

Joint Evaluation Report

ESR-2919


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<p>DIVISION: 06 00 00— WOOD, PLASTICS, AND COMPOSITES</p> <p>Section: 06 17 33— Wood I-joists</p>	<p>REPORT HOLDER: STARK TRUSS COMPANY, INC.</p>	<p>EVALUATION SUBJECT: STARK TRUSS SI-40, SI-60 AND SI-80 SERIES PREFABRICATED WOOD I-JOISTS</p>	
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1.0 EVALUATION SCOPE

1.1 Compliance with the following codes:

- 2018, 2015, 2012, and 2009 [International Building Code® \(IBC\)](#)
- 2018, 2015, 2012, and 2009 [International Residential Code® \(IRC\)](#)

Properties evaluated:

- Structural
- Fire-resistance-rated assemblies

1.2 Evaluation to the following green code(s) and/or standards:

- 2022 [California Green Building Standards Code \(CALGreen\)](#), Title 24, Part 11
- 2020, 2015, 2012 and 2008 [ICC 700 National Green Building Standard™](#) (ICC 700-2020, ICC 700-2015, ICC 700-2012 and ICC 700-2008)

Attributes verified:

- See Section 3.1

2.0 USES

Stark Truss SI series I-joists are used as roof and floor joists, blocking panels and rim boards to support code-required loads.

3.0 DESCRIPTION

3.1 General:

SI prefabricated wood I-joists consist of solid sawn lumber flanges and oriented strand board (OSB) webs. The top and bottom flanges are grooved to allow the web to be inserted to a depth of 0.5 inch (12.7 mm) in the flanges. The web sections are installed with the face grain perpendicular to the long axis of the I-joist. The I-joists are fabricated in depths of 9¹/₄, 9¹/₂, 11¹/₄, 11⁷/₈, 14, and 16 inches (235, 241, 286, 302, 356, and 406 mm), as shown in [Table 1](#).

The attributes of the wood joists have been verified as conforming to the requirements of (i) CALGreen Sections A4.404.3 for efficient framing techniques; (ii) ICC 700-2020 Sections 608.1(2), 11.608.1(2) and 13.104.3.1(4); (iii) ICC 700-2015 Section 608.1(b), 11.608.1(b) and 12(A).608.1(b) for resource-efficient materials; (iv) ICC 700-2012 Section 608.1(2), 11.608.1(2) and 12(A).608.1 for resource-efficient materials; and (v) ICC 700-2008 Section 607.1(2) for resource-efficient materials. Note that decisions on compliance for those areas rest with the user of this report. The user is advised of the project-specific provisions that may be contingent upon meeting specific conditions, and the verification of those conditions is outside the scope of this report. These codes or standards often provide supplemental information as guidance.

3.2 Materials:

3.2.1 Flanges: Flange material for SI series prefabricated wood I-joists is manufactured from spruce-pine-fir MSR lumber conforming to the requirements of the approved quality control manual. The lumber is finger jointed and re-graded to the required specifications documented in the approved quality control manual. Flange dimensions are as shown in [Table 1](#).

3.2.2 Web: Web material is ³/₈-inch (9.5 mm) OSB, Exposure 1, meeting the requirements of DOC PS-2 and the approved quality control manual.

3.2.3 Adhesives: Adhesives used in the I-joist manufacturing process are exterior-type, heat durable adhesives complying with ASTM D2559 and ASTM D5055, as specified in the approved quality control manual.

4.0 DESIGN AND INSTALLATION

4.1 Design:

Design of the prefabricated wood I-joists described in this report must be in accordance with the applicable code. Reference design moments, reactions, shear, bending stiffness (EI), and shear stiffness coefficients (K) for SI series I-joists are specified in [Table 2](#). The reference design values given in [Table 2](#) must be adjusted by the applicable adjustment factors in accordance with Section 7.3 of the AWC National Design Specification for Wood Construction (NDS). Allowable floor spans for SI series I-joists are as indicated in [Tables 3](#) and [4](#). Web stiffeners are not required when I-joists are used in accordance with the spans, spacing, and other requirements in [Tables 3](#) and [4](#), except as required by joist hanger manufacturers, where applicable. The bearing lengths at end reactions must be ¹/₄ inches (44 mm) or greater. The bearing lengths at intermediate reactions must be ³/₂ inches (89 mm) or greater. Joist webs contain prefabricated ¹/₂-inch-diameter (38 mm) knockouts, 16 inches (406 mm) on center, located approximately 2 inches (51 mm) from one flange. Round holes, other than the prefabricated knockouts, are permitted in the webs of the joists in accordance with [Table 5](#). Where required, web stiffeners must be installed in accordance with [ESR-1405](#).

