A SURVEY OF DURABILITY STANDARDS

John Robinson - Editor Corrosion Management

INTRODUCTION

'Not up to standard' and 'sub-standard' are common enough phrases in our English language.

The question is, to what standard are we referring?

This is particularly relevant to protective coatings, and other systems designed to ensure the durability of construction products.

With the globalisation of commerce and industry, there is an imperative to ensure that performance benchmarks are set in all jurisdictions. International standards are increasingly called up in specifications, and Standards Australia has adopted a policy of aligning all Australian standards with International Standards Organisation (ISO) standards as they are published or revised.

The importance of consistent standards in an international trading environment is essential to ensure that suppliers are competing on an equal footing in terms of product specifications and quality. While the world is rapidly moving towards uniform standards, there are still many regional, national and internal standards that are called up in specifications. These may include standards from:

United Kingdom	- BSI
International	- ISO, EC, ETSI
United States	- ANSI, ASTM, ASME
Germany	- DIN
New Zealand	- SANZ
Japan	- JIS
Canada	- CSA

The place of standards in the globalisation of trade has been recognized with the establishment of a partnership between the United Nations Industrial Development Organisation (UNIDO) and the International Standards Organisation (ISO). In the March 2004 issue of The Global Standard, published by SAI Global, the ISO's Alan Bryden says. " Unlike divergent national and regional standards, which can act as technical barriers to trade that shut out products from developing country exporters, International Standards level the playing field for fair competition by all. They do so by harmonizing and making transparent the specifications that products must meet on different markets."

"In addition, International Standards represent a reservoir of technological know-how and of product, performance, quality, safety and environmental specifications that are backed by international consensus on the state of the art."

There are now many Australian/New Zealand standards that have been released in recent times, related to coatings on steel in particular. Those related to zinc-based (galvanized) coatings on steel products are of particular interest, as most address identification issues that are important to specifiers.

Many zinc-based coatings look similar, but can vary significantly in durability performance as a result of the technology used in their application.

This review is aimed at listing the more important of these new standards, and highlighting the performance related issues addressed therein.

In addition, we have included a complete listing of current Australian standards associated with coatings for reference.

CATEGORIES OF COATING STANDARDS

There are six categories into which the current crop of coating standards fall. These are:

1. Process applied coatings
2. Manually applied coatings
3. Product related standards that define coating performance requirements
4. Environmental classification standards
5. Methods of measurement standards.
6. Generic materials standards (e.g. zinc metal, organic and inorganic coatings etc.)

While most of these standards are designed as stand-alone documents, most reference related standards and hence form a matrix of information sources that can be quite complex.

It is worth expanding on each of the above category descriptions to assist in the understanding of where they fit in the hierarchy of standards related to

protection of structures from corrosion.

1. **Process applied coatings.**
   These include galvanized coatings of all types, powder coatings, electroplated coatings and any other coating that is applied to an item in a purpose designed facility. The coating's characteristics are determined by the process and are usually maintained to tight specifications in a controlled environment.

2. **Manually applied coatings.**
   These include most types of commercial and industrial paint coatings, where the surface preparation is at the discretion of the operator, as is the application of the coating. These coatings are heavily dependent on the skill of the applicator and the ability to deal with the variables of the environmental conditions prevailing at the time of application.

3. **Product related standards that define coating performance requirements.**
   These types of standards reflect the shift to performance-based standards rather than prescriptive standards. The recently published AS/NZS 2699.3:2003 *Built-in components for masonry construction – Lintels and shelf angles (durability requirements)* is a good example of this new generation of standards. A minimum performance life (50 years) is nominated, and complying coatings are listed in the standard for a range of exposure classifications.

4. **Environmental classification standards.**
   These standards are intended to provide environmental classifications based on a range of corrosivity factors, which can then be overlaid on coating standards to determine system performance. AS/NZS 2312:2002 *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings,* along with ISO standards ISO 9223, 9224, 9225, and 9226 cover the classification of environments. A new standard (AS 4312 – *Corrosivity zones in Australia,* is being developed by Standards Australia, that will be a single-source document for this application.

