



Designation: E2461 – 22

Standard Practice for Determining the Thickness of Glass in Airport Traffic Control Tower Cabs¹

This standard is issued under the fixed designation E2461; 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 practice covers the determination of the thickness of glass installed in airport traffic control towers (ATCT) to resist a specified design loading with a selected probability of breakage less than or equal to either 1 lite per 1000 or 4 lites per 1000 at the first occurrence of the design wind loading.

1.2 The procedures apply to common outward sloping cab glass designs for which the specified loads do not exceed 15 kPa (313 psf).

1.3 The procedures assume control tower cab glass has an aspect ratio no greater than 3.

1.4 The procedures assume control tower cab glass has an area no less than 1.86 m² (20 ft²).

1.5 The use of the procedures assumes the following:

1.5.1 Monolithic and laminated glass installed in ATCTs shall have continuous lateral support along two parallel edges, along any three edges, or along all four edges;

1.5.2 Insulating glass shall have continuous lateral support along all four edges; and

1.5.3 Supported glass edges are simply supported and free to slip in plane.

1.6 The procedures do not apply to any form of wired, patterned, etched, sandblasted, or glass types with surface treatments that reduce the glass strength.

1.7 The procedures do not apply to drilled, notched, or grooved glass.

1.8 The procedures address the determination of thickness and construction type to resist a specified design wind load at a selected probability of breakage. The final glass thickness and construction determined also depends upon a variety of other factors (see 5.4).

1.9 These procedures do not address blast loading on glass.

1.10 These procedures do not apply to triple-glazed insulating glass units.

1.11 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.

1.12 *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 to determine the applicability of regulatory limitations prior to use.*

1.13 *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 Standards:*²

C162 Terminology of Glass and Glass Products

C1036 Specification for Flat Glass

E631 Terminology of Building Constructions

E1300 Practice for Determining Load Resistance of Glass in Buildings

2.2 *American Society of Civil Engineers Standard:*³

ASCE 7 Minimum Design Loads for Buildings and Other Structures

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of general terms related to building construction used in this practice, refer to Terminology **E631**, and for general terms related to glass and glass products, refer to Terminology **C162**.

¹ This practice is under the jurisdiction of ASTM Committee **E06** on Performance of Buildings and is the direct responsibility of Subcommittee **E06.52** on Glass Use in Buildings.

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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 American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, <http://www.asce.org>.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *annealed (AN) glass, n*—a flat, monolithic, glass lite of uniform thickness; it is formed by a process whereby the magnitudes of the residual stresses are nearly zero.

3.2.2 *aspect ratio (AR), n*—for glass simply supported along four sides, the ratio of the long dimension to the short dimension for rectangular glass or the ratio of the long dimension to the short dimension of the rectangle that completely encloses trapezoidal glass. For rectangular glass supported continuously along all four edges, AR always equals or exceeds 1.0. For glass simply supported along three sides, the ratio of the length of the longer parallel supported edge to the dimension perpendicular to the parallel supported sides, equal to or greater than 0.5.

3.2.2.1 *Discussion*—The rectangle that completely encloses the trapezoid has two sides parallel to the horizontal edges of the trapezoid and the other two sides perpendicular to the horizontal edges of the trapezoid. All dimensions shall be measured from edge to edge of glass.

3.2.3 *encompassing rectangular area (ERA), n*—the area of the smallest rectangle that will encompass a trapezoidal glass lite. The value of the ERA shall be used as the area when determining deflection in Figs. A2.1-A2.19.

3.2.4 *glass breakage, n*—the fracture of any lite or ply in monolithic, laminated, or insulating glass resulting from stress that an applied uniform lateral load induces.

3.2.5 Glass Thickness—

3.2.5.1 *thickness designation for laminated glass (LG), n*—a term used to specify an LG construction based on the combined thicknesses of its component plies.

(1) Add the minimum thicknesses of the individual glass plies and the nominal interlayer thickness. If the sum of all interlayer thicknesses is greater than 1.52 mm (0.060 in.), use 1.52 mm (0.060 in.) in the calculation.

(2) Select the nominal thickness or designation in Table 1 having the closest minimum thickness that is equal to or less than the value obtained in 3.2.5.1.

