The Daubert Dilemma in the Slip & Fall Case.
Does Forensic Science measure up?

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Abstract: A presentation of the field measurement protocols (*or lack thereof*) for Static Coefficient of Friction (SCOF) related to floors. The connection between ASTM(American Society for Testing and Materials) **ANSI(**American National Standards Institute)**, OSHA**(U.S. Department of Labor-Occupational, Safety & Health Administration**), and The Law** (Statutory and Case). **Now that ASTM has withdrawn International National certification of <u>all</u> field measurement protocols for Coefficient of Friction, <u>with no replacements</u>, can the Forensic Science Methodologies be acceptable by the courts as science under Daubert guidelines?**

Scientific proof in the slip and fall courtroom setting has been given the whammy by the withdrawal of standards for the measurement of the coefficient of friction. Without a scientifically accepted method of measurement, how can it be said that a floor is not in compliance, is dangerous and is a cause of injury? Is the expert testimony to now be excluded from the courtroom.*?***

The paradox: OSHA sets standards without the ability to measure for compliance. In the courtroom the trier of fact must be provided with proof. For the slip and fall accident that proof has often been from the competing testimony of experts utilizing the results of the measurement of the coefficient of friction of the involved surface. That testimony may now be inadmissible. Evidence and proof in slip and fall litigation is now without direction or standardization, compliance readings taken at the site can no longer be relevant. A major tool in the plaintiff's arsenal of proof has been lost, as well as the Defense's empirical basis for compliance as well as the "effective notice stance". But this does not sound the death knell on the expert's role. More than ever an expert voice to make sense of the confusion is needed, with a multi-disciplinary approach.

In the drive to prove or disprove their position in the courtroom, litigants frequently look to the experts in the field. This has been so in the slip and fall arena. While both sides need to put their best case forward the ability to look to science, if not properly screened and prepared may be lost or impaired. Some of the traditional concepts are no longer available, to the point of the potential loss of a scientific basis for opinion. The symbiotic relationship between ANSI, ASTM and OSHA has collapsed on this issue.

In 1993 expert testimony became subject to a new, more rigorous, standard. Set by Daubert v. Merrell Dow Pharmaceutical, Inc. (509 U.S. 579) the rules of evidence have changed. Now, before an expert can testify to any "scientific, technical, or other specialized knowledge," a court must be satisfied that "the testimony is based upon sufficient facts or data, the testimony is the product of reliable principles and methods, and the witness has applied the principles and methods reliably to the facts of the case. (Fed. R Evid. 702: *see also, Kumho Tire Co., ltd. V. Carmichael,* U.S. 137 (1999) (Extended Daubert to nonscientific testimony).)

In California these limitations, upon proper objection, pursuant Evidence Code section 801. have been applied.   This was the holding in the holding of the LOCKHEED LITIGATION CASES 115 Cal.App.4th 558, where it was held that an expert opinion has no value if its basis is unsound.

California evidence code section 801 provides:

> If a witness is testifying as an expert, his testimony in the form of an opinion is limited to such an opinion as is:
>
> (a) Related to a subject that is sufficiently beyond common experience that the opinion of an expert would assist the trier of fact; and (b) Based on matter (including his special knowledge, skill, experience, training, and education) perceived by or personally known to the witness or made known to him at or before the hearing, whether or not admissible, that is of a type that reasonably may be relied upon by an expert in forming an opinion upon the subject to which his testimony relates, unless an expert is precluded by law from using such matter as a basis for his opinion.

“Evidence Code section 801 limits expert testimony to a matter “of a type that reasonably may be relied upon by an expert in forming an opinion upon the subject to which his testimony relates”. Upon objection, a trial court is statutorily required to “exclude testimony in the form of an opinion that is based in whole or in significant part on a matter that is not a proper basis for such an opinion (Cal. Evid. Code § 803).

Because the subjects on which expert opinion may be received may be so numerous, the legislature expressly left to the courts the task of interpreting the general foundation standard *to be used.* The party offering the evidence must present such expert opinion(s) that contains a reasonable explanation illuminating why the facts have convinced the expert and therefore should convince the jury.

The burden is with the offeror, to show relevance and scientific basis and reliability. Regardless of whether evidence is deemed “scientific”, it will not be admitted unless it is relevant…..In California evidence is relevant only if it has any tendency in reason to prove or disprove any disputed fact. The court of Appeals has made it clear that Evidence Code section 801 requires a link between the matter the expert relies on and the opinion offered. And the court concluded that "an expert opinion based on speculation or conjecture is inadmissible (115 Cal. App. 4th at 564)"[1]

The Slip and Fall expert must now identify the science used to determine safe walking conditions. The science would be foundational. This is a daunting task in that the scientific community, the government and the courts cannot agree on a standard to measure floor safety.

As you will see, there is a consensus of scientific opinion that the standard of acceptable slip resistance is a Static Coefficient of Friction (SCOF) 0.5 for level pathways. This standard has been in existence since 1948. While this value has been constant the method of arriving at the value has evolved as well as the public policy with respect to slip resistance. But, Public law 101-336 has raised the bar to 0.6, which is now incorporated into each state's Codes.

This is the fight between Statutory Law and Case Law. All States must conform to the Federal minimum standard SCOF of .6, yet OSHA (and others) says that .5 is safe. And that is wet or dry.

There has been so much negative and contradictory evidence as to the ability to measure SCOF in the field, as well as setting a standard the covers both wet and dry measurements, that upon the mandatory eight year review, ASTM issued an announcement. ASTM standards D5859 thru 96e1, Standard Test Method for Determining Traction Using the Variable Incidence Tester (VIT, Tribometer), ASTM Standards F1678 Thru 96, Standard Test Method for using the Portable Articulated Strut Slip Tester (PAST), and ASTM C1028-96, Standard Friction of Ceramic tile and other Like Surfaces using the Horizontal Dynamometer Pull-meter Method have been "WITHDRAWN, NO REPLACEMENT"[2]

Without a protocol to empirically verify the SCOF in the field how can there be a scientific method that passes the courts needs under Daubert?

How can the use of an expert then be justified? The Forensic Scientist uses more than empirical test results to determine the causation of slippage in floor related litigation. "Scientific Method has many facets"[3]. The justification for and validity of the opinion will thus depend upon the thoroughness of the analysis made. The analysis must then encompass:

1. Observation: what is there in the world that gives us clues and answers.
   A. Look at documentation. There are a number of documents to be looked at relative the materials, the age, the use, the care. Match the

[1] Forensic Expert Witness Association Quarterly (M.C. Sunglaila, Esq., David M. Axelrod, Esq.

[2] ASTM WITHDRAWN standards 2005 from web-site (Docs 009, 010, 011)

[3] The Scientific Method by Anthony Carpi, Ph.D, Vision Learning

information to the real world conditions as a scientific basis to present your findings. Materials are rated for SCOF using laboratory equipment. The trained examiner relates that to the real world experience and draws conclusions based on support documents and expert knowledge.

2. **Hypothesis: I**n the world of Slip and Fall the floor is only half of the system, the person is the other half. There are life sciences pertaining to people in a system and how they react. Physics, Biometrics, Ergonomics. This allows the Forensic Scientist a foundation for his hypothesis.
3. **Experimentation:** In the limited scope of the slip and fall issue we find too many variables to test and no accepted test protocol to follow. The science comes in the correlation of the resources called upon, a thorough identification of the elements that lead to the final opinion.
4. **Validation:** If properly presented most courts should accept a conclusion based upon the foregoing. The opinion based a comparison of the site conditions, with SCOF as one component and a Forensic Study of other sciences and technologies as the foundation.

Additionally: the courts have not been exposed to the tenents of Ergonomics:
"Preceptual orginazation is particularly important for the design of any visual display. "if a warning signal is grouped percptually with other displays then its message may be lost. The concept of "Gestalt" who's basic idea of this law is that the organizational process will produce the simplest possible organization.
"Many sources of information come into play in the perception of distance and spatial relations, and the consensus view is that the perceptual system constructs the three dimensional representation using this information.

Studies have shown that it is common for people to see when they walk but not look".[4]

As seen below, the science of physics discusses the effects of "Hydroplaning" as part of walking on a wet surface. The practical technology of property management defines the content of airborne soil as contaminated.

And what has happened to the concept of "reasonable expectation of safety"[5]?

It is up to the expert to validate to the trier of fact the worthiness of the scientific approach. There are studies in physics that deal with the life cycle of floors after cleaning. There are behavioral studies into "walking memory". There are other national safety standards that deal with floor surfaces and walking.

It is up to the trier of fact as to the worthiness of this Forensic Scientific approach. Monocular science no longer has a support system.

[4] Handbook of Human Factors & Ergonomics 2nd edition 1997 pg. 77
[5] Baji 8th Edition 3.51

Below you will find parts of published scientific works (there are many) that are an insight into ASTM's justification for the de-certification of field methodologies to quantify SCOF. The scientific community shows how test results can be manipulated, biased and disregard the practical conditions of the site. Inside these studies, that focus on SCOF, are clues as to how some conditions might be investigated.

"In 1940, there were 22 deaths per hundred thousand from falls; today that number has fallen to about 1.6. Reductions are due in part to improvement in products and materials. A growing understanding of floor surfaces has resulted in the elimination of surface materials and finishes once considered acceptable. We seldom see carnauba waxes or new terrazzo floors, for example. Our walking surfaces are just safer than they used to be.

We now understand the human limitations which contribute to falls. For example, we commonly quantify the relation of the foot to the surface. This relationship, called traction or friction, can be simply modeled and understood. Mathematically, we call the relationship the coefficient of static friction. The coefficient of friction, or COF, is an application of Newton's general theory of relativity (gravity). To establish a surface measurement, we begin by pushing, pulling or dragging an object on a test surface. The resulting effect is recorded..

Friction or traction is the resistance to lateral movement caused by the contact between two surfaces. Slipperiness = Too Little Friction. Dividing the horizontal force by vertical force (weight), we get a number called the coefficient of friction. Concrete, with .8 COF, would have more traction, and be less slippery, than ice with a COF of .3, for example. The concept may be used to describe the friction relationship between many kinds of objects. COF has become on of the common performance measurements for products like floor finishes. However, the mere application of the concept of slip resistance can be misleading unless it is paired with information on test method used to make the measurement"[6].

NATIONAL STANDARDS

The American National Standards Institute is a clearing house for national consensus standards. ANSI combines the effort of numerous private organizations and industry groups. International Organization for Standardization (.ISO), Pacific Area Standards Congress (PASC),Pan American Standards Commission (COPANT),International Accreditation Forum (IAF) and many others.

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[6] MEASUREMENT OF SLIP RESISTANCE, *a legal and practical perspective*

None of the 4500 standards issued by the American National Standards Institute (ANSI) is mandatory in itself. ...An American National Standard implies a consensus of those substantially concerned with its scope and provisions.

ANSI standards, and ASTM test protocols are incorporated by reference in the state law and the building codes of American communities, but, for policy reasons, ANSI disclaims legal standing. On January 19, 2001, the United States Department of Labor, OSHA issued a "Memorandum of Understanding" that an agreement had been reach to work in partnership with ANSI in the development of safety standards[7].

"The 1996 "Annual Book of ASTM standards", under the heading "Slip Resistance", lists 13 different test methods for measuring the SCOF of polishes, paints, ceramic tiles, wood, footwear, bathing facilities etc. All test methods fail to establish a minimum SCOF, except D 2047, and none of the test methods correlate with each other even when using the same test sensor material and surrogate walkway surface

The most serious failure of a committee, C21 on Ceramic Whitewares & Related Products (1948), to recognize the safety needs of pedestrians when specifying the slip resistance of ceramic tiles, is demonstrated in C 1028 "Test Method for Determining the SCOF of Ceramic Tile & Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method". This method uses Neolite (rubber) rather than leather to measure the SCOF of ceramic tiles and similar hard surfaces. Since pedestrians wear leather footwear and leather typically has significantly less slip resistance than rubber, this standard is "bad" for consumers

The "bad" impact of these ASTM slip resistance standards is clearly demonstrated in the slip resistance requirements of building walkways by the Los Angeles Dept. of Building & Safety. This document states: "Surface treatment shall meet the requirement for slip resistance, which can be accomplished by either a product label or manufacturer's specification indicating that the **surface treatment meets an ASTM standard for slip resistance** for the ground and floor surfaces being treated or by having the treated surface tested by a City of Los Angeles approved testing laboratory in accordance with an ASTM standard for slip resistance. Ground and floor surfaces shall be considered slip resistant if the static coefficient friction measured for such surface is a minimum 0.8 for ramps and 0.6 for other accessible routes when tested in accordance with either ASTM C-1028 (field or laboratory test) or ASTM D-2047 (laboratory test)".[8]

About ASTM International
Overview

[7] OSHA MEMO January 19, 2001 (doc 016)
[8] ESIS Risk control Services, (Doc 005)

“ASTM International is one of the largest voluntary standards development organizations in the world-a trusted source for technical standards for materials, products, systems, and services. Known for their high technical quality and market relevancy, ASTM International standards have an important role in the information infrastructure that guides design, manufacturing and trade in the global economy.

ASTM International, originally known as the American Society for Testing and Materials (ASTM), was formed over a century ago, when a forward-thinking group of engineers and scientists got together to address frequent rail breaks in the burgeoning railroad industry. Their work led to standardization on the steel used in rail construction, ultimately improving railroad safety for the public. As the century progressed and new industrial, governmental and environmental developments created new standardization requirements, ASTM answered the call with consensus standards that have made products and services safer, better and more cost-effective. The proud tradition and forward vision that started in 1898 is still the hallmark of ASTM International.

