International Standard

ISO 18243

Electrically propelled mopeds and motorcycles — Test specifications and safety requirements for lithium-ion battery systems

Cyclomoteurs et motocycles à propulsion électrique — Spécifications d'essai et exigences de sécurité pour les systèmes de batterie au lithium-ion

Second edition
2025-12

Reference number
ISO 18243:2025(en)

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Published in Switzerland

Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Symbols and abbreviated terms **5**
4.1 Symbols 5
4.2 Abbreviated terms 6
5 Technical requirements **6**
5.1 General safety requirements 6
5.2 Testing of general safety requirements 7
5.2.1 Evidence of leakage 7
5.2.2 Evidence of rupture 7
5.2.3 Evidence of fire 7
5.2.4 Evidence of explosion 7
5.2.5 Isolation resistance 7
5.3 Mechanical requirements 7
5.4 Climatic requirements 7
5.4.1 Thermal shock 7
5.4.2 Dewing 8
5.4.3 Salt spray 8
5.5 Simulated accident requirements 8
5.5.1 Immersion into water 8
5.5.2 Exposure to fire 9
5.6 Electrical requirements 9
5.6.1 Isolation resistance 9
5.6.2 Short circuit protection 9
5.7 Functional requirements 10
5.7.1 General 10
5.7.2 Overcharge protection 10
5.7.3 Overdischarge protection 10
5.7.4 Overcurrent protection 10
5.7.5 Protection against internal overheating 10
5.7.6 Low-temperature protection 10
6 General test methods **11**
6.1 General conditions 11
6.2 Measurement accuracy 11
6.3 DUT requirements and preparation of the DUT for testing 12
6.3.1 DUT requirements 12
6.3.2 Preparation of the battery subsystem and test bench 12
6.3.3 Preparation of the battery pack or system and test bench 12
6.4 Test sequence plan 12
6.5 Tests 12
6.6 Preconditioning cycles 13
6.6.1 Purpose 13
6.6.2 Test procedure 13
6.7 Standard cycle (SC) 14
6.7.1 Purpose 14
6.7.2 Test procedure 14
7 Safety test procedures **14**
7.1 Mechanical tests 14
7.1.1 Vibration 14

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7.1.2 Mechanical shock 15
7.1.3 Drop 15
7.2 Climatic tests 15
7.2.1 Thermal shock 15
7.2.2 Dewing 16
7.2.3 Salt spray 18
7.3 Simulated accident tests 18
7.3.1 Immersion into water 18
7.3.2 Exposure to fire 18
7.4 Electrical test — Short circuit protection 19
7.5 Functional tests 20
7.5.1 General procedures 20
7.5.2 Overcharge protection 20
7.5.3 Over discharge protection 21
7.5.4 Overcurrent protection 21
7.5.5 Protection against internal overheating 22
8 Performance test methods 23
8.1 Energy and capacity at RT 23
8.1.1 Purpose 23
8.1.2 Test procedure 23
8.1.3 Requirements 23
8.2 Energy and capacity at different temperature and discharge rates 24
8.2.1 Purpose 24
8.2.2 Test procedure 24
8.2.3 Requirements 26
8.3 Power and internal resistance 27
8.3.1 Purpose 27
8.3.2 Pulse power characterization profile 27
8.3.3 Test procedure 30
8.3.4 Requirements 32
8.4 No load SOC loss 32
8.4.1 Purpose 32
8.4.2 Test procedure 32
8.4.3 Test sequence 33
8.4.4 Requirements 34
8.5 SOC loss at storage 34
8.5.1 Purpose 34
8.5.2 Test procedure 34
8.5.3 Test sequence 35
8.5.4 Requirements 35
8.6 Cycle life 35
8.6.1 Purpose 35
8.6.2 Preparation 36
8.6.3 Test procedure 36
8.6.4 Conditions 37
8.6.5 Monitoring and data logging 37
8.6.6 SOC determination 37
8.6.7 End of test criteria 37
8.6.8 Capacity fade 38
8.6.9 Self-discharging rates 38
8.6.10 Requirements 38
8.7 Cycle life specific test (optional) 39
Annex A (informative) **Battery pack and system 40**
Annex B (normative) **Description of the screen referenced in 7.3.2 44**
Annex C (informative) **Example of the cycle life specific test 45**
Bibliography 46

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 38, *Motorcycles and mopeds*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 301, *Road vehicles,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 18243:2017), which has been technically revised. It also incorporates the Amendment ISO 18243:2017/Amd 1:2020.

The main changes are as follows:

— new safety requirement of undertemperature condition;

— new safety requirement of overcurrent protection;

— alignment with ISO 6469-1 and ISO 12405-4.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Lithium-ion based battery systems are an efficient alternative energy storage system for electrically propelled mopeds and motorcycles. The requirements for lithium-ion based battery systems to be used as power source for the propulsion of electrically propelled mopeds and motorcycles are significantly different to those batteries used for consumer electronics or stationary usage.

This document provides specific test procedures for lithium-ion battery packs and systems specifically developed for propulsion of mopeds and motorcycles. This document specifies such tests and related requirements to ensure that a battery pack or system is able to meet the specific needs of the mopeds and motorcycles industry.

It enables mopeds and motorcycles manufacturers to choose test procedures to evaluate the characteristics of a battery pack or system for their specific requirements.

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Electrically propelled mopeds and motorcycles — Test specifications and safety requirements for lithium-ion battery systems

1 Scope

This document specifies the test procedures for lithium-ion battery packs and systems used in electrically propelled mopeds and motorcycles.

The specified test procedures enable the user of this document to determine the essential characteristics on performance and safety of lithium-ion battery packs and systems. It is also possible to compare the test results achieved for different battery packs or systems.

This document enables setting up a dedicated test plan for an individual battery pack or 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 are selected from the standard tests provided in this document to configure a dedicated test plan.

NOTE 1 Electrically power-assisted cycles (EPAC) cannot be considered as mopeds. The definition of electrically power-assisted cycles can differ from country to country. An example of definition can be found in Reference [7].

NOTE 2 Testing on cell level is specified in the IEC 62660 series.

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 13063-3, *Electrically propelled mopeds and motorcycles — Safety specifications — Part 3: Electrical safety*

ISO 16750-1, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 1: General*

ISO 20653, *Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access*

IEC 60068-2-47, *Environmental testing — Part 2-47: Tests – Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60068-2-52, *Environmental testing — Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium, chloride solution).*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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3.1
battery control unit
BCU
electronic device that controls, manages, detects, or calculates electric and thermal functions of the *battery system* (3.4) and that provides communication between the battery system and other vehicle controllers

Note 1 to entry: See A.3.1, Annex A for further explanations.

[SOURCE: ISO 12405-4:2018, 3.1]

3.2
battery pack
energy storage device that includes cells or cell assemblies normally connected with *cell electronics* (3.6), high voltage circuit and over current shut-off device including electrical interconnections, interfaces for external systems (e.g. cooling, high voltage, auxiliary low voltage and communication)

Note 1 to entry: See A.2, Annex A for further explanations.

[SOURCE: ISO 12405-4:2018, 3.2]

3.3
battery pack subsystem
any assembly of components of the *battery pack* (3.2) which stores energy

[SOURCE: ISO 6469-1:2019, 3.24, modified — "RESS components" replaced by "components of the battery pack".]

3.4
battery system
energy storage device that includes cells or cell assemblies or *battery pack(s)* (3.2) as well as electrical circuits and electronics (e.g. *battery control unit (BCU)* (3.1), contactors)

Note 1 to entry: See A.3.2 and A.3.3, Annex A for further explanations. Battery system components can also be distributed in different devices within the vehicle.

[SOURCE: ISO 12405-4:2018, 3.3]

3.5
capacity
total number of ampere-hours that can be withdrawn from a fully charged battery under specified conditions

[SOURCE: ISO 12405-4:2018, 3.4]

3.6
cell electronics
electronic device that collects and possibly monitors thermal and electrical data of cells or cell assemblies and contains electronic for cell balancing, if necessary

Note 1 to entry: The cell electronics can include a cell controller. The functionality of cell balancing can be controlled by the cell electronics or it can be controlled by the *battery control unit (BCU)* (3.1).

[SOURCE: ISO 12405-4:2018, 3.5]

3.7
conductive part
part which can carry electric current

[SOURCE: ISO 13063-3:2022, 3.6]

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3.8
customer
party interested in using the *battery pack* (3.2) or system and, therefore, orders or performs the test

EXAMPLE Vehicle manufacturer.

[SOURCE: ISO 6469-1:2019, 3.6]

3.9
electric chassis
conductive parts (3.7) of a vehicle that are electrically connected and whose potential is taken as reference

[SOURCE: ISO 13063-3:2022, 3.11]

3.10
energy round trip efficiency
ratio of the net DC energy (W·h discharge) delivered by a device under test (DUT) during a discharge test to the total DC energy (W·h charge) required to restore the initial *state of charge (SOC)* (3.23) by a standard charge

[SOURCE: ISO 12405-4:2018, 3.11]

3.11
explosion
sudden release of energy sufficient to cause pressure waves and/or projectiles that may cause structural and/or physical damage to the surrounding area

[SOURCE: ISO 6469-1:2019, 3.10]

