Designation: D5426 – 12 (Reapproved 2017)

Standard Practices for Visual Inspection and Grading of Fabrics Used for Inflatable Restraints[1]

This standard is issued under the fixed designation D5426; 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 These practices cover procedures for the inspection and grading of coated and uncoated woven flat and one-piece woven (OPW) fabrics, and for the inspection and culling of cut parts made of such fabrics, all of which are used in the manufacture of inflatable restraint cushions.

1.2 For ease of reference, the scope, summary of practice, significance and use, apparatus, sampling, procedure, and report sections are listed separately for each inspection practice.

Inspection Practice	Section
Fabric Rolls	7
Cut Pieces & OPW	8

1.3 These practices can be used to distinguish those fabric imperfections that may adversely affect inflatable restraint cushion fabrication or performance from those imperfections that will not.

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

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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]

D123 Terminology Relating to Textiles

D6799 Terminology Relating to Inflatable Restraints

2.2 *ASTM Adjuncts:*[3]

Reference Photographs of Imperfections

3. Terminology

3.1 For all terminology relating to D13.20, Inflatable restraints, refer to Terminology D6799.

3.1.1 The following terms are relevant to this standard: abrasion, air splice, bleedthrough, blip, broken filament, bruise, coating slub, coating streak, coating transfer, contamination, cushion, defect, filling bar, finished, foreign matter, grading, hard contamination, heavy coating streak, hole, imperfection, inflatable restraint, inspection, light coating, light coating streak, long float, loop, major imperfection, minor imperfection, missing coating, missing yarn, misweave, module, rework, sharp crease, short float, short knot, soft contamination, spit mark, stain, stitching, tight yarn, yarn streak.

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

4. Summary of Practices

4.1 Rolls of finished or coated fabric are examined for imperfections as the fabric traverses an inspection station. They are graded per Tables Tables 1-5 .

4.2 Cut pieces are inspected individually for imperfections. Cut pieces containing imperfections are culled from use for later review.

5. Significance and Use

5.1 These practices are suitable for incorporation in a specification. Any reference to material or cushion specification in these practices shall mean any similar agreement between the purchaser and supplier relating to the inspection and acceptance of fabric intended for inflatable restraint use.

5.2 These practices constitute the terminology, conditions, equipment, and procedures by which rolls of inflatable restraint fabrics or cut parts are inspected and graded.

[1] These practices are under the jurisdiction of ASTM Committee D13 on Textiles and are the direct responsibility of Subcommittee D13.20 on Inflatable Restraints.

Current edition approved Feb. 1, 2017. Published March 2017. Originally approved in 1993. Last previous edition approved in 2012 as D5426 – 12. DOI: 10.1520/D5426-12R17.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service ast service@astm.org. For *Annual Book of ASTM Standards*volume information, refer to the standrd's Document Summary page on the ASTM website.

[3] Available from: ASTM International Headquarters. Order Adjunct No. ADJD5426. Original adjunct produced in 1996.

TABLE 1 Coating Non-Uniformity

Imperfection	Definition	Limits		
		Maximum Size[A]	Minimum Separation	Maximum Frequency[B]
Soft contamination	the presence of materials not specified as part of the coating or fabric within or on the coating layer, such material visibly appearing to be of small size, smooth in surface texture, and of a thickness that does not protrude significantly above the surface of the coating layer. Examples are dirt, smudge, lint, human hair, yarn filaments, and flies and similarly small insects. Soft contamination not listed herein shall be from a known source which is demonstrated to have no adverse effect on fabric properties.	15 mm diameter		2; but none within the line where two OPW inflatable layers interface
Hard contamination	the presence of non-coating material within or on the coating layer, such material visibly appearing to be of small size, smooth in surface texture, and of a thickness that protrudes significantly above the surface of the coating layer. Examples are metal filings, glass, plastic, or wood splinters.	none		none allowed
Missing coating	portions of the coated layer containing exposed base fabric or scrape marks in the coated layer	15 mm diameter -or- 5 mm diameter		2; but none within the line where two OPW inflatable layers interface -or- 5; but none within the line where two OPW inflatable layers interface
Coating transfer	the presence of coating material on the uncoated side, covering one or more yarns			none allowed
Bleedthrough	the presence of coating material on the uncoated side, between two yarns without covering either yarn	35-mm length	500 mm	2
Coating slub	an irregularly shaped lump of coating material on the surface of the coated layer resembling a yarn slub	15 mm diameter		2 per 400 cm^2
Spit mark	an essentially round spot of coating material on the surface of the coated layer in which the coating spot is visibly at a higher rate of coverage than the surrounding material.	15 mm diameter -or- 5 mm diameter		2 per 400 cm^2 -or- 5 per 400 cm^2
Heavy coating streak	a narrow area of fabric, generally in the shape of a line oriented in the warp direction of the fabric, in which the coating layer is visibly at a higher rate of coverage than the surrounding material.	5 mm wide		No limit
Light coating crease	a narrow area of light (not missing) and heavy coating associated with localized creasing in the fabric, visibly at a lower rate of coverage than the surrounding material.	5 mm wide		3; but none within the line where two OPW inflatable layers interface
Light coating streak	a narrow area of light coating (not missing), generally in the shape of a line oriented in the warp direction of the fabric.	5 mm wide		1
Light coating (except light coating streak)	a localized amorphous area of fabric in which the coating layer is visibly at a lower rate than the surrounding material.	50 × 100 mm -or- 10 mm dia		1 -or- 5

