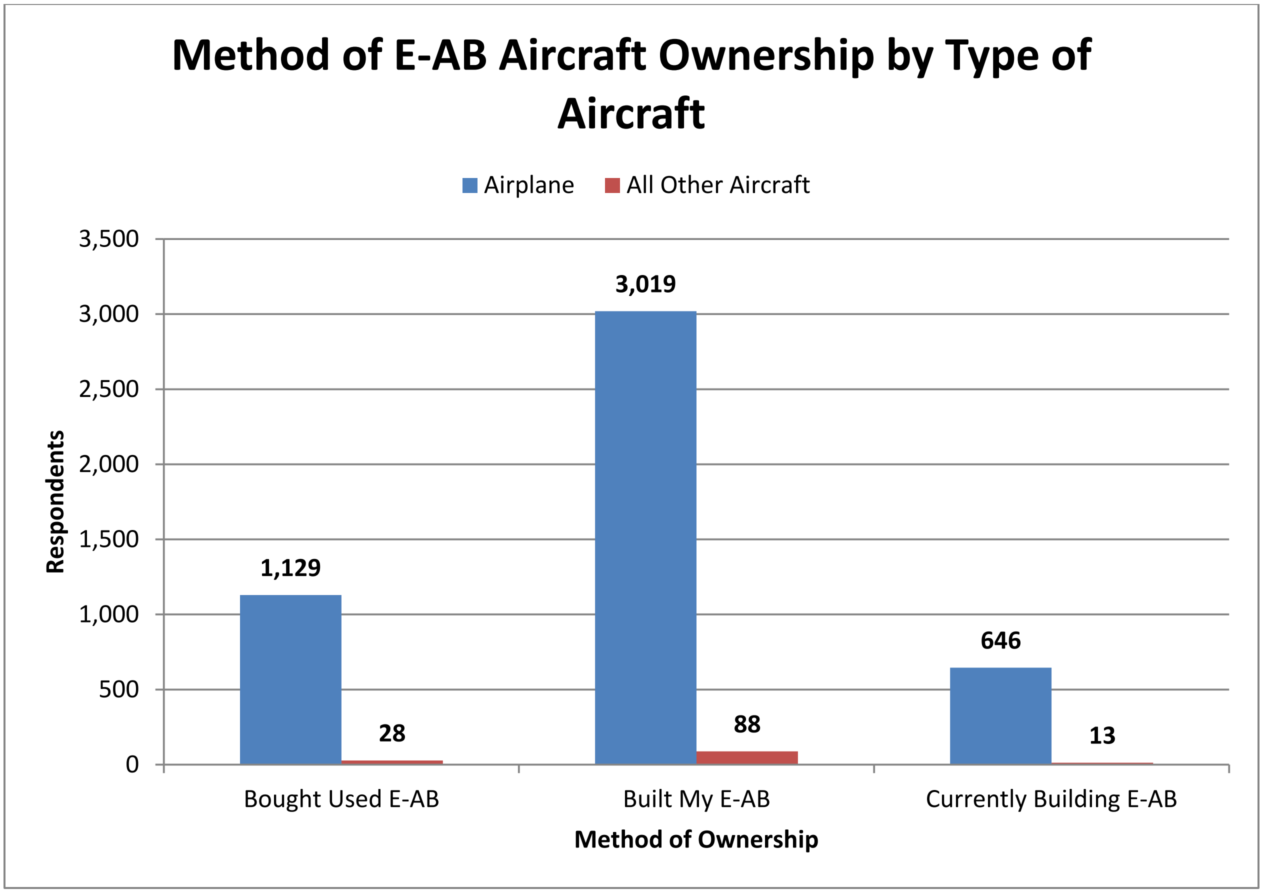

Figure 25. Method of E-AB aircraft ownership by type of aircraft.

Most (97 percent) of the aircraft described by respondents were airplanes, while the other 3 percent included helicopters, gyroplanes, gliders, balloons, and powered parachutes. The majority (63 percent) of respondents had already built the airplane that they described in the survey, while 24 percent had bought a used E-AB aircraft, and 13 percent were currently building their E-AB aircraft.

Figure 26 shows the years since certification for the respondents who built their E-AB aircraft and for those that bought used E-AB aircraft. As might be expected, respondents reporting on E-AB aircraft that they had built described a somewhat newer set of aircraft than did those who reported on E-AB aircraft that they had bought used.

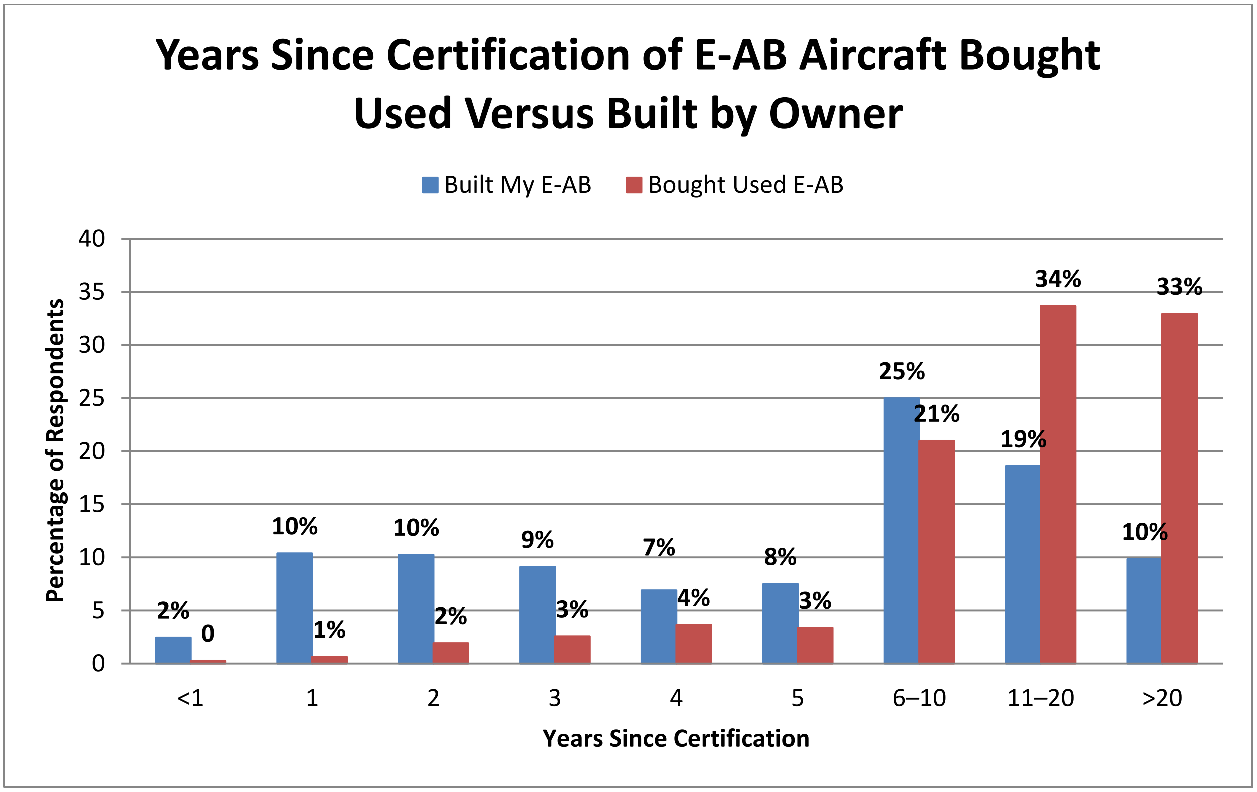

Figure 26. Years since certification for E-AB aircraft built by the respondent versus E-AB aircraft bought used by respondents (based on 4,082 survey responses).

4.1 Respondent Demographics

The median age of respondents who had bought used E-AB aircraft was 60 years, for those who had already built their E-AB aircraft it was 62 years, and for those currently building their E-AB aircraft it was 56 years. Figure 27 shows the age distribution for these groups of respondents. Nearly 36 percent of respondents who reported their occupation indicated that they were retired.

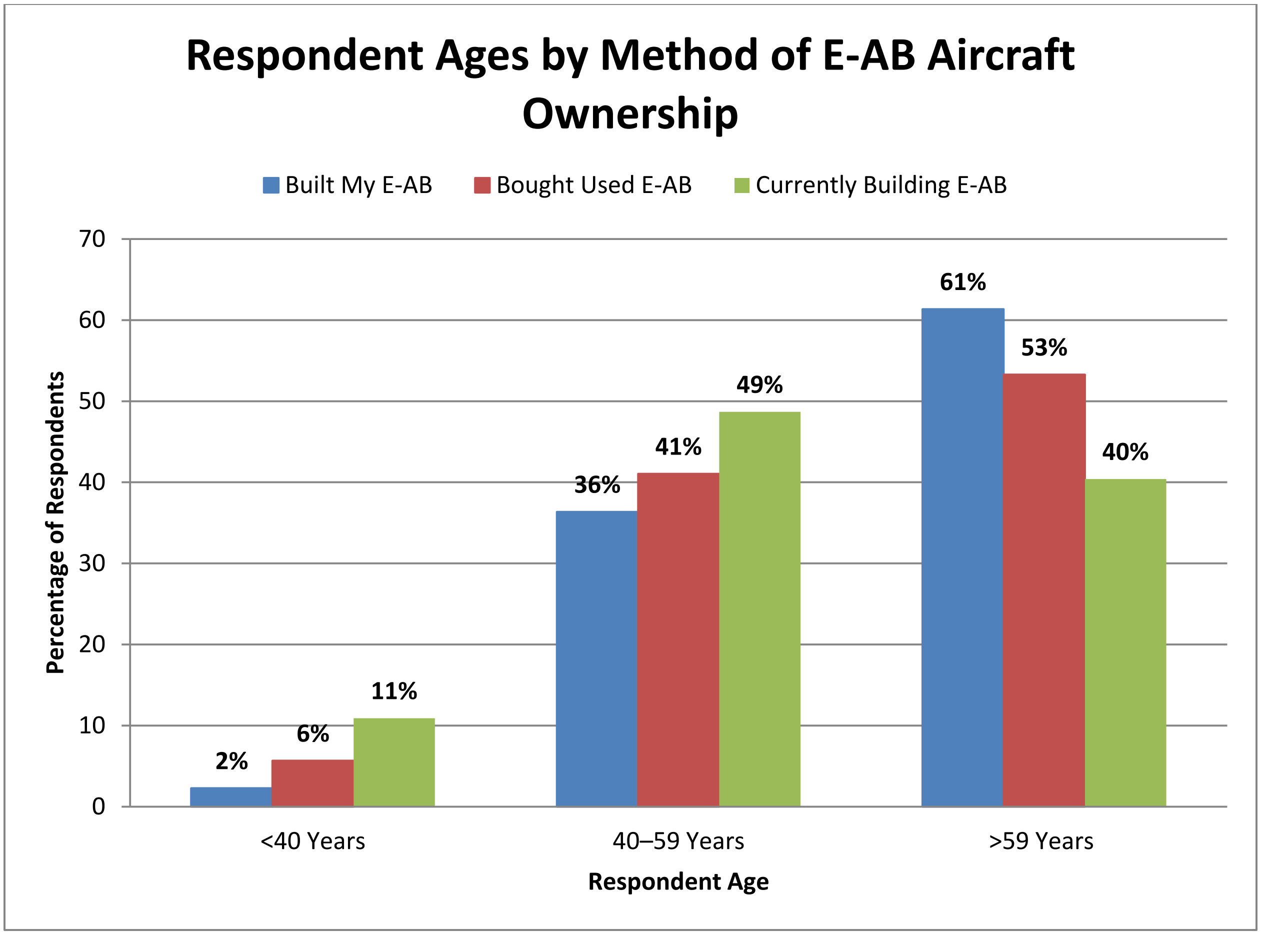

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Figure 27. Respondent age by method of E-AB aircraft ownership.

Figure 28 shows the highest pilot certificate held by method of E-AB aircraft ownership for the respondents who provided that information. The majority of respondents held a private pilot certificate, and the type of certificate was relatively uniform across the three groups.

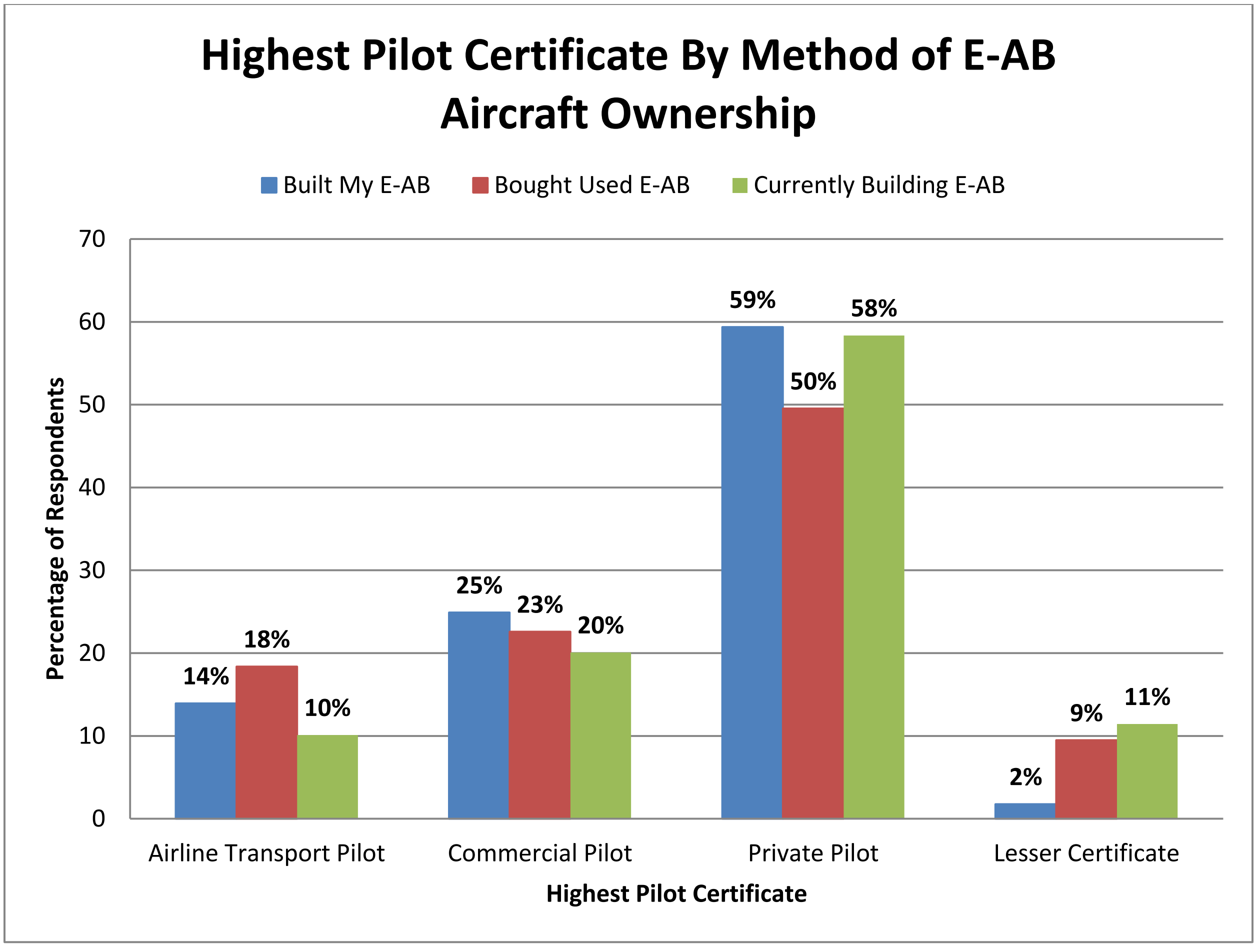

Figure 28. Highest pilot certificate by method of E-AB aircraft ownership.

Figure 29 shows the distribution of total years of pilot experience for each of the method of ownership groups, while Figure 30 shows the total flight hours for each of the groups. Median years of pilot experience for respondents who built their E-AB aircraft was 33 years, for those who bought used E-AB aircraft it was 31 years, and for those currently building their E-AB aircraft it was 23 years. Median total flight hours were 1,311 for respondents who had built their E-AB aircraft, 1,350 hours for those who had bought used E-AB aircraft, and 550 hours for those currently building an E-AB aircraft. Hours of total E-AB aircraft flying experience for the groups are summarized in Figure 31. Here, there is a distinct difference between the “built my E-AB” (median total flight hours was 279 hours) and “bought used E-AB” (median total flight hours was 200 hours) groups on the one hand, and the “currently building my E-AB” group (median total flight hours was 0 hours) on the other, suggesting that this was the first E-AB aircraft experience for most of those currently building such aircraft.

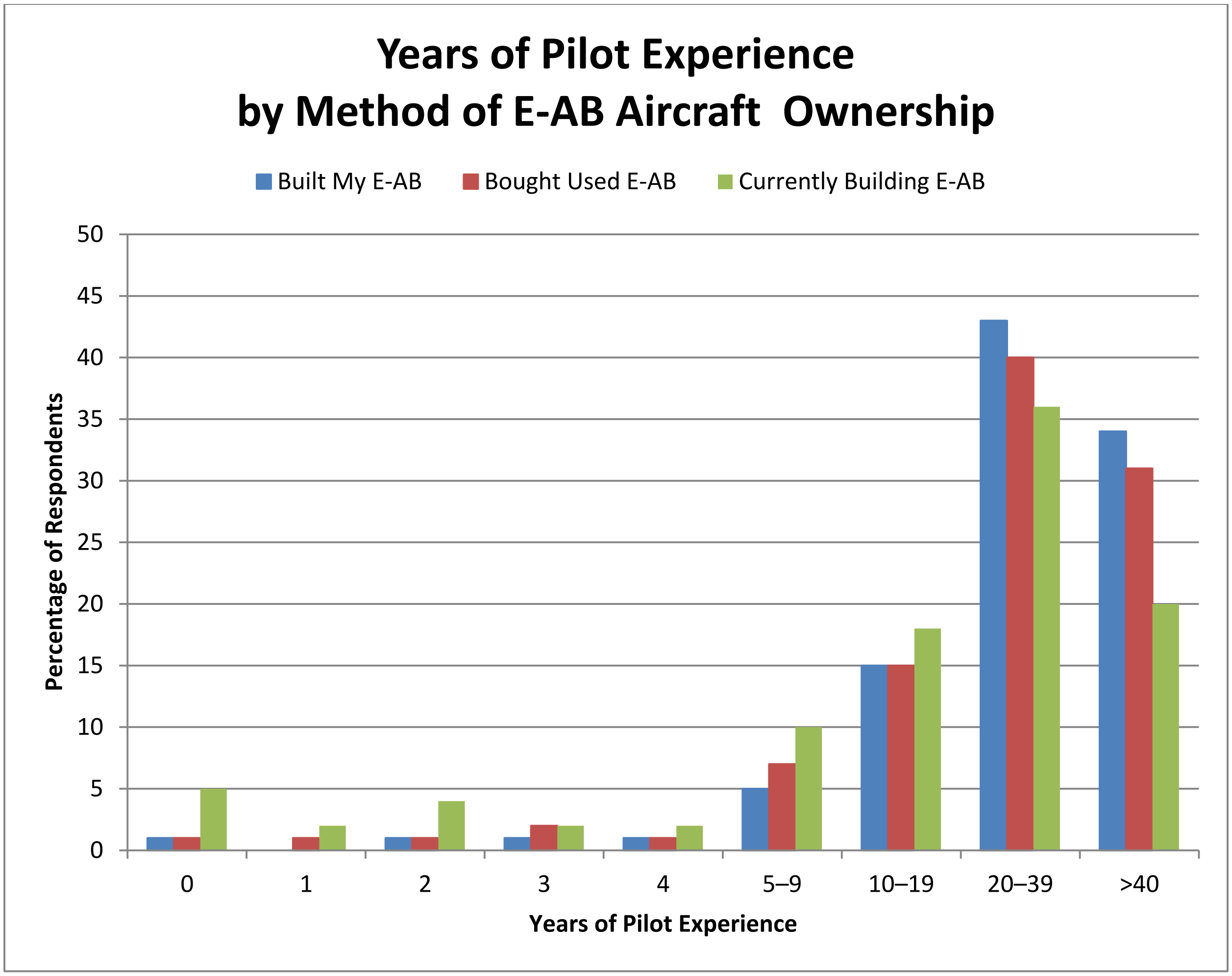

Figure 29. Years of pilot experience by method of E-AB aircraft ownership.

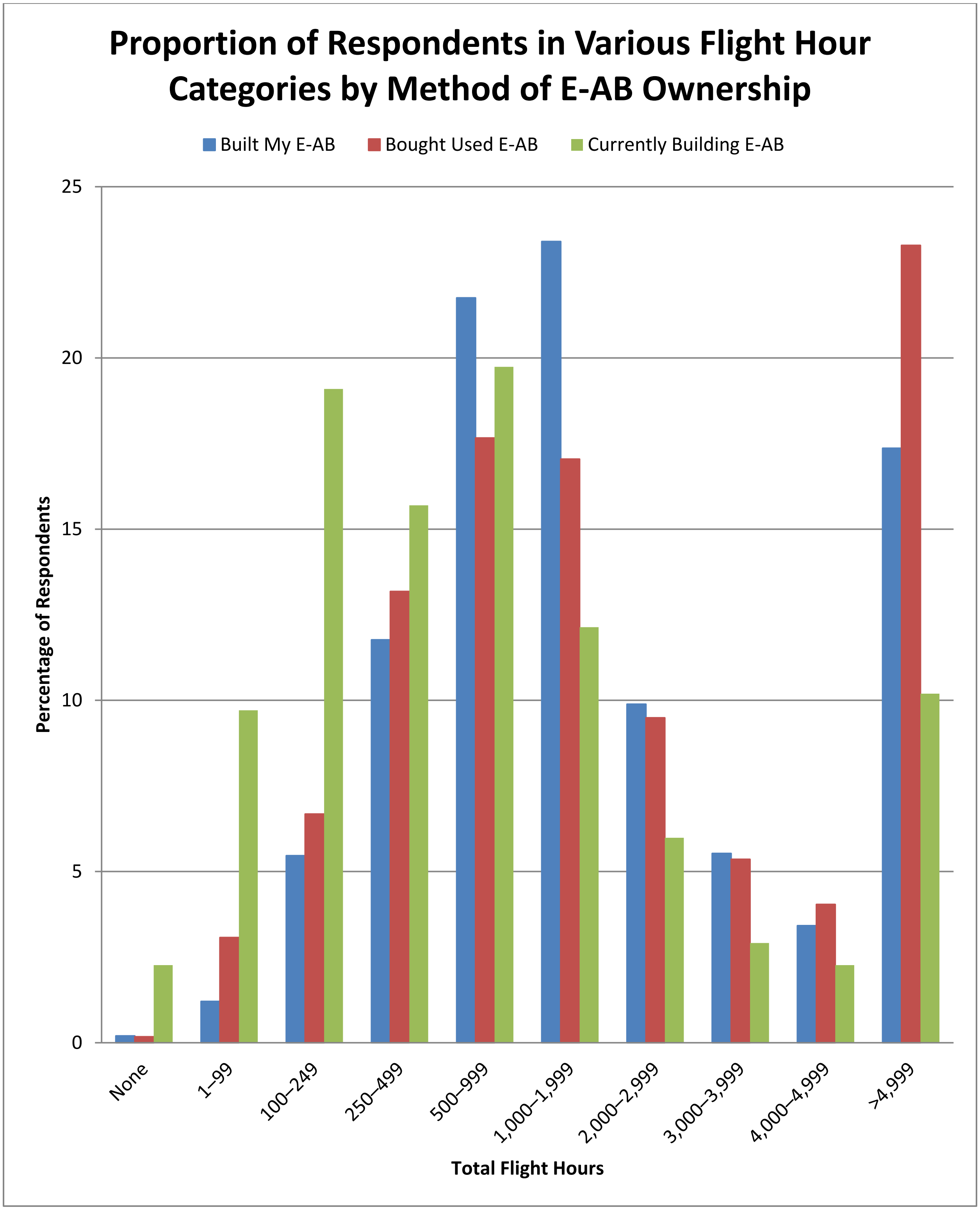

Figure 30. Total Flight Hours by E-AB aircraft method of ownership.

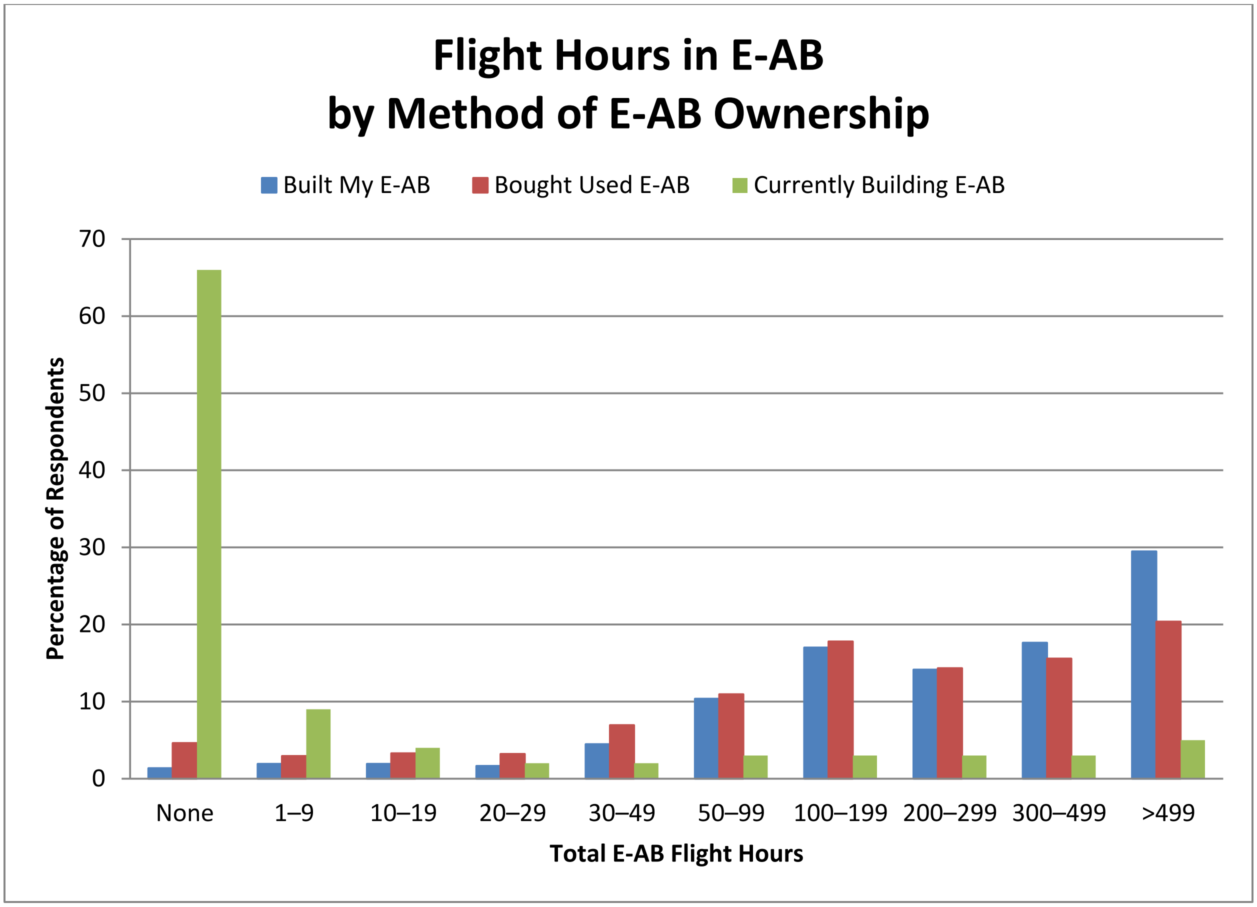

Figure 31. Total E-AB aircraft flight hours by method of ownership.

4.2 E-AB Aircraft Makes

Broadly speaking, an E-AB aircraft project can be characterized as an original design, where the builder creates the design and plans for a unique aircraft, fabricates the various parts, and assembles them as a one-of-a-kind aircraft; a plans-built project, where the builder fabricates the aircraft parts from raw materials (referred to as "miscellaneous parts" on FAA Form 8050-88) and assembles them according to published plans; or a kit-built project, where the builder assembles the aircraft from a kit consisting of prefabricated parts. Figure 32 shows the number of respondents who reported each of these types of building projects by method of E-AB aircraft ownership.

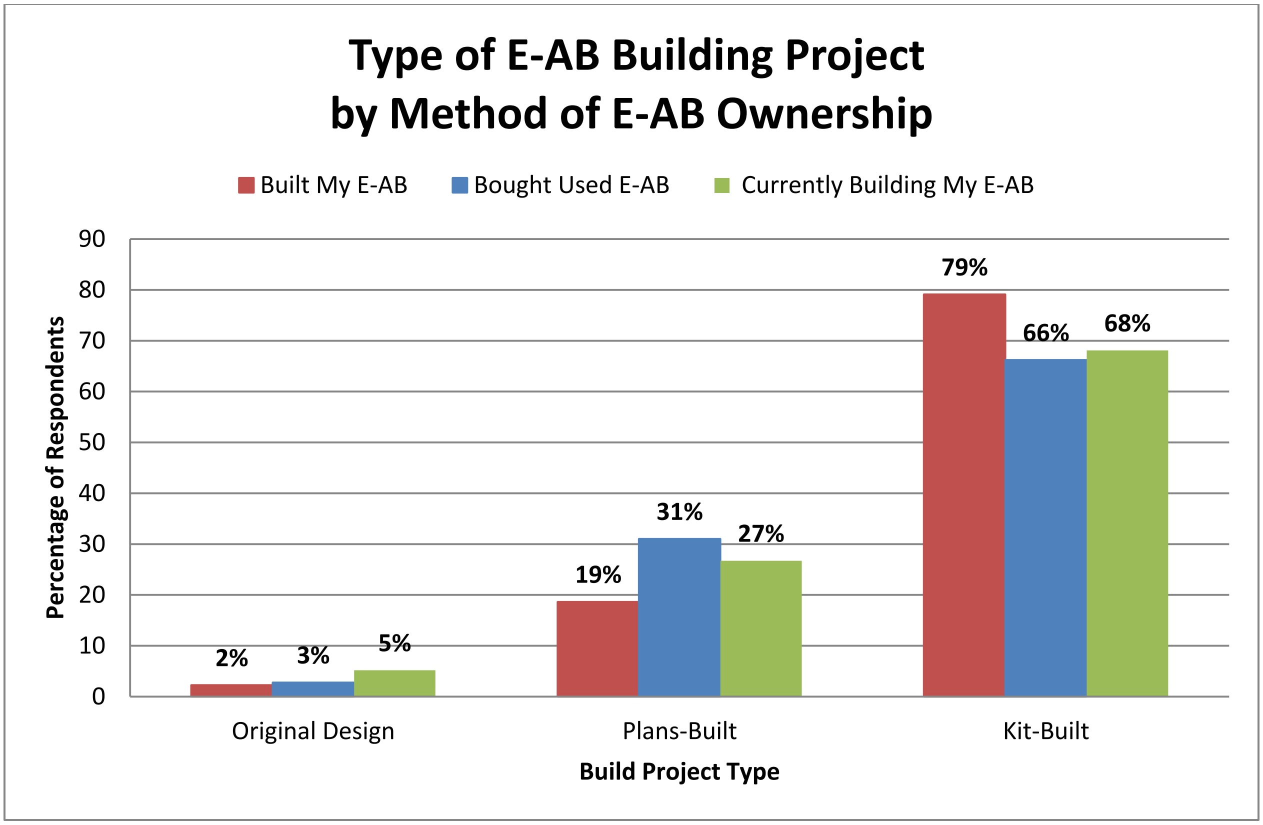

Figure 32. Type Building Project by E-AB aircraft method of ownership.

Kit-built projects clearly dominate among respondents who have already built their aircraft, bought the aircraft used, or are currently building the aircraft, although a significant number of aircraft in each group are built from published plans. A much smaller number of respondents in each group described an original design.

Overall, respondents reported 171 different E-AB aircraft kits accounting for approximately 75 percent of the aircraft in the survey. Appendix E provides additional detail about the manufacturers and models of aircraft built by survey respondents and details of their building process.

4.3 E-AB Aircraft Characteristics Requiring FAA Certificate Endorsements

Considering only the 4,794 airplanes described by survey respondents, table 6 shows the percentage of aircraft in each of the E-AB aircraft groups (bought used, already built, or currently being built) displaying the design features for which the FAA requires additional training or endorsements. This table also shows the percentage of owners within those subsets of E-AB aircraft who possess the respective FAA endorsements to their pilot certificate. Some of the owners of these aircraft would not be required to possess a particular endorsement if they had acquired appropriate experience prior to the date that each of these requirements was established.

Table 6. Aircraft design features and corresponding pilot certificate endorsements.

Reported Aircraft Design Features	Used E-AB	Built My E-AB	Building My E-AB
Engine >200HP	9%	13%	19%
Tailwheel Equipped	61%	48%	46%
Retractable gear	12%	13%	17%
Approved for aerobatics	51%	43%	39%
Reported Pilot Certificate Endorsements	**Used E-AB**	**Built My E-AB**	**Building My E-AB**
Owners with a high performance endorsement	92%	87%	59%
Owners with a tailwheel endorsement	91%	92%	69%
Owners with a complex endorsement	81%	72%	56%

Only 10 percent to 20 percent of respondents reported the engine horsepower of their aircraft to be above 200, but 92 percent of the respondents who had bought used E-AB aircraft and 87 percent of the respondents who built their E-AB aircraft reported having high performance endorsements to their pilot certificates. Some respondents likely had logged time in high performance aircraft prior to August 4, 1997, and would not be required to possess this endorsement.

A substantial proportion of the aircraft described by survey respondents were tailwheel airplanes, and more than 90 percent of owners of these aircraft reported having a tailwheel endorsement. Respondents who had logged time in tailwheel airplanes prior to April 15, 1991, would not be required to have this endorsement.

