February 3, 2020

TO: PARTIES INTERESTED IN PROPOSED REVISIONS TO THE
ACCEPTANCE CRITERIA FOR STEEL DECK ROOF AND FLOOR
SYSTEMS

SUBJECT: Proposed Revisions to the Acceptance Criteria for Steel Deck Roof and
Floor Systems, Subject AC43-0220-R1 (WU/WG)

Dear Colleague:

We are seeking your comments on proposed revisions to the subject acceptance
criteria, as presented in the enclosed draft. The revisions, which are being posted on
the ICC-ES web site for 30 days of public comment, may be summarized as follows:

When designing diaphragm capacities of concrete filled steel decks per AISI S310
using mechanical fasteners to attach steel decks to steel supports, it our
understanding that;

- The minimum steel support thickness of 0.10 inch (2.54 mm) required by
  Section D4 (k) is not applicable when using mechanical fasteners but is
  applicable when using arc-spot welds.
- The minimum steel support thickness shall be based on the mechanical
  fastener’s support connection capacity determined AISI S310 Section D1.1.
  This is consistent with designing diaphragm capacities of steel decks that do
  not have concrete fill per AISI S310.

Therefore, it is proposed that AC43 be revised to clarify our understanding as shown
in the Sections 3.4.1 and A3.4.1.1.

While the Evaluation Committee will be voting on the revised criteria during the 30-
day comment period, we will seriously consider all comments from the public and will
pull the criteria back for reconsideration if public comments raise major issues. In
that case, we would seek a new committee vote; further revise the draft and post it for
a new round of public comments; or put the revised criteria on the agenda for a future
Evaluation Committee hearing.

If they are of interest, please review the proposed revisions and send us your
comments at the earliest opportunity.
To submit your comments, please use the form on the web site and attach any letters or other materials. If you would like an explanation of the “alternate criteria process,” under which we are soliciting comments, this too is available on the ICC-ES web site.

Please do not try to communicate directly with any Evaluation Committee member about a criteria under consideration, as committee members cannot accept such communications.

Thank you for your interest and your contributions. If you have any questions, please contact me at (800) 423-6587, extension 5699, or Bill Gould, P.E., Sr. Vice President, Engineering & Technical Services, at extension 3205. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

Will Utsey, P.E. Regional Assistant Engineering Director

WU/raf

Encl.

cc: Evaluation Committee
PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR STEEL DECK ROOF AND FLOOR SYSTEMS

AC43

Proposed February 2020


(Previously editorially revised September 2013, August 2013)

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.

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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1.0 INTRODUCTION

1.1 Purpose: The purpose of this criteria is to establish requirements for the evaluation of steel deck roof and floor systems to be recognized in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the 2018 International Building Code® (IBC). The basis of recognition is IBC Sections 104.11, 2210 and 2211.

1.2 Scope: This acceptance criteria is applicable to steel deck roof and floor systems consisting of steel deck panels attached to steel, wood or concrete supports, with or without concrete fill placed on top of the steel deck panels, where the concrete fill is normal-weight concrete, lightweight concrete, insulating, or cellular concrete. This acceptance criteria is applicable to systems using power-actuated fasteners, tapping screws, welds, button punches or clinch connections. The systems under this acceptance criteria may also include accessories, such as devices used to transfer shear forces at diaphragm boundaries.

The acceptance criteria is applicable to steel deck floor and roof systems used to support gravity and uplift loads; used as components of horizontal diaphragms to resist lateral forces; and used as fire-resistance-rated assemblies.

Suitability of cellular deck panels for use as cellular metal floor raceways is outside the scope of this acceptance criteria.

Steel deck roof systems used as roof coverings also shall comply with requirements set forth in the ICC-ES Acceptance Criteria for Metal Roof Coverings (AC166).

1.3 Referenced Standards: Reference Standards are included in Table 1.

1.4 Definitions: Definitions of steel diaphragms are provided in AISI S310 with the following exception:

1.4.1 Diaphragm: A diaphragm is a horizontal floor, horizontal roof, or sloped roof that distributes wind, earthquake, and other lateral forces to the vertical lateral force resisting system. A diaphragm is analogous to a horizontal girder with interconnected floor or roof deck panels acting as the girder web.

Diaphragms under this acceptance criteria consist of steel deck panels only or steel deck panels with concrete fill attached to steel, wood or concrete supports.

2.0 BASIC INFORMATION

2.1 Product and Material Requirements:

2.1.1 Steel Deck Panels: The following shall be submitted:

- steel specifications complying with Section A3 of AISI S100;
- base-metal thickness and minimum steel thickness complying with Section B7.1 of AISI S100;
- coatings, including type and thickness; and
- dimensioned cross-sectional drawings with stated tolerances. The drawings shall illustrate the fluted patterns and web embossments, if any. For cellular decks, the resistance weld pattern and a description of the welds shall be reported and shown on the drawings.

