2005 Volume 2 Issue 2

HOT DIP GALVANIZING TODAY

HOT DIP GALVANIZERS ASSOCIATION Southern Africa

23

Featuring:

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The facts about hot dip galvanized threaded components, including availability

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Mitchelsplein Train Station case history

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

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Front Cover: *A kaleidoscope of photographs taken from the hot dip galvanizing and fastener industry.*

Hot Dip Galvanizing – Adding value to Steel

Executive Director's Comment

The Hot Dip Galvanizers Association Southern Africa has now been in existence for 40 years. Throughout these four decades, the Association has grown from strength to strength, to the extent that end users and specifiers approach us for information regarding corrosion problems, which may not necessarily entail hot dip galvanizing as the solution.

Entrenched in our philosophy is the motto "say it as it is in unambiguous terms". To illustrate, if we are requested to comment regarding the suitability of hot dip galvanizing or duplex coating for a specific project, we will, based on technical considerations, provide what we consider to be the most appropriate solution for corrosion control. If hot dip galvanizing is in our view not the ideal solution, we will say so in clear terms while at the same time we will provide a recommendation for a more appropriate material or coating.

When it comes to complaints regarding quality or the service provided by a Galvanizing Member of the Association, our stated and enforced policy is that we will never take sides. If we consider the complaint to be justified, we will say so in no uncertain terms and proactively recommend a solution. Likewise, if we consider the complaint to be unjustified, we are committed to substantiating our assessment of the situation based on technical facts. We are convinced that by strictly adhering to this policy, our credibility as the representatives of our industry is enhanced while the technical marketing activities of the Association are viewed with confidence by specifiers and end users.

Hot dip galvanizing can play a major role in controlling costly corrosion in a vast variety of applications but never let it be said that we as an Association will recommend its use in situations for which it is inadequate or even doubtfully so. Experience has shown that by combining the undoubted attributes of hot dip galvanizing with a heavy duty organic paint coating, the most cost effective solution to premature corrosion failure can be achieved in numerous aggressive applications.

Bob Wilmot

Note from the Editor

A number of years ago following a presentation to some specifiers in Pietermaritzburg, I was asked the question, "we specify hot dip galvanized bolts, but most times can't get them". I am proud to say that since then there have been some dramatic changes in terms of the availability of hot dip galvanized fasteners in various forms. Although contributions have been sourced from most fastener manufacturers and the feature easily addresses the objective, we might have inadvertently excluded some important players, for which we apologise. I have compiled a matrix of fasteners, including material grades, specifications and whether they can be hot dip galvanized and are being kept in stock. Many of the companies have kindly compiled an editorial background, including their history, mission and quality system, including typical figures relating to the manufacturing and/or stocking of hot dip galvanized fasteners.

Furthermore, we have included a discussion on whether bolting or site welding is more appropriate on sites in SA by Spencer Erling of SAISC, the process of centrifuge hot dip galvanizing and an article on bolted connections. Also included are types of fastening devices, corrosion prevention, corrosion resistant metals, protective coatings, hot dip galvanizing of fasteners which includes coating of class 10.9 fasteners, oversize tapping allowances, influence of HDG on thread stripping strength, bolt relaxation, slip factors affecting mating surfaces in friction grip joints.

Other things include bolt and nut assemblies, washers, re-use of high strength fasteners, bolt tensioning procedures and lubrication of threads of high strength fasteners.

Also featured is the effect of HDG on strength properties of fasteners, as we hot dip galvanize at about 450°C, we show a chart of temperatures with their corresponding effects on the strength of steel.

Other tips such as the precautions required when combining dissimilar material, preventing zinc ingress in nuts that have been welded onto some component when hot dip galvanizing, is also included. Abrasion resistance in terms of a hot dip galvanized coating, thus preventing mechanical damage when levering with a spanner and the current specification for centrifuged items in terms of fasteners, and although not required by the specification, the maximum recommended coating thickness for bolts.

We have also included two other matrixes one comparing the different coating materials for fasteners and the other a comparison of coating materials for repairing damaged hot dip galvanized coatings.

Based on the fact that some persons feel Zincalume is more protective than general hot dip galvanizing, we compare the differences.

We also have some test results submitted by "Pandrol" when they conducted tests on their forged chair manufactured from 3CR12 and HDG.

Besides our regular articles of Guest Writer, Misconceptions, Walter's Corner and our Personality Profiles of Tom Motlhake and John Ngwenya of Barloworld Galvanizers, who after 40 and 31 years respectively in the industry have retired, we also have a pictorial story of how not to fabricate and expect a good quality finish from a hot dip galvanized coating.

We have also included a letter from a reader in response to the last "Walter's Corner".

We trust you enjoy this edition of "Hot Dip Galvanizing Today" as much as we have enjoyed putting it together and invite you to submit any comments or interesting ideas.

Should any company be involved in manufacturing or stocking of hot dip galvanized fasteners and would like to contribute to making our fastener matrix more comprehensive, kindly contact us.

Finally readers will notice that after 15 years the Association have moved to new and we believe more respectable premises in St Andrews, Bedfordview. In fact we are so proud of the move that we would like readers to drop in anytime and have a cup of coffee/tea with us.

Editor

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Site bolt or site weld, the debate rages on!

By Spencer Erling: Education director, South African Institute of Steel Construction

Background

The South African structural steel industry has specialised for a long time in "shop-welded site bolted" construction technique for steel structures.

How did this evolve?

Historically bolts had almost completely replaced rivets as the major form of site connection method in the late 50's. Only in a few specialised cases, where the major reason for not replacing rivets with bolts was driven by keeping the aging skilled rivet workers in a job till retirement age, did riveting continue. (They were too old to retrain into new skills...)

During the same period, confidence in the welding process grew tremendously resulting mainly from the development of welding specifications and the development of non-destructive testing processes. These developments were as a direct result of the welding (brittle) failures associated with the Liberty ships during the second world war.

50 years on, welding technology and skills have developed considerably. The technology of bolts has also developed considerably in the same period and yet, in South Africa, we still seem to have stayed with the "shop-welded site bolted" construction that evolved with the replacement of rivets with bolts all those years ago.

Why?

The "case" for welding in the workshop

Firstly there is no doubt that the system (technically speaking) works for the following reasons when welding is done in a workshop:

- The process takes place under controlled conditions and supervision, free of weather issues.
- Because of the easy ability to handle and turn components in a workshop almost all welding is done in the highly productive down hand or horizontal welding positions which is the optimal position for achieving good quality welds even with the most basically trained welder.
- The "jobs" (weldments) are typically taken to the welding machine and welder who stand on the ground. Because the welder is close to his machine and has cranes to facilitate lifting, shop welders do not usually have an assistant.
- The use of weld procedures, qualified welders to suit those procedures and the ease of checking of the weld (dimensional) fit up and preparation are all easy to control in a workshop.
- Quality control is reasonably easy to carry out by professionally trained personnel, access to the weldment is easy, "wandering" supervision will immediately notice if things are going wrong and rectify matters before too much damage is done.
- Steady electrical supply, steady welding gas supply (often piped from large tanks throughout the workshop), readily available consumables stored in good dry conditions, availability of heating facilities to keep consumables dry all contribute to the high level of efficiency achieved in a workshop.
- Corrosion protection, unless components are extremely large, is usually prepared and applied after all welding has been completed thus protecting the preparation and primer coats or hot dip galvanizing from being damaged if welding takes place after this step.

So why can't all these factors be achieved on site you might ask?

The case against site welding:

- Of course many of them can but usually at a cost!
- Turning the component is the one factor that cannot usually be achieved, so many site welds become vertical up (slow and expensive) or even worse overhead (extremely difficult, slow and expensive). The Southern African institute of Steel Construction (SAISC) strongly recommends that overhead welds should not be used for structural purposes due to the difficulty of achieving high quality welds.
- Many of the welds take place at elevated positions requiring suitable access and working platforms to be built at the point where welds are to be executed and kept in place until inspection is completed, i.e. access, quality control and inspection is difficult and expensive.
- Welding machines are often kept on the ground, sometimes quite a distance from the point of welding resulting in the welder needing a non productive assistant at extra cost to the weld.
- Unless there is a big quantity of welding required, it is often not possible to cost in the services of a "wandering" supervisor and / or inspector, so problems are usually identified late in the day. Rectification becomes excessive and expensive.
- Weather conditions-i.e. wind with Mig Mag (CO_2) welding, rain with all welding, cold temperatures with all welding impact seriously on the productivity.
- Because only a limited amount of site "structural" welding (as against piping and tankage) takes place there are only a few suitably qualified welders available to execute such work cost effectively.

(Using the more highly qualified pipe welders to do this work is expensive and often not productive because of lack of experience in this field of work).

- You might ask why not use the shop welders to do this work? – well they are usually only qualified to do down hand welds and are often not comfortable to work at elevated heights on temporary accesses. (There is no doubt that the workshop welder and site welder are a totally different "breed")
- Special steps have to be taken if welding is to be done on members where corrosion protection has already been applied-in the case of hot dip galvanizing it is necessary to grind away all the zinc at the interface for both quality and integrity of the weld.
- Alternatively, as in the case of paint systems, the application of zinc or paint to weld areas is kept away from the actual weld areas until the welding is complete. But this usually requires an expensive solution to "properly" corrosion protect the weld areas after welding.
- And of course, the case for site bolting is strong as it is easy to see whether or not all the bolts have been installed, to the correct grade, and there are established methods of ensuring that all bolts have been correctly tightened.

What about costs you might be asking?

It is common knowledge that some countries especially Japan and less so the USA, extensively us site welded construction. What is their motivation?

For many years now, the Japanese have used standardised details for many of their connections. Despite all the factors mentioned above, these include site welding.

The Japanese are the first to admit and acknowledge that some of their details could be improved (both technically and cost wise). But they do not change these details because the whole industry in Japan is familiar with them and they have achieved (as the Japanese are expected to by the rest of the world) extremely high rates of productivity for these connections "so why change something that works well?" The old adage practice makes perfect is at work here.

In South Africa, some years ago the author undertook a comparative study between site bolted and site welded connections. The findings were that direct cost of site welding done in the down hand position (i.e. labour, welding machine costs and consumables) versus the cost of bolting (i.e. extra work in the workshop, cost of bolts and tightening) could in some instances be cheaper. But when the cost of positional welding, access, wind protection, higher cost of supervision and quality control, the cost of an assistant, impact of the weather and the like were all added to the direct costs then site welding appeared to be quite expensive except for the big jobs where welding was extensive and a big management crew could be justified.

So why the controversy of Developers bringing in foreign welders for high profile petro-chemical projects?

The South African construction industry has always been on a "feast or famine roller coaster". Big projects need large numbers of highly skilled welders for relatively short periods of time. Most of this welding is associated with piping or process equipment – not the structures.

Usually these welders are not "waiting on street corners" for a big project to come up every year or two and so whilst we do have well trained and qualified welders they are understandably usually occupied in more regular employment.

SAISC believes it is the responsibility of the local contracting industry to assess their skills (in general) shortages for big projects and they should be charged with the duty of training sufficient skills to do the work or be allowed to import limited numbers of foreign skills subject to part of their duty being skills transfer to local workers.

Hot dip galvanizing of threaded components

General hot dip galvanizing

The metallurgical reaction between steel and molten zinc, which produces a hot dip galvanized coating, can only take place if surfaces are free from contaminants. If steel surfaces are contaminated with marking paint, weld slag and other substances not readily removed by acid, these must first be removed by mechanical means, such as abrasive blasting or grinding. Moulding sand on the surfaces of castings is removed by means of abrasive blasting.

Grease and oil is removed with degreasing chemicals, either caustic or acid based. Rust and millscale are removed from steel surfaces by pickling in diluted hydrochloric or sulphuric acid. After pickling and rinsing, a fluxing agent is applied. The purpose of fluxing is to dissolve surface oxides on both the steel and the molten zinc surfaces thus enabling steel and zinc to make metallic contact with each other. Fluxing can be applied in two different ways, designated wet and dry galvanizing respectively. As far as coating quality is concerned, both methods give equally good results (*figure* 1).

In wet galvanizing the surface of the zinc bath is divided into two sections by a weir. The fluxing agent – ammonium chloride, is deposited on the zinc surface in one section of the bath. The steel components, still wet from pickling and rinsing are dipped through the molten flux into the zinc. The components are then moved into the flux-free section of the zinc bath. The flux residue and oxides are skimmed from the surface of the bath, whereupon the components can be lifted up through a pure, smooth zinc surface. Wet galvanizing is largely confined to small components and semi-automatic tube galvanizing.

Dry galvanizing is the preferred method for coating batch galvanized components. After pickling and water rinsing, the components are dipped in a flux solution of ammonium chloride and zinc chloride. In this way a thin layer of flux salts is deposited on the surfaces of components. Before components are dipped into and withdrawn from the bath, the surface of the molten zinc is skimmed to remove zinc oxide and flux residues. After withdrawal from the zinc bath, components are quenched either in a sodium dichromate rinse or plain water. Alternatively, they may be aircooled. Components are then ready for fettling (if necessary), inspection and dispatch.

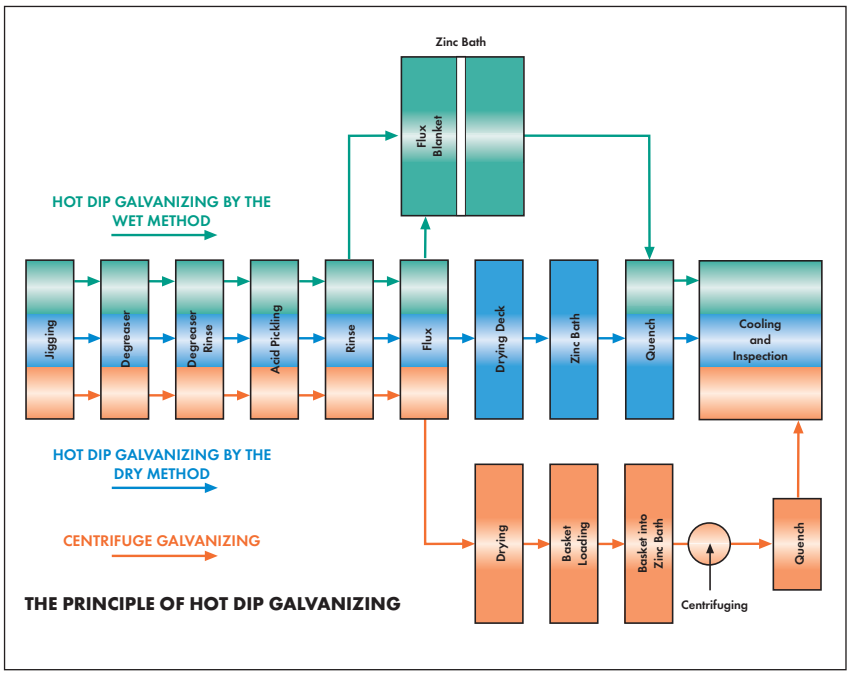


Figure 1. The principle of hot dip galvanizing.

Centrifuge hot dip galvanizing

Small components such as nails, nuts, bolts, washers and fittings are cleaned as described above and placed in perforated baskets, which are then dipped into the molten zinc. Upon withdrawal from the zinc bath, the basket is placed in a centrifuge. Rotation has the effect of throwing excess zinc off the coated surfaces, leaving the components free from uneven deposits of zinc. The zinc layer on centrifuged articles is somewhat thinner, than that obtained by the general process. Centrifuging is essential for threaded articles, where thread clearance and coating thickness tolerance are critical (figure 1).

Bolted connections

Bolted connections are one of the most widely used, versatile and reliable methods for joining structural steel members. Some of the advantages of bolting over methods such as welding and rivetting are:

- Economy, speed and ease of erection;
- Reliability of service;
- Ease of inspection
- Fewer, and less highly skilled operators required;
- Reliable performance under fluctuating stresses;
- No pre-heating of high strength steels;
- No weld cracking or induced internal stresses;
- No lamellor tearing of plates;
- No heat damage to the coating on hot dip galvanized or painted structures.

Type of structural bolts and fastening devices

Low carbon steel bolts, generally known as class 4.8, have been in use for many years. Continuing development has produced high strength structural bolts for use in high strength bearing type joints and high strength friction type joints, which are referred to as class 8.8 and 10.9. These newer strength bolting methods have greatly increased the scope of structural bolting.

Figure 2. An assortment of zinc coated bolts showing the importance of coating thickness in a particular environment.

In terms of the SABS 1282, strength of structural bolts is specified in terms of the tensile strength of the threaded fasteners. Two numbers separated by a full stop are stamped on the bolt head. The first number represents one hundredth of the nominal tensile strength and the second number represents one tenth of the ratio between nominal yield stress and nominal tensile strength expressed as a percentage. For example, a class 4.8 bolt has:

- Tensile strength of 4 x 100 = 400MPa;
- Yield strength of 0.8 x 400 = 320MPa.

A large variety of fastening devices, other than bolts and nuts, are used throughout industry and these include components such as spring clips where permanent retention of clamping force is essential.

Corrosion prevention

While the mechanical properties of fastener assemblies are structurally dependable and cost effective, the durability of such connections will be influenced by the degree of corrosion encountered in service. Deterioration brought about by rusting can lead to the seizure of fasteners and premature failure, in the form of corrosion fatigue. Adequate corrosion protection of fasteners is, therefore of paramount importance if the overall integrity of a structure is to be retained throughout its life (figures 2, 3 and 4).

Figure 3 (top) and figure 4 (bottom). Corrosion protection of holding down bolts should be equal to that provided for main structures.

In bolted steel structures the bolts and nuts are critical items on which the integrity of the entire structure depends. Protection from corrosion is provided by using corrosion resistant materials or by providing a protective coating, either before or after installation.

Corrosion resistant metals

The use of fasteners, manufactured from corrosion resistant metal alloys, frequently provides the most cost effective method of avoiding degradation by corrosion in very aggressive environments. Contact between dissimilar metals can result

	CONTACT MATERIAL (FASTENER/WASHER)											
	Aluminium and aluminium alloys		Copper and copper alloys		300 series stainless steels		Zinc coated steel and zinc		Aluminium/zinc coated steel		Lead	
Sheeting material	Industrial & marine	Rural	Industrial & marine	Rural	Industrial & marine	Rural	Industrial &marine	Rural	Industrial & marine	Rural	Industrial & marine	Rural
Aluminium and aluminium alloys	A	A	C	C	B	B	B	A	A	A	C	C
Copper and copper alloys	C	C	A	A	B	B	C	C	C	C	B	B
300 series Stainless Steels	C	B	B	B	A	A	C	C	C	B	B	B
Zinc coated steel and Zinc	A	A	C	C	B	B	A	A	A	A	B	A
Aluminium/Zinc coated steel	A	A	C	C	B	B	B	A	A	A	C	C
Lead	C	C	A	A	A	A	B	A	C	C	A	A

Legend:

A = Acceptable. Increase in the corrosion rate of the sheeting or contact material will be zero or slight.

B = Acceptable, but increase in the corrosion rate of the sheeting or contact material can occur.

C = Do not use. Accelerated corrosion will occur, or the difference in the lives of the two materials is too great, or both.

Table 1. Metals and alloys between which direct contact is acceptable.

Fastener and Thickness	Local Coating Thickness (minimum) Note: "a" µm or gms/m²	Mean Coating Thickness (minimum) Note: "b" µm or gms/m²
≥20mm diameter	45 or 325	55 or 395
≥6mm to <20mm diameter	35 or 250	45 or 325
<6mm diameter	20 or 175	25 or 200

Notes:

a. Local coating thickness obtained using a magnetic test or preferred single value from a gravimetric test.

b. Mean coating thickness being the average value of the local thicknesses on all the articles in the control sample.

c. Fasteners with machine screw threads are not commercially available hot dip galvanized in sizes <6mm diameter.

Table 2. Coating thickness on samples that are centrifuged. Refer SANS 121 (SABS ISO 1461:2000).

Threaded articles Class 10.9 fastener Diameter	Local coating thickness (min.) µm or gms/m²	Mean coating thickness µm or gms/m²	Max. coating thickness µm or gms/m²
≥20mm diameter	45 or 325	55 or 395	65 or 465
≥6mm to <20mm	35 or 250	45 or 325	55 or 395

Table 3. Coating requirements for class 10.9 hot dip galvanized fasteners.

in galvanic corrosion, particularly where a large cathode is in electrolytic contact with a small anode. Austenitic stainless steel fasteners are used with success in many applications where there is contact with metals such as zinc and in mild to moderately corrosive environments, hot dip galvanized fasteners have proved successful for connecting components manufactured from Corten steel. The use of an organic coating over one or both metal coating interfaces of a joint prior to fastening, or the sealing of that joint after bolting, in an aggressive atmosphere will substantially increase the corrosion resistance of that joint.

Table 1 provides a guide to the compatibility of various metals and alloys in contact in building applications. For example, it will be observed from the table that a zinc coated fastener (anode) connected to 300 series stainless steel (cathode) is unacceptable in a corrosive environment whereas zinc coated steel connected with 300 series stainless steel is acceptable.

Protective coatings

A coating applied to fasteners must, of necessity, be tightly adhering and resistant to damage during and after assembly. For this reason, metal coatings applied, prior to assembly, are preferred. Additional protection, after assembly by means of a paint coating, is beneficial in aggressive environments, particularly when these metal coatings have been applied.

Coating metals used include zinc and its alloys and noble metals such as nickel and tin. In the case of the more reactive metals, such as zinc, coating thickness is of paramount importance with corrosion life being more or less proportional to the coating thickness. Where metals, such as nickel and tin are used, thinner coatings will usually provide long term protection provided that these coatings are free from imperfections and not subjected to mechanical damage which, in corrosive conditions, will lead to accelerated corrosion of exposed underlying steel. The cost of providing protection by means of the more noble metals is high and this has restricted the general use of these coatings for the corrosion protection of fasteners in the structural steel industry.

Hot dip galvanizing of fasteners

Corrosion protection of carbon steel fasteners is generally achieved through the application of a coating (barrier protection), be it in the form of a paint system or through the use of a metallic coating. Metallic coatings comprise different materials, zinc is usually chosen for reason of economics, ease of application as well as the mechanism of cathodic protection provided by zinc.

Zinc is applied either by an electroplating process (electro-galvanizing) or by immersion in molten zinc (hot dip galvanizing). Corrosion protection provided by zinc is generally

proportional to the coating thickness, i.e. the thicker the coating the longer the service life.

Zinc coating thicknesses achieved using the electroplating process, generally range between 3µm to 10µm (µm = micrometers), while a hot dip galvanized coating thicknesses ranges from 45µm through to about 65µm. It is therefore imperative to specify a specific type of zinc coating required for corrosion protection. The word "galvanized" alone is insufficient and should be avoided. Corrosion protection specifications should clearly state, "electroplated or electro-galvanized" or "hot dip galvanized".

The following specification is restricted to the requirements for hot dip galvanized carbon steel fasteners, comprising bolts, nuts and washers.

Class 4.8 and 8.8 fasteners

Class 4.8 and 8.8 fasteners shall be hot dip galvanized by the centrifuging process. The coating shall conform to the thicknesses listed in tables 2 and 3.

