Designation: D 2481 – 05

Standard Test Method for Accelerated Evaluation of Wood Preservatives for Marine Services by Means of Small Size Specimens[1]

This standard is issued under the fixed designation D 2481; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers the relative effectiveness of wood preservatives in small wood specimens exposed to a natural marine environment. It is not within the scope of this test method to determine the retention or duration of protection for commercial size piles and timbers.

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

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.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

D 1165 Nomenclature of Domestic Hardwoods and Softwoods

D 2665 Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

3. Summary of Test Method

3.1 Small panels or blocks of wood are impregnated with an appropriate series of retentions of a preservative and are prepared for exposure, according to specified procedures. They are then exposed by total immersion in a natural marine environment. An index of physical condition determined during periodic inspection is used to measure the effectiveness of preservative treatment.

4. Significance and Use

4.1 This test method is useful in determining the relative efficacy between various treatments and naturally occurring wood-destroying agents. It is an initial means of estimating the tolerance limits of the biologically destructive agents or the threshold values of the chemical preservative, or both.

4.2 This test method is not intended to provide quantifiable reproducible values. It is a qualitative method designed to provide a reproducible means of establishing relative efficacy between experimental contract levels.

5. Test Specimens

5.1 *Selection of Wood*—Use sapwood of southern or Ponderosa pine or Douglas-fir for standard comparative tests. Use boards free from knots or excessive resins, and showing no visible evidence of infection by mold, stain, or decay fungi. Drill mounting holes before treatment.

5.2 *Selection of Size*:

5.2.1 *A Panels*—6 by 38 by 152 mm, vertical grain with longitudinal grain direction in the 152-mm dimension.

5.2.2 *B Panels*—19 by 76 by 460 mm.

5.2.3 *C Blocks*—19 by 19 by 19 mm, milled as accurately as possible. Holes drilled through the center of a tangential face with a 3-mm drill shall be permitted for handling. The volume

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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.

of the blocks without the hole is approximately 6.9 mL and the blocks with the hole approximately 6.8 mL.

5.2.4 Sample size shall remain constant within a given series of tests.

6. Pretreatment Handling

6.1 *Initial Conditioning and Initial Weights*—Condition the specimens for treatment by bringing them to moisture equilibrium under 15 % ovendry basis in a constant-temperature room, in an appropriate dry storage room, or by kiln drying.

6.2 *Weighing*—Specimens of uniform density as determined by their original weight facilitate uniform treatments within groups. Before impregnation, number and weigh them to the nearest 0.01 g for A panels, and 1.0 g for B panels. This weight is referred to as the initial or untreated weight of the specimen (T_1). Segregate specimens selected into treatment groups of approximate equal density as determined by weight.

NOTE 1—Coding the different weights as T_1, T_2, and T_3 avoids confusion and simplifies recording. The suggested system of T (tare) designation is as follows, with all weights recorded in grams:
T_1 = initial weight of the test specimen before impregnation,
T_2 = weight of the test specimen immediately after impregnation and wiping (equals T_1 plus grams of treating solution absorbed), and
T_3 = weight of the test specimen just before installation at the location site.

6.3 *Identification*—Identify each piece with die-stamped poly(vinyl chloride) or heavy polypropylene tags.

7. Treatment Procedure

7.1 *Treatment*—Apply preservatives by a full-cell or empty-cell process as retention warrants. Avoid solvent dilution of oil-type preservatives.

7.2 *Number of Specimens to be Treated*:

7.2.1 *Panels*—Treat sufficient panels to permit selection after treatment of at least five panels having preservation retentions closely approximating the desired retention level desired. If analysis of variance of attack gradings is desired, at least 20 replicates will be required. The retention in the selected panels shall have a coefficient of variation not greater than 10 %.

7.2.2 *Blocks*—Treat sufficient blocks to permit the selection of N replicate sets of blocks of approximate uniform retention for each preservative at each retention level. The N represents the number of planned removal periods.

