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Lithium-ion batteries and charging systems — Safety

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The UK participation in its preparation was entrusted to Technical Committee CPL/116, Safety of motor-operated electric tools.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Batteries lithium-ion et systèmes de charge – Sécurité

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LITHIUM-ION BATTERIES AND CHARGING SYSTEMS – SAFETY

FOREWORD

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The text of this International Standard is based on the following documents:

Draft	Report on voting
116/579/FDIS	116/588/RVD

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 International Standard 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/standardsdev/publications.

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In this document, the following print types are used:

– requirements: in roman type;

– *test specification: in italic type;*

– notes: in smaller roman type.

– words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and the associated noun are also in bold.

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- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

This document contains a subset of requirements from IEC 62841-1:2014 that are applicable for **battery charging systems**. The **battery charging system** includes the **battery(ies)** and its related charging circuitry. In many cases, the same **battery charging system** is utilized for a wide variety of end products. Therefore, the purpose of this document is to provide a means for evaluating a **battery charging system** for electric motor-operated hand-held tools, transportable tools and lawn and garden machinery. This evaluation can then be utilized over a wide range of **products** covered by IEC 62841 (all parts), without having to re-evaluate the **battery charging system** for each case where the **battery charging system** is utilized in or with a **product**.

NOTE This document is structured in a way that other Technical Committees could reference this document in end **product** standards. For example, **products** outside of the scope of IEC 62841 (all parts) often use the same **battery charging systems** as in products covered by IEC 62841 (all parts).

This document has been structured so that the clause and subclause numbers are aligned, as far as practical, with both the main body and Annex K of IEC 62841-1:2014.

The following is a list of subclauses in IEC 62841-1:2014 that do not need to be repeated for **battery charging systems** evaluated to this document during **product** evaluations:

– 8.2, 8.6, 8.12, 8.14, 8.14.1, 20.2, 21.3, 21.22, 21.23, 21.24, 22.1, 22.4, 22.5, 23.1.4, 23.1.5, 23.1.7, 23.1.8, 23.4, 27.2;

– K.8.3, K.8.14.1.1, K.8.14.2, K.9.1, K.9.3, K.9.5, K.12.201, K.13.2, K.13.2.201, K.18.1, K.18.201, K.18.202, K.19.202, K.20.1, K.20.3.1, K.20.3.2, K.21.202, K.21.203, K.22.2, K.23.201, K.23.202, K.28.1.

Subclause K.13.1 of IEC 62841-1:2014 may or may not need to be repeated for **battery charging systems** evaluated to this document, depending on the temperature used for the test of 13.1 of this document and the temperature required by K.13.1 of IEC 62841-1:2014.

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LITHIUM-ION BATTERIES AND CHARGING SYSTEMS – SAFETY

1 Scope

This document applies to the safety of lithium-ion **batteries** and **charging systems** for use in rechargeable **battery**-powered motor-operated or magnetically driven

– hand-held tools (IEC 62841-2),
– transportable tools (IEC 62841-3), and
– lawn and garden machinery (IEC 62841-4).

The above listed categories are hereinafter referred to as "**products**".

NOTE 1 This document is structured in a way that other Technical Committees could reference this document in end **product** standards. For example, **products** outside of the scope of IEC 62841 (all parts) often use the same **battery charging systems** as in products covered by IEC 62841 (all parts).

The maximum nominal voltage assigned by the manufacturer for **battery** packs is 75 V DC.

Electric shock hazard is considered to exist only between parts of opposite polarity, except for cases where **batteries** are charged by a non-isolated **charger**.

Battery packs covered under this document intended to be charged by a non-isolated **charger** are evaluated by this document and to the requirements for protection against electric shock specified in IEC 62841-1:2014. When evaluating a **battery** pack for protection against electric shock, **creepage distances**, **clearances** and distances through insulation, the **battery** pack is fitted to the intended **charger**.

Since **battery** packs covered under this document are submitted to different use patterns (such as rough use, high charging and discharging currents), their safety can be evaluated only by this document or by IEC 62841-1:2014 and not by using other standards for **battery** packs, such as IEC 62133-2:2017, unless otherwise indicated in this document. All relevant aspects related to the safety of **batteries** are addressed in this document, such that the requirements of IEC 62133-2:2017 need not be separately applied.

For **integral batteries**, this document only applies to the **integral battery** when in combination with the **product**.

When evaluating the risk of **fire** associated with **batteries**, consideration has been given to the fact that these **batteries** are unattended energy sources and have been evaluated as such in this document. Requirements in other documents regarding the risk of **fire** due to the charging of these **batteries** are therefore considered to be fulfilled.

The following is considered within the context of these requirements.

– These requirements address the risk of **fire** or **explosion** of these **batteries** and not any possible hazards associated with toxicity nor potential hazards associated with transportation or disposal.

  NOTE 2 IEC 62281:2019 covers the safety aspects of lithium-ion **batteries** during transport.

– **Batteries** and **charging systems** covered by these requirements are not intended to be serviced by the end user.
– This document is intended to provide an evaluation of the combination of a **battery(ies)** and its corresponding **charging system(s)**.

