



Federal Aviation Administration

Memorandum

Date: JUL 18 2006
To: Manager, Small Airplane Directorate, ACE-100
From: Manager, Fort Worth Aircraft Certification Office, ASW-150
Prepared by: Karl Schletzbaum, Aerospace Engineer, ACE-112
Subject: Review and Concurrence, Equivalent Level of Safety (ELOS) for
14 CFR §23.1353(h), Storage Battery Design and Installation, on
Eclipse Model 500, Project TC3853CH-A
(ELOS) ACE-05-35

This memorandum documents concurrence for the subject finding of Equivalent Level of Safety (ELOS). We request your office to review and concur with the proposed ELOS finding to 14 CFR part 23, § 23.1353(h), Storage Battery Design and Installation. The proposed ELOS will allow for the compliance to the regulation to be accomplished by utilizing a battery, also used for starting the engine to comply with the requirement of § 23.1353(h) with the use of a battery monitoring system. This will also include an indication if the battery is below the appropriate state of charge to meet the requirements of § 23.1353(h), and also will include appropriate Airplane Flight Manual (AFM) procedures to follow in the case that a battery is determined to be below capacity before takeoff or during flight.

Background

The Federal Aviation Administration (FAA) policy regarding compliance to 14 CFR § 23.1353(h) is published in the Advisory Circular (AC) 23-17B. This policy states that the battery which is used to show compliance to this rule should not be the battery that is used to start the airplane engines. Additionally, if the applicant proposes a design that utilizes the starter battery, that an ELOS is required because there must be compensating features to insure that while the airplane is in service that this battery will be able to supply the required electrical loads in the event of a failure of the primary electrical power generating system.

Even though the Eclipse 500 airplane does incorporate two batteries, Eclipse Aviation Corporation (EAC) proposes to show compliance with 14 CFR § 23.1353(h), utilizing both batteries. Since one of the batteries is used to start the engines and is intended to be used for emergency power, it does not meet the requirements for a showing of compliance to 14 CFR § 23.1353(h), and an Equivalent Level of Safety Finding is required to evaluate the proposed design.

Applicable Regulations

The applicable regulation is 14 CFR § 23.1353(h), which states:

Section 23.1353 Storage battery design and installation.

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(h) In the event of a complete loss of the primary electrical power generating system, the battery must be capable of providing at least 30 minutes of electrical power to those loads that are essential to continued safe flight and landing. The 30-minute time period includes the time needed for the pilots to recognize the loss of generated power and take appropriate load shedding action.

Additional guidance is provided in Advisory Circular AC 23-17B. It states:

Per previous guidance on this issue, the airplane's primary electrical power includes the airplane's electrical generation system and the airplane's starter battery when only one battery is installed. The battery for the 30-minute criteria, therefore, should be an independent power source from the airplane's starter battery. If adequate monitoring and procedures are incorporated so the pilot knows that the airplane's starter battery meets the 30 minute criteria after an engine start and during all other operations, an equivalent level of safety may be an acceptable method for using the airplane's starter battery.

Compensating Features

The relevant guidance from AC-17B as it relates to this ELOS is emphasized below:

Section 23.1353 Storage battery design and installation.

Paragraph – 3

Per previous guidance on this issue, the airplane's primary electrical power includes the airplane's electrical generation system and the airplane's starter battery when only one battery is installed. The battery for the 30-minute criteria, therefore, should be an independent power source from the airplane's starter battery. If adequate monitoring and procedures are incorporated so the pilot knows that the airplanes' starter battery meets the 30-minute criteria after an engine start and during all other operations, an equivalent level of safety finding may be an acceptable method for using the airplanes starter battery.

Paragraph – 8

Tests and analyses should be considered for determining the rated operating capacity of the battery, the normal service life, and the continued airworthiness requirement of 14 CFR § 23.1529. For these tests and analyses, the following should be established:

For the operating capacity: the discharge rate, temperature, end-point voltage, etc; and

For the airworthiness requirement: the inspection schedule, useful battery life, end-of-life, etc.

1) In developing the electrical system and the associated battery system capacity, Eclipse sized the batteries to account for the anticipated capacity requirements with a battery at diminished capacity at the lowest anticipated operating temperature.

2) Additionally, per the guidance, EAC has incorporated into its airplane design monitoring systems that monitor and test the state of charge (SOC) of both batteries prior to every take-off. An airplane flight manual procedure will require a check of the batteries' state of charge. If the batteries are not in an adequate state of charge for satisfying the 30-minute requirement, the AFM specifies "Do Not Fly."

(It is also noted that by selecting the ELEC synoptic page of the multifunction display (MFD) at any phase of flight, the pilot can determine each battery's charging current. These parameters are displayed throughout flight. If the display indicates that each battery is still being charged and the charging current is the same or lower than at take-off, then there is reasonable assurance that the batteries are functioning as designed.)

During flight, the airplane's systems monitor the state of charge of the batteries, which by design constantly keeps the batteries charged. EAC has shown by systems design that the conceivable failures that will cause the state of charge to decay below that required to sustain the 30-minute requirement will be annunciated by caution advisory system (CAS) messages, which will require the pilot to take appropriate remedial action, including a requirement to land as soon as practicable. The initial failures result in one of two subsequent failures: Systems Battery Starting to Discharge or Start Battery Starting to Discharge. Both of these events, when sensed in-flight by the aircraft computer system result in CAS messages. The AFM specifies that the pilot shall land as soon as practicable in case of either battery starting to discharge.

Monitoring means for the battery SOC are available in all situations:

1. Normal operation through the ELECT synoptic (though not necessary to periodically monitor, as is explained above,)
2. Failure conditions through CAS messages both for the causes (sensed faults) and effects (battery starting to discharge.)

3) The Model 500 batteries will be maintained in accordance with the appropriate battery vendor maintenance manual. An initial capacity test will be accomplished after a battery has been in service for 12 months. Subsequent capacity tests will occur in either three or six month intervals (depending on the result of the most recent previous test) as defined in the manual. Any battery that is not capable of providing at least 80% of its nameplate capacity will be removed from service.

Recommendation: We concur that the proposed design features described as compensating features in items (1) through (3) provide an equivalent level of safety to the requirement of 14 CFR § 23.1353(h).

Concurred by:

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7-17-06
 Date

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7/18/06
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