Designation: D 5426 – 97

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

This standard is issued under the fixed designation D 5426; 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 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.

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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 Only major imperfections are considered in the grading systems of these practices.

1.5 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.

1.6 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.

1.7 *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:*

D 123 Terminology Relating to Textile Materials[2]

D 3990 Terminology Relating to Fabric Defects[3]

2.2 ASTM Adjuncts:[4]

Reference Photographs of Imperfections

3. Terminology

3.1 *Definitions*—For definitions of textile terms used in these practices, refer to Terminologies D 123 and D 3990.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *abrasion, n—for inflatable restraint fabrics,* a fuzzy cluster of broken filaments damaged by scraping.

3.2.2 *air splice, n—for inflatable restraint fabrics,* the thicker portion of a yarn resulting from the entanglement of the filaments at the ends of two multifilament yarns to create a continuous yarn.

3.2.3 *bleedthrough, n—for coated inflatable restraint fabrics,* the presence of coating material on the uncoated side, between two yarns, without covering either yarn.

3.2.4 *blip, n—for inflatable restraint fabrics,* 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, and slubs.

3.2.5 *broken filament, n—for inflatable restraint fabrics,* an individual filament, separated from a multifilament yarn bundle, that lies on the surface of the fabric.

3.2.6 *bruise, n—for inflatable restraint fabrics,* a shift in the squareness of the weave pattern in an area that has been subjected to impact or pressure.

3.2.7 *coating slub, n—for coated inflatable restraint fabrics,* an irregularly shaped lump of coating material on the surface of the coated layer resembling a yarn slub.

3.2.8 *coating streak, n—for coated inflatable restraint fabrics,* minor variation in the color or opacity of the coated layer.

3.2.9 *coating transfer, n—for coated inflatable restraint fabrics,* the presence of coating material on the uncoated side, covering one or more yarns.

3.2.10 *contamination, n—for coated inflatable restraint fabrics,* the presence of non-coating material in the coated layer.

3.2.11 *cushion, n—for inflatable restraints,* the inflatable fabric envelope portion of a module.

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[2] *Annual Book of ASTM Standards,* Vol 07.01.

[3] *Annual Book of ASTM Standards,* Vol 07.02.

[4] Set of reference photographs are available from ASTM Headquarters. Request ADJD5426.

3.2.12 *defect, n—specific for inflatable restraints,* an imperfection in a cut piece of fabric that judgment and experience indicate is likely to result in either hazardous or improper deployment of the inflatable restraint module in which the imperfection is incorporated.

3.2.12.1 *Discussion*—An example of a defect is a hole in the piece of fabric through which inflation gases can vent improperly.

3.2.13 *filling bar, n—for inflatable restraint fabrics,* a temporary change in the filling-wise density of the weave pattern. (Syn: *stop/start mark.*)

3.2.14 *finished, adj—for inflatable restraint fabrics,* a descriptive term for fabric that has been treated after weaving and that is suitable for coating or piece cutting.

3.2.15 *foreign matter, n—for inflatable restraint fabrics,* 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.

3.2.16 *grading, n*—the procedure used to identify and quantify the number of imperfections in a roll of fabric detected during visual inspection.

3.2.17 *hole, n—for inflatable restraint fabrics,* an opening not characteristic of the normal weave pattern where one or more yarns is cut, torn, or shifted.

3.2.18 *imperfection, n*—a departure of a quality characteristic from its intended level or state.

3.2.19 *inflatable restraint, n*—a vehicular safety device designed to cushion an occupant or equipment during collision; an airbag.

3.2.20 *inspection, n—in fabric grading,* the process of viewing, measuring, examining, or otherwise comparing the visual characteristics of a fabric with applicable requirements.

3.2.21 *long float, n—for inflatable restraints fabrics,* a small change in the weave pattern where a warp or filling yarn extends over six or more filling or warp yarns with which it should be interlaced.

3.2.22 *loop, n—for inflatable restraint fabrics,* a continuous yarn that curls back on itself and protrudes from the surface of the fabric. (Syn. *kink, snag.*)

3.2.23 *major imperfection, n—in fabric grading,* a deviation in a roll of fabric that judgment and experience indicate is likely to have an adverse affect on subsequent use or processing of the fabric.

3.2.23.1 *Discussion*—Examples of major imperfections are a yarn loop that could become snagged upon deployment of the cushion and a fabric stain that could affect the physical properties of the material.

3.2.24 *minor imperfection, n—in fabric grading,* a deviation in a roll of fabric that judgment and experience indicate is likely to have no bearing on subsequent use or processing of the fabric.

3.2.24.1 *Discussion*—Examples of minor imperfections are a seam mark and a stop/start mark.

3.2.25 *missing coating, n—for coated inflatable restraint fabrics,* portions of the coated layer containing exposed base fabric or scrape marks in the coated layer.

3.2.26 *missing yarn, n—for inflatable restraint fabrics,* a yarn discontinuity resulting in a change in weave pattern.

3.2.27 *misweave, n—for inflatable restraint fabrics,* a change in the weave pattern caused by incorrect interlacing or insertion of a yarn. (Includes *mispick, wrong, draw, jerk-in.*)

3.2.28 *module, n—for inflatable restraints,* an assembly composed of an inflator, cushion, mounting device, trigger, and cover.

3.2.29 *rework, n—for inflatable restraints,* the deviation from normal process flow remedially altering finished fabric, coated fabric, or cut pieces for the purpose of minimizing or removing a major imperfection.

3.2.30 *sharp crease, n—for inflatable restraint fabrics,* a sharp ridge that can be felt easily, caused by a hard folding of the fabric over itself not by design.

3.2.31 *short float, n—for inflatable restraints fabrics,* a warp or filling yarn extending over five or fewer filling or warp yarns with which it should be interlaced.

