Designation: D5427 – 09 (Reapproved 2014)

Standard Practice for Accelerated Aging of Inflatable Restraint Fabrics[1]

This standard is issued under the fixed designation D5427; 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 practice describes the procedures for the accelerated aging of inflatable restraint fabrics when required as a preparatory step for other test methods.

1.1.1 In Section 7, this practice lists four methods for conducting accelerated aging that are of concern to the design and manufacture of inflatable restraints. They are as follows:

Description	Section
Cycle aging (Option "A" or "B")	8.4
Heat aging (Option "A" or "B")	8.4.3.1
Humidity aging (Option "A" or "B")	8.7
Ozone aging	8.8

1.2 This practice may be used in conjunction with other ASTM test methods when subsequent tests of physical properties are required of aged fabric specimens.

1.3 Procedures and apparatus other than those stated in this practice may be used by agreement between the purchaser and the supplier with the specific deviations from the standard practice acknowledged in the report.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other.

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]

D123 Terminology Relating to Textiles

D1776 Practice for Conditioning and Testing Textiles

D6799 Terminology Relating to Inflatable Restraints

E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

2.2 *Military Standard:*

MIL-STD-810E Environmental Testing and Engineering Guidelines[3]

3. Terminology

3.1 For all terminology relating to D13.20, Inflatable restraints, refer to Terminology E145.

3.1.1 The following terms are relevant to this standard: accelerated ageing, envirionmental conditions, inflatable restraint, standard atmosphere for testing textiles

3.2 For all other terms related to textiles, see Terminology D123.

4. Summary of Practice

4.1 After conditioning in the standard atmosphere for testing textiles, test specimens are subjected to accelerated aging for heat, humidity, ozone, or cycling.

4.2 Aged specimens are then reconditioned in the standard atmosphere for testing textiles for subsequent testing of the physical properties of inflatable restraint fabrics.

5. Significance and Use

5.1 For inflatable restraints, practices for conducting accelerated aging are designed to determine the aggravated effects on a fabric from exposures to heat, humidity, or ozone, or a combination thereof. These environmental conditions may also be cycled in combination. The four accelerated aging procedures of concern to the design and manufacture of inflatable restraints are referred to as cycle aging, heat aging, humidity aging, and ozone aging.

5.2 The environmental conditions described in this practice are designed to allow restraints so that reliable comparisons may be made between different fabrics and different laboratories.

5.3 In order to achieve precise and reliable physical property comparisons of different fabrics, it is necessary to control

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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] Available from the Defense Printing Office, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5093.

accurately the humidity, temperature, ozone, and cycling conditions to which the fabric is subjected.

5.4 Fabric specimens are configured in accordance with the requirements of test methods to be conducted on the specimens subsequent to accelerated aging.

5.5 Unless otherwise specified by agreement between the purchaser and the supplier, this practice shall constitute the conditions, procedures, and equipment by which inflatable restraint fabrics are conditioned and aged. It is intended to be used as a guideline in establishing a written material specification. The specification or agreement of the purchaser and the supplier may deviate from the practices described herein when (based on experience) considerations of fabric properties, material handling equipment, or inflatable restraint system design dictate otherwise.

6. Apparatus

6.1 *Conditioning Room or Chambers:*

6.1.1 Room or chamber suitable for maintaining the standard atmosphere for testing textiles, with equipment for recording the temperature and humidity of the room.

6.1.2 For heat aging, a ventilated drying oven with a temperature range from 100 to 130 °C, ±2 °C (212 to 266 °F,± 5 °F) for 500 h, in accordance with Specification E145.

6.1.3 For humidity aging, a chamber suitable for maintaining a fixed relative humidity of 60 to 98 %, within a tolerance of ±5 %, and a fixed temperature between 30 to 100 °C ±2 °C (86 to 212 °F, ±5 °F) for at least 500 h.

6.1.4 For ozone aging, a chamber suitable for maintaining the ozone concentration at 100 ± 10 parts per hundred million (pphm), and suitable for maintaining a temperature at 38 ± 2°C (100 ± 5 °F).

