



coating aluminium castings



a technical research paper



the

global

standard

for

architectural

aluminium

finishing

powder coating of aluminium castings

Powder coating of aluminium castings can be a challenge, particularly if there are contaminants present within the casting during the pretreatment and coating of the cast parts.

This document provides some in-depth research undertaken by Qualicoat and contains important data for use between the casting provider and powder coat processor to ensure good life expectancy of powder coated hardware for the fenestration industry.

Technical Information Sheet 2

April 2015 Edition

1. Introduction

Corrosion tests are among the most important tests to predict the behaviour of an organic coated surface. Each test for accelerated corrosion, however, provides an indication relating to a specific environmental characteristic, for example the SO₂ (sulphur dioxide) corrosion test simulates industrial environments, while the salt spray tests simulates the marine environment. In the case of coated aluminium, it is the Acetic Salt Spray test that is used, this is more onerous than the previous neutral salt spray test with a pH close to neutral.

QUALICOAT has extensive experience in undertaking research based on the Acetic Salt Spray test (AASS) following ISO 9227. The QUALICOAT specification requires that corrosion checks tests performance on 3 samples taken during the first yearly routine visit; the results of these tests are monitored yearly and results discussed within the QUALICOAT Committees.

In this technical information sheet we report the results of a testing program that has checked the influence of the chemical composition aluminium products produced by the casting process. The main scope of the testing is to give more technical information in reference to Appendix A5 in the QUALICOAT Specification.

With the alloys used in the casting process (EN 1706) the composition is influenced by the concentration of Silicone (Si), which can be up to 15% by mass. Without any special pretreatment it becomes very hard to pass the 1,000 hours in the Acetic Acid Salt Spray (AASS) test. We must also consider that in coating cast alloy the influence of Copper (Cu) is also of great concern on the life expectancy of the finish.

As the worlds leading architectural finishing association, QUALICOAT decided to investigate the influence of Cu on corrosion resistance. The testing program was developed by the French association (ADAL) in collaboration with the Italian Association (QUALITAL). In this technical information sheet we discuss the test program and the results.

2. Testing Programme

2.1 Surface preparation of the samples

The samples were treated in a powder coating plant to the following steps:

No.	Function
1	Degreasing
2	Rinsing
3	Alkaline Etching
2	Rinsing
5	Rinsing
6	Acid Desmutting
5	Rinsing
8	Rinsing
7	Conversion Coating
8	Rinsing
9	Rinsing
10	Drying Oven

2.2 Coating Material

In order to ensure consistent results, both the RAL colour and the supplier have been determined. QUALICOAT has decided to use only one colour, RAL 9010, for TGIC free powder coating of categories 3. and QUALICOAT approval.

2.3 Sample Codifications

The codification of the samples used in the corrosion tests were:

Type of Alloy	Type of process and description			
	Traditional pretreatment Chromium ISO 10546		Alternative pretreatment Chromium free	
	Standard Pretreatment Acid Etching	SEASIDE Pretreatment Type AA	Standard Pretreatment Acid Etching	SEASIDE Pretreatment Type AA
EN_AC_42200 AlSi7Mg0,6	A-A-1	A-D-1	A-C-1	A-B-1
	A-A-2	A-D-2	A-C-2	A-B-2
	A-A-3	A-D-3	A-C-3	A-B-3
EN_AC_44200 AlSi12Cu	B-A-1	B-D-1	B-C-1	B-B-1
	B-A-2	B-D-2	B-C-2	B-B-2
	B-A-3	B-D-3	B-C-3	B-B-3
EN_AC_46200 AlSi9Cu3	E-A-1	E-D-1	E-C-1	E-B-1
	E-A-2	E-D-2	E-C-2	E-B-2
	E-A-3	E-D-3	E-C-3	E-B-3

Results

Corrosion tests were carried out on one coated sample only, the results of which follow in the table.

