

Fire performance of communication cables installed in buildings

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National foreword

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Fire performance of communication cables installed in buildings



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FIRE PERFORMANCE OF COMMUNICATION CABLES INSTALLED IN BUILDINGS

1 Scope and object

The object of this technical report is to provide recommendations for the requirements and test methods to be specified for the fire performance of communication cables when installed in buildings.

The recommendations relate to typical applications and installation practices for copper and optical cables in buildings. This technical report includes an assessment of the fire hazards presented by such installations, and describes fire scenarios that have been established and the appropriate cable fire performances to mitigate these hazards.

The recommendations also take into account legislation and regulation applicable to the fire performance of cables, the results of known research work and an assessment of known test methods and their ability to measure the recommended fire performance.

Power cables are usually segregated from communication cables for electrical safety and installed differently so they have not been addressed in this technical report.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60332-1-1, *Tests on electric and optical cables under fire conditions – Part 1-1: Test for vertical flame propagation for a single vertical insulated wire or cable – Apparatus*

IEC 60332-1-2, *Tests on electric and optical cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame*

IEC 60332-3-10, *Tests on electric and optical cables under fire conditions – Part 3-10: Test for vertical flame spread of vertically-mounted bunched wires or cables – Apparatus*

IEC 60332-3-24, *Tests on electric and optical cables under fire conditions – Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category C*

IEC 60695-5-1, *Fire hazard testing – Part 5-1: Corrosion damage effects of fire effluent – General guidance*

IEC 60695-5-3, *Fire hazard testing – Part 5-3: Corrosion damage effects of fire effluent – Leakage current and metal loss test method*

IEC 60695-6-1, *Fire hazard testing – Part 6-1: Smoke opacity – General guidance*

IEC 60695-7-1, *Fire hazard testing – Part 7-1: Toxicity of fire effluents – General guidance*

IEC 60754 (all parts), *Test on gases evolved during combustion of materials from cables*

IEC 60794 (all parts), *Optical fibre cables*

IEC 61034(all parts), *Measurement of smoke density of electric cables burning under defined conditions*

IEC 61156 (all parts), *Multi-core and symmetrical pair / quad cables for digital communications*

ISO/IEC 11801, *Information Technology – Generic cabling for customer premises*

ISO/IEC 13943, *Fire safety – Vocabulary*

ISO 9705, *Full-scale room test for surface products*

EN 13823, *Reaction to fire tests for building products – Building products, excluding floorings, exposed to the thermal attack by a single burning item.*

EN 13501-1, *Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests.*

EN 50265-2-1, *Common test methods for cables under fire conditions – Test for vertical flame propagation for a single insulated wire or cable – Part 2-1: Procedures – 1 kW pre-mixed flame*

EN 50266-2-4, *Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-4: Procedures – Category C*

EN 50267-2-3, *Common test methods for cables under fire conditions – Tests on gases evolved during combustion of materials from cables – Part 2-3: Procedures – Determination of degree of acidity of gases for cables by determination of the weighted average of pH and conductivity*

EN 50289-4-11, *A horizontal integrated fire test method*

CSA FT4, *Canadian Standards Association, CSA 22.2 No. 03-01 “Vertical flame test – Cables in cable trays”*

CSA FT6, *Canadian Standards Association, CSA 22.2 No. 03-01 “Horizontal flame and smoke test”*

NES 713 UK *Ministry of Defence Standard 02-713 (NES 713), “Naval Engineering Standard – Determination of the toxicity index of the products of combustion from small specimens of materials”*

NFPA 262, *Standard method of test for flame travel and smoke of wires and cables for use in air handling spaces. (Formerly UL 910)*

UL 1666, *Underwriters Laboratories, Inc., “Test for flame propagation height of electrical and optical fibre cables installed vertically in shafts”*

UL 1685, *Underwriters Laboratories, Inc., “Standard for vertical tray fire propagation and smoke release test for electrical and optical fibre cables”*

UL VW-1, *Underwriters Laboratories, Inc., “VW-1 (vertical specimen) flame test – UL 1581, Reference standard for electrical wires, cables and flexible cords”*

3 Terms, definitions and abbreviations

For the purpose of this technical report, the definitions in ISO/IEC 13943, together with the following (some of which are based on EN 13501-1) apply.

3.1

BRE

Building Research Establishment

3.2

“Cardington” test rig

real-scale scenario for cables in horizontal hidden voids in buildings, developed by the BRE in the Partners in Technology project [5]¹

3.3

CENELEC

European Committee for Electrotechnical Standardisation

3.4

CFRA

Cable Fire Research Association [11] [16]

3.5

contribution to fire

energy released by a product influencing the fire growth

3.6

CPD

Construction Products Directive [3]

3.7

CSA

Canadian Standards Association

3.8

EN

European Standard

3.9

end use application

real application of a product in relation to all aspects that influence the behaviour of that product under different fire situations

3.10

FEP

Polytetrafluoroethylene, Fluorinated ethylene-propylene or Polytetrafluoroethylene-hexafluoropropylene

3.11

fire growth rate index

FIGRA

maximum quotient of heat release rate from a specimen and the time of its occurrence

¹ Numbers in square brackets refer to the Bibliography.

