Fire Safety Cables

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Cabling is a real minefield for jargon; not least of which in relation to the properties of cables in a fire. Users and specifiers should be aware of the correct terminology particularly in specifying cables with low smoke emission, reduced fire propagation and minimal toxicity. Some of the more popular terms include:

- Halogen-free
- Flame and Fire Retardant
- 'Low Smoke, Zero Halogen'
- 'Low Smoke and Fume'
- Fire Resistant

We should be aware of the characteristics that are important to us as a user of these cables:

Fire Safety Aspects

- No damage to health or property by acid or corrosive gases
- Self-extinction of flames when fire source is removed
- No propagation of fire from one location to another
- Sufficient visibility for evacuation of occupants and for fire fighting

Required Characteristics

- Zero halogen, no corrosive gases
- Flame retardance
- Reduced fire propagation
- Minimum smoke emission

Any cables used within public buildings should, as a minimum requirement, present no danger to the health of people or integrity of property through acid gas emissions during a fire. They should also be self-extinguishing, that is, not continue to burn once the source of fire is removed and neither should it propagate fire into new areas. Further, while burning - and of course everything will burn given the right conditions - the smoke produced should not impede escape by obscuring emergency lighting and exit signs.

Most modern communications cables and those used for emergency systems - such as fire alarm circuits, public address, emergency lighting etc - are available with LSOH-FR sheathing (i.e. Low Smoke, Zero Halogen and Flame Retardant). However, PVC continues to be used because of lower pricing and general ignorance of how PVC behaves in fire.
conditions. Internal cabling favours PVC instead of polythene and rubbers because unlike these other materials they will quickly extinguish themselves once the source of fire is removed or extinguished. Unfortunately, the halogens in PVC that exhibit this property produce corrosive by products such as hydrochloric acid that is fatal both to humans and sensitive electrical equipment as found in computers for example. Even quite small fires can produce enough acidic fall-out to destroy electronic equipment in buildings.

After 5-7 minutes opaque smoke from an LSOH-FR cable will cause a peak 15% deterioration in light transmission settling to around 5% compared to a 90% deterioration over an extended period for PVC sheathed cable.

The majority of standard building cable used in the UK - even where LSOH-FR types are installed - will lose their functionality in a fire very quickly. That means that even if the cable poses no threat or hazard to people or building systems they will cease to provide a circuit quite quickly. Therefore, emergency systems such as public address, lighting, heat and smoke extraction and special lifts for fire-fighters need to be protected to ensure they will continue to function for a period of time during a fire.

The fire resisting property of cable is measured in the UK by British Standard BS6387. This takes a 600mm length of cable and subjects it to a flame of 950°C for 3 hours while carrying 3 amps of current. The specification also emulates fire conditions by subjecting the burning sample to water spray and mechanical shock (categories C, W and Z respectively). A further specification - BS7629 - combines this fire survivability with low smoke and toxicity emission. Similar tests exist in Europe, such as IEC 60331 that concentrate on fire performance only.

Traditionally, fire-resisting cables such as MICC (mineral insulated, copper clad) have been used to provide robust links in fire protection systems. Often described as 'fire survival' cables they utilise mineral-based insulation and copper tube technology. Although such cables are of a high quality and robust, they are more difficult to install than alternatives.

Several years ago, a 'soft skin' approach to fire-resistant cables was introduced. Such cables are more akin to those usually installed by electrical contractors. They use thermoplastic materials and fire resisting tapes, rather than copper tube technology. Clearly these cables offer a more flexible design and are easier to install. They do not require such highly skilled technicians to install them since the required installation techniques are little different from those employed on lighting circuits.

Both solutions have their merits. The consultant or fire engineer has to weigh up the requirements of each specific installation, balancing the need for effective safety critical circuits (that will facilitate evacuation and property protection) against the available budget. A further issue relates to the way in which the standard tests the cable. At present, only power transmission performance is assessed. This needs to be amended to address the data transmission performance. This is all-important for modern addressable fire detection and alarm systems.
However, current fire-related cable standards deal only with the combustion of cables and not with the continued functionality of the life and property protection systems they interconnect. UK standards such as BS6387 and BS7629 seek to ensure that cables used in fire detection and alarm circuits (BS5839) and emergency lighting (BS5266) for example meet fire resistance, smoke and toxicity emission's and propagation criteria. Even the 'new breed' of composite 'EN' standards, such as EN50200, addresses these issues from a component-based viewpoint. As these standards do not emulate the thermal and dynamic stresses on cable and its supporting infrastructure during fires the assumption that these cables can maintain circuit integrity for extended periods in fire conditions is a dangerous fallacy.

Cabling practice for life-safety and property protection circuits too often fall far short of ideal. For example, over-loaded tray, fixing points too far apart, plastic cable ties and plastic dowels far too often compromise the integrity of the circuit before the cable is threatened. While the importance of selecting fit-for-purpose cables cannot be over-stressed, their performance in fire conditions can be ruined if insufficient attention is paid to their fixing and management. Cables with thermoplastic terminal blocks used for jointing may suffer open or short-circuit failure when the fire heats the terminal block. Cables may lose their support if not effectively fixed with fire-resistant clips or other reliable support means. This is an easily overlooked aspect of installation that may not come to light until the system is called upon to work in an emergency. Moves to regulate installers of such systems via the ECA/BFPSA sponsored training and accreditation scheme, to replace the failed LPS1014 initiative, is a welcome move.

German standard DIN4102 part 12 seeks to ensure the continued operation of cable systems in fires up to 1000°C. Similar in approach to our own BS476, the DIN standard subjects a range of electrical cable (from <225V to 0.6/1kV) and cable management methods to an ISO834 time/temperature curve. The furnace reaches 830°C after 30 minutes and 1000°C after 90 minutes. In this way, one gets a measure of the systems integrity at high temperatures; bearing in mind that the steelwork starts to deform above 600°C!

We are aware that any DIN standard will not be popular in 'BS' dominated markets. However, this performance-based standard is gaining ground in other European markets such as Netherlands, Luxembourg, Poland, Austria and even Greece. It is seems likely that momentum will move CENELEC to adopt this as a mandate for a draft EN proposal in the near future.

We concede that this particular standard does not take into account the actions of water (from sprinkler systems) or shock (from falling objects). However, cables meeting this systems-based performance standard will also meet the component-based standards described herein. In the absence of any other suitable standards it remains a valid reference point for those concerned with the fire performance of their building and adds a welcome tier of confidence in essential systems design.
A cable-based fire survival test coupled with a demonstrable and repeatable method of assessing the installation hardware would give consultants and fire engineers a more practical benchmark to assess the suitability of systems for their projects. If this can be coupled with a recognised installer accreditation scheme then we can all be better assured that we and our families are better protected in buildings we frequent.

AFD systems vendors, too, are considering the effects of fire on the performance of systems. The continual evolution of fire protection system performance will inevitably impact on the performance required of cables and the requirements specified in the relevant cable standards. Specifiers and manufacturers will need to address issues concerned with reliable provision of bandwidth in fire conditions. Indeed, manufacturers are looking to optical fibre to provide the necessary resilience in the next generation of life and property protection systems.

We can never hope to demonstrate in a test what happens in a real fire. Every fire is different; every building is different and every installation is different. We in the industry are dealing with issues of confidence. Anything that moves the focus away from component-specific arguments to a consideration of the place of cable in the greater scheme of things must be encouraged. Suppliers of cable systems must seek to provide solutions that meet the needs of the fire engineer and the requirements of the building under consideration. As every installation is unique then the industry should be in the business of providing solutions not confusion.