Secondary lithium batteries for light EV (electric vehicle) applications - Part 1: General safety requirements and test methods

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 50604-1:2016 +A1:2021 sisaldab Euroopa standardi EN 50604-1:2016 ja selle muudatuse A1:2021 ingliskeelset teksti.	This Estonian standard EVS-EN 50604-1:2016 +A1:2021 consists of the English text of the European standard EN 50604-1:2016 and its amendment A1:2021.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas. Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 05.08.2016, muudatus A1 23.07.2021.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation. Date of Availability of the European standard is 05.08.2016, for A1 23.07.2021.
Muudatusega A1 lisatud või muudetud teksti algus ja lõpp on tekstis tähistatud sümbolitega [A1] ⟨A1⟩. Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.	The start and finish of text introduced or altered by amendment A1 is indicated in the text by tags [A1] ⟨A1⟩. The standard is available from the Estonian Centre for Standardisation and Accreditation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 29.220.30

EUROPEAN STANDARD

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EN 50604-1 + A1

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English Version

Secondary lithium batteries for light EV (electric vehicle) applications - Part 1: General safety requirements and test methods

Batteries d'accumulateurs au lithium pour applications liées aux véhicules électriques légers - Partie 1 : Exigences générales de sécurité et méthodes d'essai

Lithium-Sekundärbatterien für Anwendungen in leichten Elektrofahrzeugen - Teil 1: Allgemeine Sicherheitsanforderungen und Prüfverfahren

This European Standard was approved by CENELEC on 2016-07-04. Amendment A1 was approved by CENELEC on 2021-06-21. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard and its amendment the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard and its Amendment A1 exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

This document (EN 50604-1:2016) has been prepared by CLC/TC 21X “Secondary cells and batteries”.

The following dates are fixed:

• latest date by which the existence of this document has to be announced at national level	(doa)	2017–01–04
• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2017–07–04
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2019–07–04

The goal of this standard is to increase safety of battery packs/ systems which contain lithium battery technologies in combination with their voltage converter unit for use in light electric vehicles.

Part 1 sets definitions, safety issues and test procedures.

This standard was designed to assess aspects on battery pack/system level.

This standard covers the Principal Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

This standard covers the Principal Elements of the Safety Objectives for battery packs/systems Designed for Use by Light EVs (Directive 2002/24/EC, Regulation (EU) 168/2013).

Light EV includes all electrically propelled two, three and four wheeled vehicles of category L1 up to Category L7 according to the definition of ECE/TR ANS-WP29-78r2e and all electrically propelled or assisted cycles including plug-in hybrid road vehicles (PHEV), that derive all or part of their energy from on-board rechargeable energy storage systems (RESS).

This standard covers issues mentioned in EU Mandate M/468 and M/533.

This part is to be used in conjunction with the appropriate part of the ISO 12405- series.

NOTE The following print types are used:

– requirements: in roman type;

– test specifications: in italic type;

– notes: in small roman type.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

A1 Amendment A1 European foreword

This document (EN 50604-1:2016/A1:2021) has been prepared by CLC/TC 21X “Secondary cells and batteries”.

The following dates are fixed:

• latest date by which the existence of this document has to be announced at national level	(doa)	2021-12-21
• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2022-06-21
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2024-06-21

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This part is read in conjunction with the appropriate part of the withdrawn ISO 12405-1, ISO 12405-2 and ISO 12405-3 and novel ISO 6469-1:2019. Remark: the 1st Ed of EN 50604-1 is referencing to ISO 12405-3.

NOTE 1 The following print types are used:

— requirements: in roman type;

— test specifications: *in italic type*;

— notes: in small roman type.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Any feedback and questions on this document should be directed to the users’ national committee. A complete listing of these bodies can be found on the CENELEC website. A1

Introduction

Lithium-ion battery systems are efficient rechargeable energy storage systems for electrically propelled road vehicles. The requirements for lithium-ion battery systems to be used as power source for the propulsion of electric road vehicles are significantly different to those batteries used for consumer electronics or for stationary applications.

Lithium-ion batteries may store electricity at relatively high-energy density compared to other battery chemistries currently available. Under current state of art, most lithium-ion batteries use organic electrolytes which are classified as Class 3 “flammable liquid” under “UN Recommendations on the Transport of Dangerous Goods – Model Regulations”. Therefore, mitigating potential hazards associated with fire or explosion of lithium-ion batteries is considered an important issue.

EN 50604-1 will be read in conjunction with ISO 12405-3. The clauses of the particular requirements in EN 50604-1 supplement or modify the corresponding clauses in ISO 12405-3. Where the text indicates an “addition” to or a “replacement” of the relevant requirement, test specification or explanation of ISO 12405-3, these changes are made to the relevant text of ISO 12405-3, which then becomes part of the standard. Where no change is necessary, the words “This (sub)clause of ISO 12405-3:2014 is applicable” are used.

