



PR3-260505

**There is an increasing need for all specifiers of passive fire protection treatments and systems to ensure they comply with the existing legislative requirements covering this area of operation. The crucial criteria are laid down in Appendix A of Approved Document B to the Building Regulations (for England and Wales) or Technical Standards, Part D (for Scotland).**

Recently, question marks have been raised over the true efficacy of certain techniques commonplace in the construction industry. It is important that these are brought to the attention of all parties involved in both the specification and installation of such products – architects, structural engineers, contractors and sub-contractors alike.

The key concern is to establish what flaws might exist that could compromise the integrity of a particular system and prevent it from providing full and functional fire protection.

To this end, it would be useful to define precisely what we mean by 'system integrity':

*'The integrity of a system in fire protection refers to that system's ability to meet stated fire resistance criteria whatever its circumstances and location. If the uprightness and character for which the system was designed is breached, then the integrity of the system is undermined. Similarly, the heat transference must be resisted by the insulation properties offered by the system if that is a requirement.'*

## **Uncovering Some Hidden Dangers Behind Common Methods Of Protecting Structural Steel From Fire**

With this definition in mind, let us look at a couple of traditional ways of treating circular columns to assist fire protection.

'Concrete-filling' is one such method. This may have the benefit of reducing the fire protection requirement of the steel surface (and so maximize the usable space in a building) but the process is hardly straightforward. For a start, structural engineers need to be consulted to determine the stress and load on the beam. It may well be necessary to add reinforcing bars within the steel tube and, dependant on the structural requirements may need to be pre-stressed.

In addition, the concrete must be vibrated to release the air to achieve the correct density (circa 41Nm.) This limits the size at which concrete filling can be used, as the vibration unit needs to be placed all the way down the centre of the column. Corus have produced an instructive software package for this application.

The purpose of the concrete filling is to replace the steel section when it has lost its structural strength through heat. Corus advise that serious consideration be made to any construction less than 219mm

A 12mm hole, drilled through the steel into the hollow section is required at the base and just underneath the start of the floor above -or at 4m





PR3-260505

intervals - whichever is the least distance. The bottom hole is to allow the drainage of excess water. The upper hole is to allow steam to escape during the heating process in a fire that could otherwise rupture the steel section prematurely.

The alternative method of 'slurry-filled' columns is also well used. But there is no test data to support slurry filling – so again, the integrity of the system can be called into serious question. This method is only assumed to work. Specifiers should ask themselves how the column would survive, bearing in mind that concrete filling is compacted to achieve circa 41Nm. All fire protection systems should be tested to BS476 (part 20&21) and data for load testing is given in BS490.

Arguably, the most popular procedure for fire protection currently utilized is the practice of applying a thin-film intumescent coating to the steel prior to over-cladding it with a conventional board system.

On the face of it, this sounds like a thorough enough solution. However, there are some potentially critical drawbacks to take into account.

Intumescent coatings act by swelling up under fire conditions to form an insulating char. The expansion of thin film intumescent is quoted at generally 50 – 75 times thicker than the original coating.

This means that cladding systems fixed too close to the coated steel may inhibit the swelling characteristics of the intumescent and so reduce or negate its fire protective properties. Likewise, whilst cladding systems may be designed to fall away in the event of a fire, if this does not occur before the commencement of the intumescent swelling process, it may also inhibit the performance of the fire protection.

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Moreover, cladding systems often require fixings to be fastened to the steel and such fixings may again inhibit the swelling process of the intumescent and render the protection inadequate.

The crux of the problem is that all too often the manufacturer fails to recommend sufficient to be allowed between the surface of its intumescent and the inside of the secondary cladding. In fairness this could be because insufficient information has been given. Little wonder, then, that the integrity of such a system can be easily breached.

Neither is this scenario confined to purely commercial buildings. Many modern private developments incorporate circular hollow sections in open-plan spaces such as large kitchen/dining areas. The usual method of fire protection here is to use thin-film intumescent on the column to provide the required insulation.

The trouble is that the final occupant is unlikely to know what maintenance and repairs are needed to keep the protection intact. Failure, for example, to keep the top seal in good order will mean the intumescent beneath the decorative coating will break down over time and the integrity of the system therefore seriously compromised. Similarly the integrity of a fire tested board system, commonly used and economical method of protection to structural steel is dependant on the board not being damaged over time. A cracked board needs to be replaced. The replacement can be expensive particularly if the material is used for a feature column which has also been plastered.





PR3-260505

Owners or tenants need to be made aware that any warranty is dependent on regular maintenance checks - and that insurance cover in the event of a fire could be badly jeopardized.

So, what can be done to prevent all these potential pitfalls and possible malfunction of the fire protection properties of such systems?

An obvious answer is to use a medium that is sufficiently robust, but also flexible enough, to overcome the limitations of ordinary thin-film intumescent and other conventional ways of fire protecting circular hollow sections.

One material that fits this bill is epoxy intumescent, originally developed for use on offshore oil rigs. In this environment, the formulation proved quite capable of withstanding blast and jet fire conditions—and also extreme cold (suggest omitting this), chemical attack, abrasion, corrosion, and major impact. Significantly this material is not dependant on the top decorative coat for the system to work over time.

Epoxy intumescent is basically heavily filled intumescent in an epoxy medium. It may also contain carbon fibres to increase flexibility and provide added insulation. But it is the medium that makes the big difference. This is the key to epoxy intumescent's superior longevity and durability.

The other important and distinguishing attribute is its much lower expansion rate. The expansion for thin-film intumescent is between 50–75 times, whereas the rate for epoxy is only x 5–8.

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Typical key data and substantiations for epoxy intumescent, are as follows:

- tested to BS476 (parts 20 & 21)
  - tested in both cellulosic and hydrocarbon conditions (up to 4 hours)
  - certificate of approval from Lloyd's supported by Warrington Fire Research
  - jet fire test by SINTAF (Norway)
  - blast test by Building Research Establishment (Cardington)

Given all these stringent tests and certifications, it is clear how the basic material of epoxy intumescent can be deployed as a top quality fire protection medium in the construction industry.

If architects and other specifiers are going to be able to recommend a method of fire protection that is relatively easy to apply and guaranteed to deliver an optimum level of efficacy, then epoxy intumescent must surely feature in such systems in the future.

