AS 4506—2005

Australian Standard™

Metal finishing—Thermoset powder coatings

STANDARDS AUSTRALIA

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Australian Standard™

Metal finishing—Thermoset powder coatings

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee MT-009, Metal Finishing, to supersede AS/NZS 4506:1998, *Metal finishing—Thermoset powder coatings*. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian, rather than an Australian/New Zealand Standard.

The objective of the Standard is to provide test procedures and performance requirements for powder-coated metal products, other than aluminium products intended for architectural applications. Requirements for aluminium products for use in architectural applications are contained in AS 3715, *Metal finishing—Thermoset powder coatings for architectural applications of aluminium and aluminium alloys.*

The objective of this revision is to include testing criteria which relate to service condition categories that are set out as described in AS/NZS 2312, *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings*.

Powder coatings consist of pigments and reinforcing fillers combined with resins such as epoxy and polyester. They may be applied to suitably prepared ferrous, galvanized steel, non-ferrous or metal-sprayed surfaces.

Currently there are no international (ISO) Standards on the subject.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

CONTENTS

Page

SECTION 1 SCOPE AND GENERAL
1.1 SCOPE 4
1.2 REFERENCED DOCUMENTS 4
1.3 DEFINITIONS 6
1.4 ATMOSPHERIC CLASSIFICATIONS 6
1.5 SAFETY REQUIREMENTS 7

SECTION 2 PERFORMANCE REQUIREMENTS
2.1 GENERAL 8
2.2 PRETREATMENT 8
2.3 APPEARANCE 8
2.4 SPECULAR GLOSS 8
2.5 COATING THICKNESS 9
2.6 CURE TEST (SOLVENT RESISTANCE METHOD) 9
2.7 ADHESION (CROSS-CUT) 9
2.8 HUMIDITY RESISTANCE 9
2.9 DURABILITY (EXPOSURE) OF POWDER COATINGS 9
2.10 HOLIDAY TESTING 9
2.11 CORROSION RESISTANCE 9
2.12 PERMEABILITY TEST 14
2.13 RESISTANCE TO MORTAR 14

APPENDICES
A PURCHASING REQUIREMENTS 15
B MEANS OF DEMONSTRATING COMPLIANCE WITH THIS STANDARD 16
C WEATHERING PERFORMANCE OF POWDER-COATED METAL PRODUCTS 18
D MAINTENANCE OF POWDER-COATED METAL 19
E REPAIR OF POWDER-COATED METAL 20
F HANDLING AND TEMPORARY PROTECTION DURING TRANSPORTATION AND INSTALLATION 21
G ATMOSPHERIC ENVIRONMENTS 22
H SELECTION OF TEST SPECIMENS 25
I SURFACE PRETREATMENT FOR POWDER COATINGS 26
J TEST METHODS FOR DURABILITY (EXPOSURE) AND CORROSION RESISTANCE 31
K PERMEABILITY TEST 33
L TEST METHOD FOR RESISTANCE TO MORTAR 34
M SOLVENT-CURE TEST 36

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Australian Standard
Metal finishing—Thermoset powder coatings

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out relevant test procedures and specifies performance requirements for thermoset powder coatings applied to metal substrates, with the exception of aluminium for architectural applications (see AS 3715). It specifies six atmospheric categories.

The requirements to be specified by the purchaser at the time of enquiry or order are shown in Appendix A.

NOTES:

1 The means of demonstrating compliance with the Standard is shown in Appendix B.

2 Information on the weathering of powder-coated metal products is given in Appendix C.

3 Information on maintenance of coatings is given in Appendix D.

4 Recommendations for the repair of powder coated metals are given in Appendix E.

5 Advice on handling and temporary protection during transportation and installation is given in Appendix F.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1199	Sampling procedures for inspection by attributes
1199.0	Part 0: Introductions to the ISO 2859 attribute sampling system
1199.1	Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection.
1580	Paints and related materials—Methods of test
1580.408.4	Method 408.4: Adhesion (cross-cut)
1580.481.3	Method 481.3: Coatings—Exposed to weathering—Degree of corrosion of coated metal substrates
1627	Metal finishing—Preparation and pretreatment of surfaces
1627.0	Part 0: Method selection guide
1627.1	Part 1: Removal of oil, grease and related contamination
1627.2	Part 2: Power tool cleaning
1627.4	Part 4: Abrasive blast cleaning
1627.5	Part 5: Pickling
1627.6	Part 6: Chemical conversion treatment of metals
1672	Limes and limestones
1672.1	Part 1: Limes for building
1745	Outdoor weathering of plastics in the Australian environment
1745.1	Part 1: Commercial products
2331	Methods of test for metallic and related coatings
2331.3.1	Method 3.1: Corrosion and related property tests—Neutral salt spray (NSS) test

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AS	
2331.3.8	Method 3.8: Humidity test—24 hour cycle, damp heat
2483	Metal finishing—Recommended sampling plans for the inspection and testing of coatings (ISO 4519:1980, MOD)
3715	Metal finishing—Thermoset powder coatings for architectural applications of aluminium and aluminium alloys
3754	Safe application of powder coatings by electrostatic spraying
3972	Portland and blended cements
3894	Site testing of protective coatings
3894.1	Method 1: Non-conductive coatings—Continuity testing—High voltage (‘brush’) method
4312	Corrosivity zones in Australia
AS/NZS	
1580	Paints and related materials—Methods of test
1580.457.1	Method 457.1: Resistance to natural weathering
1580.481.1.2	Method 481.1.2: Coatings—Exposed to weathering—Discolouration (including bronzing)
1580.481.1.5	Method 481.1.5: Coatings—Exposed to weathering—Change in gloss
1580.481.1.7	Method 481.1.7: Coatings—Exposed to weathering—Degree of checking
1580.481.1.8	Method 481.1.8: Coatings—Exposed to weathering—Degree of cracking
1580.481.1.9	Method 481.1.9: Coatings—Exposed to weathering—Degree of blistering
1580.481.1.10	Method 481.1.10: Coatings—Exposed to weathering—Degree of flaking and peeling
1580.481.1.11	Method 481.1.11: Coatings—Exposed to weathering—Degree of chalking
1580.481.1.12	Method 481.1.12: Coatings—Exposed to weathering—Degree of colour change
1580.602.2	Method 602.2: Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85°
2310	Glossary of paint and painting terms
2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
2633	Guide to the specification of colours
3894	Site testing of protective coatings
3894.3	Method 3: Determination of dry film thickness
AS/NZS ISO	
9001	Quality management systems—Requirements
9004	Quality management systems—Guidelines for performance improvements
HB 18	Guidelines for third-party certification and accreditation
HB 18.28	Guide 28: General rules for a model third-party certification scheme for products
ISO	
9223	Corrosion of metals and alloys—Corrosivity of atmospheres—Classification

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ASTM
D2247 Practice for testing water resistance of coatings in 100% relative humidity

BS
1199 and 1200 Specifications for building sands from natural sources

AAMA
609 and 610-02 Cleaning and maintenance guide for architecturally finished aluminium

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS/NZS 2310 and those below apply.

1.3.1 Chemical pretreatment

Modification to a substrate surface by chemical treatment with chromate ions, chromate/phosphate ions, phosphate ions or other proven methods.

1.3.2 Holiday

A localized coating defect, characterized by a very low or zero coating thickness.

1.3.3 Powder-coated metal

Pretreated metal finished with a powder coating.

1.3.4 Pretreated metal

Substrate metal with a surface to which a chemical and/or mechanical pre-treatment and/or primer has been applied.

