BBRI

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BELGIAN BUILDING RESEARCH INSTITUTE

INSTITUTION RECOGNISED UNDER APPLICATION OF THE DECREE-LAW OF 30 JANUARY 1947

BELTEST N° 054-T NBN-EN-ISO/IEC 17025

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VAT BE 407.695.057

LABORATORY: EDIM Insulation and sealing materials	**TEST REPORT**	Nr. DE, ATA, RE : DE 651xE503 Lab no. : 04/160 Sample no. : N-2004-28-025

REQUESTED BY: WORLDROOF
Tinstraat 42
B- 2580 PUTTE

Contacted persons:	**- Requesting party -**	**- BBRI -**
	Mr.W. Vandervorst	Mr. A. Lefèbvre

Conducted tests: Determination of the resistance against heat, resistance against thermal shocks, Accelerated ageing with UV ASTM G53/88, Corrosion test with saline mist (ISO 9227), Corrosion test with SO_2 (ISO 3231) and the water absorption

Date and reference of the request	:	ref. fax from Worldroof
Date of receipt of the sample(s)	:	9/07/2004
Test date	:	July – September 2004
Report drafted on	:	12/10/2004

This test report contains **5** pages, numbered from **1/5** to **5/5** inclusive and **2 annexes**, and may be reproduced only in its entirety.

Each page of the original carried the official stamp of the laboratory (in red) and was initialled by the head of the laboratory.

The results and findings are only valid for the tested samples.

- ☐ No sample
- ☐ Sample subjected to destructive test
- ☑ Sample(s) to be removed from our laboratories 60 calendar days after sending of the report, save in the case of a further written request.

Head of Testing

A. Lefèbvre

Head of Division

C.S.T.C. W.T.C.B. EDIM

F. de Barquin

Technical assistance: P. Maesschalck

PM/SDE

1 SAMPLE

Number	Color	Product-name	Dimensions (mm)	Place	File no.
6	Anthracite	Plastic roofing tiles	1180 x 354 x 3.5	PUTTE	DE651xE503
6	Red				
6	Brown				

The sample is delivered by the Manufacturer.

2 TESTS AND CONDITIONING

The behaviour of the tiles under the impact of the various tests was monitored by color measurement.
This was performed by means of a colorimeter "Minolta CR-310"; measuring scale L*, a*, b* integrated on a surface area of 50mm in diameter-colorimeter with pulsed xenon arc light (PXA), index c, geometry ´wide area /0°´. This measurement is in conformity with the prescriptions of the CIE (Comité Internationale de l´Eclairage)

See also annex 1 (see Color Systems).

2.1 Determination of the resistance against heat

Principle

The roofing tiles are aged for 21 days at 75°C in a ventilated oven.

Results
No change was noticeable upon visual inspection.
Absolutely no difference in tint could be perceived (see also table hereafter)

Resistance against 21 days at 75°C												
color	no. of test piece	Length (mm)	Width (mm)	Mass (g)	mass after test (g)	color measurement before test			color measurement after test			Δ E
						L*	a*	b*	L*	a*	b*	
brown	1	1183	354.2	1669	1665.5	31.95	7.76	9.51	30.92	7.75	9.59	**1.033**
						32.11	7.99	9.85	30.41	7.68	9.32	**1.807**
						31.54	7.69	9.36	30.67	7.68	9.50	**0.881**
	average											**1.240**
anthracite	2	1178	354.2	1872	1868.3	26.64	-0.30	-2.10	26.15	-0.42	-1.92	**0.536**
						26.45	-0.31	-1.97	25.84	-0.46	-1.84	**0.641**
						26.09	-0.33	-2.00	25.71	-0.42	-1.92	**0.399**
	average											**0.525**
red	3	1181	354.5	1641	1638.4	28.10	15.49	12.61	28.50	15.95	12.89	**0.671**
						29.09	16.06	13.20	28.53	15.96	12.66	**0.784**
						29.20	15.92	13.14	28.11	15.48	12.22	**1.493**
	average											**0.983**

2.2 Determination of the resistance against thermal shocks

Principle

The roofing tiles are subject to 42 cycles of 8 hours at –18°C,
Followed by 16 hours at 75°C

Results
No change was noticeable upon visual inspection.
Absolutely no difference in tint could be perceived (see also table hereafter).

