Cover letter for Proposed Standard

Standard for the Design and Manufacturer of
Reciprocating Spark Ignition Engines for Light Sport Aircraft

December 20, 2002

Dear Task Group

The proposed standard for Light Sport Aircraft engines has been out for some time for comment. Comments that have been received have been incorporated and some items dropped from the original drafts. Many non-members have offered comments from outside the ASTM group and in each case they have been encouraged to participate in the process to get standards that are the most comprehensive possible.

In forming the draft we had to consider the ultimate goal of the engine standard. The Sport category has many engine options that need to be assessed on an equal basis. The public will have expectation that the category of product will have some level of testing and compatibility with the end use.

Other standards were compared and some items deleted, some were incorporated, into the language of the draft. Standards for glider application do not address the more limited glide ratio of a light sport aircraft, including powered parachutes, trikes, and other light craft in this category, where the concern of power off landings is not considered an issue for gliders. Certified aircraft, used at night and on mostly heavy aircraft types, have excessive testing devoted to flight concerns that most sport aircraft will not see. Our recommendations need to be in between these two visions of powered aircraft.

In the matter of the qualification standards simplified testing can be done to assure that claims made for durability and suitability for the end user is demonstrated on each engine design. Manufactures need a simple method to prove durability without years of extensive testing and documentation that has been the normal method under FAR and JAR regulations.

In a broad overview this is the basic rational of the following sections.

Our heading reflects the idea that this standard is for piston engines that have spark ignitions. Diesels, turbines, engines not yet invented, need, and should, have there own standard written by persons who can determine what is a reasonable and necessary list of coercers to address.

Section 1
Simple statement for the practice
Section 2
Simple statement for referenced documents
Section 3
Simple statement for Use
Section 4
Base requirements to outline standards for manufacturer to apply this document to each product they may design.

Section 5

Defines data the manufacturer will need to maintain after production. Defines support material that must be available for the airframe manufacturer for the correct operations and installation of the design. Defines support material that is required to insure continued use of the design after installation.

Section 6

Defines the scope the manufacturer must design the engine for. Basic design needs for aircraft version engines that must be addressed for aircraft version engines**.**

Section 7

Requirements that a manufacturer can demonstrate the suitability for the application of aircraft usage.

With respect to simplified methods for proving the engines the section contains a formula to demonstrate durability. This formula gives the manufacturer a method to prove the TBO without extensive multiple engine tests. The limits of wear, determined by the manufacturer, and overhaul limits, determined by the manufacturer, will not require years of evaluation on test engines.

Section 8

Assurances that the manufacturer can control materials within the manufacturing process.

While this is a very brief overview of the document I invite anyone, who would like to discuss any negatives they may consider, to contact the writer. With your help on the document we can achieve something special that will give our Sport Aircraft Engine standard recognition and remove the stigma of the untested experimental tag that has been given to our category of engines. Most manufactures have extensively tested, developed, and worked towards a safe and suitable product. We need to give them the tools to have that recognized and still satisfy the expectation the public will have with our category of aircraft.

You may contact me at techsupport2@kodiakbs.com or you may contact Dan Schultz at dschultz@astm.org

Eric Tucker

Standard Specification for the Design and Manufacturer of Reciprocating Spark Ignition Engines for Light Sport Aircraft

This standard is issued under the fixed designation F37.70; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last re-approval.

1. Scope

1.1 This practice covers minimum requirements for the design and manufacture of engines for light sport aircraft.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *AWS Standards:*[2]

As applicable.

2.2 *ASME Standards:*[3]

As applicable.

2.3 ASTM F37.2X Standard Practice for light sport aircraft manufacturer quality assurance program.

2.4 ASTM F37.32 Standard Specification for a Continue Airworthiness System for Powered Parachute Aircraft.

2.5 ASTM F37.33 Standard Specification for Required Product Information to be Provided with Powered Parachute Aircraft.

3. Significance and Use

3.1 This practice provides designers and manufacturers of engines for light sport aircraft design references and criteria to use in designing and manufacturing engines.

4. Engine Model Designation

4.1 *Engine Parts List* – A parts list is required for each engine model qualified in accordance with this specification.

4.2 *New Engine Model Designations*

4.2.1 Each new engine model must be qualified in accordance with this specification.

4.2.2 Design or configuration changes that impact the installation interface, performance, or operability of the engine require a new engine model designation.

4.3 *Design Changes of Parts* – Each design change of a part or component of an engine model qualified to this specification should be evaluated relative to the requirements of this specification.

5. Data Requirements

5.1 *Retained Data* – The following data and information should be retained on file at the manufacturers facility for at least 10 years after production is discontinued.

5.1.1 Drawings that define the engine configuration

5.1.2 Material and process specifications referenced in the parts drawings

5.1.3 Engineering analyses and test data prepared for qualification with this specification.

5.2 *Delivered Data* – The following data should be delivered to the airplane manufacturer to support design and operation of the applicable airplane.

5.2.1 An Engine Performance Specification that defines the engine performance under all anticipated operating environments.

5.2.2 An Installation Manual that defines all functional and physical interface requirements of the engine. This should include an engine outline/installation drawing.

5.2.3 An Operating Manual that defines normal and abnormal operating procedures and that defines any applicable operating limitations.

