JH

HOME OFFICE
Queen Anne's Gate LONDON SW1H 9AT
Direct line: 01 273 2845
Switchboard: 01 273 3000

Our reference: FEP/87 49/242/1
Your reference FIR/80 7/6/13
FIR/80 7/6/9
FIR/81 617/6/1
FEP/87 47/94/2
FEP/86 213/1500/1

To all Chief Officers

15 April 1988

Dear Chief Officer

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Yours faithfully

A R BRANNON
Her Majesty's Acting
Chief Inspector of Fire Services

ITEM A.

DCOL NO 2/1988

LITHIUM BATTERIES

Earlier this year, the Health and Safety Executive published Guidance Note GS 43, dealing with the safe use of lithium batteries. A photocopy is attached. Further copies are available from HMSO at a cost of £2.25 each.

2. The Note gives details of the background and development of the technology of the battery and of its lightness, high energy density, long shelf life and constant voltage profiles.

3. The appendix to the document does, however, highlight six dangerous incidents involving lithium cells or batteries that have occurred in the United Kingdom causing minor explosions with emission of flames and fumes because of a failure external to the battery or because the battery was not being used in accordance with the manufacturers' instructions.

4. The Note advocates the use of a graphite-based dry powder extinguisher or other suitable extinguisher designed for alkali metal fires, should it be necessary to fight a lithium cell fire. Alternatively, the fire may be drenched with a continuous fine spray of water. However it should be noted that lithium reacts with water to form hydrogen. It should also be noted that the fire will not be put out immediately and fragments may be ejected.

5. <u>If a lithium cell is severely damaged</u> in an accident, the Note outlines the procedure to be followed:

(a) clear everyone from the area;

(b) ventilate the area with fresh air;

(c) wear a face mask, goggles and gloves while clearing up;

(d) disconnect the cell or battery (if practicable) from the equipment in a way that avoids sparks, and avoid contact with any internal components;

(e) put the cell/battery in a remote, well-ventilated area;

(f) use plenty of clean water to wash away spilt liquid, which may be corrosive. Do not use damp solids or small amounts of water, halon, carbon dioxide or dried powder extinguishers.

6. Unless additional copies of the Guidance Note are required there are no manpower or financial implications.

Reference FEP/87 49/242/1

Contact number; 01-273 3583

Guidance Note GS 43
from the
Health and Safety
Executive

Lithium batteries

General Series GS 43 (April 1987)

These Guidance Notes are published under five subject headings: Medical, Environmental Hygiene, Chemical Safety, Plant and Machinery and General.

INTRODUCTION

1 Lithium batteries are being used successfully in increasingly large numbers in a variety of military, industrial and consumer applications. This Guidance Note outlines the risks associated with such batteries and advises on the precautions necessary to avoid danger.

2 In this guidance the word 'battery' means one cell or a combination of cells. The word 'cell' means a single cell and not a combination of cells.

BACKGROUND

3 In the 1970s a new family of primary batteries was developed. Each type used lithium metal for the anodes, with the electro-chemical couple being completed by one of a number of possible compounds. This battery technology is attractive,giving relatively light weight, high energy density, long shelf life and constant voltage profiles. The early developments were for military applications and other special purposes where these attributes were particularly valuable (eg for combat man-packs, underwater equipment and heart pacemakers). Their use has now extended to consumer and industrial applications and they can be found in watches, in cameras and in computers for memory back-up power etc. More recently, rechargeable lithium systems have been developed.

4 Lithium is one of the alkali metals and is the lightest of the metal elements. It reacts readily with water and because of this, non-aqueous organic and inorganic electrolytes are used in lithium cells. Many different materials can be used for the active cathode and for the electrolyte, and some of these materials are toxic, corrosive or irritant.

5 Lithium cells can be placed, depending on the type of cathode and/or the electrolyte system used in them, into one of the following main groupings:

(a) **soluble cathode cells** use liquid or gaseous cathode materials (such as sulphur dioxide or thionyl chloride) that dissolve in the electrolyte or are electrolyte solvents. Such cells are generally manufactured in cylindrical configurations up to 50 Ah;

(b) **solid cathode cells** use a solid material such as manganese dioxide or carbon monofluoride for the cathode together with an organic electrolyte. They are manufactured in button, coin or cylindrical configurations but are usually smaller in size than soluble cathode cells. Lithium batteries for domestic products should use a solid cathode system.

(c) **solid electrolyte cells** use solid components throughout, including an ion-conducting solid electrolyte rather than a liquid electrolyte. They are expected to have a very long storage life (over 20 years), but are capable of only low-rate discharge. Typically they are used in special applications that exploit these features, eg in heart pacemakers.

(d) **rechargeable cells** are a recent development and are used where low recharging currents under carefully controlled conditions are permissible. It is expected that higher power, lithium based rechargeable cells will be developed in the future.

Types of lithium battery are listed in Table 1.

DANGERS

6 In the UK a small number of dangerous incidents involving lithium batteries have resulted from abuse, where batteries were operated outside their design parameters or while equipment incorporating lithium batteries was being tested. Although cell manufacturers do try to minimise such risks users must also take precautions to avoid danger. The possible consequences of lithium battery abuse are summarised in Table 2, and examples of dangerous incidents are given in Appendix 2.

7 Users do not always realise that forced discharge of cells can occur in any series-connected arrangement when a prematurely discharged cell can have further discharge current forced through it by the other cells driving current through the load. Similarly, users may not be aware that cells can recharge in any parallel-connected arrangement when a discharged cell is recharged by the other cells connected in parallel. Both forced discharge and recharging of primary cells can change the internal chemical composition of the cells and lead to overheating, which can, in some cases, persist long after the flow of current has ceased.