Each bundle of steel deck panels shall have a legible label, stamp or embossment, indicating the manufacturer’s name; the evaluation report number; and the acronym “ICC-ES.” In addition to the above information, each bundle of panels shall have a legible label, also indicating material minimum base metal thickness (uncoated) in decimal thickness or mils; and the minimum specified yield strength [if greater than 33 ksi (228 MPa)]. The label shall have a means of traceability back to the manufacturer’s quality records.

2.1.2 Concrete Fill: The type (normal weight, lightweight, cellular, insulating, etc.), density, and minimum compressive strength shall be submitted. Normal-weight and lightweight concrete shall comply with the ICC-ES Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements (AC70).

2.1.3 Power-Actuated Fasteners: Where the power-actuated fasteners are not recognized in an ICC-ES evaluation report, the following shall be submitted: product specifications, packaging and labeling, and quality control requirements complying with the ICC-ES Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements (AC70).

2.1.4 Tapping Screws: Where proprietary tapping screws are not recognized in an ICC-ES evaluation report, the following shall be submitted: product specifications, packaging and labeling, and quality control requirements complying with the ICC-ES Acceptance Criteria for Tapping Screw Fasteners (AC118) for tapping screws used to attach steel deck to steel supports, or ICC-ES Acceptance Criteria for Alternate Dowel-Type Threaded Fasteners (AC233) for tapping screws used to attach steel deck to wood supports.

2.1.5 Button Punches, Clinch Connections, and Welds: Button punches, clinch connections, and welds must comply with AISI S310, SDI RD, SDI NC, and SDI C, whichever is applicable. For clinch connections, detailed drawings must be submitted.

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 Plans: Before testing is completed, at the request of the report applicant, test plans may be submitted to ICC-ES for review prior to testing.

2.4 Test Reports: Test reports shall comply with AC85 and additionally include the following information:

2.4.1 Detailed identification of specimens.
2.4.2 Detailed drawings of specimens including physical characteristics, section profiles, and other construction details.
2.4.3 Detailed descriptions of test specimens and test assemblies, attachment of specimens to the fixture,
location of load points, deflection gages, deflection points and other items as applicable. Ambient conditions at the date of construction, curing period and date and time of tests shall be reported where relevant to the performance of the tested assembly. The ambient conditions include relative humidity and temperature. Wind speed shall also be considered if tested outdoors.

2.4.4 If the test specimen construction deviates from typical field construction, deviations shall be reported.

2.4.5 The test report shall state that tests were conducted in accordance with the applicable methods and the ICC-ES acceptance criteria, deviations shall be reported.

2.4.6 Statements indicating whether the constructed test specimens meet actual or intended construction shall be included, deviations shall be reported.

2.4.7 Test results shall include load-deflection readings, maximum load applied, failure mode, total time under load at the various load levels, and photographs of tested specimens before and after testing.

2.5 **Product Sampling:** Sampling of the steel deck panels, concrete constituents and fasteners for tests under this criteria shall comply with Section 3.2 of AC85.

2.6 **Calculations:** Computer generated calculations shall be identified by a version, edition, and date. Accompanying the computer generated calculations shall be a set of detailed calculations showing how calculations comply with the appropriate sections of this AC43 and the applicable referenced standard. All calculations, computer generated and detailed, shall be signed, sealed, and dated by a registered design professional.

### 3.0 TEST AND PERFORMANCE REQUIREMENTS

#### 3.1 Steel Deck Section Properties:

Section properties shall be determined in accordance with AISI S100. The section properties reported shall include the:

- base-metal design thickness;
- full moment of inertia ($I_h$);
- effective moment of inertia, normal position ($I_{eff+n}$);
- effective moment of inertia, inverted position ($I_{eff-i}$);
- effective section modulus, normal position ($S_{eff+n}$) at $F_y$; and
- effective section modulus, inverted position ($S_{eff-i}$) at $F_y$.

Under uniform vertical loads, any of the following equations are permitted to determine deflections:

- **Simple span:** $l_o = (l_x + 2l_{eff}) / 3$, or $l_{eff}$
  - **Multiple span:** $l_o = (l_x + 2l_{eff}) / 3$, or $l_{eff}$ and the minimum of $l_{eff}$ and $l_{eff}$.

To fully develop section properties of cellular steel deck panels, welds shall be placed to develop the shear flow at the intersection of the two sheets. Resistance weld strengths shall be in compliance with Section J2.7 of AISI S100.

