BELGIAN BUILDING RESEARCH INSTITUTE
Institution recognised by application of the decree-law of 30 january 1947

All tests in this report are executed according to the ISO 9001 certified Quality management system of the BBRI

Test Centre	B-1342 Limelette, avenue P. Holoffe 21	Tel.: +32 (0)2 655 77 11
Offices	B-1932 Sint-Stevens-Woluwe, Lozenberg 7	Tel.: +32 (0)2 716 42 11
Head Office	B-1000 Brussels, rue du Lombard 42	Tel.: +32 (0)2 502 66 90

TEST REPORT

Laboratory	RENOVATION	**O/References**	DE 622 X 935/EXT E Lab REN Page 1/13

Requested by	Liquisol bvba Oudstrijdersstraat 152 B-2520 Oelegem		
Contact person	**Requester** : Tom Huysmans	**BBRI :** Yves Vanhellemont	
Date of the order	21/8/2017	Samples registration	S2014-49-21
		Date of reception of samples	1/12/2014
Date of issue of the report	30/8/2017		
Test carried out	Initial effectiveness, secondary effects and durability of water repellent "Facade5+ Protect"		
References	NBN EN 16302 (april 2013) - RILEM 25 PEM (may 1980) NBN EN 16322 (december 2013) SAE J 2527 (february 2004) NBN EN 15886 (september 2010) - CIE-1976 – ISO 2813 (october 2014)		

This test report contains 9 pages and 4 appendices. This test report may only be reproduced in its entirety. Each page of the original report has been stamped (in red) by the laboratory and initialed by the head of the division. The results and findings are only valid for the tested samples. This should be kept in mind when wishing to compare current results with results from previous campaigns.

☐ *No sample*
☐ *Sample(s) subjected to destructive test*
☑ *Sample(s) to be removed from our laboratories 30 calendar days after sending of the report, save in the case of a further written request.*

Technical assistance	In charge of the test	Head of the Division
		C.S.T.C. REN W.T.C.B.
Tanguy Leduc	Yves Vanhellemont	Johan Van Dessel

1. SAMPLE

- The product "Facade5+ Protect" is a water repellent product for surface treatment, based on silanes, siloxanes and fluorinated copolymers.
- The received sample is a water-based liquid product, concentration 10%.
- The product was delivered as a ready-to-use product.

2. APPLICATION OF THE PRODUCT ON THE TEST MATERIALS

- Before application, the substrate materials have been conditioned under laboratory conditions at 23 °C and 50 % relative humidity.
- In order to avoid parasitic parameters related to a brush application, the samples were waterproofed in the laboratory by means of a surface contact with the water repellent. The contact duration, fixed at 5 seconds, corresponds to the average quantity applied in practice during treatment by momentary saturation on facades.

3. TEST PARAMETERS AND MEASUREMENT METHODS

- Artificial ageing test according to SAE J 2527 (february 2004) :
  - 40 min UV;
  - 20 min UV + water spray;
  - 60 min UV;
  - 60 min water spray.
- Measurement of water absorption (pipe method - see annex A). The results are expressed as $\Delta_{(15\text{-}5)}$, in other words as a difference in water absorption (ml) between the measurements made at 15 and 5 min.
- Measurement of the influence of the treatment on de drying behaviour of the substrate, according to NBN EN 16322 (December 2013),on artificial sand-limestone (Silka, Xella); the definition and identification of the standard support are discussed in point 5.

4. HYDROPHOBIC EFFECTIVENESS AND DURABILITY AND SIDE EFFECTS

The pages hereafter summarise the following data for the four substrate materials:

- characteristics of the substrate materials : density, porosity;
- specific application parameters : moisture content of the substrate, quantity of product applied;
- visual effect on the appearance of the materials, according to CIE-1976 and NBN EN 15886 (september 2010). Apparatus chromameter with Xenonboog – PXA, index C, "*wide area illumination/0° viewing angle*", measurements according to the L*, a*, b* system (annex B) ; ;
- water absorption of material surface before treatment;
- water absorption of material surface after treatment (initial effectiveness);
- the evolution of the hydrophobic effectiveness during 448 artificial ageing cycles (durability).

For these last two measures, note that a zero absorption value corresponds to an effectiveness of 100 %.

