

# CABLE MANAGEMENT IN DATA CENTERS

SELECTING THE RIGHT FINISH  
FOR STEEL WIRE CABLE TRAY

WHITE  
PAPER



# INTRODUCTION

Legrand is launching a new surface treatment for its Cablofil steel wire cable tray system which is ideally suited to both the white and grey space of the modern data center.

In light of this new launch, we are taking the opportunity in this paper to review the current material finishes of steel wire cable tray available to data center stakeholders today, and to discuss why a zinc aluminium finish is perfectly suited to the demands of a 21st century data center, be it large or small.

In our experience, there are recurring concerns when selecting cable management products to be used within the white space area of a data center, these include the potential formation of zinc whiskers or zinc flakes on steel wire cable tray, as well as selection of a system that will not damage cables once installed.

So, let us look at what zinc whiskers actually are and why they form. We will also review some of the more commonly used metallic finishes as well as looking at the features and benefits of Legrand's new zinc aluminium finish.



# WHAT ARE ZINC WHISKERS?

THE FORMATION OF ZINC WHISKERS ON ZINC COATED PRODUCTS WITHIN DATA CENTERS CAN OFTEN BE AN AREA OF CONCERN FOR IT SYSTEM MANAGERS.

Metallic 'whiskers' have been a topic of conversation within data center communities for the last three decades. Over the years, a substantial amount of research has been conducted on tin-plated products and the manufacturing processes involved, and the potential for growth of tin whiskers has been observed. Furthermore, there have been equal concerns that zinc-coated products will behave in similar fashion and that 'zinc whiskers' can and will form.

## Where do zinc whiskers come from?

Zinc whiskers are filaments of pure zinc that grow from steel surfaces, where zinc atoms are subjected to compressive stress. This constraint derives from an additive called 'polisher', which is placed in the electrolytic bath. The atoms are squeezed together and can then expand outwards. Their initial diameter can be approximately 2 µm. However, they can grow up to around 1mm per year [1]. We know that the rate of growth diminishes over time as the stress is released, but this affect cannot be predicted.

The most effective way to analyse if zinc whiskers are present is to use a Scanning Electron Microscope (SEM).

It is understood that when zinc whiskers form, they can break off because of scuffing, scraping or vibration. It is then thought that the whiskers can become airborne and potentially land on sensitive equipment, such as circuit boards and electronic components, causing irrevocable damage.

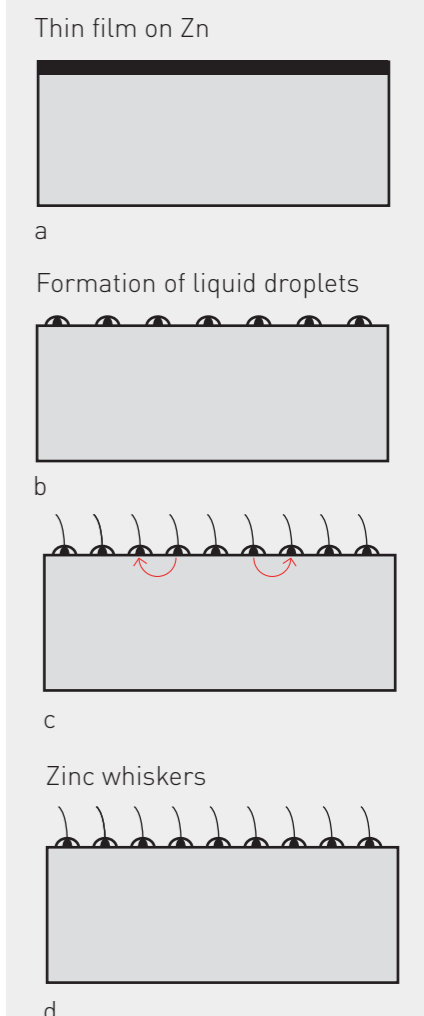


## Solid-liquid-solid growth mechanism

The most likely phenomenon observed during the formation of zinc whiskers is the SLS growth mechanism.

