

November 22, 2024

**TO: PARTIES INTERESTED IN EVALUATIONS OF GLASS RAILING AND
BALUSTRADE SYSTEMS**

**SUBJECT: Proposed Revisions to the Acceptance Criteria for Glass Railing and
Balustrade Systems, Subject AC439-0225-R1 (MG/MB)**

Hearing Information:
WebEx Event Meeting
[Wednesday, February 19, 2025](#)
8:00 am Pacific Standard Time
Click the date above to register

Dear Colleague:

You are invited to comment on proposed revisions to the ICC-ES Acceptance Criteria for Glass Railing and Balustrade Systems (AC439), which will be discussed at the Evaluation Committee hearing noted above.

Revisions to AC439 are proposed to provide more guidelines on the analysis of glass panels in glass railing and balustrade systems to establish uniform loads in interior and exterior applications. In addition, the acceptance criteria is being revised to include the 2024 IBC and IRC. Proposed revisions are based on the following references that are heavily used in the industry for glass design:

- AAMA “Conform Wall Glass” CW-12-84, “Structural Properties of Glass,” dated 1984 (reprinted 6/06), American Manufacturers Association.
- ASTM E1300-16 – Standard Practice for Determining Load Resistance of Glass in Buildings, which is referenced in Section 2404.1 of the IBC.
- NCSEA “Engineering Structural Glass Design Guide”, dated 2018, National Council of Structural Engineers Associations.

The proposed revisions are summarized below:

1. Details on analysis of stresses and deflection of laminated glass panels were added to Sections 3.3.1 and 4.9 based on Appendix X9 of ASTM E1300
2. For wind loads, Section 2404.1 of the IBC specifies ASTM E1300 for the design of glass in exterior applications. Proposed values in Table 1 of AC439 for wind loads are based solely on ASTM E1300.

3. For live loads, Section 2407.1.1 of the 2024 IBC includes specific allowable live load stresses for fully tempered and heat strengthened glass (6,000 and 3,000 psi, respectively). It is our understanding, based on review of the NCSEA document, these specific values are related to edge stresses. To determine surface stresses consistently with ASTM E1300-16, the values need to be increased by 1.274 (i.e., $6,750/5,300 = 13,500/10,600 = 1.274$). Therefore, the proposed allowable surface stresses in Table 1 of AC439 for live loads are based on the same factor.
4. To clarify edge and surface zones in the glass panel, Table 1, Footnote 1 was added based on the NCSEA "Engineering Structural Glass Design Guide" document.
5. A condition of use was added to Section 5.0 to exclude the durability of glass panels from the evaluation. Taking this position seems consistent with the code and industry practice. Also, it is our understanding that there will be some visible signs before delamination occurs.
6. Editorial revisions to include the 2024 IBC/IRC.

For the technical revisions made, we are essentially memorializing what we have been accepting. Therefore, no additional data is needed from the report holders of active evaluation reports under AC439 to comply with the requirements included in the proposed revisions.

You are invited to submit written comments on this or any other agenda item, or to attend the Evaluation Committee hearing and present your views in person. If you wish to contribute to the discussion, please note the following:

1. Regarding written comments and presentations:
 - a. You should submit these via e-mail to es@icc-es.org by the applicable due date.
 - b. Comments are to be received by **December 18, 2024**. These written comments will be forwarded to the committee before the meeting, and will also be posted on the ICC-ES web site shortly after the deadline for submission. Written comments that are not submitted by this deadline will not be considered at the meeting.
 - c. Rebuttal comments, from the proponent noted in this letter, are to be received by **January 9, 2025**. They will be forwarded to the committee before the meeting, and will also be posted on the ICC-ES web site shortly after the deadline for submission. Written rebuttal comments that are not submitted by the deadline will not be considered at the meeting.
 - d. If you want to make a visual presentation at the hearing, it must be received in PowerPoint format. The presentation is to be received by **January 24, 2025**. These will be forwarded to the committee before the meeting, and will also be posted on the

ICC-ES web site after the deadline for submission. Presentations that are not submitted by the deadline cannot be presented at the meeting. **Note:** Videos will not be posted on the web site.

Presentations will be retained with other records of the meeting.