1.3.5 Significant surface

The part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance.

1.3.6 Substrate metal

Metal in the form of sheet, coil, cut lengths, strip, extruded sections, tube, forgings or castings prior to surface treatment.

1.4 ATMOSPHERIC CLASSIFICATIONS

This Standard specifies six atmospheric classifications A, B, C, D, E and F based on the severity of the environment.

NOTE: A detailed description of each of the atmospheric classifications is given in Appendix G to facilitate determination of the appropriate category that applies to a particular set of environmental circumstances.

Category A: Mild Interior (Atmospheric classification: Very low)

Environments in this category are most commonly found inside heated or airconditioned buildings with clean atmospheres.

Category B: Moderate interior (Atmospheric classification: Low)

Environments in this category include dry, rural areas, as well as other regions remote from the coast or sources of pollution and unheated or non-airconditioned buildings where condensation may occur.

Category C: Mild exterior (1) and Moderate exterior (2) (Atmospheric classification: Medium)

This category mainly covers coastal areas with low salinity. The extent of the area varies significantly with factors such as winds, topography and vegetation, see Appendix G.

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(1) *Mild exterior*

A mild environment includes all areas remote from the coast (>15 km) and, industrial activity.

(2) *Moderate exterior*

A moderate environment includes areas with light pollution or light marine influence, or both. (Light marine is >2 km from ocean-front areas with breaking surf with significant salt spray or >50 metres from sheltered bays).

Category D: Tropical exterior (Atmospheric classification: High marine/industrial)

This category occurs mainly on the coast.

Category E—E-I: Industrial, E-M: Marine (Atmospheric classification: Very high marine/industrial)

This category is common offshore and on the beachfront in regions of rough seas and surf beaches and some industrial sites, see Appendix G.

Category F: Tropical exterior (Inland tropical)

A tropical environment is found in areas of north Queensland, Northern Territory (see AS 4312), north-west Western Australia, Papua New Guinea and the Pacific islands, except where affected by salinity.

NOTE: Coating systems used in inland tropical environments should be based on resins and additives able to resist the combined action of humidity and ultraviolet light exposure and possess good anti-fungal properties.

1.5 SAFETY REQUIREMENTS

The equipment and the procedures for the application of powder coatings by electrostatic spraying shall comply with the requirements for safe operation specified in AS 3754.

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SECTION 2 PERFORMANCE REQUIREMENTS

2.1 GENERAL

Powder-coated metal products shall comply with the appropriate requirements of this Section. These requirements may not be achievable unless the substrate metal surface receives an appropriate pretreatment.

Representative coated and cured samples shall be selected for testing in accordance with Appendix H, unless otherwise specified in this Section.

2.2 PRETREATMENT

To achieve the optimum performance of the coatings, substrate metal surfaces should be pretreated in accordance with the recommendations of the powder and pretreatment supplier. Examples of appropriate pretreatment for various substrate metal surfaces are given in Table 2.1.

NOTE: Advice on procedures for pretreatment and conversion coating application is given in Appendix I.

2.3 APPEARANCE

2.3.1 General

There shall be no irregularities likely to affect the performance of the finished item.

The coating shall cover all significant surfaces as specified by the purchaser, be of uniform appearance, colour and texture, and be free of visible defects.

For all viewing situations a minimum of 1 metre unless otherwise agreed shall apply provided that another distance be allowed commensurate with the use of the product and its in situ viewing distances.

NOTE: It is strongly recommended that the manufacturer or supplier and customer agree appropriate standards of acceptance for the presence, size or frequency of any coating defects (such as deficiencies in colour, uniformity or texture, or the presence of defects). Appropriate standards may take the form of acceptable type samples or methods of test.

2.3.2 Defects

Defects in the substrate metal surface, such as scratches, pits, non-conducting inclusions, and roll and die marks, may adversely affect the appearance and performance of the applied coating. Such defects that persist in the finish despite the observation of good metal finishing practices shall not be cause for rejection.

NOTE: Applied finishes generally perform better in service when the substrate over which they are applied is smooth and free from torn metal, inclusions, pores and other defects. It is recommended that the specifications covering the unfinished product provide limits for those defects. A metal finisher often can remove defects through special treatment such as grinding, polishing, abrasive blasting, chemical treatments and electropolishing (see AS 1627.1, AS 1627.2, AS 1627.4, AS 1627.5 and AS 1627.6). However, these are not normal in the treatment steps preceding the application of the finish. When they are desired, they are the subject of special agreement between the purchaser and the supplier.

2.4 SPECULAR GLOSS

When determined in accordance with AS/NZS 1580.602.2, using a 60° exposure head, the measurable specular gloss shall not vary by more than ±7 gloss units from the specified value.

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2.5 COATING THICKNESS

The average coating thickness on significant surfaces, if measured in accordance with AS/NZS 3894.3 shall be a minimum of 40 or 60 μm as per Table 2.1. The thickness of the coating on each part to be tested shall be measured at not less than 5 measuring areas on approximately 1 cm^2 with 3 to 5 separate readings taken with an electronic instrument at each area. The average of separate readings taken at each one of the measuring areas gives a measurement value to be recorded. None of the values measured shall be less than 80% of the specified minimum average value of Table 2.1.

2.6 CURE TEST (SOLVENT RESISTANCE METHOD)

Solvent resistance tests have been developed to differentiate between cured and under-cured powder coatings, see Appendix M.

NOTE: The cure test should be performed as specified by the powder coating supplier and the results compared with those for known cured panels representing the same process under evaluation.

2.7 ADHESION (CROSS-CUT)

A coated test sample shall be tested in accordance with AS 1580.408.4. The appearance of the surface of the cross-cut area of the tested specimen shall be not worse than Classification 1.

2.8 HUMIDITY RESISTANCE

When exposed to 100% relative humidity at 38 ±1°C (see AS 2331.3.8) in accordance with ASTM D2247, and assessed in accordance with AS 1580.408.4, AS/NZS 1580.481.1.9, and AS 1580.481.3 the test specimen shall comply with the requirements of Table 2.2, as applicable.

2.9 DURABILITY (EXPOSURE) OF POWDER COATINGS

Specimens of powder coatings subject to atmospheric classifications Categories C, D, E and F shall be exposed for 12 months, in accordance with Paragraph J2, Appendix J, and at sites that exhibit the environment attributes of the category for which the powder coat is designed. On completion of the exposure duration, the specimens shall show no loss of integrity and shall comply with the ratings of Table 2.3.

Powder manufacturers shall ensure that all powders supplied are capable of passing the durability test specified in Appendix J and shall be in a position to verify this, if requested.

2.10 HOLIDAY TESTING

When tested with a low voltage wet sponge holiday detector suitable for thin coatings in the manner described in AS 3894.1 the test specimen shall have no holidays for the atmospheric classification categories C2, D, E and F.

2.11 CORROSION RESISTANCE

A specimen shall be exposed to the neutral salt-spray (NSS) test specimen as specified in Paragraph J3, Appendix J, and for the exposure period specified in Table 2.1. The exposed specimen shall comply with the requirements of Table 2.4.

To ensure maximum coating performance, no mechanical processes shall be undertaken after (e.g. drilling for fixing, pop riveting or cutting).