3.12

FIPEC

Fire Performance of Electric Cables [7]

3.13

fire situation

stage in the development of a fire, characterised by the nature, severity and size of the thermal attack on the products involved

3.14

flaming droplets

material separating from a specimen during a fire test and continuing to flame for a minimum period as described by the test method

3.15

HF

halogen free or Low smoke zero halogen (sometimes known as LSOH)

3.16

HR

Heat Release

3.17

HRR

Heat Release Rate

3.18

ISO

International Standards Organisation

3.19

LC₅₀

concentration or volume fraction of gas or fire effluent statistically calculated from exposure data to produce lethality in 50 % of test animals within a specified exposure and post-exposure time

3.20

LSPVC

Low Smoke Flame Retardant PolyVinylChloride

3.21

NEMA

National Electrical Manufacturers Association [2]

3.22

NES

Naval Engineering Standard

3.23

NFPA[®]

National Fire Protection Association

3.24

NIST

National Institute of Standards and Technology [10]

3.25

OD

Optical Density

3.26

PCS

Gross Calorific Potential

3.27

PE

Polyethylene

3.28

PII

Partners in Innovation [6]

3.29

PIT

Partners in Technology [5]

3.30

PP

Polypropylene

3.31

PVC

Polyvinyl chloride

3.32

PVDF

Polyvinylidene Fluoride

3.33

reaction to fire

response of a product in contributing by its own decomposition to a fire to which it is exposed, under specified conditions

3.34

reference scenario

hazard situation and environment used as a reference for a given test method

3.35

SBI

Single Burning Item test (EN 13823)

3.36

small fire attack

thermal attack produced by a small flame such as a match or lighter

3.37

smoke growth rate index

SMOGRA

the maximum quotient of smoke production rate from a specimen and the time of its occurrence

3.38

smoke hazard

potential for injury and/or damage from smoke

3.39

smoke

visible part of fire effluent

3.40

SP

Smoke Production

3.41

SPR

Smoke Production Rate

3.42

THR

Total Heat Release

3.43

TSP

Total Smoke Production

3.44

UL

Underwriters Laboratories Inc.

4 Typical communication cable installations

In order to define the appropriate fire test methods and performance requirements, it is necessary to consider the fire hazards presented by typical cable installations.

During the last decade, the worldwide demand for more and more information has resulted in increasing transmission data rates, and developments in local area networks (LANs). In particular the growing popularity of structured cabling systems as defined in ISO/IEC 11801 has given rise to new types of installations. The generic structured wiring cabling system is a hierarchical star network linking campus distributors to different building distributors, which in turn link to individual floor distributors which then connect with telecommunication outlets. On each floor, the riser cable, run in vertical shafts, connects to the floor distributor which transmits data via the horizontal cables to each floor outlet. In a typical installation, the floor outlets are arranged in a matrix layout spaced about 1 or 2 metres, with the horizontal cables run in ceiling or under-floor voids. Even in a small office, this leads to a large number of cables run in building voids, particularly near the floor distributor.

The evolution of Structured Wiring has coincided with a rapid increase in system data rates, from 10 kbps in the early 1980's to 600 Mbps in the late 1990's, and on to 1,2 Gbps in the early 2000's. As transmission rates increase, system upgrades to higher performance cables and components are typically necessary. Since old redundant cables are rarely removed before new cables are installed, frequent upgrades result in a large amount of many generations of cables accumulating in building voids.

Copper conductor cables manufactured to the IEC 61156 series and optical cables manufactured to the IEC 60794 series are used in Structured Wiring. These standards detail electrical and optical transmission requirements, mechanical performance and environmental characteristics. Optical cables and communication cables operating at low voltages and currents are not a primary cause of fires, but their widespread use means that they may be involved in outbreaks of fire from an external source. Therefore, fire performance is one of the most important environmental parameters to be specified.

A review of typical installations suggested that communication cable installations in buildings are as shown in Annex B and can be grouped into the following descriptions:

