

Specifying Cable Containment Products to Eliminate Zinc Whiskers

The existence of zinc whiskers in data centre installations and the devastating effect they can have on mission critical IT systems has been extensively researched and documented. The risk of zinc whiskers from cable containment products is removed by specifying a suitable hot-dip galvanised finish rather than an electroplated zinc finish.

However, the current trend of merely stating the simple phrase 'hot-dip galvanised finish' can be ambiguous and without the correct British Standard classification has led to much confusion and the possibility of an even worse contamination by zinc flakes.

This White Paper examines the cause of zinc whiskers, reviews suggested solutions and defines the correct hot-dip galvanised resolution. It concludes with a detailed specification for cable containment products that will eliminate zinc whiskers and zinc flakes.

What is a Zinc Whisker?



Zinc whiskers are tiny filaments of zinc that grow from steel surfaces that have been electroplated zinc (zinc plated). The electroplating process forms a continuous layer of zinc atoms under compressive stress. The atoms are squeezed together and force zinc whiskers to extend from the surface. These whiskers break off, become airborne in the air cooling systems, enter the hardware equipment and cause short circuit damage to IT systems.

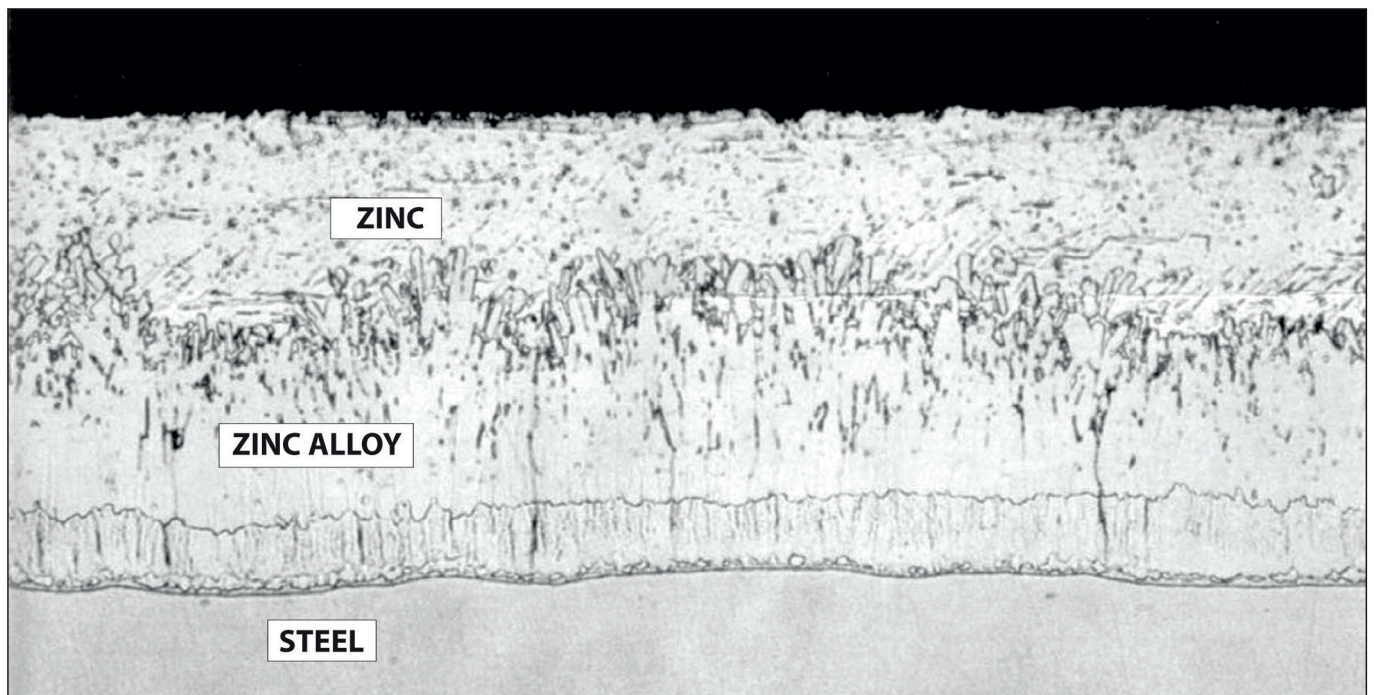
The image above shows zinc whiskers growing from an electroplated zinc surface.

