2012 Volume 9 Issue 2

HOT DIP GALVANIZING TODAY

HOT DIP GALVANIZERS ASSOCIATION Southern Africa

51

Featuring:

- Duplex Powder Coatings including a summary of an applicable standard
- Duplex coating system of a vehicle protection structure for the mining industry
- Mast and Poles; Water Storage and Heat Exchangers
- Galvanic corrosion
- Renewable energy is a large part of the green movement
- Regulars - Education and Training, Bob's BANTER and On The Couch

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The Association is an information centre established for the benefit of specifiers, consultants, end users and its members.

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Front Cover: *A kaleidoscope of photos including the structure at the entrance to Durban Harbour, a vehicle protection structure, a telecommunication mast adjacent to the beachfront area in Durban, a frame system in the streets of Cape Town and various buildings, including a frame structure for an existing Randburg office building, a structure at Waterfall Valley in Johannesburg and a private home on the ridge of Ballito Bay, KZN. The latter two buildings will be featured under architectural hot dip galvanizing in the next magazine.*

Hot Dip Galvanizing – Adding value to Steel

Executive Director's Comment

Hot Dip Galvanizing and the Environment

Discussions continue to take place with respect to environmental controls within our Industry, as a contributor to pollution and waste management.

Actions are being implemented to co-operate and work with the authorities in setting up guidelines for our industry with a view to control of pollutants and waste management, generally referred to as "waste minimization", "energy conservation" and "cleaner air production". Much work has already been undertaken by a number of our members with numerous programmes aimed at the improvement and control of effluent and air emissions.

It is purely a question of time before we shall have increased controls and the implementation of various laws aimed at the protection of the environment. In order for these laws and regulations to be workable, as well as meaningful, we require the appropriate authorities to police and enforce compliance by ALL concerned. As a minimum requirement members must develop and implement a programme or action plan that will reflect progress towards full compliance with agree standards. No new operations should receive approval from the authorities without due consideration and inclusion of capital equipment necessary to control waste and emissions.

As an Association we have produced a set of so called standards or "guidelines" that were compiled from actual practice and in accordance with figures gathered from European galvanizers. These guidelines were circulated in order for members to review and use when setting objectives in terms of their environmental controls. This is a voluntary exercise, with staff at the Association being available and willing to assist with any review and or discussion.

Bob Wilmot

Note from the Editor

Communication, communication, communication.....!

Having just been involved in a dispute between a client and supplier where apart from the specification being inadequate, communication between the various parties happened without reference to the specification resulting in an inappropriate coating being supplied. Exposure of these inappropriately coated items resulted in discolouration and premature rusting. Lessons learnt were:

- Ensure the specification is adequate. If hot dip galvanizing is required then include the specific standard eg. SANS 121 (ISO 1461), SANS 32 (EN10240) or SANS 10684 (ISO 10684) as applicable, in the document, ie. Don't just say "MSG" (mild steel galvanized) or "galvanized" (often misinterpreted as "electrogalvanized or electroplated") or even "hot dip galvanized" without reference to the standard as this could lead to the use of "Continuous hot dip galvanized sheeting" being used for purlins and the like. While the latter is acceptable for mild interior applications, it will fail dismally if used in aggressive marine exterior applications.
- Ensure that the items that are required to be hot dip galvanized, can be or are available as hot dip galvanized. (Ask the HDGASA?). While many of the "Crosby" clamps and Turnbuckles are still only supplied into SA as zinc electroplated, they can be hot dip galvanized and the female components, oversized with the correct taps, to accommodate the increased coating thickness on the male thread. This however, must be specified and the appropriate supplier selected.
- Ensure that the purchaser makes available the applicable standard/s to the supplier at the enquiry stage.
- If you are unaware of the differences and wish to improve your knowledge on hot dip galvanizing, we are always available for in-house informal discussions or formal presentations. A more in depth knowledge can be gleaned at our one or three day Galvanizers Inspector Course which is regularly offered in Johannesburg and Cape Town. The course can also be held in other areas, should we have sufficient delegates.

In order to alleviate inappropriate metallic coatings being used, we cannot over stress the importance of correct specifying. This should be followed up with knowledgeable acceptance/rejection criteria of the component's coating, in order to ensure component durability according to the end users requirements.

The main features for this edition are **Mast and Poles** with a new utility pole from CIS, **Water Storage** and **Heat Exchangers** with an article on the benefit of a correctly sized cooling tower, from BAC.

Duplex features an article by Gerard Rimerink of "Stichting Zinkinfo Benelux"on powder paint application over hot dip galvanizing as well as a summary of BS EN 15773:2009, "Industrial application of powder organic coatings to hot dip galvanized or sherardised steel articles (duplex systems) - Specifications, recommendations and guidelines".

An interesting duplex application includes the Roll Over Protection Structures (ROPS) and the Falling Object Protection Structures (FOPS), developed by Marven Equipment for the mining industry.

Unfortunately we have had to cancel the annual Awards Event due to a number of reasons out of our control.

Regulars include feedback on the Golf Day in Johannesburg; **Education and Training, Bob's BANTER**, and **On the Couch** where we chat to Alan Lamb of Lambcon in Durban.

Enjoy the "magazinc".

Terry Smith

Unique patented steel utility pole developed for electrical and communications industries

The Structa Technology Plant.

Structa Technology is a leading manufacturer of masts and poles and has a proud track record supplying masts for electrical and telecommunication distribution on the African continent.

"We are proud to announce that the new utility steel pole we have developed and patented has successfully been delivered to Eskom and various mining companies", says Mr Hercules Rossouw, Managing Director of Structa Technology.

The company manufactures monopole pylons for electrical and telecommunication distribution lines and substation steelwork. It also holds patents or proprietary technologies for the 259 electrification pole. Structa Technology's 259 and 265 electrification poles have successfully been implemented by Power Utilities throughout the African continent as well as other industries and have now been recognized by the mining industry. The company designs and supplies sub-station structures to Eskom requirements. All the electricity distribution masts are Eskom tested and approved.

Structa now offers the unique 200/240 Range Steel Utility Poles, a patented oval shape utility fitted pole for 11-66kV distribution circuits. It is part of the Structa Electrotower range and was developed, with a universal attachment design, as a viable alternative to wooden and concrete poles for the distribution of electrical and telecoms services in rural and township applications. The steel poles alleviate an 11m wooden pole shortage and also help to solve the problem of cable theft by running the cable inside the pole. The masts are manufactured from thin-walled steel tube with an optimized cross section giving strength where required.

The range is designed in 'universal' application style which allows for different configurations of phase carrier and also allows for stay cable attachments (masts are planted). No field modification or adaption is therefore required. The pole is designed to provide strength where it is required and thus makes the best use of steel compared to the normal round pole. The pole was tested and accepted at the Eskom testing Station and is listed on the Eskom System.

Structa's steel utility poles range in height from 7 to 13m.

Structa was asked recently to design a 12 and 13m utility pole for the mining industry, with a 6mm thickness and a tipload of 8.5kn. This pole is very versatile since it can be used for the distribution of power at the mine as well as for fibre optics used for telecommunications lines as well as lighting.

Advantages of the steel utility pole

The product has the following advantages when compared to wooden poles:

- No shortages of raw materials.

continued on page 4...

This unique 200/240 Range of Steel Utility Pole is a patented oval shape for 11 to 66kV distribution circuits. Offtake cables can be run inside the pole, reducing the cable theft problem.

The standard Eskom tested utility pole ranges in height from 7 to 13m and allows different configurations of phase carrier to be adopted.

- Environmental advantage in that critical green plantations are maintained.
- Controlled production process resulting in consistent quality.
- Hot dip galvanized to SANS 121 (ISO 1461).
- No maintenance during life cycle, life cycle advantages e.g. fire proof, rot proof.
- Veld-fire damage limited.
- Much lighter pole (typically 1/5th of wood) making for easier handling.
- Transport advantage gained through lighter, consistently shaped pole.
- No on site drilling or cutting required due to universal preparation. No on site preparation.
- Earthing advantage by virtue of steel material.
- More difficult to cut, hence giving anti-theft advantage, enhancing cable security.
- Universal hole set allows various standard applications.

When compared with wooden poles the above realizes a 6% life cycle cost saving up to 25 years and up to 60% if the wooden structures are replaced after 25 years

The universal transformer pole

The universal transformer pole is another unique product offered by Structa. This universal 8m pole with internal cable duct and cable locks to ensure cable security. Its advantages are:

- Cable security.
- Universal hole set allows various standard applications.
- No on-site preparation.
- Life cycle advantages e.g. fire proof, rot proof.

