



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

This document has been electronically  
approved and signed.

**DATE:** July 17, 2019

**BALLOT VOTE SHEET**

**TO:** The Commission  
Alberta E. Mills, Secretary

**THROUGH:** Patricia M. Hanz, General Counsel  
Mary T. Boyle, Executive Director

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

**SUBJECT:** Petition CP 18-2: Labeling Requirements Regarding Slip-Resistance of Floor Coverings

**BALLOT VOTE DUE** Tuesday, July 23, 2019

CPSC staff is forwarding a briefing package to the Commission regarding a petition for rulemaking submitted by the National Floor Safety Institute (NFSI or petitioner). NFSI's 2018 petition requests that the Commission initiate a rulemaking to mandate that manufacturers label the slip resistance of hard surface floor coverings and coatings using the product label specified in the American National Standards Institute (ANSI) B101.5-2014. NFSI submitted a previous petition request (CP 16-1, 2016 petition), which the Commission denied (January 2017). CPSC staff concludes that the 2018 petition does not resolve the Commission's concerns in denying the 2016 petition, and therefore recommends that the Commission deny the 2018 petition. As with the 2016 petition, staff concludes that it is unlikely that the action requested by the petitioner will reduce injuries from slips and falls.

Please indicate your vote on the following options:

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

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(Signature)

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(Date)

CPSC Hotline: 1-800-638-CPSC(2772) ★ CPSC's Web Site: <http://www.cpsc.gov>

II. Defer the petition.

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(Signature)

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(Date)

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

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(Signature)

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(Date)

IV. Take other action. (Please specify.)

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(Signature)

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(Date)

Attachment: Staff Briefing Package for Petition CP 18-2: *Labeling Requirements Regarding Slip-Resistance of Floor Coverings*



United States  
Consumer Product Safety Commission

## Staff Briefing Package

Petition CP 18-2:  
Labeling Requirements Regarding Slip Resistance of Floor  
Coverings

July 17, 2019

For further information, contact:  
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## **ACKNOWLEDGMENTS**

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Charles Smith, Directorate for Economic Analysis  
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## Executive Summary

The U.S. Consumer Product Safety Commission (CPSC) received a request from the National Floor Safety Institute (NFSI, or the petitioner) to initiate rulemaking to mandate that manufacturers label the slip resistance of hard surface floor coverings and coatings using the product label specified in 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* (ANSI/NFSI B101.5). The ANSI B101.5 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 is obtained by following the tests described by ANSI B101.3.<sup>1</sup> Petitioners assert that providing information about a flooring product's COF via a standardized label will allow consumers to be more knowledgeable about how to choose safer hard surface flooring for a specified use, which, in turn, will reduce injury incidents.

NFSI submitted a previous petition request (CP 16-1, 2016 petition), which the Commission denied due to: (1) a lack of consistency and accuracy among the various test methods available for measuring walkway COF, including the methods specified in the petition; (2) insufficient evidence to support the assertion that a high COF value reduces the hazard of slip and fall incidents; and (3) the proposed label may have limited effectiveness because COF is likely only one of a number of factors involved in slip-and-fall incidents. The resubmitted petition (CP 18-2, 2018 petition) is substantially the same as the previous petition with some changes intended to address the issues raised by the Commission regarding the 2016 petition.

Although staff agrees that accurate, relevant point-of-sale information for consumers could result in more appropriate flooring choices, staff nonetheless concludes that slip and fall injuries are unlikely to be reduced by the action requested in the petition. Staff has observed a lack of consistency and accuracy in the literature regarding the test methods (including the test methods specified in the petition), standard reference materials, and the instruments available for measuring flooring COF. Moreover, the literature does not establish the degree to which hard surface flooring COF, or any other factors (such as lighting, footwear, and or contamination), contribute to slips and falls. The variability among testing methods, as such, makes it unlikely that a standardized label containing COF values will improve the safety of floor coverings for consumers. Although the petition provides information indicating that a floor surface's COF is one of many variables associated with slips and falls, and provides studies showing that increasing the COF (value measured at the time of a slip, not at the point of sale) of a floor surface may reduce the risk of slips and falls, these studies did not report a correlation between specific COF values (or range of COF values) and the risk of slips and falls.

Because the magnitude of the contribution of dynamic COF (DCOF) on hard surface flooring materials to the risk of falling is uncertain, and given that COF measurement on flooring is not always consistent or accurate, staff believes that placing a label with a COF value on flooring products is unlikely to have the intended effect of reducing slip and fall incidents. Accordingly, based on staff's review of the petition, standards, and relevant research, staff generated a list of potential activities that could address flooring fall hazards.

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<sup>1</sup> *Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials.*



UNITED STATES  
CONSUMER PRODUCT SAFETY COMMISSION  
BETHESDA, MD 20814

**Briefing Memorandum**

Date: July 17, 2019

TO : The Commission  
Alberta E. Mills, Office of Secretariat

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

FROM : Duane Boniface, Acting Assistant Executive Director  
Office of Hazard Identification and Reduction  
  
Jacqueline Campbell, Project Manager  
Directorate for Engineering 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 floor coatings uniformly label their products to state the product's 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* (ANSI/NFSI B101.5), specifies the labeling requirements the petition seeks to mandate. The Office of the General Counsel (OGC) docketed the request as petition CP 18-2, *Resubmission of Petition to Mandate a Uniform Labeling Method for Traction of Floor Coverings, Floor Coverings with Coatings, and Treated Floor Coverings* (CP 18-2, 2018 petition).<sup>1</sup> On August 6, 2018, the Commission published a *Federal Register* notice (83 Fed. Reg. 26228), requesting public comments on the petition.

This petition is a resubmission of a petition submitted in 2016 (CP 16-1, 2016 petition) that the Commission denied.<sup>2</sup> The 2018 petition reiterates many of the arguments and repeats

<sup>1</sup> <https://www.cpsc.gov/content/ballot-vote-package-petition-cp-18-2-resubmission-of-petition-to-mandate-a-uniform-labeling>

<sup>2</sup> [https://www.cpsc.gov/s3fs-public/RCA%20-%20Draft%20Letter%20to%20Petitioner%20Regarding%20Denial%20of%20Petition%20CP%2016-1%20Floor%20Coverings%20011817\\_0.pdf?69UAvNMGzpb2MYuOeNYVPm186aESPDbQ](https://www.cpsc.gov/s3fs-public/RCA%20-%20Draft%20Letter%20to%20Petitioner%20Regarding%20Denial%20of%20Petition%20CP%2016-1%20Floor%20Coverings%20011817_0.pdf?69UAvNMGzpb2MYuOeNYVPm186aESPDbQ)

information stated in the previous petition. The 2018 petition also attempts to respond to issues the Commission noted when it denied the 2016 petition. The Commission identified three concerns with the 2016 petition: (1) a lack of consistency and accuracy among the various test methods available for measuring walkway COF, including the methods specified in the petition; (2) insufficient evidence to support the assertion that a high COF value leads to a decreased hazard of slips and falls; and (3) the proposed label may have limited effectiveness because COF is likely to be only one of a number of factors involved in slip-and-fall incidents.

CP 18-2 framed those concerns as:

- Concern #1. Lack of Consistency and accuracy among various test methods and lack of consistency of test instruments,
- Concern #2. Insufficient evidence to support the assertion that a high COF value leads to a decreased hazard of slips and falls, and
- Concern #3. Limited effectiveness of the proposed label.

In accordance with the Commission's directive on petitions, CPSC staff prepared this briefing package in response to the 2018 petition. 16 CFR § 1051. This memorandum provides the Commission with information relevant to the 2018 petition, including a review of the public comments received in response to the *Federal Register* notice, and a discussion of options for Commission consideration.

## II. Petitioner's Request

The issue of flooring slip-and-fall safety presented in the 2018 petition has not changed from that in the 2016 petition. CP 18-2 states that slips and falls cause a significant number of consumer injuries and deaths, especially to seniors. The 2018 petition seeks to mandate a label for floor coverings described in ANSI/NFSI B101.5-2014, asserting that the presence of a specified label on floor coverings to indicate the product's dynamic coefficient of friction (DCOF)<sup>3</sup> under wet conditions will educate consumers on the potential slip resistance of those products. According to CP 18-2, the label will provide consumers with the information needed to purchase the appropriate floor product for its intended use, resulting in fewer slip and fall incidents. The petition requests that packaging for floor coverings be required to carry a prescribed label indicating the wet DCOF for the hard surface, resilient flooring material, when tested according to ANSI/NFSI B101.3-2012. The method prescribes measuring the DCOF under wet conditions using an NFSI-approved tribometer. The resulting measurement would be displayed as a label on the packaging via a color-coded scale, ranging from low traction on the left, to high traction on the right. Low traction values, *i.e.*, low DCOF values are red; "moderate" values are yellow; and high values are green. The label displays a human figure falling to the left of the scale and a human figure standing upright to the right of the scale. The 2018 petition modified the request in the 2016 petition by removing a requirement to label static COF (SCOF) based on testing according to ANSI/NFSI B101.1-2009. As discussed further below, the 2018 petition claims to

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<sup>3</sup> While the petition focuses on labeling hard surface flooring with the measured dynamic coefficient of friction (DCOF), this document uses the term coefficient of friction (COF) when discussing the measurement of flooring friction generally.

provide new information to address the main concerns the Commission stated in its letter denying the previous petition.

### **III. Product Description**

Like the previous petition, the 2018 petition identifies hard surface, resilient flooring materials, and topical floor coatings as the products intended to be covered by a rule. Examples of these products include: vinyl, wood, laminate, ceramic, natural stone flooring, and any intended treatments or coatings that can be used to provide a finished walking surface. The 2018 petition (like the previous petition) does not apply to soft surface flooring, such as carpets or floor coatings, or floor care treatments, which are sold separately like waxes.

### **IV. 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 CFR. § 1051.9(a).

As explained below, and in the Commission's letter denying the 2016 petition, staff's recommendation to deny the petition is not based on the adequacy of the voluntary standard, but rather, on the inability of the rule the petitioner suggests to address the slip and fall hazard.

Because the 2018 petition seeks to provide consumers with comparative data at the point of sale, the authority for the type of rule the petitioners requests would be 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.

## V. Epidemiology Information

For the previous petition, CPSC staff conducted an analysis of injuries and incidents associated with slipping on floors that occurred in the years 2012-2014. Staff used CPSC’s epidemiological databases, National Electronic Injury Surveillance System (NEIIS) and Consumer Product Safety Risk Management System (CPSRMS). The results were presented in the December 7, 2017 Staff Briefing Package<sup>4</sup> in response to Petition CP 16-1 (CP 16-1 Briefing Package), and are briefly summarized below.<sup>5</sup>

Based on NEIIS data, CPSC staff estimated approximately 570,000 emergency department (ED) visits related to slips in the years 2012-2014. CPSC staff found no statistically significant linear 3-year trend for annual ED-treated slip injuries ( $p$ -value= 0.7198). Staff reported that injuries to torso, leg/feet and head/face, each accounted for 26 percent of total estimated ED-treated injuries associated with slipping on floors. Staff found that the most common injuries were contusions, abrasions, and/or lacerations (32%), followed by strains, sprains, dislocation (24%), and fractures (18%). Staff further found that most of the slips (57%) occurred in residential settings, and that individuals 75 years and older had the highest annual slipping injury rates (183 slips per 100,000 population).

CPSC staff’s analysis of 219 incidents associated with slipping on the floors, recorded in the CPSRMS database in the years 2012-2014, revealed that the majority (197) of the reports were

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<sup>4</sup> United States Consumer Product Safety Commission, Staff Briefing Package, Petition CP 16-1: Labeling Requirements Regarding Slip Resistance of Floor Covering, TAB A: Estimated Number of Injuries and Reported Incidents Associated with Slipping on Floors, 2012-2014, October 2016.

<sup>5</sup> The CPSC staff did not conduct a new data review for the 2018 petition because the data review for CP 16-1 was so recent and staff did not expect the trends to be different based on the previous data review. Moreover, because the majority of the slip-related injuries and incidents reported to CPSC do not have enough information about incident scenarios, staff does not expect that analysis of newer data would provide additional useful information.

fatalities. Staff found that most incidents (154) involved a person 75 years or older, but the majority of the injury and incident reports did not provide enough details to determine the flooring type or the slip scenario. Due to insufficient information in the data, CPSC staff could not determine how many injuries were associated with a floor's low COF.

## VI. Mechanical Engineering Assessment (TAB A)

Engineering Sciences Mechanical Engineering (ESMC) staff examined the studies and reports included in this petition, studies previously examined in the CP 16-1 Staff Briefing Package, additional related studies, and related standards to determine whether the 2018 petition addresses two of the concerns the Commission had expressed when the Commission denied the previous petition: *(1) lack of consistency and accuracy among various test methods and lack of consistency of test instruments, and (2) insufficient evidence to support the assertion that a high COF value leads to a decreased hazard of slips and falls.*

### A. Lack of Consistency and Accuracy Among Various Test Methods and Lack of Consistency of Test Instruments

The 2018 petition claims to address the lack of consistent and accurate test methods and instruments by suggesting a restriction of the proposed test methodology to a specific NFSI methodology (ANSI/NFSI B101.3-2012) and a select category of tribometers. Tribometers are instruments used to measure COF. However, staff found that the 2018 petition does not adequately address concerns that the test method and instruments would accurately provide meaningful COF values that will predict the risk of slips and falls associated with a given hard flooring material. More specifically, ESMC staff notes the following:

- The NFSI's tribometer certification process (described as NFSI's ILS process in Tab A) does not specify reference materials (such as flooring tiles) that can be relied on to assign an absolute COF value and to validate tribometers. Documents the petitioner provided state that reference tiles have high levels of variation raising concerns about the accuracy of the test.
- Staff's review of relevant studies indicates that different tribometers read different COF values on the same surface. Limiting the methodology to only NFSI certified tribometers may provide more consistency in COF values, but does not address the accuracy of those COF values in predicting slips and falls. Staff is concerned that limiting COF measurements to NFSI certified tribometers is likely to exclude tribometers that could potentially be better indicators of slips and falls, that are used by other flooring industries, or that are specified in other standards.

To provide a test method that could be used in a standard, it would be necessary to research the reliability and accuracy of measuring standard reference materials with tribometers.

## B. Insufficient Evidence to Support the Assertion that a High COF Value Leads to a Decreased Hazard of Slips and Falls

To address concerns about no demonstrated correlation between high COF values and injuries, the 2018 petition provided an additional research report and studies published by an insurance company. The 2018 petition claims that these sources show a clear correlation between a floor's COF and slip and fall injuries. Staff reviewed the information the petitioner submitted. Staff found that the information shows that friction between footwear and floor is a contributing factor in a slip and fall, but the degree to which the original floor COF contributes to a slip and fall is unclear. The submitted materials did not quantify a correlation between COF and the risk of slips and falls. Nor did the materials indicate the extent to which other factors contribute to the risk. After reviewing information submitted for the 2018 petition and the previous petition, staff concludes that a floor surface COF is one of many variables affecting slips and falls. The provided information did not have scientific data to show a correlation between specific COF values (or range of COF values) and the risk of slips and falls.

## VII. Human Factors Analysis (TAB B)

As in the previous petition, the 2018 petition asks the Commission to issue a standard requiring flooring products to provide a label stating their COF. The proposed labeling depicts a human figure falling on one side and standing upright on the other, and associates specific values of point-of-sale flooring DCOF with the likelihood of falling. To address the Commission's concern about the limited effectiveness of the petitioner's proposed label (Concern 3), the 2018 petition provided a 2008 research study. Engineering Sciences Human Factors (ESHF) staff examined that study and materials submitted for the previous petition to assess the effectiveness of the 2018 petition's proposed labeling intended to convey to consumers the product's slip resistance.

ESHF staff is concerned about consumers potentially being misled regarding flooring selection and use, because they are unlikely to understand the limitations and implications of the proposed point-of-sale flooring slip-resistance labeling. Staff concludes that underfoot friction and the likelihood of falling and fall-related injuries are affected by a multitude of factors beyond the slip resistance of flooring at the point of sale. The proposed labeling standard is based on methods and devices that are not consistent and accurate for across-the-board measurement of the slip resistance of hard flooring materials. Staff is concerned that the proposed label will not be effective, and staff asserts that the proposed label does not incorporate many of the recommendations from the study the Petitioner claims supports the proposed label. Furthermore, ESHF staff cautions against assigning point-of-sale DCOF values to the risk of falling without a better understanding of the magnitude of the measurement's impact in relation to risk.

In contrast, staff states that a slip-resistance label developed by consensus and determined to be reliable and valid, combined with alternative means of conveying safety information, may be able to assist consumers in comparing products at the point of sale. ESHF staff concludes that the petitioner's proposal is inadequate to reduce the likelihood of fall-related injuries associated with slipping on hard surface flooring materials.

## VIII. Market and Economic Considerations

Staff from the Directorate for Economic Analysis (EC) provided market and economic information in the CP 16-1 Staff Briefing Package.<sup>6</sup> Staff believes that information is applicable in evaluating the resubmitted 2018 petition. In the prior briefing package, staff found that at least 20 manufacturers supply hard flooring and floor finishing products to the residential market through various retailers. Staff stated that total estimated retail sales in 2014 were approximately 4,140 million square feet of flooring, with a value of around \$10 billion. Staff found that expected product life ranges from 10 to 40 years, depending on the material.

Efforts to develop the necessary information to assess the benefits of a labeling rule could require a substantial amount of staff time and resources. EC staff's memorandum notes three critical elements of information needed to estimate the potential benefits of labeling flooring for slip resistance:

1. Information on the proportion of injuries resulting from slips, and the slip resistance of the floors on which the falls occurred;
2. Information on the exposure of consumers to floors with different coefficients of friction; and
3. Information on the impact that labeling would have on the purchase decisions of consumers.

Regarding potential costs of a rule requiring testing and labeling of flooring materials, the 2016 petition and the 2018 petition state:

[t]he economic impact to the manufacturing industry will be minimal since most flooring manufacturers already test the coefficient of friction of their products as a part of their quality control process . . .<sup>7</sup>

Comments from representatives of different segments of the flooring industry disputed this assertion. As described in the 2016 EC memorandum (Li, 2016, p. 182), staff considers it likely that if the requirements proposed in the petition were mandated, the cost to manufacturers would be higher than suggested by the petition. Staff concludes that a determination of the potential costs might require a survey of manufacturers to determine if and how manufacturers currently test the slip resistance of their products, as well as an assessment of the difference in the cost of the methods that they currently use, and the cost of the method proposed in the petition.

## IX. Past Compliance Actions

For the 2016 petition, the Office of Compliance and Field Operations staff reviewed recall data between 2005 and 2016, and found no instances of Compliance action on flooring, floor coverings, or floor treatments related to fall hazards. Compliance staff found one recall of a slip-

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<sup>6</sup> United States Consumer Product Safety Commission, Staff Briefing Package, Petition CP 16-1: Labeling Requirements Regarding Slip Resistance of Floor Covering, TAB E: Market and Economic Considerations for Labeling Requirements on Floor Coverings, October 2016.

<sup>7</sup> Petition CP 16-1 at 8; CP 18-2 at 11.

resistant shower floor mat (shower rug) that did not remain in place, creating a fall hazard. CPSC has not been involved in any recalls of flooring products since the last data review.

## X. Staff Response to Public Comments (TAB C)

CPSC published a request for comments on the floor coverings petition CP 18-2 in the *Federal Register* on June 6, 2018, with the comment period ending on August 6, 2018.<sup>8</sup> The Commission received 88 comments, with support for and opposition to the petition divided among the comments.

Topics raised by comments included:

- Whether the 2018 petition addressed the Commission's concerns with the 2016 petition (CP 16-1);
- How the petition proposal would impact consumer safety;
- The existence of multiple contributing factors to slips and falls and fall-related injuries;
- Concerns with the petitioner's characterization of evidence submitted in support of the 2018 petition;
- Concerns with the proposed testing standard and equipment;
- Concerns with the proposed labeling standard;
- Potential legal implications;
- Considerations for senior safety-related to slips and falls;
- Costs and benefits associated with the petition proposal;
- Potential conflicts of interest; and
- Alternative approaches to enhancing flooring safety.

Generally, supporters of the 2018 petition expressed interest in a reliable, easy-to-read labeling scheme that would inform consumers about a floor's slipperiness at the point of sale, thereby allowing consumers to make more informed choices for a specific flooring situation and improve floor safety. These commenters mentioned the societal impacts of falls, the disproportionate impact of falls on seniors, and the lack of opportunity for consumer education. Opposition to the petition focused mostly on technical concerns with the test method, measurement instrumentation, and label content. These commenters raised a concern that consumers may be left with a false sense of security, which could negatively impact flooring safety. In some cases, commenters agreed that slips and falls should be addressed in some way, but did not agree with the 2018 petition's proposal.

## XI. 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 petition. Although staff agrees that accurate, relevant point-of-sale information for consumers could result in more appropriate flooring choices, staff has observed

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<sup>8</sup> 83 Fed. Reg. 26,228 (June 6, 2018).

in the literature a lack of consistency and accuracy regarding the various test methods, standard reference materials, and measurement instruments available for determining walkway COF, including the methods specified in the 2018 petition. As mentioned in the CP 16-1 Staff Briefing Package, and found again in developing the Staff Briefing Package for CP 18-2, staff's review of scientific studies found COF values varied greatly among the test methods, depending on the environmental conditions, footwear used, and other factors. The literature does not establish the degree of influence hard surface flooring COF, or any of the other factors, has on slips and falls. Testing variability makes it unlikely that a standardized label containing COF values from testing to any one method will improve floor safety for consumers.

Additionally, staff found little evidence to support the 2018 petition's assertion that a high COF value leads to a decreased hazard of slips and falls. Staff reviewed several studies that examine the relationship among 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 in the 2018 petition showed lower correlation between COF and the risk of falling than the other studies. Thus, staff concludes that providing a COF value to consumers on the label proposed in the 2018 petition is unlikely to assist consumers in evaluating the comparative safety of flooring products.

## **XII. Potential Agency Activities that May Address the Hazard**

Staff recognizes the need to address the risk of slips and falls. To address this hazard, staff recommends that the Commission consider the following activities:

- A data study to understand better the types of slip-and-fall incidents, how flooring and other factors could affect slips and falls, and what issues are related to seniors, among other topics. This study should include in depth investigations (IDIs) to obtain information missing from existing incident reports.
- CPSC staff's involvement in existing voluntary consensus standards related to flooring slips and falls and measuring COF. Staff identified concerns with test methods, standard reference materials, and lack of agreement among different measurement instruments (tribometers). Staff suggests that voluntary consensus standards bodies are the best place to begin addressing these concerns, so that all stakeholders have the opportunity to participate in solutions.
- An in-depth review of existing slip-and-fall research. Staff finds the research in this area helpful in understanding the issues associated with slips and falls, and advises that a more robust review of these studies may inform CPSC's effort to develop activities to improve flooring safety.
- Consumer education projects. As with many consumer safety issues, hazard awareness improves safety outcomes. The data study mentioned above may inform CPSC about how to target the information efficiently, especially to specific populations, like seniors, who are disproportionately affected by slips and falls.

### XIII. Commission Options

#### 1. Grant the 2018 petition

The Commission may grant the 2018 petition if it concludes available information indicates that the risk of injury from floor covering slips and falls can be addressed by a mandatory standard. . Granting the 2018 petition does not mean that the Commission will issue a rule specifically in the form requested by the 2018 petition.

The Commission could begin rulemaking under section 27(e) of the CPSA if it determines the 2018 petition's proposed label provides "performance or technical data related to performance and safety," and the label's information "assists consumers in evaluating the comparative safety" of flooring products.

Staff has reviewed relevant test methods, reports, and research articles. Current test methods, standard reference materials, and measurement devices cannot provide a true COF measurement. None of the studies demonstrates a definitive correlation between COF values and the risk of falling. The proposed label, even with modifications, could be confusing to consumers and the proposed label's content is based on incomplete and potentially incorrect information. Thus, staff believes that providing COF values on a flooring product label could be misleading and potentially harmful to consumers.

#### 2. Deny the 2018 petition

The Commission could deny the 2018 petition if it determines there is insufficient information showing that the 2018 petition's proposed floor covering label would reduce the number of slip-and-fall incidents.

While staff agrees that point-of-sale information to compare the slip-resistance of different flooring types could help consumers choose the most appropriate hard surface flooring for a specific use, staff concludes that the proposed label would not assist consumers in assessing the comparative safety of flooring. Staff found little evidence to support the assertion that the test advanced in the 2018 petition yields accurate or meaningful results, or that the 2018 petition's label will assist consumers. Therefore, staff does not recommend that the Commission proceed with a rulemaking to require the label proposed in the 2018 petition, because labeling is unlikely to have the intended effect of reducing incidents.

Denying the 2018 petition does not preclude the Commission from taking action to address the risk of slips and falls. In fact, staff urges the Commission to assign resources to gain more understanding of the issues related to falls associated with hard surface flooring products. To that end, staff has suggested some potential activities that could improve consumer flooring safety.

### **3. Defer a decision on the 2018 petition**

The Commission may defer a decision on the 2018 petition and direct staff to collect additional information (or take other action), if the Commission concludes that more information is required to decide whether to grant or deny the 2018 petition. Academia and standards bodies are conducting independent work to understand the correlation between floor characteristics and slip incidents. However, staff is concerned that the underlying issues raised in both the 2016 and the 2018 Staff Briefing Packages require substantial effort to address; and staff is not aware of any impending voluntary standards or academic studies that would address the defects of the petition proposal raised in this briefing package.

Deferring the 2018 petition does not preclude the Commission from initiating future rulemaking in response to this or another petition on the topic.

## **XIV. Staff Conclusion and Recommendation**

CPSC staff recommends that the Commission deny the 2018 petition. Staff found no evidence demonstrating that the tests suggested by the 2018 petition 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 fewer slips and falls. Finally, staff concludes that the proposed label will not assist consumers as intended.

**TAB A: Mechanical Engineering Assessment of Standards and Studies  
Related to Flooring Slip-Resistance (Traction)**

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

**Memorandum**

Date: June 12, 2019

**TO :** Jacqueline Campbell  
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 :** Lawrence Mella  
Mechanical Engineer  
Directorate for Engineering Sciences

**SUBJECT :** Mechanical Engineering Assessment of Standards and Studies Related to  
Flooring Slip-Resistance (Traction)

**A. Introduction**

The National Flooring Safety Institute (NFSI, the petitioner) is requesting that the Consumer Product Safety Commission (CPSC) issue a rule to mandate that manufacturers of hard surface floor coverings and coatings provide uniform dynamic coefficient of friction (DCOF) point-of-sale labeling of their products' degree of slip-resistance (traction) per the American National Standards Institute (ANSI) 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 with Coatings, and Treated Floor Coverings* (ANSI/NFSI B101.5).

The petitioner previously submitted a similar request (CP 16-1, 2016 petition),<sup>1</sup> dated October 4, 2015. On December 13, 2016, the Commission voted 3-2 to deny CP 16-1.<sup>2</sup> The current petition (CP 18-2, 2018 petition) attempts to resolve the Commission's concerns with CP 16-1.

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<sup>1</sup> In petition CP 16-1, the Petitioner requested that manufacturers of hard surface flooring materials and floor coatings be mandated to uniformly label their products to provide point of sale information about their products' degree of slip resistance in accordance with ANSI/NFSI B101.5-2014. CP 16-1 included requirements for both static coefficient of friction (SCOF) and DCOF slip resistance values per the test methods described in ANSI/NFSI B101.1-2009, *Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials*, and ANSI/NFSI B101.3-2012, *Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials*, respectively.

<sup>2</sup> <https://www.cpsc.gov/s3fs-public/RCA%20-%20Petition%20CP%2016-1%20Labeling%20Requirements%20Regarding%20Slip-Resistance%20of%20Floor%20Coverings%20121316.pdf>

The 2018 petition frames the Commission's concerns and discusses them under the following headings:

1. Concern #1. Lack of consistency and accuracy among various test methods and lack of consistency of test instruments.
2. Concern #2. Insufficient evidence to support the assertion that a high COF value leads to a decreased hazard of slips and falls.
3. Concern #3. Limited effectiveness of the proposed label.

In this memorandum, Engineering Sciences Mechanical Engineering staff evaluates the 2018 petition's discussion of concern #1 and concern #2.

## B. Coefficient of Friction

In Tab B of CPSC staff's December 2017 Staff Briefing Package regarding CP 16-1, staff defined "friction" as the force resisting the relative motion of objects sliding against each other found in many interactions between dry and lubricated surfaces, fluid layers, fluid layers and solid surfaces, and internal elements of solid materials. The resistance to start relative motion between two solid surfaces is known as "static friction." If the two surfaces are already in relative motion, the resistance is called "kinetic" or "dynamic friction." If fluid, such as water or oil, separates two solid surfaces, the resistance to relative motion is called "wet" or "lubricated friction." The COF between two objects typically ranges from close to zero to 1.0, but can be above 1.0. If the COF is low, it means the two objects slide against each other with very little resistance. If the COF is high, it means the objects have difficulty sliding against each other.

## C. Existing Standards

Several voluntary standards provide test methods for measuring the COF between a test surrogate material and hard surfaces under varying conditions. However, each standard uses different methods, is recommended only for specific surface types, or both. The methods used to measure COF include measuring static coefficient of friction (SCOF) and DCOF 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<sup>3</sup> quantities, such as COF, friction forces, and wear between two surfaces in contact.

ANSI/NFSI B101.3-2012, used as a basis for CP 16-1 and CP 18-2, has remained unchanged since the Staff Briefing Package for CP 16-1. ANSI/NFSI B101.3-2012 is summarized below.

ANSI/NFSI B101.3-2012 *Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Material* (ANSI/NFSI B101.3) specifies the procedures and devices used for both laboratory and field testing to measure the wet DCOF of common hard-surface floor materials. This standard specifies that only approved tribometers that demonstrate reliability and reproducibility in measuring the DCOF per the "NFSI: Inter-Laboratory Study (ILS) for

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<sup>3</sup> *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.

Tribometers Designed to Measure the Wet Dynamic Coefficient of Friction (DCOF) of Common Hard Surface Walkways” are acceptable for use.

Approved tribometers<sup>4</sup> at the time of the CP 16-1 Staff Briefing Package included the BOT 3000, BOT 3000E, GMG-200, GS-1, and the UWT. Since the CP 16-1 Staff Briefing Package, the BOT 3000 and BOT 3000E are no longer NFSI-approved tribometers, and the TRACSCAN tribometer has been added to the approved list.

In Tab B of the CP 16-1 Staff Briefing Package, CPSC staff reviewed the six ANSI standards, eight ASTM standards, and two European standards that were available for determining the COF of hard surfaces, and one tribometer interlaboratory process, as set forth below:

- ANSI/NFSI B101.1-2009 *Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Material*
- ANSI/NFSI B101.3-2012 *Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Material*
- ANSI/NFSI B101.5-2004 *Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic COF of Floor Coverings*
- ANSI/ASSE A1264.2-2012 *Provisions of Slip Resistance on Walking/Working Surfaces*
- ANSI/ASSE TR-A1264.3-2007 *Technical Report: Using Variable Angle Tribometers (VAT) for Measurement of the Slip Resistance of Walkway Surfaces*
- ANSI A137.1-2012 *Standards Specification for Ceramic Tile*
- 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*
- ASTM D2047-11 *Standard Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine*
- ASTM E303-93 (2013) *Measuring Surface Frictional Properties Using the British Pendulum Tester*
- ASTM F695-01 (2009) *Standard Practice for Ranking of Test Data Obtained for Measurement of Slip Resistance of Footwear Sole, Heel or Related Materials*
- ASTM F1240-01 (2009) *Standard Guide for Ranking Footwear Bottom Materials on Contaminated Walkway Surfaces According to Slip Resistance Test Results*
- ASTM F1637-13 *Standard Practice for Safe Walking Surfaces*
- ASTM F1677-05 *Standard Test Method for Using a Portable Inclinable Articulated Strut Slip Tester (PIAST)*
- ASTM F2508-13 *Standard Practice for Validation and Calibration of Walkway Tribometers Using Reference Surfaces*
- 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*
- DIN 51131 (2014) *Testing of Floor Coverings – Determination of the Anti-Slip Property – Method for Measurement of the Sliding Friction Coefficient*

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<sup>4</sup> Tab B of the CP 16-1 Staff Briefing Package details NFSI approved tribometers.

- *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).

Staff received comments on CP 18-2 stating that certain standards, such as ANSI A137.1-2017 and ANSI A326.3-2017, are more universally accepted methods for determining COF than ANSI/NFSI B101.3-2012. ANSI A137.1-2017 is the updated version of the 2012 standard that CPSC staff reviewed in the CP 16-1 Staff Briefing Package. ANSI A137.1-2017 is applicable to ceramic tile. The new ANSI A326.3 standard was based on the test method in ANSI A137.1-2017, and is applicable to all hard surface materials.

- ANSI A137.1-2017 *Standards Specifications for Ceramic Tile* specifies the sizes and shapes of ceramic tile, the physical properties of different ceramic tile grades, the basis for acceptance and methods of testing before installation, and marking and certification of ceramic tile. The 2012 version of this standard is summarized in the CP 16-1 Staff Briefing Package. ANSI made minor updates to the standard since 2012; however, the main requirements of ANSI A137.1-2012 remain the same for ANSI A137.1-2017.
  - The BOT 3000 remains the only tribometer listed for determination of DCOF.
  - The standard recommends a minimum wet DCOF of 0.42 for ceramic tile, but notes that this value is not necessarily suitable for all applications.
  - ANSI A137.1 is now integrated into a new standard, ANSI A326.3.
- ANSI A326.3-2017 *Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials* specifies the test method for measuring DCOF of hard surface flooring materials in either the laboratory or the field. Measurements are taken with the BOT 3000E instrument on wetted test paths. Hard surface flooring materials expected to be walked upon when wet with water shall have a wet DCOF of 0.42 or greater. However, the standard explains that hard surface flooring materials with a DCOF of 0.42 or greater are not suitable for all applications.

#### **D. Review of Slip-and-Fall Reports**

In Tab B of the CP 16-1 Staff Briefing Package, CPSC staff reviewed three studies assessing the use of tribometers in relation to pedestrian slips and falls. Staff concluded that research to support the assertion that COF can be used to predict the risk of slips and falls is limited. The studies indicated that, of the numerous devices and methods used to measure COF, only a few gave results that correlated with pedestrian slip risk. Moreover, the studies showed that the tribometers approved for use under ANSI/NFSI B101.3 give mixed results when predicting slips. Staff determined that additional research is needed regarding the use of COF to predict pedestrian slips and falls.

Below, staff reviews slip-and-fall research provided in the 2018 petition.

1. Does Underfoot Coefficient of Friction Affect Slip-Initiated Events or Injuries?  
(2017) by Dr. Wen-Rey Chang, Ph.D., P.E.

In this 2017 report, Dr. Wen-Rey Chang, Ph.D., P.E. summarizes scientific research to support the hypothesis that the intervention of increasing the friction between footwear and the floor can be used to reduce slip-initiated injuries. Chang differentiates friction and underfoot friction. Underfoot friction is between footwear and the floor, while friction is affected by the floor, footwear, and contaminants. Chang states that a link exists between underfoot friction and slip outcomes. Chang divides the report into four categories: field intervention studies, laboratory studies in which the participants were exposed to slippery floors unexpectedly, field observations in which no intervention was introduced, and an investigation into the slip probabilities based on a theoretical computation.

a. Field Intervention Studies: Chang reviews two field intervention studies by Bell *et al.* (2008)<sup>5</sup> and Ballance *et al.* (1985).<sup>6</sup>

The Bell study evaluated the effectiveness of interventions to address slip, trip, and fall injuries in three hospitals in the United States. The Bell study involved 11 interventions, which included measures to increase underfoot friction, such as slip-resistant footwear and floor cleaning. Chang concludes: “the contributions of each component of the interventions were unclear; therefore, a direct link between an increase in underfoot friction and injury outcomes cannot be established with these results.”

The Ballance study reported that fall incidents in a dining hall at the University of Sussex were reduced by replacing the ceramic tiles and untreated woodblock flooring with glazed ceramic tile, carpet, and rubber-based sheet material. Flooring surfaces accounted for 25 percent of fall incidents in the dining hall before replacing the floor surfaces. After replacing the flooring, the new surfaces resulted in higher COF measurement values compared to the old surfaces, and no falls occurred on the new floor surfaces before their paper published.

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<sup>5</sup> Bell, J.L., Collins, J. W., Wolf, L., Grönqvist, R., Chiou, S. S., Chang, W. R., Sorock, G. S., Courtney, T. K., Lombardi, D. A. and Evanoff, B., 2008, Evaluation of a comprehensive slip, trip, and fall prevention program for hospital employees, *Ergonomics*, 51 (12), 1906-1925.

<sup>6</sup> Ballance, P.E., Morgan, J. and Senior, D., 1985, Operational experience with a portable friction testing device in university buildings, *Ergonomics*, 28 (7), 1043-1054.

- b. Laboratory Studies: Chang summarizes three laboratory studies by Kulakowski *et al.* (1989),<sup>7</sup> Powers *et al.* (2007),<sup>8</sup> and Powers *et al.* (2010).<sup>9</sup> Staff reviewed both Powers studies in the CP 16-1 Staff Briefing Package.

The Kulakowski study exposed five participants to walking on wet rubber, galvanized steel, and the reverse side of linoleum. The Kulakowski study found that participants slipped more often on surfaces with a lower COF.

The 2007 Powers study divided 84 participants into six groups. Each group was exposed to one of six different conditions generated with three different floor types on a test walkway with either dry or wet surface conditions. The test floor type with the designated surface condition was inserted into a section of the walkway without the participants' knowledge. The results of each trial were classified as "no slip," "heel slip," or "toe slip." Researchers measured the COF of the surfaces with nine different tribometers. The Powers study showed a linear relationship between the average COF and combined slip count when COF was lower than 0.5.

The 2010 Powers study attempted to establish reference surfaces to validate tribometer measurements. The study divided 80 participants into four groups, and each group walked on one of four reference surfaces on a test walkway. The study classified each trial as "no slip," "heel slip," or "toe slip." Researchers used 12 tribometers to measure the COF of the four reference surfaces. Chang concludes that the results show a linear relationship between the average coefficient of friction and combined slip count.

- c. Field Observational Study: Chang reviews the Verma *et al.* (2011)<sup>10</sup> field observation study.

The Verma study examined the association among floor surface characteristics, slip-resistant shoes, floor cleaning frequency, and the risk of slipping for fast food restaurant workers. Participants reported their slip experience and work hours weekly for up to 12 weeks. Researchers measured COF in eight working areas of the kitchen. Chang concludes that the report determined a 0.1 higher mean COF results in a 21 percent reduction in the slip rate.

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<sup>7</sup> Kulakowski, B. T., Buczak, F. L., Cavanagh, P. R. and Pradhan, P., 1989, Evaluation of performance of three slip resistance testers, *Journal of Testing and Evaluation*, 17 (4), 234-240.

<sup>8</sup> Powers, C. M., Brault, J. R., Stefanou, M. A., Tsai, Y. J., Flynn, J. and Siegmund, G. P., 2007, Assessment of walkway tribometer readings in evaluating slip resistance: A gait-based approach, *Journal of Forensic Science*, 52 (2), 400-405.

<sup>9</sup> Powers, C. M., Blanchette, M. G., Brault, J. R., Flynn, J. and Siegmund, G. P., 2010, Validation of walkway tribometers: Establishing a reference standard, *Journal of Forensic Science*, 55 (2), 335-370.

<sup>10</sup> Verma, S. K., Chang, W. R., Courtney, T. K., Lombardi, D. A., Huang, Y. H., Brennan, M. J., Mittleman, M. A., Ware, J. H. and Perry, M. J., 2011, A prospective study of floor surface, shoes, floor cleaning and slipping in U.S. limited-service restaurant workers, *Occupational and Environmental Medicine*, 68 (4), 279-285.

- d. Investigation on Different Slip Probabilities Based on Theoretical Computation: Chang reviews the Chang *et al.* (2013)<sup>11</sup> paper.

The Chang investigation reported different slip probabilities when comparing a given available COF value with required COF. Available COF is the maximum friction that can be supported by the footwear and floor. Required COF is the friction needed underfoot in order to maintain safe walking. Chang stated that the required COF is compared with the available COF to determine if a slip may happen. If required COF is higher than available COF, a slip is likely to happen. The required COF data was drawn from a previous study, where 50 participants walked at self-selected normal and fast speeds over a force plate. Chang states that the results show that the available COF value increases as the slip probability decreases.

Chang summarizes his literature review by stating that an increase in underfoot friction could result in a decrease in slip-initiated incidents, and that the data from laboratory studies suggest that an increased level of COF is directly proportional to a reduction in slips. Chang states that intervention studies are very rare in the literature, and a direct link between a particular intervention and injury outcomes is very limited. Chang does not specify the levels of COF to ensure safety, nor detail all the variables and what significance those variables contribute to underfoot friction. From the literature review, Chang does not identify a specific range of COF values that can be directly correlated to a risk of slips and falls. Chang also notes from the 2007 Powers study that each tribometer produced different results and that researchers do not report agreement on which device might be more accurate than others.

2. Project to Establish Standard COF Values for ASTM F2508-11 Standard Tiles (2011)  
by Drew D. Troyer

NFSI requested that Drew D. Troyer, CRE establish standard COF values for the four standard reference tiles specified in ASTM F2508-11, *Standard Practice for Validation and Calibration of Walkway Tribometers Using Reference Surfaces* to confirm repeatability and reproducibility of walkway tribometers. Troyer discussed his results in the report titled, “Project to Establish Standard COF Values for ASTM F2508-11 Standard Tile.”

The study had the following objectives: (1) establish standard dynamic COF values for the ASTM 2508-11 tiles marked B, C, and D per the DIN EN51131 standard which utilizes the German GMG-200 walkway tribometer; (2) run a parallel trial with the BOT 3000 walkway tribometer; and (3) determine the static COF using the UWT 3000 walkway tribometer.

Based on his testing, Troyer drew the following four conclusions:

- The study established baseline DCOF values for ASTM F2508-11 reference tiles “B,” “C,” and “D” using the GMG tribometer.

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<sup>11</sup> Chang, W. R., Matz, S. and Chang, C. C., 2013, The available coefficient of friction associated with different slip probabilities for level straight walking, *Safety Science*, 58, 49-52.

- The BOT 3000 was determined to be a suitable tool for evaluating the DCOF of tiles because the BOT 3000 and GMG tribometers recorded similar values and similar variation. Troyer states that the correlation of the mean values between the GMG-200 and BOT 3000 was good, but more data points comparing the two techniques on a wider range of tiles would provide more correlation data.
- Troyer noted significant variation from tile-to-tile on each group of reference tiles tested, and he stated that the reference tiles cannot statistically be called identical due to the high levels of tile-to-tile variation. Troyer stated that he was uncertain if the validation test results could be repeated if the tiles were reconfigured.
- Troyer concluded that the UWT tribometer was suitable for testing SCOF on reference tiles B and D, but not C. In more than half of the tile C trials, no true reading was determined because the readings were above the scale of the tribometer. Troyer does not comment on why this occurred.

Troyer made the following four recommendations regarding NFSI's ILS procedure:

- Establish standard DCOF values for ASTM F2508 reference tiles “B,” “C,” and “D” using the exact same tiles in the same configuration.
- Further discuss with NFSI the selection of a single ASTM F2508 reference tile for the purpose of completing the DCOF ILS.
- Find a replacement for ASTM F2508 tile “C” for completing the SCOF ILS.
- Further investigate the high variability of ASTM 2508 reference tiles.

### 3. NFSI Interlaboratory Study (ILS) Process memo (2012) by Drew D. Troyer

In the memo, “NFSI Interlaboratory Study (ILS) Process,” Drew D. Troyer, CRE discusses recommended modifications to the NFSI ILS process. The recommendations are as follows.

- The first recommendation is to include a pass/fail test for validity and repeatability. At 95% confidence levels, tested tribometers must correctly measure NFSI’s three standard surface materials within the confidence limits set forth by the NFSI, which are derived from NFSI’s reference “golden” tribometer. Troyer states that his previous suggestion of using an analysis of variance (ANOVA) method for evaluating the reproducibility of a tribometer proved unfeasible because of the tremendous variations in walkway surface materials, variation in slider material, tribometer-to-tribometer variations, and lubricant variations.
- The second recommendation is to include a less statistically challenging Gage Repeatability and Reproducibility method based on ASTM F1469-11, *Standard Guide for Conducting a Repeatability and Reproducibility Study on Test*

*Equipment for Nondestructive Testing* for evaluating the reproducibility among tribometer and operator combinations.

- The third recommendation is to use the ANOVA method to ensure that tribometers can differentiate between reference materials that range from low to high COF values, but not use the ANOVA method to evaluate performance of multiple instruments on a single surface.
- The last recommendation is that the interlaboratory process use ASTM F2508-11 reference tiles “B,” “D,” and a Formica material.

Staff notes that the most recent version of NFSI’s ILS procedure does not specifically state what reference tiles are to be used for evaluating tribometers. NFSI’s ILS also does not state what the NFSI “golden” tribometer(s) are, nor how they are validated.

#### 4. Slips and Falls Study: Objective Auditing Techniques to Control Slips and Falls in Restaurants (June 2007) by CNA

In the report, CNA, an insurance and risk management company, proposes that there are five major causes for slip-and-fall accidents: lack of slip resistance on walking surfaces, poor walking surface conditions, poor visibility, lack or poor condition of handrails and guardrails, and poor accessibility. CNA conducted a case study on slips and falls for a restaurant chain. The report reviews the approach taken by CNA Risk Control in the case study to enhance slip resistance on walking surfaces and improve poor walking surface conditions. One of the primary objectives of the study was to monitor and document the results of floor cleaning and maintenance activities.

CNA generated two data sets for each of four locations tested using a BOT-3000 tribometer. CNA obtained the first slip resistance samples after the facility had closed for the evening and recorded the second set of measurements the following morning after the surface was cleaned and before the business opened. Each test consisted of a sample in an east-to-west orientation and another in a north-to-south orientation. CNA selected between nine and 13 individual sampling sites for each location. CNA recorded more than 650 measurements of flooring surfaces at four participating locations.

The CNA report states that the results highlighted the importance of establishing and adhering to a regular floor care maintenance program as the results showed consistent improvement in flooring slip resistance following cleaning. Based on the study, CNA made the following recommendations to the restaurant chain:

- Select high-traction, slip-resistant floor materials.
- Know what the out-of-the box, slip-resistance is on the floor materials in your facility as the numbers provide a baseline when considering changes to cleaning and floor maintenance practices.
- Select floor cleaning and maintenance products with proven slip-resistance characteristics.

- Be alert for workers substituting cleaning materials or supplies.
  - Apply floor cleaning and maintenance products in accordance with the manufacturer's recommendations.
  - Verify with the cleaning personnel that they are familiar with and are using the correct application procedures.
  - Remove any unauthorized or incompatible cleaning products.
  - Separate cleaning materials and equipment to reduce the likelihood of transporting a problem from one area to another.
  - Ensure permanently installed features like carpet runners and mats are included in the maintenance and housekeeping program.
  - Limit the difference in heights between flooring surfaces and mats to no more than  $\frac{1}{4}$  to  $\frac{1}{2}$  inch.
  - Regularly review slip-and-fall incident reports.
  - Ensure staff is well trained in spill prevention and response programs.
  - Ensure mats are frequently inspected and checked regularly for wear and buildup of contaminants.
5. Measuring the Risk of Slips and Falls: An Injury Reduction Study Using Tribometry by Shari Falkenburg (CNA, Assistant VP)

The CNA presentation discusses a COF standard test method and COF measurements as risk management tools for reducing slips and falls. The presentation states that slips and falls occur when there is too little friction between footwear and the floor surface. The presentation states 112 business locations had measured COF values. Out of the 112 locations measured, 34 percent had high COF floors, 48 percent had moderate COF floors, and 18 percent had low COF floors. The presentation states businesses that increase the COF of their low- and moderate-friction floors should expect a reduction in claim costs.

6. Slip and Fall Study Report: Enhancing Floor Safety Through Slip Resistance Testing, Maintenance Protocols and Risk Awareness by CNA

In the report, "Slip and Fall Study Report: Enhancing Floor Safety Through Slip Resistance Testing, Maintenance Protocols and Risk Awareness," CNA Risk Control walkway specialists examined and tested hard surface flooring in commercial settings and provided their recommendations to improve flooring safety. CNA Specialists tested walkways to determine the presence of surface contaminants and the impact of the choice of cleaning equipment, agents, or methods. Part one of the report examined CNA slip-and-fall claims that occurred over a 6-year period. The report explains that 50 percent of surveyed sites with tested floors had DCOF levels below the minimum threshold of 0.42 set in ANSI A137.1-2012.

Part two of the report examines CNA's four principles of floor safety. CNA's first principle of floor safety is flooring selection. CNA states that it is important to consider specific properties of the flooring and whether the surface is appropriate for a given location. CNA explains five properties businesses should consider when selecting flooring: material, surface, condition, cleaning, and finishing. CNA states that businesses should obtain a floor's designated COF from the manufacturer at the time of purchase, and review the flooring manufacturer's testing data because the use of coatings, sealants, and other finishing treatments may change an original surface COF. CNA states the installed flooring should continue to yield a dynamic COF greater than 0.42, as set by ANSI A326.3.

CNA's second principle of floor safety is slip-resistance testing. The CNA report recommends routine slip-resistance testing to address the level of contaminants on walkway surfaces and select cleaning agents, finishes, and sealants that will help maintain a surface's COF. CNA recognizes ANSI A137.1-2012, ANSI/NFSI B101.3-2012, and ANSI A326.3-2017 as methods to measure the DCOF of hard surface floors. In particular, the CNA report states that ANSI A326.3-2017 reflects years of collaboration among various professional flooring representatives, which first resulted in the adoption of the practice supported in the A137.1-2012 tile standard, and now, the creation of the standalone A326.3 standard.

CNA's third principle of floor safety is floor maintenance. According to CNA, floor maintenance is a key element of a floor safety program. CNA states that the products and methods used to clean and maintain floor surfaces can be the direct cause of slip-and-fall accidents. CNA informs that if flooring is not cleaned and maintained, then floor contaminants can impact the safety of flooring by changing the COF of the flooring surface.

CNA's fourth principle of floor safety is risk awareness. CNA lists human gait and vision acuity as two variables affecting slips and falls. The report explains that most people are aware of hazards that affect the safety of floors and will change their behaviors to avoid such hazards, such as slowing down while walking on a visibly wet floor. CNA states that when age, diminished vision, or environmental factors delay the normal awareness of exposures, it is the businesses' responsibility to raise a person's risk awareness.

CNA lists the following measures as actions to safeguard against risk and promote floor safety:

- Be proactive in documenting DCOF values, maintenance requirements, and managing risk.
- Train employees, property managers, or contracted vendors on fall-related safety principles.
- Design safe walkways.
- Place floor mats inside each doorway entrance.
- Remain vigilant regarding the effects of glare and design contrast when selecting floors.
- Adhere to maintenance protocols.

The petition submitted additional CNA articles and reports<sup>12</sup> as comments to CP 18-2. The additional information reiterates information in the three CNA reports summarized above. The reports highlight the importance of floor maintenance and the effectiveness of floor treatments.

## E. Discussion

In 2018, NFSI resubmitted its petition with additional information asking the Commission to require manufacturers of hard surface floor coverings and coatings to provide uniform point-of-sale labeling of their products in compliance with the ANSI/NFSI B101.3-2012 and ANSI/NFSI B101.5-2014 standards regarding wet DCOF. The petition claims to include additional information intended to address the concerns expressed in the CP 16-1 Staff Briefing Package. CPSC staff assessed CP 18-2 with a focus on the concerns raised by staff and the Commission in CP 16-1, specifically the lack of consistency and accuracy among various test methods and test instruments, and the insufficient evidence to support the assertion that a high COF value leads to a decreased hazard of slips and falls.

*Concern # 1: Lack of consistency and accuracy among various test methods and lack of consistency of test instruments.*

The petition asserts that concerns about the inconsistency between test instruments is addressed by mandating a select category of tribometers that undergo an ILS to demonstrate accuracy and reproducibility per the ANSI/NFSI B101.3-2012 standard. CPSC staff determined that NFSI's ILS process does not ensure that test instruments accurately and consistently measure DCOF for the following reasons:

- The standard reference tiles used in the ILS (which are specified by ASTM F2508<sup>13</sup>) are not referenced to a DCOF value and vary from tile to tile. The supporting documents for the ILS<sup>14</sup> provided for this petition state that the reference tiles cannot statistically be called identical due to the high levels of tile-to-tile variation, and the researcher was uncertain if the validation test results could be repeated if the tiles were reconfigured in a different orientation. Standard reference surfaces are needed to ensure that any calibrated tribometer is measuring DCOF accurately and consistently. Without a reliable standard reference surface used to calibrate tribometers to an absolute DCOF value, two or more tribometers could measure different DCOF values for the same surface.
- The ILS procedure assumes NFSI's reference "Golden Tribometers" accurately measures the DCOF for all surfaces and that all certified NFSI tribometers perform

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<sup>12</sup> CNA Slip and Fall Study Finds Flooring Often to Blame (2017); New Techniques to Control Slips and Falls in Public Places; Janke, J. and Ludwin, D., 2008, Slip and Fall Control Techniques Commercial Real Estate

<sup>13</sup> ASTM F2508 does not provide the COF of the reference tiles. ASTM uses the reference tiles to rank the order of slipperiness based against a human gait-based reference system.

<sup>14</sup> Memo to Russ Kendzior from Drew Troyer: 11-29-2011, Project to Establish Standard COF Values for ASTM F2508-11 Standard Tiles.

within the NFSI specifications of the reference tribometers. Tribometers operate using different designs and principles. Therefore, staff understands the possibility that different tribometers have different numerical COF measurements for the same surface. Staff is concerned that the ILS procedure is likely to exclude tribometers that could potentially be better indicators of slips and falls, than tribometers used by other flooring industries, or specified in other standards.

Staff reexamined studies referenced in the CP 16-1 Staff Briefing Package and additional studies that discuss COF measurements. In the CP 16-1 Staff Briefing Package, staff summarized the study by Powers *et al.* (2007)<sup>8</sup> and Powers *et al.* (2010).<sup>9</sup> Powers states that about 30 portable tribometers are on the market that measure COF using various mechanical methods, ranging from nonimpact drag sleds to complex dynamic devices that attempt to simulate foot contact. Studies show that different tribometers measure different COF values on the same surface. For example, in the Powers *et al.*, 2010 study, nine tribometers showed a wide range of COF values for the same surface, when tested under wet conditions (0.06-0.69). The four tribometers capable of ranking the surfaces correctly from least to most slippery, measured different COF values for the same surface. These large intertribometer differences suggest that the value obtained from a given tribometer cannot be used to compare slipperiness of two different surfaces, potentially resulting in confusion when different DCOF values from different tribometers are used to measure slipperiness. These studies pointed out the difficulty in using any one method to assess risk of slips and falls due to the multitude of variables involved in friction testing and differences in the mechanical design and COF calculation methods used by different tribometers.

The research by Troyer discussed in this memo showed that the ASTM reference tiles can vary tremendously from tile to tile. A scientific paper titled, “Comments on ASTM F2508 – 13,” published in the Journal of Ergonomics by Oren Masory of Florida Atlantic University,<sup>15</sup> reinforces these results. Masory examined COF measurements of a tribometer supplier and an expert using the same model tribometer and ASTM reference tiles. Masory identified problems, such as variability of different reference surfaces and variability within the same reference surface. The conclusions from Troyer, Powers, and Masory suggest that standard reference surfaces and procedures need further development to ensure that a tribometer can measure COF accurately and statistically differentiate reference surfaces. Staff is unaware of standard reference surfaces that can obtain an absolute DCOF value that can be used to validate and calibrate tribometers.

Based on a review of the additional information provided in CP 18-2, staff does not find that the petition has adequately addressed concern #1. Staff’s literature review indicates that measuring the DCOF value using different tribometers on the same surface can result in different values and standard reference surfaces. Obtaining an absolute DCOF value that can be used to validate and calibrate tribometers currently does not exist.

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<sup>15</sup> Masory O (2016) Comments on ASTM F2508 – 13. J Ergonomics 6: 177. doi: 10.4177/2165-7556.1000177.

*Concern # 2: Insufficient evidence to support the assertion that a high COF value leads to a decreased hazard of slips and falls.*

According to the CP 16-1 Staff Briefing Package, CPSC staff found that the 2016 petition did not provide any data showing a direct relationship between the DCOF ratings proposed in the petition and a risk of slips and falls. To address the concerns of staff, the petition suggested the review of several additional research reports. The 2018 petition claims that a report by Dr. Wen-Ruey Chang shows a definitive correlation between wet DCOF measurements and injury claims. The 2018 petition claims that higher-traction surfaces significantly reduce the risk of slips and falls in contrast to lower-traction surfaces. Additionally, the 2018 petition included one CNA presentation and two CNA reports, stating that these documents correlate the relationship between a floor's COF and the associated rate of slip and fall injury claims. The 2018 petition asserts that the wet COF of floor surfaces can be relied upon as a predictive model for identifying and preventing slip and fall events and resulting injuries. The 2018 petition states that the CNA reports recommend that a business know the point-of-sale slip resistance of the floor material, and ranks such knowledge as the number one recommendation to business owners in choosing flooring that is slip resistant.

The CNA reports the petitioner provided demonstrate that the friction between footwear and floor (underfoot friction) is a contributing factor in a slip and fall, but the degree to which the original floor COF contributes to a slip and fall is unclear. Chang prefaces his literature review by differentiating between underfoot friction and floor friction, stating that the term "underfoot friction" is used in the report, rather than floor friction, because friction is affected by the floor, footwear, and contaminants. In his literature review, Chang concludes that an increase in underfoot friction could result in a decrease in slip-initiated incidents. Chang's conclusion does not specify COF values that are correlated to the risk of slips and falls.

The CNA report and presentations show that the COF is a factor in slips and falls. The CNA analysis of claims based on COF did show that the high COF category had the least percentage of claims. If the claims are based on the 112 business locations in the study, then improving the COF of the floor may reduce the claims. However, the presentations and report indicated that while COF is a factor in a slip and fall incident, CNA did not establish a direct quantifiable correlation between COF and the risk of slips and falls. Additionally, the CNA reports did not establish to what extent other factors contributed to the slip and fall claims.

One of the CNA reports promotes ANSI A326.3-2017, which the CNA describes as reflecting years of collaboration among various professional flooring representatives. The CNA report states that appropriate flooring that is properly maintained should be expected to maintain a DCOF of greater than 0.42 over its use life, as recommended by ANSI A326.3-2017. The report continues to explain that coatings, sealants, and other finishing treatments may change a point-of-sale COF.

According to ANSI A326.3-2017, pre-installation COF measurements do not predict the likelihood a person will or will not slip on a hard surface flooring material. The standard lists factors that affect the possibility of a slip occurring, including material of the shoe sole and degree of its wear, the presence and nature of surface contaminants, the speed and length of

stride at the time of slip, and the physical and mental condition of the individual at the time of slip, among other factors. Two of the four principles of floor safety promoted by the CNA report specifically address variables other than point-of-sale COF. The CNA report addresses floor maintenance to deal with floor contaminants that cover an original surface, and potentially render a slip-resistant floor dangerous. Other safety principles discussed in the CNA report relate to risk awareness and control measures to address slip-and-fall issues with human gait, visibility, and environmental factors. The NFSI/ANSI B101.3-2012 standard also includes a note stating that numerous variables may enhance or reduce the available slip-resistance potential of any given floor surface.

Staff's review of the additional information provided in CP 18-2 indicates that friction is one of multiple variables related to slips. The studies provided in the 2018 petition show that increasing the COF (value at the time of slip) may reduce slip incidents, but the studies do not report a correlation between specific COF values (or range of COF values) and the risk of slips and falls.

## F. Conclusion

CPSC staff reviewed CP 18-2, the petition submitted to address concerns raised by the Commission regarding CP 16-1, as described in the Introduction section of this memo.

*Concern #1.* Lack of consistency and accuracy among various test methods and lack of consistency of test instruments.

Staff concludes that the petition did not provide sufficient evidence to support the assertion that the ANSI/NFSI B101.3-2012 test method addresses the lack of consistency and accuracy of test methods and instruments. Staff is unaware of standard reference material(s) that are reliable enough that an absolute COF value can be assigned and used to validate tribometers; and different tribometers read different COF values on the same surface.

Staff recommends research into the reliability and accuracy of measuring standard reference materials with tribometers.

*Concern #2.* Insufficient evidence to support the assertion that a high COF value leads to a decreased hazard of slips and falls.

While the 2018 petition provided information showing that a floor surface COF is one of many variables related to slips and falls, and set forth studies showing that increasing the COF (value at the time of slip) of a floor surface may reduce the risk of slips and falls, the studies do not report a correlation between specific COF values (or range of COF values) and the risk of slips and falls.

**TAB B: Human Factors Assessment for Petition (CP 18-2),  
Petition for Labeling Requirements Regarding Slip Resistance  
of Floor Covering**

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

**Memorandum**

Date: June 12, 2019

TO: Jacqueline Campbell, Project Manager  
Office of Hazard Identification and Reduction

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

FROM: Stephen Harsanyi, Engineering Psychologist  
Division of Human Factors  
Directorate for Engineering Sciences

SUBJECT: Human Factors Assessment for Petition (CP 18-2), Petition for Labeling Requirements Regarding Slip Resistance of Floor Coverings

**I. INTRODUCTION**

Russel J. Kendzior, President and Chairman of the Board of the National Floor Safety Institute (NFSI or Petitioner), petitioned the Consumer Product Safety Commission (CPSC) to mandate that manufacturers of hard surface resilient flooring materials and topical floor coatings uniformly label the slip resistance of their products to reflect the dynamic coefficient of friction (DCOF) in accordance with the American National Standards Institute (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 Floor Coverings*, and that flooring retailers provide point-of-sale information (e.g., placards, signs, etc.) to communicate the use of the label to consumers as a part of the product selection process. The flooring DCOF values specified in ANSI/NFSI B101.5-2014 are based on tests described in ANSI/NFSI B101.3-2012, *Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials*.

The Petitioner previously submitted a similar request (CP 16-1), dated October 4, 2015.<sup>1</sup> On December 13, 2016,<sup>2</sup> the Commission voted 3-2 to deny CP 16-1. The Commission concluded that the agency lacked sufficient information demonstrating that the proposed action, to mandate a floor covering label, would assist consumers in assessing the comparative safety of floor covering products, or lead to a reduced number of slip and fall incidents. The current petition (CP 18-2) attempts to resolve the Commission's concerns about the previous petition. CP 18-2 frames the Commission's concerns and discusses them under the following headings:

1. Concern #1. Lack of Consistency and accuracy among various test methods and lack of consistency of test instruments.
2. Concern #2. Insufficient evidence to support the assertion that a high COF value leads to a decreased hazard of slips and falls.
3. Concern #3. Limited effectiveness of the proposed label.

In this memorandum, Engineering Sciences Human Factors (ESHF) staff evaluates the discussion of "Concern #3. Limited effectiveness of the proposed label."

## II. DISCUSSION

### A. Background

Similar to the request in CP 16-1, the resubmission, CP 18-2, proposes mandating the DCOF flooring traction label featured in ANSI/NFSI B101.5-2014 (Figure 1).<sup>3</sup> CP 18-2 describes the label as follows: “[t]he label would provide a graphic of a gas gauge like traction scale with an arrow pointing to the product[’]s level of traction (modified DCOF).” As stated in ANSI/NFSI B101.5-2014: “[t]he indicating arrow within the symbol shall point to the numerical value of traction provided by the product across the scale from lowest value of one (1) to highest value of ten (10).” The left side of the scale has the word “LOW” accompanied by a human figure falling, and the right side of the scale has the word “HIGH” accompanied by a human figure standing upright. When the scale is printed in color, values considered to be low traction are red, moderate traction values are yellow, and high traction values are green. In response to comments on CP 16-1 regarding possible confusion caused by inclusion of both SCOF and

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<sup>1</sup> Petition CP 16-1 requested that manufacturers of hard surface flooring materials and floor coatings be mandated to uniformly label their products to provide point-of-sale information about their products' degree of slip resistance in accordance with ANSI/NFSI B101.5-2014. CP 16-1 included requirements for both static coefficient of friction (SCOF) and DCOF slip resistance values per the test methods described in ANSI/NFSI B101.1-2009, *Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials*, and ANSI/NFSI B101.3-2012, respectively.

<sup>2</sup> <https://www.cpsc.gov/s3fs-public/RCA%20-%20Petition%20CP%2016-1%20Labeling%20Requirements%20Regarding%20Slip-Resistance%20of%20Floor%20Coverings%20121316.pdf>

<sup>3</sup> Note: the label included on p. 10 of CP 18-2, which references ANSI/NFSI B101.5-2014, varies from the label in ANSI/NFSI B101.5-2014 with slight modifications to the words “LOW” and “HIGH,” and the shapes of the human figures.

DCOF scales, CP 18-2 requests compliance only with DCOF testing and labeling, although SCOF testing and labeling requirements are included in ANSI/NFSI B101.5-2014. CP 18-2 claims that the proposed label will be highly effective in reducing slips and falls and fall-related injuries.



**Figure 1.** DCOF Traction label featured in ANSI/NFSI B101.5-2014 (left) and on p. 10 of CP 18-2 (right).

### B. Safety Information Effectiveness

The Human Factors memorandum responding to CP 16-1 discussed challenges and limitations of safety information, both in general and specific to ANSI/NFSI B101.5-2014. White (2016) explained:

[r]esearchers 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).

White (2016) concluded that consumers, particularly older consumers,<sup>4</sup> may not notice, read, understand, or be motivated to act in accordance with the labels specified in ANSI/NFSI B101.5-2014. Among other factors, hard flooring materials are often viewed and selected without inspecting retail packaging; and purchasing decisions are influenced by many other factors beyond potential slip resistance, including, but not limited to, aesthetics, maintenance, longevity, and cost. Consumers are likely to perceive flooring as familiar, and research shows an inverse relationship between perceived familiarity with a product or similar products and the likelihood of searching for and adhering to safety information (Wogalter, Desaulniers, Brelsford, Jr., 1986; Sanders and McCormick, 1993; Vrendenburgh and Zackowitz, 2006; and Wogalter, Laughery, Sr., and Mayhorn, 2012). Users, particularly secondary users of hard flooring materials, are unlikely to see the safety information, and they may not have the option to select or replace the flooring. CP 18-2 proposes the same labeling standard as proposed in CP 16-1 without providing persuasive evidence to alleviate staff's previous concerns; therefore, staff's current technical findings are the same as in the previous briefing package.

<sup>4</sup> In response to CP 16-1, White (2016) stated: "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, declines most sharply between 40 and 59 years of age and becomes very pronounced in very old age (*i.e.*, 75 years and older)."

### C. Testing of Flooring Traction Labels

CP 18-2 states that the proposed traction label meets the requirements of ANSI Z535.3-2007, *Criteria for Safety Symbols*. Like CP 16-1, CP 18-2 cites support for the proposed traction label by referencing user testing conducted in 2008 by Applied Safety and Ergonomics, Inc. (ASE). Staff previously evaluated this research in forming the Human Factors technical response to CP 16-1. After reevaluating this research, staff's technical assessment remains unchanged. In summary, ASE performed a two-phase study with the goal of testing and improving, if necessary, potential flooring traction labels. ASE tested labels similar to the label proposed in CP 18-2. The study included a judged comprehension test and an open-ended comprehension test based on recommendations in ANSI Z535.3-2007.<sup>5</sup> Staff has concerns regarding the ASE study and the exclusion of recommendations from the study into the proposed labeling standard. Staff's concerns include:

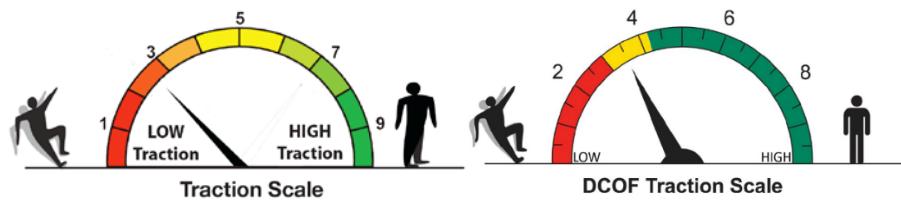
- *Limitations of participant age range.* In Phase 1 of the study, the 50 participants varied in age from 21 to 68 years, with an average age of 43.5 years. In Phase 2 of the study, the 50 participants varied in age from 18 to 85 years, with an average age of 37 years. As noted in the 2016 and 2018 Petitions and the Human Factors memorandum in response to CP 16-1 (White, 2016), older adults, in particular, appear to be at high-risk of slips and falls and fall-related injuries.<sup>6</sup> Based on the age range in the study, the samples in Phase 1 and Phase 2 may not capture proportionally the most at-risk populations identified by the incident data. Age-related factors, such as expected detriments to cognition and visual acuity, could result in meaningful differences in label comprehension.
- *Excess of critical confusions.* In Phase 2 of the study, six (12%) of the participants incorrectly reported the meaning of the modified symbol, four (8%) of whom reversed the meaning of the symbol (critical confusions), in excess of the recommended maximum of 5% by ANSI Z535.3-2007, and the current standard, ANSI Z535.3-2011.
- *Exclusion of recommendations.* Based on the results of Phase 2, ASE recommended modifying the label in ways they believed would increase user comprehension. CP 18-2 proposes a label that excludes many of these recommendations. In Figure 2 below, staff shows the variations between the label recommended by ASE (on the left) and the proposed label in CP 18-2 (on the right). Differences include: shades of colors, labeled

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<sup>5</sup> Phase 1 of the study, Judged Comprehension Test, involved showing participants three flooring traction symbols and asking them to estimate the percentage of the population that would comprehend the meaning of each of the symbols. Phase 2 of the study, Open-Ended Comprehension Test, involved showing participants a modified version of the highest rated symbol from Phase 1, and asking them to interpret the symbol. ASE found that the highest-rated symbol from Phase 1 had a mean value percentage of 60.9%, which falls below the minimum of 65% recommended by ANSI Z535.3-2007, as well as ANSI Z535.3-2011.

<sup>6</sup> In reviewing CPSRMS incident data, White (2016) found that most slip and fall incidents involved people ages 70 and older, and the next largest group of fall incidents involved people ages 60 to 69 years. Among other factors, older adults are more prone to slips and falls due to medical impairments and perceptual, cognitive, and motor deficits.

values on the scale, labeled text in and beneath the scale, scale marks/notches, human depictions, and distribution of values into low, moderate, and high traction.



**Figure 2.** Traction label recommended by ASE (left) versus proposed label on p. 10 of CP 18-2 (right).

#### D. Removal of SCOF Labeling

In response to CP 16-1, White (2016) discussed concerns regarding mandating both SCOF and DCOF scales and the potential for consumers to misunderstand the information, leading them to select unsafe flooring for their needs. CP 18-2 focuses exclusively on DCOF testing and labeling; however, SCOF labeling is included in ANSI/NFSI B101.5-2014, and the test method for SCOF, ANSI/NFSI B101.1-2009, is specified in ANSI/NFSI B101.5-2014. This may confuse manufacturers seeking to comply with the proposed standard, and consequently, consumers may be presented with both scales.

#### E. Concerns Regarding the Proposed Standards

Staff continues to have concerns regarding the labeling provisions in ANSI/NFSI B101.5-2014 and the underlying methodology on which COF values are derived (ANSI/NFSI B101.3-2012). Whereas consumers could benefit from being able to compare the slip resistance of hard flooring materials at the point of sale, the test method for slip resistance would need to be reliable and valid, and the label would need to be appropriate. Based on the Mechanical Engineering staff assessment (see Tab A), CP 18-2 failed to demonstrate the accuracy and consistency of the proposed test methods and instruments. Mechanical Engineering staff recommended further research to develop accurate, reliable, and reproducible test methods.

ESHF staff is concerned that consumers may be misled by the proposed label regarding their selection and use of hard flooring material. Staff opines that it is unlikely that consumers will understand the limitations and implications of the proposed test methods, instruments, and values. Furthermore, staff cautions against assigning DCOF values to flooring at the point of sale to estimate the risk of falling without obtaining a better understanding of the magnitude of the measurement's impact to the risk. As discussed in the CP 16-1 Staff Briefing Package, in references included in CP 18-2, and by comments on CP 16-1 and CP 18-2, the real-world slip resistance of a hard flooring material is influenced by numerous factors beyond the DCOF value for flooring materials at the point of sale. In support of the proposed test method and label in CP 18-2, the petitioner cites research by Dr. Wen-Ruey Chang (2017); however, in his report, Dr. Chang includes in the introduction, in part: “[f]or falls on the same level, slippery floors, mostly caused by contaminants, are a critical factor.” The report does not specify levels of COF to ensure safety, and it specifically makes reference to “underfoot friction,” as opposed to floor

friction, acknowledging that slip resistance is multi-factorial. Similarly, much of the other supporting evidence provided in CP 18-2, such as the material by CNA Insurance Company, also emphasizes extraneous variables, such as how well floors are cleaned and maintained.

Regarding comments on CP 16-1, which state that various government and standards organizations (such as OSHA, ABA, ADA, and ICC) have rejected or withdrawn tests based on COF measurements, Laboratory Sciences Chemistry (LSC) staff (Dreyfus, 2016) responded: “various entities have concluded there is a lack of correlation between COF measurements and risk of fall.” ASTM F1646 – 16, *Standard Terminology Relating to Walkway Safety and Footwear*, explains that slip resistance and DCOF (also referred to as kinetic or sliding coefficient of friction) are dependent on variations in the two contacting bodies; *i.e.*, “a combination of factors including the walkway surface, the footwear bottom, and the presence of foreign materials between them.” Per ANSI A326.3-2017, *American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials*:

- “[COF] does not predict the likelihood a person will or will not slip on a hard surface flooring material.”
- “Because many variables affect the risk of a slip occurring, the COF shall not be the only factor in determining the appropriateness of a hard surface flooring material for a particular application.”

Similar statements are found in ANSI A137.1-2017, *Standards Specifications for Ceramic Tile*.

Consumers may not realize that the real-world slip resistance of a hard flooring material will likely vary greatly from the slip-resistance value specified at the point of sale, discounting numerous necessary considerations for underfoot friction. The list below includes some of the factors that contribute to underfoot friction, the likelihood of slipping and falling, or both, which are not captured by an across-the-board, point-of-sale flooring DCOF value:

- floor coatings and chemical treatments (post-installation application);
- installation, cleaning, and maintenance (*e.g.*, surface contaminants/lubricants);
- effects of age and wear (varies with the particular product);
- flooring irregularities (*e.g.*, transitions, uneven surfaces, slopes);
- location (*e.g.*, entryways, kitchens);
- clutter and other obstacles (*e.g.*, loose cords, poorly placed floor mats);
- footwear (*e.g.*, texture, flexibility, contamination);
- user characteristics (*e.g.*, cognitive and physical impairments, reaction time, gait, state of awareness, expectations, perception);
- user activity (*e.g.*, walking, running, shuffling, physical exertion); and

- other factors, such as macroscopic texture, drainage, lighting, presence of handrails, use and condition of transportation assistive devices.

Staff is also concerned that high DCOF values may not be appropriate for all contexts and purposes. As discussed in ANSI A326.3-2017, high-traction flooring may result in greater retention of surface contaminants, requiring a higher frequency and quality of maintenance. Owners of high-traction flooring may mistake the flooring to require fewer preventative measures for slips, thereby, creating a false sense of safety with a flooring choice that may actually have an increased potential for falls. Furthermore, falls do not only occur from slipping, but also from stumbling and tripping, and, as stated in ANSI A326.3-2017, high-traction flooring can impede activities performed by certain populations, such as the elderly, who may have a shuffling gait, my push an assistive device for walking, or both. The elderly population is of particular concern regarding the subject hazard; therefore, the means by which the elderly interact with high-traction flooring is a critical factor.

Additionally, numerous inconsistencies exist between the requirements in ANSI/NFSI B101.5-2014 and the proposal in CP 18-2. As discussed above, ANSI/NFSI B101.5-2014 still specifies SCOF labeling and the SCOF test method, ANSI/NFSI B101.1-2009, which may confuse manufacturers, and, in turn, consumers if presented both scales. Staff identified many discrepancies in the classifications of DCOF values as low-, moderate-, and high-traction, both within and between ANSI/NFSI standards. For example, section 4.4.4 of ANSI/NFSI B101.5-2014 indicates that, when presented in whole numbers, rather than decimal values, DCOF values of 1 thru 3 indicate low traction; 4 thru 5.2 indicate moderate traction; and 5.3 thru 10 indicate high traction. However, section 4.5 shows DCOF values of 0 to 3 are low traction; 3 to 4.2 are moderate traction; and 4.2 to 10 are high traction. Neither of these classifications is consistent with similar standards, such as ANSI A326.3-2017 and ANSI A137.1-2017, which specify a wet DCOF of 0.42 as a minimum, and that do not attempt to assign levels of risk of falling to DCOF values. ANSI/ASSE A1264.2-2012, *Provisions of Slip Resistance on Walking/Working Surfaces*, suggests slip-resistance values of 0.5 and above as “acceptable” for walking surfaces in wet and dry conditions. The proposed standards are also inconsistent in their terminology regarding moderate DCOF values; *i.e.*, ANSI/NFSI B101.3 uses the term “acceptable” rather than “moderate,” as described in ANSI/NFSI B101.5.

### **III. CONCLUSION**

ESHF staff is concerned that, in their selection and use of hard flooring materials, consumers are likely to be misled by the proposed flooring traction label. The label, which was previously proposed in CP 16-1, and proposed again in CP 18-2, depicts a human figure falling on one side and standing upright on the other, and it associates specific values to point-of-sale flooring DCOF, with the likelihood of falling. CP 18-2 presents neither persuasive supporting evidence, nor substantive changes to the proposals in CP 16-1, except removing SCOF testing and labeling requirements; therefore, staff’s conclusion regarding the proposed standards remains unchanged. In particular, staff notes the following concerns with the petitioner’s proposal, which staff

suggests should be addressed before attempting to assign point-of-sale flooring DCOF values to the risk of falling:

1. The proposed DCOF values may not be accurate or comparable for across-the-board measurement of the slip resistance of hard flooring materials due to the inconsistencies of measuring DCOF.
2. The magnitude of the flooring DCOF value's impact to the risk of falling is uncertain.
3. Underfoot friction and the likelihood of falling and fall-related injuries are affected by a multitude of factors beyond the point-of-sale flooring slip resistance.

A flooring slip resistance label and underlying methodology developed by consensus and determined to be reliable and valid, combined with presenting other pertinent information related to the slipperiness of the floor, may be able to assist consumers in comparing products at the point of sale. Staff concludes that the proposal in CP 18-2 is inadequate to reduce the likelihood of fall-related injuries associated with slipping on hard flooring materials.

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**TAB C: Response to Comments Received on Floor Covering Petition**



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

Date: June 12, 2019

TO : Floor Coverings Petition File

THROUGH: Rana Balci-Sinha, Ph.D., Acting Associate Executive Director  
Directorate for Engineering Sciences

FROM : Jacqueline Campbell, Project Manager  
Directorate for Engineering Sciences

SUBJECT : Response to Comments Received on Floor Coverings Petition

## **I. Introduction**

CPSC published a request for comments on the floor coverings petition (CP 18-2, or the 2018 petition) in the *Federal Register* on June 6, 2018, with the comment period ending on August 6, 2018.<sup>1</sup> The Commission received 88 comments, with support and opposition for the petition divided among the comments.

Topics raised by comments included:

- Whether the 2018 petition did or did not address the Commission's concerns with the 2016 petition (CP 16-1),
- How the petition proposal would impact consumer safety,
- The existence of multiple contributing factors to slips and falls and fall-related injuries,
- Concerns with the petitioner's characterization of evidence submitted in support of the 2018 petition,
- Concerns with the proposed testing standard and equipment,
- Concerns with the proposed labeling standard,
- Potential legal implications,
- Considerations for senior safety related to slips and falls,
- Costs and benefits associated with the petition proposal,
- Potential conflict of interest, and
- Alternative approaches to enhancing flooring safety.

Generally, supporters of the petition expressed interest in a reliable, easy to read labeling scheme that would inform consumers about a floor's slipperiness at the point of sale, thereby allowing consumers to make more informed choices for a specific flooring situation and improving floor safety. These commenters mentioned the societal impacts of falls, the disproportionate impact of

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<sup>1</sup> 83 Fed. Reg. 26,228 (June 6, 2018).

falls on seniors, and the lack of opportunity for consumer education. Opposition to the petition focused mostly on technical concerns with the test method, measurement instrumentation, and label. These commenters raised a concern that consumers may be left with a false sense of security, which could negatively impact flooring safety. In some cases, commenters agreed that slips and falls should be addressed in some way, but did not agree with the petition's proposal.

CPSC staff's summary of the comments and responses follow.

## II. Comments Received and Staff's Responses

### A. Petition Addresses/Does Not Address Staff's Concerns

*Comment 1:* Several commenters stated that CP 18-2 addressed CPSC staff's concerns raised in response to CP 16-1. Other commenters stated that CP 18-2 did not address CPSC staff's concerns.

*Response 1:* As discussed in this briefing package, staff concludes that the Commission's concerns regarding CP 16-1 have not adequately been addressed by the 2018 petition, CP 18-2. Except for removing the SCOF testing and labeling requirements, the 2018 petition presents neither substantive changes to the proposals in CP 16-1, nor persuasive supporting evidence for the proposed standards.

### B. Impacts on Consumer Safety

*Comment 2:* Commenters were divided in opinion regarding how the proposed testing and labeling would affect the likelihood of slips and falls and fall-related injuries. Many commenters stated the proposed standards, or other mandatory testing and labeling standards for flooring generally would better inform consumers and design professionals, resulting in the selection of safer flooring materials and a reduction in injuries and deaths from falling. Some commenters stated that such labeling may create pressure in the market for manufacturers to make safer floors.

In contrast, many commenters stated that the proposed standards would adversely impact consumer safety by misleading consumers with inaccurate information. Commenters raised concerns, such as: the lack of evidence and consensus supporting the proposed testing and labeling standards, the multifactorial nature of slips and falls and fall-related injuries beyond point-of-sale DCOF, and the possibility for high-friction floors to increase the likelihood of slips and falls and fall-related injuries. Commenters expressed concern that, if the Commission issued the labeling standard that the petitioner requests, consumers would have a false sense of security, thereby underestimating the risk of injury. Commenters noting another potential consequence, suggested that consumers would rely solely on the proposed inaccurate information, at the expense of considering other information critical to selecting the most appropriate flooring for a given application.

*Response 2:* Consumers could benefit from being able to compare the slip resistance of hard flooring materials at the point of sale; however, the test method for slip resistance would need to

be reliable and valid, the label would need to be appropriate, and other pertinent information would need to be provided to consumers, so consumers do not rely solely on the point-of-sale flooring slip-resistance value. CP 18-2 does not provide sufficient evidence in support of the proposed test method, devices, or label for slip resistance; nor does the petition provide enough information regarding the relationship between point-of-sale flooring DCOF and the likelihood of slipping and falling and fall-related injuries. Staff is concerned that consumers are unlikely to understand the limitations and implications of the proposed point-of-sale flooring slip-resistance test method, devices, and values. Given the multifactorial nature of slips and falls associated with hard flooring materials (discussed below), staff opines that it is misleading to consumers to assign point-of-sale slip-resistance values regarding the likelihood of falling, such as in the proposed DCOF label (*i.e.*, the label includes images of a human figure standing on one side and falling on the other side).

Regarding the implication that high COF flooring contributes to the likelihood of slipping and falling, current research demonstrates a negative correlation between COF and the likelihood of slipping and falling, in general. However, staff agrees that there may be cases where some high-traction flooring may lead to greater surface contamination build-up. Additionally, higher friction from these floors may present greater difficulty for certain populations, such as those who shuffle their feet, drag walking-assistive devices, or both. Overall, staff assesses that the testing and labeling standard, as proposed in CP 18-2, is unlikely to improve consumer safety, and could potentially increase the likelihood of injury, by providing consumers with false or misleading information.

**Comment 3:** A commenter stated that using only wet DCOF values disregards important factors for slip reduction, such as surface structure elements. Specifically, the commenter stated that macroscopic and microscopic textures and features can result in a lower flooring DCOF measurement value, yet provide considerably better drainage and traction than other flooring options with higher wet DCOF measurement values.

**Response 3:** Staff agrees that there are limitations to the accuracy of tribometer measurements when presented with some surface design features. If a measurement technique cannot be expected to accurately measure all hard flooring surfaces within scope, consumers cannot depend on the label to inform them about the correct flooring to choose for a given application.

### C. Multiple Contributing Factors to Slips and Falls and Fall-Related Injuries

**Comment 4:** Many commenters stated that slip resistance of installed hard flooring cannot adequately be captured by a point-of-sale flooring coefficient of friction (COF) value because numerous factors contribute to slips and falls. Commenters listed contributing factors related to flooring, such as: post-installation coatings or finishes, surface contamination, care products, wear, and installation issues. Commenters listed non-flooring factors as well, such as: footwear, human locomotion, unsteady gait or other impairments, and area lighting. Because these factors would not be captured in the proposed label, commenters expressed concern that the proposed slip-resistance label would give consumers a false sense of security in the safety of hard flooring products. Many commenters felt that these other factors contribute more to the likelihood of

slipping and falling than point-of-sale flooring COF values, make determinations about real-world slip resistance a very difficult and complicated task.

Response 4: Staff agrees that numerous factors can affect the likelihood of slips and falls and fall-related injuries beyond the point-of-sale flooring slip-resistance value. Although in staff's incident data review for CP 16-1, staff found that information about contributing factors is rarely cited in the data, with some incidents indicating that a myriad of issues were associated with slips and falls. Staff found two main contributing factors beyond the point of sale flooring slip-resistance value: health issues, such as muscle weakness, poor vision, difficulties with keeping balance, or taking medications; and environmental factors, such as type of footwear, dirt or oil contamination of the flooring surface, and poor lighting. The data cited in the petition agrees that health and environmental factors often contribute to fall incidents. For example, the revised petition cites reports from Chang, WR, Falls Prevention, LLC, and the CNA Insurance Company, which indicate that factors such as after-sale finishes, maintenance, or contamination can contribute to slips and falls. These factors are discussed further in the Human Factors Memorandum (Tab B).

Comment 5: A commenter acknowledges that a number of factors contribute to floor traction, but giving consumers some uniform, empirical data to compare flooring types would improve safety, the commenter asserted.

Response 5: Staff agrees that providing consumers with directly comparable information on flooring slip resistance would improve safety; however, the revised petition does not provide sufficient evidence to resolve staff's concerns regarding the reliability and validity of the proposed test method and devices; nor does the petition address the weaknesses of the proposed label. Staff recommends that such information be data- and consensus-driven, and accompanied by alternative means of conveying safety information.

#### D. Concerns Regarding the Revised Petition's Supporting Evidence

Comment 6: Some commenters disputed the 2018 petition's use of research to support the proposed test method and devices, suggesting that research results are misrepresented in the petition.

Response 6: Staff agrees that some of the conclusions presented in the 2018 petition to support the petition proposal do not exactly express facts and conclusions stated in the cited studies. While many of the studies cited in the 2018 petition find that measurements of COF may be a useful piece of information for improving flooring safety, these studies also mention multiple other factors as important. For example, the research presented in the 2018 petition by Chang WR Falls Prevention, LLC specifically references "underfoot friction," as opposed to floor friction, acknowledging that slip resistance is influenced by two contacting surfaces and numerous variables, such as surface contamination. This study did not specify levels of COF to ensure safety, as proposed in the 2018 petition. The 2018 petition also states that CPSC staff conducted a comprehensive independent evaluation of the UWT tribometer and it demonstrated a high level of accuracy and reproducibility. Staff does not agree with this conclusion, as this activity was an informal experiment and included only one UWT device, which measured

inconsistent readings for two of the six tested surfaces. The results were not compared to other UWTs or different types of tribometers. In reviewing the supplied studies and other supporting citations, staff did not find adequate data supporting the reliability and validity of the proposed test method and devices. Additionally, staff found a lack of consensus among the cited studies, the proposed standard, and other similar standards, regarding the most appropriate methodology for slip resistance and interpretation of slip-resistance values.

*Comment 7:* Several commenters stated that there were no data to support the 2018 petition's assertion that the proposed labeling standard would improve floor safety.

*Response 7:* Staff agrees that there are no data demonstrating the effectiveness of the proposed labeling for improving floor safety. Additionally, as discussed above, staff has concerns regarding the proposed label and the study provided in the 2018 petition in support of the proposed label.

*Comment 8:* A commenter noted that the flooring industry is working toward remedying the subject hazard, including work with the University of Southern California, and OSHA, and the United States Access Board.

*Response 8:* Staff encourages research in this area and looks forward to reviewing the results of the studies.

#### E. Concerns Regarding the ANSI/NFSI B101.3 Testing Standard and Equipment

*Comment 9:* Several commenters disagreed with the use of the ANSI B101 testing and labeling standards. Commenters mentioned issues with the standard, such as lack of ability to predict slips and falls in real-world scenarios, inconsistencies in the standard, qualifications of participants, and a lack of support by the industry, and other issues.

*Response 9:* Staff agrees that the 2018 petition does not demonstrate a direct correlation between COF values provided by the ANSI/NFSI B101.3 method and the likelihood of slips and falls. Staff found inconsistencies between ANSI/NFSI B101.3 and ANSI/NFSI B101.5 regarding the DCOF mid-range measurements. In ANSI/NFSI B101.3 section 5, the middle range is 0.30 to 0.42 and is referred to as "acceptable slip potential." In ANSI/NFSI B101.5 section 4.4.4, the middle range is 0.4 to 0.52 and is referred to as "moderate traction." Staff is unaware of any current, universally accepted method of measuring COF on all hard flooring surfaces.

*Comment 10:* Some commenters claimed that other test methods and devices are already in practice that are superior to the proposed method and devices. Commenters recommended staff review ANSI A326.3, Australian Standard (AS) HB 198, and UL 410-2006, Standard for Slip Resistance of Floor Surfaces. Additionally, commenters suggested alternative devices, such as the James Machine and the British Pendulum Tester. Some commenters felt that mandating a voluntary standard would preclude the use of superior, consensus-based standards, stifle innovation in testing, and cause confusion for manufacturers and consumers. One commenter suggested testing before and after accelerated wear conditioning to characterize more accurately

the flooring surface over time. Another commenter stated that they supported mandatory labeling, but not the use of the proposed test to determine the label.

**Response 10:** Numerous standards exist for testing flooring slip resistance, which vary in the determination and interpretation of flooring slip-resistance values. Staff cannot comment on the appropriateness of other standards because this type of evaluation is not within the scope of staff's review of the 2018 petition. CPSC staff's literature review indicates that (1) measuring the absolute DCOF value using different tribometers on the same surface can result in different values and (2) standard reference surfaces to obtain an absolute DCOF value that can be used to validate and calibrate tribometers does not exist currently. Accordingly, staff recommends a thorough evaluation of available tribometers and methods of determining appropriate COF values for use in evaluating hard surface flooring safety.

**Comment 11:** Many commenters expressed concern regarding the use of a single test method or test instrument for making 1:1 comparisons across a significant variety of hard flooring materials.

**Response 11:** Staff agrees that no single method or test apparatus has been shown to be appropriate for 1:1 comparisons across all hard flooring surfaces and all conditions. In a review of existing standards and literature, as well as information offered by commenters, staff found no universally applicable method for measuring COF and no definitive data relating COF measurements to risk of fall.

**Comment 12:** Several commenters stated that ANSI B101 is not a truly consensus-based standard.

**Response 12:** Staff has a long history of participation in voluntary consensus standards, and staff considers ANSI B101 to be a consensus-based standard. The ANSI process includes measures to ensure that standards developers follow the ANSI Essential Requirements as written in the publication, *ANSI Essential Requirements:be Due process requirements for American National Standards*.<sup>2</sup>

**Comment 13:** Some commenters opined on the most relevant COF testing (*i.e.*, wet versus dry, dynamic versus static) for assessing the risk of slips and falls on hard surface flooring.

**Response 13:** The flooring industry does not agree on whether dry or wet COF measurements are more appropriate to predict the risk of fall; nor do they agree on whether DCOF is more appropriate than SCOF. CP 18-2 does not provide sufficient evidence in support of wet DCOF over the alternatives regarding assessing across-the-board slip resistance of hard flooring materials.

**Comment 14:** Some commenters stated that there are existing standards in place for some flooring types, and they added that in some cases, this type of information is already communicated to consumers.

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<sup>2</sup> [www.ansi.org/essentialrequirements](http://www.ansi.org/essentialrequirements)

**Response 14:** Staff reviewed flooring standards in the CP 16-1 Staff Briefing Package and knows that different standards cover specific types of hard surface flooring. For example, ANSI A137.1 is a standard for ceramic tile, and ASTM D2047-11 is the standard for polish-coated flooring surfaces. Staff is aware that some manufacturers provide information regarding COF measurements and use guidance. According to commenters, manufacturers report information specific to a type of hard surface flooring or use scenario. Staff is unaware how many flooring industry sectors and manufacturers provide slip-resistance information, and likewise is not aware of any manufacturers who relate COF values directly to the risk of slips and falls on a given hard surface flooring.

**Comment 15:** Some commenters expressed concern regarding agreement among different test instruments.

**Response 15:** In the CP 16-1 Staff Briefing Package, staff's review of slip-and-fall studies found that different tribometers can produce a range of COF measurements for the same hard surface flooring, due to the different mechanical designs and COF calculation methods. The 2018 petition ILS procedure proposes to remedy this concern by approving tribometers tested to be repeatable and reproducible. However, the 2018 petition does not demonstrate or provide evidence that one specific device or method provides more accurate COF values or repeatable measurements than another method. In fact, as stated in Tab B of the CP 16-1 Staff Briefing Package, the methods proposed in the 2016 petition (and 2018 petition) provide some of the lowest correlations between COF value and the risk of falling.

**Comment 16:** A commenter noted that the Occupational Safety and Health Administration (OSHA) and the Americans with Disabilities Act (ADA) have not issued mandatory standards for slipperiness due to the difficulty of accurately measuring the slip resistance of floors.

**Response 16:** The ADA Standards for floor and ground surface explain that standards do not specify a minimum level of slip resistance (COF) because no consensus method exists for rating slip resistance.<sup>3</sup> OSHA released a final rule to update the general industry walking-working surfaces and fall-protection standards.<sup>4</sup> The OSHA floor safety rule does not address COF. The final rule states that the requirements expected to yield the largest benefits from preventing falls on the same level are found in § 1910.22 General Requirements, which addresses proper maintenance of the surface conditions, maximum loading, access and egress, and inspection, maintenance, and repair processes.

**Comment 17:** Some commenters expressed concern regarding the ILS for the NFSI tribometer and the process by which accepted tribometers are certified by NFSI.

**Response 17:** Staff acknowledges the concerns raised by the commenters regarding NFSI's approved tribometers and its ILS process. Staff determined that NFSI's ILS process does not

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<sup>3</sup> <https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/guide-to-the-ada-standards/chapter-3-floor-and-ground-surfaces>

<sup>4</sup> 29 CFR Part 1910 [Docket No. OSHA-2007-0072] Walking-Working Surfaces and Personal Protective Equipment (Fall Protection Systems)

ensure that test instruments accurately and consistently measure DCOF because the reference tiles showed high levels of tile-to-tile variation. Standard reference tiles are needed to ensure that any calibrated tribometer is measuring DCOF accurately and consistently. NFSI's ILS assumes the reference "golden" tribometers are accurately measuring the DCOF for all surfaces and that all certified NFSI tribometers perform within the NFSI specifications of the reference tribometers. The 2018 petition did not provide data on the accuracy of the reference tribometers or the results of the approved tribometers.

#### F. Concerns Regarding the ANSI/NFSI B101.5 Labeling Standard

Comment 18: Commenters raised concerns regarding various inconsistencies and ambiguities in the ANSI/NFSI B101.5-2014 standard. Stated concerns included the following:

- Reference to the SCOF test method and values per ANSI/NFSI B101.1-2009;
- Categorizations of values as low, moderate, and high traction, and similarly, use of the term "acceptable";
- Use of the terms "acceptable" and "moderate" as synonyms between B101 standards; and
- Inconsistencies within and between B101 standards in the categorizations of moderate/acceptable traction.

Response 18: ANSI/NFSI B101.5-2014 is the same labeling standard previously submitted and reviewed in petition CP 16-1. Staff previously discussed concerns with the proposed labeling standard in the CP 16-1 Staff Briefing Package. Staff agrees that this labeling standard has various inconsistencies and ambiguities, as raised by the commenters (such as those discussed in response to Comment 9). Furthermore, CP 18-2 does not provide convincing evidence in support of the values considered to afford "acceptable" traction. A lack of consensus exists among standards bodies regarding "acceptable" flooring DCOF values, as similar standards set the limit at 0.42 or higher, rather than 0.3 as proposed by the petition, and do not attempt to assign numerical values to levels of risk of slipping and falling.

Comment 19: Commenters were divided regarding the proposed flooring DCOF graphic/scale. Commenters in favor of the graphic stated that the label is easy to comprehend and provides useful information. Some commenters compared the graphic to a nutritional label for food. In contrast, commenters against the proposed graphic raised concerns, such as: the label is confusing, the values are overly simplistic and misleading, and consumers would never see the label. Additionally, some commenters raised concerns regarding the research provided by the revised petition in support of the proposed graphic.

Response 19: Absent additional research, staff is unable to confirm if the proposed label is easy to comprehend. Both CP 16-1 and CP 18-2 reference user testing conducted in 2008 by Applied Safety and Ergonomics, Inc. (ASE). ASE user testing found that a similar iteration of the proposed label resulted in 12 percent of the participants incorrectly reporting the meaning of the label, and 8 percent reversed the meaning (critical confusions). ASE recommended changes to potentially increase user comprehension; however, the proposed label does not incorporate the majority of these recommended changes. Staff notes that, due to the average age of the participants, the data may not proportionally capture the most at-risk population for slips and

falls and fall-related injuries identified by the incident data, *i.e.*, older Americans, meaning the comprehension rates could be lower for the most at-risk population.

Staff disagrees that the proposed label provides useful information. On the contrary, staff concludes that the label provides misleading information regarding the risk of slipping on hard flooring materials as installed; the values exhibited in the proposed label are not proven to be based on an accurate or reliable method, and they are not proven to be appropriate for assigning risk of slipping, especially under real-world conditions. Regarding the likelihood of consumers seeing the label, staff cautions that many consumers may not see the label, as hard flooring materials are often viewed and purchased without inspecting retail packaging. In particular, secondary users of hard flooring materials, such as renters, are especially unlikely to see the packaging, or be in control of the hard flooring selection.

#### G. Legal Precedence Under Section 27(e) of the CPSA

Comment 20: Commenters stated that the requested actions in the petition have not been demonstrated to provide consumers with accurate performance or technical data related to performance and safety of the subject products, which is a requirement under section 27(e) of the CPSA.

Response 20: Staff's review of the 2018 petition and newly submitted information has not changed staff's position on the merits of the petition. Accordingly, staff continues to recommend that the Commission deny the petition because the agency lacks sufficient information to demonstrate that the proposed action to mandate a floor covering label would assist consumers in assessing the comparative safety of floor covering products, or lead to fewer slip and fall incidents, as the Commission stated in denying petition CP 16-1.<sup>5</sup>

#### H. Considerations for Seniors

Comment 21: Many commenters discussed how the elderly, in particular, would be affected by the proposed testing and labeling. Commenters in favor of the petition agreed with the petitioner that the elderly are an especially high-risk population for slips and falls and fall-related injuries, and that slip-resistance labeling would help seniors and their caretakers make better-informed decisions for improving the safety of their home environment. Commenters opposed to the petition stated that the elderly face unique challenges beyond what can effectively be remedied by the proposed standards. For example, one commenter quoted the Centers for Disease Control and Prevention (CDC), listing risk factors involved in causing or preventing falls, including: lower body weakness, Vitamin D deficiency, difficulties with walking and balance, use of medications that affect balance and stability, vision problems, foot pain or poor footwear, home hazards or dangers, such as broken or uneven steps, throw rugs, or clutter that can be tripped over, and lack of handrails along stairs and in bathrooms.

Response 21: Staff agrees that seniors are often more vulnerable to slips and falls and fall-related injuries than the general population. Due, in part, to factors such as foreseeable physical

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<sup>5</sup> See January 19, 2017 Commission Denial Letter regarding CP 16-1

impairments and detriments to cognition, seniors tend to be more susceptible to environmental factors that increase their risk of slips and falls. According to the data review performed for the first petition (CP 16-1), staff estimated that there were 1.5 million emergency department-treated injuries associated with senior falls in 2011, and the CDC National Center for Health Statistics (NCHS) database lists 33,018 fall-related deaths in 2014. Staff is unclear, however, how many of these injuries and deaths are associated with flooring slip resistance, due to the limited details in the data set, and to what extent that labeling point-of-sale flooring slip resistance would reduce the number of falls involving the elderly. For the reasons discussed in this response and the above responses, staff does not believe the standard the petitioner advocates will effectively reduce the number of injuries involving the elderly.

#### I. Costs and Benefits of the Petition Proposal

*Comment 22:* Some commenters expressed the belief that the costs of petitioner's proposed labeling standard would be easily offset by societal benefits, due to decreases in the existing substantial societal costs associated with slips and falls. Alternately, some commenters opined that the proposed labeling standard would be costly to manufacturers, difficult to implement, and not provide a benefit to consumers.

*Response 22:* Staff opines that additional information is necessary for the assessment of both the costs and benefits of the petitioner's proposed labeling standard. Staff's determination of the potential costs might require a survey of 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. To estimate the potential benefits of labeling flooring for slip resistance, staff requires information on the proportion of injuries resulting from slips, and the slip resistance of the floors on which the falls occurred; information on the exposure of consumers to floors with different coefficients of friction; and information on the impact that labeling would have on the purchase decisions of consumers.

#### J. Potential Conflict of Interest

*Comment 23:* A number of commenters suggested that NFSI has a conflict of interest in the outcome of the 2018 petition, identifying potential financial gains by the petitioner, his family, and by other NFSI members. Commenters explained that mandating these standards would give NFSI control over current and future devices to measure DCOF and SCOF, as well as validation of such devices.

*Response 23:* Staff is aware of this concern, but has not investigated further.

#### K. Alternative Approaches to Enhancing Flooring Safety

*Comment 24:* Several commenters expressed disagreement with the petition proposal; however, they acknowledged that there might be some other ideas to pursue that could improve floor safety. Suggestions included the following:

- Outreach and education of consumers;

- Support ongoing research on tribometers and reference materials used in testing floor traction;
- The development of standards for designating slip resistant flooring and finishes;
- Supporting the dissemination of best practices, such as the use of floor mats at building entrances and guidance on maintaining floors properly to support floor safety; and
- Encourage improvements in flooring design, installation, and care to enhance safety.

*Response 24:* While not within scope of the 2018 petition, staff agrees that efforts to decrease injuries and deaths related to slips and falls are worthwhile and appreciates the commenters' suggestions. Staff has included a list of recommended activities to the Commission in this briefing package.