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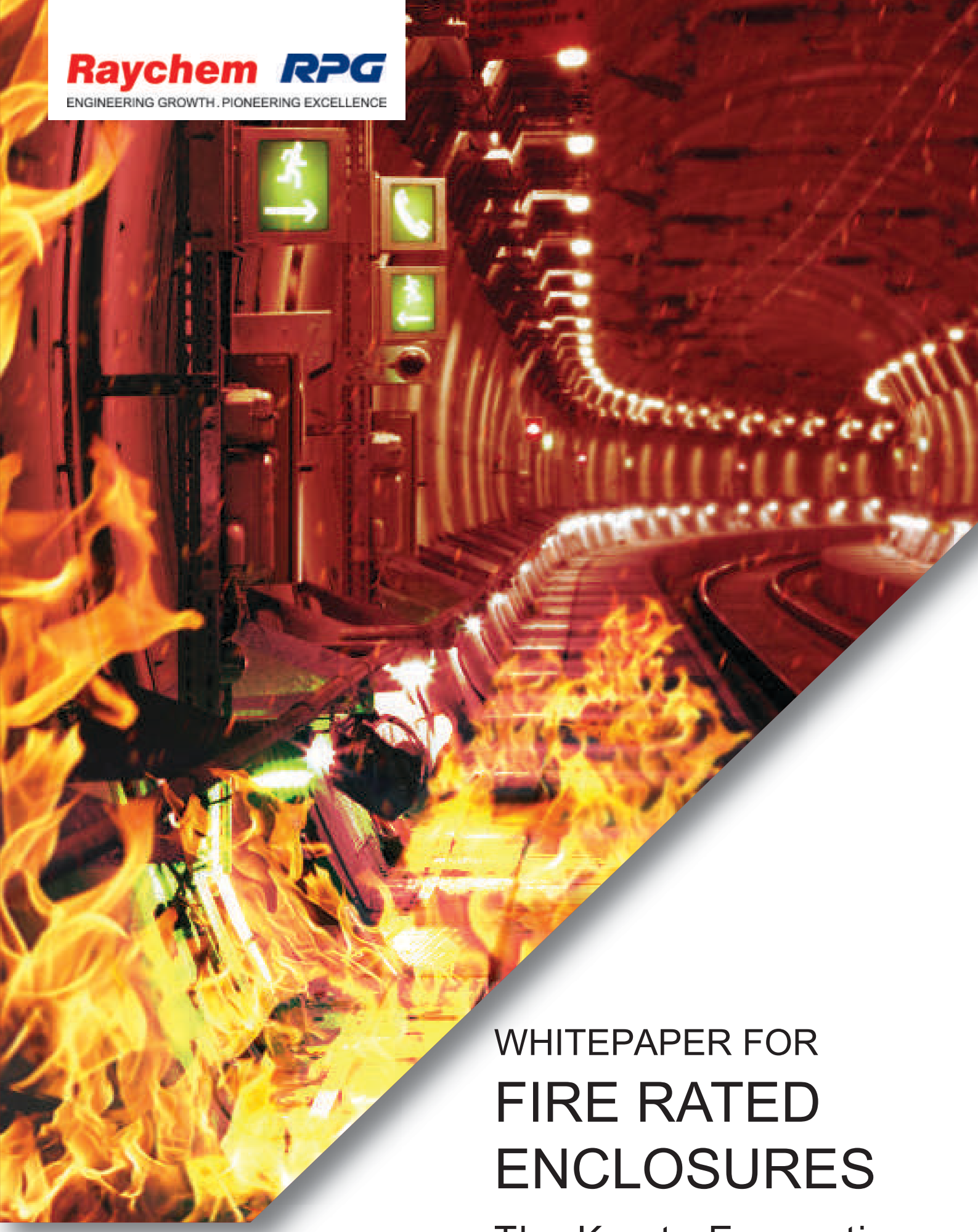


WHITEPAPER FOR

FIRE RATED ENCLOSURES

The Key to Evacuation In Emergency Situations

TE connectivity RPG

(A TE-Connectivity - RPG Enterprises JV)

INTRODUCTION

The US National Fire Safety Protection Association reported in “Fires in US Industrial or Manufacturing Properties” that annually an average of 37000 fires were reported across industrial facilities causing $ 1 Billion in direct property damage as well as civilian deaths and injuries(1).