Calculated I-joist deflection must consider both bending and shear deformation. Bending deformation must be calculated using standard engineering formulae. Shear deformation must be calculated using the following equation:

$$\Delta_{shear} = \frac{8M}{K}$$

where:

Δ_{shear} = Deflection caused by shear stress [inches (mm)]

M = Design moment [inch-lbs (mm-N)]

K = Shear stiffness coefficient from [Table 2](#) [in-lbs/in (mm-N/mm)]

For example, the deflection of a uniformly loaded, simply supported I-joist must be determined using the following formula:

$$\Delta_{total} = \Delta_{bending} + \Delta_{shear} = \frac{5wL^4}{384EI} + \frac{wL^2}{K}$$

The deflection of a simple-span I-joist with a concentrated load at mid-span must be determined using the following formula:

$$\Delta_{total} = \Delta_{bending} + \Delta_{shear} = \frac{PL^3}{48EI} + \frac{2PL}{K}$$

where:

- Δ_{total} = Total I-joist deflection [inches (mm)]
 W = Applied uniform load [lbs/inch (N/mm)]
 P = Applied concentrated load [lbs (N)]
 L = I-joist span [inches (mm)]
 EI = I-joist stiffness from [Table 2](#) [in²-lbs (mm²-N)]

When used as blocking panels or rim boards, SI series I-joists shall be designed with the vertical load capacities of 2,000 lbf/ft maximum. When used as rim boards or as diaphragm framing members, SI series I-joists shall be designed with the horizontal shear load capacities specified in [Table 6](#).

4.1 Installation:

SI series I-joists must be installed in accordance with this report, the applicable code, the manufacturer's published installation instructions, and the approved engineering drawings for each job. A copy of the manufacturer's published installation instructions and approved engineering drawings must be available at the jobsite during installation. SI series I-joists are limited to uses in covered, dry service conditions, where the in-service moisture content is less than 16 percent.

4.2 One-hour Fire-resistance-rated Assemblies:

The SI series I-joists described in this report may be used in the fire-resistance-rated assemblies described in Section 4.2.2 of [ESR-1405](#), provided they meet the minimum dimensions and other requirements specified for each assembly therein.

5.0 DESIGN AND INSTALLATION

The Stark Truss SI Series I-Joists as described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 Design calculations and details for specific applications, demonstrating compliance with this report, must be submitted to the code official. The design calculations and details for specific applications must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.2 SI series I-joists must be installed so that loads are applied parallel with the web and no concentrated loads are applied to the bottom flange.
- 5.3 Cutting and notching of SI series I-joist flanges is not permitted, except for cutting to proper length for installation. Holes in the webs must conform to the requirements of Section 4.1.
- 5.4 SI series prefabricated wood I-joists are manufactured in Beach City, Ohio, under a quality control program with inspections ICC-ES and by APA—The Engineered Wood Association (AA-649).

6.0 CONDITIONS OF USE:

Data in accordance with the [ICC-ES Acceptance Criteria for Prefabricated Wood I-Joists \(AC14\)](#), dated June 2019.

