

Rainbow® colour stability – external document

Standards and specifications

To help specifiers correctly define the corrosion resistance of metal coatings, ISO 12944 describes various **corrosivity categories** as follows:

ISO12944 classification	Impact	Interior	Exterior
C1	Very low	Heated buildings with very clean atmosphere, e.g. shops, offices, schools, hotels etc.	-
C2	Low	Unheated buildings where condensation may occur, e.g. Sports halls, depots etc.	Atmospheres with low levels of pollution. Mostly inland rural areas.
C3	Medium	Production rooms with high humidity and some air pollution, e.g. Food processing plants, laundries, breweries, dairies etc.	Urban and industrial areas, moderate sulphur dioxide pollution. Coastal areas with low salinity.
C4	High	Chemical plants, swimming pools, coastal ship and boat yards etc.	Industrial areas and coastal areas with moderate salinity.
C5-I	Very high (industrial)	Buildings or areas with almost permanent condensation and with high pollution.	Industrial areas with high humidity and aggressive atmosphere.
C5-M	Very high (marine)	Buildings or areas with almost permanent condensation and with high pollution.	Coastal and offshore areas with high salinity.

Note: ISO12944 was drawn up to be used in connection with the protection of steel structures, but is the only available standard we can use to classify the elZinc® Rainbow range as no norms exist to classify the protection of zinc coil and sheet.

European norm EN 10169 relates these **corrosivity categories** (C1 to C5-I and C5M) to corrosion resistance categories RC1 to RC5-I and RC5M respectively, and establishes the requirements a coating needs to fulfil to classify for each category, using both long term natural exposure testing and also accelerated weathering tests.

Accelerated weathering tests

Rainbow® product has been independently tested in accordance with European standards to establish the durability of the coloured layer. The results obtained in accelerated weathering tests were compared to the categories set out in EN 10169. These categories are as follows:

- Resistance to corrosion categories RC1 to RC5, with RC5 having the highest resistance to corrosion. RC5 corresponds to corrosivity category C5M as defined by ISO12944 'Very high (marine) atmospheric-corrosivity category. Exterior coastal and offshore areas with high salinity'.
- Resistance to UV radiation categories Ruv1 to Ruv4, with Ruv4 having the greatest resistance to UV radiation.



The results of these tests were independently evaluated by the prestigious firm of consultants ZID in Dusseldorf, Germany, who have certified that:

The Rainbow® product tested achieved a Resistance to corrosion category RC5.

The Rainbow® product tested achieved a Resistance to corrosion UV radiation of R_{UV}4.

In both evaluations, the Rainbow product attained the highest category possible. The certificate is given in the appendix of this document.

In addition to these comprehensive tests, we have also subjected perforated Rainbow material to a 1000hr acetic salt test. The result was again excellent, with the material **attaining the RC5 category**. This is even more noteworthy as the perforations in the material and their intersections with the surface score give plenty of possible sites where corrosion could have started, but did not. More details are given in appendix 2.

Product track record.

elZinc Rainbow® has been installed on over 400.000m² of cladding, in the varying climates of Europe, N. America, Australia, and Asia. We are unaware of any failure of the finish in any corner of the globe, no matter how aggressive the atmosphere. This is testimony to the consistency of the quality of the finish.

Conclusions.

Based on the excellent test results we expect that the finish will not blister, peel or flake. If, after many years (decades) of exposure, any changes in the appearance of the product do take place we expect them to be gradual and uniform, and to manifest themselves as a gentle fading of the Rainbow colour.

Appendix 1 - ZID certificate.


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Dr.-Ing. Werner E. Kallenberger

1st copy / No. 14 / 1590
Date: 12.02.2014

S t a t e m e n t

on test results carried out
on the elZinc Rainbow product

This report comprises 2 pages,
including 0 pages attachments, plus cover sheet

Client: Mr. Stephen Chapman
Project Manager
Asturiana de Laminados, SA

Objective: Statement on the classification of test results of tests of elZinc Rainbow
according to EN 10169.
The tests were carried out by an independent Laboratory.

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This report is destined solely for the client and shall be used under his responsibility only in full context and as a whole

For category R_u4 according to EN 10169: 2012

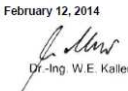
The results show a colour change (CIElab units) of less than 2 in artificial light, which fulfills the requirements $\Delta E \leq 2$

The results show a colour change (CIElab units) of less than 1 in exterior UV-radiation, which fulfills the requirements $\Delta E \leq 3$

The results show a gloss retention of greater than 80%, which fulfills the requirements $RG \geq 80$

Assessment:
All criteria for acceptance of the tested elZinc Rainbow are equal or better than required by the standard for **classification R_u4 according to EN 10169: 2012**

Duesseldorf, February 12, 2014




Dr.-Ing. W.E. Kallenberger

Any conclusions or findings are valid only for the samples described in this report. Photographs and pictures are stored in digitalized form in the quality given in this report. Samples or any material submitted will be discarded or otherwise disposed of after 6 months after the report on those samples has been issued. If no other arrangements have been made and were confirmed by Zinkberatung Ingenieurdienste GmbH in writing.

