~~Designation:C1172–03~~ Designation: C 1172 – 09

Standard Specification for Laminated Architectural Flat Glass[1]

This standard is issued under the fixed designation C 1172; 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 This specification covers the quality requirements ~~for cut sizes~~ of flat laminated glass consisting of two or more lites of glass bonded with an interlayer material for use in building glazing.

1.2 Depending on the number, thickness and treatment of ~~plies,~~lites, and the number and thickness of interlayers, the glass shall be laminated for applications including but not limited to safety security, detention, hurricane/cyclic-wind ~~resistance,~~resistant, blast resistant, bullet resistant and sound reduction glazing applications. Laminated glass used in furniture applications is not included in this specification.

1.3 Optical distortion and the evaluation thereof ~~is~~are not currently within the scope of the standard. Mockups are recommended as a method to evaluate glass. (See Appendix X1.)

1.4 The dimensional values, except thickness designations, stated in inch-pound units are to be regarded as the standard. The values ~~given~~ in parenthesies are for information only.

1.5 The following safety hazards caveat pertains only to the test method portion, Section 7, of this specification. *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 Reference to these documents shall be the latest revision unless otherwise specified by the authority applying this specification.

2.2 *ASTM Standards:*

C 162 Terminology of Glass and Glass Products

C 1036 Specification for Flat Glass

C 1048 Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass

C 1376 Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass

C 1422 Specification for Chemically Strengthened Flat Glass

C 1503 Specification for Silvered Flat Glass Mirror

E 308 Practice for Computing the Colors of Objects by Using the CIE System

E 1886 Test ~~Methods~~Method for Performance of Exterior Windows, Curtain Walls, Doors, and ~~Storm Shudders~~ Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

E 1996 Specification for Performance of Exterior Windows, Curtain Walls, Doors, and ~~Storm Shudders~~ Impact Protective Systems Impacted by Windborne Debris in Hurricanes

F 1233 Test Method for Security Glazing Materials ~~and~~And Systems

F 1642 Test Method for Glazing and Glazing Systems ~~subject~~Subject to Airblast ~~Loading~~[5]Loadings

F 1915 Test Methods for Glazing for Detention Facilities

2.3 *ANSI Standard:*

Z97.1 Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Tests[2]

2.4 *Federal Document:*[3]

CPSC 16CFR1201 Consumer Product Safety Commission Safety Standard for Architectural Glazing Materials

2.5 *UL Standards:*[4]

---

[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.
~~Current edition approved July 10, 2003. Published September 2003. Originally approved 1991. Last previous edition approved 1996 as C1172–96ε1.~~
Current edition approved May 1, 2009. Published June 2009. Originally approved 1991. Last previous edition approved 2003 as C 1172 – 03.

[2] ~~Annual Book of ASTM Standards, Vol 15.02.~~
[2] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[3] ~~Annual Book of ASTM Standards, Vol 06.01.~~
[3] Available from U.S. Consumer Product Safety Commission (CPSC), 4330 East West Hwy., Bethesda, MD 20814, http://www.cpsc.gov.

[4] ~~Annual Book of ASTM Standards, Vol 04.12.~~

UL 752 Standard for Bullet Resisting Materials
UL 972 Standard for Burglary Resisting Glazing Materials

3. Terminology

3.1 *Definitions*—Refer to Terminology C 162, Specifications C 1036 ~~or C1048~~ or C 1048, as appropriate.
3.1.1 *blemishes in flat glass*—Refer to Specifications C 1036 ~~or C1048~~ or C 1048, as appropriate.
3.2 *Definitions of Terms Specific to This Standard:*
3.2.1 *adhesion chips*—See *fuse* .
3.2.2 *blow-in*—a separation of glass and interlayer at or close to the laminate edge caused by penetration of the autoclaving medium into the edge during manufacturing.
3.2.3 *boil (bubble)*—a gas pocket in the interlayer material or between the glass and interlayer.
3.2.4 *covered edge*—the ~~perimetric~~peripheral area of the laminate covered by the channel or sash when installed.
3.2.5 ~~*decorative glass*—glass with an ornamental appearance created by a textured glass surface (patterned glass), design printed interlayer, application of decal(s) to the glass or interlayer, or other embellishments performed on or to the glass or interlayer material to give the glass an ornamental appearance.~~
~~3.2.6~~*delamination*—a condition in which one or two of the lites of glass loses the bond between the glass lite and the interlayer.
~~3.2.7~~
3.2.6 *discoloration*—a visibly noticeable color change (from original) in the appearance of a material.
~~3.2.8~~
3.2.7 *distortion*—the inability to see an image clearly; the image is twisted out of natural shape.
~~3.2.9~~
3.2.8 *edge boil*—See ~~*boil (bubble)* .~~
~~3.2.10*edge cover*—See *covered edge*.~~
~~3.2.11~~—*See boil (bubble).*
3.2.9 *exposed edge*—the ~~perimetric~~peripheral area of the laminate exposed to the environment after installation.
~~3.2.12~~3.2.10 *fuse*—a glass particle or crystalline material that is permanently bonded to a surface of a lite.
~~3.2.13*glass edge bite*—See *covered edge*.~~
~~3.2.14~~
3.2.11 *hair*—a slender, pigmented filament from human or animal epidermis or other thread-like filament.
~~3.2.15~~
3.2.12 *inside dirt*—foreign material trapped inside the laminate.
~~3.2.16~~
3.2.13 *interlayer*—~~a layer or multiple layers of material acting as an adhesive between plies of glass which adds additional performance to the finished product, for example, impact resistance, solar control, acoustical insulation.~~
~~3.2.17*laminate*—See *laminated glass*.~~
~~3.2.18*laminated bullet resistant glass*—multiple lites of flat glass, bonded by interlayer material, that resist penetration from medium- to super-power arms and high-power rifles.~~
~~3.2.19~~—*a layer or multiple layers of material acting as an adhesive between lites of glass which adds additional performance to the finished product, for example, impact resistance, solar control, acoustical insulation.*
3.2.14 *laminated glass*—an assembly consisting of two or more lites of glass, conforming to Specification C 1036 ~~or C1048~~ or C 1048 that are bonded together by interlayer material.
~~3.2.20*laminated safety glass*—two or more lites of flat glass, bonded by interlayer material. In the case of breakage, the interlayer serves to retain the glass fragments, limit the size of the opening and reduce the risk of cutting or piercing injuries.~~
~~3.2.21*laminated security glass*—two or more lites of flat glass, bonded by interlayer material, that resist manual penetration, including physical attack from hand-held or hand-thrown objects.~~
~~3.2.22~~
3.2.15 *lint*—short fibers of yarn or fabric trapped within the laminate.
~~3.2.23~~
3.2.16 *lite or light*—a panel or sheet of glass or a panel or sheet of laminated glass.
~~3.2.24~~
3.2.17 *mismatch*—misalignment of the edges of two lites of glass, when laminated.
~~3.2.25~~
3.2.18 *nonsymmetrical*—a term used to describe the construction of a laminate comprised of different glass types or thickness, or both.
~~3.2.26~~
3.2.19 *offset*—~~intentional mismatch (see *mismatch*).~~

[4] Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, http://www.ul.com.

3.2.27*ply*—one sheet or panel of glass in a laminate.
3.2.28*scuff*—See *streak*.
3.2.29—*glass lites that are intentionally not aligned in a laminate.*
3.2.20 *rub*—abrasion of a glass surface producing a frosted appearance. Also known as a scuff.
3.2.21 *separation*—an area of the laminate that has become delaminated (see delamination).delamination).
3.2.303.2.22 *shiner*—an area on a glass edge that has not been ground or polished.
3.2.31
3.2.23 *short interlayer*—a condition of the laminate in which the interlayer does not extend to the edge.
3.2.32*slippage*—See *mismatch* .
3.2.33
3.2.24 *streak*—a noticeably visible deviation on or in the laminating unit.
3.2.34*surfaces*—surfaces of glass faces are counted as Nos. 1, 2, 3, and 4, respectively. The No. 1 surface is the surface that is to the exterior; the Nos. 2 and 3 surfaces are those separated by and bonded to the interlayer material; the No. 4 surface is the surface that is to the interior.
3.2.35—*a noticeably visible directional blemish or discoloration on or in the laminated unit.*
3.2.25 *symmetrical*—a term used to describe the construction of a laminate comprised of only one glass type and thickness.
3.2.36
3.2.26 *template*—a pattern used as a guide to define the overall size and shape of a cut lite.
3.2.37*two-ply flat glass (laminates)*—See *laminated glass*.
3.2.38
3.2.27 *unlaminated area*—an area of the laminate that failed to laminate during the laminating process. This blemish ismay be discernible due to the textured appearance of the interlayer material.

