BRITISH STANDARD

BS 6132:1983

## Code of practice for

# Safe operation of alkaline secondary cells and batteries

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# Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Light Electrical Engineering Standards Committee (LEL/-) to Technical Committee LEL/12 upon which the following bodies were represented:

Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA)

British Battery Makers' Society

British Industrial Truck Association

British Railways Board

British Telecom

Electric Vehicle Association of Great Britain

Electricity Supply Industry in England and Wales

Health and Safety Executive

Institute of Wastes Management

London Transport Executive

Ministry of Defence

Society of Motor Manufacturers and Traders Limited

Coopted members

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# Contents

# Foreword

This code of practice has been prepared in conjunction with the battery manufacturers under the direction of the Light Electrical Engineering Standards Committee. It provides guidance to users of alkaline secondary cells and batteries on safety and health aspects associated with such cells and batteries. It will be of particular interest to those users who are unfamiliar with battery technology.

It is intended that the code will be revised with an extended scope as and when other types of alkaline secondary batteries come into general use.

Attention is drawn to the following.

The Health and Safety at Work Act 1974

HS (R) 11 First Aid at Work

Electricity (Factories) Act Special Regulations 1908

The European agreement concerning the international carriage of dangerous goods by road

The International Regulations concerning the carriage of dangerous goods by rail. Department of Transport

The Merchant Shipping (Dangerous Goods) Regulations 1981. Statutory Instrument 1981 No. 1747

International Maritime Organization (IMO), London. International Maritime Dangerous Goods Code Volume IV

Department of Trade, Carriage of Dangerous Goods in Ships. Report of the Standing Advisory Committee 1978. The Blue Book

International Air Transport Association. Restricted Articles Regulations. Corrosive Products: Batteries

Packaging and Labelling of Dangerous Substances Act 1978

Protection of Eyes Regulations 1974

Control of Pollution (Special Wastes) Act 1980

Control of Pollution Act 1974

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**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, 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.

**CAUTION. The general handling and use of alkaline secondary cells and batteries is not hazardous provided sensible precautions are taken. It is essential that the correct facilities are available and that operators and users are correctly instructed in their use.**

## 1 Scope

This code gives brief recommendations for the safety and health aspects associated with the handling, usage and maintenance of alkaline secondary cells and batteries including accommodation and transportation. Cells and batteries used in certain applications, e.g. aircraft, marine and hazardous areas are subject to special provisions not necessarily covered by this code.

Traction batteries are covered by BS 6287 and a British Standard dealing with starter batteries is in course of preparation.

This code does not cover manufacture of alkaline cells or batteries but many apsects may in fact be relevant.

This code does not cover the use of alkaline cells and batteries in potentially explosive atmospheres.

NOTE The titles of the publications referred to in this code are listed on the inside back cover.

## 2 Definitions

For the purposes of this code the following definitions apply.

**2.1**
**secondary cell and battery**

a voltaic (galvanic) cell or battery which, 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 For the purposes of this code the word battery will be used to indicate cells and batteries.

**2.2**
**electrolyte**

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

**2.3**
**alkaline secondary battery (nickel-cadmium or nickel-iron)**

a battery in which the electrolyte is an alkaline solution

**2.4**
**open cell**

a secondary cell having a permanent cover provided with an opening through which gaseous products may freely escape. The opening may be fitted with a vent plug

**2.5**
**sealed cell**

a cell which is sealed under normal conditions, but allows the escape of gas if the internal pressure exceeds a critical value

**2.6**
**r.m.s. current**

the square root of the mean value of the squares of the instantaneous values of current taken over a complete cycle

**2.7**
**mean current**

the algebraic sum of the instantaneous values of a current taken over a period divided by the number of values taken

## 3 Health and safety precautions

Recommendations for health and safety precautions for alkaline secondary cells and batteries are as given in Table 1.

**Table 1 — Health and safety precautions for alkaline secondary cells and batteries**

| Subject | | | Alkaline batteries | |
|---|---|---|---|---|
| | | | Open cells | Sealed cells |
| **3.1** | Safety and health of personnel | | Personnel who are required to handle batteries should receive adequate training and instruction in relation to batteries generally as well as in their particular job associated with batteries. Refresher training should be given at regular intervals.<br>All personnel involved with batteries at all stages of installation, use, maintenance, repair or disposal should wear appropriate safety clothing such as wellington boots, rubber apron, anti-splash eye protectors and rubber gloves[a]. If woven materials are used natural fibres are preferred. | As for open. |
| **3.2** | Electrolyte | Composition | An aqueous solution of potassium hydroxide (KOH) often containing a small percentage of lithium hydroxide. Normal strength is usually between 20 % and 25 % KOH *m/m*; the strength does not significantly alter with the state of the charge. | Electrolyte composition for sealed cells is similar to that for open cells but the design of sealed cells does not allow the operator to come in contact with electrolyte unless the cell is damaged or misused. |
| | | Nature of the hazard | Electrolyte is corrosive and toxic and will cause burns and irritation to the skin and particularly to the eyes. | As for open. |
| | | Precautions | Handle batteries with care and keep open batteries upright. | Handle batteries with care. |
| | | Filling | Do not overfill open batteries and charge in well ventilated area (see also **3.3**). Use eye protection and protective clothing where there is a risk of splashing. | Not applicable. |
| | | Accident or emergency action treatment[b] | *Skin contact*. Immediately wash the affected area with clean running water and remove any contaminated clothing or adorments. If any soreness or irritation persists seek medical advice. | As for open. |
| | | | *Eye contact*. If an electrolyte splash in the eye has occurred, flood the eye immediately, and copiously, using an eye wash bottle or mains tap water. The eye wash bottles should be disposable sterile eye irrigators or sterile saline solution bottles. They should be provided in or adjacent to every place where any maintenance (including topping up) is carried out. | As for open. |

[a] See Protection of Eyes Regulations 1974.
[b] See booklet' HS (R) II First Aid at Work', published by the Health and Safety Executive and available from HMSO.

**Table 1 — Health and safety precautions for alkaline secondary cells and batteries**

| Subject | | | Alkaline batteries | |
|---|---|---|---|---|
| | | | Open cells | Sealed cells |
| **3.2** | Electrolyte (*cont'd*) | Accident or emergency action or treatment (*cont'd*) | NOTE It is necessary to ensure that the sterile solutions are changed on a regular basis in accordance with the manufacturer's instructions, as the sterile security has a time limit, usually 12 to 18 months. Non-disposable containers filled with mains water should not be used even if the water has sterilizing tablets dissolved in it. Algae will grow in water, particularly if the containers are translucent and the use of such water can set up serious infection of any electrolyte affected areas of skin or eyes. | |
| | | | **Following irrigation of the eye medical advice should be sought immediately.** | |
| | | | *Ingestion*. If electrolyte is swallowed **do not induce vomiting**. It is essential the patient be made to drink plenty of water. Seek medical attention immediately. | As for open. |
| | | Spillage | Spillages should be neutralized with boric acid. If not available, dilute with copious quantities of water. | As for open. |
| | | Disposal | Alkaline electrolyte should be put into a container of mild steel or plastics, appropriately labelled[a], and disposed of in accordance with the appropriate national and local legislation. | As for open. |
| **3.3** | Electrical energy | | Secondary batteries store relatively large amounts of electrical energy and if this energy is released in an uncontrolled or unexpected way hazards may result. | As for open. |
| | | Nature of the hazard | Burns may occur from the heating effect on tools and other conductive objects short circuiting live parts on a battery (the cell container if metal may be live at battery potential). In addition arcing may occur, and molten metal may be ejected, and combustible materials may be ignited. | As for open. |
| | | | It is possible to receive a severe or even fatal electric shock from charging equipment and from batteries. | As for open. |
| | | Precautions | Before working on a battery remove metallic personal adornments from the hands, wrists and neck. Always use tools with insulated handles. **Do not** place tools or conductive objects on top of batteries otherwise short circuits and consequent explosions could occur. Before working on a battery powered electrical system switch off loads and disconnect or electrically isolate the battery whenever practicable. | As for open. |

[a] See Packaging and Labelling of Dangerous Substances Act 1978 and Control of Pollution Act 1974.