From 12 percent to 17 percent of the respondents’ aircraft were equipped with retractable landing gear. Most respondents who built their E-AB aircraft (72 percent) or bought it used (81 percent), as well as 56 percent of those building their E-AB aircraft, had an endorsement for complex aircraft.

Finally, a large proportion of the aircraft were reported by their owners to be approved for aerobatic maneuvers. The FAA approval for this function is reflected in the airworthiness certificate issued for E-AB aircraft.

4.4 The E-AB Aircraft Building Process

The 3,107 respondents who had already completed building their E-AB aircraft (or sometimes several) and the 659 respondents who were currently building an E-AB aircraft provided important insights into the building process. These respondents also indicated that they were aware of the support available from the E-AB aircraft community and that they utilized these resources.

Of the respondents who had built, or were currently building, their E-AB aircraft, 77 percent had purchased a kit, 20 percent had built, or were building, from published plans, and 3 percent had developed original designs.

Of the kit builders, 45 percent reported that they used a kit to save money and 39 percent reported that they used a kit to obtain aircraft performance advantages. Similar results were reported by the plans-built respondents, with 46 percent using published plans to save money and 29 percent using published plans to obtain aircraft performance advantages. Among the 104 respondents who had developed original designs, only 27 percent used an original design to save money and 25 percent used an original design to obtain aircraft performance advantages.

Among kit builders, 56 percent had received at least one demonstration flight before they bought their kit. About 35 percent of the demonstrations were provided by the kit manufacturer and 25 percent were provided by private individuals. About 32 percent of the respondents who built, or were building, their aircraft from plans had received a demonstration before they undertook their project, most from private individuals. Eleven percent of respondents creating their own designs had a pre-project demonstration from private individuals.

Figure 33 shows the choice of engine among the 3,567 powered aircraft built, or being built, by survey respondents. Most aircraft across all three types of construction were powered by either type-certificated or non-type-certificated versions of traditional aircraft engines. However, 21 percent of the original design aircraft and 20 percent of the plans-built aircraft used converted automobile engines.

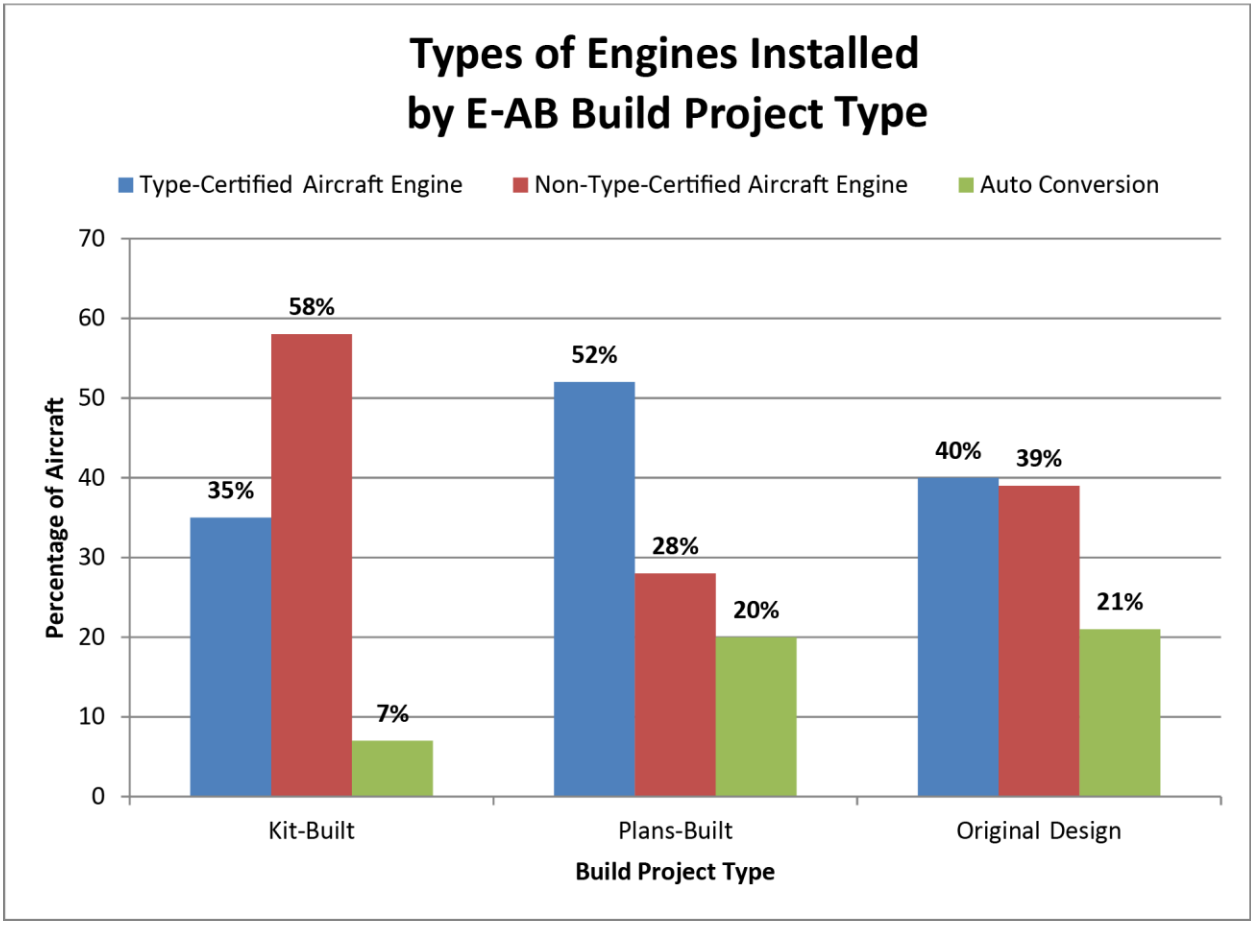

Figure 33. Engine choices among E-AB aircraft builders.

Table 7 summarizes the principal equipment characteristics of the 2,898 kit-built, 753 plans-built, and 104 original design aircraft reported by survey respondents. The percentages reported in the table are based on the total responses to each survey item, and the number of responses varies slightly between variables as a function of missing responses to some questions. Most plans-built (80 percent) and original design (55 percent) aircraft were equipped with fixed-pitch propellers, while more kit-built aircraft were equipped with constant-speed propellers (44 percent) than fixed-pitch (37 percent) propellers. Most original design and plans-built aircraft utilized conventional flight instruments, but there is a roughly even split between conventional instruments (54 percent) and glass cockpit avionics (46 percent) in kit-built E-AB aircraft.

Table 7. Principal characteristics of the kit-built, plans-built and original design E-AB aircraft built or being built by survey respondents.

Aircraft Characteristic	Kit Built	Plans Built	Original Design
Propeller			
Fixed Pitch	37%	80%	55%
Ground Adjustable	18%	7%	19%
Constant Speed	44%	13%	26%
Avionics			
Conventional	54%	84%	75%
Glass Cockpit	46%	16%	25%
Landing Gear Configuration			
Tailwheel	42%	62%	67%
Tricycle	56%	36%	30%
Other	2%	2%	3%
Landing Gear Type			
Fixed	89%	77%	82%
Retractable	11%	23%	18%
Number of seats			
One	4%	25%	33%
Two	85%	62%	45%
Three or more	11%	12%	22%

A large proportion of plans-built (62 percent) and original design (67 percent) E-AB aircraft are equipped with tailwheel landing gear, while the majority (56 percent) of kit-built E-AB aircraft are equipped with tricycle gear. Few E-AB aircraft are equipped with retractable landing gear. Most respondents reported two-seat aircraft, with much smaller numbers of respondents reporting single-seat aircraft or aircraft with more than two seats.

Figure 34 shows where the E-AB aircraft were built, or are being built. Most aircraft, whether kit-built, plans-built or original designs, are genuine “homebuilt” projects, with an airport hangar the next most frequent building location.

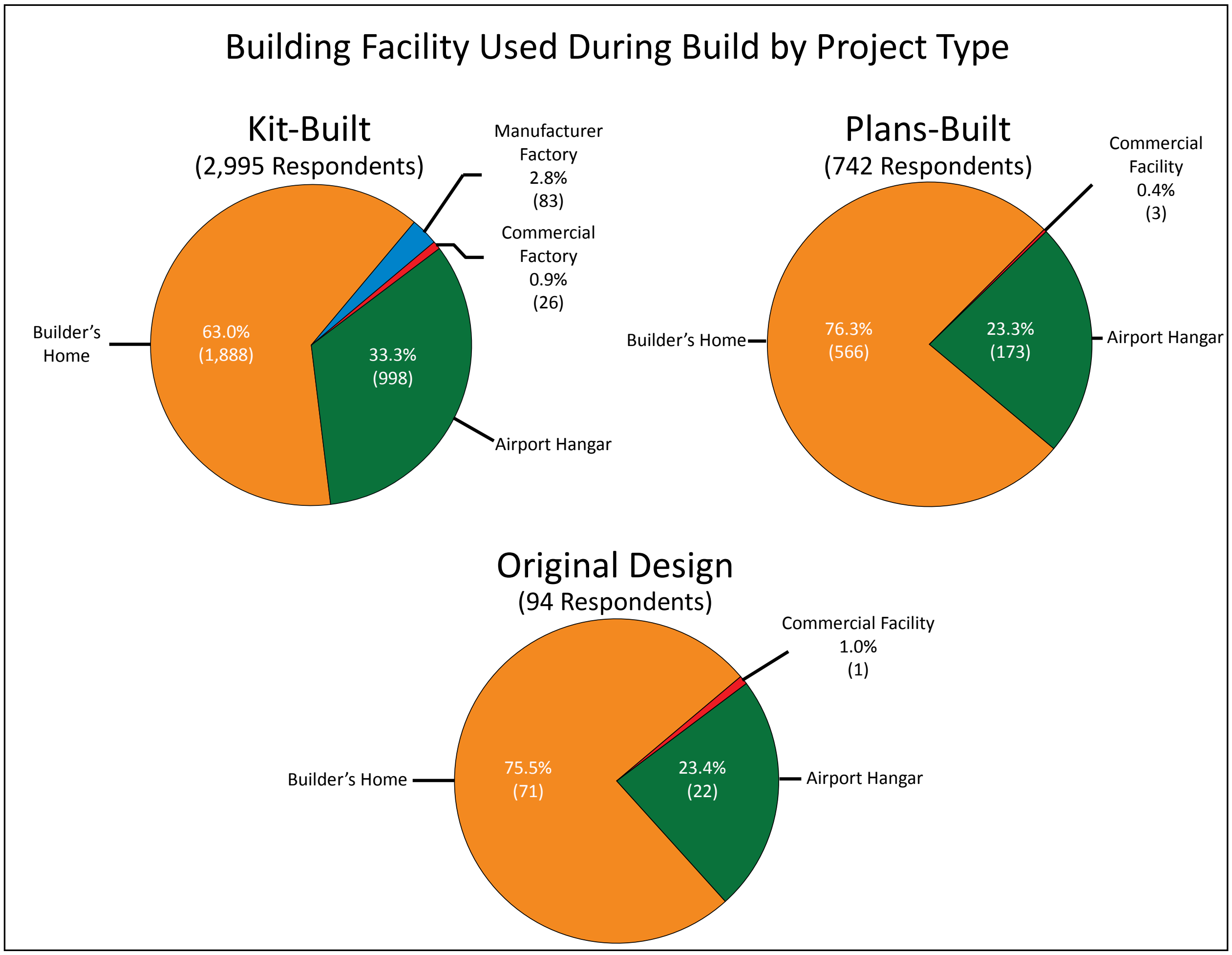

Figure 34. The location at which the E-AB aircraft was, or is being, built.

Builders have access to a variety of sources of building assistance as they complete their aircraft. Figure 35 shows the sources of assistance that were utilized by the three groups of builders. Help and advice from other builders was the most frequently sought source of assistance by all three categories of builders. Kit manufacturers provided support to purchasers of their kits and sometimes to builders of plans-built projects. EAA Technical Counselors provided assistance to significant numbers of builders in each category, and builders also sought the assistance of certified airframe and powerplant mechanics.

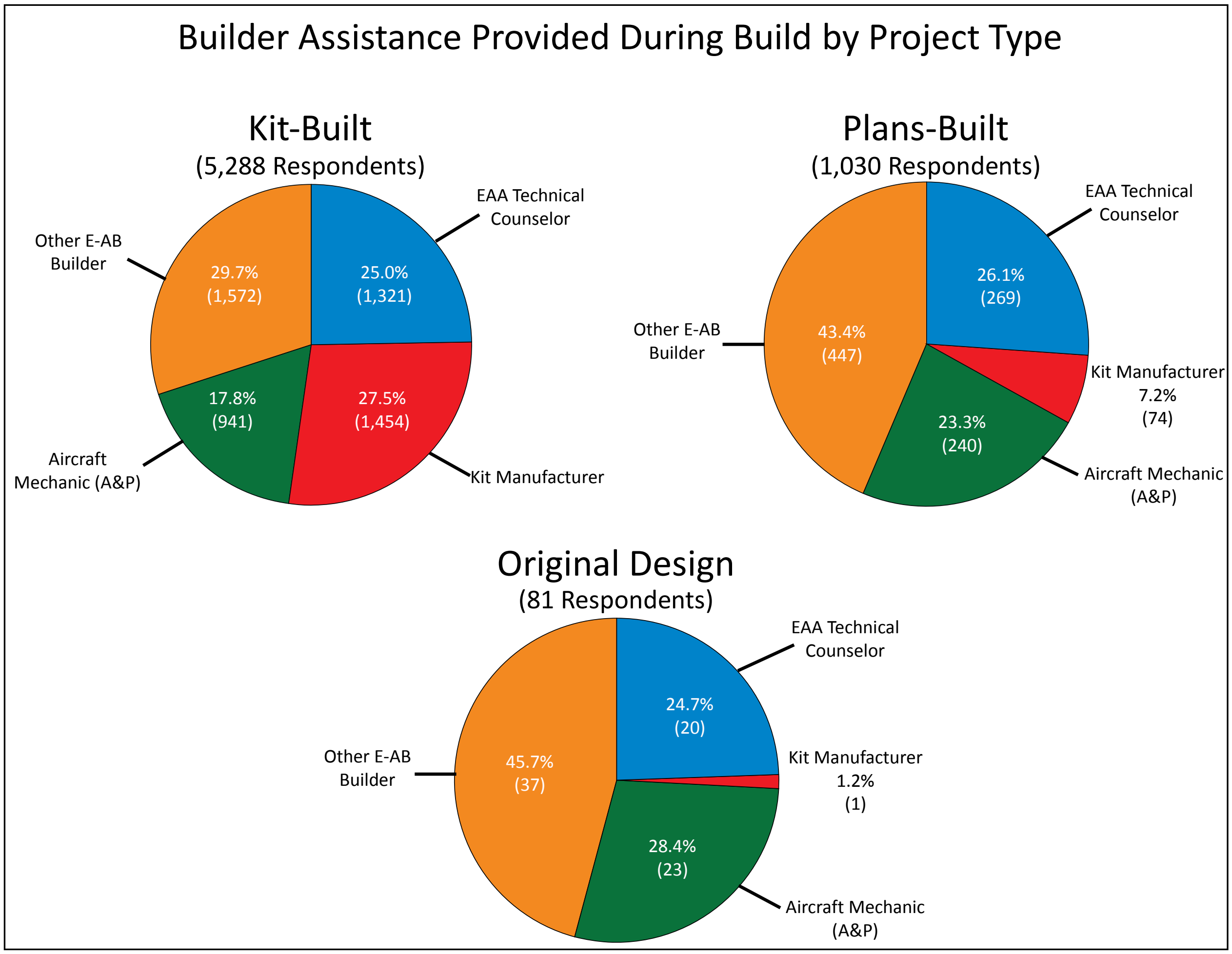

Figure 35. Sources of builder assistance.

Inspections during the building process also are an important source of support to builders, and Figure 36 identifies categories of individuals who provided this service to the three categories of builders. EAA Technical Counselors were the most frequently used inspectors during the building process, followed by other E-AB aircraft builders. Significant numbers of respondents also reported inspections by aircraft mechanics and FAA inspectors.

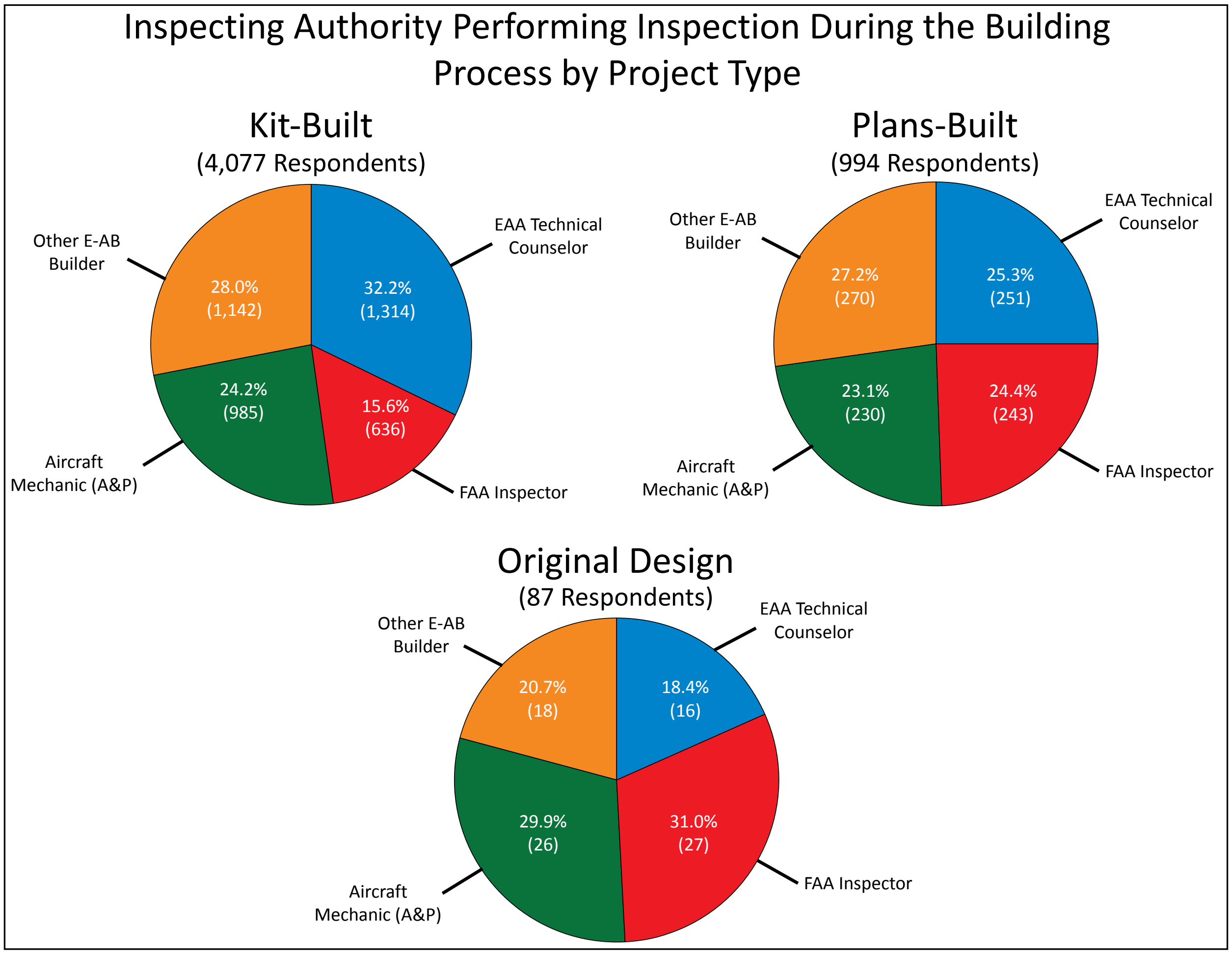

Figure 36. Individuals performing inspections during the building process.

E-AB aircraft builders can be certified repairmen, who are then authorized to conduct required annual aircraft condition inspections. Most E-AB aircraft builders, including 86 percent of kit builders, 78 percent of plans builders, and 77 percent of original designers, reported having such certification.[39]

4.5 Transition Training

Survey respondents who had completed their E-AB aircraft were asked about the training that they had completed that was specific to the transition to their new aircraft. Table 8 shows the proportion of each group of E-AB aircraft builders who had received transition training before their first flight in their new aircraft and the sources of that training.

[39] On the basis of 2,607 respondents reporting this information.

Table 8. Source of transition training reported by respondents who had completed their E-AB aircraft.

Source of Transition Training	Kit-Built	Plans-Built	Original Design
Had training prior to first flight	64%	37%	24%
Kit manufacturer	13%	0%	0%
Owner of same aircraft	21%	13%	0%
Owner of similar aircraft	10%	7%	9%
Owner of different aircraft	10%	2%	0%
Certificated flight instructor	26%	14%	10%
Total number of respondents	2452	578	70

The majority (64 percent) of kit–builders reported some type of transition training prior to their first flight, but this training came from a variety of sources. Only 37 percent of the plans-built and 24 percent of the original design groups reported specific transition training before their first flight. Insurance policies required such transition training for 37 percent of kit builders, 15 percent of the plans builders, and only 3 percent of the original designers. Many respondents (15 percent kit, 27 percent plans, and 37 percent original design) were self-insured, so this requirement did not apply.

4.6 Flight Test and Certification

Figure 37 shows the percentage of respondents who applied for airworthiness certification of their E-AB aircraft to ASIs or DARs to initiate the flight test requirement.

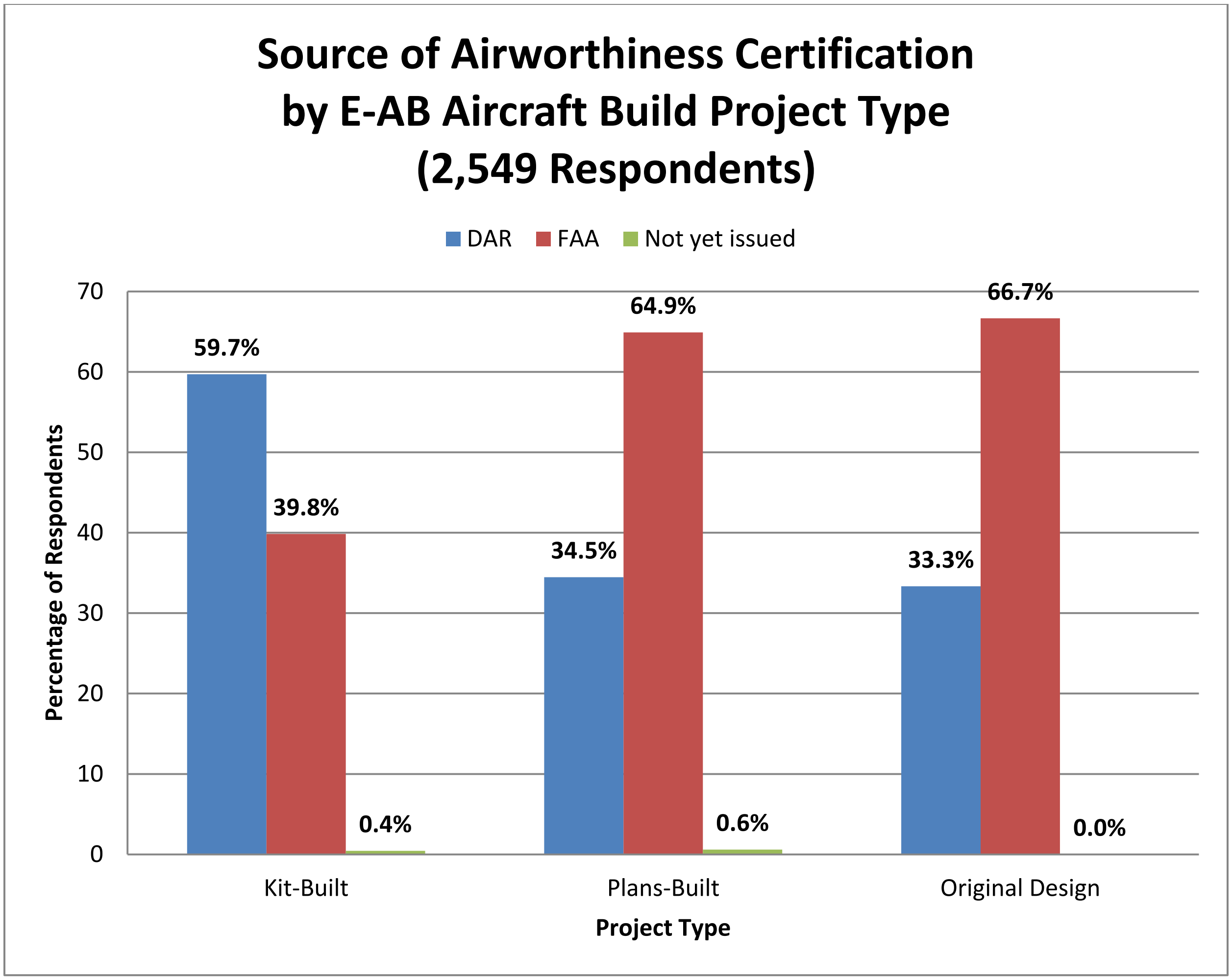

Figure 37. Issuer of airworthiness certificates reported by 2,597 of the 3,103 respondents who had completed their E-AB aircraft.

A somewhat higher proportion of kit builders sought airworthiness certification from DARs than from FAA airworthiness inspectors, while the opposite was true of plans-builders and original designers.

Of the 2,475 respondents reporting their Phase I flight test requirement, 68 percent of builders were assigned to a 40-hour Phase I flight test period by the FAA and 22 percent were required to complete 25 hours of Phase I flight test. Only a few respondents reported less than 25- or more than 40-hour requirements.[40]

Most builders reported having either "very detailed" or "somewhat detailed" flight test plans, but the survey did not ask for specifics of the test plans.

[40] FAA guidance suggests that a 10-hour test period is sufficient for certain aircraft such as balloons and gliders.

Figure 38 shows the sources of support used by these 3,103 builders in developing their Phase I test plans. The various sources of support are not mutually exclusive, and it is likely that reference to FAA AC 90-89A was a part of many of these test plans.

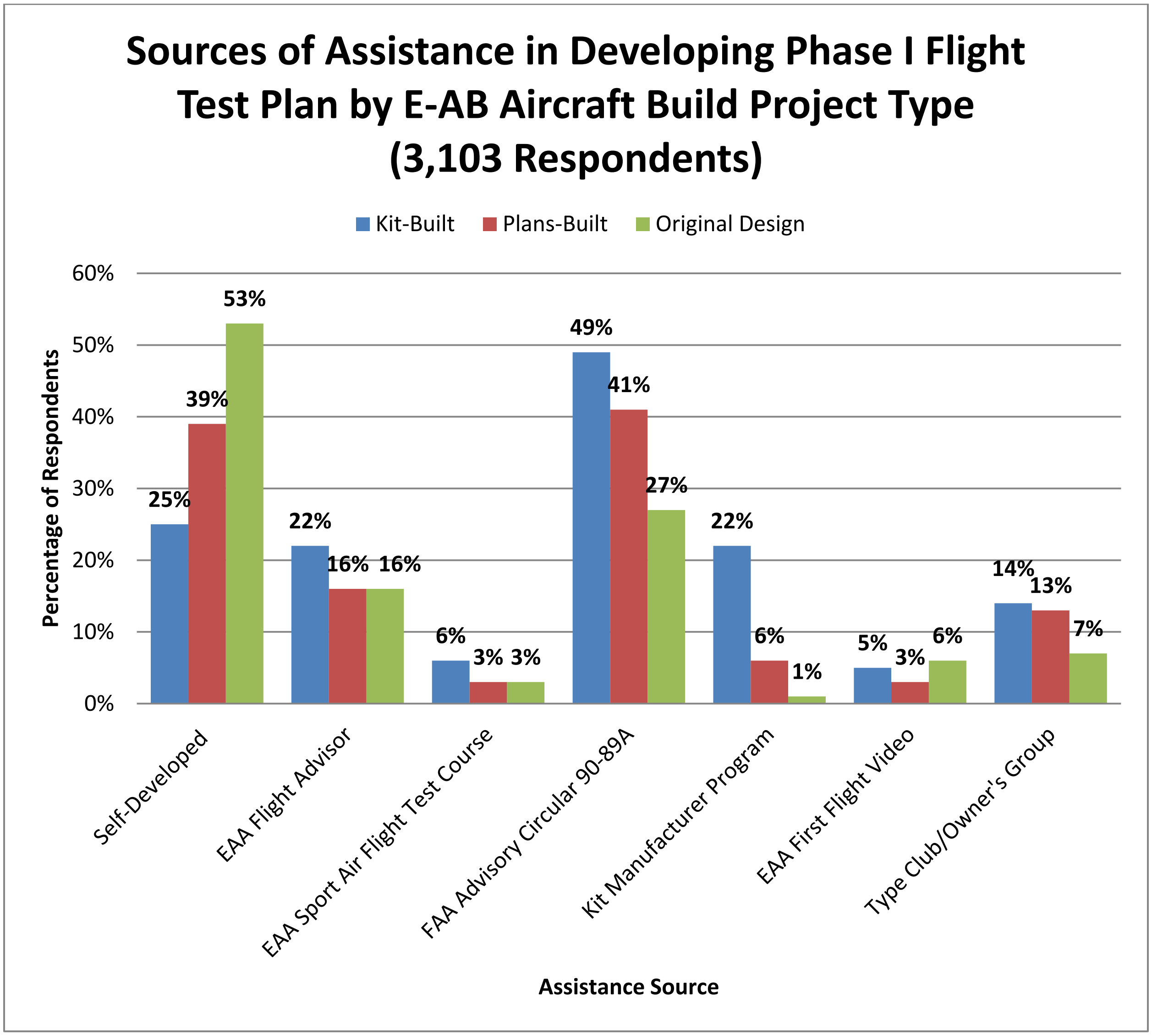

Figure 38. Sources of assistance in developing Phase I test plans for the 3,103 respondents who had built their E-AB aircraft.

Finally, 79 percent of respondents who had completed building their E-AB aircraft reported performing the first test flight themselves, while 12 percent had hired a test pilot, and 9 percent had asked a friend or more experienced pilot to perform the test flight.

4.7 Owners of E-AB Aircraft Bought Used

A total of 1,151 survey respondents reported owning an E-AB aircraft that they had purchased used. Most (98 percent) were airplanes. Kit-built aircraft accounted for 762

(66 percent) of these aircraft, while 357 (31 percent) were plans-built, and 32 (3 percent) were original designs. Table 9 summarizes the characteristics of these aircraft.

Table 9. Characteristics of the E-AB aircraft bought used by survey respondents.

Aircraft Characteristic	Kit-Built	Plans-Built	Original Design
Propeller			
Fixed Pitch	42%	81%	62%
Ground Adjustable	21%	5%	14%
Constant Speed	37%	14%	24%
Avionics			
Conventional	77%	96%	96%
Glass Cockpit	23%	4%	4%
Landing Gear Configuration			
Tailwheel	51%	81%	55%
Tricycle	47%	19%	41%
Other	2%	<1%	4%
Landing GearType			
Fixed	87%	90%	86%
Retractable	13%	10%	14%
Number of seats			
One	7%	34%	41%
Two	87%	64%	55%
Three or more	6%	2%	4%

About 60 percent of respondents reported having received at least one demonstration flight before they purchased their used E-AB aircraft. Very few reported that cost (4 percent) or performance (2 percent) were their primary motivations for buying their E-AB aircraft. Figure 39 shows the total hours of flying that these respondents had logged.

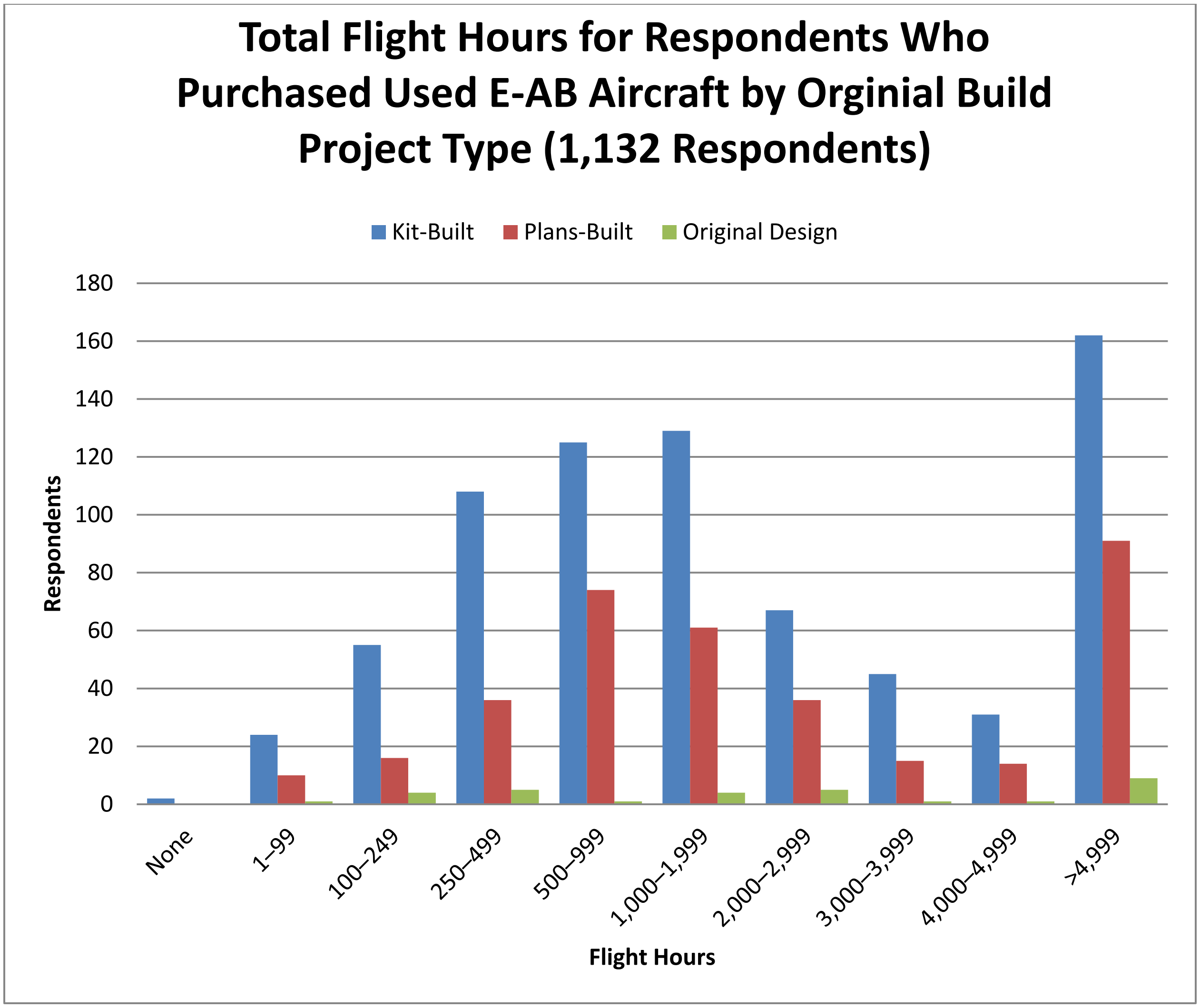

Figure 39. Total hours of flight experience for respondents who purchased used E-AB aircraft (1,132 of 1,151 reporting this information).

