~~Designation:D5428–02 (Reapproved 2007)~~ Designation: D 5428 – 08

Standard Practice for Evaluating the Performance of Inflatable Restraint Modules[1]

This standard is issued under the fixed designation D 5428; 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 and conditions used to evaluate the physical performance of inflatable restraint modules and module components during and after deployment.

1.2 The physical performance characteristics that may be obtained by this practice are internal cushion pressures determined by instrumentation, cushion geometries determined by high-speed photography, and material integrity determined by visual inspection.

1.3 This practice is applicable to driver and passenger side inflatable restraint modules.

1.4 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 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 independent 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.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 123 Terminology Relating to Textiles

D 6799 Terminology Relating to Inflatable Restraints

2.2 *Federal Standard:*[3]

CFR 49 Code of Federal Regulations

2.3 *SAE Standard:*[4]

J211 Instrumentation for Impact Test

3. Terminology

3.1 ~~*Definitions:*~~

~~3.2For definitions of other terms used in this standard, refer to Terminology D123 and Terminology D6799.~~ Definitions:

3.2 For all terminology relating to D13.20, Inflatable Restraints, refer to Terminology D 6799.

3.2.1 The following terms are relevant to this standard: breakout pressure, cushion, deployment, inflatable restraint, inflator, maximum inflation pressure, module

3.3 For all other terms related to textiles, see Terminology D 123.

4. Summary of Practice

4.1 Inflatable restraint modules are mounted into a test stand that allows for deployments under conditions that duplicate or closely resemble the conditions in a vehicle.

4.2 Instrumentation within the test stand charts inflation pressures versus time. High-speed photography visually captures changing cushion geometries over time.

4.3 Module deployments are reviewed for pressure and time relationships, cushion geometries at one or more times during the cycle, and post-inflation material analysis.

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[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 .

Current edition approved July 1, ~~2007.~~2008. Published ~~August 2007.~~July 2008. Originally approved in 1993. Last previous edition approved in ~~2002~~2007 as D 5428 – 02(2007).

[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 Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20525.

[4] Available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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.

5.2 This practice may be used by the purchaser and the supplier to establish the criteria by which inflatable restraint modules will be tested by the supplier to determine whether a lot of material is acceptable for shipment to the purchaser.

5.3 Unless otherwise specified by agreement between the purchaser and the supplier, this practice shall constitute the test conditions, procedures, and equipment by which inflatable restraint modules are deployed for testing. It is intended to be used as a guideline in establishing a written material specification or equivalent agreement between the purchaser and the supplier. The specification 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. Interferences

6.1 The pressure transducer and pickup tube must be mounted in a position which does not interfere with the unfolding cushion.

6.2 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.

7. Apparatus

7.1 *Mounting Fixture*, suitable for simulating as closely as possible the physical features of the location of a module mounted in a vehicle. See A1.1.

7.2 *Pressure Transducer and Pickup Tube*, suitable for measuring pressures inside the cushion from 0 to 689 kPa (0 to 100 psi), mounted in a static or low-pressure area in the module that does not interfere with cushion deployment, and capable of withstanding the temperatures of the conditioning chamber. See A1.2.

7.3 *Film or Tape Video System*, suitable for recording the changing geometry of the cushion during deployment at 1000 or more frames per second, and capable of being synchronized precisely with a firing pulse.

7.4 *Data Acquisition System*, suitable for recording the output of a pressure transducer versus elapsed time of deployment. See A1.3.

7.5 *Conditioning Chamber*, suitable for maintaining the temperature of a module in a range between −55°C (−67°F) and 120°C (248°F) with a tolerance of ±2°C (±4°F). See A1.4.

7.6 *Electrical Firing Pulse Source* , suitable for actuating the inflator and able to communicate with recording devices dependent on an electrical starting signal. See A1.5.

7.7 *Lighting System*, suitable for high-resolution photography.

7.8 For inflatable restraints, all measurement 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.

8. Hazards

8.1 Code of Federal Regulations 49 classifies inflatable restraint inflators which incorporate pyrotechnic devices as Explosive Class C or Flammable Solid.

8.2 Test facilities for conducting tests on pyrotechnic devices must comply with all local and state building codes. A proper floor plan should include a physical barrier between test personnel and the device under test. In addition, a temperature-controlled environment is important for test accuracy, and a room fan is required to vent smoke and particulates from the test bay.

8.3 In consideration of safety for test personnel working with inflatable restraint devices, personnel involved in module deployments must be equipped with the appropriate equipment and safety training. Examples of the necessary safety equipment include; remote firing systems, equipment shielding, laboratory clothing, safety glasses, gloves, and electrostatic grounding straps. Proper written safety procedures shall be followed in accordance with standard ordinance and pyrotechnic industry practices. All applicable OSHA safety standards shall be identified and complied with.

9. Sampling

9.1 Assembly deployment is a destructive test and therefore necessitates sampling procedures if used in conjunction with lot acceptance. The sampling plan shall be determined by agreement between the purchaser and the supplier.

10. Temperature Conditioning

10.1 Assembly deployment is a destructive test and therefore necessitates sampling procedures if used in conjunction with lot acceptance. The sampling plan shall be determined by agreement of purchaser and supplier. Module assemblies are conditioned at cold, ambient, or hot temperatures prior to deployment. Unless otherwise specified, the conditioning temperatures are: −30°C (−22°F) for cold, 22°C (72°F) for ambient, and 80°C (176°F) for hot. Use a temperature tolerance of ±2°C (±5°F) and condition for a minimum of 4 h to ensure establishment of moisture equilibrium. Assemblies shall be placed in the conditioning chamber in a manner that allows free air movement and no direct contact with the chamber walls.