

A photograph of a modern skyscraper with a glass facade, viewed from a low angle looking up. The building's structure is visible, including the grid of window frames and the dark vertical elements of the facade. The sky is a pale, clear blue.

***Aluminium surface treatments in  
buildings and other applications***

**Speaker: Eng. Giampaolo Barbarossa  
AITAL - Qualital Servizi**

*This paper is aimed at the applications in which semifinished aluminium alloys, extrusions (alloy EN AW 6060) and laminates (principally alloys of the 5000 AlMg series and, to a lesser extent, of the 3000 AlMn series), are employed for the realization of doors, windows and curtain walls, which will be referred to from here on in simply as “frames”. To this end the quality evaluations of the finishes are correlated to the protective characteristics of resistance to corrosion and to aesthetics (decay in colour and in brightness).*





*The quality (**durability**) evaluations of the finishes are correlated to the:*

- ***protective characteristics** of resistance to corrosion and to*
- ***aesthetics** (decay in colour and in brightness)*





## *Coating surfaces*

### TEST METHODS AND REQUIREMENTS (Qualicoat Specifications)

Appearance

Gloss

Coating thickness

Adhesion

Dry adhesion

Wet adhesion

Buchholz Indentation

Cupping test (only for the approval of organic coatings)

Bend test

Impact test

Resistance to humid atmospheres containing sulphur dioxide Acetic acid salt spray resistance

Machu test

Accelerated weathering test

Accelerated weathering test for classes 1, 1.5 and 2

Accelerated weathering test for class

Natural weathering test

Polymerization test

Resistance to mortar

Resistance to boiling water

Constant climate condensation water test

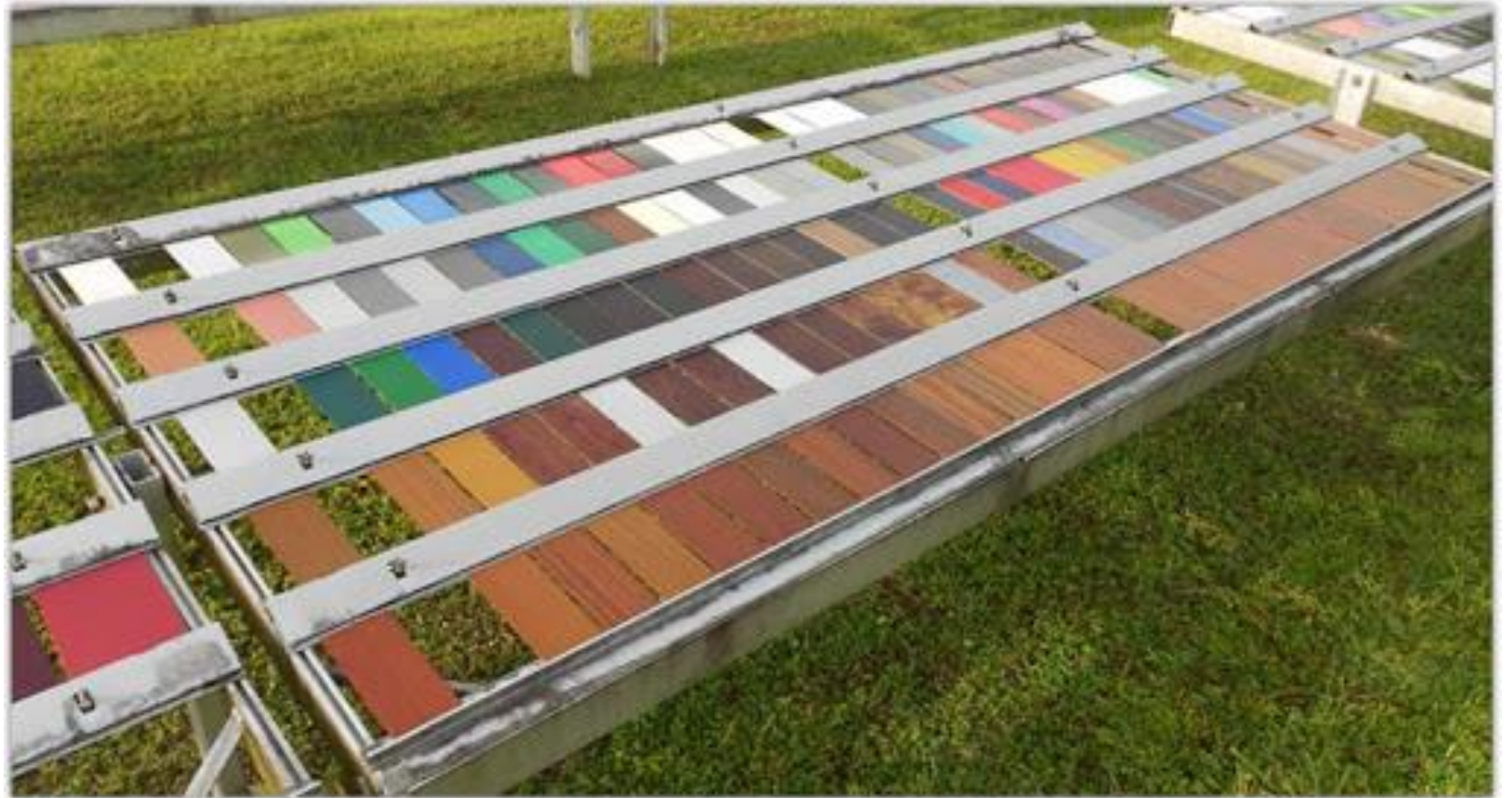
Sawing, milling and drilling

Filiform corrosion test Water spot test

Scratch and mar resistance test (Martindale)

## *Coating surfaces*

*Natural weathering  
test Exposure in Florida  
according to ISO 2810*



## Anodizing surfaces

Product test	Sub-clause	Type of anodizing			
		Architectural both appearance and protection are important 12.7 & 12.11	Industrial appearance is of secondary importance 13.7 & 13.11	Decorative decorative finish is the primary characteristic 14.7 & 14.11	Hard high wear resistance 15.7 & 15.11
Coating thickness	9.2	X	X	X	X
Dimensional tolerances			o		o
Mass loss (with predip)	9.3.1	X	X		
Mass loss (no predip)	9.3.2			X	
Dye spot	9.3.3				
Admittance	9.3.4	X	X	X	
Surface defects (no specified distance)	9.4.1		X		X
Surface defects at 5m & 3m	9.4.1	X			
Surface defects at 2m & 0.5m	9.4.1			X	
Texture & colour	9.4.2	X	o	X	
Light reflection	9.4.3			o	
Corrosion resistance (AASS)	9.5				
Corrosion resistance (NSS)	9.5		o		o
Surface abrasion resistance (glass-coated abrasive paper)	9.6.1	X			
Surface abrasion resistance (abrasive wheel)	9.6.2	X			
Wear resistance (abrasive wheel)	9.6.2		o	o	X
Wear resistance (abrasive jet)	9.6.3				
Wear resistance (falling sand)	9.6.4				
Wear resistance (Taber method)	9.6.5		o		X
Microhardness	9.7		o		o
Resistance to cracking by deformation	9.8	o	o	o	
Light fastness	9.9.1	X		o	
Resistance to ultraviolet radiation	9.9.2			o	
Electrical breakdown potential	9.10		o		o
Coating continuity	9.11	o	o	o	
Surface density	9.12		o		o
Thermal craze resistance	9.13			o	
Roughness			o		o
Service simulation tests			o	o	o

The symbol X indicates a test carried out by the sub-licensee while the symbol o indicates a test carried out by the sub-licensee depending on the agreement with the customer.



