

Code of practice for

Safe operation of lead-acid stationary batteries

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PEL/21, Secondary cells and batteries, upon which the following bodies were represented:

- Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)
- British Industrial Truck Association
- British Telecommunications plc
- Electric Vehicle Association of Great Britain
- Electricity Association
- Health and Safety Executive
- Lighting Industry Federation Ltd.
- London Regional Transport
- Ministry of Defence
- Power Supply Manufacturers' Association — PSMA (BEAMA Ltd.)
- Society of British Battery Manufacturers
- Society of Motor Manufacturers and Traders Limited

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Foreword

This British Standard has been prepared by Technical Committee PEL/21. It provides guidance on the health and safety aspects for those specifying, supplying, installing, commissioning or using lead-acid stationary cells or batteries.

The standard does not cover the design and construction of lead-acid stationary cells and batteries, nor the health and safety aspects of cell and battery manufacture. However, the hazards of electric shock, sulfuric acid and handling of lead and lead compounds are common throughout the life of a cell or battery, and guidance is given on these topics.

The standard does not give detailed specifications for electrical systems to which batteries may be connected, but guidance is given where it is relevant to the safe operation of a battery system.

Attention is drawn to the following:

Electricity at Work Regulations 1989

Memorandum of Guidance on the Electricity at Work Regulations

Control of Substances Hazardous to Health Regulations 1994

Control of Lead at Work Regulations 1980

Approved Code of Practice for the Lead at Work Regulations 1980

Control of Pollution (Special Wastes) Regulations 1980

Chemicals (Hazards, Information and Packaging for Supply)
Regulations 1994

Road Traffic (Carriage of Dangerous Substances in Packages etc.)
Regulations 1992 (PGR)

UN Recommendations on the Transport of Dangerous Goods

European Agreement for International Carriage of Dangerous Goods by Road
(ADR)

International Convention concerning the Carriage of Goods by Rail

Merchant Shipping (Dangerous goods and Marine Pollutants)
Regulations 1990

International Maritime Organisation, Dangerous Goods Code

International Civil Aviation Technical Instruction for Safe Transport of
Dangerous Goods by Air, DOC 9284-AN/905 current edition

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Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1.1 Scope

This British Standard provides guidance on safety and health aspects of the design, installation, handling, usage, maintenance, dismantling, recovery and disposal of lead-acid stationary cells and batteries. It also provides guidance on aspects of design for racks, cubicles, rooms and ventilation and for electrical systems to which the batteries are connected. It includes vented cells and valve regulated lead-acid cells. It does not include automotive starter batteries.

This standard does not cover the use of stationary cells and batteries in potentially explosive atmospheres, e.g. in mines.

This standard does not cover the use of alkaline secondary cells and batteries, for example nickel cadmium or nickel iron types. These are covered in BS 6132.

NOTE 1 If both vented cells and valve regulated lead-acid cells are located in the same room the recommendations for vented cells should prevail.

NOTE 2 Open cells, as defined in 1.3.1.3, are referred to only for the purpose of dismantling, recovery and disposal.

1.2 References

1.2.1 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this British Standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

1.2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

1.3 Definitions

For the purposes of this British Standard the following definitions apply.

1.3.1 Cells

1.3.1.1

secondary cell

a voltaic cell that, after discharge, can be brought back to its initial (charged) condition by passing a current through it in the reverse direction to that of discharge

NOTE In this standard a secondary cell is referred to as a "cell". Monobloc arrangements of cells are referred to as "units".

1.3.1.2

lead-acid cell

a cell having an electrolyte of diluted sulfuric acid, fitted with plates in which active materials are

- a) positive electrode: lead dioxide;
- b) negative electrode: spongy lead.

1.3.1.3

open cell

an obsolete design of cell in which the cell container does not have a lid. The plates are sometimes covered with plastics or glass plates to limit acid spray from the electrolyte surface

1.3.1.4

vented cell

a cell in which, under normal operating conditions, the products of electrolysis are freely released to the atmosphere

NOTE Vented cells are of three main types, known as Planté, pasted plate and tubular (see BS 4727-2: Group 17 for definitions). These descriptions relate to the design and construction of the positive plate.

