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Telecommunications equipment and telecommunications cabling – Code of practice for fire performance and protection

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Contents

Summary of pages

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 July 2016. It was prepared by Subcommittee TCT/7/2, *Telecommunications; Installation requirements: Cabling installation and UK implementation*, under the authority of Technical Committee TCT/7, *Telecommunications – Installation requirements*. A list of organizations represented on these committees can be obtained on request to their secretary.

Supersession

This British Standard supersedes BS 8492:2009, which is withdrawn.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Relationship with other publications

The recommendations of this British Standard are intended to support the requirements specified in BS 6701 and the BS EN 50174 series relating to the installation, operation and maintenance of telecommunications equipment and telecommunications cabling.

This document makes reference to the EuroClass requirements which apply to communications and energy cables installed within the scope of Construction Works as described in the Construction Product Regulations. The basis for the EuroClass requirements is EN 50575.

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Introduction

Telecommunications cabling infrastructure includes:

a) telecommunications cabling, comprising cables, cords and connecting hardware intended to support the operation of information technology equipment as, or as part of, a telecommunications system;

b) closures housing connecting hardware;

c) cable management systems housing cables and closures;

d) cabinets, frames or racks within which closures might be installed.

When subject to fire conditions, telecommunications cabling and its associated power supply cabling presents a specific potential hazard because:

1) there are specific areas in which the concentration of cabling is very high [such as equipment rooms and telecommunication rooms (see the generic cabling standards in the BS EN 50173 series)] resulting in increased impact of fire in those areas. This threat is mitigated by the application of fire detection and suppression systems usually installed in these areas (see Clause **5**) and/or the selection of cables appropriate for the installation environment (see Clause **6**);

2) telecommunications cabling is widely distributed throughout buildings within pathways, which create potential routes for flame spread between areas within the buildings. This threat is mitigated by the application of fire detection and suppression systems usually installed in these areas (see Clause **5**) and/or the selection of cables appropriate for the installation environment (see Clause **6**).

The types of pathway within which the cable management systems are installed are, to some extent, influenced by the types of premises and their application.

Fire affects both the health of personnel and the functionality of objects within the vicinity of the fire. The nature of premises dictates the comparative importance of these factors. The recommendations given in Clause **4** of this British Standard are based on an holistic or "balanced" approach to the mitigation of fire hazard in a range of premises. The recommendations address the probability of ignition, the spread and impact of fire following ignition, taking into account:

i. compartmentation;

ii. installation of appropriate fire prevention, detection, suppression systems;

iii. product selection.

Further recommendations relating to component selection are given in Clause **6**, which can be implemented in isolation but only when the nature of the building or its occupancy does not allow for the balanced approach to be followed.

The approach to fire safety in the design, management and use of buildings is defined by regulation and described in a number of documents including BS 9999 and the BS 7974 series. BS 8492 is intended to complement these regulations and standards.

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1 Scope

This British Standard gives recommendations for "reaction to fire" performance and fire protection of all types of telecommunications equipment and telecommunications cabling. It is applicable to:

a) designing and implementing cabling infrastructures;

b) selecting products, including materials and construction;

c) minimizing fire spread;

d) increasing safety levels for personnel and property.

This British Standard does not cover resistance to fire, or circuit integrity, of cables intended for use within emergency circuits.

NOTE It is expected that relevant standards addressing the performance and classification of cables with defined resistance to fire in accordance with the existing decision for cables under the Construction Products Regulation [1] will be addressed at a later date.

This British Standard is intended for use by:

1) those responsible for specifying infrastructure solutions including:
   i. premises owners;
   ii. telecommunications consultants;
   iii. telecommunications cabling installers;

2) fire authorities;

3) those involved in installing fire prevention and protection systems.

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.

BS 476-20, *Fire tests on building materials and structures – Part 20: Method for determination of the fire resistance of elements of construction (general principles)*

BS 5839-1, *Fire detection and fire alarm systems for buildings – Part 1: Code of practice for system design, installation, commissioning and maintenance of systems in non-domestic premises*

BS 6266, *Fire protection for electronic equipment installations – Code of practice*

BS 6701, *Telecommunications equipment and telecommunications cabling – Specification for installation, operation and maintenance*

BS 7671, *Requirements for electrical installations – IET Wiring Regulations*

BS 9251, *Fire sprinkler systems for domestic and residential occupancies – Code of practice*

BS EN 1366-3, *Fire resistance tests for service installations – Part 3: Penetration seals*

BS EN 15004 (all parts), *Fixed firefighting systems – Gas extinguishing systems*

BS EN 16750, *Fixed firefighting systems – Oxygen reduction systems – Design, installation, planning and maintenance*

BS EN 50174 (all parts), *Information technology – Cabling installation*

BS EN 50310, *Telecommunications bonding networks for buildings and other structures*

BS EN 60754-1, *Test on gases evolved during combustion of materials from cables – Determination of the halogen acid gas content*

NOTE 1 This standard supersedes BS EN 50267-2-1.

BS EN 60754-2, *Test on gases evolved during combustion of materials from cables – Part 1: Determination of acidity (by pH measurement) and conductivity*

NOTE 2 This standard supersedes BS EN 50267-2-2.

BS EN 61034-2, *Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements*

BS EN 61386 (all parts), *Conduit systems for cable management*

BS EN 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

BS EN ISO 13943:2010, *Fire safety – Vocabulary*

ISO 6183, *Fire protection equipment – Carbon dioxide extinguishing systems for use on premises – Design and installation*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 6701, BS EN 50174 (all parts), and the following apply.

3.1.1 cable management system

system used for the support and/or containment, retention, protection of all types of cables, information and communication lines, electrical power distribution conductors and their associated accessories (includes ducts and tubes housing, or intended to house, blown information technology cables and/or cable elements)

[SOURCE: BS EN 50174-1:2009]

3.1.2 compartmentation

principle of dividing a space into discrete fire compartments

3.1.3 fire barrier

separating element that exhibits fire integrity or fire stability or thermal insulation, or a combination thereof, for a period of time under specified conditions
[SOURCE: BS EN ISO 13943:2010, **4.99**, modified]

3.1.4 fire compartment

enclosed space, which might be subdivided, separated from adjoining spaces by fire barriers

[SOURCE: BS EN ISO 13943:2010, **4.102**, modified]

3.1.5 fire hazard

physical object or condition with a potential for an undesirable consequence from fire

[SOURCE: BS EN ISO 13943:2010, **4.112**]

3.1.6 flame retardant, adj.
the property of a material to which a substance has been added, or a treatment applied in order to suppress or delay the appearance of a flame and/or to reduce the rate of flame spread

NOTE The use of (a) flame retardant(s) does not necessarily suppress fire or terminate combustion.

