



Designation: **E2358 – 04 (Reapproved 2010) E2358 – 17**

Standard Specification for the Performance of Glass Glazing in Permanent Glass Railing Systems, Guards, and Balustrades¹

This standard is issued under the fixed designation E2358; 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 glass in permanent railing systems, ~~guards and balustrades~~ guards, and balustrades, including components such as rails and swing gates or other forms of required guardrail opening protection installed in agricultural, assembly, commercial, educational, industrial, institutional, recreational, and residential buildings, buildings, and other structures such as towers or elevated platforms.

1.2 This specification is intended to be applied to permanent glass or other glazing railing systems for buildings and to such railing systems, rails, guards, and balustrades having major structural components made of glass, or glass or other glazing material, or the secondary components such as infill or balusters made of glass-glass or other glazing material.

1.3 This specification considers that the overall outlook is based on the health and safety of all potential users of buildings. The criteria incorporated in this specification provide for normal and anticipated building uses, but not for abuses for which the building and its components are not designed.

1.4 This specification establishes basic minimum requirements and criteria that lead to satisfactory products under normal use conditions and does not give consideration to design criteria for specific field conditions, the establishment of which is the prerogative and responsibility of the designer, specification writer, and regulatory agencies.

1.5 *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 health environmental practices and to determine the applicability of regulatory limitations prior to use.*

1.6 *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

[E631 Terminology of Building Constructions](#)

~~[E2025 Test Method for Evaluating Fenestration Components and Assemblies for Resistance to Impact Energies \(Withdrawn 2015\)](#)~~³

[F1233 Test Method for Security Glazing Materials And Systems](#)

[E935 Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings](#)

[E1481 Terminology of Railing Systems and Rails for Buildings](#)

[E1886 Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile\(s\) and Exposed to Cyclic Pressure Differentials](#)

[E1996 Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes](#)

~~[E2025 Test Method for Evaluating Fenestration Components and Assemblies for Resistance to Impact Energies \(Withdrawn 2015\)](#)~~³

¹ This specification is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.56 on Performance of Railing Systems and Glass for Floors and Stairs.

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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 The last approved version of this historical standard is referenced on www.astm.org.

E2353 Test Methods for Performance of Glazing in Permanent Railing Systems, Guards, and Balustrades

2.2 ~~Other Standards:~~ ANSI Standard:

~~ANSI Z97.1 Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test~~⁴

~~CPSC 16 CFR Part 1201 Architectural Glazing Materials, Federal Register~~⁵

iTeh Standards (<https://standards.iteh.ai>) Document Preview

[ASTM E2358-17](#)

<https://standards.iteh.ai/catalog/standards/sist/fe39ebe9-8be1-46fd-9770-9f49fd2fb45/astm-e2358-17>

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

3. Terminology

3.1 *Definitions: Definitions*—General terms used in this standard test method are defined in Terminologies E631 and E1481. Terms common to this standard test method and referenced test methods are defined in the respective document documents unless defined herein.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Failure Load*—A load, which, if placed upon a structure or test piece, is just great enough to break it.

3.2.2 *Glazing Retention*—the property of maintaining the glass or glazing material, post breakage, in a system, such that the glass must be held in the framing system with no opening sufficient to pass a 76 mm (3 in.) solid steel sphere through the system using a horizontally applied force of 18 N (4.0 lbs).

3.2.3 *Guard System*—A protective railing system along the outer edges of locations of an accessible roof, parapet, balcony, landing, platform or ramp, designed to minimize the probability of an accidental fall from the walking surface.

3.2.4 *Interlayer*—a layer of material acting as an adhesive between lites of glazing, which adds additional performance attributes to the finished product, for example: impact resistance, solar control, and acoustical insulation.

3.2.5 *Lite*—a term for a single pane (or piece) of glass or other glazing material.

3.2.6 *Stile*—one of the upright structural members of a frame or a framework of bars

4. Design Requirements

4.1 *Railing Height*Height:

4.1.1 *Guardrail Systems:*

4.1.1.1 The fabricated height of a guardrail system, measured from its top surface to the finished floor level, shall be at least 1070 mm (42 in.) in accordance with the authority having jurisdiction. When variation in the evenness of the finished floor will result in any individual height measurement of the installed guardrail system to be less than 1040 mm (41 in.), the minimum height designated by the authority having jurisdiction, the fabricated height of the entire guardrail system shall be increased accordingly.

4.1.1.2 Within an individual dwelling unit, the required railing height shall be permitted to be reduced as allowed by the governing jurisdiction.