#### 3.2 Web Crippling Capacities of Bare Deck Panels at Interior and End Supports

Web crippling capacities of bare deck panels at interior and end supports shall be determined in accordance with AISI S100 Section G5.

For a deck panel exceeding the limitations of AISI S100 Section G5, or modified elements, such as perforations or nonlinear webs, web crippling capacities shall be determined, by testing only or by rational engineering analysis verified by testing, in accordance with AISI S100 Chapter K2 and AISI S909. The number of test specimens in a test series shall comply with AISI S100 Section K2.1.1(a) for testing only, or K2.1.1(b) for testing used to verify a rational engineering analysis. A test series shall be conducted for both interior and end support capacities on at least the thinnest and thickest deck panel for a particular bearing width (a minimum of four test series). Where design capacities are derived from testing, the tested value of the lighter thickness will apply to heavier thicknesses up to the point of the next tested thickness.

#### 3.3 (Optional) Vertical Load Capacities

**3.3.1 The vertical load capacity shall be determined using SDI NC, SDI RD, SDI C, and/or AISI S100, as applicable.**

#### 3.4 (Optional) Diaphragm Capacities:

Diaphragm capacities shall be determined by:

- 3.4.1 Calculation or testing procedures described in AISI S310.

**AISI S310 Table B1.1 Safety Factors and Resistance Factors for Diaphragms**

<table>
<thead>
<tr>
<th>Load Type or Combinations Including</th>
<th>Connection Type</th>
<th>Safety Factors</th>
<th>Diaphragm Capacities</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td>$\Omega$ (LRFD)</td>
<td>$\Phi$</td>
</tr>
<tr>
<td>Wind</td>
<td>Welds</td>
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<td>0.75</td>
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<tr>
<td></td>
<td>Screws</td>
<td>2.00</td>
<td>0.80</td>
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<td>Earthquake</td>
<td>Welds</td>
<td>3.00</td>
<td>0.55</td>
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<tr>
<td>and All Others</td>
<td>Screws</td>
<td>2.30</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Adjustments for differences in tested versus specified material strengths and thicknesses shall be taken into account, when testing is completed. When testing is completed, the more severe factors for both wind and seismic determined by calibration and AISI S310 Table B1.1 shall govern the design for wind and seismic. Where a combination of connection types are used in a diaphragm configuration, the more severe factor shall be used. For mechanical fasteners other than screws, $\Omega_4$ shall not be less than the Table B1.1 values for screws and $\Phi_4$ shall not be greater than the Table B1.1 values for screws.

For concrete-filled decks, the minimum steel support thickness required by AISI S310 Section D4 (k) is applicable when using arc spot welds to attach steel decks to steel supports. When mechanical fasteners are used to attach steel decks to steel supports, the minimum steel support thickness shall be based on the mechanical fastener's connection capacity determined per AISI S310 Section 3.4.1.

**3.4.2 Calculation per ACI 318 for composite steel decks with welded shear stud connectors attached to steel supports. The analysis shall be based on the minimum thickness of concrete above the top of the steel deck panels. The shear strength of each headed stud shear connector shall be as specified in Chapter I of AISC 360.**
3.5 (Optional) Fire-resistance-rated Assemblies: Reports of fire tests in accordance with ASTM E119 or UL263 shall be submitted.

4.0 QUALITY CONTROL

4.1 Steel Deck Panels:

4.1.1 General: For all steel deck panels, quality control documentation, complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10), shall be submitted. The cellular steel decks, factory-welded panels to flat bottom sheets, shall be manufactured under an approved quality control program with regular ongoing inspections. All other deck panels are required to have an approved quality control programs with annual inspections. Inspections shall be conducted by ICC-ES or by a properly accredited inspection agency that has a contractual relationship with ICC-ES.

4.1.2 Cellular Decks with Resistance Welds: Typical welded sheets shall be evaluated using the tension shear test in Sections 11.1 and 11.2 of UL 209 and a peel test in accordance with Sections 12.1 and 12.2.

4.1.3 All Steel Deck Panels: The steel deck panel quality control program shall include the following:

4.1.3.1 Mill certificates shall be received and verified to comply with a published steel specification. Published steel specifications shall comply with AISI S100 Section A3.1. Otherwise, compliance with AISI S100 Section A3.2 shall be shown.

4.1.3.2 Periodic measurements of base-metal thickness are permitted to be conducted in-house or by an independent laboratory.

4.1.3.3 Records shall be kept of all mill certificates for a minimum of two years.

5.0 EVALUATION REPORT RECOGNITION

5.1 The evaluation report on the steel deck panels shall include the information specified in Section 3.1.

5.2 Evaluation reports shall include the following statements:

5.2.1 The deck panels are manufactured, identified and installed in accordance with this report and the report holder’s published installation guidelines and instructions and this report, this report governs.