[SOURCE: BS ISO 13943:2010, **4.139** modified]

3.1.7 integrity
ability of a separating element, when exposed to fire, on one side, to prevent the passage of flame(s) and hot gases or the occurrence of flames on the unexposed side for a stated period of time in a standard fire resistance test

[SOURCE: BS EN ISO 13943:2010, **4.113** modified]

3.1.8 plenum
space where the primary purpose is the movement (typically forced) of air within which power supply cables, telecommunications cables and building services infrastructures can also be installed

3.1.9 reaction to fire
response of a test specimen when it is exposed to fire under specified conditions in a fire test

NOTE Fire resistance is regarded as a special case and is not normally considered as a reaction to fire property.

[BS EN ISO 13943:2010, **4.272**]

3.1.10 secondary ignition
ignition of an item or items other than the original burning material

3.1.11 telecommunications cabling infrastructure
telecommunications cabling, closures, cable management systems and the cabinets, frames or racks within which closures can be installed

3.1.12 telecommunications space
specified volume associated with one or more termination points of telecommunications cabling

3.2 Abbreviations

For the purposes of this British Standard, the abbreviations given in BS 6701, BS EN 50174 (all parts), and the following apply.

ABS	acrylonitrile butadiene styrene
FR	flame retardant
PC	polycarbonate
PVC	polyvinyl chloride

4 Balanced approach to fire hazard mitigation

*COMMENTARY ON CLAUSE **4***

This clause relates to the management of fire within premises and gives recommendations for the reduction of the risk of fire. It also provides guidance on the mitigation of the effects of fire by:

a) compartmentation;

b) techniques for fire prevention, fire detection and fire suppression;

c) selection of suitable components.

*A single solution within each compartment covering only fire protection (fire detection and suppression systems as described in Clause **5**) or product selection (see Clause **6**) might not be appropriate.*

4.1 Compartmentation within premises

4.1.1 General

Within the premises, compartments should be created that are separated by vertical and horizontal barriers with appropriate levels of "reaction to fire" performance in order to:

a) prevent the spread of fire and its effluent;

b) minimize the extent of loss.

The selection of compartment boundaries should take into account the impact of fire within each compartment.

The "reaction to fire" performance of items within each compartment, in combination with the fire detection and suppression systems of the compartment, should:

1) reflect the risk to property, personnel and business continuity;

2) be selected to satisfy the needs of the premises' owners, landlords, tenants and insurers.

*NOTE Guidance on risk assessment is given in **4.1.2.2**.*

4.1.2 Management of fire hazards and risk assessment

4.1.2.1 Ranking of fire hazards

NOTE 1 In cases where the location and contents of specific fire compartments remove the need to consider fire hazards as described in this subclause, the maintenance of the boundaries of those fire compartments (i.e. integrity) is critical to the fire performance of the premises as a whole.

The fire hazards specific to each fire compartment should be assessed (see BS EN 60695-1-11 for further information) in accordance with the following criteria; which give an indication of the degree of fire hazard mitigation that is necessary in a variety of installations:

a) Prevention of ignition. In all cases, the prevention of ignition is the most important factor, followed by (in order of importance) flame spread, evolution of smoke, evolution of corrosive gases and finally evolution of toxic gases (see 4.3.2).

   NOTE 2 The term "corrosive" is the more general term but for the purposes of this document, and in recognition of the referenced test methods, the term acid (and associated derivatives) is used.

b) Prevention of smoke. Following ignition, in fire compartments where evacuation of personnel is critical, the most important factor is the prevention of the evolution of smoke, followed by prevention of (in order of importance) flame spread, the evolution of toxic gases, and finally the evolution of acid gases (see **4.3.3**).

c) Prevention of corrosion. Following ignition, in fire compartments where protection of equipment is critical, the most important factor is the prevention of the evolution of acid gases, followed by prevention of (in order of importance) flame spread, the evolution of smoke, and finally the evolution of toxic gases (see **4.3.4**).

4.1.2.2 Risk assessment and business continuity analysis

A risk assessment should be carried out for each compartment; which takes account of the following:

a) architectural considerations;

b) the fabric and contents of the compartment and building;

c) the requirements of the owners, landlords, tenants and insurers, including for example:

   1) protection of the building and its personnel;

   2) business continuity;

   3) aesthetics and finish;

   4) electrical and optical performance of the cabling system.

Where appropriate, business continuity analysis should also be applied.

NOTE Recommendations for risk management are given in BS 31100. For guidance on business continuity, see BS 25999.

4.1.3 Telecommunications cabling infrastructure

4.1.3.1 General

When installing telecommunications cabling infrastructure:

a) where telecommunications cables are installed between compartments, appropriate fire-stopping techniques should be applied at compartment boundaries in accordance with **5.1**;

b) in order to minimize transmission degradation, the introduction of joints within a cabling link should be avoided (other than those that might be necessary at, or close to, building entrance facilities where external cables are jointed to those more suitable for internal environments).

NOTE 1 Telecommunications cables may be installed in plenums that provide airflow to one or more compartments.

The selection of a cable within a single compartment should be in accordance with **5.1**.

NOTE 2 However, for cables that pass through several telecommunications spaces, the most economical solution might be to select a cable of lower "reaction to fire" performance consistent with the need to evacuate personnel (see 4.3.3) and either:

1) apply increased levels of fire protection in certain compartments served by that cable; or

2) create additional sub-compartmentation in order to increase the level of fire protection.

4.1.3.2 Cables specified according to their EuroClass

NOTE 1 In the European Union, cables subject to the Construction Products Regulation are classified according to their reaction to fire, as part of the fire classification of construction products and building elements. The classification is given in BS EN 13501-6. There are seven EuroClasses: A_{ca}, $B1_{ca}$, $B2_{ca}$, C_{ca}, D_{ca}, E_{ca} and F_{ca} and certain EuroClasses have additional classifications. An overview of the classification system is given in Table 1.