1.3.1.5

valve regulated lead-acid cell (VRLA cell)

a cell in which, under normal operating conditions, the products of electrolysis are reconstituted within each individual gas-tight cell or unit. Each cell or unit is fitted with a pressure release valve

1.3.1.6

stationary cell

a cell that is erected on a fixed site and not intended to be moved habitually from place to place during its life

1.3.1.7

stationary battery

two or more stationary cells electrically connected in one circuit

1.3.2 Cell components

1.3.2.1

plate

the unit that, singly or in groups, is submerged in the electrolyte so that it forms the whole or part of one of the electrodes of the cell

1.3.2.2

positive plate

the plate that forms the anode or part of the anode during charge

1.3.2.3***negative plate***

the plate that forms the cathode or part of the cathode during charge

1.3.2.4***plate group***

a complete electrode consisting of either positive or negative plates, together with a group bar and a terminal pillar

1.3.2.5***separator***

an insulating structure used to separate plates of opposite polarity

1.3.2.6***electrolyte***

a liquid or solid phase containing mobile ions which render the phase ionically conductive

NOTE In the case of lead-acid stationary batteries, the electrolyte is a liquid phase consisting of aqueous solutions of sulfuric acid.

1.3.2.7***container***

a box of suitable material, usually glass, hard rubber, lead-lined timber or plastics, in which the plate groups and separators are assembled

1.3.3 Operation**1.3.3.1*****charging***

the passing of an electric current through the cell so as to bring it to a chemical condition in which it is capable of supplying electricity to an external circuit

NOTE The quantity of electricity passed is known as the charge and is usually measured in ampere hours.

1.3.3.2***trickle charge***

a method of charging where the current compensates for the self-discharging of a fully charged cell or battery whilst standing idle, thereby maintaining it in a fully charged condition

1.3.3.3***float charge***

the operation of a battery in parallel with a load and a charging source at constant voltage

NOTE The output power demands of a power system can vary giving rise to a situation where the battery is required to smooth out variations in that supply. This usually happens because the charger or rectifier is either insufficiently rated to meet the peak load demand or its control response is not fast enough to follow the variations in the load. Under these conditions the battery will take transient excursions into the discharge mode, and is therefore not operating in the float charge mode of operation.

1.3.3.4***boost charging***

the charging of a battery at a higher voltage than its normal recommended float voltage

NOTE For the purposes of this standard, equalizing, freshening and quick charging are all regarded as boost charging.

1.3.3.5***overcharge (of a cell or battery)***

the continued charging after the full charge of a cell or battery

1.3.3.6***d.c. ripple***

an alternating current superimposed on the d.c. charging current. It is the consequence of the charger within the power system supplying insufficiently smoothed current

NOTE In severe cases the alternating current component can be so large that the d.c. current reverses to the discharge direction.

1.3.3.7***discharging***

the connection of a cell to an external circuit in such a way that the current flows through the cell in the reverse direction to that of the charge

NOTE The quantity of electricity taken out is known as the discharge and is usually measured in ampere hours.

1.3.3.8***capacity***

the quantity of electricity, usually measured in ampere hours, that may be taken from a cell at a particular rate of discharge, under specified conditions of voltage and temperature

NOTE Unless otherwise specified, the term "capacity" may be used to describe the standard rating of a plate or cell.

1.3.3.9***rated capacity***

a designation by the manufacturer, of the capacity of a positive plate or cell under specified conditions of discharge, in ampere hours

1.3.3.10***earthed battery system***

a system in which one pole of a battery is solidly connected to the local earth system or network

1.3.3.11***isolated battery system***

a system in which the battery, its associated charger and the d.c. distribution system are isolated from earth potential

NOTE High resistance earth leakage detection circuits may be connected to the local earth system in such systems.