High strength fasteners (Class 10.9) (*Refer unpublished* SABS 094, *now* SANS 10094)

Class 10.9 fasteners may be hot dip galvanized, provided a certificate of compliance is issued, by the galvanizer, stating that the hot dip galvanized coating has been carried out in terms of the approved code of practice. Refer to the proposed annex B of the unpublished SANS 10094. The two most important factors to be considered in terms of hot dip galvanizing of class 10.9 fasteners is to restrict the acid pickling time to <15minutes and to comply with the following coating thickness requirements.

Although not laid down in specification SANS 121 (SABS ISO 1461), it is the recommendation of the Association that a maximum coating thickness be strictly adhered to in order that oversized nuts easily pass onto the bolts. Excessively thick hot dip galvanized coatings, i.e. zinc immersion times >2 minutes can result in excessive growth of the hard Fe/Zn alloy layers with possible fatigue failure from crack propagation at stress raisers.

Threads are to be clearly defined and free from excess solidified zinc, allowing for ease of nut fitting and tensioning.

Heavy-duty hot dip galvanized coatings on bolts are therefore not available. General hot dip galvanized specifications state the local (minimum) and the (mean) coating thickness. The thickness actually achieved in general hot dip galvanizing, other than centrifuging, varies with the steel composition and this can range from the minimum up to 50% greater. Should the hot dip galvanized coating on the fastener be considerably less than that achieved on the structure, it is

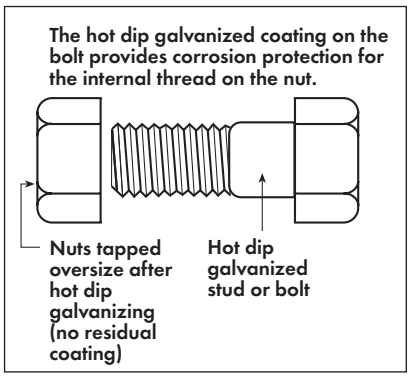


Figure 5.

Nominal size of thread	Allowance (mm)
M8 to M12	0.33
M16 to M24	0.38
>M24	0.4

Table 4. Oversize tapping allowance.

recommended that an additional barrier in the form of a paint coating, be applied over the fasteners to provide comparable performance in aggressive conditions.

Procedure for hot dip galvanizing of class 10.9 fasteners

1. Components are degreased in a 5% to 6% caustic soda solution heated to a temperature of 60°C to 70°C.

   NOTE: *If available, lightly wheelabrate for <5minutes in order to reduce the pickling time to a minimum. If tenacious scale or burnt oil is present on the steel surface, light abrasive blast cleaning will assist in reducing extended exposure within the acid pickling solution.*

2. After a water rinse, immerse in 6% to 16% hydrochloric acid, containing an inhibitor for <15minutes. Agitate by lowering and raising the components at least 3 consecutive times.
3. Immediately following the acid pickling the components are rinsed in water, fluxed and immersed into molten zinc.
4. Thick hot dip galvanized coatings are avoided by limiting the immersion times to <2 minutes, agitating in the molten zinc and ensuring that all components are immersed for similar periods of time followed by efficient centrifuging. (Quick spinning and rapid braking).
5. No stripping and re-galvanizing of rejected sub-quality coatings is allowed.
6. Uncoated areas are unacceptable.

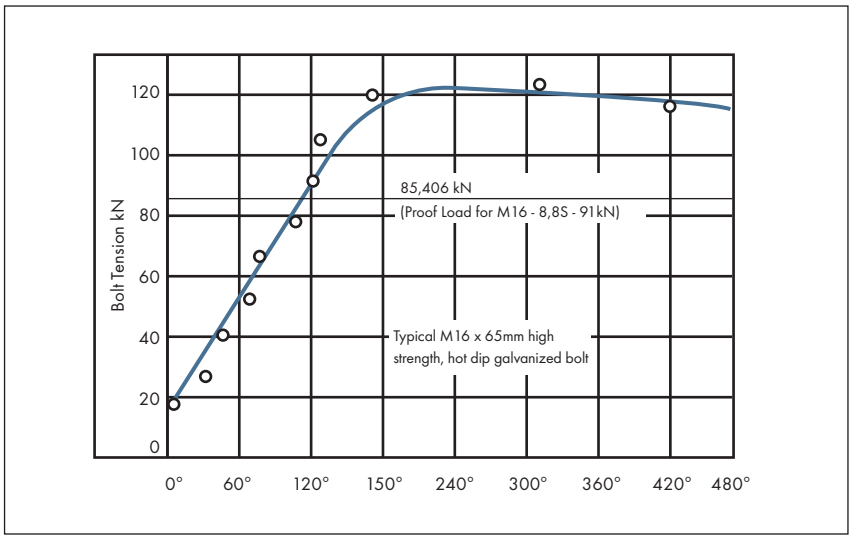


Figure 6. Demonstration of tensioning results obtained by the turn of the nut method.

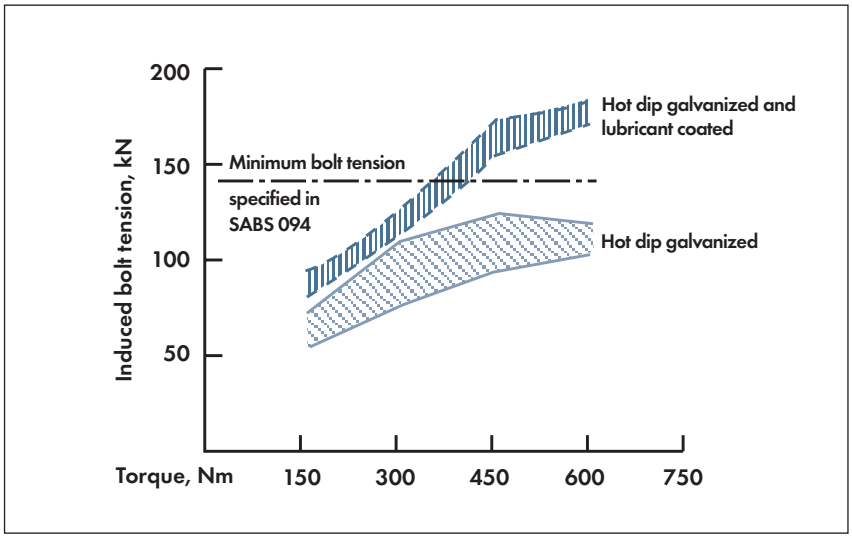


Figure 7. Torque/induced tension-relation for M20 high strength structural bolts, only hot dip galvanized and hot dip galvanized and lubricant coated.

Reference specifications

SANS 121 (SABS ISO 1461) – Hot dip galvanized coatings on fabricated iron and steel articles.

SANS 10094 – The use of high-strength friction-grip bolts.

Oversize tapping allowance for hot dip galvanized nuts

The zinc coating on external threads shall be free from lumps and shall not have been subjected to a cutting, rolling or finishing operation that could damage the zinc coating. The zinc coating of an external standard metric thread that has not been undercut shall be such as to enable the threaded part to fit an oversized tapped nut (figure 5) in accordance with the allowances given in table 4 above.

On bolts greater than M24, undercutting of bolt threads is frequently preferred to oversizing of nut threads. The allowance should be increased to 0.4mm.

Influence of hot dip galvanized coatings on thread stripping strength

In high strength bolting, correct tightening is essential, and the oversize tapping of galvanized nuts does not necessitate a reduction in the level of minimum tension which applies to uncoated fasteners. To meet this requirement, galvanized high strength nuts have a higher specified hardness than that demanded in the case of ungalvanized nuts.

Bolt relaxation

The possible effect of bolt relaxation, caused by the relatively soft outer zinc layer of the galvanized coating on mating surfaces has been investigated. Tests carried out by the Hot Dip Galvanizers Association and the SABS have revealed no substantial relaxation and this confirms international studies which show that a maximum loss of bolt load of 6.5% for galvanized plates and bolts can arise, as opposed to 2.5% for uncoated bolts and members. This loss occurs within about five days and little further loss is recorded. This loss can be allowed for indesign and is readily accommodated.

Slip factor effecting mating surfaces in friction type joints

In the case of galvanized friction grip joints the galvanized coating behaves initially as a lubricant and the co-efficient of friction is normally less than 0.2. After the first few cycles, under alternating stress, the galvanized surfaces tend to lock up and further slip, under alternating stress, is negligible (figure 8). If initial slip is undesirable, the application of a zinc silicate paint, to mating surfaces prior to assembly, will provide a slip factor in excess of 0.4 and, this enables hot dip galvanized assemblies to be designed for performance which is similar to that of uncoated steel.

Zinc metal spraying or alternatively light abrasive blasting of mating surfaces will also provide acceptable slip factors.

Lubrication of threads

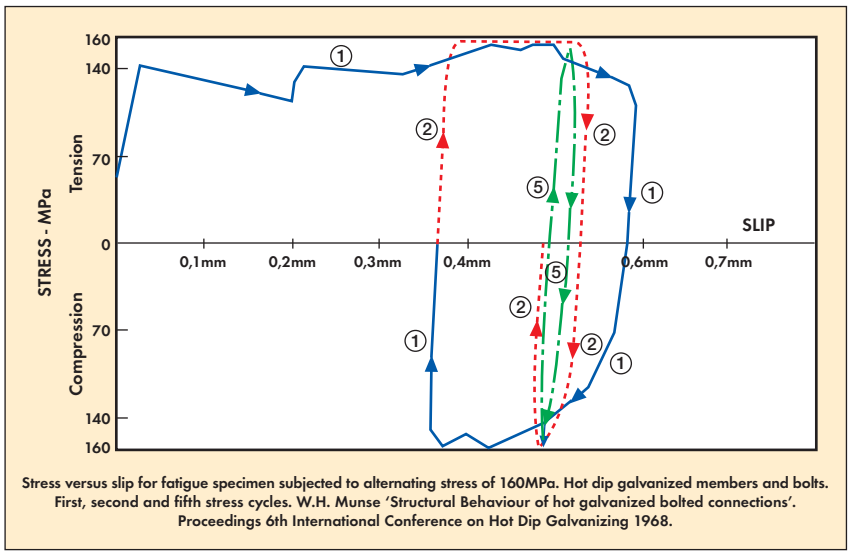
For high strength galvanized fasteners to be tensioned to the required level, thread lubrication, by means of a molybdenum disulphide based lubricant or alternatively a wax such as beeswax, is essential (figure 7).

Bolt and nut assemblies

Hot dip galvanized bolts and nuts should ideally be supplied in the nutted-up condition. This ensures that bolts and nuts have been matched and supplied by the same manufacturer while the possibility of bolts being supplied with clogged threads is avoided.

Washers

High strength washers are required to be through hardened prior to hot dip galvanizing.



Stress versus slip for fatigue specimen subjected to alternating stress of 160MPa. Hot dip galvanized members and bolts. First, second and fifth stress cycles. W.H. Munse 'Structural Behaviour of hot galvanized bolted connections'. Proceedings 6th International Conference on Hot Dip Galvanizing 1968.

Figure 8.

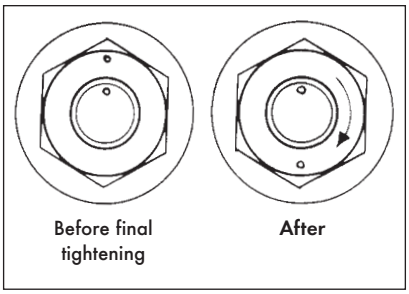


Figure 9. Where accurate tensioning is critical, permanent indication of the extent of part turn tightening can be identified by match marking.

Re-use of high strength fasteners

This is not recommended.

Bolt tensioning procedures

Extensive tests have been carried out in order to arrive at the most effective method of tensioning hot dip galvanized fasteners while ensuring that this can be performed in a reliable fashion by semi skilled personnel. The torque required to tension hot dip galvanized fasteners, even after lubrication, can vary substantially from one fastener to another and, while this fact also applies to uncoated fasteners, the scatter is greater in the case of galvanized fasteners. It is recommended that reliable tensioning of high strength hot dip galvanized fasteners should not be based on torque/tension values, particularly in the case of friction grip connections. This recommendation is in line with results obtained in countries elsewhere and, for this reason, torque control tensioning is not encouraged either for coated or uncoated high strength fasteners.

Recommended method of tensioning (turn of the nut method)

If hot dip galvanized fasteners are to be used, it is recommended that the turn of the nut method of tensioning should be adopted. This method has proved to be reliable and slight variations in the degree of final nut turning do not significantly influence the ultimate bolt tension (figure 6). The procedure is simple and does not entail the use of specialised equipment. Nuts are tightened to a snug tight position and variations in tightness at this stage do not significantly influence the final result. Snug tight is defined in many specifications as the full effort of a man on a standard podger spanner or the point at which there is a change in the note or speed of rotation when a pneumatic impact wrench begins impacting solidly. Podger spanners are graded in length, in relation to bolt size and strength and, for example, a spanner of some 450mm in length is regarded as appropriate for an M20 high strength structural bolt. It must be repeated that the clamping force supplied by snug tight is highly variable but this is not significant when bolts are subsequently fully tightened. The bolt tension/bolt elongation curve is relatively flat once the proof load is exceeded and, hence, variations in the snug tight condition result in only small variations in the final bolt tension.

For final tightening the standards in table 5 are recommended. The table provides for rotation up to 60° in excess of the recommended nut rotation or a total of 240° in the case of M16 and M20 fasteners up to a length of 120mm. This level of tension is well within the capacity of high strength fasteners as laid down in SABS 1282 (SABS 1282 is to be

	Length of bolt, mm	
Nominal bolt diameter	Nut rotation 1/2 turn with 60° tolerance over no tolerance under	Nut rotation 3/4 turn with 60° tolerance over no tolerance under
M16	up to 120mm	120 up to 240mm
M20	up to 120mm	120 up to 240mm
M24	up to 160mm	160 up to 350mm
M30	up to 160mm	160 up to 350mm
M36	up to 160mm	160 up to 350mm

Table 5. Nut Rotation from the snug-tight condition. Refer to SANS 10094 (SABS 094).

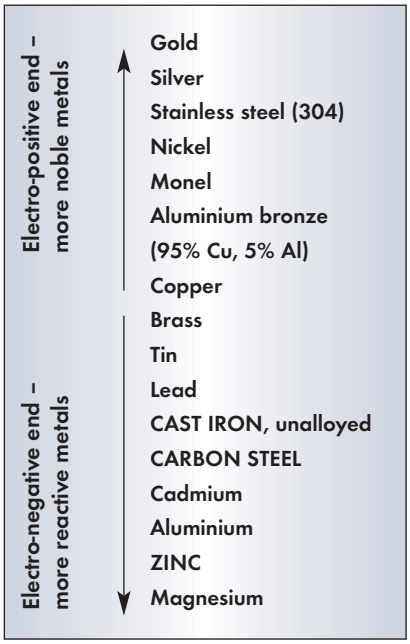


Table 6. Electrochemical potential scale in sea water at +25°C.

replaced by specific parts of SABS 1700) where, for test purposes, fasteners of this length are required to be tensioned by nut rotation after snug tightening to a minimum of 300° without fracture or the stripping of threads.

Where accurate tensioning is critical such as in the case of friction grip connections, permanent indication of the extent of part turn tightening can be identified by match marking the bolt end and nut, at the snug tightening stage, before final tightening (figure 9).

Part torque – part turn method

This procedure entails the use of a torque wrench to induce a snug tight condition to all bolts prior to applying full tension by turn of the nut procedures.

Alternative methods of tensioning hot dip galvanized fasteners

The use of load indicator washers provides effective tensioning but this entails the use of specially manufactured washers with protrusions which are flattened as tension increases and a reduction of the gap by a specified amount, indicates that minimum bolt tension has been reached.

Hydraulic tensioning equipment, which stresses the bolt to the required extent prior to nut tightening, is also available. These alternative methods entail the use of specialised equipment and for this reason the use of the uncomplicated and reliable turn of the nut method is recommended.

The effect of hot dip galvanizing on strength properties of fasteners

The hot dip galvanizing process does not adversely effect the mechanical properties of high strength fastener steel or even material such as spring steel. Hardened steels <1 000MPa yield strength, are not considered to be prone to hydrogen embrittlement as a result of pickling, prior to galvanizing, and any absorbed hydrogen would be diffused during immersion in the molten zinc at 450°C.

In the case of high strength grade 10.9 fasteners as well as products manufactured from spring steel, excessively thick galvanized coatings (>65µm) should be avoided since excessive growth of the hard Fe/Zn alloy layers can result in fatigue failure due to crack propagation from these layers into the substrate where a potential stress raiser may be present. In any case, excessively thick coatings on threads is undesirable as this will interfere with thread tolerance.

Galvanic corrosion

If two different metals or alloys, completely or partially surrounded by an electrolyte, are connected, a galvanic cell is created. Which metal becomes the anode or cathode is determined by their electrode potentials in the electrolyte in question.

Figure 10. Hot dip galvanized bolt in contact with 3CR12 plate after 10 cycle SO2 test. Note the cathodic protection provided by the hot dip galvanized bolt head to the surrounding steel.

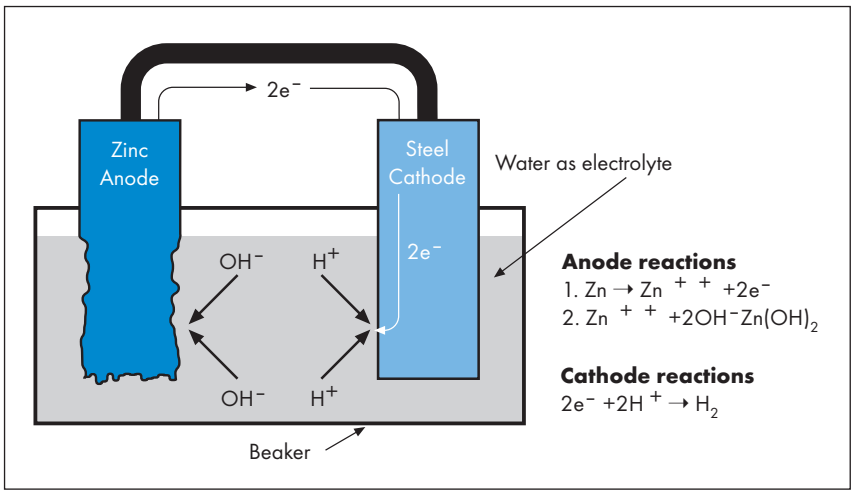


Figure 11. Galvanic corrosion of zinc in contact with steel in water.

Figure 12. After 20 years of marine exposure, this site cut unrepaired hot dip galvanized steel grating still offers cathodic protection at the cut ends. The grating is now 28 years old and at the cut ends is still being protected by the surrounding coating.

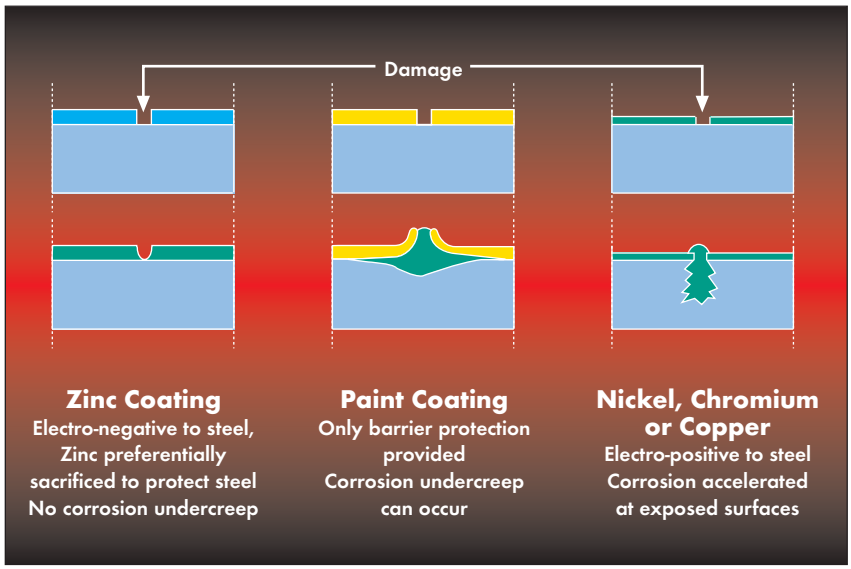


Figure 13. Schematic diagram to illustrate the consequences of damage to different types of coatings offering corrosion protection.

In sea water, which corresponds to the majority of practical conditions, some metals and alloys take up different positions on the electrochemical scale, shown in table 6.

If steel is connected to copper or brass the steel becomes the anode in the cell and corrodes. However, if steel is connected to cadmium, aluminium, zinc or magnesium, it becomes the cathode and is protected against corrosion, while the anode metal is consumed (figure 10).

Galvanic corrosion is also called bimetallic corrosion and is used to protect underwater structures from corrosion, where it is termed cathodic protection.

For maximum corrosion resistance under conditions of extreme humidity, overlapping galvanized surfaces should be insulated from each other by the application of an inhibitive jointing compound in accordance with SANS 1305. Alternatively a suitable paint may be used. Hot dip galvanized surfaces in contact with other materials may also require insulation.

Hot dip galvanized members in contact with aluminium conductors may require the use of an electrical conducting compound at joint faces, to repel moisture and inhibit corrosion.

Cathodic protection afforded by zinc coatings

In hot dip galvanized steel, zinc and steel are in good electrical contact with each other. If the zinc coating is damaged in the presence of an electrolyte a galvanic cell is created. The electrolyte could be condensate or rain water. Sometimes the entire structure can be submerged in liquid. In this cell the zinc becomes the anode i.e. corrodes, the exposed steel becomes the cathode and is therefore protected from corrosion (figure 11).

In the initial phase it is possible to see a weak rust formation on the

Figure 14. Brass bolt in hot dip galvanized steel on a parking deck.

Figure 15. Stainless steel fasteners attached to hot dip galvanized plate in immersed conditions, note the sacrificial attack of the zinc coating surrounding uninsulated fasteners (in spite of the flat fibre washer the bolts still had electrical contact with the surrounding steel) compared with the insulated fastener (here the bolt fitted dead centre in the hole, resulting in no electrical contact) and consequently no attack of the surrounding zinc has taken place.

exposed part of the steel surface where the coating has been damaged, but after a while whitish-grey areas form which gradually spread over the entire damaged area (figure 12). The zinc coating corrodes and sparingly soluble zinc alloys descend to the cathode surface where they protect the steel from continued rust attack. This is often called "self-healing", which is something of a misnomer since the zinc layer is, of course, not restored.

In case of exposure in water the zinc salts do not always precipitate at the point of damage since they can be flushed away by movement in the water. The protective action remains, however, provided that the steel surface is not too large. The steel is protected by the electrical current generated in the galvanic cell when the zinc corrodes.

Owing to the cathodic protection generated by the zinc, rust cannot "creep in" under the coating at the point of damage in the way that it can creep under films of paint or coatings of metals more noble than steel (figure 13).

Zinc coatings on steel are unusual, since a fairly large area of damage to the coating does not cause catastrophic corrosion. The range of cathodic protection is dependent on the nature of the electrolyte that creates the cell. For structures in normal atmospheres it is usual to expect protective action over several millimeters. However, in sea water significantly greater distances can be expected.

