Surface Information and Preparation Data Sheet (SIPDS)
SIPDS No 4
Steel, Metal and Metal Roofing

Contents

Introduction

Specific preparation and coating requirements for intumescent coating systems, specialised and high performance coating systems, including customised specifications and recommendations for highly corrosive environments and use areas are available in the Resene High Performance Specification system and the Engineered Coatings division of Resene Paints and from Altex / Carboline coatings.

This SIPDS covers the preparation requirements, as well as issues as how they relate to the finishing of exterior and interior steel, galvanised and metal sprayed steel and metal roofing for residential and commercial projects. New construction, the requirements for coating weathered and / or corroded surfaces, and the repainting of existing surfaces are covered in this SIPDS.

It should be read in conjunction with the relevant standard/s listed below and the AS/NZS 2312.1 (current version) "Guide to the protection of iron and steel against exterior atmospheric corrosion by the use of protective coatings" and the specification.

AS/NZS 2312.1	Guide to the Protection of Iron & Steel
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS 3894.10	Inspection Report - Daily
AS 3894.11	Equipment Report
AS 3894.12	Inspection Report - Coating
AS 1580.408.4	Coating adhesion
AS 1627.4	Abrasive blasting
Class 3	White metal blast cleaning
Class 2 ½	Near white metal blast cleaning
Class 2	Medium metal blast cleaning
AS1627.1	Solvent cleaning
AS 1627.2	Power Tool Cleaning
AS/NZS 3894.3	Film thickness measurement
AS/NZS 3984.5	Surface profile measurement
AS/NZS 3984.10	Ambient conditions
Resene	Product Data Sheets / Safety Data Sheets
ISO9223	Corrosivity Categories
ISO 2063: 2005	Thermal spraying – metallic and other inorganic coatings
SSPC Volume 1	Good Painting Practice
SSPC 91-12	Coating & Inspection Manual
NACE	Designing for Corrosion Control
Resene	Putting Your Safety First
OSH	Approved Code of Practice for Safe Use of Isocyanates https://worksafe.govt.nz/topic-and-industry/hazardous-substances/guidance/substances/safe-use-of-isocyanates/
OSH	Guidelines for the Management of Lead-Based Paint. https://worksafe.govt.nz/topic-and-industry/hazardous-substances/guidance/substances/managing-lead-based-paint/
HSW Act	Health and Safety at Work Act 2015
WorkSafe	The Absolutely Essential Health and Safety Toolkit for Small Construction Sites (November 2015).

The advice in any WorkSafe NZ documents and the Health and Safety at Work Act 2015, take precedence in the event of it being at variance with other cited documents.

Relevant information on the substrate is covered in the **Substrate Information Notes** below. Where appropriate, additional information pertinent to the substrate preparation requirements is included with the specification.
The preparation requirements for various metal surfaces are covered in the **Surface Specification (Spec) Sheets**, which are referenced by substrate type.

If the issue encountered or the surface is not covered in this SIPDS; if there is an inconsistency between documents or data sheets; or if you are unsure of the most appropriate and or best preparation methodology or paint system, please contact Resene Technical Services or a Resene Engineered Coatings Representative.

Substrate Information Notes

Note 1: Understanding the AS/NZS 2312.1 Standard

The AS/NZS 2312.1 Standard "Guide to the protection of iron and steel against exterior atmospheric corrosion by the use of protective coatings" is a fundamental document that is very much relevant to the Australasia region, that being New Zealand, Australia and the Pacific Islands.

It needs to be read and used in its entirety, however, that being said, the main function is to offer easy to follow Paint Systems Selection Sheets / Charts, allowing one to select the paint system type, followed by the environment classification and thence giving you the expected durability life, within a range, before first major maintenance is required.

Reference to these issues and understanding of "life to first maintenance" is covered within the Standard, however it is also helpful to see the following wording from within the Standard,

"It is stressed that the durability range within the Standard is not a 'guarantee time'. Durability is a technical consideration that can help the owner set up a maintenance programme. It is also noted that the coating type is only one factor in determining the durability of a protective coating system. Surface preparation, application procedures, design, local variations in environment and other factors will all influence the durability of coatings".

It is very important to understand the durability of a coating system and also the environment to which it is to be exposed. It is also just as important to have in place a maintenance system, with a plan for when to recoat to keep the entire system in good condition. The topcoat is designed to protect the underlying coats and the underlying coats are designed to protect the substrate.

Durability is expressed in terms of coating life *to first major maintenance*, assuming that the coating has been applied according to the requirements of this and other appropriate Standards, and to the recommendations of the coating manufacturer. A range is given, not only for the experimental uncertainty in obtaining such lifetimes, but because there is a range of corrosivities within a corrosivity category.

A properly applied coating should achieve the lower figure of the durability range at all sites within a given corrosivity category, and the upper figure of the range under the most favourable conditions in the less aggressive regions of the corrosivity category.

Again, the coating type is only one factor in determining the durability of a protective coating system. Surface preparation, application, procedures, design, local variations in environment and other factors will all influence the durability of coatings. Provided that the substrate can be accessed for maintenance, the integrity of the system and structure can be maintained, thereby allowing the substrate to achieve its 50 year durability.

Selection of the Corrosivity Category is very important to understanding the degree of preparation that will be required (the harsher the environment the better the preparation for long life), as well as the type of protective paint system required.

- The type of exposure: ISO 9223 Corrosivity Categories

-	Industrial	Category: **C5-I**	Very High
-	Severe coastal	Category: **C5-M**	Very High
-	Normal coastal	Category: **C4**	High
-	Moderate coastal	Category: **C3**	High
-	Rural	Category: **C2**	Low
-	Tropical atmosphere	Category: **T**	Inland Tropical - High
-	Sheltered/Exposed(canopy)		High / Very High

The full classification of each of these Categories is available within the standard and also a short version is available from within the Resene AS/NZS 2312.1 System selection charts. If you are unsure as to the corrosivity of the area in which you intend to build / refurbish, please contact Resene Technical Services. See Appendix 1.

Note: When you have more than one Category in an area, the harsher one always predominates, e.g., tropical & next to the sea, the classification will be C5-M and not T.

Note 2: Corrosion Theory

The meaning of the word corrosion is "the deterioration of the substance (usually a metal) or its properties because of a reaction with its environment". Normally it specifically applies to metals, although plastics and other non-metals such as concrete, bricks and timber also deteriorate in natural environments. Corrosion causes enormous losses, which rise yearly with the increased usage of metals in industrial development. The accepted concept of corrosion, is that it is a result of an electrochemical reaction taking place on the surface of the metal, where the metal is converted into metal oxides or other corrosion products.

Some metals produce a tight skin on the metal surface, which hinders further corrosion, and if this surface layer is broken can be self-healing. These metals are said to be passivated and include lead, nickel, cadmium, chromium and aluminium. Zinc corrosion products form a fairly tight layer on zinc and further corrosion is slow. A tight layer of iron and chromium oxides forms on the surface of stainless steel and is the reason for the resistance of this metal. Iron and steel, however, form rust as a corrosion product, which is porous, is not firmly adherent and does not prevent continued corrosion.

For further information including the Galvanic Series of Metals, see Appendix 2.

Prevention of rusting of iron and steel by painting

Three methods may be used.

1. **Inhibitive:** An anti-corrosive priming paint applied direct to the steel surface and containing an inhibiting pigment will inhibit the occurrence of the anode reaction. This is the function of, for example, zinc phosphate pigments.

2. **Barrier:** This concept is to seal off the surface from water and oxygen by applying a thick, highly adhesive coating which blocks the passage of those aggressors and preventing the corrosion reaction. This is the function of epoxy, vinyl and chlorinated rubber paints, which all have high water impermeability.

3. **Sacrificial:** Cathodic protection, using sacrificial anodes, is the best example of the mechanism, however, galvanising and zinc rich coatings also use this mechanism. These later examples are also often over-coated creating duplex systems.

These properties are most commonly combined into / within a multiple coat system.

Note 3: Design considerations

Proper planning and careful attention to protection at the design stage is essential to minimise corrosion and simplify future maintenance. Without this planning, an arbitrarily chosen system may prove expensive by causing heavy maintenance costs or even the shutdown of a plant. A structure, which is designed with corrosion prevention in mind, avoids sharp edges, crevices, rough welds, corners, depressions and pockets. Whilst it is realised that some types of structures will provide difficult areas for coating after erection, the design authority should be mindful of this, ensuring painting before erection. For further information and design detail examples, see Appendix 3.

Note 4: Maintenance Provisions

It is very important to understand the durability of a coating system and also the environment to which it is to be exposed. It is also just as important to have in place a maintenance system with a plan as to when to recoat to keep the entire system in good condition. The topcoat is designed to protect the underlying coats and the underlying coats are designed to protect the substrate.

Note that coating type is only one factor in determining the durability of a protective coating system. Surface preparation, application, procedures, design, local variations in environment and other factors will all influence the durability of coatings. Resene Paints recommends the following maintenance scheme:

6 month regular interval

Thoroughly wash down with a 25 % solution of Resene Paint Prep & House Wash and water to remove all dirt, dust, grease, chalk, cobwebs and any other contaminants.

Data Sheet D812

Thoroughly low pressure water-blast to remove all salts and residue from the cleaning process. This particularly applies to areas not naturally washed by rain, where dirt and salts can accumulate.

12 month regular interval

If any areas of moss or mould infestation are found, then treat them with Resene Deep Clean, diluted at the rate of 200 grams to 1 litre of clean water. Leave for up to 48 hours to achieve full kill. For heavy infestations, more applications may be needed.

Data Sheet D80

Thoroughly wash down with a 25% solution of Resene Paint Prep & House Wash and water to remove all dirt, dust, grease, moss and mould residue, chalk, cobwebs and any other contaminants. **Data Sheet D812**

Thoroughly low pressure water-blast to remove all salts and residue from the cleaning process. Inspect the paintwork for signs of premature breakdown. Typical causes of this may be areas of physical damage, low film builds on sharp edges, etc. Any defects found should be rectified as soon as possible.

Note 5: On-Site damage

Sections of steel that are prepared and painted off site, must be allowed to sit on completion of painting for a minimum of four days, to allow for curing of the paint coatings (to minimise damage during transportation). All transporting and lifting shall be done in such a way as to minimise any damage to the paint coating.

Any areas of damage to the paint system must addressed, and be prepared and treated in order to achieve the maximum of the paint system, and to match the original paint system including preparation. In addition, all edges must be feathered.

Note 6: Preparation Abrasive Blasting / Whip blasting

Abrasive Blast Cleaning

Mild steel, because of its strength to weight ratio and cheapness, is one of the most widely used construction materials.

However, it readily rusts and must be painted to prevent this corrosion and to provide to it a decorative appearance.

An adequate degree of surface preparation, with due consideration to the environment is essential, since it is on this basis that the adhesion of the correct painting system is dependent.

It is of supreme importance to consider the following factors in any decision of surface preparation:

- Length of service required.

- The type of exposure: ISO 9223 Corrosivity Categories

-	Industrial	Category: **C5-I**	Very High
-	Severe coastal	Category: **C5-M**	Very High
-	Normal coastal	Category: **C4**	High
-	Moderate coastal	Category: **C3**	High
-	Rural	Category: **C2**	Low
-	Tropical atmosphere	Category: **T**	Inland Tropical - High
-	Sheltered/Exposed(canopy)		High / Very High

Irrespective of the surface chosen, it is mandatory that before painting all dirt, dust, oil, grease or other loose surface contaminants be removed, since it is obvious that paint applied to them will have poor adhesion to the underlying surface and the paint will flake off exposing the substrate to attack, resulting in costly maintenance, unsightly appearance and perhaps failure of the structure. Painting must always be carried out as soon as possible after, and usually no later than the same day, as the surface preparation.

Mill scale found on new steel is a hard, brittle coating of several distinct layers of iron oxides, formed during processing of steel, such as hot rolling girders, tank plates and other structural shapes. Usually bluish-black in colour, mill scale cracks and fissures readily, and is permeable to both air and moisture.

Rusting at the mill scale steel interface occurs and in time, the scale sloughs off due to the pressure created by the rust layer. Mill scale is cathodic to the steel substrate and if left in place, corrosion will occur as a result of the electrical potential difference between them.

Scale is brittle, expands less than the iron from which it is formed and cracks on cooling. It is not uniform in composition.   Refer to picture (Ref 1) and diagram (Ref 2) below:

Ref 1

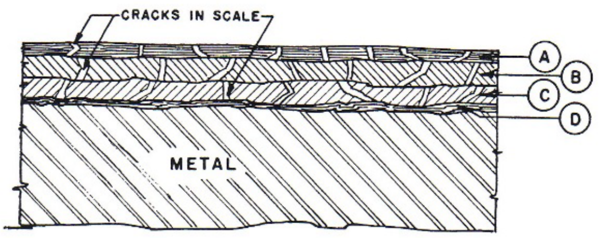


FIGURE 1
Mill scale is composed of several layers: A. Fe_2O_3 B. Fe_3O_4 C. FeO D. FeO + Fe.

Ref 2

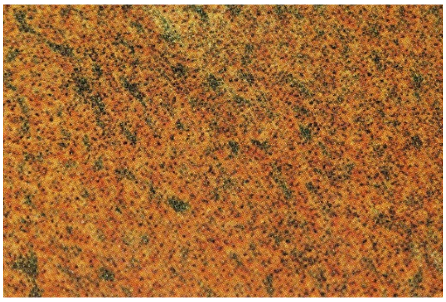
Rust is an oxide of iron formed by the action of air and water. It is voluminous and occupies one and three-quarter times the volume of the steel from which it originated.

