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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrolyte and water for vented lead acid accumulators – Part 1: Requirements for electrolyte

Électrolyte et eau pour accumulateurs plomb-acide ouverts – Partie 1: Exigences pour l'électrolyte

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Part 1: Requirements for electrolyte

FOREWORD

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International Standard IEC 62877-1 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
21/874/FDIS	21/881/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 62877 series can be found, under the general title *Electrolyte and water for vented lead acid accumulators*, 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 web site 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- withdrawn,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.

The contents of the corrigendum of May 2017 have been included in this copy.

ELECTROLYTE AND WATER FOR VENTED LEAD ACID ACCUMULATORS –

Part 1: Requirements for electrolyte

1 Scope

This part of IEC 62877 applies to electrolyte and their components used for filling vented lead-acid batteries, for example dry charged cells or batteries, and for electrolyte replacement or electrolyte density adjustment of batteries in operation. This international standard defines the composition, purity and properties of electrolyte to be applied where specific instructions from the battery manufacturer are not available.

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 62877-2, *Electrolyte and water for vented lead acid accumulators – Part 2: Requirements for water*

3 Terms and definitions

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

3.1
electrolyte
diluted sulfuric acid (H_2SO_4) for lead-acid accumulators

Note 1 to entry: The electrolyte is prepared by mixing concentrated sulfuric acid or sulfuric acid with high density of d > 1,30 kg/l and purified water to achieve the density values specified by the battery manufacturer or specified in standards related to the type and battery design in question for a defined state of charge. Its purity meet the requirements laid down in Table 3.

Note 2 to entry: Concentrated sulfuric acid is a colorless, highly corrosive and etching liquid with a density 1,84 kg/l.

3.2
water
purified water (H_2O) used for the preparation of electrolyte for batteries and for the replacement (topping up) of water loss in the operating electrolyte due to decomposition of water by overcharging and evaporation

Note 1 to entry: Purified water meet the requirements specified in IEC 62877-2.

3.3
filling electrolyte
diluted sulfuric acid to be used for the first filling of batteries or for the replacement of contaminated operating electrolyte

3.4
first filling
original filling of a battery carried out by the battery manufacturer or the user in accordance with the applicable manufacturer's instructions

3.5
operating electrolyte
electrolyte present in the battery following the first filling

Note 1 to entry: The density values and the degree of purity of the operating electrolyte may deviate from the values of the filling electrolyte due to impurity input from replenishment by water and to elution from e.g. separators, active material and electrode grids.

3.6
electrolyte density
value for the mass per volume expressed in kg/l

Note 1 to entry: The density varies with the battery´s state of charge, the electrolyte volume variation due to water loss and the temperature.

3.7
specified density
density of the battery to be stated by the battery manufacturer valid at the maximum electrolyte level (see 3.10) at full state of charge of the battery at the reference temperature

Note 1 to entry: It is related to the application and design of the battery.

3.8
reference temperature for analytical results
reference temperature for analytical results of electrolyte impurities which is 25 °C ± 1 °C

Note 1 to entry: Density values measured at temperatures deviating from this reference temperature are adjusted accordingly.

3.9
measurement of the electrolyte density
measurement is carried out by densimeters, in which areometers (hydrometers) are used, or by electronic devices based on e.g. on ultrasonic measurements

Note 1 to entry: The accuracy of the instrument is better than ± 0,001 kg/l.

3.10
electrolyte level
position of the electrolyte surface in the cell/battery, where the recommended tidal movements are indicated by maximum and minimum electrolyte level marks to assist in water replenishment

Note 1 to entry: Water replenishment should take place in a fully charged state to the upper limit, to avoid over topping and electrolyte loss.

3.11
reference temperature
value specified by the battery manufacturer for the indication of properties, such as the nominal electrolyte density, the maximum electrolyte level and the nominal capacity of the battery

Note 1 to entry: The value of the nominal temperature for the indication of parameters may differ depending on the battery type and application.

3.12
electrolyte additives
compounds which, added to the electrolyte, improve certain properties of the accumulator

Note 1 to entry: They shall be specified by the manufacturer. Other additives, not specified or not approved by the battery manufacturer, should not be used as they may cause damage to the battery and thus endanger the functional reliability.

Note 2 to entry: Examples of electrolyte additives are alkaline metal sulfates.

3.13
impurities
impurities from the electrolyte in practical use may cause damage to the battery and reduce its performance

Note 1 to entry: The type and maximum permissible quantity of impurities are specified in Tables 3 and 4.

4 Preparation of electrolyte for lead-acid accumulators

The electrolyte is prepared from sulfuric acid of high concentration by pouring it into purified water.

