Module 3

EVALUATING SLIP, TRIP AND FALL HAZARDS

Purpose

This module introduces you to the evaluation of slip, trip and fall hazards. You will learn about the three types of evaluation. You will learn how to evaluate the slipperiness of floors and the level of light in your organization. Finally, you will review the critical inventory method for evaluating hazards, and the facilitator will lead a discussion of how severity, exposure and probability factor into slips, trips and falls.

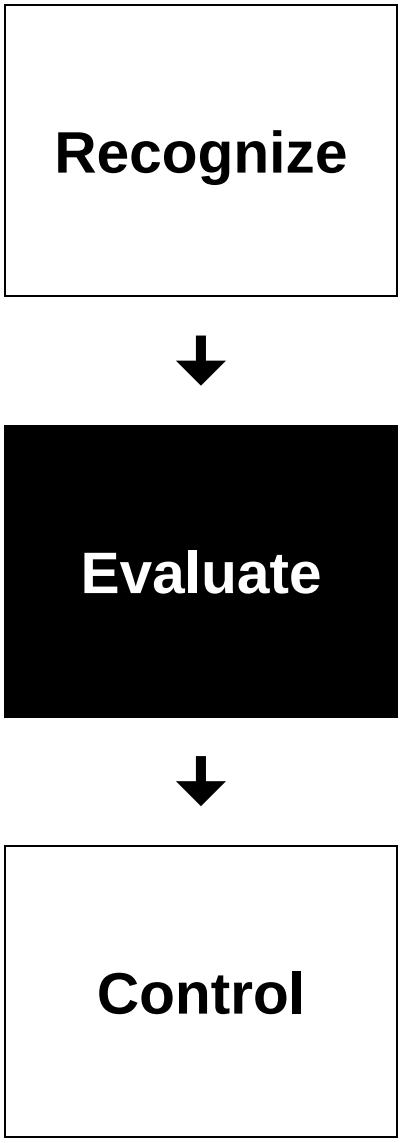
Objectives

After completing this module, you will be able to:

- Identify the three types of evaluation you can perform in your organization.
- Identify the factors that influence the slipperiness of floors.
- Identify the different floor types and their level of slip resistance.
- Understand how the coefficient of friction can be used to determine the slipperiness of a floor.
- Identify the lighting standards for both general and emergency illumination.
- Use the critical inventory method for evaluating slip, trip and fall hazards.

Hazard Recognition, Evaluation, and Control

After recognizing hazards and understanding where they may exist in the workplace, the next step is to evaluate them to determine the extent of the risk they pose.



Three Types of Evaluation

When you evaluate hazards, there are three types of evaluation you can perform.

Evaluation of Individual Parts of the Organization

- This is an evaluation of a specific item or area in your organization against established standards and benchmarks.
- For example, you could focus on the slipperiness of a floor, the safety of a ladder, the lightness in a stairwell.
- Use a published standard such as OSHA 1910 sub-part D or the NFPA Life Safety Code.

