



Designation: D7770 – 12 (Reapproved 2019)

Standard Test Method for Collection of Volatile Organic Compounds Emitted During Simulated Manufacturing of Engineered Wood Products Via a Sealed Caul Plate Method¹

This standard is issued under the fixed designation D7770; 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 provides a method for the collection of volatile organic compounds (VOC) that are emitted during the manufacture of engineered wood products using a laboratory environment designed to simulate a defined production process. The method is used for the determination of the amounts of methanol, formaldehyde, phenol and other VOC that may be emitted during conditions designed to simulate production such as hot pressing, the conditions of ‘hot stacking’ and ‘cool-down’ that occurs post-press.

1.2 The test method was originally developed to measure certain VOC from exterior plywood meeting Voluntary Product Standard PS 1–09 and structural composite lumber products such as laminated veneer lumber (LVL) meeting Specification D5456. Both of these product types are typically manufactured using phenol-formaldehyde resin based adhesives that meet Specification D2559.

1.3 The test method is suitable for many types of wood products bonded with adhesives.

1.4 This test method is specific for collecting VOC during simulated production of wood products and is not designed to determine general organic emissions from all indoor materials or sources.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.6 *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.* Some specific hazards statements are given in Section 7 on Hazards.

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

D2145 Method of Test for Phenol Content of Phenol-Water Mixtures (Withdrawn 1978)³

D2559 Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions

D4442 Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials

D4933 Guide for Moisture Conditioning of Wood and Wood-Based Materials

D5456 Specification for Evaluation of Structural Composite Lumber Products

E346 Test Methods for Analysis of Methanol (Withdrawn 2017)³

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

2.2 Other Standards:

Voluntary Product Standard PS 1–09 Structural Plywood

3. Terminology

3.1 Definitions:

3.1.1 *target production process*—a set of specified manufacturing parameters that define the production of an adhesive bonded wood product. For the purposes of this standard, those parameters are designed to be representative of a specific production facility and are used to derive the test specimen.

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.

3.1.2 *test specimen*—a combination of defined wood elements with or without applied adhesive that is exposed to pressing and post pressing conditions in a defined laboratory setting that is designed to simulate the Target Production Process (see 3.1.1).

3.1.3 *VOC*—for the purposes of this standard, the term VOC means the specific volatile organic compounds of formaldehyde, methanol and phenol that are emitted from a test specimen during the pressing and post pressing measurements.

4. Summary of Test Method

4.1 A laboratory scale press is used to simulate the target production process with respect to the key variables that influence the production process and that may affect the emission of VOC. The lab press is fitted with a caul system to create a seal around the press system to permit collection of the VOC discharged during the process. The sealed caul plate contains inlet and outlet ports to permit the controlled collection of the emitted VOC.

4.2 During the test, emitted VOC collect in the air space encompassed within the sealed caul plate. The VOC are collected by mixing them into a continuous flow of clean, dry air that is injected into the sealed space via a controlled, pressurized supply cylinder.

4.3 The VOC within the collected air stream are removed from the sealed caul system and then condensed into a water solution using impingers submerged into an ice bath.

4.4 The collected solutions are diluted to concentrations ideally suited for instrumental analysis. They are analyzed to determine their methanol, formaldehyde and phenol content. Several suitable analytical procedures are referenced in Appendix X1.

4.5 The weight of the wood elements used to assemble the wood test specimen, the weight of the adhesive applied to the

wood elements, and the concentrations of the VOC detected in the collection solutions are determined to be used to calculate the relative amount of methanol, formaldehyde, and phenol that are emitted during the test.

4.6 At least three test replications shall be conducted and results separately reported for each of the tests.

5. Significance and Use

5.1 Compliance with national and local air emission regulations create the need to determine volatile organic compound (VOC) emissions from adhesive-bonded structural wood products.

5.2 This method has been used to estimate the types and amounts of certain VOC that are emitted during production operations.

5.3 The method was originally developed to measure the methanol, formaldehyde, and phenol emitted in a laboratory setting that is designed to simulate the hot pressing, and post pressing conditions of hot stacking and cool down period for exterior plywood and laminated veneer lumber (LVL) processes. This current method generalizes the concept for adhesive-bonded wood products.

