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An American National Standard

Standard Guide for Development of Fire-Risk-Assessment Standards[1]

This standard is issued under the fixed designation E1776; 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 guide covers the development of fire-risk-assessment standards.

1.2 This guide is directed toward development of standards that will provide procedures for assessing fire risks harmful to people, property, or the environment.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This ~~fire standard~~ standard is used to establish a means of combining the potential for harm in fire scenarios with the probabilities of occurrence of those scenarios. Assessment of fire risk using this standard depends upon many factors, including the manner in which the user selects scenarios and uses them to represent all scenarios relevant to the application. This standard cannot be used to ~~provide quantitative measures.~~assess fire risk if any specifications are different from those contained in the standard.*

1.5 This fire standard cannot be used to provide quantitative measures.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E176 Terminology of Fire Standards

E1546 Guide for Development of Fire-Hazard-Assessment Standards

2.2 *Other Documents:*

SFPE Engineering Guide to Performance-Based Fire Protection, Society of Fire Protection Engineers and NFPA, Quincy, MA, 2000[3]

ISO 13943 Fire Safety – Vocabulary[4]

3. Terminology

3.1 *Definitions*—See E176, Terminology of Fire Standards and ISO 13943, Fire Safety – Vocabulary. In case of conflict, the definitions in Terminology E176 shall prevailE176.

4. Significance and Use

4.1 This guide is intended for use by those undertaking the development of fire-risk-assessment standards. Such standards are expected to be useful to manufacturers, architects, specification writers, and authorities having jurisdiction.

4.2 As a guide, this document provides information on an approach to the development of a fire-risk-assessment standard; fixed procedures are not established. Limitations of data, available tests and models, and scientific knowledge can constitute significant constraints on the fire-risk-assessment procedure and associated standard.

4.3 While the focus of this guide is on developing fire-risk-assessment standards for products, the general concepts presented also can be applied to processes, activities, occupancies, and buildings.

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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.

[3] Available from NFPA, 1 Batterymarch Park, Quincy, MA 02169–7471.

[4] Available from International Organization for Standardization (ISO), 1 rue de Varembé, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.

5. Key Elements

5.1 This guide uses as its key elements the following:

5.1.1 The purpose of a fire-risk-assessment standard is to provide a standardized procedure for assembling a compilation of information relevant to the fire risk of a product under specific conditions of use.

5.1.2 The information assembled shall be relevant to the purpose of assessing the fire risk of the specific designated product within the range of all relevant fire scenarios.

5.1.3 The information assembled shall be explicit and quantitative. It shall provide a sufficiently thorough examination of the product's fire risk under the conditions defined by the scope of the specific standard so as to permit valid choices and decisions with respect to the fire risk of that product.

5.1.4 A persuasive scientific case must be made in the documentation of a specific fire-risk-assessment standard that the procedures, data, and risk measures specified by the standard will address questions about a product's fire risk with sufficient accuracy and validity that a more thorough assessment procedure would not materially alter any decisions that are to be made based on the standard. If such a case cannot be made for all products to be addressed, then the risk assessment shall specify those conditions under which a more thorough fire-risk-assessment procedure is to be used.

5.1.5 The absence of a data source, test method, or calculation procedure of sufficient scope and proven validity to support the needs of a particular fire-risk-assessment procedure does not, by itself, provide a sufficient justification for the use of a data source, test method, or calculation procedure of lesser scope or unproven validity. It is recognized that fire-risk assessments of such products may need to be performed in any event, using relevant nonstandardized procedures. When such nonstandardized or unvalidated procedures are used, the details shall be included to such an extent that the procedures become standardized only for use within the specified fire-risk-assessment procedure through final publication of the fire-risk-assessment standard document.

5.1.6 Among the possible significant outcomes of a fire-risk assessment are a revelation that a product produces either an increase, no increase, or a decrease in fire risk on some or all risk measures and for all or some of the scenarios specified by the standard relative to another product or relative to baseline risk values for those measures and scenarios. These baseline values may or may not be derived from fire-risk assessment of products already in use. However, when the product is proposed for an existing use, the appropriate baseline for comparison is existing products having the same use. For example, if a product's risk is uniformly rated greater than the reference values on all comparisons specified by the standard, then the overall fire-risk assessment of the product will be greater than the fire risk of the baseline (or product in use).

5.1.7 If the assessment shows that the product is not uniformly rated higher than, equivalent to, or less than the other product(s) or the baseline for all risk measures, and reflecting all scenarios specified by the standard, then the implications of the fire risk assessment for product evaluation will not be clear without the development of appropriate decision rules. Such rules would determine the overall risk, giving appropriate weighting to each risk measure.

6. Relationship Between Fire Hazard and Fire Risk

6.1 It is important to differentiate between *fire hazard* and *fire risk*. The relationship is as follows:

6.1.1 A fire-hazard measure addresses the expected performance of a product for a particular fire scenario, including designated conditions of use. A fire-risk measure incorporates fire-hazard measures but also incorporates the probability of occurrence of each fire scenario and addresses all relevant fire scenarios.

6.1.2 Because the number of distinguishable relevant fire scenarios in any fire-risk assessment is usually unmanageably large, it will normally be necessary for fire scenarios to be grouped into classes for purposes of analysis. This may make the fire-risk assessment less product-specific or less specific to conditions of use than would be true of a fire-hazard assessment.