## *Anodizing surfaces*

*Natural weathering test  
Exposure in Italy and  
Holland*



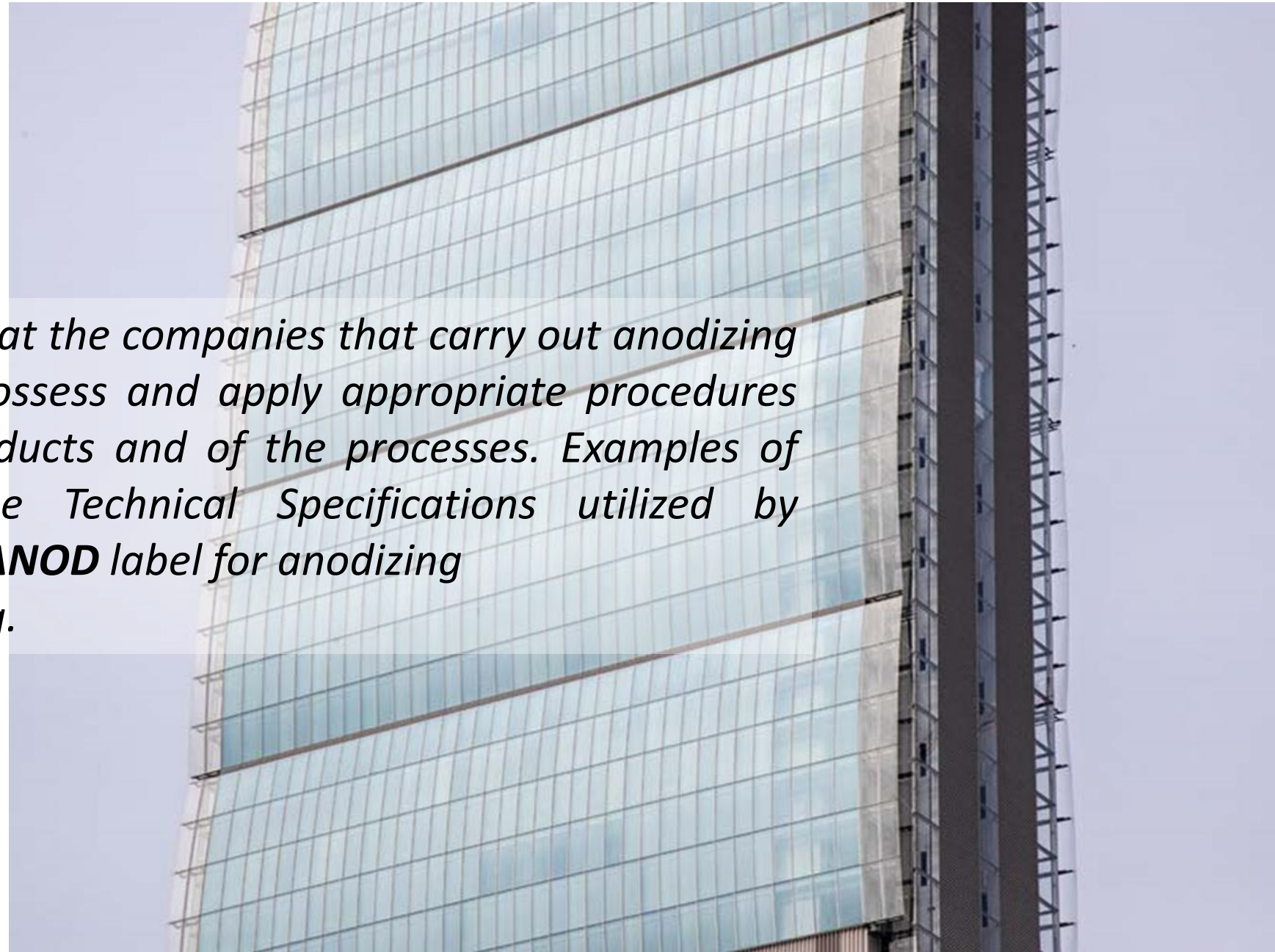
*The **durability** of a manufactured article or of a structure treated on the surface depends on several parameters, such as:*

- ***environment;***
- ***exposure conditions of the finished manufactured article in use;***
- ***structure design;***
- ***type of alloy;***
- ***support conditions before treatment;***
- ***chosen finishing cycle;***
- ***cleaning and maintenance in use.***