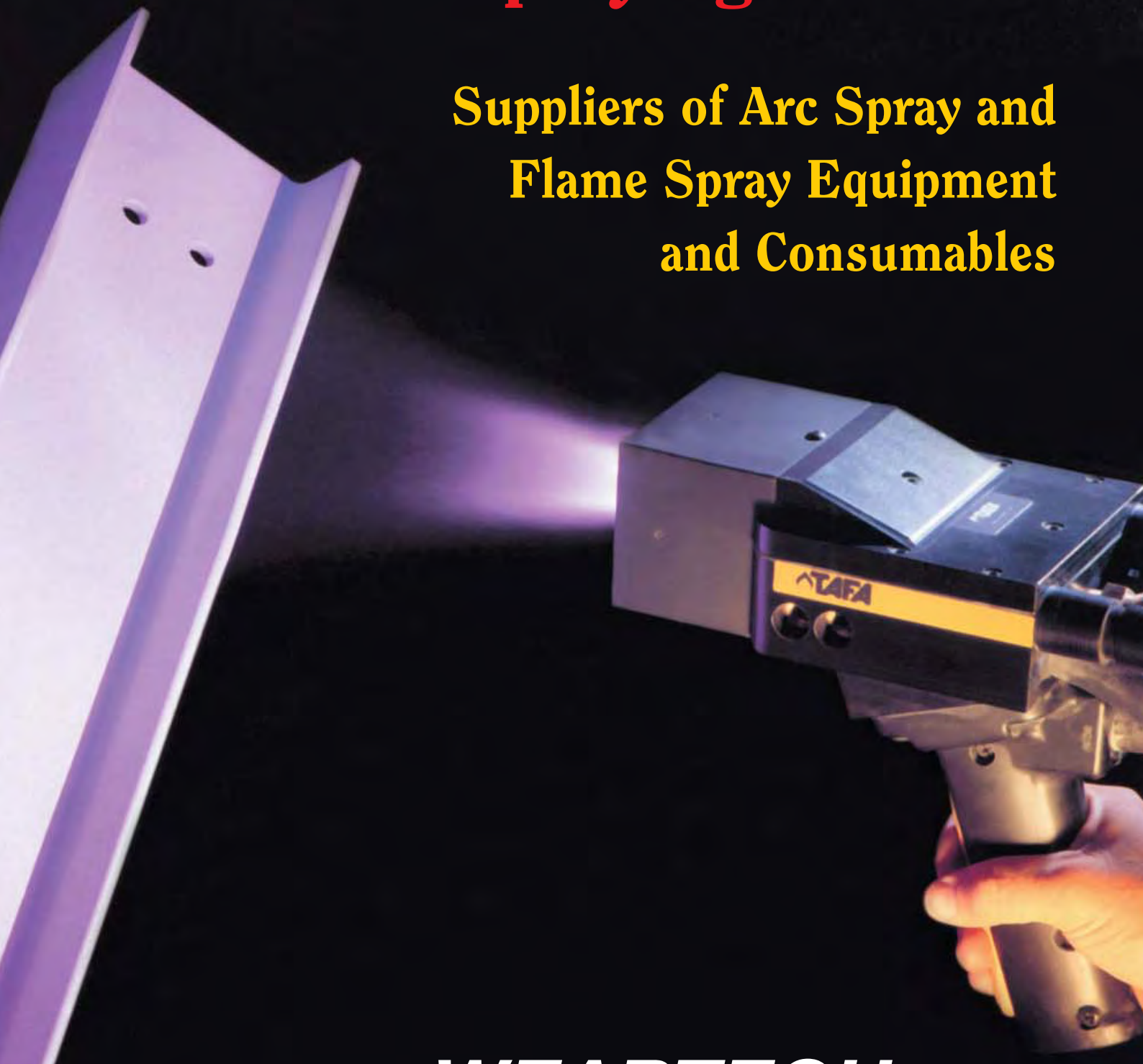
Manufacturing and quality management

The Structa Technology product range is backed by a superior manufacturing plant with sufficient capacity to do large, rapid roll-outs, as well as a design office equipped with latest C.A.D and finite element analysis software. The factory based in Meyerton and is unique in Africa in terms of equipment and processing capability. It is housed in some 12 000m² of covered area with comprehensive cranes coverage.

Special capabilities include automated lattice manufacturing, panel pressing and bending of mast sectors in 12m lengths. All long seam welds are performed with automated submerged arc processes. A quality system conforming to ISO 9001 is in place and Structa products are hot dip galvanized according to SANS standards. Structa Technology has also implemented a comprehensive Environmental Health Management System in line with current best practices.

Zinc Metal Spraying?

Suppliers of Arc Spray and Flame Spray Equipment and Consumables



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With a field of 120 players, the staff at Glenvista ensured that this year's golf day went off without a hitch. Our apologies to Transvaal Galvanisers for the delay in issuing out their "Pink Lady", rest assured the competition was not affected by this.

The winners of the 2012 Association Golf Tournament, based on a count out, with a score of 62 was the Macsteel Tube & Pipe team hosted by Metsep consisting of Eugene, Wally, Johnny and Vincent.

The team from Robor Galvanizers won the Transvaal Galvanisers Pink Lady – well done to Shaun, Braam, Nico and Danie! Incidentally, this team came second as well. Talk about cleaning up the prizes!

Frikkie Erasmus hit the Longest Drive and Bryan Watson received the prize for Nearest the Pin. Thank you to Robor Galvanizers for sponsoring these two prizes and for providing a much needed watering hole on the 4th.

The Strutfast team achieved third place, with a score of 57. Well done to Steve, Tonie, Juan and Andrew. With the same score and therefore based on a count out, the Armco team achieved fourth – Wayne, Anthonie, Bret and Bennie.

Unfortunately there always needs to be someone who is awarded the longest day and this year the prize went to our only Ladies team. Well done to Carin, Lorelle, Adre and Ronel of Supergalv!

Thank you to our sponsors; Bulldog Projects, ChemSystems Metal Chemicals, Lianru Galvanisers, Robor Galvanizers, Transvaal Galvanisers and The Golf Doctor. It is with your support that we are able to give out the prizes that we do.

To all the winners – well done! To all the players, thank you for attending the day, we hope you all enjoyed yourselves. Enjoy browsing through the photos on our website. Should there be a photograph you would like, please contact the Association on hdgasa@icon.co.za

Winners.

Second place.

Third place.

Pink Lady winners.

Power stations and mines benefit from reliable, cost effective water storage tanks

Structa Technology manufactures and supplies the pressed steel water tanks under the 40 year old brand, Prestank. Mr Hercules Rossouw, Managing Director says, "Our well known pressed steel water tank's track record speaks for itself. We have successfully provided the Medupi Power Station with a 4.2 million litre Prestank (38.4 x 28.2 x 4.8m). We also supplied Prestanks to mines in Zimbabwe and Angola as well as Sasol (Timane Gas Pipeline Project) in Mozambique."

Prestanks are hygienically safe, cost effective and a reliable way to store water for commercial sectors, private sectors and even for personalized storage. The tanks may be used for various water storage applications from temporary or permanent installations at mines, power stations, building sites, hospitals, water affairs, municipalities, rural communities and agriculture. Structa's Prestanks are fully customizable, high quality water storage solutions that are manufactured according to SANS guidelines and meet South African hot dip galvanizing requirements.

Reservoirs constructed from pressed steel sections are used extensively by the mining industry and municipal

authorities. Large storage tanks to this design which are mounted on steel towers can also be seen at many of Eskoms power stations.

Structa's pressed steel sectional tanks are hot dip galvanized for corrosion control in accordance with the requirements of the SANS 121 (ISO 1461) and achieve a coating thickness of 65 to 100µm. This is more than five times the thickness of zinc on pre-galvanized corrugated steel cylindrical tanks. The purpose is to ensure extended maintenance-free life in situations where water with aggressively corrosive properties is required to be stored. Prestanks have recently been installed at Welkom Hospital, the University of Swaziland and Northern Platinum mine to name a few projects in 2010.

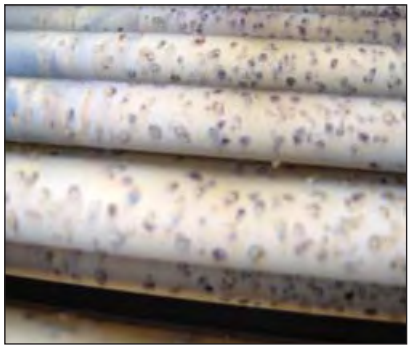
From left to right: Mr Rodney Cory (Director Structa Technology), Mr Hercules Rossouw, (MD Structa Technology) and Mr Bertus Booysen (Production Manager) in front of Structa's 1300 Ton Double Action Hydraulic Press Machine.

The benefit of a correctly sized cooling tower

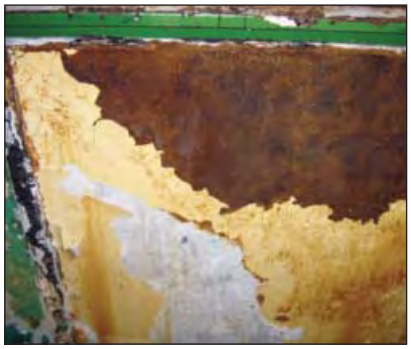
In recent times, the growing concern over natural resources and in particular one's carbon footprint and rising energy prices has prompted the building of green buildings. A big part of this challenge is to minimise the energy consumed and consulting engineers will apply stringent scrutiny to the usually expensive and high energy consumption items in the cooling systems, namely the set of chillers. The cooling tower connected to the chiller, often being a simpler, cheaper device requiring less electrical energy is given very little attention and most commonly purchased at the cheapest price. The problem however is that the carefully selected chiller will not be able to deliver the projected efficiencies and capabilities in the final installation unless the cooling tower delivers the required water temperatures. Under-sizing cooling towers will lead to high condensing temperature and this will increase the chiller motor power consumption. Without careful scrutiny, this will lead to an energy penalty being paid for the rest of the installations life. The extra cost of correctly sizing the cooling tower would have been paid back in reduced energy consumption in a short period.

It is commonly accepted that when specifying cooling towers for air-conditioning the total heat rejection, critical water temperatures required at the highest occurring wet bulb temperature are specified. This is of course appropriate and when the high wet bulb temperature is specified it's rare occurrence means that checking the cooling tower performance is unnecessary or rather difficult. The cooling tower however is still required to do the job in those peak conditions so there is a need to be satisfied that it is capable because it is difficult to deal with an undersized installation once it has been running for a while.

A hot dip galvanized cooling coil ready for delivery.



Effective and responsible monitoring of the water treatment process on a regular basis is extremely important.



Ensure strict compliance with manufacturers operation and maintenance instructions, including regular maintenance checks.

Designers have become aware of this and rather than deferring to a preference of suppliers they know and trust it has become commonplace to over specify the design wet bulb temperature as a safety measure. This unfortunately increases the cooling tower size too, and makes performance verification even more difficult because of the infrequency of the high wet bulb temperature.

CTI certification however provides an alternative solution to all possible cooling tower selection issues and performance verification. This method has been used to overcome these challenges successfully in the USA, where manufacturers provide selection literature and software to the independent body for performance verification and certification. Although in South

Hot dip galvanizing of cooling coils such as these must be forced into the molten zinc bath in order that only the outer surface of the tube be coated.

Africa the specification of CTI certified cooling towers is difficult due to the limited availability of certified cooling tower manufacturers and distributors. However the confidence provided to the industry in the USA by this independent body can also be transferred to South Africa, allowing designers to size the cooling towers without the need for exorbitant or false safety margins.

Care should be taken when choosing an appropriate cooling tower to maximize energy efficiency. It is far better to take the time at the design and specification stage than it is to try and recover from a failed system which only becomes evident when it is needed most.

While Baltimore Aircoil has the option of manufacturing the Evaporative Condensers and Closed Circuit Cooling Towers from selected grades of stainless steels, hot dip galvanized carbon steel is still the most cost effective solution to corrosion control in most instances and has been successfully used by the company for more than 40 years.

However, while hot dip galvanized evaporative condensers and closed circuit cooling towers have in many instances lasted upwards of 20 years, their durability is hugely dependent on

- *the non use of more cathodic metals (particularly upstream of the hot dip galvanized components) or thinly coated similar metals*
- *effective and responsible monitoring of the water treatment process on a regular basis (especially hardness/softness, chlorides and sulphates)*
- *in general the strict compliance to the manufacturer's operation and maintenance instructions, which includes regular maintenance checks.*

Excerpts from: Specifying Cooling Towers for Commercial Building, by John Rule (BAC Australia)

The Association would like to thank Carl Brown of Baltimore Aircoil in Cape Town for this article.