Evaluation of an Existing Hazard

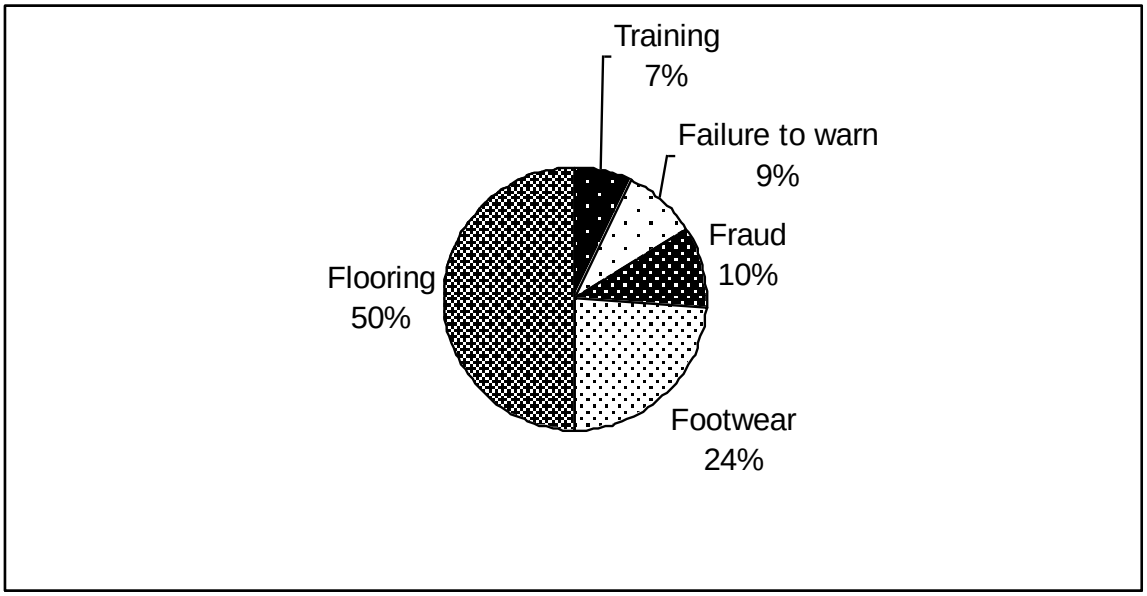
- This evaluation assesses a known hazard to determine the likelihood and extent of the harm it might cause.
- For example, you could evaluate a floor that has exhibited slipperiness, a stairwell with uneven stairs or a dark part of the building that has no light fixture.
- Use the *critical inventory* method to evaluate hazards.

Evaluation of the Entire Organization

- This is an evaluation of your entire organization to determine where hazards exist.
- For example, this could be part of a Job Safety Analysis or a safety inspection.
- It is proactive, you do this type of evaluation to help you *recognize* hazards.
- Use a checklist like the one introduced in Module 2.

Causes of Slips, Trips and Falls

The National Floor Safety Institute has evaluated the causes of slips, trips and falls. The chart below summarizes the results.



Does Measuring the Coefficient of Friction (COF) of a Floor Make a Difference?

- All incident prevention strategies require the collection and interpretation of reliable data.
- Auditing your floors' COF will allow you to locate low-, medium- and high-risk areas on which you can focus prevention efforts.
- Maintaining a history of your walkways' COF values can also play an important role in the event of a slip-and-fall lawsuit. Most courts require that property owners be aware of hazardous conditions and take timely corrective action.
- Measuring a floor's COF can alert a property owner to a hazard prior to an event.

Should the COF be measured under wet or dry conditions?

- Statistics show that 80% of all same-level slips and falls occur on a wet floor.
- The soles of 85% of today's footwear are made of synthetic rubber.
- Today's floor polishes contain little or no wax and are not inherently slippery when dry.
- Therefore, the National Floor Safety Institute recommends that floors be tested under wet conditions using a rubber-based compound as a sensor.

Note: For your reference, the *Tools and Resources* USB drive that came with your Participant Guide contains information on the various risk classes used in auditing floors.

Evaluating Floors

There are nine factors to consider when you evaluate the floors in your organization for slipperiness. Remember, even if you don't control the decision making in all of these areas, you can certainly talk to the person or people who do have control.

Factor	Can You Control? Yes	No	Comments
Floor material			
Floor finish			
Floor texture and pattern			
Floor slope			
Floor contaminants (grease, oil, soap film)			
Floor condition (broken, chipped, uneven)			
Environmental conditions (water, slush, dirt)			
A person's footwear			
A person's footstep or gait			

Floor Type and Slip Resistance

The material that a floor is made of will influence how slippery or slip-resistant it is. Look at the chart below to identify the slipperiness of the floors at your workplace.

