AISI S914-17

American
Iron and Steel
Institute

AISI STANDARD

Test Standard for Determining the Strength and Deformation Behavior of Joist Connectors Attached to Cold-Formed Steel Structural Framing

2017 Edition

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Approved by

the AISI Committee on Specifications for the Design of

Cold-Formed Steel Structural Members

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The material contained herein has been developed by the American Iron and Steel Institute (AISI) Committee on Specifications for the Design of Cold-Formed Steel Structural Members. The organization and the Committee have made a diligent effort to present accurate, reliable, and useful information on testing of cold-formed steel members, components or structures. The Committee acknowledges and is grateful for the contributions of the numerous researchers, engineers, and others who have contributed to the body of knowledge on the subject. With anticipated improvements in understanding of the behavior of cold-formed steel and the continuing development of new technology, this material will become dated. It is anticipated that future editions of this test procedure will update this material as new information becomes available, but this cannot be guaranteed.

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PREFACE

The American Iron and Steel Institute Committee on Specifications developed this Standard to provide a method to determine both the strength and deformation behavior of *joist connectors* used in cold-formed steel light-frame construction.

The Committee acknowledges and is grateful for the contribution of the numerous engineers, researchers, producers and others who have contributed to the body of knowledge on this subject.

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AISI S914-17
TEST STANDARD FOR DETERMINING THE STRENGTH AND DEFORMATION BEHAVIOR OF JOIST CONNECTORS ATTACHED TO COLD-FORMED STEEL STRUCTURAL FRAMING

1. Scope

1.1 This Standard provides a method to determine both the strength and deformation behavior of *joist connectors* used in cold-formed steel light-frame construction.

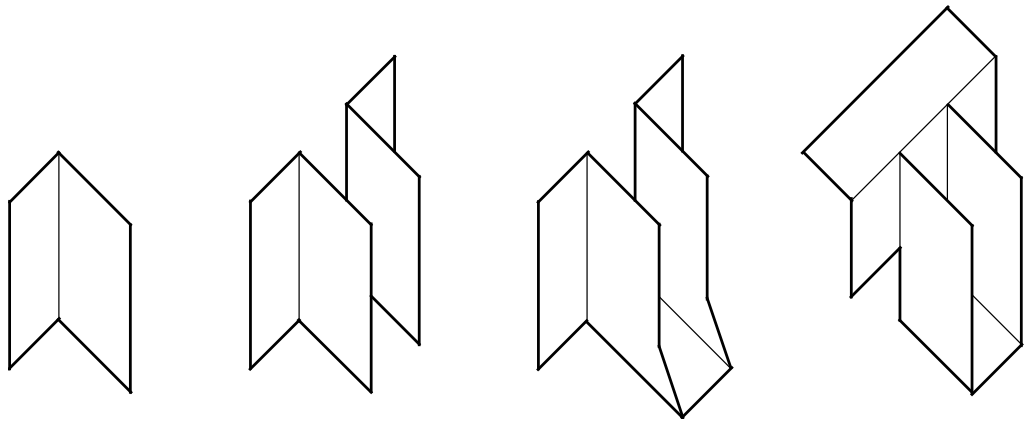

Figure 1 Typical Joist Connectors

User Note:
Illustrated in Figure 1 are some typical *joist connectors*, but there are many other configurations.

1.2 This Standard applies where the primary action of the *joist* is to impose a shear reaction to the *joist connector*. This Standard does not apply where a primary action of the *joist* is to impose an axial, bending or torsional reaction to the *joist connector*.

User Note:
If unrestrained by bracing, the asymmetry of typical C-shape *joists* would cause a torsional reaction.

A *joist* that complies with the continuously braced design provisions of AISI S240 would satisfy the requirements of Section 1.2.

Reference:
AISI S240-15, *North American Standard for Cold-Formed Steel Structural Framing*

1.3 This Standard applies to *joist connectors* attached to the cold-formed steel structural framing by use of welds or *fasteners*.

