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Standard Test Method of Evaluating Wood Preservatives by Field Tests with Stakes[1]

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1. Scope

1.1 This test method covers accelerated procedures for determining the relative permanence and effectiveness of wood preservatives in stakes exposed in field plots.

1.2 The requirements for preparation of the material for testing and the test procedures appear in the following order:

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

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 246 Test Method for Distillation of Creosote and Creosote-Coal Tar Solutions

D 390 Specification for Coal-Tar Creosote for the Preservative Treatment of Piles, Poles, and Timbers for Marine, Land, and Freshwater Use

D 1413 Test Method for Wood Preservatives by Laboratory Soil-Block Cultures

D 1625 Specification for Chromated Copper Arsenate

3. Summary of Method

3.1 Wood stakes are impregnated with an appropriate series of retentions of a preservative, and then handled, prior to exposure in the field, according to specified procedures. The treated stakes are exposed in the ground to the action of wood-destroying fungi and termites in one or more selected field plots. An index of condition determined from grades assigned to the stakes for degree of decay and termite attack, in the course of periodic inspections, is used to express results periodically and at the termination of the test.

3.2 Two test procedures are outlined, employing two specimen types, ¾-in. square and nominal 2 by 4-in. stakes, designated hereafter respectively as Method A and Method B. Method A, using smaller and more numerous specimens, is preferred for possibly more rapid results, and Method B for longer-term tests of a quasi service nature.

4. Test Plot

4.1 *General Requirements*—A warm humid climate is preferred. Select a natural area of fertile, fallow, level land of uniform soil character that is moist but well drained and large enough to permit expansion of future stake installations. The presence of wood-destroying fungi and active subterranean termites shall be proved by observation or experience and checked by exposure of suitable small specimens of untreated wood. No natural or artificial fertilizer or other chemicals shall be applied to the plot during its use as a test ground. Protection against fire, predators, and pilferage shall be provided as far as practicable.

4.2 *Control of Vegetation*—As a general rule, vegetation shall be controlled manually or by suitable mechanical means only and with minimum soil disturbance. No chemical controls shall be permitted. Weeding and cleaning the plot shall be uniform over any given test area.

4.3 *Reuse of Ground*—Stakes placed in ground that has been used previously for test purposes shall not be set closer than 6 in. (150 mm) to any earlier stake location.

5. Test Specimens

5.1 *Selection of Wood*—Sapwood of southern yellow pine (*Pinus* spp.), with 6 to 10 rings per inch, shall be the preferred wood for comparative tests. It shall be free of knots, excessive cross-grain and resins, or other obvious defects, and it shall

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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.

show no visible evidence of infection by mold, stain, or decayed fungi. Whenever practicable, select straight-grained wood for the test stakes at the sawmill. Acceptable freshly cut lumber shall be kiln-dried in order to avoid fungus infection before and during shipment. The wood shall not have been treated with chemicals to prevent sapstain. The dried lumber shall be stored flat in a dry room where it can reach an equilibrium moisture content (oven-dry basis) of 12 % or less.

5.2 For special investigations, the sapwood or heartwood of any species is permitted to be used. In such cases, the test stakes shall be all sapwood or all heartwood in any given comparative series. Individual stakes containing both sapwood and heartwood shall not be used.

5.3 *Cutting Test Blanks*—Saw test blanks from the dry lumber in any convenient lengths, usually in multiples of the stake length.

5.4 *Test Stake Dimensions*—For Method A the test blanks shall be surfaced four sides as accurately as practicable to 19 by 19 mm (0.75 by 0.75 in.) and cut to a length of 457 mm (18 in.). For Method B, the test blanks shall be surfaced four sides as accurately as practicable to 38 by 89 mm (1.5 by 3.5 in.), and cut to a length of 457 mm (18 in.). The average volume of the A stake is 165 cm^3 (10.1 $in.^3$) and of the B stake is 1546 cm^3 (94.5 $in.^3$). The ratios of surface area to volume of the stakes are respectively 5.4 to 1.0 and 2.0 to 1.0.

5.5 *Storage of Test Blanks and Prepared Stakes*—Working stocks of test blanks or surfaced untreated stakes shall be stored flat under controlled conditions to maintain an equilibrium moisture content of 12 %.

6. Pretreatment Selection of Test Stakes

6.1 *Initial Weights*—Before impregnation the stakes shall be numbered and weighed to the nearest 1 g. Discard the upper and lower 2.5 % of the stakes. Any deviation from this procedure, such as grouping on a weight or ring count basis, shall be reported in detail (see 12.1.10). The initial untreated weights shall be coded T_1.

