

**Penrhyn Celtic Grade Roofing Slate – EN 12326-1:2014**

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|--|-----------------|---------------|-----------------------|
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Commercial document issued by: **Welsh Slate, Penrhyn Quarry, Bethesda, Bangor, Gwynedd, LL57 4YG United Kingdom**

Location of quarry: **Penrhyn Quarry, Bethesda, Bangor, Gwynedd, LL57 4YG United Kingdom**

This document records the conformity of the product described below and is incomplete without the explanation of the meaning of the test results and the requirements of EN 12326-1:2014.  
The tests referred to and the criteria are contained in EN 12326-1:2014 and EN 12326-2:2011

| Date of sampling  | 12/7/23   |                        | Date of testing |                        | 3/8/23     |
|---|---|------------------------|-----------------|------------------------|------------|
| Product description and commercial name<br>Relation between bedding and cleavage  | Penrhyn Celtic Grade Roofing Slate<br>Beds parallel to cleavage |                        |                 |                        | Conformity |
| <b>1. Dimensional tolerances</b>  |   |                        |                 |                        |            |
| Format  | Rectangular   |                        |                 |                        |            |
| Deviation from declared length  | 0mm   |                        |                 |                        |            |
| Deviation from declared width   | 0mm   |                        |                 |                        |            |
| Deviation from squareness   | 0.0%  |                        |                 |                        |            |
| Deviation from straightness of edges  | Edge 1 = 0.0mm, Edge 2 = 0.0mm                                  |                        |                 |                        |            |
| Slate type for deviation of flatness  | Very Flat   | Flat (Capital)         | Normal (County) | Non-Flat (Celtic)      |            |
| Deviation from flatness   | 0.4%  |                        |                 |                        |            |
| <b>2. Thickness</b>   |   |                        |                 |                        |            |
| Nominal thickness and variation of individual thickness against nominal thickness | 9 mm, ± 35%   |                        |                 |                        |            |
| <b>3. Strength</b>  |   |                        |                 |                        |            |
| Characteristic MoR  | Transverse  | 48.4 N/mm <sup>2</sup> | Longitudinal    | 35.0 N/mm <sup>2</sup> | NR         |
| <b>4. Water absorption</b>  | Code A1 (≤0.6): 0.11%   |                        |                 |                        |            |
| <b>5. Freeze thaw</b>   |   |                        |                 |                        |            |
| <b>6. Thermal cycle test</b>  | T1  |                        |                 |                        |            |
| <b>7. Apparent calcium carbonate content</b>                                      | 0.0%  |                        |                 |                        |            |

|                                     |                                  |   |     |
|-------------------------------------|----------------------------------|---|-----|
| 8. Sulphur dioxide exposure tests   | ≤ 20% apparent calcium carbonate | S1  | YES |
|                                     | > 20% apparent calcium carbonate |   | NA  |
| 9. Non-carbonate carbon content     |                                  | 0.1%  | YES |
| 10. External fire exposure          |                                  | Deemed to satisfy class BROOF                             | YES |
| 11. Reaction to fire                |                                  | Deemed to satisfy class A1                                | YES |
| 12. Release of dangerous substances |                                  | None in conditions of use as roofing or external cladding | NR  |

## Meaning of the Test Results

|   |   |  |
|---|---|--|
| Date of sampling and testing  | If more than one date is applicable to sampling or testing they should be indicated against the individual test results   |  |
| Product description   | Slate for roofing and external cladding or carbonate slate for roofing and external cladding.<br>Slate type and origin  |  |
| <b>1. Dimensional tolerances</b>  |   |  |
| Length and width  | Maximum deviation ± 5mm   |  |
| Deviation from squareness   | Maximum deviation ± 1% of the length  |  |
| Deviation from straightness of edges  | Slate length ≤ 500mm Permitted deviation ≤ 5mm  |  |
|   | Slate length > 500mm Permitted deviation ≤ 1% of the length   |  |
| Flatness: The limits of deviation from the flatness are defined for four types of slate. The bevelled edges shall be applied to the convex face. Slates with deviation from flatness in excess of the limit may be used for special applications. | Slate type  | Maximum deviation from flatness as a % of the slate length |
|   | Very flat   | < 0.9  |
|   | Flat  | < 1.0  |
|   | Normal  | < 1.5  |
|   | Non-flat  | < 2.0  |
| <b>2. Thickness</b>   | The basic nominal thickness is determined as a function of the bending strength using the formulae given in 3, local climate conditions and traditional construction techniques. The basic nominal thickness is increased in relation to the slate's performance in the appropriate sulphur dioxide test (if required) as shown in 7 and 8 below. |  |