[A] For diameter call outs, an equivalent area is permissible

[B] Per linear m (yd), or unit of area indicated. For cut pieces, limits apply to cut pieces ≤ 2 meters in longest dimension. For cut pieces > 2 meters in longest dimension, multiply limits by 1.5. Per linear m (yd), cut piece, or unit of area indicated.

5.3 A specification incorporating these practices may deviate from them to account for considerations of fabric property, material handling equipment, or inflatable restraint cushion design, or a combination thereof. Whenever such deviations from standard occur, they are recorded in the report.

5.4 These practices acknowledge that, in the normal course of production, acceptable rolls of fabric will be produced containing imperfections; subsequently, pieces will be cut from the rolls and those pieces that contain imperfections restricted in Tables 1-5 will be culled at that time.

5.5 The accuracy in the results from visually inspecting fabric using these practices is affected by the ability of the inspector to detect, identify, and evaluate the severity of an imperfection in a moving fabric or in a cut part. Such ability

TABLE 2 Yarn Non-Uniformity

Imperfection	Definition	Limits		
		Maximum Size[A]	Minimum Separation	Maximum Frequency[B]
Foreign matter	an extraneous interwoven fragment whose size, color, or texture indicates that it is not of the same material as the fibers in the base fabric			none allowed
Loop	a continuous full yarn that curls back on itself and protrudes from the surface of the fabric (synonym: *kink*, *snag*)			none allowed
Air splice	the thicker portion of a yarn resulting from entanglement of the filaments at the ends of two multifilament yarns to create a continuous yarn			2 per 400 cm^2
Blips	any short, irregularly shaped or textured portion of an individual multifilament yarn that has been woven into the fabric, including slough offs, stripbacks, fuzz balls, snarls, kinky filling less than a loop, and slubs	35-mm by 2 -mm length		2; but none within the line where two OPW inflatable layers interface
Short knot tail	a small knob of yarn and associated tails where two yarns are tied together by interlocking loops for the purpose of maintaining yarn continuity	3-mm diameter	500 mm	2
Broken filament	an individual filament, separated from a multifilament yarn bundle, that lies on the surface of the fabric			no limit

[A] For diameter call outs, an equivalent area is permissible.
[B]Per linear m (yd) or unit of area indicated. For cut pieces, limits apply to cut pieces ≤ 2 meters in longest dimension. For cut pieces > 2 meters in longest dimension, multiply limits by 1.5.

TABLE 3 Discoloration

Imperfection	Definition	Limits		
		Maximum Size[A]	Minimum Separation	Maximum Frequency[B]
Stain	an area of discoloration that penetrates the fabric surface must be from a known source which is demonstrated to have no adverse effect on fabric properties or the presence of marking ink in an area of fabric not provided for identification by an applicable specification.	3-mm diameter -or- 15 mm diameter		10 per 400 cm^2 -or- 2 per 400 cm^2
Yarn streak	discoloration or stain of an individual yarn that does not affect adjacent yarns	1000-mm length cumulative		1

[A] For diameter call outs, an equivalent area is permissible.
[B]Per linear m (yd) or unit of area indicated. For cut pieces, limits apply to cut pieces ≤ 2 meters in longest dimension. For cut pieces > 2 meters in longest dimension, multiply limits by 1.5.

TABLE 4 Miscellaneous

Imperfection	Definition	Limits		
		Maximum Size[A]	Minimum Separation	Maximum Frequency[B]
Hole	an opening not characteristic of the normal weave pattern where one or more yarns is cut, torn, or shifted			none allowed
Missing yarn	more than one yarn discontinuity resulting in a change in weave pattern			none allowed

[A] For diameter call outs, an equivalent area is permissible.
[B]Per linear m (yd) or unit of area indicated. For cut pieces, limits apply to cut pieces ≤ 2 meters in longest dimension. For cut pieces > 2 meters in longest dimension, multiply limits by 1.5.

can be affected by visual acuity, viewing distance, fabric traverse speed, lighting conditions, inspector discipline and training, and the availability and accuracy of suitable visual aids.

5.6 Systematic bias may result from using these practices whenever the precision or scale of the visual aids used to identify and quantify imperfections differs between the purchaser and supplier.

TABLE 5 Weave Non-Uniformity

Imperfection	Definition	Limits		
		Maximum Size[A]	Minimum Separation	Maximum Frequency[B]
Abrasion	a localized concentration of multiple broken filaments.			none allowed
Fold over	a hard ridge where a layer is overlapped upon itself where if applicable coating integrity is compromised			none allowed
Long float	a warp or filling yarn extending over six or more filling or warp yarns with which it should be interlaced			none allowed
Short float	a warp or filling yarn extending over five or fewer filling or warp yarns with which it should be interlaced			5 per 400 cm^2; but none within the line where two OPW inflatable layers interface
Bruise	a shift in the squareness of the weave pattern in an area that has been subjected to impact or pressure	35-mm diameter	500 mm	2
Tight yarn	a yarn with less crimp than surrounding fibers that may create puckering, which may appear to be shinier or to lie straighter in the weave pattern, or a combination thereof	35-mm length	500 mm	2
Misweave	a change in the weave pattern visually indicated by incorrect interlacing or incorrect insertion of a single unbroken yarn or a single missing yarn. (includes *mispick, missing yarn, wrong draw, jerk-in*).)	1000-mm length		1
Filling bar	a temporary change in the filling-wise density of the weave pattern that:(synonym: *stop/start mark*)			
	1. is in compliance with the specified count			no limit
	2. is not in compliance with the specified count			none allowed
Stitching	(OPW only) the presence of an inter-lace between two layers of fabric in an area not provided for interlacing by an applicable specification.			none allowed

[A] For diameter call outs, an equivalent area is permissible.
[B] Per linear m (yd) or unit of area indicated. For cut pieces, limits apply to cut pieces ≤ 2 meters in longest dimension. For cut pieces > 2 meters in longest dimension, multiply limits by 1.5.

6. Visual Aids

6.1 A calibrated measuring device or clear template of sufficient size to contain an array of circles whose diameters equal the length, diameter, separation, or area limits listed in Tables 1-5, with labeling corresponding to the terminology for each imperfection: 3, 10, 15, 35, 50, 200, 225, 300, 400 and 500 mm. The template should be positioned such that the maximum number of imperfections is captured.

6.1.1 Dimensions on the measuring device or template shall be traceable to the National Institute for Standards and Technology (NIST) (or similarly recognized standards facility) via a master reference standard to ensure accuracy.

6.2 Reference photographs of each imperfection listed in Tables 1-5 based on ADJD5426.

7. Practice for Inspecting Fabric Rolls

7.1 *Scope*—This practice describes a procedure for the inspection and grading of coated and uncoated woven fabrics used in the manufacture of inflatable restraint cushions.

7.2 *Summary of Practice:*

7.2.1 Rolls of fabric are visually inspected for the presence of imperfections and graded at an inspection station. Rolls of fabric are unwound and rewound as the fabric traverses the inspection station, with provision for interruption of the traverse for stationary inspection.

NOTE 1—In accordance with an applicable material specification, fabric is inspected full width or within a specified distance of the outer edge of the selvage, or if its in one-piece woven fabric within a specified distance of the visible line created where the two inflatable layers initially interlace.

7.2.2 Fabric inspectors grade imperfections for severity in terms of their size, relative separation, and frequency per unit area in accordance with Tables 1-5 of these practices.

7.2.3 A count of imperfections is recorded, and the roll is further processed in accordance with the applicable material specification.

7.3 *Significance and Use:*

7.3.1 This practice for inspecting rolls of fabric is used to identify imperfections on a unit area basis and to flag them in accordance with an applicable material specification.

7.3.2 The suitability of a roll of fabric for further use or processing is not determined by the presence or severity of

imperfections, but by the limits placed on rolls of fabric, if any, in the applicable material specification.

7.3.3 This practice for inspecting rolls of fabric does not differentiate between rolls of fabric intended for incorporation in driver side, passenger side, or side impact cushions, or for incorporation in front or rear panels of such cushions.

7.3.4 Whenever differences arise between the grading results reported by the supplier and those determined by the purchaser, entire rolls of fabric are set aside by the purchaser or supplier for joint visual inspection and grading. Material is accepted or rejected subsequently by mutual agreement based on the criteria in this practice and the applicable material specification.

7.4 *Apparatus:*

7.4.1 A suitable fabric inspection machine that provides a flat viewing surface and an interruptible speed-controlled fabric rewind that measures roll length.

7.4.2 An overhead, reflected lighting source mounted parallel to the viewing surface so as to illuminate with direct perpendicular impinging light rays and a minimum surface illumination level of 1075 lux (100 foot candles), and employing fluorescent lamps having a correlated color temperature of 4100 to 4500 k with white reflectors and without baffles.

7.4.3 Optional side-mounted reflected lighting source used to determine how significantly contamination protrudes from the surface of fabric in a roll or a cut piece, mounted obliquely to the viewing surface so as to illuminate with direct impinging light rays and a minimum surface illumination level of 1075 lux (100 foot candles), and employing fluorescent lamps having a correlated color temperature of 4100 to 4500 k with white reflectors and without baffles.

7.4.4 Optional back lighting (transmitted light) or other auxiliary lighting sources such as ultraviolet sources mounted as necessary for optimal visual detection of imperfections in a particular fabric.

7.5 *Sampling*—This practice for inspecting fabric rolls requires 100% inspection of the entire length and surface area of every roll of fabric used in the manufacture of inflatable restraint cushions.

7.6 *Procedure:*

7.6.1 Visually inspect and grade the face side of the fabric from a viewing distance of 1 m (yd) while the fabric is in motion.

7.6.2 Traverse the fabric longitudinally (warp-wise) through the inspection apparatus at a visual inspection speed slow enough to spot imperfections listed in Tables 1-5.

7.6.3 Using the reference photographs as guides, inspect the total length of each roll, interrupting the movement to measure the size, separation, or frequency of each imperfection.

7.6.3.1 Flag each imperfection, signaling its location in the vicinity of the imperfection or along the selvage using only the method described in the material specification. Flagging devices or marks may interfere with subsequent processing. Do not flag imperfections unless the material specification requires it, and then only in the manner described.

7.6.3.2 Unless otherwise specified, if a imperfection extends longer than 1 m (yd) in the warp direction, flag only its beginning and end, but record its entire length in the report.

7.6.4 Using the clear template and reference photographs as guides, flag imperfections if they are not allowed according to Tables 1-5 or if their size, separation, or frequency are excessive (exceed the limits of Tables 1-5).

7.6.4.1 The inspection limits of Tables 1-5 may be relaxed if purchaser and supplier mutually agree that experience and design considerations allow for imperfections not to be flagged that in the absence of such agreement would otherwise be flagged according to the limits listed in Tables 1-5. In such case, flag the imperfections if they exceed the relaxed limits.

7.6.5 Record the total length of the roll and the location of each imperfection on an inspection report, one roll per report.

7.6.6 Record the total count of imperfections for the roll on the inspection report.

Record the total length of the roll and the location of each imperfection on an inspection report, one roll per report.

7.6.6.1 If more than one imperfection is detected within a meter (yard) of fabric, include only one in the grading count total of the entire roll.

7.6.6.2 Except for those imperfections listed as having no numerical limit to their maximum allowable frequency, dissimilar imperfections must be separated by a minimum of 500 mm.

