A RAPID GUIDE to specifications & requirements for galvanised steel structures and roofing for Consulting Engineers & Specifiers covering Rail, Road and Harbour infrastructure

1.0 Background

South Africa has an extensive requirement to construct new rail, road and harbour infrastructure across the entire country. There is also an urgent need to maintain, repair and expand existing rail, road and harbour infrastructure so that Transnet, National Ports Authority and SANRAL can provide functional & operational services to commerce, industry and the general public. All of this must be carried out in a cost effective manner utilising limited capital expenditure budgets. Thus Consulting Engineers want to achieve the longest possible operational life from their atmospherically exposed steel structures, concrete & roofing particularly at infrastructure, buildings and facilities within 5 km of the sea or exposed to corrosive air pollution.

2.0 Hot Dip Galvanising of steel structures

Carbon steel if left exposed to the atmosphere and unpainted will quickly suffer corrosion due to the impact of its environmental exposure. In particular, within 5 kilometres of the high water mark at the coast, prevailing winds can easily move salt carrying sea fog, sea mist and spray onto steel structures and this will result in very rapid destruction of a bare steel structure. Even if the steel is painted with a top of the range organic coating system, the pores and defects in the paint system will eventually allow moisture and sea salt to penetrate the coating and attack the underlying steel. However, if the steel structure is hot dip galvanized and then painted, the **combination duplex coating** is a very effective and long lasting barrier to the environment and prevents premature corrosion. The zinc coating applied during hot dip galvanizing forms a metallurgically bonded layer to the steel and not only acts as a barrier to the atmospheric moisture and environment but also is a sacrificial layer which corrodes linearly with time, dependant on both the thickness of the zinc layer and the rate of zinc corrosion in a specific region of South Africa. The zinc corrosion rate in various South African regions is available for design purposes**. We also strongly recommend that rebar for reinforced concrete be hot dip galvanized to extend the operational life of the concrete**.

3.0 Continuously Galvanized roof sheeting & cladding

When a railway or harbour buildings are to be newly built or repaired, the use of organic coated continuously galvanized steel sheeting is strongly recommended for roofing and cladding. The material chosen can either be **continuously zinc galvanized sheet** which is further coated, in a factory, with an organic primer and decorative top coat or the material can be **continuously aluminium-zinc (galvalume) galvanised sheet** which i**s** further coated, in a factory, with an organic primer and decorative top coat. Such products supplied by some companies in South Africa offer warrantees of up to 20 years. Please consult the technical data sheets for each type of product and ensure that the supplier of the roof sheeting or cladding provides accurate details of their product offering and the warrantee offered. If the roof or cladding is to be located within 5 km of the coastal high water mark, then it is strongly recommended that continuously galvanized & coated sheet be selected which is suitable for a C5 environment as defined in ISO 9223.
Continuously galvanized sheet products are factory rolled to give the required profiles for roofing applications. Continuously galvanized sheet is produced in compliance with SANS 4998, SANS 3575, EN 10346, ASTM 653M and related specifications.

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Use of continuously galvanized sheeting as building cladding – in this case a galvalume cladding

Using hot dip galvanized rebar in a structure prior to pouring concrete – galvanised rebar extends the life of bridges, waterworks structures and all manner of municipal concrete structures

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4.0 Required coating thickness values from the hot dip galvanized standard SANS 121:2011 (ISO 1461:2009)

TABLE 3. MINIMUM COATING THICKNESS ON ARTICLES THAT ARE NOT CENTRIFUGED – SANS 121:2011 (ISO 1461:2009)				
Profiles	Local coating thickness min. µm*	Local coating mass (minimum)	Mean coating thickness, min. µm*	Mean coating mass (minimum)
Steel > 6mm	70	505	85	610
Steel > 3mm to ≤ 6mm	55	395	70	505
Steel ≥1.5mm to ≤ 3mm	45	325	55	395
Steel < 1.5mm	35	250	45	325
TABLE 4. MINIMUM COATING THICKNESS ON ARTICLES THAT ARE CENTRIFUGED TO SANS 121:2011 (ISO 1461:2009)				
Diameter of the article	Local coating thickness min, um*	Local coating mass (minimum)	Mean coating thickness min, um*	Mean coating mass (minimum)
> 6mm diameter	40	285	50	360
≤ 6mm	20	145	25	180

