Long live Hot Dip Galvanizing

An introduction to the new Standard AS/NZS 2312.2

Australian Hot Dip Galvanizing Standards

Design & Durability
AS/NZS 2312.2
Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings – Part 2: Hot dip galvanizing

Manufacturing
AS/NZS 4680
Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

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galvanizers
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Background

AS/NZS 2312, *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings*, originated in 1967 as a guide for steel designers who needed advice on methods for the corrosion protection of structural steel. The last revision (2002) incorporated much information on the common methods of corrosion protection, including paint, hot dip galvanizing, thermal spray, powder coating and wrapping systems. Unfortunately the complexity of designing and specifying protective paint systems meant that much of the useful information on hot dip galvanizing was lost in the detail of the other systems.

During the review process, it was recognised that steel designers would benefit by separating the Standard into product specific sections to avoid confusion. The revised Standard was released in December 2014; with Part 1 covering paint systems and Part 2 covering hot dip galvanizing (HDG). Both new parts use the same definitions from AS 4312 for corrosivity categories in Australia, but now clearly recognise that the design process and durability of the two products are very different.

Designers wishing to specify HDG need only use two Standards; one covering the design and durability of HDG steel (AS/NZS 2312.2), and the other dealing with manufacturing process and tolerances (AS/NZS 4680).

Improved durability selection

AS/NZS 2312.2 references the latest international corrosivity and design Standards for HDG. This means that the design durability ('life to first maintenance') of HDG is now aligned with long term performance results from Australia and world recognised Standards. As a result, the quoted life for HDG coatings on structural steel has increased as shown in Table 1.

Table 1: Life to first maintenance of hot dip galvanized steel complying to AS/NZS 4680

AS/NZS 4680					AS/NZS 2312.2 Corrosivity category & Life to first maintenance (years)				
Steel thickness mm	Coating mass and thickness g/m²	µm	Designation	2002 versus 2014 edition	C2	C3	C4	C5	CX*
>1.5 to ≤3.0	390	55	HDG390	2002 2014	25+ 78->100	15-25 26-78	5-15 13-26	2-5 6-13	– 2-6
>3.0 to ≤6.0	500	70	HDG500	2002 2014	25+ >100	25+ 33-100	10-25 16-33	5-10 8-16	– 2-8
>6.0	600	85	HDG600	2002 2014	25+ >100	25+ 40->100	15-25 20-40	5-15 10-20	– 3-10
>>6.0	900†	125	HDG900†	2002 2014	25+ >100	25+ 60->100	25+ 30-60	10-25 15-30	– 5-15

NOTES:
* 'CX' is a new corrosivity category, not previously referenced in local or international Standards.
† Hot dip galvanized coatings thicker than 85µm are not specified in AS/NZS 4680, however in conjunction with the galvanizer, a specification can be written for thicker coatings.

Figure 1: With a specified minimum HDG coating thickness of 85µm, AS/NZS 2312.2 can be used to estimate this bridge rail will be protected from rust for over 50 years in a C3 (medium) environment.

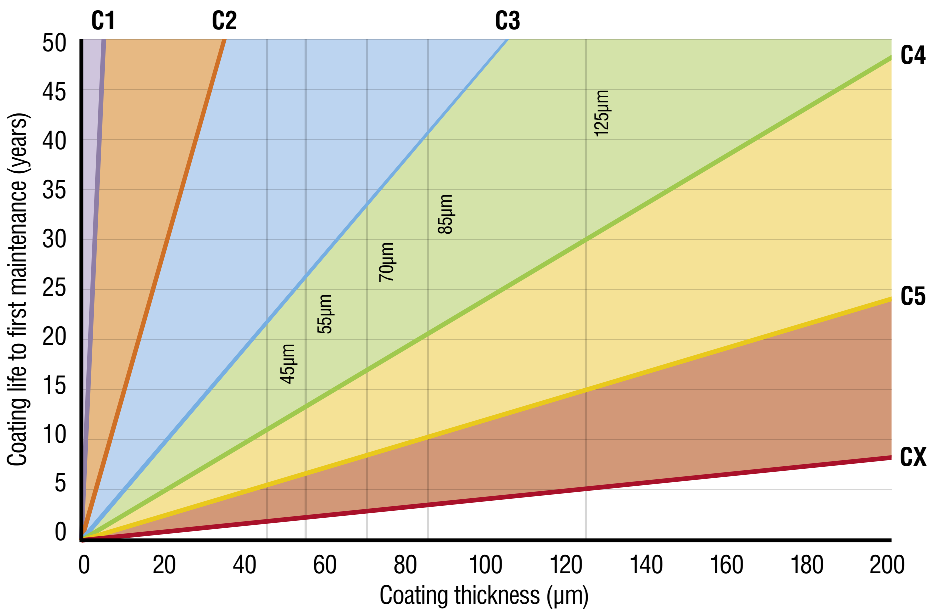

Figure 2: Calculated corrosivity rates for hot dip galvanizing from AS/NZS 2312.2 can be represented in a graphical format for quick estimates. For example, a coating thickness of 85µm can be estimated to last a minimum of 20 years to a maximum of 40 years in a C4 environment.

A single table is provided for designers to compare the expected durability of different galvanized products, including in-line galvanized steel, allowing for a faster product selection process.

The durability of a HDG coating is now calculated from the minimum average coating thickness in AS/NZS 4680, which also means non-standard HDG thicknesses can be easily assessed for estimated life to first maintenance. This can be done by using Figure 2, where the macro-environment corrosivity zone can be determined from Table 2.

Table 2: Corrosivity in Australia as described in AS 4312

Category		Generic examples	Specific examples
CX	Severe surf shore-line	Surf beach shoreline regions with very high salt deposition.	Some Newcastle beaches
C5	Surf Sea-shore	Within 200 m of rough seas & surf beaches. May be extended inland by prevailing winds & local conditions.	More than 500 m from the coast in some areas of Newcastle
C4	Calm Sea-shore	From 200 m to 1 km inland in areas with rough seas & surf. May be extended inland by prevailing winds & local conditions.	All coasts
		From the shoreline to 50 m inland around sheltered bays. In the immediate vicinity of calm salt water such as harbour foreshores.	
C3	Coastal	From 1 km to 10 km inland along ocean front areas with breaking surf & significant salt spray. May be extended inland to 50 km by prevailing winds & local conditions.	Metro areas of Perth, Wollongong, Sydney, Brisbane, Newcastle, & the Gold Coast
		From 100 m to 3 – 6 km inland for a less sheltered bay or gulf.	Adelaide & environs
		From 50 m to 1 km inland around sheltered bays.	Port Philip Bay & in urban & industrial areas with low pollution levels
C2	Arid/Urban Inland	Most areas of Australia at least 50 km from the coast.	Canberra, Ballarat, Toowoomba & Alice Springs
		Inland 3 – 6 km for a less sheltered bay or gulf.	Adelaide & environs
		Can extend to within 1 km from quiet, sheltered seas.	Suburbs of Brisbane, Melbourne, Hobart
C1	Dry indoors	Inside heated or air conditioned buildings with clean atmospheres.	Commercial buildings

New design advice

AS/NZS 2312.2 includes design advice on how the chemistry of some steels can be used to develop thicker coatings or when more durability is required than standard. In addition, when initial aesthetic appearance is important, the advice can be used to provide information on the typical coating characteristics, as described in Table 3.

Table 3: The effect of silicon and phosphorus on hot dip galvanized coating characteristics

Cat.	Si and P relationship		Initial appearance	Resistance to mechanical damage	Mass of coating	Typical use
A	Hot rolled	Si ≤ 0.040% Si+2.5P ≤ 0.090%	Excellent, typically shiny	Excellent	Standard; generally superior to the normal requirement	For compliance with Standard and excellent corrosion protection
	Cold rolled	Si + 2.5P ≤ 0.04%				
B	0.14% < Si ≤ 0.25%		Good, can tend to mottle or dull with increasing steel thickness	Good	Always heavier than normal; best specification for corrosive environments	Optimum long-term corrosion protection
C	0.04% < Si ≤ 0.14%		Can be dark and coarse	Reduced	Excessively thick coatings may occur	In non-abrasive environments can provide extreme corrosion protection
D	Si > 0.25%		Can be dark and coarse	Reduced	Increases with %Si	In non-abrasive environments can provide extreme corrosion protection

Painting over galvanizing (duplex coating)

An all new and detailed section on the design of duplex coatings (paint over HDG) is included, with two performance options for durability (aesthetic and corrosion). A duplex system will increase the service life of the HDG article beyond that of the unpainted article. Further, the total life of a properly specified, applied and maintained duplex coating system is significantly greater than the sum of the lives of the HDG coating and the paint coating alone (by 1.5 – 2.3 times, depending on the environment).

AS/NZS 2312.2 includes seven decorative and industrial paint systems suitable for most corrosivity environments.

Engineering and fabrication design details

For engineers and fabricators, the design details are extensive and pictorial advice on good design practice provides clear instruction, such as the examples in Figure 4. The effect the fabricated article's condition has on the HDG process, for example the size of the article, laser cutting and other thermal processes, and required tolerances, are clearly described.

Appendices to the Standard also cover corrosion in different environments, including bimetallic corrosion and the interaction of HDG steel with soil, concrete, water, chemicals, and wood.

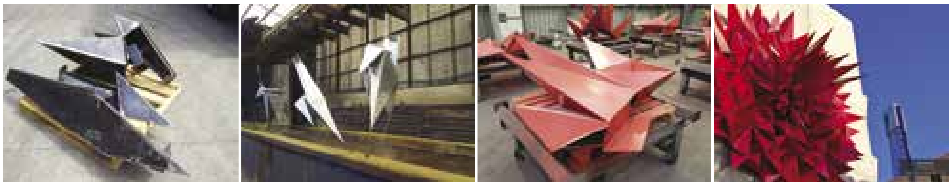

Figure 3: The Moment by Damian Vick, showing the four key stages of fabrication, galvanizing, painting and the final structure in place. This aesthetic sculpture is an example of a complex shape with sharp edges and is therefore perfectly suited to a duplex coating.

Figure 4: Illustrations in Appendix A of AS/NZS 2312.2 allow the designer to improve zinc flow in the HDG process, which will improve the aesthetics of the finished product, reduce the cost and eliminate danger to the galvanizing plant operators.

Summary

The new AS/NZS 2312.2 allows designers to more accurately estimate the durability of HDG coatings. In addition, the new Standard provides detailed design advice for duplex coatings, the effect of the steel chemistry and illustrates good design practice. It will serve as an essential aid for engineers, architects, specifiers and consultants for many years to come.

More information and free training on the use of AS/NZS 2312.2 is available from the GAA (www.gaa.com.au).
AS/NZS 2312.2 can be purchased from SAI Global (http://infostore.saiglobal.com/store/).

We provide information, publications and assistance on all aspects of design, performance and applications of hot dip galvanizing.

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