When a fire breaks out in industrial facilities or in crowded locations, the evacuation of the people becomes the top priority. This requires that several critical electrical systems maintain their functionality for an adequate duration of time even in the face of fire. In this Whitepaper, we will focus on fire rated enclosures and the key role the right enclosures can play in helping such key electrical systems maintain their functionality under demanding circumstances.

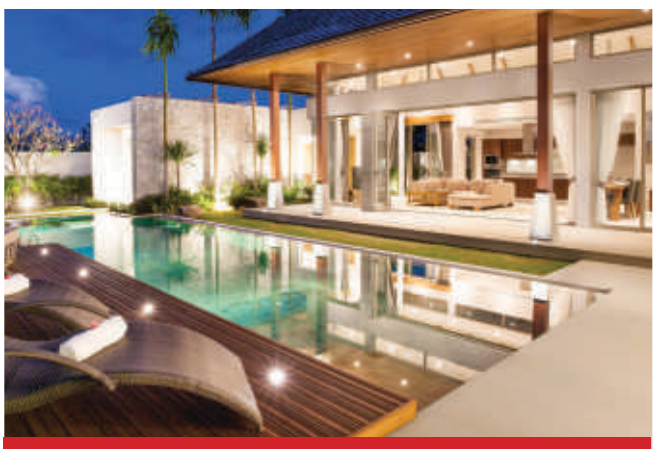
APPLICATIONS

UNDERGROUND RAILWAYS

AIRPORTS

COMMERCIAL BUILDINGS

HOSPITALS



HOTELS & RESTAURANTS

CHEMICAL INDUSTRY

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THE DANGER AND DAMAGE FROM FIRE IN INDUSTRIAL SITUATIONS.

Contents :

An Industrial fire is a type of industrial disaster involving a conflagration which occurs in an industrial setting. Industrial fires often, but not always, occur together with explosions. They are most likely to occur in facilities where there is a lot of flammable material present. Such material can include petroleum, petroleum products such as petrochemicals, or natural gas. Processing flammable materials such as hydrocarbons in units at high temperature and/or high pressure makes the hazards more severe. (2)

A significant proportion of industrial accidents are fire-related. That apart, the costs associated with industrial accidents are disproportionately skewed towards fire-related accidents. This proportion is even higher in industries like chemicals, petroleum, and similar industries. Industrial fires can cause damage to personnel, facilities, and surrounding areas. The hazards presented by industrial fires could be direct or indirect and include the following:

1. Heat and Thermal Radiation: Industrial fires can reach temperatures of close to 900°C. Exposure to flames and to the heat and thermal radiation generated by these flames can injure or kill people. Even exposure to thermal radiation of as little as 20 seconds at 370°C can cause second degree burns on exposed skin. Heat and flames can also cause severe damage to equipment and property. Structural damage to the facility could also result when the heat alters the fundamental properties of the load-bearing members of the building and weakens them. Another significant impact is that the electrical systems may become inoperable as cables, junction boxes, and other key equipment may get compromised by the flames or the heat.

2. Smoke: Smoke is a mixture of soot particles, toxic gases, and water vapour at extremely high temperature. Smoke kills more people than flames. Smoke is responsible for suffocation immediately and causes long-term lung damage and damage to other organs even after shorter exposures. Smoke also carries with it soot particles of varying sizes and density. Soot absorbs toxic gases that result from the combustion and this causes major damage to the lining of the lungs when inhaled. Soot can also cause significant structural and property damage. As smoke can spread beyond the area of the directly affected facility it can cause physical and environmental damage in a much wider area when carried by wind.