6. Apparatus

6.1 *Laboratory Press.* A laboratory scale press shall be equipped with automatic temperature (if hot pressing is used) and pressure controls to control the pressing conditions to simulate the production process. If required, the hot press platens can be heated with any suitable means such as electrical, hot oil or steam to control the press temperature within $\pm 2^\circ\text{C}$ ($\pm 4^\circ\text{F}$) during the pressing operation. The hot press platens shall be at least 600 by 600 mm (24 by 24 in.) and shall accommodate the sealed caul plate described in 6.2.

6.2 *Sealed Caul Plate.* A machined aluminum caul plate is fabricated to fit within the laboratory press. As shown in Fig. 1,

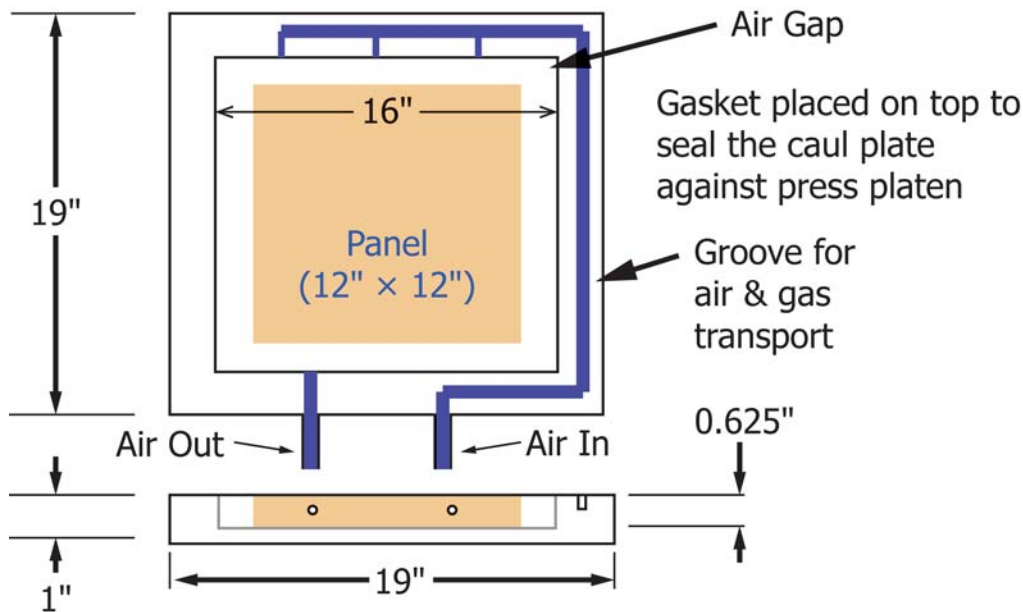


FIG. 1 Schematic of Sealed Caul Plate and Test Panel

the outside dimensions of the plate are within 125 mm (5 in.) of the outside dimension of the laboratory press. The sealed caul plate is fabricated with holes in the sides to create air 'inlet' and 'outlet' paths. The inlet and outlets are tapped to receive threaded stainless steel tubing. It is permissible to fit the 'inlet' and 'outlet' tubes with quick-disconnect couplings.⁴ The thickness of the sealed caul plate shall be thick enough to test the representative wood test specimen. See Fig. 2 and Note 1.

NOTE 1—Use of a spacer plate has been suitable to provide variable overall caul thicknesses to fit products with different thicknesses. In such cases, the spacer plate must be of compatible width and length to mate closely and tightly with the sealed caul plate during the test.

6.3 VOC Collection Equipment. The following equipment is required to collect the VOC during the simulated pressing operations.

6.3.1 Compressed air cylinder containing a supply of clean, dry, breathable air.

6.3.2 Gas flow meter. A meter suitable to measure gas flow rates to an accuracy of $\pm 1.0 \text{ cm}^3/\text{min}$ ($\pm 0.061 \text{ in.}^3/\text{min}$).⁴

6.3.3 Collection impingers.⁴

6.3.4 Teflon Socket Adapters.⁴

6.3.5 #28 Ball Joint Clips.⁴

6.3.6 Connection tubing. Teflon tubing, 6 mm (.25 in.) inside diameter with at least 1.6 mm (1/16 in.) wall thickness.

6.3.7 Ice bath. A chest or cooler of sufficient size to contain and surround three impingers with ice.

6.3.8 Amber Glass bottles

⁴ The subcommittee chair can provide a list of suitable supplies for conducting this test.