7.0 EVIDENCE SUBMITTED

- 7.1 Each SI series prefabricated wood I-joist described in this report is identified by a stamp bearing the manufacturer's name (Stark Truss Company), the I-joist series designation, and the evaluation report number (ESR-2919).
- 7.2 The report holder's contact information is the following:

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TABLE 1—SI SERIES JOIST DIMENSIONS

JOIST SERIES	DEPTH (in.)	WEB THICKNESS (in.)	FLANGE		
			WIDTH (in.)	THICKNESS (in.)	SPECIFIC GRAVITY
SI-40	9 ¹ / ₄ , 9 ¹ / ₂ , 11 ¹ / ₄ , 11 ⁷ / ₈	3 ³ / ₈	2 ¹ / ₂	1 ¹ / ₂	0.42
SI-60	9 ¹ / ₄ , 9 ¹ / ₂ , 11 ¹ / ₄ , 11 ⁷ / ₈ , 14, 16	3 ³ / ₈	2 ¹ / ₂	1 ¹ / ₂	0.46
SI-80	11 ¹ / ₄ , 11 ⁷ / ₈ , 14, 16	3 ³ / ₈	3 ¹ / ₂	1 ¹ / ₂	0.46

For **SI** units: 1 inch = 25.4 mm.

TABLE 2—REFERENCE DESIGN VALUES FOR SI SERIES I-JOISTS¹

JOIST DEPTH (inches)	JOIST SERIES	BENDING STIFFNESS ⁵ EI (in ² -lbs x10 ⁶)	MOMENT ² M _r (ft-lbs)	SHEAR V _r (lbs)	REACTIONS, R _r		SHEAR STIFFNESS ⁵ K (lbs x10 ⁶)
					End Reaction ³ (lbs)	Intermediate Reaction ⁴ (lbs)	
9 ¹ / ₄	SI-40	182	2,680	1,080	1,030	2,160	4.81
	SI-60	219	3,670	1,080	1,030	2,160	4.81
9 ¹ / ₂	SI-40	193	2,765	1,120	1,080	2,160	4.94
	SI-60	231	3,790	1,120	1,080	2,160	4.94
11 ¹ / ₄	SI-40	292	3,370	1,350	1,160	2,500	5.85
	SI-60	350	4,615	1,350	1,160	2,500	5.85
	SI-80	484	6,535	1,350	1,220	2,760	5.85
11 ⁷ / ₈	SI-40	330	3,585	1,420	1,200	2,500	6.18
	SI-60	396	4,910	1,420	1,200	2,500	6.18
	SI-80	547	6,950	1,420	1,280	2,760	6.18
14	SI-60	584	5,910	1,710	1,200	2,500	7.28
	SI-80	802	8,370	1,710	1,280	3,020	7.28
16	SI-60	799	6,855	1,970	1,200	2,500	8.32
	SI-80	1092	9,705	1,970	1,280	3,020	8.32

For **SI** units: 1 inch = 25.4 mm; 1 lb = 4.45 N; 1 ft-lb = 1.36 N-m; 1 in²-lb = 179 mm²-N.

¹Reference design values must be adjusted, as applicable, in accordance with Section 7.3 of the NDS.

²The reference design moment, M_r, of the I-joist, must not be increased by any repetitive member factor, C_r.

³Reference design reactions, R_r, are given for *end* reactions with a minimum bearing length of 1³/₄ inches, without web stiffeners. For bearing lengths of 4 inches or greater, the reference design end reaction may be set equal to the reference design shear value, V_r. Interpolation of the reference design end reaction between 1³/₄- and 4-inch bearings is permitted. For end reaction values over 1,550 lbf, web stiffeners are required.

Where required, web stiffeners must be installed in accordance with [ESR-1405](#).

⁴Reference design reactions, R_r, are given for *intermediate* reactions with a minimum bearing length of 3¹/₂ inches, without web stiffeners.

⁵I-joist deflections must be calculated in accordance with Section 4.1.