**Table 1 — Health and safety precautions for alkaline secondary cells and batteries**

| Subject | | | Alkaline batteries | |
|---|---|---|---|---|
| | | | Open cells | Sealed cells |
| **3.3** | Electrical energy (*cont'd*) | Precautions (*cont'd*) | Before using a battery charger consult the manufacturer's literature.<br>Switch off the charger before connecting or disconnecting the battery whenever practicable. Check polarities before connecting the battery to the charger, i.e. positive output of charger to positive pole of battery and similarly on the negative side. If in doubt, seek professional advice.<br>Before testing a battery make sure that any instruments used are functioning correctly and set to an appropriate range.<br>Where batteries exceeding 50 V are installed the batteries should be so arranged that the potential difference between adjacent poles does not exceed 50 V. Alternatively, exposed connections should be electrically shrouded. | |
| | | Accident or emergency action or treatment | *Electrical burns*. Apply a dry sterile dressing and seek medical attention. | As for open. |
| | | | *Electric shock*. Immediate action is essential in cases of severe shock. The nerves controlling the breathing and heart action may be affected. It is essential that treatment be started immediately, and another person sent to obtain medical assistance. | As for open. |
| | | | Make sure it is safe to approach. If the casualty is still in contact with a live conductor, switch off the current, remove the plug or wrench the cable free. If this is not possible stand on an insulating material (wood, rubber, dry brick, folded newspaper or book) and push or pull the casualty clear using a similar insulating material as a lever. **Do not use bare hands.**<br>Regulation 29 in the Electricity (Factories Act) Special Regulations 1908 requires an approved notice to be displayed giving instructions on the treatment of persons suffering from electric shock in all premises in which electrical energy is generated, transformed or used at a pressure (voltage) exceeding 125 V a.c. or 250 V d.c.[a]. | As for open. |

[a] Several suitable posters are commercially available.

**Table 1 — Health and safety precautions for alkaline secondary cells and batteries**

| Subject | | Alkaline batteries | |
|---|---|---|---|
| | | Open cells | Sealed cells |
| **3.4** Evolution of gases | | Hydrogen and oxygen gases are emitted during charging, increasing during the latter part of a charge, and can also be emitted at any time particularly if a battery is moved, shaken or over discharged. | Hydrogen and oxygen gases are not normally emitted, but may be under conditions of battery malfunction or abusive over charge or over discharge. |
| | | The gases emitted may also contain droplets of alkaline electrolyte as a fine mist and this is corrosive. | As for open. |
| | Nature of the hazard | An explosive atmosphere is created if the concentration of hydrogen in air reaches or exceeds 4 % by volume. A potentially explosive atmosphere may be regarded as existing in the immediate vicinity of the battery top. | As for open. |
| | Precautions | Charge in a well ventilated area. A special charging area should be established where charging of numerous batteries is habitually undertaken. Ensure that connections are tightly secured. More detailed recommendations are given in clause **4**.<br>It should be noted that materials including clothing with a high insulation value can reach high electrostatic potentials and discharge to produce a source of ignition. The use of materials that produce static should be avoided. Static charges can be reduced by brief contact with earth prior to contact with the battery but better and permanent earthing contact should be used.<br>Smoking should not be allowed in the vicinity of the charging stations.<br>Use no naked flames in the charging area.<br>Switch off current before making or breaking connections.[a]<br>Avoid accidental short circuits.<br>Portable electric lamps and tools, or apparatus which might give rise to sparks should not be used in the vicinity of the battery whilst it is being charged. | As gassing is not normally encountered special charging areas are not required. Charging and discharging should be carried out to the manufacturer's instructions. Ensure that connections are tightly secured. |
| | Accident or emergency action/ treatment | *Explosion*. Seek any necessary medical attention required, remember that electrolyte may have been ejected (see **3.2**). | As for open. |
| | | Attend to any secondary effects of explosion, e.g. fire or damage to other plant. Fire extinguishers should be of a type suitable for use on electrical fires. | As for open. |

[a] The use of interlocked plugs and sockets may be of advantage in certain applications.

