UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

DATE: December 7, 2016

This document has been electronically approved and signed.

BALLOT VOTE SHEET

TO: The Commission
Todd A. Stevenson, Secretary

THROUGH: Mary T. Boyle, General Counsel
Patricia H. Adkins, Executive Director

FROM: Patricia M. Pollitzer, Assistant General Counsel
Mary A. House, Attorney, OGC

SUBJECT: Petition CP 16-1: Labeling Requirements Regarding Slip-Resistance of Floor Coverings

BALLOT VOTE DUE Tuesday, December 13, 2016

CPSC staff is forwarding a briefing package to the Commission about a petition for rulemaking submitted by Russell J. Kendzior, the President and Chairman of the Board for the National Floor Safety Institute (petitioner). Petitioner requests that the U.S. Consumer Product Safety Commission (Commission or CPSC) "mandate that manufacturers of floor coverings and coatings uniformly label their products' slip-resistance per the American National Standards Institute (ANSI) B101.5-2014 Standard Guide for Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic Coefficient of Friction of Floor Coverings, Floor Coverings with Coatings, and Treated Floor Coverings." Petitioner's request was docketed as a petition, CP 16-1 (petition). CPSC staff recommends that the Commission deny the petition because staff concludes that it is unlikely that injuries from slips and falls can be reduced through the action requested by the petitioner.

Please indicate your vote on the following options:

I. Grant the petition, and direct staff to begin developing a notice of proposed rulemaking.

_____ _____
(Signature) (Date)

II. Defer the petition.

_____ _____

(Signature) (Date)

III. Deny the petition, and direct staff to draft a letter of denial to the petitioner.

_____ _____

(Signature) (Date)

IV. Take other action. (Please specify.)

_____

_____

_____

_____

_____ _____

(Signature) (Date)

Attachment: Staff Briefing Package for Petition CP 16-1: *Labeling Requirements Regarding Slip-Resistance of Floor Coverings*

United States
Consumer Product Safety Commission

Staff Briefing Package

Petition CP 16-1:
Labeling Requirements Regarding Slip Resistance of Floor Coverings

December 7, 2016

For further information, contact:
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Executive Summary

The U.S. Consumer Product Safety Commission (CPSC, or the Commission) received a request from the National Floor Safety Institute (NFSI, or the petitioner) to initiate rulemaking to mandate that manufacturers of floor coverings and coatings uniformly label their products' slip resistance. The product label specified in the petition is American National Standards Institute (ANSI) B101.5-2014, *Standard Guide for Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic Coefficient of Friction (Traction) of Floor Covering, Floor Coverings with Coatings, and Treated Floor Covering*. This label is a graphic of a traction scale with an arrow pointing to the coefficient of friction (COF) measured for the product. The COF value would be obtained by following the tests described by ANSI B101.1 and B101.3.

The petition states that falls are a significant and growing cause of fatal and nonfatal unintentional injuries in the United States. Petitioner claims that 55 percent of all same-level slips and falls occur due to a slippery walkway. The petitioner also asserts that requiring manufacturers of floor coverings to implement the labeling and test requirements in the applicable ANSI standards will reduce the number of unintentional slips and falls. By informing consumers of the flooring product's COF through a standardized label, petitioner believes that these injuries will be reduced because consumers will be able to make better choices in floor covering.

From 2012 through 2014, CPSC staff estimated nearly 570,000 emergency department-treated injuries and 197 fatalities due to accidental slips and falls. The elderly are most at-risk of hazardous slips and falls. The majority of incident reports did not provide information on the specific location of the fall or the type of flooring.

Staff concludes that it is unlikely that injuries from slips and falls can be reduced through the action requested by the petitioner. Staff has observed in the literature a lack of consistency and accuracy among the various test methods available for measuring walkway COF, including the methods specified in the petition. For example, scientific studies found COF values varied greatly among the test methods, depending on the environmental conditions and footwear used. Testing variability decreases the likelihood that a specific label containing COF values obtained from any one method will be helpful to consumers.

Additionally, staff found little evidence to support the petitioner's assertion that a high COF value leads to a decreased hazard of slips and falls. Staff reviewed several studies that examine the relationship between various COF test methods and the risk of slips and falls. Most or all of the studies conclude that the majority of test methods do not demonstrate a reliable correlation between COF values and the risk of falling. Thus, staff believes that providing a COF value to consumers on a label is unlikely to assist consumers in evaluating the comparative safety of flooring products.

Because a high COF value has not been correlated with a decrease in incidents of slips and falls, and because calculation of the COF value is not always consistent or accurate, placing a label with a COF value on flooring products is unlikely to have the intended effect of reducing slip and fall incidents.

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
BETHESDA, MD 20814

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Briefing Memorandum

Date: December 7, 2016

TO : The Commission
Todd A. Stevenson, Office of Secretary

THROUGH: Mary T. Boyle, General Counsel
Patricia H. Adkins, Executive Director
DeWane Ray, Deputy Executive Director for Safety Operations

FROM : George A. Borlase, Ph.D., P.E., Assistant Executive Director
Office of Hazard Identification and Reduction

Matthew Dreyfus, Ph.D., Project Manager
Directorate for Laboratory Sciences

SUBJECT : Petition to Mandate Uniform Labeling Requirements Regarding Slip Resistance of Floor Coverings

I. Introduction

The National Floor Safety Institute (NFSI, or the petitioner) petitioned the U.S. Consumer Product Safety Commission (CPSC) to initiate rulemaking to mandate that manufacturers of floorcoverings and coatings uniformly label their products to state the products' slip resistance. The American National Standards Institute (ANSI) B101.5-2014, *Standard Guide for Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic Coefficient of Friction (Traction) of Floor Covering, Floor Coverings with Coatings, and Treated Floor Covering,* specifies the labeling requirements the petitioner requests the Commission to mandate. The Office of the General Counsel docketed the request as petition CP 16-1.[1] On December 3, 2015, the Commission published a *Federal Register* notice (80 *Fed. Reg*. 75639), requesting public comments on the petition.

In accordance with the Commission's directive on petitions, CPSC staff prepared this briefing package in response to the petition. 16 C.F.R. § 1051. This memorandum provides the Commission with information relevant to the petition, including a review of the public comments received in response to the *Federal Register* notice and a discussion of options for Commission consideration.

[1] https://www.cpsc.gov/s3fs-public/pdfs/PetitionFloorCoverings.pdf.

II. Issue

The petitioner claims that the addition of a uniform label on floor coverings to indicate the product's static or dynamic coefficient of friction (COF) under wet conditions will educate consumers on the potential slip resistance of those products. According to the petitioner, consumers can purchase the appropriate floor product for its intended use, potentially resulting in fewer slip and fall incidents.

The petitioner states that falls are a significant and growing cause of fatal and nonfatal unintentional injuries in the United States. Fall incidents disproportionately affect the elderly. The Centers for Disease Control and Prevention (CDC) estimate the direct medical costs of falls of 65+ year olds were $34 billion in 2013, and posit that the number will increase.

III. Product Description

Floor coverings encompass a range of materials, such as vinyl, wood, laminate, ceramic, and natural stone that can be used to provide a finished walking surface. Additionally, treatments or coatings can be applied to the floor covering after installation to alter the original covering's physical characteristics. These treatments are also within the scope of this petition. The petition does not apply to floor coatings that are sold separately, such as waxes, or soft coverings like carpets, rugs, and artificial turf.

IV. Petitioner's Request

The petition seeks to mandate a label for floor coverings described in ANSI/NFSI B101.5-2014. The petition suggests that packaging for floor coverings indicate the wet static or dynamic COF for the flooring material, based on the test methods described in either ANSI/NFSI B101.1 or B101.3. These methods prescribe measuring the static COF (B101.1) and dynamic COF (B101.3) under wet conditions using an NFSI approved tribometer. The resulting static or dynamic COF value would be displayed on the packaging via a color-coded label. The color code indicates the traction of the floor covering: red represents low COF values, yellow represents medium values, and green represents high values. Low COF values are associated with low traction, medium COF values are associated with "average" traction, and high COF values are associated with high traction.

V. The Basis for Considering the Petition

The Commission's regulations on petitions state that when considering whether to grant or deny a petition, the Commission considers:

> (1) Whether the product that is the subject of the petition presents an unreasonable risk of injury;
> (2) Whether a rule is reasonably necessary to eliminate or reduce the risk of injury; and
> (3) Whether failure to initiate rulemaking would expose the petitioner or others to the risk of injury the petitioner alleges the product presents.

The petition regulations also state that when considering these factors, the Commission will consider the petition in relation to the agency's priorities, as stated in the CPSC's Policy on Establishing Priorities and the Commission's resources available for rulemaking. 16 C.F.R. § 1051.9(a).

As explained below, staff's recommendation to deny the petition is not based on the adequacy of the voluntary standard, but on the inability of the rule the petitioner suggests to address the hazard.

Because petitioner seeks to provide consumers with comparative data at the point of sale, the Commission could proceed to issue a rule under its authority pursuant to section 27(e) of the Consumer Product Safety Act (CPSA), instead of sections 7 and 9 of the CPSA. Section 27(e) of the CPSA authorizes the Commission to require, by rule, that manufacturers of consumer products provide to the Commission performance and technical data related to performance and safety as may be required to carry out the purposes of the CPSA, and to give notification of such performance and technical data at the time of original purchase to prospective purchasers and to the first purchaser of the product. 15 U.S.C. § 2076(e). Section 2(b) of the CPSA lists four purposes of the Act:

(1) To protect the public against unreasonable risks of injury associated with consumer products;
(2) To assist consumers in evaluating the comparative safety of consumer products;
(3) To develop uniform safety standards for consumer products and to minimize conflicting state and local regulations; and
(4) To promote research and investigation into the causes and prevention of product-related deaths, illnesses, and injuries.

To issue a rule under section 27(e) of the CPSA, the Commission would need to find that the information provides "performance or technical data related to performance and safety," and that the information "assists consumers in evaluating the comparative safety" of flooring products. Thus, a rule under section 27(e) of the CPSA does not require the findings regarding "unreasonable risk" that are required under sections 7 and 9 of the CPSA. However, to issue a rule under section 27(e) of the CPSA, the Commission must still be able to demonstrate a relationship between the required performance and technical data and the ability of these data to assist consumers in evaluating comparative safety.

In addition, the CPSA states that the Commission may not deny a petition on the basis of a voluntary standard unless:

(1) The Commission determines that the voluntary standard is likely to result in the elimination or adequate reduction of the risk of injury identified in the petition, and
(2) It is likely that there will be substantial compliance with the voluntary standard.

VI. Epidemiology Assessment (TAB B)

The Directorate for Epidemiology evaluated emergency department-treated injury cases in its National Electronic Injury Surveillance System (NEISS) and reported fatal incidents in CPSC's Consumer Product Safety Risk Management System involving accidental slips. Over the 3- year period between 2012 and 2014, CPSC staff estimated nearly 570,000 emergency department-treated injuries and 197 fatalities reported in the incident data. Slips were most common among females (more than twice as likely than males) and those 75 or more years old. The general location of slips was unknown for approximately 20 percent of emergency department-treated injuries. In other settings, the majority of slips occurred in residential (57%) or commercial location (23%). NEISS data did not provide information on the specific location or type of flooring.

VII. Mechanical Engineering Assessment (TAB C)

The Directorate for Engineering Sciences provided a review and assessment of several different existing standards that specify test methods for measuring COF. Staff found that no single method for testing COF is universally accepted. A critical issue is the varied performance of the available tribometers, which are devices commonly used to measure COF. Furthermore, staff found little data to demonstrate that measured COF values correlate to a risk of slips and falls.

Research shows that there are several methods to calculate COF. However, these methods produce a variety of results, and few show correlation between COF and the slips or falls. Most scientific studies show that COF, as a single measure, does not predict risk of falls. One study shows that when the required coefficient of friction exceeds the available coefficient of friction of the surface, slips will happen, but will not necessarily lead to a fall. Additionally, many floors are designed to have polishes or coatings applied after installation. This may modify the slip resistance of the installed floor, which would mean that the COF rating will be different from the COF of the installed floor.

Staff believes that more research is needed to determine whether the use of COF values can predict the risk of falling. Additional research would also help to determine whether labeling can convey COF information to assist consumers with purchasing appropriate flooring. Staff concluded that the COF scales proposed in the petition appear to be selected arbitrarily, lacking a clear definition of what red, yellow and green labels would actually mean to the consumer. Staff found that the petitioner failed to provide any data showing a direct relationship between the proposed COF ratings and the risk of slips and falls. Nor could the staff find such a link in staff's review of currently available information.

VIII. Human Factors Analysis (TAB D)

The Division of Human Factors assessed the effectiveness of the petitioner's proposed labeling intended to convey the product's slip resistance to consumers. To be effective, warnings must be noticed, read and understood, and motivate behavioral change. Consumers, in general, and older consumers, in particular, may not notice, read, and understand the warning symbols that the petitioner proposes. Even if consumers notice, read and understand the warning symbols and

this could motivate behavioral change, staff's review raises questions about the accuracy and reliability of the means used to measure slip resistance. Devices that measure slip resistance yield values that may or may not predict the user's risk of slipping. Moreover, even if the devices could make this prediction accurately, and hence, ensure that the label provided accurate and reliable information, warnings aimed at older adults are likely to have limited effectiveness. The warnings may be aimed at family members or caretakers, but family members and caregivers also may be older and suffer from similar age-related changes. Furthermore, COF is only one of a number of factors involved in slip-and-fall incidents. Thus, labeling the product's COF may have limited effectiveness.

IX. Market and Economic Considerations (TAB E)

The Directorate of Economic Analysis provided information on the market for floor coverings and floor finishing products. At least 20 manufacturers supply hard flooring and floor finishing products to the residential market through various retailers. Staff estimates that total retail sales in 2014 might have been around $10 billion. Additionally, in 2014, U.S. consumption for hard surface flooring in single family and multifamily housing was approximate 4,140 million square feet. Prices per square foot vary considerably, depending on the material, and can range between less than $1 to more than $15 per square foot. Product life ranges from 10 years to 40 years, depending on the material.

Staff has insufficient information to determine the societal costs of injuries resulting from slips or falls on floors with low COF values. NEISS data do not provide information to determine the number of slips due to floors with low slip resistance or exposure of consumers to floors with different slip resistance. The mortality database compiled by CDC's National Center for Health Statistics (NCHS) provides numbers for fall-related deaths. However, the percentage of fall-related deaths associated with slipping on floors, and what the floor's coefficient of friction was at the time of the fall are unknown.

X. Past Compliance Actions (TAB F)

The Office of Compliance and Field Operations reviewed recall data from 2005 through 2016 and found no instances of Compliance action on a floor covering or floor treatment where the identified hazard was falls due to inadequate slip resistance. Staff found one recall of a slip-resistant shower floor mat that did not remain in place, creating a fall hazard.

XI. Staff Response to Public Comments (TAB G)

CPSC published a request for comments on the petition in the *Federal Register* on December 3, 2015. The comment period closed on February 1, 2016. The Commission received 66 comments, and approximately two-thirds (42) opposed the petition. Seventeen comments supported the petition. Seven comments supported the idea of a labeling standard that displays the slip-resistance for flooring, but using different methods and standards than those specified in the petition.

Many commenters expressed concern over the increasing number of slips and falls, but disagreed that the petitioner's approach was the correct way to address the issue. These commenters cited a number of reasons for their opposition: [2]

- The ANSI/NFSI standard is not recognized by the tile and stone industry (27 comments);
- SCOF/DCOF are not correlated with slip incidents; and thus, the petition addresses the wrong problem (9 comments);
- Pertinent statistical evidence was not provided to support the petition (10 comments);
- Alleged conflict of interest, because the NFSI may stand to gain financially if the petition is approved (7 comments); and
- The standards cited in the petition were challenged for producing inconsistent and/or misleading data, and a lack of consensus when developing the standards (17 comments).

Commenters that supported the petition cited the personal and societal costs of slip incidents each year and the need to take action to reduce the number of incidents (16 comments). Other commenters supporting the petition agreed that the label proposed in the petition provided a means to educate consumers (5 comments).

XII. Can Petitioner's Requested Action Address the Hazard

Staff concludes that it is unlikely that injuries from slips and falls can be reduced through the action requested by the petitioner. Staff has observed in the literature a lack of consistency and accuracy among the various test methods available for measuring walkway COF, including the methods specified in the petition. For example, scientific studies found COF values varied greatly among the test methods, depending on the environmental conditions and footwear used. Testing variability decreases the likelihood that a specific label containing COF values obtained from any one method will be helpful to consumers.

Additionally, staff found little evidence to support the petitioner's assertion that a high COF value leads to a decreased hazard of slips and falls. Staff reviewed several studies that examine the relationship between various COF test methods and the risk of slips and falls. Most or all of the studies conclude that the majority of test methods do not demonstrate a reliable correlation between COF values and the risk of falling. In fact, the test methods specified by the petitioner showed lower correlation between COF and risk of falling than the other studies. Thus, staff believes providing a COF value to consumers on a label based on a specific method is unlikely to assist consumers in evaluating the comparative safety of flooring products.

[2] Staff is aware of an application to withdraw ANSI/NFSI B101.1-2009, which echoes many of the concerns raised by public commenters. This letter was dated June 21, 2016, after the comment period. Accordingly, the letter was not considered as part of the comments received on the petition.

XIII. Commission Options

1. Grant the petition

If the Commission concludes that the available information indicates the risk of injury from slips associated with floor coverings can be addressed by a mandatory standard of the type requested by the petitioner, the Commission may grant the petition. Granting the petition does not mean that the Commission would necessarily issue a rule in the specific form requested in the petition.

The Commission could begin rulemaking under section 27(e) of the CPSA, if the Commission determines that the information petitioner suggests for a label provides "performance or technical data related to performance and safety," and that the information "assists consumers in evaluating the comparative safety" of flooring products.

Staff has reviewed various test methods to measure COF in voluntary standards and research journals. Most or all of the studies do not demonstrate a correlation between COF values and the risk of falling. Thus, staff believes providing a COF value to consumers on a label is unlikely to assist consumers.

2. Deny the petition

If the Commission determines that it lacks sufficient information showing the petitioner's floor covering label would lead to a reduced number of slip-and-fall incidents, the Commission could deny the petition.

As stated, staff concludes that the petitioner's label would not assist consumers in assessing the comparative safety of flooring. Staff found little evidence to support the assertion that petitioner's test yields accurate or meaningful results, or that the petitioner's label will assist consumers. Therefore, staff does not recommend that the Commission proceed with a rulemaking to require the label described in the petition because labeling is unlikely to have the intended effect of reducing incidents.

Denying the petition does not preclude the Commission from taking action to address the risk of slips and falls.

3. Defer a decision on the petition

If the Commission concludes that more information is required before the Commission can decide whether to grant or deny the petition, the Commission may defer a decision and direct the staff to collect additional information or take other action. Academia and standards bodies are conducting independent work to understand the correlation between floor characteristics and slip incidents. However, staff is not aware of any impending voluntary standards or academic studies that would address issues raised in the petition.

Deferring the petition does not preclude the Commission from initiating future rulemaking in response to this or another petition.

IX. Staff Conclusion and Recommendation

CPSC staff recommends that the Commission deny the petition. Staff found no evidence demonstrating that the tests suggested by the petitioner for COF values yield consistent or accurate results. Additionally, staff does not have evidence that a high COF on a flooring product directly leads to decreased slips and falls. Finally, staff does not believe that the proposed label will assist consumers, as intended.

TAB A: Estimated Number of Injuries and Reported Incidents Associated with Slipping on Floors, 2012-2014

TAB A

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

Memorandum

Date: November 30, 2016

TO : Matthew Dreyfus, Ph.D.
Project Manager, Flooring Petition
Chemistry Division, Laboratory Sciences

THROUGH: Kathleen Stralka, Associate Executive Director
Directorate for Epidemiology

Stephen Hanway, Division Director
Division of Hazard Analysis

FROM : Wioletta Szeszel-Fedorowicz, Ph.D. , Mathematical Statistician
Division of Hazard Analysis

SUBJECT : Estimated Number of Injuries and Reported Incidents Associated with Slipping on Floors, 2012-2014[1]

I. Introduction

The Division of Hazard Analysis prepared this memorandum in response to petition CP 16-1. The petition requested that CPSC initiate rulemaking to mandate manufacturers of floor coverings, treated floor coverings, and floor coverings with coatings, to label such products specifying the slip-resistance (coefficient of friction) to reduce injuries resulting from slips and falls. This memorandum presents the estimates of U.S. emergency department-treated injuries associated with slipping on floors in the years 2012 through 2014. The memorandum also provides information about slip incidents reported to CPSC occurring between January 1, 2012 and December 31, 2014.

II. Methodology

For this memorandum, CPSC staff searched two CPSC databases: the National Electronic Injury Surveillance System (NEISS) and the Consumer Product Safety Risk Management System (CPSRMS),[2] using the product code 1807 (floors or flooring material) and the keywords: "slip,"

[1] This analysis was prepared by CPSC staff, has not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

[2]The National Electronic Injury Surveillance System (NEISS) database contains the emergency department-treated injuries from a sample of hospitals nationwide. The Consumer Product Safety Risk Management System (CPSRMS) combines anecdotal reports from IPII (Injury or Potential Injury Incidents), DTHS (Death Certificates), and INDP (In-Depth Investigations) into one searchable incident database.

"slid," "friction," and "coefficient." The search was conducted on February 2, 2016, and it was limited to the period from January 1, 2012 to December 31, 2014. The search resulted in 15,896 reports in NEISS and 428 in CPSRMS that were potential candidates for this review. Subsequently, CPSC staff reviewed the narratives of each candidate report. Some incidents were considered out of scope for the purpose of this memorandum. For example, staff excluded incidents when the slip did not occur on the floor, such as when a person slipped from a bed, a chair, or a wheelchair onto the floor, or when a fall was the result of tripping or losing balance. CPSC staff's review identified 13,434 NEISS in-scope cases and 219 in-scope CPSRMS incidents.

III. Injury Estimates[3]

Overview

Staff estimates that 569,266 emergency department-treated injuries were associated with slipping on floors from January 1, 2012 to December 31, 2014. The 95 percent confidence interval (C.I.) for this estimate is 437,160–701,372, based on a coefficient of variation (C.V.) of 0.1184.

Yearly Injury Estimates

Staff generated yearly estimates of emergency department-treated injuries associated with slipping on floors for the period from 2012 through 2014 (Table 1). The yearly estimates ranged from 185,147 in 2012 to 196,475 in 2014. The data do not show a statistically significant trend for injuries associated with slipping on floors during the 3-year period (p-value = 0.7198).

[3]The injury estimates in this memorandum are based on data from NEISS.

Table 1. Estimated Emergency Department-Treated Injuries Associated with Slipping on Floors, 2012–2014

Year	Count	Estimate	95% C.I.	C.V.
2012	4,338	185,147	141,165–229,129	0.1212
2013	4,479	187,644	141,340–233,948	0.1259
2014	4,617	196,475	144,488–248,462	0.1350
Total	13,434	569,266	437,160–701,372	0.1184

Source: National Electronic Injury Surveillance System (NEISS), February 2, 2016

Injury Estimates by Age, Gender, Body Part, Diagnosis, Disposition, Location, and Floor Type

CPSC staff categorized the incidents associated with slipping on floors by age of the victim, gender, body part injured, injury diagnosis, disposition, location of the incident, and a floor type. Presented below is staff's calculation of the estimated numbers of emergency department-treated injuries for each category for 2012 through 2014.

Table 2 provides the estimated emergency department-treated injuries associated with slipping on floors by age group. The largest percentage of estimated emergency department-treated injuries, 33 percent, was in the 40- to 64-year age group. Seniors 65 years and older represented the next largest group with 30 percent of estimated emergency department-treated injuries. Only 5 percent of estimated emergency department-treated injuries were to teens, ages 13 to 19.

Table 2. Estimated Emergency Department-Treated Injuries Associated with Slipping on Floors by Age Group, 2012–2014

Age	Estimate	% Total
<=12	68,365	12%
13-19	28,313	5%
20-39	118,618	21%
40-64	186,147	33%
65-74	60,625	11%
=>75	107,199	19%
Total	569,266	100%

Source: National Electronic Injury Surveillance System (NEISS), February 2, 2016

Table 3 provides the estimated average annual injury rates per million individuals in the U.S. population for each age group. The rates measure the frequency that the injury occurs in a population over the period 2012 to 2014. Such rates may represent better the injury risk, by age, associated with slipping on floors. The overall estimated annual average of emergency department-treated injuries associated with slipping on floors was 60 injuries per 100,000 individuals in the U.S. population. Although the 40- to 64-year age group had the highest percentage of the estimated emergency department-treated injuries (33 percent), the estimated annual average rates of emergency department-treated injuries were the highest for persons 75 years and older. The rates for individuals 75 years and older were more than twice that of individuals 65 years to 74 years old (183 vs 80), and nearly six times as high as the rate for teens (183 vs 32).

Table 3. Estimated 2012–2014 Annual Average Emergency Department-Treated Injury Rates Associated with Slipping on Floors per 100,000 Individuals in the US Population by Age Group

Age	**Annual Average Rates** (per 100,000 population)
<=12	43
13-19	32
20-39	46
40-64	60
65-74	80
=>75	183
All ages	60

Sources: National Electronic Injury Surveillance System (NEISS), February 2, 2016; U.S. Census Bureau

Seventy percent of the estimated emergency department-treated injuries associated with slipping on floors were to females (see Table 4). The higher percentage of the estimated emergency department-treated injuries for females when compared to males was consistently seen for all age groups, except children. CPSC staff observed the same higher estimated annual average of slip-related injury rates for females when comparing annual average injury rates for males. The rates are presented in Table 5. Females had higher rates than males for all age groups, except children 12 years old and younger.

Table 4. Estimated Emergency Department-Treated Injuries Associated with Slipping on Floors by Age Group and Gender, 2012–2014

Age	Gender			
	Females		Males	
	Estimate	Percentage*	Estimate	Percentage*
<=12	32,591	48%	35,774	52%
13-19	18,171	64%	10,142	36%
20-39	86,156	73%	32,461	27%
40-64	138,778	75%	47,370	25%
65-74	44,111	73%	16,514	27%
=>75	80,134	75%	27,065	25%
Total	399,940	70%	169,325	30%

Source: National Electronic Injury Surveillance System (NEISS), February 2, 2016
**Percentages are row percentages, allowing for comparison between females and males within the same age group.*

Table 5. Estimated 2012–2014 Annual Average Emergency Department-Treated Injury Rates Associated with Slipping on Floors per 100,000 Individuals in the US Population by Age Group and Gender

Age	Gender	
	Females	Males
<=12	42	43
13-19	42	22
20-39	68	25
40-64	87	31
65-74	110	47
=>75	229	115
All ages	83	36

Sources: National Electronic Injury Surveillance System (NEISS), February 2, 2016; U.S. Census Bureau

Table 6 provides the estimated emergency department-treated injuries by body part injured from slipping on floors. Injuries to torso, leg/feet and head/face, each accounted for 26 percent of total estimated emergency department-treated injuries associated with slipping on floors.

Table 6. Estimated Emergency Department-Treated Injuries Associated with Slipping on Floors by Body Part Injured, 2012–2014

Body Part	Estimate	% Total
Torso	149,303	26%
Leg/Feet	148,967	26%
Head/ Face	145,360	26%
Arm/Hand	99,190	17%
Other	26,445	5%
Total	569,266	100%

Source: National Electronic Injury Surveillance System (NEISS), February 2, 2016.

Table 7 shows the estimated emergency department-treated injuries by injury diagnosis associated with slipping on floors. The most common injuries were contusions, abrasions, and/or lacerations (32%). Strains, sprains, and/or dislocations accounted for 24 percent of the total estimated emergency department-treated injuries associated with slips, and fractures, accounting for 18 percent.

Table 7. Estimated Emergency Department-Treated Injuries Associated with Slipping on Floors by Injury Diagnosis, 2012–2014

Injury Diagnosis	Estimate	% Total
Contusion/Abrasion/Laceration	179,986	32%
Strain/Sprain/Dislocation	137,395	24%
Fracture	104,334	18%
Other/ Not Stated	147,551	26%
Total	569,266	100%

Source: National Electronic Injury Surveillance System (NEISS), February 2, 2016

Fifty-seven percent of the estimated emergency department-treated injuries associated with slips occurred at residential settings, and 23 percent happened in commercial or public settings. Twenty percent of the estimated emergency department injuries did not have information on whether the injury occurred in a residential or public setting.

Eighty-eight percent of emergency department-treated injuries associated with slipping on floors were treated and released; 11 percent were hospitalized; and nearly 1 percent left against medical advice or had an unknown disposition. CPSC staff cannot provide estimates of deaths on arrival to the emergency room, due to the small sample size. Fifty-six percent of hospitalizations were for persons 75 years and older; 19 percent were in the 40-64 age group; 18 percent in the 65-74 age group; and 4 percent in 20-39 age group. Children younger than 12 years old accounted for 3 percent of hospitalizations, and teens accounted for less than 1 percent. Fractures were the most common injury for the hospitalized, accounting for 63 percent of hospitalizations. Eight percent of hospitalizations were associated with contusions, abrasions, and/or lacerations, 4 percent with strains, sprains, and/or dislocations, and 25 percent with other diagnoses.

Seventy-four percent of the estimated emergency department-treated injuries associated with slipping on floors did not provide information about where the injury happened. Approximately 11 percent of the estimated injuries occurred in a bathroom, 7 percent in a kitchen, 5 percent in a store, 1 percent at school, and another 1 percent in a garage. The slips in a bedroom, hallway, basement, and gym contributed less than 0.5 percent each for the total estimates of emergency department-treated injuries associated with slipping on floors.

Most of the estimated emergency department-treated injuries associated with slipping on floors (87%) did not mention the type of the floor. Eight percent of the estimated emergency department-treated injuries associated with slipping on floors occurred on a tile floor, and 4 percent happened on a wood or hardwood floor. Staff could not obtain estimates of injuries associated with slipping on ceramic, vinyl, or linoleum floors, due to the small sample sizes.

Forty-seven percent of the estimated emergency department-treated injuries associated with slipping on floors resulted from a slip on a wet floor. The percentage of emergency department-treated injuries associated with slipping on wet floors could be higher than the estimate presented in this memorandum. The majority of the reports for estimated emergency department-treated injuries did not state whether the floor was dry. Accordingly, the flooring potentially could be wet, even if the incident description did not specifically mention a wet floor.

IV. Review of Incident Data[4]

CPSC staff is aware of 219 incidents associated with slipping on floors that happened in the years 2012 through 2014 (beyond those reported through the NEISS). The reported incidents included: 197 fatalities, 16 injuries, and six non-injury incidents. Injuries included concussions, face and eye lacerations, bruises and soreness of different parts of the body, feet burns, twisted ankles, hamstring tears, and other unspecified injuries.

One hundred and fifty-four of the reported incidents associated with slipping on floors involved persons 75 years and older; 25 incidents involved persons 65 to 74 year old; and 20 falls

[4]CPSC staff searched the CPSRMS.

involved individuals 40 to 64 years old. Seven incidents involved persons younger than 39 years old. Thirteen incidents did not include age information.

One hundred and thirty-two incident reports associated with slipping on floors stated that a female slipped, 83 mentioned that a male slipped, and four reports did not provide information about gender.

One hundred and thirty-two incident reports did not state where the slip occurred. Among incident reports that had information about location, a bathroom was the most frequently mentioned (48 incidents), followed by a kitchen (29 incidents). Four slip incidents took place in a bedroom, two in a garage, two in hallway, and two in a store.

Thirty-two incident reports mentioned that the slip occurred on a tile floor. Sixteen slips happened on a hardwood/ wood floor, six on linoleum, one on a laminated floor, one on plastic, and one on a vinyl floor. One hundred and sixty-two incident reports did not say what kind of flooring was involved in the incident.

Fifty-three reports indicated a wet floor. These incidents included: a wet floor, a mopped floor, water on the floor, urine on the floor, and wet slippers. Two incident reports stated that the floor was dry when the slip happened; one incident report mentioned that there was oil on the floor; and 163 incident reports do not specify if the floor was wet, oily, or dry.

Among other factors mentioned in the slip incident reports were: slippery shoes, a walker, and socks.

V. Summary

Injury data

- From January 1, 2012 to December 31, 2014, CPSC staff found 569,266 emergency department-treated injuries associated with slipping on floors.

- Staff found no statistically significant linear 3-year trend for the annual emergency department-treated slip injuries in the years 2012-2014 (p-value = 0.7198), with injuries ranging from 185,147 in 2012 to 196,475 in 2014.

- Individuals 75 and older had the highest rates for the slips, with an estimated annual average of 183 slips per 100,000 individuals in the US population.

- Rates for females were more than two times higher than for males (83 emergency department-treated injuries per 100,000 females vs. 36 emergency department-treated injuries per 100,000 males).

- Most of the slips (57%) occurred in residential settings. CPSC staff estimated that 23 percent of slips happened in commercial or public settings, and 20 percent of the

estimated emergency department-treated injuries did not provide information about the general location of the slip.

- For a majority (74%) of estimated emergency department-treated injuries reports did not mention the specific location where the slip occurred. Nearly 11 percent of slips happened in a bathroom, 7 percent in a kitchen, 5 percent in a store, 1 percent in a school, and another 1 percent in a garage.

- For eighty-seven percent of the estimated emergency department-treated slip injuries reports did not provide information about floor type. Eight percent mentioned that the slip occurred on a tile floor, 4 percent of slips involved wood or hardwood flooring , and 1 percent involved other floor types (*e.g.*, ceramic, vinyl, linoleum).

