Walkway Surface Safety & Traction in the Workplace

The Rest of the Equation

By STEVEN Di PILLA

Falls in the workplace are the number one preventable loss type, and in public places, falls are far and away the leading cause of injury (RKM 218). More than one million people suffer from a slip, trip or fall injury each year, and more than 16,000 die as a result of falls, second only to automobiles as a cause of accidental death (NSC 8). However, falls are notoriously underreported, since accident rates are normally classified by injury type rather than cause of injury in workers' compensation and National Electronic Injury Surveillance System (NEISS) statistics.

FALL CAUSATION

Four recognized factors affect slip/fall incidents: 1) walking surface; 2) footwear; 3) surface contaminants; and 4) gait dynamics (how people walk). The walking style of pedestrians is largely out of facility management's control, as is footwear in operations that admit the public. However, employers can influence the type of shoes worn by employees in the workplace. Walking surface is universally important—any measures taken to control the presence of slippery contaminants on the walkway can have a major impact on injury rates.

The most-successful fall prevention programs address all three controllable factors. That is, slip-resistant shoes are specified, slip-resistant walking surfaces are installed, and the presence of contaminants is managed through good design, appropriate prevention strategies and prompt response measures.

English's article, "Footwear Safety and Traction in the Workplace" primarily addressed footwear (23-26). This article examines the remaining two controllable components of slip/fall incidents: walkway surface slip resistance and contaminant control.

THE TRADITIONAL PROBLEM

Safety professionals have measured slip resistance in various ways over the years. Scientific literature has identified at least 70 different slipmeters (also known as "tribometers") (English (1996) 3) developed since Hunter built the first tribometer at the National Bureau of Standards in 1929 (Hunter). Currently, at least eight different ASTM tribometer standards are on the books, with more in development.

Many of these standards do not agree, however, and many are of limited use in metering contaminated surfaces. Only two of these standards can be used reliably on wet or oily surfaces, and these are the only two recognized in ASTM F-13 standards (English 23+). Since clean, dry surfaces do not ordinarily present a hazard related to traction, meters that cannot be used to evaluate contaminated surfaces are, in the author's opinion, of limited use to the safety practitioner.

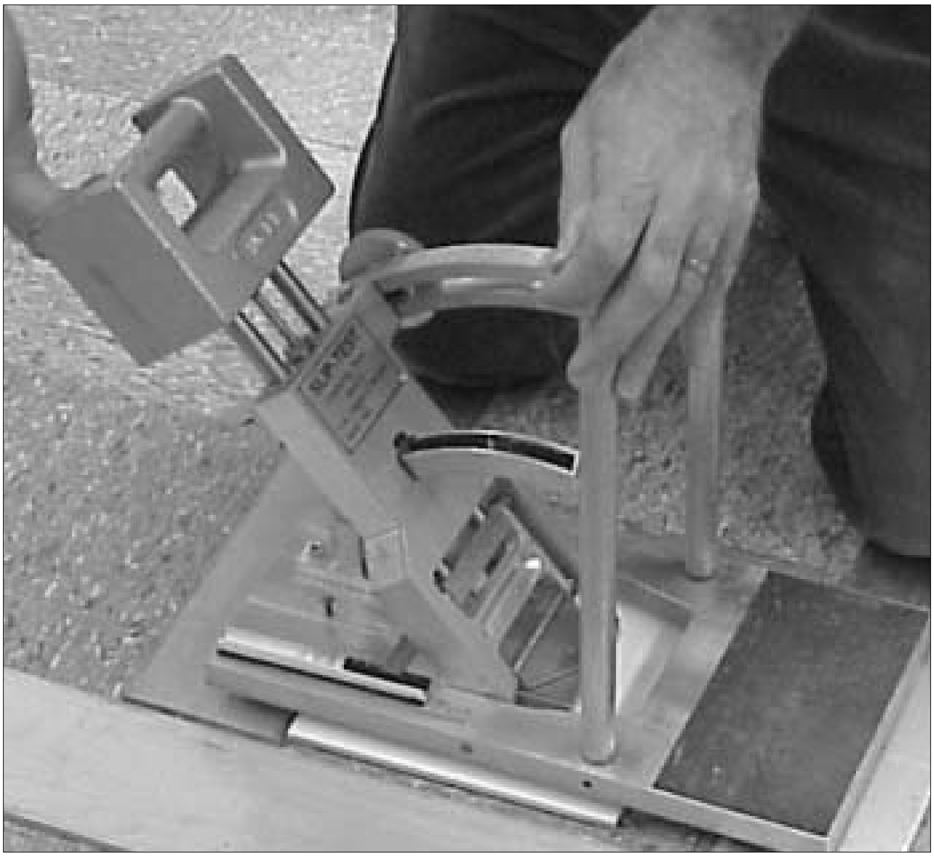
Many safety engineers do not actively use tribometers in their work, perhaps because of the confusion with conflicting standards. They also may understand that traditional meters, such as those based on dragsled principles, have been shown to be unreliable on wet surfaces due to "sticktion."

