CODE OF PRACTICE
FOR SURFACE PREPARATION AND APPLICATION OF ORGANIC COATINGS

HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA

No. HDGASA 01-1990

Code of Practice for Surface Preparation and Application of Organic Coatings

applied to New Unweathered Hot Dip Galvanized Steel (Sheet and Section) excluding In-line Coil Coating (Duplex Systems)

This Code of Practice has been prepared for the use of manufacturers, contractors, engineers and others involved in the design or application of Duplex Systems. It has been compiled from work carried out by a co-ordinating committee drawn from industry. While recognising that each system must be designed and applied to meet particular circumstances, the committee assumes no responsibility or liability of any kind, in connection with this Code of Practice or its use by any person or organisation and makes no representation or warranties of any kind hereby.

Hot Dip Galvanizers Association Southern Africa
Quality House, Unit U4, St Christopher Rd, St Andrews, Bedfordview.
P O Box 2212, Edenvale, 1610.

Tel: (011)-456 7960 Fax: (011)-454 6304

HDGASA 01-1990

Code of Practice

for Surface Preparation and

Application of Organic Coatings

Applied to New Unweathered Hot Dip Galvanized Steel (Sheet and Section) excluding In-line Coil Coating (Duplex Systems).

CONTENTS

COMMITTEE

The following organisations were represented on the committee that prepared this Code of Practice:

Advanced Coatings (Pty) Ltd
Chemrite Coatings (Pty) Ltd
ICI (SA) Ltd
Ivory Industrials (Pty) Ltd
Plascon Paints (Pty) Ltd
Supacryl (Pty) Ltd
Union Carbide (Pty) Ltd

ACKNOWLEDGEMENT

The Hot Dip Galvanizers Association Southern Africa wishes to acknowledge the professional services rendered by Eric Duligal and Associates.

SECRETARIAT

Hot Dip Galvanizers Association Southern Africa

INTRODUCTION

This Code of Practice has been prepared for specifiers, end-users, inspection authorities and painting contractors to make them aware of the procedures necessary to ensure acceptable adhesion of paint to hot dip galvanized surfaces. (**The Duplex System**).

Paints with the same generic name but manufactured by different paint companies do not always have the same characteristics, properties and performance. It is therefore, most important that a complete paint system form one manufacturer be used.

A duplex system (hot dip galvanizing plus a paint system) suitable for the environment to which it will be exposed, correctly applied in accordance with this Code, will give long maintenance free life and an aesthetically pleasing finish.

It is recommended that paint systems that comply with the appropriate requirements of Specification No. HDGASA-1 -1990 be used. A list of tested and approved systems may be obtained from the Hot Dip Galvanizers Association Southern Africa or participating manufacturers.

1. **SCOPE**

   This Code of Practice covers the jobbing application of organic coatings to hot dip galvanized steel sheet, structural sheet and pipes which have been hot dip galvanized but not weathered.

2. **GLOSSARY OF TERMS**

Acceptable	Acceptable to the purchaser but in relation to meeting requirements of the specification of the Hot Dip Galvanizers Association Southern Africa.
Adhesion	The strength of the bond between two interfaces. Frequently used in conjunction with a term denoting which interface eg. substrate adhesion, intercoat adhesion etc.
Cleaner	A material designed to remove contaminants.
Coating	A continuous film bonded to a surface for the purpose of protecting, decorating or identifying.
Coating Material	The material used to form a coating.
Defective	A product that fails to meet the requirements of a specification in one or more respects.
Degreasing	The removal of organic contaminants such as oil, grease, fats and perspiration.

Disbonding	The loss of adhesion between two interfacing surfaces.
Drying Time	The time required, after application, for a thin film of coating in the liquid phase to convert to a coating in the solid phase.
Duplex	Two different coatings used in combination. In this specification the term is used specifically to refer to the combination of hot dip galvanizing with organic coatings
Fish Eyes	Round or elliptical craters in a paint film caused by poor wetting of the substrate or occlusions of incompatible material such as oil spray.
Galvanized (Hot Dip Galvanized)	An iron based substrate such as mild steel or cast iron, which has been protected by dipping into molten zinc. The resultant coating is a mixture of iron/zinc alloys to pure zinc, metallurgically bonded to the substrate.
Induction Period	That time required, after mixing, for the components or multi-component coating to commence chemical reaction.
Lining	A coating applied to the inside surface of a vessel such as a pipe.
Orange Peel Effect	A dimpled finish resembling the surface of orange peel.
Overcoating Time	That time interval between application of one paint coat and application of the next coat.
Passivation	The application of hexavelant chromium or phosphate solutions to prevent white rust on the surface of zinc to which it is applied.
Pot Life	That time between mixing of the components of the coating or lining materials and gelation of the mix which prevents further usage. Alternatively, the pot life as specified by the manufacturer of the material.
Run	An elongated swelling of excess paint that has run down the surface by gravitational force.
Sags	Excessive material that has flowed down by gravitational force.

