



Designation: D 3273 – 86 (Reapproved 1991)^{e1}

Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber¹

This standard is issued under the fixed designation D 3273; 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 (^e) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

^{e1} NOTE—Keywords were added editorially in July 1991.

1. Scope

1.1 This test method describes a small environmental chamber and the conditions of operation to evaluate reproducibly in a 4-week period the resistance of a paint film to surface mold growth in a severe interior mold environment. The apparatus is designed so it can be easily built or obtained by any interested party and will duplicate results obtained in a large tropical chamber.

1.2 Temperature and humidity must be effectively controlled within the relatively narrow limits specified in order for the chamber to function reproducibly during the short test period. Severity and rate of mold growth on a film is a function of the moisture content of both the film and the substrate. A relative humidity of 95 to 98 % at a temperature of $90 \pm 2^\circ\text{F}$ ($32.5 \pm 1^\circ\text{C}$) is necessary for test panels to develop rapidly and maintain an adequate moisture level to support mold growth.

1.3 *This standard does not purport to address all of the safety problems, 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 Document

2.1 ASTM Standard:

D 3274 Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation²

3. Significance and Use

3.1 An accelerated test for determining the resistance of interior coatings to mold growth is useful in estimating the performance of coatings designed for use in interior environments that promote mold growth and in evaluating compounds that may inhibit such growth and the aggregate levels for their use.

3.2 This test method should preferably be used by persons who have had basic microbiological training.

4. Apparatus

4.1 *Environmental Chamber*, capable of maintaining a relative humidity of 95 to 98 % at a temperature of $90 \pm 2^\circ\text{F}$ ($32.5 \pm 1^\circ\text{C}$) while providing a continuous inoculation of the surface of exposed panels with mold spores. The chamber should be kept in a room controlled to 70 to 75°F (21 to 24°C) so that heat loss from the cabinet is insignificant and that 95 to 98 % relative humidity is readily obtained at the test temperature. Alternatively the cabinet must be insulated with suitable materials to minimize heat loss.

4.2 *Small Cabinet*, suitable for holding about twenty-five 3 by 4-in. (75 by 100-mm) test panels under these conditions can be constructed as follows (Fig. 1):

4.2.1 *Tank*, polypropylene or polyethylene, with an offset shoulder at the top rim is used as the chamber.³ A pitched top with straight sides should be constructed out of acrylic plastic so moisture condensation will run down the sides and be recirculated instead of dripping onto the panels.

4.2.2 *Heating Coil*,⁴ 125-W, regulated by a controller⁵ and installed in the bottom of the chamber by connections through the end wall. It is so placed that it is immersed when there are 2 to 3 in. (50 to 75 mm) of water in the bottom of the chamber. A 90°F (32.5°C) thermostat should be installed in the chamber in the area by the test panels to regulate the heat input through the controller to the heating coil in the water.

4.2.3 *Tray*, stainless steel or plastic, approximately 1 in. (25 mm) smaller than the inside dimensions of the chamber and 1 to 3 in. (25 to 75 mm) deep with a noncorrodible metal⁶ mesh bottom should be supported 1 in. (25 mm) above the water level and centered in the chamber. One layer of fine plastic or fiberglass screen should be placed over the metal mesh for holding soil.

4.2.4 *Small Fan*,⁷ mounted through the end wall perpen-

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² *Annual Book of ASTM Standards*, Vol 06.01.

³ Dynalab Corp., Rochester, NY, and Cole Parmer Instrument Co., Chicago, IL have tanks of this type available in dimensions approximating 27 by 18 and 18 in. (686 by 457 and 457 mm) high.

⁴ The Chromalox® heating coil manufactured by the Wiegand Div., Emerson Electric Co., Pittsburgh, PA has been found satisfactory for this purpose.

⁵ The Lumenite Electronic Level Control has been found satisfactory for this purpose.

⁶ Monel has been found satisfactory for this purpose.

⁷ 1/250-hp fan operating at 300 r/min with a 1.5-in. blade, obtained from Dayton Electric Manufacturing Co., or equivalent, has been found satisfactory for this purpose.