6.1.5 For cycle aging, a chamber with controls for cycling through several temperatures from –40 to 107 °C ± 2 °C (–40 to 225 °F, ± 5°F) and levels of relative humidity up to 95 %, ±5 % for cycle times up to 72 h.

6.1.6 The aging chamber, the accessories contained therein, the sensors, and the data collection system shall be constructed and arranged in accordance with MIL-STD-810E, Method 507.3, Section II.

6.2 For inflatable restraints, all test equipment used in accordance with the procedures referenced in this practice shall be certified for calibration annually by an independent agency or equipment manufacturer whose results are traceable to National Institute of Science and Technology (NIST) or other national standards laboratory. The test parameters of the equipment shall be tested within the operating ranges covered in the material specification or equivalent document.

7. Sampling

7.1 Rolls of fabric are sampled to yield test specimens in accordance with the sampling plan agreed upon by purchaser and supplier. The number of test specimens and their configuration shall conform to the requirements of the ASTM test methods associated with subsequent physical property testing.

8. Procedure

8.1 Condition fabric specimens in the standard atmosphere for testing textiles for 24 h and configure them in accordance with the test method that is to follow each accelerated aging procedure, or in accordance with alternate procedures established by agreement of purchaser and supplier and acknowledged in the test report.

8.2 Expose the specimens in accordance with the procedures given in 8.4 – 8.8, or in accordance with alternate procedures established by agreement between the purchaser and the supplier and acknowledged in the report.

8.2.1 If during placement of the specimens the environmental conditions within the chamber are no longer within prescribed limits, begin the timing of the aging process only when the chamber is once again stabilized within prescribed limits.

8.2.2 Ensure that the specimens are placed in the chamber in a configuration that permits free flow of air around them during the aging process.

8.2.3 The chamber temperature shall be controlled to within ±2°C (±5°F) and the relative humidity shall be controlled to within ±5 % RH.

8.3 Interruptions to an accelerated aging process may result in exposure of the test specimen(s) to environmental conditions that are more extreme than specified and that trend in a direction away from ambient (an overtest interruption), or conditions that are less extreme than specified and that trend in a direction toward ambient (an undertest interruption).

8.3.1 If an undertest interruption occurs, keep the chamber closed in an effort to maintain tolerances. As long as the tolerances are maintained, resume testing by reestablishing the prescribed conditions and continue from the point of the interruption. If an unscheduled interruption occurs that causes the environmental conditions to exceed the allowable tolerances in the direction of standard ambient conditions, reinitiate the test at the end of the last successfully completed cycle. Any test specimen subject to an undertest interruption that fails subsequent physical property testing shall be treated as a failure and the test of the specimen(s) shall be considered valid.

8.3.2 If an overtest interruption occurs, terminate the accelerated aging process and reinitiate the process with new test specimens. Physical property tests of specimens subjected to an overtest interruption shall be considered invalid.

8.4 *Cycle Aging:*

8.4.1 Prior to conducting each phase of the cycle sequence listed in Section 8.4.2, pre-set the cycling chamber to the specified temperature and relative humidity of the phase for 60 ±5 min or until the temperature has stabilized to within ±2 °C (±5 °F), whichever is less.

8.4.2 Place the specimens in the cycling chamber, and allow the specimens to remain undisturbed for the duration of three cycles:

8.4.3 Two options are provided for Cycling Aging:

8.4.3.1 Option “A” sequence:

$$29\ \text{h}, -40\ ^\circ\text{C} \pm 2\ ^\circ\text{C}\ (-40\ ^\circ\text{F} \pm 5\ ^\circ\text{F}),\ \text{ambient RH}, \quad (1)$$

$$19\ \text{h},\ 22\ ^\circ\text{C} \pm 2\ ^\circ\text{C}\ (72\ ^\circ\text{F} \pm 5\ ^\circ\text{F}),\ 95\ \%\ \text{RH}, \quad (2)$$

$$29\ \text{h},\ 107\ ^\circ\text{C} \pm 2\ ^\circ\text{C}\ (225\ ^\circ\text{F} \pm 5^\circ\ \text{F}),\ \text{ambient RH}, \quad (3)$$

19 h, 22 °C ± 2 °C (72 °F ± 5 °F), 95 % RH, (4)

NOTE 1—The times listed do not include ramp time.