Table 1 **EuroClass overview**

EuroClass	**Reaction to Fire parameters**	**Additional classifications and parameters**		
		Smoke production	**Flaming droplets**	**Acidity**
A_{ca}	**Gross heat of combustion** [BS EN ISO 1716]	None		
$B1_{ca}$ $B2_{ca}$	**Heat release** [BS EN 50399]	(s1a, s1b, s1, s2, s3) [BS EN 50399/ EN 61034-2]	(d0, d1, d2) [BS EN 50399]	(a1, a2, a3) [BS EN 60754-2]
C_{ca}	**Flame spread** [BS EN 50399 and BS EN 60332-1-2]			
D_{ca}	**Heat release** [BS EN 50399] **Flame spread** [BS EN 60332-1-2]	None		
E_{ca}	**Flame spread** [BS EN 60332-1-2]			
F_{ca}	Does not meet the above requirements			

NOTE 2 British Standards which contain cable requirements for reaction to fire performance will, in due course, be amended to reference the appropriate EuroClasses (see ***6.2.2****). Other local regulations will have to be amended to reference appropriate EuroClasses.*

4.1.3.3 Other telecommunications cables

Other cables outside the scope of the Construction Products Regulation [1] should be treated as "other cabling component and cabling infrastructure material" in accordance with **6.3**.

4.2 Management of fire hazards associated with telecommunications cabling infrastructure

4.2.1 Fire hazards external to the telecommunications cabling infrastructure

In areas beneath pathways containing large volumes of telecommunications cabling:

a) suspended ceiling systems with defined fire performance should be installed and maintained in accordance with manufacturer's/supplier's instructions;

b) penetrations of suspended ceiling systems with defined fire performance should be fitted with fire barriers of equivalent performance.

In areas above pathways containing large volumes of telecommunications cabling:

1) access floor systems with defined fire performance should be installed and maintained in accordance with manufacturer's/supplier's instructions;

2) penetrations of access floor systems with defined fire performance should be fitted with fire barriers of equivalent performance.

Storage facilities for combustible materials should not be located beneath or adjacent to main distribution pathways for telecommunications cabling unless appropriate compartmentation is applied.

Floor and ceiling voids which house pathways containing large volumes of telecommunications cabling should be inspected and cleaned on a regular and monitored basis to prevent the accumulation of combustible material.

4.2.2 Heat sources within the telecommunications cabling infrastructure

4.2.2.1 General

The recommendations given in **4.2.2.2**, **4.2.2.3** and **4.2.2.4** should be followed in order to avoid the common ignition phenomena encountered in electrotechnical products, which include abnormal temperature rises, short-circuits, accidental electric sparks and electric arcs, and high transient peak currents.

NOTE This information on common ignition phenomena is taken from BS EN 60695-1-10.

4.2.2.2 Telecommunications equipment

The telecommunications equipment selected should be able to:

a) prevent ignition caused by an electrically energized component part;

b) confine any fire that does occur within the bounds of the enclosure of the electrotechnical product;

c) minimize flame spread beyond the product's enclosure;

d) minimize harmful effects of fire effluents including heat, smoke, and toxic or acidic combustion products.

The telecommunications equipment should be installed, operated and maintained in accordance with BS 6701.

4.2.2.3 Power supply cabling

The power supply cabling connected to the telecommunications equipment should be installed, operated and maintained in accordance with BS 7671.

4.2.2.4 Telecommunications cabling

The telecommunications cabling should be installed, operated and maintained in accordance with BS 6701.

The services, applications and networks supported by the telecommunications cabling should be restricted to those for which the cabling is specified.

In addition, the following practices should be applied, as a minimum:

a) lightning protection systems should be installed in accordance with BS EN 62305-4;

b) surge protection should be installed in accordance with BS EN 62305-4, the BS EN 50174 series and BS EN 50310;

c) electrostatic charge management should be carried out in accordance with BS EN 50174-1.

4.2.3 Fire load, flame spread and absence of oxygen

4.2.3.1 Fire load

The contribution of the telecommunications cabling infrastructure to the total fire load (see **6.1**) of the premises should be minimized without jeopardizing functional and strategic objectives.

Telecommunications cables and power supply cables for telecommunications equipment that are no longer used should be removed.

4.2.3.2 Flame spread

*NOTE 1 For a given cable, flame spread can be minimized if the telecommunications cables are closely bundled (see **A.2**, Note 2).*

Cables bundled to improve flame spread performance should be held together with materials that maintain the bundle integrity under fire conditions.

However, the effect of such bundling on application support and the potential delivery of power should be taken into account (see BS EN 50173-1 and PD CLC/TR 50174-99-1).

NOTE 2 Fires will not occur or spread if oxygen is not available. The atmosphere in specific compartments may be modified to reduce the probability of ignition and the degree of flame spread. However, the application of such techniques is not generally applicable to telecommunications cabling infrastructures.

4.3 Additional measures based on installation type

4.3.1 General

In addition to the recommendations given in **4.2.2.2**, telecommunications cabling infrastructure installations should conform to **4.3.2**, **4.3.3** or **4.3.4**, as appropriate to the type of installation (see **4.1.2.1**).

4.3.2 General installations

NOTE According to 4.1.2.1, the most important issue for these installations, after the prevention of ignition, is the reduction of flame spread. The reduction of the impact of effluents (smoke, acid gas and toxic gas) is considered to be of lower importance.

To reduce the probability of fire, compartmentation (see **5.1**), detection (see **5.2**) and suppression systems (see **5.3**) should be applied such that the ignitability and flame spread properties of materials do not have to be considered.

To reduce the flame spread between telecommunications spaces within a compartment (e.g. within plenums), one or more of the following approaches should be applied:

a) the use of telecommunications cables that either do not spread flame or that minimize flame spread, in accordance with the appropriate EuroClass (see **6.2**);

b) the use of other cabling component and infrastructure materials that either do not spread flame or minimize flame spread (see **6.3.1**);

c) the use of other materials within an inert atmosphere or encased within non-combustible materials (e.g. steel tubes);

d) the use of mechanical/intumescent means of closing the plenum at the boundary of the compartment in the event of a fire.

