Loss Prevention Standards

Data Cabling

Introduction

Advances made over the last few decades in computing and communication, have resulted in significant increases in the amount of cabling installed in plenum spaces (such as ductwork), ceilings, risers and under-floor in commercial buildings. As increasing demands are placed on information technology networks to provide greater bandwidth, existing systems are constantly upgraded. Communications, data and security cables continue to be laid down and re-routed.

Over time, this constant activity can result in a build-up of large volumes of cables of different ages and materials, increasing the amount of cabling in buildings as new cables are added, whilst redundant cables if not removed remain in situ. Since it is not cost effective to remove older, redundant or abandoned cables, new cables are commonly installed alongside existing ones.

Electrical performance requirements are usually given priority when selecting cables, whereas fire rating factors that go beyond minimum standards are not often given due consideration. As a result, fires can spread rapidly throughout buildings, fuelled by the cables and following their routing.

Cables contribute significant fuel load to a fire and release toxic gases and particulates. Consequently, as IT systems develop, the building fire load increases over time. Furthermore, penetrations in fire compartments can result in rapid spread of smoke and fire throughout the building. Tests have shown cable fire temperatures in voids can exceed 1500°C and the products of combustion include particulates that can cause further localised mini explosions.

Hazards

Voids carrying cables are frequently large and without compartmentation. Even where cavity barriers are installed these are often breached to allow the passage of new cables or other services and are then imperfectly resealed.

Large voids and cavities have more oxygen readily available to support combustion and carry a greater volume of cabling, resulting in a corresponding increase in the fire load.

The insulating material used for many cables are halogenated polymers. These are inherently flame retardant but cause rigidity. To overcome this, plasticisers are added to give the cables flexibility, however this also increases their flammability considerably.

Low Smoke Zero Halogen (LSZH) cables, whilst generate less smoke when on fire, do burn and promote smoke spread, sometimes rapidly. Communications Multipurpose Plenum (CMP) rated cables whilst generally more expensive than other plenum cables, do resist and restrict fire growth.

In addition to the risk to human life, potential for property damage increases due to potential for spread through concealed spaces and penetrations between fire compartments. A small localized fire may quickly spread, leading to serious implications and interruptions in the business.

The physical arrangements of the cable runs can also increase the fire risk:

- Power and data cables should not be located in the same cable tray run or bundle
  - Power cables are an ignition source
  - Data cables can be a large fuel load
- Due to the physics of fire, vertical cable runs promote fire spread quicker than horizontal cable runs
- The nature of the cable ties can make a difference. The longer the cable bundle is held together the better as this reduces the available surface area for the fire to spread and grow on. Once a cable bundle splits and each individual cable is available for the fire, the fire grows quicker. Therefore, as metal cable ties have better integrity, they are superior to plastic in fire performance

Assessing the Risks

A typical four-pair unshielded twisted-pair (UTP) cable is designed for use within the hidden plenum space of dropped ceilings which handle air flow.

Commonly used materials for cable insulation are:

- Polyethylene (PE);
- Polyvinylchloride (PVC); and
- Fluorinated ethylene propylene (FEP).

Whilst all three offer excellent electrical insulation properties, PE is highly combustible and generates dense smoke. PVC, while still combustible, offers better fire performance although it has poor flexibility, but as mentioned above, addition of plasticizers will increase combustibility. Of the three, FEP gives the most favourable result in respect of fuel load and smoke generation.

Limited combustible cables (LCC) are available which improve upon the fuel load, combustibility and smoke generation of the aforementioned materials. They must pass rigorous tests including degradation due to temperature aging, humidity and jacket slitting.

Cables that are 'fire rated' are classified as either 'fire resistant' or 'fire retardant'. These classifications perform differently in a fire situation. Fire resistant cables are designed to maintain circuit integrity, whilst fire retardant cables will limit generation and spread of fire and smoke. However, the cables are not inherently non-combustible and after a given time the cables will eventually be involved and add fuel to a fire situation.

Controlling the Hazards

Materials used in the construction of any building should not make a significant contribution to its fire load. Therefore, the type of cables used should be able to resist fire or be protected from fire. Use of fire resistant cables that have been tested in accordance with an internationally recognised standard/protocol and approved by an independent third party organisation such as the Loss Prevention Certification Board (LPCB) or UL LLC (formerly Underwriters Laboratories) will ensure they have passed the most stringent large scale fire tests.

Following concerns for life safety, the National Electrical Code (NEC) specifically called for the removal of abandoned cables to reduce the fire load and toxic gases in fires. Such concerns have also been influential in the development of new cable technology with greater fire resistant properties.

