



Designation: ~~C1036-06~~ Designation: C1036 – 11

## Standard Specification for Flat Glass<sup>1</sup>

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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the 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 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:*<sup>2</sup>  
C162 [Terminology of Glass and Glass Products](#)
- 2.2 *NFRC Standard:*<sup>3</sup>  
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.~~ 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.

<sup>1</sup> 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. Current edition approved Oct. 15, 2006; 1, 2011. Published November 2006; October 2011. Originally approved in 1985. Last previous edition approved in 2004 as C1036 – 04. DOI: 10.1520/C1036-06.10.1520/C1036-11.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

- 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.
- 3.2.12 *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. 42).
- 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.

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 I—Clear:*

**TABLE 1 Allowable Shell Chip Size and Distribution (Type I Glass) for Cut Size and Stock Sheet Qualities**

Description	Q1	Q2	Q3	Q4
Chip depth	Chip depth $\leq$ 25 % of glass thickness	Chip depth $\leq$ 50 % of glass thickness	Chip depth $\leq$ 50 % of glass thickness	Chip depth $\leq$ 50 % of glass thickness
Chip width <sup>A</sup>	Chip width $\leq$ 25 % of glass thickness or 1.6 mm (1/16 in.) whichever is greater	Chip width $\leq$ 50% of glass thickness or 1.6 mm (1/16 in.) whichever is greater	Chip width $\leq$ glass thickness or 6 mm (1/4 in.) whichever is greater	Not limited
Chip length <sup>A</sup>	Chip length $\leq$ 2 times the chip width	Chip length $\leq$ 2 times the chip width	Chip length $\leq$ 2 times the chip width	Not limited

<sup>A</sup> Chip width for stock sheet and lengths, there are no applicable limits for stock chip width and length.

**TABLE 2 Dimensional Tolerance for Rectangular Shapes of Type 1 Transparent, Flat Glass<sup>A</sup>**

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

<sup>A</sup> Length and width of cut size and stock sheets of flat glass include flares and bevels.

<sup>B</sup> These designations apply only to ASTM International and may not reflect other international standards.

<sup>C</sup> 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.)

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.

**TABLE 3 Allowable Point Blemish Size and Distribution For Cut Size Qualities<sup>A</sup>**

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

<sup>A</sup> Table values are for 6.0 mm (¼ in.) and less. For glass thicker than 6.0 mm (¼ in.) and less than or equal to 12.0 mm (½ in.), they may contain proportionally larger blemishes for the same minimum separation distances. (For example, a 12-mm Q3 sample with a blemish size of ≥ 3.0 < 4.0 mm, the allowable minimum separation would be 600 mm.) Table 3 does not apply to glass thicker than 12.0 mm (½ in.). Allowable blemishes for glass thicker than 12.0 mm (½ in.) shall be determined by agreement between the buyer and the seller.

<sup>B</sup> See 6.1.1.1 for detection of point blemishes.

<sup>C</sup> See 6.1.1.2 for measurement of point blemishes.

<sup>D</sup> For Q1 and Q2 only, the blemish size includes associated distortion (see 6.1.1.2).

<sup>E</sup> Provided that normally-allowed detectable blemishes do not form a cluster that is detectable at 1800 mm (6 ft).

<sup>F</sup> See 6.1.1.4 for minimum blemish separation.

**TABLE 4 Point Blemishes Allowed for Stock Sheets**

NOTE 1—In addition to the point blemishes allowed per Table 3, rejectable point blemishes are allowed in Stock Sheets up to the limits shown in Table 4.

Glass Area	Rejectable Point Blemishes Allowed per Sheet
If glass area < 7 m <sup>2</sup> (75 ft <sup>2</sup> ) If glass area < 7 m <sup>2</sup> (75 ft <sup>2</sup> )	Allowable blemishes per Table 3 PLUS one rejectable point blemish One rejectable point blemish
If glass area ≥ 7 m <sup>2</sup> (75 ft <sup>2</sup> ) but < 14 m <sup>2</sup> (150 ft <sup>2</sup> ) If glass area ≥ 7 m <sup>2</sup> (75 ft <sup>2</sup> ) but < 14 m <sup>2</sup> (150 ft <sup>2</sup> )	Allowable blemishes per Table 3 PLUS two rejectable point blemishes Two rejectable point blemishes
If glass area ≥ 14 m <sup>2</sup> (150 ft <sup>2</sup> ) If glass area ≥ 14 m <sup>2</sup> (150 ft <sup>2</sup> )	Allowable blemishes per Table 3 PLUS three rejectable point blemishes Three rejectable point blemishes