Duplex system with powder paint

Successful colour coating of galvanized steel

In the Netherlands there has been a long tradition of using colour on all types of materials, including galvanized steel. In his book 'Duplex Systems: Hot-dip Galvanizing plus Painting' the renowned engineer J.F.H. van Eijnsbergen recorded the situation as it was in 1994. Since the introduction of the concept of a hot dip zinc coating with paint a great deal of experience has been gained in the Netherlands with duplex systems. Particularly the systems using powder coatings have seen a great rise in popularity.

©G. Reimerink, Amersfoort Photo by: G. Reimerink, Amersfoort.

Train passengers traveling to or from Alphen on the Rijn store their bikes in the Apple.

Duplex systems are used for various reasons:

- For steel products or structures that have to be manufactured in colour and need to combine excellent corrosion resistance with a long service life. This combination may be specified for aesthetic reasons or because it is a functional requirement (warning colour, camouflage, etc).
- In horticulture it may be necessary to protect plants that are sensitive to zinc. Rain and condensation cannot run down the zinc surface and onto the plants. Sealing off the zinc can also be necessary in ecologically fragile areas.
- The service life of an organic coating has to be made as long as possible, e.g. because on-site maintenance is impossible. This can occur in buildings and installations that are difficult to access or are continuously in operation. Maintenance of the coating layer may be impossible without affecting cultivation.

The principle of a duplex system on steel is quite simple. The zinc layer prevents the steel from corroding. The voluminous steel corrosion products (rust) that can damage organic coatings are not formed. The organic coating layers ensure that the zinc does not corrode and they prolong its life. This is known as the synergistic effect of a duplex system.

For an effective duplex system the adhesion of the organic layer or layers on the zinc layer must be good. But also the product or structure may need to appear attractive. In practice appearance has a big influence on customer satisfaction. The raw materials used must therefore be of

©Stichting Zinkinfo Benelux.

Open structure over bus terminal at Heerlen railway station.

©Stichting Zinkinfo Benelux.

Interior steelwork of an industrial company.

©G. Schmittmann, Amerongen Photo by: G. Schmittmann, Amerongen

Public park in Utrecht surrounded by elegant steel fence.

good quality and the technical, organisational and logistical steps in the entire process must be properly controlled.

Standards

The experience with duplex systems is recorded in a Dutch standard (NEN 5254). A European standard (EN 15773) for duplex systems with powder coatings was published in 2009. The basic principle is that the galvanized steel complies with EN ISO 1461 and that the guidelines and recommendations EN ISO 14713-1 and EN-ISO 14713-2 are followed. Steel tube must be galvanized in accordance with NEN-EN 10240. For continuously galvanized plate and wide strip, NEN-EN 10327 and NEN-EN 10326 apply.

Good systems must also be selected for the organic topcoat. An estimation of the severity of the service is needed for this. For the estimating corrosion resistance of the system (on steel and on galvanized steel), the EN-ISO 12944 range of standards has been issued for organic coating systems. A German standard (DIN 55663) is available for powder coating systems. These standards specify the requirements for the corrosion protection of steel and galvanized steel as a function of the corrosivity of the environment and they state methods of testing. The classification relating to corrosivity follows the international corrosion standards ISO 9223 and 9224 (Corrosivity classes C1 to C5 and CX).

A European standard (EN 13438) has been published for powders and powder coatings for use on steel and galvanized steel. This covers the requirements for powders and the results of their application to test panels.

Step-by-step

Order

In general it is possible to order a duplex system from a galvanizer, who will then apply the powder coating, or will use a powder coating subcontractor to do this. It is also possible to order from a powder coater who will organise a galvanizing subcontractor. The customer can also select a galvanizer and a powder coatings applicator himself. In all cases the customer must be convinced that all parties are fully aware of the requirements that will be imposed on the duplex system. The steel purchaser and the fabricator must be made aware at the time the order is placed that hot dip galvanizing and powder coating will take place (this relates to the steel grade required). Excessively thick zinc layers can cause adhesion problems and blister and crater formation in the organic topcoat.

When requesting the quotation or when ordering, the customer must specify the powder quality to be used, how large and heavy the sections to be coated will be and the colour and gloss level required. The latter is particularly important if a project will be supplied to the galvanizer or powder coating contractor in multiple shipments. Noticeable differences in colour or gloss within one project will certainly result in complaints.

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Luxurious apartments in Brussels incorporating balconies hanging from the roof (winner Benelux Trophy- Hot Dip Galvanizing 1997).

An important issue when selecting a system is the location where the product will be used or where the structure will be located. The powder coater or powder supplier can often provide advice on this.

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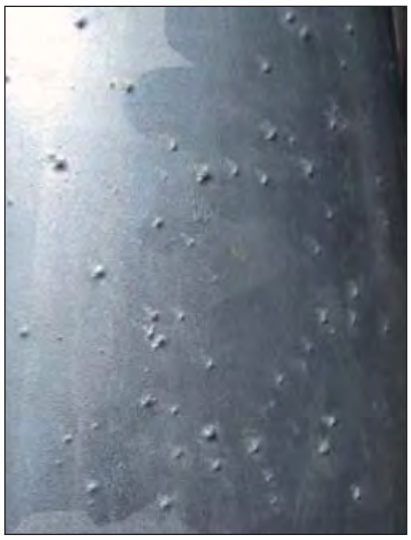

©Stichting Zinkinfo Benelux. Photo by: G. Schmittmann, Amerongen

It is impossible to obtain a duplex system of sufficient quality on hot dip coatings like this.

©Stichting Zinkinfo Benelux

Only one layer of powder coating will not last long particularly if it is exposed to an aggressive marine atmosphere.

©G. Reimerink, Amersfoort Photo by: G. Reimerink, Amersfoort.

Day to day surface abrasion damages the outer powder coating.

©G. Reimerink, Amersfoort Photo by: G. Reimerink, Amersfoort.

Even when the powder coating is damaged the steel substrate is protected by the zinc, both from a barrier and cathodic protection perspective.

The customer and the galvanizer must agree on the condition of the galvanized surface before the pretreatment for powder coating begins. It is sometimes possible for a galvanizer to prepare a galvanized product for coating, although this may influence the cost. An example is a classification of the result of preparation for coating into 'industrial', 'decorative or 'premium' surface condition with appropriately increasing prices. Clear arrangements must be made also who, the galvanizer or the coater will prepare product for coating.

Clear agreements are also needed for packaging of the products for delivery. The customer must make the requirements clear in the order with attention being paid to the ends of components, angles and projecting parts. These are easily damaged.

Fabrication

For long term performance and good appearance it is important that the hot dip galvanizing process produces a relatively smooth surface. Therefore the grade of steel used must not be one that has a tendency to cause rough or excessively thick zinc coatings. Timely attention to quality when purchasing steel is required. Any surface unevenness tends to be highlighted by an organic coating.

Welding also requires extra attention. Welds must be sufficiently robust to cope with hot dip galvanizing, but also not be irritatingly visible after galvanizing. The selection of good welding materials and efficient cleaning of the welds are required. The welds must be smooth and meet level D of EN ISO 5817.

Burrs and sharp points must be removed as effectively as possible. Sharp edges must be removed by grinding, cutting or milling. Rounding off to a radius of 2mm is the norm here. This is hardly possible with perforated plate and therefore account must be taken of the probable shorter service life of a duplex system.

Hot dip galvanizing

Products are air cooled after removal from the molten zinc bath, not quenched. This prevents the formation of brittleness in the zinc layer as well as potential adhesion problems of the powder coating.

During preparation for coating, any sharp projections, welding residues, hard zinc and zinc beads must be removed. The zinc coating must however remain intact, so abrading or grinding down to the steel surface must be avoided. Areas of damage reaching the steel surface may only be repaired if the customer agrees. The method used must also be agreed, because not all repair methods will be compatible with the specified organic system. Repair can also be done after using abrasive paper to remove projecting steel splinters.

Any additional requirements stated in the galvanizing standard (e.g. EN-ISO 1461) must also be observed. The galvanizer must make sure that if the zinc bath composition deviates significantly from the norm, compatibility with the organic systems is investigated. It is advisable to contact the powder supplier about this.

Storage, packing and transport

Dry storage is preferable to prevent the formation of zinc corrosion products (wet storage stain). If storage does take place outside, good ventilation between components is essential.

Sometimes temporary passivation can be used, but a check must be made in advance to ensure that this will not have any detrimental effects on the organic system and its adhesion to the zinc. Packaging is not essential, but when stacking for transport to the powder coater bare steel bands must not be used.

Pretreatment for powder coating

The pretreatment removes dirt, grease and zinc corrosion products from the zinc surface. This is essential to avoid undermining the adhesion of the organic topcoat. Just as with a paint system pretreatment can be dry, wet or a combination:

- *Chemical pretreatment*
  No general guidelines can be drawn up for this type of treatment. The chemical supplier's instructions must be carefully followed.
- *Mechanical pretreatment*
  The same guidelines apply to brush blasting as used for paint systems. Use fine grain, sharp, inert and non-metallic blasting grit, smaller than 0.5mm in diameter. Good results can also be obtained using stainless steel. Use low compressed air pressure for blasting (max 0.3MPa) is also advised. Move the blasting gun smoothly backwards and forwards and up and down at a distance of approx. 60cm from the surface and at an angle of between 50° and 70° until a matt surface is obtained.
- *Mechanical pretreatment followed by chemical treatment*
  This provides a better result with some organic systems.

Powder coating

Frequently used types of powder coating are:

- Polyester
- Epoxy
- Epoxy/polyester
- Epoxy primer + polyester topcoat
- Polyurethane

The client must specify a system that is suitable for the expected service conditions. The powder coater and supplier can advise about this. If the system specified is not suitable for the service conditions stated by the client in the order, it is advisable to contact the client. Repair later is often expensive, assuming it is even possible.

In the Netherlands, due to the climate (corrosivity class average C3), it is recommended that at least a two coat powder coating system of sufficient thickness is specified.

The coating system selected must be compatible with the zinc coating.

It is advisable to apply and heat cure the powder coating immediately following surface pretreatment. Some time in

continued on page 14...

Without a metallic zinc base coat, damage to the powder coating usually results underfilm creep and coating failure.

storage is possible – up to 12 hours after abrasive blasting in an air conditioned room with RH < 70%. When humidity is higher the object must be coated within three hours to avoid the risk of zinc corrosion product formation, which could negatively influence the adhesion of the organic coating. When using chemical pretreatment the instructions of the chemical supplier must be followed.

The hot curing temperature must not exceed 225°C. Above this temperature there is a high risk that the structure of the zinc surface will change, resulting in poor adhesion of the organic coating. The powder supplier's recommendations for curing time and temperature must be followed.

Delivery

The galvanizer or powder coater cannot be held responsible for what happens after delivery of the products to the site. It is often the case that insufficient care is taken during handling on site and damage is caused. Repair of the organic coating is possible following the instructions of the powder supplier.

Maintenance

As with paint systems based duplex systems periodically cleaning will improve the coatings life. Follow instructions of the powder supplier.

Literature

EN 15773 - *Industrial application of powder organic coatings to hot dip galvanized or sherardized steel articles [duplex systems] - Specifications, recommendations and guidelines*

EN-ISO 1461 - *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

EN-ISO 14713 - *Guidelines and recommendations for the protection against corrosion of iron and steel in structures — Zinc coatings — Part 1 and 2*

EN 13438 - *Paints and varnishes — Powder organic coatings for galvanized or sherardized steel products for construction purposes*

ISO 9223 - *Corrosion of metals and alloys — Corrosivity of atmospheres — Classification*

J.F.H. *van Eijnsbergen – Duplex Systems – Hot-dip Galvanizing plus Painting* (Elsevier, 1994)

Gerard Reimerink, Stichting Zinkinfo Benelux

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Duplex coating of the Ndlovu Roll Over Protection Structure (ROPS) and the Falling Object Protection Structure (FOPS)

The Roll Over Protection Structures (ROPS) and the Falling Object Protection Structures (FOPS) was developed, design registered and patented by Marven Equipment in Benoni Gauteng.

Marven Equipment, being a family owned business founded by Wayne and Christine Geldart, is a dynamic company that is constantly evolving with the times, and trying to accommodate the needs of their clients regarding mining vehicle products and accessory requirements.

Marven's ROPS was branded 'Ndlovu' after the African elephant, strong, robust, and the lightest in its class of being a heavy duty, multiple roll over protection structure. Ndlovu is capable of handling speeds of 120km/h thus enabling additional protection for contractors and employees from the moment they leave their homes and families, on the mines, and back home safely again.

Ndlovu is designed to offer additional protection for the occupants inside the cab of a vehicle in the event of a roll over accident. Ndlovu ROPS is capable of handling 4-6 times a vehicle's Gross Mass Weight. These structures were not originally duplex coated, but when Anglo Sishen asked Marven Equipment to hot dip galvanize the Ndlovu structures to help prevent the rapid corrosion rate in the highly corrosive mining environments, they began their investigations.

With the assistance of the Hot Dip Galvanizers Association of Southern Africa and Bulldog Projects (Pty) Ltd, a specification was put in place for the hot dip galvanizing and duplex coating system offering a 7 year warranty against rust and corrosion.

The standard vent, fill and drainage holes required for tubular structures

Finite Element Testing (FEA) was verified using physical tests including deliberately destroying a vehicle in a multiple roll.

were unable to be applied due to a possible weakening of the Marven's Ndlovu ROPS and FOPS structure, however, Robor Galvanizers and Macsteel Tube and Pipe who were the selected galvanizers and had the appropriate bath widths went to extraordinary measures to ensure that necessary but limited vent, fill and drainage holes were sufficient to avoid air pockets by manually manipulating the components in the molten zinc bath ensuring successful hot dip galvanizing was achieved.

As the Marven's Ndlovu ROPS is hot dip galvanized both externally and internally hidden rust cannot take place. The integrity of Ndlovu ROPS was critically important, and thus various tests were repeated after hot dip galvanizing.

Bulldog's duplex paint coating system works synergistically to extend the durable life expectancy of

continued on page 18...

the components whilst assisting with the aesthetic look of the ROPS and FOPS fitted to the mining vehicles.

Marven's Ndlovu ROPS has been tested by SABS, Gerotek, and a team of Engineers conforming to ISO 3471 ROPS, ISO 3449 FOPS, Finite Element testing (FEA), and physical testing verifying the FEA results – including deliberately destroying a vehicle in a multiple roll.

The major advantage of hot dip galvanizing and Bulldog's duplex coating system is that clients who rotate their fleet of vehicles every two and half years or so, are able to transfer their same Ndlovu ROPS structures from one vehicle to the next new vehicle, enabling them to enjoy the full 7 year warranty of Marven's Ndlovu ROPS. This in turn offers the companies huge cost savings in that there is no need for major capital outlays for new ROPS structures, for their replacement fleet of vehicles during this period (unless the ROPS has been involved in an accident, or there is obvious visible damage, in which case the ROPS is immediately scrapped and destroyed).

During the transfer from one vehicle to another, the ROPS structures undergo inspections prior to fitments, and new fitment kits are used. Traceability is very important, and Certificate of Conformance is updated with the new vehicle details. A new ID tag is fitted, 'marrying' the current ROPS to the new vehicle. New fitments and transfers may only be done through Marven Equipment and authorised agents.

This process has now become the standard for all the heavy duty Ndlovu ROP structures manufactured by Marven Equipment thanks to the Hot Dip Galvanizers Association Southern Africa and Bulldog Projects.

Marven's Ndlovu ROPS is approved by Anglo American, BHP Billiton (for contractors), and De Beers.

TESTS TO DATE ON MARVEN'S NDLOVU ROPS

SABS - SANS 1563 - R 66

Hill Roll test on a 60 degree hill SAE J857 and SAE J996

Anglo American specification ISO 3471 ROPS (Roll Over Protection Structure)

Anglo American specification ISO 3449 FOPS (Falling Object Protection Structure)

Finite Element Testing

ROPS – non linear FEA structural analysis of prototype # 9 according to the exact requirements of the (ROPS) *international standard ISO 3471 first edition 1994-02-01 Earth moving machinery roll over protective structures and laboratory tests - performance requirements and the international standard ISO 3164:1995 (E) Earth-moving machinery laboratory evaluations of protective structures - specifications for deflecting limiting volume.*

FOPS – A level II FOPS dynamic transient impact non linear FEA structural analysis of prototype # 9 according to the exact requirements of the (FOPS) *international standard ISO 3449 fourth edition 1992-05-15 Earth moving machinery – falling object protective structures – laboratory tests and performance requirements.* **The FEA test results show that our Ndlovu ROPS/FOPS is capable of handling in excess of 10 tons vertically, laterally, and horizontally.**

BHP Billiton

Standard light commercial vehicle test of dropping a vehicle from behind a moving truck with truck speeds of 60km/h to 80 km/h which equate to rollover speeds of 100km/h to 120 km/h. The test vehicle drop height is to be at least 200mm with 5° to 10° pitch, 20° to 25° roll and 25° to 35° yaw. Marven Equipment's Ndlovu Test Vehicle was dropped at 80km/h, equating to a roll over speed of 120km/h.

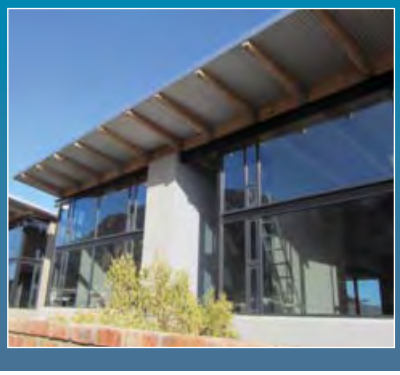
The real protection is hidden!

While hot dip galvanizing is frequently used for protection of steelwork on its own and is easily seen to be doing this, there are many instances where the coating is hidden and performs the essential back-up of corrosion control to various forms of over coatings and covers.

An example of this is when duplex coating systems are applied and while the performance of the two systems are working synergistically to provide the corrosion control solution, the hot dip galvanizing is out of sight.

Similarly, when reinforcement for concrete is hot dip galvanized it too is providing the essential back up but hidden!

This private home in Hermanus has utilised a duplex coating system to synergistically protect the steelwork.



Communicate to achieve specification requirements

When specifying general hot dip galvanizing, SANS 121 (ISO 1461) *should always be used but for an above ordinary finish required for either* Architectural Galvanizing *or subsequent over coating with powder or solution paints, written communication with the respective participating parties is always recommended.*

BS EN 15773:2009, "*Industrial application of powder organic coatings to hot dip galvanized or sherardised* (*for the purposes of this summary all reference to sherardising shall be omitted*) *steel articles* (*duplex systems*) *- Specifications, recommendations and guidelines," places huge emphasis on this and other important issues*:

In this summary of the standard, only the issues with regard to the galvanizer (*particularly that of communication*) *or the hot dip galvanized coating are highlighted. (Italics in blue are deemed relative to SA via the* HDGASA)

Introduction

Quote: "In order to achieve a duplex system which satisfies the many varied aesthetic and performance requirements currently in existence in the marketplace, the following aspects of the supply and application of the systems should be controllable."

Ordering

"The client shall make sure that all of the parties involved are notified that a duplex system will be applied. This requires good communication between the client, the steel purchaser, the fabricator, the galvanizer and the companies applying the pre-treatment and the powder coating."

Information provision

"The information provided by the client to the galvanizer shall be in accordance with EN ISO 1461 and *(particularly)* Annex A.

The client shall inform the purchaser of the steel that the steel will have a duplex coating applied and that the duplex system will include hot dip galvanizing.

The client shall inform all parties about the intended use of the product."

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Galvanizing	Powder organic coatings for galvanized products	Communications and quality issues surrounding supply of duplex coated articles
EN ISO 1461 *(SANS 121)* EN 10240 *(SANS 32)* EN 10326 EN 10327 EN 13811	EN 13438 or specific product specification.	EN 15773
Good communications in place and agreements made between galvanizer and client regarding general quality requirements in relation to the zinc coating.	NA	Good communications in place and agreements made between client, galvanizer and applicator of the powder organic coating regarding quality requirements for duplex systems in relation to quality of the zinc coating, the pre-treatment and powder organic coating.

Table 1: Standards for powder organic coatings and hot dip galvanized steel.

Delivery of product prepared for coating.

"The responsibilities for provision of work with the required surface condition (immediately prior to pre-treatment for application of a powder organic coating) shall be agreed between the client and the galvanizer and applicator."

Fabrication

This addresses several sub-titles like surface condition of the steel; nature and composition of the raw material; welds, markings and labels; deviations of edges and sides, which are vitally important.

Zinc coating and zinc surface

"Unless otherwise agreed the hot dip galvanized products, after hot dip galvanizing, shall be air cooled. S*ee* A*nnex* C."