Floor Type	Slip Resistance	Comment
Ceramic Tile	■ Low to high depending on type, surface texture, and size	■ Easy to maintain ■ Tiles must all be installed at the same level to reduce lippage ■ Susceptible to chipping and cracking
Porcelain Tile	■ Low to medium depending on type, surface texture, and size	■ Less porous than ceramic tile ■ Easy to maintain ■ Tiles must be installed at the same level to reduce lippage ■ Susceptible to chipping and cracking
Marble	■ Low to medium depending on surface finish	■ Potentially dangerous in high-traffic areas that are prone to wetness due to rain and snow ■ Expensive to maintain
Terrazzo	■ Low to medium depending on surface finish	■ Durable ■ Easy to maintain ■ Popular in government buildings, schools, and airports
Vinyl Tile (VCT)	■ Medium to high depending on type of floor finish	■ Low cost ■ Expensive to maintain ■ Susceptible to water damage

Floor Type and Slip Resistance—continued

Floor Type	Slip Resistance	Comment
Concrete	■ Medium to high depending on troweled or broom finish	■ Durable ■ Easy to maintain ■ Most practical for a manufacturing floor
Wood	■ Low to medium depending on floor finish	■ Natural material ■ Easy to maintain, however must be cautious when applying oil-based cleaners or waxes ■ Susceptible to water damage
Laminate	■ Medium	■ Easy to maintain ■ Does not require a finish ■ Susceptible to water damage
Rubber	■ Medium to high depending on surface texture	■ Natural material ■ Easy to maintain ■ Prone to buckling
Carpet	■ High, however may pose a trip hazard if not properly adhered	■ Padding must not be too thick ■ Piles should be dense ■ Must be kept free of tears and wrinkles ■ Must be secured properly ■ Visual pattern should not create confusion

The inherent characteristic of a floor that makes it slippery (or not) is the number of microscopic projectiles on its surface. Even marble, with its smooth surface, can be made more slip-resistant by applying a high-traction surface treatment or coating.

Floor Treatments and Contaminants

You may not have much control over selecting the floor in your organization, you can influence how the floor is treated and maintained. Floor treatments can make a surface less slippery; while floor contaminants can make a surface more slippery. Here are some questions you can ask to help you evaluate the effectiveness of your floor treatment and maintenance program.

Floor Treatments

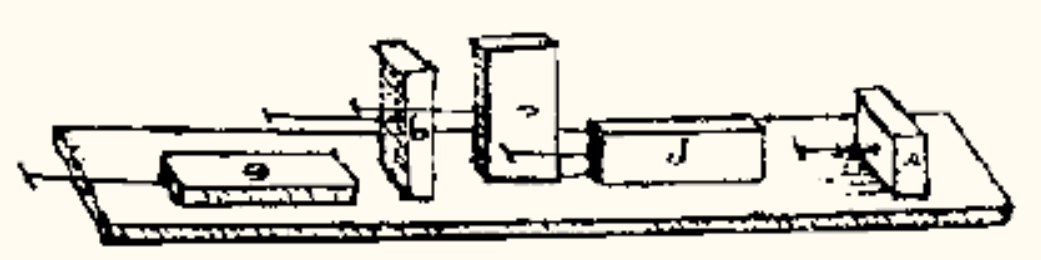
- Does your organization have a written floor treatment plan? Is it consistently followed?
- Does your organization value floor safety over floor appearance?
- Does your organization use a floor treatment that enhances the floor's slip resistance?
- Does your organization use a floor treatment with a high percentage of solids, which will increase a floor's slip resistance?
- Are your floors shiny or dull? Does your organization recognize that a shiny floor doesn't have to be slippery?
- Conversely, does your organization recognize that a dull floor isn't necessarily less slippery than a shiny floor?
- What type of floor treatment does your organization use?
  - → Abrasive treatments and coatings?
  - → Chemical etching?
  - → Acrylic finishes that form a tacky surface over the floor making it less slippery?
  - → Aluminum oxide flakes that are used in places where the floor is frequently wet?
- Does your organization remove old floor finish every time it applies a new treatment?
- Does your organization understand that floor treatments can build up, becoming slippery if not removed each time a new finish is applied?

Floor Contaminants

- Does your organization maintain a schedule for cleaning its floors?
- Do the people who clean the floors in your organization use clean mops?
- Do they use different mops for cleaning and disinfecting?
- Does your organization clean its floors frequently to prevent the build-up of dirt, oil and grease?
- Do the people who clean your floors understand how to select the proper cleaning materials for the type of floor you have?
- Do the people who clean your floors follow the manufacturers' directions that are on the cleaning products?

Science Friction

The first recorded apparatus designed to measure surface friction was published by Leonardo DiVinci in 1479.



Leonardo DaVinci (1452-1519)

It was not until the early 20th century that property owners and floor wax manufacturers popularized the use of portable slip resistance testers which called for the use of a burlap bag stuffed with ten pounds of beans. The apparatus was pulled across the floor with a spring scale. When the load began moving, the weight (force) was noted. The test was then repeated for accuracy.

This "beanbag coefficient (BF)" was interpreted as follows:

5 pounds or less:	Slippery floor
6 pounds:	Safe floor
7 pounds or more:	Tacky floor

Today, the beanbag coefficient has been replaced by the coefficient of friction (COF), and the preferred measurement instrument is the slipmeter, not a bag of beans. Slipmeters serve the same purpose as the bag of beans once did: they provide a reliable way to compare the slipperiness of surfaces. Today's slipmeters, along with standards from The American Society for Testing and Materials and the National Floor safety Institute, enable an organization to predict:

- The slipperiness of a certain floor type.
- How a floor-care product will perform when used as the manufacturer specifies.
- How contaminants affect a floor's slipperiness.

Types of Slipmeters

Slipmeters help determine the relative slipperiness of a floor. They also help determine if floors are appropriately safe for the conditions under which they will be used. Following is a summary of the types of slipmeters that are available.

James Machine	■ Cornerstone of the floor industry for measurement. ■ Invented in 1946 by Underwriters Laboratories. ■ Large laboratory device, not for field use. ■ Used exclusively by the floor finish industry and serves as the basis for the 0.5 SCOF "slip resistant" value. ■ Uses an articulated arm to push a test pad against a test surface. ■ Measures the angle of the articulated arm at the point when the machine causes the sample to slip. ■ Uses a leather sensor to measure dry surfaces only.
Horizontal Drag Meter, Pull Meter, Dynanometer	■ A drag sled type of apparatus. ■ Measures the point at which a horizontal force applied to the sled causes it to move. ■ Can be used on wet and dry surfaces, however, often produces higher readings on wet smooth surfaces due to "stiction." ■ Is most accurate in middle COF (0.2-0.8) ranges.
BOT-3000 (Binary Output Tribometer)	■ Formerly known as the Universal Walkway Tester (UWT). ■ Portable, fully automated robotic tester. ■ Measures both SCOF or DCOF. ■ Multiple test sensors (ie: leather, Neolite, rubber, etc.) ■ Measures "real-world" walkway conditions wet or dry. ■ Calibratable with a paper printout.
Portable Inclinable Articulated Strut Tester (PIAST)	■ A strut with a fixed angle pushes a movable arm against a surface. ■ When the test sample breaks loose from the surface, it is recorded by a pointer on a protractor. ■ User must then calculate the COF. ■ Easy to use, but technically difficult to understand.
English XL	■ Manually operated device which requires a CO2 gas cartridge to fire a sensor mounted shaft onto the floor at an angle. ■ Measures a floor's "slip index" and not COF. ■ Needle and dial form of output. ■ Easy to use, but technically difficult to understand.

Note: Although simple in theory, walkway surface testing requires a high degree of skill and training. For more information contact the National Floor safety Institute at www.nfsi.org.

Information About Slipmeters

Following is some additional information about slipmeters that you might find useful.

Buy or Contract?

To determine whether you should buy a slipmeter or contract out for slipmeter services, consider your answers to the following questions:

- Is there someone in your organization who is trained and knowledgeable in the science of tribometry? Tribometry is complex. Even experts don't agree on whether it's better to measure dynamic or static friction. If no one in your organization knows the difference between the two, your organization is unlikely to make the best use of a slipmeter.

- If you do decide to use a slipmeter, ensure the person doing the job has proper training so that you get accurate results.

- Is the slipmeter worth the expense? At a cost of several thousand dollars, slipmeters are expensive, but with the cost of just one injury from slipping or falling, the meter pays for itself quickly.

- If you find this information to be too confusing, or if you think buying a slipmeter is too expensive, consider hiring an expert to help you.

Criteria for Purchasing a Slipmeter

The following guidelines should help when purchasing a slipmeter:

- Easy to use and calibrate.
- Precise.
- Portable, so you can take it to various work sites.
- Usable on wet or contaminated surfaces.
- Usable on ramps and stairs.
- Easy to maintain.
- Directly readable (no calculations required).
- In compliance with ASTM, OSHA and NFSI standards.

Where to Find a Slipmeter

An Internet search will provide you with slipmeter resources. You can also contact your floor vendor or a floor safety expert such as the National Floor Safety Institute. These sources can also give information on consultants who can assess floors.

Checklist for Evaluating Floor Safety

Use the following checklist to determine if the floors in your organization are safe.

	YES	NO	
1.	❒	❒	Has your organization selected a floor material that is appropriate for the environment in which it will be used?
2.	❒	❒	Do adjacent walking surfaces in your organization have similar COFs?
3.	❒	❒	Is the wet SCOF of your floors rated 0.6 or higher?
4.	❒	❒	Does your organization have a program for regularly cleaning its floors? Is your floor cleaner NFSI Certified?
5.	❒	❒	Does your organization use different mops for cleaning and disinfecting?
6.	❒	❒	Are floors in your organization treated with a high-traction finish?
7.	❒	❒	Does your organization strip an old finish following the manufacturer's instructions before applying a new one?
8.	❒	❒	Does your organization require employees to wear appropriate footwear?

Based on the above assessment, what actions or corrective actions should your organization take?

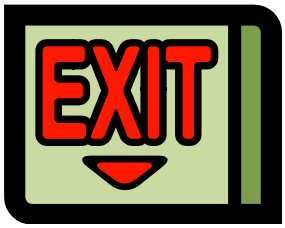
Note: For your future use, there is a blank copy of this checklist on the *Tools and Resources* USB drive that came with this Participant Guide.

Evaluating Light

Poor lighting can cause slips, trips and falls in two ways.

General Lighting

If a walking surface anywhere in the organization is poorly lit, a person will not be able to see potential obstacles, changes in floor elevation or changes in floor type. This could cause the person to stumble or fall.



Emergency Lighting

If electricity fails in an emergency and there is deficient or no emergency lighting, employees won't be able to see their way out. This could lead to slips and falls.

Now let's review what we learned about foot candles earlier today.

What is a foot candle?

GENERAL ILLUMINATION STANDARDS

The following general illumination specifications are from OSHA Sub-Part D 1926.56(a).

Area of Operation	Required Foot Candles
■ General construction areas ■ Concrete placement ■ Excavation and waste areas ■ Access ways ■ Active storage areas ■ Loading platforms ■ Refueling ■ Field maintenance areas	3
■ General construction area lighting	5
■ Warehouses ■ Corridors ■ Hallways ■ Exits	5
■ Tunnels ■ Shafts ■ Underground work areas **Exception:** 10 foot candles are required at tunnel and shaft headings during drilling, mucking and scaling.	5
■ Batch plants ■ Screening plants ■ Mechanical and electrical equipment rooms ■ Carpenter shops ■ Rigging lofts ■ Active store rooms ■ Mess halls ■ Indoor toilets ■ Work rooms	10
■ First aid stations ■ Infirmaries ■ Offices	30

EMERGENCY ILLUMINATION STANDARDS

The following emergency illumination specifications are from NFPA Life Safety Code (101).
Does your organization meet the standards?

	Conform? YES	NO	
1.	❒	❒	Exit routes, including stairs, aisles, corridors and ramps must have emergency lighting.
2.	❒	❒	When servicing the organization's lighting system, there must be a means for keeping illumination uninterrupted.
3.	❒	❒	Emergency lighting must last for at least 1½ hours after the power failure.
4.	❒	❒	Emergency lighting must emit 1 foot candle of light at any point in the building and 0.1 foot candle of light along the emergency exit path at floor level.
5.	❒	❒	At the end of the emergency illumination period (1½ hours), it is permissible for illumination to fade to 0.6 foot candle of light at any point in the building and .06 foot candle of light along the emergency path of exit at floor level.
6.	❒	❒	Maximum to minimum illumination uniformity cannot exceed a ratio of 40 to 1.
7.	❒	❒	Emergency lighting must be provided automatically in the event of a power failure.
8.	❒	❒	Exits must be marked with approved signs that are visible all the way along the evacuation path.
9.	❒	❒	The word EXIT must have letters that are at least 6 inches high and ¾ inch wide.
10.	❒	❒	Exit signs must be illuminated by a reliable light source—one that will stay lit when electricity fails.

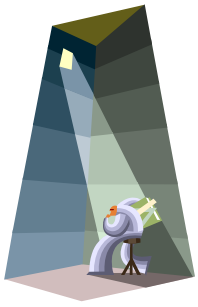
Note: For your future use, there is a blank copy of this checklist on the *Tools and Resources* USB drive that came with Participant Guide.

Criteria for Selecting Light Meters

Now that you have learned about the standards for lighting, how do you know if your organization meets these standards? You can measure the light in your organization with a light meter.

A quick search of the Internet will give you a large number of light meters from which to choose. Many light meters can be purchased for under $100. Following are some criteria you should consider when deciding which light meter to buy:

- The measurement accuracy of the instrument (should be ±5%)
- How well the instrument complies with OSHA guidelines
- Ease of operation
- Weight and size (if you will be measuring light at multiple job sights, you will want something that is portable)
- Legibility of display, even in bright ambient light
- Water resistance
- Memory storage/recall
- Printout size and clarity
- The type of light you'll be measuring
  - → Tungsten
  - → Fluorescent
  - → Mercury
  - → Sodium
- The length and terms of the warranty



Critical Inventory Method for Evaluating Hazards

Once you've identified specific hazards in your organization, it is important to determine which ones are *critical*. Which hazards should be acted upon immediately, which can be handled later? You can determine this by performing a *critical inventory* ranking that looks at a hazard using three important factors. Let's review the three factors:

Factor 1

Factor 2

Factor 3

Measuring Severity

Severity can be measured on a four-point scale. The higher the number, the more serious the consequences.

Rating	Severity	Description
1	Negligible	• This hazard is not likely to produce an injury, illness, lost production, or lost workday.
2	Marginal	• This hazard might cause minor injury or illness, or minor property damage.
3	Critical	• This hazard will likely cause severe injury or illness, major property damage, significant lost work time, but not a permanent disability or fatality.
4	Catastrophic	• This hazard is likely to cause permanent disability, loss of life, loss of facility, or major environmental impact.

How would you rate the <u>severity</u> of the situation on the slide your facilitator is showing?

Measuring Exposure

Exposure can be measured on a three-point scale. Assign a rating based on the total number of occurrences whether it is by number of employees, number of occurrences, or both.

Rating	Exposure	Description
1	Minimal	• A few employees perform the task up to a few times a day.
2	Moderate	• A few employees perform the task frequently, or • Many employees perform the task occasionally.
3	High	• Many employees perform the task frequently.

To rate the exposure in the slide your facilitator is showing you, what additional information do you need to know?

Given the information supplied by your facilitator, rate the exposure of the situation on the slide your facilitator is showing.

Measuring Probability

Probability can also be measured on a three-point scale. Assign a rating based on the likelihood that the hazard will cause an incident to occur.

