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Test Method for Formaldehyde Release from Fabric: Sealed Jar

1. Purpose and Scope

1.1 This test method is applicable to textile fabrics that may release formaldehyde, particularly fabrics finished with chemicals containing formaldehyde. It provides accelerated storage conditions and an analytical means for determining the amount of formaldehyde released under the conditions of accelerated storage (see Section 5 and 10.1). This test method determines free and hydrolyzed formaldehyde and any-additional formaldehyde which may be generated under accelerated storage conditions.

1.2 An optional accelerated incubation procedure is available (see 13.6).

1.3 An optional submersion method which approximates the amount of hydrolyzed formaldehyde while closely simulating normal user conditions is AATCC TM 206.

2. Principle

2.1 A weighed fabric specimen is suspended over water in a sealed jar. The jar is placed in an oven at a controlled temperature for a specified length of time (see 13.5). The amount of formaldehyde absorbed by the water is then determined colorimetrically.

3. Terminology

3.1 **formaldehyde release**, *n*.—That formaldehyde exuded from textiles under the accelerated storage conditions of this test, including that which is free (unbound or occluded) from unreacted chemicals, or from finish degradation as a result of this test.

3.2 **free formaldehyde**, *n*.—Formaldehyde that is not bonded to a finish or a fabric is considered to be free formaldehyde. In this form, formaldehyde can be readily extracted from the fabric by immersion in water.

3.3 **hydrolyzed formaldehyde**, *n*.—Although originally part of a larger chemical structure, such as a crosslinking reactant, during the course of this test the formaldehyde is cleaved from the larger molecule and dissolved into water.

4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all inclu-

sive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practice should be followed. Wear safety glasses in all laboratory areas.

4.2 When handling glacial acetic acid to prepare Nash reagent, use chemical goggles or face shield, impervious gloves and an impervious apron during preparation. Concentrated acids should be handled only in an adequately ventilated laboratory hood. CAUTION: Always add acid to water.

4.3 Formaldehyde is a sensory irritant and potential sensitizer. Its chronic toxicity has not been fully established. Use in an adequately ventilated laboratory hood. Avoid inhalation or skin contact. Use chemical goggles or face shield, impervious gloves and an impervious apron when working with formaldehyde (see 8.1).

4.4 An eyewash/safety shower should be located nearby and a self-contained breathing apparatus should be readily available for emergency use.

4.5 Exposure to chemicals used in this procedure must be controlled at or below levels set by governmental authorities (e.g., Occupational Safety and Health Administration's [OSHA] permissible exposure limits [PEL] as found in 29 CFR 1910.1000; see web site: www.osha.gov for latest version). In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) comprised of time weighted averages (TLV-TWA), short term exposure limits (TLV-STEL) and ceiling limits (TLV-C) are recommended as a general guide for air contaminant exposure which should be met (see 13.7).

5. Uses and Limitations

5.1 The procedure is intended for use in the range of releasable formaldehyde on hydrophobic and non-hydrophobic fabrics up to about 3500 µg/g. The upper limits are 500 µg/g if a 1:1 ratio of Nash reagent to sample solution is used in the analytical portion of the test and 3500 µg/g if a 10:1 ratio is used. The procedure

promotes formaldehyde release from odor-free, fully cured durable press fabrics that have been afterwashed (Vail, S. L. and B. A. K. Andrews, *Textile Chemist and Colorist*, Vol. 11, No. 1, January 1979, p48). For these reasons, the procedure should not be used to estimate µg/g formaldehyde in air for compliance with any mandated or voluntary standards. The procedure was originally developed to measure the "propensity of a resin-treated fabric to liberate an excessive amount of formaldehyde under hot, humid conditions." (Nuessle, A. C., *American Dyestuff Reporter*, Vol. 55, No. 17, 1966, pp48-50; also Reid, J. D., R. L. Arcenaux, R. M. Reinhardt and J. A. Harris, *American Dyestuff Reporter*, Vol. 49, No. 14, 1960, pp29-34.)

5.2 Alternatively, Test Method 206, Free and Hydrolyzed Formaldehyde, Determination of: Water Extraction Method determines free and hydrolyzed formaldehyde on the fabric from 20 µg/g up to about 3500 µg/g. This method approximates hydrolyzed formaldehyde and closely simulates normal user conditions. The appropriate test should be based on that distinction. However, since TM 206 is an aqueous immersion method, fabrics with a propensity for dye bleeding could be of concern; if the dye has an absorbance in the range of 412 nm, it could interfere with the spectrophotometer measurement. TM 112 does not use aqueous immersion; therefore there is less chance for dye contamination interfering with the spectrophotometer measurement.

6. Apparatus and Materials

6.1 Clear glass jars, Mason or equivalent canning jars, 0.95 L (1 qt) and gas sealing caps. These are clear, square glass jars with approximate dimensions of 9 cm wide × 17 cm tall, contain approximately 1L and have a screw on lid.

6.2 Small wire mesh baskets (or other suitable means for suspending fabric above the water level inside the jars; see 13.2). As an alternative to the wire mesh baskets, a double strand of sewing thread may be used to make a loop in the fabric that has been folded in half twice, suspended above the water level. The two double-thread ends are draped over the top of the jar and held securely by the jar cap.

6.3 Weighing balance, with minimum