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TEST REPORT

Requester :	**MINERAR LTDA** **SITIO MUQUEM, S/N** **ZONA RURAL** **PAPAGAIOS/MG – CEP 35669-000** **BRESIL**
Sampling date :	30 October 2013
Subject :	Verification test within the framework of European standards (Slate and stone products for discontinuous roofing and cladding - Annex ZA.1 of the NF EN 12326-1).
Reference documents :	NF EN 12326-1 - April 2005 NF EN 12326-2 - November 2000. NF EN 12326-2/A1 - November 2004.

1. PURPOSE OF THE DOCUMENT

This document is a summary of the results of test performed on the slates sampled received at the L.N.E..
The trade references communicated by the requester are contained in table 1.

Operator/Producer	Quarry	Trade Name
MINERAR Ltda	BREJO1	A.REIS/MINERAR1TC

Table 1 : **Name of the slates**

2. SAMPLES RECEIVED

On 28 January 2014, LNE received a batch of 75 pieces of slates 300*200mm with a thickness of 7.0 mm and a sett about 200*200 mm.

The general characteristics of the sampled slates are summarized in table 2.

Quarry	Trade name	Nominal thickness (mm)	Format (mm)	Réf. L.N.E.	Slate type	Color
BREJO1	A.REIS/ MINERAR1TC	7.0	300*200	P1A603B1-1-CE	Smooth	Grey

Table 2 : General characteristics

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3. IDENTIFICATION OF SAMPLES AND LIST OF TEST

The identification of the sampled products and the test performed are summarized in table 3.

Requester reference	L.N.E. References	Test performed	Standards
BREJO1	P1A603B1-1-CE 1 to 5	Length - width - straightness - squareness - individual thickness - flatness	NF EN 12326-1 NF EN 12326-2
	P1A603B1-1-CE 6 to 25 and 26 to 45	Flexural strength	
	P1A603B1-1-CE 46 to 50	Water absorption	
	P1A603B1-1-CE 51 to 53	Assay of non carbonated carbon	
	P1A603B1-1-CE 54 to 56	Assay of $CaCO_3$	
	P1A603B1-1-CE 57 to 62	Exposure to sulphur dioxide	
	P1A603B1-1-CE 63 to 68	Thermal cycle	
	P1A603B1-α-CE-Pe	Petrography	

Table 3 : **Identification of the samples and test performed according NF EN 12326-1 et NF EN 12326-2**

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4. TESTS

4.1. PROCEDURES

The tests summarized in this report were performed in accordance with the NF EN 12326-1 and NF EN 12326-2 standards in force (dimensional and geometric measurements, flexural strength, water absorption, carbonate and non carbonate carbon content, sulphur dioxide, thermal cycle, petrography)

The results of the measurements are shown in the tables on the following pages.

4.2. RESULTS

The tests were performed between 13 February 2014 and 25 April 2014

The petrographic tests were given to EPITOPOS ALSACE Company. The report is referenced D14009-5 and contains 14 pages (joined in annex to this report).

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4.2.1. Dimensional and geometric measurements

L.N.E. References	l (mm)	E_l %	b (mm)	E_b %	S_{dx} (mm)		R_d (%)	e		F_d (%)	e_n (mm)
					S_{d1}	S_{d2}		$\bar{e}_i$ (mm)	E_d (%)		
P1A603B1-1-CE 1	302	0.7	201.5	0.8	-	-	-	-	-	-	7.0
P1A603B1-1-CE 2	-	-	-	-	0.5	0.5	-	-	-	-	
P1A603B1-1-CE 3	-	-	-	-	-	-	0.7	-	-	-	
P1A603B1-1-CE 4	-	-	-	-	-	-	-	7.7	6	-	
P1A603B1-1-CE 5	-		-	-	-	-	-	-	-	0.1	

Table 4 : **Result of the dimensional and geometric measurements (NF EN 12326-2) (§5-6-7-8-9)**

l : Length.
b : Width.
E_l : Deviation with respect to length.
E_b Deviation with respect to width.
S_{dx} : Straightness of the edges on each side.
R_d : Squareness.
e : Individual thickness.
$\bar{e}_i$: Mean of the individual thickness.
E_d : Maximum deviation in relation to the mean thickness.
F_d : Curvature.
e_n : Nominal thickness.

