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# ICC-ES Evaluation Report

# ESR-3517

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**DIVISION: 03 00 00—CONCRETE**  
**SECTION: 03 21 00—REINFORCING STEEL**

**REPORT HOLDER:**

**BARSPLICE PRODUCTS INC.**

**4900 WEBSTER STREET**  
**DAYTON, OHIO 45414-4831**

**EVALUATION SUBJECT:**

**ZAP SCREWLOK® TYPE 2 AND FX MECHANICAL SPLICE SYSTEMS**  
**FOR SPLICING STEEL REINFORCING BARS**



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**ESR-3517**

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**DIVISION: 03 00 00—CONCRETE**  
**Section: 03 21 00—Reinforcing Steel**

**REPORT HOLDER:**

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**EVALUATION SUBJECT:**

**ZAP SCREWLOK® TYPE 2 AND FX MECHANICAL  
SPlice SYSTEMS FOR SPlicing STEEL REINFORCING  
BARS**

**1.0 EVALUATION SCOPE**

**Compliance with the following codes:**

- 2015 *International Building Code*® (IBC)
- Other Codes (see Section 8.0)

**Property evaluated:**

Structural

**2.0 USES**

**2.1 General:**

The Zap Screwlok® Type 2 and FX Mechanical Splice Systems are used as mechanical splices of deformed steel reinforcing bars in reinforced concrete construction.

**2.2 Zap Screwlok® Type 2 Mechanical Splice System:**

The Zap Screwlok® Type 2 system complies with Section 25.5.7 of ACI 318-14 (as referenced in Section 1901.2 of the 2015 IBC) for use as tension and compression mechanical connections of ASTM A615 Grades 40, 60, and 75, or ASTM A706 Grade 60 deformed steel reinforcing bars sizes No. 4 through No. 11, No. 14, and No. 18. This system, when used to splice ASTM A615 Grade 40 and 60 bars and ASTM A706 Grade 60 bars, complies with the Type 1 and Type 2 mechanical splice requirements of Section 18.2.7.1 of ACI 318-14, and is for use where Type 1 or Type 2 mechanical splices are specified by the IBC and ACI 318. This system, when used to splice ASTM A615 Grade 75 bars complies with the performance requirements of Section 18.2.7.1 of ACI 318-14 for Type 1 mechanical splices, except that the use of this system to splice Grade 75 bars for special seismic

applications is outside the scope of this evaluation report since Sections 20.2.2.4 and 20.2.2.5 of ACI 318-14 specify a maximum steel grade of 60 for reinforcing bars used for special seismic applications.

**2.3 Zap Screwlok® FX Mechanical Splice System:**

The Zap Screwlok® FX system complies with Section 25.5.7 of ACI 318-14 (as referenced in Section 1901.2 of the 2015 IBC) for use as tension and compression mechanical connections of ASTM A615 Grade 75 and 80, or ASTM A706 Grade 80 uncoated deformed steel reinforcing bars sizes No. 11, No. 14, and No. 18. This system, when used to splice No. 11, No. 14, and No. 18 of ASTM A615 Grade 75 bars, or No. 11 and No. 14 of ASTM A615 Grade 80 bars, or No. 11, No. 14, and No. 18 of ASTM A706 Grade 80 bars, complies with the performance requirements in ACI 318-14 Sections 25.5.7.1 and 18.2.7.1 for Type 1 and Type 2 mechanical splices and is for use where Type 1 or Type 2 mechanical splices are specified by ACI-318 and IBC. This system, when used to splice ASTM A615 Grade 80 No. 18 bars, complies with the Type 1 mechanical splice performance requirements of Section 18.2.7.1 of ACI 318-14, and is for use where Type 1 mechanical splices are specified by the IBC and ACI 318. The use of this system to splice Grade 75 and Grade 80 bars for special seismic applications is outside the scope of this evaluation report, since ACI 318-14 Sections 20.2.2.4 and 20.2.2.5 specify a maximum steel grade of 60 for reinforcing bars used for special seismic applications.

**3.0 DESCRIPTION**

**3.1 General:**

**3.1.1 Zap Screwlok® Type 2 Mechanical Splice System:** The Zap Screwlok® Type 2 Mechanical Splice System is available in two types: Standard splice system and Transition splice system. Each Standard splice system consists of a Standard splice assembly and two equal size reinforcing bars, sizes No. 4 through No. 11, with a single row of screws, or sizes No. 14 or No. 18, with double rows of screws (see Table 1 and Figure 1). Each Transition splice system consists of a Transition splice assembly and two reinforcing bars of different sizes, No. 4 through No. 11, using one row of screws (see Table 2 and Figure 1).