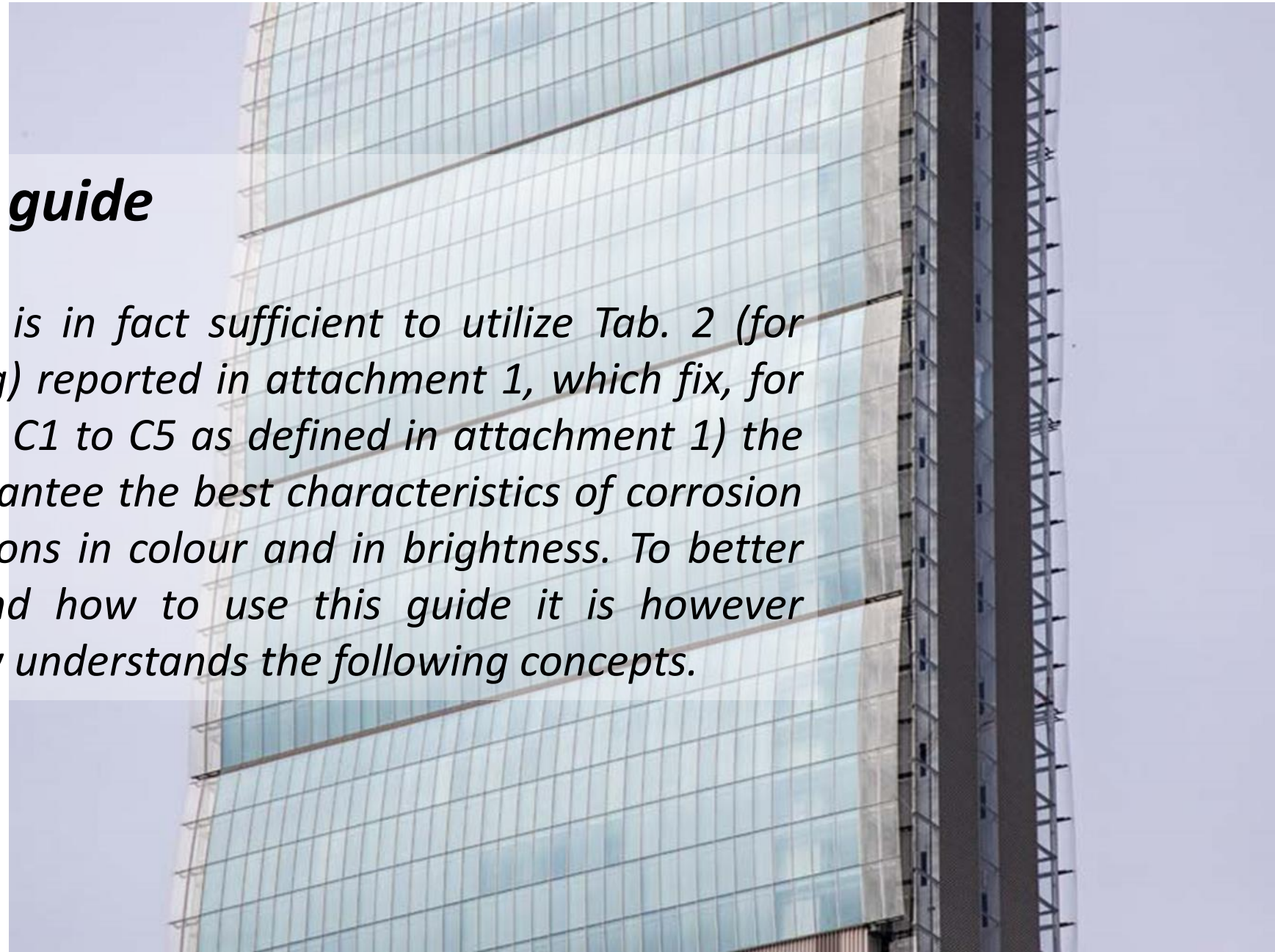


*Moreover, it is advisable that the companies that carry out anodizing and coating treatments possess and apply appropriate procedures for the control of the products and of the processes. Examples of such procedures are the Technical Specifications utilized by Companies with the **QUALANOD** label for anodizing and **QUALICOAT** for coating.*



## ***How to use the AITAL guide***

*The guide is easy to use; it is in fact sufficient to utilize Tab. 2 (for coating) and 3 (for anodizing) reported in attachment 1, which fix, for each class of exposure (from C1 to C5 as defined in attachment 1) the optimal process able to guarantee the best characteristics of corrosion resistance and of the variations in colour and in brightness. To better understand the contents and how to use this guide it is however necessary that its user clearly understands the following concepts.*



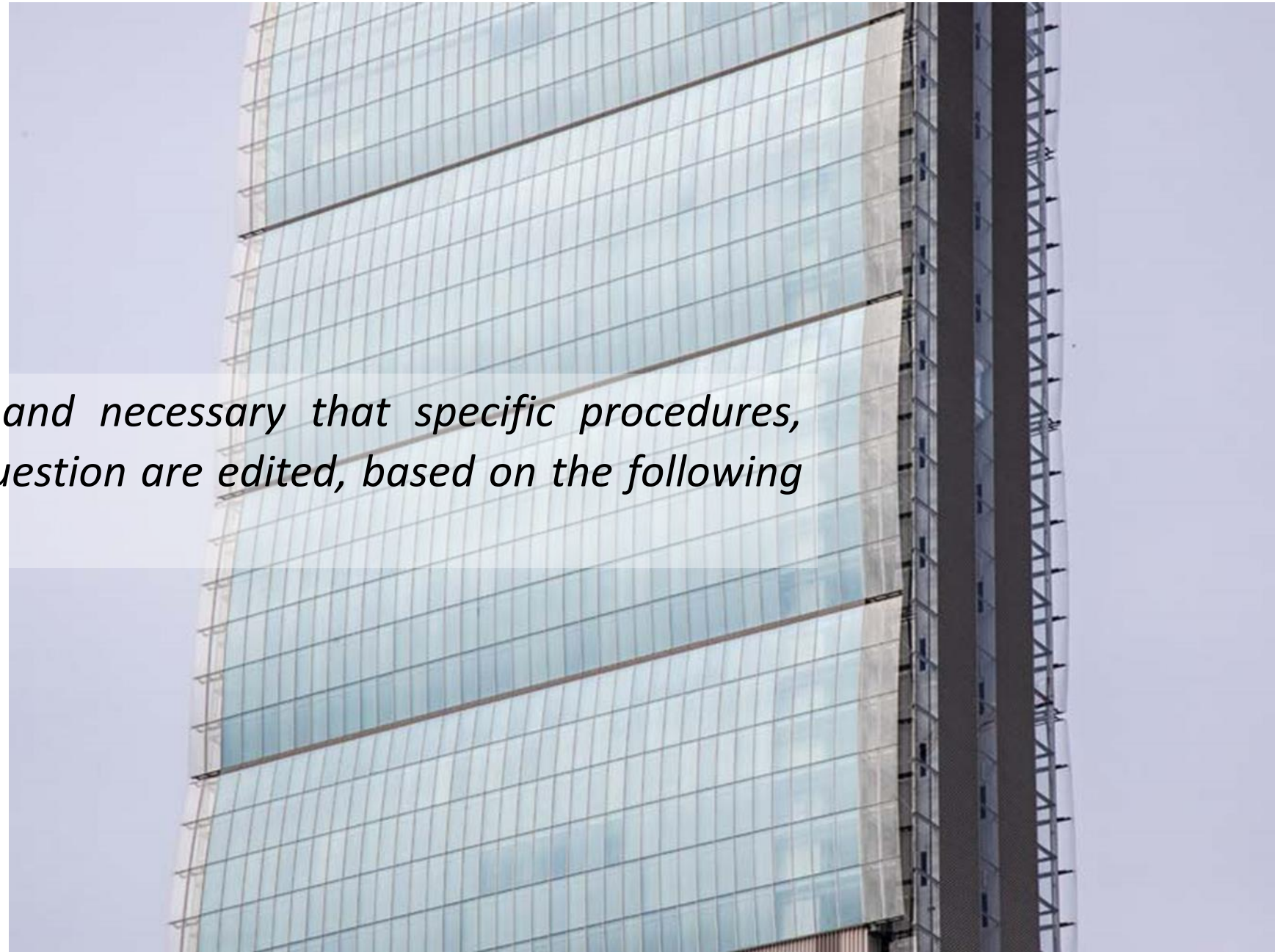


*On the basis of the experience of the applications of aluminium in architecture, consolidated by over 50 years for anodizing and by about 30 years for coating, and it is understood what is recommended hereafter, one can reasonably say that the treatments and the products estimated in tables 2 and 3 can offer a minimum useful life, in terms of durability, of **15 years to corrosion resistance and to colour and brightness variations**. The colour and brightness variations are closely related, not only to the exposure environment, but also to the class of coating products used.*