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TABLE 2.1

PRETREATMENT AND COATING THICKNESS REQUIREMENTS

Atmospheric classification as per AS/NZS 2312	Substrate	Examples of appropriate pre-treatment	Minimum coating thickness, μm	Required test
A Mild interior Very low	Aluminium (extruded and sheet)	Clean and etch	40	Adhesion Cure test Thickness
	Aluminium alloy (cast)	Clean and etch or degrease		
	Zinc	Degrease and/or amorphous phosphate		
	Zinc alloy			
	Steel (bright, semi-bright)			
	Steel (zinc coated)			
	Stainless steel	Abrasive blast or acid etch		
	Copper/copper alloys	Abrasive blast or acid etch		
B Moderate interior Low	Aluminium (extruded and sheet)	Clean and etch	40	Adhesion Cure test Thickness Neutral salt spray (100 hours) Humidity (240 hours)
	Aluminium alloy (cast)	Clean and etch or degrease		
	Zinc	Degrease and/or amorphous phosphate		
	Zinc alloy			
	Steel (bright, semi-bright)			
	Steel (zinc coated)			
	Stainless steel	Abrasive blast or acid etch		
	Copper/copper alloys	Abrasive blast or acid etch		

(*continued*)

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TABLE 2.1 (*continued*)

Atmospheric classification as per AS/NZS 2312	Substrate	Examples of appropriate pre-treatment	Minimum coating thickness, μm	Required test
C1 Mild exterior Medium	Aluminium (extruded and sheet) Aluminium alloy (cast)	Chrome chromate or Chrome phosphate	60	Adhesion Cure Thickness Neutral salt spray Humidity Durability
	Zinc Zinc alloy Steel (bright, semi-bright) Steel (zinc coated)	Amorphous phosphate		
	Stainless steel	Abrasive blast or acid etch		
	Copper/copper alloys	Abrasive blast or acid etch		
C2 Moderate (exterior) Medium	Aluminium (extruded and sheet) Aluminium alloy (cast)	Chrome chromate or chrome phosphate	60	Adhesion Cure Thickness Neutral salt spray Humidity Durability Permeability Holiday
	Zinc Zinc alloy Steel (bright, semi-bright) Steel (zinc coated)	Zinc phosphate, appropriate amorphous phosphate system or primer system		
	Stainless steel	Abrasive blast or acid etch		
	Copper/copper alloys	Abrasive blast or acid etch		

* Not all amorphous phosphates or treatment processes are capable of achieving these requirements.

(continued)

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TABLE 2.1 (*continued*)

Atmospheric classification as per AS/NZS 2312	Substrate	Examples of appropriate pre-treatment	Minimum coating thickness, μm	Required test
D High Marine/Industrial	Aluminium (Extruded and sheet) Aluminium alloy (cast)	Chrome chromate or chrome phosphate	60	Adhesion Cure Thickness Neutral salt spray Humidity Permeability Durability Holiday
	Zinc, Zinc alloys, Steel (zinc coated)	Zinc phosphate, or appropriate primer system, or Chrome chromate or chrome phosphate		
F Tropical exterior	Stainless steel	Abrasive blast or acid etch		
	Bright, semi-bright steel (bare)	Abrasive blast and appropriate primer system		
E Very high Marine/Industrial	Aluminium (Extruded short) Aluminium alloy (cast) Zinc, Zinc alloys, Steel (zinc coated)	Consult the substrate metal supplier, pre-treatment chemical supplier, and powder coater supplier for the appropriate test procedure		
EI	Stainless steel			
EM	Bright, semi-bright steel (bare)			

NOTES TO TABLE 2.1:

1 100% permeability pass may not be achievable using amorphous phosphate systems.

2 Exterior grade coating system such as polyester must be used in Categories C, D, E and F.

3 Consult substrate, powder and pre-treatment suppliers for advice on system selection and performance when using Table 2.1.

4 Steel (zinc coated) includes galvanized, zinc alloy coated aluminium alloy coated and electrogalvanized coatings.

5 Special coatings such as ripples and textures are not recommended in atmospheric classification C, D, E and F.

6 No examples of appropriate pre-treatment or testing have been specified in classification E due to the severity of this environment. Consultation with substrate, powder and pre-treatment suppliers for advice on system selection and performance when using Table 2.1 is recommended before powder coating.

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TABLE 2.2

HUMIDITY RESISTANCE REQUIREMENTS FOR COATINGS SUBJECT TO ATMOSPHERIC CLASSIFICATIONS B, C, D, E AND F

Characteristic	Test method	Requirement
Loss of adhesion (cross-cut)	AS 1580.408.4	Not worse than Classification 1
Blistering	AS/NZS 1580.481.1.9	Not worse than rating S2D2

NOTE: For Classification E consult your powder coating supplier.

TABLE 2.3

DURABILITY (EXPOSURE) RATING REQUIREMENTS FOR COATINGS SUBJECT TO ATMOSPHERIC CLASSIFICATIONS C, D, E AND F

Characteristic	Test method	Maximum allowable rating		
		Whites	Pastel colours	Deep colours
Discolouration	AS/NZS 1580.481.1.2	4	4	3
Change of gloss	AS/NZS 1580.481.1.5	3	3	3
Checking	AS/NZS 1580.481.1.7	0	0	0
Cracking	AS/NZS 1580.481.1.8	0	0	0
Flaking and peeling	AS/NZS 1580.481.1.10	0	0	0
Blistering	AS/NZS 1580.481.1.9	0	0	0
Chalking	AS/NZS 1580.481.1.11	2	2	3
Colour change	AS/NZS 1580.481.1.12	4	4	3
Corrosion of base metal	AS 1580.481.3	0	0	0

NOTES:

1 A rating of 0 indicates no deterioration.

2 For classification E consult your powder coating supplier.

TABLE 2.4

CORROSION RESISTANCE REQUIREMENTS FOR COATINGS SUBJECT TO ATMOSPHERIC CLASSIFICATION B, C, D, E AND F

Characteristic	Test method	Rating
Undercut at scribed lines	Appendix J	2.0 mm max. on either side of score marks
Loss of adhesion (cross-cut)	AS 1580.408.4	Not worse than Classification 1
Blistering	AS/NZS 1580.481.1.9	Not worse than rating S2D2
Corrosion of bare metal	AS/NZS 1580.481.3	0

NOTE: For Classification E consult your powder coating supplier.

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2.12 PERMEABILITY TEST

Unless otherwise agreed, a coated specimen representing a product specified in Classification C2, D, E and F shall be subjected to the water permeability test and then tested for adhesion, in accordance with Appendix K. The resultant appearance of the crosscut area in the water and vapour phase shall be not worse than classification 1 of AS 1580.408.4. Crosscut adhesion classifications for samples representing products subject to less severe service conditions are subject to agreement between the interested parties.

2.13 RESISTANCE TO MORTAR

When a coated test sample is tested in accordance with Appendix L, the mortar shall be readily dislodged without the use of an implement. Removal of the mortar shall not cause any detachment of the powder coating or change in the appearance of the finish.

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APPENDIX A

PURCHASING REQUIREMENTS

(Normative)

A1 GENERAL

Australian Standards are intended to include the technical requirements for relevant products, but do not purport to comprise all the necessary provisions of a contract. This Appendix contains the minimum requirements for the information to be supplied by the purchaser at the time of enquiry and/or order.

A2 INFORMATION TO BE SUPPLIED BY THE PURCHASER

Purchasers shall supply the following information to the applicator.

(a) The product form and specification of the substrate and substrate surfaces.

(b) Atmospheric classification category (see Clause 1.4).

(c) Identification of the significant surfaces, either on drawings, or by suitably marked specimens.

(d) The acceptable position of contact marks or jigging and drain holes.

(e) The required colour code number or the required colour name, or whether a representative sample of the required colour will be provided.