A - Thickness

Sample	Measurement (µm)					Mean Value (µm)	Standard Deviation (µm)	Coefficient of Variation %
	1	2	3	4	5			
EN AC 42200 AA3	109	102	121	124	103	112	10.2	9
EN AC 42200 AD1	98.4	97.8	118	118	87.2	104	13.6	13
EN AC 42200 AC2	65.5	69.8	68.8	70.5	71.4	69.2	2.3	3
EN AC 42200 AB3	114	103	114	127	120	116	8.8	8
EN AC 44200 BA2	80.1	87.9	76.4	90.6	97.8	86.6	8.5	10
EN AC 44200 BD2	109	114	100	123	93.1	108	11.7	11
EN AC 44200 BC1	81	90.6	77.4	87.8	76.2	82.6	6.4	8
EN AC 44200 BB2	78.3	76.1	88.1	90.4	93.7	85.3	7.7	9
EN AC 46200 EA2	96	80.4	101	125	119	104	18	17
EN AC 46200 ED1	94.4	88.8	97	87.7	99.9	93.6	5.2	6
EN AC 46200 EC1	79.6	77	88.7	107	109	92	15	16
EN AC 46200 EB1	106	102	114	115	118	111	6.7	6

B- Acetic Salt Spray Tests

Type of Alloy	Type of process and description			
	Traditional pretreatment Chromium ISO 10546		Alternative pretreatment Chromium free	
	Standard Pretreatment Acid Etching	SEASIDE Pretreatment Type AA	Standard Pretreatment Acid Etching	SEASIDE Pretreatment Type AA
EN_AC_42200 AlSi7Mg0,6 R. 900	A-A-1	A-D-1	A-C-1	A-B-1
	A-A-2	A-D-2	A-C-2	A-B-2
	A-A-3	A-D-3	A-C-3	A-B-3
EN_AC_44200 AlSi12Cu R. 901	B-A-1	B-D-1	B-C-1	B-B-1
	B-A-2	B-D-2	B-C-2	B-B-2
	B-A-3	B-D-3	B-C-3	B-B-3
EN_AC_46200 AlSi9Cu3 R.902	E-A-1	E-D-1	E-C-1	E-B-1
	E-A-2	E-D-2	E-C-2	E-B-2
	E-A-3	E-D-3	E-C-3	E-B-3

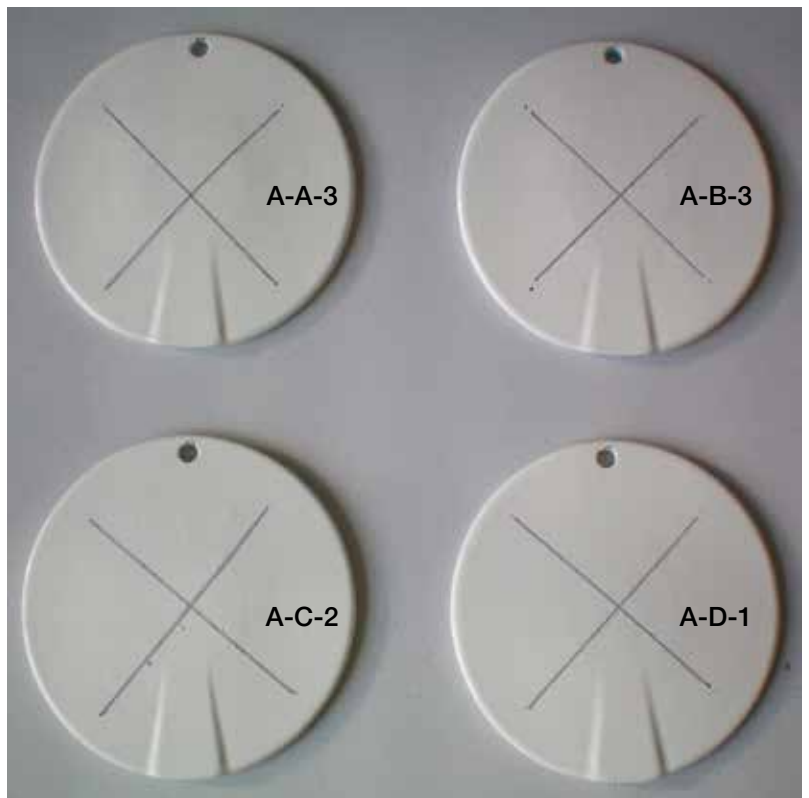
The colour in the table above gives a visual assessment of the results which are as follows:

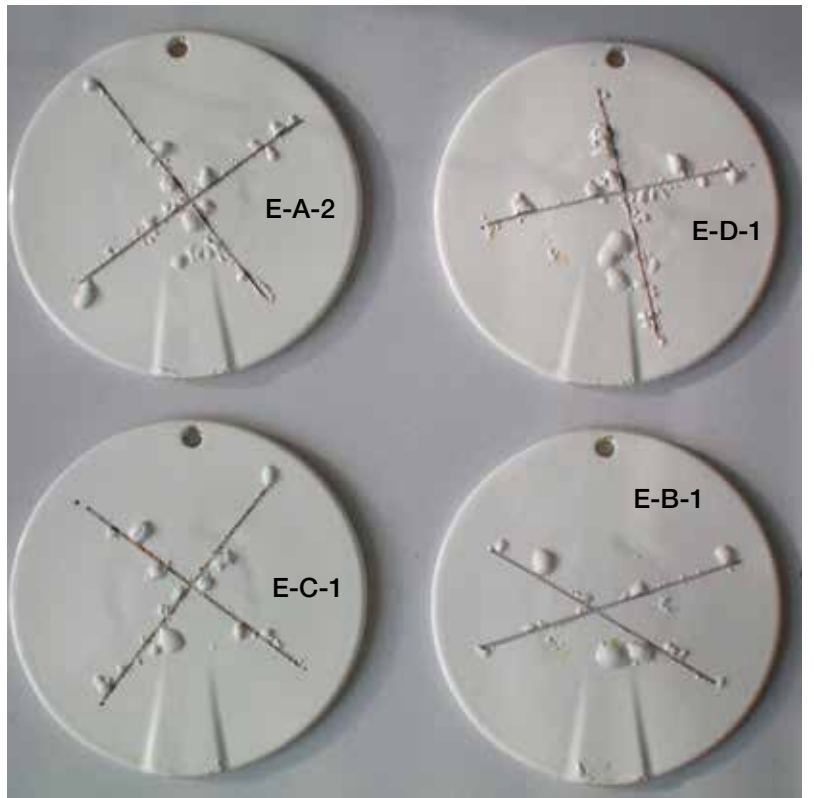
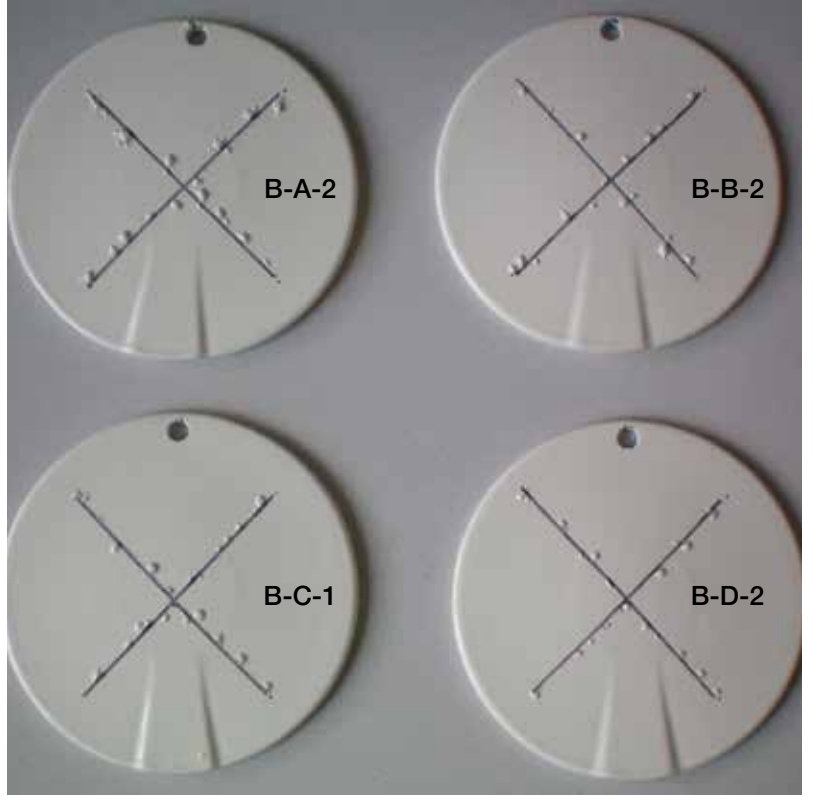
Colour	Evaluation
Green	Good
Yellow	Negative but not so far from the limits
Red	Strongly negative

Conclusion

The results show that the presence of Copper (Cu) reduce the performance on the Acetic Salt Spray test (AASS).

Samples Tested:






A look inside at the structure of aluminium alloy

To understand the reasons for the difference in the AASS results, it is necessary to look inside at the structure of the samples and to explore the inter-metallic compound and elements (Si) that play an important role in the corrosion process.

