

FOTE • REPORT

SAFETY ENGINEERING UPDATE

FOTE NOTES

At Russell Fote & Associates, our purpose is to provide our clients with the very best safety engineering and expert consulting services.

Since starting Russell Fote & Associates, Mr. Fote has given over **150 depositions** and has testified at over **25 trials**. He has been recognized as an expert in the state courts of: Illinois, Wisconsin, Iowa, Kentucky, Tennessee, Nebraska, Oklahoma, and West Virginia, plus U.S. District Courts in Atlanta, GA and Central Islip, NY.

We have two offices to serve you. Our Chicago office is located at 8770 W. Bryn Mawr Ave., Suite 1300, Chicago, IL 60631, which is about three miles east of O'Hare International Airport. Our other office is located in Wisconsin at 3635 Stonebrook Ct., Brookfield, WI 53005. You may reach us using the contact information listed at the bottom of this newsletter.

At Russell Fote & Associates, we continue to remain current on all safety engineering-related issues.

We invite you to visit our "home page" on the Internet. You may access our web site at: www.fote-engineering.com or E-mail information to our office at: rfote@wi.rr.com.

Slip Resistance and Validation of the English XL

Coefficient of Friction (Dry Conditions)

A widely accepted definition, currently used by the National Institute of Standards and Technology (NIST), defines coefficient of friction, under static conditions, as the horizontal force required to initiate relative motion between an object and the horizontal surface it is resting on.

For example, if a five-pound horizontal force is required to move a ten-pound block resting on the floor, the coefficient of friction is 0.5.

NIST has another definition for coefficient of friction. If an articulated strut instrument is used to measure coefficient of friction, the tangent of the angle from the vertical that is created when the attached strut's shoe begins to slip is defined as coefficient of friction.

Slip Resistance (Wet Conditions)

By definition, coefficient of friction of a walk surface can only describe the slippery condition between an object, such as a person's shoe, and the walking surface, such as a floor.

If a contamination like water is on the floor, the coefficient of friction cannot be measured. Therefore, we are only capable of measuring a floor surface's slip resistance under wet conditions.

Slip resistance is defined as the relative force that resists the tendency of the shoe or foot to travel on a

walking surface. This definition has the ability to include a combination of factors such as the condition of the walk's surface, the type of footwear worn and the presence of a contaminant.

English XL

As a means to measure slip resistance under wet conditions, portable variable angle tribometers (VAT) were developed, such as the English XL. Tribo in Greek means to rub and meter comes from metrum, which means to measure.

VAT's are relatively small, light weight and operate mechanically using a test foot attached to an articulated strut. When the test foot is in motion, it contacts the testing surface similar to one's shoe.

The test foot's contact ratio, which is the ratio of horizontal force to vertical force, is adjusted by the instrument's operator. This adjustment changes the angle of the test foot hitting the floor's surface until a slip occurs.

At that point, the angle is read using the instrument's scale. Its scale ranges from a minimum of zero to a maximum of one and is divided into one-tenth intervals.

Values closer to zero relate to less slip resistance for the walk surface while higher numbers, which approach one, relate to a walk surface with greater slip resistance.

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The main advantage to the English XL is its capability of measuring slip-resistance under wet surface conditions. Other surface slip meters can produce faulty readings due to adhesion conditions between the instrument and the wet floor surface, which is similar to the situation that occurs when sliding two pieces of glass together with wet surfaces. However, the English XL can measure slip resistance effectively under wet surface conditions.

In 1996, ASTM (American Society for Testing and Materials) issued two standards for variable angle tribometers for use under both wet and dry conditions, which were F1677 and F1679.

The F1677 standard determines slip resistance using the Brungraber Mark II. The F1679 standard determines slip resistance using the English XL.

ASTM's pedestrian walkway safety committee was concerned that these standards referenced proprietary apparatus; therefore, the committee withdrew them on September 30, 2006. Both standards are currently inactive but remain available for purchase from ASTM.

As a means to provide a standard to replace F1677 and F1679, ASTM took the direction of developing a standard that would validate all tribometers. Such a standard would use a series of standard floor tiles, each having a predetermined range of slip resistance from a very slippery to a non-slip walk surface.