NOTE: Colour should be matched to an agreed standard, and guidelines on this are given in AS/NZS 2633.

(f) The specular gloss level required, and whether a representative sample of the required gloss level will be provided (see Clause 2.4).

(g) Any temporary protection required.

NOTE: Appendix F provides information on temporary protection.

(h) Preferred method for coating thickness measurement, if relevant (see Clause 2.5).

(i) Required tests which are specified in Table 2.1.

(j) Any optional tests required, in addition to those specified in Section 2 of this Standard, to assess performance or to satisfy end-use requirements.

(k) Whether a test certificate or certificate of compliance is required.

(l) Any information concerning processing or end use that the purchaser considers would assist the applicator.

NOTE: An agreed means of repair.

(m) Reference to this Australian Standard, i.e. AS 4506.

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APPENDIX B

MEANS OF DEMONSTRATING COMPLIANCE WITH THIS STANDARD

(Informative)

B1 SCOPE

This Appendix sets out the following different means by which compliance with this Standard can be demonstrated by the applicator or supplier:

(a) Evaluation by means of statistical sampling.

(b) The use of a product certification scheme.

(c) Assurance using the acceptability of the supplier's quality system.

(d) Other such means proposed by the applicator or supplier and acceptable to the customer.

B2 STATISTICAL SAMPLING

Statistical sampling is a procedure which enables decisions to be made about the quality of batches of items after inspecting or testing only a portion of those items. This procedure will only be valid if the sampling plan has been determined on a statistical basis and the following requirements are met:

(a) The sample needs to be drawn randomly from a population of product of known history. The history needs to enable verification that the product was made from known materials at essentially the same time, by essentially the same processes and under essentially the same system of control.

(b) For each different situation, a suitable sampling plan needs to be defined. A sampling plan for one applicator of given capability and product throughput may not be relevant to another applicator producing the same items.

In order for statistical sampling to be meaningful to the customer, the applicator or supplier needs to demonstrate how the above conditions have been satisfied. Sampling and the establishment of a sampling plan should be carried out in accordance with AS 1199.1, guidance to which is given in AS 1199.0.

B3 PRODUCT CERTIFICATION

The purpose of product certification is to provide independent assurance of the claim by the applicator that products comply with the stated Standard.

The certification scheme should meet the criteria described in HB 18.28 in that, as well as full type testing from independently sampled production and subsequent verification of conformance, it requires the applicator to maintain effective quality planning to control production.

The certification scheme serves to indicate that the products consistently conform to the requirements of the Standard.

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B4 SUPPLIER'S QUALITY MANAGEMENT SYSTEM

Where the applicator or supplier can demonstrate an audited and registered quality management system complying with the requirements of the appropriate or stipulated Australian or international Standard for a supplier's quality management system or systems, this may provide the necessary confidence that the specified requirements will be met. The quality assurance requirements need to be agreed between the customer and supplier and should include a quality or inspection and test plan to ensure product conformity.

Information on establishing a quality management system is set out in AS/NZS ISO 9001 and AS/NZS ISO 9004.

B5 OTHER MEANS OF ASSESSMENT

If the above methods are considered inappropriate, determination of compliance with the requirements of this Standard may be assessed from the results of testing coupled with the applicator's guarantee of product conformance.

Irrespective of acceptable quality levels (AQLs) or test frequencies, the responsibility remains with the applicator or supplier to supply products that conform to the full requirements of the Standard.

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APPENDIX C

WEATHERING PERFORMANCE OF POWDER-COATED METAL PRODUCTS

(Informative)

C1 GENERAL

All powder coatings gradually change their appearance when exposed to the weather (see Appendix D). The changes that take place occur at different rates, the rate depending upon the aggressiveness of the environment and on the ability of the powder coatings to resist those changes.

The effect of dirt or industrial fallout can be greatly reduced when exposed to rain or by washing with water. It is recommended that shelter areas, such as under eaves and those that are exposed to little or no rain be regularly washed down with clean water, see Appendix D.

Changes in appearance of a powder coating do not necessarily imply that the coating will not protect the base metal. Changes which can occur and their likely effect on performance of powder-coated products are outlined in Paragraphs C2 to C6.

C2 LOSS OF GLOSS

Initial loss of gloss is caused by ageing which is the result of exposure to ultraviolet light, particularly where the surface is facing north or west. Contamination by atmospheric pollutants, e.g. sulfurous or ammoniacal fumes, and by the collection of dirt, can also cause deterioration of gloss.

The rate of impairment of gloss by the collection of dirt is lower for exposed surfaces installed vertically than for surfaces installed horizontally.

Loss of gloss usually precedes chalking.

C3 CHALKING

Chalking involves the release of one or more of the constituents of the powder coating in the form of loosely adherent fine powder. Chalking develops slowly on powder-coated products and is not considered a serious defect.

C4 CHECKING

Checking is the formation of breaks in the surface of a powder coating which are sufficiently fine as to not render the underlying metal visible.

C5 DISCOLOURATION/COLOUR CHANGE

Colour change can be due to fading, darkening, dirt collection or chalking. Discolouration due to dirt collection or chalking can usually be removed by cleaning.

C6 EROSION OF POWDER COATINGS

Erosion of the powder coating by natural weathering depends very much on exposure conditions. Products facing north or west, and installed at an angle from the vertical, can be expected to deteriorate at up to twice the rate that would occur for products installed vertically and facing south, or otherwise sheltered from the elements.

Because of the thickness of powder coatings and the low erosion rate, which rarely exceeds 3 μm/year, powder coatings generally have a long life expectancy.

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APPENDIX D

MAINTENANCE OF POWDER-COATED METAL

(Informative)

D1 MAINTENANCE

Cleaning is desirable if the applied finish of the powder coat is to be preserved. Deterioration of the coating occurs mainly as a result of ultraviolet light, grime deposition and attack by contaminated moisture, which in a coastal environment contains chlorides and in an industrial or urban environment, chlorides and sulfur compounds. Deposited grime absorbs moisture like a sponge and holds it against the powder-coated surface; this permits corrosive attack to proceed, thereby damaging the coating.

Recommendations for the frequency of cleaning are as follows:

(a) In mild and moderate environments where grime deposition and pollution are at a minimum, cleaning every six months may be sufficient to remove deposits and restore the appearance.

(b) In industrial and marine environments, monthly cleaning is advisable; however, the maximum period between cleanings should never be more than three months. Under the worst conditions involving heavy grime deposition and atmospheric pollution by both sulfur compounds and chlorides, even more frequent cleaning is advisable if deterioration of the coating is to be prevented.

D2 RECOMMENDED METHOD OF CLEANING

As a general rule for outdoor applications, powder-coated metals should be cleaned at the same frequency as is required for windows, using a non-abrasive pH-neutral detergent solution. Surfaces should be thoroughly rinsed after cleaning to remove all residue. Reference should also be made to the AAMA publications 609 and 610-02.

NOTE: Publications of the American Architectural Manufacturers Association (AAMA) can be obtained from the AAMA Technical Information Centre, 1540 E. Dundee Rd, Suite 310, Palatine, IL 60067, USA.

Mineralized water (hard water) should be avoided when cleaning due to the detrimental effect on powder coatings.

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APPENDIX E

REPAIR OF POWDER-COATED METAL

(Informative)

E1 GENERAL

Any powder-coated article that exhibits a defect from the coating process or which has been damaged subsequently by a mechanical or chemical agent shall be repaired, provided that the affected area is no more than 1% of the significant surface. Articles showing a greater level of defects or damage should be rejected.

