

## ACCEPTANCE CRITERIA FOR HANDRAILS AND GUARDS

AC273

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### PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (ICC-ES), are based upon performance features of the International family of codes. (Some reports may also reference older code families such as the BOCA National Codes, the Standard Codes, and the Uniform Codes.) Section 104.11 of the *International Building Code*® reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

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 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.

NOTE: The Preface for ICC-ES acceptance criteria was revised in July 2011 to reflect changes in policy.

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

# ACCEPTANCE CRITERIA FOR HANDRAILS AND GUARDS (AC273)

## 1.0 INTRODUCTION

**1.1 Purpose:** The purpose of this acceptance criteria is to establish requirements for handrails and guards to be recognized in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the 2012, 2009 and 2006 *International Building Code*® (IBC), the 2012, 2009 and 2006 *International Residential Code*® (IRC) and the 1997 *Uniform Building Code*™ (UBC). Bases of recognition are IBC Section 104.11, IRC Section R104.11 and UBC Section 104.2.8.

**1.2 Scope:** This criteria is limited to handrails and guards used with interior and exterior ramps, stairways, balconies or porches. Components shall be produced from metal or wood, which are permitted to be interconnected to each other and to support structure with nonconventional connection methods.

The guards may be installed in residential and nonresidential buildings.

**1.3 Codes and Reference Standards:** Where standards are referenced in this criteria, these standards shall be applied consistently with the code (IBC, IRC or UBC) upon which compliance is based.

**1.3.1** 2012, 2009 and 2006 *International Building Code*® (IBC), International Code Council.

**1.3.2** 2012, 2009 and 2006 *International Residential Code*® (IRC), International Code Council.

**1.3.3** 1997 *Uniform Building Code*™ (UBC).

**1.3.4** BS EN 942:1996, Timber in Joinery—General Classification of Timber Quality, British Standards Institution.

**1.3.5** BS EN 1186:Part 2:1988, Timber for and Workmanship in Joinery, Specification for Workmanship, British Standards Institution.

**1.3.6** BS EN 1186:Part 3:1990, Timber for and Workmanship in Joinery, Specification for Wood Trim and its Fixing, British Standards Institution.

### 1.4 Definitions:

**1.4.1 Baluster:** One of the supporting posts of a handrail or guard, usually rounded or vase-shaped. Class A

**1.4.2 Guard:** As described in Section 202 of the IBC and Section R202 of the IRC. Also known as “guardrail” in the UBC. Composite Floor Panels and Ramps:

**1.4.3 Handrail:** As described in Section 202 of the IBC and Section R202 of the IRC.

**1.4.4 Newel Post:** A post that supports a handrail at the bottom or at the landing of a staircase.

## 2.0 BASIC INFORMATION

**2.1 General:** The following information shall be submitted:

**2.1.1 Product Description:** Complete information concerning handrails and guards. Components such as balusters, top rails, base rails, newel posts, newel bases, fasteners, and fittings shall be described as to materials, dimensions, physical properties, finishes, storage

instructions, manufacturing process, and compliance with reference specifications.

**2.1.2 Installation Instructions:** Installation details and limitations, including assembly of components and attachment to supporting structure.

**2.1.3 Packaging and Identification:** A description of the method of packaging and field identification of the materials. Identification provisions shall include the evaluation report number.

**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:** Products shall be sampled in accordance with Section 3.1 of AC85.

## 3.0 TEST AND PERFORMANCE REQUIREMENTS

**3.1 Handrails:** Handrails shall comply, as applicable, with requirements in Section 1012 of the IBC, Section R311.7.8 of the 2012 IRC, Section R311.7.7 of the 2009 IRC, Section R311.5.6 of the 2006 IRC or Section 1003.3.3.6 of the UBC. 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).

Newel posts shall be a minimum of  $2^{23}/_{32}$  inches (69 mm) square or have an equivalent cross section when supporting up to nine runs, and  $3^{17}/_{32}$  inches (90 mm) square or with an equivalent cross section when supporting more than nine runs.

**3.2 Guards:** Guards shall comply with requirements in Section 1013 of the IBC, Section R312 of the IRC, or Section 509 of the UBC. The following items must be addressed:

- a. Guard height.
- b. Opening limitations.