**Table 1 — Health and safety precautions for alkaline secondary cells and batteries**

| Subject | | | Alkaline batteries | |
|---|---|---|---|---|
| | | | Open cells | Sealed cells |
| **3.5** | Weight | Nature of the hazard | Where batteries are heavy and awkward to handle correct lifting methods including any prescribed lifting points and equipment should be used. | As for open. |
| | | Precautions | Any lifting devices used should be constructed having regard to the danger of short circuits across the battery terminals or connectors.<br>Lifting tackle should be regularly inspected.[a]<br>Permissible floor loading should not be exceeded. | As for open. |
| **3.6** | Installation | Nature of the hazard | Badly installed batteries may develop electrolyte leaks or suffer internal damage. | As for open. |
| | | | Loose or dirty connections may cause local hot spots giving a risk of fire or explosion. | As for open. |
| | | Precautions | Batteries should be correctly installed on a firm, level foundation, or securely fastened in position. | Batteries should be correctly installed and securely fastened in position. |
| | | | All connections to and between batteries should be clean and secure. | As for open. |
| | | | Installation should be so arranged that there is no possibility of a conducting material causing a short circuit to the battery in normal service. This implies a reasonable clearance around live connections. | As for open. |
| **3.7** | Repair | | Alkaline cells and batteries are not normally repaired on site. | Sealed alkaline cells are not repairable. |
| **3.8** | Damaged batteries | | Active materials are only exposed if a cell container is broken open and, if they are exposed, may evolve heat and could initiate a fire. See **3.10**. | As for open. |
| | | Nature of the hazard | Cells contain alkaline electrolyte and active materials of cadmium, nickel and their compounds plus ferrous compounds. | As for open. |
| | | | Electrolyte has been covered in **3.2**. | As for open. |
| | | | Nickel and cadmium are both toxic and are subject to special provisions under the Health and Safety at Work Act. Guidance note EH 15[b] is specific to cadmium and nickel. | |

[a] See Factories Act 1961, Section 26 and Statutory Instrument 1961 No. 1581 Construction (Lifting Operations) Regulations 1961.
[b] See Health and Safety at Work Act 1974.

**Table 1 — Health and safety precautions for alkaline secondary cells and batteries**

| Subject | | | Alkaline batteries | |
|---|---|---|---|---|
| | | | Open cells | Sealed cells |
| **3.8** | Damaged batteries (*cont'd*) | Accident or emergency action or treatment | Any active material should be kept damp and swept up into a suitably labelled alkaline resistant container prior to disposal.<br>In all cases of damaged batteries advice should be sought from the manufacturer.<br>Strict personal hygiene precautions should be observed. Refer to **3.2**. The same action should be taken to remove active material containing nickel and cadmium from the skin.<br>Electrical hazards may also exist. Refer to **3.3**. | As for open. |
| **3.9** | Disposal | Action | It is essential that batteries, battery cases and containers, electrolyte, cadmium, nickel, iron and their compounds are not burned but disposed of in accordance with the appropriate legislation[a] and local authority rules and regulations. | As for open. |
| **3.10** | Fire | Nature of the hazard | Batteries and battery installations contain combustible materials and a fire involving batteries, however initiated, may cause the release of toxic or poisonous fumes and smoke. It should be noted that contamination of building, plant, paperwork and food-stuffs may ensue due to fumes. | As for open. |
| | | Precautions | Fire risk notices should be displayed where appropriate.<br>Smoking should not be allowed in the vicinity of the charging stations.<br>Suitable fire extinguishers, e.g. $CO_2$, B.C.F. or dry powder, should be available and suitably positioned. | As for open. |
| **3.11** | Storage | | Storage of batteries in quantity may introduce a number of factors which need attention, as follows. | As for open. |
| | | | *Fire hazard*. The local fire authority should be consulted. | As for open. |
| | | | *Gas hazard*. If the batteries are filled, adequate ventilation will be required to disperse any hydrogen emitted. | Not applicable. |
| | | | *Weight hazard*. Batteries are relatively heavy and the safe floor loading should not be exceeded. | As for open. |
| | | | *Electrical hazard*. Battery terminals should be protected against accidental short circuits. | As for open. |

[a] See Control of Pollution Act 1974.