Any repair work before delivery should be specified by the purchaser in addition to the information listed in Appendix A.

E2 REPAIR

In the absence of the specialized facilities needed to effect repairs using the relevant thermosetting powder, a compatible organic coating having similar properties to the powder coating should be applied. However, before doing so, it is essential that all defects and foreign matter, whether it be embedded in the coating or has arisen from a damaging agent, be carefully removed from the defective area, so that the surface of the article is rendered clean and sound.

Advice should be sought from the relevant powder manufacturer for appropriate repair coating compounds and their application.

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APPENDIX F

HANDLING AND TEMPORARY PROTECTION DURING TRANSPORTATION AND INSTALLATION

(Informative)

F1 GENERAL

When handling powder-coated products, special care is required to avoid damage of the coating during transportation and installation.

F2 TRANSPORTATION

Powder coated metal products should not be allowed to rub or slide against each other during transportation. Powder-coated surfaces should be well protected by interleaving and/or pressure packing.

F3 STORAGE

Powder-coated components in storage, or on building sites should be stored in a dry location out of direct sunlight, with spacing to allow the circulation of air between coated surfaces.

NOTE: Plastic-wrapped powder coated products should not be stored in direct sunlight.

F4 INSTALLATION

Contact between powder-coated metals and incompatible building materials, including wet cement-based products (cement mortar and terrazzo) and abrasive material, should be prevented by suitable protective measures such as—

(a) the application of strippable temporary tapes to the powder-coated component; or

(b) the use of a plastic envelope.

If contact with an incompatible material does occur, the material should be removed immediately by washing with clean water and the surface dried.

The application of sealants, mastics and structural glazing adhesives to coatings during assembly and installation is widespread and well established. It should be noted, however, that some sealants are not recommended for use on powder coatings. Sealant suppliers should be consulted to recommend sealants that are compatible with selected coating systems and substrates.

F5 BRICK CLEANING

Acids used for brick cleaning can damage the coating and reduce its protective quality. Surfaces should be protected to prevent contact with brick cleaning acids. If contact does occur, the surfaces should immediately be thoroughly washed with copious amounts of clean water.

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APPENDIX G

ATMOSPHERIC ENVIRONMENTS

(Informative)

G1 GENERAL

This Appendix classifies internal and external atmospheres that affect the corrosion of metals and the life of a paint system. When selecting an appropriate protective coating system, the overall atmospheric conditions in the intended location of the structure require consideration. A structure situated in an aggressive environment will require a much higher standard of corrosion protection than one in a benign environment. The environment can affect both the substrate and the coating system.

The effect the environment has on the life of a coating system is highly important. It should be appreciated that corrosive environments do not necessarily affect bare metal in the same way as they affect coatings. Environments that would not be considered particularly corrosive to metals, such as hot dry climates with a high amount of ultraviolet (UV) radiation, can cause early breakdown of some coatings. Tropical environments, with high humidity and rainfall, which promote mould and fungal growth, are highly aggressive to organic coatings. Furthermore, the colour of the coating may influence its performance in some environments.

In addition to climatic effects, the local environmental effects (or microclimate) produced by the erection of a structure or installation of equipment need 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. A significant acceleration of corrosion rate can occur in the following circumstances:

(a) At locations where the coated metal surface remains damp for an extended period, such as where surfaces are not freely drained or are shaded from sunlight.

(b) On unwashed surfaces, i.e. surfaces exposed to atmospheric contaminants, notably coastal salts, but protected from cleansing rain.

As a result of microclimatic effects it is very difficult, if not impossible, to predict accurately the aggressiveness of a given environment and a certain amount of educated judgement is required to assess its influence on the coating life.

Typical on-site factors or types of microclimates which may cause a breakdown of protective coatings include the following:

(i) Industrial contamination.

(ii) Contamination from agricultural fertilizers or insecticides.

(iii) Damp locations not dried by direct exposure to the sun.

(iv) Exposure to sea breezes.

(v) Alkaline or acidic fallout.

(vi) Hot or cold surfaces.

(vii) Abrasion or impact.

(viii) Animal enclosures.

Prevailing winds, which can transport contamination from one location to another, also require consideration.

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High levels of ultraviolet light and humidity have adverse effects on the performance of organic coatings and thus reduce their durability. The designer of a building should take special care to ensure that the possibility of condensation resulting from high humidity is minimized.

NOTES:

1 Information on radiation zones and annual rainfall zones within Australia is given in AS 1745.1.

2 Stresses resulting from bending or roll-forming operations may cause cracking of powder-coated films.

G2 ATMOSPHERIC CLASSIFICATIONS

Atmospheric environments are classified into the following five atmospheric corrosivity categories based on the corrosion rates of mild steel given in ISO 9223, plus one tropical category which is not determined by corrosion rate.

Category A: *Very low*

Environments in this category are most commonly found inside heated or airconditioned buildings with clean atmospheres, such as most commercial buildings. They may also be found in semi-sheltered locations remote from marine or industrial influence and in unheated or non-airconditioned buildings. The only external environments in Australia or New Zealand are some alpine regions although generally these environments will extend into Category B.

Category B: Low

Environments in this category include dry, rural areas as well as other regions remote from the coast or sources of pollution. Most areas in Australia and New Zealand beyond at least 50 kilometres from the sea are in this category, which can, however, extend as close as 1 kilometre from seas that are relatively sheltered and quiet. Typical areas occur in arid and rural inland regions, most inland cities and towns such as Canberra, Ballarat, Toowoomba, Alice Springs and Hamilton, New Zealand and suburbs of cities on sheltered bays, such as Melbourne, Hobart, Brisbane and Adelaide (except areas within 3 to 6 kilometres of the coast near Adelaide). Unheated or non-airconditioned buildings where some condensation may occur, such as warehouses and sports halls, can be in this category. Proximity to the coast is an important factor.

Category C: Medium

This category mainly covers coastal areas with low salinity. The extent of the affected area varies significantly with factors such as winds, topography and vegetation. Around sheltered seas, such as Port Philip Bay, Category C extends beyond about 50 metres from the shoreline to a distance of about one kilometre inland. For a sheltered bay or gulf, such as near Adelaide, this category extends from the shoreline to about 3 to 6 kilometres inland. Along ocean front areas with breaking surf and significant salt spray, it extends from about 1 kilometre inland to between 10 to 50 kilometres inland, depending on the strength of prevailing winds and topography. Much of the metropolitan areas of Wollongong, Sydney, Newcastle, the Gold Coast, Auckland and Wellington are in this category. In South Australia, the whole of the Yorke Peninsula falls within this or a more severe category, and in the southeast of the State, from Victor Harbor to the Victorian border, this category extends between 30 and 70 kilometres inland. Such regions are also found in urban and industrial areas with low pollution levels and, although uncommon in Australia and New Zealand, exist for several kilometres around major industries such as smelters and steelworks, and in the geothermal areas of New Zealand.

Micro-environmental effects, such as result from proximity to airports and sewage treatment works, may also place a site into this category. Interior environments with

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Category C corrosivity can occur in humid production rooms, such as food-processing plants, laundries, breweries, printing works and dairies.

Category D: High.

This category occurs mainly on the coast. Around sheltered bays. Category D extends up to 50 metres inland from the shoreline. In areas with rough seas and surf, it extends from about several hundred metres inland to about one kilometre inland. As with Categories B and C, the extent depends on winds, wave action and topography. Industrial regions may also be in this category, but in Australia and New Zealand these are only likely to be found within 1.5 kilometres of the plant. 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 manufacturers, foundries, smelters and chemical processing plants may also extend into this category.