**3.3 Material Specifications:** Materials used to produce components shall comply with specifications referenced in the IBC, IRC, and UBC. As an alternative, timber components are permitted to comply with BS EN 942 and BS EN 1186. Determination of compliance shall comply with Section 4.1. Conditions of acceptance are that the components satisfy applicable requirements set forth in the specification.

**3.4 Structural Requirements:** Handrails and guards and their attachments shall meet the requirements, as applicable, of Section 1607.8.1 of the 2012 IBC, Section 1607.7.1 of the 2009 and 2006 IBC and Section 1607.8.1 of the 2012 IBC or Section 1611 of the UBC. Compliance shall be determined by structural analysis in accordance with applicable requirements in the IBC or UBC. Where

## ACCEPTENCE CRITERIA FOR HANDRAILS AND GUARDS (AC273)

the handrails and guards contain nonconventional connection methods, testing is permitted in lieu of structural analysis. Test procedures are as set forth in Section 4.2 of this criteria.

### 4.0 TEST METHODS

**4.1 Material Specifications:** Components shall be evaluated for compliance with applicable material specifications. Except where the specification describes sampling requirements, a minimum of three specimens shall be evaluated.

#### 4.2 Structural Tests:

**4.2.1 General:** The guard and handrail test specimens shall be constructed in the same manner as described in the manufacturer's published installation instructions referenced in Section 2.1.2 of this criteria. Each guard and handrail configuration for which recognition is desired shall be tested. Testing a "worst case" configuration is permitted to gain acceptance of a more substantial configuration without the need to test the more substantial system, provided acceptable data is submitted to ICC-ES to justify the selection of the "worst case" (weakest) configuration. Additionally, for those systems that utilize multiple methods of newel post base or baluster installation, component testing shall be as provided in Sections 4.2.5 and 4.2.6 of this criteria, respectively. The guard and handrail test specimen shall be defined as two newel posts at maximum center-to-center spacing, and all components, and all connections used in the guard and handrail system, including the newel post base connection. The same test specimen shall be subjected to the in-fill load test (Section 4.2.2 of this criteria), the uniform load test (Section 4.2.3 of this criteria), and the concentrated-load test (Section 4.2.4 of this criteria), in that order. The specimen shall be loaded at a rate to achieve the specified loads between 10 seconds and 5 minutes. The specified test load shall be held for one minute before the load is released.

Handrails and guards in or on one- and two-family dwellings under the IBC and IRC shall pass only the in-fill load test (Section 4.2.2 of this criteria) and the concentrated load test (Section 4.2.4 of this criteria).

**4.2.2 In-fill Load Test:** The test specimens shall be tested and shall be capable of satisfactorily resisting a load of 125 lbf (556 N) applied over a 1-square-foot (0.09293 m<sup>2</sup>) area normal to the in-fill. The in-fill is considered to be the load-resisting elements between newel posts, such as intermediate rails, balusters or panel fillers. The load shall be applied at a position on the in-fill that will represent the "least resistance to" loading and deflection in the outward direction. The guardrail system (guard and handrail) is considered to pass if there is no failure, nor evidence of disengagement of any component, nor visible cracks in any component.

**4.2.3 Uniform Load Test:** The top rail of the guard and handrail test specimens shall be subjected to a single test where a maximum uniform load of 125 lbf/ft (1.82 kN/m) is applied vertically and in an outward direction at an angle of 45 degrees from horizontal. For purposes of this test, quarter-point loading shall be deemed to be equivalent to uniform loading. The guard and handrail system is considered to pass if there is no failure, nor any evidence of disengagement of any component, nor visible cracks in any component.

**4.2.4 Concentrated Load Test:** Two separate tests on each specimen shall be conducted, where a test load of 500 lbf (2.22 kN) is applied at the midspan of the top rail and at the top of a single post in an outward direction. In both cases, the load shall be continuously applied horizontally and normal to the top rail at the maximum guard and handrail system height. When the applied load reaches 200 lbf (0.89 kN), the deflection at the point of loading shall be recorded. The allowable deflection for the system at 200 lbf (0.890 kN) shall not exceed either one of the following allowable deflection limits:

a. The sum of the rail (guard) height,  $h$  (in inches/mm), divided by 24 plus the effective rail length,  $l$  (in inches/mm), divided by 96, or  $(h/24 + l/96)$ . Where the effective rail length is the distance between the edges of the posts, the deflection at the midspan of the top rail (guard) is measured relative to the center of the two posts (i.e., it does not include post deflection).

b. The effective newel post height (vertical support) divided by 12, or  $(h/12)$ , where the effective newel post (vertical support) height is the distance from the top of the top rail to the first point of fastener connection to the supporting construction.