- e. ICC-ES will post to the web site, on **February 5, 2025**, memos by the ICC-ES staff, responding to the previously received public comments.
- f. If you miss the deadlines for submission of written comments and visual presentations, your verbal comments can be presented at the meeting.
- g. Proposed criteria, written public comments, visual presentations, and responses by ICC-ES staff for this agenda item are all available on our website.

2. Regarding verbal comments and presentations:

Please plan to speak for not more than ten minutes. As noted above, visuals are to be in PowerPoint format.

- 3. Keep in mind that all materials submitted for committee consideration are part of the public record and will not be treated as confidential. It is the presenter's responsibility to certify to ICC-ES staff that no materials infringe copyright.
- 4. Please do not communicate with committee members before the meeting about any items on the agenda.

We appreciate your interest in the work of the Evaluation Committee. If you have any questions, please contact me at (800) 423-6587, extension 5333, or Matthew Blackstone, Evaluation Specialist, at extension 5688. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,



Mohamed Gallow, PhD, PE, SE
Principal Structural Engineer

MG/ls

Encl.

cc: Evaluation Committee

ICC EVALUATION SERVICE, LLC, RULES OF PROCEDURE FOR THE EVALUATION COMMITTEE

1.0 PURPOSE

The purpose of the Evaluation Committee is to review and approve acceptance criteria on which evaluation reports may be based.

2.0 MEMBERSHIP

2.1 The Evaluation Committee has a membership of not fewer than nine, with one of the members named by the ICC-ES president each year to serve as the chairperson–moderator.

2.2 All members of the committee shall be representatives of a body enforcing regulations related to the built environment.

2.3 Persons are appointed to the committee by the ICC-ES president, from among individuals who have formally applied for membership.

2.4 The ICC-ES Board of Managers, using simple majority vote, shall ratify the nominations of the president.

2.5 Committee membership is for one year, coinciding with the calendar year. Members may be renominated and reappointed.

2.6 In the event that a member is unable to attend a committee meeting or complete a term on the committee, the ICC-ES president may appoint a replacement to fill in at the meeting or for the remainder of the member's term. Any replacement appointed for only one meeting must have prior experience as a member of the Evaluation Committee. Appointments under this section (Section 2.6) are subject to ratification as noted in Section 2.4.

3.0 MEETINGS

3.1 The Evaluation Committee shall schedule meetings that are open to the public in discharging its duties under Section 1.0, subject to Section 3.0.

3.2 All scheduled meetings shall be publicly announced. There shall be three to six meetings per year (as necessary).

3.3 More than half of the Evaluation Committee members, counting the chairperson, shall constitute a quorum. A majority vote of members present is required on any action. To avoid any tie vote, the chairperson may choose to exercise or not exercise, as necessary, their right to vote.

3.4 In the absence of the chairperson–moderator, Evaluation Committee members present shall elect an alternate chairperson from the committee for that meeting. The alternate chairperson shall be counted as a voting committee member for purposes of maintaining a committee quorum and to cast a tie-breaking vote of the committee.

3.5 Minutes shall be kept and shall be the official record of each meeting.

3.6 An electronic record of meetings may be made by ICC-ES if deemed necessary; no other audio, video, electronic recordings of the meetings will be permitted. Visual aids (including, but not limited to, charts, slides, videos, or presentation software) viewed at meetings shall be permitted only if the presenter provides ICC-ES before the presentation with a copy of the visual aid in a medium which can be retained by ICC-ES with its record of the meeting and which can also be provided to interested parties requesting a copy.

3.7 Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members regarding agenda items. All written communications and submissions regarding agenda items must be delivered to ICC-ES and shall be considered nonconfidential and available for discussion in open session of an Evaluation Committee meeting. Such materials will be posted on the ICC-ES web site (www.icc-es.org) prior to the meeting. Comments and submissions not meeting the following deadlines will not be considered at the meeting:

- Initial comments on agenda items shall be submitted at least 28 days before the scheduled meeting.
- A rebuttal comment period shall follow, whereby rebuttal comments to the initial comments may be submitted by the proponent at least 21 days before the scheduled meeting.
- Those planning on giving a visual presentation at the meeting must submit their presentation, in PowerPoint format only, at least 10 days before the scheduled meeting.

The committee reserves the right to refuse recognition of communications which do not comply with the provisions of this section.