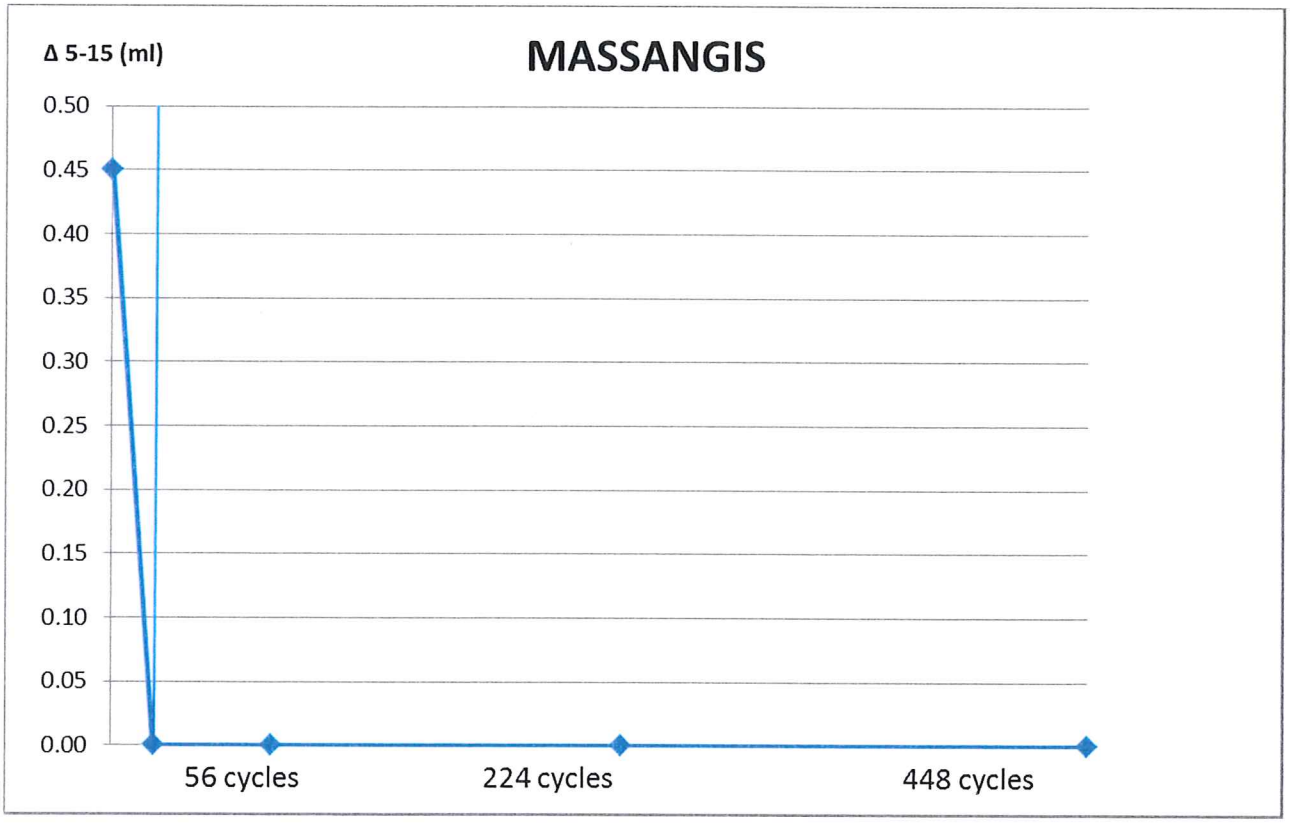
RESULTS OBTAINED ON WHITE LIMESTONE

MASSANGIS STONE

- Density 2240 kg/m³
- Total porosity (mercury porosimeter) 10.01 (vol %)
- Quantity of product applied : 189 g/m²

The following graph represents the water absorption values before and after the treatment as well as during the artificial ageing process.

Effectiveness and durability of the treatment "Facade5+ Protect"



