

Minimising fire risk in computer room cable installations

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No fire-risk minimisation plan should be considered in isolation from the other elements contained within a building and an integrated plan would take into account;

- Designing with low fire hazard materials
- Designing structural layouts to minimise fire and smoke spread
- Ensuring all electrical items are designed and operated according to their limits
- Locating fire exits and escape routes
- Planning emergency lighting and signage
- Locating automatic smoke/fire detectors and manual call points
- Planning a fire alarm system
- Installing automatic fire suppression systems and manual fire extinguishers appropriate to the situation
- Controlling all sources of ignition and storage of flammable materials
- Continued safe operation of the building to minimise fire risk
- Staff training to recognise risk and react to fire alarm situations
- Ongoing maintenance of all fire alarm/detection and related items
- Defining all the interested parties and appointing management responsibilities

Due to the lethal risks involved and the unfortunate experiences of many buildings and their occupants, fire risk, more than anything else in one's working life, is covered by Statutory Instruments, Building Regulations, European Directives and a host of codes and standards. In the USA the National Fire Protection Association (NFPA) and the National Electrical Code (NEC) control all these aspects.

The principle fire safety legislation in the UK is Statutory Instrument 2005 No. 1541 *The Regulatory Reform (Fire Safety) Order 2005*

In this article we will consider the above requirements just from the point of view of low-voltage cable plant. Computer room installations and data centres contain many tons of densely packed cables with the plastic insulation used representing a huge potential fuel load. For cabling we can consider three elements;

1. Flammability, and other combustion effects, of cable insulations
2. Installing cable containment systems to minimise smoke and flame spread especially through fire wall penetrations
3. Good practice design such as the removal of obsolete cable to reduce potential fuel load

1 Combustion effects of cable

The reaction to fire can be classified in many ways, e.g.

- Flammability; i.e. how enthusiastically does a material catch fire and sustain burning
- Smoke evolution
- Acidity of evolved smoke (often related to halogen content)

- Halogen content, e.g. Chlorine, Fluorine, Bromine and Iodine
- Toxicity of smoke, often related to the above two items
- Flaming droplets. This is a key mechanism of fire spread in horizontal cable runs, e.g. burning droplets of plastic dripping from cables downstream of the initial fire event

In the USA the fire regulations are very strict on the type of cables used and areas are generally defined as plenum, riser or general purpose. Plenum grade is the highest level. In this context 'plenum' means an architectural space where air is forced to move. Thus spaces above ceilings and under raised floors, which the air conditioning plant is using as a distribution route for chilled air, is a classical plenum zone, and any fire in these space would be bad news as the air conditioning will spread the fire and smoke rapidly around a building.

In the USA cables are marked with legends such as 'CMP', *Communications Metallic Plenum*, to indicate their suitability for use in the plenum space. Table 1 defines this and the standards that need to be met to prove compliance.

Table 1: Extract from NFPA 90A – Section 800, Communications Cable

Designation	Description	Standard
CMP	Communications Plenum Cable for use in ducts, plenums and other spaces used for environmental air	NFPA 262
CMR	Communications Riser Cable listed as being suitable for use in a vertical shaft or from floor to floor	UL 1666
CM	Communications Cable suitable for general purpose use with the exception of risers and plenums	UL 1581

In the UK there are few mandatory requirements covering cables although many standards are available to be invoked if required by the building owner. It was the intention within the European Union to use the Construction Product Directive to control the flammability of all materials permanently incorporated into the fabric of a building. Although CENELEC standards for cable fire performance have been developed for use within CPD classifications, they are not yet a legal requirement.

One of the few times that cable flammability is mentioned is in BS 6701:2004 which requires that very flammable external grade cable, usually made of polyethylene and petroleum gel, is terminated within two metres of entering a building or be installed in conduit with a fire resistance 'agreed with local fire authorities'. BS 6701:2004, *Telecommunications equipment and telecommunications cabling – Specification for installation, operation and maintenance. Section 4.4.2 Telecommunications cabling at building entrance facilities.*

The level of mandatory compliance of BS 6701 can be inferred from the requirement of the *Electricity at Work Regulations 1989* requiring compliance with BS 7671:2001 *Requirements for electrical installations. IEE Wiring Regulations, Seventeenth Edition*, which in turn invokes BS 6701 when communications cables are discussed.

One of the few specifications used in the UK that does require low flammability, low fire hazard cabling is;

DEFENCE CO-ORDINATING INSTALLATION DESIGN AUTHORITY MANUAL of REGULATIONS for INSTALLATION of COMMUNICATION & INFORMATION SYSTEMS

Also known as JSP 480 2008, and is the standard used for all Ministry of Defence buildings. It states that for all windowless areas, 'All cables shall be flame retardant cables of the low smoke and fume emission type.'