Sticktion (also known as adhesion) is the result of water being squeezed out of the interface (between the test foot and walkway surface), creating a temporary bond between the two surfaces (Brungraber, et al 23). Instruments subject to sticktion typically deliver unrealistically high slip-resistance readings on wet surfaces, sometimes producing results even higher than the same surface when metered dry.

Sticktion is caused by residence time, which is any delay between the instant of surface contact and the application of horizontal force. Tribometers that can reliably meter wet surfaces are able to avoid sticktion by applying the horizontal and normal forces simultaneously, thus having no residence time—and hence no sticktion (Brungraber).

CONTAMINANTS

The most-effective method of controlling slips and falls due to water and other contaminants is to preclude their presence. However, cleaning up slippery contaminants is not as effective as preventing their occurrence. Aside from immediate clean-up of spills, measures such as repairing leaks, capturing mist at its source, and modifying processes and



Safety professionals can use slipmeters to assess slip-resistance when little or no prior accident history exists, as well as to conduct a thorough accident investigation, assess potential slip-and-fall problem areas and evaluate floor treatment and cleaning products/methods.

equipment to reduce the release of contaminants on walkways is optimal. If contaminants cannot be kept off the floor, management should consider methods for increasing traction.

When removing contaminants from walkway surfaces, methods that use agitation, such as deck brushes, are preferable to less-abrasive methods such as mopping. It can be difficult to properly clean a floor by mopping even when cleaning solvents are used properly.

Mopping has several other disadvantages, such as the tendency of cleaning personnel to neglect manufacturer specifications with regard to square footage covered. Workers often fill the bucket once and mop most or all of an area. This can result in the spread of contaminants to larger areas, which exacerbates, rather than minimizes, the problem.

Even when performed diligently, mopping may fail to agitate the surface sufficiently to remove many contaminants, especially spills that have remained on the surface for extended periods. This is made worse when the contaminated area is the starting point—thus providing a stronger concentration of dirt/grease to spread.

IDENTIFYING ACCIDENT PROBLEMS

With a large enough sample of loss experience to analyze, one can identify accident problems without the use of a tribometer. For example, suppose one is analyzing a large number of similar facilities, such as a chain of restaurants. Some have terrazzo floors, some have smooth quarry tile floors and some have abrasive quarry tile floors. In such cases, one can determine the degree of hazard by floor type. The first step is to identify the type of floor in each facility and track accidents by floor type and exposure.

Tracking Exposure

Determine the exposure basis for each floor type. For most operations, business activity indices can be used to quantify exposure. For example, restaurant operations would use activities such as transaction counts, unit sales or manhours to determine the exposure of people to fall hazards. Exposure is determined by multiplying the unit exposure by the number of units. For example, if the exposure unit is store receipts, it is fairly easy to track the number of falls per million dollars of sales or per million manhours.