Coated samples of different aluminium alloys labelled as follows:

Type of Alloy	Description	Photo (metallographic specimen)
EN AC 42200 - Al Si 7 Mg 0,6	Cast accessories	 <p>Photo 1. Sample of cast accessory Micrographic specimen – observation direction</p>
EN AC 44200 - Al Si 12 Cu	Cast accessories	
EN AC 46200 - Al Si 9 Cu 3	Cast accessories	
Specimen Preparation (IO-15)		
<p>The specimens were obtained as showed in photos 1 and 2, with a section length of about 15 mm.</p> <p>They were mounted in hot transparent resin and polished to up to 0.05 µm.</p>		

Permanent Mould and Sand Castings.

Cast Accessory – Alloy EN AC 42200 - Al Si 7 Mg 0,6

Cross-sectional examination – Optical Microscope

Chemical Etching: Hydrofluoric acid HF 0.5% 10"

		Si%	Fe%	Cu%	Mn%	Mg%	Zn%	Ti%
EN AC-42200	AB2	6.74	0.201	0.0441	0.0878	0.424	0.0623	0.108
Uncertainty		± 0.21	± 0.019	± 0.0066	± 0.0106	± 0.031	± 0.0083	± 0.012
Specification UNI EN 1706:2010 lega EN AC-42200		From 6.5 to 7.5	Max 0.19	Max 0.05	Max 0.10	From 0.45 to 0.70	Max 0.07	From 0.08 to 0.25
<p>Notes:</p> <ul style="list-style-type: none"> The concentration of each other element less than 0,03% and the sum of their concentrations below 0,10% (EN AC-42200). Uncertainty of measurement multiplied by a coverage factor k=2 (confidence level of approximately 95%). 								



Photo 3.

EN AC 42200
Coating Thickness = 101 µm



Photo 4

Micrography
EN AC 42200

Magnification 100x



Photo 5.

Micrography
EN AC 42200

Magnification 500x

Heat treated TA. Mg₂ Si is completely dissolved by solution treatment; Si and, in a quite less measure α (Al Fe Mn Si) particles are rounded and agglomerated. Very fine precipitation of α (Al Fe Mn Si) is present on the background.

Permanent Mould Casting

Cast Accessory – Alloy EN AC 44200 - Al Si12

Cross-sectional examination – Optical Microscope

Chemical Etching: Hydrofluoric acid HF 0.5% 10"

		Si%	Fe%	Cu%	Mn%	Mg%	Ni%	Zn%	Ti%
EN AC-44200	BB1	12.56	0.570	0.0769	0.156	0.141	0.00871	0.148	0.0372
Uncertainty		± 0.33	± 0.038	± 0.0096	± 0.0166	± 0.015	± 0.00214	± 0.015	± 0.0058
Spec. UNI EN 1706:2010 alloy EN AC-44200		From 10.5 to 13.5	Max 0.55	Max 0.05	Max 0.35			Max 0.10	Max 0.15
Alloy EN AC-44100		From 10.5 to 13.5	Max 0.65	Max 0.15	Max 0.55	Max 0.10	Max 0.10	Max 0.15	Max 0.20
<p>Note:</p> <ul style="list-style-type: none"> The concentration of each other element less than 0.05% and the sum of their concentrations below 0.15% Uncertainty of measurement multiplied by a coverage factor k=2 (confidence level of approximately 95%). 									



Photo 6.

EN AC 44200
Coating Thickness = 90 μ m



Photo 7.

Micrography
EN AC 44200

Magnification 100x



Photo 8.

Micrography
EN AC 44200

Magnification 500x

Heat treated TA, with unmodified structure. In addition to binary eutectic Si, residual particles of Si + Mg₂ Si of the original ternary eutectic a (Al) - Mg₂ Si - Si, are present.

Pressure Die Casting

Cast Accessory – Alloy EN AC 46200 - Al Si 8 Cu 3

Cross-sectional examination – Optical Microscope

Chemical Etching: Hydrofluoric acid HF 0.5% 10"

		Si%	Fe%	Cu%	Mn%	Mg%	Ni%	Zn%	Ti%	Pb%	Sn%
EN AC-46200	EB3	9.23	0.708	3.12	0.148	0.101	0.0838	0,851	0.0621	0.0621	0.020
Uncertainty		± 0.26	± 0.045	± 0.12	± 0.015	± 0.012	± 0.0102	± 0.051	± 0.0067	± 0.0083	0.004
Specification UNI EN 1706:2010 alloy EN AC- 46200		From 7.5 to 9.5	Max 0.8	From 2.0 to 3.5	From 0.15 to 0.65	From 0.05 to 0.55	Max 0.35	Max 1.2	Max 0.25	Max 0.25	Max 0.15



Photo 9.

EN AC 46200
Coating Thickness = 103 μm



Photo 10.

Micrography
EN AC 46200
Magnification 100x



Photo 11.

Micrography
EN AC 46200
Magnification 500x

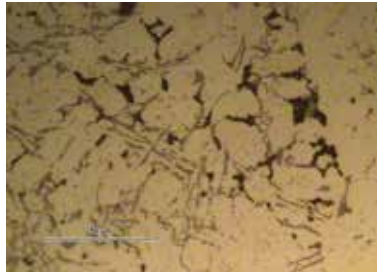


Photo 12.

Micrography
EN AC46200

Magnification 500x

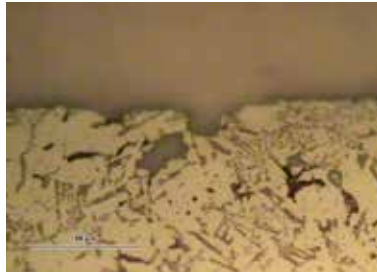


Photo 13.

Micrography
EN AC46200

Magnification 500x



Photo 14.

Micrography
EN AC 46200

Magnification 100x

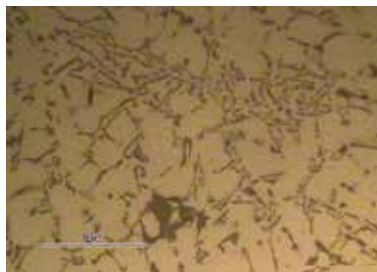


Photo 15.

Micrography
EN AC 46200

Magnification 100x

Typical structures consisting essentially in α (Al) dendrites and eutectics containing Si, Cu Al₂, Al₇ CU₂ Fe, on parts of the castings having different thickness. Rare needles and oxide inclusions.

**AUSTRALIA****Qualicoat Australia**

Australasian Institute of Surface Finishing (AISF)
Mr. Mark Hardy
Suite 3, 458 Middleborough Road
Blackburn AU3030 Collingwood Victoria Australia

Tel: +61 3 9890 6700
Email: qualicoat@aisf.org.au
Web: <http://www.aisf.org.au>

**GREECE****AAG**

Aluminium Association of Greece N.P.C.
Mrs. Ellie Ganakou
41-43 Michalakopoulou str.
GR-115 28 Athens

Tel: +30 210 72 56 130-2
Fax +30 210 72 56 133
E-mail: eganakou@aluminium.org.gr
Web: www.aluminium.org.gr

**BELGIUM****QUALUBEL**

Mr. Simon Meirsschaut
Chemin des Soeurs 7 Nodebais
BE - 1320 Beauvechain

Tel: +32 473 451 263
E-mail: simonmeirsschaut@yahoo.com

**HUNGARY****AFMSZ**

Hungarian Aluminium Surface Treaters'
Association
Mr. Imre Fehér
Népfürdo u. 19/A. I/4.
HU - 1138 Budapest

Tel: +36 30 9590575
E-Mail: feher.imre@atenzio.hu
Web: www.afmsz.hu

**CHINA****QUALISINO Limited**

Mrs. Jerry Li
No.99, 4th Jianshe Rd.
Xiaoshan Eco. & Tec. Dev. Zone
CN - 311200 Hangzhou City

Tel: +86-571 8286 5811
Fax: +852-21 80 99 56
Email: jerry@qualisino.com
Web: <http://www.qualisino.com>

**ITALY****QUALITAL**

Mr. Riccardo Boi
Via Privata Ragni 13/15
IT-28062 Cameri (Novara)

Tel: +39 0321 51 05 78
Fax: +39 0321 51 79 37
E-mail: boi@qualital.eu
Website: <http://www.qualital.eu>

**FRANCE****ADAL**

Mrs. Caroline Colombier
17, rue de l'Amiral Hamelin
FR - 75783 Paris Cedex 16

Tel: +33 1 42 25 26 44
Fax: +33 1 53 75 02 13
E-mail: caroline.colombier@aluminium.fr
Web: <http://www.aluminium.fr/industrie/associations/adal>

**JAPAN****QUALICOAT JAPAN**

c/o JAPAN ALUMINIUM PRODUCTS
ASSOCIATION
Mr. S. Kikuchi
13-13 Akasaka 2-chrome, Minatoku, JP - Tokyo

