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DEFENCE CO-ORDINATING INSTALLATION DESIGN AUTHORITY

MANUAL of REGULATIONS for INSTALLATION of COMMUNICATION & INFORMATION SYSTEMS

CHAPTER 05

LIMITED FIRE HAZARD CABLES & MATERIALS

INTRODUCTION

0501. Cables rarely initiate fires, but they could be involved in them and can significantly increase the damage caused should they propagate the fire. Until recently the flame retarding of cables was achieved by the use of halogenated flame retardants which are effective fire suppressants, but which unfortunately produce dense smoke and corrosive acid gases when burned. These effects are highly undesirable in a fire, hindering evacuation and fire fighting, endangering life and causing corrosion damage to expensive and vital equipment.

0502. The terms Limited Fire Hazard (LFH), Low Smoke & Fume (LSF), Low Smoke Halogen Free (LSHF) and Low Smoke Zero Halogen (LSZH) (LS0H) are used as material descriptions and as industry trade marks. Various Defence (Def Stan), British, (BS) European, (EN) International, (ISO) American (UL & IEEE) and Canadian (CSA) Standards exist for LFH cables and cable containment systems and the methods to be used to quantify test criteria. Some of the relevant standards and tests are listed on the CIDA website.

DEFINITION OF LIMITED FIRE HAZARD MATERIALS

0503. The attributes inferred on a particular material do not automatically qualify it for installation into a particular facility. Irrespective of whether a material is identified as LFH, LSF, LSHF, LS0H, LSZH, or any other title, if it has not been included in the CIDA Fire Hazard Materials Database (FHMD), then it must not be used in MOD facilities where specific LSZH standards have been specified.

0504. Current strategy on fire hazard management defines the term 'Fire Risk'. The definition recognises that the risk in a fire situation is influenced strongly by several factors including, ignitability, heat release, smoke evolution and toxic gas emission together with flammability.

0505. To meet MOD FH standards and therefore qualify for inclusion in the CIDA FHMD, a material must meet stringent standards for one or more of Flammability, Temperature Index, Oxygen Index, Smoke, Corrosiveness, Toxicity Index and Halogen Content.

Flammability

0506. There are several test procedures available for the assessment of the flammability of wires and cables. Still in widespread use is Oxygen Index, but it is now generally recognised that because the test is conducted on a single specimen of cable, jacket or wire in laboratory conditions, the results are, at best, only weakly correlated to actual fire situations. Temperature Index, is a related test and assesses performance at elevated temperature but nevertheless it is still conducted on a single specimen. More recent evidence and thinking places significantly greater importance on large scale flammability tests, such as BS EN 50266, in which the sample consists of several bundles of wires. These tests predict more accurately the likely behaviour of cables in actual fire scenarios.

0507. To meet the requirement for LFH rating, a cable, when tested to BS EN 50266, must not be charred higher than 2.5 metres above the bottom edge of the burner.

Temperature Index

0508. Temperature Index is defined as the temperature of a material at which the Oxygen Index equals 20.9%. Alternatively as the temperature at which combustion of a material is just supported in air under specified test conditions. Testing to BS EN ISO 4589-3 can determine the Temperature Index of a material.

0509. An LFH rating, requires a material to have a Temperature Index not less than 250°C.

Oxygen Index

0510. Oxygen Index is defined as the minimum concentration of oxygen, by volume percentage, in a mixture of oxygen and nitrogen, introduced at 23°C ± 2°C that will just support combustion of a material under specified test conditions. Testing to BS EN ISO 4589-2 can determine the Oxygen Index of a material.

0511. To meet the requirement for LFH rating, a material must have a Oxygen Index not less than 29%.

Smoke

0512. The method for measuring smoke generation accepted by most authorities involves the use of a smoke chamber where the optical density of the chamber's atmosphere is constantly measured during combustion and pyrolysis. The minimum light transmittance can be determined, as in BS EN 50268, or, as in Def Stan 02-711, the rate of change of smoke density can be summarised to a single numerical value to give a smoke index for a material. Both methods offer simple comparison of material performance.

0513. To meet the requirement for LFH rating, a cable must have a Smoke Index not greater than 20 or a minimum light transmittance of 60%.