8 Cells may also overheat for other reasons (because they are short circuited or placed near a source of heat, for example) but this hazard is not unique to

TABLE 1 TYPES OF LITHIUM BATTERY

Primary cells		*Nominal voltage*	*type*
Lithium/thionyl chloride	$Li/SOCl_2$	3.5	soluble cathode
Lithium/sulphuryl chloride	Li/SO_2C1_2	3.9	
Lithium/sulphur dioxide	Li/SO_2	3.0	
Lithium/iron disulphide	Li/FeS_2	1.5	solid cathode
Lithium/iron sulphide	Li/FeS	1.5	
Lithium/manganese dioxide	Li/MnO_2	3.0	
Lithium/polycarbon monofluoride	$Li/(CF_x)_n$	3.0	
Lithium/copper sulphide	Li/CuS	1.7	
Lithium/copper oxide	Li/CuO	1.5	
Lithium/silver chromate	Li/Ag_2CrO_4	3.2	
Lithium/chromium oxide	Li/CrO_3	3.5	
Lithium/bismuth trioxide	Li/BiO_3	2.0	
Lithium/bismuth plumbate Lithium/lead bismuthate	$Li/Bi_2Pb_2O_3$	1.5	
Lithium/copper oxyphosphate	$Li/Cu_4O(PO_4)_2$	2.5	
Lithiuim/vanadium pentoxide	Li/V_2O_5	3.3	
Lithium/iodine	Li/I	2.75	solid electrode
Lithium/lead iodine/lead sulphide	$Li/PbI_2/PbS$	1.9	
Rechargeable cells			
Lithium/molybdenum disulphide	Li/MoS_2	1.9	
Lithium/vanadium oxide	Li/V_6O_{13}	2.1	

TABLE 2 CONSEQUENCES OF LITHIUM BATTERY ABUSE

Type of abuse	*Possible consequences (depending on cell type)*
Charging/connection to other power sources	Venting, explosion
Forced discharge	Venting
Short circuit	Overheating, venting
Incineration/overheating	Venting, explosion if heating is excessive (over 175°C)
Physical damage	Release of potentially hazardous materials, spontaneous ignition

lithium cells. However, the characteristics of lithium metal and of the other components used in some lithium cells increase the risk of injury should an accident occur. The extent of risk depends on:

(a) the electrochemical system of the cell;

(b) the size of the cell (the smaller the quantity of active material, the lower the energy that will be released);

(c) the design and internal resistance of the cell;

(d) the number and configuration of cells in a battery;

(e) the built-in safety features of the cell (eg vents, electrical fuses, diodes, limiting resistors, thermal cut-outs);

(f) the way in which the cell or battery is used.

TESTING BY MANUFACTURERS/SUPPLIERS

9 Manufacturers, designers and importers of lithium batteries should recognise the dangers set out in Table 2, and manufacturers or designers should eliminate or minimise them at the design stage. Tests, preferably those contained in BS G239, should be carried out on each type of cell or battery. It is the manufacturer's or supplier's duty to see that such tests or their equivalent adequately support the information given to users. Tests should establish, for example:

(a) that so far as is reasonably practicable enclosures remain essentially intact when a battery is subjected to foreseeable abuse;

(b) the minimum and maximum environmental temperatures at which the battery can be used;

(c) the maximum permissible level of forced discharge current;

(d) the minimum permissible level of voltage on discharge;

(e) whether the battery can withstand an externally applied charging source. (If it cannot, users should be provided with adequate information about the precautions to take to avoid danger.);

(f) the short circuit withstand capability.

10 The manufacturer or importer should keep records to show which tests have been carried out on each type of battery. Tests will have to be repeated whenever any design changes are made.

PROTECTIVE DEVICES

11 Most types of lithium battery may well need protective devices such as diodes, limiting resistors and/or fuses. Where possible these should be incorporated into the battery by the manufacturer, though there are some applications where this will not be practicable and the protective devices will have to be external. To guard against component failure duplication of protective components may be necessary.

12 As well as forming an integral part of the battery or equipment (where possible), protective devices should:

(a) not be susceptible to short circuit or to any failure that will allow them to be bypassed;

(b) not be replaceable by the user;

(c) be suitably rated in accordance with the duty of the battery.

INFORMATION

13 It is the duty of the manufacturer (or importer) and supplier to ensure that safety information is made available to the user. This should include details of limitations on use and precautions to take during storage, installation, use and disposal of cells and batteries.

14 The most appropriate way of making safety information available is to put it on the battery itself, but this is clearly impracticable for very small cells. In such cases special thought should be given to the packaging; it should carry the information and warnings needed by the user, in a position where he is most likely to read it. Instructions on throw-away enclosures are often not read, and information contained in catalogues and advertising leaflets is least satisfactory as a safety message, though such documents should contain whatever information is needed for designers and specifiers to choose the right product and appreciate its limitations.

15 All but the smallest cells should be marked LITHIUM BATTERY and the following information should be provided, preferably on the battery itself or on the packaging (see paragraph 14):

(a) manufacturer's, importer's or supplier's name and address

(b) type reference

(c) chemical composition (in words or formula)

(d) nominal voltage

(e) warnings on the dangers of abuse, short circuiting and the need for safe disposal.

Manufacturer's literature should include information on discharge duty (in terms of current, power or circuit impedence against time), maximum safe reverse current and the applications for which the battery is suitable.

SELECTION AND DESIGN

16 In a few cases a single lithium cell can be used in place of a non-lithium battery (eg one 3 volt Li/MnO_2 cell instead of two 1.5 volt button cells in a camera), but, in general, lithium cells should not be made to be interchangeable with non-lithium ones; it would be

undesirable, for example, to use lithium primary cells in a photographic flashgun which might be connected to an external charger. However, the desire to exploit the advantages of lithium technology means that cells are specially selected or batteries are specially built up for particular applications.

17 Batteries should not be encapsulated without first consulting the manufacturer.

18 It is strongly recommended that batteries of more than one cell are built up only by the cell manufacturer, who will then be able to choose the most appropriate protecti e devices for each type of battery application. Protective devices should meet the requirements outlined in paragraphs 11 and 12.