7.3 *Treating Reference Specimens*—Treat to obtain a minimum of four panels or blocks at each retention of 128 and 256 kg/m^3. Treatment shall be made using Marine Grade creosote conforming to Table 2 of Specification D 390 for coal-tar creosote having a minimum specific gravity of 1.08. Use creosote or creosote solutions undiluted. Install such reference specimens on a random basis throughout the exposure rack with each installation of treated specimens.

7.4 *Untreated Control Specimens*—Randomly install a minimum of four untreated control panels or blocks throughout the exposure rack with each installation of treated panels or blocks. It is desirable to replace destroyed untreated control specimens to verify continued marine borer activity.

7.5 *Graded Retentions of Preservatives*—Test each preservative in a geometric series of not less than three and preferably in five graded retentions. The retention nearest the expected effective retention shall be at or near the middle of the series. When little or nothing is known regarding the effectiveness of the preservative, wider ranges in retention are to be used.

7.6 *Concentration of Treating Solutions*—Make up the aqueous treating solutions for tests in appropriate gradient concentrations with a view to leaving in the panels or blocks after treatment a predetermined range of retentions running from below to above an anticipated effective (protective) retention.

7.7 *Weight After Treatment*—Determine the amount of preservative absorbed by weighing the panels or blocks individually immediately after treatment. The code designation for after-treatment weight shall be T_2(Note 1). In all treatments with creosote or petroleum solutions, remove each specimen individually from the treating chamber, wipe lightly to remove surface preservative or preservative solution, and weigh promptly to the nearest 0.01 g for A panels and 1.0 g for B panels to determine T_2. Follow the same procedure with waterborne preservatives.

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

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

where:
G = grams of treating solution absorbed by the specimens. Use G_2 or G_3, depending on how retention was determined (T_2 or T_3 weights),
G_2 = ($T_2 - T_1$) = grams of preservative or preservative solution absorbed by the specimen (initial weight of specimen, subtracted from the initial weight plus the amount absorbed),
G_3 = ($T_3 - T_1$) = grams of preservative remaining in the specimen at the time of installation,
C = grams of preservative in 100 g of treating solution, and
V = volume of specimen, mL.

8. Post-Treatment Handling

8.1 *Treatment with Water Solutions*—Dry the specimens treated with waterborne preservatives by air seasoning, kiln drying, or a combination of both. Upon final weighing after treatment, stack the specimens so that air can circulate freely between them until their moisture content is less than 30 % or dry the specimens in an oven or kiln at a temperature not to exceed 60°C until their moisture content is less than 30 %. Some preservatives may require other types of conditioning than those specified. Record and report fully the method of post-treatment handling.

8.2 *Treatment with Oil-Type Preservatives*—Specimens treated with undiluted preservatives, for example, creosote or creosote solutions using any empty-cell process, shall be wrapped as described in 6.2 within 8 h after the T_2 weighing. Wrap the specimens individually in aluminum foil or polyethylene film. Store the specimens under cover in a cool location until shipment to the exposure site for installation. Record and report any observations of preservative bleeding if present.

8.3 *Weighing Before Installation*—With the exception of specimens treated with a water solution of a preservative, it is desirable to weigh the specimens to the nearest 0.01 g for A panels and 1.0 g for B panels prior to installation.

9. Assembly of Test Specimens

9.1 Fasten A and B panels (Note 2) to a frame of noncorrosive metal or fiberglass-reinforced polyester or PVC pipe and fittings (1120, Schedule 40, Specification D 2665). Fasten the panel including the identification tag (6.1) to the frame with rigid poly(vinyl chloride), stainless steel, nylon, or Monel bolts. Minimum spacing shall be 38 mm between panels. Secure the frames with either braided nylon or polypropylene rope.

NOTE 2—The assemblies should be of suitable weight to maintain complete immersion of the entire assembly. Suitable means should be provided to facilitate easy removal of the entire assembly from the water for periodic inspection.

9.2 String C blocks on nylon-covered, braided stainless steel wire, material of equal serviceability, and attach to a suitable frame of permanent construction for complete submersion. Each line shall contain one of the replicate sets of blocks for each retention level of each preservative. Separate blocks within the set by 6-mm plastic or ceramic beads; and separate sets by 12-mm beads. Space lines approximately 150 mm apart in the rack.

