

Australian Standard®

Hot-dipped galvanized coatings on ferrous articles

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PREFACE

This Standard was prepared by Standards Australia's Committee on Metal Finishing to supersede AS 1650—1981, *Galvanized coatings*.

In this edition the section on fasteners has been deleted. It is considered that this is adequately covered by AS 1214, *Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)*.

The Preece Test for uniformity of coating is not included in the Standard since it is recognized, both in Australia and overseas, that it has many drawbacks which make it highly suspect in a pass/fail situation.

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STANDARDS AUSTRALIA

Australian Standard

Hot-dipped galvanized coatings on ferrous articles

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This Standard specifies requirements for the mass, quality and testing of the hot-dip zinc (galvanized) coating on ferrous articles, of the following product types:

- (a) Sheet.
- (b) Hollow sections (circular and non-circular).
- (c) Wire of circular cross-section.
- (d) General articles (forgings, fabricated steelwork, castings, centrifuged work, bar and wire products).

Matters relating to the quality, properties, or dimensional requirements of the iron or steel base material are outside the scope of this Standard.

NOTES:

1. Appendix A contains advice and recommendations on information which should be supplied by the purchaser at the time of enquiry or order.
2. Advisory information on methods of determining compliance of a lot with this Standard is given in Appendix B.

1.2 REFERENCED DOCUMENTS. The following documents are referred to in this Standard:

AS			
1074	Steel tubes and tubulars threaded or suitable for threading with pipe threads of Whitworth form	2331.1.5	Method 1.5: Local thickness tests—Beta-backscatter method
1199	Sampling procedures and tables for inspection by attributes	2331.2.1	Method 2.1: Average thickness tests—Dissolution methods—Strip and weigh, and analytical
1250	SAA Steel Structures Code	2331.2.3	Method 2.3: Average thickness tests—Hydrogen evolution method for zinc coatings
1397	Steel sheet and strip—Hot-dipped zinc-coated or aluminium/zinc coated	2483	Metal finishing—Recommended sampling plans for the inspection and testing of coatings
1399	Guide to AS 1199, Sampling procedures and tables for inspection by attributes	2490	Sampling procedures and charts for inspection by variables for percent defective
1511	SAA High-strength Structural Bolting Code	2505	Methods for bend and related testing of metals
1791	Chromate conversion coatings—Zinc and cadmium	2505.1	Part 1: Sheet, strip and plate
1821–1823	Suppliers Quality Systems	2706	Numerical values—Rounding and interpretation of limiting values
2000	Guide to AS 1821–1823—Suppliers quality systems	3900	Quality systems—Guide to selection and use
2204	Zinc-rich organic priming paint	3901	Quality systems for design/development, production, installation and servicing
2331	Methods of test for metallic and related coatings	3902	Quality systems for production and installation
2331.1.3	Method 1.3: Local thickness tests—Magnetic method	3903	Quality systems for final inspection and test
2331.1.4	Method 1.4: Local thickness tests—Magnetic induction and eddy current methods	3904	Quality systems—Guide to quality management and quality system elements
		BS 443	Specification for testing zinc coatings on steel wire and for quality requirements
		ASTM A 143	Recommended practice for safeguarding against embrittlement of hot-dip galvanized structural steel products and procedure for detecting embrittlement

1.3 DEFINITIONS. For the purpose of this Standard, the definitions below apply.

1.3.1 Coating mass—mass of the zinc coating per unit area expressed in grams per square metre.

NOTE: The mass of the coating for sheet is expressed as the total amount on both surfaces of the steel base (see also AS 1397).

1.3.2 Galvanized coating—a coating obtained by dipping prepared ferrous articles in molten zinc.

1.3.3 Galvanizer—a person, persons, or organization responsible for the coating of the article with molten zinc.

1.3.4 Supplier—a person, persons, or organization responsible for the supply of the galvanized product.

1.4 BASIS METAL.

NOTE: Recommended principles of design and preparation of materials prior to galvanizing are listed in Appendices C, D and E.

1.4.1 Holes for filling, venting or draining. The design of the article shall include where necessary holes to be drilled for filling, venting or draining.

1.4.2 Mechanical properties. The galvanizer should take due care as changes to the mechanical properties of the basis metal can result from the galvanizing process.

1.4.3 Distortion and cracking. The galvanizer should take due care to avoid distortion or cracking occurring during galvanizing.

1.4.4 Embrittlement. The galvanizer should take due care in processing steel that is susceptible to embrittlement.

1.5 GALVANIZING PROCESS.

1.5.1 Pretreatment. The galvanizer shall not damage the article by over-pickling.

1.5.2 Hot-dip galvanizing. The molten metal in the working area of the galvanizing bath shall contain not less than 98.0 percent by mass of zinc. If required, surplus zinc shall be removed from threads by centrifuging, brushing or similar process.