5.2.4 A Maintenance Manual that defines periodic installed maintenance, major inspection or overhaul intervals, and defines any other maintenance limitations.

5.2.5 An Overhaul Manual that provides instruction for disassembling the engine to replace and/or repair parts as required to return the engine to airworthy condition that is safe for operation to the next major overhaul.

6. Design Criteria

6.1 *Materials* – The materials used in the engine must be adequate for the intended design conditions of the engine.

6.2 *Fire Prevention* – The design and construction of the engine and the materials used must minimize the probability of the occurrence and spread of fire by:

6.2.1 Using fire resistant lines, fittings and other components which contain a flammable liquid when supplied with the engine.

6.2.1 Shielding or locating components to safeguard against the ignition of leaking flammable fluid.

6.3 *Engine Cooling* – The engine design must include provisions for cooling and the Installation Manual must specify engine and component temperature limitations.

6.4 *Engine mounting* – The maximum allowable limit and ultimate loads for the engine mounting attachments and related structure must be specified.

6.5 *Mechanical Ignition Systems* – Each spark-ignition engine must have a dual ignition system that includes dual spark plugs and separate sources of electrical energy.

6.6 *Electronic Engine Controllers* – (EEC)

6.6.1 Single Fault Tolerance: The EEC should be designed to accommodate single failures of the electrical circuit.

6.6.2 The functioning of EEC's must not be adversely affected by the declared environmental conditions, including temperature, moisture, Electromagnetic Interference (EMI), and High Intensity Radiated Fields (HIRF). The limits to which the system has been qualified shall be documented in the Installation Manual.

6.7 *Fuel and Induction System* –
6.7.1 Induction System Icing: The fuel and air intake passages must be designed to minimize the accretion of ice.
6.7.2 Filtering: The type and degree of fuel and air filtering necessary to prevent obstruction of air or fuel flow must be specified.
6.7.3 Liquid Lock: Each passage in the induction system that conducts a mixture of fuel and air must be self-draining.

6.8 *Lubrication system* – 4 stroke
6.8.1 The lubrication system of the engine must be designed and constructed so that it will function properly in all flight attitudes and atmospheric conditions in which the engine is expected to operate. In wet sump engines, this requirement must be met when only one-half of the maximum lubricant supply is in the engine.
6.8.2 The lubrication system of the engine must be designed and constructed to allow installing a means of cooling the lubricant.
6.8.3 The crankcase must be vented to the atmosphere to preclude leakage of oil from excessive pressure in the crankcase.

6.9 Vibration - The engine must be designed and constructed to function throughout its normal operating range of crankshaft rotational speeds and engine powers without inducing the following conditions:
6.9.1 Excessive stress in any of the engine parts
6.9.2 Excessive vibration forces transmitted to the aircraft structure.

7. Qualification Tests

7.1 *Calibration Test* – Each engine design shall be tested and the basic characteristics of engine rated power, speeds, and fuel consumption shall be determined.
7.2 *Detonation Test* – each engine shall be tested to confirm that the engine will not detonate throughout its range of intended conditions of operation using the fuel which the designer/manufacturer has specified for the engine.
7.3 *Accelerated Overhaul Test* – Each engine model must be subjected to an engine test that simulates an engine overhaul interval. This test shall incorporate:
7.3.1 At least 100% of the time at maximum power that would occur over the overhaul interval.
7.3.2 At least 10% of the time at cruise power that would occur over the overhaul interval.
7.3.3 At least 1 cycle per hour of test from maximum power to cruise power and back.
7.3.4 At least one engine start for each five hours of testing.
7.3.5 During operation at maximum power, one cylinder must be maintained within 10ºF of the limiting cylinder head temperature, the other cylinders must be operated at a temperature not lower than 50 degrees F below the limiting temperature, and the oil inlet temperature must be maintained within 10 degrees F of the limiting temperature.
7.3.6 The engine must be fitted with a propeller that thrust-loads the engine to the maximum thrust which the engine is designed to resist at each applicable operating condition specified in this section.
7.3.7 Each accessory drive and mounting attachment must be loaded. During operation at maximum power, the load imposed by each accessory used only for an aircraft service must be the limit load specified by the applicant for the engine drive or attachment point.
7.3.8 After completing the Accelerated Overhaul Test each engine must be completely disassembled and each component must conform to the new or overhaul limits established by the designer/manufacturer.

8. Manufacturing Requirements The engine manufacturer shall establish inspections and tests necessary to ensure that each article produced conforms to the design and is in a condition for safe operation, including as applicable:
8.1 Inspections for raw materials, purchased items, and parts and assemblies produced by suppliers, including methods used to ensure acceptable quality of parts and assemblies that cannot be completely inspected for conformity and quality when delivered to the engine manufacturers facility.
8.2 Production inspection of individual parts and complete assemblies, including the identification of any special manufacturing processes involved, the means used to control the processes, and the final test procedure for the completed engine.
8.3 A non-conforming materials review system, that includes documentation of parts disposition decisions, and a system to dispose of rejected parts.
8.4 A system for informing company inspectors of current changes in engineering drawings, specifications, and quality control procedures.

[1] This practice is under the jurisdiction of ASTM Committee F37 on Recreational Aviation Products and is the direct responsibility of Subcommittee F37.7 Cross Cutting issues. Current edition approved ???. Published ???. Originally published as ??. Last previous edition ??.