IEC 62485-1

Edition 1.0 2015-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Safety requirements for secondary batteries and battery installations –
Part 1: General safety information

Exigences de sécurité pour les batteries d'accumulateurs et les installations de batteries –
Partie 1: Informations générales de sécurité

IEC 62485-1:2015-04(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SAFETY REQUIREMENTS FOR SECONDARY BATTERIES AND BATTERY INSTALLATIONS –

Part 1: General safety information

FOREWORD

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International Standard IEC 62485-1 has been prepared by IEC technical committee 21: Secondary cells and batteries.

The text of this standard is based on the following documents:

FDIS	Report on voting
21/851/FDIS	21/856/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 62485 series can be found, under the general title *Safety requirements for secondary batteries and battery installations,* on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

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SAFETY REQUIREMENTS FOR SECONDARY BATTERIES AND BATTERY INSTALLATIONS –

Part 1: General safety information

1 Scope

This Part of IEC 62485 specifies the basic requirements for secondary batteries and battery installations.

The requirements regarding safety, reliability, life expectancy, mechanical strength, cycle stability, internal resistance, and battery temperature, are determined by various applications, and this, in turn, determines the selection of the battery design and technology.

In general, the requirements and definitions are specified for lead-acid and nickel-cadmium batteries. For other battery systems with aqueous electrolyte, the requirements may be applied accordingly.

The standard covers safety aspects taking into account hazards associated with:

– electricity (installation, charging, discharging, etc.);
– electrolyte;
– inflammable gas mixtures;
– storage and transportation.

With respect to electrical safety, reference is made to IEC 60364-4-41.

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.

IEC 60050-482:2004, *International Electrotechnical Vocabulary – Part 482: Primary and secondary cells and batteries*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60993, *Electrolyte for vented nickel-cadmium cells*

IEC 61429:1995, *Marking of secondary cells and batteries with the international recycling symbol ISO 7000-1135*

IEC 62485-2, *Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries*

IEC 62485-3, *Safety requirements for secondary batteries and battery installations – Part 3: Traction batteries*

IEC 62485-4, *Safety requirements for secondary batteries and battery installations – Part 4: Valve-regulated lead-acid batteries for use in portable appliances*

ISO 7000, *Graphical symbols for use on equipment – Registered symbols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-482, as well the following apply.

3.1
stationary battery
stationary battery installation
battery installed in a fixed location and not generally intended to be moved from place to place

Note 1 to entry: The batteries are permanently connected to a charger and in many cases in addition to the load and the power supply and are incorporated into stationary equipment or installed in battery rooms for use in telecom, uninterruptible power supply (UPS), utility switching, emergency power or similar applications.

3.2
traction battery
secondary battery designed to provide the propulsion energy for electrical vehicles

3.3
cranking battery
battery used for starting of internal combustion engines in stationary, railway or other onboard applications

3.4
starter battery
battery primarily used as a power source for the starting of internal combustion engines, lighting and also for auxiliary equipment of internal combustion engine vehicles

3.5
onboard battery
battery used for power supply of a DC network onboard ships, rail vehicles or off-road vehicles without authorization for public traffic

3.6
aircraft battery
battery used in aircrafts and helicopters for starting the auxiliary engine and powering the DC network

3.7
portable battery
battery mainly used for power supply of portable appliances

Note 1 to entry: Batteries for portable equipment are usually maintenance-free.

3.8
battery room
room in a building dedicated for the accommodation of stationary batteries

3.9
battery enclosure
enclosure designed for the accommodation of batteries to protect against environmental impacts, unauthorised access of persons and hazards caused by the batteries

3.10
mode of operation
condition where the batteries require different type of charging and discharging depending on the type of application

Note 1 to entry: The modes are listed in 4.2.4.

3.11
charge of a battery
operation during which a secondary cell or battery is supplied with electric energy from an external circuit which results in chemical changes within the cell and thus the storage of this energy as chemical energy

[SOURCE: IEC 60050-482:2004, 482-05-27, modified – replacement of "charging" by "charge" in the entry]

3.12
discharge (of a battery)
operation by which a secondary cell or battery delivers to an external electric circuit and under specified conditions electric energy produced in the cells

[SOURCE: IEC 60050-482:2004, 482-03-23, modified – replacement of "battery" by "secondary cell or battery" in the definition]

4 General information

4.1 General

The technical characteristics of secondary cells are listed in Table 1. The different electro-chemical systems have acidic or alkaline aqueous electrolyte. These electro-chemical systems generate different voltages depending on the type of positive and negative electrodes and the type of electrolyte. For each of the systems a nominal voltage is defined.