4. Classification

4.1 *Kinds*Type—Laminated flat glass furnished under this specification shall be of the following kinds,types, as specified:
4.1.1 *Kind LA*—Two or more lites of flat annealed transparent glass conforming to the applicable requirements of Specification C1036 and bonded by an interlayer material. Type I - Laminated Glass—an assembly consisting of two or more lites of glass, conforming to Specification C 1036 or C 1048 that are bonded together by interlayer material.
4.1.2 *Kind LC*—Two or more lites of flat glass, one or more of which are chemically strengthened glass bonded by an interlayer material.
4.1.3*Kind LD*—Two or more lites of flat glass, bonded by an interlayer material yielding a decorative laminate.
4.1.4*Kind LHS*—Two or more lites of flat glass, all of which are heat-strengthened glass conforming to the applicable requirements of Specification C1048 and bonded by an interlayer material.
4.1.5*Kind LM*—Two or more lites of flat glass, one or more of which are mirror glass conforming to the applicable requirements of Specifications C 1036, C 1048 (if one or more of the lites are tempered or heat-strengthened glass), and C 1503 and bonded by an interlayer material.
4.1.6*Kind LP*—Two or more lites of flat glass, one or more of which are pattern glass conforming to the applicable requirements of Specifications C1036 and C1048 (if one or more of the lites are tempered or heat-strengthened glass) and bonded by an interlayer material.
4.1.7*Kind LR*—Two or more lites of flat glass, one or more of which are reflective glass, conforming to the applicable requirements of Specifications C1036 and C1048 (if one or more of the lites are tempered or heat-strengthened glass) and bonded by an interlayer material.
4.1.8*Kind LSP*—Two or more lites of flat glass, one or more of which are spandrel glass, conforming to the applicable requirements of Specifications C1036 and C1048 (if one or more of the lites are tempered or heat-strengthened glass) and bonded by an interlayer material.
4.1.9*Kind LT*—Two or more lites of flat glass, all of which are fully tempered glass conforming to the applicable requirements of Specification C1048 and bonded by an interlayer material.
4.1.10*Kind LW*—Two or more lites of flat glass, one or more of which are wired glass, conforming to the applicable requirements of Specification C1036 and bonded by an interlayer material.
4.1.11*Kind LX*—Laminated glass with combinations not previously defined. Type II - Laminated Safety Glass— as defined in ANSI Z97.1 or CPSC 16CFR1201 or both. Two or more lites of flat glass, bonded by interlayer material. In the case of breakage, the interlayer serves to retain the glass fragments, limit the size of the opening and reduce the risk of cutting or piercing injuries.
4.2 *Application*— the following terms are designed to guide the user to the appropriate inspection charts and requirements. The glazing can usually, but not always be viewed in transmittance and reflectance.
4.2.1 *Laminated Vertical Glazing*—Glazing used in an installation in which the lower edge of the glazing is a maximum of 1.8 m (6 ft) above the walking surface. The glazing is usually vertical, however may also be sloping in or out from the vertical plane. The glazing can be approached within 3 m (10 ft) or less (if distance is greater than 3 m (10 ft) see Laminated Overhead Glazing). Interior decorative glazing will be judged according to laminated vertical glazing criteria.
4.2.2 *Laminated Overhead Glazing*—Glazing used in an installation in which the lower edge of the glass is more than 1.8 m

(6 ft) above a walking floor level or cannot be approached within 3 m (10 ft). The glazing is usually sloping from the vertical plane, however may also be vertical. Sloped glazing is considered any glazing that slopes more than 15 degrees from the vertical in any direction.