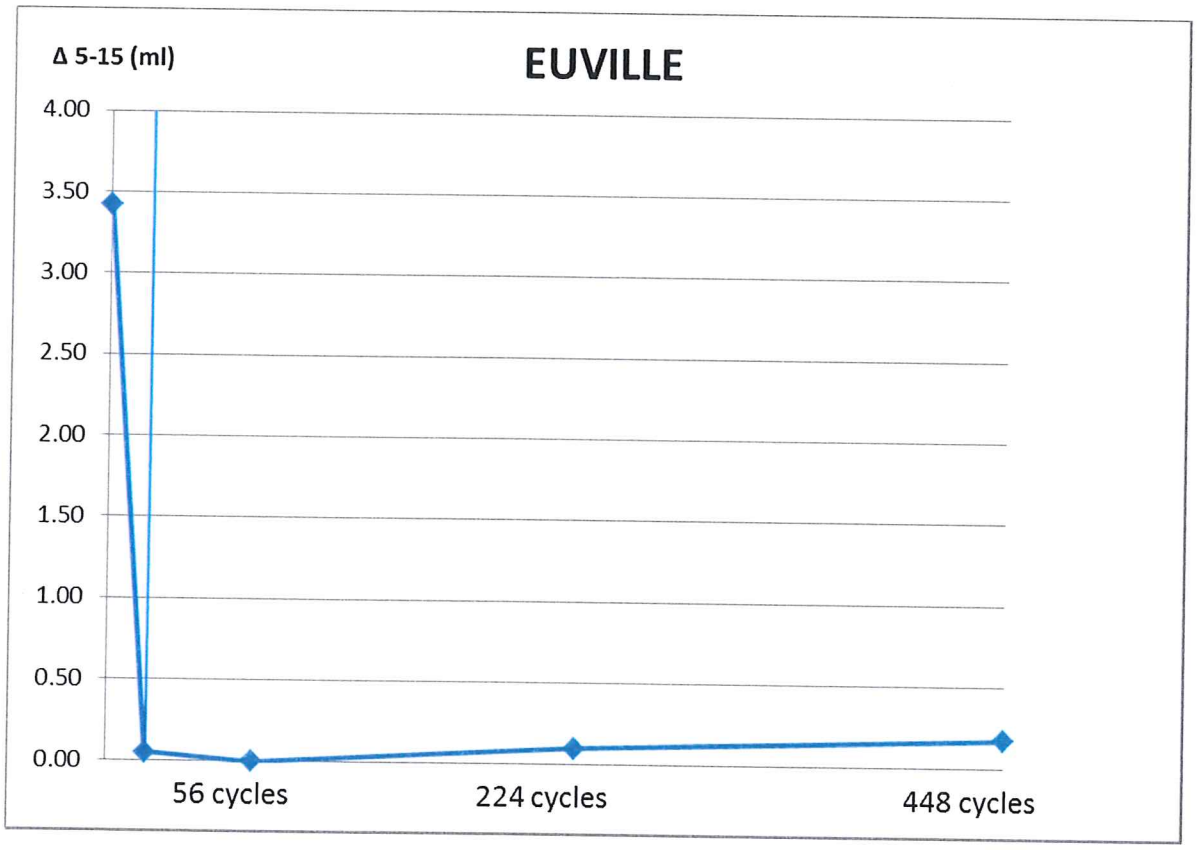
C.S.T.C. W.T.C.B. REN

EUVILLE STONE

- Density 2250 kg/m³
- Total porosity (mercury porosimeter) 10.29 (vol %)
- Quantity of product applied : 355 g/m²

The following graph represents the water absorption values before and after the treatment as well as during the artificial ageing process.

Effectiveness and durability of the treatment "Facade5+ Protect"



C.S.T.C. W.T.C.B. REN

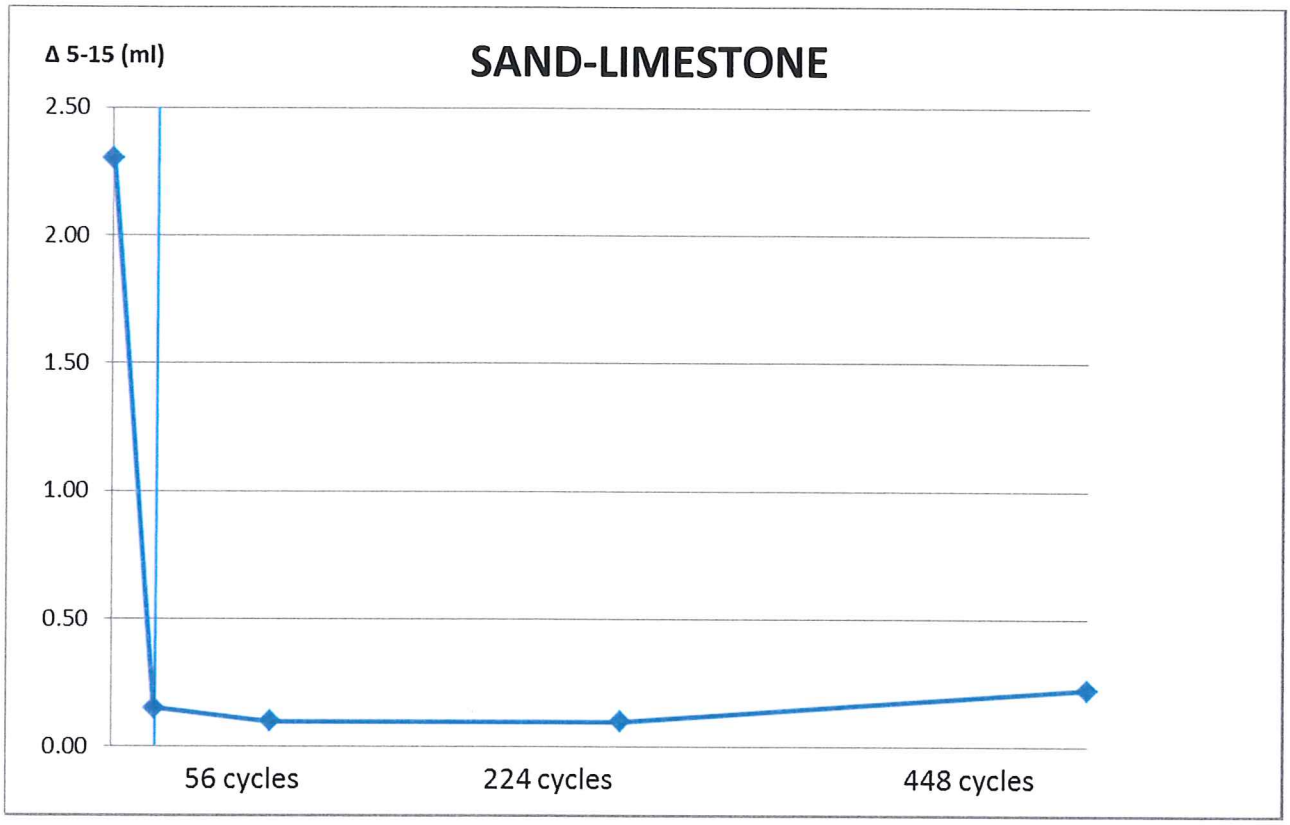
RESULTS OBTAINED ON ARTIFICIAL SAND-LIMESTONE

ARTIFICIAL SAND-LIMESTONE (TYPE SILKA, XELLA)

- Density 1870 kg/m³
- Total porosity (mercury porosimeter) 27 (vol %)
- Quantity of product applied : 507 g/m²

The following graph represents the water absorption values before and after the treatment as well as during the artificial ageing process.