5.2.2 The base metal thickness for deck panels delivered to the jobsite must be at least 95 percent of the base (design) metal thickness.

5.2.3 Special inspection shall comply with IBC Chapter 17.

5.2.4 Calculations and details demonstrating that the loads applied to the deck panels comply with this report must be submitted to the code official for approval. Calculations and drawings, must be prepared, signed and sealed by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.3 Evaluation reports shall include the following statements, as applicable:

5.3.1 Concrete-filled sections must not be used to support loads that are predominantly vibratory, such as those for operation of heavy machinery, reciprocating motors and moving loads.

5.3.2 Vertical load design of deck panels, without concrete fill, must be based on section properties noted within the ICC-ES evaluation report.

5.3.3 Cellular deck panels are manufactured at <insert location(s)> under a quality control program with regular ongoing inspections by ICC-ES. All other deck panels are manufactured in <insert location(s)> under a quality program with annual inspection by ICC-ES.

5.3.4 When the steel deck panels are used as roof decks, the panels must be covered with an approved code-complying roof covering (only applicable for deck panels not complying with AC166).

5.3.5 Evaluation reports that include fire-resistance-rated assemblies consisting of normal weight or lightweight concrete fill and a restrained assembly rating shall include a statement that interior spans of the steel deck panels may be considered restrained. The evaluation reports shall contain a statement that Appendix X3 of ASTM E119 may be referenced as guidance on other possible restraint conditions at both exterior spans and discontinuities within fire-resistance-rated constructions, subject to the approval of the code official.
### TABLE 1 - REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>STANDARD EDITIONS UNDER THE 2018 IBC</th>
<th>OTHER STANDARD EDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI 318, American Concrete Institute, Building Code Requirements for Structural Concrete</td>
<td>2014</td>
<td>-</td>
</tr>
<tr>
<td>AISC 360, American Institute of Steel Construction, Specification for Structural Steel Buildings</td>
<td>2016</td>
<td>-</td>
</tr>
<tr>
<td>AISI S100, American Iron and Steel Institute, North American Standard for Design of Cold-formed Steel Structural Members</td>
<td>2016</td>
<td>-</td>
</tr>
<tr>
<td>AISI S310, American Iron and Steel Institute, North American Standard for the Design of Profiled Steel Diaphragm Panels</td>
<td>-</td>
<td>2016</td>
</tr>
<tr>
<td>AISI S909, American Iron and Steel Institute, Standard Test Method for Determining the Web Crippling Strength of Cold-Formed Steel Beams</td>
<td>-</td>
<td>2017</td>
</tr>
<tr>
<td>SDI NC, Steel Deck Institute, Standard for Non-composite Steel Floor Deck.</td>
<td>2017</td>
<td>-</td>
</tr>
<tr>
<td>SDI RD, Steel Deck Institute, Standard for Steel Roof Deck</td>
<td>2017</td>
<td>-</td>
</tr>
<tr>
<td>SDI C, Steel Deck Institute, Standard for Composite Steel Floor Deck Slabs</td>
<td>2017</td>
<td>-</td>
</tr>
</tbody>
</table>
APPENDIX A

Recognition under the 2015 and earlier editions of the International Building Code®

A1.0 INTRODUCTION

A1.1 Purpose: The purpose of this criteria is to establish requirements for steel deck roof and floor systems to be recognized in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the 2015 International Building Code® (IBC). The basis of recognition is IBC Section 104.11.

The reason for the development of this criteria is to provide a guideline for the evaluation of steel deck floor and roof systems, since the provisions of Chapter 22 of the IBC do not provide requirements for the systems being used as diaphragms or composite slabs with headed shear studs.

A1.2 Scope: This acceptance criteria is applicable to steel deck roof and floor systems consisting of steel deck panels attached to steel supports, with or without concrete fill placed on top of the steel deck panels, where the concrete fill is normalweight concrete, lightweight concrete, insulating, or cellular concrete. This acceptance criteria is applicable to systems using power-actuated fasteners, tapping screws, welds, button punches or clinch connections. The systems under this acceptance criteria may also include accessories, such as devices used to transfer shear forces at diaphragm boundaries.

This acceptance criteria is applicable to steel deck floor and roof systems used to support gravity and uplift loads; used as components of horizontal diaphragms to resist lateral forces; and used as fire-resistance-rated assemblies. Suitability of cellular deck panels for use as cellular metal floor raceways is outside the scope of this acceptance criteria.

Steel deck roof systems used as roof coverings also shall comply with requirements set forth in the ICC-ES Acceptance Criteria for Metal Roof Coverings (AC166).

A1.3 Referenced Standards: Reference Standards are included in Table A1.

Definitions: Definitions of steel diaphragms are provided in AISI S310 with the following exception:

A1.3.1 Diaphragm: A diaphragm is a horizontal floor, horizontal roof, or sloped roof that distributes wind, earthquake, and other lateral forces to the vertical lateral force resisting system. A diaphragm is analogous to a horizontal girder with interconnected floor or roof deck panels acting as the girder web, where:

- Intermediate joists or beams, act as web stiffeners and provide vertical load support; and
- Perimeter steel beams or perimeter concrete or masonry elements with reinforcement, act as girder flanges.

Diaphragms under this acceptance criteria may be plain steel roof decks, non-composite or composite slabs.

A2.0 BASIC INFORMATION

A2.1 Product and Material Requirements:

A2.1.1 Steel Deck Panels: The following shall be submitted:

- steel specifications complying with Section A2 of AISI S100;
- base-metal thickness and minimum steel thickness complying with Section A2.4 of AISI S100;
- coatings, including type and thickness; and
- dimensioned cross-sectional drawings with stated tolerances. The drawings shall illustrate the fluted patterns and web embossments, if any. For cellular decks, the resistance weld pattern and a description of the welds shall be reported and shown on the drawings.

Each bundle of steel deck panels shall have a legible label, stamp or embossment, indicating the manufacturer’s name; the evaluation report number; and the acronym “ICC-ES.” In addition to the above information, each bundle of panels shall have a legible label, also indicating material minimum base metal thickness (uncoated) in decimal thickness or mils; and the minimum specified yield strength [if greater than 33 ksi (228 MPa)]. The label shall have a means of traceability back to the manufacturer’s quality records.

A2.1.2 Concrete Fill: The type (normal weight, lightweight, cellular, insulating, etc.), density, and minimum compressive strength shall be submitted. Normalweight and lightweight concrete shall comply with the IBC. Proprietary concrete products such as cellular and insulating concrete, (products not covered in the IBC for their intended use) shall be recognized in a separate ICC-ES evaluation report.

A2.1.3 Power-Actuated Fasteners: Where the power-actuated fasteners are not recognized in an ICC-ES evaluation report, the following shall be submitted: product specifications, packaging and labeling, and quality control requirements complying with the ICC-ES Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements (AC70).

A2.1.4 Tapping Screws: Where proprietary tapping screws are not recognized in an ICC-ES evaluation report, the following shall be submitted: product specifications, packaging and labeling, and quality control requirements complying with the ICC-ES Acceptance Criteria for Tapping Screw Fasteners (AC118).
A2.1.5 Button Punches, Clinch Connections, and Welds: Button punches, clinch connections, and welds must comply with AISI S310, SDI RD, SDI NC, and SDI C, whichever is applicable. For clinch connections, detailed drawings must be submitted.

A2.2 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.

A2.3 Test Plans: Before testing is completed, at the request of the report applicant, test plans may be submitted to ICC-ES for review prior to testing.

A2.4 Test Reports: Test reports shall comply with AC85 and additionally include the following information:

A2.4.1 Detailed identification of specimens.

A2.4.2 Detailed drawings of specimens including physical characteristics, section profiles, and other construction details.

A2.4.3 Detailed descriptions of test specimens and test assemblies, attachment of specimens to the fixture, location of load points, deflection gages, deflection points and other items as applicable. Ambient conditions at the date of construction, curing period and date and time of tests shall be reported where relevant to the performance of the tested assembly. The ambient conditions include relative humidity, temperature and wind speed.

A2.4.4 If the test specimen construction deviates from typical field construction, deviations shall be reported.

A2.4.5 The test report shall state that tests were conducted in accordance with the applicable methods and the ICC-ES acceptance criteria, deviations shall be reported.

A2.4.6 Statements indicating whether the constructed test specimens meet actual or intended construction shall be included, deviations shall be reported.

A2.4.7 Test results shall include load-deflection readings, maximum load applied, failure mode, total time under load at the various load levels, and photographs of tested specimens before and after testing.

A2.5 Product Sampling: Sampling of the steel deck panels, concrete constituents and fasteners for tests under this criteria shall comply with Section 3.2 of AC85.

A2.6 Calculations: Computer generated calculations shall be identified by a version, edition, and date. Accompanying the computer generated calculations shall be a set of detailed calculations showing how calculations comply with the appropriate sections of this AC43 and the appropriate referenced standard. All calculations, computer generated and detailed, shall be signed, sealed, and dated by a registered design professional.

A3.0 TEST AND PERFORMANCE REQUIREMENTS

A3.1 Steel Deck Section Properties: Section properties shall be determined in accordance with AISI S100. The section properties reported shall include the

- base-metal design thickness;
- full moment of inertia (I);
- effective moment of inertia, normal position (Ieff+);
- effective moment of inertia, inverted position (Ieff-);
- effective section modulus, normal position (Seff+) at Fy; and
- effective section modulus, inverted position (Seff-) at Fy.