Following the implementation of a balanced approach to prevent ignition and to control flame spread, the reduction of effluent production (see **6.2.3** and **A.3.4**) should be considered.

4.3.3 Installations where evacuation of personnel is critical

*NOTE According to **4.2.2.1**, the most important issue for these installations, after the prevention of ignition, is the reduction of smoke. A secondary issue is the reduction of flame spread. The reduction of the impact of the other fire effluent components (acid gas and toxic gas) is considered to be of lower importance.*

To reduce the probability of fire, compartmentation (see **5.1**), detection (see **5.2**) and suppression systems (see **5.3**) should be applied such that the smoke-producing and flame-spread properties of materials do not have to be considered.

To reduce the hazard from smoke between telecommunications spaces within a compartment (e.g. within plenums), one or more of the following approaches should be applied:

a) the use of telecommunications cables that either do not spread flame or that minimize flame spread, in accordance with the appropriate EuroClass (see **6.2**);

b) the use of other cabling component and infrastructure materials that either do not spread flame or minimize flame spread (see **6.2.4**);

c) the use of telecommunications cables that produce low levels of smoke effluent in accordance with the appropriate additional EuroClass (see **6.2.3.1**);

d) the use of other cabling component and infrastructure materials that produce low levels of smoke effluent (see **6.3.4.2**);

e) the use of mechanical/intumescent means of closing the plenum at the boundary of the compartment in the event of a fire.

Following the implementation of a balanced approach to prevent ignition and to control smoke production and flame spread, the reduction of acid gas (see **6.2.3.3** and **A.3.4.3**) and toxic gas (see **A.3.4.2**) should be considered.

4.3.4 Installations where protection of equipment is critical

*NOTE According to **4.1.2.1**, the most important issue for these installations, after the prevention of ignition, is the reduction of acid gas. A secondary issue is the reduction of flame spread. The reduction of the impact of the other fire effluent components (smoke and toxic gas) is considered to be of lower importance.*

To reduce the probability of fire, compartmentation (see **5.1**), detection (see **5.2**) and suppression systems (see **5.3**) should be applied such that the acid-gas-producing and flame-spread properties of materials do not have to be considered.

To reduce the hazard from acid gas between telecommunications spaces within a compartment (e.g. within plenums), one or more of the following approaches should be applied:

a) the use of telecommunications cables that either do not spread flame or that minimize flame spread, in accordance with the appropriate EuroClass (see **6.2**);

b) the use of other cabling component and infrastructure materials that either do not spread flame or minimize flame spread (see **6.3.1**);

c) the use of telecommunications cables that produce low amounts of acid gas when exposed to fire in accordance with the appropriate additional EuroClass (see **6.2.3.3**);

d) the use of other cabling component and infrastructure materials that produce low amounts of acid gas when exposed to fire (see **A.3.4.3**);

e) the use of mechanical/intumescent means of closing the plenum at the boundary of the compartment in the event of a fire.

Following the implementation of a balanced approach to prevent ignition and to control the production of corrosive gas and the spread of flame, the reduction of smoke (see **6.2.3.1** and **A.3.4.1**) and toxic gas (see **A.3.4.2**) should be considered.

5 Fire protection measures

5.1 Compartmentation

5.1.1 Fire barrier integrity

NOTE 1 Additional guidance on fire-stopping of containment systems can be found in BS 7671 (Regulation 527).

All cables and cable management systems passing through compartment boundaries (e.g. walls, floors or ceilings) should be protected by appropriate fire-stopping techniques that reinstate the original fire rating of the boundary.

NOTE 2 Such techniques include fire-stopping materials and/or penetration sealing systems.

Advice regarding the programming, installation sequence and suitability of particular fire-stopping techniques should be sought from both the manufacturer and specialist contractors at the earliest possible opportunity in the construction phase.

A fire-stopping technique should be specified in terms of:

a) the fire rating, construction details and orientation of the fire compartment structure [e.g. plasterboard wall (2 h) or concrete floor (4 h)];

b) the type and size of cable management system to be fire-stopped [e.g. 50 mm × 50 mm polyvinyl chloride (PVC) or steel electrical trunking];

c) where there is no housing surrounding the components passing through the fire barrier, the size of the fire barrier penetration and the percentage fill at the penetration;

d) where there is a housing surrounding the components passing through the fire barrier, the size of the penetration internally and the percentage fill within the housing;

e) a detailed description of the fire-stopping system including any additional supports required for the components passing through the penetration.

The fire-stopping technique applied should be proven to meet the specification criteria using the test methods given in BS EN 1366-3 and BS 476-20. It is noted that a technique based upon interacting components should be regarded as a complete system and should only be used as such.

The telecommunications cabling system specifier should:

1) obtain documentary evidence from the manufacturer/supplier which defines the capability of the fire-stopping technique;

2) verify that the proposed specification is covered within the scope of this document;

3) ensure that the fire-stopping technique is fit for purpose.

5.1.2 Installation of fire-stopping techniques

Fire-stopping techniques should be installed in accordance with the manufacturer's/supplier's installation instructions.

Each fire stop should be clearly labelled or otherwise marked to indicate its function so that it can be identified during future cable installations.

5.2 Detection systems

*COMMENTARY ON **5.2***

There are many active measures that can be implemented to warn occupants and building management about the existence of a fire and to change or modify the normal progress of a fire so that safety and loss reduction criteria can be satisfied.

The detection system should detect fire at the earliest practicable moment and generate signals and indications in the form of an alarm so that appropriate action can be taken in order to preserve life and minimize loss.

Fire detection and alarm systems should be designed, installed and maintained in accordance with BS 5839-1.

NOTE 1 Fire detection and fire alarm functions may be combined in a single system.

Automatic fire detection and indication in dedicated electronic equipment areas should conform to BS 6266.

NOTE 2 A fire detection and alarm system may be linked to remote fault and fire alarm monitoring stations and to fire protection systems (e.g. compartmentalization, smoke control and fixed fire-fighting systems) which are designed to contain or extinguish the fire without further intervention.

5.3 Suppression systems

5.3.1 General

A fixed fire extinguishing system should be provided if it is deemed necessary in the outcome of the risk assessment in **4.1.2.2**.

If a fixed fire extinguishing system is to be installed to extinguish an incipient fire in any part of the protected compartment and/or to prevent a fire from spreading outside the protected compartment then the system should be:

a) designed to minimize hazards to personnel;

b) designed to minimize hazards to equipment.