Silicon	The second most abundant element in the earth's crust. Use as a deoxidiser in the manufacture of steel. It affects the formation of iron/zinc based alloys in the hot dip galvanizing process.
Spangle	A silver grey metallic appearance on the surface of the hot dip galvanized surface showing clear crystalline patterns with a range of size and brightness.
Steel	An alloy of iron, carbon and other elements. For the purpose of this specification, it includes mild steel, cast iron and other iron based alloys that can be hot dip galvanized.
System	A combination of coating materials from one manufacturer that are compatible with each other and with the hot dip galvanized substrate when used in accordance with the manufacturer's instructions.
Time Window	That period of time between the minimum and maximum time intervals specified by the manufacturer of a system for overcoating without special surface preparation requirements.
Water Break Free	The condition of a surface whereby clean potable water spread on the surface forms a continuous film without breaking up into islets of unwetted surface.
White Rust	The white corrosion products of zinc usually zinc hydroxides but may also contain zinc carbonate and hydroxy carbonate.
Wrinkle	A shrivelled appearance due to skin drying of an excessively thick film of paint.
V-Cut	Two straight cuts about 50mm long made by a sharp knife through the coating to the substrate such that the cuts cross each other at an angle of approximately 30°.
X-Cut	A series of straight cuts made with a sharp knife or special tool to form a grid of 25 or 100 squares at 2mm or 1mm side, as specified.

3. COMMON REQUIREMENTS

3.1. A recommendation is obtained for a suitable paint system to be applied to the hot dip galvanized steel which meets the minimum laboratory test requirements of HDGASA Specification No. 1-1990. This specification covers paint systems for exposure to the following environments or equivalent:

* **Mild** (rural) conditions.
* **Industrial** conditions.
* **Marine** (coastal) environments.
* **Mining** applications underground.
* **Immersion** – for the lining and coating of pipe carrying raw potable or recirculated water, gas or oil, but excluding very aggressive chemicals such as acids, bleach solutions, ferric chloride solutions and brine.

NB: Pipes should be joined by flanges or hydraulic couplings. Flanges and collars, where required, should be welded to the pipe before hot dip galvanizing.

3.2. The strength of the paint bond between the hot dip galvanized substrate and primer, shall meet the minimum requirement of the HDGASA Specification No.1-1990. Preparation of the hot dip galvanized substrate is critical for satisfactory initial adhesion.

3.3. The following require strict control:

(a) Preparation of the hot dip galvanized surface including adequate surface cleanliness.
(b) Wet film thickness.
(c) Dry film thickness.
(d) Ensure mixing of multi pack products in the correct ratio.
(e) Spray equipment and air supply must be free from oil and moisture.
(f) The hot dip galvanized surface temperature at least 5ºC above dewpoint.
(g) Relative humidity below 85%.
(h) Ambient temperature above 5ºC.
(I) No dirt deposits between coats.
(j) Packaging to avoid damage during transportation.

3.4. Strict quality control/assurance should be applied at the painting site to control the variables. (Appendix 2). These procedures require profile gauges, equipment for determining residual dust and debris, wet film thickness gauges, electromagnetic or permanent magnet type instruments to determine dry film thickness, hygrometers, surface and conventional thermometers and equipment to determine cross-hatch adhesion and pull-off adhesion.

4. SURFACE PREPARATION FOR DUPLEXING

4.1. Contaminants and Physical Factors

The importance of correct surface preparation and the prevention of subsequent contamination prior to painting cannot be too strongly emphasised.

Nearly all failures in painting of hot dip galvanized steel occur because of inadequate surface preparation or recontamination of the reactive clean zinc surface before painting.

The contaminants to be removed include the following:

(a) Galvanizing residues and passivating products.
(b) Oil and grease.
(c) Perspiration and oil contamination from contact with hands.
(d) Dust and chemical pollution.

In addition, physical requirements for painting which may not be applicable in the process of hot dip galvanizing must also be considered especially in corrosive environments.

These include:

(a) Rounding of sharp edges to a radius of 3mm or 50% of the steel thickness whichever is the lesser.
(b) Removal of weld spatter.
(c) Sealing of crevices which will retain water.