Under uniform vertical loads, any of the following equations are permitted to determine deflections:

Simple span: \( I_0 = (I_e + 2I_{eff}) / 3 \), or \( I_{eff} \)

Multiple span: \( I_0 = (I_e + 2I_{eff}) / 3 \), \( (I_e + 2I_{eff}) / 3 \), or the minimum of \( I_{eff} \) and \( I_{eff} \).

To fully develop section properties of cellular steel deck panels, welds shall be placed to develop the shear flow at the intersection of the two sheets. Resistance weld strengths shall be in compliance with Section E2.7 of AISI S100.

A3.2 Web Crippling Capacities of Bare Deck Panels at Interior and End Supports

Web crippling capacities of bare deck panels at interior and end supports shall be determined in accordance with AISI S100 Section C3.4.

For a deck panel exceeding the limitations of AISI S100 Section C3.4, or modified elements, such as perforations or nonlinear webs, web crippling capacities shall be determined, by testing only or by rational engineering analysis verified by testing, in accordance with AISI S100 Chapter F and AISI S909. The number of test specimens in a test series shall comply with AISI S100 Section F1.1(a) for testing only, or F1.1(b) for testing used to verify a rational engineering analysis. A test series shall be conducted for both interior and end support capacities on at least the thinnest and thickest deck panel for a particular bearing width (a minimum of four test series). Where design capacities are derived from testing, the tested value of the lighter thickness will apply to heavier thicknesses up to the point of the next tested thickness.
A3.3 (Optional) Vertical Load Capacities

A3.3.1 Non-Composite Steel Decks: The vertical load capacity shall be determined using SDI NC, SDI RD, and/or AISI S100, as applicable. Other rational methods of analysis may be considered with prior concurrence of the ICC-ES staff.

A3.3.2 Composite Steel Decks: The vertical load capacity shall be determined using one of the following methods. Other rational methods of analysis may be considered with prior concurrence of the ICC-ES staff:

a. Without Headed Shear Studs: The design and analysis shall comply with the methods described within SDI-C.

b. With Headed Shear Stud Connectors: The design and analysis shall comply with Section 2.4 of SDI FDDM.

A3.4 (Optional) Diaphragm Capacities: Diaphragm capacities shall be determined by:

A3.4.1 Calculation or testing procedures described in AISI S310 as modified by Sections A3.4.1.1 and A3.4.1.2. Other rational methods of analysis may be considered with prior concurrence of the ICC-ES staff.

A3.4.1.1 Under AISI S310 Section B1, in the extraction taken from AISI S100 Table D5, replace only connection related factors with the following.

<table>
<thead>
<tr>
<th>LOAD TYPE OR COMBINATIONS INCLUDING</th>
<th>COMBINATION TYPE</th>
<th>CONNECTION RELATED LIMIT STATE</th>
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<tr>
<td></td>
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<td>Ω₁ (ASD)</td>
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<tr>
<td>Wind</td>
<td>Welds</td>
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<td>Earthquake and All others</td>
<td>Welds</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>Screws</td>
<td>2.30</td>
</tr>
</tbody>
</table>

For concrete-filled decks, the minimum steel support thickness required by AISI S310 Section D4 (k) is applicable when using arc spot welds to attach steel decks to steel supports. When mechanical fasteners are used to attach steel decks to steel supports, the minimum steel support thickness shall be based on the mechanical fastener’s connection capacity determined per AISI S310 Section 3.4.1.

A3.4.1.2 The last sentence of AISI S100 Section F1.1(b) is no longer applicable which states “Section F1.1(b) is not applicable to floor, roof, or wall steel diaphragms in accordance with Section D5.”

Adjustments for differences in tested versus specified material strengths and thicknesses shall be taken into account, when testing is completed.

A3.4.2 Calculation per ACI 318 for composite steel decks with welded shear stud connectors attached to steel supports. The analysis shall be based on the minimum thickness of concrete above the top of the steel deck panels. The shear strength of each headed stud shear connector shall be as specified in Chapter I of AISC 360.

A3.5 (Optional) Fire-resistance-rated Assemblies: Reports of fire tests in accordance with ASTM E119 or UL263 shall be submitted.

A4.0 QUALITY CONTROL

A4.1 Steel Deck Panels:

A4.1.1 General: For all steel deck panels, quality control documentation, complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10), shall be submitted. The cellular steel decks, factory-welded panels to flat bottom sheets, shall be manufactured under an approved quality control program with regular ongoing inspections. All other deck panels are required to have an approved quality control programs with annual inspections. Inspections shall be conducted by ICC-ES or by a properly accredited inspection agency that has a contractual relationship with ICC-ES.