Rust forming under a paint coating or through breaks in the coating can burst through and may creep under the coating resulting in flaking so that repair is both difficult and costly. Refer to pictures below of the types of corrosion (Ref 3 and Ref 4).

General Corrosion

Ref 3

Pitting Corrosion



Ref 4

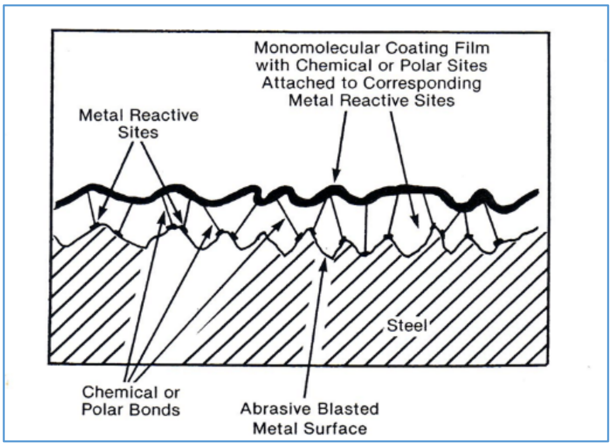
It may cost a little more for a better surface preparation, but as the paint coating will last many times longer, the overall cost saving in maintenance will justify the initial expense. Other types of steel, such as low alloy steels (e.g. Austen 50), which are selected in areas requiring increased strength, hardness or improved resistance to corrosion, can also be prepared by the following methods.

For Australasia, the most commonly quoted reference standards for the preparation of steel for painting are given by the AS/NZS 2312.1 Guide to the Protection of Steel and also in the Swedish Standard SIS 055900.

Abrasive Blast Cleaning

A method for removing rust and mill scale by the physical impact of an abrasive, propelled on to the surface by compressed air. Non-metallic abrasives, such as garnet, are the most common material used due to its sharpness, cleanliness and the fact that it can be recycled many times. Not only does abrasive blasting remove mill scale and rust products, it also imparts profile or tooth to be cleaned surface which helps is both mechanical as well as chemical adhesion. Refer to Ref 5 and Ref 6 below.

Note: Profile must be controlled (coupled with specified primer thickness) to ensure that 'rough peaks' do not protrude above the primer surface.



Ref 5

Ref 6

For the various methods and levels of cleanliness, see Appendix 4.

Hot Dip Galvanized Steel Preparation - Sweep (Whip) Blast Cleaning

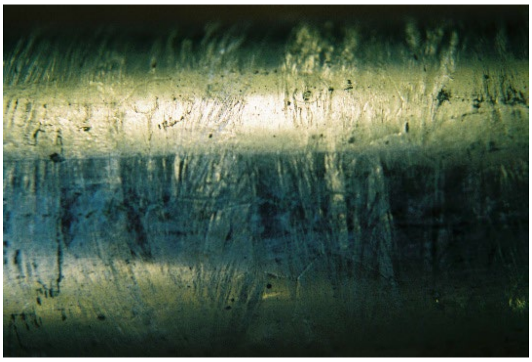
The hot dip galvanising process produces a durable coating of metallic zinc and zinc iron alloys, bonded metallurgically to the parent (base) metal. The sacrificial zinc coating ensures that a small area of the base metal, exposed through abrasion or impact, is protected from corrosion by the surrounding galvanising. A range of different sized items may be galvanized, with consideration to the size limitation being that of the galvanizing bath. There are also special design requirements that need to be taken into account if Hot Dip Galvanizing is to be carried out. Refer to the Galvanizing design requirements available you're your local galvanizer or http://www.gaa.com.au/.

During the process, the entire surface of the item is coated and may include internal areas difficult to protect by other means. After removal from the bath of molten zinc, the coated steel is usually quenched in water containing a small quantity of sodium dichromate. Chromate quenching is a process that passivates the rich outer zinc surface and results in a shiny silver appearance, and prolongs the time before any zinc corrosion can take place.

However, paint does not adhere very well to this surface and therefore, before painting, this needs to be removed by light sweep blasting (also known as Whip Blasting) with non-metallic media.

Whip blasting is often required to prepare such surfaces as Hot Dip Galvanising, aluminium and other non-ferrous metals. It is very important that this process is carried out using fine, clean, non-metallic blasting media. If you use iron contaminated or iron / steel blasting media, you will contaminate the surface with iron which will cause corrosion. This is a requirement of the AS/NZS 2312.1 standard and other AS/NZS Standards for painting of Hot Dip galvanized surfaces.

Chromate quenched surface



Ref 7

After Whip blasting

Ref 8

Care must be taken to ensure that no more than 10um of zinc, from the galvanised surface, is removed during this process. Suggested criteria from the Galvanisers Association of Australia should be observed for this process. Blast pressure of 40 psi maximum, abrasive grade 0.2 – 0.55mm (clean and no iron contamination) angle of blasting to surface 45° angle, distance of between 300 – 400mm from the surface, using a nozzle type minimum 10mm of venture.

If, for any reason, the above mentioned preparation process cannot be carried out, then hand / power tool preparation will be required.

However, it must be understood that this is not a preferred method of preparing the chromate quenched surface, due to the difficulty of achieving the desired and correct level of even preparation. However, if sweep blasting is not possible, glossy areas must be sanded by using a mechanical sanding with 100 grit abrasive paper to achieve a dull finish. Care must be taken to ensure minimal removal of the zinc layer in this process.

After orbital power sanding with 100g abrasive paper

Ref 9

Note 7: Mixing & Induction Times for 2 Pack Coating Systems

Many 2 component systems require a precise induction time, followed by re-mixing, in order to achieve their designed properties. Applicators should be familiar with all the Data Sheets for products used and also the Safety Data Sheets.

Resene product data sheets and material safety data sheets (MSDS) can be accessed from the Resene website: www.resene.co.nz.

For more detail see Appendix 5.

Note 8: Recoat Windows for 2 Pack Coating Systems

Time between coats:

Each coat will be applied before the underlying coat becomes fully cured, chalks or becomes contaminated. This is to ensure inter-coat adhesion is attained, to achieve maximum performance and durability of the coating system. The maximum time between coats is indicated on the product Data Sheet. This must not be exceeded as adhesion and durability of the system will be compromised.

Note 9: Isocyanate (2 pack Polyurethanes)

If spraying urethanes, then the OSH 'Approved Code of Practice for the Safe Use of Isocyanate' https://worksafe.govt.nz/topic-and-industry/hazardous-substances/guidance/substances/safe-use-of-isocyanates/ must be read and followed.

Note 10: Use of solvents, Requirements, safe handling of

Handling of solvents is a large section, which is fully covered in Appendix 6. Safety is of paramount importance to all involved in the painting process. Please see Appendix 6 for these details. In addition, please refer to the Resene publication, 'Putting Your Safety First', at http://www.resene.co.nz/pdf/safety_first.pdf.

Note 11: Metal Roofing – Lap Priming / removal of surface contaminants

Lap priming (overlapping surfaces) is recommended prior to installation of bare galvanising or Zincalume roofing. Salt can accumulate under laps and this, combined with the potential for longer times of dampness, can lead to rapid loss of the zinc layer. This crevice corrosion leads to higher corrosion rates, particularly with roofs close to the coast.

Note 12: Windblown Salt (contamination)

Salt is a serious contaminant on steel surfaces and wind can drive sea water, in aerosol form, many kilometres inland. Up to 100km inland has been recorded in windy New Zealand. As the majority of cities in Australasia, and all in Oceania, are coastal; the effect of windblown salt is ubiquitous.

Salt, being readily water-soluble, is easily washed off smoother, impervious surfaces and natural rain washing mitigates the condition significantly. However, areas of low rainfall, such as the Australian West Coast, and anywhere after a long, dry period, should expect the presence of windblown salt. Of particular concerns is rain protected areas, such as steel under canopies and eaves.

Salt can be taken up by waterborne paints affecting the film formation, film integrity and appearance.

Note 13: Spreading Rates

For metal protection, minimum film builds are typically mandated and sufficient product must be purchased and applied to achieve the spreading rates.

Industrial coatings are typically designed to be sprayed. If for any reason small areas need to be touched up using brush or roller application, then more than one application may be needed to achieve the specified film thickness.

Note 14: Colour

The selection of colour is generally outside of the specification process. Most Resene colour and paint systems have excellent hiding and coverage. Two coats applied over a suitably sealed or primed surface are generally sufficient. However, some colours, notably yellow based hues, both pale and strong, and some reds may require a third coat or be applied over a white basecoat, to ensure coverage and or the correct colour is achieved.

Additionally, when repainting over a darker shade, a basecoat and / or an additional colour coat may be required to ensure coverage and / or the correct colour is achieved.

It is the responsibility of the painting contractor to be aware of the schedule of colours or colour scheme and prepare their quote accordingly. Where the colour scheme has not been released or is changed after the tenders are received, the painting contractor should note this in their tender response.

Note 15: Repaints

Ideally paint should break down by gradual erosion of the surface, leaving a perfectly adhering, etched surface and repainting should only require washing down to remove surface chalking and any dirt and other contaminants. Unfortunately, this not always the case and additional time consuming surface preparation and priming is often required.

The worst case scenario is when the paint surface has broken down, due to loss of adhesion resulting in flaking, peeling and blistering of the paint. Where any of these breakdowns have occurred, unless specific localised reasons for the failure can be identified, it is wise to assume that the weakness may be prevalent over the whole surface.

The assessment that has to be made is whether the existing system has sufficient adhesion to hold on when subjected to the extra stress and weight of two or three more coats of paint. Stresses are, of course, increased if the new system is darker in colour than the existing system.

As the thickness of paint builds up on a substrate, there is a corresponding increase in tension on the underlying paint layers.

Upon inspection of these issues, the new coatings have invariably adhered well to the old coatings but the coatings underneath have lost all there adhesion and flexibility properties, in turn causing them to pull away. When investigating a failure, the best practice is to check what the failure type is and if inter-coat adhesion, which layers are involved. This can easily be seen by checking the back of a flake and comparing it to what remains where the flake delaminated from. If the failure is cohesive, there is usually evidence of the same paint colour being present on the back of the flake and where the flake peeled from.

Unfortunately, in most cases this issue cannot be reasonably foreseen and often does not become an issue until the new coatings are applied. This makes identification of who is responsible unclear.

Even when adhesion tests are done on the old coatings, they still may appear sound but because there are so many layers (sometimes up to 300 + microns), they are brittle and their adhesion becomes limited. A common cause of delamination occurs with a change from a pale to a much darker topcoat colour. The extra heat associated with the colour change is the tipping point and delamination is common.

Note 16: Test for adhesion

Adhesion testing, using the cross hatch cut or cross X cut test, should be carried out and reported as per AS 1580.408.4-1993 Adhesion Standard, using Tesafix 4970 Tape @ 20 N / 25mm strength. The space between the cross hatch cuts is dependent upon the film thickness of the existing coating.

Note 17: **Paint Film Thickness**

The film thickness and dry film thicknesses quoted are the minimum to be achieved. Do not exceed these thicknesses by more than 20% of that specified. The specified film thickness for each coat / application shall be achieved prior to the application of the subsequent coat. Measurement shall be as per AS/NZS 3894.3 standard (SSPC-PA2) and agreed on before commencement of paint application.

Note 18: **After Abrasive Blasting**

The surface profile can be confirmed using replica tape or profile depth gauge as per AS/NZS 3984.5.

The surface must be completely free from loose particles, dust, etc. Immediately apply the paint system before any discolouration or contamination of the cleaned prepared surface has occurred. The surface must be above that of the dew point and recorded as per AS 3894.10.

Note 19: **Shop Priming / Shop Primers**

Shop priming refers to preparation and priming of steel undertaken off site and usually by a dedicated commercial operation. Some 'shops' offer abrasive blast cleaning, along with paint application, while others may be steel fabricators who assemble then prime. Unless the shop priming step is covered with a specification, it is likely that the shop primer will be a lower cost primer; applied over steel with a lower, or reduced level, of surface preparation and designed to give steel short term corrosion protection prior to the steel work being encased within a building envelope.

Shop primers should not be used to prime steel that is to be exposed to full weathering or where the potential for sheltered corrosion, such as canopy steel, exists.

Note 20: **Coating Design**

The term 'coating design' has been coined to describe the process of determining the most practicable and pragmatic method of delivering a high performance steel protective coating system to a project.

Typically, onsite welding and fixing will be required and the coating system should be designed to allow for this and for onsite repair of any transport and erection damage.

Onsite welds present the largest challenge to the long term protection of steel, as they are the weak point in most coating systems.

Excellent and correct preparation of the onsite weld before applying the protective coating system is therefore vital to the integrity of the system.

Minimising or eliminating such welds is a pragmatic approach, additionally, if practicable, allow for, or require, that the majority of the coating system is applied off site and under controlled conditions, with the final coat or coats applied on site after welds have been prepared and primed.

Spray application to steel on site is generally not a practicable nor viable alternative. Resene have developed a series of brush and roller applied epoxies and urethanes specifically designed to achieve a high level of performance.

Additionally, the design should allow for future maintenance, with re-coatable topcoats selected and potential weak points in the structure (weld margins, crevices, etc.) positioned to allow for future easy access.

Note 21: Exterior Zinc Metal Spray Steel (including zinc and aluminium)

Zinc metal spray (metallization) is the process whereby molten, or near molten zinc metal, is sprayed onto a prepared steel substrate. All grades of steel may be zinc sprayed, as the process does not affect metallurgical properties. Steel substrates require grit blasting to a 'white metal' finish with a minimum anchor profile. Metal spray processes can apply thick metal coatings (thicker that that achieved by Hot Dip Galvanizing). The sprayed zinc cannot coat internals of pipes / tubes as with Hot Dip Galvanizing and also requires different design parameters to be followed, and special paint system specifications, with care taken around the film builds of paint applied. Steel coated with zinc metal spray must be sealed within 4 hours of spraying of the zinc. The metal spray is porous and there are channels within the zinc layer that can allow water and salts access to the base steel surface. Hence, sealing of the fresh metal spray is required. There are a range of sealers that can be used but all are designed to penetrate into the zinc layer and seal porosity.

