



Technical Introduction to Types of Tiles

1. Types of Tiles & Their Characteristics
2. Technical Terms & Explanations
3. Features and Benefits
4. Sources of Technical Information
5. Slip Ratings and Testing Equipment

July 19

Technical Introduction to Different Types of Tiles

A common dilemma when it comes to choosing tiles is whether to pick ceramic or porcelain. What is the difference? Which do I need? Is one better than the other?

Ceramic tiles are made from natural clay with a durable glaze; the biscuit of the tile is baked to reduce water content. Next the design is added to the same biscuit before it's baked again in a kiln at a high temperature.

Porcelain tiles are also made from natural clay but of a denser nature as finely ground sand is also added into the manufacturing mix. This mixture is then pressed and fired at a much higher temperature than ceramic tiles, and are also fired for longer to remove almost all of the water content and make them less porous than a ceramic tile. In simple terms this means porcelain tiles are much more hardwearing and suitable for both indoor and outdoor applications.

Whilst ceramic tiles are only recommended for interior walls and floors, porcelain tiles are a more now popular choice for floors that anticipate heavier traffic such as kitchen floors, hallways and commercial applications as they are increasingly resistant to scratching, chipping and wearing.

Aim of this presentation...

To enable you to make informed decisions when helping customers choose tiles for projects. This section will provide information and advice on different types and characteristics of tiles; and provide an easily accessible & practical source of information when required.

1. Highlight Different Types of Tiles & Their Characteristics
2. Useful Technical Terms & Explanations in Tile Production
3. Features and Benefits of Tiles
4. Slip Ratings and Values

1. Types of Tiles

A. Glazed Ceramic Tiles – Wall

Includes;

- Red Body Glazed Tiles
- White Body Glazed Tiles - Rectified & Non Rectified
- Glazed Porcelain Tiles - Rectified & Non Rectified
- Glossy, Matt & Satin Finishes

B. Glazed Ceramic Tiles – Floor

Includes;

- Red Body Floor Tiles
- Glazed White Body Tiles
- Glazed Porcelain Tiles - Rectified & Non Rectified
- Glossy, Matt & Satin Finishes

C. Unglazed Tiles - Generally Floor

Includes;

- Clinker Tiles
- Quarry Tiles
- Extruded Tiles
- Matt & Structured Finishes

D. Quartz and other Resin Based Tiles

- Generally, three types of resin agglomerated floor tiles are available, these are: quartz, granite and marble
- Suitable for walls and floors
- Moisture Sensitive

E. Porcelain Tiles - Can be used on Wall and Floor

Includes;

- Glazed Porcelain
- Full Body Or Through Body Porcelain
- Numerous Finishes; Natural Finishes, Satin/Honed/Lapatto Finishes, Polished Finishes and Structured (Anti-Slip) Finishes
- Polished Porcelains - Soluble Salts Tiles, Double Loaded Tiles
- Sealing Porcelain Tiles - Micro-pores and Hooks
- Nano Sealed Polished Porcelain Tiles

2. Characteristics of Different Types of Tiles

A. Characteristics of Glazed Red Body Tiles

- Body of tile (back) is Porous - Glazed surface is not porous.
- Softer than porcelain.
- Potential for impact damage high. Glaze can chip as a result
- Red body can sometimes be seen at grout edges if tiles are not grouted properly
- Water penetration can cause 'shadowing' behind the glaze
- Generally available in smaller sizes and are cheaper to produce as the raw materials cost less, and less energy is used in production as lower firing temperature in the kilns is required
- The glazes on red body tiles can be matt, satin, glossy or even anti slip.

B. Characteristics of White Body Tiles

- A finer smoother body than the red which allows for a better, cleaner and smoother finish on the glaze.
- If grout is not fixed properly the "defect" is not as obvious as it would be with red body tiles
- Body is soft and susceptible to impact damage. Glaze can chip as a result
- If rectified, can be fitted with smaller joint to provide a clean minimal appearance.
- Rectified tiles are more susceptible to damage before or during fixing, but less so after
- Smooth level walls and a skilled fixer are needed to fix rectified tiles as if they are not fixed level the tile may show signs of "lipping" at the edge.
- Generally available in larger wall tile sizes than red body tiles and are more expensive to produce due to the costs of the raw materials used to create the smooth white biscuit

C. Characteristics of Glazed Porcelain Tiles

- Porcelain body with a glazed surface
- Body is durable and less subject to impact damage as the body is fired to temperatures in excess of 1200 degrees centigrade which make the tile almost impervious to water and gives the body greater strength
- The glaze is still subject to wear and tear according to the PEI ratings unlike full or through body porcelain tiles which are unglazed, highly durable, frost, scratch and stain resistant.

D. Characteristics of Unglazed Tiles - Generally Floor

- Examples of these are quarry and clinker tiles, e.g. Sierra Gres, Gres De Aragon
- These tiles are generally used outside due to their more anti-slip properties
- These tiles can be pressed, like porcelain tiles, or extruded, like quarry tiles
- Generally more rustic and traditional in appearance

E. Quartz and other Resin Based Tiles

Marble and granite are used to manufacture blocks, which comprise a mix of 95% selected and dried raw materials and 5% polyester resins (this will vary depending on the manufacturer, some manufacturers use a higher percentage of resin, which can affect the performance of the floor tiles. A higher percentage of resin will increase the coefficient of thermal expansion and reduce abrasion resistance. These materials are then vibro-compressed under vacuum and allowed to stand while the resin generates heat to set.

Resin agglomerated tiles may show varying degrees of moisture sensitivity and this characteristic is exhibited by curling caused by differential expansion. Therefore, resin agglomerated tiles are not recommended for use in external areas or swimming pools or any other water retaining structures, e.g. spa baths or fountains. Resin agglomerated tiles can be used externally on facades by utilising mechanical fixing.

F. Characteristics of Porcelain Tiles

There are two types of porcelain tiles;

- **Through-body (Unglazed) Porcelain**

Through-body (also known as full body) porcelain is where the tile has no glaze so the colour and design are the same all the way through. So, if there was any wear or chips to the tile they would be very difficult to see. They are highly durable, frost, scratch and stain resistant, and can be used in almost any domestic or commercial installation on both floors and walls. While through-body porcelain tend to be blander in finish, recent updates in Ink-jet printing technology have resulted in much more decorative full-bodied porcelain tiles creating tiles that look amazing and perform better than virtually any other surface.

- **Glazed Porcelain**

Glazed porcelain is where the tile has been manufactured with a glaze applied to the tile face. In this case the body of the tile is just as hard wearing as a through body porcelain however the glaze has the same characteristics as the glaze on a ceramic tile. Please check suitability for use in different areas by referring to PEI and Slip-resistant Ratings as appropriate.

- **What are Coloured Body Porcelain Tiles**

Just to confuse matters a little some porcelain tiles have a glaze mixed with the body and therefore are classed as neither full body nor glazed!! These Coloured Body tiles are created with continuous coloured stains from the glaze surface throughout the body of the tile. Mixing the colour of both the glaze and body lessens the visibility of any impact chips which may occur. The colour remains consistent throughout the tile, but any surface design does not continue through the tile body.

Further Notes on Through (Full) Body Porcelain Tiles

- Are suitable for use in heavy traffic areas such as shopping malls, supermarkets, airports, train stations, leisure centres and swimming pools etc.
- Can be used outside, providing they are fixed according to manufacturer's instructions and slip-resistance ratings are taken into consideration.
- Are available in large formats; 750x750mm, 800x800mm, 900x900mm, 1000x1000mm, 1200x1200mm, 1200x600mm, 1800x800mm and even in large thin slabs, e.g. 3000x1000x6mm
- Can be produced to look like other materials including natural stone and wood, due to huge advances in decorating and digital technology
- The finish on the tile can be honed/natural, semi-polished, polished and even bush hammered to create a stone effect with anti-slip properties

Types of Porcelain Tile Finishes

Porcelain tiles are not only available in a large variety of shapes, size and colours, there are also many different finishes. When choosing tiles for your home it is important to consider the look and feel you are trying to achieve. Whether it's a shiny gloss look, matt natural look, a smooth velvety look or even a textured finish tile can represent an opportunity to stamp your personal style on a project.

- **Polished Porcelain Tiles**

After being fired porcelain tiles are polished by a machine to give a mirror like finish before being cut to square the edges of the tile. The shiny finish gives the tiles a rich high-end flawless appearance which is also extremely durable.

Polished porcelain tiles are very easy to clean, and if you ensure to use the correct product to prevent any water marks or streaks your floor will maintain its finish and shine. However, shiny tiles are very slippery when wet.

- **Semi Polished Tiles**

The semi polished finish on tiles is also referred to as "**Lappato**".

The tile is lightly polished, using the same process as polished porcelain, to create a velvety, silky finish with a reflective surface. It is recommended that ALL Semi Polished tiles being installed on a floor are treated with a protective impregnator immediately after installation. This is to fill the micropores created on the surface during manufacturing, prevent ingress of dirt and contaminants filling up the pores and make the tiles easier to clean during their lifetime of use.

- **Satin Porcelain Tiles**

During manufacture the tile is prefinished with a decorative glaze leaving a smooth, satin surface. This is slightly more slip resistant than the polished finish but does need more maintenance. Occasionally marks from grinding may be visible.

- **Matt Porcelain Tiles**

Matt finish tiles are also known as "unpolished". They are incredibly stylish and on trend today, especially in concrete effect and jura limestone finishes. During the manufacturing process the tile comes out of the fire kiln in its natural form and no further treatment or processing is required.

- **Structured Porcelain**

The surface of the matt tile is pressed to create a rough texture or structured finish that can provide more slip resistance. The slip resistance of a tiled floor finish is the most important safety consideration particularly for older, mobility impaired and visually impaired people. Effective and suitable slip resistant characteristics are also important on commercial projects to reduce the likelihood of slipping. The only downside is that structured tiles can be more difficult to keep clean.

2. Technical Terms & Explanations in Tile Production

A. Tile Batches

Tiles are made in batch runs which are usually in excess of 3,000m²; and could be up to 10,000m² or more. Tiles change in both size (known as calibration) and shade (also known as tone) between batches (and sometimes even within a single batch run). These are sorted at the point of manufacture and 'batched' by both shade and size. Batch numbers are generally indicated on the outside of each tile box for easy reference.

It is important to ensure that all tiles are from the same batch when ordering; and should be checked **BEFORE FIXING**.

- **NO CLAIMS FOR SHADING OR SIZING ISSUES CAN BE ACCEPTED AFTER FIXING.**

Therefore, it is important to ensure that your customer orders sufficient tiles to fully complete their tiling project. You must take wastage into account, for cutting/breakages, when fitting. If you don't order enough tiles to complete the project, the next batch of tiles may be a different shade or size and this will lead to issues with aesthetics for your customer.

B. Tile Calibration

All tiles are "calibrated" to the same batch 'size' (within a certain tolerance)

These batches are identified by Calibre and Shade numbers

Every batch of tiles can be slightly different (both in calibration and shade). If a customer needs additional tiles it is important to ensure that tiles with the batch details are provided.

- It is important to ensure that all tiles are the same calibration (size) for the complete project **BEFORE FIXING**

C. Tile Shading

Tiles often change shade (tone) between batches (and sometimes even within a single batch run). This can be slight but still visible when two tiles of different batches are positioned beside each other. Therefore, it is important to ensure that your customer orders sufficient tiles with the same batch details to fully complete their tiling project

D. Tile Sizes - Nominal V's Actual Sizes

There can be several "calibrations" (actual sizes) within a nominal size. For example the nominal size of a tile could be 600x600mm, but the actual size could be;

- 600x600mm or
- 599x599mm or
- 598x598mm or
- 595x595mm etc

It is important to ensure that all tiles are the same actual size (rather than nominal size) **BEFORE FIXING**

E. Rectified Tiles

This is where tile edges have been cut during manufacture to give a right angle edge to the tile. All tiles, from one batch, when rectified will be the same size; making them easier to fix, provide a more minimal look and a slicker finish.

F. PEI Ratings

The Porcelain Enamel Institute (PEI) came up with a testing system to rate the strength glazes that are applied to the tile surface in relation to scratching and wearing. The 'PEI' Rating system uses numbers 1-5 rate the strength of the glaze on the tile with 1 being the least scratch and wear resistant and 5 being the most scratch and wear resistant.

The test is performed by placing a carbide wheel to the surface of the tile, with weights on the top of the wheel to keep even pressure during testing. The carbide wheel is then turned in a circular motion over the tile, and depending on how many revolutions it takes to penetrate the glaze of the tile is the number rating it receives. For example, for a tile to receive the highest rating, which is a PEI RATING of 5, the glaze will have to withstand over 10,000 revolutions on the machine!

The following PEI RATING GUIDE will help you choose the right tile for your particular project;

- **PEI Class 0** - No foot traffic (wall tile only)
- **PEI Class I** - Ceramic tile suggested for residential and commercial wall applications only.
- **PEI Class II** - Ceramic tile suggested for interior residential and commercial wall applications and for residential bathroom floor applications only.
- **PEI Class III** - Ceramic tile suggested for residential floors, light to moderate traffic areas only, e.g. bathrooms, halls, living rooms and wall applications.
- **PEI Class IV** - Ceramic tile suggested for residential floors, moderate to heavy traffic areas, e.g. bathrooms, halls, kitchens, conservatories and wall applications
- **PEI Class V** - Ceramic tile suggested for all residential floors, medium commercial floors and wall applications.

Most ceramic floor tiles will carry a PEI rating from 0 to 4 with porcelain tiles ranging from PEI 3 to 5.

• Do Polished Porcelain Tiles Need to be Sealed?

Polished Porcelain is just another type of glazed porcelain tile, but following the firing process the surface of the glaze is grinded with large stones to create the high gloss shine. Please note that this creates micropores in the tile surface. These are not visible to the naked eye, but the tile may become more susceptible to liquids entering these micro-pores and causing what appears to be "staining" on the surface of the tile. This is why it is advisable to "seal" polished/honed/lapatto/semi-polished porcelain tiles. (See notes on both "Nano Sealing" and "Optical Hazing.")