Rating	Probability	Description
1	Minimal	• It is unlikely that this hazard will cause an incident.
2	Moderate	• It is moderately likely that this hazard will cause an incident.
3	High	• It is highly likely that this hazard will cause an incident.

What are the possible incidents that could occur in the situation shown on the slide?

For each instance you identified above, rate the <u>probability</u>, or likelihood, that it will occur.

Risk Assessment Priority Rating

The ratings for severity, exposure, and probability are added together to form a risk assessment priority rating.

Points	Priority Rating	Description
10	Emergency	• This situation must be handled immediately without delays!
8-9	Extremely Important	• This situation needs to be handled today.
6-7	Very Important	• This situation needs to be handled within a week.
4-5	Somewhat Important	• This situation needs to be handled within a month.
3	Least Important	• This situation needs to be handled within three months.

Severity Score: _____ Exposure Score: _____

Probability Score: _____ **Total Score:** _____

When does this situation need to be handled? _____

_____

_____

Case Study: Critical Inventory Method for Evaluating Hazards

Severity

Rating	Severity	Description
1	Negligible	• This hazard is not likely to produce an injury, illness, lost production, or lost workday.
2	Marginal	• This hazard might cause minor injury or illness, or minor property damage.
3	Critical	• This hazard will likely cause severe injury or illness, major property damage, significant lost work time, but not a permanent disability or fatality.
4	Catastrophic	• This hazard is likely to cause permanent disability, loss of life, loss of facility, or major environmental impact.

Exposure

Rating	Exposure	Description
1	Minimal	• A few employees perform the task up to a few times a day.
2	Moderate	• A few employees perform the task frequently, or • Many employees perform the task occasionally.
3	High	• Many employees perform the task frequently.

Probability

Rating	Probability	Description
1	Minimal	• It is unlikely that this hazard will cause an incident.
2	Moderate	• It is moderately likely that this hazard will cause an incident.
3	High	• It is highly likely that this hazard will cause an incident.

Case Study: Critical Inventory Method for Evaluating Hazards— continued

Points	Priority Rating	Description
10	Emergency	• This situation must be handled immediately—no delays!
8-9	Extremely Important	• This situation needs to be handled today.
6-7	Very Important	• This situation needs to be handled within a week.
4-5	Somewhat Important	• This situation needs to be handled within a month.
3	Least Important	• This situation should be handled within three months.

Severity Score: _____ Exposure Score: _____

Probability Score: _____ **Total Score:** _____

When does this situation need to be handled? _____

_____

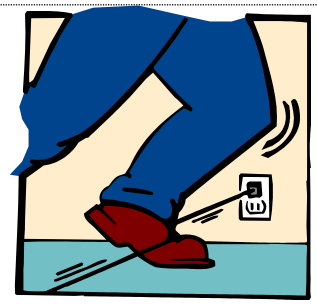
_____

Note: For your future use, there is a blank copy of this risk assessment on the *Tools and Resources* USB drive that came with your Participant Guide.

Severity and Frequency with Slips, Trips and Falls

As a Rule…

Slips and trips are frequent but not severe.



As a Rule…

Falls happen infrequently, but they tend to be severe.

With this in mind, which should your organization be more concerned about? Slips and trips or falls? Why?

Planning for Your Business

Directions: Based on what you've learned in this module, what will you do back on the job?

1. Identify two or three actions to take when you return to your worksite. Select from the actions listed below, or identify your own. Refer to the ideas you wrote on Page 12 to guide your planning.
2. Identify the potential barriers you might encounter in taking these actions.
3. List ideas for overcoming the barriers you have identified. Be sure to identify corrective actions.

Possible Actions

- ❒ Talk to supervisors and employees about the three types of evaluation for slips, trips and falls.
- ❒ Evaluate the slipperiness of the floors in your organization.
- ❒ Evaluate the level of illumination in your organization.
- ❒ Select a known slip, trip or fall hazard in your organization and evaluate that hazard using the *critical inventory* method.

Action Plan

Action	Potential Barriers	Overcoming the Barriers