5. Analysis and Discussion

Comparisons of accident occurrences and aircraft characteristics indicate that the E-AB aircraft accident record during 2011 was similar to that of the preceding ten-year period. Comparisons of accident records and the EAA's survey results indicate that the population of E-AB aircraft and of E-AB aircraft owners involved in accidents is similar, in most respects, to the larger population of E-AB aircraft and E-AB aircraft owners included in the survey. The average E-AB aircraft owners are older, relatively high-time pilots with private pilot or higher certification compared with other general aviation pilots. The E-AB aircraft fleet, as identified by accident and survey information, is increasingly dominated by kit-built airplanes.

5.1 Key Findings

The pattern of study results identifies several safety-critical issues that, if addressed, could improve the E-AB aircraft accident record and better prepare pilots to operate E-AB aircraft. Study results indicate:

- The largest proportion of E-AB aircraft accidents involved loss of control in flight and powerplant failures, and loss of control in flight has been the greatest contributor to fatal E-AB aircraft accidents.

- More than one-half of the E-AB aircraft accidents investigated in 2011 were aircraft that had been purchased used, rather than built by the current owner.

- A large proportion of accidents occurs early in the operating life of a new E-AB aircraft, or shortly after being purchased by a new owner.

- During 2011, more E-AB aircraft accidents occurred during the first flight by a new owner of a used E-AB aircraft than during the first flight of a newly-built aircraft.

- The most common accident occurrence for first flights of both newly-built and newly purchased aircraft was loss of control in flight.

As a group, the E-AB accident aircraft did not experience a large number of structural failures or problems related to the strength of a particular aircraft's structure. Rather, the occurrences of aircraft system and component malfunctions and failures were most often associated with non-structural systems and components and were typically unique to the accident aircraft. However, the prevalence of accidents involving loss of engine power represents a fleet-wide safety concern for E-AB aircraft. Powerplant malfunctions and failures early in the operational life of a new aircraft include installation or system integrity issues that could be reduced by additional functional testing prior to flight. Powerplant accidents could be further reduced by using recorded data, when available, to monitor the condition and performance of the aircraft engine.

Loss of control accidents may result from the unique aircraft controllability and design characteristics of a particular E-AB aircraft and because pilots may be inadequately prepared to manage these unique flight characteristics. Accidents may also occur during flight testing if pilots are not prepared for the unique demands of flight testing, or do not follow safe flight test procedures.

The safety of flight testing could also be improved by pilots developing and following a detailed flight test plan tailored to the aircraft and using all available information to evaluate and document the aircraft's performance during the flight test. Accidents involving subsequent owners of E-AB aircraft could be improved by ensuring that they are provided with the information necessary to safely operate their aircraft. The prevalence of loss of control in flight could be reduced by ensuring that all pilots are adequately trained prior to engaging in flight test operations or transitioning to an unfamiliar E-AB aircraft. The finding that E-AB aircraft accident pilots had significantly more total experience but significantly less experience in the accident aircraft type provides further support for the potential safety benefits of transition training.

Finally, the study identified deficiencies in aircraft registration information and accident records pertaining to E-AB aircraft. Future efforts to assess E-AB aircraft safety and to act on identified safety concerns could be greatly improved by addressing these record-keeping deficiencies.

5.2 Opportunities to Improve Safety During Initial Certification

The pattern of results in this study identified areas for safety improvement that could be addressed during initial airworthiness certification. These include additional functional testing of aircraft systems to reduce instances of loss of engine power early in the operational life of a new aircraft, and submission of a detailed flight test plan to systematically assess aircraft airworthiness and flight characteristics, and development of a detail aircraft flight manual.

5.2.1 Airworthiness Certification of E-AB Aircraft

The United States imposes far less regulatory and safety oversight of E-AB aircraft than other countries,[41] particularly prior to issuing an airworthiness certificate. Canadian regulations require the filing of a letter of intent before the project is started, a pre-covering inspection during the building process that ensures that methods of fabrication and workmanship adhere to aviation quality standards, and a final inspection.[42] As part of the final inspection, the Canadian builder is required to report the results of a functional test of the aircraft's fuel system to ensure that adequate fuel is supplied to the engine in all flight attitudes and to test the integrity of the

[41] How Other Countries Address Sophisticated and High-Performance Amateur-Built Aircraft, FAA Memorandum, May 12, 2011.

[42] Part V – Airworthiness Manual Chapter 549 – Amateur-Built Aircraft, Canadian Aviation Regulations 2010-1, Revised February 17, 1998.

fuel supply to the powerplant. The requirement for pre-cover inspections[43] was removed from U.S. regulations in 1990.[44]

In the United States, oversight of an E-AB aircraft effectively begins with the submission of the FAA Form 8130-6, Application for Airworthiness Certificate (Amateur-Built) when the project is completed.[45] FAA AC 20-27G provides broad guidance relative to building E-AB aircraft and the application for, and issuance of, an airworthiness certificate permitting the operation of an amateur-built aircraft. An airworthiness certificate for operating amateur-built aircraft may be issued either by an ASI or a DAR upon review of FAA Form 8130-6 (along with a certification that the major portion rule was met and a validation of aircraft registration), review of builder documents, and completion of an airworthiness inspection. Although much of the guidance for documentation review provided in Order 8130.2G is focused on establishing compliance with the major portion requirement, FAA Order 8130.2G, section 4102.d identifies FAA responsibilities at the time of certification to include: (1) ensuring that the aircraft is complete and all documentation is sufficient, (2) examining evidence that appropriate weight and balance measurements have been made to establish most forward and aft center of gravity locations under empty and maximum gross weight conditions; and (3) ensuring that the completed weight and balance report is available in the aircraft along with other applicable placards and markings. Section 4102.g stipulates that the ASI's or DAR's inspection, at a minimum, will determine that:

- The ID plate meets the requirements of 14 CFR 45.11, as applicable.
- The information on the ID plate matches the information on FAA Form 8130-6 and Aeronautical Center Form 8050-3.
- The aircraft nationality and registration marks are in accordance with 14 CFR Part 45, subpart C.
- The flight control system, engine(s), propeller(s), pitot static system, and associated instruments operate properly.
- The cockpit instruments are appropriately marked and needed placards are installed and placed for easy reference.
- System controls are appropriately placed, clearly marked, provide for easy access and operation, and function as intended by the amateur builder/owner.

[43] A "pre-cover inspection" is an inspection conducted before the structural framework of the aircraft is "covered" with skin or other components.

[44] FAA, Amateur-Built Aircraft Aviation Rulemaking Committee Final Report, February 14, 2008.

[45] See discussion of E-AB airworthiness certification in chapter 1.

- An emergency locator transmitter is installed, if required.[46]
- All explosive devices used in ballistic parachutes are clearly marked and identified.

5.2.2 Functional Test Requirements

Among the list of items identified in FAA Order 8130.2G to be determined during inspection for initial airworthiness certification are requirements that the flight controls, engine, and propeller operate properly and that applicants are required to submit a weight and balance report. However, no specific functional testing is currently required. Analyses of E-AB aircraft accidents from 2001 through 2011 identify powerplant malfunctions and failures as the most common E-AB aircraft accident occurrence and second most common fatal accident occurrence overall, and the most common accident occurrence during Phase I flight testing. Results of the EAA survey of E-AB aircraft owners and builders and the accident record also highlight the wide variety of powerplants installed in E-AB aircraft, making powerplant-specific safety improvement efforts more difficult.

Investigations of many of the E-AB aircraft accidents during 2011 included in this report are still ongoing at the time of writing. However, there are examples among the completed cases that illustrate the potential safety benefit of requiring builders to conduct, and report the results of, a functional test of the aircraft's fuel system prior to certification.

On April 27, 2011, in Minford, Ohio, an experimental amateur-built Chang RV-10 airplane was substantially damaged during an emergency landing following an in-flight fire. The aircraft was in the Phase 1 flight test phase and had accumulated about 4 hours flight time when the accident occurred. The pilot reported that he had noticed low fuel pressure during the accident flight and activated the fuel boost pump, after which the fuel pressure returned to within normal limits. As the airplane approached the intended destination airport, the pilot smelled smoke and observed a fire in front of his right foot. He discharged a fire extinguisher, which put out the fire; however, the cabin filled with smoke. He closed the fuel valve and opened the pilot's side door. The door separated and some of the smoke dissipated. The pilot made an emergency landing in a pasture, during which the fuselage and right wing were damaged.

A postaccident examination of the engine revealed a loose fuel line fitting at the mechanical fuel pump. The fire occurred along the lower fuselage skin in the center console area, which ran forward to aft between the pilot and copilot seats. The lower fuselage skin was burned through as a result of the in-flight fire. The NTSB determined the probable cause of this accident to be a loose fuel line fitting, which caused a fuel leak and subsequent in-flight fire.[47]

The 2001–2010 accident cases include additional examples involving loss of engine power during the first few hours of operation of a newly built aircraft. Some of the fuel system

[46] Title 14 CFR 91.207(f) includes several exemptions to the requirements for U.S.-registered civil airplanes to be equipped with an emergency locator transmitter. Examples include single-person aircraft, aircraft engaged in flight instruction within a 50 nautical mile radius of the originating airport, or aircraft engaged in flight operations incident to design and testing.

[47] NTSB accident case number CEN11CA321.

design and installation problems found in these cases include incorrectly installed fuel lines,[48] crimped vent lines,[49] system leaks,[50] and a fuel system that did not provide adequate fuel pressure to maintain engine power.[51]

The NTSB concludes that a functional test of the aircraft fuel system could identify design deficiencies, leaks, and malfunctions prior to flight that would prevent fuel system- and powerplant-related accidents early in the operational life of an aircraft. For example, Canadian regulations and guidance for E-AB aircraft certification stipulate that a fuel flow test must be conducted, and a form reporting on the methods and result of this test be submitted during final airworthiness inspection.[52] The prevalence of E-AB aircraft powerplant malfunctions and failures would be reduced with the implementation of a similar functional test as part of the airworthiness certification process. Therefore, the NTSB recommends that the FAA revise 14 *Code of Federal Regulations* 21.193, FAA Order 8130.2G, and related guidance or regulations, as necessary, to define aircraft fuel system functional test procedures and require applicants for an airworthiness certificate for a powered experimental, operating amateur-built aircraft to conduct that test and submit a report of the results for FAA acceptance.

5.2.3 Flight Test Plan

FAA AC 90-89A provides extensive guidance to the E-AB aircraft builder for the development and execution of the flight test program, and it begins by stating the primary objectives of the flight test program:

> a. *The most important task* for an amateur-builder is to develop a comprehensive FLIGHT TEST PLAN. This PLAN should be individually tailored to define the aircraft's specific level of performance. It is therefore important that the entire flight test plan be developed and completed BEFORE the aircraft's first flight.
>
> b. *The objective of a* FLIGHT TEST PLAN is to determine the aircraft's controllability through-out all the maneuvers and to detect any hazardous operating characteristics or design features. This data should be used in developing a FLIGHT MANUAL that specifies the aircraft's performance and defines its operating envelope.[53]

EAA survey respondents who had achieved airworthiness certification were asked how detailed their flight plans were—37 percent claimed to have a "very detailed" plan, while an additional 47 percent claimed a "somewhat detailed" plan, and 16 percent indicated a "somewhat informal" test plan. No consistent evidence of the existence or quality of flight test plans was available in accident investigation records or FAA certification files for the E-AB aircraft involved in accidents during 2011.

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[48] For example, see NTSB accident case number LAX04LA132.

[49] For example, see NTSB accident case number CEN09CA382.

[50] For example, see NTSB accident case number LAX02LA256.

[51] For example, see NTSB accident case number LAX07LA220.

[52] Refer to Appendix G for a copy of the Canadian fuel flow test report form.

[53] FAA AC 90-89A, Amateur-Built Aircraft and Ultralight Flight Testing Handbook, May 24, 1995.

FAA Order 8130.2G does not require that a builder's flight test plan be reviewed by the ASI or DAR. In marked contrast, the United Kingdom's CAP 659[54] lists the following actions (among others) that the builder must satisfy before being issued a Permit to Fly for Test:[55]

- Have produced and have agreed by the CAA's Design and Production Standards Division Test Pilot your proposed flight test programme,
- Have agreed with the CAA's Test Pilot the competency and suitability of the person(s) who will be undertaking the test flying,
- Have agreed with the CAA's Test Pilot and the Regional Office Surveyor the arrangements for the management of your flight test program, and
- Have produced a preliminary flight manual for the aircraft.

Absent a review and assessment of the flight test program by the FAA, the adequacy of the flight test program stipulated in Order 8130.2G cannot be ascertained or ensured. Therefore, the NTSB recommends that the FAA revise 14 *Code of Federal Regulations* 21.193, FAA Order 8130.2G, and related guidance or regulations, as necessary, to require applicants for an airworthiness certificate for experimental, operating amateur-built aircraft to submit for FAA acceptance a flight test plan that will (1) ensure the aircraft has been adequately tested and has been determined to be safe to fly within the aircraft's flight envelope and (2) produce flight test data to develop an accurate and complete aircraft flight manual, and to establish emergency procedures and make a copy of this flight test plan should be made a part of the aircraft's certification file.

5.3 Opportunities to Improve Safety During Phase I Flight Test

The high proportion of E-AB aircraft accidents occurring early in the operational life of the aircraft, particularly during the first flight, provides evidence for the potential for safety improvements during Phase I flight testing. An area identified for improvement includes making sure that pilots are adequately prepared and capable of conducting flight test operations. The data collected during flight testing and the documentation of flight test results also provides safety-critical information to subsequent aircraft owners and pilots. Additional safety benefits can be had for E-AB aircraft builders and subsequent owners by ensuring that a detailed flight test plan is completed and an aircraft flight manual is created during Phase I testing.

5.3.1 Phase I Flight Testing of E-AB Aircraft

Based on the review of the required forms and documents and the inspection of the aircraft, the ASI or DAR will issue a Special Airworthiness Certificate (FAA Form 8130-7) for the Category/Designation – Experimental, and the Purpose – Operating Amateur-Built Aircraft,

[54] CAP 659 Amateur Built Aircraft: A Guide to Approval, Construction and Operation of Amateur Built Aircraft, UK Civil Aviation Authority, Aircraft Certification Department, Safety Regulation Group, November 2005.

[55] Comparable to the U.S. Phase I authorization granted with the E-AB Airworthiness Certificate.

ordinarily with an "unlimited" expiration.[56] The ASI or DAR will also issue a set of operating limitations for both a Phase I flight test period and Phase II operations, when the flight test period has been completed and recorded in the aircraft logbook.

Airworthiness records were reviewed for 223 of the 227 E-AB aircraft involved in accidents during 2011. Most of these files contained copies of Forms 8130-6 and 8130-7, documentation of the major portion requirement, and Phase I and Phase II operating limitations. Relatively few records contained documentation of weight and balance calculations and other details of the aircraft's construction that had supported the issuance of the airworthiness certificate.[57]

The operating limitations issued with the Special Airworthiness Certificate for Operating Amateur-Built Aircraft include three main restrictions during Phase I: (1) All flights must be limited to a specifically defined geographic area over open water or sparsely populated areas having light air traffic, (2) the aircraft must be limited to the specified geographic area for an assigned number of hours, and (3) "no person may be carried in the aircraft during flight unless that person is essential to the purpose of flight." Under current regulations, Phase I is completed when the builder/owner has self-certified his or her compliance by recording the following, or a similarly worded statement, in the aircraft logbook or records [bolded text appears in the original]:

> **I certify that the prescribed flight test hours have been completed and the aircraft is controllable throughout its normal range of speeds and throughout all maneuvers to be executed, has no hazardous operating characteristics or design features, and is safe for operation. The following aircraft operating data has been demonstrated during the flight testing: speeds V_{SO} ____, V_X _____, and V_Y_____, and the weight _____ and CG location _____ at which they were obtained.**

When this logbook endorsement is accomplished, the aircraft enters Phase II for an unlimited duration, the restriction on carrying passengers is removed, and the specific geographic restrictions of Phase I are replaced with the following:

This aircraft is prohibited from operating in congested airways or over densely populated areas unless directed by air traffic control, or unless sufficient altitude is maintained to effect a safe emergency landing in the event of a power unit failure, without hazard to persons or property on the ground.

FAA Order 8130.2G states that the period of assignment to the Phase I test period should be a minimum of 25 hours for E-AB aircraft with type-certificated engine/propeller combinations and that a minimum of 40 hours is required for any non-type-certificated engine/propeller combination or for any type-certificated engine/propeller combination that has been modified in any way. The recommended Phase I flight testing period for gliders, balloons, and ultralight

[56] Expiry limits of E-AB airworthiness certificates changed, in most cases, to unlimited duration in 1979.

[57] Current FAA airworthiness records associated with E-AB aircraft do not normally include information such as flight test plans, an aircraft flight manual, or a Pilot's Operating Handbook.

vehicles is ten hours. The order also states that any major change to an E-AB aircraft requires the return to Phase I limitations for a minimum of five hours.

The Order does not cite a basis for these guidelines, although FAA AC 90-89A describes a broad flight test program that includes a pre-flight phase with inspections and taxi tests, the important first flight, and subsequent periods of testing dictated by a series of test objectives.

5.3.2 Accidents During Phase I Flight Testing

Thirty-four of the E-AB aircraft accidents investigated during 2011 involved aircraft being operated in Phase I, ostensibly undergoing flight testing. Eight of these accidents occurred on the first test flight.[58] Unfortunately, no information is available from these accidents regarding the flight test plan that was presumably being followed.

An example of an accident involving an E-AB aircraft in Phase I flight testing occurred on July 16, 2011, at 1930 eastern daylight time, when an amateur-built Dixon Volksplane VP-1, collided with a barn following a partial loss of engine power on takeoff from the Jackson County Airport in Jackson, Michigan. The pilot received minor injuries and the airplane was substantially damaged. The 14 CFR Part 91 flight was operating in visual meteorological conditions without a flight plan. The flight was originating at the time of the accident.[59]

The pilot reported he was making the first flight in the airplane, which was built by someone else. He stated that he inspected the airplane and paperwork and believed the airplane was satisfactory to fly.

The pilot was cleared for takeoff on runway 32 and the winds were calm. He stated that the takeoff roll seemed sluggish, but he thought it was due to the warm outside temperature. The airplane lifted off about halfway down the 4,000-foot-long runway. He stated that the airplane was significantly left-wing heavy, but he was able to maintain control by applying right aileron. The airplane was out of ground effect when he reached the end of the runway, at which point the airspeed and engine power were decreasing very slowly. The pilot made a shallow turn in an attempt to land on runway 26. The engine continued to lose power and the airplane stalled at tree top height. The left wing contacted a pole barn, which spun the airplane around prior to it contacting the ground, resulting in substantial damage to the wings and fuselage.

The Volkswagen engine was equipped with dual carburetors and an oil cooler. The mixture control setting was preset and was not adjustable from the cockpit. The airplane owner stated that he performed a teardown inspection on the engine following the accident and he was not able to identify any mechanical failures/malfunctions that would have resulted in the loss of engine power. No further engine examination was performed and the reason for the loss of power was not determined.[60]

[58] Two additional first-flight accidents involved unregistered aircraft with no airworthiness certification.

[59] NTSB accident case number CEN11LA488.

[60] The NTSB determined the probable cause of this accident (NTSB accident case number CEN11LA488) to be a partial loss of engine power during initial climb after takeoff for undetermined reasons.

Two of the 34 E-AB aircraft accidents involving aircraft operating in Phase I had been bought used before the Phase I testing period had been completed. Therefore, the new owner would have been required to complete the Phase I flight test requirements before conducting normal operations. In both of these cases, the purpose of the accident flight was described to the NTSB investigator as familiarization with the newly purchased aircraft, rather than performance of flight test activities. In one of these cases, this was the new owner's first flight. In neither of the cases had a new application for airworthiness certification been filed, or had a new Airworthiness Certificate for Operation of Amateur-Built Aircraft been issued. FAA Order 8130.2G is explicit in stating that the airworthiness certificate is transferred upon the sale of the aircraft and that "there is no FAA inspection required after transfer of an aircraft with its airworthiness certificate, unless it is determined that revised operating limitations are necessary."[61] It is not clear how, or by whom, such a determination that revised limitations are necessary would be made. The NTSB concludes that such transfers of ownership, and thus responsibility for the completion of flight test requirements during Phase I, do not ensure an opportunity for the FAA to review and accept the continuing appropriateness of Phase I operating limitations and requirements for the new owner of the aircraft.[62]

5.3.3 Loss of Control During Phase I Flight Testing

Loss of aircraft control in flight made a particularly large contribution to accidents early in the life of the aircraft involved in the 2011 case studies. Four of the eight fatal E-AB aircraft accidents during Phase I flight testing in 2011 were associated with loss of control in flight. The NTSB concludes that the Phase I flight test period is uniquely challenging for most pilots because they must learn to manage the handling characteristics of an unfamiliar aircraft while also managing the challenges of the flight test environment, including instrumentation that is not yet calibrated, controls that may need adjustment, and possible malfunctions or adverse handling characteristics. FAA AC 90-89A, *Amateur-Built Aircraft and Ultralight Flight Testing Handbook*,[63] provides guidance for flight testing amateur-built aircraft and offers safety-related recommendations to assist amateur builders in developing individualized aircraft flight test plans.

5.3.4 Phase I Test Pilot Qualifications

The aircraft builder was the test pilot in 29 of the 34 Phase I accidents during 2011. The majority (62 percent) of the 34 test pilots held a private pilot certificate, while 27 percent held commercial pilot certificates. The median age of these pilots was 62 years, the median hours of total flight time was 1,000 hours, and the median hours of experience in the accident make and model was 4 hours. Forty-four percent of these pilots had had no prior mechanical or building experience, 24 percent claimed previous E-AB aircraft building experience, 20 percent were A&P mechanics, and 12 percent reported military aviation experience. FAA AC 90-89A states that Phase I flight test requirements should be performed by pilots who are "rated, current and

[61] FAA Order 8130.2G, Section 4102i.

[62] This issue is considered further in a later section of this report, "Providing Information to Purchasers of Used E-AB Aircraft."

[63] http://www.faa.gov/library/manuals/aircraft/media/ac90-89a.pdf.

competent in the same category and class as the aircraft being tested."[64] Test pilot flight time requirements suggested by FAA AC 90-89A are:

1. 100 hours of solo time before flight testing a kit plane or an aircraft built from a time-proven set of plans.

2. 200 hours of solo time before flight testing a 'one-of-a-kind' or high-performance aircraft.

3. A minimum of 50 recent takeoffs and landings in a conventional (tailwheel aircraft) if the aircraft to be tested is a tail dragger.

FAA AC 90-89A also recommends that the builder attach the same budgetary and time priority to obtaining and maintaining pilot competence as is assigned to the building project, if he or she intends to perform the test pilot functions. The NTSB concludes that the E-AB aircraft safety record could be improved by providing pilots with additional training and guidance to safely perform Phase I test pilot functions. The EAA periodically offers a Sport Aviation Workshop titled *Test Flying and Developing Pilot Operating Handbook*. The focus of this course is to assist the builder/pilot to safely explore the aircraft's flight envelope, gather and interpret flight test data and develop the aircraft flight manual. The EAA's Flight Advisor Program also provides support to the builder/pilot in developing and executing a flight test program. Therefore, the NTSB recommends that the FAA and the EAA identify and apply incentives to encourage owners, builders, and pilots of E-AB aircraft to complete flight test training, such as that available in the Experimental Aircraft Association's *Test Flying and Developing Pilot Operating Handbook*, prior to conducting flight tests of E-AB aircraft.

5.3.5 Additional Persons Onboard During Phase I Flight Testing

On September 27, 2011, at 1915 eastern daylight time, an Owen model Vans RV-10 airplane, N499RV, was substantially damaged during a forced landing and post-impact ground fire near Marietta, Ohio. The pilot and passenger sustained serious injuries. The local flight departed Mid-Ohio Valley Regional Airport, near Parkersburg, West Virginia, at 1855.

According to the pilot, the purpose of the flight was to familiarize himself with the experimental amateur-built airplane. The pilot-rated passenger had contributed in the assembly of the airplane and subsequently completed about 20 hours of flight testing on the airplane before the accident flight. The pilot stated that after departure he completed 15–20 minutes of basic flight maneuvers before returning to the departure airport. After receiving a clearance from the tower controller, he reduced engine power to initiate a descent from 3,000 feet mean sea level. The passenger suggested using a higher engine power setting during the cruise-descent. As the pilot slowly increased engine power, they heard a loud bang from the engine and oil began covering the windscreen. He noted that the engine continued to run erratically, but engine speed could not be controlled using the throttle or propeller controls. The pilot relinquished control of the aircraft to the passenger, who had more experience in the accident airplane, and a forced

[64] http://www.faa.gov/library/manuals/aircraft/media/ac90-89a.pdf.

landing was made to a nearby wooded area. The airplane was extensively damaged during a post-impact ground fire.

In this and one other Phase I accident during 2011, there were two individuals aboard the accident aircraft, in apparent conflict with the operating limitation that, "During the flight testing phase, no person may be carried in this aircraft during flight unless that person is essential to the purpose of flight." In the other Phase I accident with two persons on board, the second individual was described as a copilot/observer who was involved with the building of the aircraft. While FAA Order 8130.2G does not precisely define "essential to the purpose of flight," it is generally understood that this provision does not encompass training of the E-AB aircraft builder. The position taken by the EAA in response to a question posed to its home-builders website was as follows:[65]

> We concur with the FAA that during all flight testing only the test pilot is allowed in the aircraft. We have yet to see a homebuilt aircraft that requires a co-pilot. If flight data needs to be recorded, make use of a tape recorder or other recording device to record flight data, e.g., airspeeds, engine instrument readings, etc.

While it is true that virtually all E-AB aircraft are single pilot aircraft, it is likely that the safety and efficiency of some Phase I flight test activities would be enhanced by the presence, in the cockpit, of two qualified pilots.

Results of accident data analyses, FAA guidance materials, and the qualitative feedback from subject matters experts, such as the EAA Builder's Council, indicate that even experienced pilots are at a particularly high risk of accidents early in the life of a new E-AB aircraft. Some builders have sought the assistance of another pilot to assist in the flight test process, but FAA Order 8130.2G currently prohibits anyone other than the pilot to occupy an aircraft during the Phase 1 flight test period. The NTSB agrees with the EAA position that transition training should not be combined with Phase I flight testing requirements. However, the NTSB believes that the safety of E-AB aircraft flight testing could be improved for some pilots and flight test circumstances if a qualified second pilot was authorized to accompany the pilot for the purpose of flight testing and not training. Other countries specify provisions for more than one pilot to occupy an aircraft during flight testing. For example, the U.K.'s CAP 659 advises that:

> If you need an additional crewmember for a particular flight test, then specify this in your flight test programme and have it agreed by the CAA's Test Pilot and the [Regional Office] Surveyor. When agreed, we will list this need in the operating limitations on your Permit to Fly for Test.

FAA AC 20-27G contains language similar to this statement from CAP 659; however, no related guidance is provided to ASIs or DARs in Order 8130.2G. Providing pilots with a clearly defined policy regarding authorizing the presence of a second pilot would enhance flight safety during portions of the flight test program that simultaneously demand high levels of piloting skill and the capture of necessary flight test data. Therefore, the NTSB recommends that the FAA

[65] http://members.eaa.org/home/homebuilders/faq/3Pilot%20Checkouts%20during%20the%20flight%20test%20period.html.

revise Order 8130.2G, and related guidance or regulations, as necessary, to clarify those circumstances in which a second qualified pilot could be authorized to assist in the performance of flight tests when specified in the flight test plan and Phase I operating limitations.

5.3.6 Completion of Phase I Flight Testing

FAA Order 8130.2G states that an explicit flight test program must be accomplished before E-AB aircraft are issued an airworthiness certificate and Phase I operating limitations can enter the less restrictive Phase II operating limitations.

> **Showing Compliance to 14 CFR 91.319(b).**[66] The applicant should be advised that after the experimental amateur-built airworthiness certificate has been issued, they must show compliance to 14 CFR 91.319(b). This is done by developing a flight test program that addresses the requirements, goals, and objectives of each test flight. The flight test program should be developed in accordance with AC 90-89, *Amateur-Built Aircraft and Ultralight Flight Testing Handbook*, or its equivalent in scope and detail. Flight test programs serve two purposes:
>
> They ensure the aircraft has been adequately tested and determined to be safe to fly within the aircraft's flight envelope.
>
> The flight test data is used to develop an accurate and complete aircraft flight manual and to establish emergency procedures.

The owner/builder's self-endorsement in the aircraft logbook and maintenance records, stating that the prescribed flight hours were completed, is the only explicit evidence that the aircraft has been shown to comply with 14 CFR 91.319(b). There is no requirement that the ASI or DAR confirm this claim.

The UK's CAP 659, in comparison, provides that:

- Once the flight test programme has been completed and the CAA's Test Pilot has accepted your flight test results, the Design Surveyor needs to be informed so that he can finalise any design approvals outstanding for your aircraft. He will also liaise with our Test Pilot to ensure that your flight manual is acceptable to us.

- When the Design Surveyor has completed and issued any outstanding design approvals and the flight manual has been approved, the RO Surveyor will issue the full Permit to Fly[67] for your aircraft

In addition to the guidance provided by FAA AC 90-89A, the EAA, many kit manufacturers, and type clubs also provide guidance and training directed toward the

[66] Title 14 CFR 91.319(b) prescribes operating limitations of aircraft having experimental airworthiness certificates. The FAA may authorize changes to the operating limitations of 14 CFR 91.319 through special operating limitations issued to an individual aircraft.

[67] Comparable to the authorization provided by the U.S. Phase II operating limitations.

development and conduct of a flight test plan and the preparation of an aircraft flight manual. One of EAA's Sport Aviation Workshops, for example, is a two-day course titled *Test Flying & Developing Pilot Operating Handbook*.[68] FAA AC 90-89A advises builders that:

> It is imperative a flight manual describing the anticipated performance of the aircraft be written by the aircraft builder/kit manufacturer. The manual will be revised several times during the flight test phase until it accurately reports the aircraft's performance.

The NTSB concludes that because no mechanism, other than the builder's self-certification, currently exists to ensure that the aircraft has been adequately tested and determined to be safe to fly within the aircraft's flight envelope or that the flight test data is used to develop an accurate and complete aircraft flight manual and to establish emergency procedures, it is likely that these flight test objectives are not achieved for some E-AB aircraft.

The NTSB further concludes that the risk of E-AB aircraft accidents could be reduced by verifying that all E-AB aircraft are adequately tested according to a flight test plan, and that the resulting test data are used to create an accurate and complete aircraft flight manual. Therefore, the NTSB recommends that the FAA revise Order 8130.2G, and related guidance or regulations, as necessary, to require the review and acceptance of the completed test plan documents and aircraft flight manual (or its equivalent) that documents the aircraft's performance data and operating envelope, and that establishes emergency procedures, prior to the issuance of Phase II operating limitations.

5.3.7 Use of Recorded Data for Phase I Flight Testing and Continued Airworthiness

FAA AC 90-89A describes, in general terms, the tests to be performed to explore the aircraft's flight envelope but does not prescribe specific parameters to be measured or data to be collected. Since FAA AC 90-89A was published on May 24, 1995, a number of technological improvements to such data collection have been introduced. Citing these data recording capabilities in its 2010 safety study of the introduction of glass cockpit avionics into light aircraft,[69] the NTSB concluded, "Some glass cockpit displays include recording capabilities that have significantly benefited accident investigations and that provide the general aviation community with the ability to improve equipment reliability and the safety and efficiency of aircraft operations through data analyses."

Similarly, a number of manufacturers make electronic flight information systems and primary flight displays that provide capable and sophisticated electronic recording of aerodynamic and engine parameters that can greatly facilitate the collection of data needed to carefully map the E-AB aircraft's flight envelope and performance characteristics. Glass cockpit avionics were reported by 16 percent of EAA survey respondents who had bought used aircraft, 35 percent of respondents who had finished their E-AB aircraft, and 58 percent of respondents

[68] http://www.sportair.com/schedule.html.

[69] National Transportation Safety Board. 2010. *Introduction of Glass Cockpit Avionics into Light Aircraft.* Safety Study NTSB/SS-10/01. Washington, DC. Available: <http://www.ntsb.gov/doclib/safetystudies/SS1001.pdf>.

who were in the process of building their aircraft. Among the 2011 accident aircraft, 34 percent of the built-by-owner aircraft were equipped with glass cockpit instruments compared with 14 percent of the bought-used accident aircraft.

