# Nelson Lindsay Agencies

# CERAMIC TILES
# SLIP, SLIP RESISTANCE. ITS SPECIFICATION AND MAINTENANCE

These seminar notes accompany the CPD presentation and will confirm the principal points of the subject matter, provide additional diagrams, information, technical references and recommendations for further reading.

Contact details are provided to request further information, assistance with specifications and sample products.

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## BACKGROUND

Every floor finishing specifier wants to create a floor that is fit for its purpose; attractive and safe in use and that will provide sufficient resistance to slipping as dictated by its application. Indeed this is a primary criterion in the EU Construction Products Directive.

It may be a surprise to learn then, strangely that there is no agreed pan-European standard or harmonised Code of Practice currently existing that specifies minimum slip resistance or how slip resistance should be measured or specified. That is until you understand the complexities of defining and measuring a property as subjective as slipperiness. Indeed the flooring industry has spent close on 30 years discussing this issue and has still failed to agree to a single common approach to either the method of testing or acceptable values. There are, however, a number of national standards and recommended guidelines in use within the EU.

## THE COMPLEXITY OF SLIP AND ITS MEASUREMENT

The nature of slipping and the perception of slipperiness are very subjective and also dependent on the interaction of a large number of variables that may, individually or in combination effect this perception. That is, apart from the individuals own perceptions, slip resistance is likely to be effected by the wetness of the floor, whether it is clean or contaminated, the type of contamination, the speed of travel, whether ascending or descending, whether the feet are bare or shod, if shod the type of footwear, the heel and sole material, etc. etc. etc. All of which combine to make for quite a headache when designing suitable test methods or agreeing what is considered to be “safe” and what is not “safe”.

A number of test methods have been developed over the years by various national testing organisations. In the UK these centre around measuring the coefficient of Friction or an equivalent figure using a Tortus or Pendulum while Continental Europe largely favours the very pragmatic figures provided by the German DIN Ramp Test. The USA uses a different concept again with a measure of the Static Coefficient of Friction.
Within Ireland in practice we use both the UK and Continental Europe approaches. Health and Safety executives and accident investigators copy the UK in favouring the Pendulum test which can be carried out in situ on a floor. Construction Industry Professionals and Specifiers favour the German DIN Standards firstly because figures for these are generally provided by manufacturer’s of flooring materials and secondly because the DIN standards give clear recommendations on what the rating should be for different types of application.

The Pendulum test has the great advantage that the measuring apparatus is portable and so can be used for in situ tests when an accident has occurred. It can also be used in the same way in wet and dry situations. It’s disadvantages are that it does not work very well on profiled surfaces, there are no use specific recommendations for the figures it produces and it is not used by the majority of floor material manufacturers, most of whom are sited overseas and focused on much larger markets than Ireland.
The Pendulum Test involves measuring the resistance to a swinging arm when it strikes the floor. The figure obtained can be directly related to Coefficient of Friction.

It is suggested that as far as slip resistance is concerned, Pendulum readings of:

Less than or equal to 24 are Unsatisfactory
25 to 39 are Marginal
40 to 64 are Satisfactory
65 and over are Very Good

Current recommendations are that a safe floor should provide a minimum reading of 40 wet or dry.

It has also been found that surface roughness, Rz, measured in micrometres can be related to a pendulum test, e.g 4 micrometres will give a Pendulum reading of about 20. A floor with a surface roughness of 20 micrometres is generally considered to give a good degree of slip resistance.

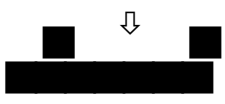
The German DIN Ramp Test has emerged as the one favoured by most European manufacturers. It's chief disadvantage is that it is a laboratory method. It classifies floors by reference to the inclination of the ramp at which a user could safely travel across the floor i.e. the steeper the ramp angle the greater the slip resistance of the floor. This has led to a classification of slip resistance of ceramic tiles using the "R" system as shown below.