4.2.3 *Laminated Spandrel Glazing*—Glazing used in an installation in which the glazing is only viewed in reflection from the building's exterior. The glazing is usually installed vertically, however, may be at a slope to the vertical plane. Laminated spandrel glazing shall be inspected using the criteria of vertical or overhead laminated glazing. (See section 4.2.1 or 4.2.2) based upon installation as vertical or overhead glazing.

5. Ordering Information

5.1 Purchasers should select the preferred options permitted in this specification and include the following information in procurement documents:

5.1.1 Title, number, and date of this specification.

~~5.1.2Kind~~5.1.2 Type of laminated flat glass as referred to in this specification (see Section 4).

5.1.3 Edgework requirements (see 8.2).

5.1.4 Thickness requirements:

5.1.4.1 Thickness designation of each individual ~~ply~~lite of glass to be used in the laminate,

5.1.4.2 Interlayer type and thickness designation, and

5.1.4.3 Overall nominal thickness of the laminate.

5.1.5 Nominal length and width of the laminate.

5.1.5.1 Blueprint, drawing, template, configuration specification, or other forms of information which detail overall size, configuration, and orientation.

~~5.1.6Classification of each individual lite of glass to be used in the laminate, in accordance with the Classification and Intended Use section of Specification C1036.~~

~~5.1.6.1Color, tint, decorative effect and strength of each individual lite of glass.~~

5.1.6 Types of each individual lite of glass to be used in the laminate.

5.1.6.1 Color, tint, coating, decorative effect and strength of each individual lite of glass.

5.1.7 Color, tint and decorative effect of the interlayer.

5.1.8 The luminous transmittance of the laminate (see 7.11).

5.1.9 Safety standards or regulations to which the laminate must ~~conform (see 6.8).~~ conform.

5.1.10 All other standards to which the laminate must conform.

5.2 *Packaging Requirements*—Glass packaging and protection will be standard manufacturer practice unless otherwise specified. Consult manufacturer before specifying.

6. Other Requirements

~~6.1Heat strengthened or fully tempered glass plies shall conform to the requirements of Specification C1048~~

6.1 Annealed glass lites shall conform to the requirements of Specification C 1036 for the incorporated glass type.

~~6.2Annealed glass plies shall conform to the requirements of Specification C1036 for the incorporated glass type.~~

~~6.3Chemically strengthened glass plies shall conform to the requirements of Specification C 1422~~

6.2 Chemically strengthened glass lites shall conform to the requirements of Specification C 1422.

~~6.4Pyrolytic and vacuum deposition coated glass plies shall conform to the requirements of Specification C 1376~~

6.3 Heat strengthened or fully tempered glass lites shall conform to the requirements of Specification C 1048.

~~6.5Mirror glass plies shall conform to the requirements of Specification C 1503~~

6.4 Mirror glass lites shall conform to the requirements of Specification C 1503.

~~6.6Spandrel glass plies shall conform to the requirements of Specification C1048~~

6.5 Pyrolytic and vacuum deposition coated glass plies shall conform to the requirements of Specification C 1376.

6.6 solar and Optical property shall be as specified..

6.7 Solar Heat Gain Coefficient shall be as specified.

6.8 Spandrel glass lites shall conform to the requirements of Specification C 1048 for the incorporated glass type.

~~6.7Luminous transmittance shall be as specified.~~

~~6.8Laminates specified for safety glazing shall meet the requirements of the specified safety glazing standards (see 7.1).~~

6.9 Visible reflection shall be as specified.

6.10 Visible transmittance shall be as specified.

6.11 U-factor shall be a specified.

7. Test Methods

7.1 *Impact Test for Safety Glazing*— Test and interpret in accordance with ANSI Z97.1 or CPSC 16CFR1201, or both, as applicable.

7.2 *Test for Missile Impact and Cyclic Pressure* —Test and interpret in accordance with Test Method E 1886 and Specification E 1996.