The principle of growth by SLS is based on: a low-melting impurity being present on the surface of the coating

- a A thin film, such as brightener, will form a drop of liquid at a certain temperature. The zinc in contact with this drop will diffuse and dissolve inside
- b The liquid mixture will then oversaturate with zinc and, from a certain concentration, the pure zinc will precipitate in solid form
- c Whiskers are formed
- d The growth of zinc whiskers is favoured by high temperatures. [2]



[1] : Croissance et Caractérisation de Nanofils de Silicium - Fabrice Oehler - ENS Lyon - 2007  
[2] : Characterisation of Si and Ge nanofils - Mahmoud Israel - University of Rennes 1 thesis - 2015

# A range of finishes for differing requirements

When discussing metallic cable management solutions, there are four main material finishes considered for data centers to ensure the steel cable containment used does not corrode. There is often confusion surrounding the finishes available and their suitability within a data center environment.

For example the vast majority of cable management supplied to data center clients today is coated in zinc. Zinc coating is the most cost-effective and available option for protecting steel from corrosion. However, there are several different application processes that can be used to apply the zinc to the steel.

## Pre-galvanised Zinc Aluminum finish (ZnAl) BS EN 10244

Legrand has developed a new surface treatment for its steel wire cable tray. The process is similar to that of traditional pre-galvanisation. However, the wire material is immersed in an alloy containing zinc and aluminum (ZnAl). The welding process is also adapted so that there are no resulting 'weld burns' or vulnerable points for corrosion to attack, as can be the case with traditional pre-galvanised steel wire tray today.

The finish also offers greater longer-term resistance to corrosion and offers lifetime expectancy superior to that of hot dip galvanising (after manufacture). The new zinc aluminium range has withstood 1000 hours in salt spray tests meaning it is certified as a Class 8 finish product. As such, by specifying the new zinc aluminium finish, clients and specifiers have peace of mind that the support system will be designed and built to last. To date, zinc whiskers have not been found on any ZnAl coated Cablofil products.



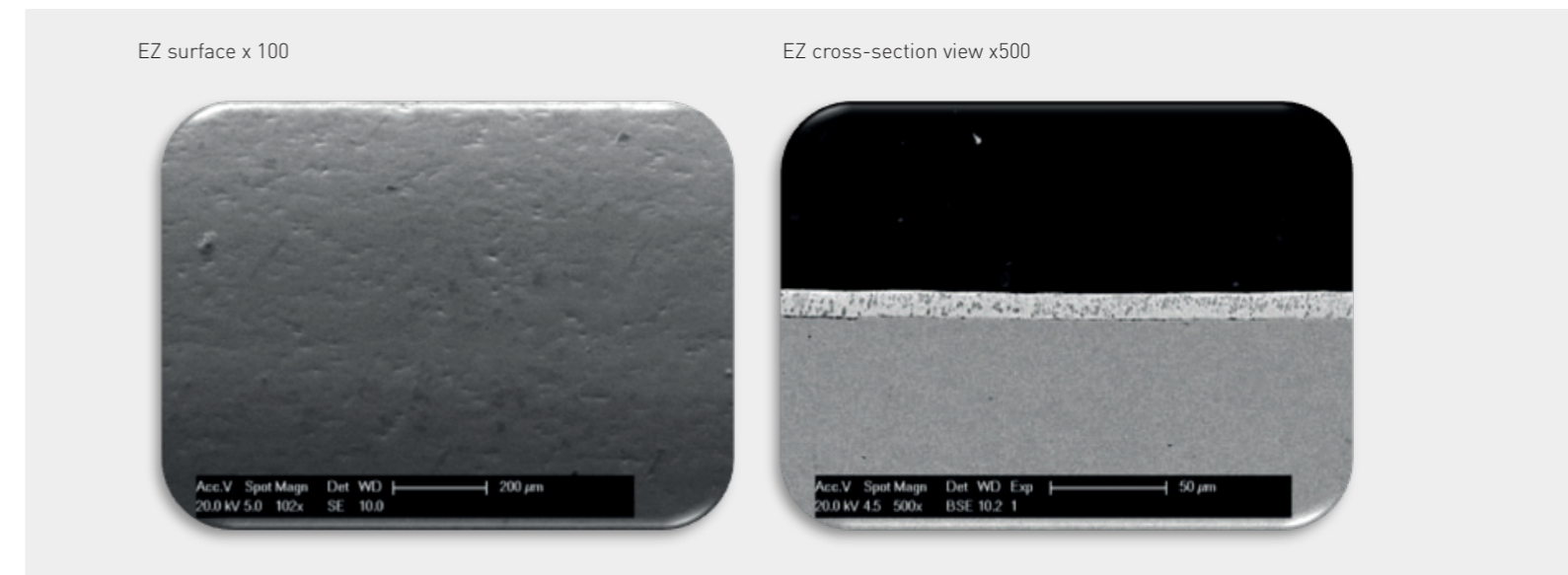
Pre-galvanised systems are largely specified to counter concerns over zinc whiskers, which we will discuss in this paper. Until the launch of these new ZnAl products, Legrand has not had a pre-galvanised option within its Cablofil range.