1.6 APPEARANCE. The galvanized coating shall be continuous, as smooth and evenly distributed as possible, and free from defects that are detrimental to the stated use of the coated article. Methods recommended for the renovation of damaged

galvanized coatings or uncoated areas are given in Appendix F.

NOTES:

1. Defects cannot be completely quantified. Where the presence, size or frequency of any defects in the coating is considered to be of concern, appropriate arrangements should be made between the purchaser and the manufacturer. This may be achieved by the provision of acceptable type samples or methods of test.

Where defects are present and the product is submitted for acceptance, the manufacturer should be able to demonstrate fitness for purpose.

2. A thicker, less smooth coating is obtained on job galvanized articles compared with continuously galvanized sheet or wire.

3. The coating on hot-dip galvanized wire is not perfectly smooth or devoid of irregularities. Therefore it is intended that the diameter tolerances shown in the appropriate wire specifications apply to uniformly coated areas of the wire.

4. The finish of the coated object may be partly or wholly grey in colour for steels of certain composition or for articles slowly cooled after galvanizing. Provided that such a coating has adequate adhesion, the grey finish is not detrimental, although premature staining may occur in service.

5. Advice on the transport and storage of galvanized articles is given in Appendix G.

1.7 TEST REQUIREMENTS.

1.7.1 Coating mass. When determined in accordance with Appendix H, the coating mass shall comply with the relevant requirements specified in Section 2, Section 3, Section 4 or Section 5, as appropriate.

In cases of dispute, the gravimetric method described in Paragraph H2 of Appendix H, shall be used as the referee test method, if practicable.

1.7.2 Adherence of coating. When tested in accordance with Section 2, Section 3, Section 4, or Section 5, as appropriate, the adherence of the coating shall comply with the requirements specified.

SECTION 2. SHEET

2.1 SCOPE OF SECTION. This Section specifies requirements for the mass, quality and testing of six classes of zinc coating on steel sheet. These requirements also apply to hollow sections fabricated from continuously hot-dipped steel sheet.

NOTE: For details of the properties and finish of standard galvanized steel sheet available in strip and cut lengths, reference should be made to AS 1397.

2.2 CLASSIFICATION AND DESIGNATION OF COATING. The coating class is designated by the prefix letter 'Z' followed by a three-digit number representing the minimum zinc coating mass determined by the triple-spot test described in Clause 2.4.2.

NOTE: A Type Z coating is a zinc coating which contains minor additions of control elements only. It is normally provided with a chromate passivation finish.

2.3 SELECTION OF TEST SPECIMENS.

2.3.1 For determination of coating mass. Spot tests for determination of coating mass shall be performed on specimens approximately, 20 cm² in area, selected as follows:

- (a) *For triple-spot test.* The triple-spot test shall be performed on three specimens selected from a sample representing the full width of the strip. One specimen shall be selected from the centre line, and the others from each edge but not closer than 25 mm to the coated edge.
- (b) *For single-spot test.* A single-spot test shall be performed on specimens selected from any part of the strip not closer than 25 mm to either coated edge.
- (c) *For one-surface single-spot test.* The one-surface single-spot test shall be performed on specimens selected from any part of the strip not closer than 25 mm to either coated edge.

2.3.2 For adherence of coating. For coating adherence tests, the position of the test specimen shall be not less than 5 mm from the coated edge. The specimen shall be of sufficient size to enable the required testing to be performed (see Clause 2.5).

2.4 COATING MASS REQUIREMENTS.

2.4.1 General. The triple-spot and single-spot tests for coating mass, determined in accordance with one of the methods described in Appendix H, shall comply with the requirements of this Clause, and shall be expressed as the total mass of coating on both surfaces of the steel basis metal, measured in grams per square metre.

NOTE: Because of the inherent difficulties in accurately measuring thickness of normal galvanized articles, zinc-coating thickness is not subject to specification.

2.4.2 Triple-spot test. The triple-spot test determines the average mass of coating on the three

specimens selected in accordance with Clause 2.3.1. When tested in accordance with one of the methods described in Appendix H, the coating mass shall conform to the requirements specified in Table 2.1 for the relevant coating class.

2.4.3 Single-spot test. The single-spot test shall be carried out on specimens selected in accordance with Clause 2.3.1. When tested in accordance with one of the methods described in Appendix H, the coating mass shall conform to the limits specified in Table 2.1, for the relevant coating class.