- a) In public buildings such as airports, shops and older commercial offices with solid floors, cables are generally installed in ceiling voids with some local cabling in wall ducts. Regulations generally require segregation of power cables for electrical safety.
- b) In general, in offices and newer commercial offices, cables are generally installed in ceiling and under-floor voids, and wall ducts. Lighting power cables and some communication cables are run in ceiling voids, whilst computer and telephone cables and their associated low voltage power cables are often run in under-floor voids. Again, regulations generally require the segregation of power cables (in conduit or trunking) for electrical safety. In such installations, relatively shallow raised flooring provides the under-floor voids, and forced airflow is generally not used.
- c) In newer large commercial offices with extensive computer facilities, the raised flooring is deep (1,0 to 1,5 m is not uncommon) and the void can be densely packed with communication cables. This void can also be used for the provision of environmental air to computer equipment.
- d) Under-floor and ceiling voids can have particular airflow dynamics that should be reflected in the test method. In general, as airflow rate increases in any given apparatus, fire propagation increases and smoke generation reduces. However research [5] has shown that in hidden voids, combustion proceeds to the same degree whether under forced or natural convection.
- e) A considerable amount of cables can be installed in vertical riser shafts. For convenience, these may be the same cables as are used for horizontal runs.
- f) Patch cords and work area cables, whilst not permanently installed in buildings, often accumulate in large numbers and have been included in the scope of this technical report.
- g) In many installations, there can also be a number of cables that run behind and within walls.
- h) Large buildings are being designed and constructed worldwide by large multi-national businesses, resulting in similar architecture and distribution of utilities within the structure with raised floors and suspended ceilings creating building voids through which fire and smoke can spread. Over 80% of cables installed in new offices are communication cables and that could increase the fuel load in the event of a fire, an aspect not previously addressed by IEC cable and installation standards.
- i) For the purposes of defining the fire hazards and the fire performance to be specified, the typical installations as described above and shown in Annex B, can be categorised as:
 - Horizontal installations in building voids.
 - Vertical installations in riser shafts.
 - General installations.
 - Exposed work areas.
 - Installations where protection of equipment is critical.

5 Legislation and regulation

There are many different regional and local regulations. For example:

- a) In Germany the amount of cable allowed in a public building is based on PCS values of 50 MJ/m² for HF cables and 25 MJ/m² for PVC cables. Guidance on the calculation of PCS is given by the German Insurers [13], but it is not clear why a greater fuel load is allowed for HF cables than for PVC cables. Doubt can also be cast on the stated advantages that HF cables are less flammable and extinguish within a few min when the ignition source is removed (PVC cables do not extinguish) and have less flame propagation because of improved flame resistance.
- b) Building codes in USA have very strong fire performance requirements. Cables installed in buildings are regulated by the National Electrical Code [12]. The fire performance requirements are specified either in code regulations (e.g. NFPA) as well as in specific product standards. Flame propagation and smoke are the main criteria for cables in building voids with air movement.

- c) In the UK, there is very little regulation for the fire performance of cables. In the Building Regulations, the main concerns regarding fire safety are means of escape, fire spread and access facilities for the fire service. On the other hand, the insurance industry (de-facto legislation) recognises new requirements for cables, and the particular hazard of communication cables in building voids [9].

The Loss Prevention Council is a leading authority in the field of loss prevention and control and it publishes a "Design Guide for the Fire Protection of Buildings" [20] to allow architects and building designers to take into account insurers' recommendations for fire protection. The Guide highlights the increasing numbers of cables being used in buildings, and in particular it recommends the use of cables with enhanced fire performance in communication rooms.

- d) In South Africa, there is little or no regulation for the fire performance of cables in dwellings and high-rise buildings. The Wiring Code provides for the segregation of power and communication cables as well as the certification of installations by means of physical examination and electrical testing, by accredited persons. In the Building Regulations, the main concerns regarding fire safety are means of escape, the prevention of fire spread by the use of firewalls, fire fighting equipment and the accessibility of the premises for external fire fighting. In the mining industry, although not regulated, underground power and communication cables generally have a superior fire performance.
- e) In Europe, developments with respect to cables and the Construction Products Directive may have a significant impact on the fire performance requirements for cables.

The Construction Products Directive [3] was published by the European Commission in 1989, and has six essential requirements for building products, namely Mechanical stability, Safety in case of fire, Health and environment, Safety in use, Protection against noise and Energy economy. For safety in case of fire, a harmonised European system for the classification of the fire performance of building products and the corresponding test methods has been developed. This is based on the ISO 9705 real scale reference scenario and the EN 13823 (SBI) intermediate scale reference test.

From time to time, the Construction Products Directive (CPD) has been amended by Commission Decisions which reflect progress in defining and testing the fire performance of products. In a recent Decision [4], test methods and requirements are given for the classification of the reaction to fire performance of all construction products. Products are considered in relation to their end-use application and appeals may be made against the appropriateness of the reference scenario or the reference test method and alternatives may be proposed for one or both. However, any alternative intermediate reference test should be shown to correlate with its real scale reference scenario, and should use the EN 13823 test (modified or not) as the starting point.

In December 1998, it was decided that cables permanently installed in buildings fall within the scope of the CPD. Since then, industry and the European Commission and its Fire Regulators Group have been working to establish whether cables as linear products can be treated as any other building product or whether a special classification system and test methods are necessary.

Once the Fire Regulators Group proposals for the Classification Criteria and Test Methods have been approved, a further Decision will be published and a mandate will be issued to prepare product specifications for the cables involved.

A concern to the cable industry is the reluctance of the Fire Regulators Group to include smoke production as a mandatory requirement.

It should be noted that the CPD is not intended to harmonise Regulation, or to impose Regulation where none exists, but it is intended to harmonise the classification of the reaction to fire of products, and the test methods used.