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Drawing the Big Picture for Slip, Trip, and Fall Prevention

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Approach

Do you have effective slip, trip, and fall prevention measures in place in your facilities? Are you following a systematic approach? When someone in your organization mentions a slippery floor or a trip hazard, are they likely to be taken seriously if no one has yet experienced an injury? Are there spots in your facilities where it's accepted that a floor is slippery but nothing is being done about it?

A systematic approach can be facilitated with the use of several key consensus standards focused on pedestrian safety. Rather than beginning with a blank sheet of paper, these standards can form the framework for effective proactive prevention efforts.

A proactive approach to prevention of slips, trips, and falls is the responsible way to tackle this ever-present issue. Many organizations follow reactive approaches, and essentially are waiting for accidents to happen. Taking the time to proactively identify hazards is time well spent, considering the alternative of responding to litigation, or workers compensation discovery requests. Once a claim has been filed and litigation is initiated, your valuable time will be spent: looking through and for records and answering interrogatories; preparing for and giving depositions, not only your own, but other personnel who's time could certainly be better spent; and sitting through a trial waiting to be cross examined by an unfriendly attorney. Not to mention the pain and suffering incurred upon the victim of a fall, which could have been prevented had appropriate and timely measures been taken.

The first step toward reduction of any significant accident type is to do a thorough analysis and rank loss types in order of their magnitude in loss dollars. In many instances this analysis will show that a fall safety and control program will be a high priority, often the first priority. Such an analysis will validate the allocation of resources to show management not only what falls are costing them but what cost-efficient means can be implemented to reduce their losses.

A fall analysis will examine where falls are occurring and potentially the demographics of persons falling. You can then look at floor type, contaminants present on the floor, the footwear being worn, and other potential factors. Once a thorough accident analysis has been performed,

remedies to the major problems will begin to suggest themselves, and you will be able to pursue possible fixes that appear most practical.

Well designed facilities can still be susceptible to frequent falling incidents. It is therefore necessary to implement an appropriate management control program, which maintains a facility in a condition that is as free of falling hazards as is reasonably possible. The scope and size of management controls may depend on a number of factors including: the size of the facility and its grounds; the amount of pedestrian traffic and the demographic makeup of that traffic; the familiarity of the pedestrian traffic with the facility and its surroundings; the type of hazards and extent of environmental exposure and influence.

It is reasonable to assume that high pedestrian traffic flow areas are more susceptible to falling incidents. And it is equally reasonable to assume that the longer a given pathway is, the likelihood of any given person falling becomes greater[1]. Inspection and maintenance programs should take these assumptions into consideration, by focusing appropriate resources toward high traffic areas and longer pathways that are exposed to changing environmental factors, and/or are comprised of surfaces that have differing traction availability, and/or changes in levels along the pathways, and/or have impediments or hardware integrated into them that may create slipping or tripping hazards.

Understanding the risk category

Slips arise from a failure of traction on the interface between the footwear and the walking surface. Many falls occur as a result of the human expectation of consistent frictional qualities on a walking surface, when a localized spot of lowered slip resistance (e.g., a wet spot) is encountered on a walking surface. The difference in available traction (slip resistance) on the dry floor versus the wetted surface creates a hazardous condition because many people are unable to physically and mentally compensate for the difference in available traction.

Trips occur when a pedestrian's foot is hindered during the walking process, usually as a result of striking some type of obstruction. Taller obstructions, more abrupt level changes, and surface anomalies that are more difficult for a pedestrian to see are the most problematic. One must remember that pedestrians generally look toward their objective as they traverse a surface. They do not tend to look at the floor immediately in front of them unless something causes them to look there. What may be obvious to persons who are familiar with a walkway, may be nearly invisible to one who is not familiar. And even if one is familiar, distractions and objectives can cause one to lose track of where the "hidden defect" is, and still represent a significant hazard.

Stumbles (sometimes referred to as *miss-steps* or *air steps*) are sometimes categorized as trips, yet they are different in that they occur not because of an obstruction but because of an unexpected condition or anomaly that disrupts a person's normal gait. Stumbles can be initiated in instances where unseen elevation changes occur e.g., on stairs where improper stair geometry exists, or where an unseen single riser or small change in elevation exists.

