

## 28. EFFECT OF GALVANIZING ON STEEL STRENGTH

### INTRODUCTION

Over the past 10 years, steel makers worldwide have developed new structural grades of steel with higher yield and tensile strengths. These developments have enabled manufacturers to design their steel products using lighter-section steel that in turn reduces the production, transport and erection costs of the finished product. Prior to these developments, the steel fabrications that were most commonly galvanized were manufactured from Grade 250MPa hot rolled structural steels.

Since the early 1970's, the results from research and testing centres around the world have shown that the hot dip galvanizing process does not affect the tensile and proof (yield) strengths of the Grade 250 MPa structural steels. But does the hot dip galvanizing process affect the yield and tensile strengths of the newer high-tensile grades of structural steels?

Industrial Galvanizers has been asked these questions on a number of occasions. To ensure that factual information is available, Industrial Galvanizers undertook a testing program involving galvanizing these steels to establish the effect of hot dip galvanizing on their structural performance.

### OBJECTIVE

The aim of this test program was to establish whether the process of dipping steel in molten zinc adversely affected the strength properties of a typical high tensile steel using standard hot dip galvanizing practices. These practices include duplicating the immersion time of the steel in the molten zinc (this is typically 5 - 10 minutes under normal conditions) at a temperature of 455°C.

### TEST 1

Product: HA70T-P Hot rolled, with black finish manufactured by BlueScope Steel.

HA70T-P hot rolled steel has guaranteed minimum yield strength of 450 MPa, and minimum hardness of 70 HRB. The typical yield strength is between 520 to 610 MPa. The typical tensile strength is between 530 to 620 MPa. This steel is normally used in shelving, automotive parts and more recently for purlins and other roll-formed light structural sections.

### PROCEDURE

The test procedure involved cutting eleven pieces from a of 3.0mm thick black HA70T-P steel coil. Six of the pieces were hot dip galvanized in accordance with AS/NZS 4680:1999. The remaining pieces were left in black (as rolled) finish. All sections were then delivered to BlueScope Technical Services Laboratory at Port Kembla for testing.

Table 1.

	Finish	Thickness Nominal mm	Thickness Actual mm	Hardness (Brinell)	Yield Strength MPa	Tensile Strength MPa
1.	Black	3.000	2.982	82	471	482
2.	Black	3.000	2.996	83	450	465
3.	Black	3.000	2.986	83	451	466
4.	Black	3.000	2.984	83	453	466
5.	Black	3.000	2.982	83	448	466
6.	HDG	3.000	2.966	83	445	482
7.	HDG	3.000	2.969	84	465	499
8.	HDG	3.000	2.977	84	473	501
9.	HDG	3.000	2.972	84	443	480
10.	HDG	3.000	2.966	83	443	481
11.	HDG	3.000	2.968	84	442	482

**TEST 2**

**Product: GALVSPAN G450 Zinc coated, structural grade manufactured by BlueScope Steel.**

GALVSPAN G450 has guaranteed minimum yield strength of 450 Mpa, and is an in-line hot dip zinc coated structural grade steel. The typical yield strength is between 470 to 550 MPa. The typical tensile strength is between 510 to 600 MPa. This steel is normally roll formed into products such as purlins, girts and light structural profiles.

**PROCEDURE**

The test procedure involved cutting six pieces from a single length of a roll-formed Z25024 purlin, which had been roll formed by BHP Building Products. The steel thickness is 2.4mm. Three of the pieces were acid pickled (to completely remove the Z350 mill applied zinc coating) and hot dip galvanized in accordance with AS1650-1989 Section 5. The remaining pieces were left in the mill applied Z350 Zinc coating (as rolled) finish. All sections were then delivered to the BlueScope Steel Technical Services at Port Kembla for testing.

Table 2.

	Finish	Thickness Nominal	Thickness Actual	Hardness (Brinell)	Yield Strength Mpa	Tensile Strength MPa
1.	Zinc coated	2.400	2.400	91	537	573
2.	Zinc coated	2.400	2.374	91	531	564
3.	Zinc coated	2.400	2.372	92	535	569
4.	HDG	2.400	2.372	91	532	566
5.	HDG	2.400	2.383	91	529	563
6.	HDG	2.400	2.383	92	536	569

### RESULTS

Tables 1 and 2 show the results of the testing. If the results of the yield strengths of the black sections and the results for the galvanized sections of the HA70T-P are averaged, the difference is 0.4%. As this variation is less than 1% it is considered to be within the accuracy tolerance of the testing procedure.

If the results of the yield strengths of the black sections and the results for the galvanized sections of the Galvaspan G450 are averaged, the difference is 0.6%. As this variation is less than 1% it is considered to be within the accuracy tolerance of the testing procedure.

Both of these tests have verified that hot dip galvanizing of either un-coated high strength steel or the hot dip galvanizing of pre-galvanized high strength steel after acid stripping of the original coating has no effect on the structural strength of the steels involved.

### NOTE

A subsequent comprehensive test program was undertaken by Industrial Galvanizers in partnership with OneSteel to evaluate the effect of hot dip galvanizing on 500N Grade reinforcing bar in 2007. The results of these tests are reported in Section XX of the Specifiers Manual, and support the findings of the testing detailed above, in that hot dip galvanizing does not affect the mechanical properties of standard grades of steel.







# INGAL

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# 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](http://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](mailto:mt.solutions@optusnet.com.au)

## **LAYOUT AND DESIGN:**

Adrian Edmunds,  
Nodding Dog Design  
Ph: 0402 260 734  
Email: [adrian@noddingdogdesign.com](mailto:adrian@noddingdogdesign.com)  
Web: [www.noddingdogdesign.com](http://www.noddingdogdesign.com)