19 Where possible, designers should avoid the use of a number of individual lithium cells in a single piece of equipment. If such an arrangement cannot be avoided, the cell manufacturer should be consulted at the design stage.

20 Designers and specifiers should choose batteries with the lowest power output needed to meet their requirements. Where higher powers are needed, parallel configurations should be avoided; if higher power batteries are not available the cell manufacturer should be consulted. Cells should not be connected in series or parallel configurations without acting on the cell manufacturer's recommendations. Where the manufacturer states that a battery will not withstand short circuit an additional safety device such as a fuse or a current limiting resistor should be fitted external to the battery.

21 It is particularly important that, where there is another source of power (eg where the cell is being used for memory back-up), precautions are taken to avoid forced discharge or the charging of primary batteries. The ideal arrangement is to connect the battery between two high quality diodes or between a high quality diode and a limiting resistor of a type that is unlikely to fail to short circuit (eg metal oxide). The diode should have a high reverse resistance and is intended to prevent the charging of the battery by an external power source. The limiting resistor should limit the current to the lowest practical value consistent with the application. The two devices should be connected to opposite poles of the battery to minimise the risk of a single failure shorting out both safety devices.

USING LITHIUM BATTERIES

22 The supplier of a lithium battery should provide sufficient information to enable it to be used safely; it is then up to the user to take note of that information. If the purchaser is not the end user of the battery the safety information should be passed on to the end user.

23 In most cases small lithium batteries for consumer applications require no special attention unless the manufacturer advises otherwise, but no lithium battery should be used other than for its intended purpose. No primary battery (lithium or other type) should be physically abused, charged or connected in series or parallel except as specified by the manufacturer.

24 Users should ensure that cells are usually stored at a temperature below +60°C, although the operating temperature allowed by the manufacturers may be considerably higher than is normal for other types of battery. Terminals should be insulated during storage (the packaging may do this) and after use. Lithium cells and batteries should not be stored with flammable materials.

25 Lithium cells are fully sealed to prevent the ingress of moisture. In the event of safety vent operation there may be seepage of corrosive electrolyte, and such seepages can damage the circuits protecting the battery. Thorough examination and electrical testing of the protective devices (see paragraphs 11 and 12) should be carried out before a battery is replaced. Crushing or piercing a cell may cause the contents to spontaneously ignite.

26 Cells with terminals similar to those on conventional batteries should not be soldered or spot welded unless the cell manufacturer states that it is safe to do so. Batteries should not be used in temperatures that exceed the manufacturer's specification.

27 Whatever internal precautions are built into lithium batteries, recharging should not be attempted. With certain types of primary lithium cell **there is no safe recharging current.** Replacing a high impedence blocking diode with one of a lower impedence may create danger. Batteries should neither be discharged beyond their useful life nor left in equipment after they have been discharged.

TESTING BY PURCHASERS/USERS

28 Purchasers or others who need to carry out tests on equipment incorporating lithium batteries should make sure that the test procedures they follow agree with the advice of the cell or battery manufacturer. Tests should be carried out in a way that minimises the risk of battery failure, and precautions against the effects of such a failure should also be taken. To guard against inadvertent charging the manufacturer should connect the cell or battery between a high quality diode and a resistor (see paragraph 21) or between two high quality diodes. Where this is not possible and external components have to be used it is again recommended that two should be fitted, one in each pole. Single component failure tests may be carried out on these devices after suitable precautions have been taken, but in any circuit containing another power source both blocking devices should never be short circuited at the same time.

ACCIDENT PROCEDURE

29 If a lithium cell is severely damaged in an accident, the details of its chemical composition may

not be known at the time, so the following measures should be taken:

(a) clear everyone from the area;

(b) ventilate the area with fresh air;

(c) wear a face mask, goggles and gloves while clearing up;

(d) disconnect the cell or battery (if practicable) from the equipment in a way that avoids any sparks, and avoid contact with any internal components;

(e) put the cell/battery in a remote, well-ventilated area;

(f) use plenty of clean water to wash away spilt liquid, which may be corrosive. Do not use damp solids or small amounts of water.

30 If there is a fire, the material inside the battery will be released. This can last for several minutes. Where relatively small quantities of lithium are involved, this type of fire should, if possible, be fought with a graphite powder extinguisher. If there is not one available, the fire may be drenched with plenty of water applied continuously in a fine spray, even though lithium reacts with water to form hydrogen. Note however that the fire will not be put out immediately and fragments may be ejected from the fire. Damp solids or small amounts of water should not be used, nor should halon, CO_2, or dry powder extinguishers that are not graphite-based unless they are specifically designed to cope with lithium fires.

31 If a small lithium (coin or button) cell is swallowed the greatest risk of death is from choking. The cell casing material is unlikely to be attacked by digestive juices and, in most cases, the cell will pass through the system in a few days, though medical assistance should, nevertheless, be promptly sought. Vomiting should not be induced. If there is any doubt about the number of cells swallowed and where they are in the body, chest and/or abdominal x-rays should be taken. If a cell is lodged in the oesophagus it should be removed immediately. Attempts to remove cells from the stomach, duodenum or colon are not usually successful.

TRANSPORTATION AND DISPOSAL

32 Cell manufacturers can provide information on current requirements for transportation and disposal. All batteries should have their terminals insulated before disposal. In general up to five small lithium cells (eg of the type used in watches, calculators and cameras) may be disposed of in domestic rubbish. Greater quantities or larger batteries should be specially disposed of by the manufacturer or by a suitably qualified refuse disposal agency. Under no circumstances should lithium cells be crushed or incinerated. Damaged cells or debris should have any exposed terminals insulated, and then be wrapped and sealed in plastic containers and labelled for disposal. Special regulations cover transportation by air.