Zinc metal spray is porous and MUST be sealed with a suitable sealer that is compatible with the proposed paint system before being sent to site, to protect it from moisture uptake and to avoid pin holes / bubbling when the primer and top coat systems are being applied.

Use thinned Armourcote 220 Epoxy Primer Sealer, as specified later in this section, when applying paint systems on top of.

DO NOT use *Vinyl Aluminium Sealers* if paint systems are to be applied.

Vinyl Aluminium sealers are ONLY used when there is NO paint system to be applied, as the Vinyl Aluminium sealer helps to retard the corrosion rate of the zinc when exposed to the elements.

Note 22: Aluminium

Aluminium is a light metal and can be given increased strength by alloying. Pure aluminium has very good corrosion resistance in most environments, primarily because aluminium spontaneously forms a thin but effective oxide layer that prevents further oxidation.

The oxide layer is impermeable and unlike oxide layers on many other metals, it adheres strongly to the parent metal and if mechanically damaged, the aluminium oxide layer is self-healing almost immediately.

Anodising is a chemical process that produces a decorative a protective film on the aluminium. An increased thickness of the oxide layer gives improved corrosion resistance, and the process can produce a coloured finish.

Aluminium can corrode, the common types of corrosion are galvanic, pitting, and crevice corrosion.

Aluminium extruded joinery sections have all but replaced timber for joinery construction. Joinery is either anodised or powder coated. The belier was that use of aluminium would remove the requirement for regular maintenance, as is the case with timber joinery. However, time and corrosion have taken their toll on aluminium joinery, with unsightly corrosion of the anodized surface and fading and chalking of powder coated joinery.

Aluminium roofing was introduced to take advantage of the increased corrosion resistance, compared to galvanised roofing but has now been replaced by Zincalume.

As the oxidation layer on aluminium is dense and stable, and is suitable for painting after careful cleaning, to remove contaminants such as dirt and salts. Where corrosion has occurred, this extends to sanding to remove the corrosion products back to bright metal. Very highly polished aluminium can be difficult to get paint to adhere to and may also require surface abrasion prior to painting. Alternatively, etch primers such as Resene Vinyl Etch can be used.

Note 23: Custom/Special Colours

Where the specification requires a custom/special colour to be applied, the applicator is required to produce a sample of the colour, to be approved by the owner/specifier prior to commencing painting.
For a custom/special stain colour the sample for approval must be the full stain system, applied as per the Resene datasheet, to the timber to be stained.

Note 24: Cast/Wrought Iron

Cast iron is an alloy of iron and carbon with a carbon content greater than 2%. The usefulness of cast iron comes from its relatively low melting point. The oldest cast iron artifacts date back to the 5th century BC. Cast iron is made from pig iron, which is the result of heating iron ore in a blast furnace. The low melting point allows for the molten metal to be easily poured into a mold and allowed to solidify. Cast iron can be very brittle, as in some cases the caron particles can create internal stress points which are conducive to fracture.

While the composition of wrought iron is essentially the same, the iron is heated, not to melting, and then worked/shaped with tools. Wrought iron is highly malleable, allowing it to be heated and worked with tools to give a range of shapes, the more times the material is heated and worked the harder the product.

Both cast and wrought iron are prone to atmospheric corrosion and need to have a protective coating system applied to control corrosion.

Cast iron has been used as a construction material for centuries, all of the original NZ lighthouses were constructed from assembled cast iron sections. The other common use of cast iron is for cooking utensils, and piping for acidic waste discharge. Wrought iron has been used as the metal substrate for gates and fences, this use has now been replaced by lighter weight aluminium designs.

SURFACE SPECIFICATION SHEETS

SECTION 1 – Exterior Steel

Spec Sheet 4:1HP/1 - New Exterior Unpainted Steel

New exterior steel is generally primed before site delivery. The preparation and type of primer vary greatly however, and exacting standards exist to guide and determine the required levels and primer type.

High performing protective coating systems are required for structural steel used for canopies, and steel subject to weathering. There is little compromise allowed in these situations.

The steel must be prepared by abrasive blasting to 'near white metal' state and a sacrificial primer (zinc coating) or metal spray applied.

Ideally, the bulk of the protective coating system (usually consisting of high build barrier coating (typically an epoxy) and a UV resistant, durable topcoat, (typically a urethane)) should be applied in a controlled environment off site.

However, these requirements are frequently not met or are misunderstood, and fabrication primers may be applied, often over compromised or inadequately prepared steel, which results in poor corrosion protection.

Preparation and coating for steel primed with shop primers is covered in **Spec Sheet 4:1/1**. Whilst these primers are perfectly suitable for benign, interior exposure; even so, an early onset of corrosion will occur if these primers are left for extended periods of time exposed to weathering (before closing in).

The preparation and system detailed below is based on AS/NZS 2312.1 standard and relates to steel prepared off site, where a high performance protective coating system is specified.

Condition: Unpainted new steelwork with mill scale and a varying degree of surface corrosion. Offsite preparation and priming.

Step 1: Thoroughly degrease / clean the surface as per AS 1627.1 standard and then use water blasting to remove all cleaning products and contaminants including salts.

Step 2: Any welded sections must be thoroughly cleaned and free from flux, weld spatter and surface defects, including cracks and deep pits. Weld spatter must be removed carefully by blasting or mechanical grinding. There should be no areas of rough welding.

Note I: Removal of such defects may affect the weld certification.

Step 3: All internal and external corners / edges are to be removed by grinding to provide a minimum radius of 2mm.

Step 4: Abrasive blast clean to AS 1627.4 Class 2.5 or equivalent standard (**refer to note 18**) to achieve a blast profile of 25-45 microns. Immediately apply the specified primer to prevent flash rusting or other contamination, typically within a maximum of 4 hours after blast cleaning.

Note II: The contractor shall ensure that there is no deterioration in the condition of the surfaces to be painted, between the actual preparation and the application of the priming paint. Any extraneous matter deposited before painting shall be completely removed and the surface restored to (a near white metal finish) the appropriate standard.

Note III: On completion of painting, all crevices shall be filled with a suitable silicone or mastic sealant, applied as per manufacturer's instruction, to aid in corrosion prevention.

Spec Sheet 4:1/1 - New Exterior Non-structural Steel: primed with shop primer

Steel used for gates, fencing and other non–structural elements is frequently primed using low build shop primers and delivered to site. Whilst not considered robust enough for New Zealand's mostly coastal environment, they are used in Australia (where the environment is less aggressive) in inland areas.

The system below is considered to be a compromise of a high performance, protective system as per AS/NZS 2312.1 Standard. Typically, the preparation used before coating is also of a lower standard than acceptable for a high performance system to be applied to.

Shortened durability and the early onset of corrosion are therefore likely. Where a long term protective solution is required, such as for canopy steelwork / supports, we recommend the paint system and preparation is upgraded to meet the AS/NZS 2312.1 Standard and Resene customised specification. Contact Resene Technical Services for advice, if this is the case.

These systems are suitable for internal steelwork with no exposure to the elements. Preparation is covered in **Section 5.**

Identification of the existing shop primer technology is required, to ensure that it is compatible with the proposed protective coating system.

Step 1: Scrub down using Resene Roof and Metal Wash diluted to label / data sheet directions. Rinse clean with copious quantities of clean water or water blast to remove all salts, loose or flaking coatings, dirt, grease, dust and any other contaminants. Test surface is degreased by wiping with clean cotton wool. Repeat process if necessary.

Step 2: All sharp edges are to be removed by grinding to provide a 2mm minimum radiuses edge.

Step 3: To any areas showing rust, power tool clean to AS 1627.2 or equivalent, such as SSPC-SP3 Standard. Power tool cleaning removes all loose rust, loose paint, and other loose detrimental foreign matter. Operate power tools in a manner that prevents the formation of burrs, sharp ridges and sharp cuts.

Step 4: Immediately spot prime the prepared area with Resene Rust Arrest as per **Data Sheet RA30A**, to prevent further corrosion or contamination.

Note I: 2 coats of GP Metal Primer will give a much thicker coat than the surrounding shop primer.

Spec Sheet 4:1/3 - Repaint Exterior Mild Steel

Identification of the existing paint system is required, to ensure that surface preparation and selection of priming and top coats are compatible with the old paint system.

If a repaint is required only for aesthetics or colour change, then surface preparation will usually only involve washing down and possibly sanding of the existing paint system before application of new top coats.

Previously painted steel structures will more than likely have areas of rust and possibly be salt contaminated. In most cases, the only surface preparation that can be achieved will be power tool cleaning. Preparation to a higher level (abrasive blasting) will always give a better outcome; however there are restrictions on site blasting. Given this, power tool cleaning should be seen as a compromise method of surface preparation which will only hold rust for a short term period. This period depends on exposure conditions, the degree of initial corrosion, the local microclimate and the success of the surface preparation process.

For repainting, the surface must be free of salts and prepared to ensure that areas of corrosion are prepared to a sound surface.

Windblown salt deposits should be thoroughly washed off with copious amounts of water and the surfaces allowed to dry, not only before painting commences but at the beginning of each days painting. Any contaminants such as airborne pollutants, greases, oils, dirt, dust, which would affect the integrity of the applied coating, must also be removed prior to application of paint coatings.

Step 1: Using scrapers, remove as much loosely adhering rust, etc., as is practical to allow greater effectiveness of the water-blasting stage.

Step 2: Scrub down using Resene Roof and Metal Wash diluted to label / data sheet directions. Rinse clean with copious quantities of clean water or water blast at 2500 psi to remove all salts, loose or flaking coatings, dirt, grease, dust and any other contaminants. Test surface is degreased by wiping with clean cotton wool. Repeat process if necessary.

Step 3: All sharp edges are to be removed by grinding to provide a 2mm minimum radiuses edge.

Step 4: Power tool clean to AS 1627.2 or equivalent such as SSPC-SP3 standard. Power tool cleaning removes all loose rust, loose paint, and other loose detrimental foreign matter. Operate power tools in a manner that prevents the formation of burrs, sharp ridges and sharp cuts. Regardless of the method used, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance. All areas of old paint should be thoroughly abraded to achieve a good key for adhesion.

Step 5: Immediately apply the specified primer to prevent further corrosion or contamination.

Spec Sheet 4:1A/3 - Stripping Paintwork to Bare Metal/Galvanising/Aluminium

Paint will need to be completely stripped off a metal substrate when its condition deteriorates and it delaminates, blisters and / or flakes off. The extent and type of corrosion (especially extensive red rusting) of mild steel and galvanizing can also trigger the need for a total strip.
There are number of methods that can be employed to remove failed paint coatings from metal substrates on site. These include chemical, mechanical and heat stripping.
Heat stripping is rarely used to strip coatings from metal substrates.
Chemical stripping is used but can be messy, unpleasant, and time consuming. Additionally, some traditional chemical strippers are highly toxic and dangerous; many are based on methylene chloride; a known carcinogen or phenols which cause skin burn if skin contact occurs.
For a chemical strip Resene recommend the Sea 2 Sky system as it is waterborne; environmentally preferable and proven.
Mechanical stripping using power operated tools is the preferred site method for coating removal. Power tools such as drills or grinders fitted with an appropriate cleaning disc offer effective and relatively quick removal of paint and corrosion products.
Apart from complete removal of failed coatings preparation must also include removal of loose corrosion deposits back to a sound base.

Step 1: Scrub down using a stiff nylon brush or broom with Resene Roof and Metal Wash diluted and used to label/data sheet directions

Step 2: Water blast at pressures up to 3000 psi (higher pressures may be used if the site and substrate type allows) to remove all slats, loose and flaking paint, grease, dirt, surface chalk, and loss corrosion deposits.

Step 3: Remove any remaining paint using a 3M Rust and Paint Removal Disc or a Strip Eaze Disc. Pay particular attention to areas of corrosion and when removing coatings take care not to damage sound substrate (Zinc/Mild Steel/Aluminium/Galvanising etc.)

Step 4: Immediately apply the specified primer.

Note I: If moss/mould/algal growths are present treat these with Resene Moss and Mould Killer prior to Step 1

Note II: Before beginning any surface preparation, tests should be done to ensure the old paint does not contain lead. Paint flakes with layers older than 1970 are likely to have lead in them. If lead based paints are identified on this job, then the OSH Guidelines https://worksafe.govt.nz/topic-and-industry/hazardous-substances/guidance/substances/managing-lead-based-paint/ for the Management of lead Based Paint must be read and followed. Where these guidelines are in conflict with any part of this specification, the guidelines must take precedence. Flakes of lead paints and any sanding dust need to be carefully managed collected and disposed of.

Spec Sheet 4:1B/3 – Site Repairs to High Performance Paint System

Site repairs to an offsite applied high performance paint system will be required to reinstate the paint system when there is damage during transport to site, on site installation or following site welding. This repair system applies to steel that has been prepared and primed off site with high performance system applied to blast cleaned mild steel using Resene Zincilate 11 or ArmourZinc 120 zinc rich primers.

Step 1: Scrub down with Resene Paint Prep and Housewash. Rinse clean with clean water to remove all salts, lose or flaking coatings, dirt, dust and any other contaminants. Allow the surface to dry.