(3) *Exceptions*—The construction of two 6 mm (¼ in.) glass plies plus 0.38 mm (0.015 in.) or 0.76 mm (0.030 in.) interlayer shall be defined as 12 mm (½ in.). The construction of two 2.5 mm (⅜ in.) glass plies plus 1.52 mm (0.060 in.) interlayer shall be defined as 5 mm (⅜ in.). The construction of two 4 mm (⅝ in.) glass plies plus any thickness interlayer shall be defined as 8 mm (⅝ in.).

3.2.5.2 *thickness designation for monolithic glass, n*—the designated or nominal thickness commonly used in specifying a particular glass product, based on the minimum thicknesses presented in Table 1 and Specification C1036.

3.2.6 *insulating glass (IG) unit, n*—consists of any combination of two glass lites, as defined herein, that enclose a sealed space filled with air or other gas.

3.2.7 *laminated glass (LG), n*—a flat-lite of uniform thickness that is fabricated by bonding two or more monolithic glass lites or plies of equal thickness, as defined herein, together with polyvinyl butyral (PVB) interlayer(s).

3.2.7.1 *Discussion*—Many different interlayer materials are used in LG. The information in this practice applies to polyvinyl butyral (PVB) interlayer or those interlayers that demonstrate equivalency according to Appendix X8 in Practice E1300.

3.2.8 *lateral, adj*—perpendicular to the glass surface.

3.2.9 *load, n*—a uniformly distributed lateral pressure.

3.2.9.1 *design load, n*—the magnitude of the 3 second duration load used to design glass for ATCT cabs. Equations used herein for computing magnitudes for design loads adjust glass self-weight to a magnitude consistent with a 3 second duration.

3.2.9.2 *specified design load, n*—the magnitude in kPa (psf), type (for example, wind or self-weight) and duration of the load. The wind load has a duration of approximately 3 seconds. Glass self-weight (Table 1) has a long duration, typically equal to the in-service life of the window glass lite. Earth facing cab glass is only subjected to wind load and its self-weight.

3.2.9.3 *long duration load, n*—any load lasting approximately 30 days or longer.

3.2.9.4 *short duration load, n*—any load lasting approximately 3 seconds, such as, wind load.

3.2.10 *minimum thickness of monolithic glass, n*—the minimum allowable thickness associated with a nominal or designated glass thickness as given in Table 1 and Specification C1036.

3.2.11 *probability of breakage (P_b), n*—the theoretical fraction of glass lites or plies that would break at the first occurrence of the resistance load, typically expressed in lites per thousand.

3.2.12 *specifying authority, n*—the design professional responsible for interpreting applicable regulations of authorities having jurisdiction and considering appropriate site-specific factors to determine the proper values used to calculate the specified design load and the selection of the Probability of Breakage (P_b) to be used with this practice.

TABLE 1 Thickness Designations, Minimum Glass Thickness, and Unit Self-Weight

Nominal thickness or designation, mm (in.)	Minimum thickness, mm (in.)	Glass weight Pa (psf)
2.7 (lami)	2.59 (0.102)	67.0 (1.40)
3.0 (⅙)	2.92 (0.115)	74.2 (1.55)
4.0 (⅕)	3.78 (0.149)	99.1 (2.07)
5.0 (⅜)	4.57 (0.180)	124 (2.59)
6.0 (¼)	5.56 (0.219)	149 (3.11)
8.0 (⅝)	7.42 (0.292)	199 (4.15)
10.0 (⅜)	9.02 (0.355)	248 (5.18)
12.0 (½)	11.91 (0.469)	298 (6.22)
16.0 (⅝)	15.09 (0.595)	397 (8.29)
19.0 (¾)	18.26 (0.719)	472 (9.85)
22.0 (7/8)	21.44 (0.844)	546 (11.4)
25.0 (1)	24.4 (0.969)	622 (13.0)
32 (1¼) ^A	27.38 (1.22)	795 (16.6)
38 (1½) ^A	31.6 (1.47)	943 (19.7)
44 (1¾) ^A	44.3 (1.75)	1070 (22.3)
52 (2) ^A	50.3 (2.00)	1220 (25.5)
57 (2¼) ^A	57 (2.25)	1390 (29.1)

^A Not a glazing industry standard thickness designation.