Van's Aircraft, for example, publishes a flight test data template and sample flight test data for RV-12 on their website, based on the data-recording capabilities of the Dynon EFIS systems that are included with this kit. The NTSB concludes that data obtained from glass cockpit avionics, electronic flight instruments, or other recording devices can significantly enhance the efficient accomplishment of flight test objectives, as well as the monitoring of parameters important to the continuing airworthiness of the E-AB aircraft, provided that they are demonstrated to be precise and reliable, record at sufficiently high sampling rates, and are easily downloaded by the aircraft owner. Therefore, the NTSB recommends that the FAA revise AC 90-89A, *Amateur-Built Aircraft and Ultralight Flight Testing Handbook*, to include guidance for the use of recorded flight data for the purposes of flight testing and maintaining continued airworthiness of experimental aircraft. The NTSB further recommends that once developed, the FAA revise Order 8130.2G, and related guidance or regulations, as necessary, to include provisions for the use of electronic data recordings from electronic flight displays, engine instruments, or other recording devices in support of Phase I flight testing of E-AB aircraft to document the aircraft performance data and operating envelope and develop an accurate and complete aircraft flight manual.

The NTSB also recommends that the EAA work with its membership, aircraft kit manufacturers, and avionics manufacturers to develop standards for the recording of data in electronic flight displays, engine instruments, or other recording devices to be used in support of flight tests or continued airworthiness of E-AB aircraft.

5.4 Training and Information to Prevent Loss of Control in Flight

As previously noted, the largest proportion of fatal E-AB aircraft accidents has historically involved loss of aircraft control in flight. The study identified several opportunities to reduce loss of control accidents by improving pilots' access to training prior to flying an E-AB aircraft, and ensuring that pilots have the performance information necessary to safely operate their E-AB aircraft.

5.4.1 Transition Training

The FAA and the EAA, as well as several E-AB aircraft kit manufacturers and aircraft type clubs, strongly encourage specific training for pilots transitioning to E-AB aircraft and provide information and resources to support this training. Transition training is needed to prepare E-AB aircraft pilots for the unique handling characteristics of their aircraft. According to the EAA, the network of advisors comprising its Flight Advisor program, [70]

> …helps with everything from finding the right instructor and planning a first flight to determining the types of additional training needed. More than 500 flight

[70] http://www.eaa.org/flightadvisors/.

advisors council members considering purchasing an aircraft, preparing for flight in a newly built or restored aircraft, or looking to transition to a high performance or unfamiliar aircraft.

In the summer of 2011, representatives of the EAA, pilot groups, and owner type clubs announced the intention to form a coalition to improve safety. One of the planned efforts is to specifically seek out pilots transitioning to new aircraft to notify them of model-specific safety information and how to obtain transition training.[71]

In March 2011, the FAA also published AC 90-109, *Airmen Transition to Experimental or Unfamiliar Airplanes*, to be used as a guide for pilots flying an aircraft for the first time, with an emphasis on amateur-built experimental aircraft. Analysis of responses to the EAA survey of E-AB aircraft owners and builders indicates that 1,499 (58 percent) of the 2,583 respondents who built their E-AB aircraft and who answered the question reported some type of transition training prior to their first flight. In contrast, NTSB investigators found evidence of a transition training requirement—typically from an aircraft insurance company—for only 19 (8 percent) of the 227 pilots of E-AB accident aircraft investigated in 2011. While the lack of evidence for transition training or an insurance training requirement on the basis of accident investigation records may underestimate the actual incidence of such training (particularly for fatal accidents where the pilot could not be interviewed), the reported proportion is strikingly low. The NTSB concludes that the difference between the EAA survey respondents and the 2011 accident pilots suggests that pilots who did not seek training were overrepresented in the accidents, and that E-AB aircraft accidents involving of loss of aircraft control could be reduced if more pilots received transition training.

5.4.2 Barriers to E-AB Aircraft Transition Training

During focus group discussions with NTSB investigators during EAA AirVenture 2011, members of the EAA Builder's Council stressed the importance of transition training for any pilot transitioning from one type of aircraft to another. They noted that this is particularly true of E-AB aircraft, which frequently have different handling characteristics than the type-certificated aircraft with which pilots may be familiar.[72] Members of the Builder's Council referenced regulations regarding the use of experimental aircraft that limit pilot's access to transition training. Specifically, they referred to limitations in 14 CFR 91.319, which states:

> (a) No person may operate an aircraft that has an experimental certificate—(1) For other than the purpose for which the certificate was issued; or (2) Carrying persons or property for compensation or hire.

As referenced in that limitation, 14 CFR 21.191 states that experimental certificates are issued for the following purposes:

[71] http://www.airventure.org/news/2011/110729_type_clubs.html.

[72] The need for focused transition training was the object of recommendations A-99-007 and A-99-009, which were issued in 1999, and classified "Closed—Acceptable Action" in 2000 and 2001 respectively. These recommendations resulted from the NTSB investigation (LAX98FA008) of an accident on October 12, 1997, near Pacific Grove, California, involving an experimental amateur-built Adrian Davis Long-EZ. The aircraft was piloted by singer John Denver, who was fatally injured as a result of the accident.

- Research and development.
- Showing compliance with regulations.
- Crew training.
- Exhibition.
- Air racing.
- Market surveys.
- Operating amateur-built aircraft.
- Operating primary kit-built aircraft.
- Operating light-sport aircraft (LSA).

Guidance to FAA inspectors in FAA Order 8900.1[73] explicitly states that the term "crew training" in section 21.191 does not permit for-hire pilot flight training. The inspector guidance in FAA Order 8900.1 further states:

> **Use of Experimental Aircraft for Flight Training.** Persons may receive, and provide compensation for, flight training in an aircraft holding an experimental certificate issued for any of the purposes specified in section 21.191. Other than the person receiving flight training, the operation must not involve the carriage of persons or property for compensation or hire or be prohibited by the aircraft's operating limitations.
>
> **Flight Instructors.** Flight instructors may receive compensation for providing flight training in an experimental aircraft, but may not receive compensation for the use of the aircraft in which they provide that flight training unless in accordance with a LODA issued under section 91.319(h) and as described in paragraph 3-293. An experimental aircraft owner may not rent an experimental LSA to a person for the purpose of conducting solo flight.
>
> **Experimental Aircraft Owners.** Owners of experimental aircraft may receive, and provide compensation for, flight training received in their aircraft. An owner of an experimental aircraft may not receive compensation for the use of their aircraft to provide flight training except in accordance with a LODA issued under [section] 91.319(h) and described in paragraph 3-293. An owner of an experimental LSA may not rent the experimental LSA to a person for the purpose of conducting solo flights.

[73] FAA Order 8900.1, Flight Standards Information Management System (FSIMS) CHG 155, May 24, 2011, Use of Aircraft Issued Experimental Certificates in Flight Training for Compensation or Hire, http://fsims.faa.gov/wdocs/8900.1/v03%20tech%20admin/chapter%2011/03_011_001.pdf.

The LODA mentioned in this section is referencing a Letter of Deviation Authority. Title 14 CFR 91.319(h) permits the FAA to issue a LODA to an applicant for the purpose of conducting flight training. A LODA permits the holder to provide flight training for compensation in an experimental aircraft which the holder provides. Based on discussions with members of the EAA Builder's Council, E-AB aircraft builders, kit manufacturers and type club representatives, the NTSB concludes that the guidance currently available to qualified E-AB aircraft owner/instructors to obtain a LODA to conduct flight training is deficient and variable from one FAA region to another. Based on discussions, the NTSB concludes that the difficulty of finding suitable E-AB aircraft and instructors available for training presents a barrier to pilots seeking transition training. Therefore, the NTSB recommends that the FAA develop and publish an advisory circular, or similar guidance, for the issuance of a LODA to conduct flight instruction in an experimental aircraft, to include sample documentation and sample training materials. The NTSB also recommends that the EAA create and publish a repository of voluntarily provided information regarding holders of LODAs to conduct flight instruction in experimental aircraft.

The NTSB acknowledges that the development of guidance materials and related regulatory actions will likely require considerable time. However, voluntary efforts such as the planned creation of a coalition of kit manufacturers could assist in the promotion of transition training in the interim. Therefore, the NTSB recommends to the FAA and the EAA that they complete planned action[74] to create a coalition of kit manufacturers, type clubs, and pilot and owner groups and (1) develop transition training resources and (2) identify and apply incentives to encourage both builders of E-AB aircraft and purchasers of used E-AB aircraft to complete the training that is developed.

5.4.3 Providing Information to Purchasers of Used E-AB Aircraft

On August 25, 2011, at 1856 eastern daylight time, a Nichols model Lancair 235 airplane, N777BN, was substantially damaged when it impacted trees and terrain during initial climb from Newark-Heath Airport, Heath, Ohio. The pilot was fatally injured. The airplane was registered to and operated by a private pilot, under the provisions of 14 CFR Part 91. Daytime visual meteorological conditions prevailed for the flight, which was operated without a flight plan. The local flight was originating at the time of the accident.

A witness stated that the airplane appeared to be "very unstable" after it became airborne, alternately rolling right and left while remaining only a few feet above the runway. The witness noted that he did not believe the pilot had control of the airplane. The airplane then turned left and proceeded off the runway directly toward the witness's position. The witness noted that the airplane continued to fly erratically, with continuous pitch, yaw, and roll changes, and cleared a row of hangars by approximately 10 feet. The airplane continued in a climb to 100–150 feet above the ground before it banked sharply to the left and entered a nose-down descent into trees.

[74] http://www.airventure.org/news/2011/110729_type_clubs.html.

The experimental amateur-built airplane had accumulated 1,131 hours since being issued an airworthiness certificate on August 10, 1990. The pilot reportedly had not flown the airplane since he purchased it from the original builder on September 14, 2010.[75]

In FAA AC 90-109, regarding pilots transitioning to unfamiliar aircraft, the FAA states:

> Current accident analysis indicates that subsequent owners and/or pilots of experimental airplanes, during initial flight time, have a higher accident rate than that of the original owner/pilot. Therefore, the recommendation is that the subsequent owners/pilots of experimental airplanes receive airplane-specific training before operating the airplane.

Fifty-five percent (125 of 227) of the 2011 accident aircraft had been bought used, but it was not possible, on the basis of available data, to determine if the risk was higher for this group than for the original builders of E-AB aircraft. FAA AC 90-109 goes on to state:

> The new buyer of an experimental airplane may not fully understand the challenges of transitioning to a new airplane, particularly one which has characteristics outside his or her previous aviation experience.

The NTSB concludes that purchasers of used E-AB aircraft face particular challenges in transitioning to the unfamiliar E-AB aircraft. Like builders of new E-AB aircraft, they must learn to manage the unique handling characteristics of their aircraft, but they must also learn the systems, structure, and equipment without the firsthand knowledge afforded to the builder. In this regard, FAA AC 90-109 states that, to become familiar and competent in the new airplane, pilots should follow an organized methodology that includes the systems, procedures, performance, and limitations applicable to their aircraft. However, this guidance includes a caution that:

> Even in simple airplanes of a similar design or even the same model, the innovation of individual designers and builders may cause problems for a pilot new to the airplane.

Pilots of type-certificated aircraft have access to the applicable aircraft and systems information in the *Pilot's Operating Handbook* developed by the airplane manufacturer, which contains the FAA-approved aircraft flight manual. However, unless the original builder of an E-AB aircraft creates similar materials during the course of aircraft flight testing, a subsequent owner may not have the detailed aircraft information necessary to support safe operation during transition to the aircraft and subsequent operation of the aircraft. The NTSB concludes that accident case studies included in this report indicate that not all builders of E-AB aircraft create a detailed aircraft flight manual during Phase I flight testing.

For example, on March 29, 2011, about 1630 eastern daylight time, an experimental amateur-built Hrosik Aventura II, N5842, was substantially damaged during a collision with terrain after takeoff from Thunderbird Air Park, Crescent City, Florida. The certificated sport

[75] NTSB investigation case number CEN11FA597.

pilot sustained a minor injury. In a written statement, the pilot said the purpose of the flight was to position the amphibious airplane at the Sun 'n Fun Fly-In so that it could be offered for auction. According to the FAA inspector, there was no checklist for the airplane, no placarded V-speeds in the cockpit, and no color-coded airspeed range markings on the airspeed indicator.[76] As discussed earlier in this chapter, the development of a detailed aircraft flight manual is an intended product of E-AB aircraft flight testing. The NTSB concludes that absent an appropriate aircraft flight manual, purchasers of used E-AB aircraft are not provided with sufficient information to understand the aircraft's controllability throughout all maneuvers, to detect any hazardous operating characteristics, or to understand emergency procedures.

Therefore, the NTSB recommends that the FAA revise 14 *Code of Federal Regulations* 47.31 and related guidance or regulations, as necessary, to require the review and acceptance of aircraft operating limitations and supporting documentation as a condition of registration or re-registration of an experimental amateur-built aircraft. The NTSB also recommends that the FAA revise Order 8130.2G, and related guidance or regulations, as necessary, to include provisions for modifying the operating limitations of aircraft previously certificated as experimental, operating amateur-built, such as returning the aircraft to Phase I flight testing, as necessary, to address identified safety concerns or to correct deficiencies in the aircraft flight manual or equivalent documents.

5.5 Accurate Identification of Amateur-Built Aircraft

Finally, the study found problems related to the accurate identification of amateur-built aircraft, and the aircraft make and model, that currently make effective E-AB aircraft safety oversight difficult. Section 501(a) of the Federal Aviation Act of 1958, as amended, codified at section 44102(b) of title 49, *United States Code*, requires registration as a condition to the operation of any applicable aircraft, and this Statutory requirement is implemented by the 14 CFR Parts 47 and 49 that include regulations for aircraft registration and related documentation.

Title 14 CFR 49.11 establishes the FAA Aircraft Registry as the official custodian of U.S. aviation aircraft records. The FAA Flight Standards Service, Civil Aviation Registry, Aircraft Registration Branch is responsible for the review, evaluation, and development of any new or amended regulations pertaining to aircraft registration and recording of documents contained in 14 CFR Parts 47 and 49. The registry provides information to FAA Aviation Safety Inspectors and NTSB investigators to support aviation safety activities and provides statistics for aviation safety analyses. Registry records are also a source of aircraft owner contact information to publicize aircraft- or fleet-specific safety programs or safety concerns.[77]

The registry maintains a publicly available database containing fields identifying each U.S. registered aircraft by its current registration number, its unique airframe serial number, and characteristics like category and engine type. Aircraft type is identified in the registry with the combination of two fields, aircraft manufacturer and aircraft model, and the FAA uses the

[76] NTSB investigation case number ERA11LA228.

[77] http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afs/afs700/reg_responsibilities/.

combination of these details to assign a manufacturer-model code that is also recorded in the registry. For type-certificated aircraft, the manufacturer field identifies the aircraft builder and the model field indicates the model and series. For example, the Registry database fields for a common type-certificated light aircraft would be *Cessna Aircraft Company* for the manufacturer and *172S* for the model.

When registering a new E-AB aircraft, the aircraft owner/builder must submit:

- An *Affidavit of Ownership for Experimental Aircraft*, AC Form 8050-88,[78] establishing ownership and the formal description of the aircraft. The model name and serial number provided on this form by the builder, along with the builder's name, becomes the official aircraft description.
- An Aircraft Registration Application, AC Form 8050-1,[79] containing the same aircraft description provided on the affidavit.
- And, if more than 50 percent of your amateur-built aircraft was built from a kit, the owner must also include a kit bill of sale from the kit manufacturer.

Unlike a type-certificated aircraft, when a builder registers an amateur-built aircraft he or she is free to choose a manufacturer and model name to identify their aircraft regardless of the aircraft design. For example, the builder of an experimental amateur-built kit, such as a Van's Aircraft RV-9 kit, may register the aircraft as *John Doe* for the manufacturer and *Model 1* for the model. The design of the original kit would not be identifiable from the registry database record, even though the kit bill of sale is required to be submitted during registration and is retained in the registry's records. As discussed in chapter 3 and appendix C of this report, incorrect identification of E-AB aircraft in NTSB accident records has affected the tracking and analysis of E-AB aircraft safety issues and the problem has increased since the introduction of the Special Light-Sport and Experimental Light-Sport certification categories.

The ability to accurately identify E-AB aircraft built from a kit or from plans of a recognized design would be greatly improved if the FAA Civil Aircraft Registry database were modified to capture aircraft manufacturer, make, and model.[80] Although the terms are often used interchangeably, manufacturer and make are not synonymous. With regard to aircraft, "make" identifies an aircraft design and "manufacturer" identifies the entity that constructs an aircraft. As applied to the previous example, the addition of make information would allow identification of the previous example *John Doe Model 1* as being a Van's Aircraft kit.

The addition of aircraft make information to the FAA Civil Aircraft Registry database would also improve the identification of type-certificated aircraft that are produced by more than one manufacturer. The CAST/ICAO Common Taxonomy Team (CICTT) has developed

[78] http://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/media/8050-88.pdf.

[79] http://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/faa_customer_service_forms/##ACForm8050-1.

[80] The NTSB identified similar concerns regarding identification of E-AB aircraft kits owners in its August 29, 1997, Safety Recommendation letter to the FAA (A-97-53, "Closed—Acceptable Action," December 1998).

business rules for the identification of aircraft. The CICTT aircraft make/model/series taxonomy has been included in the ECCAIRS[81] software suite used by ICAO and aviation safety authorities worldwide to manage safety data and is used to identify aircraft in the International Registry of Mobile Assets.[82]

The inability to identify the aircraft design in the FAA Civil Aircraft Registry limits the ability to conduct safety analyses and hampers notification of aircraft owners in the event that an aircraft- or engine-specific issue is ever identified. The NTSB concludes that accurate identification of experimental amateur-built aircraft would greatly improve the ability to assess the continued safety of experimental aircraft and identify design-specific safety issues. Therefore, the NTSB recommends that the FAA revise the Civil Aircraft Registry database to include a means of identifying aircraft manufacturer, make, model, and series—such as the aircraft make, model, and series classification developed by the CAST/ICAO Common Taxonomy Team—that unambiguously identifies the aircraft kit or plans design as well as the builder of the aircraft.

[81] European Coordination Centre for Accident and Incident Reporting Systems (ECCAIRS) is a cooperative network of international Transport Authorities and Accident Investigation Bodies. The project is being managed by the Joint Research Centre (JRC) of the European Commission. The ECCAIRS Reporting System, developed by the JRC, is a software suite used for reporting, analysis, and sharing of safety data. For additional information, see: http://eccairsportal.jrc.ec.europa.eu/.

[82] The International Registry operates under the legal framework of the Cape Town Convention and the Aircraft Protocol adopted on the 16th of November 2001 at Cape Town. It provides for the registration and protection of 'international interests' that are recognized by all ratifying states, of which the United States of America is included. Aircraft and aircraft engines eligible for International Registry recording include airframes that are type certificated to transport at least eight persons including crew or goods in excess of 2,750 kilograms (6,050 pounds); helicopters that are type certificated to transport at least five persons including crew or goods in excess of 450 kilograms (990 pounds); jet propulsion aircraft engines with at least 1,750 pounds of thrust or its equivalent; and turbine-powered or Piston-powered aircraft engines with at least 550 rated take-off horsepower or its equivalent. For more information see: http://www.internationalregistry.aero.

6. Conclusions

Experimental amateur-built aircraft represents a growing segment of the United States' general aviation fleet. A review of the accident record indicates that E-AB aircraft account for a disproportionate number of total accidents, and an even more disproportionate share of fatal accidents when compared to similar non-E-AB aircraft conducting similar flight operations. By conducting a comprehensive review of E-AB aircraft safety, using a variety of information sources, this study was able to characterize the aircraft, builder, and pilot populations; assess safety resources and management; and identify areas for recommended improvement.

The airworthiness certification and maintenance of E-AB aircraft are managed according to a different regulatory and policy framework than non-E-AB aircraft. The experimental nature of amateur-built aircraft is evident in the wide range of powerplants, equipment, and design features found in these aircraft. Accident analyses indicate that powerplant failures and loss of control in flight are the most common accident occurrences by a large margin, and that accident occurrences are similar for both new and used aircraft. However, it is notable that structural failures have not been a common occurrence among E-AB aircraft. Accidents involving equipment failures or build problems are instead frequently associated with unique decisions made by an individual owner or builder. The majority of new E-AB aircraft are now built from commercial kits, a fact that has likely contributed to an overall improvement in the design and construction of E-AB aircraft. Kit manufacturers also represent a potential source of valuable construction, flight testing, operation, and maintenance information.

The community of E-AB aircraft builders and owners is actively involved in their own safety oversight and management. Builder groups, aircraft type clubs, kit manufacturers, and industry associations provide a wealth of training and guidance materials to pilots and builders. The FAA has also published guidance materials to assist builders, to promote thorough flight testing of E-AB aircraft, and to encourage pilots to seek necessary transition training. Pilots of E-AB aircraft, whether involved in accidents or not, have similar, or higher, levels of total aviation experience than pilots of non-E-AB aircraft engaged in similar general aviation operations. However, pilots of E-AB aircraft, on average, had significantly less flight experience in the type of aircraft they were flying. The difference in type-specific experience is likely due to the uniqueness of the aircraft they are flying. The prevalence of accidents involving E-AB aircraft very early in their operational life, or after being purchased by a new owner, highlights the need for training and information to safely operate these unique aircraft.

6.1 Findings

1. The risk of E-AB aircraft accidents could be reduced by verifying that all E-AB aircraft are adequately tested according to a flight test plan, and that the resulting test data are used to create an accurate and complete aircraft flight manual.

2. Data obtained from glass cockpit avionics, electronic flight instruments, or other recording devices can significantly enhance the efficient accomplishment of flight test objectives, as well as the monitoring of parameters important to the continuing airworthiness of the E-AB aircraft, provided that they are demonstrated to be precise and reliable, record at sufficiently high sampling rates, and are easily downloaded by the aircraft owner.

3. A functional test of the aircraft fuel system could identify design deficiencies, leaks, and malfunctions prior to flight that would prevent fuel system- and powerplant-related accidents early in the operational life of an aircraft.

4. Accident case studies included in this report indicate that not all builders of E-AB aircraft create a detailed aircraft flight manual during Phase I flight testing.

5. Absent a review and assessment by the FAA, the adequacy of the flight test program stipulated in Order 8130.2G cannot be ascertained or ensured.

6. The Phase I flight test period is uniquely challenging for most pilots because they must learn to manage the handling characteristics of an unfamiliar aircraft while also managing the challenges of the flight test environment, including instrumentation that is not yet calibrated, controls that may need adjustment, and possible malfunctions or adverse handling characteristics.

7. The E-AB aircraft safety record could be improved by providing pilots with additional training resources to safely perform Phase I test pilot functions.

8. The safety of E-AB aircraft flight testing could be improved for some pilots and flight test circumstances if a qualified second pilot was authorized to accompany the pilot for the purpose of flight testing and not training.

9. Because no mechanism, other than the builder's self-certification, currently exists to ensure that the aircraft has been adequately tested and determined to be safe to fly within the aircraft's flight envelope or that the flight test data is used to develop an accurate and complete aircraft flight manual and to establish emergency procedures, it is likely that these flight test objectives are not achieved for some E-AB aircraft.

10. The difference between the EAA survey respondents and the 2011 accident pilots suggests that pilots who did not seek training were overrepresented in the accidents, and that E-AB aircraft accidents involving loss of aircraft control could be reduced if more pilots received transition training.

11. The difficulty of finding suitable E-AB aircraft and instructors available for training presents a barrier to pilots seeking transition training.

12. The FAA guidance currently available to qualified E-AB aircraft owner/instructors to obtain a Letter of Deviation Authority to conduct flight training is deficient and variable from one FAA region to another.

13. Purchasers of used E-AB aircraft face particular challenges in transitioning to the unfamiliar E-AB aircraft. Like builders of new E-AB aircraft, they must learn to manage the unique handling characteristics of their aircraft and learn the systems, structure, and equipment, but without the firsthand knowledge afforded to the builder.

14. Transfers of ownership, and thus responsibility for the completion of flight test requirements during Phase I, do not ensure an opportunity for FAA review and acceptance of the continuing appropriateness of Phase I operating limitations and requirements for the new owner of the aircraft.

15. Absent an appropriate aircraft flight manual, purchasers of used E-AB aircraft are not provided with sufficient information to understand the aircraft's controllability throughout all maneuvers, to detect any hazardous operating characteristics, or to understand emergency procedures.

16. Accurate identification of experimental amateur-built aircraft would greatly improve the ability to assess the continued safety of experimental aircraft and identify design-specific safety issues.

7. Recommendations

As a result of its safety study, the National Transportation Safety Board makes the following recommendations:

To the Federal Aviation Administration:

Revise 14 *Code of Federal Regulations* 21.193, Federal Aviation Administration Order 8130.2G, and related guidance or regulations, as necessary, to define aircraft fuel system functional test procedures and require applicants for an airworthiness certificate for a powered experimental, operating amateur-built aircraft to conduct that test and submit a report of the results for Federal Aviation Administration acceptance. (A-12-28)

Revise 14 *Code of Federal Regulations* 21.193, Federal Aviation Administration Order 8130.2G, and related guidance or regulations, as necessary, to require applicants for an airworthiness certificate for experimental, operating amateur-built aircraft to submit for Federal Aviation Administration acceptance a flight test plan that will (1) ensure the aircraft has been adequately tested and has been determined to be safe to fly within the aircraft's flight envelope and (2) produce flight test data to develop an accurate and complete aircraft flight manual and to establish emergency procedures and make a copy of this flight test plan part of the aircraft's certification file. (A-12-29)

Identify and apply incentives to encourage owners, builders, and pilots of experimental amateur-built aircraft to complete flight test training, such as that available in the Experimental Aircraft Association's *Test Flying and Developing Pilot Operating Handbook*, prior to conducting flight tests of experimental amateur-built aircraft. (A-12-30)

Revise Federal Aviation Administration Order 8130.2G, and related guidance or regulations, as necessary, to clarify those circumstances in which a second qualified pilot could be authorized to assist in the performance of flight tests when specified in the flight test plan and Phase I operating limitations. (A-12-31)

Revise Federal Aviation Administration Order 8130.2G, and related guidance or regulations, as necessary, to require the review and acceptance of the completed test plan documents and aircraft flight manual (or its equivalent) that documents the aircraft's performance data and operating envelope, and that establishes emergency procedures, prior to the issuance of Phase II operating limitations. (A-12-32)

Revise Federal Aviation Administration Advisory Circular 90-89A, *Amateur-Built Aircraft and Ultralight Flight Testing Handbook*, to include guidance for the use of recorded flight data for the purposes of flight testing and maintaining continued airworthiness of experimental aircraft. (A-12-33)

Revise Federal Aviation Administration Order 8130.2G, and related guidance or regulations, as necessary, to include provisions for the use of electronic data recordings from electronic flight displays, engine instruments, or other recording devices in support of Phase I flight testing of experimental amateur-built aircraft to document the aircraft performance data and operating envelope and develop an accurate and complete aircraft flight manual. (A-12-34)

Develop and publish an advisory circular, or similar guidance, for the issuance of a Letter of Deviation Authority to conduct flight instruction in an experimental aircraft, to include sample documentation and sample training materials. (A-12-35)

Complete planned action to create a coalition of kit manufacturers, type clubs, and pilot and owner groups and (1) develop transition training resources and (2) identify and apply incentives to encourage both builders of experimental amateur-built aircraft and purchasers of used experimental amateur-built aircraft to complete the training that is developed. (A-12-36)

Revise 14 *Code of Federal Regulations* 47.31 and related guidance or regulations, as necessary, to require the review and acceptance of aircraft operating limitations and supporting documentation as a condition of registration or re-registration of an experimental amateur-built aircraft. (A-12-37)

Revise Federal Aviation Administration Order 8130.2G, and related guidance or regulations, as necessary, to include provisions for modifying the operating limitations of aircraft previously certificated as experimental, operating amateur-built, such as returning the aircraft to Phase I flight testing, as necessary, to address identified safety concerns or to correct deficiencies in the aircraft flight manual or equivalent documents. (A-12-38)

Revise the Civil Aircraft Registry database to include a means of identifying aircraft manufacturer, make, model, and series—such as the aircraft make, model, and series classification developed by the CAST/ICAO Common Taxonomy Team—that unambiguously identifies the aircraft kit or plans design as well as the builder of the aircraft. (A-12-39)

To the Experimental Aircraft Association:

Identify and apply incentives to encourage owners, builders, and pilots of experimental amateur-built aircraft to complete flight test training, such as that available in the Experimental Aircraft Association's *Test Flying and Developing Pilot Operating Handbook*, prior to conducting flight tests of experimental amateur-built aircraft. (A-12-40)

Work with your membership, aircraft kit manufacturers, and avionics manufacturers to develop standards for the recording of data in electronic flight displays, engine instruments, or other recording devices to be used in support of flight tests or continued airworthiness of experimental amateur-built aircraft. (A-12-41)

Create and publish a repository of voluntarily provided information regarding holders of Letters of Deviation Authority to conduct flight instruction in experimental aircraft. (A-12-42)

Complete planned action to create a coalition of kit manufacturers, type clubs, and pilot and owner groups and (1) develop transition training resources and (2) identify and apply incentives to encourage both builders of experimental amateur-built aircraft and purchasers of used experimental amateur-built aircraft to complete the training that is developed. (A-12-43)

Appendix A: NTSB Aviation Accident Data Validation

NTSB staff reviewed records in the NTSB Aviation Accident Database[83] to verify the aircraft airworthiness classification information relative to "Experimental – Amateur-Built." The NTSB Aviation Accident Database currently includes data fields to record aircraft airworthiness certificate type and category, such as "Standard – Normal" or "Special – Experimental." However, the airworthiness data field does not include the additional level of detail necessary to distinguish between "Special – Experimental – Amateur-Built" and other categories of Experimental certificates such as "Exhibition", "Air Racing", or "Research and Development." An additional yes/no field in the NTSB database, titled "Homebuilt," has historically been used to identify amateur-built accident aircraft.

Although the field is intended to readily identify amateur-built aircraft, a summary review of NTSB database records reveals numerous cases in which the homebuilt field value was reported as "yes" for aircraft with a special airworthiness certificate, but not in the amateur-built category. Errors and misapplications of the homebuilt code lead to an inaccurate assessment of the accident risk for amateur-built aircraft. In coordination with the FAA and the EAA, the NTSB used to the following methodology to validate the homebuilt yes/no data in the NTSB Aviation Accident Database records.

- NTSB accident records from 2001 through 2010 were matched with archived, historic FAA aircraft registry records[84] using aircraft registration, serial number, make, and model information, as available.
- Aircraft airworthiness certificate data and the homebuilt yes/no field in the NTSB database were compared with the manufacturer model code[85] and airworthiness certificate data in the FAA aircraft registry database to identify inconsistent data elements in either system.
- Copies of the original aircraft airworthiness and registration documents were used to validate the amateur-built status of those aircraft with missing or inconsistent FAA registry and/or NTSB accident database records.

[83] The NTSB maintains a database for the storage, retrieval, and management of information associated with its aviation accident/incident investigations. The NTSB Aviation Accident Database is comprised of 15 data tables, with approximately 350 data fields. The database currently contains approximately 70,000 cases, and approximately 2,000 new cases are generated each year.

[84] The FAA aircraft registry database contains the records of all U.S. civil aircraft maintained by the FAA, Civil Aviation Registry, Aircraft Registration Branch, AFS-750. The aircraft registry database is available for public download from the FAA website at: http://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/releasable_aircraft_download/.

[85] The FAA assigns a seven-digit code to each aircraft at the time of registration to identify the aircraft manufacturer, model, and series. The first three characters correspond to the manufacturer, the fourth and fifth characters refer to the model, and the sixth and seventh refer to the aircraft series.

This methodology resulted in the verification of 2,077 accident aircraft as E-AB aircraft, changes to indicate that 324 accident aircraft with missing or incorrect records are not E-AB aircraft, and changes to indicate that 46 accident aircraft with missing or incorrect records were, in fact, E-AB aircraft. The airworthiness status of an additional 138 accident aircraft could not be verified because they were unregistered, foreign registered, or did not have the necessary records on file for review.

In sum, the number of accident aircraft identified as E-AB aircraft in the NTSB records from 2001–2010 decreased by 278. However, not all of these cases are included in the United States civil general aviation accident record tabulations[86]. Figure A1 illustrates changes in the annual U.S. civil general aviation accident and fatal accident records from 2001 through 2010 for cases involving E-AB aircraft.

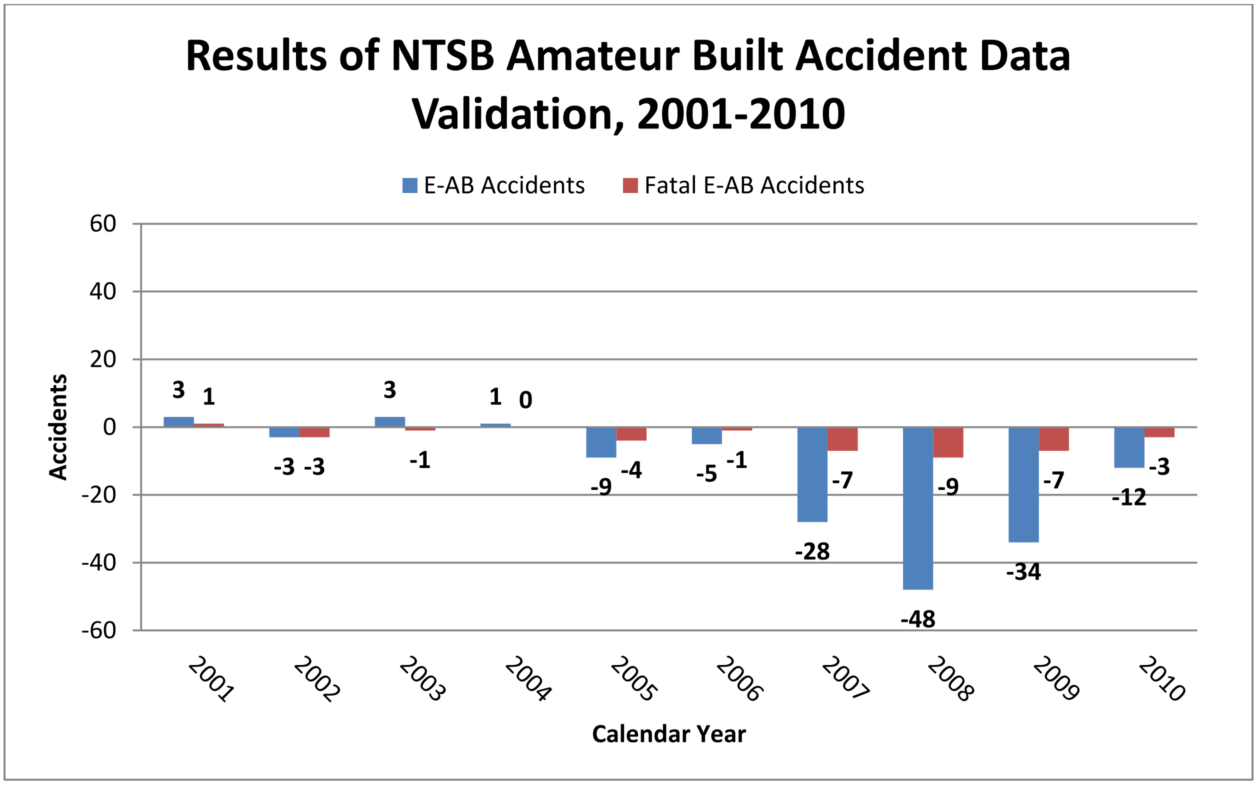


Figure A1. Changes in the annual U.S. civil general aviation accident and fatal accident records for E-AB aircraft, 2001–2010.

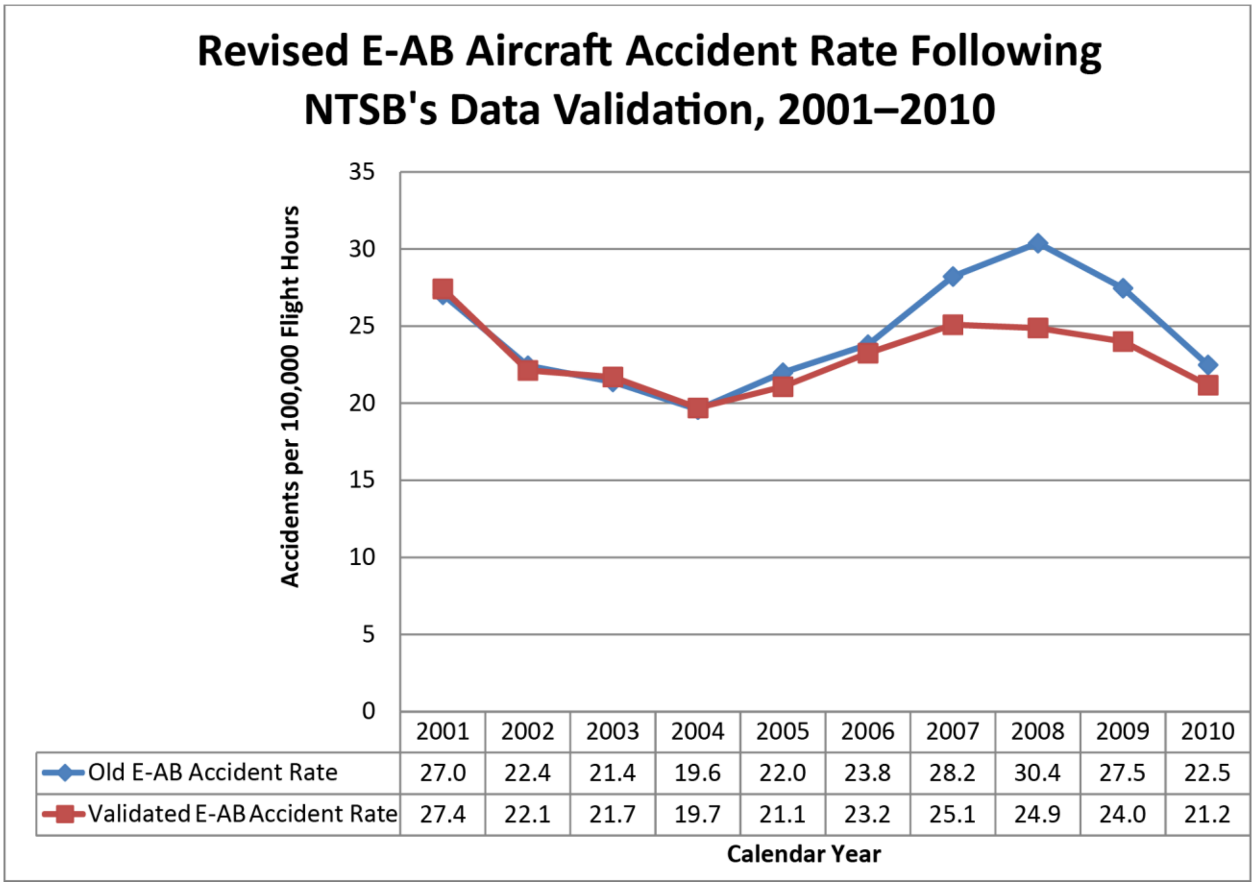
The greatest number of E-AB aircraft data corrections were to accident records spanning 2007 to 2009, suggesting that data errors increased with the introduction of the special light-sport aircraft category of airworthiness certificates in 2005 and the registration of "fat ultralights" and two-seat ultralights previously exempted under a training provision of 14 CFR Part 103[87]. The

[86] U.S. civil aviation accidents, as defined by 49 CFR Part 830.1, include accidents that involve U.S.-registered civil aircraft and certain public aircraft of the United States "wherever they occur." General aviation includes any civil aircraft operation that is not covered by 14 CFR Parts 121 or 135; or by Part 129, which applies to foreign air carriers; or non-U.S. commercial operations.

[87] See http://www.faa.gov/aircraft/gen_av/light_sport/.

special light-sport aircraft (S-LSA) and experimental light-sport aircraft (E-LSA) fleets increased rapidly during this period, and these aircraft were subsequently involved in more accidents. A review of these aircraft-related data errors in the FAA and NTSB databases suggests initial misunderstandings among aircraft owners, inspectors, and investigators about this new aircraft classification. In other cases, identification was made more difficult because some popular aircraft models are available in E-AB, S-LSA, and/or E-LSA versions.

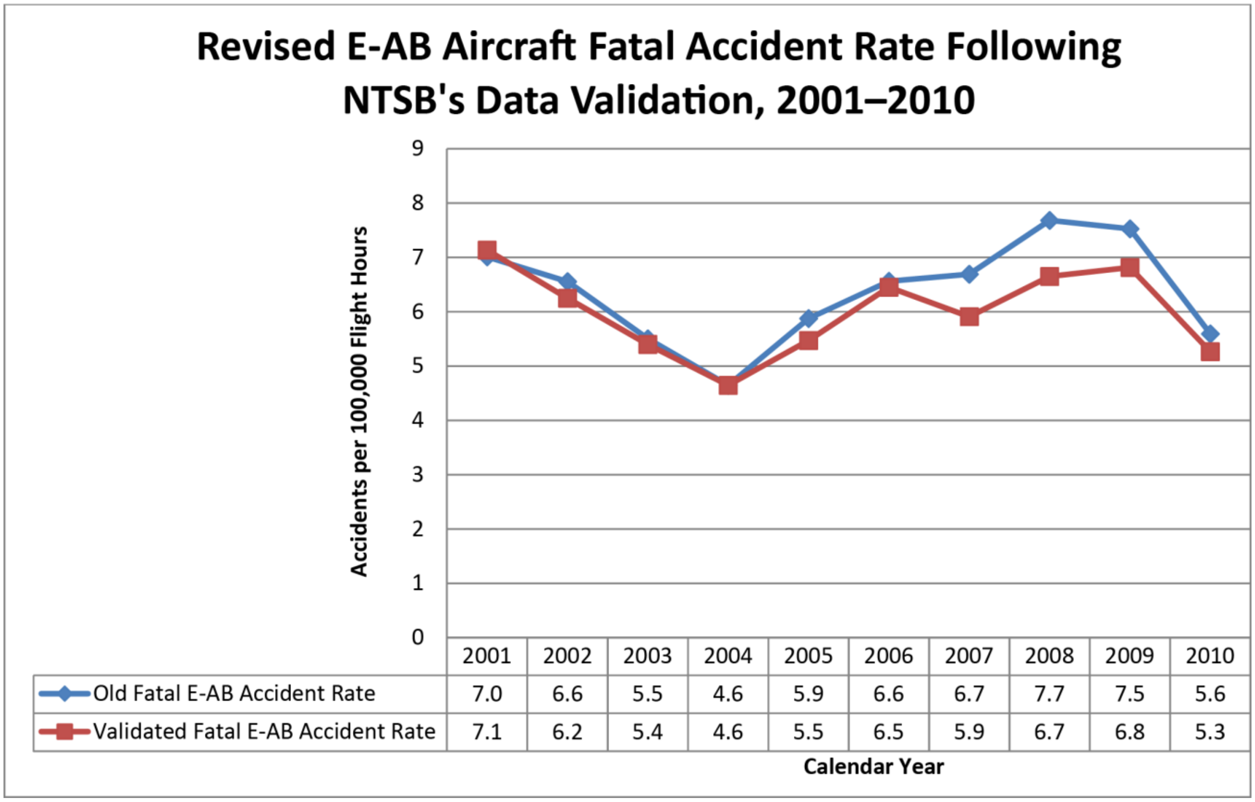
The net reduction in accident E-AB aircraft results in a slight reduction in calculated accident rates when compared with annual FAA estimates of E-AB aircraft flight hours.[88] Figure A2 illustrates the previous and revised U.S. civil general aviation accident rate for E-AB aircraft annually from 2001 through 2010, and Figure A3 shows the E-AB aircraft fatal accident rate.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Old E-AB Accident Rate	27.0	22.4	21.4	19.6	22.0	23.8	28.2	30.4	27.5	22.5
Validated E-AB Accident Rate	27.4	22.1	21.7	19.7	21.1	23.2	25.1	24.9	24.0	21.2

Figure A2. Revised amateur-built aircraft accident rate following NTSB accident data validation, 2001–2010.

[88] Flight activity of general aviation and nonscheduled Part 135 operations is estimated using the annual General Aviation and Part 135 Activity Survey. This voluntary survey is sent to registered aircraft owners. http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/."



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Old Fatal E-AB Accident Rate	7.0	6.6	5.5	4.6	5.9	6.6	6.7	7.7	7.5	5.6
Validated Fatal E-AB Accident Rate	7.1	6.2	5.4	4.6	5.5	6.5	5.9	6.7	6.8	5.3

Figure A3. Revised amateur-built aircraft fatal accident rate following NTSB accident data validation, 2001–2010.

Appendix B: E-AB Aircraft Accident Supplementary Data Form

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EXPERIMENTAL AMATEUR-BUILT (E-AB) AIRCRAFT SAFETY STUDY

[redacted]

General Instructions

1. Fields marked with a single asterisk are required fields. Fields marked with two asterisks are fields that are required as able through launches. If you launched on this accident and are able, complete these fields.
2. See page 6 for detailed instructions to several fields.
3. If you have any questions, e-mail [redacted] or call (202) 314-[redacted] or e-mail [redacted] at [redacted] or call (202) 314-[redacted]

A. Basic Accident Information			
1. NTSB Investigator ***(Last Name, First Name)****		**1a. FAA Inspector/Investigator** ***(Last Name, First Name)***	
2. NTSB Accident Number*	**2a. Accident date**	**2b. Accident location**	
B. Aircraft Information			
3. Make: ***(e.g., Vans)****	**4. Model:** ***(e.g., RV-6A)****	**5. Aircraft Category*** ☐Airplane ☐Glider ☐Helicopter ☐Gyroplane ☐Powered parachute ☐Lighter-than-air ☐Weight shift ☐Other (specify)	**6. Airframe hours at time of accident***
7. Was aircraft purchased used ***(e.g., not built by owner)?**** ☐ Yes ☐ No ☐ Unknown		**8. Manner in which the aircraft was built*** ☐Kit-built ☐Plans-built ☐Original design ☐Other (specify)	**8a. Year built**
9. Are you aware of any major modifications made to the kit or design?** ☐ Yes ☐ No ☐ Unknown			
9a. If yes, describe and Attach Photo(s) **, if available****			
10. Has aircraft been in a previous accident? ☐ Yes ☐ No ☐ Unknown			
10a. If yes, what is the NTSB number?			
11. Have service instructions or bulletins related to the airframe been issued? ☐ Yes ☐ No ☐ Unknown			
11a. Was failure to complete the above related to the accident? ☐ Yes ☐ No ☐ Unknown			
11b. If yes, explain			

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12. Have airworthiness directives, service instructions, or bulletins related to the powerplant or propeller been issued?
☐ Yes ☐ No ☐ Unknown

12a. Was failure to complete any of the above related to the accident? ☐ Yes ☐ No ☐ Unknown

12b. If yes, explain

13. What is your overall assessment of the quality of the construction?** ☐ Excellent ☐ Average ☐ Poor

13a. Explain**

C. Performance Characteristics

14. Stall speeds (*specify kts/mph*) V_S ______ V_{SO} ______

15. Max speeds (*specify kts/mph*) V_A ______ V_{NE} ______

16. Wing Span (*ft*)

17. Wing Area (*ft²*)

18. Maximum gross weight (*lbs*)

19. Stall Warning Indicator?**
☐ Yes ☐ No ☐ Unknown

20. AOA Indicator?**
☐ Yes ☐ No ☐ Unknown

21. Other stall warning?**
☐ Yes ☐ No ☐ Unknown

22. Approved for aerobatics?
☐ Yes ☐ No ☐ Unknown

22a. If approved for aerobatics, list restrictions

23. Engine category* ☐ Aircraft engine ☐ Automotive conversion ☐ Not applicable ☐ Other (specify) ______

24. Engine origin* ☐ New ☐ Used (not overhauled)
☐ Overhauled by A&P ☐ Overhauled non-A&P ☐ Other

24a. If overhauled, extent of overhaul ☐ Complete ☐ Top ☐ Bottom

24b. If other, specify

25. Engine Make*

26. Model*

27. HP

28. Engine Data Tag?* ☐ Yes ☐ No ☐ Unknown ☐ Not applicable

28a. Enter the engine data tag and/or attach [Attach Photo(s)]

29. Was engine of make/model/hp recommended for the kit or design? ☐ Yes ☐ No ☐ Not applicable

30. Propeller Make*

31. Propeller Model*

32. Propeller Type*
☐ Fixed
☐ Ground adjustable
☐ Constant speed
☐ Not applicable

33. Propeller Construction*
☐ Metal
☐ Wood
☐ Composite
☐ Not applicable

34. Enter and/or [Attach Photo(s)] of propeller ID tag, if available

35. Avionics* ☐ Conventional ☐ Glass cockpit (if available, [Attach Photo(s)] of panel) ☐ Not applicable

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D. Crashworthiness/Survivability Features

36. Pilot's injury severity* ☐ Fatal ☐ Serious ☐ Minor ☐ None

36a. Mechanism of injury: what caused the most severe injury, if known?

37. Most severe passenger injury ☐ Fatal ☐ Serious ☐ Minor ☐ None

37a. Mechanism of injury: what caused the most severe injury, if known?

Note: If there was more than one passenger, enter the information from Fields 37 and 37a into Field 72 for each additional passenger.

38. Restraints installed*
☐ Lap belt only ☐ 5-point
☐ 3-point ☐ Other (specify) ____________
☐ 4-point

39. Restraints worn?* ☐ Yes ☐ No

39a. If yes, did they appear to be worn correctly?** ☐ Yes ☐ No ☐ Unknown

39b. If not worn correctly, explain**

40. Air bag(s) installed?* ☐ Yes ☐ No

40a. If yes, did it/they deploy? ☐ Yes ☐ No

41. Ballistic parachute installed?* ☐ Yes ☐ No

41a. If yes, did it deploy? ☐ Yes ☐ No

42. Was seat compromised?** ☐ Yes ☐ No ☐ Unknown

42a. If yes, describe and Attach Photo(s), if available**

43. Was there survivable space for occupants?** ☐ Yes ☐ No ☐ Unknown

43a. If no, describe and Attach Photo(s) with tape measure visible, if available**

44. Was post-accident egress compromised?** ☐ Yes ☐ No ☐ Unknown

44a. If yes, how**

45. ELT installed?* ☐ No ☐ Yes (121.5 MHz) ☐ Yes (406 MHz) ☐ Yes (type unknown)

45a. If not installed, why?

45b. ELT activated? ☐ Yes ☐ No

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46. Describe and Attach Photo(s), if available, other crashworthiness issues**

E. Airworthiness Certification Issues

47. Airworthiness certificate issued by ☐ FAA ☐ DAR ☐ Unknown

48. Certificate for
☐ Phase 1 ☐ Phase 2 ☐ Both Phase 1 and Phase 2

49. How many Phase 1 test hours were required?

50. Who performed first test flight? ☐ Builder ☐ Other (specify) ____________

F. Builder Characteristics

51. Relationship of accident pilot to the accident aircraft*
☐ Builder ☐ Owner, other than builder ☐ Other (specify) ____________

52. Aeronautics background of builder
☐ Aircraft Mechanic: Airframe ☐ Aircraft Mechanic: Powerplant ☐ Aircraft Mechanic: Airframe and Powerplant
☐ None ☐ Other (specify) ____________

53. Highest pilot certificate of builder
☐ None ☐ Student ☐ Recreational
☐ Sport ☐ Private ☐ Commercial
☐ Airline Transport

54. Total flight hours of builder

55. How many other E-AB aircraft has this individual built?

56. Built by ☐ Individual ☐ Group

56a. If built by a group, such as a flying club, describe

57. Where was the aircraft built?
☐ Kit manufacturer's on-site factory assist ☐ Airport hanger ☐ Commercial aircraft service facility
☐ Owner's home ☐ Other (specify) ____________

58. Supervision/assistance?
☐ EAA technical counselor ☐ Kit manufacturer ☐ Commercial consultant
☐ None ☐ Other (specify) ____________

59. Were inspections performed by someone else during build? ☐ Yes ☐ No ☐ Unknown

59a. If yes, who performed the inspections?

60. Was aircraft purchased partially completed? ☐ Yes ☐ No ☐ Unknown

61. If the builder visited or maintained a website, discussion board, etc., enter the hyperlink

62. Total man hours to complete aircraft

63. Build duration *(months)*

G. Training Issues

64. Was the aircraft insured?
☐ Yes ☐ No ☐ Unknown

65. Was transition training required by insurance company?*
☐ Yes ☐ No ☐ Unknown

65a. If yes, describe the transition training required by the insurance company

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66. What transition training, if any, was accomplished?

67. Hours of dual instruction completed in same or similar aircraft*

68. Assistance/support by EAA Flight Advisor? ☐ Yes ☐ No ☐ Unknown

H. Operating Characteristics (in addition to normal accident investigation items)

69. Did accident occur during Phase 1?* ☐ Yes ☐ No ☐ Unknown

70. Did accident occur during the first test flight?* ☐ Yes ☐ No ☐ Unknown

I. Other Information

71. Home airport/base of builder/operator *(airport code)**

71a. If not airport, describe

72. Other comments, Attachments, and/or Photographs

For RE Use Only

Reviewed by

☐ [redacted] Date

☐ [redacted] Date

Comments

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Data Form Instructions

1) NTSB investigator Enter the name of the NTSB investigator assigned to this accident.

1a) FAA inspector Enter the name of the FAA inspector/investigator assigned to this accident.

2) NTSB accident number Enter the NTSB accident number identifier for this accident. The number is supplied by the NTSB office with jurisdictional responsibility.

2a) Accident date Enter the local date when the accident occurred in the format: mm/dd/yyyy.

2b) Accident location Enter the city or town, and state (two letter abbreviation) location nearest to the accident site. If the accident site was on an airport, enter the city or town and state (two letter abbreviation) location of the airport.

3) Aircraft make Enter the aircraft make. If the aircraft is an identifiable kit or plans design, enter the kit or plans manufacturer name rather than the registered aircraft make (e.g. Vans rather than Joe Doe Flyer).

4) Aircraft model Enter the aircraft model. If the aircraft is an identifiable kit or plans design, enter the kit or plans model name rather than the registered aircraft model (e.g. RV6).

5) Aircraft category Identify the accident aircraft category.

6) Airframe hours at time of accident Enter the accident aircraft airframe hours at time of accident, or the nearest approximation based on the available data.

8a) Year built Enter the year the accident aircraft was built - year the original airworthiness certificate was issued in the format: yyyy

9) Any major modifications made to the original kit or design? Indicate whether any major modifications were made to the original kit or plans design that could affect the structural strength, operation, or performance of the aircraft.

9a) If yes, describe If the answer to Question 9 is "Yes," briefly describe major aircraft modifications.

19) Stall warning indicator Specify whether the accident aircraft had a stall warning indicator.

20) AOA indicator Specify whether the accident aircraft had an angle of attack indicator.

25) Engine make Enter the engine make/manufacturer name. Enter "N/A" if the accident aircraft was not powered.

26) Engine model Enter the engine model name. Enter "N/A" if the accident aircraft was not powered.

27) Engine horsepower Enter the aircraft engine horsepower rating. Enter "N/A" if the accident aircraft was not powered.

28) Engine data tag Specify whether the aircraft engine had a data tag installed. Enter "N/A" if the accident aircraft was not powered.

28a) If yes, enter engine data tag info If the answer to Question 28 is "Yes," enter the information on the installed data tag.

30) Propeller make Enter the aircraft propeller make/manufacturer. Select "not applicable" if the accident aircraft did not have a propeller.

31) Propeller model Enter the aircraft propeller model. Select "not applicable" if the accident aircraft did not have a propeller.

32) Propeller type Identify whether the accident aircraft had a fixed, ground adjustable, or constant speed propellor. Select "not applicable" if the accident aircraft did not have a propeller.

33) Propeller construction Identify whether the accident aircraft propeller was constructed of metal, wood, or composite. Select "not applicable" if the accident aircraft did not have a propeller.

34) Enter propeller ID tag, if available If the accident aircraft propeller had an ID tag installed, enter the tag data.

35) Primary display avionics Specify whether the primary flight instruments in the accident aircraft were conventional instruments or a "glass cockpit" electronic primary flight display(s).

36a) What caused most severe pilot injury Indicate the mechanism of the most serious pilot injury, if identifiable. Enter "N/A" if the pilot was uninjured.

37a) What caused most severe passenger injury Indicate the mechanism of the most serious passenger injury, if identifiable. Enter "N/A" if the passenger was uninjured, or if there were no passengers aboard. Indentify passengers by number (e.g., passenger 1, passenger 2. etc.) if there was more than one passenger aboard that accident aircraft.

38) Type restraints installed Identify whether the aircraft had lap-belt only; or 3-, 4-, or 5-point; or some other type of passenger restraints installed in the aircraft. If the aircraft had more than one type of restraint installed, identify the installed restraints and describe in Question 72.

39) Were restraints worn Indicate whether the aircraft occupants were wearing restraints at the time of the accident. If some occupants were restrained and some were not, select "No" and describe in Question 72. If unable to determine first hand, use best available source (interview first responders, etc).

39a) If yes, did they appear to be worn correctly If the occupants were restrained, indicate whether they appear to have been wearing the restraints correctly at the time of the accident. If some occupants were wearing restraints correctly and some were not, select "No" and describe in Question 39b. If unable to determine first hand, use best available source (interview first responders, etc).

39b) If not worn correctly, explain If one or more occupant was not wearing their restraint correctly at the time of the accident, describe the incorrect use and reason, if known. If unable to determine first hand, use best available source (interview first responders, etc).

40) Were airbags installed Indicate whether the accident aircraft had inflatable restraints/airbag installed at one or more seats.

40a) If yes, did they deploy If the answer to Question 40 is "Yes," indicate whether one or more restraints/airbags deployed during the accident.

41) Was a ballistic parachute installed Indicate whether the accident aircraft had a ballistic airframe parachute recovery system installed.

41a) If yes, did it deploy If the answer to Question 41 is "Yes," indicate whether the parachute was deployed during the accident sequence. Select "No" if the parachute deployed as a result of the accident impact or post-impact.

42) Was seat compromised Indicate whether the structural integrity of one or more aircraft seat(s) was compromised during the accident.

43) Was there survivable space for occupants Indicate whether there was sufficient survivable space available for aircraft occupants. If survivable space was compromised, or if it is unclear whether available space affected survivability, explain in Question 72.

44) Was post-accident egress compromised Indicate whether egress from the accident aircraft was compromised or limited following the accident due to aircraft damage, equipment malfunction, or aircraft wreckage orientation. If egress was compromised, or if it is unclear whether egress was affected, explain in Question 72.

45) Was an ELT installed Indicate whether an Emergency Locator Transmitter (ELT) was installed in the accident aircraft and type, if known.

45b) Was ELT activated If the answer to Question 45 is "Yes," indicate whether the ELT was activated during the accident.

69) Did accident occur during Phase 1 flight test Indicate whether the accident occurred during Phase 1 of the aircraft airworthiness flight testing. Note: Refer to aircraft operating limitations, as necessary, to determine whether the aircraft was in the Phase 1 test period.

70) Did accident occur during first flight test Indicate whether the accident occurred during the first aircraft test flight.

72) Other comments Provide any additional comments, descriptions, or details about the accident, accident aircraft, accident pilot, study data form questions, or study in general.

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Appendix C: Expanded Analysis of Amateur-Built Aircraft Accident Data, Calendar Year 2011

Most of the 227 E-AB aircraft involved in the 224 accidents investigated during 2011 were airplanes. Figure C1 shows the types of aircraft involved in accidents during 2011.

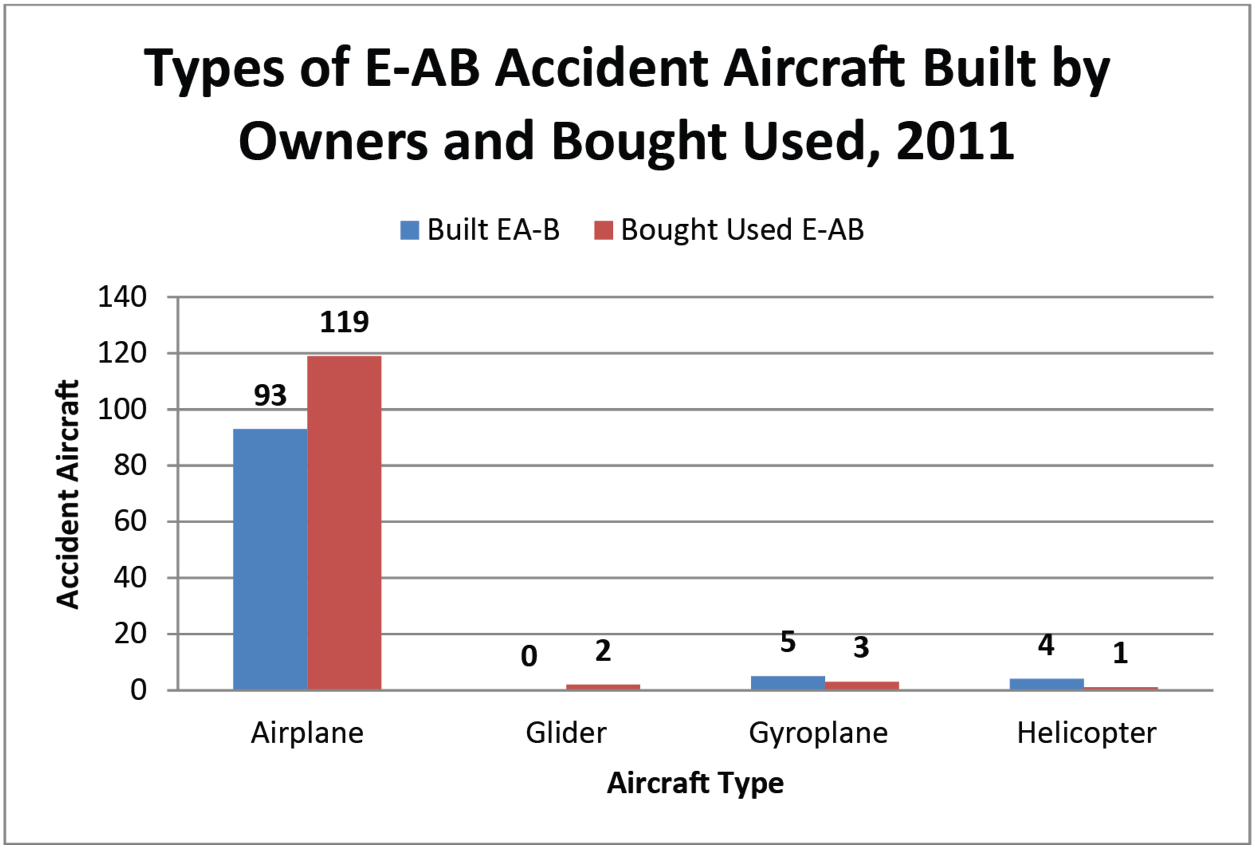

Figure C1. Types of E-AB accident aircraft built by owners and bought as used, 2011.

E-AB Aircraft Makes

Figure C2 shows the manner in which the accident E-AB aircraft were built for those bought used and those built by their owners. The majority of accident aircraft, whether built by the owner or bought used, were built from kits, fewer were built from plans, and only three were built from original designs. Figure C3 shows the principal "makes" of E-AB aircraft built by their owners, and Figure C4 shows the principal "makes" of E-AB aircraft bought used. A large variety of aircraft kits and published plans are represented in both groups of aircraft. Kit manufacturers Van's Aircraft Company, Zenith Aircraft Company, Lancair, Kitfox Aircraft, and Rans Aircraft accounted for significant numbers of aircraft in both groups. The E-AB aircraft make is identified for each accident aircraft in appendix F.

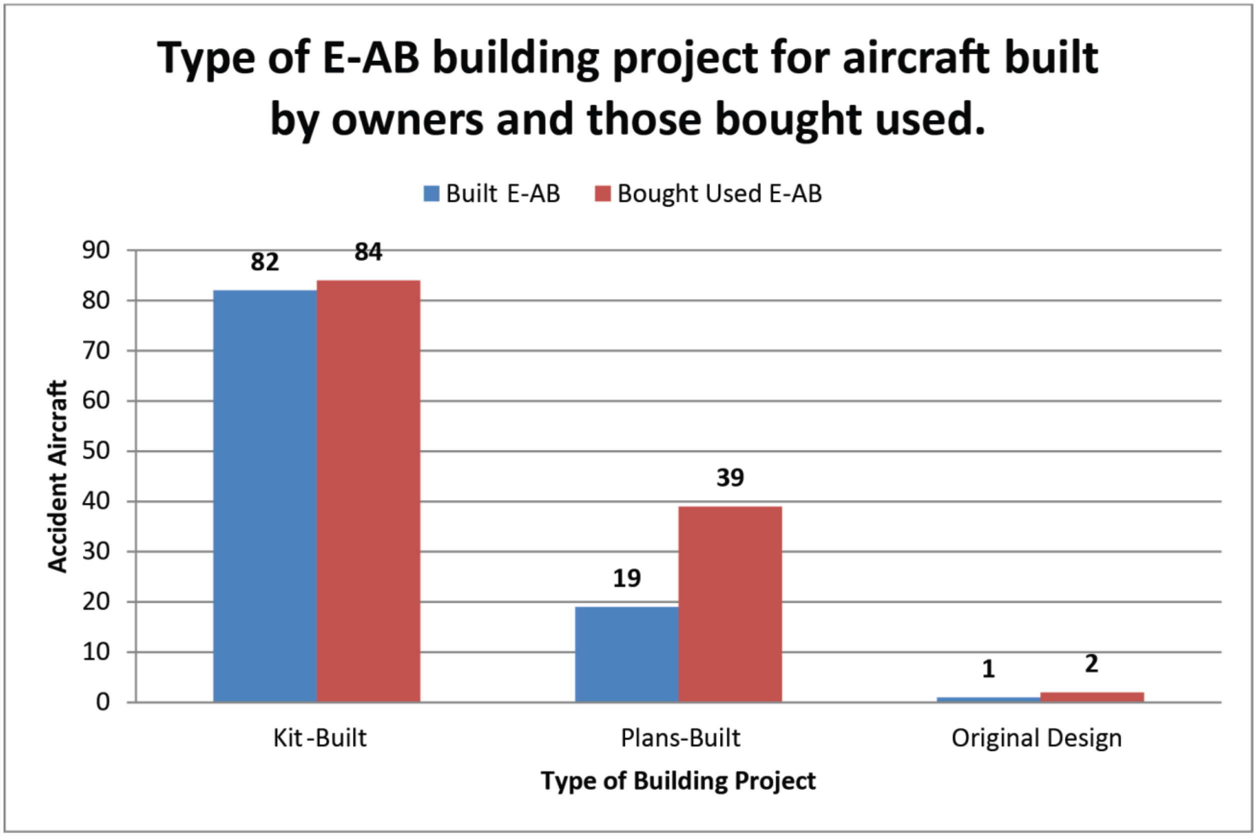

Figure C2. Type of E-AB aircraft building project for aircraft built by owners and those bought used.