From 1 July 2017, the new Construction Products Regulation (CPR) fire safety classifications became mandatory, requiring all cabling sold through the European Economic Area (EEA) to carry a CE mark and Declaration of Performance Certificate (covered by European Standard EN 50575). Whereas previous regulations only classified cables on flame spread, there are now seven main classifications of fire performance (including heat release and flame spread), plus three sub classifications covering smoke production, flaming droplets and production of acidic gases. The new cable classifications are:

$$A_{ca},\ B1_{ca},\ B2_{ca},\ C_{ca},\ D_{ca},\ E_{ca},\ F_{ca}$$

Which is a scale of performance, where A_{ca} is non-combustible and F_{ca} is a cable that burns completely. Most cables to be used in buildings will have a minimum performance requirement of E_{ca}, although a higher rating is recommended.

Classes $B1_{ca}$ & $B2_{ca}$ (maximum performance against fire), and C_{ca}, D_{ca} (basic level of safety) also have sub-classes:

Opacity of smoke emitted – s	
s1	Little production and slow propagation of smoke
s1a	S1 with visibility over 80%
s1b	S1 with visibility over 60%
s2	Intermediate values of production and propagation of smoke
s3	Neither s1 or s2

Droplets released in combustion – d	
d0	No fall of droplets or flamed particles
d1	Fall of droplets and flamed particles that persist for less than ten seconds
d2	Neither d0 or d1

Smoke acidity/toxicity – a	
a1	Low acidity
a2	Intermediate values of acid
a3	Neither a1 or a2

A full Reaction to Fire Code covers 'Class + Smoke + Droplets + Acidity', so for example, a high performance cable that has smoke emission with 80% visibility, no droplets or flamed particles, and low acidity smoke would be referenced as follows:

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

British Standard BS 6701:2016+A1:2017 (*Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance*) published on 30 November 2017 states the minimum acceptable Euro class cable is C_{ca}–s1b-d1-a1. British Standard BS 7671 (*Requirements for Electrical Installations)* also published on 30 November 2017 gives a minimum acceptable Euro class cable installed within a 'Non-flame propagating containment system' (stainless steel tube with fire stop at each end) shall be C_{ca}–s1b-d2-a2. Despite the metal tube, the minimum class cannot be lower than this. Aviva's preference would however be for $B2_{ca}$-s1a-d0-a1 to be used.

Fire Stopping

Section 17 of the Fire Protection Association (FPA) Design Guide core document '*Protection of Openings and Service Penetrations from Fire*' recognises the potential fire risk in hidden voids.

Buildings are divided into fire resistant compartments, each of which must be capable of withstanding a fire for a minimum stated period of time. These compartments are penetrated by openings for doors, ducting, pipes and cables, etc., which reduces the fire resistant capabilities and allows fire, smoke and hot gases to spread rapidly from one compartment to another and throughout the building. To maintain integrity of a compartment, the openings must be fire stopped to the minimum allowed fire rating. When penetrating a compartment wall the fire stopping must be fit for purpose.

Cavity barriers should be designed, installed and maintained at intervals of not more than 20 metres in any direction, and must have a minimum fire resistance of 30 minutes integrity and insulation. It is recommended that ceilings have a fire resistance of 60 minutes integrity and insulation.

An addressable remotely monitored automatic fire detection system installed within all areas should be provided, and the system should conform to BS 5839 Part1:2013 Category P1, to ensure the highest level of property protection. In addition, in some cases an automatic fire suppression or extinguishing system should be installed/extended to protect cavities.

Removal of Abandoned or Redundant Cables

When alterations or additions are made to an installation, wherever possible, and as far as is reasonably practical, care should be taken to remove all abandoned or redundant cables, to reduce the fire load.

Management Procedures
Approved Document B states that for a fire separating element to be effective, every opening in a fire rated element needs to be reinstated. Specifically:

> *"Where a wiring system passes through elements of building construction such as floors, walls, roofs, ceilings, partitions or cavity barriers, the openings remaining after passage of the wiring systems shall be sealed according to the degree of fire resistance required of the element concerned"*

and

> *"Where a wiring system such as a conduit, cable ducting, cable trunking, busbar or busbar trunking penetrates an element of building construction having specified fire resistance, it shall be internally sealed so as to maintain the degree of fire resistance of the respective element as well as being externally sealed to maintain the required fire resistance"*

In an existing building, the Regulatory Reform (Fire Safety) Order 2005 (in England and Wales) and the Fire (Scotland) Act 2005, requires every employer to appoint a 'Responsible Person' who will ensure their company complies with these regulations. Amongst other things, they are responsible for identifying structural features that could promote the spread of fire, and to take steps to reduce the potential for rapid fire growth.