Step 2: Any welded sections will need special attention. After welding, all surfaces to be painted must be thoroughly cleaned and free from flux, weld spatter and surface defects including cracks and deep pits. Weld spatter must be removed carefully by mechanical grinding. There should be no areas of rough welding (Removal of such defects may affect weld certification.) Weld flux must be removed by thorough washing with a detergent solution followed by copious washing with fresh water.

Step 3: To any weld and bare steel areas, power tool clean the area to a white metal finish as per SSPC-SP11-87T Standard. Care must be taken not to damage the sound coated surrounding areas. All paint edges must be feathered to a smooth finish and the sound paint coating slightly roughened to assist in adhesion of the newly applied coating system. The contractor shall ensure that there is no deterioration in the condition of the surfaces to be painted between the actual preparation and the application of the priming paint. Any extraneous matter deposited before painting shall be completely removed and the surface restored to its prepared finish state.

Step 4: Spot prime all bare prepared steel areas only with Resene Armourzinc 120 to achieve a dry film thickness of 75 microns. Ensure an overlap of 10mm onto sound existing painted surface. Then apply the specified epoxy/urethane over coat system to the required dry film thicknesses.

SECTION 2 – Exterior Galvanised Steel

Spec Sheet 4:2/1 - Uncoated, New and Weathered Hot Dip Galvanised Steel

Hot dipped galvanised steel is frequently used for exterior steel. The size of the steel capable of being galvanised will depend on the size and capacity of the molten zinc bath and its design, as specific design parameters are required for Hot Dip Galvanizing items.
Please refer to **http://www.gaa.com.au.**

There are other methods for applying zinc to steel and these include application of metal spray zinc or zinc rich paints **(see Section 3),** the limitation being that they are line of sight application, e.g. They do not coat the inside of tubes and tight angles.

Galvanised steel is chromate quenched and this typically results in a hard, glass like surface to which a paint coating (even an etch primer) will not adhere.

Whip blasting (an off-site process refer to **Surface Information Note 6**) is the best method to profile a chromate quenched surface. Alternatives, as detailed below, can be used when on site preparation of chromate quenched galvanising is required.

This specification assumes the steel has been hot dip galvanised to achieve 450-600 g/m2 (63-84 microns zinc thickness), as per the current accepted AS/NZS 4680. Furthermore, that the steelwork has not been welded nor damaged in transit to the site. If this is not the case, a new specification will be required.

Step 1: Thoroughly degrease / clean the surface as per AS 1627. Standard and then use water blasting to remove all cleaning products and contaminants, including salts.

Note I: Glossy areas on new HD galvanising are an indication of chromate quenching post galvanising and this surface MUST be removed prior to painting.

Step 2: Sweep blast the galvanised surfaces with a clean non-metallic media, to slightly profile the surface and provide a dull uniform finish. Care must be taken to ensure that no more than 10 microns of zinc is removed from the galvanised surface during this process.

Note II: Hand tool cleaning is not a preferred method of preparing the chromate quenched surface, due to the difficulty of achieving the desired and correct level of even preparation. However, if sweep blasting is not possible, then these areas must be sanded using a mechanical sanding with 100 grit abrasive paper to achieve a dull finish. Care must be taken to ensure no excess removal of the zinc layer in this process.

Refer to **Surface Information Note 6** – sub-section “Sweep Blast Cleaning – Hot Dip Galvanized Steel”.

Note III: Priming must commence within 2 hours of preparation taking place. The contractor shall ensure that there is no deterioration in the condition of the surfaces to be painted, between the actual preparation and the application of the priming paint. Any extraneous matter deposited before painting, shall be completely removed and the surface restored to that specified.

Note IV: Unpainted hot dip galvanised steel that has been exposed and weathered for considerable time will develop corrosion products (both white and red rust). Zinc corrosion products are hydrophilic (water loving) and become honeycombed and porous. Paint systems will perform poorly on these surfaces; an assessment of the degree of corrosion and practicality of painting should be undertaken. For this and additional advice please contact Resene Technical Services

Spec Sheet 4:2/3 - Repaint Exterior Hot Dip Galvanised Steel

Identification of the existing paint system is required to ensure that surface preparation and selection of priming and top coats s are compatible with the old paint system.

If a repaint is required only for aesthetics or colour change, then surface preparation will usually only involve washing down and possibly sanding of the existing paint system before application of new top coats.

Previously painted hot dip galvanized steel structures may have areas of red and white corrosion and possibly be salt contaminated. In most cases, the only surface preparation that can be achieved will be power tool cleaning. Preparation to a higher level (abrasive blasting) will always give a better outcome if there are restrictions on site blasting. Given this, power tool cleaning should be seen as a compromise method of surface preparation, which will only hold rust for a short term period. This period depends on exposure conditions, the degree of initial corrosion, the local microclimate and the success of the surface preparation process.

For repainting, the surface must be free of salts and prepared to ensure that areas of corrosion are prepared to a sound surface. Any under-film corrosion requires the overlying paint to be totally removed to allow direct access for preparation of the metal surface.

Salt is a serious contaminant on steel surfaces and wind can drive sea water, in aerosol form, many kilometres inland. Up to 100km inland has been recorded in windy New Zealand. As the majority of cities in Australasia, and all in Oceania, are coastal; the effect of windblown salt is ubiquitous.

Salt, being readily water-soluble, is easily washed off smoother, impervious surfaces and natural rain washing mitigates the condition significantly. However, areas of low rainfall, such as the Australian West Coast, and anywhere after a long, dry period, should expect the presence of windblown salt. Of particular concerns is rain protected areas, such as steel under canopies and eaves.

Salt can be taken up by waterborne paints affecting the film formation, film integrity and appearance.

Step 1: Using scrapers, remove as much loosely adhering rust, etc., as is practical to allow greater effectiveness of the water-blasting stage.

Step 2: Scrub down using Resene Roof and Metal Wash diluted to label / data sheet directions. Rinse clean with copious quantities of clean water or water blast at 2500 psi to remove all salts, loose or flaking coatings, dirt, grease, dust and any other contaminants. Test surface is degreased by wiping with clean cotton wool. Repeat process if necessary.

Step 3: All sharp edges are to be removed by grinding to provide a 2mm minimum radiuses edge.

Step 4: For red rust areas, power tool clean to AS 1627.2 or equivalent such as SSPC-SP3 Standard to remove. Power tool cleaning removes all loose rust, loose paint, and other loose detrimental foreign matter. Operate power tools in a manner that prevents the formation of burrs, sharp ridges and sharp cuts. Regardless of the method used, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance. All areas of old paint should be thoroughly abraded to achieve a good key for adhesion.

Any areas of white zinc corrosion must be removed using an orbital sander with 100 grit abrasive paper. Care must be taken to ensure no excess removal of the zinc layer in this process.

Step 5: Immediately apply the specified primer to prevent further corrosion or contamination.

SECTION 3 – Exterior Metal Spray Steel

Spec Sheet 4:3/1 - Exterior Zinc Metal Spray Steel

This section covers the preparation of new uncoated mild steel off site, by abrasive blast cleaning and application of a coating of zinc by hot spray, then priming with Resene Armourcote 220. On site work includes repair of damage to coating and repair of any new weld areas. The finish is Resene Uracryl 400 series topcoats, which will maximise durability.

Zinc metal spray finishes are porous and require sealing before finishing protective systems are applied. Failure to adequately seal the surface invariably results in adhesive failure of the systems.

This system is also referred to as: Arc Spray; Thermal Spray and Metallisation, refer also to **Surface Information Note 21**. If the metal spray specified is other than pure zinc, contact Resene Technical Services. Note: these systems are not commonly specified for architectural structural steel.

Note I: The design of the structure is to be such that it aids in the correct application of the thermal spray zinc system specified in this document. Details of this are covered in the AS/NZS 2312.1 - Metal Spray Coatings and ISO 2063:2005 Standards.

Note II: All crevices should be eliminated during the engineering fabrication stage by fully seal welding any joint.

Step 1: Thoroughly degrease / clean the surface as per AS 1627.1 Standard and then use water blasting to remove all cleaning products and contaminants, including salts.

Step 2: Any welded sections must be thoroughly cleaned and free from flux, weld spatter and surface defects, including cracks and deep pits. Weld spatter must be removed carefully by blasting or mechanical grinding. There should be no areas of rough welding.

Note III: Removal of such defects may affect the weld certification.

Step 3: All internal and external corners / edges are to be removed by grinding to provide a minimum radius of 3mm.
In addition, any plasma cut edges on steel that is >10mm in thickness, are to be ground to remove the hardened surface effect from the plasma cutting process, to aid in achieving a suitable anchor profile during the abrasive blasting process.

Step 4: Abrasive blast clean to AS 1627.4 Class 2.5 minimum or equivalent standard (refer to **Substrate Information Note 18**) to achieve a sharp angular blast profile of 65 microns minimum. Immediately apply the specified zinc to prevent flash rusting or other contamination, typically within a maximum of 4 hours after blast cleaning.

Note IV: The contractor shall ensure that there is no deterioration in the condition of the surfaces to be zinc spray coated between the actual preparation and the application of the zinc spray. Any extraneous matter deposited before application of the system shall be completely removed and the surface restored to a near white metal finish.

Step 5: Apply zinc spray (Thermal Spray Metal Zinc) to achieve a 100µ film thickness as per AS/NZS 2312.1 – Metal Spray Coatings &ISO 2063 – 2005 (SSPC-CS 23.00 &AWS C2.23M) Standard/s. Care must be taken to ensure that the finished surface is as smooth as possible. Ensure a profile height of <50um is achieved. Confirmation is achieved by use of replica tape according to AS/NZS 3894.5 prior to paint application.

Step 6: Hand sand the zinc sprayed surface to remove any rough and or rogue peak areas of zinc, which would protrude through the applied paint finish. Remove any loose sanding material / dust.

Step 7: Apply a 30% thinned, sealer coat of Resene Armourcote 220 to achieve ≤10µ DFT.

Data Sheet RA34

Note V: The specified system cannot be applied to zinc metal spray sealed with an alternative ZMS sealer.

Spec Sheet 4:3/3 - Repaint Exterior Zinc Metal Spray Steel

Warning: If the Zinc Metal Spray is sealed with a silver aluminium vinyl type sealer, then **DO NOT PAINT**.

This type of sealer has leafing aluminium pigments and cannot be painted, as the sealer is cohesively weak.

Identification of the existing paint system is required, to ensure that surface preparation and selection of priming and top coats are compatible with the old paint system.

Do NOT over build the paint system applied to Zinc Arc Spray.

If a repaint is required only for aesthetics or colour change, then surface preparation will usually only involve washing down and possibly sanding of the existing paint system before application of new top coats,

Previously painted Zinc Metal Spray steel structures may have areas of red and white corrosion and possibly be salt contaminated. In most cases, the only surface preparation that can be achieved will be power tool cleaning. Preparation to a higher level (abrasive blasting) will always give a better outcome, however there are restrictions on site blasting. Given this, power tool cleaning should be seen as a compromise method of surface preparation, which will only hold rust for a short term period. This period depends on exposure conditions, the degree of initial corrosion, the local microclimate and the success of the surface preparation process.

For repainting, the surface must be free of salts and prepared to ensure that areas of corrosion are sound. Any under-film corrosion requires the overlying paint to be totally removed to allow direct access for preparation of the metal surface.

Windblown salt deposits must be thoroughly washed off with copious amounts of water and the surfaces allowed to dry before painting commences and at the beginning of each days painting. Any contaminants such as airborne pollutants, greases, oils, dirt, dust, which would affect the integrity of the applied coating, must also be removed prior to application of paint coatings.

Step 1: Using scrapers, remove as much loosely adhering rust, etc., as is practical to allow greater effectiveness of the water-blasting stage.

Step 2: Scrub down using Resene Roof and Metal Wash diluted to label / data sheet directions. Rinse clean with copious quantities of clean water or water blast at 2500 psi to remove all salts, loose or flaking coatings, dirt, grease, dust and any other contaminants. Test surface is degreased by wiping with clean cotton wool. Repeat process if necessary.

Step 3: All sharp edges are to be removed by grinding to provide a 2mm minimum radiuses edge.

Step 4: For red rust areas, power tool clean to AS 1627.2 or equivalent such as SSPC-SP3 Standard to remove. Power tool cleaning removes all loose rust, loose paint, and other loose

detrimental foreign matter. Operate power tools in a manner that prevents the formation of burrs, sharp ridges and sharp cuts.
Regardless of the method used, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance. All areas of old paint should be thoroughly abraded to achieve a good key for adhesion.

Any areas of white zinc corrosion must be removed using an orbital sander with 100 grit abrasive paper. Care must be taken to ensure no excess removal of the zinc layer in this process.

Step 5: Immediately apply the specified primer to prevent further corrosion or contamination.

SECTION 4 – Metal Roofing (Galvanised and Zincalume)

Spec Sheet 4:4/1 - New Metal Roofing (Galvanised and Zincalume)

New roofing is classed as having less than 6 months exterior exposure. Preparation and painting is usually straightforward, with the key element being to remove any form oils and contaminates from the surface before priming and painting.

Laps and exposed overhangs, including those over guttering should be primed (or double primed if with 500m of the sea) before installation. These areas do not receive any rain-washing once installed and windblown salts and other contaminants lodge there. These are always the first areas of the roof to corrode.

Step 1: Apply a liberal wash of Resene Roof & Metal Wash diluted to label / data sheet directions. Thoroughly scrub the surface with a nylon bristle brush or broom. Rinse thoroughly with fresh water to ensure complete removal of all grease and other contaminants and allow to dry. In marine areas (or if roof has been left unpainted for an extended time or is located in a marine environment), water washing to remove any sea salts that may have accumulated over time is mandatory.