TABLE 3—ALLOWABLE SPANS FOR SI SERIES JOISTS – SIMPLE SPAN ONLY^{1, 2, 3, 4}

JOIST DEPTH (in.)	JOIST SERIES	ALLOWABLE SIMPLE SPANS (feet - inches)			
		On Center Joist Spacing			
		12"	16"	19.2"	24"
9 ¹ / ₄	SI-40	17'-8"	16'-2"	15'-3"	14'-3"
	SI-60	18'-7"	17'-0"	16'-0"	14'-11"
9 ¹ / ₂	SI-40	18'-0"	16'-5"	15'-6"	14'-6"
	SI-60	18'-11"	17'-4"	16'-4"	15'-3"
11 ¹ / ₄	SI-40	20'-7"	18'-10"	17'-9"	16'-3"
	SI-60	21'-9"	19'-10"	18'-8"	17'-5"
	SI-80	23'-11"	21'-9"	20'-6"	19'-1"
11 ⁷ / ₈	SI-40	21'-5"	19'-7"	18'-6"	16'-9"
	SI-60	22'-7"	20'-8"	19'-6"	18'-2"
	SI-80	24'-11"	22'-8"	21'-4"	19'-10"
14	SI-60	25'-9"	23'-6"	22'-2"	20'-8"
	SI-80	28'-3"	25'-9"	24'-3"	22'-7"
16	SI-60	28'-6"	26'-0"	24'-7"	22'-10"
	SI-80	31'-4"	28'-6"	26'-10"	25'-0"

For SI units: 1 inch = 25.4 mm; 1 foot = 305 mm.

¹Allowable clear spans are applicable to simple-span residential floor construction with a design dead load of 10 psf and live load of 40 psf. The live load deflection is limited to span/480.

²Spans are based on a composite floor with glued-nailed sheathing meeting the requirements for APA Rated Sheathing or APA Rated STURD- I-FLOOR conforming to PS 1 or PS 2 with a minimum thickness of 19/32 inch (40/20 or 20 oc) for a joist spacing of 19.2 inches on center or less, or 23/32 inch (48/24 or 24 oc) for a joist spacing of 24 inches on center. Adhesive must meet APA Specification AFG-01 or ASTM D3498-03. Spans must be reduced by 12 inches when the floor sheathing is nailed only.

³Bearing lengths must be 1³/₄ inches or greater for the end bearings.

⁴Web stiffeners are not required when I-joists are used with the spans and spacings given in this table, except as required by joist hanger manufacturers.

TABLE 4—ALLOWABLE SPANS FOR SI SERIES JOISTS – MULTIPLE SPANS ONLY^{1, 2, 3, 4}

JOIST DEPTH (in.)	JOIST SERIES	ALLOWABLE MULTIPLE SPANS (feet - inches)			
		On Center Joist Spacing			
		12"	16"	19.2"	24"
9 ¹ / ₄	SI-40	19'-3"	17'-7"	16'-2"	14'-5"
	SI-60	20'-3"	18'-6"	17'-5"	16'-3"
9 ¹ / ₂	SI-40	19'-7"	17'-11"	16'-5"	14'-8"
	SI-60	20'-8"	18'-10"	17'-9"	16'-6"
11 ¹ / ₄	SI-40	22'-5"	19'-11"	18'-2"	16'-2"
	SI-60	23'-8"	21'-7"	20'-4"	18'-11"
	SI-80	26'-0"	23'-8"	22'-3"	20'-9"
11 ⁷ / ₈	SI-40	23'-5"	20'-6"	18'-9"	16'-9"
	SI-60	24'-8"	22'-6"	21'-2"	19'-7"
	SI-80	27'-1"	24'-8"	23'-3"	21'-7"
14	SI-60	28'-0"	25'-7"	24'-1"	19'-9"
	SI-80	30'-10"	28'-0"	26'-5"	23'-11"
16	SI-60	31'-1"	28'-4"	24'-9"	19'-9"
	SI-80	34'-2"	31'-1"	29'-3"	23'-11"

For SI units: 1 inch = 25.4 mm; 1 foot = 305 mm.

¹Allowable clear spans are applicable to multiple-span residential floor construction with a design dead load of 10 psf and live load of 40 psf. The end spans must have a length of 40% or more of the adjacent span. The live load deflection is limited to span/480.

²Spans are based on a composite floor with glued-nailed sheathing meeting the requirements for APA Rated Sheathing or APA Rated STURD- I-FLOOR conforming to PS 1 or PS 2 with a minimum thickness of 19/32 inch (40/20 or 20 oc) for a joist spacing of 19.2 inches on center or less, or 23/32 inch (48/24 or 24 oc) for a joist spacing of 24 inches on center. Adhesive must meet APA Specification AFG-01 or ASTM D3498-03. Spans must be reduced by 12 inches when the floor sheathing is nailed only.

