# DURABILITY of **GALVANIZED STEEL LINTELS**

# VS

# INORGANIC ZINC SILICATE PAINT

*Practical information to Builders, Owner Builders and Specifiers*

Direct reference to the corrosion protection of built-in structural steel members such as lintels, shelf angles, connectors, accessories (other than wall ties) in accordance with BCA 2009/10 Vol. 2 Table 3.3.3.2 in Section 3.3.3.5 Corrosion Protection.

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**In 2010 there were changes to the Building Code of Australia (BCA) to meet with the current performance based specifications with respect to lintels, shelf angles, connectors, accessories (other than wall ties) used in the building and construction industry.**

These changes are in fact an upgrade to improve installation efficiency, extend service life (durability) and to contain costs.

**Principle Changes**

(1) There are 5 recognised zones of steel corrosion used in the Australian and New Zealand and International Standards. There is now a schedule of coating systems suitable for built-in structures (e.g. lintels) in each of the 5 exposure conditions.

(2) The minimum steel surface preparation requirement has increased from limited hand wire brushing to blast cleaning to Grade 2.5 which is typically a mechanical clean. This means all surfaces must be **clean**, sound and free from dust, oils, grease or contaminants (Table 1).

(3) There is guidance on references and methods to best predict corrosion rates at various locations by consideration of the following factors:

- Climatic conditions and seasonal variations
- Humidity occurrence
- Condensations and its resulting time of steel surface wetness
- Topography
- Wind influence
- Microclimates -coastal, industrial, agricultural
- Sheltered dampness

Much of the supporting data for these changes can be found in AS2312 -2002.

**GALVANIZED STEEL OR INORGANIC ZINC SILICATE PAINT COATING**

The minimum protective coating to provide the most appropriate durability depends upon the highest expected level of exposure to pollutants and potential build-up on the surface of the steel.

If a zinc silicate paint system is selected, the changes to the BCA now require the surface of plain steel to be **Near-White Blast Clean** prior to the application of a zinc silicate paint system when produced on site or in a factory. A galvanized steel coating does not require this surface preparation or added cost.

**TABLE 1**: Definition of **Near-White Blast Cleaning** Surface Finishing for Painted Coatings on Plain Steel

| **AS/NZS: 1627.4 Class 2.5, Sa 2-1/2, SSPC-SP10 or NACE - 2** |
|---|
| Removal of all mill scale, rust, rust scale, paint, contaminates and other foreign material by using impact abrasives or by wheel abrader.<br><br>A near-white abrasive surface finish removes all contaminates except for very light shadows, light streaks or staining. |

**GALVANIZED STEEL** offers a continuous zinc alloy coating over the total surface of the base steel.

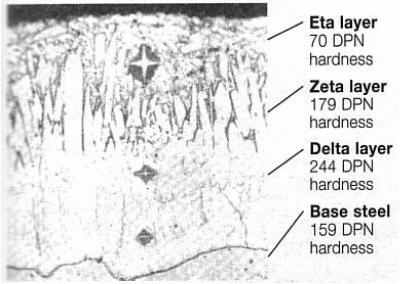


**Figure 1**: Alloy layers of zinc with steel formed during standard hot dip galvanizing

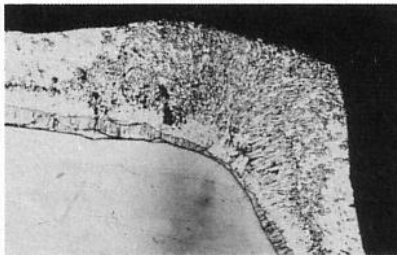

**Figure 2**: Thicker coating on corners after standard hot dip galvanizing

The corrosion rate of the coating decreases significantly as the zeta and delta (Figure 1) layers are revealed/uncovered after many years of exposure to the surrounding environment. The edges of the steel have a thicker galvanized coating and it is the zinc-iron alloys that provide the toughness with regard to damage during transportation and installation.

**THE ZINC SILICATE PAINT COATING SYSTEM** requires several coats to be applied to provide adequate dry film thickness (DFT) as required in the BCA Table 3.3.3.2 for medium and high environmental conditions, with a minimum of 100µm.

The zinc silicate system is an inorganic paint in which zinc metal dust is mixed into the coating. All these metal particles are subsequently consumed at the same time as the coating is protecting the steel substrate. This is a problematic characteristic of the zinc silicate paint system as it needs to be replaced once the zinc in the coating has been consumed.

Zinc silicate paint films have around 85% zinc by weight as per ISO12944-5 requirements and have good corrosion resistance but significantly less durability than 600g/$m^2$ hot dip galvanized steel in most environments and applications, e.g. steel lintels.

The problem is that the zinc particles near the surface of the paint film operate independent of each other. They are not a continuous self healing barrier to corrosion. Once the zinc particles have corroded and are consumed, they leave behind a small hole in the paint film which retains moisture and can accelerate the degradation of the paint.

The zinc in the hot dip galvanized coating is a continuous casing, as it chemically reacts with the steel creating metallurgical bonds which therefore generate direct contact and offer cathodic protection for the steel substrate.

The adhesion of the galvanized coating is so high it cannot be measured as the coating is actually alloyed with the substrate. The painted zinc silicate coating is limited by the adhesion strength of the coating to the steel, which is significantly lower.

**DURABILITY: Hot dip galvanizing's zinc performance improves with age, zinc silicate coating's performance decreases with age.**

Figure 1 shows the different alloy layers within the galvanized coating on the steel. Of these layers, it is the zeta alloy layer which offers the highest corrosion resistance. Simply put, as the coating corrodes after a long exposure period (years) and this layer is finally revealed/uncovered, corrosion takes place at an even slower rate. Hence, the older the galvanized coating the better it works.

Zinc silicates have the opposite performance; the older the coating the worse it performs because there is less zinc (weight /weight) and formation of micro voids which can retain moisture and result in accelerated degradation of the paint film and corrosion of the steel substrate.

Other significant problems with the zinc silicate coating are the cost for surface preparation, damage to the coating during shipping or installation (and cost of repair) and typically lower coating thickness on the edges which make it more vulnerable to damage (Figure 2).

**HOT DIP GALVANIZING: First and last line of defence.**

A very large proportion of the inhabited part of Australia is located in the medium to high corrosivity environments listed in BCA 2009/10 Vol. 2 Table 3.3.3.2 in Section 3.3.3.5 Corrosion Protection.

For the majority, when building it is a wise and significantly more durable option to use a galvanized lintel than to rely on a painted finish as your first and last line of defence against corrosion of structural components. Even in high corrosivity environments, and if any additional paint coating fails, there is still the assurance that the underlying galvanized zinc coating will protect the structural steel.