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CHAPTER 6

Painting Galvanized Steel

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galvanizers
ASSOCIATION OF AUSTRALIA

Painting Galvanized Steel

Prepared by Don Bartlett of CTI Consultants in collaboration with Galvanizers Association of Australia

The painting of hot dip galvanized steel is an orthodox and well-proven practice in outdoor environments, both in Australia (AS/NZS 4680[1]) and internationally[2]. However, there are examples of early failures of paints over galvanizing due to incorrect specifications and poor practice. This chapter aims to avoid such failures by directing specifiers and applicators to the paint systems, surface preparation and application practices that will provide a durable paint finish over galvanizing in a broad range of service conditions.

While good painting practices and generic products for the various exposure conditions have been nominated, this does not preclude the possibility of other paints and methodologies also performing satisfactorily. However, in selecting alternative products, specifiers are urged to select products only from those with verified records of satisfactory long-term performance in equivalent or more severe service conditions.

This is a general guide only and requires strict compliance with the individual paint manufacturers detailed application instructions for each proprietary product.

Painting objectives

Reasons for painting galvanized steel are primarily:

- Decorative - to create an aesthetic colour and gloss or provide an identifying colour.
- Enhanced durability - to increase service life.
- Wider chemical resistance – in a situation where galvanizing alone may be vulnerable, such as outside the pH the range 6 to 12.

Decorative painting

In outdoor service, remote from the coastal fringe and isolated areas of industrial pollution, hot dip galvanizing is inherently durable. This contrasts with paints and other organic materials, which are degraded by solar radiation. Therefore, in most conditions of atmospheric exposure, little is to be gained from painting galvanizing of a coating thickness 300g/m^2 or more unless aesthetic or colour considerations are important.

In benign internal situations, and particularly conditions of extreme impact or hard wear, unless a change in colour or gloss is considered necessary, galvanizing is usually best left unpainted.

A great deal of galvanizing is painted on a casual basis, with conventional latex or suitably primed solvent-based alkyd paint[3]. Choice of this primer is crucial and requires a clear recommendation from the paint manufacturer. In particular, the use of an alkyd primer in direct contact with the galvanizing risks delamination of the paint due to its saponification.

It is important to note that because these paint systems are quite thin, typically 70 - 120 micrometres for a three coat system, the characteristic spangle profile and localised areas of increased zinc thickness, such as at edges, may be visible in the finish, much in the same way as the grain is visible in painted timber. If this is a problem, then higher build paints can be used, as part of the painting specification.

While acknowledging the lesser absolute demands of conventional (DIY) decorative paints, strict adherence to the appropriate surface preparation and prime coat specification are a key to reliability.

The paint systems detailed under Service Conditions 1 and 2 in the following pages are essentially decorative paint systems.

Painting for enhanced durability

It is perhaps obvious that in circumstances where the galvanized coating is slowly being attacked by a corrosive environment, the application of a suitable coating which insulates the zinc from that environment will prolong the galvanizing's life. Indeed, a synergistic increase in service life of paints over galvanizing has been well documented[5]. Therefore, in severe coastal service and unwashed coastal conditions such as under verandas and in severe industrial service[4], the over painting of galvanizing can significantly extend service life. Even in quite benign outdoor service conditions where galvanizing might last for many decades, it can be prudent to paint areas that are sheltered from the cleansing influence of rain to extend the service life of the structure even further.

In similar vein, while a galvanized structure might be essentially exposed to the atmosphere at some points it may be in ground contact or may be exposed to intermittent or continuous ponding of rainwater. In such situations localised over painting may be needed to avoid premature corrosion in these areas.

The paint systems detailed under Service Requirements 3-5 in the following pages are essentially paint systems intended to provide enhanced durability performance, resistance to wear and trafficking and more aggressive atmospheric service conditions. The paints range from two-pack epoxies and polyurethanes to powder coatings. Most paints have specific restrictions in how they are applied and cured. For example, below about 8°C latex paints will not usually dry and many two-pack coatings have a limited recoating time. Powder coatings, because they are hard cured as soon as they are stoved, can offer logistical benefits. In addition, because they can be applied electrostatically, more uniform coverage can be achieved with intricate shapes than is possible with conventional paints. However, judicious selection of pretreatment and application by competent operators is critical to performance.

It is important to note that for effective protective coatings over galvanizing, the thickness of the paint system must be increased, as the environment becomes more corrosive. An effective corrosion inhibitive primer is usually another prerequisite. Indeed, many failures of paint systems over galvanizing can be traced to either an inappropriate primer or an inadequate total paint thickness[6].

