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AnAmerican National Standard

Standard Guide for Development of Fire Hazard Assessment Standards of Electrotechnical Products[1]

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1. Scope*

1.1 This guide provides guidance on the development of fire hazard assessment standards for electrotechnical products. For the purposes of this guide, products include materials, components, and end-use products.

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

1.3 *This fire standard cannot be used to provide quantitative measures.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1711 Terminology Relating to Electrical Insulation

E176 Terminology of Fire Standards

E603 Guide for Room Fire Experiments

E1546 Guide for Development of Fire-Hazard-Assessment Standards

E2061 Guide for Fire Hazard Assessment of Rail Transportation Vehicles

E2067 Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests

2.2 *NFPA Codes and Standards:*[3]

NFPA 555 Guide on Methods for Decreasing the Probability of Flashover

NFPA 901 Uniform Coding for Fire Protection

2.3 *International Electrotechnical Commission (IEC) Standards:*[4]

IEC 60695-1-1 Fire Hazard Testing - Part 1-1: Guidance for assessing the fire hazard of electrotechnical products - General guidelines

2.4 *International Organization for Standardization (ISO) Standards:*[5]

ISO 13943 Fire Safety: Vocabulary

3. Terminology

3.1 Use Terminology E176, ISO 13943, and IEC 60695-1–1, ed. 3, 1999–11 as the guides for terminology on fire issues (see 5.1). Where differences exist in definitions, use those contained in Terminology E176.

3.1.1 Terminology D1711 should be used as the guide for terminology on issues associated with electrical or electronic insulating materials.

3.2 Use Terminology D1711 as the guide for terminology on issues associated with electrical and electronic insulating materials.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *electrotechnical product, n*—item that generates or uses electrical power as a source of energy or that is associated with the conduction or transmission of electrical signals or power.

3.3.1.1 *Discussion*—Electrotechnical products include the materials insulating electrical wires and cables and the materials enclosing other products that generate or are fed by electricity, as well as the products themselves and all of their parts.

3.3.2 *fire scenario, n*—a detailed description of conditions, including environmental, of one or more of the stages from

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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 National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

[4] Available from International Electrotechnical Commission (IEC), 3 rue de Varembé, Case postale 131, CH-1211, Geneva 20, Switzerland, http://www.iec.ch.

[5] Available from International Organization for Standardization, P.O. Box 56, CH-1211, Geneva 20, Switzerland or from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

***A Summary of Changes section appears at the end of this standard**

before ignition to the completion of combustion in an actual fire at specific location, or in a full-scale simulation.

3.3.3 *products, n*—material, component, or end-use product.

4. Significance and Use

4.1 This guide is intended for use by those undertaking the development of fire hazard assessment standards for electrotechnical products. 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 hazard assessment standard; fixed procedures are not established. Any limitations in the availability of data, of appropriate test procedures, of adequate fire models, or in the advancement of scientific knowledge will place significant constraints upon the procedure for the assessment of fire hazard.

4.3 The focus of this guide is on fire assessment standards for electrotechnical products. However, insofar as the concepts in this guide are consistent with those of Guide E1546, the general concepts presented also may be applicable to processes, activities, occupancies, and buildings. Guide E2061 contains an example of how to use information on fire-test-response characteristics of electrotechnical products (electric cables) in a fire hazard assessment for a specific occupancy (rail transportation vehicle).

4.4 A standard developed following this guide should not attempt to set a safety threshold or other pass/fail criteria. Such a standard should specify all steps required to determine fire hazard measures for which safety thresholds or pass/fail criteria can be meaningfully set by authorities having jurisdiction.

5. General Concepts

5.1 It is important to understand and maintain the differences between fire hazard and fire risk.

5.1.1 Fire hazard is defined in Terminology E176 as:

5.1.1.1 *fire hazard, n*—the potential for harm associated with fire.

