Designation: C1036 – 21

Standard Specification for Flat Glass[1]

This standard is issued under the fixed designation C1036; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers the requirements for annealed, monolithic flat soda-lime glass supplied as cut sizes or stock sheets.

1.2 This specification is focused upon the quality of flat glass as produced. The specification is applicable for laboratory and field evaluation only to the extent that such evaluation can be carried out in accordance with the test method(s) prescribed herein.

1.3 This specification covers the quality requirements of flat, transparent, clear, low-iron, and tinted glass. This glass is intended to be used primarily for architectural glazing products such as coated glass, insulating glass units, laminated glass, mirrors, and spandrel glass.

NOTE 1—Reflective distortion is not addressed in this specification.

1.4 This specification covers the quality requirements of patterned or wired glasses intended to be used primarily for decorative and general glazing applications.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

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.*

2. Referenced Documents

2.1 *ASTM Standard:*[2]

C162 Terminology of Glass and Glass Products

2.2 *NFRC Standard:*[3]

NFRC 300 Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems

3. Terminology

3.1 *Definitions:*

3.1.1 For additional definitions of terms, refer to Terminology C162.

3.2 *Definitions of Key Terms:*

3.2.1 *associated distortion, n*—alteration of viewed images caused by variations in glass flatness or inhomogeneous portions within the glass.

3.2.2 *bevel, n*—angled surface at the edge of a lite of glass.

3.2.3 *blemish, n*—imperfection in the body or on the surface of the glass; for the purpose of this specification, blemishes are divided into two categories; blemishes not specifically mentioned shall each be compared to the blemish that they most closely resemble.

3.2.3.1 *linear blemish, n*—scratches, rubs, digs, and other similar imperfections, which may be straight or curved in nature; if curved, the length of such a blemish is to be measured from end to end along the curve.

3.2.3.2 *point blemish, n*—crush, knots, dirt, stones, gaseous inclusions, tin drip, and other similar imperfections.

3.2.4 *bow, n*—the deviation in flatness of a lite of glass, expressed over the entire width or length dimension of the lite or over a smaller, local span.

3.2.5 *chip, n*—indentation in the glass edge as a result of breakage of a small fragment; chips fall into two categories:

3.2.5.1 *shell chip, n*—any chip other than a v-chip.

[1] This specification is under the jurisdiction of ASTM Committee C14 on Glass and Glass Products and is the direct responsibility of Subcommittee C14.08 on Flat Glass.

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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.

[3] Available from National Fenestration Rating Council (NFRC), 6305 Ivy Ln., Suite 140, Greenbelt, MD 20770, http://www.nfrc.org.

3.2.5.2 *v-chip, n*—a chip forming an acute angle, located at the edge(s) of a glass lite and which may cause a crack in the glass.

3.2.6 *chip depth, n*—measured distance of a chip from the glass surface into the thickness.

3.2.7 *chip length, n*—maximum distance parallel to the edge of the glass from one edge of a chip to the other.

3.2.8 *chip width, n*—maximum perpendicular distance from the edge of the glass to the inner edge of the chip, as measured on the glass surface.

3.2.9 *clear glass, n*—glass formulated to have transmittance in the visible spectrum greater than 82 % (reference to NFRC 300 measurement method) at a standard thickness of 6 mm (¼ in.) with lack of color as compared to tinted glass of the same thickness.

3.2.10 *crush, n*—pitted condition with a dull appearance.

3.2.11 *cut size, n*—glass ordered cut to its final intended size.

3.2.12 *dig, n*—a deep scratch in the glass surface.

3.2.13 *dirt, n*—small particle of foreign matter embedded in the surface of flat glass.

3.2.14 *fire crack, n*—small, sometimes microscopic fissure in the edge of wired or patterned glass.

3.2.15 *flare, n*—protrusion on the glass edge or corner of an otherwise rectangular surface.

3.2.16 *gaseous inclusion, n*—round or elongated bubble in the glass.

3.2.17 *knot, n*—inhomogeneity in the form of a vitreous lump.

3.2.18 *low-iron glass, n*—glass formulated to have transmittance in the visible spectrum higher than that of clear glass of the same thickness; edge color can vary, so the glass manufacturer should be consulted regarding an application where edge color is an aesthetic consideration.

3.2.19 *patterned glass, n*—rolled flat glass having a pattern on one or both surfaces.

3.2.20 *ream, n*—linear distortion as a result of non-homogeneous layers of flat glass.

3.2.21 *rub, n*—abrasion of a glass surface producing a frosted appearance.

3.2.22 *scratch, n*—an abrasion of a glass surface in the form of a curved line, a straight line, or both.

3.2.23 *stock sheets, n*—glass ordered in sizes intended to be cut to create final or cut size (that is, uncuts, intermediates, jumbos, and lehr ends).

3.2.24 *stone, n*—crystalline inclusion in glass.

3.2.25 *string, n*—straight line or curled blemish, usually on the surface, often resulting from slow melting of a large grain of sand or foreign material.

3.2.26 *tin drip, n*—droplet of oxidized tin that falls onto, and bonds to, the top surface of float glass within the tin bath.

3.2.27 *tinted glass, n*—glass formulated to have a uniform color throughout the glass, often with the purpose of reducing one or more of the following: glare, solar heat gain, or ultraviolet (UV) transmittance.

3.2.28 *vision interference angle, n*—viewing angle at which distortion in transmission first appears (see 6.1.2).

3.2.29 *wired glass, n*—flat glass with a layer of wire mesh embedded in the glass.

4. Classification and Intended Use

NOTE 2—When referencing this specification, the user should indicate the title and edition of the specification, and the type, class, quality (including cut-size or stock sheets), size, and thickness of the glass as appropriate.

4.1 *Types, Classes, Qualities, Forms, Finishes, Meshes, and Patterns*—Glass shall be of the following types, classes, qualities, forms, finishes, meshes, and patterns as specified:

4.1.1 *Type I—Transparent Flat Glass: Class 1—Clear and Low-iron, or Class 2—Tinted:* See Table 1.

4.1.2 *Type II—Wired and Patterned Flat Glass Class 1—Clear and Low-iron, or Class 2—Tinted:* See Table 2.

5. Requirements

5.1 *Requirements for Type I (Transparent Flat Glass):*

5.1.1 *Edge Requirements*—Edges of glass shall be supplied as specified. Chips on the glass edges shall be viewed at close proximity (12 in.) without magnification, using localized lighting.

NOTE 3—Glass edges are typically supplied as factory cut. Optional edge work can be specified as seamed, ground, polished, beveled, mitered, or other, as arranged with the manufacturer.

5.1.1.1 *Shell Chips*—Shell chips are permitted within the requirements shown in Table 3, as long as there are no associated cracks, detectable without magnification, as viewed from the edge.

5.1.1.2 *V-chips*—Visible V-chips are not permitted.

5.1.2 *Dimensional Tolerances*—Tolerances for length, width, squareness, and thickness for rectangular shapes shall be in accordance with Table 4. Nonrectangular shapes shall use the same thickness tolerances in Table 4. For linear dimensions of nonrectangular shapes, the length and width requirements in Table 4 shall be used. For curvilinear dimensions of nonrectangular shapes, tolerances shall be as agreed upon by the involved parties.

TABLE 1 Type I, Class 1 and 2 Quality and Use

Quality	Typical Use
Quality-Q1 (cut-size or stock sheets)	Production of high-quality mirrors.
Quality-Q2 (cut-size or stock sheets)	Production of general use mirrors and other applications.
Quality-Q3 (cut-size or stock sheets)	Production of architectural glass products including coated, heat treated, laminated, and other select glass products.
Quality-Q4 (cut-size or stock sheets)	General glazing applications.

TABLE 2 Type II, Class 1 and 2 Quality and Use

Quality	Typical Use
Quality-Q5	Applications in which design and aesthetic characteristics are major considerations.
Quality-Q6	Applications in which functional characteristics are a consideration and blemishes are not a major concern.
Form	**Description**
Form 1	Wired glass, polished both sides
Form 2	Wired glass, patterned surfaces
Form 3	Patterned glass
Finish	**Description**
Finish 1 (F1)	Patterned one side
Finish 2 (F2)	Patterned both sides
Mesh	**Description**
Mesh 1 (M1)	Diamond
Mesh 2 (M2)	Square
Mesh 3 (M3)	Parallel strand
Mesh 4 (M4)	Special
Pattern	**Description**
Pattern 1 (P1)	Linear
Pattern 2 (P2)	Geometric
Pattern 3 (P3)	Random

5.1.3 *Blemishes*—Allowable blemishes are addressed in Section 6 and in Tables 5-7.

NOTE 4—In addition to the point blemishes allowed in accordance with Table 5, rejectable point blemishes are allowed in Stock Sheets up to the limits shown in Table 6.

5.1.4 *Uniformity*—For glass with a thickness of 6 mm (¼ in.) or less, the glass shall not vary in thickness more than 0.1 mm (0.004 in.) over a 100 mm (4 in.) length.

5.1.5 *Distortion*—Reams, strings, and other allowable distortion (in transmission) are addressed in Section 6 and Table 8.

5.1.6 *Squareness*—The squareness requirements are shown in 6.1.4 and Table 4.

5.1.7 *Bow*—The deviation in flatness of a cut size and stock sheet shall be maximum 2.6 mm per linear meter of span length (0.031 in. per linear foot of span length). See Appendix X1.