APPENDIX 1 : A summary of safety measures

Do not:

1 try to charge any primary (ie non-rechargeable) cell or battery;

2 crush, puncture, open, dismantle or otherwise mechanically interfere with or abuse such cells;

3 store cells at temperatures above +60°C;

4 short circuit cells. Terminations must be suitably protected at all times when they are not connected to a circuit. Unless cells or batteries are suitably insulated they should not be: (a) carried in pockets with keys, coins, or other metal objects; (b) put in metal drawers, filing cabinets etc; (c) mixed with other batteries; or (d) exposed to any other situation that may lead to a short circuit;

5 'flow solder' without the cell manufacturer's permission;

6 connect cells to form a battery except where the arrangement has been approved by the cell manufacturer;

7 dispose of cells by burning;

8 encapsulate cells without the approval of the cell manufacturer;

9 replace ordinary primary or rechargeable cells with similar lithium cells of a different voltage;

10 install lithium cells next to a source of heat.

Do:

1 provide short circuit protection in electrical circuits where lithium cells are fitted, unless the manufacturer specifically says that such protection is not needed;

2 observe the polarity of the cells and insert them correctly;

3 tape or otherwise protect terminations before disposal;

4 if there is a fire, use a graphite-based dry powder extinguisher or another suitable extinguisher designed for alkali metal fires, or drench with a fine spray of water.

APPENDIX 2 : Dangerous incidents involving lithium cells or batteries

This Appendix outlines six dangerous incidents involving lithium cells or batteries that have occurred in the UK. All occurred either because of a failure external to the battery or because the battery was not being used in accordance with the manufacturer's instructions.

1 Telecommunications equipment being tested at the manufacturer's works incorporated a small lithium

thionyl chloride cell designed to provide back-up power for a microprocessor memory in the event of mains failure, and a semiconductor diode in the circuit to prevent mains-derived low voltage from back-feeding to the battery. Part of the test involved testing for single component failure, including short circuiting of the blocking diode. With the diode short circuited and the power applied, the lithium cell exploded, wrecking the test laboratory and blowing out the windows. Fortunately no one was injured, but a video camera recording the tests showed that the explosion was so sudden that it occurred between successive frames, and there was no warning of impending disaster. The cell manufacturer's literature included the warning 'do not recharge'.

2 An 'AA' size lithium thionyl chloride cell exploded while a bus ticket machine was being tested in a bus workshop. The failure arose because the blocking diode failed short circuit. Five people were affected by fume and electrolyte contamination but did not need medical treatment.

3 Another 'AA' size lithium thionyl chloride cell exploded while a bus ticket machine was being tested, this time in the manufacturer's workshop. The blocking diode had been short circuited by an undetected solder bridge on the printed circuit board. No one was hurt.

4 A '½AA' lithium sulphur dioxide cell exploded on a printed circuit board during development testing. The battery was thrown across the room, narrowly missing someone. Several people were affected by fume. The incident arose because the blocking diode was connected in reverse, allowing the cell to be charged.

5 A small lithium manganese dioxide cell in a personal computer was protected by a circuit incorporating a field effect transistor and a series resistor to disconnect the cell when the circuit was under external power. These measures failed to prevent reverse charging, which led to overheating and eventual failure.

6 A major electrical manufacturer was developing a lithium battery pack for high-rate discharge using lithium thionyl chloride cells. In two of the 40 tests there were explosions with the emission of fume and flames. In both cases the discharge tests had been discontinued before the explosions, but this did not prevent the incidents occurring about 5 seconds and 50 seconds after disconnection. This emphasises how important it is to ensure that the manufacturer's discharge rates are not exceeded.

HEALTH AND SAFETY EXECUTIVE AREA OFFICES

South West Inter City House, Mitchell Lane, Victoria Street, Bristol BS1 6AN
Tel: 0272 290681

South Priestley House, Priestley Road, Basingstoke RG24 9NW
Tel: 0256 473181

South East 3 East Grinstead House, London Road, East Grinstead, West Sussex RH19 1RR
Tel: 0342 26922

London N Maritime House, 1 Linton Road, Barking, Essex 1G11 8HF
Tel: 01-594 5522

London S 1 Long Lane, London SE1 4PG
Tel: 01-407 8911

East Anglia 39 Baddow Road, Chelmsford, Essex CM2 0HL
Tel: 0245 284661

Northern Home Counties 14 Cardiff Road, Luton, Beds LU1 1PP
Tel: 0582 34121

East Midlands Belgrave House, 1 Greyfriars, Northampton NN1 2BS
Tel: 0604 21233

West Midlands McLaren Bldg, 2 Masshouse Circus, Queensway, Birmingham B4 7NP
Tel: 021-200 2299

Wales Brunel House, 2 Fitzalan Road, Cardiff CF2 1SH
Tel: 0222 497777

Marches The Marches House, Midway, Newcastle-under-Lyme, Staffs ST5 1DT
Tel: 0782 717181

North Midlands Birkbeck House, Trinity Square, Nottingham NG1 4AU
Tel: 0602 470712

South Yorkshire Sovereign House, 40 Silver Street, Sheffield S1 2ES
Tel: 0742 739081

W & N Yorks 8 St Pauls Street, Leeds LS1 2LE
Tel: 0532 446191

Greater Manchester Quay House, Quay Street, Manchester M3 3JB
Tel: 061-831 7111

Merseyside The Triad, Stanley Road, Bootle L20 3PG
Tel: 051-922 7211

North West Victoria House, Ormskirk Road, Preston, PR1 1HH
Tel: 0772 59321

North East Arden House, Regent Centre, Gosforth, Newcastle-upon-Tyne, NE3 3JM
Tel: 091-284 8448

Scotland East Belford House, 59 Belford Road, Edinburgh EH4 3UE
Tel: 031-225 1313

