The Importance of Fire Resistant Cables in Our Life and Property Safety

PART I

Could cables be one of the factors that can cause loss of life and property during fire in every part of our lives? Why are fire resistant cables important for our lives? What is the impact of standards and tests on these cables? On this technical article, we will share the answers for these questions with you and evaluate the structure of fire resistant cables.

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What is the role of cables in every part of our lives in starting and during fire?

Although the fire measures taken in the buildings in Istanbul have improved in recent years, we can say that the biggest reason for the increase in all structural and non-structural fires is the rapid increase in the number of buildings and the population. In regions and cities with increased populations, there is an increase in fires due to the increase in energy consumption per person and the effect of aging installations.

Considering the statistics by the IBB Department for the last 5 years, approximately 25% of fires are caused by electricity, as the second reason after smoking.

Cables are found through out structures and are often invisible after installation. They pass through walls without interruption, connecting rooms and floors. Cables can act as carriers when the fire that starts with sparking in one part of the cable advances the flames and surrounds the whole building.

Why cables are so important for our lives?

The first way to prevent and reduce the loss of life and property that may arise from fire is to eliminate or reduce the factors that may cause fire. It should not be forgotten that the golden rule for protection from fire is to prevent fire rather than extinguish it.

Literature reveals that taking fire safety measures is easier and less costly than fire extinguishing. In order to minimize the fire hazard as much as possible and to intervene in the fire quickly, it is necessary to consider a series of measures during the design phase of the buildings, to apply them during the construction period and to ensure their functionality during the operation period.

In the 50s, the average time between the ignition of a fire and the flare was 15 minutes, today fatal situations can occur after 3 minutes.
The reason for this change is that plastic materials are increasingly replacing traditional materials in our environments. This has a significant impact on the evacuation time. It is vital to reduce the time exposed to these gases by ensuring safe evacuation with the best visibility. The cause of most deaths in a fire is inhalation of toxic gases.

Efforts to reduce smoke and toxic gases during fire greatly contribute to saving human life and facilitating the work of rescue teams. In fires, the spread of fire, smoke, acid gas and

poisoning hazards associated with the cables in the fire environment are prioritized differently depending on the nature of the area where the installation is located.

Table-1: Priority Ranking According to General Installations

Priority Ranking	General Installations	Evacuation of Personnel Installations in Critical Locations	Protection of Equipment Installations in Critical Locations
1	Fire Propagation	Smoke	Acid Gas
2	Smoke	Fire Propagation	Fire Propagation
3	Acid Gas	Poisoning	Smoke
4	Poisoning	Acid Gas	Poisoning

Therefore, cables are the first for the passive and active measures to be taken against a possible fire in buildings.

- Passive Measures

It should be a flame retardant cable, not the cause of fire, and prevent the spread of fire.

It should have low smoke density under fire conditions.

It should not emit toxic and corrosive gas under fire conditions.

Its heat release should be low.

- Active Measures

It must operate for a certain period of time in emergency safety circuits in buildings.

Emergency safety circuits are the ones necessary for the rapid evacuation of people from the fire zone, rapid fire response and extinguishing.

What is fire resistant cable?

Fire resistant cables are the ones that carry energy and signals to the emergency safety circuits that must work during a fire for the safety of people in public buildings, for the protection of valuable goods and devices and facilitating fire response.

Fire resistant cables, due to their nature, can delay the flame during a fire that will occur in the building, do not emit toxic and corrosive gas, and their smoke density is low. However, it cannot be used in electrical circuits (emergency safety circuits) where insulation continuity is required. The cables of these circuits should have the characteristics of fire resistant cables, and at the same time, maintain the continuity of the electricity transmission for a certain period of time during the fire.

To summarize; fire resistant cables are able to carry energy and signal under fire for the minimum periods specified in standards and regulations.

We can specify the following systems for emergency safety circuits in buildings fire warning and alarm systems.

- Fire warning and alarm systems
- Emergency lighting systems
- Emergency announcement systems
- Fire-fighting water systems
- Fire exit lighting
- Smoke and heat exhaust fans
- Firefighter elevators
- Elevators for evacuation purposes

What are the common terms used in fire resistant cables?

FE180: Cables are simulated in order to maintain their function (ensuring circuit integrity) under rated voltage, at 750 °C, for at least the period specified by the standards (IEC 60331-21/23/25).
The numbers after the term FE express the time in minutes. 180 minutes is commonly preferred.

PH120: According to EN 50200 standard, cables are simulated under rated voltage, 830 °C flame and 25 kg impact, in order to maintain circuit integrity for at least the specified time.
The numbers after the PH term represent time in minutes. Periods of 30, 60, 120 and 180 minutes are commonly preferred.