G. Polished Porcelain – Soluble Salt Manufacturing

It is called Soluble Salt Technology because soluble salt is used for giving the tile a particular pattern and colour. It is an older and cheaper technology. In this process, the yet unfired tile body is given a liquid colour screen-printing to create the design on the tile. With this technology 2 – 2.7 mm print is penetrated into the tile. Once the tiles have been fired and polished in order to create a glossy surface, approximately 0.7 mm of the soluble print will have been shaved off, leaving a total print penetration of only 1 to 2 mm

H. Polished Porcelain – Double Loaded

Modern 'Double Loaded' polished porcelain is manufactured with two layers of porcelain pressed together and then fired. The top layer is pressed to the base porcelain layer under high pressure. This top layer is comprised of porcelain clays randomly infused with various color pigments that create an infinite range of color combinations and patterns emulating that of natural stones. This bonded porcelain is then fired.

I. Nano Sealing

More often than not polished porcelain tiles are pre-sealed or 'NANO-SEALED' prior to leaving the factory. For example RAK Lounge polished tiles are NANO-SEALED, so do not require any further sealing. However, some manufacturers still do not seal polished tiles, so it is vital that this is pointed out to customers and the appropriate sealing product and advice is provided.

J. Optical Hazing

Optical hazing is an inherent feature in polished porcelain tiles, even though its degree and extent can vary between tile manufacturers and between colours. It will present as a smoky, hazy, smudgy type of finish in the surface of polished porcelain tiles. It will only be visible when a direct light source reflects at a certain angle across the surface of the tile and is primarily an aesthetic issue. Polished porcelain tiles are not mirrors and therefore a mirror like finish should not be expected from a polished porcelain tile.

The amount of hazing visible depends on several factors:

1. Number of light sources i.e. a single source of light would limit the number of positions available to observe any haze. The same surface when lit by a number of light sources will increase the amount of haze visible as there are more opportunities to see the reflected light
2. Bulk sunlight shining through large windows and doors will increase the amount of haze visible
3. The size of clay particles and other ingredients of the tile can also have an effect on the amount of haze visible

K. Screen-printing

The surface glaze of the tile is 'screen-printed' with a repeat pattern. As a result every tile has the same pattern on the surface. This method of tile production has become almost obsolete and is now more associated with budget tile ranges.

L. Rotor Or Roto-screen Printing

This technology was introduced after repeat screen-printing whereby the pattern was applied to the tiles by means of a larger rotor screen-printer drum system which allowed for more varied patterns to be applied to the tile.

M. Digital Printing

The newest digital technologies allow tiles to be printed with a huge amount of difference in patterns from tile to tile. In fact rotor-screening is sometimes combined with digital printing to provide for more depth of colour and random patterns on the finished tiles. This allows manufacturers to create tiles that are almost indistinguishable from natural marbles, stones and wood.

N. Fast Track Screeds

Many projects demand fast turnarounds. From commercial projects where closures and downtime must be minimised, to the domestic sector where homeowners simply want their builds completed as quickly as possible. However, traditional sand and cement based screeds require months of drying before the final floorcoverings can be installed, delaying the completion of the entire project.

Although calcium sulphate screeds (Also known as Flow Screeds, Anhydrite and Semi Hydrite Screeds) are sometimes sold and applied as a fast track option, their drying times are in fact similar to traditional sand/cement screeds: typically 1mm per day up to a thickness of 40mm, and then an additional two days per mm over this. Please note: These Calcium Based Screeds are Fast Installation Products, NOT Fast Drying and sample drying times in ideal conditions are:

- 40mm screed thickness – 40 days
- 50mm screed thickness – 60 days
- 60mm screed thickness – 80 days

Where a fast turnaround is required please consider products such as Mapei's Topcem Product. Finished floor surfaces can be laid directly on this screed in the following timescales:

- 24-48 hours for ceramic tiles
- 3 days for stone material
- 7 days for resilient and wooden floors

O. Movement Joints/ Expansion Joints

Movement joints must be installed in certain areas and positions to prevent tiles or grout from cracking. In some cases they are required to prevent the tiles from tenting (pushing up into a peak) and becoming debonded from the substrate.

A movement joint is a profile fitted between the tiles as the interruption of the surface to allow for movement. Common terms are:

- Movement joint
- Expansion joint
- Stress relieving joint

They are needed because all tiles expand and contract (even minutely) with temperature and moisture changes. In almost every case the substrate will also move but at a different rate to the covering material. The larger the tiled area, the more it will expand and contract, and be vulnerable to failure. Movement/expansion joints must therefore be incorporated in tiled floors under certain conditions at between 5 to 10m intervals depending on project conditions to 'de-stress' the tiled surface. Doorways are also vulnerable areas. Please refer to **British Standard: BS 5385 Parts 1 to 5 inclusive**.

A useful contact for information on the proper use of expansion joints is: www.schluter.co.uk

P. Uncoupling Membranes

The use of a decoupling, debonding or most known uncoupling membrane has become more common in recent years. This is due to multiple problems often encountered in substrates, when tiling a floor.