5.3.2 Fire extinguishing systems using gaseous agents

Gaseous systems should be designed, installed and maintained in accordance with the BS EN 15004 series (for gases other than carbon dioxide) or ISO 6183 (for carbon dioxide systems).

However, carbon dioxide, which is lethal at normal extinguishing concentrations, should only be used in spaces within which appropriate procedures are in place to protect personnel.

5.3.3 Oxygen reduction systems

NOTE Oxygen reduction fire prevention systems maintain the oxygen at a reduced concentration to inhibit ignition or spread of fire.

Oxygen reduction fire prevention systems should be designed, installed and maintained in accordance with BS EN 16750.

5.3.4 Water-based fire suppression systems

NOTE The main purpose of water-based fire suppression systems is the protection of the building and spaces.

For the protection of electrical equipment, the risks of equipment damage associated with water-based systems should be considered.

There are two water-based technologies:

a) sprinklers - which should be designed, installed and maintained in accordance with BS EN 12845;

b) water mist - which should be designed, installed and maintained in accordance with BS 9251 and/or BS EN 1284 as applicable.

5.3.5 Other fixed fire extinguishing technologies

Condensed aerosol or foam discharge systems should not be used in occupied spaces or in spaces containing electronic equipment and are not considered appropriate for protected compartments covered by this British Standard.

6 Fire hazard mitigation by product selection

6.1 General

The levels of resistance to ignition, flame spread, heat release and fire effluent production that result from cables should be in accordance with **6.2**.

The reaction to fire of materials selected for other cabling components and infrastructures should be in accordance with **6.3**.

6.2 Cables

6.2.1 Examples of EuroClass and additional classifications

NOTE 1 Table 1 provides an overview to the EuroClass designation of cables.

As indicated in **4.1.3** cables should be specified as having a primary "reaction to fire" performance of EuroClass:

- A_{ca};
- $B1_{ca}$, with possible additional classifications -s, -d and -a;
- $B2_{ca}$, with possible additional classifications -s, -d and -a;
- C_{ca}, with possible additional classifications -s, -d and -a;
- D_{ca}, with possible additional classifications -s, -d and -a;
- E_{ca};
- F_{ca}.

NOTE 2 A typical designation of a cable not subject to the additional classifications would be

"E_{ca}".

NOTE 3 The additional classifications are described in 6.2.3.

NOTE 4 A typical designation of a cable subject to the additional classifications would be

"$B2_{ca}$-s1a-d0-a1"

6.2.2 Relationships with existing standards

NOTE 1 BS EN 50174 series standards require that unmitigated installations within a building adopt the use of EuroClass E_{ca} as a minimum. For EuroClasses $B1_{ca}$, $B2_{ca}$, C_{ca} and D_{ca}, flame spread, heat release and the additional classifications (smoke, flaming droplets and acidity) should be in accordance with the requirements given in Table 1.

NOTE 2 Existing standards and specifications for cables or cabling might refer to one or more of these classifications, but are most likely to refer to BS EN 60332-3-24 (or BS EN 60332-3-25) and BS EN 61034-2 and/or BS EN 60754-1 which do not have direct equivalence with the reaction to fire requirements of EuroClasses D_{ca}, C_{ca}, $B2_{ca}$ or $B1_{ca}$.

NOTE 3 EuroClass C_{ca} has the closest correspondence to the bunched cable tests of BS EN 60332-3-24 (or -25).

NOTE 4 The requirement for 60% light transmittance in escape routes within BS 7671 is equivalent to s1b.

Pending the revision of the existing cable or cabling standards to include the EuroClass requirements or recommendations, or in the absence of such standards, customer's specification of cables should define the EuroClass required; taking account of the following:

a) the fact that the additional classifications (see **6.2.3**) can be used with EuroClass D_{ca}, C_{ca}, $B2_{ca}$ or $B1_{ca}$;

b) EuroClass D_{ca} has heat release requirements and is required to meet only BS EN 60332-1-2 for flame spread;

c) there is a legally recognized progressive improvement in flame spread and heat release characteristics going from D_{ca} to $B1_{ca}$.

NOTE 5 Cables of EuroClass A_{ca} are unlikely to be available for the applications within the scope of this British Standard.

6.2.3 Additional classifications

6.2.3.1 Production of smoke

Products classified $B1_{ca}$, $B2_{ca}$, C_{ca}, D_{ca} obtain an additional classification of s1, s1a, s1b, s2 or s3 relating to the production of smoke.

- s1, s2 and s3 are based on performance in the BS EN 50399 vertical ladder test.
- s1 is the most demanding classification and corresponds to a total smoke production at 1200 s of ≤ 50 m^2 together with a peak smoke production rate of ≤ 0.25 m^2/s.
- s2 corresponds to a total smoke production at 1200 s of ≤ 400 m^2 together with a peak smoke production rate of ≤ 1.5 m^2/s.
- s3 corresponds to no declared performance or to non-compliance with either s1 or s2.
- s1a and s1b both require compliance with s1, but in addition require performance levels measured in the BS EN 61034-2 smoke chamber test.

Of the two, s1a is the more demanding classification; it requires a light transmission level of ≥ 80% in the BS EN 61034-2 test. s1b requires a light transmission level of ≥ 60% and < 80% in the BS EN 61034-2 test.

NOTE In terms of the amounts of smoke produced per metre of tested cable, s1a is about half that of s1b. s1 is eight times lower than s2. s1b is numerically similar to s1. However, the fire models in the two test methods are quite different so no direct comparisons of actual fire performance can be made. s1a can be considered to be the most demanding classification, as the lower smoke requirements in two different test methods apply.

6.2.3.2 Production of flaming droplets

Products classified $B1_{ca}$, $B2_{ca}$, C_{ca}, D_{ca} obtain an additional classification of d0, d1 or d2 relating to the production of flaming droplets where:

- d0 is the most demanding criterion;
- d1 is a less demanding criterion;
- d2 applies to products for which no performance is declared or which do not conform to the d0 and d1 criteria.

6.2.3.3 Acid gas evolution

Products classified $B1_{ca}$, $B2_{ca}$, C_{ca}, D_{ca} obtain an additional classification of a1, a2 or a3 relating to the production of acid gas effluent where:

- a1 is the most demanding criterion;
- a2 is a less demanding criterion;
- a3 applies to products for which no performance is declared or which do not conform to the a1 and a2 criteria.

6.3 Other cabling component and cabling infrastructure material

*COMMENTARY ON **6.3***

When selecting materials, it is important to note that, for a given combustible material, a larger mass can result in a larger and more intense fire, greater heat release and, increased amounts of fire effluent.

For a given material, if the heat of combustion is known, the fire load is equal to the mass of that material multiplied by its heat of combustion.

For a fire scenario in which there are many different materials, each individual fire load is calculated and then they are summed to give the total fire load.

There is no British or European standard which addresses the "reaction to fire" performance of connecting hardware or closures. Products meeting such requirements may be designed to meet National standards such as UL 1863 "Communications, Audio/Video, Data and Other Signalling-circuit Accessories"

*Specific recommendations for product selection are included in **6.3.5**.*

6.3.1 Ignition and flame spread

6.3.1.1 General

NOTE 1 Guidance on ignitability is given in DD IEC/TS 60695-1-20.
PD IEC/TR 60695-1-21 is a summary of ignitability test methods including comments on their relevance.

NOTE 2 Guidance on flame spread is given in BS EN 60695-9-1. BS EN 60695-9-2 is a summary of surface spread of flame test methods including comments on their relevance.

In the absence of other measures to limit the probability of ignition and restrict flame spread, the selection of materials for the telecommunications cabling infrastructure and cable management systems should follow the recommendations of **6.3.1.3** and **6.3.1.4** as appropriate.

6.3.1.2 Thermoplastic materials

Many of the materials used in telecommunications cabling infrastructure are thermoplastic. Some thermoplastic materials can produce molten flaming drips when ignited which then act as secondary ignition sources, thus spreading the fire. Such materials should be avoided.

6.3.1.3 Materials with very high resistance to ignition and no flame spread

Where the outcome of the risk assessment of **4.1.2.1** leads to a requirement for very high resistance to ignition and no flame spread, the materials comprising the telecommunications cabling infrastructure and cable management systems should be non-combustible, i.e. steel cable tray, basket or trunking.

6.3.1.4 Materials with high resistance to ignition and very low flame spread

Where the outcome of the risk assessment of **4.1.2.1** leads to a requirement for high resistance to ignition and very low flame spread, the materials comprising the telecommunications cabling infrastructure and cable management systems should preferably be selected from intrinsically flame retardant (FR) materials such as those made with fluoropolymers or unplasticized PVC (also known as uPVC).

Where halogen content is deemed unacceptable, other FR materials should be selected, e.g. closures and connecting hardware made from FR PC or FR PC/ABS.

6.3.1.5 Materials with low resistance to ignition and high flame spread

Where the outcome of the risk assessment of **4.2.2.2** leads to an allowance for low resistance to ignition and high flame spread, the materials comprising the telecommunications cabling infrastructure and cable management systems may be selected from materials which are not inherently FR or which contain no FR additives.

6.3.2 Heat release

6.3.2.1 General

NOTE Guidance on heat release is given in BS EN 60695-8-1. PD IEC/TS 60695-8-2 is a summary of heat release test methods including comments on their relevance.

In the absence of other measures to restrict heat release, the selection of materials for telecommunications cables and cable management systems should follow the recommendations of **6.3.3.2**, **6.3.3.3** and **6.3.3.4**, as appropriate.

6.3.2.2 Materials with very low heat release

Where the outcome of the risk assessment of **4.1.2.1** leads to a requirement for very low heat release, the materials comprising the telecommunications cabling infrastructure and cable management systems should be either;

a) non-combustible, i.e. steel cable tray, basket or trunking; or

b) have a low heat of combustion and high resistance to ignition.

6.3.2.3 Materials with high heat release

Where the outcome of the risk assessment of **4.1.2.1** leads to a the allowance of high heat release the materials comprising the telecommunications cabling infrastructure and cable management systems may be selected from materials which are not inherently FR or which contain no FR additives.

6.3.3 Fire effluent

6.3.3.1 General

NOTE 1 Halogenated FR materials were introduced to increase ignition resistance, to reduce flame spread and to provide self-extinguishing properties. When such products are the ignition source, this technology has been very effective in suppressing ignition and limiting subsequent fire development. However, when these products are subject to a fire that has started from another ignition source, and the halogenated materials are forced to burn, smoke production, acid gas production and carbon monoxide production all tend to be increased.

As the chemical composition of the combustible material influences the composition of the fire effluent, the following should be taken into account: if the combustible material contains nitrogen (e.g. polyamides and polyurethanes), then hydrogen cyanide, oxides of nitrogen and acrylamides might be produced; if the combustible material contains sulfur (e.g. polysulfones), then sulfur dioxide and sulfurous or sulfuric acid might be produced; if the combustible material contains chlorine or bromine (e.g. PVC or polymers containing halogenated fire retardants), then halogen acids might be produced.

NOTE 2 Fire effluent can comprise smoke, corrosive gases and toxic gases.

NOTE 3 Guidance on smoke obscuration is given in BS EN 60695-6-1. BS EN 60695-6-2 is a summary of smoke obscuration test methods including comments on their relevance.

NOTE 4 Guidance on the corrosion damage effects of fire effluent is given in BS EN 60695-5-1. IEC/TS 60695-5-2 is a summary of test methods for the corrosion damage effects of fire effluent, including comments on their relevance.

NOTE 5 Guidance on the toxicity of fire effluent is given in BS EN 60695-7-1. BS EN 60695-7-2 is a summary of toxicity test methods including comments on their relevance. BS EN 60695-7-3 describes the use and interpretation of toxicity test results.

6.3.3.2 Material selection with regard to production of smoke

6.3.3.2.1 General

The effective mitigation of smoke production should be accomplished by limiting the probability of ignition and restricting flame spread, thus limiting the level of exposure to fire effluent.

Where product selection alone is used to restrict the amount of effluent, the materials for telecommunications cabling infrastructure and cable management systems should follow the recommendations of **6.3.3.2.2** and **6.3.3.2.3** as appropriate.