**Table 1 — Health and safety precautions for alkaline secondary cells and batteries**

| Subject | | | Alkaline batteries | |
|---|---|---|---|---|
| | | | Open cells | Sealed cells |
| **3.11** | Storage (*cont'd*) | | It is not normal to store alkaline electrolyte in quantity in a liquid state, but if it is stored then precautions should be taken to allow for leakage or rupture of the storage vessel[a].<br>The vessel should be well sealed. | Not applicable. |
| **3.12** | General | Electrical leakage | Storage batteries are by nature difficult to insulate and with the passage of time leakage paths may form so that a battery of cells may establish a voltage with respect to earth and significant leakage currents can flow. These leakage currents not only tend to discharge the battery but also may cause problems with associated electrical equipment. In extreme cases charring of the battery container may occur, leading to a potential fire hazard. In addition it should be remembered that cell containers when made of metal may be live at battery potential. Electrical leakage problems can be substantially avoided if the battery and its components are kept clean in accordance with the manufacturer's recommendations. Stand insulators should be used with all batteries above 110 V. | As for open. |
| | | Chargers | Normal electrical precautions should be taken in respect of any charging equipment but in addition it should be remembered that the battery can feed back into the charger if a fault occurs. Whenever possible the battery should be isolated when charger servicing is carried out.<br>Chargers should normally be provided with output fuse(s). | As for open. |
| | | Ratings of cables and components | A battery is normally charged and discharged in relation to the mean current passed through it (except for internal heating effects) whereas cables, connections, fuses, contactors, reactifiers, etc., connected to the battery will need to be rated in accordance with the r.m.s. value of current. Due account of the waveform of the current should therefore be taken when calculating the rating of the items. | As for open. |

[a] Prolonged storage of electrolyte in a plastics container can weaken the container.

**Table 1 — Health and safety precautions for alkaline secondary cells and batteries**

| Subject | | | Alkaline batteries | |
|---|---|---|---|---|
| | | | Open cells | Sealed cells |
| **3.12** | General (*cont'd*) | Instruments and test gear | All instruments used for battery servicing and checking should be kept clean and in good working order; a regular functional check should be carried out. Particular attention should be given to test probes, leads and connectors. | As for open. |
| | | | All electrical test gear should be given a functional check at least every six months. | As for open. |
| | | Tools | All tools used on batteries should be insulated and single ended, and periodically checked to ensure the integrity of the insulation and the state of the tool. A numerical check should be made of tools after working on batteries. | As for open. |
| | | Precautions | Whenever possible, alkaline and lead-acid batteries should not be housed in the same room, but in locations where both alkaline and lead-acid batteries are used, tested or maintained it is essential that every precaution is taken to prevent cross-contamination of the electrolyte. Acid and alkaline electrolytes, tools, accessories, etc., should be stored separately. | As for open. |

## 4 Accommodation for alkaline open cells and batteries

**4.1 General.** Installations of batteries may vary considerably in size, from large static batteries used by public utilities to those used for small emergency lighting installations. The former are usually housed in battery rooms whilst the latter are often in enclosed situations or cubicles.

Batteries in a battery room are often installed on open type shelves variously described as stands, stillages or racks. These should be protected from corrosion and be fire resistant. In all cases the cells forming the battery should be installed in such a way that there is maximum freedom of access for maintenance purposes.

The battery room can conveniently house all the maintenance equipment, protective clothing and services. The access doors to the room should be provided with a lock or padlock.

No smoking and no naked lights should be allowed in a battery room or adjacent to a cubicle. Appropriate notices should be displayed prominently within the room, by all entrances and on cubicle doors. Food should not be consumed in the charging area.