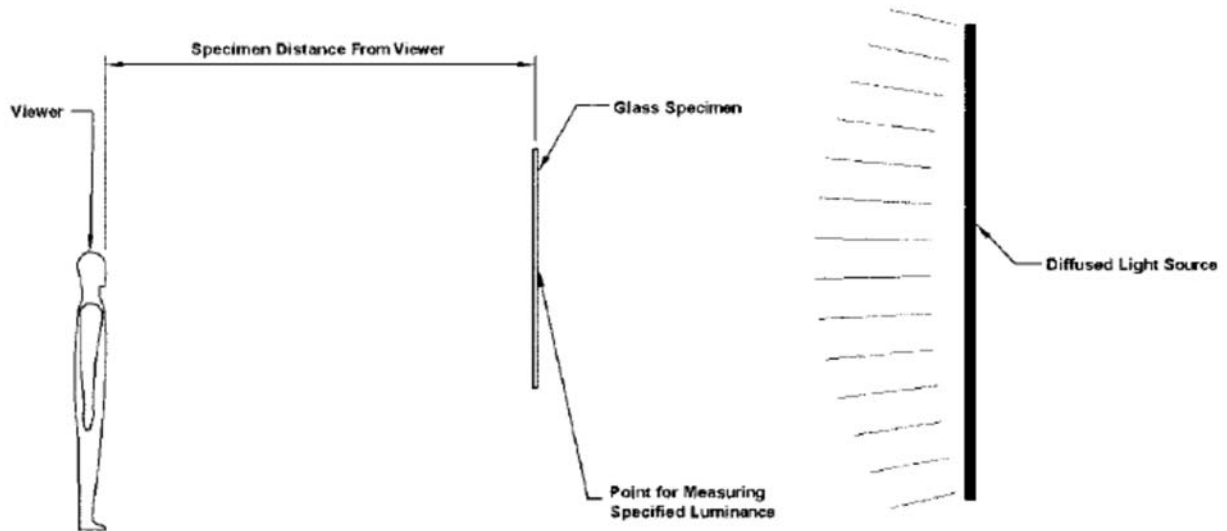


FIG. 1 Viewing Conditions for Blemish Detection

TABLE 5 Allowable Linear Blemish Size and Distribution for Cut Size and Stock Sheet Qualities

Linear Blemish Size <sup>A</sup> 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

<sup>A</sup> See 6.1.1.3 for detection of linear blemishes.

4.1.2 Type II—Patterned and Wired Flat Glass:

4.1.2.1 Class 1—Clear

4.1.2.2 Class 2—Tinted:

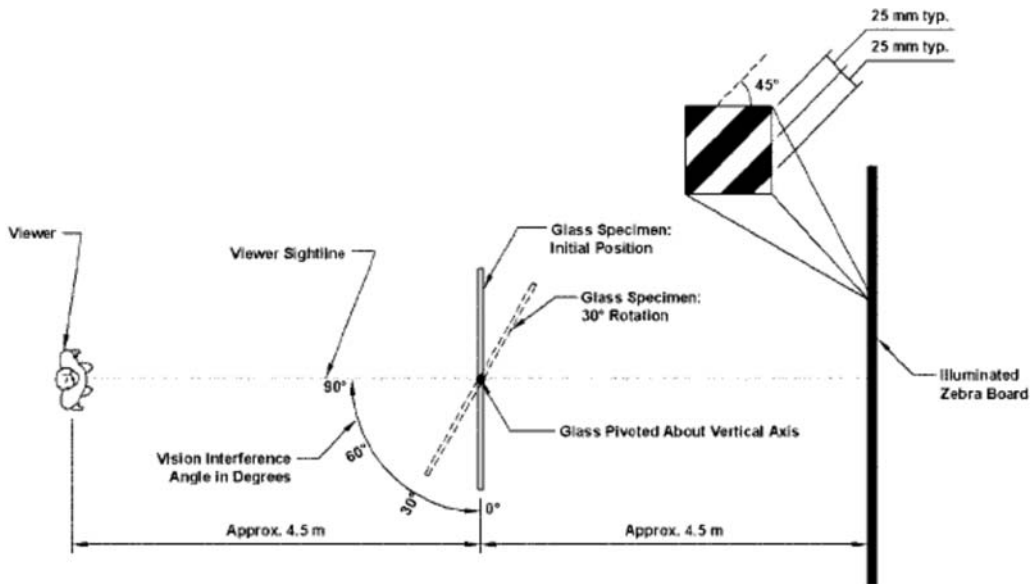


FIG. 2 Vision Interference Angle Procedure

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
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:

NOTE3—Edges may be supplied or specified, or both, as factory cut, seamed, ground, polished, beveled, mitered, and so forth. See manufacturers' literature for more information. 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.