Table1 DIN R Values for Specifying Slip Resistance

| Slip Resistance Classification | Ramp Inclination | Typical Applications |
|---|---|---|
| **R9** | $< 9^o$ | Low risk internal applications, customer reception areas |
| **R10** | $10^o$ to $19^o$ | Toilet and bathroom areas, self-service cafeterias |
| **R11** | $20^o$ to $27^o$ | Cold stores, dish washing areas |
| **R12** | $28^o$ to $35^o$ | Liquid spillage areas, large commercial kitchens |
| **R13** | Over $35^o$ | High risk of slip, oil spillage or similar present |

Floor coverings such as e.g. Ceramic tiles offer surfaces in a range of finishes that include textured finishes, abrasive inclusions and various surface relief profiles. Each is specifically designed to maximise slip resistant properties under specific conditions. The two biggest factors influencing the choice of slip-resistant tile for each application are the likely wetness of the floor and the type of foot traffic using the floor (i.e. barefoot or shod).
Applications involving wet floors will require tiles with a surface finish that will improve drainage performance and so improve overall slip resistance. The drainage ability of such tiles will also be classed by their underfoot liquid drainage cavity volume and denoted by the letter "V" followed by a number for the volume ($cm^3/dm^)$ ).

Table 2 DIN V Values for Specifying Surface Drainage Capacity

| Min drainage cavity volume |  |  |  |  |
|---|---|---|---|---|
| $Cm^3/dm^2$ | 4 | 6 | 8 | 10 |

| | | | | |
|---|---|---|---|---|
| Slip Resistance Class | **V4** | **V6** | **V8** | **V10** |

EXAMPLES OF USES/ APPLICATIONS ACCORDING TO ANTI-SLIP CLASSIFICATION

| Specification | Indication of general application | Examples | Tile Finish |
|---|---|---|---|
| R9V.<br>R10V. | General internal applications | Reception Areas<br>Toilet facilities | Plain/ Mat |
| R10V.<br>R11 V.<br>R11V4 | Low risk (level/ low speed) outdoor floors, Medium risk internal applications (water spillage) | Food Service Areas<br>Factory floors<br>Dish Washing Areas | Plain/ Mat<br>Lightly Riven<br>Big Stud |
| R11V6<br>R12V.<br>R12V4 - 6<br>R12V8 | Applications where slip risk is high<br>(e.g. floor contamination, speed, water present, other activities being conducted on floor) | Food preparation (wet)<br>Industrial process areas<br>Commercial kitchens<br>Meat processing | Small Studs<br>Rock textured tile<br>Raised Surface profiles |
| R13V10 | Applications with very high slip risk | Fish Processing<br>Tanning works<br>Abattoir s | Grit inclusion/ Texture + raised surface profile |

BAREFOOT APPLICATIONS

The German standards also include floor classes for barefoot applications, such as swimming pools, showers, changing rooms etc. These are designated into three classes (A, B, C) in increasing order of the severity of the likely slip hazard (based on the amount of standing water and consequent risk of slipping). The actual test is conducted using a continuous stream of water running down the ramp.

| Class | Minimum angle | Typical applications | Tile finish |
|---|---|---|---|
| A | $2^o$ | Bare foot traffic (mainly dry areas) such as common changing rooms, wading pools (water more than 80 cm) | Plain |
| B | $18^o$ | Barefoot traffic (wet areas) such as showers, pool surrounds, stairways and steps to water (max width 1m with handrails to both sides) wading pools (water depth less than 80 cm) | Textured or riven |

| | | | |
|---|---|---|---|
| C | $24^{o}$ | Pool entry stairways, footbaths, pool surrounds sloped pool surrounds | Studded or raised profile |

SUMMARY OF PROCEDURE WHEN SELECTING SLIP RESISTANT CERAMIC TILES

When considering the suitability of a ceramic tile for use in a particular application, it is essential to consider how the floor will be used and to assess the potential hazards that the application is likely to impose. The type of questions that need to be asked when making this assessment are illustrated below;

**1. What will the floor be used for ?**

- ? Consider the environmental factors (external/ internal/, likelihood of getting wet)
- ? Consider the activities (working environment, walk through area, stopping/ turning/ running area, etc.
- ? Consider the application (will it be wet, greasy, dusty, subject to spillage or other contamination, type of traffic (shod/ barefoot), etc.)
- ? Consider the users (young, elderly, disabled, etc.)

**2. Do these considerations indicate the need for additional slip resistance ?**

- ? What are the potential hazards (standing water, walk in wetness, change of texture (rough to smooth), industrial contamination, barefoot areas, etc.)

**3. If Yes, is the potential for slipping considered to be moderate or severe** ?

**4. Is the consequence of slipping likely to be moderate or severe?**

For example: slipping in a supermarket may cause bruising or broken bones. Slipping on a railway platform may be fatal.

**5. Does the application have any additional criteria that need to be considered ?**

- ? Barefoot/ shod area
- ? The need for easy cleaning/ disinfecting (e.g. food preparation areas)
- ? The ability to resist abrasion/ impact loads (e.g. industrial areas, loading bays, etc.)

**6. Are there any applicable guidelines that can be applied ?**

**7. Will the tile manufacturer verify the tile's suitability ?**

**8. Document the assessment and any warranties provided.**

CLEANING AND MAINTENANCE

Once fixed, the single largest influence that is likely to effect the slip resistance performance of ceramic tiles (and any other flooring finish) is that of cleaning. Ceramic tiles are very easy to clean and maintain, but it is important that an effective cleaning regime is established for each area.

The type of dirt/ contamination that the floor is exposed to will influence the cleaning regime and its frequency. In most domestic and commercial applications a daily procedure involves the removal of any gross debris by sweeping/ vacuuming followed by washing with a neutral low sulphate detergent in warm water. This cleaning solution may be applied by mopping or scrubbing machine and allowed to act on the tile surface for 5 to 15 minutes before it is rinsed off. It is essential that the cleaning solution is completely removed from the floor by rinsing.

Depending on the application, a disinfecting process may also be required to prevent bacterial contamination. Again the type of disinfectant will be determined by the application and substances exposed. If the application requires absolute cleanliness (e.g. hospitals, food preparation areas, etc.), it is recommended that a cleaning/ hygiene specialist develop a detailed cleaning regime.

In addition to the daily cleaning procedure, it is prudent to undertake a periodic deep cleansing by more vigorous cleaning techniques using strongly alkaline or acidic cleaning agents to remove any build up of lime scale, grease or cleaning agent residue.

The application of polishes or sealants is not recommended for fully vitrified porcelain tiles as it offers no benefit to the tiles, but will require considerable maintenance and increases the potential for slipping.

Stubborn stains may be removed by;

- Scrubbing with abrasive soaps, pads or both
- Dissolving by suitable chemicals or solvents
- Pressure jet washing. This may involve the use of detergents and cleaners.

RENVOVATION OF EXISTING FLOORS

Often the slip resistance of existing “problem” floors can be dramatically improved by thorough cleaning. The degree of renovation required will be proportional to the neglect and general condition of the floor. Working in small trail areas, apply an intensive cleaner such as Stone Care Europe “ Masterclean “ or if necessary a heavy-duty floor strippers such as Stone care Europe “ Solvent Stripper”, which is designed to cut through waxes, floor sealers, oils and soap residue. The treatment should be carried out in accordance with manufacturers instructions.

It may be necessary to alternate between alkali [ e.g. Stone Care Europe “ Pro Clean 04”] and acid [ e.g. Stone Care Europe “ Grout Cleaner”] cleaners to get back to the original tile surface.

RECOMMENDATIONS FOR FURTHER READING

*DIN 51130* *German Standards Test Method for Ramp Test for Industrial Applications*

*DIN 51097 1992* *German Standards Test Method for Ramp Test with Bare Feet*

ZH 1/571 October 1993 *Merkblatt fuer Furboden in Arbeitraeumen und Arbeitsbereichen mit Rutschgefahr. (Walking on floor tiles in work areas and zones exposed to risk of slipping).*

*Review of Slip resistance* The Tile Association. St Albans, UK.

*The Cleaning of Ceramic Tiles* National Association of Tiles Distributors. St Albans, UK. 2000.

*Products for cleaning, protecting and care treatment of ceramic tiles, terracotta and stone*
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