- Floor wetness was mentioned in reports for 47 percent of estimated emergency department-treated slip injuries.

Incident data

- In the years 2012-2014, CPSC staff found 219 additional incidents associated with slipping on floors reported to CPSC outside of the NEISS. The incidents include: 197 fatalities, 16 injuries, and six non-injury incidents.

- Most of the reported slip incidents (154) involved individuals 75 years and older.

- Slip incident reports were more frequent for females than males (132 vs 83). Four reports did not provide information about gender.

- Forty-eight slip incidents occurred in bathrooms, 29 in a kitchen, four in a bedroom, two in a garage, two in a hallway, and two in a store. One hundred and thirty-two incident reports did not state where the slip occurred.

- Thirty-two slip incident reports mentioned a tile floor. Sixteen slip incidents occurred on hardwood/ wood flooring, six on linoleum flooring, one on a laminated floor, one on a plastic floor, and one on a vinyl floor. One hundred and sixty-four incident reports did not provide information about floor type.

- Fifty-three of the 219 reported slip incidents involved a wet floor.

TAB B: Assessment of Existing Standards and Practices Related to Flooring Slip-Resistance (Traction)

TAB B

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
ROCKVILLE, MD 20850

Date: November 30, 2016

TO : Matthew Dreyfus
Flooring Labeling Petition Project Manager
Office of Hazard Identification and Reduction

THROUGH : Mark Kumagai
Director, Division of Mechanical and Combustion Engineering
Directorate for Engineering Sciences

FROM : Vincent J. Amodeo
Mechanical Engineer
Directorate for Engineering Sciences

SUBJECT : Assessment of Existing Standards and Practices Related to Flooring Slip-Resistance (Traction)

I. Introduction and Background

The National Flooring Safety Institute (NFSI, the petitioner) is requesting that the Consumer Product Safety Commission (CPSC, or Commission) issue a rule to mandate that manufacturers of hard surface floor coverings and coatings provide uniform point-of-sale labeling of their products' degree of slip-resistance (traction) per the American National Standards Institute (ANSI) B101.5-2014 *Standard Guide for Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic Coefficient of Friction (traction) of Floor Coverings, Floor Coverings with Coatings, and Treated Floor Coverings*.

The petitioner also states that floor covering manufacturers do not provide consumers with information about the slip resistance of their products. The petitioner claims that ceramic tile manufacturers are the only manufacturers that test and label their products for slip-resistance, and are the only floor covering segment that has adopted a standardized test method for doing so. The petitioner lists the following types of floor covering materials that purportedly are not tested or labeled for slip-resistance:

- ceramic tile (porcelain);
- natural stone (marble, granite, etc.);
- resilient flooring (vinyl);
- Laminate;
- wood (bamboo, cork, etc.); and
- floor finishes, paints, and coatings.

As such, the petitioner states that the consumer is left without an obvious means to select safe flooring and may purchase floor coverings that are inappropriate for their intended use. The petitioner claims that the lack of point-of-sale slip-resistance information available to the consumer is one of the leading factors contributing to elderly American slip and fall incidents. NFSI states that mandating the labeling requirements found in ANSI/NFSI B101.5-2014 for floor coverings would provide consumers with a graphic label to indicate the slip-resistance (via a coefficient of friction (COF) rating) of the flooring material. The petitioner states that 55 percent of all same-level slips and falls occur due to hazardous (slippery) walkways, and estimates that approximately half of same-level falls taking place in the home are also the result of a slip and fall.

This memorandum provides an assessment of existing standards and practices, including ANSI/NFSI B101.5-2014, related to flooring slip-resistance (traction).

II. Coefficient of Friction

The petition seeks to inform consumers about the slip-resistance of flooring, by mandating labeling of flooring products based on a coefficient of friction rating, or COF rating.

Friction[1] is the force-resisting relative motion of objects sliding against each other. Friction forces are found in many interactions: between dry and lubricated solid surfaces, between fluid layers, between fluid layers and solid surfaces, and between internal elements of solid materials.

The resistance to start relative motion between two solid surfaces is known as "static friction," commonly termed "stiction." If the two surfaces are already in relative motion, the resistance is called "kinetic friction" or "dynamic friction." Static friction is typically higher than kinetic friction between any given pair of surfaces.

If two solid surfaces are in direct contact, the resistance to relative motion is known as "dry friction." If fluid, such as water or oil, separates two solid surfaces, the resistance to relative motion is called "lubricated friction."

The coefficient of friction (COF), typically symbolized by the Greek letter μ, is the ratio of the friction between two objects and the force pressing them together.

Static coefficient of friction is symbolized as μ_s. Kinetic coefficient of friction is symbolized as μ_k or μ_D. The coefficient of friction between two objects typically ranges from close to zero to 1.0, but can be above 1.0. If μ is low, it means the two objects slide against each other with

[1] Friction is a key phenomenon in applied physics, whose origin has been studied for centuries. Until now, it has been understood that mechanical wear-resistance and fluid lubrication affect friction, but the fundamental origin of sliding friction has been unknown. Dr. Lasse Makkonen, Principal Scientist at VTT Technical Research Centre of Finland, presented an explanation for the origin of sliding friction between solid objects in a research paper published in 2012. Lasse Makkonen. **A Thermodynamic Model of Sliding Friction**. *AIP Advances*, 2012; 2 (1): 012179 DOI: 10.1063/1.3699027.

very little resistance, such as PTFE (used in non-stick coatings for cookware) on steel ($0.02 \leq \mu_s \leq 0.20$). If μ is high, it means the objects have difficulty sliding against each other, such as steel on steel ($0.74 \leq \mu_s \leq 0.80$).

The labeling suggested by the petitioner is based on determining the COF rating of various flooring products using specific methods called out in ANSI/NFSI B101.1-2009 *Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Material* and ANSI/NFSI B101.3-2012 *Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Material.*

III. Existing Standards and Practices

Several voluntary standards provide test methods for measuring the coefficient of friction between a test surrogate material and hard surfaces under varying conditions; however, they each use different methods or are recommended for specific surface types. The methods include measuring static and dynamic COF on wet or dry surfaces. The measurements required in each standard are often determined by using a tribometer, which is an instrument or device designed to measure tribological[2] quantities, such as coefficient of friction, friction forces, and wear volume between two surfaces in contact. The following is a summary of some of the standards available for determining the COF of hard surfaces.

a. ANSI Standards

1. ANSI/NFSI B101.1-2009 *Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Material* specifies the procedures and devices used for both laboratory and field testing to measure the wet static coefficient of friction (SCOF) of common hard-surface floor materials. The standard contains the following requirements:

- Test device - procedure may use any recognized tribometer designed to measure the wet SCOF between a Neolite[3] test sensor material and a hard surface under expected use conditions. The standard does not specify what constitutes a "recognized tribometer."
- Test surface – specifies cleaning and wetting of the test surface using distilled or de-ionized water.
- Test procedure – specifies the orientation (direction) and number of measurements to be taken in the laboratory and on-site locations, following the tribometer manufacturer's operating instructions.
- Test results – specifies calculation of the test data in accordance with the

[2] *Tribology* is the study dealing with the design, friction, wear, and lubrication of interacting surfaces in relative motion (as in bearings or gears). *Merriam-Webster*. Merriam-Webster, n.d. Web. 31 Aug. 2016.
[3] *Neolite* is a styrene-butadiene synthetic rubber (SBR) originally developed by Goodyear.

testing device manufacturer's instructions and recording of the wet SCOF values on a linear scale from 0.00 to 1.00μ_s.

- Test result interpretation – correlates wet SCOF values to three "traction" ratings:
  i. $\mu_s \geq 0.60$ as High traction – lower probability of slip
  ii. $0.40 \leq \mu_s < 0.60$ as Moderate traction – increased probability of slip
  iii. $\mu_s < 0.40$ as Minimal traction – higher probability of slip

2. ANSI/NFSI B101.3-2012 *Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Material* specifies the procedures and devices used for both laboratory and field testing to measure the wet dynamic coefficient of friction (DCOF) of common hard-surface floor materials. The standard contains the following requirements:

   - Test device - procedure must utilize an approved tribometer designed to measure the wet DCOF between a styrene butadiene rubber (SBR)[4] test sensor material and a hard surface under expected use conditions. An "approved" tribometer shall demonstrate reliability and reproducibility in measuring the DCOF per the National Floor Safety Institute (NFSI): *Inter-Laboratory Study (ILS) for Tribometers Designed to Measure the Wet Dynamic Coefficient of Friction (DCOF) of Common Hard Surface Walkways*. A list of approved tribometers is found in Table 1. The test device shall be verified using a reference tile.
   - Test surface – specifies selection of the test surface areas, cleaning of the test surface with mild detergent and distilled water, and wetting of the test surface using a surfactant solution of 0.1 +/- 0.005 percent sodium lauryl sulfate (SLS) in distilled water.
   - Test procedure – specifies the orientation (direction) and number of measurements to be taken in the laboratory and on-site locations, following the tribometer manufacturer's operating instructions.
   - Test results – specifies calculation of the test data in accordance with the testing device manufacturer's instructions and recording of the wet DCOF values on a linear scale from 0.00 to 1.00μ_D.
   - Test result interpretation – correlates wet SCOF values to three "Slip Resistance Potential" ratings:

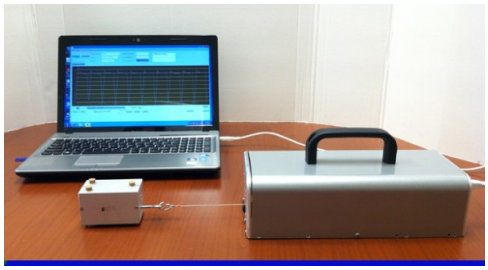
[4] The *SBR* must meet the physical characteristics specified in Attachment A of the standard. The material thickness is 4.0 +/- 0.2 mm, a density of 1.23 +/- 0.02, and a Shore A hardness of 95 +/- 3.

i. $\mu_D \geq 0.42$ as High – lower probability of slip

ii. $0.30 \leq \mu_D < 0.42$ as Acceptable – increased probability of slip

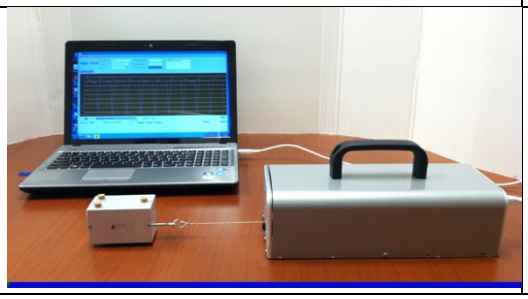
iii. $\mu_D < 0.30$ as Low – higher probability of slip

Table 1. Tribometers Approved by NFSI[5]

Approved for Dynamic COF		
BOT 3000E / BOT 3000 (Note: The BOT 3000E replaced the BOT 3000, which previously replaced the Universal Walkway Tester (UWT)		Manufactured by Regan Scientific Instruments, Inc., 901 S. Kimball Ave, Southlake, TX 76092 (www.reganssci.com)
GMG-200 (Note: meets German standard Deutsches Institute fur Normung DIN 51131-2014)		Manufactured by GTE GmbH, Germany (www.gte.de)
GS-1		Manufactured by Impact General, 1405 E. Chapman, Ave, Orange, CA 92866 (www.gsslipmeter.com)

[5] NFSI's website (www.nfsi.org)

Table 1. Continued

Approved for Static COF		
Universal Walkway Tester (UWT) (precursor to the BOT 3000)		This device was originally manufactured by Elcon GmBH (Germany) for sale in the US by NFSI. NFSI sold the manufacturing and distribution rights to Variosystems, Switzerland, in 2004. Variosystems partnered with Universal Walkway Testing, LP (UWTLP) of Southlake, TX for US sales and distribution. In 2006, UWTLP became Regan Scientific Instruments, Inc.
GS-1		Manufactured by Impact General, 1405 E. Chapman, Ave, Orange, CA 92866 (www.gsslipmeter.com)

3. ANSI/NFSI B101.5-2004 *Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic COF of Floor Coverings* specifies a uniform product labeling method which identifies the wet static and wet dynamic coefficient of friction of floor coverings, floor coverings with coatings, and treated floor coverings. The standard is intended to provide point of sale guidance to users/purchasers regarding the traction capabilities of products via package labels and markings. The standard contains the following requirements:

    - Location of label – the standard sets requirements symbols and markings placement on the package or container of the product.
    - Symbol composition – the standard sets requirements for the symbol size, color, and content. The specific symbols are based on the values derived from testing the product in accordance with either ANSI/NFSI B101.1-2009 or ANSI/NFSI B101.3-2012.
    - If the product was tested to ANSI/NFSI B101.1-2009, the product is to be labeled with one of the following symbols to indicate the SCOF interpreted as low, moderate, or high traction.

Figure 1 A

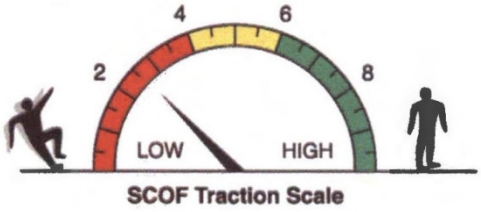


Figure 1 B

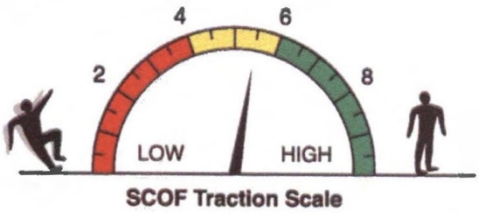
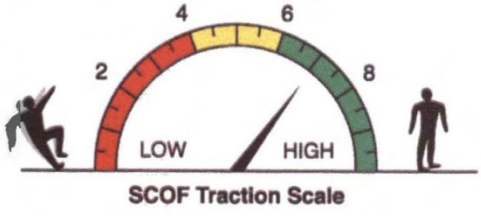


Figure 1 C



    - If the product was tested to ANSI/NFSI B101.3-20012, the product is to

be labeled with one of the following symbols to indicate DCOF interpreted as low, moderate, or high traction.

Figure 2 A

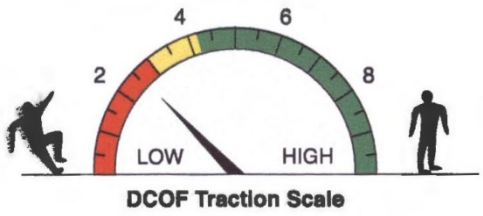


Figure 2 B

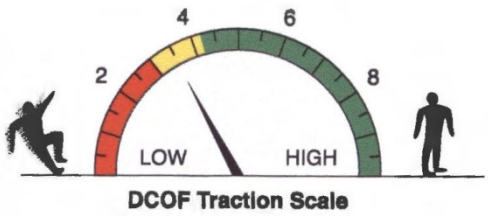
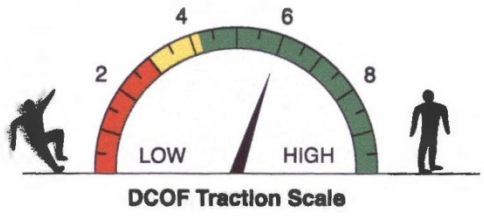


Figure 2 C



- The packaging/container of products meeting the requirements of this standard may include a statement of compliance, such as "This product meets all the requirements of the ANSI/NFSI B101.5-2014 Standard."

4. ANSI/ASSE A1264.2-2012 *Provisions of Slip Resistance on Walking/Working Surfaces* specifies provisions for reasonably safe working and walking environments for persons pursuing foreseeable activities, primarily in the workplace. The standard contains the following requirements:

    - General guidance for safe working environment to minimize slips and falls focusing on floor surface characteristics affecting slip resistance, footwear traction properties, and environmental factors (*e.g.*, contaminants such as water and oil).
    - Floor surface testing in both wet and dry conditions shall be performed with tribometers meeting ASTM F2508 *Standard Practice for Validation, Calibration, and Certification of Walkway Tribometers Using Reference Surfaces.*
    - The standard suggests that slip-resistance values of 0.5 and above are

acceptable for walking surfaces in wet and dry conditions, though floors not meeting this value are not necessarily hazardous because many other factors influence slips and falls, including shoes, environmental conditions, and contaminants.

- The standard notes that slip-resistance values using different types of equipment, as well as different test conditions (such as wet vs. dry), are not necessarily comparable to one another.
- The standard notes that certain testing devices are susceptible to "stiction," which is a delay in slip initiation (increased contact time) due to a liquid film being squeezed out of the interface between the contact material (test foot or shoe bottom) and the floor surface. As a result, testing in wet conditions with these devices produces unreliable and unrepeatable results. The standard recommends using devices that are designed to impart both normal and tangential forces to the test sensor material during testing, which has been shown to avoid this type of stiction.