4.0 CLOSED SESSIONS

Evaluation Committee meetings shall be open except that at the discretion of the chairperson, staff counsel may be necessary. Also, matters related to clients or potential clients covered by confidentiality requirements of ICC-ES Rules of Procedure for Evaluation Reports are discussed only during closed meetings.

5.0 ACCEPTANCE CRITERIA

5.1 Acceptance criteria are established by the committee to provide a basis for issuing ICC-ES evaluation reports on products and systems under codes referenced in Section 2.0 of the Rules of Procedure for Evaluation Reports. They also clarify conditions of acceptance for products and systems specifically regulated by the codes.

Acceptance criteria may involve a product, material, or method of construction. Consideration of any acceptance criteria must be in conjunction with a current and valid application for an ICC-ES evaluation report, an existing ICC-ES evaluation report, or as otherwise determined by the ICC-ES President.

EXCEPTIONS: The following acceptance criteria are controlled by the ICC-ES executive staff and are not subject to committee approval:

- The Acceptance Criteria for Quality Documentation (AC10)
- The Acceptance Criteria for Test Reports (AC85)
- The Acceptance Criteria for Inspections and Inspection Agencies (AC304)

5.2 Procedure:

5.2.1 Proposed acceptance criteria shall be developed by the ICC-ES staff and discussed in open session with the Evaluation Committee during a scheduled meeting, except as permitted in Section 4.0 of these rules.

5.2.2 Proposed acceptance criteria shall be available to interested parties at least 30 days before discussion at the committee meeting.

5.2.3 The committee shall be informed of all pertinent written communications received by ICC-ES.

5.2.4 Attendees at Evaluation Committee meetings shall have the opportunity to speak on acceptance criteria listed on the meeting agenda, to provide information to committee members. In the interest of fairness, each speaker requesting to testify on a proposed acceptance criteria or proposed changes to an existing acceptance criteria will be given the same amount of time, as follows:

- a. A 10-minute time limit applies to speakers giving their first testimony on any item, which applies to both verbal testimony and/or visual presentations.
- b. A 5-minute time limit applies to speakers returning to the microphone to offer additional testimony and/or to rebut testimony given by others.
- c. A 2-minute time limit applies to speakers offering testimony on the staff recommendation to criteria.

Should a company have multiple speakers, the speaker time limits above apply the company, in that multiple speakers from the same company shall share the testimony time, i.e., multiple speakers from the same company shall not each get their own testimony times. Time limits do not include time needed to answer questions from the staff and/or committee members. The chairperson-moderator shall have limited authority to modify time limitations on testimony. The chairperson-moderator shall also have the authority to adjust time limits as necessary in order to get through the hearing agenda.

An automatic timing device shall keep time for testimony and shall provide the time remaining to the speaker testifying. Interruptions during testimony will not be tolerated. It is the responsibility of the chairperson-moderator to maintain decorum and order during all testimony.

5.3 Approval of any action on an acceptance criteria shall be as specified in Section 3.3 of these rules. Possible actions made by the Evaluation Committee include:

Approval; Approval with Revisions; Disapproval; or Further Study. The Evaluation Committee must give the reason(s) for any Disapproval or Further Study actions with specific recommendations.

5.4 Actions of the Evaluation Committee may be appealed in accordance with the ICC-ES Rules of Procedure for Appeal of Acceptance Criteria or the ICC-ES Rules of Procedure for Appeals of Evaluation Committee Technical Decisions.

6.0 COMMITTEE BALLOTING FOR ACCEPTANCE CRITERIA

6.1 Acceptance criteria may be revised without a public hearing following a 30-day public comment period and a majority vote for approval by the Evaluation Committee (i.e., alternative criteria development process), when at the discretion of the ICC-ES executive staff, the subject is a revision that requires formal action by the Evaluation Committee.

6.2 Negative votes must be based upon one or more of the following, for the ballots to be considered valid and require resolution:

- a. *Lack of clarity:* There is insufficient explanation of the scope of the acceptance criteria or insufficient description of the intended use of the product or system; or the acceptance criteria is so unclear as to be unacceptable. (The areas where greater clarity is required must be specifically identified.)
- b. *Insufficiency:* The criteria is insufficient for proper evaluation of the product or system. (The provisions of the criteria that are in question must be specifically identified.)
- c. *The subject of the acceptance criteria is not within the scope of the applicable codes:* A report issued by ICC-ES is intended to provide a basis for approval under the codes. If the subject of the acceptance criteria is not regulated by the codes, there is no basis for issuing a report, or a criteria. (Specifics must be provided concerning the inapplicability of the code.)
- d. *The subject of the acceptance criteria needs to be discussed in public hearings.* The committee member requests additional input from other committee members, staff or industry.