Accident rate for each type of floor can readily reveal the extent of fall hazards for each operation. If 9.6 falls per million dollars of sales occur on terrazzo, 7.3 falls per million occur on smooth quarry tile and 4.7 per million occur on abrasive quarry tile, one can determine the degree of hazard for each floor type and prepare accident-reduction action plans.

Fine-Tuning The Analysis

Superior safety engineering results are based on world-class accident analysis. Unless the proper information concerning the circumstances of each fall has been collected, available data will not likely support the rationale for corrective action. Thus, to capture relevant data, accidents must first be professionally investigated.

In most operations, one can identify characteristic patterns of falls that arise from the type of hazards, facility layout and design, and personnel activities. It may be necessary to devise a specific report format to capture the essential information for each fall.

How does one determine what kind of information is important? A good place to start is with an analysis of the last year-end loss run, selecting the most-severe fall cases. The amount paid plus reserve is a good indicator of severity, so it is best to start by reviewing the highest-cost cases. It may be necessary to reinvestigate these few cases to develop an accurate profile. Once enough losses have been reviewed to develop a good picture of recurrent patterns, it is relatively easy to devise a report format that prompts the user to document relevant information.

The next step is to create a coding system that captures relevant information in a database. For example, it might be useful to record time of day; activity being performed by the victim; location within the facility; and floor condition at the time of the fall. Often, selecting the right coding is not a single, straightforward decision. If an employee slips and falls on broken glass and is severely cut, one must look at fall causation as well as ways of controlling the presence of broken glass.

Once proper data are captured by investigation and coded into the database, analysis can be readily performed in considerable detail. Such professional analysis will prompt various remedies and help set priorities so that management can attack the worst problems first, and achieve significant improvement by the most-efficient means.

Prevention Works

Having identified the critical few problem areas, the next step is to develop solutions. Consider this scenario: After realizing that most falls were occurring in kitchen and dining room areas, a hotel chain reduced falls by 50 percent by installing epoxy concrete coatings for floors in kitchen areas; it then virtually eliminated employee and guest falls in dining room areas by installing carpeting.

Through analysis and testing, a large museum determined the dust created by pedestrian traffic on soft stone flooring

Effective fall prevention programs address walkway surface traction characteristics, contaminant control and, where possible, the type of footwear worn in the operation.

contributed to falls when pedestrians walked from those areas into waxed wood floor galleries. Sealing the stone flooring prevented the accumulation of dust on shoe soles, thus significantly reducing the potential for falls.

Footwear

Where footwear can be controlled, specific products should be comparatively tested in the actual work environment. This is an effective way to validate manufacturer claims. Shoes that are effective on kitchen grease may not perform as well in the presence of engine oil or glycerin. Consideration should also be given to the shoe's ability to resist deterioration in the presence of contaminants as well as to its slip-resist characteristics.

ON THE USE OF SLIPMETERS

If accident analysis is of such value, why are tribometers needed? Several reasons can be cited.

•**Little or no prior history.** At times, loss history cannot be analyzed because such information is unknown or unavailable. Examples include new ventures, use of new flooring materials, poor prior accident reporting and investigation procedures, and the acquisition of new properties or business units.

•**Accident investigation.** Any factual investigation may, at some point, be scrutinized through the legal process of discovery (Sherman 37+). Thus, all support for claims, including slip-resistance testing, must be as thorough and accurate as possible. Prompt testing of the area in question can provide strong evidence that the floor surface did not contribute to the accident.

•**Evaluation of floor treatment/cleaning products and methods** (English (1996) 81). Slip-resistance testing can provide a means to directly compare the relative effectiveness of current or proposed floor treatments, cleaning products and cleaning methods upon application and over time.

The systematic approach to selecting an effective floor treatment or to evaluate a cleaning regimen is a controlled evaluation. Finding the right product involves a process of elimination. Working with a professional enables one to document the steps that support a given floor treatment recommendation.