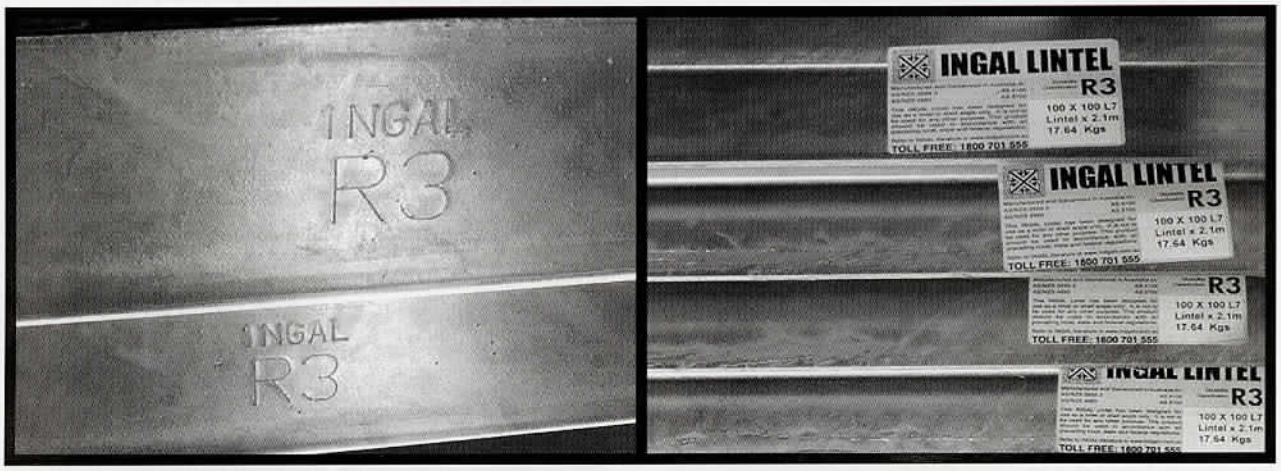
5. **Methods of measurement standards.**
   There is a large number of very specific standards related to the measurements and test procedures associated with the application and performance of applied coatings of all types. These standards range from methods of measurement of coating thickness to the determination of surface cleanliness.

6. **Generic materials standards.**
   These standards related to the quality requirements for the basic materials used in the protective coating process. Some are incorporated into the coatings standards. Examples include a standard for testing the metallic zinc content of zinc-rich paint coatings and the component requirements for two-pack epoxy paint designed for industrial applications.

The aim of all standards is to clearly define the requirements of the product or process for the purposes of specification and the assurance of the quality of the finished product. Most standards are quite product-specific, and rarely give rise to confusion in the specification process.

One exception is zinc (galvanized and electroplated) coatings, which until recently, have not been separated sufficiently the facilitate clear specification based on required performance.

For that reason, these standards will be dealt with in more detail in this summary.



Australian Standard AS/NZS 2699.3 - Lintels and self angles - requires lintels to be marked with their durability rating and identified as complying with the standard. Many lintels do not comply with this requirement and their use may result in future liability for the builder.

For 25 years, prior to 1999, almost all galvanized products (sheet, wire, tube, fasteners and after-fabrication galvanizing were included in a single standard – AS 1650. This created a great deal of confusion with specifiers, as each product coating can have quite different characteristics that impact directly on its durability.

Since 1999, a complete set of new standards related to the zinc coatings of each of these product categories has been published. This has allowed much clearer identification of the various zinc coatings applied to this range of steel materials.

THE ZINC-COATED (GALVANIZED) STEEL STANDARDS.

AS/NZS 4680:1999 – *Hot dip galvanized (zinc) coatings on fabricated ferrous articles*

AS/NZS 4680 is specific to after-fabrication galvanizing and specifies the heaviest galvanized coatings. In most cases, the hot dip coating will always exceed the specified minimum thickness because of the nature of the application process. Minimum coating thickness is specified on the basis of steel thickness. The coating is specified in grams/m^2 which is usually converted to average coating thickness in microns so non-destructive measurement of the coating can be done.

