Pliable **Fire Resistant Cables**

It has been recognised that electrical wiring in buildings may pose a serious risk to both life and property in the event of a fire. Burning cables can propagate flames around the building especially through ducting and roof spaces which may make the fire difficult to contain. The polymer insulation and sheathing materials, which are necessary components of electric cables, are organic materials which will burn. Much of the critical equipment needed to support the building systems including safety circuits for fire alarms, sounder systems and emergency lighting appliances etc., which are powered by these electric cables may also fail if the cables are sufficiently damaged by fire. Traditional PVC cables will produce significant quantities of black smoke, toxic fumes and acid gas when they burn. These fumes obscure exits and make evacuation of the building far more difficult. Toxic fumes and acid gasses may cause asphyxia and are also poisonous to those in the building and the acid gases have been proven to cause substantial damage to sensitive electronic equipment. Indeed it has been estimated that 80% of the fatalities in burning buildings are as a result of fume inhalation.

There are three primary solutions to the problems posed by electric cables in fire situations, flame retardant cables, Low smoke halogen free cables and fire resistant cables.

Most cables used in buildings are designed with a flame retardant component. In PVC cables this material is a halogen, Chlorine. Other halogens may also be used such as fluorine which is used in cables for higher temperature applications. The problem is that when these cables do eventually burn, readily at temperatures in excess of 500°C, they will produce acid gas, black smoke and other toxic fumes.

Low smoke halogen free cables are designed without a halogen component and produce significantly less smoke. The polymer material in these cables is primarily based on Polyolefin and it is heavily filled with fire retarding minerals such as alumina trihydrate or magnesium hydroxide. These fillers release water as they decompose in a fire and help to form a tough fire resistant char around the conductors.

British Standard Fire resistant cables are made from low smoke halogen free materials with significant flame retardant components. They have been designed and constructed to resist fire conditions and continue operate critical electrical circuits such as fire alarm and emergency lighting circuits long enough to support the safe evacuation of the building and the shutdown of essential equipment etc.

Initially the toughest requirements for fire resistant cables were met by mineral insulated cables. MI cables are basically conductors in a copper tube insulated from one another by Magnesium oxide. The copper tube is sheathed with a polymer skin. These cables have given way to pliable fire resistant cables which are much easier to use and install and are more adaptable.

Pliable Fire resistant alarm cables use a combination of materials and various constructions. Low smoke halogen free compounds are used in all cases. These materials include combinations of organic and inorganic materials e.g., Polyolefin based materials with mineral fire retardant fillers, silicone rubber insulation which forms silica when burnt, mica and glass tapes, metal tapes and screens and even steel wired armour are used in various combinations to provide appropriate fire resistance, water proofing and mechanical protection. The materials and constructions which can be used are specified in the cable standards and these standards reference the particular dimensions, constructions and material requirements.

In developing these pliable fire resistant cables, tests were developed to simulate actual fire conditions and methods of measuring the behaviour of the cables were determined under such conditions. Simulating real fire conditions, heat, fire, water from sprinkler systems and mechanical shocks are applied in varying degrees.

The appropriate performance criteria for these fire resistant cables are set down in the relevant standards. Cable manufacturing standards determine the materials which can be used and the various constructions which are allowed. The system standards take cognisance of the whole system and the building in which the various fire resistant cable circuits are required to operate. The various test standards determine how these fire tests are performed for the different cable categories.

Cable Manufacturing Standards

BS 7629 Electric cables. Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire. Multicore and multi pairs.

BS 7846 Electric cables. Specification for 600/1000 armoured fire resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire.

Systems Standards

BS 5839: Fire Detection and fire alarm systems for buildings

Part 1: Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises.

Part 8: Code of practice for the design, installation, commissioning and maintenance of voice alarm systems.

Part 9: Code of practice for design, installation and maintenance of emergency voice communication systems.

All three parts of this standard determine that the cables used in these applications should be either mineral insulated cables to BS EN 60702-1, Pliable fire resistant cables to BS 7629 or the pliable SWA version for the larger sized cables to BS 7846.

This standard makes recommendations for two different category of fire resistant cables, the type of building and fire alarm installed determine which category is used and where.

- 'Standard' fire resistance is recommended for general use Essentially this is a PH30 Cable with Annex E according to BS EN 50200.
- 'Enhanced' fire resistance 'is recommended for systems, in particular building types, in which cables might need to operate correctly during a fire in excess of those normally required for single phase evacuation of a building. Examples are unsprinklered high rise buildings with phased evacuation arrangements and premises of such a nature that areas remote from the fire could continue to be occupied for a prolonged duration during a fire that might then damage cables serving parts of the fire alarm system in occupied areas.' The requirements of an 'Enhanced' grade cable are defined as 120mins to the test determined in BS 8434-2.

BS 5266-1: Emergency Lighting – Code of practice for the emergency lighting of premises.

