

# TECHNICAL REPORT

IEC  
TR 62060

First edition  
2001-09

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## Secondary cells and batteries – Monitoring of lead acid stationary batteries – User guide

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SECONDARY CELLS AND BATTERIES –  
MONITORING OF LEAD ACID STATIONARY BATTERIES – USER GUIDE**

## FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 62060, which is a technical report, has been prepared by IEC technical committee 21: Secondary cells and batteries.

The text of this technical report is based on the following documents:

| Enquiry draft | Report on voting |
|---------------|------------------|
| 21/481/CDV    | 21/527/RVC       |

Full information on the voting for the approval of this technical report 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 3.

The committee has decided that the contents of this publication will remain unchanged until 2003-12. At this date, the publication will be

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- withdrawn;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

This document which is purely informative is not to be regarded as an International Standard.

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## INTRODUCTION

The monitoring of vented lead-acid (VLA) stationary batteries by manual techniques has developed with experience gained over 70 years of operational service. While the traditional methods of monitoring have a reliable record, most of the investigations relied on non-electrical visual observations and measurements which required expert interpretation and, ultimately, the discharge capacity test was the final reference criterium.

Manual techniques of monitoring VLAs are still valid today, however the costs of the investigations are very high, and to some operators the prospect of an on-site capacity test is less acceptable. In the case of the valve regulated lead-acid (VRLA) stationary batteries now being increasingly used, the opportunity for visual observations and measurements is no longer possible, and the remaining electrical measurements that can be taken (capacity test excluded) have less interpretative meaning than similar measurements with VLAs.

Given this background, this technical report provides advisory information on techniques for the remote monitoring of all types of lead-acid stationary batteries. Because this report is advisory in content, and for information only, it is not published as a Standard but as a technical report and, as such, cannot be used as a reference document for performance requirements.

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## SECONDARY CELLS AND BATTERIES – MONITORING OF LEAD ACID STATIONARY BATTERIES – USER GUIDE

### 1 Scope and object

This technical report is applicable to lead-acid vented and valve regulated batteries, for use in stationary battery applications.

The object of this technical report is:

- to assist users in the selection of methods to obtain sufficient information to indicate the state of health of an operating stationary lead-acid battery;
- to achieve this by describing characteristics that can be electrically measured and remotely interrogated on a regular basis;
- to indicate the sensitivity and reliability of the measured data and to provide the user with methods of interpretation;
- to provide users with good operating characteristics and general guidelines.

### 2 Reference documents

IEC 60896 (all parts), *Stationary lead-acid batteries*

ETS 300 132-2, *Equipment Engineering (EE) – Power supply interface at the input to telecommunications equipment – Part 2: Operated by direct current (dc)*

ETS 300 253, *Equipment Engineering (EE) – Earthing and bonding of telecommunication equipment in telecommunication centres*

ETS 300 386-1, *Equipment Engineering (EE) – Telecommunication network equipment – Electro-Magnetic Compatibility (EMC) requirements – Part 1: Product family overview, compliance criteria and test levels*

### 3 Definitions

For the purpose of this technical report, the following definitions apply:

#### 3.1

##### **VLA cell or battery**

vented lead-acid cell or battery

#### 3.2

##### **VRLA cell or battery**

valve regulated lead-acid cell or battery

**3.3****online discharge**

discharge of a battery through its connected load by reducing the charger voltage such that the charger supplies no current to the load

**3.4****residual life span**

remaining period of useful life of a battery in service

**3.5****d.c. resistance**

quotient of direct battery voltage by direct battery current as measured by d.c. techniques

**3.6****a.c. resistance**

the real resistive component of the battery impedance

**3.7****impedance**

quotient of the fundamental component of the battery voltage by the sinusoidal battery current as measured by a.c. techniques

**4 Desirable user characteristics****4.1 Autonomy time**

The capability of the battery to give its design run time at the claimed power level is a very important characteristic for the user. The direct way to determine this capability is to perform a capacity test, but this will only establish the autonomy time capability at the time of the test.

Capacity testing is however undesirable in a monitoring environment, and estimates of autonomy will have to be derived from load tests or a.c./d.c. resistance or conductance characteristics.

**4.2 Sudden failure**

The risk of sudden failure of the battery is equally important to the user. The most common source of sudden failure arises from either a short circuit or an open circuit in the battery. These conditions may be detected from changes of voltage, current, temperature and a.c./d.c. resistance, against time. It should be noted however that sudden failure may not be detected in the float condition but may become apparent in any subsequent discharge.