1)Develop a list of potential floor treatment products based on flooring type and use, and the appropriateness of the particular treatment.

2) Review application and maintenance requirements. Methods vary by type of treatment; some are easily applied by users while others require professionals. The facility must be able to accept the care, cleaning and maintenance requirements.

3) Apply and test products on a small sample of the given flooring to narrow the field. This is best performed by a professional trained and experienced in the use of the tribometer being used.

4) Conduct a 30-day trial of products that have performed best to this point. Monitor results by re-measuring slip resistance and heeding employee feedback. This will narrow the field to a short list of products, which should then be tested for an extended period (at least 90 days).

•**Problem identification/prevention** (Vidal 8512). To take corrective action, one must first know where problems exist. Slip-resistance testing can help identify problem conditions before they produce accidents. High-traffic locations, entrance/exit areas and areas where history indicates problems may exist should be assessed.

•**Claims defense and documentation** (Vidal 8513). Performing and documenting periodic slip testing on surfaces that may be subject to slip-and-fall claims as part of an ongoing prevention program can help minimize claim occurrences and costs. It can also demonstrate a good-faith effort to prevent fall accidents.

CONCLUSION

To achieve significant reductions in accidental losses, risk managers and safety professionals must identify loss problems through analysis, establish priorities and attack the worst problems first. Falls are the dominant controllable loss type in most types of businesses, whether the exposure is highest to employees, customers or both. Fall prevention programs must address walkway surface traction characteristics, contaminant control and, where possible, the type of footwear worn in the operation.

Floor traction properties can be measured with tribometers and shoe traction properties can be compared in hazardous environments. Selection of slip-resistant floor materials, finishes and footwear can have a significant impact on a company's performance relative to overhead and budget. Safety practitioners whose results support the operation's management objectives tend to be appreciated as valuable players on the management team. ■

REFERENCES

Brungraber, R. "A New Portable Tester for the Evaluation of the Slip-Resistance of Walkway Surfaces." National Bureau of Standards Technical Note 953. Gaithersburg, MD: National Bureau of Standards, July 1977.

Brungraber, R., et al. "Bucknell University F-13 Workshop to Evaluate Various Slip Resistance Measuring Devices." *ASTM Standardization News.* May 1992.

English, W. "Footwear Safety & Traction in the Workplace." *Professional Safety.* April 2000: 23-26.

English, W. *Pedestrian Slip Resistance: How to Measure It, How to Improve It.* Alva, FL: William English Inc., 1996.

Hunter, R.B. "A Method of Measuring Frictional Coefficients of Walkway Materials." *Bureau of Standards Journal of Research.* March 1929.

National Safety Council (NSC). *Injury Facts.* 1999 ed. Itasca, IL: NSC, 2000.

Richard K. Miller & Assoc. (RKM), ed. *Industrial Safety & Occupational Health Markets.* Norcross, GA: RKM, 1999.

Sherman, R. "Role of the Expert in a Slip-and-Fall Lawsuit." *Professional Safety.* Jan. 1999: 37-39.

Vidal, K. "Slips, Trips and Falls." *CCH Safety Management Handbook.* Riverwoods, IL: CCH Inc., 1998.

***Steven Di Pilla,** ARM, AIC, AMIM, CST, is director of product development and training for risk control services with ACE USA in Philadelphia. In this position, he is responsible for identifying and filling staff needs for all lines of business by researching technical issues and developing references, training and certification programs, standards, loss analyses and external publications. Di Pilla currently serves as chair of ASTM Subcommittee F13.10 - Traction, the primary focus of which is the study of slip resistance. Di Pilla holds a B.B.A. in Property and Casualty Insurance from the College of Insurance. He is a member of ASSE's Penn-Jersey Chapter.*

READER FEEDBACK

Did you find this article interesting and useful? Circle the corresponding number on the reader service card.

YES	31
SOMEWHAT	32
NO	33