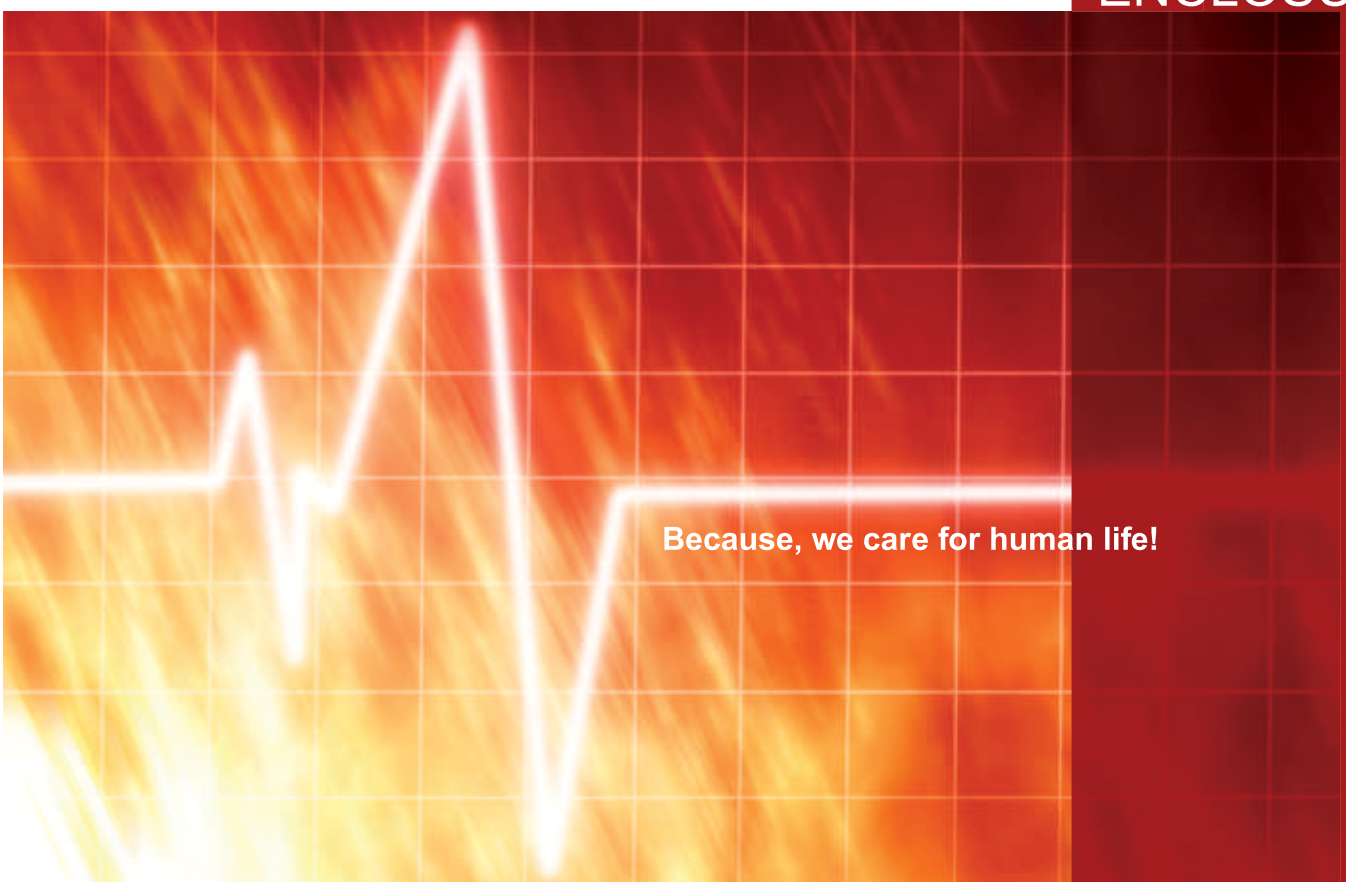
3. Boiling Liquid Expanding Vapor Explosion (BLEVE): This is an indirect result of industrial fires and it occurs when the surrounding fire heats up liquid stored inside a sealed or closed storage vessel to past it's boiling point. The pressure builds up as the resulting vapor gets trapped inside the vessel to a point where the vessel fails. The consequent explosion violently distributes the vessel fragments over the surrounding area. This can also set off a chain reaction as other pipes, valves, and storage vessels can get damaged by these fragments.

4. Boilover: This hazard is prevalent in cases where water is used to set out oil or petrochemical fires within enclosed or semi-enclosed locations. The water that sinks to the bottom of the containers boils over into steam and expels the fuel up and over the edge of the container to spread uncontrolled over a wide area.

The hazards from industrial fire are many and this places a great responsibility on the organization to ensure the safety of the workers. Providing solutions that allow for evacuation of personnel from the areas directly impacted by industrial fires as well as areas that could potentially be indirectly impacted both become key considerations.

