Designation: D6007 – 14

Standard Test Method for Determining Formaldehyde Concentrations in Air from Wood Products Using a Small-Scale Chamber[1]

This standard is issued under the fixed designation D6007; 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 test method measures the formaldehyde concentrations in air emitted by wood product test specimens under defined test conditions of temperature and relative humidity. Results obtained from this small-scale chamber test method are intended to be comparable to results obtained from testing larger product samples by the large chamber test method for wood products, ASTM Test Method E1333. The results may be correlated to values obtained from ASTM Test Method E1333. The quantity of formaldehyde in an air sample from the small chamber is determined by a modification of NIOSH 3500 chromotropic acid test procedure. As with ASTM Test Method E1333, other analytical procedures may be used to determine the quantity of formaldehyde in the air sample provided that such methods give results comparable to those obtained by using the chromotropic acid procedure. However, the test results and test report must be properly qualified and the analytical procedure employed must be accurately described.

1.2 The wood-based panel products to be tested by this test method are characteristically used for different applications and are tested at different relative amounts or loading ratios to reflect different applications. This is a test method that specifies testing at various loading ratios for different product types. However, the test results and test report must be properly qualified and must specify the make-up air flow, sample surface area, and chamber volume.

1.3 Ideal candidates for small-scale chamber testing are products relatively homogeneous in their formaldehyde release characteristics. Still, product inhomogeneities must be considered when selecting and preparing samples for small-scale chamber testing.

1.4 The values stated in SI units are the standard values. Any values given in parentheses are for information only.

1.5 *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]

D3195 Practice for Rotameter Calibration

D5197 Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)

D5221 Test Method for Continuous Measurement of Formaldehyde in Air (Withdrawn 1997)[3]

E77 Test Method for Inspection and Verification of Thermometers

E220 Test Method for Calibration of Thermocouples By Comparison Techniques

E337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E741 Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution

E1333 Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber

2.2 *U.S. Department of Housing and Urban Development Standard:*[4]

HUD 24 CFR 3280, Manufactured Home Construction and Safety Standards

[1] This test method is under the jurisdiction of ASTM Committee D07 on Wood and is the direct responsibility of Subcommittee D07.03 on Panel Products.

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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] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov; request Federal Register, Vol 49, No. 155, Aug. 8, 1984

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2.3 *National Institute for Occupational Safety and Health Standard:*

NIOSH 3500 Formaldehyde Method[5]

2.4 *Other Documents:*

Minnesota Statutes Sections 144.495, 325f.18, and 325F.181—Formaldehyde Gases in Building Materials[6]

California Air Resources Board (CARB) California Code of Regulations sections 93120-93120.12, title 17, Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *air change rate, (Q/V):* the ratio of the conditioned and filtered air, Q, that enters or is replaced in the small chamber in one hour divided by the interior volume of the small chamber, V, air changes per hour (ACH).

3.1.2 *loading ratio, L:* ($L = A/V$) , the total exposed surface area (A), excluding panel edges, of the product being tested divided by the test chamber's interior volume, V, in m^2/m^3.

3.1.3 *make-up air flow, Q:* the quantity of conditioned and filtered air fed into the chamber per unit time, m^3/h. Q can be determined by taking the Q/A value from Table 1 and dividing by A.

3.1.4 *Q/A ratio:* the ratio of air flow through the chamber (Q) to sample surface area (A), m^3/h air per m^2 test area (see Section 8, Table 1)

3.1.5 *sample surface area, A:* the total area of all sample faces exposed in the chamber, m^2.

3.1.6 *steady state concentration, C_s:* the formaldehyde concentration (expressed in parts of formaldehyde per million parts air (ppm) under the defined environmental test parameters of this method.

3.1.7 *volume of closed system, V:* the interior volume of the test chamber, m^3.

4. Significance and Use

4.1 Upper limits for the formaldehyde emission rates have been established for wood panel building products made with urea-formaldehyde adhesives and permanently installed in homes or used as components in kitchen cabinets and similar industrial products. This test method is intended for use in conjunction with the test method referenced by HUD 24 for manufactured housing and by Minnesota Statutes for housing units and building materials. This method may also be used for monitoring products for compliance to the California Air Resources Board (CARB) regulation for composite wood products. This test method provides a means of testing smaller samples and reduces the time required for testing.