4.2. Preparation of Sheet Steel

4.2.1. Spangle

When thin film coatings are to be applied, the use of “flattened spangle” sheet is recommended for a smooth finish that will prevent thinning of the paint at the edges of the spangles.

4.2.2. Cut Edges

All cut edges should be rounded with a file or abrasive paper or scraped with a sharp tool to remove any burr and to round the edge.

4.2.3. Degreasing

Apply the degreasing agent recommended by the manufacturer of the coating system to be used.
If the manufacturer of the coating system does not supply a degreasing material, then use a water rinsable solvent degreaser complying with the SANS 1344.

Some cleaners for galvanized steel contain abrasives, which are supplied in the form of a paste. These should be used in accordance with the manufacturer's recommendations but it is stressed that vigorous scrubbing action is required to effectively remove all contaminants.

On the other hand, the liquid type solvent degreasers dissolve oil and grease and require less physical effort to obtain a completely degreased surface.

For solvent type degreasers, apply the material generously to the surface with a brush using a scrubbing action to dissolve the surface contaminants. Allow about 10 minutes for solution of oil to take place then wash off with clean potable water.

Contaminated water such as recirculated mine water, is not recommended although it can be used if rinsing is followed by a further thorough wash with potable water.

After degreasing and washing, the surface should be "water break free". If not, remove any surplus water with clean rags or paper towels, or allow to dry naturally then repeat the process until a "water break free" surface is obtained. Allow the surface to dry.

From this stage, operators handling the hot dip galvanized surfaces must wear clean gloves that are free from oil and grease.

4.3. Preparation of Fabricated Structural Steel

4.3.1. Physical Factors

Sharp edges should be rounded to a radius of 3mm, or 50% of the steel thickness, whichever is the lesser.

Note that in the hot dip galvanizing process, zinc tends to become thicker at sharp edges, hence rounding by mechanical means may not be necessary.

Weld spatter shall be removed by chipping or grinding together with any projections resulting from hot dip galvanizing. It must be remembered that paint is a liquid material, hence it tends to draw away from sharp edges by surface tension, thus leaving an under thickness coating on the protrusions.

If quenching after hot dip galvanizing is desirable, this should be done in clean water free from any

passivating chemicals.

4.3.2. **Degreasing**

Degrease surfaces as described in 4.2.3 using a water rinseable solvent detergent type of degreaser. Wash thoroughly to remove all residues then allow to dry.

If the surface is not “water break free”, repeat the operation until this condition is achieved.

Allow to dry, taking particular care to remove water from recesses and crevices.

Handle the fabrications with oil and grease free equipment. Operators shall wear clean gloves.

4.3.3. **Sweep Blast Cleaning**

Tests have shown that abrasion of the surface of hot dip galvanized silicon killed steel is unnecessary, since the alloy growth imparts a sufficiently rough profile.

However, in cases of smooth, bright hot dip galvanized surfaces, it may be necessary to create a profile by mechanical means. In the case of small areas, this can be done by manual or mechanical abrasion with medium-fine abrasive paper using an orbital sander not a high-speed disc sander.

On large surfaces, the process of sweep blast cleaning may be employed. It is similar in principle to normal blast cleaning of mild steel except that different parameters are required. Normal blast cleaning, as used on mild steel, will damage the hot dip galvanized layer and is not recommended.

The parameters for sweep blast cleaning are as follows:

(a) Equipment and air supply free of oil and moisture.
(b) Nozzle pressure – not greater than 300kPa.
(c) Nozzle angle to the surface being cleaned - 30 º - 60 º.
(d) Sweeping distance 450 – 600mm.
(e) Abrasive – ultrafine non-metallic grit – not less than 0,2mm and not greater than 0,8mm.
(f) Grit should not be recycled.
(g) The blasted zinc surface must be free from all contaminants including oil and dust.

Similar results can be achieved with water blast

cleaning using a water pressure not greater than 15MPa, an angle of blast of about 30 º and with injection of ultrafine abrasive as described above.

The advantage of water blast cleaning is that detergent can be injected into the system as well as abrasive so that degreasing and creating of a profile can be carried out simultaneously.

Due to the high energy of the water, the amount of abrasive required is much less than in the case of air blast cleaning. The equipment must be sturdily designed to resist the reaction forces on the nozzle of the lance.

If water blast cleaning is used, the cleaned surface should be dried and painted as soon as possible after cleaning otherwise the reactive clean zinc surface will rapidly deteriorate.

4.4. Preparation of Pipes

4.4.1. Physical Factors

Recommendations given in 4.3.1 apply equally to pipes. In E.R.W. pipes, the interior weld must be scarfed during manufacture to be flush with the pipe wall. Exterior welds should have a smooth profile.

4.4.2. Degreasing

Degreasing of pipes is best carried out by high pressure water blast cleaning equipment with specially designed lances to run the full length of the inside of the pipe.

The equipment should be so designed that detergent can be applied through flexible hoses, which can then be switched to clean potable water.

The nozzle should operate at an angle of 30º to the wall of the pipe. Water pressure should not be greater than **15Mpa** (150 bar).

Firstly apply a suitable degreasing agent or detergent that will rapidly dissolve the grease. Allow 2-5 minutes to react then wash off with a high-pressure water jet at less than **15MPa** (150 bar) using clean potable water.

It is recommended that the pipe should be constantly rotated at a steady speed during the cleaning process in order to ensure that the whole surface is cleaned. If

the pipe is maintained at about 5 º to horizontal, it will assist in good drainage.

Blow clean, warm air through the pipe until all water is removed, then apply the appropriate lining materials.

The outside surface of the pipes should be similarly treated. In this case flanges should be carefully examined for weld spatter, blobs of zinc and similar protuberances, which should be removed as described in 4.3.1.

4.4.3. **Sweep Blast Cleaning**
Refer to Section 4.3.3

4.5. Preparation of nuts, bolts and other fasteners use the method described
in 4.3.2.

5. **APPLICATION OF COATINGS**
Painting should be carried out ***immediately*** after cleaning. All paints shall be applied in strict accordance with the manufacturer's instructions. In the case of nuts, bolts and other fasteners, care must be taken to ensure that all edges are well coated with the adequate thickness of the system being applied.

6. **REPAIRS TO PAINT COATINGS DAMAGED IN TRANSPORTATION**
To repair coatings damaged during transportation, handling or erection, the following procedures should be followed:

6.1. Abrade the damaged area with medium grade abrasive paper (320 grade) for 20mm around the damaged area.

6.2. Remove all dust and debris.

6.3. In the case of two component materials such as epoxies, wipe the surface with methyl ethyl ketone and allow to dry. For acrylic, vinyl or chlorinated rubber paints, omit this step as the strong solvent will dissolve the coating.

6.4. If bare steel is exposed, apply at least two coats of zinc rich primer from the same manufacturer that supplied the system or one coat of "Zincfix". This is to replace the damaged zinc coating.

When dry, apply the same system as originally applied so as to cover the damaged area and for 20mm surrounding it, after preparation of the surface as described in (a) and (b) above.

6.5. If the coating is damaged only down to the zinc surface, then repair with the same system as originally applied after preparation of the surface as described in (a) and (b) above.

7. TREATMENT OF CREVICES

Crevices in overlapped joints such as between mating surfaces of bolted connections and similar narrow gaps, should be sealed with a suitable sealant such as silicon, polyurethane, polysulphide or oleoresinous sealant depending on the degree of movement anticipated.

The relevant South African National Standards (SANS) specifications for these materials are given in Appendix 1.

APPENDIX 1

APPLICABLE STANDARDS

Reference is made to the latest issue of the following standards and methods of test:

SANS 14713 / ISO 14713	Protection against corrosion of iron and steel in structures – Zinc and aluminium coatings – Guidelines.
SANS 110	Sealing compounds for the building industry, two-component, polysulphide based.
SANS 121 / ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods.
SANS 3575 / ISO 3575	Continuous hot dip zinc coated carbon steel sheet of commercial, lock forming and drawing grades.
SANS 1077	Sealing compound for the building and construction industry, two-component, polyurethane based.
SANS 1305	Sealing compound for the building industry, one-component, silicone rubber base.

APPENDIX 2

RECOMMENDED QUALITY CONTROL PROCEDURES

Quality control in duplex coating should be carried out at the following stages:

Before commencing work, to check removal of sharp edges, weld spatter, slivers and similar mechanical interference with the application of organic coatings.

After cleaning, when the surface must be tested to ensure that it is “water-break” free.

During and after each coat of paint to ensure that the paint is uniformly applied to the correct wet film or dry film thickness as appropriate, in accordance with the manufacturer’s recommendations.

Gloss, uniformity and absence of craters, fish eyes, blisters, runs, sags and other visible defects.

Total coating dry film thickness, determined by an electromagnetic gauge calibrated on a similar hot dip galvanized but unpainted surface. Alternatively, the gauge may be calibrated on smooth polished steel plate, and then the thickness of the hot dip galvanizing (without paint) can be measured. The mean of at least 10 hot dip galvanized thickness readings is then deducted from total layer thickness over steel to obtain the average thickness of paint.