As people grow older, the ability of the mind and body to quickly compute what is happening when a fall initiates, and then physically recover, begins to diminish. This is why the statistics

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[1] Barnett, R.L., Glowiak, S.A., Extreme value formulation of Human Slip – A summary, Safety Brief, Vol. 27, No. 4, June 2005, Triodyne, Inc., Northbrook, IL, 60062

show that older people are involved in a greater number of fatal and disabling falls. The mind and body aren't as sharp as they were when we were younger. Our bodies become more fragile and brittle as we age, and the energy of a fall tends to break bones and joints more readily.

There are several reasons why falls are greatly under-reported as an accident type and their importance disguised. In the first place, accident analyses are usually derived from workers compensation data, which are injury statistics rather than accident statistics. The report forms ask general questions about injuries, not about the accidents that initiated the injury occurrences. Workplace loss databases are normally compiled from employers' first reports of injury, which are usually filled out by a plant nurse or a supervisor, using forms that don't even ask the right questions (their content being more concerned with matters not directly related to accident prevention methodology.) And if you don't put proper accident data into your database in the first place, no matter how you analyze it you can't define safety problems so as to be able to devise effective control measures.

Most accidents are not investigated by someone having been trained to trace the proximate cause of an injury-causing incident. Many secondary injuries that are initiated by slip occurrences are reported as cuts, burns, bruises and fractures rather than as having arisen from a slipping incident. If a waitress slips on a greasy floor while carrying a pot of hot coffee, which breaks and burns her, it is likely to be reported as a second-degree burn, with no mention of the slip. An analysis based upon the forms filled out after the incident may suggest coffee pots are dangerous rather than the more relevant notion that the floor is dangerous.

Another noteworthy point is that many slips, stumbles and falls never get reported because the person was either able to recover, or fell, but was not hurt. Most people after falling (and not being seriously hurt) feel embarrassed and get up and leave the scene as quickly as they can.

Slips and Traction

It is generally recognized that there are four factors that affect footwear traction: (1) the floor surface, (2) contaminants on the floor, (3) footwear, and (4) gait dynamics.

Slips occur due to the fact that the available traction is less than the required traction. A significant number of slips and falls result from wet or otherwise contaminated surfaces. One of the most significant properties of a floor that makes it slip resistant in the presence of contaminants such as water or oil is its surface roughness. On a microscopic scale all surfaces have asperities, and it is these asperities that must be tall enough and sharp enough to extend upward through a contaminant to engage the shoe bottom. Therefore, it is important to select flooring materials that are sufficiently rough with durable micro-peaks that will protrude through a contaminant and engage or dig into the shoe bottom. The trade off here is that rougher surfaces can be more difficult to clean, but with proper maintenance and cleaning procedures this should be of minimal consequence.

To date, direct measurements of surface roughness have not been able to fully predict the traction properties of a surface because although the height and amount of micro-peaks can be determined, the shape and orientation of the micro-peaks cannot be measured easily. Most instruments that measure surface roughness rely on a mechanical stylus to trace the profile of the

surface, and there are inherent limitations of the mechanics of that interface and the computations of roughness that are used to arrive at results.[2]

Slip resistant flooring can be a considerable engineering challenge. In many instances the designer is concerned about factors other than pedestrian safety. Pedestrian surfaces should be durable, cleanable, and maintainable. Many designers and specifiers of building materials are primarily concerned with whether the floor is aesthetically pleasing. Building codes alone are seldom sufficient assurance that a floor surface will have appropriate traction for the application.When building codes require slip resistant surfaces be installed on certain surfaces, they generally do not define "slip resistant", what it means, or how it should be measured.

Our expectation of consistent surface traction characteristics can result in a slip if we step onto a wet or otherwise contaminated spot without realizing its presence (See *Understanding the risk category*). It is possible to walk on a slippery surface without falling down, if one knows that the surface is slippery. Prior knowledge of similar surfaces and conditions dictates our expectations of how that surface will perform under our feet. That knowledge assists us in adjusting to a reasonable walking speed and an appropriate length of stride.

Floor Factors

As a general guideline most floor and walkways should have a slip index of 0.5 or greater under normal or expected use conditions. What method is used to derive this measurement is an important consideration, and should be carefully selected. The discussion of methods for testing is a topic unto itself and is worthy of the attention of the safety professional (See the Maintenance and Housekeeping section below, as well as "**State of the Art in Slip-Resistance Measurement: A review of current standards and continuing developments"**, Loss Control Quarterly, Jan. 2006, Vol. 17, Number1, CPCU Society, by Vidal and DiPilla.) The American National Standards Institute (ANSI) *Standard for the Provision of Slip Resistance on Walking/Working Surfaces ANSI A1264.2-2006* has significant discussion on this topic. and should be used as a guide in selecting an appropriate tribometer for the determination of a floor's slip index.

It is also important to select materials that are durable enough to maintain their frictional qualities over the life of the facility, or the owner should be prepared to rejuvenate the surface on a regular basis Of course there are exceptions to this recommendation. For example, a floor in a bowling alley approach is expected to be constructed of material that allows the bowlers to slide as they deliver the ball. Dance floors are another example of a surface where a slip index below 0.5 would be warranted. On the other hand an outdoor ramp is an application that may require a slip index greater than 0.5.

Effective surfacing applications and/or treatments are available that can impart enhanced slip resistance to many hard flooring surfaces. Particularly in the realm of surface treatments that claim to leave the surface appearance unaltered, promising results on one specific surface cannot be extrapolated to accurately predict performance on different surfaces. It is wise to use a qualified professional to assist in selecting any treatments. Test patches of various applications and/or treatments can reveal just how effective it is on a given floor. Slip resistance testing of the

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[2] ISO 3274 and ISO 4288 *Dimensional and geometrical product specifications and verification; guidelines for measurement of surface roughness*, 1996, International Organization for Standardization, Geneva, Switzerland

patches can be helpful when comparing a treatment's long-term effectiveness, by performing slip resistance testing on the surface after it has been in service for some time.

Mats and Runners

Although they are considered somewhat of a band-aid fix, mats and runners are used to enhance slip resistance and reduce the tracking of contaminants into a facility. Mats and runners should comply with Section 4 (Walkway Surfaces) of ASTM F1637-95 *(Practice for Safe Walking Surfaces*),[3] and Section 4.5 (Ground and Floor Surfaces) of ANSI A117.1-1992[4] (*Accessible and Usable Buildings and Facilities*). Both of these standards discuss appropriate installation and maintenance practices.

Mats and runners are used for temporary situations as well as in semi-permanent applications. Carpet on the other hand is considered to be permanent in nature. Mats and/or runners placed at building entrances help remove moisture and particles from the bottoms of footwear and help keep the floor in a clean and dry condition. Mats or runners may be required during wet or inclement weather conditions, or when such conditions have been forecast. Mats and/or runners should also be considered for use in areas where it may be foreseen that operations may produce slippery contaminants or foreign materials on walking surfaces. Examples of areas that may benefit include: machinery process areas; areas adjacent to water fountains and icemakers; near food counters and food preparation areas; under and around sinks; water and beverage serving stations: and near any machinery or other areas where spills may occur and are part of the workplace.

Improperly installed mats and runners can create tripping hazards. Selection of mats and runners with stiff rubber edging is advisable when the mats or runners are not recessed, making it unlikely for the mats to roll up, curl up, or bunch up, and create a tripping hazard. When mats and runners are not recessed, they should be adequately secured against movement. Some mats are manufactured with slip resistant backing; however they can still slide on some surfaces. Mats that slide are hazardous and should be removed or properly secured. Mats are generally not recommended for use on top of carpet, as they can present a tripping hazard.

Mats and runners require routine inspection and maintenance. There is the additional risk of material handling issues from lifting, carrying, and cleaning mats. Mats that have become saturated are incapable of performing their intended function and should be removed well before becoming saturated. As a general rule of safe practice, footprints should not be seen on the floor surface beyond the last mat of an entrance. Rotation of mats can provide more even wear and prevent corners or edges from curling. Heavily worn or frayed carpet or mat fabric should be discarded and replaced.

Food courts, concession areas, and areas near ice machines or water fountains require special precautions. These areas are especially conducive to spills and contaminants creating a hazard that service personnel can't clean up as soon as it hits the floor. If these areas do not have slip

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[3] ASTM F 1637-95 *Practice for Safe Walking Surfaces*, American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.

[4] ANSI A117.1-1992, *Accessible and Usable Buildings and Facilities*, Council of American Building Officials, 5203 Leesburg Pike, #708, Falls Church, VA 22041.

resistant flooring installed it is necessary to implement supplementary control measures including the use of mats or slip resistant surface treatments.