|                    |  |
|--------------------|--|
| <b>3. Strength</b> | Longitudinal and transverse characteristic modulus of rupture; there is no limit for characteristic modulus. However, the basic nominal thickness is determined as a function of the bend strength using the formulae given below, local climate conditions and traditional construction techniques. |
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|  |  |
|--|--|
| $e_l = X \sqrt{\frac{l}{R_{cl}}}$ <p>And</p> $e_t = X \sqrt{\frac{b}{R_{ct}}}$ | <p><b>Where</b></p> <p><math>e_l</math> is the longitudinal thickness, (in mm);<br/> <math>e_t</math> is the transverse thickness, (in mm);<br/> <math>l</math> is the length of the slate, (in mm);<br/> <math>b</math> is the width of the slate, (in mm);<br/> <math>R_{cl}</math> is the characteristic longitudinal modulus of rupture, (in N/mm<sup>2</sup>);<br/> <math>R_{ct}</math> is the characteristic transverse modulus of rupture, (in N/mm<sup>2</sup>);<br/> <math>X</math> is a constant determined as a function of climate and the traditional construction techniques (in N<sup>1/2</sup>.mm<sup>-1/2</sup>).</p> <p>NOTE: It may be different for each formula and is selected for the member state of use according to the table below.</p> |
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|                     |              |            |              |              |            |
|---------------------|--------------|------------|--------------|--------------|------------|
| National X Factors: | Member state | Transverse | Longitudinal | Member state | Transverse |
|                     | Belgium      | 1.0        | 1.0          | Czech Repub. | 1.2        |
|                     | Ireland      | 0.9        | 1.1          | Italy        | 1.2        |
|                     | France       | 1.0        | 1.0          | Spain        | 1.0        |
|                     | Germany      | 1.2        | 1.2          | UK           | 0.9        |

Those member states that have not declared a national value should select a value or pair of values in relation to their country's climate and traditional construction techniques. It should not be less than the minimum value or pair of values given above.

$e_l$  and  $e_t$  are determined by using the length  $l$  and the width  $b$  of the slates. The maximum value determined is the basic individual thickness of the slate,  $e_{bi}$ . The basic individual thickness is increased in relation to the slate's performance in the appropriate sulphur dioxide test as shown in 7 and 8 below.

|                            |  |
|----------------------------|--|
| <b>4. Water Absorption</b> | Code A1 ( $\leq 0.6$ ), A2 ( $> 0.6$ ) |
|----------------------------|--|

|                            |   |
|----------------------------|---|
| <b>5. Freeze-thaw test</b> | Slates tested indicate the mean value of the modulus of rupture after 50 cycles in transverse and longitudinal directions before and after the freeze/thaw test, if relevant, (test (if $W_1 > 0.6$ )), or not required |
|----------------------------|---|

|                              |  |
|------------------------------|--|
| <b>6. Thermal cycle test</b> | The following table explains the meaning of the test codes |
|------------------------------|--|

| Code | Observation in the test   | Conformity to the standard           |
|------|---|--------------------------------------|
| T1   | No changes in appearance. Surface oxidation of metallic minerals. Colour changes that neither affect the structure nor form runs of discolouration. | Acceptable                           |
| T2   | Oxidation or appearance changes of the metallic inclusions with runs of discolouration but without structural changes.                              | Acceptable                           |
| T3   | Oxidation or appearance changes of the metallic minerals which penetrate the slate and risk the formation of holes.                                 | Acceptable subject to the note below |

NOTE: It is best only to use slates within code T3, which potentially may result in water penetration selectively with suitable methods of construction that avoid such penetration. Slates showing exfoliation splitting or other structural changes in this test are not acceptable.

**7. Apparent calcium carbonate content**

There is no limit on apparent calcium carbonate content. However, the apparent calcium carbonate content determines which sulphur dioxide exposure test procedure should be carried out and, together with the strength, the minimum nominal thickness of the product.

If the carbonate content is less than or equal to 20% then the sulphur dioxide exposure test procedure in EN 12326-2:2011, 14.1 applies. If the carbonate content is more than 20%, the sulphur dioxide exposure test procedure in EN 12326-2:2011, 14.2 applies. The minimum thickness is calculated using the table below

**8. Minimal nominal thickness in relation to apparent calcium carbonate content and sulphur dioxide exposure code**

| Carbonate content % | SO2 exposure test code from EN 12326-2:2011, 14.1 | Depth of softened layer from EN12326-2:2011, 14.2 | Thickness adjustment                                       |
|---------------------|---|---|--|
| ≤ 5.0               | S1  |   | None   |
|                     | S2  |   | ebi + 5%   |
|                     | S3  |   | ebi ≥ 8.0mm or switch to the test in EN 12326-2:2011, 14.2 |
| > 5.0<br>≤ 20.0     | S1  |   | ebi + 5%   |
|                     | S2  |   | ebi + 10%  |
|                     | S3  |   | ebi ≥ 8.0mm or switch to the test in EN 12326-2:2011, 14.2 |
| > 20.0              |   | 0mm to 0.70mm                                     | ebi + 0.50mm + 7t <sup>2</sup>                             |

ebi is the basic individual thickness obtained from 3 above (in mm)

t is the thickness of the softened layer obtained from EN 12326-2:2011, 14.2 (in mm)

**9. Non-carbonate carbon content: The non-carbonate carbon content shall be less than 2%**