BS EN 50272-1:2010

BSI Standards Publication

Safety requirements for secondary batteries and battery installations

Part 1: General safety information

National foreword

This British Standard is the UK implementation of EN 50272-1:2010. It supersedes BS 6132:1983 and BS 6133:1995, which will be withdrawn on 1 October 2011.

The UK participation in its preparation was entrusted to Technical Committee PEL/21, Secondary cells and batteries.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Règles de sécurité pour les batteries et les installations de batteries - Partie 1: Information générale de sécurité

Sicherheitsanforderungen an Batterien und Batterieanlagen - Teil 1: Allgemeine Sicherheitsinformationen

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

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CENELEC

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

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 21X, Secondary cells and batteries. It was submitted to the formal vote and was approved by CENELEC as EN 50272-1 on 2010-10-01.

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

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-10-01

Contents

1 Scope

This European Standard is Part 1 of EN 50272 under the generic title *"Safety requirements for secondary batteries and battery installations"* with nominal voltages up to DC 1 500 V (low voltage directive) and specifies the basic requirements referred to in the other parts of the standard as follows:

- Part 2 Stationary batteries
- Part 3 Traction batteries
- Part 4 Batteries for use in portable appliances

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, 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 EN 60364-4-41.

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.

EN 50272-2	Safety requirements for secondary batteries and battery installations - Part 2: Stationary batteries
EN 50272-3	Safety requirements for secondary batteries and battery installations - Part 3: Traction batteries
EN 50272-4	Safety requirements for secondary batteries and battery installations - Part 4: Batteries for use in portable appliances
EN 60364-4-41	Electrical installations of buildings - Part 4: Protection for safety - Chapter 41: Protection against electric shock (IEC 60364-4-41)
EN 61429:1996 + A11:1998	Marking of secondary cells and batteries with the international recycling symbol ISO 7000-1135 and indications regarding directives 93/86/EEC and 91/157/EEC (IEC 61429:1995)
EN 62281	Safety of primary and secondary lithium cells and batteries during transport (IEC 62281)
IEC 60050-482	International Electrotechnical Vocabulary - Chapter 482: Primary and secondary cells and batteries
IEC 60993 series	Electrolyte for vented nickel-cadmium cells

3 Terms and definitions

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

3.1
stationary battery / stationary battery installation
stationary batteries are installed in a fixed location and not generally intended to be moved from place to place. They are permanently connected to both 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
a secondary battery which is designed to provide the propulsion energy for electrical vehicles

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

3.4
starter battery
starter batteries are 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
batteries 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
batteries used in aircrafts and helicopters for starting auxiliary engine and powering DC network

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

NOTE 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

3.9.1
battery cabinet
enclosure equipped with lockable or non-lockable doors for servicing the battery. The cabinet can be completely or partly filled with batteries or can be equipped with additional electric or electronic devices respectively

3.9.2
battery shelter
battery enclosure for outdoor installations. It can be designed as a movable unit for transportation

3.9.3
battery box
closed box designed for the accommodation of batteries. They can form an integral part or parts of other equipment

3.10
mode of operation
batteries require different type of charging and discharging depending on the type of application. The following modes of operation are typical:

- battery / cycle operation (charge / discharge operation)

  The load is powered by the battery only, after the battery has been charged. This can be permanently repeated (cycle operation);
- response mode operation (switch mode operation)
  In case of power failure the load is switched to the fully charged battery. The battery is charged by a separate charger;
- parallel operation mode. Battery, load and charger are permanently connected and operated in parallel. In case of power failure the load is continuously powered without any interruption by discharging the battery

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 storage of energy as chemical energy [IEV 482-05-27 MOD]

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
[IEV 482-03-23 MOD]

4 General Information

4.1 General

The technical characteristics of secondary cells are listed in Table 1. The different electro-chemical systems have acidic, alkaline, non-aqueous or solid 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 [V]	Gassing voltage [V]	Simplified equation of cell reaction charged condition → discharged condition
	Electrodes	Electrolyte	Active mass of electrodes						
			charged		discharged				
			positive	negative	positive	negative			
Lead-acid	Pb / PbO_2	H_2SO_4	PbO_2	Pb	$PbSO_4$	$PbSO_4$	2,00	≈ 2,40	$PbO_2 + Pb + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O$
Nickel-cadmium	Ni / Cd	KOH / NaOH	NiOOH	Cd	$Ni(OH)_2$	$Cd(OH)_2$	1,20	≈ 1,55	$2NiOOH + Cd + 2H_2O \rightarrow 2Ni(OH)_2 + Cd(OH)_2$
Ni-metal-hydride	Ni/MH	KOH	NiOOH	H_2	$Ni(OH)_2$	H_2O	1,20	≈ 1,55	$2(NiOOH{\bullet}H_2O) + H_2 \rightarrow 2Ni(OH)_2 + 2H_2O$
Nickel-iron	Ni / Fe	KOH	NiOOH	Fe	$Ni(OH)_2$	$Fe(OH)_2$	1,20	≈ 1,70	$2NiOOH + Fe + 2H_2O \rightarrow 2Ni(OH)_2 + Fe(OH)_2$
Silver-zinc	Ag / Zn	KOH	AgO	Zn	Ag	$Zn(OH)_2$	1,55	≈ 2,05	$AgO + Zn + H_2O \rightarrow Ag + Zn(OH)_2$
Lithium-systems	Li_x / C	non-aqueous	$Li_{1-x}MetO_2$ + xLi	C	$LiMetO_2$	C+xLi	3,60 [a]	none [b]	$Li_{1-x}MO_2 + CLi_x \rightarrow LiMO_2 + C$

[a] Typical nominal voltage.

[b] Li or Li-Ion cells have a limiting voltage specified by the manufacturer.

Table 2 - Preferred fields of application of secondary battery design

Field of application	**Stationary battery EN 50272-2**	**Traction battery EN 50272-3**	**Portable battery EN 50272-4**
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 / Electric handling machines /		☑	
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. It is recommended to control charge voltage (over charge protection) and current to detect irregularities on time. Charge currents and voltages remaining below specified values, e.g. due to low voltage of the mains supply, or low electrolyte temperature require longer recharge time, or will result in insufficient charge condition.

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

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 depend on influences by the mains supply, i.e. variations of mains voltage and frequency. If these influences need to be eliminated, additional measures are required to achieve the specified set values, e.g. by manual setting of transformer taps

NOTE In case of longer lasting deviations of the output values when using uncontrolled taper charge rectifiers, the electrical limit values for battery and charger shall be readjusted by means of using different transformer taps.

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 of identical electro-chemical system and with identical number of cells 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.

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.

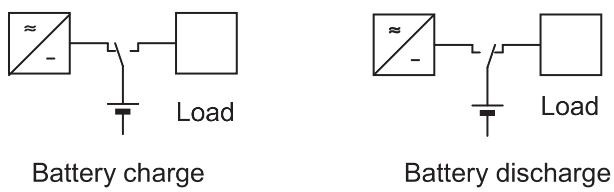

Figure 1 - Battery / cycle operation mode of a battery (charge / discharge)

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.

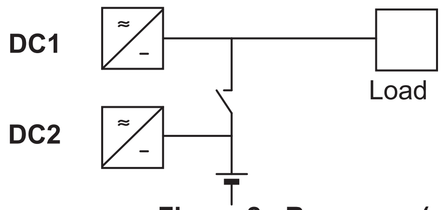

Figure 2 - Response (switch) mode operation

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

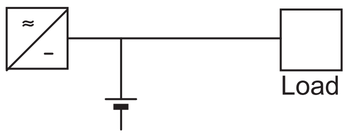

Figure 3 - Parallel operation mode (incl. standby and buffer operation mode)

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 current will be supplied by the battery. The battery provides the peak loads and is not always fully charged at any time. 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).

4.4 Superimposed AC current / ripple current

Depending on the charger and load design and its characteristic, AC current, superimposed on the DC charge current, does flow through the battery during the charging process. This superimposed AC current can be generated by the charger or fed back from the load. This AC current will generate additional heat in the battery with consequential damage or accelerated ageing.

Values for the maximum permitted superimposed AC current are specified in EN 50272-2.

5 Protection against electric shock

The required measures for the protection against electric shock are based on the requirements specified in IEC 60364-4. Reference is made to this standard wherever applicable in DC power supply systems, and additional information is given where explanation for DC systems including batteries is required.

More detailed information is available in the relevant parts of EN 50272 series.

NOTE In addition, relevant national regulations regarding installation and working conditions shall be applied.

6 Disconnection and separation

Devices shall be provided to separate the battery from all incoming and outgoing current circuits and also from protective earth, especially in case of maintenance and repair.

The connection terminals of batteries can be considered as separation contacts.

Disconnection of connectors or contacts (plugs) is only permitted when no current is flowing.

NOTE Before disconnecting batteries switch off charger and load, to avoid of risk of sparks.

7 Commissioning and putting batteries into operation

7.1 Delivery conditions of batteries

Batteries can be supplied in different initial conditions and shall be put into operation according to the manufacturer's instructions. Initial conditions and relating procedures for putting into operation might be:

a) unfilled (dry) and uncharged (NiCd): electrolyte filling and commissioning charge required;

b) unfilled and charged (dry charged) (Pb): electrolyte filling; eventually charge required;

c) filled and charged (Pb; NiCd,Ni-MH, Li-Ion);

d) filled and discharged (NiCd,Ni-MH, Li-Ion): charge required.

7.2 Electrolyte and topping up water (for vented / flooded type cells only)

Properties of electrolyte for filling and of water for topping-up shall comply with IEC 60993 for Ni/Cd. For electrolyte density (SG), amount respectively level of electrolyte refer to the manufacturer's specification.

7.3 Commissioning

Voltages, currents, rest and charging periods as well as temperature limits specified by the manufacturer shall be considered.

The manufacturer shall specify the maximum storage time and the conditioning requirements.

8 Limit values and correction factors

8.1 General

The following limit values specify the conditions under which safe use and operation of batteries is ensured Permanent operation outside or close to the limit values leads to reduction of reliability and may cause malfunction with risks for health and environment, premature ageing and battery failure.

8.2 Rated capacity and depth of discharge

Rated capacity stated by the manufacturer refers to a depth of discharge of 100 % at rated current.

Where batteries are regularly cyclic charged and discharged, especially lead-acid batteries, not more than 80 % rated capacity shall be discharged. Discharge below the specified end of discharge voltage is defined as deep discharge.

Frequent discharge of more than 80 % of rated capacity and deep discharge leads to irreversible damage and reduced lifetime of lead-acid batteries. Lead-acid batteries remaining in low state of charge for long periods will receive irreversible damage and loss of capacity.

Vented NiCd batteries are not sensitive to deep discharge.

NOTE For sealed NiCd and NiMH batteries refer to battery manufacture's recommendations.

Taking into account a capacity loss over the battery life due to ageing the required initial capacity shall be corrected by an ageing factor. In case of stationary / traction battery applications the ageing factor of 1,25 is typical with reference to a capacity reduction to 80 % at the end of life. Also certain margin shall be included for later expansion of the DC power supply system.

8.3 Charge current, charge voltage

8.3.1 General

For recharge currents see manufacturers instruction. When applying higher charging voltage, exceeding the gassing voltage, the charging current will increase leading to increased oxygen and hydrogen gas emission, increased water loss, increased temperature and reduced lifetime.

The accuracy of battery charger output voltage shall be better than ± 1 %

8.3.2 Charge voltage

The single cells may have slightly different voltages, when charging a fully charged battery with constant voltage, e.g. float or boost charge voltage. The following variations of the voltage values listed in Table 3 can be expected. Depending of the product design other values can be specified by the manufacturer.

Table 3 - Permitted variation of single cell voltage during charging with constant voltage at 20 battery temperaure°C

Pb Vented	**Pb Valve-regulated**	**NiCd vented**	**NiCd sealed portable**	**Ni MH sealed portable**	**Li-Ion**
Vpc	Vpc	Vpc	Float charge at constant voltage is prohibited. Preferred charging method: Constant current charge with adequate cut off method. Refer to manufacturer's instructions		Constant current charge with voltage limitation. Refer to manufacturer's instructions
2,20 – 2,40 [1)]	2,25 – 2,40[1)]	1,40 – 1,45[1)]			
+ 0,1 [2)]	+ 0,15 [2)]	+ 0,1 [2)]			
- 0,05 [3)]	- 0,075 [3)]	- 0,05 [3)]			

NOTE The same tolerances may be applied for boost charge voltages values.

[1)] Range of operation, manufacturer has to define a working voltage for one cell.

[2)] upper level of average voltage deviation of one cell in a string. Out of level is a signal for male function.

[3)] lower level of average voltage deviation of one cell in a string. Out of level is a signal for male function.

8.4 External short circuit

Batteries are able to withstand an external short circuit under specified conditions. The batteries resist certain over-current or a short circuit current for a specified duration. These values determine the design of the electrical power supply systems consisting of fuses, circuit breakers and cables. The manufacturer shall provide appropriate values. External shorts can lead to irreversible damage and a reduced service life.

8.5 Battery temperature

8.5.1 Temperature limits

The limit values specified in Table 4 are possible and depend on battery design and application.