3.2.32 *short knot, n—for inflatable restraints fabrics,* a small knob of yarn and associated tails where two yarns are tied together by interlocking loops for the purpose of maintaining yarn continuity.

3.2.33 *spit mark, n—for coated inflatable restraint fabrics,* an essentially round spot of coating material on the surface of the coated layer.

3.2.34 *stain, n*—an area of discoloration that penetrates the fabric surface.

3.2.35 *tight yarn, n—for inflatable restraint fabrics,* 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.

3.2.36 *yarn streak, n—for inflatable restraint fabrics,* discoloration of an individual yarn that does not affect adjacent yarns.

4. Summary of Practices

4.1 Rolls of finished or coated fabric are examined for major imperfections as the fabric traverses an inspection station. They are graded on the basis of a unit area.

4.2 Cut pieces are inspected individually for major imperfections that would constitute defects in a subsequently sewn cushion. Cut pieces containing major 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.

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 sewn, and those pieces that contain major 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 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 major imperfections differs between the purchaser and supplier.

6. Visual Aids

6.1 Clear a 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, 35, 50, 200, 225, 300, and 500 mm (0.10, 0.4, 1,4, 2.0, 7.9, 8.9, 11.8, and 19.75 in.).

6.1.1 Dimensions of circles on the 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 Adjunct.

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 major 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.

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 major 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 This practice allows for no rework of finished or coated fabric.

7.3.5 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*—A suitable fabric inspection machine that provides a flat viewing area and an interruptable speed-controlled fabric rewind that measures roll length. The lighting source(s) shall be mounted at such an angle to the viewing surface as to provide sufficient illumination and clarity to ensure effective detection of the major imperfections listed in Tables 1-5.

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 major imperfections listed in Tables 1-5.

7.6.3 Using the reference photographs as guides, inspect the

TABLE 1 Coating Non-Uniformity

Imperfection	Definition	Limits		
		Maximum Size	Minimum Separation	Maximum Frequency[A]
Contamination	the presence of non-coating material in the coated layer			none allowed
Missing coating	portions of the coated layer containing exposed base fabric or scrape marks in the coated layer			none allowed
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	10-mm length		2 per 400 cm^2
Spit mark	an essentially round spot of coating material on the surface of the coated layer	3-mm diameter		2 per 400 cm^2
Coating streak	minor variation in the color or opacity of the coated layer			no limit

[A]Per linear m (yd), cut piece, or unit of area indicated.

TABLE 2 Yarn Non-Uniformity

Imperfection	Definition	Limits		
		Maximum Size	Minimum Separation	Maximum Frequency[A]
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 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	35-mm length	500 mm	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, and slubs	35-mm length	500 mm	2
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]Per linear m (yd) cut piece, or unit of area indicated.

TABLE 3 Discoloration

Imperfection	Definition	Limits		
		Maximum Size	Minimum Separation	Maximum Frequency[A]
Stain	an area of discoloration that penetrates the fabric surface	3-mm diameter	300 mm	1 per 400 cm^2
Yarn streak	discoloration of an individual yarn that does not affect adjacent yarns	50-mm length		3 per 400 cm^2
		200-mm length	500 mm	2

[A]Per linear m (yd), cut piece, or unit of area indicated.

TABLE 4 Holes

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

[A]Per linear m (yd), cut piece, or unit of area indicated.

total length of each roll, interrupting the movement to measure the size, separation, or frequency of each major imperfection.

7.6.3.1 Flag each major imperfection, signaling its location in the vicinity of the imperfection or along the selvage using only the method described in the material specification.

NOTE 1—Flagging devices or marks may interfere with subsequent processing. Do not flag major imperfections unless the material specification requires it, and then only in the manner described.

7.6.3.2 Unless otherwise specified, if a major 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).

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

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

NOTE 2—If more than one major imperfection is detected within a metre (yard) of fabric, include only one in the grading count total of the entire roll.

NOTE 3—Aside from those major imperfections listed in Tables 1-5 as having no limit and unless otherwise specified, flag two or more major imperfections of different types if they are located within 500 mm of each other.

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

$$C_a = C_t \times L_s \div L_m \quad (1)$$

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 major imperfections adjusted to a

TABLE 5 Weave Non-Uniformity

Imperfection	Definition	Limits		
		Maximum Size	Minimum Separation	Maximum Frequency[A]
Abrasion mark	a fuzzy cluster of broken filaments damaged by scraping			none allowed
Sharp crease	a sharp ridge that can be felt easily, caused by a hard folding of the fabric over itself not by design			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		500 mm	
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 caused by the incorrect interlacing or insertion of a yarn (includes *mispick, wrong draw, jerk-in*)	500-mm length		2
Filling bar	a temporary change in the filling-wise density of the weave pattern (synonym: *stop/start mark*)			no limit

[A]Per linear m (yd), cut piece, or unit of area indicated.

standard 100-m roll length is 5:

$$C_s = C_t \times L_s + L_m = 7 \times 100 \div 140 = 5 \quad (2)$$

7.7 *Report*:

7.7.1 State that the rolls of fabric were inspected as directed in accordance with Practice D 5426.

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 major 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 sewing into inflatable restraint cushions.

8.2 *Summary of Practice*:

8.2.1 Prior to being sewn into inflatable restraint cushions, individual cut pieces of fabric are visually inspected for major imperfections. Cut pieces containing the major imperfections listed in Tables 1-5 of these practices are culled from use as defective parts, 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 This practice allows for no rework of cut pieces.

8.3.4 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 4—Aside from those major imperfections listed in Tables 1-5 as having no limit and unless otherwise specified, cull cut parts containing two or more major 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; defect; grading; imperfection; inflatable restraint; inspection