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# TECHNICAL SPECIFICATION

**Nanomanufacturing - Key control characteristics -**
**Part 4-9: Nano-enabled energy storage - Electrochemical characteristics of carbon nanomaterial for the electrodes of electric double-layer capacitors: Coin cell preparation**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# Nanomanufacturing - Key control characteristics - Part 4-9: Nano-enabled energy storage - Electrochemical characteristics of carbon nanomaterial for the electrodes of electric double-layer capacitors: Coin cell preparation

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IEC TS 62607-4-9 has been prepared by IEC technical committee 113: Nanotechnology for electrotechnical products and systems. It is a Technical Specification.

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

| Draft | Report on voting |
|---|---|
| 113/960/DTS | 113/984/RVDTS |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC TS 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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

# INTRODUCTION

Electrochemical capacitors are widely used in electric vehicles, high-speed trains, aviation, photovoltaics, wind power and electronics, due to their ultra-fast charge/discharge capability, long cycle life, wide working temperature range, high safety and reliability and low maintenance costs.

Electric double-layer capacitors (EDLCs) are a type of electrochemical capacitors. The mechanism of energy storage for EDLCs relies on reversible ion adsorption at the active material-electrolyte interface. Therefore, materials with large specific surface area – such as nanoporous carbon materials – are commonly employed as active materials in EDLCs. Additionally, to improve the electrode conductivity, high-conductivity materials (e.g. carbon black, graphene, and carbon nanotubes/CNTs) serve as conductive agents in EDLCs. Thus, carbon nanomaterials play an irreplaceable and critical role in EDLCs, directly determining their electrochemical performance.

The electrochemical performance of carbon nanomaterials for EDLCs requires proper electrochemical characterization. Prior to such measurements, the carbon nanomaterials will be pre-assembled into devices such as coin cells, three-electrode cells, or cylindrical cells. Coin-cell-based characterization offers advantages including low cost, versatility, and high efficiency, making it widely used in both academic and industrial settings.

The assembly process of a coin-cell EDLC is time-consuming and complex, which typically involves electrode slurry preparation, slurry coating onto current collectors, electrode rolling, cutting the rolled electrodes into multiple electrode discs, and final EDLC assembly. Each step contains numerous factors that can exert a significant impact on the accuracy of subsequent electrochemical performance characterization of the materials. Therefore, standardizing the coin-cell preparation process is an essential prerequisite for achieving accurate, highly reproducible, and repeatable electrochemical performance determination.

This document introduces a standard method and process to assemble the coin-cell EDLCs of carbon nanomaterials.

## 1 Scope

This part of IEC TS 62607 establishes a standardized method for assembling

– coin-cell EDLCs

in order to characterize the electrochemical key control characteristic of carbon nanomaterials.

The coin-cell EDLC is fabricated through sequential steps: electrode slurry preparation (mixing), coating, rolling, cutting, weighing, and final assembly.

– The document specifies the assembly process and data recording.
– The document is applicable for carbon nanomaterials used in EDLC as active material or conductive agents, such as nanoporous activated carbon, carbon aerogel, carbon nanotube, carbon black, graphene, nano graphite sheet, vapour-grown carbon fibre and so on.
– Typical application areas of this method are research, manufacturer and downstream user to guide material processing and quality control.

## 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.

IEC TS 62565-5-1:2023, *Nanomanufacturing - Product specifications - Part 5-1: Nanoporous activated carbon - Blank detail specification: Electrochemical capacitors*

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IEC 60050-113:2011, *International Electrotechnical Vocabulary (IEV) - Part 113: Physics for electrotechnology*

IEC 60050-151:2001, *International Electrotechnical Vocabulary (IEV) - Part 151: Electrical and magnetic devices*

IEC 60050-482:2004, *International Electrotechnical Vocabulary (IEV) - Part 482: Primary and secondary cells and batteries*

IEC 60050-485:2020, *International Electrotechnical Vocabulary (IEV) - Part 485: Fuel cell technologies*

IEC TS 62565-5-2:2022, *Nanomanufacturing - Material specifications - Part 5-2: Nano-enabled electrodes of electrochemical capacitors - Blank detail specification*

ISO 18300:2016, *Electrically propelled vehicles - Test specifications for lithium-ion battery systems combined with lead acid battery or capacitor*

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