Effectiveness and durability of the treatment "Facade5+ Protect"



C.S.T.C. W.T.C.B. REN

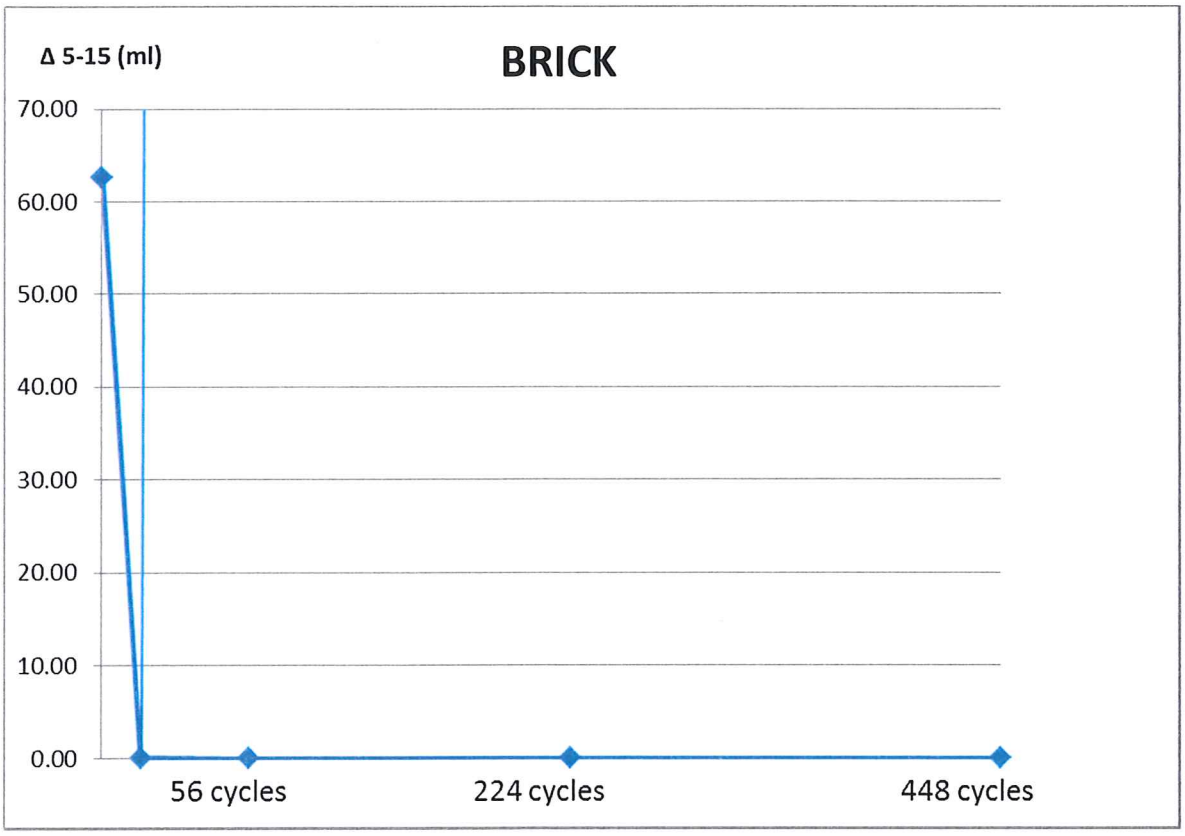
RESULTS OBTAINED ON CLAY BRICK

CLAY BRICK

- Density 1680 kg/m³
- Total porosity (mercury porosimeter) 27.75 (vol %)
- Quantity of product applied : 869 g/m²

The following graph represents the water absorption values before and after the treatment as well as during the artificial ageing process.

Effectiveness and durability of the treatment "Facade5+ Protect"



C.S.T.C. W.T.C.B. REN

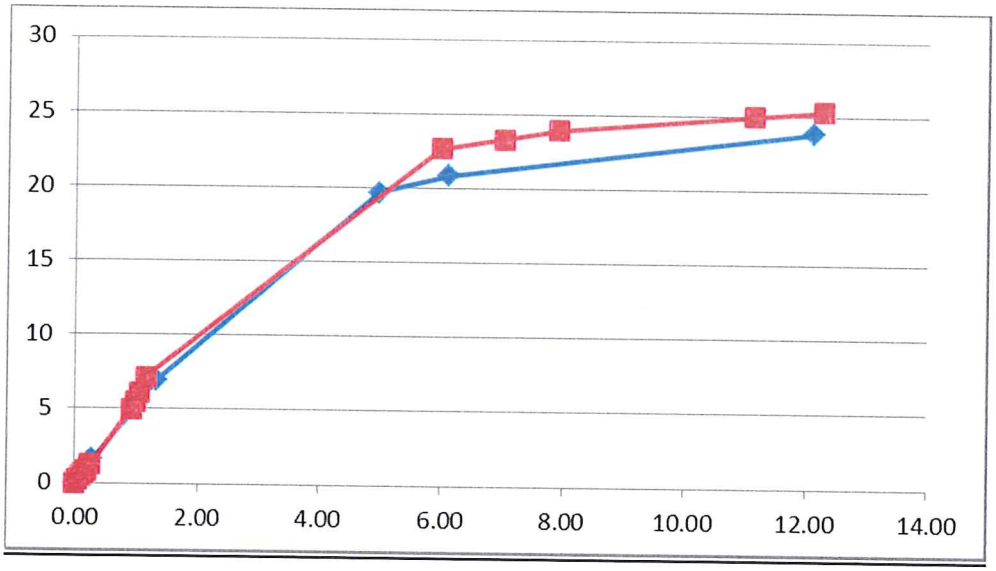
5. EFFECT OF WATER REPELLENT TREATMENT ON THE DRYING BEHAVIOUR

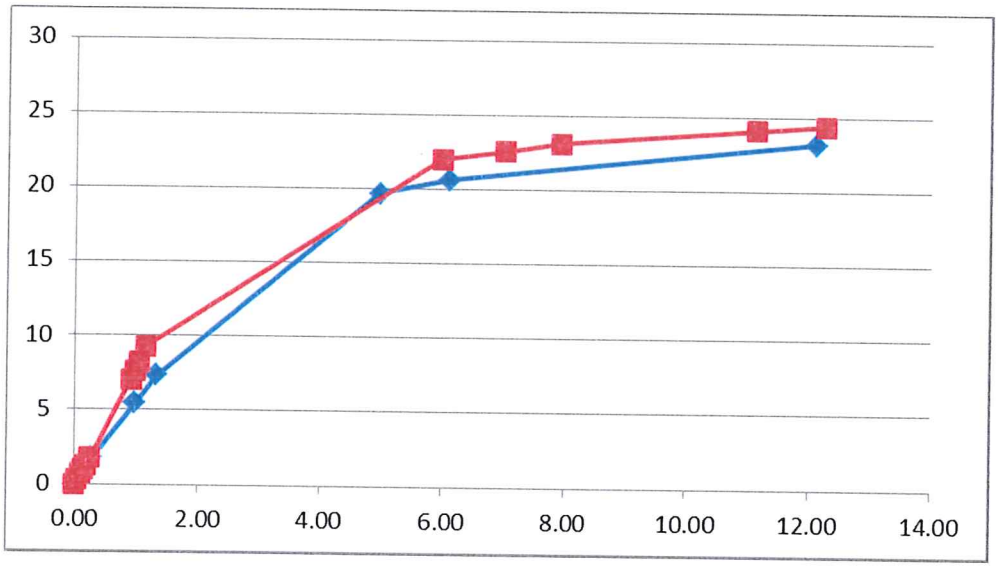
- The application of a water repellent treatment is supposed to influence as less as possible the drying capacity of a façade.
- The influence of the treatment on the drying capacity of a substrate is measured according to NBN EN 16322 (December 2013) – conservation of cultural heritage – Test methods – Determination of Drying properties.
- Susbtrate: artificial sand-limestone, type Silka, Xella. This substrate has been chosen because of its strong resemblance to the pore structure of mortar. In historic masonry, the drying of a wall takes place through natural stones, bricks and most of all through mortar. Therefore the influence of a water repellent treatment through mortar is of great importance.
- The test is carried out on 3 cubes, 50x50x50 mm^3 of the selected material. The cubes are immersed into demineralised water, until constant mass is obtained: the weight difference between two subsequent weighings, with an interval of 24h, should be maximum 0.1% of the mass of the sample. Subsequently 5 surfaces of the cube are sealed water- and vapour tight, in a reversible manner. The cubes are placed in a climatic chamber (50%RH and 23°C), with the unsealed surface facing upward. Through regular weighings, one obtains the drying curve of the cubes.
- After removing the sealing, the cubes are dried until constant mass. Followed by the treatment of one surface of the cubes, according to the methode described in point 2 (cfr. Supra). The cubes are kept in laboratory circumstances during 7 days, with the treated surface facing up. Subsequently, the cubes are immersed in water, until constant mass is reached. After this procedure, the same 5 sides of the cubes are sealed, identically to the procedure described above. The treated surface should be kept free. On these sealed and treated cubes, the above mentioned drying experiment is carried out a second time.
- The drying curve is obtained by plotting the mass of water, that has evaporated out of the sample since the beginning of the drying experiment, in function of time.

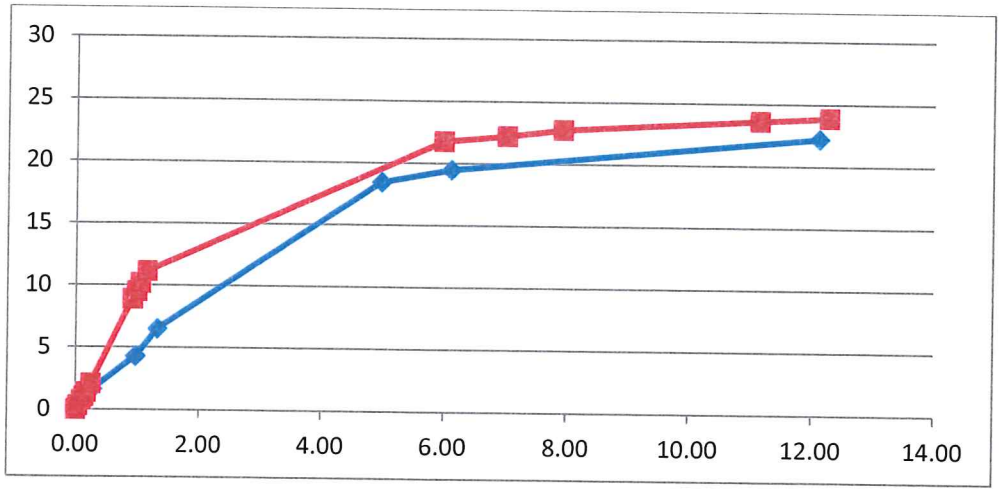
Results

The following graphs show the drying curves of each individual cube. Per curve, two results are calculated:

- The slope of the first part of the drying curve (the linear part, starting at t=0) gives the drying rate during the first drying phase. In this phase, the majority of the humidity loss takes place.
- When plotting the drying curve in function of the square root of the time, one obtains an S-shaped curve. The slope of the linear part in the middle of the curve gives the drying rate in the second drying phase of the sample. This is the phase where humidity is retiring from the surface of the sample, where the moisture transport takes place under the form of diffusion of vapour.
- By comparing the slope of these linear curves for the treated and the untreated sample, one obtains de reduction in drying rate. This reduction is expressed in %. The lower the percentage, the lesser the influence of the treatment on the drying of the sample.







Reduction of the drying rate during the first drying phase: <30 %

C.S.T.C. W.T.C.B. REN

SYNTHESIS OF TEST RESULTS ON WATER REPELLENT
"Facade5+ Protect"

SUPPORT	MASSANGIS	EUVILLE	SAND-LIMESTONE	BRICK
Density (kg/m³)	2240	2250	1850	1680
Applied quantity (g/m²)	189	355	507	869
INFLUENCE ON THE APPEARANCE				
Colour (ΔE) *	**2.54 (class A)**	**1.21 (class A)**	**1.33 (class A)**	**3.14 (class A)**
Gloss (Δ%) **	**0 (class A)**	**0 (class A)**	**0 (class A)**	**0 (class A)**
BEFORE TREATMENT				
Water absorption of the untreated material (ml)	0.45	3.42	2.30	62.60
AFTER TREATMENT				
Water absorption of the treated material (ml)	0.00	0.05	0.15	0.05
Initial efficiency (%)	**100 (class A)**	**99 (class A)**	**93 (class B)**	**100 (class A)**
AFTER TREATMENT + AGEING				
Water absorption of the treated and aged material (ml)	0,00	0,18	0,23	0,00
Efficiency after ageing (%)	**100 (class A)**	**95 (class A)**	**90 (class B)**	**100 (class A)**
REDUCTION OF THE WATER VAPOUR PERMEABILITY (%) *	**First drying phase : <30% (class A)**			

* See annex B

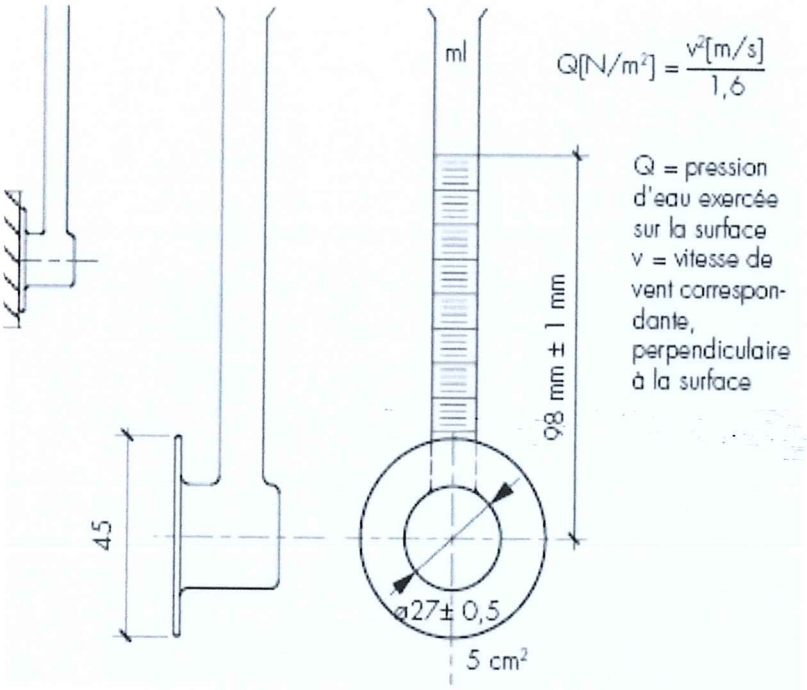
** See annex C

*** The tests have been executed on a disc of artificial silicate-limestone. This is another material than employed in previous test campaigns (where a disc of clay brick was used). The results of this campaign are therefore not immediately comparable to those of previous campaigns.

**** See annex D for more information on performance classes

C.S.T.C. W.T.C.B. REN

ANNEX A : Water absorption measurement (pipe method)



The measurement method is based on the recommendations of RILEM (Réunion Internationale des Laboratoires d'Essais sur les Matériaux), TC-25 PEM – II.2.

This involves the determination, in function of time, of the quantity of water that penetrates into the support, under a pressure of 98±1 mm water column (which corresponds to the pressure at which drops are projected onto a facade at perpendicular wind speeds of 40 m/s ≈ 140 km/h).

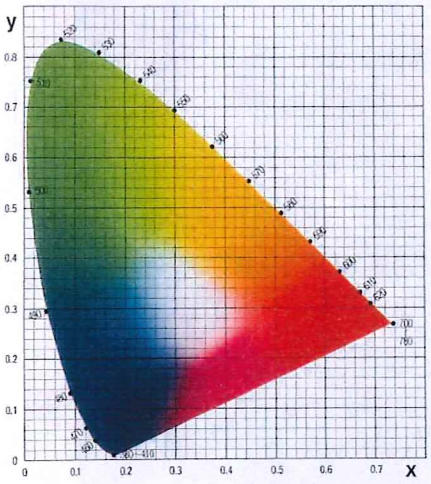
The quantity of absorbed water is measured after 0, 5, 10 and 15 minutes. The result of the absorption is expressed (with a precision of 0.1 millilitre) between the 5th and 15th minute $\Delta_{(15\text{-}5\ min)}$.

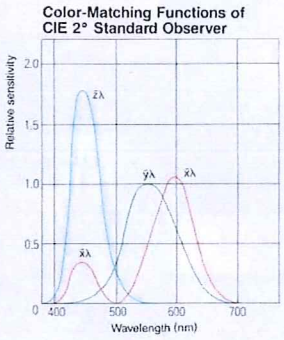
ANNEX B : Colour measurement

COLOR SYSTEMS

Minolta CR-300 series Chroma Meters allow measurements of absolute color to be displayed in any of five color systems: Yxy, L*a*b*, L*C*H°, Hunter Lab, or tristimulus values XYZ. Measurements of color difference can be displayed in any of four systems: Δ(Yxy), Δ(L*a*b*)/ΔE*ab, Δ(L*C*H*)/ΔE*ab, and Hunter Δ(Lab)/ΔE. Two of these color systems are shown below.

Yxy Color System (CIE 1931)



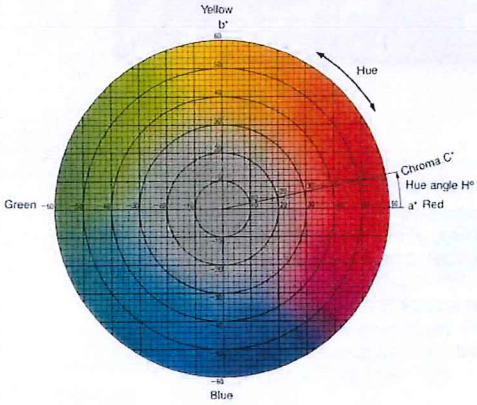


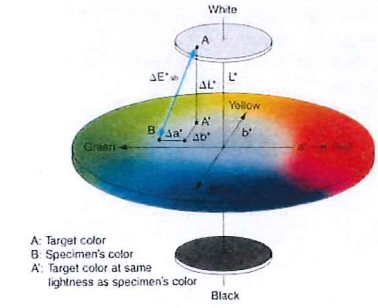
The Yxy color system was defined by the CIE (Commission Internationale de l'Eclairage) in 1931, and forms the base for other CIE color systems. In this system, Y is the lightness factor expressed as a percentage based on a perfect reflectance of 100%; x and y are the chromaticity coordinates in the CIE x, y chromaticity diagram (shown at left), and are defined by the following equations:

$$x = \frac{X}{X+Y+Z} \qquad y = \frac{Y}{X+Y+Z}$$

where
X, Y, Z: Tristimulus values based on the color-matching functions of the CIE 2° Standard Observer (shown at right)

L*a*b* Color System (CIE 1976)





A: Target color
B: Specimen's color
A': Target color at same lightness as specimen's color

The L*a*b* color system is one of the uniform color spaces recommended by CIE in 1976 as a way of more closely representing perceived color and color difference. In this system, L* is the lightness factor; a* and b* are the chromaticity coordinates. Their defining equations are as follows:

$$L^* = 116\left(\frac{Y}{Yo}\right)^{1/3} - 16$$

$$a^* = 500\left[\left(\frac{X}{Xo}\right)^{1/3} - \left(\frac{Y}{Yo}\right)^{1/3}\right]$$

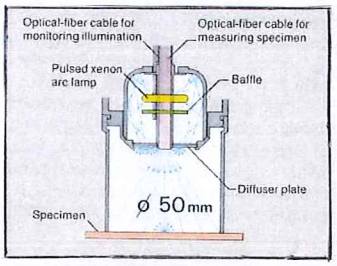
$$b^* = 200\left[\left(\frac{Y}{Yo}\right)^{1/3} - \left(\frac{Z}{Zo}\right)^{1/3}\right]$$

where
Xo, Yo, Zo: Tristimulus values of illuminant:
for Standard Illuminant C (and 2° observer)
Yo = 100, Xo = 98.072, and Zo = 118.225;
for Standard Illuminant D_{65} (and 2° observer)
Yo = 100, Xo = 95.045, and Zo = 108.892.

Above formulas apply only when X/Xo, Y/Yo, and Z/Zo are greater than 0.008856.