AS/NZS 4534:1998/2001 - *Zinc and zinc/aluminium coatings on steel wire*

AS/NZS 4534 is specific to continuously galvanized wire. The coating is applied in a continuous process. A number of coating classes is available that vary with wire diameter. A WXX identification system is used, with W10 being the standard class against which the other classes are rated. e.g. W20 is double the coating mass of W10 and W05 is half the coating mass of W10 for the same wire diameter.

AS/NZS 4791:1999 - *Hot dip galvanized (zinc) coatings on ferrous open sections applied by a continuous or specialised process.*

AS/NZS 4792:1999 – *Hot dip galvanized (zinc) coatings on ferrous hollow sections applied by a continuous or specialised process.*

AS/NZS 4791 - *Open sections; AS/NZS 4792 - Hollow sections*

These two standards were developed specifically for OneSteel's Duragal™ continuously galvanized hollow and open sections and Palmer Tube's and Orrcon's hollow sections manufactured from continuously galvanized (CG) strip. Some sections may be hot dip galvanized using a semi-continuous galvanizing process.

Where the hot dip galvanized coating is used, the coating class is designated by the classification HDGXXX, where the XXX numerals are the coating mass per square metre on each surface. e.g. HDG200 is 200 g/m^2 average.

Where CG strip is used, the coating class is designated by the classification ZBXXX/XXX. The ZB indicates 'zinc both sides' and the XXX is the coating mass per side in g/m^2. e.g. ZB100/100 represents 100 g/m^2 coating mass average on both sides.

Where the coating is applied by an in-line process (Duragal™), the coating class is designated by the classification ILGXXX, where ILG indicates in-line galvanized and the XXX is the single-side coating mass in g/m^2. e.g. ILG100 represents 100 g/m^2 on the outside of hollow sections and all surfaces of open sections.

AS 1397:2001 – *Steel sheet and strip – Hot dipped zinc coated and aluminium/zinc coated*

This standard has been virtually unchanged from previous editions and covers both galvanized (zinc), zinc/iron alloy and Zincalume™ coated steel sheet and strip. The Zincalume™ coating contains approximately 60% aluminium and 40% zinc.

The steel strength grade is designated by a GXXX classification, where the XXX represents the steel's yield strength in megapascals (MPa). e.g. G350 indicates a 350 MPa minimum yield strength.

The coating type is designated by ZXXX for galvanized (zinc) coatings, ZFXXX for zinc/iron alloy coatings and AZXXX for Zincalume™ coatings, where the XXX represents the total average coating mass on **BOTH** sides of the sheet. e.g. Z350 indicates a galvanized coating with a total coating mass on **BOTH** sides of the sheet of 350 g/m^2 or 175 g/m^2 on each side of the sheet.

AS 4750:2003 – *Electro- galvanized (zinc) coatings on ferrous hollow sections.*

This standard was developed to complement the other in-line galvanizing standards, where the zinc coating is applied by a continuous electroplating process, rather than using a molten zinc bath.

There are a number of hot-dip galvanizing standards related to structural fasteners. These standards are similar with respect to coating specifications, but are

differentiated by the types of fasteners.

These standards include:

AS 1214:1984 *Hot-dip galvanized coatings on threaded fasteners (ISO Metric coarse thread series)*

AS/NZS 1559:1997 *Hot-dip galvanized steel bolts with associated nuts and washers for tower construction.*

AS/NZS 1252:1996 *High strength steel bolts with associated nuts and washers for structural engineering.*

AS/NZS 1390:1997 *Cup head bolts with ISO metric coarse pitch threads.*

THE ENVIRONMENTAL CLASSIFICATION STANDARDS.

The most significant document in the Standards Australia library on the classification of environments for corrosivity is AS/NZS 2312:2002 – *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.*

The section in this standard covering classification of atmospheres is largely descriptive and makes no attempt to quantify corrosivity in given environments.

