

case study



Highest flame-retardant fiber optic cables for building installations

Introduction

Planning structured cabling in buildings is a challenge due to the numerous specifications, regulations and guidelines that must be considered. This is made more difficult because of the variety of different classifications of cables in regard to their flame-retardant performance, as well as the diverse locations of installations. By reducing the number of cables with different performance classifications, work during the planning, installation and provisioning stages will be decreased.

The flame-retardant performance of construction products has become more important due to their role in preventing severe fire incidents. The European Regulation for Construction Products (CPR, EU 305/2011) ^[1] was introduced to increase health and safety, and the “reaction to fire” requirements for cables under CPR were made mandatory in July 2017. All cable types that are permanently installed in construction works are covered by this regula-

Application

Cabling in construction works

Technology

Fiber optics

Solutions

Highest flame-retardant fiber optic cables

Region

Europe

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tion and need to be tested and classified according to EN standards.

In this document we use the term “flame-retardant performance or behaviour” instead of the more commonly-used term “fire performance”, since the aim is to achieve good flame retardancy.

Theoretically, cables can be classified in the main classes from F_{ca} to A_{ca} as shown in Figure 1. In practice, the used materials limit the classification of fiber optic cables from F_{ca} to $B2_{ca}$. Cables with the classifications $B1_{ca}$ and A_{ca} are not commercially available.

must be performed to classify cables for a higher class than E_{ca} , as shown in Figure 1. For example, cable installations in escape routes usually require classes with a better flame-retardant performance, such as C_{ca} or $B2_{ca}$. Cables with the classification $B2_{ca}-s1a,d1,a1$ have a very good flame-retardant performance, particularly suitable for installations where evacuation is difficult, such as tunnels.

The additional classes (s, d, a) are also important because they classify cables with critical and non-critical behaviour. Cables with critical behaviour have one or more additional classes, s3, d2 or a3 (see grey background in Figure 1), and can have

Class		Additional classes								
A _{ca}	Heat of combustion (EN ISO 1716)	—								
B1 _{ca}	Heat release, flame spread (EN 50399) Flame spread (EN 60332-1-2)	s1a	Smoke production (EN 50399, EN 61034-2)	d0	Flaming droplets (EN 50399)	a1	Acidity (EN 60754-2)			
B2 _{ca}		s1b		d1		a2				
C _{ca}		s2		d2		a3				
D _{ca}		s3								
E _{ca}	Flame spread (EN 60332-1-2)	—								
F _{ca}	does not meet E _{ca}	—								

increase of "reaction to fire"
requirements

Increase of “reaction to fire” requirements

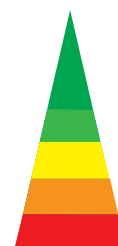


Figure 1 - Classification “reaction to fire” for cables according to EN 13501-6 [2]

The minimum classifications of cables are specified by regional or national regulations and are not uniformly harmonized within Europe. The classification requirements of cables usually depend on where and how the cables are installed in buildings, and in what type of construction works they are installed. The list of product contact points for construction in the EU can be viewed at: <https://ec.europa.eu/docsroom/documents/44018>. To test the minimum performance level in building installations, the flame spread test method is required, as defined in EN 60332-1-2 [3]. If the vertical single cable sample passes the fire test, then the cable can be classified in class E_{ca} . Cables with classification E_{ca} are typically installed in locations with low risk, where no additional requirements are needed, or outside escape routes. Additional tests

hazardous fire effects such as strong smoke production, continuously flaming droplets and high acidity of combustion gases. Cables with non-critical behaviour, as depicted with green backgrounds in Figure 1, have little (s1a, s1b or s1) or medium (s2) smoke production. The light transmission through smoke, simulating the „visibility”, is measured in a cube-shaped smoke density chamber with three metre lengths each. The additional class s1a designates cables with good “visibility” ($\geq 80\%$), while s1b has slightly reduced “visibility” through smoke ($\geq 60\%$ and $< 80\%$). The “visibility” is not assessed for the additional class s1. Cables with non-critical behaviour either have no (d0) flaming droplets, or none that persist for longer than 10 seconds (d1). The additional classes, a0 and a1, have very low or low acidity of combustion gases, respectively.

Challenge

Due to the added health and safety measures introduced by CPR, building owners, planners and installers need to decide which concept they want to pursue in regards to the cable classification. Some examples of concepts which can be used are: (a) specifying the mandatory minimum classifications of the regional or national regulation, (b) using the classifications recommended by cable associations that are equal or higher than the minimum regulatory classifications, or (c) using the highest classification for all cable types that fulfils all requirements.

In our experience planners often prefer concept (c) above, that fulfils all requirements in a building. This simplifies the installation work as it requires no use of cables with different classifications and the effort, as well as the error rate, can be reduced. The same cables can be used throughout the building as well, such as for intra-rack and inter-rack installations. Due to this, cables with the classification $B2_{ca}-s1a,d1,a1$ are frequently requested, independent of where they are finally installed. Additionally, insurance companies offer the lower fees if all installed cables comply with a classification of very good flame-retardant performance.

Regular updates to increase the data processing capabilities in data centers and other telecommunication facilities require a higher fiber density of cabling within racks, between racks and in cable ducts that require smaller cables, or cables that contain more fibers. To achieve a very good flame-retardant behaviour is particularly challenging for thin fiber optic cables.