NOTE The amount of smoke that is produced in a fire depends not only on the propensity of a product to produce smoke (as measured in a standard test), but also on how much of the product is burning and on the fire conditions, which might differ from the conditions used in the fire test. The reduction in visibility caused by smoke also depends on the volume into which the smoke is being dispersed.

6.3.3.2.2 Materials with very low smoke production

Where the outcome of the risk assessment of **4.1.2.1** leads to a requirement for very low smoke production, the materials comprising the telecommunications cabling infrastructure and cable management systems should be non-combustible, i.e. steel cable tray, basket or trunking.

6.3.3.2.3 Materials with low smoke production

Where the outcome of the risk assessment of **4.1.2.1** leads to a requirement for low smoke production, the materials comprising the telecommunications cabling infrastructure and cable management systems should be those that not only have a good resistance to ignition and flame spread, but which also have been formulated to produce low levels of smoke in relevant fire tests.

NOTE It is important to be aware that "low smoke" products do not necessarily have a good resistance to ignition or flame spread.

6.3.3.2.4 Materials with high smoke production

Where the outcome of the risk assessment of **4.2.2.2** leads to the allowance of high smoke production, the materials comprising the telecommunications cabling infrastructure and cable management systems may be selected from materials which are not inherently FR or which contain no FR additives (see **6.3.2.5**).

6.3.3.3 Material selection with regard to production of acid gas

The effective mitigation of acid gas production should be accomplished by limiting the probability of ignition and restricting flame spread, thus limiting the level of exposure to fire effluent.

Where product selection alone is used to restrict of the amount of effluent, the materials for telecommunications cabling infrastructure and cable management systems should follow the recommendations of **6.3.3** as appropriate.

NOTE There is no evidence that fire effluent from electrotechnical products offers a greater probability of corrosion damage than the fire effluent from other products such as furnishings or building materials. Indeed telecommunications equipment could be at risk due to the corrosive effluent from those other products. Selection of materials that contain very low levels of halogenated material restricts/avoids the production of halogen acid gases. Halogenated FR materials produce halogen acid effluents when forced to burn. The absence of halogen does not mean that corrosive effluent will not be produced. Guidance is given in BS EN 60695-5-1.

6.3.3.4 Material selection with regard to production of toxic gas

The effective mitigation of toxic gas production should be accomplished by limiting the probability of ignition and restricting flame spread, thus limiting the level of exposure to fire effluent.

Where product selection alone is used to restrict of the amount of effluent, the materials for telecommunications cabling infrastructure and cable management systems should follow the recommendations of **6.3.3** as appropriate.

NOTE There is no evidence that fire effluent from electrotechnical products offers a greater toxic hazard than the fire effluent from other products such as furnishings or building materials. All fire effluent is toxic and one of the most significant toxic components of fire effluent is carbon monoxide. The toxic significance of carbon monoxide is enhanced by the impact of other effluents, such as irritant gases, which could incapacitate personnel leading to increased carbon monoxide inhalation.

6.3.4 Implementation

It should be noted that cable management products and systems are not subject to the EuroClass system for the purposes of product selection whereas the cables they contain are classified according to BS EN 13501-6 (see **6.2).** As a result, the "reaction to fire" performance of cable management products should take into consideration the "reaction to fire" performance of the cables they contain.

It should be noted that certain standards contain requirements for cable management systems and other pathway systems in relation to fire events which extend beyond the reaction to fire parameters.

BS EN 50174-2 and BS 7671 requires the use of the following cable management systems:

- conduit systems in accordance with the BS EN 61386 series;
- cable trunking systems and cable ducting systems in accordance with BS EN 50085;
- cable tray and cable ladder systems in accordance with BS EN 61537.

NOTE 1 The term "non-flame propagating" is used for these products if they meet similar requirements to that of the minimum recommended requirements for flame spread of BS EN 60332-1-2 but when subjected, generally, to a test of shorter duration This suggests that these non-flame propagating materials are approximately equivalent with the flame spread concept of EuroClass E_{ca} *for cables.*

Cable management systems should be specified with flame spread characteristics equal to or better than the cables they contain.

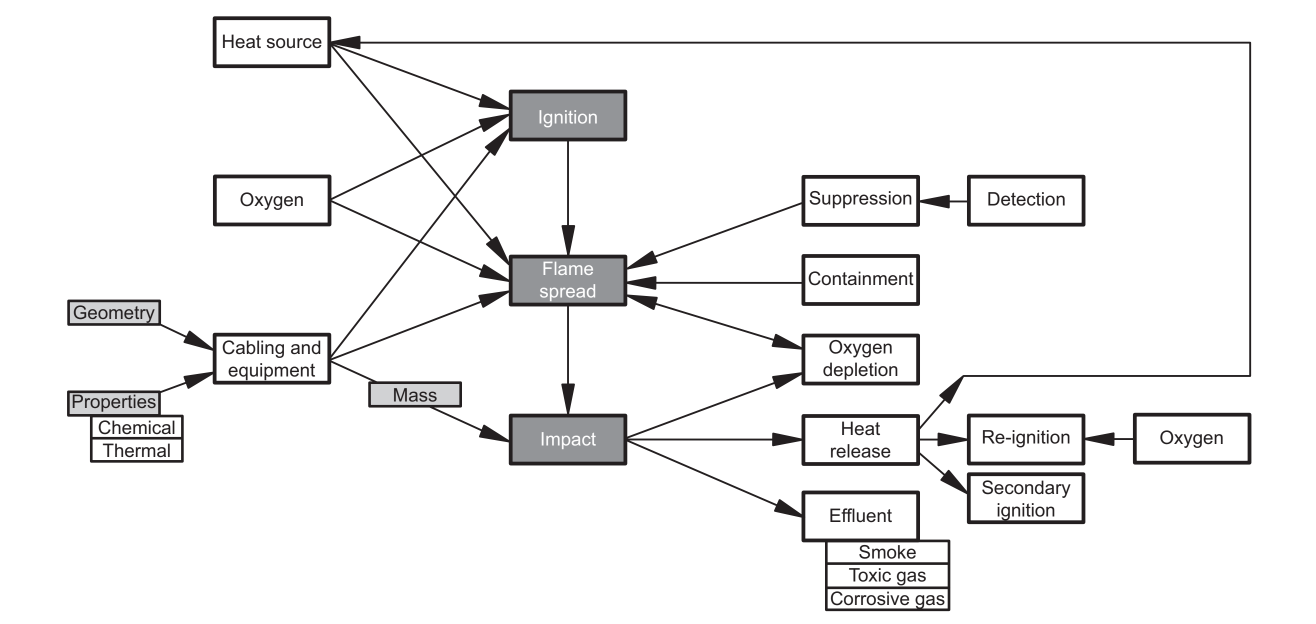
NOTE 2 For the purpose of this recommendation, blown fibre tubes are considered to act as conduit (they are treated as cable management systems in BS EN 50174-2).