ASTM F2508-11

On March 15, 2011, ASTM approved F2508-11, Standard Practice for Validation and Calibration of Walkway Tribometers Using Reference Surfaces.

F2508 requires the tribometer being validated to be tested using four

standardized floor tiles, A, B, C and D, which are available for purchase from ASTM. These floor tiles are polished black granite, porcelain, vinyl composition and ceramic.

Forty tests are to be performed on each floor tile with each tile's surface being made wet. The granite tile is to be made wet with a solution of distilled water mixed with a wetting agent to a concentration of 0.04 % by volume.

The other three tiles are made wet with only distilled water. The tested tribometer is required to rank these standard floor tiles in order of slip resistance.

The English XL passed all validation testing as required by ASTM F2508-11.

If the tribometer is successful in properly ranking these four tiles, the tribometer being tested meets ASTM F2508. The English XL performed these 40 tests and successfully ranked the four tiles in order.

The mean (average) and standard deviation of each tile's forty tests are calculated. The standard deviation is a calculation to determine the variation or dispersion from the mean.

A normal distribution of collected data represents a bell curve with about two standard deviations (47.5%) of the data above the mean and about two standard deviations (47.5%) of the data below the mean.

Approximately 95% of the area under the bell curve is represented by these four standard deviations.

ASTM F2508 also requires additional testing be conducted for the tribometer to receive validation.

Using standard deviation calculations and advanced statistical analysis, calculations of paired T tests are performed.

First, the mean of the differences between two sets of collected data from two floor tiles is computed, which involves the previous noted forty tests for each set of tiles.

To obtain a T value, the mean is then divided by another term. This term is comprised of the standard deviation of these differences divided by the square root of the number of tests conducted, which is the square root of 40.

Once T values are calculated for the various sets of tiles, these values are compared to the critical T value, which may be calculated or determined using statistical tables. ASTM has set the critical T value at 1.694, which is based on the probability of a false rejection of 5% for the number of tests conducted, which are 40.

If a calculated T value is greater than 1.694 (critical value), then a statistically significant difference exists between the reference surfaces tested and the tribometer being tested.

Three paired T tests were conducted, which used all four tiles in the following order: A-B, B-C and C-D. All three T values were greater than 1.694 and therefore, the English XL passed these tests.

Excel Tribometers, LLC, the current supplier of the English XL completed the above validation testing using the parameters of ASTM F2508. Their published test results demonstrate that the English XL passed all testing as required by ASTM F2508. Please reference their web site for the full report, www.exceltribometers.com.

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Establishing 0.5 Slip Resistance Threshold

Current consensus for a slip resistance threshold is 0.50. Slip resistance measurements below 0.50 are generally considered slippery and therefore, not a safe walk surface, while measurements above 0.50 are generally considered safe.

ANSI/ASSE (American National Standards Institute/American Society of Safety Engineers) published a technical report, February 2008, TR-A1264.3, Using Variable Angle Tribometers (VAT) for the Measurement of the Slip Resistance of Walkway Surfaces.

This report states the following: “0.50 has emerged as the default threshold, and is the most recognized and accepted reference value in the U.S. for pedestrian safety.”

TR-A1264.3 further states: “A majority of slip and fall incidents occur as a result of contact with a spot on the floor surface that is unexpectedly slippery, usually due to moisture. It is important to determine how slip resistant the surface is under dry and wet conditions because of pedestrian expectation.”

Rosenfeld vs. Oceania Cruises, Inc.

On September 7, 2011 the U. S. Court of Appeals for the Eleventh Circuit, Southern District of Florida reversed a lower court’s verdict, which favored Oceania Cruises, Inc. (Oceania), the defendant.

This case involves a passenger, Ms. Lydia Rosenfeld, who slipped and fell on a ceramic tile floor near the ship’s self-serve buffet bar, resulting in a fractured shoulder.

Ms. Rosenfeld brought suit against Oceania for negligently failing to provide an adequate flooring surface for the buffet area where she fell.

Ms. Rosenfeld, though her attorney, retained a floor safety expert who performed slip resistance testing on the floor surface involved in her fall.

