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An American National Standard

Standard Specification for Ball Drop Impact Resistance of Laminated Architectural Flat Glazing[1]

This standard is issued under the fixed designation F3006; 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 destructive ball drop testing of laminated flat glass products intended for use in architectural glazing applications.

1.2 This specification is intended for use as an in-plant quality control test to evaluate the impact performance of laminated flat glass when a 2.3 kg, 83 mm diameter smooth solid steel ball is dropped from a specified height.

1.3 This specification does not yield data that is a substitute for safety glazing test requirements of ANSI Z97.1 or CPSC 16 CFR 1201. Qualification under this specification provides a basis for judgment of the ability of specimens to withstand the appropriate shot-bag impact. This specification provides a mechanism to allow fabricators a less cumbersome and lower cost method for the evaluation of impact performance that may be performed on a frequent basis while reducing the amount of waste materials generated from traditional impact tests.

1.4 This specification is applicable to symmetrical and asymmetrical annealed, heat-strengthened, chemically strengthened, fully tempered laminated architectural flat glass including but not limited to: float, patterned, sheet, sandblasted, grooved, and fritted.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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 and health practices and determine the applicability of regulatory limitations prior to use. Some specific hazards statements are given in Section 4 on Hazards.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C162 Terminology of Glass and Glass Products

C1036 Specification for Flat Glass

C1048 Specification for Heat-Strengthened and Fully Tempered Flat Glass

C1172 Specification for Laminated Architectural Flat Glass

C1422 Specification for Chemically Strengthened Flat Glass

E631 Terminology of Building Constructions

F3007

2.2 *ANSI Standards:*[3]

Z26.1 American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways—Safety Standard

Z97.1 American National Standard for Safety Glazing Materials Used in Buildings—Safety Performance Specification and Methods of Test

2.3 *Other Standards:*

CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials[4]

GANA LD-100-06 Standard Test Method for Ball Drop Impact of Laminated Architectural Flat Glass[5]

3. Terminology

3.1 *Definitions:*

3.1.1 For definition of terms used in this specification, refer to Terminologies C162 and E631.

[1] This specification is under the jurisdiction of ASTM Committee F12 on Security Systems and Equipment and is the direct responsibility of Subcommittee F12.10 on Systems Products and Services.

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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 National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from U.S. Consumer Product Safety Commission (CPSC), 4330 East West Hwy., Bethesda, MD 20814, http://www.cpsc.gov.

[5] Available from Glass Association of North America (GANA), Laminating Division, 2945 SW Wanamaker Dr., Suite A, Topeka, KS 66614-5321, http://www.glasswebsite.com.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *asymmetrical*—a term used to describe the construction of a laminate comprised of dissimilar glass types or thicknesses, or both. An example of an asymmetrical construction is: 3 mm annealed glass – 0.76 mm PVB interlayer – 6 mm annealed glass.

3.2.2 *glass/plastic laminates*—a manufactured assembly consisting of at least one layer of glass and at least one layer of plastic glazing sheet material bonded together with an interlayer.

3.2.3 *multi-ply laminates*—a laminated glazing consisting of more than two layers of glass or plastic glazing sheet material, or both, bonded together by an interlayer between each sheet of glazing.

3.2.4 *organic-coated glass*—a manufactured assembly consisting of a sheet of glass covered on one or both surfaces with either: (*1*) an adhesive-applied organic film or sheeting, or (*2*) an applied coating.

3.2.5 *symmetrical*—a term used to describe the construction of a laminate comprised of only one glass type and thickness. An example of a symmetrical construction is: 3 mm annealed glass – 0.76 mm PVB interlayer – 3 mm annealed glass.

3.2.5.1 *Discussion*—A color difference in the glass plies does not affect symmetry.

3.2.6 *two (2)-ply glass laminates*—a manufactured assembly consisting of two sheets of glass bonded together with an interlayer to at least one other sheet of glass.

3.2.7 *two (2)-ply plastic laminates*—a manufactured assembly consisting of two sheets of plastic bonded together with an interlayer to at least one other sheet of plastic.

4. Hazards

4.1 **Warning:** Test impact cited in this specification is intended to result in glass fracture. Proper glass handling safety gear should be worn at all times during specimen handling, testing, evaluation, and disposal.

5. Classification

5.1 Products shall be classified as indicated in Table 1.

6. Test Specimens

6.1 *Number of Test Specimens:*

6.1.1 The number of specimens required for testing is dependent upon the configuration of the glazing and are indicated in 6.2 and 6.3.