The paint systems detailed under Service Requirements 3-5 also provide options for situations where an aesthetic finish is also needed.

Painting for enhanced chemical resistance

Galvanizing is used within the pH range 6 to 12. Outside this range, its service life is likely to be unacceptable. This includes exposure to strong acids and alkalis and salts of strong acids and weak bases and vice versa. Galvanizing may also catalyse the deterioration of certain organic chemicals that are exposed to it. This phenomenon is rare and causes no damage to the galvanizing.

Just as coatings provide enhanced protection in corrosive atmospheric service, judiciously selected paint systems can also protect galvanizing from aggressive chemicals. Such approaches are usually only taken where the chemical exposure is low or moderate, as the safe principle to adopt in extreme situations is to use a substrate material that is inherently inert. In such situations, stainless steels and plastic composites often find advantage.

In specific chemical exposure, the recommendations of an expert or an established successful case history should always be sought[7].

Surface preparation

When painting galvanizing, as when painting any other surface, the cleanliness and condition of the surface are of critical importance and a high proportion of paint failures on galvanized steel can be attributed to inappropriate or inadequate surface preparation.

In preparing galvanizing for painting, the basic requirements are largely the same as for other surfaces. Namely, anything that prevents the paint wetting out or adhering to the surface needs to be removed. Therefore oils, dirt, dust, salts, corrosion products and other friable material and soluble salts must be removed as a precursor to any subsequent treatment. Refer to AS/NZS 2312[8] Section 4 and AS 1627[9]. The difficulty of removing some contaminants should not be underestimated and for severely corroded galvanizing, in particular, reinstatement may be impractical, because of the extensive preparation required.

For the removal of oil and grease, water based emulsifiers, alkaline cleaners of pH less than 12 or organic solvents are variously appropriate. Where oils and grease are removed by solvent-soaked cloths these need to be changed frequently, as oil contaminated cloths only serve to spread the contamination.

Apart from the removal of dirt, dust and grease, which are common to all substrates, it is important to recognise that all sophisticated coatings intended for extended durability service, require high standards of surface preparation for maximised performance.

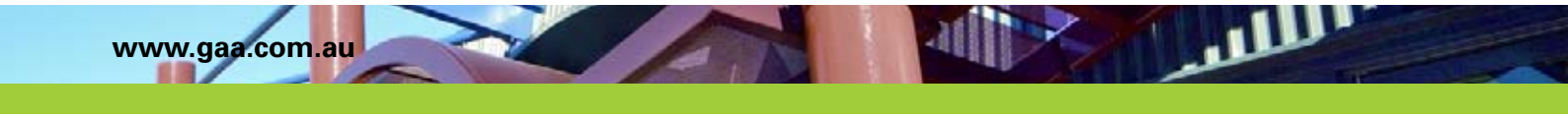
One important issue for galvanized surfaces is the time lapse between galvanizing and painting. The best advice is to paint galvanizing as soon as possible, for the sooner it is painted the less likely it is to be contaminated by dust, salts and corrosion products. Conversely, the longer the time lapse and the more severe the conditions of exposure prior to painting, the more difficult and costly the preparation will be. In extreme cases, such as where surfaces have been close packed in humid or damp conditions and suffered wet storage staining, brushing with 1-2% ammonia, or in extreme cases one part citric or acetic acid to 25 parts water, may be required[10].

A second consideration, which needs to often be addressed with galvanizing, is the smooth, glossy surface that emerges from the galvanizing bath. This can inhibit paint adhesion. In the past, two methods of dealing with this problem were to etch the surface with an aggressive salt solution or mineral acid or allow the zinc to weather for some time before painting. These techniques have long been discredited.

For painting unweathered galvanizing with conventional low build paints (see Service Requirements 1 and 2) cleaning and degreasing is normally adequate, although light scuffing with sandpaper will invariably enhance paint adhesion. For higher build paints and under conditions of more arduous wear, brush (whip) abrasive blasting is favoured (see Service Requirements 3-6)

This process lightly roughens the surface without removing a significant amount of galvanizing and provides a key to promote adhesion of the paint film. This procedure should be carried out using a soft abrasive, by impacting the surface at a glancing angle and operating at low air pressure.
The following criteria are included in both AS/NZS 4680[1] and AS1627.4[9] are recommended[11]:

- Blast pressure 280 kPa (40 psi.)
- Abrasive Grade 0.2- 0.5 mm (clean ilmenite)
- Angle of blasting to surface 45^{o}
- Distance from surface 300-400 mm
- Nozzle type min. 10 mm of venturi type.



