Designation: D1975 – 21

Standard Test Method for Environmental Stress Crack Resistance of Plastic Injection Molded Open Head Pails[1]

This standard is issued under the fixed designation D1975; 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 procedures for an indication of the environmental stress crack resistance of plastic injection molded open head pails, covers, and components as a summation of the effects of container design, resin, manufacturing conditions, field performance, and other factors.

1.2 This test method may be used to evaluate a container's resistance to mechanical failure by cracking when in the presence of chemical and physical stresses.

1.3 Two procedures are provided as follows:

1.3.1 *Procedure A, Specified Stress-Crack Resistance Test Method*—This procedure is particularly useful for quality control since the conditions of the test are specified.

1.3.2 *Procedure B, User Selected Stress-Crack Resistance Test Method*—This procedure allows individual selection of test levels and is particularly useful as a design and development tool.

1.4 These procedures are not designed to test the ability of the cover gasketing material or closure to retain the test reagent. Loss or leakage of the reagent through these openings does not constitute container failure. However, this may indicate an internal pressure loss that might affect test results.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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.* Specific warning statements are given in 6.2, 10.2.3, 10.2.4, 10.2.6, and 10.2.8.

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]

D996 Terminology of Packaging and Distribution Environments

D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

3. Terminology

3.1 *Definitions*—Reference Terminology D996 for definitions applicable to this test method.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *environmental stress crack*—an external or internal crack that develops when a container is exposed to chemical or physical stresses, or both.

3.2.2 *stress crack failure*—any environmental stress crack that causes a loss or leakage of the test reagent shall be interpreted as container failure.

4. Summary of Test Method

4.1 The environmental stress-crack resistance is determined by subjecting an injection molded open head pail and cover that is filled and sealed with a stress-crack reagent to a mechanical top load at elevated temperatures. The recommended minimum test duration shall be 14 days, or as specified by the user. The time to stress-crack failure is observed.

4.1.1 Procedure A exposes a minimum of three containers to specified levels of chemical and physical stresses.

4.1.2 Procedure B exposes containers to varying chemical and physical stresses based on the user's knowledge and objectives.

[1] This test method is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.21 on Shipping Containers and Systems - Application of Performance Test Methods.

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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.

***A Summary of Changes section appears at the end of this standard**

5. Significance and Use

5.1 These procedures provide an indication of the environmental stress-crack resistance of injection molded open head pails, covers, and components from a selected group or lot. Provided the thermal history of each container is constant, this test method may be used for determining the applicability of various plastic resins and mold designs for injection molding of open head pails and covers.

5.2 The environmental stress-crack that occurs is indicative of what results when a container is exposed to agents such as soaps, organics, or any surface active solutions while under environmental conditions of stress.

5.3 Environmental stress-cracking is a mechanism of chemical attack that is highly dependent upon the test reagent, resin, container manufacturing or processing history, exposure temperature, applied stress, and other factors. The combination of these factors may result in eventual stress-crack failure.

5.4 Procedure A minimizes the potential for test variability by providing the user with rigidly defined test conditions. This test method may be used for production quality control of injection molded open head containers.

5.5 Procedure B allows the user to select and evaluate extreme individual elements or the interaction of several test levels on container performance. These conditions are established based on laboratory experience and available knowledge of the distribution environment. This test method may be used for identifying critical stresses which could aid in container design or help in minimizing the occurrence of these stresses during distribution.

5.6 This test method is intended only as a pass/fail procedure in accordance with the user's specification, or as agreed upon between the user and the supplier. It is not intended as a predictor or indicator of field performance regarding time to failure.

6. Apparatus

6.1 *Environmental Chamber*—The environmental chamber should be capable of maintaining a temperature control of ±2.5 °F (±1.4 °C) of set point. For best circulation and a constant temperature throughout, a forced air system is recommended.

6.2 *Top Load*—Requires a pail identical to the test pail be filled to rated capacity or weight and then nested above the test pail. Free weights are then placed above in amounts necessary to equal the specified top load. A calibrated pneumatic or hydraulic cylinder may be substituted for the additional free weights. (**Warning—**The potential exists for catastrophic stress-crack failure causing an instability of the applied top load. Precautionary steps should be taken (that is, through restraining or guiding of the top load) to reduce the chance for injury to the operators or damage to the test chamber and surrounding test containers.)

7. Reagents

7.1 *Procedure A; Nonyl Phenoxypoly (Ethyleneoxy) Ethanol Solution*—Prepare a 10 % solution, by volume, of the stress-cracking agent[3] and water.

NOTE 1—Due to the viscosity of the stress-cracking agent, it is helpful to prepare the solution at an elevated temperature. A maximum temperature of 122 °F (50° C) is an acceptable level provided caution is used to avoid prolonged heating and eventual volume losses.

7.2 *Procedure B*—Any reagent or proprietary product (liquid, solid, etc.) that is potentially a stress-cracking agent.

8. Sampling

8.1 A minimum of three containers are required for this test method. When possible, for direct comparison, the test containers should be produced on the same equipment, including mold and under identical conditions from the same production lot. It is suggested that test container resin, machine, mold, and molding conditions be thoroughly documented to improve statistical reliability of the test data. (Practice E122.)

9. Conditioning

9.1 Condition empty test containers at 73 °F ± 2 °F (23 °C ± 1.3 °C) 50 % ± 3 % relative humidity for 48 h prior to testing (see Practice D4332).

10. Procedure

10.1 *Procedure A—Specified Stress-Crack Resistance Method:*

10.1.1 Place the environmental chamber set point control at 122 °F ± 2 °F (50 °C ± 1.3 °C) and allow it to reach equilibrium. Fill each test specimen to 98 % of the container's maximum volumetric capacity (with cover in place) with the test reagent. Apply the cover to the pail as specified by the manufacture's closing instructions.

10.1.2 Place test specimens in the environmental chamber on an even horizontal surface. Place an identical pail filled to rated capacity with sand or water on top of each test specimen. Apply additional weight (if needed) to the top of the pail filled with sand or water to bring the total top load weight (sand or water pail plus weight) up to the values specified in Table 1. Example is shown in Fig. X1.1 in Appendix X1. Record the time and date the test was started.

10.1.3 Inspect the test pails and covers daily for any evidence of stress-crack failure. Inspection of the cover may require the removal of the top load from the test container. Stress crack may be more easily detected by placing the pail on

[3] The sole source of supply of the stress-cracking agent (nonyl phenoxypoly (ethyleneoxy) ethanol solution, known as Igepal CO-630 (Antanox CO-630)) known to the committee at this time is Rhodia, Inc. Home, Personal Care and Industrial Ingredients, CN 7500, 259 Prospect Plains Road, Cranbury, NJ 08512–7500 (1888–776–7337). If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.