The launch of the new pre-galvanised zinc aluminium range brings with it all the features and benefits installers have become accustomed to with the Cablofil system, including the T-welded safety edge, a fast assembly system (FAS) and high performing load bearing properties.

## Electroplating (EZ) BS EN 150 2081 : 2018

Carbon steel is immersed in a bath containing a dissolved zinc compound. An electric current is passed through the bath which applies the zinc to the steel. The visual appearance of electrozinc-plated products is generally that of a 'shiny' finish.

Cable tray and accessories are generally made from raw steel, they are then deep cleaned and immersed into the electrolytic bath containing zinc. The introduction of an electric current through the bath creates the connection between the steel and zinc creating the zinc coating. A top coat is usually added in a separate aqueous process that enables the top layer of zinc to become less reactive and increases corrosion resistance. The quality of the process ensures the performance of the coating. It is possible that zinc whiskers could form in electro-plated products.



Zinc-plated products are generally very smooth to the touch, clean and have a very long 'shelf life' in an indoor application, like a data center. Electrozinc-plated products are still the preferred finish of choice for most data centers around the world.

Although the topic of zinc whiskers is often discussed, with such little research, data and testimonies available, general rules have often been adopted. Some members of the data center community have taken a very generalised stance against using all electrozinc-plated product due to the perceived risks and possible formation of zinc whiskers.

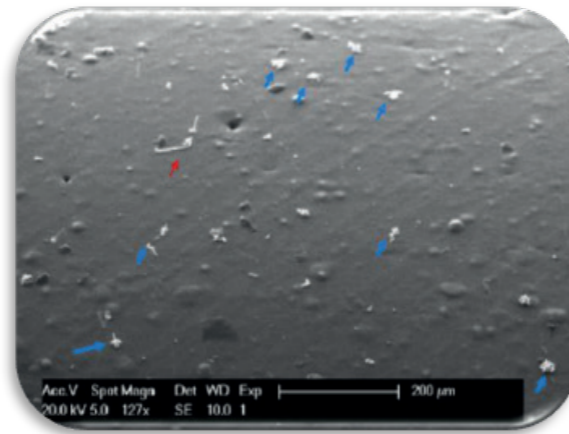
It is important to note that industry stakeholders, with the highest risk, such as server, hard drive and memory board switch manufacturers as well as other electronic equipment manufacturers, continue to use zinc-plated chassis, drive cover hardware within their own manufactured products. The threat of zinc whiskers to many is seen to be very small and therefore manufacturers are happy to continue using zinc-plated products and to provide a warranty for the installation. Electrostatic issues are a far greater risk than zinc whiskers.

## Powder coated (PC)

An epoxy powder coating can be applied to steel. This can also be applied using an organic coating, acrylic coating, chromate coating or polyester coating. This process is often used when there is a requirement for the cable management to be a particular colour.

Specific RAL numbers can be provided by the client so that the desired colour is achieved.

Some industry members have suggested the use of painted finishes in data centers to mitigate zinc whiskers. However, it is believed that zinc whiskers may still form (red in the illustration opposite) and grow through the acrylic coating, possibly up to one millimetre in length per year.