Preparing to hot dip galvanize a batch of steel tubes in a bath of molten zinc

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5.0 Good design & fabrication with quality welding prior to hot dip galvanizing will lead to quality galvanizing

- Design and fabrication of all fabricated components must take into consideration all aspects of **SANS 14713**

- Weld quality before galvanizing to be done at least in accordance with preparation in **ISO 8501-3 2006**

- **All general hot dip galvanizing to be done according to SANS 121:2011 (ISO 1461:2009)**

- A **certificate of compliance** either via SABS (If the galvanizer is so registered) or in terms of ISO 10474 should be requested from the galvanizer at tender stage. This will ensure that the steel components will be galvanized and subsequently cleaned by the galvanizer to SANS 121: 2011. Coating thickness readings of the various components must be taken and recorded by the galvanizer

- **All bolts (grades 4.8 & 8.8) are to be hot dip galvanized to SANS 121:2011** and as duplex coatings are specified, the bolts after installation are to be over coated with the selected coating system following suitable preparation on site

  NB: Zinc electroplated (electrogalvanized) bolts, nuts and flat washers are not acceptable

Spin hot dip galvanizing of small components such as nuts, bolts, hinges & fixtures

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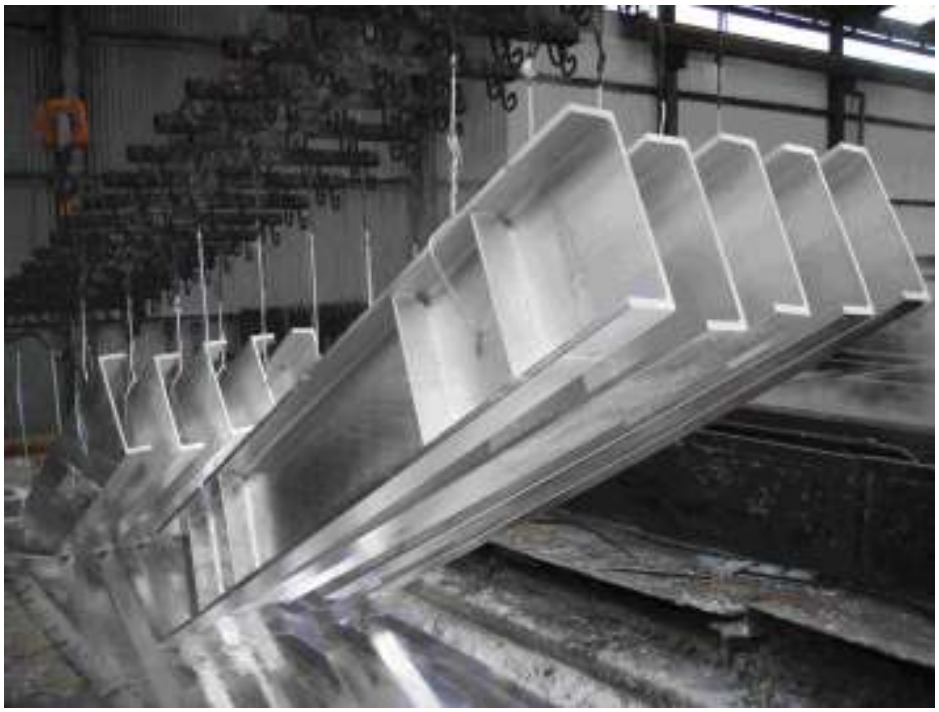
6.0 Zinc coating repair - at the galvanizer or on site during installation

SANS 121 (ISO 1461) allows coating repairs to take place, with the following provisos:

- Maximum single repair area not greater than 10cm² (2 x R5 coins)
- Maximum total repair area not greater than 0,5% of the surface area of a single component
- Dry Film Thickness (DFT) of the repaired coating to be at least 100µm (microns)

- While brush applied single pack zinc rich paints such as “Zincdek 90” from Specoats or “Polygalv” from Plascon are acceptable, they require several coats to achieve the required DFT for duplex coatings

