

slip

RESISTANCE

What Specifiers Should Know

Slip Resistance: What Specifiers Should Know

By Jeff Green and Erik Boyll

Many manufacturers of man made hard surface floor products, such as ceramic, glass and engineered stone, have their tile tested to provide information indicating that their tiles pass "industry standards" for slip resistance. Architects, designers and end-users, who are concerned about slip resistance, seek out this information and feel secure that they have done their research. If the tile shows passing numbers (exceeds 0.60 on the ASTM C-1028 test, wet and dry), they are comfortable with their choice. The belief is that these standards meet the requirements established by the Americans with Disabilities Act (ADA). However, this is a misconception and not the case at all.

We have conducted extensive research on this topic and have compiled our findings into this report. In short, there are no established industry standards for slip resistance testing and the ADA does not require any minimum test results on slip resistance.

This article describes the tests that currently exist, who created them, who administers them and what industry leaders have to say about their relevance or validity. At the end, we give our recommendations about how to deal with the various issues of slip resistance.

Summary of Testing Devices

In order to explain current thinking, we need to explain the most popular testing methods currently used to measure slip resistance. These tests rely on the concept of Coefficient of Friction (COF), which measures the resistance of an object as it dragged across the tile.

The first attempt to measure COF was the bean-bag test, developed in the 1930s. A ten pound bag of beans was placed on a clean piece of burlap. The weighted burlap was pulled across the floor with a spring scale. The point at which the load began to move was noted and the test was then repeated. A floor that required six pounds of pull was considered safe. A floor with less than five was slippery, and a floor with a drag of more than seven was considered to be tacky, causing slips and therefore, not acceptable.

By today's standards, the bean-bag test is primitive. However, at the time of its inception, it provided a simple way of comparing results and surfaces. The most utilized test in the U.S. today is the Horizontal Dynamometer Pull-Meter, known as the drag sled. This test is conducted within the guidelines of ASTM C-1028. Although the drag sled test is more

advanced than the bean bag test of the 1930s, the principle remains the same. A weighted board with a Neolite (rubber) attachment, used to simulate the bottom of a shoe, is dragged along the surface of a test sample. The COF is measured by dividing the lateral force of pulling on the spring weight by the vertical force of the weight on the sled. The assumption is that the more pressure that is required to pull the weight, the more slip resistance exists on the surface tile.



While the ASTM C-1028 test is the most commonly used slip resistance test in the United States, there are issues with this procedure. (1) It is a manual test that requires a person to pull on the spring weight until the sample moves across the surface and therefore subject to user error. Different results could be derived from repeated testing of the same material. (2) There is no consensus as to the amount of resistance that is required to produce slip resistance, (3) Test results for textured surfaces are subject to additional reliability questions, due to variation caused by the manufacturing process in the surface texture from tile to tile and within each tile, and (4) The C-1028 test only measures the static COF, or the force it takes to move a stationary object across a surface. Human locomotion is not only a static process but is a dynamic process as well. People do not always slip while moving from a stationary position. They also slip while maneuvering across a surface.

The BOT-3000, or Binary Output Tribometer measures both static and dynamic COF. While static COF is a measurement of the force required to move a stationary object into motion, dynamic COF is a measurement of the resistance generated from a moving object coming into contact with an object at rest. The BOT-3000 is automated and thus, largely eliminates operator error since it does not depend on manually sliding a sled or test material across a

surface. Additionally, it produces both digital readouts and printouts of results for documentation purposes. Although the BOT-3000 produces measurements that are probably more “real world” and useful, it has not been approved by a US standards organization. Currently ASTM International is in the process of developing a protocol to conduct testing with this device. We are not aware of any hard surface tile manufacturer that publishes results from this test.

European countries have been using dynamic COF testing devices for several years, but the testing methods are also flawed. The most widely accepted test in Europe is the ramp test (DIN 51130) which was standardized by the Deutsches Institut für Normung, <http://www.din.de>.

The test involves a person walking along a platform of tiles that are being tested. The incline is then increased to a point where the person starts to slip. The slipping point is then recorded and given a value from R-9 to R-13. Any value below R-9 is not recorded and deemed as a failed test. However, people react differently when they anticipate a slip, which can cause misleading results. In addition, this test is often performed by the floor covering manufacturer, making the results subject to tester bias.

There are slip resistance tests that can be used for measuring the dynamic slip resistance of installed floors in place. Since this article pertains to test results that are used in the specification of products before installation, we will not include discussions of these alternative test methodologies here.


Industry Leaders Position on Testing

Perhaps the two most influential organizations that are developing standards in North America are **ASTM International** <http://astm.org> and **ANSI (American National Standards Institute)** <http://web.ansi.org>

Both organizations have established committees dedicated to the study of walkway safety and the measurement of frictional properties of walking surfaces. ASTM, Committee F13 (Pedestrian/Walkway Safety and Footwear) is responsible for this field of study, while in ANSI, a recently formed Committee B101 (Standards Committee on Safety Requirements for Slip, Trip and Fall Prevention) which is charged with the same task. Although both groups have active committees working towards developing a slip resistance standard, neither association will hold a position

until their respective committees reach an agreement.