(1) Where the vertical distance between adjacent finished floor levels is less than 1830 mm (72 in.), the height of the guardrail system shall be at least 810 mm (32 in.) (Fig. 1) unless otherwise specified by the authority having jurisdiction. When variation in the evenness of the finished floor results in any individual height measurement of the installed guardrail system less than 790 mm (31 in.), minimum, the fabricated height of the entire guardrail system shall be increased accordingly.

(2) Where the vertical distance between adjacent finished floor levels is a minimum of 1830 mm (72 in.), the height shall be a minimum of 860 mm (34 in.) (Fig. 2). When variations in the evenness of the finished floor results in individual height measurements of the installed guardrail system less than 840 mm (33 in.), the fabricated height of the guardrail system shall be increased accordingly.

4.1.1.3 In public assembly, elementary school, and multiple-family buildings where the vertical distance between stair and adjacent floor levels is more than 6100 mm (20 ft), the required height of the top of the railing above the finished floor including any variation shall be at least 1220 mm (48 in.).

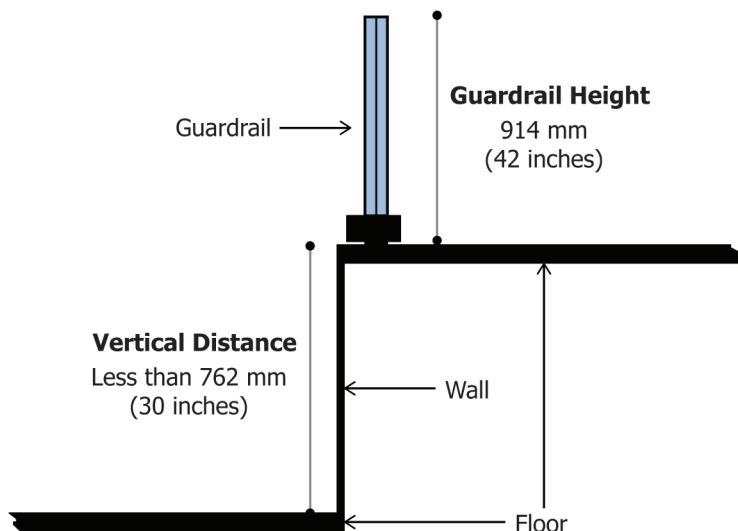


FIG. 1 Guardrail height for adjacent floors with wall heights up to but not including 1830 mm (72 in.) Height for Adjacent Floors

4.1.1.4 For balconies in public-assembly buildings, the required railing height in front of the first row of fixed seats shall be reduced to 660 mm (26 in.) provided adequate safety is established by the design and approved by the authority having jurisdiction; however, it shall be a minimum of 910 mm (36 in.) at aisle ends and a minimum of 1070 mm (42 in.) where aisle steps are perpendicular to the railing system.

4.1.2 *Handrails and Stair-rail Systems*~~Systems~~:

4.1.2.1 In corridors, ramp, walkways, and enclosed stair-ways having a slope of at least 1 in 20, the height of the handrail of the stair-rail system, measured from its top surface to the finished floor level or tread-nose line, shall be not less than 860 mm (34 in.) nor more than 970 mm (38 in.). When a stair-rail system is higher than 970 mm (38 in.), a separate handrail shall be installed at a height of not less than 860 mm (34 in.) nor more than 970 mm (38 in.).

4.1.2.2 Where required and in childcare and educational facilities serving children under the age of 12 years, a second separate handrail shall be permitted to be installed at a mounting height of 610 mm to 710 mm (24 in. to 28 in.). The vertical clearance between the handrails shall be at least ~~230 mm~~ 230 mm (9 in.).

4.1.3 *Transfer Rails Systems*—where transfer rail systems are to be installed, such as in toilets and bathrooms, the required height, measured from its top surface to the finished floor level, shall not be less than 760 mm (30 in.) nor more than 860 mm (34 in.).

4.2 *Railing System Penetration*~~Penetration~~:

4.2.1 Various members of the railing system, such as balusters, screens, wire mesh, or scrolls, shall be arranged in such a way that a sphere, 76 mm (3 in.) in diameter cannot be passed through any opening in the system.

4.2.2 Toe boards shall be provided in areas where tools and other objects could be dislodged and fall on occupants below. The top of the toe board shall not be less than 102 mm (4 in.) and the bottom not more than 12 mm (½ in.) above the average finished level at the line of the vertical supports of the railing system.

4.3 *Handrail Design*:

4.3.1 Handrails shall be designed to permit continuous sliding of hands. The hardware chosen for attaching handrails to balusters or walls shall be such that projecting lugs, devices, or other construction elements shall have no sharp edges or dangerous protrusions.