Unsuitable Initial Solution

The first solution proposed by specifiers was for cable containment with a 'passivated finish'. Unfortunately this passivated finish (yellow in appearance) is still an electroplated zinc finish with a yellow chromate film on its surface rather than the normal clear chromate film (silver in appearance). Technically this passivated finish affords slightly greater corrosive resistance than the silver finish and it was hoped that this property would provide a better 'seal' on the underlying zinc whisker growth. In practice however, the yellow chromate is still a very thin layer that only provides an initial protection during storage and transportation. Zinc whiskers will grow in the same way as the electroplated zinc 'silver' finish.

Appropriate Current Solution

Having realised the frailty of the 'passivated finish' specifications have been amended to require cable containment with a 'hot-dip galvanised finish'. This process involves immersing the steel in a bath of molten zinc which forms a zinc alloy layer. These atoms are not therefore, under a compressive stress so do not subsequently form zinc whiskers. The photomicrograph below shows a cross section of a hot-dip galvanised coating.



Defining the Correct Hot-Dip Galvanised Solution

However, care must be taken as there are 2 distinct types of hot-dip galvanised finish available for cable containment products commonly known as pre-galv and post-galv. The pre-galv surface is clean and smooth whereas the post-galv is uneven and has a tendency to deposit flakes of zinc that could be equally damaging as zinc whiskers.

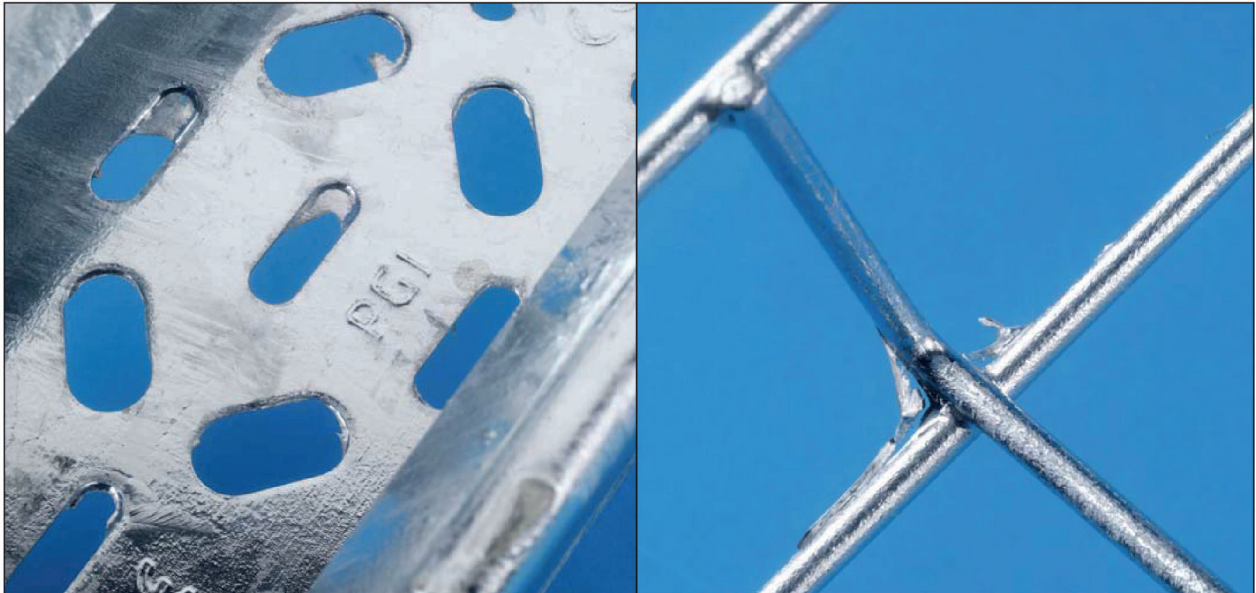
In order to fully understand the difference between post-galv and pre-galv finishes we firstly need to understand the two processes and look at the resulting surface finish.

Post-Galv Type Hot-Dip Galvanising Process (BS EN ISO 1461)

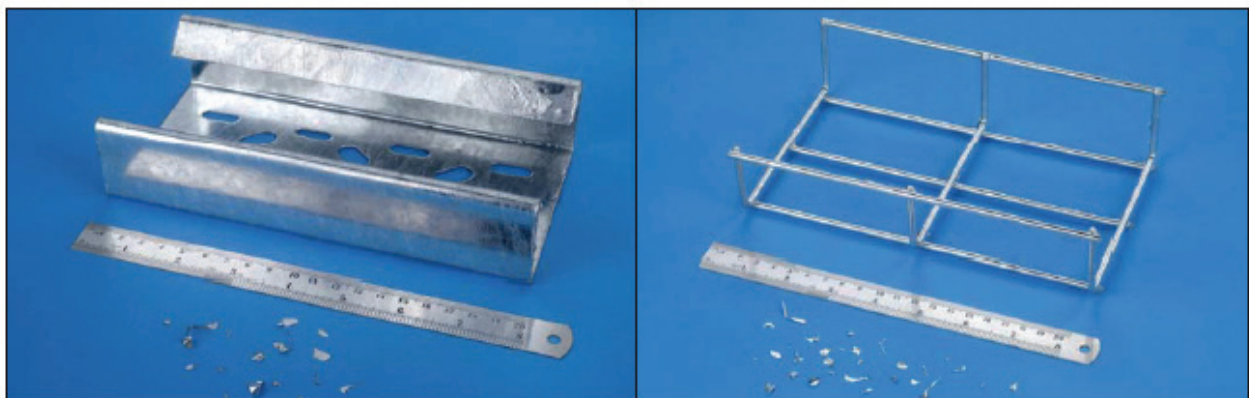
This method of hot-dip galvanising involves the application of zinc onto a fabricated part. This means the steel is punched and formed into the final product e.g. cable tray, cable ladder or basket tray and then dipped into molten zinc to apply a zinc coating. Hence the term post-galvanised i.e. galvanised after manufacture.

Batches of the final product are immersed in several cleaning agents of alkali, acids, and flux before entering the molten zinc bath for galvanising.

After a period of time the products are removed from the molten zinc allowing excess zinc to drip off. As the product cools the zinc solidifies on the surface of the metal with the resulting surface finish as shown in the photographs below.



Due to this uncontrolled cooling process zinc webs and zinc drips tend to build up around the punched holes, along the wires and in the corners of the basket tray. The zinc web is easily detached, can become airborne and cause damage to IT systems in the same way as zinc whiskers and increase data hall contamination during installation.



The above photograph shows the amount of flakes removed from a 200mm long section.

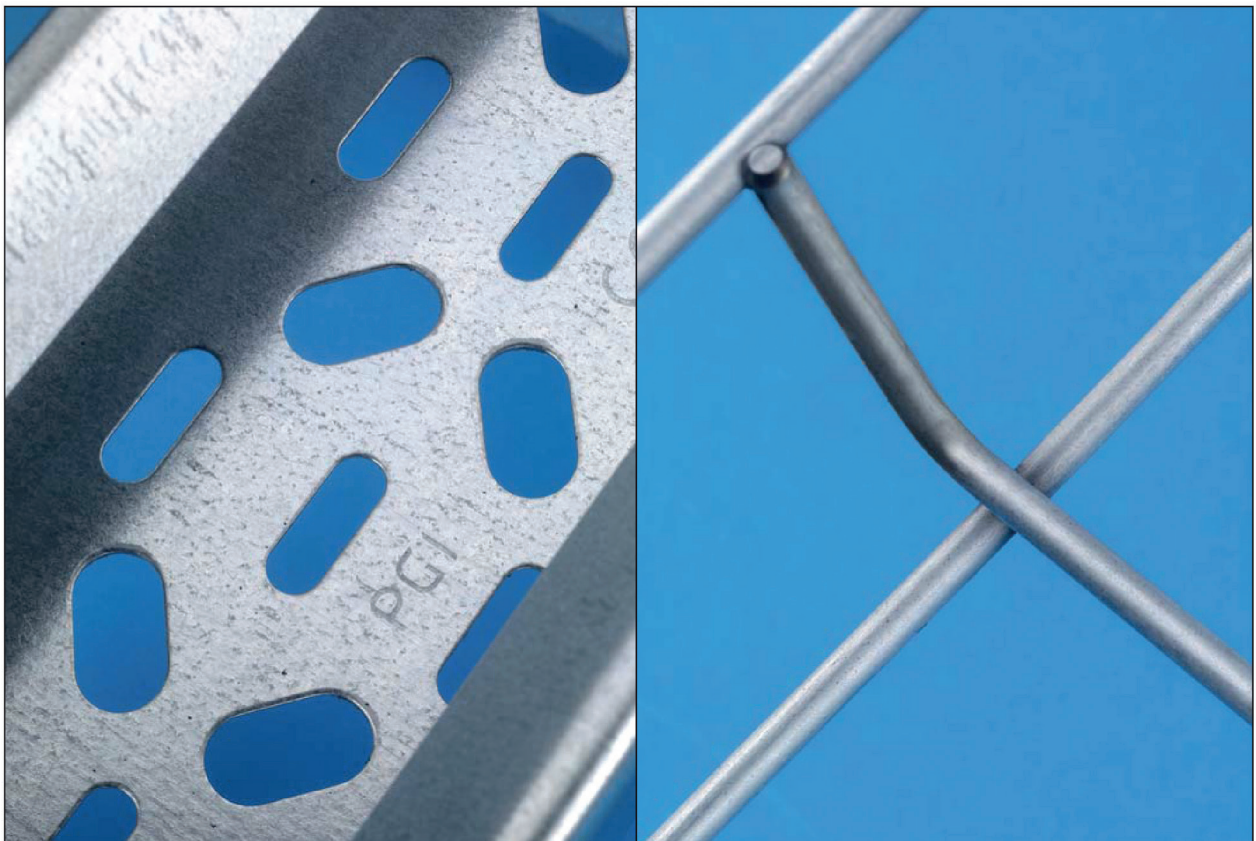
Pre-Galv Type Hot-Dip Galvanising Process (BS EN 10346)

This method of hot-dip galvanising involves the application of zinc onto the surface of sheet steel in a continuous process at the steel mill. The galvanised sheet steel is then punched and formed into the final product e.g. cable tray, cable ladder or basket tray. Hence the term pre-galvanised i.e. galvanised before manufacture.

In general terms the pre-galv and post-galv processes are very similar in that the steel is prepared using alkali, acids, and annealing before being immersed in a bath of molten zinc.

There is however, one important difference in the final stages of the pre-galv process when the steel strip is passing through the molten zinc at extremely high speed (200m/min). As the strip exits the bath a set of gas knives wipe off the excess zinc and the surface is rapidly cooled to leave a smooth finish.

The resulting surface finish is shown on the photographs below.



Due to this highly controlled wiping and cooling process a smooth layer of zinc remains. After punching and forming this material into the final product there are no residual webs of zinc around the punched holes nor along the wires or in the corners of the basket tray.

The punched holes and sheared edges on the pre-galv products are still protected against corrosion due to the sacrificial action of the zinc coating. (Please refer to our white paper 'Pre-Galv vs Post-Galv Specifications for Cable Containment Products' for full details).

Conclusions

The phenomenon of zinc whiskers is directly attributable to a surface finish that has been electroplated zinc (zinc plated). It is therefore prudent to eliminate as far as possible all products that have this form of zinc coating from a data centre installation. In order to eliminate the risk of zinc whiskers a hot-dip galvanised finish should be specified. However, to eliminate zinc whiskers and zinc flakes a Hot-Dip Pre-Galvanised finish to BS EN 10346 or equivalent should be specified. This can be phrased in the following ways;

Below are suggested full specifications that could be used for each product range.

Hot-Dip Pre-Galvanised Finish

Pre-Galvanised Finish

Pre-Galvanised to BS EN 10346

Cable Tray compliant with BS EN 61537. Hot-Dip Pre-Galvanised to BS EN 10346.

Cable Ladder compliant with BS EN 61537. Hot-Dip Pre-Galvanised to BS EN 10346.

Basket Tray compliant with BS EN 61537. Hot-Dip Pre-Galvanised to BS EN 10244.

Cable Trunking compliant with BS EN 50085. Hot-Dip Pre-Galvanised to BS EN 10346.

Should you require further details or assistance with your specification please contact our Technical Department - technical@philipgrahame.co.uk