**3.1.2 Zap Screwlok® FX Mechanical Splice System:** The Zap Screwlok® FX Mechanical Splice System is available in Standard splice type and is used to splice two equal size reinforcing bars. For reinforcing bar size No. 11, a single row of screws are used, and for reinforcing bar

sizes No. 14 or No. 18, double rows of screws are used (see Table 3 and Figure 1).

### 3.2 Materials:

**3.2.1 General:** Each Zap Screwlok® Type 2 and FX Mechanical Splice assembly consists of a shaped steel sleeve with converging sides, an optional central stop pin that establishes the proper insertion depth of the connected reinforcing bars, and a series of steel screws with cone-shaped points. The sleeve is produced from steel conforming to ASTM A519 Grades 1018 to 1026, with minimum yield strength of 36,000 psi (248 MPa) and a minimum tensile strength of 60,000 psi (420 MPa). The screws are produced from steel conforming to ASTM A322 Grade 4140.

**3.2.2 Zap Screwlok® Type 2 Mechanical Splice System:** Each Zap Screwlok® Type 2 system is used for splicing two deformed, reinforcing bars having either equal or unequal diameters and having a yield strength of 40 ksi (280 MPa), 60 ksi (420 MPa), or 75 ksi (520 MPa) for ASTM A615 Grade 40, 60, or 75, respectively, or 60 ksi (420 MPa) for ASTM A706 Grade 60. The reinforcing bars, except for #14 and #18, may be coated in accordance with A767 (zinc-coated) or A775 (epoxy-coated). Dimensional data is presented in Tables 1 and 2 for the Zap Screwlok® Type 2 Standard and Transition Splice Systems respectively, and is illustrated in Figure 1.

**3.2.3 Zap Screwlok® FX Mechanical Splice System:** Each Zap Screwlok® FX system is used for splicing two uncoated deformed reinforcing bars having equal diameters and a yield strength of 75 ksi (520 MPa), 80 ksi (550 MPa) for ASTM A615 Grade 75 and 80 respectively, or 80 ksi (550 MPa) for ASTM A706 Grade 80. Dimensional data is presented in Table 3 for the Zap Screwlok® FX Standard Splice System and is illustrated in Figure 1.

## 4.0 DESIGN AND INSTALLATION

### 4.1 General:

The Zap Screwlok® Type 2 and FX Mechanical Splice Systems are installed at the jobsite. These systems allow pre-bent and pre-tied reinforcing bars to be spliced in place without having to rotate the bar. All splice assembly components and reinforcement to be spliced must be clean and free from loose rust, oils, and other foreign matter. Water must also be removed from the sleeves prior to installation.

- First, one of the reinforcing bars to be spliced is inserted into one sleeve end to the center stop. The screws are then tightened from the sleeve end inward towards the center of the sleeve. The reinforcing bar is engaged to the sleeve by indenting the bar surface and wedging the bar into the converging sleeve sides through tightening of the screws. Screws must be tightened to the corresponding torque values shown in Tables 1, 2, and 3, as applicable, at which point the screw heads shear off.
- After the first bar is secured, the other reinforcing bar is inserted into the opposite sleeve end to the center stop. The screws are then tightened in the same manner as for the first bar, from the end of sleeve inward towards the center of the sleeve until the screw heads shear off.
- For the splices with two rows of screws at each side of the sleeve, first, one of the row of screws must be tightened as described above, followed by the entire second row of screws.

- If the splice sleeve is specially supplied, without a center stop, or if the center stop is removed to facilitate construction, one half of the splice length ( $L/2$ ) must be measured and marked on the reinforcing bar before inserting it into the splice. Once the splice is placed so that the bars are at the proper insertion, and the screws on the first reinforcing bar have been tightened down and heads twisted off, the second reinforcing bar can then be secured as described above.

All measurements pertaining to minimum bar spacing distance and concrete coverage requirements described in the IBC and ACI 318, must be measured from the outside of the sleeves.

### 4.2 Zap Screwlok® Type 2 Mechanical Splice Systems

The use of this splice system must comply with Section 2.2 of this report.

### 4.3 Zap Screwlok® FX Mechanical Splice Systems

The use of this splice system must comply with Section 2.3 of this report.

### 4.4 Special Inspection

Special inspection must be provided at the jobsite as required by Section 1705 of the 2015 IBC. In addition to verifying placement of steel reinforcing bar splices, the special inspector must verify the grade and size of reinforcing bars, reinforcing bar embedment, spacing, concrete cover, splice system identification, field preparation of components, and assembly of the components resulting in the spliced bars.