During operation some systems may generate and release gasses, which may be hazardous under certain conditions and require specific protective measures.

Table 1 – Electrochemical couples (secondary cells)

Battery system	Designation of system components						Nominal voltage[a]	Gassing voltage	Simplified equation of cell reaction charged condition ⇄ discharged condition
	Electrodes	Electrolyte	Active mass of electrodes						
			charged		discharged				
			positive	negative	positive	negative	[V]	[V]	
Lead-acid	Pb / PbO_2	H_2SO_4	PbO_2	Pb	$PbSO_4$	$PbSO_4$	2,00	≈ 2,40	$PbO_2 + Pb + 2H_2SO_4 \leftrightarrow 2PbSO_4 + 2H_2O$
Nickel-cadmium	Ni / Cd	KOH / NaOH	NiOOH	Cd	$Ni(OH)_2$	$Cd(OH)_2$	1,20	≈ 1,55	$2NiOOH + Cd + 2H_2O \leftrightarrow 2Ni(OH)_2 + Cd(OH)_2$
Ni-metal-hydride	Ni/MH	KOH	NiOOH	H_2	$Ni(OH)_2$	H_2O	1,20	≈ 1,55	$2(NiOOH \cdot H_2O) + H_2 \leftrightarrow 2Ni(OH)_2 + 2H_2O$
Nickel-iron	Ni / Fe	KOH	NiOOH	Fe	$Ni(OH)_2$	$Fe(OH)_2$	1,20	≈ 1,70	$2NiOOH + Fe + 2H_2O \leftrightarrow 2Ni(OH)_2 + Fe(OH)_2$
Silver-zinc	Ag / Zn	KOH	AgO	Zn	Ag	$Zn(OH)_2$	1,55	≈ 2,05	$AgO + Zn + H_2O \leftrightarrow Ag + Zn(OH)_2$

[a] Typical nominal voltage.

In Table 2 preferred applications according to the battery design are listed.

Table 2 – Preferred fields of application of secondary battery design

Field of application	Stationary battery IEC 62485-2	Traction battery IEC 62485-3	Portable battery IEC 62485-4
Telecommunication	☑		
Power plants / Substations	☑		
DC power supply systems alarm system, signal systems, railway crossings, etc.	☑		
Emergency power supply	☑		
UPS systems	☑		
Starting of internal combustion engines (cranking battery)	☑		
PV solar systems	☑		
Forklift trucks / Materials Handling Equipment (MHE)		☑	
Automatic guided vehicles Mobile robots		☑	
Cleaning machines Wheel chairs		☑	
Explosion proof batteries mining batteries		☑	
Leisure type batteries, e.g. Caravans, boats, yachts		☑	
Batteries onboard ships (boats), railway and other vehicles	☑	☑	
Portable appliances			☑
General purpose batteries	☑	☑	☑

4.2 Charge

4.2.1 General

After a discharge, secondary batteries can be recharged by use of a suitable DC power source. Normally batteries supply the energy for a specified time period to appliances, systems or vehicles independent from the mains power supply.

Batteries can also be kept fully charged by applying permanent float charge and can be operated as a reserve power source, e.g. in ‘fail safe’ power supply systems.

The characteristic of the charge equipment is determined by the electro-chemical system, the battery design and the application. The charger shall provide the required charging characteristics and charging regime to suit to the operating conditions.

In the case of parallel operation of the battery with the charger and load, the system’s settings for current and voltage shall reflect the values specified by the battery manufacturer.

4.2.2 Charging techniques and charging procedures

For proper charging of secondary batteries, manufacturer’s specified charging procedures and charging regimes shall be applied. For achieving long service life of secondary batteries the limit values and operating conditions shall be observed. The control of charge voltage (over charge protection) and current are recommended to detect irregularities during a charge. Some conditions can extend a recharge time, e.g. low voltage of the mains supply, or low electrolyte temperature requiring a longer recharge time, or suffer undercharge.