Test items were selected to simulate conditions likely to occur during handling (e.g. removal or replacement) or during operation. They cover conditions of normal operation, rough handling and as well likely conditions of misuse or negligent handling. For electric vehicles operating under extreme conditions (e.g. off-road, extreme climate, etc.) additional requirements may be necessary which are not covered by this standard.

Additional requirements might also apply to battery system after the integration into the vehicle resulting from national or regional regulations and are not dealt within this standard. Same applies to hazards from electric shock.

This European Standard provides specific test procedures and related requirements to ensure an appropriate and acceptable level of safety of lithium-ion battery systems specifically developed for propulsion of road vehicles.

This standard refers to the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria: Section 38.3 which are performed independently from this testing program. Test reports issued by an ILAC, APLAC or similar accredited party are acceptable for the battery system complying with all aspects of Section 38.3 of Manual of Tests and Criteria of UN Recommendations on the Transport of Dangerous Goods for this test option.

A1 Introduction to Amendment A1

Lithium-ion battery systems are efficient rechargeable energy storage systems for electrically propelled road vehicles. The requirements for lithium-ion battery systems to be used as power source for the propulsion of electric road vehicles are significantly different to those batteries used for consumer electronics or for stationary applications.

Lithium-ion batteries can store electricity at relatively high-energy density compared to other battery chemistries currently available. Under current state of art, most lithium-ion batteries use organic electrolytes classified as Class 3 “flammable liquid” under “UN Recommendations on the Transport of Dangerous Goods – Model Regulations”. Therefore, mitigating potential hazards associated with fire or explosion of lithium-ion batteries are considered as an important issue.

The EN 50604-1 series is read in conjunction with ISO 12405-3:2014 (withdrawn) and ISO 6469-1:2019 (for this amendment). The clauses of the particular requirements in EN 50604-1 supplement or modify the corresponding clauses in ISO 12405-3:2014 (withdrawn) and ISO 6469-1:2019 (for this amendment). Where the text indicates an “addition” to or a “replacement” of the relevant requirement, test specification or explanation of ISO 12405-3:2014 (withdrawn) and ISO 6469-1:2019 (for this amendment), these changes are made to the relevant text of ISO 12405-3:2014 (withdrawn) and ISO 6469-1:2019 (for this amendment), which then becomes part of the standard. Where no change is necessary, the words “This clause of ISO 12405-3:2014 is applicable” are used.

Test items were selected to simulate conditions likely to occur during handling (e.g. removal or replacement) or during operation. They cover conditions of normal operation, rough handling and as well likely conditions of misuse or negligent handling. For electric vehicles operating under extreme conditions (e.g. off-road, extreme climate etc.) additional requirements could be necessary which are not covered by this document.

NOTE Additional requirements might also apply to battery system after the integration into the vehicle resulting from national or regional regulations and are not dealt with in this document. Same applies to hazards from electric shock.

This document provides specific test procedures and related requirements to ensure an appropriate and acceptable level of safety of lithium-ion (Li-ion) battery systems specifically developed for propulsion of road vehicles. Propositions for other chemistries are given in informative Annex HH.

This document indicates references to the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria: Section 38.3 which are performed independently from this testing program. Test reports issued by an ILAC, APLAC or similar accredited party are acceptable for the battery system complying with all aspects of Section 38.3 of Manual of Tests and Criteria of UN Recommendations on the Transport of Dangerous Goods for this test option. Test reports issued and verified by in house testing according to UN 38.3 are also accepted. A1

1 Scope

This European Standard specifies test procedures and provides acceptable safety requirements for voltage class A and voltage class B removable lithium-ion battery (packs and) systems, to be used as traction batteries of or for electrically propelled road vehicles. This European Standard is related to the testing of safety performance of battery packs and systems for their intended use for a vehicle.

This European Standard is not intended to be applied for the evaluation of the safety of battery packs/systems storage, vehicle production, repair and maintenance services.

〚A1〛 Light EV includes all electrically propelled vehicles of category L1 up to category L7 according to the definition of ECE-TRANS-WP29-78r6e and all electrically propelled or assisted cycles including plug-in hybrid road vehicles (PHEV), that derive all or part of their energy from on-board rechargeable energy storage systems (RESS). 〚A1〛

This European Standard enables setting up a dedicated test plan for an individual battery pack/system subject to an agreement between customer and supplier. If required, the relevant test procedures and/or test conditions of lithium-ion battery packs and systems may be selected from the standard tests provided in this standard to configure a dedicated test plan.

〚A1〛 *deleted text* 〚A1〛

NOTE 〚A1〛 1 〚A1〛 Testing on cell level is specified in the IEC 62660 series.

〚A1〛 This document also applies to:

— built-in battery packs/systems in EVs.

