



Designation: D5807 – 18

Standard Practice for Evaluating the Overpressurization Characteristics of Inflatable Restraint Cushions¹

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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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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.*

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. 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

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.

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.

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 for Testing of Driver and Passenger Cushions

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 $\pm 3\%$, 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 physical and noise

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 $\pm 3\%$, 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.

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 $\pm 3\%$.

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 *High Speed 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. Apparatus for Testing of Side Curtain and Other Cushions Designed to Maintain Pressure

7.1 *Continuous Flow Compressed Air Source*, capable of supplying from 0 to no less than 345 kPa (50 psi) and preferably 690 kPa (100 psi) sufficient volume flow to adequately challenge the strength of the cushion being tested, and equipped with either manual or electrically controlled valve.

7.2 *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 physical and noise shielding for operator protection if the cushion overpressurization testing unit is not physically isolated in a separate room from the operator during actuation.

7.3 *Pressure Transducer and Pickup Tube*, suitable for measuring pressures inside the cushion from 0–700 kPa (0–100 psi) with a tolerance of $\pm 1\%$.

7.3.1 The pickup tube should be mounted coaxially through the fill nozzle or opening and extend a minimum of 100 mm past the cushion neck and into the inflatable space of the cushion, and not interfere with cushion expansion. The inner diameter of the fill nozzle should be the largest inner diameter that will fit into the cushion neck such that the coaxial pick-up tube will not significantly block the air flow into the cushion.

7.4 *Data Acquisition System*, suitable for recording the output of the pressure transducer versus elapsed time of overpressurization. Overall accuracy of the data acquisition system shall be within $\pm 1\%$. Data Acquisition system can be synchronized either manually, electrically, or through software algorithm with the cushion pressurization.