Category E (E-I: Industrial, E-M: Marine): Very high

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. (In some areas of Newcastle, for example, it extends more than half a kilometre from the coast.) This category may also be found in aggressive industrial areas, where the environment may be acidic with a pH of less than 5. For this reason, Category E is divided into marine and industrial for purposes of coating selection. Some of the damp and/or contaminated interior environments in Category D may occasionally extend into this category.

Category F: Inland tropical

A tropical environment is found in areas of north Queensland, Northern Territory, north-west Western Australia, Papua New Guinea and the Pacific islands, except where affected by salinity (see AS 4312). Corrosivity in inland regions is generally low (similar to that of Category B), but the aggressiveness of the environment to organic coatings means special protection is required.

If a site is considered to be in more than one category, for example an industry on the coast in a tropical region, then a selected coating should be capable of resisting the most severe of the environments involved.

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APPENDIX H

SELECTION OF TEST SPECIMENS

(Normative)

H1 SCOPE

This Appendix specifies procedures for the selection of test specimens and test panels for use in tests specified in this Standard.

H2 SELECTION

H2.1 Sheet and strip products

Unless otherwise agreed, test specimen dimensions shall be 150 mm × 100 mm minimum, and shall be selected as follows:

(a) Take one test specimen from the centre-line of the coated product.

(b) Take two test specimens from any part of the coated product away from the centre-line and at least 25 mm from a coated edge.

H2.2 Castings and forgings

If size permits, test specimens shall be coated production components. If the dimensions of the component prevent the conduct of the specified tests, then one or more test panels shall be cut from significant surfaces in accordance with the requirements of Paragraphs H2.3 and H2.4.

H2.3 Extruded products/Roll-formed products

Test samples shall be of full cross-section of the coated product and approximately 150 mm long. Take one sample 200 mm from each end of the product and a third sample at a mid-length position.

H2.4 Test panels

Test panels or representative sections may be used where it is impractical to cut test specimens from the coated work. The dimensions of test panels or representative specimens should be 150 mm × 100 mm and where possible 0.7 mm to 1.2 mm thick. The panels or representative sections should be of the same substrate metal surface type and temper as the product being coated. The test panels shall be processed together with the product.

For steel sheet and strip, the standard test panel size is 300 mm × 100 mm.

H2.5 Frequency

Unless otherwise agreed, the number of test specimens or test panels and the frequency of testing shall be in accordance with AS 2483.

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APPENDIX I

SURFACE PRETREATMENT FOR POWDER COATINGS

(Informative)

I1 UNTREATED SURFACES

The need for chemical, abrasive or solvent treatment of a surface prior to the application of a powder coating depends on the following:

(a) The condition of the surface (see AS 1627.0).

(b) The nature of the surface (see AS 1627.0).

(c) The intended end use of the coated article.

In general, epoxy, hybrid or polyester powders adhere well to metal surfaces. It is essential, however, that the surface is clean, dry, and free from porosity that could allow trapped air to cause pinholes in the coating. Powder, unlike solvent-based paints, will not absorb slight traces of oil on a surface.

The requirements of this Standard cannot be met when metal surfaces are contaminated by mill scale, oxide layers, smut, dust, oils, greases and fabrication lubricants. Aqueous alkali degreasing or solvent cleaning will remove most oily contaminants but not scale, oxide layers, swarf, dust, lanolin-based lubricants or smut (see AS 1627.1).

Where degreasing is not fully effective, surfaces may also require chemical cleaning, mechanical abrasion or acid pickling to remove smut, scale or oxide. Cost comparisons should be made to determine whether it is desirable to use a higher grade of metal to avoid this extra process.

Powder coatings applied to clean, dry surfaces are often satisfactory for a wide variety of articles used inside homes, offices and factories; however, pretreatment is recommended for best results; powder coatings on surfaces that have not been pretreated may not always maintain their high initial adhesion. Bright or exceptionally smooth surfaces can diminish adhesion.

Corrosion protection of the metal substrate surface and coating adhesion will be significantly improved by the use of chemical or mechanical treatment.

Zinc-coated surfaces and zinc alloys can present a special case (see Paragraph I3.3).

Powder coatings can provide good coverage over edges and uneven surfaces but it is imperative that edges are sufficiently radiused with no burrs. Other specific design considerations to avoid are, for example, narrow gaps or recessed areas as they can be difficult to coat. Rough welds should be ground smooth. Always allow for the extra thickness if coating parts are to fit in areas of tight tolerance.

I2 ABRASIVE-TREATED SURFACES

Abrasive blast cleaning (see AS 1627.4) is a long-favoured method of treating metal surfaces to remove contaminants and assist adhesion by providing a mechanically roughened surface. Abrasive blast is generally not appropriate for sheetmetal products.

Good adhesion of the coating can result from a clean abraded surface which, for many applications, can be regarded as a sound base for powder coating. However, a clean surface alone will not provide protection against underfilm corrosion. Care needs to be taken to ensure that an adequate film-build is applied to give protection to the peaks of the abraded surface. These peaks should be kept to a minimum. The use of a low voltage wet sponge holiday detector is valuable for ensuring adequate surface protection.

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NOTE: The application of the powder coating should be carried out as soon as possible after blasting as delays can bring about surface oxidation which may result in inferior adhesion and weathering properties.

I3 CHEMICAL PRETREATMENT

I3.1 General

Protection against underfilm corrosion provided by an appropriate conversion coating is important where long life in atmospheric classification categories C, D, E and F environments is required, see Table 2.1.

A chemical conversion coating is applied by treatment with a solution containing usually chromate ions or phosphate ions as the active components. The amount of conversion coating deposited should be within the limits specified by the chemical supplier.

Most conversion coatings need to be thoroughly rinsed, either with the solution specified by the chemical supplier or with demineralized water, and then dried at the temperature and for the time specified by the chemical supplier. The conductivity of the deionized water draining off the rinsed work pieces should not exceed 80 μS/cm at 20°C.

NOTES:

1 The application of the powder coating should be carried out as soon as possible after the pretreatment. Delays in excess of 24 h may result in inferior adhesion and weathering properties.

2 Attention is drawn to AS 1627.6, which specifies procedures and requirements for the chemical conversion treatment of metals (both ferrous and non-ferrous) prior to the application of a coating.

I3.2 Iron and steel (see AS 1627.6)

For the successful application of a conversion coating, the cleaning system applied to the metal should be designed to enable the effective removal of all contaminants, e.g. the use of a solvent or an alkaline wash to remove oils and greases followed by a rinse and acid pickling to remove rust, scale and other oxides.

An alkaline metal phosphate (amorphous phosphate) or zinc phosphate pretreatment of iron and steel can provide a satisfactory surface for powder coating.

An amorphous phosphate pretreatment gives intermediate protection to the powder coating and is suitable for internal and moderate exterior applications. It may be considered as an all-purpose treatment for iron, steel, zinc and aluminium and is applied by dipping or spraying. It is recommended that (iron/amorphous) phosphate coatings are given a chromate seal prior to powder coating to enhance performance.

Zinc phosphate is preferred as a base for the powder coating of iron and steel for external applications. Care is required during the phosphate pretreatment stage to avoid the formation of a heavy crystalline deposit, which may adversely affect coating adhesion.

Cast products frequently contain porosity and may require pre-heating to expel entrapped gases or use of special casting grade powders in order to minimize or eliminating pinholing.