There many different types of these often plastic membranes that are manufactured in 1m wide roles approx. 3mm thick. Uncoupling membranes are recommended to be applied to problematic substrates prior to the installation of tiled floors where movement and cracking are a highly likely. Such problematic floors include wooden floors in upstairs bathrooms or previously repaired floors. Uncoupling membranes eliminate the major cause of cracking and delaminating of tiled surfaces by effectively neutralizing lateral movement stresses between the substrate and the tile.

It is very important to follow the membrane manufacturer's directions and information can be found at www.schluter.co.uk or www.mapei.co.uk

Q. Tanking Systems

Waterproofing Tanking Kits, such as Mapei WPS, are now considered an essential requirement for bathroom tiling to offer customers peace of mind for all shower and bath installations. The 'Tanking System' is applied to the Wall, Floor and Joints and effectively stop water ingress to the substrate, preventing leaks and damage caused by damp.

It is very important to follow the manufacturer's directions and information can be found at www.mapei.co.uk or www.schluter.co.uk

3. Features & Benefits of Tiles

Ceramic Tiles V's Porcelain Tiles

- Porcelain tiles are fired to higher temperatures than ceramic tiles (1200C +) and as a result, become almost impervious to water penetration. This means that porcelain tiles are extremely durable, stain, scratch and impact resistant and can be used in high traffic commercial areas
- Ceramic tiles can be cheaper to purchase but are more susceptible to chipping, breakages and general wear and tear over time
- Porcelain tiles are made in larger formats than ceramic, e.g. 600x600mm, 750x750mm, 800x800mm, 1200x600mm, 1000x1000mm, 1200x1200mm, 3000x1000mm etc
- New technologies have allowed porcelain tiles to appear like natural stones, woods and marbles. However, porcelain tiles have more technical advantages than the materials that they imitate. For example, stone, marble and wood can stain and scratch more easily than porcelain
- Porcelain tiles are more suitable than ceramics for use in high traffic commercial areas
- Porcelain tiles can be suitable for use outdoors (check with supplier first) as they are generally frost resistant. Ceramic tiles (generally) should not be used outdoors as they are not frost resistant
- Porcelain tiles come in many different sizes and finishes and some of these finishes are suitable for use in areas that require anti-slip flooring.

Ceramic Vs Porcelain

Ceramic: How it's made

Ceramic tiles are made from a clay biscuit that is baked to reduce the water content.

01

02

Price

Ceramic tiles are generally cheaper

Uses

Ceramic is less durable and recommended for domestic walls and floors only.

03

04

Design & Form

Ceramic tiles tend to be smaller sizes with a plainer matt or glass finish.

Porcelain: How it's made

Manufactured using a combination of clay and fine sand for a denser product.

01

02

Price

The better quality is reflected in a higher price.

Uses

Suitable for heavier traffic areas in both domestic and commercial applications.

03

04

Design & Form

Available in larger decorative sizes in matt, polished, satin and structured finishes.

4. Sources of Technical Information

Schlüter-Systems

Technical Information on; Expansion Joints, Step-threads, Metal Trims, Un-coupling Membranes, Tanking Systems etc

Head Office

Units 4-5 Bardon
22 Industrial Estate
Beveridge Lane
Coalville
Leicestershire
LE67 1TE

Area Sales Consultant

James Callinan
Mob: 00 353 858144242
Email: james.callinan@schluter.co.uk

Head Office Contact Details

Tel: 01530 813396
Fax: 01530 813376
Web: www.schluter.co.uk

Mapei

Technical Information on; Adhesive, Grouts, Silicone, Fast Track Screed, Un-coupling Membranes, Tanking System, Concrete Repair etc

Head Office

Mapei House
Steel Park Road
Halesowen
West Midlands
B62 8HD

Area Sales Consultant

Stephen Martin
Mob: 0044 7974 268387
Email: s.martin@mapei.co.uk

Head Office Contact Details

Tel: 0044 121-5086970
Fax: 0044 121-5086960
Web: www.mapei.co.uk

Fila Surface Solutions

Technical Information on; Cleaning and Maintenance Products

Head Office

Fila Surface Care Products Ltd
Third Floor East
12 Bridewell Place
London
EC4V 6AP

Area Sales Consultant

Mark Ruthven
Mob: 0044 7733895036
Email: mark.c.ruthven@filasolutions.com

Head Office Contact Details

Tel: 01584.877286
Web: www.filasolutions.com

General Tile Enquiries - Armatile

Technical Information on; Tiles, Uses, Suitability, Finishes, etc

Head Office

Armatile
Station Road Industrial Estate
Loughgall Road
Armagh
BT61 7NP

Tel: 0044 28 37527007
Email: wholesale@armatile.com
Web: www.armatile.com

Other Useful Contacts

The Tile Association:
The Health & Safety Executive:

www.tiles.org.uk
www.hseni.gov.uk

5. Slip Ratings and Values of Tiles

Information on the Slip Resistance of Tiles

The slip resistance of a tiled floor finish is the most important safety consideration. Effective and suitable slip resistant characteristics will reduce the likelihood of slipping, particularly for older, mobility impaired and visually impaired people.