THE NEED FOR FIRE RATED ENCLOSURES

The primary task in case of industrial fires is to evacuate the personnel to a safe location. This becomes a challenge when the electrical systems get compromised. Critical equipment like emergency lighting, fire-fighting and safety systems, and communications equipment can be rendered inoperable if the electrical systems get damaged. The need is to ensure

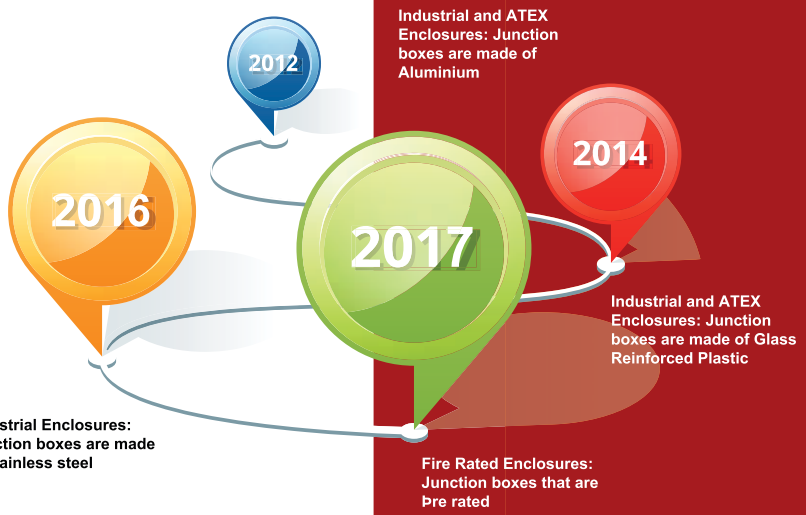


that the electrical systems remain operational for long enough to allow the personnel to be safely evacuated. The critical electrical systems like fire-fighting equipment and emergency lighting have to be designed and installed in such a manner that ensures their survival in case of fire. This also calls for a special emphasis on the protection of components like fire dampers, actuators, and cables.

A critical role in keeping the electrical systems functional for an extended period of time is fulfilled by junction boxes or enclosures. If the junction boxes and enclosures are fire rated they can withstand the temperature, physical impacts from the fire, water from the fire-fighting equipment, and other consequences. For some time this prevents the fire from reaching the equipment and shutting them down. Fire rated enclosures form a protective barrier around the sensitive equipment and keep the electricity flowing, emergency lighting working, and water pressure in the systems high enough for fire-fighting. This gives precious time for the personnel to be evacuated from the premises.

THE TYPES OF ENCLOSURES

Enclosures are often used for harsh and demanding applications. They can be customized as per the specific requirements of the organization and the applicable conditions. There are a wide range of enclosures, classified based on their area of use, the material of construction, and utility. Over the last few years, enclosures have undergone a significant evolution and various types of enclosures and junction boxes are available now. As an example, our own product range has evolved to address specific needs and add specific capabilities.



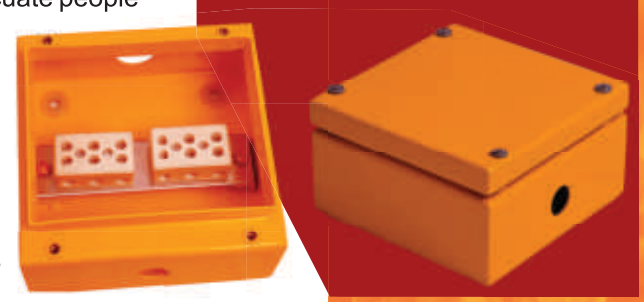
2012 – Industrial & ATEX Enclosures (Material Aluminum) : These can be made as Standard or specifically rated to withstand explosions, hence EX. The primary utility is in areas like automation, process control, mining, in the oil and gas sector, in the renewable energy sector, and within locomotives.

2014 – Industrial & ATEX Enclosures (Material Glass Reinforced Polyester) : These could be made as Standard or specifically rated to withstand explosions, hence EX. The primary utility is in areas like automation, mining, in the oil and gas sector, in the renewable energy sector, and in the marine sector.

2016 – Industrial Enclosures (Material Stainless Steel) : These have found application in the process control, automation, pharmaceuticals, and the food and beverages sector.

Mild Steel junction boxes are also available, finding applications in industries where SS is not called for. This includes the process control, automation, machine building, and infrastructure industries.

2017 – Fire Rated Enclosures: These are intended for specific applications in places where there exists a greater need to evacuate people in the event of fires. These include locations like hospitals, tunnels, airports, hotels, commercial buildings, and within the chemical industry.



Selecting the right material to protect enclosures has become a complex task with several new materials developed over the span of the past five decades(3). Electrical control designers and panel builders must make sure that the material they select not only ensures the safety of the electrical equipment but also helps in meeting the product's performance goal. Exposure to harsh environmental conditions such as dirt, dust, soot or water can be detrimental to the life of the product. This is more than about selecting a sealed box and mounting the hardware in it. Electrical control designers and panel builders must ensure that they select an enclosure that can defend their system against the environment. Additionally, they also have to assess cable management, heat from the hardware, the in and out connectivity from the hardware, and clear space requirements to ensure optimal product performance. More details about the considerations that can assist in enclosure material selection are available in our blog.