5. ANSI/ASSE TR-A1264.3-2007 *Technical Report: Using Variable Angle Tribometers (VAT) for Measurement of the Slip Resistance of Walkway Surfaces* discusses the technical aspects, research, legislation, standards activities, and operation of the widely used Variable Angle Tribometers commercially available for testing of walkway surface slip resistance (the Brungraber Mark II/III and the English XL devices).

6. ANSI A137.1-2012 *Standards Specifications for Ceramic Tile* specifies the sizes and shapes of ceramic tile, the physical properties of standard and second grade ceramic tile, the basis for acceptance and methods of testing before installation, and marking and certification of ceramic tile. The standard contains the following requirements related to ceramic tile slip-resistance:

    - Floor surface testing in wet conditions, the wet DCOF shall be measured with a BOT 3000 tribometer (see Table 1) using an SBR test sensor material. The surface shall be wetted with a 0.05% solution of sodium-lauryl sulfate (SLS) in distilled or de-ionized water. The test sensor shall be verified to measure a wet DCOF value of 0.27 to 0.32 on a "Renovator #120" tile. The number and direction of measurements for the flooring surface is specified.
    - If a dry DCOF is desired for comparison purposes, measurements may be performed with a BOT 3000 tribometer using an SBR test sensor material. The test sensor shall be verified to measure a dry DCOF value of 0.67 to 0.73 on a "Renovator #120" tile. The number and direction of

measurements for the flooring surface is the same as for wet conditions.

- Alternatively, if a dry SCOF is desired, measurements may be taken using the test method specified in ASTM C1028, *Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method* (Withdrawn 2014). However, direct comparison of various COF values is not recommended because the values do no correlate.
- The standard recommends a minimum wet DCOF of 0.42 for ceramic tile. It states that COF values are useful for comparison of tile surfaces, but it does not predict the likelihood a person will or will not slip on a tile surface because many factors affect the possibility of a slip occurring, such as: material of shoe and degree of its wear, the presence and nature of contaminants, the speed and length of the walkers stride, the physical and mental condition of the individual, the angle of the floor, maintenance of the floor, the COF of the tile, the tile structure, drainage characteristics of the tile. Therefore, the standard states that the COF shall not be the only factor in determining whether a particular tile is suitable for an application.
- The standard notes that tiles with a wet DCOF of 0.42 or greater are not necessarily suitable for all projects.

b. ASTM International (ASTM) Standards

1. ASTM C1028-07 *Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method* (Withdrawn 2014) specifies the measurement of SCOF of ceramic tile or other surfaces under both wet and dry conditions while using Neolite heel assemblies.

    - This standard has been withdrawn and replaced by the DCOF test method in Section 9.6 of ANSI A137.1.

2. ASTM D2047-11 *Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine* specifies the test method for the measurement of the SCOF of polish-coated flooring surfaces with respect to human locomotion safety. The standard contains the following criteria:

    - Establishes a compliance criterion for non-hazardous polished walkway surfaces.
    - Not intended for use on wet surfaces or textured surfaces where the test

sensor and test surface do not permit adequate contact.
- The only method appropriate for testing polishes for specification compliance with the floor polish SCOF criterion.
- Polishes and other floor maintenance coatings having a static coefficient of friction of not less than 0.5, as measured by this method, have been recognized as providing non-hazardous walkways.
- Utilizes a leather test sensor on a wet surface.

3. ASTM E303-93 (2013) *Measuring Surface Frictional Properties Using the British Pendulum Tester* specifies the test method for measuring surface frictional properties using the British Pendulum Skid Resistance Tester. The standard contains the following requirements:

    - Procedures for using a dynamic pendulum impact-type tester which measures the energy loss when a rubber slider edge is propelled over a test surface.
    - Provides a British Pendulum Tester Number (BPN) representing the frictional properties which does not necessarily correlate with other slipperiness measuring equipment.
    - The measured values can be used to determine relative effects of various polishing processes on materials or material combinations.
    - Utilizes a rubber test sensor.

4. ASTM F695-01 (2009) *Standard Practice for Ranking of Test Data Obtained for Measurement of Slip Resistance of Footwear Sole, Heel or Related Materials* specifies the ranking of slip-resistance of sole, heel, or related materials on various walkway surfaces. The standard contains the following requirements:

    - Outlines a procedure for selecting walkway samples, reference footwear sole or heel material, and test methods under the jurisdiction of ASTM F13 subcommittee.
    - Specifies taking, recording, and tabulation of measurements and ranking of each walkway material.

5. ASTM F1240 - 01(2009) *Standard Guide for Ranking Footwear Bottom Materials on Contaminated Walkway Surfaces According to Slip Resistance Test Results* describes a method for ranking slip-resistance test results of footwear bottom materials on contaminated walkway surfaces. The standard:

    - Outlines a procedure for selecting two or more footwear bottom

materials, appropriate flooring contaminant, and test methods under the jurisdiction of ASTM F13 subcommittee.
- Specifies ranking of each footwear bottom relative to each contaminant tested, according to the slip resistance values.

6. ASTM F1637-13 *Standard Practice for Safe Walking Surfaces* covers design and construction guidelines for providing reasonably safe walkways including floors and walkway surfaces, sidewalks, short flight stairs, gratings, wheel stops, and speed bumps when wearing ordinary footwear. The standard:

    - Conformance is intended to reduce pedestrian risks.
    - States that walkway surfaces shall be slip resistant under expected environmental conditions and use.
    - Indoor walkways that are not slip resistant when wet shall be maintained dry during periods of pedestrian use.

7. ASTM F1677 (withdrawn in 2006):

    - This standard was written around the Slip-Test Mark II PIAST tribometer produced by Robert Brungraber. It has been withdrawn since it referred to a proprietary device, which is no longer allowed by ASTM where alternatives exist.

8. ASTM F2508-13 *Standard Practice for Validation and Calibration of Walkway Tribometers Using Reference Surfaces* establish the procedures for validation, calibration, and certification of walkway tribometers by providing a procedure and reference surfaces.

    - Validation of walkway tribometer models against human gait-based reference with a series of 40 tests on each of four surfaces with known relative slip potential (polished black granite, porcelain, vinyl composite tile, ceramic tile). The surfaces were validated using ambulation studies.
    - Calibration of each walkway tribometer against published suppliers' reference values with a series of 16 tests.
    - Certification that the tribometer has completed a documented validation and interlaboratory study.
    - The validation and calibration does not imply validation and calibration of all combinations of test sensor materials and walkway surfaces and is not intended to establish a safe threshold value for any walkway surface.
    - A valid tribometer must properly rank and differentiate the four test surfaces.

c. Other Standards and Methods

1. DIN 51130 (2014) *Testing of Floor Coverings – Determination of the Anti-Slip Property – Workrooms and Fields of Activities with Slip Danger – Walking Method – Ramp test* specifies a performance test method for determining and classifying the slip resistance of floor coverings used in the workplace and work areas where there is a risk of slip. The standard includes the following requirements:

    - Test is conducted with a person wearing footwear with nitrile rubber soles walking forward and backwards up a ramp that is gradually tilted from the horizontal position until slip occurs, indicating the "acceptance" angle.
    - The flooring surface on the ramp is lubricated with standard SAE 10W30 motor oil.
    - The test flooring is rated with a slip resistance class based on the mean acceptance angle (6 degrees and above).

2. DIN 51131 (2014) *Testing of Floor Coverings – Determination of the Anti-Slip Property – Method for Measurement of the Sliding Friction Coefficient* specifies the parameters for the measurement of the coefficient of sliding friction for surfaces usually walked on with footwear. The standard contains the following requirements:

    - Testing can be done on dry and wet surfaces, as well as on floors with a defined slip agent.
    - A sliding device of a defined material, shape, and pressure is pulled parallel to a floor surface covering at constant velocity. The force is recorded and the coefficient of sliding friction is calculated as the sliding force divided by the vertical effective force of the sliding device.
    - The resulting sliding COF is correlated to the slip resistance classes of DIN 51130.

3. *Standard Method for Conducting an Interlaboratory Study (ILS) to Establish Validity, Repeatability and Reproducibility of a Walkway Tribometer Measuring Wet Static Coefficient of Friction (SCOF) for a Common Hard-Surface Walkway,* National Floor Safety Institute (NFSI)

    - Specifies the procedure for conducting an interlaboratory study (ILS) for walkway tribometers used to measure wet SCOF of hard-surface

walkway surfaces.

- Specifies that six unique laboratories each test three different tribometers with two normally trained operators.
- Each laboratory is to conduct 64 observations with each tribometer on three standardized walkway materials: one "low traction," one "moderate traction," and one "high traction." The standardized surfaces are supplied by NFSI. The standard does not specify any properties for the test surfaces.
- Wet SCOF Tests shall be conducted in accordance with ANSI/NFSI B101.1-2009.
- Specifies collection, analyzing, and recording of data.
- Tribometers are given pass ratings if they meet the statistical variance tolerance stated calculated from all observations.

4. *Standard Method for Conducting an Interlaboratory Study (ILS) to Establish Validity, Repeatability and Reproducibility of a Walkway Tribometer Measuring Wet Dynamic Coefficient of Friction (DCOF) for a Common Hard-Surface Walkway*, National Floor Safety Institute (NFSI)

    - Similar to the ILS study for wet SCOF but using wet DCOF in accordance with ANSI/NFSI B101.3-2012.

IV. Review of Slip and Fall Studies

1. *Assessment of Walkway Tribometer Readings in Evaluating Slip Resistance: A Gait-Based Approach (2007)*, Powers, C.M., Brault, J.R., Stefanou, M.A., Tsai, J.Y., Flynn, J., and Siegmund, G.P.

    - The study uses the results of human subject walking trials on three different surfaces (HPL, Delrin, and Teflon)[6] in dry and wet conditions (six total conditions), the results of which are used to establish a baseline reference for assessing the tested tribometers.
    - Eighty-four human subjects (aged 22 to 38) were asked to walk across the test surface without knowledge of the surface material or surface condition. Each test was categorized as No Slip, Toe Slip, or Heel Slip. Each subject was asked whether they perceived a heel or toe slip during

[6] HPL is high-pressure laminate, a common high-density fiberboard.
Delrin is a low-friction plastic polymer, acetal material manufactured by DuPont.
Teflon is a low-friction plastic polymer manufactured by DuPont.

each trial. Video was used to record whether the subject experienced footwear slip. Toe slip was considered less hazardous than heel slip. Heel slip was defined as 10 mm or more of forward translation of the heel during the loading or mid-stance phase of the gait cycles. Toe slip was defined as any rearward velocity of the toe before toe-off. In all cases, the video data agreed with the subjects' perception of slip.

Nine tribometers or methods were used to independently measure and rank the surface slipperiness under all six conditions. The nine methods are shown in the following table.

Tribometer/Method	Operating Principle	Test Foot Material
Horizontal Pull Slipmeter	Drag sled - motor pulled	Neolite
ASTM C1028	Drag sled - manually pulled	Neolite
Tortus II	Drag sled - motor driven	Rubber
Universal Walkway Tester (UWT)	Drag sled - motor driven	Neolite
Wessex Pendulum	Pendulum	Rubber
Sigler Pendulum	Pendulum	Neolite
Brungraber Mark II	Inclinable mast - gravity driven	Neolite
Brungraber Mark III	Inclinable mast - spring activated	Neolite
English XL	Inclinable mast	Neolite

- To judge a tribometer acceptable, the tribometer readings had to rank the six conditions and differentiate between the conditions in the same order as the human subject walking trials.
- Of the nine tribometers tested, only two met the study criteria. These where the Tortus II and the Brungraber Mark III.
- Three test apparatuses failed to differentiate between wet and dry Delrin, most likely due to stiction, which can occur with sled-type units. These were the C1028, HPS, and UWT.
- The findings point out the need for objective criteria to ascertain which tribometers effectively evaluate floor slipperiness and pedestrian's risk of slipping. The study points out the difficulty in using any one method to assess human slip potential due to the nature of friction testing and its dependence on the operational characteristics of each tribometer.
- The studies recommend future studies analyzing more typical walkway materials and over a broader range of expected activities such as when the subject is running or pushing a load, in order to effectively evaluate floor slipperiness versus a pedestrian's risk of slipping.

2. *Validation of Walkway Tribometers: Establishing a Reference Standard (2010),* Powers, C.M., Blanchette, M.G., Brault, J.R., Flynn, J., and Siegmund, G.P.

- The study proposed to define a reference standard to calibrate and validate the performance of various tribometers.
- The authors state that there are over 30 different tribometer models using a wide range of mechanical designs and COF calculation methods. They indicate no tribometer model or mechanical test for measuring COF as representative of human ambulation has universal acceptance due to the fact that the measurement of friction is a function of the material being tested and the measuring system itself. This explains why several different studies show a wide range of COF measurements when using various measuring devices on the same surface and surface conditions.
- Eighty human subjects (aged 20-39) were randomly assigned to walk across one of four walkway surfaces (polished black granite, porcelain, vinyl composite tile, and ceramic tile) coated with a film of distilled water to establish the relative slipperiness reference. All subjects wore footwear with smooth SBR soles. The four surfaces were the same as the test surfaces used for validation in ASTM F2508-13.
- During each subject's walk, toe slips and heel slips were confirmed using an 8 camera motion analysis system.
- Eleven tribometers were then used to measure the wet COF of all four surfaces. The eleven tribometers/methods are shown in the following table.

Tribometer/Method	Operating Principle	Test Foot Material
English XL	Inclinable mast	Neolite
BOT 3000	Drag sled - motor driven	Leather
ASTM C1028	Drag sled - manually pulled	Neolite
Tortus II	Drag sled - motor driven	Rubber
Tortus III	Drag sled - motor driven	Rubber
Horizontal Pull Slipmeter	Drag sled - motor pulled	Neolite
Wessex Pendulum	Pendulum	Rubber
Sigler Pendulum	Pendulum	Neolite
Brungraber Mark I	Inclinable mast - gravity driven	Neolite
Brungraber Mark II	Inclinable mast - gravity driven	Neolite
Brungraber Mark III	Inclinable mast - spring activated	Neolite

- Of the eleven tribometers tested, only four (Wessex pendulum, Sigler pendulum, Brungraber Mark II, and Brungraber Mark III) met the compliance criteria of ranking all four surfaces by slipperiness and differentiating between the varying degrees of slipperiness.
- The most consistent range of COF values was observed on black granite surface (0.05-0.35). The broadest range of COF values was observed on ceramic tile (0.24-0.94).
- Two tribometers (BOT 3000 and Mark I) were able to rank the surfaces in the correct order, but failed to statistically differentiate among them.
- The Tortus II did not meet either criterion, though it had met both in the previous study.
- The study points out that tribometers that utilize a drag sled type of mechanism (BOT 3000, Tortus II, Tortus III, HPS, and C1028) have a greater probability of producing a higher reading on certain wet surfaces due to stiction.
- The study suggests that human gait-based measures of slipperiness can be used to create reference standards against which tribometers can be validated. However, because only four of the eleven tribometers used in this study produced acceptable results, the study states that care should be taken when interpreting COF data to predict walkway surface safety.

3. *The Prediction Model of Slips and Falls Probability Based on the Utilized Coefficient of Friction* (Zhang Junxia, Cao Lin, Su Hailong, and Wang Xinting, 2013).

    - This study defines a new concept, Utilized Coefficient of Friction (UCOF), to describe the probability of flips and falls. UCOF is the maximum ratio of the resultant shear force and vertical force on a contaminated floor.
    - Slips and falls occur when the required coefficient of friction (RCOF) (to keep the subject upright) exceeds the available coefficient of friction (ACOF) (of the walkway).
    - This study uses a Brungraber Mark II tribometer to determine the ACOF of the walkway.
    - The walkway is a 5 meter by 1 meter elevated surface with two embedded force plates.
    - A safety belt was used to protect the test subject from falling during a slip.
    - The test utilized four sole materials, four walkway surfaces and four contaminants:

Experimental Condition	Level	Name
Sole sample（A）	1	Thermo plastic rubber (TPR)
	2	Natural rubber (NR)
	3	Styrene butadiene rubber (SBR)
	4	Leather (LE)
Floor material（B）	1	Marble
	2	Tile
	3	Glass
	4	Wooden floor
Contaminant(C)	1	Dry
	2	Water
	3	Soapsuds
	4	Oil

- The study analyzed the ACOF and the RCOF statistically to ensure they followed normal distributions. The resulting UCOF also followed a normal distribution.
- The study concludes that slip and falls are overestimated when comparing RCOF with ACOF by traditional methods. However, when comparing UCOF with ACOF, results are consistent with test data. The study shows that when RCOF exceeds ACOF, slips will happen, but will not necessarily lead to a fall.

