Designation: E3082 – 20

An American National Standard

Standard Test Methods for Determining the Effectiveness of Fire Retardant Treatments for Natural Christmas Trees[1]

This standard is issued under the fixed designation E3082; 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 fire-test-response standard provides a two-step testing process for determining the effectiveness of surface applied treatments for natural Christmas trees to improve fire test response. In order for a treatment to be considered compliant with this standard, the Conditions of Acceptance of both Methods 1 and 2 are to be met.

1.2 The purpose of these test methods is to:

1.2.1 Utilize a detached branch test (Method 1) to screen potential surface-applied fire retardant products and to determine their effectiveness in limiting the spread of flame and the continuation of flaming by comparing the burning characteristics of treated and untreated small Christmas tree branches subjected to a small open Bunsen-burner type flame ignition source, and

1.2.2 Use whole natural Christmas trees (Method 2) to determine the effectiveness of surface applied fire retardants found to be effective in the detached branch test (Method 1) through comparison of heat release rate contribution of treated trees as compared to untreated trees when subjected to an open flame ignition source.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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.*

1.5 Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.

1.6 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.7 *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]

E176 Terminology of Fire Standards

D1835 Specification for Liquefied Petroleum (LP) Gases

D5025 Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials

E2067 Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests

2.2 *California Regulations:*[3]

California Code of Regulations, Title 19, Chapter 8, Article 3 Registration and Labeling of Chemicals

2.3 *NFPA Standards:*[4]

NFPA 1 Fire Code

NFPA 289 Standard Method of Fire Test for Individual Fuel Packages

2.4 *UL Standards:*[5]

UL 1975 Standard for Fire Tests for Foamed Plastics Used for Decorative Purposes

UL 2358 Outline for Fire Tests of Pre-lit Artificial Seasonal Use Trees and Other Seasonal Decorative Items

2.5 *Gas Processors Association Standard:*[6]

GPA 2140 Liquefied Petroleum Gas Specifications and Test Method

[1] These test methods are under the jurisdiction of ASTM Committee E05 on Fire Standards and are the direct responsibility of Subcommittee E05.15 on Furnishings and Contents.

Current edition approved March 15, 2020. Published April 2020. Originally approved in 2017. Last previous edition approved in 2017 as E3082–17ε1. DOI: 10.1520/E3082-20.

[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 State of California Department of Industrial Relations.

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

[5] Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, http://www.ul.com.

[6] Available from Gas Processors Association (GPA), 66 American Plaza, Suite 700, Tulsa, OK 74135, http://www.gpaglobal.org.

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

3. Terminology

3.1 *Definitions*—For definitions of terms used in these test methods refer to Terminology E176.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *distal end*—the apex or tip of the tree branch.

3.2.2 *Christmas trees—for the purpose of this standard*, a natural tree product intended to be decorated or displayed in a manner associated with the Christmas, or other holiday season of the year.

4. Significance and Use

4.1 In past research experiments, some surface applied fire retardant chemicals improved the fire performance characteristics of natural Christmas trees, whereas other retardants were not effective, or adversely affected tree quality or burning characteristics. These methods are intended to provide a two-step process to determine the effectiveness of surface applied treatments to natural Christmas trees.

4.2 The fire performance of natural trees is highly variable and varies from species to species. Test results from these methods do not intend to provide data for judgment on the absolute fire performance of any natural or treated natural tree, but rather provide a means for comparing the fire performance of treated versus untreated trees.

4.3 These test methods do not take into account the influence of decorations that are added to the tree.

4.4 For Test Method 1, only Fraser fir [*Abies fraseri* (Pursh) Poi.] trees are tested. Although this is one of the most commonly used Christmas trees in the United States, it is possible that results for other tree species will differ from the results for this species.

4.5 For Test Method 2, Large Scale Fire Test, it is important that the treated and untreated tree specimens be evaluated consistently and as simultaneously as possible for adequate comparative results.

4.6 The performance of the treatment will vary depending on the uniformity of the application of the treatment. This quality of application is not determined by these test methods.

Method 1 – Small Scale Detached Branch Fire Tests

5. Test Method

5.1 *Test Specimens*—For each test, specimen branches shall be selected from five 8 to 15 ft (2.4 to 4.6 m) tall non-sheared Fraser fir [*Abies fraseri* (Pursh) Poir.] trees grown at a single location, during November or December. Trees shall be healthy, with no visible pest or disease problems. Branches shall have no cones nor evidence that cones were present. Nine 2-year-old specimen branches, each 18 to 24 in. (457 to 610 mm) long, and of similar diameter and foliage density, shall be cut from the distal ends of branches in the upper half of each tree specimen (Fig. 1). Bundle together branches from each tree, labeled to indicate the tree (1 to 5) they were harvested from, and place them in a 4 to 5 gal (15 to 19 L) plastic bucket containing sufficient water to cover the bases of the branches for transport to the conditioning room.

FIG. 1 Example of Open-grown Tree with a Circled Typical 2-yr-old Distal Branch Specimen

5.2 *Assignment of Branches to Specific Treatments*—Given that moisture content is the single most important factor relating to the flammability of conifer foliage, conduct the small scale branch fire test 1, 7, 14, and 21 days after treatment of branches to ensure that potential fire retardants are effective over a range of moisture contents. Assign a single branch from each tree randomly to each of the 8 treatment groups (Table 1 and 2). Place a small aluminum or paper tag on each branch, and label it with the assigned treatment codes. The use of color-coded tags, one color for each burn test schedule number will make it easier to identify groups of branches that need to be removed from the racks on any given testing date. Use the 9th branch from each tree to determine the initial moisture content of the specimens upon arrival of the branches at the conditioning room.

5.3 *Conditioning*—All specimen branches shall be stored in racks or hung from a wire in a well-lit room maintained at 70 ± 5°F (21 ± 3°C) and at a relative humidity of 45 ± 5 % (Fig. 2). Branches shall be spaced far enough apart so that they are not touching each other to promote uniform drying and to facilitate making assessments of the effects of the fire retardant or needle retention and quality. (See Note 1).

NOTE 1—If cone containers are used, it is recommended that they be spaced further apart than in the photo in Fig. 2.

TABLE 1 Fire Test Schedule

Fire Test Schedule Number	Days of Conditioning after Treatment	Number of Branches	
		Non-treated Control (NTC)	Treated (T)
1	1 day	5	5
2	7 days	5	5
3	14 days	5	5
4	21 days	5	5

FIG. 2 Example of Branches Displayed in Cone Containers

5.4 *Moisture Content*—The percent moisture content (MC) of each branch shall be determined as described in 5.4.1 just prior to the fire test. Determine the moisture content of specimens from a single branch from each tree as soon as feasible after arrival at the conditioning room to determine the initial MC of the branches (See Fig. 3).

5.4.1 Moisture content shall be determined by weighing a current-season shoot removed from each branch to the nearest 0.1 g. Place each shoot in a labeled paper envelope, staple the envelope closed, and dry all shoots for 3 days at 150 to 160°F (65 to 71°C). Determine the dry weight of each shoot by immediately weighing the dried shoot after removal of the envelope from the oven. The moisture content shall be calculated as follows:

$$MC = (Mass_{wet} - Mass_{dry})/(Mass_{dry}) \times 100 \quad (1)$$

where:

$Mass_{wet}$ = mass of the specimen before drying.
$Mass_{dry}$ = mass of the specimen after drying.

5.5 *Application of Treatment*—The treatment shall then be applied to the 20 "T" labeled branch specimens prior to set up in the conditioning room. Use colored flagging to tag all of the branches at the time of labeling in order to make it easier to identify the branches to be treated. The treatment shall be applied at the manufacturer's application rate and in accordance with the manufacturer's application instructions. Following treatment, all branches shall be stored in the conditioning environment described in 5.2 until the fire test.

5.6 *Burner*—A laboratory type burner having a tube with a length of 4 ± ¼ in. (102 ± 6.4 mm) and an inside diameter of ⅜ ± 1/16 in. (9.5 ± 1.6 mm). The barrel is to be open-ended. The burner wing tip shall have a slit 2 ± ¼ in. (51 ± 6.4 mm) in length by 0.05 in. ± 0.005 in. (1.3 ± 0.13 mm) width, for the burner. The burner shall be in compliance with Specification D5025.

FIG. 3 A 2-year-old Branch Specimen with Arrows Showing a Pair of Current-Season Shoots to be used for Moisture Content and Fire Tests

5.7 *Test Apparatus*—Arrange the gas burner, box, racks, ruler, and test specimen under a fume hood as shown in Fig. 4.

5.8 *Test Procedure:*

5.8.1 Following the conditioning, and prior to each fire test, note the condition of each branch to be tested (such as discoloration, significant needle loss, or the presence of stiff needles). If significant needle loss has occurred, such as several needles visibly falling off, the branch is not suitable for use in the fire test.

5.8.2 Arrange the gas burner such that the tip of the burner is ¾ in. (19 mm) below the level of the sheet metal box, with the air supply off, and gas adjusted to give a luminous flame 1½-in. (38-mm) long.

5.8.3 Within 30 min of taking the specimens from the conditioning environment, cut a 6 to 8-in. (152 to 203-mm) long current season shoot from the branch specimen (Fig. 4) and clip the specimen into the sliding rack so that the tip of the specimen is touching the top surface of the sheet metal box.

5.8.4 Slide the specimen to the test position over the flame. After a 12-s exposure, slide the specimen out of the flame.

5.8.5 If the specimen is flaming, wait until it has extinguished, then move the specimen against the ruler.

5.9 *Data Report:*

5.9.1 Report the following:

5.9.1.1 Date and location of specimen collections.

5.9.1.2 Approximate age of trees (in years/months).

5.9.1.3 Labeling system (see example in Table 2).

5.9.1.4 Temperature, relative humidity, and light level of conditioning room.

5.9.1.5 The condition of the branch prior to the flame test (note issues such as discoloration, accelerated needle loss, or stiff needles).

5.9.1.6 Moisture content of each branch at the time of testing (in %).

5.9.1.7 Duration of flaming after removing from flame (after-flame, in seconds).

5.9.1.8 If there was flame spread after removal of the specimen from the flame and how far the flame spread (in inches).

5.9.1.9 Total length of the test specimen (in inches).

5.9.1.10 Flame spread length (in inches).

5.9.1.11 A plot of the average moisture content versus average flaming time and average moisture content and average percent of specimen flame spread from the test data comparing treated and control specimens.

5.9.1.12 A bar graph showing the number of "NTC" and "T" specimens that passed the fire tests (Section 6) at each test interval.

5.9.1.13 Photograph of specimen following the fire test.

6. Conditions of Acceptance

6.1 Specimens shall meet all of the criteria in 6.1 through 6.5 in order to be considered to have passed the test.