

**Overview**

This document aims to both introduce Zinga and underline some of the technical highlights of the product when it is used as a unique system for the protection of rail rolling stock, bogies and vehicle chassis components. Zinga has been studied at each stage of the components life cycle and, where appropriate, compared with more conventional systems i.e. paint systems.

**Product Introduction**

Zinga is a remarkable form of zinc-based corrosion protection because it provides both active and passive protection in a form that is easy to apply and repair.

Active protection, or cathodic protection, arises from the zinc (the anode) sacrificing itself in favour of the base metal (the cathode). Once applied, the 96% pure zinc in Zinga creates an initial potential with the steel of -1040mV. When the steelwork becomes wet the zinc ions go into dissolution and the current starts to flow from the zinc to the steel, depleting the zinc layer in preference to the steel beneath. In this way the protection of the metal is guaranteed, even when the zinc layer is damaged. Other well established methods of cathodic protection include hot-dip galvanising (HDG) and zinc thermal spraying, both of which exhibit a constant sacrificial rate of the zinc layer.

Within Zinga though this sacrificial rate reduces dramatically after the zinc layer has oxidised. Each zinc particle within the Zinga layer is encased and protected by the organic binder without adversely affecting the electrical conductivity. This enables Zinga to create a sufficiently negative potential to provide galvanic protection (less than -850mV) but with a lower rate of zinc loss than HDG because the binder acts as a "corrosion inhibitor" to slow the rate of natural and induced zinc dissolution.

If the Zinga layer is sufficiently damaged to expose the base metal below, the steel forms a layer of surface rust but no corrosion takes place beneath it. This is called "throw" and enables Zinga to protect bare metal up to 5mm or so away from where the coating ends. This is the same working principle as sacrificial anodes used in immersed conditions. Zinga is simply a different form of these anodes working on a more localised level across the entire coated surface.

Passive protection, such as paints and cladding, creates a "barrier" between the steel substrate and the elements. Once this barrier is compromised then the moisture and atmospheric salts will be able to start corroding the steel beneath the damaged area. This corrosion will then begin to creep extensively beneath the coating.

With Zinga, the organic binder and the zinc oxide layer that forms on the surface create an impervious barrier by blocking the zinc's natural porosity with oxide particles. Unlike other passive coatings, once breached the zinc oxide layer simply renews itself by re-oxidising.

Zinga was originally invented in the 1970's by Ghent University after an original request from the Belgium navy looking for a "service-free" alternative to sacrificial anodes. Zinga has been manufactured in Belgium by Zingametall ever since and Zinga UK has been actively marketing it in the UK since the beginning of 2002.

## Surface Preparation

Zinga requires abrasive blast cleaning to Sa 2.5 with a blast profile of 60-80µm and the surface needs to be free from grease etc. The correct surface preparation is vital to the long service life of Zinga because, unlike paints, Zinga is not "sticky" and relies solely on a deep penetration into the blast profile to adhere.

## Application

Application can be done using airless, conventional or electrostatic spray equipment or with a normal brush where applicable. Zinga can be applied in a wide range of temperatures and humidity and can even be applied to mildly damp surfaces. This, coupled with Zinga's unlimited shelf and pot life, means a significant reduction in wasted time and materials.

Zinga dries very quickly with each coat only requiring the maximum of an hour before another coat is applied (at 20°C). Two hours after the final coat has been applied the component can enter service. Alternatively, twenty four hours after the final Zinga coat an epoxy tie-coat can be applied or four hours later for water based topcoats.

By contrast an epoxy coating requires at least twenty-four hours between coats and anywhere between forty-eight hours and seven days to cure fully before service.

Zinga is presently compliant with EEC Directive 2004/42/CE until amendment in 2010, but it's relatively high VOC level of 0.534 kg/ltr must be considered in tandem with its very high density (2.67 kg/ltr) compared with typical "zinc-rich" paints (1.6 kg/ltr) or normal epoxies (1.2 kg/ltr). Because of this the British Ministry of Defence was able to make an exception to its very strict VOC policy to qualify Zinga.

