



Designation: C1036 – 11^{ε1}

Standard Specification for Flat Glass¹

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

^{ε1} NOTE—Editorial changes were made in February 2012.

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 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, and tinted glass. This glass is intended to be used primarily for architectural glazing products including: coated glass, insulating glass units, laminated glass, mirrors, spandrel glass, or similar uses.

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 given 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
[C162 Terminology of Glass and Glass Products](#)

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.

- 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*—For additional definitions of terms, refer to Terminology [C162](#).

3.2 *Definitions of Terms Specific to This Standard*:

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:

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, and other similar imperfections.

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

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

3.2.6 *chip width, n*—perpendicular distance from the edge of the glass to the inner edge of the chip.

3.2.7 *crush, n*—lightly pitted condition with a dull gray appearance.

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

3.2.9 *dig, n*—deep, short scratch.

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

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

³ National Fenestration Rating Council, 84884 Georgia Ave., Suite 320, Silver Spring, MD 20910.

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

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

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

3.2.15 *line*, *n*—fine cords or string, usually on the surface of flat glass.

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

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

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

3.2.19 *scratch*, *n*—damage on a glass surface in the form of a line caused by the movement of an object across and in contact with the glass surface.

3.2.20 *shell chip*, *n*—circular indentation in the glass edge as a result of breakage of a small fragment out of an otherwise regular surface.

3.2.21 *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).

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

3.2.23 *string*, *n*—straight or curled line, usually resulting from slow solution of a large grain of sand or foreign material.

3.2.24 *tinted glass*, *n*—glass formulated to have a uniform color throughout the glass, with the purpose of reducing glare (visible transmittance), solar heat gain, or visible/ultraviolet (UV) transmittance.

3.2.25 *v-chip*, *n*—v-shaped imperfection in the edge of the glass lite.

3.2.26 *vision interference angle*, *n*—viewing angle at which distortion in transmission first appears (see Fig. 1).

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

3.2.28 *bow*, *n*—a condition in which a lite of flat glass departs from a true plane.

3.2.29 *clear glass*, *n*—glass formulated to have high transmittance in the visible spectrum greater than 82 % (reference to NFRC 300 measurement method) at a standard thickness of 6 mm (1/4 in.) with high clarity and lack of color as compared to tinted glass of the same thickness. This includes glass with ultra high transmittance for additional clarity. Edge color of clear glass can vary so the glass manufacturer should be consulted regarding an application where edge color is an aesthetic consideration.

4. Classification and Intended Use

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

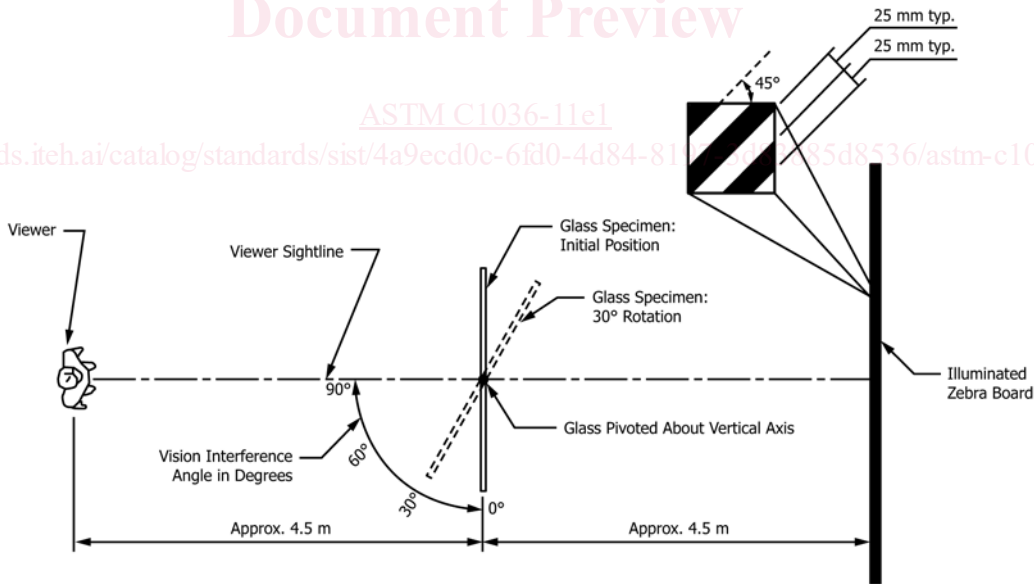


FIG. 1 Vision Interference Angle Procedure

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

4.1.1 *Type I—Transparent Flat Glass:*

4.1.1.1 *Class 1—Clear:*

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.

4.1.1.2 *Class 2—Tinted:*

Quality	Typical Use
Quality-Q1	Not available.
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.