"Where hot dip galvanized products have been prepared for application of powder organic coatings, the zinc surface shall, in all cases be free from sharp points or build up of zinc that would contravene the associated supply standard. Small, sharp projections caused by steel splinters that have been rolled in (to the surface) and other protrusions shall be smoothed off from surfaces in view, for example an abrasive cloth. The removal of zinc when preparing for organic coating shall be minimized.

A slight (sloping) thickening of the zinc coating shall be accepted provided this does not interfere with and is not damaging to the use of the product as indicated in advance by the client. Surface roughness (inherent to the galvanizing process) shall not be considered detrimental."

Storage, packaging and transport after galvanizing.

Pre-treatment of the zinc surface

General "The pre-treatment shall remove any significant contamination on the zinc surface, including grease, dirt and zinc corrosion products, which could otherwise undermine the adhesion and corrosion resistance of the subsequently applied organic coating system."

Chemical and mechanical (sweep blasting) pre-treatment.

Powder organic coating layers, includes general; specification of powder organic coating; repair of coating system; packaging, storage and further movement of finished products; installation; inspection of finished goods and health and safety.

Zinc saves kids in Peru

The Zinc Saves Kids initiative, launched by the International Zinc Association (IZA) in support of UNICEF, has significantly helped the nutrition component of UNICEF Peru. Our national and local programs are aimed at reducing child mortality and improving the health, nutrition and development of thousands of girls and boys living in the rural areas of the country, said Paul Martin, Representative, UNICEF-Peru. In its one-year progress report UNICEF indicated that multi-micronutrient supplementation for children under the age of five, as well as zinc supplementation for the treatment of diarrhea, have progressed significantly in Peru.

First year results

41.6% of the Peruvian population is at risk of inadequate zinc intake making it one of the highest-risk countries in the world for zinc deficiency. The project supported by the Government of Peru, UNICEF and IZA made multiple micronutrient powders (MNP), including iron and zinc, available to the 101 000 children aged six to 36 months living in the three prioritized regions Apurimac, Ayacucho and Huancavelica. 90% of children started MNP supplementation; in April 2011 58% received the complete dose of sachets covering six months sachets were to be taken every other day.

Thanks to IZAs support, many children have overcome anemia. Health personnel and the parents of children noticed that after taking multi-micronutrients supplements, children were more alert, active, playful and had a better appetite, commented Paul Martin.

Based on these results, the Peruvian Ministry of Health and the Ministry of Womens Affairs and Social Develop-ment, with support of UNICEF, will expand micronutrient supplementation to 13 additional regions targeting 424 607 children between six and 36 months of age.

The Ministry of Health has also incorporated therapeutic zinc supplementation as part of the treatment protocol for diarrhea and has included zinc supplementation in the clinical guidelines for child healthcare. Zinc as a treatment of diarrhea was started in 24 health establishments in Ayacucho and Ventanilla with a population of 45 100 children under the age of five. 40 000 zinc sulphate tablets were distributed to 4 000 children in the Ventanilla district to treat over 5 000 cases of diarrhea. It is expected that by 2012 the administration of zinc tablets for the treatment of diarrhea will be expanded nationwide.

For more information contact Rob White of IZASA on izasa@icon.co.za.

Supply phase	Essential communication links between parties involved	Requirements / Guidance
Design	Designer and client	Clause 5; EN ISO 14713-2 & 3; EN ISO 1461; EN 13811
Order	Client; *(steel supplier)*; fabricator; builder; construction company; galvanizer; powder manufacturer; pre-treatment chemical supplier; applicator	Clause 4; EN 10021; EN 10130; EN ISO 1461; EN 10326; EN 10327; EN 13811; EN 13438
Fabrication	Client; *(steel supplier)*; fabricator; construction company	Clause 5; EN 10021; EN 10163-!,2 & 3; EN 10221; EN ISO 1461; EN ISO 5817; EN ISO 14713-2 & 3
Hot dip galvanizing	Client; galvanizer	Clause 6; EN ISO 1461; EN 10240; EN 13811; EN ISO 14713-2 & 3
Transport and storage of galvanized articles	Client; galvanizer; transporter; applicator	Clause 6.3
Pre-treatment	Galvanizer; chemical supplier and applicator	Clause 7; EN 13438
Organic coating	Client; galvanizer; applicator	Clause 6.3 & 8; EN 13438; EN ISO 1461; EN 10240; EN 13811
Inspection #1	Client; galvanizer and applicator	Clause 11; EN 13438; EN ISO 1461; EN 13811; ISO 9223
Transport and storage of duplex coated articles in transit and on site	Client; applicator; transporter	Clause 9 and 10 and EN 13438
Installation	Client and construction company	Clause 8.3, 9 and 10

Table 2 outlines the phases of the supply process.

Ref class	Typical coating characteristics	Typical levels of reactive elements	Additional information
A	Coating has shiny appearance with finer texture.	≤ 0.04% Si and < 0.02% P	See NOTE below
B	Coating structure includes outer zinc layer.	> 0.14% to ≤ 0.25% Si	Fe/Zn alloy may extend through to coating surface. Coating thickness increases with increasing silicon content. Other elements also affect steel reactivity. In particular, phosphorous levels > 0.035% will give increased reactivity.
C	Coating has darker appearance with coarser texture.	> 0.04% to ≤ 0.14% Si	Excessively thick coatings might be formed.
D	Iron/zinc alloys dominate coating structure and often extend to coating surface, with reduced resistance to handling damage	> 0.25% Si	Coating thickness increases with increasing silicon content.
NOTE: Steels with compositions satisfying the formula Si + 2.5P ≤ 0.09% are also expected to exhibit these characteristics. For cold rolled steels, these characteristics are expected to be observed when steel composition satisfies the formula Si + 2.5P ≤ 0.04%. #2			
#1 Coating inspection after hot dip galvanizing is best done at the galvanizer before delivery. #2 As far as the HDGASA is concerned this is still open for discussion.			

Table B1: Coating characteristics related to steel composition.

Annex B (informative)

"Guidance on the influence of steel surface chemistry on the surface condition and pre-treatment of galvanized articles prior to application of powder organic coatings."

"When steel of a reactive composition has been used in manufacture of the work, the risk of lower quality of organic coating should rest with the client unless the defects in the coating are attributable to faulty processing. When galvanizing reactive steels, rougher coatings can be produced that can show an increased tendency to flake under mechanical stress."

Roof fixings in aggressive environments

In magazine No. 50 (Fasteners) we published an article on "Roof fixings in aggressive environments" which invited some comment as to the methodology of the proposal. Reitze Hylkema of Kare Industrial Suppliers (Pty) Ltd, has provided the following explanation:

Hi Terry

- *The 19mm round EPDM/ stainless steel washers prevents contact between the upper stainless steel section and the profiled aluminium washer. The upper stainless steel section of the washer has contact with the stainless steel screw*
- *The top section of the plastic sleeve fits in underneath the domed section of the aluminium saddle washer. The plastic sleeve fits through a predrilled hole in the roof sheeting but does not fit through the purlin.*
- *The Topspeed screw is tapped into a pre-drilled hole in the purlin.*
- *To the best of my knowledge Somta Tools make a stepped drill bit that drills two hole diameters: one ± 5.8mm through the purlin for the screw to tap into and a ± 10mm hole through the sheeting to accommodate the plastic sleeve. The sleeve then prevents contact between the screw and the sheeting.*

Regards
Reitze

On the Couch.....

Alan Lamb

By Desere Strydom

The year 2012 has been galloping away with Alan Lamb of Lamb Consultants based in Durban with many interesting projects on the cards both locally and abroad. On The Couch caught up with Alan in his nature filled home office in Morningside.

Please tell us a little about your background: I was born in Gwelo in the former Rhodesia, one of four children. We grew up on a deciduous fruit farm in the Eastern Highlands and schooled in Umtali. Both my grandfather and father were involved in construction, the latter a qualified engineer having worked with Ove Arup, founder of the multi-national Arup Group. My father opened up two offices for Ove Arup in two countries. I think that once my father had children, he felt like he needed a more settled life and decided on farming. I do however remember growing up always surrounded by engineering plans which he kept on his drawing board and worked on at night.

So no prizes for guessing then how you got into the field? Ha ha, actually I wasn't so sure, but applied at UCT nonetheless. During the wait to hear whether I had been accepted, I visited Durban and fell in love with the place. I had the proverbial "Arnie" moment in my head, when I looked down Innes Road, over the Lion Match Factory and the sea beyond, thinking "I'll be back!"

After completing your studies, where did you do your internship? I was fortunate to have had the best experience as an engineer-in-training at Thomson and van Eck in Cape Town. The then M.D. stated that I must go to site and that he didn't want to see me in the office for a whole year. It was an excellent experience, because I got to see on a large construction site, what I learnt at varsity first hand. In a way the experience moulded me to what I am today and I am grateful for it.

You spent a long time abroad, before finally returning to South Africa in 2004, please tell us about this period? Well initially it started as six months of travelling in Europe which eventually saw me living in the UK and working for a small London based firm called Heath & Spearing. Here I worked on an award winning project, which stands out as a highlight in my career – Windsor House in Plymouth. It was towards the tail-end of this project that I met my wife Rina, whom I married in 1994.

What made you return to South Africa? After my wife's untimely death in 2002, I visited family in Cape Town, where I spent some time with my nephew, who was just a little boy at the time. He looked up at me and said: "why don't you just come back?", and I thought "why not?"

This choice ultimately lead you back to Durban? Funnily enough yes and I was even more blown away when I discovered that the practice where I was going to work, ZAI Consultants, had their offices at the Lion Match Factory! The very same building that made such an impression on me during my first holiday to Durban. I left ZAI in 2010 to start Lamb Consultants (shortened to Lambcon).

You are known in the industry as a staunch supporter of the hot dip galvanized coating, please tell us why? For its durability, low maintenance and that damage can so easily and effectively be fixed. The coating is in a sense self-healing! I

specify the coating for ALL coastal projects with duplex paint system if required.

Please tell us about your hobbies and passions? I love the sea and enjoy swimming and body-surfing in it. I consider myself a new-comer to KZN, even though I've lived here for eight years! I enjoy exploring the province over weekends. I'm a lover of South African music and also passionate about nature. This passion shines through in my work and I wish more professionals would truly embrace green design principals. We have too many flat roofs, serving no purpose other than being a roof; we should plant gardens and grow vegetables up there!

Complete the sentence... 5pm on a Friday afternoon... Alan Lamb is getting ready for what the weekend has to offer!

Alan Lamb can be reached on ahlamb@telkomsa.net.
Website: www.lambconsultants.co.za or www.lambcon.co.za

Article by Des Ray for HDG Today 2012©

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HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA

Galvanic corrosion

Galvanic protection

When zinc is galvanically coupled to another metal, the galvanic corrosion of zinc generally results in galvanic protection of the coupled metal. This property of zinc has been used in many applications, especially for the protection of steel by galvanizing. The steel is protected by the zinc coating by means of both a barrier effect and a galvanic effect, in which zinc acts as the sacrificial anode, while steel acts as the cathode. Besides galvanizing, zinc is also widely used cathodically as bulk sacrificial anode material for cathodic protection of steel structures. The principles of a protection of steel structure through sacrificial zinc anodes are in essence the same as those through impressed current by a rectifier. When a cathodic current is passed through steel, the potential of the steel will be changed to more negative potentials. When the potential is in the region where iron is thermodynamically stable, the steel becomes inert.

In most natural environments, zinc corrodes much less than steel, by a factor of 10-100 times[357,539]. The protection of steel by zinc coating is, thus, mainly through the barrier effect. However, at the places where the zinc coating is removed or defective, leaving the steel exposed, the galvanic action between steel and zinc can protect the exposed steel from corrosion. The galvanic corrosion of galvanized steel is quite unique because, unlike for other galvanic couplings, the combination of materials and geometry in galvanized steel, do not change much with application. The galvanic corrosion rate of zinc and, at the same time, the extent of galvanic protection for the steel, can be determined based on dimensional and environmental factors.

Galvanic series

The polarity and direction of galvanic current flow between two connected bare metals is determined by the thermodynamic reversible potentials of the metals. The metal which has a higher reversible potential in the electromotive force (EMF) series is the cathode in the galvanic couple. *Table* 2 shows the standard EMF series of common metals[1124].

Galvanic corrosion in atmospheres

Galvanic corrosion can be a significant contributor to corrosion when a small piece of zinc is connected to a similar or larger piece of other metal. *Table* 8 shows that, except for aluminum and magnesium, the corrosion of zinc is increased by electrically connecting to other common metals. Depending on the connected metal and the type of atmosphere, the galvanic corrosion can be as much as five times the normal corrosion of zinc in a rural atmosphere and three times that in a marine atmosphere. The corrosion rate of zinc decreases when it is connected to aluminum in urban and marine atmospheres and to magnesium in all atmospheres[293,544,551]. In other atmospheres, zinc is anodic to aluminum, due to the passive film on aluminum. The zinc is

	Metal-metal ion equilibrium (unit activity)	Electrode potential vs. NHE at 25C (volts)
	$Au-Au^{+3}$	+1.498
	$Pt-Pt^{+2}$	+1.118
Noble or cathodic	$Pd-Pd^{+2}$	+0.951
	$Ag-Ag^{+}$	+0.799
	$Hg-Hg2^{+2}$	+0.797
	$Cu-Cu^{+2}$	+0.342
	$H2-H^{+}$	0.000
	$Pb-Pb^{+2}$	-0.126
	$Sn-Sn^{+2}$	-0.138
	$Ni-Ni^{+2}$	-0.257
	$Co-Co^{+2}$	-0.277
	$Cd-Cd^{+2}$	-0.403
	$Fe-Fe^{+2}$	-0.447
	$Cr-Cr^{+3}$	-0.744
	$Zn-Zn^{+2}$	-0.762
Active or anodic	$Al-Al^{+3}$	-1.662
	$Mg-Mg^{+2}$	-2.372
	$Na-Na^{+}$	-2.714
	$K-K^{+}$	-2.931

Table 2: Standard EMF series of common metals[1224].

Coupled alloy	Rural	Urban	Marine
Zinc freely exp.	0.5	2.4	1.3
Mild steel	3.0	3.3	3.9
Stainless steel	1.1	1.8	2.0
Copper	2.2	2.0	3.2
Lead	1.6	2.4	3.4
Nickel	1.5	1.9	2.8
Aluminum	0.4	1.1	1.1
Anode aluminum	0.9	1.9	1.0
Tin	1.0	2.6	2.4
Chromium	0.7	1.4	1.9
Magnesium	0.02	0.04	1.1

Table 8: Galvanic corrosion rate of zinc coupled to other common commercial metals in different atmospheres (µm/y)[293].

Couple humid	Industrial		Rural		Industrial, Marine		Industrial	
	W[1]	R[2]	W	R	W	R	W	R
Zn/Zn	187	–	27	–	195	–	43	–
Zn/Pb	313	1.7	47	1.7	328	1.7	83	1.9
Zn/Cu	292	1.6	48	1.8	338	1.7	100	2.3
Zn/Al	362	1.9	100	3.7	440	2.3	141	3.3
Zn/Fe	332	1.8	81	3.0	349	1.8	127	3.0
Fe/Fe	1825	–	470	–	1534	–	1406	–
Fe/Zn	43	1/40	147	1/3	5	1/300	6	1/230

1. Weight loss in mg; 2. Increase ratio; 3. Weight loss of the first metal in a couple, e.g. Zn in Zn/Al. Samples consisted of two 1.5 in. diameter disc. 1/16 in. in thickness, clamped together with 1 in. diameter Bakelite washers, giving an exposed area of 1/16 in. all round the edge of the disc, and an annular area 1/4 in. deep = 1.275 sq. in.

Table 9:Corrosion of galvanic couples in different atmospheres after seven years' exposure[3] [1229].

anodic to the aluminum in most of the industrial and some of the marine atmospheric exposures[515]. Zinc alloy coatings with more than 60% Al behave more like aluminum and provide no galvanic protection to the steel[248]. The galvanic effect is most significant in marine atmospheres because of the high conductivity of surface moisture. The thinner the moisture film on the metal surface, the more localized the attack at the galvanic couple contact[293].

Compared to other types of corrosion, galvanic corrosion in the field has not been well investigated. This is probably due to its greater complexity, including many factors which may affect the normal corrosion of a metal together with others, such as the kind of cathodic materials, the size of the electrodes, anode and cathode arrangement etc. In addition, this complexity makes application of the field corrosion data limited because in real situations conditions are not usually close enough for the direct comparison of results.

Galvanic corrosion of galvanized steel occurs at areas where the coating is damaged and the steel underneath is exposed, such as at cuts or scratches. At these areas, the exposed steel is cathodically protected while the surrounding zinc coating is galvanically corroded. However, in most cases for galvanized steel, the amount of coating loss due to galvanic corrosion, compared to normal corrosion, is small because the exposed areas of bare steel are usually too small to cause significant corrosion of the relatively much larger zinc surface area. As a result, the atmospheric corrosion rate, including galvanic and normal corrosion, of galvanized zinc coating is usually very similar to that of uncoupled zinc.

Galvanic corrosion can, however, be a significant contributor to the total corrosion of zinc in some atmospheres when it is connected to other metals of similar size.

Galvanic corrosion of zinc at a discontinuity in a galvanized coating, in an atmospheric environment, has been mathematically simulated. and this model can be accessed here by clicking on the word “simulated”. In this model, the conditions discussed above can be modified by entering different values and the results can be seen as a graph of surface potential across the interface and then as an animated figure showing the progress of corrosion on both the zinc and the steel and the size of the protection distance.

Galvanic couples

Table 8 shows the galvanic corrosion of zinc coupled to different metals. It can be seen that the amount of corrosion is not

continued on page 26...

directly related to the difference between the reversible potentials of zinc and the coupled metal. Among the metals, mild steel acts as the most efficient cathodic material, largely owing to the voluminous rust which can absorb pollutants and retain moisture and thus give rise to an aggressive electrolyte of good conductivity.

Table 9 shows the galvanic corrosion of zinc and iron in four different atmospheres using metal discs clamped together with insulating washers[1229]. In this galvanic cell, the corrosion rate of zinc disc samples is increased by a factor of 1.7 to 3.7. For zinc/steel couples, the galvanic corrosion of zinc is generally insignificant compared to the decrease in the corrosion of iron resulting from the galvanic action. Galvanic protection of the steel is more effective in industrial and marine atmospheres than in rural ones. This suggests that the pollutants in the atmospheres are beneficial to the galvanic protection of steel, although they are very harmful to the normal corrosion of the uncoupled steel. The galvanic effect is most significant in marine atmospheres because of the high conductivity of surface moisture. The thinner the moisture film on the metal surface, the more localized the attack at the galvanic couple contact.

The extent of galvanic corrosion of zinc does not vary much when coupled to different metal alloys, even though there are wide differences in the reversible potentials among the alloys [545]. It was suggested that, under atmospheric conditions, other factors, such as corrosion products on zinc and other metals, are more important in controlling the galvanic corrosion of zinc than the differences in the metal potentials.

Benefit of galvanic protection

Atmospheric exposure testing of mild steel wire wrapped around the threads of zinc bolts indicated that galvanic action reduced the corrosion of the steel wire by a factor of 10 to 40 depending on the type of atmosphere[293]. This can also be seen in *Table* 9, which presents the results of a seven-year exposure test with discs of the metals clamped together with insulating washers exposing an annular area of each metal 1/45 in. (0.6mm) wide. The galvanic action reduced the corrosion of the steel by 40 times in industrial, 230 times in humid-industrial and 300 times in sea-coast industrial atmospheres. The reduction was only about three times in rural atmospheres. The much lower galvanic effect on the corrosion of steel in rural atmospheres is largely due to the relatively non-conductive nature of the moisture. *Table* 9 also shows that the accelerating effect, a factor of 1.6 to 3, of galvanic action on the corrosion of zinc is generally insignificant compared with the reduction of steel corrosion.

From: GalvInfo Center using information from: "Corrosion and Electrochemistry of Zinc", Xiaoge Gregory Zhang, Plenum Press, New York, 1996.

What readers have to say...

Hi Bob and Terry,

Congratulations on the outstanding quality of your Journal. The articles in your latest edition by Prof. Waldo Stompf on hydrogen embrittlement and cathodic protection by Gerald Haynes were both particularly good.

I receive many publications but yours' stands out amongst the very best. Specifiers and decision makers don't need to be told what materials they should use – they need to be given honest facts and reasons in order to make sound rational choices themselves. Honesty is probably the most underrated marketing strategy.

Your journal is educational and digestible and it is presented in a factual and objective manner.

Keep up the good work.

Best regards
Rod

Dr. Roderick G.D. Rankine PrEng
Professional Engineer and Construction Consultant

3 CPD POINTS

3-day Galvanizers Inspectors Course

Hot dip galvanizing is one of the most widely used methods of protecting steel from corrosion. During fabrication and after hot dip galvanizing the coating is inspected for compliance with the relevant specifications.

Following up on comments received from the many participants attending our regular two day inspector courses over the last nine years, we decided to expand and update our 2-Day course into a more comprehensive 3-Day course.

Included are revisions of the course material and the introduction of more practical activities in the form of a full morning at a hot dip galvanizing plant followed by an afternoon of Duplex coatings. The galvanizing plant visit examines materials prior to galvanizing and hands on inspections of finished product. The afternoon is a visit to a paint applicators yard and Duplex coatings systems. Included are demonstrations on chemical cleaning and/or sweep blasting, examination of resulting profiles and followed by the application of paint onto galvanizing. The course will provide delegates with sufficient knowledge to advise on fabrication for successful hot dip galvanizing and also test, inspect and interpret test results after hot dip galvanizing.

COURSE DURATION AND CONTENTS

Day 1	**(08h00 to 16h00)**
Lecture 1	Introduction to the Environment, Steel & Corrosion
Lecture 2	Understanding Zinc Coatings (How does Zn protect) ISO 9223 & 12944
Lecture 3	Designs, Fabrication and Inspection before hot dip galvanizing SANS (ISO) 14713:1999
Lecture 4	General Hot Dip Galvanizing Processes SANS 121 (ISO 1461:2009) Batch type galvanizing SANS 32 (EN 10240: 1997) Automatic T & P SANS 10094:2007 HDG of Friction Grip Fasteners
Day 2	**(07h00 to 16h00)**
	Hot Dip Galvanizing Plant Visit and Inspection
Lecture 5	Duplex Coatings and HDG Reinforcement in Concrete Duplex Coatings Plant Visit and Applications
Day 3	**(08h00 to Completion of Exam)**
Lecture 6	Inspections after Hot Dip Galvanizing
Lecture 7	Quality Assurances in Coating Applications Application of specifications Control documentation for a QA System Examination on Course Effectiveness

Course schedule may be altered and interesting activities added for the benefit of delegates.

Following the course and successful result in a three part exam, the delegate will be issued with a certificate and if required, registered as an approved HDGSA Galvanizing Inspector. Registration will be confirmed on an annual basis. Successful galvanizing inspectors will become Affiliate Galvanizing Inspector Members of the HDGASA for the year.

VENUE AND NUMBER OF DELEGATES

The courses are usually run in Johannesburg from the Hot Dip Galvanizers Association in St Andrews, Bedfordview and also from a suitable venue in Cape Town. Bookings are limited to 10 people per course on a first come first serve basis.

DATE AND TIME

Courses commence at 08h00 sharp and end at 16h30 (or as otherwise instructed). Lunch and refreshments will be provided. Comprehensive course notes can be collected from our offices two weeks before the course (this is highly recommended).

Johannesburg:
21 to 23 February; 13 to 15 March; 15 to 17 May; 26 to 28 June; 14 to 16 August; 9 to 11 October; 27 to 29 November.

Cape Town:
6 to 8 March; 5 to 7 June; 18 to 20 September.

Special courses can be arranged for a minimum of 6 delegates at appropriate venues in South Africa.

COURSE COST AND PAYMENT TERMS

R4 200.00 per person exclusive of VAT. Should you have two or more delegates from the same company, course costs will be R4 000.00 per person exclusive of VAT. Please note that payment is due on the first day of training. Cheques are to be made out to "Hot Dip Galvanizers Association SA". Members qualify for a discount.

CONTINUOUS PROFESSIONAL DEVELOPMENT (CPD)

By attending the Association's 3 day course Galvanizing Inspectors Course, you will obtain 3 points (accredited by ECSA).

SHOULD YOU BE INTERESTED, KINDLY CONTACT SASKIA SALVATORI OR MARJORIE MONTGOMERIE AT THE ASSOCIATION

Renewable energy is a large part of the green movement

Whether you are watching TV, reading a magazine, or just commuting to work, it seems everywhere you look you are inundated with messages about being green or going green. The increasingly popular green movement seems to touch every industry, from automobiles to home appliances. The construction and building industry is a major player in the green movement, with demand for green construction increasing at a dramatic rate. One major aspect of becoming a greener nation includes finding renewable sources of energy.

The recent presidential campaign in the USA is a strong indication of the population's interest in energy. Besides the economy, energy and infrastructure were two of the most important topics debated during the campaign. With the historic election behind us, President-Elect Barack Obama will be responsible for steering the future of this nation's energy resources. Both Obama and Congress have shown significant interest in regulating energy and mandating renewable energy resources.

Estimates have varied as to when and how much renewable energy will be required, but many believe it will be in the neighbourhood of 15-20% in the next 12 years. Regardless of the amount required or when it will be enforced, the nation's future is dependent on developing and sustaining increased power and energy resources. Coupled with the green movement and focus on reducing carbon footprints, the renewable or alternative energy markets are poised to grow significantly over the next 10-12 years.

A critical element often overlooked when discussing the development of alternative energy is how such resources will be constructed. Once a percentage of our power and energy is transferred to renewable sources, it will be imperative those sources are able to continue to produce a constant level of energy. The construction of the energy sources, whether solar, wind, hydro-electric, or biofuel will need to take into consideration the durability and longevity of the products used to construct them.

Hot dip galvanized steel is a logical and viable option for alternative energy resources for a number of reasons, but namely because of its longevity and maintenance-free qualities. The longevity of hot dip galvanized steel will allow the renewable energy resources to continue to generate power for decades without costly shut-downs for maintenance, repair, or replacement of the structures. Additionally, hot dip galvanized steel is 100% recyclable, which will support both the green movement and the purpose of finding renewable resources.

Galvanizing has a lengthy and successful track record in the power and energy industry, and has already been utilized in the installation of alternative energy projects. The American Galvanizers Association recently produced a publication on the use of galvanized steel in alternative energy projects, including case studies to whet your creative appetite. Sustainable Solutions is offered for free download on our website by visiting *www.galvanizeit.org/images/uploads/publication*PDFs/*Alt._Energy_Low_Res_.pdf*, or you can request a complimentary printed copy by contacting Jenny Clawson at jclawson@galvanizeit.org.

Lectures and plant tours through hot dip galvanizing facilities forms an essential component of the Association's ongoing promotional efforts to Architectural and Engineering students of all disciplines.

Black Swans

Cynics say that there are only two things in life that are certain: you will pay taxes and you will die. Everything else is uncertain.

The concept of uncertainty has been debated for many centuries by philosophers, religious fundamentalists, physicists, economists, financiers, statisticians, astronomers, engineers and information scientists. Each sees uncertainty in subtly different ways: physicists view uncertainty as the inability to simultaneously measure more than one physical property of an atomic particle. Uncertainty can also arise by errors or variances in measurements. With people, uncertainty can arise from risky behaviour.

Lack of understanding of the behaviour of complex systems is the major cause of uncertainty. These include the weather, economic, socio-political, human and financial systems, economies of countries and stock markets. Patterns and trends may often be apparent, but one can never fully describe them or make accurate predictions about them.

But, we have a need and a want to make predictions and we normally base these on previous measurements, historical information, knowledge and experience. Intuition is important and a variation of this may be how psychics work with predictions of paranormal happenings or extra sensory perception.

Many events, with disastrous consequences, were never predicted,

e.g. two airplanes crashing into the World Trade Centre on 11th September 2001 and the financial disasters of 1987 and 2008. How many of the innovative electronic devices we use today were predicted, say, three years ago? According to the website 'Bible.ca', more than 220 dates, from 44 AD to the present, and including many in future years, have predicted the dates on which the world will end. Most of these predictions are based on interpretations of religious scriptures and unfathomable numerology.

Financial advisers, stock brokers, insurance salespeople who, in order to sell you some fancy-sounding financially derived product, predict high returns on investments. Many of these predictions, or so we are told, are based on 'key' information and analysis of past financial performance, but there are others that are probably nothing more than a good sales pitch. In gambling, we are predicting that we will win. Have you ever come across anyone who is predicting that they will lose money when they gamble? How many people believe that they will be losing money, sometimes their entire life savings, when they buy shares or make other investments?

The failure for predictions to most usually not come true shows that many things are unpredictable. The classic metaphor for unpredictability has been given by the writer Nassim Taleb and described in his book 'The Black Swan'. In the 16th century in England, all swans were presumed to be white because information on swans indicated this: a black swan was considered impossible and could not exist. In 1697 in Australia, however, black swans were discovered, so that the assumption that all swans were white was incorrect. Taleb uses the Black Swan as the iconic symbol of an unexpected event, something that was not predicted and yet, at least in the context of swans, was a major event that had significant consequences.

Life is full of Black Swans. Each of us can give an example of Black Swans in our lives and will most probably recognise that there will be many more Black Swans still to come. You will not be able to say what they will be, when they will arise and what their affect on you will be: they will just happen. The challenge is for us to know how to live our lives knowing that there could be Black Swans around the corner.

The Association wishes to thank Bob Andrew who is a consulting value engineer and honourary member of the Association for his article. *He can be contacted on anneve@iafrica.com or boband@mweb.co.za.*

Evaluation of hot dip galvanized structural steel subjected to a fire at the waste collection and sorting facility, IDZ – East London

The Hot Dip Galvanizers Association Southern Africa was requested by Jim Weaver to evaluate the condition of the hot dip galvanized structural steelwork that was subjected to a fire at the Waste Collection and Sorting Facility at the IDZ in East London. The inspection was briefly carried out while in East London on 7 September 2011. I report as follows:

Photo 1 shows the facility and the appearance of the front of the building after the fire. Note the damage to the aluminium sheeting.

Photos 2 - 4 show the 4 columns (numbered 1 to 4) and X-bracing (XB) left and right (XBL and XBR) where the hot dip galvanized coating was tested and

continued on page 32...

Photo 1.

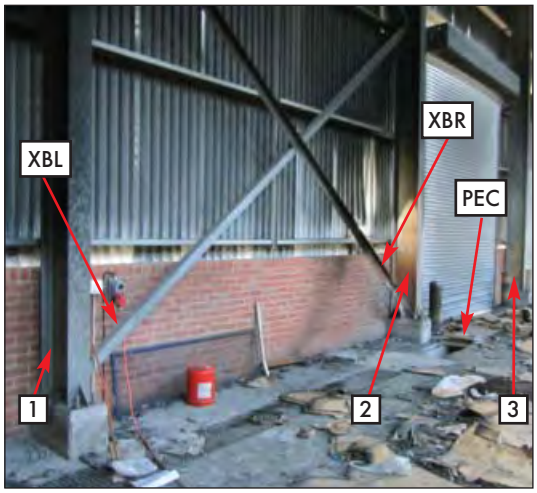

Photo 2.