Scotland West 314 St Vincent Street, Glasgow G3 8XG
Tel: 041-204 2646

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HMSO AB
ISBN 0 11 883947 0

First published 1987

Printed in the UK for HMSO
C120 - 4/87

ITEM 8 OF DCOL 2/1988

AMENDMENTS TO THE MANUAL OF FIREMANSHIP - BOOK 8

"BUILDING CONSTRUCTION AND STRUCTURAL FIRE PROTECTION"

a. Within Book 8 there are frequent references to "the requirements of the building regulations". However, since the introduction of the Building Regulations 1985 such references are no longer strictly correct.

b. Whereas the Building Regulations 1976 made specific requirements in respect of structural fire precautions; eg they specified the minimum periods of fire resistance for elements of structure for different types of occupancies depending on the size and height of the building, the 1985 Regulations are what are termed functional regulations. That is to say that they require a particular performance; eg "the building shall be so constructed that, in the event of fire, its stability will be maintained for a reasonable period" without specifying precisely how the standard is to be achieved.

c. These functional regulations are supported by what are termed approved documents. These are documents that have been approved by the Secretary of State as practical guidance to meeting the requirements of the regulations albeit that there is no obligation to adopt any particular solution in the documents if some other way of meeting the requirements is preferred.

d. Consequently any reference in Book 8 to the requirements of the regulations should be construed as reference to the guidance contained in the approved documents.

e. The exception to d. above is where there are building regulations relating to means of escape in case of fire (see 2 d. below).

2. The Building Regulations 1985

a. The Building Regulations 1985, made under the powers contained in the Building Act 1984, came into operation on 11 November 1985 and apply throughout England and Wales. They replaced the Building Regulations 1976, which are revoked.

b. The 1985 regulations impose a less detailed form of control than the previous regulations in that they do not specify constructional details; eg the regulation relating to compartmentation merely states:-

> "The building, or the building as extended, shall be sub-divided into compartments where this is necessary to inhibit the spread of fire within the building."

This form of regulation is known as a functional regulation or functional requirement.

There are, in fact, now only 4 functional regulations relating to fire protection; ie

Regulation B1 - Means of Escape

B2 - Internal fire spread (surfaces)

B3 - Internal fire spread (structure) and

each are expressed in terms similar to the example given above.

c. The regulations are, however, supported by a set of APPROVED DOCUMENTS which give practical guidance on some of the ways the functional requirements might be achieved. These, however, are not mandatory and there is therefore no obligation to use this guidance. Other solutions may be employed providing that it is possible to demonstrate that the functional requirement of the particular regulation has been satisfied.

d. The only exception to functional regulations supported by APPROVED DOCUMENTS is in respect of paragraph B1 of the regulations. B1 deals with means of escape in case of fire and, like the other structural fire precautions regulations, is expressed in functional terms, ie

> "There shall be means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times."

However, this requirement may be met only by complying with the relevant requirements of the publication entitled "THE BUILDING REGULATIONS 1985 MANDATORY RULES FOR MEANS OF ESCAPE IN CASE OF FIRE" published by HMSO. There is no approved document relating to regulation B1 (see also item 4 below).

3. Relaxation, Dispensation and Consultation

a. The power to either relax or dispense with any particular requirement of the Building Regulations 1985 is exercisable by the Local Authority. If on application the local authority considers that the operation of a requirement of the regulations would be unreasonable they may either dispense with or relax that particular requirement.

b. Relaxation is a reduction in the standard required by the regulations and is exercisable on application to the local authority.

c. Dispensation, which is also exercisable on application to the local authority, is the total waiving of the particular requirement; ie the requirement is dispensed with.

d. Because the regulations are in functional terms they in fact require nothing more than the provision of the particular aspect to be to an adequate level; eg "surfaces of materials used on walls and ceilings shall offer adequate resistance to the spread of flame over their surfaces." Consequently to relax such requirements must result in the provision of something that is less than adequate. Therefore in essence functional regulations cannot be relaxed although they can, if the local authority consider that it is unreasonable for the particular requirement to apply, be dispensed with entirely.

e. It is only in the case of the regulation relating to means of escape in case of fire that relaxations may be granted. This is because the only way to comply with the means of escape requirements is by complying with the relevant requirements of the Mandatory Rules for Means of Escape in Case of Fire which are specific. (See also 6 b. below).

f. Section 15 of the Building Act 1984 requires that the local authority shall consult the fire authority before granting a relaxation or dispensation of the regulations so far as they relate to:-

i. Structural fire precautions;

ii. The provision of means of escape from buildings in case of fire; or

iii. The provision of means for securing that such means of escape can be safely and effectively used at all material times.

4. Regulation B1 - Means of Escape and the Mandatory Rules for Means of Escape in Case of Fire

a. Regulation B1, which applies to certain classes of buildings, only requires that:-

"There shall be means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times."

b. Regulation B1 goes on to specify that:-

This requirement may be met only by complying with the relevant requirements of the publication entitled "The Building Regulations 1985 - Mandatory Rules for Means of Escape in Case of Fire".

c. The Mandatory Rules for Means of Escape in Case of Fire differ from the approved documents in that they are mandatory, not advisory. The only way in which the requirement set out in 4a. above can be satisfied is by complying with the 'mandatory rules'.

d. At present regulation B1 and, consequently, The Mandatory Rules for Means of Escape in Case of Fire apply only to a limited range of occupancies; ie

1. A building which is erected and which:-

i. is or contains a dwelling house of 3 or more storeys;

ii. contains a flat and is of 3 or more storeys;

iii. is or contains an office;

iv. is or contains a shop.