³Bearing lengths must be 1³/₄ inches or greater for the end bearings, and 3¹/₂ inches or greater for the intermediate bearings.

⁴Web stiffeners are not required when I-joists are used with the spans and spacings given in this table, except as required by joist hanger manufacturers.

TABLE 5—MINIMUM DISTANCES FROM JOIST SUPPORTS TO THE CENTER OF A ROUND HOLE^{1, 2, 3, 4, 5}

JOIST DEPTH (in.)	JOIST SERIES	SAF ⁵	MINIMUM DISTANCE FROM INSIDE FACE OF ANY SUPPORT TO CENTER OF ROUND HOLE, D (feet - inches)														
			Round Hole Diameter (in.)														
			2	3	4	5	6	6¼	7	8	8⅝	9	10	10¾	11	12	12¾
9¼	SI-40	14'-3"	0'-9"	2'-0"	3'-3"	4'-7"	6'-2"										
	SI-60	14'-11"	1'-11"	3'-2"	4'-6"	5'-11"	7'-6"										
9½	SI-40	14'-6"	0'-7"	1'-9"	3'-0"	4'-5"	5'-10"	6'-4"									
	SI-60	15'-3"	1'-8"	3'-0"	4'-4"	5'-8"	7'-3"	7'-8"									
11¼	SI-40	16'-2"	0'-7"	0'-8"	1'-8"	2'-11"	4'-3"	4'-7"	5'-9"	7'-6"							
	SI-60	17'-5"	0'-11"	2'-2"	3'-6"	4'-10"	6'-3"	6'-7"	7'-9"	9'-5"							
	SI-80	19'-1"	2'-1"	3'-5"	4'-9"	6'-1"	7'-7"	8'-0"	9'-2"	10'-11"							
11⅞	SI-40	16'-9"	0'-7"	0'-8"	1'-3"	2'-6"	3'-10"	4'-2"	5'-3"	6'-9"	8'-0"						
	SI-60	18'-2"	0'-8"	1'-10"	3'-2"	4'-5"	5'-10"	6'-2"	7'-4"	8'-11"	10'-0"						
	SI-80	19'-10"	1'-11"	3'-2"	4'-6"	5'-10"	7'-3"	7'-8"	8'-10"	10'-6"	11'-7"						
14	SI-60	19'-9"	0'-7"	0'-8"	0'-8"	1'-7"	3'-2"	3'-6"	4'-9"	6'-6"	7'-8"	8'-4"	10'-4"	11'-11"			
	SI-80	22'-7"	0'-7"	1'-9"	3'-0"	4'-4"	5'-8"	6'-1"	7'-1"	8'-7"	9'-7"	10'-3"	12'-2"	13'-10"			
16	SI-60	19'-9"	0'-7"	0'-8"	0'-8"	0'-9"	0'-9"	0'-10"	1'-10"	3'-6"	4'-6"	5'-2"	7'-3"	8'-11"	9'-6"	11'-10"	13'-9"
	SI-80	23'-11"	0'-7"	0'-8"	0'-8"	1'-7"	3'-2"	3'-7"	4'-10"	6'-6"	7'-7"	8'-3"	10'-2"	11'-8"	12'-2"	14'-3"	16'-0"

For SI units: 1 inch = 25.4 mm; 1 foot = 305 mm.

¹Tabulated values may be used for simple or multiple spans with a 10 psf dead load, 40 psf live load, and an I-joist spacing of 24 inches on center or less.

²Hole location distance is measured from inside face of supports to center of hole.

³Distances in this chart are based on uniformly loaded joists.

⁴Joists with web hole locations and/or sizes that fall outside the scope of this table must be analyzed based on the actual hole size, joist spacing, span and loading conditions. The I-joist shear capacity at the location of a circular web hole is calculated using the following equation: $V_{rh} = \text{Published Shear Value} \times [(Joist\ Depth - Hole\ Diameter) / Joist\ Depth]$.

⁵SAF = Span adjustment factor, used as defined below.