3.12
isolation resistance
resistance between *live parts* (3.14) of *voltage class* (3.27) B electric circuit and the *electric chassis* (3.9) as well as the voltage class A system

[SOURCE: ISO 13063-3:2022, 3.18]

3.13
leakage
escape of liquid or gas except for *venting* (3.26)

[SOURCE: ISO 6469-1:2019, 3.15]

3.14
live part
conductor or *conductive part* (3.7) intended to be energized in normal use, but by convention, not the *electric chassis* (3.9)

[SOURCE: ISO 13063-3:2022, 3.19]

3.15
maximum operating temperature
highest value of the temperature at which the systems/components can be operated continuously

[SOURCE: ISO 6469-1:2019, 3.17]

3.16
maximum working voltage
highest value of AC voltage (r.m.s.) or of DC voltage which may occur in an electrical system under any normal operating conditions according to the manufacturer's specifications, disregarding transients

[SOURCE: ISO 13063-3:2022, 3.20]

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3.17
overcurrent protection
protection intended to operate when the current is in excess of a predetermined value

[SOURCE: ISO 6469-1:2019, 3.21]

3.18
passenger compartment
space for occupant accommodation, bounded by at least 4 of the following: the roof, floor, side walls, doors, outside glazing, front bulkhead and rear bulkhead, or rear gate, as well as by the electrical protection barriers and enclosures provided for protecting the occupants from direct contact with *voltage class* (3.27) B *live parts* (3.14)

[SOURCE: Reference [8], modified — "high voltage" has been replaced by "voltage class B".]

3.19
rated capacity
supplier's (3.25) specification of the total number of ampere-hours that can be withdrawn from a fully charged *battery pack* (3.2) or system for a specified set of test conditions such as discharge rate, temperature, discharge cut-off voltage, etc

[SOURCE: ISO 12405-4:2018, 3.16]

3.20
removable battery pack
battery pack (3.2) that is designed to be taken out from the vehicle by the vehicle user

[SOURCE: ISO 13063-1:2022, 3.14, modified — "RESS" was replaced by "battery pack", Note 1 to entry was deleted.]

3.21
room temperature
RT
temperature of (25 ± 2) °C

[SOURCE: ISO 12405-4:2018, 3.17]

3.22
rupture
loss of mechanical integrity of the enclosure of the DUT resulting in openings that do not fulfil protection degree IPXXB according to ISO 20653

Note 1 to entry: Predetermined openings for *venting* (3.26) are not considered as rupture.

[SOURCE: ISO 6469-1:2019 3.25]

3.23
state of charge
SOC
available *capacity* (3.5) in a *battery pack* (3.2) or system expressed as a percentage of *rated capacity* (3.19)

[SOURCE: ISO 12405-4:2018, 3.20]

3.24
standard charge for top off
SCH for top off
additional charge which eliminates possible *state of charge (SOC)* (3.23) reduction after standard charge (SCH) at *room temperature (RT)* (3.21) followed by thermal equilibration at a different temperature

[SOURCE: ISO 12405-4:2018, 3.21]

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3.25
supplier
party that provides *battery systems* (3.4) and packs

EXAMPLE A battery manufacturer.

[SOURCE: ISO 6469-1:2019, 3.27]

3.26
venting
release of excessive pressure intended by design

[SOURCE: ISO 6469-1:2019, 3.28]

3.27
voltage class
classification of an electric component or circuit with a *maximum working voltage* (3.16) of ≤30 V a.c. or ≤60 V d.c., respectively classification of an electric component or circuit according to its maximum working voltage

Note 1 to entry: The classification to the voltage classes A and B is according to ISO 13063-3:2022.

[SOURCE: ISO 13063-3:2022, 3.36, modified — Note 1 to entry added.]

3.28
water depth
level of water a vehicle is designed for operation according to the vehicle manufacturer's specification

Note 1 to entry: The vehicle manufacturer may consider the local environmental conditions where the vehicle is placed on the market.

[SOURCE: ISO 6469-1:2019, 3.30]

3.31
internal resistance
opposition to the flow of current within a cell or a battery under reference conditions, that is, the sum of electronic resistance and ionic resistance to the contribution to total effective resistance including inductive/capacitive properties

[SOURCE: Reference [9]]

4 Symbols and abbreviated terms

4.1 Symbols

C_{fade}	capacity fade
I_{cp}	charge pulse current specified by the supplier for power, internal resistance and energy efficiency testing
$I_{d,max}$	maximum continuous discharge current specified by the supplier for energy and capacity testing
$I_{dp,max}$	maximum discharge pulse current specified by the supplier for power, internal resistance and energy efficiency testing
P	power
R	resistance
T_{max}	maximum temperature

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