2. A dwelling house which is extended or materially altered and will have 3 or more storeys; and

3. A building of 3 or more storeys, the use of which is materially changed to use as a dwelling house.

e. It should be noted that in the case of a building containing a flat and in the case of a dwelling house, the means of escape provided need only afford escape for people from the third storey and above. In the case of a building containing an office or a shop the means of escape need only afford escape for people from the office or shop.

f. The Mandatory Rules for Means of Escape in Case of Fire call up the relevant clauses of the appropriate British Standards; ie

i. In the case of dwelling houses - British Standard 5588 Fire Precautions in the Design and Construction of Buildings; Section 1.1: 1984 'Code of Practice for Single Family Dwelling Houses'.

ii. In the case of flats - British Standard Code of Practice CP3 Code of Basic Data for the Design of Buildings: "Chapter IV Precautions Against Fire Part 1; 1971 Flats and Maisonettes (in blocks over 2 storeys)."

iii. In the case of office buildings - British Standard 5588 'Part 3: 1983 Code of Practice for Office Buildings'; and

iv. In the case of shops - British Standard 5588 'Part 2: 1985 Code of Practice for Shops'.

g. The effect is that the only way in which to conform to the mandatory rules and, consequently, the Building Regulations requirement for means of escape in case of fire, is to construct the building in accordance with the relevant clauses of the appropriate British Standard. The relevant clauses of the various British Standards are set out in the document entitled 'Mandatory Rules for Means of Escape in Case of Fire'.

5. The Building (Approved Inspectors etc) Regulations 1985 and the Building (Prescribed Fees etc) Regulations 1985

a. The above regulations are made under the Building Act 1984. The Building (Prescribed Fees etc) Regulations 1985 merely enable local authorities, ie building control authorities, to charge fees for work done in connection with various aspects of their duties, namely:

i. the passing or rejection of plans;

ii. the inspection of work in respect of plans submitted;

iii. the inspection of work in respect of building notices; and

iv. the consideration of plans reverting to local authority control.

b. The Building (Approved Inspectors etc) Regulations 1985, however, prescribe an alternative method of building control to that normally applying. Under these regulations a developer may opt for supervision of the building work to be carried out by an approved inspector instead of by the local authority. The regulations also allow for approved public bodies to carry out supervision of their own building works.

The regulations relate to the approval of inspectors and detail the procedures under which they are required to operate.

The responsibilities of an approved inspector are to ensure that the developer conforms to the requirements of the Building Regulations.

Of particular interest to the fire officer is the fact that, whereas a local authority is required to consult the fire authority before passing or rejecting plans of any building which will be put to a use designated under Section 1 of the Fire Precautions Act 1971, an approved inspector is not so required, albeit that he is advised to do so.

However, if regulation B1 (means of escape in case of fire) applies to the building being erected then the approved inspector must not only consult the fire authority but must also give copies of the relevant plans and allow 15 working days for the fire authority to comment before giving a certificate.

6. Fire Doors

a. Due to new technology and new concepts the information contained in Chapter 7 of Book 8 in relation to fire doors is no longer entirely correct. The following paragraphs are intended to give broad guidance on the current position.

b. Information and guidance on fire doors including shutters is contained in Published Document 6512 ; Part 1 1985 which was prepared under the direction of the Fire Standards Committee of the British Standards Institute.

c. The generally accepted definition of a fire door is 'a door or shutter provided for the passage of persons, air or things which, together with its frame and furniture as installed in a building, is intended when closed, to resist the passage of fire and/or gaseous products of combustion and is capable of meeting performance criteria to these ends.'

d. Fire doors have at least one of two functions to perform and, in certain situations, both; ie:

i. To protect escape routes from the effects of fire so that occupants can safely reach a final exit; and

ii. To protect the contents and/or structure of a building by limiting the spread of fire.

Consequently any particular fire door may have to perform one or both of these functions for the purposes of smoke control, protecting means of escape, compartmentation or the segregation of special risk areas.

7. Performance of Fire Doors

a. Fire doors provided for smoke control purposes should be capable of withstanding:

i. Smoke at ambient temperatures;

ii. Limited smoke at medium temperatures.

b. Fire doors provided to protect means of escape should:

i. Be capable of achieving a minimum fire resistance for integrity only of 20 minutes;

ii. Withstand smoke at ambient temperatures;

iii. Withstand limited smoke at medium temperatures.

c. Fire doors provided for fire compartmentation and the segregation of special risk areas should:

i. Be capable of achieving the period of fire resistance appropriate to the structural requirements.

They will also, if they are provided to protect a means of escape route, need to withstand smoke as in b.ii and iii. above in some circumstances; eg: the protection of property, it may be necessary for them to be capable of withstanding high temperature smoke.

NB: When other methods of smoke control are provided in buildings, eg pressurisation of escape routes, the ability of fire doors to withstand smoke may not be applicable.

d. Smoke control fire doors are provided for life safety purposes and play an important role in the vicinity of the fire in its early stages and in protecting escape routes more remote from a fully developed fire. There is at present no criteria for smoke control doors although a recommendation for performance for fire doors to resist the passage of smoke is under consideration. Opinion expressed in Published Document 6512 : Part 1 is that smoke control doors should not, in the early stages of fire, depend on either rebated door frames or heat activated seals; ie intumescent strips. In practice doors are likely to warp and make rebates ineffective and heat activated seals which operate between 140°C and 300°C respond too late for the protection of escape routes from smoke.

In the absence of any criteria for Smoke Control Doors it is recommended that:

i. Flexible edge seals should be provided for the early control of smoke movement; and

ii. The doors, whilst not requiring any specified period of fire resistance should be of substantial construction.

e. Doors to Protect Means of Escape are required to keep the escape route sufficiently free from smoke for sufficient time for occupants to reach a place of safety and to maintain integrity against the effects of fire for long enough to fulfil that objective.

It follows that, in addition to a smoke control capability, these doors require a measure of fire resistance. Consequently codes of practice generally recommend such doors to be of either 20 or 30 minutes fire resistance and to have both flexible edge seals and heat activated seals; ie intumescent strips.

f. Doors for Compartmentation and the Segregation of Special Risks must be capable of achieving the period of fire resistance appropriate to the structure which is not less than 30 minutes and may be as much as 4 or even 6 hours, in exceptional circumstances. The required fire resistance may need to be achieved by the provision of 2 fire doors in series both of half the required fire resistance.

