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Certification Test Guidance for Small and Medium Sized Rechargeable Lithium Batteries and Battery Systems

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Prepared by: SC-225
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FOREWORD

This report was prepared by Special Committee 225 (SC-225) and approved by the RTCA Program Management Committee (PMC) on December 18, 2013.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal advisory committee and develops consensus-based recommendations on contemporary aviation issues. RTCA's objectives include, but are not limited to:

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- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;

- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and

- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

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EXECUTIVE SUMMARY

RTCA Special Committee SC-225 was formed to develop certification guidance for small and medium sized rechargeable lithium batteries and battery systems.

Members of this committee included representatives from battery and cell manufacturers, avionics manufacturers, aircraft manufacturers, aircraft operators, pilot and flight attendant associations, regulatory and other government agencies, and related industry associations.

The SC-225 committee reviewed and considered regulatory requirements, multiple standards and resources associated with rechargeable lithium batteries in developing this standard. These include FAA Special Conditions related to rechargeable lithium batteries, RTCA/DO-311, UL 1642, UL 2054, UN Section 38.3, and IEC 62133.

1 INTRODUCTION

This document provides design, testing and installation guidance for small (including very small) and medium sized rechargeable lithium batteries and battery systems that are permanently installed on aircraft (see Table 1-1). This document further categorizes battery systems as either Standalone or Embedded.

This section contains safety and design requirements and guidelines as well as quality and other test considerations.

2 QUALIFICATION REQUIREMENTS AND TEST PROCEDURES

This section contains the qualification requirements and test procedures that are performed on rechargeable lithium batteries and battery systems. They include electrical, environmental, and performance requirements and tests.

Testing procedures vary depending on the size of the battery. Some very small batteries are exempted from this standard. A minimum of eight (8) samples are required to perform these tests (see Table 2-2).

3 INSTALLATION CONSIDERATIONS

Basic guidance information is provided to the aircraft installer in this section. This guidance includes the need for a flight crew warning indication (as applicable), a list of some commonly generated hazardous battery emissions, and the importance of reviewing the test data to ensure that the installation design can handle any of the reported results that could have an impact on the aircraft.

The installation should accommodate any venting provisions of the battery or battery system, and must provide containment for electrolyte leakage, toxic gases, and debris. In addition to the guidelines contained within this document, additional lab testing, safety analyses, or on-aircraft testing may need to be performed to demonstrate compliance to the regulatory requirements.

4 GLOSSARY

The Glossary contains a Definition of Terms and a list of Acronyms used in the document.

Appendix A SAFETY GUIDELINES FOR RECHARGEABLE LITHIUM BATTERIES

A summary of the hazards that are associated with rechargeable lithium batteries and the precautions that should be followed when using or handling them are contained in this Appendix.

Appendix B ADDITIONAL REFERENCE MATERIAL

Two matrices comparing the requirements and guidelines in Section 1 to the test procedures in section 2 and the installation considerations in section 3.

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1 INTRODUCTION

Rechargeable lithium batteries, battery systems, and systems with embedded rechargeable lithium batteries (from now on called "batteries and battery systems") of various chemical compositions, sizes, and construction details are being widely promoted for aircraft applications. Among their desirable characteristics are high energy content per unit weight, relatively constant voltage during discharge, the ability to indicate state of charge, and long cycle life. Rechargeable lithium battery systems can provide power throughout the aircraft, including engine or Auxiliary Power Unit (APU) starting, avionics, emergency, and other systems. Because of their high specific energy and potential thermal instability, they can present hazards if improperly designed, tested, used, or stored.

1.1 Purpose

This document provides design, testing, and installation guidance for small[1] and medium sized rechargeable lithium batteries and battery systems that are permanently installed on aircraft. The tests defined in this document also provide a standardized method for characterization of performance of batteries and battery systems.

This document contains certification guidance for batteries and battery systems permanently installed on aircraft. This guidance is provided to the designers and manufacturers of rechargeable lithium batteries and battery systems, aircraft equipment installers, and users within the aviation community. It is the equipment installers responsibility to ensure that the batteries and battery systems meet the certification and installation requirements of the aircraft.

Compliance with these standards is recommended as a means of assuring that the batteries and battery systems will perform their intended function(s) safely under conditions encountered in aeronautical operations. It is imperative that the manufacturer, aeronautical equipment manufacturer, and aircraft manufacturer thoroughly understand the aircraft performance requirements and the capabilities and limitations of the batteries and battery systems to ensure safe operation on the aircraft. Any regulatory application of this document is the responsibility of the applicable government agency.

1.2 References

The following documents contain provisions which, through reference in this text, constitute provisions of this Standard. For all references, the latest edition of the document applies.

IEC 62133 Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications

ISO-9001 Quality management Systems - Requirements

[1] Very small batteries are also included in this standard.

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RTCA/DO-160 Environmental Conditions and Test Procedures for Airborne Equipment (latest revision)

RTCA/DO-178 Software Considerations in Airborne Systems and Equipment Certification (latest revision)

RTCA/DO-254 Design Assurance Guidance for Airborne Electronic Hardware (latest revision)

RTCA/DO-311 Minimum Operational Performance Standards for Rechargeable Lithium Batteries and Battery Systems (latest revision)

SAE AS9100 Quality Management Systems - Requirements for Aviation, Space and Defense Organizations

UL 1642 Standard for Safety for Lithium Batteries

UL 2054 Standard for Safety for Household and Commercial Batteries

United Nations Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, Section 38.3 (UN 38.3)

1.3 Scope

This document applies to small and medium sized rechargeable lithium batteries and battery systems that are permanently installed on aircraft. For the purpose of this document, a battery or battery system is considered permanently installed equipment when it is included as part of the type design of the aircraft (or supplemental/amended type design). This standard also applies to rechargeable lithium batteries contained within Portable Electronic Devices (PEDs) that are part of the type design. This document does not apply to primary lithium batteries or large rechargeable lithium batteries or battery systems.

Note: *Rechargeable lithium batteries within PEDs that are not part of the type design are outside the scope of this document; these PEDs fall under the purview of Federal Aviation Administration (FAA) Flight Standards Division and are regulated by operational rules under Title 14 of the Code of Federal Regulations (CFR). PEDs that are not part of the type design, especially those being recharged on the flight deck, present similar hazards as permanently installed equipment.*

1.3.1 Battery and Battery System Size

This standard identifies three sizes of rechargeable lithium batteries and battery systems (see Table 1-1). The Equipment Under Test (EUT) should be identified as to which type it is for determination of applicable test procedures. These categories are used to define applicability of testing per section 2.8.

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