1.4 This Standard consists of Sections 1 through 11 inclusive.

2. Referenced Documents

The following documents or portions thereof are referenced within this Standard and shall be considered as part of the requirements of this document:

a. American Iron and Steel Institute (AISI), Washington, DC:

AISI S100-16, *North American Specification for the Design of Cold-Formed Steel Structural Members*

b. ASTM International (ASTM), West Conshohocken, PA:

ASTM A370-16, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM E6-15, *Standard Terminology Relating to Methods of Mechanical Testing*

IEEE/ASTM SI10-10, *American National Standard for Metric Practice*

3. Terminology

Where the following terms appear in this Standard, they shall have the meaning as defined herein. Terms not defined in Section 3 of this Standard, AISI S100 or ASTM E6 shall have the ordinary accepted meaning for the context for which they are intended.

Connection. Combination of structural elements and joints used to transmit forces between two or more members.

Connector. Device used to transmit forces between cold-formed steel structural members and other structural elements.

Fastener. Bolts, screws, power-driven pins or nails, clinches, or other mechanical devices.

Joist. Structural member primarily used in floor and ceiling framing.

Joist Connector. Connector, such as a clip angle(s) or *joist hanger*, used to transmit forces between a *joist* and its support.

Joist Hanger. Joist connector with a seat.

4. Units of Symbols and Terms

Any compatible system of measurement units is permitted to be used in this Standard, except where explicitly stated otherwise. The unit systems considered in this Standard shall include U.S. Customary units (force in kips and length in inches), and SI units (force in Newtons and length in millimeters) in accordance with IEEE/ASTM-SI10.

5. Measurement Precision

5.1 Loads shall be recorded to a precision of ±1 percent of the full range of the measuring device.

User Note:
The capacity (range) of the load-measuring device should be appropriate to the expected maximum tested load. The use of a measuring device with a calibrated capacity greatly exceeding the anticipated load is inappropriate. A target ratio of the load-measuring device capacity to specimen strength of no greater than three is recommended.

The tests should be conducted on a testing machine that complies with the requirements of ASTM E4-16, *Standard Practices for Force Verification of Testing Machines*.

5.2 Deflections shall be recorded to a precision of 0.001 in. (0.025 mm).

6. Test Fixture

The test fixture shall consist of either:

(a) A hydraulic or screw-operated testing machine capable of operating at a constant rate of motion of the movable crosshead or a constant rate of loading, and a calibrated force-measuring device, or

(b) A hydraulic cylinder with a steel fixture, and a calibrated load cell.

7. Test Specimen

7.1 The test specimen shall consist of the tested *joist connectors* and the *fasteners* used to connect the *joist connectors* to the *joists* and to the supporting members.

7.2 The number of specimens tested shall comply with the requirements of Section K2.1 of AISI S100.

7.3 The mechanical properties of the tested *joist connectors*, including yield stress, tensile strength, percent elongation, and uncoated base steel thickness shall be determined. Standard tensile tests of the steel from which the *joist connectors* were produced shall be conducted in accordance with ASTM A370 and Section K2.1.1(d) of AISI S100.

7.4 *Fasteners* used in *joist connector* testing shall be selected at random from one manufacturer's lot and installed in a manner that is representative of field conditions.

7.5 Welding, clinching or other fastening techniques are permitted in a manner that is representative of field conditions.

8. Test Setup

8.1 The test setup shall consist of cold-formed steel *joist*(*s*) and two supporting members representative of field conditions, and the *joist connectors* and *fasteners* to be evaluated (See Figure 2).

8.2 Supporting members shall be long enough to provide the intended contact surface for the *joist connector*; e.g., space for *fasteners* and bearings as applicable.

8.3 To avoid an unintentional load path, *joist* lengths shall be long enough to prevent contact between *joist connectors* and any material other than the attached supporting members and *joist*(*s*). A minimum horizontal clear distance (H) of 3 in. (76 mm) or 1/3 the *joist* depth, whichever is smaller, shall be provided between the load transfer block and the nearest portion of the *joist connector*, such as the outstanding leg of a clip angle or the seat of a *joist hanger*, as applicable.

8.4 The relative vertical movement between the end of the *joist*(*s*) and the supporting member shall be measured. The measurement location shall be no further than 1½ in. (38 mm) from the end of the *joist* (top, bottom, or side). Where the joist setup is inverted for uplift testing, the measurement location shall be within 1 in. (25 mm) from the end of the *joist*.