6.1.3 Some existing fire-risk-assessment models and calculation procedures define fire risk as the sum over all fire scenario classes of the probability-weighted fire hazard for that fire scenario class. In such an approach:

6.1.3.1 The fire scenarios in each fire scenario class shall be very similar with respect to those characteristics that determine fire hazard.

6.1.3.2 Each fire scenario class will have a probability (P_i) that represents the likelihood of a fire corresponding to a scenario in that class.

6.1.3.3 For each fire scenario class, a specific fire scenario shall be chosen as representative of the class, so that the fire hazard for that specific fire scenario can be used as a valid estimate of H_i, the fire hazard of the fire scenario class. This is defined as the probability-weighted mean fire hazard for all the specific fire scenarios in the fire scenario class, a quantity that cannot be directly calculated.

6.1.3.4 If this structure is adopted, then the relationship between fire risk measure and fire hazard measure is given by the following formula:

$$Risk = \sum_i (P_i \times H_i) \tag{1}$$

where:

H_i = hazard for representative scenario of scenario class i,i = 1, ..., n and
P_i = probability of scenario class i,i = 1, ..., n.

6.1.4 For a fire-risk-assessment standard, this formula shows that a fire-risk-assessment procedure may be constructed from a fire-hazard-assessment procedure, a valid structure of fire scenario class and representative fire scenarios by class, and valid sources for fire scenario class probability data.

7. Fire Risk-Assessment Standards

7.1 Fire-risk-assessment standards shall conform in style and content to the *ASTM Form and Style Manual*[5].

7.2 Fire-risk-assessment standards shall include sections entitled: Scope, Significance and Use, Terminology, and Procedure. The sections shall be numbered and arranged in that order.

7.2.1 *Scope*—The statement in the Scope should clearly state:

7.2.1.1 The product or class of products of interest,

7.2.1.2 The fire scenario classes and representative fire scenarios included in the standard,

7.2.1.3 The assumptions used in the standard,

7.2.1.4 The structure of the fire-risk-assessment procedure, including test methods, models, other calculation procedures, data sources, fire hazard measures, fire risk measures, and any other evaluation criteria or procedures used, and

7.2.1.5 Any limitations on the application of the standard, such as the manner, form, or orientation in which the product is incorporated within an assembly, geometric restrictions essential to use of the product, the quantity of product in use, the end use of the product, and the type of occupancy to which the standard is applicable.

7.2.2 *Significance and Use:*

7.2.2.1 The major uses and any limitations of the standard fire-risk-assessment procedure should be clearly described, including an explicit description of the extent to which the included fire scenario classes and representative fire scenarios, in 7.2.1.2, constitute all the relevant fire scenario classes and representative fire scenarios for the product (class) and occupancy type addressed by the standard.

7.2.2.2 The significance of the assessment to users shall be clearly stated.

7.2.3 *Terminology*—Terms unique to the fire-risk-assessment standard shall be clearly defined. Standard terms as defined in Terminology E176 shall be used.

7.2.4 *Procedure:*

7.2.4.1 This section shall include detailed descriptions of the fire-risk-assessment procedure and its component parts, including test methods, calculation procedures, scenario description, data sources, and evaluation criteria or procedures.

7.2.4.2 Where sources for data on fire experience or expert judgment are cited, the procedures for assembling the data and the accuracy, precision, and reliability of the data shall be documented. The data shall be accessible to personnel conducting or reviewing the fire-risk assessment.

7.2.4.3 If calculation procedures include models, the versions used shall be carefully identified and referenced, and major assumptions and limitations of the models shall be noted. Validation information, or lack thereof, shall also be noted.

7.2.4.4 If calculation procedures are used, it will be especially helpful if sample calculations are included.

7.2.4.5 Standard test methods shall be carefully identified and referenced. If a test method not yet adopted as a national standard is used, its descriptions shall provide all the information that would be included if it were being submitted separately for consideration as a standard test method. Data on reproducibility and validation of nonstandardized methods shall be included or its unavailability shall be explicitly noted. Engineering Guide to Performance-Based Fire Protection, Society of Fire Protection Engineers and NFPA, Quinc. If a standard test method has been modified for the standard, all details of the modification and evidence of the effects of the modification on results shall be included. These guidelines also apply to any large-scale test protocols.

8. Fire-Risk-Assessment Procedure

8.1 *Overview of Elements of Fire Risk:*

8.1.1 Possible sources of harm to people, directly or indirectly, include toxic (narcotic or irritant) substances produced by a fire, thermal insults (heat stress and burns) due to convected and radiant flux, obscuration of vision by smoke (which may interfere with the ability to escape), oxygen depletion, and structural damage leading to traumatic injury.

8.1.2 Possible sources of harm to property include direct damage to contents, furnishings, structure, or other installed or moveable combustibles, from heat, corrosive smoke, soot or firefighting, and indirect damage as a consequence of business interruption or other adverse effects on the ability of the property to be used for its designed purposes.

8.1.3 Harm to the environment includes direct harm to animals or plant life located outside the property of origin, and indirect harm to people, animals, plant life, or property as a result of contamination of air, water, or adjacent land.

8.1.4 The fire risk of a product depends on its properties, how it is used, and the context in which it is used, including the number and characteristics of people potentially exposed and the value and fragility of property exposed to a fire involving the product. Therefore, a fire-risk-assessment procedure for a particular product should describe the product, how it is used, and its context of use.

[5] Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.