The expert found this ceramic tile floor’s surface to have a low slip resistance under wet conditions. He was to testify at trial that the floor surface was not reasonably safe for a buffet area.

The district court (Court) in a pre-trial order prohibited the plaintiff’s expert from testifying, stating that the expert’s conclusions are to be left for the Court or the jury to decide.

“0.50 has emerged as the default threshold, and is the most recognized and accepted reference value in the U.S. for pedestrian safety.”

The Court ruled, in essence, the plaintiff failed to establish that the expert’s testimony would help the Court in understanding a matter of scientific, technical or specialist expertise.

At trial, Ms. Rosenfeld’s attorney asked the Court to allow the reading of the expert’s deposition to the jury, which the Court denied.

In this case, for the plaintiff to prevail at trial, she was required to prove, first, the defendant was negligent and second, that this negligence was the cause of her injuries. After several hours of deliberation, the jury returned a verdict for Oceania and Ms. Rosenfeld appealed this verdict to a higher court.

Ms. Rosenfeld’s premise for Oceania’s negligence was its choice

of ceramic tile flooring near a busy self-serve food buffet, which was susceptible to spills. The appeals court stated a qualified expert, using accepted testing practices can testify as to a floor’s safety, based on its slip resistance.

The appeals court further stated that matters involving a floor’s slip resistance are beyond the understanding and experience of the average lay citizen.

Oceania argued on appeal that the expert’s testing was not accurate for wet conditions and his conclusions were imprecise and unspecific. The defendant also argued the expert’s testing was at an incorrect location, not where Ms. Rosenfeld fell.

However, the appeals court stated Oceania is able to present these arguments at retrial through cross-examination and through presentation of contrary evidence.

The appeals court concluded a new trial is warranted at which time Ms. Rosenfeld will be able to submit expert testimony regarding the adequacy of Oceania’s choice of flooring materials.

Therefore, the appeals court reversed the lower court’s verdict and remanded the case back to the district court for retrial.

Summarizing

The discussion in this case’s review uses wording pertinent to the defendant’s choice of flooring. Nothing was stated about maintenance of the floor such as acid etching the floor to improve slip resistance and/or providing a non-slip floor sealer.

Also, there was nothing stated about the use of warning signs to reduce the slip and fall hazard.

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Slip Resistance and Validation of the English XL (continued from page three)

The safety expert retained in this case is an Australian who developed his testing instrument to measure slip resistance and began its use during 2005.

Published court documents do not give a date for Ms. Rosenfeld's fall or a trial date. If we assume a trial date, September 2010 and floor testing performed sometime prior, it appears this would give only about five years of experience for the use of this expert's testing instrument. Also, there is no information present which

validates this instrument by any U.S. consensus standard such as ASTM (American Society for Testing and Materials) and ANSI (American National Standard Institute.)

Our firm uses the English XL for testing the slip resistance of walk surfaces. Its U.S. patent was issued in 1993 and the ASTM standard for its operation was published in 1996. Subsequent ANSI publications in 2001, 2006 and 2008 collaborate the use of the English XL. Finally, the English XL passed all testing as

required by ASTM F2508, which further confirms its importance as an effective instrument for measuring slip resistance.

During the past fourteen plus years our firm has had numerous cases involving the measuring of slip resistance under both wet and dry conditions. Most of these matters were settled before trial; however, some were tried, which resulted in us successfully demonstrating the English XL before the jury. □



Russell Fote, P.E.,
C.S.P., C.F.E.I.
Expert Safety Engineer

For Expert Testimony, Talk to an Expert

Russell Fote & Associates has over 30 years of safety engineering experience. The firm's field of expertise includes: **fires, explosions, carbon monoxide, scalds, flammable liquids/gases, water heaters, appliances, furnaces, slips/falls and motor vehicle collisions.**

- Investigations & Reconstructions
- Hazard Analysis & Evaluations
- Depositions & Trial Testimony

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We have two offices to serve you, one in the Milwaukee area and the other in Chicago, near O'Hare International. Our contact information is listed at the bottom of this newsletter.

**For Expert Testimony,
Talk to an Expert**



FREE Newsletter Inside
Slip Resistance and Validation of the English XL

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