

Date: 20.09.99

TIN: 09

CABLING AND THE FIRE PERFORMANCE OF DATA CABLES

Introduction

In this Technical Information Notice (TIN), TIA SIG/2 provides a balanced view to the industry on the fire performance of data cabling (copper and fibre).

The TIN clarifies: -

- C the cable sheath materials in common use
- C the relevant fire performance standards available
- C the considerations that need to be made before choosing which cable type to install

Cable Types

The most common sheath material for data cabling in use in the UK is PVC. For many environments, PVC is the ideal material, having superior mechanical characteristics and high reliability. However, in a fire, PVC emits heavy black smoke mixed with hydrochloric acid, thus reducing vision, immediately impairing breathing, and additionally initiating corrosion of all equipment exposed to the fumes.

For improved fire performance, it is common for LSZH Low Smoke Zero Halogen (usually meeting IEC61034, IEC60754-2 and IEC60332-3) cable sheaths to be used within Europe. In the US, Riser grade (meeting UL1666) and Plenum grade cable sheaths (meeting UL910) are required to be used in risers and plenums respectively. These cable types have been approved by testing to the quoted fire performance standards.

In the US, the main focus is on fire propagation and smoke emission due to the widespread practice of installing cables in enclosed areas (plenums) where there is also the movement of air. In Europe, installation environments are somewhat different and it is recognised that there are a number of other fire properties of cables that may be important (such as smoke emission, flame spread, corrosive and toxic gas emission). All these factors should be considered in the context of the user's risk assessment and the installation environment.

IMPORTANT NOTICE

Whilst the Telecommunications Industry Association (TIA) use every effort to ensure that the information in its Technical Information Notices (TINs) is accurate, the Association will not be held responsible in any way whatsoever for errors, omissions or misrepresentations.

TIA TINs are available free of charge to TIA Members. The Association reserves the right to charge a fee to Non-Members. TINs are the copyright of the TIA as of the date of issue.

Fire Performance Standards

The major Standards in common use are shown in the table.

Test	International Standard (Note 1)	Other Standards (Note 1)
Tests for evolution of acidic and corrosive gas	IEC60754 Part 1 - halogen acid gas Part 2 - total acid gases	EN50267
Tests for smoke opacity	IEC 61034 IEC60695-6	BS7622 (possibly the same content) NES 711 Smoke Index
Tests for toxicity	None known	
Tests for flame propagation	IEC 60332 (Note 2) Part 1 - single vertical cable Part 3 - bunched cable	EN50265 EN50266 US Standards: - UL1581 - General - UL1666 - Riser - UL910 - Plenum (Note 3)
Tests for fire resistance	IEC60331	

NOTES:

1. *It is recognised that the widespread use of communications cables in building is not fully supported by these standards which have been in existence for many years. Revisions to these standards are under development to more accurately meet the needs of the computer age. European fire performance standards are also under development to support the coming Construction Products Directive.*

2. *Cables meeting IEC60332-3 have better fire performance characteristics than those meeting IEC60332-1: They use either a thicker cable sheath or a more expensive sheath material and therefore the cable is more costly. Plenum cable uses a fluoropolymer sheath and is even more costly.*

The way IEC60332 specifies the test does not reflect current typical industry installation practices. Therefore, in a real fire situation, the outcome and results from the actual fire would differ from those in the test. FIPEC are looking at how to modify the IEC60332 tests to reflect current practices and intend to publish their findings in 1999.

3. *In extensive full-scale fire tests held at the Building Research Establishment to compare both standard grade PVC, cable contained in metal conduit, LSZH and Plenum cables in a typical current UK installation, it was concluded that:*

- C Plenum cables have a significantly lower propensity for ignition, flame spread, heat release and smoke opacity than for LSZH cables. The fire performance of plenum cables was comparable to standard PVC cables in metallic trunking*
- C The performance of IEC60332-3 was superior to IEC60332-1*
- C Cables enclosed in metallic trunking are not protected from the fire. The effects of smoke spread and the limit of fire spread are limited by the enclosure of cables within trunking or conduit systems*
- C Cables often represent a small percentage of the potential fire fuel in any one place, so assessment of fire hazard needs to be comprehensively addressed. Furniture is generally more significant.*

Choosing which Cable Type to Install

The following table attempts to classify some of the considerations. Following a risk assessment of the building, the cable installation environment should be identified and the cable sheath type chosen. The guidance notes in the table may be used to help with the specification of a suitable cable.