## 5.0 CONDITIONS OF USE

The Zap Screwlok® Type 2 and FX Mechanical Splice Systems for splicing steel reinforcing bars, as described in this report, comply with, or are a suitable alternative to what is specified in the code indicated in Section 1.0 of this report, subject to the following conditions:

- 5.1** The splice assemblies must be identified, designed and installed in accordance with the applicable code, the manufacturer's instructions, and this report. In the event of conflict between this report and the manufacturer's instructions, this report governs.
- 5.2** Special inspection must be provided in accordance with Section 4.4 of this report.
- 5.3** The minimum concrete cover and spacing between spliced bars must be in accordance with the ACI 318-14 (IBC 2015) and must be measured from the outer surface of the splices.
- 5.4** Splice locations must comply with the applicable ACI 318-14 (IBC 2015) requirements and must be noted on plans approved by the code official.
- 5.5** For structures regulated by Chapter 18 of ACI 318-14 (as required by 2015 IBC Section 1905.1), to splice deformed reinforcing bars resisting earthquake-induced flexure, axial force, or both, in special moment frames, special structural walls, and all components of special structural walls including coupling beams and wall piers, with the Zap Screwlok® Type 2 mechanical splice system, mill certificates for reinforcing bars must be submitted to the code official as evidence that the steel reinforcing bars comply with ACI 318-14 Sections 20.2.2.5 and 26.13.2.3.
- 5.6** The use of Zap Screwlok® Type 2 and FX mechanical splice systems must comply with Sections 2.2 and 2.3, respectively.

5.7 The use of mechanical splice systems in fire-resistance-rated construction is outside the scope of this evaluation report.

## 6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Splice Systems for Steel Reinforcing Bars (AC133), dated October 2015.

## 7.0 IDENTIFICATION

7.1 All components of each Zap Screwlok® Type 2 and FX splice assembly, including the screws, are packaged in containers labeled with the name and address of Barsplice Products Inc., product group name (Zap Screwlok®), product model/type (“Type 2” or “FX”; “Standard” or “Transition” designation), size, the ICC-ES evaluation report number (ESR-3517), part identification code, and material/heat lot number.

7.2 Each Zap Screwlok® Type 2 and FX splice assembly is identified with the Barsplice Zap Screwlok® name, the “Type 2” or “FX” brand designation, the part identification code, and a material/heat lot code. Each individual splice system assembly must also be similarly identified, and must indicate the intended mechanical splice type designation in accordance with Section 18.2.7.1 of ACI 318-14 (symbol ◆ for Type 1 or symbol ❖ for Type 2 that must correspond to the findings in Section 2.0 of this evaluation report.

## 8.0 OTHER CODES

### 8.1 Evaluation Scope:

In addition to the code referenced in Section 1.0, the products described in this report were evaluated for compliance with the requirements of the 2012 *International Building Code*® (2012 IBC) and the 2009 *International Building Code*® (2009 IBC). The Zap Screwlok® Type 2 and FX Mechanical Splice System comply with, or are suitable alternative to what is specified in the 2012 IBC and 2009 IBC, subject to the provisions of Sections 8.2 to 8.7 of this report.

### 8.2 Uses:

See Section 2.0, except as follows:

**8.2.1 Zap Screwlok® Type 2 Mechanical Splice System:** The Zap Screwlok® Type 2 Mechanical Splice System comply with Section 12.14.3.2 of ACI 318-11 (2012 IBC) or of ACI 318-08 (2009 IBC) for use as tension and compression mechanical connections of ASTM A615 Grades 40, 60 and 75 or ASTM A706 Grade 60 deformed steel reinforcing bars sizes No. 4 through No. 11, No. 14, and No. 18. This system, when used to splice ASTM A615 Grade 40 and 60 bars and ASTM A706 Grade 60 bars, complies with the Type 1 and Type 2 mechanical splice requirements of Section 21.1.6.1 of ACI 318, and is for use where Type 1 or Type 2 mechanical splices are specified by the ACI 318 and IBC. This system, when used to splice ASTM A615 Grade 75 bars complies with the performance requirements of Section 21.1.6.1 of ACI 318 for Type 1 mechanical splices, except that the use of this system to splice Grade 75 bars in special seismic applications is outside the scope of this evaluation report since Section 21.1.5.1 and Section 21.1.5.2 of ACI 318-11 and ACI 318-08 specifies a maximum steel grade of 60 for reinforcing bars for special seismic applications.

