[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 23

[Docket No. FAA-2015-5034; Notice No. 23-15-01-SC]

Special Conditions: Kestrel Aircraft Company, Model K-350 Turboprop, Lithium Batteries

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed special conditions.

SUMMARY: This action proposes special conditions for the Kestrel Aircraft Company, Model K-350 Turboprop airplane. This airplane will have a novel or unusual design feature associated with the installation of a rechargeable lithium battery**.** The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: Send your comments on or before **[insert a date 45 days after date of publication in the Federal Register]**.

ADDRESSES: Send comments identified by docket number FAA-2015-5034 using any of the following methods:

- Federal eRegulations Portal: Go to http://www.regulations.gov and follow the online instructions for sending your comments electronically.

- Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, D.C., 20590-0001.
- Hand Delivery of Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, S.E., Washington, D.C., between 9 a.m., and 5 p.m., Monday through Friday, except Federal holidays.
- Fax: Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to http://regulations.gov, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at http://DocketsInfo.dot.gov.

Docket: Background documents or comments received may be read at http://www.regulations.gov at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, D.C., between 9 a.m., and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Ruth Hirt, Federal Aviation Administration, Small Airplane Directorate, Aircraft Certification Service, 901 Locust; Kansas City, Missouri 64106; telephone (816) 329-4108; facsimile (816) 329-4090.

SUPPLEMENTARY INFORMATION:

Comments Invited

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data. We ask that you send us two copies of written comments.

We will consider all comments we receive on or before the closing date for comments. We will consider comments filed late if it is possible to do so without incurring expense or delay. We may change these special conditions based on the comments we receive.

Background

On November 22, 2011, Kestrel Aircraft Company applied for a type certificate for their new Model K-350. The Kestrel Aircraft Company Model K-350 is a single-engine turboprop airplane with the primary structure constructed largely of carbon and epoxy composite material. The turboprop engine will be a Honeywell Model TPE331-14GR-801KT that is integrated with a Hartzell 4 bladed, 110-inch carbon composite propeller. The standard seating configuration offers a one plus five cabin (one pilot and five passengers). Alternate interior configurations will be available from two seats (cargo configuration) up to eight seats total. The K-350 will incorporate an integrated avionics system, retractable landing gear, and a conventional tail configuration.

Specifications expected for the K-350 include the following:

- Maximum altitude: 31,000 Feet
- Maximum cruise speed: 320 Knots True Air Speed

- Maximum takeoff weight: 8,900 Pounds
- Maximum economy cruise: 1,200 Nautical Miles

The K-350 will be certified for single-pilot operations under part 91 and part 135 operating rules. The following operating conditions will be included:

- Day and Night Visual Flight Rules
- Instrument Flight Rules
- Flight Into Known Icing (Phase B certification)

Kestrel Aircraft Company proposes to utilize a rechargeable lithium Main Battery on their new Model K-350 turboprop airplane. The current regulatory requirements for part 23 airplanes do not contain adequate requirements for the application of rechargeable lithium batteries in airborne applications. This type of battery possesses certain failure and operational characteristics with maintenance requirements that differ significantly from that of the nickel cadmium and lead acid rechargeable batteries currently approved in other normal, utility, acrobatic, and commuter category airplanes. Therefore, the FAA is proposing this special condition to require that (1) all characteristics of the rechargeable lithium batteries and their installation that could affect safe operation of the K-350 are addressed, and (2) appropriate Instructions for Continued Airworthiness that include maintenance requirements are established to ensure the availability of electrical power from the batteries when needed.

Type Certification Basis

Under the provisions of 14 CFR 21.17, Kestrel Aircraft Company must show that the K-350 meets the applicable provisions of part 23**,** as amended by amendments 23-1 through 23-62 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 23) do not contain adequate or appropriate safety standards for the K-350 because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the K-350 must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36, and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the Noise Control Act of 1972.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

Novel or Unusual Design Features

The K-350 will incorporate the following novel or unusual design feature: Installation of a rechargeable lithium battery as the Main or Engine Start aircraft battery.