NOTE 2 Informative Annex HH gives information on possible tests for other chemistries. 〚A1〛

This European Standard does not apply to:

— 〚A1〛 individual cells;

— non-removable battery systems; 〚A1〛

— primary Batteries(including lithium types);

— batteries covered by the ISO 12405- series.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12405-3:2014, *Electrically propelled road vehicles — Test specification for lithium-ion traction battery packs and systems — Part 3: Safety performance requirements*

This clause of ISO 12405-3:2014 is applicable except as follows:

Additions:

EN 60068-2-47, *Environmental testing — Part 2-47: Test — Mounting of specimens for vibration, impact and similar dynamic tests (IEC 60068-2-47)*

EN 60335-2-29, *Household and similar electrical appliances — Safety — Part 2-29: Particular requirements for battery chargers (IEC 60335-2-29)*

EN ISO 14021, *Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling) (ISO 14021)*

EN ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps (ISO 4892-2)*

EN ISO 7010:2012, *Graphical symbols - Safety colours and safety signs - Registered safety signs (ISO 7010:2011)*

EN ISO 13849 (all parts), *Safety of machinery — Safety-related parts of control systems (ISO 13849, all parts)*

IEC 60335-1, *Household and similar electrical appliances — Safety — Part 1: General requirements*

IEC 60417:2002, *Graphical symbols for use on equipment — 12-month subscription to online database comprising all graphical symbols published in IEC 60417*

IEC/TS 60479-2:2007, *Effects of current on human beings and livestock — Part 2: Special aspects*

IEC 61140, *Protection against electric shock — Common aspects for installation and equipment*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC/TS 61851-3-1:2016[1)], *Electric Vehicles conductive power supply system — Part 3-1: General Requirements for Light Electric Vehicles (LEV) AC and DC conductive power supply systems*

IEC/TS 61851-3[2)], *Electric Vehicles conductive power supply system*

IEC/TS 62196-4[3)], *Plugs, socket-outlets, and vehicle couplers — Conductive charging of electric vehicles — Part 4: Dimensional compatibility and interchangeability requirements for a.c., d.c. and a.c./ d.c. vehicle couplers for Class II or Class III light electric vehicles (LEV)*

IEC 62660 (all parts), *Secondary lithium-ion cells for the propulsion of electric road vehicles*

〈A1〉 EN IEC 60812:2018, *Failure modes and effects analysis (FMEA and FMECA) (IEC 60812:2018)*

EN 60529:1991[4], *Degrees of protection provided by enclosures (IP Code)*

EN 61000-6-7:2015, *Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations (IEC 61000-6-7:2014)*

EN 61326-3-1:2017, *Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications (IEC 61326-3-1:2017)*

EN 61508 (series), *Functional safety of electrical/electronic/programmable electronic safety-related systems (IEC 61508 series)*

EN 62133-2, *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 62133-2:2017)*

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1) Under consideration.

2) Under consideration.

3) Under consideration.

4 As impacted by EN 60529:1991/A1:2000, EN 60529:1991/A2:2013, EN 60529:1991/A2:2013/AC:2019-02, EN 60529:1991/AC:2016-12, and EN 60529:1991/corrigendum May 1993.

EN ISO 178:2010[5], *Plastics – Determination of flexural properties (ISO 178:2010)*

EN ISO 179 (series), *Plastics – Determination of Charpy impact properties (ISO 179 series)*

EN ISO 2409:2013[6], *Paints and varnishes – Cross-cut test (ISO 2409:2013)*

EN ISO 4892-2:2013, *Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps (ISO 4892-2:2013)*

EN ISO 13849 (all parts), *Safety of machinery – Safety-related parts of control systems*

ISO 6469-1:2019, *Electrically propelled road vehicles — Safety specifications — Part 1: Rechargeable energy storage system (RESS)*

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

SAE J 1739:2009, *Potential Failure Mode and Effects Analysis in Design (Design FMEA), Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA)* 〈A1〉

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 8713 and ISO 12405-3 and the following apply.

Addition:

3.1
battery control unit
BCU
electronic device that controls, manages, detects or calculates electric and thermal functions of the battery system and that provides communication between the battery system and other vehicle controllers

Note 1 to entry: See also Annex AA for further explanation.

[SOURCE: ISO 12405-3:2014, 3.1]

3.2
battery pack
energy storage device that includes cells or cell assemblies normally connected with cell electronics, voltage class A or B circuit and overcurrent shut-off device, including electrical interconnections, interfaces for external systems

Note 1 to entry: For further explanation, see AA.2.

Note 2 to entry: Examples of external systems are cooling, voltage class B, auxiliary voltage class A and communication.

[SOURCE: ISO 12405-3:2014, 3.2, modified — The original definition mentioned voltage class B circuit only.]

3.3
battery pack subsystem
representative portion of the battery pack

[SOURCE: ISO 12405-3:2014, 3.3]

[5] A newer edition exists: EN ISO 178:2019.

[6] A newer edition exists: EN ISO 2409:2020.