5.2 *Requirements for Type II (Wired and Patterned Flat Glass):*

5.2.1 *Wired (Forms 1 and 2):*

5.2.1.1 *Form 1 (Polished Both Sides)*—Glass may contain waviness that does not interfere with vision normal to the surface.

5.2.1.2 *Form 1 and 2 (Patterned One or Both Sides)*—Glass shall not contain visible fire cracks.

5.2.1.3 *Dimensional Tolerances*—Tolerance for length, width, and thickness shall be in accordance with Table 9.

5.2.1.4 *Wire and Mesh*—Diameter of wires shall be from 0.43 to 0.64 mm (0.017 to 0.025 in.). Discoloration and slight distortion of wire are permissible. Wired glass may contain numerous gaseous inclusions along the wire.

(1) Mesh M1, diamond shall be welded. Opening in the mesh shall not exceed 32 mm (1¼ in.) between wire intersections measured across diagonal corners of the diamond.

(2) Mesh M2, square shall be welded. Opening in the mesh shall not exceed 16 mm (⅝ in.) between wire intersections measured along a side of the square.

(3) Mesh M3, parallel strand, spacing shall be as specified.

(4) Mesh M4, as specified.

5.2.2 *Patterned (Form 3):*

5.2.2.1 *Dimensional Tolerances—Finishes F1 and F2, Patterns P1, P2, and P3*—Tolerances for Patterns P1 and P2 for length, width, and thickness shall be in accordance with Table 10. Check with the manufacturer for thickness and dimensional tolerances on random Pattern P3.

5.2.2.2 *Blemishes*—Allowable blemishes are addressed in Section 6 and in Table 11.

5.2.2.3 Patterned glass shall not contain visible fire cracks.

5.2.2.4 *Surface Pattern:*

(1) Quality Q5—Surface pattern shall be clear, sharp, defined, and free of obvious disfiguration that affects the appearance of the pattern.

(2) Quality Q6—Surface pattern shall be free of large areas of blemishes. Scattered areas of non-uniform surface and scattered surface blemishes are permissible.

NOTE 5—Patterned glass can vary slightly in both configuration and color from run to run. Glass edge requirements stated in this standard do not apply to Type II glass.

6. Test Methods

6.1 *Test Methods for Type I Glass (Transparent Flat Glass):*

6.1.1 *Viewing Conditions for Blemish Detection*—All visual inspections shall be made with 20/20 vision. View samples in the vertical position at the distance as specified in the sections following. The viewer shall be positioned perpendicular to the glass surface (Fig. 1) using the following lighting unless otherwise specified: uniform diffused background lighting with a minimum luminance of 1700 lux (160 foot-candles) and maximum of 2500 lux (230 foot-candles) measured at the center of the glass surface, or alternatively daylight (without direct sunlight).

6.1.1.1 *Blemish Detection for Point Blemish (Knots, Dirt, Stones, Crush, Gaseous Inclusions, and Other Similar Blemishes)*—Samples shall be viewed from a distance of 1 m (39 in.). If blemishes are readily detected, refer to Tables 5 and 6 for evaluation criteria.

6.1.1.2 *Point Blemish Measurement*—Point blemish size shall be determined by measuring the maximum length and maximum perpendicular width of the blemish and calculating the average of the two dimensions. The allowable blemish sizes listed in Table 5 include associated distortion for Q1 and Q2, but do not include associated distortion for Q3 and Q4.

6.1.1.3 *Detection for Linear Blemishes (Scratches, Rubs, Digs, and Other Similar Blemishes)*—Samples shall be viewed at the detection distance of 3.3 m (130 in.). The inspection shall then progress sequentially to each of the shorter distances for other applicable blemish intensities listed in Table 12. Any

TABLE 3 Allowable Shell Chip Size and Distribution for Cut Size and Stock Sheet Qualities of Type 1—Transparent Flat Glass

Description	Q1	Q2	Q3	Q4
Chip depth	Chip depth ≤ 25 % of glass thickness	Chip depth ≤ 50 % of glass thickness	Chip depth ≤ 50 % of glass thickness	Chip depth ≤ 50 % of glass thickness
Chip width[A]	Chip width ≤ 25 % of glass thickness or 1.6 mm (1/16 in.) whichever is greater	Chip width ≤ 50 % of glass thickness or 1.6 mm (1/16 in.) whichever is greater	Chip width ≤ glass thickness or 6 mm (¼ in.) whichever is greater	Not limited
Chip length[A]	Chip length ≤ 2 times the chip width[B]	Chip length ≤ 2 times the chip width[B]	Chip length ≤ 2 times the chip width[B]	Not limited

[A] For stock sheets, there is no limit for chip width and length.
[B] For a chip located at the corner of a cut size, the chip length shall not exceed the allowable chip width.