Inclement weather considerations
Where snow and ice exists on pedestrian walking surfaces, safe maintenance techniques including: plowing, shoveling, deicing, salting, and sanding can, and should, be utilized. Various deicing chemicals are commercially available to assist in the melting of snow and ice, and should be used proactively when inclement whether is forecast. Deicing chemicals should also be used in areas where melting has occurred and dropping temperatures can be expected. Avoid having snow piles placed uphill of where melting snow can run across walking routes and refreeze, if at all possible. Plan ahead with snow removal crews to determine the best areas for snow pile deposits, keeping in mind that the piles should be located in locations that utilize available drainage facilities efficiently.

Lighting
Pedestrian walking surfaces should have adequate lighting as lighting can be a contributing factor in any fall. A person's ability to see changes on a surface, whether elevation or perceived traction, assists a person in avoiding defects or anomalies, and assists in reconnoitering the surface safely. Lighting levels should follow the recommendations and standards published by the Illuminating Engineering Society of North America (IESNA).

Consideration should also be given to lighting level transitions along pedestrian pathways. Transitions should be as gradual as possible so that the pedestrian’s eyes can adjust to new light levels. Visual cues and barriers can be used to slow pedestrian traffic giving them more time to adjust to different lighting levels.

Shadows created by artificial and natural lighting can mask hazardous conditions. For example a light at the top of a stairway can create a shadow that makes it difficult for a person to discern the noses of a set of steps. On the other hand, glare can also cause a blinding effect that can increase the potential for a fall.

Footwear
The floor and its condition are not the only factors that determine its slip resistance. A pedestrian’s shoe bottom material is significant although it is often beyond the control of the premises owner, especially in publicly accessed buildings. Bathrooms and pool decks are areas where it would be foreseeable that pedestrians would be barefoot. Hotel/motel rooms and hospital rooms are examples of areas that would be expected to be used by pedestrians in stocking feet or fabric-soled slippers.

Many work environments are conducive to the control of footwear that is being worn. In those environments, consideration of the footwear with respect to slip resistance is recommended, including the required use of special shoes, or overshoes, when inclement or extreme conditions exist or are anticipated. Specifying the type or characteristics of footwear for employees is one part of this equation; ongoing checks of footwear complete the picture. These checks allow an employer to make sure that their workers are wearing the appropriate shoes, that they are being worn properly, and they are not worn out.

Consideration of the foreseeable factors or conditions in which the footwear will be worn is advisable. These include: types of flooring, potential contaminating substances, and the types of tasks required or performed.

Footwear traction considerations include: slip resistance, tread design, tread hardness, shape of sole and heel, abrasion resistance, oil resistance, chemical resistance, heat resistance, etc. Some of these characteristics do not have consistent consensus standards across industry, making selection difficult. A field test of prospective products before implementation can be important in this regard.

Walking Style Factors

The manner in which a pedestrian walks has an affect on their likelihood of experiencing a slip, trip, or fall. There are a number of factors that come into play, including speed, changes in direction, and the manner in which obstacles are crossed.

Typically there is much more that can be done to control this with employees than with the public, but that does not mean that there is nothing than can be done through facility design and layout to influence how people walk. One example of design that influences walking style would be a deliberate interruption in the straight-line path of travel where a carpeted area transitions to a smooth floor, which would both moderate the speed of the pedestrian and bring attention to the change in floor surface.

For protection of workers, it is possible to go one step further and conduct training on avoidance of slips, trips, and falls. One obvious element of this training is the importance of walking versus running, but there is much more. Workers can be taught how to best traverse obstacles on the floor, what the "early warning signs" of a slippery floor are, and how to alter their stride to negotiate floors that they know are slippery. Ultimately, this walking style training also helps a workforce and their management see the interplay of factors in slip, trip, and fall prevention and do a better job at things such as spill response.

Trips

Trips account for a significant portion of the general statistical category of falls and as such should not be discounted. However, trips can also be initiated in instances where unseen elevation changes occur, and on stairs where improper stair geometry exists.

Unseen elevation changes include expansion joints, and other transitional edges, where settling of a surface has created a raised edge. Transitions between concrete and asphalt that are poorly constructed or maintained can develop cracks, ruts and other discontinuities that can be hazardous even if they seem to be open and obvious. Elevation changes of up to 1/4 inch are allowed by Federal guidelines and the voluntary consensus standards, but can still present an unwanted trip hazard. Anything over 1/4 of an inch requires remedial treatment and should comply with the *Americans with Disabilities Act (ADA)*,[5] *ANSI A117.1-1992*,[6] and *ASTM F-1637*.[7] Changes in

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[5] *Americans With Disabilities Act* (ADA), Public Law 101-336, 7/26/90. Federal Register/ Vol. 56, No. 144/ Friday, July 26, 1991/ Rules and Regulations.

[6] ANSI A117.1-1992, *Accessible and Usable Buildings and Facilities*, Council of American Building Officials, 5203 Leesburg Pike, #708, Falls Church, VA 22041.

levels between 1/4 and ½ inch should be beveled with a slope no greater than 1:2 (rise: run). Changes in levels greater than ½ inch should be transitioned by means of a ramp or stairway that complies with applicable building codes, regulations, standards, or ordinances, or all of these.

Tapered curbs, built-up curb ramps, returned curbs and flared-side ramps are examples of applications where the use of yellow paint is advisable to demarcate transitional edges. The slope of any ramp should be in compliance with the above cited references.

Walking surface hardware that is in foreseeable pedestrian pathways should be maintained flush with surrounding surfaces. The use of speed bumps should be avoided, but in the alternative they should comply with slope and transitional requirements, and in addition they should be painted a contrasting color. It is advisable to use abrasive additives to the paint in such an application.

Short flights of stairs (three steps or fewer) are another area where trips can occur, and as such should be avoided if at all possible. Changes in elevation of this magnitude are often not perceived by pedestrians and as such create an accident waiting to happen. Short flights are much more likely to present a stumbling hazard for a person going down them, than for a person going up them. They are generally more visible from the lower surface than the upper surface, and there is less likelihood of injury when a person falls up the stairs than down them. Where short stair flights are used additional measures must be taken, including the use of handrails, delineated nosing edges, tactile cues, warning signs, contrasting surface colors, and accent lighting. Research has shown that the use of darker carpet colors and patterned carpets make it more difficult for pedestrians to perceive elevational changes and stair tread nosings. Therefore their use is not recommended on any stairs, whether they are short flights or not.

Wheel stops are a recognized trip hazard and their use is discouraged. The use of wheel stops should be limited to applications where the wheel stop is protecting something that cannot feasibly be protected by other means. Appropriately marked bollards, not less than 3 feet 6 inches in height are an acceptable alternative to wheel stops. When used, wheel stops should be of a contrasting color to the surface on which they set. Wheel stops in use should be appropriately maintained. They should not be longer than 6 feet, with no less than 3 feet between wheel stops. They should not be more than 6.5 inches above the parking surface, and they should be adequately illuminated.

Gratings are another area where trips as well as slips can occur. Aside from being slip resistant, they should not have openings wider than ½ inch in the direction of predominant travel.

Ramps

A significant number of falls occur each year on ramps, many of which could have been prevented had good design practices been employed. Any surface with a slope greater than 1:20 (rise: run) is technically a ramp. The National Building Codes, Federal Guidelines, The National Fire Code (Life Safety Code), and various voluntary consensus standards all address ramp construction. What is important to stress relates to the visibility aspects of ramps as they are inherently less obvious and can be difficult to highlight.

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[7] ASTM F 1637-95 *Practice for Safe Walking Surfaces*, American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.

Many falls occur on ramps as a result of people tripping over the edges of them or slipping because the grade is to steep or the surface is too slippery. Ramps that are intended for disabled persons should have a maximum slope of 1:12. This ratio refers to the rise:run of a sloped surface. So, a 1:12 slope would be one inch rise in 12 inches of run. Although older codes and space limitations allow general usage ramps to have a slope no greater than 1:8, this is a fairly steep slope. If space allows, a ramp should not be sloped greater than 1:12. The flared sides of ramps, or shoulders, must be properly sloped. The Americans with Disabilities Act and the ANSI A117.1-1992 Standard specify a maximum slope of 1:10 for flared sides of ramps, however a lesser slope of 1:12 makes a much easier transitional surface. Flared sides of ramps should also be demarcated with abrasive yellow paint as a visual cue.