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Report No. 14 / 1590 page 1
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Order from: 11.02.2014 - AN 7723
 Designation of subject: Accelerated weathering tests
 Date of submission of data: 12.02.2014

A) General

Test were carried out on 3 different panels of elZinc Rainbow by an independent laboratory for examination of the corrosion behaviour and the weathering resistance of the coated zinc-copper-titanium sheet, brand name elZinc Rainbow.

The test reports and some pictures of the samples were submitted for check and interpretation of the test results. Also some details of the testing equipment were given.

The test results as given in the survey reports of all 3 test panels were checked and evaluated.

ZID was asked as an expert institute to give an opinion on those results.

B) Findings

The tests were carried out to measure the resistance to corrosion and resistance to UV radiation according to the respective standards, namely EN 10169 and others for specific weathering tests.

The test results as given in the survey sheets were compared to the requirements of the standard.

- Resistance to corrosion categories RC1 to RC5, with RC5 having the highest resistance to corrosion (see EN 10169 Tab 7).
 RC5 corresponds to corrosivity class C5-M (EN ISO 12944-2, Tab 1) "very high (marine) atmospheric corrosivity category; for external applications in coastal and offshore areas with high salinity"
- Resistance to UV radiation categories R_{uv}1 to R_{uv}4, with R_{uv}4 having the greatest resistance to UV radiation (see EN 10169 Tab 8).

According to the reports submitted all 3 samples tested have met the following criteria (EN 10169) as follows:

For category RC5 according to EN 10169: 2012

The results show an edge peel <2mm, which corresponds to RC5 according to EN 10169.

Information about bending was given "good adherence", which corresponds to requirement "no cracking or flaking of the coating in the bend area"

Max blistering grade 2 (S2) according to EN 13523-26, which corresponds to RC5 according to EN 10169

Assessment:
 The criteria for acceptance of the tested elZinc Rainbow are equal or better than required by the standard for **classification RC5 according to EN 10169: 2012**

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Appendix 2 – Report of Acetic salt spray test on perforated material.



Corrosion resistance.
Acetic salt chamber test

Objective.
To determine in an accelerated manner the corrosion resistance of continuously applied finishes of Asturiana de Laminados using an acetic salt chamber test, carried out according to EN 13523-8.

Duration.
The material was examined after 500 hours and after 1000 hours.

Assessment of results.
The results are assessed according to the following table.

Classification	Value	Edge blistering	Surface blistering
Excellent	9 – 10	0mm	0% blistering
Very good	7 – 8	< 1,5mm	< 1% blistering
Good	5 – 6	< 3mm	< 5% blistering
Weak	3 – 4	3 – 4mm	< 10% blistering
Bad	1 – 2	> 4mm	< 10% blistering

Samples that were tested.
 No 1 – unperforated sample with cross scored on surface
 No 2 – Face A of 1st perforated sample with cross scored on surface
 No 3 – Face A of 2nd perforated sample with cross scored on surface
 No 4 – Face B of 1st perforated sample with cross scored on surface
 No 5 – Face B of 2nd perforated sample with cross scored on surface

Results after 500h.

Rainbow Gold	500h acetic salt chamber test - classification			Classification
	Blistering at score and edge	Blistering around perforation	Surface blistering	
Sample 1	0mm		0%	Excellent
Sample 2	0mm (at edge)	0mm	0%	Excellent
Sample 3	0mm	0mm	0%	Excellent
Sample 4	0mm (at edge)	0mm	0%	Excellent
Sample 5	0mm	0mm	0%	Excellent



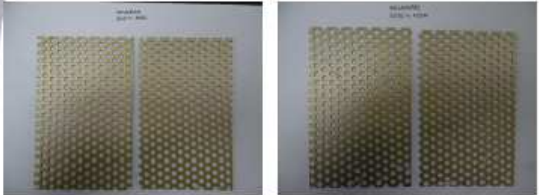
Global assessment.
The product tested in the acetic salt chamber test has reached the classification "Very good" after 1000 hours.
The blistering that appears at 1000 hours around the perforated holes is less than 1mm.

Interpretation of results.
According to EN ISO 4628 – 8, an edge peel of less than 2mm corresponds to an RC5 category finish.
This is the highest category specified under ISO 12944. Therefore, the Rainbow samples tested achieved RC5 corrosion resistance category, the highest classified under ISO norm.

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Photographs after 500 hours.



Results after 1000hours

Rainbow Gold	1000h acetic salt chamber test - classification			Classification
	Blistering at score and edge	Blistering around perforation	Surface blistering	
Sample 1	<1,5mm	-	0%	Very good
Sample 2	0mm (at edge)	< 1mm	0%	Very good
Sample 3	0mm	< 1mm	0%	Very good
Sample 4	0mm (at edge)	< 1mm	0%	Very good
Sample 5	0mm	< 1mm	0%	Very good

Photos after 1000h.



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It should be noted that the results obtained in accelerated weathering tests do not give direct correlation to natural weathering behaviour. They do however, give an accepted means of establishing a material's quality under artificial conditions.

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