**4.2 Floor loadings.** The floor loading capability should be able to sustain the weight of the batteries and equipment imposed on it, both as a whole and also in relation to the peak loading that may occur under cubicles, stand legs, truck wheels, etc. Similarly, stands and cubicles should be rigidly constructed to withstand the weight of the batteries and equipment involved.

**4.3 Electrical connections and cables.** All electrical connections and cables should be correctly fitted and suitably protected from any ill effects due to battery gases or caustic electrolyte spray.

**4.4 Floor, wall and ceiling finishes.** The floor, walls and ceiling of the battery room and cubicles should be constructed of materials which will not be affected by any spillage, spray or gases emanating from the battery. Finishes should be durable, free from flaking and capable of withstanding corrosion. Where practicable, floor finishes should be non-slip and antistatic. Floors should be laid level beneath the battery and access area. Elsewhere they should preferably slope to a drain and/or have a retaining sill across internal doorways. False ceilings should not be used.

**4.5 Ventilation.** Battery rooms and cubicles have to be ventilated, in order to ensure that high concentrations of hydrogen are not created. It is fundamental that all cells in which the electrolyte is an aqueous solution give off hydrogen and oxygen gases during charging, the major gassing generally occurring towards the end of the charging period, during any boost charging or overcharging of the battery. Although hydrogen and oxygen will diffuse into the air within the battery room, it should be borne in mind that hydrogen forms an explosive mixture with air when the hydrogen concentration by volume exceeds about 4 %. The aim of any ventilation system is therefore to maintain the average concentration below 1 % but concentrations above this level will occur in the immediate vicinity of the cell tops. The volume of gases evolved can be calculated from Faraday's law of electrolysis to be 0.42 L of hydrogen and 0.21 L of oxygen per cell per 1 A h excess charge. Because of the potential unreliability of forced ventilation, battery accommodation should be designed wherever possible for natural ventilation. Suitable gas detectors are available to measure the hydrogen concentration. It is important that the ventilator outlets are at the highest level in the battery accommodation. The air inlets should be at the bottom of the room on the opposite side to the outlets so as to ensure that air re-cycling cannot take place and that the ventilation flow is through the room and across the cells themselves. Outlets have to vent to the open air.

It is preferable that installations are designed so that the air flow does not pass over other electrical equipment because of the possibility of electrolyte droplet contamination from the open type cells.

Cubicles or cupboards should be provided with ventilation by means of holes, grilles or vents so positioned that there is a sweeping action across at least two opposite faces of the enclosure by natural air convection. The upper ventilation and design of the enclosure roof should avoid gas being trapped there. In operational service the enclosure should provide adequate ventilation to keep the average concentration of hydrogen to a value not exceeding 1%.

All heating and ventilation installations for battery installations should be made of materials resistant to corrosion. Where mechanical ventilation is required in battery rooms and is of the extraction type, then the ventilation system on the outlet side of the room should be exclusive to the battery-room. Switches should be suitably protected for Zone 1[1)] hazardous area application.

**4.6 Lighting.** The provision of luminaires directly over the cells should be avoided. Luminaires should be installed over the access area. Where mechanical ventilation is required all light fittings and switches should be suitably protected for Zone 1[1)] hazardous area application.

**4.7 Services.** It is recommended that an adequate quantity of mains water or suitably treated water is available for cleaning battery cells and receptacles that have held electrolyte. It is desirable, however, to have a water supply readily available on the site for all installations. If the water has not been confirmed for topping up purposes a notice should be posted that reads "It is essential that this water is not used for topping up batteries".

A supply of distilled or de-ionized water for topping up may be provided and this should be of a quality recommended by the manufacturer. Where large capacity open type batteries are fitted and where a bulk supply of purified water is required, either a larger storage tank should be provided or, if preferred, de-ionizing equipment should be installed. The tank should be enclosed by a close fitting cover with a tap provided for drawing off the water so that contamination of the water stored can be avoided. Other measures to avoid contamination include taking precautions to prevent rust, dirt or packing material falling into the storage tank when distilled water is being poured into it from carboys. If any form of contamination is found in the tank, the tank should be carefully cleaned out and refilled with fresh distilled water. All containers should be boldly labelled "Not to be used for drinking water", and "Distilled water for batteries only".