Slip resistant floor tile finishes are recommended for use in areas where safety is a paramount factor such as entrances, ramps, stairs and landings, escape routes, commercial kitchen areas, areas adjacent to hazardous machinery and areas subject to frequent wetting ie shower floors, swimming pool surrounds. Please note this is not an exhaustive list.

There are no mandatory requirements for slip resistant tiles written into UK legislation. There are more guidelines than recommendations, and these concentrate on the application of tiles in commercial/work related environments rather than domestic installations. The law does require flooring surfaces to be safe for use and fit for purpose, but does not specify exactly what should be used on each area. Therefore employers, suppliers, specifiers & manufacturers all have a responsibility to the end user to ensure the proper product is installed.

Aim of this presentation...

To enable you to make informed decisions when specifying tiles for projects, and to have easily accessible & practical sources of information at hand when required. There exists a wide range of instruments and apparatus, which are designed for measuring static or dynamic coefficient of friction, slip resistance, or surface roughness etc. Values obtained from various test methods do not correlate with one another. It is therefore important to choose the right test for the specific application of tiles where required.

Factors on the slip resistance of tiles

Slip resistance of a floor tile depends upon many factors:

- The roughness of the tile surface
- Whether it is wet or dry when in use
- Whether the floor finish is regularly contaminated by liquids or other contaminants such as oil, soaps etc
- Proper implementation of a suitable cleaning and maintenance schedule
- The wear characteristics of the floor finish

In addition to the above there are a number of other factors that can affect the slip resistance and performance characteristics of a tiled floor finish, these include:-

- Humidity
- Slopes and ramps
- Change of surface textures, eg from a rough tile to a smooth tile
- Type of footwear worn
- Visual or acoustic distractions
- Lighting and glare

Where there is a change of floor texture there is an increased risk of slipping or tripping if the roughness of the two materials varies greatly. This can be minimised by locating the finish changes at predictable locations such as at doorways or wall openings.

There are Various Slip Resistance Test Methods

Slip Resistance Tests provide important information about a tile and its suitability to be used in different environments. This is particularly important information when recommending a tile to be used on the floors of commercial, leisure and hospitality projects.

Please note that not all tiles are tested for slip resistance, and therefore will not have a slip resistant value or reading.

1. The Pendulum Test Method

The Pendulum Test determines the dynamic friction between the tile surface and the rubber slider on the end of a swinging pendulum. It is designed to replicate a pedestrian heel strike, the point at which most slips occur. Working in wet conditions because it generates a similar fluid film between the slider and the floor. It can be used to accurately test the slip potential on both clean and dry or contaminated floors.

The Slip Resistance Value (SRV) produced by the pendulum test is sometimes called the Co-Efficiency of Friction (CoF), and the measurement from the Pendulum Test can be expressed as either SRV, PTV or Co-Efficiency of Friction on data sheets from tile suppliers with the following values (UKSRG 2011);

Slip Resistance Values (SRV's)

- 0-24 - Higher Potential for Slipping (>1in20 in wet/contaminated conditions)
- 25-35 - Moderate Potential for Slipping
- 36+ - Low Potential for Slipping (<1in1,000,000)