Table 4 - Operating temperatures

Temperature	Pb vented	Pb VRLA	NiCd vented	NiCd sealed portable	NiMH sealed portable	Li-Ion
Lower limit (fully charged)	- 40 °C	- 40 °C	- 50 °C	- 50 °C	- 40 °C	- 40 °C
Upper limit[1)]	+ 60 °C	+ 55 °C	+ 70 °C	+ 60 °C	+ 60 °C	+ 60 °C

1) Stress temperature which should be applied only for a limited time . If used permanently reduction in lifetime in inevitable.

NOTE For other battery systems refer to the manufacturer's information.

The lower temperature limit is determined by the freezing of the electrolyte. Lead-acid batteries reduce the specific gravity of the electrolyte during discharge. At very low temperature ice crystals may affect the plate structure or frozen electrolyte may destroy the battery container.

Low temperature will significantly decrease the battery capacity / power, charge acceptance and efficiency.

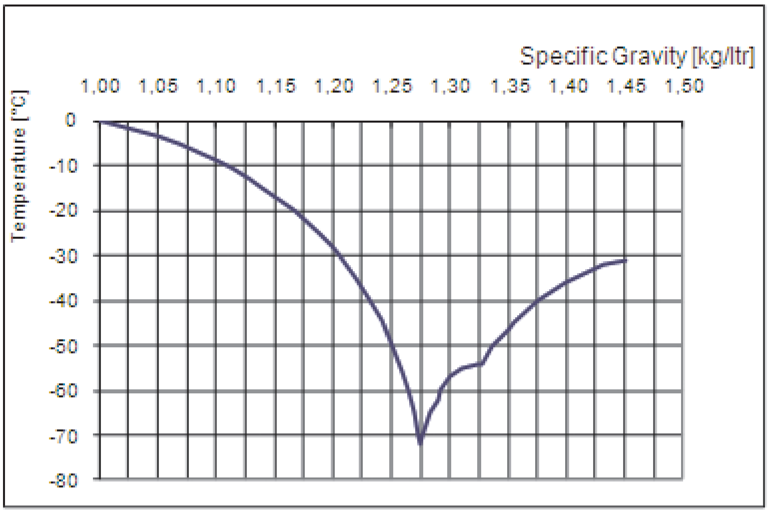

Figure 4 - Freezing point curve of sulphuric acid

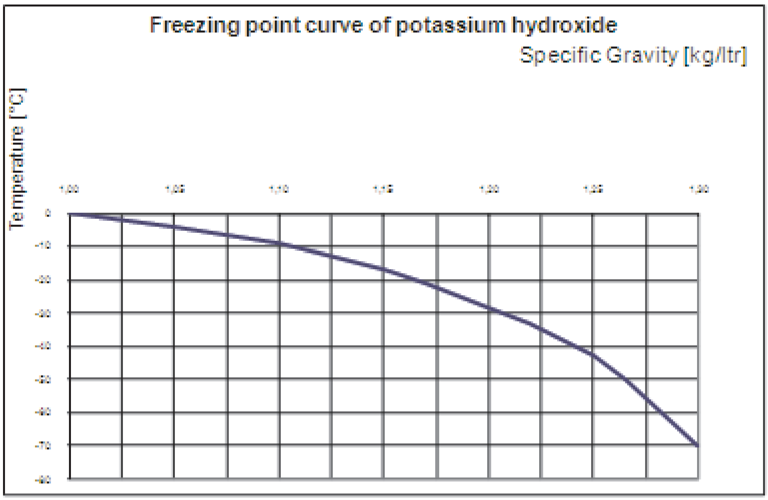

Figure 5 - Freezing point curve of potassium hydroxide solution

8.5.2 Temperature correction of the charging voltage

Charging voltage range is limited by the open circuit voltage and the gassing voltage.

High charging voltage	→ High gassing rate	→ High water loss
Low charging voltage	→ Low charge acceptance	→ Low state of charge

The charging voltage of a battery depends on the temperature and therefore shall be temperature corrected, e.g. when charging with constant voltage.

High temperature → Low voltage
Low temperature → High voltage

Therefore the output voltage of the charger shall be temperature compensated to avoid damage to the battery. Where no other information is provided by the manufacturer the following formula for the correction of the single cell charging voltage may be applied:

$$U_{CC} = U_C + \lambda_U (\vartheta - \vartheta_{rt})$$

where

U_{CC} = temperature compensated charge voltage [V];
U_C = charge voltage at reference temperature [V];
λ_u = temperature correction factor [V/K];
ϑ = measured temperature [°C];
ϑ_{rt} = reference temperature [°C].