5.1.1.1.1 *Discussion*—A fire may pose one or more types of hazard to people, animals, or property. These hazards are associated with the environment and with a number of fire test response characteristics of materials, products, or assemblies including, but not limited to, ease of ignition, flame spread, rate of heat release, smoke generation and obscuration, toxicity of combustion products and ease of extinguishment.

5.1.2 Fire hazard is defined in IEC 60695-1–1, ed. 3, 1999–11 as:

5.1.2.1 *fire hazard, n*—the possible danger of personal injury or damage to property by fire.

5.1.3 Fire risk is defined in Terminology E176 as:

5.1.3.1 *fire risk, n*—an estimation of expected fire loss that combines the potential for harm in various fire scenarios that can occur with the probabilities of occurrence of those scenarios.

5.1.3.1.1 *Discussion*—Risk may be defined as the probability of having a certain type of fire, where the type of fire may be defined in whole or in part by the degree of potential harm associated with it or as potential for harm weighted by associated probabilities. However it is defined, no risk scale implies a single value of acceptable risk. Different individuals presented with the same risk situation may have different opinions on its acceptability.

5.1.4 Fire risk is defined in IEC 60695-1–1, ed. 3, 1999–11 as:

5.1.4.1 *fire risk, n*—the probability of fire.

5.1.4.1.1 *Discussion*—The risk is described in terms of probability, combining the frequency of occurrence of an undesired event to be expected in a given technical operation or state, and the extent of damage to be expected on the occurrence of the event.

5.2 The primary concern in the fire hazard assessment of electrotechnical products is to minimize the fire hazard resulting when such products ignite. Should a fire start, it is then desirable to limit the fire propagation. Give consideration to external events, such as the outbreak of a fire in the environment. In general, however, disregard deliberate misuse of an electrotechnical product, in the fire hazard assessment.

5.3 Give consideration also to heat release (both rate and amount) and opacity, toxicity and corrosivity of the smoke from a burning product and any necessary ability to function under fire conditions. These hazards are directly related to the ignition and fire propagation. The emission of gases may also, under certain circumstances, lead to the possibility of explosion.

5.4 Certain electrotechnical products such as large enclosures, insulated cables, and conduits, may in fact replace large portions of surfaces and finishing materials of building construction or may penetrate fire-resisting walls. In these circumstances, the requirements for fire performance of the electrotechnical products, when exposed to an external fire, must ensure that they do not contribute to the hazard of fire to a greater degree than is permitted by the building materials or structures that are replaced.

5.5 Following a detailed review of all of the expected hazards as related to a specific fire scenario, the final hazard assessment standards, as drafted, should include a series of tests or a single test, as appropriate, to address the specific hazard(s) defined. Single test standards are acceptable if they address the major hazard(s) defined or are interrelated to the various components involved.

5.6 In order to design electrotechnical products with acceptable characteristics for minimizing fire hazard, pay careful attention to the permissible mechanical, electrical and thermal stresses. This should minimize the fire hazard under all conditions of use: normal operation, foreseeable deviations from normal use and faulty operation conditions. The desired level of fire hazard is achievable by the procedures in 5.6.1-5.6.3:

5.6.1 The use of parts or circuit design and protection, or both, which, under overload or failure, are not likely to ignite or to cause ignition;

5.6.2 The use of parts, including enclosures, which are sufficiently resistant to probable ignition sources and heat within an electrotechnical product; or,

5.6.3 The use of designs that will adequately resist the propagation of fire spread and surface spread by fire.

6. Types of Fire Tests

6.1 Technical committees engaged in the preparation of requirements and test specifications with regard to fire involving electrotechnical products should recognize the following types of tests:

6.1.1 *Fire Simulation Tests:*

6.1.1.1 These tests examine the reaction to fire of electrotechnical products, in a way as representative as possible of the use of the product in practice.

6.1.1.2 When the actual conditions of use (including foreseeable abnormal use, malfunction, or failure) of a product are simulated as closely as possible, and the design of the test procedure is related to the actual fire hazard, such tests are likely to assess one or more relevant aspects of the fire hazard associated with the use of the product under consideration in a specific scenario. The results of this type of test are thus well suited for use as elements of a fire hazard assessment that takes into account all the factors pertinent to an assessment of the fire hazard of the electrotechnical product in a particular end use.

6.1.1.3 Do not use the results of fire simulation tests for fire hazard assessment when a change of product design is made, or when conditions of use are changed from those simulated in the test.

6.1.1.4 Since such tests are designed specifically for a detailed fire scenario, they often do not become test standards.

6.1.2 *Fire Resistance Tests:*

6.1.2.1 These tests are intended to assess the ability of an electrotechnical product, or one of its parts, to preserve the various properties necessary for its use, under specified conditions of exposure to fire and for a stated period of time. In other words, these tests measure continuity of operation.

6.1.2.2 They are intended to provide data on the electrical behavior and performance of an electrotechnical product, or finished assembly, under a particular condition of exposure to heat or flame.

6.1.2.3 Recent studies show a need for very careful consideration of the test conditions and comparison with the actual fire situation and to the possible effect of any uncontrolled variables, such as the environment in which the product is placed.

6.1.2.4 It is unlikely that the results of fire resistance tests are directly applicable to fire hazard assessment of the corresponding electrotechnical product.

6.1.3 *Combustion Characteristic Tests :*

6.1.3.1 These tests examine the reaction to fire of small standardized specimens under controlled conditions. These tests are used to give data on properties related to the burning behavior of the materials, components or end-use products tested. They are also useful for comparative evaluations. The fire properties measured include, but are not limited to, flammability, ignitability, flame spread rate, smoke density, fire effluent generation, and heat release rate. Examples of such tests include the application of a number of fire-test-response standards to electrotechnical products.

6.1.3.2 The data provided by such tests are usually not representative of fire performance under conditions other than those to which the specimen is subjected. Combustion characteristic tests are most useful when designed to simulate as closely as possible the situation to which materials, components, or end-use products may be exposed in actual use. They may then lead to the proper selection of materials, components, and end-use products, which will meet the appropriate requirement when testing the complete product.

6.1.3.3 These tests measure responses of electrotechnical materials, components, or end-use products to heat or flame under controlled laboratory conditions. They are a step further away from real fire conditions when compared to fire simulation tests. However, when done appropriately, results from these tests, in combination with those from other tests, may be useful as elements of the fire hazard assessment of an electrotechnical product in a particular end use once all the pertinent factors are taken into account.

6.1.4 *"Basic Property" Tests:*

6.1.4.1 These tests are designed to measure one basic physical or chemical property of a material. They yield information that is, at least to some extent, independent of the testing method. Some examples of such properties are: heat of combustion, heat of vaporization, thermal conductivity, or melting point.

6.1.4.2 In a real fire situation, a number of such properties collectively affect the fire behavior of the electrotechnical product. However, a single basic property measurement will, at most, define only a single aspect of the fire hazard associated with a system. Thus, it is unlikely that the results of these basic property tests are useful elements of a fire hazard assessment.

6.1.4.3 However, eventually, after fire safety engineering develops a firmer technical base, the hope is that the results of combustion characteristic tests may be used to assess a wide range of fire safety situations.

7. Fire Hazard Assessment Standards

7.1 Fire hazard assessment standards are to conform in style and content with *Form and Style for ASTM Standards* .[6]

7.2 Fire hazard assessment standards are to include sections labeled Scope, Terminology, Significance and Use, and Procedure, numbered and arranged in that order.

7.3 *Scope:*

7.3.1 State clearly in the Scope:

7.3.1.1 The product or class of products of interest,

7.3.1.2 The fire scenario(s) included in the standard,

7.3.1.3 The assumptions used in the standard,

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

[6] *Form and Style for ASTM Standards*, 9th Edition, Nov. 1994, Available from ASTM International Headquarters, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.