- **SANS 121 requires that the DFT of any coating repair be equal to the surrounding galvanized coating thickness before applying a paint coating.**
  Zinc rich epoxies can often achieve the required DFT in a single application. “Galvpatch” or “Zincfix” were introduced especially for coating repair conveniently packed to limit waste. Both products will cover a quarter of a square metre at a DFT of about 100µm. The initial darker colour is intentional in order to blend in with the formation of the matt grey zinc carbonate patina, which will take two to six months to develop. If the galvanized item is to be duplex coated then the repair coating colour is irrelevant



Web forged steel channel products being hot dip galvanized

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7.0 Duplex coating specification.

The operational life of a properly applied duplex coating is normally greater than the sum of the lives of the two individual coating systems i.e. zinc galvanized + organic paint. In a severely aggressive climate, the duplex system increases the life by a factor of x 1.8 – x 2.0

Effective protection by a duplex system is only possible if long term inter-coat adhesion is obtained by means of a paint coating which will not react chemically with the zinc substrate.

Inadequate preparation and cleaning of the zinc surface, prior to the application of a compatible paint system or powder coating, is the main cause of premature failure.

All galvanizers apply post galvanizing treatments to their zinc coating to prevent the formation of white rust. Additionally, the galvanized part is sometimes quenched in a water bath to accelerate cooling. **These treatments and quenching MUST be avoided if the galvanizer has been contracted to do the post galvanizing painting.**

Alternatively, if a third party paint contractor is used – then written notice of painting MUST be given to the galvanizer prior to hot dip galvanizing.

NB: Water quenching in itself is not harmful to the surface but the quench bath often has small amounts of oil, grease or flux on the surface which could interfere with paint adhesion.

Two conditions of galvanized steel that need little or no surface preparation are:

(i) **newly galvanized part that is less than 24 to 48 hours old** after removal from the zinc bath

(ii) **weathered galvanized steel** that has been exposed to a rural atmosphere for more than one year (excludes marine exposure)

However, galvanized articles that do not meet these criteria or have been exposed to a moderate to aggressive coastal or industrial atmosphere need thorough surface preparation to remove the zinc oxides, chlorides and zinc hydroxide.

Most galvanized steel articles fall into this last category, as few galvanizing facilities have painting capability in their galvanizing plant, the components are often shipped to a paint shop or to the field and painted some days after they have been hot dip galvanized.

IMPORTANT: **It is for this reason that we recommend that a galvanizer who is also a proficient paint applicator be contracted to carry out both the hot dip galvanizing and the application of the organic coating system (paint system)**

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7.1 Substrate preparation.

- Following hot dip galvanizing all components are to be mechanically cleaned of all zinc ash, dross and zinc spikes and all surface imperfections adequately mechanically smoothed and cleaned to ensure that they are not visible following painting

- All surfaces shall then be "Sweep Blasted" using micro-grit such as Garnet with a blast pressure of less than 300 kPa. Sweep blasting shall be carried out at an optimum angle and distance from the substrate so as to limit coating damage and achieve a uniform matt grey sheen

- **Following sweep blasting and prior to painting all surfaces are to be inspected by an independent third party inspector**

- All components shall be placed under cover until the primer is applied which must be applied within 8 hours of surface preparation

7.2 Packaging, transport and minimizing coating damage.

- Completed components are to be individually wrapped in an appropriate amount of packaging to ensure limited coating damage & prevent white rust formation -Vapour phase inhibited paper is very successful

- Care is to be taken when loading or offloading the packaged components to ensure limited coating damage

- Suitable under cover offloading areas including adequate timber dunnage is to be provided at the site for appropriate offloading and site storage

Beautiful integration of hot dip galvanized steel with coloured coatings & tiles

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South African Container Depot (SACD) facility at Cape Town harbour
A high performance aluminium-zinc continuously galvanized roof sheeting used to cover a warehouse very close to the sea. The aluzinc coating on the steel sheet is protected by the factory application of a special primer on top of the aluzinc coating and the further application of a high quality top coat
Photo courtesy of BlueScope Steel

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