Table 5 - Typical Temperature correction factor λ_U of the single cell charging voltage

	Temperature correction factor λ_u (per cell)	Temperature range ϑ
Vented lead-acid battery	-0,004 V/K	0 °C to +60 °C
Valve-regulated lead-acid battery	-0,003 V/K	0 °C to +55 °C
Ni Cd battery	-0,003 V/K	-20 °C to +70 °C
NOTE For other battery systems refer to the manufacturer's information.		

For lead-acid batteries the calculated charging voltage for 0 °C to 60 °C and 0 °C to 55 °C can be applied down to –40 °C.

For high temperature float service application with VRLA batteries the appearance of thermal run-away effects shout be taken into consideration. Specific information regarding temperature limits shall be given by the battery manufacturer.

9 Provisions against explosion hazards

Gasses can be released during operation (mainly during charging) depending on the type of battery. The gasses can be flammable and can explode at certain gas concentration, temperature and external source of ignition. Risks can be minimised by adjusted charging procedure, by design, by ventilation of accommodation area and/or prevention of ignition sources. Details can be found in the appropriate application standards.

10 Provision against electrolyte hazards

Most of the electrolytes used in batteries are hazardous and can create irritation or burns on eyes and skin. Inhalation and swallowing of electrolyte is dangerous. In case of contact with electrolyte, medical attention is always required. The battery manufacturers are recommended to provide safety instructions. Protective measures are specified in the appropriate application standard.
Contact with electrolyte is possible, for example due to:

- handling of electrolyte;
- touching of battery surface or vent plugs, i.e. vented type batteries;
- accidental burst of battery container;
- tilting of vented batteries during handling and transport;
- spilling of electrolyte and ejection of a fine acidic mist or spray being emitted from the battery vents due to gassing.

11 Marking, labeling and instructions

Cells, batteries, and battery packs, shall be equipped with markings, e.g. polarity and plastic marking, labels or prints indicating technical information, warnings and supplier information in accordance to relevant battery standards listed in the bibliography. Appropriate instructions for safety requirements and operation shall be provided.

12 Transport and storage

Packing and transportation of secondary batteries is covered in national and international regulations. The following international regulations for transport, safe packing and carriage of dangerous goods apply:

- Road: European Agreement for the International Carriage of Dangerous Goods by Road (ADR);
- Rail (international): International Convention concerning the carriage of Goods by Rail (CIM) Annex A: International regulations concerning the carriage of dangerous goods by rail (RID);
- Sea: International Maritime Organisation, Dangerous Goods Code;
  IMDG Code 8 Class 8 corrosive;
- Air: International Air Transport Association (IATA);
  Dangerous Goods Regulations (latest edition).

For the transportation of lithium cells or batteries refer also to EN 62281 “Safety of primary and secondary lithium cells and batteries during transport”.

For storage of cells or batteries under various climatic conditions, the characteristics regarding charge retention and corrosion effects shall be observed. The manufacturer’s recommendations shall be followed.

13 Disposal and environmental aspects

All cells and batteries containing the electro-chemically active substances mercury, cadmium or lead shall be marked with the recycling symbol ISO 7000-1135 according to EN 61429:1996, respectively with the crossed-out waste bin and the ISO symbol in accordance with EN 61429:1996/A11:1998 and Directive 2006/66/EC.

When used cells or batteries are subjected to disposal and recycling the Directive 2006/66/EC shall be followed.

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EN 60952-2	Aircraft batteries - Part 2: Design and construction requirements (IEC 60952-2)
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EN 61982-1	Secondary batteries for the propulsion of electric road vehicles - Part 1: Test parameters (IEC 61982-1)
EN 61982-2	Secondary batteries for the propulsion of electric road vehicles - Part 2: Dynamic discharge performance test and dynamic endurance test (IEC 61982-2)
EN 61982-3	Secondary batteries for the propulsion of electric road vehicles - Part 3: Performance and life testing (traffic compatible, urban use vehicles) (IEC 61982-3)
EN 62133	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 (IEC 62133)
EN 62259	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Nickel-cadmium prismatic secondary single cells with partial gas recombination (IEC 62259)
IEC/TS 61438	Possible safety and health hazards in the use of alkaline secondary cells and batteries - Guide to equipment manufacturers and users
IEC/TR 62188	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Design and manufacturing recommendations for portable batteries made from sealed secondary cells

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