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TECHNICAL SPECIFICATION

colour inside

Nanomanufacturing – Key control characteristics – Part 4-4: Nano-enabled electrical energy storage – Thermal characterization of nanomaterials, nail penetration method



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NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 4-4: Nano-enabled electrical energy storage – Thermal characterization of nanomaterials, nail penetration method

FOREWORD

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
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Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62607-4-4, which is a Technical Specification, has been prepared by IEC technical committee 113: Nanotechnology for electrotechnical products and systems.

The text of this Technical Specification is based on the following documents:

Enquiry draft	Report on voting
113/306/DTS	113/329/RVC

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62607 series, published under the general title *Nanomanufacturing – Key control characteristics*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International Standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

Energy storage devices are becoming increasingly important for many applications such as consumer devices, electric vehicles and aircrafts. Energy storage devices with high performance and reliability are the key factors to earn the confidence of customers. Also, in smart grid and renewable energy applications, where energy efficiency and reliable power supplies are critical, an energy storage system is an essential device. There are many types of energy storage devices for various applications. Lithium-ion batteries are the most popular and promising energy storage devices for portable electronics, consumer electronics, military, electric vehicle and aerospace applications. It is a good test carrier for performance and reliability characteristics.

One of the characteristics that draws the attention of users is the thermal runaway behaviour when a short circuit occurs inside the energy storage devices due to a manufacturing process defect, improper operation or external shocks. The poor control of manufacturing process may cause the energy storage device's internal defects, such as particle impurity, defects of separator, burr of electrodes or a prominence of conductive arms. Energy storage devices operated under abnormal conditions, such as quick charging or piercing by external objects, may cause an internal short circuit. Large current generated short circuit will generate an abnormal exothermic reaction and a local temperature rise, but the temperature of the short circuit spot drops due to heat transfer. These effects cause the energy storage device's temperature to continue to rise rapidly. If it reaches thermal runaway temperature, it usually leads to fire and explosion of the energy storage devices. The event can result in damage to personnel and equipment. In the worst case scenario, this may hamper the development of such type of energy storage devices.

In order to prevent such a scenario, nanomaterial additives have been used to prevent thermal runaway to ensure the reliability and safety of energy storage devices. The nanomaterial additives may mix with active materials of electrodes, electrolyte, coated on the surface of electrodes or separator.

This document specifies general testing procedures and requirements for the assessment of thermal runaway performance and risk associated with the nano-enabled energy storage devices prepared by employing nanomaterial additives, and serves as the basis for further developing particular product specific standards. This method covers only large temperature rises in cell temperature caused by shorting of the anode and cathode. This method does not generally cover thermal runaway due to other causes such as high external temperature and is not a general method to prevent thermal runaway.

NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 4-4: Nano-enabled electrical energy storage – Thermal characterization of nanomaterials, nail penetration method

1 Scope

This part of IEC 62607, which is a Technical Specification, provides a measurement method for thermal runaway quality level test for nano-enabled energy storage devices. This method uses comparative measurement to enable a manufacturer to decide whether or not the nanomaterial additives used in energy storage devices are resilient against the thermal runaway caused by a faulty or accidental low resistance connection between two or several internal points depending on the number of stacking electrode layers of the test sample. The nanomaterial additives may mix with the materials of positive and negative electrodes, electrolyte, coated on electrodes or separator. This document includes definitions of terminology, test sample, puncture nail requirements, test procedures, data analysis and methods of interpretation of results and a case study.

This document does not apply directly to the safety testing for energy storage device products due to complex safety design schemes embedded in these products.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9001:2015, *Quality management systems – Requirements*

ISO 14001:2015, *Environmental management systems – Requirements with guidance for use*

ISO 26000:2010, *Guidance on social responsibility*

ISO/TS 80004-1:2015, *Nanotechnologies – Vocabulary – Part 1: Core terms*

ISO/TS 80004-2:2015, *Nanotechnologies – Vocabulary – Part 2: Nano-objects*

ISO/TS 80004-4:2011, *Nanotechnologies – Vocabulary – Part 4: Nanostructured materials*

IEC TS 80004-9:2016, *Nanotechnologies – Vocabulary – Part 9: Nano-enabled electro-technical products and systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9001, ISO 14001, ISO 26000, the core terms of ISO/TS 80004-1, ISO/TS 80004-2, ISO/TS 80004-4, IEC TS 80004-9 and the following apply.

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