## Performance

- Unlike most epoxy coatings, Zinga is non-toxic and is even certified to BS6920 (2000) for use in contact with drinking water.
- Zinga is extremely flexible (x3 more than steel) and adheres extremely well due to the high penetration of the zinc into the blast profile so it will not crack, peel or delaminate – even after physical damage or impact.
- Zinga will not degrade under any form of UV.
- Zinga can work down to -40°C and up to 160°C.
- Zinga is certified as non-flammable to BS476 Parts 6&7 and in extreme heat produces very low levels of smoke with correspondingly low toxicity. Zinga is in fact cleared for use on the inside of Naval Submarines.
- Testimonials from the rail industry (CITA) have shown that Zinga lasts at least twice as long as conventional coatings between service intervals.
- Testimonials from other industry sectors illustrate the extreme longevity of Zinga coated steel even in the harsh marine splash zone or contaminated conditions like a concrete factory.

### Future Maintenance

Annual dry film thickness measurements allow for accurate zinc loss rates to be established early in the components life. This enables precise forecasting for future maintenance requirements. Like anode blocks, Zinga will begin to lose efficiency when the coating has depleted down to a certain weight. This figure for Zinga is in the region of 35µm d.f.t. (250 g/m<sup>2</sup>), but asset owners are always advised to re-load the zinc when the layer thickness reaches 50µm. This is the lowest figure to work off when calculating maintenance schedules and is easy to monitor.

Zinga possesses the unique characteristic that existing coats can be directly covered with a new layer regardless of the age. The old layer will re-liquidise and fuse together to form one single homogenous Zinga layer. Fresh Zinga will simply "melt" into the underlying and adjacent zinc coating without compromising the protection. A steam clean will suffice to remove surface salts and contamination prior to "re-loading" which negates the need for further abrasive blasting with obvious cost savings. Hence if the coating is damaged it can be repaired easily by using a paintbrush or roller and without the need for abrasive blasting or "feathering in".

Experience from the Oil and Gas Industry has shown that Magnetic Particle Inspections (MPI) can be conducted through Zinga up to 150µm thick (See attached OIS letter). It should be noted however that different metals or structures may behave differently and that trials are prudent on an application by application basis. Obviously the ability to conduct full MPI testing without the need to abrasive blast and re-coat each time realises further significant cost savings (see below).

Additionally Zinganised steel with up to 60µm of coating can be welded directly without fear of compromising the quality of the weld or causing "zinc fever" from toxic smoke as per HDG. This means that running repairs or additional fitments can be added at a later stage without the need for a complete abrasive blast and re-coat.

### Cost Comparisons

Typical cost comparison over 10 year period for rail bogie frame:

#### *Traditional Paint System*

1 off Bogie Frame BT10  
Abrasive Blast to Sa2.5  
Paint in Copon EAS 80 – 100µm

Cost = £275

Redo as above every 2 years to allow for MPI Testing.

Total Cost for 10 Years = **£1375**

#### *Zinga System*

1 off Bogie Frame BT10  
Abrasive Blast to Sa2.5  
Coat in Zinga 120µm

Cost = £395

No need to remove coating for MPI.  
Touch-ups can be completed as required without re-blasting.

Total Cost for 10 Years = **£395**

**References**

Please find the following documents attached:

*Technical Background*

- Working Principles of Zinga (Ghent University)
- An Initial Evaluation of Zinga (BNF Fulmer - 1990)
- Atmospheric Exposure & Electrochemical Evaluation of Zinga (1992)
- 8500 Hour Salt Spray Test Results (Taiwan University – 2000)

Visit the “Key Reports” on the “Reports” page of the website for many more technical papers.

*Testimonials*

- CITA Railways – Belgium
- OIS Letter – UK
- Killybeggs Fish Landing Pier – Ireland
- BC Ferry Ramps – Canada
- Schwenk Cement Factory – Germany

Visit the summary of best testimonials on the “Testimonials” page of the website for many more examples.

For further information please contact Zinga UK or visit the website [www.zinga-uk.com](http://www.zinga-uk.com)