Designation: D5807 – 08 (Reapproved 2013)

Standard Practice for Evaluating the Overpressurization Characteristics of Inflatable Restraint Cushions[1]

This standard is issued under the fixed designation D5807; 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 covers the procedures and conditions used to evaluate the physical performance of inflatable restraint cushions during and after overpressurization testing at elevated pressures capable of causing cushion bursting using air pressurization equipment.

1.2 The physical performance characteristics that may be obtained in conjunction with this practice are internal cushion pressures determined by instrumentation and material integrity, determined by visual inspection.

1.3 This practice is applicable to all inflatable restraint cushions.

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

1.5 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.

1.6 *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 and health practices and determine the applicability of regulatory limitations prior to use.* See Section 8 for specific hazard information.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

D6799 Terminology Relating to Inflatable Restraints

3. Terminology

3.1 *Definitions:*

3.2 For all terminology relating to D13.20, Inflatable Restraints, refer to Terminology D6799.

3.2.1 The following terms are relevant to this standard: cushion, cushion overpressurization, deployment, inflatable restraint, module, standard atmosphere for testing textiles.

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

4. Summary of Practice

4.1 Inflatable restraint cushions are tested under laboratory conditions to evaluate cushion integrity when exposed to internal cushion pressures greater than deployment pressures. If cushion rupture occurs, the rupture pressure, time to rupture, and mode of rupture are recorded.

4.2 Inflatable restraint cushions are mounted into a test stand that allows for inflations under conditions that exceed deployment pressures. Instrumentation within the test stand charts inflation pressures versus time and may allow for photographic review of the overpressurization sequence.

4.3 Cushion overpressurization results are reviewed for pressure and time relationships, and post-inflation material analysis.

5. Significance and Use

5.1 This practice is intended to be a general guideline for repetitive testing, safe conduct of tests, and accurate data collection for inflatable restraints. Cushion overpressurization testing may be used for design and production validation, for manufacturing process control, for lot acceptance, or for a combination thereof.

5.2 This practice constitutes the conditions, apparatus, and procedures by which inflatable restraints are commonly tested for cushion overpressurization. It is intended to be used as a guideline in establishing a cushion specification or equivalent document. The practices in the specification may deviate from the practices described herein when (based on experience) considerations of equipment, cushion design, or other factors dictate otherwise.

[1] This practice is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.20 on Inflatable Restraints.

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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.

5.3 There exists a large variety in cushion configurations and equipment designs, obviating a standard test method for cushion overpressurization. Therefore, a cushion specification should incorporate the practices stated herein when describing a test method for testing a specific cushion geometry and apparatus design. To ensure accuracy and repeatability, the specification should also address precision and bias in a manner consistent with ASTM prescribed procedures and consistent with the particular cushion geometry, equipment in use, and test procedures.

5.3.1 Sources of variation in cushion overpressurization testing procedures include orifice size, attachment fixture, sensor location, method of attachment, presence or absence of internal bladder, accumulator size and pressure, transducer type and location, the presence or absence of tethers, presence or absence of vent plugs, and the accuracy of timing devices and pressure sensors. All sources of equipment and procedural variation should be addressed in the applicable specification.

5.4 In accordance with the applicable specification, cushions may be pressurized without bursting to determine their resistance to a fixed level of high internal pressure, or they may be subjected to increasing pressures to determine their ultimate bursting strength.

6. Apparatus

6.1 *Plastic Liner Bags,* with a combined bursting strength of 3.5 kPa (0.5 psi) or less for use as optional bladders to aid in the bursting of cushions whose fabric permeability is too high to permit ultimate bursting strength testing without them.

6.2 *Patches or Plugs,* to seal cushion vents, if cushion bursting is required and cushion overpressurization testing equipment does not provide the required air volume for bursting.

6.3 *Pressure Vessel,* capable of being charged pneumatically from 0 to no less than 865 kPa (0 to no less than 125 psi) with a tolerance of ±3 %, of sufficient volume to adequately challenge the volume of the cushion being tested, and equipped with intake and outlet air lines and a quick-release solenoid valve.

6.4 *Mounting Fixture,* capable of retaining the cushion assembly by its attachment points without damaging the cushion material, in an orientation for free expansion of the cushion geometry, and with sufficient shielding for operator protection if the cushion overpressurization testing unit is not physically isolated in a separate room from the operator during actuation.

6.5 *Pressure Transducer and Pickup Tube,* suitable for measuring pressures inside the cushion from 0–700 kPa (0–100 psi) with a tolerance of ±3 %, mounted in a static or low pressure area in the test fixture that does not interfere with cushion overpressurization.