Resistance against thermal shocks 42 cycles of 8 hours at -18°C and 16 hours at 75°C												
color	no. of test piece	Length (mm)	Width (mm)	Mass (g)	mass after test (g)	color measurement before test			color measurement after test			Δ E
						L*	a*	b*	L*	a*	b*	
brown	4	1182	353.8	1634	1625.1	32.00	7.76	9.51	30.19	7.27	8.60	**2.084**
						31.56	7.99	9.85	30.15	7.40	8.95	**1.774**
						31.92	7.69	9.36	30.01	7.67	9.04	**1.937**
	average											**1.932**
anthracite	5	1177	353.6	1666	1653.3	26.32	-0.40	-2.05	25.23	-0.37	-1.90	**1.101**
						26.60	-0.41	-1.99	26.03	-0.42	-1.88	**0.581**
						27.06	-0.49	-2.06	25.71	-0.46	-1.79	**1.377**
	average											**1.020**
red	6	1176	354.1	1659	1647.3	28.92	14.99	12.01	27.98	14.84	11.74	**0.989**
						28.93	15.11	12.06	28.27	15.72	12.75	**1.133**
						28.88	15.76	12.94	28.20	14.63	11.48	**1.967**
	average											**1.363**

2.3 Accelerated ageing with UV

Principle

The roofing tiles are cut to the ideal maximum size in order to obtain complete exposure of the panels.

The roofing tiles are exposed to cycles of 7 hours of UV at 60°C (± 5°C), followed by 1 hour of condensation at 50°C (± 5°C), equipment Q-UV Panel Radiation source UV – B 340, Emission wavelength with a peak at 340nm and with a radiation energy of ca. 0.50W/m²/nm at the peak wavelength.

The total exposure amounts to 1000 hours, of which 875 hours of UV and 125 hours of condensation. This ageing should correspond to roughly 10 years of natural exposure in our climate, according to tests performed on HDPE (High Density PolyEthylene) by the TNO laboratories.

Results

1. No change was noticeable upon visual inspection (see also table hereafter).

Accelerated ageing with UV and condensation											
color	no. of test piece	Length (mm)	Width (mm)	Mass (g)	color measurement before test			color measurement after test			Δ E
					L*	a*	b*	L*	a*	b*	
brown	7	535.4	315.2	625.43	30.78	7.31	9.17	31.83	7.16	9.36	**1.078**
					32.11	7.66	9.39	31.60	6.19	7.63	**2.349**
					31.05	7.51	9.20	31.98	6.28	7.95	**2.229**
	average										**1.885**
anthracite	8	527.9	317.8	679.39	26.50	-0.37	-1.99	28.00	-0.41	-1.55	**1.564**
					26.88	-0.34	-1.97	28.15	-0.32	-1.41	**1.323**
					26.48	-0.34	-2.01	28.61	-0.33	-1.60	**2.169**
	average										**1.685**
red	9	511.8	312.4	619.43	28.86	16.06	13.23	30.45	15.35	12.90	**1.772**
					28.96	15.82	13.01	30.61	15.59	12.79	**1.680**
					29.34	15.78	12.92	30.24	15.17	12.31	**1.247**
	average										**1.566**

2.4 Corrosion test with saline mist (ISO 9227)

Principle

The roofing tiles are placed in a saline mist environment for 350 hours at 35°C.

Results

No change upon visual inspection for the exact results we refer to the test report of the CORI nr. ESO 40907 of 23.09.04 in annex..

2.5 Corrosion test with SO_2 (ISO3231)

Principle

The roofing tiles are subject to cycles composed of 8 hours at 40°C and 100 % relative humidity with SO_2 followed by 16 hours at 20 °C and <75 % relative humidity without SO_2.
The concentration of SO_2 amounts to 0.2 g/litre.

Results

No change upon visual inspection for the exact results we refer to the test report of the CORI nr. ESO 40907 of 23.09.04 in annex..

2.6 Determination of the water absorption

Principle

The roof tile is weighed in advance,
Fully immersed for 48 hours and then weighed again.
From this one derives the water-absorbing capacity of this material.