*In practice it is important and necessary that specific procedures, adequate to the project in question are edited, based on the following aspects*



*Identification of the **exposure class** (see table 1) of the zone in which the aluminium has to be placed*





Exposure Class	Examples of Environments	
	Internal Environment	External Environment
C <sub>1</sub>	BUILDINGS HEATED WITH CLEAN ATMOSPHERE, FOR EXAMPLE OFFICES, SHOPS SHOOOLS, HOTELS	NOT APPLICABLE
C <sub>2</sub>	NOT-HEATED BUILDINGS WHERE CONDENSATION CAN FORM, FOR EXAMPLE WA-REHOUSE, SPORT CENTERS	ENVIRONMENTS WITH A LOW POLLUTION LEVEL, ABOVE ALL RURAL AREAS (see the definition in the appendix)
C <sub>3</sub>	AREAS OF PRODUCTION WITH HIGH HUMIDITY AND A CERTAIN ATMOSPHERIC POLLUTION; FOR EXAMPLE FOOD INDU-STRIES, LAUNDRIES, BREWERIES, DAIRIES	URBAN AND INDUSTRIAL ENVIRONMENTS, MODEST POLLUTION FROM SOLPHUR DIOXIDE, COASTAL AREAS (see the definition in the appendix) WITH LOW SALINITY
C <sub>4</sub>	CHEMICAL PLANTS, SWIMMING POOLS, COASTAL BOATYARDA	INDUSTRIAL AND COASTAL AREAS WITH MODERATE SALINITY
C <sub>5-I</sub>	BUILDING OR AREAS WITH AN ALMOST PERMANENT CONDENSATION AND WITH HIGH POLLUTION	INDUSTRIAL AREAS WITH HIGH HUMIDITY AND AGGRESSIVE ATMOSPHERE
C <sub>5-M</sub>	BUILDING OR AREAS WITH AN ALMOST PERMANENT CONDENSATION AND WITH HIGH POLLUTION	COASTAL AND OFFSHORE AREAS WITH HIGH SALINITY

*Note:* To determine the “C” classes of atmospheric exposure, the regulation ISO 12944 advises an exposure of one year on a sheet of steel with low carbon content and of a galvanized sheet and then calculates the loss in weight (in g/m<sup>2</sup>) and the decrease in the thickness (in μm) of zinc and steel. For each class “C” (from C1 to C5) precise limits of weight loss reported in an appropriate table are set.

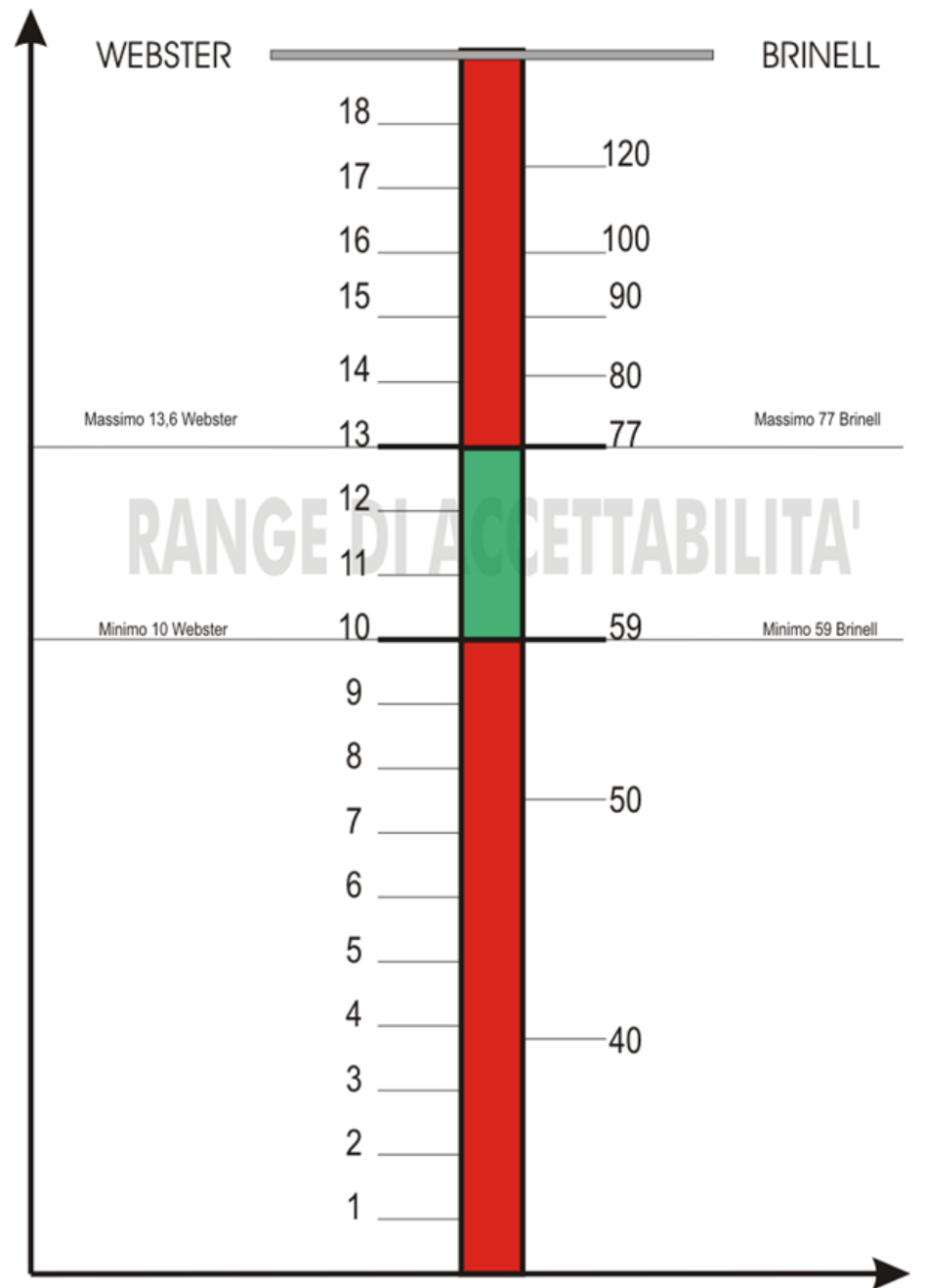


## ***Chemical composition of aluminium alloy***

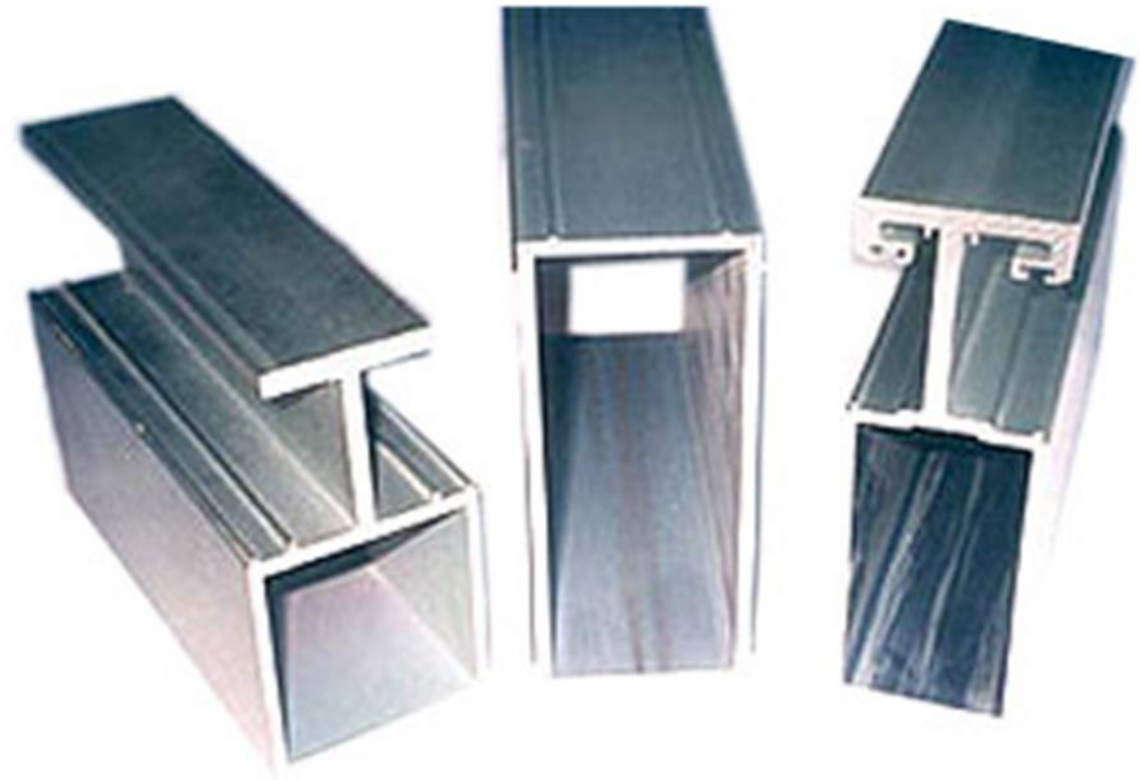
*The alloy EN AW 6060 used for building constitutes the best compromise in terms of needs on the part of producers of profiles, who take advantage of its excellent extrudability, and by the users for its good mechanical characteristics and resistance to polluting agents. It must, however, be emphasized that the behavior of such an alloy in terms of resistance to corrosion can change according to its chemical composition when the eligible impurities (in particular copper, zinc and iron) reach and exceed determined percentage values in weight, even though they are within the limits allowed in the alloy.*

<b>Elementi</b>	<b>Min</b>	<b>Max</b>	<b>EN 573/3</b>
<b>Si (Silicio)</b>	0,40	0,47	0,3÷0,6
<b>Fe (Ferro) (*)</b>	0,15	0,23	0,10÷0,30
<b>Cu (Rame)</b>	-	0,03	max 0,10
<b>Mn (Manganese)</b>	-	0,04	max 0,10
<b>Mg (Magnesio)</b>	0,40	0,47	0,35÷0,60
<b>Cr (Cromo)</b>	-	0,02	max 0,05
<b>Zn (Zinco)</b>	-	0,03	max 0,15
<b>Ti (Titanio)</b>	-	0,03	max 0,15
<b>Altre impurità</b>	Ciascuna Max 0,03 Totale Max 0,10		Ciascuna Max 0,05 Totale Max 0,15

*Temper  
alloy EN AW 6060*



***Conditions of the support  
before treatment***





## *Surface treatment*



Fonte: ITALTECNO

## *Cleaning and maintenance*



# Certifications and product approvals



*Recommendations  
for anodizing*







*Recommendations  
for coating*



## Certifications and product approvals



*Recommendations  
for decoration*



- Identification of the exposure class;
- The windows and doors must be free of "corrosion traps" and their geometry must allow adequate accessibility for cleaning and maintenance;
- Protect painted and anodized surfaces during storage, assembly and installation of windows;
- Preparation and execution of a suitable cleaning program (see technical data sheet AITAL n. 34/2003) and maintenance extended to the entire service life of the windows.



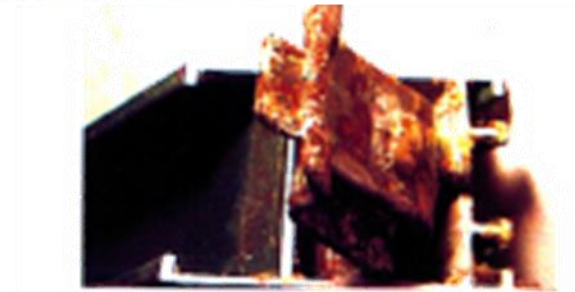
## Basic conditions

- **Identification of the exposure class;**
- The windows and doors must be free of "corrosion traps" and their geometry must allow adequate accessibility for cleaning and maintenance;
- Protect painted and anodized surfaces during storage, assembly and installation of windows;
- Preparation and execution of a suitable cleaning program (see technical data sheet AITAL n. 34/2003) and maintenance extended to the entire service life of the windows.

Table 1 – Classes and corresponding examples of exposure environments

Exposure Class	Examples of Environments	
	Internal Environment	External Environment
C <sub>1</sub>	BUILDINGS HEATED WITH CLEAN ATMOSPHERE, FOR EXAMPLE OFFICES, SHOPS SHOOOLS, HOTELS	NOT APPLICABLE
C <sub>2</sub>	NOT-HEATED BUILDINGS WHERE CONDENSATION CAN FORM, FOR EXAMPLE WA-REHOUSE, SPORT CENTERS	ENVIRONMENTS WITH A LOW POLLUTION LEVEL, ABOVE ALL RURAL AREAS (see the definition in the appendix)
C <sub>3</sub>	AREAS OF PRODUCTION WITH HIGH HUMIDITY AND A CERTAIN ATMOSPHERIC POLLUTION; FOR EXAMPLE FOOD INDU-STRIES, LAUNDRIES, BREWERIES, DAIRIES	URBAN AND INDUSTRIAL ENVIRONMENTS, MODEST POLLUTION FROM SOLPHUR DIOXIDE, COASTAL AREAS (see the definition in the appendix) WITH LOW SALINITY
C <sub>4</sub>	CHEMICAL PLANTS, SWIMMING POOLS, COASTAL BOATYARDA	INDUSTRIAL AND COASTAL AREAS WITH MODERATE SALINITY
C <sub>5-I</sub>	BUILDING OR AREAS WITH AN ALMOST PERMANENT CONDENSATION AND WITH HIGH POLLUTION	INDUSTRIAL AREAS WITH HIGH HUMIDITY AND AGGRESSIVE ATMOSPHERE
C <sub>5-M</sub>	BUILDING OR AREAS WITH AN ALMOST PERMANENT CONDENSATION AND WITH HIGH POLLUTION	COASTAL AND OFFSHORE AREAS WITH HIGH SALINITY

- Identification of the exposure class;
- **The windows and doors must be free of "corrosion traps" and their geometry must allow adequate accessibility for cleaning and maintenance;**
- Protect painted and anodized surfaces during storage, assembly and installation of windows;
- Preparation and execution of a suitable cleaning program (see technical data sheet AITAL n. 34/2003) and maintenance extended to the entire service life of the windows.



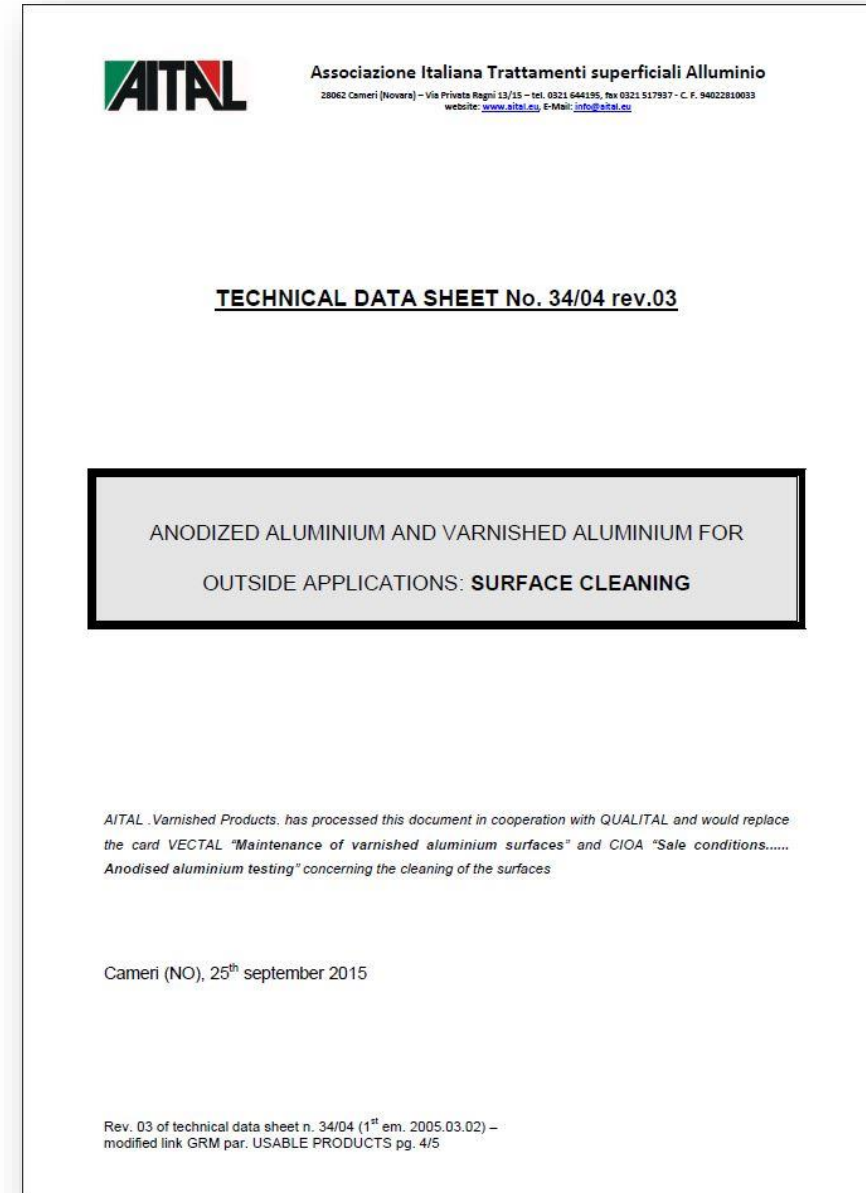
## Basic conditions


- Identification of the exposure class;
- The windows and doors must be free of "corrosion traps" and their geometry must allow adequate accessibility for cleaning and maintenance;
- **Protect painted and anodized surfaces during storage, assembly and installation of windows;**
- Preparation and execution of a suitable cleaning program (see technical data sheet AITAL n. 34/2003) and maintenance extended to the entire service life of the windows.





- Identification of the exposure class;
- The windows and doors must be free of "corrosion traps" and their geometry must allow adequate accessibility for cleaning and maintenance;
- Protect painted and anodized surfaces during storage, assembly and installation of windows;
- **Preparation and execution of a suitable cleaning program (see technical data sheet AITAL n. 34/2003) and maintenance extended to the entire service life of the windows.**



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**TECHNICAL DATA SHEET No. 34/04 rev.03**

**ANODIZED ALUMINIUM AND VARNISHED ALUMINIUM FOR  
OUTSIDE APPLICATIONS: SURFACE CLEANING**

AITAL - Varnished Products, has processed this document in cooperation with QUALITAL and would replace the card VECTAL "Maintenance of varnished aluminium surfaces" and CIOA "Sale conditions..... Anodised aluminium testing" concerning the cleaning of the surfaces

Camerti (NO), 25<sup>th</sup> september 2015

Rev. 03 of technical data sheet n. 34/04 (1<sup>st</sup> em. 2005.03.02) -  
modified link GRM par. USABLE PRODUCTS pg. 4/5

# How to use the guide

Use the Tables:

2 (for coating)

3 (for anodizing)

for each exposure class (C<sub>1</sub> to C<sub>5</sub>)  
tables provide the best process

Table 2 – Preliminary treatments and coating products for the coated finishes for each class of exposure “C”

Pretreatment (surface removal)	Chemical conversion	C <sub>1</sub>	C <sub>2</sub>		C <sub>3</sub>		C <sub>4</sub>		C <sub>5-I</sub>		C <sub>5-M</sub>	
		INTERNAL ONLY	WITH MEDIUM R.S.A.	WITH HIGH R.S.A.	WITH MEDIUM R.S.A.	WITH HIGH R.S.A.	WITH MEDIUM R.S.A.	WITH HIGH R.S.A.	WITH MEDIUM R.S.A.	WITH HIGH R.S.A.	WITH MEDIUM R.S.A.	WITH HIGH R.S.A.
QUALICOAT STANDARD Pretreatment	Hexavalent chromium or hexavalent chromium-free	P.V. CL. 1	P.V. CL. 1	P.V. CL. 2 or 3								
QUALICOAT SEASIDE Pretreatment	Hexavalent chromium or hexavalent chromium-free				P.V. CL. 1	P.V. CL. 2 or 3						
QUALICOAT SEASIDE Pretreatment	Hexavalent chromium or hexavalent chromium-free or not fixed oxide layer						P.V. CL. 1	P.V. CL. 2 or 3				
QUALICOAT SEASIDE Pretreatment	Hexavalent chromium or hexavalent chromium-free or not fixed oxide layer								PRIMER + P.V. CL. 1	PRIMER + P.V. CL. 2 or 3		
QUALICOAT SEASIDE Pretreatment	Evaluate case by case										PRIMER + P.V. CL. 1	PRIMER + P.V. CL. 2 or 3

Legend:

- P.V. = coating product
- CL. = class of coating products according to QUALICOAT specifications
- R.S.A. = annual solar radiation (MJ/m<sup>2</sup>)

# How to use the guide

## Use the Tables:

2 (for painting)

3 (for anodizing)

for each exposure class ( $C_1$  to  $C_5$ )  
tables provide the best process

Table 3 – Classes of anodic oxide thickness for each class “C” exposure

Process	Class of oxide	$C_1$	$C_2$	$C_3$	$C_4$	$C_{5-I}$	$C_{5-M}$
		INTERNAL ONLY	INTERNAL AND EXTERNAL	INTERNAL AND EXTERNAL	INTERNAL AND EXTERNAL	INTERNAL AND EXTERNAL	INTERNAL AND EXTERNAL
QUALANOD According to label specifications	10	X					
QUALANOD According to label specifications	15		X				
QUALANOD According to label specifications	20			X			
QUALANOD According to label specifications	20				X		
QUALANOD According to label specifications	20 o 25 (see note)					X	

Particular precautions for class 25



# Coating

Pretreatment (surface removal)	Chemical conversion	C <sub>1</sub>	C <sub>2</sub>	
		INTERNAL ONLY	WITH MEDIUM RSA	WITH HIGH RSA
QUALICOAT STANDARD Pretreatment	Hexavalent chromium or hexavalent chromium-free	P.V. CL. 1	P.V. CL. 1	P.V. CL. 2 or 3

C <sub>1</sub>	BUILDINGS HEATED WITH CLEAN ATMOSPHERE, FOR EXAMPLE OFFICES, SHOPS SHOOOLS, HOTELS	NOT APPLICABLE
C <sub>2</sub>	NOT-HEATED BUILDINGS WHERE CONDEN- SATION CAN FORM, FOR EXAMPLE WA- REHOUSE, SPORT CENTERS	ENVIRONMENTS WITH A LOW POLLUTION LEVEL, ABOVE ALL RURAL AREAS (see the definition in the appendix)

# Coating

Pretreatment (surface removal)	Chemical conversion	$C_4$	
		WITH MEDIUM RSA	WITH HIGH RSA
QUALICOAT SEASIDE Pretreatment	Hexavalent cromium or hexavalent cromium-free or not fixed oxide layer	P.V. CL. 1	P.V. CL. 2 or 3

$C_4$	CHEMICAL PLANTS, SWIMMING POOLS, COASTAL BOATYARDA	INDUSTRIAL AND COASTAL AREAS WITH MODERATE SALINITY
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# Coating

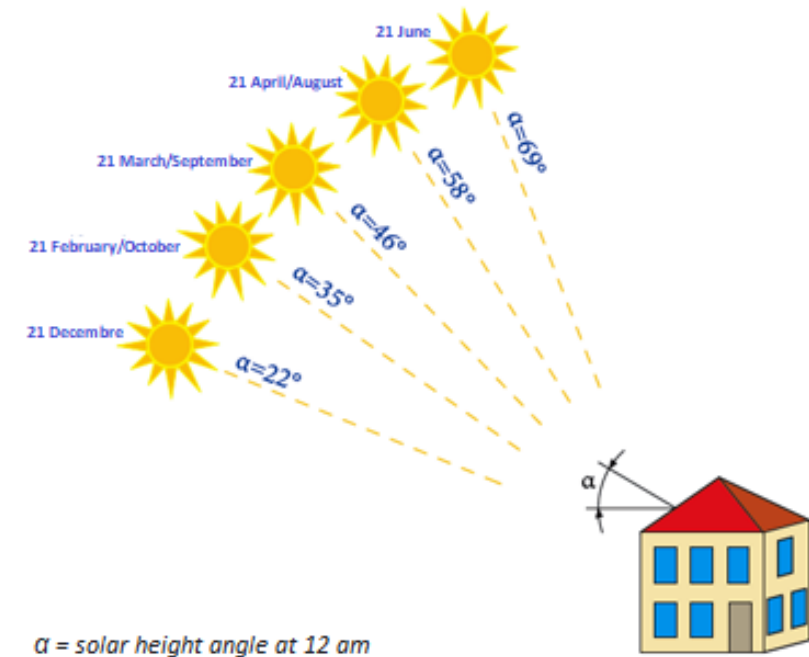
Pretreatment (surface removal)	Chemical conversion	C <sub>5-I</sub>		C <sub>5-M</sub>	
		WITH MEDIUM RSA	WITH HIGH RSA	WITH MEDIUM RSA	WITH HIGH RSA
QUALICOAT SEASIDE Pretreatment	Hexavalent cromium or hexavalent cromium-free or not fixed oxide layer	PRIMER + P.V. CL. 1	PRIMER + P.V. CL. 2 or 3		
QUALICOAT SEASIDE Pretreatment	Evaluate case by case			PRIMER + P.V. CL. 1	PRIMER + P.V. CL. 2 or 3