Painting systems

The following pages provide guidance on paint systems suitable for use in industrial and commercial situations under six different "service requirements" as follows:

Service Requirement 1	Low corrosivity conditions & medium term service.
Service Requirement 2	Low corrosivity conditions & high resistance to wear & trafficking/long term service.
Service Requirement 3	Medium corrosivity conditions & high resistance to wear & trafficking/long term service.
Service Requirement 4	High corrosivity conditions & high resistance to wear & trafficking/long term service.
Service Requirement 5	Very high corrosivity conditions & high resistance to wear & trafficking/long term service.
Service Requirement 6	Specific industrial chemical or solvent exposure.

Notes

- Medium and long term service are typically of 5-10 years and 10-15 years respectively for a maintenance repainting cycle to retain aesthetic performance.
- The corrosivity condition assessment is based upon the guidelines of AS/NZS 2312[8], which essentially relate corrosivity in terms of distance from the seacoast and need careful interpretation.
- Specific typical commercial products relevant to each specification are listed in Appendix 1, which follows these specifications.
- Application should be strictly in accordance with the paint manufacturer's written instructions and the relevant recommendations of AS/NZS 2311 in the case of Service Requirement 1 and to AS/NZS 2312 in the case of Service Requirements 2 - 6.

Service requirement 1

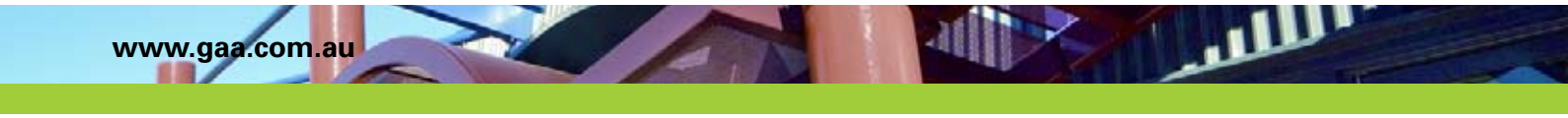
Low Corrosivity Conditions (Refer Note 1) & Medium Term Service (Refer Note 2)

Clean Degrease >	1 coat of Latex Primer (to AS 3730.15 or APAS 00134) >	1 coat of 100% Acrylic Gloss Latex (to AS 3730.10 or APAS 0280/1) >	1 coat of 100% Acrylic Gloss Latex (to AS 3730.10 or APAS 0280/1)
Note 1	AS/NZS 2312 Corrosion Categories A (Very Low) and B (Low). These locations range from more than 50km from a surf beach down to about 1km from quiescent seawater. It also includes Category C (Medium) locations, provided the structure is totally exposed to the cleansing influence of rainwater or is subject to an appropriate regular hosing with fresh water, as unwashed areas in Category C can be quite corrosive.		
Note 2	Typically 5-10 year maintenance repainting cycle to retain aesthetic performance.		
Note 3	For enhanced resistance to wear and trafficking and staining adopt "Service Requirement 3". Lower gloss 100% acrylic latex finishes may be used, as aesthetics demand.		
Note 4	Application should be strictly in accordance with the paint manufacturer's written instructions and consistent with the relevant recommendations of AS/NZS 2311 "Guide to the painting of buildings"		

Service requirement 2

Low Corrosivity Conditions (Refer Note 1) & Long Term Service (Refer Note 2)

Clean Degrease >	1 coat of 2 pack inhibitive epoxy primer – min DFT 50µm see Appendix product (i) >	1 coat of 100% Acrylic Gloss Latex (to AS 3730.10 or APAS 0280/1)
Note 1	AS/NZS 2312 Corrosion Categories A (Very Low) and B (Low). These locations range from more than 50km from a surf beach down to about 1km from quiescent seawater. It also includes Category C (Medium) locations, provided the structure is totally exposed to the cleansing influence of rainwater or is subject to an appropriate, regular hosing with fresh water, as unwashed areas in Category C can be quite corrosive.	
Note 2	Typically 10 -15 year maintenance repainting cycle to retain aesthetic performance	
Note 3	For enhanced resistance to wear and trafficking or staining adopt "Service Requirement 3"	
Note 4	Powder Coatings covered under Service Requirement 3 are also appropriate.	