6.6 *Data Acquisition System,* suitable for recording the output of the pressure transducer versus elapsed time of overpressurization (optional).

6.6.1 Filter requirements, data sampling rate, transducer frequency response, and amplifier frequency response shall be such that minimal effect on accuracy of the data occurs. Overall accuracy of the data acquisition system shall be within ±3 %.

6.7 *Electrical Firing Pulse Source,* suitable for actuating the inflation and for communicating with the data acquisition system dependent on an electrical signal.

6.8 *Film or Tape Video System,* suitable for recording the cushion geometry or mode of rupture during overpressurization at 1000 or more frames per second, and capable of being synchronized precisely with a firing pulse (optional).

6.9 *Lighting System,* suitable for high resolution photography (optional).

7. Interferences

7.1 The pressure transducer and/or pickup tube within the mounting fixture must be mounted in a position that does not interfere with the unfolding cushion.

7.2 The pressure versus time data is subject to recording anomalies and electronic noise. The data should be digitally filtered to obtain the underlying smooth pressure curve prior to data analysis.

8. Hazards

8.1 Personnel conducting cushion overpressurization testing in the same room as the testing unit must be equipped with the appropriate safety equipment and safety training. Examples of the necessary safety equipment include, but are not limited to, ear protection, equipment shielding, and safety glasses. Proper written safety procedures shall be provided to all test personnel for compliance with standard industry practices. There shall be compliance to all applicable Occupational Safety and Health Association (OSHA) standards.

9. Sampling

9.1 Cushion overpressurization testing is a destructive test and therefore necessitates sampling procedures if used in conjunction with lot acceptance.

9.2 For acceptance testing, the lot size is the quantity of cushions sewn on one production line in one production day.

9.3 *Lot Sample*—For acceptance testing, take at random the number of cushions directed in an applicable cushion specification or other agreement between purchaser and supplier. Consider cushions to be the primary sampling units.

9.4 Each cushion in the lot sample is a test specimen.

10. Equipment Calibration

10.1 For inflatable restraints, all test equipment used in accordance with this practice shall be certified for calibration annually by an independent agency or equipment manufacturer whose results are traceable to the 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 cushion specification or equivalent document.

11. Conditioning

11.1 Conditioning of specimens for cushion overpressurization testing is conducted at the standard atmosphere for testing textiles for at least 4 h prior to test.

12. Procedures

12.1 Select and condition cushion specimens in accordance with Sections 11 and 9.

12.2 If cushion bursting is intended and cushion overpressurization testing equipment does not provide the required air volume for bursting, seal the cushion vents with a plug or with a sewn fabric patch made of the same material as the cushion.

12.3 Mount the cushion specimen on the test fixture, ensuring that the retention mechanism does not damage the cushion material, and that the pressure transducer and pickup tube do not interfere with the inflation of the cushion.

12.4 Install a protective screen around the test fixture, if needed.

12.5 Perform all system calibrations.

12.6 Verify proper framing rate, camera settings, and lighting intensity levels, if needed.

12.7 Enter the test serial number into recording portions of the data acquisition and video systems.

12.8 Ensure the pressure vessel is pressurized sufficiently to evaluate the cushion under test.

12.9 Turn on the warning light before arming the pressurization switch.

12.10 Initiate the starting sequence and note the response of the data acquisition system to verify successful pressurization.

12.11 Pressurize the cushion until it reaches the pre-set internal pressure or until it ruptures, as specified.

12.12 Record test measurements such as maximum cushion pressure in kPa (psi), time to maximum cushion pressure in m/s, or the location and nature of the cushion rupture, as specified.

12.13 De-arm the starting switch and remove the cushion from the test stand.

13. Report

13.1 State that the tests were conducted in accordance with Practice D5807 for evaluating the overpressurization characteristics of inflatable restraint cushions.

13.1.1 If deviation from Practice D5807 occurred, any reference to this practice shall state: “Testing was performed in accordance with Practice D5807, with the following changes:

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

13.2.1 Cushion designation(s),
13.2.2 Lot identification,
13.2.3 Date of report,
13.2.4 Name of person certifying report,
13.2.5 Relevant specification,
13.2.6 Number of specimens used in each test,
13.2.7 Tests performed and data obtained,
13.2.8 Laboratory conditions if other than standard, and
13.2.9 Deviations from standard procedures and apparatus.

14. Keywords

14.1 airbag; bag burst; cushion; inflatable restraint; rupture