Note I: Prior to commencing painting on any given day, wash down areas to be painted with fresh water and allow to dry. This is to reduce the likelihood of salt contamination between coats, which can compromise film formation and long term durability.

Spec Sheet 4:4/2 - Weathered, unpainted Metal Roofing (Galvanised and Zincalume)

New roofing is classed as having less than 6 months exterior exposure. After this period, the metal surface will have corroded to the point where corrosion product, zinc oxide or white rust, and possibly red rust may be present. Waterborne primers, including Resene Galvo-Prime are less effective on white rust than solventborne alternatives – Resene Galvo One or Resene GP Metal Primer.

It is unlikely that moss, mould or lichen will be present. If this is not the case, treat as per repaints – **Spec Sheet 4:4/3.**

Step 1: Apply a liberal wash of Resene Roof & Metal Wash diluted to label / data sheet directions. Thoroughly scrub the surface with a nylon bristle brush or broom. Rinse thoroughly with fresh water to ensure complete removal of all grease and other contaminants and allow to dry. In marine areas (or if roof has been left unpainted for an extended time or is located in a marine environment), water-blasting to remove any sea salts that may have accumulated over time is recommended.

Step 2: Any areas of white corrosion must be thoroughly removed by abrading, using 220 grit sandpaper before priming. Any red rust must be removed using mechanical methods (3M Rust and Paint Removal Disc), taking care not to damage the remaining zinc layer or the surrounding areas. Immediately spot prime bare areas with the specified primer.

Note I: It is strongly recommended that any badly rusted sections of galvanised steel be replaced.

Note II: The performance of the subsequent paint systems will be largely dependent on the thoroughness of this surface preparation stage.

Note III: Prior to commencing painting on any given day, wash down areas to be painted with fresh water and allow to dry. This is to reduce the likelihood of salt contamination between coats.

Spec Sheet 4:4/3 - Repaint Metal Roofing

Most domestic roofs will have been painted with acrylic paints; commercial roofs will usually be a proprietary factory coated roof cladding (ColorSteel or ColorBond). Depending on age and location, there may be corrosion present; white and red rust and areas of flaking paint with the possibility of mould and / or lichen infestation.

Windblown salt deposits must be thoroughly washed off with copious amounts of water and the surfaces allowed to dry before painting commences. This work may need to be repeated daily depending on local wind conditions.

Windblown salt and zinc corrosion products are hygroscopic and will draw water through the coating by osmotic effect. Along with windblown salts, all zinc corrosion product MUST be thoroughly removed before painting.

Step 1: Treat moss and mould with Resene Moss and Mould Killer; use as directed on the label.

Note I: For heavy infestations, an additional application(s) may be needed. Data Sheet D80

Step 2: Treat lichen with undiluted Resene Moss and Mould Killer; leave for 24 hours before scraping off or mechanically removing. Alternatively, water blasting is effective at removing lichen and other contaminates.

Step 3: Apply a liberal wash of Resene Paint Prep and House Wash diluted to label / data sheet directions. Thoroughly scrub the surface, using a stiff nylon brush or broom. Rinse clean, hose down with fresh water or water blast to ensure complete removal of all grease, moss and mould residue and any other contaminants.

Step 4: All paint that is flaking or unsound must be removed by using mechanical methods (3M Rust and Paint Removal Disc), chemical stripper or high pressure water-blasting, taking care not to damage either the substrate or the surrounding areas.

Step 5: Where under-film corrosion is taking place, the existing paint must first be removed as per Step 4 and the corrosion products removed, taking care not to damage sound zinc coated areas. All paint edges must be feathered to a smooth finish. It is strongly recommended that any badly rusted sections of galvanised steel be replaced.

The performance of the subsequent paint systems will be largely dependent on the thoroughness of this surface preparation stage.

Immediately spot prime bare areas with the specified primer

SECTION 5 – Interior Mild Steel

New Interior Steel - for high performance refer to preparation in Section 1**:** **Spec Sheet 4:1HP/1**

Spec Sheet 4:5/1 - New Interior Mild Steel - Shop Primed

Generally, interior steelwork will have a low build shop primer applied. While not offering sufficient protection for long term exterior exposure, these systems are generally suitable for most interior steelwork. Preparation is therefore straightforward and limited to ensuring the surface is clean and contaminate free.

If a specification is required for interior steel that includes a priming system refer to **Spec Sheet 4:5A/1**, or if a high performance or intumescent coating is required, please contact Resene Technical Services or refer to **Spec Sheet 4:7HP/3.**

Step 1: Wash using Resene Interior Paint Prep and Cleaner as per label / data sheet directions.

Step 2: Prepare areas of corrosion by power tool cleaning to a sound base, before spot priming any bare metal areas with the specified primer to prevent corrosion or contamination.

Spec Sheet 4:5A/1 - New Interior Steel (off site prepared)

The preparation requirements before priming with a low build shop primer are less exacting than required for high performance systems; or where there is the likelihood of external exposure for the steel (for example beside an open delivery bay); or if the elapsed time before over coating is likely to exceed 2 months and where the steel is exposed to the elements during this time; or if the internal environment is aggressive, such as a public swimming pool or industrial plant.

Where these situations occur, please treat the steel as per exterior high performance **Spec Sheet 4:1HP/1** or contact Resene Technical Services.

These should be considered exceptions however, and then it is generally accepted that the steel fabricator will supply shop primed steel to site.

The preparation before priming follows:

Step 1: Thoroughly degrease / clean the surface as per AS 1627.1 Standard and then use water blasting to remove all cleaning products and contaminants, including salts.

Step 2: Any welded sections must be thoroughly cleaned and free from flux, weld spatter and surface defects, including cracks and deep pits. Weld spatter must be removed carefully by blasting or mechanical grinding. There should be no areas of rough welding.

Note I: Removal of such defects may affect the weld certification.

Step 3: All internal and external corners / edges are to be removed by grinding to provide a minimum radius of 2mm.

Step 4: Abrasive blast clean to AS 1627.4 Class 2 (commercial) or equivalent standard (refer to **Substrate Information Note 18)**, to achieve a blast profile of 25-45 microns. Immediately apply the specified primer to prevent flash rusting or other contamination, typically within a maximum of 4 hours after blast cleaning.

Alternatively, power tool clean to AS/NZS 1627.2 Standard. This is a method of preparing steel surfaces by use of power assisted hand tools. Operate power tools in a manner that prevents the formation of burrs, sharp ridges and sharp cuts. Immediately apply the specified primer to prevent further corrosion or contamination.

Step 5: Immediately prime with the specified primer to prevent corrosion or contamination.

Note II: The contractor shall ensure that there is no deterioration in the condition of the surfaces to be painted, between the actual preparation and the application of the priming paint. Any extraneous matter deposited before painting shall be completely removed and the surface restored to a near white metal finish.

Spec Sheet 4:5B/1 - New Interior Mild Steel

Generally mild steel sections will arrive on site primed with a shop primer, these primers are designed to give short term protection until the building envelope is put in place. However if the mild steel is not primed off site then anti corrosive protection will be required to protect the steel from corrosion until the building envelope is completed.

If a specification is required for interior steel that includes a priming system refer to **Spec Sheet 4:5A/1**, or if a high performance or intumescent coating is required, please contact Resene Technical Services or refer to **Spec Sheet 4:7HP/3.**

Step 1: Wash using Resene Interior Paint Prep and Cleaner as per label / data sheet directions.

Step 2: Prepare areas of corrosion by power tool cleaning to a sound base, before applying the specified primer.

Spec Sheet 4:5/3 - Repaint previously painted Interior Steel and galvanised steel surfaces

If the surface is in good condition with no corrosion (red or white rust) or flaked paintwork, and the repaint is required for aesthetics or colour change, then surface preparation will usually only involve washing down and sanding of the existing paint system before application of new top coats.

Where the paint system is being upgraded to a high performance system; usually requiring the application of 2 pack paints or coatings, the existing paint system will need to be identified to ensure compatibility with the new system. Where this is unable to be ascertained, in particular if the existing paint surface is soft and easily scratched (with a fingernail), removal and / or a trail patch should be required.

The preparation below covers compromised, corroded, previously painted steel and galvanised surfaces, as well as surfaces in good condition.

Step 1: Wash using Resene Interior Paint Prep and Cleaner as per label / data sheet directions.

Step 2: Sand and **s**crape and / or power tool clean to remove all flaked paint and corroded areas. Remove dust.

Regardless of the method used, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance. All areas of old paint should be thoroughly abraded to achieve a good key for adhesion.

Step 3: Immediately prime with the specified primer to prevent corrosion or contamination.

SECTION 6 – Interior Galvanised Steel

Spec Sheet 4:6/1 - New Interior Galvanised Steel

Hot dipped galvanised steel is frequently used for exterior steel, although it can be used for interior. The size of the steel capable of being galvanised will depend on the size and capacity of the molten zinc bath and its design, as specific design parameters are required for Hot Dip Galvanizing items, please refer to **http://www.gaa.com.au.**

There are other methods for applying zinc to steel and these include application of metal spray zinc or zinc rich paints (**see Section 3**). The limitation being that they are line of sight application, e.g. they do not coat the inside of tubes and tight angles.

Galvanised steel is chromate quenched and this typically results in a hard, glass like surface to which a paint coating (even an etch primer) will not adhere.

Whip blasting (an off-site process refer to **Surface Information Note 6**) is the best method to profile a chromate quenched surface. Alternatives (as detailed below) can be used when on site preparation of chromate quenched galvanising is required.

This specification assumes the steel has been hot dip galvanised to achieve 450-600 g/m2 (63-84 microns zinc thickness) as per the current accepted AS/NZS 4680. Furthermore, that the steelwork has not been welded nor damaged in transit to the site. If this is not the case, a new specification will be required.

Step 1: Thoroughly degrease / clean the surface as per AS 1627.1 Standard and then use water blasting to remove all cleaning products and contaminants, including salts.

Note I: Glossy areas on new HD galvanising are an indication of chromate quenching post galvanising and this surface MUST be removed prior to painting.

Step 2: Sweep blast the galvanised surfaces with a clean, non-metallic media to slightly profile the surface and provide a dull uniform finish. Care must be taken to ensure that no more than 10 microns of zinc is removed from the galvanised surface during this process.

Note II: Hand tool cleaning is not a preferred method of preparing the chromate quenched surface, due to the difficulty of achieving the desired and correct level of even preparation. However, if sweep blasting is not possible, then these areas must be sanded using a mechanical sanding with 100 grit abrasive paper to achieve a dull finish. Care must be taken to ensure no excess removal of the zinc layer in this process.

Refer to **Surface Information Note 6**; sub-section “Sweep Blast Cleaning – Hot Dip Galvanized Steel”.

Note III: Priming must commence within 2 hours of preparation taking place. The contractor shall ensure that there is no deterioration in the condition of the surfaces to be painted, between the actual preparation and the application of the priming paint. Any extraneous matter deposited before painting shall be completely removed and the surface restored to that specified.

Spec Sheet 4:6/3 - Repaint Interior Galvanised Steel

Preparation for repainting galvanised interior steel is the same for primed interior mild steel; refer to **Spec Sheet 4:5/3.**

Where a high performance coating system is required, either to upgrade an existing structure for an alternative use or before applying an intumescent coating, contact Resene Technical Services.

SECTION 7 – Preparation before applying Intumescent Coating

Spec Sheet 4:7HP/3 - Repainting or Upgrading Steel to an Intumescent Coating

Refer to a Technical Resene Services.

Spec Sheet 4:7/3 - Repaint Intumescent Coating

Refer to a Technical Resene Services.

SECTION 8 - Aluminium

Spec Sheet 4:8/1 - New Aluminium; including Anodised, Powder coated

New aluminium typically has form oil and other contaminants on the surface from the forming process. A thorough and careful clean is required, including a check to ensure the surface is contaminant free. Most aluminium supplied to projects is used on window joinery and is typically anodised or powder coated. The preparation for painting new anodised or powder coated aluminium is unchanged.

Step 1: Scrub down using Resene Roof and Metal Wash diluted to label / data sheet directions. Rinse clean with copious quantities of clean water to remove all oils, grease, dust and any other contaminants. Test surface is degreased by wiping with clean cotton wool. Repeat process if necessary. **Data Sheet D88**

Note I: For window joinery, special care is needed to avoid coating any rubber seals / sealants with any paints specified in this section. If practical, remove the rubber seal (and possibly the window glass) and once painted, replace with new rubber seals.

Note II: The mitre joint in aluminium windows will be more noticeable, the lighter the colour selected.

Spec Sheet 4:8/2 - Weathered Aluminium; including Anodised, Powder coated

The surface will typically be dulled with some corrosion present (aluminium oxide AlO2). Anodised and powder coated aluminium will be chalky. A thorough careful clean is required to remove chalked paint and contaminants. There is likely to be mould or moss growth on powder coated surfaces

Step 1: Treat moss and mould with Resene Moss & Mould Killer; use as directed on the label.

Note I: For heavy infestations, an additional application(s) may be needed. **Data Sheet D80**

Step 2: Scrub down using Resene Roof and Metal Wash diluted to label / data sheet directions. Rinse clean with copious quantities of clean water to remove all oils, grease, dust and any other contaminants. Test surface is degreased by wiping with clean cotton wool. Repeat process if necessary. **Data Sheet D88**

Step 3: Thoroughly wet sand to remove any areas of corrosion, and to remove aluminium oxide layer and provide a better key for adhesion. Any pitted areas should be wet sanded to a smooth profile. If possible, any sharp edges on the aluminium profile should be rounded off, to allow better coating film build.

Note II: For window joinery, special care is needed to avoid coating any rubber seals / sealants with any paints specified in this section. If practical, remove the rubber seal (and possibly the window glass) and once painted, replace with new rubber seals.