Service requirement 3

Medium Corrosivity Conditions (Refer Note 1)
High Resistance to Wear & Trafficking/Long Term Service (Refer Note 2 & 3)

Clean Degrease >	Brush Blast >	1 coat of 2 pack inhibitive epoxy primer min. DFT 50µm see Appendix products (i) >	2 coats of 2 pack polyurethane or 2 pack acrylic at min DFT 50µm/coat min system DFT 200µm – see Note 4 & Appendix products (ii) & (iii)
POWDER COATING	**Clean, coat and cure in accordance with the powder coating manufacturers written instructions using the appropriate polyester powder coating to a cured thickness of not less than 70 micrometres (Note 5) Refer Appendix products (iv)**		
Note 1	AS/NZS 2312 Corrosion Category C (Medium). These locations range from more than 1km from a surf beach and down to about 50 metres from quiescent seawater, except in tropical locations where Service Requirement 4 is more appropriate. It also includes Category D (High) locations, provided the structure is totally exposed to the cleansing influence of rainwater or is subject to an appropriate, regular hosing with fresh water, as unwashed areas in Category D can be very highly corrosive.		
Note 2	Wear & Trafficking is defined as surfaces subject to mild abrasion and scuffing, such as occurring in public thoroughfares, kitchens and other work areas.		
Note 3	Typically 10 -15 year maintenance repainting cycle to retain aesthetic performance.		
Note 4	Where decorative finish is not required polyurethane or acrylic may be replaced by high build 2 pack epoxy to equivalent dry film thickness – refer Appendix product (v) or (vi)		
Note 5	For enhanced performance or in the more corrosive areas within the Category C zone a higher minimum total cured film thickness may be prudent.		

Service requirement 4

High Corrosivity Conditions (Refer Note 1)
High Resistance to Wear & Trafficking/Long Term Service (Refer Note 2 & 3)

Decorative Finish			
Clean Degrease >	**Brush Blast >**	**2 coats of high build of 2 pack epoxy min. DFT 250µm per coat see Appendix 1 product (v) >**	**2 coats of 2 pack polyurethane or 2 pack acrylic at min. DFT 50µm min. system DFT 350µm – see Note 4 & Appendix products (ii) & (iii)**

Industrial Finish		
Clean Degrease >	**Brush Blast >**	**3 coats 2 pack high build MIO epoxy – min. system DFT 350µm – see Appendix products (vi)**
Note 1	AS/NZS 2312 Corrosion Category D (High). These include locations more than 200 metres from surf and down to the seashore in quiescent seawater, tropical coastal service and indoor swimming pools.	
Note 2	Wear & Trafficking is defined as surfaces subject to mild abrasion and scuffing, such as occurring in public thoroughfares, kitchens and other work areas.	
Note 3	Typically 10 - 15 year maintenance repainting cycle to retain aesthetic performance.	
Note 4	Where decorative finish is not required polyurethane or acrylic may be replaced by a further coat of high build 2 pack epoxy of equivalent thickness – refer Appendix product (iv)	

Service requirement 5

Very High Corrosivity Conditions (Refer Note 1)
High Resistance to Wear & Trafficking/Long Term Service (Refer Note 2 & 3)

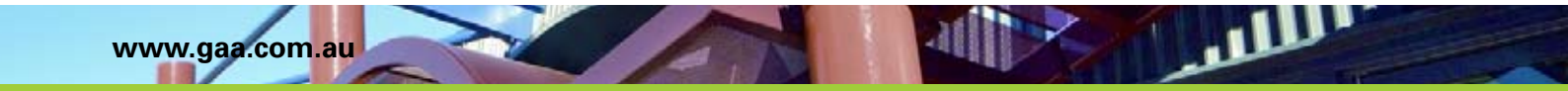
Decorative Finish				
Clean Degrease >	Brush Blast >	1 coat of inhibitive 2 pack epoxy primer – min. DFT 50µm see Appendix 1 product (i) >	1 or more coats of high build 2 pack epoxy min. DFT 200µm/coat see Appendix 1 product (v) >	2 coats of 2 pack polyurethane or acrylic, min. DFT 50µm/coat min system DFT 400µm – see Note 4 & Appendix products (ii) & (iii)

Industrial Finish			
Clean Degrease >	Brush Blast >	1 coat of inhibitive 2 pack epoxy primer – min. DFT 100µm see Appendix 1 product (i) >	3 coats of 2 pack high build MIO epoxy min. DFT 150µm/coat, total DFT 400µm see Appendix products (vi)
Note 1	AS/NZS 2312 Corrosion Categories E (Very High). These locations are offshore and on the beachfront in regions of rough seas and surf. It also applies in a few aggressive industrial areas.		
Note 2	Wear & Trafficking is defined as surfaces subject to mild abrasion and scuffing, such as occurring in public thoroughfares, kitchens and other work areas.		
Note 3	Typically 10 -15 year maintenance repainting cycle to retain aesthetic performance.		
Note 4	Polyurethane finish preferred unless OH &S considerations prohibit isocyanates.		