**4.3 Residual life span**

Residual life span is probably the most difficult user characteristic to evaluate. However, quantifying residual life span is very important for security purposes and identifying the optimum time for battery replacement.

Indications of residual life span can be derived from regularly recorded a.c./d.c. resistance or conductance data and load tests. In addition, knowing the actual life span of the battery under standard conditions, it is possible to estimate residual life span using time – temperature data.

#### 4.4 State of operation

The state of operation establishes for the user that the battery is operating within agreed parameters. The necessary monitor information required to determine the state of battery operation can be obtained from battery voltage, battery charge current and battery temperature.

### 5 Monitoring overview

#### 5.1 Data collection and alarms

There are six practical characteristics that can be used for monitoring purposes, and five of the characteristics can be used for alarm purposes. Because there is interdependence between the performance of the characteristics, there is a recommended sequence of interrogation for the characteristics that will assist subsequent interpretation.

This sequence is shown in figure 1 where it can be seen that an “operational discharge” does not provide an alarm condition, but can provide useful post emergency monitoring data.

The sequence of events leading to data collection and life prediction is provided by the flow chart in figure 2.

#### 5.2 Accuracy for the characteristics

The units of measurement associated with the characteristics used in this guide are shown together with their desirable levels of accuracy in table 1.

**Table 1 – Characteristics, units of measurement and recommended accuracy**

| Characteristics       | Units           | Recommended accuracy |
|-----------------------|-----------------|----------------------|
| Time                  | h or min        | ±1 s per day         |
| Temperature           | °C              | ±0,5 K               |
| Voltage               | V               | ±0,5 %               |
| Current               | A               | ±0,5 %               |
| AC/DC resistance      | Ω               | ±1,0 %               |
| Conductance           | S               | ±1,0 %               |
| AC/DC current         | A               | ±0,5 %               |
| AC/DC voltage         | V               | ±0,5 %               |
| Battery float voltage | V               | ±0,5 %               |
| Cell float voltage    | V               | ±0,5 %               |
| Float current         | mA              | ±0,5 %               |
| Life                  | Years or months | ±0,25 %              |
| Capacity              | Ah              | ±1,0 %               |
| Discharge time        | h or min        | ±0,5 %               |

## **6 Characteristics**

### **6.1 Temperature**

#### **6.1.1 General considerations**

The temperature is a critical parameter for VRLA and VLA batteries. The following temperature parameters all apply to both VRLA and VLA batteries with the exception of the influence on water consumption, which relates only to VLA batteries.

#### **6.1.2 Specific considerations**

##### **6.1.2.1 Influence on available battery capacity**

Available battery capacity is influenced by the battery temperature. In order to accommodate for various temperatures (10 °C to 30 °C), a capacity compensation of 0,6 % per degree Celsius is normally applied (see also IEC 60896 series). For high rate discharges, the capacity compensation coefficient can be considerably larger.

##### **6.1.2.2 Influence on battery life span**

The battery life span is normally specified at 20 °C and is influenced by the operating temperature. Elevated temperatures lead to a shortening of useful battery life. For a constant temperature increase of 10 °C, the life is expected to be reduced by approximately 50 %.

##### **6.1.2.3 Influence on battery charge state**

In order to maintain a fully charged stationary battery, a d.c. voltage is applied across the battery to compensate for the effect of self-discharge. The battery self-discharge is influenced by the temperature and increases progressively with temperature.

##### **6.1.2.4 Influence on battery charge current**

At a given constant voltage, the float current passing through a fully charged stationary battery increases progressively with increasing battery temperature. Where the battery temperature is higher than normal, consideration should be given to reduce the float charge current into the cell or monobloc battery by adjusting the output of the charger (e.g. by reducing the voltage). This procedure can not only assist in prolonging battery life, but it also reduces the risk of thermal run-away. In such circumstances, reference should be made to the battery manufacturer's recommendations.

##### **6.1.2.5 Influence of ripple currents on battery temperature**

Ripple currents generate heat within the battery resulting in an increase of battery operating temperature.

##### **6.1.2.6 Influence on water consumption**

The rate of water consumption and the frequency of water service intervals depend on the battery design, operating conditions and temperature. Increasing temperatures demand frequent water servicing.