I3.3 Zinc

I3.3.1 *General*

Zinc and zinc alloys are usually applied as protective coatings to steel, but solid zinc is also used in die-casting. Zinc coatings on steel may be hot-dip galvanized, iron/zinc alloy, aluminium/zinc alloy, electrodeposited zinc, or metal-sprayed zinc and its alloys.

As zinc-coatings are highly reactive and protect sacrificially, care should be taken when selecting their use in corrosive environments under powder coatings, making surface preparation and coating system selection critical.

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Some grades of zinc-coated steel are supplied pre-phosphated and only require mild cleaning prior to powder coating whilst others are passivated and/or clear polymer coated and may require additional treatment. Powder coating cut and/or welded zinc-coated steel requires further attention as exposed steel, fabrication burrs, weld flux and weld type can all contribute to premature coating failure if left untreated. Zinc corrosion (oxidation or 'white rust') should be removed using an acid treatment or mechanical means. Consultation with the substrate, chemical and powder suppliers is always recommended to ensure appropriate use, specification and application.

I3.3.2 *Batch hot-dip galvanized coatings*

Hot-dip galvanizing is a common form of steel protection but must be treated specifically to ensure fitness for use.

Zinc coatings applied by batch hot-dip galvanizing are generally chrome quenched (passivated). Whilst the passivation serves to protect the zinc, it is not a satisfactory pre-treatment for powder coating, can adversely affect paint adhesion and should be removed. Unpassivated material should be specified where possible. Removal of the passivation is possible with a strong alkaline cleaner or whip blasting, (see AS 1627.4).

Batch hot-dip galvanized surfaces require the use of chemical or mechanical treatment prior to conversion coating and/or powder application in order to achieve satisfactory adhesion. Care should be taken however, to ensure excessive removal or damage to the zinc coating does not occur.

Conversion coating of the treated zinc surface according to Table 2.1 will assist with the coating performance and adhesion in the more severe environments. The additional use of powder primers can also facilitate increased durability.

The powder coating of batch hot-dip galvanized metal substrates can give rise to surface defects and degassing, is generally required to minimize or eliminate this effect, special powders are available to help overcome these defects, refer Paragraph I3.7.

I3.3.3 *Pre-galvanized strip/ In-line galvanized product*

Galvanized steel strip and formed products are also readily available. They may be passivated and/or have a clear polymer coating.

Specification assistance for coating systems selection and product use should be sought from substrate, powder and pre-treatment suppliers as well as evaluation performance of the selected system as per the requirement of this Standard.

I3.3.4 *Hot-dip zinc-alloy and aluminium alloy coated steel products*

The characteristics of these coatings vary considerably depending on the alloy composition, coating thickness and surface treatments. These variables affect either the suitability of powder coating or the methods or pre-treatment and the coating required. Substrate, powder and pretreatment suppliers should be consulted to ascertain suitability for powder coating and recommended methods for cleaning, pre-treatment and powder coating.

I3.3.5 *Zinc-based die castings*

Degreasing and abrasive blast cleaning or vibratory finishing is recommended for zinc-based die casting to remove mould release agents. This should be followed by a pre-treatment of conversion coating suitable for the atmospheric classification (see Table 2.1). Die-castings may require an outgassing treatment because they frequently contain porosity, which can cause failure of the powder coating (see Paragraph I3.7).

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I3.3.6 *Thermal metal-sprayed coatings*

Thermal sprayed coatings should be clean, dry and free of contaminants and may be protected by a pre-treatment of conversion coating suitable for the atmospheric classification (see Table 2.1) and/or primed with a suitable coating prior to top coating with a powder.

I3.3.7 *Electroplated coatings*

If electroplated parts for powdercoating have been passivated (either clear or yellow chromate), the surface may be suitable for powdercoating after simple cleaning with a mild detergent or solvent cleaner. Tests should be performed to assess the potential performance of the powdercoat.

I3.4 Aluminium and aluminium alloys

It is important that aluminium-alloy extrusions, sheet or preformed sections be given a thorough cleaning and chemical pretreatment using alkaline or acidic solutions, followed by rinsing, according to a procedure specified by the pretreatment supplier. A chemical conversion coating should then be applied (see Table 2.1). The amount of conversion coating deposited should be within the limits specified by the pretreatment supplier, (see AS 1627.6).

Most conversion coatings should be thoroughly rinsed with deionized water with or without chemical additions to the specifications of the pretreatment supplier, and then dried at the temperature and for the time specified by the pretreatment supplier. The conductivity of the deionized water drained off the rinsed work piece should not exceed 80 μS/cm at 20°C.

Non-chrome and dried in place pretreatment systems require very strict process control and should only be used and applied in accordance with pretreatment suppliers' procedures.

NOTE: The application of the powder coating should be carried out as soon as possible after the pre-treatment. Delays in excess of 24 h may result in inferior adhesion and weathering properties.

A non-sealed anodic pretreatment applied to produce a film thickness of not less than 3 μm, but not greater than 8 μm, can be used as a pretreatment for aluminium-alloy extrusions, sheet or preformed sections.

I3.5 Copper and copper alloys

Clear powder coatings are sometimes used on polished or acid-cleaned copper or brass, but should be confined to interior (Category A and B) use to avoid underfilm corrosion or tarnishing. For opaque finishes, chromating is an option. Large articles may be abrasive blast cleaned to remove the oxide layer and improve coating adhesion.

I3.6 Stainless steel

Adhesion of a powder coating to stainless steel articles is enhanced by avoiding the use of bright finished surfaces which can be roughened by chemical or mechanical means. The high resistance of these surfaces to chemicals makes them difficult to treat. In such instances chemical suppliers should be consulted. Polished surfaces may be roughened by abrasive blast cleaning, sanding and/or linishing or chemical etch to give a degree of mechanical adhesion.

I3.7 Outgassing (Degassing)

Castings such as high-pressure zinc and aluminium die castings but more specifically low pressure or gravity castings, e.g. steel, frequently contain porosity or corrosion products which can cause gassing defects of the powder coating (pinholing). To prevent this, it may be necessary to preheat the items to be coated to achieve a surface temperature at least 20°C above the curing temperature of the powder for at least 10 min prior to the application of the powder coating at or around the curing temperature. Degassing of hot-dipped galvanized coatings is also achieved this way, but they may be cooled prior to powder application.

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Special powders have been designed to help with outgassing.

Preheating will reduce the corrosion resistance of the conversion coating.

I3.8 Powder coating over painted product

It is not generally advisable to powder-coat over an existing paint coating as the curing temperature may cause blistering of the underlying coat and cause appearance and adhesion problems. Some of these coatings and clear resin systems provide a reasonably good base for powder coating but should only be used after testing has demonstrated their performance potential.

I3.9 Zinc and epoxy primers

The application of zinc primers either in liquid or powder form can significantly enhance the corrosion protection of steel in many corrosive environments.

The application of a suitable epoxy/modified (either liquid or powder) primer can also significantly enhance the protection of zinc-coated substrates.

I3.10 Other substrates (not covered above) magnesium, nickel and other thermal spray metals

For other substrates, consult the powder coater suppliers.

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APPENDIX J

TEST METHODS FOR DURABILITY (EXPOSURE) AND CORROSION RESISTANCE

(Normative)

J1 SCOPE

This Appendix specifies test procedures for the durability testing of powder-coated metal test specimens (see Section 2).

J2 DURABILITY (EXPOSURE) TEST

The test procedure shall be as follows:

(a) Expose test samples of the powder-coated metal product at one or more test sites, ensuring that test panels are exposed at the subtropical test site.