### 8.2.2 Zap Screwlok® FX Mechanical Splice System:

The Zap Screwlok® FX Mechanical Splice System complies with Section 12.14.3 of ACI 318-11 (2012 IBC) and ACI 318-08 (2009 IBC) for use as tension and compression mechanical connections of ASTM A615 Grade 75 and 80 or ASTM A706 Grade 80 uncoated deformed steel reinforcing bars sizes No. 11, No. 14, and No. 18. This system when used to splice No. 11, No. 14, and No. 18 ASTM A615 Grade 75 bars, or No. 11 and No. 14 ASTM A615 Grade 80 bars, or No. 11, No. 14 and No. 18 ASTM A706 Grade 80 bars complies with the mechanical splice performance requirements of Type 1 and Type 2 mechanical splices specified by Section 21.1.6.1 ACI-318, and is for use where Type 1 or Type 2 mechanical splices are specified by ACI-318 and IBC. This splice system, when used to splice No. 18 ASTM A615 Grade 80 complies with the mechanical splice performance requirements of Type 1 mechanical splices specified by Section 21.1.6.1 of ACI-318, and is for use where Type 1 mechanical splices are specified by ACI 318 and IBC. The use of this system to splice Grade 75 and 80 bars in special seismic applications is outside the scope of this evaluation report since Section 21.1.5.1 and Section 21.1.5.2 of ACI 318-11 and ACI 318-08 specifies a maximum steel grade of 60 for reinforcing bars for special seismic applications.

### 8.3 Description:

See Section 3.0.

### 8.4 Design and Installation:

See Section 4.0, except as follows:

The use of the Zap Screwlok® Type 2 and FX Mechanical Splice Systems must comply with Section 8.2.1 and Section 8.2.2, respectively.

Special inspection must be provided at the jobsite as required by Section 1705 of the 2012 IBC or Section 1704 of the 2009 IBC (see Section 4.4).

### 8.5 Conditions of Use

See Section 5.0 except as follows:

Under the 2012 IBC and 2009 IBC, for structures regulated by Chapter 21 of ACI 318 (as required by IBC Section 1908.1), to splice reinforcing bars resisting earthquake-induced flexural and axial forces in special moment frame members, special structural walls and coupling beams, with the Zap Screwlok® Type 2 Mechanical Splice System, mill certificates for reinforcing bars must be submitted to the code official as evidence that the steel reinforcing bars comply with Section 21.1.5.2 of ACI 318-11 (2012 IBC) or ACI-08 (2009 IBC).

### 8.6 Evidence Submitted

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Splice Systems for Steel Reinforcing Bars (AC133) dated October 2015 (for the 2015 IBC), May 2012 (for the 2012 IBC) or dated December 2012 (for the 2009 IBC).

### 8.7 Identification

See Section 7.0.

TABLE 1 - DESCRIPTIVE DATA FOR ZAP SCREWLOK TYPE 2 STANDARD SPLICE SYSTEMS

INCH SYSTEM						
Splice Size	Nominal Coupler Wt. (lbs.)	Coupler Length (in.)	Ave. Dimension "A" (in.)	Dimension "B" (in.)	Number of Screws per Bar	Torque (Ave.) (ft.-lbs.)
#4	2.2	7	1 1/16	11/16	3	50
#5	3.4	9	1 1/8	3/4	4	50
#6	4.7	11	1 3/16	15/16	5	50
#7	7.6	13	1 1/4	1 1/16	5	100
#8	10.9	15 1/4	1 5/16	1 1/16	6	100
#9	17.6	16 3/4	1 5/8	1 1/4	6	200
#10	21.4	19 1/8	1 11/16	1 7/16	7	200
#11	25.4	21 1/2	1 13/16	1 1/2	8	200
#14	31.7	15 3/8	2 5/16	1 3/4	9	350
#18	74.0	29 1/2	2 1/2	2 1/4	21	350

SI UNITS SYSTEM						
Splice Size	Nominal Coupler Wt. (kg)	Coupler Length (mm)	Ave. Dimension "A" (mm)	Dimension "B" (mm)	Number of Screws per Bar	Torque (Ave.) (N-m)
#13	1.00	178	27	17	3	70
#16	1.54	229	29	19	4	70
#19	2.13	280	30	24	5	70
#22	3.45	330	32	27	5	140
#25	4.94	388	33	27	6	140
#29	7.98	426	41	32	6	280
#32	9.71	486	43	37	7	280
#36	11.50	546	46	38	8	280
#43	14.40	391	59	44	9	475
#57	33.60	749	64	57	21	475

