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## Electrically propelled road vehicles — Test specification for Lithium-ion traction battery packs and systems —

### Part 3: Safety performance requirements

ICS 43.120

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 12405-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 21, *Electrically propelled road vehicles*.

ISO 12405 consists of the following parts, under the general title *Electrically propelled road vehicles — Test specification for lithium-ion battery packs and systems*:

- *Part 1: High power application*
- *Part 2: High energy application*
- *Part 3: Safety performance requirements*

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## 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.

This International 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.

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# Electrically propelled road vehicles — Test specification for lithium-ion battery packs and systems — Part 3: Safety performance requirements

## 1 Scope

This International Standard specifies test procedures and provides acceptable safety requirements for voltage class B lithium-ion battery packs and systems, to be used as traction batteries in electrically propelled road vehicles. Traction battery packs and systems used for two-wheel or three-wheel vehicles are not covered by this standard. This International Standard is related to the testing of safety performance of battery packs and systems for their intended use in a vehicle. This International Standard is not intended to be applied for the evaluation of the safety of battery packs and systems during transport, storage, vehicle production, repair and maintenance services.

## 2 Normative references

The following referenced documents are indispensable for the application 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 6469-1, *Electrically propelled road vehicles – Safety specifications — Part 1: On-board rechargeable energy storage system (RESS)*

ISO DIS 6469, *Electrically propelled road vehicles – Safety specifications — Part 4: Post crash electrical safety requirements*

ISO/TR 8713, *Electrically Propelled Road vehicles -- Vocabulary*

ISO 12405-1:2011, *Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems — Part 1: High-power applications*

ISO 12405-2:2012, *Electrically propelled road vehicles — Test specification for lithium-ion traction battery packs and systems — Part 2: High-energy applications*

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

## 3 Terms and definitions

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

### 3.1

#### **battery control unit**

#### **BCU**

electronic device that controls or manages or detects or calculates electric and thermal functions of the battery systems and other vehicle controllers

NOTE See also Annex A for further explanation.

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

NOTE 1 For further explanation, see A.2.

NOTE 2 Examples of external systems are cooling, voltage class B, auxiliary voltage class A and communication.

**3.3  
battery system**  
energy storage device that includes cells or cell assemblies or battery pack(s) as well as electrical circuits and electronics

NOTE 1 For further explanation, see A.3.1 and A.3.2. Battery system components can also be distributed in different devices within the vehicle.

NOTE 2 Examples of electronics are the BCU and contactors.

**3.4  
capacity**  
total number of ampere-hours that can be withdrawn from a fully charged battery under specified conditions

**3.5  
cell electronics**  
electronic device that collects and possibly monitors thermal or electric data of cells or cell assemblies and contains electronics for cell balancing, if necessary

NOTE The cell electronics may include a cell controller. The functionality of cell balancing may be controlled by the cell electronics or it may be controlled by the BCU.

**3.6  
customer**  
party that is interested in using the battery pack or system and, therefore, orders or performs the test

EXAMPLE A vehicle manufacturer.

**3.7  
device under test  
DUT**  
within this part of ISO 12405 a battery pack or battery system

**3.8  
explosion**  
sudden release of energy sufficient to cause pressure waves and/or projectiles that may cause structural and/or physical damage to the surrounding of the DUT

NOTE The kinetic energy of flying debris from the battery pack or system may be sufficient to cause damage to the surrounding of the DUT as well.

**3.9  
fire**  
continuous emission of flames from a DUT (approximately more than one second)

NOTE Sparks and arcing are not considered as flames.



**3.10****high energy application**

characteristic of device or application, for which the numerical ratio between maximum allowed electric power output (power in W) and electric energy output (energy in Wh) at a 1 C discharge rate at RT for a battery pack or system is typically lower than 10

NOTE Typically high energy battery packs and systems are designed for applications in BEVs.

**3.11****high power application**

characteristic of device or application, for which by the numerical ratio between maximum allowed electric power output (power in W) and electric energy output (energy in Wh) at a 1 C discharge rate at RT for a battery pack or system is typically equal or higher than 10

NOTE Typically high power battery packs and systems are designed for application in HEVs and FCVs.

**3.12****isolation resistance**

resistance between live parts of voltage class B electric circuit and the electric chassis as well as the voltage class A system

**3.13****leakage**

escape of liquid or gas from a DUT except for venting

**3.14****maximum working voltage**

highest value of a.c. voltage (rms) or of d.c. voltage which may occur in an electrical system under any normal operating conditions according to the battery manufacturer's specifications, disregarding transients

**3.15****rated capacity**

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

**3.16****room temperature****RT**

temperature of  $(25 \pm 2)^\circ\text{C}$

**3.17****rupture**

loss of mechanical integrity of the enclosure of the battery pack or system resulting in openings not fulfilling protection degree IPXXB according to ISO 20653

NOTE The kinetic energy of released material is not sufficient to cause structural and/or physical damage to the surrounding of the DUT.

**3.18****state of charge****SOC**

available capacity in a battery pack or system expressed as a percentage of rated capacity

**3.19****supplier**

party that provides battery systems and packs

EXAMPLE A battery manufacturer.

**3.20  
venting**

release of excessive pressure from a DUT intended by design to preclude rupture or explosion

**3.21  
voltage class A**

classification of an electric component or circuit with a maximum working voltage of  $\leq 30$  V a.c. or  $\leq 60$  V d.c., respectively

NOTE For more details, see ISO 6469-3.

**3.22  
voltage class B**

classification of an electric component or circuit with a maximum voltage of ( $> 30$  and  $\leq 1000$ ) V a.c. or ( $> 60$  and  $\leq 1500$ ) V d.c., respectively

NOTE For more details, see ISO 6469-3.

**4 Symbols and abbreviated terms**

a.c.	alternating current
BCU	battery control unit
BEV	battery electric vehicle
d.c.	direct current
DUT	device under test
FCV	fuel cell vehicle
HEV	hybrid electric vehicle
RT	room temperature ( $25 \pm 2$ ) ° C
SOC	state of charge
UNECE	United Nations Economic Commission for Europe

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**5 General requirements**

**5.1 General conditions**

A battery pack or system to be tested according to this standard shall fulfil the following requirements:

- The necessary documentation for operation and needed interface parts for connection to the test equipment (i.e. connectors, plugs including cooling) shall be delivered together with the DUT.
- A battery system shall enable the specified tests, e.g. by specified test modes implemented in the BCU, and shall be able to communicate with the test bench via common communication buses.
- The DUT may also be equipped with additional sensors, wires, support jig which are necessary to conduct the specific test or to obtain the required data for such test. Such additional devices shall not influence the result with respect to the intended purpose of the test.

If not otherwise specified, the tests described apply to battery packs and systems.