6.3 An Evaluation Committee member, in voting on an acceptance criteria, may only cast the following ballots:

- Approved
- Approved with Comments
- Negative: Do Not Proceed

7.0 COMMITTEE COMMUNICATION

Direct communication between committee members, and between committee members and an applicant or concerned party, with regard to the processing of a particular acceptance criteria or evaluation report, shall take place only in a public hearing of the Evaluation Committee. Accordingly:

7.1 Committee members receiving an electronic ballot should respond only to the sender (ICC-ES staff). Committee members who wish to discuss a particular

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matter with other committee members, before reaching a decision, should ballot accordingly and bring the matter to the attention of ICC-ES staff, so the issue can be placed on the agenda of a future committee meeting.

7.2 Committee members who are contacted by an applicant or concerned party on a particular matter that will be brought to the committee will refrain from private communication and will encourage the applicant or

concerned party to forward their concerns through the ICC-ES staff in writing, and/or make their concerns known by addressing the committee at a public hearing, so that their concerns can receive the attention of all committee members.■

Revised May 2024

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR GLASS RAILING AND BALUSTRADE SYSTEMS

AC439

Proposed November 2024

Previously approved April 2019, February 2014, October 2013, February 2013, February 2012

(Previously editorially revised August 2020, July 2015)

PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (ICC-ES), are based upon performance features of the International family of codes, and may include other codes, as applicable.

For alternative materials, design and methods of construction and equipment, see Section 104.2.3 of the 2024 *International Building Code*® (IBC), Section R104.2.2 of the 2024 *International Residential Code*® (IRC), Section 104.11 of the 2021 IBC and earlier editions, and Section R104.11 of the 2021 IRC and earlier editions.

This acceptance criteria has been issued to provide interested parties with guidelines for demonstrating compliance with performance features of the codes referenced in the criteria. The criteria was developed through a transparent process involving public hearings of the ICC-ES Evaluation Committee, and/or on-line postings where public comment was solicited.

New acceptance criteria will only have an “approved” date, which is the date the document was approved by the Evaluation Committee. When existing acceptance criteria are revised, the Evaluation Committee will decide whether the revised document should carry only an “approved” date, or an “approved” date combined with a “compliance” date. The compliance date is the date by which relevant evaluation reports must comply with the requirements of the criteria. See the ICC-ES web site for more information on compliance dates.

If this criteria is a revised edition, a solid vertical line (|) in the margin within the criteria indicates a change from the previous edition. A deletion indicator (→) is provided in the margin where any significant wording has been deleted.

ICC-ES may consider alternate criteria for report approval, provided the report applicant submits data demonstrating that the alternate criteria are at least equivalent to the criteria set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. ICC-ES retains the right to refuse to issue or renew any evaluation report, if the applicable product, material, or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or if malfunctioning is apt to cause injury or unreasonable damage.

Acceptance criteria are developed for use solely by ICC-ES for purposes of issuing ICC-ES evaluation reports.

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PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR GLASS RAILING AND BALUSTRADE SYSTEMS (AC439)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for glass railing and balustrade systems to be ~~recognized~~ evaluated in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the 2024, 2021, 2018 and, 2015, 2012 and 2009 International Building Code® (IBC) and the 2024, 2021, 2018 and, 2015, 2012 and 2009 International Residential Code® (IRC). Basis of ~~recognition~~ evaluation is 2024 IBC Section 104.2.3 (2021, 2018 and 2015 IBC Section 104.11) and 2024 IRC Section R104.2.2 (2021, 2018 and 2015 IRC Section R104.11). For compliance with the 2012 and 2009 International Building Code® (IBC), and 2012 and 2009 International Residential Code® (IRC), refer to a previous version of this criteria, dated April 2019; editorially revised August 2020 (available from ICC-ES upon request).

The reason for this criteria is to provide guidance for the testing of the systems, since the codes do not provide specific test requirements. The criteria also provides design information consistent with Section 2407.1.1 of the IBC and Table R301.5 of the IRC.