We have seen earlier the specific utility demanded of fire rated enclosures. When enclosures are designed to be fire rated they have to fulfill some very specific requirements. Chief among them is the ability to maintain electrical continuity for an adequate length of time, usually 90+ minutes, even in the face of temperatures as high as 950°C. These enclosures must also be designed to prevent the water being used to fight the fire entering the enclosures with the live electrical equipment. Industrial fire can also cause structural damage to the building and this carries with it the risk of physical impact on the junction boxes from debris or falling objects. The enclosures must be able to withstand such impacts too.

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WHAT GOES INTO THE MAKING OF A FIRE RATED JUNCTION ENCLOSURE

A typical junction box has several important components. In case of fire rated junction boxes, each of these individual components as well as how they come together must be specifically designed to deliver the desired utility. Some design considerations include:

- **Ceramic Terminal Block:** Should be capable of withstanding a temperature of 2000 °C
- **Fire Rated Cables:** Should be capable of withstanding a temperature of 950 °C
- **Stainless Steel Cable Glands & Mounting Bracket:** Should be capable of withstanding a temperature of 1450 °C
- **Sheet Steel Enclosure & Mounting Strip:** Should be capable of withstanding a temperature of 1370 °C
- **Silicon VMQ Gasket:** To provide ingress protection up to IP 65

Enclosures must conform to specific Standards to be accepted as fire rated. A range of standards bodies like IEC, CENELEC, and region-specific bodies have specified standards to be adhered to and test protocols to be followed to certify this adherence. The standards specify the capabilities of the enclosures to withstand fire as well as fire with other accompanying conditions. Tests focus on the capability of the enclosure to withstand the fire and associated damage. Other tests focus on the ability of the enclosure to perform its function as a part of the system in the event a fire occurs. Testing the enclosures to ensure conformance with the standards as well as with the specifications designed for is extremely critical. Some commonly used standards and the tests they specify are:

BS6387 Fire Test: The standard specifies 3 separate tests as follows:

- Category C test for fire alone that tests the enclosures at 950 °C for 3 hours with powered cables.
- Category W test for fire with water that tests for the flame at 650 °C for 15 minutes and then for flame with a water spray for another 15 minutes.
- Category Z test for fire with mechanical shock. This tests the enclosure for flame at 950 °C with a mechanical shock applied at intervals of every 30 seconds for 15 minutes.

This test ensures the electrical circuit integrity during the testing of all three categories.

IEC331 Fire Test : Specifies that the enclosure must withstand 750 °C for 3 hours followed by a visual inspection.

DIN 4102-12: This specifies testing the enclosure at 950°C for 90 minutes in a closed chamber. The main thing to check for is that the electrical continuity is maintained for the duration of the test. This would call for the integrity of the terminal block to be maintained and that the connections remain undamaged without melting or otherwise breaking.

Just how long the system integrity can be maintained in the event of a fire is a key measure. Systems are divided into E30, E60, and E90 groups. The number signifies the emergency running time, so the E30 groups provides system integrity for at least 30 minutes, E60 group for minimum 60 minutes, and E90 group for at least 90 minutes.

Different fire rated enclosures can help maintain functionality for differing lengths of time. Depending upon the time that the functionality can be maintained different levels of safety can be achieved. For instance, if the functionality is maintained for 30 minutes safe evacuation and rescue of people can be achieved. This would need for systems like safety lighting systems, fire control lifts, fire alarm systems, and fire extraction systems to remain functioning. If the functionality can be maintained for 90 minutes then this can help in effective fire-fighting. Effective fire-fighting needs the maintenance of electrical power to a variety of equipment like the fire water supply, the smoke extraction systems, smoke protection pressure systems, and the fire brigade lifts.

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CONCLUSION

The US Fire Administration reported that in 2015 there were over 3200 deaths and 15700 injuries due to fires.(4)

In case of fires in industrial settings or in places with high footfall, getting a reasonable amount of time to evacuate people from the premises could help prevent fatalities. Safe evacuation depends on the continued functioning of critical electrical systems that drive safety and fire-fighting equipment. Under the circumstances, providing the appropriate fire rated enclosures could make the difference between getting the time needed for a safe evacuation and falling short of time by crucial minutes. This should make fire rated enclosures an extremely key component of any industry's safety plans.

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