Additionally, the mounting of handrails shall be such that the completed handrail and supporting structure are capable of withstanding a load of at least 500 lbf (2.22 kN) when determined by tests. The applied load shall be applied in the most restrictive direction and location on the rail.

**4.2.5 Newel Post Base Performance:** When evaluation of multiple newel post bases and attachment methods, in addition to the one evaluated in the assemblies described in Section 4.2.1 of this criteria, is required, testing of the individual newel post may be used in lieu of retesting the entire guard and handrail system. The test specimen shall consist of a post, a portion of guard or handrail attached on each side of the post in accordance with the installation instructions described in Section 2.1.2 at the appropriate rail height, and the specific newel post base to be evaluated. The supporting construction that the newel post base is attached to shall be consistent with the type of material that the specific attachment is designed for, and shall be capable of resisting the required test load. Each newel post base attachment method shall be tested with a minimum of three test specimens. If the average ultimate horizontal load, as described in the second paragraph of this section (Section 4.2.5), of any of the tests varies by more than 20 percent from the average ultimate load, at least three additional tests shall be conducted unless the lowest of the initial three test values is used. The ultimate load shall be the average of the six tests as described in the second paragraph of this section (Section 4.2.5). The test report shall provide a clear description of the newel post base and fastener layout/spacing utilized in the test setup.

The newel post shall be tested to failure when the test load is applied in the outward direction with regard to the newel post base attachment method. Failure shall be when evidence of visible damage or disengagement occurs. The load shall be applied through the short portions of top rail attached on each side of the newel post. The maximum allowable span that the newel post base and/or attachment method will support shall be determined as the average ultimate load divided by 125. If

## ACCEPTENCE CRITERIA FOR HANDRAILS AND GUARDS (AC273)

the maximum allowable span of the newel post base is less than that of the maximum guard and handrail system, the evaluation report shall contain a Condition of Use outlining the span limitations for the corresponding newel post base/attachment method.

**4.2.6 Baluster Performance:** When evaluation of multiple baluster options, in addition to the one evaluated in the assembly described in Section 4.2.1 of this criteria, is required, testing of the additional baluster, utilizing the guard and handrail system as described in Section 4.2.1 of this criteria, utilizing only the load requirements specified in Section 4.2.2 of this criteria, is allowed.

**4.2.7 Assembly Fastener Testing:** Assembly testing shall be provided which establishes the ability of the guard and handrail system to resist separation of the adjacent top rail and newel post where the top rails on each side of a newel post are not aligned and one of the top rails is loaded horizontally and normal with the appropriate tributary load of 50 lbf/ft. Alternatively, the individual fastener capacity of nails, screws, and staples shall be calculated according to applicable code.

**4.2.8** If treated wood is used, data must be submitted that demonstrates compatibility of fasteners and metal components with chemically treated wood in accordance with ICC-ES Acceptance Criteria for Corrosion-resistant Fasteners (AC257).

### 5.0 QUALITY CONTROL

**5.1** The products shall be manufactured under an approved quality control program with inspections by an

inspection agency accredited by the International Accreditation Service (IAS) or otherwise acceptable to ICC-ES.

**5.2** Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality control program shall verify component compliance with specifications described in Section 2.1.1.

### 6.0 EVALUATION REPORT RECOGNITION

**6.1** The evaluation report shall include the product description, installation instructions, and packaging and identification information, based on requirements in Section 2.1 of this criteria.

**6.2** When guards are evaluated for one- and two-family dwellings only, the following shall occur:

**6.2.1** The report shall include the following statement: The use of this product shall be limited to exterior or interior use as a guard system for balconies and porches for one- and two-family dwellings of Type V-B (IBC) construction and dwellings constructed in accordance with the IRC.

**6.2.2** The identification section of the report shall include the following statement: **The** label shall also include the phrase: "For Use in One- and Two-Family Dwellings Only".

**6.3** The evaluation report shall state the type of handrail (i.e., Type I or Type II) ■