A4.1.2 Cellular Decks with Resistance Welds: Typical welded sheets shall be evaluated using the tension shear test in Sections 11.1 and 11.2 of UL 209 and a peel test in accordance with Sections 12.1 and 12.2 of the UL Standard.

A4.1.3 All Steel Deck Panels: The steel deck panel quality control program shall include the following:

A4.1.3.1 Verification of incoming steel-coil material in the form of mill certificates, service center certificates, independent laboratory tests or in-house testing with calibrated test equipment. Tests shall verify the following, if the steel does not conform to one of the steel specifications noted in Section A2.1 of AISI S100:

- steel base metal thickness,
- yield strength,
- tensile strength,
PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR STEEL DECK ROOF AND FLOOR SYSTEMS (AC43)

- galvanized coating weight,
- and ductility.

Ductility compliance shall be determined in accordance with Section A2.3 of AISI S100.

A4.1.3.2 Periodic testing for base-metal thickness is permitted to be conducted in-house or by an independent laboratory. Periodic testing consists of testing one out of every 120 pieces. Periodic testing of coated material is permitted, provided complete details covering the method of thickness determination are included in the quality control manual.

A4.1.3.3 Records shall be kept of all mill certificates, service center certificates, independent laboratory tests and in-house tests for a minimum of two years.

A4.1.3.4 Tests shall be conducted in accordance with the following:
- Yield strength – ASTM A370
- Tensile strength – ASTM A370
- Galvanized coating (hot-dip process) – ASTM A653, Section 8.2

Additionally, ductility compliance shall be determined in accordance with Section A2.3 of AISI S100. Minimum acceptance criteria for each test shall be specified in the quality documentation.

A5.0 EVALUATION REPORT RECOGNITION

A5.1 The evaluation report on the steel deck panels shall include the information specified in Section A3.1.

A5.2 Evaluation reports shall include the following statements:

A5.2.1 The deck panels are manufactured, identified and installed in accordance with this report and the report holder’s published installation guidelines and instructions. If there is a conflict between the report holder’s published installation guidelines and instruction and this report, this report governs.

A5.2.2 The base metal thickness for deck panels delivered to the jobsite must be at least 95 percent of the base (design) metal thickness.

A5.2.3 Special inspection shall comply with IBC Chapter 17.

A5.2.4 Calculations and details demonstrating that the loads applied to the deck panels comply with this report must be submitted to the code official for approval. Calculations and drawings, must be prepared, signed and sealed by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

A5.3 Evaluation reports shall include the following statements, as applicable:

A5.3.1 Evaluation reports that include recognition of steel deck diaphragms shall include Table A2 of this criteria.

A5.3.2 Concrete-filled sections must not be used to support loads that are predominantly vibratory, such as those for operation of heavy machinery, reciprocating motors and moving loads.

A5.3.3 Vertical load design of deck panels, without concrete fill, must be based on section properties noted within the ICC-ES evaluation report.

A5.3.4 Cellular deck panels are manufactured at <insert location(s)> under a quality control program with regular ongoing inspections by ICC-ES. All other deck panels are manufactured in <insert location(s)> under a quality program with annual inspection by ICC-ES.

A5.3.5 When the steel deck panels are used as roof decks, the panels must be covered with an approved code-complying roof covering (only applicable for deck panels not complying with AC166).