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– This document addresses the safety of lithium-ion **batteries** and **charging systems** during storage, use and charging. These requirements are only considered to be supplementary requirements in regards to **battery charger fire** and electric shock.
– This document refers to and requires parameters supplied in reference to the **cells** that establish conditions for safe use of those **cells**. Those parameters form the basis of acceptance criteria for a number of tests contained herein. This document does not independently evaluate the safety of **cells**. These parameters, taken as a set, constitute the "**specified operating region**" for a **cell**. There may be several sets of **specified operating region(s)**.

This document is not intended to apply to **general purpose batteries**.

This document does not apply to the safety of **battery chargers** themselves. However, this document covers the safe functioning of lithium-ion **batteries** and **charging systems**.

For a **battery(ies)** intended to be charged by stand-alone **battery chargers**, the risks associated with a mains connection is addressed by the relevant **battery charger** standard. For **products** that incorporate power conversion circuitry for the purposes of providing an energy source for charging, the protection against the risks associated with a mains is addressed in the relevant **product** standard.

NOTE 3 IEC 60335-2-29:2016 and IEC 60335-2-29:2016/AMD1:2019 cover a variety of stand-alone **chargers**.

This document does not include safety requirements for the **battery** when incorporated into the **product** with respect to heating and mechanical strength. It is possible additional testing needs to be conducted in accordance with the relevant end **product** standard.

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 60068-2-75:1997, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC TR 60083, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

IEC 60127 (all parts), *Miniature fuses*

IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 60320-1, *Appliance couplers for household and similar general purposes – Part 1: General requirements*

IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*[1]

IEC 60695-2-13:2010, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*[2]

IEC 60695-10-2:2003, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*[3]

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60730-1:2010, *Automatic electrical controls – Part 1: General requirements*[4]

IEC 60884 (all parts), *Plugs and socket-outlets for household and similar purposes*

IEC 60906-1, *IEC system of plugs and socket-outlets for household and similar purposes – Part 1: Plugs and socket-outlets 16 A 250 V a.c.*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*[5]
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61558-1, *Safety of transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

IEC 61558-2-4, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-4: Particular requirements and tests for isolating transformers and power supply units incorporating isolating transformers*[6]

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*[7]

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1 This publication has been withdrawn.

2 This publication has been withdrawn.

3 This publication has been withdrawn.

4 This publication has been withdrawn.

5 This publication has been withdrawn.

6 This publication has been withdrawn.

7 This publication has been withdrawn.

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IEC 61558-2-16, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units*[8]

IEC 61960-3, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 3: Prismatic and cylindrical lithium secondary cells and batteries made from them*

IEC 61960-4, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 4: Coin secondary lithium cells, and batteries made from them*

IEC 62133-2:2017, *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 – Part 2: Lithium systems*

IEC 62841-1:2014, *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety – Part 1: General requirements*

ISO 2768-1, *General tolerances – Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 3864-2, *Graphical symbols – Safety colours and safety signs – Part 2: Design principles for product safety labels*

ISO 7000, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs* (available at https://www.iso.org/obp)

ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

UL 969, *Standard for marking and labeling systems*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
accessible part
conductive part or surface of insulating materials that can be touched by means of the test probe B of IEC 61032:1997

[8] This publication has been withdrawn.

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3.2
battery
assembly of one or more **cells** intended to provide electrical current to the **product**

3.3
cell
basic functional electrochemical unit containing an assembly of electrodes, electrolyte, container, terminals, and usually separators, which is a source of electrical energy by direct conversion of chemical energy

3.4
charger
part or all of the **charging system** contained in a separate enclosure

Note 1 to entry: Not all **charging systems** include a separate **charger** as in the case where a tool may be charged utilizing a mains supply cord or may incorporate a plug for attachment to a mains receptacle. As a minimum, the **charger** includes some of the power conversion circuitry.

3.5
charging system
combination of circuitry intended to charge, balance and/or maintain the state of charge of the **battery**

3.6
charring
condition in which untreated 100 % medical gauze is blackened by combustion

Note 1 to entry: Discolouration of untreated 100 % medical gauze caused by smoke is not considered to be **charring**.

3.7
clearance
shortest distance between two conductive parts, or between a conductive part and the outer surface of the enclosure, considered as though metal foil were pressed into contact with accessible surfaces of insulating material, measured through air

Note 1 to entry: Examples of **clearances** are given in Annex A of IEC 62841-1:2014.

3.8
creepage distance
shortest path between two conductive parts, or between a conductive part and the outer surface of the enclosure, considered as though metal foil were pressed into contact with accessible surfaces of insulating material, measured along the surface of the insulating material

Note 1 to entry: Examples of **creepage distances** are given in Annex A of IEC 62841-1:2014.

3.9
C_5 rate
current, in amperes, which a **cell** or **battery** can be discharged at for 5 h to the voltage cut-off point specified by the **cell** manufacturer

3.10
detachable battery pack
battery which is contained in a separate enclosure from the **product** and is intended to be removed from the **product** for charging purposes

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