This standard defines a cable's fire performance in terms of flammability, smoke index, oxygen index, temperature index, corrosivity, toxicity and halogen content. It invokes many standards but interestingly calls up two recent CENELEC standards;

BS EN 50267 Common test methods for cables under fire conditions. Tests on gases evolved during combustion of materials from cables. Procedures. Determination of the amount of halogen acid gas

BS EN 50266 Common test methods for cables under fire conditions. Test for vertical flame spread of vertically-mounted bunched wires or cables

These are European equivalents of the more commonly seen IEC 60754 and IEC 60332 respectively.

IEC 60332 contains many variants and the best quality and most appropriate for data centres appears to be 60332-3-25.

This part of IEC 60332 covers category D and relates only to small cables of overall diameter 12 mm or smaller installed on the test ladder to achieve a nominal total volume of non-metallic material of 0,5 l/m of test sample. The flame application time is 20 minutes. The category is intended for use with small cables where very low volumes of non-metallic material are required to be evaluated.

It has to be remembered that this standard arose from the use of power cables in vertical risers in power stations and so is not optimised for small data communications cables. The acceptable height of the 'char' level in this test should not exceed 2.5 m. Many manufacturers quote IEC 60332 in their data sheets but are very non-specific about which level they are offering.

In comparison with the American General Purpose, Riser and Plenum grading scheme, the IEC/EN specifications described above would roughly equate to a Riser grade of performance. But another big difference with European style cables is the popularity of zero halogen materials, which has never been much of an issue in North America, where the emphasis has always been on flammability.

Fire Stopping

The second essential element in safe cable installation is to ensure that cable containment systems minimise smoke and flame spread especially through fire wall penetrations.

The Building Regulations: 2000 Part B, dictate the need for fire stopping in the UK;

11.12 In addition to any other provisions in this document for fire-stopping:

- a. joints between fire separating elements should be fire-stopped; and
- b. **all openings** for pipes, ducts, conduits or cables to pass through any part of a fire separating element **should be**:
 - i. kept as few in number as possible, and
 - ii. kept as small as practicable, and
 - iii. **fire-stopped**

11.14 Proprietary fire-stopping and sealing systems, (including those designed for service penetrations) which have been shown by test to maintain the fire resistance of the wall or other element, are available and may be used. Other fire-stopping materials include: Cement mortar, gypsum based plaster, cement or gypsum based vermiculite/perlite mixes, glass fibre, crushed rock, blast furnace slag or ceramic based products (with or without resin binders), and intumescent mastics.

The European Union has a standard known as BS EN 1366-3 for the fire performance of service penetrations; EN 1366:2004 *Fire resistance tests for service installations*.

Good practice design

Included in 'good practice' is the removal of redundant cable so that it reduces the available fuel load in any fire situation. Concomitant with this is the need for accurate and up-to-date labelling and marking of the cable plant so that it can be identified in the future and marked for retirement and removal when appropriate.

The American National Electric Code (NEC) is a set of rules intended to ensure the safety during installation, use and/or disposal of materials, components, fixtures, and systems. The most recent code, NEC 2002, requires that abandoned cable be removed for both copper and fibre.

The definition of abandoned cable, as found in paragraphs 800.2 and 770.2 of the NEC 2002 Book, states "...Installed communications cable that is not terminated at both ends at a connector or other equipment and not identified "For Future Use" with a tag." For copper cable, paragraph 800.52(B) of the NEC Code states "...The accessible portion of abandoned communications cables shall not be permitted to remain.." Additionally, paragraph 800.52(1) states that *abandoned cables in vertical runs shall not be permitted to remain*. Article 770 states the same requirements for optical fibre risers and horizontal cables.

In the UK there is no specific statement about cable removal but unnecessary fuel loads are outlawed by The Regulatory Reform (Fire Safety) Order 2005.

If we consider Part 4.Article 12

MEASURES TO BE TAKEN IN RESPECT OF DANGEROUS SUBSTANCES

In applying measures to control risks the responsible person must, in order of priority—

- (a) reduce the quantity of dangerous substances to a minimum;
- (b) avoid or minimise the release of a dangerous substance;
- (c) control the release of a dangerous substance at source;
- (d) prevent the formation of an explosive atmosphere, including the application of appropriate ventilation;
- (e) ensure that any release of a dangerous substance which may give rise to risk is suitably collected, safely contained, removed to a safe place, or otherwise rendered safe, as appropriate;

One can see that the removal of unnecessary, flammable cable is inferred from the above new law.

Conclusion

Although Europe has no legal framework for defining cable fire performance similar to the American market there are attempts to move in that direction, e.g. IEC REPORT TR 62222 *"Fire performance of communication cables in buildings"*.

The European market has and still tends towards specifying cables according to IEC Standards;

IEC 60332-3-25	Flammability test on a group of cables
IEC 60332-1	Flammability test on a single cable
IEC 61034	Smoke evolution
IEC 60754	Corrosivity (and hence halogen content by implication)

Note that wherever cables and their containment pass through firewalls the integrity of the penetration must be protected with a suitable fire seal.

Redundant cables must be removed from underfloor areas, risers and other hidden plenum spaces to reduce the fuel load available to a fire.

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