If such doors are also required to protect an escape route they will need also to have the smoke control capabilities described above.

8. Identification of Fire Doors

a. Fire doors should be identified by the initials FD followed by the performance in minutes that the door should achieve when tested for integrity only. For example: a door identified as FD 30 implies an integrity of not less than 30 minutes (ie 30 minutes fire resistance).

Where the door should also resist the passage of smoke at ambient temperatures the suffix 'S' should be added to the identification.

b. The practical application of the above is, for example, when specifying for a flat entrance door in a block of flats where the door would be required to protect means of escape, as in 7e. above, the requirement would be for a FD 30S door. Or alternatively a fire door required in a compartment wall of 60 minutes fire resistance with no means of escape implications the requirement would be for a FD 60 door.

9. British Standard 459 : Part 3 : 1951

a. Book 8, Chapter 5 Section 5(h), page 98, makes specific reference to doors made to BS 459 : Part 3 : 1951 and shows examples of the construction of them in Fig. 5.31 on page 99.

b. The Building Regulations 1985, for the first time, accepted only a positive pressure fire test as set out in BS 476 : Part 8. This excluded doors conforming to BS 459 : Part 3. Therefore any reference to BS 549 : Part 3 : 1951 and the types of doors described must now be ignored.

10. Summary

A summary of the above:

i. The 1985 Building Regulations are expressed in functional terms.

ii. References in Book 8 of the Manual of Firemanship to any particular form of construction being required, or satisfying, the Building Regulations are no longer correct.

iii. There are Mandatory Rules for Means of Escape in Case of Fire which are linked to the appropriate British Standards.

APPENDIX

To be read in conjunction with the Note on Amendments to Book 8, Manual of Firemanship.

A. Chapter 5 Section 5(h), pages 98, 99, 100

The whole of this section together with Fig. 5.31 is to be ignored.

B. Fig. 6.2 page 115

The first line of the caption should read:-

"Methods by which fire can be prevented from penetrating separating walls."

C. Chapter 7 Section 3, pages 118, 119

The whole of this section and Fig. 7.2 is to be ignored.

D. Fig. 7.3 page 121

Delete first word of caption : 'Definition'. Substitute 'Example'.

E. Chapter 7 Sections 6 and 7, pages 123, 124

Both these sections to be ignored.

F. Throughout Book 8 reference is made to 'non-combustible material'. The term 'materials of limited combustibility' should be used instead.

File reference: FIR/80 7/6/13

Telephone number of contact: 01 273 2637

ITEM C OF DCOL 2/1988

AMENDMENT TO MANUAL OF FIREMANSHIP - BOOK 4

Amendment to Item C, DCOL 11/87 entitled "Amendment to the Manual of Firemanship".

Disregard any reference to Book 5 Manual of Firemanship.

Book 4 Manual of Firemanship. Page 231, line 15 amend minimum distance from OLE to 3 metres.

File Reference: FIR/80 7/6/9
Telephone Number of Contact: 01 273 2637

Item D of DCOL/ 2 1988

PROGRAMMED LEARNING MATERIAL

During July and August 1988 stocks of the programmed learning material produced for the fire service by the former Home Office Unit for Educational Methods (HOUEM) are to be transferred from the Home Office store at Caxton to the store at Steventon.

2. Brigades are requested not to place any orders for programmed learning material during these months and during June.

3. Brigades are also requested not to place higher demands than are really necessary during the preceding months as this may result in an inability to meet reasonable requests before the transfer starts.

4. Stocks of programmed learning material are being kept at a level commensurate with the usual demands of the fire service so that, apart from during the transfer period, brigades should experience no difficulty in getting the stocks they require.

5. The procedure for the placing of orders for programmed learning material remains unchanged and is described in Dear Chief Officer Letters No 35/1980 and No 3/1982.

File reference: FIR/81 617/6/1

Telephone number of contact: 01-273 2637

FIRE PRECAUTIONS IN NATIONAL HEALTH SERVICE PREMISES - FIRECODE

1. The Department of Health and Social Security are in the process of bringing together in one comprehensive series of documents under the general title FIRECODE their policy and technical guidance to health authorities on fire precautions in hospitals and other NHS premises. All existing DHSS guidance including Health Technical Memoranda (HTMs) and Fire Practice Notes (FPNs) has been or is being revised and consolidated and will be re-issued in the FIRECODE format.

2. The FIRECODE series presently consists of the following documents: Policy and Principles; Fire Precautions in New Hospitals (HTM 81); Assessing Fire Risk in Existing Hospital Wards (HTM 86); Directory of Fire Documents; FPN1 - Laundries; FPN2 - Storage of Flammable Liquids and FPN3 - Escape Bed Lifts. Copies of each, together with the covering health notice HC(87)24 and a ring binder and slipcase, are attached for the information of chief fire officers. Advance copies of Fire Precautions in New Hospitals (HTM 81) were distributed to chief fire officers under cover of a health circular HC(87)2 in January 1987. The Nucleus Hospital Design Package and Building System which was issued under cover of DCOL 11/1987 will also be re-issued in due course in the FIRECODE format.

3. As part of the guidance health authorities are directed to seek the advice and assistance of local fire authorities in defining the policies and programmes for fire precautions in hospitals and other NHS premises and on any proposals to alter or develop the premises. It is accordingly recommended that fire prevention officers should refer to the appropriate parts of the guidance when responding to such requests for advice.

4. As chief fire officers will be aware, in the case of those parts of the premises put to uses designated under the Fire Precautions Act 1971 as amended by the Fire Safety and Safety of Places of Sport Act 1987, eg offices, shops workshops etc the responsibility for certification lies with Home Office Fire Service Inspectors. Although paragraph 2.10 of the Policy and Principles document does not make it clear, health authorities should be aware of the need to inform the Fire Service Inspectorate in advance of any proposals to make extensions or alterations etc to the premises as this is clearly spelt out in the letters which accompany existing fire certificates.