Today, ASTM continues to play a leadership role in addressing the standardization needs of the global marketplace. Known for its best in class practices for standards development and delivery, ASTM is at the forefront in the use of innovative technology to help its members do standards development work, while also increasing the accessibility of ASTM International standards to the world.

ASTM continues to be the standards forum of choice of a diverse range of industries that come together under the ASTM umbrella to solve standardization challenges. In recent years, stakeholders involved in issues ranging from safety in recreational aviation, to fiber optic cable installations in underground utilities, to homeland security, have come together under ASTM to set consensus standards for their industries.

Standards developed at ASTM are the work of over 30,000 ASTM members. These technical experts represent producers, users, consumers, government and academia from over 100 countries. Participation in ASTM International is open to all with a material interest, anywhere in the world”.[9]

American Society for Testing and Materials develop test methods for defining quality in many materials. ASTM standards require a test protocol to be reasonable and methodologically sound. The method must be consistent, and reasonably analyze the subject-matter being investigated. Standardization implies a comparison between things, not absolutes. A test must be precise, which implies a less rigid standard of proof than accuracy. In most cases, a test

[9] ASTM web page “about ASTM” (Doc 018)

protocol must demonstrate bias, that is, the variation between a known value and the result of the test device. At present slip resistance testing correctly performed under different consensus standards may produce different results. Both disabled persons, and manufacturers of products deserve specific performance-based regulations.

How is slip resistance measured (from the U. S. Department of Justice)?

“Measuring slip resistance involves the minimum tangential force necessary to initiate sliding of a body over the surface and the body gravity force. The coefficient of friction between the two surfaces is the ratio of the horizontal and vertical forces required to move one surface over another to the total force pressing the two surfaces together.

There are three critical stages in an individual's gait: 1) touchdown, 2) full load, and 3) push-off. In order to avoid slippage while walking, the horizontal and vertical forces applied by the individual must be resisted by forces acting against the foot as it contacts the walking surface. The definitive component of this resisting force, and the variable most subject to manipulation, is the coefficient of friction of the surface material. Consider, for example, an icy surface with a negligible coefficient of friction. A runner whose forward motion applies a substantial horizontal force will slip-and probably fall-on such a surface. A more careful pedestrian may be able to limit his horizontal force contribution so that it balances the available frictional resistance of the ice and thus cross it safely. Adding sand to the icy surface will increase its coefficient of friction and allow for a more standard gait. Once the ice has melted, the higher coefficient of friction of the newly-exposed surface will offer sufficient resisting force to permit the runner to speed across it without incident.

The dynamic coefficient of friction varies in a complex and non-uniform way. Although R can be calculated and modeled in the laboratory using sophisticated computer programs, the more straightforward measurement of the static coefficient of friction provides a reasonable approximation of the slip resistance of most surfaces and is the method most appropriate for evaluating surface materials and finishes.

A variety of devices are available for such measurements. The most common device, the James machine, was developed in the early 1940s and was the testing device specified by the Underwriters Laboratory (UL) shortly thereafter when it established--from laboratory test data corroborated by field experience--a minimum value of 0.5 for the static coefficient of friction for floor polish bearing the UL seal. Since then, 0.5 has become the commonly accepted threshold for classifying slip resistance in products. Measurement by the James machine, utilizing a leather sensor, is the only method appropriate for assessing surfaces and products against the 0.5 UL standard for static coefficient of friction. Using a different sensor material, even If measured by the James machine, will give a different reading for the same surface material.

This is a significant point. An informal comparison of data collected under three different research protocols, involving four different friction-testers and four different shoe sensor materials, all applied to the same 8-inch by 8-inch ceramic tile surface, resulted in thirty readings ranging from a low of .29 to a high of .99-for its static coefficient of friction. Even limiting values to those measured by the James machine but using both leather and Neolite sensor material resulted in a range of 0.57 (leather) to 0.79 (Neolite) for the same surface being tested.

It is impossible to correctly specify a slip-resistance rating without identifying the testing method, tester, and sensor material to be used in evaluating the specified product and equally invalid to compare values obtained through one methodology to those resulting from different testing protocols. Because a consensus test protocol has not yet been identified, the ADA Access Board did not specify a value or testing method for determining the coefficient of friction along an accessible route.

The James machine continues to be a laboratory mainstay, but is not portable and thus cannot be used in field testing. In order to measure the slip-resistance of surfaces already in place, researchers at The Pennsylvania State University evaluated three portable testers: the NBS-Brungraber Tester (also known as the Mark I Slip Tester), the PTI (Pennsylvania Transportation Institute) Drag Sled Tester, and the Horizontal Pull Slipmeter.

Study criteria included relevance (the measuring results should correlate in a known and constant manner with human perception of the surface slipperiness); versatility (accurate measurements of slip resistance must be possible on various types of surfaces and under diverse conditions); sensitivity to measuring technique (the difference between measurements performed on the same surface and under the same conditions by different persons should be minimal), and repeatability (tests of the same surfaces under the same conditions should be consistent over time). In addition, the reliability and precision of the testers were assessed.

Based on the results of this study, **the NBS-Brungraber Tester was recommended as the best portable device currently available for measuring slip resistance under dry conditions on all but carpeted surfaces.** Easy to use, the NBS-Brungraber testing procedure can be mastered in 30 minutes. It measures the static coefficient of friction between a representative sample of shoe sole material and a flooring surface. The result from the recording shaft is converted into an equivalent value of static coefficient of friction by means of a calibration chart supplied with the tester.

The PTI Drag Sled Tester performed well in the tests but was not commercially available at the time of completion of the report. The Horizontal Pull Slipmeter, which proved to be an excellent device for laboratory measurements of slip resistance, did not produce satisfactory results in field measurements. **Other portable testers that may be used to measure static coefficient of friction include the Mark II Slip Tester (available from the manufacturer of the NBS-Brungraber Tester) and the Model 80 Tester.**

The slip resistance of indoor and outdoor walking surfaces already in place can be measured with one of the portable testers listed in this Bulletin in order to monitor the process of wear and polishing of walking surfaces. An initial reading of the coefficient of friction taken after flooring has been placed and finished will provide a baseline for future comparisons. However, do not attempt to compare such readings to the UL 0.5 coefficient of friction standard or to a manufacturer's slip resistance values unless the same testing methodology, machine, and sensor material was used in each instance.

What values are recommended for ground and floor surfaces along an accessible route? The surfaces of the accessible route on a site or within a building or facility must be designed to provide slip-resistant locomotion for both level and inclined travel by persons with disabilities. Research findings suggest that such surfaces should have a slip resistance somewhat higher than might be provided for individuals without disabilities.

Correlating these values with a single static coefficient of friction (the relationship is complex and non-linear) is inexact and involves some approximation in order to facilitate simplified field testing procedures. In the Access Board research, the static coefficients of friction for a variety of common indoor and outdoor surfacing materials were measured in place using the NBS-Brungraber Tester with a silastic sensor material. Although this machine operates on a principle similar to that of the James machine, the use of a non-standard silastic sensor (instead of the leather required by the protocol for the UL standard) results in significantly higher values for the coefficient of friction of the surfaces being measured. As no correlation was made to any other standards or methodologies in the research, the values for coefficient of friction cannot be compared.