Depending upon the design configuration and the application, the Codes may require the use of handrails. Curb-cut and built-up curb ramps should not have handrails as they can become hazardous obstructions. Constructing ramps of concrete is preferred as the walking surface can be brush finished for slip resistance. Asphalt ramps are discouraged as asphalt can be slippery, especially after a long awaited light rain.

Prevention Program Elements

Identify high hazard areas where falls may have occurred before, or where conditions are more obviously dangerous. High risk areas should be easily recognizable from fall incident data and accident records.

Identify potential risk areas that may be contaminated due to processes (e.g. grease, oil, food, in plants, kitchens, etc.) Areas that can be contaminated by environmental conditions (e.g. rain, snow, dirt, on sidewalks, walkways, ramps, etc.) Potential risk areas require some knowledge of safety and the conditions that are foreseeable in an environment. These areas can be considered safe until some change results in increased risk. In other words the conditions are transient and can arise expectedly or unexpectedly. Use this chapter or the cited references (especially ASTM F 1637[8] and ANSI A1264.2) as aids in identifying hazards and potential hazards.

There is no set rule as to what difference in slip-resistance of wet vs. dry conditions will cause a fall. However, it is a fact that unseen or unexpected changes in available friction can and do contribute to falls. These changes in available friction in many instances are the result of the presence of some kind of contaminant. They can also be present on surfaces where the surface material transitions from a higher slip index to a lower slip index, i.e., a carpet to marble floor transition. Consider the type of persons, tasks, abilities and disabilities of people that would be expected to use the surface.

Evaluation of walking surfaces with appropriate tribometers under foreseeable conditions will yield values of slip resistance for those surfaces. A minimum slip resistance value of 0.5 is recommended for most environments, although other factors should be considered in certain environments.

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[8] ASTM F 1637-95 *Practice for Safe Walking Surfaces,* American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.

The philosophy of just doing something once and then forgetting about it is an irresponsible philosophy especially in the field of safety. An effective safety program continues to strive for excellence. Periodic testing and evaluation is part of this process. Through periodic testing and evaluation various insights can be gained that would otherwise go unnoticed until after an accident occurred. Things such as: the consistency of maintenance methods and materials; deterioration of slip resistant properties; or the presence of contaminants from housekeeping or indoor plant care operations may be uncovered.

Maintenance and Housekeeping

In many instances businesses acquire existing properties where a slippery floor was installed, and in other instances safe floors can be made hazardous by faulty maintenance practices. Once a determination has been made of what cleaners, chemicals and finishes are going to be used, all of the Material Safety Data Sheets (MSDSs) can be gathered and put with any other MSDS. These product/processes determinations should be based upon (if at all possible) the material manufacturers' literature and/or recommendations.

Technical assistance should be obtained from suppliers for appropriate materials, equipment and methods. Beware of the promotional literature that is published by manufacturers of flooring products regarding slip resistance of coefficient of friction, as it can be misleading. Many manufacturers report values of slip resistance (or static coefficient of friction, or SCOF) as 0.5 minimum (ASTM D2047). Unfortunately most people aren't aware of what this statement really means. The ASTM D2047[9] test method is for testing polish coated floors, and is performed under dry conditions only. The *slip resistance* of the surface under wet conditions may be substantially below the 0.5 value reported in the manufacturer's literature. Independent testing of these materials using tribometers that are appropriate for wet testing should be considered. See ANSI A1264.2. If a polish coated floor is dry, it will pose little risk of causing a slip. However, a wet polish-coated floor can be very slippery.

Once materials, equipment and methods have been selected, any prospective process should be tested in actual operation under all expected environmental conditions. This verification of the efficacy of the program is an important step in implementing and adapting the most appropriate and safe processes.

Once the methods and materials have been decided upon, a clear, written procedure should be made available to all parties involved in the process. A written cleaning and maintenance program is essential in establishing an effective slip prevention policy. Operations management personnel should devise an effective training procedure, which is then monitored and supervised by a designated person. The responsibility and accountability aspect is important because many programs that are "everybody's responsibility" are really nobody's responsibility.

Written maintenance procedures should specify cleaning and maintenance procedures including immediate response, routine operations, remedial measures and reporting requirements. Written programs provide a higher level of consistency and quality. The program should describe materials, equipment, scheduling, methods, and training of those conducting housekeeping. Procedures should be reviewed on a regular basis and updated as necessary so that an effective program is maintained. Certain spills involving hazardous chemicals may be subject to regulatory reporting. Occasional testing of pedestrian walking surfaces should be performed to monitor slip resistance levels as some applications, treatments or coatings can deteriorate over

time. They can also be incorrectly applied and maintained. Occasional testing can reveal flaws in these processes.

Housekeeping staff and other persons with responsibility of a given area should be trained to:

- Inspect walking surfaces and recognize appropriate maintenance and cleaning requirements;
- Inspect walking surfaces and be knowledgeable of appropriate maintenance and cleaning procedures;
- Safely handle and dispose of chemicals and/or solutions, and have appropriate hazard communication training (HAZCOM);
- Safely operate maintenance and cleaning equipment;
- React appropriately in emergency conditions and operations; and
- Keep appropriate reporting records relating to housekeeping and maintenance.

Housekeeping conditions should be monitored by an authorized person who can promptly initiate corrective action including:

- Inspection of pedestrian walking surfaces;
- Notification of responsible personnel; and
- Placement of signage, barriers or personnel until a hazard has been remediated.

Anytime any leaks or spills are left on a floor, there is an increased potential for slips and falls. Leaky or condensating pipes, windows and skylights can be unwanted sources of moisture which should be repaired or maintained immediately.

Food courts, concession areas, and areas where ice machines or water fountains are, require special precautions. These areas are especially conducive to spills and contaminants creating a hazard that service personnel can't clean up as soon as it hits the floor. If these areas do not have slip resistant flooring installed it is necessary to implement supplementary control measures including the use of mats or slip resistant surface treatments.

Warnings

Slip and fall hazards should be reduced or eliminated whenever possible through the use of engineering design, maintenance, facility layout or operational modifications. In the event that a slip/fall hazard cannot be eliminated, or until appropriate hazard control measures can be implemented, a visual hazard-alert warning message should be provided. The warning should be provided whenever a slip/fall hazard has been identified and kept in place until appropriate corrections have been made. When a slip/fall hazard covers an entire walkway, barricades should be used to prevent access. In addition, stationing an employee in the area to detour pedestrians may be appropriate. This should be done in conjunction with the appropriate use of warning signs until the barricade can be erected or the hazard is removed.

Warning signs should be placed at principal approaches to the areas where slip/fall hazards exist and should clearly indicate/demarcate the hazardous area. Barricades with affixed warnings, stanchions with warning signs, and the use of warning tape affixed appropriately on portable

stands with warning messages are acceptable examples of methods to place visual alert warning messages.

Incident Follow-Up

The importance of thorough investigations of falls cannot be stressed enough. Proper documentation and investigation can give insight into possible housekeeping and/or maintenance problems. A thoroughly performed investigation enables informed decision making possibilities. A poorly executed investigation often misses these possibilities. A thorough investigation can also lead to remedial action(s) that can prevent future accidents. ASTM has developed a *Standard Guide for Composing Walkway Surface Evaluation and Incident Report Forms for Slips, Stumbles, Trips, and Falls* in ASTM F 1694-96.[10] Using the guide can be useful for developing a reporting form.

When a fall has occurred properly trained personnel should secure the area as soon as possible. Any evidence of contaminants or foreign objects may be obliterated if pedestrians are allowed to traverse the area, not to mention the potential for other falls if a contaminant is present. Documenting the area with photographs is advisable. Several broad views of the area from different perspectives should be taken so that the overall situation can be recorded. Additional photographs closing in on the area where the slip, trip and fall occurred are essential, making sure that the exact area is identified and can be located at a later time or date. A checklist is recommended and should be used and followed by the investigating person.

Drawing the Big Picture

The proactive approach described will require ongoing communication to senior management. Inherent in this communication is the idea that investment in time and funds is necessary for prevention activities, but it is a lesser and more controllable investment than reactive measures.

Use of two standards mentioned previously, ASTM F1637 and ANSI A1264.2, can help to provide a solid basis for your prevention measures. Obtaining these standards, and beginning to outline how their provisions match up to conditions and deficiencies in your organization is a very straightforward way to embark on systematic prevention efforts.

A clear communication of the initial exposures is instrumental in maintaining efforts over time after the accident numbers have dropped and it may seem that there is no longer an issue. The case for sustained diligence must be made to avoid the typical cyclical results of reactive safety approaches.