The flame spread characteristic, according to EN 60332-1-2 ^[3], tests the vertical flame propagation of single vertical cables, and is required for all classifications from class E_{ca} to $B1_{ca}$. During testing, we observed the tendency of thin fiber optic cables

(< 2.7 millimetres) to move out of the flame in the seconds after the powerful flame burned through the cable elements, as shown in Figure 2. This resulted in a different cable-flame behaviour compared to the intention of the test method, which states that the cable interacts with the flame continuously.

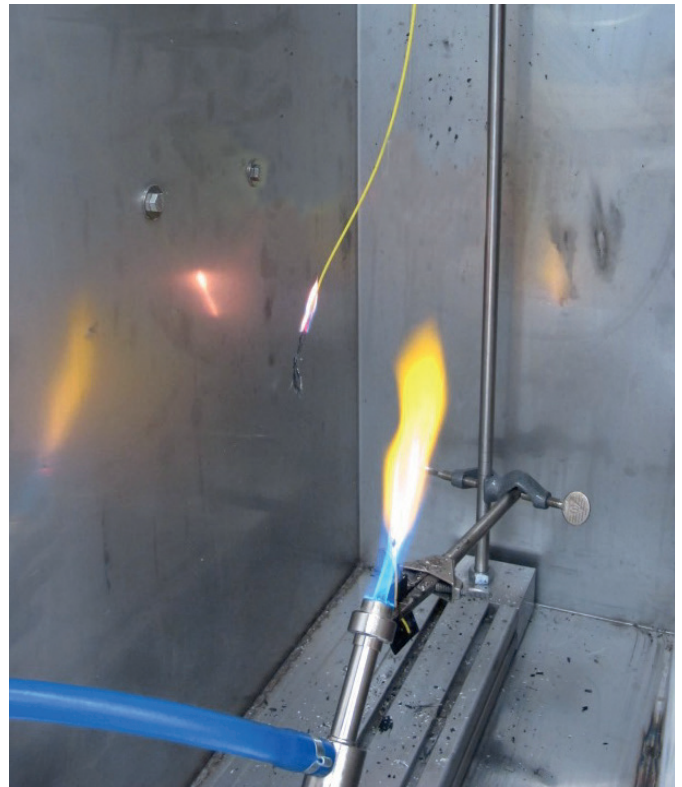


Figure 2 – Sample moved out of flame during flame application

Solution

To find the best solution, HUBER+SUHNER tested a number of variants in the fiber optic test laboratory. In the final solution, the cable being tested was guided by metal wire loops at different heights, as illustrated in Figure 3. In case of a cable break, the wire loops stop the lateral movement of the cable within a few millimetres. This ensures that the cable stays within its vertical position and interacts with the flame. HUBER+SUHNER submitted suggestions for a standardised procedure for thin cables to CENELEC, which defined an amendment to the vertical flame propagation test. This was published as EN 60332-1-2/A12:2020 ^[4] in November 2020.

HUBER+SUHNER has the expertise to design and manufacture fiber optic cables and perform fire tests to ensure very good flame-retardant performance, especially for thin fiber optic cables. Single-coated fiber cables for termination with simplex and duplex connectors, as well as multi-fiber cables for termination with MPO connectors, were developed. These cables offer a small outer diameter, good mechanical robustness, high thermal stability and a very high classification of flame-retardant behaviour.

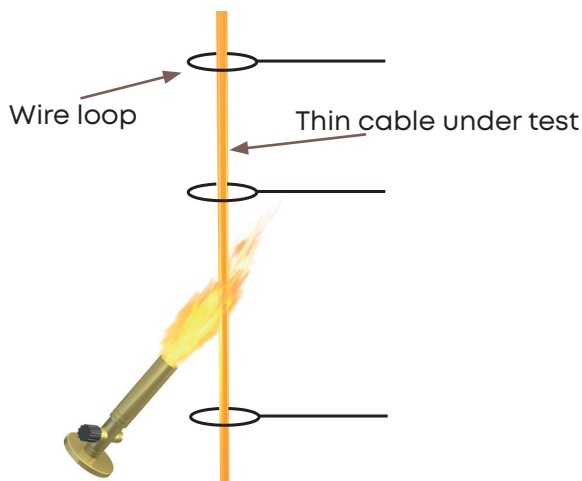


Figure 3 – Application of test flame with optional wire loops

Result

The broad portfolio of fiber optic cables from HUBER+SUHNER offers a wide range of different cable types, with medium to highest classification according to CPR. This even includes thin fiber optic cables, such as patch cords. The cables are suitable for backbone, trunk, interconnect and cross-connect cabling.

As required by CPR, HUBER+SUHNER offers a declaration of performance for all CPR classified cables, available in all European languages. These declarations confirm the flame-retardant performance and the certification work done by the independent notified body and the manufacturer. Moreover, they can be used for documentation purposes.

More to explore

After the classification requirements of all cables are defined, HUBER+SUHNER recommends checking the availability and conditions of the required classification for all cable types with the suppliers at an early stage.

If you are not sure what cables and classifications you should use, HUBER+SUHNER experts will gladly advise you. With their support, cables and components can be selected that are suitable for building a communication network that is functional, safe and effective. Please contact your local representative.

Sales partners

www.hubersuhner.com/contacts

References

- [1] Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, <https://ec.europa.eu/growth/sectors/construction/product-regulation/>
- [2] EN 13501-6, Fire classification of construction products and building elements - Part 6: Classification using data from reaction to fire tests on power, control and communication cables
- [3] EN 60332-1-2:2004+A1:2015+A11:2016, Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame
- [4] EN 60332-1-2/A12:2020, Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame