10. CUT EDGE PROTECTION

INTRODUCTION

One of the most important characteristics of zinc (galvanized) coatings on steel is the ability of the zinc to protect adjacent steel from corrosion. The electrical potential between zinc and steel ensures that zinc will act as an anode to adjacent exposed steel and prevent its corrosion.

All continuously galvanized products are dependent on the cathodic protection of their galvanized coatings to protect them from localised corrosion, as the galvanized coatings on all of these products are 'damaged' during the manufacturing process. They are cut, formed or punched after being manufactured from sheet, wire, or hollow and open sections to feed the next stage of the manufacturing process.

The degree of protection provided by the zinc coating to the exposed cut edges will be determined by:

1. The thickness of the material.
2. The mass of zinc available in the coating adjacent to the exposed steel.
3. The nature of the environment to which the product is exposed.

The cut edge corrosion phenomenon is almost always ignored in Standards and specifications. Australian Standard AS/NZS 4680:2006 Hot dip galvanized coatings on fabricated ferrous items, is a good example of this. The requirement to repair damaged areas on items galvanized after fabrication is clearly defined in the Standard, where the maximum permissible un-coated areas are nominated in terms of area.

In other standards associated with continuously galvanized products, there is no such requirement for repair of cut edges on sheet, tube, or wire products that are galvanized prior to fabrication. This is particularly relevant with cold-formed structural sections (purlins, channels) used for commercial construction, where the exposed steel per unit of surface exceeds the maximum allowable repairable area in the hot dip galvanizing standard.

Pre-galvanized products rely on cathodic protection to prevent corrosion on their cut edges. Thicker sections such as these heavy purlins are on the borderline and corrosion is visible on installation.

HOW FAR DOES GALVANIC PROTECTION EXTEND?

For many years, the only type of product reliant on galvanic protection of its cut edges was hot dip galvanized sheet used for roofing and cladding. The base steel used for these applications is very thin, typically 0.5-0.7 mm in thickness and thus the surface area of bare steel exposed is negligible.

Development in continuous manufacturing and coating of pipe and open structural sections, as well as heavier (up to 3.2 mm) sheet has resulted in a wide range of products being developed that have significant areas of exposed steel between the coated surfaces.

The other factor common to all galvanized products is the coating's ability to protect any exposed steel in the event of damage to the coated surface. While the ability of galvanized coatings to cathodically protect adjacent exposed steel has been evaluated empirically for over 100 years, few attempts have been made to quantify this phenomenon.

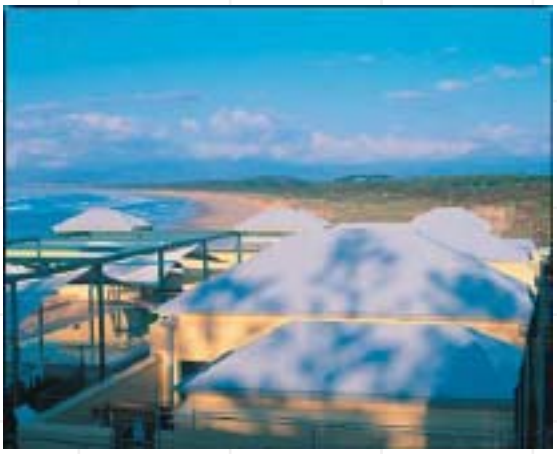
Work done in by X.G.(Gregory) Zhang of the Cominco Product Technology Centre, Mississauga, Canada, has allowed a more scientific approach to be taken.

EXPERIMENTAL RESULTS

The Cominco research by Gregory Zhang was aimed at determining the consumption rate of zinc as a barrier coating along with its galvanic protection of the exposed steel. Samples were prepared to simulate various zinc/steel combinations and included a number of degrees of separation, using zinc and steel strips of various thicknesses embedded in epoxy resin mounts. The samples were subjected to testing in the following environments:

- ASTM standard salt spray test
- full immersion test
- cyclic wet-dry humidity tests
- actual atmosphere exposure test.

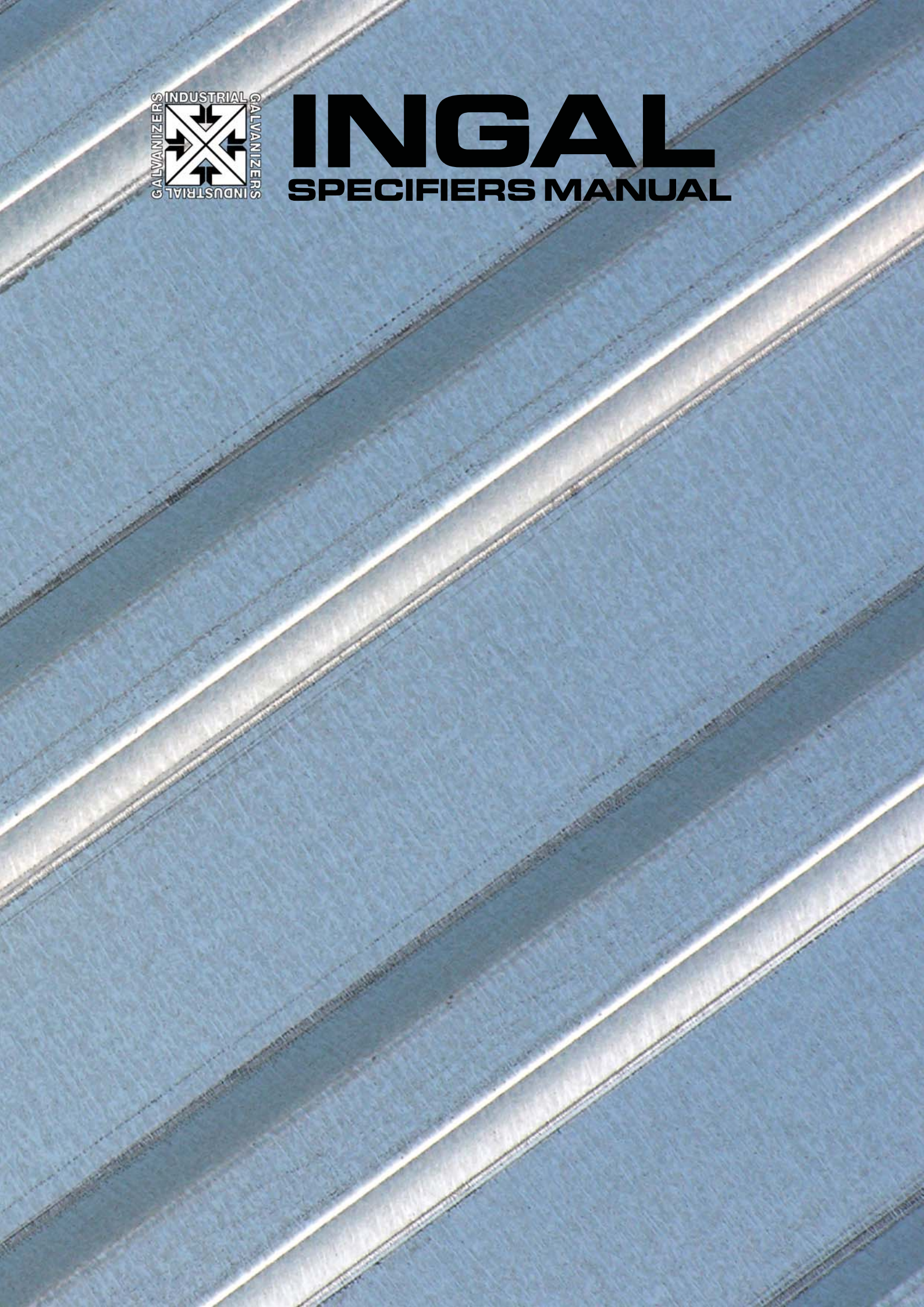
After testing in each corrosion environment, the samples were evaluated with an optical microscope. Each sample was inspected for areas of rusted and non-rusted steel surface based on both colour and depth of corrosion. Brown to dark brown discoloration on the steel surfaces was used to define the range of galvanic protection provided by the zinc.



Very thin (<0.5 mm) sections used for roofing and cladding are well protected on their cut edges because of the proximity of the zinc-based coating on each face of the sheeting.

CONCLUSION

In atmospheric exposure conditions, the Cominco report concludes that cathodic protection afforded to exposed steel by a zinc (galvanized) coating will be about 2 mm. This will vary somewhat depending on exposure conditions, and while rusting may occur outside this area, partial galvanic protection will cover a much larger area and significantly moderate the rate of steel corrosion in this area. The thin (0.2 mm) lateral surface of the zinc coating will be subject to galvanic corrosion in protecting the adjacent exposed steel while the rest of the zinc coating will corrode normally.



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.

PUBLISHER:
Industrial Galvanizers Australian Galvanizing Division,
PO Box 503, MOOROOKA
QLD 4105
Ph: 07 38597418

EDITOR:
John Robinson,
Mount Townsend Solutions Pty Ltd
PO Box 355, JESMOND NSW 2299
Ph: 0411 886 884
Email: mt.solutions@optusnet.com.au

LAYOUT AND DESIGN:
Adrian Edmunds,
Nodding Dog Design
Ph: 0402 260 734
Email: adrian@noddingdogdesign.com
Web: www.noddingdogdesign.com