1.2 Scope: This criteria covers the design and testing of glass railings and balustrade systems to determine compliance with Section 2407 of the IBC and Section R321 of the IRC (Section R312 of the 2021, 2018 and 2015 IRC).

1.3 Codes and Referenced Standards:

1.3.1 ~~2024, 2021, 2018, and 2015, 2012 and 2009 International Building Code® (IBC)~~, International Code Council.

1.3.2 ~~2024, 2021, 2018, and 2015, 2012 and 2009 International Residential Code® (IRC)~~, International Code Council.

1.3.3 AAMA "Conform Wall Glass" CW-12-84, "Structural Properties of Glass," dated 1984 (reprinted 6/06), American Architectural Manufacturers Association.

1.3.4 ANSI Z97.1-15 (Reaffirmed 2020), Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test, American National Standards Institute.

1.3.5 ASTM C1048-18, Standard Specification for Heat-Treated Flat Glass, Kind HS, Kind FT Coated and Uncoated Glass, ASTM International.

1.3.6 ASTM C1172-19 Standard Specification for Laminated Architectural Flat Glass, ASTM International.

1.3.7 ASTM E935-~~43~~421, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings, ASTM International.

1.3.8 ASTM E1300-16, Standard Practice for Determining Load Resistance of Glass in Buildings, ASTM International

1.3.9 ASTM E1996-~~4720~~, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes, ASTM International.

1.3.10 ASTM E2353-~~4621~~, Standard Test Methods for Performance of Glazing in Permanent Railing Systems, Guards, and Balustrades, ASTM International.

1.3.11 CPSC 16 CFR Part 1201 (2002), Safety Standard for Architectural Glazing Material, U.S. Consumer Products Safety Commission.

1.3.12 NCSEA "Engineering Structural Glass Design Guide", dated 2018, National Council of Structural Engineers Associations.

1.4 Definitions:

Balustrade System (Assembly): This system consists of glass balusters, a handrail or top rail and a shoe.

1.4.1 Baluster: An upright glass panel that structurally supports a handrail or top rail.

1.4.2 Glass Railings (Guardrails): A railing of either glass balusters (a series of which is called a balustrade) or glass in-fill panels.

1.4.3 Handrail: A narrow rail mounted parallel to a stair or landing that is used for grasping with the hand for support.

1.4.4 In-fill Panel: A structural glass panel supported by a frame and not supporting a handrail or top rail.

1.4.5 Point Support: A clamp or through-glass fitting that supports a glass baluster or in-fill panel, or attaches a handrail to a glass panel.

1.4.6 Post: An upright structural member that supports a top rail, handrail, baluster or in-fill panel.

1.4.7 Shoe: The bottom supporting member of a balustrade that anchors and supports a balustrade system.

1.4.8 Top Rail: The uppermost part of a balustrade system consisting of a structural member capable of supporting the loads specified in Section 1607.9 of the 2024 and 2021 IBC (Section 1607.8 of the 2018 and, 2015, 2012 or 2009 IBC), or Table R301.5 of the IRC, respectively, whichever is applicable. In a stairway glass railing, this is a handrail.

Additional information on the various types of balustrade assemblies is provided in Section 5 of ASTM E2353.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted:

2.1.1 Product Description: The product description shall include a physical description of each of the components of each system, including the material and physical properties and specification reference requirements.

2.1.2 Installation Instructions: Manufacturer's published installation instructions, including procedures for the proper installation and system support details.

2.1.3 Packaging and Identification: A description of the method of packaging and field identification of the components of each system. Product identification shall be in accordance with the product identification provisions of the ICC-ES Rules of Procedure for Evaluation Reports. Marking on the glass shall comply with Section 2406.3 of the IBC.

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR GLASS RAILING AND BALUSTRADE SYSTEMS (AC439)

2.1.4 Field Preparation: A description of the methods of cutting, erection, and assembly.

2.2 Testing Laboratories: Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports.

2.3 Test Reports: Test reports shall comply with AC85.

2.4 Product Sampling: Sampling of the product for tests under this criteria shall comply with Section 3.2 of AC85.

2.5 Qualification Test Plan: A qualification test plan shall be submitted to and approved by ICC-ES staff prior to any testing being conducted.

3.0 DESIGN AND PERFORMANCE REQUIREMENTS

3.1 Testing and Analysis Requirements: To be evaluated under this criteria, all railing, in-fill panels and balustrade systems, for which ~~recognition-evaluation~~ is sought, shall meet the requirements of Sections 3.3 through 3.5 and be tested in accordance with the requirements noted in Section 4.0 of this criteria.

3.2 Alternate Testing and Analysis Method:

An alternate method of demonstrating compliance by providing engineering analysis and performing a limited amount of testing may be performed as follows:

A preliminary plan outlining the analysis approach and the testing requirements to support analysis, shall be submitted to ICC-ES for review prior to any testing. The analysis and testing shall, at a minimum, include consideration of the following:

1. Requirements noted in Sections 3.3 through 3.5 of this criteria.
2. Engineering analysis shall account for test results that would be obtained when testing is conducted in accordance with Section 4.0 of this criteria.
3. Required loading on the glass railing system (top and handrails), including connection of the handrailing system to the glass.
4. The ability of the glazing to resist the required loads prescribed by the codes.
5. Connection of the glazing system to a shoe or other bottom support and the shoe's (bottom support) connection to the substrate (e.g., wood, steel or concrete).

Note: For ~~recognition-evaluation~~ under the 2024, 2021 and 2018 IBC, systems without a top rail or handrail must be shown to comply with Section 4.7 of this criteria.

3.3 Railing and Balustrade System Components Material Properties:

3.3.1 Glass:

Glass shall comply with the requirements in Section 2407.1 of the IBC; Section R324.4.4 of the 2024 IRC; or Section R308.4.4 of the 2021, 2018 and, 2015, and 2012 IRC; or Section R308.4 of the 2009 IRC, as applicable. Data in the form of test results and analysis verifying compliance with IBC Section 2407.1, while considering the allowable stresses in Table 1, shall be submitted.

For laminated glass panels with PVB (poly vinyl butyral) and non-PVB interlayers, the method for determining effective thickness of laminated glass for analysis of stresses and deflection are as outlined in ASTM E1300 Appendix X9. ASTM E1300 Appendix X9 shall be used for analysis of stresses related to live loads and wind loads. For PVB interlayers, the maximum interlayer shear modulus (G) value shall be determined in accordance with ASTM E1300. For non-PVB interlayers, the interlayer shear modulus (G) values, at temperatures for which recognition is sought, shall be provided by the report holder and the evaluation report shall simply indicate the shear modulus referenced by the submitted analysis. If the non-PVB interlayer is to be named in the evaluation report and the evaluation report is to list the non-PVBs' interlayer shear modulus (G) value, then reports of testing will need to be submitted per Section 4.9.

3.3.2 Handrail: Handrails shall comply with the requirements in Section 1014 of the ~~2021, 2018, and 2015 IBC (Section 1012 of the 2012 and 2009 IBC)~~ or Section R318.7.8 of the 2024 IRC (Section R311.7.8 of the 2021, 2018 and, 2015, and 2012 IRC (Section R311.7.7 of the 2009 IRC), whichever is applicable. Guardrails and handrails shall also comply with Table R301.5 in the IRC. The following items must be addressed:

1. Handrail height from stair tread nosing.
2. Handrail extensions beyond stair treads.
3. Handrail terminations.
4. Handrail graspability.
5. Handrail continuity (transitions).
6. Method of connection of handrail.
7. Handrail projection.
8. Handrail clearance.

3.3.3 Shoe: The rail base shall be of configuration, material type and size sufficient to support the glass baluster so that the system complies with Section 2407 of the IBC or Table R301.5 of the IRC. The shoe may be continuous or non-continuous. When the shoe is non-continuous, the baluster shall be considered point-supported.

3.3.4 Top Rail: Top rails shall be of a size, configuration and material type so that the system complies with the requirements of Sections ~~1014 of the 2021, 2018 and 2015 IBC (Section 1012 of the 2012 and 2009 IBC)~~ and Section 2407.1 of the IBC, or Table R301.5 of the IRC and Section R318.7.8 of the 2024 IRC (Section R311.7.8 of the 2021, 2018 and, 2015 and 2012 IRC (Section R311.7.7 of the 2009 IRC), whichever is applicable.