Researchers' recommendations for a static coefficient of friction for surfaces along an accessible route, when measured by the NBS- Brungraber machine using a silastic sensor shoe, were approximately 0.6 for a level surface and 0.8 for ramps. These values are included in the advisory material in the Appendix to ADAAG, but are not in any way mandatory”[10].

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[10] Unites States Department of Justice Bulletin #4 “Ground and Floor Surfaces” (Doc 001)

“The language is not always standard. We speak about surfaces wet with water, for example. Surfaces wet with other viscous materials like break fluid or motor oil are described as contaminated. Water can activate innocuous materials and turn them into dangerous conditions. In fact, it is usually water that activates some second process and creates slipperiness. A floor might be wet with water, but contaminated by a floor finish which emulsified when it got wet”[11].
The duty of a party to civil litigation would be completely different depending which of these hypothetical conditions could be demonstrated.

Testing wet surfaces is difficult for both theoretical and practical reasons. All existing floor test methods depend on the mathematical manipulation of a theoretical model; a shoe and a surface in equilibrium. When a surface is wet, test results sometime show elevated friction levels. This happens for reasons that have are peculiar to floor testing and not surface characteristics. A phenomenon, called covalent bonding, can bind free electrons in the valence ring of the water molecule. Some device manufacturers claim their equipment to be free of this bonding. They are not. Shoe materials like leather might swell when wet, creating still further analytical questions. For this reason, most standards for products exclude wet measurements, or at best, accept them with caution. Paradoxically, though slip accidents usually happen on wet surfaces, most experts agree that standards must be based on the measurement of dry uncontaminated surfaces.

Testing for Slip Resistance (from American Society of Safety Engineers)

“Many slip-and-fall incidents occur as a result of contact with a spot on the floor surface that is unexpectedly slippery, often due to moisture. Currently, only two devices have an ASTM F-13 standard for wet testing: the portable inclineable articulated strut tribometer (PIAST, aka Brungraber Mark II) and the variable incidence tribometer (VIT, aka English XL). Many independent studies have verified the reliability of these devices for wet testing. From forceplate analysis and roughness measurement to testing in workshops conducted by the American Society for Testing and Materials (ASTM) and others, the PIAST and VIT have proven to produce repeatable and reproducible results.

Why can these devices meter wet surfaces more accurately than others? They avoid “sticktion” (also known as “stick-slip”). Sticktion is the result of water being squeezed out of the interface (between the test foot and the walkway surface), creating a temporary bond between these surfaces. Test results of devices subject to sticktion can produce unrealistically high slip-resistance readings on wet surfaces—sometimes producing results indicating greater slip resistance than the same surface when metered dry. Sticktion is a byproduct of residence time, which is any delay between the instant of surface contact and the application of horizontal force. The PIAST and VIT avoid sticktion by applying the horizontal and normal forces simultaneously, thus eliminating residence time and sticktion. A similar phenomenon cited in the literature relating to dry conditions is referred to as “adhesion” (Brungraber). While all F-13 ASTM-recognized

[11] MSDS Waxie Tight Slip-Resistant High-gloss floor finish 29 CFR 1910.1200 (Doc 020)

tribometers can be used for dry testing, remember that dry contaminants can alter test results.

ASTM Tribometer Standards

ASTM, a nationally recognized consensus standards-making organization, is active in the development of slip-resistance-related standards. It currently has eight active standards for six different slipmeters, which include the build-it-yourself horizontal dynamometer pullmeter method (also known as the “50-pound monster”), the no-longer-manufactured horizontal pull slipmeter (HPS), the laboratory-only James Machine, and the proprietary PAST, PIAST and VIT devices.

Some methods are approved only for specific uses. For example, the standard for the horizontal dynamometer pullmeter method (C1028) specifies that this device is approved for use only on ceramic tile and like surfaces. Therefore, using it to test walkway surfaces other than ceramic tile is of questionable validity since the device has been evaluated and approved for use only on this specific material.

Readings on the same surface under substantially identical conditions with two different types of instruments can result in different slip-resistance determinations. For example, tests performed with an HPS and a James Machine on the same surface and under the same conditions can produce different results. Currently, there is no known correlation between these devices; this is because test methods have their own set of biases and operator variability issues, and also because friction is, in part, a property of the system used to measure it.

ASTM F-13 Tribometer Standards

The title of the ASTM F-13 technical committee is Safety and Traction for Footwear. This name is a bit misleading, since its scope also includes safety and traction for walkway surfaces, as well as practices related to the prevention of slips and falls. Currently, five tribometers have an F-13 standard.

James Machine

The James Machine is a laboratory-only device for dry testing in accordance with standard F489, Standard Test Method for Using a James Machine. Sidney James of Underwriters Laboratories developed this early slipmeter in the 1940s. As an articulated strut class of tribometer, the James Machine applies a known constant vertical force to a test pad (leather when evaluating flooring materials), then applies an increasing lateral force until a slip occurs.

The James Machine has several inherent biases, prompting users to make modifications in an attempt to achieve good repeatability on a single instrument and good correlation between several machines. The device needs continuous maintenance and adjustment, in part due to the required release of an 80-lb. weight (ASTM D6205).

Horizontal Pull Slipmeter

This device is approved for dry testing only under standard F609, Standard Test Method for Using a Horizontal Pull Slipmeter (HPS). Charles Irvine developed this instrument in the 1960s. The basic principle of the HPS, a dragsled class of slipmeter, is the pulling of a footwear or surrogate material against a walkway surface under a fixed load at a constant velocity. The HPS consists of a 10-lb. weight onto which a slip index meter is attached. This component is attached to a nylon string and pulled by a capstan-headed motor. Aside from the problem of sticktion that makes this device unreliable on wet surfaces, it raises other concerns.

•Use of a spring combined with the analog indicator makes obtaining a definitive reading difficult.

•Lack of structure between the motor and the meter/weight (a nylon string) can result in operator variances in the application of lateral forces.

•Although other devices are based on similar dragsled technology, the ASTM-approved version of the HPS is no longer in production.

NBS-Brungraber (Mark I)

This device is also approved for dry testing only as the portable articulated strut tester (PAST) under standard F1678, Standard Test Method for Using a Portable Articulated Strut Slip Tester. While working for the National Bureau of Standards (NBS, now known as the National Institute for Standards and Technology) in the 1970s, Robert Brungraber developed this tester. Similar in principle to the James Machine, the Mark I is also an articulated strut instrument approved only for dry testing. It is generally used with a leather test pad. Unlike the James Machine, however, it is portable and can test actual floors; it uses a graduated rod that provides a direct reading from the device. Some calculation is required to convert this to a slip-resistance measurement (Brungraber). Although the Mark I is still in use, Brungraber's subsequent invention, the Mark II, has gained wider acceptance.