TABLE 4 Dimensional Tolerances for Rectangular Shapes of Type 1—Transparent Flat Glass

Nominal Designation		Thickness Range				Length and Width Tolerance[A]				Squareness (D1–D2)			
SI Designation,[B] mm	Traditional Designation	mm		in.		Cut Size		Stock Sheet		Cut Size		Stock Sheet	
		min	max	min	max	± mm	(± in.)	± mm	(± in.)	mm	(in.)	mm	(in.)
1.0	micro-slide	0.79	1.24	0.031	0.049	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
1.5	photo	1.27	1.78	0.05	0.07	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
2	picture	1.80	2.13	0.071	0.084	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
2.5	single	2.16	2.57	0.085	0.101	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
2.7	lami	2.59	2.90	0.102	0.114	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
3[C]	double, ⅛ in.	2.92	3.40	0.115	0.134	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
4	5/32 in.	3.78	4.19	0.149	0.165	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
5	3/16 in.	4.57	5.05	0.18	0.199	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
6	¼ in.	5.56	6.20	0.219	0.244	1.6	(1/16)	6.4	(¼)	2.0	(5/64)	3.0	(⅛)
8	5/16 in.	7.42	8.43	0.292	0.332	2.0	(5/64)	6.4	(¼)	2.8	(7/64)	6.0	(¼)
10	⅜ in.	9.02	10.31	0.355	0.406	2.4	(3/32)	6.4	(¼)	3.4	(⅛)	6.0	(¼)
12	½ in.	11.91	13.49	0.469	0.531	3.2	(⅛)	6.4	(¼)	4.5	(11/64)	10.0	(⅜)
16	⅝ in.	15.09	16.66	0.595	0.656	4.0	(5/32)	6.4	(¼)	5.7	(7/32)	12.0	(½)
19	¾ in.	18.26	19.84	0.719	0.781	4.8	(3/16)	6.4	(¼)	6.8	(¼)	14.0	(9/16)
22	⅞ in.	21.44	23.01	0.844	0.906	5.6	(7/32)	6.4	(¼)	7.9	(19/64)	16.0	(⅝)
25	1 in.	24.61	26.19	0.969	1.031	6.4	(¼)	6.4	(¼)	9.0	(11/32)	18.0	(¾)

[A] Length and width of cut size and stock sheets of flat glass include flares and bevels.
[B] These designations apply only to ASTM International and may not reflect other international standards.
[C] Within the 3 mm designation there are some applications that may require different thickness ranges such as DST. (Typical minimum thickness for DST is 0.120 in.)

blemishes readily detected from these distances shall be compared with the length and separation criteria for allowable blemishes given in Table 7.

6.1.1.4 *Blemish Distribution*—Separation between blemishes shall be determined by measuring the distance between the two closest points of the blemishes. For blemish size ranges with different separation distance criteria, the minimum separation distance is determined by the minimum separation distance required for the larger of the two blemishes. Blemishes in size ranges that are allowed without separation distance criteria shall not be compared with those that have separation criteria.

6.1.2 *Ream, Strings, and Distortion*—(See Fig. 2.) Place sample, with the direction of the draw oriented vertically, at a distance of 4.5 m (15 ft) from a zebra board with a measured illumination of 215 lux (20 foot-candles) minimum with 25 mm (1 in.) alternating black-and-white diagonal stripes oriented at 45 degrees. Start with the glass sample parallel with the zebra board (identified as 0°) and perpendicular with the viewer's line of sight. Rotate the specimen clockwise from zero until it reaches the angle at which the distortion appears and report that angle as the vision interference angle. Refer to Table 8 for evaluation criteria. If the direction of draw cannot be determined, then the sample shall also be viewed turning the

TABLE 5 Allowable Point Blemish Size and Distribution For Cut Size Qualities[A]

Blemish Size mm (in.)[B,C,D]	Q1 Quality 1	Q2 Quality 2	Q3 Quality 3	Q4 Quality 4
< 0.50 (0.02)	Allowed[E]	Allowed[E]	Allowed	Allowed
≥ 0.50 < 0.80 ≥ (0.02) < (0.03)	Allowed with a minimum separation of 1500 mm (60 in.)[F]	Allowed with a minimum separation of 600 mm (24 in.)[F]	Allowed	Allowed
≥ 0.80 < 1.20 ≥ (0.03) < (0.05)	None allowed	Allowed with a minimum separation of 1200 mm (48 in.)[F]	Allowed	Allowed
≥ 1.20 < 1.50 ≥ (0.05) < (0.06)	None allowed	Allowed with a minimum separation of 1500 mm (60 in.)[F]	Allowed with a minimum separation of 600 mm (24 in.)[F]	Allowed
≥ 1.50 < 2.00 ≥ (0.06) < (0.08)	None allowed	None allowed	Allowed with a minimum separation of 600 mm (24 in.)[F]	Allowed
≥ 2.00 < 2.50 ≥ (0.08) < (0.10)	None allowed	None allowed	None allowed	Allowed with a minimum separation of 600 mm (24 in.)[F]
≥ 2.5 ≥ (0.10)	None allowed	None allowed	None allowed	None allowed