9.3 Prior to water immersion, plot the location of each specimen within an assembly for future reference in the event of loss or obliterated number on the panels. Suspend assemblies in water by means of nylon or dacron-nylon cordage of sufficient diameter to adequately support the assembly with 100 % safety factor.

10. Exposure

10.1 *Location*—Expose in a warm water location where the marine borer attack rate is known to be high. Choose a location having some protection from storm damage. Using exposure sites at more than one harbor is recommended. Verify activity by both mollusks and crustacea by simultaneous immersion of untreated specimens.

10.2 *Time Lapse Between Treatment and Installation*—Install the specimen in the test site location as soon as possible after treatment, consistent with the requirements outlined in Section 9. The lapse of time between treatment and installation shall not exceed three months.

10.3 *Placement*—Randomize the location of test specimens, as well as the treated reference and untreated specimens. Expose all assemblies so that the test specimens are continuously submerged below the low tide level.

11. Inspection

11.1 *Frequency of Inspection*:

11.1.1 *Panels*:

11.1.1.1 *A Panels*—Grade (11.2) A panels no less than once every three months. When present, remove fouling by scraping at each inspection.

11.1.1.2 *B Panels*—Grade (11.2) B panels on an annual or semiannual basis. In test installations showing severe surface fouling (barnacles, slime, moss, and so forth), retrieve all test groups at periodic intervals between graded inspections for removal of the surface fouling. The interval between scraping will be dependent on the rate and amount of fouling at the test site. Keep records on frequency of scraping. Grade specimens for evidence of attack immediately following removal of fouling. Return specimens to the water as quickly as possible.

11.1.2 *Blocks*—Remove each line after its predesignated exposure time; for example, 6, 12, 18, 24, and 36 months. Clean blocks of all surface fouling and grade in accordance with 11.2. Do not return such inspected and graded lines to the water for further exposure.

11.2 *Grading System*—Use the following grading system:

Rating	Description
10	No more than trace attack
9	Light attack
7	Moderate attack
4	Heavy attack
0	Destroyed by attack

12. Evaluation of Results

12.1 *Termination of Test*—Prior to complete destruction, termination of the test shall be permitted when the calculated average index of condition is 7.0 or less and the general pattern of preservative performance for a group and its relationship to the creosote controls is established.

Nominal Retention G_2 or G_3, kg/m^3	Number of Specimens in Group	Rating, Y	Number of Specimens in Each Grade, n	Weighted Grades, nY
128	20	10	1	10
		9	2	18
		7	6	42
		4	8	32
		0	8	0
			20	102

$$I = \Sigma nY/\Sigma n = 102/20 = 5.1 \quad (2)$$

I = average index of condition for the group,
n = number of specimens in each grade, and
Y = rating.

Do not include specimens lost through accidental causes in calculations.

13. Reports

13.1 Include the following testing information and data in the reports:

13.1.1 Name and complete description of preservative chemical and its carrier sufficient to identify it fully,

13.1.2 Calculated retention of preservative chemical in each specimen,

13.1.3 Species of wood according to Nomenclature D 1165,

13.1.4 Treatment procedure employed,

13.1.5 Post-treatment handling,

13.1.6 Exact location of marine exposure. Identification of marine borers and incidence of attack on controls and test specimens,

13.1.7 Date of installation,

13.1.8 Frequency of inspection and removal of fouling,

13.1.9 Average index of condition of test specimens and reference specimens at each inspection, and

13.1.10 Deviations, if any, from standard procedure.

14. Precision and Bias

14.1 This test method is dependent upon the physiological action of living organisms and care should be taken to avoid inferring that the results are quantitatively repeatable or reproducible. The relative efficacy on performance of the individual experimental levels should be obtainable but repeatability and reproducibility as it relates to some absolute relationship between treatments should not be anticipated.

15. Keywords

15.1 evaluation; marine borer