IEC 63118-1

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

12 V lithium-ion secondary batteries for automotive starting, lighting, ignition (SLI) applications and auxiliary purposes – Part 1: General requirements and methods of test

Accumulateur ion-lithium 12 V pour les applications de démarrage, d'éclairage, d'allumage (SLI) et les utilisations auxiliaires des véhicules automobiles – Partie 1 : Exigences et méthodes d'essai générales

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12 V LITHIUM-ION SECONDARY BATTERIES FOR AUTOMOTIVE STARTING, LIGHTING, IGNITION (SLI) APPLICATIONS AND AUXILIARY PURPOSES –

Part 1: General requirements and methods of test

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IEC 63118-1 has been prepared by IEC technical committee 21: Secondary cells and batteries. It is an International Standard.

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

Draft	Report on voting
21/1177/FDIS	21/1185/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/publications.

A list of all parts in the IEC 63118 series, published under the general title *12 V lithium-ion secondary batteries for automotive starting, lighting, ignition (SLI) applications and auxiliary purposes*, 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- withdrawn, or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.

12 V LITHIUM-ION SECONDARY BATTERIES FOR AUTOMOTIVE STARTING, LIGHTING, IGNITION (SLI) APPLICATIONS AND AUXILIARY PURPOSES –

Part 1: General requirements and methods of test

1 Scope

This part of IEC 63118 specifies the general tests and requirements for the performance of lithium secondary batteries with a nominal voltage of 12 V permanently installed in road vehicles not for propulsion. The replacement of secondary batteries permanently installed in road vehicles not for propulsion is covered by this document.

The following are typical applications that utilize the batteries under the scope of this document: power source for the starting of internal combustion engines, lighting, stop and start function, on-board auxiliary equipment and energy absorption for regeneration from braking.

The batteries primarily used for propulsion of electric vehicles (EV) including battery electric vehicles (BEV), hybrid electric vehicles (HEV), and plug-in hybrid electric vehicles (PHEV) are not covered by this document.

This document includes:

- electrical characteristics tests methods and requirements;
- a life duration tests method.

This document does not include:

- dimensions;
- the system communication protocol;
- safety aspects.

NOTE The safety aspects of the batteries are covered by IEC 63057.

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 60050-482, *International Electrotechnical Vocabulary (IEV) – Part 482: Primary and secondary cells and batteries,* available at http://www.electropedia.org

IEC 62902, *Secondary cells and batteries – Marking symbols for identification of their chemistry*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-482 and ISO/IEC Guide 51, and the following apply.

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

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

3.1.1
battery
unit comprising one or more cells, modules and a battery management system

3.1.2
battery management system
BMS
set of protection functions associated with a battery to prevent overcharge, overcurrent, over temperature, under temperature and if applicable overdischarge

Note 1 to entry: The function of the BMS can be assigned to the battery or to the vehicle that uses the battery. See IEC 63057:2020, Figure 1.

Note 2 to entry: The BMS can be divided, and it can be found partially in the battery and partially on the equipment that uses the battery. See IEC 63057:2020, Figure 1.

Note 3 to entry: The BMS is sometimes also referred to as a battery management unit (BMU).

Note 4 to entry: The electrical tests specified in Clause 6 can be verified without a BMS by setting the upper and lower limit range set by the manufacturer.

3.1.3
cell
secondary cell
basic functional unit where the electrical energy is derived from the insertion or extraction reactions of lithium ions or the oxidation-reduction reaction of lithium between the negative electrode and the positive electrode

Note 1 to entry: The cell typically has an electrolyte that consists of a lithium salt and organic solvent compound in liquid, gel or solid form and has a metal or a laminate film casing. It is not ready for use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device.

3.1.4
final voltage
specified closed circuit voltage at which the discharge of a battery is terminated

Note 1 to entry: The final voltage should be declared by the battery manufacturer.

3.1.5
module
group of cells connected together in a series or parallel configuration, or both, with or without protective device (e.g. fuse or positive temperature coefficient device) and monitoring circuitry

3.1.6
nominal charge current
charge current used to designate or identify the charge performance of a battery

Note 1 to entry: The nominal charge current is declared by the battery manufacturer.

3.1.7
nominal cranking current
discharge current used to designate or identify the cranking performance of a battery

Note 1 to entry: The nominal cranking current is declared by the battery manufacturer.

Note 2 to entry: The nominal cranking current shall not exceed the operating range specified by the battery manufacturer.

3.1.8
nominal voltage
suitable approximate value of the voltage used to designate or identify a battery

Note 1 to entry: The scope of this document is applicable to a battery with a nominal voltage of 12 V.