ΔE^*_{ab} is the straight-line distance between two colors in the L*a*b* system. It is defined as follows:

$$\Delta E^*_{ab} = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

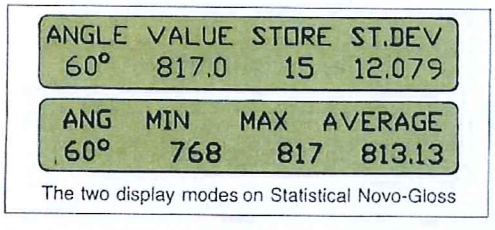


ANNEX C : Gloss measurement

Instrument range	20° ISO; 20° TAPPI; 45° ASTM; 45° BS; 45° BSe; 60° ISO; 75° TAPPI; 75° JIS; 85° ISO; 20°-60°-75°; 20°-60°-85°; 20°-60°; Reflectometer 45°/0°.
Auto-ranging facility	Gloss measurements 0.1 to 1000 gloss units. Same instrument used for paint, plastics, substrate metal, plating, metallised plastics.
Display	24 Ch 2 line "Super Twist" Dot Matrix gives high contrast ratio and wide viewing angle.
Continuous reading	With the read button depressed continuous readings can be taken to assess the variation on the surface.
Full calibration facilities	In conformity with ISO, DIN, BS, ASTM and all national standards, plus settable auto calibration.
Calibration titles	Certificated and traceable to BAM. Intermediate calibration standards available to check linearity down to 5 and up to 950 gloss units.
Operation	All functions are push button operations.
Automatic zero	No zero drift.
Source	Tungsten halogen filtered to illuminant C with infra-red compensation.
Coincidental vertical plane of measurement	Multiple angle instruments read the same surface from identical direction.
Auto compensation for lamp ageing	Negligible calibration drift using exclusive opto/electrical compensation arrangement (pat. app).
Lamp replacement in house	Long life lamps easily replaced in minutes. Spare lamp supplied.
Statistics	Max, Min, Average, Number of Readings, Standard Deviation.
Memory	Memory to 999 readings in each angle.
	Data in memory downloads directly via RS232 port to printer or computer (no interrogate programme needed). Data retained in memory after download until deliberately reset.
False entry delete	False readings can be deleted in turn and the statistics are automatically corrected.
Disable facility	A very simple entry modifies operation to that of a simple non-statistical glossmeter. Re-enable entry restores statistical functions.
Mains and battery operation	Mains recharger unit also serves as a mains adaptor if batteries discharged.
2 year guarantee	

Sizes mm & Weight Kg	Dimensions	Instruments	Case	Packed	Gross Weight Packed
	Single & Double Angle Instruments	150×110×50	300×100×340	480×170×370	3.5
	3 Angle Instruments	180×110×50	300×100×340	480×170×370	3.6

Accuracy.....0.5 gloss units
Repeatability.....0.5 gloss units*



The two display modes on Statistical Novo-Gloss

*When used in accordance with international standard ISO 2813

STATISTICAL NOVO-GLOSS

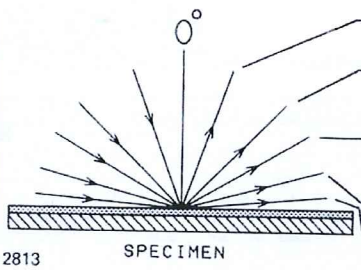
The new Statistical Novogloss instruments complete the world's first fully comprehensive range of glossmeters, providing precise definition of gloss on virtually every measurable surface in accordance with national and international standards.

The most important of the many attractive features of this series are, reliability, ease of use, reproducibility and traceability of calibration.

Supplied complete with cased high gloss, traceable, calibration standard and zero reference. Mains adaptor/battery charger, cleaning kit, spare lamp, all in robust carrying case.

ANGLE	CONFORMS TO SPECIFICATION	ORDER CODE
20	TAPPI	NG20S (T)
20	ISO	NG20S (I)
45	ASTM	NG45S (A)
45	BS	NG45S (B)
45	BS Method (e)	NG45S (BE)
60	ISO	NG60S
60	Comparator ASTM	NG60SC
75	TAPPI	NG75S (T)
75	J.I.S.	NG75S (J)
85	ISO	NG85S
45/0	Reflectometer	NGR45 S
60–20	ISO	NG60-20S
20–60–85	ISO	NG20-60-85S
20–60–75	ISO	NG20-60-75S

When ordering please quote *NOVO-GLOSS* followed by the order code.



APPLICATIONS & STANDARDS

20°	ISO TAPPI	High Gloss Paints Waxed Papers
45°	BS BS(e) ASTM	Anodised Aluminium Mirrorlike Aluminium Paint, Plastics, Magnetic Tape
60°	ISO BS DIN	Universal Standard Paint, Plastics Metals, Anodised Aluminium up to 1000 gloss units)
75°	TAPPI JIS	Paper and Card Paper and Card (Japanese)
85°	ISO	Matt, Low Gloss Paints, Plastics

ANNEX D : Performance classes

Water absorption – effiency (initially and after ageing)

The following classes have been defined:

- Class A : efficiency > 95 %
- Class B : 85 % < efficiency ≤ 95 %
- Class C : 75 % < efficiency ≤ 85 %
- Class D : efficiency ≤ 75 %

Reduction of the drying speed

- Class A: reduction < 30 %
- Class B: reduction ≥ 30 %

Colour

The colour difference $\Delta E^*ab = (\Delta L^{*2}+\Delta a^{*2}+\Delta b^{*2})1/2$ (colour measured in the L*a*b*-system) between the (untreated) test substrate(-s) and the (treated) test specimen shall be declared in accordance with ISO 7724-1 and -2. The following classes have been defined:

- Class A : $\Delta E^*ab < 6$
- Class B : $\Delta E^*ab > 6$

Gloss

Gloss difference is calculated as the difference between the gloss (angle of 60°) measured on the same spot on a sample, before and after treatment. The following classes have been defined:

- Class A: difference ≤ 3 %
- Class B: difference > 3 %