Discussion

The current regulatory requirements for part 23 airplanes do not contain adequate requirements for the application of rechargeable lithium batteries in electrical system design. This type of battery possesses certain failures with operational characteristics and maintenance requirements that differ significantly from that of the nickel cadmium and lead acid rechargeable

batteries currently approved in other normal, utility, acrobatic, and commuter category airplanes. Therefore, the FAA is proposing this special condition to require that (1) all characteristics of the rechargeable lithium batteries and their installation that could affect safe operation of the K-350 are addressed, and (2) appropriate Instructions for Continuous Airworthiness which include maintenance requirements are established to ensure the availability of electrical power from the batteries when needed.

As previously mentioned, Kestrel Aircraft Company proposes to utilize a rechargeable lithium Main Battery on their new Model K-350 turboprop airplane. At the Kestrel Preliminary Type Certification Board Meeting it was brought to the attention of the FAA that the Lithium battery used in the K-350 will be qualified to RTCA standards DO-311, titled Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems. Additionally, on July 18, 2013, Kestrel advised the Civil Aviation Contingency Operations (CACO) that the battery will have Technical Standard Order Authorization for TSO C-179a, titled Permanently Installed Rechargeable Lithium Cells, Batteries and Battery Systems. Finally, Kestrel plans to use the same manufacturer for both the lithium battery and the battery controller.

Presently, there is limited experience with use of rechargeable lithium batteries in applications involving commercial aviation. However, other users of this technology, ranging from wireless telephone manufacturers to the electric vehicle industry, have noted safety problems with lithium batteries. These problems include overcharging, over-discharging, and flammability of cell components, described in the following:

1. Overcharging: In general, lithium batteries are significantly more susceptible to internal failures that can result in self-sustaining increases in temperature and pressure (i.e., thermal

runaway) than the nickel-cadmium or lead-acid counterparts. This is especially true for overcharging which causes heating and destabilization of the components of the cell, leading to the formation (by plating) of highly unstable metallic lithium. The metallic lithium may ignite, resulting in a fire or explosion. Finally, the severity of thermal runaway due to overcharging increases with increasing battery capacity and physical size.

2. Over-discharging: Discharge of some types of lithium battery cells beyond a certain voltage (typically 2.4 volts) can cause corrosion of the electrodes of the cell, resulting in loss of battery capacity that cannot be reversed by recharging. This loss of capacity may not be detected by the simple voltage measurements commonly available to flight crews as a means of checking battery status, which is a problem shared with nickel-cadmium batteries.

3. Flammability of Cell Components: Unlike nickel-cadmium and lead-acid batteries, some types of lithium batteries use liquid electrolytes that are flammable. The electrolyte may serve as a source of fuel for an external fire, if there is a breach of the battery container.

These problems experienced by users of lithium batteries raise concern about the use of these batteries in commercial aviation. The intent of the proposed special condition is to establish appropriate airworthiness standards for lithium battery installations in the K-350 and to ensure, as required by §§ 23.1309 and 23.601, that these battery installations are not hazardous or unreliable.

Applicability

As previously discussed, these special conditions are applicable to the K-350**.** Should Kestrel Aircraft Company apply at a later date for a change to the type certificate to include

another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

Conclusion

This action affects only certain novel or unusual design features on one model of airplane. It is not a rule of general applicability.

List of Subjects in 14 CFR Part 23

Aircraft, Aviation safety, Signs and symbols.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

The Proposed Special Conditions

Accordingly, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for Kestrel Aircraft Company, Model K-350 Turboprop airplanes**.**

1. Kestrel Aircraft Company, Model K-350 Turboprop, Lithium Batteries.

The FAA proposes special conditions that adopt the following requirements:

(a) The flammable fluid fire protection requirement is § 23.863. In the past, this rule was not applied to batteries of normal, utility, acrobatic, and commuter category airplanes since the electrolytes utilized in lead-acid batteries and nickel-cadmium batteries are not flammable.

(b) New Instructions for Continuous Airworthiness that include maintenance requirements to ensure that batteries used as spares have been maintained in an appropriate state of charge and installed lithium batteries have been sufficiently charged at appropriate intervals.

These instructions must also describe proper repairs, if allowed, and battery part number configuration control.

(c) The applicant must conduct a system safety assessment for the failure condition classification of a failure of the battery charging and monitoring functionality (per Advisory Circular 23.1309-1E), and develop mitigation to preclude any adverse safety effects. Mitigation may include software, Airborne Electronic Hardware (AEH) or a combination of software and hardware, which should be developed to the appropriate Design Assurance Level(s) (DALs), respectively (per Advisory Circular 20-115C and Advisory Circular 20-152).