6.2 *Coding the Weight*—The system of *T* (tare) designations is as follows, with all weights recorded in grams:

T_1 = initial weight of the test stake before impregnation, and

T_2 = weight of the test stake after impregnation and after wiping to remove superficial liquid (equals T_1 plus grams of treating solution absorbed).

NOTE 1—The T_2 weight does not apply in certain cases, as in treatments employing liquefied petroleum gas (see 7.7).

7. Treatment Procedure

7.1 *Preferred Treatment Method*—The preferred treatment method is a full-cell process, simulating commercial practice as far as practicable with laboratory or pilot plant equipment. Use an initial vacuum, suitable temperature, and an appropriate pressure period determined by trial lots, but omit the final vacuum. (See 7.9 for method of obtaining gradient retentions by toluene dilutions.)

7.2 *Standard Reference Preservative*—The standard reference preservative shall be a freshly made aqueous solution of chromated copper arsenate (CCA-Type C; Specification D 1625; AWPA Standard P 5). Periodically treat not less than 20 stakes with this preservative by a full-cell process to retentions of 0.20, 0.40 and 0.60 lb/ft^3 (3.2, 6.4 and 9.6 kg/m^3). Randomize the stakes over the plot area on the same basis as the treated test stakes. Record their condition each inspection.

7.3 *Untreated Control Stakes*—Install not less than 20 untreated control stakes of each species of wood and of the same size used for preservative testing throughout the test area when the plot is first established and each time a new series of tests is installed. Installation shall be on the same random basis as the treated test stakes. Record the condition of the untreated control stakes at each inspection.

7.4 *Retention Populations*—The retentions in any given group of treatments of a preservative shall represent as far as practicable a series running from low to high absorption in order to provide data on the effective protective retention level. The spread in the series shall be designed to straddle the expected or predetermined effective retention for outdoor stake tests (see Note 2).

NOTE 2—The retention spread may be determined through experience or the results of soil-block tests (Specification D 1413), or both. The expected effective retention should be at or near the upper end of the series but lower than the highest retention selected. The lowest retention should be low enough to permit attack and provide proof of the presence of tolerant wood-destroying fungi or termites, or both over the area of the test plot.

7.5 *Number of Stakes to Be Treated*—The number of stakes to be treated depends on available information and experience. In no case shall there be less than 10 stakes in a test. Treat enough stakes to provide, within the graded retention population, extra stakes, or pilot stakes. If used, remove these stakes periodically in the early course of a test to determine the presence and progress of fungus or termite attack. Use such stakes where practicable to determine the identity of the attacking fungus and the depletion or change in character of the preservative tested.

NOTE 3—As examples, since the retentions in the stakes in a given charge will vary around the nominal retention for the charge, the above scheme may be accomplished by treating 20 stakes each in a series of nominal retention charges as follows:

Creosote: 80, 100, 130, 160, and 220 kg/m^3 (5.0, 6.25, 8.13, 10.0, and 13.8 lb/ft^3).
Pentachlorophenol: 1.5, 3.0, 5.0, 8.0, and 11.0 kg/m^3 (0.094, 0.19, 0.31, 0.5, and 0.69 lb/ft^3).
Chromated copper arsenate: 1.5, 3.0, 5.0, 8.0, and 11.0 kg/m^3 (0.094, 0.19, 0.31, 0.5, and 0.69 lb/ft^3).

7.6 *Preservative Analysis*—Analyze each preservative or preservative solution prior to treatment. If there is reason to believe that a change in composition occurs during treatment, analyze after each treatment, and avoid extended use of the same solution.

7.7 *Treatment Retentions*—Determine the amount of preservative absorbed by the individual test stakes as accurately as possible in terms of kg/m^3 as soon as they have cooled to approximate room temperature (*1*) by weighing them on suitable scales, or (*2*) by assay of representative stakes by a method appropriate for the preservative concerned.

7.7.1 Preservative retentions in stakes treated with preservatives in highly volatile solvent carriers cannot be calculated from before and after treatment weights since the solvent is removed during the processing. Retentions must therefore be determined by an analysis of treated stakes. This shall be accomplished by one of two methods:

7.7.1.1 *Method 1*—Several extra stakes (not less than 10) the same size, species, and density range shall be included in each retention charge. Cross sections of these stakes taken at a point between 100 and 125 mm (4 and 5 in.) from one end shall be composited and analyzed. The resultant value shall be the retention for the entire charge.

7.7.1.2 *Method 2*—A sample shall be cut at a point between 100 and 125 mm (4 and 5 in.) from the tip end of each test stake representing half the cross section in 19 mm (¾-in.) stakes from a radial side as far as possible. Analyze each sample. The value determined shall be the retention for each stake. Coat surfaces exposed as a result of the sampling with a sealer such as a phenolic adhesive.