As concentrated and diluted sulfuric acid has a highly etching effect on human skin and corrosive effect on clothes and many materials, and therefore the electrolyte shall be prepared by the battery manufacturer or skilled personnel only.

NOTE The mixing of sulphuric acid of high concentrations with water releases a high amount of heat. To avoid sudden splashing of hot acid, always pour acid into water, never the opposite. Pay attention to the safety data sheets.

5 Physical properties of diluted sulfuric acid as electrolyte

5.1 Dependence of acid density on temperature

The value of acid densities obtained at the measuring temperature shall be converted to the value of acid density at the reference temperature of 25 °C by following equation:

$$d_n = d_T + f_d \ (T - T_n)$$

where

d_n is the acid density at 25 °C;

d_T is the acid density at measuring temperature T;

f_d is the correction factor according to Table 1;

T is the measuring temperature;

T_n is the reference temperature 25 °C.

Table 1 – Correction of density from measuring temperature to reference/specified temperature

Acid density d_n kg/l	Correction factor f_d [a] kg/l per K
1,10	0,000 50
1,15	0,000 60
1,20	0,000 70
1,30	0,000 75

[a] The correction factor refers to the temperature range from 0 °C to 55 °C.

5.2 Relationship of electrolyte density on the content of sulfuric acid at 25 °C

The following Table 2 presents the relationship between the density and the content of sulphuric acid in the electrolyte.

Table 2 – Acid density versus percentage of sulphuric acid at 25 °C

Sulfuric acid content (H_2SO_4)			
Acid density at 25 °C kg/l	**Mass ratio** H_2SO_4 % w/w	**Amount of** H_2SO_4 mol/l	**Concentration** H_2SO_4 g/l
1,100	15,18	1,704	166,98
1,110	16,45	1,863	182,60
1,120	17,80	2,034	199,36
1,130	19,15	2,208	216,40
1,140	20,47	2,381	233,36
1,150	21,81	2,558	250,70
1,160	23,11	2,735	268,07
1,170	24,39	2,911	285,36
1,180	25,63	3,086	302,43
1,190	26,90	3,266	320,11
1,200	28,12	3,443	337,44
1,210	29,34	3,622	355,01
1,220	30,55	3,803	372,71
1,230	31,78	3,989	390,89
1,240	32,98	4,173	408,95
1,250	34,18	4,360	427,25
1,260	35,40	4,551	446,04
1,270	36,60	4,743	464,82
1,280	37,81	4,938	483,97
1,290	38,93	5,124	502,20
1,300	40,10	5,319	521,30

5.3 Electrolyte density compared to the state of discharge

The electrolyte density decreases during discharge of a battery. Therefore the specified electrolyte densities relate to a fully charged state. The permissible limit values shall be specified by the battery manufacturer for the various battery types and applications.

6 Requirements of sulfuric acid used as electrolyte

6.1 Impurities of sulfuric acid of higher concentration degrees

The purity of sulfuric acid of higher concentration degrees shall be such, that after the following dilution with water to values of ≦ 1,30 kg/l as filling electrolyte, the values given in Table 3 are by no means exceeded.

6.2 Impurities of filling acid

The sulfuric acid used for filling lead-acid batteries shall be clear and colorless.

The impurities included in the acid shall not exceed any value quoted in Table 3.

This level of purity is required also for acid to be used a density higher than 1,30 kg/l, e.g. for adjustment of the electrolyte density in batteries where an electrolyte loss has occurred.

Table 3 – Maximum allowed impurities of diluted sulfuric acid as filling electrolyte for lead-acid batteries in the density range ≦ 1,30 kg/l

Cons. no.	Impurities	mg/l max.
1	Palladium (Pd), Platinium (Pt), Rhenium (Re)	0,05
2	Copper (Cu)	0,5
3	Arsenic (As), Antimony (Sb), Bismuth (Bi), Tin (Sn), Selenium (Se), Tellurium (Te), Cadmium (Cd), Mercury (Hg), – each individually – total (all together)	 1,0 2,0
4	Manganese (Mn), Chromium (Cr), Titanium (Ti), Nickel (Ni), – each individually	 0,2
5	Iron (Fe)	30
6	Cobalt (Co), Zink (Zn) – each individually – a total (all together)	 1,0 2,0
7	halogens calculated as chloride	5
8	nitrogen in the form of nitrate	10
9	nitrogen in other form as e.g. ammonia	50
10	volatile organic acids calculated as acetic acid	20
11	oxidable organic substances calculated as $KMnO_4$ consumption	30
12	annealing residue	250

6.3 Impurities of operating electrolyte

The sulfuric acid used for filling lead-acid batteries should be clear and colorless.

The impurities of the operating electrolyte shall not exceed any value quoted in Table 4.