8.4.3.2 Option "B" sequence:

29 h, −40 °C ± 2 °C (−40 °F ± 5 °F), ambient RH, (5)

19 h, 22 °C ± 2 °C (72 °F ± 5 °F), 95 % RH, (6)

29 h, 105 °C ± 2 °C (221 °F ± 5 °F), ambient RH, (7)

19 h, 22 °C ± 2 °C (72 °F ± 5° F), 95 % RH, (8)

8.5 Upon completion of the cycles, remove the specimens and recondition them for 24 h in the standard atmosphere for testing textiles prior to conducting subsequent tests.

8.6 *Heat Aging:*

8.6.1 Two options are provided for temperature/duration:

8.6.1.1 Option "A" 120 ºC ±2 ºC for 336 h.

8.6.1.2 Option "B" 105 ºC ±2 ºC for 408 h.

8.6.2 Preheat the ventilated drying oven to required temperature for 60 min or until the temperature has stabilized to within ±2 °C (±5 °F).

8.6.3 Place the test specimens in the oven in a flat, horizontal configuration and allow them to remain undisturbed for specified duration as identified by Option "A" or "B".

8.7 *Humidity Aging:*

8.7.1 Two options are provided for temperature/humidity/duration:P,

8.7.1.1 Option "A" 80 °C ± 2 ºC (180 °F ± 5 ºC) and 95 % ± 2% RH for 336 h.

8.7.1.2 Option "B" 70 ºC ± 2 ºC (160 ºF ± 5º F) and 95% ± 2% RH for 408 h.

8.7.2 Preset the temperature and relative humidity in the humidity chamber as identified in Option "A" or "B"for 60 min or until the temperature has stabilized to within ±2 °C (±5 °F) and the humidity to within ± 2% RH.

8.7.3 Place the specimens in the humidity chamber, and allow the specimens to remain undisturbed at the preset conditions for.specified duration.

8.7.4 When the process is completed, remove the specimens from the humidity chamber. Precondition in accordance with Practice D1776 and then recondition the specimens for 24 h in the standard atmosphere for testing textiles prior to conducting subsequent tests.

8.8 *Ozone Aging:*

8.8.1 Preset the ozone chamber to 40 °C (100 °F), 65 % RH, and 50 pphm for 60 min or until the temperature has stabilized to within ±2 °C (±5 °F), and the ozone concentration to within ±20 pphm.

8.8.2 Place the test specimens in the ozone chamber in a flat, horizontal position and allow them to remain undisturbed at the preset conditions for 336 h.

8.8.3 When the process is completed, remove the specimens from the ozone chamber and recondition them for 24 h in the standard atmosphere for testing textiles prior to conducting subsequent tests.

9. Report

9.1 State that the fabric specimens were treated as directed in accordance with Practice D5427 for accelerated aging of inflatable restraint fabrics.

9.2 The purchaser and the supplier shall determine the exact form of the report. Unless otherwise specified, the form shall provide the following information:

9.2.1 Fabric designation,

9.2.2 Roll and lot identification,

9.2.3 Date of report,

9.2.4 Name of person certifying report,

9.2.5 Relevant specification,

9.2.6 Accelerated aging procedure(s) performed, including method/option(s) used,

9.2.7 Nature and extent of test interruptions, and

9.2.8 Deviations from standard practice procedures and apparatus.

10. Precision and Bias

10.1 No statement is made about either the precision or bias of this practice for accelerated aging of inflatable restraint fabric since the result merely prepares the fabric for subsequent physical tests not covered by this practice, and no measurements are made.

11. Keywords

11.1 accelerated aging; aging; airbag; conditioning; inflatable restraint