Brungraber Mark II

Approved for dry and wet testing as the PIAST under standard F1677, Standard Test Method for Using a Portable Inclineable Articulated Strut Slip Tester, this device was invented by Brungraber in the 1980s. A gravity-based articulated strut device designed to avoid sticktion, the Mark II enables users to reliably meter wet surfaces. It does so by eliminating the residence time (or time delay) between the application of the vertical and horizontal forces. Like the Mark I, it is a portable device. It uses a 10-lb. weight on an inclineable frame, with a test foot suspended just above the walkway surface. Each time the angle is set to a more-horizontal position, the weight is released, until a slip occurs. The slip-resistance reading can be taken directly from the instrument.

English XL

The English XL is approved for dry and wet testing as the VIT under standard F1679, Standard Test Method for Using a Variable Incidence Tribometer. In the early 1990s, William English developed this device, an articulated strut device similar in principle to the James Machine and the Mark II. Unlike those devices, the English XL does not rely on gravity, but is powered by a small carbon dioxide cartridge at a set pressure. This feature ensures consistent operation by the application of uniform force for each test, and it permits reliable metering of inclined surfaces such as ramps (English). Like the Mark II, the application of vertical and horizontal forces is simultaneous, thus avoiding residence-time and permitting reliable measurement of wet surfaces (Powers 373).

Test Pad Materials

Various materials have been used to test for slip resistance, including leather, Neolite® test liner, and various rubbers. Debate continues regarding the most-suitable material.

Neolite® Test Liner

•Despite protests to the contrary, Neolite® was at one time used by the footwear industry as a heel material. Documents from the U.S. Trademark Electronic Search System verify that this material was registered in 1953 by the Goodyear Tire & Rubber Co. for "soles and heels composed of an elastomer and a resin."

•Material characteristics do not change under normal conditions, regardless of wear or moisture.

•Its traction properties are in the median range of commonly used shoe-bottom materials (Goodwin).

•It has been proven reliable and repeatable over many years in service as a friction pad material, as the material of choice for the horizontal pull dynamometer pullmeter, HPS, PIAST and VIT (Vidal 80, 815).

Leather

•Leather is not homogenous. In fact, as it is an organic material, each piece of leather could be considered a unique material.

•Leather is highly absorbent and highly sensitive to humidity. Once leather is used for wet testing, its properties are permanently altered (Bowman, “Legal and Practical”).

•Leather is also not representative of heel material. Most heels are of a synthetic compound. Essentially, slips occur more on the rubber heels of leather-soled shoes.

•Leather can react differently depending on how worn the material has become.

Rubbers

Various rubber compounds (e.g., 4S, Neoprene, Nitrile) have been proposed (and used) as a friction pad material. In most cases, these have been in relation to overseas test methods such as the pendulum tester and Tortus-type devices (see Overseas Standards). Most rubber compounds have a curing period of six months or more during which they are unstable and, thus, unreliable. In addition, there is no source of a consistent, long-term formulation. Many rubbers are among the most slip-resistant materials currently in use for footwear and can provide overly optimistic readings when assessing the slip resistance of flooring materials (James 14). In contrast, neoprene rubber, a specification of some U.S. government shoes, provides low traction on lubricated surfaces. The impact of wear on rubbers is another variable.

Other ASTM Standards

Some standards relating to the measurement of pedestrian slip resistance/surface traction are the responsibility of other ASTM committees, but are usually intended for merchantability of products. Except for C1028, each specifies devices for which ASTM F-13 standards also exist.

•D2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine, is under the jurisdiction of technical committee D21, Polishes. This standard uses the same apparatus as ASTM F489. As a laboratory-based machine, it can be used only on floor samples, not in-service floors. Since the device is subject to sticktion and specifies the use of leather (the properties of which change when wet, delivering overly optimistic readings), this device should be used only to test dry surfaces (ASTM D2047). Setup instructions have never been standardized, an issue made more complex by the presence of at least four different versions of the James Machine, some of which are no longer commercially available. Despite these shortcomings, the device is still used to validate the merchantability of new flooring materials and treatments.

•D5859, Standard Test Method for Determining the Traction of Footwear on Painted Surfaces Using the Variable Incidence Tester, has been transferred from D01, Paints to ASTM F-13.

•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, is under the jurisdiction of technical committee C21, Ceramic Tile. Although often confused with the F609 HPS device (since it operates in a similar way), the manually operated C1028 is a different instrument—a do-it-yourself device. C1028 contains instructions on how to construct and operate the device, calling for an analog dynamometer, Neolite® test pad and 50-lb. weight (ASTM C1028). Because it is not a manufactured device, most C1028 units are unique, increasing the potential for variability in results. Although it is currently approved for wet testing, like other dragsled technologies, the C1028 method produces erratic results on wet surfaces (Guevin 5).

Plans for the ASTM "Gold" Standard

The ASTM Board of Directors appointed a Slip Resistance Task Group to address various slip-resistance issues. In essence, the documents being considered present a relative ranking. Standards may call for the identification of a set of external calibration material sets (footwear- and walkway-reference materials or surrogates) that represent the range (low to high) of pedestrian slip-resistance situations. Following a detailed procedure, a valid tribometer would be required to rank these material sets in their proper order, thereby developing a calibration curve. Once generated for any apparatus, this curve would then be used to verify the instrument or qualify/measure the slip resistance of surfaces, using the reference set of surrogates. Various surfaces or footwear materials tested would be ranked against this calibration set.

If this approach is technically feasible, ranking results may eliminate the need to reconcile the differences in numeric results of the various tribometers. Work continues on this challenging effort"[12].

"The above study only begins the adventure into standardization of the SCOF science.

Two modern devices designed to overcome the adhesion effect are the Brungraber Mark II and the English XL. With these devices, one can more-accurately assess walkway slip resistance under wet conditions. The objectives of this study are to provide Safety, Health & Environment professionals with practical information regarding the use of these devices and to report slip-resistance measurement values for various floor surface materials in "as purchased condition" under wet and dry conditions using both devices.

Discussion

Though designed for the same purpose, the slip-meters tested are quite different in structure and operation. While this study found the slip-resistance readings of the two machines to be fairly comparable, subtle discrepancies in the readings of the two devices were noted, which may be attributable to these structural and operational differences. The following analyses of the results provide some insight into the implications of the use of these devices under various conditions.

For dry testing, slip-resistance readings were found to be marginally higher (+0.03) for the English XL than the Brungraber Mark II. However, a closer look at the results reveals that there are a few surfaces for which this may not be true. For example, the XL did not achieve significantly higher slip readings than the Mark II on textured surfaces such as quarry tile or linoleum. This may be attributable to the greater contact area between the test foot of the Mark II compared to that of the XL. A large test foot, it seems, may be more likely to "catch" on raised portions of a textured tile, thus preventing slippage. So, while the English XL may generally achieve slightly greater slip readings on dry surfaces, it should be noted that textured surfaces may be an exception.