Watch Video of Pendulum Testing

<https://ukslipresistance.org.uk/how-to-use-a-pendulum/>

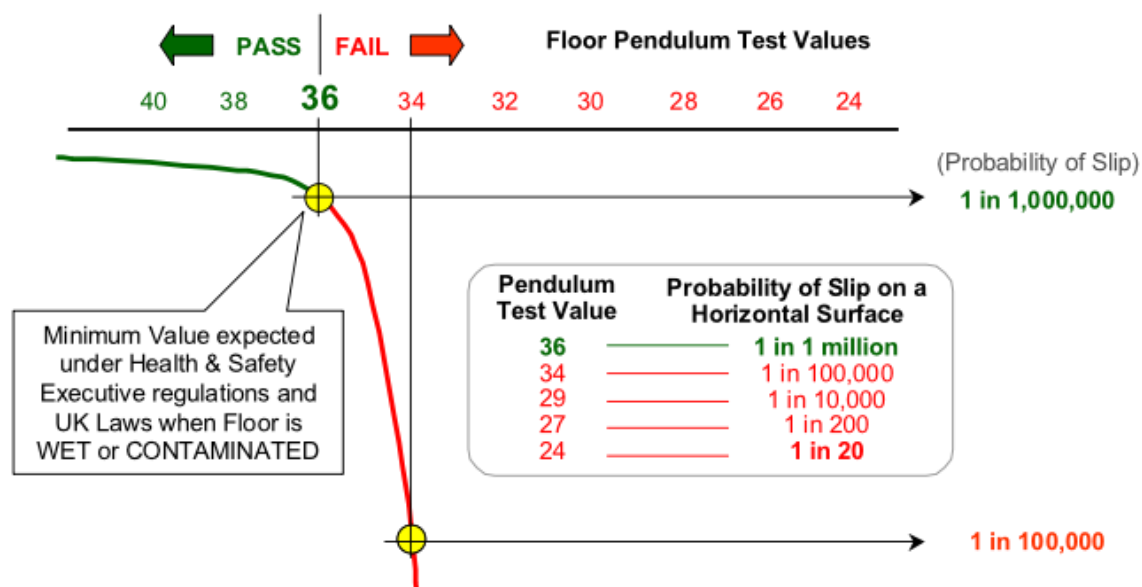


The Pendulum Test is The Health & Safety Executive's (HSE) preferred method of testing, because it is portable and works in the conditions that slip accidents happen.

(http://www.hse.gov.uk/SLIPS/step/general/advanced/8E7F777B-3B84-49FE-A3D6-D0324E25A801/HSLCourseTemplate/28531/slidetype1_280757.htm)

Pendulum Test Equipment

For commercial projects where the surface is often wet or contaminated (eg a butchery) **The Health & Safety Executive (HSE) recommend that tiles used in such meet 36+ when tested in wet and contaminated conditions.**



Advantages of The Pendulum Test

- Apparatus is portable and can be used on/off site
- Does not tend to overestimate slip-resistance in the wet, unlike Tortus
- Preferred method of testing by HSE

Disadvantages of The Pendulum Test

- Caution should be used when using results for barefoot applications or heavily textured surfaces
- Boundary levels between one value and another are not significant in themselves. For example there is no major difference between a tile with SRV of 24 or one with an SRV 26, even though one is classified as high potential for slipping and the other is classified in the moderate category

The Ramp Test Methods









There are **TWO** recognised types of Ramp Test;

- DIN 51100
Shoe Shod Ramp Test that produces '**R**' Values for commercial areas with shoe wearing clientele
- DIN 50197
Barefoot Ramp Test that produces '**ABC**' Values for commercial areas with bare foot clientele

Watch the Ramp Tests taking place:

<https://www.youtube.com/watch?v=P1YjzrWHQVw>

The Health and Safety Executive (HSE) also recognises using floor surfaces that meet floor slip '**R Ratings**' for environments where shod feet are found; and '**A,B,C Ratings**' for wet floor conditions where bare feet are the norm (such as swimming pools, changing facilities, shower areas etc).

RAMP TESTS	DIN51130 Shod Foot					DIN51097 Bare Foot		
Degree of Ramp	≥6°-10°	≥10°-19°	≥19°-27°	≥27°-35°	≥35°	≥12°	≥18°	≥35°
Test Result	R9	R10	R11	R12	R13	A	B	C
								

Shoe Shod Ramp Test (German National Test Method DIN 51130)

The test operator is shod with rubber soled boots. The test ramp has a lubricant applied to the surface, usually the lubricant is engine oil.

In the dry conditions most, but by no means all, shoe sole/heel materials give good values of friction on most flooring surfaces.

The Shoe Shod Ramp Test results are quoted as "R" values. These relate to the angle of the ramp at point of slipping as follows;

- R-9 = 6 Degrees-9 Degrees
- R-10 = 10 Degrees-18 Degrees
- R-11 = 19 Degrees-26 Degrees
- R-12 = 26 Degrees-34 Degrees
- R-13 = 35+ Degrees

Note: There is no test value below R-9



The Ramp Test Equipment
DIN 51130 Shod Foot

Barefoot Ramp Test (German National Test Method DIN 51097)

The test operator is barefoot and the lubricant applied to the test ramp is a soap solution.

The Barefoot Ramp Test results are quoted as a letter rating - A, B or C which relates to the ramp angle as follows;

- A = 12 Degrees-17 Degrees
- B = 18 Degrees-23 Degrees
- C = 24+ Degrees

Traditionally the A-B-C Ratings were often taken into account when planning a specification for swimming pool decks, wet changing areas, showers etc. Please see table of recommendations for use of ABC Rated Tiles in specific areas.



The Ramp Test Equipment
DIN 51130 Bare Foot

Ramp Test Recommendations for use of A-B-C Rated Tiles in Barefoot Tiled Areas

Category	Lower Limit	Upper Limit	Area
A	12°	18°	<ul style="list-style-type: none">•barefoot hallways (mainly dry).•individual and group changing rooms with lockers.•pool floor in the non-swimmer areas, where the water level exceeds 80 cm.
B	>18°	24°	<ul style="list-style-type: none">•barefoot hallways, if not classified in A .•showers.•area surrounding the disinfectant sprayers.•pool surrounds.•pool floor in the non-swimmer areas where the water level is less than 80 cm in parts.•pool floor in the non-swimmer areas in the tide effect pool.•lift slab floors.•paddling pools.•steps leading into the water.•steps, of maximum 1 m width with hand rails, leading into the water.•steps outside of the pool area.
C	>24°		<ul style="list-style-type: none">•steps leading into the water, if not classified in B.•foot baths.•inclined pool borders.