AS/NZS 2312 references a suite of ISO standards that are intended to provide the platform for classification of corrosivity or atmospheres. These standards are:

ISO 9223 - *Corrosivity of atmospheres - Classification*

ISO 9224 - *Corrosivity of atmospheres - Guiding values for corrosivity categories*

ISO 9225 - *Corrosivity of atmospheres - Measurement of pollution*

ISO 9226 - *Corrosivity of atmospheres - Determination of corrosion rate for standard specimens for the evaluation of corrosion.*

While these standards provide the metrics to determine atmospheric corrosivity, they have been developed for Northern Hemisphere conditions, and fall short in some areas that are appropriate for the Asia-Pacific region.

These shortcomings have been recognized by Standards Australia and a local standard, AS 4312 *Corrosivity zones in Australia* (Draft) is under development in 2004 at Standards Committee level.

Standards of this type will become increasingly important as the determination of durability of construction materials will lead to more performance based, rather than prescriptive, standards being published and also incorporated in to building codes and standard specifications.

FINDING THE STANDARD

It is no longer necessary to reference a large printed catalogue of standards, or even purchase a printed standard from an authorized distributor. Standards Australia has been providing an excellent web-based service for some time.

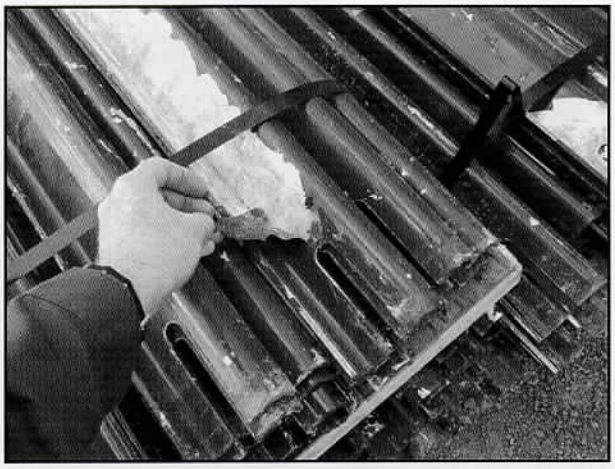
This allows all Australian and many other national and international standards to be accessed, on-line.

A search facility allows searches to be done on subject or standard number, and purchase options are available to either buy a printed copy or purchase the standard as a downloadable .pdf file at a saving over the printed copy option.

Becoming a member allows access to other areas of the site, as well as allowing discounts on purchases. Draft standards are listed, as well as those currently issued.

The Standards Australia web site has also facilitated the development of new standards through the Consensus Builder section of the site. This allows Standards Committee members to access documents and updates associated with the standard in which they are involved as soon as the information is posted in the Consensus Builder folder.

Students can register with Standards Australia and this will allow access to any standard for downloading for reference. These files are time stamped and copyrighted and have very short use-by date after downloading, but provide students with



This polyester powder coating has failed when applied to a galvanized substrate. Australian Standard AS/NZS 4506 details the correct procedure for this application which was not followed in this case.

standards access on a 24/7 basis, at no cost.

The Standards Australia web address is www.standards.com.au.

COATING STANDARDS SURVEY

This listing contains most of the Australian Standards that cover industrial protective coatings. There are additional standards that deal with specialised coatings (gold plating, vitreous enamel, etc) that have been excluded for practical reasons from this listing.

❑

Standard	Title
AS 1231-2000	Aluminium and aluminium alloys – Anodic oxidation coatings
AS 4750-2003	Electrogalvanized (zinc) coatings on ferrous hollow and open sections
AS 1192	Electroplated coatings – nickel and chromium
AS 4397-1996	Electroplated coatings of zinc on steel fasteners with imperial threads
AS 1897-1976	Electroplated coatings on threaded components (metric coarse series)
AS 1798-2003	Electroplated zinc (electro galvanized) coatings on ferrous articles (batch process)
AS/NZS 2312-2002	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.
AS 1214-1983	Hot-dip coatings on threaded fasteners (ISO metric coarse thread series)
AS/NZS 4680 –1999	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS 4791 -1999	Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or specialised process.
AS/NZS 4792 -1999	Hot-dip galvanized (zinc) coatings on ferrous open sections, applied by a continuous or specialised process.
AS/NZS 1559 -1997	Hot-dip galvanized steel bolts with associated nuts and washers for tower construction
AS 2483-2003	Metal finishing – Recommended sampling plans for the inspection and testing of coatings (ISO 4519:1980, Mod)
AS 1247-2004	Metallic coatings – Rating of test specimens and manufactured articles subject to corrosion tests
AS 2331.3.11-2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Chemical residue tests
AS 2331.3.2 – 2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Chemical residue tests - Acetic acid salt spray test (ASS test)
AS 2331.3.3 – 2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Chemical residue tests - Copper accelerated acetic acid salt spray test (CASS test)
AS 2331.3.4 – 2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Thioacetamide anti-tarnish and porosity tests
AS 2331.3.5 – 2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Sulfur dioxide/hydrogen sulfide porosity tests
AS 2331.3.6 – 2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Electrographic porosity tests
AS 2331.3.7 – 2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Corrodkote (Corr) test (ISO 4541:1978.Mod)