A5.3.6 Evaluation reports that include fire-resistance-rated assemblies consisting of normalweight or lightweight concrete fill and a restrained assembly rating shall include a statement that interior spans of the steel deck panels may be considered restrained. The evaluation reports shall contain a statement that Appendix X3 of ASTM E 119 may be referenced as guidance on other possible restraint conditions at both exterior spans and discontinuities within fire-resistance-rated constructions, subject to the approval of the code official.
## TABLE A1 - REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>STANDARD EDITIONS UNDER THE 2015 IBC</th>
<th>OTHER STANDARD EDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI 318, American Concrete Institute, Building Code Requirements for Structural Concrete</td>
<td>2014</td>
<td>-</td>
</tr>
<tr>
<td>AISC 360, American Institute of Steel Construction, Specification for Structural Steel Buildings</td>
<td>2010</td>
<td>-</td>
</tr>
<tr>
<td>AISI S100, American Iron and Steel Institute, North American Standard for Design of Cold-formed Steel Structural Members</td>
<td>2012</td>
<td>-</td>
</tr>
<tr>
<td>AISI S310, American Iron and Steel Institute, North American Standard for the Design of Profiled Steel Diaphragm Panels</td>
<td>-</td>
<td>2013</td>
</tr>
<tr>
<td>AISI S909, American Iron and Steel Institute, Standard Test Method for Determining the Web Crippling Strength of Cold-Formed Steel Beams</td>
<td>-</td>
<td>2013</td>
</tr>
<tr>
<td>ASTM A370, ASTM International, Standard Test Methods and Definitions for Mechanical Testing of Steel Products</td>
<td>-</td>
<td>2011a</td>
</tr>
<tr>
<td>ASTM A653, ASTM International Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process</td>
<td>2011</td>
<td>-</td>
</tr>
<tr>
<td>SDI NC, Steel Deck Institute, Standard for Non-composite Steel Floor Deck.</td>
<td>2010</td>
<td>-</td>
</tr>
<tr>
<td>SDI RD, Steel Deck Institute, Standard for Steel Roof Deck</td>
<td>2010</td>
<td>-</td>
</tr>
<tr>
<td>SDI C, Steel Deck Institute, Standard for Composite Steel Floor Deck Slabs</td>
<td>2011</td>
<td>-</td>
</tr>
<tr>
<td>SDI FDDM, Steel Deck Institute, Floor Deck Design engineering manual (first edition)</td>
<td>-</td>
<td>2014</td>
</tr>
<tr>
<td>UL 263, Underwriters Laboratories Inc., Standard for Fire Tests of Building Construction and Materials</td>
<td>2011</td>
<td>-</td>
</tr>
</tbody>
</table>
### TABLE A2—DIAPHRAGM FLEXIBILITY LIMITATIONS TABLE\(^{1,2,3,4}\)

<table>
<thead>
<tr>
<th>FLEXIBILITY FACTOR (F)</th>
<th>MAXIMUM DIAPHRAGM SPAN FOR MASONRY OR CONCRETE WALLS (feet)</th>
<th>DIAPHRAGM SPAN-DEPTH LIMITATION</th>
<th>Rotation Not Considered in Diaphragm</th>
<th>Rotation Considered in Diaphragm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Masonry or Concrete Walls</td>
<td>Flexible Walls</td>
<td>Masonry or Concrete Walls</td>
<td>Flexible Walls</td>
</tr>
<tr>
<td>More than 150</td>
<td>Not used</td>
<td>Not used</td>
<td>2:1 or as required for deflection</td>
<td>Not used</td>
</tr>
<tr>
<td>70-150</td>
<td>200</td>
<td>2:1 or as required for deflection</td>
<td>3:1</td>
<td>Not used</td>
</tr>
<tr>
<td>10-70</td>
<td>400</td>
<td>2(\frac{1}{2}):1 or as required for deflection</td>
<td>4:1</td>
<td>As required for deflection</td>
</tr>
<tr>
<td>1-10</td>
<td>No limitation</td>
<td>3:1 or as required for deflection</td>
<td>5:1</td>
<td>As required for deflection</td>
</tr>
<tr>
<td>Less than 1</td>
<td>No limitation</td>
<td>As required for deflection</td>
<td>No limitation</td>
<td>As required for deflection</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 plf = 14.594 N/m, 1 psi = 6894 Pa.

\(^1\)Diaphragms are to be investigated regarding their flexibility and recommended span-depth limitations.

\(^2\)Diaphragms supporting masonry or concrete walls are to have their deflections limited to the following amount:

\[
\Delta_{\text{wall}} = \frac{H^2 f_c}{0.01 Et}
\]

where:

- \(H\) = Unsupported height of wall in feet.
- \(t\) = Thickness of wall in inches.
- \(E\) = Modulus of elasticity of wall material for deflection determination in pounds per square inch.
- \(f_{c}\) = Allowable compression strength of wall material in flexure in pounds per square inch.
  
  For concrete, \(f_c = 0.45 f_{c'}\). For masonry, \(f_c = F_b = 0.33 f_{m'}\).

\(^3\)The total deflection \(\Delta\) of the diaphragm may be computed from the equation: \(\Delta = \Delta_r + \Delta_w\)

where:

- \(\Delta_r\) = Flexural deflection of the diaphragm determined in the same manner as the deflection of beams
- \(\Delta_w\) = The web deflection may be determined by the equation:

\[
\Delta_w = \frac{q_{\text{ave}} L F}{10^3}
\]

where:

- \(L\) = Distance in feet between vertical resisting element (such as shear wall) and the point to which the deflection is to be determined.
- \(q_{\text{ave}}\) = Average shear in diaphragm in pounds per foot over length \(L\).
- \(F\) = Flexibility factor: The average micro inches a diaphragm web will deflect in a span of 1 foot under a shear of 1 pound per foot.

\(^4\)When applying these limitations to cantilevered diaphragms, the allowable span-depth ratio will be half that shown.