4.1.2 *Type II—Patterned and Wired Flat Glass:*

4.1.2.1 *Class 1—Clear*

4.1.2.2 *Class 2—Tinted:*

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

Quality	Typical Use
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
Pattern 4 (P4)	Special

5. Requirements

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

5.1.1 *Edge Requirements*—Edges of glass shall be supplied as specified:

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. See manufacturer’s literature for more information.

5.1.1.1 *Shell Chips*—Shell chips are permitted within the requirements shown in **Table 1**.

5.1.1.2 *V-Chips*—Visible V-chips are not permitted. (See **6.1.1** for viewing criteria.)

5.1.2 *Dimensional Tolerances*—Tolerances for length, width, squareness, and thickness for rectangular shapes shall be in accordance with **Table 2**. Nonrectangular shapes shall use the same thickness tolerances in **Table 2**. For linear straight line dimensions of nonrectangular shapes, the length and width requirements in **Table 2** shall be used. For curvilinear dimensions of nonrectangular shapes, tolerances shall be as agreed upon by the involved parties.

5.1.3 *Blemishes*—Allowable blemishes are addressed in **Section 6** and in **Tables 3-5**.

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.

TABLE 1 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 (⅛ in.) whichever is greater	Chip width ≤ 50 % of glass thickness or 1.6 mm (⅛ 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	Chip length ≤ 2 times the chip width	Chip length ≤ 2 times the chip width	Not limited

^A For stock sheets, there is no limit for chip width and length.

TABLE 2 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	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
1.5	photo	1.27	1.78	0.05	0.07	1.6	(¹ / ₁₆)	6.4	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
2	picture	1.80	2.13	0.071	0.084	1.6	(¹ / ₁₆)	6.4	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
2.5	single	2.16	2.57	0.085	0.101	1.6	(¹ / ₁₆)	6.4	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
2.7	lami	2.59	2.90	0.102	0.114	1.6	(¹ / ₁₆)	6.4	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
3 ^C	double, ¹ / ₈ in.	2.92	3.40	0.115	0.134	1.6	(¹ / ₁₆)	6.4	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
4	⁵ / ₃₂ in.	3.78	4.19	0.149	0.165	1.6	(¹ / ₁₆)	6.4	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
5	³ / ₁₆ in.	4.57	5.05	0.18	0.199	1.6	(¹ / ₁₆)	6.4	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
6	¹ / ₄ in.	5.56	6.20	0.219	0.244	1.6	(¹ / ₁₆)	6.4	(¹ / ₄)	2.0	(⁵ / ₆₄)	3.0	(¹ / ₈)
8	⁵ / ₁₆ in.	7.42	8.43	0.292	0.332	2.0	(⁵ / ₆₄)	6.4	(¹ / ₄)	2.8	(⁷ / ₆₄)	6.0	(¹ / ₄)
10	³ / ₈ in.	9.02	10.31	0.355	0.406	2.4	(³ / ₃₂)	6.4	(¹ / ₄)	3.4	(¹ / ₈)	6.0	(¹ / ₄)
12	¹ / ₂ in.	11.91	13.49	0.469	0.531	3.2	(¹ / ₈)	6.4	(¹ / ₄)	4.5	(¹¹ / ₆₄)	10.0	(³ / ₈)
16	⁵ / ₈ in.	15.09	16.66	0.595	0.656	4.0	(⁵ / ₃₂)	6.4	(¹ / ₄)	5.7	(⁷ / ₃₂)	12.0	(¹ / ₂)
19	³ / ₄ in.	18.26	19.84	0.719	0.781	4.8	(³ / ₁₆)	6.4	(¹ / ₄)	6.8	(¹ / ₄)	14.0	(⁹ / ₁₆)
22	⁷ / ₈ in.	21.44	23.01	0.844	0.906	5.6	(⁷ / ₃₂)	6.4	(¹ / ₄)	7.9	(¹⁹ / ₆₄)	16.0	(⁵ / ₈)
25	1 in.	24.61	26.19	0.969	1.031	6.4	(¹ / ₄)	6.4	(¹ / ₄)	9.0	(¹¹ / ₃₂)	18.0	(³ / ₄)

^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 3.0 designation there are some applications that may require different thickness ranges such as DST. (Typical minimum thickness for DST is 0.120 in.)

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

5.1.6 *Squareness*—The squareness requirements for cut glass are shown in 6.1.4 and Table 2.

5.2 *Requirements for Type II (Patterned and Wired 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 & 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 7.

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 (5⁄8 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, P3, and P4*—Tolerances for Patterns P1 and P2 for length, width, and thickness shall be in accordance with Table 8. Check with the manufacturer for thickness and dimensional tolerances on random Pattern P3 and special Pattern P4.

5.2.2.2 *Blemishes*—Allowable blemishes are addressed in Section 6 and in Table 9.

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 4—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)*: