

Technical Properties 1

Frost resistance

Dennis Ruabon quarry tiles are manufactured to comply with the requirements for tiles subjected to extremes of temperature.

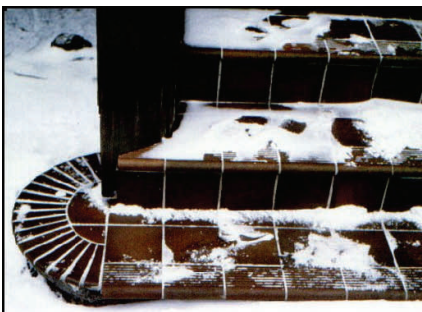
The British/European/International standards include a frost resistance test which is described in BS EN ISO 10545: Part 12. The method involves testing a minimum of 10 tiles by impregnation with water and freeze/thaw cycling between +5°C and -5°C. A minimum of 100 such cycles without damage is required for classification as frost resistant.

Ruabon Group A1 quarry tiles exhibit no signs of damage after 100 cycles of the above test and are classified as frost resistant. Ruabon Flame (Group Alla) shows little damage after 100 cycles and is therefore described as probably frost resistant.

Under BS EN 14411:2003 all products within Group A1 are required to be classified as frost resistant and suitable for use under all climatic conditions.

In general terms, frost resistance is related to water absorption and the following table may be used as a guide.

Water Absorption	Frost Resistance
≤ 3%	Frost Resistant
3 - 4%	Probably Resistant
> 4%	Unlikely to be resistant



Chemical Resistance

BS EN ISO 10545: Part 13 requires all products to be tested against a range of acids and alkalis and a variety of household cleaners, swimming pool chemicals, and acid and alkali solutions. The test solutions used in the ISO Standard are:

Ammonium Chloride solution (110g/l)

Sodium Hypochlorite solution (20mg/l)

Hydrochloric Acid (3%v/v and 18%v/v)

Lactic Acid (5%v/v)

Citric Acid (110g/l)

Potassium Hydroxide solution (30 and 200g/l)

Hydrochloric Acid solution (3% and 18% v/v)

Lactic Acid solution (5% v/v)

All Ruabon quarry tiles meet the requirements, although if in prolonged contact there may be a very slight attack from the potassium hydroxide solution. In general concentrated acids such as sulphuric, hydrochloric, acetic and lactic, and alkalis such as sodium and potassium hydroxides attack Ruabon products extremely slowly at room temperature. Corrosion, if any, would normally take place at such a slow rate that it would not significantly alter the life of the installation. In the case of strong alkalis there may be some discolouration of the tile after prolonged contact.

Ruabon quarry tiles, in common with other ceramic materials, would not normally be specified for environments where they would be in prolonged contact with fluoride chemicals, especially hydrofluoric acid.

In addition to the chemical resistance properties of quarry tiles consideration must be given to the proposed completed installation taking into account the fixing products to be used. Further detailed information regarding chemical resistance of fixing products is contained in Technical Data Sheet No. 11.

Staining resistance

In the new International standard, as previously in BS 6431, unglazed tiles are not required to demonstrate staining resistance. However, a test method is to be included which can be used to indicate the ease of cleaning of quarry tiles.

The test requires the tiles to be subjected to a range of staining agents.

- Chrome green (or a red stain) in light oil (tracing stain)
- Iodine in alcoholic solution (chemical/oxidising stain)
- Olive oil (filming stain)

Each staining agent is applied in turn to the surface of a tile and attempts are then made to remove the stain from the tile using a range of standard cleaning regimes. The severity of the cleaning regime required to remove the stain classifies the tile into a grade of between 1 to 5 (5 being the easiest to clean and 1 the hardest). The cleaning regimes are applied in the order shown until the stain is removed.

Class 5. Flowing hot water and hand wiped

Class 4. Hand cleaning using a weak cleaning agent and non-abrasive materials

Class 3. Mechanical cleaning using concentrated cleaning agents and abrasives

Class 2. 24-hour immersion in a suitable solvent (not used on tracing stains)

Class 1. Irreversible damage of the proper surface of the tile

All Dennis Ruabon Tiles demonstrate Class 5 ease of cleaning

Technical Properties 2

Technical Properties:

Comparison of British/European/International Standards related to Ruabon Values.

Technical Properties of extruded ceramic tiles:

All Ruabon quarry tiles are manufactured to achieve technical properties which comply with the highest requirements of BS EN 14411 Group A1 and are suitable for internal or external use, with the exception of Ruabon Flame which complies with Group A11a (internal use only).

The technical requirements are detailed in the table opposite. It can be seen that Ruabon quarry tiles meet the more stringent classifications of the standard.

Further details of dimensional specifications can be found on Technical Data Sheet No.3 (Quality Standards).

All Ruabon 1st quality products are subject to independent testing carried out at approved National Ceramics Laboratories.

Technical Support:

Our Technical Services Department provides a full support service including advice and fixing specifications. Technical Data Sheets covering every aspect of quarry tiles from planning and preparation, through to maintenance and after-care, can be freely viewed and downloaded from our website. Hard copies are available on request from our sales department.

Request forms are also available on our website ensuring a speedy response for fixing specifications, samples requests and literature requests.

Technical property	ISO 10545 Requirement	Ruabon Tiles Typical value
Water absorption ISO 10545 - 3	AI ≤ 3% AIIa 3-6%	~ 2.4% ~ 3.2%
Modulus of rupture ISO 10545 - 4	Group AI Av ≥ 23N/mm ² Group AIIa Av ≥ 20N/mm ²	Group AI Av > 23N/mm ² Group AIIa Av > 23N/mm ²
Abrasion resistance ISO 10545 - 6	Group AI < 275mm ³ Group AIIa < 393mm ³	100mm ³ 100mm ³
Scratch hardness EN 101	No requirement	>7 Moh's scale
Moisture expansion ISO 10545 - 10	Not finalised	Negligible
Linear thermal expansion ISO 10545 - 8 & En 103	No requirement	<5x10 ⁻⁶ ° C
Thermal conductivity	No requirement	1wm -1 ° C
Thermal shock resistance ISO 10545 - 9 & EN 104	Required	Pass
Frost resistance ISO 10545 - 12	100 freeze thaw cycles	100 cycles
Chemical resistance ISO 10545 - 13		
(a) Household chemicals & pool cleaning salts – Sodium Hypochlorite & Ammonium Chloride	Manufacturer to state classification	Class UA (no visible effect)
(b) Low concentration acids & alkalis – Hydrochloric Acid 3% v/v & Citric Acid sol.	Manufacturer to state classification	Class ULA (no visible effect)
(c) High concentration acids & alkalis – Hydrochloric Acid 18% v/v, Lactic Acid 5% v/v & Potassium Hydroxide sol.	Manufacturer to state classification	Class UHA (no visible effect)
Slip resistance ISO 10545 - 14	Stated co-efficient of friction	R11 – R13 . Pendulum SRV's ranging from 47 to 65 See Technical Data Sheet No. 6 for full details
Staining resistance Class 1 –5	Manufacturer to state classification 1 = not resistant 5 = highly resistant	Class 5