Super-Krete® Products

Measuring Surface Traction and Engineering for Slip-Resistance Technical Guide

SLIP and FALL INCIDENTS

The Consumer Product Safety Commission reports that more than one million people seek medical attention from a hospital emergency room for “slip-and-fall accidents” each year and more than 12,000 people die.

Property owners, end users and their insurance companies are often found to be responsible for slip-and-fall injuries that occur on their property, especially if they are reoccurring.

AVOIDING COSTLY LITIGATION

Slips and falls result from various causes. To avoid costly litigation at multi-residential, commercial, industrial, institutional and governmental facilities, it is recommended instituting proactive Preventative Accident Programs and Third Party Testing.

HISTORY

Much has changed since APF’s initial publication of “Measuring Surface Traction and Engineering for Slip-Resistance” in May of 2002. The standards addressed in 2002 were written around the American Disabilities Act (ADA) and Occupational Safety and Health Administration (OSHA) recommendations.

ADA is credited with having required the toughest values for slip-resistance on pedestrian surfaces with a static coefficient of friction of 0.6 on level surfaces and 0.8 on ramps, wet or dry, using ASTM C1028 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method and ASTM F1679 Standard Test Method for Using a Variable Incident Tribometer. (The latter is applicable for only dry conditions.) Both of these tests have been withdrawn by ASTM without replacements.

ASTM (American International, formerly American Society of Testing and Materials) withdrew these standards known in the industry as “portable test equipment,” without replacements. They were the most popular field tests for static coefficient of friction available. However, neither test offered a DCOF (dynamic coefficient of friction) test.

Today, the industry standards have been re-written among the professionals to conform to American National Standard Institute.

The ANSI has three pedestrian floor and wearing surface friction standards involving tests using equipment, such as, the BOT-3000E portable digital tribometer, intended for testing floors and wearing surfaces for indoor use. Why do they have three standards, and what’s the difference among them? They all have different test methods and different minimum coefficient of friction values (0.42, 0.43, and 0.60).

All three test methods are primarily used to assess safety of indoor flooring and wearing surfaces that will be used while wet. However, each test method uses a slightly different wetting liquid.

1. The first standard passed by ANSI was B101.1, which involves measurement of static coefficient of friction (SCOF) and the wetting liquid is purified water.
2. The second standard is ANSI B101.3, which involves measuring dynamic coefficient of friction (DCOF) using a trace of wetting agent (sodium lauryl sulfate, or SLS, an ingredient in many

detergents) in the water used for the testing.

3. The third and most recent standard is ANSI A137.1. It was written by the Tile Council of North America and is now incorporated by reference in the 2012 International Building Code.

Arizona Polymer Flooring recommends the most demanding of the three ANSI tests: B101.3 Test Method for Measuring Wet DCOF (dynamic coefficient of friction) of Common Hard-Surface Floor Materials (Including Action and Limit Thresholds for the Suitable Assessment of the Measured Values). The B101.3 DOCF is considered the most stringent of all the ANSI standards, since it addresses a wet dynamic coefficient of friction substrate.

The wet measurement under B101.3 test method uses slightly soapy water (containing sodium lauryl sulfate or SLS), which is a common surfactant in most floor cleaning agents. The sodium lauryl sulfate is used to represent normal “real life” conditions where a residual film of sodium lauryl sulfate can be re-emulsified when water is spilled or tracked in, creating a slippery condition.

The DCOF test accurately measures the coefficient of friction of very smooth surfaces, which may be conducted with the portable BOT 3000E device that can be used to take in situ (job site) measurements with a high-level repeatability.

SCOF versus DCOF

Defined:

1. SCOF (static coefficient of friction) relates to the force required for a surface to begin sliding over another, divided by weight.
2. DCOF (dynamic coefficient of friction) relates to the force needed to keep a surface in motion sliding over another, divided by weight.
3. With DCOF, the individual is already in motion versus a SCOF, where the individual is not in motion (static) position.

NOTES TO PROFESSIONAL SPECIFIERS, OWNERS and END USERS

The values of 0.6 and 0.8 static coefficient of friction (SCOF) per ASTM C1028 and F1679 have been commonly specified, but it is frequently misrepresented in the industry because the standard does not actually exist. Specifiers regularly cite the 0.6 and 0.8 as a requirement of Americans with Disabilities Act (ADA) compliance, which is not accurate. ADA does not set the requirements. ADA-referenced accessibility guidelines recommend the values of 0.6 and 0.8 SCOF. The ADA does not specify a measurement. The SCOF requirements are meaningless without a standardized test method, rather it is standard practice.

The Architectural Barrier Act (ABA) access guidelines to federal facilities that was updated to 0.6 SCOF has been withdrawn; however, it is still cited.

Under the ANSI guidelines, the specifier should specify a minimum value of 0.42 DCOF, as measured by the BOT 3000E (or equal) for the fluid-applied flooring surface. Meaning that an acceptable walking surface when tested “wet” meets B101.3, which has an average value of 0.42 or greater.