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4.2.2. Rupture load on flexion

a) Load speed

LNE References	Load speed $N.s^{-1}$ T D_{ir}	LNE References	Load speed $N.s^{-1}$ L D_{ir}
P1A603B1-1-CE-6	21	P1A603B1-1-CE-26	29
P1A603B1-1-CE-7	24	P1A603B1-1-CE-27	20
P1A603B1-1-CE-8	18	P1A603B1-1-CE-28	23
P1A603B1-1-CE-9	28	P1A603B1-1-CE-29	22
P1A603B1-1-CE-10	24	P1A603B1-1-CE-30	18
P1A603B1-1-CE-11	16	P1A603B1-1-CE-31	19
P1A603B1-1-CE-12	26	P1A603B1-1-CE-32	23
P1A603B1-1-CE-13	22	P1A603B1-1-CE-33	18
P1A603B1-1-CE-14	29	P1A603B1-1-CE-34	32
P1A603B1-1-CE-15	18	P1A603B1-1-CE-35	24
P1A603B1-1-CE-16	25	P1A603B1-1-CE-36	27
P1A603B1-1-CE-17	18	P1A603B1-1-CE-37	24
P1A603B1-1-CE-18	27	P1A603B1-1-CE-38	25
P1A603B1-1-CE-19	30	P1A603B1-1-CE-39	24
P1A603B1-1-CE-20	30	P1A603B1-1-CE-40	23
P1A603B1-1-CE-21	17	P1A603B1-1-CE-41	26
P1A603B1-1-CE-22	14	P1A603B1-1-CE-42	23
P1A603B1-1-CE-23	22	P1A603B1-1-CE-43	30
P1A603B1-1-CE-24	23	P1A603B1-1-CE-44	19
P1A603B1-1-CE-25	22	P1A603B1-1-CE-45	24

Table 5 : **Load speed (NF EN 12326-2) (§10.4)**

L D_{ir}: Longitudinal direction.
T D_{ir}: Transversal direction.

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b) Rupture load on flexion

L.N.E. References	$\overline{P}$ (N) Longitudinal direction	$\overline{P}$ (N) Transversal direction	$\overline{R}$ (Mpa) Longitudinal direction	S_l	ē (mm) Longitudinal direction	$\overline{R}$ (Mpa) Transversal direction	S_t	ē (mm) Transversal direction	R_C(Mpa) Longitudinal direction	R_C(Mpa) Transversal direction	Orientation of the maximum module
P1A603B1-1-CE 6 to 25	-	1339	-	-	-	58	7	7.1	-	45	$\overline{R}_{St}$
P1A603B1-1-CE 26 to 45	1223	-	52	7	7.1	-	-	-	39	-	

Table 6 : **Results of the mechanical tests (NF EN 12326-2) - (§ 10.4)**

$\overline{P}$: Mean rupture load.
$\overline{R}$: Mean rupture modulus.
S_l : Standard deviation of the rupture modulus in the longitudinal direction.
S_t : Standard deviation of the rupture modulus in the transversal direction.
ē : Mean of the thickness.
R_C : Characteristic rupture modulus.
$\overline{R}_{St}$: Rupture modulus in the transversal direction.

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4.2.3. Determination of the individual base thickness

L.N.E. References	e_{bi} (mm) France	e_{bi} (mm) Belgium	e_{bi} (mm) Deutschland - Italy Spain	e_{bi} (mm) RU
P1A603B1-1-CE	2.8	3.7	3.3	3.0

Table 7 : **Results of the individual base thickness Annex B EN 12326-1**

e_{bi} : Individual base thickness

Note :

It was determined for each thickness in accordance with the provisions of annex B of standard NF EN 12326-1.

x factors used for France :
- Transversal direction : 1.0.
- Longitudinal direction : 1.0.

x factors used for Belgium :
- Transversal direction : 1.35.
- Longitudinal direction : 1.35.

x factors used for Deutschland, Italy and Spain :
- Transversal direction : 1.2.
- Longitudinal direction : 1.2.

x factors used for RU :
- Transversal direction : 0.9.
- Longitudinal direction : 1.1

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4.2.4. Water absorption

LNE References	Thickness ē (mm)	Water Absorption A_w (%)	Water Absorption $\overline{A_w}$ (%)	Code
P1A603B1-1-CE-46	7.5	0.43	0.39	A1
P1A603B1-1-CE-47		0.32		
P1A603B1-1-CE-48		0.41		
P1A603B1-1-CE-49		0.32		
P1A603B1-1-CE-50		0.46		

Table 8 : **Results for water absorption (NF EN 12326-2) (§11.5)**

4.2.5. Determination of the non-carbonated carbon content

LNE References	C_{nc} (%)	$\overline{C_{nc}}$ (%)
P1A603B1-1-CE-51	0.04	0.04
P1A603B1-1-CE-52	0.04	
P1A603B1-1-CE-53	0.04	

Table 9 : **Results for the non-carbonated carbon content (NF EN 12326-2) (§13.1.5)**

C_{nc} : Non-carbonated free carbon content.

Note :

The level of non-carbonated carbon was determined by thermal decomposition by catalysis.

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4.2.6. Determination of carbonate content

LNE References	C_t (%)	$\overline{C'a}$ (%)
P1A603B1-1-CE-54	0.56	1.05
P1A603B1-1-CE-55	0.67	
P1A603B1-1-CE-56	0.67	

Table 10 : **Results for carbonate content (NF EN 12326-2) (§14.2)**

C_t : Carbonate content.
C'_a : Apparent calcium carbonate content.

Note :

The carbon level was determined by calcimetry

4.2.7. Sulphur dioxide exposure tests (SO_2)

LNE References	Observations	Code
P1A603B1-1-CE-57	①	S1
P1A603B1-1-CE-58	①	
P1A603B1-1-CE-59	①	
P1A603B1-1-CE-60	①	
P1A603B1-1-CE-61	①	
P1A603B1-1-CE-62	①	

Table 11 : **Results for exposure to sulphur dioxide (NF EN 12326-2) (§15.1.5)**

① At the end of the test, we observed no degradations such as swelling, softening, disintegration, scales, or fissures, nor did we observe any colour changes.

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4.2.8. Thermal cycle test

LNE References	Observations	Code
P1A603B1-1-CE-63	surface oxidation on one side and on one slice, without rust staining ①	T2
P1A603B1-1-CE-64	multiple oxidations on one side with rust staining ①.	
P1A603B1-1-CE-65	4 surface oxidations on one side without rust staining ①.	
P1A603B1-1-CE-66	3 surface oxidations on one side without rust staining ①.	
P1A603B1-1-CE-67	3 surface oxidations on one side without rust staining ①.	
P1A603B1-1-CE-68	① ②	

Table 12 : **Thermal cycle results (NF EN 12326-2) (§16.5)**

Note :

① At the end of the test, we observed no degradations such as swelling, disintegration, scaling, or exfoliation.
② We observed no traces of oxidation, stains, or colour changes in metallic inclusions.

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5. EVALUATION OF THE RESULTS

5.1. REMINDER OF THE CONFORMITY CRITERIA

5.1.1. Dimensional and geometric criteria

Length	:	$l_{declared}$ - 5mm ≤ l ≤ $l_{declared}$ + 5mm.
Width	:	$b_{declared}$ - 5mm ≤ b ≤ $b_{declared}$ + 5mm.
Straightness of edges	:	For L ≤ 500mm S_{dx} ≤ 5mm.
		For L > 500mm S_{dx} ≤ 1% of the length.
Squareness	:	R_d ± 1% .
Flatness deviation	:	Very Smooth slate - F_d< 0.9%.
		Smooth slate - F_d< 1%.
		Normal slate - F_d< 1.5%.
		Rough slate - F_d< 2.0%.
Individual thickness	:	$0.65e_n \leq e \leq 1.35e_n$
$e_{bi} \leq e_n$		

5.1.2. Physico-chemical criteria

Water absorption	:	$A_1 \leq 0.60\%$.
Water absorption	:	$A_2 > 0.60\%$.

5.1.3. Chemical criteria

Non-carbonated carbon	:	$C_{nc} \leq 2.0\%$.
Carbonate	:	$CaCO_3$ ≤ manufacturer declared value
Sulphur dioxide	:	S1-S2-S3
Thermal cycle	:	T1-T2-T3

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6. SUMMARY TABLE

Quarry	Trade Name	Water absorption	Thermal cycle	Sulphur dioxide
BREJO1	A.REIS/MINERAR1TC	A1	T2	S1

Table n° 13 : **summary of results : water absorption, thermal cycle and sulphur dioxide**

7. VERIFICATION RESULTS.

Table n°14 shows where the results of the test met the requirements of European standard NF EN 12326-1.

		Characteristics								
Quarry	Trade Name	l	b	e	S_{d1}- S_{d2}	R_d	F_d	e_{bi}	C_{nc}	Defaults
BREJO1	A.REIS/ MINERAR1TC	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

Table n° 14 : **Verification of result for CE requirements**.

Trappes, le 28 juillet 2014

Le Responsable de l'Essai
Test Officer

Jean-Pierre KAMINSKI

The results which are quoted are only applicable to the sample, the product or material submitted to LNE and which is fully described in this document