4.2 Formaldehyde concentration levels obtained by this small-scale method may differ from expected in full-scale indoor environments. Variations in product loading, temperature, relative humidity, and air exchange will affect formaldehyde emission rates and thus likely indoor air formaldehyde concentrations.

4.3 This test method requires the use of a chamber of 0.02 to 1 m^3 in volume to evaluate the formaldehyde concentration in air using the following controlled conditions:

4.3.1 Conditioning of specimens prior to testing,

4.3.2 Exposed surface area of the specimens in the test chamber,

4.3.3 Test chamber temperature and relative humidity,

4.3.4 The Q/A ratio, and

4.3.5 Air circulation within the chamber.

5. Interferences

5.1 The NIOSH 3500 analytical method lists phenols as a negative interference when present at an 8:1 excess over formaldehyde. Modifications in the analytical procedure shall be made when relatively high phenol to formaldehyde concentrations (8:1) are anticipated.[8,9]

6. Apparatus

6.1 *Test Chamber*—The interior volume of the small chamber shall be from 0.02 to 1 m^3. The interior of the test chamber shall be free of refrigeration coils that condense water and items such as humidifiers with water reservoirs since water has the potential for collecting formaldehyde and thus influencing test results. The interior surfaces of the small chamber, including any sample support system, shall be a nonadsorbent material. Stainless steel, aluminum, and polytetrafluoroethylene (PTFE) have been found appropriate as chamber lining materials. All joints except for doors used for loading and unloading specimens should be sealed. Doors shall be self-sealing.

6.2 *Make-Up Air:*

6.2.1 The make-up air shall come from a filtered dust-free environment and a formaldehyde concentration in air no more than 0.02 ppm. This can be accomplished by passing make-up air through a filter bed of activated carbon, activated alumina impregnated with potassium permanganate, or other materials capable of absorbing or oxidizing formaldehyde.

6.2.2 Make-up air for the chamber must pass through a calibrated air flow measuring device.

6.2.3 *Air Circulation*—Low speed mixing fans or multi-port inlet and outlet diffusers are two techniques that have been used successfully to ensure mixing of the chamber air over all sample surfaces.

6.2.4 *Air Sampling Port*—The exhaust flow (that is, chamber outlet) is normally used as the sampling point, although separate sampling ports in the chamber can be used. The sampling system shall be constructed of a material to minimize

[5] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov; request U.S. Dept. of Health and Human Services, 1989.

[6] Available from Print Communications, Dept. of Administration, 117 University Ave., St. Paul, MN 55155.

[8] Hakes, D., Johnson, G., and Marhevka, J., *Procedure for Elimination of Phenol Interference in the Chromotropic Acid Method for Formaldehyde*, American Industrial Hygiene Association, April 1984.

[9] *Technical Bulletin No. 415*, National Council of the Paper Industry for Air and Stream Improvement Inc. (NCASI), 1983.

adsorption (for example, glass, stainless steel), and the system should be maintained at the same temperature as the test chambers.

6.3 Examples of acceptable reagents, materials, and equipment are provided in Appendix X1.

7. Hazards

7.1 *Chromotropic Acid Reagent Treatment*—(See 10.3.4 and 10.3.5.) During this hazardous operation, the operator must wear rubber gloves, apron, and a full face mask or be protected from splashing by a transparent shield such as a hood window. The solution becomes extremely hot during addition of sulfuric acid. If acid is not added slowly, some loss of sample could occur due to splattering.

7.2 *Cleaning Chemicals for Glassware*—Use appropriate precautions if cleaning chemicals are considered to be hazardous.

8. Test Specimens

8.1 *Specimen Size and Chamber Air Change*—Chambers are operated at a fixed sample size by varying the make-up air (Q), or at fixed Q by varying the product sample size by product type. Either mode is acceptable as long as the appropriate Q/A ratios for the product type are met (see Table 1).