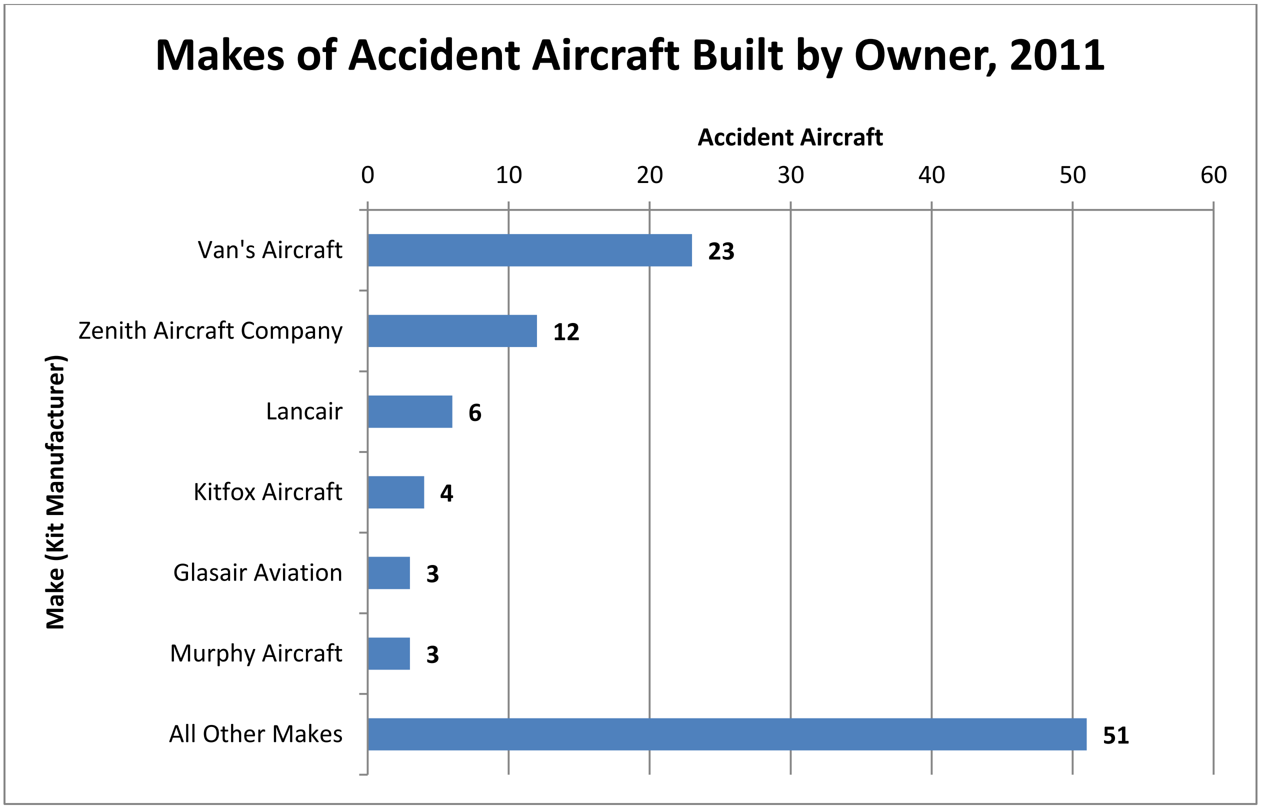

Figure C3. E-AB accident aircraft makes built by owners.

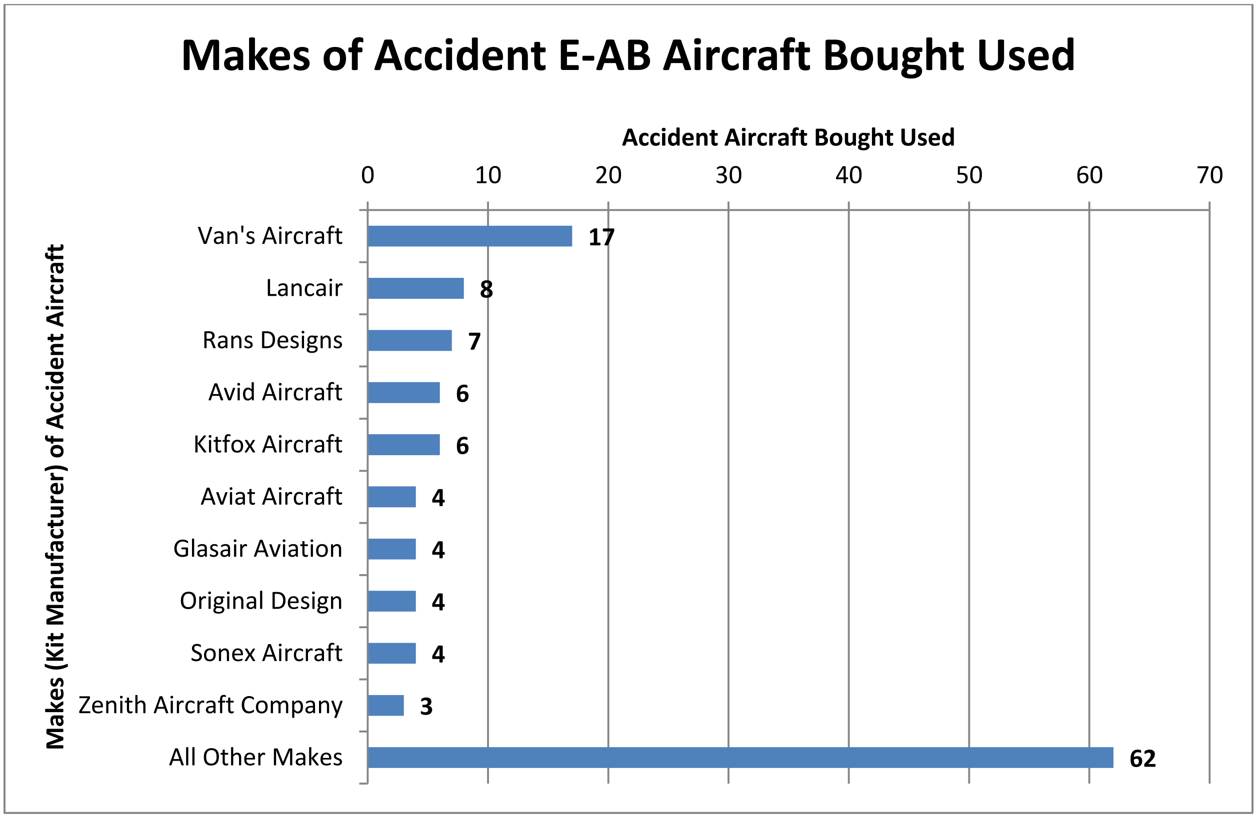

Figure C4. E-AB accident aircraft makes bought used.

Figure C5 shows the number of previous owners of these aircraft. Less than 50 percent had had only one previous owner, and more than 20 percent had been bought and sold more than four times since they were built.

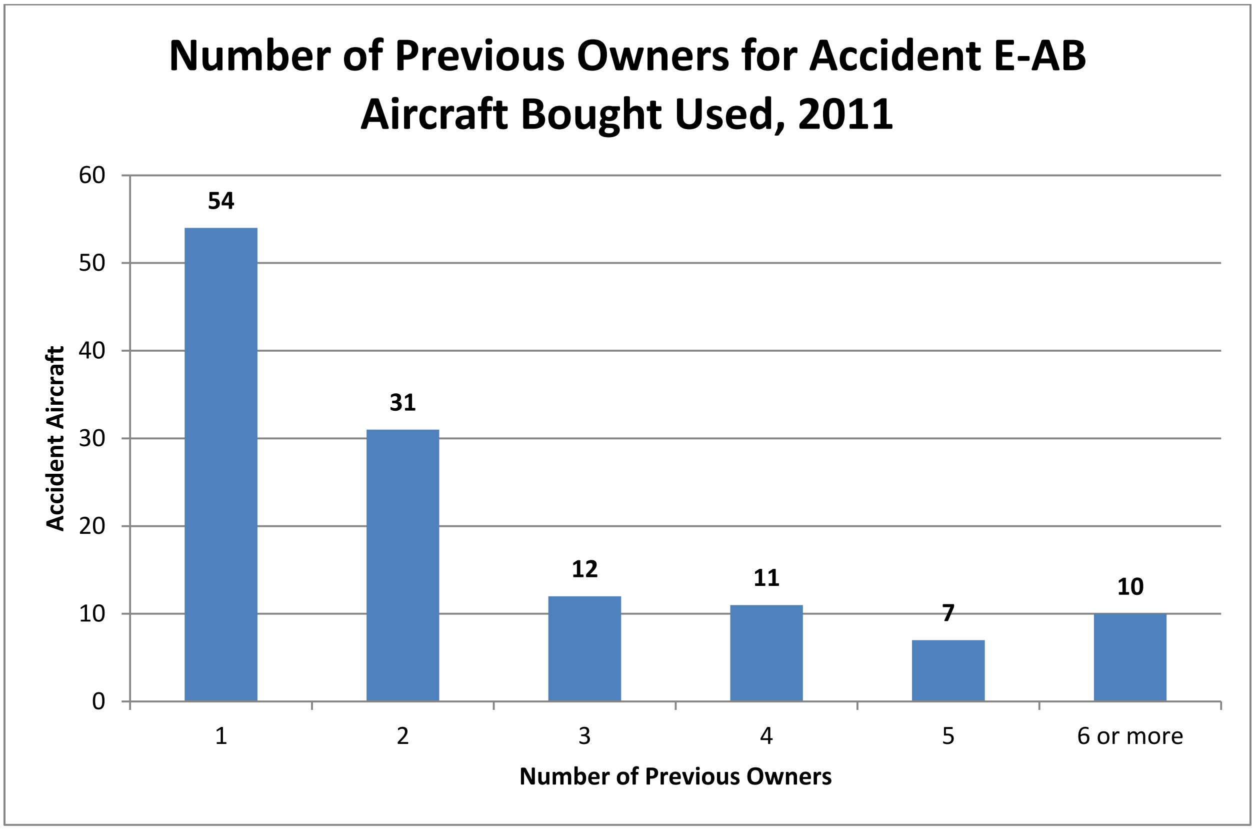

Figure C5. Number of previous owners for accident E-AB aircraft bought used.

Appendix D: Amateur-Built Aircraft Survey

1.How many years have you been a certificated pilot? (enter whole numbers)

2.What is the highest certificate you hold?

- Student
- Sport
- Recreational
- Private
- Commercial
- Airline Transport (ATP)

3.What ratings or other certificates do you hold? *[Mark all that apply]*

- Single-engine Land
- Single-engine Sea
- Multi-engine Land
- Multi-engine Sea
- Instrument
- Rotorcraft (helicopter/gyroplane)
- Lighter than air
- Flight Instructor (CFI, CFII, MEI)
- Mechanic (A&P)
- Repairman
- Other (please specify)

4. What additional endorsements have you obtained? *[Mark all that apply]*

- High performance
- Complex
- Tail wheel
- High altitude
- None – or Not applicable
- Other (please specify)

YOUR CURRENT AMATEUR-BUILT AIRCRAFT

If you do not currently own or own multiple amateur-built aircraft please answer the remainder of the survey questions using your most recently owned or purchased amateur-built aircraft.

5. How many hours have you logged as Pilot in Command (PIC) over the following time periods for both all aircraft and your current amateur-built aircraft (E-AB)?

TotalHrsLast YearLast 90 days

All Aircraft

Current E-AB Aircraft

6. Approximately how many landings have you made in the last 90 days?

All Aircraft

Current E-AB Aircraft

7. What type of amateur-built aircraft do you currently own?

Make

Model

Year Certified

8. Your amateur-built aircraft is a:

- Airplane
- Glider
- Helicopter
- Gyrocopter
- Lighter than Air
- Weight-Shift
- Power Parachute

The following questions are intended to provide more detail about your current amateur-built aircraft.

9. Which of the following best describes your current amateur-built aircraft?

- Standard Factory kit
- Quick Build kit
- Plans built
- Original Design
- Other (please specify)

10. How many total hours on the airframe and engine? *(enter whole number)*

Airframe [ ]

Engine [ ]

11. What year was the airworthiness certificate issued?

[ ]

12. What type of engine is in your current amateur-built aircraft?

- ○ Traditional Aircraft engine (including non-certified variants)
- ○ Other Production-type four-stroke aircraft engine (Jabiru, Rotax 912, etc.)
- ○ Production-type two-stroke aircraft engine (Rotax 582, 2SI, etc.)
- ○ Volkswagen
- ○ Subaru
- ○ Honda
- ○ Ford
- ○ Corvair
- ○ GM (other than Corvair)
- ○ GEO
- ○ Suzuki
- ○ Other
- ○ Two-stroke conversion
- ○ Not Applicable
- ○ Other (please specify): [ ]

13. What is the specific make, model and horsepower of your engine?

Make [ ]

Model [ ]

Horsepower [ ]

14. Was your engine …

- ○ New
- ○ Used (not overhauled)
- ○ Overhauled by an A&P
- ○ Overhauled by a non-A&P
- ○ Other (specify) [ ]

15. What was the extent of the overhaul?

- Complete
- Top only

16. What is the specific make and model of your propeller?

Make

Model

17. Your propeller is…

- Wood
- Metal
- Composite

18. Your propeller is…

- Fixed
- Ground Adjustable
- Constant Speed

19. What type of instruments/avionics in your aircraft?

- Conventional primary flight instruments
- Glass cockpit primary flight display

20. What type of landing gear configuration does your aircraft have?

- Tricycle
- Tail wheel
- Floats
- Amphibian
- Other (specify)

21. Your landing gear is …

- Fixed
- Retractable

22. What is the wing span, wing area and max gross weight of your amateur- built aircraft?

Wing Span (ft)

Wing Area (sq. ft)

Max Gross Weight (lbs)

23. What are the stall and max speeds (in knots) of your amateur-built aircraft?

V_S

V_{SO}

V_A

V_{NE}

24. Is your aircraft approved for aerobatics?

- ○ Yes
- ○ No

25. Any restrictions (please specify)

26. Do you conduct aerobatics in your aircraft?

- ○ Yes
- ○ No

27. What is the number of seats in your current amateur-built aircraft?

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 or more

28. What type of restraints are installed in your aircraft?

- ○ Lap Belt only
- ○ 3 point shoulder harness
- ○ 4 point harness
- ○ 5 point harness
- ○ Other (please specify)

29. What other safety related equipment is installed in your current amateur-built aircraft?

- ○ Airbag
- ○ Ballistic parachute
- ○ Other (please specify)

30. Did you do an introductory or demo flight of your current model of amateur-built aircraft before obtaining one?

- Yes
- No

31. Who provided the introductory or demo flight?

- Kit manufacturer
- Private Owner
- Other (please specify) [ ]

32. Did you receive flight training for your current amateur-built aircraft **<u>before</u>** your first flight as pilot in command of your aircraft?

- Yes
- No

33. Who conducted the training?

- Kit Manufacturer
- Private Owner of <u>same</u> type of aircraft
- Private Owner of <u>similar</u> type of aircraft
- Private Owner of <u>different</u> type of aircraft
- CFI
- Other (please specify) [ ]

34. Did you receive flight training for your current amateur-built aircraft **<u>after</u>** your first flight as pilot in command of your aircraft?

- Yes
- No

35. Who conducted the training?

- Kit Manufacturer
- Owner of <u>same</u> type of aircraft
- Owner of <u>similar</u> type of aircraft
- Private Owner of <u>different</u> type of aircraft
- CFI
- Other (please specify) [ ]

36. Did your insurance company require any special transition training to insure your current amateur-built aircraft?

- o Yes
- o No
- o N/A-Self insured

37. How many hours of training did the insurance company require? How many did you complete?

Required Completed		
Hours of dual instruction		
Hours of solo instruction		

38. Did you build your current amateur-built aircraft?

- o Yes
- o No (skip to Q55)

39. Did you completely build the aircraft or purchase it as a completed aircraft or a partially completed project?

- o Built myself
- o Purchased partially completed project
- o Purchased completed aircraft

40. Why did you choose to build rather than purchase a completed aircraft (other than for educational or recreational purposes)?

- o To save money
- o Performance advantages
- o Other (please specify)

The following questions are about your building experience

41. Why did you choose to build rather than purchase a completed aircraft (other than for educational or recreational purposes)?

- ☐ To save money
- ☐ Performance advantages
- ☐ Other (please specify)

42. How long did it take you to complete your current amateur-built aircraft?

Years

Months

Total Hours

43. How many aircraft (including your current amateur-built aircraft) have you built?

44. Do you have a repairman certificate for your current amateur-built aircraft?

- ○ Yes
- ○ No

45. Where was your aircraft built? *(check all that apply)*

- ☐ Kit manufacturer onsite factory assist
- ☐ Commercial aircraft service facility
- ☐ Hangar
- ☐ Owner's home

46. Did you receive technical assistance from any of the following during the building of your aircraft? *(check all that apply)*

- ☐ EAA Technical Counselor
- ☐ Kit Manufacturer
- ☐ A & P
- ☐ Other Builder(s)

47. How many inspections by others were performed during the build? (Enter 0 if none)

48. Who were the inspections performed by? *(check all that apply)*

- ☐ EAA Technical Counselor
- ☐ FAA inspector
- ☐ A&P
- ☐ Other builders

49. What type (if any) of training or experience in aircraft building techniques did you receive before or during your building process?

- ☐ Assisted on another aircraft build
- ☐ Attended kit manufacturer workshop
- ☐ Attended EAA SportAir workshop
- ☐ Attended workshops at AirVenture or other events
- ☐ Other

The following questions are about your flight test and airworthiness certification process

50. The airworthiness certificate was issued by

- o FAA
- o DAR

51. Who performed the first test flight?

- o Builder
- o Hired flight test pilot
- o Other (please specify) [ ]

52. How many Phase 1 test hours were required and completed?

Required [ ]

Completed [ ]

53. How detailed would you say was your flight test plan?

- o Very Detailed
- o Somewhat Detailed
- o Somewhat Informal

54. What sources (if any) did you use in the development of your flight test plan?

- ☐ Self-Developed only
- ☐ EAA Flight Advisor
- ☐ EAA Sport Air Flight testing Course
- ☐ FAA Test flight Advisory Circular AC-90-89A
- ☐ Kit Manufacturer training program
- ☐ First Flight Video
- ☐ Type Club/Owners Group
- ☐ Other [ ]

55. Has your current amateur-built aircraft been modified from the original design specifications?

- o Yes
- o No
- o Don't Know

56. In which areas has your current amateur-built aircraft been modified? *[Mark all that apply]*

- ☐ Fuel Systems
- ☐ Airframe Design
- ☐ Canopy/Door Mechanisms
- ☐ Safety Harness
- ☐ Control Systems
- ☐ Powerplant
- ☐ Other (please specify) ____________

57. Who made the modifications? (If owner/builder holds a current A&P certificate select FAA certified mechanic)

	Builder	Owner Other Than Builder	FAA Certified Mechanic	Don't Know	Other	NA
Fuel Systems	o	o	o	o	o	o
Airframe Design	o	o	o	o	o	o
Canopy/Door Mechanisms	o	o	o	o	o	o
Safety Harness	o	o	o	o	o	o
Control System	o	o	o	o	o	o
Powerplant	o	o	o	o	o	o
Other	o	o	o	o	o	o

58. Why were the modifications made?

	Correct Deficiency	Improve Handling	Improve Performance	Other Reason	NA
Fuel Systems	o	o	o	o	o
Airframe Design	o	o	o	o	o
Canopy/Door Mechanisms	o	o	o	o	o
Safety Harness	o	o	o	o	o
Control Systems	o	o	o	o	o
Powerplant	o	o	o	o	o
Other	o	o	o	o	o

59. After the modifications were completed did you conduct any formal test flight(s)?

- ○ Yes
- ○ No

60. Have you received or found service instructions or bulletins related to the airframe since the purchase of your kit/plans?

- ○ Yes
- ○ No

61. Have they been completed?

- ○ Yes
- ○ No

62. How did you hear about them?

- ☐ From FAA.Gov web site
- ☐ From kit producer
- ☐ Owners Forum/website
- ☐ Type Club
- ☐ General Aviation Press (e.g. Aero-News, AV-Web, etc.)
- ☐ Other

63. Have you received or found service instructions or bulletins related to the powerplant or propeller since they were purchased?

- Yes
- No

64. Have they been completed?

- Yes
- No

65. How did you hear about them?

- ☐ From FAA.Gov web site
- ☐ From kit producer
- ☐ Owners Forum/website
- ☐ Type Club
- ☐ General Aviation Press (e.g. Aero-News, AV-Web, etc.)
- ☐ Other

The following questions are for analysis purposes only. They represent information that might provide insight into some of the answers to the questions on the survey.

66. What is your age?

67. What is your approximate annual household income?

- Less than $50,000
- Between $50,000 and $75,000
- Between $75,000 and $100,000
- Between $100,000 and $150,000
- Between $150,000 and $200,000
- $200,000 or more

68. Please indicate your highest level of education.

- High School or less
- Vocational/Technical
- College
- Graduate/Professional School

69. Please select the category that most closely describes your occupation.

- Professional/Technical
- Sales/Service
- Craftsman/Hourly Employee
- Self Employed Prof/Tech
- Self Employed Sales/Marketing
- Self Employed Craftsman
- Self Employed Other
- Admin/Managerial
- Clerical/Office
- Not Employed
- Military
- Student
- Retired

Appendix E: Expanded Results of Experimental Aircraft Association Survey of E-AB Aircraft Owners and Builders.

Figure E1 shows the breakdown of kit-built aircraft by manufacturer. Kits manufactured by Vans Aircraft Company accounted for 43 percent of these aircraft, with other manufacturers accounting for much smaller proportions of respondents' aircraft.

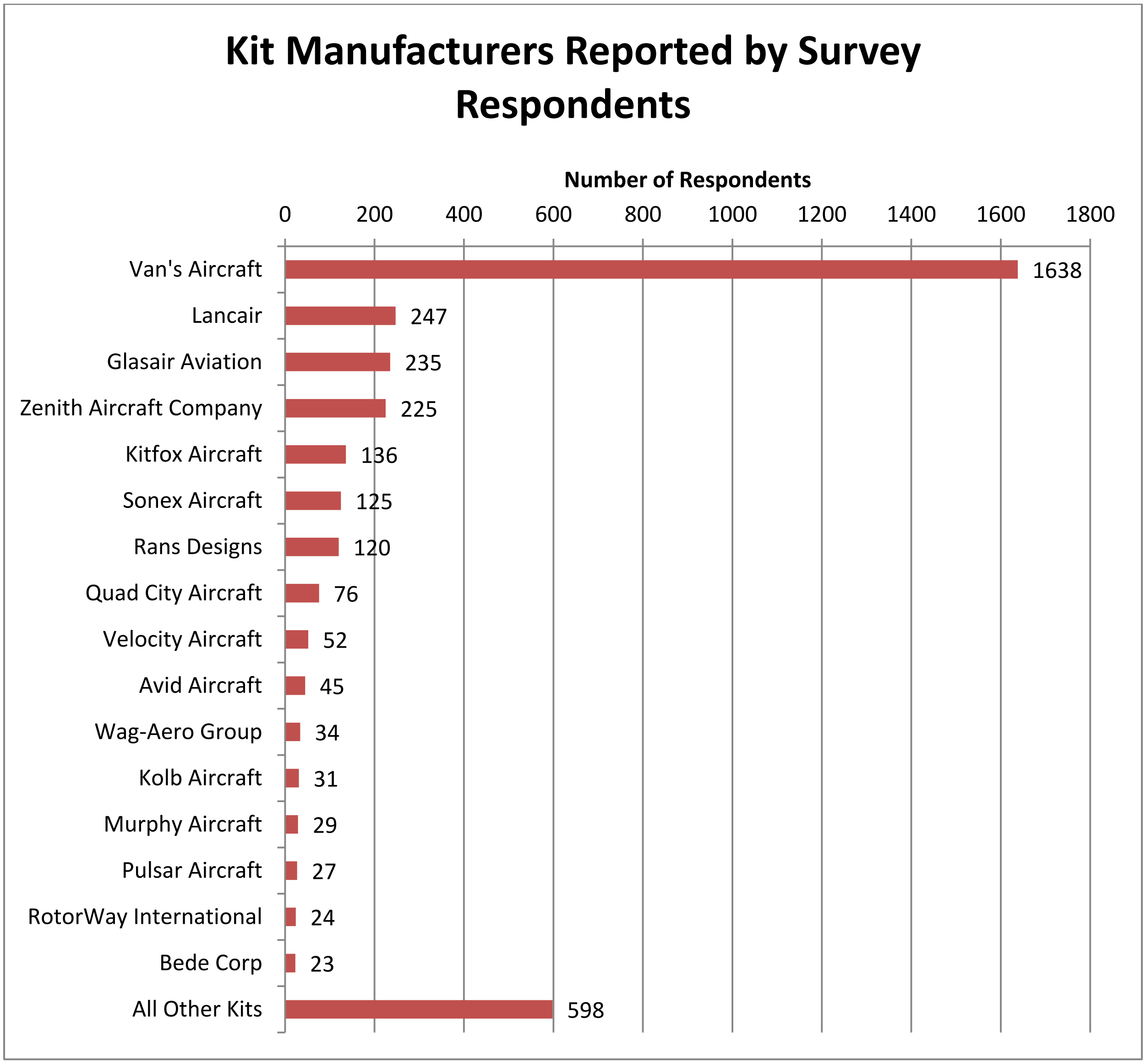

Figure E1. Kit manufacturers reported by survey respondents.

Figure E2 shows the specific models of the aircraft kits produced by the four leading kit manufacturers reported by the survey respondents.

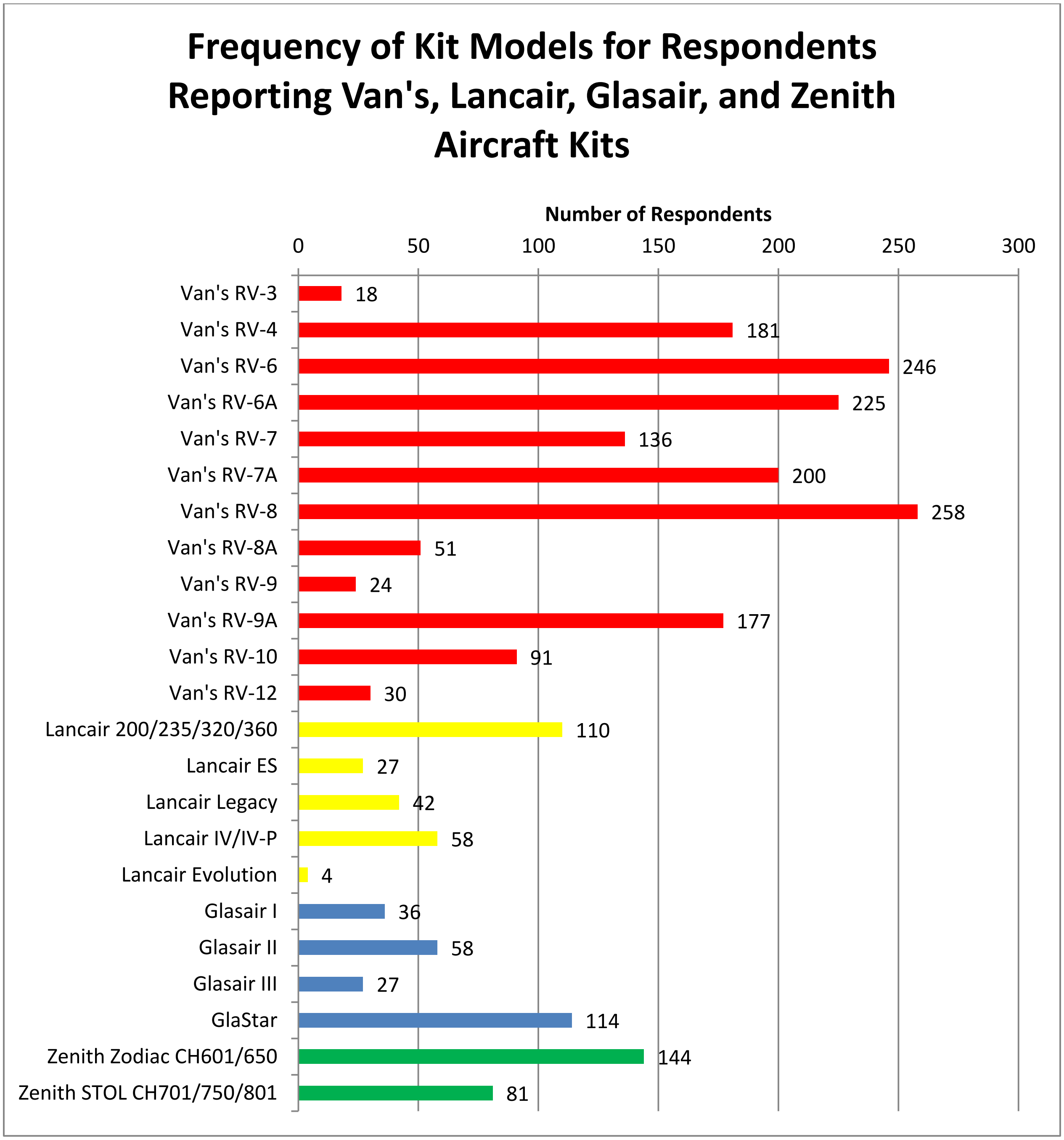

Figure E2. Kit models for the Van's, Lancair, Glasair, and Zenith aircraft kits reported in the survey.

Twenty-three percent of respondents reported aircraft that were built according to published plans, rather than assembled from manufactured kits. Respondents reported 140 distinct published plans. The distribution of plans-built aircraft makes, or designs, is shown in Figure E3.

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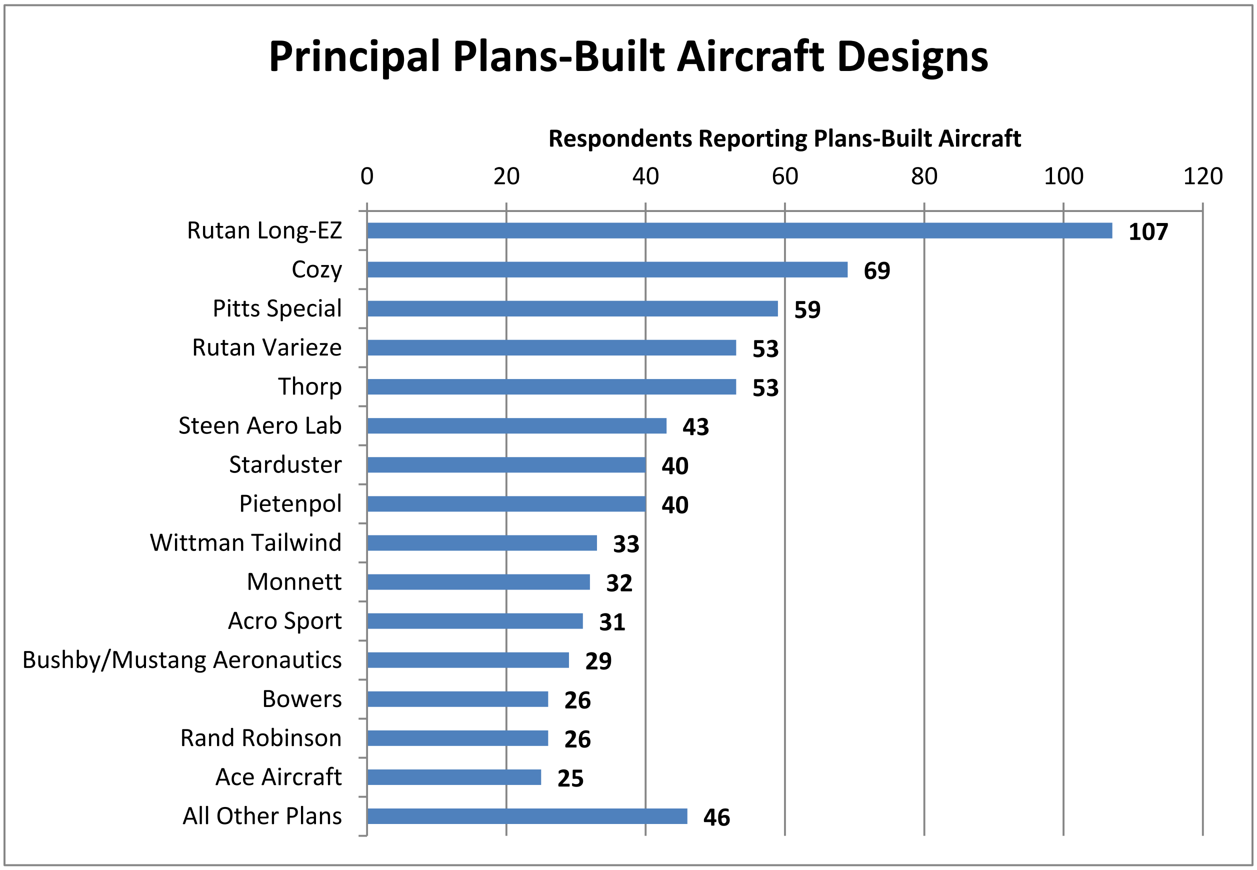

Figure E3. Plans-built aircraft designs reported by survey respondents.

The largest of the plans-built aircraft makes is the Burt Rutan Long-EZ. A very large number of other published plans are also reflected in the survey responses. The original design category comprises 136 unique one-off designs described by a small subset of survey respondents.

Figure E4 shows the years taken to complete the E-AB aircraft project for the respondents who had finished building their aircraft. The median years to complete the aircraft was 4 years, but there was considerable variation. Figure E5 shows the total hours reported by these respondents to complete their E-AB aircraft. The median was 2,000 hours, but again, there was considerable variation.