In 1991, the **U.S. Access Board** published the ADA Accessibility Guidelines (ADAAG), adopted as the ADA standards for new construction and alterations by the U.S. Department of Justice. ADAAG 4.5.1 requires accessible routes to be stable, firm, and slip resistant. An advisory note, not part of the enforceable standard, reports on slip resistance research conducted for the Board that suggested that people who have mobility disabilities would benefit from higher slip resistance values for easy ambulation on walks and ramps. The Board advises that specifiers select surface materials that provide higher slip resistance values



“Because of the great number of variables that affect the performance of a given walking surface... no single set of technical specifications or measurement standards can encompass all criteria that contribute to the safety of a walking surface.” ADA Accessibility Guidelines

where feasible and notes that slip resistance standards vary by material type, which have not been correlated, therefore, threshold values will differ between test methods.

See <http://www.access-board.gov/adaag/about/bulletins/surfaces.htm> for additional information.

The advisory note on slip resistance included an important value, 0.60, which is now accepted by many people as “the industry standard” for minimum slip resistance on flat floor surfaces (0.80 on ramps). However the value of 0.60 for flat surfaces (and 0.80 on ramps) was removed from the advisory shortly after its release. The original report did not mention the test method, although it was assumed by the industry to be the ASTM C-1028 test. In actuality, the testing device used in the Access Boards research was a Force Plate which is not a test used by the flooring industry.

The fact that the advisory was never required and was later removed from the guide has not been well communicated. Bulletin #4 of the ADAAG states, “Because of the great number of variables that affect the performance of a given walking surface, its slope and cross slope, its material, texture and finish, the presence of moisture or contaminants, the material that contacts it and the method of ambulation, no single set of technical specifications or

measurement standards can encompass all criteria that contribute to the safety of a walking surface.”
(Department of Justice: <http://www.usdoj.gov/crt/ada/reg3a.html#Anchor-11683>).

Marble Institute of America (MIA) does not take a position on this issue and indicates that they are awaiting a national consensus standard before they commit to a position.

MIA website: <http://www.marble-institute.com>

Tile Council of North America (TCNA) is a trade organization that operates a testing lab and offers a multitude of standard testing services to ASTM, ANSI, and ISO specifications. The TCNA is very much involved in testing of static and dynamic COF and participates in numerous committees working on slip-fall issues and means of measurement. The TCNA makes no recommendation pertaining to a safe COF. They will run any test you want, but, like the MIA, are awaiting a national consensus standard before they commit to a position.

TCNA website: <http://www.tileusa.com>

Ceramic Tile Distributors Association (CTDA) states that they follow the recommendations of the Tile Council of North America (TCNA) although the TCNA makes no recommendation.

CTDA website: <http://www.ctdahome.org>

American Institute of Architects (AIA) acknowledges that slip resistance should always be taken into account when specifying floor coverings, but do not make a recommendation as to what an acceptable coefficient of friction should be.

AIA website: <http://www.aia.org>

Occupational Health and Safety Administration (OSHA) does not mandate a particular COF for walking/working surfaces, although they do make a recommendation that a walking surface in the workplace should have a COF of 0.50 or greater on the ASTM C-1028 test. This is only a recommendation and not a requirement.

OSHA website: <http://www.osha.gov>

Conclusion

In summary, (1) There are no current tests that have been proven to reliably measure slip resistance of hard surface floor tiles in the laboratory. Therefore, no test provides a standard for pass/fail results. (2) ADA does not require any minimum test results in order to meet slip resistance requirements. (3) There is not an industry consensus for minimum test requirements for slip resistance testing.

Recommendations

- While the issue of COF should not be ignored, we suggest that you should not feel secure with current test results at this time. It is unknown when and by whom a national consensus standard for slip resistance of hard surface flooring will be agreed upon, but once a recommendation is reached, it is expected that the USAB and OSHA will adopt the recommendation and make definitive, legal requirements. Before this is possible, a greater understanding of human locomotion must be reached.
- Always stipulate that hard surface flooring be properly installed, or as the ADA states, “stable, firm and slip resistant”.
- Communicate with the end-user the importance of maintenance. A wet floor is a slippery floor. Therefore, floor mats should be used near entry ways during inclement weather. Dusty or dirty floors are slippery. Owners should make sure that floors are cleaned as often as needed and that foreign objects are removed as soon as possible.
- Consider the material being used on a subjective basis. Lightly textured surfaces tend to be more slip inhibiting than slick or highly polished material.
- Chemical applications on installed floors have proven to be successful under certain conditions. For example, we have been told that Safety Seal Products Corp. offers Grip On Anti-Slip Solution, a water based impregnator that applies an invisible micro-texture to stone and ceramic tile, thereby increasing the slip resistance of the floor to varying degrees.
- Please note that the test information in this article relates to man made products and not natural stone. Since every piece of natural stone is different and every area within the piece is different, it would not be possible for laboratory testing to be reliable. However, we do suggest adhering to the recommendations listed above.

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