[A] Table values are for 6 mm (¼ in.) and less. For glass thicker than 6 mm (¼ in.) and less than or equal to 12 mm (½ in.), proportionally larger blemishes are permitted but with the same minimum separation distances. (For example, a 12 mm Q3 sample with a blemish size of ≥ 3 mm < 4 mm and minimum separation of 600 mm would be allowed.) Table 5 does not apply to glass thicker than 12 mm (½ in.). Allowable blemishes for glass thicker than 12 mm (½ in.) shall be determined by agreement between the buyer and the seller.
[B] See 6.1.1.1 for detection of point blemishes.
[C] See 6.1.1.2 for measurement of point blemishes.
[D] For Q1 and Q2 only, the blemish size includes associated distortion (see 6.1.1.2).
[E] Provided that normally allowable blemishes do not form a cluster that is detectable at 1800 mm (6 ft).
[F] See 6.1.1.4 for minimum blemish separation.

TABLE 6 Point Blemishes Allowed for Stock Sheets

Glass Area	Rejectable Point Blemishes Allowed per Sheet
If glass area < 7 m^2 (75 ft^2)	One rejectable point blemish
If glass area ≥ 7 m^2 (75 ft^2), but < 14 m^2 (150 ft^2)	Two rejectable point blemishes
If glass area ≥ 14 m^2 (150 ft^2)	Three rejectable point blemishes

sample 90° and evaluated as stated above. The lower of the two interference angles measured shall be used to compare to the evaluation criteria in Table 8.

6.1.3 *Dimensional Measurements*—To measure the length and width of cut size and stock sheets of flat glass, measure the perpendicular distance from edge to edge, including flares and bevels. Measurements, including length, width, and thickness, shall meet the tolerance requirements of Table 4.

6.1.4 *Squareness Measurement*—Measure the length of both diagonals (corner to corner). The difference in length between the two diagonals (D1–D2) shall not exceed the limits set forth in Table 4.

6.1.5 *Solar/Optical Properties*—If specified, the reflectance and transmittance of glass are to be determined in accordance with NFRC 300.

6.2 *Test Methods for Type II Glass (Wired or Patterned Glass):*

6.2.1 *Associated Distortion and Blemish Appraisal*—Because of the variety of uses of patterned and wired glass, specific inspection guidelines are beyond the scope of this specification. Check with the manufacturer for more information.

6.2.2 *Dimensional Measurements*—To measure the length and width of cut size and stock sheets of flat glass, measure the perpendicular distance from edge to edge, including flares and bevels. Measurements, including length, width, and thickness shall meet the tolerance requirements of Table 9 or Table 10, or both.

6.2.3 *Point Blemish Measurement*—Point blemish size shall be determined by measuring the maximum length and maximum perpendicular width of the blemish and calculating the average of the two dimensions. The allowable blemish sizes listed in Table 11 do not include associated distortion. Glass

TABLE 7 Allowable Linear Blemish Size and Distribution for Cut Size and Stock Sheet Qualities

Linear Blemish Size[A] Intensity Length	Q1 Quality 1 Distribution	Q2 Quality 2 Distribution	Q3 Quality 3 Distribution	Q4 Quality 4 Distribution
Faint ≤ 75 mm (3 in.)	Allowed with a minimum separation of 1500 mm (60 in.)	Allowed with a minimum separation of 1200 mm (48 in.)	Allowed	Allowed
Faint > 75 mm (3 in.)	None allowed	None allowed	Allowed	Allowed
Light ≤ 75 mm (3 in.)	None allowed	Allowed with a minimum separation of 1200 mm (48 in.)	Allowed	Allowed
Light > 75 mm (3 in.)	None allowed	None allowed	Allowed	Allowed
Medium ≤ 75 mm (3 in.)	None allowed	None allowed	Allowed with a minimum separation of 600 mm (24 in.)	Allowed
Medium > 75 mm (3 in.)	None allowed	None allowed	None allowed	Allowed
Heavy ≤ 150 mm (6 in.)	None allowed	None allowed	None allowed	Allowed with a minimum separation of 600 mm (24 in.)
Heavy > 150 mm (6 in.)	None allowed	None allowed	None allowed	None allowed

[A] See Table 12 ("Blemish Intensity Chart") for definitions of Faint, Light, Medium and Heavy blemish intensity using viewing detection distance.