The cables used in compliance with this standard should be either mineral insulated cables to BS EN 60702-1, pliable fire resistant cables to BS 7629 or the pliable SWA version for the larger size cables to BS 7846.

The principle category of fire resistant cables applicable in this standard is PH60 in accordance with BS EN 50200.

BS 8519: Code of practice for selection and installation of fire-resistance power and control cable systems for life safety and fire-fighting applications.

This standard defines 3 different fire resistant cable categories for the various applications.

Category 1
Means of escape (30 min fire survival) either:

- BS 8491 with 30 min survival for cables over 20mm in diameter or
- PH30 cables with Annex E in accordance with BS EN 50200.

Category 2
Means of escape (60 min survival time) either:

- BS 8491 with 60 min survival time for cables over 20mm in diameter or
- PH60 cables in accordance with BS EN 50200 and 120min survival time when tested in accordance with BS 8434-2.

Category 3
Firefighting (120 min fire survival time) either:

- BS 8491 with 120min survival for cables over 20mm in diameter or
- PH120 in accordance with BS EN 50200 and 120min survival time in accordance with Annex B of BS 8519.

Circuit integrity / performance tests

BS6387 CWZ Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions.

Resistance to fire alone	Category C	3 hours @ 950°C
Resistance to fire and Water	Category W	15mins @ 650°C
Resistance to fire and mechanical shock	Category Z	15mins @ 950°C

(Mechanical shock is applied to the cable backboard and mounting not the cable directly)

These tests are done on three different cable samples and are included as a basic requirement for approval to the manufacturing standard BS 7629.

BS EN 50200 : Method for test for resistance to fire of unprotected small cables for use in emergency circuits.

This is a European standard which has been adopted by UK.

This is a circuit integrity test which includes both fire and mechanical shock elements. There is also an optional water spray application, Annex E which has been adopted as a requirement in UK and Ireland.

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Various classifications are given to the cables depending on the survival times:

PH15	842°C	15mins
PH30	842°C	30mins
PH60	842°C	60mins
PH90	842°C	90mins
PH120	842°C	120mins

Annex E, which applies to each category, includes a separate test on a second sample. This sample must maintain circuit integrity for 30mins. This includes 15 minutes of fire and mechanical shock followed immediately by 15minutes of fire mechanical shock and water application on the same second sample. PH30 with Annex E is referred to as 'Standard Grade' fire resistance in BS 5839-1.

Note: the mechanical shock is applied to the cable backboard mounting and not directly on the cable.

BS 8434-2: Methods of test for assessment of the fire integrity of electric cables test for unprotected small cables for use in emergency circuits. BS EN 50200 with a 930° flame and with water spray.

This standard determines the test requirement for cables referred to as 'Enhanced Grade' cables in BS 5839-1. The same sample is subject to fire, mechanical shock and water.

Fire and Mechanical shock	60mins	950°C
+		
Fire, Mechanical shock and water jets	60mins	950°C

BS 8491: Method for assessment of fire integrity of large diameter power cables for use as components for smoke and heat control systems and certain other active fire safety systems

The standard categorises cables to 3 different survival times; 30, 60 and 120 min.

Fire and Mechanical shock	25mins	842°C
+		
Water applied in 5 second bursts each minute for 5 minutes		842°C

Fire and Mechanical shock	55mins	842°C
+		
Water applied in 5 second bursts each minute for 5 minutes		842°C

Fire and Mechanical shock	115mins	842°C
+		
Water applied in 5 second bursts each minute for 5 minutes		842°C

The mechanical shock elements of this test are directly applied to the cables being tested. The significant impact resistance is usually possible due to steel wire armouring.

Other Tests Applicable to Fire Resistance Cables

BS EN 50267 (IEC 60754) Acid Gas Emission. Confirms that the cables are halogen free.

BS EN5 0268 (IEC 61034) Smoke Emission. Confirms that only very low levels of smoke are produced when the cables are burnt.

BS EN 50265, 50266 (IEC 60332) Flame Propagation. Confirms that the cable will not propagate flame and when ignited.

Frequently Asked Questions

Q: Is cable marked flame retardant the same as cable identified as fire resistant?
A: No, flame retardant cables are designed to prevent the propagation of flames whereas fire resistant cables are designed to continue to operate for a defined period of time in a fire situation.

Q: What fire resistant cables should be used?
A: This depends on several factors including the system being used and the building design etc. The code of practice for the particular application should always be referred to.

Q: Is PH120 Fire resistant cable the same as 'Enhanced Grade' cable and suitable for areas designed for 'Enhanced grade' applications?
A: No The PH120 test, as defined in BS EN 50200, does not meet the requirement as an 'Enhanced Grade' cable as defined in BS 5839. The 120 minutes classification to BS 8434-2 meets the requirement for 'Enhanced Grade' cables as defined in BS 5839 and is a more rigorous test.

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