Zinc coatings in contact with non-ferrous metals

Aluminium and stainless steel can often be connected directly to galvanized material in air or fairly dry environments without noticeable corrosion taking place. However, in water an insulator should always be used to prevent accelerated corrosion of the zinc (figure 15).

Copper and copper alloys are more electrically active, and there is often a release of copper ions which spread over large surfaces and cause noticeable attack. For this reason, these metals should never be allowed to come into contact with hot dip galvanized steel, and an effective insulator should always be used (figure 14).

Acceptable / rejectable surface conditions relating to centrifuged components

These have been extracted from the Association booklet, "Practical Guidelines for the Inspection and Repair of Hot Dip Galvanized Coatings", copies of which are available from the Association.

SC	DESCRIPTION	CAUSE	EFFECT / REMEDY RESPONSIBILITY	A/R/N C/REP	EXAMPLE
8	**CLOGGED THREADS** Threaded components or attachments have threads clogged with zinc	Insufficient centrifuging or poor drainage of threaded attachments on withdrawal from the galvanizing bath.	The correct centrifuging equipment or post galvanizing thread cleaning by heating, wire brushing or oversize tapping of nuts, will generally remove clogging. If necessary specify delivery of bolts and nuts in nutted up form. G	R C / REP	
18	**COATING THICKNESS PROVIDED ON FASTENERS USED TO ASSEMBLE HOT DIP GALVANIZED STRUCTURES**	No matter how the zinc coating is applied, the coating life is proportional to its thickness in a given environment. Often electroplated fasteners with insufficient coating thickness are incorrectly used in external environments.	Specify hot dip galvanized fasteners to SANS 121 (SABS ISO 1461), where required. Alternatively / or in addition overcoat fastener with an approved zinc rich paint or epoxy. See Coating Repair Procedures – available from the HDGASA. D / B	R REP If acceptable	
27	**ROUGH HEAVY COATINGS CAUSED BY INSUFFICIENT CENTRIFUGING**	Efficient centrifuging, will generally remove excess zinc and provide a smooth and attractive exterior.	Provided the steel / casting surface is reasonably smooth, correctly centrifuged articles will provide an acceptable finish. G	R C / REP If acceptable	
30	**TOUCH MARKS** The zinc in the galvanizing bath should have free access to all component surfaces or small uncoated or damaged areas can result.	Articles entering the galvanizing bath should not be in tight contact with each other. Jigging wire should also be loosely attached to eliminate wire marks. Where a component has been resting on jigging or dipping equipment, an uncoated area or touch mark could appear.	Minimise contact between components and jig connections. (Loosen jigging wire). Small components can be centrifuged. G	A REP If necessary and acceptable	
34	**UNGALVANIZED SURFACES CAUSED BY SCALE OR SAND**	Sand on cast iron or scale on the steel surface is generally caused by the process used to form or roll the product. A localised ungalvanized area in an otherwise continuous coating can occur if scale or sand from the moulding or rolling is not removed by acid pickling or abrasive blasting.	These ungalvanized areas may occur in a linear pattern on angles, channels or other rolled products. They can also appear on cast iron products. S / G	R/N REP If acceptable	

LEGEND:

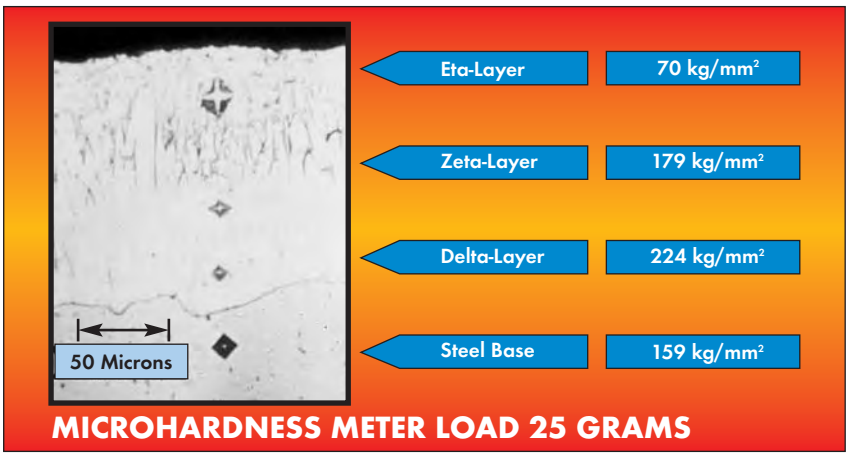
A - Accept R - Reject N - Negotiate C - Clean REP - Repair
RESPONSIBILITY: G - Galvanizer D - Designer B - Builder/Fabricator S - Steel Type/Surface

Hot dip galvanized fasteners have excellent abrasion resistance

Pure zinc is a soft metal, even though it is harder than most organic coating materials. The iron/zinc alloys produced in hot dip galvanized coatings are, however, very hard. In fact they are harder than ordinary structural steel.

The alloys are therefore more resistant to abrasion than pure zinc and experiments have shown that the alloy layer has a resistance to abrasion 4-5 times that of pure zinc.

For this reason a hot dip galvanized coating applied to fasteners provides exceptional abrasion resistance particularly when the nut or bolt is tightened by means of a spanner or other tensioning device.



Microsection of a hot dip galvanized coating showing variations in hardness through the coating.

S.A. Bolt Manufacturers (Pty) Ltd

The original company was established in 1966 as Algarve Engineering (Pty) Ltd, a machine shop manufacturing mainly specialized machined bolts, nuts and components.

The Business was bought in 1981 by Rodney Wooldridge the current Managing Director, who rapidly expanded the business into hot forged and more sophisticated machined fasteners catering for the Mining, Armaments, Engineering, Construction and Agricultural Industries.

The Company name was changed in 1985 to S.A. Bolt Manufacturers (Pty) Ltd, which was more synonymous with the products being supplied, and the factory was moved from Ophirton to Kew in Johannesburg. Later, in 2002, the manufacturing divisions as well as the distribution arm were relocated under one roof in Nigel.

Since their inception 37 years ago, S.A Bolt Manufacturers have become leaders in the manufacture and distribution of industrial fasteners. They offer a one stop shop for any conceivable shape or size of the most specialised or standard off-the-shelf bolts and nuts and all types of fasteners in mild steel, high tensile, stainless steel and aluminum. The size range is from 6mm through to 120mm diameter in all lengths.

Their dynamic management team and professional sales and manufacturing staff have over a 100 years of cumulative experience in the fastener industry, and they are confident that they have the necessary skills and expertise to provide customers with the best possible products and service. Any fastener application problems can be discussed with their Technical Department.

The Sales and Marketing division is responsible for distributing nuts and bolts countrywide, through a network of distributors and agents. Products are also exported throughout North and central Africa, the United States and to various countries in Europe.

The Company focus is on quality, reliability and full technical support, coupled with the most competitive prices. It is through these ideals that they have attained recognition from major companies throughout Africa, Europe and America who use their services on a regular basis.

The quality assurance department has access to a well-equipped laboratory to ensure stringent controls during all manufacturing processes.

All fasteners are made to SABS, ISO DIN, ASTMA and British standards with a variety of threads, including metric coarse, metric fine, UNF, UNC, BSW and even BSF

The manufacturing plant in Nigel has a total capacity of 450 tonnes per month of which approximately 45% is hot dip galvanized. High volume standard type bolts and nuts are manufactured mainly by the cold-forming process while their more specialised fasteners such as tube mill liner bolts and larger diameter bolts and nuts are made to customer specifications by the hot-forging process.

The marketing and distribution division carry a vast range of stock of both standard and specialised fasteners in plain and hot dip galvanized finishes, catering for industries such as Mining, Construction, Railway, Power Generation, Cell phone Mast, Petrochemical and Agricultural and they welcome enquiries from all sectors of industry.

A recent addition to their product range is foundation bolts, used for the Construction and Cell phone Mast industries in diameters ranging from M16 to M76.

Ex-stock foundation bolts with oversized nuts and flat washers, ranging in diameter from M16 to M76.

A range of different hot dip galvanized bolts, nuts and washers are kept as ex-stock items in the above facilities.

The Nuts & Bolts of the fastener industry

A leader in the industry for the past 39 years, S.A. Bolt manufactures and distributes a fully comprehensive range of top quality standard and non-standard fasteners to suit any application.

S.A. Bolt produces up to 400 tons per month in:

- 6mm to 120mm diameter in all lengths.
- Metric and Imperial sizes.
- Carbon steel, alloy steel, stainless steel A2 & A4
- Grades 4,6 / 4,8 / 6,8 / 8,8 / 10,9 / 12,9.
- Anti vandal nuts and bolts.
- Customized specifications.

S.A. BOLT OFFERS A FIRST CLASS PERSONALIZED SERVICE AND HIGHLY COMPETITIVE PRICING FOR ALL OF YOUR FASTENER REQUIREMENTS.

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e-mail: info@sabolt.co.za • Website: www.sabolt.co.za
BRANCHES: Nigeria (2341) 497 7601

CBC Fasteners (Pty) Ltd

In 1988 CBC Fasteners established operations at their premises in Factoria, Krugersdorp, as a manufacturer of nuts and bolts. Over the years the company has seen continued growth and in 2000 it merged its operations with National Bolts to become the leading manufacturer and warehouse distributors of fasteners in South Africa.

The result of this was to increase production from 600 tonnes per month to over 1 300 tonnes, with the transfer of a number of bolt makers and the complete nut production plant to CBC's premises.

Then in June 2002 the management of CBC Fasteners, together with a few outside shareholders bought the company from WACO International and the Industrial Development Bank, and moved the company into a new phase as a profitable and productive privately-owned enterprise.

Managing director and shareholder Rob Pietersma is enthusiastic about his company's future and the support he receives from the technical staff, who rank among the best in the world. Rob has a proven track record of leading industrial companies to success and now with CBC he has a personal stake in overseeing the continued growth and success of this enterprise.

The current management see the development and upliftment of their staff as crucial to this success. Marketing director Rodney Nwamba is responsible for in-house skills and development training for the staff compliment of 220, which includes the branches in Germiston and Durban as well as the recently acquired tool production company, Enterprise Tool & Die.

This training includes basic adult education, sales induction training and supervisor/management training. CBC is also active in confronting the AIDS issue in the working environment, and has established an in-house private clinic where employees can receive counselling and advice on adapting their lifestyle and improving their quality of life when living with AIDS.

Other work issues that are diligently addressed include health and safety in the workplace, with monthly meetings being conducted and an outside consultant advising on compliance and inspections. On the recreational side, CBC recently instigated an art competition using the factory products as a medium for the art creations. A total of R15 000's worth of prizes was given away to the winners.

CBC's premises house the bolt and nut factory, pickling plant, tool making facilities, warehouse, metallurgical laboratories and office, with a conference and training centre being planned for the near future.

Production is in the order of about one million pieces a day. Two years ago, CBC identified a need to provide hot dip galvanized products ex-stock, based on the number of to-order enquiries being received. Today most popular items used are in stock, while a quick turn-around is ensured where stock is not on hand. Hot dip galvanized fasteners stocked include hexagon bolts and hexagon sets and nuts all to DIN and ISO standards, with certification provided where required.

CBC operates according to a total quality system, starting with the inspection of in-coming raw material through to process checking and final inspection and testing. Stringent batch testing is done in their metallurgical laboratories. The company is ISO 9002:1994 accredited and is audited by the SABS twice a year.

With the recent acquisition of Enterprise Tool & Die and its integration into the in-house tool manufacturing division, CBC Fasteners is on track for continued growth and the ability to provide their customers with quality products, timeous service and value for money.

One of the many sizes of hot dip galvanized oversize nuts kept in stock.

Most of the popular sizes and shapes as hot dip galvanized are kept ex-stock.

Proudly Holding Industry Together ...

The buildings below are but a few of the many structures in South Africa and around the world which have used our fasteners. Whether it be a project on a grand scale, like the Barclays Building in London, or one with the mechanical demands of the London Eye, CBC can be relied upon to provide fasteners of the highest quality.

CBC manufactures over one million units a day, ranging from standard mild steel fasteners to sophisticated grade 10.9 and 12.9 bolts. We also produce specialised fasteners like the Hydraloc 'T' lockbolt system. CBC can boast an increasing role in supporting the steel construction industry with technical information and backup.

CBC has invested substantially in training and development, as well as worker-safety programmes. We are committed to maintaining the highest of standards thereby flying the flag of the South African steel industry both at home and abroad.

... and proud to be associated with the Hot Dip Galvanizers Association

CBC

FASTENERS

www.cbc.co.za

6 Coppinger Street, Factoria, Mogale City. Tel: 011 955 4485 H/O Fax: 011 664 6218

*Please e-mail **tech@cbc.co.za** if you have a technical query or if you would like an electronic copy of our technical data manual.*

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Buildings (from left to right) : Nelson Mandela Bridge, Johannesburg • Cape Town Convention Centre • The London Eye • Barclays Building, Canary Wharf, London

PYC GRAPHICS

Avlock International – lockbolt fastening systems

Avlock International produces, through CBC Fasteners, a high tensile fastening system generically known as the lockbolt, for customers who require a faultless vibration-resistant product.

Lockbolts are used mostly in heavy engineering and the mining industry where safety is critical. Application examples include their use in vibrating screens in coal and platinum plants; conveyance skips and cages in mining or agriculture as well as in railway wagons and coaches. The main characteristic of a lockbolt is that it eliminates the gap condition between the two products being fastened, thus minimising the effects of vibration and damage.

Hot dip galvanized shaft bunton sets providing horizontal supports for shaft steelwork in many mining operations have been assembled using hot dip galvanized lock bolt systems. In order to enhance the corrosion protection, all of the lock bolts were overcoated with a coaltar epoxy.

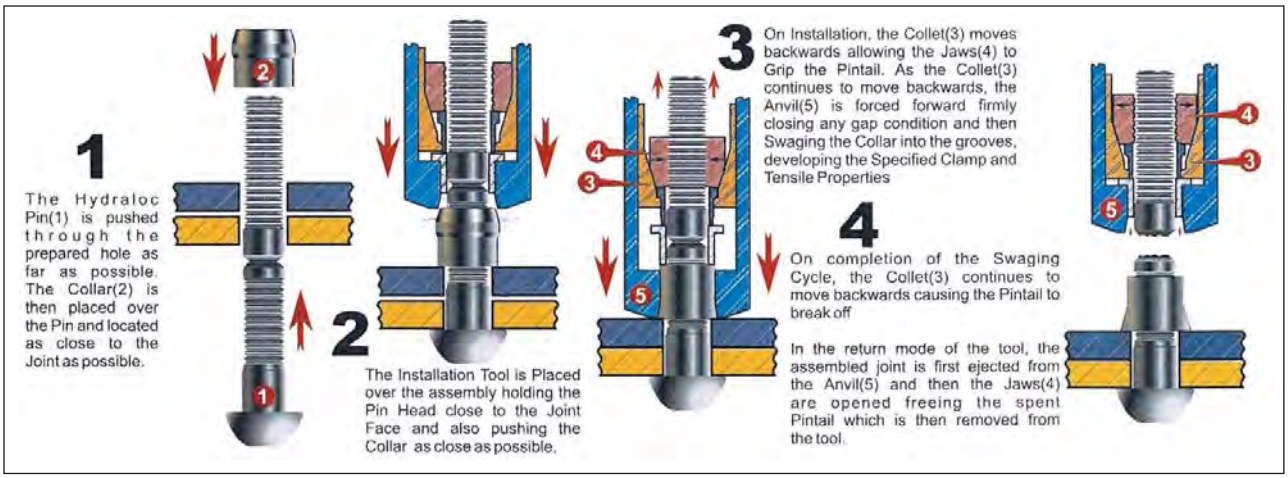
Another characteristic of the lockbolt is its consistency in that each bolt has the same torque, tension and clamp load. Installation requires the use of specialised hydraulic equipment and is efficient and generally free of operator error.

This tamper-proof fastener consists of a plain shank of the material thickness with a non-threaded parallel locking groove. The breakneck is the indent where the pintail is broken flush with the collar after the fastener has been installed.

The pin cannot function without a collar and therefore the lockbolt is a complete fastening system. The collar size depends on the size of the shank of the pin and is available in two types – standard and flange.

In order to provide safe working conditions and derive any measurable maintenance free life from applications in the mining industry, hot dip galvanized "Hydraloc T" pins and collars are normally specified for connecting shaft and station steelwork in aggressive exposure conditions like underground mining applications.

Avlock has recently supplied huge quantities of hot dip galvanized "Hydraloc T" pins and collars in various diameters to South Deep, Beatrix, Black Mountain, Phakisa (The old Freddies Shaft) and RPM in Rustenburg.



The installation procedure.

Tel-Screw Products (Pty) Ltd

Tel-Screw Products is a Manufacturer of special and standard fasteners and related products, ranging from M2 to M76, backed by 35 years experience. Stringent quality procedures are in place to ensure quality and customer satisfaction at all times. They are currently implementing ISO 9001-2000 Quality and should be fully compliant before the end of 2005.

Tel-Screw Products manufacture components for the mining, building, construction, motor, telecommunication, electrification, farming and security industries and with state of the art equipment produce in excess of 500 tonnes per month.

They carry a wide range of hot dip galvanized products ranging from bolts, nuts, washers, u-bolts, eye bolts, hook bolts, studs, brackets, foundation bolts, threaded rod, chemical anchors and brackets etc.

Tel-Screw offer the special service of supplying hot dip fasteners and components, fully assembled, bagged or boxed and palletised to customer specifications. Their assembly facility enables them to supply hot dip galvanized products fitted with nuts at ±20 000 to 60 000 units per day, depending on the combination of products to be fitted.

Experience has proved that on average a small percentage of all hot dip galvanized male threaded components can be defective after hot dip galvanizing. The only way to ensure that the hot dip galvanizing is 100% perfect on male threaded components, is by fitting oversized nuts onto male threaded components. Tel-Screw encourage their clients to make use of this service, at a small extra cost, saving many man-hour costs.

Part of their Quality Policy is to monitor all hot dip galvanized products with electronic thickness testing equipment and printing their own reports to ensure that their customers receive what they have requested and ensuring that coating thickness' are in accordance with spec SANS 121 (SABS ISO 1461).

Tel-Screw are able to manufacture and supply, hot dip galvanized, assembled and fitted special products at short notice, within 3 (three) working days and can also manufacture to order a single special hot dip galvanized fastener. The quantity obviously affects the price – the bigger the quantity, the better the price.

Their capabilities include:

- cold heading,
- hot forging,
- blanking,
- pressings,
- hot forming,
- cold forming,
- thread rolling (M2 – M76),
- screw cutting (M2 – M76),
- automatic machining,
- CNC machining,
- milling,
- production welding and
- guillotining.

"We have and always will be dedicated to quality and customer satisfaction" says Ronnie Teleng, Tel-Screw's Managing Director.

"Small enough to care – Big enough to perform"

Editors Note:
Machine threads M2 to M6 cannot be commercially hot dip galvanized.

Self drilling screws

Self-tapping and self-drilling fasteners are manufactured from various grades of medium carbon cold grade steel which, when heat-treated, provides optimum strength for tapping and drilling.

Fasteners are generally cold forged. Forging of the screw head is the first step in the production process followed by thread rolling, pointing and heat treatment (Carburising).

Following manufacture, the screws are either electroplated or hot dip galvanized to suit the requirements of the customer.

When buying fasteners it is of the utmost importance that the application and environment within which they are used are given considerable consideration, to avoid premature corrosion.

Since 1993 New Aloe Fastening Systems cc has manufactured fasteners primarily for the roofing and cladding industry, supplying South Africa and neighbouring countries with a comprehensive range of finished products.

The length of the drill flute determines the metal thickness that can be drilled.

Points to remember when choosing a fastener

Drill flute

The length of the drill flute determines the metal thickness that can be drilled. The flute itself provides a channel for the removal of material during the drilling operation. If it becomes completely imbedded in the material, drill chips will be trapped in the flute and the cutting action will cease. This will cause the point to burn up or break.

Pilot length

The unthreaded section from the point to the first thread (pilot length) should be long enough to ensure the drilling action is complete before the first thread engages the drilled metal. This is important as the screw's threads advance at a rate of up to ten

Expansion Bolts

The use of electroplated expansion bolts when hot dip galvanizing is preferred does no longer have to be tolerated by the specifier or the end user as hot dip galvanized equivalents are available, see Types of Fasteners and Availability Matrix.

Electroplated expansion bolts offering less protection on steelwork projects that are hot dip galvanized for durability, no longer have to be tolerated by the specifiers.

times faster than the drill can remove metal. All drilling therefore should be complete before threads begin to form.

Stitching screws

Stitching screws are used for sheet-to-sheet connections to join two or more sheets of light-gauge metal such as IBR sheeting,

They are supplied with an assembled EPDM (Ethylene Propylene Diene Monomer) elastomer sealing washer. The washer is designed to fit in a shallow groove under the hexagonal head. It is protected from the elements and offers an excellent seal.

Bonded washers

For most roofing applications an E.V.A. foam-bonded to a hot dip galvanized steel washer is the most commonly used washer for HEX head self-drilling screws. When used to attach IBR sheeting a minimum diameter washer of 19mm is recommended on the ridges and at least 26mm diameter if the sheet is attached with a 20 or 25mm HEX head self-drilling screw in the valley of the IBR sheet. The hot dip galvanized washers are SABS approved, and depending on the type and environment, have a minimum life expectancy of over 10 years.

Stitching screws are used for sheet-to-sheet connection.

Quantity to order

A rough guide is approximately 4 - 5 self-drilling screws per square metre for most roofing applications.

Drilling through wood to metal

For applications that call for timber over 12mm thick to be attached to steel, a WING TEKS may offer the solution. The fastener features two wings, which ream a clearance hole through the timber. The timber does not thus pull away from the steel. The wings break-off on contact with the steel to be drilled. The fastener then drills through the steel and as the timber is pulled tight against the steel the fastener, by virtue of its head design, counter sinks into the timber so as to leave a flush finish. Typical applications include fitting timber to the beds of trailers, floors of containers, site offices, suspended floors and to steel frames in shopfitting applications.

Hot dip galvanizing of self drilling screws will provide considerably enhanced corrosion protection properties.

New Aloe Fastening Systems cc.

Editors note:
Life expectancy quoted in the above article is obviously dependent on the environment at hand.

An evaluation of coated self drilling screws

Four self-drilling screws (all with 8mm heads – across flats) were submitted for assessment. Two of the screws were Australian sourced (head marking 'BX'), whilst the second two items were locally sourced (head marking absent or 'A').

It was stated that the Australian screws had been mechanically plated and that the local items were hot dip galvanized.

The base composition of the Australian screws was that of a mild steel that had been carburised. The coating on the screw surface was found to be a zinc-tin-aluminium alloy, with approximately 30% tin in the composition. The local screw composition was to the AISI 15B36 grade. The applied coating was the conventional iron-zinc alloy generated by the hot dip galvanizing operation.

A cross section through the drill point nose of the screws revealed that the structure of the Australian items consisted of martensite with 5-10% discrete fine iron carbides. The Vickers hardness at the thread surface of the screw was 624-630 HV (≈57 HRc). The core region had a hardness of 514-520 HV (≈49-50 HRc). The structure of the local fastener consisted of martensite. The core hardness of the fastener was 304-310 HV (≈30 HRc), with the threads achieving a hardness of 428-440 HV (≈43 HRc).

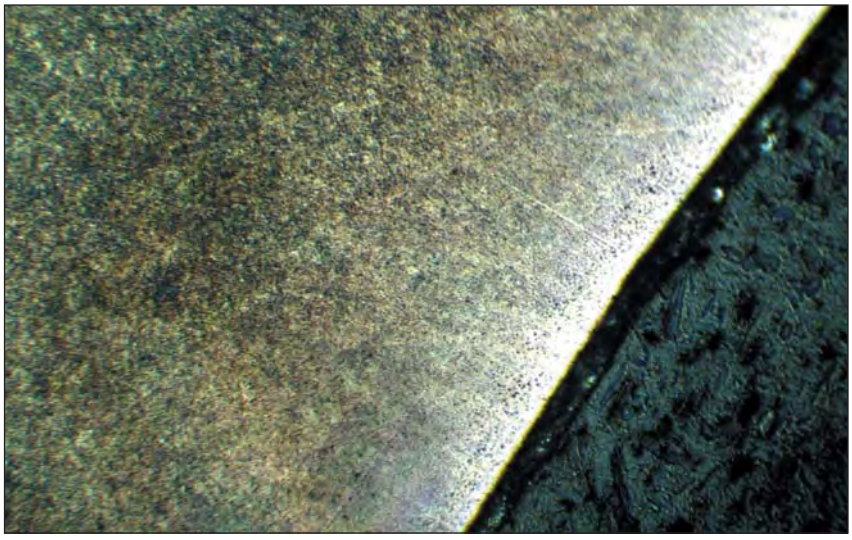


Figure 16: Cross section through the mechanically plated coating (100X).

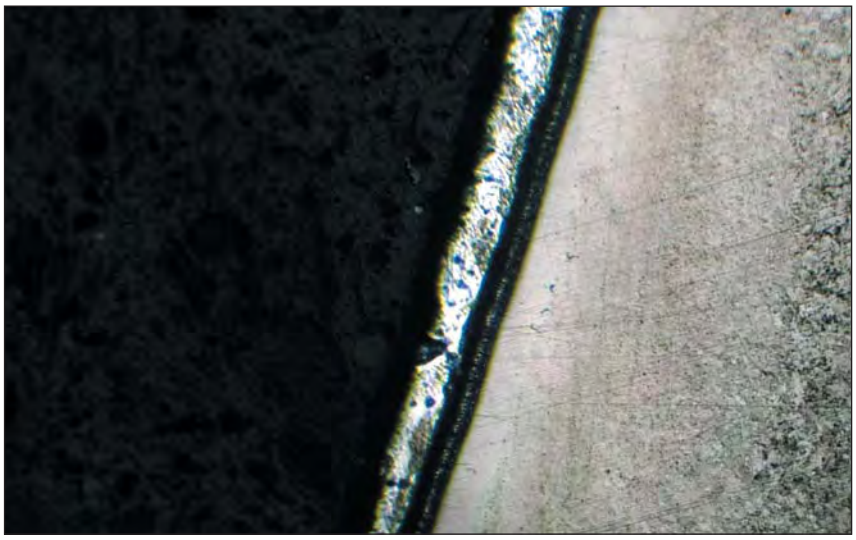


Figure 17: Cross-section through the hot dip galvanized coating (100X).

The coating thickness applied to the Australian fastener, was 20-25µm (figure 16). Micropores were discerned. The coating applied to the local fasteners had the typical non-reactive multi-layer structure associated with hot dip galvanized articles. The thickness of the compound layers was 27-32µm (figure 17).

The use of a mild steel that has been carburised results in a fastener that has a high surface hardness, riding on a softer and tougher core. The high surface hardness is essential for the drill point to enable it to cut a thread through mild steel type materials, typically used as bearers and supports for roofing sheet, with relative ease. An alloy steel may be treated to achieve a similar hardness state, although a lower disparity in hardness between surface and core will prevail. The fasteners, in either the low alloy or carburised grades, have no inherent corrosion resistance and the use of a zinc rich surface film offers the possibility of barrier and sacrificial protection. The coating will also function as a form of 'dry' friction modifying lubricant for the thread cutting process during installation of the screws.

The 'corrosion life' of the steel fastener is a function of the zinc content and nature of the coating.

The application of a zinc-rich layer to the steel surface may be via several methods. For self-drilling screws, chromium passivated electroplated zinc is commonly encountered. Mechanically plated zinc is available and hot dip galvanized fasteners in this category are proposed.

The electroplating route offers a thin film of zinc as a sacrificial material to the steel substrate, with the passivation layer offering further protection to the zinc itself. The coating thickness however (typically 3-15µm) restricts the potential life under severe corrosive conditions. Furthermore, the risk of latent failure via hydrogen-assisted embrittlement is an inherent risk associated with the electroplating method of zinc application, particularly at the high hardness levels and microstructural conditions that are associated with the application.

Hot dip galvanizing is carried out at approximately 450°C, which produces temper softening of the case hardened structure. When the fastener is immersed into the molten zinc from cold, the surface of the component attains the zinc bath temperature very rapidly. This thermal front then proceeds to migrate into the interior of the component at a rate governed by the thermal conductivity of the material. Roughly, the temperature front advances at a rate of $^1/_2$mm per minute. To overcome the softening phenomenon, it is necessary to use an alloy that is resistant to thermal softening, or alternatively, one that achieves the desired hardness condition after having been tempered at 475°C or higher.

As noted from the hot dip galvanized local screws, the drill point and threads had hardnesses below that of the Australian items. The hardnesses of the former were concomitant with that anticipated after exposing the quench hardened alloy steel grade to the 450-460°C temperature range via the galvanizing bath.

Using a drill point in the temper-softened state does not necessarily have a 'down' side as there are several contributing factors from the application of the screws which have an influential role. Drilling will occur – providing that the screw hardness exceeds that of the material into which the thread is being cut. However, the screws are commonly employed without 'wet' lubricant. This will result in frictional heating of the drill point and therewith, localised softening and the associated degradation in drilling behaviour. This is applicable to all hardnesses of screw. If the section into which the thread is being cut is deep, then the frictional heating is prolonged and the effect becomes increasingly significant.

The use of mechanical plating overcomes several production difficulties associated with the above methods of zinc application. It avoids the softening effect (if the thermal consolidation of the coating is not followed) exerted upon the hardened screws that is associated with a galvanizing treatment. It also eliminates the risk of embrittlement associated with electroplating. The coating thickness is also comparable to that of the hot dip galvanized route, although the presence of additional (tin) alloying into the coating reduces the volume of zinc available for sacrificial protection. Thermal consolidation of the mechanically applied coating is advisable, as this results in a diffusion bond between the substrate and the coating. For mechanical plating, the screw has the zinc-rich, fine metal powder coating peened onto the screw surface. Without the consolidation process, the adhesion and coating strength is restricted to that achieved by the mechanical deformation induced during the

application. Open porosity is also a factor that has to be controlled and can have a latent effect upon the corrosion behaviour of the zinc rich surface film. Thermal consolidation is carried out at approximately 400°C, which will thus also introduce the temper-softening phenomenon, characteristic of the hot dip galvanizing route – albeit to a reduced extent.

In summary, the use of any of the aforementioned processes that may be considered to apply zinc to the surface of the drill-point screws is a balance of the functional parameters offered by each. With regard to the electroplating route, the unaffected high hardness of the drill tip screw offers efficiency during the installation of the fastener, coupled with a comparatively shorter service life under severe corrosion conditions.

Hot dip galvanizing reduces the hardness of the screw (for typical fastener alloys), degrading the drilling efficiency, whilst offering relatively long term protection (due to the thicker coating dimensions) under comparatively severe corrosion conditions.

The mechanical plating route (for the fasteners as-received – unconsolidated) has not reduced the drill point hardness and a high drilling efficiency will be realised. However, the long-term corrosion resistance of the coating under aggressive service environment conditions will be relatively compromised - for the unconsolidated state of the film.

PHYSMET CC
R.S. *Thompson*

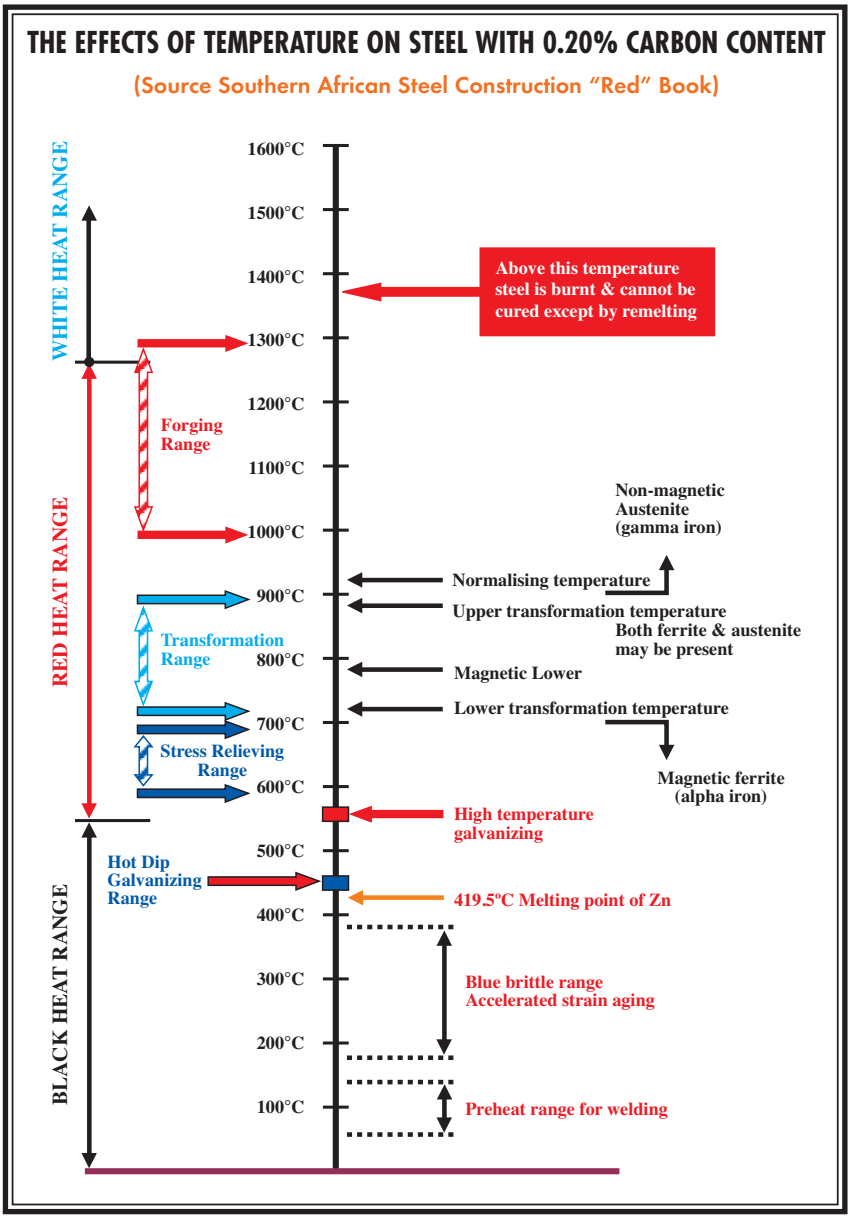
Editors note:
There are a number of alternative alloys that can be considered which will maintain the appropriate core and thread hardness when hot dip galvanizing is specified.

New specification covering fasteners for roof and wall cladding

The South African National Standards are presently in the process of compiling a specification (SANS 1273:2004) covering fasteners for roof and wall coverings in the form of sheeting.

Scope

This specification covers the material, dimensional and mechanical strength requirements for 10 types of fasteners and 5 types of washers that are used in the building industry for the fixing of roof and wall coverings in the form of sheeting.



Corrosion in roofing fasteners and seals

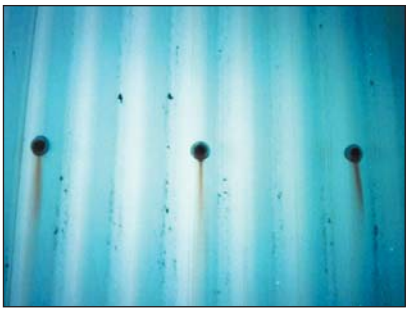
For a long time, roofing fasteners have been the weak link in the construction of industrial and commercial buildings. Often a lot of time and effort is put into specifying the most suitable roof sheeting and insulation material for a project, but when it comes to the roofing fasteners the clause: "Roof sheeting to be fixed in accordance to the manufacturer's specification" is used. Unfortunately the manufacturers of roof sheeting do not specify the quality of the roofing fasteners.

This leaves the choice of which type of roofing fasteners to use to the roofing contractor, and the fastener and washer selection usually ends up being based on price, rather than on the suitability and quality of the fasteners.

Roofing fasteners and washers should be selected based on the environment and the roof sheeting that will be used on a project. Environments are classified in I.S.O. categories (see table on page 62).

Unfortunately the majority of roofing fasteners used in South Africa are zinc electro plated with a coating thickness of 3-5 micron. Although these screws are only suitable for use in the C1 category, the screws are frequently used in C3 and C4 categories (*see Atmospheric Corrosivity Categories on page* 62).

Poor fastener quality including hydrogen embrittlement can be the cause of shearing of fasteners.



The selection of the incorrect coating can lead to premature corrosion of the roof or side cladding screws.

If one compares the electro plated coating thickness of the roofing screws (3-5µm) to the nominal coating thickness of 20µm found on a Z275 continuous hot dip galvanized sheeting used for roof sheeting and concealed fix clips used on commercial and industrial buildings it is clear that the roof sheeting has four to six times the life span of the roofing screws – a situation obviously not acceptable to the developers / owners of the building.

The problems caused by poor quality roofing screws and washers are manifold and include the following:

1. Inferior quality roofing fasteners and washers will lead to premature corrosion which will result in unsightly rust streaks on the roof sheeting, and the eventual corrosion of the roof sheeting around the washers and the roofing fasteners.
2. The incorrect hardening and poor standards of plating on roofing fasteners can cause hydrogen-embrittlement which will result in the shearing of fasteners under a steady load.
3. Poor quality roofing washers and seals break down and deteriorate under U.V. and high temperatures, resulting in leaks and consequential damage. Roofing washers and seals with high carbon content will promote pit corrosion on the roof sheeting.

In order to overcome the problems associated with poor quality roofing fasteners and seals, Kare Industrial Suppliers (Pty) Ltd offers the southern African roofing and cladding industry a comprehensive range of roofing fasteners and washers suitable for use in any of the corrosivity categories C1 - C5.

Kare Industrial Suppliers is the official distributor of Buildex Teks® screws in Southern Africa. ITW Buildex (Australia) have developed unique anti-corrosive coatings and patented design features to combat corrosion in roofing fasteners.

In addition to the high quality protective coating on the Buildex Teks® screws, features like ShankGuard and Hi-Grip limit the effects of under-roof corrosion and ensure structural integrity of the roofing system.

As a result of the Climaseal and Zacs 4 coating and the additional product features on the Teks® screws, ITW Buildex offers a warranty on their roofing fasteners which ranges from 12 years to 60 years depending on the environment where the fasteners will be used.

***Kare Industrial Suppliers* (Pty) Ltd. (*Export*)**

Tek® screws have patented design features such as ShankGuard and Hi-Grip and include appropriate roofing washers and seals.

Performance of coated self drilling screws

Alcatraz Security Systems reports back on the performance of hot dip galvanized versus electroplated self drilling screws used for the installation of electrification requirements on security fences in East London.

Alcatraz are manufacturers and erectors of quality palisade fence systems including electrical wiring systems for intruder control.

As quality has always been the corner stone of our company we continuously strive to improve on this aspect.

Self drilling screws, Shear Nuts and Cup Square Bolts have always posed a corrosion problem in our industry, because of their size they are mostly only available in an electro-plated finish. Very often we found ourselves embarrassed to request payment on projects when corrosion on these fasteners was immediately apparent.

Toward the end of 2003, we approached Terry Smith of the Hot Dip Galvanizers Association of Southern Africa for assistance with our dilemma. Since no-one was prepared to hot dip galvanize items as small as self drilling screws and 8mm bolts we found it necessary to take a huge risk on placing an order of approximately 20 000 of each item as an experiment. To our relief, the risk paid off and with the guidance of the Hot Dip Galvanizers Association, these items were successfully hot dip galvanized resulting in excess of 200 000 of these items being installed to date.

The only problem encountered on the self drilling screws was that a small percentage did not drill their own hole. We have overcome the problem by providing a small pilot hole and this slight inconvenience has extended the life span of the projects and catapulted us to new quality levels.

We've included photographs from the WESTBANK GOLF COURSE, which is less than 100m from the high water level and has no protection from onshore winds. The hot dip galvanized fasteners were first utilised in January / February 2004 and to date there is still no sign of corrosion! The electro plated equivalents utilised in areas greater than 500m from high water levels in spite of fairly heavy plant and bush protection from onshore winds, show extensive corrosion.

We wish to thank Terry Smith and the Hot Dip Galvanizers Association for their ongoing assistance with our quest to improve the quality of our projects.

***Editorial comment*:**
We were extremely pleased to assist in this instance, however, it must be borne in mind that for long term maintenance free protection a hot dip galvanized coating must stabilise. This occurs naturally when the coating is exposed to moisture and carbon dioxide from the atmosphere, whereby a stable zinc carbonate film forms. This stable film is essentially the condition that provides the long life associated with most hot dip galvanized coatings.

In many instances where the prevailing winds, coupled with high wave action, height above sea level, limited rainfall and distance from the sea create more aggressive conditions, in the interests of long service life, a duplex coating (hot dip galvanizing and a appropriate paint system) should be considered.

Hot dip galvanized self drilling screws installed at Westbank Golf Course show no corrosion after more than a year in a marine atmosphere.

Electroplated screws used in less aggressive marine areas, surrounded by bush show corrosion after the same exposure time.

Hot dip galvanized S-Hooks are used for maintaining tension on the electrical insulators.

UPAT S.A. (Pty) Ltd

Upat S.A. (Pty) Ltd is the sole southern Africa distributor of the fischer and Upat range of anchor bolts, chemical anchors, plugs and general construction fasteners. They are also stockists of a large selection of the locally manufactured products, as hot dip galvanized.

Hot dip galvanized anchors takes third position in volume of sales, which unfortunately is not how the company believes the situation, should be. The coastal regions should not sell any anchors that have not been hot dip galvanized or manufactured out of stainless steel! Users of anchor bolts in the coastal areas tend to ignore the importance of a higher corrosion resistant anchor and purchase purely on price even if the price difference is only marginal.

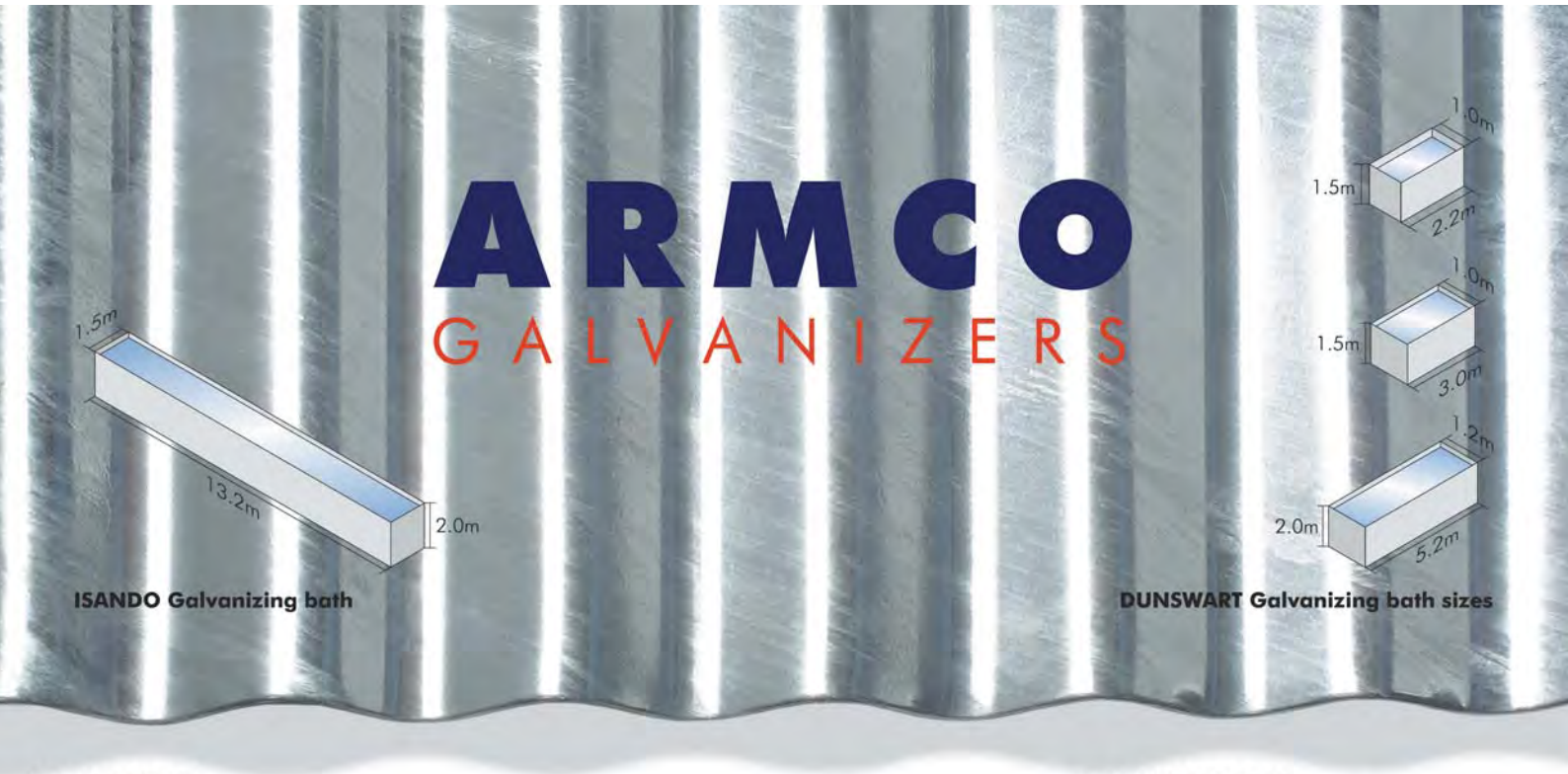
The tendency in Europe is to use electro-plated anchors in indoor applications and for anchors that are exposed to the weather to be either hot dip galvanized or stainless steel. One of the company's objectives is to educate end users to adopt the European principles.

Fischer Upat are world renowned for their range of chemical fixings and supply an extensive range of anchor and chemical mortar studs in a variety of lengths ranging from diameters M10 to M24 in hot dip galvanized, ex stock. Special diameters such as M27, M30 and M35 are manufactured on demand.

The most popular sizes in both the chemical anchor studs and express anchors are M12 and M16 and these diameters form the bulk of the sales of hot dip galvanized anchors. The production facility is also geared to have unplated bodies hot dip galvanized at very short notice when required.

There has unfortunately not been any major increase in the sale of hot dip galvanized anchors in the coastal region due to the fact that there has been an influx of "no name brand", lower quality and much cheaper priced anchors in electro plating. This has resulted in purchasers buying on price only without due consideration to the corrosion consequences. The cost difference between a locally manufactured anchor bolt in electro plating and hot dip galvanizing is approximately 15% which, with the hot dip galvanized coating being ten times thicker than the electro plating, makes the hot dip galvanized anchor a much more viable proposition.

The company's' mission is to be the leading and preferred supplier of cost effective technologically, superior and top quality anchor bolts and fasteners to the entire industry in southern Africa by direct selling and selling through retail outlets on a national basis.



ISANDO PLANT
- In operation since 1989
- Can accommodate heavy steel structures
- Kettle over 13m in length
- Average output: 2000 tons per month
- A white fume filtration and extraction system has been installed and conforms to EC standards
- In-house transport facility available

DUNSWART PLANT
- Specialises in small difficult-to-handle items
- Handles centrifugal and jobbing work efficiently
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SAISC updates the "Red Book"

by Spencer Erling – Education Director

Since the Southern African Steel Construction Handbook was first written in 1987, whilst the tables have been updated regularly the editorial content has not really been revisited.

The SAISC is busy with a totally updated version due for publication in June 2005.

The content of the fasteners section (chapter 6) has been reviewed and amongst the changes that will be noticed is that the word " property class" replaces "grade" when it comes to describing bolts. Details of ultimate tensile strengths have been expanded as new codes take into account small variations in ultimate tensile strengths depending upon the diameter of the bolts.

Great emphasis has been placed on bringing the relevant details of the various specifications (SANS1700 and ISO, DIN and EN) up to date and how they relate to each other. Tables of dimensions take into account the bolts that are readily available in South Africa and the small but important variations in size depending upon which specification the bolts are being made to.

Clarity is given for equivalent materials for grade 8.8 and 10.9 round bars (which are typically not a stock item at merchants).

But, perhaps, the most far-reaching change in the book is the paragraph on standardization of "Bolt lengths and diameters". The emphasis is twofold for this standardisation:

1. To try to eliminate the use of the wrong class of bolt by suggesting that class 4.8 be dedicated to 16 diameter and smaller, and class 8.8 for 20 diameter and larger.
2. To limit the number of length variations by permitting a maximum 25mm projection of the bolt past the nut thus allowing one length of fully threaded (set screws) bolts to be suitable for a range on grip lengths.

Additional information about precision (close tolerance fit) bolts, friction grip bolts and the like is also supplied.

Watch this space for availability of the book

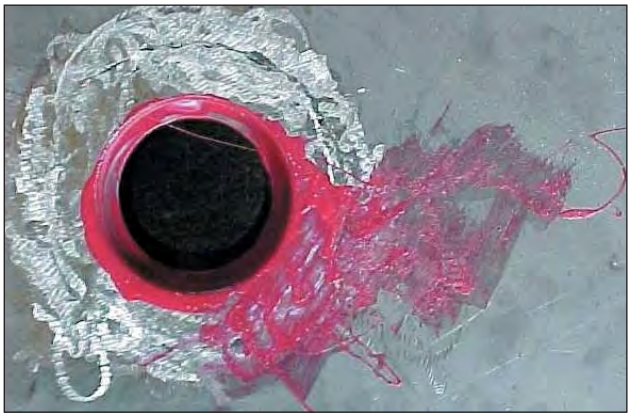
Thread protection on welded nuts

When it is necessary to weld a nut on a fabrication while ensuring that after hot dip galvanizing there is no zinc coating on the inside of the threads so that a standard bolt may be used in the nut, the following method works and has proven to be useful.

Obtain a masking product called "Galvastop" available from Orlik Speciality Chemicals. Take the bolt and dip it into the "Galvastop" liquid. Allow to dry (approximately two hours). Turn the coated bolt into the nut. The fabrication can now be hot dip galvanized.

After hot dip galvanizing the bolts can be easily removed leaving a clean thread in the nut for receipt of the new bolt.
This tip was kindly supplied by Marco Barnard of Galvadip.

"Galvastop" was developed as an effective masking liquid and has been, amongst other things, used extremely successfully in preventing the hot dip galvanized coating forming on close tolerance coupling mechanisms used for high pressure water piping.



The masking liquid "Galvastop" is so effective that precautions must be taken to avoid splashing of the product where unnecessary, otherwise uncoated areas will result after hot dip galvanizing.

Due to the build-up of zinc inside the threads of the above nut, the thread must be re-tapped to accept a standard uncoated bolt or oversized to accept a hot dip galvanized bolt.

GALVASTOP

Galvastop is a rapidly air drying blend of synthetic resins specifically formulated for the HOT-DIP galvanising industry as a suitable and convenient stop off material

Easy, brush on or dip application before the chemical galvanising process prevents galvanising on all components.

Easily removable after galvanising

Galvastop is a well acclaimed and internationally used product

This product won a research and development award at the 2004 Hot Dip Galvanizing Awards

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Impala Bolt & Nut S.A. (PTY) Ltd

Impala Bolt & Nut S.A. (PTY) Ltd was founded in November 1995 with a view to serving the South African market.

They have a production plant that manufactures a full range of fasteners in mild steel and high tensile from M8 - M24 in diameter. They manufacture a full range of hex nuts also from M8 - M30.

All the above are available as hot dip galvanized, a large portion of which is available ex-stock.

Impala Bolt & Nut also manufactures a full range of special products which are manufactured to client's specifications on request.

Impala Bolt & Nut staff have many years experience in the industry and are available at any time to discuss any needs or queries one may have regarding products.

National Socket Screws

National Socket Screws have been a key supplier of fasteners to the wholesale and retail trade in Africa for twenty years. The addition of hot dip galvanized fasteners a number of years back has greatly enhanced their product range.

They are the largest importer and distributor of fastener products on the continent and carry a vast range of hot dip galvanized products ex-stock in their Jet Park, Johannesburg warehouse. These include high tensile and mild steel setscrews and bolts, with both the full and half-lock oversized nuts to suit.

Also included in the range are flat washers, taper washers and spring washers all hot dip galvanized to SANS 121 (SABS ISO1461) standard. The spring washers have been monitored and tested throughout the entire galvanizing process and comply in all respects to the material and tensile specifications required.

New additions to the range are hot dip galvanized threaded rods in both high tensile and mild steel, in 1m lengths. Apart from the products mentioned, National Socket Screws are able to supply hot dip galvanized bolts and sets up to M56 x 400mm long complete with oversized nuts within seven to ten days.

National Socket Screws General Manager Tim Struwig says, "As hot dip galvanized products are an important part of our business, there is always a large stock holding available to ensure that distributors have continuity of supply."

2005 FEATURES

May/June:
Hot dip galvanized fasteners – process, types and availability

August/September:
Safety and security, the annual awards event and HDGASA celebrates its 40th birthday

November/December:
Duplex coatings (hot dip galvanizing plus an appropriate paint) and the world of hot dip galvanizing around us.

Bascol (Pty) Ltd

Bascol has 20 years experience in the manufacturing of fasteners. They are centrally situated with extensive premises in Selby, Johannesburg.

Their operation comprises 30 threadrolling and 15 bending machines. While they are unable to do heading work, they have specialised in threading and cold bending. Thread sizes from 4mm to 64mm in mild steel, EN8 and stainless steel. Bascol aims at a quick turnabout and can generally produce self colour items within 48 hours.

Over the years, Bascol have noticed a growing trend in the fastening industry away from electroplating towards hot dip galvanizing. At the same time, they have observed the various galvanizers improving their ability to produce top quality hot dip galvanizing on threads as small as 1.25 pitch on M8 bolts.

All the threads, which they produce, are rolled. By rolling the thread there are no chips, burrs or defects on the thread. It is imperative that the rollers are in good condition and the setting of the machines is precise. Without fail, the success of the plating process is reliant on a high quality thread.

Bascol encourages their customers to take their bolts directly to their own galvanizers for coating so that they can concentrate on the manufacturing process.

Products include threaded rod, studs, tie rods, u-bolts, eyebolts, pigtails and foundation bolts. Bascol hold a large amount of finished goods and raw material.

An extensive stock of hot dip galvanized threaded rod in diameters from M8 to M64 is maintained.

WLS Fastener Manufacturing Company cc

WLS Fastener Manufacturing Company cc owes much of it's success to having a manufacturing plant in Rosslyn Pretoria, which works hand in hand with their sales and distribution centre in Kew, Johannesburg.

Over the past 17 years WLS have manufactured numerous mechanical expansion bolts, chemical anchoring bolts, foundation bolts, either individually or in cages. All of which were hot dip galvanized to SANS 121 (SABS ISO 1461). From this experience they have learned that in the case of large foundation bolts or assemblies that cannot be spun after hot dip galvanizing, that it is wise to fit all female threaded items to male threads after hot dip galvanizing, before they leave their premises.

WLS Fasteners manufacture and hot dip galvanize items such as:

- "Trugrip" Expansion Anchors
- "Kalm" Chemical Anchor Bolts
- Cast in Concrete Sockets
- Foundation Bolts and Assemblies to drawing
- Tie Rods Threaded Bars and Studs
- High Load Anchors.

WLS Fasteners customer manufacture to clients specifications and requirements.

Standardisation of holding down bolts

In order to become more competitive to concrete or any other building material, specifiers and stakeholders in the steel industry must address several issues.

One small way that will contribute immensely to this, is by standardising of components such as holding down bolts, this will lead to availability of both bolt and oversized nuts, repetitiveness and achievement of consistent coating quality, particularly from the hot dip galvanizing industry.

For this reason, the Association recommends that hot dip galvanized standard straight holding down bolts of varying lengths and diameters be kept as stock items.

The bolts could each be supplied with an appropriate square plate welded to the base and be supplied with up to three oversized nuts and flat washers.

Straight bolts with no encumbrances such as cage configurations, are far easier to hot dip galvanize and maintain an achievable quality coating. Manufacturing of cage type configurations are costly to manufacture and extremely difficult to hot dip galvanize with repeated coating quality.

Manufacturing of cage type configurations are costly to manufacture and extremely difficult to hot dip galvanize with repeated coating quality.

Some contractors cast-in hot dip galvanized holding down bolts and find that the supplied nuts are not oversized, resulting in the coating being removed by a tap so that the nuts may fit.

Frequently, due to last minute ordering of holding down bolts, they are installed with no coating at all and must be protected with some other method, which often requires regular maintenance.

Hot dip galvanizing of only the exposed end of a holding down bolt is neither cost effective nor practical from the manufacturer and galvanizers perspective.

Unless repaired the cut end of a hot dip galvanized threaded rod must rely on the sacrifical protection of the surrounding zinc coating.

Due to site confusion, hot dip galvanized (left) and electroplated (right) holding down bolts are sometimes incorrectly mixed up.

Furthermore, hot dip galvanizing of only the exposed end of a holding down bolt is neither cost effective nor practical from the manufacturer and galvanizers perspective.

The hot dip galvanized coating does in no way affect the bonding of the concrete (*see Hot Dip galvanizing Today – 2004 Volume 1 Issue 1*).

Making use of hot dip galvanized threaded rod, available in 1m lengths, in most diameters from M8 to M76, can also be used for holding down bolts. The only disadvantage is that if cut, with the uncoated area at the protruding end, corrosion protection will rely on the sacrificial protection of the surrounding zinc coating or the end should be repaired after the nut is turned on.

Frequently, due to last minute ordering of the holding down bolts, either electro-plated or even uncoated bolts are used (sometimes electroplated and hot dip galvanized bolts are mixed up) and then must be over coated by other methods, which may or may not be as appropriate to the selected coating on the structure.

Finally, some contractors do cast-in hot dip galvanized holding down bolts and then when the structure is lifted into place, find that the supplied nuts are not oversized and due to the urgency, over tap the thread on the bolt, removing the hot dip galvanized coating.

Editor

Hot dip galvanized holding down bolts, supplied with 3 x oversized nuts and flat washers.

Fastener Coating Comparisons

CHARACTERISTICS OF THE COATING	HOT DIP GALVANIZING	ELECTROPLATING (ELECTROGALVANIZING)	MECHANICAL COATINGS	SHERADIZING
Adhesion	Coating metallurgically bonded to the steel because the formation process produces iron/zinc alloy layers overcoated with zinc.	Good mechanical bond, comparable with other electroplated coatings.	Good mechanical bond, comparable with electroplated coatings. Should coatings greater than 30µm be specified heat consolidation is necessary to ensure successful adhesion.	Good – the diffused coating provides a metallurgical bond.
Continuity and Uniformity	Good – any discontinuities are readily visible as "black spots". Can have excess zinc at drainage points on products.	Uniform within limitations of "throwing power" of bath. Pores not a problem, as exposed steel protected by adjacent zinc.	Thin at corners – the opposite of hot dip galvanized coatings.	Continuous and very uniform, even on threaded and irregular parts.
Thickness	Depending on the diameter, a minimum coating thickness of 45µm is achieved and a maximum coating thickness of 65µm is recommended for bolts. Although same applies to the nut, excessive coating thickness of >120µm will not interfere with the thread or spanner.	Thickness variable at will; generally 2.5-15µm. Thicker layers are possible but generally uneconomical.	Variable at will, usually between 10-80µm.	Usually 15-30µm closely controlled.
Mechanical Properties	Alloy layer is extremely abrasion resistant. Alloys are harder than mild steel.	Pure zinc used in electroplating is softer than the hard iron/zinc alloys in hot dip galvanizing and therefore less abrasion resistant.	Pure zinc used in mechanical plating is softer than the hard iron/zinc alloys in hot dip galvanizing and therefore less abrasion resistant.	Excellent abrasion resistance.
Extra Treatments	Conversion coatings – chromates prevent wet storage stain. New conversion coatings for enhancing corrosion protection currently under development.	Conversion coatings (e.g. chromates used to prevent wet storage stain). Numerous other conversion coatings available, which enhance corrosion protection.	Can have conversion coatings applied.	Can have conversion coatings applied.
Other Considerations	Although M6 machine screws threaded components are generally not available, nails and self drilling screws are coated. Efficient centrifuging and basket loading are important. Coating thickness determined by a metallurgical law.	No heating except for hydrogen embrittlement relief on high strength steels. Unless correctly specified and monitored the electroplated coating can in the interests of the electroplater be reduced to coatings of 2 - 3µm thick.	Ideal for small parts including washers and springs. (e.g. up to 15cm or 250g). Access difficulties (e.g. inside hollow items). Coating thickness is extensively controlled by the plater. No hydrogen embrittlement possibilities.	Generally used for fairly small complex components. Useful when close control of tolerances important. No hydrogen embrittlement possibilities.

"C/Peach" water a South Africanism?

Something that occurred the other day, which we would like to share with our readers was when some water samples were submitted for testing purposes, and when they arrived one of the samples was named "C/Peach" water.

After much discussion we arrived at the actual name, which was actually seepage water.

SOME POPULAR PUBLICATIONS AVAILABLE FROM THE ASSOCIATION

Steel Protection by Hot Dip Galvanizing and Duplex Systems

Practical Guidelines for the Inspection and Repair of Hot Dip Galvanized Coatings

Wall Chart – Design for Hot Dip Galvanizing

Code of Practice for Preparation for Duplex Coatings

Code of Practice for Evaluation of the Performance of Duplex Coatings

Ideal Bolt

Ideal Bolt was established in 1976 and over the 28 year period, has been involved in numerous projects such as bridge's, hotels, warehouse buildings, process plants and sport stadiums in South Africa, Africa, and abroad.

Their policy is to be as competitive as possible within the market place and to offer a service to their customers, which according to a spokesman, is second to none. Ideal Bolt are stockists of industrial fasteners and auxiliary items for structural, civil, roofing, mechanical, mining and piping industries.

The company structure promotes quality assured products, prompt and personalised service with competitive pricing and local availability. The informal conduct of the business structure allows fast response to market opportunities and customer service requirements.

Many popular sizes are kept as hot dip galvanized ex-stock.

Ideal Bolt stocks a variety of fastening sizes to accommodate various industries. They stock black, hot dip galvanized and on request electro plated fasteners.

The company remains responsive and flexible so it can adapt quickly to changing demands in the market place.

Types of Fasteners and Availability Matrix

TYPE OF FASTENER	COMPANY	STEEL GRADE	SPECIFICATION	SPECIFICATION	AVAILABLE SIZES	HOT DIP GALVANIZED TO ORDER	HOT DIP GALVANIZED EX STOCK
LOCKING NUTS							
Half Lock Nuts	Bolt & Eng Distributors	MS				Yes	
	Ideal Bolt	MS			M8 – M20		Yes
	National Socket Screws	Gr: 8	DIN 439		M6 – M42	M8 – M42	
	Springset	Gr: 8	DIN 439		M6 – M24	M8 – M24	Yes
	Tel-Screw Products	MS/HT			M8 – M48	Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M36		Yes
Hard Lock Nuts	Bolt & Eng Distributors	Gr: 8	No Spec			Yes	
Castle Nuts	Bolt & Eng Distributors	Gr: 8	Various			Yes	
Steel Hex Lock Nuts	Bolt & Eng Distributors	MS				Yes	
	Ideal Bolt	MS			M10 – M20		Yes
	National Socket Screws	MS	DIN 439		M6 – M42		M8 – M42
	S.A. Bolt Manufacturers	MS			M8 – M20	Yes	
	Springset	HT	DIN 439		M6 – M24		Yes
	Tel-Screw Products	MS				Yes	
	Transvaal Pressed	MS			M8 – M20	Yes	
Crimped Nuts	Impala Bolt & Nut	MS				Yes	
	S.A. Bolt Manufacturers	MS				Yes	
	Tel-Screw Products	MS			M8 – M48	Yes	
	Transvaal Pressed	MS				Yes	
Flanged Crimped Nuts	Impala Bolt & Nut					Yes	
Locking Washers	Bolt & Eng Distributors		DIN 127			Yes	
	Bolt Corporation	MS	Tall Washer	5 Degrees	M12 – M24	Yes	
	National Socket Screws		Star Washers			Possible	No
	National Socket Screws	MS	Taper Washer	5 Degrees	M8 – M24		M8 – M24
	S.A. Bolt Manufacturers						Yes
	Springset	HT	DIN 6798		M3 – M20		Yes
Nyloc Nuts	Most suppliers	Most smaller size Nyloc nuts are imported and are only available as electroplated					
	Bolt Corporation		DIN 985		M30 – M42	Possible	
	Impala Bolt & Nut		DIN 985				Yes
	National Socket Screws		DIN 985		M30 – M42	Possible	No
	S.A. Bolt Manufacturers				M30 – M42	No	No
	Springset	HT	DIN 985		M3 – M24		Yes
Cleeve Lock Nuts	Transvaal Pressed					No	
Prevailing Torque Hex Lock Nuts	Tel-Screw Products	Gr: 8 & 10	DIN 980V			Yes	
	S.A. Bolt Manufacturers	Gr: 8 & 10.9	DIN 980V			Yes	
NORMAL NUTS							
Hex OS Nuts	Bolt & Eng Distributors	Gr: 8	DIN 934				Yes
	Bolt & Eng Distributors	Gr: 10	SABS 1282			Yes	
	Bolt Corporation	Gr: 8	DIN 934		M10 – M90	Yes	M10 – M24
	Bolt Corporation	Gr: 8.8S/10.9S	SABS 1282	Friction Grip	M20 – M30	Yes	M20 – M30
	Bolt Corporation	HV10	DIN 6915	Friction Grip	M16 – M30	Yes	M16 – M30
	CBC Fasteners	Gr: 8	DIN 934	ISO 4032	M6 – M30	Yes	Yes
	Ideal Bolt	Gr: 8.8S	SABS 1282	Friction Grip Nuts			Yes
	Ideal Bolt	Gr: 8	DIN 934		M8 – M36		Yes
	Ideal Bolt	MS/Gr: 4	ISO 4032		M36 – M64	Yes	
	Impala Bolt & Nut	Gr: 8	DIN 934		M8 – M30		Yes
	National Socket Screws	Gr: 8	DIN 934	Self	M2 – M72		M8 – M48
	National Socket Screws	M/A	DIN 555	Colour	M24 – M72		M24 – M48

TYPE OF FASTENER	COMPANY	STEEL GRADE	SPECIFICATION	SPECIFICATION	AVAILABLE SIZES	HOT DIP GALVANIZED TO ORDER	HOT DIP GALVANIZED EX STOCK
NORMAL NUTS continued							
Hex OS Nuts continued	SA Bolt Manufacturers	Gr: 8	DIN 934		M6 – M64		Yes
	Springset	MS/HT	DIN 934		M8 – M30		Yes
	Tel-Screw Products	Gr: 8,10 & 12	DIN 934			Yes	
	Tel-Screw Products – HS Friction Grip	Gr: 8 & 10	DIN 6915			Yes	
	Transvaal Pressed	Gr: 8	DIN 934		M8 – M36	Yes	
	Transvaal Pressed	MS			M36 – M64	Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M64		Yes
Hex Long OS Nuts	Tel-Screw Products	MS / HT	TSP		M8 – M48	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M8 – M36		Yes
Shear Nuts or Anti-vandal Nuts	Auto Turned Inserts	MS / Gr: 8	ATI	As per customer requirements	M8 – M24	>M24	M8 – M20
	Bolt & Eng Distributors	MS	No Spec			Yes	
	Impala Bolt & Nut						Yes
	SA Bolt Manufacturers	Gr: 6			M8 – M24		Yes
	Springset	MS			M8 – M12		Yes
	Tel-Screw Products	MS			M8 – M16	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M8 – M24	Yes	
Flanged Nuts	S.A. Bolt Manufacturers	HT			M12 – M24	Yes	
	Transvaal Pressed	HT			M8 – M16	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M8 – M16		Yes
WASHERS							
Thru Hardened Washers	Bolt & Eng Distributors		DIN 6916				Yes
	Bolt Corporation		SABS 1282	DIN 6916	M16 – M30		Yes
	Ideal Bolt		DIN 6916				Yes
	National Socket Screws		DIN 6916			Yes	
	S.A. Bolt Manufacturers				M12 – M64		Yes
	Springset		DIN 6916		M12 – M34		Yes
	Tel-Screw Products		DIN 6916			Yes	
	WLS Fastener Manufacturing Co. cc	MS			M8 – M36		Yes
Flat Washers	Bolt & Eng Distributors						Yes
	Bolt Corporation		DIN 125		M10 – M64	Yes	Yes
	Ideal Bolt		DIN 126				Yes
	Impala Bolt & Nut		DIN 120/125		M8 – M30		Yes
	National Socket Screws		DIN 125A		M6 – M36	No	No
	National Socket Screws		DIN 126C	BS 4320	M6 – M36		Yes
	S.A. Bolt Manufacturers	MS			M6 – M76		Yes
	Springset	MS	BS 4320		M3 – M36		Yes
	Tel-Screw Products				M8 – M56		Yes
	WLS Fastener Manufacturing Co. cc	MS			M8 – M76		Yes
Square Flat Washers	Bolt Corporation	Specially Manufactured to Order			M16 – M24	Yes	
	S.A. Bolt Manufacturers	MS			M16 – M24	Yes	
	Tel-Screw Products	Specially Manufactured to Order			M6 – M24	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M8 – M30		Yes
Square Curved Washers	Bolt Corporation	Specially Manufactured to Order			M16 – M24	Yes	
	Tel-Screw Products	Specially Manufactured to Order			M6 – M24	Yes	
Spring Washers	Bolt & Eng Distributors		DIN 127				Yes
	Impala Bolt & Nut		DIN 127		M8 – M30		Yes
	National Socket Screws		DIN 7917		M6 – M36		M8 – M36
	S.A. Bolt Manufacturers				M6 – M48		Yes
	Springset	MS	DIN 7980		M3 – M36		Yes
	Tel-Screw Products				M8 – M24		Yes
	WLS Fastener Manufacturing Co. cc	MS			M8 – M36		Yes