3.4 Railing and Balustrade System Analysis: The various components of the system shall be analyzed as a system. The analysis shall include calculations and results of tests verifying ~~compliance—the system's capability of withstanding the live loads specified in~~ Section 2407.4.11607.9 of the IBC and/or Table R301.5 of the IRC, whichever is applicable, while considering the allowable stresses in Table 1 for the glass panels. It is acceptable to use AAMA CW-12-84 or ASTM E1300 (including all appendices) as a guideline in the engineered analysis and design. ~~The analysis shall include verification that the glass panels have been designed to resist the design loads~~

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR GLASS RAILING AND BALUSTRADE SYSTEMS (AC439)

~~specified in this section with a safety factor of 4.0 applied.~~
For wind resistance evaluation of the glass panels, the analysis shall be in accordance with Section 2404.1 of the IBC, which references ASTM E1300 (see Table 1 for the allowable wind load stresses).

All other components of the guardrail system shall be designed using a safety factor as applicable per the appropriate design standard for that component. Additionally, the analysis shall include verification that the glass does not deflect more than 1 inch (25.4mm) for any code-required design load.

3.5 System Test Requirements: Tests conducted in accordance with Section 4.0 of this criteria shall demonstrate that the various systems for which ~~recognition~~ evaluation is sought meet the design load requirements of Section 3.4 of this criteria. The fully assembled system shall be tested at a factor of 2.5 applied to the design loads of Section 3.4 of this criteria. If glass breakage occurs at any location within the panel during testing, a safety factor of 4 shall be applied to the load at which breakage occurred. The test program and analysis to be used to verify compliance with Sections 3.3 of this criteria shall be submitted to ICC-ES for review prior to the beginning of testing.

4.0 TEST REQUIREMENTS

4.1 Load testing shall be conducted in accordance with ASTM E2353 for each of the loading conditions specified in Section 2407.1.1 of the IBC and/or Table R301.5 of the IRC, whichever is applicable.

4.2 In applying ASTM E2353, the in-fill types may be applied to structural glass for similar support conditions. Point-supported structural glass shall be considered as either Type III when tested between the point supports or as Type V when tested in a cantilevered section.

4.3 The top/handrail shall be tested for a condition simulating the rupture of a supporting glass light by testing a three-glass-light configuration with the center light omitted. The grab/handrail shall be tested using the horizontal and vertical test configurations, non-concurrently, of ASTM E935, applied at mid span.

4.4 When the top/handrail is intended to be installed solely supported by the glass balustrades, the test shall also be performed with a three-light configuration with the end light omitted. The top/handrail shall be tested using the horizontal and vertical test configurations, non-concurrently, of ASTM E935, applied at rail end.

4.5 The guard, when tested in accordance with Sections 4.3 and 4.4, will be deemed as passing these tests if the top/handrail supports a load of 334 pounds for 60 seconds without collapse and with a total deflection of under 12 inches regardless of damage to the rail and its supports.

4.6 When acceptance for use in Wind-Borne Debris Regions is desired, the glass balustrades shall demonstrate compliance with IBC Section 1609.2 by testing in accordance with the large missile test of ASTM E1996.

4.7 If the balustrade is to be installed without a top rail or handrail in accordance with the IBC Section 2407.1.2 Exception, the glass shall be fully tempered or heat-strengthened laminated glass. In addition to the testing requirements previously required by this acceptance

criteria, the glass balustrade system shall remain in place as a barrier following impact or glass breakage in accordance with ASTM E2353. ASTM E2353 Test 1 at a load of 83.5 plf or 334 pounds concentrated load shall be conducted to demonstrate that the system will remain in place as a barrier.

4.8 When the glass railing and balustrade systems are to be installed in exterior locations, a proposal shall be submitted to the ICC-ES staff for review. The proposal shall include specific test data and system component materials information, shall provide a means to verify that the system can be installed in exterior locations, and shall provide a means to examine any possible deterioration of the railing, guard or balustrade system or their connections resulting from adverse environmental or in-service conditions.

4.9 As required by the end of Section 3.3.1, reports of testing using the methods described in ASTM E1300 X8 or X9 shall be submitted showing the interlayer shear modulus (G) value.

5.0 QUALITY CONTROL

5.1 Regular, ongoing inspections are not required under this criteria, but the manufacturing facilities may be subject to annual inspections in accordance with Section 9.0 of the ICC-ES Rules of Procedure for Evaluation Reports.

5.2 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted.