TABLE 8 Allowable Distortion for Cut Size and Stock Sheet Qualities of Type 1—Transparent Flat Glass

	Q1	Q2	Q3	Q4
Allowable Vision Interference Angle[A]	≥ 60°	≥ 50°	≥ 35°	≥ 25°

[A] See 6.1.2 and Fig. 2 for determining the vision interference angle.

TABLE 9 Thickness and Tolerance of Type II—Wired Glass[A]

SI Designation, mm	Traditional Designation, in.	Thickness Range, mm		Thickness Range, in.		Length and Width Tolerance	
		min	max	min	max	± mm	(± in.)
6	¼	6.4	7.6	0.252	0.299	4.8	(3⁄16)
10	⅜	8.76	10.03	0.303	0.390	4.8	(3⁄16)

[A] While the designation in millimeters and inches (traditional designation) are the same as shown in Table 4, actual wired glass thickness is greater than non-wired glass.

shall be viewed at a distance of 1.5 m (59 in.) normal to the glass surface in accordance with the lighting described in 6.1.1 (see Fig. 1).

6.2.4 *Solar/Optical Properties*—For patterned and wired glass, consult with the manufacturer when the solar and optical properties are required.

6.2.5 *Measuring the Thickness of Patterned Glass*—The thickness of patterned glass shall be determined by measuring high point to high point to the precision and accuracy in Table 10, using a measuring device with 19 mm (¾-in.) diameter or greater contact surfaces. As an alternate method, the thickness may be measured using two bars with flat and parallel surfaces 75 mm (3 in.) long or greater by 6 mm (0.25 in.) wide or greater by 6 mm (0.25 in.) thick or greater.

7. Package Marking

7.1 Each package of glass shall be identified by the manufacturer and include the manufacturer's name or trademark, nominal thickness, glass description, date of manufacture or date of final packaging, and place of manufacture.

8. Keywords

8.1 architectural glass; clear glass; flat glass; glazing; low-iron glass; patterned glass; tinted glass; transparent glass; wired glass

TABLE 10 Thickness and Tolerance of Type II—Patterned Glass

Designation, mm	Traditional Designation	Thickness Range, mm		Thickness Range, in.		Length and Width Tolerance	
		min	max	min	max	± mm	(± in.)
2	Picture	1.80	2.14	0.071	0.084	1.6	(1/16)
2.5	Single	2.15	2.90	0.085	0.114	1.6	(1/16)
3	Double 1/8 in.	3.00	3.61	0.118	0.142	1.6	(1/16)
4	5/32 in.	3.62	4.37	0.143	0.172	1.6	(1/16)
5	3/16 in.	4.39	5.42	0.173	0.213	1.6	(1/16)
5.5	7/32 in.	5.43	5.90	0.214	0.232	2.4	(3/32)
6	1/4 in.	5.70	7.60	0.224	0.299	3.2	(1/8)
8	5/16 in.	7.61	9.10	0.300	0.358	4.0	(5/32)
10	3/8 in.	9.11	10.70	0.359	0.421	4.8	(3/16)
12	1/2 in.	11.50	13.00	0.453	0.512	4.8	(3/16)

TABLE 11 Allowable Blemish Size and Distribution for Cut Size and Stock Sheet of Type II—Patterned Glass[A]

Blemish Size[B] mm (in.)	Q5 Quality 5	Q6 Quality 6
< 2.50 (0.10)	Allowed	Allowed
≥ 2.50 < 4.00 ≥ (0.10) < (0.16)	Allowed with a minimum separation of 600 mm (24 in.)	Allowed with a minimum separation of 600 mm (24 in.)
≥ 4.00 < 6.00 ≥ (0.16) < (0.24)	Allowed with a minimum separation of 1200 mm (48 in.)	Allowed with a minimum separation of 1200 mm (48 in.)
≥ 6.00 < 8.00 ≥ (0.24) < (0.31)	Allowed with a minimum separation of 1500 mm (60 in.)	Allowed with a minimum separation of 1500 mm (60 in.)
≥ 8.00 < 10.00 ≥ (0.31) < (0.39)	Allowed with a minimum separation of 1500 mm (60 in.)	Allowed with a minimum separation of 1500 mm (60 in.)
≥ 10.00 < 15.00 ≥ (0.39) < (0.59)	Allowed with a minimum separation of 1500 mm (60 in.)	Allowed with a minimum separation of 1500 mm (60 in.)
≥ 15.00 < 19.00 ≥ (0.59) < (0.75)	Not allowed	Allowed with a minimum separation of 1500 mm (60 in.)
> 19.00 (0.75)	Not allowed	Not allowed

[A] Table values are for 6 mm (¼ in.) and less. For glass thicker than 6 mm (¼ in.) and less than or equal to 12 mm (½ in.), proportionally larger blemishes are permitted amidst the same minimum separation distances. For example, a 12 mm Q5 sample with a blemish size of ≥ 20 mm < 30 mm, and a minimum separation of 1500 mm would be allowed. Table 11 does not apply to glass thicker than 12 mm (½ in.). Allowable blemishes for glass thicker than 12 mm (½ in.) shall be determined by agreement between the buyer and the seller.