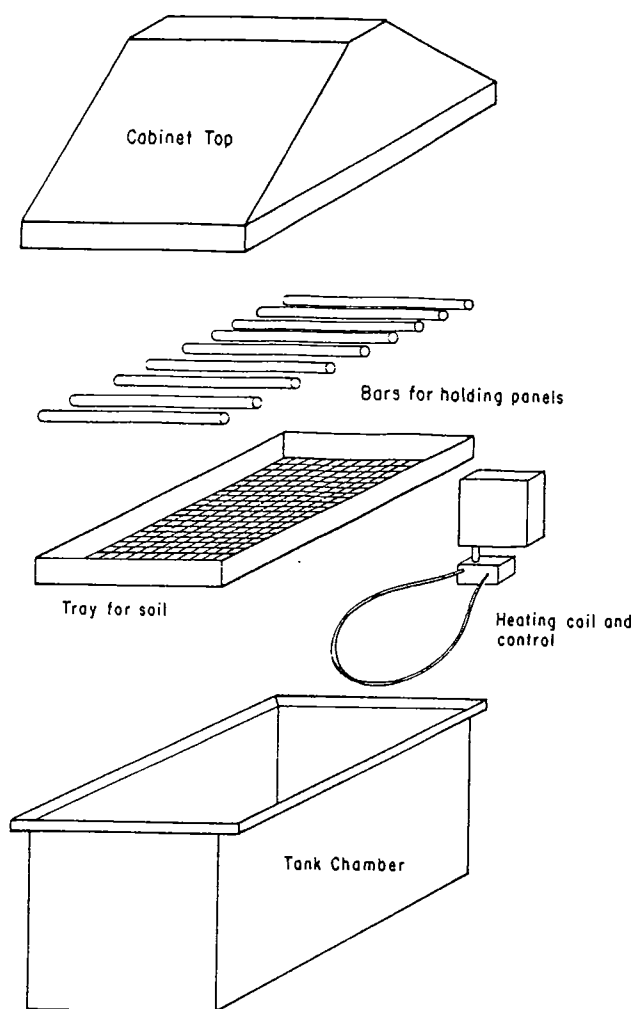


FIG. 1 Environmental Cabinet Assembly

dicular to and just above the surface of the soil bed in the tray (4.2.3) to provide dispersion and circulation of the mold spores to achieve continuous inoculation of the surfaces of the painted panels.

4.2.5 *Series of Wood Bars*, suspended across the width of the chamber at a height and spacing that allows the use of test panels 3 by 4 in. (75 by 100 mm), hung vertically, with approximately 3-in. (75-mm) clearance above the inoculated soil with a suitable method of fastening. Screw eyes are used with the wooden panels while a wire frame or a large clip is used with the gypsum board panels. Other support systems may be utilized.

NOTE 1—Other angles of exposure may be used but may alter the rate and severity of mold growth.

4.3 *Psychrometer*, for measuring relative humidity in the test area.

5. Reagents and Materials

5.1 *Soil*—A good quality greenhouse-grade potting soil, suitable for plant propagation, containing 25 % peat moss. pH of the soil should fall from 5.5 to 7.6. Do not allow soil to become compacted.

5.2 *Cultures*:

5.2.1 *Aureobasidium pullulans*,⁸ ATCC 9348

5.2.2 *Aspergillus niger*,⁸ ATCC 6275

5.2.3 *Penicillium*,⁸ Sp. 12667 or ATCC 9849

5.3 *Test Panels*:

5.3.1 *Ponderosa Pine* (*Pinus ponderosa* Laws) *Sapwood Panels*. ½ in. (12.7 mm) thick, 3 by 4 in. (75 by 100 mm), free of excessive resins, knots, growth rings or other abnormalities, surfaced smooth on four sides. Wood shall be kiln dried after sawing to avoid infestation of wood-rotting fungi and any wood showing evidence of such infestation shall be eliminated as test material. Wood shall be weighed after conditioning at room temperature in a dry room to 15 % moisture content. Calculated weight shall fall between 6.0 and 7.0 g/in.³ (365 and 425 kg/m³). Panels containing heartwood areas should not be used as they will inhibit mold growth under test conditions.

5.3.2 *Gypsum Board Panels*, ½ in. (12.7 mm) thick, 3 by 4 in. (75 by 100 mm).

NOTE 2—Other substrates may be used but may result in a different rate or severity of mold growth.

6. Preparation of Apparatus

6.1 Place greenhouse soil in the tray in the cabinet and add water to the tank chamber to the desired depth. Allow the cabinet to equilibrate for 24 h before inoculating the soil with the specified mold suspensions.

6.2 Prepare mold slants of all three cultures and age 10 to 14 days or purchase prepared mold slants⁸ of all three cultures. Prepare mold suspensions from each type of mold slant by the following procedure: Add one drop of 25 % nonionic surfactant⁹ solution to 95 to 100 mL sterile deionized or distilled water and shake. Pipet 5 mL of this solution onto the mold slant. Scrub the surface of the slant with a sterile cotton swab to remove as much spore and mycelial growth as possible without digging up the surface of the agar. Pour the water from the scrubbed slant back into the surfactant-sterile water mixture for dilution. Shake gently for 15 to 20 min to break up clumps of mold. Use a pipet to distribute the mold suspensions evenly over the surface of the greenhouse soil in the tray in the cabinet.

6.3 Allow two weeks of continuous operation for the mold to sporulate and equilibrate with the environment before starting a test. It should not be necessary to recontaminate continually the chamber of panels after sufficient microorganism growth has built up in the soil, if the chamber is maintained in continuous operation.

6.4 Viability of the mold growth in the cabinet can be checked by placing several malt agar or potato dextrose agar plates,¹⁰ open and face up, at several locations on the panel support rods. After 1 h, cover plates and place in incubator at 90 ± 2°F (32.5 ± 1°C) for 3 days. If an incubator is not available, leave the covered plates in the cabinet. Mold

⁸ Suitable cultures can be obtained from American Type Culture Collection, 12301 Parklawn Dr., Rockville, MD 20852. Cultures can be maintained on malt agar or potato dextrose agar. Prepared slants can be obtained from Difco Laboratories, Inc., Detroit, MI 48232; Baltimore Biological Laboratories, Baltimore, MD 21218 or from equivalent sources.

⁹ Triton X100, Rohm & Haas, Igepal CA-630, G.A.F., or equivalent.

¹⁰ Prepared agar plates can be obtained from Difco Laboratories, Inc., Detroit, MI 48232; Baltimore Biological Laboratories, Baltimore, MD 21218, or from equivalent sources.