8.5 To avoid friction between the *joist* and supporting member, a minimum gap of 1/8 in. (3.2 mm) shall be provided between the end of each *joist* and abutting material, such as the adjacent supporting member or any portion of the *joist connector* that is perpendicular to the

end of the *joist*. Prior to loading, the 1/8-in. (3.2-mm) gap shall be maintained by providing shims, or equivalent means.

8.6 To minimize load transfer due to friction, a low-friction material, such as Teflon® or polyethylene, with a thickness no greater than 0.063 in. (1.6 mm), shall be inserted into the 1/8-in. (3.2-mm) gap prior to loading.

8.7 To avoid an unintentional load path, the *joist* bottom flange and seat of the *joist hanger*, as applicable, shall be prevented from having direct contact with the supporting member during the test.

8.8 To avoid an unintentional load path, no portion of the *joist connector* shall bear on any support other than the supporting member during the test. This shall be accomplished by either:

(a) Using raised supports with a minimum supporting member overhang of 1/8 in. (3.2 mm) at the inside edges, or

(b) Using supporting members that are deeper than the *joist* by an amount sufficient to ensure that neither the *joist* nor the *joist connector* contact the test bed.

8.9 Reinforcement of *joist* members at the area of load application is permitted to prevent member failure in bending, shear, or web crippling at the applied load to ensure a failure of the *joist connector*, *fasteners* or supporting member, or of the *joist* due to bearing at the *joist connector*. The length of *joist* reinforcement shall be no closer than 2 in. (51 mm) from the end of each *joist connector*.