Corrosiveness

0514. Under fire conditions, polymers containing halogens, sulphur and phosphorous all form corrosive acid gases or liquids. These acids can then attack items such as printed circuit boards, connectors, control relays and metal structures, including steel reinforcement bars embedded in concrete. Test methods to evaluate corrosiveness involve direct measurement of the amount of acid gas produced during pyrolysis as in BS EN 50267-2-1, or, measurement of pH and electrical conductivity of the material in solution as in BS EN 50267-2-2 & -2-3.

0515. A Zero Halogen category requires a material test in accordance with BS EN 50267 to result in a pH value not less than 4.3 with conductivity not exceeding 10µS/mm.

Toxicity Index

0516. The various gases given off by combustion and pyrolysis of polymeric materials are toxic to differing degrees. Def Stan 02-713, assesses the concentration of each of the possible by-products and, by measuring the amounts of these materials, and employing a numerical summation of the toxicity factors, a Toxicity Index can be assigned. The toxicity factors are derived from the calculated quantity of each gas that would be produced when 100g of the material is burnt in air in a volume of 1cubic metre and the resulting concentration expressed as a factor of the concentration fatal to man at a 30 minute exposure time (see Table 05-1). An index of 1 for a given volume will, on average, bring about death in 30 minutes. The analysis of the products of combustion in the test chamber must include the quantitative determination of all gases listed in Table 05-1.

0517. A Zero Halogen categorisation requires a Toxicity Index≤ 0.2 for single wire insulation, and a Toxicity Index ≤ 5.0 for cable sheaths, when tested in accordance with Def Stan 02-713.

Combustion product gases		**ppm**	**Combustion product gases**		**ppm**
Carbon dioxide	CO_2	100 000	Sulphur dioxide	SO_2	400
Carbon monoxide	CO	4000	Nitrogen oxides	$NO+NO_2$	250
Hydrogen sulphide	H_2S	750	Phenol	C_6H_5OH	250
Ammonia	NH_3	550	Hydrogen cyanide	HCN	150
Formaldehyde	HCHO	500	Hydrogen bromide	HBr	150
Hydrogen chloride	HCl	400	Hydrogen fluoride	HF	100
Acrylonitrile	CH_2CHCN	400	Phosgene	$COCl_2$	25

Table 05-1 ~ Toxicity Index Combustion Product Gases

Halogen Content

0518. Material is tested for potential acid gas evolution by using the Lassaigne Test (sodium fusion test). The test is designed to detect the presence of halogens (fluorine, chlorine, bromine or iodine) when a small sample of the material is subjected to combustion and pyrolysis. The test is commonly employed as a 'go/no-go' indicator to notify or obviate the requirement for a more detailed quantitative analysis.

0519. A negative result (i.e. no detectable halogens) would indicate a Zero Halogen rating for the material.

THE MOD PERSPECTIVE

0520. MOD facilities containing CIS range from a single stand alone management support PC with no operationally significant purpose in a small, single occupancy, single room, isolated, nine to five building with multiple means of escape, to complex, multi rack, operationally essential systems in large, densely populated, multi-room, multi-floor, 24 hr manned, live in, underground, limited access bunkers which, for operational reasons, do not have the luxury of evacuation in the event of fire.

0521. MOD policy is to limit the fire hazard posed by cable and cable containment in all buildings on the MOD Estate by minimising the spread of fire and the formation of acrid smoke and toxic gases.

0522. In underground accommodation, such as bunkers, and certain windowless facilities (unfenistrated facilities) with forced air ventilation, the **Crown Fire Standard (CFS), E8 Paragraph 4.13b** *'Engineering Services'*, states that 'All cables shall be flame retardant cables of the low smoke and fume emission type. Cable bedding and sheathing materials shall be of the low smoke, low or zero halogen type (LSZH).' MOD policy states that the fire loading of windowless or underground accommodation must not be increased by the use of materials that would add to the smoke and fire propagation problem when alternative, less hazardous, materials are available. This policy therefore requires that wires and cables within and between equipment racks, but external to the individual items of equipment, and all power leads carrying mains voltage to office equipment and computers are to be of the LSZH type.