Normally the charge current for vented batteries is not limited until the gassing voltage is reached. With valve-regulated and gastight sealed batteries the manufacturer's instruction regarding charge current, voltage and temperature shall be followed.

When exceeding the gassing voltage the charge current shall be adjusted according to information from the battery manufacturer or from the relevant safety standards.

4.2.3 Charger characteristics

Chargers with uncontrolled taper characteristics are affected by variations in the mains supply, i.e. variations of mains voltage and frequency. In order to compensate for these variations, manual adjustment of the transformer tappings may be required, to achieve the chargers specified recharge values.

The mains voltage variation for long periods on uncontrolled taper charge rectifiers gives deviations of the output current. The manual adjustment of the transformer tappings may be necessary to bring the charger back to recommended output limits

Influences from the mains supply are compensated when chargers with controlled charge characteristic are used, e.g. constant current / constant voltage (IU) characteristic.

Parallel connected batteries shall have identical electrochemical system and identical number of cells. They shall be charged with controlled IU-chargers only. The individual strings in the installation shall have an equal potential.

4.2.4 Mode of operation

4.2.4.1 General

The mode of operation specifies the joint operation of the DC power source, the battery and the consumer load.

The following modes of operation are typical:

- battery / cycle operation (charge / discharge operation);
- response mode operation (switch mode operation);
- parallel operation mode. Battery, load and charger are permanently connected and operate in parallel.

4.2.4.2 Battery / cycle operation mode (charge / discharge)

The load is powered by the battery only. A conductive connection between load and DC power source does not exist. The DC power source recharges the battery only. Figure 1 illustrates this operation mode.

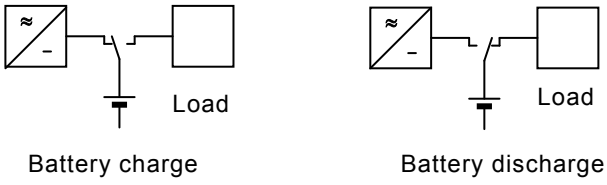

Figure 1 – Battery/cycle operation mode of a battery (charge/discharge)

4.2.4.3 Response (switch) mode operation

The power source DC1 feeds the load. The battery is kept charged by a second power source DC2. A conductive connection between both circuits does not exist in the first instance. When the power source DC1 of the load fails, the switching contact responds and connects the battery to the load. Figure 2 illustrates this operation mode.

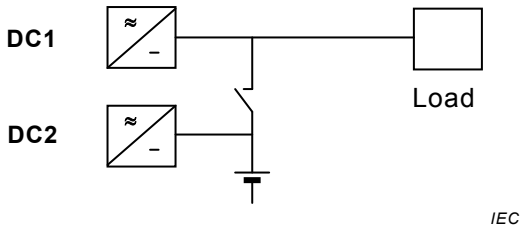

Figure 2 – Response (switch) mode operation

4.2.4.4 Parallel operation mode

4.2.4.4.1 General

The DC power source, the batteries and the consumer load are permanently connected in parallel. Figure 3 illustrates this operation mode.

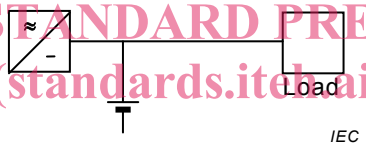

Figure 3 – Parallel operation mode (including standby and buffer operation mode)

4.2.4.4.2 Parallel standby operation mode

The DC power source is designed to supply the sum of the maximum load current and the battery charge current (also recharge current after a discharge) at any time. The battery is kept fully charged. The battery supplies only the load, when the DC power source fails.

4.2.4.4.3 Buffer operation

At times, the load current can exceed the nominal current of the DC power source. During these periods the current will be supplied by the battery. The battery provides the peak loads and is not always in a fully state of charge. In case of DC power source failure the battery supplies the load.

4.3 Discharge

The battery capacity depends on the discharge current. The corresponding voltage shall not drop below the specified end of discharge voltage. Discharges exceeding these limits are deep discharges.

The voltage curve during discharge is determined by the battery design and is influenced by the current, discharge time, initial state of charge, temperature and the battery's state of health.

Test of capacity shall be performed in accordance with the appropriate standards of the products (see bibliography).