6.3.9 Gasket Material.

6.3.10 O-ring gaskets.

7. Hazards

7.1 This test method involves heating, handling of wood and adhesives, pressure, presence and handling of VOC and handling of laboratory glassware.

8. Test Specimen

8.1 The test specimen is designed to simulate the target production process with respect to wood element(s), adhesive and production process. The test specimen is defined in accordance with the sections below.

8.2 Product type and wood elements. Define the wood element(s) used in the test as defined in this section.

8.2.1 Define the product type with specifics that are appropriate for that type. See Note 2.

NOTE 2—For example, plywood would be defined with respect to nominal thickness and number of plies and layers.

8.2.2 Type of wood element(s) (for example, veneer, solid sawn wood, strands, particles, and fibers).

8.2.3 Species of the wood element(s).

8.2.4 Pre-conditioning applied to the wood elements such as preheating, drying, steam exposure, chemical additions, or combinations thereof.

8.2.5 Moisture content of the wood elements shall be conditioned to be within $\pm 2 \%$ of the expected moisture content of the defined target production process. See Note 3. Measure the moisture content of representative matched specimens using Test Methods D4442.

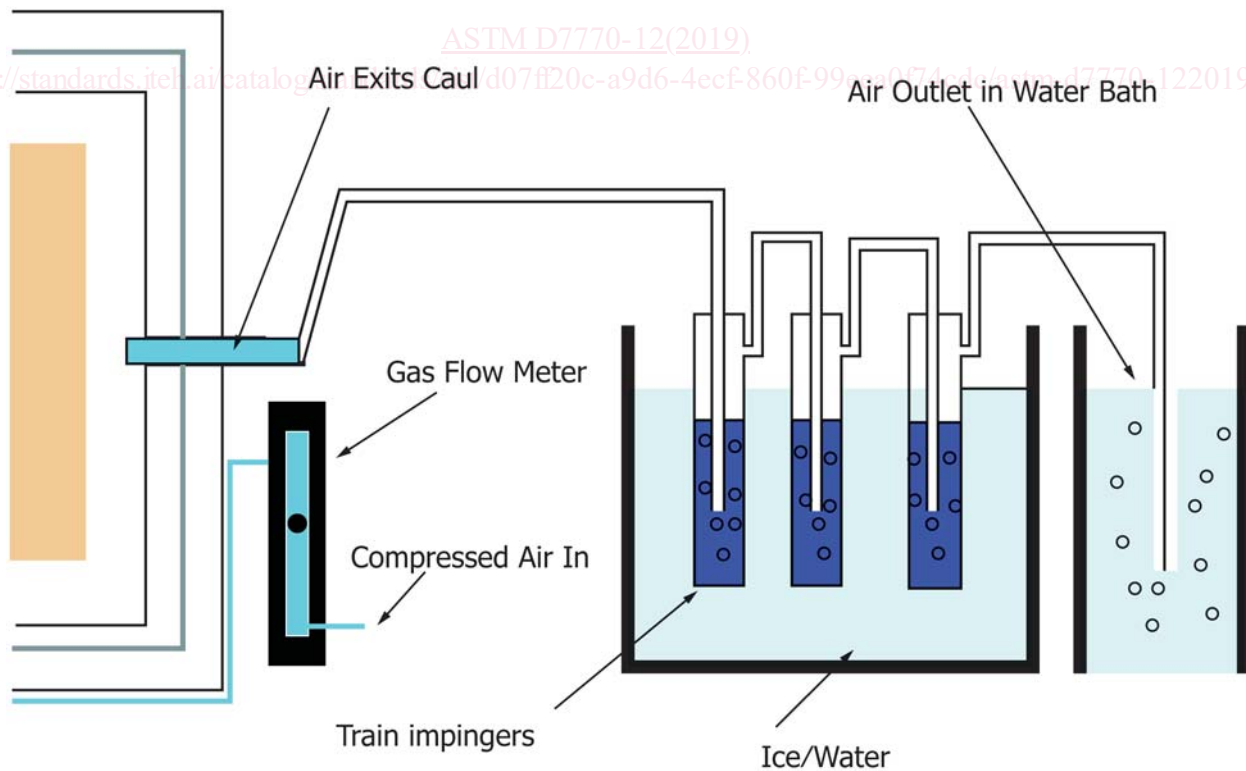


FIG. 2 Schematic of Air Source and Collection Impingers