Advantages of Ramp Tests

- Barefoot test commonly regarded as the most useful guide to barefoot slip resistance in the wet
- The shod test is regarded as useful for assessing slip resistance of profiled tiles, or tiles to be used in areas where there is a high risk of contamination
- DIN Standards incorporated into insurance requirements of the German National Accident Insurance Board.

Disadvantages of Ramp Tests

- Apparatus is not portable and cannot be used on site
- Only useful for determining “factory gate” values
- R-9 is a broad category. Therefore ratings not very useful for specifying tiles where lower levels of slip resistance required

Changing Emphasis of Slip Test Results for Tiles in Commercial Applications

Please note that while the 'R' and 'ABC' rating systems have generally been used to assess product suitability in the UK & Ireland.

According to HSE, this is changing dramatically as it is increasingly recommending the Pendulum Test as its preferred test method (HSE 2015);

"The pendulum is the preferred method of test of the UK government for assessing floor surface slipperiness in the workplace throughout Great Britain."

Important Notice

There is No Correlation in results between different methods

- Flooring manufacturers use a range of tests.
- Different tests can produce different results. Each test is independent and should be assessed in each individual case taking consideration of situations, users, conditions and potential for slipping.
- Each test method relates to a specific use – shod foot or barefoot area
- HSE recommends use of Pendulum Test Values



Test Method				
DIN 51130	R9	R10	R11	R12
DIN 51097	A	A + B	A + B + C	A + B + C
PENDULUM BS 7976-2:2002	Moderate slip potential	Low slip potential	Low slip potential	Low slip potential
UNI ENV 12633:2006	Class 1	Class 2	Class 3	Class 3

Cleaning and Maintenance of Slip Resistant Tiles

An effective cleaning & maintenance regime is vital to sustain the slip resistance value of tiles during their lifetime. The slip rating of a tile will change following installation due to contaminants on the tiles.

Slip resistance of tiles can reduce by up to 10%-50% in the first 3 months from installation unless the proper Care & Maintenance Regime is provided and carried out efficiently (RIBA).



The lack of a proper initial clean with a recommended acid based cleaner can leave a invisible grout haze. This hazing will create a staining effect (even when water is dripped on to the floor), reduce the slip resistance of the surface and make the tiles harder to keep clean.

Regular cleaning and maintenance must be undertaken, so the slip resistance value of the tile remains over the life of the tile

Slip resistant tiles are not more difficult to clean, however due to their rougher surface they are more difficult to keep clean. Therefore a good maintenance regime is important as the following factors can affect slip resistance of the tile;

- Residues on Surface of Tile, including Grout
- Build-up of Body Fat in Barefoot Situations
- Build-up of Residues from Cleaning Materials
- Exposure to Chemicals which May Etch Surface
- Application of Cleaners, Sealers, Impregnators or Waxes...
- Wear & Tear of Surface
- General Dirt/Soiling

To help improve the effectiveness of the slip resistant tiles the following recommendations should be followed as effective maintenance prevents slips:

- An Initial Builders Clean Prior to Handover Must be thorough and Effective
- Ensure Adequate Barrier Matting in Place to Remove Water/dirt from Feet at Entrances/Exits
- Isolate & Remove Contaminants/Spills As and when they Occur
- Employ an Effective Daily Cleaning Regime, using Professional Cleaning Products and Method Statements
- Ensure Staff are trained to Use Correct Cleaning Products (and Machinery if Applicable)

Summary

The law requires flooring surfaces to be safe but does not specify what should be used. Employers, Manufacturers, Suppliers & Specifiers all have a responsibility to ensure the correct product is supplied to the end user. Government guidelines focus the application of tiles in commercial/work related environments rather than domestic applications.

There are numerous test methods available and slip resistance test results need to be interpreted with care. While R Ratings and ABC Ratings are widely recognised and accepted slip resistance results, the Pendulum Test is the preferred method of test of the UK government for assessing floor surface slipperiness in the workplace (UK Health & Safety Executive (HSE)). HSE recommends that you specify floorings with an 'in situ' Coefficient of Friction (CoF) pendulum test value (PTV) of 36+ in wet or contaminated conditions.

An appropriate cleaning & maintenance regime is essential in preventing slips and trips as sustainability of slip resistance is vital during the lifetime of the tile.

Technical Advice

If you have any questions or queries please
do not hesitate to contact our friendly and knowledgeable team.

Armatile
Station Road Industrial Estate
Loughgall Road
Armagh
BT61 7NP

028 37527007 (Head Office)
028 37521060 (Wholesale Dept)
0207 1111 613 (London Office)

design@armatile.com
www.armatile.com