Service requirement 6

Specific Industrial Chemical or Solvent Exposure (Refer Note 1)

Decorative Finish			
Clean Degrease >	Brush Blast >	1 coat of inhibitive 2 pack epoxy primer – min. DFT 100µm see Appendix 1 product (i) >	Finish coat subject to manufacturer's technical advice – typical min. system DFT 300µm (Note 3)
Note 1	While the requirements for surface cleaning and brush blasting are mandatory, the specific paint system and its total system thickness are dependent upon the type and concentration of the chemical/solvents exposure and the manufacturer's advice.		
Note 2	Typically 10 -15 year maintenance repainting cycle to retain aesthetic performance.		
Note 3	Typically polyurethanes are specified for resistance to acids and organic solvents and epoxies for resistance to alkalis. Where strong acid or alkali contact is envisaged, alternative construction materials should be considered.		



Appendix 1 Typical paints

Products (i) – 2 Pack Inhibitive Epoxy Primer

Product	Paint Supplier	Nominal Dry Film Thickness per coat µm (Note 1)
Penguard Special	Jotun Paints	100
Intergard 251	International Paints	50
Sigma EP Universal Primer	Wattyl	50 - 75

Note: For low/very low corrosivity 50 µm DFT adequate

Products (ii) – 2 Pack Acrylic Polyurethane

Product (Note 2)	Paint Supplier	Nominal Dry Film Thickness per coat µm
Hardtop Ultra	Jotun Paints	50
Imperite 300	Jotun Paints	50
Interthane 990	International Paints	50
Sigmadur 400	Wattyl	50

Note 2: Imperite preferred to Hardtop Ultra where maximised resistance to graffiti is required

Products (iii) – 2 Pack Acrylic

Product	Paint Supplier	Nominal Dry Film Thickness per coat µm
Jotacote 371T	Jotun Paints	50
Interfine 629	International Paints	50
Sigmadur 540	Wattyl	50

Products (iv) – Powder Coating

Product	Paint Supplier	Nominal Dry Film Thickness per coat µm
Corr-Cote Polyester Powder PEF	Jotun Paints	As specified by the manufacturer, but not less than 70 µm
Interpon D610 Excel Polyester Powder	International Paints	As specified by the manufacturer, but not less than 70 µm

Products (v) – 2 Pack High Build Epoxy – Normal

Product	Paint Supplier	Nominal Dry Film Thickness per coat µm
Jotacote 605	Jotun Paints	150
Intergseal 670HS	International Paints	150
Sigmacover DTM 800	Wattyl	150

Products (vi) – 2 Pack High Build Epoxy – Mio Pigmented

Product	Paint Supplier	Nominal Dry Film Thickness per coat µm
Jotacote 910	Jotun Paints	150
Intercure 420	International Paints	150
Sigmacover DTM 800 MIO	Wattyl	150

Sample specification

The following provides guidelines for preparing an appropriate specification for painting galvanizing. Specific projects may need to encompass additional requirements not included in this generalised specification and Section 12 of AS/NZS 2312 provides additional advice.

Note: For powder coating, while the general specification format would be appropriate, the technical requirements, notably surface preparation and application and cure conditions will be considerably different and need to be consistent with the guidelines of the specific powder coating manufacturer.

1. Introduction

1.1 Purpose

This Specification defines the technical requirements for surface preparation and application of protective coatings that have been hot-dip galvanized in accordance with AS/NZ 4680. It does not cover powder coatings, which require specific recommendations regarding surface preparation and coating system selection, application and cure.

(accurately describe location and scope of items to be painted)

1.2 Definitions/Glossary of Terms

For a glossary of paint and painting terms, refer to AS 2310.

