Classification of ceramic tiles

Ceramic tiles are classified with respect to water absorption and shaping.

The table below indicates the nine potential classes and the associated product standards.

The greater the water absorption of the tile, the greater will be its expansion in damp or wet conditions.

<table>
<thead>
<tr>
<th>Classification of ceramic tiles</th>
<th>Water absorption E (% by mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaping</td>
<td>Group I</td>
</tr>
<tr>
<td>B. Dry pressed†</td>
<td>Group B1</td>
</tr>
<tr>
<td>C. Tiles made by other processes††</td>
<td>Group C1</td>
</tr>
</tbody>
</table>

Notes:
* Groups AII and AIII are divided into two parts (Part 1 and Part 2) with different product specifications.
† Group BIII covers glazed tiles only. There is a low quantity of dry pressed unglazed tiles produced with water absorption greater than 10% that is not covered by this product group.
†† These tiles are not covered by ISO 13006.
Specification of tile types

Composition and manufacture
Ceramic tiles are derived from mixtures of clay, sand and other natural materials that are shaped into slabs and fired at high temperatures, up to 1250°C. Their composition is the same as that of all ceramic material, from tableware and sanitary ware to roofing tiles. Like all ceramic material, ceramic tiles are durable, hygienic, non-combustible, fire-resistant and easy to maintain. Tiles are also rigid and feature relatively low resistance to shock. These features are intrinsic to the nature of ceramic materials.

As floor and wall covering, ceramic tile serves a dual function: an aesthetic function as a design component and a technical function as a finishing building material. As a building material, ceramic tile must be able to withstand a range of environmental stresses. Features defined by international norms govern the technical function of ceramic floor and wall tiles.

Ceramic tiles are classified by their shaping or production method (either dry pressed or extruded), and the level of water absorption measured as a percentage. Most ceramic tiles are shaped by dry pressing (B groups).

Performance properties
The product performance standards contain the technical characteristics and the required tolerance values that must be met or exceeded for the tile to conform to the standard. The main characteristics covered by test methods are summarised below:

- Dimensions and surface quality
- Water absorption
- Modulus of rupture
- Impact resistance
- Deep abrasion
- Thermal expansion
- Crazing resistance
- Chemical resistance
- Surface abrasion
- Moisture expansion
- Frost resistance
- Stain resistance
- Thermal shock
- Lead and cadmium release
- Small colour differences

Refer to section 5.1 in this binder for further information.

Slip resistance
Ceramic tiles have other performance properties that are not ‘covered’ by harmonised BS or EN standards, slip resistance. The UK Slip Resistance Group recommends the Pendulum Test Method. Porcelanosa use this method as well as other recognised test methods. For more information on this, please refer to section 5.2 in this binder.
The following table outlines the range and variety of product types that can be included in the classification of ceramic tile for floors and walls. The range of technical and aesthetic features and of the performances by the different types is vast. Once relegated to kitchens and bathrooms, the specification of ceramic tiles is now a viable alternative for any commercial application.

### Porcelain (fully vitrified)
Either unglazed or glazed and characterised by a low water absorption of less than 0.5% (BΙ), porcelain tiles are normally dry pressed.

### Vitrified and semi-vitrified
These can either be unglazed or glazed and made by dry pressing or extruding. Such tiles fall into two main categories based on the water absorption of the tile body measured as a percentage.

- **Vitrified tiles Class BΙ (dry pressed) and Class AΙ (extruded)** have a water absorption of between 0.5% to 3%.
- **Semi-vitrified tiles Class BΙΙ (dry pressed) and AΙΙ (extruded)** have a water absorption of between 3% to 6%.

### Terracotta
Literally meaning ‘cooked earth’, terracotta is made from local natural clays with a minimum of processing, tend to be unglazed and normally have a water absorption >10%. Tiles of this type generally have a more porous surface and need surface treatments to enhance staining resistance and cleaning properties.

### Glazed porous body
The majority of standard wall tiles have glazed porous bodies with a water absorption between 10% and 20% and are classified BΙΙΙ. When the face of such tiles is covered with a vitreous glazing either gloss or satin they are suitable for a wide variety of internal applications. Such tiles are not frost resistant and should only be used in internal conditions above sub zero temperatures.

### Glazed vitrified
The porcelain vitrified and semi-vitrified tiles possess similar technical properties when glazed and can be used for internal cladding applications. Only vitrified and porcelain tiles with a water absorption value lower than 3% should be used for external cladding applications in conditions that are subject to frost.

### Mosaics
Mosaics are defined by size (generally less than 25 mm). Mosaics are composed from a variety of product types (made from individual tessarae that could be porcelain, vitrified or earthenware ceramic, glass or natural stone) and can be unglazed or glazed.
Manufacturing of ceramic tiles

Raw materials
The range of tile bodies is vast: majolica, cottoforte, red body single-fired products, cotto and red stoneware are mainly obtained from a natural mixture, i.e. a mixture of few clays coming from the same quarry. White or light body tiles (earthenware, white single-fired products and porcelain stoneware) are obtained from mixtures prepared in the factory. Illitic and kaolinitic white clays, calcite and dolomite, sand, talc and feldspars generally form the earthenware body.

Mixtures of kaolin, white-firing plastic clays, feldspars and sands are used for white single-fired products and porcelain stoneware.

Body preparation
The dry process with traditional wetting is generally used for all products obtained from a single raw material (majolica, cottoforte, red stoneware). The dry process with granulation is used for medium-sintered or porous red single-fired products to be fired in slow-firing kilns. The wet process (wet grinding and spray drying) is used for all the white body products (earthenware, white single-fired products, and porcelain stoneware) and for red single-fired and highly vitrified products to be fired in fast-firing kilns.

Shaping
With the exception of cotto and clinker, which are shaped by extrusion, all types of ceramic tiles are shaped by dry pressing, generally with hydraulic presses.

Drying
Hot air, rapid dryers are most commonly used.

Glazes and glazing
Glazes are mixtures of frits, sand, kaolin, coloring agents and opacifiers, mostly applied wet using different systems. Decoration is often obtained by silk-screening. The double-firing technique in which glaze is applied to the previously fired body, is still used today for products in majolica and cottoforte. In the single-firing method glaze is applied to the dried raw body before firing. Many innovative techniques have been developed to improve the mechanical features of the glazed surface. Some of the most important are dry applications and press-glazing (the application of the glaze in powder form when pressing the body).

Firing
Single-layer fast-firing kilns are used for most products. Firing temperatures range between 1000°C to 1020°C for porous products; 1050°C to 1200°C for single-fired products; and 1200°C to 1220°C for porcelain.