(d) New requirements, listed in paragraph (e), address the hazards of overcharging and over-discharging that are unique to lithium batteries, which should be applied to all rechargeable lithium battery and battery installations on the Model K-350 airplane in lieu of the requirements of § 23.1353(a)(b)(c)(d)(e), amendment 23-62.

Note 1: These special conditions are not intended to replace § 23.1353(a)(b)(c)(d)(e) at amendment 23-62 in the certification basis of airplane K-350 series airplanes. These special conditions apply only to rechargeable lithium batteries and lithium battery systems and their installations. The requirements of § 25.1353 at amendment 23-62 remains in effect for batteries and battery installations on K-350 series that do not use newly technologically developed batteries.

(e) Rechargeable lithium batteries and battery installations on the Model K-350 airplane must be designed and installed as follows:

(1) Safe cell temperatures and pressures must be maintained during—

i. Normal operations;

ii. Any probable failure conditions of charging or discharging or battery monitoring system;

iii. Any failure of the charging or battery monitoring system not shown to be extremely remote.

(2) The rechargeable lithium battery installation must be designed to preclude explosion or fire in the event of (e)(1)(ii) and (e)(1)(iii) failures.

(3) Design of the rechargeable lithium batteries must preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.

(4) No explosive or toxic gasses emitted by any rechargeable lithium battery in normal operation or as the result of any failure of the battery charging system, monitoring system, or battery installation which is not shown to be extremely remote, may accumulate in hazardous quantities within the airplane.

(5) Installations of rechargeable lithium batteries must meet the requirements of § 23.863(a) through (d) at amendment 23-34.

(6) No corrosive fluids or gases that may escape from any rechargeable lithium battery may damage surrounding structure or any adjacent systems, equipment, electrical wiring, or the airplane in such a way as to cause a major or more severe failure condition, in accordance with § 23.1309(c) at amendment 23-62 and applicable regulatory guidance.

(7) Each rechargeable lithium battery installation must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

(8) Rechargeable lithium battery installations must have—

i. A system to automatically control the charging rate of the battery to prevent battery overheating and overcharging, or;

ii. A battery temperature sensing and over-temperature warning system with a means for automatically disconnecting the battery from its charging source in the event of an over-temperature condition, or;

iii. A battery failure sensing and warning system with a means for automatically disconnecting the battery from its charging source in the event of battery failure.

(9) Any rechargeable lithium battery installation functionally required for safe operation of the airplane must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers whenever the State of Charge (SOC) of the batteries has fallen below levels considered acceptable for dispatch of the airplane.

(10) The Instructions for Continued Airworthiness required by § 23.1529 at amendment 23-26 must contain maintenance requirements to assure that the battery has been sufficiently charged at appropriate intervals specified by the battery manufacturer and the equipment manufacturer that contain the rechargeable lithium battery or rechargeable lithium battery system. This is required to ensure that lithium rechargeable batteries and lithium rechargeable battery systems will not degrade below specified ampere-hour levels sufficient to power the aircraft system. The Instructions for Continued Airworthiness must also contain

procedures for the maintenance of replacement batteries in spares storage to prevent the installation of batteries that have degraded charge retention ability or other damage due to prolonged storage at a low state of charge. Replacement batteries must be of the same manufacturer and part number as approved by the FAA.

Note 2: The term "sufficiently charged" means that the battery will retain enough of a charge, expressed in ampere-hours, to ensure that the battery cells will not be damaged. A battery cell may be damaged by lowering the charge below a point where there is a reduction in the ability to charge and retain a full charge. This reduction would be greater than the reduction that may result from normal operational degradation.

(11) In showing compliance with the proposed special conditions herein, paragraphs (e)(1) through (e)(8), and the RTCA document, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems, DO-311, may be used. The list of planned DO-311 tests should be documented in the certification or compliance plan and agreed to by the CACO. Alternate methods of compliance other than DO-311 tests must be coordinated with the directorate and CACO.

Issued in Kansas City, Missouri, on October 28, 2015.

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Aircraft Certification Service
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