Optional:

This table is based on I-joists being used at their maximum span. If the I-joists are used in applications at less than their full allowable span, as given in [Tables 3 and 4](#), the minimum distance from the centerline of the hole to the face of any support (D), as given above may be reduced as follows:

$$D_{\text{reduced}} = \frac{L_{\text{actual}}}{SAF} \times D$$

where:

D_{reduced} = Minimum distance from the inside face of any support to center of hole, reduced for less-than-maximum span applications (ft). The reduced distance must not be less than 6 inches from the face of the support to the edge of the hole.

L_{actual} = The actual measured span distance between the inside faces of supports (ft).

SAF = Span Adjustment Factor given in the table above.

D = The minimum distance from the inside face of any support to the center of the hole, as given in the table above.

If L_{actual}/SAF is greater than 1, use 1 in the above calculation for L_{actual}/SAF .

TABLE 6—ALLOWABLE SHEAR (PLF) FOR HORIZONTAL WOOD STRUCTURAL PANEL DIAPHRAGMS FRAMED WITH SI SERIES I-JOISTS FOR WIND¹ OR SEISMIC LOADING^{2,3,9}

SHEATHING GRADE	COMMON NAIL SIZE	MINIMUM NOMINAL PANEL THICKNESS (in.)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBERS AT ADJOINING EDGES AND BOUNDARIES (in.) ⁴	BLOCKED DIAPHRAGMS			UNBLOCKED DIAPHRAGMS	
				Nail Spacing (in.) at Diaphragm Boundaries (All Cases), at Continuous Panel Edges Parallel to Load (Cases 3 & 4), and at All Panel Edges (Cases 5 & 6) ^{5,6}			Nails Spaced 6 in. Max at Supported Edges ⁵	
				6	4	2- ¹ / ₂ ⁷	Case 1 (No Unblocked Edges or Continuous Joints Parallel to Load)	All Other Configurations (Cases 2, 3 4, 5 & 6)
				Nail Spacing (in.) at Other Panel Edges (Cases 1, 2, 3 & 4) ⁵				
6	6	4						
Structural I	6d ⁸	⁵ / ₁₆	3	210	280	420	185	140
	8d	³ / ₈	3	300	400	600	265	200
	10d	¹⁵ / ₃₂	3	360	480	720	320	240
Sheathing and Single Floor	6d ⁸	⁵ / ₁₆	3	190	250	380	170	125
		³ / ₈	3	210	280	420	185	140
	8d	³ / ₈	3	270	360	540	240	180
		⁷ / ₁₆	3	285	380	570	255	190
		¹⁵ / ₃₂	3	300	400	600	265	200
	10d	¹⁵ / ₃₂	3	325	430	650	290	215
		¹⁹ / ₃₂	3	360	480	720	320	240

For SI: 1 inch = 25.4 mm; 1 plf = 14.59 N/m.

¹For wind load applications, the values in the table above shall be permitted to be multiplied by 1.4.

²For shear loads of normal or permanent load duration as defined in the NDS, the values in the table above shall be multiplied by 0.63 or 0.56, respectively.

³The tabulated allowable shear capacities are for I-joist series with flanges having a specific gravity (G) of 0.50 or higher (see Table 1). For G < 0.50 the allowable shear capacities shall be reduced by multiplying the allowable shear capacities by the Specific Gravity Adjustment Factor = [1-(0.5-G)]. The Specific Gravity Adjustment Factor shall not be greater than 1.

⁴Minimum flange widths of SI series framing members are 2 1/2 inches (3 inches nominal).

⁵Space nails maximum 12 inches on center along intermediate framing members (6 inches on center when supports are spaced 48 inches on center or greater). Fasteners shall be located ³/₈ inch minimum from panel edges.

⁶When nail spacing is 4 inches on center at diaphragm boundaries, adjacent nails within a row must be offset (staggered) ¹/₂ inch.

⁷When nail spacing is 2 1/2 inches on center at adjoining panel edges, adjacent nails within a row must be offset (staggered)

¹/₂ inch. ⁸8d common nails minimum are recommended for roof panel attachments.

⁹See Table 4.2A of SDPWS for diaphragm configurations.

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