1.3.3.12***partially isolated battery system***

a system in which the battery is indirectly connected to earth potential via other equipment, e.g. an insulated battery connected to a charger which is earthed on the a.c. side of the rectifying bridge

1.3.3.13 *high voltage battery*

a battery consisting of 60 or more cells connected in series (i.e. having a nominal voltage of 120 V or greater).

Section 2. Recommendations common to all battery installations

2.1 Precautions recommended for safe working

2.1.1 Competence of personnel

The possible dangers arising from accidental contact with batteries and the fact that a battery is always live are described in 2.1.5. To ensure compliance with the Electricity at Work Regulations, personnel involved in work on or close to a battery have to be competent to carry out such work, and to be trained in any special procedures necessary.

When any work is carried out on high voltage batteries, the person carrying out the work should be accompanied by a person of equal competence.

NOTE The attention of managers and supervisors responsible for personnel carrying out such work is drawn to regulations 3, 4, 14 and 16 of the Electricity at Work Regulations 1989, and to the information given in the Memorandum of Guidance to those Regulations.

2.1.2 Health and safety

Health dangers exist from the handling of lead, lead compounds and sulfuric acid.

Whenever work on a battery involves contact with these materials, the strictest discipline should be observed with regard to personal hygiene to prevent the contamination of food and subsequent ingestion.

Lead in particular accumulates in the body and is only slowly discharged. It is essential therefore to adhere strictly to the discipline of washing the hands and scrubbing the fingernails whenever a break is taken from the work.

With the use of protective clothing the risk of acid in any significant quantity being spilled on an operative is minimized and, therefore, the use of panic showers should not normally be necessary.

Panic showers should be made available where major work is being undertaken, for example the bulk handling of acid.

NOTE The attention of managers and supervisors responsible for personnel working with such materials is drawn to the Control of Substances Hazardous to Health Regulations 1988, and to the Control of Lead at Work Regulations 1980, together with the Approved Code of Practice for the latter.

2.1.3 Electrolyte

The electrolyte consists of a solution of sulfuric acid in water. The solution is corrosive to the skin and poisonous if ingested. When handling the electrolyte, suitable footwear, protective clothing and gloves should be worn. It is essential that eye protection be worn to protect against acid splashes and also for protection against the acid mist which can form at the top of vented type cells that are under charge. Sulfuric acid is known to “creep” up the sides of containers and the presence of acid on surfaces above the electrolyte liquid level should be anticipated.

2.1.4 Lead

The cell plates are made from lead and lead compounds and there is a risk of inhaling toxic dusts when handling the plates, particularly when they are dry. To avoid contamination, it is essential that gloves and dust masks be worn if direct contact with cell plates is expected.

The melting of lead or lead alloys produces toxic fumes and it is essential that when carried out, special ventilation is provided to remove those fumes from the work area.

If regular contact with lead and lead compounds is expected then health monitoring of personnel is essential.

2.1.5 Electrical energy

2.1.5.1 General

A battery represents a considerable quantity of stored energy and, unlike most other items of electrical equipment, cannot be made electrically safe by isolation. Accidental short-circuiting of a cell or battery can cause burns, eye damage (from arcing) and considerable damage to the cell or battery and other equipment, including melting and ejection of metal and burning of adjacent flammable material. Sparks can be caused by electrostatic discharges, abrasion of metal, or electrical connections and disconnections. If hydrogen gas is present sparks or arcing can ignite this gas, leading to hazard from explosion.

2.1.5.2 Preparation and safety precautions

To avoid accidental short circuits, and injury to the eyes, it is essential that all tools used for installation and maintenance are suitable for battery work, all metallic items worn about the person (e.g. neck chains, rings, bracelets, etc.) are insulated or removed before working on a battery, and that safety spectacles conforming to BS 2092 are worn at all times.

Work on battery systems should be planned in order to minimize the number of conductors or terminals exposed at any one time. Insulated cell covers and connector covers should only be removed when it is necessary to work on the cell terminals. They should be replaced immediately work is completed. Where the terminal pillars and connectors are not insulated, temporary insulation should be employed to ensure that any work in progress does not lead to short circuiting of neighbouring cells.