TABLE 1 Q/A Ratios, ±2 %

Q/A (m^3/h air per m^2 test area)	Product Type
0.526	hardwood plywood wall paneling
1.172	particleboard flooring panels, industrial particleboard panels, industrial hardwood plywood panels
1.905	medium density fiberboard (MDF)
3.811	particleboard door core

8.2 *Standard Face and Back Configuration Testing*—Loading ratio (L or A/V) is defined as the total exposed specimen surface area, excluding edge area, divided by the chamber volume. Aluminum tape, or coatings with similar performance, shall be used to cover the edges of the specimens if the edge exposure is greater than 5 % of the surface area, thereby retarding formaldehyde emission from the edge.

8.3 *Nonstandard Sample Configuration Testing Products with Single Surface Exposed*—Some products have significantly different formaldehyde release characteristics for each surface. In those cases, panels may be tested back-to-back with edges taped together. The panels shall be identified as tested in the back-to-back mode.

8.4 *Combination Testing*—Different products may be tested in combination. Qualify the test report and note the Q/A ratio used.

9. Sample Material Handling and Specimen Conditioning

9.1 *Handling*—Materials selected for testing shall be wrapped in polyethylene plastic having a minimum thickness of 0.15 mm (6 mil) until sample conditioning is initiated. When testing wood products that are not newly manufactured such as after original application, installation or use, the method of packaging and shipping the products for testing shall be fully described. Information on the age and history of the product shall be detailed in the test report.

9.2 *Conditioning*—Condition test specimens with a minimum distance of 0.15 m (6 in.) between each specimen for 2 h ± 15 min at conditions of 24 ± 3°C (75 ± 5°F) and 50 ± 5 % relative humidity. The formaldehyde concentration in the air within 0.3 m (12 in.) of where panels are conditioned shall be not more than the lesser of 0.10 ppm or the applicable compliance limit when testing for compliance purposes, during the conditioning period. Alternative conditioning intervals may give better correlation, such as seven day conditioning that parallels Test Method E1333.

10. Procedure

10.1 *Test Procedure for Materials:*

10.1.1 Purge the chamber by running empty or with the use of filters designed to reduce the formaldehyde background concentration in air, or both. The formaldehyde background concentration in air of the empty operating chamber shall not exceed 0.02 ppm. Clean chamber surfaces with water or suitable solvent if formaldehyde background concentrations approach 0.02 ppm.

10.1.2 Locate the specimens in the chamber so that the conditioned air stream circulates over all panel surfaces.

10.1.3 Operate the chamber at 25 ± 1°C (77± 2°F) and 50 ± 4 % relative humidity. Record the temperature, relative humidity, and barometric pressure during the testing period. Conduct the chamber test at a given Q/A ratio and record this ratio in the report.

10.1.4 After placing samples in chamber, allow time for no less than three full air changes or 15 min, whichever is greater, before beginning air sample collection (see Note 1).

NOTE 1—For products with very low emissions or to establish equivalence to ASTM Test Method E1333, it may be necessary to allow a longer time period prior to beginning air sampling.

10.2 *Air Sampling*—Purge air sampling lines for 1 min. At the sampling station, bubble air through a single impinger containing 20 mL of a 1 % sodium bisulfite ($NaHSO_3$) solution. A filter trap may be placed between the impinger and the flowmeter. Set a calibrated flowmeter to maintain an average airflow of 1 ± 0.05 L/min for 30 to 60 min (see Note 2) with time measured accurately to within 5 s. Following air sampling, analyze the collection solution.

NOTE 2—For products with very low emissions or to establish equivalence to ASTM Test Method E1333, it may be necessary to use the 60 min sampling time.

10.3 *Analysis of Air Samples:*

10.3.1 Pipet 4 mL of the $NaHSO_3$ solution from the impinger into each of three 16 by 150-mm screwcap test tubes for triplicate analysis of each impinger sample.

10.3.2 Pipet 4 mL of 1 % $NaHSO_3$ into a 16 by 150-mm screwcap test tube to act as a reagent blank.

10.3.3 Add 0.1 mL of 1 % chromotropic acid reagent to each test tube. Shake tube after addition.