Annex A (informative) Consideration of fire hazard

A.1 General

Figure A.1 illustrates the relationship between the processes involved in the ignition, flame spread and impact of fire and demonstrates the need to consider all the aspects in a holistic manner.

Figure A.1 **Relationship of the processes involved in the ignition, flame spread and impact of fire**



A.2 Ignition and flame spread

A fire can only start if materials ignite. The conditions for ignition depend upon the presence of a heat source, adequate oxygen levels and the geometry, chemical and thermal properties of the material.

NOTE 1 With some exceptions, solids do not generally ignite. Normally it is combustible vapour that ignites. The combustible vapour is produced by pyrolysis of the solid, and the vaporization process is dependent on the temperature and chemical composition of the solid. The rate at which the surface temperature of a material increases when exposed to a heat source is a function of a number of properties of that material, in particular: thermal conductivity, density and specific heat.

NOTE 2 In a thick test specimen, material below the surface is able to conduct heat away, thus reducing the rate of surface heating and increasing the resistance to ignition. In a thin specimen, this cannot happen and so resistance to ignition is lower. In general, therefore, a single exposed cable is easier to ignite than a closely packed bundle of such cables.

Once ignited, flame spread occurs provided that combustible material, heat and oxygen are available. The heat source might be created by the burning material (producing a self-sustaining fire) or might be an external heat source. In addition, external influences might restrict flame spread. These include suppression systems activated following the detection of the fire, compartmentation practices that physically prevent flame spread and the depletion of oxygen within the immediate area caused by the fire itself.

A.3 The impact of fire

A.3.1 General

The impact of a fire includes:

a) heat release;

b) the production of fire effluent in the form of smoke, toxic gases and acid gases;

c) depletion of oxygen.

The relative importance and the scale of each of the impacts depends upon the mass of the burning material together with its geometry and its chemical and thermal properties.

Heat release acts as a heat source for the growth of the original fire and can result in:

1) secondary ignition;

2) re-ignition: this can occur when a new source of oxygen is introduced to a material in which flame spread has been suppressed owing to depletion of local oxygen.

A.3.2 Heat release

One of the most important measurements in fire testing is the measurement of heat release, and it is used as an important factor in fire hazard assessments and in fire safety engineering calculations. Heat release data, together with other fire test data, can be used to reduce the likelihood of (or the effects of) fire, even in the event of foreseeable abnormal use, malfunction or failure of electrotechnical products.

When a material is heated by an external source, fire effluent can be generated and form a mixture with air, which can ignite and initiate a fire. The heat released in the process is carried away by the fire effluent–air mixture, radioactively lost or transferred back to the solid material, to generate further pyrolysis products, thus continuing the process.

Heat can also be transferred to other nearby products, which could burn and then release additional heat and fire effluent.

Heat release is a useful parameter because it can be used to quantify the size of a fire. The heat release rate is significant because it:

a) can be used to quantify the intensity of a fire;

b) influences flame spread;

c) influences the initiation of secondary fires;

d) is recognized as being the primary variable that determines the fire hazards from materials and products (additional information is given in the SFPE *Handbook of Fire Protection Engineering* [2]).

For a given combustible material and a given stage of fire, the rate of effluent production is dependent on the rate of heat release; therefore, if heat release can be reduced, effluent production can also be reduced.

Many factors influence the amount and rate of heat release. Some of the most important are the resistance to ignition of the material, its heat of combustion, the mass of material involved, and the nature of the ventilation.

A.3.3 Oxygen depletion, re-ignition and secondary ignition

If the ventilation of the fire is restricted, the oxygen concentration falls as heat is released and eventually the fire dies down because of lack of oxygen. Low levels of oxygen also act as an asphyxiant, but this need not be considered as a threat to life unless the volume fraction falls below 13% (see ISO 13571). If the ventilation is then increased, e.g. by opening a door or through the breaking of a window, re-ignition occurs resulting in rapid flaming combustion. This is known as “backdraft”, which in some cases might be explosive.

Excessive radiant heat from the source of the fire can ignite material at some distance from the source, i.e. secondary ignition. This is a significant cause of fire propagation.

A.3.4 Fire effluent

A.3.4.1 Smoke

The presence of smoke can provide an indication that ignition has taken place. Many detection systems rely on the presence of smoke, which generally travels faster than the flame spread.

Smoke reduces visibility for people attempting to leave the premises and for fire-fighters entering the premises. In addition, smoke moving within cable management systems and particularly within forced ventilation systems can provide false indications of the location of the fire.

Therefore, smoke generation during fires is a hazard to personnel and can increase the extent of damage to building fabric and contents.

A.3.4.2 Toxic gas

Carbon monoxide is one of the most significant agents contributing to toxic hazard. Other agents of major significance are hydrogen cyanide, carbon dioxide and irritants.

NOTE Common irritants include acrolein, formaldehyde, hydrogen bromide, hydrogen chloride, hydrogen fluoride, nitrogen dioxide and sulfur dioxide (see BS EN 60695-7-1).

A.3.4.3 Acid gas

All fire effluent is corrosive to some degree and the level of potential to corrode depends on the:

a) nature of the fire;

b) combination of combustible materials involved in the fire;

c) nature of the substrate under attack;

d) temperature and relative humidity of the environment.

The performance of electrical and electronic components can be adversely affected by corrosion damage when subjected to fire effluent. A wide variety of combinations of small quantities of effluent gases, smoke particles, moisture and temperature might provide conditions for electrical component or system failures from breakage, overheating or shorting.

Evaluation of potential corrosion damage is particularly important for high value and safety-related electrotechnical products and installations.

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Further reading

New Approach Notified and Designated Organisation: List of Notified Bodies: http://ec.europa.eu/enterprise/newapproach/nando/

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