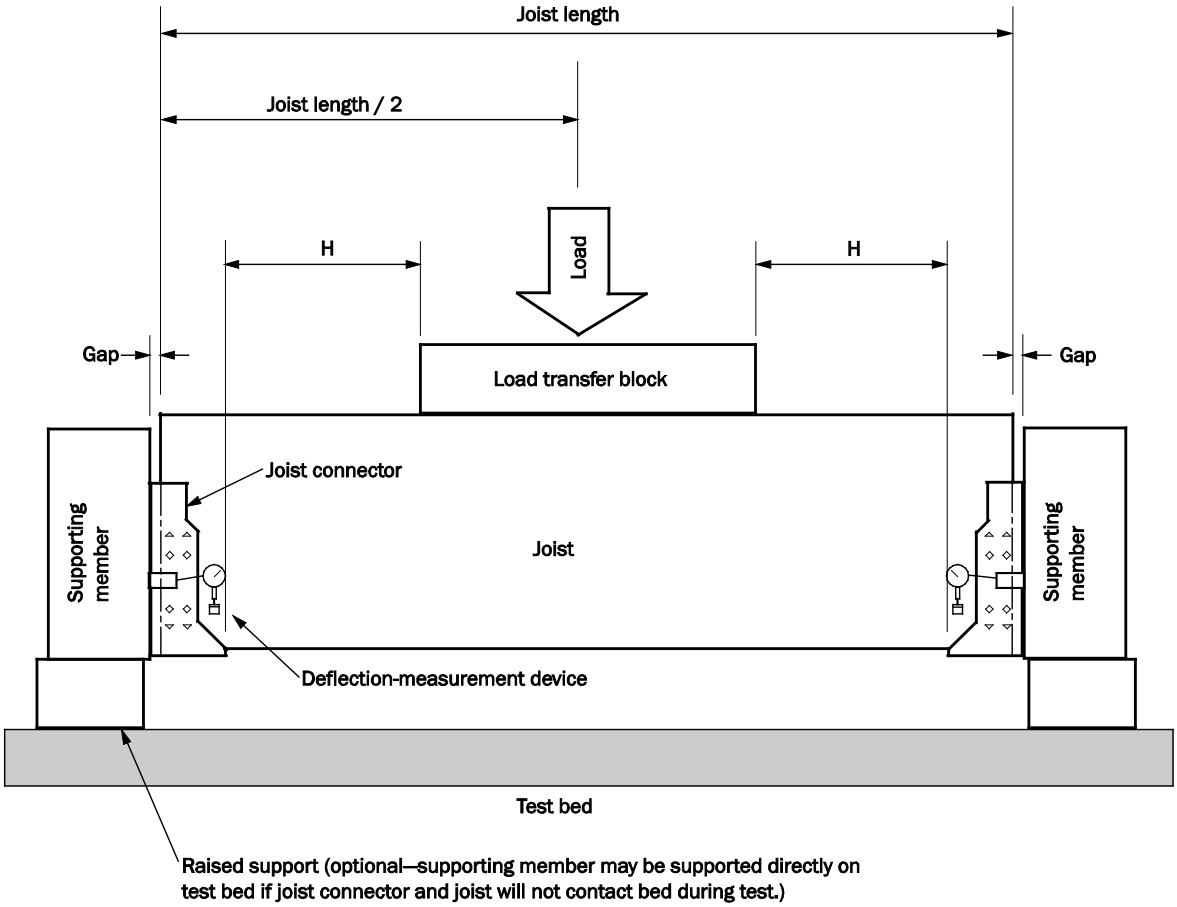

Figure 2 Test Setup for Joist Connector

8.10 To prevent rotation of the supporting members inward towards the *joist*, blocking between the supporting members or another bracing method shall be provided (See Figure 2). Tension reinforcement between the supporting members is permitted to prevent rotation of the supporting members outward away from the *joist*. Such reinforcement shall not contact the *joist connectors* or otherwise interfere with their performance.

9. Test Procedure

9.1 An initial load, or preload, is permitted to be applied to seat the assembly. This preload shall not exceed 10 percent of the average ultimate load and is removed prior to loading the specimen to failure or maximum load.

9.2 The specimen shall be loaded such that the load is applied with reference to the intended application of the *joist connector*. The test load shall be applied at a uniform rate between 0.03 and 0.10 in. (0.76 to 2.54 mm) per minute until failure or maximum load.

9.3 Load-deflection characteristics of the *joist connector* shall be determined. Deflections shall be recorded at a sufficient number of load levels to permit the establishment of a load-deflection curve. At least eight readings shall be taken prior to reaching the deflection limit state.

10. Data Evaluation

10.1 Evaluation of the test results and the determination of the available strength (i.e., allowable strength and/or design strength [resistance]) shall be made in accordance with the procedures described in Section K2.1 of AISI S100.

10.2 No test result shall be eliminated unless a rationale for its exclusion can be given.

10.3 The deflection limit shall be 1/8 in. (3.2 mm) unless otherwise defined by the applicable building code or an approved design standard where a building code does not exist. The deflection limit shall be permitted to exclude the initial deflection corresponding to 10% of the ultimate load for gravity loading only and when no initial preload has been applied.

Commentary:
In 2015, a change was made to allow the determination of the deflection limit to exclude the initial deflection corresponding to 10% of the ultimate load. This recognizes that in reality, the joist hanger subjected to gravity loading will be supporting some dead load and the deflection limit is intended to be a live load deflection.

11. Test Report

11.1 The test report shall include a description of the test specimens, including a drawing that details all pertinent dimensions.

11.2 The test report shall include the measured steel mechanical properties of the *joist connectors* and *joists*.

11.3 The test report shall include a description of any modifications made to the *joists*.

11.4 The test report shall include a description of the bolts, screws, welds or other *fasteners*.

11.5 The test report shall include a detailed drawing of the test setup, depicting location and direction of load application, location of displacement instrumentation and their point of reference, and details of any deviations from the test requirements as stipulated in Sections 6, 8, and 9. Additionally, photographs shall supplement the detailed drawings of the test setup.

11.6 The test report shall include individual load-versus-deformation values and curves as plotted directly or as reprinted from data acquisition systems. Additionally, the specified deflection limit and the corresponding load shall be reported.

11.7 The test report shall include individual and average maximum test load values observed; a description of the nature, type and location of failure exhibited by each specimen tested; and a description of the general behavior of the test fixture during load application. Additionally, photographs shall supplement the description of the failure mode(s).

11.8 The test report shall include a description of the test method and loading procedure used, whether a preload was applied, the deduction of any initial deflection (if applicable), as well as rate of loading or rate of motion of the crosshead movement.

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