NOTE: An example is the Allunga Exposure Laboratory in Townsville, Queensland.

(b) Place the test specimens on an exposure rack at an angle of 45° to the vertical, facing north, in accordance with AS 1580.457.1.

(c) After 12 months of continuous exposure, examine and assess the test samples in accordance with the AS/NZS 1580.481 series of Standards as specified in Table 2.3.

J3 SALT SPRAY TEST

The test procedure shall be as follows:

(a) Score the coating of the test specimens of powder-coated metal product with a sharp scoring tool or similar cutting device so as to expose a 1 mm width of the substrate metal. Sheet samples shall be scored diagonally from each corner, forming a cross. Extrusion samples shall be scored centrally along the longitudinal axis of an exposed significant surface (see AS/NZS 1580.408.4).

(b) Protect sheared edges by use of an appropriate waterproof masking paint or tape that is stable under the conditions of the test.

(c) Expose the powder-coated metal test samples to the neutral salt spray (NSS) test in accordance with AS 2331.3.1 with the scribed surface in the vertical plane, as specified in Table 2.1.

(d) At the completion of the exposure period, remove the test samples from the salt spray cabinet and examine after two hours as follows:

(i) For undercut, insert the point of a scalpel or sharp knife blade into the score marks and attempt to lift the powder coating film from the substrate by a gentle prising action. Assess the adhesion of the coating by measuring the width of coating that has peeled away on either side of the score marks, using a finely graduated rule, see Table 2.4.

(ii) For loss of adhesion (cross-cut method), in accordance with AS 1580.408.4.

(iii) For blistering, in accordance with AS/NZS 1580.481.1.9.

(iv) For corrosion of the base metal, visually examine coating in accordance with AS 1580.481.3.

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J4 REPORT

J4.1 Durability (Exposure) test

For each exposure or series of exposures, the report shall contain the following information:

(a) Name of testing authority.

(b) Report number and date of issue.

(c) Location and atmospheric corrosivity category of exposure site (see Appendix G).

NOTE: It is recommended that for sites subject to marine/coastal fallout, the distance of the site from the nearest coastline be reported.

(d) Identification of coating or coating system under test, details of substrate and method of preparation.

(e) Dates of commencement and termination of exposure.

(f) Orientation of the panels throughout the exposure.

(g) Results of assessments of the exposed panel(s).

(h) Any unusual incident or condition likely to have affected the results of the exposure.

(i) Reference to this test method, i.e. Appendix J, AS 4506.

J4.2 Neutral salt spray test

For each test, the report shall contain the following information:

(a) Name of testing authority.

(b) Report number and date of issue.

(c) Identification of coating or coating system under test, details of substrate and method of preparation.

(d) Times and dates of commencement and termination of exposure.

(e) Orientation of the panels throughout the exposure.

(f) Results of assessments of exposed panels.

(g) Reference to this test method, i.e. Appendix J, AS 4506.

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APPENDIX K

PERMEABILITY TEST

(Normative)

K1 SCOPE

This Appendix sets out the method for assessing the permeability of the powder coating and quality of pretreatment of metal substrates, metallic-coated steel and other metallic substrates.

K2 APPARATUS

A pressure cooker equipped with a weighted needle valve is required.

K3 PROCEDURE

The procedure shall be as follows:

(a) Add demineralized water to the pressure cooker to a depth of up to 75 mm.

(b) Immerse approximately half of a coated test specimen selected in accordance with Paragraph H2 of Appendix H, or a portion of a coated test panel, in the water. A minimum immersion depth of 25 mm is recommended.

NOTE: It is important that a sufficient portion of the test specimen or test panel be immersed and also that a sufficient portion remain above the water so that the adhesion tests referred to in Step (g) can be carried out.

(c) Secure the lid of the cooker.

(d) Apply heat to the pressure cooker until steam is emitted from the valve.

(e) Insert a weighted needle valve to give an internal pressure of 100 ±10 kPa.

(f) Continue heating for 1 h after steam is first emitted from the valve.

(g) Remove the test specimen, allow it to cool to ambient temperature and immediately examine it for adhesion in the vapour and water phase in accordance with AS 1580.408.4.

K4 REPORT

On completion of the test, a report shall be issued. The report shall include the following information:

(a) Name of testing authority.

(b) Report number and date of issue.

(c) Identification of the coating or coating system under test, details of the substrate and the method of preparation.

(d) Results of the permeability test, and a statement of compliance or otherwise with the requirements of this Standard.

(e) Reference to this test method, i.e. Appendix K, AS 4506.

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APPENDIX L

TEST METHOD FOR RESISTANCE TO MORTAR

(Normative)

L1 SCOPE

This Appendix sets out a method for assessing the resistance to mortar of a powder-coated metal product.

L2 PRINCIPLE

A pat of wet lime mortar is applied to the dry coating and, after allowing the mortar to set and dry, the effect of the mortar on the coated surface is assessed.

L3 MATERIALS

The following materials are required:

(a) *Sand*

Dry and complying with BS 1199 and 1200.

(b) *Lime*

Complying with AS 1672.1.

(c) *Cement*

Complying with AS 3972.

L4 PROCEDURE

The test procedure shall be as follows:

(a) Prepare a mortar by mixing 15 g of lime, 41 g of cement, and 244 g of sand with sufficient water to make a soft paste.

(b) Apply 4 pats of the mortar, each about 15 mm diameter and about 6 mm thick, to the coated surface of a test specimen.

(c) Allow the test specimen to stand for 24 h.

(d) At the end of this period, dislodge the mortar by hand from the surface and remove any residue with a damp cloth.

(e) Allow the specimen to dry and examine the finish, using normal or corrected vision, for detachment of the coating and for a change in appearance due to the effect and removal of the mortar.

L5 REPORT

On completion of the test a report shall be issued. The report shall include the following information:

(a) Name of testing authority.

(b) Report number and date of issue.

(c) Identification of coating or coating system under test and details of substrate.

(d) Date of the test.

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(e) Results of the test, and a statement of compliance or otherwise with the requirements of this Standard.

(f) Reference to this test method, i.e. Appendix L, AS 4506.

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APPENDIX M

SOLVENT-CURE TEST

(Normative)

M1 SCOPE

The solvent cure test provides an indication of whether the powder coating has been correctly cured.

The test is best regarded as a valuable guide to the state of cure rather than as an absolute test. Where there is doubt about the state of cure, thermal analysis such as differential scanning calorimetry may be used for an analytical assessment.

M2 PROCEDURE

The following procedure shall be followed:

(a) Obtain Corsol PMA (or MEK).

(b) Place a drop onto the powder coat.

(c) After 30 seconds, remove the solvent with a colour contrast cotton cloth and observe any colour transfer. There shall be minimal transfer of colour. Colour transfer can indicate under-curing.

NOTES:

1 Bright deep coloured powder coatings based on organic pigments, such as yellow, greens, blues and reds, will tend to exhibit higher levels of discolouration due to pigment colour strength.

2 The time may need to change depending on the chemistry of the coating being used. If unsure check with the powder supplier.

(d) Immediately scratch the dampened coating with a fingernail.

When the film is scratched, only slight surface softening is permissible. Deep softening indicates under-cure.

M3 REPORT

On completion of the test a report shall be issued. The report shall include the following information:

(a) Name of testing authority.

(b) Report number and date of issue.

(c) Identification of coating or coating system under test and details of substrate.

(d) Date of the test.

(e) Results of the test, and a statement of compliance or otherwise with the requirements of this Standard.

(f) Reference to this test method, i.e. Appendix M, AS 4506.

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