[B] See 6.2.3 for measurement of point blemishes.

TABLE 12 Blemish Intensity Chart

Detection Distance	Blemish Intensity
3.3 m (130 in.)	Heavy
1 m (39 in.)	Medium
0.2 m (8 in.)	Light
Less than 0.2 m (8 in.)	Faint

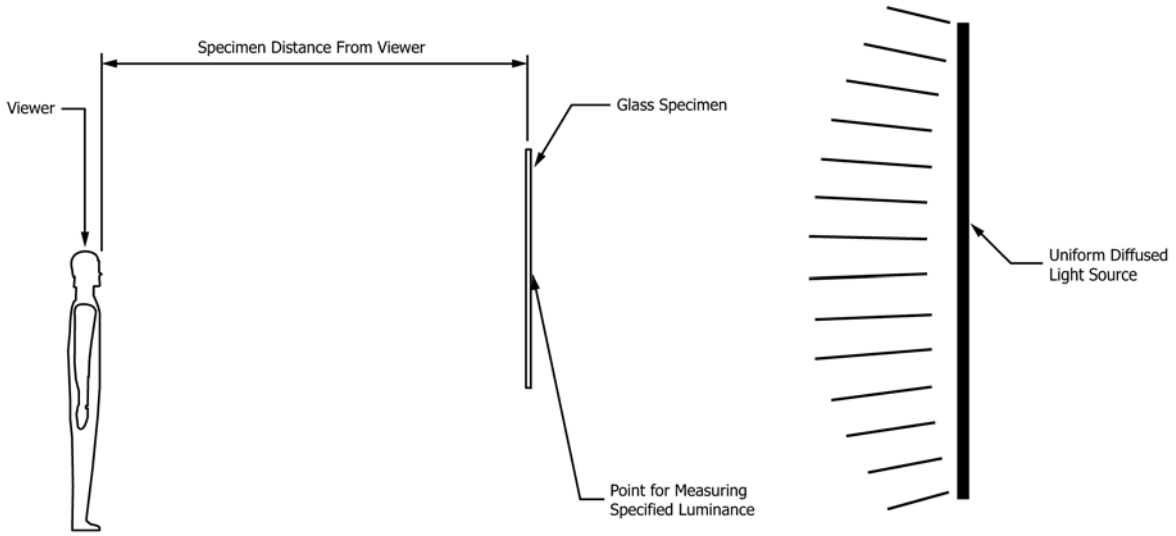

FIG. 1 Viewing Conditions for Blemish Detection

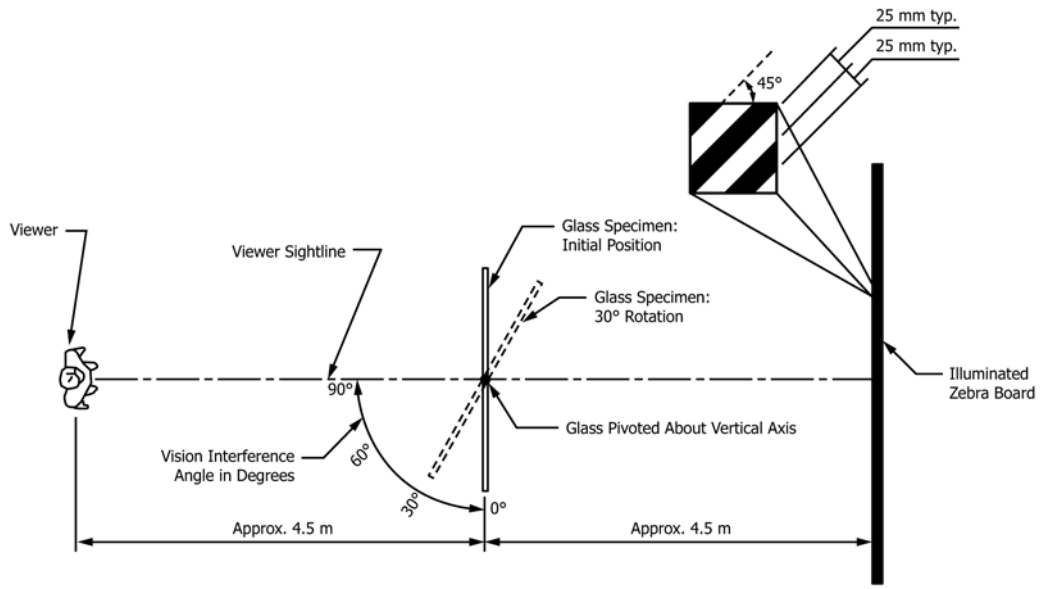

FIG. 2 Vision Interference Angle Procedure

APPENDIX

(Nonmandatory Information)

