



Standard Test Method for Laboratory Measurement of Formaldehyde Evolved During the Curing of Melamine-Formaldehyde-Based Coatings¹

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1. Scope

1.1 This test method is for the determination of formaldehyde evolved from melamine-formaldehyde-based coatings during the cure step. The results may be used to determine the “cure formaldehyde” evolved from a sample under controlled laboratory conditions.

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

1.3 This test method is capable of measuring from 500 $\mu\text{g/g}$ to 22 000 μg formaldehyde/g dry coating under the test conditions specified (3 000 ml/min total flow, 50 ml/min DNPH tube flow). The ratio of total flow to DNPH tube flow could be adjusted to extend the range of the method.

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

D362 Specification for Industrial Grade Toluene (Withdrawn 1989)³

D1979 Test Method for Free Formaldehyde Content of Amino Resins (Withdrawn 2006)³

D6191 Test Method for Measurement of Evolved Formaldehyde from Water Reducible Air-Dry Coatings

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

¹ This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.21 on Chemical Analysis of Paints and Paint Materials.

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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. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *cure formaldehyde, n*—the formaldehyde generated as the result of a chemical reaction during coating curing.

3.1.2 *free formaldehyde, n*—the residual formaldehyde in a coating due to the raw materials.

4. Summary of Test Method

4.1 Approximately 0.2 g of coating formulation is placed in an aluminum foil pan, dried in a vacuum oven at 40°C (to remove free formaldehyde and solvents) and then baked at the optimum process cure temperature for 30 min. Formaldehyde emissions are collected from the cure chamber on a DNPH/Silica tube, which is then extracted and the extract analyzed by HPLC/UV. The amount of formaldehyde evolved from the coating during the cure step is calculated on both a wet-weight and dry-weight basis. The test is run in triplicate plus a blank and system standard.

5. Significance and Use

5.1 This test method measures the amount of formaldehyde that is evolved from a coating containing melamine-formaldehyde resin(s) during cure at elevated temperature. Cure formaldehyde results from a side-reaction during cross-linking of functionalized polymers with melamine-formaldehyde resins. Cure formaldehyde is evolved in the final bake or cure oven, when the coating temperature is high enough to initiate cross-linking. Formaldehyde can be released from a coating during application, solvent flash-off and cure. Free formaldehyde is primarily evolved during coating application and solvent flash-off. Test Method D1979 measures “free formaldehyde” in amino resins and Test Method D6191 measures formaldehyde evolved from coatings at ambient temperature. This method measures only the formaldehyde released during heat cure, which is primarily “cure formaldehyde.”

5.2 This test method is not intended to duplicate the evolved formaldehyde from an industrial process, but serves as a reproducible comparative laboratory evaluation.

5.3 This test method has not been evaluated with catalyzed coating systems that cure at or below 40°C, such as those used