Note III: The mitre joint in aluminium windows will be more noticeable the lighter the colour selected.

SECTION 9 – Copper Spouting

Spec Sheet 4:9/3 - Repaint copper spouting

The surface will typically be dulled with the possible flaking and / or detachment of the paint system to bare copper. A thorough careful clean is required to remove chalked paint and contaminants.

Step 1: Treat moss and mould with Resene Moss & Mould Killer; use as directed on the label.

Note I: For heavy infestations, an additional application(s) may be needed. **Data Sheet D80**

Step 2: Scrub down using Resene Paint Prep and House Wash diluted to label / data sheet directions. Rinse clean with copious quantities of clean water to remove all oils, grease, dust and any other contaminants. Test surface is degreased by wiping with clean cotton wool. Repeat process if necessary. **Data Sheet D812**

Step 3: Thoroughly wet sand to remove any areas of flaking and / or detachment paint back to a sound edge.

SECTION 10 – Stainless Steel

Spec Sheet 4:10/1 - Painting Stainless Steel

Stainless steel does not readily corrode, rust or stain with water as ordinary steel does. However, it is not fully stain-proof in low-oxygen, high-salinity, poor air-circulation or industrial contamination environments. There are various grades and surface finishes of stainless steel to suit the environment the alloy must endure. Stainless steel is used where both the properties of steel and corrosion resistance are required.

Stainless steel differs from carbon steel by the amount of chromium present. Unprotected carbon steel rusts readily when exposed to air and moisture. This iron oxide film (the rust) is active and accelerates corrosion by forming more iron oxide which, because of the greater volume of the iron oxide, tends to flake and fall away. Stainless steels contain sufficient chromium and other rare metals to form a passive film of chromium oxide which prevents further surface corrosion by blocking oxygen diffusion to the steel surface and blocks corrosion from spreading into the metal's internal structure. Passivation occurs only if the proportion of chromium is high enough and oxygen is present.

There are over 150 grades of stainless steel, of which 15 are most commonly used. There are a number of systems for grading stainless steel. The most commonly used grades are 304 and 316.
304 Stainless is a Cr-Ni general purpose stainless steel. Grade 316 is the standard molybdenum-bearing grade, second in importance to 304 the molybdenum gives 316 better overall corrosion resistant properties than Grade 304, particularly higher resistance to pitting and crevice corrosion in chloride environments.

Where long term corrosion resistance is the prime requirement stainless steel is best left unpainted.

If damage to the protective oxide layer occurs stainless steel can show tea staining.
Tea staining can be described as: discolouration of the surface of stainless steel that does not affect the structural integrity or the longevity of the material. Visually it is a discolouration of the metal surface, which tends to follow the “grain” of any surface finish. Although unpleasant to look at, it is not a serious form of corrosion. Aesthetically it is unacceptable so the following information is designed to help you understand its causes and institute a maintenance plan to keep your stainless steel looking better for longer. Tea staining of stainless steels occurs most commonly in coastal areas and becomes progressively worse the closer you get to water (note that most of New Zealand is considered a coastal area). Other factors such as pollution, higher temperatures, surface finish, (the smoother the better and more highly polished) and humidity can also increase the tea staining effect.

Painting is usually undertaken for aesthetics only. The stainless steel surface needs to be abraded to produce a mechanical key for a paint system and this damages the protective oxide layer.

Step 1: Scrub down using Resene Roof and Metal Wash. Data Sheet D88

Step 2: Lightly abrade the surface using a very fine sandpaper e.g. 320 girt sand paper or a red 3M poly pad. Care must be taken to minimize damage or scratching the surface as scratch marks may telegraph through the paint system

SECTION 11 – Cast/Wrought Iron

Spec Sheet 4:11/2 - Weathered Cast/Wrought Iron

It is now rare to find new cast iron, so this SIPDS focuses on the preparation and painting of old or weathered structures.

Step 1: Treat areas of moss/mould infestation with Resene Moss and Mould Killer diluted and used to label/data sheet instructions. For heavy infestations, more applications may be needed. **Data Sheet D80**

Step 2: Scrub down using Resene Roof and Metal Wash diluted and used to label/data sheet. **Do not allow the wash solution to dry out on the surface** (this includes window glass and joinery). Rinse clean or hose down with copious amounts of fresh water, ensuring all wash solution is removed. **Do not allow runoff to enter wastewater drains.** Contact your local council for discharge details. **Data Sheet D88**

Note I: Remove as much red rust as is practicable by using mechanical methods e.g., 3M Rust Removal Disc, to leave only soundly adherent corrosion products taking care not to damage either the substrate or the surrounding areas.

Note II: **Dry abrasive or vapour blasting can be used to achieve the highest level of surface preparation.**

Note III: For more information on Cast/Wrought Iron, see Substrate Information Notes **Note 24**

Spec Sheet 4:11/3 - Repaint Cast/Wrought Iron

It is now rare to find new cast iron, so this SIPDS focuses on the preparation and painting of previously painted structures.

Step 1: Before starting any preparation, check for lead in the existing paint work.

Note 1: Before beginning any surface preparation, tests should be done to ensure the old paint does not contain lead. Paint flakes with layers older than 1970 are likely to have lead in them. If lead-based paints are identified on this job, then the OSH Guidelines for the Management of lead Based Paint must be read and followed. **Where these guidelines conflict with any part of this specification, the guidelines must take precedence.** Flakes of lead paints and any sanding dust need to be carefully managed collected and disposed of.

Step 2: Treat areas of moss/mould infestation with Resene Moss and Mould Killer diluted and used to label/data sheet instructions. For heavy infestations, more applications may be needed. **Data Sheet D80**

Step 3: Scrub down using Paint Prep and Housewash diluted and used to label/data sheet. **Do not allow the wash solution to dry out on the surface** (this includes window glass and joinery). Rinse clean or hose down with copious amounts of fresh water, ensuring all wash solution and surface chalk residues are removed. **Do not allow runoff to enter wastewater drains.** Contact your local council for discharge details. **Data Sheet D812**

Note II: All paint that is flaking or unsound must be removed by using mechanical methods, (3M Rust and Paint Removal Disc), chemical stripper or high-pressure water-blasting taking care not to damage either the substrate or the surrounding areas.

Remove as much red rust as is practicable and all paint that is flaking or unsound must be removed by using mechanical methods e.g., 3M Rust and Paint Removal Disc, to leave only soundly adherent corrosion products taking care not to damage either the substrate or the surrounding areas.

Where under-film corrosion is taking place, the existing paint must first be removed as above and remove under film corrosion products. All paint edges must be feathered to a smooth finish.

Note III: **If lead is not present in the existing paint system, dry abrasive or vapour blasting can be used to achieve the highest level of surface preparation.**

Note 1V: For more information on Cast/Wrought Iron, see Substrate Information Notes **Note 24**

APPENDIX

Appendix 1 – Classification of Environments

As per AS/NZS 2312 and based on ISO 9223 corrosivity categories

Micro-Environments

In addition to climatic effects, the local environmental effects (microclimate) produced by the erection of a structure or instillation of equipment needed to be taken into account. Such on-site factors require additional consideration because a mildly corrosive atmosphere can be converted into an aggressive environment by microclimatic effects. For example, a significant acceleration of corrosion rate can occur in the following circumstances:

1/ At locations where the metal surface remains damp for an extended period, such as where surfaces are not freely drained or are sheltered from sunlight.

2/ On unwashed surfaces, i.e. surfaces exposed to the atmospheric contaminants, notably coastal salts and pollution, but protected from cleansing rain.

Other microclimatic effects which may accelerate the corrosion rate of the deterioration of its protective coating include acidic or alkaline fallout, industrial chemicals and solvents, airborne fertilizers and chemicals, prevailing winds which transport contamination, hot or cold surfaces and surfaces exposed to abrasion and/or impact etc. It is very difficult, if not impossible, to predict accurately the aggressiveness of a given environment and a certain amount of educated judgment is required to assess its influence on coating life.

Category C1: Very Low

Most commonly found inside heated or air conditioned buildings with clean atmospheres. They may also be found in semi-sheltered locations remote from marine or industrial influence and in unheated or non-air conditioned buildings. The only external environments in Australia or New Zealand are some alpine regions although generally these environments will extend into category C2.

Category C2: Low

This category includes dry, rural areas as well as other regions remote from the coast or sources of pollution. Most (but not all) areas of Australia or New Zealand beyond 50km from the sea are in this category. Unheated buildings where some condensation may occur, such as warehouses and sports halls, can be in this category, however proximity to the coast is an important factor.

Category C3: Medium

This category covers coastal areas with low salinity. The extent of the affected area varies with factors such as winds, topography and vegetation. Along ocean front areas with breaking surf and significant salt spray, it extends from about 1km inland to between 10 to 50 km inland, depending on the strength of prevailing winds and topography. Such regions are also found in urban and industrial areas with low pollution levels, however these areas are uncommon.

Category C4: High

This category occurs mainly on the coast. Around sheltered bays, Category C4 extends up to 50m inland from the shoreline. In areas of rough seas and surf, it extends from about 200-300m to 1km inland. As with other categories the extent depends on winds, wave action and topography. Industrial regions may also fit into this category and this category extends inside the plant where it is best considered as a microenvironment. Damp, contaminated interior environments such as occur with swimming pools, dye works, paper plants, foundry's, smelters and chemical plants may also extend into this category.

Category C5: Very High

(C5-I: Industrial C5-M: Marine) & CX-Extreme

This category is common offshore and on the beachfront in regions of rough seas and surf beaches. The region can extend inland for several hundred metres and in some areas it can extend more than 1/2km from the coast. This category may also be found in aggressive industrial areas, where the environment may be acidic with pH of <5. For this reason, Category C5 is divided into Marine and Industrial for purposes of coating selection. Some of the damp and/or contaminated interior environments in category C4 may occasionally extend into this category. In addition there is an additional Category CX Extreme, for severe surf and off shore. If this is encountered the user should seek professional advice.

Category T: Inland Tropical has been omitted in this list. Please refer to the Standard if required.

Important Note :
If a site is considered to be in more than one category, then a selected coating should be capable of resisting the most sever of the environments involved.

Note: For a full, more detailed description please refer to the above mentioned Standard

To obtain the full AS/NZS 2312 Standard, contact either www.standards.co.nz or www.standards.org.au

Appendix 2: Corrosion Theory

Corrosion mechanism

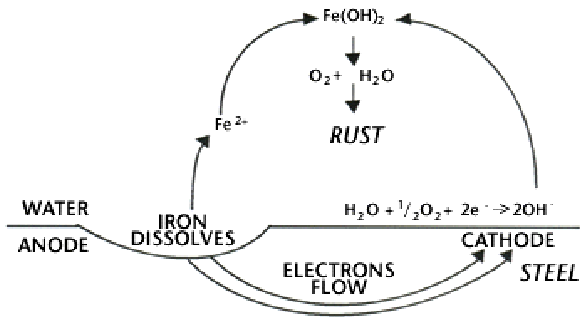
Steel is an alloy or mixture of iron and up to 1.7% carbon, sometimes with small quantities of elements such as manganese, phosphorous, sulphur and silicon. The corrosion resistance of steel is dominated by interactions between the constituents of the steel. The steel surface contains both anodic and cathodic sites. In the presence of a surface layer of water or other conducting solution, an electric current passes between the anodes and cathodes. By convention, the transmission of the current is by electrons, which are the electrical charges attached to atoms, and are generated at anodes. Their loss leaves the anodic areas deficient in electrons and iron goes into solution as ferrous ions viz.

Fe	**$\rightarrow$**	**Fe^{+2}**	**+**	**$2e^-$**
Iron		**Ferrous ions**	**Electrons**	**(anode reaction)**

This reaction is the basis of the corrosion of iron. Electrons generated as shown above are consumed at the cathode area, and react there in various ways depending on the availability of oxygen. In normal atmospheric corrosion, there is an ample supply of oxygen and the following reaction occurs.

Fe	**$\rightarrow$**	**Fe^{+2}**	**+**	**$2e^-$**
Iron		**Ferrous ions**	**Electrons**	**(anode reaction)**
$H_2O + ½O_2$ **Water Oxygen**	**+**	**$2e^-$** **Electrons**	**$\rightarrow$** **Hydroxyl Ions**	**$2OH^-$** **(cathode reaction)**

The hydroxyl ions (OH) from the cathode combine with the ferrous ions (Fe+2) from the anode to form ferrous hydroxide, which is precipitated. This further reacts with oxygen and water to form hydrated ferric oxide, which is known as rust. This is shown as:



The rate of rust formation rapidly increases if the transfer of electrons from the anode to the cathode can be made easier; which happens if the conductivity of the water increases. This can occur due to the presence of dissolved salts, such as sea salts, on the surface or sulphur products from pollution fallout.

In atmospheric corrosion, it has been found that moisture is the controlling factor in the rate of rust formation and little rusting occurs unless the relative humidity is above 60-70%. In contact with acids, corrosion increases because of direct attack on the metal, while under alkaline conditions the rusting of iron is inhibited.

Care must be taken when joining metals of different potentials together as dissimilar metal corrosion may take place. Use of a galvanic series chart is of help in this area.

Galvanic Series of Metals

Anodic end - greater tendency to corrode

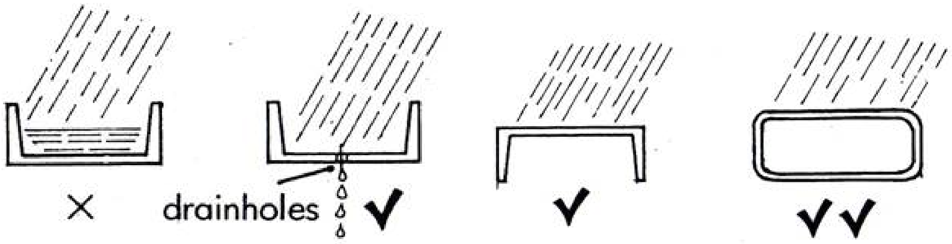
1. Magnesium
2. Zinc
3. Aluminium
4. Cadium
5. Steel
6. Cast Iron
7. Stainless steels (A)
8. Lead / Tin solders
9. Lead
10. Tin
11. Nickel (A)
12. Iconel (A)
13. Nickel / hromium alloys
14. Brasses
15. Copper bronzes
16. Nickel / Silver alloys
17. Copper / Nickel alloys
18. Monel
19. Silver solder
20. Nickel
21. Iconel
22. Stainless steels (P)
23. Silver
24. Graphite
25. Gold
26. Platinum

Cathodic end - lesser tendency to corrode

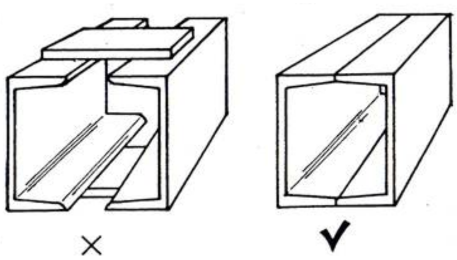
(A) = Active metal surfaces
(P) = Passive metal surfaces

Appendix 3: DESIGN CONSIDERATIONS

The engineer should avoid all details, which would make it possible for water or foreign matter to accumulate and therefore accelerate the failure of coatings. Where this is not possible drainage holes should be provided, or even better avoid the possibility of accumulation in the first place.



The structure should be designed to facilitate the application of maintenance coatings in the future. Some details of structures can make it virtually impossible to apply a continuous coating.

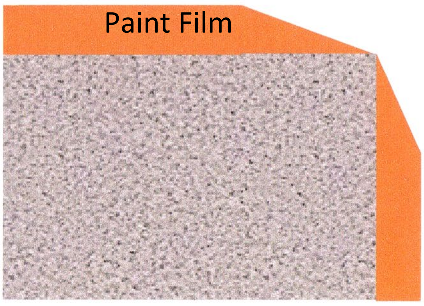


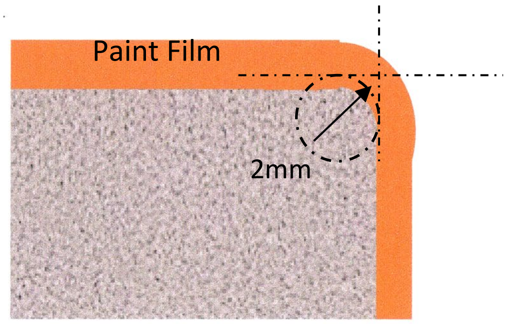
Structural steel shapes

The outside of an angle always presents a problem, being difficult to coat because coatings tend to pull away from a point or sharp edge. The interior of a square angle is difficult to coat as dirt accumulates here and it is often a difficult area to reach by spray or brush.

Sharp edges

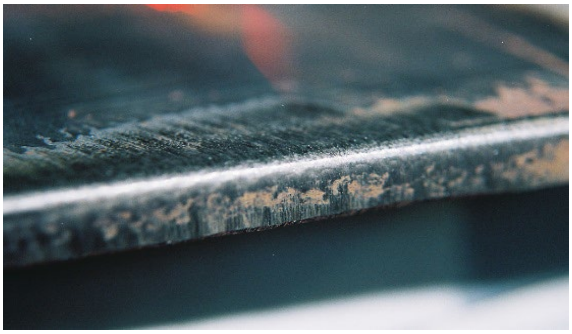
Sharp edges should be eliminated wherever possible. Remember coating materials tend to run away from an edge. If the coating is applied by brush and the applicator brushes away from the edge, the coating is invariably brushed off, leaving a thin area. Brushing should be towards an edge. When spraying, double coating of edges should take place where possible.





Raw Steel Edge

Removed using a sanding disc in a grinder

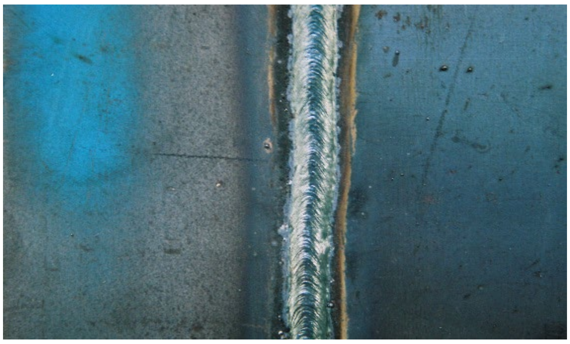


All internal and external sharp corners / edges are to be removed by grinding to provide a minimum radius of 2mm. (in case of Metal Spray a minimum of 3mm)

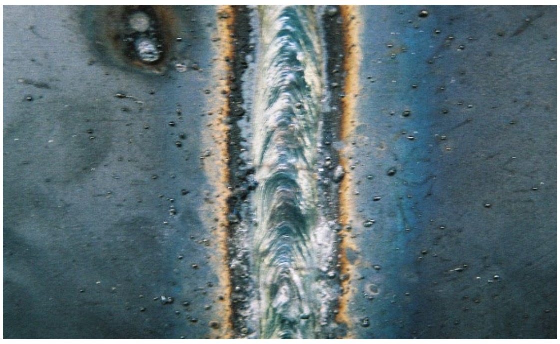
Welded joints

Welds must be given special attention when coatings are specified. One of the major difficulties along the welds occurs because of weld splatter. Weld splatter should be carefully removed by blasting or chipping. Where resistance to corrosion is required, all rough welding should be ground smooth. All welds should, if possible, be double coated.

Good Weld



Poor Weld



After welding, all surfaces to be coated must be thoroughly cleaned and free from flux, weld spatter and surface defects, including cracks and deep pits. Weld spatter must be removed carefully by blasting or mechanical grinding. There should be no areas of rough welding.

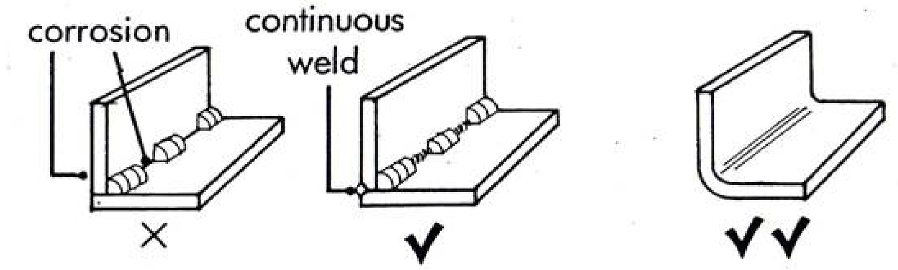
Removal of such defects may affect the weld certification.

Weld flux

Weld flux is a hygroscopic material. Left on a weld it absorbs moisture and creates a spot where early coating failure can be anticipated. Specifications should ensure complete removal of all weld flux, by wire brushing and washing with copious quantities of fresh water.

Discontinuous, tack or skip welds

In a corrosive atmosphere these welds are vulnerable since they cannot be properly coated. Skip welding consists of welding a 5cm bead and then skipping from 5cm to 30cm before welding another 5cm bead. Skip welding is used mainly for reinforcing purposes when a continuous weld is not considered necessary. Structures, which will be exposed to a corrosive environment, should have continuous welds.

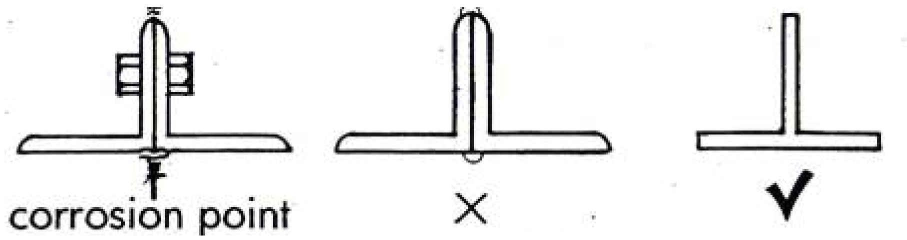


Lap welds

Lap welding consists of continuous welding on the outside surfaces only, leaving the steel plates lapped on the inside thus forming crevices, which are difficult to coat properly. If a coating is to give best results, all joints should be completely sealed.

Steel angles

Steel angles placed back to back are often used to form trusses. These angles are usually separated by washers or other members of the truss. The resultant gap is difficult to protect in a corrosive atmosphere. Trusses should be designed with a minimum of crevices between steel members or alternatively adequately coated before joining.



Brackets

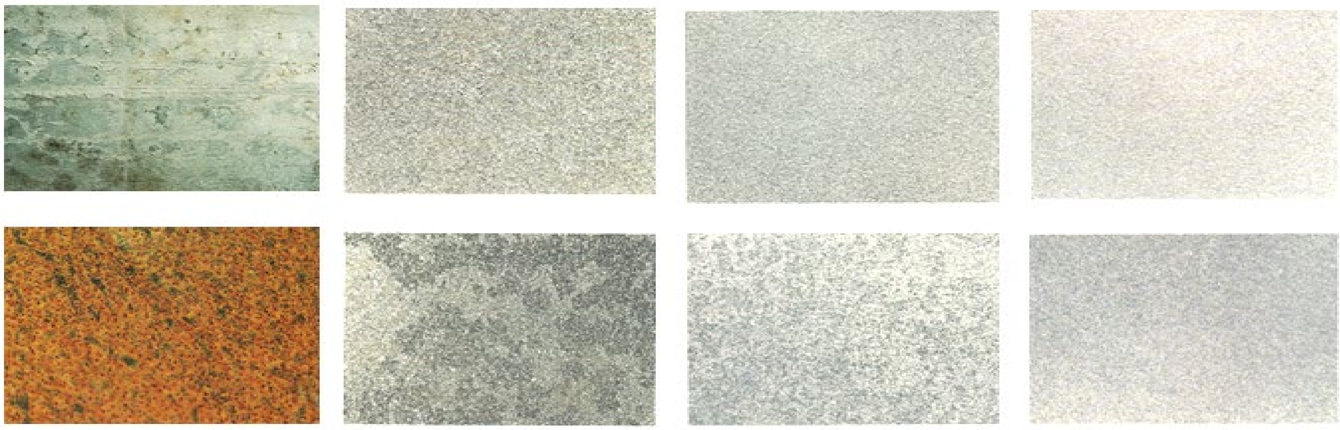
Brackets and other temporary fabricating aids are frequently welded on the surface of structures during construction. They are sometimes left in place after the job is completed. If the brackets are cut from the surface a rough spot usually remains, thus starting a corrosion problem. If left in situ and even though thoroughly cleaned by blasting, these fixtures are extremely difficult to coat properly. All brackets and extra metal should be removed and previous contact areas ground smooth.

Appendix 4: PREPARATION ABRASIVE BLASTING / WHIP BLASTINGS

These are given in the AS1627 Standards as seen in the below chart:

Description	Australian Standard	Swedish Standard	SSPC Standard	NACE Standard
Brush Blast	AS1627.4 Class 1	Sa1	SSPC-SP 7	NACE 4
Commercial Blast	AS1627.4 Class 2	Sa2	SSPC-SP 6	NACE 3
Near White Blast	AS1627.4 Class 2.5	Sa2 ½	SSPC-SP 10	NACE2
White Blast	AS1627.4 Class 3	Sa3	SSPC-SP5	NACE1

Start Condition	Class 2	Class 2 ½	Class 3
	67% Clean	95% Clean	100% Clean



It is important that the surface profile is also specified. This must be enough for adhesion of the coating but not too much that it will require excessive paint to cover it. Contact Resene Technical Services for advice in this area.

In most cases, for paint, a blast profile of 25-50 microns must be achieved. A much higher profile is required for thermal spray metals and high impact paint coatings. More for in this process.

Immediately apply the specified primer to prevent flash rusting or other contamination (4 hours is the maximum time the surface can be left unprimed).

Appendix 5: MIXING & INDUCTION TIMES FOR 2 PACK COATING SYSTEMS

Special Mixing Needed

All mixing is to be done using an air driven or explosion proof power stirrer, to ensure all the base on the sides and bottom of the can is intimately mixed in with the hardener. Add the hardener slowly to the base, while power stirring. Failure to mix the hardener in properly will result in poor film formation and serious degradation of the performance of the applied product.

The speed of the POWER STIRRER should be as low as possible. The coating should have a slight vortex at the surface. A large vortex tends to mix air into the coating, which can cause pinholes and air bubbles during application. The mixed coating should have a uniform colour and consistency.

Induction Time

Two component mixed products should be left for the specified induction time (check requirement on product data sheet) before application to allow for chemical cross-linking (hardening reactions) to be initiated.

Pot Life

The pot life will be indicated on the product data sheet and these will differ for each product and under different temperatures. Do not use the product after the stated time of pot life. Application equipment should be thoroughly cleaned before being used to apply newly mixed product. Higher temperatures will shorten the pot-life. 10°C increases in temperature can half the pot-life, for example, if the temperate range increases from 20 to 30 degrees. Care is needed on hot days!

Adherence to the pot life must be strictly followed and, where necessary, allowances made for temperature changes during application (as above). Many mixed 2 pack products maintain a liquid state well after the pot life window has been exceeded. Thickening or gelling of the product is therefore **not** a safe indication of when to cease applying the product. On no account must thickening product be thinned to facilitate further application.

Appendix 6: USE OF SOLVENTS, REQUIREMENTS, SAFE HANDLING

Fire and explosion

Many paints contain flammable organic solvents. As soon as a paint container is opened, solvent vapours are released.

The flash point is the lowest temperature at which a liquid gives off sufficient vapour to form a flammable mixture in contact with air.

If the flash point of the paint is lower, or close to the ambient air temperature, there is a very considerable risk of fire or explosion. It only needs a spark or flame to set it off. If the flash point exceeds the ambient air temperature, there is still a risk of fire. Therefore no naked flames, cigarettes or matches should be allowed near the area where paint is being applied or stored. Precautions should also be taken to avoid sparks caused by metal to metal contact or from electrical appliances. If a fire involving paint does occur:

- Do not extinguish with water, as paint solvents float on water, and this helps to spread fire.
- Use a dry chemical, foam, or CO_2 extinguisher.
- Protect yourself from the fumes with breathing apparatus.

Skin and eye contact

If paint is spilt, the following precautions should be taken:

- Ventilate the area to remove the fumes.
- Mop up all spilled paint with absorbent material, ensuring that all materials used to mop up the paint are disposed of in closed metal containers.

It is recommended that the following precautions should be taken to prevent paint coming into contact with the skin and eyes:

- Select sensible working clothes that cover as much of the body as possible.
- Always wear gloves and eye protection.
- Do not touch your mouth or eyes with your gloves.
- Read and observe precautionary notices on paint containers.
- Eyes are particularly sensitive, so if you are splashed in the eyes, by paint or thinners flood them immediately with fresh water for at least 10 minutes and SEEK MEDICAL ADVICE IMMEDIATELY.
- If paint should splash on your skin, remove it with soap and water or a proprietary cleaner. NEVER USE SOLVENT.
- Remember to wash hands and rinse mouth after working with paint.
- Despite these precautions, paint can still come into contact with the skin or eyes (e.g. spray mist, excessive splashing), so a non-greasy barrier cream is recommended for all exposed skin.

Remember the object is to avoid skin contact. If your clothes become soaked in paint, change them immediately and thoroughly wash the affected garments with soap and water.

Inhalation

The inhalation of solvent fumes, dust, paint vapours must be avoided. Please follow these precautions listed:

- Ensure that ventilation is available to remove solvent fumes.
- If spaces are difficult to ventilate, efficiently wear an airfed hood / mask.
- Think about where the fumes are being vented. They could affect other people in adjacent spaces.
- Remember solvent fumes are heavier than air, they push breathable air upwards. They can flow down drains or ventilation ducts.
- If dizziness, drunkenness or headaches are experienced, this could indicate you are being affected by solvent fumes. Move into the fresh air and do not return until the ventilation has improved.
- If breathing fumes results in the collapse of a painter, they should be carefully moved into fresh air and allowed to recover gradually. Forced exercise is inadvisable.
- Never enter a space where fumes have or could have accumulated, without wearing breathing apparatus.
- The mist of paint particles created when spraying should not be inhaled.

To prevent the inhalation of spray mists:

- In well ventilated spaces, a dust cartridge respirator can filter out these particles of paint effectively. (Replace the cartridge regularly.)
- If ventilation is poor, an airfed hood or mask is essential, if any doubt whatsoever exists, wear an airfed hood / mask.
- Never filter spray mists through rags wrapped over the mouth, as the rags can get soaked and allow paint to come into direct contact with the mouth. The rags are also rather inefficient filters.
- When surface preparation involves removal of old coatings, minimise the spread of dust generated to protect workers and neighbourhood communities and dispose of coatings residues carefully.
- When sprayed ISOCYANATE containing products may be harmful by inhalation or through contact with skin and eyes. Spraying iocyanate containing products is harmful and covered under specific Legislation.
- Wear suitable protective clothing, gloves, eye and face protection, suitable breathing protection such as an air supplied respirator, or hood when applying isocyanate containing products by spray.
- Additional information is available from the Health Department on the safe handling and application procedures for isocyanate containing products.

Ingestion

Food and drink should not be consumed, stored or prepared in areas where paint is stored or being applied.

In the case of accidental paint ingestion, medical attention should be obtained at once.

It is the purpose of this SIPDS to establish the minimum standards of hygiene and protection for personnel applying paints in the surface coatings industry. It must be recognised that in a progressive society, improvements in the quality and application of paints are inevitable, resulting in the better protection of steel.

Older slower methods of paint application are giving way to modern, faster techniques, and it is important to carefully study and overcome any health hazards, which may result from these newer methods.

It is not the purpose of this SIPDS to spread alarm to the industry. We are well aware that vast quantities of paint have been, and are being applied to steel, without any serious harm occurring to painters, who often have very rudimentary or no protection at all. We do, however, recommend that our advice be carefully studied, as it is intended to improve the hygiene and in some cases, the safety of painters using older conventional paints, as well as the more modern coatings. These recommendations are meant to supplement and not replace any special legal regulations in any country, regarding the application of surface coatings.

Airless spray

Application of paint by airless spray is probably the most popular method. This rapid method of paint application produces fine paint mists, which in addition to having a nuisance value to workers, may in the case of some paints, present a respiratory health hazard. Laboratory and field trials have shown that the mist, other than isocyanate based, is essentially a dust problem that can be satisfactorily overcome by the use of a suitable respirator, with a dust cartridge to British Standard Specification 2091 (type B) and pre-filter, or similar national standard specification. Other protective equipment necessary includes eye shields, head cover, rubber gloves and overalls.

Earthing

High velocity flow rates of paint and cleaning solvents in airless spray application will cause a build up of static electricity, particularly in dry weather, resulting in a high voltage spark discharge. To eliminate fire risk from this cause, earthing of the airless spray gun and unit is essential. While they hold the gun, this will also help to earth the painter's protective clothing, which can also build up electrical charge. Rubber and plastic garments are particularly prone to this effect.

Brush and roller

With brush or roller application, the precautions required are minimal, there being no respiratory hazard associated with these traditional methods. Discomfort due to eye splashes is perhaps the most important mishap that can occur. This discomfort can be eliminated by the use of inexpensive eye shields. Hand protection is also desirable, plastic or rubber gloves being suitable for this purpose.

However, some of these may be miscible / swellable with some paint solvents and it is possible that they may assist organic poison absorption through the skin, and for this reason most authorities are against their use. However, it is difficult to remove dried paint from the skin using only soap and water without the prior use of barrier creams, and to leave paint on the skin also cannot be considered satisfactory.

The use of a proprietary industrial skin cleanser, followed by a skin conditioner (to replace lost natural oils), is often the best way of overcoming these skin cleaning difficulties. If painters insist on pre-treating their skin before spraying, then a non-greasy barrier cream should be supplied. Greasy substances such as Vaseline or petroleum jelly should not be used.

General precautions

- Do not smoke while stirring, handling and applying compositions.
- Always wash hands before smoking and eating.
- In case of splashing, wash skin immediately with soap and water.
- If splashes get into eyes, flood copiously with water at once and obtain medical attention.

The foregoing recommendations can be considered as the minimum standards, consistent with hygiene and safety. However, more sophisticated but expensive equipment is available in the field of respiratory protection, and there are other protective measures which can add to the comfort of the painter.

Air line respirators

Although expensive, the advantages of an airline respirator are obvious. Clean fresh air is supplied to workpeople through an air hose, making them independent of any polluted atmosphere in which they may have to work.

Solvent fumes

In situations where solvent odour becomes objectionable, a "light fume" cartridge can be added to the respirator in a duplex arrangement. This arrangement is intended for outdoor use and it must always be remembered that cartridge respirators must never be used in atmospheres deficient in oxygen.

Disposable overalls and head cowls

The overalls are available as coats to be worn over normal overalls - the head cowls cover the whole of the head apart from a 15cm diameter circle for the face. Both are made of a fibre composition, which affords excellent protection against spray and splashes.

The notes listed below are designed to provide help and guidance when modern Protective Coatings are being used in different environments. These notes are not intended to be a complete treatise on the subject of safety during painting but are designed to make one aware of some of the dangers involved. Further information may be made available if required by contacting our local representatives. The two notes presented cover: (1) The interior painting of tanks, (2) Exterior painting.

Tank painting

A high proportion of tank coatings applied throughout the world contain flammable organic solvents, which can form explosive mixtures with air. Refer to AS/NZS 2865:2001 Safe Working in a Confined Space, for safety precautions to be taken while applying these coatings. Attention must be given to the following points:

- Danger of explosion or fire.
- Provision of a suitable breathing environment
- Prevention of skin irritation problems.

<u>Danger of explosion or fire</u>

The key factors in preventing explosion or fire are:

- Adequate ventilation.
- Elimination of naked flames, sparks and any ignition sources.

Any organic based coating could, merely by the normal process of drying, give off sufficient solvent vapour to produce an explosive mixture in a tank, when the vapour concentration reaches or exceeds 1% by volume in air. However, at 1% these solvents produce an intolerably unpleasant odour, often with irritating skin effects and smarting of the eyes. These symptoms should be taken as a warning sign that better ventilation is needed. 0.2% solvent vapour in air is normally recommended to give a five-fold safety margin and at this concentration. NO EXPLOSION CAN OCCUR.

Ventilation

Both air blowing and extraction methods of ventilation have been suggested but experience has shown that of the two methods, blowing is more efficient. Extraction tends to produce channelling with smooth air flow and dangerous pockets of solvent vapour. Blowing causes turbulence, which disperses solvent pockets.

For individual tanks, the blowing air is trunked into the coaming down to a depth of 2.5-3 metres in a 12 metre tank. This prevents the blowing air immediately returning through the coaming without sweeping the tank. The geometry and size of tanks makes each one a separate problem and it is essential to check that the ventilation arrangement, fan output, etc., is suitable before painting commences.

FORE AND AFT PEAKS AND DOUBLE BOTTOMS of ship tanks require special attention. Because of their construction, adequate ventilation is difficult, resulting in a rapid build up of solvent vapours to toxic and explosive concentrations. It is necessary to have a responsible standby man at the tank opening to keep a "head count" of painters and other workers and to ensure no interruption of essential services, i.e. air supplies and electricity.

Elimination of ignition sources

- Welding, cutting or grinding in the tank must be forbidden until paint fumes are totally dispersed. This also applies to all areas within a 15 metre radius of the tank and trunking outlet.
- Coamings must be simply covered to prevent spark entry where welding is being carried out on superstructure.
- Lights, including hand torches, must be certified as flash proof.
- Smoking must be prohibited in or near tanks or extraction systems.
- No electrical junction boxes should be allowed in tanks.
- Airless spray equipment must be earthed (static electricity danger).

Solvent vapour and paint mists - protection of painting personnel

No ventilation system can reduce solvent vapour levels to below the Threshold Limit Values for solvents in tank coating procedures. Painters must therefore wear air fed hoods or pressure fed masks with additional eye protection. Normal protective clothing must be worn, e.g. overalls, gloves and non-spark footwear.

Skin irritation

If proper protective clothing has been worn, e.g. overalls, gloves, airline hood, etc., no difficulty should be experienced from skin irritation. Any small areas not protected by clothing, such as wrists or neck can be treated with a non-greasy barrier cream. Petroleum jelly is not recommended. Areas of skin accidentally contaminated with paint should be cleaned with a proprietary industrial skin cleaner, then thoroughly washed with soap and water. Skin conditioners designed to replace the natural oils in the skin can be used with advantage.

Summary of precautions to be taken:

1. Provide adequate ventilation.
2. Ensure that the tanks and surrounding areas are flame and spark free.
3. Provide painters with full respiratory protection.
4. Ensure that suitable protective clothing is worn.
5. Do not smoke while stirring, handling and applying compositions.
6. Always wash hands before smoking or eating.
7. In case of splashing, wash skin immediately with soap and water.
8. If splashes get into the eye, flood copiously with water at once and obtain medical attention.
9. Rescue equipment with independent air supply (air cylinder) to be available for use in emergencies.
10. Operate a "head count" of men working in the tank and ensure no interruption of essential services.

It is believed that the foregoing notes will provide a practical basis for the safe painting of tanks. There are however, a number of technical terms and principles, which provide the scientific basis of these notes and which are often quoted (or misquoted) in practice. The following simple definitions should help clear up any misconceptions:

Flashpoint

The lowest temperature at which a liquid gives off vapour sufficient to form an inflammable mixture in contact with air. It is a rather rough, yet quick way of measuring the relative combustibility of volatile liquids and, in turn, determines the appropriate temperature below which combustibles may be stored and used without creating explosive atmospheres. The flashpoint is always determined in a standard apparatus.

Explosion limits

- **Lower** - The lowest concentration of vapour in air, which can be ignited (exploded).
- **Upper** - The highest concentration of vapour in air, which can be ignited (exploded).

Flashpoint and lower explosive limit are interconnected. The flashpoint is the temperature at which a liquid gives off sufficient vapour into a fixed volume of air, so that when a naked flame is applied the mixture will ignite. The quantity (%) of vapour in the mixture when ignition occurs, is the lower explosive limit for that particular solvent. This means that at all temperatures below the flashpoint of a solvent, the quantity of vapour it can give off into the atmosphere must be less than the lower explosive limit.
This simple guide to the volatility of solvents is, however, complicated by the presence of paint spray and solvent mist (liquid particles) in tank atmospheres. If particulate spray is present it will also have a lower explosive limit, which is not dependent on the flashpoint of any solvent mixture present.

Threshold limit value (TLV) or Maximum allowable concentration (MAC)

Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. The TLV is expressed in milligrams per cubic metre (mg/M^3) of air and in parts per million; that is parts of gas per million parts of air. The TLV's for paint solvents are very much lower than safe explosion limit concentrations and in ship tanks it is totally impractical to attempt to ventilate to below the TLV for a solvent mixture. Painters must be provided with suitable breathing apparatus.