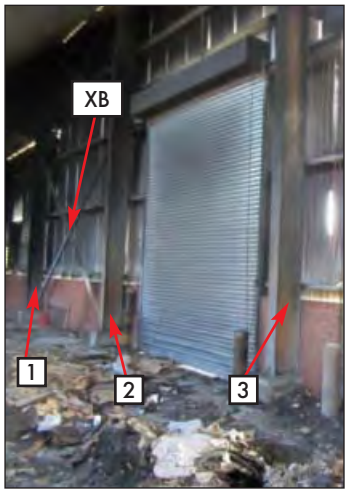

Photo 3.

Photo 4.

Photo 5.

Photo 6.

Photo 7.

Photo 8.

Photo 9.

Photo 10.

Photo 11.

Photo 12.

Photo 13.

Photo 14.

Photo 15.

Photo 16.

Photo 17.

Photo 18.

Photo 19.

Photo 20.

Photo 21.

Photo 22.

Photo 23.


Photo 24.

Photo 25.

Photo 26.

Photo 27.

residual thickness reported. Possible epi-centre of the fire (PEC). *Photo* 5 shows coating thickness reading of Column 1 Flange (261µm).

Photo 6 shows coating thickness reading of Column 1 Web (255µm). *Photo* 7 shows coating thickness reading of X Bracing left (98.3µm) and *photos* 8 *and* 9, X bracing right (8.2 and 14.7µm respectively).

Photos 10 *and* 11 show coating thickness readings of Column 2 Flange (47.6, closer to the fire, and 182µm) and *photos* 12 *and* 13 Column 2 Web (104 and 191µm respectively).

Photos 14 *and* 15 show coating thickness readings of Column 3 Flange (127.0 and 138.0µm) and *Photos* 16 *and* 17 Column 3 Web (closest to the fire) 63.8 and 59.2µm respectively.

Photo 18 shows a typical coating thickness reading of Column 4 Flange (307.0µm) and *Photo* 19, Column 4 Web (322.0µm)

Photos 20 *and* 21 show coating thickness readings on continuous hot dip galvanized sheeting rails at Column 2 and X Bracing Right (27.0 and 25.0µm respectively).

Photo 22 shows a coating thickness reading on continuous hot dip galvanized sheeting rails at Column 1 (27.8µm) and *Photo* 23 Column 3 (32.5µm).

Photos 24 *and* 25 show the louvre window and continuous hot dip galvanized sheeting frame with a typical coating thickness reading of 24.3µm.

Photos 26 *and* 27 show the holding down bolts and nuts at Column 2 with coating thickness readings on the nuts of 27.3 and 19.3µm respectively.

Conclusion and recommendation

The hot dip galvanized coating at Column 2 and X-Bracing right has been considerably reduced in coating thickness by the fire and apart from the deformation of the X-Bracing which obviously must be replaced, the reduced coating thickness will result in a reduced service life.

The holding down bolts when reused will have to be over coated with something like Zincfix or Galvpatch (*see the* HDGASA *Coating Repair Procedure*) to provide extended corrosion protection.

The continuous hot dip galvanized sheeting rails and louvre frames seemingly have not been affected by the fire, with the residual coating thickness being much the same as it was when originally installed.

The affected areas can be cleaned by using a high pressure water blast with added abrasive.

Terry Smith, Technical Marketing Director.

BAMR, suppliers of the Elcometer range of measuring instruments, felt that it was appropriate to donate two new Elcometer 456 coating thickness gauges to the Hot Dip Galvanizers Association for use in both Johannesburg and Cape Town, due to the positive exposure they continually receive via Hot Dip Galvanizing Today and other promotional activities including the Association's Galvanizing Inspectors Courses. Here Graham Duk, Director of BAMR hands one of the Elcometer 456's to Terry Smith in Cape Town. The Association wishes to thank BAMR for their generous donation!

PROPOSED FEATURES FOR 2012

August / September (No 52):

• Cable ladders and trays • Artistic / Architectural hot dip galvanizing

November / December (No 53):

• The world of hot dip galvanizing around us • Greening of the hot dip galvanizing industry

NOTE: FEATURES MAY BE SUBJECT TO CHANGE

The Association would like to acknowledge the advertisers and thank them for their support

HOT DIP GALVANIZING MEMBERS

GALVANIZER	LOCATION	TEL. NO	SPIN	NO. OF LINES	BATH SIZES (L x W x D) (m)
GAUTENG					
ArcelorMittal South Africa	Vanderbijlpark	016 889-9111		3	Sheet galvanizer
Armco Galvanizers	Isando	011 974-8511		1	13.2m x 1.5m x 2.2m
Armco Galvanizers – Dunswart	Dunswart	011 914-3512	●	3	5.2m x 1.2m x 2.0m 3.0m x 1.0m x 1.5m 2.0m x 1.0m x 1.5m
Armco Galvanizers – Randfontein	Randfontein	011 693-5825		1	6.5m x 1.3m x 2.0m
Babcock Ntuthuko Powerlines (Pty) Ltd	Nigel	011 739-8200		1	12.0m x 1.4m x 1.8m
DB Thermal SA (Pty) Ltd	Nigel	011 814-6460		In-line	16.0m x 1.0m x 1.0m
Galvadip (Pty) Ltd	Waltloo	012 803-5168		2	7.2m x 1.7m x 2.2m 7.0m x 1.5m x 2.5m
Galvaglow	Factoria	011 955-5200		1	4.0m x 1.5m x 2.5m
Galvspin Galvanizers cc	Boksburg North	011 918-6177	●	2	4.6m x 4.6m x 1.6m 3.0m x 1.0m x 1.5m
GEA Air Cooled Systems	Germiston	011 861-1571		In-line	11.5m x 1.0m x 1.0m
Lianru Galvanisers cc	Nigel	011 814-8658		2	7.2m x 1.3m x 1.6m 4.5m x 1.3m x 1.6m
Macsteel Tube & Pipe	Boksburg	011 897-2194		In-line	13.5m x 1.6m x 2.4m
Pro-Tech Galvanizers (Pty) Ltd	Nigel	011 814-4292	●	2	3.2m x 1.1m x 1.5m 3.0m x 1.1m x 1.2m
Robor Galvanizers (Pty) Ltd	Germiston	011 876-2900		3 Tube	14.0m x 1.35m x 2.5m 10.0m x 2.0m x 4.0m Dia 42mm to 114mm max tube length 6.7m
Robor Tube	Elandsfontein	011 971-1600		1	Tube & pipe galvanizer
SMT Galvanizers	Benoni South	011 421-1495	●	2	2.6m x 1.0m x 1.5m 2.0m x 1.0m x 1.5m
Supergalv	Alrode	011 908-3411		1	6.0m x 1.2m x 1.8m
Transvaal Galvanisers In-line & general	Nigel	011 814-1113		3	9.0m x 1.0m x 1.0m 8.0m x 1.2m x 1.5m 6.0m x 1.3m x 1.3m
NORTH WEST					
Andrag Agrico	Lichtenburg	018 632-7260		#	In-line galvanizer
FREE STATE					
Harrismith Galvanizing & Steel Profile (NB: Big line is not in operation)	Harrismith	058 623-2765		2	4.5m x 1.3m x 2.5m (12.0m x 1.2m x 2.5m)
WESTERN CAPE					
Advanced Galvanising (Pty) Ltd	Bellville	021 951-6242		1	8.0m x 1.5m x 3.0m
Cape Galvanising (Pty) Ltd	Parowvalley	021 931-7224		1	14.0m x 1.6m x 2.6m
Galvatech (Pty) Ltd	Bellville	021 951-1211		1	7.5m x 1.5m x 2.6m
Helderberg Galvanizing	Strand	021 845-4500		1	5.5m x 0.8m x 2.4m
Pro-Galv cc	Stikland	021 945-1803		1	7.2m x 1.3m x 2.6m
South Cape Galvanizing (Pty) Ltd (NB: Big line is not in operation)	George Industria	044 884-0882		2	3.7m x 0.94m x 2.3m (5.5m x 1.0m x 2.6m)
EASTERN CAPE					
Border Metal Industries	Butterworth	047 491-5577		1	1.2m x 0.8m x 1.0m
Galvanising Techniques cc	Port Elizabeth	041 486-1432		1	12.0m x 1.3m x 2.3m
Galvaspin (Pty) Ltd	Port Elizabeth	041 451-1947	●	1	3.0m x 1.2m x 1.8m
Morhot (Pty) Ltd	East London	043 763-1143		1	6.0m x 1.2m x 2.5m
KWAZULU/NATAL					
A&A Galvanisers	Pietermaritzburg	033 387-5783	●	1	3.3m x 0.9m x 1.9m
Bay Galvanisers	Richards Bay	035 751-1942		1	5.0m x 1.2m x 2.5m
Phoenix Galvanizing (Pty) Ltd	Phoenix	031 500-1607	●	2	14.0m x 1.4m x 2.5m 3.0m x 1.2m x 1.2m
Pinetown Galvanizing	Pinetown	031 700-5599		1	9.0m x 1.2m x 3.0m
Voigt & Willecke (Pty) Ltd	Durban	031 902-2248		1	14.0m x 1.3m x 2.5m
MOZAMBIQUE					
F&F Services	Beleuane	+258 823021260		1	4.0m x 0.8m x 1.5m

 # Sheet, wire, pipe and other in-line galvanizing members dedicate their plants to the galvanizing of their own products.

Note:

- *Where more than one galvanizing line is available, the number of lines and the significant bath dimensions are listed, ie. widest, longest and deepest.*
- *For specific contact names (e.g. sales or production personnel) and mobile telephone numbers, contact company receptionist.*
- *The bath sizes are inside dimensions and not maximum component size (length, width and depth). Kindly take note of the expansion of the component when dipped into molten zinc, or discuss with relevant galvanizer.*

CONSISTENTLY DELIVERING **SUPERIOR QUALITY** GALVANIZED PRODUCTS TO ALL OUR CUSTOMERS

Our **Isando** plant can accommodate heavy steel structures due to our 13,2 meter kettle and improved cranage and loading facilities.
Our **Dunswart** plant specialises in difficult-to-handle items as well as centrifugal work.
Both plants offer an in-house transport facility, a high level of expertise and quick turn around time.

The company has it's own SANS 121 2000 ISO 1461 accredited Hot Dip Galvanizing plants. And is listed under the SABS ISO 9001 scheme.

"ARMCO IS OUR NAME, GALVANIZING IS OUR GAME"

GALVANIZING BATH SIZES

ISANDO

13.2m x 1.5m x 2.2m
(length x width x depth)

DUNSWART

5.2m x 1.25m x 2.0m

3.0m x 1.0m x 1.5m

Isando +27 11 974 8511 | Dunswart +27 11 914 3512 | www.armco.co.za

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