

## How to specify intumescent coatings

Specifying intumescent coatings can seem daunting, but getting it right is vital. During 2006, non-residential building fires caused 37 deaths and 1,482 non-fatal casualties ([www.communities.gov.uk/publications/fire/firestats2006summary](http://www.communities.gov.uk/publications/fire/firestats2006summary)). In addition, the May 2008 issue of *Fire Risk Management* analysed major building fires between June 2006 and May 2007. Omitting residential buildings, the remaining 90 cases had a combined cost of £103,372,248: an average of more than £1.1 million for a major building fire.

### Protection

Fire protection is essential for the safe escape of building occupants and to prevent or contain the spread of fire and smoke. Almost as important is limiting damage to building structures and reducing the risk of building collapse. From the legislative viewpoint, the Building Regulations contain requirements regarding fire protection, including the structural integrity of buildings.

There are two complementary classes of fire protection. Everybody is familiar with the active systems, including extinguishers, sprinklers, alarms and extract ventilation, which need little explanation. Passive systems, however, tend to pass unnoticed. Ranging from fire doors and ceilings to structural protection, their purpose is to compartmentalise, contain and hinder the spread of fire and smoke and to delay building collapse.

Our perception of steel as a strong material means that the need to protect it may not be obvious. During a building fire, the temperature can rise from its ambient norm, around 20° C, to 1,000° C, as does the temperature of the steel structure supporting the building. As it heats, steel loses its load-bearing strength. Eventually, it reaches 'critical temperature' and begins to buckle. Then the building is at risk of collapses.

### Options

There are three main ways to protect steel structures and meet Building Regulations requirements: boarding, sprays and intumescent coatings.

Boarding has been favoured for aesthetic reasons, but is impractical for the protection of more complex structures such as castellated or cellular beams featuring holes for services penetrations, and where the steel structure has been designed as an integral aesthetic feature within the building. In addition, application is not fast and both thickness and weight can be an issue in high-performance installations.

Cementitious sprays have been a low-cost compromise for some specifiers, as these can be applied to complex shapes and offer reasonable protection. The finish quality, however, renders them unsuitable when the steel members can be seen. They are also easily damaged and likely to need wire reinforcement for larger members.

Intumescent coatings offer a range of solutions without compromise. They are easily applied to any steel structure, either on- or off-site, offer a choice of protection times and have an appearance similar to that of a painted finish. They comprise a polyols carbon source, such as starch or pentaerythritol; ammonium phosphate as an organic acid source and an expanding agent, melamine. These are bound in a solvent- or water-based polymeric binder. Additional components enable easy application and fast drying.

When the temperature rises in a fire, a chemical reaction between the active components causes expansion to many times the coating's original thickness. This creates an insulating foam-like coating, which protects the steel by slowing the rise to its critical temperature. Coatings are rated according to the delay they offer: 30, 60, 90 or 120 minutes.

### **Criteria**

Opting to protect structural steel with intumescent coatings is not a difficult decision. The challenge to the architect, specifier or consultant is distinguishing between the broad ranges of product types. These offer differing characteristics, suiting different applications, and choosing the right one requires the accurate answering of a series of questions. Any reputable supplier should be able to offer detailed, impartial advice, but the quality of their recommendation will depend upon the amount of information given by the specifier.

The first issue will be the intended location of the steel structure: internal, external or semi-exposed. All coatings are subject to wear and tear, but varying degrees of resistance are available. Steel which will be sited wholly within an enclosed space can be given a less robust coating, as there is little need to withstand weathering. At the other extreme, steelwork that will be entirely exposed to the elements needs the most durable of treatments. Between the two, 'semi-exposed' structures are those, which are outside but partly protected, such as steel within a car park, which is roofed but has open walls.

In addition, the geographical location is a key factor; for health and safety reasons, being situated close to coasts and rivers imposes constraints upon product options. Alongside this, anyone recommending a coating type will have to know how long it needs to last; properly installed and maintained, the right coating could offer a virtually indefinite working life.

A fundamental issue will be when the coating is to be applied. If protection is to be factory-applied prior to erection, there is a broader range of possible solutions than if the coating is to be applied on-site.