6.2 *Symmetrical Constructions:*

6.2.1 Three test specimens shall be submitted for the ball drop test.

6.2.2 One additional test specimen may be submitted for the ball drop test should no more than one of the original three specimens fail during testing or result in a non-test.

6.3 *Asymmetrical Constructions:*

6.3.1 Six test specimens shall be submitted for the ball drop test.

6.3.1.1 Three specimens shall be impacted for each orientation.

6.3.1.2 One additional test specimen may be submitted for the ball drop test should no more than one of the original six specimens fail during testing or result in a non-test.

6.4 Test specimens shall be prepared as specified in this specification.

6.5 The test specimen size shall be as specified in this specification. All glazing and interlayers of each specimen shall be identified.

7. Test Methods

7.1 Test specimens shall be tested according to Test Method F3007.

7.2 *Drop Heights:*

7.2.1 The following drop heights correlate with the impact requirements of CPSC 16 CFR 1201, ANSI Z97.1, and ANSI Z26.1. For instances where other regulations are in use, a User Defined height is available.

NOTE 1—User defined drop heights are not correlated with any regulation cited in this specification. Consult specifying authority for correlations.

7.3 *Test Temperature:*

7.3.1 The temperature of the glazing at impact shall be as indicated in Table 2.

7.4 *Performance Requirements:*

7.4.1 The results are interpreted according to Table 3.

7.4.2 At least three specimens from the same lot must be tested and exhibit passing retention characteristics.

TABLE 1 Product Classification

Classification	Product Name	Product Description
I	2-ply glass laminates	A manufactured assembly consisting of two sheets of glass bonded together with an interlayer to at least one other sheet of glass. Note: When broken, numerous cracks appear, but glass fragments tend to adhere to the interlayer. If the nominal glass thickness is not equal on both sides, the structure is considered asymmetrical.
II	glass/plastic laminates	A manufactured assembly consisting of one layer of glass and one layer of plastic glazing sheet material bonded together with interlayer. These structures are considered asymmetrical.
III	2-ply plastic laminates	A manufactured assembly consisting of two sheets of plastic bonded together with an interlayer to at least one other sheet of plastic. If the nominal plastic thickness is not equal on both sides, the structure is considered asymmetrical.
IV	multi-ply laminates	A laminated glazing consisting of more than two layers of glass or plastic glazing sheet material, or both, bonded together by interlayers. These structures are considered asymmetrical.
V	organic-coated glass	A manufactured assembly consisting of a sheet of glass covered on one or both surfaces with either: (*1*) an adhesive-applied organic film or sheeting, or (*2*) an applied coating. When broken, numerous cracks appear, but the glass fragments tend to adhere to the applied organic material.

TABLE 2 Drop Heights

Drop Height m	Surface Temperature of the Glazing at Impact	Correlated Impact
0.75	18 to 30°C	CPSC 16 CFR 1201 Cat I and ANSI Z97.1 Class A
3.66	18 to 30°C	CPSC 16 CFR 1201 Cat II and ANSI Z97.1 Class A
3.66	18 to 30°C	ANSI Z26.1 (flat transportation parts)
User Defined	User Defined	User Defined

TABLE 3 Retention Characteristics After Ball Drop

NOTE 1—If the specimen completely leaves the frame, the test for that specimen will be deemed a void (non-test). Another specimen shall be tested with increased clamping force sufficient to retain the specimen during testing.

Category	Retention Characteristics	Results
1	Ball Held – glass unbroken	Pass
2	Ball Held – glass broken, no tears in interlayer	Pass
3	Ball Held – glass broken, tears in interlayer which do not permit a non-compressible 83 mm diameter ball to pass freely within 5 s after impact.	Pass
4	Ball not retained	Fail

8. Report

8.1 Record the following information:

8.1.1 Date and time of sample production, lot number, and testing.

8.1.2 Laminated Glazing configuration (detailed description of all glasses, plastics, and interlayers, including glass type, kind, and thickness, color, coating and interlayer type, thickness and color).

8.1.3 Glazing temperature.

8.1.4 Specimen size.

8.1.5 Drop height(s).

8.1.6 Retention Characteristic.

8.1.7 Results.

9. Compliance Statement

9.1 A statement indicating whether or not the specimens are in compliance with this specification is required and must include the product classification, drop height, and number of retained samples per specimens tested.

10. Keywords

10.1 annealed glass; architectural flat glass; ball drop; chemically strengthened glass; flat glass; fragmentation; heat strengthened glass; laminated glass; plastic sheeting; plastics; retention; safety glass; safety glazing; tempered glass