Standard	Title
AS 2331.3.8 – 2001	Methods of test for metallic and related coatings - Corrosion and related property tests- Humidity test –24 hour cycle - Damp heat
AS 2331.3.9 – 2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Metallic coatings - Porosity tests - Ferroxyl test
AS 2331.3. 1–2001	Methods of test for metallic and related coatings - Corrosion and related property tests - Neutral salt spay (NSS) tests
AS 2331.0 –2001	Methods of test for metallic and related coatings - Introduction and list of methods
AS 2331.1.1-2001	Methods of test for metallic and related coatings - Local thickness tests - Micrographic examination of cross section
AS 2331.1.2-2001	Methods of test for metallic and related coatings - Local thickness tests - Coulometric method
AS 2331.1.3-2001	Methods of test for metallic and related coatings - Local thickness tests - Magnetic method
AS 2331.1.4-2001	Methods of test for metallic and related coatings - Local thickness tests - Magnetic induction and eddy current method
AS 2331.1.5-2001	Methods of test for metallic and related coatings - Local thickness tests - Beta backscatter method
AS 2331.4.2-1990	Methods of test for metallic and related coatings - Physical tests - Ductility test
AS 2331.4.1-2001	Methods of test for metallic and related coatings - Physical tests - Qualitative adhesion tests
AS 2331.4.4-2001	Methods of test for metallic and related coatings - Physical tests - Assessment of intensity of shot peening.
AS 2331.2.1-2001	Methods of test for metallic and related coatings - Test for average coating mass per unit area or for thickness. Dissolution methods - Strip and weight analytical
AS 2331.2.3-2001	Methods of test for metallic and related coatings - Test for average coating mass per unit area or for thickness. Hydrogen evolution method for zinc coatings
AS/NZS 1580.205.3-1997	Paints and related materials - Methods of test – Application properties – Roller coating
AS/NZS 1580.481.0-2003	Paints and related materials – Methods of test – Coatings – Guide to assessing paint systems exposed to weathering conditions
AS/NZS 1580.481.5-1993	Paints and related materials – Methods of test – Durability and resistance to fouling – Marine underwater paint systems
AS/NZS 1580.481.1.10-1998	Paints and related materials – Methods of test – Exposed to weathering – Degree of flaking and peeling
AS/NZS 1580.481.1.11-1998	Paints and related materials – Methods of test – Exposed to weathering – Degree of chalking
AS/NZS 1580.481.1.12-1998	Paints and related materials – Methods of test – Exposed to weathering – Degree of colour change
AS/NZS 1580.481.1.13-1998	Paints and related materials – Methods of test – Exposed to weathering – Degree of fungal and algal growth
AS/NZS 1580.481.1.2 -1998	Paints and related materials – Methods of test – Exposed to weathering – Discoloration (including bronzing)