The specifier, owner and end user should know that the coefficient of friction will change over time as a result of surface contamination, wearing, polishing, or damage, thus requiring cleaning and maintenance.

That is why Arizona Polymer Flooring strongly recommends an internal Proactive Preventative Accident Program with Third Party Testing be a part of the fluid-applied flooring protocol.

VALIDATION

Arizona Polymer Flooring Inc. (APF) recommends that the facility owners or end users establish a Proactive Preventative Accident Program, validated by an in-house Safety Committee. Further, APF strongly recommends a Third-Party Testing Firm, which should reduce the litigation claims that the slip-and-fall incidents were caused by negligence. By documenting that the floors and other wearing surfaces are periodically tested by the owner's safety committee and a Third-Party Test Firm, and by taking the appropriate remedies, facility owners and end users can help eliminate potential hazards that are detected. This demonstrates good faith, which should reduce or eliminate litigation and mitigation when it comes to slip-and-fall incidents.

FLUID-APPLIED FLOORING

Polymer coatings and polymer surfacing floors are installed at the job site. They are unique in the sense that they are not produced in an environment-controlled manufacturing atmosphere; instead they are fabricated, installed, and finished on the job site.

Established laboratory tests, such as the James Machine (ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine), has been a standard for the tile industry since 1942. A number of fluid-applied flooring manufacturers have adopted this test protocol; however, most fluid-applied flooring manufacturers fail to disclose that ASTM D2047 testing cannot be done at the job site on the finished fluid-applied floor(s).

IN SITU TEST EQUIPMENT BOT 3000E

Most fluid-applied flooring manufacturers over the years have recognized that the James Machine (ASTM D2047) laboratory test results are not viable for their industry. Until recently, the fluid-applied flooring manufacturers could rely on the two ASTM Standards (ASTM C1028 and ASTM F1679); however, as discussed, they have been withdrawn.

The new standard for in situ testing is ANSI B101.3 Test Method for Measuring Wet DCOF (dynamic coefficient of friction) of Common Hard-Surface Floor Materials (Including Action and Limit Thresholds for the Suitable Assessment of the Measured Values.

The BOT 3000E conforms to American National Standard B101.1, "Test Method for Measuring Wet SCOF of Common Hard-Surfaced Floor Materials," which measures static coefficient of friction (SCOF). It also conforms to ANSI B101.3 and A137.1, which measures dynamic coefficient of friction (DCOF).

It has been validated, according to ASTM F2508 "Standard Practice for Validation, Calibration, and Certification of Walkway Tribometers Using Reference Surfaces," meeting ANSI and ASTM measurement and read requirements.

The frequency of the test should be established based on "real" data of slip-and-fall incidents collected on the fluid-applied floor. It may be daily, weekly, monthly, or longer depending on environmental use and seasonal changes in use, such as a swimming pool.

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BOT 3000E Machine

BOT 3000E Print Out (6 reads)

SELECT THE TEST AREA(S)

The fluid-applied flooring surface area to be tested must be large enough to fully accommodate the normal operation of the BOT 3000E testing device without restriction. Effort should be made to test each area using a minimum of two directions, 90 degrees apart; often referred to as an "X-Y" pattern. One of the tests should be performed in the direction of normal pedestrian traffic, if possible.

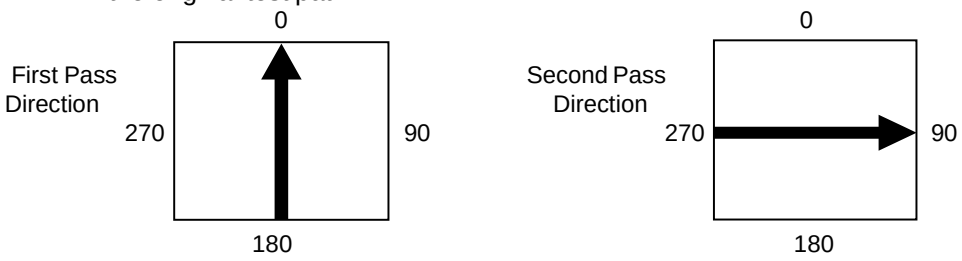
PREPARE THE CONTACT MATERIAL

The fluid-applied flooring surface will be tested with a SBR (Styrene Butadiene Rubber) sliders, with a Shore A Hardness of 75, which shall be maintained as to prevent buildup of contaminants that may affect the DCOF or SCOF test results. Follow the BOT 3000 E manufacturer's instructions for conditioning the SBR slider material. ASTM F2508 Standard Practice for Validation, Calibration, and Certification of Walkway Tribometers Using Reference Surfaces. It is important to point out that the standard does not specifically reference Fluid-Applied Coatings and Fluid-Applied Flooring surfaces. The absence of the fluid-applied flooring means that the standard must be stated as "modified" to pertinent to fluid-applied flooring when referenced.

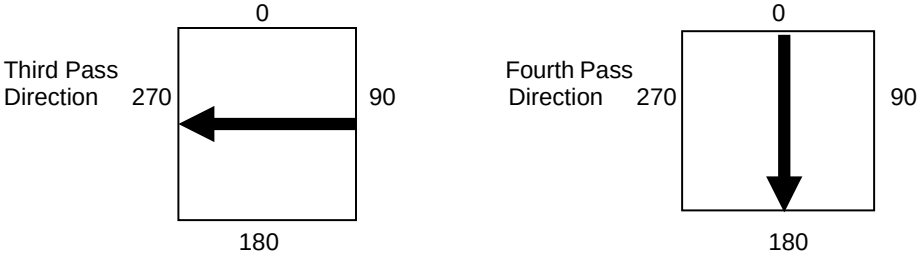
ASTM F2508 requires that the test validation consists of twenty-four (24) tests on each referenced surface. (It does not state the square footage minimums or maximums.)

1. First Directional Test
   a. Place the measuring device on the surface and conduct three (3) tests in one direction. Record the resulting DCOF values.
   b. Dry the test surface by blotting with an untreated paper towel. Use care to not contaminate the surface condition.

2. Second Directional Test
   a. Repeat the above procedure at a 90-degree angle rotated clockwise from the original test path.



1. Calculate the average for the six (6) readings collected from the test area.
2. Evaluate the six (6) readings relative to the upper and lower limit bounds established in above:
   a. If all readings fall within the established limit bounds, accept the average and evaluate the walkway's DCOF per the instructions set forth in section 5.0 of this standard.
   b. If any readings fall outside of the established limit bounds, reject the test and re-test or correct the testing procedure and/or tribometer as required.
3. If a test area surface exhibits an obvious directional bias or grain (such as a wood floor tile) the test should be conducted in four (4) directions, ninety (90) degrees apart.



CALCULATE THE TEST RESULT DATA

The calculation is in accordance with the testing device manufacturer's directions. The final test results shall be recorded as DCOF values on a linear scale from 0.00 to 1.00.

Wet DCOF Value	Slip Resistance Potential	Action
>0.45 (inclines) >0.42 (level)	High - Lower probability of slipping	Monitor DCOF regularly and maintain cleanliness
0.30 - 0.45 (inclines) 0.30 – 0.42 (level)	Acceptable - Increased probability of slipping	Monitor DCOF regularly and maintain cleanliness. Consider traction enhancing products and practices where applicable for intended use
< 0.30	Low - Higher probability of slipping	Seek professional intervention; Consider replacing flooring and/or coating with high-traction products

WALKING TRIBOMETER VALIDATION REPORT

The Third Party Testing Firm's report must include the tribometer used, test foot, reference surfaces, test procedure and analysis method, etc. The report should include at a minimum the following:

1. Operator, test address, company, and contact information;
2. Source of reference surfaces and date acquired;
3. Validation test date;
4. Validation temperature and humidity;
5. Walkway tribometer supplier, model number, and serial number;
6. Test foot number, material, age, preparation procedure, and dimensions;
7. The supplier's published version of the walkway tribometer's operating instructions, test foot preparation, and test procedure. If a different procedure is used, attach a full description to the report;
8. *Test Results*—Mean, standard deviation, standard error of the mean, and 95th percentile confidence intervals for each reference surface;
9. Results of the rank order of reference surfaces and a statement of whether the walkway tribometer complies;
10. Results of the differentiation of reference surfaces and a statement of whether the walkway tribometer complies;
11. Comments on any aspect of the validation process that the operator judged to be noteworthy or that may have affected the test results; and
12. Statement that validation has been performed in accordance with this practice.

CONCLUSION

The time has now arrived for everyone to take more responsibility for the avoidance of slip-and-fall accidents. The ideal situation is for the specialty flooring contractor to install fluid-applied flooring systems that meet the current requirements. The industry now has the capability to do effective wet surface slip-resistant testing. Actual samples showing different coefficients of friction that can be loaned to customers to help design compliant systems; however, the actual installed fluid-applied floor surface may vary.

DISCLAIMER

Arizona Polymer Flooring's Technical Guidelines are developed in good faith for the sole purpose of assisting others with products, systems, and industry standards. The information published herein is gathered from different sources that are thought to be reliable, but the reader should not assume that the information absolves the reader from validating information from other sources, such as listed below, before making a decision. Since information from others can change without notice, Arizona Polymer Flooring cannot be held at fault if any of the information conveyed in good faith is deemed in error. Listed below is a number of Trade Association Organizations that can provide additional assistance to the reader.

American International (formerly American Society of Testing and Materials) (ASTM)

ASTM C1028 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method (withdrawn 2014)

ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

ASTM F1679 Standard Test Method for Using a Variable Incident Tribometer (withdrawn 2006)

ASTM F2508 Standard Practice for Validation, Calibration, and Certification of Walkway Tribometers Using Reference Surfaces

American National Standard Institute (ANSI)

ANSI A137.1 American National Standards Specifications for Ceramic Tile

ANSI B101.1 Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Material

ANSI B101.3 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials