This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: F3539 – 22

Standard Practice for Creation of Walkway Tribometer Interlaboratory Study Reports and Test Procedures[1]

This standard is issued under the fixed designation F3539; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers creation of interlaboratory study reports and test procedures for the use of portable walkway tribometers for obtaining walkway surface friction measurements.

1.2 This practice does not address the interpretation of data relative to pedestrian safety.

1.3 This practice does not address the suitability of a walkway surface for a particular application.

1.4 This practice does not directly address the important issue of the frictional homogeneity and stability of reference materials and in-use walkway materials.

1.5 Conformance to this practice does not result in an ASTM Test Method.

1.6 Values stated in SI (metric) units are to be regarded as the standard. Values in parentheses are for information only.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F3132 Practice for Selection of Walkway Surfaces When Considering Pedestrian Safety

2.2 *Other Standards:*

EN 16165 Determination of Slip Resistance of Pedestrian Surfaces – Methods of Evaluation

ISO Guide 30 Reference materials Selected terms and definitions

ISO Guide 35 Reference materials Guidance for characterization and assessment of homogeneity and stability

3. Terminology

3.1 *Definitions:*

3.1.1 *accepted reference value, n*—a value that serves as an agreed-upon reference for comparison, and which is derived as: *(1)* a theoretical or established value, based on scientific principles, *(2)* an assigned or certified value, based on experimental work of some national or international organization, or *(3)* a consensus or certified value, based on collaborative experimental work under the auspices of a scientific or engineering group. **E177**

3.1.2 *available friction, n*—an inherent characteristic of a walkway surface that would result in measurable friction upon the attempted or actual sliding of another object across that surface; can only be measured using a method, apparatus and contaminant (if any) that have their own inherent influences on the measurement value itself. **F3132**

3.1.3 *bias, n*—the difference between the expectation of the test results and an accepted reference value. **E177**

3.1.4 *friction, n*—the resistance to sliding of one surface across another surface; may be evaluated through different methodologies and described using different terms. **F3132**

3.1.5 *precision, n*—the closeness of agreements between independent test results obtained under stipulated conditions. **E177**

3.1.6 *reference material, n*—material, sufficiently homogeneous and stable with respect to one or more specified properties, which has been established to be fit for its intended use in a measurement process. **ISO Guide 30**

[1] This practice is under the jurisdiction of ASTM Committee F13 on Pedestrian/Walkway Safety and Footwear and is the direct responsibility of Subcommittee F13.10 on Traction.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *coordinator, n*—an entity that produces the interlaboratory study report and test procedures required by this practice.

3.2.2 *field testing, n*—friction testing conducted on walkway materials in a non-laboratory setting.

3.2.3 *laboratory verification, n*—a coordinator-defined procedure for periodically confirming that a tribometer is performing according to defined specifications.

3.2.3.1 *Discussion*—The coordinator determines or approves the interval between verifications, and the entities that can complete the verification. Different terms may be used for the actual procedure.

3.2.4 *slider, n*—a mounted material on a walkway tribometer that comes into frictional contact with the surface being tested.

3.2.5 *user, n*—the operator of an individual tribometer.

3.2.6 *user verification, n*—the coordinator-defined procedure for a user to verify that their individual tribometer is performing and being operated within coordinator-defined parameters.

4. Summary of Practice

4.1 An understanding of a tribometer's *precision* and *bias* is useful in evaluating how test results compare to the results of others using different units of the same device. Precision can be determined using an interlaboratory study (ILS) conducted in accordance with Practice E691; when an *accepted reference value* exists for a reference material, the *bias* of a test procedure or laboratory result can be evaluated. See Practices E177 and E691 for discussions of these terms and topics. Evaluating the comparability of ILS results to subsequent friction testing, whether in the laboratory or field, is more straightforward when *(1)* the ILS test procedure and apparatus details are thoroughly documented, and *(2)* the ILS is conducted in a manner consistent with a *coordinator*-published test procedure. This practice provides a formalized framework for:

4.1.1 Preparation of a *coordinator*-published ILS report that documents apparatus configuration details, apparatus sourcing details, test procedure, raw data, and results from that study; and

4.1.2 Preparation of a *coordinator*-published test procedure suitable for field testing with sufficient detail to facilitate direct comparison of such testing with ILS results.

5. Significance and Use

5.1 The test procedures and interlaboratory study report that result from *coordinator* compliance with this Practice are intended to include all information required for an ASTM Test Method and its associated Research Report; the interlaboratory study is to be conducted in compliance with Practice E691, also as required for an ASTM Test Method.[3] The reason that the content of this Practice is not prepared as an actual ASTM Test Method is as follows. ASTM regulations preclude reference (in a Standard) to patented or otherwise proprietary test apparatus where "alternatives exist".[4] While a proprietary apparatus may be mentioned in the Test Method's Research Report, this would prevent the Test Method from being a standalone document containing all information necessary for testing. As such, a standalone Test Method could only be for a non-proprietary apparatus design, with this design expressed in terms of physical characteristics and performance specifications sufficient to enable the reader to fabricate their own "identical" copy of the design. Further, to achieve consensus approval and publication of such a Test Method, it could be considered necessary that ILS results for this design include data from devices made by different entities. However, typical walkway tribometer designs (versus other types of test apparatus) are sufficiently complex that full documentation of all performance-affecting physical characteristics (sufficient that a reader could build one) may be impractical. European standard EN 16165 Annexes C and D illustrate what physical and performance characteristics are and are not documented in that standard's specifications for two non-proprietary tribometers. In general, each different tribometer design may have advantages and disadvantages for testing different surfaces, and this Practice provides a rigorous and standardized structure for creating tribometer test procedures and interlaboratory study reports that would comply with the requirements for ASTM Test Methods, were it practical to create such test methods. It is recognized that a *coordinator's* claim of compliance with this practice should be evaluated by the user, as formal consensus approval of the *coordinator's* outputs will not have occurred.

5.2 If compliance with this practice is claimed by a *coordinator*, all steps in Section 6 shall have been followed.

5.3 The *user* can benefit from ILS reports and test procedures prepared in compliance with this standard, as there are potentially ~150 different elements (in Annex A1) of apparatus and methodological specifics, and it is important to note that the burden for specifying this information rests with the *coordinator*, not the *user*. The information will be there for the *user* if they want it.

5.4 Precision statistics obtained in an ILS conducted on a single sample of a particular reference material will not capture the frictional variability that exists between different samples of that same reference material. The ILS test procedure may not capture the frictional variability that exists within a single sample of that reference material. The ILS test procedure will not evaluate the stability of the frictional characteristics of a reference material with repeated use over time. While outside the scope of this practice, the homogeneity and stability of reference materials are relevant to the interpretation and utilization of ILS results. Refer to ISO Guide 35 for a discussion of these topics.

5.5 Friction measurements represent characteristics of a surface at the time of testing; the available friction of the surface after use may change significantly. As with reference

[3] Refer to *Form and Style for ASTM Standards* Section A21.2.2.

[4] Refer to *Regulations Governing ASTM Technical Committees* Section 15.

materials, the measured friction of one sample of a manufactured walkway surface may not represent the friction of other samples of the same product.

5.6 Obtaining test results is one part of a multi-part process of determining whether the available friction of an underfoot surface is adequate. Appendix X1 outlines a set of standards the F13.10 subcommittee intends to develop towards this goal.

6. Procedure

6.1 The *coordinator* shall conduct an ILS for a single tribometer model/configuration in accordance with Practice E691, subject to the following requirements:

6.1.1 No individual tribometer unit, individual slider unit, or operator shall contribute to more than one laboratory's data.

6.1.2 An ILS report shall be published (via the *coordinator's* website or similar) that documents the following information:

6.1.2.1 ILS General Information per A1.1.

6.1.2.2 Tribometer Information per A1.2.

6.1.2.3 ILS Reference Material Information per A1.3.

6.1.2.4 Cleaning Supplies for ILS Reference Materials per A1.4.

6.1.2.5 Contaminant Information per A1.5.

6.1.2.6 Friction Test Procedure for ILS per A1.6. If a written test procedure was provided to operators, include it in the ILS report.

6.1.2.7 Data Conversion Instructions per A1.7.

6.1.2.8 A tabulation of all test observations, sorted by laboratory and by test order. This may be omitted if no conversion is needed between test observations and test results. Data shall not be identifiable as to the laboratory that obtained it.

6.1.2.9 A tabulation of all test results, sorted by laboratory and by test order. Data shall not be identifiable as to the laboratory that obtained it.

6.1.2.10 A tabulation of the Practice E691 Section 15-derived cell average, repeatability standard deviation, reproducibility standard deviation, repeatability limit, and reproducibility limit for each ILS reference material.

6.1.2.11 A tabulation of the Practice E691 Section 15-derived *h* and *k* consistency statistics for each ILS reference material, for each laboratory.

6.2 A test procedure shall be published (via the *coordinator's* website or similar) that documents the following information:

6.2.1 The date of publication or other revision designator for the test procedure.

6.2.2 Tribometer Information per A1.2.

6.2.3 Contaminant Information per A1.5.

6.2.4 General Information for Field Testing per A1.8.

6.2.5 Reference Material Information for Use in *User Verification* per A1.9.

6.2.6 Cleaning Supplies for *User Verification* Reference Material(s) per A1.10.

6.2.7 Friction Test Procedure for *User Verification* per A1.11.

6.2.8 Friction Test Procedure for *Field Testing* per A1.12.

6.2.9 Data Conversion Instructions per A1.7.

6.2.10 *ILS information:*

6.2.10.1 A description of the ILS documented in 6.1, to include ILS date(s), number of laboratories, a brief description of the ILS reference materials, slider frictional material, and contaminant(s), and information on obtaining the full ILS report.

6.2.10.2 A tabulation of the Practice E691 Section 15-derived cell average, repeatability standard deviation, reproducibility standard deviation, repeatability limit, and reproducibility limit for each ILS reference material.

6.2.10.3 A reference pointing the reader to Practice E177 or Practice E691 for definitions of cell average, repeatability standard deviation, reproducibility standard deviation, repeatability limit, and reproducibility limit.

7. Keywords

7.1 coefficient of friction; COF; pedestrian; slip resistant; tribometer; walkway

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ANNEX

(Mandatory Information)

A1. APPARATUS AND METHODOLOGICAL DETAILS (UNLESS INAPPLICABLE)

A1.1 ILS General Information

A1.1.1 Date or date range of ILS.

A1.1.2 Operator name and contact information for each laboratory.

A1.1.3 ILS ambient temperature/humidity range.

A1.1.4 Serial numbers of tribometers used in ILS.

A1.1.5 Serial numbers of sliders used in ILS.

A1.1.6 Number of valid lab data sets (see Practice E691 Sections 17 - 19).

A1.2 Tribometer Information

A1.2.1 Tribometer supplier:

A1.2.1.1 Mailing address.

A1.2.1.2 Phone numbers.

A1.2.1.3 Website.

A1.2.2 Tribometer model (unique):

A1.2.2.1 Slider (complete) part identifier.

A1.2.2.2 Serial numbering method for each slider.

A1.2.3 Tribometer energy source consumables – description:

A1.2.3.1 Supplier and website.
A1.2.3.2 Supplier part identifier.

A1.2.4 Tribometer energy source setting range.

A1.2.5 Slider frictional material – description:
A1.2.5.1 Supplier and website.
A1.2.5.2 Supplier part identifier.
A1.2.5.3 Overall dimensions of frictional material (mm).
A1.2.5.4 Contact surface feature (for example, grooving) dimensions.

A1.2.6 Slider resurfacing tools (not consumables) – description:
A1.2.6.1 Supplier and website.
A1.2.6.2 Supplier part identifier.

A1.2.7 Slider resurfacing consumables – description:
A1.2.7.1 Supplier and website.
A1.2.7.2 Supplier part identifier.

A1.2.8 Slider cleaning materials – description:
A1.2.8.1 Supplier and website.
A1.2.8.2 Supplier part identifier.

A1.2.9 Instructions for actuating tribometer to obtain a test observation.

A1.3 ILS Reference Material Information (for each material used)

A1.3.1 Reference material description:
A1.3.1.1 Material and finish (bare substrate).
A1.3.1.2 Supplier and website.
A1.3.1.3 Supplier part identifier.
A1.3.1.4 Date obtained.
A1.3.1.5 Quantity used in ILS.
A1.3.1.6 Lot/batch/serial number for each material used in ILS.
A1.3.1.7 One of the following statements:
(1) A citation to specific documentation of the homogeneity and stability of the reference material.
(2) A statement that the homogeneity and stability of the reference material has not been documented.
A1.3.1.8 Reference material supplemental coating/finish:
(1) Supplier and website.
(2) Supplier part identifier.
(3) Application instructions used for ILS materials.

A1.4 Cleaning Supplies for ILS Reference Materials (for each cleaner used)

A1.4.1 Cleaner solute (or solution if sold premixed):
A1.4.1.1 Supplier and website.
A1.4.1.2 Supplier part identifier.

A1.4.2 Cleaner solvent:
A1.4.2.1 Supplier and website.
A1.4.2.2 Supplier part identifier.
A1.4.2.3 Mixing proportions.

A1.4.3 Cleaner application tools:
A1.4.3.1 Supplier and website.
A1.4.3.2 Supplier part identifier.

A1.5 Contaminant Information (for each contaminant used)

A1.5.1 Contaminant solute name:
A1.5.1.1 Supplier and website.
A1.5.1.2 Supplier part identifier.

A1.5.2 Contaminant solvent name:
A1.5.2.1 Supplier and website.
A1.5.2.2 Supplier part identifier.
A1.5.2.3 Mixing proportions.

A1.5.3 Contaminant application tools:
A1.5.3.1 Supplier and website.
A1.5.3.2 Supplier part identifier.

A1.6 Friction Test Procedure for ILS

A1.6.1 Reference material cleaning method.

A1.6.2 Reference material cleaning frequency.

A1.6.3 Method for slider cleaning.

A1.6.4 Slider resurfacing method (for example, sanding).

A1.6.5 Slider resurfacing frequency (for example, number of slips).

A1.6.6 Slider post-resurfacing/pre-testing "break-in" procedure.

A1.6.7 Contaminant application instructions.

A1.6.8 Test position(s) on reference tiles (with dimensions if not centered).

A1.6.9 Test direction(s) on reference tiles (initial and rotation degrees).

A1.6.10 Number of test observations in each direction.

A1.7 Data Conversion Instructions

A1.7.1 Instructions for converting a test observation (or observations) into a test result.

A1.7.2 Instructions for converting measurements obtained on sloped surfaces.

A1.8 General Information for Field Testing

A1.8.1 Tribometer serial number range that test procedure applies to.

A1.8.2 Tribometer storage requirements if not indoor climate controlled.

A1.8.3 Allowable temperature and humidity ranges for use.

A1.8.4 Tribometer maintenance required of *user*.

A1.8.5 Recommendations for and frequency of *laboratory verification*.

A1.8.6 Recommendations for and frequency of *user verification*.

A1.8.7 Information on the useful life of apparatus:
A1.8.7.1 Slider useful life.
A1.8.7.2 Contaminant(s) useful life.
A1.8.7.3 Cleaner useful life.

A1.8.8 Maximum slope allowable for friction testing.

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