Classification	Fire Performance	Typical Tests	Guidance Notes
A	General Flammability Resistance	IEC 60332-1	This cable provides a level of flammability resistance for general purpose applications
B	Reduced Flame Spread	IEC 60332-1 & IEC 60332-3	This cable provides reduced flame spread from bunched cables, as required in cable risers
C	Low Smoke & Fume	IEC 60332-1 & IEC 60754-1 & IEC 60754-2 & IEC 61034	This cable provides low emission of smoke and corrosive fumes
D	Reduced Fire Hazard	IEC 60332-1 & IEC 60332-3 & IEC 60754-1 & IEC 61034	This cable provides reduced flame spread from bunched cables with low smoke and acid gas emission.
E	Limited Fire Hazard	IEC 60332-1 & IEC 60332-3 & IEC 60754-1 & IEC 60754-2 & IEC 61034 & Toxicity (?)	This cable provides an overall limited fire hazard performance and combines reduced flame spread with low emission of smoke and noxious fumes
F	Fire Resistant	IEC 60331	This cable is designed for wiring and interconnection where it is required to maintain circuit integrity under fire conditions for long periods

NOTE: These classifications are not the CPD European Classifications to Fire Resistance.

Guidance is also available from the building insurers and other bodies. The Loss Prevention Council (LPC) Building Design Guide adopts a basic strategy that any material, including data cables, used in a building should not make a significant contribution to a fire. Any combustible material must therefore either be specified to meet this objective or protected by a fire-resisting barrier.

The LPC 1999 guide further recognises that communication rooms represent a high fire risk and recommends that either:

- a) the cavity is protected by an automatic gaseous (connected to a fire detector and alarm system) or sprinkler system; or
- b) Cables used should have been tested and approved to UL910 or other specification acceptable to the LPC; and
- c) The platform floor should have a fire resistance of 15 minutes integrity and insulation when exposed to the heating conditions of BS 476:Part 20.

Conclusions

1. When specifying cabling for installation in a building it is important to assess the fire risk for the environment and choose the appropriate materials for the job.
2. The fire performance can be assessed according to a number of International standards. The guidance on how to apply these standards to data cables offered here should be considered when choosing a cable type.
3. Other measures for protecting the building, such as the maintenance of fire barriers, installation of sprinkler systems in high risk areas etc should also be considered.

GLOSSARY/NOTEBOOK

(These notes relate specifically to 'fire' characteristics)

Acid gas

Corrosive effluent causing narcosis and tissue damage.

Afterburn

The time that burning continues after removal of the ignition source.

Ash

Residue after complete combustion.

Burning

Combustion

Calorific value

Heat produced when a substance burns (usually under specific conditions).

Carbon monoxide

CO. A toxic, invisible, odourless gas given off by all burning plastics. It rapidly reduces muscle effectiveness, leading to collapse and suffocation.

Char

Carbonaceous residue from pyrolysis or combustion.

Combustion

Exothermic reaction of a substance with an oxidiser, generally producing flames and effluent.

Fire barrier

A separator to resist the passage of flame/heat/effluents.

Fire effluent

Everything emitted from a fire.

Fire Hazard

In specification terms, the combination of flammability, smoke emission, and toxicity. Hence 'Low Fire Hazard' should indicate low levels in all of these, and an increased likelihood of escape from the fire situation. 'Reduced fire hazard' indicates improvements without implying high levels of fire protection.

Fire load

The quantity of heat released by complete combustion of something.

Flame retardant

FR. An added substance to suppress or delay burning. Brominated FRs are often added to polyolefins, eg polythene, to reduce the tendency to burn. Sadly, this increases toxicity. Aluminium trihydrates are halogen-free FR additives.

Flameproof

A deprecated term. Items formerly stated as 'flameproof' suggest they do not burn under any conditions, which is very misleading.

Flammability

The degree to which something burns with a flame. Flammability of a material can often be reduced by addition of retardants.

Flammable

Able to be ignited and burn. NB the term 'inflammable' is confusing and is no longer advised.

Flashover

The point at which a 'young' fire in an enclosed space suddenly becomes an inferno, due to the ignition of all items not yet burning. Caused by trapped heat increasing the temperature of all 'fuel'.

