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# The Performance and Protection of Bolts in Structural Connections at High Temperature It Needs Doing Properly



# Connection Protection Protocols



TECHNICAL ADVISORY DOCUMENT TAD0016

## On-Site Treatment of Boltheads and Nuts

When erecting steel structures nuts and bolts (bolts) are the most common means of fixing the connections, once in place consideration should be given to the protection of these bolts. Typically bolts may be plain steel or could be treated in some way:

- Black Bolts – untreated steel bolts
- Galvanised Bolts – hot-dipped galvanised steel bolts
- Sheradised Bolts – zinc coated (via thermal deposition) bolts
- Greenkote Bolts – zinc/aluminium coated (via thermal deposition) bolts

Based on extensive experience Sherwin-Williams Protective and Marine Coatings would offer the following advice for the treatment of bolts:

The preparation of a surface to be painted is critical; it is a long established and well documented fact that most premature coating failures are due to poor substrate preparation. Almost without exception the best form of surface preparation is abrasive blast cleaning but it is recognised that to specify blast cleaning for bolts may be impractical and unrealistic. Sherwin-Williams Protective and Marine Coatings therefore suggest the following alternative preparation for bolts.

### Where Corrosion Protection is Required

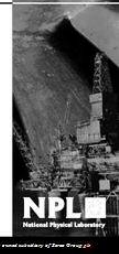
Environment	Surface Preparation	Coating System
C1 and C2	Remove any contamination such as zinc salts then degrease with Envirogard W500 Degreaser. Thoroughly dry the nuts and bolts. <sup>1</sup>	Apply the same coating scheme to the bolts as used on the steelwork.
C3, C4 and C5	As for C1 and C2, then: Black Bolts should be mechanically prepared to Sd. Galvanised and Sheradised Bolts should be treated with Leight L700 Mordant Wash. Greenkote Bolts should be degreased with Envirogard W500 Degreaser. Thoroughly dry the nuts and bolts.	One of the primers shown below should be used. This should be followed by the buldoat and/or finish used on the steelwork. If the coating system is greater than 250µ dry film thickness (DFT) please consult Sherwin-Williams Protective and Marine Coatings for advice.

<sup>1</sup> In certain circumstances it may not be necessary to coat galvanised, Sheradised or Greenkote bolts in C1 and C2 environments, contact Sherwin-Williams Protective and Marine Coatings for advice.

- **Constructional steelwork** usually involves bolted connections needing **fire protection**
- **ASFP TGD016 & TGD011** set out the protocols for applying intumescent coatings to bolts
- **BS 5950-8** defines the coating thickness dft for the steel members and the bolts
- **ASFP Yellow Book** stresses that the specifier must understand that bolt preparation conditions *must be within the scope of certification of the intumescent product*
- **BS 5950-8** requires **test evidence** if coating thickness is to be reduced on bolts
- **ASFP method statement (N74)** for treating bolts advises **inspecting bolts** with thickness and adhesion checks
- **Paint manufacturers** advise **several visits** to a connection to ensure meeting fire rating requirements
- **Traditional protocols stipulate Mordant or T-wash** and subsequent rinse and dry before paint application **within 4 hours.**

Guides to Good Practice  
in Corrosion Control!

Surface  
Preparation  
for Coating



NPL  
National Physical Laboratory

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# Examples Of Where Fire Protection Of The Bolted Connections Has Failed

- Twin towers



## Concrete Evidence!

Safety... a Concrete Advantage when we talk about Structural Integrity

A demonstration of the structural integrity of cast-in-place reinforced concrete over steel construction was the recent fire at Madrid's Windsor Tower. Evidence of the disaster was used at the Fifth Concrete Fire Forum in London recently to examine how concrete can contribute to the science of structural fire engineering.

The 30-story landmark was consumed in a top-to-bottom blaze that raged for 36 hours on Feb. 14 to 15.


The building featured a concrete core with concrete columns up to the 21<sup>st</sup> floor. Columns on the 22 to 30<sup>th</sup> floors were steel. Despite the intensity and duration of the fire, the concrete core, floors and columns of the first 21 floors remained intact. The steel supported upper floors, meanwhile collapsed, leaving the concrete core in-situ and exposed.