With regard to wet testing, no significant difference was found in the readings of the two devices. However, the Brungraber Mark II did have slightly higher slip readings on textured surfaces than the English XL. As noted, this could be attributable to the greater contact area between the Mark II test foot and the test surface.

While the slip-resistance readings (both wet and dry) of the Brungraber Mark II were fairly comparable with those of the English XL when the grooved foot was used on the Mark II, it does not appear that this would have been the case had the ungrooved foot been used. Used in conjunction with the grooved foot, the Mark II yielded significantly higher readings for both the wet and the dry condition than the same device used in conjunction with the ungrooved foot. For the wet test condition, the slip-resistance values attained by the smooth foot were found to be extremely low. This was not an isolated finding, as Chang's (303+) results also document this phenomenon. Chang reports that the Brungraber instrument yielded a slip resistance of less than 0.1 on wet quarry tile.

[12] American Society of Safety Engineers, June 2002 Volume 47, No. 6 (doc 014) by: Seven Di Pilla and Keith Vidal

An explanation for this finding may lie in the dynamics of this device. During its operation, the entire test foot contacts the test surface at once. As a result, it seems possible for a small amount of water to get trapped between the foot and surface, causing the test foot to hydroplane. Using a grooved test foot seems to overcome this problem because water from the test surface is likely channeled into the grooves at the time of initial contact, allowing the test foot to make better contact with the surface material. Although the grooved foot is obviously preferred for slip-resistance measurements, it is possible that the hydroplaning phenomenon of the ungrooved test foot might be similar to shoe sole/walking surface interactions in certain slip-and-fall situations.

The smooth Neolite® test foot on the English XL does not appear to exhibit this hydroplaning phenomenon. The explanation for this seems to lie partially in the dynamics of the devices. Unlike the Mark II, the test foot on the English XL strikes the test surface at an angle so that the edge of the circular foot strikes the surface before the entire foot makes contact with the surface. This movement pattern appears to displace excess liquid that could otherwise result in **hydroplanin**g.

Conclusion

Although this study is not a substitute for continuing efforts of the ASTM F-13 Committee to assess the English XL and Brungraber Mark II, it nevertheless shows that the slip-resistance readings they produce are generally comparable under both dry and wet conditions, so long as the Mark II is used with a grooved test foot. This means that competent SH&E professionals can now measure slip resistance in the field and assess, for example, slip resistance under wet conditions afforded by alternative floor treatments, finishes or maintenance methods.

Of course, the ability to take measurements does not address the issue of interpreting the data taken with these devices using the Neolite® sensor material. A leather sensor is traditionally used with the James Machine to assess whether or not a floor finish achieves at least a 0.50 static coefficient of friction and can be marketed as “slip resistant”. However, leather is not considered suitable for wet testing because it is highly water absorbent and its physical properties permanently change as it absorbs water. When Neolite® is used with portable slip testers, should the same 0.50 criterion still apply? Should this criterion apply under both dry and wet conditions? These are complex research issues that involve the relationship between the amount of slip resistance task versus the slip resistance under a given set of shoe sole and site conditions, standards related to evolving, with ASSE taking a lead role as secretariat of ANSI A1264.2, Standard for the Provision of Slip Resistance on Walking/Working Surfaces.

Perhaps the most-practical use of these two slip-meters is the assessment of alternative floors, floor finishes and maintenance practices under wet as well as dry conditions. Beyond assessing floors, even greater benefit can be achieved by selecting shoes with appropriate slip-resistant tread and shoe sole material characteristics. With the development of better measurement devices, SH&E professionals will be able to select better floors, floor finishes and shoes that—combined with good housekeeping—can help reduce slip-and-fall injuries.

Why Is Neolite ® Used?

As described in this article, test-grade Neolite® rubber was used as the test foot material. Neolite® is a material with a record of providing reliable and repeatable slip test data in a variety of conditions. The test-grade used for slip-resistance testing is manufactured so that its physical properties (e.g., density and hardness) are consistent across test specimens. Unlike materials such as leather, Neolite® has low moisture absorbency and sensitivity, and its physical properties are not permanently changed when exposed to water. Also, its slip-resistance properties change very little, if at all, as it ages and wears. Neolite's traction properties are considered to be in the medium range in comparison to other commonly used heel and sole materials (it should be noted that a floor surface which achieves a 0.50 value with Neolite® will not necessarily achieve 0.50 with all non-Neolite shoe bottom materials. These favorable properties have helped make it a material of choice for much of ASTM's recent slipmeter test activities. Neolite® is also the standard factory-supplied test foot material provided with the English XL.

How Much Slip Resistance Is Needed?

"Although we often talk about the slip resistance of a floor, slip resistance is actually related to three major factors: 1) surface conditions (i.e., floor material and finish); 2) absence or presence of contaminants (e.g., dirt and liquids); and 3) footwear characteristics (i.e., tread material and pattern). To evaluate the slip resistance of a floor under all variations of contaminants and footwear is impractical. ANSI A1264.2, Standard for the Provision of Slip Resistance on Walking/Working Surfaces, suggests a slip-resistance value of 0.50 for dry occupational walking surfaces as measured according to ASTM standards. This value is the most commonly cited for a surface to be considered slip resistant Depending on the task involved, a slip-resistance value less than 0.50 may be adequate, while in other cases, especially where strenuous push and pull tasks are involved, a value greater than 0.50 may be needed"[13].

From the above study two areas of consideration become clear, ANSI 1264.2 and the effects of **Hydroplaning** (def. To skim along on the surface of the water[14]).

"The American National Standards Institute (ANSI) A1264.2-2001 Standard, "Standard for the Provision of Slip Resistance on Walking/Working Surfaces", of which the American Society of Safety Engineers (ASSE) is secretariat, was approved by ANSI on July 2, 2001 and is now being distributed on a national and international level.

<u>Intent</u>

The intent of this standard is to help in the reduction of falls due to conditions, which in some fashion are manageable. The standards committee offers this standard as the state of the art, however continuing developments are to be expected, and revisions of the standard will be necessary as tribometric science progresses. It is felt, however, that guidelines and recommendations were/are very much needed and that the standard in its

[13] American Society of Safety Engineers, "Field measurements using two modern slipmeters. By" Brian C. Grieser, Timoth P. Roades and Raina J. Shah (Doc 014)
[14] Dictionary.com

present form provides for the minimum performance requirements necessary for increased safety on walking/working surfaces in the workplace. There are three basic overall areas addressed in the standard: 1) provisions for reducing hazards; 2) test procedures and equipment; and 3) slip resistance guideline. The committee is aware of other standards development activities, which have been in development for many years with regard to test procedures and equipment, and opted to reference those standards in keeping with the advancements in this area.

History and Impact on Safety, Health & Environment (SH&E) Professionals

The project initiation of this specific standard was set in motion after a "letter ballot" of the ANSI A1264 Committee approved such action. Following this ballot was registration of the PINS (public identification and number system) whereby public comment and notice were solicited. When the sixty (60) day public notice expired on June 15, 1993, without comment, the project was officially launched with ASSE as the secretariat. As an accredited standard developer, ASSE was approved to act as secretariat for the development of the standard.