EZ+ black (black paint) surface 100X

Painted product would not necessarily eliminate the risk of zinc whiskers. However, this finish can be an aesthetically attractive proposition or can be used as a method of identifying cable runs.

## Pre-galvanised (PG) BS EN 10244

Pre-galvanised is sometimes referred to as Hot Dip Pre-galvanised, or simply 'Pre-galv'

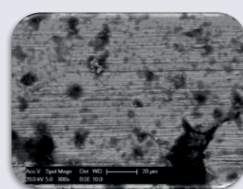
Pre-galvanised systems are manufactured with steel that has been galvanised by continuous immersion in a zinc bath prior to the products' manufacture.

Pre-galvanised steel wire cable trays often show 'weld burns' as there is no surface treatment applied after the product is manufactured.

The use of pre-galvanised cable management products for data center applications has, for many customers, become the 'go to' finish of choice. The decision to use pre-galvanised products has been largely based on price but also the belief that zinc whiskers will not form on pre-galvanised products.

Pre-galvanised finish steel wire cable trays will not offer the same level of resistance to corrosion as other finishes, such as electrozinc-plated, hot dip galvanised or zinc aluminium finishes. Closer review of pre-

galvanised steel wire cable tray shows impurity and a lack of surface protection which can cause the weld area to start to oxidise (rust) almost immediately. In an indoor application, the colour of pre-galvanised steel wire cable tray can vary over the time. It is vitally important therefore that any pre-galvanised product is stored correctly prior to installation to avoid early degradation.



PG surface 800X



Cross-section view of PG 1000X

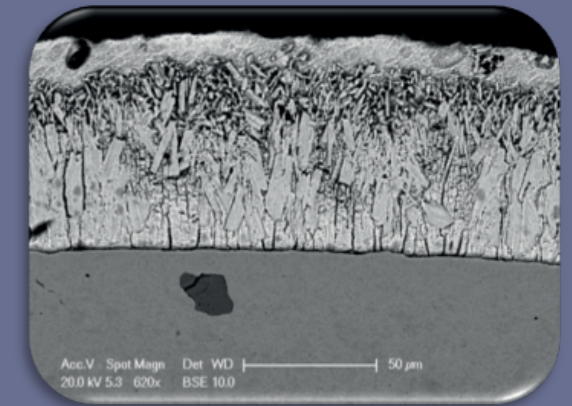
## Hot Dip Galvanizing

BS EN ISO 1461

(often referred to as 'Galv after' or 'Post Galv')

Untreated cable management products are subjected to a rigorous deep clean and then dipped into a bath of molten zinc.

Different micron thicknesses can be achieved by altering the process, or by using a steel with a high silicon content, allowing for longer life expectancies.



HDG cross section view 620X

After being immersed in a molten zinc bath, the coated product is left to cool allowing the zinc coating to solidify. It is not unusual for 'zinc flakes' to build up in any openings such as cable tray perforations, or in the corners of basket trays. When the galvanizing is carried out in a good, quality-controlled environment, most of these zinc flakes are removed manually using steel brushes. For industrial environments the appearance of occasional zinc flakes is generally not an issue. However, for clean room environments, such as data centers, the appearance of zinc flakes may not be acceptable.

HDG cable tray



Cablofil CF54/300 EZ

## Cablofil... trusted for installations large and small

Cablofil steel wire cable tray has been tried and tested in installations of all sizes throughout the world, from light duty requirements in small commercial buildings through to extra heavy duty installations in refineries and heavy industry applications such as shipbuilding.

Electrozinc-plated Cablofil has been supplied to the data communications industry since the early 1970s. In this time, there have been no reported failures to equipment due to zinc whiskers having been found on our steel cable tray systems. We do not agree that zinc whiskers are an issue.

We are confident in recommending Cablofil zinc-plated steel wire cable trays (EZ) for your data center

projects. If concerns around zinc whiskers persist, then we believe Cablofil zinc aluminium (ZnAl) finish or painted product offer a great alternative and ensure extended lifetime expectancy over traditional pre-galvanised.

Please feel to contact us directly if you have any further questions or concerns.



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