

# BOLT CAPS

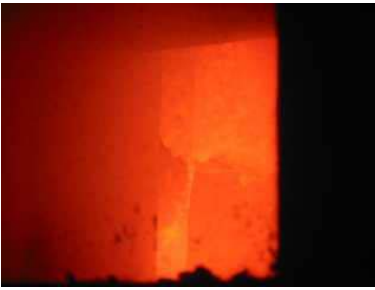
## Introduction



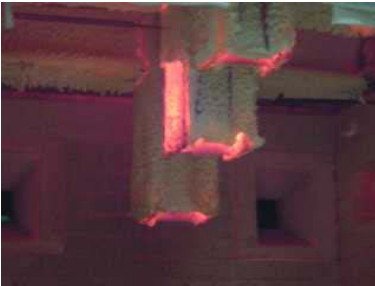
It has long been felt that the bolted connections in multi-storey steel frames have been the Achilles' heel in fire resistant design. The connection is a critical element of the frame, and is never treated as such. The Boltcap is a solution designed to satisfy this problem, and the data below outlines the indicative requirements as well as the performance of the 'Boltcap', as tested to date.

## Requirements

There are presently no definitive standards for the protection of structural connections. It can be assumed that where the steel frame is encased with either 'boarded' or 'sprayed' protection the connection will maintain a 'similar' degree of protection as the beam. However, where intumescent paint is applied, the bolts rarely receive protection that is easily quantified. Furthermore, the paint is usually applied to untreated surfaces, begging the question of sufficient adhesion.



It has additionally been demonstrated that theoretical failure of the bolts can take place at lower temperatures than the structural elements they are connecting, questioning the viability of providing equivalent protection to that on the beams and columns (studies and fire tests carried out by The Steel Construction Institute\*)



## The Solution

A research project has been ongoing during the last 4 years involving fire engineers, material technologists, manufacturers and applicators into a method of applying an enhanced level of protection to the bolts, whilst endeavouring to keep within the tight cost constraints typical in the construction market place.

The Boltcap has been independently tested on two occasions on an ad hoc basis (as a standard test has not been defined so far), and it is intended that a full 'Loss Prevention Certification Board' certificate will be applied for in due course, based on the results gathered to date.



During testing, the Boltcap is seen to provide sufficient external protection to ensure the bolts remain within their limiting temperature for a period of 90 minutes, addressing the growing need in multi-storey construction to meet the increasing degree of performance demanded for Eurocode structural fire engineering. Additional development and testing will, in due course, allow the bolt cap protection period to be increased to 120 minutes.

\*Subsequent to the publication of BS 5950: Part 8 a series of tests were carried out by Kirby to assess the degradation of high strength Grade 8.8 bolt characteristics at elevated temperatures. In all tests a similar pattern of degradation was observed, with the bolts showing a marked reduction in strength between 300°C and 700°C. Based on a study of the findings a proposal was made to amend the guidance presented in BS 5950: Part 8 to reflect more closely the influence of temperature on ultimate bolt capacity.

## The Performance

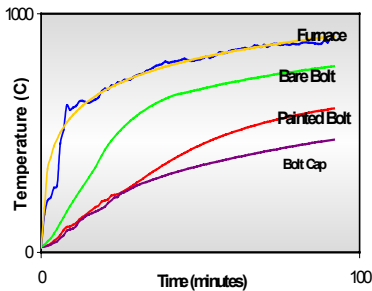


The technology utilised is the additive “Cirtam”, which by its nature provides both ‘toughening’ and ‘thermal’ enhancing properties to the base material polyester dough moulding compound. The thermal properties insulate the bolts without the need for an intumescent ‘swelling’ requirement.

As can be seen in figure 1, the curve for the capped bolts (a mean across a number of tests carried out by an independent manufacturer) shows considerably increased protection to the bolted connections compared with unpainted and painted bolts.



Initial research indicates that the bolt temperature should lag that of the structural elements by some 70 degrees C. With a mean value inside the bolt protected by a boltcap of 467 degrees C compared to 734 degrees C without a cap, it is clear that the boltcap adds considerable protection. Similar independent tests indicate that the painted bolt, after 90 minutes, reaches a mean temperature of 600 degrees C. If the limiting temperature of a worst case element (for instance a column) is taken as 520 degrees C, it is seen that the Boltcap is the only viable solution.



This data demonstrates that, not only is the capped solution enhancing the present degree of protection, it is the sole solution maintaining the bolts at a temperature anywhere near those required to ensure structural stability.

## The Benefits

The Boltcap:

- provides a level of fire protection to structural bolts unachievable by present methods
- provides a Quality Controlled product that can be visually inspected
- provides an aesthetically pleasing finish to exposed steelwork
- provides colour options as it can be supplied in any specified colour
- provides a cost effective solution
- provides a sprung friction grip connection which will expand with the heating bolt
- provides an easily manufactured and transported product; can be manufactured globally
- provides a simple-to-fix solution, which fits the fire stopping package
- provides an easily specified solution to a critical element of the structure, previously unaddressed
- provides enhanced fire safety
- provides enhanced corrosion protection



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