V. Discussion

Staff reviewed the petitioner's recommendation that manufacturers of hard surface floor coverings and coatings provide uniform point-of-sale labeling of their products' degree of slip-resistance (traction) as described in American National Standards Institute (ANSI) B101.5-2014 *Standard Guide for Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic Coefficient of Friction (traction) of Floor Coverings, Floor Coverings with Coatings, and Treated Floor Coverings.*

Staff's review of test methods for determining COF values of flooring surfaces indicates that no one method is universally accepted by flooring manufacturers and voluntary standards developers. Additionally, there is no agreement within the industry whether dry or wet COF measurements more appropriately predict risk of fall. Staff found very little research supporting the assertion COF is commonly used to predict the risk of fall. Two studies attempted to correlate a risk of fall to a test method for COF values: however, both studies indicate the numerous devices and methods to calculate COF give mixed results. Furthermore, few devices

used in these studies show any correlation. In fact, staff's review of the test methods and related studies demonstrates that the methods proposed by the petitioner provide some of the lowest correlations between COF value and the risk of falling. Another study shows that when the required coefficient of friction exceeds the available coefficient of friction of the surface, slips will happen, but will not necessarily lead to a fall.

Some flooring manufacturers, such as the ceramic tile industry, already provide COF ratings on their products. However, these firms state that COF should not be used as a sole predictor of safety; COF is one of many other factors, such as environment, surface wear, footwear, contaminants, lighting, and specific application, which can influence the slipperiness of the floor.

Staff believes that the petitioner did not provide any data showing a direct relationship between the COF ratings the petitioner suggests and risk of slips and falls. Additionally, many floors are designed to have polishes or coatings applied after installation. This may modify the slip resistance of the installed floor which would mean that the COF rating will be different from the COF of the installed floor. The petitioner's labeling scales are not based on any scientific research and differ based on whether the SCOF or DCOF is used. Staff concludes the potentially differing COF values will provide inconsistent and confusing information to the buyer, because the buyer will not understand the difference between the SCOF and DCOF ratings.

VI. Conclusion

Staff concludes the petition did not provide evidence to support its assertion that the test methods suggested by the petitioner accurately and consistently provide meaningful COF values. The petitioner did not provide data or information to support its assertion the proposed labels in ANSI/NSFI standards will reduce the risk of fall. Staff believes that the petitioner's labels do not show a direct relationship between COF and reduced risk of slips and falls, and therefore do not translate to a numeric scale that consumers can effectively use to compare products.

TAB C: Human Factors Assessment for Petition (CP 16-1), Petition for Labeling Requirements Regarding Slip Resistance of Floor Covering

TAB C

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
ROCKVILLE, MD 20850

Memorandum

Date: November 30, 2016

TO : Matthew Dreyfus, Ph.D., Project Manager,
Flooring Petition

THROUGH: Rana Balci-Sinha, Ph.D., Director,
Division of Human Factors,
Directorate for Engineering Sciences

FROM : Sharon R. White, Engineering Psychologist

SUBJECT : Human Factors Assessment for Petition (CP 16-1), Petition for Labeling Requirements Regarding Slip Resistance of Floor Coverings

I. BACKGROUND

Russel J. Kendzior, President and Chairman of the Board of the National Floor Safety Institute (NFSI), petitioned the Commission to initiate rulemaking to require that manufacturers of hard-surface flooring materials and floor coatings label their products to inform consumers of the product's slip resistance according to the labeling requirements in ANSI/NFSI B101.5 (2014), *Standard Guide for Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic Coefficient of Friction (Traction) of Floor Coverings, Floor Coverings with Coatings, and Treated Coverings* (ANSI/NFSI B101.5). The slip-resistance values are based on tests described in the ANSI/NFSI B101.1 and B101.3, *Test Method for Measuring Wet SCOF (*static coefficient of friction*) of Common Hard-Surface Floor Materials* and *Test Method for Measuring Wet DCOF (*dynamic coefficient of friction*) of Common Hard Surface Floor Materials*, respectively.

NFSI states that accidental falls disproportionately affect the elderly population more than any other demographic segment of our society. Additionally, NFSI states that the lack of point-of-sale information on slip resistance available to the consumer is one of the leading factors contributing to elderly American slips and falls. Therefore, although this petition requests that the Commission mandate labeling about the product's slip resistance so that consumers can make informed flooring purchases, the petition's primary focus is aimed at older consumers, who the NFSI considers the most vulnerable to slips and falls.

This memorandum assesses the effectiveness of the labeling provisions in ANSI/NFSI B101.5, intended to communicate the product's degree of slip resistance at the point-of-sale so consumers, particularly older consumers, can make an informed choice.

II. DISCUSSION

ANSI/NFSI B101.5 defines a "floor" as a surface in a building, usually horizontal, on which persons typically walk or run. In addition, the standard defines "floor covering" as "an essentially planar material, combination of resilient materials or combination of resilient material and rigid materials used to provide a finished walking surface on a floor to enhance the beauty, comfort, and utility of the floor."

A. Injury Data

Staff in the Directorate for Epidemiology identified 219 reported slip-and-fall incidents in the Consumer Product Safety Risk Management System (CPSMRS) data that occurred between January 1, 2012 and December 31, 2014. The data show that 154 incidents involved persons 75 years and older (70 percent); 25 incidents involved persons 65 to 74 years old (11 percent); and 20 involved individuals 40 to 64 years old (9 percent). Of the 219 reported incidents, there were 197 deaths, 16 injuries, and six non-injury incidents. Human Factors' staff analysis showed that most incidents involved ages 70 and older. The next largest group involved those ages 60 to 69 years.

Fifty-three (25 percent) of the 219 reported incidents indicated a wet floor. One hundred and sixty-three incident reports did not specify if the floor was wet, oily, or dry; two incident reports stated that the floor was dry when the slip occurred; and one incident mentioned that there was oil on the floor.

A further Human Factors' staff analysis of the data, showed that about 110 (55 percent) of the death-related incident reports stated that victims had preexisting medical conditions, often multiple medical conditions. Where known, 36 of the death-related incident reports mentioned that the victims were taking medicine, and most of the 36 victims were taking multiple medications.

B. Factors Contributing to Slip-and-Fall Incidents

Characteristics of the user, product characteristics, and environmental factors likely contribute to slip-and-fall incidents.

1. User Characteristics

Although individuals of all age groups can slip and fall, slips and falls become more common and more serious in older adults, due to age-related changes.[1] Slips and falls are due to, but not limited to:

Balance. The ability to balance while standing and moving depends on the sensory (*i.e.*, vision, somatosensory, and vestibular), cognitive, and motor systems. The sensory system provides a visual layout of the surrounding environment; information about limb position relative to other

[1] Consulted Physical Dimensions of Aging (Spirduso et al., 2005) for this discussion unless otherwise specified.

limbs; position of the body relative to objects; spatial position and movement of the body relative to the support surface; and position and movement of the head. The cognitive system processes and integrates the sensory information and plans the motor response. Finally, the motor system makes adjustment to maintain upright balance. Age-related changes in one of these systems may have little observable effect on balance. However, changes in multiple systems are associated with observable and adverse effects on balance. Noticeable differences in balance may be observed in those over age 60 (Haywood, K., 1986).

Muscle Strength. Humans achieve maximum muscle strength in their 20s and 30s, which then declines with age, with strength losses most dramatic after the age of 70 years. Normal decline in muscle strength and joint flexibility can change the ease with which an older person stands up, walks, or gets out of chairs. For example, where reported, several incidents involved victims over age 80 attempting to get out of bed or otherwise attempting to get up and then slipping and falling. Where known, around 28 incidents involved walking when victims 70 and older slipped and fell. Lack of muscular strength may have played a role in these incidents.

Reaction Time. Processing speed in older adults declines due to a decline in the functioning of the brain and central nervous system (Finch, 2009; Salthouse, 2009). One study showed that the average reaction time begins to slow in the 40s, and declines accelerate in the 60s and 70s (Salthouse, 1994). Thus, it is reasonable to conclude that the decline of reaction time in older adults affects their ability to move away from obstacles quickly enough or avoid a hazardous walking surface.

Gait. Changes in gait that occur with age (*e.g.*, wider stance, smaller steps, slower gait, decreased arm counterbalance, and trunk leaning forward), which also increases the risk of falls. A population-based study has shown a 35 percent prevalence of gait disorders among persons over age 70. Eighty-five percent of 60-year-olds still walk normally; but only 20 percent of 85-year-olds do. The latter fact also implies, however, that gait disturbances do not necessarily accompany increased age. Problems of gait are associated with immobility and falls, which markedly impair the quality of life.[2]

Given that more than half of the victims involved in the death-related incidents were reported to have had preexisting medical conditions, it is reasonable to conclude that medical conditions may have contributed to the incidents. The medicine the victims took may also have increased the risk of slips and falls. According to the research, some medications may adversely affect vision, balance or the ability to recover from perturbed balance (Bakken, 2007). The researcher also maintains that the greater the number of medications taken, the greater the risk of an interactive adverse response and, therefore, the greater the risk of slips and falls.

[2] Source of material is at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2872829/.

2. Product Characteristics

Coefficient of friction (COF) is the primary risk factor for slipping (Sherehiy et. al, 2009), but it is only one characteristic of the floor that can affect the slipperiness of the floor. The surface roughness of a floor is a characteristic that makes the floor slip resistant, particularly in the presence of contaminants, such as water or oil (DiPilla, 2010). However, a flat and smooth surface has an increased probability of demonstrating a low COF, and hence, risk of slip, when in contact with another flat and smooth surface. This is particularly true when one or both surfaces are contaminated, for example, from dirt, oil, or water (Bakken et al, 2007). Surface texture, another characteristic of the floor, which affects the ability of the floor to disperse liquid quickly, may also contribute to slipping (DiPilla, 2010). Additionally, the characteristics of floor surfaces are constantly modified as a function of wear and dirt (Leclereq, 1999). Therefore, traction of the floor may change over time and result in slips and falls.

3. Environmental Factors

Environmental factors, such as contaminants (water, oil, grease, etc.), are risk factors for slips and falls (Sherehiy, 2009). According to the researchers, slip-and fall-related injuries often occur on wet, dirty, and greasy or other contaminated walking surfaces. The CPSC injury data are consistent with the research as the data indicate that 53 (25%) of 219 reported incidents involved a wet floor. Two incident reports stated that the floor was dry when the slip occurred; and one incident report mentioned that there was oil on the floor. One hundred sixty-three incident reports did not specify whether the floor was wet, oily, or dry, which may mean that the presence of contaminants on the floor may be underestimated because some of the unknown cases could involve contaminants on the floor.

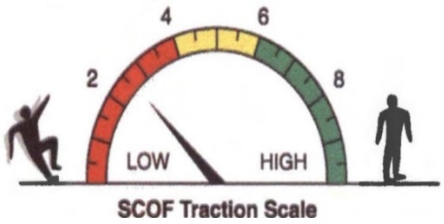
The material of the shoe and degree of its wear can contribute to slip and fall incidents (DiPilla, 2010). For example, footwear with hard plastic or leather soles, or soles with little or no tread pattern, are less slip-resistant than shoes with softer soles. However, the presence of liquid contaminants or solid matter wedged in tread patterns of softer-soled shoes can reduce slip-resistance. Lack of footwear may also contribute to slip-and-fall incidents. For example, wearing socks provide less slip-resistance than bare feet. However, bare feet in wet conditions, such as in areas of the pool, spa, and bathtubs, may result in falls.

C. ANSI/NFSI B101.5 Labeling Requirements

As previously mentioned, the petitioner requests that the Commission mandate ANSI/NFSI B101.5 labeling requirements to address the incidents. Section 4 of the standard contains requirements for labeling. The standard requires that two symbols indicating the product's SCOF and DCOF, respectively, be placed on the principal display of the product's packaging or container within the user's field of view. The standard states that the symbol must be "black and shades of black and markings" (sic) on a white or other background surrounded by a rectangle shape. Color must be permitted within the symbol to enhance the message. The print font within the symbol must be Ariel, no less than 8-point type. The standard requires that the labels be based on the values derived from testing the product in accordance with ANSI/NFSI B101.1-2009 and ANSI/NFSI B101.3-2012. When the product is tested according to ANSI/NFSI

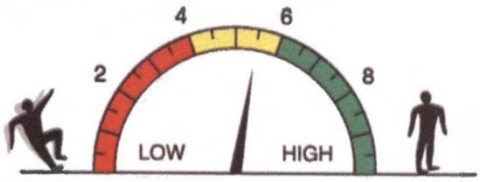
B10l.1, the product's packaging or container must be labeled with one of the following symbols to indicate the SCOF.

Figure 1 A



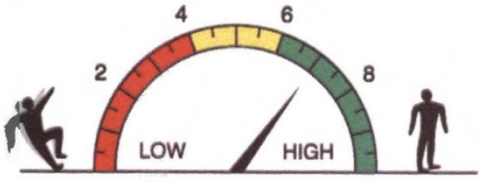
SCOF Traction Scale

Figure 1 B



SCOF Traction Scale

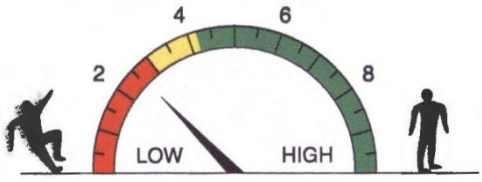
Figure 1 C



SCOF Traction Scale

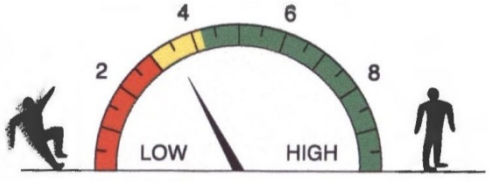
When the product is tested according to ANSI/NFSI B10l.3, the product's packaging or container must be labeled with one of the following symbols to indicate the DCOF.

Figure 2 A



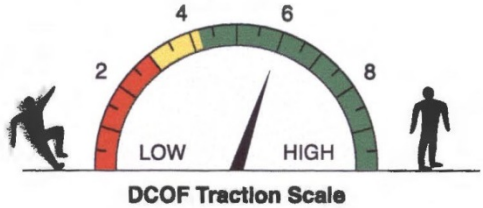
DCOF Traction Scale

Figure 2 B



DCOF Traction Scale

Figure 2 C



DCOF Traction Scale

Analysis of ANSI/NFSI B101.5 Labeling Requirements

The petitioner is requesting that the Commission require manufacturers to label their floor's wet SCOF and DCOF to inform consumers, particularly older adults, about their risk of slip. The petitioner believes that, armed with this information, consumers will have the benefit of selecting flooring that offers higher slip-resistance to reduce the potential for a slip-and-fall incident.

Risk information is communicated via warnings (Dejoy, 1999). Warnings may be conveyed via text only, text plus symbol combinations, warning symbols only, warning symbols supplemented with word messages, and other modes of communication (Goldsworthy and Kaplan, 2009). In this case, the petitioner proposes to convey the risk information via warning symbols supplemented with word messages.

Researchers maintain that for warnings to achieve the ultimate goal of inducing safety-related behavior, three factors must be met. These factors are: (1) noticing the warning, (2) processing the safety messages, and (3) motivating behavioral change (Barbera and Gill, 1986; Rogers, Lamson, and Rousseau, 2000; Rousseau and Wogalter, 2006; and Laughery and Wogalter, 2006). HF staff considered these factors and evaluated the current requirements to determine whether the requirements meet these criteria.

1. Noticing the Warning

Warnings must possess characteristics that make them prominent and salient so that they stand out from background clutter and noise (Wogalter, Kalsher, and Racicot, 1993a). Use of symbols is one method to achieve salience. They may also facilitate attention to associated text (Wogalter, Silver, Leonard, and Zaikina, 2006). Several studies have shown that warnings with symbols are more noticeable than warnings without symbols (Laughery et al., 1993; Heck, 1996; and Bzostek and Wogalter, 1999). Additionally, placing a border around important safety information is another way to make a warning stand out from or contrast with its background by enhancing the figure-ground relationship (Wogalter and Vigilante, Jr., 2006). Colors may also assist to achieve salience as color may assist in making warnings stand out from the environments in which they are placed (Bzostek and Wogalter, 1999; Wogalter and Vigilante, Jr., 2006). Size of the warning is another factor that may affect warning noticeability. Additionally, placement of a warning may also influence its prominence. For example, consumers are more likely to notice a warning placed on the top or front than on the bottom or back of a product.

As earlier noted, the current requirements in ANSI/NFSI B101.5 specify two symbols, each surrounded by a rectangular shape, to be the method of conveying the floor's COF at the point of sale. As required, color must also be permitted within the symbols to enhance the message, *i.e.*, red for low traction, yellow for moderate traction, and green for high traction. Additionally, the print font within the symbol must be no less than 8-point type. Furthermore, the symbols must be placed on the principal panel of the package or container within the normal field of view. The term *principal display panel* means the part of the packaging that is most likely to be displayed, presented, shown, or examined under customary conditions of display for retail sale based on various definitions of principal display panel from a number of sources.