6.0 EVALUATION

REPORT

RECOGNITION REQUIREMENTS

6.1 The evaluation report shall include statements that the glass railing and balustrade systems must be installed in accordance with the evaluation report, the manufacturer's published installation instructions and Sections 1014, and 1015 of the 2021, 2018, and 2015 IBC (~~Sections 1012 and 1013 of the 2012 and 2009 IBC~~) and Section 2407 of the IBC, or Section R318.7.8 of the 2024 IRC (Section R311.7.8 of the 2021, 2018 and 2015, and 2012 IRC (Section R311.7.7 of the 2009 IRC) and Section R312 of the IRC, whichever is applicable.

6.2 The evaluation report shall include information on the various systems qualified under the requirements noted in Section 3.0 of this criteria, including material descriptions, installation, glass geometry to include minimum and maximum light widths, holes, notches, and details of system connection to the supporting structure.

6.3 The evaluation report shall include a statement that attachment of the shoe to the structural frame shall be designed.

6.4 If tests are only conducted to meet the requirements of Table R301.5 of the IRC, use shall be limited to structures meeting the requirements of the IRC.

6.5 If the evaluation report includes exterior installations, the report shall include a statement that the guard is suitable for exterior installations, and shall report the maximum average glass bending moments, M_{gmax} ft-lbs/ft, supported with the allowable uniform wind pressure, W psf, calculated as:

$$W = \left(\frac{M_{gmax}}{2.5} \right) / (0.55 * H^2)$$

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Where *H* is the glass height above the supports in feet.

6.6 If the evaluation report includes use in Wind-Borne Debris Regions, the report shall include the statement, "This product has been demonstrated as compliant for use in Wind-Borne Debris Regions when installed in accordance with this report." The report shall also include the wind zone and level of protection that the system is rated for per IBC Section 1609.2 (for 2021, 2018 and 2015 IBC) and ASTM E1996 (for 2024 IBC).

6.7 If the evaluation report is to include installations without a top rail, then the report shall specify the fully tempered or heat-strengthened laminated glass thickness with the specific interlayer tested, maximum balustrade height, minimum and maximum glass light lengths, and this statement: "When installed with laminated glass as specified in this section, the balustrade has demonstrated

compliance with IBC Section 2407.1.2 for installation without a top rail or handrail. Substitution of other interlayer materials is not permitted."

6.8 The evaluation report shall include this statement: "All glass shall be fully tempered fabricated and inspected in accordance with ASTM C1048, and the glass fabricator shall provide certification of compliance with ASTM C1048 for fully tempered glass." If the evaluation report is intended to include laminated glass, then the report shall include this statement: "All glass shall be [state fully tempered or heat-strengthened] Type II laminated glass with [state interlayer thickness and type] interlayer, fabricated and inspected in accordance with ASTM C1172; and the glass fabricator shall provide certification of compliance with ASTM C1172.■

TABLE 1—ALLOWABLE STRESSES IN GLASS PANELS

Load Type	Glass Type	Modulus of Rupture (psi)	Allowable Edge Stress (psi)			Allowable Surface Stress (psi) ¹
			Clean Cut Edges	Seamed Edges	Polished Edges	
Wind Loads ²	HS: Heat Strengthened	12,000	---	5,300	5,300	6,750
	FT: Fully Tempered	24,000	---	10,600	10,600	13,500
Live Loads ³	HS: Heat Strengthened	12,000	---	3,000		3,820
	FT: Fully Tempered	24,000	---	6,000		7,640

¹Surface stresses are stresses located away from cut, drilled or processed edges. Minimum distance from straight edges is 2 times the thickness of glass and 6.5 times the thickness of glass from corner edges. See NCSEA Engineering Structural Glass Design Guide Section 1.2 for additional information.

²Wind load stresses in the glass panels, determined in accordance with Section 2404.1 of the IBC, shall not exceed the allowable stress values provided in this table. Allowable edge and surface stresses for wind loads in this table were based on ASTM E1300 Sections X6.2 and X7.1.

³Live load stresses in the glass panels, determined in accordance with Section 1607.9 of the IBC and/or Table R301.5 of the IRC, whichever is applicable, shall not exceed the allowable stress values provided in this table. The allowable live load surface stress was determined by multiplying the allowable edge stresses by a factor of 1.274 (the ratio of allowable surface-to-edge stresses for wind loads = 6,750/5,300 = 13,500/10,600 = 1.274).