4.3.2 Handrail ends shall be returned to supporting walls or otherwise arranged to avoid projecting rail ends. Wall handrails at stairs and ramps and other handrails that are not continuous shall be extended horizontally for a distance of at least 305 mm (12 in.) beyond the intersection of the finish line (plane of tread nose lines) of the stair or ramp and the landings, unless interference limits such an extension.

4.3.3 The clearance between the handrail and the mounting surface or any protrusions from this surface shall be 38 mm (1½ in.). The handrail shall project no more than 89 mm (3½ in.) ~~in.~~ into the required egress width. The vertical clearance in a recess shall be in accordance with the provision in 4.4.5.

4.3.4 The hand-grip portion of the handrail shall not be less than 32 mm (1¼ in.) or more than 51 mm (2 in.) in outside diameter.

4.4 *Transfer Rail Design*:

4.4.1 Transfer rails shall be designed to permit continuous sliding of the arm and hand supporting the body weight during transfer. The hardware chosen for attaching the transfer rails shall be such that projecting lugs, devices, or other construction elements shall not interrupt the continuous sliding of the arm or hand or catches loose clothing. The transfer rails, including their fasteners, shall not have sharp edges or dangerous protrusions. The transfer rail top surface shall not be abrasive.

4.4.2 Transfer rails shall be returned to supporting walls or otherwise arranged to avoid projecting rail ends that could catch clothing or objects during normal activity around the rail ends.

4.4.3 The clearance between the face of the transfer rail and that of the mounting surface or any protrusions from this surface shall be at least ~~38 mm~~ 38 mm (1½ in.).

4.4.4 The hand-grip portion of the transfer rail shall have a perimeter of not less than 102 mm (4 in.) nor more than ~~165 mm~~ 165 mm (6½ in.), and a maximum to minimum cross-sectional dimension ratio of not more than two.

4.4.5 Transfer rails shall not be located in a wall recess unless this recess is not more than 76 mm (3 in.) deep and extends at least 460 mm (18 in.) above the top of the transfer rail, with the extension parallel with the wall surface or sloping from the depth of the recess to the wall surface above the recess in such a way that grasping of the transfer rail and transfer of the body weight is not impeded. (See Fig. 2.)

4.5 *Special Consideration Concerning Performance of Structural System*—In the event of lateral loading resulting from wind and seismic forces, the designer of the railing system shall evaluate the influence of the railing system on the building's structural system.

4.6 *Permissible Dimensional Tolerances, except as indicated otherwise*:

4.6.1 Fabrication tolerances of components shall be within $\pm 1.5 \pm 1.5$ mm (0.0625 in.).

4.6.2 Alignment tolerances of installed products shall be within $\pm 6 \pm 6$ mm (¼ in.) within a length of 6100 mm (20 ft).

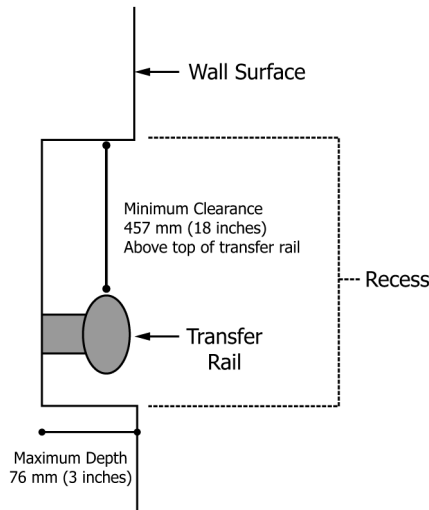


FIG. 32 Recessed Transfer Rail

5. Classification

5.1 Classifications of systems passing the performance requirements are outlined in section 6 of this standard specification. Basic classification shall indicate type of system (Type I through VVI see Figs. 3-8 4-8e) and level of performance (1, 2, 3 or 4), with level one relating to 3, or 4) as defined in Test Methods E2353 Basic, level two relating to Safety, and level three and four relating to Enhanced. Each supported edge is indicated by a dashed line (---).

6. Performance Requirements

6.1 The Performance Requirements performance requirements are outlined in Table 1 and section 6.26.3 below.

6.2 Exterior glazing in balcony rails in windborne debris regions shall also comply with missile impact requirements of Test Method E1886 and Specification E1996.

6.3 Deflection Requirements:

6.3.1 The maximum allowable deflection at the required test load, measured at the top of the rail system at the critical point of load application and from the position of the rail after release of the preload, shall not be more than described in 6.2.1.4 6.3.1.1 - 6.2.1.4 6.3.1.4 of this standard specification.

6.3.1.1 When the load is applied at the line of vertical support, the horizontal deflection shall not exceed the rail height (h) divided by 12 or $h/12$, with h being the distance between the surface of the uppermost post anchorage and the top of the top rail.

6.3.1.2 When the horizontal load is applied at the mid-span of the rail, the horizontal deflection shall not exceed the sum of the rail height (h) divided by 24 plus the rail length (l) between the vertical supports divided by 96, or $h/24 + l/96$.

6.3.1.3 When the vertical load is applied at the mid-span of the rail, the vertical deflection shall not exceed the length (l) divided by 96 or $l/96$.

6.3.1.4 Residual deflection at the released test load, which is at 50% of the preload, shall not exceed 20% of the deflection permitted in 6.2.1.4 6.3.1.1 - 6.2.1.4 6.3.1.3 or 12 mm (1/2 in.), whichever is less.

7. Pass/Fail Criteria

7.1 Structural (Frame) Performance:

7.1.1 Complete glazing retention must occur and the glass must be unbroken at the completion of each test.

7.2 Shot Bag Impact Performance:

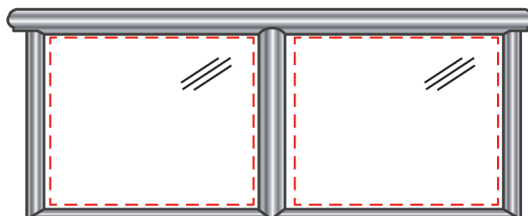


FIG. 43 Type I: Four-side support—Support—Glazing as Infill

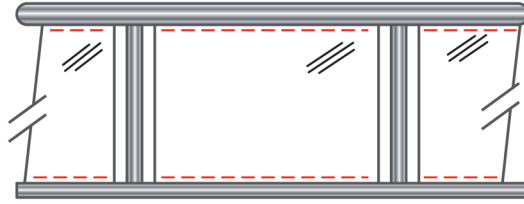


FIG. 54 a Type II: Two-side support—Single Lite Support—Single Lite Glazing as Infill

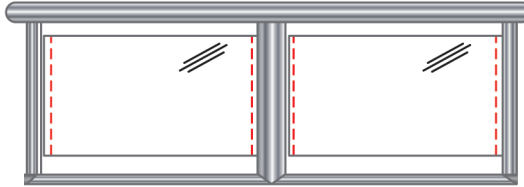


FIG. 54 b Type II: Two-side support—Multiple Lite Support—Single Lite Glazing as Infill (continued)

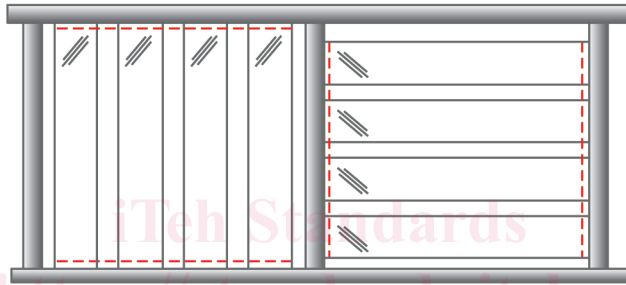


FIG. 4 c Type II: Two-side Support—Multiple Lite Glazings as Infill (continued)

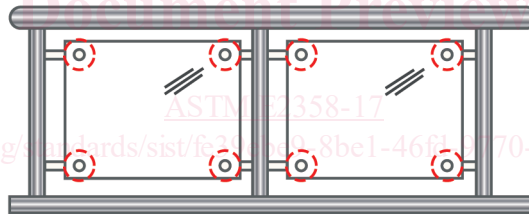


FIG. 65 a Type III: Point Fixed Glazing System—System—Glazing as Infill

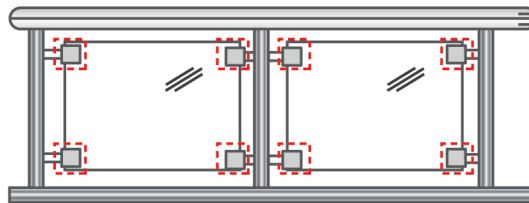


FIG. 5 b Type III: Edge Clamping Glazing System—Glazing as Infill (continued)

7.2.1 The glass glazing system shall be retained in the framing system such that a 76 mm (3 in.) solid steel sphere shall not pass through any part of the system classified in accordance with Section 14 of Test Methods E2353 using a horizontally applied force of 18 N (4.0 lb).