X1. BOW INSPECTION METHOD

X1.1 Equipment

X1.1.1 *Straight Edge Device*—A true straight edge, wire, string or monofilament fishing line long enough to span the section of glass being checked; two large binder clips, tape, or other method used to hold down the ends of the wire/string/line; and approximately 150 mm (6 in.) graduated steel rule, feeler, or tapered gauge. A bow measurement stand and digital measuring devices may be substituted for this manual measurement method.

X1.2 Procedure

X1.2.1 The glass is placed vertically on two blocks located as nearly as possible at the quarter points of the longest edge in a free-standing position and supported to prevent falling. Each of the four sides are checked for overall bow by positioning the straight edge device against the concave portion of the glass within 25 mm (1 in.) of the glass edge and parallel to the glass edge. In a similar fashion, the approximate horizontal and vertical centerlines are checked for overall bow. The span length is determined by measuring the distance between the two adjacent points of contact of the straight edge device and the glass surface. Normally the span length is between the points where the straight edge device is touching or attached to the ends of the glass except where localized bow or an inflection point is present in the glass. In the vicinity of an inflection point, measurements are made on both glass surfaces. (See Fig. X1.1.) The perpendicular distance or gap from the glass surface to the straight edge device at the point of maximum value, as measured with a 6 in. steel rule or feeler or tapered gage, is determined for the length of the span being checked. For jumbo size glass sheets, the glass may be cut down to sizes that are more easily and safely handled. Note that in this case the measured bow is only an estimate of the overall bow. The measured gap value is divided by the span length and compared to the maximum bow allowable. For localized bow or bow surrounding an inflection point, the calculated bow value for each span of glass is compared to the maximum bow allowable.

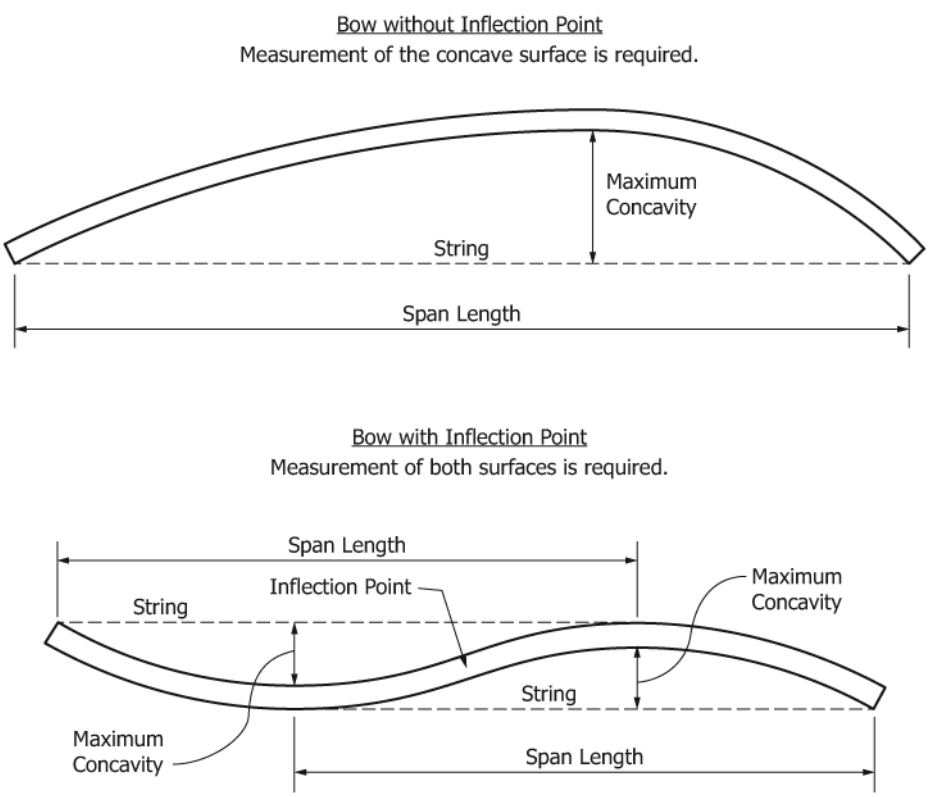

FIG. X1.1 Exaggerated View of Glass Bow