[1)] Zone in which an explosive gas/air mixture is likely to occur in normal operation. See BS 5345-2.

All drains in the vicinity of the installation should be alkali resisting and the disposal of effluent should meet any local authority requirements.

**4.8 Notices.** A notice giving details of battery maintenance and the care and precautions to be taken should be displayed in the battery room or on self-contained equipment. Warning notices and any statutory notices should be displayed in battery rooms, drawing attention to potentially dangerous and toxic substances that may exist in the battery room. Notices are available from the battery manufacturers.

**4.9 Battery main connections in battery rooms.** The extent of cabling not associated with the battery in the installation should be kept to a minimum and all cables, wherever possible, arranged to avoid passing through floors. Where this is unavoidable, upstands should be provided to prevent any electrolyte spillages leaking into the cable opening and/or ducts.

All cable openings through walls or floors should be sealed against the spread of fire and the possible entrance of vermin into the battery room or enclosure.

Main connections should be supported to withstand the electromagnetic forces experienced in the event of an inadvertent short circuit. They should be installed in accordance with BS 159 and coated to provide insulation.

**4.10 Fire fighting equipment.** All battery installations over 15 A·h should be provided with portable type fire extinguishers suitable for use on alkali solutions and electrical fires, e.g. $CO_2$ and B.C.F. types. Two extinguishers should be installed in rooms exceeding 10 $m^2$. The extinguishers should be sited adjacent to the entrance(s) of rooms or convenient to battery cabinets. It is essential that the provision of fire fighting equipment complies with the requirements of the local fire authority.

## 5 Transportation of alkaline open cells and batteries

NOTE Attention is drawn to the Packaging and Labelling of Dangerous Substances Act 1978. The requirements for packaging contained in the regulations referred to in this clause are not intended to cover the situation of abnormal shock during transport.

**5.1 General.** The packaging and transport of batteries is covered in various national and international regulations relating to shipping, rail (international), air and road transport. It should be noted that unfilled batteries are regarded as non-hazardous, whereas filled cells or batteries are covered by these regulations and should display externally on the packaging the appropriate hazard warning sign.

**5.2 Road transport.** For transport by road, attention is drawn to the European agreement concerning the international carriage of dangerous goods by road.

**5.3 Rail (international).** For transport by rail, attention is drawn to the International Regulations concerning the carriage of dangerous goods by rail. Department of Transport.

**5.4 Shipping.** For shipping, attention is drawn to the following three documents.

a) The Merchant Shipping (Dangerous Goods) Regulations 1981. Under the terms of this legislation batteries come within class 8 of the document dealing with corrosive products.

b) International Maritime Organization (IMO), London. International Maritime Dangerous Goods Code Volume IV.

NOTE The appropriate section of this document is class 8.

c) The Department of Trade, Carriage of Dangerous Goods in Ships. Report of the Standing Advisory Committee 1978. The Blue Book.

**5.5 Air transport.** For transport by air, attention is drawn to the International Air Transport Association (IATA). Restricted Articles Regulations. Corrosive Products: Batteries.

**5.6 Crates or cases.** Any crate or case used for packing, should be so constructed that it is obvious which is the base and it should be difficult to tip over. Indications should be given where lifting hooks, clamps or forks can be used.

Every crate or case should carry the following minimal information.

a) Gross mass.

b) Appropriate symbol indicating “way up”.

c) Wine glass symbol indicating “fragile, handle with care”.

d) Corrosive symbol **A.2.4** from BS 5378-1:1980 with wording “corrosive liquid” or “caustic potash”.

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# Publications referred to

BS 159, *Busbars and busbar connections.*

BS 5345, *Code of practice for selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining applications or explosive processing and manufacture).*

BS 5345-2, *Classification of hazardous areas.*

BS 5378, *Safety signs and colours.*

BS 5378-1, *Specification for colour and design.*

BS 6287, *Code of practice for the safe operation of traction batteries.*

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