TABLE 2 - DESCRIPTIVE DATA FOR ZAP SCREWLOK TYPE 2 TRANSITION SPLICE SYSTEMS

INCH SYSTEM						
Splice Size	Nominal Coupler Wt. (lbs.)	Coupler Length (in.)	Ave. Dimension "A" (in.)	Dimension "B" (in.)	Number of Screws per Bar	Torque (Ave.) (ft.-lbs.)
#5/4	3.0	8	1 1/8	3/4	3	50
#6/5	4.3	10	1 3/16	15/16	4	50
#7/6	6.8	12	1 1/4	1 1/16	4	100
#8/7	9.9	14 1/8	1 5/16	1 1/8	5	100
#9/8	16.2	15 9/16	1 5/8	1 1/4	5	200
#10/9	20.1	17 15/16	1 11/16	1 7/16	6	200
#11/9	20.1	17 15/16	1 13/16	1 1/2	6	200
#11/10	22.8	20 5/16	1 13/16	1 1/2	7	200

SI UNITS SYSTEM						
Splice Size	Nominal Coupler Wt. (kg)	Coupler Length (mm)	Ave. Dimension "A" (mm)	Dimension "B" (mm)	Number of Screws per Bar	Torque (Ave.) (N-m)
#16/13	1.36	203	29	19	3	70
#19/16	1.95	254	30	24	4	70
#22/19	3.08	305	32	27	4	140
#25/22	4.49	359	33	29	5	140
#29/25	7.35	395	41	32	5	280
#32/29	9.12	456	43	37	6	280
#36/29	9.12	456	46	38	6	280
#36/32	10.3	516	46	38	7	280

TABLE 3 - DESCRIPTIVE DATA FOR ZAP SCREWLOK FX STANDARD SPLICE SYSTEMS

INCH SYSTEM						
Splice Size	Nominal Coupler Wt. (lbs.)	Coupler Length (in.)	Ave. Dimension "A" (in.)	Dimension "B" (in.)	Number of Screws per Bar	Torque (Ave.) (ft.-lbs.)
#11	25.4	21 1/2	1 13/16	1 1/2	8	200
#14	41.2	20 1/8	2 5/16	1 3/4	12	350
#18	74.0	29 1/2	2 1/2	2 1/4	21	350

SI UNITS SYSTEM						
Splice Size	Nominal Coupler Wt. (kg)	Coupler Length (mm)	Ave. Dimension "A" (mm)	Dimension "B" (mm)	Number of Screws per Bar	Torque (Ave.) (N-m)
#36	11.5	546	46	38	8	280
#43	19.1	511	59	44	12	475
#57	33.6	749	64	57	21	475

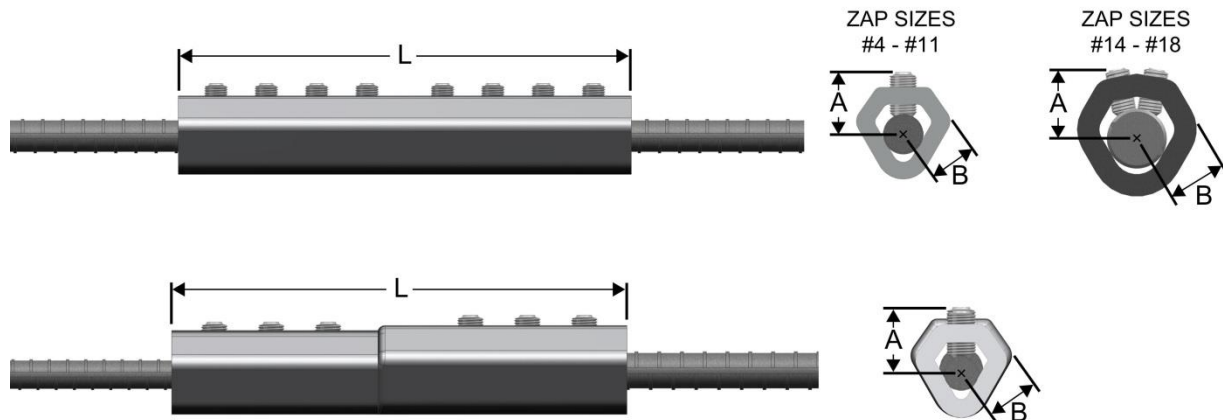


FIGURE 1—Illustration of ZAP™ Screwlok® Type 2 and FX Standard and Transition Splice Systems