Although the ANSI/NFSI B101.5 standard requires manufacturers to place the warning symbols surrounded by a border on the principal display panel of the packaging, and color may be permitted to enhance the symbols, consumers still may miss the warning symbols. According to research on warnings, warning text less than 10 or 11 point type is small and difficult to read. The size of the text determines the size of the label. Therefore, if the size of the text is 8-point type, the size of the label may be small. Additionally, if the symbols are placed on the principal display panel surrounded by and embedded in other texts or graphics that are typically found on flooring packaging, consumers may even be less likely to notice the labels since other texts and graphics may also be competing for consumer's attention.

Older consumers may be even less likely to notice the warning symbols. According to the scholarly research on older consumers (Haywood, 1986, Kline and Scialfa, 1997, Craik, 2000, and Santrock, 2010), visual acuity, the ability to see nearby images clearly, decline most sharply between 40 and 59 years of age and become very pronounced in very old age (*i.e.*, 75 years and older). The diameter of the pupil also decreases with aging, reducing the amount of light reaching the retina in a 60-year-old to one-third of a young adult. Additionally, lenses yellow with age, reducing the amount of illuminance reaching the eye, making glare a problem for older adults. Additionally, contrast sensitivity, the ability to distinguish differences in luminance, declines with aging. Researchers believe that contrast sensitivity is more important to discrimination tasks such as the ability to detect and recognize common objects, than visual acuity. Moreover, older adults have difficulty detecting and attending to relevant information while simultaneously ignoring irrelevant information. Thus, type sizes less than 10-point or 11-point type is likely to pose a problem for older consumers specifically since larger print (*i.e.*, 12 and 14-point type) and hence larger symbols are more appropriate for this age group.

The perception of hazard and familiarity with the product are other factors that may influence the likelihood that consumers will notice the warnings. Consumers, in general, are likely to perceive flooring as safe. The petitioner also recognizes this fact since the petitioner stated that consumers "often times assume that all floors are safe" (Petition at p.1). According to the research, consumers are not likely to look for warnings on products perceived as safe (Wogalter, Brelsford, Desaulniers, and Laughery, 1991; Ortiz, Resnick, and Kengskool, 2000, and Lesch, 2006). Floors are very familiar products. Consumers interact with floors daily whether they stand, walk, or run on them, and consumers see others use the product. The research demonstrates quite clearly that users who are more familiar or experienced with a product or a similar product are less likely to look for and notice (Wogalter, Desaulniers, Brelsford, Jr., 1986; Sanders and McCormick, 1993; Vrendenburgh and Zackowitz, 2006,; and Wogalter, Laughery, Sr., and Mayhorn, 2012) warnings especially when the perception of hazard is low. Although older adults are aware of some home hazards such as slips and falls, perhaps based on past negative experiences, familiarity may reduce the likelihood that the older age group will look for warning information. Additionally, consumers who use the floor may not necessarily be the ones who purchased the floor so the warning symbols would not be visible to this group when the floor is in use.

2. Processing the Safety Messages

Once consumers notice and attend to warnings, they must process (*i.e.*, read and understand) the warning to make appropriate decisions regarding the hazard and how to avoid it. Research on warnings indicates that there are a number of ways to increase the likelihood that consumers will read and understand the safety messages. Wogalter and Vigilante (2003) maintain that aesthetically pleasing warnings are more likely to hold attention (and thus be read). Also, symbols should be easy to read and understand (Deppa, 2009; Wogalter, Laughery, and Mayhorn, 2012).

In this case, color per ANSI/NFSIB101.5 (2014) may be used to enhance the warnings. Surrounding the symbols with a border may also enhance the appearance of the warning symbols. These may give the symbols an aesthetically pleasing appearance and increase the likelihood that consumers will attend to the symbols. However, a print size of no less than 8-point type is likely to be difficult to read in general, and for older consumers to read, in particular due to age-related changes. Furthermore, consumers may not comprehend the symbols. The petitioner provided documentation to show that researchers tested the symbols for comprehension to the ANSI Z535.3, *American National Standard Criteria for Safety Symbols* (2011), Annex B. General procedures for evaluating candidate safety symbols. To accept a symbol, ANSI Z535.3 recommends a criterion of 85 percent correct responses with a maximum of 5% critical confusion (response opposite the intended meaning), assuming a sample of 50 respondents. If a symbol fails to meet this criteria, the symbol should be rejected, modified and retested, used with a supplementary word message, or be supplemented by specialized training. The symbols the researchers tested received 88% correct responses with 8% critical confusion. Because the symbols did not meet the ANSI Z535.3 criteria for acceptance, the researchers recommended modifying the symbols to include additional text. This approach is consistent with ANSI Z535.3 and additional testing is not required. The additional text added is the supplemental word "Traction" to the "LOW" and HIGH" text to clarify that it is traction rather than "slipperiness" being indicated. To enhance the readability of the additional text, the researchers recommended orienting the text "LOW and HIGH" on the horizontal plane rather than angled. However, the symbols in the standard that the petitioner requests the Commission to mandate are not the ones the researchers recommended. The standard does not require the word, "Traction" to be mentioned together with the "LOW" and "HIGH" text as the researchers recommended. Consumers could, therefore, reverse the meaning (critical confusion) of the symbol to mean "low slipperiness" as subjects incorrectly did in the study. This may lead to a false sense of security that the floor the consumers will purchase is safe for use.

Older adults demonstrate greater difficulty in understanding warning symbols than younger adults (Wogalter and Laughery, 2006; Lesch, 2006). This may be due to certain cognitive skills and abilities deteriorating with increasing age with minimal declines in cognitive abilities evident by the mid-to- late- sixties and more pronounced declines beyond 75 years of age. Thus, many in the older adult population to whom these warning symbols are primarily aimed may not understand the symbols altogether.

Furthermore, the standard requires two different graphics, representing wet SCOF and wet DCOF, respectively, on the principal display panel. ESHF staff has concerns with this approach. First, consumers may not know for what the acronyms (SCOF and DCOF) stands which may be confusing. Second, each is based on two different test methods of slip-resistance (*i.e.*, SCOF and DCOF). Based on the research, both measures of slip-resistance yield different results, with SCOF typically higher, because it takes more force to initiate a sliding motion than to keep a sliding motion (Bakken, Cohen, Abele, Hyde, and LaRue, 2007 and DiPilla, S., 2010). And, since the test methods apply only to wet flooring conditions, the B101.1 test method which measures SCOF is well documented to provide a high value of COF due to stiction (*i.e.*, surface-tension adhesion)(Powers, Brault, Stefanou, Tsai, Flynn, and Siegmund, 2007). For example, a floor with SCOF in the green area of the scale may have DCOF in the yellow or even red area. This is likely to be confusing to consumers, leading them to select flooring that may increase the risk of slip.

3. Motivating Behavioral Change

As stated earlier, the goal of the petition is to assist consumers to make an informed purchase and ultimately select flooring which offers higher slip-resistance. To motivate consumers to select appropriate flooring, the warning should tell consumers why they need to do so. Given that the symbol depicts a fall hazard, and the warning will be placed on the principal display package of flooring, the context of use may provide enough information to the user to understand that there is a potential for slips and falls. Therefore, staff believes that if consumers notice, read and understand the symbols, the symbols and context of use may provide enough information to the user to motivate him/her to select appropriate flooring.

However, as previously mentioned, the standard requires that the warning symbols be based on the values derived from testing the product in accordance with ANSI/NFSI B101.1-2009 and ANSI/NFSI B101.3-2012. According to the research on slips and falls, different tribometers, devices for measuring slip-resistance of various surface combinations, yield different COF measurements for the same flooring surface. For example, a study concluded that tribometers can be quite different in their measurement characteristics (Chang and Matz, 2001) and that there is an urgent need to design more credible tribometers (Gronqvist et al., 1999). A more recent study compared the readings of nine tribometers on three surfaces (wet and dry) to rank their traction against the results of human subjects. The results indicate that different tribometers gave varied COF values for the same surface. The study concluded that the wide range of COF values underscores the impossibility of ascribing to a floor surface a single number to indicate its potential for causing a slip (Powers, Brault, Stefanou, Tsai, Flynn, and Siegmund, 2007). Stated another way, the value obtained from a given tribometer may or may not represent the user's risk of slipping. A 2010 follow-up study by Powers et al., yielded the same results. Research corroborating these findings suggests that rarely do any two tribometer agree, even on dry surfaces, and many have proven unreliable for wet testing (DiPilla, 2010.) Staff of the Directorate of Engineering Sciences supports these findings (See Tab C).

Warnings should contain adequate safety information so that consumers can make an informed choice. Given that the value obtained from a given tribometer may or may not represent the user's risk of slipping, and even less in wet conditions, staff believes that it is

unlikely that the label will provide consumers adequate, accurate, and reliable information. Even if the label provided such information, warnings aimed at older adults are likely to have limited effectiveness due to the previously mentioned age-related factors that may affect their ability to even notice and understand warning symbols. The warnings may be aimed at family members or caretakers, but they may also be older and suffer similar age-related changes. Additionally, the flooring industry points out that many floors are designed to have polishes or coatings applied after installation. This may modify the slip resistance of the installed floor which would mean that the reported traction will be different from the traction of the installed floor. Furthermore, COF is only one of a number of factors involved in slip and fall incidents. Thus, labeling the product's COF may have limited effectiveness.

III. CONCLUSION

Most slip and fall incidents involved people ages 70 and older. The next largest group of fall incidents involved people ages 60 to 69 years. Slip and fall incidents become more common for older adults due to age-related changes related to perceptual, cognitive, and motor deficits. Some of these decrements likely contributed to the incidents. Preexisting medical conditions and the adverse effects from multiple medications also likely contributed to the incidents. Factors related to the product and the environment are also risk factors for slips and falls and may also have played a role in these incidents. To reduce the risk of slip and fall incidents, the petitioner requests that the Commission require manufacturers to label their floor's slip resistance to inform consumers at the point of sale, particularly older consumers, so consumers can make informed purchases. The petitioner proposes to convey the risk information via warning symbols supplemented with word messages.

In order for warnings to be effective, the warnings must be noticed, read and understood, and motivate behavioral change. Consumers, in general, and older consumers, in particular, may not notice, and read and understand the warning symbols requested in this petition for the reasons mentioned. Even if consumers notice, read and understand the warning symbols and this could motivate behavioral change, staff's review raises questions about the accuracy and reliability of the means used to measure slip resistance. Devices that measure slip resistance yield values that may or may not represent the user's risk of slipping given the multiple factors involved. And, even if the devices could accurately predict the users risk of slipping and hence, the label provided accurate and reliable information, warnings aimed at older adults are likely to have limited effectiveness. The warnings may be aimed at family members or caretakers, but they may also be older and suffer similar age-related changes. Furthermore, COF is only one of a number of factors involved in slip and fall incidents. Thus, labeling the product's COF may have limited effectiveness.

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TAB D: Market and Economic Considerations for Labeling Requirements on Floor Coverings

TAB D

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
BETHESDA, MD 20814

Memorandum

Date: November 30, 2016

TO : Matthew Dreyfus, Ph.D.
Project Manager, Petition for Labeling Requirements on Floor Coverings

THROUGH: Gregory B. Rodgers, Ph.D.
Associate Executive Director
Directorate for Economic Analysis

Robert Franklin
Senior Staff Coordinator
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FROM : Samantha Li
Economist
Directorate for Economic Analysis

SUBJECT : Market and Economic Considerations for Labeling Requirements on Floor Coverings

Introduction

The Commission received a petition (CP 16-1) requesting that the Commission initiate rulemaking to require manufacturers of floor coverings and coatings to label their products' slip-resistance in accordance with the applicable American National Standard Institute standard (ANSI/NFSI B101). The petition asserts that different types of floor coverings have different slip resistances, and a mandatory label would adequately reduce slip and fall hazards for elderly consumers. The petition states that a mandatory rule requiring flooring materials to be labeled in accordance with ANSI B101.5-2014 would empower consumers to make informed choices regarding their flooring material choices at the time or point of sale.

This memorandum provides information on the market for floor covering products and economic considerations related to the petition. The discussion is based on information that was readily available, including information provided by the petitioner and public comments.

The Products

The petitioner requests that the Commission mandate that manufacturers of hard floor coverings and coatings label their products' slip-resistance. The following sections describe the different types of hard floor coverings and coatings and the market for these products.

Hard Floor Coverings

Hard floor coverings encompass a range of materials including resilient and non-resilient flooring: these products include vinyl, cork, linoleum, bamboo, laminate, ceramic tile, natural stone, and wood. All flooring products are available in a variety of colors, shapes, and designs. Each category is described in more detail below.

Vinyl flooring products include vinyl sheet flooring, luxury vinyl tile (LVT), and vinyl composition tile (VCT). Vinyl flooring consists of a core layer, backing, and protective top layer. Vinyl flooring can also have different sheens or finishes. VCT consists of a mixture of vinyl resins, fillers, and plasticizers whereas LVT consists of a solid vinyl core. LVT and vinyl sheet flooring can have hues and textures similar to that of wood or stone. Vinyl flooring is frequently used in kitchens, bathrooms, recreation rooms, and basements.

Cork flooring is produced from the bark of cork oak trees. Cork flooring is available as unfinished as well as waxed. Cork is considered environmentally sustainable.

Bamboo flooring is produced from tree-like grass. Bamboo comes in two types: horizontal (also called strand) and vertical. Like cork, bamboo is considered environmentally sustainable.

Linoleum flooring comprises a blend of materials, including linseed oil, pine rosins, reclaimed cork, and wood dust. Linoleum can be purchased with or without a protective coating.

Laminate floor coverings are composed of multiple layers of plywood or compressed wood fiber with a top layer of a plastic coating applied over a photograph to give the appearance of solid wood.

Ceramic and porcelain tiles are composed of mixtures of clay, water, feldspar and other minerals that are pressed into a model and fired in a kiln at high temperature. Porcelain tile consists of approximately 50 percent feldspar and is fired at a much higher temperature than other ceramic tiles. Most ceramic tile is glazed, while porcelain tile is mostly unglazed. Tiles can also resemble mosaic art or contain patterns or geometric designs.

Natural stone tiles are made from such stone types as granite and marble. Stone used to make tile is quarried into rough slabs and then taken to a production site to be cut into tiles of the desired size and shape. Natural stone is frequently used to enhance the aesthetic value of kitchens and dining rooms.

Solid wood flooring products consist of pieces of wood, such as oak, that have been processed by drying, surfacing, sizing, and cutting. Solid wood can be both unfinished and prefinished. Unfinished flooring can be installed and stained and finished in residential homes. Engineered wood contains a top veneer of real wood with layers of plywood or similar material underneath. The top layers of engineered wood can contain textures or patterns to resemble reclaimed wood. Engineered wood is less susceptible to cracking caused by contraction and expansion than solid wood.

Flooring products can be sold as individual planks ranging from 1.5 inches wide to 8 inches wide or as sheets. Some flooring products, such as laminate, engineered wood, and LVT, can snap or lock into place and do not require glue or nails for installation. Others, such as solid wood, require nails or glue/sealant.

Some flooring products can last the life of the house, particularly ceramic, porcelain, natural stone, bamboo, and wood. Vinyl flooring lasts 10 to 20 years while linoleum lasts 20 to 40 years. Laminate flooring lasts 15 to 20 years. Cork flooring may last 20 to 25 years.

Floor covering products can be purchased at specialty floor covering stores and home improvement stores and prices are quoted per square feet. Manufacturing and retail prices vary, depending on the material. In general, the retail price of vinyl flooring is less than $1 per square foot, but the retail prices of luxury vinyl may be as high as $7 per square foot. Retail prices for laminate flooring are generally priced from less than $1 to about $4 per square foot. Ceramic and porcelain floor tile is generally priced between about $1.50 and $4 per square foot. Retail prices for bamboo and cork flooring is about $4.50 per square foot and $5 per square foot, respectively. Hardwood flooring is generally priced between $3 and $7 per square foot. Retail prices for natural stone generally range from less than $3 to more than $15 per square foot. [1]

Flooring can be installed either by professional installers or home owners. While a small do-it-yourself (DIY) market exists for vinyl sheet flooring, the majority of vinyl floors are installed by professionals. A home improvement website recommends engineered wood for kitchens and basements for DIY projects, while a flooring manufacturer recommends laminate flooring for high traffic indoor home use.[2] Vinyl, wood, and laminate were the three most popular flooring products used in residential market due to their low cost and ease of installation. Engineered wood is used more often in remodeling than new construction.

Market for Flooring Products

Number and Size of Firms Associated with Hard Flooring Products

Manufacturers of hard flooring may be classified in one of several different North American Industrial Classification (NAICS) categories depending upon the primary material used in manufacturing their products. Table 1 summarizes the total number of firms in each of these categories and the number of firms that are considered to be small firms according to the Small Business Administration criteria.[3] With the exception of ceramic tile manufacturers, hard flooring manufacturers (NAICS category 327120) are considered to be small businesses if they

[1] These retail prices are based on retail prices observed on several websites including homedepot.com, homeflooringpros.com, and improvenet.com. Price information was collected on July 6, 2016.
[2] Armstrong Flooring Product Types. 2016. Accessed June 21, 2016. http://www.armstrong.com/flooring/flooring-types.html.
[3] The most recent Small Business Administration (SBA) Size Standards are available at: https://www.sba.gov/contracting/getting-started-contractor/make-sure-you-meet-sba-size-standards/table-small-business-size-standards.

have fewer than 500 employees. Firms in this category are considered to be small if they have fewer than 750 employees.[4] It should be noted that each of the categories in Table 1 are broad categories and include many products other than flooring. It is possible that most of the firms in each of the categories do not manufacture flooring.