Standard	Title
AS/NZS 1580.481.1.3-1998	Paints and related materials – Methods of test – Exposed to weathering – Degree of dirt collection
AS/NZS 1580.481.1.4-1998	Paints and related materials – Methods of test – Exposed to weathering – Degree of dirt retention (after washing)
AS/NZS 1580.481.1.5-1998	Paints and related materials – Methods of test – Exposed to weathering – Change in gloss
AS/NZS 1580.481.1.6-1998	Paints and related materials - Methods of test - Exposed to weathering - Degree of erosion
AS/NZS 1580.481.1.7-1998	Paints and related materials - Methods of test - Exposed to weathering - Degree of checking
AS/NZS 1580.481.1.8-1998	Paints and related materials - Methods of test - Exposed to weathering - Degree of cracking
AS/NZS 1580.481.1.9-1998	Paints and related materials - Methods of test - Exposed to weathering - Degree of blistering
AS/NZS 2699.3-2003	Building components for masonry construction - Lintels and shelf angles (durability requirements)
AS 3894.4-2002	Site testing of protective coatings - Assessment of degree of cure
AS 3894.1-2002	Site testing of protective coatings - Continuity testing - High voltage (brush) method
AS 3894.9-2002	Site testing of protective coatings - Determination of adhesion
AS 3894.3-2002	Site testing of protective coatings - Determination of dry film thickness
AS 3894.6-2002	Site testing of protective coatings - Determination of residual contaminants
AS 3894.5-2002	Site testing of protective coatings - Determination of surface profile
AS 3894.7-2002	Site testing of protective coatings - Determination of surface temperature
AS 3894.11-2002	Site testing of protective coatings - Equipment report
AS 3894.12-2002	Site testing of protective coatings - Inspection report - Coating
AS 3894.13-2002	Site testing of protective coatings - Inspection report - Daily
AS 3894.14-2002	Site testing of protective coatings - Inspection report - Daily painting
AS 3894.10-2002	Site testing of protective coatings - Inspection report - Daily surface and ambient conditions
AS 3894.0-2002	Site testing of protective coatings - Introduction and list of test methods
AS 3894.2-2002	Site testing of protective coatings - non-conductive method - Continuity testing - Wet sponge method
AS 3894.8-2002	Site testing of protective coatings - Visual determination of gloss
AS 1397-2001	Steel sheet and strip - Hot-dip zinc coated or aluminium/zinc coated
AS/NZS 4506-1998	Thermoset powder coatings
AS/NZS 4534-1998	Zinc and zinc/aluminium alloy coatings on steel wire

CORROSION MANAGEMENT

PUBLISHER:
Industrial Galvanizers Corporation Pty Ltd

EDITOR:
John Robinson
312 Pacific Highway
Hexham NSW 2322
Phone: 02 4967 9089
Fax: 02 4964 8341
Email: tech@indgalv.com.au
Web: www.indgalv.com.au/cmmagazine

LAYOUT & TYPESETTING:
Keyboard Solutions
6 Oak Close
Fletcher NSW 2287
Phone: 0407 110 307
Email: leoni@keyboardsolutions.com.au
Web: www.keyboardsolutions.com.au

PRINTING:
Newcastle City Printers P/L
34 Metro Court, Gateshead
Newcastle NSW 2290
Phone: 02 4947 8111
Fax: 02 4947 8666

***CORROSION MANAGEMENT** is published by Industrial Galvanizers Corporation, which operates internationally through a network of galvanizing and manufacturing plants. Industrial Galvanizers Corporation is involved in the application of protective coatings for industrial, mining, domestic and commercial projects, using the best available technology and is not affiliated with any specific suppliers of corrosion or abrasion resistant coatings.*

The opinions expressed herein are not necessarily those of the Publisher.

***CORROSION MANAGEMENT** is published for those interested in the specification, application and performance of protective coating systems.*

Editor.

CONTENTS

Cover:

While not readily visible in this photograph, the main structural angles on an upper section of this 330KV tower at Sandgate, NSW show that the hot dip galvanized coating is reaching the end of its service life. Only one segment is affected, indicating that the sections used elsewhere on the tower had a heavier galvanized coating originally.

CORROSION MANAGEMENT

Volume 11 No 2 $5.50
Registered By Australia Post PP No. 229640 / 00002
May 2004

IN THIS ISSUE:

- A Survey of Durability Standards
- Restoring Serviceable Galvanized Structures
- Design and Material Solutions To Corrosion Problems
- New Research Reveals Better Performance for Hot Dip Galvanized Coatings
- Chemical Surface Treatments on Stainless Steel