2. Reference Documents

The following documents have been referred to in this Specification:

2.1 Standards/Codes

AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.
AS 1627	Metal Finishing - Preparation and Pre-Treatment of Steel Surfaces
AS 1627.4	Part 4: Abrasive Blast Cleaning (Note I)
AS 2310	Glossary of Paint & Painting Terms
AS 3894	Site Testing of Protective Coatings
AS/NZS 2311	Guide to the painting of Buildings (Note II)
AS/NZS 2312	Guide to the Protection of Iron and Steel Against Exterior Atmospheric Corrosion

Note I Not relevant to Service Requirement 1
Note II Not relevant to Service Requirements 2-6

3. Technical Requirements – Coatings

3.1 General

(i) Surface preparation treatments, inspection and testing and health and safety shall comply with statutory requirements and the guidelines of AS/NZS 2311 or AS/NZS 2312 as appropriate.

(ii) All cutting, welding and other physical working of the metal shall be completed before surface preparation and these shall be completed off-site, except for repairs made necessary because of damage during transport, storage and construction.

(iii) All paint forming part of the one paint system shall be from the same paint manufacturer.

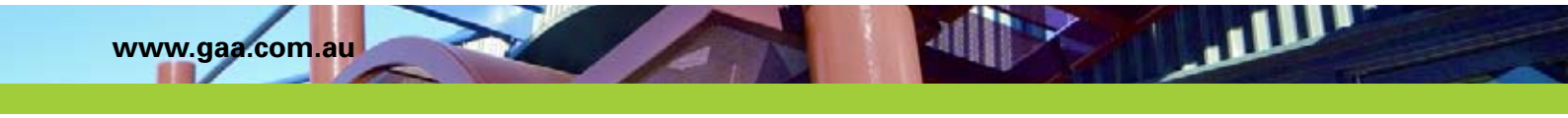
(iv) No paint shall be used after the expiration of its shelf life or its pot life and all paint shall be mixed, thinned as appropriate and applied in strict accordance with the manufacturer's written instructions.

(v) Apply the first (prime) coat to the clean, dry surface as soon as practicable after it has been prepared for coating.

(vi) Coating application shall only proceed when the surface temperature is greater than 15°C and at least 3°C above the dew point of the surrounding air.

(vii) Coating application procedures and the time elapsed between coats shall be consistent with this specification and strictly in accordance with the manufacturer's written recommendations.

(viii) Where repairs to the coated finish are necessary and permitted by the Project Manager, they shall be carried out using the system approved by the manufacturers of the original system, and to a standard which will not compromise the protective performance of the overall coating system.



(ix) The Project Manager reserves the right to check each and every stage of the coating process to determine the cleanliness of surfaces, degree of cure, adhesion, time between application and coating thickness, colour gloss and finish. When tested in accordance with AS 3894.3 each coat and the total coating thickness shall be not less than the specified minimum.

(x) After the completion of all painting works, all equipment and materials used in painting activities and all paint debris shall be removed from the site, which shall be restored to its original condition.

3.2 Surface Preparation

(i) Remove any oil, grease or wax in accordance with the relevant method described in AS 1627 Part 1.

(ii) Remove all dirt, dust, water-soluble salts and other contaminants by appropriate methods consistent with the requirements of AS1627.

(iii) Remove or smooth out all sharp edges, dags, weld spatter and laminations in a manner that such physical imperfections in the galvanized surface shall not thwart the even build up of the subsequent paint system.

(iv) **Service Requirements 3-6 only**
Lightly (brush or whip) blast all galvanized steel using a soft abrasive, such as limestone or aluminium magnesium silicate in a manner that profiles the surface without removing a significant amount of zinc from the surface.

3.3 Painting

(i) The first coat of paint shall be applied to the clean, dry prepared surface as soon as practicable after it has been prepared for coating and at least within 4 hours. Immediately prior to coating, the surface shall be air blasted or dusted off to remove any surface dust.

(ii) The prime coat shall be …….
Refer systems and products detailed in Painting systems.
(Detail at least product name and minimum dry film thickness)

(iii) As soon as practicable after the minimum recoat time for the primer, apply …….
Refer systems and products detailed in Painting systems.
(Detail at least the product name, the minimum dry film thickness for each coat to be applied and the minimum total dry film thickness of the paint system and colour/ gloss of final finish)
The final finish shall be smooth and uniform in colour and gloss consistent with best industry practice for the products specified.

(vi) Damage or other defects in the coating system shall be feathered back to a smooth transition and patch repaired with the same products to not less than the specified, dry film thickness.

Bibliography

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