TYPE OF FASTENER	COMPANY	STEEL GRADE	SPECIFICATION	SPECIFICATION	AVAILABLE SIZES	HOT DIP GALVANIZED TO ORDER	HOT DIP GALVANIZED EX STOCK
BOLTS AND SCREWS							
Hex Head Screws	Bolt & Eng Distributors	MS	DIN 558		M8 – M24	Yes	
	Bolt & Eng Distributors	Gr: 8.8	DIN 933		M8 – M30		Yes
	Bolt Corporation	MS/8.8	DIN 558/933		M12 – M72	Yes	
	CBC Fasteners	MS	DIN 933	ISO 4017	M18 – M30	Yes	Yes
	CBC Fasteners	Gr: 8.8	DIN 933	ISO 4017	M8 – M30	Yes	Yes
	Ideal Bolt	MS			M8 – M24		Yes
	Ideal Bolt	Gr: 8.8			M8 – M30		Yes
	Impala Bolt & Nut	MS	DIN 658		M8 – M24		Yes
	Impala Bolt & Nut	Gr: 8.8	DIN 933		M8 – M30		Yes
	National Socket Screws	MS	DIN 558		M8 – M30	M30	M8 – M24
	National Socket Screws	Gr: 8.8	DIN 933		M8 – M30	M36 – M48	M8 – M30
	S.A. Bolt Manufacturers	Gr: MS/6.8/8.8/10.9			M6 – M64		M8 – M64
	Springset	MS/HT	DIN 933		M6 – M24		M8 – M24
	Tel-Screw Products	MS			M8 – M39	Yes	
	Tel-Screw Products	Gr: 8.8			M8 – M39	Yes	
	Transvaal Pressed	MS			M8 – M24	Yes	
	Transvaal Pressed	Gr: 8.8			M8 – M30	Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M36		Yes
Hex Head Bolts and OS Nuts	Bolt & Eng Distributors	MS	DIN 601		M8 – M30	Yes	
	Bolt Corporation	MS	DIN 601	DIN 555	M12 – M72	Yes	
	CBC Fasteners	MS	DIN 601	SABS 135	M8 – M30	Yes	Yes
	Ideal Bolt	MS	DIN 601		M8 – M30		Yes
	Impala Bolt & Nut	MS			M8 – M30	Yes	
	National Socket Screws	Gr: 8.8	DIN 931/934		M6 – M56	M33 – M56	M8 – M30
	S.A. Bolt Manufacturers	Gr: MS/6.8/8.8/10.9			M6 – M64		M8 – M64
	Springset	MS	DIN 934		M8 – M30		Yes
	Tel-Screw Products	MS			M8 – M39	Yes	
	Transvaal Pressed	MS			M8 – M30	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M8 – M36		Yes
Hex Head Bolts and OS Nuts (High tensile)	Bolt & Eng Distributors	Gr: 8.8	DIN 933		M27 – M56	Yes	
	Bolt Corporation	Gr: 8.8	DIN 931	DIN 934	M12 – M72	Yes	Yes
	CBC Fasteners	Gr: 8.8	DIN 931	ISO 4014	M8 – M30	Yes	Yes
	Ideal Bolt	Gr: 8.8			M8 – M30		Yes
	Impala Bolt & Nut	Gr: 8.8	DIN 931		M8 – M30		Yes
	Springset	HT	DIN 934		M8 – M30		Yes
	Transvaal Pressed	Gr: 8.8			M27 – M56	Yes	
	WLS Fastener Manufacturing Co. cc	HT			M8 – M36		Yes
Large Dia Bolts & OS Nuts	Bolt & Eng Distributors		DIN 601/934			Yes	
	Bolt Corporation	Gr: MS/8.8/10.9	DIN 601/931/924		M27 – M72	Yes	Yes
	Ideal Bolt						Yes
	National Socket Screws	Gr: 8.8	DIN 931/934		M27 – M56	M33 – M56	M30
	S.A. Bolt Manufacturers	Gr: MS/6.8/8.8/10.9			>M36		Yes
	Tel-Screw Products	Gr: MS/8.8				Yes	
	Transvaal Pressed					Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M39 – M76	Yes	
Cup Head Square Neck Bolts & OS Nuts	Bolt & Eng Distributors	MS	SABS 1143		M8 – M20	Yes	
	Bolt Corporation	Gr: MS / 8.8	SABS 1143	DIN 603	M12 – M36	Yes	
	CBC Fasteners	MS	SABS 1143		M8 – M20	Yes	Selected
	Impala Bolt & Nut	MS	DIN 603		M8 – M16	Yes	
	S.A. Bolt Manufacturers	MS/HT			M6 – M24	Yes	
	Springset	MS	SABS 1143		M6 – M26	Yes	
	Tel-Screw Products	MS			M8 – M30	Yes	
	Transvaal Pressed	MS			M8 – M20	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M8 – M20	Yes	

TYPE OF FASTENER	COMPANY	STEEL GRADE	SPECIFICATION	SPECIFICATION	AVAILABLE SIZES	HOT DIP GALVANIZED TO ORDER	HOT DIP GALVANIZED EX STOCK
BOLTS AND SCREWS continued							
C/Sunk Square Neck Bolts & OS Nuts	Bolt & Eng Distributors	MS	SABS 1143		M12 – M24	Yes	
	Bolt Corporation	Gr: MS/8.8/10.9	SABS 1143	DIN 605	M12 – M36	Yes	
	CBC Fasteners	MS	SABS 1143		M10 – M20	Yes	
	Impala Bolt & Nut	MS	DIN 605		M10 – M16	Yes	
	S.A. Bolt Manufacturers	Gr: 8.8/10.9			M12 – M33	Yes	
	Tel-Screw Products	MS			M8 – M30	Yes	
	Transvaal Pressed	MS			M10 – M20	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M10 – M20	Yes	
C/Sunk Nib Bolts & OS Nuts	Bolt Corporation	MS/HT	SABS 1143	DIN 604	M12 – M36	Yes	
	CBC Fasteners	MS	SABS 1143		M12 – M24	Yes	
	Ideal Bolt	MS			M12 – M24		Yes
	Impala Bolt & Nut	MS	DIN 604		M10 – M20	Yes	
	S.A. Bolt Manufacturers	MS/HT			M12 – M20	Yes	
	Tel-Screw Products	MS			M8 – M20	Yes	
	Transvaal Pressed	MS			M12 – M24	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M12 – M24	Yes	
Friction Grip Bolts & Nuts	Bolt & Eng Distributors	Gr: 10.9S	SABS 1282		M12 – M30	Yes	
	Bolt Corporation	Gr: 8.8S/10.9S	SABS 1282	DIN 694/ISO 7411	M12 – M30	Yes	
	CBC Fasteners	Gr: 8.8S/10.9S	SABS 1282	ISO 7411	M12 – M30	Yes	
	Ideal Bolt	Gr: 8.8S			M12 – M30		Yes
	S.A. Bolt Manufacturers	Gr: 8.8/10.9S			M12 – M30	Yes	
	Transvaal Pressed	Gr: 8.8S/10.9S			M12 – M30	Yes	
	WLS Fastener Manufacturing Co. cc	HT			M12 – M30	Yes	
Hex Socket C/Sunk Head Screws	Bolt & Eng Distributors	Gr: 10.9	DIN 7991		M8 – M24	Yes	
	National Socket Screws	Gr: 12.9	DIN 912		M2 – M36	No	No
	S.A. Bolt Manufacturers	Gr: 10.9/12.9			M6 – M48	Yes	
	Springset	HT	DIN 912		M4 – M16	Yes	
	Transvaal Pressed	Gr: 10.9			M8 – M24	Yes	
	WLS Fastener Manufacturing Co. cc	HT			M8 – M24	Yes	
Lockbolts	S.A. Bolt Manufacturers Pins & Collars	Gr: 6.8/8.8			M12 – M24	Yes	
Pigtails – 1 &1$^{1}/_{2}$ Turn	Bascol (Pty) Ltd	MS			M8 – M12	Yes	Yes
	Bolt & Eng Distributors	MS			M8 – M12	Yes	
	Ideal Bolt	MS			M8 – M10		Yes
	Tel-Screw Products				M8 – M76	Yes	
	WLS Fastener Manufacturing Co. cc	MS			M8 – M24	Yes	
THREADED ROD / FOUNDATION BOLTS							
3m – Threaded Rod	Bascol (Pty) Ltd	MS EN8			M10 – M64	Yes	Yes
	Bolt Corporation	MS/HT			M12 – M56	Yes	
	Impala Bolt & Nut	MS/HT	DIN 975		M8 – M24	Yes	
	S.A. Bolt Manufacturers	MS/HT			M12 – M48	Yes	
	Springset	MS	DIN 975		M8 – M36	Yes	
	Tel-Screw Products				M8 – M36	Yes	
	Transvaal Pressed				M24 – M30	Yes	
	WLS Fastener Manufacturing Co. cc				M8 – M36		Yes
1m – Threaded Rod	Bascol (Pty) Ltd	MS EN8			M10 – M64	Yes	Yes
	Bolt & Eng Distributors	DIN 975			M12 – M30		Yes
	Bolt Corporation	MS/HT			M12 – M56	Yes	
	Ideal Bolt	MS/HT			M10 – M30		Yes
	Impala Bolt & Nut	MS/HT	DIN 975		M8 – M24	Yes	
	National Socket Screws	MS/HT			M6 – M36	Yes	No Yet
	S.A. Bolt Manufacturers	MS/HT			M16 – M64	Yes	
	Springset	MS	DIN 975		M3 – M36	Yes	
	Tel-Screw Products				M8 – M36		Yes

TYPE OF FASTENER	COMPANY	STEEL GRADE	SPECIFICATION	SPECIFICATION	AVAILABLE SIZES	HOT DIP GALVANIZED TO ORDER	HOT DIP GALVANIZED EX STOCK
THREADED ROD / FOUNDATION BOLTS continued							
1m – Threaded Rod continued	Transvaal Pressed				M10 – M36	Yes	
	WLS Fastener Manufacturing Co. cc				M8 – M36		Yes
Stay Rods (Eskom)	Bolt corporation				M12 – M24		Yes
HD Bolts (Foundation Bolts) & OS Nuts	Bascol (Pty) Ltd	MS EN8			M10 – M64	Yes	Yes
	Bolt & Eng Distributors	MS	NO SPEC			Yes	
	Bolt Corporation	MS/HT			M10 – M125	Yes	
	Ideal Bolt	MS/HT			M10 – M72		Yes
	SA Bolt Manufacturing	MS/HT			M16 – M64	Yes	
	Tel-Screw Products				M8 – M72	Yes	
	WLS Fastener Manufacturing Co. cc				M8 – M72	Yes	
CONCRETE ANCHOR BOLTS							
Express Anchor Bolts	Fischer Upat Fixings				M10 – M24	Yes	
Chemical Anchors & Threaded Studs	Bascol (Pty) Ltd	MS EN8			M10 – M64	Yes	
	Bolt & Eng Distributors	EN8	NO SPEC			Yes	
	Ideal Bolt	MS/HT			M10 – M24	Yes	
	Rawlplug					Yes	
	Tel-Screw Products	MS			M8 – M36	Yes	Yes
	WLS Fastener Manufacturing Co. cc	EN8			M8 – M30	Yes	Yes
Kalm Chemical Anchor Bolt	WLS Fastener Manufacturing Co. cc	EN8			M8 – M30	Yes	
Trugrip Anchor Bolt	WLS Fastener Manufacturing Co. cc	EN8			M10 - M30		Yes
Rawl Kemfix Chemical Anchor Studs – for use with all chemical anchoring (capsule and/or cartridge systems)	Rawlplug South Africa	Gr: 5.8	Imported	Imported	M8 – M30 Various lengths		Yes
Through Bolts/ Stud Anchors/ Wedge Anchors	Rawlplug South Africa	Gr: 5.8	Imported	Imported	M8 – M20 Various lengths		Yes
MISCELLANEOUS							
Self Drilling Screws	Fischer Upat					Yes	
	Ideal Bolt					Yes	
	Kare Industrial Suppliers					Yes	
	National Socket Screws		Special			Yes	
	New Aloe Fastening Systems					Yes	
	Springset		Special			Yes	
	WLS Fastener Manufacturing Co. cc					Yes	
Cast-In Lifting Sockets	WLS Fastener Manufacturing Co. cc	EN8			M8 – M36	Yes	
Hydraloc "T" Pins & Collars	Avlock International				M12, M16, M19, M22, M25	Yes	
SPECIAL FASTENERS							
Countersunk Machine Screws	Bolt & Eng Distributors	MS/HT	DIN 963			Yes	
	Ideal Bolt	MS/HT					Yes
	National Socket Screws					Yes	
	S.A. Bolt Manufacturers	MS			M16 – M20	Yes	
	Springset	MS			M3 – M8		Yes
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M36	Yes	
	Tel-Screw Products					Yes	
Round U-Bolts	Bascol (Pty) Ltd	MS			M8 – M36	Yes	Yes
	Ideal Bolt	MS/HT			M8 – M36		Yes
	Springset	MS					Yes
	Tel-Screw Products	MS			M8 – M76		Yes
	Tel-Screw Products	HT				Yes	

TYPE OF FASTENER	COMPANY	STEEL GRADE	SPECIFICATION	SPECIFICATION	AVAILABLE SIZES	HOT DIP GALVANIZED TO ORDER	HOT DIP GALVANIZED EX STOCK
SPECIAL FASTENERS continued							
Square U-Bolts	Bascol (Pty) Ltd	MS			M8 – M48	Yes	
	Bolt & Eng Distributors	MS	NO SPEC		M8 – M24	Yes	
	Bolt Corporation					Yes	
	Ideal Bolt	MS			M8 – M30		Yes
	Springset	MS			M8 – M24		Yes
	Tel-Screw Products	MS/HT			M8 – M76	Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M36	Yes	
TV U- Bolts	Bascol (Pty) Ltd	MS			M8 – M16	Yes	Yes
	Springset	Special			M8 – M76		Yes
	Tel-Screw Products				M8 – M76		Yes
Hook Bolts	Bascol (Pty) Ltd	MS			M8 – M20	Yes	
	Bolt & Eng Distributors	MS	NO SPEC		M8 – M76	Yes	
	Bolt Corporation	MS/HT			M16 – M72	Yes	
	Ideal Bolt	MS			M8 – M12		Yes
	Tel-Screw Products				M8 – M76		Yes
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M76	Yes	
Channel Bolts	Bascol (Pty) Ltd	MS			M8 – M10	Yes	
	Bolt & Eng Distributors	MS			M8 – M10	Yes	
	Bolt Corporation	HT			M16 – M72	Yes	
	Ideal Bolt	MS			M8 – M12		Yes
	Tel-Screw Products				M8 – M76	Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M76	Yes	
J-Bolts	Bascol (Pty) Ltd	MS			M8 – M36	Yes	
	Bolt & Eng Distributors	MS	NO SPEC		M8 – M24	Yes	
	Bolt Corporation	MS/HT			M12 – M72	Yes	
	Ideal Bolt	MS			M8 – M24		Yes
	Springset	MS			M8 – M24	Yes	
	Tel-Screw Products				M8 – M76	Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M76	Yes	
Eye-Bolts	Bascol (Pty) Ltd	MS			M8 – M16	Yes	
	Bolt & Eng Distributors	MS	NO SPEC		M8 – M76	Yes	
	Bolt Corporation	MS			M16 – M36	Yes	
	Tel-Screw Products				M8 – M76	Yes	Yes
	WLS Fastener Manufacturing Co. cc	MS			M6 – M76	Yes	
Straining Eye-Bolts	Bascol (Pty) Ltd	MS			M8 – M16	Yes	
	Tel-Screw Products				M76	Yes	Yes
	WLS Fastener Manufacturing Co. cc	MS			M8 – M24	Yes	
Linked Eye Rods	Tel-Screw Products				M8 – M76	Yes	
Forged Eyebolts	Bolt Corporation	MS			M16 – M36	Yes	
	S.A. Bolt Manufacturers	MS			M12 – M24	Yes	
	Tel-Screw Products				M8 – M30	Yes	
Threaded Studs	Bascol (Pty) Ltd	MS EN8			M8 – M64	Yes	
	Bolt & Eng Distributors	MS	NO SPEC		M8 – M76	Yes	
	Bolt Corporation	MS/HT			M12 – M125	Yes	
	Tel-Screw Products				M8 – M76	Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M76		Yes
Tie Rods	Bascol (Pty) Ltd	MS EN8			M8 – M64	Yes	
	Bolt & Eng Distributors	MS	NO SPEC		M8 – M76	Yes	
	Bolt Corporation	MS/HT			M16 – M125	Yes	
	Ideal Bolt	MS/HT			M8 – M76		Yes
	Tel-Screw Products				M8 – M76	Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 – M76	Yes	

TYPE OF FASTENER	COMPANY	STEEL GRADE	SPECIFICATION	SPECIFICATION	AVAILABLE SIZES	HOT DIP GALVANIZED TO ORDER	HOT DIP GALVANIZED EX STOCK
SPECIAL FASTENERS continued							
Other specials	Bascol (Pty) Ltd	MS EN8	Threading & Bending to Customers specification			Yes	
	Bolt Corporation	Non preferred sizes and types manufactured to customer specifications			M12 - M72	Yes	
	Ideal Bolt	Non preferred sizes and type can be manufactured				Yes	
	S.A. Bolt Manufacturers	Non preferred sizes and types manufactured to customer specifications				Yes	
	Tel-Screw Products	Specials manufactured to order			M8 – M76	Yes	
	Transvaal Pressed	Non preferred sizes and types can be manufactured dependent on quantities				Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 - M76	Yes	
Domed Head or Cap Nuts	National Socket Screws		DIN 1587			Yes	
	S.A. Bolt Manufacturers	4			M6 – M24	Yes	
	Springset	MS			M6 - M20	Yes	
	Tel-Screw Products	Gr: 6	DIN 1587			Yes	
	Transvaal Pressed					Yes	
	WLS Fastener Manufacturing Co. cc	MS/HT			M8 - M36	Yes	
Hex Coach Screws	Springset	MS			M6 - M12	Yes	
	Tel-Screw Products		DIN 7976		M6 – M12	Yes	Yes

OS – Over sized / MS – Mild steel / HT – High Tensile

PARTICIPATING FASTENER COMPANY CONTACT DETAILS

COMPANY	1st CONTACT	2nd CONTACT	TELEPHONE	FACSIMILE	EMAIL	LOCATION
Auto Turned Inserts	Garth Fletcher		011-894-2755	011-894-1722	rowent@acenet.co.za	Benoni – Jhb
Avlock International	Rob Tomlin		011-917-2110	011-917-0260	avlock@iafrica.com	Benoni – Jhb
Bascol (Pty) Ltd	Mike Swarbreck	Paula Swarbreck	011-493-8160	011-493-1206	bascol@mweb.co.za	Booysens – Jhb
Bolt & Eng Distributors	Ernie Barnett	Mike Giltrow	011-827-8312	011-824-0890	ernie@bolteng.co.za	Wadeville – Jhb
Bolt Corporation	Pat Duffield	Ian Rose	011-955-4480	011-955-2677	irose@boltcorp.co.za	Krugersdorp
CBC Fasteners	Rob Pietersma	Jay Coopen	011-955-4485	011-664-6218	Tech@cbc.co.za	Krugersdorp
Fischer Upat Fixing Systems	Wayne Weber	Adam Stander	011-624-6700	011-402-6807	wayne@upat.co.za	Ellis Park – Jhb
Ideal Bolt	Ivan Dekker	Justin Dekker	011-894-1300	011-894-7828	Idealbolt@icon.co.za	Benoni – Jhb
Impala Bolt & Nut	Anthony Diamond	N. Coppin	011-824-3925	011-824-3803	adimond@worldonline.co.za	Wadeville – Jhb
Kare Industrial Suppliers	Reitze Hylkema		011-941-3170	011-941-1615	reitze@kare.co.za	Allan Manor – Jhb
M&D Specialised Fasteners cc	Jerry Tasker		011-868-1172	011-868-1190	jerry@m-d.co.za	Alrode South– Jhb
National Socket Screws (Pty) Ltd	Tim Struwig	Charles Schreiber	011-397-0150	011-397-2158	Nss@screws.co.za	Jet Park – Boksburg
New Aloe Fastening Systems	Franco Fiaschi		011-835-2171	011-835-1571	aloe@icon.co.za	Crown Mines – Jhb
Rawl Fixing Systems	Rob Muller		011-894-7147	011-894-5189	rmuller@infodoor.co.za	Benoni – Jhb
SA Bolt Manufacturers	Rodney Wooldridge	Sales	011-814-2240	011-814-2249	Info@sabolt.co.za	Nigel – Jhb
Springset	Shane Edwards		011-613-1993	011-613-8926	shanee@springset.co.za	City Deep – Jhb
Tel-Screw Products	Ronnie Teleng		011-917-9710	011-892-5132	Info@telscrew.co.za	Boksburg North – Jhb
Transvaal Pressed Nuts, Bolts & Rivets (Pty) Ltd	Ivo Cerrai	Jianni Cerrai	011-900-1310	011-900-1532	ivo@tvlpnb.co.za	Alrode South – Jhb
WL&S Fastener Manufacturing Co.	Nick Allen	Wayne Louw	011-882-1150	011-882-1043	wlsfast@cybertrade.co.za	Kew – Jhb

Should you contact one of the participating companies after reading through this publication, please inform them as to your source of reference.

Hot dip galvanized bolts still "shine" while guard rails discolour and corrode

A common site for motorists and other road users are the hot dip galvanized guardrail safety barriers. The steel profile universally used for these safety barriers was developed many years ago by Armco in the United States.

Over the years, the word Armco has become synonymous with guardrail to the extent that one will frequently hear a racing commentator describe how a driver crashed into the "Armco" as opposed to the guardrail.

Throughout the years, hot dip galvanizing has become the accepted method of corrosion control for guardrail virtually throughout the world.

Many years ago, a similar product but with a different profile was frequently used but not hot dip galvanized. When driving recently from Port Elizabeth to Hogsback, I came across some of this painted guardrail which was rusting severely. Meanwhile, the bolts which had been hot dip galvanized were in excellent condition without any evidence of corrosion.

When the Johannesburg City Council constructed the M1 and M2 motorways, the decision was taken to erect uncoated guardrail manufactured from Corten Steel. These rails are slowly being replaced with conventional hot dip galvanized material.

There was a stage when it was considered that guardrail should be painted white for visibility reasons. In contrast, the more recent opinion by road safety authorities is that white safety barriers can distract a motorist's attention and that the typical grey appearance of a weathered hot dip galvanized coating is preferable.

