42 - ATMOSPHERIC CORROSIVITY ASSESSMENT

INTRODUCTION

The durability of all materials is governed by the environment to which they are exposed. The effect of atmospheric exposure is by far the dominant factor affecting the durability of materials of construction, including steel itself and the coatings used to protect it from corrosion.

There has been a long-standing interest in the performance of materials in general and in steel in particular in atmospheric exposures and there have been a number of methods developed to classify atmospheric corrosivity throughout the industrial world.

Through the various national and international standards organisations or their affiliates, standards have been developed that provide a structure to allow atmospheric corrosivity to be assessed. While these standards contain methods or recommendations for classification of the corrosivity of atmospheres, there is little consistency in the methodology.

Some Standards such as AS/NZS 2312 Guide to the protection of iron and steel from atmospheric corrosion have narrative descriptions of atmosphere corrosivity classification, other use more scientific classification parameters such as chloride deposition rates or quantified measurement of other pollutants that are factors on the corrosion of metals.

In addition, the terminology used to classify atmospheric corrosivity varies between standards. AS/NZS 2312 uses an A,B…E rating for classification, while AS/NZS 2699 Built-in components or masonry construction, uses an R0..R5 rating system. The ISO (International) Standards use a C1-C5 rating system.

It is Standards Australia policy to harmonise all its standards to ISO, and for that reason, new standards that have been recently publish will adopt the ISO system of atmospheric corrosivity classifications with some modification to accommodate environments (e.g. tropical) that are not included the ISO classifications.

AS 4312:2008 ATMOSPHERIC CORROSIVITY ZONES IN AUSTRALIA

The deficiencies of the existing documents were recognised by Standards Australia, and this has resulted in the development of a new standard that has been published in 2008. It is AS 4312:2008 Atmospheric corrosivity zones in Australia.

This new standard should override any previously published standards with respect to atmospheric corrosivity classification.

AS 4312 deals with macro-climatic factors affecting corrosivity and also deals in with micro-climatic factors and the influence of design on durability in the context of atmospheric exposure.
The corrosivity categories are based on those used in ISO 9223 and are classified as follows:

ISO 9223 category	Corrosivity rating	Steel corrosion rate – Microns/year	Typical environment
C1	Very low	<1.3	Dry indoors
C2	Low	1.3 - 25	Arid/urban inland
C3	Medium	25 - 50	Coastal/industrial
C4	High	50 - 80	Marine (calm water)
C5	Very high	80 - 200	Marine (Ocean surf)

An additional ‘T’ classification has been included for AS 4312 to cover the tropical zones of Australia. Because of the monsoonal nature of the weather and the lack of ocean surf on tropical areas. The corrosivity classification would be generally equivalent to C2 for metals but would be higher for applied paint coatings because of the high levels of UV and its duration in tropical areas.

3. AS 2309:2008 Durability of galvanized and electro-galvanized zinc coatings for the protection of steel in structural applications - Atmospheric

Because zinc-based coatings are among the most widely used anti-corrosion coatings for steel, and there is a wide variation in the performance of the different types of zinc-based coatings that directly relate to their durability, Standards Australia implemented the development of a new standard, AS 2309:200X Durability of galvanized and electro-galvanized zinc coatings for the protection of steel in structural applications that was closely connected with AS 4312:2008 Atmospheric corrosivity zones in Australia.

This new and innovative Standard is due for publication in 2008, and classifies the various types of zinc-based coatings (electro-galvanized, continuously galvanized and hot-dip galvanized) in terms of their durability in given atmospheric corrosion environments.

AS 2309 references AS 2312 and AS 4312 with respect to environmental classifications. It also classifies the various types of zinc-based coatings in terms of their coating thickness. It has been long established that the durability of a galvanized (zinc) coating in any given environment is proportional to its thickness.

The nominal coating thickness of each type of galvanized coating is listed against its estimated service life in years in a given atmospheric corrosivity classifications. Thus the coating on a continuously galvanized sheet product such as a roll-formed purlin that is typically 25 microns in thickness, has an expected service life of 5-8 years in an industrial environment while an HDG 600 hot dip galvanized coating has an expected life of 17-20 years in the same application.

The Standard had developed a 'Star Rating' system for classifying zinc-based coatings with respect to their durability, to make it easier for specifiers and end users to differentiate the performance of zinc-coated steel products (which may all appear similar while the on them may differ).

This durability rating is as follows:

Coating mass g/m^2	Class	Star rating
<100	D1	1 star
100-199	D2	2 star
200-399	D3	3 star
400-599	D4	4 star
>600	D5	5 star

4. CORROSION MAPPING

Corrosion Mapping is covered in detail in another chapter of this Specifiers Manual, as are the factors that affect the deterioration of zinc (galvanized) coatings. However, the principles to which its use is applied can be applied logically in any known environment.

In Australia, the major driver of metal corrosion is chloride generated from ocean surf. The extent to which chlorides influence metal corrosion depends on whitecap activity in the ocean adjacent to the shoreline, the prevailing winds and their average velocity and the topography of the coastline.
It is generally accepted, and also listed in AS 4312, that the influence of chlorides does not normally extend more than a kilometer from the coastline, although there are exceptions in flat terrain with

prevailing strong on-shore winds.
The time that the metal is wet is also a major influence on its rate of corrosion. For this reason, galvanized steel products used in temperate areas with moderate rainfall (<750mm/year) may suffer more corrosion stress than similar materials used in tropical environments with much higher rainfall. This occurs because the higher ambient temperatures in the tropics maintain the steel's surface temperature well above the Dew Point, allowing it to dry quickly after rain. In colder climates, the steel surface may be below the Dew Point (and thus wet) for 24 hours/day in the winter months.
For the same reason, the shaded or sheltered sides of structures can suffer higher rates of corrosion that open and exposed areas of the same structure.

5. APPLYING THE STANDARDS

The development of these new Standards, in conjunction with use of the IG Corrosion Mapping System and other information sources, allows atmospheric corrosivity to be assesses with a high degree of confidence. This then allows life cycle estimates of the performance of steel structures to be made, which will then determine the most cost-effective methods of managing these steel assets with respect o their durability.

For important infrastructure assets such as power distribution systems, durability criteria can be etablished for individual structures in their specific environments, and inspection and management plans can be developed that ensure that the safe condition of the structure can be monitored without unjustified additional inspection.

INGAL
SPECIFIERS MANUAL

01 - SPECIFIERS MANUAL — THIRD EDITION

Industrial Galvanizers Australian Galvanizing Division (IGAG) operates nine galvanizing plants around Australia, ranging in size from large structural galvanizing facilities to specialised small plants designed to process small parts.

The Australian Galvanizing Division has galvanized in excess of 2 million tonnes of steel products in Australia since its first plant was commissioned in 1965 and is recognized for its ability to handle complex and difficult projects, as well as routine contracts.

This experience has been collated in the Specifiers Design Manual, to assist those involved in the design of steel products and projects to better understanding the galvanizing process and allow the most durable and cost-effective solutions to be delivered to these products and projects. All sections of this Third Edition have been completely updated and additional sections have been included to provide additional technical information related to the use of hot dip galvanized steel.

In addition to its Australian Galvanizing operations, Industrial Galvanizers Corporation has a network of manufacturing operations in Australia, as well as galvanizing and manufacturing businesses throughout Asia and in the USA.

The company's staff in all these locations will be pleased to assist with advice on design and performance of hot dip galvanized coatings and products. Contact details for each of these locations are located elsewhere in this manual.

This edition of the Industrial Galvanizers Specifiers Manual has been produced in both html and .pdf formats for ease of access and distribution and all documents in the Manual are in .pdf format and can be printed if paper documents are required.

The Specifiers Manual is also accessible in its entirety on the company's web site at www.ingal.com.au.

Additional copies of the Specifiers Manual are available on CD on request.

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