E90: According to DIN 4102-12 standard, it is the testing of the system in a closed room where the flame reaching up to 1000 °C is applied with all components (trays, cable ducts, clips ...) with which the cables come into contact, such as inside buildings, in order to obtain an almost accurate simulation. . In other words, it is functional integrity.
The numbers after the term E express the time in minutes. Periods of 30, 60 and 90 minutes are commonly preferred.

Table-2: Standards and Test Methods

	FE180	PH120	E30	E60	E90
Standard	IEC 60331-21/23	TS/BS/EN 50200 TS/BS/EN 50362	DIN VDE 4102-12		
Flame Temperature	750 °C	830÷40 °C	Up to 1000 °C		
Time	180 min	120 min	30 min	60 min	90 min
Applied Voltage	Up to 1 kV	Up to 1 kV	Up to 1 kV		
Simulation	Circuit Integrity	Circuit Integrity	Functional Integrity		
Test Method	The circuit integrity of the horizontally laid cable at 750 °C is tested.	The circuit integrity of a single cable once in every 5 minutes with 25 kg mechanical force at 830 °C is tested.	The system with cables and all components (ladder, tray, holder, clips,…) up to 1000 °C in oven is tested.		

What are the features of fire resistant cables?

Cables used in public buildings, especially in electrical installations in case of fire, must meet the following characteristics:

1. **Limitation of flame propagation**

- ✓ To facilitate the spread of fire, thus saving time for evacuation and fire fighting.
- ✓ Fire propagation in single cable systems is simulated according to EN 60332-1-2 standard; and it is simulated in multi-cable systems according to EN 60332-3-21 / 22/23/24/25 standards.

2. **Limitation of smoke spread**

- ✓ It reduces the risk of suffocation and poisoning.
- ✓ It facilitates escape activities by increasing the visibility range.
- ✓ Contrary to the PVC-based materials, LSZH/HFFR materials, thanks to their special structures, reduce the spread rate of smoke by decreasing the combustion temperature and absorbing the smoke. The light transmittance of the smoke density is generally desired to be above 60%.
- ✓ It is tested according to the EN 61034-2 standard.

3. **Limiting the release of harmful gases**

- ✓ It reduces the risks of suffocation and poisoning.
- ✓ Reduces the occurrence of skin and eye irritation.
- ✓ It reduces corrosion in electronic devices.
- ✓ Chlorine, especially in PVC, spreads as gas during combustion. Although chlorine gas is extremely toxic, it forms hydrochloric acid when combined with water vapor in the air.
- ✓ The amount of halogen acid gas and the acidity and conductivity values of the resultant gas are measured by testing according to EN 60754-1 & 2 standard.

4. **Heat release and smoke generation measurements and their limitation**

- ✓ The determination of fire reaction performance (EN 13501-6) provides later a guidance on which cable to use and in which structure.
- ✓ Basically, EN 50399 standard-based measurement results of the parameters such as flame spread, heat release rate, total heat output, smoke production rate, total smoke production, fire growth rate index, formation of flaming droplets/particles are used for the classification of cables, and the determination of fire reaction performance.

Cables that provide these features are called "***Fire Resistant Cables***".

What are the raw materials used in fire resistant cable production and their properties?

In case of fire, the sheath materials of the cables are one of the most important layers because they are the first contact point with flame and temperature. Likewise, under-sheath protection layers should also have similar properties. Especially in the last 20 years, it has been aimed to meet the first three main conditions by modifying the plastic materials with various additives

or with additional layers in cables where fire performance is important. Such polymeric materials are called Halogen Free Flame Retardant (HFFR) compounds.

However, for the continuity of the cable function during fire, it is important that the insulation materials do not melt and dissolve under the flame, prevent short circuit by remaining on the metal conductor and maintain the electrical transmission.

Today, in addition to the use of customized silicone rubbers for the insulation of fire-resistant cables, natural or artificial mica-based tapes can be wrapped on the conductor to ensure function continuity during fire. Taping with mica tape is the most typical solution, it allows the use of different insulation materials permitted by the standards since the fire resistance is provided by the tape. Silicone rubber, on the other hand, is currently the most commonly used solution, as it simplifies and speeds installation thanks to easy peeling and lack of tape.

Additionally, various windings made of high temperature resistant materials are used to prevent the insulations from being exposed to direct flame. For this purpose, mica, glass fiber or their versions coated with some polymers may be preferred.

*You can read this technical article's Part II "**Fire Performance Tests**" writing by R&D Manager Mrs. Pınarbaşı*

Key Words: *weak current cable, fire resistant cable, flame retartand, halogen free flame retardant, fire performance test, construction products regulation, CPR*