3.1.9
rated capacity
capacity value of a battery determined under specified conditions and declared by the battery manufacturer

Note 1 to entry: The rated capacity is the quantity of electricity declared by the battery manufacturer which a battery can deliver during an n h period when charging, storing and discharging under the conditions specified in 6.3.

3.2 Symbols

The following symbols are used to denote various numerical values associated with the corresponding quantities:

I_{ca} numerical value of the charge current, expressed in amperes (A);

I_{cc} numerical value of the cranking current, expressed in amperes (A);

C_n numerical value of the rated capacity, expressed in ampere-hours (Ah).

4 Parameter measurement tolerances

The overall accuracy of controlled or measured values, relative to the specified or actual values, shall be within the following tolerances:

a) ±0,5 % for voltage;

b) ±1 % for current;

c) ±5 °C for temperature;

d) ±0,1 % for time.

These tolerances comprise the combined accuracy of the measuring instruments, the measurement techniques used, and all other sources of error in the test procedure.

The details of the instrumentation used shall be provided in any report of results.

5 Marking and designation

Each battery that is installed or maintained shall carry clear and durable markings giving the following information. Details are defined by national regulations:

- "secondary (rechargeable) Li" or "Li-ion";
- polarity;
- name or identification of battery manufacturer or battery supplier;
- rated capacity in 1 h;

- nominal voltage: 12 V;
- nominal cranking current;
- appropriate caution statement;
- identification of chemistry with reference to IEC 62902.

The model name and manufacturing traceability shall be marked on the battery surface. The other items listed above can be marked on the smallest package or supplied with the battery.

The following information shall be marked on or supplied with the battery in document form such as a specification sheet, an instruction manual, or similar documents:

- disposal instructions;
- final voltage;
- nominal charge current;
- recommended charge instructions;
- operating temperature;
- storage temperature.

6 Electrical tests

6.1 General

Electrical tests are applied to batteries.

The charge and discharge currents for the tests shall be based on the value of the rated capacity C_n Ah. These currents are expressed as a multiple of I_t A:

I_t A = C_n Ah/1 h

where

I_t is the numerical value of the reference test current, expressed in amperes (A);

C_n is the numerical value of the rated capacity, expressed in ampere-hours (Ah);

n is the numerical value of the time base, expressed in hours (h), for which the rated capacity is declared.

6.2 Charging procedure for test purposes

The battery shall be stored at an ambient temperature of 25 °C for more than 4 h.

Prior to charging, the battery shall be discharged at 25 °C at a constant current of 1,0 I_t A, down to the final voltage specified by the battery manufacturer.

Batteries shall be charged at an ambient temperature of 25 °C, using the method specified by the battery manufacturer, unless otherwise stated in this document.

The battery manufacturer shall propose a nominal charge profile at 25 °C including: charge current, constant voltage value and cut-off charge current.

6.3 Capacity

6.3.1 General

This test verifies the rated capacity of a battery.

6.3.2 Method

Step 1 – The battery shall be fully charged in accordance with 6.2.

Step 2 – The battery shall be stored at an ambient temperature of 25 °C ± 2 °C, for not less than 1 h and not more than 24 h. The stored time should be set to stabilize the battery temperature.

Step 3 – The battery shall then be discharged at the same ambient temperature at 1,0 I_t A to the final voltage specified by the battery manufacturer.

6.3.3 Acceptance criteria

The capacity (Ah), delivered during step 3 of 6.3.2, shall not be less than the rated capacity.

6.4 Discharge performance at low temperature

6.4.1 General

This test verifies the discharge performance of the battery at low temperatures.

6.4.2 Method

a) Discharge performance at −18 °C

Step 1 – The battery shall be fully charged in accordance with 6.2.

Step 2 – The battery shall be stored at a temperature of −18 °C ± 1 °C, for not less than 16 h and not more than 24 h.

Step 3 – The battery shall then be discharged, either within or outside the cooling chamber within 2 min after the end of the cooling period with a nominal cranking current I_{cc} A at an ambient temperature of −18 °C ± 1 °C.

Step 4 – After a 10 s discharge, the terminal voltage U_{f10s} shall be recorded and the current shall be cut off.

b) Discharge performance at −29 °C

Step 5 – The battery shall be fully charged in accordance with 6.2.

Step 6 – The battery shall be stored at an ambient temperature of 25 °C, for not less than 1 h and not more than 24 h. The stored time should be set to stabilize the battery temperature.

Step 7 – The battery is discharged using a current of 1,0 I_t A during 30 min.

Step 8 – The battery shall be stored at a temperature of −29 °C ± 1 °C, for not less than 16 h and not more than 24 h.

Step 9 – The battery shall then be discharged, either within or outside the cooling chamber within 2 min after the end of the cooling period with a nominal cranking current of 0,6 I_{cc} A at an ambient temperature of −29 °C ± 1 °C.

Step 10 – After a 10 s discharge, the terminal voltage U_{f10s} shall be recorded.

6.4.3 Acceptance criteria

a) Acceptance criteria of discharge performance at −18 °C

The voltage (U_{f10s}), delivered during step 4 of 6.4.2, shall not be less than 7,5 V.

b) Acceptance criteria of discharge performance at −29 °C

The voltage (U_{f10s}), delivered during step 10 of 6.4.2, shall not be less than 7,5 V.

6.5 Charge performance at 0 °C and −18 °C

6.5.1 General

This test verifies the charge acceptability of the battery.

6.5.2 Method

a) Charge performance at 0 °C

Step 1 – The battery shall be fully charged in accordance with 6.2.

Step 2 – The battery shall be stored at an ambient temperature of 25 °C for not less than 1 h and not more than 24 h. The stored time should be set to stabilize the battery temperature.

Step 3 – The battery shall then be discharged at the same ambient temperature at 1,0 I_t A for 30 min.

Step 4 – The battery shall be stored at a temperature of 0 °C ± 1 °C, for not less than 16 h and not more than 24 h.

Step 5 – The battery shall then be charged at the maximum charge current and maximum charge voltage specified by the battery manufacturer at an ambient temperature of 0 °C ± 1 °C.

Step 6 – After 10 s, the charging current I_{10s} A shall be recorded.

b) Charge performance at −18 °C

Step 7 – The battery shall be fully charged in accordance with 6.2.

Step 8 – The battery shall be stored at an ambient temperature of 25 °C, for not less than 1 h and not more than 24 h. The stored time should be set to stabilize the battery temperature.

Step 9 – The battery is discharged using a current of 1,0 I_t A during 30 min.

Step 10 – The battery shall be stored at a temperature of −18 °C ± 1 °C, for not less than 16 h and not more than 24 h.

Step 11 – The battery shall then be charged at the maximum charge current and maximum charge voltage specified by the battery manufacturer at an ambient temperature of –18 °C ± 1 °C.

Step 12 – After 10 s, the charging current I_{10s} A shall be recorded.

6.5.3 Acceptance criteria

a) Acceptance criteria of charge performance at 0 °C

The current (I_{10s} A), measured during step 6 of 6.5.2, shall be not less than I_{ca} A.

b) Acceptance criteria of charge performance at −18 °C

The current (I_{10s} A), measured during step 12 of 6.5.2, shall be not less than 0,7 I_{ca} A.

6.6 Charge retention

6.6.1 General

This test verifies the self-consumption (self-discharge and BMS) of the battery after long-term shipping.

6.6.2 Method

Step 1 – The battery shall be fully charged in accordance with 6.2.

Step 2 – The battery shall be stored at an ambient temperature of 40 °C, for 90 days.

Step 3 – The battery shall be stored at a temperature of 25 °C, for not less than 16 h and not more than 24 h.

The battery shall then be discharged at the same ambient temperature at 1,0 I_t A to the final voltage specified by the battery manufacturer.

6.6.3 Acceptance criteria

The passing criteria shall be based on the agreement between the battery manufacturer and the customer.

6.7 Endurance

6.7.1 Endurance in cycles

6.7.1.1 General

This test verifies the capacity and the discharge performance at low temperature of the battery in cycling.

6.7.1.2 Method

Step 1 – The battery shall be fully charged in accordance with 6.2.

Step 2 – The battery shall be stored at a temperature of 40 °C, for not less than 16 h and not more than 24 h.

Step 3 – The battery shall then be discharged at the same ambient temperature at 1,0 I_t A during 30 min.

Step 4 – 10 min rest period (adjustable rest period).

Step 5 – The battery shall be fully charged, at an ambient temperature of 40 °C, using the method specified by the battery manufacturer.

Step 6 – 10 min rest period (adjustable rest period).

The step 3 to step 6 sequence represents one cycle.

One unit represents 500 cycles.

The rest period duration in step 4 and step 6 of 6.7.1.2 shall be adjusted in order to obtain an average battery temperature of 45 °C after stabilization.

The check-up sequence is performed before the first unit and after each unit.

The battery shall perform for at least three units corresponding to 1 500 cycles.

6.7.1.3 Check-up sequence

6.7.1.3.1 General

The check-up sequence is composed of a capacity and a discharge performance measurement at low temperature.

6.7.1.3.2 Capacity measurement

The battery shall be stored at an ambient temperature of 25 °C, for not less than 16 h and not more than 24 h.

The battery shall be fully charged in accordance with 6.2.

The battery shall be stored at an ambient temperature of 25 °C ± 2 °C, for not less than 1 h and not more than 24 h. The stored time should be set to stabilize the battery temperature.

The battery shall then be discharged at the same ambient temperature at 1,0 I_t A to the final voltage specified by the battery manufacturer. The capacity is recorded.

6.7.1.3.3 Discharge performance measurement at low temperature

The battery shall be fully charged in accordance with 6.2.

After a 1 h rest period at 25 °C, the battery is discharged using a current of 1, 0 I_t A during 30 min.

The battery shall be stored at a temperature of –18 °C ± 1°C, for not less than 16 h and not more than 24 h.

The battery shall then be discharged, with the nominal cranking current of I_{cc} A at an ambient temperature of –18 °C ± 1 °C.

The terminal voltage U_{f1s} after a 1 s discharge and U_{f0s} before discharge shall be recorded and compared.

The battery shall be stored at a temperature of 25 °C, for not less than 16 h and not more than 24 h.

The battery shall be fully charged in accordance with 6.2.

And then a new unit is launched.

6.7.1.3.4 Acceptance criteria

The passing criteria shall be based on the agreement between the battery manufacturer and the customer.

6.7.2 Floating-calendar life test

6.7.2.1 General

This test verifies the capacity and the discharge performance at charge and storage of the battery.

6.7.2.2 Method

Step 1 – The battery shall be fully charged in accordance with 6.2.

Step 2 – The sample is charged according to the standard charge method and put in a climatic chamber where the ambient temperature is adjusted to 55 °C ± 2 °C.

Step 3 – The battery shall be connected to a device where it undergoes the continuous series of cycles, each cycle consisting of:

- charge period: 13 days in charge at maximum charge current and maximum charge voltage specified by the battery manufacturer;
- rest period: 13 days in open circuit conditions.

These charge and rest periods at 55 °C ± 2 °C represent one unit.

The check-up sequence is performed before the first unit and after each unit.

The test shall be performed until eight units are completed.

6.7.2.3 Check-up sequence

6.7.2.3.1 General

The check-up sequence is composed of a capacity and a discharge performance measurement at low temperature.

6.7.2.3.2 Capacity measurement

The battery shall be stored at an ambient temperature of 25 °C, for not less than 16 h and not more than 24 h.

The battery shall be fully charged in accordance with 6.2.

The battery shall be stored at an ambient temperature of 25 °C ± 2 °C, for not less than 1 h and not more than 24 h. The stored time should be set to stabilize the battery temperature.

The battery shall then be discharged at the same ambient temperature at 1,0 I_t A to the final voltage specified by the battery manufacturer. The capacity is recorded.

6.7.2.3.3 Discharge performance measurement at low temperature

The battery shall be fully charged in accordance with 6.2.

After a 1 h rest period at 25 °C, the battery is discharged using a current of 1,0 I_t A during 30 min.

The battery shall be stored at a temperature of −18 °C ± 1 °C, for not less than 16 h and not more than 24 h.

The battery shall then be discharged, with the nominal cranking current of I_{cc} A at an ambient temperature of −18 °C ± 1 °C.

The terminal voltage U_{f1s} after a 1 s discharge and U_{f0s} before discharge shall be recorded and compared.

The battery shall be stored at a temperature of 25 °C, for not less than 16 h and not more than 24 h.

The battery shall be fully charged in accordance with 6.2.

And then a new unit is launched.

6.7.2.3.4 Acceptance criteria

The passing criteria shall be based on the agreement between the battery manufacturer and the customer.

7 Type test conditions

7.1 General

The type test conditions and protocol should be agreed between the battery manufacturer and the customer. When this is not the case, the type test conditions of 7.2 shall apply.

7.2 Test items

Tests are made with the number of batteries specified in Table 1, using batteries that are stored under the conditions specified by the manufacturer and that are not more than six months old. The tests are carried out at an ambient temperature of 25 °C ± 5 °C, unless otherwise specified.

NOTE The test conditions are for type tests only. The limit of six months is introduced for consistency and does not imply that the battery performance is reduced after six months.

Table 1 – Type tests

Test	Subclause	Battery[a]
Capacity	6.3	Y
Discharge performance at low temperature	6.4	Y
Charge performance at 0 °C and −18 °C	6.5	Y
Charge retention	6.6	Y
Endurance in cycles	6.7.1	Y
Floating-calendar life test	6.7.2	Y
[a] "Y" indicates that the test is required: the sample number is at least one.		

Bibliography

IEC 61434:1996, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Guide to designation of current in alkaline secondary cell and battery standards*

IEC 63057:2020, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium batteries for use in road vehicles not for the propulsion*

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