Editor

Uncoated guard rails discolour and corrode.

Residual coating thickness on the bolts was still about 100µm (107µm shown in photo).

Hot dip galvanized bolts still providing corrosion protection.

"Zincalume" versus hot dip galvanizing

The zinc / aluminium coating as applied to continuously coated steel sheet provides excellent corrosion resistance in the case of atmospheric exposure in most environments. The same does not of course pertain in buried or immersed conditions where the corrosion mechanism of selective leaching can significantly influence the corrosion resistant life of this coating. For atmospheric exposure, the claim is made that "Zincalume" will provide a lifetime of up to four times that of hot dip galvanized steel under the same conditions. This claim is no doubt correct when it comes to comparing normal continuously hot dip galvanized steel e.g. roof sheeting with material onto which the Zn/AI coating has been applied by means of a similar process.

The bland statement that "Zincalume" steel has a lifetime of up to four times that of hot dip galvanized steel is, however, nebulous and, hence, misleading since it does not define coating thickness or for that matter the difference in coating structure obtained from the hot dip galvanized coating applied after fabrication to that obtained on continuously hot dip galvanized coil. The following technical information is given with a view to providing a transparent and unbiased picture.

Continuously hot dip galvanized steel coil (Zendzimir Process). The zinc coating applied on this material in general use is referred to as Z275 i.e. 275g/m^2 of zinc or more accurately 137.5g/m^2 per side. Converted into coating thickness, this yields an average thickness between 18 and 20 microns per side of a relatively pure zinc coating where iron/zinc alloys are virtually absent.

Furthermore, the specification makes allowances for only 40% of the individual value (235g/m^2) i.e. 13.5µm to be found on one side.

The claim that a "Zincalume" coating will provide up to four times the life of this coating in atmospheric exposure is probably correct from a barrier protection aspect.

General Hot Dip Galvanizing after Fabrication

This process provides a coating thickness of 60 to 80 microns on relatively thin steel sections such as that used for the manufacture of palisade fencing. Added to this, the coating structure consists of between 50% and about 80% iron/zinc alloys, which provide 30% greater corrosion resistance in most environments than that available from pure zinc.

Apart from the added protection provided by the iron/zinc alloys, it must be borne in mind that this coating is some 5 times thicker than that provided by the "Zincalume" coating.

For these reasons, the claim that a life of four times greater is obtainable from "Zincalume" is most certainly not applicable to hot dip galvanizing as applied by the general hot dip galvanizing process.

Other Factors that need to be considered

Formability:

The Zinc Aluminium coating is more prone to damage and cracking than a pure zinc coating, particularly where thicker steel sections are involved. This can result in micro cracking of the coating when severe bending or forming takes place.

Edge Protection:

The cathodic protection provided by the hot dip galvanizing processes is substantially more effective than that available from the Zinc Aluminium coating. Steel sections in excess of 0.6mm thickness will display distinct rust staining on cropped edges. In the case of the general hot dip galvanizing process, such problems do not apply in that all surfaces are provided with a protective coating.

Summary:

The zinc / aluminium coating (Zincalume) is an excellent coating in most environments when used, for example, as roof sheeting. To claim that its protective properties are superior to the substantially thicker and metallurgically different hot dip galvanized coating applied to fabricated products would be both misleading and irresponsible.

The edge protection properties provided by a zinc / aluminium coating are substantially less than that provided by a hot dip galvanized coating.

Increasing the possibility of achieving a quality hot dip galvanized coating

Fabrication standard and positioning of vent & fill holes has a direct impact on the quality of the hot dip galvanized coating.

When inspecting hot dip galvanizing for corrosion protection, two considerations are most important, and they are coating thickness and coating continuity. The first is generally a function of the type of steel being hot dip galvanized and because of a metallurgical law between molten zinc and steel in most applications the minimum coating thickness will be achieved. The second of coating continuity is normally a function of the fabrication quality, with welding being paramount to success.

Welding and welding slag

Welds should be continuous and free from excessive pin-holing and porosity. Weld slag, normally associated with stick welding, is not readily removed by acid cleaning and such slag must be removed by abrasive blast cleaning, chipping, grinding, flame cleaning or a pneumatic needle gun, prior to hot dip galvanizing. Shielded arc welding is preferred since this method does not result in the presence of tightly adhering slag.

In case of double-sided fillet welds, the weld must be continued around the ends to prevent the unnecessary penetration of acid into any conceivable crevice.

Weld spatter

Weld spatter does not reduce the protective properties of a hot dip galvanized coating to the same extent as a paint coating, but it is recommended practice to remove spatter prior to hot dip galvanizing.

The photos show what is sometimes delivered to the galvanizer, in the hope that hot dip galvanizing will improve the finish.

We call hot dip galvanizing an "Honest Coating", whereby the coating won't hide contaminants and bad fabrication. There is no cover up of bad fabrication by hot dip galvanizing.

Although if these components were hot dip galvanized, the coating will not fail, due to the sacrificial protection afforded by the surrounding coating, the final coating however would be aesthetically unacceptable.

An evaluation of material and coating for railway sleeper shoulders – Pandrol South Africa

PANDROL SA (PTY) LTD

WORK INSTRUCTION FOR THE PURPOSE OF ACHIEVING QUALITY HOT DIP GALVANIZED RAIL CLIPS

GENERAL

1. The purpose of this work instruction is to ensure that Pandrol Products hot dip galvanized by outside suppliers, must conform to the requirements of SANS 121 (SABS ISO 1461) standard for hot dip galvanizing and additionally the procedures set out below.

RESPONSIBILITY AND AUTHORITY

1. The Quality Manager is responsible for ensuring compliance with this work instruction.

METHOD

1. The products for hot dip galvanizing are to be abrasively blasted in a rotary barrel wheelabrator to remove any scale etc.
2. When clean they are to be pickled in inhibited hydrochloric acid solution, with a maximum concentration of 14% - 16%. Maximum permissible pickling time is 10 minutes. Under no circumstances is this pickling time to be exceeded.
3. The product is rinsed with a hose to remove most of the acid solution. It is then dipped in a water tank to remove any further residual solution.
4. Product is then dipped in cold flux (to facilitate adhesion of the zinc).
5. The product is then passed through a drying oven, maximum temperature of 140°C.
6. Product is dipped in a zinc bath, with a temperature of between 450° - 460°C and then centrifuged (rapid spinning and quick braking).
7. Product is then cooled in a warm passivation solution.
8. After hot dip galvanizing the product surface is to be smooth, with a minimum of roughness, lumpiness, pimples and stains. Bare patches, Dross inclusions and Flux staining are not acceptable. The hot dip galvanized coating thickness is to be a maximum of 100 microns.
9. Rejects are to be returned to Pandrol, where they will be appropriately repaired. Under no circumstances are rejects to be stripped and re-galvanized.
10. Care is to be taken by the galvanizer to ensure that ungalvanized product is not stored in a corrosive environment, or on corrosive soil, (near acid baths etc).
11. The steel supplier is to pay special attention to the quality of the steel and the heat treatment. Rolling defects such as "Laps", "Folds", "Laminations" and "Non metallic impurities" are unacceptable.

    Overheating, surface defects, excessive heat soaking times, and interruptions in the "Heat Treatment" sequences are contributory factors to the problems of "Surface Brittleness", "Surface Cracks" and "Hydrogen Embrittlement"

THESE CONDITIONS ARE TO BE AVOIDED AT ALL COSTS.

Pandrol South Africa supplies rail fastenings to the local and international rail industry.

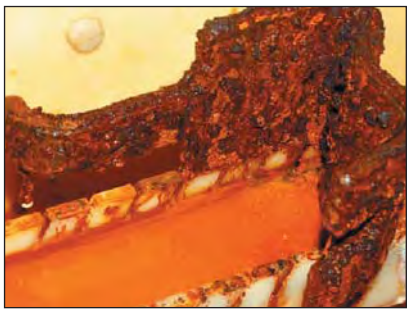
Many of the rail components are hot dip galvanized to ensure longevity in highly corrosive areas.

Remembering that rail fastenings are treated as safety critical components in the rail industry, it is imperative that there are no failures. Both rail clips and shoulders are hot dip galvanized, but the rail clips are at higher risk of

As received mild steel shoulder.

As received hot dip galvanized mild steel shoulder.

As received 3CR12 shoulder.



Mild steel shoulder after 1 000 hours of testing.

Hot dip galvanized mild steel shoulder after 1 000 hours of testing.

3CR12 shoulder after 1 000 hours of testing.

failing due to potential hydrogen embrittlement than the shoulder, because of the EN45 steel used and the continuous loading they are designed to endure in the rail fastening assembly.

Pandrol and the Hot Dip Galvanizers Association of Southern Africa, carried out extensive trials in the 90's to come up with a hot dip galvanizing process that would ensure no hydrogen embrittlement failure of components. Initially the clips were prone to hydrogen embrittlement failure, but this was resolved through a derived procedure, which is now a standard Works Instruction issued to the preferred galvanizer (see works instruction on previous page). After this Works Instruction was issued and implemented, all hydrogen embrittlement failures were eliminated.

As mentioned, Pandrol makes shoulders for the concrete sleepers used in railway lines. It was requested by one of Pandrol's customers to supply shoulders with superior life to that of hot dip galvanizing and a decision was made to manufacture shoulders from 3CR12 material.

Thousands of 3CR12 shoulders were manufactured by Pandrol and installed in high corrosive areas. The 3CR12 shoulders were very successful, however price was an issue.

Pandrol, with the Hot Dip Galvanizers Association, once again carried out trials on hot dip galvanized mild steel shoulders, with slightly different specifications to the previous hot dip galvanized shoulders, to ascertain

whether these could replace the 3CR12 shoulders. The trials proved very successful in favour of hot dip galvanizing and the coating has subsequently been accepted by Pandrol in place of 3CR12. (*see sequence of photos*).

As one can ascertain from the photos, Pandrol has had much success with hot dip galvanizing of rail fastening components. Pandrol continues to supply these components as hot dip galvanized, worldwide.

All in all it has been a real success story for Pandrol but it is important that the galvanizer be issued and must not deviate from the Pandrol Works Instruction.

IAN VICTOR,
Pandrol South Africa

Mild steel shoulder after cleaning.

Hot dip galvanized mild steel shoulder after cleaning.

3CR12 steel shoulder after cleaning.

Introducing SANS 1431 grade 350WA structural steel

In order to conform to the International trend, local steel producers will be producing a grade 350WA that will provide improved mechanical properties to the grade 300WA product presently available.

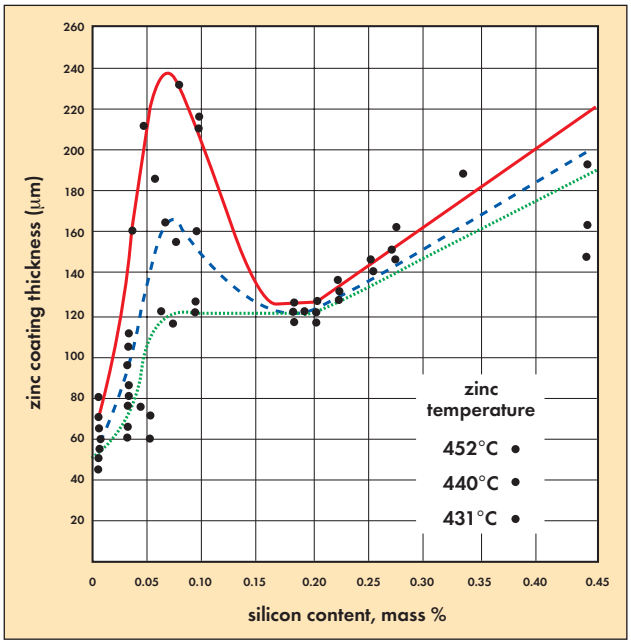
This will result in an increase in demand for structural steel in some applications where concrete structures are presently preferred. It could also result in the use of thinner sections with similar structural properties to those of thicker grade 300WA material.

From the corrosion aspect, there will be no difference between these two grades, thus similar corrosion control measures for grade 350WA steel will be required as recommended for the grade 300WA material.

If hot dip galvanizing is selected as the preferred method of protection, the galvanizing process will have no detrimental influence on the mechanical properties of grade 350WA steel.

In the case of silicon killed hot rolled profiled steel, the producers have given the assurance that the silicon content will invariably range between 0.20% and 0.30% while on rare occasions it may reach 0.33 or 0.34%. This will ensure that in the vast majority of cases the metallurgical reactivity level of this steel in the presence of molten zinc will fall into the less reactive silicon range as depicted by the well-known Sandelin curve.

For architectural applications where hot dip galvanizing has been selected as the final coating for aesthetical reasons, specifying of the silicon range of between 0.2% to 0.25% is essential for success. Unfortunately this might not be feasible where small quantities of steel are involved but in the case of large contracts, the steel producer should be advised at the procurement stage that this silicon range is necessary in all hot rolled steel sections.



Bath temperature effect on the Traditional Sandelin Curve.

The silicon range between 0.20% and 0.30% will enable galvanizers to provide durable thick coatings without excessively thick and brittle iron / zinc alloy layers associated with silicon levels outside this range.

There are precautions that a galvanizer can take to minimise excessive zinc / iron alloy layer growth provided the chemical composition certificate of the steel is included with the order to galvanize.

GRADE 300WA versus GRADE 350WA

	Chemical Composition (Ladle Analysis)													Mechanical Properties		
	1	2	3	4	5	6	7	8	9	10	11	12	13	Yield Strength	Tensile Strength	Minimum Elongation
GRADE	C	Mn	Si	P	S	Nb	V	Nb+ V *	Al+	Cu+	Ni+	Cr+	Mo+	Minimum MPa	Range MPa	%
	Maximum Content %															
300WA	0.22	1.60	0.50	0.050	0.050	0.03	0.10	0.05	0.10	0.35	-	-	-	300	450/620	20
350WA	0.22	1.60	0.50	0.050	0.050	0.10	0.10	0.10	0.10	0.35	0.30	0.30	0.10	350	480/650	18

Notes:

\+ *Addition of these elements is optional.*

* *It is permissible that the steel be supplied with no Niobium or Vanadium.*

If grain refining elements are used, it must be recorded on the test certificate.

If Nb or V is used separately, the maximum % of either shall conform to the limits given in columns 6 & 7.

If used in combination, the maximum % shall conform to the limits given in column 8.

Hot dip galvanized coating repair materials – A comparison in terms of the specification requirements

When certain steels, due to their reactivity are dipped into molten zinc, a thicker coating than that required by the specification may result. This coating although providing greater corrosion protection is often more prone to brittleness and can, in spite of the abrasion resisting properties offered by the coating, become damaged during transport and handling. In addition site alterations are often required and the damaged or cut hot dip galvanized coating should be repaired.

SANS 121 (SABS ISO 1461) makes allowances for coating repair, with the following provisos:

- The individual repair area shall be no greater than 10cm^2.
- Total repair area shall be no greater than 0.5% of the surface area of the component.
- The customer shall be informed by the galvanizer as to the method of repair.
- Repair may be done by zinc metal spraying, zinc rich paint or epoxy or a zinc alloy stick, providing:
- The repair material has sacrificial protection properties.
- The repair coating shall be applied at least 30µm greater than the local coating thickness prescribed in the specification, which for structural steel (thickness of steel equal or greater than 6mm) will be at least 70µm. This means that the repair coating shall be at least 100µm thick for this thickness of steel.

The Association has compiled a matrix of different coating repair materials for comparison purposes.

	CARBOLINE – STONCOR		JOTUN		SIGMA		PLASCON		ZINCFIX
	676	658	Barrier	Zinc Rich Cold Galvanizing	Proferral PR	Sigmarite HS Zinc	Polygalv Primer	Interzinc 52	Squish Pack
Type	Modified single pack zinc-rich phenoxy	Zinc-filled, epoxy polyamide primer	2 Component zinc rich epoxy primer	Single pack polyurethane zinc dust primer	1 Component zinc rich epoxy primer	2 Component high solids polyamide adduct cured zinc epoxy primer	Organic zinc rich primer	Zinc filled epoxy polyamide primer	Solvent free epoxy based metallic coating
Colour	Grey	Grey & red	Grey	Light grey	Grey – flat	Reddish grey – flat	Metallic grey	Metallic grey/red	Matt grey
Single application DFT	50 to 75µm	75µm	40 to 90µm	30 to 50µm	35µm	75µm	25 to 50µm	50 to 75µm	150 to 200µm
Can be overcoated	Yes – certain paint types	Yes – certain paint types	Yes	Yes	Yes with unsaponi-fiable coatings	Yes	Yes	Yes	Yes
Overcoat interval time (Min)	4 hrs at 25°C	6 hrs at 25°C	1½ hrs at 23°C	3 hrs at 23°C	2 hrs at 20°C	8 hrs	4 hrs at 23°C	3 hrs at 25°C	2 hrs at 20°C #1
Overcoat interval time (Max)	<30 days	3 days	NA	NA	Several months	Several months	NA	Extended	NA
Single pack	Yes	NA	NA	Yes	Yes	No	Yes	NA	NA
Twin pack	NA	Yes	Yes	NA	NA	Yes	NA	Yes	Yes
Surface preparation	Remove contaminants, roughen with light blast or mechanical grind	Remove contaminants, roughen with light blast or mechanical grind	Remove contaminants, roughen with light blast or mechanical grind	Contaminants removed with detergents and fresh water	Remove contaminants, roughen with light blast or mechanical grind	Remove contaminants and apply primer	Remove contaminants. Light blast or abrade with abrasive paper	Remove contaminants. Light blast/ mechanical grind	Remove contaminants. Abrade with abrasive paper
Mix ratio	NA	1 to 4	3 to 1	NA	NA	80:20 by vol.	NA	4 parts base to 1 part hardener by vol.	Premixed in squish pack
Zinc content	86%	60%	53%	58%	90%	81%	90 – 93%	81%	>80%
Volume solids	37%	53%	80%	70%	38%	66%	36%	59%	100%
Pot life	NA	6 hrs at 25°C	24 hrs	NA	NA	8 hrs at 20°C	NA	2 hrs at 25°C	25 min at 25°C
Min. pack size	1 litre pack	5 litre pack	4 litre pack	1 litre pack	1 litre pack	5 litre pack	1 litre pack	5 litre pack	100gm squish pack
Spread rate at recommended DFT	5.7m^2/l at 65µm DFT	7.1m^2/l at 75µm	13.3m^2/l at 40µm DFT	11.86m^2/l at 50µm DFT	10.9m^2/l at 35µm DFT	8.8m^2/l at 75µm DFT	10m^2/l at 35µm DFT	5.5m^2/l at 75µm DFT	6.7m^2/l & 0.22m^2/ 100gm at 150µm DFT
Application method	Airless and air spray & brush	Airless and air spray & brush	Airless, brush to touch up	Airless, brush to touch up	Airless, air spray & brush/roller	Airless, air spray & brush/roller	Brush	Airless and air spray brush	Brush or spatula

#1: Can be overcoated after touch dry at about 2 hours, the product will continue to cure under the topcoat.

Defects on thread profiles can affect coating quality

Most threads on fasteners are formed by way of a rolling process as opposed to cutting. If the rolling tools become worn and are not refurbished, small loosely adhering steel particles or laps are formed on surfaces within the thread profile. When immersed in molten zinc, these small defects tend to lift partially, trapping excess zinc, which is difficult to remove by conventional centrifuging methods required to ensure a uniform clearly defined thread profile after hot dip galvanizing.

Frequently, the cause of this particular problem is attributed to poor galvanizing practice, which is incorrect. If the affected zinc coating is removed with acid, these small partially adhering steel surface defects can be clearly seen with the naked eye.

Providing rolling tools are maintained to the correct standard this phenomena will not occur. In the case of cut as opposed to rolled thread profiles this problem is not encountered.

When rolling tools become worn and are not refurbished, small loosely adhering steel particles or laps are formed and after hot dip galvanizing are highlighted

Appropriate corrosion protection

When accessibility to structures such as mining station steelwork and long overland conveyor structures is difficult and future maintenance extremely time consuming and expensive, the correct selection of an appropriate material or coated fastener is of paramount importance.

Guest Writer

Bob Andrew, our guest writer, is a consulting value engineer and Honorary Life Member of this Association.

The indigenous knowledge of bushmen has relevance to modern business management and leadership

South Africa, like many other countries in Africa, is documenting and exploiting its indigenous knowledge. Plants with medicinal value and the various practices of alternative medicine, which are now gaining recognition in circles outside those of traditional African cultures, are based on very old applications of indigenous knowledge.

The original font of South Africa's indigenous knowledge was that of the Bushmen, who were hunter-gatherers and enjoyed the great open spaces of southern Africa. Being able to wander as they wished they developed a harmonious and symbiotic relationship with their environment. Very little of the original Bushmen lifestyle is around anymore but there is an ever increasing appreciation of the way Bushmen lived, behaved and organised their lives. While it all may seem very distant and strange to us, the behavioural knowledge of the Bushmen, where cooperation abounded and competition and greed were unknown, has some strong messages for us, especially in the fields of business management and leadership.

On all levels, ours is a hostile world: there is hostility between countries, cultures, ethnic groups, companies and corporations and even between individuals. Bushmen on the other hand could not afford to fight with each other because their only weapon was a poisoned arrow, for which there was no antidote but caused inevitable death within 8 hours. If one Bushman wanted to kill another, he would know with certainty that the other Bushman would retaliate and he too would die. Because of this, Bushmen were not keen to fight. Their only dispute resolution mechanism was to remove the cause of the disagreement to everyone's satisfaction. They avoided making others jealous and for this reason were careful not to have too many possessions. Instead, they tended to share their possessions to avoid envy thereby eliminating hostility. From this aspect of Bushmen behaviour we can learn that partnerships between businesses or organisations can have a lot to offer, even in these times where competition is seen as the only catalyst for advancement. But, for partnerships to be effective there has to be a strengthening environment of cooperation and a weakening environment of competition. A clear understanding is also required of what all the ramifications are when competition-rich business models are used. The Bushmen were very clear on this.

The cooperative culture of the Bushmen, which was the basis for their survival, was based on social learning through conversation, storytelling and observation. They were the optimum 'knowledge workers', always seeking answers and continually learning by acting. Unlike many modern businesses, they were not afraid to ask anyone for help and they knew exactly who to ask for help. Importantly, they also knew who needed help and would freely and willingly provide help where required.

Among certain groups of Bushmen, everything around them had a male and a female side, with specific gender characteristics, like power and strength for the male side or tenderness and nurturing for the female part. There was no demarcation of the genders, however, but, in a holistic way, every characteristic had its place and the individual advantages of the genders were strongly recognised. Isn't it strange how long it has taken us to appreciate the strength of gender diversity in business?

Using the analogy of a new moth emerging from a cocoon, Bushmen believed that everyone is susceptible to damage at times when there is change, like marriage or death of a loved one. At these times, affected people were protected by a group ritual, which, it is told, suspended them between earth and sky and hid them from the sun. In times of business organisational change, like re-engineering, downsizing and retrenchment, should we not also protect those most affected by change?