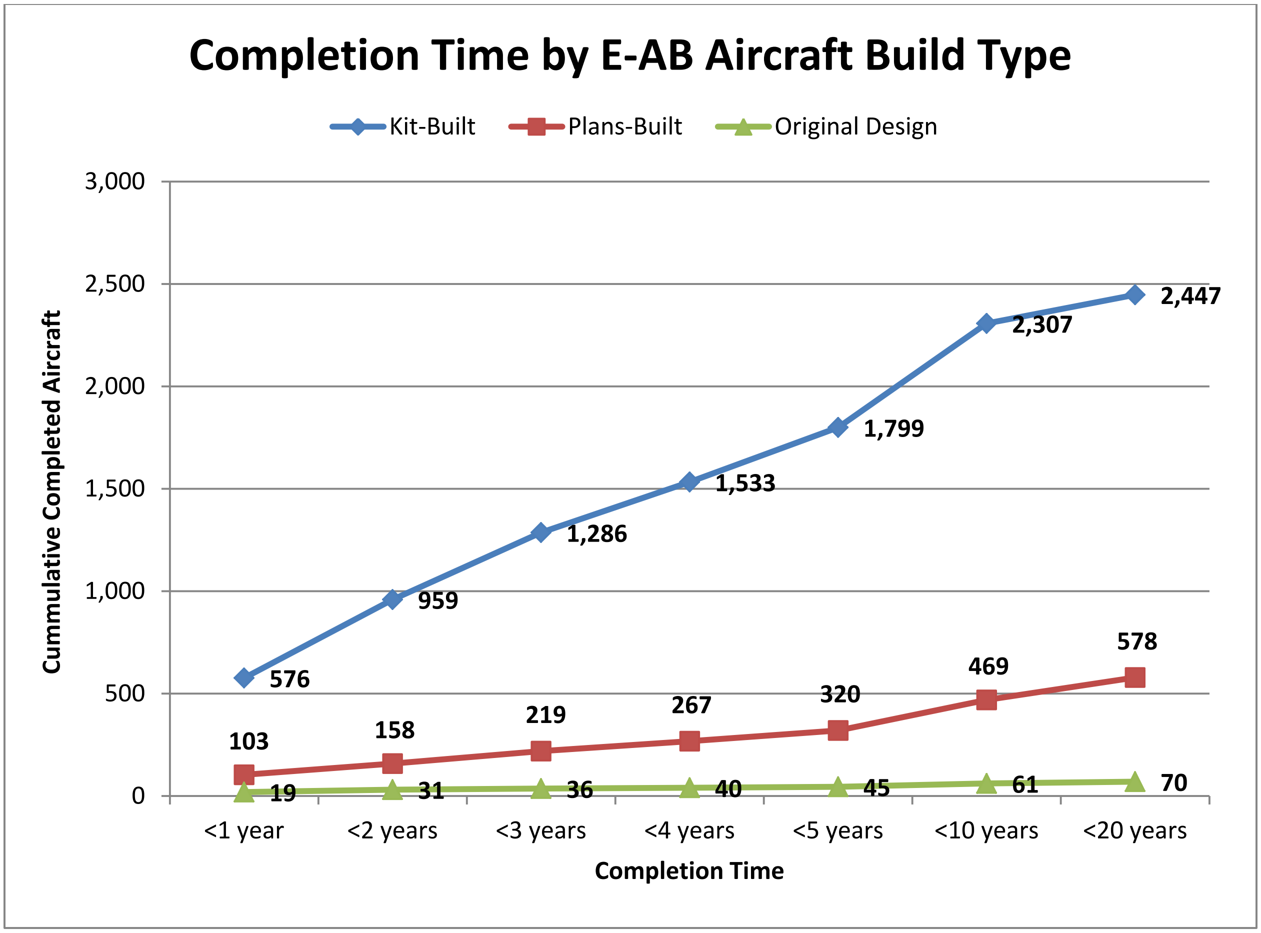

Figure E4. Years to complete for the 3,095 respondents reporting this information.

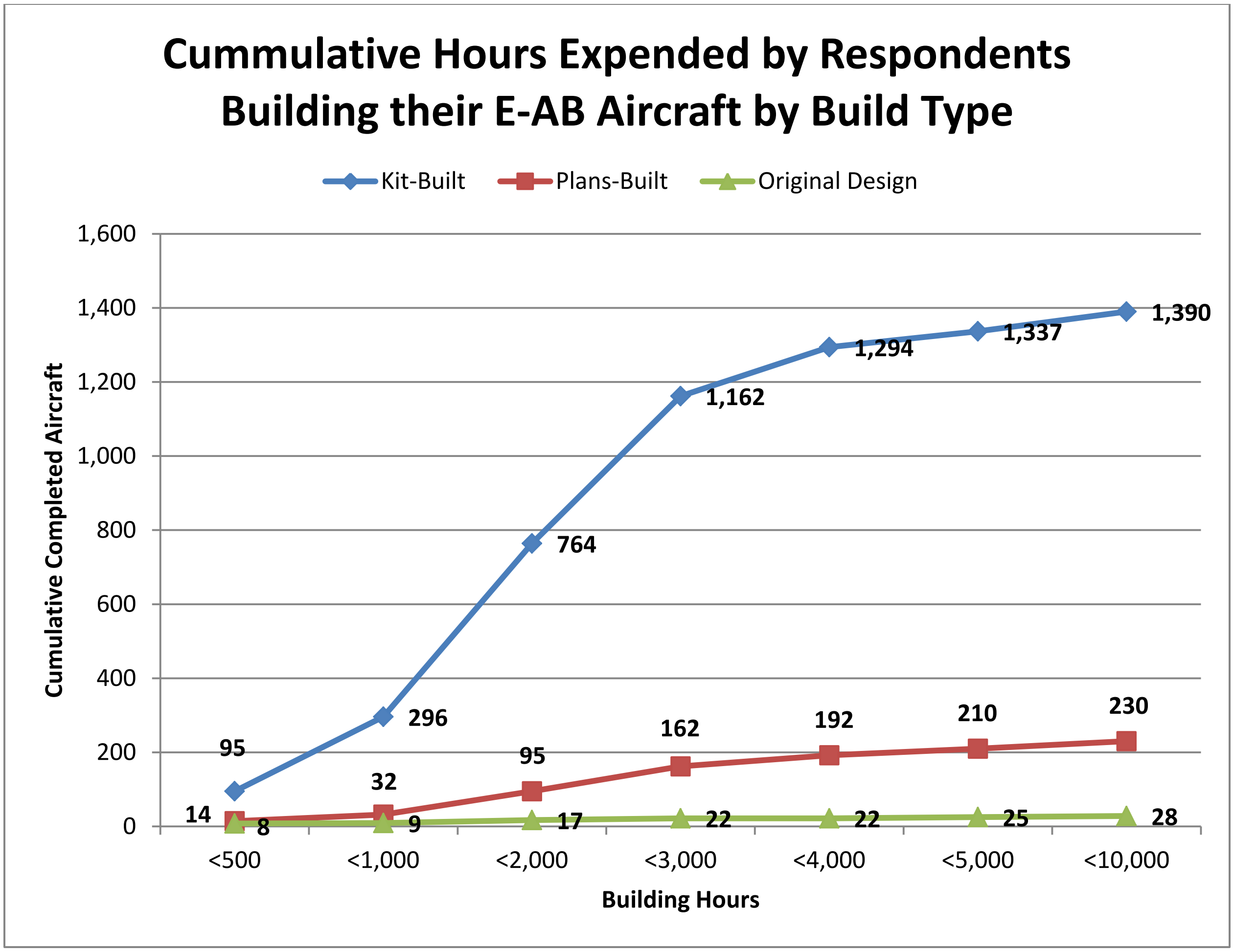

Figure E5. Total build hours for the 1,648 respondents reporting this information.

Appendix F: Experimental Amateur-Built Study Cases, Calendar Year 2011

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
WPR11CA086	1/1/2011	Torrance, CA	Nonfatal	N322RV	Airplane	Vans RV4	Built	Landing	Abnormal Runway Contact
CEN11CA143	1/2/2011	Carlisle, AR	Nonfatal	N876KF	Airplane	Kitfox III	Purchased Used	Landing	System/ Component Failure – Non-Power
WPR11CA088	1/4/2011	Homedale, ID	Nonfatal	N90TY	Airplane	Kitfox IV	Built	Takeoff	Abnormal Runway Contact
CEN11CA165	1/25/2011	Terlingua, TX	Nonfatal	N947RG	Airplane	Kitfox III	Purchased Used	Takeoff	Loss of Control on Ground
WPR11CA110	1/26/2011	Toutle, WA	Nonfatal	N92LW	Airplane	Cuby	Purchased Used	Landing	Abnormal Runway Contact
WPR11CA112	1/28/2011	Buckeye, AZ	Nonfatal	N8053R	Airplane	Rans S-6	Built	En Route	System/ Component Failure – Non-Power
ANC11CA011	1/29/2011	Anchorage, AK	Nonfatal	N9015U	Airplane	Got Rocks	Purchased Used	Landing	Loss of Control on Ground
CEN11CA166	1/29/2011	Wellington, CO	Nonfatal	N15XP	Glider	Rutan Solitaire	Purchased Used	Landing	Undershoot/ Overshoot
CEN11LA168A	1/29/2011	Burlington, IA	Nonfatal	N200BE	Airplane	Zenith Aircraft Company 601XL	Built	Landing	Runway Incursion - Vehicle
CEN11LA168B	1/29/2011	Burlington, IA	Nonfatal	N602CB	Airplane	Model-1	Purchased Used	Landing	Runway Incursion - Vehicle
ERA11CA153	1/30/2011	Crescent City, FL	Nonfatal	N324AL	Airplane	Arion Aircraft Lightning	Purchased Used	Landing	Abnormal Runway Contact
WPR11CA130	2/9/2011	Wilsonville, OR	Nonfatal	N238MA	Airplane	Glastar	Purchased Used	Landing	Abnormal Runway Contact

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
WPR11CA134	2/12/2011	Groveland, CA	Nonfatal	N17AJ	Airplane	Christen Eagle II	Purchased Used	Landing	Loss of Control on Ground
ERA11LA142	2/13/2011	Dawsonville, GA	Nonfatal	N351E	Airplane	Lancair 320	Purchased Used	Maneuvering	Fuel Related
ERA11LA150	2/17/2011	Stetson, ME	Nonfatal	N213	Airplane	Kolb MK III	Purchased Used	En Route	System/ Component Failure – Powerplant
WPR11FA147	2/26/2011	Milford, UT	Fatal	N989TT	Airplane	Lancair 360	Purchased Used	En Route	Unintended Flight in IMC
ERA11CA177	3/3/2011	Indian Trail, NC	Nonfatal	N788Q	Airplane	Kitfox IV	Built	Takeoff	Abnormal Runway Contact
WPR11FA153	3/4/2011	Myrtle Creek, OR	Nonfatal	N4374K	Airplane	Kitfox IV-1200	Built	Initial Climb	Windshear/ Thunderstorm
WPR11FA155	3/7/2011	Newberry Springs, CA	Fatal	N122B	Airplane	Rand Robinson KR-2	Purchased Used	En Route	System/ Component Failure – Non-Power
WPR11FAMS1	3/11/2011	Unknown, AZ	Fatal	N650RV	Airplane	Vans RV6	Built	Unknown	Unknown
ERA11CA195	3/19/2011	Gainesville, FL	Nonfatal	N109BX	Airplane	Christen Eagle II	Purchased Used	Approach	Loss of Control in Flight
ERA11LA197	3/19/2011	Lincoln, AL	Nonfatal	N192AB	Helicopter	Rotorway Exec	Purchased Used	En Route	System/ Component Failure – Powerplant
ERA11LA208	3/19/2011	Clinton, SC	Fatal	None	Airplane	JTD Mini-Max	Built	Takeoff	Collision on Takeoff or Landing
WPR11CA171B	3/19/2011	Arlington, WA	Nonfatal	N11NL	Airplane	Rutan Long-EZ	Built	Standing	Ground Collision
CEN11CA242	3/21/2011	Ferris, TX	Nonfatal	N1317L	Airplane	Aero Adventure Aventura	Purchased Used	Landing	Loss of Control in Flight
ERA11LA213	3/25/2011	Calhoun, GA	Nonfatal	N770VP	Airplane	Volksplane VP-1	Built	Initial Climb	System/ Component Failure – Powerplant
ERA11LA228	3/29/2011	Crescent City, FL	Nonfatal	N5842	Airplane	Aero Adventure Aventura II	Built	Initial Climb	Loss of Control in Flight

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
WPR11LA180	4/1/2011	Cedar City, UT	Nonfatal	N613HH	Airplane	Avid Flyer	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
CEN11LA281	4/2/2011	Brookfield, MO	Nonfatal	N6313T	Airplane	Avid Mark IV	Purchased Used	Landing	System/ Component Failure – Non-Power
ERA11FA222	4/3/2011	Chesapeake, VA	Fatal	N164T	Airplane	Lancair 360	Purchased Used	Initial Climb	Fuel Related
WPR11LA187	4/5/2011	El Centro, CA	Nonfatal	N128CF	Airplane	Zenith Aircraft Company STOL CH701	Built	Landing	System/ Component Failure – Powerplant
WPR11LA193	4/8/2011	Temple Bar, AZ	Nonfatal	N320BB	Airplane	Lancair 360	Purchased Used	En Route	System/ Component Failure – Powerplant
WPR11LA205	4/10/2011	Ramona, CA	Nonfatal	N611JB	Airplane	Bushby/Mustang Aeronautics Midget Mustang	Purchased Used	Initial Climb	System/ Component Failure – Non-Power
CEN11CA282	4/12/2011	Davenport, IA	Nonfatal	N701YB	Airplane	Zenith Aircraft Company STOL CH701	Built	Takeoff	System/Component Failure – Non-Power
WPR11LA199	4/14/2011	Winchester, CA	Nonfatal	N632DR	Airplane	Zenith Aircraft Company STOL CH750	Built	En Route	System/ Component Failure – Powerplant
ERA11CA248	4/15/2011	Baltimore, MD	Nonfatal	N57CW	Airplane	Lancair 320	Built	Landing	Abnormal Runway Contact
WPR11LA202	4/16/2011	Marana, AZ	Nonfatal	N107JL	Airplane	Rans S-12	Purchased Used	En Route	System/ Component Failure – Powerplant
CEN11FA299	4/17/2011	San Angelo, TX	Fatal	N38RC	Airplane	Christen Eagle II	Purchased Used	Maneuvering	Low Altitude Operation
CEN11FA300	4/21/2011	Elk City, OK	Fatal	N7804C	Airplane	Wittman Tailwind W-8	Purchased Used	Maneuvering	Loss of Control in Flight
ERA11CA256	4/21/2011	Locust Grove, GA	Nonfatal	N190GE	Airplane	Vans RV8	Built	Takeoff	Loss of Control on Ground

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
CEN11LA305	4/23/2011	Massillon, OH	Nonfatal	N614S	Helicopter	Rotorway Exec	Built	En Route	System/ Component Failure – Powerplant
WPR11CA206	4/23/2011	Heber, UT	Nonfatal	N5491W	Airplane	Team Rocket F1	Built	Landing	Loss of Control on Ground
WPR11LA207	4/23/2011	Marsing, ID	Nonfatal	N59TD	Airplane	Vans RV7A	Built	Initial Climb	System/ Component Failure – Powerplant
CEN11CA321	4/27/2011	Minford, OH	Nonfatal	N718PF	Airplane	Vans RV10	Built	En Route	System/ Component Failure – Non-Power
CEN11FA310	4/29/2011	Pulaski, WI	Fatal	N701MJ	Airplane	Zenith Aircraft Company STOL CH701	Built	Initial Climb	Loss of Control in Flight
ERA11CA279	4/30/2011	Somerset, PA	Nonfatal	N145HF	Airplane	Avid Flyer	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
CEN11FA312	5/1/2011	Elephant Butte, NM	Fatal	N89MM	Airplane	Kitfox Speedster	Purchased Used	En Route	Loss of Control in Flight
WPR11LA216	5/1/2011	Livermore, CA	Nonfatal	N998RV	Airplane	Vans RV8	Built	Landing	Abrupt Maneuver
CEN11CA314	5/2/2011	Kansas City, MO	Nonfatal	N50KP	Airplane	Lancair Legacy	Built	Landing	Undershoot/ Overshoot
CEN11LA316	5/3/2011	Blue Springs, NE	Fatal	N103EB	Gyroplane	Rotor Flight Dynamics Dominator	Built	Initial Climb	Collision on Takeoff or Landing
CEN11FA319	5/4/2011	Shreveport, LA	Fatal	N914KM	Airplane	Europa XS	Purchased Used	En Route	Loss of Control in Flight
ERA11LA282	5/4/2011	Palm Coast, FL	Nonfatal	N705AP	Airplane	D'Apuzzo Senior Aero Sport D-260	Purchased Used	En Route	System/ Component Failure – Powerplant
CEN11CA326	5/5/2011	Albuquerque, NM	Nonfatal	N314JF	Airplane	Quickie Aircraft Quickie Q2	Purchased Used	Maneuvering	System/ Component Failure – Non-Power
ERA11FA285	5/6/2011	Richlands, NC	Fatal	N23PH	Airplane	Lancair Legacy	Built	En Route	Fuel Related

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
CEN11FA324	5/7/2011	Conroe, TX	Fatal	N913RA	Airplane	S.A.Ravin Aircraft 500	Built	Initial Climb	Fire – Non-Impact
ERA11LA300	5/13/2011	Tidioute, PA	Nonfatal	N433UB	Airplane	Zenith Aircraft Company STOL CH701	Built	Approach	Other
CEN11CA336	5/14/2011	Scott, LA	Nonfatal	None	Gyroplane	KB3 Gyroplane	Built	Takeoff	Collision on Takeoff or Landing
ERA11CA311	5/17/2011	Taccoa, GA	Nonfatal	N1150	Airplane	Ace Aircraft Corben Junior Ace	Purchased Used	Landing	Loss of Control on Ground
WPR11FA230	5/18/2011	Pioneer, CA	Fatal	N121J	Airplane	Lancair Legacy	Purchased Used	En Route	Controlled Flight Info Terrain
CEN11CA354	5/21/2011	Albuquerque, NM	Nonfatal	N79BC	Airplane	Lancair 320	Purchased Used	Landing	Loss of Control on Ground
WPR11LA233	5/21/2011	Cody, WY	Nonfatal	N52VC	Airplane	Vans RV6A	Purchased Used	En Route	Controlled Flight Info Terrain
CEN11FA346	5/22/2011	Erie, CO	Fatal	N420FH	Airplane	Cassutt III	Built	Initial Climb	Other
CEN11LA361	5/22/2011	Colorado Springs, CO	Nonfatal	N457CF	Airplane	Pitts S1S	Purchased Used	Landing	Abnormal Runway Contact
WPR11LA234	5/24/2011	Puyallup, WA	Nonfatal	N34NH	Airplane	Zenith Aircraft Company STOL CH701	Built	Landing	Loss of Control in Flight
CEN11LA367	5/30/2011	Sioux City, IA	Nonfatal	N204TJ	Airplane	Cozy MK III	Built	Maneuvering	System/ Component Failure – Powerplant
ERA11LA325	6/3/2011	Merritt Island, FL	Nonfatal	N434JC	Airplane	Comp Air CA-4	Built	Landing	Abnormal Runway Contact
WPR11CA249	6/3/2011	Heron, MT	Nonfatal	N316BR	Airplane	Smith Aviation Super Cub	Built	Landing	Abnormal Runway Contact
CEN11CA377	6/4/2011	Dexter, NM	Nonfatal	N820RC	Airplane	Vans RV6A	Purchased Used	Landing	Collision on Takeoff or Landing
CEN11LA371	6/4/2011	Edgewood, NM	Nonfatal	N514R	Airplane	Vans RV9A	Built	Takeoff	Runway Excursion

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
CEN11LA374	6/4/2011	Minneapolis, MN	Nonfatal	N242RM	Airplane	Progressive Aerodyne SeaRey	Built	Initial Climb	System/ Component Failure – Non-Power
WPR11CA247	6/4/2011	Bellingham, WA	Nonfatal	N118PS	Airplane	Nieuport 11	Purchased Used	Landing	Loss of Control on Ground
CEN11CA410	6/6/2011	Canon City, CO	Nonfatal	N238W	Airplane	Glasair Glastar	Built	Approach	System/ Component Failure – Powerplant
CEN11CA389	6/10/2011	Oakwood, OK	Nonfatal	N25LC	Airplane	Vans RV6A	Built	Landing	Collision on Takeoff or Landing
ERA11LA336	6/10/2011	Scarborough, ME	Nonfatal	N915PK	Airplane	Kitfox II	Purchased Used	Initial Climb	Loss of Control in Flight
CEN11LA384	6/12/2011	Azle, TX	Nonfatal	N6ZY	Airplane	Lancair 360	Built	En Route	System/ Component Failure – Powerplant
ERA11CA339	6/12/2011	Bennettsville, SC	Nonfatal	N444YB	Airplane	Rans S-10	Purchased Used	Takeoff	Runway Excursion
WPR11FA258	6/12/2011	Aguila, AZ	Nonfatal	N189SB	Airplane	Murphy Moose	Built	Maneuvering	System/ Component Failure – Powerplant
CEN11CA395	6/13/2011	Moriarity, NM	Nonfatal	N81DN	Airplane	Rutan Long-EZ	Purchased Used	Landing	Loss of Control on Ground
CEN11LA385	6/13/2011	Coalgate, OK	Nonfatal	N80WW	Airplane	Vans RV6A	Built	En Route	System/ Component Failure – Powerplant
CEN11CA411	6/18/2011	Gardner, KS	Nonfatal	N563	Airplane	Sonex	Purchased Used	Approach	Undershoot/ Overshoot
WPR11FA268	6/19/2011	Tehachapi, CA	Fatal	N851LT	Airplane	Thorp T-18	Purchased Used	En Route	Controlled Flight Info Terrain
ERA11CA355	6/20/2011	Carthage, NC	Nonfatal	N4209F	Airplane	CGS Aviation Hawk Arrow	Purchased Used	Approach	System/ Component Failure – Powerplant

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
WPR11LA280	6/22/2011	Sheridan, WY	Nonfatal	N4546Y	Airplane	Vans RV8	Built	Landing	Loss of Control on Ground
CEN11CA423	6/24/2011	Angel Fire, NM	Nonfatal	N678VR	Airplane	Vans RV8	Purchased Used	Landing	Loss of Control on Ground
CEN11LA419	6/25/2011	Gwinn, MI	Nonfatal	N16DV	Airplane	Pietenpol Air Camper	Built	Landing	Loss of Control on Ground
ERA11FA360	6/26/2011	Andalusia, AL	Fatal	N289DH	Airplane	Barracuda	Built	Approach	Loss of Control in Flight
ERA11LA361B	6/26/2011	Pompano Beach, FL	Nonfatal	N484BD	Airplane	Cozy MK IV	Built	Taxi	Ground Collision
WPR11LA289	6/26/2011	West Glacier, MT	Nonfatal	N397JL	Airplane	Fly Fisher	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
WPR11LA291	6/27/2011	Moses Lake, WA	Nonfatal	N9103L	Airplane	Quad City Ultralight Challenger II	Purchased Used	Maneuvering	System/ Component Failure – Powerplant
CEN11LA432	6/28/2011	Gladewater, TX	Nonfatal	N751WB	Airplane	Zenith Aircraft Company CH750	Built	Takeoff	Loss of Control in Flight
CEN11FA431	6/29/2011	Howell, MI	Fatal	N8AL	Airplane	Thorp T-18	Purchased Used	Approach	Loss of Control in Flight
CEN11FA433	6/29/2011	Neshkoro, WI	Fatal	N12911	Airplane	Quad City Ultralight Challenger II	Built	Initial Climb	System/ Component Failure – Powerplant
CEN11LA429	6/29/2011	Oshkosh, WI	Nonfatal	N56PK	Airplane	Wittman Tailwind W-8	Built	Initial Climb	System/ Component Failure – Powerplant
CEN11CA439	6/30/2011	Sisterdale, TX	Nonfatal	N6917	Airplane	B-2	Purchased Used	Maneuvering	Controlled Flight Info Terrain
CEN11FA434	6/30/2011	Yukon, OK	Fatal	N358MA	Airplane	Lancair 320	Purchased Used	Approach	Loss of Control in Flight

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
CEN11FA436	6/30/2011	Ottumwa, IA	Fatal	N773RY	Airplane	773 Racer	Built	En Route	System/ Component Failure – Powerplant
CEN11LA449	6/30/2011	Leander, TX	Nonfatal	N59VA	Airplane	Vans RV9A	Purchased Used	Landing	System/ Component Failure – Powerplant
ERA11CA373	6/30/2011	Gray Coourt, SC	Nonfatal	N67KL	Airplane	Zenith Aircraft Company CH601	Built	En Route	System/ Component Failure – Powerplant
CEN11LA455	7/1/2011	Toledo, OH	Nonfatal	N433GC	Airplane	Rans S-17	Purchased Used	Initial Climb	Loss of Control in Flight
ERA11FA374	7/2/2011	Calhoun, GA	Fatal	N6PX	Airplane	Sonex	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
CEN11FA443	7/3/2011	Port O'Connor, TX	Fatal	N11001	Airplane	Lancair IV P	Built	En Route	Loss of Control in Flight
ERA11LA400	7/4/2011	Fort Drum, FL	Nonfatal	N3226N	Airplane	Vans RV4	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
CEN11CA454	7/6/2011	Decker, IN	Nonfatal	N25VK	Gyroplane	Rotary Air Force RAF 2000	Purchased Used	Landing	Abnormal Runway Contact
ANC11LA060	7/7/2011	Sterling, AK	Nonfatal	N18YX	Airplane	Sonex Waiex	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
CEN11LA464	7/7/2011	East Liverpool, OH	Nonfatal	N7808M	Airplane	DerJager D 1X	Purchased Used	Approach	Loss of Control in Flight
CEN11FA469	7/9/2011	Dudley, MO	Fatal	N113RB	Airplane	Monnett Sonerai II	Built	Unknown	Loss of Control in Flight
WPR11CA321	7/10/2011	Cedar City, UT	Nonfatal	N2015U	Airplane	Thorp T-221	Purchased used	En Route	Fuel Related
CEN11LA490	7/13/2011	Peyton, CO	Nonfatal	N61262	Airplane	Darrow AL-6	Purchased Used	En Route	System/ Component Failure – Powerplant

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
CEN11LA481	7/15/2011	Jackson, MI	Nonfatal	N122DG	Gyroplane	Rhino II	Built	Takeoff	Loss of Control in Flight
ERA11LA403	7/15/2011	Batavia, NY	Nonfatal	N113SM	Airplane	Murphy Rebel Elite	Purchased Used	Initial Climb	Loss of Control in Flight
CEN11CA486	7/16/2011	Paxton, IL	Nonfatal	N9040W	Airplane	Zenith Aircraft Company STOL CH701	Purchased Used	Takeoff	Loss of Control in Flight
CEN11LA488	7/16/2011	Jackson, MI	Nonfatal	N341MD	Airplane	Volksplane VP-1	Built	Initial Climb	System/ Component Failure – Powerplant
WPR11FA333	7/17/2011	Glendale, OR	Fatal	N701RD	Airplane	Zenith Aircraft Company STOL CH701	Purchased Used	Takeoff	System/ Component Failure – Powerplant
WPR11CA341	7/19/2011	SAN JOSE, CA	Nonfatal	N411TM	Airplane	Starduster Starduster Too SA-300	Purchased Used	Landing	Ground Collision
CEN11CA521	7/20/2011	Jamestown, ND	Nonfatal	N343A	Airplane	Glasair II	Built	Landing	Loss of Control on Ground
CEN11LA527	7/22/2011	Ashtabula, OH	Nonfatal	N240JS	Airplane	Quickie Aircraft Quickie Q2	Built	Takeoff	System/ Component Failure – Powerplant
ERA11LA418	7/24/2011	Hartford, KY	Nonfatal	N164BF	Airplane	Vans RV6	Built	En Route	Fuel Related
CEN11LA506	7/25/2011	Oshkosh, WI	Nonfatal	N559RD	Gyroplane	Rotor Flight Dynamics Dominator	Purchased Used	Takeoff	Loss of Control in Flight
CEN11LA514	7/25/2011	Monroe City, MO	Nonfatal	N20JE	Airplane	Vans RV4	Purchased Used	Approach	System/ Component Failure – Powerplant
WPR11LA364	7/26/2011	Sedona, AZ	Nonfatal	N671T	Airplane	Express Aircraft Company Series 2000	Built	Landing	Abnormal Runway Contact
CEN11LA530	7/28/2011	Fort Worth, TX	Nonfatal	N114DC	Airplane	Vans RV4	Purchased Used	En Route	Fuel Related
CEN11LA539	7/29/2011	Salem, IA	Nonfatal	N115RH	Airplane	Cavalier SA102.5	Purchased Used	Maneuvering	System/ Component Failure – Powerplant

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
WPR11CA353	7/29/2011	Sheridan, WY	Nonfatal	N742RJ	Airplane	Vans RV7A	Built	Takeoff	Loss of Control in Flight
CEN11FA528	7/30/2011	Springfield, OH	Fatal	N453WB	Airplane	Wright B Flyer	Built	En Route	System/ Component Failure – Powerplant
ERA11CA432	7/30/2011	Huntington, WV	Nonfatal	N434WM	Airplane	Rans S-6S	Purchased Used	Takeoff	Abnormal Runway Contact
CEN11FA537	7/31/2011	Big Rock, IL	Fatal	N345JM	Airplane	E-Racer	Built	Maneuvering	Loss of Control in Flight
WPR11CA358	7/31/2011	Yamhill, OR	Nonfatal	N30456	Airplane	Avid Mark IV	Built	Landing	System/ Component Failure – Non-Power
WPR11LA371	8/2/2011	Republic, WA	Nonfatal	N3135J	Airplane	Kolb Twinstar II	Built	Landing	Loss of Control on Ground
CEN11LA546	8/4/2011	Reedsburg, WI	Fatal	N340BR	Airplane	Quad City Ultralight Challenger II	Built	Takeoff	Loss of Control in Flight
CEN11CA550	8/5/2011	Colorado Springs, CO	Nonfatal	N675RE	Airplane	Vans RV6A	Purchased Used	Landing	Abnormal Runway Contact
ERA11CA440	8/5/2011	Frostproof, FL	Nonfatal	N13LN	Airplane	Arion Aircraft Lightning	Built	Initial Climb	Loss of Control in Flight
CEN11LA553	8/6/2011	Metone, IN	Nonfatal	N128BH	Helicopter	Eagle R&D Helicycle	Built	Landing	System/ Component Failure – Powerplant
ERA11CA442	8/6/2011	Farmingdale, NY	Nonfatal	N723AD	Airplane	Arion Aircraft Lightning	Built	Landing	Loss of Control on Ground
WPR11LA373	8/6/2011	Chino Hills, CA	Nonfatal	N162CT	Helicopter	Rotorway Exec	Built	En Route	System/ Component Failure – Powerplant
ERA11LA444	8/7/2011	Paducah, KY	Nonfatal	N462WP	Airplane	Vans RV7A	Built	Initial Climb	System/ Component Failure – Powerplant

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
WPR11CA399	8/12/2011	Dubois, WY	Nonfatal	N56WY	Airplane	CubCrafters Carbon Cub	Purchased Used	En Route	Controlled Flight Info Terrain
CEN11LA573A	8/13/2011	Conroe, TX	Fatal	N16DD	Airplane	Vans RV8	Built	Maneuvering	Midair Collision
CEN11LA573B	8/13/2011	Conroe, TX	Fatal	N189DK	Airplane	Vans RV6	Built	Maneuvering	Midair Collision
CEN11LA671	8/13/2011	Lake Jackson, TX	Nonfatal	N7167S	Airplane	Fisher Flying Products Horizon 2	Purchased Used	Takeoff	System/ Component Failure – Powerplant
CEN11LA672	8/13/2011	Bryan, TX	Nonfatal	N53QB	Airplane	Slip Stream International Genesis	Purchased Used	Initial Climb	Loss of Control in Flight
ERA11CA455	8/13/2011	Abingdon, VA	Nonfatal	N376CG	Airplane	Just Aircraft Highlander	Built	Takeoff	Runway Excursion
CEN11LA596	8/17/2011	Columbia, IL	Nonfatal	N284E	Airplane	Jabiru SP170	Purchased Used	Landing	System/ Component Failure – Non-Power
ERA11FA463	8/17/2011	Ransom Township, PA	Fatal	N6613Z	Airplane	Quad City Ultralight Challenger II	Purchased Used	Maneuvering	Controlled Flight Info Terrain
ERA11LA459	8/17/2011	Maysville, NC	Nonfatal	N523RE	Airplane	Pegazair STOL 100	Built	Initial Climb	Loss of Control in Flight
WPR11FA392	8/18/2011	Moore, ID	Fatal	N559Y	Glider	Briegleb BG-12B	Purchased Used	Landing	Loss of Control in Flight
WPR11LA405	8/18/2011	Snohomish, WA	Nonfatal	N701BZ	Airplane	Zenith Aircraft Company STOL CH701	Built	Landing	Abnormal Runway Contact
CEN11LA591	8/20/2011	Delaware, OH	Nonfatal	N2631B	Gyroplane	American Autogyro Sparrow Hawk	Purchased Used	Initial Climb	Abnormal Runway Contact
ERA11CA477	8/20/2011	Bessemer, AL	Nonfatal	N2997G	Airplane	Pitts S1C	Purchased Used	Landing	Loss of Control on Ground
ERA11CA478	8/20/2011	Smithville, TN	Nonfatal	N52CH	Airplane	Avid Mark IV	Purchased Used	Takeoff	Loss of Control on Ground
ERA11FA468A	8/20/2011	Hammonton, NJ	Fatal	N71DM	Airplane	Lancair IV-P	Built	Maneuvering	Midair Collision