0523. Additionally, if the facility is subject to sleeping or Close-Down activity, then all cables associated with telephones, computer keyboards, mice and other peripherals and. all plastics, including equipment cases, furniture and office related items, are to be provided in LSZH materials if they are available at reasonable cost.

0524. One of the most important fire related aspects of cable containment is correct fire-stopping of the cable containment route between fire compartmented areas, **BS 7671** clauses 527-02 to 527-04 refer. Within MOD buildings, all walls and all floors in bunkers and all floors in other MOD facilities are classed as fire resisting elements (with a fire rating) and thus require an equivalent rated fire-stopping to be applied to all cable containment that traverse them. Fire compartmentation detail for specific MOD buildings should be obtained from the site facilities organisation. Table 05-2 lays down the minimum requirements to be applied to any MOD facility and incorporates all policy issues referred to in paragraphs 0521 to 0524 inclusive.

	Cable Containment Fire-Stopping	System Cables & Non-Metallic Cable Containment	Internal Rack Wiring	Office Equipment Power Cables	Supplementary Equipment Wiring & Equipment Cases etc
Bunkers & Significant Windowless Facilities Subject to Close-Down Activity	All Walls & All Floors	LSZH	LSZH	LSZH	LSZH if available at reasonable cost
Bunkers & Significant Windowless Facilities NOT Subject to Close-Down Activity	All Walls & All Floors	LSZH	LSZH	LSZH	LFH unless LSZH policy is easy to implement
All Other Buildings, Including Small Enclosed Buildings, ISO Containers & Vehicles	Some Walls [1] & All Floors	LFH [2]	LFH	LFH	LFH

Notes:

1. Fire compartmentation detail for specific MOD buildings should be obtained from the site facilities organisation.

2. Where communications cables pass through Means of Escape routes, use of low smoke zero halogen (LSZH) cables is only dictated by the requirement to have a continuous unbroken cable from the NER * (where LSZH materials are specified) through to the TAP. For other cables that run within Means of Escape routes, the use of LSZH cables is not mandatory. However, their use should be encouraged where the cost difference is not excessive.

***** An NER (Network Equipment Room) is defined as any room which has Network Equipment as its primary occupancy.

Table 05-2 ~ Limited Fire Hazard Material Policy Requirements Applicable to MOD Facilities

PROCESS FOR INSTALLATION AGREEMENT

0525. Any cable or containment whose data sheet confirms product compliance with the Fire Hazard policy indicated in Table 05-2 may be selected for use in MOD facilities, However, where policy indicates use of an LSZH, product, installation is not to commence unless the detail of the material and evidence confirming compliance is included in the CIDA FHMD, without first obtaining either:

a. Product compliance confirmation and installation agreement from CIDA or,

b. An installation concession, granted by the: Defence Estates Specialist Services (DESS), Senior Fire Prevention Officer (SFPO).

Requests For Compliance Confirmation

0526. If it is believed that a proposed material complies with the CIDA FH requirement but is not listed in the CIDA FHMD, a copy of the appropriate manufacturer's datasheet along with any supporting standards information must be provided to CIDA before installation of the material. Where CIDA agrees that the information supplied substantiates compliance, the material may be installed and the detail added to the Database to inform future compliance agreement.

Requests For Installation Concession

0527. When the proposed material is not listed in the CIDA FHMD and the standards quoted in the manufacturers data-sheet are not considered to be adequate, then a concession for installation of the material may be applied for from the DESS SFPO. Each application for a concession must include a request to the SFPO that the departmental ruling is copied to CIDA with a recommendation regarding inclusion of the detail in the CIDA FHMD.

LEGACY INSTALLATIONS

0528. Whilst the above policy is mandated for all changes effecting existing facilities and all new build projects, within those facilities where CFS E8 applies and existing wires, cables, cable containment and materials are not compliant, the MOD SFPO and the CIDA are to be requested to conduct an audit and establish a rectification strategy to identify replacement priorities.

POLICY ASSISTANCE

0529. Assistance with the implementation of this policy may be obtained from the CIDA Help Desk.