Engineers agree the building remained standing thanks to the excellent fire resistance of the building's cast in place reinforced concrete construction.

*The Concrete Alliance, Inc. represents the New York Concrete Construction Institute, New York Concrete Promotional Council and a consortium of skilled New York area unions:*

Cement & Concrete Workers D.C.  
Metallic Lathers Union Local 46  
NYC District Council of Carpenters  
Teamsters Union Local 282  
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Phone 212-575-0950  
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## Connection Tests

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- **Loaded beam tests** show that **ONLY** if proper recommendations are followed will the painted connections meet the **SAME** level of fire protection as the beam as per specification – this will take **AT LEAST 100 minutes per connection** plus access time – using bolt caps it is **less than 5 minutes**.

- Numerous **examples exist of poor quality** bolted connection protection exist e.g.

- Bolts with **paint cracking**



- Bolts with **uneven paint**



- Bolts with **shiny unpainted threads**

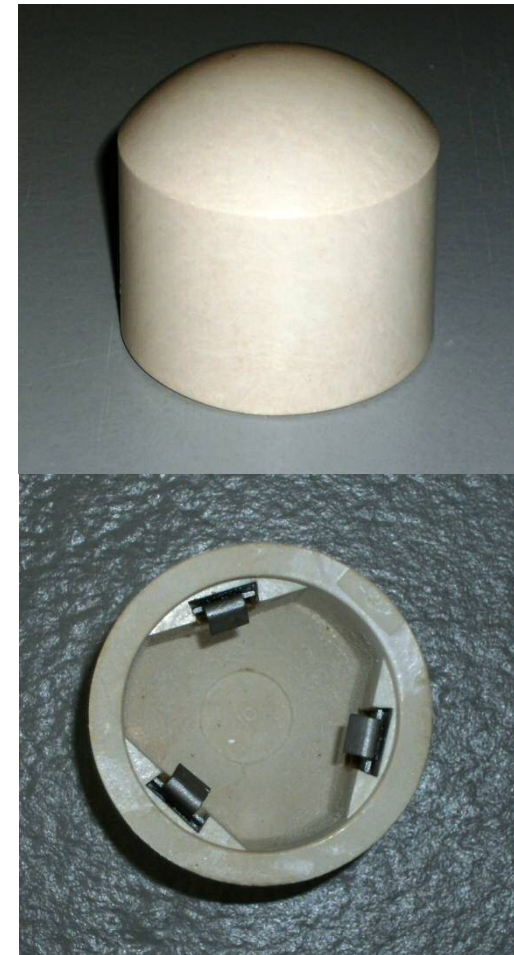


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## Eliminate Risk & Uncertainty

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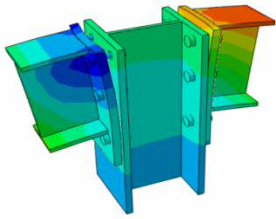
- **Use a Bolt Cap** ⇒ **quick and easy**
- **Fire tested**
  - **3 hr Cellulosic** rating per ASTM UL263
  - **2 hr Cellulosic** rating per BS476
  - **2 hr Hydrocarbon** rating per UL1709
  - **2 hr Jet Fire** rating per ISO 22899
- **Installation – 3 Seconds per bolt**
  - Snapped into place
  - Corrosion resistant clips
  - No surface prep or primer
- **Successful Installation History** in external and internal sites with extensive testing
- **Not affected** by extremes of environment
- **Inspection** is visual and easy



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## Conclusion

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- Bolt Caps take 3 seconds per bolt to clip in place with no preparation needed & give 30 year life and certainty of protection to jet fire levels.
  - Easy subsequent gloss/colour painting for exposed connections.
  - Quality assured protection at minimum cost.
  - Cost and time is eliminated if the bolt cap is fitted when floor levelling.
  - No acid washing or possibility of enhanced acid/stress corrosion of bolts, no wet trades on site, no messy connections or connections with insufficient paint, no need for several visits, shuttering and drying, scaffolding over the edge for access, costly inspection, time constraints between coatings, and so on.
  - Caps give cost saving over the proper painting cost when carried out to the fire certificate test standard.
  - Caps give significant time saving (~ 95 minutes per connection), and save significant build programme time as no need for multiple visits.
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