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
CEN11LA588	8/21/2011	La Porte City, IA	Nonfatal	N540AF	Airplane	Murphy Rebel Elite	Built	Maneuvering	System/ Component Failure – Non-Power
ERA11CA471	8/24/2011	Ocala, FL	Nonfatal	N250CH	Airplane	Glasair I TD	Purchased Used	Landing	System/ Component Failure – Non-Power
CEN11FA597	8/25/2011	Heath, OH	Fatal	N777BN	Airplane	Lancair 235	Purchased Used	Takeoff	Loss of Control on Ground
WPR11LA436	8/25/2011	Mile Hi Landing Strip, ID	Nonfatal	N727WW	Airplane	Performance Air PA-18	Purchased Used	Landing	Abnormal Runway Contact
ERA11LA473	8/26/2011	Carlton, NY	Nonfatal	N246CV	Airplane	Zenith Aircraft Company STOL CH701	Built	Maneuvering	Fuel Related
WPR11LA412	8/28/2011	Albany, OR	Nonfatal	N642DW	Airplane	Vans RV6A	Built	En Route	System/ Component Failure – Powerplant
CEN11LA618	9/2/2011	Marion, IL	Nonfatal	N100VY	Airplane	Sonex Waiex	Built	Initial Climb	System/ Component Failure – Powerplant
ERA11LA483	9/3/2011	Hollywood, FL	Nonfatal	N241BD	Airplane	Vans RV6A	Purchased Used	Takeoff	System/ Component Failure – Powerplant
WPR11CA433	9/3/2011	Kanab, UT	Nonfatal	N17S	Airplane	Glasair III	Purchased Used	Landing	System/ Component Failure – Non-Power
CEN11FA616	9/4/2011	Seward, NE	Fatal	N88CE	Airplane	Christen Eagle II	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
ERA11CA482	9/4/2011	Memphis, TN	Nonfatal	N36V	Airplane	Questair Venture	Built	Landing	System/ Component Failure – Non-Power
WPR11FA428	9/4/2011	Caldwell, ID	Fatal	N624JS	Airplane	Kitfox Series 7	Built	Initial Climb	Loss of Control in Flight
WPR11FA429	9/4/2011	Kanab, UT	Fatal	N9DZ	Airplane	Rutan Long-EZ	Built	En Route	Unknown

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
ERA11CA485	9/5/2011	Beaufort, NC	Nonfatal	N334JH	Airplane	Glasair SHA	Built	Initial Climb	Fuel Related
CEN11FA634	9/7/2011	Winfield, KS	Fatal	N554JR	Airplane	Vans RV7A	Built	Unknown	Loss of Control in Flight
ERA11CA487	9/10/2011	Panama City, FL	Nonfatal	N407HK	Airplane	Thorp T-18	Built	Landing	Collision on Takeoff or Landing
WPR11LA451	9/12/2011	Lancaster, CA	Nonfatal	N2WL	Airplane	White Lightning WLAC-1	Purchased Used	Approach	System/ Component Failure – Powerplant
WPR11FA450	9/15/2011	West Jordan, UT	Fatal	N641JC	Airplane	Vans RV6A	Purchased Used	Approach	Loss of Control in Flight
WPR11FA453	9/15/2011	Reno, NV	Nonfatal	N521XD	Airplane	Questair Venture	Built	Initial Climb	System/ Component Failure – Powerplant
CEN11LA658	9/18/2011	Lancaster, TX	Nonfatal	N98D	Airplane	Vans RV8	Built	Landing	System/ Component Failure – Non-Power
CEN11FA652	9/19/2011	Socorro, NM	Fatal	N91TX	Airplane	New Century Aerosport Radial Rocket	Purchased Used	Maneuvering	Loss of Control in Flight
ERA11LA519	9/19/2011	Okeechobee, FL	Nonfatal	N79GH	Airplane	Bakeng Deuce	Purchased Used	Landing	Abnormal Runway Contact
WPR11LA459	9/19/2011	Greenleaf, ID	Nonfatal	N77VW	Airplane	Steen Aero Lab Skybolt	Purchased Used	Maneuvering	System/ Component Failure – Non-Power
WPR11LA461	9/22/2011	Wells, NV	Nonfatal	N49S	Airplane	Breezy RLU-1	Purchased Used	Maneuvering	Controlled Flight Info Terrain
CEN11CA665	9/23/2011	Lyons, WI	Nonfatal	N6YC	Airplane	Vans RV6	Purchased Used	Landing	Abnormal Runway Contact
CEN11FA663	9/23/2011	Plainwell, MI	Fatal	N54WB	Airplane	Thorp T-18	Built	Approach	Collision on Takeoff or Landing
CEN11CA667	9/24/2011	Lemars, IA	Nonfatal	N29RT	Airplane	Tandem Rocket	Built	Maneuvering	Loss of Control in Flight

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
CEN11LA415	9/24/2011	Lafayette, LA	Nonfatal	N211KF	Airplane	Kitfox IV	Purchased Used	Landing	System/ Component Failure – Powerplant
WPR11LA477A	9/24/2011	West Jordan, UT	Nonfatal	N23UT	Airplane	Starduster Starduster Too SA-300	Purchased Used	Taxi	Ground Collision
ERA11FA504	9/25/2011	Sanford, NC	Fatal	N360TV	Airplane	Velocity RG	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
CEN11LA669	9/27/2011	Marietta, OH	Nonfatal	N499RV	Airplane	Vans RV10	Purchased Used	En Route	System/ Component Failure – Powerplant
WPR11FA474	9/29/2011	Chualar, CA	Fatal	N42GP	Airplane	Zivko Aeronautics Edge 540	Purchased Used	Maneuvering	Low Altitude Operation
CEN11CA679	9/30/2011	Hays, KS	Nonfatal	N384JP	Airplane	Murphy Moose	Built	En Route	System/ Component Failure – Non-Power
ERA11FA512	9/30/2011	Falls of Rough, KY	Fatal	N43KH	Airplane	Glasair III	Purchased Used	Maneuvering	System/ Component Failure – Powerplant
CEN12CA003	10/1/2011	Riley, KS	Nonfatal	N2417T	Airplane	Rans S-7	Purchased Used	Takeoff	Fuel Related
CEN12CA005	10/2/2011	Brush, CO	Nonfatal	N287BM	Airplane	Bushby/Mustang Aeronautics Mustang II	Built	Taxi	Loss of Control on Ground
WPR12FA001	10/4/2011	West Jordan, UT	Fatal	N91BV	Airplane	Pulsar 582	Purchased Used	Initial Climb	Loss of Control in Flight
CEN12LA008	10/5/2011	Versailles, MO	Nonfatal	N9144E	Airplane	Kolb MK III	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
ERA12FA006	10/5/2011	Hedgesville, WV	Fatal	N747HW	Airplane	Arion Aircraft Lightning	Built	Initial Climb	Loss of Control in Flight
CEN12FA010	10/6/2011	Holland, MI	Fatal	N2935R	Airplane	Quickie Aircraft Q200	Built	Approach	Collision on Takeoff or Landing
ERA12CA010	10/6/2011	Sebastian, FL	Nonfatal	N67WR	Airplane	Velocity RG	Purchased Used	Landing	Collision on Takeoff or Landing

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
ERA12LA011	10/6/2011	Wytheville, VA	Fatal	N7026G	Airplane	Rand Robinson KR-2	Purchased Used	Initial Climb	Loss of Control in Flight
CEN12LA013	10/7/2011	Thompsonville, MI	Nonfatal	N455BW	Gyroplane	AutoGyro Calidus	Built	Landing	Loss of Control on Ground
WPR12CA006	10/10/2011	Diamond, WA	Nonfatal	N132LL	Airplane	Bushman	Purchased Used	Landing	Abnormal Runway Contact
CEN12LA014	10/11/2011	Traverse City, MI	Nonfatal	N4595P	Airplane	Zenith Aircraft Company 601XL	Built	Initial Climb	System/ Component Failure – Powerplant
WPR12CA005A	10/11/2011	Madera, CA	Nonfatal	N506DC	Airplane	Vans RV4	Built	Maneuvering	Midair Collision
WPR12CA005B	10/11/2011	Madera, CA	Nonfatal	N427EF	Airplane	Vans RV8	Purchased Used	Maneuvering	Midair Collision
WPR12LA009	10/13/2011	San Rafael, CA	Nonfatal	N762S	Airplane	Pietenpol Air Camper	Purchased Used	Takeoff	System/ Component Failure – Powerplant
CEN12CA027	10/14/2011	Breaux Bridge, LA	Nonfatal	N610EC	Airplane	Vans RV8	Purchased Used	Landing	Collision on Takeoff or Landing
CEN12CA029	10/15/2011	Blair, NE	Nonfatal	N29HT	Gyroplane	American Autogyro Sparrow Hawk	Built	Takeoff	System/Component Failure – Non-Power
WPR12LA013	10/15/2011	Susanville, CA	Nonfatal	N4077B	Airplane	Avid Flyer	Purchased Used	Takeoff	System/ Component Failure – Powerplant
CEN12CA026	10/16/2011	Terrell, TX	Nonfatal	N331EJ	Airplane	Volksplane VP-1	Purchased Used	Initial Climb	Loss of Control in Flight
ERA12CA043	10/17/2011	Grantham, NC	Nonfatal	N25WS	Airplane	Aerosport Scamp	Purchased Used	Approach	Collision on Takeoff or Landing
ERA12LA045	10/18/2011	Woodrow, WV	Nonfatal	N5456C	Airplane	Bearhawk	Purchased Used	Maneuvering	System/ Component Failure – Powerplant
CEN12CA035	10/21/2011	Hibbing, MN	Nonfatal	N43280	Airplane	Avid Mark IV	Purchased Used	En Route	System/ Component Failure – Powerplant

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
ERA12FA018	10/22/2011	Washington, GA	Fatal	N75654	Airplane	Sonex Waiex	Purchased Used	Maneuvering	System/ Component Failure – Non-Power
ERA12FA021	10/23/2011	Lexington, NC	Fatal	N795DB	Airplane	Cozy MK IV	Purchased Used	Approach	Fuel Related
CEN12LA049	10/29/2011	Vienna, OH	Nonfatal	N486LB	Airplane	Pietenpol Air Camper	Purchased Used	Initial Climb	System/ Component Failure – Powerplant
ERA12CA055	10/30/2011	Folkston, GA	Nonfatal	N968TP	Airplane	Vans RV10	Built	En Route	Fuel Related
ERA12FA057	11/1/2011	Taylorsville, GA	Fatal	N262MA	Airplane	Vans RV6	Purchased Used	Unknown	Unknown
ERA12LA100A	11/6/2011	Abingdon, VA	Nonfatal	N62HS	Airplane	Vans RV6	Purchased Used	Landing	Runway Incursion - Vehicle
ERA12LA069	11/9/2011	Nashua, NH	Nonfatal	N220RG	Airplane	Vans RV8	Built	Landing	Abnormal Runway Contact
WPR12CA033	11/9/2011	San Carlos, AZ	Nonfatal	N5089Q	Airplane	Thatcher CX4	Purchased Used	Takeoff	Loss of Control on Ground
CEN12LA071	11/17/2011	Clinton, AR	Nonfatal	N274	Airplane	Zenith Aircraft Company CH602	Purchased Used	Takeoff	System/ Component Failure – Non-Power
ERA12CA078	11/20/2011	Bunn, NC	Nonfatal	N6844B	Airplane	Kitfox IV-1200	Purchased Used	Landing	Abnormal Runway Contact
CEN12CA081	11/23/2011	Center, TX	Nonfatal	N808F	Airplane	Davis DA-2A	Purchased Used	Landing	Loss of Control on Ground
ERA12CA088	11/25/2011	Quinton, VA	Nonfatal	N816BA	Airplane	Vans RV7A	Purchased Used	Initial Climb	Fuel Related
ERA12LA087	11/27/2011	Hernando, FL	Nonfatal	N1321	Airplane	Smith Miniplane DSA-4	Purchased Used	En Route	System/ Component Failure – Powerplant
ERA12CA094	12/1/2011	Caroleen, NC	Nonfatal	N295JS	Airplane	Team Rocket F1H	Purchased Used	Takeoff	Runway Incursion - Animal
ERA12FA093	12/1/2011	Fulton, NY	Fatal	N865JT	Airplane	Wittman Tailwind W-10	Built	Approach	Fuel Related
ERA12CA096	12/4/2011	Courtland, AL	Nonfatal	N212WE	Airplane	Loehle Aircraft Company P5151	Purchased Used	Approach	Windshear/ Thunderstorm

NTSB case ID	Date	Location	Severity	Registra-++tion	++	Aircraft	Built or Used	CICTT phase code	CICTT event code
CEN12LA102	12/8/2011	Festus, MO	Nonfatal	N7138K	Airplane	Rans S-13	Purchased Used	Approach	Loss of Control in Flight
WPR12FA059	12/10/2011	Surprise, AZ	Fatal	N724WD	Airplane	Vans RV7A	Built	En Route	Loss of Control in Flight
WPR12FA062	12/10/2011	Armistead, CA	Fatal	N948RC	Airplane	Vans RV8	Built	Maneuvering	Low Altitude Operation
ERA12FA107	12/11/2011	Somerville, TN	Fatal	N347DS	Airplane	Rans S-7	Purchased Used	Takeoff	Other
ERA12CA124	12/26/2011	Simsbury, CT	Nonfatal	N435AB	Gyroplane	Aerial Gyroplane	Built	Takeoff	Loss of Control in Flight
ERA12CA129	12/30/2011	Mansfield, MA	Nonfatal	N344MK	Airplane	Jabiru Calypso	Purchased Used	Landing	Loss of Control on Ground

Appendix G: Canadian Minister’s Delegate – Recreational Aviation Form C14E Fuel Flow Test Report

Think Pensons

Safety **MD – RA** Sécurité

Minister's Delegates - Recreational Aviation
Représentants du Ministre - Aviation de loisir
Inspection Service - Service d'inspection

FUEL FLOW REPORT

____________________ ____________________________________
Aircraft registration Name of signatory (print)

This functional test of the aircraft fuel system is required to ensure adequate fuel is constantly supplied to the engine in all flight attitudes. It will test the integrity of your fuel supply circuit to power plant.

This test should be carried out on both gravity feed and pressurized systems, and should have all lines and fittings installed.

For this test the aircraft should be positioned in the MAXIMUM ANGLE OF CLIMB and only have the minimum fuel as per the weight and balance report. (MD-RA Form C17/C17F).

Note: *In the past, this report has identified defects such as: dirt/débris lodged inside fuel lines, fuel valves and gascolators with restricted ports, incorrect diameter fuel lines, and faulty electric pumps.*

Method:____

Results:____

Date: ____________ Signature ____

MD-RA Form C14E 20110128

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Appendix H: Special Light-Sport and Experimental Light-Sport Airworthiness Certificates and Sport Pilot Airmen Certificate

Effective September 1, 2004, the Federal Aviation Administration (FAA) defined characteristics describing a category of simple, small, lightweight, low-performance aircraft; identifying them as *light-sport aircraft*. Along with defining this group of aircraft, the FAA created new airworthiness categories and certification procedures for aircraft meeting the light-sport definition. Specifically, two categories of special airworthiness certificate were created, *special light-sport aircraft* (S-LSA) which include aircraft manufactured according to an industry consensus standard rather than a type certificate, and *experimental light-sport aircraft* (E-LSA), which includes provisions for kit-built versions of S-LSA aircraft, S-LSA re-certificated as experimental, and a temporary provision to allow migration of so-called “fat ultralights” that included aircraft that did not conform to 14 CFR Part 103 and that were previously unregistered into the category of E-LSA aircraft.

At the same time, the FAA created a new *sport pilot* airmen certificate(s), with associated operating limitations that granted privileges to operate aircraft meeting the *light-sport aircraft* definition. The sport pilot certificate was envisioned as less expensive and less restrictive entry to pilot certification for purpose of personal recreation. As a tradeoff, the operating limitations of the sport pilot certificate are more restrictive with regard to the aircraft that can be flown, the number of passengers carried, and the time of day during which they could operate. In particular, pilots exercising the privileges of the light-sport certificate are restricted to aircraft meeting the definition of light-sport aircraft. It is important to note that this not only includes aircraft with an S-LSA or E-LSA airworthiness certificates, but any aircraft meeting the definition shown in the next section. For example, aircraft with a standard or experimental airworthiness certificate may be flown by a pilot exercising the privileges of the sport pilot certificate.

The most notable of the differences introduced with the sport pilot certificate is the option to use a current driver’s license to meet the airmen medical certification requirements, and the extension of this option to pilots holding other levels of airmen certification so long as they adhere to the aircraft and operating limitations of the sport pilot certificate. For example, this change is related to E-AB aircraft in that a pilot holding a private, commercial, or air transport pilot airmen certificate may operate an E-AB or type-certificated aircraft that conforms to the definition of a light-sport aircraft (as opposed to the airworthiness certification of S-LSA or E-LSA) using a valid driver’s license to meet the medical certification requirements, so long as they adhere to operating limitations of the sport pilot airmen certificate.

Light-Sport Aircraft Definition

Title 14, *Code of Federal Regulations*, section 1.1 includes the following definition of light sport aircraft:

Light-sport aircraft means an aircraft, other than a helicopter or powered-lift that, since its original certification, has continued to meet the following:

(1) A maximum takeoff weight of not more than—

(i) 1,320 pounds (600 kilograms) for aircraft not intended for operation on water; or

(ii) 1,430 pounds (650 kilograms) for an aircraft intended for operation on water.

(2) A maximum airspeed in level flight with maximum continuous power (V_H) of not more than 120 knots CAS under standard atmospheric conditions at sea level.

(3) A maximum never-exceed speed (V_{NE}) of not more than 120 knots CAS for a glider.

(4) A maximum stalling speed or minimum steady flight speed without the use of lift-enhancing devices (V_{S1}) of not more than 45 knots CAS at the aircraft's maximum certificated takeoff weight and most critical center of gravity.

(5) A maximum seating capacity of no more than two persons, including the pilot.

(6) A single, reciprocating engine, if powered.

(7) A fixed or ground-adjustable propeller if a powered aircraft other than a powered glider.

(8) A fixed or feathering propeller system if a powered glider.

(9) A fixed-pitch, semi-rigid, teetering, two-blade rotor system, if a gyroplane.

(10) A nonpressurized cabin, if equipped with a cabin.

(11) Fixed landing gear, except for an aircraft intended for operation on water or a glider.

(12) Fixed or retractable landing gear, or a hull, for an aircraft intended for operation on water.

(13) Fixed or retractable landing gear for a glider.

Special Light-sport Aircraft and Experimental Light-sport Aircraft Airworthiness Certification

Title 14, Code of Federal Regulations, section 21.190 includes the following regulations pertaining to certification of special light sport aircraft:

21.190 **Issue of a special airworthiness certificate for a light-sport category aircraft.**

(a) *Purpose.* The FAA issues a special airworthiness certificate in the light-sport category to operate a light-sport aircraft, other than a gyroplane.

(b) *Eligibility.* To be eligible for a special airworthiness certificate in the light-sport category:

(1) An applicant must provide the FAA with—

(i) The aircraft's operating instructions;

(ii) The aircraft's maintenance and inspection procedures;

(iii) The manufacturer's statement of compliance as described in paragraph (c) of this section; and

(iv) The aircraft's flight training supplement.

(2) The aircraft must not have been previously issued a standard, primary, restricted, limited, or provisional airworthiness certificate, or an equivalent airworthiness certificate issued by a foreign civil aviation authority.

(3) The aircraft must be inspected by the FAA and found to be in a condition for safe operation.

(c) *Manufacturer's statement of compliance for light-sport category aircraft.* The manufacturer's statement of compliance required in paragraph (b)(1)(iii) of this section must—

(1) Identify the aircraft by make and model, serial number, class, date of manufacture, and consensus standard used;

(2) State that the aircraft meets the provisions of the identified consensus standard;

(3) State that the aircraft conforms to the manufacturer's design data, using the manufacturer's quality assurance system that meets the identified consensus standard;

(4) State that the manufacturer will make available to any interested person the following documents that meet the identified consensus standard:

(i) The aircraft's operating instructions.

(ii) The aircraft's maintenance and inspection procedures.

(iii) The aircraft's flight training supplement.

(5) State that the manufacturer will monitor and correct safety-of-flight issues through the issuance of safety directives and a continued airworthiness system that meets the identified consensus standard;

(6) State that at the request of the FAA, the manufacturer will provide unrestricted access to its facilities; and

(7) State that the manufacturer, in accordance with a production acceptance test procedure that meets an applicable consensus standard has—

(i) Ground and flight tested the aircraft;

(ii) Found the aircraft performance acceptable; and

(iii) Determined that the aircraft is in a condition for safe operation.

(d) *Light-sport aircraft manufactured outside the United States.* For aircraft manufactured outside of the United States to be eligible for a special airworthiness certificate in the light-sport category, an applicant must meet the requirements of paragraph (b) of this section and provide to the FAA evidence that—

(1) The aircraft was manufactured in a country with which the United States has a Bilateral Airworthiness Agreement concerning airplanes or Bilateral Aviation Safety Agreement with associated Implementation Procedures for Airworthiness concerning airplanes, or an equivalent airworthiness agreement; and

(2) The aircraft is eligible for an airworthiness certificate, flight authorization, or other similar certification in its country of manufacture.

Title 14, *Code of Federal Regulations,* sections 21.191(i) and 21.193(e) include the following regulations pertaining to certification of special light-sport aircraft, with 14 CFR 21.191(i)(1) being the provision by which the "fat-ultralights" could be certified as E-LSA:

21.191 (i) *Operating light-sport aircraft.* Operating a light-sport aircraft that—

(1) Has not been issued a U.S. or foreign airworthiness certificate and does not meet the provisions of §103.1 of this chapter. An experimental certificate will not be issued under this paragraph for these aircraft after January 31, 2008;

(2) Has been assembled—

(i) From an aircraft kit for which the applicant can provide the information required by §21.193(e); and

(ii) In accordance with manufacturer's assembly instructions that meet an applicable consensus standard; or

(3) Has been previously issued a special airworthiness certificate in the light-sport category under §21.190.

21.193 (e) In the case of a light-sport aircraft assembled from a kit to be certificated in accordance with §21.191(i)(2), an applicant must provide the following:

(1) Evidence that an aircraft of the same make and model was manufactured and assembled by the aircraft kit manufacturer and issued a special airworthiness certificate in the light-sport category.

(2) The aircraft's operating instructions.

(3) The aircraft's maintenance and inspection procedures.

(4) The manufacturer's statement of compliance for the aircraft kit used in the aircraft assembly that meets §21.190(c), except that instead of meeting §21.190(c)(7), the statement must identify assembly instructions for the aircraft that meet an applicable consensus standard.

(5) The aircraft's flight training supplement.

(6) In addition to paragraphs (e)(1) through (e)(5) of this section, for an aircraft kit manufactured outside of the United States, evidence that the aircraft kit was manufactured in a country with which the United States has a Bilateral Airworthiness Agreement concerning airplanes or a Bilateral Aviation Safety Agreement with associated Implementation Procedures for Airworthiness concerning airplanes, or an equivalent airworthiness agreement.

Title 14, *Code of Federal Regulations*, section 61.315 include the following regulations pertaining to the sport pilot airmen certificate:

61.315 **What are the privileges and limits of my sport pilot certificate?**

(a) If you hold a sport pilot certificate you may act as pilot in command of a light-sport aircraft, except as specified in paragraph (c) of this section.

(b) You may share the operating expenses of a flight with a passenger, provided the expenses involve only fuel, oil, airport expenses, or aircraft rental fees. You must pay at least half the operating expenses of the flight.

(c) You may not act as pilot in command of a light-sport aircraft:

(1) That is carrying a passenger or property for compensation or hire.

(2) For compensation or hire.

(3) In furtherance of a business.

(4) While carrying more than one passenger.

(5) At night.

(6) In Class A airspace.

(7) In Class B, C, and D airspace, at an airport located in Class B, C, or D airspace, and to, from, through, or at an airport having an operational control tower unless you have met the requirements specified in §61.325.

(8) Outside the United States, unless you have prior authorization from the country in which you seek to operate. Your sport pilot certificate carries the limit "Holder does not meet ICAO requirements."

(9) To demonstrate the aircraft in flight to a prospective buyer if you are an aircraft salesperson.

(10) In a passenger-carrying airlift sponsored by a charitable organization.

(11) At an altitude of more than 10,000 feet MSL or 2,000 feet AGL, whichever is higher.

(12) When the flight or surface visibility is less than 3 statute miles.

(13) Without visual reference to the surface.

(14) If the aircraft:

(i) Has a V_H greater than 87 knots CAS, unless you have met the requirements of §61.327(b).

(ii) Has a V_H less than or equal to 87 knots CAS, unless you have met the requirements of §61.327(a) or have logged flight time as pilot in command of an airplane with a V_H less than or equal to 87 knots CAS before April 2, 2010.

(15) Contrary to any operating limitation placed on the airworthiness certificate of the aircraft being flown.

(16) Contrary to any limit on your pilot certificate or airman medical certificate, or any other limit or endorsement from an authorized instructor.

(17) Contrary to any restriction or limitation on your U.S. driver's license or any restriction or limitation imposed by judicial or administrative order when using your driver's license to satisfy a requirement of this part.

(18) While towing any object.

(19) As a pilot flight crewmember on any aircraft for which more than one pilot is required by the type certificate of the aircraft or the regulations under which the flight is conducted.

Title 14, *Code of Federal Regulations*, section 61.303(b) include the following regulations pertaining to the driver's license medical provision:

61.303 (b) A person using a U.S. driver's license to meet the requirements of this paragraph must—

(1) Comply with each restriction and limitation imposed by that person's U.S. driver's license and any judicial or administrative order applying to the operation of a motor vehicle;

(2) Have been found eligible for the issuance of at least a third-class airman medical certificate at the time of his or her most recent application (if the person has applied for a medical certificate);

(3) Not have had his or her most recently issued medical certificate (if the person has held a medical certificate) suspended or revoked or most recent Authorization for a Special Issuance of a Medical Certificate withdrawn; and

(4) Not know or have reason to know of any medical condition that would make that person unable to operate a light-sport aircraft in a safe manner.

The present study did not specifically attempt to assess the impact of the regulatory changes related to light-sport aircraft and sport pilot airmen certificate; however, there is evidence of those effects in the accident record. Figure H1 illustrates the increase in the proportion of accident aircraft meeting the weight definition of light-sport aircraft and Figure H2 illustrates the increase in proportion of E-AB aircraft accidents without a first, second, or third class medical. In the absence of associated data, it can be assumed that these findings are indicative of an increase in activity related to pilots exercising the sport pilot provision. They do not, however, assess the specific risk of these changes in regulation.

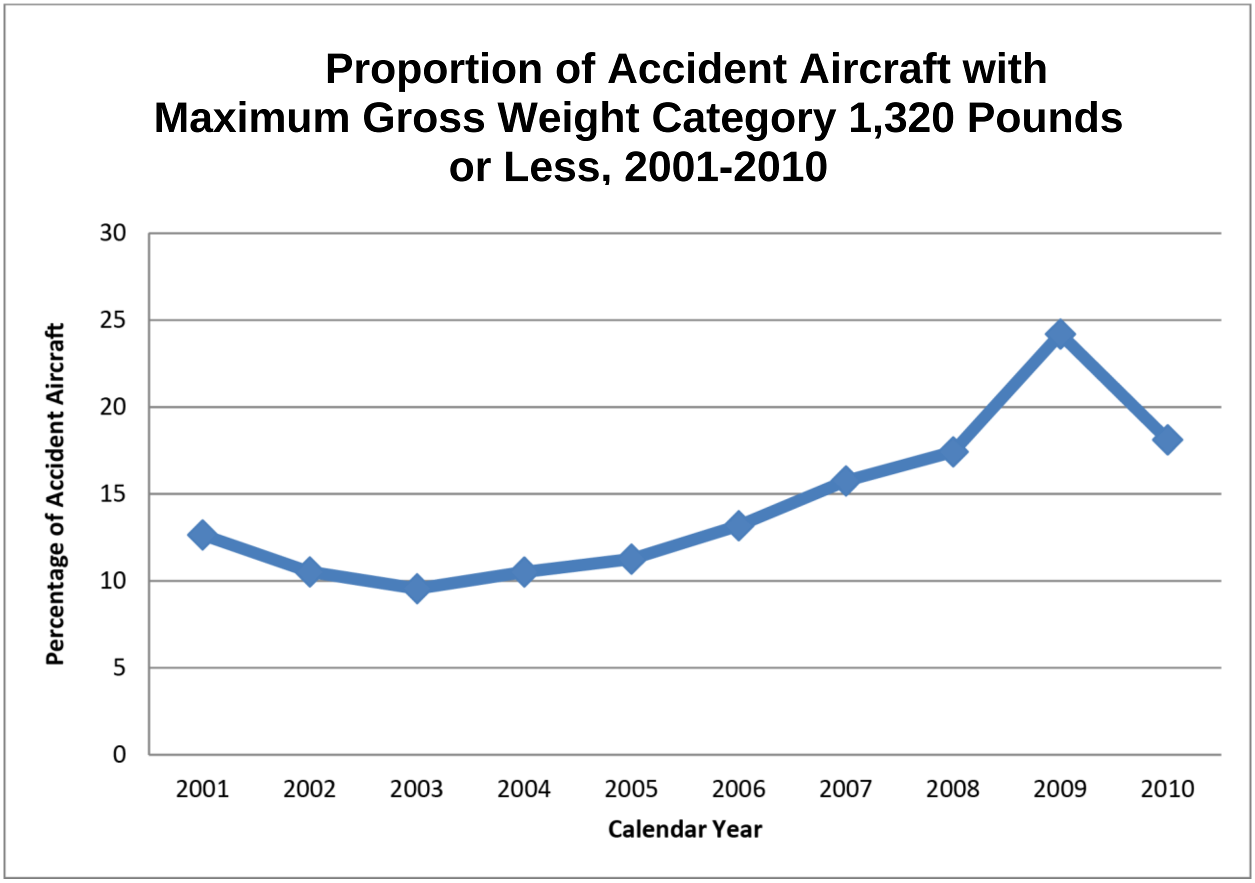

Figure H1. Chart illustrating an increase in the proportion of accident aircraft meeting the weight limitation of light-sport aircraft, following the 2004 effectiveness date of the light-sport aircraft and sport pilot rule.

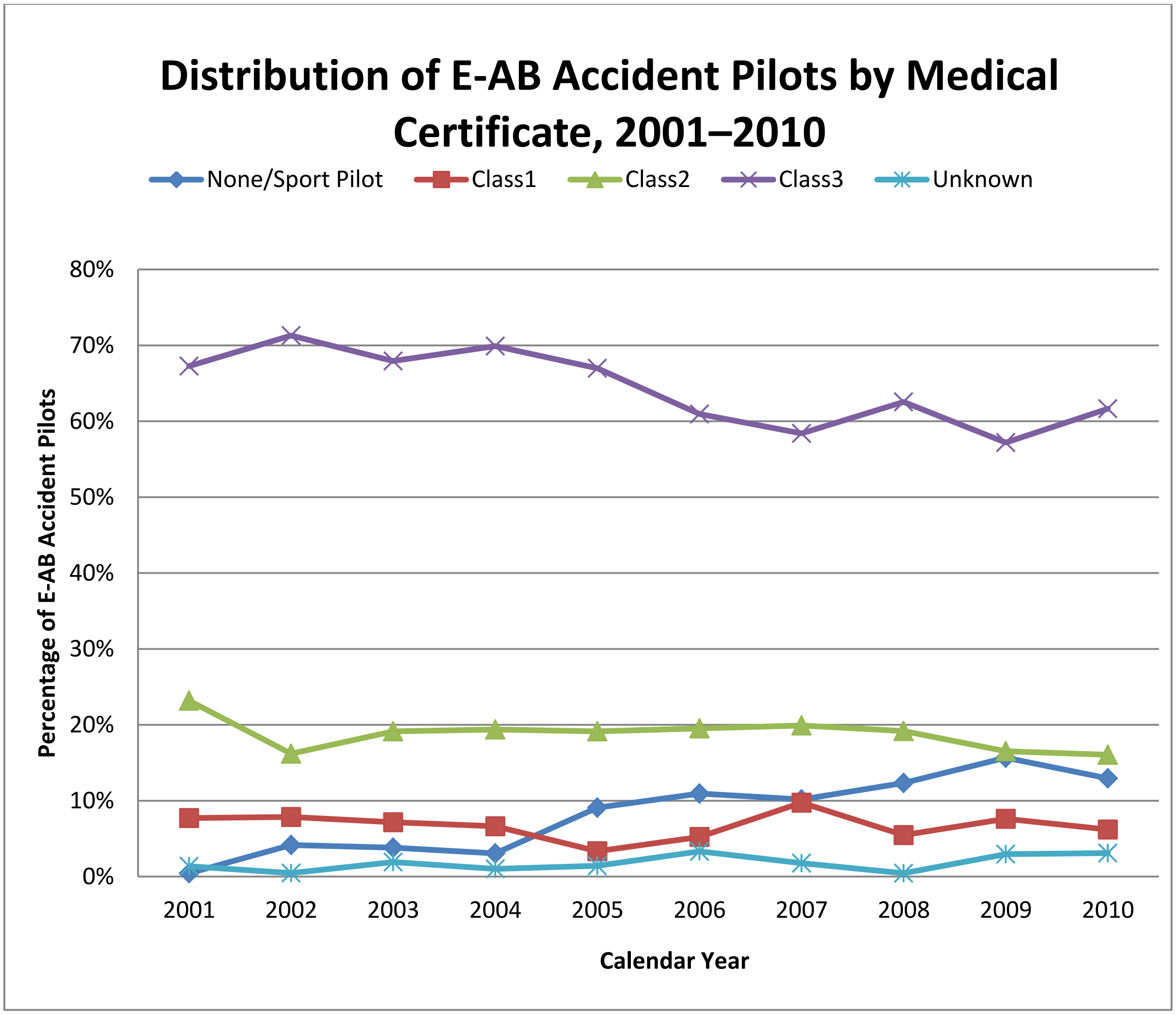

Figure H2. Chart illustrating an increase in the proportion of accident pilots of E-AB aircraft without a First, Second, or Third Class medical following the 2004 effective date of the light-sport aircraft and sport pilot rule.