5. Chief fire officers are reminded that Crown Inspectors should only be involved in inspections or consultations on those parts of hospitals designated under the FPA 1971 and that in giving advice themselves on non-designated areas, as they are required to under the Fire Services Act 1947 when so requested, they are doing so on a goodwill basis.

6. In responding to requests for advice on fire precautions within "totally soft play environments" (see para 4.10 of the Policy and Principles document) brigades should refer to Fire Service Circular 1/1988 Fire Hazards Associated with the use of Cellular Foam in Sports and Recreational Facilities.

7. There are no significant additional costs of manpower implications arising from the circulation of this guidance to fire brigades.

8. Dear Chief Officer Letter 10/78 is now cancelled.

Telephone number of contact 01-273 3406

Ref Number FEP/87 47/94/2

LIFEJACKETS

1. The purpose of this advice is to apprise fire brigades of the difficulties which may arise if lifejackets have to be worn simultaneously with BA. The Joint Committee on Fire Brigade Operations (JCFBO) had been asked to consider the use of lifejackets with breathing apparatus. Previous guidance on types of lifejackets available for fire fighting at sea, for crews of fire boats and for firefighters on fire boats and other craft, recommended that lifejackets should comply with BS 3595 and should have a minimum total buoyancy of 35lbs with inherent buoyancy of 20lbs. The guidance, which does not seem to have considered use with BA, was given in Fire Service Circular No 18/1973 and in Part 7 of the Manual of Firemanship. Where helicopters are used, all-inflatable lifejackets meeting the requirements of the regulatory bodies concerned must be used.

2. The Fire Experimental Unit of the Home Office Scientific Research and Development Branch carried out an investigation and tests at the request of the JCFBO. These tests were made with a variety of lifejackets and with a number of types of BA commonly in use in UK fire brigades and fitted with 2250 litre or 1800 litre cylinders, these being the most common types of cylinder presently in use. A copy of the report produced by the FEU is attached to this letter.

3. The tests confirmed that wearers of BA, when wearing a lifejacket in water, do float face upwards. It was found, however, that the additional net sinking force of a BA set in water should be taken as 10lbs for sets fitted with a 2250 litre cylinder and 20lbs for sets fitted with an 1800 litre cylinder. The report also identified at Section 2 and Section 6 a number of other operational constraints affecting the simultaneous use of lifejackets and BA and, in Section 5, possible difficulties which might arise due to exposure of lifejackets to flame, heat and high humidity.

4. The JCFBO has considered the report and agreed that it should be circulated to brigades with comment on a number of issues as follows:

a. The report contains at Appendix C advice which brigades may find useful in selecting lifejackets intended for use with BA.

b. Although the limited tests made in flame, heat and high humidity produced no flaming and little significant damage, nevertheless the possibility of minor damage rendering the lifejacket useless should be borne in mind and every effort should be made to avoid exposure to heat and flame, including contact with hot surfaces.

c. It is important that adequate buoyancy should be available, particularly in rough water conditions and having regard to the additional encumbrance with a BA set would impose if the wearer was compelled to take to the water while still wearing the set. Some of the lifejackets which are currently available exceed the minimum buoyancy requirement of 155N (34.8lbs) of BS3595 (155N - 34.8lbs) by about 10lbs. If necessary, they could reasonably be used in conjunction with BA having 2250 litre cylinders. However, none of the lifejackets has the additional 20lbs of buoyancy necessary to compensate fully for the net sinking force of sets fitted with 1800 litre cylinders. A similar difficulty could be expected in relation to BA sets with twin cylinders.

d. Additionally, the available lifejackets of the partial inherent buoyancy type had inherent buoyancy in the range 22-27lbs approximately. It is evident therefore that when allowance is made for the net sinking force of a BA set, a wearer who entered the water before inflating the

jacket to achieve its total buoyancy, or who suffered a loss of the inflation element of buoyancy in the water, would be inadequately supported even in calm conditions, especially if the BA set had one of the heavier cylinder configurations.

5. Personnel who may be engaged in fire fighting at sea, on fire boats or other small craft (or, exceptionally, engaged in any other operations in proximity to open water where use of lifejackets might be considered to be necessary) should be reminded of the following points which are relevant to the wearing of BA and a lifejacket together:

a. the problem which may arise for the foreseeable future in securing adequate buoyancy to compensate for the additional weight of the BA set, especially where 1800 litre cylinders or other heavy cylinder combinations are used, and of the consequent need to minimise, as far as practicable, occasions when personnel wear BA with a lifejacket;

b. where the wearing of BA is necessary, all practicable steps should be taken to obviate any immediate need for the simultaneous wearing of a lifejacket;

c. if circumstance necessitate the wearing of a lifejacket with BA, wearers should:

(1) ensure if at all possible that the lifejacket is fully inflated to provide maximum buoyancy,

and

(2) if compelled to take to the water, discard the BA set at the earliest opportunity, preferably before immersion.

6. In view of the limitations of lifejackets currently available, the Operations Committee has agreed that the Joint Committee on Fire Research should be asked to consider the feasibility of finding or developing a lifejacket more compatible with the wearing of breathing apparatus. Chief Fire Officers will be advised of the outcome.

7. Previous guidance, including Fire Service Circular 18/1973 and DCOL 36/1973, is cancelled.

8. It is not anticipated that brigades will replace existing lifejackets before expiry of their normal life expectancy; indeed, brigades are recommended to await the outcome of the next phase of research before embarking on any major replacement programme other than one involving the replacement of defective or damaged lifejackets. On that basis this advice has no financial or manpower implications.

File Ref no: FEP/86 213/1500/1.

Telephone number of contact: 01 273 3942