Such features include ducts, flues, openings, combustible linings and other penetrations to the fabric of the building. These penetrations must be sealed. Employers therefore have a duty to protect employees and users of the building from fire. Prosecutions under this legislation carry a fine and up to 2 years imprisonment.

All cabling is expected to be clearly identified on all outlets and panels. For every 48 way panel, a 1U management bar should be installed. Velcro ties should be used to secure cables throughout the installation, and cable management socks are to be used in all cabinets.

Manufacturer specifications should be met throughout, and all bend radii regulations should be met.

General Guidance

- Be aware of the increased fire load that cables can introduce into a building and assess the extent of the problem in your premises
- Ensure the removal of obsolete cables
- Provide separate routes for power and communication cables
- Use approved cables (e.g. LPCB or UL LLC)
- Provide fire resistant voids for cables (minimum 30 minutes)
- Ensure hatches/doors in to the voids have an equivalent fire resistance as the void
- Provide cavity barriers and ensure that their integrity is maintained
- Consider providing automatic fire detection and/or extinguishment in cable voids, particularly for high risk areas such as computer suites and control rooms
- Keep records of products used, who supplied them, who installed them and location/date/time of installation
- Fire stops to be clearly identified, with instructions on resealing if penetrated
- Ensure cable contractors are aware of fire stops
- Enforce a Permit to Work scheme incorporating a formal review and approval process for cabling works, and pre/post inspections of work areas, particularly where fire stopping/barriers may be breached

Summary

The increased use of cables for information technology and communications has led to an increase in the volume of data cables in voids and plenum spaces, if redundant cables are not removed. This increases the fire load in a building which can aid rapid fire spread and release toxic gases.

Fire rated cables reduce fire load and smoke generation and are classified as fire resistant or fire retardant. Organisations such as the LPCB or UL LLC, test and approve fire resistant cables.

The CPR made it mandatory from 1 July 2017 for cables sold in the EEA to carry the CE mark and a Declaration of Performance Certificate. The CPR increased the number of fire performance classifications to seven main and three sub-classifications.

Cavity barriers must be installed in a building at distances of not more than 20 metres in any direction, and a minimum of 30 minutes fire resistance. Penetration to barriers must be fire stopped to the same standard as the barrier. It is recommended that automatic fire detection and extinguishing systems are installed in cavities.

When works on cables are being carried out, this opportunity should be taken to remove redundant/abandoned cables wherever possible.

Employers have a legal responsibility under the Regulatory Reform (Fire Safety) Order 2005 to identify structural features that may propagate fire, and to take steps to reduce this potential.

Cabling must be clearly identified and secured tidily.

Checklist

A generic Data Cabling Checklist is presented in Appendix 1 which can be tailored to your own organisation.

Additional Information

- Aviva Loss Prevention Standard: Managing Change
- NFPA 262: Standard Method of Test for Flame Travel and Smoke of Wires and Cables for use in Air-Handling Spaces
- Construction Products Regulation
- RedBookLive - Fire Rated Cables
- RISCAuthority - Service Sealing Penetration Seals

Further risk management information can be obtained from Aviva Risk Management Solutions

Appendix 1 – Data Cabling Checklist

Location	
Date	
Completed by (name and signature)	

	Data Cabling	Y/N	Comments
1.	Has a risk assessment for the site been completed that includes the exposures of the data cables?		
2.	Do you have drawings showing the layouts and routes of the data and power cabling?		
3.	Do you have drawings showing fire compartment walls? Does this identify doors, dampers, etc. and the fire resistance rating?		
4.	Do you know the nature/type of the data cabling in use?		
5.	Do you separate power and data cables from the same cable run/cable tray?		
6.	Are all cable penetrations through fire compartment walls appropriately fire stopped, including: • Floor voids? • Ceiling voids? Is this formally checked after every change? Is this formally checked annually?		
7.	Is cable management considered part of your Management of Change process?		
8.	Are obsolete or redundant cables removed when new cables are introduced?		
9.	Do you understand what cable ties are being used and implications of using plastic vs metal (especially for vertical cable runs)?		
10.	Are appropriate fire breaks created in service risers, floor voids and ceiling/roof voids to prevent fire spread?		
11.	Where cabling is present, is an addressable automatic fire detection system in place in all voids and compartments? Are the addresses clear so you know if there is an issue in a void area?		

	Data Cabling Contd.	Y/N	Comments
12.	Are all void areas where cabling is present maintained clean and included in regular housekeeping checks? For floors, are appropriate floor tile pullers available?		
13.	Has a business interruption risk assessment considered the data cabling routes and the impact of the fire exposures to this? Can a small fire expose any important or critical cables?		
14.	Additional comments:		