Results

Water absorption						
color	**no. of test piece**	**Length (mm)**	**Width (mm)**	**Mass (g)**	**mass after test (g)**	**absorption capacity kg/m²**
anthracite	**17**	1181.9	354.9	1652.63	1710.4	0.14

C.S.T.C. W.T.C.B. EDIM

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Avenue P. Holoffe 21

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TEST REPORT

IDENTIFICATION NUMBER: ES-040907.b **DATE:** 23.09.2004

LABORATORY: Coatings Research Institute
Avenue P. Holoffe
1342 LIMELETTE

CUSTOMER: BBRI
Avenue P. Holoffe 21
1342 Limelette

REFERENCE ORDER: Your order with reference 071479 dd. 2.8.2004

DATE OF RECEPTION OF THE SAMPLES: 9.7.2004

NUMBER OF THE DOCUMENT OF RECEPTION: ES/4310

SAMPLES: 3 series of roofing tiles Worldroof ref. 04/160
1. With brown coating
2. With black coating
3. With red coating

PERFORMED TESTS AND TESTING METHODS:

Resistance to humid atmospheres containing sulfur dioxide

Realized following ISO 3231 "Determination of resistance to humid atmospheres containing sulfur dioxide"
Quantity SO_2: 0,2 l
Apparatus: Humidotherm 519
Cycle: 8 h at 40 °C and 100 % RH with SO_2
16 h at room temperature and < 75 % RH without SO_2
Number of cycles: 30
After the test, the tiles are visually evaluated.

TEST REPORT

Resistance to neutral salt spray

Realized according ISO 9227 "Salt spray tests".
Experimental conditions:
- temperature in the climatic chamber: 34,7 °C
- concentration NaCl: 5 %
- pH of the solution: 6,7
- exposure time: 350 hours
- volume of the sprayed salt solution: between 1,01 and 1,26 per hour
- air pressure: 0,98

After the test, the panels are visually examined.

Remark: a "X"scratch is made in the coating before exposure of the tiles

DATE OF EXECUTION OF THE TESTS: July - September 2004

RESULTS:

Resistance to humid atmospheres containing sulfur dioxide

All the roofing tiles are unchanged after the test.

Resistance to neutral salt spray

All the roofing tiles are unchanged after the test.

Performed by: R. Guns/V. Pirsoul

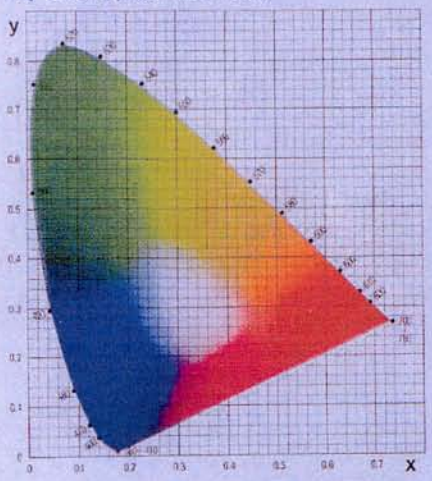
Approved by: R.Treckels/S. Vonckx

!!!!!!!!! Samples will be stored at CoRI during 6 months and then removed in accordance with the waste legislation, unless you make an appeal to prolongate this period or you recall the samples yourself (on charge of the customer).

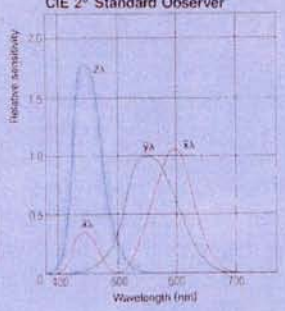
COLOR SYSTEMS

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)



Color-Matching Functions of CIE 2° Standard Observer

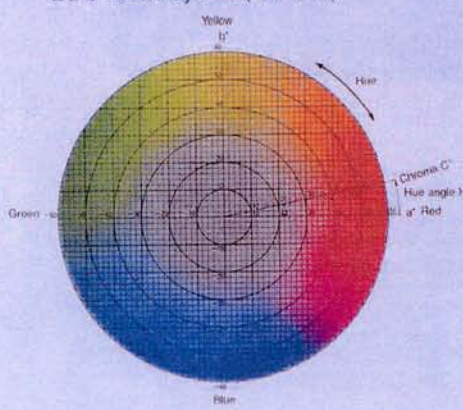


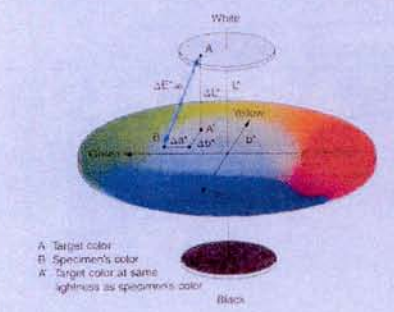
The Yxy color system was defined by the CIE (Commission Internationale de l'Eclairage) in 1931, and forms the base for other CIE color systems. In this system, Y is the lightness factor expressed as a percentage based on a perfect reflectance of 100%. x and y are the chromaticity coordinates in the CIE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





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 D65 (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:

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