The minimum value obtained by the single-spot test shall be not less than 90 percent of the minimum triple-spot test value obtained.

2.4.4 One-surface single-spot test. The one-surface single-spot test shall be carried out on specimens selected in accordance with Clause 2.3.1. When tested in accordance with one of the methods described in Appendix H, the coating mass shall conform to the limits specified in Table 2.1, for the relevant coating class.

The minimum value obtained by the one-surface single-spot test on either surface shall be not less than 40 percent of the minimum triple-spot test value obtained.

TABLE 2.1
COATING MASS REQUIREMENTS

Coating class	Min. coating mass (total both surfaces) g/m ²		Min. coating mass (one surface, single spot) g/m ²
	Triple spot	Single spot	
Z100	100	90	40
Z200	200	180	80
Z275	275	248	110
Z350	350	315	140
Z450	450	405	180
Z600	600	540	240

2.5 ADHERENCE OF COATING. The coating shall be sufficiently adherent to withstand normal handling conditions without peeling or flaking.

Specimens for coating adherence tests shall be selected in accordance with Clause 2.3.2. When tested in accordance with AS 2505.1, specimens shall be capable of withstanding a bend through 180 degrees around a mandrel with diameter as specified in Table 2.2. Failure of the coating within 5 mm of the edge of the test specimen shall be disregarded.

In addition, the coating shall remain firmly adherent to the steel base and shall not crack or flake to a degree that any flakes of coating can be removed by rubbing with the bare fingers.

NOTE: The direction of testing is not significant but to reduce the incidence of base metal failure before the adhesion limit has been reached, the direction of testing should be performed with the axis of bend at right angles to the rolling direction.

TABLE 2.2
COATING ADHESION (180° BEND TEST) REQUIREMENTS

Steel grade†	Diameter of mandrel in terms of thickness (<i>t</i>) of product					
	Coating class					
	Z100	Z200	Z275	Z350	Z450	Z600
G550	*	*	*	*	*	*
G500	*	*	*	*	*	*
G450	0	<i>t</i>	2 <i>t</i>	2 <i>t</i>	2 <i>t</i>	3 <i>t</i>
G350	0	0	<i>t</i>	<i>t</i>	<i>t</i>	2 <i>t</i>
G300	0	0	<i>t</i>	<i>t</i>	<i>t</i>	2 <i>t</i>
G250	0	0	0	0	<i>t</i>	2 <i>t</i>
G1	0	0	0	0	<i>t</i>	2 <i>t</i>
G2	0	0	0	0	<i>t</i>	2 <i>t</i>
G3	0	0	0	0	<i>t</i>	2 <i>t</i>

* Coating to withstand base forming limits.

† Refer to AS 1397 for details of steel grade.

SECTION 3. HOLLOW SECTIONS

3.1 SCOPE OF SECTION. This Section specifies requirements for the mass, quality and testing of the continuously hot-dipped galvanized coatings applied to hollow sections on both surfaces, or on the external surface only.

NOTES:

1. The requirements for zinc coating on hollow sections fabricated from continuously hot-dipped steel sheet are not included in this Section. They are included in Section 2.
2. For details of test requirements for steel tubes requiring galvanizing see AS 1074.

3.2 SELECTION OF TEST SPECIMENS.

3.2.1 Coating mass. For coating mass determinations, two specimens at least 50 mm long shall be cut from each end of the sample after first discarding approximately 50 mm from the ends.

3.2.2 Adherence of coating (circular sections only). For adherence of coating of circular hollow sections, a test specimen of sufficient length shall be cut from the sample.

3.3 COATING MASS REQUIREMENTS.

3.3.1 Continuous hot-dipped galvanized hollow sections. When the coating mass of test specimens

prepared in accordance with Clause 3.2.1 is determined by the gravimetric method described in Paragraph H2 of Appendix H, each surface coated shall have a coating mass of not less than 300 g/m².

NOTE: There is no direct correlation between the coating masses of the inside and outside surfaces, and for all practical purposes they can be considered as having been galvanized separately.

3.3.2 Continuous hot-dipped galvanized hollow sections (external surface only). When tested in accordance with one of the methods described in Appendix H, the coating mass of hollow sections galvanized on the external surface only shall be not less than 180 g/m².

3.4 ADHERENCE OF COATING. Galvanized circular hollow sections of internal diameter up to and including 50 mm shall withstand a bend around a grooved mandrel having a root radius of 8 times the outside diameter. The coating shall remain firmly adherent to the steel base and shall not crack or flake to a degree that any flakes of coating can be removed by rubbing with the bare fingers.

In addition the coating shall be sufficiently adherent to withstand normal handling conditions without peeling or flaking.