Tel: +81 3 3583 7971
Email: qualicoatj@apajapan.org
Web: www.apajapan.org

**GERMANY****VOA**

Haus der Bayerischen Wirtschaft
Mrs. Dr. Alexa Becker
Max-Joseph-Str. 5
DE - 80333 München

Tel: +49 895 517 86 70
Fax: +49 895 517 86 75
E-mail: info@industrieverbaende-nbg.de
Web: www.voa.de

**MEXICO****AMELAQ**

c/o Oxal SA de CV
Mr. Alejandro Ruiz
Francisco I. Madero 146
San Esteban, Naucalpan
Estado de Mexico, 53550

Tel: +52 555 1083 5092:
E-mail: alejandro.ruiz@amelaq.org



NETHERLANDS

QUAL.ION

Mr. Egbert Stremmelaar
Vereniging Industrieel Oppervlaktebehandelend
Nederland
Postbus 2600
NL - 3430 GA Nieuwegein
Tel: +31 30 630 03 90
E-mail: henraat@vereniging-ion.nl
Email: secretariaat@vereniging-ion.nl
Web: www.vereniging-ion.nl



SWITZERLAND

QUALICOAT SCHWEIZ

c/o ARCO Association Management AG
Mr. Josef Schoppig
Postfach 1507
CH-8027 Zürich

Tel: +41 43 305 09 70
E-mail: josef.schoppig@arco.swiss
Web: www.qualicoat.ch



BAHRAIN



EGYPT



KUWAIT



OMAN



QATAR



SAUDI ARABIA



SYRIA



UNITED ARAB EMIRATES

QMEA

Quali Middle East Association
Mr. Nasir Fahmeed
7th Floor, Sheikh Rashid Tower
Dubai World Trade Centre
P.O. Box 23070
Dubai

Tel: +971 4 309 7088
Email: admin@qualimiddleeast.com
Web: qualimiddleeast.com



POLAND

QUALIPOL

Mrs. Katarzyna Bartoszak
ul. Sepia 22
PL - 04-512 Warsaw

tel/fax: +48 500 579 089
e-mail: sekretariat@qualipol.pl
Web: www.qualipol.pl



RUSSIA

RAEA

Mrs. Marina Yatsenko
Office. 160, 7/4 Build.1
Kutuzovsky Prospekt
RU- 121248 Moscow

Tel: +7 (962) 941 2707
Email: imarina@apral.org
Email: qualicoat@apral.org
Web: www.apral.org



PORTUGAL

APAL

Associação Portuguesa do Alumínio
Mrs. Margarida Casqueiro
R. Cons. Luis de Magalhães, 46-1-B-2
Apartado 287
PT - 3811-901 Aveiro
Tel: +351 234 42 22 41
Fax: +351 234 481 189
E-mail: apaluminio@sapo.pt
Web: www.apal.pt



TURKEY

AYID

Alüminyum Yüzey İşlem Derneği
Mr. Metin Yılmaz
Semsettin Günaltay Caddesi Serhan Apt. 193/5
Erenköy - Kadıköy
TR - 34738 Istanbul
Tel: +90 216 386 16 85
Fax: +90 216 359 19 42
E-Mail: aydem@superonline.com



SERBIA & CROATIA

QUALIBAL

Mrs. Bugarinovic
Bose Milićević 5
RS-11000 Belgrade

Tel: +381 63 20 35 99
E-mail: office@qualibal.org
Web: www.qualibal.org



**UNITED KINGDOM
& IRELAND**

Qualicoat (UK & Ireland)



c/o Aluminium Federation Ltd
Mr. Jan Lukaszewski
National Metalforming Centre
47 Birmingham Road
West Bromwich
West Midlands. B70 6PY

Tel: +44 (0)121 601 6746
E-mail: j_lukaszewski@alfed.org.uk
Web: http://www.qualicoatuki.org/



SPAIN

AEA

(Asociación Española del Aluminio y Tratamientos
de Superficie)
Mr. Jon de Olabarria Ruiz
Principe de Vergara, 74 - 3ª, ES - 28006 Madrid

Tel: +34 91 802 08 78
Fax: +34 914 115 971
E-mail: informes@asoc-aluminio.es
Web: www.asoc-aluminio.es

QUALICOAT

Certification Body

Office:

Tödistrasse 48

CH-8002 Zürich

Accreditation: ARCO

Tödistrasse 42

CH-8002 Zurich

Accreditation number SCESp 0045

Tel: +41 44 515 98 40

E-Mail: info@qualicoat.net



the **global** standard for architectural **aluminium** coatings