The American National Standard A1264.1-1995: Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems, as well as many regional model building codes, OSHA regulations, and other ANSI Standards, use the term "slip resistance." The perceived need for this standard was to further define the term "slip resistance," and to set forth common and accepted practices for providing reasonably safe walking/working surfaces. A1264.2 has taken a step in addressing this need and formalizing a minimum consensus standard which would allow businesses and industry to advance the art of measuring slip resistance on walking/working surfaces, thereby enabling safer workplaces.

The A1264.2 Subgroup was constituted and advertised in accordance with all ANSI guidelines, and the balance of the main committee, is well within these requirements. Specifically:

1. Announcement of the formation of the Subcommittee, along with its scope and appropriate contact information appeared in the 5/14/93 issue of Standards Action, and resulting commentary has been received from around the world, in response to this official notice.

2. The A1264.2 Subcommittee Chairman as well as the ASSE secretariat staff made official presentations mentioning this Subcommittee and the status of the proposed standard, at the November 1996 Conference hosted by the National Institute of Standards and Technology (NIST).

3. Information about the A1264.2 activity was posted on the ASSE Web site, in Professional Safety Journal, and included media statements and releases.

4. The public review announcement of A1264.2 establishment was reported to the 33,000 members of ASSE. There is heavy slip/fall prevention competence among this large group of professionals.

5. On 9/27/96, ANSI published the following seven (7) ASTM standards for general public review in Standards Action as proposed new ANSI standards. The standards were: BSR/ASTM F-1637, Practice for Safe Walking Surfaces; B SR/ASTM F-802 Guide for the Selection of Certain Walkway Surfaces when Considering Footwear Traction; BSR/ASTM F-1240 Guide for Categorizing Results of footwear Slip Resistance Measurements on Walkway Surfaces with an Interface of Various Foreign Substances; BSR/ASTM F- 1677 Test Method for Using a Portable Inclineable Articulated Strut Slip Tester (PIAST); BSR/ASTMF-1 678 Test Method for Using a Portable Articulated Strut Slip Tester (PAST); BSR/ASTM F-1679 Test Method for Using a Variable Incidence Tribometer (VIT); BSR/ASTM F-489 Test Method for Using a James Machine, BSR/ASTM F-695 Practice for Evaluation of Test Data Obtained for Measurement of Slip Resistance of footwear, Sole, Heel or Related Materials; BSR/ASTM F-609 Test Method for Using a Horizontal Pull Slipmeter.

This standard should be of interest to SH&E (Safety, Health & Environment) managers and professionals since it addresses walking/working surfaces in facilities they are potentially responsible for. In addition, SH&E managers on many occasions are called to consult on construction projects and to act as a resource for cutting edge information. Since slips, trips, and falls are leading causes of injuries and fatalities in the U.S., the newly enacted standard could serve as an excellent source of technical guidance information for SH&E managers.

The utilization of national consensus standards has been of increased importance to this country as the economy of the U. S. moves closer to a global perspective. National consensus standards reflect the opinions of the professionals who work at all levels of the public and private sectors in technology development, manufacturing, training, financial analysis, personnel, academia as well as insight from the final end user. This balanced insight enables standards to be crafted in a way, which not only benefits and protects users of the standard, but also furthers the interests of the businesses, which have been created to meet user demand.

It is also important to note the increased utilization of consensus standards in the formulation of public policy, (e.g.: legislation and regulation for occupation safety and health). Governmental agencies such as the Occupational Safety and Health Administration (OSHA), the Consumer Product Safety Commission (CPSC), the National Highway Transportation Safety Administration (NHTSA), etc., have been encouraged to utilize these consensus standards as they provide an efficient/effective alternative to traditional public sector rule making. Such activity has been encouraged since the enactment of (Public 104-113, The National Technology Transfer and Advancement Act of 1995). Such action is also in accordance with the U.S. Office of Management and Budget (OMB) Circular A-119 Federal Participation in the Development and Use of Voluntary Standards. The use of voluntary national consensus standards in regulation has grown as a result of this initiative, and such standards have been cited by government agencies such as the Department of Defense, OSHA, and also by state regulatory bodies.

Key Issues of Discussion Within the Standard

“The scientific investigation of pedestrian safety, by measuring the frictional resistances of walkway surfaces/materials to obtain data and aid in the formulation of a walkway safety code in the U.S., began in the 1920's by R.B. Hunter under project A-22 of the American Standards Association (now ANSI), with subsequent research study fellowships at the National Bureau of Standards (now the National Institute for Standards and Technology - NIST). Subsequently, there have been numerous scientific studies of pedestrian safety, and many slip resistance-testing devices have been developed. Additional standards and related research initiatives have also been undertaken by universities, consensus writing bodies, testing and research facilities, and independent researchers. These studies ultimately produced more questions than answers. However, one common problem was the difficulty in developing an acceptable tribometric device, which would produce valid, reliable, and reproducible results in a field setting under both wet and dry conditions.

During the public review of the standard there were a number of comments and concerns raised with the issue of 0.5 slip resistance criterion, which is recognized in the standard. The A1264 ASC took the position that even though organizations are continuing to investigate the relationship between floor traction and slipping incidents, other organizations have studied the problem in depth for many years. There is a relationship between the slipperiness of a surface and slip/fall occurrences, and there is a significant body of literature and evidence that maintains the relationship does exist. The A1264 ASC took the position that there is a significant body of court precedent recognizing the significance of the 0.5 criterion, and adoption of this threshold is simply recognition of what has been a widely-accepted value over the past half century. The fact is that this standard has put forth specifics as to how the slip resistance of a surface is to be determined, and makes the misuse and misleading interpretations of the standard(s) less likely, not only in the field, but also in the court rooms of America.

In addition to the representative benchmark positions cited in the Rationale statement in the draft standard supporting the 0. 5 criterion, the A1264 ASC also cited several other entries from Government, trade associations and the scientific literature.

1. A study from Winter, 1995 Journal of Safety Research, recognized the 0.5 criterion as being consistently acceptable as the quantitative standard, and a 1983 literature study by Miller indicated that six (6) recognized studies indicated that the 0.5 criterion as being the generally accepted standard.

2. The 0.5 criterion is already recognized by the federal government in Federal Specification P-D-430C per an article in the 10/95 issue of ASTM Standardization News.

3. In the 1/95 Symposia Section of an issue of Standardization News addressing a 10/95 Symposium, ASTM itself recognizes that over fifty (50) years of correlations in laboratory and field experience have identified the 0.5 criterion as being the recognized standard.

4. An article in an ASTM publication indicates that the Chemical Specialties Manufacturers Association has accepted the validity of the 0.5 criterion.

5. An ASTM publication indicates that Underwriters Laboratories has consistently used the 0.5 criterion when addressing slip resistance issues.