Staff has identified at least 20 manufacturers that supply hard flooring products to the residential market. This includes a few large manufacturers that own multiple brands and supply multiple types of flooring products, particularly for wood and tile. The U.S. residential flooring market is dominated by a few large firms that offer a range of products in most market segments and price ranges.

Flooring products are generally not available for purchase directly from manufacturers to consumers; manufacturers supply their products through various retailers, such as floor covering stores or home improvement stores. Table 1 also provides some information on the number of specialty floor covering retailers and home centers.[5]

Table 1: Firms in NAICS Categories That Include Hard Floor Covering Manufacturers

NAICS category	**Number of firms**	**Number of small firms**
321918 Other Mill Work including Flooring (includes wood flooring)	1,476	1,451
326199 All Other Plastics Product Manufacturing (includes vinyl flooring)	5,324	5,008
327120 Clay building material and refractories manufacturing (includes ceramic and porcelain tile)	401	370*
327991 Cut stone and stone product manufacturing (includes granite and marble flooring)	1,780	1,764
Total number of manufacturers	***8,981***	***8,593***
NAICS category	**Number of firms**	**Number of small firms**
442210 Floor Covering Stores	9,597	9,523
444110 Home Centers	2,110	2,036
Total number of retailers	***11,707***	***11,559***

Source: 2013 Census data. *Number of firms with fewer than 500 employees.

[4] However, the number of firms with fewer than 500 employees is provided for convenience.
[5] Because dollar sales would not take into consideration the types of floor covering retailers, staff is providing information on the number of firms. Firms with fewer than 100 employees are considered small.

Apparent U.S. Consumption for Hard Surface Flooring

Table 2 summarizes the consumption for hard surface flooring in 2014 by various categories.[6] In 2014, total apparent U.S. consumption for hard surface flooring in single family and multifamily housing was approximately 4,140 million square feet. Most hard surface flooring sold in 2014 was used in existing homes and single family homes.[7] Vinyl, decorative tile, wood, and laminate each accounted for a significant portion of the sales. The apparent consumption for other hard surface flooring, including cork, linoleum, and bamboo, accounted for less than 3 percent of the sales in 2014.

Based on 2013 National Association of Home Builders data, the average size of a room in new homes was approximately 200 to 225 square feet.[8] If the average room size for houses built in 2013 is similar to the average room size in existing houses, it suggests that enough hard surface flooring was sold in 2014 to cover 18 million to 21 million rooms.

Based on the apparent U.S. consumption of flooring reported in Table 2 and the observed retail prices for several types of flooring reported earlier, the total retail value of hard flooring sales in 2014 might have been around $10 billion. However, this estimate does not account for the fact that some flooring might have been obtained at lower prices by home builders or remodeling contractors, nor does it include the cost of installation.

Table 2: 2014 Flooring Sales by Categories (millions of square feet)

Category	Sales
Total Consumption	4,140
Single Family Housing	3,505
Multifamily Housing	500
Manufactured Housing	135
Existing Housing	3,410
New Housing	730
Type of Flooring	
Vinyl	925
Decorative Tile (incl. ceramic, porcelain, and natural stone)	1,270
Wood	935

[6] Consumption (or sales) is calculated as the sum of production and imports, less exports (The Freedonia Group, 2015).
[7] Hard surface flooring includes resilient floor coverings and non-resilient products. These products include vinyl, rubber, linoleum, cork, wood, laminate, tile flooring, natural stone, glass, and metal flooring.
[8] Emrath, Paul. October 1, 2013. Special Studies: Spaces in New Homes. National Association of Home Builders. Accessed April 22, 2016. https://www.nahb.org/en/research/housing-economics/special-studies/spaces-in-new-homes-2013.aspx.

Laminate	910
Other (e.g., cork, linoleum, bamboo)	100

Source: The Freedonia Group

Floor Finishes, Paints, and Coatings

Floor finish products include paints, finishes, and coatings that are applied to the floor covering product as final step in manufacturing process or as treatments to existing home products. As aftermarket products, floor paints and coatings can be used to resurface and retouch the original floor covering as well as to fill in cracks. The petition could change the COF values for in-use floors and as uncoated products. Floor paints, finishes, and coatings are sold at retailers in quart and gallon sizes.

Floor finishes, paints, and coatings used as aftermarket flooring treatments are sold at a wide variety of retailers, including paint stores, home improvement centers, and hardware stores. Dollar sales for floor finishes, paints, and coatings are not available. According to 2013 Census data, there were approximately 900 firms listed under the category *325510 Paint and Coat Manufacturer*. Approximately 2,700 firms are categorized as paint retailer: 1,600 firms were categorized under *444120 Paint and Wallpaper Stores* and 1,100 firms were categorized under *424950 Paint, Varnish, and Supplies Merchant Wholesalers*.

Information That Would Be Required to Estimate the Societal Cost of Injuries

We cannot provide any information on the societal costs of injuries resulting from slips on floors due to low slip resistant flooring. Although there were 190,000 emergency department-treated falls annually from 2012 through 2014 associated with slips, [9] the number that involved low slip resistance is unknown. It is unlikely that all of the injuries involving slips would have occurred on floors with low slip resistance. In order to estimate the societal costs of the slip that occurred on floors with low slip resistance, staff would need information on the proportion of injuries resulting from slips, and the slip resistance of the floors on which the falls occurred. Developing this information would require a substantial amount of time and effort. It would likely involve selecting a representative subsample of NEISS fall cases and obtaining additional information about the cases, including the reason for the fall, the type of floor on which the fall occurred and the slip resistance of that floor at the time of the injury. Obtaining information on the slip resistance of the floor would likely involve at least some site visits and testing in order to determine the slip resistance of the floors.

[9] Memorandum from Wioletta Szeszel-Fedorowicz, Directorate for Epidemiology, dated June 14, 2016, Subject: Estimated Number of Injuries and Reported Incidents Associated with Slipping on Floors, 2012-2014.

In order to estimate the potential societal benefit of a rule mandating the labeling of hard surface flooring with its slip resistance, it would also be necessary to determine the difference in the risk of falls on various types of floorings with different degrees of slip resistance. To do this, staff would need to develop information on the exposure of consumers to floors with different slip resistances. This might be accomplished by selecting a representative sample of housing units and measuring the area and slip resistance of each hard flooring surface. This information could be used to estimate the risk of falls by slip resistance of the flooring material. By comparing the differences in the risk of falls by slip resistance, it might be possible to estimate the reduction in the number of falls that would occur if the exposure of consumers to flooring materials with low slip resistance were reduced.

Finally, in order to estimate the potential benefit of such a rule, it would be necessary to determine the impact that such a rule would have on the purchase decision of consumers. Presumably consumers already have experience walking on different surfaces and have some idea that some floor surfaces are more "slippery" than others. Moreover, consumers may already have some knowledge of the characteristics that contribute to the slipperiness of floors and this information may already influence their purchase decisions. Therefore, a rule mandating the labeling of hard flooring with the slip resistance might not provide consumers with much more information than they already have and as a result have little impact on the number of falls. An experiment to determine whether such a label could have an impact on consumer knowledge might be to have consumers rank a number of flooring samples by their slipperiness. Some consumers would be provided only the flooring samples and the information currently available to the consumers. Other consumers would also be provided the label for each sample requested by the petitioner. If there is little difference in the way the two groups rank the samples one could conclude that the label would have little impact on consumer purchase decisions. If it significantly changes the way consumers rank the materials, one might conclude that it could have some impact on the purchase decisions. CPSC staff does not believe COF information would be accurate, reliable or consistent on different types of flooring.[10]

Costs to manufacturers

The petition asserts the costs of the labeling rule the petitioner suggests are low because manufacturers are already testing products' resistance.[11] However, several representatives of different segments of the flooring industry seemed to dispute this assertion. For example, the International Wood Products Association stated that an informal survey of their members found that few were aware of the test method described in the petition and stated that they would incur considerable costs to implement the testing and reporting that would be required by the petition. Mohawk Industries Inc., a large and diversified manufacturer of floor coverings, including

[10] Memorandum from Sharon White, Division of Human Factors, dated July 6, 2016, Subject: Factors Assessment for Petition (CP 16-1), Petition for Labeling Requirements Regarding Slip Resistance of Floor Coverings and Memorandum from Vincent Amodeo, Division of Engineering Sciences, dated August 15, 2016, Subject: Assessment of Existing Standards and Practices Related to Flooring Slip-Resistance (Traction).
[11] Petition, pg 8.

ceramic tile, stated that they do not use the B101 test methods proposed by the petitioner and further stated that they do not know of any ceramic tile manufacturer that does. Based on these assertions it seems reasonable to conclude that if the requirements proposed in the petition were mandated, the cost to manufacturers would be higher than suggested by the petitioner. In order to determine the potential costs, it might be necessary to survey manufacturers to determine if and how they currently test the slip resistance of their products and the difference between the cost of the methods that they currently use and the cost of the method proposed in the petition.

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ANSI/NFSI B101.3-2012 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials (Including Action and Limit Thresholds for the Suitable Assessment of Measured Values).

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TAB E: CPSC recalls involving the slip resistance of floor coverings from 2005-2016

TAB E

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
BETHESDA, MD 20814

Memorandum

DATE: November 30, 2016

TO: Matthew Dreyfus, Project Manager
Laboratory Sciences, Division of Chemistry

THROUGH: DeWane Ray, Acting AED
Office of Compliance and Field Operations

Mary Toro, Director
Regulatory Enforcement Division, Office of Compliance and Field Operations

Troy Whitfield, Mechanical Team Leader
Regulatory Enforcement Division, Office of Compliance and Field Operations

FROM : Lawrence Mella, Compliance Officer
Regulatory Enforcement Division, Office of Compliance and Field Operations

SUBJECT: CPSC recalls involving the slip resistance of floor coverings from 2005-2016

This memorandum was prepared in response to a request from the Project Manager for the Petition for Labeling Requirements Regarding Slip Resistance of Floor Coverings which requests that the U.S. Consumer Product Safety Commission (CPSC) initiate rulemaking under the Consumer Product Safety Act (CPSA) to require that manufacturers of floor coverings, floor coverings with coatings, and treated floor coverings label their products' slip resistance in accordance with the applicable American National Standards Institute (ANSI) standard. The current standard, ANSI/NFSI B101.5 Standard Guide for Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic Coefficient of Friction (Traction) of Floor Coverings, Floor Coverings with Coatings, and Treated Floor Coverings sets forth a uniform product labeling for floor coverings, floor coverings with coatings, and treated floor coverings identifying wet static and wet dynamic coefficient of frictions in order to provide guidance to users/purchasers on the traction capabilities of the floor covering product.

Compliance staff reviewed recall data between the years 2005 through 2016. Staff identified one recall involving a 'shower rug.' The recall involved a slip-resistant floor mat for the shower that may not remain in place and slip along the shower floor surface creating a fall hazard due to the failure of suction cups on the underside of the rugs.[1] The recall summary states that there were 60 reports of consumers falling in the shower or bathtub while using the shower rug with 30 reports involving bruises, cuts, and fractured or broken bones. Compliance staff found no other flooring recalls related to problems with the slip resistance of the floor covering.

[1] http://www.cpsc.gov/en/recalls/2016/tristar-products-recalls-aquarug-shower-rugs/

TAB F: Response to Comments Received on Floor Covering Petition

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UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
ROCKVILLE, MD 20850

Memorandum

Date: November 30, 2016

TO : Floor Coverings Petition File

THROUGH: Andrew Stadnik, Associate Executive Director
Directorate for Laboratory Sciences

FROM : Matthew Dreyfus, Ph.D., Project Manager
Directorate for Laboratory Sciences

SUBJECT : Response to Comments Received on Floor Coverings Petition

Introduction

CPSC published a request for comments on the floor coverings petition (CP 16-1) in the *Federal Register* on December 3, 2015, with the comment period ending on February 1, 2016. The Commission received 66 comments, the majority of which (42) opposed the petition. Seventeen comments supported the petition. CPSC staffs' summary of the comments and proposed responses follow.

Comments Received and Staff's Responses

Many commenters expressed concern over the increasing number of slips and falls, but disagreed that the action proposed in the petition was the correct way to address the issue. These commenters cited a number of reasons for their opposition: [1]

- The ANSI/NFSI standard is not recognized by the tile and stone industry (27 comments);
- SCOF/DCOF are not correlated with slip incidents, and thus the petition addresses the wrong problem (9 comments);
- Pertinent statistical evidence was not provided to support the petition (10 comments);
- Alleged conflict of interest, because the NFSI may stand to gain financially if the petition is approved (7 comments); and

[1] Staff is aware of an application to withdraw ANSI/NFSI B101.1-2009, which echoes many of the concerns raised by public commenters. This letter was dated June 21, 2016, after the comment period. Accordingly, the letter was not considered as part of the comments received on the petition.

- The standards cited in the petition were challenged for producing inconsistent and/or misleading data, and a lack of consensus when developing the standards (17 comments).

Commenters that supported the petition cited the personal and societal costs of slip incidents each year and the need to take action to reduce the number of incidents (16 comments). Other commenters supported the petition as a means to educate consumers (5 comments). The significant issues raised in the comments are presented below, followed by staff's responses.

Support for the Petition

Petition Will Reduce Slips, Trips and Falls

Comment: Commenters expressed broad support for the petition in order to reduce the number of slip, trip and fall accidents. These commenters noted that the number of accidental injuries stemming from slips, trips and falls are increasing. Resulting injuries can be life-altering or life-ending, and can negatively impact the family, friends and community of the victim. Additionally, some comments (18 and 20) provided statistics:

"According to the Center for Disease Control and Prevention:

- *One in three older adults falls each year*
- *About 2.5 million nonfatal falls were treated in emergency departments in 2013*
- *Of those, over 700,000 people were admitted to the hospital*
- *In 2014, more than 27,000 older adults die from unintentional falls*
- *More than 250,000 hip fractures are reported every year, and 95 percent of those are from falls"*

Response: Commenters that support the petition represent a cross section of stakeholders. CPSC staff conducted analysis of emergency department-treated injuries associated with slips on floors in the years 2012-2014. Because of the number and complexity of slip incidents, staff reviewed and analyzed data from the 3 most recent years.[2] CPSC staff's analysis found no statistically significant linear increasing 3-year trend of the estimated annual emergency department-treated slip injuries in the years 2012-2014. We can't rule out that the higher point estimates observed year to year might simply be a product of sampling error. Further, there are demographic changes in the population to consider as the total U.S. population rose by 2% overall between 2012 and 2014. The two-year population increase was 7% for the number of seniors aged 65 and older[3]. Thus, CPSC staff's analysis does not align with some commenters' assertion that the number of slip injuries is increasing.

[2]*Szeszel-Fedorowicz W. Memorandum: Estimated Number of Injuries and Reported Incidents Associated with Slipping on Floors, 2012-2014.*

[3]Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties and Puerto Rico Commonwealth and Municipios: April 1, 2010 to July 1, 2015, U.S. Census Bureau, June 2016

Table 1 presents the estimated annual emergency department-treated injuries associated with slipping on floors for all age groups in the years 2012-2014. Staff did not find a statistically significant linear increasing 3-year trend for the annual estimated department-injuries associated with slipping on floors in the years 2012-2014 (p-value = 0.7198).

Table 1. Estimated Annual Emergency Department-Treated Injuries Associated with Slipping on Floors for All Age Individuals, 2012–2014

Year	Estimate	95% C.I.	C.V.
2012	185,147	141,165–229,129	0.1212
2013	187,644	141,340–233,948	0.1259
2014	196,475	144,488–248,462	0.135

Staff estimated that the average annual rate of emergency department-treated slip injuries was 60 injuries per 100,000 population. The estimated annual rate of emergency department-treated slip injuries are shown in Table 2. Staff did not find a statistically significant linear increasing 3-year trend for the estimated annual rates of emergency department-treated injuries associated with slipping on floors in the years 2012-2014 (p-value = 0.7950).

Table 2. Estimated Annual Rate of Emergency Department-Treated Injury Rates Associated with Slipping on Floors for All Age Individuals, 2012–2014

Year	Estimate Rates per 100,000	95% C.I.
2012	60	45–73
2013	59	45–74
2014	62	45–78

CPSC staff found 197 deaths associated with slipping on floors reported to CPSC through death certificates and Medical Examiners and Coroners Alert Projects (MECAPs) in the years 2012-2014. These reports comprised 64 fatalities in the year 2012, 71 fatalities in the year 2013 and 62 fatalities in the year 2014. Given that reported fatalities are not based on a probability sample, CPSC staff does not encourage conclusions about any year-to-year increases or decreases that may seem apparent in the reported data.