The behaviour of Bushmen produced a society where the individual had function and status and where a strong relationship between the individual and group life existed. This behaviour was essentially one with a strong spirit of practice and learning. Bushmen were enthusiastic learners-they wanted to know everything associated with their environment. Learning was a combination of gaining knowledge from their elders and putting this knowledge to work-they were well versed in the art of action learning. For survival, however, this spirit of learning and practice had to result in high performance standards, not only for each individual but for the group as a whole: mistakes were often fatal.

As South Africans, we should be very proud of our Bushmen heritage and the legacies they left behind. These legacies should not only be viewed as the wonderful examples of art dotted around the countryside but also as their cooperative and synergistic behaviour that has much to offer us in this seemingly total different world we live in today.

Walter's Corner

Fighting the common corrosion enemy (Episode 2)

In the last issue, we considered the success that can be achieved and the benefits for all parties who are involved in a united attack against the costly ravages of corrosion. This is perhaps aptly summed up by the quotation from the Good Book "If a kingdom be divided against itself that kingdom cannot stand".

We were recently approached by a consulting group for advice concerning the corrosion control of bolted lattice type telecommunication towers to be erected in some of the remotest central African regions. The design engineers had ingeniously developed a stable base section for these structures, aimed at eliminating the need for costly concrete foundations.

It was decided that the first line of defence would be to hot dip galvanize all the components including bolts and nuts, since the levels of atmospheric corrosion in these regions can be described as mild to moderate, where from past experience, hot dip galvanizing will in all probability provide a maintenance free corrosion life of some 50 years.

Without knowledge of the corrosivity levels of the various soil types, it was not possible to predict the corrosion resistant life of hot dip galvanizing on buried tower sections, while to establish this over substantial distances in these remote areas is simply not practical.

The recommended solution in an application such as this is to provide duplex protection for all buried sections, which in the long term will no doubt be the safest and least costly route to take. When considering the most suitable paint system to apply onto these hot dip galvanized surfaces, various options were considered. For practical reasons and effective results it was agreed that painting would take place in factory conditions prior to despatch. Coal tar epoxy has proved to be very effective when applied to buried hot dip galvanized steel but in this case it was not recommended since it is not recoatable after a few days. Thus effective touch up of areas where handling damage of the paint film had occurred, during transit to sites, would not be feasible.

After consulting our technical colleagues in the paint industry a suitable alternative epoxy system was agreed upon.

Readers comment

Response to** Corrosion: The common enemy **in Walter's Corner, Volume 2 Issue 1, 2005

Dear Walter

As always, I read your above article with considerable interest. After taking in the last two paragraphs, however, I could not help feeling that, as positive as your conclusions may have been, that the reality concerning Duplex Coatings in our country, in many cases seemed to indicate that the political divide between the paint and hot dip galvanizing fraternity is alive and well.

As a layman, I have learnt to respect the fact that corrosion prevention and barrier protection by way of a protective coating system is a highly complex subject, which requires the application of specialised knowledge, research and commitment of both the manufacturers of chemicals, paints, powders and applicators (including hot dip galvanizers).

The role and responsibility of the knowledgeable specifying body or specifier is paramount in order to achieve a correctly designed and reliable barrier protection coating system, which will protect the product for its design life in each specific corrosion environment. In addition, the specifier should be responsible for approving and appointing the Duplex applicator, secure in the knowledge that such party fully understands the importance of following each step of the coating process to the letter (including the chemical pre-treatment or sweep blasting).

The very fact that Duplex systems have failed in harsh South African coastal environments with costly repercussions, in my opinion, indicates clearly that a great deal more work has to be done before Duplex Systems find their rightful place in the southern African environment. This means that paint and galvanizing bodies will have to set aside their primary objectives to promote their own coatings in opposition to each other and embrace the Duplex concept with the enthusiasm of the late paint chemist, Jan van Eijnsbergen.

Until then, I am afraid that I will definitely not promote the undeniable potential benefits of Duplex Systems to unsuspecting customers. I shall rather advise them of the very real risks and liabilities associated with coating on hot dip galvanizing and instead promote guaranteed paint systems, hot dip galvanizing and correct material selection.

Pieter Uys

When a paint supplier was approached by the manufacturer, the salesman expressed the view that galvanizing was not the solution and that entirely ungalvanized towers should merely be painted. This comment was met with a degree of mirth and amusement but one has to admire his enthusiasm! I have no doubt that salesmen in the hot dip galvanizing industry have adopted the same stance in reverse so "let him that is without sin cast the first stone".

There are several lessons that can be learnt from this particular example. Corrosion science is a somewhat complex yet fascinating subject. It can be caused by several different natural mechanisms. To illustrate, the various forms of corrosion include uniform corrosion, galvanic corrosion i.e. dissimilar metals in contact, under-deposit corrosion, differential aeration, stress corrosion cracking, hydrogen embrittlement and microbially influenced corrosion, to name but a few.

In many applications a single material or protective paint coating will not necessarily be the most cost effective solution. Wild claims by enthusiastic marketers should be viewed with a jaundiced eye unless they can be substantiated by technical facts and ideally, practical case histories.

The success of the Hot Dip Galvanizers Association over many years has been enhanced by our committed policy never to recommend hot dip galvanizing on its own where, based on technical considerations, it is not the ideal solution. Meanwhile, we believe that we have the necessary expertise to recommend a cost effective solution in most applications.

Editor's reply to Pieter Uys's letter

Your comment re the contents of "Walter's Corner" are noted with appreciation.

With respect we understand the predicament that you and so many other similar persons face with the success of "Duplex Coatings" however, although the Association has a Code of Practice for both substrate preparation and evaluation of the applied coating over hot dip galvanizing, we will endeavour to update this valuable standard with the assistance of players in the paint industry.

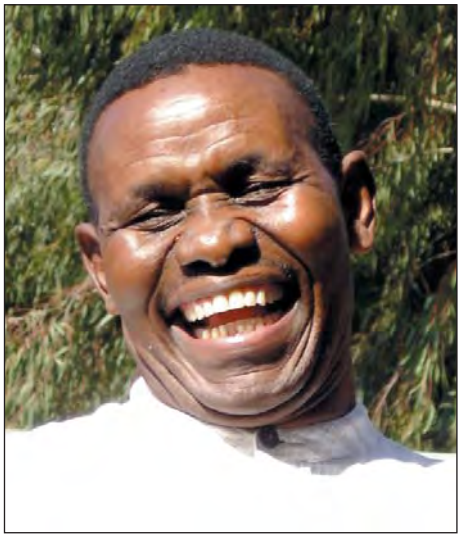
In striving for a cost effective solution of applying single coat technology while maintaining a high build coating, that is both chemical and UV resistant, for duplex coatings in aggressive environments, we are currently testing a number of sample systems. Results of these tests will be published in a subsequent magazine.

Co-incidentally one of the Association's latest Affiliate members is a paint contractor who has been involved in successful duplex applications for more than a decade. This has been achieved amongst other things by appropriate substrate preparation and correct choice and coating thickness of the paint system in view of the environment at hand.

Personality Profiles

Tom Motlhake and John Ngwenya

Two veterans of the hot dip galvanizing industry were recently presented with long-service awards prior to their early retirement, at a relaxed ceremony with cool drinks, beer and boerewors rolls at Barloworld Galvanizers in Germiston.



Tom Motlhake.

John Ngwenya.

Tom Motlhake began his career in the industry in 1967, when his brother-in-law Philemon Mashala found him a job at Rietfontein General Galvanizers. Philemon was working as a storeman and Tom started on one of the small galvanizing lines with the insulator bath. From there he moved on to the holloware bath and after gaining enough experience he applied to a Mr. Cooper for a promotion. Tom waited a week before Mr. Cooper said he had a position for him as an inspector for the SABS. However, Pat Murray who was the foreman at the time, intervened and said he would rather that Tom handled dispatch, and so Tom ended up filling both positions and gaining more valuable experience. By 1971 he was the warehouse dispatch manager.

By the mid-1980's the industry was being troubled by union agitation and strikes and Tom found himself the target of dissatisfied workers. Entering his office one day he found a letter lying on his desk, telling him to resign. The workers had decided he must be a management spy, as he carried a "walkie talkie" with him on his rounds – this of course was necessary for his job, keeping track of stock and communicating with staff from one end of the factory to the other! Tom took the letter to Walter Barnett, who was MD at the time and Bill Garvie (GM), who suggested he report the matter to the police. He took the letter to the Bedfordview police station and as he recognised the handwriting he was able to give the police a name. Despite feeling threatened at his home, Tom refused to be intimidated and continued working, although Walter moved him into the main offices to work as customer liaison officer where he remained until Rietfontein closed in 1987.

January 1988 saw Tom at Monoweld, where he worked for a while on the manual weighbridge. He was soon moved to internal sales where he stayed until 1990, when he asked to be moved back to the plant, as in his opinion sales was a "ladies job". After 3 years he was again in charge of the warehouse, as superintendent, and it was here that he initiated many changes including installing bin locations, changing the weighbridge system and cleaning up the jumble of mess that he found all around.

We asked Tom how he would compare the local galvanizing industry with that of overseas. His opinion, after his visit to the UK, was that South Africa definitely has a more active and user-friendly industry. "We told the people there how we work", he said, "and they were surprised. Overseas they don't have a "black-deck" and warehouse like here – they phone the customers to bring their material and they must take it again when it's hot dip galvanized".

On the subject of his best experience, Tom is definite. "That was when I was sent to Oxford University by the company on a galvanizing course presented by the UK Galvanizers Association – that was the best experience of my life. I also enjoyed all the getaways we as a company went on. We strategized at these getaways and when we came back to work we implemented the changes".

One of his funniest experiences was at a getaway at Mabula Lodge. "We were on a Landrover, looking at lions some 500m away. We were told to keep sitting and keep quiet in case they attacked us, but they were all fast asleep".

When asked to name the most influential person in his career, Tom said it had been Walter Barnett. When a job opportunity came up to work for more money at Sousa

Brothers, Walter refused to let Tom resign. He pointed out that Tom would be working with people he didn't know and then he offered Tom a R1 an hour increase and a promotion to Customer Liaison Officer and so Tom stayed and the rest is history.

Tom's home life includes a family of 7 children by his wife and a daughter with his girlfriend. Although he is taking early retirement he has plans to start his own business after a well-earned rest. He feels he will be doing his bit in creating jobs for others in doing so.

His thoughts on the future of hot dip galvanizing in South Africa are positive. There will always be a need for galvanizing and it has proved its durability. Tom Motlhake believes that the industry must be prepared to give the youngsters a chance, as any business needs "fresh people with fresh ideas".

John Ngwenya has completed 31 years in the galvanizing industry. He started in April 1974 as a corrosion protection painter at what was known as Hume Corrosion Protection in Kazerne. By 1976 the company was galvanizing products, changed its name to Monoweld Galvanizers and had moved to Germiston. It was at this point that John started driving a tractor, shunting trailers in the yard.

In 1977 he moved on to driving the company trucks. The transport manager at that time was Schozari and Ken Shamley was MD of the company.

By 1992, a general strike of all steel company workers hit Monoweld, and Lieb Prinsloo was employed to drive the trucks. Although John was the more experienced man, he remained as Transport Supervisor while Lieb Prinsloo became Transport Manager. When Lieb left the company, he spoke to Geoff Colloty who was now MD, asking him to keep his job for John, and so John was promoted to Transport Manager in 1996.

Of good and bad experiences, John had this to say: "Bad experiences were in the old apartheid times, when we were "taught" by force. But my good experiences were learning good business sense, such as the fact that driving fast uses up a lot of fuel!".

John believes that Geoff Colloty has been the most influential person in his career. "Geoff always came to ask me things in a nice manner and then asked me to explain why I gave a particular answer. We never fought".

John has a large family which includes 2 wives, 2 girlfriends and 5 children. In Swazi culture, he says, a man is allowed up to 16 wives! Like Tom, he also plans to start his own business, in the line he knows best – transport.

Case History
No. 03/2005

Mitchelsplein Train Station / Transport Interchange

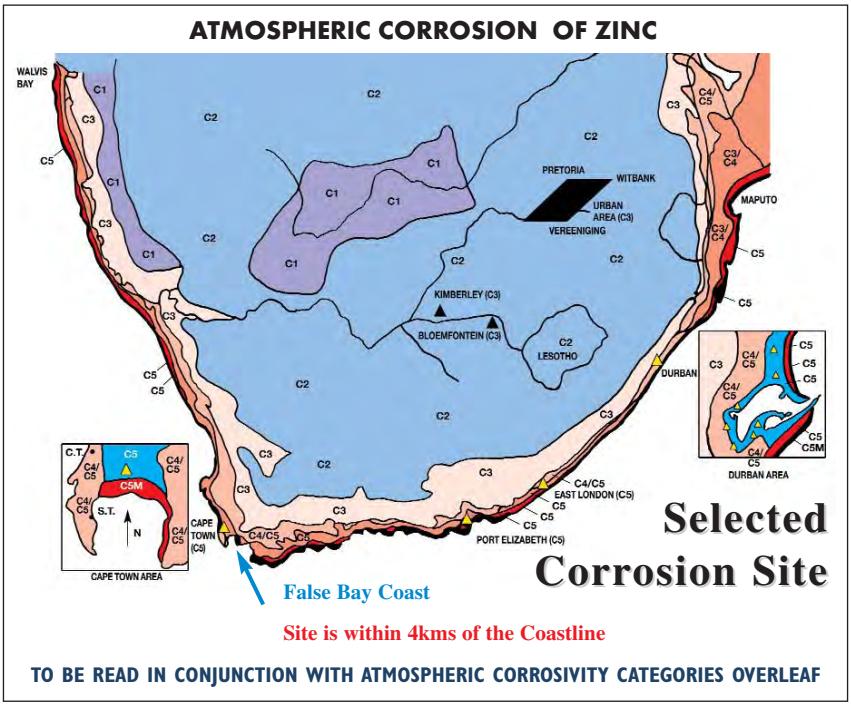
The application

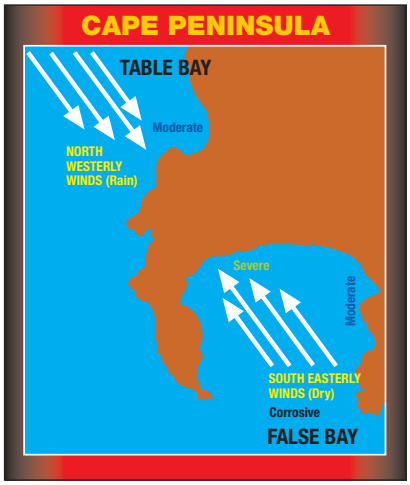
Many parts of the Cape flats are considered aggressive to hot dip galvanizing on its own. In this evaluation and case history hot dip galvanized coatings have preformed remarkably well and has lead to further specifying of the coating to protect the structural steelwork at the new Mitchelsplein Transport Interchange in Cape Town.

This case history includes an evaluation of hot dip galvanized coatings on two existing light poles and a fence support, which were installed at the time the station was built in 1979 (about 26 years old). The one light pole was installed in 1992 (13 years old). The inspection and evaluation took place at the railway station adjacent to the 1st phase Taxi Rank, which is part of the subsequent phases of the transport interchange.

The Environmental Conditions

The environmental conditions of the Mitchelsplein Train Station is off the False Bay coastline, approximately 4km from the sea. The area is subjected to the prevailing winds being the south easterly. Steel structures exposed to these conditions are therefore subjected to high levels of coastal saline atmospheres.





The coastline of False Bay is considered to be extremely corrosive, due to the South Easter (bringing chloride laden air into the low lying land form), high wave action and lack of rainfall from the south east. Conversely, the coastline off Table Bay is mildly corrosive due mostly to the wash-off effect of the rain.

General view of the light pole that has been exposed to the elements for 26 years.

Close-up of the coating on the marine side showing the scraped surface.

Coating thickness (95µm) on the scraped surface.

Residual coating thickness (133µm) on the light pole installed in 1992.

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Our Findings

On the three areas registered for evaluation, the coating is in remarkably good condition despite the misleading surface contamination.

The residual coating thickness on the light pole (95µm) and on the diagonal fence support (98µm) is still in excess of the coating thickness required by the specification (SANS 121) after 26 years of exposure. The specification requires an individual coating thickness of 55µm with a mean of 70µm for steel equal to and greater than 3mm but not greater than 6mm thick.

Conclusion

After approximately 26 years of service, the hot dip galvanized coatings on these light poles and fence supports installed at Mitchelsplein Train Station, will continue to provide adequate and effective corrosion protection for at least another 25 years.

There is little doubt that hot dip galvanizing can and does provide cost effective solutions to the often vexed question of corrosion protection in questionable areas adjacent to the coast.

Due to the performance of the hot dip galvanized coating in this instance it was decided that the coating on its own be specified for the protection of all the steelwork in all the phases of the Transport Interchange currently being erected adjacent to this site. See a photo of a general view of the transport interchange below.

1	2	3	4	5	6	7
				MAINTENANCE FREE LIFE OF THE COATING		
Corrosion category	Description of environment	Corrosion rate (av. loss of steel in µm/yr.)	Corrosion rate (ave. loss of zinc in µm/yr.)	Continuously hot dip galvanized sheeting Coating class – Z275 (±20µm)	Hot dip galvanized coating (85µm) Steel thickness ≥ 6mm	DUPLEX COATING SYSTEM Hot dip galvanizing + an appropriate paint system
C1	Interior: dry	≤ 1.3	≤ 0.1	>50	>50 #1	Not required for corrosion protection #2
C2	Interior: occasional condensation Exterior: exposed rural inland	> 1.3 to 25	0.1 to 0.7	>40	>50 #1	Not required for corrosion protection #2
C3	Interior: high humidity, some air pollution Exterior: urban inland or mild coastal	> 25 to 50	0.7 to 2.1	10 to 40	>40	Not required for corrosion protection #2
C4	Interior: swimming pools, chemical plant, etc. Exterior: industrial inland or urban coastal	>50 to 80	21 to 4.2	5 to 10	20 to 40	Coating life in columns 5 & 6, plus the paint life multiplied by a factor of at least 50%
C5-I or C5-M	Exterior: industrial with high humidity or high salinity coastal	>80 to 200	4,2 to 8,4	2 to 5	10 to 20	Coating life in columns 5 & 6, plus the paint life multiplied by a factor of at least 50%

#1 Although mathematically incorrect (coating thickness divided by the corrosion rate), the maintenance free life indicated in column 6 has for practical purposes been curtailed to a maximum of 50 years.

General hot dip galvanizing specifications state the local (minimum) and the mean coating thicknesses. The coating thickness actually achieved, varies with the steel composition and this can range from the minimum to at least 50% greater.

As life expectancy predictions are normally based on the minimum coating thickness, they are usually conservative.

#2 A duplex system may also be specified in order to provide a colour for aesthetic reasons.

Note 1: The specification does not stipulate a maximum upper coating thickness limitation, however, excessively thick coatings on threaded articles are undesirable. In order to ensure effective tensioning, the coating thickness on the bolt should not exceed a maximum of 65µm, this applies particularly to high strength bolts. See note 2.

Note 2: The coating thickness referred to in the Association's booklet, "Steel Protection by Hot Dip Galvanizing and Duplex Systems" in chapter 10 page 33 states this maximum to be 90µm. This is incorrect and should be amended to read 65µm.

Where the service life of the coating is based on the coating thickness on the structure, all hot dip galvanized fasteners should be over coated with an appropriate paint system (duplex coating) in order to derive a similar life to that of the structure.

Note 3: The loss values used for the corrosivity categories are identical to those of ISO 12944 part 2 and SANS 14713 (ISO 14713).

Note 4: In coastal areas in hot humid zones, the coating thickness loss can exceed the limits of category C5-M. Special precautions must therefore be taken when selecting a protective coating system for steel structures in such areas.

Atmospheric corrosivity categories and examples of typical environments taken from ISO 9223.

An end view of one of the bus shelters which forms part of the new Transport Interchange.

General view of the hot dip galvanized fence support installed in 1979 (26 years old).

Residual coating thickness (98µm) on the diagonal fence support.

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Surface Treatment Technologies (Pty) Ltd reaches a milestone by achieving ISO 9001:2000

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STT would like to thank all their customers / partners for their loyal support without whom this milestone could never have been achieved. STT would like to invite readers to give them a call and put their service, quality and excellent prices to the test.

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Retirees from Barloworld

From left to right: Geoff Colloty, current Managing Director of Barloworld Galvanizers and retirees Tom Motlhake – 17 years of service; John Ngwenya – 31 years of service; Philemon Matshaba – 20 years of service; Simon Sathegi – 23 years of service.

Not in the photo: Sam Tshehla – 9 years of service.

MISCONCEPTIONS

Miss Conception puts it "straight"

"Miss Conception" rectifies incorrect impressions concerning hot dip galvanizing.

Hot dip galvanizing provides both barrier and cathodic protection which is why small uncoated steel surfaces are not significant since they will not influence the overall corrosion control life of the coating.

True or False?

Hot dip galvanizing provides control from corrosion essentially by way of barrier protection in the form of a largely impermeable film of zinc and iron / zinc alloys which gradually wastes away over a period of time. For this reason, the initial thickness of the applied coating will determine its overall protective life in a given environment. To illustrate, a hot dip galvanized coating 100µm in thickness can provide up to 80 years maintenance free life in an inland rural environment (corrosion categories C1, C2 and C3) whereas the same coating situated in aggressive conditions such as the spray zone close to the ocean (Corrosion category C5M) is unlikely to survive longer than five to ten years. This is where duplex protection (zinc plus paint) is capable of providing remarkably extended resistance to corrosion attack.

The second line of defence provided by hot dip galvanizing is of course the mechanism of cathodic protection provided by zinc when in contact with steel. Corrosion is an electro-chemical reaction aptly described by the theory of the corrosion cell, which principally constitutes the fundamental teaching for students who are studying corrosion in all its aspects.

It states that for corrosion to occur, there are four requirements namely an anode, a cathode, an electrolyte and a continuous electrical circuit. Eliminate any one of these requirements and corrosion ceases. In the case of a hot dip galvanized coating, the zinc constitutes the anode and steel the cathode. Corrosion theory teaches us that the anode (zinc in this case) is attacked while the cathode (steel in this case) is protected. What this tells us in practice is that at a small uncoated steel surface, the hot dip galvanized coating (zinc anode) will be preferentially sacrificed to protect the uncoated steel (cathode). The most beneficial aspect of this corrosion mechanism is that, unlike most organic paint coatings, corrosion cannot creep underneath a hot dip galvanized protective film as long as the coating remains intact.

What then is the downside of this well documented and proven theory in the case of exposed underlying steel? The answer is simple. As described by way of the corrosion cell, it is the anode that corrodes while the steel is protected at an exposed surface. This naturally means that the surrounding zinc coating is sacrificially corroded at a faster rate than necessary in order to protect the exposed steel.

Clearly, uncoated surfaces are to be discouraged but since we do not live in a perfect world there is no such thing as a perfect coating. Hot dip galvanizing specifications provide for the acceptance of minor defects in the coating the quantity and size of which is limited. Unlike most organic coatings it is not possible for corrosion to creep underneath a hot dip galvanized coating. For this reason, the value of zinc and its ability to protect steel cathodically should not be underestimated.

Editors comment:
Readers that require more information on the subject of acceptance of minor defects in the coating, kindly contact the Association for a copy of "Practical Guidelines for Inspection and Repair of Hot Dip Galvanized Coatings".

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