Fumes

Gases given off in fire, as distinct from smoke. They are often invisible. They can include toxic gases and acid gases

Halogens

The elements chlorine, bromine and fluorine. Plastics containing these have a natural resistance to burning, eg PVC, PCP, PTFE. Carbon tetrachloride is an effective fire extinguishant, now phased out. (Iodine is a halogen but not used for fire retardance).

Halogen-free

Anything containing no halogens. This is regarded as good (in one sense) since halogen-containing effluents are very toxic.

IEC

International Electrotechnical Commission, the standards body.

Ignitability

The ease with which something can be ignited. See Temperature Index.

Inflammable

Deprecated term. See 'flammable'.

LC 50

(Lethal concentration). The gas concentration which kills 50% of test animals.

LFH

See Fire Hazard.

L.O.I.

See Oxygen Index.

'Low Smoke'

Emitting smoke of lower density, thus aiding escape from the fire.

LSF

'Low smoke and fume'. A cable descriptor indicating some degree of fire hazard reduction. It is advisable to request specific cable test performance for such products.

LSOH or LSZH

'Low Smoke, Zero Halogen' addresses two of the fire hazards. These terms apply to many products, so do not assume they all behave the same way.

M.I.C.

Mineral insulated cable ('Pyro') uses mineral powder and copper tube as insulant and sheath, hence providing true resistance to fire in an emergency. Much better resistance than plastics cables. Fails at 1080EC when the copper melts.

Narcosis

Depression of the central nervous system. Leads to inability to escape.

Non-flammable

Not capable of burning under specified conditions. Use this term with care.

Opacity of smoke

Ratio of light transmitted through smoke to the source flux.

Optical density

The logarithm of smoke opacity.

Oxygen Index

(or Limiting Oxygen Index: LOI) The oxygen level in an artificial atmosphere that will just permit burning at room temperature. **Note:** Materials with a high LOI are regarded as resistant to burning. When the LOI is 21% or less, the material will burn in air. As the temperature of the material rises, its LOI will tend to fall, and so a material deemed 'resistant' may well ignite given time.

Plenum

The space above a false ceiling, often used as an air conditioning return route. Old cables in plenum spaces are a serious hazard to occupants. Plenum-rated cables (eg UL 910-approved) are resistant to burning without protection

Pyrolysis

Chemical decomposition caused by heat (not burning)

Riser

A vertical space in a building, often several floors high, often used to route cables, e.g. a lift shaft. **Note:** Cables can burn rapidly when vertical, hence the popularity of 'riser' tests. IEC 332-3 simulates cables in such a configuration. As does UL 1666

Self-extinguishing

A deprecated term. It related to inability of materials to sustain burning

Smoke

The visible portion of fire effluent. For test purposes, smoke is regarded as separate from the fumes or acids it may be mixed with. Dense smoke is one of the main causes of death in fires as it hides the exits.

Steiner Tunnel

The fierce USA tunnel fire test used to assess plenum and other cables.

Temperature Index

The temperature at which something will burn in normal air (ie 21% oxygen). In other words the temperature at which the LOI reduces to 21%. **Note:** Coal has an LOI of around 50% when cold, but at 150EC, its temperature index, the LOI reduces to below 21%, so it burns. Higher numbers mean better fire resistance. Products with a T.I. of say 300EC or more give a better chance of escape.

Toxicity

The ability of a substance to produce adverse effects on living organisms.

Toxicity Index

The number obtained when the individual emissions of specific gases from a burning material are combined (according to the procedure). High numbers mean higher toxicity.

UL

Underwriters Laboratories, the USA-based standards organisation.

The Telecommunications Industry Association
gratefully acknowledges the support of the Members of the
TIA Cable System Suppliers Sector Interest Group (SIG/2))
and specifically the following who gave their invaluable
assistance to the content of this document

Malcolm Saunders - British Telecom Plc

Don Carless - Reuters

Phil Clayton - Mainetti Technologies

Peter Kite - MiTech Europe Ltd

Peter Pearson - Cablelines Ltd

Telecommunications Industry Association

Douglas House, 32-34 Simpson Road, Fenny Stratford,
Bletchley, Milton Keynes, MK1 1BA

Tel: 01908 645000 **Fax:** 01908 632263 **E-mail:** info@tia.org.uk