7.7.2 For the usual weight determination, remove each stake individually from the treating chamber, wipe lightly to remove surface preservative or preservative solution, and weigh promptly to the nearest 1.0 g (Code T_2) (6.2).

7.8 *Calculation of Retentions*—Calculate the retention of preservative or preservative solution as follows:

7.8.1 For undiluted preservatives, such as creosote or creosote solution:

$$\text{Retention, kg/m}^3 = 1000\ G/V \quad (1)$$

7.8.2 For diluted preservatives such as toluene solutions of creosote, pentachlorophenol in petroleum carriers, or preservative salts in water solution:

$$\text{Retention, kg/m}^3 = 1000\ GC/V \quad (2)$$

where:

G = $(T_2 - T_1)$ = grams of preservative or preservative solution absorbed by the stake,

C = grams of preservative or preservative solution system in 100 g of treating solution, as a decimal fraction, and

V = volume of stake, cm^3 : 0.000165 m^3 for Method A stakes, and 0.001546 m^3 for Method B stakes.

To convert kg/m^3 to lb/ft^3 divide by 16.

7.8.3 *Test Stake Identification*—After calculation of treatment retentions, identify each test stake adequately with a tag of weather-resistant metal or plastic.

7.9 *Alternative Treatment Methods*—If it is necessary or desirable to establish the plot potential for creosoted stakes with respect to fungus or termite hazard, or both, by installing standard reference stakes treated with both undiluted creosote and with diluted creosote, use an alternative treatment method applicable only to creosote.

7.9.1 Dilute the creosote with toluene to obtain approximate average charge retentions as follows:

	%	
	Creosote	Toluene
For 80 kg/m³(5.0 lb/ft³)	17	83
For 100 kg/m³(6.25 lb/ft³)	21	79
For 130 kg/m³(8.13 lb/ft³)	27	73
For 160 kg/m³(10.0 lb/ft³)	33	67
For 220 kg/m³(13.8 lb/ft³)	46	54

7.9.2 Treat the stakes by a full-cell process, and proceed as outlined under 7.1.

7.10 *Empty Cell Treatments*—For comparative purposes the empty-cell treatment processes may be used for for creosote, for pentachlorophenol-petroleum solutions, or for preservatives in volatile carriers at the discretion of the operator.

8. After Treatment Handling of Test Stakes

8.1 *Stakes Treated with Water Solution*—Dry stakes treated with water-borne preservatives by air-seasoning, kiln-drying, or a combination of both. Stack the stakes so that air can circulate freely between them until their average moisture content is less than 12 %, oven-dry weight basis, or dry them in an oven or kiln at a temperature not to exceed 140°F until their average moisture content is less than 30 %. If other types of conditioning before installation are employed, report the method of after-treatment handling fully. In all cases, the drying period shall be long enough, not less than 15 days, for the salt preservatives to set thoroughly.

8.2 *Stakes Treated with Diluted Oil-Type Preservatives or with Preservatives Dissolved in Highly Volatile Solvents*—Cross-pile stakes treated with volatile solvent solutions, such as creosote in toluene, or pentachlorophenol in light petroleum solvents or in liquefied petroleum gas, horizontally over a flat base or other suitable support, or stack in a space rack frame, in such a manner as to permit free air circulation to all faces of the stakes and to facilitate removal of individual stakes for periodic weighing. Continue the exposure until the average loss in weight is equivalent to at least 90 %, but not more than 95 %, of the amount of solvent or diluent is absorbed.

8.3 *Stakes Treated with Undiluted Preservatives*—Stack stakes treated with undiluted preservatives, such as creosote or pentachlorophenol-petroleum solutions, for drying as prescribed for air-seasoning under 8.1 for a period of not less than 15 days to permit drying of any superficial or bleeding liquid.

8.4 *Individual Stake Condition*—It is essential to maintain the integrity of the individual test specimens before installation as far as practicable. At the end of any drying or evaporation period, bundle or wrap only those stakes with treatment retentions within the limits of the coded retention cells together for storage. To prevent transference of oil-type preservatives from one to another, wrap the stakes individually in heavy aluminum foil prior to bundling.

8.5 *Storage of Treated Test Stakes*—Store the wrapped test stakes in a cool room until shipment for installation.

9. Installation of Stakes

9.1 *Time Lapse Between Treatment and Installation*—Install the treated stakes in the test plot as soon as practicable after treatment (see 12.1.9).

9.2 *Spacing of Stakes in Test Plot*—For Method A, space the test stakes not less than 300 mm (1 ft) between specimens and not less than 600 mm (2 ft) between rows. For Method B, space the test stakes not less than 600 mm (2 ft) between specimens and not less than 900 mm (3 ft) between rows.

9.3 *Depth of Installation*—Install the stakes, with all tags oriented in the same direction in the row, at a depth of 229 to