CPSC estimated that in 2011 there were 1.5 million emergency department-treated injuries associated with senior falls.[4] Staff categorized senior falls seen in emergency departments as

[4] *Hanway S. Hazard Screening Report consumer Product-Related Injuries to Persons 65 Years of age. U.S. Consumer Product Safety Commission, 2013.*

follows: loss of balance (12%), slips (11%), trips due to a change in elevation (11%), trips over an obstacle (10%), missteps (5%), other falls (29%), and falls due to unknown reasons (23%). CPSC staff also reviewed the Centers for Disease Control and Prevention (CDC) fatal injury reports. Based on the mortality database compiled by CDC's National Center for Health Statistics (NCHS), 20,426 fall-related deaths occurred in the year 2005 and 33,018 fall-related deaths occurred in the year 2014.[5] However, CPSC staff does not know what percentage of these fall-related deaths is associated with slipping on floors.

Labels will Educate Consumers

Comment: Commenters stated that this petition will serve to educate the consumer and allow for more informed purchases to limit risk of slip, trip and/or fall accidents.

Response: Staff disagrees. The petitioner states that labeling the floor's slip resistance would better educate consumers about risk of slips and falls. However, the labeling standard the petitioner requests are not likely to do so. Based on the published research, different devices for measuring slip resistance of various surface combinations yield different coefficient of friction measurements for the same flooring surface. Therefore, the value obtained from a given tribometer may or may not represent the user's risk of slipping, and even less so in wet conditions or in actual use outside the test lab. Thus, staff does not believe that the label suggested by the petition will provide consumers adequate, accurate, and reliable information to make an informed choice.

COF Information is Difficult to Obtain

Comment: A commenter stated that it is difficult to acquire the proper coefficient of friction information on grouted tile products, resilient titles, and floor coatings due to the lack of available or applicable tests.

Response: Staff's review of available test methods and friction measuring devices as discussed previously indicates that no single method or device is able to accurately determine COF (static or dynamic) on every surface. Staff found no consensus among flooring manufacturers and standards developers on a universal method or device for measuring SCOF or DCOF and found no agreement on measuring wet versus dry conditions as an accurate predictor of risk.

[5] *http://www.cdc.gov/injury/wisqars/fatal_injury_reports.html*

Low-COF Related to Fall Accidents

Comment: One commenter stated that many injuries from fall accidents involved a floor walking surface with a low COF, which would fail the ANSI B101.5 standard.

Response*:* CPSC staff cannot determine how many injuries are associated with falls on floors with a low coefficient of friction (COF) because this information is not available in the CPSC's injury data.

Opposition

Concerns with Using Coefficient of Friction as Guideline for Safe/Unsafe Flooring

Comment: Many commenters stated that the petitioner does not provide pertinent statistical evidence to support the need for a labeling standard, because falls are due to a myriad of issues, such as: a lack of physical strength, balance, coordination, the unanticipated change in traction, and/or environmental issues. Another commenter notes that data presented by NFSI are "generally directed towards showing the frequency and impacts *of* slip and fall events, *not* the impact that either the floor COF or COF labeling has *on* slip and falls."

Response*:* CPSC staff's review of the incident data indicates that many issues may contribute to a person's fall. For example, people have varying health issues: muscle weakness, poor vision, difficulties with keeping balance, taking medications. Environmental factors may also play a role, such as the type of footwear a person is wearing, and the poor lighting of a room. The data cited in the petition do not provide information about health or environmental factors which may have contributed to fall incidents. Staff's incident review found that information about contributing factors is rarely cited in the data, making it difficult to obtain statistical evidence to pinpoint the potential benefit of a labeling standard.

Comment: One commenter noted that the proposed label would not be a practical means of reducing risk, stating "Consider the wide array of scenarios in which the individual who may slip – and who may have chosen a different flooring product had meaningful, accurate information regarding the slip resistance of the product been available when that floor was selected – is not the purchaser and is in no way involved in the floor selection or other design choices. Such scenarios include, for example, commercial, hospitality, and workplace settings, and even residential and nursing home or other medical care settings."

Response*:* CPSC staff estimated that, in the years 2012-2014, 57 percent of emergency department-treated injuries associated with slipping on floors took place in residential settings and 23 percent in commercial or public settings. Twenty percent of the estimated emergency department-treated injuries associated with slipping on floors did not provide information about where the injury occurred. While it is accurate to state that the person slipping on a floor may not be the person that selected or purchased the flooring, especially in commercial buildings, floor purchasers likely have an understanding of the intended use for flooring products. Regardless of purchaser, however, staff is concerned that the proposed label conveying the COF

will not be useful information. Based on studies, staff did not find evidence to suggest test methods outlined in the voluntary standard are consistent, reliable, and robust. Additionally, staff found little evidence to support the assertion that a high COF would lead to fewer slip and fall incidents.

Comment: Several commenters stated that static coefficient of friction (SCOF) does not predict slip risk. Commenter adds that other factors, such as proper maintenance, floor finish, and installation must be considered. Another commenter states that even a "surface with a high COF can still become slippery very quickly with contamination or poor maintenance."

Response: A review of available test methods and friction measuring devices as discussed above indicates that no single method or device is able to accurately determine COF on every surface. Staff found no consensus among flooring manufacturers and standards developers on a universal method for measuring SCOF or DCOF and no agreement on measuring wet versus dry conditions as an accurate predictor of risk. Testing shows that certain devices can give misleading COF measurements due to stiction, indicating that a surface is higher traction than reasonable. ANSI A137.1 *Standards Specifications for Ceramic Tile* specifically states that COF is not the determining factor for traction and that traction needs to be evaluated in the context of other information. Staff agrees with the commenters that SCOF cannot be used by itself to predict slip risk.

Comment: Multiple commenters state that various government and standards organizations (such as OSHA, ABA, ADA, and ICC) have rejected or withdrawn tests based on COF measurements due to a lack of correlation with risk.

Response: Based on a review of existing and withdrawn voluntary standards, staff agrees with the commenters that various entities have concluded there is a lack of correlation between COF measurements and risk of fall.

Comment: Several commenters stated that the petitioner has not appropriately considered additional factors that can affect flooring performance, such as variable environmental and application factors. One commenter adds that "cleaning and maintenance (or lack thereof), surface damage, exposure to environmental conditions, wear and tear, the introduction of foreign material, as well as the gradual buildup of dirt and grime" can change a flooring surface's COF. A commenter noted that the COF cannot be determined until after the floor is installed and a final finish is applied.

Response: Staff agrees with the commenters that risk of fall on a flooring surface depends upon multiple factors, such as contaminants, surface wear, footwear, maintenance, and lighting conditions and the risk of fall is difficult to predict due to this continuous variability.

Comment: Some commenters stated that the petition does not differentiate between different floors for different applications, and that such a "one size fits all" approach does not make sense.

Response: Based on a review of test methods and research papers, staff agrees with the commenters that no single method is appropriate for all surfaces and conditions. Staff found no consensus among flooring manufacturers and standards developers on a universal method for

measuring SCOF or DCOF, and found no consensus on relating COF measurements to risk of fall.

Comment: Commenters note that the COF values of a flooring material may change over the floor's lifespan, and that such aging is not covered under the standard the petitioner requests.

Response: Staff agrees with the commenters that aging of the flooring surface and other environmental conditions are not considered in the petitioner's standard.

Comment: Commenters stated that some manufacturers currently provide COF information about their products, which is in contrast to claims made by the petitioner.

Response: CPSC staff is aware that some manufacturers may provide COF information. However, the petitioner's request is to mandate labeling for all hard flooring products, regardless whether that information is provided by select companies.

Comment: A commenter stated that engineered wood flooring is not recommended for areas that are wet or moist; and that labeling would not reduce slip occurrences.

Response: Staff agrees with the commenter that the petitioner's method may not be applicable to all types of flooring surfaces and conditions and the petitioner's methods may provide misleading assessments.

Concerns about NFSI

Comment: Several commenters noted that the NFSI stands to profit from the standard the petitioner requests. These commenters expressed that this appears to be a conflict of interest on the NFSI's behalf, and that any safety standard should be in the public domain and absent of proprietary devices.

Response: CPSC staff is aware of this concern, but has not investigated further.

Comment: Commenters discussed a concern that the NFSI requires an annual fee; this cost precludes all interested parties from participating, thus the committee lacks balance and the authored standard is not a consensus document. Other commenters also voiced concerns about committee balance, but did not reference the annual fee.

Response: CPSC staff understands the concerns that an annual fee may preclude some from participating. Staff notes that many standards associations and trade groups also require fees, which is typically not considered to be a substantial hindrance in other industries.

Concerns about Test Method and Equipment

Comment: Commenters stated that tribometers are not a consistent or reliable measurement device. One commenter notes that "several scientific, peer-reviewed studies have reported that different tribometers measure different coefficients of friction (either SCOF or DCOF) for the same condition." Other commenters added that no criteria exist for defining a "recognized" tribometer.

Response: Staff's review of available test methods and friction measuring devices as discussed previously indicates that no single method or device is able to accurately determine COF (static or dynamic) on every surface. Staff found no consensus among flooring manufacturers and standards developers on a universal method or device for measuring SCOF or DCOF and found no agreement on measuring wet versus dry conditions as an accurate predictor of risk. Staff agrees with the commenters that tribometers are not consistent or reliable measurement devices for predicting risk of fall.

Comment: Commenters stated that the standard the petitioner requests uses a hard plastic slider, which does not emulate the average fall victim's typical footwear.

Response: The various methods and devices used for measuring COF specify specific foot material that contacts the flooring surface during the measurement. Typically, this is a Neolite rubber or leather foot which may provide COF readings that are not applicable to other types of footwear material. Staff agrees with the commenters.

Comment: Commenters stated that during the test, the test foot can create a vacuum on the wet test surface, resulting in an artificially high COF value, which is not addressed in the petitioner's standard.

Response: Staff agrees with the commenters that that certain devices can give misleading COF measurements due to stiction, indicating that a surface has higher traction than reasonable.

Comment: One commenter noted that no third party oversight exists for testing that would be required under the petitioner's standard.

Response: Staff agrees with the commenter that the standard for labeling requested by the petitioner, NFSI, specifies a method that requires approval by the petitioner with no oversight from outside bodies. NFSI would maintain sole ability to determine the approved methods and devices and the use of the label requires product manufactures to pay for the evaluation.

Comment: One commenter stated that some of the "test methods for static friction under NFSI B101.1 can be influenced by human factors that may affect the results to the detriment of the consumer."

Response: Staff agrees with the commenter that the method for determining COF can be affected by the operator of the measuring equipment.

Comment: One commenter stated that the test should be tailored to scenarios where the most slips occur, such as when barefoot in the bathroom or shower.

Response: Staff agrees with the commenter that the specified method for measuring COF may not be applicable for the intended use and environment of the flooring surface. The test method specifies the use of a specific test foot material (typically leather or Neolite rubber) which may not be applicable to other footwear material and environments.

Comment: One commenter expressed concern that there is not reference standard to validate tribometer results.

Response: The specified test method does not require the "NFSI recognized" tribometers to be calibrated on reference surfaces to ensure meaningful results. In fact, in the two flooring studies discussed above, the tribometers currently recognized by NFSI proved to be the least capable of accurately ranking reference flooring. Staff agrees with the commenter.

Comments Regarding Alternative Test Methods

Comment: Commenters stated that the petitioner's requested standard would preclude current voluntary standards or emerging efforts from other standards organizations like ASTM.

Response: Staff agrees with the commenters that mandating the petitioner's test method for labeling would make it difficult for development of consensus methods currently under development by ASTM and other standards bodies.

Comment: One commenter stated that there is no "test or series of tests by any standard body, ANSI or otherwise, that measures slip resistance accurately for all types of floor coverings, surfacing, and coatings, let alone the wide variety of applications where a product may be used."

Response: Based on a review of test methods and research papers, staff agrees with the commenters that no one method for measuring COF is appropriate for all surfaces and conditions. Staff found no consensus among flooring manufacturers and standards developers on a universal method for measuring SCOF or DCOF, and found no consensus on relating COF measurements to risk of fall.

Comments Regarding Label the Petitioner Requests

Comment: Commenters stated that SCOF and DCOF are not defined well on the petitioner's label. Additionally, these commenters noted that two ratings may confuse consumers, especially when the two ratings are opposing values (high SCOF and low DCOF, or vice-versa).

Response: Staff agrees with the commenters.

Comment: Commenters stated that the petitioner's label does not account for condition (whether floor is wet or dry), the function, or intended installation location of the flooring material.

Response: Staff agrees with the commenters.

Comment: Commenters stated that the label may be confusing for floors that are designed to have after installation polish or coating applied.

Response: Staff agrees. The traction for floors designed to have polish or coating after installation can be different from the reported traction. This can be misleading to consumers.

Comment: Commenters stated that the label might give the consumer a false sense of security, because risk of slipping involves factors beyond COF.

Response: Staff agrees. Multiple user, product, and environmental factors beyond COF are involved in slips and falls. User characteristics involved are gait, balance, strength, and vision. These in turn may be moderated by age, health, medication and environmental factors such as floor surface, contaminants, footwear (e.g., material properties, tread, and wear), and other factors. Thus, labeling the product's slip resistance may imply that the COF is the sole factor determining the slipperiness of the floor. This may provide consumers a false sense of security given that other factors are also involved in slips and falls.

Comment: Commenters stated that phrases such as "high traction" and their definitions as stated in the proposed standard are inappropriate because such terms are subjective, potentially confusing, and not generally agreed upon.

Response: Staff agrees with the commenters that the petitioner's labeling scales are subjective, may be confusing, and are not universally accepted by the flooring products manufacturers.

Comment: Commenters stated that the threshold levels illustrated by the petitioner's label contradict those found in published research.

Response: Staff agrees with the commenters that the petitioner provides no data to support the labelling of flooring surfaces as low, medium, or high traction. The petitioner's labeling scales' ranges appear to be arbitrarily selected and differ based on the whether the SCOF or DCOF was used. This would provide inconsistent and confusing information to the buyer who would not understand the difference between the two ratings. It is also inconsistent with other available methods that suggest COF over 0.5 are acceptable.

Comment: Commenters state that the graphics in the B101.5 standard are not consistent throughout the document.

Response: Staff agrees. These numbers should be consistent to avoid confusion.

Comment: A commenter noted that the petitioner's standard does not clearly state how the label will indicate that tile and stone floors are not applicable to be tested under the B101.1 standard.

Response: The petitioner states that the intent of the label is to convey the floor's slip resistance to consumers at the point of sale so consumers can make an informed choice. The label will not

include information about which floor types are or are not subject to the B101.1 standard. The B101.1 standard is the appropriate source in which to include that information.

Comment: Commenter stated that the label should be a plain text description of the flooring material's slip resistance, as opposed to a graphic.

Response: Staff agrees. Although the research indicates that symbols can have attention-getting benefits and well-tested symbols can increase the likelihood that consumers will understand the safety message, symbols may not convey all of the intended messages. Therefore, given the expected use of a floor, a text of the floor's slip resistance may be more appropriate. However, labeling the floor's slip resistance either via text or symbol is likely to have limited effectiveness.

Comment: A commenter stated that consumers instinctively and routinely make traction determinations by tactile response.

Response: Staff disagrees. Consumers must first recognize a slip hazard before they can decide on any action intended to decrease the likelihood of a slip and fall incident. Considering that consumers generally expect a walking surface to be reasonably safe, they may not perceive or recognize a slip hazard. Older consumers may be less likely to perceive a hazard due to age-related changes. Thus, staff does not believe that consumers instinctively and routinely make traction determinations by tactile input. Staff also does not believe that labeling will be very effective, if at all, either.

Use of Resources

Comment: A commenter stated that resources should be devoted to helping the elderly increase strength, balance and mobility in order to reduce slips, trips and falls.

Response: CPSC has jurisdiction over consumer products; therefore such a program would fall outside the reach of this agency.

Comment: Commenters stated that flooring manufacturers and retailers would have to spend considerable resources to address the petitioner's requested requirement. Conversely, a commenter stated that the cost per label would be approximately 12 cents.

Response: In order to determine the potential costs to manufacturers for conducting the tests in accordance to the requirements requested by the petitioner, CPSC staff would have to determine the tests that manufacturers are currently conducting, if any, and the difference in cost between the current test methods and those in the standard the petitioner requests. This might involve surveying a sample of flooring manufacturers to determine their current practices.

Comment: Commenters stated that the risk of falls is not a stated top priority for the CPSC in 2016, and that the resources spent supporting the petitioner's standard would be better utilized on other priorities.

Response: The Commission decides how resources are allocated and if priorities should shift to address various hazards.