Another critical addressed by the A1264 ASC during creation of the standard addressed the using of testing equipment. The A1264.2 standard adopts two F-13 standards F-13 standards by reference for wet testing purposes. These standards are F-1677 and F-1679, both current standards issued by both ASTM and ANSI in accordance with their published guidelines. ASTM requires that precision and bias studies be completed within five years of initial issuance of the standards. As you are aware, that work is already underway to accelerate production of satisfactory precision and bias statements for the two standards.

Of interest is that the standard does not disallow other equipment, and, in fact, does allow for technological advancement. The A1264.2 Subcommittee recognized the expertise of the American Society of Testing and Materials ASTM F-13 Committees in regard to testing equipment. The link for the ASTM F13 Committee for Pedestrian/Walkway Safety and Footwear is:

The A1264 ASC believes the following supports its position:

* ASTM F-13 is the only nationally recognized standards development committee concerned with actual real world pedestrian slip resistance on walkway surfaces as opposed to measurement in laboratories of floor polishes, ceramic tile, painted surfaces, etc...

* ASTM F-13 is the only committee recognized by ASTM as authoritative on pedestrian slip resistance.

* ASTM F-13 is the only nationally recognized standards development committee, which has promulgated standards for use in metering wet walking surfaces.

* Other standards such as the James Machine are not useful on walkways, are excluded from metering wet surfaces, and other equipment (e.g.: Model 80 and the BPT) are not recognized in a standard.

ASTM has agreed that F-13 is the only committee authorized to write standards for pedestrian traction and walkway surface traction. F- 13 is a main committee, not just a subcommittee of material specific main committee. The subcommittees of the material specific committees are primarily concerned with quality control not "field" control”l[15].

None of the above brings the issue to a conclusion, but only fuels the controversy. The ANSI standard was used to create the ASTM protocols for “slip resistance measurement” as we have seen above. The ASTM protocols were then used by OSHA to create standard S-029. We can see the relationship between ANSI and OSHA from this memo:

“It is agreed that:

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[15] American Society of Safety Engineers, PREVENTING SLIPS, TRIPS, AND FALLS IN THE WORKPLACEA1264.2 GENERAL OVERVIEW DOCUMENT By: Keith Vidal, P.E., Chair A1264 ASC (Doc. 013)

ANSI will furnish assistance and support and continue to encourage the development of national consensus standards for occupational safety and health issues for the use of OSHA and others. OSHA will continue to cooperate and assist the ANSI Federation in its mission in a manner consistent with OSHA policy. Such technical assistance and support generally includes but is not limited to the following program activities:

ANSI will encourage its Accredited Standards Developers to provide technical support, as requested, in the development, promulgation and application of OSHA's occupational safety and health standards, such as the preparation and distribution of technical guides, and the development of training curriculums;

ANSI will provide assistance to OSHA, as requested, in connection with the activities of OSHA's standards advisory committees;

As the U.S. member body to the International Organization for Standardization (ISO), the Pacific Area Standards Congress (PASC), the Pan American Standards Commission (COPANT), and the International Accreditation Forum (IAF), and, through the U.S. National Committee, to the International Electrotechnical Commission (IEC), ANSI will be encouraged to participate in the safety and health-related policy-making groups and committees of these organizations. ANSI will provide OSHA with proposed draft international safety and health standards from these organizations. OSHA will provide ANSI with comments on the proposed international standards, and ANSI will provide these comments to the Technical Advisory Group developing the U.S. position on these standards;

ANSI will coordinate the interpretation and rationale of selected American National Standards for OSHA, as requested, in connection with OSHA standards development and compliance activities;

ANSI and OSHA will maintain a mechanism for consultation in the planning of occupational safety and health standards development activities in the areas of mutual concern to the extent consistent with OSHA policy and section 6 of the OSHA Act”[16].

CONCLUSION:

Due to this relationship an alliance of misconceptions became public as shown in the above studies. In so doing the scientific community became aware that there might be a need for further discussion and clarification in the three agencies responsible for setting public policy and laws.

[16] OSHA Memo of Understanding between OSHA and ANSI, January 19, 2001 (Doc 016)

"The United States Department of Justice has made recommendations as to the relative values for slip resistance"[17]. Included is the idea that the SCOF readings are affected by contaminants. This is part of Public Law 101-336. As public law it is mandatory that it become the minimum standard of each state codes. As an example, California has adopted the provisions of the American With Disabilities Act Access Guide as its minimum standard in their Title 24 part 2 of the State Code of Regulation, the Uniform Building Code"[18]

Barrett Miller, BA, Med, OHST "wrote to OSHA on July 28, 2003 in which he described the contradictions and biases present in ANSI 1264.2. He states, "the history of the courts can be fooled" by slip meter evidence. Also, "OSHA research show that on wet surfaces, there is a 400% difference between the readings each other", the machines sponsored in ANSI 1264.2"[19].

"There has been so much negative and contradictory evidence as to the ability to measure SCOF in the field, as well as setting a standard the covers both wet and dry measurements, that upon the mandatory eight year review, ASTM issued an announcement. ASTM standards D5859 thru 96e1, Standard Test Method for Determining Traction Using the Variable Incidence Tester (VIT, Tribometer), ASTM Standards F1678 Thru 96, Standard Test Method for using the Portable Articulated Strut Slip Tester (PAST), and ASTM C1028-96, Standard Friction of Ceramic tile and other Like Surfaces using the Horizontal Dynamometer Pull-meter Method have been WITHDRAWN, NO REPLACEMEN"T[20]

As an example, a slip and fall takes place. The conditions exhibit a high gloss wax coating over a vinyl tile floor.

1. Observations: Witness reports, maintenance logs, wax production documents, evidence that the floor was wet from tracked in rain. The shoes worn by the person, relevant laboratory science, existing performance statutes.
2. Hypothesis: Examining the evidence presented by behavioral scientists a theory of the incident is expertly prepared.
3. Experimentation: Listing all of the variables, a comparison is made to show either an empirical result (when available) or an intellectual, and practical result.
4. Validation: Facility records indicate like accidents.

Take a look again at the waxed floor. The label on the can says UL (Underwriters Laboratory) approved with a coefficient of friction 0.5. Once on the floor the care

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[17] ADAAG appendix A4.5.1 Ground and floor surfaces (Doc 001)
[18] Cal. UBC Title 24 part 2, Vol. 1 1124B (Doc 019)
[19] Barrett Miller to OSHA Docket Office, Re: S-029, July 28, 2003 (Doc 006)
[20] ASTM WITHDRAWN standards 2005 from web-site (Docs 009, 010, 011)

process includes mopping, a look at the MSDS (Material Safety Data Sheet)[21] shows the product to be water-soluble. Which means the conditions change when touched by water, and now the coefficient of friction cannot be measured to confirm the standard on the label was produced from ASTM D2047-04[22] ,a laboratory test, even though Building and Safety Law requires a SCOF of 0.6.

[21] Waxie Doc OMB No 1218-0072 Tight Slip-resistant (Doc 020)
[22] ASTM D2047-04 (Doc 025)