7.6.7 If the material specification establishes a maximum allowable limit for the number of imperfections, adjust the total count of imperfections per roll to account for variations in roll length. Calculate the adjusted count using (Eq 1):

$$C_a = C_t \times L_s \div L_m \tag{1}$$

where:

C_a = adjusted count,
C_t = total count recorded,
L_s = standard roll length, m (yd), and
L_m = measured roll length, m (yd).

Example—The adjusted total count for a 140-m roll of fabric with a count of seven imperfections adjusted to a standard 100-m roll length is 5:

$$C_s = C_t \times L_s + L_m = 7 \times 100 \div 140 = 5 \tag{2}$$

7.7 *Report:*

7.7.1 State that the rolls of fabric were inspected as directed in accordance with Practice D5426.

7.7.2 The purchaser and supplier shall determine the exact form of the inspection report, providing the following information:

7.7.2.1 Roll identification and lot traceability,
7.7.2.2 Name of inspector,
7.7.2.3 Date of inspection,
7.7.2.4 Fabric designation,
7.7.2.5 Relevant specification,
7.7.2.6 Space for recording imperfections, and
7.7.2.7 Deviations from standard practice procedures and apparatus.

8. Practice for Inspecting and Culling Cut Parts

8.1 *Scope*—This practice describes a procedure for the inspection and culling of pieces cut from coated and uncoated woven fabrics for subsequent incorporation into inflatable restraint cushions.

8.2 *Summary of Practice:*

8.2.1 Prior to being incorporated into inflatable restraint cushions, individual cut pieces of fabric are visually inspected for imperfections. Cut pieces containing the imperfections listed in Tables 1-5 of these practices are culled from use, and the remaining parts are approved for incorporation into airbag cushions.

8.2.2 Culled pieces are saved for subsequent review by the purchaser and supplier.

8.3 *Significance and Use:*

8.3.1 This practice for inspecting cut parts does not differentiate between cut pieces intended for incorporation in driver side, passenger side, or side impact cushions, or for incorporation in front or rear panels of a cushion. Such differentiation may be allowed by the applicable cushion specification.

8.3.2 Whenever differences arise between the grading results reported by the supplier and those determined by the purchaser, cut pieces of fabric are set aside by the purchaser or supplier for joint visual inspection and grading. Material is accepted or rejected subsequently by mutual agreement based on the criteria in this practice.

8.3.3 For the purposes of this practice, the terms *pieces, parts,* and *panels* are synonymous.

8.4 *Sampling*—This practice for inspecting and culling cut parts requires 100 % inspection of every cut part used in the manufacture of inflatable restraint cushions.

8.5 *Procedure:*

8.5.1 Remove a single cut panel from the stack of parts. Orient the coated side facing the inspector if the fabric is coated.

8.5.2 Hold the panel up to the light or place it on a backlit table top. Using the clear template and reference photographs as guides, reject parts if they contain imperfections that are not allowed according to Tables 1-5 or if their size, separation, or frequency are excessive (exceed the limits of Tables 1-5).

NOTE 2—Experience may indicate that for certain secondary fabric components such as heat shielded and tethers the limitations of Tables 1-5 may be too restrictive or not sufficiently restrictive, causing the rejection of otherwise acceptable parts or acceptance of non-conforming material. In such cases, deviations from Tables 1–5 shall be in accordance with and reported according to the applicable material specification.

8.5.2.1 For front and back faces of parts cut from one-piece woven fabric, inspect the entire inflatable portion and only the non-inflatable portion that is within 7 mm (0.25 in.) of the line where the two inflatable layers interlace. Inspect the non-inflatable portion beyond the 7 mm (0.25 in) inspection boundary only if required by and in accordance with an applicable supply agreement.

8.5.2.2 Aside from those imperfections listed in Tables 1-5 as having no limit and unless otherwise specified, cull cut parts containing two or more imperfections of different types if such imperfection are located within 500 mm of each other.

8.5.3 Accept any cut parts for production that have not been culled in accordance with 8.5.2. Save all culled parts for later review.

8.6 *Report*—The report associated with inspection of cut parts shall be agreed upon by the purchaser and supplier.

9. Keywords

9.1 airbag; cushion; grading; imperfection; inflatable restraint; inspection