In such cases, whether during initial construction or as refurbishment, health and safety issues need consideration. In some cases, off-site preparation may be mandatory.

A key consideration will be the Building Class, using the generally accepted classifications originally created by Corus. Three classes define the risk of corrosion, beyond normal weathering, to which coatings are exposed. In most areas of schools and airports, for example, steel is in a warm, dry interior that is considered C1, offering a very low corrosion risk. Where there is exposure to moisture, as in exhibition halls and vehicle depots, the risk is low, but the higher C2 classification is appropriate. Medium-risk installations, classified C3, include such locations as dairies and breweries where there is exposure to both moisture and pollution. Such sites as chemical plants need careful evaluation of the specific corrosion risks as part of the specifying process.

More straightforwardly, the supplier will next need to know the type of fire which is most likely to occur. For such premises as offices, this will normally be cellulosic, caused by the burning of such materials as wood, paper and fabrics. Cellulosic fires, slow to build, mandate a different type of coating to the intense, fast-spreading hydrocarbon fires involving such fuels as petrol, diesel and petrochemicals, typical of chemical plants and offshore facilities.

Deciding upon the fire rating — the duration that the steel structure is required to remain stable, from 30 to 120 minutes — is not normally difficult. It will be laid down in the Building Regulations, with the possibility of further requirements imposed by the relevant local authority.

A key influence on protection choice will be the nature of the steel structure itself, with typical possibilities including universal and channel sections in open-profile H or C shapes. Note that it does not suffice to state that the steel is hollow. It makes a difference to the suitability of particular product types whether the section is square, rectangular, circular; for bracing, the specifier will need to detail whether this comprises mainly hollow sections or is a solid circular rod. It also matters whether the section is left hollow or filled with concrete; filled sections require less material.

The level of detail required from specifiers may be surprising; it makes a difference whether a steel member is horizontal or vertical. It is possible that a beam and a column in the same room require slightly different treatment: generally beams require protection to 620° C, while columns need protection to 550° C. Finally, you should specify how many sides of each steel member would be exposed to a fire. If a beam supports a concrete floor, for example, then three sides of the steel are exposed.

## Suppliers

If you have answers to all of these questions, you are ready to contact a supplier. Your challenge is to find the right one. It should now be clear that this is a specialist area and a specifier contacting a non-specialist manufacturer should tread carefully. A generalist paint manufacturer, which also makes intumescent products, may not be the best option. The simple test of a supplier's commitment to intumescent coatings is to ask whether it has its own in-house testing facilities. This requires a furnace on-site for the ongoing ability to fire-test batches of product to ensure product consistency and quality. Consider carefully the commitment and ramifications of a company that does not have this in-house fire-testing facility.

Ask about test certification and do not accept less than the minimum level of product certification, testing to BS476: Part 20/21. Assessment should be conducted according to industry guidelines and certified by an independent third party, such as CERTFIRE or BRE. Third-party certification is the industry norm and helps to ensure consistency and correctness of testing and analysis. Remember that any coatings for specialist structures such as cellular beams or concrete-filled columns require specific testing and analysis.

Examine the level of technical back up on offer, both pre- and post-installation. Rule out any company that appears either unable or unwilling to answer every question you ask. As a standard filter, request clarification of the difference between water-based and solvent-based products and consider how well this is explained. Ask about experience. As with any product, a manufacturer with countless reference sites, installed over a period of decades, is likely to be a better bet than a relative newcomer. Consider whether a prospective supplier assumes that you already know the roles of primers and top coats, or takes the trouble to discuss these in detail.

Always bear in mind the potential consequences of specifying the wrong products. At the very least, if this is spotted prior to application, it will mean repeating the specification process. That brings project delays, additional expense and, perhaps, arguments over who will pick up the bill.

Finally, always remember that specifying products is not the end of ensuring fire protection. Even the very best products need to be installed properly, if they are to work correctly. Applying intumescent coatings is a specialist task and employing third-party applicators, accredited by the independent Intumescent Coatings Forum, is strongly recommended.

When protecting steel structures within buildings, you are investing in saving future costs and, potentially, lives. There is no room for compromise, as you are not merely looking for products, but for specialist expertise you can rely on.