C <sub>5-I</sub>	BUILDING OR AREAS WITH AN ALMOST PERMANENT CONDENSATION AND WITH HIGH POLLUTION	INDUSTRIAL AREAS WITH HIGH HUMIDITY AND AGGRESSIVE ATMOSPHERE
C <sub>5-M</sub>	BUILDING OR AREAS WITH AN ALMOST PERMANENT CONDENSATION AND WITH HIGH POLLUTION	COASTAL AND OFFSHORE AREAS WITH HIGH SALINITY



## R.S.A.= Annual solar radiation

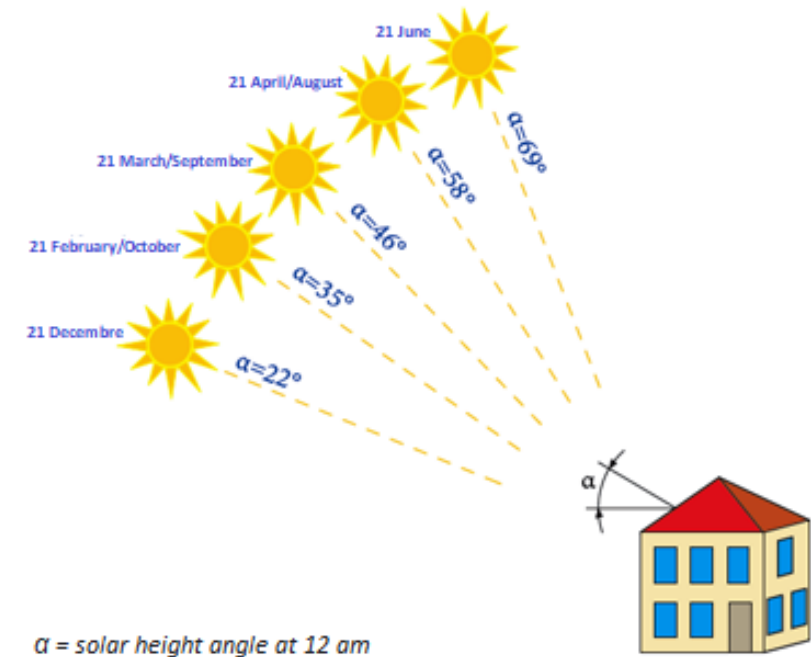
On the basis of surveys carried out by ENEA in the five years between 1995-1999, in Italy, in a year, the quantity of solar radiation that reaches a surface of one square metre is around, on average, 5000 MJ. The solar energy occurs as a collection of electromagnetic radiation of different wavelengths: about 10% in the form of ultraviolet radiation with a wavelength of between 0.2 and 0.4 micrometres (1 micrometre is equal to 1 thousandth of a millimetre), about 50% is in the form of visible radiation, with a wavelength between 0.4 and 0.8 micrometres and around 40% is in the form of infrared radiation, between 0.8 and 3 micrometres.



## R.S.A.= Annual solar radiation

How to calculate the value of R.S.A.:

1. On the Google Maps website or on Wikipedia it is possible to find the coordinates (latitude and longitude) of the site in which the frames will be placed;
2. On the website <http://www.solaritaly.enea.it/CalcRggmmOrizz/Calcola3.php> of ENEA **renewable resources** on “Italian atlas of solar radiation” there is the possibility to obtain the “Monthly average of daily global solar radiation on a horizontal surface” (five-year average 1995-1999),
  - By inserting the latitude and longitude of the place in which windows and curtain walls will be installed,
  - By selecting the ENEA-SOLTERM box,
  - By choosing MJ/m<sup>2</sup> as the measurement unit and requesting the value of R.S.A. for all months.
3. Double click on calculate and at the bottom of the third page it will be possible to find the “global annual radiation on a horizontal surface” value (a typical 365-day year).





## Coating

In the exposure conditions with R.S.A. values = Average Annual Solar Radiation greater than 5.400 MJ/m<sup>2</sup> class 2 or 3 powders have to be used.

Purely as an example, the R.S.A. values of some Italian cities are reported in the table.

City	I.S.A. in MJ/m <sup>2</sup>	Latitude N	Longitude E
Bolzano	4.829	46°30'0"	11°21'0"
Milano	5.065	45°27'50"	9°21'25"
Bologna	5.413	45°29'7"	11°21'0"
Firenze	5.147	43°46'17"	11°15'15"
Roma	5.460	41°53'35"	12°28'58"
Napoli	5.535	40°50'0"	14°15'0"
Taranto	5.549	40°28'0"	17°14'0"
Porto Torres	5.627	40°50'13"	8°24'5"
Palermo	5.812	38°06'56"	13°21'41"
Ragusa	5.901	36°55'30"	14°43'50"

For information only: in Florida the annual values of R.S.A in the four-year period 2007-2011 have varied between 6200 and 6400 MJ/m<sup>2</sup>.

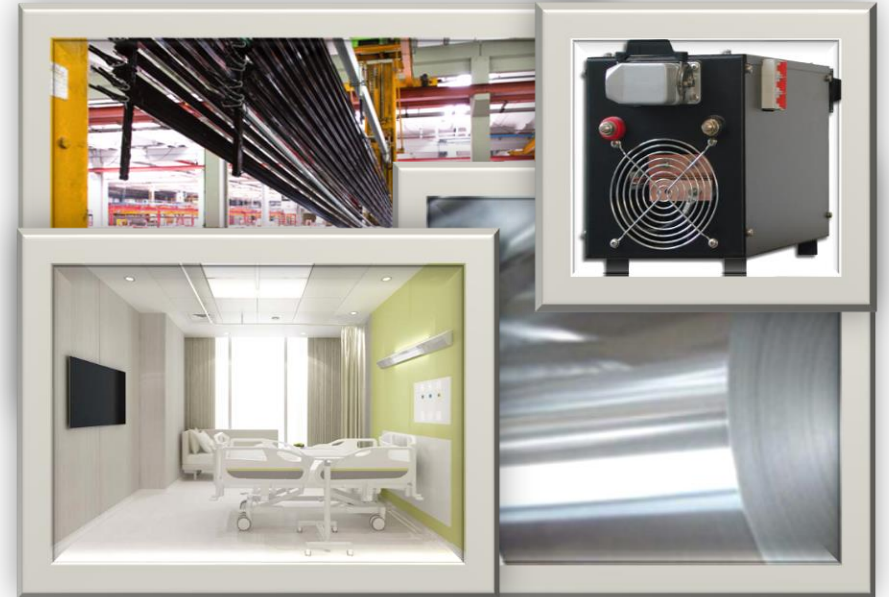


## New projects

### Research and Development in Anodizing

Cooperation with **QUALITAL** and **QUALITAL SERVIZI**

- *by waterfall on aluminum extrusions*
- *by waterfall in continuous on coil*
- *by pulsating waves*
- *antibacterial*





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# Thanks for your attention